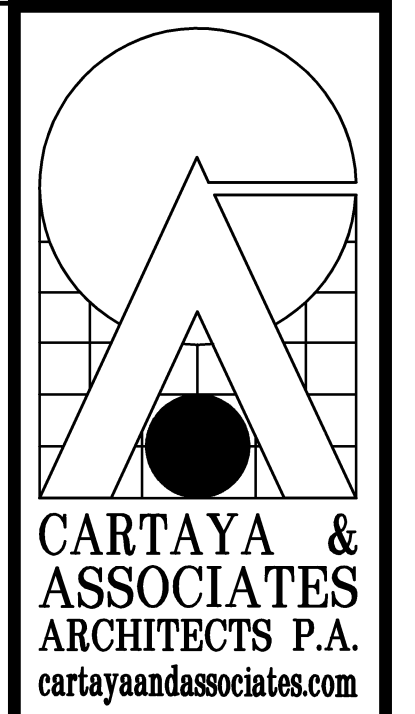


POMPANO BEACH

AIRPARK MAINTENANCE STORAGE FACILITY

CITY OF POMPANO BEACH, FLORIDA 33060

CAPITAL IMPROVEMENTS PROJECT # 08-962



2400 E. COMMERCIAL BLVD. SUITE 415
FT. LAUDERDALE, FLORIDA 33308
(954)771-2724 FAX 776-4280

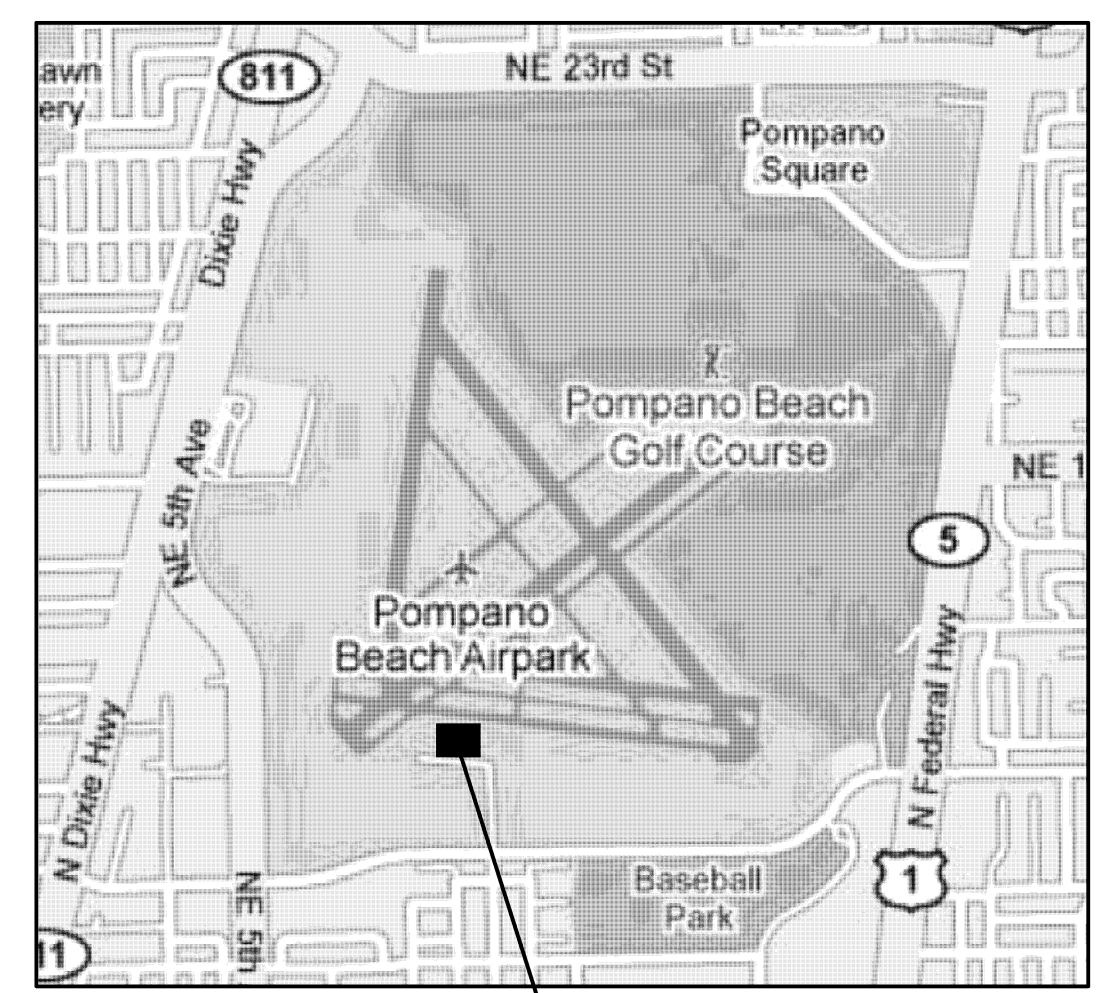
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CARTAYA & ASSOCIATES ARCHITECTS, P.A.	(ARCHITECTURE)
2400 E. COMMERCIAL BLVD. SUITE 415 FT. LAUDERDALE, FL. 33308 954-771-2724	
KAMM CONSULTING, INC.	(MECHANICAL/ELECTRICAL/PLUMBING/FIRE PROTECTION ENGINEERING)
1407 WEST NEWPORT CENTER DRIVE DEERFIELD BEACH, FL 33442 954-949 2200	
KEITH & ASSOCIATES	(CIVIL ENGINEERING)
301 E. ATLANTIC BLVD. POMPANO BEACH. 33060 954-788-3400	
CURTIS & ROGERS DESIGN STUDIO INC.	(LANDSCAPE ARCHITECTURE)
3250 MARY STREET, SUITE 301 COCONUT GROVE, FL. 33133 305-442-1774	
TRC WORLDWIDE ENGINEERING, INC.	(STRUCTURAL)
3590 NW 56TH STREET FORT LAUDERDALE, FL 33309 954-484-7777	

DRAWING INDEX

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C-2	ENGINEERING DETAILS	M0.1	M2.1 MECHANICAL PLAN
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CITY OF POMPANO BEACH	
LAMAR FISHER	MAYOR
GEORGE BRUMMER	VICE MAYOR
WOODROW J. POITIER	COMMISSIONER
BARRY DOCKSWELL	COMMISSIONER
CHARLOTTE BURRIE	COMMISSIONER
REX HARDIN	COMMISSIONER
DENNIS W. BEACH	CITY MANAGER
ALESSANDRA DELFICO	INTERIM CITY ENGINEER
ROBERT MCCAUGHAN	PUBLIC WORKS DIRECTOR
STEVEN ROCCO	AIRPORT MANAGER
TAMMY GOOD, PMP	PROJECT MANAGER

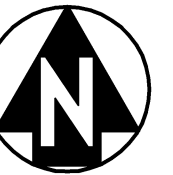


PROJECT LOCATION
NORTH
N.T.S.

PROJECT: AIRPARK MAINTENANCE STORAGE FACILITY
POMPANO BEACH, FLORIDA 33060

COVER SHEET	REVISIONS
DATE: AUGUST 25, 2010	DRAWN BY: BH/EC/JJJ
CHECKED BY: MC	JOB NO: 0908
SHEET: COV	1 OF 1

LOCATION MAP - NOT TO SCALE



LEGAL DESCRIPTION:

A PARCEL OF LAND IN THE NORTH ONE-HALF (1/2) OF SECTION 36, TOWNSHIP 48 SOUTH, RANGE 42 EAST, MORE PARTICULARLY DESCRIBED AS FOLLOWS:

COMMENCING AT THE SOUTHWEST CORNER OF THE NORTHEAST ONE-QUARTER (NE 1/4) OF SAID SECTION 36; THENCE ON AN ASSUMED BEARING OF N 00°55'14" W ALONG THE WEST LINE OF SAID NORTHEAST ONE-QUARTER (NE 1/4) A DISTANCE OF 1,001.70 FEET TO THE LIMITED ACCESS RIGHT-OF-WAY LINE OF NE 10TH STREET; THENCE S 89°15'33" W ALONG SAID LIMITED ACCESS RIGHT-OF-WAY LINE A DISTANCE OF 411.20 FEET; THENCE N 00°55'21" W A DISTANCE OF 60.00 FEET TO THE POINT OF BEGINNING; THENCE S 89°15'53" W ALONG SAID LIMITED ACCESS RIGHT-OF-WAY LINE A DISTANCE OF 560.55 FEET; THENCE N 00°55'21" W A DISTANCE OF 416.01 FEET; THENCE S 00°55'21" A DISTANCE OF 498.79 FEET TO THE POINT OF BEGINNING.

SAID LANDS SITUATE IN POMPANO BEACH AIR PARK, BROWARD COUNTY, FLORIDA CONTAINING 5.00 ACRES MORE OR LESS.

"LEGAL DESCRIPTION BY OTHERS"

LEGEND:

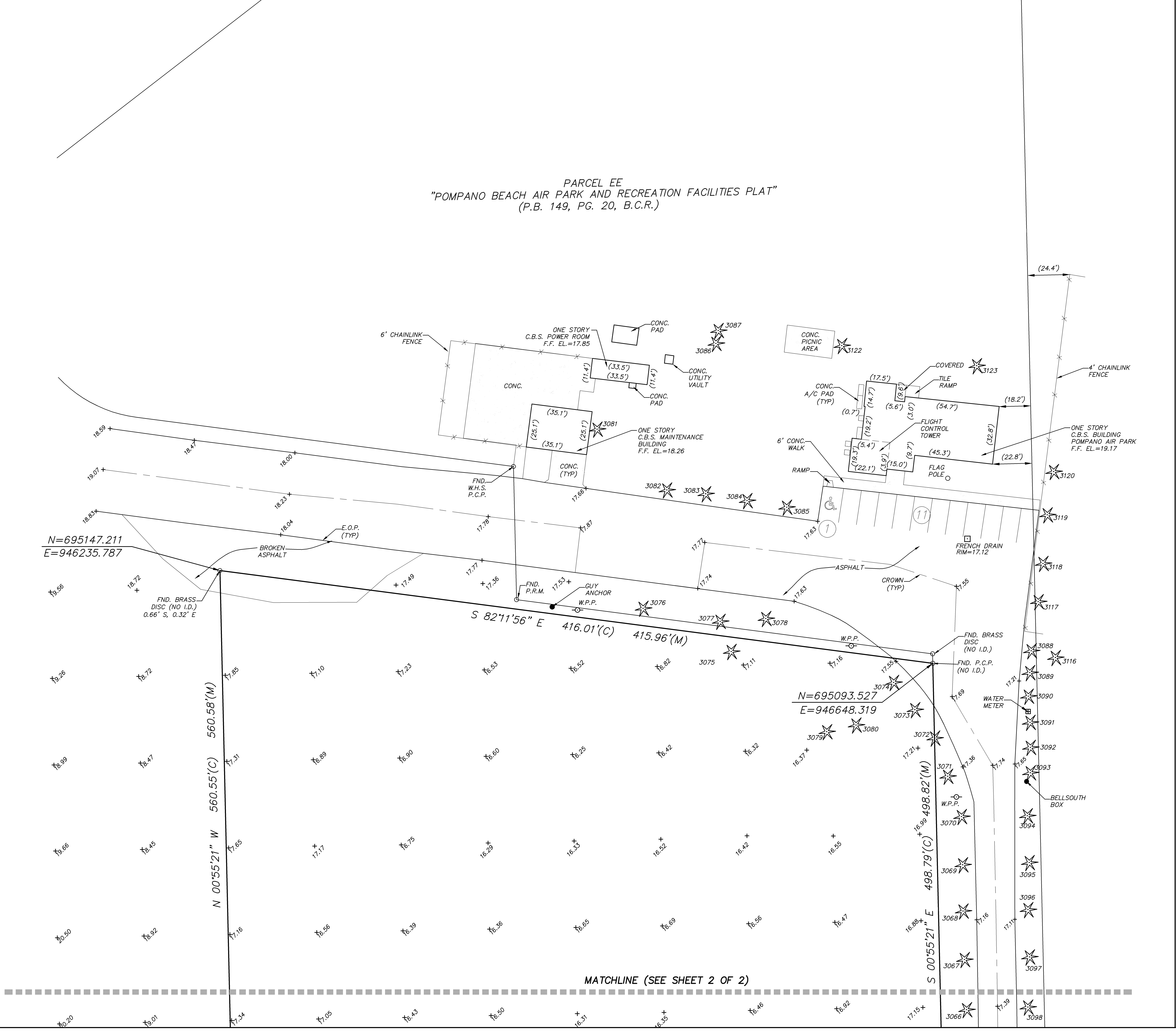
- AVE - avenue
- BSCR - Broward County Records
- BFP - back flow prevention
- BM - benchmark
- BST - bellmouth telephone
- CB - catch basin
- CL - centerline
- CLB - cul-de-sac
- CONC - concrete
- EL - elevation
- ELEC - electric
- EMF - easement
- FD - field data
- FB - field book
- FI - fire hydrant
- FND - found
- FPL - Florida Power and Light
- FR - fire
- IS - iron rod
- LP - light pole
- MH - manhole
- NIS - non-iron-rod
- ORB - Official Records Book
- PI - plot book
- PO - page
- PL - property line
- PT - plotted
- POB - point of beginning
- PRM - permanent reference monument
- RET - retention area
- RM - rim elevation
- R/W - right-of-way
- (S) - set
- SMB - sanitary manhole
- SO, FT. - square feet
- TYP - typical
- #### - non-vehicle access line
- N - north
- S - south
- E - east
- W - west
- DB - deed book
- PCC - point of commencement
- ELEV - Elevation

SURVEY NOTES AND QUALIFICATIONS:

1. This survey map and report is not valid without the signature and original raised seal of Florida licensed surveyor and mapper which can be found at the end of this survey.
2. Elevations shown hereon are based on the National Geodetic Vertical Datum of 1929.
3. Benchmark references: Benchmark at S.W. Corner of Parcel "EE", Brass Disc. El.=17.75
4. Bearings shown hereon are relative to "Pompano Beach Air Park and Recreation Facilities" - P.B. 149, PG. 20
5. Set IR w/cap (LB# 6727) at property corners unless otherwise noted
6. Property contains 5.00 acres, more or less (TOTAL)
7. Expected use of property is Commercial. The minimum relative distance accuracy for this type of Boundary Survey is 1 ft. in 10,000 ft. The accuracy obtained by measurement & calculations was found to exceed this requirement.
8. Lands shown hereon were not abstracted for easements or Rights-of-way of record.

TREE TABLE			
TREE #	TYPE	HEIGHT	CIRCUMFERENCE
3038	CABBAGE PALM	25.00'	3.00'
3039	CABBAGE PALM	20.00'	3.50'
3040	CABBAGE PALM	15.00'	3.50'
3041	CABBAGE PALM	10.00'	2.50'
3042	CABBAGE PALM	20.00'	3.00'
3043	CABBAGE PALM	15.00'	3.80'
3044	CABBAGE PALM	30.00'	3.30'
3045	CABBAGE PALM	28.00'	3.50'
3046	CABBAGE PALM	23.00'	3.50'
3047	CABBAGE PALM	25.00'	3.00'
3048	CABBAGE PALM	20.00'	3.30'
3049	CABBAGE PALM	25.00'	3.20'
3050	CABBAGE PALM	30.00'	4.00'
3051	CABBAGE PALM	22.00'	3.30'
3052	CABBAGE PALM	19.00'	3.30'
3053	CABBAGE PALM	25.00'	4.00'
3054	CABBAGE PALM	20.00'	3.00'
3055	CABBAGE PALM	20.00'	3.50'
3056	CABBAGE PALM	20.00'	3.50'
3057	ROYAL PALM	25.00'	3.20'
3058	ROYAL PALM	25.00'	3.50'
3059	ROYAL PALM	27.00'	3.50'
3060	ROYAL PALM	25.00'	2.80'
3061	ROYAL PALM	22.00'	3.10'
3062	ROYAL PALM	23.00'	3.30'
3063	ROYAL PALM	12.00'	3.00'
3064	ROYAL PALM	20.00'	3.60'
3065	ROYAL PALM	23.00'	3.40'
3066	ROYAL PALM	18.00'	2.80'
3067	ROYAL PALM	22.00'	3.30'
3068	ROYAL PALM	21.00'	4.50'
3069	ROYAL PALM	19.00'	2.00'
3070	ROYAL PALM	20.00'	3.60'
3071	ROYAL PALM	22.00'	2.50'
3072	ROYAL PALM	16.00'	2.20'
3073	ROYAL PALM	23.00'	2.60'
3074	ROYAL PALM	20.00'	2.90'
3075	CABBAGE PALM	25.00'	3.10'
3076	UNKNOWN	18.00'	3.20'
3077	UNKNOWN	14.00'	2.10'
3078	UNKNOWN	23.00'	2.60'
3079	UNKNOWN	13.00'	2.60'
3080	UNKNOWN	25.00'	5.00'
3081	SEA GRAPE	13.00'	4.00'
3082	ROYAL PALM	15.00'	2.40'
3083	ROYAL PALM	17.00'	2.50'
3084	ROYAL PALM	14.00'	2.50'
3085	ROYAL PALM	16.00'	2.50'
3086	ROYAL PALM	15.00'	1.00'
3087	PALM FRONZ	10.00'	3.30'
3088	QUEEN PALM	25.00'	4.00'
3089	QUEEN PALM	18.00'	2.30'
3090	QUEEN PALM	13.00'	2.20'
3091	QUEEN PALM	12.00'	2.20'
3092	QUEEN PALM	14.00'	2.50'
3093	QUEEN PALM	16.00'	2.60'
3094	ROYAL PALM	24.00'	3.30'
3095	ROYAL PALM	10.00'	2.50'
3096	ROYAL PALM	11.00'	2.20'
3097	ROYAL PALM	13.00'	2.20'
3098	ROYAL PALM	15.00'	2.10'
3099	ROYAL PALM	18.00'	3.10'
3100	ROYAL PALM	20.00'	2.60'
3101	ROYAL PALM	22.00'	3.00'
3102	ROYAL PALM	20.00'	2.20'
3103	ROYAL PALM	20.00'	2.80'
3104	ROYAL PALM	23.00'	3.50'
3105	ROYAL PALM	23.00'	2.90'
3106	ROYAL PALM	24.00'	2.80'
3107	ROYAL PALM	25.00'	3.50'
3108	ROYAL PALM	24.00'	3.50'
3109	ROYAL PALM	25.00'	3.00'
3116	ROYAL PALM	9.00'	1.80'
3117	ROYAL PALM	13.00'	2.00'
3118	ROYAL PALM	8.00'	1.90'
3119	ROYAL PALM	14.00'	3.20'
3120	ROYAL PALM	9.50'	2.80'
3122	UNKNOWN	35.00'	5.00'
3123	SPECIAL PALM	33.00'	7.50'

FLOOD ZONE DATA:
 FLOOD ZONE: X
 COMMUNITY NO: 120055
 PANEL NO: Q119
 SUFFIX: G
 DATE OF MAP: OCTOBER 2, 1997



PREPARED BY:
DOUGLASS, LEAVY & ASSOCIATES INC.
 PROFESSIONAL SURVEYORS & MAPPERS
 7914 WILES ROAD
 CORAL SPRINGS, FLORIDA 33067
 OFFICE: (954) 344-7994 FAX: (954) 344-2638
 LICENSED BUSINESS No. 6727

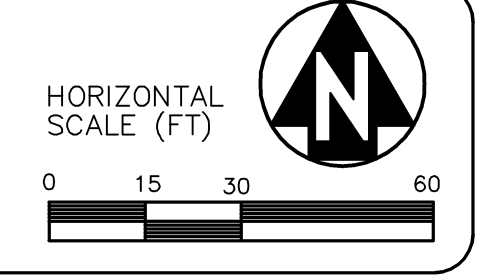
PREPARED FOR:
AOG AIRCRAFT SERVICES

PROJECT:
**POMPANO BEACH AIR PARK
 BOUNDARY SURVEY**

REVISIONS:		
Date	Description	By
05/18/06	BOUNDARY SURVEY	JEC

DRAWING DATA:
 Drawing date: 05/18/06
 fb/pg source: 696/69
 Drafter: JEC
 Checked: sjd
 CADD dwg no: 06051-plot
SHEET: 1/2

SEAL:
 For the Firm _____
 Scott J. Douglass
 Professional Surveyor & Mapper
 Florida Registration No 4532



REMAINDER OF
NORTH ONE HALF (N. 1/2) OF
SECTION 36, TOWNSHIP 48 SOUTH, RANGE 42 EAST

MATCHLINE (SEE SHEET 1 OF 2)
PORTION OF
NORTH ONE HALF (N. 1/2) OF
SECTION 36, TOWNSHIP 48 SOUTH, RANGE 42 EAST

VACANT
217,801 S.F. ±
5.00 ACRES ±

REMAINDER OF
NORTH ONE HALF (N. 1/2) OF
SECTION 36, TOWNSHIP 48 SOUTH, RANGE 42 EAST

N=694586.807
E=946248.595

N=694594.859
E=946659.716

S 89°15'53" W 411.20'(C) 411.08'(M)

W. 6TH STREET
(P.B. 149, PG. 20)

REMAINDER OF
NORTH ONE HALF (N. 1/2) OF
SECTION 36, TOWNSHIP 48 SOUTH, RANGE 42 EAST

- LEGEND:
- AVE = avenue
 - BCR = Broward County Records
 - BFP = back flow prevention
 - BM = benchmark
 - BST = bellmouth telephone
 - (C) = calculated
 - CB = catch basin
 - CL = centerline
 - CONC = concrete
 - EL = elevation
 - ELEC = electric
 - EQMT = equipment
 - (F) = field data
 - FB = field book
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 - FND = found
 - FPL = Florida Power and Light
 - IP = iron pipe
 - IR = iron rod
 - LP = light pole
 - MH = manhole
 - NTS = not-to-scale
 - ORB = Official Records Book
 - PIB = plot book
 - PO = pipe
 - PL = property line
 - (P) = plotted
 - POB = point of beginning
 - PRM = permanent reference monument
 - RET = retention area
 - RM = rim elevation
 - R/W = right-of-way
 - (S) = set
 - SMH = sanitary manhole
 - SQ. FT. = square feet
 - TYP = typical
 - ////// = non-vehicle access line
 - N = north
 - S = south
 - E = east
 - W = west
 - DB = deed book
 - POC = Point of commencement
 - ELV = Elevation

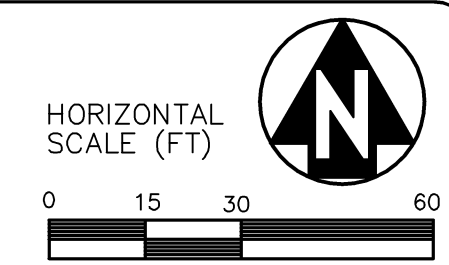
PREPARED BY:
DOUGLASS, LEAVY & ASSOCIATES INC.
PROFESSIONAL SURVEYORS & MAPPERS
7914 WILES ROAD
CORAL SPRINGS, FLORIDA 33067
OFFICE: (954) 344-7994 FAX: (954) 344-2638
LICENSED BUSINESS No. 6727

PREPARED FOR:
AOG AIRCRAFT SERVICES

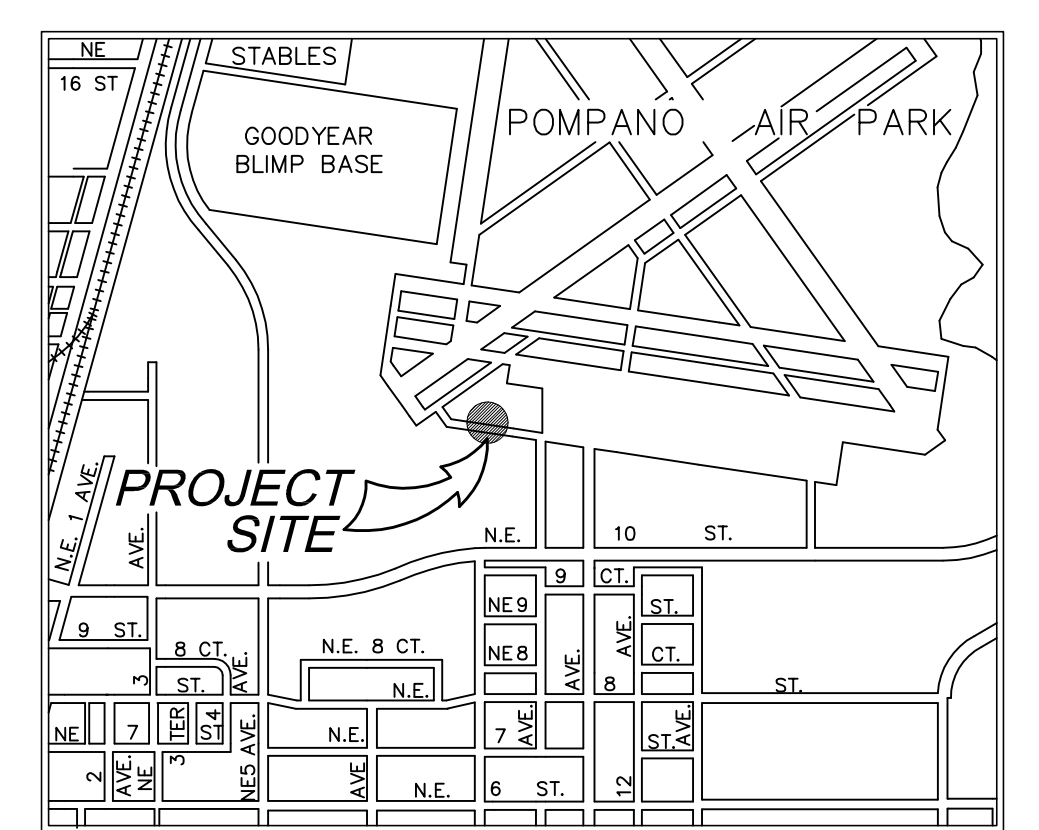
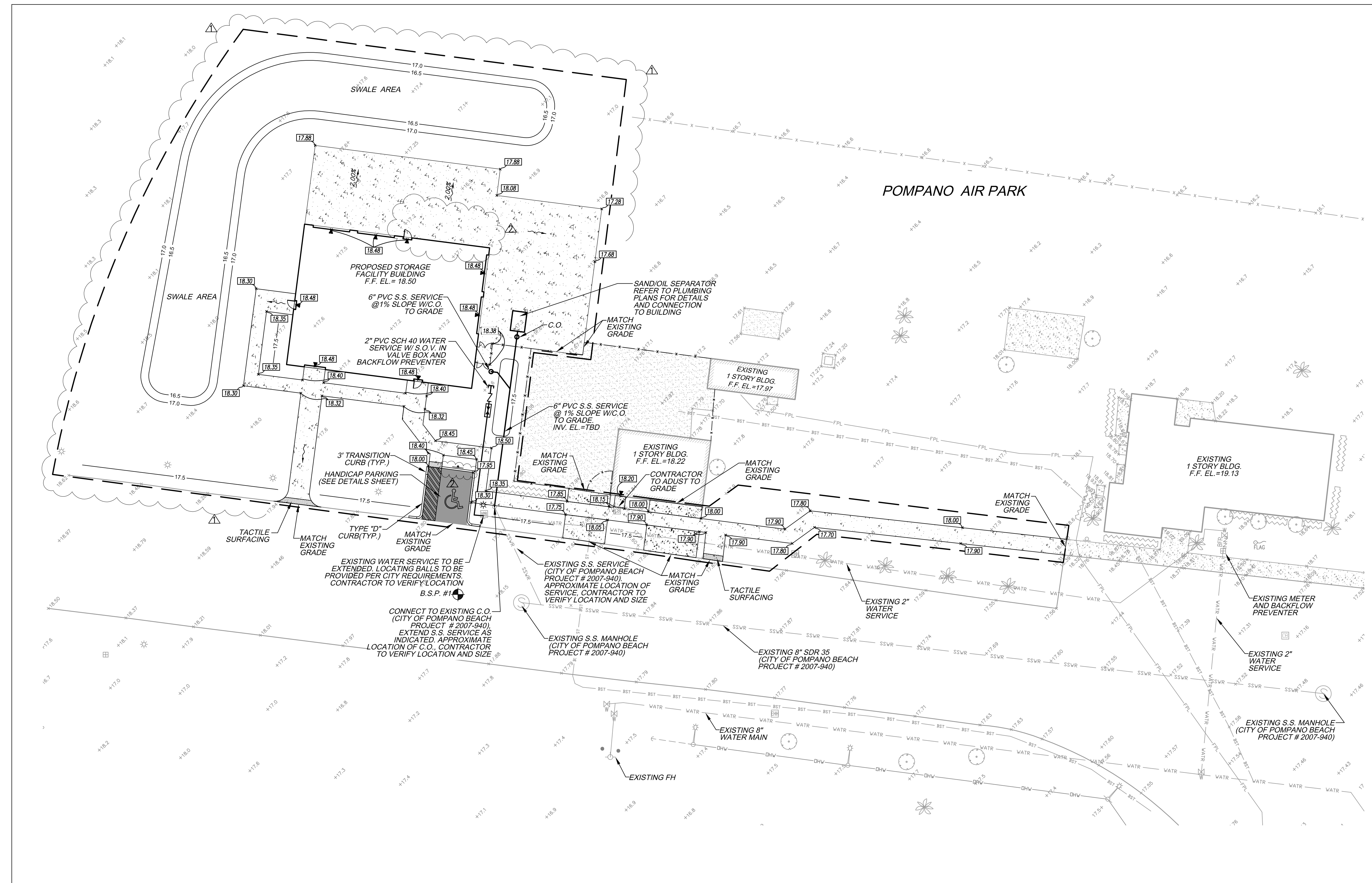
PROJECT:
POMPANO BEACH AIR PARK
BOUNDARY SURVEY

REVISIONS:		
Date	Description	By
05/18/06	BOUNDARY SURVEY	JEC

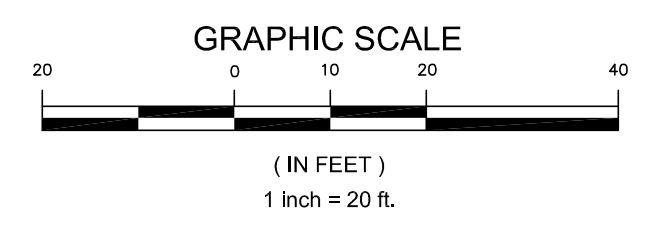
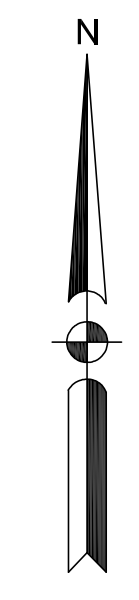
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Drawing date: 05/18/06
fb/pg source: 696/69
Drafted: JEC
Checked: SJD
CADD dwg no: 06051-plot
SHEET: 2/2



SEAL:
For the Firm _____
Scott J. Douglass
Professional Surveyor & Mapper
Florida Registration No 4532



VICINITY MAP
(NOT TO SCALE)



LEGEND	
	BUILDING ACCESS
	PROPOSED GRADE ELEVATION
	PROPOSED WATER SERVICE
	PROPOSED BACTERIOLOGICAL SAMPLE POINT
	PROPOSED SEWER LATERAL
	PROPOSED 6' HIGH CHAIN LINK FENCE REFER TO ARCHITECTURAL PLANS
	PROPOSED SWALE CENTER LINE
	PROPOSED LIMITS OF CONSTRUCTION
	PROPOSED PAVEMENT
	PROPOSED CONCRETE
	PROPOSED TRUNCATED DOMES
	EXISTING CONCRETE
	EXISTING RUNWAY LIGHT TO BE REMOVED SEE ARCHITECTURAL PLANS
	EXISTING SPOT ELEVATION
	EXISTING SANITARY SEWER MANHOLE
	EXISTING SANITARY SEWER LATERAL W/ CLEAN OUT
	EXISTING FIRE HYDRANT WITH BOLLARDS
	EXISTING GATE VALVE
	EXISTING WATER METER
	EXISTING WATER CONTROL BOX
	EXISTING ELECTRIC HANDHOLE
	EXISTING RUNWAY LIGHT
	EXISTING WOOD UTILITY POLE WITH LIGHT
	EXISTING GUY ANCHOR
	EXISTING SEWER LINE
	EXISTING WATER LINE
	EXISTING FPL UNDERGROUND LINE
	EXISTING BELLSOUTH UNDERGROUND LINE
	EXISTING FENCE
	EXISTING TREE

GENERAL NOTES

1. THE CONTRACTOR SHALL BE RESPONSIBLE FOR READING AND FAMILIARIZING THEMSELVES WITH ALL OF THE PERMITS PREVIOUSLY ACQUIRED FOR THIS PROJECT. THE CONDITIONS OUTLINED IN THE PERMITS ARE IN FORCE AND FULL EFFECT AS PART OF THE PROPOSED IMPROVEMENTS. THE CONTRACTOR IS RESPONSIBLE TO ENSURE ALL WORK ASSOCIATED WITH THIS PROJECT IS IN COMPLIANCE WITH ALL OF THE REQUIREMENTS OF THESE PERMITS.
2. THE CONTRACTOR WILL BE RESPONSIBLE FOR ACQUIRING A VALID NPDES PERMIT, UNLESS SUCH PERMIT IS DETERMINED TO BE NON-APPLICABLE BY REGULATORY AGENCY HAVING PROPER JURISDICTION REGARDING THIS MATTER.
3. THE CONTRACTOR IS RESPONSIBLE FOR ALL UTILITY RELOCATION AND GRADE ADJUSTMENTS WITHIN PROJECT LIMITS AND FOR COORDINATION WITH APPLICABLE UTILITY COMPANIES PRIOR TO ADJUSTMENTS. CONTRACTOR SHALL CONTACT SUNSHINE STATE ONE CALL OF FLORIDA, INC. AT 1-800-432-4770.
4. INFORMATION AS THE LOCATION OF EXISTING UTILITIES HAS BEEN COLLECTED FROM VARIOUS SOURCES. THE RESULTS OF SUCH INVESTIGATIONS AS SHOWN ON THE DRAWINGS ARE NOT GUARANTEED AS TO THE ACCURACY. THE CONTRACTOR SHALL MAKE ALL NECESSARY INVESTIGATIONS TO SATISFY HIMSELF AS TO THE EXISTING CONDITIONS PRIOR TO STARTING CONSTRUCTION ACTIVITIES. CONTRACTOR SHALL BE RESPONSIBLE FOR REPAIRING ANY DAMAGE TO SAID UTILITIES AS A RESULT OF CONSTRUCTION ACTIVITIES.
5. CONTRACTOR SHALL BE RESPONSIBLE FOR INVESTIGATING CONFLICTS BETWEEN ALL EXISTING UTILITIES WITH PROPOSED STRUCTURES.
6. ALL WASTE MATERIAL/DEBRIS TO BE DISPOSED OF BY CONTRACTOR AT HIS EXPENSE.
7. ALL AREAS OUTSIDE THE PROJECT LIMITS DAMAGED BY THE CONSTRUCTION WORK MUST BE RESTORED TO ITS ORIGINAL CONDITION, INCLUDING AREAS COVERED WITH SOD, CONCRETE, AND PAVEMENT.
8. CONTRACTOR IS RESPONSIBLE FOR PROVIDING MAINTENANCE OF TRAFFIC THROUGHOUT CONSTRUCTION. THE MOT SHALL BE PERFORMED IN ACCORDANCE TO THE MUTCD AND FDOT STANDARDS AND SHALL BE APPROVED BY THE CITY, THE ENGINEER AND ANY OTHER APPLICABLE AGENCIES PRIOR TO STARTING CONSTRUCTION OF THE PROJECT.
9. THE CONTRACTOR SHALL BE RESPONSIBLE FOR PROVIDING THE NECESSARY AS-BUILT DRAWINGS TO THE ENGINEER OF RECORD. ONCE THE AS-BUILTS ARE APPROVED BY THE ENGINEER OF RECORD, THE ENGINEER WILL SUBMIT FINAL CERTIFICATION PACKAGES WITH COPIES OF THE AS-BUILTS TO THE AGENCIES FOR CERTIFICATION APPROVALS AND PERMIT CLOSE-OUTS. THE AS-BUILTS SHALL INDICATE ALL INFORMATION REQUIRED BY THE CITY, ENGINEER OF RECORD AND ALL AGENCIES HAVING JURISDICTION. THE AS-BUILTS PROVIDED BY THE CONTRACTOR SHALL BE SIGNED AND SEALED BY A PROFESSIONAL LAND SURVEYOR CURRENTLY REGISTERED IN THE STATE OF FLORIDA AND SHALL BE FIRST REVIEWED BY THE CONTRACTOR TO ASSURE THEY ARE SUFFICIENTLY ACCURATE, CLEAR AND LEGIBLE TO SATISFY THE ENGINEER OF RECORD AND ALL PERMITTING AGENCIES IN ORDER TO OBTAIN FINAL CERTIFICATION APPROVALS AND PERMIT CLOSE-OUTS. THE PROJECT WILL NOT BE CONSIDERED COMPLETE UNTIL ALL FINAL CERTIFICATIONS HAVE BEEN APPROVED AND PERMITS HAVE BEEN CLOSED-OUT.
10. CONTRACTOR IS RESPONSIBLE FOR CLEARING/GRUBBING WITHIN THE PROJECT LIMITS. REFER TO LANDSCAPE PLANS FOR VEGETATION AND TREE REMOVAL REQUIREMENTS.
11. THE CONTRACTOR SHALL MAINTAIN CONTINUOUS SAFE AND ADEQUATE PEDESTRIAN AND VEHICULAR ACCESS THROUGHOUT CONSTRUCTION OPERATIONS.

CARTAYA & ASSOCIATES ARCHITECTS P.A.
cartayaandassociates.com

2400 E. COMMERCIAL BLVD. SUITE 415
FT. LAUDERDALE, FLORIDA 33308
(954) 771-2724 FAX 776-4280

SEAL
MICHAEL GUINAGLIA, P.E.
REGISTERED PROFESSIONAL ENGINEER
(FOR THE STATE OF FLORIDA)

PROJECT: AIR PARK MAINTENANCE STORAGE FACILITY
POMPAÑO BEACH, FLORIDA 33060

REVISIONS:
AS PERFORMED IN
SITE PLAN MODIFICATIONS
02/18/10 BUILDING
DRAWN BY: DC
DEPARTMENT COMMENTS

DATE: AUGUST 25, 2010
DRAWN BY: DC
CHECKED BY: RM

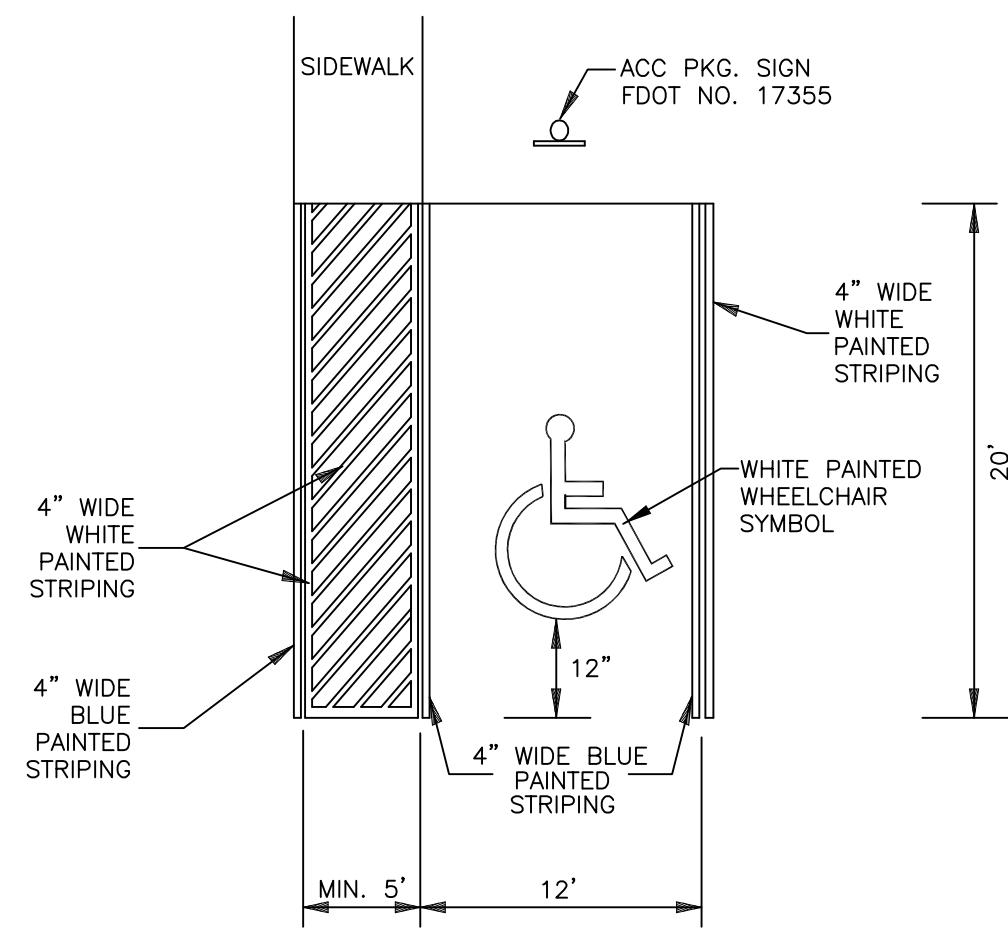
TITLE: ENGINEERING PLAN
JOB NO: 0908

SHEET: C-1
1 of 1

KEITH ASSOCIATES, INC.
consulting engineers

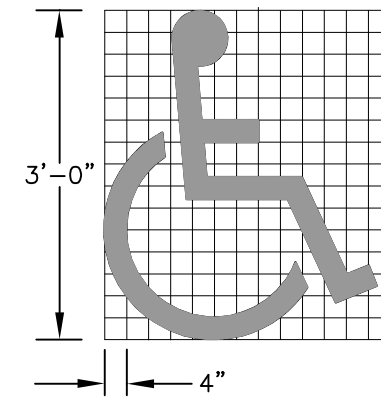
301 EAST ATLANTIC BOULEVARD
POMPAÑO BEACH, FLORIDA 33060-6643
(954) 788-3400 FAX (954) 788-3500
STATE OF FLORIDA CERTIFICATE OF AUTHORIZATION NUMBER - 7928

N:\07\0908\01 Pompano Beach Airpark Maintenance Sheet - Cartaya\Engineering\cadd\dwg\070908-00-engl.plt.rvt



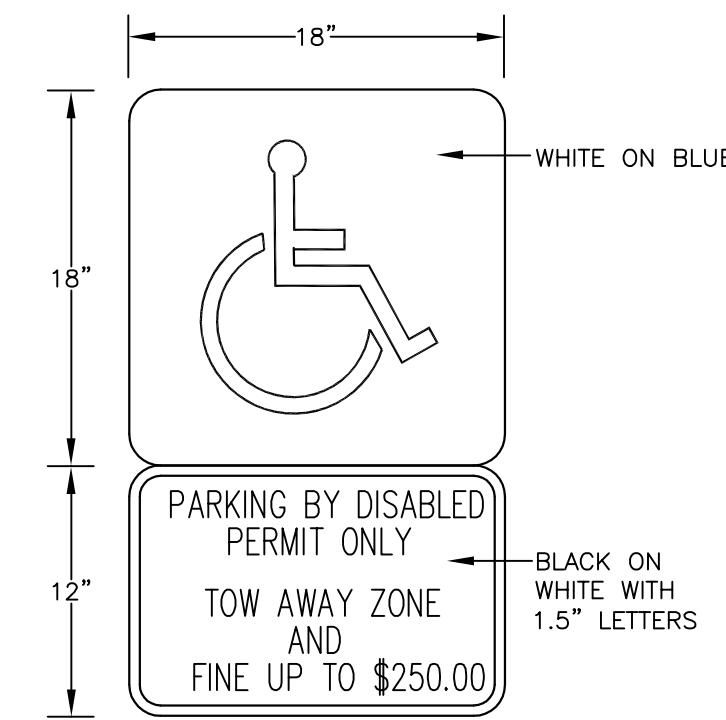
NOTE:
HANDICAPPED PARKING SPACES SHALL BE PROMINENTLY OUTLINED WITH PAINT AND POSTED WITH A FIXED POLE SIGN (NOT LESS THAN 84" FROM THE GROUND IN HEIGHT) CLEARLY MARKED "HANDICAPPED PARKING" OR THE INTERNATIONAL WHEELCHAIR SYMBOL AND CAPTION "PARKING BY DISABLE PERMIT ONLY - \$250 FINE". PROVIDE 4" BLUE STRIPING AS INDICATED.

TYPICAL HANDICAP PARKING
N.T.S.



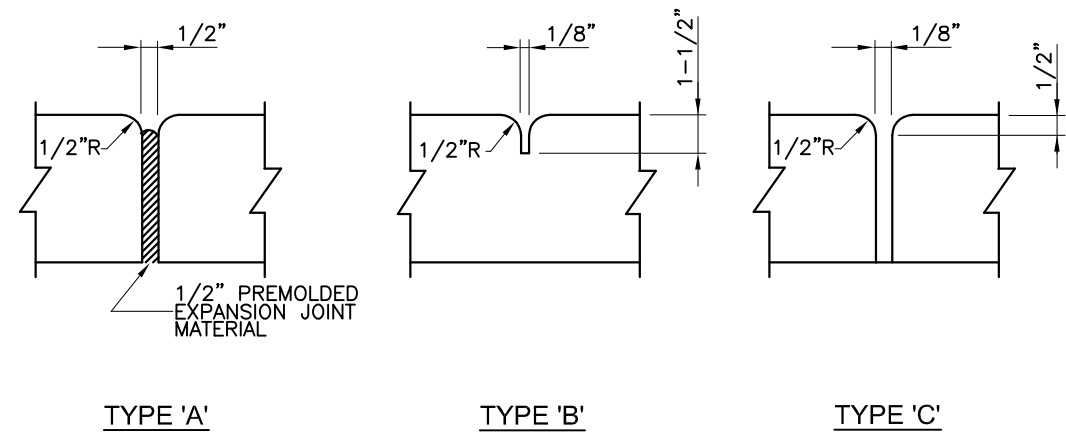
USE OF PAVEMENT SYMBOL IN HANDICAPPED PARKING SPACES IS REQUIRED, THE SYMBOL SHALL BE 3 FT. HIGH AND WHITE IN COLOR.

HANDICAPPED PAVEMENT SYMBOL
N.T.S.



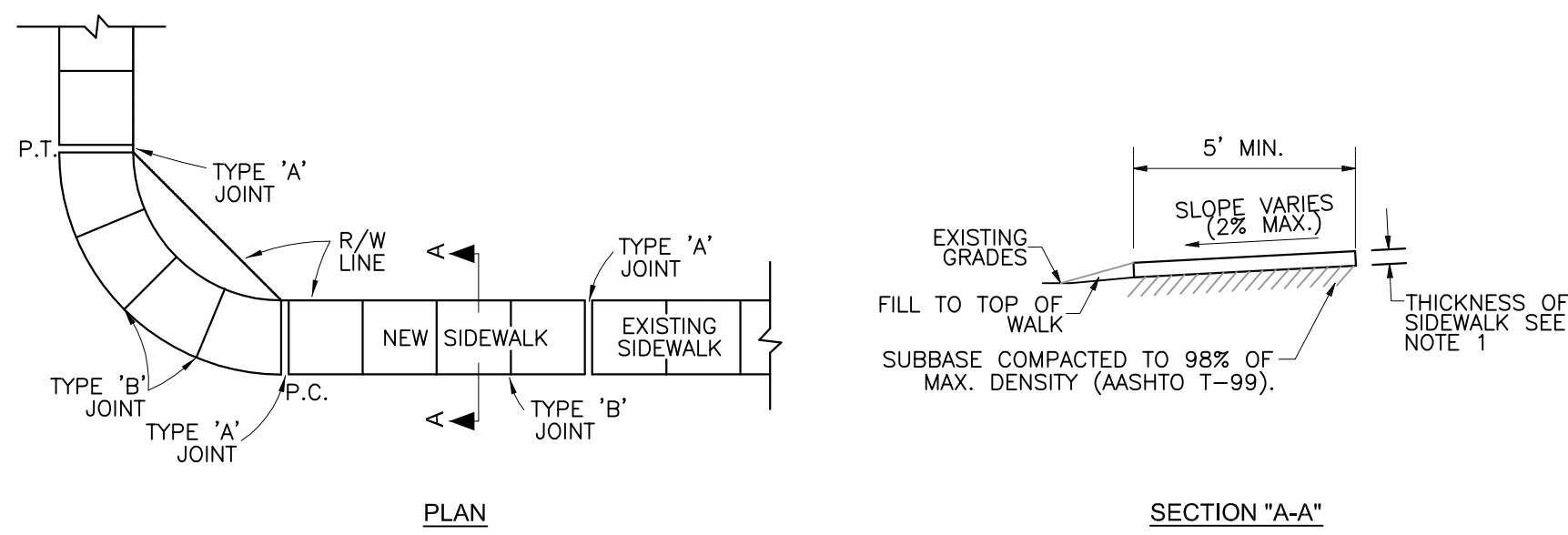
1. TOP PORTION OF SIGN SHALL HAVE A REFLECTIVE BLUE BACKGROUND WITH WHITE REFLECTIVE SYMBOL.
2. BOTTOM PORTION SHALL HAVE A REFLECTIVE WHITE BACKGROUND WITH BLACK OPAQUE LEGEND AND BORDER.
3. SIGN MAY BE FABRICATED ON ONE PANEL OR TWO.
4. SIGNS ARE TO BE MOUNTED AT A HEIGHT OF 7'-0" FROM PAVEMENT TO BOTTOM OF SIGN.

HANDICAPPED PARKING SIGN
N.T.S.



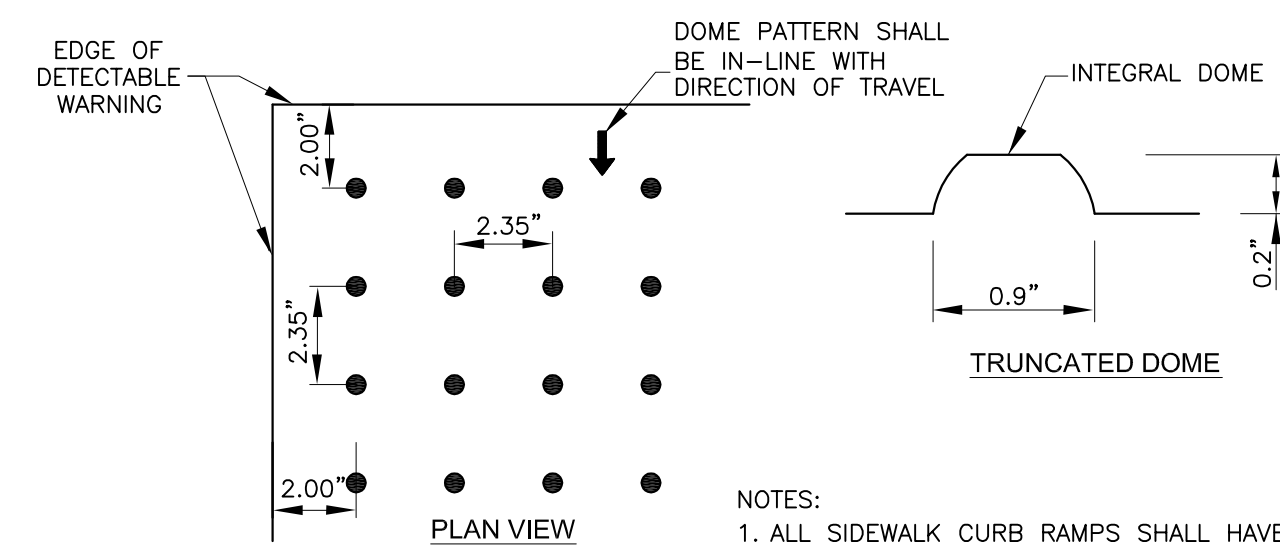
TYPE	LOCATION
'A'	P.C. & P.T. OF CURVES JUNCTION OF EXISTING AND NEW SIDEWALKS
'B'	5'-0" CENTER TO CENTER ON SIDEWALKS.
'C'	WHERE SIDEWALK ABUTS CONCRETE CURBS, DRIVEWAYS AND SIMILAR STRUCTURES.

SIDEWALK JOINTS



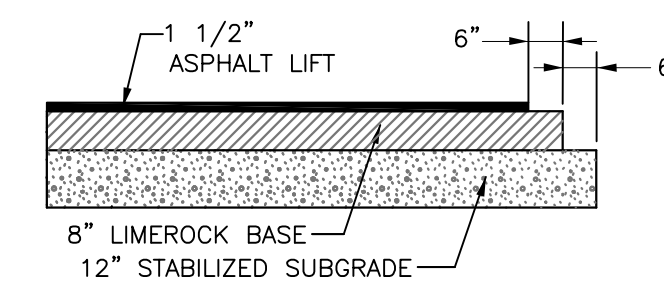
- NOTES
- 1) SIDEWALK THICKNESS SHALL BE 4" THICK. THICKNESS IN TRAFFIC LOADING AREAS AND IN DRIVEWAYS SHALL BE 6".
 - 2) SIDEWALK RAMP PER FDOT INDEX # 304.
 - 3) 6"x6"-10/10 WIRE MESH REINFORCEMENTS SHALL BE USED IN THE 6" THICK SIDEWALKS.
 - 4) CONCRETE TO BE 3,000 PSI IN 28 DAYS.
 - 5) CURE ALL CONCRETE WITH CLEAN SAND, PLASTIC MEMBRANE OR OTHER APPROVED METHOD.
 - 6) SIDEWALK FOUNDATION SHALL BE COMPACTED TO A FIRM, EVEN SURFACE, TRUE TO GRADE AND CROSS SECTION, AND SHALL BE MOIST AT THE TIME CONCRETE IS PLACED.
 - 7) ALL CONSTRUCTION SHALL CONFORM TO LOCAL CONSTRUCTION CODES AND STANDARDS.

SIDEWALK DETAIL
N.T.S.



- NOTES:
1. ALL SIDEWALK CURB RAMP SHALL HAVE DETECTABLE WARNING SURFACES THAT EXTEND THE FULL WIDTH OF THE RAMP AND IN THE DIRECTION OF TRAVEL 36" INCHES FROM THE BACK OF CURB.
 2. GROOVES NOT PERMITTED.
 3. REFER TO FBC/FACBC 11-4.7.7, 11-4.29.2, 11-4.29.5/ANSI A117.1-1986

DETECTABLE WARNING DETAIL ("TRUNCATED DOMES")
N.T.S.



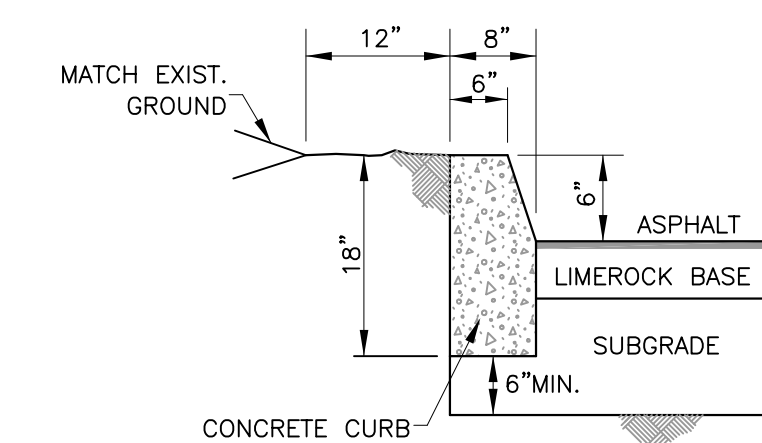
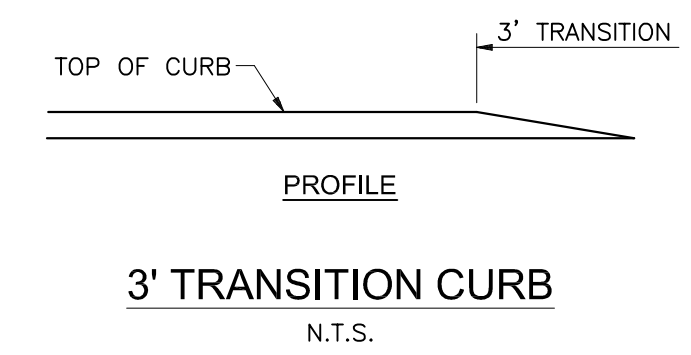
ASPHALTIC CONCRETE VEHICULAR:
2-3/4" LIFTS, FDOT TYPE S-III ASPHALT SURFACE COURSE SHALL CONFORM TO THE REQUIREMENTS OF FDOT STANDARDS SPECIFICATIONS SECTIONS 330 AND 331.
SECOND LIFT OF ASPHALT SHALL NOT BE PLACED UNTIL FINAL LANDSCAPE/HARDSCAPE HAS BEEN INSTALLED.

PRIME AND TACK COAT:
THE LIMEROCK BASE COURSE SHALL CONFORM TO THE REQUIREMENTS OF FDOT STANDARDS SPECIFICATIONS SECTION 300.
APPLICATION RATES:
PRIME COAT - 0.10 GALLONS PER SQ. YD.
TACK COAT - 0.08 GALLONS PER SQ. YD.

BASE:
8" LIMEROCK BASE COMPACTED TO 98% OF MAXIMUM DENSITY (AASHTO T-180), LIMEROCK BASE TO CONFORM WITH THE REQUIREMENTS OF FDOT SPECIFICATIONS SECTIONS 200 AND 311.

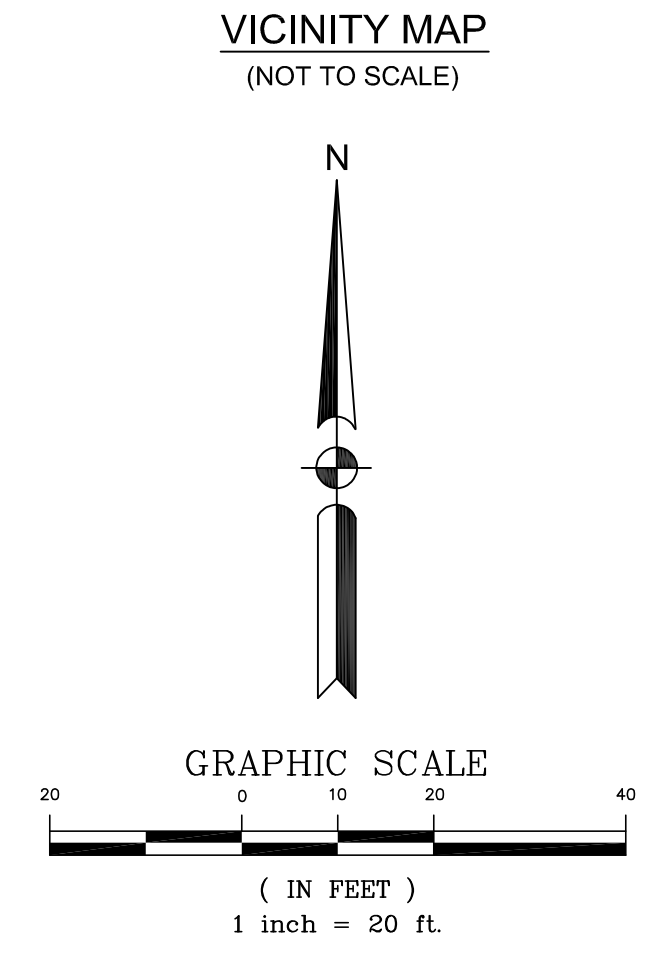
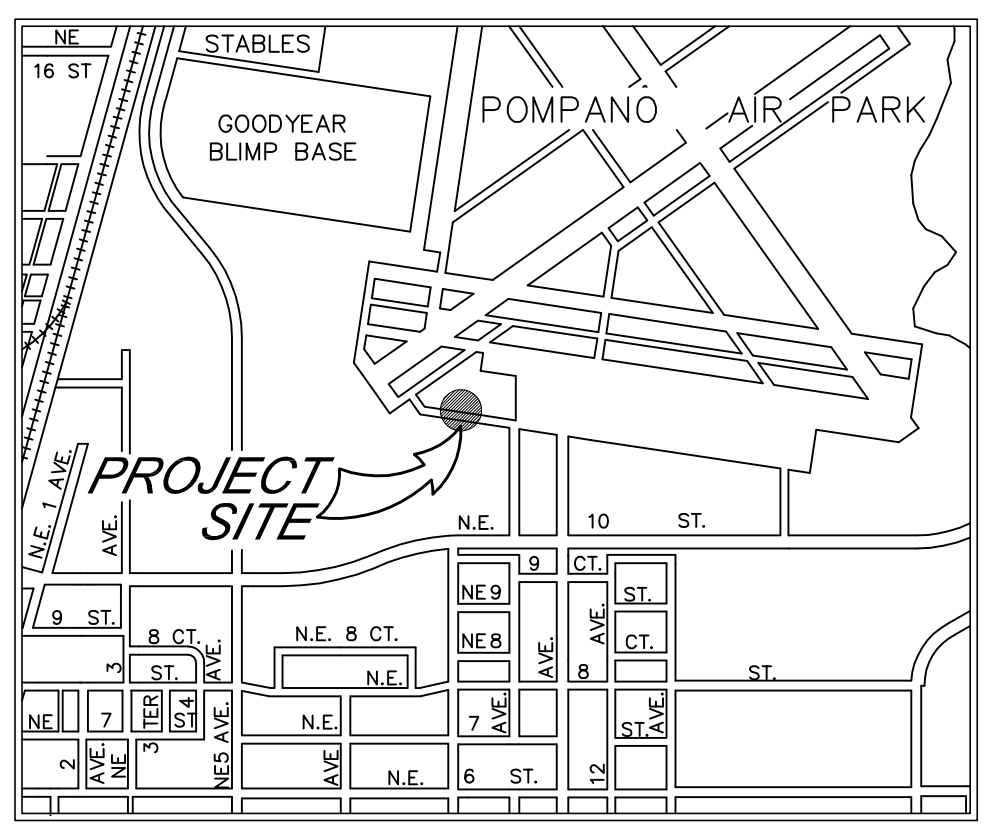
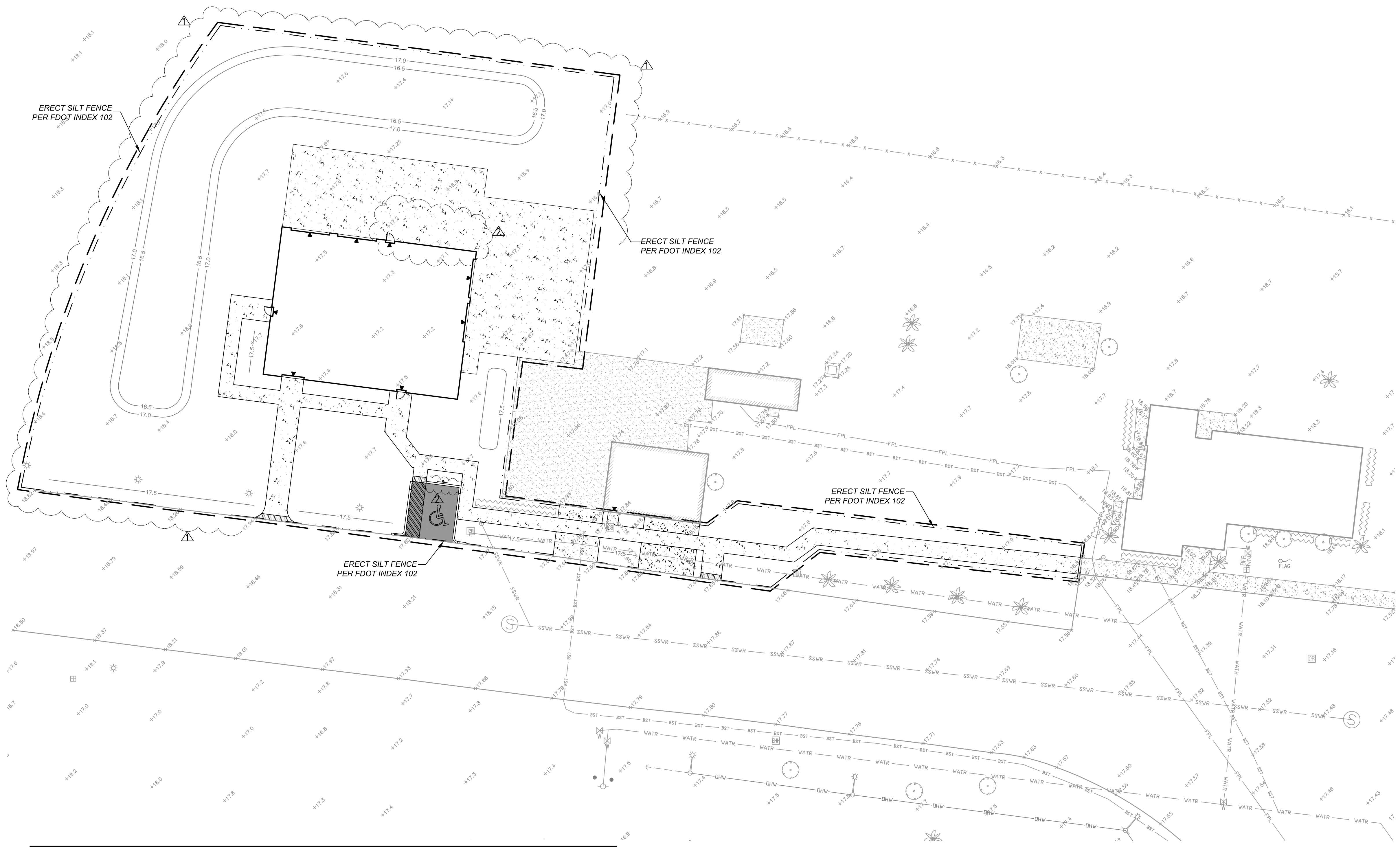
SUBGRADE:
12" STABILIZED SUBGRADE COMPACTED TO 98% OF MAXIMUM DENSITY (AASHTO T-180); MINIMUM LBR = 40.
GROUND ADJACENT TO PAVEMENT HAVING RUNOFF SHALL BE GRADED TWO INCHES LOWER THAN THE EDGE OF PAVEMENT TO ALLOW FOR THE PLACEMENT OF SOD.

ASPHALT PAVEMENT DETAIL (TYP.)
N.T.S.



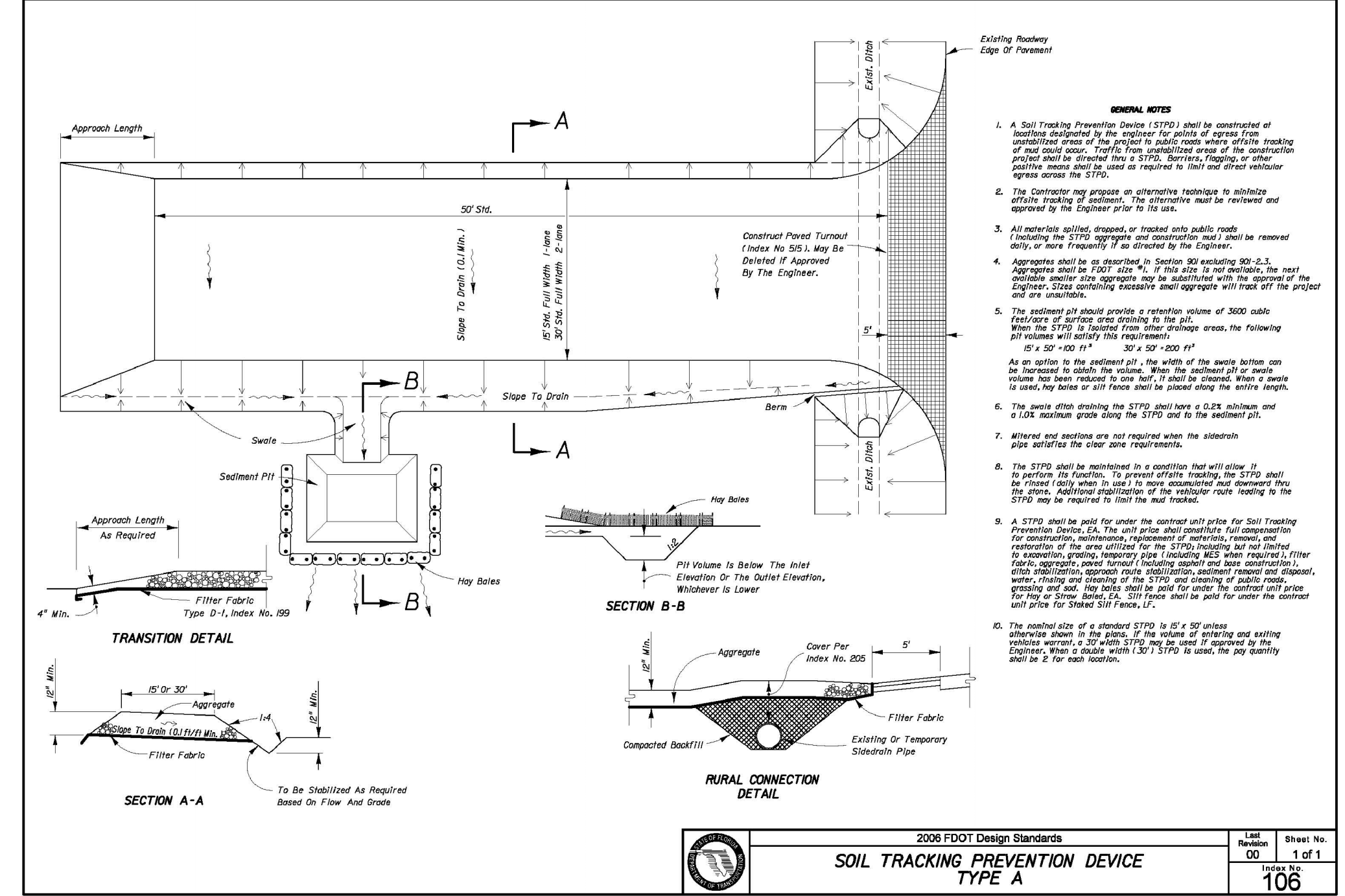
TYPE 'D' CURB
N.T.S.

N:\07\7563_00 Pompano Beach Airport Maintenance Shed - Cartaya\Engineering\Cad\dwg\07563_00-wppp.dwg

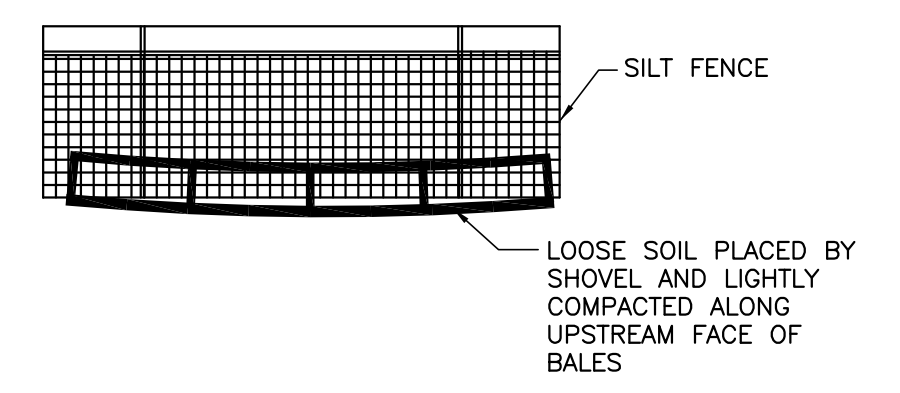


LEGEND

	BUILDING ACCESS
	PROPOSED SILT FENCE
	PROPOSED LIMITS OF CONSTRUCTION
	PROPOSED PAVEMENT
	PROPOSED CONCRETE
	PROPOSED TRUNCATED DOMES
	EXISTING CONCRETE
	EXISTING SPOT ELEVATION
	EXISTING SANITARY SEWER MANHOLE
	EXISTING SANITARY SEWER LATERAL W/ CLEAN OUT
	EXISTING FIRE HYDRANT WITH BOLLARDS
	EXISTING GATE VALVE
	EXISTING WATER METER
	EXISTING WATER CONTROL BOX
	EXISTING ELECTRIC HANDHOLE
	EXISTING RUNWAY LIGHT
	EXISTING WOOD UTILITY POLE WITH LIGHT
	EXISTING GUY ANCHOR
	EXISTING SEWER LINE
	EXISTING WATER LINE
	EXISTING FPL UNDERGROUND LINE
	EXISTING BELLSOUTH UNDERGROUND LINE
	EXISTING FENCE
	EXISTING TREE



NOTE:
FDOT DESIGN STANDARDS INDEX NO. 106 IS PROVIDED FOR REFERENCE ONLY. CONTRACTOR SHALL OBTAIN THE MOST RECENT FDOT DESIGN STANDARDS FOR USE DURING CONSTRUCTION. ONE (1) COPY OF INDEX NO. 106 WILL BE MADE AVAILABLE BY ENGINEER AT CONTRACTORS REQUEST.



EROSION CONTROL NOTES

- CONTRACTOR SHALL INSTALL AND MAINTAIN EROSION CONTROL AND SEDIMENTATION CONTROL MEASURES IN ACCORDANCE WITH THE STANDARDS FOR SOIL EROSION AND SEDIMENT CONTROL IN FLORIDA (HEREAFTER REFERRED TO AS FL GUIDELINES).
- MAINTENANCE MEASURES SHALL BE APPLIED AS NEEDED DURING THE ENTIRE CONSTRUCTION CYCLE. AFTER EACH RAINFALL, A VISUAL INSPECTION SHALL BE MADE OF ALL INSTALLED EROSION CONTROL MEASURES AND REPAIRS SHALL BE CONDUCTED TO ENSURE THEIR CONTINUING FUNCTION AS DESIGNED.
- CATCH BASIN, INLETS AND STORM SEWER MANHOLES STRUCTURES WITHIN SITE WILL BE PROTECTED DURING FILLING OPERATIONS FROM SEDIMENT RUNOFF AND DEBRIS BY PLACING A FILTER FABRIC MATERIAL IN THE FRAME AND GRATE/MANHOLE COVER. PREVENTIVE METHODS MUST BE UTILIZED AROUND THESE STRUCTURES (DURING FILLING OPERATIONS) BY GRADING TO DRAIN AWAY FROM STRUCTURES AND ANY OTHER METHODS APPROVED BY THE COUNTY ENGINEER OR DESIGN ENGINEER OF RECORD.
- THE CONTRACTOR SHALL BE RESPONSIBLE FOR READING AND FAMILIARIZING THEMSELVES WITH ALL OF THE PERMITS PREVIOUSLY ACQUIRED FOR THIS PROJECT. THE CONDITIONS OUTLINED IN THE PERMITS ARE IN FORCE AND FULL EFFECT AS PART OF THE PROPOSED IMPROVEMENTS. THE CONTRACTOR IS RESPONSIBLE FOR ENSURING ALL WORK ASSOCIATED WITH THIS PROJECT IS IN COMPLIANCE WITH ALL OF THE REQUIREMENTS OF THESE PERMITS.
- THE CONTRACTOR WILL BE RESPONSIBLE FOR ACQUIRING A VALID NPDES PERMIT, UNLESS SUCH PERMIT IS DETERMINED TO BE NON-APPLICABLE BY REGULATORY AGENCY HAVING PROPER JURISDICTION REGARDING THIS MATTER.



301 EAST ATLANTIC BOULEVARD
POMPAÑO BEACH, FLORIDA 33060-6643
(954) 788-3400 FAX (954) 788-3500
STATE OF FLORIDA CERTIFICATE OF AUTHORIZATION NUMBER - 7928

CARTAYA & ASSOCIATES ARCHITECTS P.A.
cartayaandassociates.com

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FT. LAUDERDALE, FLORIDA 33308
(954) 771-2724 FAX 776-4280

SEAL: MICHAEL GUINAGUI, P.E.
FLORIDA LICENSE NO. 104942
(FOR THE FIRM)

PROJECT: AIR PARK MAINTENANCE STORAGE FACILITY
POMPAÑO BEACH, FLORIDA 33060

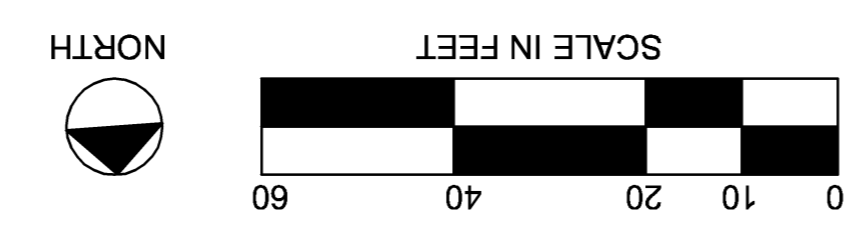
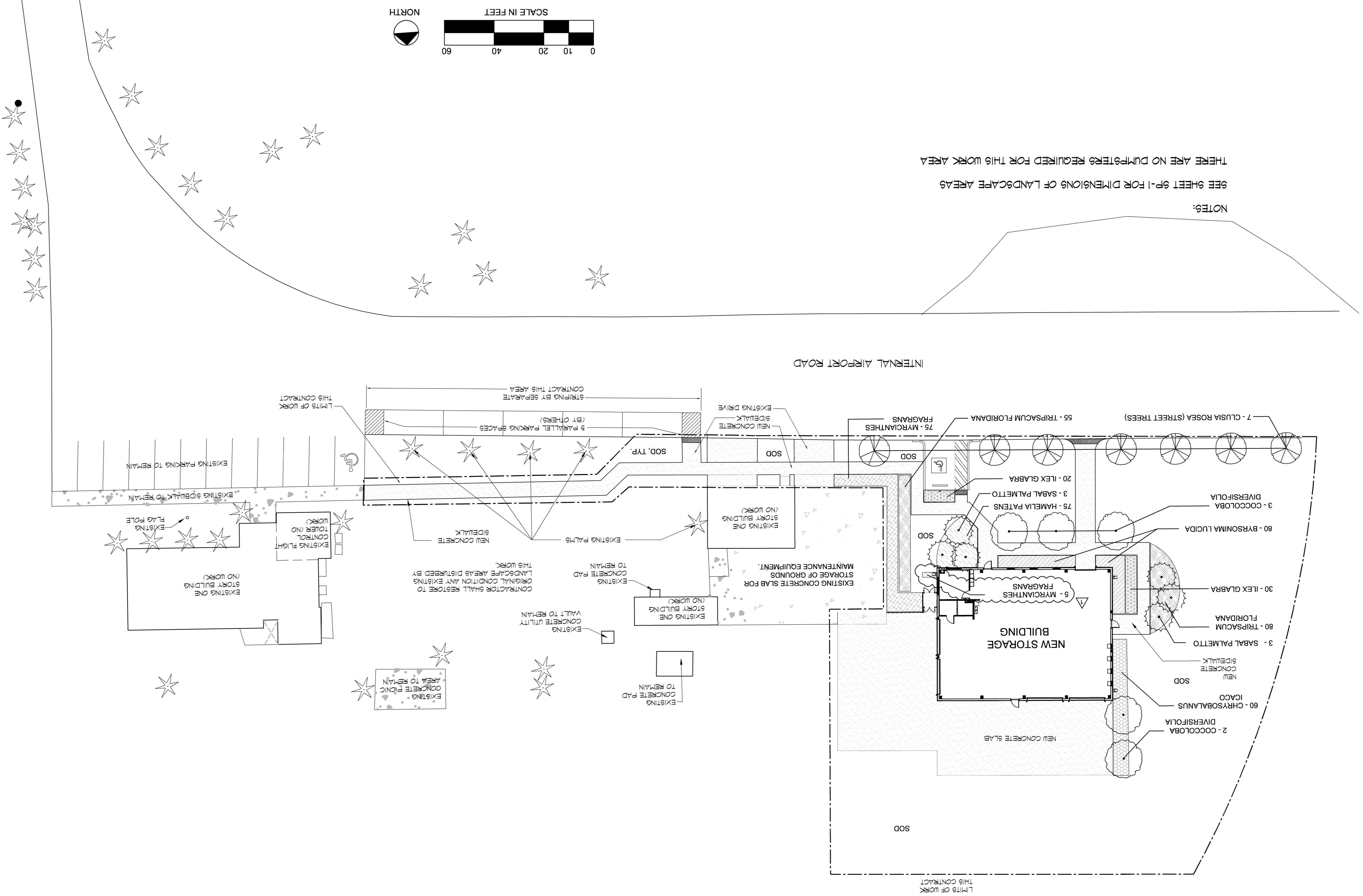
REVISIONS:
08/16/10 ADDENDUM 1 -
02/16/10 BUILDING DEPARTMENT COMMENTS

DATE: AUGUST 25, 2010
DRAWN BY: DC
CHECKED BY: RM

JOB NO: 0908

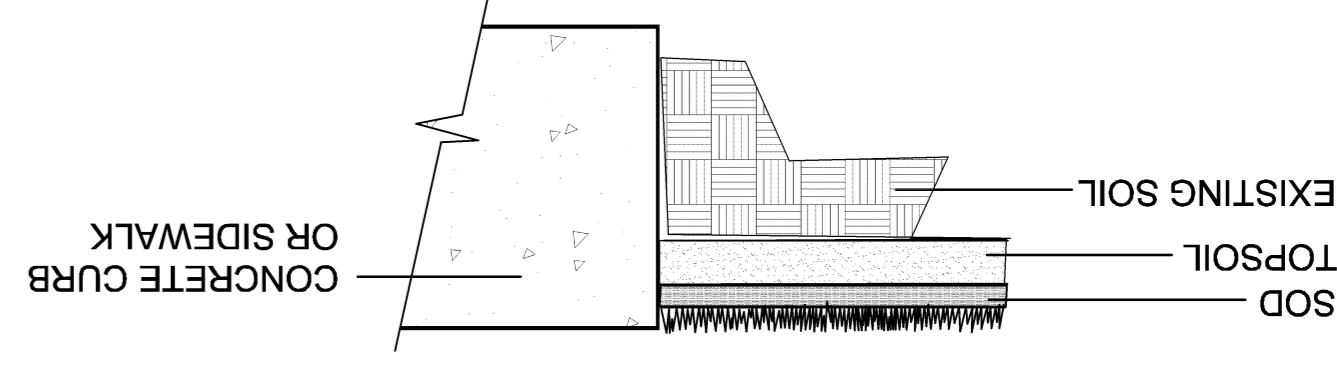
SHEET: C-3
1 OF 1

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3290 MARY STREET, SUITE 301
CORAL GABLES, FLORIDA 33134
Landscape Architecture
CURTIS + ROGERS DESIGN STUDIO INC

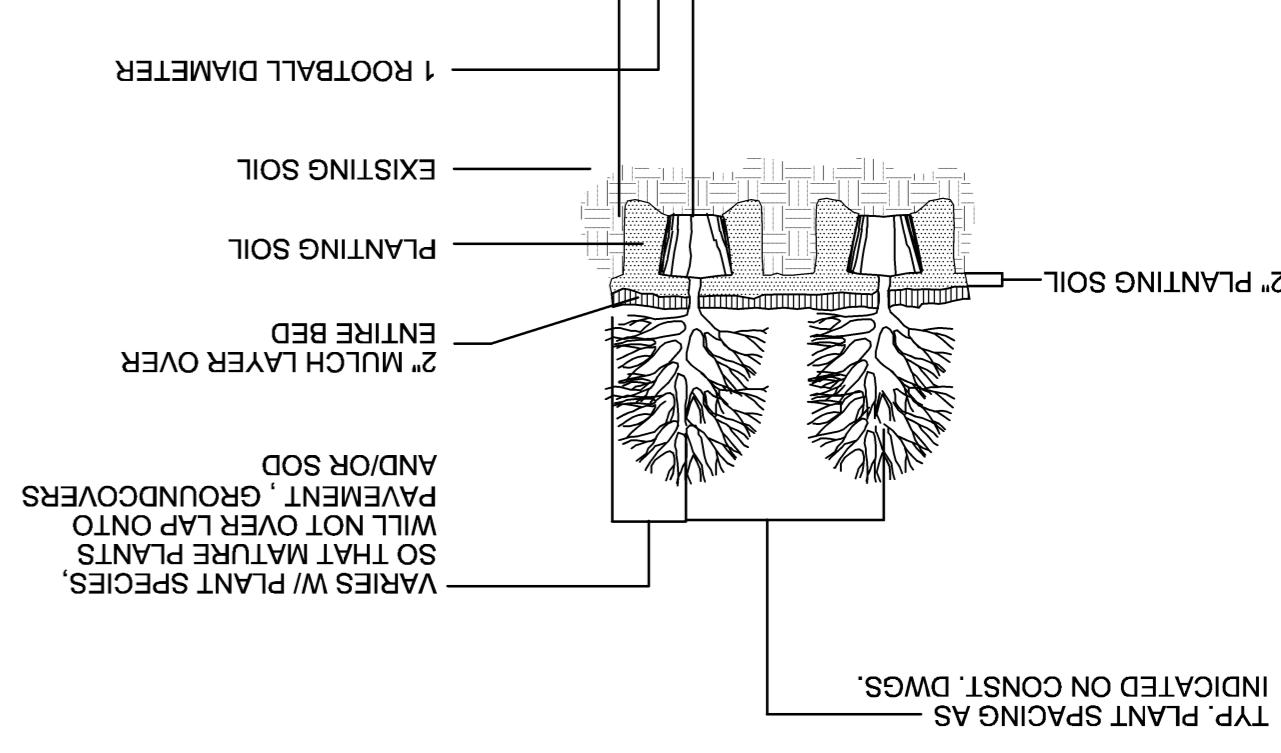


NOTES:
SEE SHEET 9P-1 FOR DIMENSIONS OF LANDSCAPE AREAS
THERE ARE NO DUMPSTERS REQUIRED FOR THIS WORK AREA

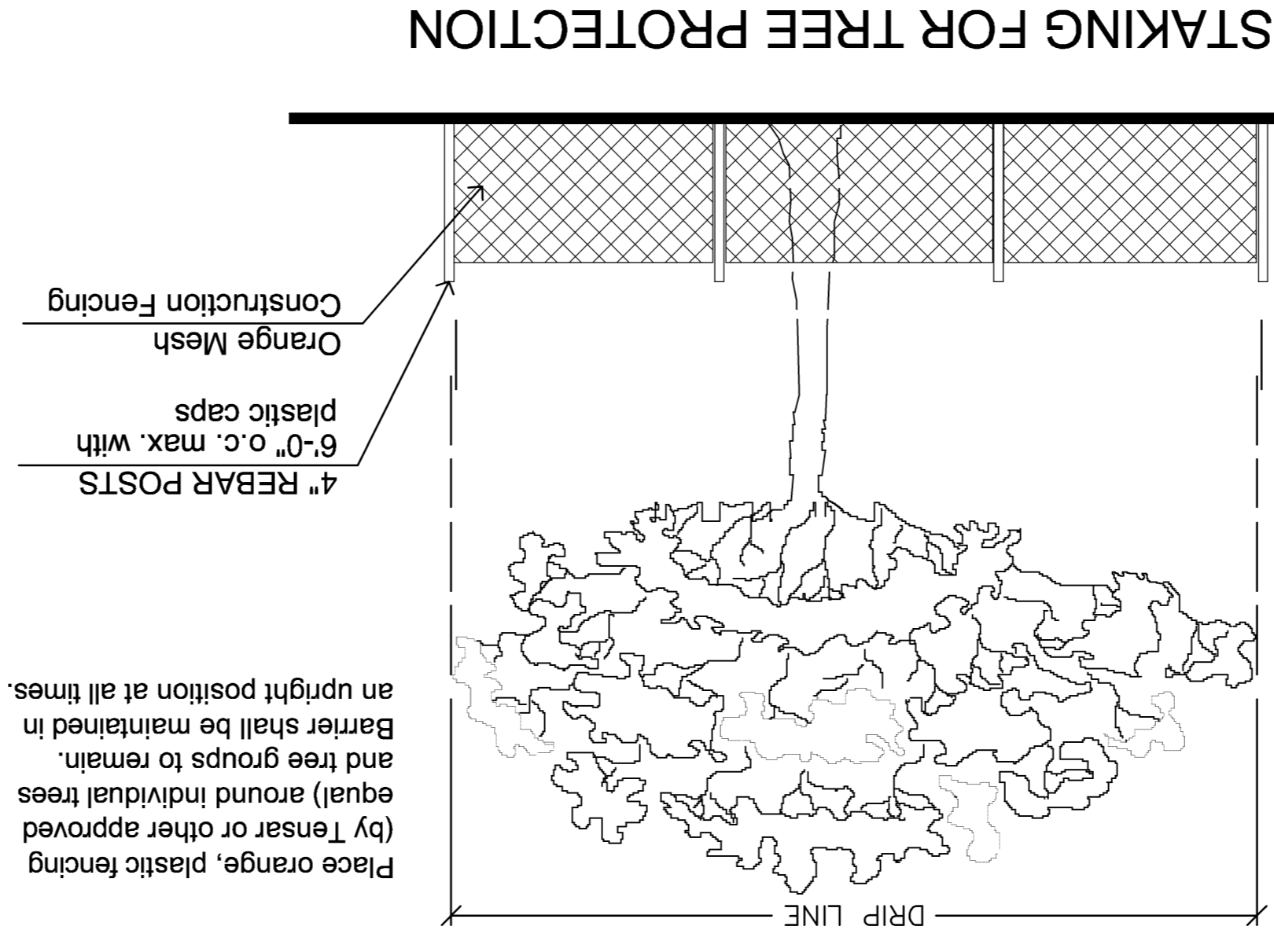
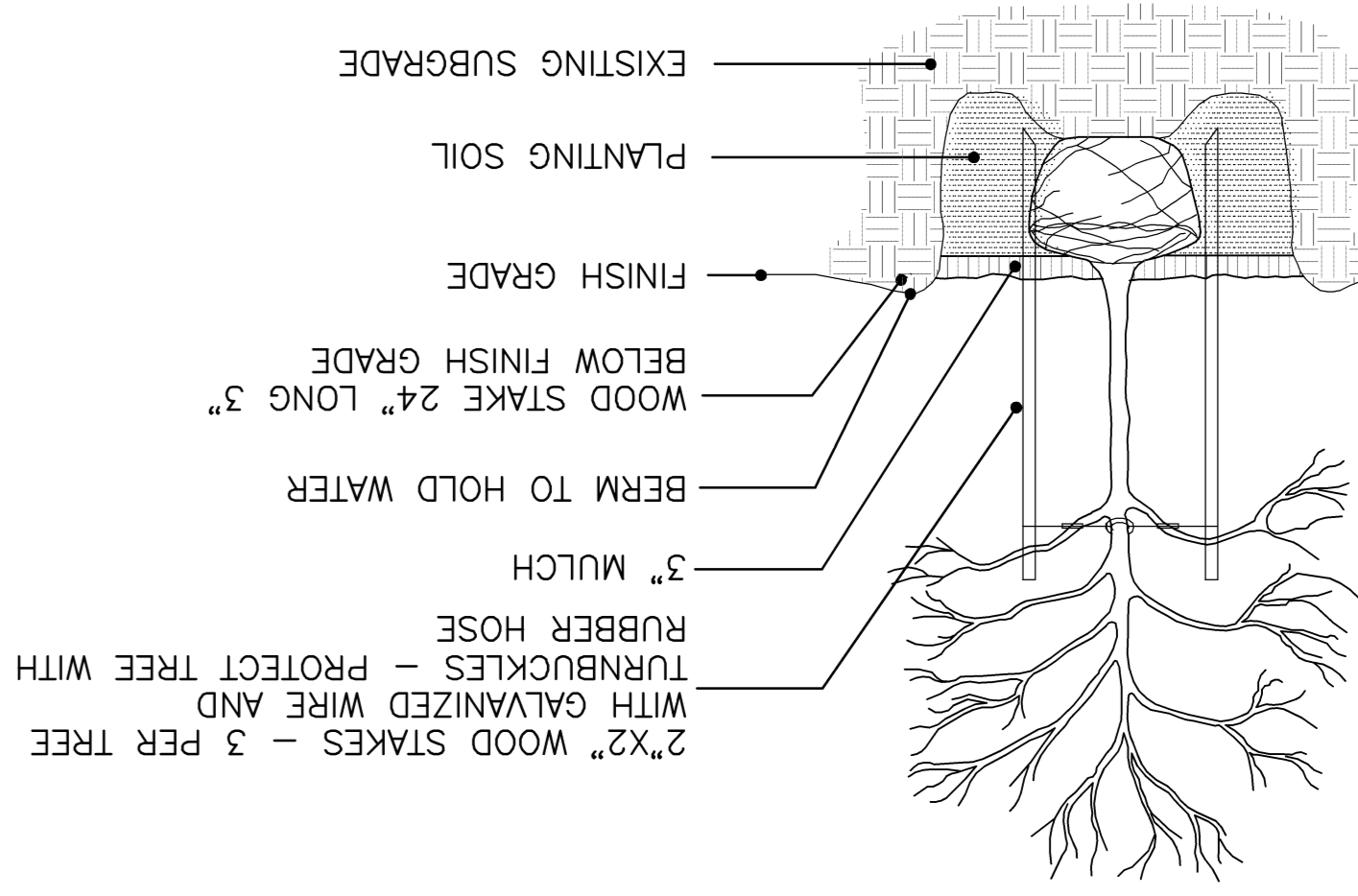
N.T.S.
SOD ADJACENT TO CONCRETE DETAIL



N.T.S.
SHRUB / GROUNDCOVER PLANTING DETAIL

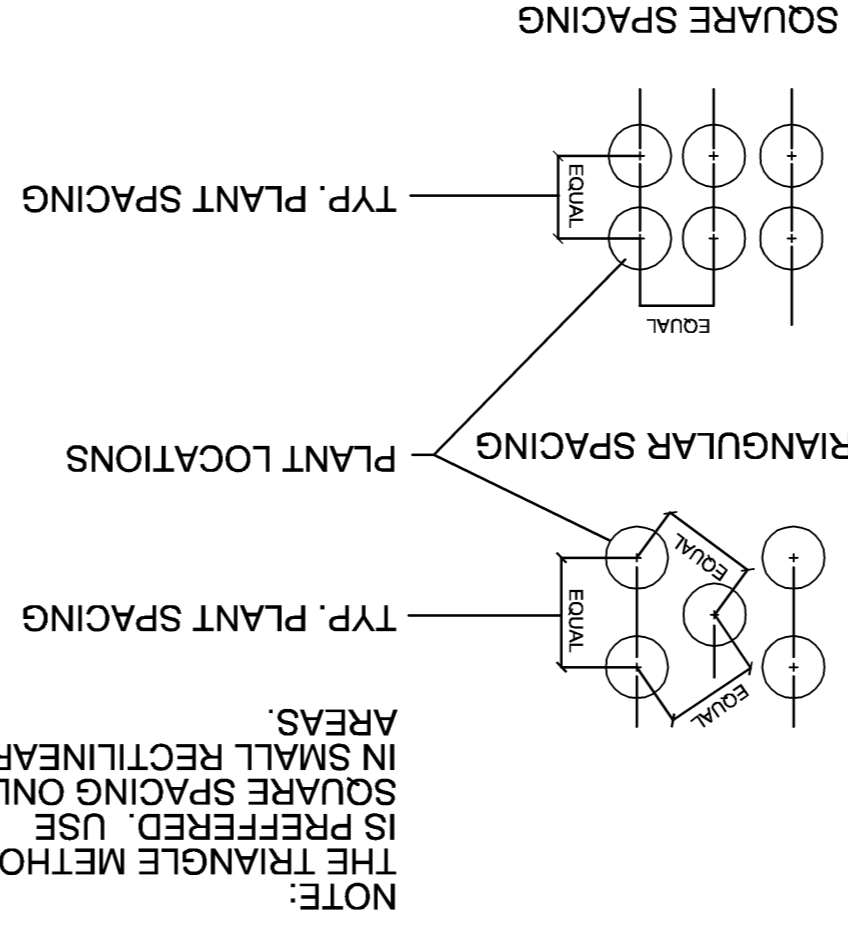


N.T.S.
TREE PLANTING DETAIL



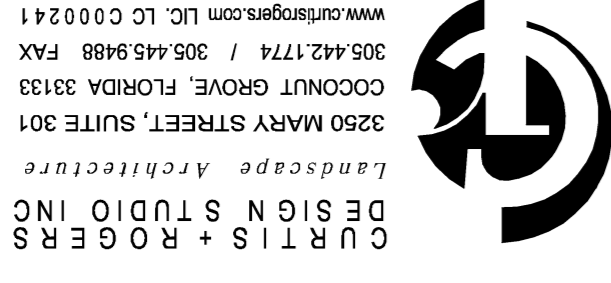
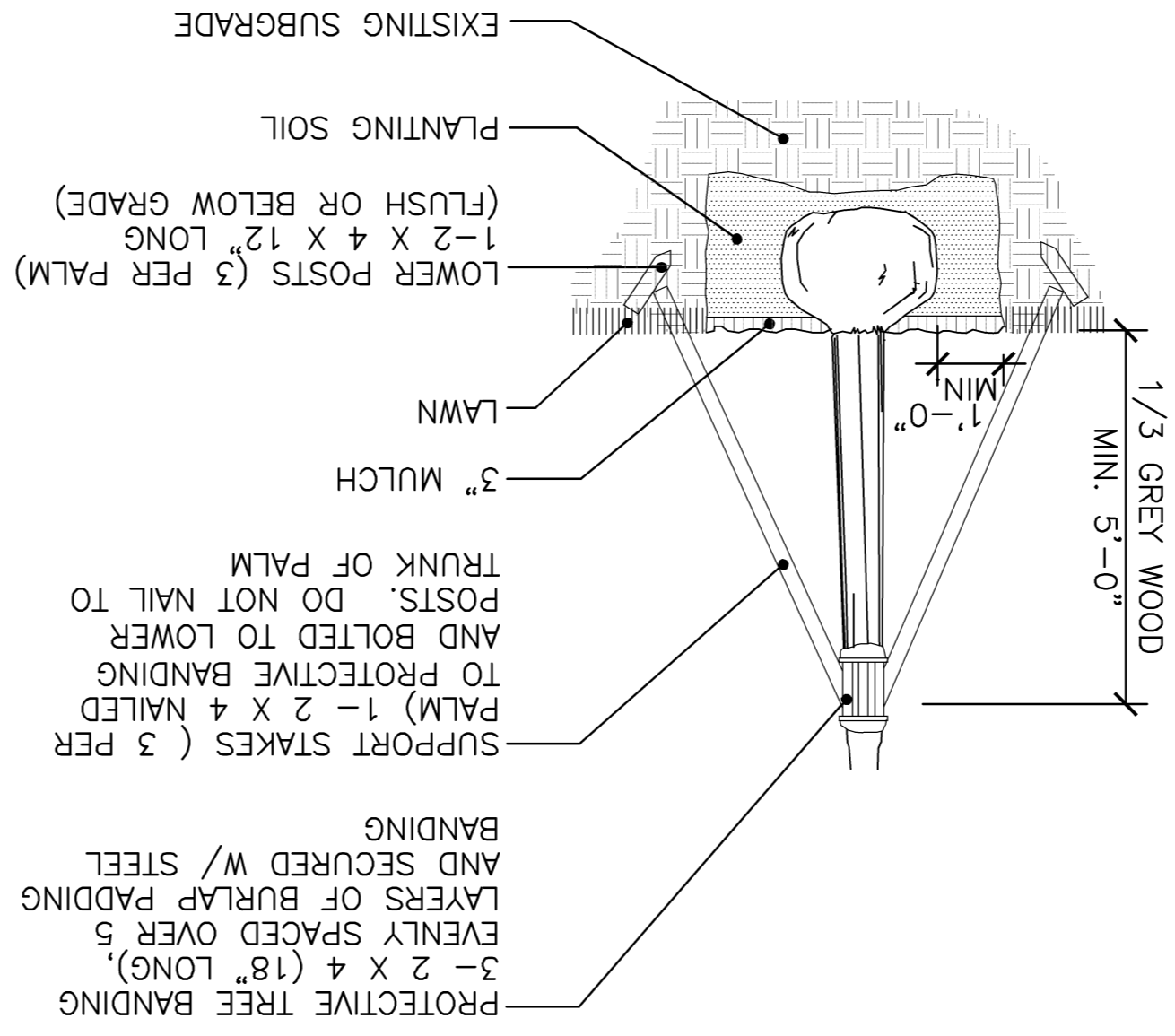
Place orange, plastic fencing (by Tensar or other approved equal) around individual trees and tree groups to remain. Barrier shall be maintained in an upright position at all times.

N.T.S.
SHRUB AND GROUNDCOVER SPACING



NOTE: THE TRIANGLE METHOD IS PREFERRED. USE SQUARE SPACING ONLY IN SMALL RECTILINEAR AREAS.

N.T.S.
PALM PLANTING DETAIL - LAWN AREA



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COCONUT GROVE, FLORIDA 33133
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www.curtisrogers.com LLC, LC C000241

2 OF 2
L-2

TITLE: PLANTING NOTES & DETAILS
JOB NO: 0908
DATE: AUGUST 25, 2010
DRAWN BY: JJP
CHECKED BY: JIL

PROJECT: AIRPARK MAINTENANCE STORAGE FACILITY
POMPANO BEACH, FLORIDA 39060

SCALE: LC C000241

2400 E. COMMERCIAL BLVD. SUITE 415
FT. LAUDERDALE, FLORIDA 33308
(954)771-2724 FAX 776-4280

CARTAYA & ASSOCIATES ARCHITECTS P.A.
cartayavandassociates.com

- LANDSCAPE NOTES:**
1. ALL PLANT MATERIAL SHALL BE FLORIDA NO. 1, AS SPECIFIED IN THE GRADES AND STANDARDS FOR NURSERY PLANTS AND PART II, PALMS AND TREES CURRENT EDITION.
 2. ALL TREES AND PALMS SHALL BE STAKED OR GUYED, GUYING AND STAKING SHALL BE DONE IN ACCORDANCE WITH DETAILS AND ALL LOCAL PRACTICES.
 3. ALL PLANT MATERIAL SHALL MEET OR EXCEED THE SIZE REQUIREMENTS AS SPECIFIED IN THE PLANT LIST. NO SUBSTITUTIONS SHALL BE ACCEPTED WITHOUT THE LANDSCAPE ARCHITECTS APPROVAL.
 4. CONTRACTOR IS RESPONSIBLE FOR VERIFYING ALL UNDERGROUND UTILITIES AND OBTAINING THE NECESSARY CLEARANCES PRIOR TO PLANTING.
 5. ALL AREAS TO RECEIVE PLANTING SHALL BE PREPARED WITH PLANTING SOIL. PLANTING SOIL SHALL CONSIST OF A MIXTURE OF 80% SAND AND 20% MUCK.
 6. ALL PLANTED AREAS ARE TO RECEIVE A 2" LAYER OF FLORIMULCH - SHREDDED MELALEUCA MULCH.
 7. NEW TREES, PALMS, SHRUBS AND GROUNDCOVERS SHALL BE FERTILIZED WITH AGRIFORM PLANTING TABLETS, 20-10-5 FORMULA, 21 GRAM, IN ACCORDANCE WITH MANUFACTURERS RECOMMENDATIONS.
 8. SODDED AREAS SHALL BE FERTILIZED WITH A GRANULAR FERTILIZER HAVING A 12-6-8 ANALYSIS, AT A RATE OF 12 LBS. PER 1000 SF OF LAWN AND IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS.
 9. ALL TREES, PALMS, SHRUBS AND GROUNDCOVERS SHALL BE GUARANTEED FOR A PERIOD OF ONE (1) YEAR FROM THE TIME OF FINAL ACCEPTANCE.
 10. ALL LANDSCAPED AREAS SHALL BE IRRIGATED WITH AN AUTOMATIC IRRIGATION SYSTEM PROVIDING 100% COVERAGE. A RAIN SENSOR SHALL BE INCLUDED FOR THE SYSTEM.
 11. ALL AREAS WITHIN LIMIT OF WORK NOT COVERED BY BUILDINGS, PAVING, PLAYGROUNDS, SHRUBS OR GROUNDCOVER SHALL BE PLANTED WITH SOD.

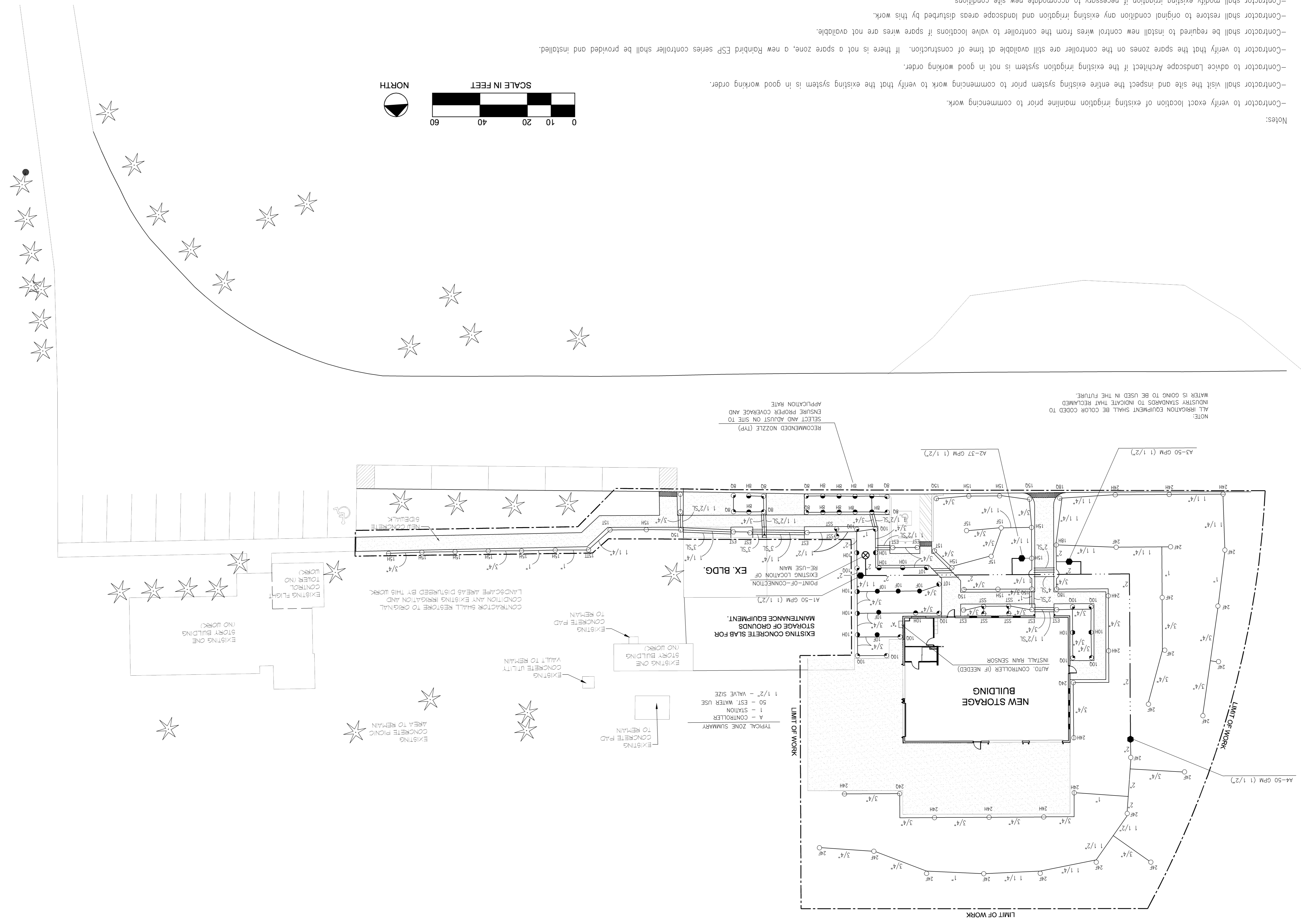
NOTED:
ABOVE QUANTITIES ARE FOR COMPARISON ONLY. CONTRACTOR SHALL VERIFY QUANTITIES PRIOR TO STARTING PLANTING WITH ST. AUGUSTINE SOD. ALL PLANT MATERIAL SHALL BE FLORIDA #1 OR BETTER UNLESS OTHERWISE WORK. ALL AREAS NOT COVERED BY BUILDINGS, PAVING, PLAYGROUNDS, SHRUBS OR GROUNDCOVER SHALL BE PLANTED WITH ST. AUGUSTINE SOD. CONTRACTOR'S RESPONSIBILITY TO VERIFY QTY.

QUAN	BOTANICAL NAME	COMMON NAME	SPECIFICATIONS	NATIVE
7	CLUSIA ROSEA	PITCH APPLE	12' HT. X 5' SPR., 3' CT	YES
5	COCCOLOBA DIVERSIFOLIA	PIGEON PLUM	14' HT., X 5' SPR., 4' CT	YES
6	SABAL PALMETTO	SABAL PALMS	14' OA HT., BOOTED	YES
80	SHRUBS & GROUNDCOVER			
80	LOCUSTBERRY		3 GAL, 24"HT. X 22"SPR., 24" OC	YES
60	CHRYSOBALANUS ICACO	COCOPALUM	3 GAL, 24"HT. X 22"SPR., 30" OC	YES
76	HAMELIA PATENS 'COMPACTA'	DWARF FIREBUSH	3 GAL, 18"HT. X 20"SPR., 24" OC	YES
50	ILEX GLABRA	INKBERRY	3 GAL, 18"HT. X 20"SPR., 24" OC	YES
80	MYRSANTHES FRAGRANS	SIMPSON'S STOPPER	5' HT, 30" SPR, 30" OC, FULL TO BASE	YES
135	TRIPSAcium FLORIDANA	DWARF FAKAHATCHEE GRASS	3 GAL, 24"HT. X 24"SPR., 24" OC	YES
SF	ST. AUGUSTINE FLORATAM AND BAHIA SOD	CONTRACTOR'S RESPONSIBILITY TO VERIFY QTY.		

PLANT LIST

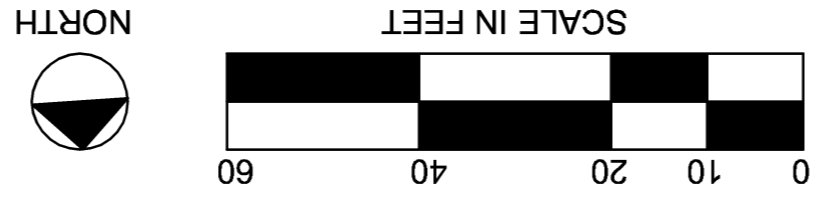
 CARTAYA & ASSOCIATES P.A. ARCHITECTS P.A. cartayaandassociates.com	2400 E. COMMERCIAL BLVD., SUITE 415 FT. LAUDERDALE, FLORIDA 33308 (954)771-2724 FAX 776-4280	SEAL LC C000241	PROJECT: AIRPARK MAINTENANCE STORAGE FACILITY POMPANO BEACH, FLORIDA 33060	REVISIONS: 	DATE: AUGUST 25, 2010 DRAWN BY: JJP CHECKED BY: JIL	JOB NO.: 0908	TITLE: IRRIGATION PLAN	1 OF 2 IR-1
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 Landscape Architecture
 3250 MARY STREET, SUITE 301
 COCONUT GROVE, FLORIDA 33133
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NOTE:
 ALL IRRIGATION EQUIPMENT SHALL BE COLOR CODED TO INDUSTRY STANDARDS TO INDICATE THAT RECLAIMED WATER IS GOING TO BE USED IN THE FUTURE.

- Notes:
- Contractor to verify exact location of existing irrigation mainline prior to commencing work.
 - Contractor shall visit the site and inspect the entire existing irrigation system prior to commencing work to verify that the existing system is in good working order.
 - Contractor to advise Landscape Architect if the existing irrigation system is not in good working order.
 - Contractor shall be required to install new control wires from the controller to valve locations if spare wires are not available.
 - Contractor shall restore to original condition any existing irrigation and landscape areas disturbed by this work.
 - Contractor shall modify existing irrigation if necessary to accommodate new site conditions.



ALL EXISTING AND NEW DETAILS, WORKMANSHIP, MATERIALS, AND INSTALLATION SHALL BE IN ACCORDANCE WITH THE SPECIFICATIONS AND STANDARDS SET FORTH IN THE CONTRACT DOCUMENTS. THE CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING ALL NECESSARY PERMITS AND APPROVALS FROM THE APPLICABLE AGENCIES. THE CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING ALL NECESSARY PERMITS AND APPROVALS FROM THE APPLICABLE AGENCIES. THE CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING ALL NECESSARY PERMITS AND APPROVALS FROM THE APPLICABLE AGENCIES.

SITE STATISTICS

LAND USE/ZONING: 'T' TRANSPORTATION - ALL ABUTTING PROPERTIES ARE ZONED 'T' TRANSPORTATION

STORAGE BUILDING FOR MAINTENANCE EQUIPMENT ALREADY ON SITE. NO WAREHOUSE USE. ONE HANDICAP PARKING REQUIRED SHOWN FOR SINGLE OFFICE SPACE. NO DUMPSTER REQUIRED.

NEW PARKING: 1 HANDICAP PARKING SPACE (THIS CONTRACT)
5 PARALLEL PARKING SPACES (UNDER SEPARATE CONTRACT)

TOTAL BUILDING AREA: 3,775 S.F.

PERVIOUS WORK AREA: 0.31 ACRES (60%)
IMPERVIOUS WORK AREA: 0.20 ACRES (40%)

TOTAL SITE AREA: 0.51 ACRES (100%)

WORK AREA IS .051 ACRE (NET AND GROSS AREA ARE NOT APPLICABLE. THIS PROJECT IS INTERNAL TO THE AIRPORT SITE AND IS SMALL IN SCOPE)

LEGAL DESCRIPTION

A PORTION OF PARCEL 'A', POMPANO BEACH AIR PARK F.B.O., PHASE 1, PLAT BOOK 171, PAGES 189 THROUGH 194, AS RECORDED IN THE PUBLIC RECORDS OF BROWARD COUNTY, FLORIDA.

BUILDING STATISTICS:

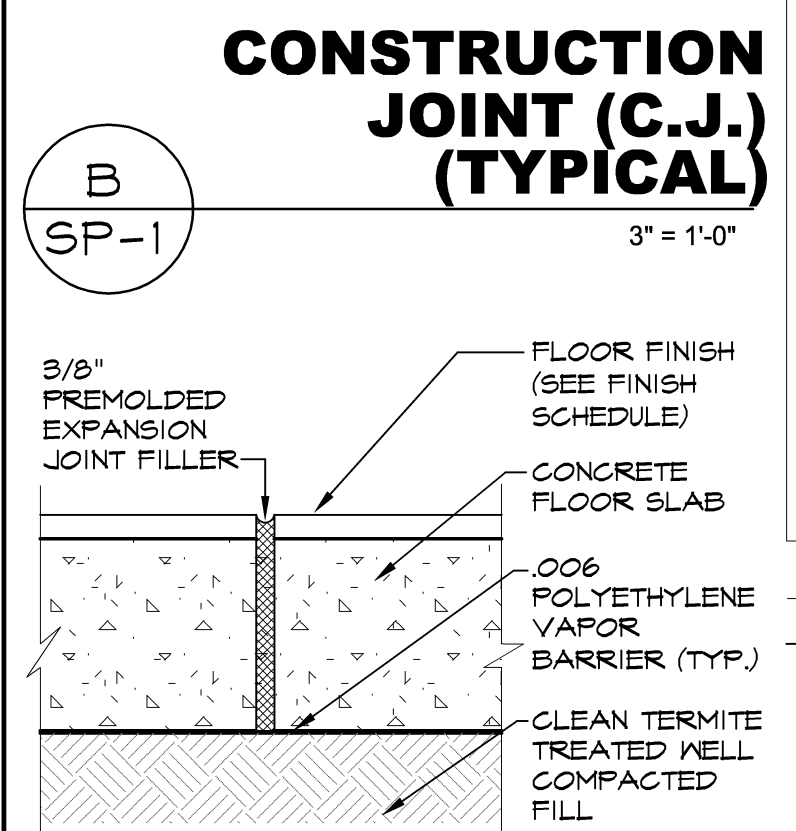
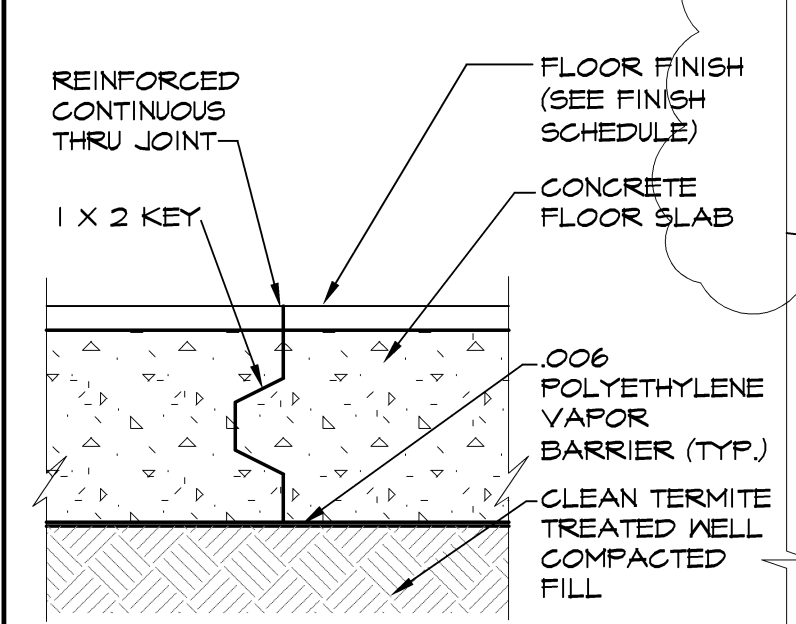
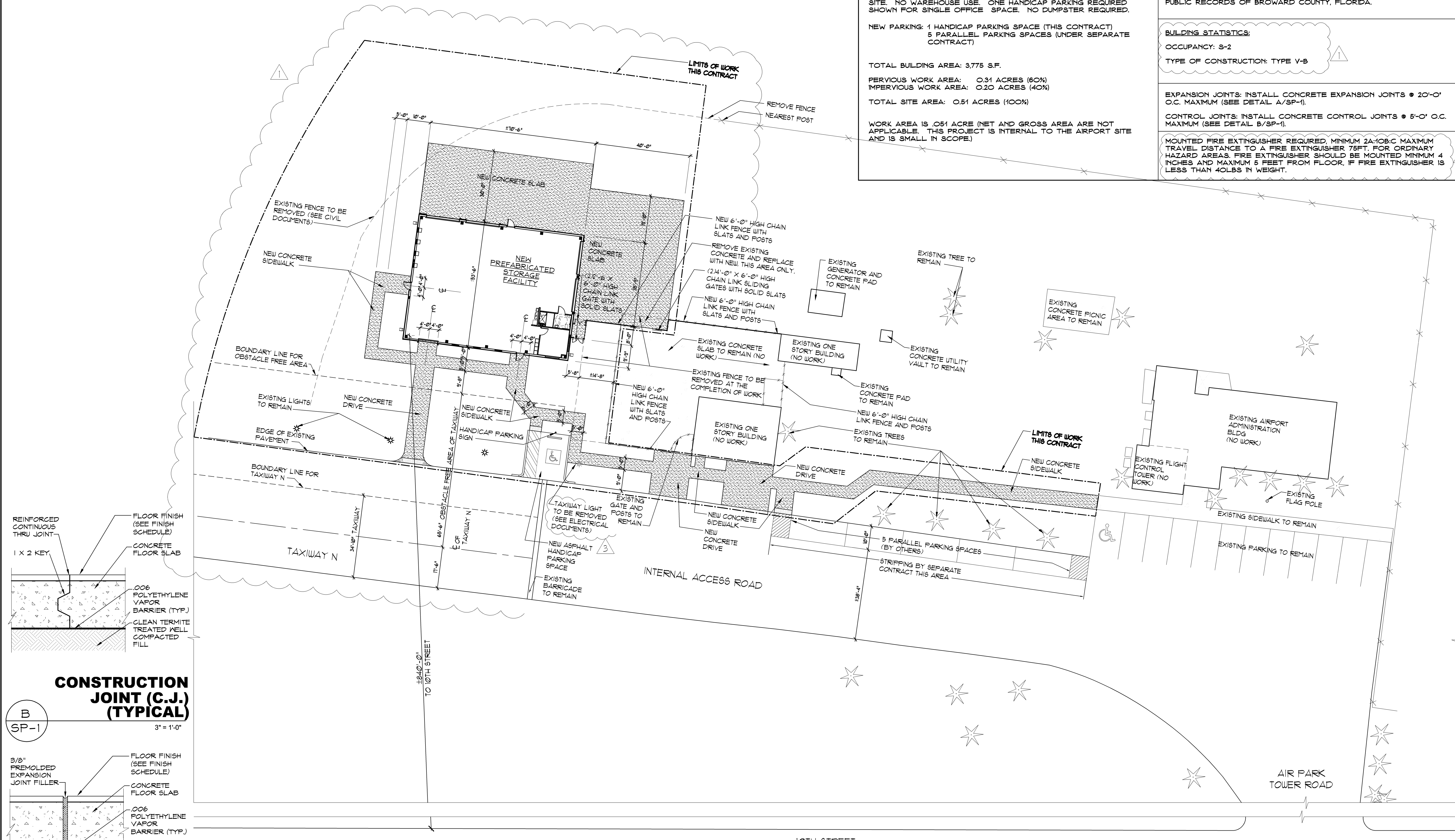
OCCUPANCY: S-2

TYPE OF CONSTRUCTION: TYPE V-B

EXPANSION JOINTS: INSTALL CONCRETE EXPANSION JOINTS @ 20'-0" O.C. MAXIMUM (SEE DETAIL A/SP-1).

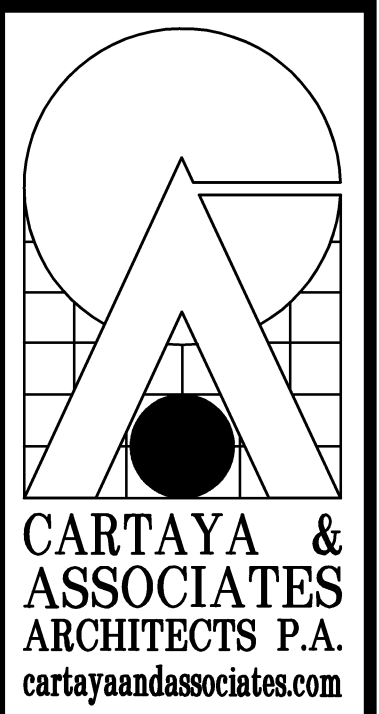
CONTROL JOINTS: INSTALL CONCRETE CONTROL JOINTS @ 5'-0" O.C. MAXIMUM (SEE DETAIL B/SP-1).

MOUNTED FIRE EXTINGUISHER REQUIRED, MINIMUM 2A:10B:C MAXIMUM TRAVEL DISTANCE TO A FIRE EXTINGUISHER 75FT. FOR ORDINARY HAZARD AREAS. FIRE EXTINGUISHER SHOULD BE MOUNTED MINIMUM 4 INCHES AND MAXIMUM 5 FEET FROM FLOOR, IF FIRE EXTINGUISHER IS LESS THAN 40LBS IN WEIGHT.



SITE PLAN

SCALE 1" = 20'



2400 E. COMMERCIAL BLD. SUITE 415
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(954)771-2724 FAX 776-4280

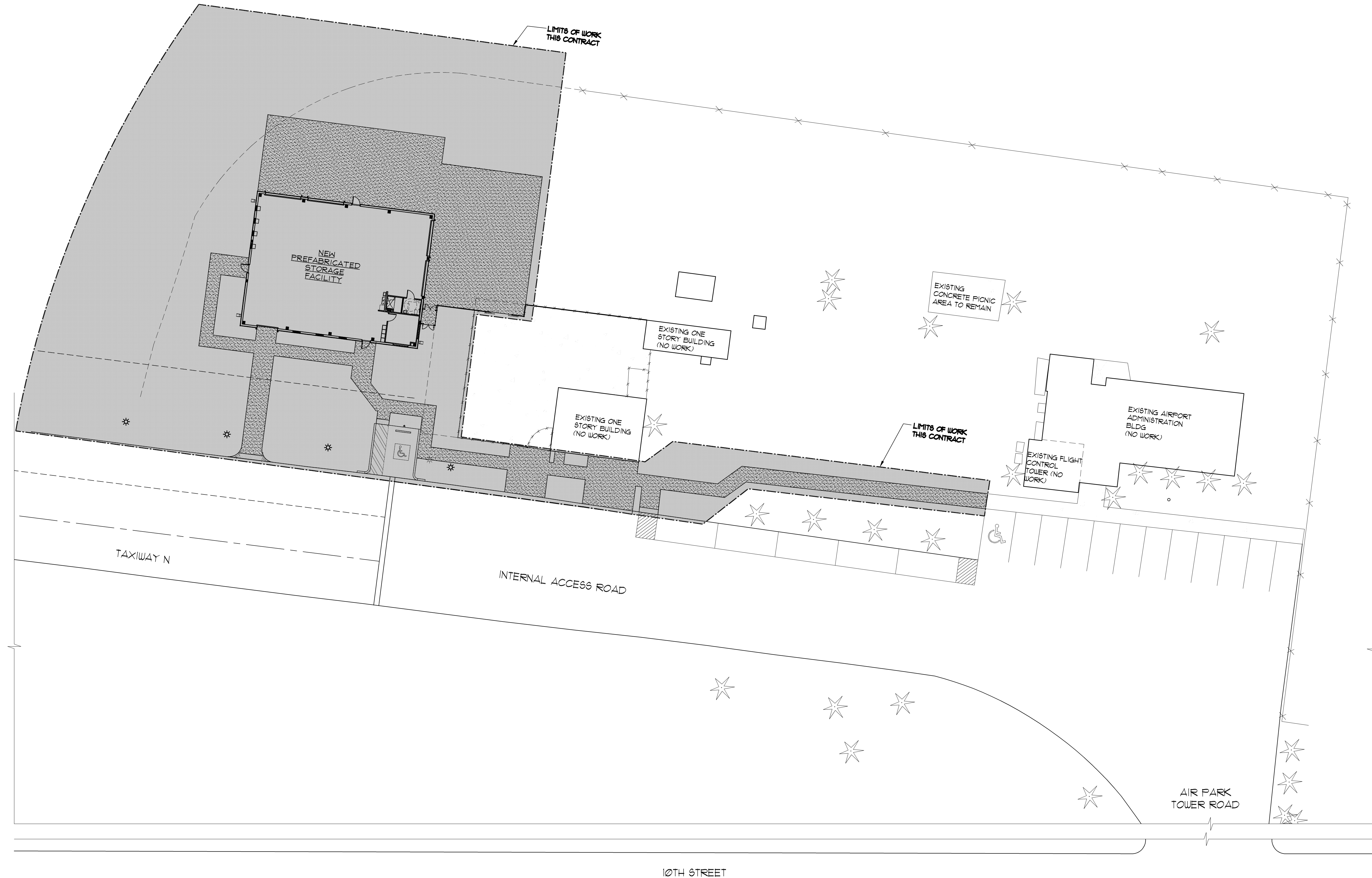
SEAL: AA 0001888

PROJECT: AIRPARK MAINTENANCE STORAGE FACILITY
POMPANO BEACH, FLORIDA 33060

REVISIONS:
DATE: AUGUST 25, 2010
DRAWN BY: BH/EG/JJ
CHECKED BY: MC

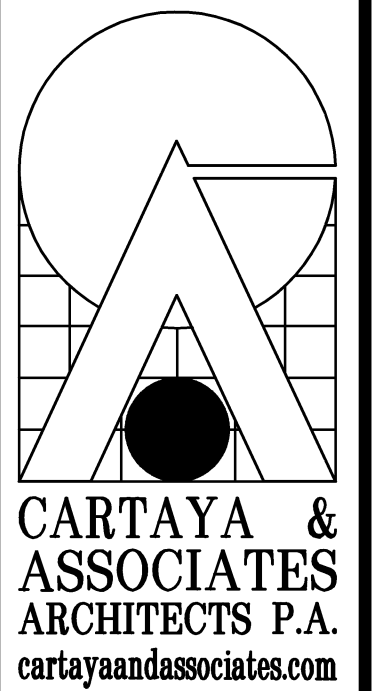
TITLE: SITE PLAN
JOB NO: 0908

SHEET: SP-1
1 OF 1



SITE PLAN - LIMITS OF WORK

SCALE 1" = 20'



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PROJECT: **AIRPARK MAINTENANCE STORAGE FACILITY**
POMPANO BEACH, FLORIDA 33060

TITLE: **SITE PLAN - LIMITS OF WORK**

DATE: **AUGUST 25, 2010**

DRAWN BY: **PH/EG/JJ**

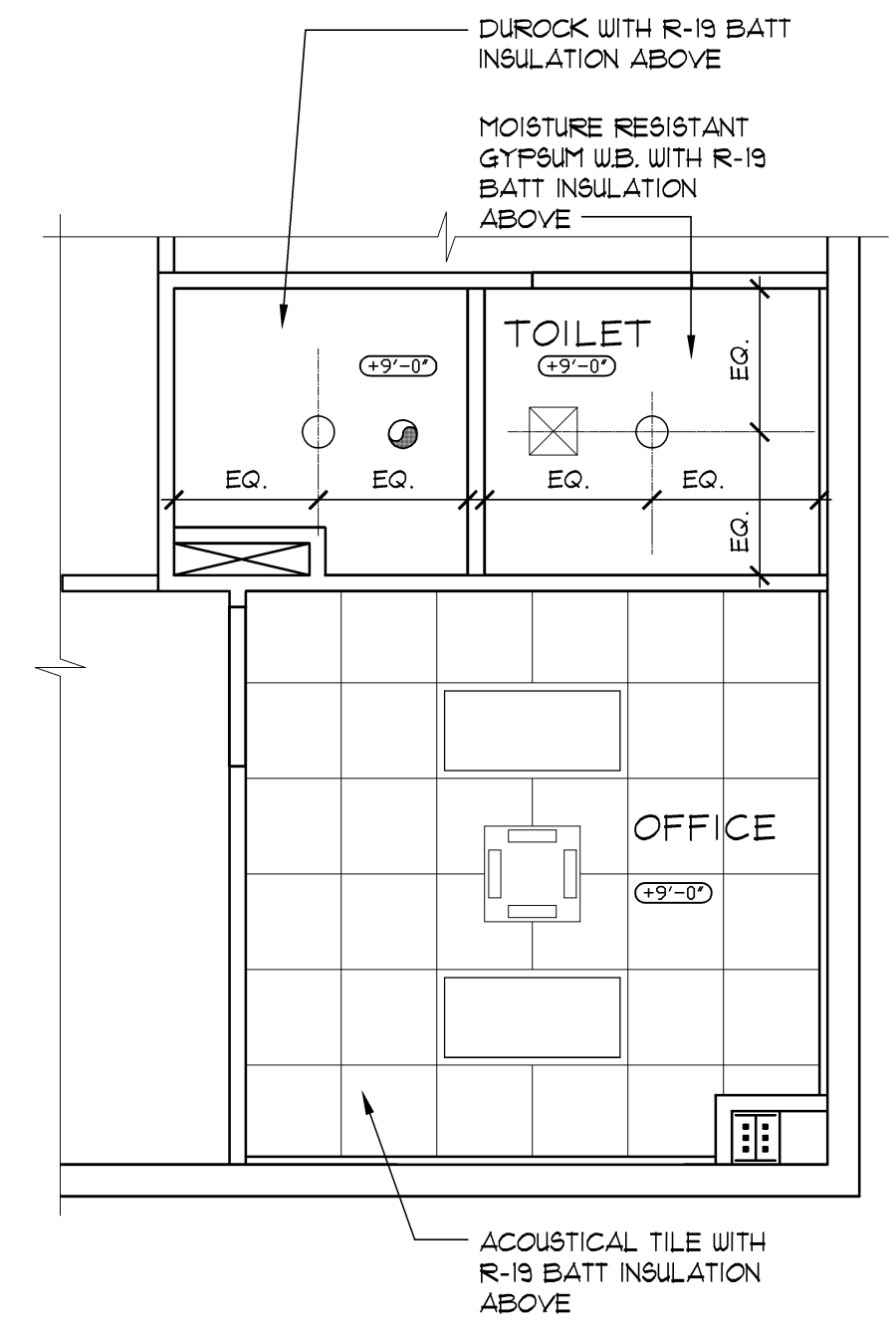
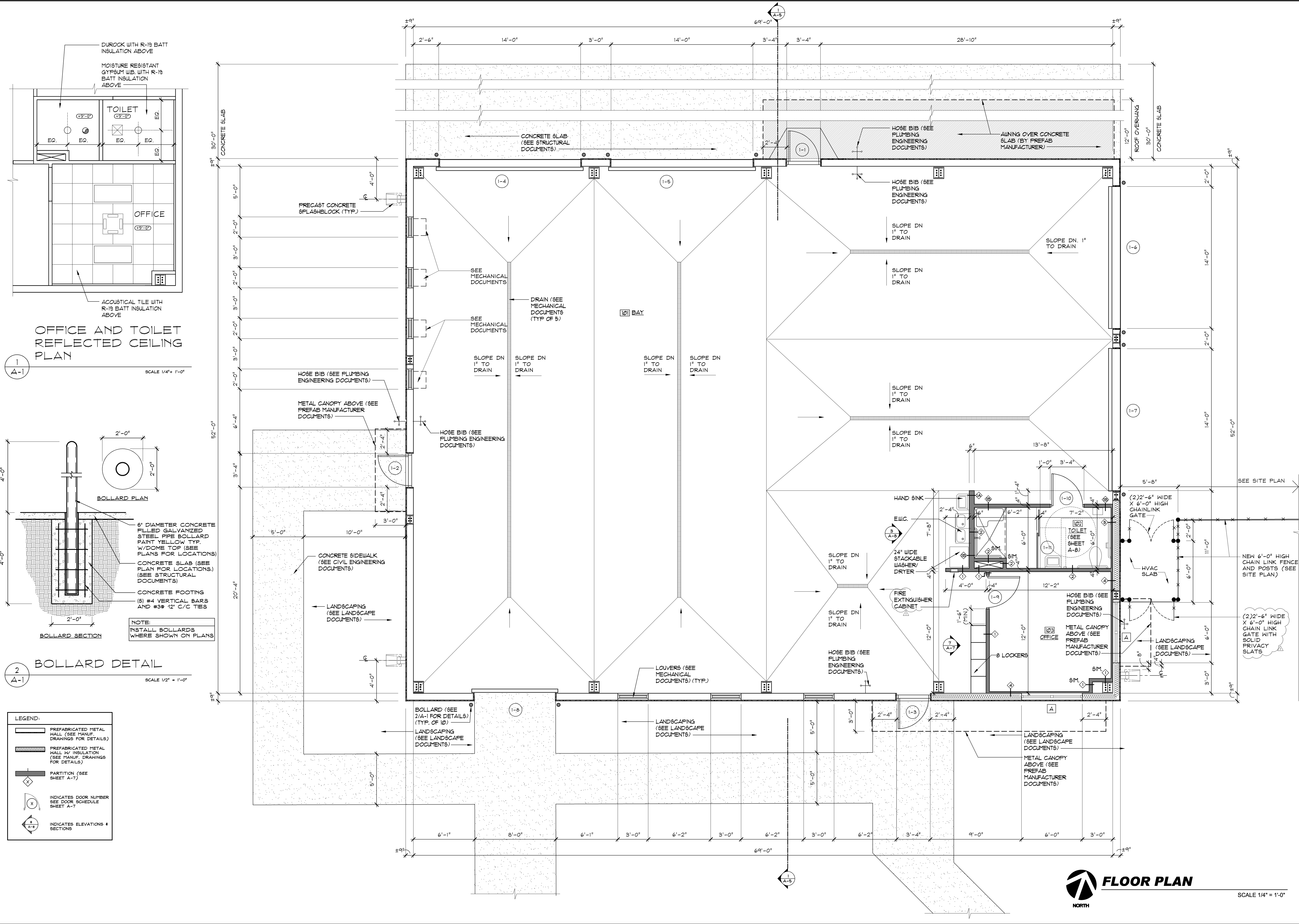
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REVISIONS:

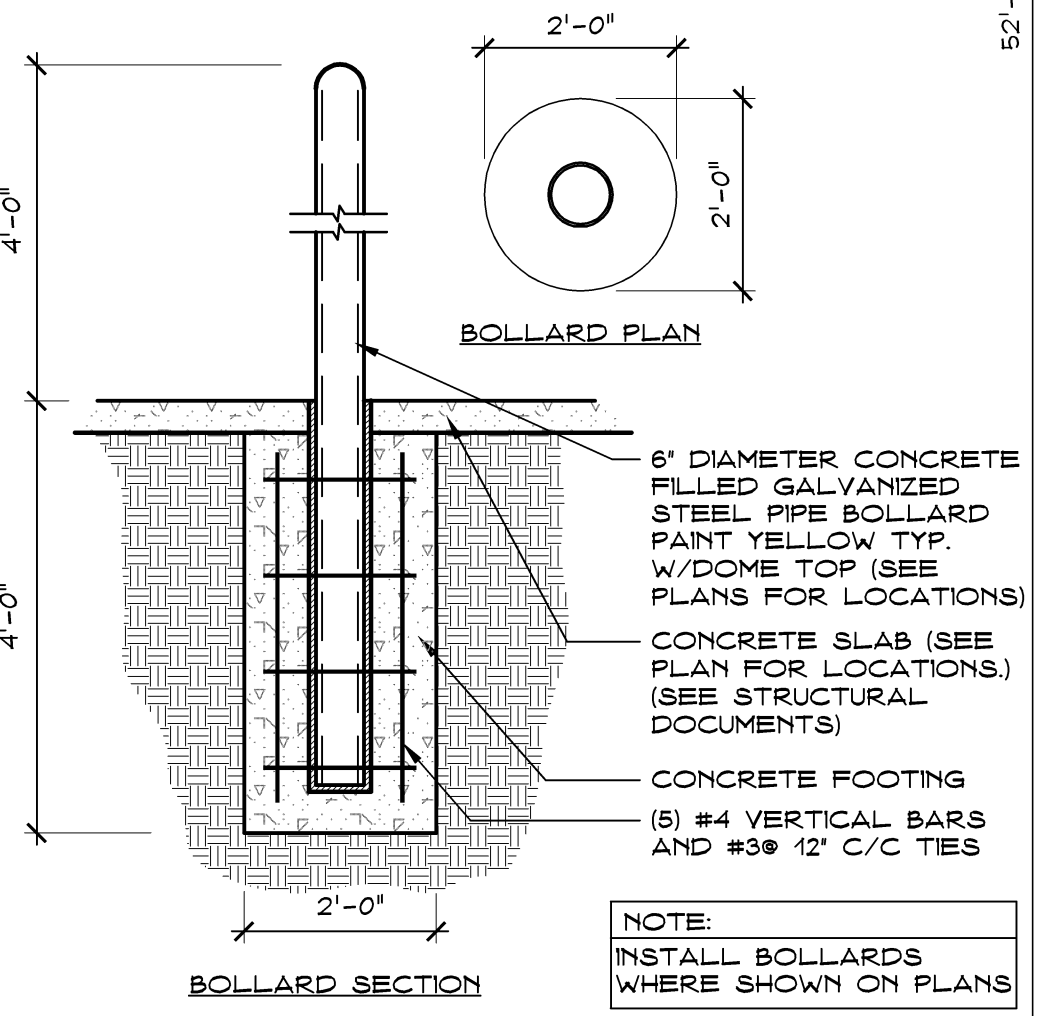
NO. 1: **0908**

SHEET NO. **SP-2**
2 OF 2

ALL DESIGNS AND DETAILS INDICATED OR REPRESENTED BY THIS DRAWING ARE FOR USE, ON AND IN CONNECTION WITH THE SPECIFIED PROJECT. THIS IS THE PROPERTY OF THE ARCHITECT AND SHALL REMAIN HIS OR HER PROPERTY. NO PART OF THIS DRAWING SHALL BE REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS, ELECTRONIC OR MECHANICAL, INCLUDING PHOTOCOPYING, RECORDING, OR BY ANY INFORMATION STORAGE AND RETRIEVAL SYSTEM, WITHOUT THE WRITTEN PERMISSION OF THE ARCHITECT. THE ARCHITECT ASSUMES NO LIABILITY FOR ANY DAMAGE OR INJURY TO PERSONS OR PROPERTY ARISING FROM THE USE OF THIS DRAWING.



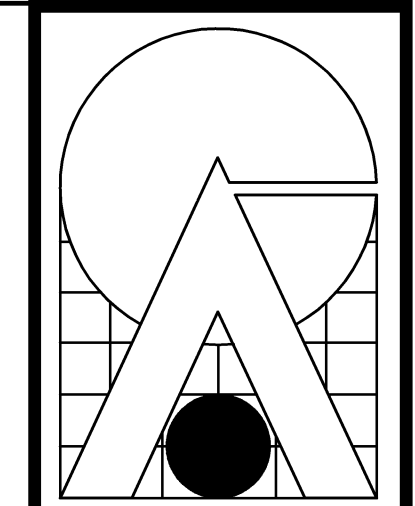
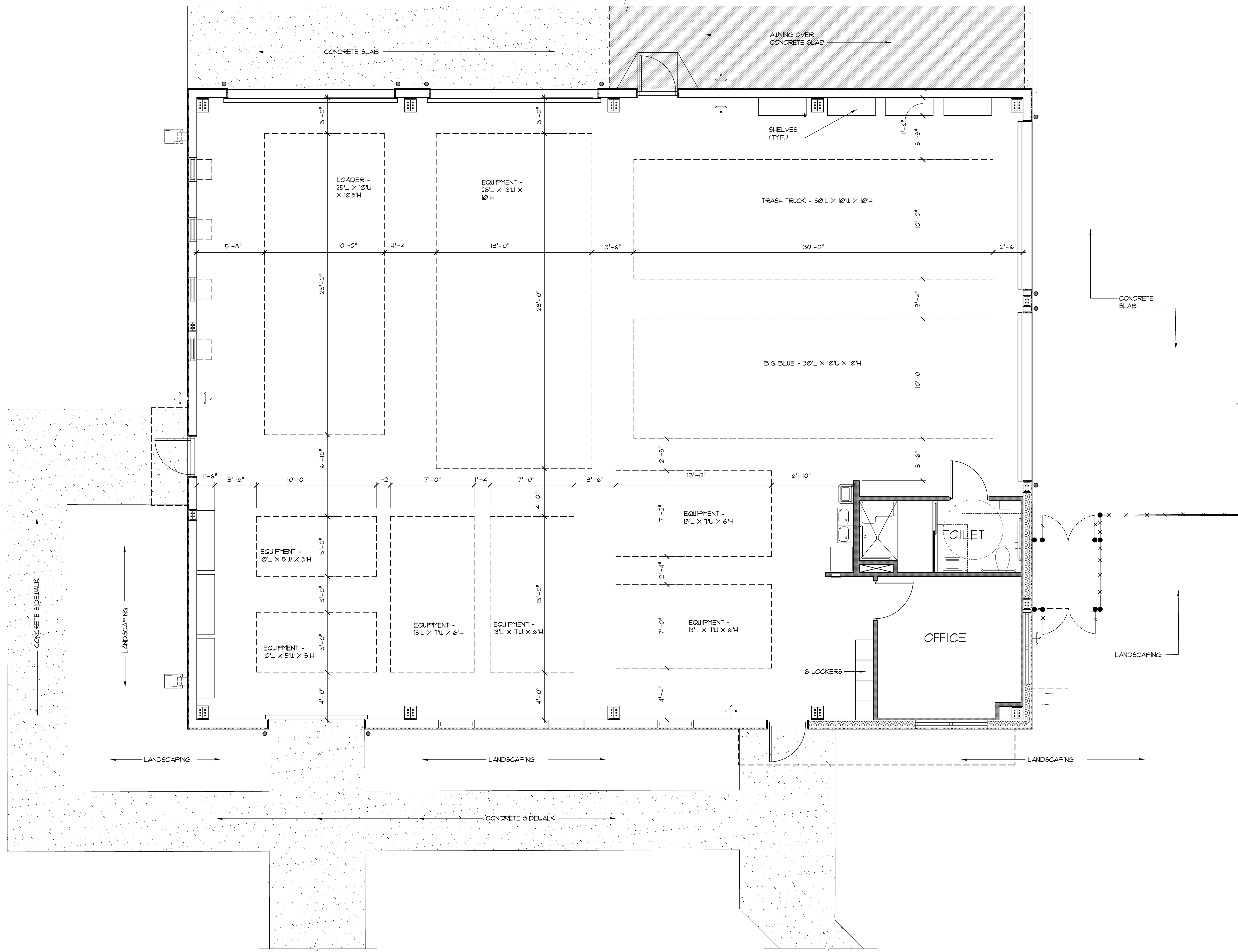
OFFICE AND TOILET REFLECTED CEILING PLAN
SCALE 1/4" = 1'-0"



BOLLARD DETAIL
SCALE 1/2" = 1'-0"

LEGEND:

- PREFABRICATED METAL WALL (SEE MANUF. DRAWINGS FOR DETAILS)
- PREFABRICATED METAL WALL W/ INSULATION (SEE MANUF. DRAWINGS FOR DETAILS)
- PARTITION (SEE SHEET A-7)
- INDICATES DOOR NUMBER SEE DOOR SCHEDULE SHEET A-7
- INDICATES ELEVATIONS & SECTIONS



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 cartayaandassociates.com

2400 E. COMMERCIAL BLD. SUITE 415
 FT. LAUDERDALE, FLORIDA 33308
 (954)771-2724 FAX 776-4280

SEAL: AA C001888

PROJECT: **AIRPARK MAINTENANCE STORAGE FACILITY**
 POMPANO BEACH, FLORIDA 33060

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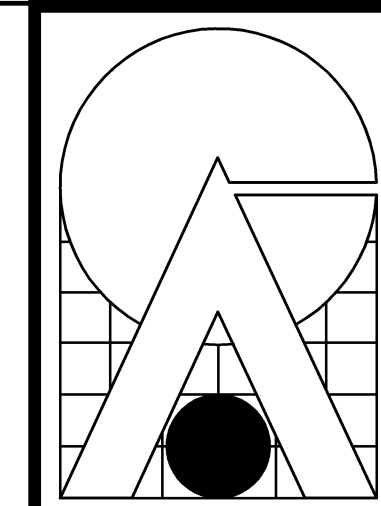
TITLE: **VEHICLE STORAGE PLAN**

DATE: AUGUST 25, 2010
 DRAWN BY: BH/EG/JJ
 CHECKED BY: MC

REVISIONS:

JOB NO: **0908**

SHEET: **A-2**
 2 OF 8



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AA C001888

PROJECT: AIRPARK MAINTENANCE STORAGE FACILITY
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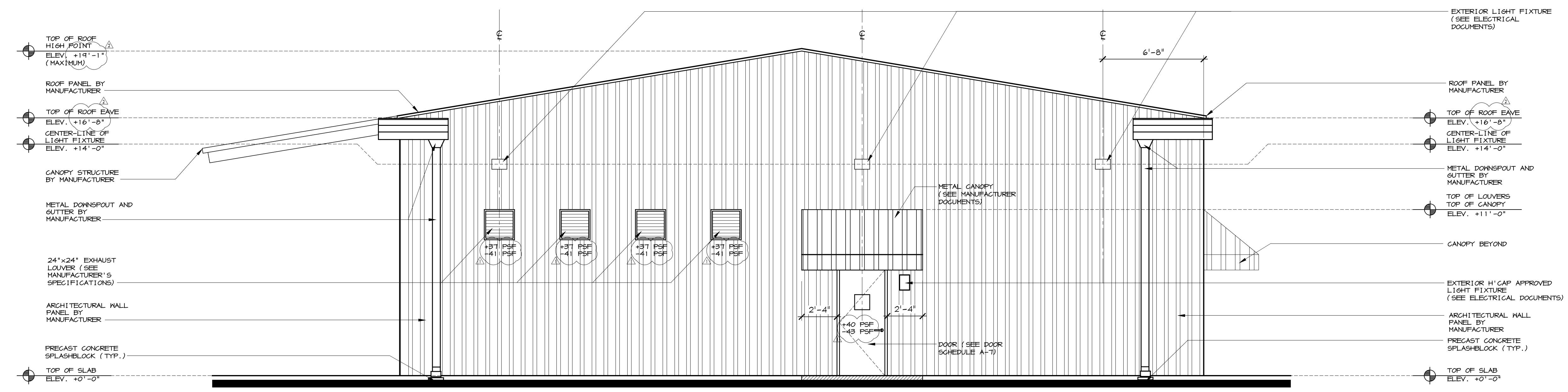
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REVISIONS
DATE: 08/25/2010
DRAWN BY: JH/EG/JJ
CHECKED BY: MC

DATE: AUGUST 25, 2010
DRAWN BY: JH/EG/JJ
CHECKED BY: MC

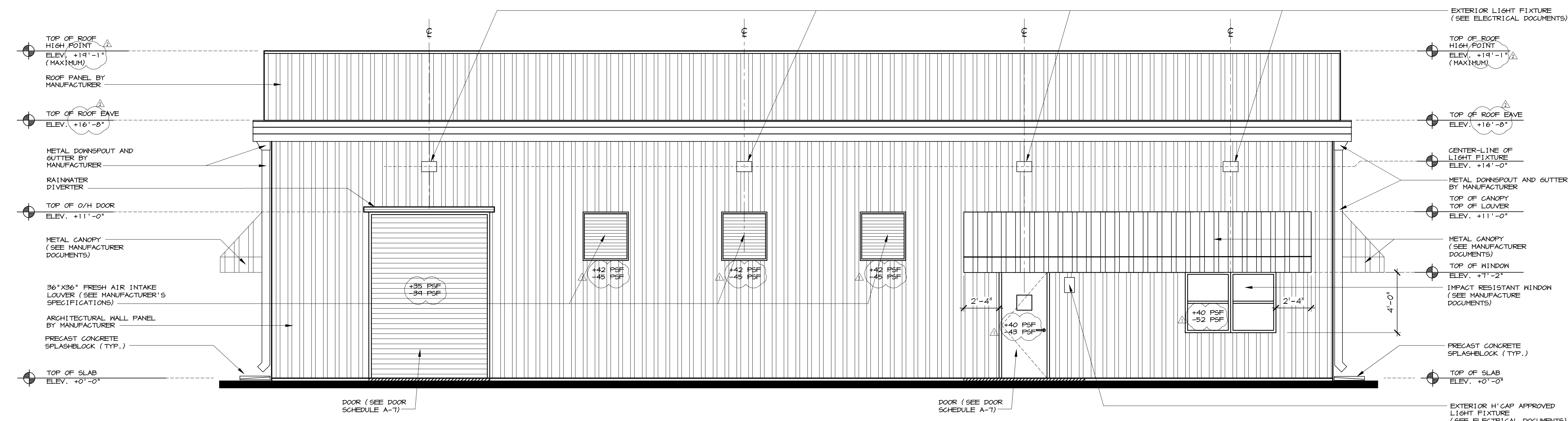
TITLE: EXTERIOR ELEVATIONS
JOB NO: 0908

SHEET: A-3
3 OF 8



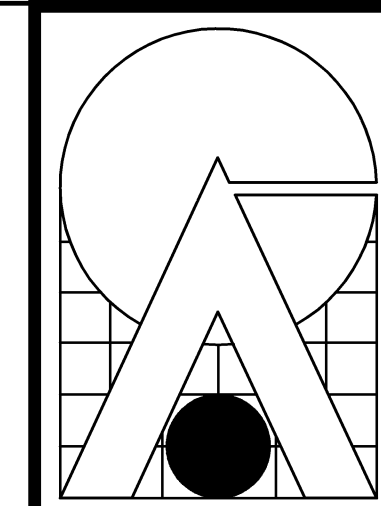
WEST ELEVATION

SCALE: 1/4" = 1'-0"



SOUTH ELEVATION

SCALE: 1/4" = 1'-0"



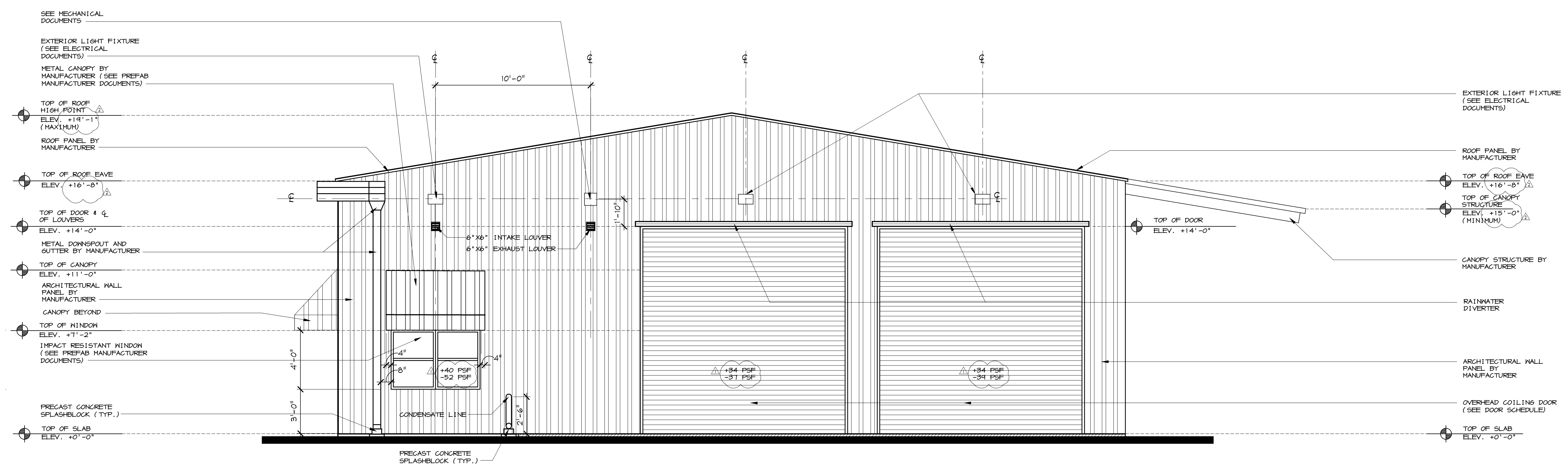
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SEAU AA C001888

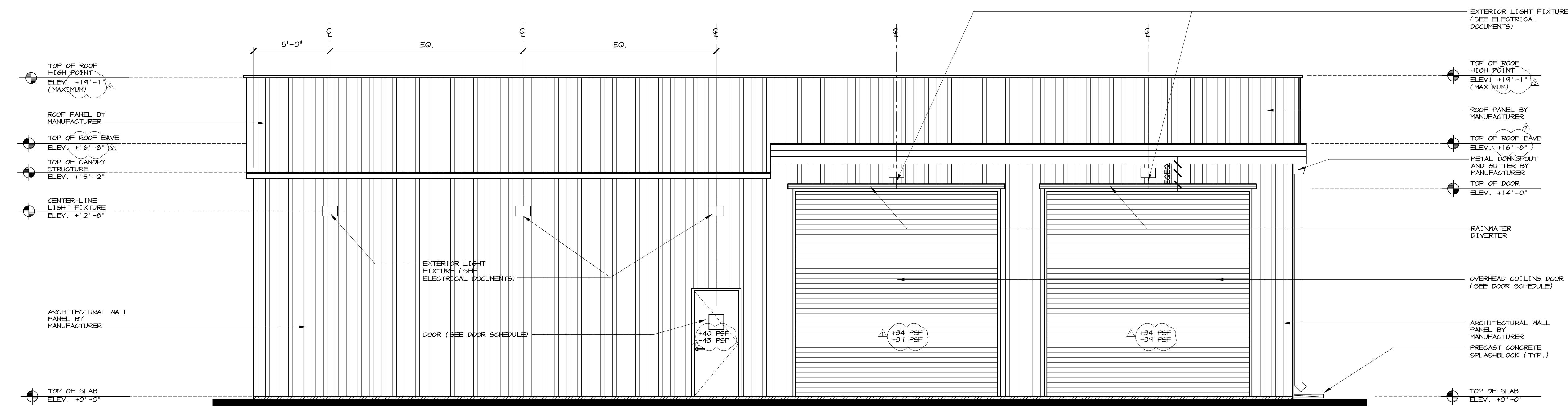
PROJECT: AIRPARK MAINTENANCE STORAGE FACILITY
POMPANO BEACH, FLORIDA 33060

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EAST ELEVATION

SCALE: 1/4" = 1'-0"



NORTH ELEVATION

SCALE: 1/4" = 1'-0"

TITLE: EXTERIOR ELEVATIONS

DATE: AUGUST 25, 2010

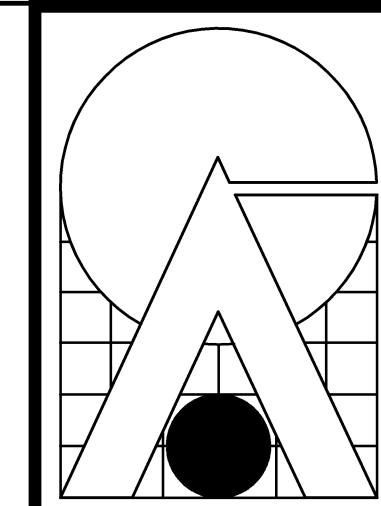
DRAWN BY: BH/EG/JJ

CHECKED BY: MC

JOB NO: 0908

SHEET: A-4

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SEAL: AA C001888

PROJECT: AIRPARK MAINTENANCE STORAGE FACILITY
POMPANO BEACH, FLORIDA 33060

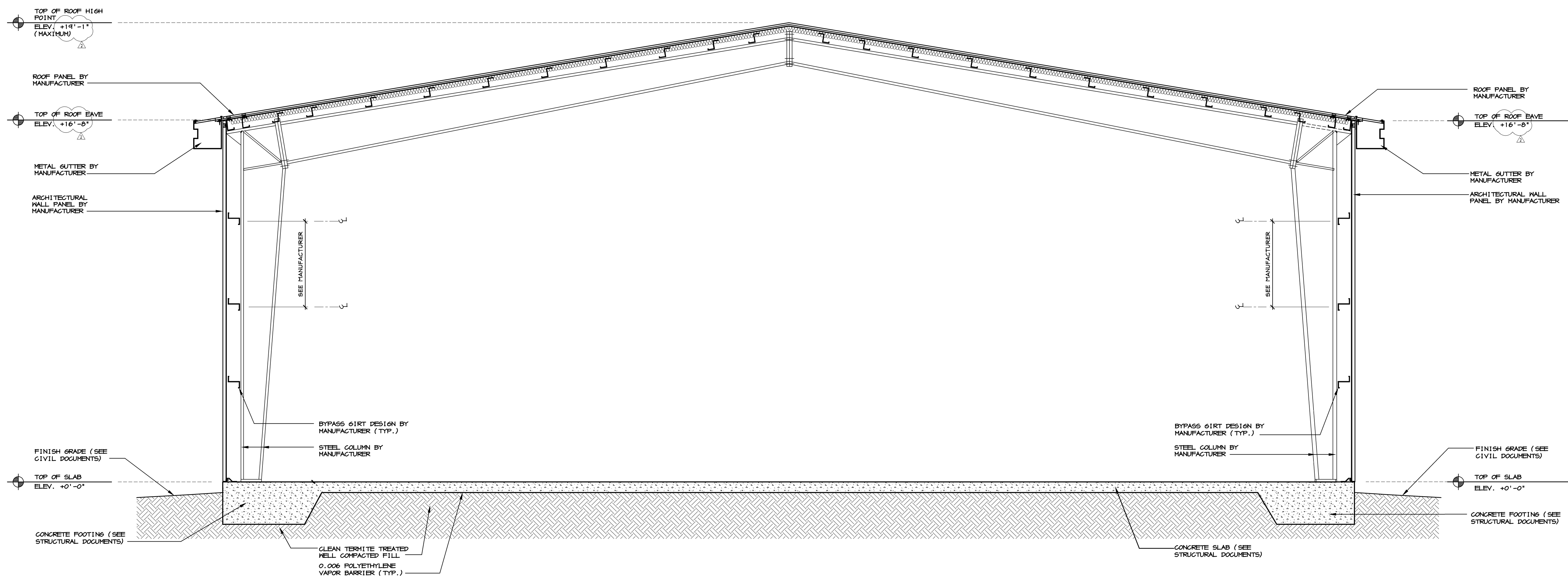
ALL DIMENSIONS AND DETAILS INDICATED OR REPRESENTED BY THIS DRAWING ARE FOR USE ON AND IN CONNECTION WITH THE SPECIFIED PROJECT. THIS IS THE PROPERTY OF CARTAYA AND ASSOCIATES ARCHITECTS P.A. AND SHALL NOT BE REPRODUCED IN WHOLE OR IN PART WITHOUT WRITTEN PERMISSION FROM CARTAYA AND ASSOCIATES ARCHITECTS P.A. ANY DIMENSIONS SHOWN ON THIS DRAWING SHALL TAKE PRECEDENCE OVER ANY DIMENSIONS SHOWN ON ANY OTHER DRAWING. AND NOTIFY THIS OFFICE OF ANY DISCREPANCIES PRIOR TO THE BEGINNING OF THE WORK.

REVISIONS:
1. INITIAL OWNER CORRECTION

DATE: AUGUST 25, 2010
DRAWN BY: JH/EG/JJ
CHECKED BY: MC

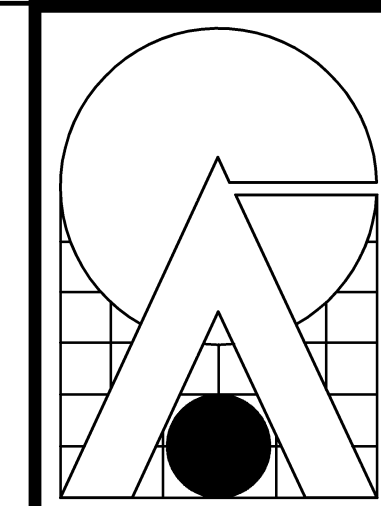
TITLE: SECTION
JOB NO: 0908

SHEET: A-5
5 OF 8



1 BUILDING SECTION
A-5

SCALE: 3/8" = 1'-0"



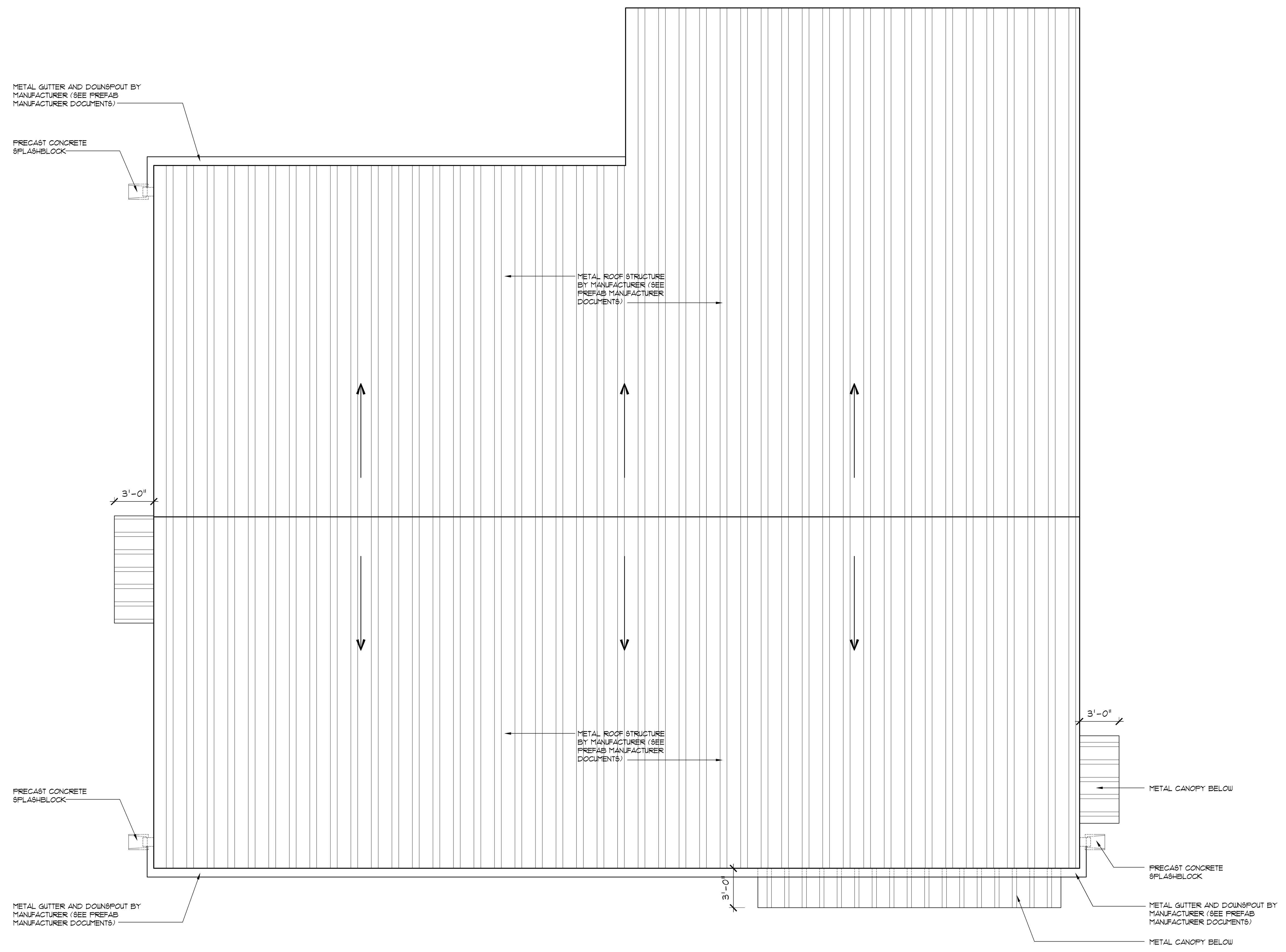
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SEAL: AA C001888

PROJECT: AIRPARK MAINTENANCE STORAGE FACILITY
POMPANO BEACH, FLORIDA 33060

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ROOF PLAN

SCALE 1/4" = 1'-0"

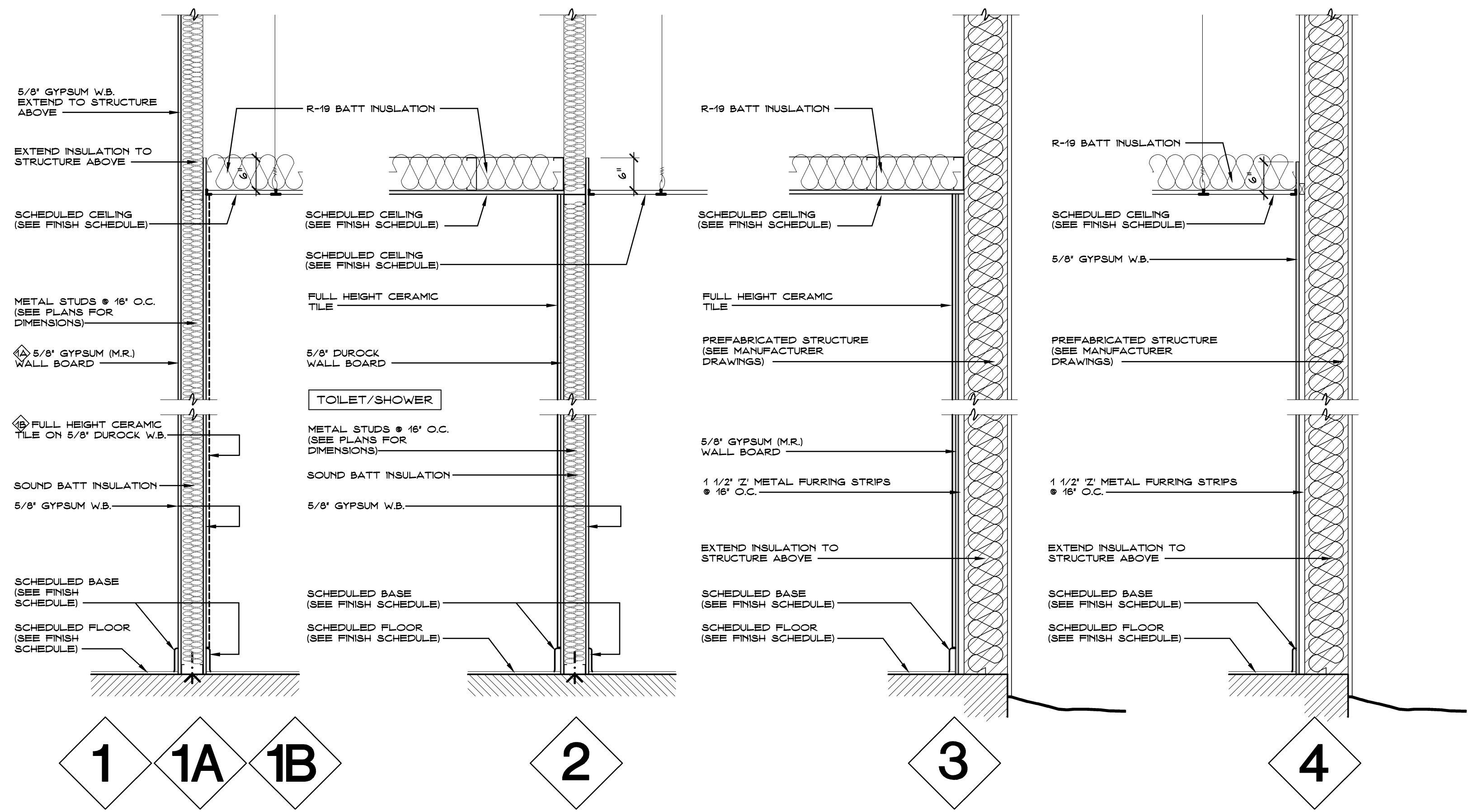


TITLE: **ROOF PLAN**

DATE: AUGUST 25, 2010
DRAWN BY: IH/EG/JJ
CHECKED BY: MC

REVISIONS:

SHEET: **A-6**
6 OF 8



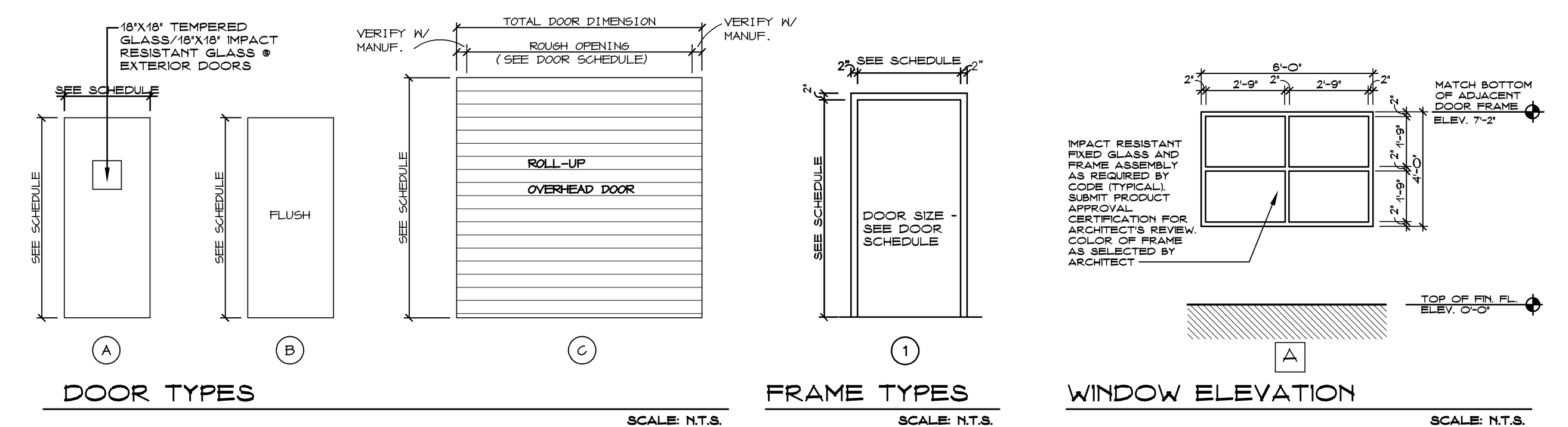
1 WALL PARTITIONS
A-7

SCALE N.T.S.

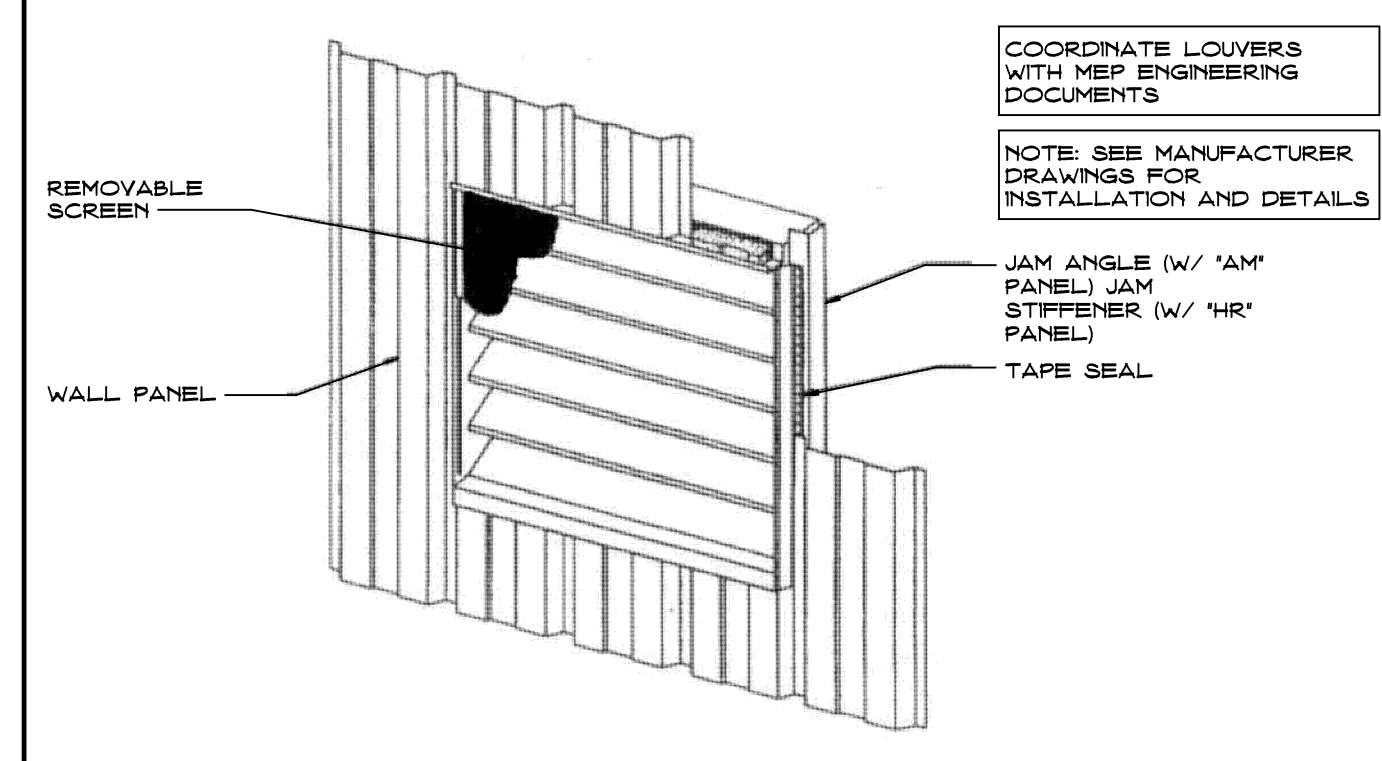
FINISH SCHEDULE					
NO.	ROOM	BASE	FLOOR	WALL	CEILING (SEE REFLECTED CEILING PLAN)
101	BAY	BY PREFAB MANUFACTURER	SEALED CONCRETE	PAINTED METAL (BY PREFAB MANUFACTURER)	PAINTED METAL (BY PREFAB MANUFACTURER)
102	TOILET	CERAMIC TILE COVE	CERAMIC TILE	CERAMIC TILE	PAINTED GYPSUM WALL BOARD (M.R.)
103	OFFICE	VINYL	VINYL TILE	PAINTED GYPSUM WALL BOARD	ACOUSTICAL TILE

DOOR SCHEDULE									
NO.	SIZE	DOOR		FRAME		THRESHOLD	CLOSER/PANIC HARDWARE	IMPACT RESISTANT	REMARKS *
		MATERIAL	ELEV.	MATERIAL	ELEV.				
1-1	3'-0" X 7'-0" X 1 3/4"	METAL	A	METAL	1	ALUMINUM	YES	YES	PROVIDE ADA THRESHOLD * BY PREFAB MANUFACTURER
1-2	3'-0" X 7'-0" X 1 3/4"	METAL	A	METAL	1	ALUMINUM	YES	YES	PROVIDE ADA THRESHOLD * BY PREFAB MANUFACTURER
1-3	3'-0" X 7'-0" X 1 3/4"	METAL	A	METAL	1	ALUMINUM	YES	YES	PROVIDE ADA THRESHOLD * BY PREFAB MANUFACTURER
1-4	14'-0" WIDE X 14'-0" HIGH ROUGH OPENING	METAL	C	METAL	--	NONE	--	YES	BY PREFAB MANUFACTURER *
1-5	14'-0" WIDE X 14'-0" HIGH ROUGH OPENING	METAL	C	METAL	--	NONE	--	YES	BY PREFAB MANUFACTURER *
1-6	14'-0" WIDE X 14'-0" HIGH ROUGH OPENING	METAL	C	METAL	--	NONE	--	YES	BY PREFAB MANUFACTURER *
1-7	14'-0" WIDE X 14'-0" HIGH ROUGH OPENING	METAL	C	METAL	--	NONE	--	YES	BY PREFAB MANUFACTURER *
1-8	8'-0" WIDE X 11'-0" HIGH ROUGH OPENING	METAL	C	METAL	--	NONE	--	YES	BY PREFAB MANUFACTURER *
1-9	3'-0" X 7'-0" X 1 3/4"	HOLLOW METAL	A	HOLLOW METAL	1	ALUMINUM	NO	NO	--
1-10	3'-0" X 7'-0" X 1 3/4"	HOLLOW METAL	B	HOLLOW METAL	1	MARBLE	NO	NO	--
1-11	4'-6" X 6'-8"	OPAQUE SAFETY GLASS	-	ALUMINUM	-	ALUMINUM	NO	NO	MEASURE WIDTH & FIELD PRIOR TO MFG. HEAD CONDITION

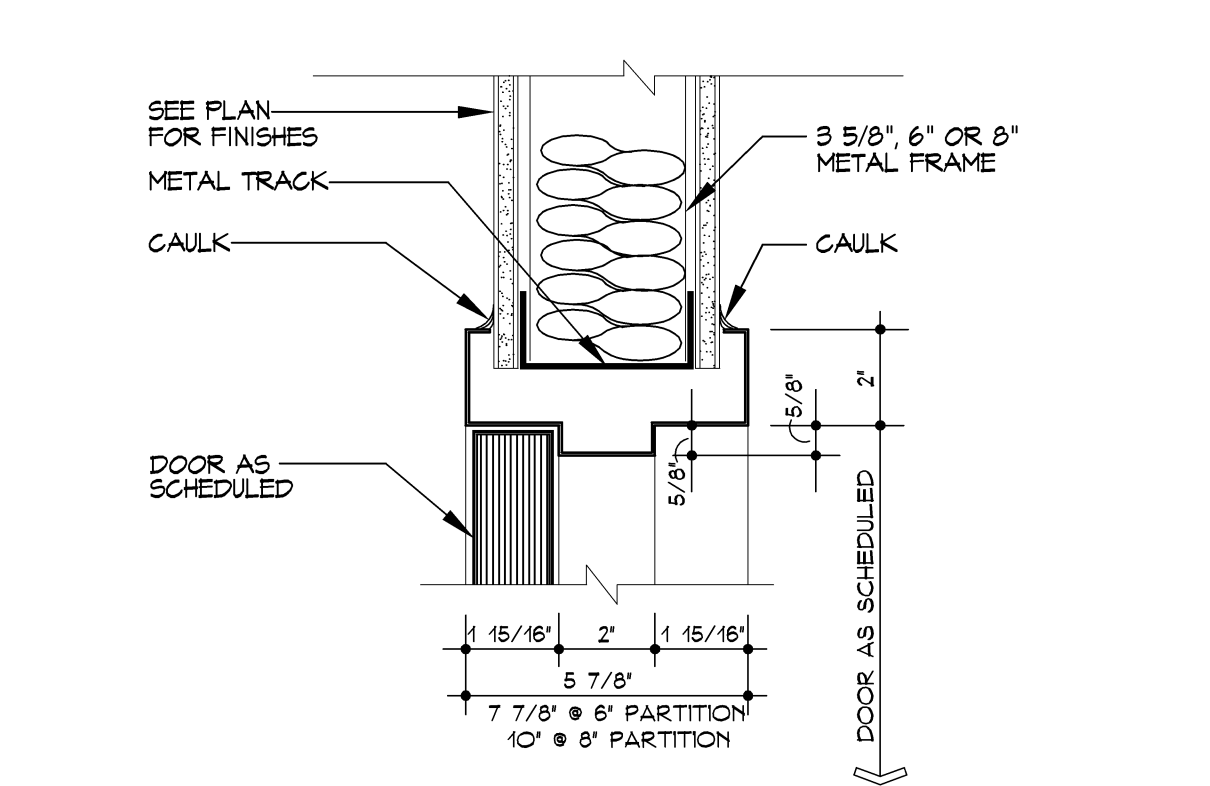
* SUBMIT IMPACT RESISTANT AND PRODUCT APPROVAL CERTIFICATION FOR ARCHITECT'S REVIEW



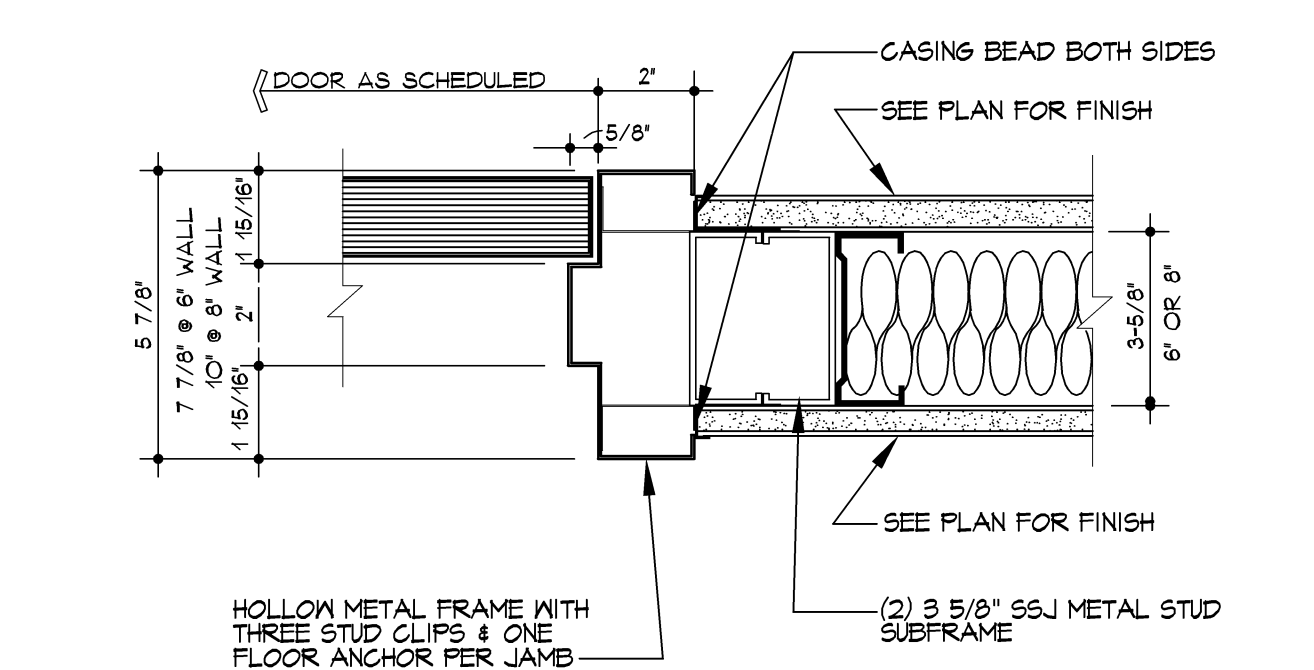
DOOR TYPES SCALE N.T.S. FRAME TYPES SCALE N.T.S. WINDOW ELEVATION SCALE N.T.S.



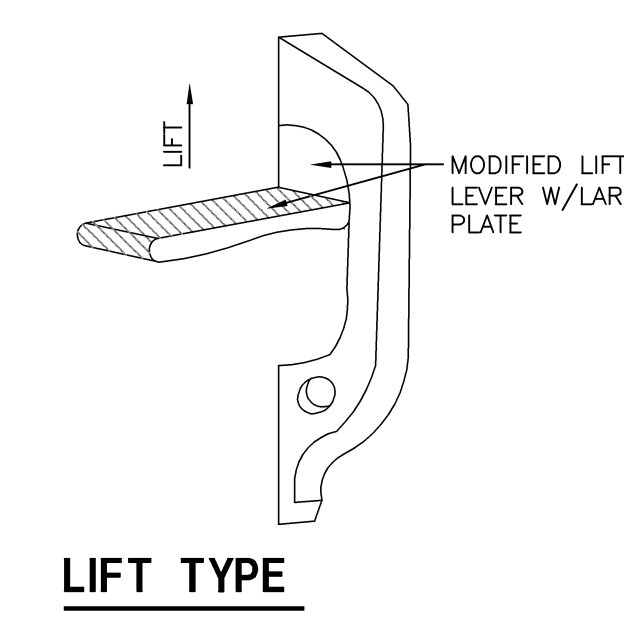
2 SELF-FLASHING FIXED & ADJUSTABLE LOUVERS DETAIL
A-7 (SUBMIT N.O.A.) SCALE = N.T.S.



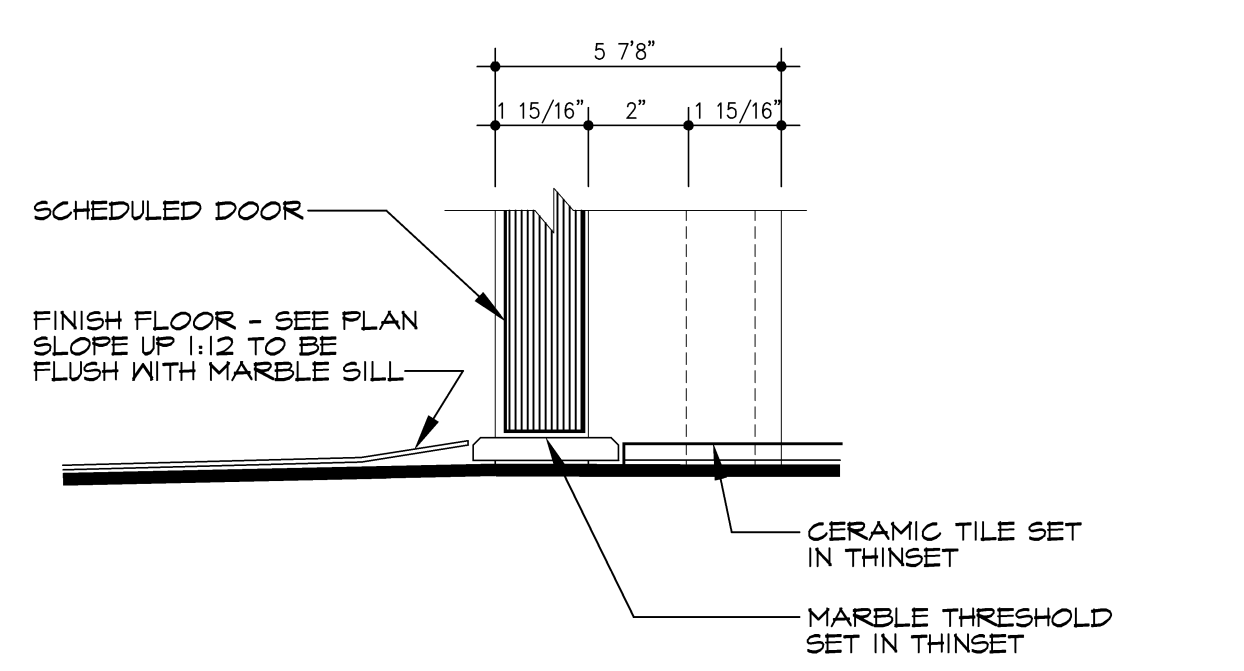
3 INTERIOR DOOR HEADER DETAIL
A-7 SCALE N.T.S.



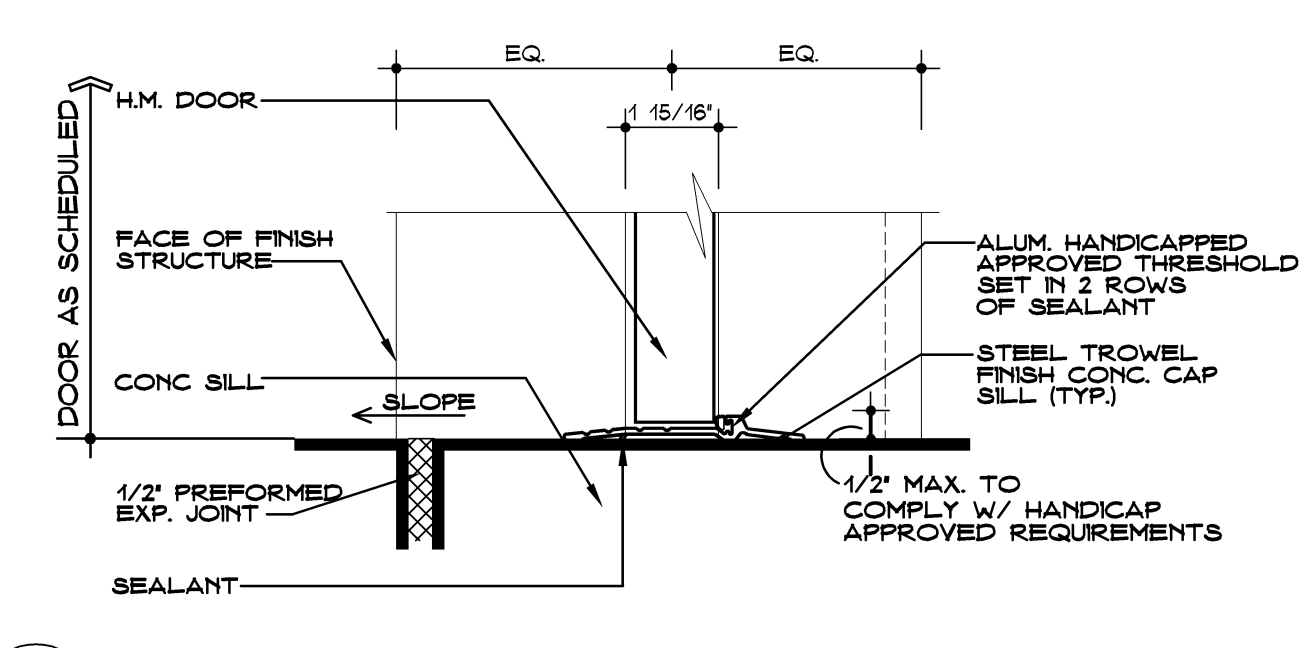
4 INTERIOR DOOR JAMB DETAIL
A-7 SCALE N.T.S.



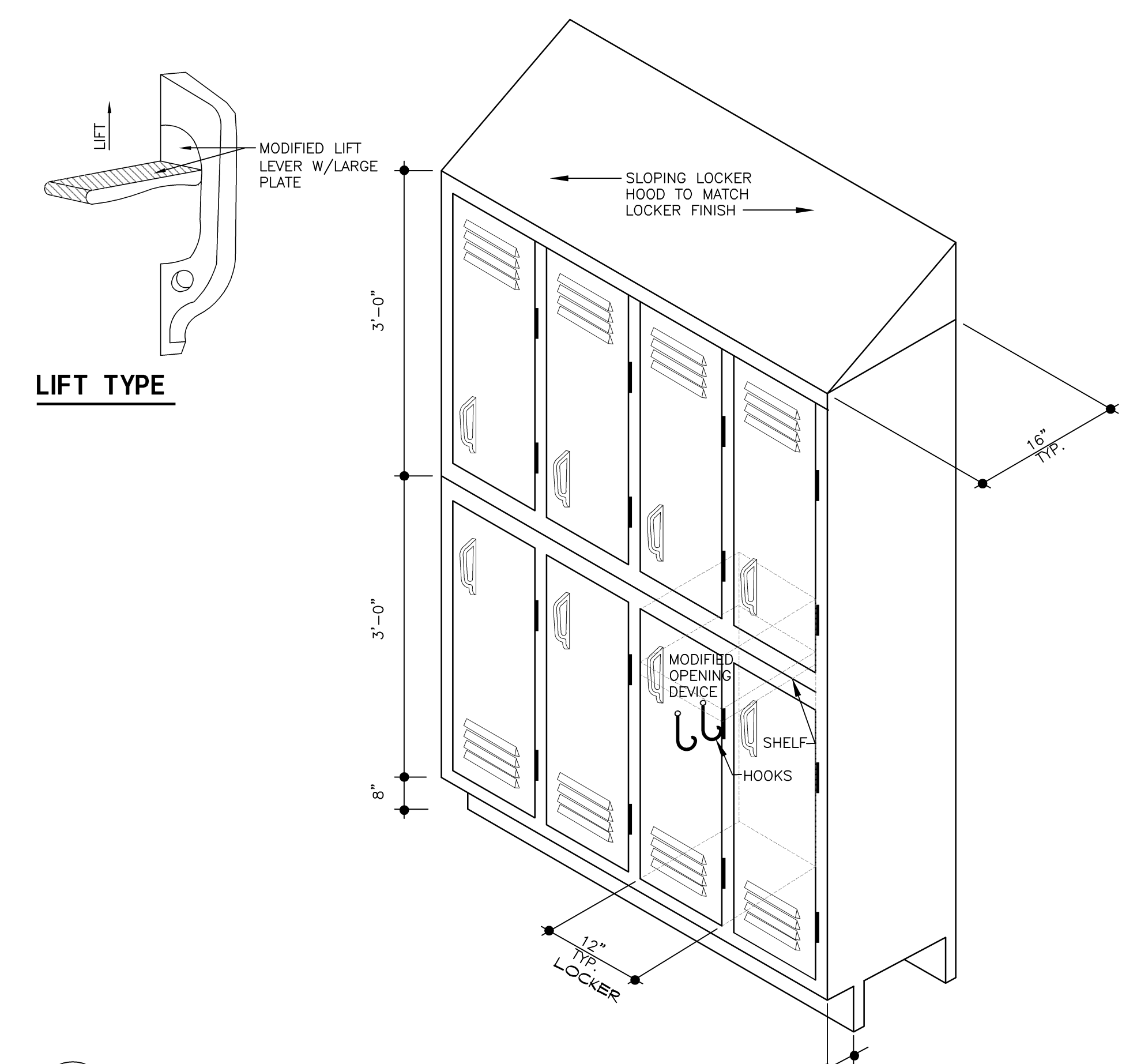
LIFT TYPE



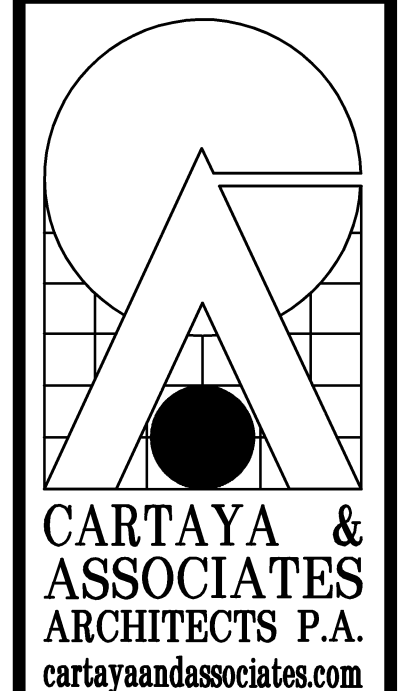
5 THRESHOLD @ CERAMIC TILE
A-7 SCALE N.T.S.



6 THRESHOLD @ EXTERIOR
A-7 SCALE N.T.S.



7 LOCKER DETAILS
A-7 SCALE N.T.S.



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SEAL AA C001388

PROJECT: AIRPARK MAINTENANCE STORAGE FACILITY
POMPANO BEACH, FLORIDA 33060

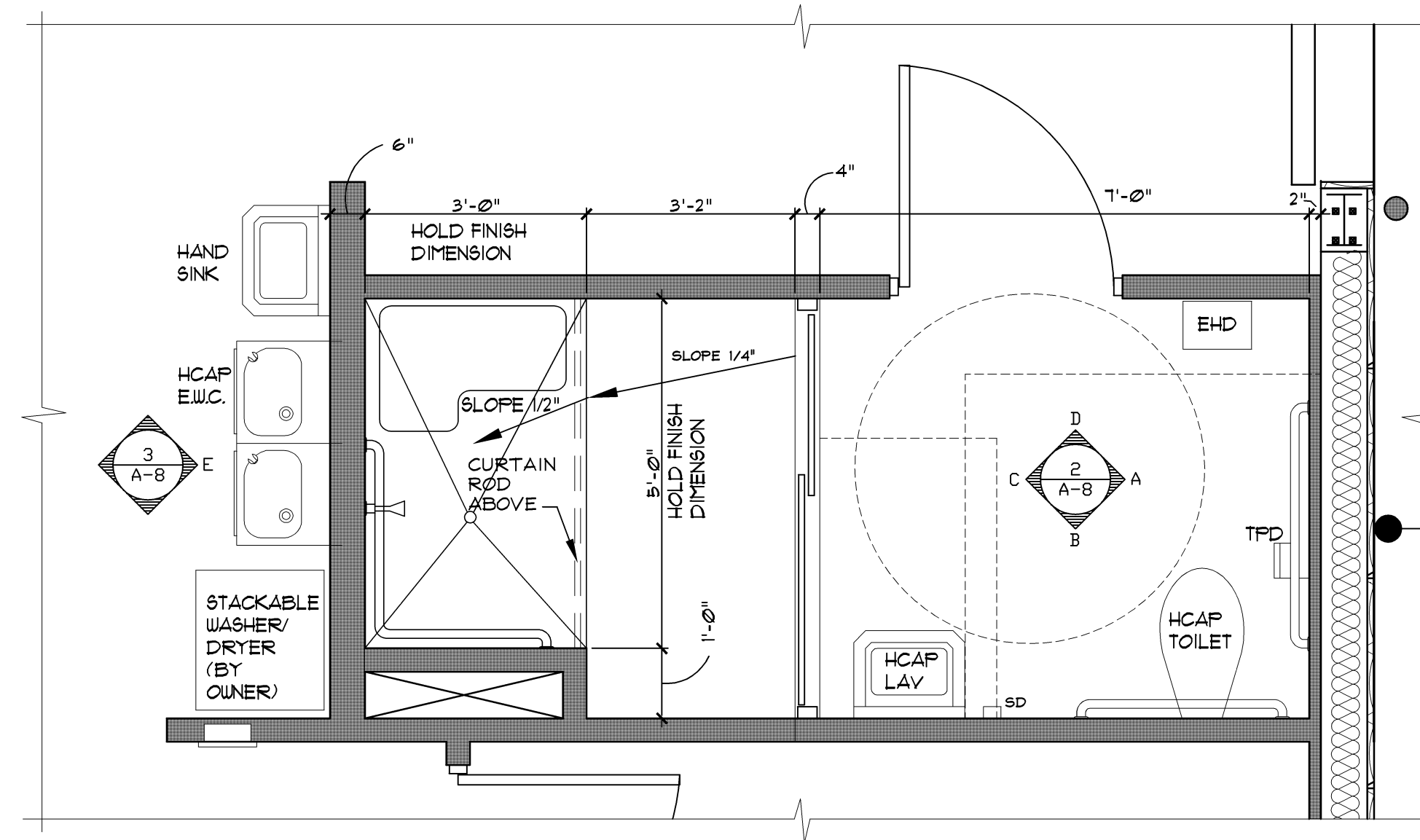
TITLE: PARTITION, DOOR & FINISH SCHEDULES
DETAILS

REVISIONS

DATE: AUGUST 25, 2010
DRAWN BY: ECG/JJJ
CHECKED BY: MC

JOB NO: 0908

SHEET: A-7
7 OF 8



1 TOILET FLOOR PLAN SCALE 1/2" = 1'-0"

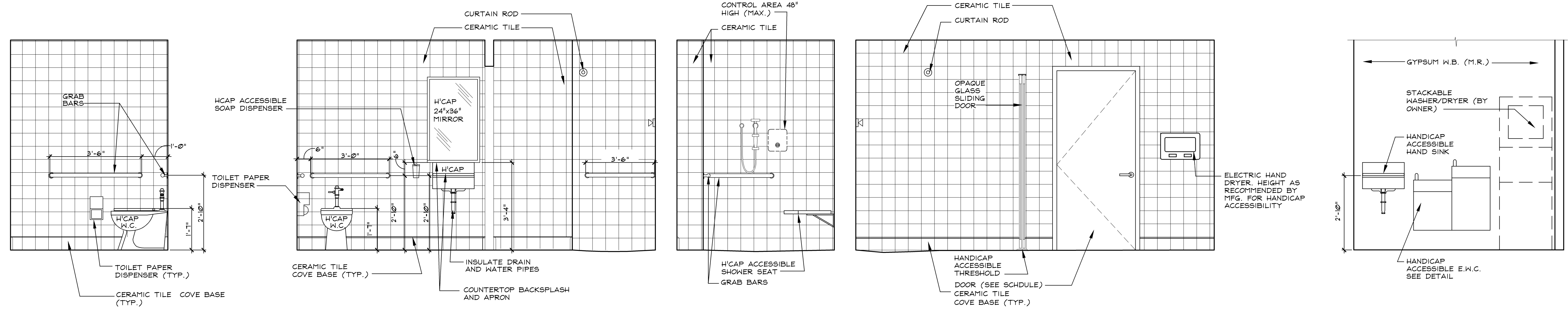
FINISH NOTES

- 1 - ALL EXPOSED SURFACES SHALL BE PAINTED CUSTOM COLORS AS SELECTED BY THE ARCHITECT.
- 2 - ALL CERAMIC TILES, COLORS, TEXTURES, AND PATTERNS SHALL BE AS SELECTED BY ARCHITECT FROM SPECIFIED PRODUCT. (REFER TO SPECIFICATIONS)
- 3 - ALL CERAMIC TILE BASE SHALL BE AS SPECIFIED. (REFER TO SPECIFICATIONS)
- 4 - ALL FIXTURES & ACCESSORIES LOCATED IN HANDICAP ACCESSIBLE STALLS SHALL BE HANDICAP ACCESSIBLE APPROVED

LEGEND

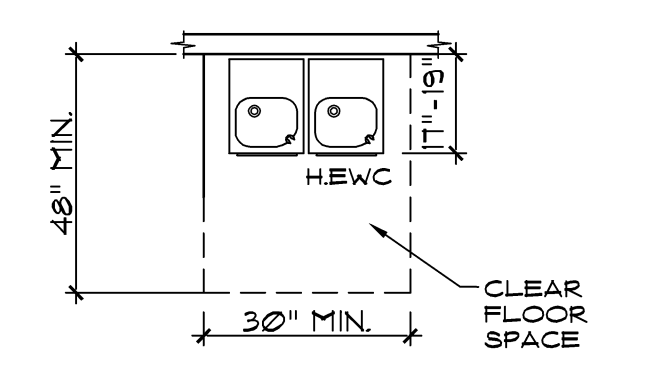
TPD - TOILET PAPER DISPENSER
 SD - SOAP DISPENSER
 EHD - ELECTRIC HAND DRYER

WALL HUNG FIXTURES SHALL BE SUPPORTED AS PER FLORIDA BUILDING CODE 2007



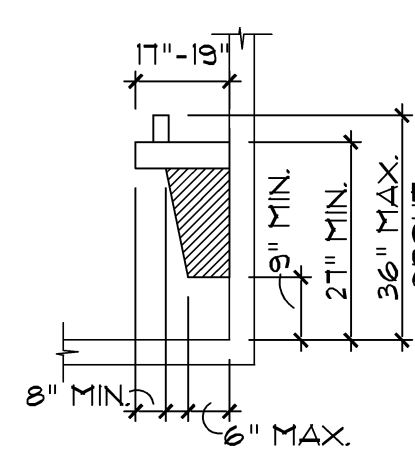
2 TOILET INTERIOR ELEVATIONS SCALE 1/2" = 1'-0"

3 INTERIOR ELEVATIONS SCALE 1/2" = 1'-0"

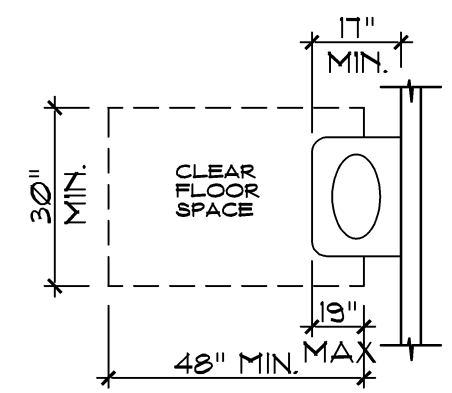


CLEAR FLOOR SPACE AT HANDICAP WATER COOLER

DETAIL AT HANDICAP ACCESSIBLE WATER COOLER

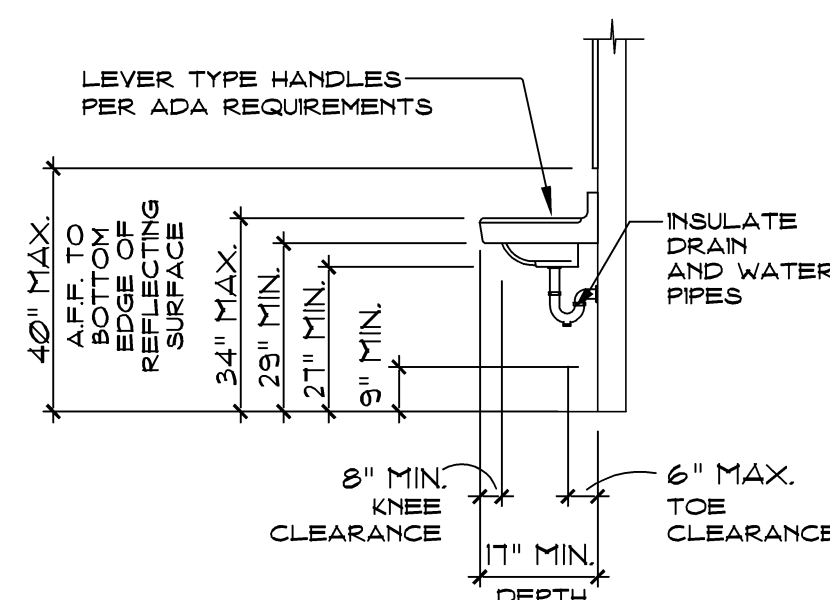


HANDICAP APPROVED WATER COOLER CLEARANCES

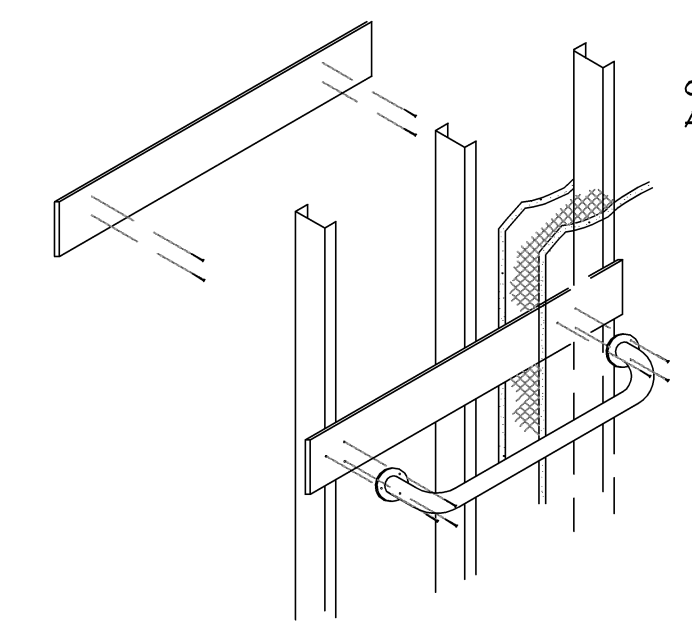


CLEAR FLOOR SPACE AT HANDICAP LAVATORIES

DETAIL AT HANDICAP ACCESSIBLE LAVATORY



HANDICAP APPROVED LAVATORY CLEARANCES



DETAIL AT HANDICAP ACCESSIBLE WATER COOLER

CONCEALED ANCHOR PLATE FOR GRAB BARS AND SAFETY RAILINGS (STUD WALL CONSTRUCTION)

MATERIALS: ANCHOR - 12 GAUGE (105) STEEL PLATE WITH 1/4" 20 THREADED HOLES EXTRUDED TO GIVE 200-INCH MIN USABLE THREAD PER HOLE.
 MOUNTING SCREWS - 300 SERIES STAINLESS STEEL MACHINE SCREWS 1-1/2" LONG.
 INSTALLATION: ANCHOR PLATE MUST BE PROPERLY SECURED TO STUDS TO SUPPORT MAXIMUM LOAD ON GRAB BAR OR SAFETY RAILING.
 AFTER WALL IS FINISHED, FLANGE OR CONCEALED MOUNTING PLATE IS TO BE ATTACHED TO ANCHOR PLATE WITH MOUNTING SCREWS FURNISHED. FOR PLASTER OR TILE WALLS, MOUNTING SCREWS SHOULD BE TEMPORARILY SCREWED INTO ANCHOR PLATE BEFORE APPLICATION OF FINISHED WALL. SPECIFICATION: CONCEALED STUD WALL ANCHOR PLATE SHALL BE 12 GA. (105) STEEL PLATE WITH PIERCED HOLES TO GIVE 200-INCH MINIMUM LENGTH OF 1/4" 20 MACHINE THREADS

STRUCTURAL NOTES

GENERAL:
STRUCTURAL DRAWINGS SHALL BE USED IN CONJUNCTION WITH JOB SPECIFICATIONS AND ARCHITECTURAL, MECHANICAL, ELECTRICAL, PLUMBING, AND SITE DRAWINGS. CONSULT THESE DRAWINGS FOR DIMENSIONS, AND OTHER DETAILS NOT SHOWN ON STRUCTURAL DRAWINGS.

DIMENSIONS AND CONDITIONS MUST BE VERIFIED IN THE FIELD. ANY DISCREPANCIES SHALL BE BROUGHT TO THE ATTENTION OF THE ENGINEER BEFORE PROCEEDING WITH THE AFFECTED PART OF THE WORK.
THE STRUCTURE IS DESIGNED TO BE SELF-SUPPORTING AND STABLE AFTER THE BUILDING IS COMPLETE. IT IS THE CONTRACTOR'S RESPONSIBILITY TO DETERMINE ERECTION PROCEDURES AND SEQUENCE TO INSURE SAFETY OF THE BUILDING AND ITS COMPONENTS DURING ERECTION. THIS INCLUDES THE ADDITION OF NECESSARY SHORING, SHEETING, TEMPORARY BRACING, GUY'S OR TIEDOWNS.

CONTRACTOR PROPOSED CHANGES AND SUBSTITUTIONS:
PROPOSED CHANGES OR SUBSTITUTIONS TO STRUCTURAL DETAILS OR PLANS SHALL BE SUBMITTED TO THE ENGINEER OF RECORD (EOR) FOR REVIEW AND APPROVAL. SUBMITTALS SHALL CONTAIN FULL DOCUMENTATION OF CHANGES OR SUBSTITUTIONS WITH SUPPORTING SEALED CALCULATIONS (WHERE APPLICABLE). THE REVIEW OF CHANGES AND SUBSTITUTIONS, RE-ANALYSIS AND/OR RE-DRAWING TO BE APPROVED BY THE ENGINEER OF RECORD. CONTRACT DOCUMENTS ARE BETWEEN THE CONTRACTOR AND OWNER AND ARE NOT REVIEWED BY THE EOR.

DESIGN LOADS:
ALL DESIGN LOADS FOR THIS BUILDING HAS BEEN DESIGNED IN ACCORDANCE WITH THE FLORIDA BUILDING CODE 2007 EDITION. THE FOLLOWING SUPERIMPOSED LOADINGS HAVE BEEN UTILIZED FROM THE CALCULATIONS PACKAGE:

- ROOF LOAD = 30 psf
- WIND: 140 MPH VELOCITY
- EXPOSURE C
- CATEGORY II
- ENCLOSED BUILDING
- INTER PRESSURE COEFF = +/- 0.18

SHOP DRAWING REVIEW:
ELECTRONIC VERSIONS OF STRUCTURAL DRAWINGS ARE THE SOLE, COPYRIGHTED PROPERTY OF TRC WORLDWIDE ENGINEERING, INC. ELECTRONIC VERSIONS OF DRAWINGS ARE NOT TO BE USED OR TRANSMITTED WITHOUT THE EXPRESS WRITTEN PERMISSION OF TRC WORLDWIDE ENGINEERING, INC. USERS WILL SIGN A RELEASE AND REMUNDS FOR TRC WORLDWIDE ENGINEERING, INC.

SHOP DRAWINGS WILL BE REVIEWED FOR GENERAL COMPLIANCE WITH THE DESIGN INTENT OF THE CONTRACT DOCUMENTS ONLY. IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO VERIFY COMPLIANCE WITH THE CONTRACT DOCUMENTS AS TO QUANTITY, LENGTH, ELEVATIONS, DIMENSIONS, ETC.
SHOP DRAWINGS SHALL BE REVIEWED BY THE CONTRACTOR'S FIELD ENGINEER PRIOR TO SUBMITTAL TO THE ARCHITECT/ENGINEER. DRAWINGS SUBMITTED WITHOUT REVIEW WILL BE RETURNED UNCHECKED.

SHOP DRAWING SUBMITTALS SHALL INCLUDE ONE GOOD QUALITY REPRODUCTION AND THREE SETS OF BLUEPRINTS. ONE SET OF PRINTS WILL BE RETAINED BY THE ENGINEER, ONE BY THE ARCHITECT, ONE BY THE LOCAL BUILDING DEPARTMENT (WHERE REQUIRED) AND THE CONTRACTOR SHALL MAKE PRINTS FROM THE REPRODUCIBLES AND AS REQUIRED FOR DISTRIBUTION. ENGINEER'S REVIEW STAMP AND SHALL BE APPLIED TO ALL DRAWINGS PRIOR TO SUBMITTAL.

THE CONTRACT DOCUMENTS WILL GOVERN OVER THE SHOP DRAWINGS UNLESS OTHERWISE SPECIFIED IN WRITING BY THE ENGINEER.

CHANGES AND ADDITIONS MADE ON RE-SUBMITTALS SHALL BE CLEARLY FLAGGED AND NOTED. THE PURPOSE OF THE RE-SUBMITTALS SHALL BE REVIEWED AND NOTED ON THE LETTER TRANSMITTING THE RE-SUBMITTAL. REVIEW WILL BE LIMITED TO THOSE ITEMS CAUSING THE RE-SUBMITTAL.

SHOP DRAWINGS SUBMITTALS ARE REQUIRED FOR ALL FRAMING SHOWN ON THESE DRAWINGS INCLUDING, BUT NOT LIMITED TO, CONCRETE MIXES, CONCRETE AND MASONRY REINFORCING, STRUCTURAL STEEL AND CONNECTIONS, STEEL DECK, LIGHT GAUGE FRAMING, WOOD ROOF TRUSS FRAMING.

FOUNDATIONS:
SEE THE FOLLOWING REPORT FOR COMPLETE GEOTECHNICAL RECOMMENDATIONS AND INSTALLATION PROCEDURES.
REPORT No. 09/126-3
PREPARED BY: TESTING LAB OF THE PALM BEACH TITLED: GEOTECHNICAL INVESTIGATION FOR THE PROPOSED POMPANO BEACH AIR PARK MAINTENANCE BUILDING POMPANO BEACH, FLORIDA DATED: SEPTEMBER 28, 2009

THIS REPORT SHALL BE CONSIDERED PART OF THE CONTRACT DOCUMENTS. FOUNDATION DESIGN IS BASED ON A SOIL BEARING PRESSURE OF 2,500 psf.

FORMWORK AND SHORING:
NO STRUCTURAL FORMWORK SHALL BE STRIPPED UNTIL IT HAS REACHED A MINIMUM STRENGTH OF 28 DAY DESIGN STRENGTH. DESIGN, ERECTION AND REMOVAL OF ALL FORMWORK, SHORES AND RESHORES SHALL MEET THE REQUIREMENTS SET FORTH IN ACI STANDARDS 347 AND 301.

REINFORCING STEEL:
SCALE AND LISTED. GAUGE 60 DEFORMED BARS, FREE FROM OIL, SCALE AND RUST AND PLACED IN ACCORDANCE WITH THE TYPICAL BENDING DIAGRAM AND PLACING DETAILS OF ACI STANDARDS AND SPECIFICATIONS. SECURE APPROVAL OF SHOP DRAWINGS PRIOR TO COMMENCING FABRICATION.

WELDED WIRE FABRIC:
TO CONTRACTOR TO USE A 18G, FREE FROM OIL, SCALE AND RUST AND PLACED IN ACCORDANCE WITH THE TYPICAL PLACING DETAILS OF ACI STANDARDS AND SPECIFICATIONS. MINIMUM LAP SHALL BE ONE SPACE PLUS TWO INCHES. USE OF FLAT MANUFACTURED SHEETS IS RECOMMENDED.

CONCRETE:
SHALL BE PER AN APPROVED MIX DESIGN PROPORTIONED TO ACHIEVE A STRENGTH AT 28 DAYS AS LISTED BELOW WITH A PLASTIC AND WORKABLE MIX:
3000 psi FOR FOUNDATIONS AND SLABS ON GRADE.
CONCRETE SHALL BE PLACED AND CURED ACCORDING TO ACI STANDARDS AND SPECIFICATIONS.
WHERE THE SPECIFIED CONCRETE STRENGTH OF A COLUMN OR SHEARWALL IS GREATER THAN THE STRENGTH OF THE COLUMN OR SHEARWALL, LOCAL, THE AREA OF THE COLUMN OR SHEARWALL, CONCRETE STRENGTH POURED IN THE SLAB SHALL EXTEND A MINIMUM OF 2 FEET INTO THE SLAB FROM THE FACE OF THE COLUMN OR SHEARWALL.

CONCRETE (CONT.)

SUBMIT PROPOSED MIX DESIGN WITH RECENT FIELD CYLINDER OR LAB TESTS FOR REVIEW PRIOR TO USE. MIX SHALL BE UNIQUELY IDENTIFIED BY MIX NUMBER OR OTHER POSITIVE IDENTIFICATION. MIX SHALL MEET THE REQUIREMENTS OF ASTM C39 FOR COMPRESSIVE STRENGTH, ASTM C143 FOR SLUMP, ASTM C136 FOR CONCRETE MEASURING, MIXING, TRANSPORTING, ETC. CONCRETE TICKETS SHALL BE TIME STAMPED WHEN CONCRETE IS BATCHED. THE MAXIMUM TIME ALLOWED FROM THE TIME THE MIXING WATER IS ADDED UNTIL IT IS DEPOSITED IN ITS FINAL POSITION SHALL NOT EXCEED ONE AND ONE HALF (1 1/2) HOURS. IF FOR ANY REASON THERE IS A LONGER DELAY THAN THAT STATED ABOVE, THE CONCRETE SHALL BE DISCARDED. IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO NOTIFY THE OWNER'S REPRESENTATIVE AND THE CONTRACTOR OF ANY NONCOMPLIANCE WITH THE ABOVE. SLABS SHALL BE CURED USING A DISPENSING CURING COMPOUND MEETING ASTM STANDARD C309 TYPE 1-D AND SHALL HAVE A FUGITIVE DYE. THE COMPOUND SHALL BE PLACED AS SOON AS THE FINISHING IS COMPLETED OR AS SOON AS THE CURING MEMBRANE IS APPLIED TO THE SURFACE. BROKEN FLEAS IN THE CURING MEMBRANE SHALL BE RECONDITIONED. CALCIUM CHLORIDES SHALL NOT BE UTILIZED. OTHER ADMIXTURES MAY BE USED ONLY WITH THE APPROVAL OF THE ENGINEER.

CONCRETE MIX DESIGNS SHALL INCLUDE A WRITTEN DESCRIPTION OF THE MIX DESIGN. WHEN ACCEPTED PER PLAN, MIX DESIGN LIMITED TO VERTICAL ELEMENT POURS AND BEAM POURS LESS THAN 60 LINEAL FEET PER POUR.

CONCRETE DESIGN MIX SUBMITTALS SHALL INCLUDE TESTED, STATISTICAL WATER/CEMENT RATIO FOR CONCRETE AT EXTERIOR BALCONIES SHALL NOT EXCEED 0.40 BY WEIGHT.

CONCRETE TESTING:
AN INDEPENDENT TESTING LABORATORY SHALL PERFORM THE FOLLOWING TESTS ON CAST IN PLACE CONCRETE:
ASTM C143 "STANDARD TEST METHOD FOR SLUMP OF PORTLAND CEMENT CONCRETE." MAXIMUM SLUMP SHALL BE 5 INCHES ±1.
ASTM C39 "STANDARD TEST METHOD FOR COMPRESSIVE STRENGTH OF CYLINDRICAL CONCRETE SPECIMENS." A SEPARATE TEST SHALL BE CONDUCTED FOR EACH CLASS, FOR EVERY 50 CUBIC YARDS (OR FRACTION THEREOF) PLACED PER DAY. REQUIRED CYLINDERS(S) QUANTITIES AND TEST AGE AS FOLLOWS:
1 AT 3 DAYS
1 AT 7 DAYS
2 AT 28 DAYS

ONE ADDITIONAL RESERVE CYLINDER TO BE TESTED UNDER THE DIRECTION OF THE ENGINEER, IF REQUIRED. IF 28 DAY STRENGTH IS ACHIEVED, THE ADDITIONAL CYLINDER(S) MAY BE DISCARDED.

PRE-ENGINEERED METAL BUILDING:
THE PRE-ENGINEERED METAL BUILDING SHALL CONSIST OF ROOF DECK, FLOOR FRAMES BRACING, METAL WALL PANELS ON FRAMING, COLUMN FROM FLOOR TO ROOF, METAL CEILING, METAL FLOORING, METAL TRUSS AND BRAY SPACING SHOWN ON THE PLANS SHALL NOT BE PERMITTED TO SUIT MANUFACTURERS STANDARDS.

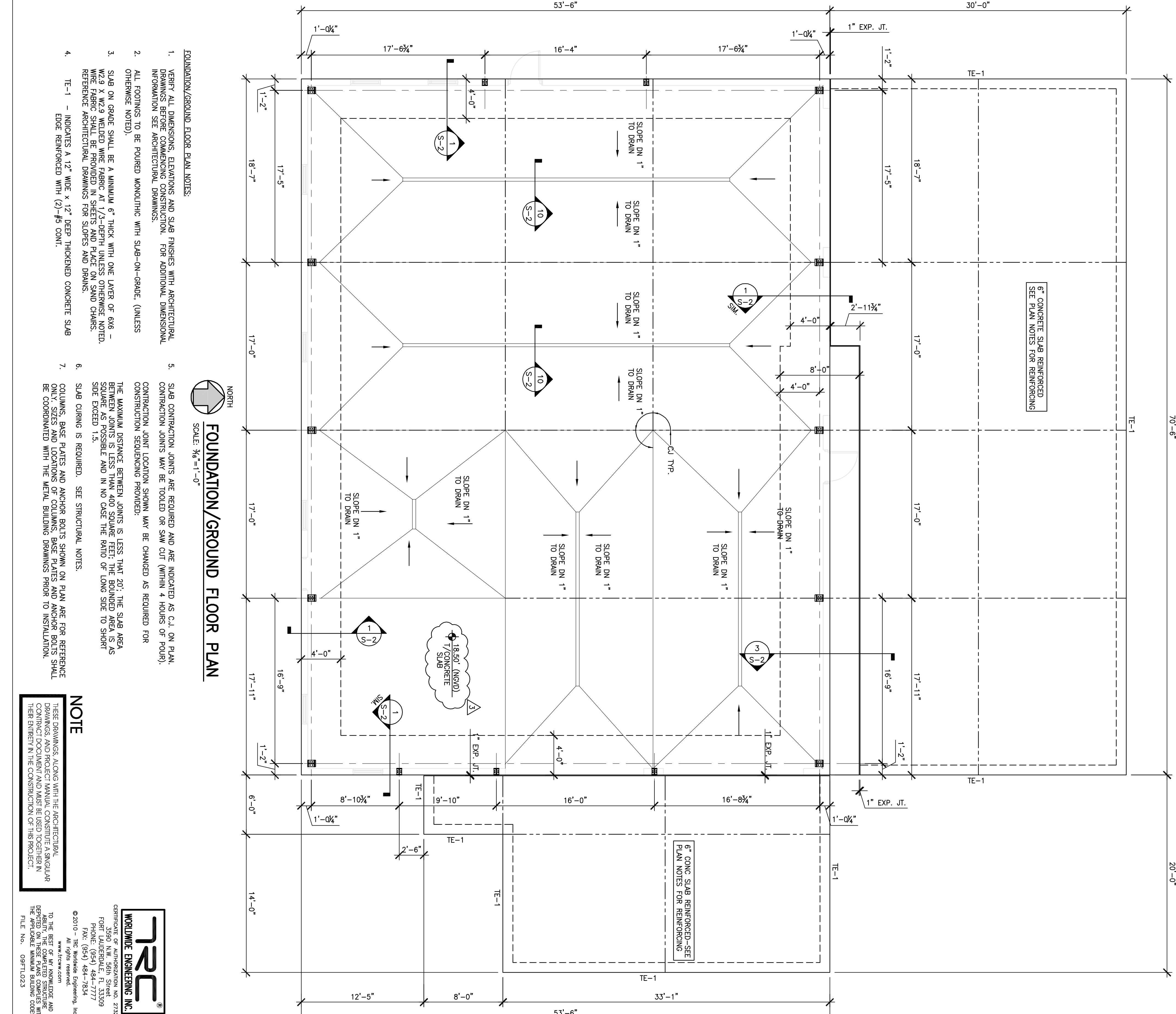
THE SYSTEM SHALL BE DESIGNED AND DETAILED BY THE MANUFACTURER TO SUSTAIN THE DESIGN LOADS SPECIFIED AS A STAND ALONE AND AS INTEGRATED WITH THE DESIGN LOADS, IN ACCORDANCE TO AISC AND AISI SPECIFICATIONS. THE DESIGN SHALL BE IN ACCORDANCE WITH THE MANUFACTURER'S LATEST ISSUES.

THE MANUFACTURER SHALL BE REGULARLY ENGAGED IN METAL BUILDING DESIGN AND MANUFACTURING. CURRENT WMAA MEMBERS ARE APPROVED. OTHERS SHALL SUBMIT PRODUCT DATA FOR REVIEW.

COLUMNS SHALL BE DESIGNED AS UNBRACED BY THE MASONRY LOADS. LONGITUDINAL WIND BRACING SHALL BE DESIGNED TO TRANSFER LOADS TO THE LOW SIDE MASONRY WALLS.

SHOP DRAWINGS AND A LETTER OF CERTIFICATION SHALL BE SUBMITTED TO THE ENGINEER AND ARCHITECT FOR REVIEW. ALL SUBMITTALS SHALL BE DRAWINGS SHALL BEAR THE SIGNATURE AND IMPRESSED SEAL OF A FLORIDA REGISTERED PROFESSIONAL ENGINEER. SHOP DRAWINGS SHALL INDICATE THE DESIGN LOADS, LOAD PATH AND JOB NAME AND NUMBER. THEY SHALL INCLUDE DRAWINGS OF THE FRAMING MEMBERS WITH THE CONNECTIONS, THE ANCHOR BOLT PLAN AND RECTIONS. STANDARD OUT SPECIFICATIONS SHALL BE USED FOR ALL CONNECTIONS. SHOP DRAWINGS MAY BE SUBMITTED FOR SECONDARY FRAMING CONNECTION DETAILS, FLASHING AND SHEETING DETAILS, etc.

FOUNDATIONS/GROUND FLOOR PLAN NOTES:
1. VERIFY ALL DIMENSIONS, ELEVATIONS AND SLAB FINISHES WITH ARCHITECTURAL DRAWINGS AND ARCHITECTURAL INFORMATION. FOR ADDITIONAL DIMENSIONAL INFORMATION SEE ARCHITECTURAL DRAWINGS.
2. ALL FOOTINGS TO BE POURED MONOLITHIC WITH SLAB-ON-GRADE. (UNLESS OTHERWISE NOTED).
3. SLAB ON GRADE SHALL BE A MINIMUM 6" THICK WITH ONE LAYER OF 6X8 - W2.9 X W2.9 WELDED WIRE FABRIC AT 1/3-DEPTH UNLESS OTHERWISE NOTED. WIRE FABRIC SHALL BE PROVIDED SHEETS AND PLACE ON GRADE. REFER ARCHITECTURAL DRAWINGS FOR SLOPED AND DRAINS.
4. TE-1 - INDICATES A 12" WIDE X 12" DEEP THICKENED CONCRETE SLAB EDGE REINFORCED WITH (2)-#5 CONT.
5. SLAB CONTRACTION JOINTS ARE REQUIRED AND ARE INDICATED AS C.J. ON PLAN. CONTRACTION JOINT LOCATION SHOWN MAY BE CHANGED AS REQUIRED FOR CONSTRUCTION SEQUENCING PROVIDED.
6. SLAB CURING IS REQUIRED. SEE STRUCTURAL NOTES.
7. COLUMNS, BASE PLATES AND ANCHOR BOLTS SHOWN ON PLAN ARE FOR REFERENCE ONLY. ALL PLATES AND ANCHOR BOLTS SHALL BE COORDINATED WITH THE METAL BUILDING DRAWINGS TO INSTALLATION.

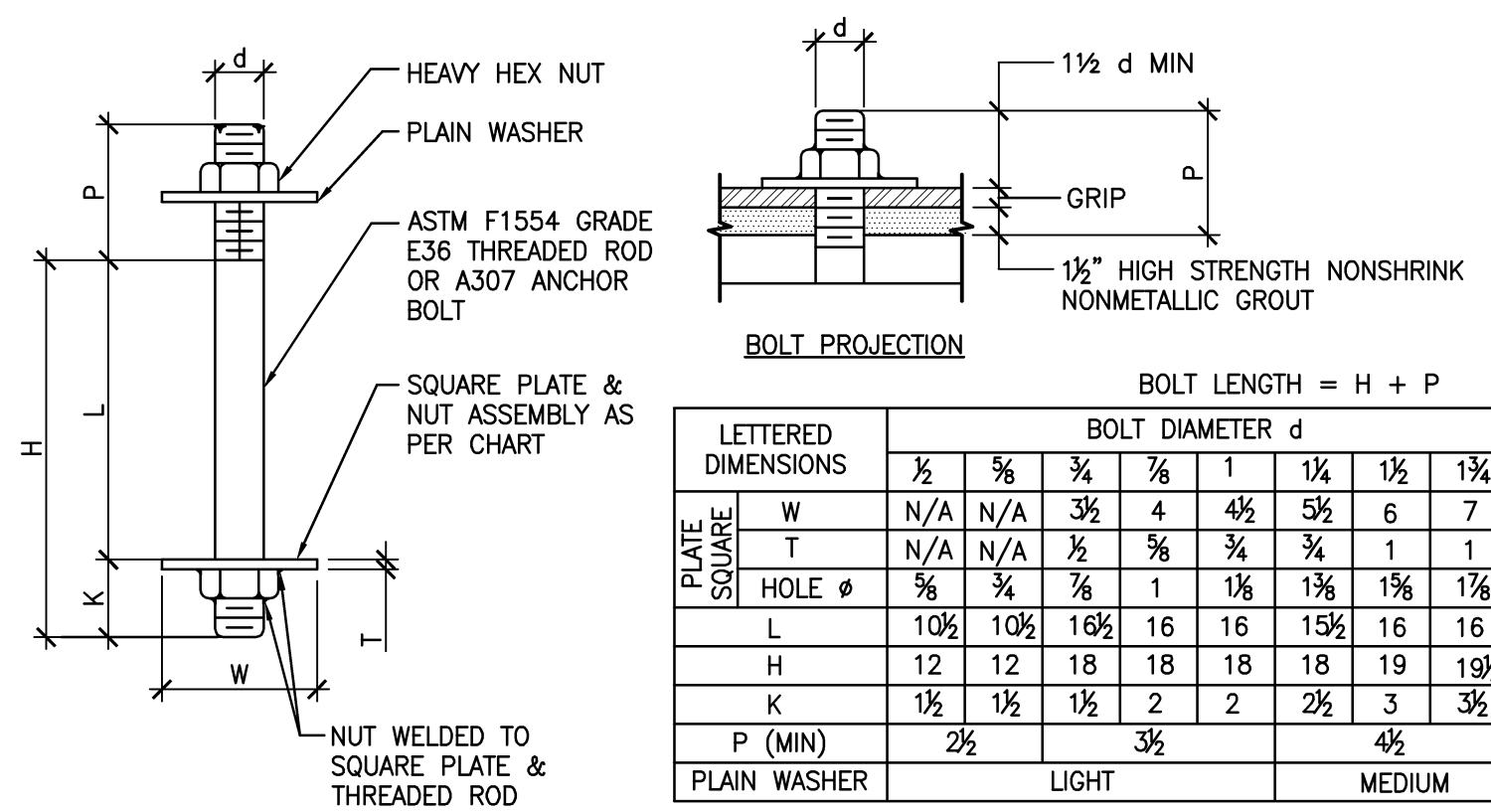


FOUNDATION/GROUND FLOOR PLAN
SCALE: 3/8" = 1'-0"
NORTH

NOTE
THESE DRAWINGS, ALONG WITH THE ARCHITECTURAL DRAWINGS, AND PROJECT MANUAL, CONSTITUTE A SINGLE CONTRACT DOCUMENT AND MUST BE USED TOGETHER IN THEIR ENTIRETY IN THE CONSTRUCTION OF THIS PROJECT.

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TO THE BEST OF MY KNOWLEDGE AND BELIEF, THESE PLANS COMPLY WITH THE APPLICABLE MINIMUM BUILDING CODES.
FILE NO. 09FTL023

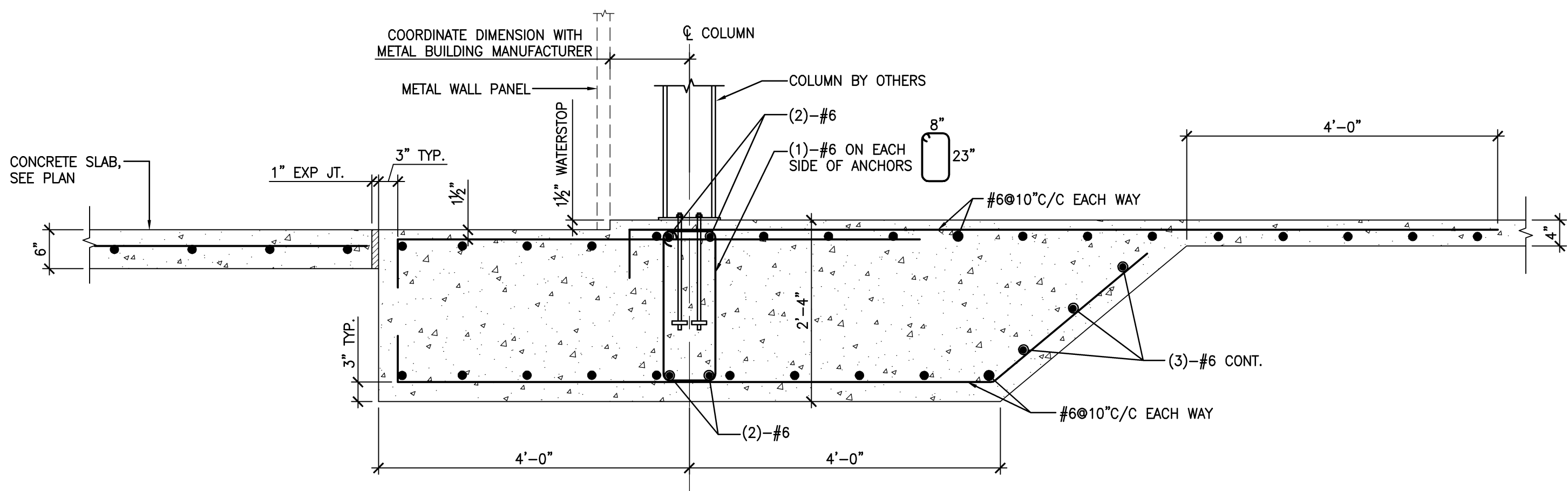
<p>SHEET S-1 1 OF 2</p>	<p>FOUNDATION/GROUND FLOOR PLAN</p>	<p>REVISIONS BLDG. DEPT. COMMENTS FEBRUARY 18, 2011</p>	<p>PROJECT: AIRPARK MAINTENANCE STORAGE FACILITY POMPANO BEACH, FLORIDA 33060</p>	<p>DEREK A. WASSINK FILE #E55303 FEBRUARY 23, 2011</p>	<p>CARTAYA & ASSOCIATES ARCHITECTS P.A. cartyaandassociates.com 3017 E. COMMERCE BLVD. SUITE 201 FT. LAUDERDALE, FLORIDA 33308 774-2724 FAX 774-4280</p>
	<p>JOB NO: 0908</p>	<p>DATE: AUGUST 25, 2010 DRAWN BY: MMM CHECKED BY: MU</p>	<p>ALL DESIGNS AND DETAILS INDICATED OR REPRESENTED BY THIS DRAWING ARE FOR USE ON AND IN CONJUNCTION WITH THE SPECIFIED PROJECT. THIS IS THE PROPERTY OF CARTAYA AND ASSOCIATES ARCHITECTS, P.A. AND SHALL NOT BE USED OR REPRODUCED IN WHOLE OR IN PART WITHOUT WRITTEN PERMISSION FROM A REPRESENTATIVE OF THE FIRM OR IN VIOLATION OF THE FULLY ENFORCEABLE LEGAL RECORD. THE CONTRACTOR SHALL VERIFY ALL EXISTING CONDITIONS AND DIMENSIONS AND NOTIFY THIS OFFICE OF ANY DISCREPANCIES PRIOR TO THE EXECUTION OF THE WORK. WRITTEN DIMENSIONS TAKE PRECEDENCE OVER SCALED DIMENSIONS.</p>	<p>3017 E. COMMERCE BLVD. SUITE 201 FT. LAUDERDALE, FLORIDA 33308 774-2724 FAX 774-4280</p>	<p>CARTAYA & ASSOCIATES ARCHITECTS P.A. cartyaandassociates.com</p>



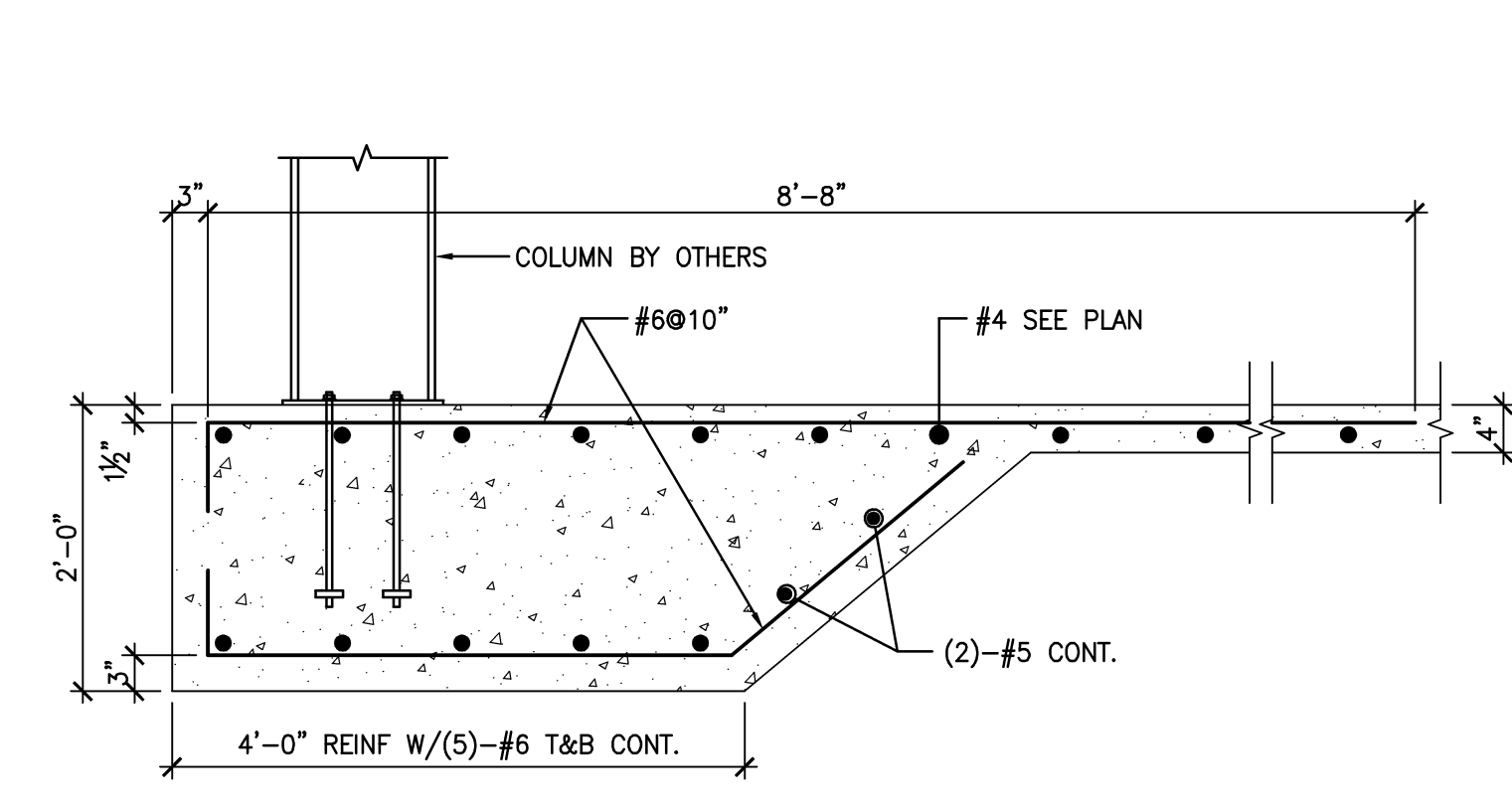
BOLT LENGTH = H + P

LETTERED DIMENSIONS	BOLT DIAMETER d						
	1/2	3/8	1/2	3/4	1	1 1/4	1 1/2
W	N/A	N/A	3/4	4	4 1/2	5 1/2	6
T	N/A	N/A	1/2	3/4	3/4	1	1
HOLE Ø	5/8	3/4	1	1 1/8	1 1/2	1 5/8	1 7/8
L	10 1/2	10 1/2	16 1/2	16	16	15 1/2	16
H	12	12	18	18	18	18	19 1/2
K	1 1/2	1 1/2	1 1/2	2	2	2 1/2	3
P (MIN)	2 1/2		3 1/2			4 1/2	
PLAIN WASHER	LIGHT					MEDIUM	

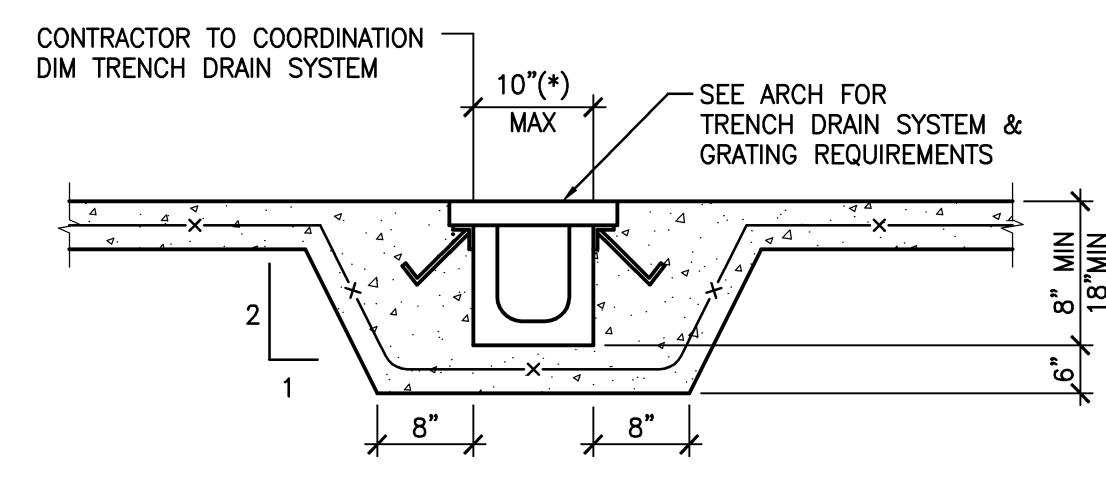
4 TYPICAL DIMENSIONS OF ANCHOR BOLT ASSEMBLY DETAIL
SCALE: N.T.S.



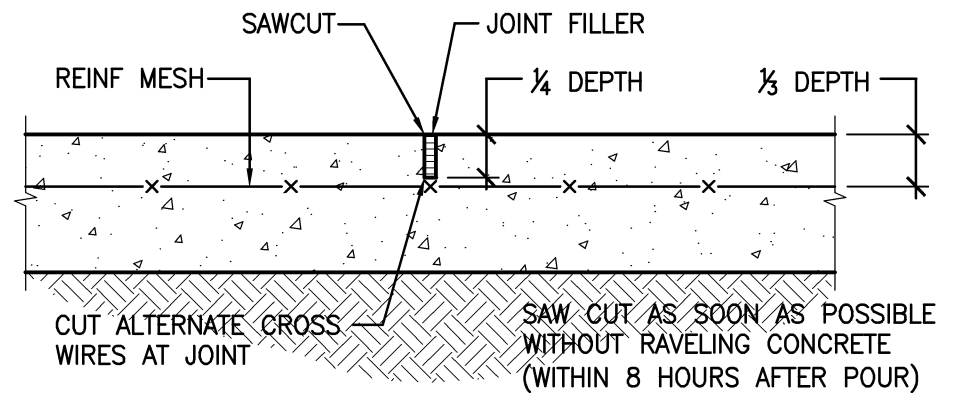
3 SECTION
SCALE: 3/4"=1'-0"



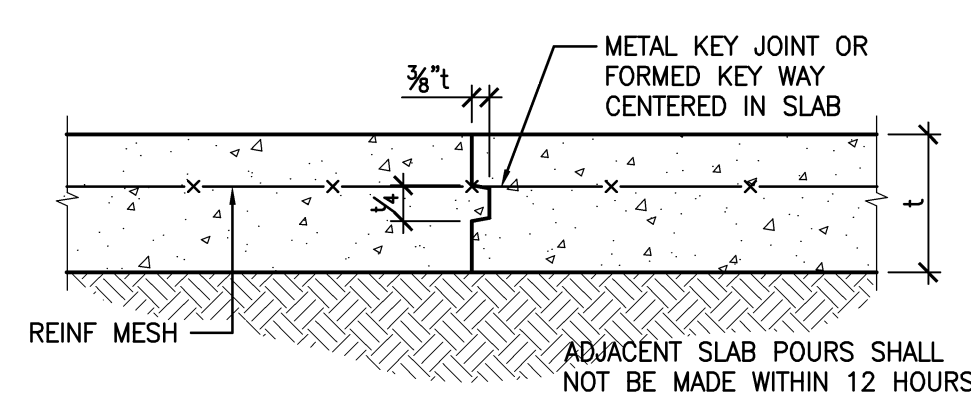
1 SECTION
SCALE: 3/4"=1'-0"



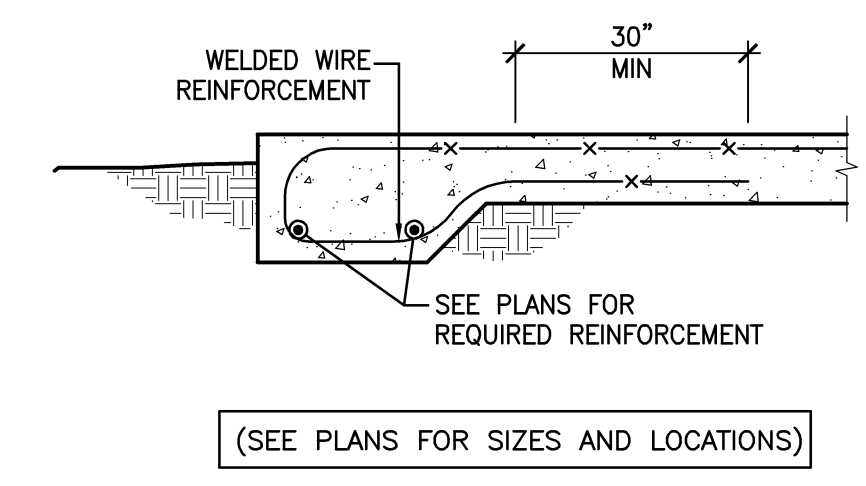
8 TYPICAL TRENCH DRAIN DETAIL
SCALE: N.T.S.



7 TYPICAL CONTROL JOINT DETAIL (CJ)
SCALE: N.T.S.



6 TYPICAL CONSTRUCTION JOINT IN SLAB-ON-GRADE DETAIL (KJ)
SCALE: N.T.S.



5 TYPICAL SECTION THRU THICKENED CONCRETE EDGE
SCALE: N.T.S.

NOTE
THESE DRAWINGS, ALONG WITH THE ARCHITECTURAL DRAWINGS, AND PROJECT MANUAL CONSTITUTE A SINGULAR CONTRACT DOCUMENT AND MUST BE USED TOGETHER IN THEIR ENTIRETY IN THE CONSTRUCTION OF THIS PROJECT.

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771-2724 FAX 778-4280

MARCUS O. UNTERMEYER
FL PE #69860
August 25, 2010

PROJECT: **AIRPARK MAINTENANCE STORAGE FACILITY**
POMPANO BEACH, FLORIDA 33060
ALL RIGHTS RESERVED. THIS DRAWING IS THE PROPERTY OF CARTAYA & ASSOCIATES ARCHITECTS P.A. AND SHALL NOT BE REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS, WITHOUT THE WRITTEN PERMISSION OF CARTAYA & ASSOCIATES ARCHITECTS P.A. AND NOT BE USED FOR ANY OTHER PROJECT WITHOUT THE WRITTEN PERMISSION OF CARTAYA & ASSOCIATES ARCHITECTS P.A.

TITLE: **SECTIONS AND DETAILS**
DATE: **AUGUST 25, 2010**
DRAWN BY: **MM**
CHECKED BY: **MU**
JOB NO.: **0908**
SHEET: **S-2**
2 OF 2

AIR BALANCE SCHEDULE

UNIT TAG	SUPPLY AIR (CFM)	RETURN (CFM)	OUTSIDE AIR (CFM)	EXHAUST AIR (CFM)
AHU-1	350	300	50	-
TOTAL	-	-	-	-

NOTES:
1. BLDG IS 50 CFM POSITIVE WHEN A/C UNIT IS OPERATING.

OUTSIDE AIR CALCULATIONS

(BASED ON ASHRAE 62.1-04, TABLE 6.1)

AIRPARK STORAGE FACILITY

AREA SERVED OR UNIT TAG	NET OCCUPABLE AREA SQ.FT.	ACTUAL OCCUPANCY O/A CFM/SQ.FT.	NO. OF PEOPLE O/A CFM/PERSON	COMBINED TOTAL CFM O/A PROVIDED	COMBINED TOTAL NOTES
OFFICE	160	0.06	2	5	10+10=20
-	-	-	-	-	-
TOTAL	160	-	-	-	20.0

NOTES:
1. CALCULATIONS ARE BASED ON ESTIMATED MAX. OCCUPANCY RATES PER ARCHITECTURAL PLANS AND ASHRAE 62.1-04.

EXHAUST AIR CALCULATIONS

SPACE SERVED OR UNIT TAG	SPACE AREA (SQ.FT.)	SPACE HEIGHT (FT.)	SPACE VOLUME (CU.FT.)	VENTILATION RATE (CFM/1000 CU.FT.)	TOTAL CFM REQUIRED	TOTAL CFM PROVIDED	EXHAUST FAN
EF-1,2,3,4	3320	21'-0"	68720	1.50 CFM PER 1000 CU.FT.	4980	5000	EF-1,2,3,4
EF-5,6	93	10'-0"	930	50 CFM/W.C.	100	150	EF-5,6
TOTAL	3413.0	-	-	-	5080.0	5150.0	-

NOTES:
1. CALCULATIONS ARE BASED ON LOCAL CODE REQUIREMENTS, FBC-2007 AND ICC.
2. EF-5,6 IS INTERMITTENT.

MECHANICAL NOTES

- THE CONTRACTOR SHALL FURNISH ALL LABOR, MATERIALS, AND EQUIPMENT NECESSARY FOR THE INSTALLATION OF A COMPLETE SYSTEM IN ACCORDANCE WITH THESE DRAWINGS, THE FLORIDA BUILDING CODE 2007 AND ALL OTHER APPLICABLE STATE, COUNTY AND LOCAL ORDINANCES AND THE LATEST EDITION OF THE FOLLOWING:
 - MECHANICAL SYSTEMS AND RELATED TRADES, 2007, 900-02, 908-02, 91-99, 96-01, 101-06; ANSI Z10.1-98, Z10.3-98, Z21.8-94, Z21.83-98.
- THE CONTRACTOR SHALL PAY ALL COSTS OF PERMIT, INSPECTIONS AND ALL OTHER COSTS INCIDENTAL TO THE COMPLETION AND TESTING OF THIS WORK.
- THE CONTRACTOR SHALL VISIT THE SITE AND COORDINATE WORK WITH OTHER TRADES.
- THE CONTRACTOR SHALL SUPPLY THE ARCHITECT/ENGINEER WITH "AS-BUILT" DRAWINGS.
- CONTRACTOR SHALL SUBMIT, FOR APPROVAL FIVE (5) COPIES OF A COMPLETE SET OF SHOP DWGS, MANUFACTURER'S SUBMITTALS FOR EACH PIECE OF EQUIPMENT & CONTROLS INCLUDED IN CONTRACT.
- ALL MATERIAL SHALL BE NEW OF U.S. MANUFACTURER OF GOOD QUALITY. ALL WORK SHALL BE PERFORMED AT INDUSTRY STANDARD QUALITY LEVEL BY CERTIFIED PROFESSIONALS. ALL INSTALLATIONS SHALL COMPLY WITH FMC 2007, CH. 3, GENERAL REGULATIONS. MATERIALS LOCATED WITHIN 36" OF EXPOSED SUPPORTS, STAIRS, FASTENERS, ETC. SHALL BE GALVANIZED SHEETMETAL WITH SEALED SEAMS AND JOINTS WITH EXTERNAL BLANK INSULATION R-6 SHEETMETAL DUCTWORK, HANGERS, AUX. SUPPORT STEEL, ETC. ALL FLEX DUCT SHALL BE RATED CLASS 1, UL-181 LISTED WITH METALLIZED INNER AND OUTER FOIL LINERS, MIN. R-6 WITH A MAX. TOTAL LENGTH NOT TO EXCEED 15 FT. INSTALL UL LISTED FOR PLENUM, FLEXIBLE DUCTWORK ELBOW SUPPORTS AT EACH DIFFUSER. ALL METAL DUCTS SHALL BE FABRICATED IN ACCORDANCE WITH LATEST EDITION OF S.M.A.C.N.A.
- SPECIAL NOTE**
PRESSURE CLASSES BASED ON OPERATING PRESSURE ARE: 1/2", 1", 2", 3", 4", 5" W.C. EACH DUCT SYSTEM SHALL BE CONSTRUCTED FOR THE SPECIFIC DUCT PRESSURE CLASS SHOWN ON PLANS.
WHERE NO PRESSURE CLASS IS SPECIFIED FOR CONSTANT VOLUME SYSTEMS, 1" W.G. PRESSURE CLASS IS THE BASIS OF COMPLIANCE WITH THE S.M.A.C.N.A. STANDARDS REGARDLESS OF VELOCITY. ALL DUCTWORK SHALL BE CONSTRUCTED TO MEET THE S.M.A.C.N.A. STANDARDS FOR DUCTWORK UPSTREAM OF VAV BOXES.
ALL DUCTWORK SHALL BE SEALED TO SMOGNA "HVAC DUCT CONSTRUCTION STANDARDS" FOR ITS PRESSURE CLASS SEALING METHODS.
 - ALL EXHAUST DUCTS AND OUTSIDE AIR DUCTS SHALL BE GALVANIZED SHEET METAL WITH EXTERNAL BLANK INSULATION R-6 SHEETMETAL DUCTWORK, HANGERS, AUX. SUPPORT STEEL, ETC. ALL FLEX DUCT SHALL BE RATED CLASS 1, UL-181 LISTED WITH METALLIZED INNER AND OUTER FOIL LINERS, MAKE-UP OR OTHERWISE DUCTS INSTALLED IN LOCATIONS WHERE DEWPOINT CONDITIONS CAN OCCUR INSIDE THE DUCT SHALL BE EXTERNALLY INSULATED WITH R-6 MIN.
 - AIR INTAKE AND EXHAUST OPENINGS SHALL BE SCREENED WITH A CORROSION RESISTANT MATERIAL PER FMC TABLE 401.6. O/A INTAKES SHALL NOT BE TAKEN FROM A LOCATION CLOSER THAN 10 FT FROM ANY CHIMNEY, VENT OUTLET OR SANITARY SEWER VENT OUTLET PER FMC 2007, SEC. 401.5.1. OUTSIDE AIR INTAKES SHALL BE LOCATED ON ROOFS WILL BE PROPERLY MARKED WITH A UNIVERSAL WARNING "INLET", PERMANENTLY ATTACHED.
 - DUCT SIZES SHOWN ARE INSIDE DIMENSIONS.
- ALL AIR DEVICES (DIFFUSERS, REGISTERS AND GRILLES) SHALL BE ALL ALUMINUM WITH FINISH TO MATCH THE FINISH OF THE SURFACE TO WHICH THEY ARE TO BE INSTALLED. PROVIDE OPPOSED BLADE DAMPERS AT ALL DIFFUSERS AND REGISTERS AS INDICATED ON PLANS. PROVIDE BALANCING DAMPERS FOR ALL SUPPLY AND RETURN DIFFUSERS AND REGISTERS PER: 801.4 FOR BALANCED RETURN TRANSFER AIR FLOW.
- TEMPERATURE CONTROLS/THERMOSTAT:
 - FOR NEW UNITS: SHALL BE COMBINATION COOLING/HEATING, WITH SYSTEM "COOL-AUTO-HEAT-OFF" AND FAN "ON-AUTO" SELECTOR SWITCHES PROVIDE PROGRAMMABLE TYPE AS RECOMMENDED BY MANUFACTURER, HONEYWELL OR EQUAL. PROVIDE TAMPER PROOF COVERS.
 - THERMOSTAT LOCATION SHALL BE APPROVED BY OWNER AND ENGINEER BEFORE INSTALLATION. MECHANICAL CONTRACTOR SHALL COORDINATE WITH ELECTRICAL CONTRACTOR ALL REQUIREMENTS FOR JUNCTION BOXES, CONDUITS, CONTROL WIRING, POWER, ETC. AND DEFINE RESPONSIBILITIES AND SCOPE OF WORK FOR EACH TRADE PRIOR TO ANY PURCHASING OR INSTALLATION.
 - REFRIGERANT LINES SHALL BE COPPER, TYPE "L" HARD DRAWN WITH WROUGHT COPPER BRAZING-JOINT TYPE FITTINGS. USE BRAZING MATERIALS FOR HIGH PRESSURE PIPING PER AWS A3.8. BCUP SERIES COPPER-PHOSPHORUS ALLOY OR BAq1 SILVER ALLOY. ALL REFRIGERANT LINES SHALL BE INSULATED WITH 1/2" MIN. THICKNESS OF POLYURETHANE SOFT COPPER TYPE "M" SHALL BE ALLOWED FOR RISER PIPING INSIDE CHASE TO LIMIT NUMBER OF JOINTS. COORDINATE WITH ENGINEER FOR PRIOR APPROVAL.
 - ALL EXPOSED INSULATION SHALL BE PROTECTED WITH UV RESISTANT PAINT OR ALUMIN. SHIELD.
- CONDENSATE DRAIN PIPING TO BE AS SPECIFIED PER PLUMBING PLANS. IF NOT SPECIFIED PROVIDE APPROVED WATER LEVEL DETECTOR OR FLOAT SWITCH TO AUTOMATICALLY SHUT DOWN THE AIR COND. UNIT, AS A SECONDARY DRAIN SYSTEM TO COMPLY WITH FMC 2007, SEC. 307 SUPPLY CONDENSATE PUMP WHERE NECESSARY AS IMPOSED BY FIELD CONDITIONS OR INSTALLATION CHANGES AND PIPE TO CONDENSATE DRAIN PER PLUMBING PLANS.
- CLEARANCE FOR MAINTENANCE SERVICE REPAIRS AND REPLACEMENT FOR ALL MECHANICAL EQUIPMENT SHALL BE PROVIDED TO COMPLY WITH FMC 2007, SEC. 306. SERVICE ACCESS PANELS FOR MECH. EQUIPMENT IN CONCEALED SPACES SHALL BE PROVIDED TO COMPLY WITH THE REQUIREMENTS OF SEC. 306.
- MANUFACTURER'S WARRANTY: CONTRACTOR SHALL PROVIDE WARRANTY FOR A PERIOD OF (1) ONE YEAR AFTER BUILDING C.O. FOR ALL MECHANICAL SYSTEMS, DUCTWORK, CONTROLS ACCESSORIES AND ALL OTHER EQUIPMENT, PARTS AND LABOR UNDER THESE DRAWINGS AND AND SPECIFICATIONS. CONTRACTOR SHALL PROVIDE WARRANTY FOR COMPRESSORS FOR NON-OPERATIONAL PERIODS OR AS AGREED WITH OWNER.
- AUXILIARY DRAIN PANS SHALL BE INSTALLED UNDER ALL COILS ON WHICH CONDENSATION CAN OCCUR AND UNDER ALL UNITS IN CONCEALED SPACES OR ANY AREA WHERE BLDG. DAMAGE CAN OCCUR AS A RESULT OF AN OVERFLOW, TO COMPLY WITH FBC 2007, PAR. 307.2.
- ARMAFLEX INSULATION SHALL BE USED FOR SUCTION LINES (1/2" FOR ABOVE 40' F AND 1" FOR BELOW 40' F) PER FLORIDA ENERGY CODE TABLE 4-11 FOR PIPING INSULATION. FILTER/DRAINER AND SIGHT GLASS SHALL BE PROVIDED AT LIQUID LINES.
- ALL BRANCH TAKE-OFFS TO BE PROVIDED W/ MANUAL VOLUME DAMPERS. PROVIDE RADIIUS ELBOWS WHERE FEASIBLE. SQUARE ELBOWS AND TEE'S SHALL BE FURNISHED W/SINGLE FOIL TURNING VANES. PROVIDE REMOTE CABLE OPERATED VOLUME DAMPERS IN INACCESSIBLE AND HARD CEILING AREAS, "YOUNG REGULATOR" OR EQUAL.
- PROVIDE NEW FILTERS FOR ALL AIR CONDITIONING EQUIPMENT BEFORE START-UP, REPLACE PRIOR TO FINAL ACCEPTANCE BY OWNER.
 SPECIAL NOTE
ALL INSTALLED ELECTRICAL DEVICES, ACTUATORS, APPURTENANCES, AUXILIARY EQUIPMENT, ETC. SHALL BE INSTALLED IN ACCORDANCE WITH THE NATIONAL ELECTRICAL CODE (NEC) AND ALL REQUIREMENTS FOR THE CONDITIONS WHERE INSTALLED, WEATHER INDOORS OR OUTDOORS, EVEN IF NOT SPECIFICALLY INDICATED ON PLANS.
 - HVAC CONTRACTOR SHALL PROVIDE A, T & B REPORT PER F.B.C. 2007, CH. 13, 410.ABC.4 (THE T & B REPORT SHALL BE INDEPENDENT FOR SYSTEMS OVER 15 TONS) FOR ALL MECHANICAL EQUIPMENT, AIR DEVICES, DAMPERS, AHU'S AND FANS. THE TEST AND BALANCE REPORT SHALL BE IN ACCORDANCE WITH THE AIR BALANCE COUNCIL (A.B.C.) TEST AND BALANCE REPORT. THE BALANCE REPORT SHALL INCLUDE RETURN AIR AND EXHAUST GRILLES AND THE LEAKING AND ENTERING AIR TEMPERATURE (T) FROM SUPPLY GRILLES AND EVAPORATORS.
 - ROOF INSULATED FIRE RATED CONDENSATE DRAINS AS REQUIRED.
 - ALL INSULATION WILL HAVE FIRE/SMOKE RATING LESS THAN 25/50.
 - MECHANICAL EQUIPMENT ON ROOF OR ELEVATED STRUCTURES SHALL COMPLY WITH FMC 2007 PAR. 306.3 IF THE EQUIPMENT CAN NOT BE SERVICED/REMOVED THROUGH REQUIRED OPENING. MECHANICAL EQUIPMENT SHALL BE PROTECTED WITH MECHANICAL BARRIERS IF EXPOSED TO WEAR, DAMAGE. ALL EQUIPMENT SHALL BE INSTALLED ON 6" CONCRETE PAD AT GRADE LEVEL.**SPECIAL NOTE**
MECHANICAL PLANS AND OTHER COMPLIANCE CALCULATIONS AND/OR INSTALLATION DETAILS FOR ROOF MOUNTED EQUIPMENT AS REQUIRED BY FBC 2007, SEC. 1509. 1522 AND CHAPTER 16, SHALL BE PROVIDED BY STRUCTURAL ENGINEER/ARCHITECT. CONTRACTOR TO PROVIDE WIND LOAD CALCULATIONS SIGNED AND SEALED BY A FLORIDA REGISTERED ENGINEER FOR NON PRE-APPROVED CONFIGURATIONS DEVIATING FROM THE ORIGINAL CONSTRUCTION DOCUMENTS.
 - PROVIDE A MIN. OF 36" CLEARANCE IN FRONT OF ALL 120V-208 VOLT PANELS AND MIN. 42" CLEARANCE IN FRONT OF ANY 240-480 VOLT PANEL. PROVIDE ADEQUATE SIDE CLEARANCE PER NEC.
 - MECHANICAL PLANS IN GENERAL ARE DIAGRAMMATIC IN NATURE, AND ARE TO BE READ IN CONJUNCTION WITH ARCHITECTURAL, PLUMBING, ELECTRICAL, FIRE SPRINKLER, AND STRUCTURAL PLANS AND SHALL BE CONSIDERED AS ONE SET OF DOCUMENTS. DUCT AND PIPING OFFSETS, BENDS AND TRANSITIONS SHALL BE REQUIRED TO PROVIDE AND AT NO ADDITIONAL COST TO THE OWNER. CHANGES IN DUCTWORK SIZE AND ROUTING WILL BE REQUIRED TO AVOID STRUCTURAL, PLUMBING, FIRE SPRINKLER AND ARCHITECTURAL BUILDING FEATURES. DUCTWORK CHANGES MAY BE MADE BY CONTRACTOR USING EQUIVALENT SIZED DUCT. CONTACT ENGINEER IF DUCT AREA WILL NOT FIT.
 - THE CONTRACTOR SHALL VERIFY EXISTING CONDITIONS PRIOR TO BIDDING, ORDERING, FABRICATION OR INSTALLATION OF MATERIALS OR EQUIPMENT, IN ORDER TO PROVIDE A FULLY INTEGRATED MECHANICAL AND CONTROLS SYSTEMS WITH THE EXISTING ONES. ANY DISCREPANCY BETWEEN EXISTING CONDITIONS AND PLANS, OR ADDITIONAL CLARIFICATION REQ'D SHALL BE BROUGHT TO THE ATTENTION OF ENGINEER PRIOR TO FINAL BIDDING AND WORK.
 - MATERIALS ALLOWED IN RETURN AIR PLENUMS OR ABOVE CEILINGS USED AS RETURN AIR PLENUM SHALL COMPLY WITH FMC 2007, SEC. 602.2.1. IF SPACE WITH RETURN AIR PLENUM IS NOT SPECIFIED IN THE PLANS, THE CONTRACTOR SHALL PROVIDE A RETURN AIR PLENUM WHEN CPVC PIPING IS USED FOR FIRE SPRINKLER SYSTEMS. THE R/A GRILLES LAYOUT SHALL BE (FIELD) COORDINATED WITH SUCH PIPING SO THAT NO PORTION OF THE GRILLES WILL BE DIRECTLY BELOW THE CPVC PIPING.
 - STUD CAVITIES AND JOIST SPACE PLENUMS SHALL COMPLY WITH FMC 2007, SEC. 602.3.
 - CONDENSATE DRAIN PIPING TO BE AS SPECIFIED PER PLUMBING PLANS. IF NOT SPECIFIED PROVIDE APPROVED WATER LEVEL DETECTOR OR FLOAT SWITCH TO AUTOMATICALLY SHUT DOWN THE AIR COND. UNIT, AS A SECONDARY DRAIN SYSTEM TO COMPLY WITH FMC 2007, SEC. 307 SUPPLY CONDENSATE PUMP WHERE NECESSARY AS IMPOSED BY FIELD CONDITIONS OR INSTALLATION CHANGES AND PIPE TO CONDENSATE DRAIN PER PLUMBING PLANS.
 - CLEARANCE FOR MAINTENANCE SERVICE REPAIRS AND REPLACEMENT FOR ALL MECHANICAL EQUIPMENT SHALL BE PROVIDED TO COMPLY WITH FMC 2007, SEC. 306. SERVICE ACCESS PANELS FOR MECH. EQUIPMENT IN CONCEALED SPACES SHALL BE PROVIDED TO COMPLY WITH THE REQUIREMENTS OF SEC. 306.
 - MANUFACTURER'S WARRANTY: CONTRACTOR SHALL PROVIDE WARRANTY FOR A PERIOD OF (1) ONE YEAR AFTER BUILDING C.O. FOR ALL MECHANICAL SYSTEMS, DUCTWORK, CONTROLS ACCESSORIES AND ALL OTHER EQUIPMENT, PARTS AND LABOR UNDER THESE DRAWINGS AND AND SPECIFICATIONS. CONTRACTOR SHALL PROVIDE WARRANTY FOR COMPRESSORS FOR NON-OPERATIONAL PERIODS OR AS AGREED WITH OWNER.
 - AUXILIARY DRAIN PANS SHALL BE INSTALLED UNDER ALL COILS ON WHICH CONDENSATION CAN OCCUR AND UNDER ALL UNITS IN CONCEALED SPACES OR ANY AREA WHERE BLDG. DAMAGE CAN OCCUR AS A RESULT OF AN OVERFLOW, TO COMPLY WITH FBC 2007, PAR. 307.2.

MECHANICAL SHEET INDEX

SHEET#	DESCRIPTION
M0.1	MECHANICAL NOTES, LEGEND & INDEX
M2.1	MECHANICAL PLAN
M6.1	MECHANICAL SCHEDULES & DETAILS

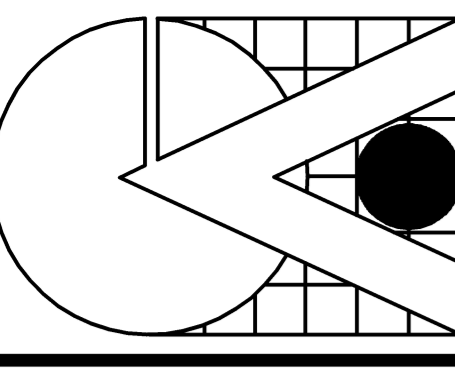
HVAC ABBREVIATION LEGEND

AF	ABOVE FINISH FLOOR	GR	GRILLE
AHU	AIR HANDLING UNIT	NCA	MINIMUM CIRCUIT AMPS (FOR WIRE SIZING)
CU	CONDENSING UNIT	MOCP	MAXIMUM OVERCURRENT PROTECTION DEVICE AMPS
EWT	ENTERING WATER TEMPERATURE	LWT	LEAVING WATER TEMPERATURE
EAG	EXHAUST AIR GRILLE	R/A	RETURN AIR
EF	EXHAUST FAN	RAG	RETURN AIR GRILLE
EXH	EXHAUST	O/A	OUTSIDE AIR
FD	FIRE DAMPER	M/A	MAKE-UP AIR
E/A	EXHAUST AIR	WMS	WIRE MESH SCREEN
S/A	SUPPLY AIR	CS	CEILING
		BDD	BACK DRAFT DAMPER

MECHANICAL LEGEND

	NEW S/A CEILING DIFFUSER		CEILING EXHAUST FAN
	NEW R/A CEILING GRILLE		SUPPLY AIR DIFFUSER OR GRILLE DESIGNATION
	EXISTING S/A CEILING GRILLE		RETURN EXHAUST AIR DIFFUSER OR GRILLE DESIGNATION
	EXISTING R/A CEILING GRILLE		EQUIPMENT TAG
	SLOT / LINEAR DIFFUSER		THERMOSTAT
	VOLUME CONTROL DAMPER		POC- POINT OF CONNECTION
	REDUCER OR INCREASER		SUPPLY AIR
	NEW FLEX DUCT		RETURN AIR
	EXISTING FLEX DUCT		DOOR UNDER CUT
	NEW DUCTWORK		SECTION MARK
	EXISTING DUCTWORK		SHOE TAP DAMPER
	"Z" BOOT TRANSFER DUCT		FIRE DAMPER
	BELLMOUTH TAP		DUCT SMOKE DETECTOR
	SIDEWALL EXHAUST FAN		

NOT ALL SYMBOLS MAY APPLY TO THESE PLANS



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AA 00088

PROJECT: AIRPARK MAINTENANCE STORAGE FACILITY
POMPANO BEACH, FLORIDA 33060

DATE: AUGUST 25, 2010	DRAWN BY: JH/EG/JJ	CHECKED BY: MC
REVISIONS		

MECHANICAL NOTES

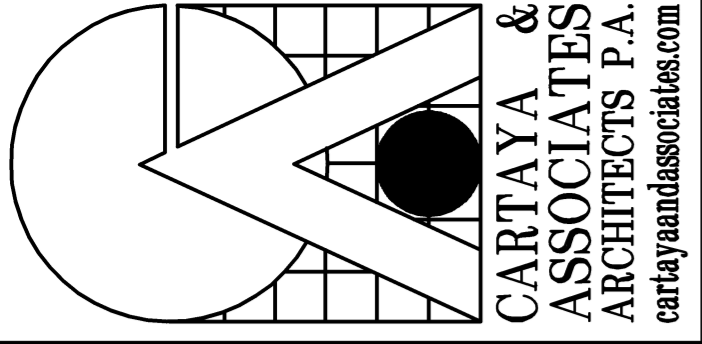
ISSUED FOR PERMIT
ISSUED FOR CONSTRUCTION

KAMM CONSULTING PROJECT #: 2009-0362
PROJECT MANAGER: JUAN J. BEROVIA

KAMM Consulting
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Engineering@kammconsulting.com
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LEAD ENGINEER OF MECHANICAL: LEO T. CAHER
DIRECTOR OF ELECTRICAL ENGINEERING: Robert A. Kamm
DIRECTOR OF MECHANICAL ENGINEERING: Robert A. Kamm

DATE: _____
SCALE: 1"=6'-0"
SHEET: M0.1 OF 1



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AA COOR198

PROJECT: AIRPARK MAINTENANCE STORAGE FACILITY
POMPANO BEACH, FLORIDA 33060

DATE: AUGUST 25, 2010
DRAWN BY: IH/EG/JJ
CHECKED BY: MC

JOB NO. 0908

SHEET: M2.1
2 OF 2

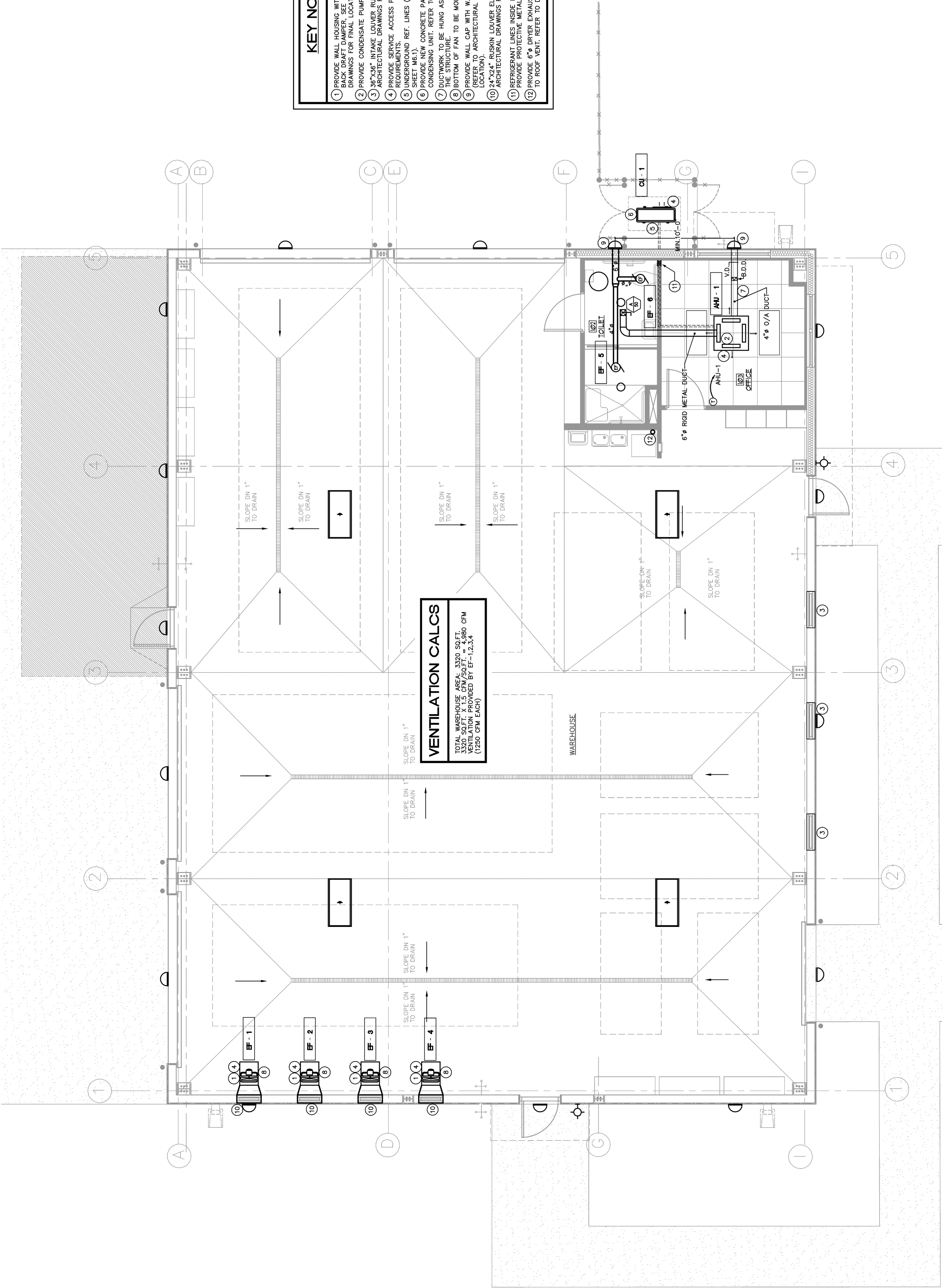
MECHANICAL PLAN

ISSUED FOR PERMIT
ISSUED FOR CONSTRUCTION

KAMM CONSULTING PROJECT # 2009-0362
PROJECT MANAGER: JIANI BEROVA

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1407 West Newport Center Drive
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Director of Mechanical Engineering: Robert V. Kamm
Director of Electrical Engineering: Robert V. Kamm
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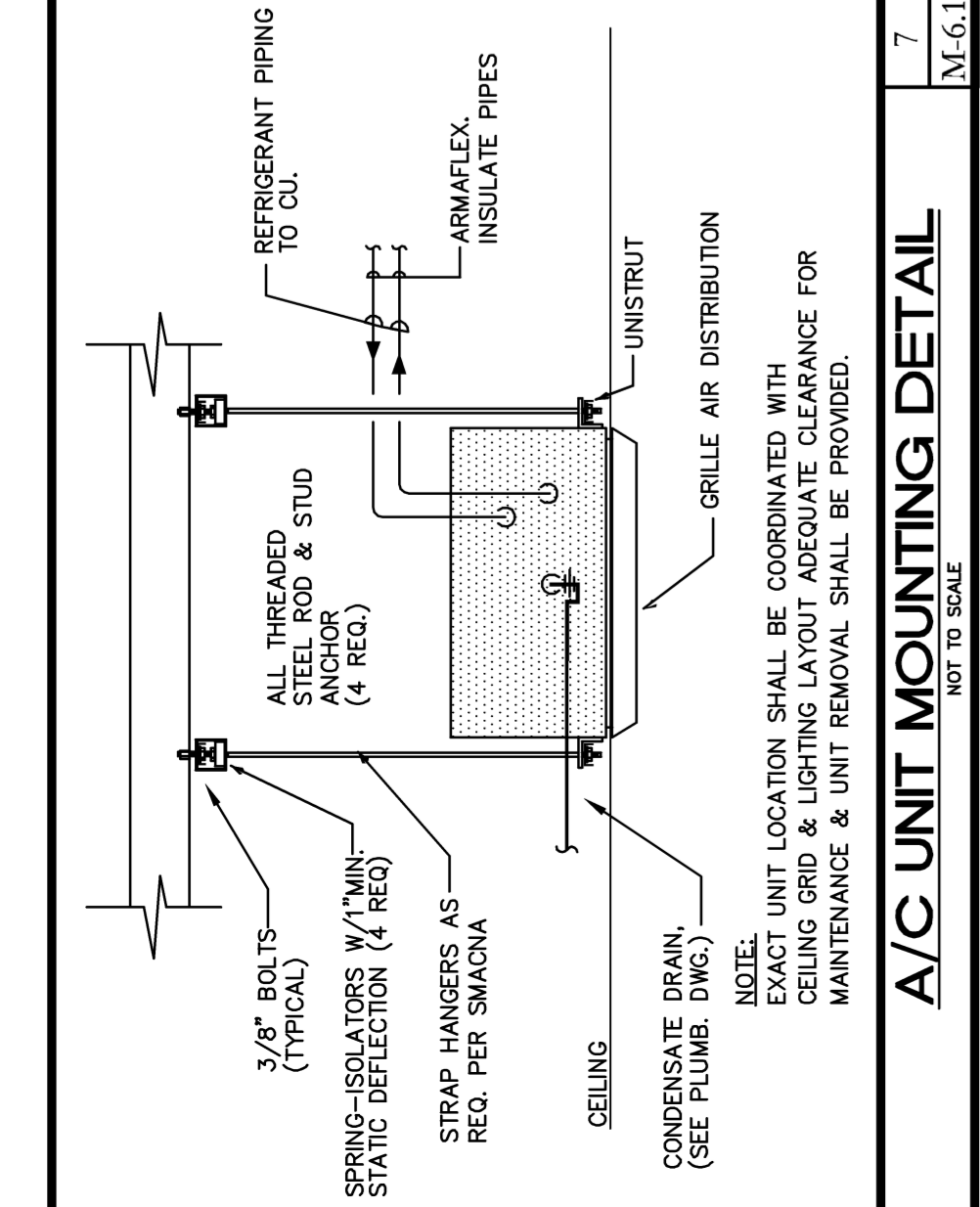
- KEY NOTES**
- 1) PROVIDE WALL HOUSING WITH OSHA GUARD, BACK DRAFT DAMPER, SEE ARCHITECTURAL DRAWINGS FOR FINAL LOCATION.
 - 2) PROVIDE CONDENSATE PUMP AND OVERFLOW SWITCH.
 - 3) 36"x36" INTAKE LOUVER RUSKIN EME662SD, SEE ARCHITECTURAL DRAWINGS FOR EXACT LOCATION, REQUIREMENTS.
 - 4) PROVIDE SERVICE ACCESS PER MANUFACTURER REQUIREMENTS.
 - 5) UNDERGROUND REF. LINES (REFER TO DETAIL #4 SHEET M6.1).
 - 6) PROVIDE NEW CONCRETE PAD FOR MOUNTING OF CONDENSING UNIT. REFER TO DETAIL #3 SHEET M6.1.
 - 7) DUCTWORK TO BE HUNG AS TIGHT AS POSSIBLE TO THE STRUCTURE.
 - 8) BOTTOM OF FAN TO BE MOUNTED @ 9'-0".
 - 9) PROVIDE WALL CAP WITH W.M.S.
 - 10) 24"x24" RUSKIN LOUVER E16375D, SEE ARCHITECTURAL DRAWINGS FOR EXACT LOCATION.
 - 11) REFRIGERANT LINES INSIDE PARTITION WALL. PROVIDE PROTECTIVE METAL PLATES ON BOTH SIDES.
 - 12) PROVIDE 6" DRYER EXHAUST METAL DUCTWORK UP TO ROOF VENT. REFER TO DETAIL #6 SHEET M6.1.



VENTILATION CALCS

TOTAL WAREHOUSE AREA: 3370 SQ.FT.
3370 SQ.FT. @ 1250 CFM EACH
VENTILATION PROVIDED BY EF-1,2,3,4
(1250 CFM EACH)

MECHANICAL PLAN
1/8"=1'-0" NORTH

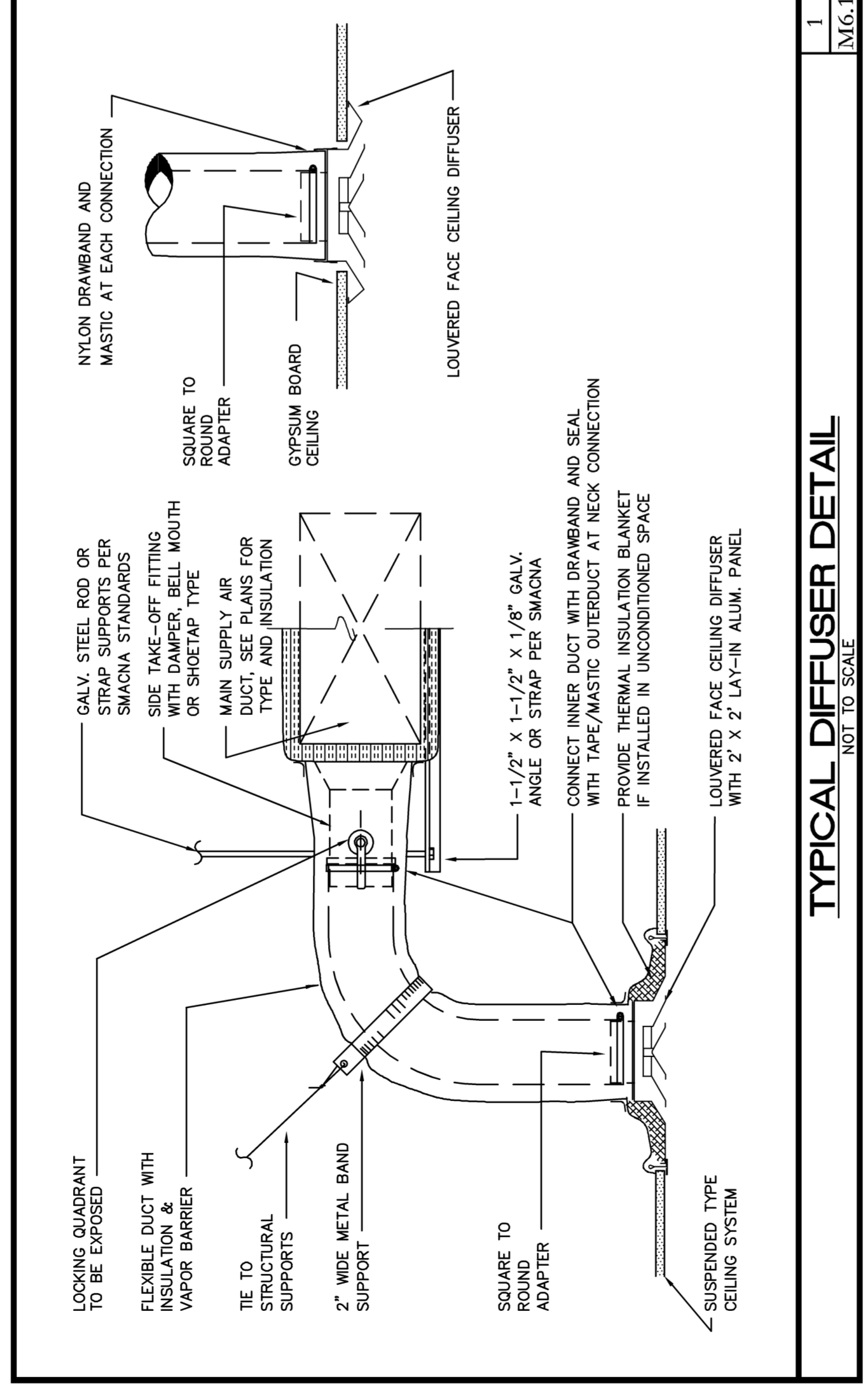


A/C UNIT MOUNTING DETAIL
NOT TO SCALE
7
M6.1

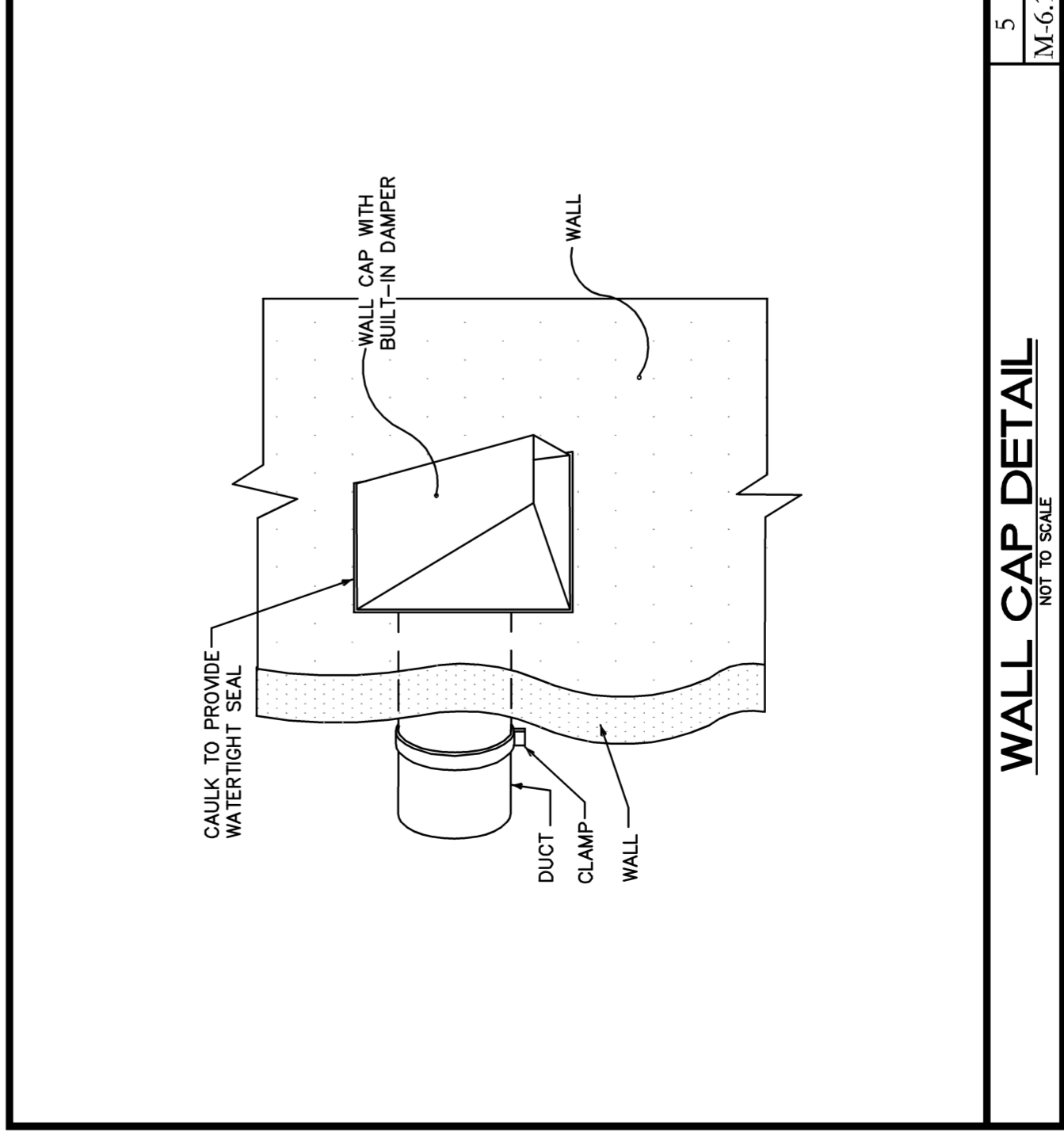
AIR DISTRIBUTION SCHEDULE

TAG	MANUF. & MODEL	FACE SIZE	NECK SIZE	MATERIAL	FRAME	FINISH	DAMPER	THROW	NC	CFM RANGE	NOTES
A	TITUS-TDC-AA	6X6	SEE SCHEDULE	ALUM.	LAY-IN	OFF WHITE	OBD	4-WAY	MAX. 30	SEE SCH.	SEE NOTES
<p>(C) EQUIVALENT MANUFACTURER: METALABRE, CARNES, T & B, NAIOR</p> <p>GENERAL NOTES:</p> <ol style="list-style-type: none"> IN COLLAR WITH VOLUME DAMPER AT TRUNK TO REX DUCT CONNECTION (SEE DETAIL). IF NOT ACCESSIBLE FROM MEZZANINE, PROVIDE CABLE OPERATED DAMPER. PROVIDE TYPICAL 4-WAY DIFFUSION, 2-WAY OR 3-WAY ONLY WHERE INDICATED ON PLANS. REFER TO ARCHITECT PLANS FOR CEILING TYPE. FINAL COLOR SELECTION SUBJECT TO ARCHITECT APPROVAL. PROVIDE INSULATION ON THE BACK OF DIFFUSER IF IN UNCONDITIONED SPACE. PROVIDE VOLUME CONTROL DAMPERS FOR ALL RETURN GRILLES OR REGISTERS FOR BALANCED AIRFLOW. CONTRACTOR SHALL VERIFY WITH ARCHITECT AND TENANT/OWNER, REGARDING THE TYPE AND INSULATION TYPE AND INSULATION STANDARD HAS TO BE FOLLOWED REGARDING A SPECIFIC MODEL OR MANUFACTURER AND SHALL BRING ANY DISCREPANCY TO THE ATTENTION OF ENGINEER. 											

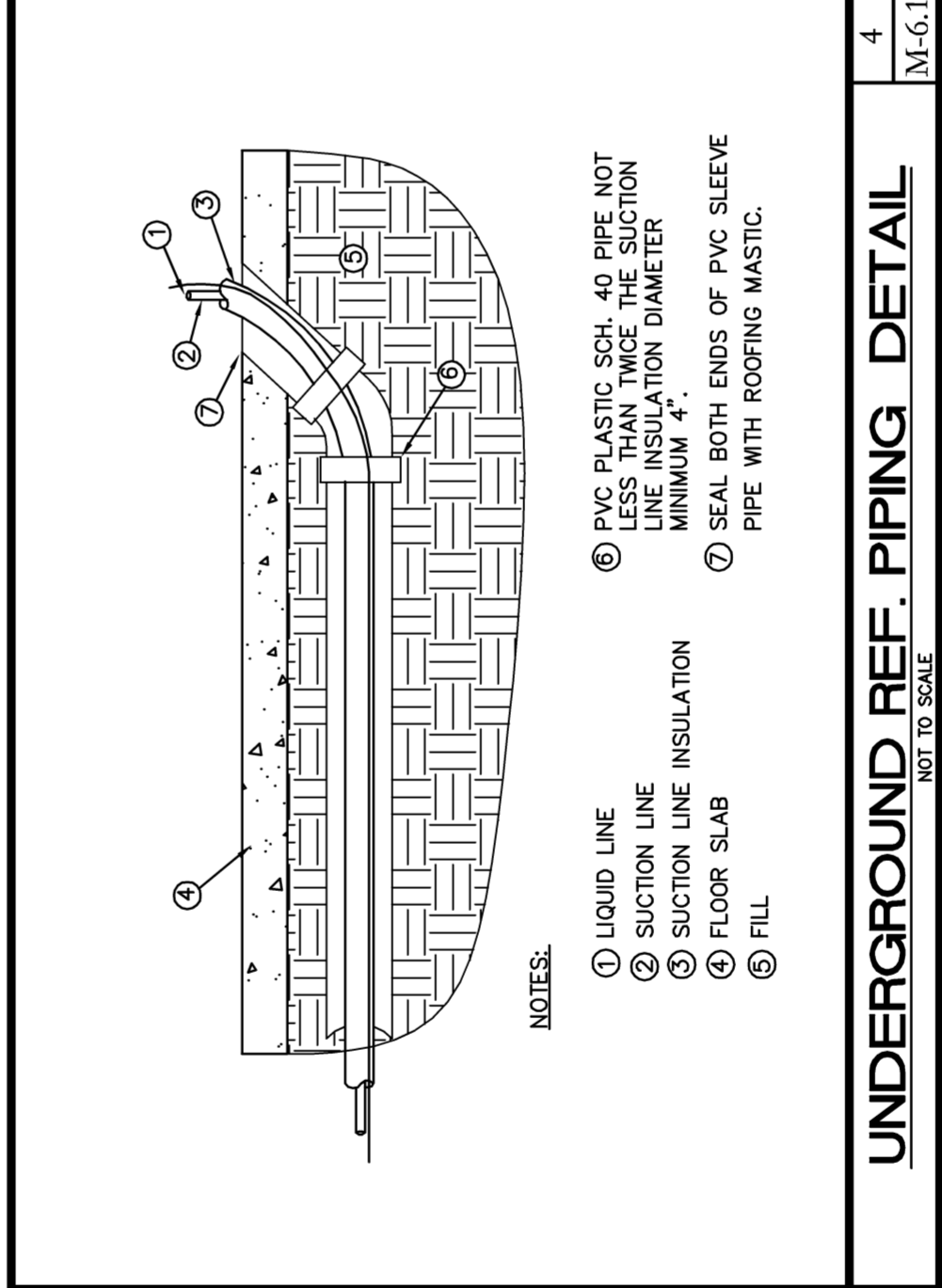
SIA FLEX SCHEDULE	
6"	50-125 CFM
8"	130-200 CFM
10"	205-330 CFM
12"	335-450 CFM
14"	485-700 CFM



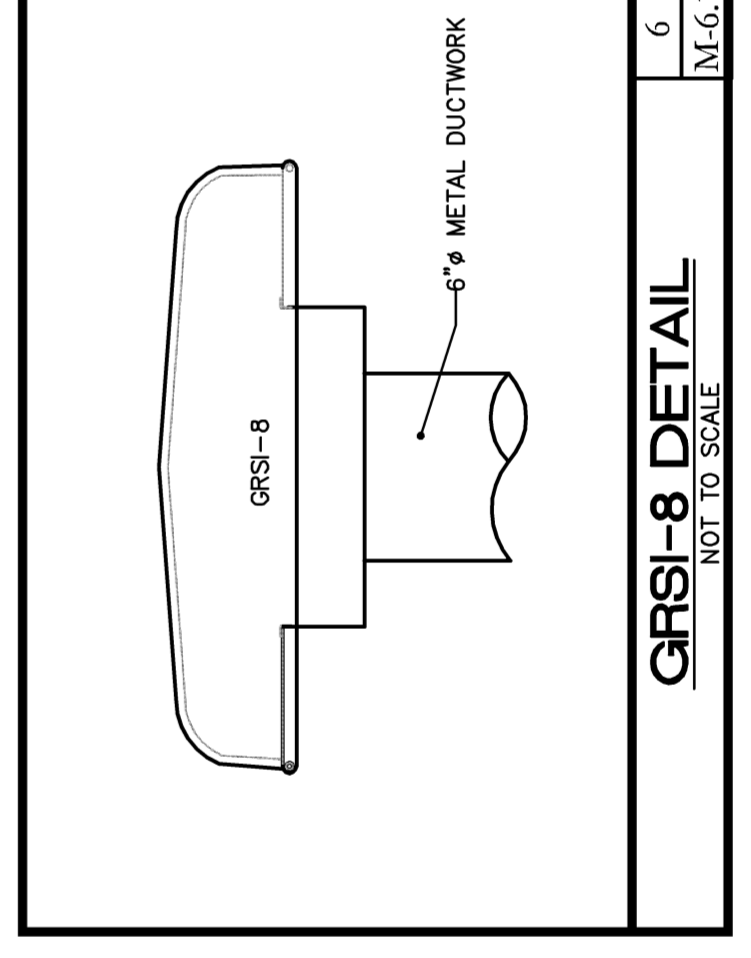
TYPICAL DIFFUSER DETAIL
NOT TO SCALE
1
M6.1



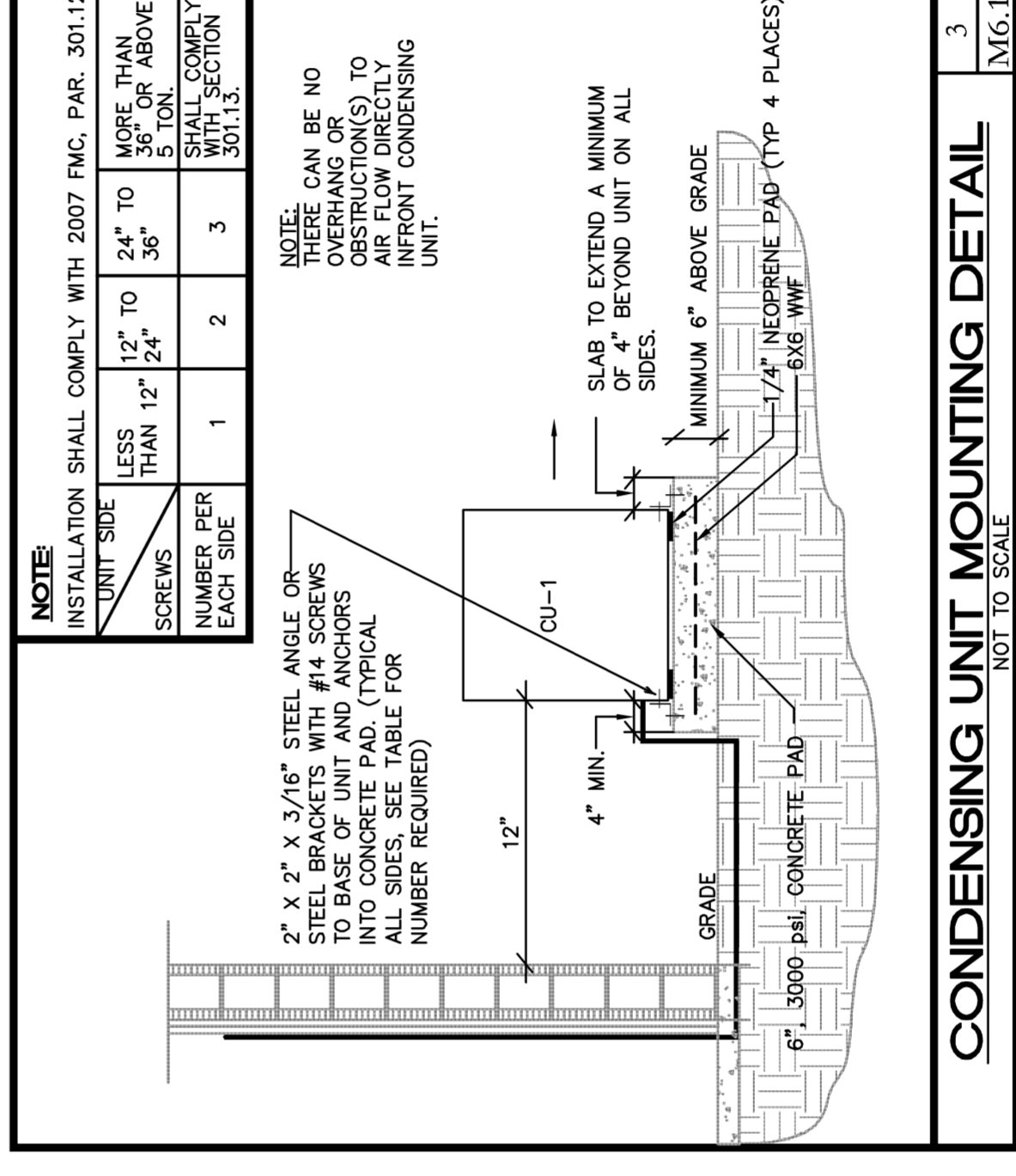
WALL CAP DETAIL
NOT TO SCALE
5
M6.1



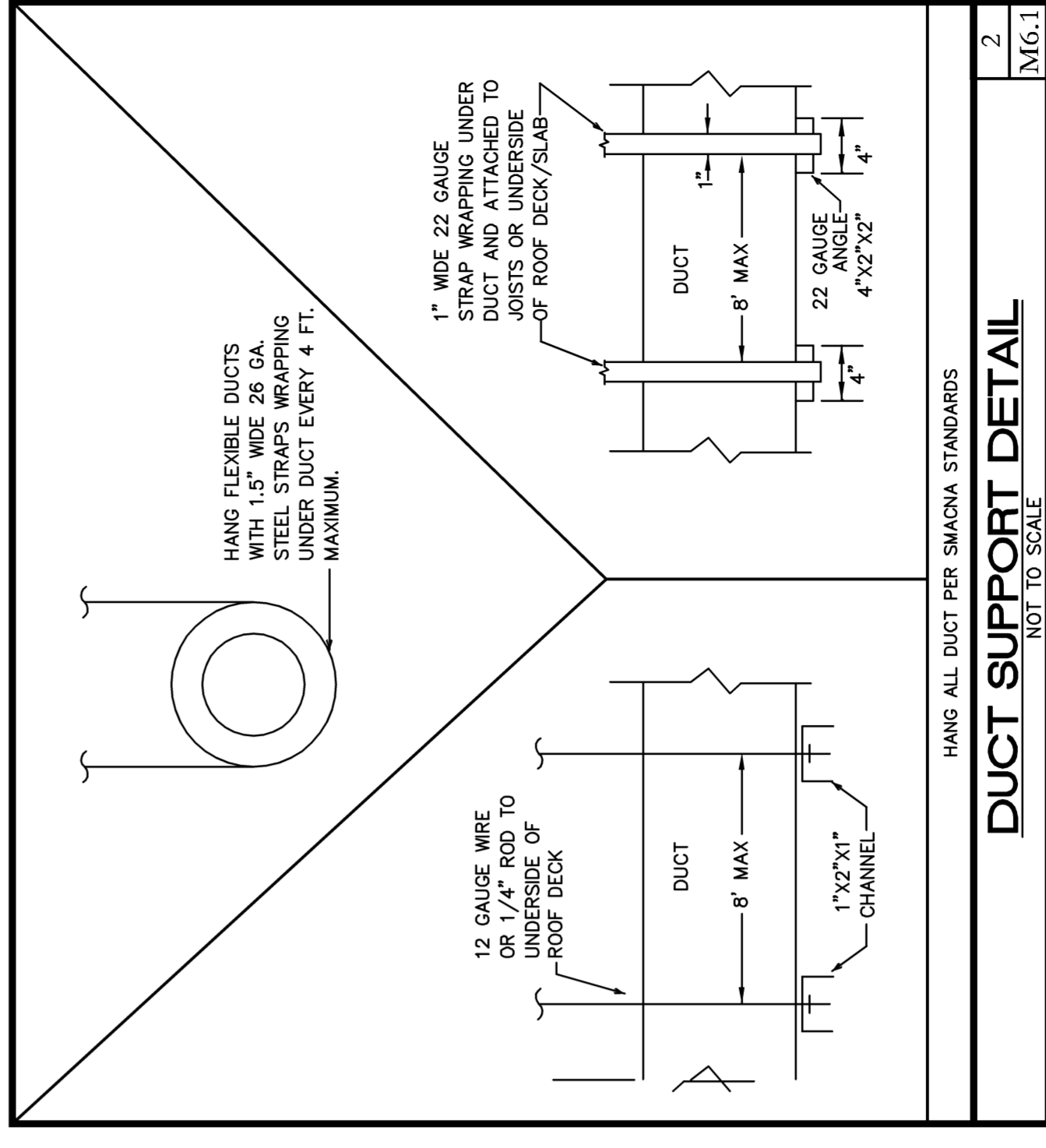
UNDERGROUND REF. PIPING DETAIL
NOT TO SCALE
4
M6.1



GRSI-8 DETAIL
NOT TO SCALE
6
M6.1



CONDENSING UNIT MOUNTING DETAIL
NOT TO SCALE
3
M6.1



DUCT SUPPORT DETAIL
NOT TO SCALE
2
M6.1

FAN SCHEDULE

TAG	SERVICE AREA	MANUF. (*)	MODEL	FAN DATA			MOTOR DATA			GENERAL DATA			ACCESSORIES		
				CONFIG.	CFM	ESP. (W.C.)	HP	RPM	DRIVE	VOLTAGE	WEIGHT (LBS)	DIMENSIONS L"X"W"X"H" L"X"W"		OPENING L"X"W"	
EF-1,2	WAREHOUSE	GREENHECK	SEI-12-432-DBSIDEWALL	1250	0.15	7.1	0.1	1550	DIRECT	115/1/60	20	23X18X18	19X19	CONTINUOUS	SEE NOTES
EF-3,4	WAREHOUSE	GREENHECK	SEI-12-432-DBSIDEWALL	1250	0.15	7.1	0.1	1550	DIRECT	115/1/60	20	23X18X18	19X19	CONTINUOUS	SEE NOTES
EF-5,6	BATHROOM	GREENHECK	SP-B90	CEILING	75	0.25	3.0	50 WATT	DIRECT	115/1/60	10	15X12X8	*	LIGHT INTERLOCK	SEE NOTES
RV-1	WAREHOUSE	GREENHECK	GRSH-8	ROOF	100	0.01	-	-	-	-	-	20X7.25	8.25"	-	-

(*) APPROVED EQUAL MANUFACTURER: COOK, ACME, PENN

ACCESSORIES NOTES:

- PROVIDE BACKDRAFT DAMPER
- PROVIDE FACTORY MOUNTED DISCONNECT SWITCH BEARINGS WITH GREASE FITTINGS
- PROVIDE MOTOR WITH THERMAL OVERLOADS
- PROVIDE TRANSITION FROM FAN TO DUCT WHERE SIZES DIFFER
- SUPPORT COMPLETE FROM STRUCTURE WITH VIBRATION ISOLATORS
- PROVIDE GRILLE COLOR PER ARCH. SPECS
- PROVIDE SPEED CONTROLLER FOR EF-1,2,3,4.
- PROVIDE STEP-DOWN TRANSFORMER AS REQUIRED.

GENERAL FAN NOTES:

- MOTOR STARTERS, DISCONNECTS (IF NOT FACTORY PROVIDED) AND ALL EQUIPMENT NORMAL POWER WIRING BY ELEC. CONTRACTOR
- ALL CONTINUOUS-DUTY MOTORS SHALL BE PROVIDED WITH OVERLOAD PROTECTION ACCORDING TO NATIONAL ELECTRICAL CODE PAR. 430-52.
- FIELD ADJUST OPENINGS WITH STRUCTURE.
- COORDINATE WITH ELECTRICAL CONTRACTOR BEFORE BIDDING OR ORDERING ANY EQUIPMENT.
- SEE PROJECT PLANS AND SPECIFICATIONS FOR OTHER FIELD SUPPLIED ITEMS AND ADDITIONAL INFORMATION.

Project: AIRPARK MAINTENANCE STORAGE FACILITY
POMPANO BEACH, FLORIDA 33060

MECHANICAL SCHEDULES & DETAILS

DATE: AUGUST 25, 2010
DRAWN BY: JH/EG/JJ
CHECKED BY: MC

JOB NO. 0908

REVISIONS

SHEET: M6.1
3 OF

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ISSUED FOR CONSTRUCTION

KAMM CONSULTING PROJECT #: 2009-0362
PROJECT MANAGER: JUAN J. BEROVA
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Director of Electrical Engineering: Lee T. Carter
Director of Mechanical Engineering: Robert A. Kamm
Florida License #3349
Florida License #4804

AIR CONDITIONING SPLIT SYSTEM SCHEDULE

CU TAG	MANUFACTURER & MODEL	NOMINAL TONNAGE	CAP. STAGES (S)EER/PLV	REFRIG./ABS	LIQ./SVCT.	NO. FANS	FAN FLA(EA)	NO. COMP.	COMP. PLAC(EA)	VOLTAGE/PH	MCA/MOCP	WEIGHT (LBS)	L X W X H (IN)	NOTES
CU-1	SANYO-CH2672R	2.0	14.1	R410A/-	3/8"-5/8"	1	-	1	-	208-230/1/60	-/20	128	37X44X31	SEE NOTES

AHU TAG	MANUFACTURER & MODEL	TOTAL MBH	SENSIBLE MBH	TOTAL CFM	O/A CFM	E.S.P. (W.C.)	INT. DB/AMB	LEAV. DB/AMB	ROWS/PH	FAN HP/FLA	HEAT/MBH	VOLTAGE/PH	MCA/MOCP	WEIGHT (LBS)	W X D X H (IN)	NOTES
AHU-1	SANYO-SHW2672	24.8	18.6	450/550/700	50	-	28.8	208-230/1/60	-	-	-	-/15	49	34X44X14	SEE NOTES	

* APPROVED EQUAL MANUFACTURER: DAIKIN, MITSUBISHI, TRANE, LENNOX, CARRIER, YORK

NOTES:

- UNITS RATED PER ARI 210, 240 AND 270. APPROVED EQUAL: CARRIER, LENNOX, TRANE, MITSUBISHI
- PROVIDE WITH TXV, LIQUID LINE FILTER DRYER AND MULTI-USE SERVICE VALVES
- PROVIDE COMPRESSOR WITH CRANKCASE HEATER AND MIN. 5-YEAR WARRANTY
- PROVIDE HIGH AND LOW PRESSURE CONTROL AND OVER TEMPERATURE PROTECTION.
- PROVIDE WEATHERPROOF ELECTRIC CONTROLS AND SINGLE SIDE SERVICE ACCESS
- PROVIDE SINGLE POINT POWER ENTRY.
- PROVIDE 1" THROWAWAY, MIN. 30% EFF. FILTER AND VIBRATION ISOLATION FOR AHU.
- PROVIDE FACTORY MOUNTED FUSIBLE DISCONNECT/STARTER FOR AHU. COORDINATE PRIOR TO PURCHASING
- PROVIDE DISCONNECT FOR C.O. (INSTALLED BY ELECTRICAL) COORDINATE PRIOR TO PURCHASING AND LOCKING COVER.
- PROVIDE FACTORY PROGRAMMABLE THERMOSTAT TO MATCH CAPACITY STAGES. PROVIDE WITH REMOTE CONTROL
- EQUIV. LENGTH FOR LONGER RUNS COORDINATED WITH MANUFACTURER PRIOR TO PURCHASE OR ANY WORK.

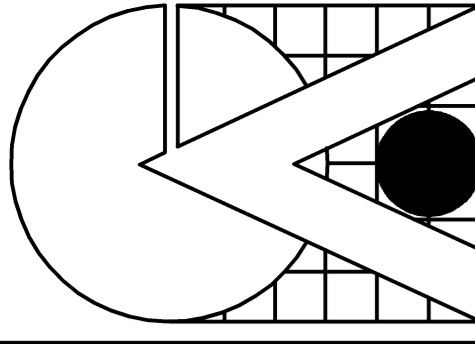
COORDINATION NOTE:

MECHANICAL CONTRACTOR SHALL COORDINATE ALL ELECTRICAL REQUIREMENTS AND ACCESSORIES WITH ELECTRICAL CONTRACTOR PRIOR TO PURCHASING AND INSTALLATION AND SHALL BRING ANY DISCREPANCIES TO THE ATTENTION OF ENGINEER

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AA 000198
SEAL

PROJECT: AIRPARK MAINTENANCE STORAGE FACILITY
POMPANO BEACH, FLORIDA 33060

REVISIONS
OWNER CHANGES
02-18-11

DATE: AUGUST 25, 2010
DRAWN BY: IH/EG/JJ
CHECKED BY: MC

JOB NO. 0908

SHEET: E1.1
5 OF 5

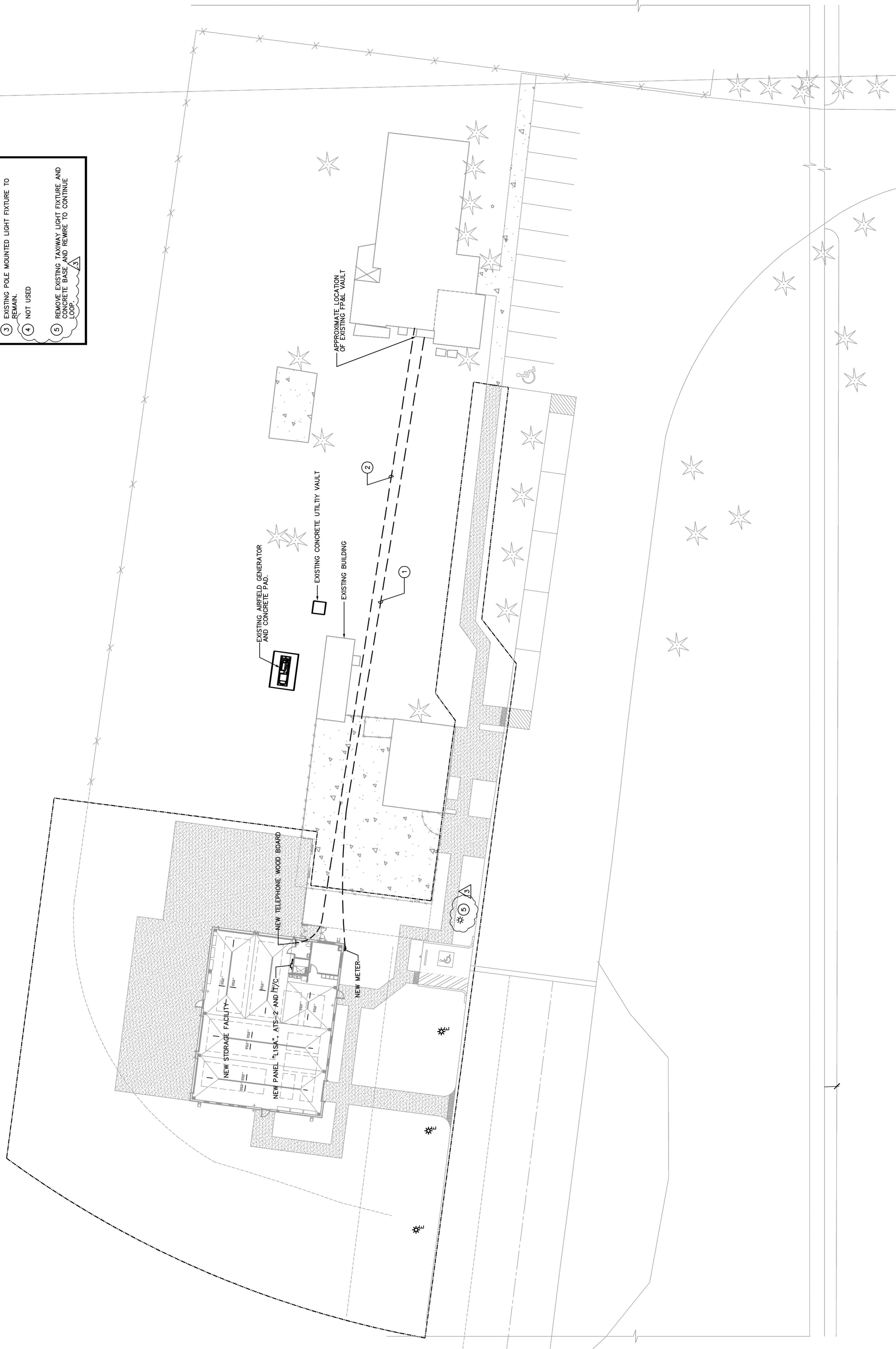
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ISSUED FOR PERMIT
ISSUED FOR CONSTRUCTION

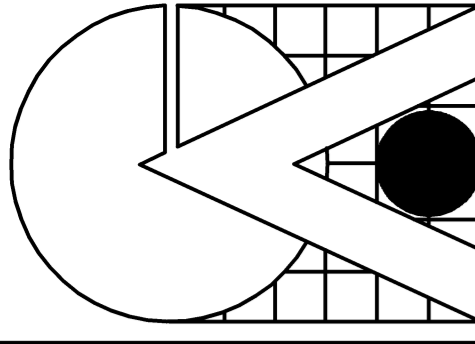
KAMM CONSULTING PROJECT # 2009-0362
PROJECT MANAGER: TIANI BEROVA

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Professional Seal of T. Berova
DIRECTOR OF ELECTRICAL ENGINEERING
Florida License #53349
DIRECTOR OF MECHANICAL ENGINEERING
Florida License #4804
Robert A. Kamm

- KEY NOTES**
- 1 UNDERGROUND SERVICE LATERAL. SEE RISER DIAGRAM ON SHEET ES.1.
 - 2 UNDERGROUND TELEPHONE CONDUIT ROUTING. SEE TELEPHONE RISER DIAGRAM ON SHEET EQ.1.
 - 3 EXISTING POLE MOUNTED LIGHT FIXTURE TO REMAIN.
 - 4 NOT USED
 - 5 REMOVE EXISTING TAXIWAY LIGHT FIXTURE AND CONCRETE BASE. AND REWIRE TO CONTINUE LOOP.



SITE ELECTRICAL PLAN
1"=20'-0" NORTH



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AA C00198
SEAL

PROJECT
AIRPARK MAINTENANCE STORAGE FACILITY
POMPANO BEACH, FLORIDA 33060

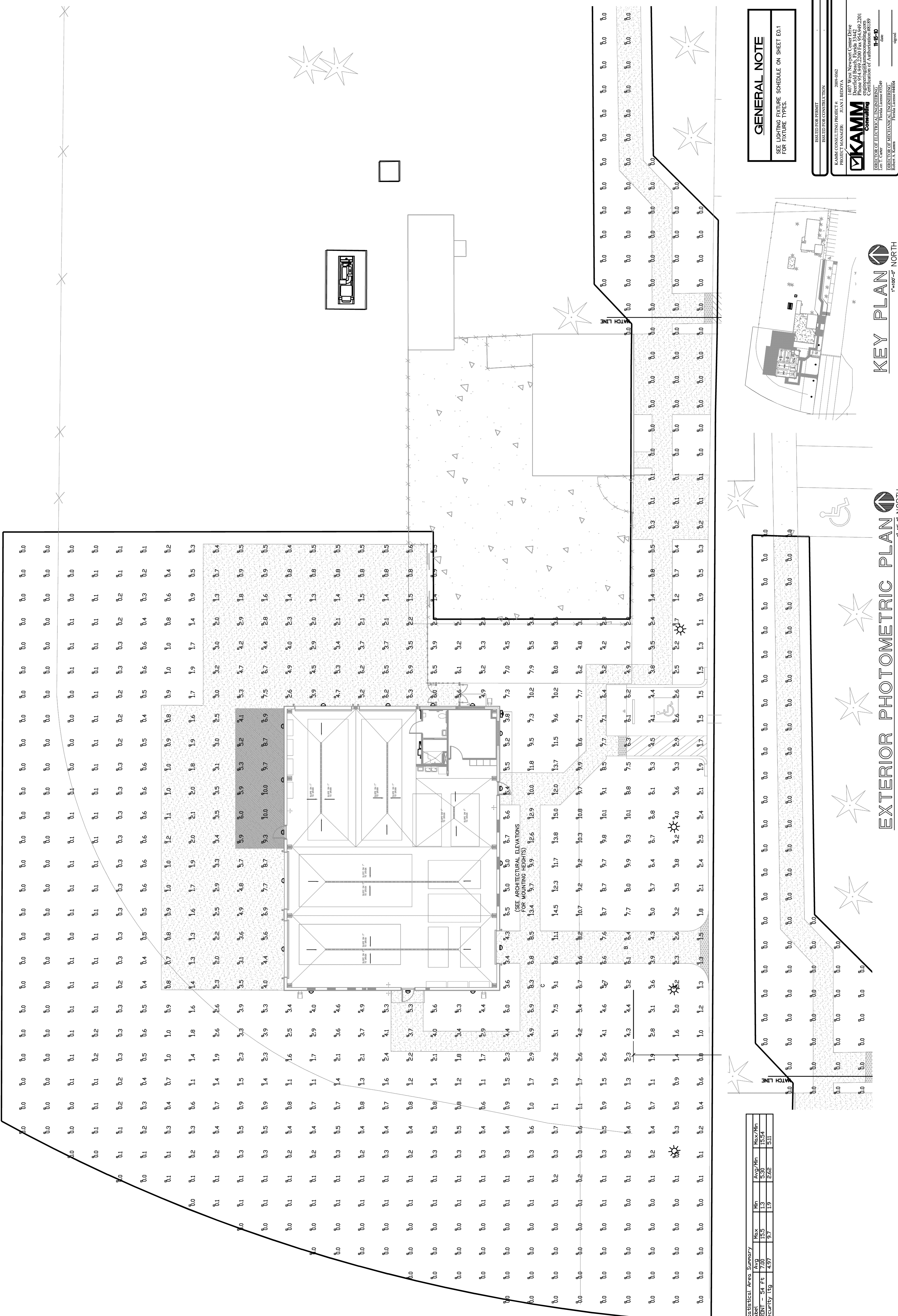
REVISIONS

DATE: AUGUST 25, 2010
DRAWN BY: IH/EG/JJ
CHECKED BY: MC

JOB NO.
0908

SHEET
E1.2
6 OF

PHOTOMETRIC PLAN



Statistical Area Summary

Label	AVG	Max	Min	Avg/Min	Max/Min
FRONT - 54 ft security lig	7.00	15.5	1.3	5.30	11.92
	4.97	9.7	1.9	2.62	5.11

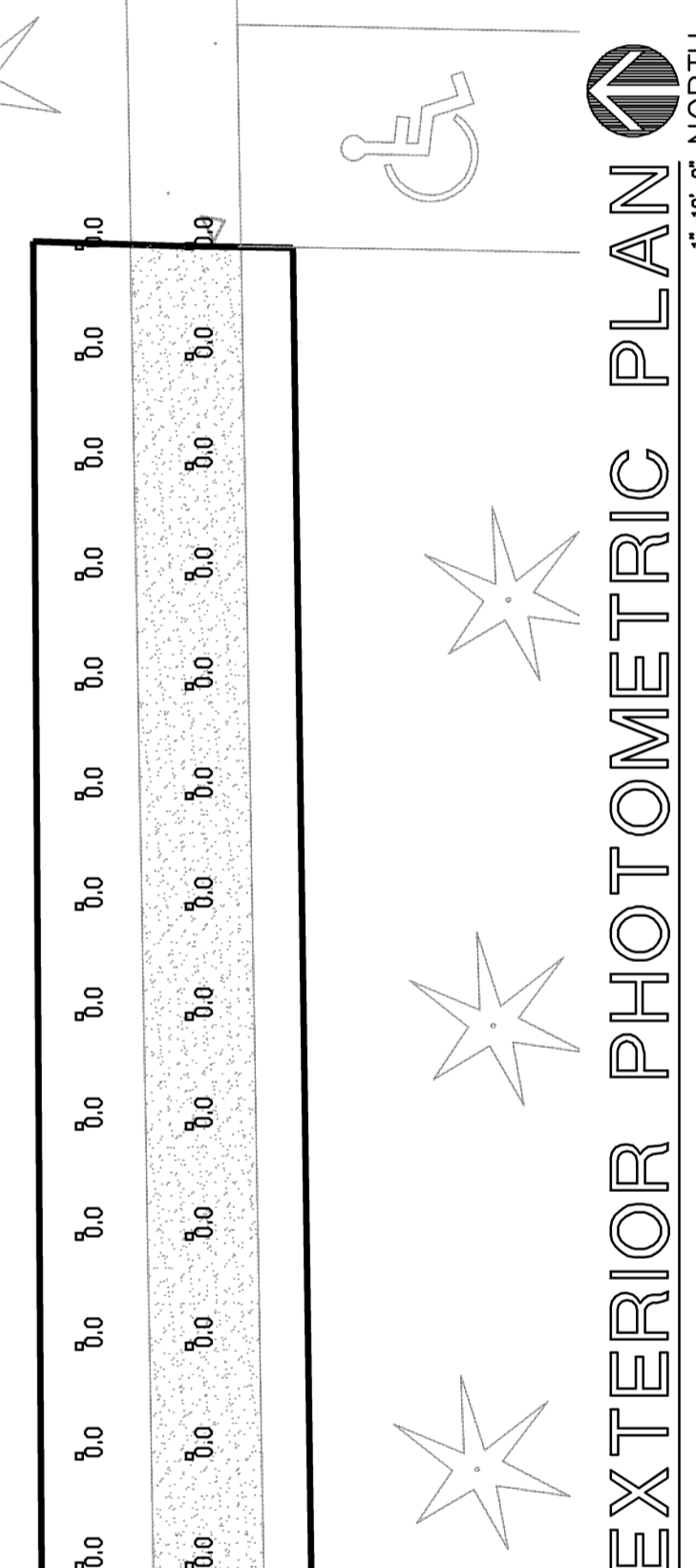
GENERAL NOTE
SEE LIGHTING FIXTURE SCHEDULE ON SHEET E0.1 FOR FIXTURE TYPES.

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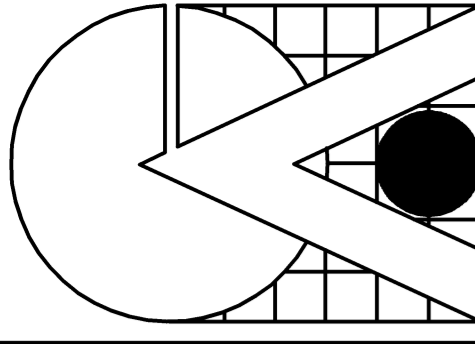
KAMM CONSULTING PROJECT # 2009-0162
PROJECT MANAGER: JUAN I. BEROVA

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Professional Engineer License # 11-50109
Date: 11-5-10

DIRECTOR OF ELECTRICAL ENGINEERING: Robert A. Kamm
DIRECTOR OF MECHANICAL ENGINEERING: Robert A. Kamm



ALL DIMENSIONS AND DETAILS INDICATED ON THIS DRAWING ARE FOR INFORMATION ONLY AND IN CONFORMANCE WITH THE REVISIONS PROJECT. THIS IS THE FINAL DRAWING FOR THE PROJECT. ANY CHANGES TO THIS DRAWING MUST BE MADE BY THE ARCHITECT OR ENGINEER OF RECORD. THE CONTRACTOR SHALL VERIFY ALL EXISTING CONDITIONS AND CONDITIONS OF THE SITE AND MAKE NECESSARY ADJUSTMENTS TO THE DRAWING. THE ARCHITECT AND ENGINEER OF RECORD SHALL BE RESPONSIBLE FOR THE DESIGN AND CONSTRUCTION OF THE PROJECT. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE CONSTRUCTION OF THE PROJECT. THE ARCHITECT AND ENGINEER OF RECORD SHALL BE RESPONSIBLE FOR THE DESIGN AND CONSTRUCTION OF THE PROJECT. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE CONSTRUCTION OF THE PROJECT.



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AA COOR198

PROJECT: AIRPARK MAINTENANCE STORAGE FACILITY
POMPANO BEACH, FLORIDA 33060

REVISIONS
APPENDUM 05/18/10

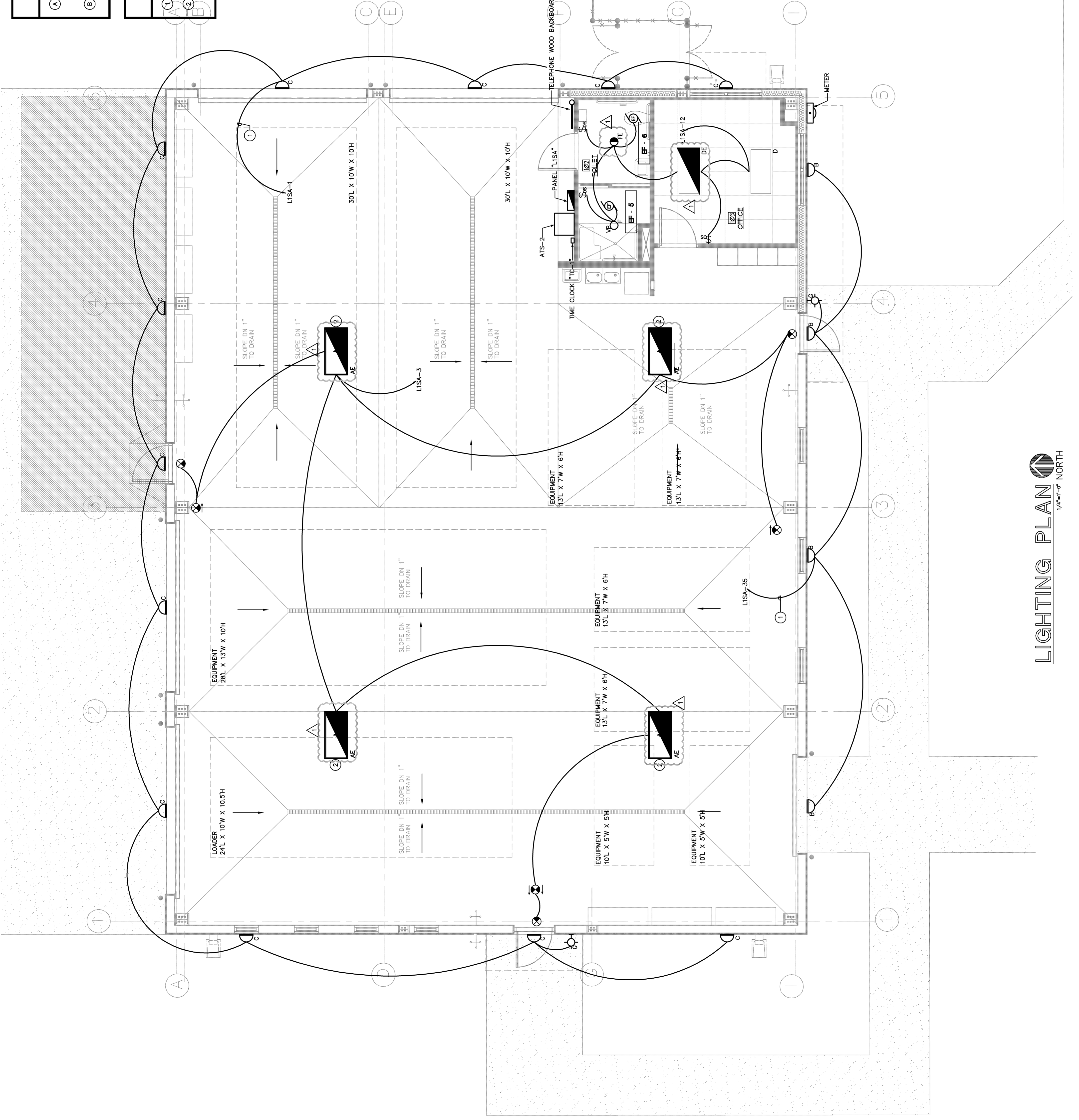
DATE: AUGUST 25, 2010
DRAWN BY: IH/EG/JJ
CHECKED BY: MC

JOB NO. 0908

SHEET: E2.1
7 OF

LIGHTING PLAN

- GENERAL NOTES**
- (A) WIRE ALL EXIT SIGNS AND EMERGENCY BATTERY PACKS IN EMERGENCY LIGHT FIXTURES AHEAD OF LIGHTING CONTROL DEVICE.
 - (B) SEE ARCHITECTURAL EXTERIOR ELEVATIONS FOR BUILDING EXTERIOR LIGHT FIXTURE HEIGHTS.
- KEY NOTES**
- (1) WIRE CIRCUIT THRU TIME CLOCK "TC-1". SEE DETAIL ON SHEET ED.1.
 - (2) LIGHT FIXTURE CONTROLLED BY INTEGRAL OCCUPANCY SENSOR. SEE LIGHTING FIXTURE SCHEDULE ON SHEET ED.1.



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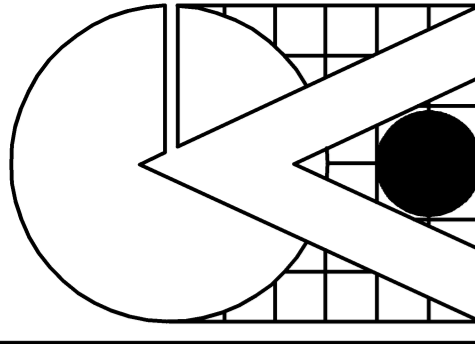
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PROJECT MANAGER: JIANI BEROVA

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LIGHTING PLAN
1/4"=1'-0" NORTH



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PROJECT: AIRPARK MAINTENANCE STORAGE FACILITY
POMPANO BEACH, FLORIDA 33060

REVISIONS

DATE: AUGUST 25, 2010
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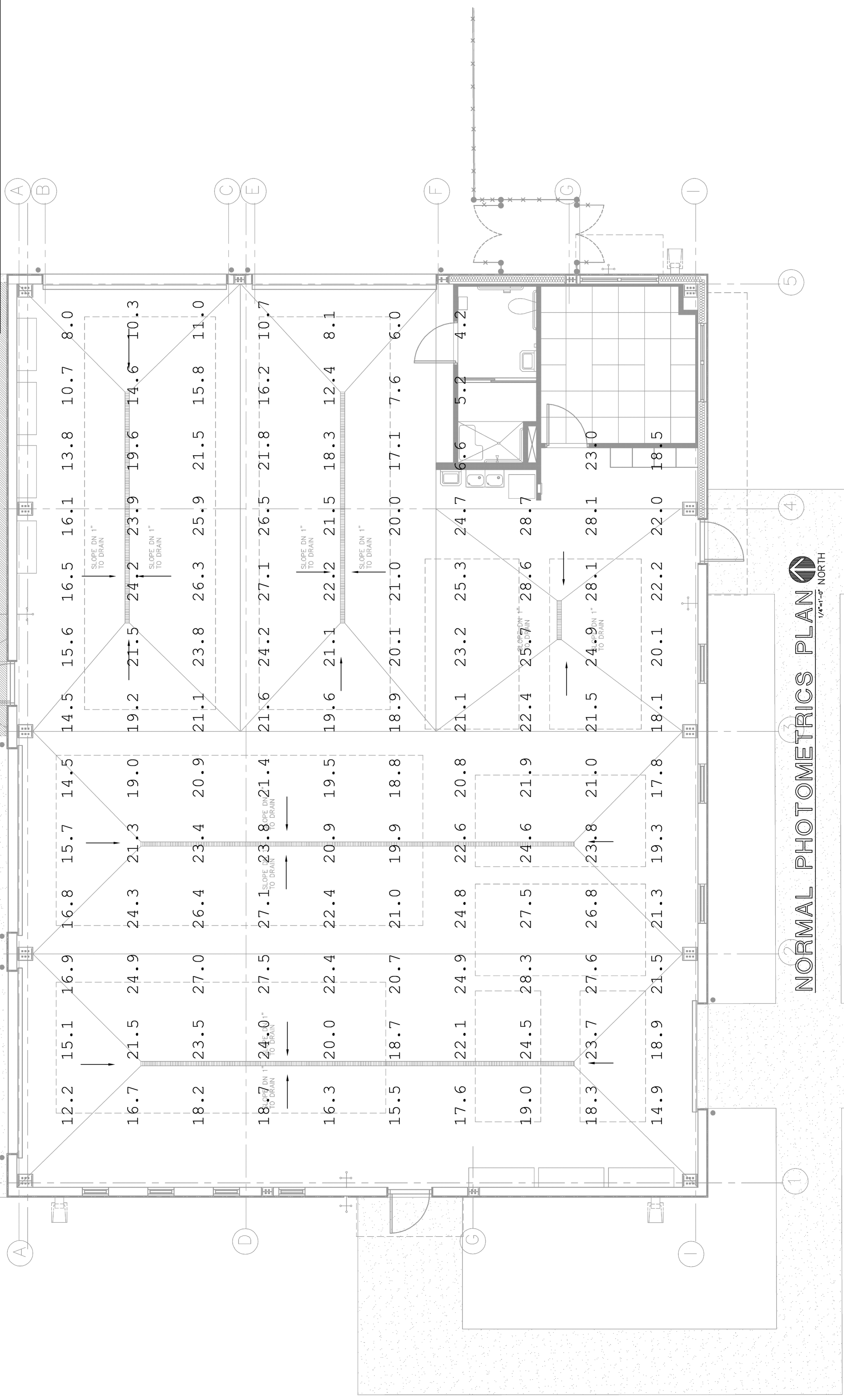
JOB NO. 0908

SHEET: E2.2
8 OF 8

PHOTOMETRICS PLAN

Calculation Summary

Label	CalcType	Units	Avg	Max	Min	Avg/Min	Max/Min
Floor	Illuminance	Fc	20.07	28.7	4.2	4.78	6.83
LPD Area Summary							
Label	Area	Total Watts	LPD				
Storage Facility	3364	1416	0.421				



NORMAL PHOTOMETRICS PLAN
1/4"=1'-0" NORTH

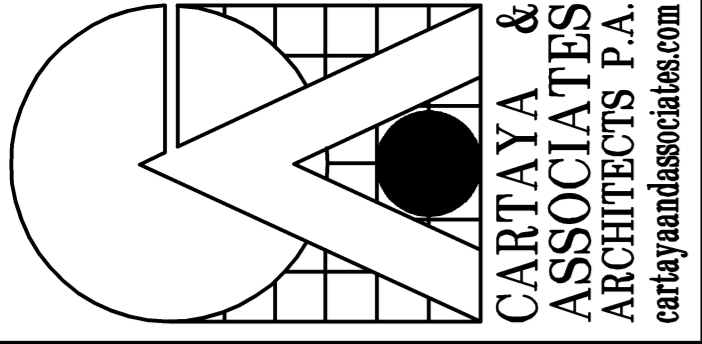
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PROJECT MANAGER: JUAN I. BEROVA

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PROJECT: AIRPARK MAINTENANCE STORAGE FACILITY
 POMPANO BEACH, FLORIDA 33060

DATE: AUGUST 25, 2010
CHECKED BY: MC
DRAWN BY: IH/EG/JJ
REVISIONS:

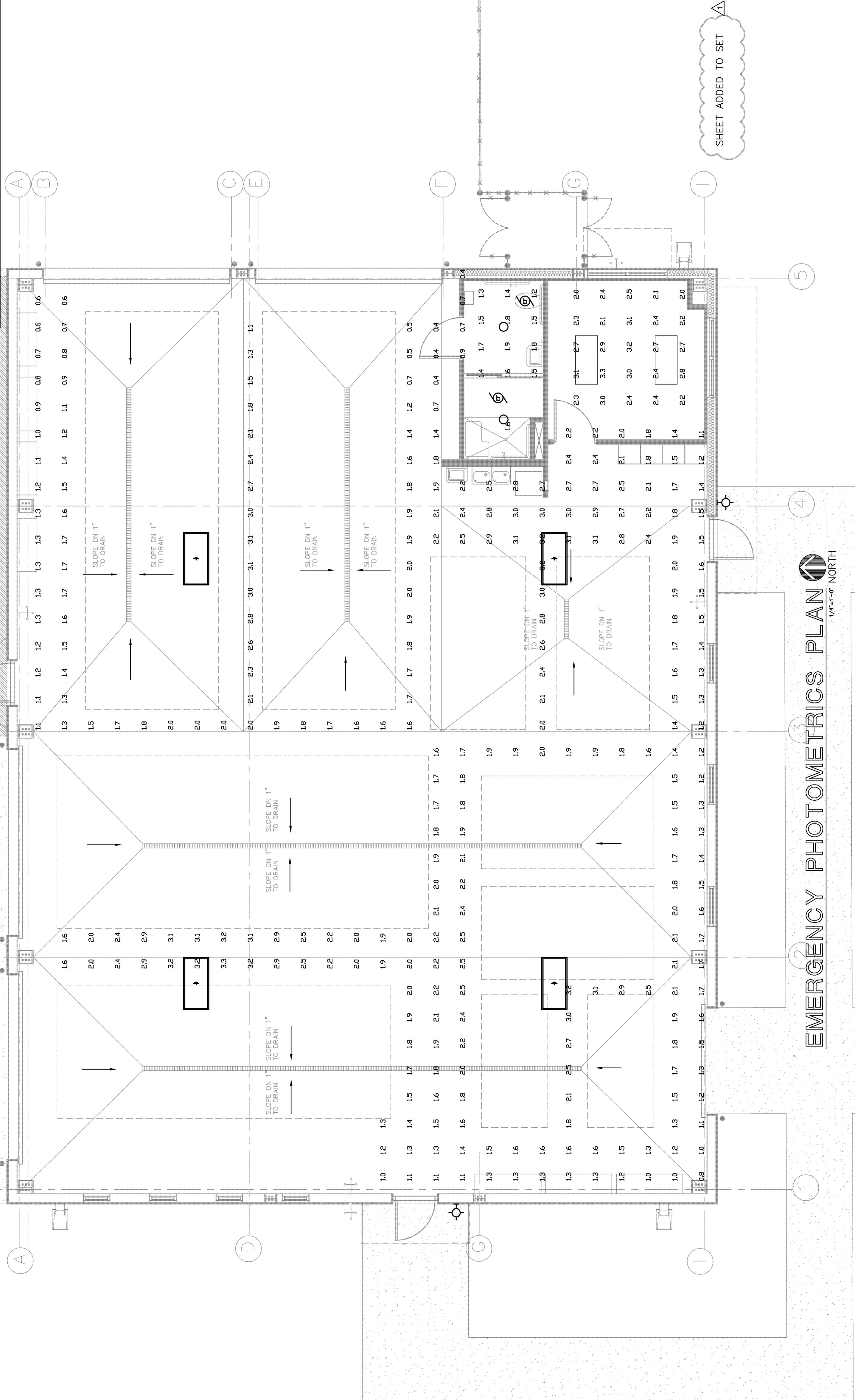
JOB NO.: 0908

SHEET: E2.3
 8 OF

TLF: PHOTOMETRICS PLAN

Calculation Summary

Label	CalcType	Units	Avg	Max	Min	Avg/Min	Max/Min
GARAGE	Illuminance	Fc	1.82	3.3	0.4	4.55	8.25
OFFICE	Illuminance	Fc	2.57	3.3	2.0	1.29	1.65
RR	Illuminance	Fc	1.52	1.9	1.2	1.27	1.58

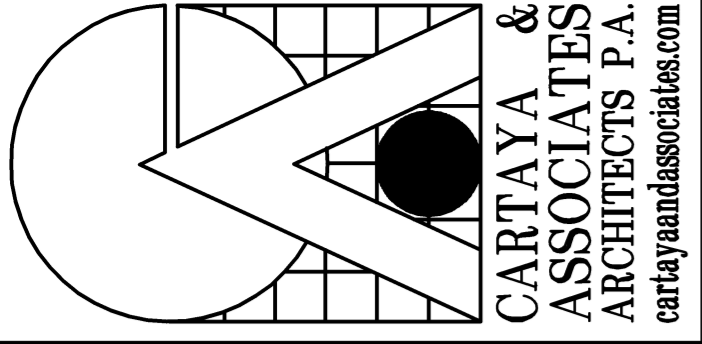


EMERGENCY PHOTOMETRICS PLAN
 1/4"=1'-0" NORTH

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KAMM CONSULTING PROJECT # 2009-0362
 PROJECT MANAGER: TIANI REDDYVA

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 11-5-10
 Director of Electrical Engineering: Robert V. Kamm
 Director of Mechanical Engineering: Robert V. Kamm
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AA C00188
SCALE

PROJECT: AIRPARK MAINTENANCE STORAGE FACILITY
POMPANO BEACH, FLORIDA 33060

TITLE: POWER PLAN

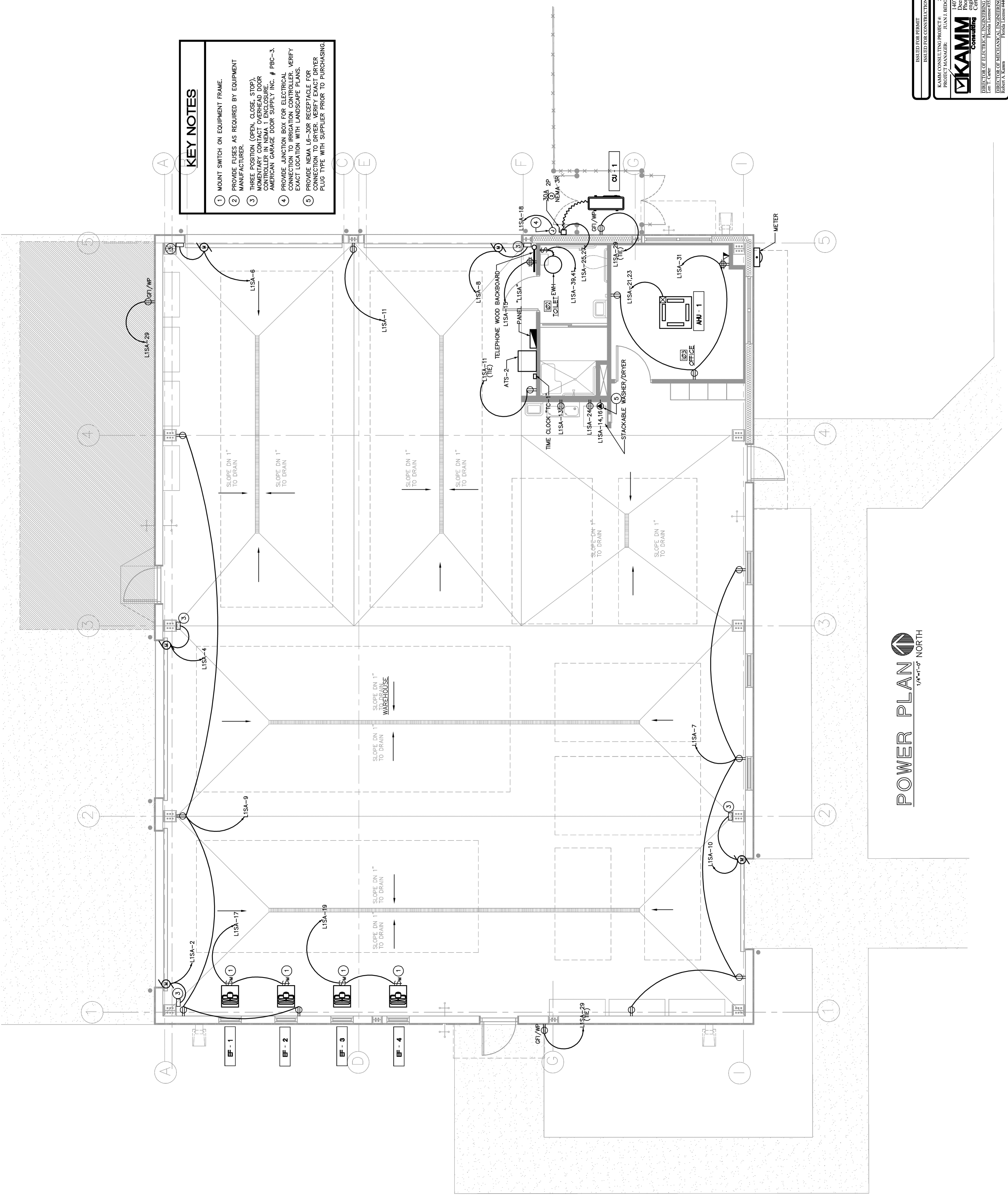
REVISIONS

CHECKED BY: MC
DATE: AUGUST 25, 2010
DRAWN BY: IH/EG/JJ

JOB NO. 0908

SHEET: **E3.1**
9 OF 9

- KEY NOTES**
- 1 MOUNT SWITCH ON EQUIPMENT FRAME.
 - 2 PROVIDE FUSES AS REQUIRED BY EQUIPMENT MANUFACTURER.
 - 3 THREE POSITION (OPEN, CLOSE, STOP), MOMENTARY CONTACT OVERHEAD DOOR CONTROLLER IN NEMA 1 ENCLOSURE. AMERICAN GARAGE DOOR SUPPLY, INC. # PBC-3.
 - 4 PROVIDE JUNCTION BOX FOR ELECTRICAL CONNECTION TO IRRIGATION CONTROLLER. VERIFY EXACT LOCATION WITH LANDSCAPE PLANS.
 - 5 PROVIDE NEMA LG-30R RECEPTACLE FOR CONNECTION TO DRYER. VERIFY EXACT DRYER PLUG TYPE WITH SUPPLIER PRIOR TO PURCHASING.



POWER PLAN
1/4"=1'-0" NORTH

ISSUED FOR PERMIT
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KAMM CONSULTING PROJECT # 2009-0362
PROJECT MANAGER: JUAN I. BEROVA

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Director of Electrical Engineering: Len T. Carter
Florida License #85349
Florida License #85349

DATE: 11-5-10
DATE:

VOLTAGE DROP CALCULATIONS

VOLTAGE DROP CALCS. FROM GENERATOR TO ATS-2

Voltage: 208
Load: 367 kVA
Load Circuit: 3PH, 4W, Wye
Power Factor: 0.9
Insulation Temp: 75°C/167°F
Conductor: Copper
Conductors per Phase: 1
Conduit: PVC/ABS
Cable Length: 144 Feet
Conductor Gauge: 110

Results:
1.42%

2.96 Volts Line-to-Line
1.71 Volts Line-to-Neutral

Source: EDR, Electrical Designer's Reference
Software Version: 3.0 (Build 2). Based on the 2005 NEC®
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VOLTAGE DROP CALCS. FROM FP&L VAULT TO METER

Voltage: 208
Load: 367 kVA
Load Circuit: 3PH, 4W, Wye
Power Factor: 0.9
Insulation Temp: 75°C/167°F
Conductor: Copper
Conductors per Phase: 1
Conduit: PVC/ABS
Cable Length: 282 Feet
Conductor Gauge: 40

Results:
1.67%

3.46 Volts Line-to-Line
2.01 Volts Line-to-Neutral

Source: EDR, Electrical Designer's Reference
Software Version: 3.0 (Build 2). Based on the 2005 NEC®
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SCHEDULE OF AUTOMATIC TRANSFER SWITCHES

MARK	AMPERE RATING	POLES	VOLTAGE RATING	FEEDER			NOTES
				WIRE	GROUND, & CONDUIT		
ATS-2	225	3	120/208	WALL	ATS2-1L	4 #4/0 & 1 #4G IN 2-1/2" Δ	(1)

SPECIFICATIONS:

- RETRANSFER TO NORMAL (TEST MODE).
- DELAYED RETRANSFER (LOAD "OFF" TIME).
- SIGNAL AND AUXILIARY FEATURES:
- ENGINE START CONTROL (FORM "C" CONTACT)
- TRANSFER SWITCH AUXILIARY POSITION INDICATING EMERGENCY SOURCE
- TRANSFER SWITCH POSITION INDICATION
- GREEN LED:
- RED LED:
- ACCESSORIES:
- TRANSFER TO EMERGENCY OR AVAILABILITY OF EMERGENCY SOURCE.
- EMERGENCY SOURCE FAILURE RETRANSFER (NORMAL SOURCE AVAILABLE).
- ENGINE COOL DOWN FOLLOWING RETRANSFER TO NORMAL.
- RETRANSFER TO NORMAL (NORMAL FAILURE MODE).

VOLTAGE AND FREQUENCY SENSING:

- RMS VOLTAGE SENSING ON ALL PHASES OF THE NORMAL AND EMERGENCY SOURCES.
- FREQUENCY SENSING OF THE NORMAL AND EMERGENCY SOURCES.
- TIME DELAY FEATURES:
- NORMAL SOURCE FAILURE TO ENGINE START.
- TRANSFER TO EMERGENCY OR AVAILABILITY OF EMERGENCY SOURCE.
- EMERGENCY SOURCE FAILURE RETRANSFER (NORMAL SOURCE AVAILABLE).
- ENGINE COOL DOWN FOLLOWING RETRANSFER TO NORMAL.
- RETRANSFER TO NORMAL (NORMAL FAILURE MODE).

NOTES:

- UTILITY MAIN/TRANSFER BREAKER AND GENERATOR TRANSFER BREAKER SHALL BE 225 AMPS.

SCHEDULE OF BRANCH CIRCUIT PANEL "LISA"

225 AMP MAIN LUIS ONLY
MOUNTING: SURFACE

VOLTAGE: 208/120V, 3Ø, 4 WIRE
AC SYM: 10,000

DESCRIPTION	WIRE	END. #12	TRIP DKT.	A PHASE KVA	B PHASE KVA	C PHASE KVA	COND. END. #10	WIRE	DESCRIPTION
EXTERIOR LIGHTING	#12	1/2"	20	1	0.1	0.2	2	30	1/2" #10 OVERHEAD DOOR
STORAGE LIGHTING	#12	1/2"	20	3	0.1	0.2	4	30	1/2" #10 OVERHEAD DOOR
OFFICE & RESTROOM LIGHTING	#12	1/2"	20	5	0.1	0.2	6	30	1/2" #10 OVERHEAD DOOR
NORTH STORAGE RECEPTACLES	#12	1/2"	20	6	0.1	0.2	7	30	1/2" #10 OVERHEAD DOOR
EAST STORAGE RECEPTACLES	#12	1/2"	20	11	0.1	0.2	12	30	1/2" #10 OFFICE & RESTROOM LIGHTS
DRINKING FOUNTAIN	#12	1/2"	20	13	1.0	1.1	14	30	1/2" #10 2 #10 DRYER
WATER HEATER	#12	1/2"	20	19	0.4	1.1	20	30	1/2" #12 IRRIGATION CONTROLLER
EF-1 & EF-2	#12	1/2"	20	19	1.2	1.2	20	30	SPACE
EF-3 & EF-4	#12	1/2"	20	19	1.2	1.2	20	30	SPACE
AHU-1	#12	1/2"	20	23	2.0	2.0	24	30	SPACE
CU-1	#12	1/2"	20	25	2.0	2.0	26	30	SPACE
SPARE RECEPTACLES	#12	1/2"	20	27	2.0	2.0	28	30	SPACE
OFFICE RECEPTACLES	#12	1/2"	20	29	0.8	0.8	30	30	SPACE
SPARE	#12	1/2"	20	30	0.8	0.8	31	30	SPACE
EXTERIOR LIGHTING (FRONT)	#12	1/2"	20	33	1.7	1.7	34	30	SPACE
EXTERIOR LIGHTING (REAR)	#12	1/2"	20	35	1.7	1.7	36	30	SPACE
ELECTRIC WATER HEATER "EWH"	#10	1/2"	2	39	2.3	2.3	40	30	SPACE
	#10	1/2"	2	41	2.3	2.3	42	30	SPACE
				12.9	12.6	13.2			KVA PER PHASE
				102.9	103.0	103.0			TOTAL KVA
					38.7	38.7			TOTAL KVA

NOTES:

- PROVIDE CIRCUIT BREAKER WITH CLASS "A" (+6-mv) GROUND FAULT PROTECTION.
- LIGHTING LOADS CALCULATED @ 125%.

GENERATOR LOAD SUMMARY

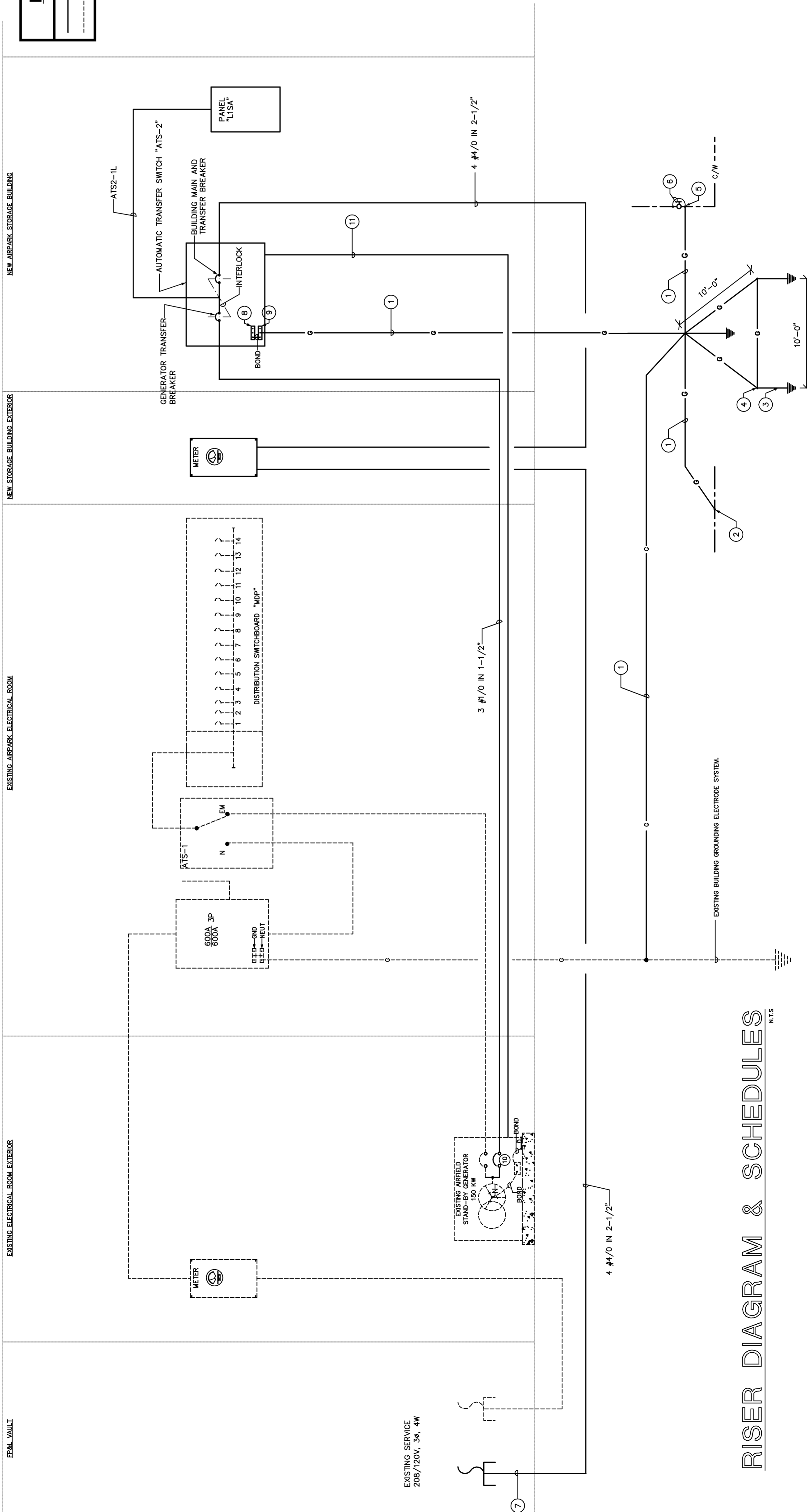
GENERATOR SIZE: 187.5 KVA

SWITCHBOARD "MSP"	KVA	45.0	45.0
PANEL "LISA"	12.9	12.6	13.2
KVA PER PHASE	42.9	42.6	43.6
TOTAL KVA	162.0	162.6	168.6

LEGEND

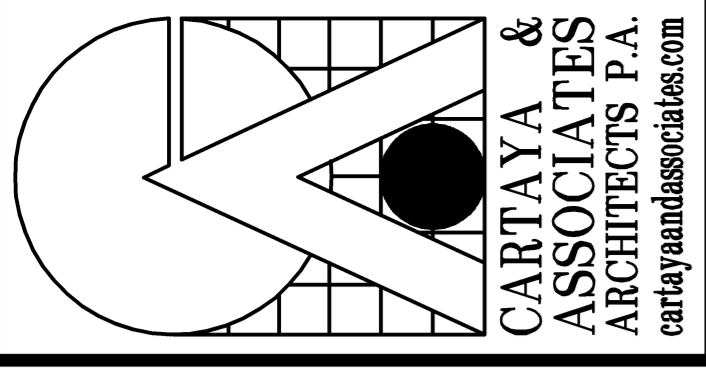
---	NEW
---	EXISTING

- ### KEY NOTES
- #2 GROUNDING ELECTRODE CONDUCTOR IN 1/2" SCHEDULE 40 PVC CONDUIT.
 - EXTERIOR CONNECTION AS HEAVY DUTY SOLID BRONZE BONDING GROUND CLAMP U.L. LISTED FOR THE PURPOSE. ELECTRICALLY CONTINUOUS STEEL REINFORCING BAR (20FT MIN. LENGTH) IN BOTTOM OF BUILDING FOUNDATION IN DIRECT CONTACT WITH EARTH. 10 FT. LONG x 3/4" DIAMETER COPPER DRIVEN GROUND ELECTRODE.
 - GROUNDING CONDUCTOR SHALL BE HEAVY DUTY SOLID BRONZE BONDING GROUND CLAMP U.L. LISTED FOR THE PURPOSE. (TYPICAL)
 - MAKE CONNECTION TO METALLIC COLD WATER ENTRANCE PIPE BEFORE FIRST VALVE WITH HEAVY DUTY BRONZE GROUND CLAMP.
 - PROVIDE #6 BONDING JUMPER AROUND FIRST VALVE.
 - TERMINATE CONDUITS IN EXACT MANNER AND LOCATION AS REQUIRED BY UTILITY COMPANY. LEAVE 10 FT SLACK CONDUCTOR PER CONDUCTOR FOR EXTENSION AND CONNECTION FOR UTILITY COMPANY.
 - GROUND BAR.
 - NEUTRAL BAR.
 - INSTALL NEW 150 AMP CIRCUIT BREAKER IN EXISTING STAND-BY GENERATOR AS INDICATED.
 - PROVIDE 2 #12 IN 1/2" CONDUIT FOR GENERATOR START/STOP WIRING.



RISER DIAGRAM & SCHEDULES

N.T.S



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BEAL

PROJECT: AIRPARK MAINTENANCE STORAGE FACILITY
POMPANO BEACH, FLORIDA 33060

REVISIONS
APPENDUM 05/18/10

DATE AUGUST 25, 2010
DRAWN BY: IH/EG/JJ
CHECKED BY: MC

JOB NO. 0908
TITLE: RISER DIAGRAM

SHEET: E5.1
10 OF 10

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KAMM CONSULTING PROJECT #: 2009-0362
PROJECT MANAGER: JUAN J. BEROVOJA

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DIRECTOR OF ELECTRICAL ENGINEERING: Leo T. Carter
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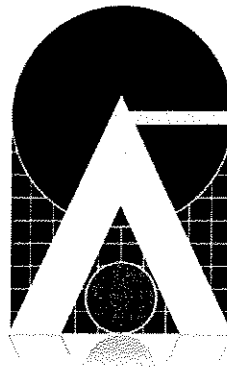
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signature:

CITY OF POMPANO BEACH
AIRPARK MAINTENANCE
STORAGE FACILITY

CITY OF POMPANO BEACH, FL 33060

PROJECT SPECIFICATIONS

03/01/10



CARTAYA &
ASSOCIATES
ARCHITECTS P.A.

PROJECT SPECIFICATIONS

03/01/10

Airpark Maintenance Storage Facility

DIVISION 1 – GENERAL REQUIREMENTS

DIVISION 2 – SITE WORK

02100	SITE PREPARATION	01-04
02200	EARTHWORK	01-18
02222	CONTRACTORS RESPONSIBILITES	01-02
02280	SOIL TREATMENT	01-04
02317	EXCAVATION, BACKFILLING AND COMPACTING FOR UTILITIES	01-03
02319	EXCAVATION, BACKFILLING AND COMPACTING FOR PAVING	01-03
02332	SELECT EMBANKMENT	01-01
02400	DEWATERING	01-02
02485	FINISH GRADING, SODDING AND EROSION SEDIMENTATION CONTROL	01-06
02500	RESTORATION AND CLEANUP	01-05
02502	DUCTILE IRON PIPE AND FITTINGS	01-09
02504	FORCE MAIN PIPE AND FITTINGS	01-13
02506	VALVES AND APPURTENANCES	01-05
02510	ASPHALTIC CONCRETE PAVING, SUB-BASE AND LIMEROCK	01-10
02550	SITE UTILITIES WATER AND SEWER SYSTEMS	01-09
02560	PIPELINE TESTING	01-04
02570	ELECTRONIC UTILITY LOCATION SYSTEM	01-05
02632	POLYVINYL CHLORIDE (PVC) PRESSURE PIPE	01-07
02810	IRRIGATION SYSTEMS	01-10
02935	SODDING	01-08
02950	TREE, PLANTS, AND GROUNDCOVERS	01-15

DIVISION 3 – CONCRETE

03100	CONCRETE FORMWORK	01-07
03200	CONCRETE REINFORCING	01-07
03300	CAST-IN-PLACE CONCRETE	01-13

DIVISION 4 – MASONRY

NOT USED

DIVISION 5 – METALS

05120 STRUCTURAL STEEL, GALVANIZED STEEL, BOLTS FOR EXTERIOR APPLICATION 01-09

DIVISION 6 – WOOD AND PLASTIC

06100 ROUGH CARPENTRY WORK 01-04

DIVISION 7 – THERMAL AND MOISTURE PROTECTION

07210 BUILDING INSULATION 01-04

DIVISION 8 – DOORS AND WINDOWS

08110 HOLLOW METAL DOORS AND FRAMES 01-04

08710 FINISH HARDWARE 01-06

DIVISION 9 – FINISHES

09111 METAL STUD FRAMING SYSTEM 01-04

09260 GYPSUM BOARD SYSTEM 01-06

09310 CERAMIC TILE 01-04

09500 ACOUSTICAL CEILING SYSTEM 01-05

09651 RESILIENT TILE FLOORING 01-03

09900 PAINTING 01-06

DIVISION 10 – SPECIALTY

10505 METAL LOCKERS 01-03

10800 TOILET AND ACCESSORIES 01-03

DIVISION 11 – NOT USED

DIVISION 12 – NOT USED

DIVISION 13 – SPECIAL CONSTRUCTION

13121 METAL BUILDING SYSTEMS 01-13

DIVISION 14 – NOT USED

DIVISION 15 – MECHANICAL

15058 COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT 01-03

15061 HANGARS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT 01-09

15062 HANGARS AND SUPPORTS FOR HVAC EQUIPMENT 01-05

DIVISION 15 – MECHANICAL (CONTINUED)

15076	IDENTIFICATION FOR PLUMBING PIPING EQUIPMENT	01-03
15077	IDENTIFICATION FOR HVAC PIPING EQUIPMENT	01-03
15082	PLUMBING INSULATION	01-17
15086	HVAC INSULATION	01-13
15123	EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING	01-03
15126	METERS AND GAGES FOR PLUMBING PIPING	01-03
15140	DOMESTIC WATER PIPING	01-10
15145	DOMESTIC WATER PIPING SPECIALTIES	01-07
15150	SANITARY WASTE AND VENTING	01-05
15155	SANITARY WASTE PIPING SPECIALTIES	01-06
15183	REFRIGERANT PIPING	01-08
15410	PLUMBING FIXTURES	01-07
15415	DRINKING FOUNTAINS AND WATER COOLERS	01-03
15485	ELECTRIC WATER HEATERS	01-04
15671	CONDENSING UNITS	01-05
15815	METAL DUCTS	01-09
15820	DUCT ACCESSORIES	01-10
15855	DIFFUSERS REGISTERS AND GRILLES	01-02
15950	TESTING ADJUSTING AND BALANCING	01-08

DIVISION 16 – ELECTRICAL

16050	BASIC ELECTRICAL MATERIALS AND METHODS	01-09
16060	GROUNDING AND BONDING	01-06
16075	ELECTRICAL IDENTIFICATION	01-06
16120	CONDUCTORS AND CABLES	01-03
16130	RACEWAYS AND BOXES	01-07
16140	WIRING DEVICES	01-04
16145	LIGHTING CONTROL DEVICES	01-06
16415	TRANSFER SWITCHES	01-05
16442	PANELBOARDS	01-04
16485	ELECTRIC DOMESTIC WATER HEATERS	01-08
16491	FUSES	01-02
16511	INTERIOR LIGHTING	01-05
16521	EXTERIOR LIGHTING	01-04

SECTION 02100

SITE PREPARATION (Clearing and Grubbing)

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The work of this section includes, but is not limited to:
 - 1. Clearing
 - 2. Grubbing
 - 3. Stripping and stock piling top soil
 - 4. Debris disposal

1.2 RELATED SECTIONS

- A. Section 02050: Site Demolition
- B. Section 02200: Earthwork
- C. Section 02550: Site Utilities - Water and Sewer Systems

1.3 DEFINITIONS

- 1. Clearing is defined as the removal of trees, brush, down timber, rotten wood, rubbish, any other vegetation, and objectionable material at or above original ground elevation not designated to be saved. Clearing also includes removal of fences, walls, guard posts, guardrail, signs, and other obstructions interfering with the proposed work.
- 2. Grubbing is defined as the removal from below the surface of the natural ground of stumps, roots and stubs, brush, organic materials and debris.

1.4 SUBMITTALS

- A. Burning Permits will not be issued by the CITY.
- B. All disposal sites must be approved by the Engineer.

PART 2 – PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect benchmarks, utilities, existing trees, shrubs and other landscape features designated for preservation with temporary fencing or barricades satisfactory to the Engineer. No material shall be stored or construction operation carried on within 4 feet of any tree to be saved or within the tree protection fence. The CONTRACTOR is to familiarize himself with the provisions of Local, County and State Tree Preservation and Abuse Regulations. CONTRACTOR shall make every effort to prevent damage to existing trees, including but not limited to the installation of tree protection barriers. The CONTRACTOR is responsible for all required remedial action resulting from said damage occurring from work performed under this contract.

- B. All areas, as shown on the plans, shall be cleared of all structures obstructions as defined above. Those trees, shrubs and other landscape features specifically designated for preservation shall be carefully protected from abuse, marring or damage during construction operations. Continual parking and servicing of equipment under the drip line or canopy of trees marked for preservation is not permitted. When trees and shrubs are designated for preservation and require pruning, they shall be trimmed as directed by the CONSULTANT.

3.2 UTILITY RELOCATIONS

- A. Inform all companies, individuals and other owning or controlling facilities or structures within the limits of the work which have to be relocated, adjusted or reconstructed in sufficient time for the utility or organization to perform such work in conjunction with or in advance of the Contractor's operations.

- B. No drainage structure shall be removed or obstructed such that it may cause flooding or a dangerous condition during a rain event. Positive drainage must be provided at all times.

3.3 CLEARING

- A. Fell trees in a manner that will avoid damage to trees, shrubs, and other installations, which are to be retained.

3.4 GRUBBING

- A. Grub areas within the construction limits to remove roots and other objectionable

material to a minimum depth of 6 inches.

- B. Remove all stumps within the cleared areas unless otherwise authorized by the Engineer.
- C. Contractor to field locate all utilities prior to grubbing.

3.5 STRIPPING AND STOCKPILING TOPSOIL

- A. Stockpile location to be approved by the Engineer.

3.6 DEBRIS DISPOSAL

- A. Trees, logs, branches, brush, stumps, and other debris resulting from clearing and grubbing operations shall become the property of the Contractor and shall be legally disposed of.
- B. Do not deposit or bury on the site debris resulting from clearing and grubbing work, wasted construction materials or any other debris.
- C. Existing frames, grates, light poles, luminaries and appurtenances shall be salvaged to the CITY. The location shall be determined upon the commencement of the WORK. If no direction is given by the CITY then CONTRACTOR shall dispose of them offsite.

3.7 RESTORATION

- A. Prior to repairing any injuries to bark, trunk, limbs, and roots of remaining plantings, the Contractor shall hire (at his own expense) a licensed Arborist to inspect tree damage. The Arborist shall prepare a report outlining the appropriate course of action for each occurrence. All work shall be completed using approved arboricultural practices and materials.
- B. Replace trees, shrubs and plants designated to be saved which are permanently injured or die during the life of the Contract as a result of construction operations with like or approved alternate species acceptable to the project Owner.
- C. Remove protective fences, enclosures and guards upon the completion of the project.
- D. Restore guard posts, guardrail, signs and other interferences to the condition equal to that existing before construction operations.
- E. Restore area to an equal or better condition.

- F. Holes remaining after removal of all obstructions, objectionable material, tree stumps, etc., shall be backfilled in accordance with 02317 Excavating, Backfilling and Compacting for Utilities and or 02319 Excavating, Backfilling and Compacting for Paving. Contours shall be reestablished to approximately the same as existed prior to removal of the obstruction, unless directed otherwise by the CONSULTANT.
- G. Before backfilling the open ends of all storm drainage structures pipes and conduits shall be capped and plugged with sufficient concrete to insure a watertight seal. All electrical, gas, water and sanitary sewer pipes and mains shall be properly capped and sealed in accordance with the direction of the CONSULTANT.

END OF SECTION

SECTION 02200

EARTHWORK

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. The work of this Section includes all earthwork required for construction of the Project. Such earthwork shall include, but not be limited to, the loosening, removing, loading, transporting, depositing, and compacting in its final location of all materials, wet and dry, as required for the purposes of completing the work specified in the Contract Documents. This shall include, but not be limited to, the furnishing, placing, and removing of sheeting and bracing necessary to safely support the sides of all excavation; all operations required for dewatering excavations including pumping, ditching, draining, and other required measures for the removal or exclusion of water from the excavation; the supporting of structures and utilities above and below the ground; all backfilling around structures and all backfilling of trenches and pits; the control and disposal of excess excavated materials; borrow of materials to make up deficiencies for fills; rough grading; restoration of unpaved surfaces; and all other incidental earthwork, all in accordance with the requirements of the Contract Documents.
- B. See GENERAL REQUIREMENTS, which contain information and requirements that apply to the Work specified herein and are mandatory for this project.

1.2 RELATED SECTIONS

- A. Section 02050: Site Demolition
- B. Section 02100: Site Preparation (Clearing and Grubbing)
- C. Section 02550: Site Utilities - Water and Sewer Systems

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Commercial Standards:

CONTRACTOR is to use the latest edition/revision available for all Commercial Standards reference within this contract unless otherwise directed by the applicable regulatory agency.

ASTM C 33 Specifications for Concrete Aggregates.

ASTM D 422 Method for Particle-Size Analysis of Soils.

ASTM D 698 Test Methods for Moisture-Density Relations of Soils and Soil Aggregate Mixtures, Using 5.5-lb. (2.49-kg) hammer and 12-in. (304.8-mm) Drop.

ASTM D 1140 Test Method for Density of Soil in Place by the Sand Cone Method.

ASTM D 1557 Test methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-lb. (4.54-kg) hammer and 18-in. (457-mm) Drop.

ASTM D 1633 Test Method for Compressive Strength of Molded Soil-Cement Cylinders.

ASTM D 2419 Test Method for Sand Equivalent Value of Soils and Fine Aggregate.

ASTM D 2487 Classification of Soils for Engineering Purposes.

ASTM D 2901 Test Method for Cement Content of Freshly Mixed Soil-Cement.

ASTM D 2922 Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

ASTM D 4253 Test Methods for Maximum Index Density of Soils Using a Vibratory Table.

ASTM D 4254 Test Methods for Minimum Index Density of Soils and Calculation of Relative Density.

American Association of State Highway and Transportation Officials:

- a. AASHTO-T99
- b. AASHTO-T180

1.4 TRENCH SAFETY

- A. The Contractor's attention is directed to the "Florida Trench Safety Act" which mandates the provisions of Subpart P, Section 1926.650 of the OSHA Safety and Health Standards for Construction, which requires that all trenches of depth greater than 5 feet shall be shored or sloped to the angle of repose. All excavations shall be properly shored, sheeted, and braced or cut back at the proper slope to provide safe working conditions, to prevent shifting of material, to prevent damage to structures or other work, and to avoid delay to the work, all in compliance with the U.S. Department of Labor Safety and Health Act, the State of Florida Trench

Safety Act, and under Section 107 of the Contract Work Hours and Safety Act (PL 91-54 or as amended). In all cases where a conflict exists in the requirements of OSHA Regulations, Florida Trench Safety Act and these specifications, the requirements of the state agency shall prevail.

- B. Submit information in accordance with Section 01300 - Submittals, detailing the method of trench safety to be implemented. Submittal should include geotechnical investigation results if required.
- C. It shall be the Contractor's responsibility to acquaint himself with existing conditions and to locate structures and utilities along the proposed utility alignment in order to avoid conflicts. Where actual conflicts are unavoidable, work shall be coordinated with the facility owner and performed so as to cause as little interference as possible with the service rendered by the facility disturbed. All affected utilities shall be notified prior to excavation in their vicinity.
- D. Contractor shall backfill or steel plate all trenches at the end of each workday so as to provide a surface passable by standard vehicular traffic.

1.5 QUALITY ASSURANCE

- A. Soils testing will be done by a testing laboratory of the Owner's choice at the Owner's expense with the exception that all failed tests shall be paid for by the Contractor.
- B. Where soil material is required to be compacted to a percentage of maximum density, the maximum density at optimum moisture content will be determined in accordance with ASTM D 1557. Where cohesionless, free draining soil material is required to be compacted to a percentage of relative density, the calculation of relative density will be determined in accordance with ASTM D 4253 and D 4254. Field density in-place tests will be performed in accordance with ASTM D 1556, ASTM D 2922, or by such other means acceptable to the Owner or Engineer.
- C. In case the tests of the fill or backfill show non-compliance with the required density, the Contractor shall accomplish such remedy as may be required to insure compliance.
- D. Particle size analysis of soils and aggregates will be performed using ASTM D 422.
- E. Determination of sand equivalent value will be performed using ASTM D 2419.
- F. Unified Soil Classification System: References in these specifications to soil classification types and standards set forth in ASTM D 2487 shall have the meanings and definitions indicated in the chart illustrated at the end of this Section. The chart is reproduced herein for the convenience of the Contractor only, and no

limitation, amendment, or modification is intended thereby. The Contractor shall be bound by all applicable provisions of said ASTM D 2487 in the interpretation of soil classifications.

PART 2 - PRODUCTS

2.1 SUITABLE FILL AND BACKFILL MATERIAL REQUIREMENTS

- A. General: Fill, backfill, and embankment materials shall be suitable selected or processed clean, fine earth, rock, or sand, free from grass, roots, brush, or other vegetation.
- B. Fill and backfill materials to be placed within 6 inches of any structure or pipe shall be free of rocks or unbroken masses of earth materials having a maximum dimension larger than 3 inches.
- C. Suitable Materials: Soils not classified as unsuitable as defined in Paragraph entitled, "Unsuitable Material" herein, are defined as suitable materials and may be used in fills, backfilling, and embankment construction subject to the specified limitations. In addition, when acceptable to the Engineer, some of the material listed as unsuitable may be used when thoroughly mixed with suitable material to form a stable composite.
- D. Suitable materials may be obtained from on-site excavations, may be processed on-site materials, or may be imported. If imported materials are required to meet the requirements of this Section or to meet the quantity requirements of the project the Contractor shall provide the imported materials within the scope of the contract.
- E. The following types of suitable materials are designated and defined as follows:
 - 1. Type A: Crushed limerock or sand with 100 percent passing a 1-inch sieve and a sand equivalent value not less than 50.
 - 2. Type B: Crushed limerock or sand with 100 percent passing a 1/2-inch sieve and a sand equivalent value not less than 50.
 - 3. Type C: Sand with 100 percent passing a 3/8-inch sieve, at least 90 percent passing a Number 4 sieve, and a sand equivalent value not less than 30.
 - 4. Type D: Crushed limerock with 100 percent passing a 1-inch sieve and not more than 10 percent passing a Number 4 sieve.
 - 5. Type E: Crushed limerock with 100 percent passing a 3/4-inch sieve and not more than 10 percent passing a Number 4 sieve.

6. Type F: Crushed limerock meeting the following gradation requirements:

<u>Sieve Size</u>	<u>Percentage Passing</u>
2-inch	100
1-1/2-inch	90 - 100
1-inch	20 - 55
3/4-inch	0 - 15
No. 200	0 - 3

7. Type G: Crushed rock aggregate base material of such nature that it can be compacted readily by watering and rolling to form a firm, stable base for pavements. At least 97% of the material shall pass a 3-1/2 inch screen and the material shall be uniformly graded uniformly down to the 200 sieve. The liquid limit shall not exceed 35 and the plastic index shall not exceed 10. For stabilized base, the material shall meet all of the above requirements except that 97% shall pass a 1-1/2 inch screen.

8. Type H: Drainrock shall be crushed rock or gravel, durable and free from slaking or decomposition under the action of alternate wetting or drying. The material shall be uniformly graded and shall meet the following gradation requirements:

<u>Sieve Size</u>	<u>Percentage Passing</u>
1-inch	100
3/4-inch	90 - 100
3/8-inch	40 - 100
No. 4	25 - 40
No. 8	18 - 33
No. 30	5 - 15
No. 50	0 - 7
No. 200	0 - 3

The drain rock shall have a sand equivalent value not less than 75.

9. Type I: Any other suitable material as defined in Paragraph 2.01, herein.
10. Type J: Material which consists of Type H material, or any mixture of Types B, C, G, and H materials which has been cement-treated so that the cement content of the material is not less than 5 percent by weight when tested in accordance with ASTM D 2901. The ultimate compressive strength at 28 days shall be not less than 400 psi when tested in accordance with ASTM D1633.

11. Type K: Stockpiled topsoil material which has been obtained at the site by removing soil to a depth not exceeding 2 feet. Removal of the topsoil shall be done after the area has been stripped of vegetation and debris as specified.

2.2 UNSUITABLE MATERIAL

- A. Unsuitable soils for fill material shall include soils which, when classified under ASTM D 2487, fall in the classifications of Pt, OH, CH, MH, HL, or SC.
- B. In addition, any soil that cannot be compacted sufficiently to achieve the percentage of maximum density specified for the intended use shall be classed as unsuitable material.

2.3 USE OF FILL, BACKFILL, AND EMBANKMENT MATERIAL TYPES

- A. Use the types of materials designated herein for all required fill, backfill, and embankment construction hereunder.
- B. Where these Specifications conflict with the requirements of any local agency having jurisdiction, or with the requirements of a material manufacturer, the Engineer shall be immediately notified. In case of conflict therewith, the Contractor shall use the most stringent requirement, as determined by the Engineer.
- C. Fill and backfill types shall be used in accordance with the following provisions:
 1. Embankment fills shall be constructed of Type I material, as defined in Paragraph 2.01E, herein, or any mixture of Type I and Type A through Type H materials.
 2. Pipe zone backfill, as defined under "Pipe and Utility Trench Backfill" herein, shall consist of the following materials for each pipe material listed below. Where pipelines are installed on grades exceeding 4 percent, and where backfill materials are graded such that there is less than 10 percent passing a Number 4 sieve, trench plugs of Type J material shall be provided at minimum intervals of 200 feet.
 - a. Mortar coated pipe and concrete pipe, shall be provided Type A, B, C, D, or E pipe zone backfill material.
 - b. Coal tar enamel coated pipe, polyethylene encased pipe, tape wrapped pipe, and other non-mortar coated pipe shall be backfilled with Type C pipe zone backfill material.
 - c. Plastic pipe and vitrified clay pipe shall be backfilled with Types B, C, or E pipe zone backfill material.

3. Trench zone backfill for pipelines as defined under "Pipe and Utility Trench Backfill" shall be Type I backfill material or any of Types A through H backfill materials or any mixture thereof.
4. Final backfill material for pipelines under paved areas, as defined under "Pipe and Utility Trench Backfill" shall be Type G backfill material. Final backfill under areas not paved shall be the same materials as that used for trench backfill, except that Type K material shall be used for final backfill in agricultural areas unless otherwise shown or specified.
5. Trench backfill and final backfill for pipelines under structures shall be the same material as used in the pipe zone, except where concrete encasement is required by the Contract Documents.
6. Aggregate base materials under pavements shall be Type G material constructed to the thickness shown or specified.
7. Backfill around structures shall be Type I material, or Types A through Type H materials, or any mixture thereof.
8. Backfill materials beneath structures shall be as follows:
 - a. Drainrock materials under reservoirs or other water retaining structures with underdrain systems shall be Type H material.
 - b. Under concrete reservoirs or other water retaining structures without underdrain systems, Types G or H materials shall be used.
 - c. Under structures where groundwater must be removed to allow placement of concrete, Type F material shall be used.
 - d. Under all other structures, Type D, E, G, or H material shall be used.
9. Backfill used to replace pipeline trench over-excavation shall be a layer of Type F material with a 6-inch top filter layer of Type E material for wet trench conditions or the same material as used for the pipe zone backfill if the trench conditions are not wet.
10. The top 6 inches of fill on reservoir roofs, embankment fills around reservoirs, and all other embankment fills shall consist of Type K material, topsoil.
11. Where specified or shown, pea gravel shall be Type E material.

PART 3 - EXECUTION

3.1 CLEARING

- A. The Contractor shall perform all clearing necessary for the proper installation of all piping and appurtenances.
- B. Plantings, shrubbery, trees, utility poles or structures subject to damage resulting from the excavation shall be transplanted, relocated, braced, shored, or otherwise protected and preserved unless otherwise protected and preserved unless otherwise directed by the Engineer. Injury or damage to the referenced items shall be restored at no cost to the Owner.
- C. Protection of Existing Utilities and Structures:
 - 1. Take all precautions and utilize all facilities required to protect existing utilities and structures. Advise each Utility Company at least three working days in advance of intent to excavate or do demolition work and give location of the job site. Request cooperative steps of the utility company and suggestions for procedures to avoid damage to its lines.
 - 2. Advise each person in physical control of powered equipment used in excavation or demolition work of the type and location of utility lines at the job site, the Utility Company assistance to expect, and procedures to follow to prevent damage.
 - 3. Immediately report to the Utility Company and the Engineer any break, leak or other damage to the lines or protective coatings made or discovered during the work and immediately alert the occupants of premises of any emergency created or discovered.
 - 4. Allow free access to Utility Company personnel at all times for purposes of maintenance, repair and inspection.

3.2 REMOVAL OF WATER

- A. Contractor shall not discharge water in any manner that will:
 - 1. Adversely affect water quality of adjoining water bodies.
 - 2. Violate Federal, State or Local laws or regulations.
 - 3. Allow discharge to flow onto private property.
 - 4. Hamper movement of traffic.

5. Damage portions of the work previously constructed.

- B. Provide and operate equipment adequate to keep all excavations and trenches free of water. Remove all water during periods when concrete is being deposited, when pipe is being laid, during the placing of backfill, and at such other times as required for efficient and safe execution of the Work. Avoid settlement or damage to adjacent property. Dispose of water in a manner that will not damage adjacent property. When dewatering open excavations, dewater from outside the structural limits and from a point below the bottom of the excavation when possible. Design dewatering system to prevent removal of fines from existing ground.
- C. Contractor shall be responsible for determining all requirements, make all necessary arrangements and obtain all permits that may be required for dewatering operations.
- D. The engine for dewatering pump(s) shall have a second, in-line, muffler added to the normal muffler and the set-up shall be baffled to minimize noise. The Contractor shall be responsible for any nuisance created due to the disposal of the water from his discharge system.
- E. The method of dewatering shall be approved by Engineer and all applicable regulatory agencies. It may include:
 - 1. Well points
 - 2. Sump pumps
 - 3. Bedding rock
 - 4. Other approved items
- F. The maximum allowable turbidity limit for waters discharging from dewatering operations shall meet applicable water quality standards. The water discharged from the Contractor's dewatering operation shall not exceed this limit.

3.3 STRUCTURE, ROADWAY, AND EMBANKMENT EXCAVATION

- A. General: Except where specifically provided to the contrary, excavation shall include the removal of all materials of whatever nature encountered, including all obstructions of any nature that would interfere with the proper execution and completion of the work. The removal of said materials shall conform to the lines and grades shown or ordered. Furnish, place, and maintain all supports and shoring that may be required for the sides of the excavations, and all pumping, ditching, or other measures for the removal or exclusion of water. Dispose of storm water, groundwater, and wastewater reaching the site of the Work from any source so as to

prevent damage to the Work or adjoining property. Excavations shall be sloped or otherwise supported in a safe manner in accordance with applicable State safety requirements and the requirements of OSHA Safety and Health Standards for Construction (29CFR1926).

- B. **Excavation Beneath Structures and Embankments:** Except where otherwise specified for a particular structure or ordered by the Engineer, excavation shall be carried to the grade of the bottom of the footing or slab. Where shown or ordered, areas beneath structures or fills shall be over-excavated. The subgrade areas beneath embankments shall be excavated to remove not less than the top 6 inches of original material and where such subgrade is sloped, the original material shall be benched. When such over-excavation is shown, both over-excavation and subsequent backfill to the required grade shall be performed by the Contractor. When such over-excavation is not shown but is ordered by the Engineer, such over-excavation and any resulting backfill will be paid for under a separate unit price bid item if such bid item has been established; otherwise payment will be made in accordance with a negotiated price. After the required excavation or over-excavation has been completed, the exposed surface shall be scarified to a depth of 6 inches, brought to optimum moisture content, and rolled with heavy compaction equipment to obtain 95 percent of maximum density.
- C. **Excavation Beneath Paved Areas:** Excavation under areas to be paved shall extend to the bottom of the aggregate base, if such base is called for; otherwise it shall extend for the paving thickness. After the required excavation has been completed, the exposed surface shall be scarified, brought to optimum moisture content, and rolled with heavy compaction equipment to obtain 95 percent of maximum density.
- D. Where installation of pipelines, miscellaneous structures, and appurtenances necessitate breaking a paved surface, make cuts in a neat uniform fashion forming straight lines parallel with the centerline of the trench. Cut offsets at right angles to the centerline of the trench.
- E. Protect edges of cut pavement during excavation to prevent raveling or breaking square edges prior to pavement replacement.
- F. **Notification of Engineer:** Notify the Engineer at least 3 days in advance of completion of any structure excavation and allow the Engineer a review period of at least one day before the exposed foundation is scarified and compacted or is covered with backfill or with any construction materials.

3.4 PIPELINE AND UTILITY TRENCH EXCAVATION

- A. **General:** Unless otherwise shown or ordered, excavation for pipelines and utilities shall be open-cut trenches. Trench widths shall be kept as narrow as is practical for the method of pipe zone densification selected by the Contractor, but shall have a

minimum width at the bottom of the trench equal to the outside diameter of the pipe plus 24 inches maximum for mechanical compaction methods and 18 inches for water consolidation methods. The maximum width at the top of the pipe shall be equal to the outside diameter of the pipe plus 36 inches for pipe diameters 18-inches and larger and to the outside diameter of the pipe plus 24 inches for pipe diameters less than 18-inches.

- B. Where unsuitable bearing material is encountered in the trench bottom, continue excavation until the unsuitable material is removed, solid bearing is obtained or can be established, or concrete cradle can be placed. If no concrete cradle is to be installed, refill the trench to required pipeline grade with Type II pipe protection material.
- C. Where Type II, III or IV pipe protection material is being utilized and rock is encountered in the trench bottom, remove the rock to a depth of 5 inches plus 0.1 X O.D of the pipe below design trench bottom and place the Type II, III or IV pipe protection material
- D. Where the Contractor, by error or intent, excavates beyond the minimum required depth, backfill the trench to the required pipeline grade with Type II, III or IV pipe protection material as specified.
- E. Trench Bottom: Except when pipe bedding is required, the bottom of the trench shall be excavated uniformly to the grade of the bottom of the pipe. The trench bottom shall be given a final trim, using a string line for establishing grade, such that each pipe section when first laid will be continually in contact with the ground along the extreme bottom of the pipe. Rounding out the trench to form a cradle for the pipe will not be required.
- F. Open Trench: The maximum amount of open trench permitted shall be no greater than the distance from one intersecting street to the next along the roadway. All trenches shall be fully backfilled at the end of each day or, in lieu thereof, shall be covered by heavy steel plates adequately braced and capable of supporting vehicular traffic in those locations where it is impractical to backfill at the end of each day. The above requirements for backfilling or use of steel plate will be waived in cases where the trench is located further than 100 feet from any traveled roadway or occupied structure. In such cases, however, barricades and warning lights meeting OSHA requirements shall be provided and maintained.
- G. Trench Over-Excavation: Where the Drawings indicate that trenches shall be over-excavated, they shall be excavated to the depth shown, and then backfilled to the grade of the bottom of the pipe.
- H. Over-Excavation: When ordered by the Engineer, whether indicated on the Drawings or not, trenches shall be over-excavated beyond the depth shown. Such

over-excavation shall be to the depth ordered. The trench shall then be backfilled to the grade of the bottom of the pipe. All work specified in this Section shall be performed within the scope of the Contract when the over-excavation ordered by the Engineer is less than 6 inches below the limits shown. When the over-excavation ordered by the Engineer is 6 inches or greater below the limits shown, additional payment will be made to the Contractor for that portion of the work which is located below said 6-inch distance. Said additional payment will be made under separate unit price bid items for over-excavation and bedding if such bid items have been established; otherwise payment will be made in accordance with a negotiated price.

- I. Where pipelines are to be installed in embankment or structure fills, the fill shall be constructed to a level at least one foot above the top of the pipe before the trench is excavated.

3.5 OVER-EXCAVATION NOT ORDERED, SPECIFIED, OR SHOWN

- A. Any over-excavation carried below the grade ordered, specified, or shown, shall be backfilled to the required grade with the specified material and compaction. Such work shall be performed by the Contractor at his own expense.

3.6 EXCAVATION IN VICINITY OF TREES

- A. Except where trees are shown to be removed, trees shall be protected from injury during construction operations. No tree roots over 2 inches in diameter shall be cut without express permission of the Engineer. Trees shall be supported during excavation by any means previously reviewed/approved by the Engineer and/or applicable regulatory agency.

3.7 ROCK EXCAVATION

- A. Rock excavation shall include removal and disposal of the following: (1) all boulders measuring 1/3 of a cubic yard or more in volume; (2) all rock material in ledges, bedding deposits, and unstratified masses which cannot be removed without systematic drilling and blasting; (3) concrete or masonry structures which have been abandoned; and (4) conglomerate deposits which are so firmly cemented that they possess the characteristics of solid rock and which cannot be removed without systematic drilling and blasting.

3.8 CONTROL OF EXCAVATED MATERIAL

- A. Keep the ground surface, within a minimum of 2 feet of both sides of the excavated free of excavated material.
- B. Provide temporary barricades to prevent excavated material from encroaching on private property, walks, gutters, and storm drains.

- C. Maintain accessibility to all fire hydrants, valve pit covers, valve boxes, curb boxes, fire and police call boxes, and other utility controls at all times. Keep gutters clear or provide other satisfactory facilities for street drainage. Do not obstruct natural watercourses. Where necessary, provide temporary channels to allow the flow of water either along or across the site of work.

3.9 DISPOSAL OF EXCESS EXCAVATED MATERIAL

- A. Remove and dispose of all excess excavated material at a site selected by the CONTRACTOR and reviewed by the Engineer. The material being disposed should be tested for contamination, and disposed in accordance with Local, State and Federal regulations.

3.10 BACKFILL - GENERAL

- A. Backfill shall not be dropped directly upon any structure or pipe. Backfill shall not be placed around or upon any structure until the concrete has attained sufficient strength to withstand the loads imposed. Backfill around water retaining structures shall not be placed until the structures have been tested, and the structures shall be full of water while backfill is being placed.
- B. Except for drainrock materials being placed in over-excavated areas or trenches, backfill shall be placed after all water is removed from the excavation.

3.11 PLACING AND SPREADING OF BACKFILL MATERIALS

- A. Backfill materials shall be placed and spread evenly in layers. When compaction is achieved using mechanical equipment the layers shall be evenly spread so that when compacted each layer shall not exceed 12- inches in thickness. When compaction is achieved using flooding and jetting methods, each layer shall not exceed 3 feet in thickness after compaction.
- B. During spreading each layer shall be thoroughly mixed as necessary to promote uniformity of material in each layer. Pipe zone backfill materials shall be manually spread around and under the pipe so that when compacted the pipe zone backfill will provide uniform bearing and side support.
- C. Where the backfill material moisture content is below the optimum moisture content water shall be added before or during spreading until the property moisture content is achieved.
- D. Where the backfill material moisture content is too high to permit the specified degree of compaction the material shall be dried until the moisture content is satisfactory.

3.12 COMPACTION OF FILL, BACKFILL, AND EMBANKMENT MATERIALS

- A. Each layer of Types A, B, C, G, H, I, and K backfill materials as defined in Paragraph 2.01E, herein, where the material is graded such that at least 10 percent passes a No. 4 sieve, shall be mechanically compacted to the specified percentage of maximum density. Equipment that is consistently capable of achieving the required degree of compaction shall be used and each layer shall be compacted over its entire area while the material is at the required moisture content.
- B. Each layer of Type D, E, F, and J backfill materials shall be compacted by means of at least 2 passes from a flat plate vibratory compactor. When such materials are used for pipe zone backfill, vibratory compaction shall be used at the top of the pipe zone or at vertical intervals of 24 inches, whichever is the least distance from the subgrade.
- C. Flooding, ponding, or jetting shall not be used for fill on roads, backfill around structures, backfill around reservoir walls, for final backfill materials, or aggregate base materials.
- D. Pipe zone backfill materials that are granular may be compacted by a combination of flooding and vibration using concrete vibrators or by jetting, when acceptable to the Engineer.
- E. Pipeline trench zone backfill materials, containing 5 percent or less of material passing a No. 200 sieve, may be compacted using flooding and jetting or vibration if the Contractor uses effective procedures that yield the specified compaction test results. Flooding and jetting shall not be done in such a manner that the pipe or nearby utilities are damaged, in areas of poorly draining or expansive soils, or where the use of the procedure is prohibited by any agency having jurisdiction over the street or right-of-way. Suitable jet pipes or immersible vibrators shall be used so that each backfill layer is saturated and consolidated to its full depth before the next layer is placed. Jet pipes shall be kept at least 6 inches away from the pipe where the backfill is being consolidated and 2 feet away from other pipes or utilities.
- F. Equipment weighing more than 10,000 pounds shall not be used closer to walls than a horizontal distance equal to the depth of the fill at that time. Hand operated power compaction equipment shall be used where use of heavier equipment is impractical or restricted due to weight limitations.
- G. Compacting Testing:
 - 1. Conduct one test for each 1,000 linear feet of pipeline, or a minimum of two compaction tests for projects with less than 1,000 linear feet of pipeline, unless CITY specifies otherwise.

2. Conduct compaction tests at locations as directed by the Engineer during backfilling operations.
 3. Determine compaction in state highways and shoulders by the testing procedure contained in Florida Department of Transportation, Standard Specifications for Road and Bridge Construction Section 125.8.
 4. Determine compaction in areas other than state highways and shoulders by the testing procedure contained in ASTM D698.
- H. The following compaction test requirements shall be in accordance with ASTM D 1557 for Type A, B, C, G, H, I, and K materials. Where agency or utility company requirements govern, the highest compaction standards shall apply.

<u>Location or Use of Fill</u>	<u>Percentage Of Maximum Density</u>
Pipe zone backfill portion above bedding for flexible pipe.	95
Pipe zone backfill bedding and over-excavated zones under bedding/ pipe for flexible pipe.	95
Pipe zone backfill portion above bedding for rigid pipe.	95
Pipe zone backfill bedding and over-excavated zones under bedding/ pipe for rigid pipe.	95
Final backfill, beneath paved areas or structures.	98
Final backfill, not beneath paved areas or structures.	90
Trench zone backfill.	95
Embankments.	90
Embankments, beneath paved areas of structures.	95
Backfill beneath structures, reservoirs.	95
Backfill around structures, on reservoir or structure roof.	80
Topsoil (Type K material)	80
Aggregate base (Type G material)	98

- I. Trench Backfill Requirements: The pipe has been structurally designed based upon the trench configuration specified in Section 3.03A, herein.
- J. Maintain the indicated trench cross section up to a horizontal plane lying 6 inches above the top of the pipe.
- K. If, at any location under said horizontal plane, the trench walls we sloped or exceed the maximum trench widths indicated in the Contract Documents are exceeded, the pipe zone backfill shall be "improved" or the pipe class increased as specified herein, within the scope of the Contract. "Improved" backfill shall mean sand backfill or other equivalent materials acceptable to the Engineer.
- L. If the allowable deflection specified for the pipe is exceeded, expose and reround or replace the pipe, repair all damaged lining and coating, and reinstall the pipe zone material and trench backfill as specified within the scope of the Contract.

3.13 PIPE AND UTILITY TRENCH BACKFILL

- A. Pipe Zone Backfill: The pipe zone is defined as that portion of the vertical trench cross-section lying between a plane 6 inches below the bottom surface of the pipe, i.e., the trench subgrade, and a plane at a point 6 inches above the top surface of the pipe. The bedding for flexible pipe is defined as that portion of pipe zone backfill material between the trench subgrade and the bottom of the pipe. The bedding for rigid pipe is defined as that portion of the pipe zone backfill material between the trench subgrade and a level line which varies from the bottom of the pipe to the spring line as shown.
- B. Bedding shall be provided for all sewers, drainage pipelines, and other gravity flow pipelines in accordance with the details shown on the Drawings and materials specified herein.
- C. Where bedding is required after compaction of the bedding, perform a final trim using a string line for establishing grade, such that each pipe section when first laid will be continually in contact with the bedding along the extreme bottom of the pipe.
- D. The pipe zone shall be backfilled with the specified backfill material. Exercise care to prevent damage to the pipeline coating, cathodic bonds, or the pipe itself during the installation and backfill operations.
- E. Trench Zone Backfill: After the pipe zone backfill has been placed as specified above, and after all excess water has completely drained from the trench, backfilling of the trench zone may proceed. The trench zone is defined as that portion of the vertical trench cross-section lying between a plane 6 inches above the top surface of the pipe and a plane at a point 18 inches below the finished surface grade, or if the

trench is under pavement, 18 inches below the roadway subgrade. If flooding, ponding, or jetting is used the pipe shall be filled with water to prevent flotation.

- F. Final Backfill: Final backfill is all backfill in the trench cross-sectional area within 10 inches of finished grade, or if the trench is under pavement, all backfill to the roadway base restoration.

3.14 FIELD DENSITY AND MOISTURE TESTS

- A. An independent soil testing company shall determine the in-place density and moisture content of the subgrade and compacted fill by any one or combination of the following methods: ASTM D 1556, D 3017, or D 2922. The Contractor shall cooperate with this testing work by leveling small test areas as designated by the soil testing company. These test results, certified by the soil testing company and reviewed by the Engineer, shall indicate that the actual soil compaction found meets these Specifications. Testing will occur as the work progresses and compliance with the Specifications is required prior to final acceptance and payment for the work.
- B. A minimum of one test every 200 cubic yards of fill, one test per every 2,000 square feet of subgrade, or 4 tests per lift, whichever is larger in number of tests, shall be conducted.
- C. Any re-testing required showing compliance with these Specifications shall be within the Scope of the Contract.

3.15 EMBANKMENT CONSTRUCTION

- A. The area where an embankment is to be constructed shall be cleared of all vegetation, roots and foreign material. Following this, the surface shall be moistened, scarified to a depth of 6 inches, and rolled or otherwise mechanically compacted to 98 percent of maximum density under structures and paved areas, and 90 percent of maximum density elsewhere.
- B. Where embankment or structure fills are constructed over pipelines, the first 4 feet of fill over the pipe shall be constructed using light placement and compaction equipment that does not damage the pipe.

3.16 PROTECTIVE CONCRETE SLAB

- A. Protective concrete slab shall be installed over the top of trenches, where required to protect the installed utility against excessive loads or when insufficient cover exists.
- B. Required concrete shall comply with the applicable provisions of ACI-318 and shall have a minimum 3,000 pounds per square inch 28-day compressive strength.

3.17 RESTORATION OF EXISTING SURFACES

- A. All concrete and pavement disturbed by the operations required under this Section shall be restored as indicated on the drawing and specifications.

3.18 ROUGH GRADING

- A. Rough grade areas disturbed by construction to a uniform finish from the bases for terraces, banks, lawns and paved areas.
- B. Grade areas to be paved to depths required for placing sub base and paving materials.

3.19 RESTORATION OF UNPAVED SURFACES

- A. Restore unpaved surface disturbed by construction to equal or better than the surface condition prior to construction.
- B. All excavations within the road or street right-of-way must be backfilled the same day.
- C. Pavement cuts must be repaired with asphalt pavement within 48 hours.

3.20 TRAFFIC CONTROL

- A. Employ traffic control measures in accordance with Florida Department of Transportation Manual of Traffic Controls and Safe Practices for Streets and Highway Construction, Maintenance and Utility Operations and the CITY meeting BTCED standards.
- B. The Contractor shall submit a maintenance of traffic plan to the CITY on the appropriate MOT forms.
- C. Maintain access to all streets and private drives.
- D. Provide and maintain signs, flashing warning lights, barricades, markers, and other protective devices as required to conform with construction operations and to keep traffic flowing with minimum restrictions.
- E. Comply with state and local codes, permits and regulations.

END OF SECTION

SECTION 02222

CONTRACTOR'S RESPONSIBILITIES

1.1 DESCRIPTION

A. Facilities and Structures Interfering with Contractors Operations

The Contractor is required to fully inform himself concerning the location of public and private facilities and structures on, under, or over the project which may or may not require relocation, adjustment, and/or reconstruction, and which may interfere with his operations, and it is assumed that he has prepared his bid and entered into the Contract in full understanding of the conditions to be encountered and his responsibility therewith. The Owner has shown on the Drawings such facilities and structure that are obvious from a visit to the site, the locations of which have been obtained from existing maps and records and are, therefore, shown in approximate locations. Such indication on the Drawings shall not relieve the Contractor of any responsibility in this respect. The Owner shall not be held responsible for any omission or failure to give notice to the Contractor of any facility or structure on, under, or over the project.

B. It shall be the duty of the Contractor, upon execution of the Contract, to inform all public services companies, individuals, and any others owning or controlling any facilities or structures within the limits of the project which may conflict with construction of this project.

C. It shall be the responsibility of the Contractor to make proper arrangements with the Owners of said facilities for the exact field locations of said facilities. The Contractor shall cooperate with the Owners of said facilities and structures by arranging and performing his work in and around such facilities and structures, without additional compensation from the Owner, to facilitate their relocation, preservation, or reconstruction.

D. Any facility or structure damaged by the Contractor shall be repaired or replaced at his expense. Any facility or structure disturbed by the Contractor after relocation by its Owner shall be reset at the expense of the Contractor.

E. The Contractor shall save harmless the Owner from any expenses incurred in the relocation, preservation, or reconstruction of any and all public or private facilities or structures.

F. The Contractor shall provide and furnish approved FDOT maintenance of traffic plans as specified including control devices, warning devices, barriers and flagmen as required. The maintenance of traffic plan shall provide for proper vehicular, pedestrian and bicycle traffic over the bridge 24 hours a day during the entire

construction period and be processed through FDOT, Broward County and/or City of Pompano Beach as required.

- G. The Contractor shall maintain utility services throughout the entire construction period. If necessary, the Contractor may need to provide temporary measures to maintain utility service in the area until permanent installation/adjustments of these utilities are completed per the plans. All temporary measures must be approved by the City and Engineer prior to implementation and may require the contractor to provide signed and sealed documents by a Professional Engineer.
- H. Provide a detailed Maintenance of Traffic Plan which shall include provisions for vehicular, pedestrian and/or school student traffic at all times. Cost associated with the following provisions shall be part of the cost of maintenance of traffic pay item. The following are minimum requirements:
 - 1. It shall be the responsibility of the CONTRACTOR to install any necessary temporary or permanent pavement, road rock, pavement marking and signage and/or signalization as required to maintain at least one lane (10ft-minimum and/or otherwise approved) open at all times (24 hours a day).
 - 2. The CONTRACTOR shall provide at least one lane open at all times (24 hours a day). This lane shall be able to provide means of ingress and egress to area residents, emergency vehicles, and other type vehicles to and from the island. In order to provide this the CONTRACTOR may need to provide a temporary signal to allow traffic to be controlled accordingly across the bridge during construction. The CONTRACTOR must provide all requires signal information (specifications/location/timing/etc.) to Broward County Traffic Engineering, City of Pompano Beach and the Engineer for review and approval.
 - 3. CONTRACTOR shall be responsible for providing a safe and adequate walking surface for all school children/pedestrians. This safe walk route shall be part of the Maintenance of Traffic Plan.
- I. Contractor shall complete all permitting requirements listed herein per the requirements of the Contract Documents.
- J. Contractor is responsible for familiarizing himself with the Contract Documents (including the Specifications and Plans). All requirements included or implied within the Contract Documents shall be the Contractor's responsibility.

END OF SECTION

SECTION 02280 – SOIL TREATMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. **Soil** treatment with termiticide.

1.3 SUBMITTALS

- A. Product Data: For each type of termite control product.
 - 1. Include the EPA-Registered Label for termiticide products.
- B. Qualification Data: For qualified Installer.
- C. Product Certificates: For termite control products, from manufacturer.
- D. Soil Treatment Application Report: After application of termiticide is completed, submit report for Owner's records and include the following:
 - 1. Date and time of application.
 - 2. Moisture content of soil before application.
 - 3. Termiticide brand name and manufacturer.
 - 4. Quantity of undiluted termiticide used.
 - 5. Dilutions, methods, volumes used, and rates of application.
 - 6. Areas of application.
 - 7. Water source for application.
- E. Warranties: Sample of special warranties.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: A specialist who is licensed according to regulations of authorities having jurisdiction to apply termite control treatment and products in jurisdiction where Project is located, and who employs workers trained and approved by manufacturer to install manufacturer's products.

- B. Regulatory Requirements: Formulate and apply termiticides and termiticide devices according to the EPA-Registered Label.
- C. Source Limitations: Obtain termite control products from single manufacturer.

1.5 PROJECT CONDITIONS

- A. Environmental Limitations: To ensure penetration, do not treat soil that is water saturated . Do not treat soil while precipitation is occurring. Comply with requirements of the EPA-Registered Label and requirements of authorities having jurisdiction.
- B. Coordinate soil treatment application with excavating, filling, grading, and concreting operations. Treat soil under footings, grade beams, and ground-supported slabs before construction.

1.6 WARRANTY

- A. Soil Treatment Special Warranty: Manufacturer's standard form, signed by Applicator and Contractor, certifying that termite control work, consisting of applied soil termiticide treatment, will prevent infestation of subterranean termites. If subterranean termite activity or damage is discovered during warranty period, re-treat soil and repair or replace damage caused by termite infestation.

- 1. Warranty Period: Three years from date of Substantial Completion.

1.7 MAINTENANCE SERVICE

- A. Continuing Service: Beginning at Substantial Completion, provide 12 months' continuing service including monitoring, inspection, and re-treatment for occurrences of termite activity. Provide a standard continuing service agreement. State services, obligations, conditions, terms for agreement period, and terms for future renewal options.

PART 2 - PRODUCTS

2.1 SOIL TREATMENT

- A. Termiticide: Provide an EPA-Registered termiticide, complying with requirements of authorities having jurisdiction, in an aqueous solution formulated to prevent termite infestation. Provide quantity required for application at the label volume and rate for the maximum termiticide concentration allowed for each specific use, according to product's EPA-Registered Label.

- 1. Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. BASF Corporation, Agricultural Products; Termidor.
 - b. Bayer Environmental Science; Premise 75.

- c. FMC Corporation, Agricultural Products Group; Dragnet FT, Talstar, Prevail.
 - d. Syngenta; Demon TC, Prelude, Probuild TC.
2. Service Life of Treatment: Soil treatment termiticide that is effective for not less than three years against infestation of subterranean termites.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for moisture content of soil per termiticide label requirements, interfaces with earthwork, slab and foundation work, landscaping, utility installation, and other conditions affecting performance of termite control.
- B. Proceed with application only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. General: Comply with the most stringent requirements of authorities having jurisdiction and with manufacturer's written instructions for preparation before beginning application of termite control treatment. Remove all extraneous sources of wood cellulose and other edible materials such as wood debris, tree stumps and roots, stakes, formwork, and construction waste wood from soil within and around foundations.
- B. Soil Treatment Preparation: Remove foreign matter and impermeable soil materials that could decrease treatment effectiveness on areas to be treated. Loosen, rake, and level soil to be treated except previously compacted areas under slabs and footings. Termiticides may be applied before placing compacted fill under slabs if recommended in writing by termiticide manufacturer.
 - 1. Fit filling hose connected to water source at the site with a backflow preventer, complying with requirements of authorities having jurisdiction.

3.3 APPLICATION, GENERAL

- A. General: Comply with the most stringent requirements of authorities having jurisdiction and with manufacturer's EPA-Registered Label for products.

3.4 APPLYING SOIL TREATMENT

- A. Application: Mix soil treatment termiticide solution to a uniform consistency. Provide quantity required for application at the label volume and rate for the maximum specified concentration of termiticide, according to manufacturer's EPA-Registered Label, to the following so that a continuous horizontal and vertical termiticidal barrier or treated zone is established around and under building construction. Distribute treatment evenly.

1. Slabs-on-Grade and Basement Slabs: Under ground-supported slab construction, including footings, building slabs, and attached slabs as an overall treatment. Treat soil materials before concrete footings and slabs are placed.
 2. Foundations: Adjacent soil, including soil along the entire inside perimeter of foundation walls; along both sides of interior partition walls; around plumbing pipes and electric conduit penetrating the slab; around interior column footers, piers, and chimney bases; and along the entire outside perimeter, from grade to bottom of footing. Avoid soil washout around footings.
 3. Penetrations: At expansion joints, control joints, and areas where slabs will be penetrated.
- B. Avoid disturbance of treated soil after application. Keep off treated areas until completely dry.
- C. Protect termiticide solution, dispersed in treated soils and fills, from being diluted until ground-supported slabs are installed. Use waterproof barrier according to EPA-Registered Label instructions.
- D. Post warning signs in areas of application.
- E. Reapply soil treatment solution to areas disturbed by subsequent excavation, grading, landscaping, or other construction activities following application.

END OF SECTION 02280

SECTION 02317

EXCAVATING, BACKFILLING AND COMPACTING FOR UTILITIES

PART 1 - GENERAL

1.01 WORK INCLUDED

All material, labor, equipment, tools and superintendence necessary to furnish and install excavating, backfilling, and compacting for utilities, complete in place.

1.02 RELATED SECTIONS

1. Section 02332 – Select Embankment (Imported Fill)

1.02 SITE CONDITIONS

Site is subject to frequent inundating rains, and may be subject to localized flooding and surface flows. Site is subject to groundwater conditions that may impede the Work sequence. Contractor must use caution when working near existing tie-backs and/or anchors for the existing seawalls/bridge. Location and/or presence of tie-backs and/or anchors are unknown and it should be the Contractor's to take necessary precautions.

PART 2 - PRODUCTS

2.01 MATERIAL

When trench spoil is determined by the ENGINEER to be unsuitable as backfill material Select Embankment as specified under Section 02332 shall be used.

PART 3 - EXECUTION

3.01 LINE AND GRADE

All fill and excavation to be graded to subgrade (+ / -) 0.10 foot. CONTRACTOR shall be responsible for final grading, smoothing and clean-up of all areas between R.O.W. and / or easement lines and curb or pavement, regardless of work performed by other contractors.

3.02 EXCAVATION SPOIL

All spoil from excavation, except as may be determined by the ENGINEER to be unsuitable, shall be placed in the fill areas.

3.03 BENCHING

CONTRACTOR shall tie all fills into undisturbed bank with benches of not less than 3H:1 V, with a minimum H=2'-0.

3.04 GENERAL WORK SEQUENCE

Trench backfill shall be of sufficient depth to insure that the Work constructed under this Contract and existing adjacent utilities and structures are stabilized for all conditions that may exist and/or arise. CONTRACTOR shall not lay more pipe on any single day than trench backfill can be placed and compacted, and / or such that stabilization of the Work performed and surrounding existing utilities and structures cannot be achieved.

3.05 DEPTH OF FILL:

CONTRACTOR shall place fill in level, uniform layers. Each layer shall have a uniform loose thickness of not more than ten (10) inches and/or a maximum compacted thickness of not more than six (6) inches, whichever is less.

3.06 MOISTURE CONTENT:

CONTRACTOR shall prepare and bring each layer of fill to (+/-) 3% of optimum moisture. Where soils are placed in water the requirement for moisture control will be waived until such time as 1'-0 foot of comparative dry fill can be placed. At that time, moisture control and density control will begin again. The testing laboratory shall determine soils type and required moisture content. Where moisture fails to meet specified limits, CONTRACTOR shall rework, re-compact, and retest failed areas as follows:

1. High Moisture Content

Should moisture content exceed established maximum moisture content, CONTRACTOR shall spread, disk, aerate, and / or otherwise cause the moisture content to be reduced to within uniform maximum allowable limits.

2. Low Moisture Content

Should moisture content not reach established minimum moisture content, CONTRACTOR shall disk, sprinkler, water, mix, and/or otherwise bring the moisture content to within uniform minimum allowable limits.

3.07 COMPACTION

Reference Section 02200.

Where compaction fails to meet specified limits, CONTRACTOR shall rework, re-compact, and retest failed areas.

3.08 FIELD QUALITY CONTROL

Provide passing density / moisture tests in accordance with Section 01410, testing schedule.

END OF SECTION

SECTION 02319

EXCAVATING, BACKFILLING, AND COMPACTING FOR PAVING

PART 1 - GENERAL

1.01 WORK INCLUDED

All material, labor, equipment, tools and superintendence necessary to furnish and install excavating, backfilling, and compacting for paving, complete in place.

1.02 RELATED SECTIONS

Section 02100 - Site Preparation (Clearing and Grubbing)

Section 02200 - Earthwork

Section 02332 - Select Embankment (Imported Fill)

1.03 SITE CONDITION

Site is subject to frequent inundating rains, and may be subject to localized flooding and surface flows. Site is subject to groundwater conditions which may impede the Work sequence.

PART 2 – PRODUCTS (Not Used)

PART 3 - EXECUTION

3.01 PREPARATION

1. Clear grub and strip site and prepare the site as required prior to commencement of grading operations.
2. Eradicate and mix existing asphalt pavement into existing base material to a minimum depth of 6 inches below the existing grade. Reshape composite base material to conform with proposed grades; add additional material as required to provide 8 inch thick base minimum. Compact to 98% of the maximum dry density per AASHTO T-180C.

3.02 LINE AND GRADE

All fill and excavation to be graded to subgrade (+ / -) 0.10 foot. CONTRACTOR shall

be responsible for final grading, smoothing and clean-up of all areas between R.O.W. and / or easement lines and curb or pavement, regardless of work performed by other contractors. Final grade shall be established by "Blue Top" method.

3.03 EXCAVATION SPOIL

All spoil from excavation, except as may be determined by the ENGINEER to be unsuitable, shall be placed in the fill areas.

3.04 BENCHING

CONTRACTOR shall tie all fills into undisturbed bank with benches of not less than 3H:1 V, with a minimum H=2'-0.

3.05 DEPTH OF FILL:

CONTRACTOR shall place fill in level, uniform layers. Each layer shall have a uniform loose thickness of not more than ten (10) inches and/or a maximum compacted thickness of not more than six (6) inches, whichever is less.

3.06 MOISTURE CONTENT:

CONTRACTOR shall prepare and bring each layer of fill to (+/-) 3% of optimum moisture. Where soils are placed in water the requirement for moisture control will be waived until such time as 1'-0 foot of comparative dry fill can be placed. At that time, moisture control and density control will begin again. The testing laboratory shall determine soils type and required moisture content. Where moisture fails to meet specified limits, CONTRACTOR shall rework, re-compact, and retest failed areas as follows:

1. High Moisture Content:

Should moisture content exceed established maximum moisture content, CONTRACTOR shall spread, disk, aerate, and / or otherwise cause the moisture content to be reduced to within uniform maximum allowable limits.

2. Low Moisture Content:

Should moisture content not reach established minimum moisture content, CONTRACTOR shall disk, sprinkler, water, mix, and/or otherwise bring the moisture content to within uniform minimum allowable limits.

3.07 COMPACTION

Reference Section 02200

Where compaction fails to meet specified limits, CONTRACTOR shall rework, re-compact, and retest failed areas.

3.08 FIELD QUALITY CONTROL

Provide passing density / moisture tests in accordance with Section 01410, testing schedule.

END OF SECTION

SECTION 02332

SELECT EMBANKMENT (IMPORTED FILL)

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. All material, labor, equipment, tools and superintendence necessary to furnish and install select embankment (imported fill), complete in place. This includes any material required for demucking.

1.02 RELATED SECTIONS

- A. Section 02200: Earthwork
- B. Section 02550: Site Utilities – Water and Sewer Systems

1.03 REFERENCES

- A. ASTM D-2487 - Unified Soil Classification System.
- B. ASTM D-4318 - Liquid Limit, Plastic Limit, and Plasticity Index of Soils Test.
- C. ASTM D-1140 - Materials Greater than #200 Sieve.

PART 2 - PRODUCTS

2.01 MATERIAL

- A. Select embankment shall be classified as SP, SP - SM, SW or SW - SM in accordance with the Unified Soil Classification System.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install Select Embankment per:
 - 1. Section 02200: Earthwork
 - 2. Section 02550: Site Utilities – Water and Sewer Systems

END OF SECTION

SECTION 02400

DEWATERING

PART 1 - GENERAL

1.01 SCOPE

- A. The work covered by this section consists of furnishing all labor, equipment, and materials, and performing all operations required for dewatering all excavation as required insuring all work is performed in the dry.
- B. Contractor shall not discharge water in any manner that will:
 - 1. Adversely affect water quality of adjoining water bodies.
 - 2. Violate Federal, State or local laws or regulations.
 - 3. Allow discharge to flow onto private property.
 - 4. Hamper movement of traffic.
 - 5. Damage portions of the work previously constructed.
- C. See GENERAL REQUIREMENTS which contain information and requirements that apply to the Work specified herein and are mandatory for this project.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.01 GENERAL

- A. The Contractor shall provide all labor, materials, tools and equipment necessary to properly control the quality of the discharge from his dewatering operations as described herein. The Contractor shall comply with all applicable laws, rules and regulations governing the discharge of water from his dewatering operations. All dewatering shall be accomplished by the use of sanded wellpoints and other techniques deemed necessary by the Contractor to properly dewater the excavation site.

3.02 DEWATERING METHODS

- A. The method of dewatering shall be approved by Engineer. It may include:
1. Wellpoints
 2. Sump pumps
 3. Bedding rock
 4. Other approved items

3.03 SILTATION CONTROL

- A. The maximum allowable turbidity limit for waters discharging from dewatering operations shall meet applicable water quality standards. The water discharged from the Contractor's dewatering operation shall not exceed this limit.

3.04 BACTERIOLOGICAL CONTROL

- A. The Contractor shall utilize any and all methods approved by the Engineer to control the Bacteriological quality of wellpoint discharge into existing drainage ditches and/or canals. The maximum allowable level for fecal coliform in the wellpoint discharge is a mean MPN of 14 per 100 ML with not more than 10% of the samples exceeding an MPN of 43 per 100 ML.

END OF SECTION

SECTION 02485

FINISH GRADING SODDING AND EROSION SEDIMENTATION CONTROL

PART 1 - GENERAL

1.01 DESCRIPTION

- A. The work of this section includes, but is not limited to:
 - 1. Finish grading
 - 2. Sodding
 - 3. Erosion and sedimentation control
 - 4. Maintenance
 - 5. Guarantee

1.02 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver sod on pallets.
- B. Protect root system from exposure to wind or sun.
- C. Protect sod against dehydration, contamination and heating during transportation and delivery.
- D. Do not deliver more sod than can be installed within 24 hours.
- E. Keep stored sod moist and under shade or covered with moistened burlap.
- F. Do not pile sod more than 2' deep.
- G. Do not tear, stretch or drop sod.
- H. Mow sod in the field to a height of not more than 22 inches within five (5) days prior to lifting.
- I. Cut sod to a depth equal to the growth of the fibrous roots, but in no case less than 12 inches, exclusive of grass and thatch. Do not cut sod when the ground temperature is below 32°F.
- J. Deliver sod to the project site within 24 hours after being cut and place sod within 36 hours after being cut. Do not deliver small, irregular, or broken pieces of sod.

1.03 JOB CONDITIONS:

- A. Begin installation of sod after preceding related work is accepted.
- B. Environmental Requirements:
 - 1. Install sod during months acceptable to the City and/or Engineer.
 - 2. Do not install sod on saturated soil.
- C. Protection: Erect signs and barriers against vehicular traffic.

1.04 GUARANTEE:

- A. Guarantee sod for period of twelve (12) months after date of Substantial Completion.
- B. Replacement sod under this guarantee shall be guaranteed for twelve (12) months from the date of substantial completion.
- C. Repair damage to other plants during sod replacement at no cost to the Owner.

PART 2 - PRODUCTS

2.01 SOD:

- A. Match existing species as that used in adjacent lawn(s). Grass Species: St. Augustine Floratam, Florida "Premium" grade. Use of other sod subject to City approval.
- B. American Sod Producers Association (ASPA) Grade: Nursery Grown or Approved. Field grown sod is not acceptable.
- C. Furnished in pads
 - 1. Size:
 - a. Length: 24" plus or minus 5%
 - b. Width: 18" plus or minus 5%
 - c. Thickness: 1-1/2" excluding top growth and thatch.
 - 2. Not stretched, broken or torn.
- D. Uniformly mowed height when harvested: 2-1/2".
- E. Thatch: Maximum 1/2" uncompressed.
- F. Inspected and found free of diseases, nematodes, pests and pest larvae, by entomologist of State Department of Agriculture.

- G. Weeds: Free of Bermuda grass, nut grass or other objectionable weeds.
- H. Uniform in color, leaf texture and density.

2.02 WATER:

- A. Free of substances harmful to plant growth.

2.03 FERTILIZER:

- A. FS O-F-241 c(1), Grade A or B.
- B. The Chemical designation shall be 12-8-8, with at least 50% of the nitrogen from a non-water-soluble organic source.

2.04 HERBICIDES:

- A. As recommended by the State Department of Agriculture and approved by Landscape Architect.

2.05 STAKES:

- A. Softwood, 3/4" diameter, 8" length.

PART 3 - EXECUTION

3.01 INSPECTION:

- A. Verify that soil to depth of 2" in compacted areas.
- B. Water dry soil to depth of 6", 48 hours before sodding.

3.02 PREPARATION:

- A. Verify finish grades are to elevations called for.
- B. Smooth area to be sodded to produce an even surface with no peaks or valleys and free of all debris.
- C. Wet surface to a uniform depth of 2"-3" or until upper surface is reasonably wet and compacted.
- D. Roll soil with 100 lb. roller; make 2 passes.

3.03 INSTALLATION:

- A. Install sod species as indicated on planting plans.
- B. Transplant sod within 48 hours after harvesting.
- C. Begin sodding at bottom of slopes.
- D. Lay first row of sod in straight line with long dimension of pads parallel to slope contours.
- E. Butt side and end joints.
- F. Stagger end joints in adjacent rows.
- G. Do not stretch or overlap sod.
- H. Peg sod on slope ratio of 1 in 3 or greater with minimum of two stakes per sq. yd., using 6" minimum nursery grade bamboo stakes.
- I. Water sod immediately after transplanting.
- J. Roll sod, except on pegged areas, with roller weighing not more than 150 lbs. per foot of roller width; make 2 passes.
- K. Water sod and soil to depth of 6" within four hours after rolling.

3.04 LAWN ESTABLISHMENT:

- A. Watering:
 - 1. Keep sod moist during first week after planting.
 - 2. After first week, supplement rainfall to produce total of 2" per day.
- B. Mowing:
 - 1. When grass reaches 3" in height, mow to 2" in height.
 - 2. Maintain grass between 2" and 2-1/2" in height.
 - 3. Do not cut off more than 40% of grass leaf in single mowing.
 - 4. Remove grass clippings.
- C. Resod spots larger than 1 sq. ft. not having uniform stand of grass.
- D. Weed Eradication: Between second and third mowing, apply herbicide uniformly at manufacturer's recommended rate. Inform Landscape Architect prior to installation of herbicide.

- E. Fertilizer: Apply fertilizer uniformly at manufacturer's recommended rate 2 days after sodding. Insure that fertilizer is watered in well.
- F. Establishment period to extend until acceptance by the Owner.

3.05 CLEANING:

- A. Immediately clean spills from paved and finished surface areas.
- B. Remove debris and excess materials from project site.
- C. Dispose of protective barricades and warning signs at termination of lawn establishment.

3.06 FINAL INSPECTION AND ACCEPTANCE:

- A. Request final inspection for acceptance when completed.
- B. Replace rejected sod area with acceptable sod within two weeks after the inspection or as otherwise directed by Architect.
- C. Request substantial completion inspection for total areas as completed.

3.07 GUARANTEE

- A. The Contractor shall be responsible for the proper development of vegetation on the regraded areas until final acceptance by the Owner.

3.08 EROSION AND SEDIMENTATION CONTROL

- A. Contractor shall be responsible for obtaining an NPDES Erosion Control Permit.
- B. The Contractor shall take suitable precautions to prevent soil erosion and waterway siltation and any other pollution of the waters of the State. Improper construction practices, such as dumping of spoil material into or near a waterway; excessive or unnecessary operation of equipment in or near a waterway; pumping of silt-laden water from excavations into a waterway; disposal of trees and brush and other debris into a waterway are strictly and specifically prohibited.
- C. Storm run-off shall be controlled by confining the operations of the Contractor to as small an area as is feasible and constructing divisions, where necessary, to intercept and divert surface run-off before it gains sufficient volume and velocity to create harmful erosion.
- D. Earth-moving activities shall be carried out in the following manner:

1. A minimum length of trench shall be opened at any time (never to exceed 25 LF).
 2. Top soil shall be stripped, stockpiled and protected from loss for later use as top layer of backfill.
 3. All excavated material shall be stored in such a manner as to prevent loss from wind, rain, and/or other natural or construction-caused activities.
 4. To the greatest extent possible, construction activities will be scheduled so that trenches can be backfilled at the close of the working day and a maximum quantity of excavated material will be stockpiled and not subject to loss.
- E. All water pumped or drained from the excavation shall be either directed through straw bales or to a sedimentation basin so that suspended silt is removed from the flow.
- F. Dust control measures to minimize wind erosion and dust nuisance situations shall include periodic wetting of exposed soil.
- G. Temporary Control Measures - Temporary control measures and facilities shall be used during construction to prevent washing of excavated materials and water and wind erosion of newly backfilled areas. These measures will involve placement of sod, straw silt barriers, silt fences, etc. In areas where long slopes and/or steep grades are encountered, the application of straw mulch which can be removed or worked into the soil, to form a suitable subgrade for sod, will be required. In addition, in areas where storm water run-off can be expected to concentrate, baled straw shall be positioned in such a manner to filter the flow and prevent solids from entering the watercourse.
- H. Permanent Control Measures - The best technique for permanent restoration and long-term protection of a site affected by construction is to alter the terrain as little as possible and leave no soil exposed. Therefore, ditches should be backfilled and compacted to the original or proposed ground surface elevation, the top backfill layer to be from the topsoil stockpile and placement of sod.

END OF SECTION

SECTION 02500

RESTORATION AND CLEANUP

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. The work includes the restoration of driveways, grass areas, trees and plants, roadways, and any other existing improvement affected by the proposed work. This section includes furnishing equipment, labor and materials, and performing all necessary and incidental operations to perform the required work.
- B. All areas disturbed or damaged during construction shall be restored to conditions existing prior to the work.
- C. See GENERAL CONDITIONS which contain information and requirements that apply to the Work specified herein and are mandatory for this project.

1.2 SUBMITTALS

- A. Submitted construction progress schedule should indicate restoration, by restoration type, for each street following the sequencing specified herein. Final cleanup time should also be referenced to the progress schedule for each street.

PART 2 - PRODUCTS

2.1 ASPHALTIC CONCRETE PAVEMENT AND BASE

- A. Materials shall be as specified in Section 02510 - Asphaltic Concrete Pavement, Subbase and Limerock.

2.2 CONCRETE PAVEMENT

- A. Materials for concrete driveway approaches, sidewalks and curbs shall be as specified in Structural Plans.

2.3 SOD

- A. Sod shall be as specified in Section 02485 – Finish Grading, Sodding and Erosion Sedimentation Control.

2.4 SEED AND MULCH MATERIALS

- A. Seed shall be used for restoration of areas where seed is present.
- B. Grass seed shall be a mixture of 20 parts Bermuda and 80 parts Argentine Bahia seed. Quick-growing type grass seed shall be included, which will provide early ground cover during the season in which the planting is done and which will not compete with the permanent grass. The Bermuda seed shall be an equal mixture of hulled and unhulled seed. The Argentine Bahia seed shall be scarified seed having a minimum active germination of 40 percent and a total active germination of 85 percent.
- C. Mulch shall be straw or hay, consisting of oat, rye or wheat straw, or of pangola, peanut, coastal bermuda or bahia grass hay. Only undeteriorated mulch, which can be readily cut into the soil, shall be used.

2.5 COMMERCIAL FERTILIZER

- A. Commercial fertilizers shall comply with the state fertilizer laws.
- B. The numeral designations for fertilizer indicate the minimum percentages respectively of (1) total nitrogen, (2) available phosphoric acid, and (3) water soluble potash contained in the fertilizer.
- C. The chemical designation of the fertilizer shall be 12-8-8. At least 50 percent of the phosphoric acid shall be from normal super phosphate or an equivalent source that will provide a minimum of two units of sulfur. The amount of sulfur shall be indicated on the quantitative analysis card attached to each bag or other container.

2.6 WATER

- A. Water shall be as specified in Section 02485 – Finish Grading, Sodding and Erosion Sedimentation Control.

2.7 EQUIPMENT

- A. Fertilizer Spreader: The device for spreading fertilizer shall be capable of uniformly distributing the material at the specified rate.
- B. Seed Spreader: The seed spreader shall be an approved mechanical hand spreader or other approved type of spreader.
- C. Equipment for Cutting Mulch Into Soil: The mulching equipment shall be capable of cutting the specified materials uniformly into the soil and to the required controlled depth. Harrows will not be allowed.

- D. Rollers: A cultipacker, traffic roller, or other suitable equipment will be required for rolling the grassed areas.
- E. Hydraulic Mulcher: The mulch shall be mixed in standard hydraulic equipment to form homogeneous slurry. The equipment shall be capable of spraying the slurry, under pressure, uniformly over the soil surface at the material application rate indicated. A continuous agitation system that keeps all materials in uniform suspension throughout the mixing and distribution cycles is required.

PART 3 - EXECUTION

3.1 ASPHALTIC CONCRETE PAVEMENT RESTORATION

- A. Restore asphaltic concrete as specified in Section 02510 - Asphaltic Concrete Pavement, Subbase and Limerock.

3.2 CONCRETE PAVEMENT RESTORATION

- A. Restore concrete drives, sidewalks and curbs as specified in Section 02630 - Concrete Sidewalks, Driveways and Curbs.

3.3 ROCK ROAD AND DRIVEWAY RESTORATION

- A. Replace gravel where disturbed to match existing type.
- B. All driveway replacement with asphaltic concrete shall be matched to a saw cut joint and have an asphaltic concrete thickness of at least one (1) inch placed on a 6-inch compacted limerock base. The subgrade shall be compacted before the limerock is placed.
- C. Any driveway replacement with concrete shall be poured monolithically on a compacted subgrade. The concrete shall have a minimum thickness of six (6) inches and a minimum 28-day compressive strength of 2,500 psi. The concrete surface shall have a broom finish.

3.4 SODDING

- A. Sod shall be placed as to the extent to achieve the conditions existing prior to the work as specified in 02485 – Finish Grading, Sodding and Erosion Sedimentation Control.

3.5 SEEDING AND MULCHING

- A. Do not use wet, moldy seed.
- B. Sow seed using mechanical spreader and do not seed unless wind velocity is five (5) mph or less. Distribute seed evenly over all designated areas, sowing equal quantities in two (2) perpendicular directions.
- C. Apply mixture at a rate of 100 pounds per acre.
- D. Rake seed lightly into top 1/8-inch of soil, roll lightly and water with fine spray.
- E. If erosion areas are identifiable, protect such seeded areas by spreading a continuous blanket not less than 1/2-inch in depth of loose measurement of hay, straw or other approved mulch material.

3.6 RESTORATION SEQUENCE

- A. General - The restoration sequencing described shall be for each individual street.
- B. Properly backfill and compact pipe trench immediately following installation of pipe to allow for movement of traffic.
- C. Provide asphaltic pavement patch, as applicable, for all road crossings immediately following pipe installation.
- D. Remove and dispose of excess fill materials immediately following pipe installation.
- E. Within one (1) week following pipe installation, the contractor shall:
 - 1. Properly prepare subgrade and place sod as indicated by drawings and specified herein.
 - 2. Repair rock drives and road crossings and all other items damaged as a result of the work.
 - 3. Remove and dispose of excess materials and debris generated as a result of the work.
- F. Within fourteen (14) days following initial cut of driveway or sidewalk, the Contractor shall:
 - 1. Restore asphalt driveway approaches as shown on the drawings and specified herein.
 - 2. Restore concrete driveway approaches and sidewalks as shown on the drawings and specified herein.

- G. Thirty (30) to sixty (60) days after the asphaltic concrete roadway patch has been placed, the tack coat and asphaltic concrete overlay shall be applied where necessary as indicated on the Drawings.
- H. Where applicable, traffic markings and signage shall be restored following the completion of the asphaltic concrete roadway restoration. Traffic markings and signage shall be restored in accordance with the requirements of Section 02510 - Asphaltic Pavement, Subbase and Limerock.
- I. Contractor shall maintain adequate accessibility to business and residences during restoration period. This shall include the construction of temporary rock drives or roads where necessary.
- J. Time requirements for restoration as specified herein shall be strictly adhered to. When, in the opinion of the Owner or Engineer, the Contractor's restoration falls behind schedule, pipe-laying operations will be halted. Pipe laying operations will remain halted until in the opinion of Owner and Engineer, that restoration requirements have been brought back into compliance with these specifications. In no way shall these stoppages be considered as a delay or a reason for additional contract time.

END OF SECTION

SECTION 02502

DUCTILE IRON PIPE AND FITTINGS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Furnish and install ductile iron pipe and all appurtenant work, complete in place, all in accordance with the requirements of the Contract Documents.
- B. Like items provided hereunder shall be the end products of one manufacturer in order to achieve standardization for appearance, operation and maintenance.
- C. See GENERAL REQUIREMENTS which contain information and requirements that apply to the Work specified herein and are mandatory for this project.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 02200 - Earthwork.
- B. Section 15002 - Polyvinyl Chloride (PVC) Pressure Pipe.
- C. Section 15029 - Pipeline Testing.

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Commercial Standards (Latest Revisions):

ANSI/AWWA C104/A21.4	Cement-mortar lining for Ductile-Iron Pipe and Fittings for Water.
ANSI/AWWA C110/A21.10	Ductile-Iron and Gray-Iron fittings, 3 in. through 48 in. for water and other liquids.
ANSI/AWWA C111/A21.11	Rubber Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings.
ANSI/AWWA C115/A21.15	Flanged Ductile-Iron Pipe with Threaded Flanges.
ANSI/AWWA C150/A21.50	Thickness Design of Ductile-Iron Pipe.
ANSI/AWWA C151/A21.51	Ductile-Iron Pipe, Centrifugally Cast, for Water and Other Liquids.

ANSI/AWWA C153/A21.53	Ductile-Iron Compact Fittings, 3 in. through 24 in. and 54 in. through 64 in. for water service.
ANSI/AWWA C600	Installation of Ductile-Iron Water Mains and their appurtenances.
ASTM C150	Specification for Portland cement.

1.04 PROJECT DESIGN REQUIREMENTS

- A. Thrust restraint for buried pipe shall be accomplished by the use of mechanical joint restraints only. Concrete thrust blocks will be allowed at locations indicated on Drawings only.
- B. Thrust restraint design shall be in accordance with the procedures and recommendations of Thrust Restraint Design for Ductile Iron Pipe, current edition, as published by the Ductile Iron Pipe Research Association (DIPRA).
- C. Trench laying conditions and depth of cover shall be as shown by the Drawings and standard details.
- D. Test pressure for the completed pipelines shall be as indicated by the piping schedule on the Drawings.
- E. Soil conditions are typical for the area. Tan quartz fine sand with traces of shell. Maximum dry density range is 100 to 110 pcf. Actual soil conditions to be verified by CONTRACTOR.
- F. Design factor of safety to be utilized for restraint calculations shall be 2.0 as per DIPRA.

1.05 SUBMITTALS

- A. Submit shop drawings and manufacturer's material specifications of pipe and fittings in accordance with the requirements in Section 01300 - submittals and the requirements of the referenced standards.
- B. Certifications: Furnish an affidavit of compliance to the ENGINEER for all pipe, fittings, pipe linings and other miscellaneous pieces and accessories furnished by the pipe manufacturer. Affidavit shall certify that all materials supplied to the job site have been manufactured in accordance with these specifications and that all tests and inspections have been conducted and approved.
- C. All expenses incurred in making samples for certification of tests and shall be within the Scope of the Contract.

1.06 QUALITY ASSURANCE

- A. Inspection: All pipe shall be subject to inspection at the place of manufacture in accordance with the provisions of the referenced standards, as supplemented by the requirements herein. Notify the ENGINEER in writing of the manufacturing starting date not less than 14 days prior to the start of any phase of the pipe manufacture.
- B. During the manufacture of the pipe, the ENGINEER shall be given access to all areas where manufacturing is in process and shall be permitted to make all inspections necessary to confirm compliance with the Specifications.
- C. Tests: Except as modified herein, all materials used in the manufacture of the pipe shall be tested in accordance with the requirements of the referenced standards as applicable.
- D. Perform said material tests within the Scope of the Contract. The ENGINEER shall have the right to witness all testing conducted; provided, that the schedule is not delayed for the convenience of the ENGINEER.
- E. In addition to those tests specifically required, the ENGINEER may request additional samples of any material including lining and coating samples for testing by the OWNER. The additional samples shall be furnished within the Scope of the Contract.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Handling and Storage: All pipe, fittings, etc., shall be carefully handled and protected against damage, impact shocks, and free fall. All pipe handling equipment shall be acceptable to the ENGINEER. Pipe shall not be placed directly on rough ground but shall be supported in a manner which will protect the pipe against injury whenever stored at the trench site or elsewhere. Pipe shall be handled and stored at the trench site in accordance with the following paragraphs. No pipe shall be installed where the lining or coating show defects that may be harmful as determined by the ENGINEER. Such damaged lining or coating shall be repaired, or a new undamaged pipe shall be furnished and installed.
- B. Stockpiled pipe shall be supported on sand or earth berms free of rock exceeding 3 inches in diameter. The pipe shall not be rolled and shall be secured to prevent accidental rolling.
- C. Strutting: Adequate strutting shall be provided on all specials, fittings, and straight pipe 48 inches in diameter and larger so as to avoid damage to the pipe and fittings during handling, storage, hauling, and installation.
- D. All pipe damaged prior to Substantial Completion of the project shall be repaired or

replaced by the CONTRACTOR within the Scope of the Contract.

PART 2 - PRODUCTS

2.01 GENERAL

- A. The pipe shall be of the diameter shown, shall be furnished complete with rubber gaskets and all specials and fittings shall be provided as specified herein and required under the Contract Documents.
- B. Laying Lengths: Maximum pipe laying lengths shall be 20 ft. with shorter lengths provided as required.
- C. Finish: The pipe shall have smooth dense interior surfaces and shall be free from fractures, excessive interior surface crazing and roughness.
- D. The use of a manufacturer's name and model number is for the purpose of establishing the standard of quality and general configuration desired. Products from other manufacturers will be considered in accordance with the GENERAL REQUIREMENTS.

2.02 MATERIALS

- A. Ductile Iron Pipe: Pipe materials shall conform to the requirements of ANSI/AWWA C151/A21.51 and unless otherwise noted herein this specification or the drawings, all ductile iron pipe shall be as follows:

<u>Nominal Diameter</u>	<u>Minimum Pressure Class</u>	<u>Special Cases Thickness Class</u>
3" thru 12"	350 Psi	—
14" thru 20"	250 Psi	—

<u>Nominal Diameter</u>	<u>Minimum Pressure Class</u>	<u>Special Cases Thickness Class</u>
24" thru 42"	200 psi	—
Flanged Pipe (all diameters)	—	53 (Min)

- B. Cement: Cement for mortar lining shall conform to the requirements of ANSI/AWWA C104/A21.4; provided, that cement for mortar lining shall be Type II or V. Fly ash or pozzolan shall not be used as a cement replacement.

2.03 DUCTILE IRON PIPE

- A. General: Ductile iron pipe used in this project shall be in accordance with the requirements of ANSI/AWWA C150/A21.50, ANSI/AWWA C151/A21.51 and ANSI/AWWA C115/A21.15 as applicable.
- B. Ductile iron pipe used in this project shall be standard cement lined in accordance with ANSI/AWWA C104/A21.4 and seal coating with an asphaltic coating approximately 1 mil thick in accordance with AWWA C151.
- C. Ductile iron pipe shall be of the diameter as shown on the drawings and class as specified herein.

2.04 PUSH-ON JOINTS (NON-RESTRAINED TYPE)

- A. Push-on pipe joints (non-restrained type) shall be "Fastite" as manufactured by American Cast Iron Pipe Company, "Tyton" as manufactured by U.S. Pipe and Foundry, or equal. Push-on joints shall meet the requirements of ANSI/AWWA C111/A21.11.

2.05 PUSH-ON JOINTS (RESTRAINED TYPE)

- A. Push-on joints (restrained type), 12-inch and smaller, shall be "Fastgrip" gasket system by American Cast Iron Pipe Company, "Field-Lok" gasket system by U.S. Pipe and Foundry, or equal.
- B. Push-on joints (restrained type), greater than 12-inch, shall be "LOK-Ring restrained joint by American Cast Iron Pipe or "TR Flex" restrained joint by U.S. Pipe and Foundry.

2.06 MECHANICAL JOINTS (RESTRAINED)

- A. Restrained mechanical joints shall be utilized for fittings and valves and as indicated on the drawings.
- B. Restraint of mechanical joints shall be accomplished by using a Megalug Series 1100 restraining follower gland as manufactured by EBAA Iron Sales, Inc. or equal.
- C. Mechanical joints for fittings and valves shall meet the requirements of ANSI/AWWA C111/A21.11.

2.07 FLANGED JOINTS

- A. Flanged joints meeting the requirements of ANSI/AWWA C115/A21.15 shall be utilized at locations shown on the Drawings.

- B. Gaskets for flanged joints shall be ring type gaskets, 1/8-inch thick, compatible for the service conveyed by the pipeline. Bolts, nuts and washers shall meet the requirements of AWWA C115/A21.15 and shall be either type 304 stainless steel or standard low carbon steel as follows: type 304 stainless steel, bolts, nuts and washers shall be used for all flanged locations exposed to weather and the low carbon steel bolts, nuts and washers shall be used for all interior flanged piping locations.

2.08 JOINT ACCESSORIES

- A. Joint gaskets shall be synthetic rubber as per ANSI/AWWA C111/A21.11. Gaskets shall be compatible to applicable service.
- B. Joint lubricants shall be furnished by the pipe manufacturer.

2.09 FITTINGS AND SPECIALS

- A. Mechanical joint fittings (24-inches and smaller) shall be compact ductile iron fittings manufactured in accordance with ANSI/AWWA C153/A21.53 with a pressure rating of 350 psi. Fittings shall have mechanical joints in accordance with ANSI/AWWA C111/A21.11.
- B. Mechanical joint fittings (30-inches and larger) shall be ductile iron fittings manufactured in accordance with ANSI/AWWA C110/A21.10 with a pressure rating of 250 psi. Fittings shall have mechanical joints in accordance with ANSI/AWWA C111/A21.11.
- C. Fittings for flanged pipe shall be short body ductile iron with flanged ends in accordance with AWWA/C110 with 125# flanges having a pressure rating of 250 psi.
- D. Fittings shall be coated and lined as specified for the applicable pipe application.
- E. Fittings shall be of the diameter and class as shown on the Drawings or specified herein.

2.10 DUCTILE IRON COUPLINGS

- A. Couplings for joining of plain end pipe shall be Ford Ductile Iron Couplings Style FC1, Dresser Style 153, or equal. Thrust ties, where indicated on drawings, shall be provided as required to sustain the force developed by 1-1/2 times the specified maximum operating pressure.
- B. Couplings for joining of plain end pipe of different outside diameter (O.D.) shall be Ford ductile iron couplings FC2A, Dresser Style 162, or equal. Thrust ties, where indicated on drawings, shall be provided as required to sustain the force developed by

1-1/2 times the specified maximum operating pressure.

2.11 CEMENT-MORTAR LINING

- A. Cement-Mortar Lining for Shop Application: Except as otherwise provided herein, interior surfaces of all ductile iron pipe, fittings, and specials shall be cleaned and lined by the pipe manufacturer with cement-mortar lining applied centrifugally in conformity with ANSI/AWWA C104/A21.4. The lining machines shall be of a type that has been used successfully for similar work. Every precaution shall be taken to prevent damage to the lining. If lining is damaged or found faulty at delivery site, the damaged or unsatisfactory portions shall be replaced with lining conforming to these Specifications.
- B. The minimum lining thickness shall be as specified in ANSI/AWWA C104/A21.4.

2.12 PIPE FINISH (BURIED)

- A. The outside coating shall be an asphaltic coating at least 1 mil thick and applied to the pipe after cement lining has been placed. A similar material shall be used as a seal-coat on the cement mortar lining on the inside of the pipe applied while the cement mortar is still moist.

2.13 PIPE FINISH (EXPOSED)

- A. Exposed piping and fittings shall be shop primed with a catalyzed rust inhibitive epoxy primer. Minimum dry film thickness shall be 2-3 mils. Surface preparation shall be white metal blast cleaning in accordance with Steel Structures Painting Council No. 10 (SSPC-SP10).
- B. Exterior of ductile iron piping used for reuseed water service shall be purple in color.

2.14 PIPE IDENTIFICATION (FORCE MAIN)

- A. All utility pipe shall be installed with 4" marking balls placed every forty (40) feet and at every fitting at a depth of 24" or as approved by the OWNER. The frequency of the marker balls shall be 66.35 Khz. The marker balls can be buried in any orientation.

PART 3 - EXECUTION

3.01 INSTALLATION OF PIPE

- A. Inspect each piece of pipe and fitting prior to installation to insure that there are no damaged portions of the pipe.
- B. Before placement of the pipe in the trench, the interior of each pipe or fitting shall be

thoroughly cleaned of any foreign substance, which may have collected thereon and shall be kept clean at all times thereafter. For this purpose, the openings of all pipes and fittings in the trench shall be closed during any interruption of the Work.

- C. Pipe shall be installed in accordance with AWWA C600.
- D. Pipe shall be laid directly on the bedding material. No blocking will be permitted, and the bedding shall be such that it forms a continuous, solid bearing for the full length of the pipe. Excavations shall be made as needed to facilitate removal of handling devices after the pipe is laid. Bell holes shall be formed at the ends of the pipe to prevent point loading at the bells or couplings. Excavation shall be made as needed outside the normal trench section at field joints to permit adequate access to the joints for field connection operations and for application of coating on field joints.
- E. In laying pipe, it shall be laid to the set line and grade, within approximately one inch plus or minus. On grades of zero slope, the intent is to lay to grade.
- F. Where necessary to raise or lower the pipe due to unforeseen obstructions or other causes, the ENGINEER may change the alignment and/or the grades. Such change shall be made by the deflection of joints, by the use of bevel adapters, or by the use of additional fittings. However, in no case shall the deflection in the joint exceed the maximum deflection recommended by the pipe manufacturer. No joint shall be misfit any amount which will be detrimental to the strength and water tightness of the finished joint. In all cases the joint opening shall be the controlling factor.

3.02 PUSH-ON JOINTS

- A. Immediately before jointing pipe, the bell end of the pipe shall be thoroughly cleaned, and a clean rubber gasket installed lubricated with a manufacturers approved vegetable-based lubricant. The spigot end of the pipe section shall then be inserted into the bell of the previously laid joint and telescoped into its proper position. Tilting of the pipe to insert the spigot into the bell will not be permitted. After the pipe lengths have been joined, a feeler gauge shall be inserted into the recess and moved around the periphery of the joint to detect any irregularity in the position of the gasket. If the gasket cannot be felt all around, or there is a shallow area, the joint shall be disassembled. If the gasket is undamaged, as determined by the ENGINEER, it may be reused, but only after the bell end and gasket have been re-lubricated.

3.03 RESTRAINED JOINTS

- A. Provide and install joint restraint and accessories as indicated on the Drawings and specified herein.
- B. Restrained joints shall be completed in accordance with the manufacturer's installation instructions.

3.04 INSTALLATION OF PIPE APPURTENANCES

- A. All valves shall be handled in a manner to prevent any injury or damage to any part of the valve or adjoining pipe. All joints shall be thoroughly cleaned and prepared prior to installation.
- B. All valves shall be installed so that the valve stems are plumb and in the location shown.

3.05 TESTING

- A. All piping specified herein this section shall be hydrostatically tested following procedures specified in Section 15029 - Pipeline Testing.

3.06 CLEANING

- A. As pipe laying progresses, keep the pipe interior free of all debris. Completely clean the interior of the pipe of all sand, dirt, mortar splatter and any other debris following completion of pipe laying and any necessary interior repairs prior to testing the completed pipeline.

END OF SECTION

SECTION 02504

FORCE MAIN PIPE AND FITTINGS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. The work covered by this section and the related sections following consists of providing all labor, material, equipment and performing all construction required to install the force main piping, valves and accessories as specified and shown on the drawings.
- B. Like items provided hereunder shall be the end products of one manufacturer in order to achieve standardization for appearance, operation and maintenance.
- C. See GENERAL REQUIREMENTS which contain information and requirements that apply to the Work specified herein and are mandatory for this project.

1.02 RELATED SECTIONS

- A. Section 01050 - Field Engineering
- B. Section 01550 - Traffic Control
- C. Section 01720 - Project Record Documents
- D. Section 02200 - Earthwork
- E. Section 02400 - Dewatering
- F. Section 02500 – Restoration and Cleanup
- G. Section 02560 – Pipeline Testing

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Latest edition of Commercial Standards:

ANSI/AWWA C104/A21.4 Cement-mortar lining for Ductile-Iron Pipe and Fittings for Water.

ANSI/AWWA C110/A21.10 Ductile-Iron and Gray-Iron fittings, 3 in. through 48 in. for water and other liquids.

ANSI/AWWA C111/A21.11 Rubber Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings.

ANSI/AWWA C115/A21.15 Flanged Ductile-Iron Pipe with Threaded Flanges.

ANSI/AWWA C150/A21.50 Thickness Design of Ductile-Iron Pipe.

ANSI/AWWA C151/A21.51 Ductile-Iron Pipe, Centrifugally Cast, in Metal Molds or Sand-Lined Molds for Water and Other Liquids.

ANSI/AWWA C153/A21.53 Ductile-Iron Compact Fittings, 3 in. through 16 in., for water and other liquids.

ANSI/AWWA C210 Liquid Epoxy Coating Systems for the Interior and Exterior of Steel Pipelines.

ANSI/AWWA C600 Installation of Ductile-Iron Water Mains and their appurtenances.

ANSI/AWWA C900 Polyvinyl Chloride (PVC) Pressure Pipe, 4 Inch Through 12 Inch

ANSI/AWWA C906 Polyethylene Pressure Pipe and Fittings, 4 Inch through 63 Inch.

ASTM D1785 Polyvinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80, and 120.

1.04 SUBMITTALS

- A. Submit shop drawings of pipe and fittings in accordance with Section 01300 Submittals and the requirements of the referenced standards.
- B. Furnish an affidavit of compliance to the Engineer for all pipe, fittings, pipe linings and other miscellaneous pieces and accessories furnished by the pipe manufacturer. Affidavit shall certify that all materials supplied to the job site have been manufactured in accordance with these specifications and that all tests and inspections have been conducted and approved.
- C. All expenses incurred in making samples for certification of tests shall be within the Scope of the Contract.

1.05 QUALITY ASSURANCE

- A. All pipe shall be subject to inspection at the place of manufacture in accordance with the provisions of the referenced standards, as supplemented by the requirements herein. Notify the Engineer in writing of the manufacturing starting date not less than 14 days prior to the start of any phase of the pipe manufacture.
- B. During the manufacture of the pipe, the Engineer shall be given access to all areas where manufacturing is in process and shall be permitted to make all inspections necessary to confirm compliance with the Specifications.
- C. Except as modified herein, all materials used in the manufacture of the pipe shall be tested in accordance with the requirements of the referenced standards as applicable.
- D. Perform said material tests within the Scope of the Contract. The Engineer shall have the right to witness all testing conducted; provided, that the schedule is not delayed for the convenience of the Engineer.
- E. In addition to those tests specifically required, the Engineer may request additional samples of any material including lining and coating samples for testing by the Owner. The additional samples shall be furnished within the Scope of the Contract.

1.06 DELIVERY, STORAGE AND HANDLING

- A. All pipe, fittings, etc., shall be carefully handled and protected against damage, impact shocks, and free fall. All pipe handling equipment shall be acceptable to the Engineer. Pipe shall not be placed directly on rough ground but shall be supported in a manner that will protect the pipe against injury whenever stored at the trench site or elsewhere. Pipe shall be handled and stored at the trench site in accordance with the following paragraphs. No pipe shall be installed where the lining or coating show defects that may be harmful as determined by the Engineer. Such damaged lining or coating shall be repaired, or a new undamaged pipe shall be furnished and installed.
- B. Stockpiled pipe shall be supported on sand or earth berms free of rock exceeding 3 inches in diameter. The pipe shall not be rolled and shall be secured to prevent accidental rolling.
- C. Adequate strutting shall be provided on all specials, fittings, and straight pipe 48 inches in diameter and larger so as to avoid damage to the pipe and fittings during handling, storage, hauling, and installation.

- D. All pipe damaged prior to Substantial Completion of the project shall be repaired or replaced by the Contractor within the Scope of the Contract.

1.07 CONNECTION TO EXISTING WORK BY OTHERS OR EXISTING LINES

- A. Connection to existing lines, to which piping of this Contract must connect, the following work shall be performed:
 - 1. Confirm or determine end connection, pipe material dimensions and diameter.
 - 2. Furnish and install appropriate piping, couplings and make proper connections.
 - 3. Maintain sewage system service.

PART 2 - PRODUCTS

2.01 POLYVINYL CHLORIDE (PVC):

SEE SECTION 02632

2.02 DUCTILE IRON PIPE:

SEE SECTION 02502

2.03 DUCTILE IRON FITTINGS

- A. Fittings shall be as shown on the drawings and/or shall conform to the following:
 - 1. Mechanical Joint Fittings - ANSI/AWWA C 153 A21.53 or ANSI/AWWA C111 A2 1.11.
 - 2. Push-On Pipe Fittings - Use mechanical joint fittings, ANSI/AWWA C153 A21.53 or ANSI/AWWA C I 10 A2 1. 10.
 - 3. Flanged Fittings - ANSI/AWWA C I 10 A2 1. 10.
 - 4. Screwed Fittings - ANSI/AWWA C1 10 A2 1. 10.
 - 5. Linings and coatings for all fittings shall be the same as for the pipe.
- B. Fasteners shall be 304 stainless steel.

2.04 POLYETHYLENE PIPE

- A. Polyethylene pipe shall be DR 11 certified by NSF for use in water main service. Pipe shall conform to AWWA C906 and ASTM C3350, latest edition. HDPE shall have an outside diameter equal to standard ductile iron pipe dimensions (DIPS).
- B. Installation of polyethylene pipe shall be in accordance with Directional Crossing Contractors Association.

2.05 POLYETHYLENE FITTINGS

- A. Polyethylene pipe and fittings shall be produced by the same manufacturer. Products made by subcontractors or manufacturer's distributor are not acceptable. Pipe and fittings from different manufacturers shall not be interchanged.
- B. Polyethylene fittings and custom fabrications shall be molded or fabricated by the pipe manufacturer. Butt fusion outlets shall be made to the same outside diameter, wall thickness, and tolerances as the mating pipe. All fittings and custom fabrications shall be fully rated for the same internal pressure as the mating pipe. Pressure de-rated fabricated fittings are prohibited.
- C. Molded fittings shall be manufactured in accordance with ASTM D 3261, Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing, and shall be so marked. Each production lot of molded fittings shall be subjected to the tests required under ASTM D 3261.
- D. Fabricated fittings shall be made by heat fusion joining specially machined shapes cut from pipe, polyethylene sheet stock, or molded fittings. Fabricated fittings shall be rated for internal pressure service at least equal to the full service pressure rating of the mating pipe. Directional fittings 16" DIPS and larger such as elbows, tees, etc., shall have a plain end inlet for butt fusion and flanged directional outlets. Drawings shall be submitted for the approval of the Engineer.
- E. Flange adapters shall be with sufficient thorough-bore length to be clamped in a butt fusion-joining machine without the use of a stub-end holder. The sealing surface of the flange adapter shall be machined with a series of small V-shaped grooves to provide gasketless sealing, or to restrain the gasket against blow-out. Flange adapters shall be fitted with back-up rings pressure rated equal to, or greater than, the mating pipe. The back-up ring bore shall be chamfered or have a radius to provide clearance to the flange adapter radius. Flange bolts and nuts shall be 316 stainless steel.
- F. Manufacturer's inspection and testing of the materials: In case of conflict with manufacturer's certifications, the Engineer or Owner may request testing by the manufacturer or have retests performed by and outside testing service.

2.06 WATER MAIN SEPARATION FROM FORCE, REUSE AND SANITARY SEWER MAIN

- A. Any force main, reuse, sanitary sewer or sanitary sewer manholes shall be located at least 6 feet, 10 feet preferred, horizontally from water mains; the distance shall be measured from the outside of each pipe. When local conditions prevent a horizontal separation of 6 feet, a force main, reuse main or sanitary sewer may be laid closer to a water main provided that:

The bottom of the water main is at least 12 inches above the top of the force main, reuse main or sewer main. If a clearance of 12 inches cannot be obtained both the water main and force main, reuse main and sewer main shall be ductile iron, with a minimum clearance of 6 inches.

- B. Where this vertical separation cannot be obtained, the pipe joints that are equivalent to water main standards of construction for 10 feet beyond the substandard separation in each direction. The joint spacing shall be staggered such that the force main or sanitary sewer joints are located at the midpoints of the waterline pipe (centered between the joints).

PART 3 - EXECUTION

3.01 GENERAL

- A. Unless otherwise noted on the drawings or in other sections of this specification, the pipe shall be handled and installed in strict accordance with the manufacturer's instructions and with the applicable AWWA and/or ASTM standards. If a conflict exists between the manufacturer's instructions and the AWWA and/or ASTM standards, the manufacturer's instructions shall govern.
- B. For pipe that is field cut, the internal lining system if applicable shall be repaired in strict accordance with the manufacturer's recommendations and be inspected by the Engineer or his representative.

3.02 PREPARATION

- A. The layout of some of the piping systems shown on the drawings may be diagrammatic, but shall be followed as closely as the work will permit. The Contractor shall field verify the location and size of existing pipe and utilities.
- B. Before running lines, the Contractor shall carefully verify location, type of joint needed and size of pipe to which connection is proposed. The Contractor shall then assure itself that the lines can be run as contemplated without interfering with

footings, walls, other piping, and utilities etc. Any necessary deviation shall be referred to the Engineer for final adjustment before installation.

- C. All lengths of pipe shall be dimensioned accurately to the measurement established at the site, and shall be worked into place without springing or forcing. Cut sections of pipe shall be reamed to remove all burrs.
- D. The Contractor shall cut all pipe and drill holes that may be necessary, whenever and whatever so required. This work shall be done in a thorough and workmanlike manner.
- E. All changes in direction, unless otherwise noted on the drawings or approved by the Engineer, shall be made with fittings, as bending pipe is prohibited. Deflection of piping at joints will be permitted at angles 75% of the manufacturer's maximum recommended deflection. Minor changes in alignment and grade to field conditions shall not be considered extra work, additional fittings needed will be paid for at the unit bid price.
- F. The pipe shall be kept clean. All foreign material shall be removed from the inside of the pipe before it is placed. Plugs shall be used when pipe laying is not taking place to prevent entrance of foreign materials or water.

3.03 PIPE INSTALLATION

- A. Lines, Grades Stakes and Templates:
 - 1. The Contractor shall, at the Contractor's own expense, furnish all stakes, templates, patterns, platforms and labor that may be required in the layout of any part of the work.
 - 2. Limit marks and benchmarks reasonably necessary for the execution of the work are shown on the plans.
 - 3. The Engineer will furnish a representative to check alignment and grade after it has been laid out ready for construction; however, this will in no way lessen the responsibility of the Contractor to maintain correct grade and alignment at all times.
 - 4. The line and grade of all piping, as well as the location of all appurtenances, will be as shown on the Drawings, or as directed by the Engineer. Pipe shall be laid at a uniform grade with air release valves at high points or as directed by the Engineer.
 - 5. The Contractor shall give the Engineer a minimum of 48 hours notice for any engineering or inspection necessary to continue or complete the work.

B. Excavation:

1. The Contractor shall perform all excavation that may be required for the installation of any and all parts of this Section. Excavations shall conform to all Federal, state and local safety requirements.
2. The excavation of the trench shall not advance more than 100 feet ahead of the completed pipe work except where, in the opinion of the Engineer, it is necessary to drain wet ground, or for other reasons as approved by the Engineer.
3. Asphalt pavement and concrete shall be pre-cut before excavation.
4. All excavations shall be made by open cut except as shown on the Drawings. The sides of the trench shall be kept as nearly vertical as possible in order to provide safe operation, especially from the trench floor to a level of one foot above the top of the pipe. Trench bottoms shall not be less than 16" wider, nor more than 24" than the outside diameter of the pipe laid therein, and shall be excavated true to line, so that a clear space of not less than 8", nor more than 12" in width is provided on each side of the pipe.
5. The bottom of trenches shall be accurately graded to provide uniform bearing and support for each section of pipe on undisturbed soil or compacted bedding material at every point along its entire length, except for portions of the pipe sections where it is necessary to excavate for bell holes. Bell holes shall be excavated only to an extent sufficient to permit accurate work in the making of the joints and to ensure that the pipe, for a maximum of its length, will rest upon the prepared bottom of the trench.
6. Excavation carried beyond or below grades specified by the Engineer shall be backfilled at the Contractor's expense with 3/4" rock, as directed by the Engineer, and shall be thoroughly tamped.
7. The materials excavated shall be deposited on the side of the trenches and beyond the reach slides, with the banks trimmed up so as little inconvenience as possible is made to public travel or tenants occupying adjoining property.
8. Sidewalks, roads, streets and pavements shall not be blocked or obstructed by excavated materials, except as authorized by the Engineer. In this case, adequate temporary provisions will be made for a satisfactory temporary passage of pedestrians and vehicles. Barriers, lights, flares and any other necessary warning devices shall be provided and maintained by the Contractor at all trenches, excavations and embankments at no additional compensation.

9. In case it is necessary to place excavated material adjacent to buildings, the contractor shall erect barriers to keep the earth at least 4' from the front of such buildings. In case earth is deposited on grass plots, the Contractor shall remove it carefully when backfilling so as to not to destroy the grass. All trees, shrubs, etc., along the line of construction shall be reasonably protected.
10. The Contractor shall, without additional expense, provide suitable temporary channels for any water that may flow along or across the site of the work.
11. Where the bottom of the trench is found to consist of material which is unstable to such a degree that, in the opinion of the Engineer, it cannot be removed and shaped to adequately support the pipe, the trench bottom shall be stabilized by the Contractor to the satisfaction of the Engineer.
12. When excavations exceed 5' in depth in order to comply with CS/HB 3183, Florida Trench Safety Act and OSHA Trench Safety Standards, a trench box or other approved means of work protection must be used.

C. Pipe Clearances in Rocks:

1. Bedrock, boulders and large stones shall be removed to provide a clearance of at least 4" below and on each side of all pipe, valves and fittings. Before the pipe is laid, all irregularities of the rock are to be filled with 3/4" rock and compacted into place, and the bottom of the trench brought to proper grade.
2. The specified minimum clearances are the minimum clear distances which will be permitted between any part of the pipe and appurtenances being laid and any part, projection or point of such rock, boulder or stone.

D. Blasting:

1. No blasting will be allowed.

E. Bracing and Shoring:

1. The Contractor shall do all bracing, sheathing and shoring necessary to perform and protect all excavations as indicated on the Drawings as required for safety, as directed by the Engineers, or to conform with all governing laws.

F. Dewatering:

1. The Contractor shall at all times during construction, provide and maintain ample means and devices with which to promptly remove and properly dispose of all water entering the trenches or excavations and keep said excavations dry until the structures to be built thereon are completed. No

masonry shall be laid or pipe joints made in water, nor shall water be allowed to rise over masonry or mortar until the concrete or mortar has set at least 24 hours.

G. Bedding and Base Fill:

1. Bedding shall be as detailed on the plans with less than 1" material.
2. After pipe joints have been inspected and given preliminary approval, and sufficient time has elapsed for setting joints is necessary, backfilling shall be performed by hand, together with tamping, until fill has progress to an elevation of at least 1' above the top of the pipe.
3. During this initial stage of backfilling, approved granular materials (where required) or loose soil free from lumps, muck, organic materials, clods, frozen materials or stones larger than 2" or other deleterious materials shall be deposited in layers of approximately 6" thick and compacted by hand, or with manually operated machine tampers actuated by compressed air, or other suitable means. Tamps and machines shall be suitable for the work, and subject to the approval of the Engineer.

H. Backfilling:

1. The Contractor shall perform all backfilling that may be required for the installation of any and all parts of this Section.
2. Backfilling shall be performed in accordance with the specifications.

I. Clean Up:

1. The Contractor shall clean up and dispose of all excess excavation, material, remove asphalt and concrete, trash, wood forms, and other debris and restore the job site to a condition acceptable to the Owner. Pipe laying operations shall not be permitted to extend excessive distances ahead of clean up. Unless otherwise directed by the Engineer, clean up activities shall not lag behind pipe installation by more than 500 feet.

J. Plugs, Caps, Blind Flanges, Anchorage and Thrust Blocks:

1. Standard plugs shall be inserted into the bells of all deadened pipes, tees, or crosses; spigot ends shall be capped, flanged ends shall have suitable blind flanges. Force mains that are to be abandoned shall be cut at the connection point. The connection point shall be plugged with non-shrinking grout.

2. Reaction or thrust blocks shall only be applied where shown on plans or specifically approved by the Engineer.
3. Concrete reaction or thrust blocks shall have a 28-day compressive strength of not less than 2,500 psi. The concrete mix shall consist of one part cement, two parts sand and five parts stone or gravel, by weight. Blocks will be poured between solid ground and the fitting. The concrete shall be so placed that pipe joints and fitting joints will be accessible for repair. The dimensions of concrete thrust blocks shall be as shown on the Drawings, but in no case less than 2 cubic feet in volume.

K. Temporary Plugging

1. Installed piping systems shall be temporarily plugged at the end of each day's work, in other interruption, to the progress on a given line. Plugging shall be installed in a manner satisfactory to the Engineer, and it shall be adequate to prevent entry of animals into the pipe or the entrance or insertion of water or deleterious materials.
2. Plugs installed for pressure testing shall be fully secured and blocked to withstand the test pressure.
3. Where plugging is required because of contract division or phasing for later connection, the ends of such lines shall be equipped with a permanent-type plug or blind flange. Installation or removal of such plugging shall be considered incidental to the Work.

L. Flanged Joints:

1. Care shall be taken in bolting flanged joints that there is no restraint on the opposite end of the piece which would prevent pressure from being evenly and uniformly applied upon the gasket. The pipe or fitting must be free to move in any direction while bolting. Bolts shall be gradually tightened, each in turn, at a uniform rate of gasket compression around the entire flange.

M. Turbidity Control:

1. The Contractor shall take adequate precautions to minimize siltation and bank erosion in waterways. Contractor must control turbidity on aqueous crossing or bank work so that it does not exceed established background turbidity by more than 50 Jackson Units at a distance greater than 100 feet from the point of work. A turbidity barrier shall be used for all aqueous and bank work. This shall be done by the use of four turbidity screens suspended by floats or other methods approved by the Engineer. The turbidity screens shall be spaced 25' apart, two screens on each side of the crossing.

N. Conformity with Permits and Regulations:

1. The Contractor shall comply with all regulations, conditions and other requirements promulgated under these permits or by these or other governmental agencies having jurisdiction over the Work; the cost of all such compliance having been included in amounts bid and as shown in the Contract.

O. Restrained Joints:

1. Restrained joints shall be provided as shown on the plans or as approved by the Engineer. All fittings and valves shall be restrained with restrained joint lengths indicated on the pipeline details on the drawings.
2. Restrained joints shall be constructed using pipe and fittings with restrained "locked-type" joints and the joints shall be capable of holding against withdrawal for line pressures up to 150 psi. Megalug restraints as manufactured by EBBA Iron, Inc., may be used when approved by the Engineer.
3. Restrained pipe joints that achieve restraint by incorporating cut sections in the wall of the pipe shall have a minimum wall thickness at the point of cut out that corresponds with the minimum specified wall thickness for the rest of the pipe.

3.04 MISCELLANEOUS INSTALLATION CONDITIONS

- A. Where connections are required between new work and existing force mains, the connections shall be made in a thorough and workmanlike manner, using proper fittings to suit the actual conditions.
- B. The contractor is responsible for repairing all existing utilities and facilities including but not limited to water mains and services, sanitary sewer, sanitary sewer laterals, stormwater, existing force main, electrical, telephone, gas, cable TV, signal loops, signal interconnects, and streetlight power during installation of the new force main piping and associated work. All repairs shall be completed at no additional cost to the Owner.
- C. Where a connection is made to an existing fitting in the line, the Contractor shall schedule his work so that digging and locating the existing fittings can be completed prior to starting trench work on the line. Tie-ins into lines shall be done at a time approved by the Engineer. The Contractor shall verify the dimensions of all pipe before ordering special fittings, couplings, or taps.

3.05 ELECTRONIC UTILITY MARKERS

- A. Install electronic utility locator markers at all main line fittings and valves as specified in Section 13800 Electronic Utility Location System.

3.06 TESTING

- A. All piping specified herein this section shall be hydrostatically tested following procedures specified in Section 15029 Pipeline Testing.

3.07 CLEANING

- A. As pipe laying progresses, keep the pipe interior free of all debris. Completely clean the interior of the pipe of all sand, dirt, mortar splatter and any other debris following completion of pipe laying and any necessary interior repairs prior to testing the completed pipeline.

END OF SECTION

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SECTION 02506

VALVES AND APPURTENANCES

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and install complete and ready operation all valves and appurtenances as shown on the Drawings and as specified herein.
- B. All valves and appurtenances shall be of the size shown on the Drawings and as far as possible all equipment of the same type shall be from one manufacturer.
- C. All valves and appurtenances shall have the name of the maker, flow directional arrows, and the working pressure for which they are designed cast in raised letters upon some appropriate part of the body.
- D. All exposed valves, where applicable, shall have "open-closed" position indicators. The position indicators shall be conveniently located for easy visibility.
- E. All buried valves shall open left (counterclockwise). Insofar as possible, all valves shall open counterclockwise.
- F. The equipment shall include, but not be limited to, the following:

Description

- 1. Valve Stem Extension
 - 2. Identification Tag Requirements
 - 3. Gate Valves
- G. Although they may not be specifically shown on the drawings or called for elsewhere in the Technical Provisions, the Contractor shall include in his bid price the cost of all fittings, piping supports, and miscellaneous appurtenances needed to provide a secure, workable pipe and valve system. Equipment discharge piping and other exposed piping shall be supported and restrained as necessary to insure a stable installation.
 - H. See GENERAL REQUIREMENTS which contain information and requirements that apply to the Work specified herein and are mandatory for this project

1.02 RELATED SECTIONS

- A. Section 01300 - Submittals
- B. Section 01730 - Operating and Maintenance Data
- C. Section 02500 - Restoration and Cleanup
- D. Section 02504 - Piping and Fittings

1.03 DESCRIPTION OF SYSTEMS

- A. All of the equipment and materials specified herein are intended to be standard for use in controlling the flow reuse water,

1.04 QUALIFICATIONS

- A. All of the types of valves and appurtenances shall be products of well-established, reputable firms who are fully experienced, reputable and qualified in the manufacture of the particular equipment to be furnished. The equipment shall be designed, constructed and installed in accordance with the best practices and methods and shall comply with these specifications as applicable.

1.05 SUBMITTALS

- A. Submit to the Engineer, within 30 days after execution of the contract, a list of materials to be furnished, the names of the suppliers, and the date of delivery of materials to the site.
- B. Complete shop drawings of all valves and appurtenances shall be submitted to the Engineer for approval in accordance with the requirements of Section 01300 and the General Requirements.

1.06 OPERATING INSTRUCTIONS

- A. Operating and maintenance instructions shall be furnished to the Engineer. The instructions shall be prepared specifically for this installation and shall include all required cuts, drawings, equipment lists, descriptions, etc., that are required to instruct operating and maintenance personnel unfamiliar with such equipment.

1.07 TOOLS

- A. Special tools, if required for normal operation and maintenance, shall be supplied with the equipment.

- B. Two tee-handled gate wrenches of suitable length shall be furnished to operate all valves with valve boxes.

PART 2 - PRODUCTS

2.01 VALVE STEM EXTENTIONS

- A. Where the depth of the valve is such that its centerline is more than 4 feet below grade, operating extension stems shall be provided to bring the operating nut to a point 6 inches below the surface of the ground and/or box cover. Extension stems shall have 2-inch standard operating nut and steel alignment washer. Extension stems shall be by the General Engineering Company, or equal.

2.02 VALVE BOXES

- A. Valve boxes shall be of the two-piece adjustable screw type, cast iron, with 5-1/4-inch shaft of appropriate length for the installation. Extension pieces, if required, shall be the manufacturer's standard type. Valve box tops shall have raised letters saying "WASTEWATER". Valve boxes shall be USF 7500 as manufactured by U.S. Foundry and Manufacturing Corporation of Miami, Florida, or equal.
- B. Valves box lids are to be purple in color.

2.03 IDENTIFICATION TAG REQUIREMENTS

- A. Buried Valves: Underground valve identification markers shall be 3-inch diameter, 3/8-inch thick, solid hard brass, with 1/4-inch thick tamper-proof hood-end rod anchor. Surface to be engraved with 1/4-inch to 3/8-inch capital letters, approximately 0.015-inch deep. Hand punched lettering is not acceptable surface of marker ground smooth and epoxy coated to prevent tarnishing. Markers shall be Wago markers or equal.

2.04 GATE VALVES

- A. Resilient-seated gate valves must be wedge type conforming to ANSI/AWWA C509 and UL262 shall be provided for 3-inch and larger buried service. Resilient-seated gate valves shall have a cast iron body and bonnet, rubber-coated cast iron disc, mechanical joint ends, non-rising stem, O-ring seals, bronze stem nut, flanged bonnet and square operating nut sized relative to service requirements. All ferrous surfaces, interior and exterior, shall receive a minimum 8 mil fusion-bonded epoxy coating conforming to AWWA C550.
- B. All valves must be UL Listed and FM approved. AWWA, UL-FM designation must be cast into valve body.

- C. Square operating nut sizes are 2-inch.
- D. Valves shall be as manufactured by American Flow Control, M&H Valve Co., Clow, or equal.

PART 3 - EXECUTION

3.01 GENERAL

- A. Before installation, the valves shall be thoroughly cleaned of all foreign material and shall be inspected for proper operation, both opening and closing, and to verify that the valves seat properly. Valves shall be installed so that the stems are vertical. Jointing shall conform to AWWA C600. Valves shall be installed as depicted in the standard details. Joints shall be tested with the adjacent pipeline. If joints leak under test, valves shall be disconnected and reconnected, and the valve and/or the pipeline retested.
- B. Valves shall be installed at locations shown on the Drawings in a manner recommended by the manufacturer and acceptable to Engineer.
- C. Bolt holes of flanged valves shall straddle the vertical centerline of the pipe run. Prior to installing flanged valves, the flange faces shall be thoroughly cleaned. After cleaning, insert gasket and bolts, and tighten the nuts progressively and uniformly. If flanges leak under pressure, loosen or remove the nuts and bolts, reseal or replace the gasket, retighten and/or reinstall the nuts and bolts, and retest the joints. Joints shall be watertight at test pressures before acceptance.
- D. Thoroughly clean threads of screwed joints by wire brushing or other approved method. Apply approved joint compound to threads prior to making joints. Joints shall be watertight at test pressures before acceptance.

3.02 VALVE BOXES

- A. Center the valve boxes and set plumb over the operating nuts of the valves. Set valve boxes so that they do not transmit shock or stress to the valves. Set the valve box covers flush with the surface of the finished pavement or grade as shown. Cut extensions to the proper length so that the valve box does not ride on the extension when set at grade. Valve boxes shall be installed as depicted in the Standard Details.
- B. Backfill shall be the same as specified for the adjacent pipe. Place backfill around the valve boxes and thoroughly compact to a density equal to that specified for the adjacent trench and in such a manner that will not damage or displace the valve box

from proper alignment or grade. Misaligned valve boxes shall be excavated, plumbed and backfilled within the Scope of the Contract.

3.03 TESTING

- A. Valves shall be tested at the same time that the adjacent pipeline is tested. Joints shall show no visible leakage under test. Repair joints that show signs of leakage prior to final acceptance. If there are any special parts of control systems or operators that might be damaged by the pipeline test, they shall be properly protected. The Contractor will be held responsible for any damage caused by the testing.
- B. If requested by the Engineer, the valve manufacturer shall furnish an affidavit stating the materials options furnished and/or that it has complied with these and other referenced specifications.

END OF SECTION

SECTION 02510

ASPHALTIC PAVEMENT, SUBBASE AND LIMEROCK

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Perform all work associated with furnishing and installing Asphaltic Concrete Pavement, Prime and Tack Coats, Subbase (Stabilized Subgrade) and Limerock as shown and as specified herein including all labor, materials, equipment supplies, and facilities associated with providing a finished product satisfying all the requirements of the Contract Documents.
- B. See General Conditions which contain information and requirements that apply to the Work specified herein and are mandatory for this project.

1.2 RELATED SECTIONS

- A. Section 01300: Submittals.
- B. Section 02100: Site Preparation (Clearing and Grubbing)
- C. Section 02200: Earthwork
- D. Section 02319: Excavating, Backfilling, and Compacting for Paving
- E. Section 02485: Finish Grading, Seeding and Sodding
- F. Section 02550: Site Utilities - Water and Sewer Systems
- G. Section 02500: Restoration and Cleanup.

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. CONTRACTOR is to use the latest edition/revision available for all Commercial Standards reference within this contract unless otherwise directed by the applicable regulatory agency.

1.4 SUBMITTALS

- A. Submit, in writing, materials testing reports, job-mix formulas, and other pertinent information acceptable to the Owner or Engineer demonstrating that materials and methods proposed for use will comply with the provisions of this Section in accordance with Section 01300 - Submittals.
- B. Tests for conformance with the Specifications shall be performed prior to start of the work. The samples shall be identified to show the name of the material, aggregate source, name of the supplier, contract number, and the segment of the Work where the material represented by the sample is to be used. Results of all tests shall be

submitted to the Owner or Engineer for review. Materials to be tested shall include aggregate base, coarse and fine aggregate for paving mixtures, mineral filler, and asphalt cement.

- C. Before placing any paving material, a testing laboratory hired by the Contractor and acceptable to the Owner or Engineer shall prepare a trial batch of asphalt concrete for each job-mix formula to be used for the Work. The trial batch shall be prepared using the aggregates and asphalt cement acceptable to the Owner or Engineer. The compacted trial batch shall provide a basis for computing the voids ratio, provide an indication of the optimum asphalt content, and establish a basis for controlling compaction during construction. The cost of the laboratory trial batch tests will be borne by the Contractor who shall furnish the materials at no cost.

1.5 QUALITY CONTROL

- A. Testing will be done by a testing laboratory of the Owner's choice at the Owner's expense with the exception that all failed tests shall be paid for by the Contractor. An independent testing will be required to verify proper placement and compaction of the subbase, base and pavement sections.
- B. The Contractor must have the Engineer inspect and accept each phase of the work before proceeding with the next phase. Inspections will therefore be made for the subgrade, the base, the prime or tack coat, during and after laying the surface course. Acceptance by the Engineer of any phase shall not relieve the Contractor of the responsibility of correcting any deficiencies that subsequently may be discovered.

PART 2 - PRODUCTS

2.1 SUBBASE

- A. The stabilized subbase shall achieve a minimum Limerock Bearing Ratio of 40. Subbase soils that do not achieve a minimum LBR of 40 shall either be replaced or consistently and uniformly mixed with limerock throughout the thickness of the subbase. The subbase shall be smooth without ruts or other irregularities. The thickness of the subbase shall be as shown on the approved plans.
- B. Earthwork, including the swales, shall be substantially completed before final preparation of the subgrade begins. Thus, the swale and beginning subgrade shall be shaped to within plus or minus two (2) inches of the required elevations.
- C. Material which contains weeds, roots or other unsuitable matter shall not be used, or allowed to remain, in the right-of-way under construction.

- D. The Contractor shall contact the Engineer for an inspection of the sub base before proceeding further.

2.2 LIMEROCK BASE

- A. The limerock base shall be constructed with Grade No. 2 Oolite Formation Limerock meeting the following requirements unless otherwise specified and approved by the Engineer.

Carbonates of Calcium and Magnesium	Min. 70.0%
Oxides of Iron and Aluminum	Max. 2.0%
Organic Matter	Max. 0.5%

Any other constituents shall be silica or inert material. Further, it shall be graded uniformly down to dust with all fine material consisting of dust of fracture.

- B. Eradicate and mix existing asphalt pavement into existing base material to a minimum depth of 6 inches below the existing grade. Reshape composite base material to conform with proposed grades; add additional material as required to provide 8 inch thick base minimum. Compact to 98% of the maximum dry density per AASHTO T-180C.
- C. The limerock shall be placed, spread, worked, compacted and finished in accordance with good road-building techniques and practices to the specified grade and cross section. It shall be compacted to a density of at least 98 percent of maximum density as determined by AASHTO T180 and have a limerock bearing ratio of 100. The finished surface shall be checked with a template cut to the required crown and with a straightedge laid parallel to the centerline of the road. All irregularities greater than 1/4 inch shall be corrected.
- D. The Contractor shall contact the Engineer for an inspection of the limerock base before proceeding further.

2.3 PRIME COAT AND TACK COATS

- A. Prime and tack coats shall be applied when the air temperature in the shade is above 40 degrees F and when all other weather conditions and the condition of the surface are suitable. Immediately before applying the prime or tack coat, the limerock base shall be kept clean of all dust, sand, dirt, and other foreign materials. Prime or tack coats shall not be applied when it is raining, nor when the limerock base is too wet as determined by the Engineer.
- B. The material used for prime coat shall be cutback asphalt, either Grade RC-70 or RC-250, or other types and grades of prime material called for on the City approved Plans.

- C. The prime coat material shall be applied by means of a pressure distributor and the rate of application shall be not less than 0.10 gallons per square yard. The primed base shall be covered by a light uniform application of sand, which is free of any objectionable material. No traffic shall be permitted and no bituminous material shall be applied over the prime coat until it has become thoroughly cured, as determined by the engineer.
- D. The material used for tack coat shall be Emulsified Asphalt, Grade RS-2, or other types and grades of tack material called for on the City approved Plans.
- E. The tack coat material shall be applied by means of a pressure distributor except that, on small jobs, if approved by the Engineer, application may be by other mechanical devices or by hand. The rate of application shall be between 0.02 and 0.08 gallons per square yard. The tack coat shall be applied sufficiently in advance of the laying of the bituminous mix to permit drying, but shall not be applied so far in advance that it might lose its adhesiveness as a result of being covered with dust or other foreign material. It shall be kept free from traffic until the subsequent layer of bituminous mix has been laid.

2.4 SURFACE COURSE

- A. The Contractor shall notify the Engineer at least 48 hours in advance of the time the surface course is to be laid, so that the Engineer may inspect the base and also observe the surface course being laid.
- B. Prior to the laying of the surface course, the surface of the base to be covered shall be leveled in order to achieve final grades. Asphalt leveling course to be added as required and cleaned of all loose and deleterious material by the use of power brooms or blowers, supplemented by hand brooming where necessary.
- C. Prior to the laying of the surface course, the surface of the base to be covered shall be cleaned of all loose and deleterious material by the use of power brooms or blowers, supplemented by hand brooming where necessary.
- D. The surface course material shall be either Type S-3 Asphaltic Concrete, unless otherwise approved by the Engineer, and it shall be laid with a paving machine equipped with tamping bars or a vibratory screed and it shall have a minimum track length of six (6) feet. The thickness of the surface course after compaction shall be 1-1/4 inches for type S-1 (1-Lift) and 3/4 inches for Type S-3 (1-Lift), unless otherwise noted on the City approved Plans.
- E. The surface course material may be spread and finished by hand in limited areas where the use of the paving machine is impossible or impracticable. The quality of this work shall equal that of the rest of the job.

- F. The surface course shall be compacted with a 10 to 12-ton tandem roller followed by a self-propelled pneumatic-tired roller, which shall cover every portion of the surface with at least five passes.
- G. Areas which are inaccessible to a roller shall be compacted by the use of hand tamps or other satisfactory means. The quality of this work shall equal that of the rest of the job.
- H. The finished surface shall be checked with a template cut to the required crown and with a 13-foot straightedge laid parallel to the centerline of the road. All irregularities greater than 1/4-inch shall be corrected in a manner approved by the Engineer.

2.5 LEVELING COURSE

- A. Before any leveling course is spread, all depressions in the existing surface more than 1-inch deep shall be filled by spot patching with Type S-3 Asphalt and then thoroughly compacted.
- B. The final leveling course shall be placed by the use of a paving machine meeting the requirements of the City, over the full width of the paved roadway and to the thickness specified on the City approved Plans.
- C. In no case shall the thickness of the leveling course exceed two (2) inches. In localized areas where the thickness of the leveling course would otherwise exceed two (2) inches (for example, in depressed areas around manholes), the depressed area shall first be filled with the Asphaltic Concrete and compacted with equipment and techniques approved by the Engineer or as called for on the Plans.

2.6 ASPHALT

- A. Type S-1 (1-Lift) and Type S-3 (1-Lift), unless otherwise noted on the City approved Plans. Types S-1 and S-3 shall meet the Specifications set forth in the Bituminous Treatments Surface Courses and Concrete Pavement Section of the Florida Department of Transportation Standard Specifications for Road and Bridge Construction, latest edition.

2.7 TRAFFIC CONTROL MARKINGS

- A. Thermoplastic stripes and markings shall be as specified in Section 711 of the "Standard Specifications".

- B Reflective pavement markings shall be as specified in Section 706 of the “Standard Specifications”.
- C Signing shall be as specified in Section 700 of the “Standard Specifications”.

PART 3 - EXECUTION

3.1 SUBGRADE PREPARATION

- A. Clear grub and strip site and prepare the site prior to commencement of grading operations.
- B. All fill and excavation to be graded to subgrade (+/-) 0.10 foot. Contractor shall be responsible for final grading, smoothing and clean up of all within the project limits, regardless of work performed by other contractors. Final grade shall be established by “Blue Top” method.
- C. All spoil from excavation, except as may be determined by the Engineer to be unsuitable, shall be placed in the fill areas.
- D. Contractor shall tie all fills into undisturbed bank with benches no steeper than 3' horizontal:1' vertical.
- E. Contractor shall place fill in level, uniform layers. Each layer shall have a uniform loose thickness of not more than ten (10) inches and/or a maximum compacted thickness of not more than six (6) inches, whichever is less.
- F. Contractor shall prepare and bring each layer of fill to (+/-) 3 percent of optimum moisture. Where soils are placed in water the requirement for moisture control will be waived until such time as 1'-0" of comparative dry fill can be placed. At that time, moisture control and density control will begin again. The testing laboratory shall determine soils type and required moisture content. Where moisture fails to meet specified limits, Contractor shall rework, re-compact, and retest failed areas as follows:
 - 1. High Moisture Content:

Should moisture content exceed established maximum moisture content, Contractor shall spread, disk, aerate, and/or otherwise cause the moisture content to be reduced to within uniform maximum allowable limits.
 - 2. Low Moisture Content:

Should moisture content not reach established minimum moisture content, Contractor shall disk, sprinkler, water, mix, and/or otherwise bring the moisture content to within uniform minimum allowable limits.

- G. The "blue top" grade stakes shall be set an equal and minimum distance of six (6) inches outside of and on both sides of the specified width of the base course.
- H. The Contractor shall provide a string line with jack stakes that have a rectangular notch at their base, so that they may be held securely on the "blue tops" when the string is tensioned. The jack stakes shall also have small notches in which the string line is secured a constant distance from the base of the jack stakes.
- I. The subgrade shall be prepared as specified in the Section 02200 - Earthwork as applicable to roadways and embankments. The surface of the subgrade after compaction shall be hard, uniform, smooth and true to grade and cross-section. Subgrade for pavement shall not vary more than 0.02 foot from the specified grade and cross section. Subgrade for base material shall not vary more than 0.04 foot from the specified grade and cross section. Compaction on Subgrade shall be 98% of the maximum density as determined by AASHTO T180 in the upper 12 inches. Where compaction fails to meet specified limits, Contractor shall rework, recompact, and retest failed areas. The Contractor will have tests made by an independent testing laboratory to verify that the required compaction densities are obtained.

3.2 LIMEROCK BASE

- A. Aggregate base shall be provided where shown and to the thickness shown. Imported aggregate bases shall be delivered to the job site as uniform mixtures and each layer shall be spread in one operation. Segregation shall be avoided and the base shall be free of pockets of coarse or fine material. All segregated areas of fine or coarse rock shall be removed and replaced with well-graded rock. Where the required thickness is 6 inches or less, the base materials may be spread and compacted in one course. Where the required thickness is more than 6 inches, the base material shall be spread and compacted in two or more courses of approximately equal thickness and the maximum compacted thickness of any one course shall not exceed 8 inches. The relative compaction of each course of aggregate base shall be not less than 98 percent of maximum density at optimum moisture content when measured in accordance with ASTM D 1557. The compacted surface of the finished aggregate shall be hard, uniform, smooth and at any point shall not vary more than 0.02 feet from the specified grade or cross section.
- B. Verify that substrate has been inspected, that gradients and elevations are correct, and that it is dry.

- C. Correct irregularities in substrate gradient and elevation by scarifying, reshaping, and recompacting.
- D. A minimum of one test every 500 linear feet of trench repair shall be made. If tests indicate Work does not meet specified requirements, remove Work, replace, and retest.
- E. Use mechanical tamping equipment in areas inaccessible to compaction equipment.
- F. The following tolerances for the aggregate base course shall be maintained.
 - 1. Flatness: maximum variation of 1/4 inch measured with 10-foot straight edge.
 - 2. Scheduled compacted thickness: within 1/4 inch.
 - 3. Variation from design elevation: within 1/2 inch.
- G. Requirements for limerock base other than those above shall be as specified in Section 200 of the "Standard Specifications".

3.3 PRIME COAT

- A. Prime coat shall be applied when the limerock base meets the specified density requirements and the moisture content of the top half of the base does not exceed 90 percent of the optimum moisture of the base material. At the time of priming, the limerock base shall be firm, unyielding and in such a condition that no undue distortion will occur.
- B. Before any bituminous material is applied, all loose material, dust, dirt and other foreign material which might prevent proper bond shall be removed from the base for the full width of application. The surface to be primed shall have the glazed finish removed by "hard-planing" prior to the application.
- C. The prime shall be allowed to stand, without sanding, for a period of at least 4 hours. A uniform application of clean sand shall be applied prior to opening the primed base to traffic, in which case the sand shall be rolled with a traffic roller in conjunction with traffic to cure the prime coat. The sand to be used shall be free of silt, rock, particles, sticks, trash, vegetation, or other deleterious material.
- D. Requirements for Prime Coat other than those above shall be as specified in Section 300 of the "Standard Specifications".

3.4 TACK COAT

- A. A tack coat shall be applied to the base and to the contact surfaces of all cold pavement joints, curbs, gutters, manholes and the like before the asphalt pavement is placed. Care shall be taken to prevent the application of tack coat material to surfaces that will not be in contact with the new asphaltic concrete pavement.
- B. Requirements for Tack Coat other than those above shall be as specified in Section 300-7 of the "Standard Specifications".

3.5 ASPHALTIC CONCRETE

- A. Paving shall be as specified in Section 330 of the "Standard Specifications" and the specifications herein.
- B. At the time of delivery to the Work site, the temperature of mixture shall be within ± 25 deg F of the mix temperature.
- C. Asphalt concrete shall not be placed when the atmospheric temperature is below 40 deg F or during unsuitable weather.
- D. Verify that compacted granular base is dry and ready to support paving and imposed loads.
- E. Verify gradients and elevations of base are correct. Rock as-builts must be approved by Engineer prior to placement of any asphalt.
- F. The asphaltic concrete shall be evenly spread upon the base to such a depth that, after rolling, it will be of the specified cross section and grade of the course being constructed.
- G. The depositing, distributing, and spreading of the asphalt concrete shall be accomplished in a single, continuous operation by means of a self-propelled mechanical spreading and finishing machine designed specially for that purpose. The machine shall be equipped with a screed or strike-off assembly capable of being accurately regulated and adjusted to distribute a layer of the material to a definite pre-determined thickness. When paving is of a size or in a location that use of a self-propelled machine is impractical the Engineer may waive the self-propelled requirement.
- H. Spreading, once commenced, must be continuous without interruption.
- I. The mix shall be compacted immediately after placing. Initial rolling with a steel-wheeled tandem roller, steel three-wheeled roller, vibratory roller, or a pneumatic-tired roller shall follow the paver as closely as possible. If needed, intermediate

rolling with a pneumatic-tired roller shall be done immediately behind the initial rolling. Final rolling shall eliminate marks from previous rolling. In areas too small for the roller a vibrating plate compactor or a hand tamper shall be used to achieve thorough compaction.

- J. Upon completion, the pavement shall be true to grade and cross-section. When a 10-foot straightedge is laid on the finished surface parallel to the center of the roadway, the surface shall not vary from the edge of the straightedge more than 1/8 inch except at intersections or changes of grade. In the transverse direction, the surface shall not vary from the edge of the straightedge more than 1/4 inch.
- K. The relative density after compaction shall be 98 percent of the density obtained by using ASTM D1188 or D2726. A properly calibrated nuclear asphalt-testing device may be used for determining the field density of compacted asphalt concrete, or slabs or cores shall be laboratory tested in accordance with ASTM D1188.

3.6 TRAFFIC CONTROL MARKING RESTORATION

- A. Contractor shall be responsible for restoring all traffic striping, reflective markers, signalization systems and signage, which are damaged or disturbed during construction.
- B. Contractor shall submit pavement marking plans in accordance with the requirements of the applicable right-of-way authority. Plans shall be at a scale suitable to indicate the dimensional requirements of the pavement markings. Plan shall receive approval of Owner or Engineer, and the applicable right-of-way authority prior to implementation.
- C. The intent is to restore traffic control to the plan and markings existing prior to construction.
- D. Restoration shall be as specified in Sections 706, 710 and 711 of the "Standard Specifications".
- E. Where a roadway section will be reopened prior to application of traffic markings, the following conditions must be met:
 - 1. Temporary traffic markings must be in place prior to reopening road.
 - 2. Temporary traffic markings are allowable for the ninety (90) day waiting period prior to overlay.

END OF SECTION

SECTION 02550

SITE UTILITIES - WATER AND SEWER SYSTEMS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. The work under this section of the specifications shall include furnishing all labor, materials, equipment, excavation, pumping, sheeting and bracing, installation, backfilling, testing, cleanup, temporary and permanent street patches, restoration of all areas damaged or affected by the construction and all incidentals necessary for a complete installation of all sewer lines, sewer mains, water mains, fittings, and appurtenances.
- B. All work shall be in first class condition and constructed properly in accordance with the drawings, specifications and CITY requirements. All defects and leaks disclosed by the tests shall be remedied. All tests shall be performed by the Contractor and observed by the Consultant.
- C. Prior to construction, the Contractor shall submit to the Consultant for approval all certificates of inspection from the various utility manufacturers insuring all site utility pipe, tanks, appurtenances, and fittings to be supplied have been inspected at the plant and meet the requirements of these specifications.
- D. Upon completion of the work, the Contractor shall furnish to the Consultant, one set of prints of the drawings marked to scale, indicating the installed size, elevation and location of all utilities, structures, and concealed materials, including utility reconnections as made. All changes made during construction shall be noted. Drawings shall give accurate dimensions to concealed materials from visible fixed location points.
- E. All materials shall be new and free from defects impairing strength and durability and be of the best commercial quality for the purpose specified. It shall have structural properties sufficient to safely sustain or withstand strains and stresses to which it is normally subjected and be true to detail.
- F. All pipe and fittings for potable water shall be PVC, Cast, or Ductile Iron in sizes 2 inch through 24 inch. Fittings for sizes 4 inches and larger shall be cast iron and fittings for 2-inch pipe may be PVC.

1.2 RELATED SECTIONS

- A. Section 01300: Submittals
- B. Section 02100: Site Preparation
- C. Section 02200: Earthwork
- D. Section 02485: Finish Grading, Seeding and Sodding

1.3 QUALITY ASSURANCE

- A. Reference Standards:

CONTRACTOR is to use the latest edition/revision available for all Commercial Standards reference within this contract unless otherwise directed by the applicable regulatory agency.

- 1. Florida Department of Transportation Standard Specifications for Road and Bridge Construction, Latest Edition, including supplements.

PART 2 - PRODUCTS

2.1 GRAVITY SEWERS

- A. Sewer Pipe and Fittings:
 - 1. Non-pressure polyvinyl chloride (PVC) pipe conforming to ASTM D3034, SDR 35, with push-on rubber gasket joints.
 - 2. Fittings and accessories: As manufactured or supplied by the pipe manufacturer and conforming to the following additional requirements:
 - (a) Provide PVC sewer piping having a dimension ratio (DR) of 35 and minimum pipe stiffness (PS) of 46 PSI.
 - (b) Joints:
 - 3. Integral bell gasketed joint designed for radial compression of the elastomeric gasket inside the bell on the pipe spigot to ensure a positive seal.
 - 4. Design joint to avoid displacement of the gasket when installed under provisions of the manufacturer's recommendation.
 - 5. Use lubricants to join pipe as recommended by the manufacturer. Solvent cement joints: acceptable. Joint pipe entirely in the trench under strict provisions of the pipe manufacturer's instructions.
- B. Pipe and Fittings:
 - 1. Pipe:
 - (a) Made of PVC plastic having a cell classification of 12454-B or 12454-C or 13364-B (with minimum tensile Modulus of 500,000 PSI) as defined in specification D1784.
 - (b) Uniform in color, opacity, density and other physical properties.

2. Fittings: Made of PVC plastic having a cell classification of 12454-B, 12454-C or 13343-C as defined in specification D1782.
3. Compounds with different superior cell classifications are acceptable.
4. Clean reworked material generated by the manufacturer's own production meeting all requirements of specifications are acceptable.
5. Pipe and fittings: homogenous throughout and free from cracks, holes, foreign inclusions or other injurious defects.
6. PVC pipe and fittings showing signs of ultra-violet degradation are not allowed.
7. Pipe Marking: Mark each standard and random length of pipe with the following information:
 - (a) Manufacturer's Name or Trademark.
 - (b) Nominal Pipe Size.
 - (c) The PVC Cell Classification.
 - (d) The Legend "Type P#! DR 35 PVC Sewer Pipe".
8. Fittings Marking: Mark fittings with the following information:
 - (a) Manufacturer's Name or Trademark.
 - (b) Nominal Size.
 - (c) The Material Designation "PVC" PSM.
9. Adapters: As required by the field conditions.
10. Service Plugs: Flexible virgin polyvinyl chloride similar to those supplied by Fernco Joint Sealer Company.

2.2 WATER MAINS

A. Ductile Iron Pipe and Fittings:

1. Ductile Iron Pipe and Fittings shall be in accordance with ANSI A21.50 and A21.51 using 60,000-psi tensile strength, 42,000-psi yield strength and 10 percent minimum elongation. The pipe shall have a rated working pressure of 150 psi and shall be Class 51 thickness.
2. Joints may be either mechanical or push-on type. The gasket material for either joint type shall conform to ANSI A21.11, suitable for water service.
3. All ductile iron piping shall have cement-mortar lining conforming to ANSI A21.4.

B. PVC Pipe and Fittings:

1. Pipe 3 Inches and Smaller: Plastic pipe shall be in accordance with ASTM D1785 or D 2855. Plastic pipe fittings shall be in accordance with ASTM D2467. Plastic valves per Cabot Piping Systems, or equal.
 - a. Pipe 1-1/2 Inches and Smaller shall be Schedule 80 PVC. Sizes 1-1/2 inches but not larger than 3 inches shall be Schedule 40. Sizes 3 to 4 inches shall be pressure rated at 160 psi, SDR 26.
 - b. Fittings: Solvent weld PVC fittings shall be used where possible. Schedule 80 pipe may be threaded and used with threaded metal

fittings or valves, where flanges or solvent welding fittings cannot be used.

- C. All water main installations shall comply with the color coating requirements of Chapter 62-555.320, FAC.

2.3 GATE VALVES

- A. General: Gate valves 3 to 12 inches in diameter shall be designed for 200-psi minimum working pressure. Gate valves, when fully open, shall have a clear waterway equal to the nominal diameter of the pipe. The valve shall open by turning to the right or clockwise when viewed from the stem. The operating nut or wheel shall have an arrow cast in the metal indicating the direction of opening. Each valve shall have the manufacturer's distinctive marking, pressure rating and year of manufacture cast on the body. Prior to shipment from the factory, each valve shall be tested by applying to it a hydraulic pressure equal to twice the specified working pressure.
 - 1. All gate valves shall be of the non-rising stem type and open by turning to the right unless otherwise noted, and shall be Mueller M&H or other approved manufacturer.
 - 2. All buried gate valves shall be provided with a 2-inch square operating nut and adjustable cast iron valve box.
 - 3. Buried valves shall be installed vertically, with stem pointing up.
 - 4. All gate valves shall have push-on joints, mechanical joint ends, flanged ends, or screw joints to fit the pipe run in which they are to be used.
- B. Gate Valves, 3 Inch and Larger: Gate valves shall be iron body, fully bronze mounted, double disc, parallel seat, tapered wedge type, except as noted otherwise on the drawings. The valves shall conform to AWWA C500 and to the latest issue of Federal Specification WW-V-58 for Type II, Class A valves.
- C. Gate Valves, 2-1/2 Inch and Smaller: Gate Valves, unless otherwise noted on the drawings, shall be bronze valves and shall conform to the requirements of Federal Specification WW-V-54, Type I, Class A. Gate valves shall be handwheel operated and if installed below ground shall have an adjustable valve box with cover.

2.4 VALVE BOXES

- A. The Contractor shall furnish, assemble and place a cast iron valve box for each buried valve.
- B. All buried valves shall be fitted with a cast iron valve box having suitable barrel and shaft extension sections to cover and protect the valve bonnet section and to permit operation of the valve with a standard valve wrench. Box assemblies shall be Clow No. F-2450, or approved equal. The cap shall have cast in the metal the word

"WATER" for water valves and "SEWER" for sewer valves. All parts of the box shall receive a factory applied coal tar coating.

PART 3 - EXECUTION

3.1 LINE AND GRADE

All fill and excavation to be graded to subgrade (+ / -) 0.10 foot. Contractor shall be responsible for final grading, smoothing and clean up of all areas within the project limits.

3.2 INSTALLATION, GRAVITY SEWERS

- A. General: The installation of sanitary sewer force main shall be in conformance with the CITY Construction Standards and Specifications.

3.3 INSTALLATION, SANITARY SEWER FORCE MAIN

- A. General: The installation of sanitary sewer force main shall be in conformance with the CITY Construction Standards and Specifications.

3.4 CONCRETE ENCASEMENT AND SPECIAL PIPE SUPPORTS

- A. Provide concrete pipe encasements or special pipe supports as shown on the drawings or as approved by the ENGINEER. Various pipe supports shall be as worked out in the field and approved by the ENGINEER to suit local conditions and emergencies. Concrete encasement for protection shall be provided in accordance with the details on the drawings where there is less than 24 inches of cover over top of pipe and at all crossings of water lines and sanitary lines, at which point the sanitary sewer line shall be encased for 10 feet on both sides of the water lines. All other concrete needed to build and protect the pipe work properly shall be used at the direction of the Consultant.

3.5 INSTALLATION, PRESSURE MAINS

- A. General: Where invert elevations are not indicated, lay water and sewer lines with not less than 36 inches cover. Cover for pipe under pavement shall be measured from the bottom of the base material. Greater depths will be permitted where required to miss obstructions or for the proper installation of valves. Locate lines generally as shown on the drawings and as directed by the Consultant. Contractor shall investigate well in advance of pipe laying any conflicts, which may require readjustments in planned locations and shall advise the Consultant of the results of these investigations so that a determination may be made and the Consultant may give instructions as to modifications required. All adjustments shall be subject to

approval by the ENGINEER prior to installation. Water and sewer and reuse lines should not be laid parallel where the lateral separation is less than six (6) feet, ten (10) feet preferred. In case of crossing, the vertical separation should be not less than 12 inches from outside of water main to outside of sewer and reuse mains. In the event this is impossible, the crossing shall be constructed in accordance with the Standard Details for such shown on the drawings.

- B. Laying Pipe: The interior of the pipe shall be thoroughly cleaned of all foreign matter before being lowered into the trench and shall be kept clean during construction by means of plugs or other suitable methods. No trench water shall be allowed to enter the pipe or fittings. During suspension of work, for any reason at any time, a suitable stopper shall be placed in the end last laid to prevent mud or any other foreign material from entering the pipe. Lines shall be laid reasonably straight, and any change in grade in following the contour of the ground shall be made in long sweeping curves. Abrupt changes in grade will not be permitted except as indicated on the Contract Drawings or approved by the ENGINEER.
- C. Joints: Type of joints used shall be approved by the ENGINEER prior to installation. Joints shall be made in accordance with approved printed instructions of the manufacturer, and shall be made absolutely watertight.
- D. Restrained joints shall be used at bends, fittings, valves and at all points of unbalanced reaction in the piping. Anchors and thrust blocks shall not be permitted by the CITY within the right-of-way.
- E. Valves shall be set with stems vertically above the centerline of the pipe except valves with gear boxes or where indicated or directed otherwise. Keep valves tightly closed during installation and take care to prevent dirt from damaging seating surfaces. Tighten stuffing box, if provided, and operate valve to see that all parts are in working condition before installation. Set valve box, for buried valve, plumb and place directly over the valve operating nut. Tamp earth fill completely around the valve box for a distance of one foot. Provide valve box extensions where required by depth of cover.

3.6 INSPECTION AND TESTING

- A. All pipe and fittings shall be inspected and tested at the plant as required by the standard specifications to which the material is manufactured. The Contractor shall furnish to the ENGINEER sworn certificate of such tests and materials.
- B. Pipe and fittings shall be subjected to a careful inspection just before being laid or installed. Defective pipe and fittings shall be immediately removed and replaced with sound material.

3.7 TESTING

A. Gravity Sewers:

1. General: All work constructed shall be subject to visual inspection for faults or defects and any such deviation or omissions shall be corrected at once. All tests shall be made by the Contractor who shall provide necessary equipment for testing and lamping the system in the presence of, and under the supervision and instructions of the Consultant. All costs for testing defined below shall be borne by the Contractor. Lamp tests shall be observed first hand by the Consultant. Upon completion, each section of the sewer line shall show a full circle of light when lamped between manholes.
2. Infiltration: After completion, the sewers, or sections thereof, shall be tested and gaged for infiltration. To check the amount of infiltration, the Contractor, at no added compensation over the contract price for the sewers, shall furnish, install and maintain a V-notch sharp crested weir in a wood frame tightly secured at the low end of each sewer lateral and at locations on the main sewers as directed by the Consultant. Maximum allowable infiltration shall be 300 gallons per mile per inch of diameter of sewer per 24-hour day at any time. The joints shall be tight and visible leakage in the joints or leakage in excess of that specified above shall be repaired at the Contractor's expense by any means found to be necessary and approved by the Consultant. When infiltration is demonstrated to be within the allowable limits, the Contractor shall remove such weirs. For making the infiltration tests, underdrains, if used, shall be plugged and other groundwater drainage shall be stopped to permit the groundwater to return to its normal level insofar as practicable.
3. Exfiltration: In areas where groundwater is not encountered in construction or it is desired to run exfiltration tests, the Contractor shall furnish and install all necessary materials, equipment, shall supply water, etc. and shall run exfiltration tests to determine acceptance of the sewer. The maximum allowable exfiltration shall be 300 gallons per mile per inch of diameter of sewer per 24-hour day at any time, based on a two-foot minimum internal head. An allowance of 10 percent of gallonage shall be permitted for each additional two-foot head over the basic head. The joints shall be tight and leakage in excess of that specified above shall be repaired at the Contractor's expense by any means found to be necessary and approved by the Consultant.
4. All testing shall be performed in the presence of the Engineer.
5. Unless otherwise provided herein, water for testing and flushing will be furnished by the Owner; however, the Contractor shall make all necessary

provisions for conveying the water from the Owner-designated source to the points of use.

6. Where water from the Owner is not available, the contractor shall furnish water by tank truck or barrels.
7. Release of water from pipelines after testing has been completed shall be performed as reviewed by the Engineer.

B. Pressure Mains:

1. All pressure mains carrying water, reuse and sewage shall be tested at 150-psi test pressure in the presence of the ENGINEER. After the pipe has been installed and partially backfilled, suitable caps or plugs shall be installed at the ends of the newly laid section, the section to be tested shall be slowly filled with water with care being exercised to expel all air from the pipes. If necessary, the pipes shall be tapped at high points to vent the air. The required pressure as measured at the point of highest elevation shall be applied for at least two hours and any component of the completed section found defective under this test shall be replaced or corrected in an approved manner. The Contractor shall then repeat the pressure test until no defects are found. The duration of the final pressure and leakage test shall be at least two hours. The leakage allowance shall be less than the allowance set forth in Section 13.7 of AWWA Standard C600.
2. For the tests the Contractor shall supply fresh water, furnish suitable temporary testing plugs or caps, and other necessary equipment and all labor required, without additional compensation. The Contractor shall also furnish suitable pressure gages.

3.8 FLUSHING AND CLEANING

- A. The Contractor shall thoroughly flush all mains and appurtenances installed under this contract to the lowest manholes or as directed by the Engineer. The water used in flushing shall be pumped from the low manholes to a storm sewer, canal or gutter. All dirt, sand and debris pumped from the manhole shall be removed and disposed of properly. **Sewage pumping stations shall not be used for disposal of cleaning water.**
- B. The contractor shall flush the lines as often as required by the Engineer in order to remove all sand, dirt and debris from them.

3.9 DISINFECTION

- A. The water main and distribution piping shall be disinfected at the Contractors expense in accordance with AWWA C651 and all Board of Health requirements. The Contractor shall supply copies of the clearance to the Consultant.

END OF SECTION

SECTION 02560

PIPELINE TESTING

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. This section covers the work necessary to hydrostatically test new pipeline systems and appurtenances.
- B. See GENERAL REQUIREMENTS which contain information and requirements that apply to the Work specified herein and are mandatory for this project

1.02 RELATED SECTIONS

- A. Section 02504 - Piping and Fittings

1.03 DESCRIPTION

- A. Perform testing of piping systems in accordance with the latest edition of AWWA C-600 and as specified below.
- B. The Contractor shall make instruments available to Engineer to facilitate spot checks during testing, and shall retain possession of instruments and remove from the site at completion of services.
- C. Provide all water required for flushing and testing. The Contractor shall obtain a construction meter from the Owner at current rates.
- D. The Contractor shall provide all necessary pumping equipment and other equipment, materials and facilities required for proper completion of the flushing and testing specified.
- E. Source and quality of water, procedure and test equipment shall be acceptable to the Engineer. Length of tested line shall not exceed 2,000 feet.
- F. All tests shall be made in the presence of the Engineer and Owner. Notify Engineer at least 48 hours before any Work is to be inspected or tested.
- G. If inspection or test fails, the piping system(s) shall be repaired or replaced at the expense of the Contractor, and inspection repeated, until such piping passes.
- H. Exposed pipe, fittings, valves and joints shall be carefully examined during test.

Leaky joints shall be repaired.

1.04 QUALITY ASSURANCE

- A. Submit a minimum 48-hour advance written notice of proposed testing schedule for review and concurrence of the Engineer.
- B. Submit copies of all test results to Engineer.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.01 GENERAL

- A. All pressure pipelines shall be tested. All testing operations shall be performed in the presence of the Engineer.

3.02 TESTING OF PIPELINES

- A. Conduct pressure and leakage tests on all newly installed pipelines. Furnish all necessary equipment and material and make all taps in the pipe, as required. The Engineer will monitor the tests. Test pressures shall be as specified below:

<u>Service</u>	<u>Legend</u>	<u>Test Pressure (Psig)</u>
Force Main	FM	150
Water Main	WM	150

- B. Testing New Pipe Which Connects to Existing Pipe: New pipelines which are to be connected to existing pipelines shall be tested by isolating the new pipe with spectacle blinds or blind flanges.
- C. Furnish the following equipment for the hydrostatic tests:

<u>Amount</u>	<u>Description</u>
2	Graduated containers
2	Pressure gauges
1	Hydraulic force pump
1	Suitable hose and suction pipe as required

- D. Prior to testing, all pipelines shall be flushed or blown out as appropriate. Test all pipelines either in sections or as a unit. No section of the pipeline shall be tested until all field-placed concrete or mortar has obtained an age of 7 days. The test shall be made

by closing valves when available, or by placing temporary bulkheads in the pipe and filling the line slowly with water. Responsibility for ascertaining that all test bulkheads are suitably restrained to resist the thrust of the test pressure without damage to, or movement of, the adjacent pipe are the Contractor's. Care shall be taken to see that all air vents are open during filling.

- E. The pipeline shall be filled at a rate that will not cause any surges or exceed the rate at which the air can be released through the air valves at a reasonable velocity and all the air within the pipeline shall be properly purged. After the pipeline or section thereof has been filled, it shall be allowed to stand under a slight pressure for a sufficient length of time to allow the concrete or mortar lining, as applicable, to absorb what water it will and to allow the escape of air from any air pockets. During this period, bulkheads, valves, and connections shall be examined for leaks. If leaks are found, corrective measures acceptable to the Engineer shall be taken.
- F. The test shall consist of holding the test pressure on the pipeline for a period of 2 hours. The test pressure shall be as indicated on the pipe schedule measured at the lowest point of the pipeline section being tested. All visible leaks shall be repaired in an acceptable manner.
- G. Maximum allowable leakage shall be determined by the following formula:

$$L = \frac{SD (P)^{1/2}}{148,000}$$

In which L is allowable leakage in gallons per hour; S is the length of pipe tested in feet; D is nominal diameter of pipe in inches; and P is average test pressure in pounds per square inch gage. Pressure during the test shall not vary more than ± 5 psi. An additional amount of 0.0078 gal/hr/inch of nominal valve size will be allowed if test is run against a closed, metal-seated valve. In the case of pipelines that fail to pass the prescribed leakage test, the Contractor shall determine the cause of the excessive leakage, shall take corrective measures necessary to repair the leaks, and shall again test the pipelines, all at no additional cost to the Owner.

- H. Test records shall be made of each piping system installation during the test. These records shall include:
 - 1. Date of test.
 - 2. Description and identification of piping tested.
 - 3. Test fluid.
 - 4. Test pressure.
 - 5. Test results.

6. Remarks, to include such items as leaks (type, location) and repairs made on leaks.
7. Certification by Contractor and initialed acknowledgement by Engineer.

3.03 CLEANING

- A. Following assembly and testing and prior to final acceptance, all pipelines installed under this section, except process air lines and instrument air lines, shall be flushed with water and all accumulated construction debris and other foreign matter removed. Flushing velocities shall be a minimum of 2.5 feet per second

END OF SECTION

SECTION 02570

ELECTRONIC UTILITY LOCATION SYSTEM

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Furnish and install markers and marker locating equipment at every 40' and every fitting (change of direction) for the entire length of the Force Main. Contractor to provide the Utility Location System specified herein.
- B. Like items of equipment provided hereunder shall be the end products of one manufacturer in order to achieve standardization for appearance, operation, maintenance, spare parts and manufacturer's service.
- C. See GENERAL REQUIREMENTS which contain information and requirements that apply to the Work specified herein and are mandatory for this project

1.02 RELATED SECTIONS

- A. Section 01050 - Field Engineering
- B. Section 01300 - Submittals.
- C. Section 02504 - Piping and Fittings

1.03 SUBMITTALS

- A. Submit manufacturers data sheets and specifications describing frequency ranges, bury depths, installation instructions and additional information as required to fully describe system. Submittals shall be made in accordance with Section 01300 - Submittals.
- B. Submit complete operation and maintenance instructions in accordance with Section 01730 - Operation and Maintenance Data.

1.04 QUALITY ASSURANCE

- A. After utility installations have been completed, demonstrate the proper operation of the Electronic Utility Location System. Make any and all repairs and adjustments necessary for proper operation.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Materials and equipment specified herein shall be as manufactured by Tempo or OMNI or 3M Locator System or approved equal.

2.02 MARKERS

- A. All markers shall be color coded and tuned to the specific utility frequency as per APWA Standards.

<u>Utility</u>	<u>Color</u>	<u>Frequency</u>
Water	Blue	145.7 KHZ
Force Main/Wastewater	Green	121.6 KHZ
Reclaim Water	Purple	66.35 KHZ

- B. 4-inch diameter self leveling ball markers, shall be used for depths up to 4 feet.

2.03 SPARE PARTS

- A. Provide twelve (12) additional markers for each frequency specified herein. Marker models shall be as selected by the Owner.

PART 3 - EXECUTION

3.01 GENERAL

- A. Install Electronic Markers in strict accordance with the manufacturer's installation instructions and recommendations.

3.02 MARKERS

- A. Place marker at each main line fitting and valve location during backfill operation. Place additional markers as applicable to limit the maximum distance between markers to 40 feet.
- B. Correct marker for frequency and depth of bury shall be selected as specified herein.

3.04 TESTING

- A. Prior to completion of final surface restoration, check for proper operation of buried utility marker.

- B. Replace or repair any and all damaged or incorrectly operating markers.

3.05 RECORD DRAWINGS

- A. Provide data on record drawings to show locations and model of all installed electronic utility markers.

END OF SECTION

SECTION 02632

POLYVINYL CHLORIDE (PVC) PRESSURE PIPE

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. This Section covers the work required to furnish and install all PVC pressure pipe, complete.
- B. See GENERAL REQUIREMENTS which contain information and requirements that apply to the work specified herein and are mandatory for this project.
- C. Like items provided hereunder shall be the end products of one manufacturer in order to achieve standardization for appearance, operation and maintenance.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 02200 - Earthwork.
- B. Section 15005 - Ductile Iron Pipe and Fittings
- C. Section 15029 - Pipeline Testing.

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Commercial Standards (Latest Revision):

ANSI/AWWA C900 Polyvinyl chloride (PVC) pressure pipe, 4 inches through 12 inches, for water distribution.

ANSI/AWWA C905 Polyvinyl chloride (PVC) pressure pipe, 14 inches through 48 inches, for water distribution.

AWWA M23 PVC Pipe - Design and Installation.

ASTM D 1784 Specification for Rigid Polyvinyl Chloride (PVC) Compounds and Chlorinated Polyvinyl Chloride (CPVC) Compounds.

ASTM D 2241 Specification for Polyvinyl Chloride (PVC) pressure rated pipe (SDR-Series)

ASTM D 1784	Specification for Rigid Polyvinyl chloride (PVC) Compounds and Chlorinated Polyvinyl Chloride (CPVC) Compounds.
ASTM D 2122	Method for Determining Dimensions of Thermoplastic Pipe and Fittings.
ASTM F 477	Specification for Elastomeric Seals (Gaskets) for joining Plastic Pipe.

1.04 SUBMITTALS

- A. Submit to the ENGINEER for review samples of all the materials proposed for use on the work. The samples shall be clearly marked to show the manufacturer's name and product identification and shall be submitted along with the manufacturer's technical data and application instructions. All sample submittals shall conform to the requirements for samples in the GENERAL REQUIREMENTS.
- B. Submit shop drawings of all pipe, joints, bends, special fittings and appurtenances in accordance with Section 01300 - Submittals.
- C. Provide manufacturer's certificates for all materials indicating conformance to the Contract Documents.

1.05 QUALITY ASSURANCE

- A. All materials testing will be based upon applicable ASTM Test Methods and AWWA Standards referenced herein for the materials specified.
- B. All costs of such inspection and tests shall be included within the Scope of the Contract.
- C. Manufacturer's notarized certificates of compliance shall be furnished by the CONTRACTOR.
- D. The pipe shall be subjected to the specified hydrostatic strength tests, flexure tests and crushing tests. The crushing tests shall be made on samples taken from the center of full-length sections of pipe.

PART 2 - PRODUCTS

2.01 GENERAL

- A. All pipe shall be continuously and permanently marked with the manufacturer's name, pipe size and pressure rating in psi, DR rating of pipe and specification manufactured under AWWA C900 and C905.
- B. The manufacturer shall also mark the date of extrusion on the pipe. This dating shall be done in conjunction with records to be held by the manufacturer for 2 years, covering quality control tests, raw material batch number and other information deemed necessary by the manufacturer.

2.02 POLYVINYL CHLORIDE (PVC) PRESSURE PIPE (4-INCH - 12-INCH)

- A. PVC pressure pipe shall conform to the requirements of AWWA C900, latest revision. PVC pressure pipe shall be made from Class 12454-B virgin compounds as defined in ASTM D1784. Pipe shall be minimum 150 psi pressure class and have outside diameter of cast iron with a minimum wall thickness of DR Series 18.
- B. Pipe for reuse water service shall be purple.
- C. Pipe shall be provided in standard laying lengths not to exceed 20 feet.

2.03 POLYVINYL CHLORIDE (PVC) PRESSURE PIPE (14-INCH - 48-INCH)

- A. PVC pressure pipe shall conform to the requirements of AWWA C905, latest revision. PVC pressure pipe shall be made from Class 12454-B virgin compounds as defined in ASTM D1784. Pipe shall be minimum 125 psi pressure class and have outside diameter of cast iron with a minimum wall thickness of DR Series 32.5.
- B. Pipe for reuse water service shall be purple.
- C. Pipe shall be provided in standard laying lengths not to exceed 20 feet.

2.04 PUSH-ON JOINTS (NON-RESTRAINED TYPE)

- A. Joints for PVC pressure pipe shall be accomplished by a factory fabricated, continuous, flexible rubber compression ring or gasket permanently attached to the bell of the pipe.
- B. Joint gaskets shall meet the requirements of ASTM F477 for high head applications.

2.05 PUSH-ON JOINTS (RESTRAINED TYPE)

- A. Restraint of AWWA C900 push-on joints shall be accomplished by using a Series 1600 PVC pipe bell restraint harness as manufactured by EBAA Iron Sales, Inc., or equal.
- B. Restraint of AWWA C905 push-on joints shall be accomplished by using a Series 2800 PVC pipe bell restraint harness as manufactured by EBAA Iron Sales, Inc., or equal.
- C. Number of push-on joint restraints required shall be as per the standard details.

2.06 MECHANICAL JOINT FITTINGS

- A. Mechanical joint fittings shall be as specified in Section 15005 - Ductile Iron Pipe.

2.07 MECHANICAL JOINTS (RESTRAINED TYPE)

- A. Restrained mechanical joints shall be utilized for all fittings and valves indicated on the drawings.
- B. Restraint of mechanical joints shall be accomplished by using a Megalug Series 2000 PV restraining follower gland as manufactured by EBAA Iron Sales, Inc. or equal.
- C. Mechanical joints for fittings and valves shall meet the requirements of ANSI/AWWA C111/A21.11.

2.08 PIPE IDENTIFICATION (FORCE MAIN)

- A. All utility pipe shall be installed with 4" marking balls placed every forty (40) feet and at every fitting at a depth of 24" or as approved by the OWNER. The frequency of the marker balls shall be 66.35 Khz. The marker balls can be buried in any orientation.

PART 3 - EXECUTION

3.01 GENERAL

- A. All laying, jointing, testing for defects and for leakage shall be performed in the presence of the ENGINEER and shall be subject to his review before acceptance. All material found during the progress of the work to have defects will be rejected and promptly removed from the site of the Work.
- B. Pipe shall be installed in accordance with AWWA M23.

- C. The CONTRACTOR's attention is directed to the provisions of "The Florida Trench Safety Act" and Subpart P, Section 1926.652 of the OSHA Safety and Health Standards for Construction, which require that all banks and trenches over 5 feet shall be shored or sloped to the angle of repose.

3.02 INSTALLATION, PRESSURE MAINS

- A. General: Where invert elevations are not indicated, lay pressure lines with not less than 36 inches cover. Cover for pipe under pavement shall be measured from the bottom of the base material. Greater depths will be permitted where required to miss obstructions or for the proper installation of valves. Locate lines generally as shown on the drawings and as directed by the Consultant. Contractor shall investigate well in advance of pipe laying any conflicts, which may require readjustments in planned locations and shall advise the Consultant of the results of these investigations so that a determination may be made and the Consultant may give instructions as to modifications required. All adjustments shall be subject to approval by the Consultant prior to installation. Water and sewer lines should not be laid parallel where the lateral separation is less than six feet, ten feet preferred, and in case of crossing, the vertical separation should be not less than 12 inches. In the event this is impossible, the crossing shall be constructed in accordance with the Standard Details for such shown on the drawings.
- B. Laying Pipe: The interior of the pipe shall be thoroughly cleaned of all foreign matter before being lowered into the trench and shall be kept clean during construction by means of plugs or other suitable methods. No trench water shall be allowed to enter the pipe or fittings. During suspension of work, for any reason at any time, a suitable stopper shall be placed in the end last laid to prevent mud or any other foreign material from entering the pipe. Lines shall be laid reasonably straight, and any change in grade in following the contour of the ground shall be made in long sweeping curves. Abrupt changes in grade will not be permitted except as indicated on the Contract Drawings or approved by the Consultant.
- C. Joints: Type of joints used shall be approved by the Consultant prior to installation. Joints shall be made in accordance with approved printed instructions of the manufacturer, and shall be made absolutely watertight.
- D. Restrained joints shall be used at bends, fittings, valves and at all points of unbalanced reaction in the piping. Anchors and thrust blocks shall not be permitted by the CITY within the right-of-way.
- E. Valves shall be set with stems vertically above the centerline of the pipe except valves with gear boxes or where indicated or directed otherwise. Keep valves tightly closed during installation and take care to prevent dirt from damaging seating surfaces. Tighten stuffing box, if provided, and operate valve to see that all parts are in working condition before installation. Set valve box, for buried valve, plumb and

place directly over the valve operating nut. Tamp earth fill completely around the valve box for a distance of one foot. Provide valve box extensions where required by depth of cover.

3.03 PUSH-ON JOINTS

- A. Immediately before jointing pipe, the bell end of the pipe shall be thoroughly cleaned, and a clean rubber gasket installed lubricated with a manufacturers approved vegetable-based lubricant. The spigot end of the pipe section shall then be inserted into the bell of the previously laid joint and telescoped into its proper position. Tilting of the pipe to insert the spigot into the bell will not be permitted. After the pipe lengths have been joined, a feeler gauge shall be inserted into the recess and moved around the periphery of the joint to detect any irregularity in the position of the gasket. If the gasket cannot be felt all around, or there is a shallow area, the joint shall be disassembled. If the gasket is undamaged, as determined by the ENGINEER, it may be reused, but only after the bell end and gasket have been re-lubricated.

3.04 RESTRAINED JOINTS

- A. Provide and install restrained joint fittings, valves, pipe and accessories as indicated on the Drawings and specified herein.
- B. Restrained joints shall be completed in accordance with the manufacturer's installation instructions.

3.05 INSTALLATION OF PIPE APPURTENANCES

- A. All valves shall be handled in a manner to prevent any injury or damage to any part of the valve or adjoining pipe. All joints shall be thoroughly cleaned and prepared prior to installation. Adjust all stem packing and operate each valve prior to installation to insure proper operation.
- B. All valves shall be installed so that the valve stems are plumb and in the location shown.

3.06 UTILITY MARKERS

- A. Install utility pipe with 4" diameter marking balls placed every forty (40) feet in accordance with 13800 Electronic Utility Location System.

3.07 INSPECTION

- A. All pipe and fittings shall be inspected and tested at the plant as required by the standard specifications to which the material is manufactured. The Contractor shall furnish to the Consultant sworn certificate of such tests and materials.

- B. Pipe and fittings shall be subjected to a careful inspection just before being laid or installed. Defective pipe and fittings shall be immediately removed and replaced with sound material.

3.08 TESTING

- A. All piping specified herein this section shall be hydrostatically tested following procedures specified in Section 15029 - Pipeline Testing.
- B. All pressure mains carrying water and sewage shall be tested at 150-psi test pressure in the presence of the Consultant. After the pipe has been installed and partially backfilled, suitable caps or plugs shall be installed at the ends of the newly laid section, the section to be tested shall be slowly filled with water with care being exercised to expel all air from the pipes. If necessary, the pipes shall be tapped at high points to vent the air. The required pressure as measured at the point of highest elevation shall be applied for at least two hours and any component of the completed section found defective under this test shall be replaced or corrected in an approved manner. The Contractor shall then repeat the pressure test until no defects are found. The duration of the final pressure and leakage test shall be at least two hours. The leakage allowance shall be less than the allowance set forth in Section 13.7 of AWWA Standard C600.
- C. For the tests the Contractor shall supply fresh water, furnish suitable temporary testing plugs or caps, and other necessary equipment and all labor required, without additional compensation. The Contractor shall also furnish suitable pressure gages.

3.9 CLEANING

- A. As pipe laying progresses, keep the pipe interior free of all debris. Completely clean the interior of the pipe of all sand, dirt, mortar splatter and any other debris following completion of pipe laying and any necessary interior repairs prior to testing the complete pipeline.

END OF SECTION

SECTION 02810 - IRRIGATION SYSTEMS

PART 1- GENERAL

1.1 WORK INCLUDED

- A. Provide all labor, materials, and equipment necessary to perform the irrigation work, complete, as indicated on the Drawings and as specified.
- B. The completed and proper construction of the landscape irrigation system including, but not limited to:
 1. All piping, including: mains, laterals, fittings, connections, tees, risers, clamps, and swing joints. All Irrigation Equipment shall be color coded to industry standards to indicate that reclaimed water shall be used.
 2. All control, gate, globe, pressure reducing, quick coupling and other valves including: valve boxes, markers, connections, operators and other accessories.
 3. Complete automatic control system as shown on plans: including controllers, control wiring connections and electrical supply.
 4. All rotating and stationary sprinkler heads including: proper nozzles as called for herein and shown on the plans and all other appurtenances and accessories for proper operations.
 5. Connections of piping to the supply sources as shown on the plans.
 6. All excavation, site-work, relocation or replacement of utilities, backfill and restoration of all disturbed areas.
 7. Provide complete and operable system for the irrigation of all areas to be landscaped on the project site. The plans and these specifications are intended to include all items obviously necessary and requisite for the proper irrigation of the project. This in no way relieves the Contractor of his responsibility to furnish any additional labor, materials and equipment required for a proper system.
 8. Adjust head location, type and size, and any other system components to comply with the requirements of landscaping as actually installed.
 9. Supply, deliver, store, and protect all equipment and materials including pipe and fittings, sprinkler heads, valves, controllers, wire, and all other component parts necessary for the installation of a fully automatic irrigation system as indicated in the plans and specifications.
 10. Provide adequate security of materials on site.

1.2 QUALITY ASSURANCE

- A. All applicable ANSI, AWWA, and ASTM Standards and Specifications, and all applicable building codes and other public agencies having jurisdiction upon the work.
- B. The Contractor shall be responsible for constructing the system in complete accordance with all local codes, ordinances and laws. Any modification made to conform to said codes, laws, and ordinances shall be completed at the Contractor's expenses with no additional compensation allowed.
- C. Protection of Existing Plants and Site Conditions: The Contractor shall take necessary precautions to protect site conditions to remain. Should damages be incurred, this Contractor shall repair the damage to its original condition at his own expense.
- D. Permits and Fees: Obtain all permits and pay required fees to any governmental agency having jurisdiction over the work. Inspection required by local ordinances during the course of construction shall be arranged as required. On completion of the work, satisfactory evidence shall be furnished to Landscape Architect to show that all work has been installed in accordance with the ordinances and code requirements.
- E. The Contractor shall provide full coverage in all irrigated areas and shall be responsible for additional heads and components as required, installed at his own cost.
- F. Workmanship: All work shall be installed by skilled personnel, proficient in the trades required, in a neat, orderly, and responsible manner with recognized standards of workmanship. The Contractor shall have had considerable experience and demonstrated ability in the installation of sprinkler irrigation systems of this type.
- G. Work shall be guaranteed for one year from date of acceptance against all defects in material, equipment and workmanship. Repairs if required shall be done promptly.

1.3 SUBMITTALS

- A. Submit Shop Drawings of irrigation system equipment indicating details of construction including fitting and materials. Where appropriate, and when approved by the Landscape Architect, manufacturer's product data may be substituted for shop Drawings.
- B. Provide manufacturer's warranties as applicable.
- C. After completion of installation, furnish complete as-built reproducibles showing locations of all sprinkler heads, valves, drains, and piping to scale, with dimensions where required or necessary, to show vertical and horizontal deviations from the bid documents made during construction affecting but not limited to the mainline pipe, controller locations, remote control valves, quick-coupling valves and all sprinkler heads. The Drawings shall also indicate and show approved substitutions of size,

material and manufacturer's name and catalog number. All piping shall be dimensioned and drawn to scale. Remote control valves and isolation valves shall have two (2) measurements from fixed objects. Provide two copies of the drawings.

PART 2 - PRODUCTS

2.1 PVC PIPING

- A. Polyvinyl Chloride (PVC) plastic pipe shall be virgin, high impact, and shall be continuously and permanently marked with the following information: Manufacturer's name, pipe size, schedule or type of pipe and material. Pipe shall conform to U.S. Department of Commerce Commercial Standard CS 207-60 or latest revision.
- B. Main lines, sleeves, laterals, risers and suction line shall be SCH 40 PVC conforming to ASTM D, 1785 and shall be purple to designate the use of reclaimed water.

2.2 GALVANIZED PIPE

- A. Pipe installed above grade for the pump station shall be galvanized painted steel conforming to ASTM A.120 Schedule 40.

2.3 FITTINGS

- A. PVC fittings shall be SCH 40, Type 1, and must be of domestic manufacture. Fittings shall be identified according to pressure rating or schedule.
- B. Galvanized fittings shall be malleable iron screwed fittings conforming to ANSI B. 16.3.

2.4 SWING JOINTS AND RISERS

- A. Shrub heads shall be installed on 1/2" SCH 40 PVC Risers which shall be painted black.
- B. Pop-up spray heads and smaller rotor heads shall be installed on flexible swing joints consisting of Toro thick-walled poly pipe and appropriate insert elbows.
- C. Pop-up rotor heads used in non-athletic fields shall be installed on flexible swing joints consisting of Toro thick-walled poly pipe and appropriate insert elbows.

2.5 SPRINKLER HEADS

- A. All sprinkler heads shall be as manufactured by Toro, Inc. or approved equal and shall have a purple color to show that reclaimed water shall be used. The manufacturer shall guarantee all sprinklers and components for not less than

one (1) year from installation, warranted against all defects in normal material and workmanship.

B. Pop-up Spray Heads (Series 570) shall be of the fixed spray type designed for in ground installation. The sprinkler shall be capable of covering up to a fifteen-foot radius at 25 P.S.I.

1. The nozzle shall be comprised of one orifice at two radius ranges and shall be adjustable from full on to full off. The nozzle shall elevate four or twelve inches when in operation. Retraction shall be achieved by a heavy-duty stainless steel spring. The nozzle position shall have a smooth external surface operation in a smooth resilient guide. A riser wiper shall be included in the sprinkler for continuous operation under the pressure of sand and other foreign material. The nozzle shall have the pressure regulation and zero flow features.
2. Coverage shall be either full or part circle. The part circle coverage shall be available in areas of 90, 120, 180, 240, and 270 degrees. Also included shall be special configurations. Nozzle delivery shall be such as to allow part circle patterns to match full circle patterns in participation rates.
3. The body of the sprinkler shall be constructed of non-corrosive heavy duty Cicolac. A filter screen shall be in the nozzle piston. All sprinkler parts shall be removable through the top of the unit by removal of a threaded cap.

C. Shrub Spray Heads (Series 570) shall be of the fixed spray type designed for in ground installation. The sprinkler shall be capable of covering up to a fifteen-foot radius at 25 P.S.I.

1. The nozzles shall be of the spray type for use on slopes, adjustable by means of a stainless steel screw. Nozzle delivery at maximum flow shall be such as to allow part circle patterns to be compatible in precipitation rates with full circle nozzles. The nozzle shall have the pressure regulation and zero flow features.
2. The body of the sprinkler shall be constructed of non-corrosive heavy duty Cicolac. A 2" long cone strainer shall be a separate part from the nozzle assembly to allow for easy flushing of the sprinkler. Maximum working pressure at the base of the sprinkler shall be 50 P.S.I. The sprinkler base shall have 1/2" I.P.S. female threads and shall be approximately 1- 1/4" high.

D. Pop-Up Rotary Heads: (Toro S700 Series)

1. The full and/or part circle sprinklers shall be gear type rotary. Part circle shall be adjustable from a 45 degree to a 315 degree arc shape. The sprinklers shall be capable of covering 43 foot radius at 35 pounds per square inch pressure with a discharge rate of 3 gallons per minute. Radius reductions shall be adjustable by 25%, by means of a radius adjustment screw accessible from the top of the cap when the sprinkler is

properly installed. Water distribution shall be via one (1) nozzle mounted in a 1 3/8" diameter nozzle turret. The nozzle shall elevate 2" when in operation.

2. Retraction shall be achieved by a heavy-duty stainless steel retraction spring. The sprinkler shall have a riser seal and a wiper which permits limited flushing on down stroke to clear away debris from the riser. Rotation shall be accomplished by a sealed, oil packed assembly isolated from the water supply.
3. The body of the sprinkler shall be constructed of non-corrosive heavy duty Cycolac. The sprinkler shall be equipped with a filter screen, and all parts shall be removable through the top of the sprinkler case.

2.6 PLASTIC ELECTRIC VALVES

A. Series and manufacturer

1. Irritrol manufacturer.
2. 100 Series Plastic Diaphragm Valves

B. Electrically activated remote control valve (size as required) shall be constructed with stainless steel trim, normally close with manual bleed plug and manual control (cross handle on 1-1/2" and 2" models; screw driver adjustment on 1" model). Solenoid shall be 3.5 watt, 24 volt A.C. with waterproof molded coil and removable from valve without running coil and twisting wire. Diaphragm shall be of rubber material. Tir-Act solenoid porting shall prevent a continuous flow of water through the ports during operation. Inlet port to solenoid shall be filtered with self-flushing stainless steel screen, removable from outside of valve body for maintenance. All parts shall be serviceable without removing valve from the line. Valve shall have no external plumbing or tubing that can be installed at any angle without affecting valve operation. Some valves shall have pressure regulation feature.

2.7 VALVE BOXES

- A. Valve boxes for electric and manual valves shall be Ametek plastic boxes or approved equal with purple covers and designed for installation with irrigation systems using reclaimed water. The valve box shall be large enough to provide at least 2" of clearance around all valve parts. The word "irrigation" and "non-potable" shall be imprinted in the valve box cover. Each valve box shall have a cover with an anti-theft mechanism.
- B. Valve boxes shall be installed flush with the finished grade as detailed on the drawings. Contractor shall assure percolation beneath the valve box by appropriate means. At least one cubic foot of porous material shall be installed per valve box to promote drainage.

2.8 ELECTRICAL CONTROLLER

- A. A new Rainbird ESP-6LX PLUS Modular Controller shall be installed.

2.9 IRRIGATION CONTROL WIRE

- A. All electrical control and ground wire shall be irrigation control cable. All wiring to be used for connecting the automatic remote control valves to the automatic independent station controllers shall be Type "UF," 600_volt, solid copper, single conductor wire with PVC insulation and bear UL approval for direct underground burial feeder cable.
- B. Insulation shall be 4/64" thick minimum covering of an approved thermoplastic compound for positive waterproof protection of sizes AWG 18 through and including 10. AWG size 8 through 00 shall be insulated with 5/64" of the approved thermoplastic compound.
- C. Verification of wire types and installation procedures shall be checked with and made to conform to local codes. Wires shall be color coded and have different color or stripes for each zone control wire between controller and valve.

2.10 GATE VALVES

- A. Gate valves shall be 150 Lb. Brass with non-rising stem, and shall be manufactured by Crane or approved equal.

2.11 PAINT

- A. Exterior alkyd enamel, flat black or approved equal shall be use on all above ground PVC risers and other designated irrigation equipment. Contractor shall provide paint sample to Landscape Architect for approval prior to execution of painting.

2.12 WATER CONSERVATION EQUIPMENT

- A. Rain sensors. Rain sensors shall be UL listed, 125 VAC, 4AMP rated, which interrupts the common wire to the controller by sensing a preset amount of rainfall. Rain Check® by Rainbird, or approved equal.

2.13 EXISTING WATER SOURCE

- A. The proposed irrigation zones shall be connected to an existing water source that may become reclaimed water in the near future. Contractor to ensure that existing system is operational prior to connection and shall coordinate connection with Airpark maintenance staff.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Layout of Mains and Laterals: Layout sprinkler main lines and perform line adjustments and site modification to lateral prior to excavation.
- B. Layout of Sprinkler Heads: Stake sprinkler head locations and check for uniformity of coverage and correctness of pattern.
- C. Valve Location: Locate valves to assure ease of access for maintenance and that no physical interference with other elements of the project exist. Align valves parallel to each other in manifold systems.
- D. Furnish temporary support, adequate protection and maintenance of all underground and surface utilities, structures, drains, sewers, and other obstructions encountered in the progress of the work.
- E. Where the grade or alignment of the pipe is obstructed by existing utility structures such as conduit, ducts, pipe branch connections to sewer mains, main drains, water services, etc., the obstruction shall be permanently supported, relocated, removed, or reconstructed by the Contractor in cooperation with the owner of such utility.
 - 1. No deviation from the required line or grade shall be made without the written direction of the Owner.

3.2 PIPE INSTALLATION

- A. The Contractor shall stake out the location of each run of pipe, sprinkler heads, and valves prior to trenching. Contractor shall refer and comply to the Trench Safety Act in General Conditions, prior to any excavation.
- B. Excavation shall be unclassified and shall include all materials whatsoever encountered in the excavation of trenches for pipe installation. The trench shall be of sufficient width and depth for installation of the pipe as indicated herein. The Contractor shall cause minimum disturbance to all existing conditions wherever possible; the Contractor shall bore under existing pavement and sidewalks rather than cut and restore. No pavement shall be cut without the Landscape Architects permission.
- C. Pipe shall be delivered and stored on the job site with suitable protection against any damage to pipe and fittings.
- D. Trenches shall be made wide enough to allow a minimum of 6 inches between parallel pipe lines. Parallel lines shall not be installed directly over one another. No lateral line shall be installed directly over another. No lateral line shall be installed in the main line trench. Trenches for pipe lines shall be made of sufficient depths to provide the minimum cover from finish grade as follows:
 - 1. 24 in. minimum cover over main lines and laterals routed under pavement.
 - 2. 18 in. Minimum cover over main lines and 12" minimum cover over laterals.
 - 3. 15 in. minimum cover over control wires from controllers to valves.
 - 4. 24 in. minimum cover for pipe under vehicular use areas or roads.

5. Allow for sufficient width of excavating and working in trenches made in soft soil.
- E. The pipe and fittings shall be carefully inspected before installation of the trench. All rocks over 1 in. diameter and unsuitable bearing materials shall be removed from trench in strict accordance with the manufacturer's recommendations.
1. Solvent welded joints shall be made only on clean, dry, square cut, smooth pipe sections. Fittings shall be "dry" tested for proper size before solvent is applied. The assembly shall proceed in strict accordance with recommended procedures furnished by the manufacturer.
 2. Solvent welded pipe sections shall be "snaked" from side to side in the trench to prevent joint rupture due to thermal contraction.
 3. Pipe openings shall be plugged during construction to prevent entrance of foreign materials.
- F. Place pipe to be installed under roadways, sidewalks, walls, stairs or other hardscape areas, in SCH 40 PVC sleeve which had an inside diameter of not less than one inch larger than the outside of the pipe or the combined outside diameter of pipes installed. All sleeves shall be buried a minimum of 24" beneath all hard surfaces and extend a minimum of 24" beyond hard surface areas. Run irrigation piping and electrical conduit sleeves in same trench with a minimum of 6" separation. Irrigation Contractor shall coordinate with General Contractor so that installation of sleeves precedes hard surface installation.
- G. Backfill shall be carefully placed to avoid pipe dislocation. Backfill material shall be free of rocks, stumps, roots and other unsuitable material. In planting areas, the top 6 in. shall be suitable planting soil. If existing fill is not suitable contractor shall use clean sand. Backfill shall be placed in 6 in. lifts and shall be thoroughly compacted, except in planting area where planting soil is used. Backfill under pavement or sidewalks shall be compacted to 98% of maximum AASHTO T 180 density. The surface of backfilled trenches shall be even with the surrounding ground surface.

3.3 SPRINKLER HEAD INSTALLATION

- A. Contractor shall be responsible for the exact location of all sprinkler heads, acknowledging that the plans are schematic in nature. The Contractor shall accordingly place all sprinkler heads, adjust all nozzles, spray patterns, and make whatever other adjustments that may be required to give the landscaped areas full, complete, and proper coverage and distributions, and to meet all manufacturer's requirements. The Contractor shall make all such adjustments and additions solely at his/hers expense.
- B. Shrub spray sprinklers shall be installed on SCH 40 PVC risers as shown in the detailed drawings. Each sprinkler shall be installed within plant masses to be concealed from view. Shrub sprinklers shall be installed 12" away from adjacent curbs, sidewalks, fences, buildings, or edge of paving for protection.

- C. Pop-up sprinklers shall be installed on swing joints as shown in detailed drawings. Each sprinkler head shall be installed so that the top is slightly above the finish grade level. Backfill around swing joints and sprinklers shall be clean and free of large rocks, root or foreign debris. If existing fill is not suitable contractor shall use clean sand. Sprinkler elevations shall be properly maintained to eliminate the chance of injury to the public.
- D. Pop-up spray sprinklers located adjacent curbs sidewalks, fences, buildings or edges of paving shall be installed 6 in. from back of curb, sidewalk, buildings or paving. Pop-up rotary sprinklers shall be adjacent to curbs, sidewalks, or edge of parking shall be installed 12 in. from back of curb, sidewalk or pavement.
- E. All sprinklers shall be adjusted to eliminate overthrow onto impervious surfaces.

3.4 CONTROLLER

- A. Contractor shall coordinate final location of controller with Landscape Architect and Airpark Maintenance staff. Install per manufacturer's instructions. Controller shall be able to be located outdoors in a lockable cabinet.

3.5 CONTROL WIRE INSTALLATION

- A. Install control wires at least 15 in. below finish grade and lay to the side of the main line. Provide a minimum of 24 in. of looped wire slack at valves and snake wires in trench to allow for contraction of wires. Tie color-coded wires in bundles at 10 ft. intervals.
- B. All underground splices shall be made at electric valves in valve boxes. Solder splices and coat with elastomeric waterproof cement. Wrap with electrical tape and coat again with elastomeric waterproof cement.
- C. All wire passing under existing or future paving or construction shall be encased in SCH 40 PVC conduit extending at least 24 in. beyond the edges of paving and stabilized for construction. Any wire in plant beds shall be installed in 3/4" Class 160 PVC. 18" min. burial. Installation procedures must conform to local codes.
- D. Wire shall be color coded to facilitate troubleshooting.

3.6 AUTOMATIC VALVES

- A. All automatic valves shall be installed in a valve box and shall be arranged for easy adjustment and removal. A union shall be installed on the downstream side. Valve boxes shall be installed flush with grade and shall contain a minimum of ten inches of coarse gravel under the valve itself. Contractor shall insure percolation through the box. Valves with pressure regulating feature shall be set at pressured indicated on the drawing.

3.7 PUMPING STATIONS

- A. The location of the existing pump station shall be verified on site.

3.8 GATE VALVES

- A. Gate valves shall be installed in accordance with local codes and arranged in valve box for easy adjustment and removal.

3.9 VALVE BOXES

- A. Valve boxes shall be installed so the top of the box is at finished grade and parallel to adjacent boxes, curbs and walks.
- B. Proper drainage material shall be provided for each box.

3.10 TESTING AND INSPECTION

- A. The Contractor shall notify Landscape Architect and Owner 72 hrs. in advance of testing.
- B. Cleaning and pressure testing: Flush irrigation system with water to clear lines of foreign materials after system assembly is complete and prior to installation of sprinkler heads. Cap and plug outlets and fill lines with water. Pressurize assembly to 100 P.S.I. and shut off pump. System shall hold at 100 P.S.I. for one hour at no loss of pressure. Joints, tees, elbows, caps and connections shall be left uncovered during this test. Main line sections of solid unbroken pipe should be buried at intervals adequate to secure stabilization of pipe runs when pressurized. If necessary, repair leaks and retest assembly until satisfactory. Install sprinkler heads after approval of test results.
- C. Final inspection shall be made when the complete system is in place, operable, and all repairs, additions, adjustments, and other work is complete. At such time, the Contractor shall adequately demonstrate the proper operation of the system, shall show the system's complete conformance with the plans and specifications, and demonstrate that the irrigation system gives proper and adequate coverage of all landscaped areas.
- D. Acceptance by the Landscape Architect and/or Owner in no way removes the Contractor of his (her) responsibility to make further repairs, corrections and adjustments to eliminate any deficiencies which may later be discovered. Moreover, the Contractor shall fully honor the one year warranty outlined herein.

END OF SECTION

SECTION 02935 -SODDING

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Provide all labor, materials, necessary equipment and services, included but not limited to all related work to complete the Sodding work, as indicated on the Drawings, as specified herein or both, except for items specifically indicated as "NIC ITEMS".

1.2 RELATED WORK

- A. Examine Contract Documents for requirements that affect the work of this Section. Other Specifications Sections that relate directly to work of this Section include but are not limited to:
 - 1. Section 02810, IRRIGATION SYSTEM
 - 2. Section 02950, TREES, PLANTS, AND GROUNDCOVERS

1.3 REFERENCES

- A. Comply with applicable requirements of the following standards. Where these standards conflict with other specification requirements, the most restrictive requirements shall govern.
 - 1. American Society For Testing and Materials (ASTM)
D1557 Moisture-Density Relations of Soils and Soil Aggregate Mixtures Using 10 lb(4.54kg) Rammer and 18 in (457mm) Drop.
 - 2. State of Florida Department of Transportation (FDOT):
Standard Specifications for Road and Bridge Construction.

1.4 SUBMITTALS

- A. Test report of the topsoil shall be submitted to the Landscape Architect. Report shall include recommendations on the type and quantity of additives required to achieve the required pH and nutrients to maintain healthy growth of sod growth.
- B. Certificates:
 - 1. Growers certification:
 - a. Grass species and location of field from which sod is cut.
 - b. Compliance with State and Federal quarantine restrictions.
 - c. Manufacturer's certification of fertilizer and herbicide composition.
- C. Maintenance Instruction.

1. Prior to the end of the maintenance period, furnish two copies of written maintenance instructions to the Owner and one copy to the Landscape Architect for maintenance and care of the sod areas throughout a full growing season.

1.5 QUALITY ASSURANCE

- A. Testing Agency: An Independent Testing Laboratory.
- B. Requirements of Regulatory Agencies: Conform to the requirements of the State Department of Agriculture.

1.6 DELIVERY STORAGE AND HANDLING

- A. Digging
 1. Do not dig sod at the nursery or other approved source until ready to transport sod to the Project site or approved storage location.
 2. Before stripping sod, mow to a uniform height of 2 in.
 3. Cut sod to specified thickness and to standard width and length desired.
- B. Transporting
 1. Deliver sod on pallets. Protect sod against dehydration, contamination and heating during transport and delivery. Sod transported to the Project in open vehicles shall be covered with tarpaulins or other suitable covers securely fastened to the body of the vehicle to prevent injury to the sod material and to protect root system from exposure to wind or sun. Closed vehicles shall be adequately ventilated to prevent overheating of the sod. Evidence of inadequate protection against drying out in transit shall be the cause for rejection.
 2. Sod shall be kept moist, fresh, and protected at all times, under shade or covered with moistening burlap. Such protection shall encompass the entire period during which the sod is in transit, being handled, or in temporary storage. Do not pile sod more than 2 ft. deep.
 3. Upon arrival at the temporary storage location or the site of the work, sod shall be inspected for proper shipping procedures. Should the roots be dried out, the Landscape Architect will reject the sod. When sod has been rejected, the Contractor shall remove it at once from the area of the work and replace it.
 4. Unless otherwise authorized by the Landscape Architect, the Contractor shall notify the Landscape Architect at least 48 hrs in advance of the anticipated delivery date of the sod material. A legible copy of the invoice showing species and variety of the sod included for each shipment shall be

submitted to the Landscape Architect. Certificate of inspection, when required, must accompany each sod shipment.

C. Storage of Sod

1. Do not deliver more sod than can be installed within 24 hrs.
2. Sod shall be kept moist and stored in a compact group to prevent drying out.

D. Handling of Sod

1. Contractor shall take extreme care in the handling of sod material to avoid breaking, stretching, tearing, and dropping strips. The Landscape Architect may reject sod that has been damaged by poor handling.

1.7 JOB CONDITIONS

- A. Begin installation of sodding only after the preceding related work is accepted.
- B. Install sod during months acceptable to the Landscape Architect.
- C. Do not install sod on saturated soil.
- D. Protection: Erect signs and barriers against vehicular traffic over the areas prepared for sod.

1.8 SUBSTANTIAL COMPLETION

- A. The Landscape Architect will inspect all work for Substantial Completion upon written notice of completion. The request shall be received at least ten calendar days before the anticipated date of inspection.
- B. Acceptance of material by the Landscape Architect will be for general conformance to specified requirements and shall not diminish responsibility for full conformance with the Contract Documents.
- C. Upon completion and re-inspection of all repairs or renewals necessary in the judgment of the Landscape Architect, the Landscape Architect will recommend to the Owner that the work of this Section be accepted as Substantially Complete.
- D. Sod areas will be accepted as substantially complete when in compliance with the following conditions:
 1. Roots are thoroughly knit to the soil;
 2. Absence of visible joints;
 3. All areas show a uniform stand of the specified grass in a healthy condition.

E. Acceptance in Part

1. The work may be accepted in parts when it is deemed to be in the Owner's best interest to do so, and when permission is given to the Contractor in writing to complete the work in parts.
2. Acceptance and use of such areas by the Owner shall not waive any other provisions of this Contract.

1.9 GUARANTEE

- A. Guarantee sod for a period of three months after date of Substantial Completion.
- B. Replacement sod under this guarantee shall be guaranteed for an additional three months from the date of installation.
- C. Repair any damage caused by sod replacement at no cost to the Owner.

1.10 QUALITY GUARANTEE

- A. Sod shall be uniform in color, leaf texture, leaf and root density, and free from weeds, diseases, and other visible imperfections at acceptance.
- B. Guarantee does not cover damage as a result of fertilizers, pesticides, or other applications not supervised by the Contractor or as a result of acts of God or vandalism.

1.11 MAINTENANCE

- A. Maintain sod as described in PART 3 of this section.

PART 2 - PRODUCTS

2.1 SOD

- A. Sod shall be nursery grown on cultivated mineral agricultural soils. Sod shall have been mowed regularly and carefully and otherwise maintained until harvest.
- B. Grass Species: St. Augustine "Floritam"
- C. Thickness of cut: Sod shall be machine cut at a uniform soil thickness of 5/8 in. Measurement of thickness shall exclude top growth and thatch.
- D. Strip Size: Sod shall be cut to the supplier's standard width and length. Maximum allowable deviation from standard widths and lengths shall be plus or minus 1/2 in. on width and 5% on length. Broken strips and torn or uneven ends will not be accepted.

- E. Strength of Sod Strips: Sod strips shall be strong enough to support their own weight and retain their size and shape if suspended vertically when grasped in the upper 10% of the section.
- F. Moisture Content: Sod shall not be harvested or transplanted when moisture content (excessively wet or dry) may adversely affect its survival.
- G. Time Limitations: Sod shall be harvested, delivered, and transplanted within a 30 hour period unless a suitable preservation method is approved by the Landscape Architect prior to delivery. Sod not transplanted within this period shall be inspected and approved by the Landscape Architect prior to its installation.
- H. Thatch: Sod shall be relatively free of thatch. A maximum of 1/2 in. (uncompressed) thatch will be permitted.
- I. Diseases, Nematodes, and Insects: Sod shall be free of disease, nematodes and soil borne insects. State Nursery and Plant Laws require that all sod be inspected and approved for sale. The inspection and approval must be made by the State Agriculture Department, Office of the State Entomologist.
- J. Weeds: Sod shall be free of grassy and broadleaf weeds.

2.2 SOIL MATERIALS

- A. Sand: sand shall be a well washed, medium to coarse sand free of silt and sludge. Cyclone sand is not acceptable.
- B. Muck: Muck shall be peat material removed from areas marked "Florida Everglades Peat" on Soil Conservation Service Soils Maps. Muck shall be suitable for plant growth, capable of sustaining vigorous plant growth, and specifically pulverized for agricultural use. Florida peat shall be free of deleterious materials that would be harmful to plant growth, shall be free of nematodes, shall be uniform in quality, and shall have a pH of between 5.5 and 6.5 as determined by ASTM E70. Muck shall be sterilized to make it free of all viable nut grasses and other undesirable weeds.

2.3 PLANTING SOIL

- A. Planting soil shall be 80% coarse sand and 20% muck. Contractor shall be responsible for spreading the planting soil to the required depths.
- B. Before sod is installed, test planting soil and amend as recommended by the Testing Laboratory such that planting soil ph falls within the range of 6.0 to 7.0 pH.

2.4 WATER

- A. Free of substances harmful to plant growth, objectionable odor or staining agents.

2.5 FERTILIZER

- A. The chemical designation for granular fertilizer shall be 12-8-8, with at least 50 percent (50%) of the nitrogen from a non-soluble organic source for all planting.
- B. Apply and distribute by methods and rates as recommended by the manufacturer.

2.6 HERBICIDES

- A. Post-emergent Herbicide: Roundup as manufactured by Monsanto Corp. or approved equal.
- B. Pre-emergent Herbicide: Ron-Star or approved equal.
- C. Certify that herbicide and application technique will not damage plant material prior to application, and replace or repair damage to any plants injured by herbicide application at no cost to the Owner.

PART 3 - EXECUTION

3.1 PREPARATION OF SUBGRADE

- A. Existing sub-grade shall be examined to ensure that the rough grading is correct and that suitable sub-grade materials exist prior to start of sodding work. Start of work shall constitute acceptance of the sub-grade.
- B. Existing sub-grade shall be loosened or scarified to a minimum depth of 3 in. prior to spreading of topsoil. Subgrade shall be brought to true and uniform grade, and shall be cleared of stones greater than 1 in., sticks, and other extraneous material.
- C. Soil in compacted areas shall be tilled to a depth of 12 in. to produce a loose friable soil.

3.2 SPREADING OF PLANTING SOIL

- A. Subgrade shall be damp when planting soil is spread.
- B. Areas where sod is to be planted shall have a sub-grade 4" lower than the finish grade. A **two** inch layer of planting soil shall added prior to laying of sod.
- C. Planting soil in areas to receive lawns and grasses shall be fine graded with a drag or rake. Remove sticks, stones rubbish and extraneous matter. Grading shall round out all breaks in grade, smooth down all lumps and ridges, and fill in all holes and crevices. Grade shall be maintained until installation of sod.

3.3 WEED CONTROL

- A. Apply post-emergent herbicide per manufacturer's rate and use as a spot application to selectively kill weeds within the sod.
- B. Apply pre-emergent herbicide before sodding and again as necessary throughout required maintenance period to prevent weed seed germination.
- C. Verify that the herbicide and application technique will not damage sod prior to application, and replace, and/or repair damage to any sod injured by herbicide at no cost to the Owner.

3.4 SODDING

- A. Weather Conditions
 - 1. Schedule work for periods of favorable weather.
 - 2. Sod placement on days, which in the judgment of the Landscape Architect, are too hot, sunny, dry, or windy for optimal installation may be prohibited.
- B. Begin sodding at the bottom of slopes.
- C. Lay first row of sod in straight line.
- D. Butt side and end joints. Ensure that joints are tight, thereby eliminating the need to patch to eliminate gaps.
- E. Lateral joints shall be staggered.
- F. Do not stretch or overlap rows.
- G. As sodding is completed in any one section, the entire area shall be rolled. Roll sod, except on pegged areas, with roller weighing no more than 150 lbs. per foot of roller width to eliminate air pockets. Following tamping, screened topsoil shall be used to fill all cracks and excess soil shall be worked into the sod with rakes or other suitable equipment. Sod shall not be smothered with too much top dressing of topsoil.
- H. Watering
 - 1. Immediately after top dressing thoroughly water to a depth sufficient that the underside of the new sod strips and the soil immediately below the sod are thoroughly wet, or a minimum of 6 in.
 - 2. Provide an adequate supply of water to and during transplanting of the sod.

3.5 MAINTENANCE

- A. Maintenance of sodded areas shall begin immediately after sod installation and shall continue until work is accepted as Substantially Complete.

B. Maintenance shall consist of protecting, watering, weeding, cutting, fertilizing, repairing of eroded areas, and re-sodding which in the opinion of the Landscape Architect is required to establish a uniform stand of grass.

E. Mowing

1. Whenever grass reaches a height of 3 in., it shall be cut back to 2 in. Clippings shall be removed.
2. After two mowings the Contractor shall top dress the sod with an application of fertilizer at the rate of one lb. of Nitrogen per 1000 square feet.

3.6 CLEANING

- A. Immediately clean spills from paved and finish surface areas.
- B. Remove debris and excess materials from project site.
- C. Dispose of protective barricades and warning signs at the termination of lawn establishment.

END OF SECTION 02935

SECTION 02950 – TREES, PLANTS AND GROWDCOVERS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Provide all necessary labor, materials, equipment, and services to complete all work, as indicated on the Drawings, and/or as specified herein, except for items specifically indicated as "NIC ITEMS".

1.02 RELATED WORK

- A. Examine Contract Documents for requirements that affect the work of this Section. Other specification Sections which directly relate to the work of this Section include, but are not limited to:

1. Section 02200, EARTHWORK.
2. Section 02810, IRRIGATION SYSTEM
3. Section 02935, SODDING

1.03 REFERENCES

- A. Comply with applicable requirements of the following standards. Where these standards conflict with other specified requirements, the most restrictive requirements shall govern.

1. American National Standards Institute, Inc. (ANSI)
Z60.1 American Standard for Nursery Stock (Sponsor: American Association of Nurserymen, Inc.)
2. American Society for Testing Materials (ASTM):
C136 Sieve Analysis of Fine and Course Aggregates.
E 11 Wire-Cloth Sieves for Testing Purposes.
3. "Hortus Third", A Concise Dictionary of Plants Cultivated in the United States and Canada, Cornell University, L.H. Bailey Hortorium, MacMillan Publishing Company, New York, New York.
4. State of Florida Department of Agriculture and Consumer Services (FDACS),
Grades and Standards for Nursery plants, 2ND Edition, February 1998.

1.04 SUBMITTALS

- A. Certificate of inspection of plant material by State Authorities.
- B. Samples: the following samples shall be submitted:

<u>Material</u>	<u>Sample Size or Quantity</u>
Mulch	1 Cu. Ft.
Planting Soil	1 Cu. Ft.
Webbing Tape	1 yard
Topsoil from Off-site Sources	1 Cu. Ft.
Weed Control Fabric	1 Sq. Ft.
Soil Moisturizer	8 oz.

- C. Certificates: Labels from the manufacturer's container certifying that the product meets the specified requirements shall be submitted for the following materials:

Commercial fertilizer.

- D. Test Reports: test reports from an approved testing agency indicating compliance with the specifications shall be submitted for topsoil, peat, planting soil mixture, and any other materials designated by the Landscape Architect.
- E. If requested by Landscape Architect, submit a written schedule of sources or suppliers of all materials for inspection and approval by Landscape Architect before they are delivered and installed on project.

1.05 PERMITTING

- A. Permits and Fees: Obtain all permits and pay required fees to any governmental agency having jurisdiction over the work. Inspection required by local ordinances during the course of construction shall be arranged as required. On completion of the work, satisfactory evidence shall be furnished to the Architect to show that all work has been installed in accordance with the ordinances and code requirements.

1.06 OWNERS INSPECTION AND TESTING

- A. Work shall be subject to inspection at all times by the Landscape Architect. The Owner reserves the right to engage an independent testing laboratory in accordance with requirements of the conditions of the Contract to analyze and test materials used in construction of the work. Where directed by the Landscape Architect, the testing laboratory will make material analysis and will report to the Landscape Architect whether materials conform to the requirements of this specification. The Owner/ Landscape Architect reserves the right to engage and independent expert to evaluate work conditions, installation and work product.
1. Cost of tests and materials analyses made by the testing laboratory shall be borne by the Owner when they indicate compliance with the specification and by the Contractor when they indicate non-compliance.
 2. Testing equipment shall be provided by and tests performed by the testing laboratory. Upon request by the Landscape Architect, the Contractor shall

provide such auxiliary personnel and services needed to accomplish the testing work.

3. Gradation of granular material shall be determined in accordance with ASTM C 136. Sieves for determining material gradation shall be as described in ASTM E-11.

1.07 CONTRACTORS INSPECTION AND TESTING

- A. Testing analysis, and inspection required by the Contractor for his own information or guidance shall be at his own expense.
- B. The Contractor shall engage an independent testing agency, acceptable to the Landscape Architect, to perform the following tests and analysis:

<u>Material</u>	<u>Tests and Analysis Required</u>
Planting Soil	Determination of pH, organic content, and nutrient content. Recommendation shall be made by the testing agency as to the type and quantity of soil additives required to bring nutrient content and pH to satisfactory levels for planting.

1.08 SOURCE QUALITY CONTROL

- A. Identification of plant names shall be as in Hortus Third.
- B. Selection of plant materials
 1. Contractor shall submit to the Landscape Architect the names and locations of nurseries proposed as sources of acceptable plant material, and inspect all nursery materials to determine that the materials meet the requirements of this Section. Proposed materials shall be flagged at the nurseries by the Contractor prior to viewing by the Landscape Architect.
 2. Contractor shall schedule with the Landscape Architect a time for viewing plant material at the nursery. Trips to nurseries shall be efficiently arranged to allow Landscape Architect to maximize his/her viewing time. A minimum of six weeks shall be allowed for this viewing prior to the time that the plants are to be dug.
 - a. The Landscape Architect shall make up to two planting selection trips in connection with the work specified in this Contract.
 - b. Costs of any subsequent plant selection trips shall be borne entirely by the Contractor. The cost of a planting materials selection trip shall include reimbursable expenses such as the cost of transportation, meals, lodging and all other ordinary and necessary costs associated with plant selection. The cost shall also include inspection time to be

charged at the rate of \$85.00/hour. The Contractor shall be billed for these expenses for each additional trip the Landscape Architect must make in order to secure acceptable plant materials in conformance with the requirements of this specification.

3. Landscape Architect may choose to attach his seal to each plant, or representative samples.
 - a. Where requested by the Landscape Architect, photographs of plant material or representative samples of plants shall be submitted.
 4. Viewing and/or sealing of plant materials by the Landscape Architect at the nursery does not preclude the Landscape Architect's right to reject material at the site of planting.
- C. Permits and Fees: Obtain all permits and pay required fees to any governmental agency having jurisdiction over the work. Inspection required by local ordinances during the course of the work shall be arranged as required.

1.09 UNAVAILABILITY OF PLANT MATERIAL

- A. Before changes or substitutions can be made due to unavailability of plant material, Contractor shall submit satisfactory evidence that he/she has advertised for one month in a trade journal such as the "Landscape Information Services", with no response, or has undertaken other methods of locating plant material satisfactory to the Landscape Architect. The Landscape Architect shall approve all substitutions before they are delivered and installed. **DO NOT DELIVER AND INSTALL ANY MATERIAL, WHICH IS ANTICIPATED TO BE A SUBSTITUTE, BEFORE IT HAS BEEN SUBMITTED IN WRITING AND APPROVED AS A SUBSTITUTE BY THE LANDSCAPE ARCHITECT.**

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Digging Plant Material
1. Plants shall not be dug at the nursery or approved source until the Contractor is ready to transport them from their original locations to the site of the work or acceptable storage location.
 2. Root-pruning of field-grown or collected plants shall be performed at least 4 to 6 weeks prior to digging, as determined by industry standards for that species.
- B. Transportation of Plant Material
1. Plants transported to the project in open vehicles shall be covered with tarpaulins or other suitable covers securely fastened to the body of the vehicle to prevent injury to the plants. Closed vehicles shall be adequately ventilated to prevent overheating of the plants.

2. Plants shall be kept moist, fresh, and protected at all times. Such protection shall encompass the entire period during which the plants are in transit, being handled, or are in temporary storage.
3. Unless otherwise authorized by the Landscape Architect, Contractor shall notify the Landscape Architect at least two working days in advance of the anticipated delivery date of any plant material. A legible copy of the bill of lading, showing quantities, kinds, and sizes of materials included for each shipment shall be furnished to the Landscape Architect.

C. Storage

1. Unless specific authorization is obtained from the Landscape Architect, plants shall not remain on the site of the work any longer than two days prior to being installed.
2. Plants that are not installed immediately shall be protected as follows:
 - a. Plants shall be stored in an area protected from high winds, extreme temperatures, flooding, theft, vandalism, or other potential causes of damage.
 - b. Shade-grown plants shall be stored in a shaded location.
 - c. Rootballs shall be kept moist and intact.
 - d. Plants shall not be allowed to dry out.
3. Both the duration and method of storage of plant materials shall be subject to the approval of the Landscape Architect.

D. Handling of Plant Materials

1. Exercise care in handling plant materials to avoid damage or stress.

1.11 REJECTION OF MATERIALS

- A. Evidence of improper digging, transportation, storage, or handling of plant material shall be cause for rejection.
- B. Upon arrival at the temporary storage location or the site of the work, plants shall be inspected by the Landscape Architect for damage or stress due to improper digging, transportation, storage, or handling of plant material. Any plants which are damaged or stressed due to such causes shall be rejected.
- C. Contractor shall remove all rejected plants from the area of work and replace them with plants of the same quantities, species, sizes, and qualities specified.

1.12 PLANTING SEASON

- A. Planting shall be performed when weather and soil conditions are suitable for planting the material specified, in accordance with locally accepted practice.

1.13 TRAFFIC CONTROL

- A. The Contractor shall at his/hers cost, observe all safety regulations including: placing and display of safety devices, provisions of police to control traffic, etc., as may be necessary in order to conduct the public through the project area in accordance with FDOT's "Manual of Traffic Controls and Safe Practices for Street and Highway Construction, Maintenance and Utility Operations."

1.14 SUBSTANTIAL COMPLETION

- A. Landscape Architect shall inspect all work for Substantial Completion following written notice of completion from the Contractor, which must be received by the Landscape Architect at least ten calendar days before the anticipated date of inspection.
- B. Final Acceptance of plant material by the Landscape Architect shall be dependent upon general conformance to specified size, character, and quality, and shall not diminish responsibility for full conformance with the Contract Documents.
- C. Upon completion and re-inspection of all repairs or renewals deemed necessary by the Landscape Architect, the Landscape Architect shall recommend to the Owner that the work of this Section be accepted as Substantially Complete.
- D. Acceptance in Part
 - 1. The work may be accepted in parts when it is deemed to be in the Owner's best interest to do so, and when permission is given to the Contractor in writing to complete the work in parts.
 - 2. Acceptance and use of such areas by the Owner shall not waive any other provisions of this Contract.

1.15 MAINTENANCE

- A. Maintain plant material as described in PART 3 of this Section.

1.16 GUARANTEE

- A. Plants, shall be guaranteed for a period of one year after the date of Final Acceptance.
 - 1. When the work is accepted in parts, the guarantee periods shall extend from each of the partial acceptances to the terminal date of the last guarantee period. Thus all guarantee periods terminate at one time.
- B. Contractor shall make as many inspections as necessary during the guarantee period, at no additional cost to the Owner, to evaluate the condition of all plant material. Contractor shall submit a written report of each inspection to the Owner and the Landscape Architect outlining corrective measures required in order to keep the guarantee valid.

- C. At the end of the guarantee period plants shall be healthy, vigorous, and free of pests, diseases, nutritional deficiencies, dieback, stress, or decline.
- D. Contractor shall replace dead plants and all plants not in a vigorous, thriving condition, as determined by the Landscape Architect, before the end of the guarantee period, without cost to the Owner, as soon as weather conditions permit and within the specified planting period.
 - 1. Replacements shall closely match adjacent plants of the same species. Replacements shall be subject to all requirements stated in these specifications.
 - 2. Contractor shall make all necessary repairs to surrounding areas caused by plant replacement activities. Such repairs shall be performed at no additional cost to the Owner.
 - 3. The guarantee period for all replacement plants shall be extended for an additional one year period from the date of their acceptance after replacement. In the event that a replacement plant is not acceptable during or at the end of the said extended guarantee period, the Owner may elect either one more replacement, without guarantee, or credit for each item.
- E. At the end of the guarantee period, and no less than five days prior to final inspection or as approved by the Owner, all staking and guying materials, and tree wrap and ties shall be removed from the site.
- F. At the end of the guarantee period, Landscape Architect shall inspect all work for Final Acceptance following written notice of completion from the Contractor, which must be received by the Landscape Architect at least ten calendar days prior to the anticipated date for Final Inspection.
- G. Upon completion and re-inspection of full repairs or replacements deemed necessary by the Landscape Architect at that time, the Landscape Architect shall recommend to the Owner that Final Acceptance of the work of this Section be given.

PART 2 - PRODUCTS

2.01 PLANTS

- A. Except as otherwise specified, all plant material shall conform to FDACS Grades and Standards for Nursery Plants, 1998.
- B. Plant material shall be Florida No. 1 quality or better. Plants shall have outstanding form; symmetrical, heavily branched with an even branch distribution, densely foliated and/or budded, and a strong, straight, distinct leader where this is a characteristic of the species. Plants shall possess a normal balance between height and spread. Rootball size shall meet the requirements

specified for a Grade No. 1 specimen. The Landscape Architect shall be the final arbiter of the acceptability of plant form.

- C. Plants shall be healthy and vigorous, and free of disease, insects and pests and their eggs, and larvae.
- D. Plants shall have a well developed fibrous root system.
- E. Plants shall be free of physical damage such as scrapes, broken or split branches, scars, bark abrasions, sunscalds, fresh limb cuts, disfiguring knots, or other defects.
- F. Plants shall meet the size requirements indicated on the plant list. Plants larger or smaller than specified may be used only if accepted by the Landscape Architect.
- G. Where a caliper or size range is specified, at least 50% of the material shall be closer to the top of the range stated.
- H. Plants shall not be pruned before or after delivery, except as required to correct minor damage incurred during handling.
- I. Plants indicated as "B&B" shall be balled and burlapped.
 - 1. Unless otherwise permitted by the Landscape Architect plants shall be nursery grown, not collected.
 - 2. Plants shall be grown for at least two years under climatic conditions similar to those in the locale of the project.
 - 3. Nursery grown plants shall be properly root-pruned and freshly dug. No healed in plants or plants from cold storage will be accepted unless otherwise permitted by the Landscape Architect.
- J. Container grown plants shall be well rooted and established in the container in which they are growing. They shall have grown in the container for a sufficient length of time for the root system to hold the planting medium when taken from the container, but not long enough to become root bound. Container grown plants exceeding the sizes indicated in ANSI Z60.1 shall have containers which are not less than 75% of the ball sizes for comparable B&B plant material. Circling roots shall be severed or spread apart when the specimen is planted. Each container plant shall be inspected and root pruned as needed.
 - 1. Canes or Trunk(s) and Branches:
 - a. Very well formed and sturdy.
 - b. Branching plentiful and uniformly distributed to form a well balanced plant.
 - c. Scars shall be free from rot and shall not exceed 1/4 the diameter of the wood beneath in greatest dimension unless completely healed (except pruning scars).

- d. Pruning scars shall be clean cut leaving little or no protrusion from the trunk or branch.
- e. Graft union completely healed.
- f. No mechanical or pest damage.
- g. No extreme succulence.

2. Foliage

- a. Densely supplied with healthy, vigorous leaves of normal size, color, and texture.
- b. No holes, cavities, or depressed areas caused by broken or dead branches or insufficient foliage.
- c. No chlorosis.
- d. No more than 5% of total foliage affected by pest or mechanical damage.

3. Root system:

- a. Sturdily established in container.
- b. Shall not be rootbound except plants deliberately grown rootbound to produce a dwarf plant or bonsai.
- c. No large roots growing out of containers.

2.02 SOIL MATERIALS

- A. Sand: sand shall be a well-washed, medium to coarse grade sand free of silt and sludge. Cyclone or builder's sand is not acceptable.
- B. Muck: Peat shall be peat material removed from areas marked "Florida Everglades Peat" on Soil Conservation Service Soils Maps. Muck shall be suitable for plant growth, capable of sustaining vigorous plant growth, and specifically pulverized for agricultural use. Florida peat shall be free of deleterious materials that would be harmful to plant growth, shall be free of nematodes, shall be uniform in quality, and shall have a pH of between 5.5 and 6.5 as determined by ASTM E70. Muck shall be sterilized to make it free of all viable nut grasses and other undesirable weeds.

2.03 PLANTING SOIL

- A. Planting soil shall be a mixture of 60% sand and 40% muck, by volume, except for palms, which shall be a mixture of 80% sand and 20% muck by volume.
- B. Before planting materials are installed, test planting soil and amend planting soil as recommended by the Testing Laboratory such that planting soil pH falls within the range of 6.5 to 7.5 pH and have an Infiltration Rate (K-sat) of 8-16 inches/hour.

2.04 BIOSTIMULANTS

A. Biostimulants shall be Die Hard Transplant by Horticultural Alliance (800)628-6373 or approved equal and shall contain miccorhizal fungi and water absorbing polymers.

1. Proportions: Planting soil shall be amended by the addition of Biostimulants in accordance with the amounts recommended by the manufacturer.
2. Biostimulants shall be mixed into the backfill planting soil. Placement shall be in the upper 8-10 inches for trees/palms, and upper 4-6 inches for shrubs; making sure Biostimulants mix is in contact with root ball.

2.05 WATER

A. Water shall be suitable for irrigation and shall be free of salts or other potentially phytotoxic materials.

2.06 COMMERCIAL FERTILIZER

A. Fertilizer content shall conform to the following:

<u>Constituent</u>	<u>% Present by Weight</u>	
Nitrogen(N)	8	(at least 50% in slow release form)
Phosphorus(P)	4	
Potassium(K)	12	(at least 50% in slow release form)

1. At least 50% of nitrogen shall be derived from slow-release (polymer coated) sulfur-coated urea.
2. Available phosphorus shall be derived from super-phosphate, bone meal, or tankage.
3. At least 50% of potassium shall be derived from slow-release (polymer coated) sulfur-coated potassium.
4. Product shall contain at least 4% magnesium sulfate, derived from Kieserite.
5. Product shall contain the micronutrients iron (chelated with EDTA), manganese sulfate, copper, zinc, boron, and sulfur.

B. Fertilizer shall be delivered in manufacturer's standard container printed with manufacturer's name, material weight and guaranteed analysis.

C. Controlled-release fertilizer shall be equal to the following:

<u>Product</u>	<u>Manufacturer</u>
8-4-12 Palm Mix and General Fertilizer	Atlantic F.E.C. 18375 S.W 260 Street Homestead, FL 33031

2.08 MULCH

- A. Mulch shall be shredded Grade "A" Eucalyptus mulch, manufactured by AAction Nursery Products, Inc., Fort Myers, FL 33911, or approved equal.

2.09 GUYING AND STAKING MATERIALS

- A. Wood Stakes: Straight, sound, rough sawn lumber not less than 2 x 4 in.
- B. Black Webbing Tape: as supplied by Terra International, Inc., Miami, Florida, Landscape Supplies, Miami, Florida or approved equal.
- C. Deadmen: Sound, rough sawn lumber 2 x 4 in., 12 in. long or other material approved by the Landscape Architect.

2.10 WEED CONTROL FABRIC

- A. Weed control fabric shall be Pro5 Weed Barrier by Dewitt or approved equal.

PART 3 - EXECUTION

3.01 EXAMINATION OF SUBGRADE

- A. Prior to the work, carefully inspect the installed work of other trades and the site conditions and verify that all such work and site conditions are complete to the point where this installation may properly commence. Examine subgrade and rough grade before planting. Alert Landscape Architect about unacceptable rough grading or subgrade.
- B. Start of work shall imply acceptance of the site conditions.
- C. Utilities (Overhead and Underground)
 - 1. The work area may have existing utilities, such as, but not limited to, fuel, phone, electrical and storm sewer. The locations of some of these existing utilities have been indicated on the Plans. However, no guarantee is implied that the Plans are accurate or complete. It shall be the responsibility of the Landscape contractor to verify the location of all such utilities, structures, etc., by hand excavation or other appropriate measures before performing any work that could result in damage or injury to persons, utilities, structures or property. The Landscape contractor shall make a thorough search of the site for utilities, structures, etc., before work is commenced in any particular location.
 - 2. The Landscape contractor shall take immediate steps to repair, replace, or restore all services to any utilities or other facilities, which are disrupted due to his or her operations. Further, the Landscape contractor shall engage any additional outside repairs on a continuous "around the clock" basis until services are restored. He or she shall also provide and operate any supplemental temporary services to maintain uninterrupted use of the facilities. All costs involved in the repairs and restoring of disrupted service

resulting from negligence on the part of the Landscape contractor shall be borne by the Landscape contractor and he or she shall be fully responsible for any and all claims resulting from the damage.

3. Should utilities, structures, etc., be encountered which interfere with the work the Landscape Architect shall be consulted immediately in order for a decision to be made on the relocation of the work so it will clear the obstruction, if the obstruction cannot be relocated.
4. The Landscape contractor shall not purposefully disrupt or disconnect any type of utility whatsoever without first obtaining the written permission of the Owner. Requests for disconnection must be in writing and received by the Owner at least 72 hours prior to the time of the requested interruption.

3.02 DRAINAGE OF SOILS

- A. The Landscape contractor shall notify the A/E, in writing, of all soil or drainage conditions that he considers detrimental to growth of plant material.
- B. Subsurface Conditions: Some or all work areas may be compacted and/or contain existing material such as limerock which may interfere with adequate vertical drainage and/or proper plant survival and growth and therefore removal of this material is part of the scope of work for the project. The Landscape contractor shall be responsible for insuring adequate drainage in these areas and shall remove this existing material, as required, by such means as auguring, drilling or roto-tilling. THEREFORE, THE LANDSCAPE CONTRACTOR MAY BE REQUIRED TO PERFORM ADDITIONAL EXCAVATION ON THE HOLES FOR ALL PALMS AND TREES. This additional excavation shall be to a depth beyond the required excavation depth indicated below for the holes, in order to insure proper vertical drainage necessary for plant survival and growth.

3.03 LAYOUT OF PLANTING AREAS

- A. Individual tree and palm (as per plant list on the drawings) locations and outlines of shrub and groundcover areas to be planted shall be staked by the Contractor in ample time to allow inspection by the Landscape Architect.
- B. Digging shall not begin until locations of trees and shrub beds are approved by the Landscape Architect.

3.04 PREPARATION OF SUBGRADE

- A. Subgrade of planting areas shall be loosened or scarified to a minimum depth of 3 inches prior to spreading planting soil. Subgrade shall be brought to true and uniform grade and shall be cleared of stones greater than 2 inches, sticks, and other extraneous material.

3.05 PLANTING PIT EXCAVATION

- A. Planting pits for trees, palms, shrubs and groundcovers shall be excavated to the depth and dimension indicated on the Drawings. Planting pits shall be the same depth as the plant rootball and at least two times as wide.
- B. Excavation shall not begin until locations are approved by the Landscape Architect.

3.06 SPREADING OF PLANTING SOIL

- A. Planting soil shall be spread and placed to required depths.
- B. Surfaces shall be graded and smoothed, eliminating all sharp breaks by rounding, scraping off bumps and ridges, and filling in holes and cuts.

3.07 PLANTING

- A. Walls of planting pits shall be dug so that they are vertical and scarified.
- B. Plants shall be set as indicated on Drawings. Final placement shall be such that the top of the original rootball - with the first primary root visible at the soil surface - is located at or slightly above (no more than 1 to 2 inches) final grade. If nursery-grown plants have excess soil covering the original rootball (if the first primary root is not visible at the soil surface), excess soil should be removed to that point. If fine roots have grown into excess soil, they should be removed prior to installation.
- C. Plants shall be turned to the desired orientation when required by the Landscape Architect.
- D. Containerized plants shall be removed from container taking care not to damage roots. If circling roots are present, they shall be severed or spread apart.
- E. Planting shall be positioned in the center of the plant pit, set plumb, and rigidly braced in position until all planting soil has been placed solidly around the ball.
- F. All ropes or strings on top of balls shall be cut and pulled back. Burlap or cloth wrapping shall be left intact around ball except that portions of wrap that are exposed on top of the ball shall be turned under and buried. Non-biodegradable ball wrapping and support wire shall be totally removed from ball and plant pit. There shall be no wrapping materials left on top of the rootball or against/surrounding the stem or trunk.
- G. Incorporate the specified quantity of soil moisturizer in the landscape soil mix and backfill around the plant. Soil mix shall be worked carefully, and thoroughly watered in to fill voids and wash out air pockets.

3.08 WEED CONTROL FABRIC

- A. Weed control fabric shall be installed as shown on details and as per manufacturer's recommendations.

3.09 APPLICATION OF FERTILIZER

- A. Upon completion of plant installation, and prior to mulch applications, Contractor shall apply granular fertilizer as specified in Section 2.07. It shall be evenly broadcast on the soil surface of all shrub beds at the rate of 10 pounds per 1,000 square feet of surface area. It shall be evenly distributed beneath trees and shrubs, but not allowed to accumulate against stems or trunks, or in plant crowns. It shall be watered in immediately after installation.
- B. Fertilizer shall be applied as specified in 3.09, A, above, one time each 3 months during the guarantee period.

3.10 STAKING AND GUYING

- A. Contractor shall stake or guy all trees and palms as needed, immediately after planting. Plants shall stand plumb after staking or guying. (See drawings for staking details)

3.11 MULCHING

- A. Contractor shall apply mulch to a depth of 3 inches in all shrub bed areas and beneath individual trees and palms as shown on details. It shall be evenly distributed and not allowed to accumulate directly against stems or trunks, or over plant crowns.

3.12 WATERING

- A. Initially, water the plant material to develop uniform coverage and deep-water penetration of at least six inches. Avoid erosion, puddling, and washing soil away from plant roots.
- B. Provide continuous watering of plant material and sod after planting in order to achieve optimum growth conditions to establish plants. Water shall be applied as necessary and the amount of water and frequency of watering shall be based on the specific needs of each plant type, the time of year, amount of rainfall and other environmental conditions it is exposed to. This watering shall begin after the plant is planted, and continue until final acceptance or for a minimum of sixty (60) consecutive calendar days, whichever is greater in time. **ALL TREES AND PALMS SHALL BE HAND WATERED, ONLY, DURING THIS PERIOD. DO NOT RELY ON THE IRRIGATION SYSTEM, IF THERE IS ONE, TO ACHIEVE THIS TASK.** It cannot deliver the volume of water required, without flooding areas beyond where water is needed and/or over watering other landscape material. Shrubs and ground cover may be watered by using the irrigation system.

- C. If there is no source for water available at the project, such as a hose bib(s) or fire hydrant(s) if approved for use, then the Landscape contractor shall be responsible for supplying water for hand watering by means of a truck or tank.

3.11 PRUNING

- A. Contractor shall prune each tree and shrub as needed to remove dead or damaged branches.
- B. Pruning shall be done with sharp, clean tools. Bypass clippers are preferred over anvil-type.
- C. Cuts shall be made at appropriate nodes or laterals, leaving no stubs. No pruning paint shall be used.

3.12 MAINTENANCE OF PLANTING

- A. Contractor shall provide landscape maintenance, which shall begin immediately after each plant is planted and continue until Final Acceptance.
- B. Landscape maintenance shall consist of pruning, watering, cultivating, weeding, mulching, removal of dead material, repairing and replacing tree stakes, tightening and repairing guys, resetting plants to proper grades and upright position, and furnishing and applying such treatments as are necessary to keep plants free of insects and disease, and in a healthy growing condition.
- C. Contractor shall promptly replace Impaired or dead plants and shall not wait until the end of the guarantee period to replace plants which have become unacceptable.

3.13 CLEANING

- A. Contractor shall fill all pits and depressions in holding area and rough grade to meet surrounding elevations. Remove any debris resulting from the planting process.
- B. Contractor shall sweep and wash all paved surfaces.

END OF SECTION

SECTION 03100 - CONCRETE FORMWORK

PART 1 GENERAL

1.01 SECTION INCLUDES:

- A. Formwork for cast-in-place concrete or tilt-up-concrete, with shoring, bracing and anchorage.
- B. Openings for other affected work.
- C. Form accessories
- D. Setting of embeds in concrete.
- E. Stripping forms.

1.02 RELATED SECTIONS:

- A. 03200 - Concrete Reinforcement
- B. 03300 - Cast-in-Place Concrete

1.03 REFERENCES

- A. ASTM International:
 - 1. D994 Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).
 - 2. E154 Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls or as Ground Cover.
- B. Codes and Standards: Comply with the following codes, specifications, and standards, except where more stringent requirements are shown or specified (Current Edition U.O.N.):
 - 1. ACI 117 Tolerances for Concrete Construction and Materials.
 - 2. ACI 301 Specifications for Structural Concrete for Buildings.
 - 3. ACI 318 Building Code Requirements for Reinforced Concrete.
 - 4. ACI 347 Recommended Practice for Concrete Formwork.

1.04 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Formwork Engineer: Professional engineer, with Florida license and experience in design of formwork and related items.

2. Formwork Contractor: Florida licensed contracting firm having 5 years successful experience in fabrication and erection of formwork systems of similar scope and complexity as required for this project. Contractor shall have sufficient capacity to produce formwork without causing delay in work.

1.05 FORMWORK AND RESHORING DESIGN

A. Formwork:

1. Comply with ACI 301
2. Formwork engineer shall perform or oversee design, drawings, erection, and removal.
3. Design formwork, shores and reshores according to ACI 117 and ACI 347, including provisions for construction loads and placing equipment to be used on project.
4. Verify strength and stiffness of in-place building elements to resist required loads and restrict deformations to specified tolerances.
5. Earth cuts shall not be used as forms for vertical surfaces. Comply with OSHA's "Trench Safety Act".
6. Design and Installation of Formwork: Form ties that leave through holes in the concrete are not allowed.

B. Removal Strength:

1. No Structural Concrete shall be stripped until it has reached at least two thirds of the 28 day design strength.
2. Strength of concrete shall be determined from testing of job-cured concrete cylinders. Cost of cylinder casting and testing of job-cured specimens cast for this use shall be borne by the contractor.

C. Reshoring:

1. Design reshoring to resist active loads.
2. Space shoring so no lower floor or member will be excessively loaded from design live loads or will induce tensile stress in concrete members where no reinforcing steel is provided.
3. Extend shores beyond minimums to ensure proper distribution of loads throughout structure.
4. Consider special loading requirements to support load of special elements where elements of similar size and capacity do not exist in supporting structure below.

1.06 FORMWORK SUBMITTALS

- A. Product Data: Submit manufacturer's product data with application and installation instructions for proprietary materials and items.
- B. Formwork:
 - 1. Submit shop drawings, signed and sealed by formwork engineer, for fabrication and erection of specific finished concrete surfaces as indicated. Show construction of forms as required. Shoring drawings are required for all elevated concrete work.
 - 2. A/E'S review is for general applications and features only. Design of formwork for structural stability and efficiency is Contractor's responsibility, and will not be reviewed.

PART 2 PRODUCTS

2.01 FORM MATERIALS

- A. Forms for Exposed Finish Concrete:
 - 1. Unless otherwise indicated, construct formwork for exposed concrete surfaces with plywood, metal, or other acceptable panel-type materials. Provide continuous, straight, smooth, exposed surfaces. Earth forming for foundations is prohibited, except for monolithic footings.
 - 2. Furnish in largest practicable sizes to minimize number of joints and to comply with joint system shown on drawings.
 - 3. Provide form material with sufficient thickness to withstand pressure of newly placed concrete, restricting bow and deflection to specified tolerances.
 - 4. Use plywood complying with U.S. Product Standard PS-1 "B-B (Concrete Form) Plywood", Class I, Exterior Grade or better, mill-oiled and edge-sealed, with each piece bearing legible inspection trademark.
 - 5. Where concrete is scheduled to have Smooth Rubbed Finish (Sm Rb-Fn), use plywood complying with U.S. Product Standard PS-1 "B-B (Medium Density Overlaid Concrete Form)", Class I, with each piece bearing legible inspection trademark.
- B. Forms for Unexposed Finish Concrete: Form concrete surfaces to be concealed in finished structure with plywood, lumber, metal, or other material.
- C. Forms for Textured Finish Concrete:

1. Form textured finish concrete surfaces with units of face design, arrangement, and configuration as shown on drawings or as required to match A/E'S control sample.
 2. Provide form supports to ensure stability of textured form liners.
- D. Form Ties: Ties that leave plastic tube lined holes through members are not allowed. Provide factory-fabricated adjustable-length, removable or snap-off metal form ties, designed to prevent form deflection and to prevent spalling concrete. Provide units that will leave no metal closer than 1 and 1.5 inches to exposed surface. Provide ties that will leave holes no larger than 1 inch diameter in concrete surface.
- E. Form Coatings: Provide commercial formulation form-coating compounds with a maximum VOC of 350 mg/l that will not bond with, stain, nor adversely affect concrete surfaces, and will not impair subsequent treatments of concrete surfaces.
- F. Forming Accessories: CRD-C572-74 polyvinyl chloride (PVC).
1. Waterstops: Flat dumbbell type at construction joints and center bulb type at building expansion joints.
 2. Chamfers: 1/2 inch radius on outside corners of exposed-to-view concrete unless drawings show other size or shape.
 3. Drips: 3/8 inch wide x 1/2 inch high drip groove placed 3/4 inch back from edge in cast-in-place exterior soffits.
- G. Premolded Expansion Joint: ASTM D994, 1/2 inch thick.
- H. Vapor Retarder:
1. Provide moisture retarder cover over prepared base material where indicated.
 2. Use polyethylene sheet not less than 10 mils thick or other materials resistant to decay when tested according to ASTM E154.

PART 3 EXECUTION

3.01 FORMS

- A. Erect, support, brace, and maintain formwork to support applied vertical and lateral loads until such loads can be supported by concrete structure. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation, and position.
1. Formwork shall be coated with a form release which will not stain or damage the concrete. The form release shall be applied prior to the installation of any reinforcing steel.

2. Design formwork to be readily removable without impact, shock, or damage to cast-in-place concrete surfaces and adjacent materials. Formwork shall be designed to support pressure resulting from placement and consolidation of the concrete. Design of formwork is the responsibility of the Contractor.
3. Construct forms to sizes, shapes, lines, and dimensions shown to obtain accurate alignment, location, grades, and level and plumb work in finished structures.
4. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features required in work.
5. Use selected materials to obtain required finishes.
6. Solidly butt joints and provide backup at joints to prevent leakage of cement paste.
7. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces.
8. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only.
9. Kerf wood inserts for forming keyways, reglets, recesses, and the like, to prevent swelling and for easy removal.
10. Provide temporary opening where interior area of formwork is inaccessible for clean out, for inspection before concrete placement, and for placement of concrete.
 - (a) Securely brace temporary openings and set tightly to forms to prevent loss of concrete mortar.
 - (b) Locate temporary openings on forms at inconspicuous locations.
11. Chamfer exposed corners and edges as shown on Drawings, using wood, metal, PVC, rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints. Provide corners and edges with 1/2 inch radius PVC accessories to produce uniform smooth lines and tight edge joints, unless otherwise indicated or accepted by A/E.
12. Form Ties:
 - (a) Factory-fabricated, adjustable-length, removable or snapoff metal form ties, designed to prevent form deflection, and to prevent spalling concrete surfaces upon removal.
 - (b) Unless otherwise indicated, provide ties so portion remaining within concrete after removal is at least 1-1/2 inch inside concrete.
 - (c) Unless otherwise shown, provide form ties that will not leave holes larger than 1-inch diameter in concrete surface.

13. Provisions for Other Trades:
 - (a) Provide openings in concrete formwork to accommodate work of other trades.
 - (b) Determine size and location of opening, recesses, and chases from trades providing such items.
 - (c) Accurately place and securely support items built into forms.
 - (d) Accurately place and securely anchor embeds prior to the placing of concrete.

14. Cleaning and Tightening:
 - (a) Thoroughly clean forms and adjacent surfaces to receive concrete.
 - (b) Remove chips, wood, sawdust, dirt, or other debris just before concrete is placed.

3.02 JOINTS

- A. Construction Joints: Locate and install construction joints not shown on drawings to not impair strength and appearance of the structure, as acceptable to A/E.

- B. Provide keyways at least 1-1/2 inch deep in construction joints in walls, slabs, and between walls and footings. Accepted bulkheads designed for this purpose may be used for slabs.

- C. Place construction joints perpendicular to the main reinforcement. Continue reinforcement across construction joints.

- D. Waterstops:
 1. Provide waterstops in construction joints as indicated.
 2. Install waterstops to form continuous diaphragm in each joint.
 3. Make provisions to support and protect exposed waterstops during progress of work.
 4. Fabricate field joints in waterstops according to manufacturer's printed instructions.
 5. Isolation Joints in Slabs-on-Ground:
 - (a) Construct isolation joints in slabs-on-ground at points of contact between slabs on ground and vertical surfaces, such as column pedestals, foundation walls, grade beams, and elsewhere as indicated.
 - (b) Joint filler and sealant materials are specified in Division 7 sections of these specifications.
 6. Contraction (Control) Joints in Slabs-on-Ground:
 - (a) Construct contraction joints in slabs-on-ground to form panels of patterns as shown on drawings.

- (b) Use inserts 1/4 inch wide x 1/4 of slab depth, unless otherwise indicated.
- (c) Form contraction joints by inserting premolded hardboard or fiberboard strip into fresh concrete until top surface of strip is flush with slab surface. After concrete has cured, remove inserts and clean groove of loose debris.
- (d) Contraction joints may be formed by saw cuts (when permitted by the drawings) as soon after slab finishing as possible without dislodging aggregate or tearing or raveling the concrete. Depth of cut shall be 1/4 of slab depth.

3.03 RE-USE OF FORMS

- A. Clean and repair surfaces of forms to be re-used in work. Split, frayed, delaminated, or otherwise damaged form facing materials are not acceptable for exposed surfaces. Apply new form coating compound as specified for new formwork.
- B. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close joints. Align and secure joint to avoid offsets. Do not use "patched" forms for exposed concrete surfaces, except as acceptable to A/E.

END OF SECTION

SECTION 03200 - CONCRETE REINFORCEMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Steel reinforcement for cast-in-place concrete, tilt-up-concrete, and reinforced masonry.

1.02 RELATED SECTIONS:

- A. Section 01572-Construction Waste Management.
- B. 03100-Concrete Formwork.
- C. 03300-Cast-in-Place Concrete.

1.03 REFERENCES

A. ASTM International:

1. A82 Specification for Steel Wire, Plain, for Concrete Reinforcement.
2. A184 Specification for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement.
3. A185 Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.
4. A496 Specification for Steel Wire, Deformed, for Concrete Reinforcement.
5. A497 Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement.
6. A615/A97 Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
7. A706/A706M Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
8. A775 Specification for Epoxy-Coated Reinforcing Steel Bars.

B. Codes and Standards: Comply with the following codes, specifications, and standards, except where more stringent requirements are shown or specified:

1. ACI 117 Tolerances for Concrete Construction and Materials.
2. ACI 301 Specifications for Structural Concrete for Buildings.
3. ACI 315 Details and Detailing of Concrete Reinforcement.

4. ACI 318 Building Code requirements for Reinforced Concrete.
5. ACI 439 Mechanical Connection of Reinforcing Bars.
6. AWS D1.4 Structural Welding Code Reinforcing Steel.
7. CRSI "Manual of Standard Practice".
8. CRSI "Placing Reinforcing Bars".
9. Wire Reinforcement Institute "Manual Standard Practice".

- C. International Organization for Standardization (ISO) 14021–1999; Environmental Labels and Declarations

1.04 QUALITY ASSURANCE

- A. Steel Contractor: Florida licensed contracting firm having 5 years successful experience in fabrication and erection of reinforcing steel of similar scope and complexity as required for this project. Contractor shall have sufficient capacity to install reinforcing steel without causing delay in work.

1.05 SUBMITTALS

- A. Product Data:

1. Recycled Content:
 - (a) Indicate recycled content; indicate percentage of pre-consumer and post-consumer recycled content per unit of product.
 - (b) Indicate relative dollar value of recycled content product to total dollar value of product included in project.
 - (c) If recycled content product is part of an assembly, indicate the percentage of recycled content product in the assembly by weight.
 - (d) If recycled content product is part of an assembly, indicate relative dollar value of recycled content product to total dollar value of assembly.

- B. General:

1. Submit shop drawings for fabrication, bending, and placement of concrete reinforcement.
 - (a) Comply with ACI 315 showing bar schedules, stirrup spacing, diagrams of bent bars, arrangement of concrete reinforcement and accessories.
 - (b) Include special reinforcement required at openings through concrete structures.

- C. Shop drawings made from sepias (or other reproductive methods) of the structural drawings will not be accepted and shall be cause for resubmittal.

1. Selection of splices: Splices shall be full tension, unless noted otherwise.
- D. Splices noted on the drawings to be compression splices shall be furnished by one of the following:
1. Compression lap splices according to ACI 315. Mechanical compression only connectors according to ACI 439, staggered 1/2 Class "B" lap length and maintaining not less than 1/4 the total tensile capacity of any column face.
 2. Full penetration welds staggered not less than 18 diameters.
- E. Splices shown on the drawings as either Class "A" or Class "B" may be one of the following:
1. Class "B" lap splices.
 2. Class "A" (but not less than compression lap) lap splices staggered not less than one Class "B" lap length.
 - (a) Exception: This shall not be allowed when shown as class "B" in a location, which by design, has already accounted for other continuing bars or staggered splices.
 3. Appropriate mechanical connectors according to ACI 439 staggered not less than 24 diameters.
 4. Full penetration welds staggered not less than 24 diameters.
- F. Unless otherwise noted in the drawings, reinforcing shall be spliced to develop the full strength of the bar in either tension or compression. Those splices shall be furnished by one of the following:
1. Class "B" lap splices where only 1/2 of the total rebars are spliced at any one floor.
 2. Full penetration welds staggered not less than 36 diameters.
 3. Appropriate mechanical connectors according to ACI 439-3R staggered not less than 36 diameters.
- G. Total steel at lap splices shall not exceed 8 percent for columns or shear wall cores containing the spliced bars.
1. All bars may be lapped at one section for up to 4 percent steel.
 2. 1/2 of the bars may be lapped for up to 5.3 percent steel.
 3. 1/3 of the bars may be lapped for up to 6 percent steel.
 4. Above 6 percent steel, other splice choices shall be used.

- H. Where staggered lap splices are used, provide a mixture of bar sizes as appropriate where vertical bar size changes on the drawings.
- I. Where different size bars are lap spliced, the length of splice may be based on the smaller bar size. If there is a larger quantity of the smaller bar size, the splice length shall be based on the larger bar.
- J. It shall be the responsibility of the reinforcing detailer to determine the concrete strength at the point of a lap splice, the bar position (top or other), bar spacing, confinement condition based on ties or stirrups or edge condition to select the proper lap length.
- K. Increase laps for bundled bars according to ACI 318, with number based on total bars in-group including lapped bars.
 - 1. Detailing of Splices: Placing shop drawings shall specifically show splice lap lengths where they occur. Bar diameter lap tables and references to other charts are not acceptable.
 - 2. Staggered Laps Required: Provide staggered laps in any member as necessary to keep space between bars within splice zone at least 1 inch or 1 bar diameter clear.
 - 3. Detailing of Bar Placement: For any bar other than those placed at an edge condition, between edge condition or openings, or any other location where the bar cannot be shifted longitudinally, a dimension shall be shown from an identifiable building grid, wall, or edge to at least one end of the bar.
 - 4. Congested Areas of Placement: For any conditions resulting in bar spacing less than 2 diameters clear or where the placement of bars in one member requires critical templating to allow bar placement in an intersecting member, furnish details of sufficient scale to show clearances, spacing, and arrangements for properly placing those bars.
 - 5. Accessories: Show accessories, supports, chairs, bolsters, and spacers necessary to complete the installation. Where supports are beyond the scope of CRSI detailing standards and custom designed supports are required, provide engineering calculations demonstrating the capacity of the system.
 - 6. Flat Plates: Provide not less than 3 separate drawings of each plate separately showing bottom bars, top bars, and accessories.
- L. Welding Submittals:
 - 1. If welding of reinforcing bars is to be included as part of the work, submit the following:
 - (a) A complete welding procedure specification according to AWS D1.4.
 - (b) A certified chemical analysis of the steel to be welded.
 - (c) Carbon equivalence calculations according to AWS D1.4.
 - (d) Qualification papers for welders who will be employed on the project. Welders shall have passed a qualification test within a 12 month

period before the work or furnish a statement from a testing agency acceptable to A/E that they have observed or tested that welder's work under similar requirements within the past 6 months.

M. Alternate Reinforcing Splicing:

1. Splices shown in the drawings shall be considered mandatory for base bid purposes.
2. Alternative methods of providing for splices are available within the constraints of this specification and ACI 318.
3. If alternative splices are desired, the shop drawing submitted shall clearly indicate the change and include authorization by any other subcontractors involved in the change.

PART 2 PRODUCTS

2.01 REINFORCING MATERIALS

- A. All manufactured steel reinforcement products are to contain recycled content.
- B. Comply with Chapter 5 of ACI 301.
- C. Reinforcing Steel:
 1. Bars #3 through #11 shall be deformed bars according to ASTM A615 Grade 60 and according to the additional requirements of Paragraph 5.2.2.1 of ACI 301.
 2. Bars #2 in size shall be plain round meeting A615/A-96a Grade 40.
 3. Welded wire fabric shall be of plain wire.
 4. Unless indicated otherwise the minimum concrete protective cover specified in ACI 301 is the specified cover for this project unless indicated otherwise.
 - (a) Epoxy-Coated Reinforcing Bars: ASTM A775.
 - (b) Form-Saving Splice Connectors: Flanged devices to allow insertion of threaded reinforcing bars into a previously formed face. Available products include, but are not limited to:
 - (c) Form Saver by Lenton.
 - (d) DB-SAE Splices System by Richmond.
 - (e) Rebar Flange Coupler by Williams.
 5. Mechanical Connectors and Splice Devices: Proprietary products suitable for the use intended and listed in ACI 439-3R-83.
 6. Steel Wire: ASTM A82, plain, cold-drawn, steel.
 7. Fabricated Deformed Steel Bar Mats: ASTM A184.

8. Welded Steel Wire Fabric: ASTM A185.
 9. Deformed Steel Wire: ASTM A496.
 10. Welded Deformed Steel Wire Fabric: ASTM A497.
 11. Supports for Reinforcement: Provide supports for reinforcement including bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Use wire bar type supports complying with CRSI Class C or Class A as required acceptable.
- D. For slabs-on-grade, use supports with sand plates or horizontal runners where base material will not support chair legs. Maximum spacing of supports is 3 feet in both directions.
 - E. For exposed-to-view concrete surfaces and with legs of supports in contact with forms, provide supports with legs, either plastic protected according to CRSI, Class 1 or stainless steel protected according to CRSI, Class 2.
 - F. Provide custom supports as required to support top layer of mats and other special conditions not provided for within CRSI standards.

PART 3 EXECUTION

3.01 PLACING REINFORCEMENT

- A. Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars", for details and methods of reinforcement placement and supports, and as specified.
- B. Clean reinforcement of loose rust and mill scale, dirt, and other materials that reduce or destroy bond with concrete.
- C. Accurately position, support, and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers as required.
- D. When any reinforcing bar is placed projecting either horizontally or vertically from a given element to subsequently lap with other reinforcing bar, verify the detailed lap length will be achieved.
 1. Report any deviation to the A/E for correction before placing concrete in the first element.
 2. Bar projections resulting in laps shorter than the detailed laps shall be considered rejected, and corrective measures shall be taken at the direction of the A/E with no additional cost to the Owner.

- E. Place reinforcement to obtain at least minimum coverages for concrete protection. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.
- F. Install welded wire fabric in as long lengths as practicable. Lap adjoining pieces at least one full mesh plus 2 inches and wire splices. Offset end laps in adjacent widths to prevent continuous laps in either direction.
- G. Provide the A/E with not less than 48 hours notice before starting any welding of reinforcing bars.
 - 1. Welding of reinforcing bars shall only be allowed under the direct supervision of the A/E.
 - 2. Welding of crossing reinforcing bars is not allowed.
 - 3. Any bars with unauthorized or unacceptable welds shall be replaced at no additional cost to the Owner.

END OF SECTION

SECTION 03300 - CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Normal weight cast-in-place concrete, including production, formwork, reinforcement, mix design, delivery, placement procedures, and finishes.
- B. The Base Specification for cast-in-place concrete is ACI 301. This specification Section is written to supplement the ACI Standards by designation or specifying individual project requirements for materials and performance.

1.02 RELATED SECTIONS

- A. 01572-Construction Waste Management.
- B. 02200-Earthwork: Sub grade and capillary break vapor barrier: placement of drainage.
- C. 03100-Concrete Formwork.
- D. 03200-Concrete Reinforcement.
- E. 07121-Fluid Applied Waterproofing Substrate requirements: coordination.
- F. 09310-Ceramic Tile.
- G. 09330-Quarry Tile.

1.03 REFERENCES

- A. American Concrete Institute (ACI).
 - 1. ACI 117-Standard Tolerances for Concrete Construction and Materials.
 - 2. ACI 301-Specifications for Structural Concrete.
 - 3. ACI 302-Guide for Concrete Floor and Slab Construction.
 - 4. ACI 304-Guide for Measuring, Mixing, Transporting and Placing Concrete.
 - 5. ACI 305-Hot Weather Concreting.
 - 6. ACI 306R-Cold Weather Concreting.
 - 7. ACI 309-Guide for Consolidation of Concrete.
 - 8. ACI 318-Building Code Requirements for Reinforced Concrete.

9. ACI 347-Recommended Practice for Concrete Formwork.
- B. ASCE 37-02 Design Loads On Structures During Construction.
- C. ASTM International:
1. A185 Standard Specification for Welded Wire Steel Fabric for Concrete Reinforcement.
 2. A497 Standard Specification for Welded Deformed Steel Wire Fabric for Concrete Reinforcement.
 3. A615 Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
 4. C31-Standard Practice for Making and Curing Concrete Test Specimens in the Field.
 5. C33-Standard Specification for Concrete Aggregates.
 6. C39-Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
 7. C94-Standard Specification for Ready-Mixed Concrete.
 8. C143-Standard Test Method for Slump of Portland Cement Concrete.
 9. C150-Standard Specification for Portland Cement.
 10. C172-Standard Practice for Sampling Freshly Mixed Concrete.
 11. C260-Standard Specification for Air-Entraining Admixtures for Concrete.
 12. C309-Standard Specification for Liquid Membrane Forming Compounds for Curing Concrete.
 13. C330-Standard Specification for Lightweight Aggregate for Structural Concrete.
 14. C494-Standard Specification for Chemical Admixtures for Concrete.
 15. C618-Standard Specification for Fly Ash and Raw or Claimed Natural Pozzolin for Use as a Mineral Admixture in Portland Cement Concrete.
 16. C989-Standard Specification for Ground Granulated Blast-Furnace Slag for use in Concrete and Mortars.
 17. C1116-Standard Specification for Fiber-Reinforced Concrete and Shotcrete.
- D. International Organization for Standardization (ISO) 14021–1999; Environmental Labels and Declarations

1.04 SUBMITTALS

- A. Mix Designs: Submit mix designs to Engineer for review 20 days before first placement. Do not proceed without Engineer's written approval.
1. Mix design shall include laboratory test results or production records of 30 consecutive tests as defined by ACI 301.
 2. Indicate material content per cubic yard of each class of concrete furnished:
 - (a) Saturated surface-dried weights of fine and coarse aggregate.
 - (b) Type and name of admixtures.
 - (c) Wet unit weight of each concrete mix.
- B. Certificates:
1. Manufacturer's certification that materials meet specification requirements.
 2. Ready-mix delivery tickets, ASTM C94.
- C. Product Data: Submit product data for all concrete materials and admixtures proposed for use including the following information:
1. Recycled Content:
 - (a) Indicate recycled content; indicate percentage of pre-consumer and post-consumer recycled content per unit of product.
 - (b) Indicate relative dollar value of recycled content product to total dollar value of product included in project.
 - (c) If recycled content product is part of an assembly, indicate the percentage of recycled content product in the assembly by weight.
 - (d) If recycled content product is part of an assembly, indicate relative dollar value of recycled content product to total dollar value of assembly.
 2. Regional Materials:
 - (a) Sourcing location(s): Indicate location of extraction, harvesting, and recovery; indicate distance between extraction, harvesting, and recovery and the project site.
 - (b) Manufacturing location(s): Indicate location of manufacturing facility; indicate distance between manufacturing facility and the project site.
 - (c) Product Value: Indicate dollar value of product containing local/regional materials; include materials cost only.
 - (d) Product Component(s) Value: Where product components are sourced or manufactured in separate locations, provide location information for each component. Indicate the percentage by weight of each component per unit of product.
- D. Related Materials: Submit product data for all proposed release agents, curing compounds and evaporation reducer, and polypropylene fibers that demonstrate conformance to specification.

- E. Shop Drawings: Indicate floor plan and precise locations of all control joints and construction joints in relation to building grid lines that are not shown on drawings. Submit drawings for reinforcement, for fabrication, bending, and placement of concrete reinforcement. Comply with ACI SP-66 "ACI Detailing Manual" showing bar schedules, stirrup spacing diagrams of bent bars, and arrangement of concrete reinforcement.
- F. Records: Retain records of all concrete poured, including; exact mix proportions, slump, air content test, strength, date, time, location of the placement, weather conditions at the time of placement, and the source of concrete. Submit copy to Engineer.

1.05 QUALITY ASSURANCE

- A. Reinforced concrete to comply with ACI 301 and ACI 318, and other stated requirements, codes and standards.
- B. Only one source of cement and aggregates shall be used in one structure to insure uniform color and appearance.
- C. Inspection and Tests: Notify Engineer and testing agency of concrete placement, a minimum of 24 hours before placement begins.

1.06 ENVIRONMENTAL REQUIREMENTS

- A. Hot weather placements: Follow all of the special procedures in Article "Placing Concrete" below and conform to ACI 305R.PRODUCTS

PART 2 PRODUCTS

2.01 CONCRETE MATERIALS

- A. All concrete materials are to contain recycled content such as fly ash, granulated ground blast-furnace slag, and normal weight aggregates.
- B. Cement: ASTM C150, Type I or Type II; other types as approved.
- C. Supplemental Cement Materials
 1. Fly Ash.: ASTM C618, Type F. Not to exceed 20% by weight of total cementitious material
 2. Granulated Ground Blast-Furnace Slag: ASTM C989. Not to exceed 30% by weight of cementitious material.
- D. Normal Weight Coarse; Aggregate; ASTM C33
- E. Water: ACI 301. Clean and potable
- F. Admixtures, General: All concrete shall contain a Type A or D admixture in the basic design with dosages high enough to reduce water by at least 7 percent from the

same mix without the admixture. No admixture shall have added chloride in its manufacture. Add all admixtures at the concrete batch plant.

1. Air-Entraining agent: Shall conform to ASTM C 260. (if used)
 - (a) MB AE 90 or MB-VR by Master Builders.
 - (b) Darex by WR Grace & Co.
 - (c) Air Mix by Euclid Chemical Co.
2. Water-Reducing Admixture: Shall conform to ASTM C 494 Type A (if used).
 - (a) Pozzolith 200N or Pozzolith 322N by Master Builders.
 - (b) WRDA 60 by WR Grace & Co.
 - (c) Eucon WR 75 by Euclid Chemical Co.
3. Water-Reducing Retarding Admixture: Shall conform to ASTM C 494 Type D.
 - (a) Pozzolith 961R or Pozzolith 200N by Master Builders.
 - (b) WRDA 60 by WR Grace & Co.
 - (c) Eucon WR by Euclid Chemical Co.
4. Mid-Range Water-Reducing Admixture: Shall conform to ASTM C 494 Type A or F.
 - (a) Polyheed 997 by Master Builders.
 - (b) Mira 70 by WR Grace & Co.
 - (c) Eucon MR by Euclid Chemical Co.
5. High-Range Water-Reducing Admixture (Superplasticizer): Shall conform to ASTM C 494 type F.
 - (a) Rheobuild or PS 1232 by Master Builders.
 - (b) Adva Flow by WR Grace & Co.
 - (c) Eucon 37 by Euclid Chemical Co.
6. Fibrous Concrete Reinforcement: Shall meet ASTM C-1116 Type III 4.1.3 and ASTM C-1116. Shall be 100 percent virgin polypropylene fibrillated fibers containing no reprocessed olefin materials and specifically manufactured for use as concrete reinforcement at a minimum of 0.1 percent by volume for the control of cracking due to plastic shrinkage and thermal expansion/contraction.

2.02 RELATED MATERIALS

- A. Evaporation Reducer: Shall be specially formulated material to be sprayed on fresh concrete to prevent rapid drying during hot and windy weather, and reduce plastic shrinkage cracking. Sprayed over plastic concrete, the material produces a monomolecular film that holds the water in until the next finishing operation. Product shall contain a yellow fluorescent color tint to easily identify the areas covered.
 1. Confirm by Master Builders.
 2. Eucobar by Euclid Chemical Co.
 3. Sikafilm by Sika Corp.

- B. Liquid Membrane-Forming Curing Compound: Shall be a membrane-forming curing compound complying with ASTM C 309, Type I, except that minimum solids content shall be 30% and moisture loss shall not exceed 0.040 gm/cm² of surface in 72 hours at a coverage rate of 2 coats at 300 sq. ft per gallon.
1. Masterkure 200W by Master Builders.
 2. Super Aqua-Cure VOX by Euclid Chemical Co.
 3. Kure-N-Seal 30 by Sonneborn.
- C. Epoxy Adhesives: Two component, 100% solids, 100% reactive compound suitable for use on dry or damp surfaces:
1. Concesive LPL by Master Builders.
 2. EpoGrip by Sonneborn.
 3. Hi-Mod Epoxy Adhesive by ThoRock.
- D. Epoxy Joint Filler: Two components, 100% solids compound with minimum Shore D hardness of 60 and a maximum of 65.
1. Masterfill 300 I by Master Builders.
 2. Epolith by Sonneborn.
 3. Sikadur 51 by Sika Corp.
- E. Preformed concrete joint filler.
1. Asphalt Saturated Filler containing post-consumer wastepaper, ASTM D1751.
 2. Recycled Rubber, ASTM D1752.
- F. Moisture-Retaining Cover: Shall be one of the following, complying with ASTM C171.
1. Waterproof paper.
 2. Polyethylene film.
 3. Polyethylene-coated burlap.
- G. All coating/ sealant shall be compatible with each other and applied floor finishes or be completely removed prior to application of other coating or finish.
- H. Bonding Agent: Shall conform to ASTM C881 Type 2, Grade 2 Class B and C.
1. Concesive 1414 by Master Builders.

2. Engineer Approved Alternative.

2.03 PROPORTIONING AND DESIGN OF MIXES

- A. Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301. If trial batch method used, use an independent testing facility acceptable to Architect for preparing and reporting proposed mix designs. The testing facility shall not be the same as used for field quality control testing.
- B. Design mixes to provide normal weight concrete with the following properties, as indicated on drawings and schedules:

<u>Concrete Use</u>	<u>Compressive Strength</u>	<u>Maximum water/cementitious ratio</u>
Slab-on-ground and Foundations	3000 psi	.60

- C. Slump Limits: Maximum slump of all concrete at point of placement shall be 5 inches except as modified here:
 - 1. Maximum slump of all concrete containing mid-range water-reducing admixture shall be 7.5 inches.
 - 2. Maximum slump of all concrete containing high-range water-reducing admixture shall be 10 inches.
- D. Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant, as accepted by Engineer. Laboratory test data for revised mix design and strength results must be submitted to and accepted by Engineer before using in work.
- E. Use of aggregate smaller than #67 is prohibited in foundations and slabs.

PART 3 EXECUTION

3.01 PREPARATION OF FORMED SURFACES

- A. General: Coat surfaces of forms with non-residual low-VOC form release agent before reinforcement is placed. Do not allow excess form release agent to accumulate in forms or come into contact with in-place concrete surfaces against which concrete will be placed.

3.02 MIXING: CONCRETE

- A. Ready-mixed Concrete: Mix and transport in accordance with ASTM C94.

- B. Admixture: Dispense admixtures in mix using automatic dispenser or similar metering device at the batch plant with the type and quantity of admixture printed on the batch ticket.
- C. Addition of water in excess of that prescribed in the approved mix design or that increases slump beyond specified values is not permitted.

3.03 PLACING CONCRETE

- A. General: Comply with ACI 304.
- B. Ensure compliance with requirements of ASCE 37-02.
- C. Hot Weather Concreting: In accordance with the current edition of ACI 305.
 - 1. Protect to prevent rapid drying of concrete surface. Start finishing and curing as soon as possible. Use continuous fog sprays or use the specified hot weather evaporation reducer after placement. Apply cure as soon as finishing is complete then protect from sun and wind for at least 24 hours.
 - 2. Allowable Concrete Temperatures: Hot weather: Maximum 95 degrees F. Concrete exceeding this temperature shall be discarded.
- D. Conveying:
 - 1. General: Conform to ACI 301. Convey concrete from mixer to place of final deposit by methods preventing; separation or loss of materials.
 - 2. Equipment: Use pump, crane bucket, wheelbarrow, or buggies to deliver concrete to placing location. Chuting permitted only by method to insure a practically continuous flow of concrete at delivery end to prevent material separation.

3.04 DEPOSITING

- A. Conform to ACI 301. Deposit concrete in or close to its final position. Avoid segregation due to rehandling or flowing. Deposit at rate that concrete is always plastic and flows readily into spaces between reinforcement. Deposit in one continuous operation until panel or section is complete, top surface generally level.
- B. Wall Tops, Horizontal Offsets, Other unformed surfaces: Strike smooth after placing concrete float to continued uniform texture reasonably consistent with adjacent formed surfaces. Tool edges and corners to be exposed in the finished work to approximate $1/4 =$ radius, unless otherwise detailed.

3.05 CONSOLIDATION OF WALLS, COLUMNS, BEAMS AND SLABS OVER EIGHT-INCHES THICK

- A. All concrete shall be thoroughly consolidated by means of mechanical vibrators. Vibrators shall be in accordance with ACI 309.

- B. Use internal mechanical vibrators with 7000 rpm minimum frequency operated in nearly vertical position, vibration points uniformly spaced, close enough to assure complete consolidation, and at no time over twice the radius over which vibration is visibly effective. Vibration should continue until:
 - 1. Frequency returns to normal.
 - 2. Surface appears liquefied, flattened, and glistening.
 - 3. Trapped air ceases to rise.
 - 4. Coarse aggregate has blended into surface, but has not disappeared.
- C. Penetrate vibrator head into upper portion of underlying plastic layer. Do not over-vibrate so as to cause segregation.
- D. Vibrate around reinforcement, embedded items, and into corners and angles of forms by spading and rodding to exclude rock-pockets, air bubbles and honeycomb. Never have the vibrator more than 3 feet from the point of discharge into the form.
- E. This mid-range slump concrete will require only 1/2 of the vibration time of 3 inch slump concrete, while high-range slump will require 1/3 of the vibration time of 3 inch slump concrete.

3.06 CONSOLIDATION OF SLABS LESS THAN EIGHT- INCHES THICK

- A. Use vibrating screed.
- B. Use of a "jitterbug" is not allowed unless concrete slump is less than 2 inches.

3.07 BONDING CONCRETE

- A. Apply bonding agent to existing hardened concrete where noted to be bonded to new concrete. Be sure bonding agent is still tacky at the time of placement of new concrete. Prepare surface and install per manufacturer's instructions.

3.08 JOINTS

- A. Construction Joints:
 - 1. Locate where indicated on Drawings.
 - 2. Make joints perpendicular to principal reinforcement.
 - 3. Unless indicated otherwise, provide longitudinal keys 1 and 1.5 inches minimum depth in walls.
 - 4. Where concrete is to be exposed in finished construction, install rustication strips in formwork to form straight joint line.
- B. Expansion Joints:

1. Unless indicated otherwise, place expansion joints where exterior slabs abut concrete walls, the building perimeter, and other fixed objects abutting or within the slab area.
2. Provide non-extruding filler where sealant is indicated. Allow 1/2 inch for application of sealant.
3. Provide asphalt impregnated filler where sealant is not to be used.
4. Do not extend reinforcement through joint, except as shown on structural drawings.
5. Sealants are specified in Section 07920.

C. Contraction Joints:

1. Make joints straight perpendicular or parallel to building lines and slab edges, as appropriate.
2. Contraction joints shall be saw cut, unless indicated otherwise. Cut as soon as possible after concrete placement without dislodgment or damage to the slab surface, using test cuts as soon as the concrete will not be damaged by traffic.
3. Contraction joints shall penetrate the slab a minimum 1/4 the thickness of the slab and shall be 3/16 inches in width minimum.
4. Align joints with column lines when ever possible. Joints shall form squares where possible or rectangular panels with the long side less than 1-1/2 times the length of the short side. Provide circular or diamond shaped joint lines around columns. Locate contraction joints at reentrant corners. Coordinate with placement of joints in tile surface.
5. If joint pattern is not shown on Drawings, or joint plan is not submitted for approval to Engineer, maximum distance between joints shall be 20 feet on center.
6. Fill interior joints as indicated on Drawings with specified joint filler at least 90 days after concrete placement.

3.09 FINISHING OF FORMED SURFACES

- A. Finish surfaces within 96 hours after removal of forms, allowing minimum of 24 hours for curing. After removal of forms and immediately following any required repair and patching finish formed surfaces with one or more of the following finish operations
1. Form Tie Holes: Do not fill form tie holes, except as required for application of waterproof membrane and/or interior finishing.

2. As-cast Finish: Completely remove all surface fins by hand or power grinding; with stone to approved smoothness. Clean with light wire brushing.

3.10 FINISHING OF FLOOR SLABS

A. General:

1. Finish floor slabs in accordance with ACI 301.
2. Screed all slabs, for whatever finish, to true levels or slopes work surfaces only to the degree required to produce the desired finish. Do no finishing in areas where water has accumulated; drain and re-screed, do not use cement and sand sprinkling to absorb moisture. Carefully finish all joints and edges with proper tools.
3. Consolidate placed concrete preferably with power driven floats of impact type use wood floats for surfaces inaccessible to power floats
4. In areas where drains are indicated, without depressed slab to accommodate subsequent thick bed setting system or leveling course, slope slabs evenly to drains, 1/8 inch per foot in the area within 8 feet of the drain, unless otherwise indicated.
5. Steel trowel finish only those slab surfaces scheduled to remain exposed in the finished work, and slab surfaces to receive resilient flooring, carpeting, ceramic or quarry tile or other final finish. Grind smooth, surface defects that would telegraph through applied floor covering.
6. Apply trowel and fine broom finish to slab surfaces to be covered by thinset terrazzo, or ceramic or quarry tile that is to be installed with thinset mortar.
7. Provide medium broom finish to concrete stair treads, loading docks, and pedestrian areas subject to foot traffic to provide a nonslip finish.
8. Slabs with excessive shrinkage cracks, curling, and slabs not properly sloped to drains, shall be removed and replaced with complying work, at no additional cost to Owner.

B. Tolerance: Provide floor tolerances as follows, when measured in accordance with ACI 301 and ACI 117, including those floors to receive subsequent finishes.

1. Interior Slabs in equipment areas: Class B 1/4 inch in 10 feet.
2. Interior Areas Indicated For Slopes And Pitches To Drain: Class B 1/4 inch in 10 feet.
3. Exterior Areas Indicated For Slopes And Pitches To Drain: Class B 1/4 inch in 10 feet.
4. Dried slabs shall not show curling at the corners of more than 1/8 inch when measured by a 2 foot straight edge placed in any direction.

3.11 CURING

A. General:

1. Protect all freshly placed concrete from premature drying. Maintain curing procedures used for three days, at temperatures above 70 degrees F. If mean daily temperature drops below 70 degrees F. during this period, extend curing period appropriately to 5 days.
2. Field application of curing compound shall be 2 coats, one as soon as finishing is complete and the second the next morning in accordance with recommendations of the product manufacturer, but not at a rate in excess of 300 sq. ft per gallon.
3. Protect all concrete during curing period from all damaging; mechanical disturbances, load stresses, heavy shock and excessive vibration.
4. Protect finish surfaces from all damage.
5. Leave curing compound on slab for a minimum of 7 days.
6. If curing compound later requires removal within 3 weeks of application, strip following the procedures recommended by manufacturer, for all slab areas that require coatings or tile.

3.12 PATCHING AND REPAIRS

- A. General: Defective concrete and honeycombed areas as determined by Engineer shall be repaired. Contact Engineer of Record for repair procedure.
- B. Upon removal of forms, remove plugs and break off metal ties. Where form ties are to be filled promptly fill holes upon stripping as follows:
 1. Moisten holes with water, brush on a coat 1/16 inch of neat cement slurry mixed to consistency of paste. Plug hole with a 1 to 1.5 mixture of cement and concrete sand, mixed to a slightly damp to the touch consistency. Hammer the grout into the hole until dense, and an excess of paste appears on the surface in the form. Trowel smooth with heavy pressure, and avoid burnishing.

3.13 QUALITY CONTROL TESTING DURING CONSTRUCTION

- A. General: The Owner shall employ a testing laboratory to perform tests and submit test reports. Testing lab shall furnish all equipment for taking and testing concrete samples. Sampling and testing of concrete shall be performed by ACI certified Concrete Field Technicians Grade 1.
- B. Sampling Fresh Concrete: Shall conform to ASTM C 172 and ASTM C 94 except as modified here.

1. Slump: ASTM C 143. One test at point of discharge for each class of concrete during the days placement, and one every additional 50 yards of each class of concrete. Additional tests should be taken if consistency of concrete changes.
2. Concrete and Ambient Temperature: Performed each time concrete compressive strength cylinders are cast per ASTM C-1064.
3. Compressive Test Specimens: ASTM C 31. One set of 5 cylinders for each compressive strength test taken at same frequency as slump test. Do not store cylinders in the field over 24 hours until picked up and then placed into laboratory curing conditions.
4. Compressive Strength Tests: ASTM C 39. Test one specimen at 3 days, test one specimen at 7 days, 2 cylinders at 28 days and hold one specimen for 56 days if the average of the 2 28 day cylinders strength is less than required compressive strength.
5. Test results will be reported in writing to Architect, Engineer, Ready-Mix Producer, and Contractor within 24 hours after tests are completed. Reports of compressive strength tests shall contain the project identification name and number, date of concrete placement, name of concrete testing service, concrete type and class, location of concrete batch in the structure, design strength at 28 days, compressive strength, type of break, ambient and concrete temperature.
6. Additional tests: The testing lab will make additional tests of in-place concrete when test results indicate specified compressive strength and other characteristics have not been attained. Engineer will direct location and type of testing to be conducted. Costs of testing to be paid by contractor. Strength evaluations of structure and testing of in place concrete shall be per ACI 318.

3.14 CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

- A. Formwork: Reuse forms without damaging structural integrity of concrete and without damaging aesthetics of exposed concrete.
- B. Mixing Equipment: Return excess concrete to supplier; minimize water used to wash equipment.
- C. Hardened, Cured Waste Concrete: Hardened, cured waste concrete may be crushed and reused as fill or as a base course for pavement.

END OF SECTION

SECTION 05120 – STRUCTURAL STEEL

PART I - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
 - 1. Setting anchor bolts and embedded items for base plates, beam pockets, etc. – Section 03300.
 - 2. Section 05300 – Metal Decking
 - 3. Section 05400 – Cold Formed Metal Framing
 - 4. Section 07400 – Fireproofing
 - 5. Section 09800 – Special Coating
 - 6. Section 09900 – Painting

1.2 SUMMARY

- A. Extent of structural steel work is shown on drawings, including schedules, notes and details to show size and location of members, typical connections, and type of steel required.
- B. Structural steel is that work defined in American Institute of Steel Construction (AISC) "Code of Standard Practice" and as otherwise shown on drawings.
- C. Miscellaneous Metal Fabrications are specified elsewhere in Division 5. Refer to Division 3 for anchor bolt installation in concrete; Division 4 for masonry.
- D. Source Quality Control: Materials and fabrication procedures are subject to inspection and tests in mill, shop, and field, conducted by a qualified inspection agency. Such inspections and tests will not relieve Contractor of responsibility for providing materials and fabrication procedures in compliance with specified requirements. Promptly remove and replace materials or fabricated components which do not comply.
- E. Design of Members and Connections: Details shown are typical; similar details apply to similar conditions, unless otherwise indicated. Verify dimensions at site whenever possible without causing delay in the work.

Promptly notify Architect whenever design of members and connections for any portion of structure are not clearly indicated.

1.3 SUBMITTALS

- A. Product Data: Submit producer's or manufacturer's specifications and installation instructions for following products. Include laboratory test reports and other data to show compliance with specifications.
 - 1. Structural steel (each type), including certified copies of mill reports covering chemical and physical properties.

2. High-strength bolts (each type), including nuts and washers.
3. Structural steel primer paint.
4. Shrinkage-resistant grout.

- B. Shop Drawings: Submit shop drawings prepared under supervision of a registered professional engineer, including complete details and schedules for fabrication and assembly of structural steel members, procedures and diagrams.

Include details of cuts, connections, camber, holes, and other pertinent data. Indicate welds by standard AWS A2.1 and A2.4 symbols, and show size, length, and type of each weld.

Provide setting drawings, templates, and directions for installation of anchor bolts and other anchorages to be installed as work of others sections.

Engineer shall have ten working days for review of shop drawings from the date they are received by the engineer.

1. Drawing Review: The review of connection design and the review of shop and erection drawings by the Engineer of Record shall be for general conformance with the design concept of the work and with the information given in the contract documents only and will not in any way relieve the Contractor or the Contractor's Engineer from:
 - a. responsibility for the adequacy of the design of those connections designed by the Contractor's Engineer,
 - b. the responsibility for all required detailing,
 - c. the responsibility for the proper fitting of construction work in strict conformance with the contract requirements,
 - d. the necessity of furnishing material and workmanship required by contract drawings and specifications which may not be indicated on the shop and erection drawings.
2. The responses on the shop and erection drawing review stamp used by the Engineer require the following actions:
 - a. REVIEWED indicates that the Engineer has found that the information presented on the shop or erection drawing appears to conform to the requirements of the Contract Documents.
 - b. REVIEWED WITH NOTATIONS indicates that the Engineer requires the shop or erection drawing to be corrected to reflect the notes and comments shown. Fabrication may proceed only if the work will incorporate the corrections. Resubmit the corrected shop or erection drawing for record purposes.
 - c. REVISE and RESUBMIT alone or with (b) indicates that the Engineer requires resubmission of the shop or erection drawing after correction per notes and comments. Fabrication shall not proceed until the Contractor has received a returned shop or erection drawing

- d. marked REVIEWED or REVIEWED WITH NOTATION.
NOT APPROVED indicates that the shop or erection drawing does not conform to the Contract Documents and must be extensively revised before resubmittal. Fabrication shall not proceed.

The review of shop and erection drawings shall not be construed as permitting any departure from the contract documents. Requests for such must be submitted in writing by the Contractor and approved in writing by the Engineer. Failure to submit calculations or to specifically indicate modifications, departure from contract documents, or revisions to previously submitted job standards, shop drawings, or erection drawings, shall automatically be considered cause for rejection of the modification or revision whether or not the drawing has been approved by the Engineer.

- C. Test Reports: Submit copies of reports of tests conducted on shop and field bolted and welded connections. Include data on type(s) of tests conducted and test results.
- D. Surveys: Submit certified copies of each survey conducted by a registered surveyor, when required, at Architects direction, showing elevations and locations of base plates and anchor bolts to receive structural steel, and final elevations and locations for major members. Indicate discrepancies between actual installation and contract documents.

1.4 QUALITY ASSURANCE

- A. Codes and Standards: Comply with provisions of following, except as otherwise indicated:
 - 1. AISC "Code of Standard Practice for Steel Buildings and Bridges".

Paragraph 4.2.1 of the above code is hereby modified by deletion of the following sentence: "This approval constitutes the owner's acceptance of all responsibility for the design adequacy of any connections designed by the fabricator as a part of his preparation of these shop drawings".
 - 2. AISC "Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings", including "Commentary" and Supplements thereto as issued.
 - 3. AISC "Specifications for Structural Joints using ASTM A 325 or A 490 Bolts" approved by the Research Council on Riveted and Bolted Structural Joints of the Engineering Foundation.
 - 4. American Welding Society (AWS) D1.1 "Structural Welding Code - Steel".
 - 5. ASTM A 6A 6M-96b "General Requirements for Delivery of Rolled Steel Plates, Shapes, Sheet Piling and Bars for Structural Use".
- B. Qualifications for Welding Work: Qualify welding processes and welding operators in accordance with AWS "Standard Qualification Procedure".

1. Provide certification that welders to be employed in work have satisfactorily passed AWS qualification tests.
2. If recertification of welders is required, retesting will be Contractor's responsibility.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to site at such intervals to insure uninterrupted progress of work.
- B. Deliver anchor bolts and anchorage devices, which are to be embedded in cast-in-place concrete in ample time to not to delay work.
- B. Store materials to permit easy access for inspection and identification. Keep steel members off ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from erosion and deterioration.
- D. Do not store materials on structure in a manner that might cause distortion or damage to members or supporting structures. Repair or replace damaged materials or structures as directed.

PART II - PRODUCTS

2.1 MATERIALS

- A. Metal Surfaces, General: For fabrication of work which will be exposed to view, use only materials which are smooth and free of surface blemishes including pitting, rust and scale seam marks, roller marks, rolled trade names and roughness. Remove such blemishes by grinding, or by welding and grinding, prior to cleaning, treating and application of surface finishes.
 1. Structural Steel Shapes, Plates and Bars: ASTM A 36/A 36M-96, steel shapes W8 and larger, ASTM A 992, GR 50.
 2. Cold-Formed Steel Tubing: ASTM A 500-93, Grade B.
 3. Steel Castings: ASTM A 27/A 27M-95, Grade 65-35, medium-strength carbon steel.
 4. Anchor Bolts: ASTM A 1554 Grade 36, non-headed type unless otherwise indicated.
- B. Unfinished Threaded Fasteners: ASTM A 1554, Grade 36, regular low-carbon steel bolts and nuts.
 1. Provide hexagonal heads and nuts for all connections.
 2. Provide either hexagonal or square, heads and nuts, except use only hexagonal units for exposed connections.
- C. Headed Studs: ASTM A 108, Grade 1019-1020, Cold-finished carbon steel AWS D1.1, Type B.
- D. High-Strength Threaded Fasteners: Heavy hexagon structural bolts, heavy hexagon nuts, and hardened washers, as follows:

1. Quenched and tempered medium-carbon steel bolts, nuts and washers, complying with ASTM A 325M-93.
 2. Direct tension indicator washers may be used at Contractor's option.
- E. Electrodes for Welding: Comply with AWS Code.
- F. Structural Steel Primer Paint: SSPC - Paint 13.
- G. Expansion Anchors: Expansion anchors shall be stud type with a single piece three section wedge and zinc plated.
- H. Cement Grout: Portland cement (ASTM C 150-96, Type I or Type III) and clean, uniformly graded, natural sand (ASTM C 404, Size No.2). Mix at a ratio of 1.0 part cement to 3.0 parts sand, by volume, with minimum water required for placement and hydration.
- I. Non-metallic Shrinkage-Resistant Grout: Pre-mixed, non-metallic, non-corrosive, non-staining product containing selected silica sands, portland cement, shrinkage compensating agents, plasticizing and water reducing agents, complying with CE-CRD-C621.
1. Products: Subject to compliance with requirements, provide one of the following:

Euco N.S.; Euclid Chemical Co.
Masterflow 713; Master Builders
Five Star Grout; U.S. Grout Corp.

2.2 FABRICATION

- A. Shop Fabrication and Assembly: Fabricate and assemble structural assemblies in shop to greatest extent possible. Fabricate items of structural steel in accordance with AISC Specifications and as indicated on final shop drawings. Provide camber in structural members where indicated.
1. Properly mark and match-mark materials for field assembly. Fabricate for delivery sequence which will expedite erection and minimize field handling of materials.
 2. Where finishing is required, complete assembly, including welding of units, before start of finishing operations. Provide finish surfaces of members exposed in final structure free of markings, burrs, and other defects.
- B. Connections: Weld or bolt shop connections, as indicated.
- C. Bolt field connections, except where welded connections or other connections are indicated.
- D. Provide high-strength threaded fasteners for all bolted connections, except where unfinished bolts are indicated.

- E. Provide unfinished threaded fasteners for only bolted connections of secondary framing members to primary members (including purlins, girts, and other framing members taking only nominal stresses) and for temporary bracing to facilitate erection.
- F. High-Strength Bolted Construction: Install high-strength threaded fasteners in accordance with AISC "Specifications for Structural Joints using ASTM A 325M-93 or A 490M-93 Bolts" (RCRBSJ).
- G. Welded Construction: Comply with AWS Code for procedures, appearance and quality of welds, and methods used in correcting welding work.
- H. Steel Wall Framing: Select members which are true and straight for fabrication of steel wall framing. Straighten as required to provide uniform, square and true members in completed wall framing.
- I. Build up welded door frames attached to structural steel framing. Weld exposed joints continuously and grind smooth. Plug weld steel bar stops to frames, except where shown removable. Secure removable stops to frames with countersunk, cross-recessed head machine screws, uniformly spaced not more than 10" o.c., unless otherwise indicated.
- J. Holes for Other Work: Provide holes required for securing other work to structural steel framing, and for passage of other work through steel framing members, as shown on final shop drawings.
- K. Provide threaded nuts welded to framing, and other specialty items as indicated to receive other work.
- L. Cut, drill, or punch holes perpendicular to metal surfaces. Do not flame cut holes or enlarge holes by burning. Drill holes in bearing plates.

2.3 SHOP PAINTING

- A. General: Shop paint structural steel, except those members or portions of members to be embedded in concrete or mortar. Paint embedded steel which is partially exposed on exposed portions and initial 2" of embedded areas only.
 - 1. Do not paint surfaces which are to be welded or high-strength bolted with friction-type connections.
 - 2. Do not paint surfaces which are scheduled to receive sprayed-on fireproofing.
 - 3. Apply 2 coats of paint to surfaces which are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.
- B. Surface Preparation: After inspection and before shipping, clean steelwork to be painted. Remove loose rust, loose mill scale, and spatter, slag or flux deposits. Clean steel in accordance with Steel Structures Painting Council (SSPC) as follows:
 - 1. SP-1 "Solvent Cleaning".
 - 2. SP-2 "Hand Tool Cleaning".
 - 3. SP-3 "Power Tool Cleaning".

- C. Painting: Immediately after surface preparation, apply structural steel primer paint in accordance with manufacturer's instructions and at a rate to provide dry film thickness of not less than 1.5 mils. Use painting methods which result in full coverage of joints, corners, edges and exposed surfaces.
- D. Painting: Provide a one-coat shop applied paint system complying with Steel Structures Painting Council (SSPC)-Paint System Guide No. 7.00.

PART III - EXECUTION

3.1 ERECTION

- A. Surveys: Check elevations of concrete and masonry bearing surfaces, and locations of anchor bolts and similar devices, before erection work proceeds, and report discrepancies to Architect. Do not proceed with erection until corrections have been made, or until compensating adjustments to structural steel work have been agreed upon with Architect.
- B. Temporary Shoring and Bracing: Provide temporary shoring and bracing members with connections of sufficient strength to bear imposed loads. Remove temporary members and connections when permanent members are in place and final connections are made. Provide temporary guy lines to achieve proper alignment of structures as erection proceeds.
- C. Temporary Planking: Provide temporary planking and working platforms as necessary to effectively complete work.
- D. Setting Bases and Bearing Plates: Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen to improve bond to surfaces. Clean bottom surface of base and bearing plates.
 - 1. Set loose and attached base plates and bearing plates for structural members on wedges or other adjusting devices.
- E. Tighten anchor bolts after supported members have been positioned and plumbed. Do not remove wedges or shims, but if protruding, cut off flush with edge of base or bearing plate prior to packing with grout. Pack grout solidly between bearing surfaces and bases or plates to ensure that no voids remain. Finish exposed surfaces, protect installed materials, and allow to cure.
- F. Field Assembly: Set structural frames accurately to lines and elevations indicated. Align and adjust various members forming part of complete frame or structure before permanently fastening. Clean bearing surfaces and other surfaces which will be in permanent contact before assembly. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 - 1. Level and plumb individual members of structure within specified AISC tolerances.
 - 2. Establish required leveling and plumbing measurements on mean operating temperature of structure. Make allowances for difference between temperature at time of erection and mean temperature at which structure will

be when completed and in service.

- G. Erection Bolts: On exposed welded construction, remove erection bolts, fill holes with plug welds and grind smooth at exposed surfaces.
 - 1. Comply with AISC Specifications for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.
 - 2. Do not enlarge unfair holes in members by burning or by use of drift pins, except in secondary bracing members. Ream holes that must be enlarged to admit bolts.
- H. Gas Cutting: Do not use gas cutting torches in field for correcting fabrication errors in primary structural framing. Cutting will be permitted only on secondary members which are not under stress, as acceptable to Architect. Finish gas-cut sections equal to a sheared appearance when permitted.
- I. Touch-Up Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint. Apply paint to exposed areas using same material as used for shop painting.
 - 1. Apply by brush or spray to provide minimum dry film thickness of 1.5 mils.

3.2 QUALITY CONTROL

- A. Engage an independent testing and inspection agency to inspect high-strength bolted connections and welded connections and to perform tests and prepare test reports. All costs associated with testing and inspection shall be paid for by the owner.
- B. Testing agency shall conduct and interpret tests and state in each report whether test specimens comply with requirements, and specifically state any deviations therefrom.
- C. Provide access for testing agency to places where structural steel work is being fabricated or produced so that required inspection and testing can be accomplished.
- D. Testing agency may inspect structural steel at plant before shipment; however, Architect reserves right, at any time before final acceptance, to reject material not complying with specified requirements.
- E. Correct deficiencies in structural steel work which inspections and laboratory test reports have indicated to be not in compliance with requirements. Perform additional tests, at Contractor's expense, as may be necessary to reconfirm any non-compliance of original work, and as may be necessary to show compliance of corrected work.
- F. Shop Bolted Connections: Inspect or test in accordance with AISC specifications.
- G. Field Bolted Connections: Inspect in accordance with AISC specifications.
- H. Shop and Field Welding: Inspect and test during fabrication of structural steel

assemblies, as follows:

1. Certify welders and conduct inspections and tests as required. Record types and locations of defects found in work. Record work required and performed to correct deficiencies.
2. Perform visual inspection of all welds.
3. 100% of full penetration welds shall be tested for soundness by means of either radiographic or ultrasonic testing.
4. 100% of partial penetration welds shall be tested for soundness by visual and magnetic particle inspection.
5. Perform tests of questionable and penetration welds as follows. Required inspection procedures listed are to be used at Architect's option.
 - a. Liquid Penetrant Inspection: ASTM E 165.
 - b. Magnetic Particle Inspection: ASTM E 109; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration not acceptable.
 - c. Radiographic Inspection: ASTM E 94 and ASTM E142; minimum quality level "2-2T".
 - d. Ultrasonic Inspection: ASTM E 164.

END OF SECTION

SECTION 06100 - ROUGH CARPENTRY

PART 1 GENERAL

1.01 THE REQUIREMENT

- A. The CONTRACTOR shall furnish and install all items of rough carpentry work, necessary for a complete installation, as shown on the Drawings and as specified herein.

1.02 STANDARDS AND REGULATIONS

A. Standards:

1. Lumber to conform to American Lumber Standards' Product Standard PS 20-70. Graded by rules of manufacture's association under whose rules lumber is produced. Evidence of grade and mill marked on each piece.
2. National Design Specification for Wood Construction - 1991 (National Forest Products Association).
3. Southern Pine Association.
4. Western Wood Products Association.
5. American Plywood Association.

- B. Moisture Content: Moisture content of lumber shall be maintained within the requirements of the association under whose grading rules it is produced.

- C. Comply with the requirements of the latest edition of the Florida Building Code.

1.03 SHIPPING, HANDLING AND STORAGE

- A. Materials shall be kept dry during delivery and storage. The CONTRACTOR shall protect materials against exposure from weather and contact with damp or wet surfaces. Lumber shall be stacked with provisions for air circulation within stacks.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Lumber: Lumber for headers, rafters, wood grounds, nailers and blocking shall be No. 2 common yellow pine or standard grade Douglas Fir. Moisture content shall not exceed 19%.
- B. Fire Retardant Lumber and Plywood:

1. Sizes shown or noted on the Drawings shall be used for all wood members except rot protected pressure treated lumber herein specified.

2. Each piece shall be treated with Koppers Co., "Dricon" process, Hoover Exterior Fire-X Blue, or equal, meeting the U.L. FR-S classification for flame spread and smoke contribution.

C. Pressure Treated Lumber:

1. Lumber that is required to be pressure treated shall be impregnated with Chromated Copper Arsenate (CCA) conforming to American Wood Preservers Association Standard (P5 in a closed cylinder by vacuum process in accordance with AWPA Standard C2. Retention of CCA dry salts shall be 0.35 pound per cubic foot for above ground use and .40 pound per cubic foot for ground contact.

2. Each piece of the pressure-treated lumber shall be treated in accordance with the proper requirements, of the standard specifications of the American Wood Preservers Association and shall bear the brand conforming to the standard of AWPA.

3. Lumber in contact with concrete, including roof nailers, shall be pressure preservative treated in accordance with AWPA Standard C9.

4. Cut or sawed surfaces in preservative treated member shall receive two coats of the same preservative used in the original treatment.

D. Rough Hardware: Rough hardware shall be the most suitable for project requirements. Expansion shields or bolts and toggle bolts shall be provided as required. All bolts, nails, screws, anchors, straps, clips, etc., shall be galvanized.

E. Connecting Hardware:

1. Nails shall be stainless steel common wire for exterior work.

2. Screws shall be standard domestic manufacture, stainless steel for exterior use and of brass, bronze, aluminum or stainless steel when used to attach items made of those materials.

3. Bolts shall be machine bolts (or carriage bolts if called for on Drawings) of Series 300 stainless steel with hexagon nuts, of sizes noted on Drawings. Wood fascia fasteners shall be galvanized steel and conform to the requirements of ASTM Designation A 307.

4. Steel plates and angles shall be carbon steel, ASTM A 36, galvanized after fabrication for temporary items and stainless steel for permanent items as shown on the Drawings.

5. Lag screws, shear plates and split ring connectors shall conform to the requirements of the "National Design Specifications for Wood Construction from the National Forest Products Association and shall be stainless steel.

6. Power actuated fasteners shall conform to Federal Specification GGG-D-777a, and shall be installed as per manufacturer's printed directions. Power charge shall be powerful enough to prevent spalling of concrete.

PART 3 EXECUTION

3.01 JOB CONDITIONS

- A. Protection: Installed carpentry Work shall be protected from damage by Work of other trades until final acceptance of work. Wood surfaces to be finished shall be protected from moisture and dirt until prime coat has been applied.
- B. Coordination: Fit carpentry Work to other work; scribe and cope as required for accurate fit. Correlate location of during, nailers, blockings, grounds and similar supports to allow proper attachment of other work.
- C. Inspection: The CONTRACTOR shall examine the substrates, supporting structure and the condition under which carpentry will be installed. Work shall not be started until unsatisfactory conditions are corrected.

3.02 INSTALLATION

- A. General: The CONTRACTOR shall provide and install all rough hardware for proper installation of carpentry, nails, spikes, screws, machine bolts and similar items shall be of types and sizes sufficient to draw and rigidly secure members into place. All rough hardware shall be hot dipped galvanized on both interior and exterior work.
- B. Quality: Units of material with defects which might impair the quality of work, and units which are too small to fabricate the Work with minimum joints or the optimum joint arrangement shall be discarded.
- C. Carpentry Work shall be set accurately to required levels and lines, with members plumb and true and accurately cut and fitted.
- D. Fastening: Carpentry Work shall be securely attached to substrates by anchoring and fastening shown and as required by recognized standards. All connections between members shall be tight. Fasteners shall be installed without splitting of wood; predrill as required.
- E. Fasteners shall be of size that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Bolts and nuts shall be countersunk flush with surfaces, unless otherwise shown.
- F. All work shall be erected level, and plumb and shall meet required heights, layout and details. All work shall be well nailed or bolted and adequately braced. All work shall be executed in accordance with the best practices of the trade by men skilled in the craft. Nailing shall be in accordance with the provisions of the Florida Building Code 2001.

- G. Furring: Furring shall be 1-inch x 2-inch strips, 12-inches o.c., or 1-inch x 3-inch strips, 16-inches o.c., securely attached to masonry and concrete with casehardened nails.

_ END OF SECTION _

SECTION 07210 -- BUILDING INSULATION

PART 1 GENERAL

1.01 THE REQUIREMENT

- A. The CONTRACTOR shall furnish and install all building insulation work complete, all in accordance with the requirements of the Contract Documents.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Codes: Comply with the requirements of the latest edition of the Florida Building Code.

- B. Federal Specifications:

HH-I-524C Insulation Board, Thermal (Polystyrene)

HH-I-526C Insulation Board, Thermal (Mineral Fiber).

HH-1-521E Type II, Insulation, Blanket (Fiberglass)

HH-I-1972/1 Insulation Board, Thermal, Polyurethane or Polyisocyanurate, Faced with Aluminum Foil on both sides of the foam.

L-P-375C(3) Plastic Film, Flexible, Vinyl Chloride.

TT-S-001657 Sealing Compound, single Component, Butyl Rubber Based, Solvent Release Type (for buildings and other types of construction).

- C. Commercial Standards:

ASTM C 665 Specification for Mineral Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.

ASTM D 312 Specification for Asphalt Used in Roofing.

ASTM D 2178 Specification for Asphalt Glass (Felt) Used in Roofing and Waterproofing.

ASTM D 2626 Specification for Asphalt-Saturated and Coated Organic Gelt Base Sheet Used in Roofing.

ASTM E 84 Test Method for Surface Burning Characteristics of Building Materials.

ANSI/
ASTM A 525 Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.

ANSI/
ASTM D 41 Specification for Asphalt Primer Used in Roofing and Waterproofing.

- D. Manufacturer's Standards: In addition to the standards listed above, the insulation products and their installation shall be in accordance with the manufacturer's published recommendations and specifications.

1.03 SUBMITTALS

- A. Samples: The CONTRACTOR shall submit to the Architect for review, samples of all materials and fabricated items proposed for use on the work. The samples shall be clearly marked to show the manufacturer's name and product identification. All sample submittals shall conform to the requirements for "Samples" in Section entitled "Submittals."
- B. Manufacturer's Information: Manufacturer's literature, specifications, installation instructions, technical data, and general recommendations for the vapor retarder materials shall be submitted to the Architect.
- C. Manufacturer's certification or other data substantiating that the proposed materials comply with the Specifications shall be submitted to the Architect.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Delivery of Materials: Manufactured materials shall be delivered in original, unbroken packages, containers, or bundles bearing the name of the manufacturer.
- B. Storage: All materials shall be carefully stored in an area which is protected from the elements in a manner recommended by the material manufacturer, to prevent damage to the material and marring of its finish.

PART 2 -- PRODUCTS

2.01 GENERAL

- A. The materials and application of building insulation shall conform to the applicable requirement of the Underwriters Laboratories "Fire Resistance Index", Factory Mutual requirements, manufacturer's printed recommendations and Specifications, and Federal specifications.
- B. Thermal and acoustical insulation shall have a flame-spread rating of 25 or less and a smoke density not exceeding 450 when tested in accordance with ASTM E 84.

2.02 BLANKET INSULATION

- A. Blanket insulation shall be mineral fiber blanket thermal insulation, conforming to ASTM C-665. See plans for R-value.

PART 3 -- EXECUTION

3.01 GENERAL

- A. Blanket insulation shall be provided on all wall and roof panels.

3.02 PREPARATION

- A. The CONTRACTOR shall verify site conditions affecting work of this Section and shall obtain accurate dimensions of all openings, levels, and location and arrangements of embedded anchorage.
- B. Any discrepancies between the Drawings and field dimensions and other irregularities or improper conditions which affect the work shall be reported to the Architect for correction prior to commencing work. Commencement of work shall indicate CONTRACTOR's acceptance of conditions and surfaces underlying or adjacent to work of this Section.

3.03 INSTALLATION OF INSULATION

- A. Insulation shall be installed in accordance with the manufacturer's printed installation instructions.
- B. Insulation shall be installed to provide maximum thermal benefits for material specified. The insulation shall be installed to completely fill or cover voids, providing a continuous blanket of insulation. Insulation shall be cut neatly to snugly fit angles, corners and irregular areas and carefully wrapped around pipes, conduits, outlets, switches, beams, etc., to maintain continuity of insulation. Gaps or bridges shall be avoided. Insulation shall be tight fitting batts and shall be secured as recommended by the Florida Building Code and the material manufacturers for job conditions.

3.04 ADJUSTMENT AND CLEANING

- A. Protection: The CONTRACTOR shall adequately protect all work from damage resulting from subsequent construction operations. Damaged or soiled work shall be replaced by the CONTRACTOR, at no additional cost to the OWNER.
- B. Clean-up: The CONTRACTOR shall at all times keep the premises free from accumulation of waste materials and rubbish caused by his employees, in accordance with the requirements of Section entitled "Project Closeout".
- C. Upon completion of work, rubbish and excess materials shall be removed from the site, leaving the areas acceptably clean.

__ END OF SECTION __

SECTION 08110 - HOLLOW METAL DOORS AND FRAMES

PART 1 –GENERAL

1.01 THE REQUIREMENT

The Contractor shall furnish and install hollow metal doors and frames as specified herein and as required for a complete installation.

1.02 MANUFACTURERS

The hollow metal doors and frames shall be as manufactured by Curries, Amweld, Ceco, Steelcraft, Stratford Industries, or an approved equal.

1.03 SHIPPING, HANDLING, AND STORAGE

The Contractor shall deliver, store, and handle doors and frames in a manner to prevent damage and deformation; store on pallets at the job site and undercover to form weather tight enclosure. Spacers shall be provided between doors and frames to prevent metal to metal contact. Damaged doors or doors with rust shall not be accepted.

1.04 SUBMITTALS

- A. Submit detailed shop drawings, signed and sealed by an Engineer registered in the State of Florida, showing the following:
1. Impact Resistance Product Approval Certification notice as required by the Florida Building Code - Latest Edition.
 2. Dimensioned elevation of the profiles of the framing system over the specified masonry/rough opening with panel arrangement.
 3. Installation details, edge distances, material, size, and spacing of anchorage.
 4. Locking arrangement.
 5. Sealants.
 6. Hardware.
 7. Certification that the assembly has been designed for the minimum wind loads indicated on the Contract Drawings.
- B. Submit simultaneously with the shop drawings, copies of the Impact Resistance Product Control Notice of Approval conforming with the requirements of the Florida Building Code - Latest Edition.

1.05 CODE

- A. All window and door lites shall be designed per ASCE 7-05 for wind velocity 140 mph, importance factor 1.15, exposure C.
- B. All windows and door lites shall be successfully tested for resistance to penetration by flying missiles and cyclic loading per ASTM E1886, ASTM E1996 or Miami-Dade TAS 201, 202, or 203.
- C. Comply with the Florida Building Code 2007 Edition with the 2009 Supplements.

PART 2 – PRODUCTS

2.01 HOLLOW METAL DOORS

- A. General: The Contractor shall provide doors and frames from the same manufacturer.
- B. Flush Doors: Flush doors shall be constructed of two outer sheets of steel over resin impregnated kraft honeycomb core or welded steel stiffeners filled with glass fiber. Top and bottom doors shall be finished flush and be sealed against water penetration.
- C. Gauges: All doors shall be fabricated in accordance with Steel Door Institute (SDI) Publication 107. The minimum gauges of steel shall be listed as follows:
 - 1. Exterior Doors: 16 Gauge
 - 2. Interior Doors: 18 Gauge

2.02 HOLLOW METAL DOOR FRAMES

- A. Hollow metal door frames shall be fabricated of 16 gauge cold rolled steel in accordance with ASTM A366. After fabrication frames shall be primed with light gray rust inhibitive primer. Paint color finish shall be as selected by Architect.
- B. Standard floor knee shall be provided for anchorage to floor.
- C. Three sided frames shall have angle spreaders secured to bottom of frame for rigidity during shipment.
- D. Frame corners shall be mitred and internally reinforced, welded, and ground smooth. Adequate reinforcement shall be provided for all hardware, drilled and tapped for field application. Dust clogging of tapped holes by mortar or plaster. Reinforcement shall also be provided for surface applied hardware for which drilling and tapping is done in the field. After fabrication, frame shall be degraded and then prime coated.

- E. Punch single leaf frames to receive three (3) silencers on lock jamb. Punch double leaf frames to receive one (1) silencer at each leaf in head members.

2.03 ANCHORS

- A. Floor anchors at doors shall be 16 gauge galvanized sheet steel at each jamb. Clip type anchors with two (2) holes to receive fasteners shall be welded to bottom jambs.
 - 1. In metal-stud partitions, install at least 3 wall anchors per jamb at hinge and strike levels. In steel-stud partitions, attach wall anchors to studs with screws.

2.04 GASKETS FOR EXTERIOR DOORS

Gaskets for exterior doors shall be Zero Series 10K bronze and felt head and jamb protection, and Zero No. 22 spring bronze sill protection or equal by Pemko, National Guard Products, Inc., or Reese Enterprises, Inc.

2.05 LOUVERS

Slats shall be 16 gauge, galvanized steel. Louver slats shall be as indicated on the Drawings. For exterior doors, slats shall be of the storm-proof type with insert screen.

2.06 SHOP PAINTING

Doors shall be cleaned, filled and bonderized prior to painting. **Doors shall receive one (1) coat of rust inhibiting primer compatible with the coating system specified in the Section entitled "Painting". Fill materials shall be compatible with the referenced coating system. The Contractor shall verify, in writing, that this requirement has been met.**

PART 3 - EXECUTION

3.01 FRAME INSTALLATION

Place frames before constructing enclosing walls and ceilings.
Frames shall be installed plumb, level, and true to line, rigidly secured in openings.
Anchors shall be provided in accordance with SDI Standards

3.02 DOOR INSTALLATION

- A. Doors shall be installed plumb, level, and true to line. Hardware shall be applied and adjusted to achieve quiet and smooth operation. Installation shall be in accordance with the manufacturer's recommendations.
- B. Doors shall fit snugly and close without forcing or binding. Door clearances shall not exceed $\frac{1}{8}$ " at jambs and heads and meeting stiles at pairs of doors. Clearance between bottom of door and finished floor material or threshold shall not exceed $\frac{1}{4}$ ". Frames shall be manufactured and machined to within $\frac{1}{32}$ " for all dimensions.

3.03 PROTECTION

The Contractor shall protect installation from damage and touch up scratched areas with same paint used for shop coats. Damaged work shall be replaced.

END OF SECTION

SECTION 08710 - FINISH HARDWARE

PART 1 GENERAL

1.01 THE REQUIREMENT

- A. The CONTRACTOR shall furnish and install all finish hardware and appurtenant work, complete, all in accordance with the requirements of the Contract Documents. Coordinate hardware with door requirements. Hardware shall exactly match those listed for exterior door Impact Resistance Product Approval Certification Assemblies.
- B. The work hereunder shall include all fabrication and mounting templates as needed for fabricators and for control of application of metal items.
- C. In addition thereto, the CONTRACTOR shall provide and install all trim, attachments, and fastenings specified or required for proper and complete installation. The Work of this Section shall include all hardware that is not specified in other sections, whether or not such hardware is herein specifically scheduled.
- D. The CONTRACTOR shall protect the finish hardware from damage during construction, painting, and clean-up.

1.02 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Codes
 - 1. Comply with all the requirements of the latest edition of the Florida Building Code.
- B. Commercial Standards
 - 1. Underwriters' Laboratories, Inc. (UL) requirements and approvals.
 - 2. Hardware Institute (DHI) "Recommended Procedure for Processing Hardware Schedules and Templates" and "Architectural Hardware Scheduling and Format".
 - 3. BHMA Builder's Hardware Manufacturers' Association
- C. Manufacturer's Standards
 - 1. In addition to the standards listed above, the finish hardware and its installation shall be in accordance with the manufacturer's published recommendations and specifications.

1.03 SUBMITTALS

- A. The samples of all items requested by the Architect shall be furnished by the hardware supplier no later than ten (10) days after said request is received.
- B. The CONTRACTOR shall submit a complete detailed hardware list and a schedule along with manufacturer's literature on each item for review. No hardware shall be delivered until the hardware schedule has been accepted by the Architect.

- C. The hardware schedule submitted by the CONTRACTOR shall list the actual product series numbers. Manufacturer's catalog requirements for actual size of door closers, brackets, and holders shall be observed. All door sizes shall be noted on the hardware schedule and all hardware shall be in strict accordance with height, width, and thickness requirements.
- D. The schedule shall indicate groups, type, manufacturer's name, catalog number, location, and finish of each item to be provided, all in accordance with the DHI "Architectural Hardware Scheduling Sequence and Format".
- E. The schedule shall also include a complete template list showing template references and data for each item requiring preparation of metal doors and frames.
- F. CONTRACTOR shall submit simultaneously with the shop drawings, copies of Impact Resistance Product Control Notice of Approval conforming with the requirements of the latest edition of the Florida Building Code.

1.04 PROPRIETARY DESIGNATIONS

- A. Manufacturer's product names, numbers, and models are given herein for the purpose of indicating the requirements for the type, general construction, material, and operation of the specific item, not with the intention of limiting the item to the manufacturer's listed product. It shall be the CONTRACTOR's responsibility to supply detailed and complete data to the Architect as required to facilitate appropriate evaluation of all proposed substitute items.

1.05 PACKING, MARKING, AND DELIVERY

- A. All locks, exit devices, door closers, roll-up door holders, hinges, kickplates, pulls and push plates, thresholds, and other similar items shall be individually packed in separate, suitable, original, containers as furnished by the hardware manufacturers. Each container shall be clearly marked with item numbers, article numbers, and names corresponding to those listed in the hardware schedule.
- B. Small miscellaneous items that would not require specific location identifications, such as door stops, coat and hat hooks, and door silencers may be quantity packed if properly labeled with item numbers and other identification.
- C. CONTRACTOR shall check the hardware upon delivery with the aid of a representative of the hardware supplier's firm. The CONTRACTOR shall be responsible for the proper storage of all hardware until ready for application.

PART 2 PRODUCTS

2.01 GENERAL

- A. Finish hardware shall be coordinated with all other Work requiring builder's hardware or attaching to it. Copies of schedules, templates, etc., shall be furnished in ample time to avoid fabrication and construction delays. Each item of hardware shall be identified according to the accepted list and schedule. All hardware shall be made to template.

- B. All hardware furnished in connection with doors bearing Underwriters' Labels or where necessary to meet special requirements shall be in strict accordance with conditions established by the authority having jurisdiction and shall be subject to approval of that authority.
- C. Hand of lock shall be as shown. If door hand is changed during construction, the CONTRACTOR shall make necessary changes at no extra cost to OWNER.
- D. Exit doors shall be openable at all times from the inside without the use of key or any special knowledge or effort.
- E. The CONTRACTOR shall provide the hardware supplier with final reviewed and processed shop drawings from those trades with which hardware must be coordinated. After checking these shop drawings, the CONTRACTOR shall promptly supply necessary template information to all concerned as may be required to facilitate the progress of the job. All procedures for template information shall be in accordance with the handbook, "Recommended Procedure for Processing Hardware Schedules and Templates".

2.02 KEYING

- A. All locks and cylinders shall be masterkeyed to OWNER's requirements as directed by the Owner.
- B. All lock cylinders shall be construction masterkeyed or provided with construction cylinders and construction keys. Five construction master keys shall be obtained by the CONTRACTOR, of which three (3) may be retained by the CONTRACTOR for use during construction, and the remaining two (2) construction keys shall be provided to OWNER for its use.
- C. The CONTRACTOR shall furnish five (5) keys per cylinder keying combination. All keys along with five (5) master keys shall be delivered to OWNER at the completion of the job.
- D. All keying (except when matching existing keying system or when less than then (10) locksets are required) shall be done at the factory unless otherwise accepted by the Architect.
- E. A keying schedule will be worked out between the Architect, OWNER, the CONTRACTOR, and the hardware supplier. The CONTRACTOR shall have the hardware supplier submit a keying schedule for review, and have it accepted prior to placing an order for the locks and keying of cylinders.

2.03 FASTENERS

- A. The CONTRACTOR shall provide all necessary screws, bolts, and other fasteners of suitable size and type to secure the hardware into position. The fasteners shall match the hardware in material and finish. Screws, bolts and other hardware fastening devices shall be Type 316 stainless steel.

- B. The hardware provided, such as expansion bolts, sex bolts, toggle bolts and other acceptable anchorages shall be coordinated with the job and to each setting condition.
- C. Phillips head screws shall be used at exposed conditions. Machine screws shall be used at metal doors and frames.

2.04 HINGES AND PIVOTS

- A. Three (3) hinges or pivots shall be provided for each door leaf up to and including 7-feet in height, and an additional hinge shall be added for 8 feet and 9 feet doors.
- B. Width of hinges shall be determined by trim conditions.
- C. All hinges on exterior doors shall be provided with nonremovable pins and security studs.
- D. Hinges shall be US 32D stainless steel unless otherwise specified.
- E. Hinge models shown on the hardware schedule are manufactured by McKinney.

2.05 OVERHEAD CLOSERS

- A. All closers shall be DORMA 640A Series STA corrosion resistant units or equal. The closers will have aluminum alloy bodies with high compression steel springs and hardened racks. The closer pinion shall be stainless steel. All closers shall have hydraulic backcheck to prevent uncontrolled opening of the door from 60°. All closers shall have adjustable spring power from sizes 3-6 to meet on-site conditions. The regular arm assembly, main arm, adjustment arm, rod and shoe shall be constructed of stainless steel. Closers and related components shall be finished with a prime coat and color top coat matching the door.

2.06 LOCKSETS AND SURFACE BOLTS

- A. Surface bolts shall be Ives 360-12 or equal.
- B. Locks shall be Schlage ND Series Cylinder lever locks or equal.
- C. Padlocks shall be heavy duty type, keyed as directed and shall be of same manufacture as locksets.

2.07 EXIT DEVICES

- A. Exit devices shall be Sargent Model 8800 for interior doors and Sargent Model HC 8713 for exterior doors or equal.

2.08 THRESHOLDS

- A. Thresholds shall be handicap approved aluminum.

PART 3 EXECUTION

3.01 GENERAL

- A. All required items of hardware, including cylinders for locks, and all fitting, adjusting, and securing of each item neatly and firmly in place, shall be in perfect working order. Any Work less than this shall form a basis for corrective measures.
- B. All finish hardware shall be fitted and dismantled before painting Work and shall be reinstalled after finish painting work.

3.02 LATCHES AND BOLTS

- A. Latches and bolts shall be installed to automatically engage in keepers, whether activated by closers or by manual push. In no case should additional manual pressure be required to engage latch or bolt in keepers.

3.03 CLOSERS AND HINGES

- A. Closers and hinges shall be carefully adjusted to operate the doors noiselessly and evenly, and hinges shall be installed so as not to bind. Closers, closer arms, and hold-open arms shall be attached with sex bolts.

3.04 WEATHERSTRIPPING AND SEALS

- A. All doors shall be provided with weather-stripping or seals unless mutes, product weather-stripping or other special seals are specified. Whenever two types of seals are shown on the Finish Hardware Schedule on a given door they both are to be provided.

END OF SECTION –

SECTION 09111 – METAL STUD FRAMING SYSTEM

PART 1 – GENERAL

1.01 SECTION INCLUDES

- A. Formed metal stud framing at interior locations.
- B. Framing accessories.

1.02 REFERENCES

- A. ASTM A525 - General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.
- B. ANSI/ASTM A591 - Steel Sheet, Cold-Rolled, Electrolytic Zinc-Coated.
- C. ASTM C645 – Non-Load (Axial) Bearing Steel Studs, Runners (Track) and Rigid Furring Channels for Screw Application of Gypsum Board.
- D. ASTM C 754 - Installation of Steel Framing Members to Receive Screw-Attached Gypsum Wallboard, Backing Board, or Water-Resistant Backing Board.
- E. FS TT-P-645 - Primer, Paint, Zinc-Chromate, Alkyd Type.
- F. GA 203 - Installation of Screw-Type Steel Framing Members to Receive Gypsum Board.

1.03 SYSTEM DESCRIPTION

- A. Metal stud framing system for interior walls, consisting of top and bottom tracks, studs and supports to structure.
- B. Maximum Allowable Deflection: $1/360$ span.
- C. Design system to accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.

1.04 SUBMITTALS

- A. Submit shop drawings indicating component details, framed openings, anchorage to structure, type and location of fasteners, and accessories or items required of other related work.
- B. Describe method for securing studs to tracks, splicing, and for blocking and reinforcement to framing connections.

- C. Submit product data.
- D. Submit product data describing standard framing member materials and finish, product criteria, load charts and limitations.
- E. Submit manufacturer's installation instructions.
- F. LEED Submittals:
 - 1. Product Data for Credit MR 4.1 and MR 4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content

1.05 QUALITY ASSURANCE

- A. Perform work in accordance with GA 203 and ASTM C754.
- B. Maintain one copy of each document on site.

1.06 MOCK-UP

- A. Provide mock-up of Interior Wall Section.
- B. Coordinate construction of mock-up with related Sections.
- C. Provide analysis of mock-up.
- D. When accepted, mock-up will demonstrate minimum standard for the Work. Mock-up may remain as part of the Work.

1.07 PRE-INSTALLATION CONFERENCE

- A. Convene one week prior to commencing work of this Section.
- B. Coordinate construction of mock-up with related Sections.

1.08 SEQUENCING AND SCHEDULING

- A. Sequence work with other work directly affected by this Section.
- B. Coordinate the work of related Sections.

1.09 CODE

- A. Comply with the requirements of the Florida Building Code – Latest Edition.

PART 2 – PRODUCTS

2.01 STUD FRAMING MATERIALS

- A. Studs: ASTM A525, galvanized to G90 coating class, ANSI/ASTM A591, electrogalvanized, non-load bearing rolled steel, channel shaped, punched for utility access, as scheduled. Minimum 20 GA except as noted otherwise on plans. See UL fire rating assembly as shown on plans for compliance with minimum gauge at fire rated walls. See plans for minimum gauge of selected framing members.
- B. Runners: Of same material and finish as studs, bent leg retainer notched to receive studs. Ceiling runners with extended legs.
- C. Furring and Bracing Members: Of same material and finish as studs, thickness to suit purpose.
- D. Fasteners: GA 203. Self-drilling, self-tapping screws.
- E. Metal Backing: 20 gage galvanized steel.
- F. Anchorage Devices: Power driven. Powder actuated or drilled expansion bolts. Comply with GA-203.
- G. Primer: FSTT-P-645, for touch-up of galvanized surfaces.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Verify that conditions are ready to receive work.
- B. Verify field measurements are as shown on Drawings.
- C. Verify that rough-in utilities are in proper location.
- D. Beginning of installation means installer accepts existing conditions.

3.02 ERECTION

- A. Align and secure top and bottom runners at 16" inches O.C.. Place two beads of sealant between runners and substrate. Achieve air seal between runners and substrate.
- B. Fit runners under and above openings; secure intermediate studs at spacing of wall studs.

- C. Install studs vertically at 16 inches O.C. Achieve air seal between studs and adjacent vertical surfaces.
- D. Connect studs to tracks using fastener method.
- E. Stud splicing not permissible, except if approved in writing by Architect prior to bid.
- F. Construct corners using minimum three studs.
- G. Double studs at wall openings, door and window jambs, at connection to 1 hr Rated enclosed columns, not more than 2 inches each side of openings, start of all partitions and as shown on plans.
- H. Brace stud framing system and make rigid.
- I. Coordinate erection of studs with requirements of door and window frame supports and attachments.
- J. Align stud web openings.
- K. Coordinate installation of bucks, anchors, and blocking with electrical and mechanical work to be placed in or behind stud framing.
- L. Blocking: Secure wood blocking to studs. Install blocking for support of plumbing fixtures, toilet partitions, wall cabinets, toilet accessories, hardware, and cabinetry.
- M. Refer to Drawings for indication of partitions extending through ceiling to structure above. Maintain clearance under structural building members to avoid deflection transfer to studs. Provide extended leg ceiling runners.
- N. Coordinate placement of insulation in multiple stud spaces made inaccessible after stud framing erection.

3.04 TOLERANCES

- A. Maximum Variation From True Position: 1/4 inch.
- B. Maximum Variation of any Member from Plane: 1/8 inch.

END OF SECTION

SECTION 09260 - GYPSUM BOARD SYSTEM

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The CONTRACTOR shall furnish and install the gypsum drywall system required for a complete installation as shown on the Drawings and as specified herein, including the following:
 - 1. Resilient base where scheduled throughout project, straight type at carpet and cover type at other floor conditions.
 - 2. Joint treatment at all joints in gypsum wallboard, as specified herein.

1.02 MANUFACTURERS

- A. The following list of companies manufacture products that are acceptable for this section, subject to conformance with the specified requirements: National Gypsum Company, U.S. Gypsum Company, Flintkote Company, Celotes Corporation, Manville, or an approved equal.
- B. Gypsum boards, veneer plaster products, trim accessories, studs, adhesives and joint treatment shall be the products of a single manufacturer, or from manufacturers recommended by the prime manufacturer of the gypsum board products.

1.03 SUBMITTALS

- A. The CONTRACTOR shall submit shop drawings and other information as required to the Architect for review. Shop drawings shall include details of construction and erection, including materials, type, thickness or gauge, tape, joint compound, and accessories.
- B. LEED Submittals:
 - 1. Product Data for Credit MR 4.1 and MR 4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.
 - a. Include a statement indicating costs for each product having recycled content.
 - 2. Product Data for Credit EQ 4.1: For adhesives used to laminate gypsum board panels to substrates, including printed statement of VOC content

1.04 QUALITY CONTROL

- A. Gypsum wallboard sustaining damage due to weather, handling or improper storage methods shall be removed from the site and replaced at the CONTRACTOR's expense.

1.05 SHIPPING, HANDLING AND STORAGE

- A. All materials shall be kept dry, preferably by being stored inside roofed buildings. If necessary to store wallboard outside, it shall be stacked off the ground, properly supported on a level platform and fully protected from the elements.
- B. Gypsum wallboard shall be neatly stacked flat with sufficient support underneath to avoid sagging and care taken to avoid damage to edge, corners and surfaces.

1.06 CODE

- A. Comply with the requirements of the Florida Building Code – Latest Edition.

PART 2 -- PRODUCTS

2.01 GENERAL

- A. All components shall be Gold Bond products as manufactured by National Gypsum Company, or an acceptable equal.

2.02 STANDARD GYPSUM WALLBOARD

- A. Gypsum wallboard shall be 5/8-inch thick or as noted on drawings, and 48-inches wide conforming to ASTM C 36, with tapered and rounded edges for top layers. Use for facing layers of all partitions, soffit and ceiling board is required.

2.03 FURRING CHANNELS

- A. Furring channels shall be 25 gauge galvanized steel, as per plans, designed for screw application of wallboard.

2.04 METAL STUDS

- A. See section 09111 Metal Stud Framing System.

2.05 JOINT REINFORCING TAPE AND JOINT COMPOUND

- A. Joint compound and reinforcing tape shall be specifically prepared for finishing gypsum wallboard shall be in conformance with ASTM C 474 and be of the highest quality. Tape and compound shall be manufactured by the wallboard manufacturer.

2.06 CORNER BEADS

- A. Corner beads shall be 26 gauge galvanized steel with perforated flanges, 1-1/4-inch x 1-1/4-inch.

2.07 SCREWS AND ACCESSORIES

- A. Screws and miscellaneous accessories required, including casing beads and expansion joint assemblies shall be galvanized. Where gypsum terminates and is not closed off, provide Gold Bond No. 200 casing beads, equal by U.S. Gypsum, or equal. Screws and other fastening devices shall be of the size and type required by the manufacturer and as acceptable to the Architect. Expansion joint assemblies shall be 20 gauge plate and slot type as detailed.

2.08 FIRE RESISTANCE RATINGS (TYPE X GYPSUM WALL BOARD)

- A. Fire resistance gypsum wallboard shall have a fire rating by Underwriter's Laboratories or United States Gypsum Company as called for on the Drawings.
- B. Fire rated assemblies shall be complete in all respects including hold-down clips and protection at recessed lighting fixtures and constructed in strict compliance with Underwriter's Laboratories design label number.

2.09 WATER RESISTANCE RATING (TYPE M.R. GYPSUM WALL BOARD)

- A. Water resistant gypsum wallboard shall have a rating as provided by manufacturer conforming to federal specification, commercial and trade standards.

PART 3 -- EXECUTION

3.01 JOB CONDITIONS

- A. The CONTRACTOR shall repair, prior to gypsum board insulation, any defects in adjacent or underlying Work which will affect the satisfactory execution and stability of the drywall construction.

3.02 GENERAL INSTALLATION

- A. All installation shall be performed by workmen experienced in drywall installation in strict accordance with the details shown on the Drawings, the shop drawings and the manufacturer's recommendations.
- B. The Work of this Section shall be carefully coordinated with the Work of all other related trades including materials to be built into or applied on wallboard and items requiring additional supports within partitions.
- C. The CONTRACTOR shall maintain a minimum room temperature of 55 degrees F, during application of wallboard and joint treatment, and until completely dry or

occupied. The CONTRACTOR shall provide adequate ventilation as acceptable to the Architect.

3.03 FRAMING AND FURRING

- A. Runner tracks shall be aligned to the partition layout at both floors and ceilings. Tracks to floor and ceiling construction shall be secured, 16-inch O.C. maximum. Fasteners shall be provided at all corners and ends of runner tracks.
- B. Full length studs between runner tracks shall be used wherever possible. When necessary, studs shall be provided by nesting with a minimum lap of 8-inches and fasten laps with 2 screws through each flange. Studs shall be friction fit to runner tracks by positioning and rotating into place. Positive attachment shall be provided to runner tracks for studs using 3/8-inch self-drilling screws or stud clinching tool on both flanges or studs. Except where otherwise shown, studs shall be spaced at 16-inches O.C. maximum.
- C. Additional studs shall be provided to support inside corners at partition intersections and corners, and to support outside corners, terminations of partitions and both sides of control joints. Any additional bracing and reinforcing members shall be provided as recommended by the system manufacturer to assume complete rigidity at partitions or as shown on plans.
- D. Framing of all partitions shall be as shown on plans.
- E. At pressed metal door frames, the CONTRACTOR shall install 2 full height studs at all jambs. The first stud shall be fastened at each jamb with 2 self-drilling screws to all frame joint anchors. The second stud shall be placed in tandem with and against the first stud.
- F. Above heads of pressed metal frames a cut-to-length section of track shall be installed. Flanges to overlap jamb studs and shall be securely attached to jamb studs.
- G. Between frames and ceiling, cut-to-length jack studs shall be installed extending from door frame header track to ceiling track. Where control joint is called for at jamb line above frame, jack stud shall be installed approximately 1-inch from first jamb stud. At all other locations, jack studs shall be kept at least 5-inches from jambs to avoid wallboard joints at jamb line.
- H. At masonry walls to receive wallboard finish, the CONTRACTOR shall install to receive the wallboard, horizontal furring members at the tops and bottoms of the wall board installation and intermediate vertical members spread at 16-inches O.C. Masonry anchors shall be installed.
- I. Supplementary framing, runners, furring, blocking and bracing shall be installed at openings and terminations in the Work and at locations required to support fixtures, equipment, services, heavy trim, furnishings and similar Work which cannot be adequately supported directly on gypsum board alone. Attention is directed to electrical equipment and to toilet partitions and accessories requiring additional

support. The CONTRACTOR shall coordinate these requirements with the respective trade sections for exact locations.

3.04 WALLBOARD

- A. Boards shall be of such length so as to eliminate end joints and installed with vertical joints only. Boards shall be brought into contact with each other but shall not be forced into place. Joints on opposite sides of a partition shall not occur on the same stud. Boards shall be applied using screws specified. Expansion joints shall be provided as recommended, and as directed.
- B. Wallboard shall be held in firm contact with framing member while fastenings are being driven. Fastening shall proceed from center portion of the wallboard toward the edges and ends. Fasteners shall be set with heads slightly below the surface of the wallboard in the dimple formed by the power screwdriver. Care shall be taken to avoid the breaking of the face paper of the wallboard. Improperly driven screws shall be removed.
- C. Install sound control insulation where required in conjunction with wallboard installation as shown and indicated.
- D. Corner beads on external corners, joint treatment at re-entrant angles and wallboard trim where wallboard butts other materials shall be provided.
- E. Screws shall be spaced not to exceed 12-inches O.C. except at vertical butting edges of the fire-rated partitions where they shall be 8-inches O.C.
- F. Corner beads shall be nailed with gypsum wallboard nails spaced no greater than 8-inches apart on each flange of the bead with the nails opposite. Similar nailing for wallboard trim shall be provided.
- G. Where wallboard butts other materials, such as masonry walls and structural frame and decking, the wallboard shall be held back so as to form a joint, which shall be sealed with an acceptable synthetic rubber base perimeter sealant.

3.05 JOINT TREATMENT

- A. Joint compound shall be mixed in accordance with manufacturer's instructions. A uniform layer of compound shall be applied over the joint approximately 4-inches wide and filling the groove. The tape shall be centered over the joint and embedded into the compound leaving sufficient compound under tape to provide proper bond.
- B. A second and third coat of joint compound or joint finishing compound shall be applied after each preceding coat has been allowed to thoroughly dry. Coats shall be spread over tape and the tapered portion of edge and feathered out at the edge.
- C. All inside corners shall be coated with at least one coat of joint compound over perforated tape with the edges feathered out.
- D. All screw head dimples shall receive at least 3 coats of compound.

- E. Flanges of corner and casing beads shall be concealed by at least two coats of compound feathered out approximately 9-inches on one or both sides of the exposed metal as applicable.
- F. Each application of compound to joints and fastener heads shall be allowed to dry, then be sanded as required. Roughing of the wallboard paper surfaces shall not be permitted.
- G. All wallboard and treated areas shall be sanded smooth and ready for application of paint as acceptable to the Architect.

3.06 PROTECTION

- A. The CONTRACTOR shall provide all necessary protective measures to prevent soiling or damage to the finished drywall construction from subsequent building operations. Work stained, damaged or defective shall be cleaned, repaired or replaced as may be required to completely satisfy the Architect, and at no cost to the OWNER. This shall include continuous Work dislocated or damaged as a result of the corrective Work.

3.07 CLEANING

- A. At completion, the CONTRACTOR shall remove all excessive materials and all debris resultant from operations of Work of this Section. The CONTRACTOR shall leave entire Work in neat, clean condition satisfactory for receipt of other related items of Work which are to be installed or applied as part of Work of other Sections of these Specifications and the Drawings.

END OF SECTION

SECTION 09310 - CERAMIC TILE

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The CONTRACTOR shall furnish and install thin set tile.

1.02 REFERENCES

A. Commercial Standards:

- ANSI A108.1 Ceramic Tile Installed with Portland Cement Mortar.
- ANSI A108.5 Ceramic Tile Installed with Dry-Set Portland Cement Mortar.
- ANSI A118.1 Dry-Set Portland Cement Mortar.
- ANSI A136.1 Organic Adhesives for Installation of Ceramic Tile.
- ANSI TCA 137.1 Recommended Standard Specifications for Ceramic Tile.

B. Trade Standards:

Tile Council of America (TCA)

1.03 QUALITY ASSURANCE

- A. Work shall conform to American National Standard Specifications for the Installation of Ceramic Tile.

1.04 SUBMITTALS

- A. The CONTRACTOR shall submit shop drawings, samples and other information for Architect's review:
 1. Sample board of the ceramic tiles and grout for color selection by the Architect.
 2. Product data specifications and instructions for using adhesives and grouts.
 3. Manufacturer's certification that tile materials supplied conform to TCA 137.1.
 4. Submit maintenance data.
 5. Cleaning methods, cleaning solutions recommended, stain removal methods, and polishes and waxes recommended, and
 6. Tile equal to 2% of each size and color provided on project for the OWNER.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Maintain tile in protective packaging whenever possible.
- B. Adhesives shall be protected from freezing or overheating in accordance with manufacturer's instructions.

1.06 CODE

- A. Comply with the requirements of the Florida Building Code – Latest Edition.

PART 2 -- PRODUCTS

2.01 ACCEPTABLE TILE MANUFACTURERS, OR EQUAL

- A. Mid-State Tile Company.
- B. American Olean Company.
- C. Dal Tile Company.
- D. Forms and Surfaces, (Niro Ceramic).
- E. Metropolitan Ironrock Ceramics

2.02 TILE MATERIALS

- A. Ceramic Floor Tile: Ceramic floor tile shall be 8"x 8" non-slip unglazed finish size, style/pattern and color to be selected by the Architect from price Group 2. Tile shall match ceramic base tile.
- B. Ceramic Wall Tile: Ceramic wall tile 8"x 8" shall be glazed finish size, style, pattern and color to be selected by the Architect from price Group 2.

2.03 SETTING MATERIALS

- A. Mortar materials shall conform to ANSI Ceramic Tile Standard A-2.
- B. Mortar bed shall conform to the following:
 - 1. ANSI A118.1, thinset bond coat, dry-set cementitious mortar.
- C. Organic adhesive shall conform to ANSI A136.1, thinset bond type.

2.04 GROUT TYPE

- A. Grout shall be of the cementitious type, resistant to shrinking, and manufactured by Jamo, Southern Grouts and Mortars, Inc., American Olean, or equal. Color will be as selected by the Architect.
- B. Grout shall contain a latex additive, for wet areas, and manufactured as above. Color will be selected by the Architect.

2.05 ACCESSORIES

- A. Metal edge strips shall be zinc alloy or stainless steel.
- B. Reinforcing mesh shall be welded fabric 2-inch x 2-inch size weave of 16/16 galvanized wire.

PART 3 -- EXECUTION

3.01 INSTALLATION, GENERAL

- A. Comply with TCA recommended procedures.
- B. Conventional setting bed shall be mixed with one part Portland Cement to six parts damp sand by volume.
- C. Setting bed shrinkage mesh shall be placed in fit areas and lapped a minimum of two mesh openings. Mesh shall extend to within two inches of all enclosing wall surfaces.

3.02 TILE INSTALLATION

- A. Tile shall be installed in accordance with ANSI A108.1.
- B. Tile shall be laid to pattern indicated, verifying pattern is uninterrupted through openings.
- C. Thresholds shall be provided at wall or frame openings to other building areas not receiving ceramic tile floor finish. Thresholds shall comply with all Federal and State handicap accessibility requirements.
- D. Tile shall be cut and fit tight to protrusions and vertical interruptions. Corners and bases shall be formed neatly.
- E. Internal angles shall be formed coved and external angles bullnosed.
- F. Work tile joints uniform in width, subject to variance in tolerance allowed in tile size. Joints shall be watertight, without voids, cracks, excess mortar, or grout.

G. Tile shall be sounded after setting. Hollow sounding units shall be replaced.

H. Tile shall be allowed to set for a minimum of 48 hours prior to grouting.

3.03 PROTECTION

A. Cover exposed tile spandrels, stools and sills with polyethylene film for a minimum period of 48 hours for curing and protection.

B. Activities near wall finish shall be prohibited for 48 hours after installation. Tile shall be covered as necessary, to maintain curing moisture until grout cures properly.

C. If construction foot traffic must use the floor areas, they shall be covered with heavy-duty non-staining construction paper taped in place.

END OF SECTION

SECTION 09500 - ACOUSTICAL CEILING SYSTEM

PART 1 - GENERAL

1.01 THE REQUIREMENT

- A. The CONTRACTOR shall furnish and install all acoustical ceiling systems, including all supporting systems and appurtenant work, complete, all in accordance with the requirements of the Contract Documents.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Codes: All codes, as referenced herein, specified in Section entitled "Reference Standards."
- B. Federal Specifications:
SS-S-118B Sound Controlling (Acoustical) Tiles and Panels.
- C. Commercial Standards:
ASTM C 635 Specification for Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.
- D. Trade Standards:
"Specification for Acoustical Tile and Lay-in Panel Ceiling Suspension Systems" by the Acoustical Material Association (AMA).
- E. Manufacturers' Standards: In addition to the standards listed above, the acoustical ceiling system products and their installation shall be in accordance with the manufacturer's published recommendations and specifications.
- F. Florida Building Code – 2007 Edition with 2009 Supplements.

1.03 SUBMITTALS

- A. Manufacturer's literature, installation instructions, and samples shall be submitted for Architect's review.
- B. The CONTRACTOR shall submit sample tiles and suspension system for Architect's review.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Delivery of Materials: Manufactured materials shall be delivered in original, unbroken, packages, containers, or bundles bearing the manufacturer's label.
- B. Storage: All materials shall be carefully stored in an area that is protected from the elements in a manner recommended by the product manufacturer. Storage shall be in a manner that will prevent damage to the material or marring of its finish.

1.05 CODE

- A. Comply with the requirements of the Florida Building Code 2007 Edition with 2009 Supplements.

PART 2 -- PRODUCTS

2.01 GRID SYSTEM MATERIALS

- A. Cross Tees: Cross tees shall be properly sized, cold-rolled, electro-galvanized steel, with white baked enamel finish.
- B. Wall Molding: Wall molding shall match the beams and tees in material and finish. Wall moldings with reveal shall be provided where shown.
- C. Hanger and Diagonal Bracing Wires: Hanger and diagonal bracing wires shall be not lighter than 12-gage, pre-straightened, galvanized, annealed steel wire, to rigidly secure acoustic ceiling system including mechanical and electrical components with maximum deflection of 1/360.
- D. Spacers: Spacers shall be tempered spring steel and shall be fitted into wall molding to provide tension on the ceiling system.
- E. Resilient Hangers: Refer to plan for location: Resilient hangers shall be as recommended by Mfg.

2.02 EXPOSED GRID SYSTEMS

- A. The exposed grid system shall be a "Heavy Duty" classified system as manufactured by Armstrong, Manville, Celotex, or U.S.G. Interiors. Size and shape shall be as shown on the plans.

2.03 ACOUSTICAL PANEL AND TILE MATERIALS

- A. Acceptable Manufacturer: Acoustical panels shall be as shown on the plans. See plans for locations and sizes.

- B. Flame Spread Rating: Panels shall be mineral fiber tile or panel, as specified or shown, and shall have a Class 1, ASTM flame spread and a flame spread rating of under 25 per Federal Specifications SS-S-118B.
- C. Finish: Finish shall be factory-applied white latex paint.

2.04 ACOUSTICAL PANEL AND TILE PATTERNS AND SIZES

- A. Acceptable Manufacturer: Acoustical panels shall be similar to Armstrong Fissured square lay-in #756, 24" x 24" with 15/16" exposed grid or an approved equal. See plans for locations, sizes and patterns.

2.05 MOLDINGS

- A. "U" Molding: Slip-on "U" molding shall be a semi-rigid, white cover molding sized to fit the tile.
- B. Reveal Wall Molding: Reveal (shadow) line (wall) molding shall be white at all conditions where tile abuts walls and partitions.

PART 3 -- EXECUTION

3.01 GENERAL

- A. The acoustical ceiling system shall consist basically of continuous main beams and intersecting cross tees, joined together to form the patterns specified or shown on the Drawings, and acoustical ceiling panels and tiles. The system shall be complete with all necessary components, anchors, and supports.
- B. The system shall be designed so that the ceiling panels may be removed and replaced without damage, and so that main beams and cross tees can be removed or replaced without deforming the members or disturbing the balance of the grid system.
- C. Suspension systems and tile work shall be coordinated with lighting fixtures, air diffusers, and other features so that all installations work together without interference.

3.02 INSTALLATION

- A. Installation shall be in strict accordance with the manufacturer's published directions, installation instructions, and specifications.

3.03 PROBLEM AREAS

- A. Manufacturers published recommendations and specifications shall be followed for installation, materials, and treatment of problem areas; provided, that the manufacturer's published recommendations and specifications are not less than those required by "Specification for Acoustical Tile and Lay-In Panel Ceiling

3.04 DEFLECTIONS

- A. The system shall be designed by the manufacturer. The ceiling system shall be engineered to carry the applied dead and live loads with a deflection of less than $1/360$ of the span and shall be level to within $1/8$ -inch in 12 feet. The ceiling system shall conform to ASTM C 635 (Heavy Duty classification) with a minimum load carrying capacity of the main runner of 16 pounds per LF of span of 4-feet 0-inches.

3.05 PREPARATION

- A. The CONTRACTOR and its tradesman shall be responsible for inspecting all acoustical treatment receiving areas so as to ensure a proper installation. The CONTRACTOR shall not proceed with its work before all conditions are ready to receive the acoustical panel work.

3.06 PATTERN AND SYMMETRY

- A. The layout scheme shall be as shown on plans. The panels shall be laid in a pattern with all edges in alignment and with all faces in a plane. There shall be no noticeable variations in the finish ceiling plane. Items located within the ceiling plane such as, but not limited to, the following: light fixtures, air diffusers, speakers, smoke detectors, and fire sprinklers shall be coordinated with other trades and shall be installed at the locations shown. Whenever the CONTRACTOR is not sure of an installation location he shall obtain directions from the Architect.
- B. Non-directional tile shall be laid so no fissure pattern direction is established.
- C.

3.07 BEAM SPLICES AND TEE INTERSECTIONS

- A. General: All main beams shall be joined together by a splice clip which draws the members tightly together with bottom flanges flush. Cross tee intersections shall be joined together by interlock methods, by positioning the ends of the cross tees snugly against the main beam and in holding the cross tees in vertical alignment with bottom flanges flush. All main beam splices and cross tee intersections shall be capable of withstanding at least 100 lbs. tension or compression.
- B. Termination at Walls: The main beams and cross tees which terminate at the walls shall be attached to a perimeter wall molding, which shall be continuous along at least 2 intersecting walls, with spring steel stops. Wall molding shall be securely attached to the walls at approximately 16-inch intervals in an acceptable manner.

3.08 HANGER WIRES

- A. Hanger wires shall be spaced at maximum 48-inch o.c. along the main beams and at the corners of lay-in-fixtures and elsewhere as required for a fire-rated system.
- B. Hanger wires shall be secured to the supporting structure with acceptable fastenings. Hangers and fastenings shall be capable of carrying at least 4 times the design load but not less than 100 lbs.

3.09 ACCESS PANELS

- A. In the concealed grid system, access panels shall comprise at least 5 percent of the ceiling area, with a minimum of one per room. Access panels shall be located as directed.

3.10 MOLDINGS

- A. All outside edges such as against walls shall be provided with reveal wall moldings. Slip-on "U" moldings shall be provided wherever tile does not abut against a wall molding or where the edge is otherwise exposed.

3.11 HORIZONTAL RESTRAINT

- A. Ceiling systems shall be provided with diagonal bracing wires. Horizontal restraints shall be affected by 4 No. 12-gage wires secured to the main beams within 2 inches of the cross tee intersection and splayed 90 degrees from each other at an angle not exceeding 45 degrees from the plane of the ceiling. The horizontal restraint points shall be placed 12 feet on center in both directions with the first point within 4 feet from each wall. The restraint wire attachment to the supporting structure shall be adequate for the loads imposed.

3.12 FINISHED CONDITION

- A. After installation, the acoustical ceiling system shall be free from any discoloration, dirt, smidges, scratches, chips, blemishes, and/or any misalignment. All damaged materials shall be replaced so that a new uniform acoustical ceiling system is provided.
- B. Provide a minimum of 20 extra panels to the OWNER for spares.

END OF SECTION

SECTION 09651 - RESILIENT TILE FLOORING

1.1 GENERAL

A. Submittals: As follows:

1. Product Data: For each type of product specified.
2. Samples: Of each different color and pattern of resilient product specified.
3. Maintenance Data: For resilient floor tile to include in the maintenance manuals specified in Division 1.

B. Extra Materials: Deliver extra materials to Owner as follows:

1. Furnish not less than one box for each type, color, pattern, class, wearing surface, and size of resilient tile flooring installed.
2. Furnish not less than 10 linear feet (3 linear m) of each type, color, pattern, and size of resilient accessory installed.

1.2 PRODUCTS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, those indicated in the Resilient Tile Flooring Schedule at the end of this Section.
- B. Products: Subject to compliance with requirements, provide one of the products indicated for each designation in the Resilient Tile Flooring Schedule at the end of this Section.
- C. Vinyl Composition Floor Tile: Products complying with ASTM F 1066 and with requirements specified in the Resilient Tile Flooring Schedule.
- D. Vinyl Wall Base: Products complying with FS SS-W-40, Type II and with requirements specified in the Resilient Tile Flooring Schedule.
- E. Vinyl Accessory Moldings: Products complying with requirements specified in the Resilient Tile Flooring Schedule.
- F. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based formulation provided or approved by flooring manufacturer for applications indicated.
- G. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.
- H. Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edge of tiles, and in maximum available lengths to minimize running joints.

1.3 EXECUTION

- A. Examine substrates, areas, and conditions where installation of resilient products will occur, with Installer present, for compliance with manufacturer's requirements. Verify that substrates and conditions are satisfactory for resilient product installation and comply with requirements specified.
 - 1. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by flooring manufacturer.
 - 2. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Preparation: Comply with resilient product manufacturer's written installation instructions for preparing substrates indicated to receive resilient products.
- C. Tile Installation: Comply with tile manufacturer's written installation instructions.
 - 1. Lay out tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half of a tile at perimeter.
 - a. Lay tiles square with room axis, unless otherwise indicated.
 - b. Lay tiles at a 45-degree angle with room axis, unless otherwise indicated.
 - 2. Match tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered.
 - a. Lay tiles in basket-weave pattern with grain direction alternating in adjacent tiles.
- D. Resilient Accessory Installation: Install resilient accessories according to manufacturer's written installation instructions.
 - 1. Apply resilient wall base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
 - a. Install wall base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.
 - b. Tightly adhere wall base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
 - c. Do not stretch base during installation.
 - d. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient wall base with manufacturer's recommended adhesive filler material.
 - e. Form corners on job from straight pieces of maximum lengths possible, without whitening at bends.
 - 2. Place resilient accessories so they are butted to adjacent materials and bond to substrates with adhesive. Install reducer strips at edges of flooring that would otherwise be exposed.

- E. Clean and protect resilient products according to manufacturer's written recommendations. Clean resilient products after installation and not more than 4 days before dates scheduled for inspections intended to establish date of Substantial Completion in each area of Project.

END OF SECTION 09651

SECTION 09900 - PAINTING

PART 1 -- GENERAL

1.01 WORK INCLUDED

- A. Surface preparation.
- B. Surface finish schedule.

1.02 REFERENCES

- A. ANSI/ASTM D16 _ Definitions of Terms Relating to Paint, Varnish, Laquer, and Related Products.
- B. ASTM D2016 _ Test Method for Moisture Content of Wood.
- C. Comply with the latest edition of the Florida Building Code.

1.03 DEFINITIONS

- A. Conform to ANSI/ASTM D16 for interpretation of terms used in this Section.

1.04 QUALITY ASSURANCE

- A. Applicator: Company specializing in commercial painting and finishing with 5 years documented experience.
- B. Products: manufacturer's best quality.

1.05 REGULATORY REQUIREMENTS

- A. Conform to applicable code for flame/fuel/smoke rating requirements for finishes.

1.06 TESTS

- A. Provide analysis and testing of coating or finish.

1.07 SUBMITTALS

- A. Submit product data for Architect Review.
- B. Submit samples for Architect Review.

- C. Submit two samples 6 x 6 inch in size illustrating range of colors and textures available for each surface finishing product scheduled, including paint finish for selection by Architect..
- D. Submit manufacturer's application instructions.

1.08 FIELD SAMPLES

- A. Provide samples.
- B. Provide field sample panel, a 4 foot wide interior panel or 10' x 10' exterior panel, illustrating special coating color, texture, and finish.
- C. Locate where directed.
- D. Accepted sample may remain as part of the Work.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site.
- B. Store and protect products.
- C. Deliver products to site in sealed and labelled containers; inspect to verify acceptance.
- C. Container labelling to include manufacturer's name, type of paint, brand name, brand code, coverage, surface preparation, drying time, cleanup, color designation, and instructions for mixing and reducing.
- D. Store paint materials at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in well ventilated area, unless required otherwise by manufacturer's instructions.
- E. Take precautionary measures to prevent fire hazards and spontaneous combustion.

1.10 ENVIRONMENTAL REQUIREMENTS

- A. Provide continuous ventilation and heating facilities to maintain surface and ambient temperatures above 45 degrees F for 24 hours before, during, and 48 hours after application of finishes, unless required otherwise by manufacturer's instructions.

- B. Do not apply exterior coatings during rain or when relative humidity is above 70 percent, unless required otherwise by manufacturer's instructions.
- C. Minimum Application Temperatures for Latex Paints: 45 degrees F for interiors; 50 degrees F for exterior; unless required otherwise by manufacturer's instructions.
- D. Minimum Application Temperature for Varnish and Finishes: 65 degrees F for interior or exterior, unless required otherwise by manufacturer's instructions.

PART 2 -- PRODUCTS

2.01 MATERIALS

- A. Acceptable manufacturers: Sherwin Williams, Benjamin Moore or M.A.B.
- B. Coatings: Ready mixed, except field catalysed coatings. Process pigments to a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating.
- C. Coatings: Good flow and brushing properties; capable of drying or curing free of streaks or sags.
- D. Accessory Materials: Linseed oil, shellac, turpentine, paint thinners and other materials not specifically indicated but required to achieve the finishes specified, of commercial quality.

2.02 FINISHES

- A. Refer to schedule at end of Section.
- B. All colors and textures as selected by Architect.

PART 3 -- EXECUTION

3.01 INSPECTION

- A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.
- C. Beginning of installation means acceptance of existing surfaces.

3.02 PREPARATION

- A. Remove electrical plates, hardware, light fixture trim, and fittings prior to preparing surfaces or finishing.
- B. Correct minor defects and clean surfaces which affect work of this Section.
- C. Shellac and seal marks which may bleed through surface finishes.
- D. Impervious Surfaces: Remove mildew by scrubbing with solution of tri_sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
- E. Galvanized Surfaces: Remove surface contamination and oils and wash with solvent. Apply coat of etching primer.
- F. Metal doors specified to receive painting. Seal top and bottom edges with primer.
- G. Uncoated Steel Surfaces: Remove grease, scale, dirt, and rust. Where heavy coatings of scale are evident, remove by wire brushing or sandblasting; clean by washing with solvent. Apply a treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Spot prime paint after repairs.
- H. Shop Primed Steel Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch_up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces.
- I. Interior Wood Items Scheduled to Receive Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats.
- J. Concrete masonry Scheduled to Receive Paint: Remove dirt, loose mortar, scale, salt or alkali powder, and other foreign matter. Remove oil and grease with a solution of tri-sodium phosphate; rinse well and allow to dry. Remove stains caused by weathering of corroding metals with a solution of sodium metasilicate after thoroughly wetting with water. Allow to dry.

3.03 PROTECTION

- A. Protect elements surrounding the work of this Section from damage or disfiguration.
- B. Repair damage to other surfaces caused by work of this Section.
- C. Furnish drop cloths, shields, and protective methods to prevent spray or droppings from disfiguring other surfaces.

- D. Remove empty paint containers from site.

3.04 APPLICATION

- A. Apply products in accordance with manufacturer's instructions.
- B. Do not apply finishes to surfaces that are not dry.
- C. Apply each coat to uniform finish.
- D. Apply each coat of paint slightly darker than preceding coat unless otherwise approved.
- E. Sand lightly between coats to achieve required finish.
- F. Allow applied coat to dry before next coat is applied.

3.05 FINISHING MECHANICAL AND ELECTRICAL EQUIPMENT

- A. Refer to Mechanical and Electrical for schedule of color coding and identification banding of equipment, ductwork, piping, and conduit.
- B. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
- C. Prime and paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, and except where items are prefinished.
- D. Replace identification markings on mechanical or electrical equipment when painted accidentally.
- E. Paint interior surfaces of air ducts, and convector and baseboard heating cabinets that are visible through grilles and louvers with one coat of flat black paint, to limit of sight line. Paint dampers exposed behind louvers, grilles, and convector and baseboard cabinets to match face panels.
- F. Paint exposed conduit and electrical equipment occurring in finished areas.
- G. Paint both sides and edges of plywood backboards for electrical and telephone equipment before installing equipment.
- H. Color code equipment, piping, conduit, and exposed ductwork in accordance with color schedule. Color band and identify with flow arrows, names, and numbering.

- I. Replace electrical plates, hardware, light fixture trim, and fittings removed prior to finishing.

3.06 CLEANING

- A. As Work proceeds, promptly remove paint where spilled, splashed, or spattered.
- B. During progress of Work maintain premises free of unnecessary accumulation of tools, equipment, surplus materials, and debris.
- C. Collect cotton waste, cloths, and material which may constitute a fire hazard, place in closed metal containers and remove daily from site.

3.07 SCHEDULE _ INTERIOR SURFACES

A. Wood _ Painted

- 1. One coat alkyd primer sealer.
- 2. Two coats alkyd enamel, semi gloss.

B. Metal-Galvanized

- 1. One coat Zinc Chromate primer.
- 2. Two coats Alkyd Enamel, gloss.

C. Concrete

- 1. One coat block filler.
- 2. Two coats acrylic epoxy, flat enamel.

D. Gypsum Board

- 1. One coat latex primer sealer.
- 2. Two coats latex eggshell.

E. Gypsum Board in Toilet Rooms

- 1. One coat primer sealer.
- 2. Two coats of acrylic epoxy paint.

F. Metal Shop Primed

- 1. Touch-up with Zinc Chromate primer
- 2. Two coats of Alkyd Enamel, gloss.

END OF SECTION -

SECTION 10505 - METAL LOCKERS

1.1 GENERAL

A. Submittals: Submit the following:

1. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of locker and bench.
2. Shop Drawings: Include plans, elevations, sections, details, attachments to other Work, and locker-numbering sequence.
3. Samples: Manufacturer's color charts showing the full range of colors available for units with factory-applied color finishes.
4. Maintenance Data: For adjusting, repairing, and replacing locker doors and latching mechanisms to include in maintenance manuals specified in Division 1.

B. Deliver master keys, control keys, and combination control charts to Owner.

C. Coordinate size and location of concrete bases.

1.2 PRODUCTS

A. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. American Locker Security Systems, Inc.
2. List Industries, Inc.
3. Republic Storage Systems Co., Inc.

B. Wardrobe Lockers: Fabricate lockers as follows:

1. Body: Form backs, tops, bottoms, sides, and intermediate partitions from steel sheet; flanged for double thickness at back vertical corners. Comply with the following:
 - a. Back-Material Sheet Thickness: 0.0239 inch (0.60 mm).
 - b. Side-Material Sheet Thickness: 0.0239 inch (0.60 mm).
 - c. Exposed Ends: Form exposed ends of nonrecessed lockers from minimum 0.0598-inch- (1.50-mm-) thick steel sheet.
2. Frames: Form channel frames from minimum 0.0598-inch- (1.50-mm-) thick steel sheet. Form continuous integral door strike on vertical frame members, with latch hooks welded or riveted to door frames. Provide resilient bumpers to cushion door closing.
3. Doors: One-piece steel sheet, formed into channel shape at vertical edges and flanged at right angles at top and bottom edges. Fabricate to prevent springing when opening or closing, and to swing 180 degrees. Comply with the following:
 - a. Sheet Thickness: 0.0598 inch (1.50 mm) minimum.

- b. Reinforcement: Brace or reinforce inner face of doors more than 15 inches (381 mm) wide.
 - c. Acoustical Treatment: Fabricate lockers for quiet operation with manufacturer's standard rattle-free latching mechanism and moving components isolated to prevent metal-to-metal contact.
 - d. Louvered Vents: Manufacturer's standard arrangement of stamped, louvered vents in door face.
 - e. Security Vents: Manufacturer's standard arrangement of stamped horizontal or vertical security vents in door face.
 - f. Perforated Vents: Manufacturer's standard arrangement of perforated vents in door face.
 - g. Concealed Vents: Provide slotted perforations in top and bottom horizontal return flanges of doors.
- 4. Shelves: Provide hat shelf in single-tier units; fabricated from minimum 0.0239-inch- (0.60-mm-) thick, formed steel sheet; flanged on all edges.
 - 5. Hinges: Steel, full loop, five or seven knuckle; tight pin; minimum 2 inches (51 mm) high. Weld to inside of door frame and attach to door with factory-installed, tamper-resistant fasteners.
 - a. Provide at least three hinges for each door more than 42 inches (1067 mm) high and at least two hinges for each door 42 inches (1067 mm) high or less.
 - 6. Projecting Handle and Latch: Manufacturer's standard, positive automatic, prelocking, pry-resistant latch and pull; chromium-plated, heavy-duty, vandal-resistant, lift-up handle, as follows:
 - a. Provide minimum three-point latching for each door more than 42 inches (1067 mm) high; minimum two-point latching for each door 42 inches (1067 mm) high or less.
 - b. Provide single-point gravity or spring-actuated latch with padlock lug.
- C. Locks: Fabricate lockers to receive manufacturer's standard locking devices, installed on lockers using security-type fasteners:
- 1. Combination Padlocks: Key-controlled, three-number dialing combination locks.
 - a. removable cylinder and key.
- D. Locker Accessories: Provide the following accessories, finished to match lockers, unless otherwise indicated:
- 1. Interior Equipment: Furnish each locker with manufacturer's standard zinc-plated, ball-pointed, double-prong steel hooks.
 - 2. Number Plates: Manufacturer's standard aluminum number plates. Number lockers in sequence indicated. Attach plates to each locker door with rivets.
 - 3. Legs: Provide nominal 6-inch- (152-mm-) long legs by extending vertical frame members, or by attaching gusset-type legs to locker body. Fabricate legs from at least 0.0598-inch- (1.50-mm-) thick steel sheet, with provision for fastening to floor.
 - a. Closed Front/End Bases: Minimum 0.0359-inch- (0.90-mm-) thick steel sheet.

4. Continuous Metal Base: Minimum 0.0598-inch- (1.50-mm-) thick steel sheet, channel or zee profiled; 4 inches (102 mm) high.
 5. Continuously Sloping Tops: Manufacturer's standard, fabricated from minimum 0.0359-inch- (0.90-mm-) thick steel sheet.
 6. Recess Trim: Manufacturer's standard; fabricated from minimum 0.0478-inch- (1.20-mm-) thick steel sheet, minimum 2-1/2-inch (64-mm) face width.
 7. Boxed End Panels: Manufacturer's standard; fabricated from minimum 0.0598-inch- (1.50-mm-) thick steel sheet, with 1-inch- (25-mm-) wide edge dimension.
 8. Finished End Panels: Manufacturer's standard; fabricated from minimum 0.0239-inch- (0.60-mm-) thick steel sheet.
- E. Fabrication: Fabricate each locker with an individual door and frame; individual top, bottom, back, and shelves; and common intermediate uprights separating compartments.
1. Knocked-Down Construction: Fabricate lockers for nominal assembly at Project site.
 2. All-Welded Construction: Preassemble lockers by welding all joints, seams, and connections, with no bolts, screws, or rivets used in assembly.
 3. Fabricate lockers square, rigid, and without warp, with metal faces flat and free of dents or distortion. Weld frame members together to form a rigid, one-piece assembly. Form locker-body panels, doors, shelves and accessories from one-piece steel sheet.
- F. Finish all steel surfaces and accessories, except prefinished stainless-steel and chrome-plated surfaces.
1. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard baked-enamel finish consisting of a thermosetting topcoat; with a minimum dry film thickness of 1.4 mils (0.036 mm) on doors, frames, and legs, and 1.1 mils (0.028 mm) elsewhere.

1.3 EXECUTION

- A. Install metal lockers and accessories level, plumb, rigid, and flush according to manufacturer's written instructions.
- B. Assemble knocked-down lockers with standard fasteners, with no exposed fasteners on door faces and face frames.
- C. Connect groups of all-welded lockers together with standard fasteners, with no exposed fasteners on face frames.
- D. Anchor lockers to floors and walls at intervals recommended by manufacturer, but not more than 36 inches (910 mm) o.c.

END OF SECTION

SECTION 10800 - TOILET ACCESSORIES

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. The CONTRACTOR shall, but is not necessarily limited to, furnishing and installing wall mirrors, paper towel dispensers, waste receptacles, toilet tissue dispensers, grab bars, soap dispensers, and feminine napkin vendor and disposal units. Extent of each type of toilet accessory is shown on drawings and schedules.

1.02 QUALITY ASSURANCE

- A. Inserts and anchoring devices which shall be set in concrete or built into masonry.
- B. Accessory locations shall be coordinated with other work to avoid interference and to assure proper operation and servicing of accessory units.

1.03 MANUFACTURERS

- A. Each type of toilet accessory required shall be as manufactured by one of the following:
 - 1. Accessory specialties, Inc.
 - 2. Bobrick Washroom Equipment, Inc.
 - 3. Bradley Corp.
 - 4. G. M. Ketcham Co., Inc.
 - 5. The Charles Parker Co.
 - 6. Watrous, Inc.

1.04 SUBMITTALS

- A. Submit manufacturer's technical data and installation instructions for each type of toilet accessory for Architect's Review.

1.05 HANDICAP ACCESSIBILITY

- A. All toilet and bath accessories shall comply in product and mounting height with all Federal and state handicap accessibility requirements.

1.06 CODE

- A. Comply with the requirements of the Florida Building Code – Latest Edition.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. The CONTRACTOR shall provide the following Toilet Accessories. See Plans for location and quantities.

ITEM

1. Electric Hand Dryer
2. Toilet Tissue Dispenser
3. Soap Dispensers
(wall mounted)
4. Mirrors
(all locations)
5. Feminine Napkin Disposal
6. Grab Bars
7. Shower Seat

- B. Materials shall conform to the following:

1. Stainless Steel: ANSI TYPE 302/304, with polished No. 4 finish, 22 gauge minimum.
2. Fasteners: Screws, bolts, and other devices of same material as accessory unit or of stainless steel where concealed.

2.02 MIRRORS

- A. Mirrors shall be provided as follows:

1. Mirrors shall be provided at locations shown on the Drawings. All dimensions shall be field verified.
2. All mirror glass shall be Number 1 Quality 1/4_inch safety glass, guaranteed against silver spoilage for 15 years.
3. All mirrors shall be provided with one piece roll formed stainless steel frames.

PART 3 – EXECUTION

3.01 INSPECTION

- A. Installer shall examine substrates, previously installed inserts and anchorages necessary for mounting of toilet accessories, and other conditions under which installation is to occur, and shall notify the CONTRACTOR of conditions detrimental to proper completion of work. Work shall not proceed until unsatisfactory conditions have been corrected in a manner acceptable to the installer.

3.02 INSTALLATION

- A. Toilet accessory units shall be installed in accordance with manufacturer's instructions, to comply with Federal and State of Florida handicap accessibility requirements using fasteners which are appropriate to substrate and recommended by the manufacturer of the unit. Units shall be installed plumb and level, firmly anchored in locations indicated.
- B. Install mirrors with back frame concealed fasteners.

3.03 ADJUST AND CLEAN

- A. Toilet accessories shall be adjusted for proper operation so that mechanisms function smoothly.
- B. All exposed surfaces shall be cleaned and polished after removing protective coating.

END OF SECTION

SECTION 13121 - METAL BUILDING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes a single-story, single- and multi-span, rigid-frame-type pre-engineered metal building of the nominal length, width, eave height, and roof pitch indicated.
 - 1. Exterior walls are covered with field-assembled insulated wall panels attached to framing members using exposed fasteners. Endwalls are not expandable.
 - 2. Roof system consists of the manufacturer's standard standing-seam insulated roof.
 - 3. Manufacturer's standard building components and accessories may be used, provided components, accessories, and complete structure conform to design indicated and specified requirements.
- B. Related Sections: The following sections contain requirements that relate to this section:
 - 1. Concrete floor and foundations and installation of anchor bolts are specified in Division 3 Section "Concrete Work."
 - 2. Sealants and caulking are specified in Division 7 Section "Joint Sealers."
 - 3. Finish hardware and provisions for masterkeying are specified in Division 8 Section "Finish Hardware."

1.3 SYSTEM PERFORMANCE REQUIREMENTS

- A. General: Engineer, design, fabricate and erect the pre-engineered metal building system to withstand loads from winds, gravity, structural movement including movement thermally induced, and to resist in-service use conditions that the building will experience, including exposure to the weather, without failure.
 - 1. Design each member to withstand stresses resulting from combinations of loads that produce the maximum allowable stresses in that member as prescribed in MBMA's "Design Practices Manual."
- B. Design Loads: Basic design loads, as well as auxiliary and collateral loads, are indicated on the drawings.
 - 1. Basic design loads include live load and wind load, in addition to the dead load.

2. Collateral loads include additional dead loads over and above the weight of the metal building system such as sprinkler systems, suspended refrigeration panels, and roof-mounted mechanical systems.
- C. Code: Comply with the Florida Building Code 2007 Edition with the 2009 Supplements.
- D. Structural Framing and Roof and Siding Panels: Design primary and secondary structural members and exterior covering materials for applicable loads and combinations of loads in accordance with the Metal Building Manufacturers Association's (MBMA) "Design Practices Manual."
1. Structural Steel: Comply with the American Institute of Steel Construction's (AISC) "Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings" for design requirements and allowable stresses.
 2. Light Gage Steel: Comply with the American Iron and Steel Institute's (AISI) "Specification for the Design of Cold Formed Steel Structural Members" and "Design of Light Gage Steel Diaphragms" for design requirements and allowable stresses.
 3. Welded Connections: Comply with the American Welding Society's (AWS) "Standard Code for Arc and Gas Welding in Building Construction" for welding procedures.
- D. Building Accessories: Provide metal building system accessories that comply with the Construction Documents.

1.4 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of the Contract and Division 1 Specification Sections.
- B. Product data consisting of metal building system manufacturer's product information for building components and accessories.
- C. Shop drawings for metal building structural framing system, roofing and siding panels, and other metal building system components and accessories that are not fully detailed or dimensioned in manufacturer's product data.
1. Structural Framing: Furnish complete erection drawings prepared by or under the supervision of a professional engineer legally authorized to practice in the jurisdiction where the Project is located. Include details showing fabrication and assembly of the metal building system. Show anchor bolts settings and sidewall, endwall, and roof framing. Include transverse cross-sections.
 2. Roofing and Siding Panels: Provide layouts of panels on walls and roofs, details of edge conditions, joints, corners, custom profiles, supports, anchorages, trim, flashings, closures, and special details. Include transverse cross-sections.
 3. Building Accessory Components: Provide details of metal building accessory components to clearly indicate methods of installation including the following:

- a. Personnel doors: Provide elevations and details of each type of door and frame, including anchors and reinforcement; show location and installation requirements for finish hardware. Provide schedule of doors and frames using the same reference numbers for details and openings as those indicated on the drawings; include complete hardware schedule. Submit impact resistant and product approval certifications for Architect's review.
- b. Overhead Service Door: Provide fully dimensioned details of construction, including 1/4 inch per foot (1:50) scale elevations of door units and not less than 3/4 inch per foot (1:20) scale details. Submit impact resistant product approval certifications.
- c. Louvers: Provide 1/4 inch per foot (1:50) scale elevations of louver units and not less than 3/4 inch per foot (1:20) scale details showing anchors, hardware, operators, and glazing details. Submit impact resistant product approval certifications.
- d. Sheet Metal Accessories: Provide layouts at 1/4 inch per foot (1:50) scale. Provide details of gutters, downspouts, and other sheet metal accessories at not less than 1-1/2 inch per foot (1:10) scale showing profiles, methods of joining, and anchorages.
- e. Windows: Provide fully dimensioned details of construction, including 1/4 inch per foot (1:50) scale elevations of window units and not less than 3/4 inch per foot (1:20) scale details. Submit impact resistant product approval certifications.

- D. Wiring diagrams from the manufacturer of motor operated overhead service doors detailing power, signal, and control systems differentiating clearly between field-installed and manufacturer-installed wiring.
- E. Samples for initial selection purposes in form of manufacturer's color charts or chips showing full range of colors, textures, and patterns available for metal roofing and siding panels with factory-applied finishes.
- F. Samples for verification purposes of roofing and siding panels. Provide sample panels 12 inch (300 mm) long by actual panel width, in the profile, style, color, and texture indicated. Include clips, battens, fasteners, closures, and other panel accessories.
- G. Installer certificates signed by metal building manufacturer written certification certifying that the installer complies with requirements included under the "Quality Assurance" Article.
- H. Professional engineer's certificate prepared and signed by a Professional Engineer, legally authorized to practice in the jurisdiction where Project is located, verifying that the structural framing and covering panels meet indicated loading requirements and codes of authorities having jurisdiction (including the latest edition of the Florida Building Code).

1.5 QUALITY ASSURANCE

- A. **Installer Qualifications:** Engage an experienced Installer to erect the pre-engineered metal building who has specialized in the erection and installation of types of metal buildings systems similar to that required for this project and who is certified in writing by the metal building system manufacturer as qualified for erection of the manufacturer's products.
- B. **Manufacturer's Qualifications:** Provide pre-engineered metal buildings manufactured by a firm experienced in manufacturing metal buildings systems that are similar to those indicated for this project and have a record of successful in-service performance.
- C. **Single-Source Responsibility:** Obtain the metal building system components, including structural framing, wall and roof covering, and accessory components, from one source from a single manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver prefabricated components, sheets, panels, and other manufactured items so they will not be damaged or deformed. Package wall and roof panels for protection against transportation damage.
- B. **Handling:** Exercise care in unloading, storing, and erecting wall and roof covering panels to prevent bending, warping, twisting, and surface damage.
- C. Stack materials on platforms or pallets, covered with tarpaulins or other suitable weathertight ventilated covering. Store metal wall and roof panels so that water accumulations will drain freely. Do not store panels in contact with other materials that might cause staining, denting or other surface damage.

1.7 WARRANTY

- A. **Roofing and Siding Panel Finish Warranty:** Furnish the roofing and siding panel manufacturer's written warranty, covering failure of the factory-applied exterior finish on metal wall and roof panels within the warranty period. This warranty shall be in addition to and not a limitation of other rights the Owner may have against the Contractor under the Contract Documents.
 - 1. Warranty period for factory-applied exterior finishes on wall and roof panels is 20 years after the date of Substantial Completion.

1.8 EXTRA MATERIALS

- A. **Maintenance Stock:** Furnish at least 5 percent excess over required amount of nuts, bolts, screws, washers, and other required fasteners for each metal building. Pack in cartons labeled to identify the contents and store on the site where directed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturer: Subject to compliance with specified requirements, provide metal building systems provided by the following or similar manufacturer approved by the Architect and Engineer prior to Bidding:
 - 1. MBMI Metal Buildings

2.2 MATERIALS

- A. Hot-Rolled Structural Steel Shapes: Comply with ASTM A 36 (ASTM A 36M) or ASTM A 529 (ASTM A 529M).
- B. Steel Tubing or Pipe: Comply with ASTM A 500 Grade B, ASTM A 501, or ASTM A 53.
- C. Steel Members Fabricated from Plate or Bar Stock: Provide 42,000 psi (290 MPa) minimum yield strength. Comply with ASTM A 529 (ASTM A 529M), ASTM A 570 (ASTM A 570M), or ASTM A 572 (ASTM A 572M).
- D. Steel Members Fabricated by Cold Forming: Comply with ASTM A 607 Grade 50.
- E. Cold-Rolled Carbon Steel Sheet: Comply with requirements of ASTM A 366 (ASTM A 366M) or ASTM A 568 (ASTM A 568M).
- F. Hot-Rolled Carbon Steel Sheet: Comply with requirements of ASTM A 568 (ASTM A 568M) or ASTM A 569.
- G. Structural Quality Zinc-Coated (Galvanized) Steel Sheet: Comply with ASTM A 446 with G90 (ASTM A 446M with Z275) coating complying with ASTM A 525 (ASTM A 525M). Grade to suit manufacturer's standards.
- H. Commercial Quality Zinc-Coated (Galvanized) Steel Sheet: Comply with ASTM A 526 with G60 (ASTM A 526M with Z180) coating complying with ASTM A 525 (ASTM A 525M).
- I. Aluminum-Coated Steel Sheets: Comply with ASTM A 463 with T1-40 coating.
- J. Aluminum Sheets: Comply with ASTM B 209 (ASTM B 209M) for Alclad alloy 3003 or 3004 with temper as required to suit forming operations.
- K. Bolts for Structural Framing: Comply with ASTM A 307 or ASTM A 325 (ASTM A 325M) as necessary for design loads and connection details.
- L. Glass and Glazing Materials: Provide impact glass complying with IMPACT RESISTANT PRODUCT APPROVALS, of quality and type as shown on Architectural drawings. Place manufacturer's label identification on each glass light.

- M. Thermal Insulation: Glass fiber blanket insulation, complying with ASTM C 991, of 0.5 lb per cu. ft. (8 kg/cu. m) density, thickness as indicated, with UL flame spread classification of 25 or less, and 2 inch (50 mm) wide continuous vapor-tight edge tabs.
- N. Paint and Coating Materials: Comply with performance requirements of the federal specifications indicated. Unless specifically indicated otherwise, compliance with compositional requirements of federal specifications indicated is not required.
 - 1. Shop Primer for Ferrous Metal: Fast-curing, lead-free, universal primer, selected by the manufacturer for resistance to normal atmospheric corrosion, compatibility with finish paint systems, and capability to provide a sound foundation for field-applied topcoats despite prolonged exposure. Comply with FS TT-P-645.

2.3 STRUCTURAL FRAMING

- A. Rigid Frames: Fabricate from hot-rolled structural steel shapes. Provide factory-welded, shop-painted, built-up "I-beam"-shape or open-web-type frames consisting of tapered or parallel flange beams and tapered columns. Furnish frames with attachment plates, bearing plates, and splice members. Factory drill for field-bolted assembly.
 - 1. Provide length of span and spacing of frames indicated. Slight variations in length of span and frame spacing may be acceptable if necessary to meet manufacturer's standard.
 - 2. Provide rigid frames at endwalls where indicated.
- B. Primary Endwall Framing: Provide the following primary endwall framing members fabricated for field-bolted assembly:
 - 1. Endwall Columns: Manufacturer's standard shop-painted, built-up factory-welded "I"-shape or cold-formed "C" sections.
 - 2. Endwall Beams: Manufacturer's standard shop-painted "C"-shape roll-formed sections.
- C. Secondary Framing: Provide the following secondary framing members:
 - 1. Roof Purlins, Sidewall and Endwall Girts: "C"-or "Z"-shaped sections shop-painted roll-formed steel. Purlin spacers shall be fabricated from 14 gage (2.0 mm) cold-formed galvanized steel sections.
 - 2. Eave Struts: Unequal flange "C"-shaped sections formed to provide adequate backup for both wall and roof panels.
 - 3. Flange and Sag Bracing: Angles, shop-painted roll-formed steel.
 - 4. Base or Sill Angles: Fabricate from 14 gage (1.9 mm) cold-formed galvanized steel sections.
 - 5. Secondary endwall structural members, except columns and beams, shall be the manufacturer's standard sections fabricated from 14 gage (2.0 mm) cold-formed galvanized steel.

- D. Wind Bracing: Provide adjustable wind bracing using threaded steel rods; comply with ASTM A 36/A36M or ASTM A 572/A572M, Grade D. Locate interior end bay bracing only where indicated.
- E. Bolts: Provide shop-painted bolts except when structural framing components are in direct contact with roofing and siding panels. Provide zinc-plated or cadmium-plated bolts when structural framing components are in direct contact with roofing and siding panels.
- F. Shop Painting: Clean surfaces to be primed of loose mill scale, rust, dirt, oil, grease, and other matter precluding paint bond. Follow procedures of SSPC-SP3 for power-tool cleaning, SSPC-SP7 for brush-off blast cleaning, and SSPC-SP1 for solvent cleaning.
 - 1. Prime structural steel primary and secondary framing members with the manufacturer's standard rust-inhibitive primer.
 - 2. Prime galvanized members, after phosphoric acid pretreatment, with manufacturer's standard zinc dust-zinc oxide primer.

2.4 ROOFING AND SIDING PANELS

- A. Face Sheets: Fabricate wall and roof panel face sheets to the profile or configuration indicated in drawings.
- B. Standing Seam Roof Panels: Manufacturer's standard factory-formed standing-seam roof panel system designed for mechanical attachment of panels to roof purlins using a concealed clip.
 - 1. Clips: Provide 16 gage (1.5 mm) panel clips.
 - 2. Cleats: Factory-calked, mechanically seamed cleats formed from 24 gage (0.70 mm), Grade C, zinc-coated steel sheets.
- C. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets, self-locking bolts, end-welded studs, and other suitable fasteners designed to withstand design loads.
 - 1. Provide metal-backed neoprene washers under heads of fasteners bearing on weather side of panels.
 - 2. Use aluminum or stainless steel fasteners for exterior application and galvanized or cadmium-plated fasteners for interior applications.
 - 3. Locate and space fastenings in true vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of neoprene washer.
 - 4. Provide fasteners with heads matching color of roofing or siding sheets by means of plastic caps or factory-applied coating.
- D. Accessories: Provide the following sheet metal accessories factory-formed of the same material in the same finish as roof and wall panels:
 - 1. Flashings.

2. Closers.
3. Fillers.
4. Metal expansion joints.
5. Ridge covers.
6. Fascias.

- E. Flexible Closure Strips: Closed-cell, expanded cellular rubber, self-extinguishing flexible closure strips. Cut or premold to match configuration of roofing and siding sheets. Provide closure strips where indicated or necessary to ensure weathertight construction.
- F. Sealing Tape: Pressure-sensitive 100 percent solids grey polyisobutylene compound sealing tape with release paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.
- G. Joint Sealant: One-part elastomeric polyurethane, polysulfide, or silicone rubber sealant as recommended by the building manufacturer.
- H. Baked Enamel Finish: Provide the manufacturer's standard shop-applied baked enamel finish to galvanized steel roof and wall panels, and related trim and accessory elements. For roofing and siding, apply finish coat on exterior facings and manufacturer's standard wash coat on reverse face.
1. Clean galvanized steel with an alkaline compound, then treat with a zinc phosphate conversion coating, and seal with a chromic acid rinse.
 2. Apply baked-on thermo-setting modified acrylic enamel to pretreated steel sheets, in one or more coats as standard with the manufacturer to achieve a minimum dry film thickness of 1.5 mils (0.04 mm).
 - a. Color: As selected by the Architect from the manufacturer's standard colors.

2.5 PERSONNEL DOORS

- A. Certification: Submit impact resistant and product approval Certification.
- B. Materials: Fabricate personnel doors and frames from commercial quality, cold-rolled carbon steel sheet or commercial quality hot-rolled, pickled and oiled carbon steel sheet.
1. Zinc-coated Steel Sheets: Comply with ASTM A 526 with G60 (ASTM A 526M with Z180) coating complying with ASTM A 525 (ASTM A 525M), mill phosphatized.
- C. Anchors and Accessories: Provide manufacturer's standard units. For items built into exterior walls, use galvanized units complying with ASTM A 123.

- D. Doors: Provide doors of types and styles indicated. Comply with SDI-100 for material quality, metal gages, and construction details.
- E. Frames: Provide frames of the types and sizes indicated. Comply with SDI-100 for material quality, metal gages, and construction details.
 - 1. Provide standard hollow metal frames for doors, transoms, sidelights, borrowed lights, and other openings as indicated.
 - 2. Prepare frames to receive 3 silencers on strike jambs of single door frames and 2 silencers on heads of frames for pairs of doors.
- F. Fabrication: Fabricate units to be rigid, neat in appearance, and free from defects, warp, or buckle. Provide continuous welds on exposed joints; grind, dress, and make welds smooth, flush, and invisible.
- G. Hardware: Prepare hollow metal units to receive mortised and concealed finish hardware, including cutouts, reinforcing, drilling, and tapping. Comply with ANSI A115.
 - 1. Reinforce to receive field-applied, surface-mounted finish hardware.
 - 2. Locate finish hardware as indicated.
 - 3. Locate finish hardware in accordance with "Recommended Locations for Builder's Hardware," published by the Door and Hardware Institute.
 - 4. Provide hardware for each door leaf, as shown on Section 08710 – Finish Hardware.
- H. Shop-paint exposed surfaces, including galvanized surfaces, using manufacturer's standard baked-on rust-inhibitive primer.
- I. Finish Paint: Color shall be white –refer to Section 09900- Painting

2.6 OVERHEAD COILING DOOR

- A. General: Provide complete overhead coiling door assemblies including door curtain, guides, counterbalance, hardware, operators, and installation accessories.
- B. Performance Requirements: Provide doors certified to withstand a 30 psf (1.0 kPa) wind load pressure with maximum deflection of 1/120 of the opening width.
- C. Certification: Submit impact resistant and product approval certification.
- D. Door Curtain: Interlocking steel slat door curtain with one-piece slats for the full length of door width. Form from 20 gage (1.0 mm), Grade A, structural quality, zinc-coated steel sheets. Phosphate treat before fabrication.
- E. Endlocks: Provide endlocks fabricated from malleable iron castings, galvanized after fabrication, secured to curtain slats with galvanized rivets.

- F. Windlocks: Provide windlocks fabricated from malleable iron castings, galvanized after fabrication, secured to curtain slats at 24 inches (600 mm) on center on both edges with galvanized rivets.
- G. Bottom Bar: Provide bottom bar on door curtain consisting of two 1/8 inch (3 mm) thick angles of the same metal as the door curtain slats. Provide flexible rubber, vinyl, or neoprene weather seal and cushion bumper on the bottom bar.
- H. Curtain Jamb Guides: Provide curtain jamb guides, built up using steel angles, channels and flat bars complying with ASTM A 36/A36M. Galvanize after fabrication.
- I. Weather Seals: 1/8 inch (3 mm) thick continuous rubber or neoprene sheet weather seals on metal pressure bars secured to inside of curtain coil hood. At door jambs, use 1/8 inch (3 mm) thick continuous strip secured to exterior side of jamb guide.
- J. Counterbalance: Adjustable steel helical torsion spring counterbalance, mounted around a steel shaft in a spring barrel and connected to door curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.
- K. Brackets: Cast-iron or cold-rolled steel plate mounting brackets with bell-mouth guide groove for curtain.
- L. Hood: Form to enclose the coiled curtain and operating mechanism entirely at the opening head and to act as a weather seal. Contour to suit end brackets to which attached. Roll and reinforce top and bottom edges for stiffness. Provide closed ends for surface-mounted hoods, and any portion of between-jamb mounting projecting beyond wall face. Provide intermediate support brackets to prevent sag.
 - 1. Fabricate hoods for steel doors of 24 gage (0.7 mm), zinc-coated steel sheet. Phosphate treat before fabrication.
- M. Shop Finish: Except for tightly joined and lubricated surfaces, shop-clean and prime ferrous and galvanized metal surfaces, both exposed and concealed, with the manufacturer's standard rust-inhibitive primer.
- N. Finish Paint: Color shall be white – refer to Section 09900- Painting.
- O. Door Operator: Provide electrical door operators with emergency chain hoist operator unit.

2.8 SHEET METAL ACCESSORIES

- A. General: Provide coated steel sheet metal accessories with coated steel roofing and siding panels.
- B. Gutters: Form in 96 inch (2400 mm) long sections, complete with end pieces, outlet tubes, and other special pieces as required. Size in accordance with SMACNA. Join sections with riveted and soldered or sealed joints. Provide expansion-type slip joint at center of runs. Furnish gutter supports spaced 36 inches (900 mm) on center,

constructed of same metal as gutters. Provide bronze, copper, or aluminum wire ball strainers at outlets. Finish to match roof fascia and rake.

- C. Downspouts: Form in 10 feet (3 m) long sections, complete with elbows and offsets. Join sections with 1-1/2 inch (38 mm) telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch (25 mm) away from walls; locate fasteners at top and bottom and at approximately 60 inch (1500 mm) on center in between. Finish to match wall panels.

2.8 FABRICATION

- A. General: Design prefabricated components and necessary field connections required for erection to permit easy assembly and disassembly.
 - 1. Fabricate components in such a manner that once assembled, they may be disassembled, repackaged, and reassembled with a minimum amount of labor.
 - 2. Clearly and legibly mark each piece and part of the assembly to correspond with previously prepared erection drawings, diagrams, and instruction manuals.
- B. Structural Framing: Shop-fabricate framing components to indicated size and section with base plates, bearing plates, and other plates required for erection, welded in place. Provide holes for anchoring or connections shop-drilled or punched to template dimensions.
 - 1. Shop Connections: Provide bolted, or welded shop connections.
 - 2. Field Connections: Provide bolted field connections.

PART 3 - EXECUTION

3.1 ERECTION

- A. Framing: Erect framing true to line, level, plumb, rigid, and secure. Level base plates to a true even plane with full bearing to supporting structures, set with double-nutted anchor bolts. Use a nonshrinking grout to obtain uniform bearing and to maintain a level base line elevation. Moist cure grout for not less than 7 days after placement.
- B. Purlins and Girts: Provide rake or gable purlins with tight-fitting closure channels and fascias. Locate and space wall girts to suit door and window arrangements and heights. Secure purlins and girts to structural framing and hold rigidly to a straight line by sag rods.
- C. Bracing: Provide diagonal rod or angle bracing in roof and sidewalls as indicated.
 - 1. Movement-resisting frames may be used in lieu of sidewall rod bracing, to suit manufacturer's standards.
 - 2. Where diaphragm strength of roof or wall covering is adequate to resist wind forces, rod or angle bracing will not be required.

- D. Framed Openings: Provide shapes of proper design and size to reinforce openings and to carry loads and vibrations imposed, including equipment furnished under mechanical and electrical work. Securely attach to building structural frame.

3.2 ROOFING AND SIDING

- A. General: Arrange and nest sidelap joints so prevailing winds blow over, not into, lapped joints. Lap ribbed or fluted sheets one full rib corrugation. Apply panels and associated items for neat and weathertight enclosure. Avoid "panel creep" or application not true to line. Protect factory finishes from damage.
 - 1. Field cutting of exterior panels by torch is not permitted.
 - 2. Provide weatherseal under ridge cap. Flash and seal roof panels at eave and rake with rubber, neoprene, or other closures to exclude weather.
- B. Roof Sheets: Provide sealant tape at lapped joints of ribbed or fluted roof sheets and between roof sheets and protruding equipment, vents, and accessories.
 - 1. Apply a continuous ribbon of sealant tape to clean, dry surface of the weather side of fastenings on end laps, and on side laps of corrugated nesting-type, ribbed, or fluted panels and elsewhere as needed to make roof sheets weatherproof to driving rains.
- C. Standing-Seam Roof Panel System: Fasten roof panels to purlins with concealed clip in accordance with the manufacturer's instructions.
 - 1. Install clips at each support with self-drilling fasteners.
 - 2. At end laps of panels, install tape calk between panels.
 - 3. Install factory-calked cleats at standing-seam joints. Machine-seam cleats to the panels to provide a weathertight joint.
- D. Wall Sheets: Apply elastomeric sealant continuously between metal base channel (sill angle) and concrete and elsewhere as necessary for waterproofing. Handle and apply sealant and backup in accordance with the sealant manufacturer's recommendations.
 - 1. Align bottom of wall panels and fasten panels with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws. Fasten window and door frames with machine screws or bolts. When building height requires two rows of panels at gable ends, align lap of gable panels over wall panels at eave height.
 - 2. Install screw fasteners with power tools having controlled torque adjusted to compress neoprene washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.
 - 3. Provide weatherproof escutcheons for pipe and conduit penetrating exterior walls.
- E. Sheet Metal Accessories: Install gutters, downspouts, ventilators, louvers, and other sheet metal accessories in accordance with manufacturer's recommendations for

positive anchorage to building and weathertight mounting. Adjust operating mechanism for precise operation.

- F. Hollow Metal Doors and Frames: Install doors and frames straight, plumb, and level. Securely anchor frames to building structure. Set units with 1/8 inch (3 mm) maximum clearance between door and frame at jambs and head and 3/4 inch (19 mm) maximum between door and floor. Adjust hardware for proper operation.
- G. Overhead Coiling Doors: Set doors and operating equipment complete with necessary hardware, jamb and head mold stops, anchors, inserts, hangers, and equipment supports in accordance with manufacturer's instructions. Adjust moving hardware for proper operation.
- H. Thermal Insulation: Install insulation concurrently with installation of roof panels in accordance with manufacturer's directions. Install blankets straight and true in one-piece lengths with both sets of tabs sealed to provide a complete vapor barrier. Locate insulation on underside of roof sheets, extending across the top flange of purlin members and held taut and snug to roofing panels with retainer clips. Install retainer strips at each longitudinal joint, straight and taut, nesting with roof rib to hold insulation in place.
- I. Cleaning and Touch-Up: Clean component surfaces of matter that could preclude paint bond. Touch up abrasions, marks, skips, or other defects to shop-primed surfaces with same type material as shop primer.

END OF SECTION 13121

SECTION 15058

COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.2 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 - 1. Motor controllers.
 - 2. Torque, speed, and horsepower requirements of the load.
 - 3. Ratings and characteristics of supply circuit and required control sequence.
 - 4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.
- B. Comply with NEMA MG 1 unless otherwise indicated.

2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.

- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Energy efficient, as defined in NEMA MG 1.
- C. Service Factor: 1.15.
- D. Multispeed Motors: Variable torque.
 - 1. For motors with 2:1 speed ratio, consequent pole, single winding.
 - 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- E. Rotor: Random-wound, squirrel cage.
- F. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- G. Temperature Rise: Match insulation rating.

2.4 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
 - 1. Permanent-split capacitor.
 - 2. Split phase.
 - 3. Capacitor start, inductor run.
 - 4. Capacitor start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- D. Motors 1/20 HP and Smaller: Shaded-pole type.

- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 15058

SECTION 15061

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Steel pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Metal framing systems.
 - 4. Thermal-hanger shield inserts.
 - 5. Fastener systems.
 - 6. Equipment supports.

1.2 DEFINITIONS

- A. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.3 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.4 SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel pipe hangers and supports.
 - 2. Thermal-hanger shield inserts.
 - 3. Powder-actuated fastener systems.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
 - 1. Trapeze pipe hangers. Include Product Data for components.
 - 2. Metal framing systems. Include Product Data for components.
 - 3. Equipment supports.
- C. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 STEEL PIPE HANGERS AND SUPPORTS

- A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.
- B. Available Manufacturers:
 - 1. AAA Technology & Specialties Co., Inc.
 - 2. Bergen-Power Pipe Supports.
 - 3. B-Line Systems, Inc.; a division of Cooper Industries.
 - 4. Carpenter & Paterson, Inc.
 - 5. Empire Industries, Inc.
 - 6. ERICO/Michigan Hanger Co.
 - 7. Globe Pipe Hanger Products, Inc.
 - 8. Grinnell Corp.
 - 9. GS Metals Corp.
 - 10. National Pipe Hanger Corporation.
 - 11. PHD Manufacturing, Inc.
 - 12. PHS Industries, Inc.
 - 13. Piping Technology & Products, Inc.
 - 14. Tolco Inc.
- C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.
- E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

- A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.
- B. Available Manufacturers:
 - 1. B-Line Systems, Inc.; a division of Cooper Industries.
 - 2. ERICO/Michigan Hanger Co.; ERISTRUT Div.
 - 3. GS Metals Corp.
 - 4. Power-Strut Div.; Tyco International, Ltd.
 - 5. Thomas & Betts Corporation.
 - 6. Tolco Inc.
 - 7. Unistrut Corp.; Tyco International, Ltd.
- C. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.5 THERMAL-HANGER SHIELD INSERTS

- A. Description: 100-psig- minimum, compressive-strength insulation insert encased in sheet metal shield.
- B. Available Manufacturers:
 - 1. Carpenter & Paterson, Inc.
 - 2. ERICO/Michigan Hanger Co.
 - 3. PHS Industries, Inc.
 - 4. Pipe Shields, Inc.
 - 5. Rilco Manufacturing Company, Inc.
 - 6. Value Engineered Products, Inc.
- C. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass with vapor barrier.
- D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass.
- E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

- G. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.6 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

- 1. Available Manufacturers:

- a. Hilti, Inc.
- b. ITW Ramset/Red Head.
- c. Masterset Fastening Systems, Inc.
- d. MKT Fastening, LLC.
- e. Powers Fasteners.

- B. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated or stainless steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

- 1. Available Manufacturers:

- a. B-Line Systems, Inc.; a division of Cooper Industries.
- b. Empire Industries, Inc.
- c. Hilti, Inc.
- d. ITW Ramset/Red Head.
- e. MKT Fastening, LLC.
- f. Powers Fasteners.

2.7 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.8 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

- 1. Properties: Nonstaining, noncorrosive, and nongaseous.
- 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use padded hangers for piping that is subject to scratching.
- F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
 - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
 - 4. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
 - 5. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
 - 6. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange.
 - 7. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
 - 8. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
- G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
 - 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.
- H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.

I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.

J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

K. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
3. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.

L. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.

- M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
- N. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
 - 2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. Fastener System Installation:
 - 1. Install powder-actuated fasteners in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- F. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- H. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- I. Install lateral bracing with pipe hangers and supports to prevent swaying.
- J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers,

NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

- K. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9 (for building services piping) are not exceeded.
- M. Insulated Piping: Comply with the following:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits according to ASME B31.9 for building services piping.
 - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
 - b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
 - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
 - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
 - 5. Pipes NPS 8 and Larger: Include wood inserts.
 - 6. Insert Material: Length at least as long as protective shield.
 - 7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make smooth bearing surface.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

3.6 PAINTING

- A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 15061

SECTION 15062

HANGERS AND SUPPORTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Equipment supports.
- B. See Division 15 Section "Vibration and Seismic Controls for HVAC Piping and Equipment" for vibration isolation devices.
- C. See Division 15 Section(s) "Metal Ducts" for duct hangers and supports.

1.2 DEFINITIONS

- A. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.3 PERFORMANCE REQUIREMENTS

- A. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.4 SUBMITTALS

- A. Shop Drawings: Show fabrication and installation details and include calculations for the following:
 - 1. Equipment supports.
- B. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.3 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.
- B. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.
- C. Hanger-Rod Attachments: Unless otherwise indicated, install the following types:
 - 1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 - 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
- D. Building Attachments: Unless otherwise indicated, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.

E. Spring Hangers and Supports: Unless otherwise indicated, install the following types:

1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
3. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- B. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- C. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make smooth bearing surface.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.5 PAINTING

- A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 15062

SECTION 15076

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Pipe labels.

1.2 SUBMITTAL

- A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
 - 1. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 - 2. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 - 3. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Plastic Labels for Equipment:
 - 1. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 - 2. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 - 3. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

- C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.
- D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

- A. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- B. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- C. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- D. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- E. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially cover circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches high.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

- A. Piping Color-Coding: Painting of piping is specified in Division 9 Section "High-Performance Coatings."
- B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

END OF SECTION 15076

SECTION 15077

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Duct labels.

1.2 SUBMITTAL

- A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
 - 1. Material and Thickness: Aluminum, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 - 3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 - 4. Fasteners: Stainless-steel rivets or self-tapping screws.
 - 5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

2.2 DUCT LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch or 1/8 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: Black.

- C. Background Color: Black.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches high.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.3 DUCT LABEL INSTALLATION

- A. Install self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:
 - 1. Blue: For cold-air supply ducts.
 - 2. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
 - 3. ASME A13.1 Colors and Designs: For hazardous material exhaust.

- B. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

END OF SECTION 15077

Michelle Gilmore

From: Szabo, Agota [agota.szabo@jacobs-consultancy.com]
Sent: Friday, March 05, 2010 10:26 AM
To: Michelle Gilmore
Subject: RE: Ft. Lauderdale/Hollywood Int'l Airport T1/T2 Planning Study

Hello Michelle,

Yes, please that would be really helpful, for the Terminal 2 Concept Study the number is: WA-303-5JC, and for the Terminal 1 Concept Study the number is: WA-305-6JC.

Thank you so much--Agota

From: Michelle Gilmore [mailto:mgilmore@cartayaandassociates.com]
Sent: Friday, March 05, 2010 7:19 AM
To: Szabo, Agota
Subject: Ft. Lauderdale/Hollywood Int'l Airport T1/T2 Planning Study

Good morning Agota,

I am working on the invoice for Ft. Laud/Hollywood Int'l Airport T1/T2 Planning Study is there a specific WA # you want listed on the invoice?

Thanks,



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SECTION 15082

PLUMBING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Insulation Materials:
 - a. Cellular glass.
 - b. Flexible elastomeric.
 - c. Mineral fiber.
 - d. Polyolefin.
 - e. Polystyrene.
 - 2. Insulating cements.
 - 3. Adhesives.
 - 4. Mastics.
 - 5. Sealants.
 - 6. Factory-applied jackets.
 - 7. Field-applied fabric-reinforcing mesh.
 - 8. Field-applied jackets.
 - 9. Tapes.
 - 10. Securements.
 - 11. Corner angles.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings:
 - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Detail attachment and covering of heat tracing inside insulation.
 - 3. Detail insulation application at pipe expansion joints for each type of insulation.
 - 4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 - 5. Detail removable insulation at piping specialties, equipment connections, and access panels.
 - 6. Detail application of field-applied jackets.
 - 7. Detail application at linkages of control devices.
 - 8. Detail field application for each equipment type.
- C. Field quality-control reports.

1.3 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket

materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Cell-U-Foam Corporation; Ultra-CUF.
 - b. Pittsburgh Corning Corporation; Foamglas Super K.
 2. Block Insulation: ASTM C 552, Type I.
 3. Special-Shaped Insulation: ASTM C 552, Type III.
 4. Board Insulation: ASTM C 552, Type IV.
 5. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
 6. Preformed Pipe Insulation with Factory-Applied ASJ or ASJ-SSL: Comply with ASTM C 552, Type II, Class 2.
 7. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
- G. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Aeroflex USA Inc.; Aerocel.
 - b. Armacell LLC; AP Armaflex.
 - c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.
- H. High-Temperature, Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type V, without factory-applied jacket.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Johns Manville; HTB 23 Spin-Glas.
 - b. Owens Corning; High Temperature Flexible Batt Insulations.

- I. High-Temperature, Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type III, without factory-applied jacket.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Fibrex Insulations Inc.; FBX.
 - b. Johns Manville; 1000 Series Spin-Glas.
 - c. Owens Corning; High Temperature Industrial Board Insulations.
 - d. Rock Wool Manufacturing Company; Delta Board.
 - e. Roxul Inc.; Roxul RW.
 - f. Thermafiber; Thermafiber Industrial Felt.

- J. Mineral-Fiber, Preformed Pipe Insulation:
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Fibrex Insulations Inc.; Coreplus 1200.
 - b. Johns Manville; Micro-Lok.
 - c. Knauf Insulation; 1000 Pipe Insulation.
 - d. Manson Insulation Inc.; Alley-K.
 - e. Owens Corning; Fiberglas Pipe Insulation.
 - 2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A.
 - a. Owens Corning; Fiberglas Pipe and Tank Insulation.

- K. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials and Type II, Grade 1 for sheet materials.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Armacell LLC; Tubolit.
 - b. Nomaco Inc.; IMCOLOCK, IMCOSHEET, NOMALOCK, and NOMAPLY.
 - c. RBX Corporation; Therma-cell.

- L. Polystyrene: Rigid, extruded cellular polystyrene intended for use as thermal insulation. Comply with ASTM C 578, Type IV or Type XIII, except thermal conductivity (k-value) shall not exceed 0.26 Btu x in./h x sq. ft. x deg F after 180 days of aging. Fabricate shapes according to ASTM C 450 and ASTM C 585.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dow Chemical Company (The); Styrofoam.
 - b. Knauf Insulation; Knauf Polystyrene.

2.2 INSULATING CEMENTS

- A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Insulco, Division of MFS, Inc.; SmoothKote.
 - b. P. K. Insulation Mfg. Co., Inc.; PK No. 127, and Quik-Cote.
 - c. Rock Wool Manufacturing Company; Delta One Shot.

2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

- B. Cellular-Glass Polystyrene Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-96.
 - b. Foster Products Corporation, H. B. Fuller Company; 81-33.

- C. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Aeroflex USA Inc.; Aero seal.
 - b. Armacell LCC; 520 Adhesive.
 - c. Foster Products Corporation, H. B. Fuller Company; 85-75.
 - d. RBX Corporation; Rubatex Contact Adhesive.

- D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
 - d. Marathon Industries, Inc.; 225.
 - e. Mon-Eco Industries, Inc.; 22-25.

- E. Polystyrene Adhesive: Solvent- or water-based, synthetic resin adhesive with a service temperature range of minus 20 to plus 140 deg F.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-96.
 - b. Foster Products Corporation, H. B. Fuller Company; 97-13.

- F. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
 - d. Marathon Industries, Inc.; 225.
 - e. Mon-Eco Industries, Inc.; 22-25.

- G. PVC Jacket Adhesive: Compatible with PVC jacket.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dow Chemical Company (The); 739, Dow Silicone.
 - b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
 - c. P.I.C. Plastics, Inc.; Welding Adhesive.
 - d. Red Devil, Inc.; Celulon Ultra Clear.
 - e. Speedline Corporation; Speedline Vinyl Adhesive.

2.4 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.

- B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-35.
 - b. Foster Products Corporation, H. B. Fuller Company; 30-90.
 - c. ITW TACC, Division of Illinois Tool Works; CB-50.
 - d. Marathon Industries, Inc.; 590.
 - e. Mon-Eco Industries, Inc.; 55-40.
 - f. Vimasco Corporation; 749.
 - 2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
 - 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 - 4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
 - 5. Color: White.

- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-10.
 - b. Foster Products Corporation, H. B. Fuller Company; 35-00.
 - c. ITW TACC, Division of Illinois Tool Works; CB-05/15.
 - d. Marathon Industries, Inc.; 550.
 - e. Mon-Eco Industries, Inc.; 55-50.
 - f. Vimasco Corporation; WC-1/WC-5.
 - 2. Water-Vapor Permeance: ASTM F 1249, 3 perms at 0.0625-inch dry film thickness.
 - 3. Service Temperature Range: Minus 20 to plus 200 deg F.
 - 4. Solids Content: 63 percent by volume and 73 percent by weight.
 - 5. Color: White.

2.5 SEALANTS

- A. Joint Sealants:
 - 1. Joint Sealants for Cellular-Glass Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-76.
 - b. Foster Products Corporation, H. B. Fuller Company; 30-45.
 - c. Marathon Industries, Inc.; 405.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Pittsburgh Corning Corporation; Pittseal 444.
 - f. Vimasco Corporation; 750.
 - 2. Joint Sealants for Polystyrene Products: Subject to compliance with requirements, provide the available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-70.
 - b. Foster Products Corporation, H. B. Fuller Company; 30-45/30-46.
 - c. Marathon Industries, Inc.; 405.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Vimasco Corporation; 750.
 - 3. Materials shall be compatible with insulation materials, jackets, and substrates.
 - 4. Permanently flexible, elastomeric sealant.
 - 5. Service Temperature Range: Minus 100 to plus 300 deg F.
 - 6. Color: White or gray.

- B. FSK and Metal Jacket Flashing Sealants:
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- a. Childers Products, Division of ITW; CP-76-8.
 - b. Foster Products Corporation, H. B. Fuller Company; 95-44.
 - c. Marathon Industries, Inc.; 405.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Vimasco Corporation; 750.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
 3. Fire- and water-resistant, flexible, elastomeric sealant.
 4. Service Temperature Range: Minus 40 to plus 250 deg F.
 5. Color: Aluminum.
- C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-76.
 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 3. Fire- and water-resistant, flexible, elastomeric sealant.
 4. Service Temperature Range: Minus 40 to plus 250 deg F.
 5. Color: White.

2.6 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
 3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
 4. PVDC Jacket for Indoor Applications: 4-mil- thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perms when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.
 5. PVDC Jacket for Outdoor Applications: 6-mil- thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perms when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.
 6. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

2.7 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. inch, in a Leno weave, for equipment and pipe.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Foster Products Corporation, H. B. Fuller Company; Mast-A-Fab.
 - b. Vimasco Corporation; Elastafab 894.

2.8 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Johns Manville; Zeston.
 - b. P.I.C. Plastics, Inc.; FG Series.
 - c. Proto PVC Corporation; LoSmoke.
 - d. Speedline Corporation; SmokeSafe.
 2. Adhesive: As recommended by jacket material manufacturer.
 3. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
 - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
 4. Factory-fabricated tank heads and tank side panels.
- C. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105 or 5005, Temper H-14.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; Metal Jacketing Systems.
 - b. PABCO Metals Corporation; Surefit.
 - c. RPR Products, Inc.; Insul-Mate.
 - d.
 2. Factory-Fabricated Fitting Covers:
 - a. Same material, finish, and thickness as jacket.
 - b. Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - c. Tee covers.
 - d. Flange and union covers.
 - e. End caps.
 - f. Beveled collars.
 - g. Valve covers.
 - h. Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
- D. Underground Direct-Buried Jacket: 125-mil- thick vapor barrier and waterproofing membrane consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Pittsburgh Corning Corporation; Pittwrap.
 - b. Polyguard; Insulrap No Torch 125.

2.9 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
 - b. Compac Corp.; 104 and 105.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
 - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
 2. Width: 3 inches.
 3. Thickness: 11.5 mils.
 4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch in width.
 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
 - b. Compac Corp.; 110 and 111.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
 - d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.
 2. Width: 3 inches.
 3. Thickness: 6.5 mils.
 4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch in width.
 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0555.
 - b. Compac Corp.; 130.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
 - d. Venture Tape; 1506 CW NS.
 2. Width: 2 inches.
 3. Thickness: 6 mils.
 4. Adhesion: 64 ounces force/inch in width.
 5. Elongation: 500 percent.
 6. Tensile Strength: 18 lbf/inch in width.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
 - b. Compac Corp.; 120.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
 - d. Venture Tape; 3520 CW.
 2. Width: 2 inches.
 3. Thickness: 3.7 mils.
 4. Adhesion: 100 ounces force/inch in width.

5. Elongation: 5 percent.
 6. Tensile Strength: 34 lbf/inch in width.
- E. PVDC Tape: White vapor-retarder PVDC tape with acrylic adhesive.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dow Chemical Company (The); Saran 540 Vapor Retarder Tape.
 2. Width: 3 inches.
 3. Film Thickness: 4 mils.
 4. Adhesive Thickness: 1.5 mils.
 5. Elongation at Break: 145 percent.
 6. Tensile Strength: 55 lbf/inch in width.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
1. Draw jacket tight and smooth.
 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above ambient services, do not install insulation to the following:
1. Vibration-control devices.
 2. Testing agency labels and stamps.
 3. Nameplates and data plates.
 4. Manholes.
 5. Handholes.
 6. Cleanouts.

3.3 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 - 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
 - 1. Comply with requirements in Division 7 Section "Through-Penetration Firestop Systems" for firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
 - 1. Pipe: Install insulation continuously through floor penetrations.
 - 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 7 Section "Through-Penetration Firestop Systems."

3.4 EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION

- A. Mineral Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.
 - 1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of tank and vessel surfaces.
 - 2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
 - 3. Protect exposed corners with secured corner angles.
 - 4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:
 - a. Do not weld anchor pins to ASME-labeled pressure vessels.
 - b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
 - c. On tanks and vessels, maximum anchor-pin spacing is 3 inches from insulation end joints, and 16 inches o.c. in both directions.
 - d. Do not overcompress insulation during installation.
 - e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
 - f. Impale insulation over anchor pins and attach speed washers.
 - g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 - 5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
 - 6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches from each end. Install wire or cable between two circumferential girdles 12 inches o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches o.c. Use this network for securing insulation with tie wire or bands.

7. Stagger joints between insulation layers at least 3 inches.
8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.

- B. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.
1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
 2. Seal longitudinal seams and end joints.

3.5 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.

- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
 - 1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
 - 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
 - 3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
 - 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
 - 5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 CELLULAR-GLASS INSULATION INSTALLATION

- A. Insulation Installation on Straight Pipes and Tubes:
 - 1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
 - 2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
 - 3. For insulation with factory-applied jackets on above ambient services, secure laps with outward clinched staples at 6 inches o.c.
 - 4. For insulation with factory-applied jackets on below ambient services, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
- B. Insulation Installation on Pipe Flanges:
 - 1. Install preformed pipe insulation to outer diameter of pipe flange.
 - 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 - 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
 - 4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.
- C. Insulation Installation on Pipe Fittings and Elbows:
 - 1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
 - 2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.
- D. Insulation Installation on Valves and Pipe Specialties:
 - 1. Install preformed sections of cellular-glass insulation to valve body.

2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.7 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
 1. Install pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
 4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
 1. Install mitered sections of pipe insulation.
 2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- D. Insulation Installation on Valves and Pipe Specialties:
 1. Install preformed valve covers manufactured of same material as pipe insulation when available.
 2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 3. Install insulation to flanges as specified for flange insulation application.
 4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.8 MINERAL-FIBER INSULATION INSTALLATION

- A. Insulation Installation on Straight Pipes and Tubes:
 1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
 2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
 3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
 4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
- B. Insulation Installation on Pipe Flanges:
 1. Install preformed pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
 4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

- C. Insulation Installation on Pipe Fittings and Elbows:
 - 1. Install preformed sections of same material as straight segments of pipe insulation when available.
 - 2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.
- D. Insulation Installation on Valves and Pipe Specialties:
 - 1. Install preformed sections of same material as straight segments of pipe insulation when available.
 - 2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
 - 3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 - 4. Install insulation to flanges as specified for flange insulation application.

3.9 POLYOLEFIN INSULATION INSTALLATION

- A. Insulation Installation on Straight Pipes and Tubes:
 - 1. Seal split-tube longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
 - 1. Install pipe insulation to outer diameter of pipe flange.
 - 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 - 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyolefin sheet insulation of same thickness as pipe insulation.
 - 4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
 - 1. Install mitered sections of polyolefin pipe insulation.
 - 2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- D. Insulation Installation on Valves and Pipe Specialties:
 - 1. Install cut sections of polyolefin pipe and sheet insulation to valve body.
 - 2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 - 3. Install insulation to flanges as specified for flange insulation application.
 - 4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.10 POLYSTYRENE INSULATION INSTALLATION

- A. Insulation Installation on Straight Pipes and Tubes:
 - 1. Secure each layer of insulation with tape or bands and tighten bands without deforming insulation materials. Orient longitudinal joints between half sections in 3 and 9 o'clock positions on the pipe.
 - 2. For insulation with factory-applied jackets with vapor barriers, do not staple longitudinal tabs but secure tabs with additional adhesive or tape as recommended by insulation material manufacturer and seal with vapor-barrier mastic.
 - 3. All insulation shall be tightly butted and free of voids and gaps at all joints. Vapor barrier must be continuous. Before installing jacket material, install vapor-barrier system.

- B. Insulation Installation on Pipe Flanges:
 1. Install preformed pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation section same as overall width of flange and bolts, same thickness of adjacent pipe insulation, not to exceed 1-1/2-inch thickness.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polystyrene block insulation of same thickness as pipe insulation.
- C. Insulation Installation on Pipe Fittings and Elbows:
 1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.
- D. Insulation Installation on Valves and Pipe Specialties:
 1. Install preformed section of polystyrene insulation to valve body.
 2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 3. Install insulation to flanges as specified for flange insulation application.

3.11 FIELD-APPLIED JACKET INSTALLATION

- A. Where FSK jackets are indicated, install as follows:
 1. Draw jacket material smooth and tight.
 2. Install lap or joint strips with same material as jacket.
 3. Secure jacket to insulation with manufacturer's recommended adhesive.
 4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
 5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- B. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
 1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- C. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.
- D. Where PVDC jackets are indicated, install as follows:
 1. Apply three separate wraps of filament tape per insulation section to secure pipe insulation to pipe prior to installation of PVDC jacket.
 2. Wrap factory-presize jackets around individual pipe insulation sections with one end overlapping the previously installed sheet. Install presize jacket with an approximate overlap at butt joint of 2 inches over the previous section. Adhere lap seal using adhesive or SSL, and then apply 1-1/4 circumferences of appropriate PVDC tape around overlapped butt joint.
 3. Continuous jacket can be spiral wrapped around a length of pipe insulation. Apply adhesive or PVDC tape at overlapped spiral edge. When electing to use adhesives, refer to manufacturer's written instructions for application of adhesives along this spiral edge to maintain a permanent bond.
 4. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches or less. The 33-1/2-inch- circumference limit allows for 2-inch-overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fishmouthing," and use PVDC tape along lap seal to secure joint.

5. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

3.12 FINISHES

- A. Equipment and Pipe Insulation with ASJ or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 9 painting Sections.
 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

3.13 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 1. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
 2. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, [three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

END OF SECTION 15082

SECTION 15086
HVAC INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Insulation Materials:
 - a. Mineral fiber.
2. Adhesives.
3. Mastics.
4. Sealants.
5. Factory-applied jackets.
6. Tapes.
7. Securements.
8. Corner angles.

B. Related Sections:

1. Division 15 Section "Metal Ducts" for duct liners.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings:

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail attachment and covering of heat tracing inside insulation.
3. Detail insulation application at pipe expansion joints for each type of insulation.
4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
5. Detail removable insulation at piping specialties, equipment connections, and access panels.
6. Detail application of field-applied jackets.
7. Detail application at linkages of control devices.
8. Detail field application for each equipment type.

C. Field quality-control reports.

1.3 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type II with factory-applied vinyl jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; Duct Wrap.
 - b. Johns Manville; Microlite.
 - c. Knauf Insulation; Duct Wrap.
 - d. Manson Insulation Inc.; Alley Wrap.
 - e. Owens Corning; All-Service Duct Wrap.

2.2 MASTICS

A. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-35.
 - b. Foster Products Corporation, H. B. Fuller Company; 30-90.
 - c. ITW TACC, Division of Illinois Tool Works; CB-50.
 - d. Marathon Industries, Inc.; 590.
 - e. Mon-Eco Industries, Inc.; 55-40.
 - f. Vimasco Corporation; 749.
2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
5. Color: White.

B. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-10.
 - b. Foster Products Corporation, H. B. Fuller Company; 35-00.
 - c. ITW TACC, Division of Illinois Tool Works; CB-05/15.
 - d. Marathon Industries, Inc.; 550.
 - e. Mon-Eco Industries, Inc.; 55-50.
 - f. Vimasco Corporation; WC-1/WC-5.
2. Water-Vapor Permeance: ASTM F 1249, 3 perms at 0.0625-inch dry film thickness.
3. Service Temperature Range: Minus 20 to plus 200 deg F.
4. Solids Content: 63 percent by volume and 73 percent by weight.
5. Color: White.

2.3 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-76-8.
 - b. Foster Products Corporation, H. B. Fuller Company; 95-44.
 - c. Marathon Industries, Inc.; 405.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Vimasco Corporation; 750.
2. Materials shall be compatible with insulation materials, jackets, and substrates.

3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.

2.4 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.5 TAPES

- A. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
 - b. Compac Corp.; 110 and 111.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
 - d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.
2. Width: 3 inches.
3. Thickness: 6.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

- B. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
 - b. Compac Corp.; 120.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
 - d. Venture Tape; 3520 CW.
2. Width: 2 inches.
3. Thickness: 3.7 mils.
4. Adhesion: 100 ounces force/inch in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

2.6 SECUREMENTS

- A. Aluminum Bands: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch or 3/4 inch wide with wing or closed seal.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products; Bands.
 - b. PABCO Metals Corporation; Bands.
 - c. RPR Products, Inc.; Bands.
- B. Insulation Pins and Hangers:
1. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series T.
 - 2) GEMCO; Perforated Base.
 - 3) Midwest Fasteners, Inc.; Spindle.
 - b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. Spindle: Copper- or zinc-coated, low carbon steel or Aluminum, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
 2. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) GEMCO; Nylon Hangers.
 - 2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.
 - b. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
 - c. Spindle: Nylon, 0.106-inch- diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.

- d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
3. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
- a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series TSA.
 - 2) GEMCO; Press and Peel.
 - 3) Midwest Fasteners, Inc.; Self Stick.
 - b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. Spindle: Copper- or zinc-coated, low carbon steel or Aluminum, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive-backed base with a peel-off protective cover.
4. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick, galvanized-steel or aluminum sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
- a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; RC-150.
 - 2) GEMCO; R-150.
 - 3) Midwest Fasteners, Inc.; WA-150.
 - 4) Nelson Stud Welding; Speed Clips.
 - b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
5. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
- a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) GEMCO.
 - 2) Midwest Fasteners, Inc.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.
- D. Wire: 0.080-inch nickel-copper alloy or 0.062-inch soft-annealed, galvanized steel.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. C & F Wire.
- b. Childers Products.
- c. PABCO Metals Corporation.
- d. RPR Products, Inc.

2.7 CORNER ANGLES

- A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.
- B. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105 or 5005; Temper H-14.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.
- B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.

- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at [2 inches] [4 inches] o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
 - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above ambient services, do not install insulation to the following:
 - 1. Vibration-control devices.
 - 2. Testing agency labels and stamps.
 - 3. Nameplates and data plates.
 - 4. Manholes.
 - 5. Handholes.
 - 6. Cleanouts.

3.3 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 - 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- C. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
 - 1. Comply with requirements in Division 7 Section "Through-Penetration Firestop Systems" for firestopping and fire-resistive joint sealers.

3.4 MINERAL-FIBER INSULATION INSTALLATION

- A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
 - 1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for [100] [50] percent coverage of duct and plenum surfaces.
 - 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.

3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 - e. Impale insulation over pins and attach speed washers.
 - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.
5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.5 FIRE-RATED INSULATION SYSTEM INSTALLATION

- A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.
- B. Insulate duct access panels and doors to achieve same fire rating as duct.

- C. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Division 7 Section "Through-Penetration Firestop Systems."

3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.7 DUCT INSULATION SCHEDULE, GENERAL

- A. Plenums and Ducts Requiring Insulation:
 - 1. Indoor, concealed supply and outdoor air.
 - 2. Indoor, exposed supply and outdoor air.
 - 3. Indoor, concealed return located in nonconditioned space.
 - 4. Indoor, exposed return located in nonconditioned space.
 - 5. Outdoor, concealed supply and return.
 - 6. Outdoor, exposed supply and return.
- B. Items Not Insulated:
 - 1. Supply and return duct located in conditioned space.
 - 2. Factory-insulated flexible ducts.
 - 3. Factory-insulated plenums and casings.
 - 4. Flexible connectors.
 - 5. Vibration-control devices.
 - 6. Factory-insulated access panels and doors.

3.8 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Concealed, Supply-Air Duct and Plenum Insulation: Mineral-fiber blanket, 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.
- B. Concealed, Return-Air Duct and Plenum Insulation: Mineral-fiber blanket, 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.
- C. Concealed, Outdoor-Air Duct and Plenum Insulation: Mineral-fiber blanket, 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.

END OF SECTION 15086

SECTION 15123

EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Metal-bellows expansion joints.
 - 2. Pipe bends and loops.
 - 3. Alignment guides and anchors.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Delegated-Design Submittal: For each anchor and alignment guide indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and bends.
 - 2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
 - 3. Alignment Guide Details: Detail field assembly and attachment to building structure.
 - 4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.
- C. Welding certificates.
- D. Product certificates.
- E. Maintenance data.

1.3 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. Steel Shapes and Plates: AWS D1.1, "Structural Welding Code - Steel."
 - 2. Welding to Piping: ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.1 EXPANSION JOINTS

- A. Metal-Bellows Expansion Joints: ASTM F 1120, circular-corrugated-bellows type with external tie rods.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Adscio Manufacturing, LLC.
 - b. Anamet, Inc.
 - c. Badger Industries.
 - d. Expansion Joint Systems, Inc.

- e. Flex-Hose Co., Inc.
- f. Flexicraft Industries.
- g. Flex-Pression, Ltd.
- h. Flex-Weld, Inc.
- i. Hyspan Precision Products, Inc.
- j. Metraflex, Inc.
- k. Piping Technology & Products, Inc.
- l. Proco Products, Inc.
- m. Senior Flexonics, Inc.; Pathway Division.
- n. Tozen America Corp.
- o. Unaflex Inc.
- p. WahleoMetroflex.

2.2 ALIGNMENT GUIDES

- A. Description: Steel, factory fabricated, with bolted two-section outer cylinder and base for alignment of piping and two-section guiding spider for bolting to pipe.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Adscio Manufacturing, LLC.
 - b. Advanced Thermal Systems, Inc.
 - c. Flex-Hose Co., Inc.
 - d. Flexicraft Industries.
 - e. Flex-Weld, Inc.
 - f. Hyspan Precision Products, Inc.
 - g. Metraflex, Inc.
 - h. Piping Technology & Products, Inc.
 - i. Senior Flexonics, Inc.; Pathway Division.

2.3 MATERIALS FOR ANCHORS

- A. Steel Shapes and Plates: ASTM A 36/A 36M.
- B. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel, hex head.
- C. Washers: ASTM F 844, steel, plain, flat washers.
- D. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, and tension and shear capacities appropriate for application.
 - 1. Stud: Threaded, zinc-coated carbon steel.
 - 2. Expansion Plug: Zinc-coated steel.
 - 3. Washer and Nut: Zinc-coated steel.
- E. Concrete: Portland cement mix, 3000 psi minimum. Comply with requirements in Division 3 Section "Cast-in-Place Concrete" for formwork, reinforcement, and concrete.
- F. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink, nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 EXPANSION-JOINT INSTALLATION

- A. Install manufactured, nonmetallic expansion joints according to FSA's "Technical Handbook: Non-Metallic Expansion Joints and Flexible Pipe Connectors."
- B. Install expansion joints of sizes matching size of piping in which they are installed.
- C. Install alignment guides to allow expansion and to avoid end-loading and torsional stress.

3.2 PIPE BEND AND LOOP INSTALLATION

- A. Install pipe bends and loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature.
- B. Attach pipe bends and loops to anchors.
 - 1. Steel Anchors: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 2. Concrete Anchors: Attach by fasteners. Follow fastener manufacturer's written instructions.

3.3 SWING CONNECTIONS

- A. Connect risers and branch connections to mains with at least five pipe fittings, including tee in main.
- B. Connect risers and branch connections to terminal units with at least four pipe fittings, including tee in riser.
- C. Connect mains and branch connections to terminal units with at least four pipe fittings, including tee in main.

3.4 ALIGNMENT-GUIDE INSTALLATION

- A. Install guides on piping adjoining pipe expansion fittings and loops.
- B. Attach guides to pipe and secure to building structure.

3.5 ANCHOR INSTALLATION

- A. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.
- B. Fabricate and install steel anchors by welding steel shapes, plates, and bars to piping and to structure. Comply with ASME B31.9 and AWS D1.1.
- C. Construct concrete anchors of poured-in-place concrete of dimensions indicated and include embedded fasteners.
- D. Install pipe anchors according to expansion-joint manufacturer's written instructions if expansion joints are indicated.
- E. Use grout to form flat bearing surfaces for expansion fittings, guides, and anchors installed on or in concrete.

END OF SECTION 15123

SECTION 15126

METERS AND GAGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Thermometers.
 - 2. Gages.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 METAL-CASE, LIQUID-IN-GLASS THERMOMETERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Palmer - Wahl Instruments Inc.
 - 2. Terrice, H. O. Co.
 - 3. Weiss Instruments, Inc.
 - 4. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.

2.2 BIMETALLIC-ACTUATED DIAL THERMOMETERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
 - 2. Ernst Gage Co.
 - 3. Eugene Ernst Products Co.
 - 4. Marsh Bellofram.
 - 5. Miljoco Corp.
 - 6. NANMAC Corporation.
 - 7. Noshok, Inc.
 - 8. Palmer - Wahl Instruments Inc.
 - 9. REO TEMP Instrument Corporation.
 - 10. Tel-Tru Manufacturing Company.
 - 11. Terrice, H. O. Co.
 - 12. Weiss Instruments, Inc.
 - 13. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
 - 14. WIKA Instrument Corporation.
 - 15. Winters Instruments.

2.3 THERMOWELLS

- A. Manufacturers: Same as manufacturer of thermometer being used.
- B. Description: Pressure-tight, socket-type metal fitting made for insertion into piping and of type, diameter, and length required to hold thermometer.

2.4 PRESSURE GAGES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. AMETEK, Inc.; U.S. Gauge Div.
 - 2. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
 - 3. Ernst Gage Co.
 - 4. Eugene Ernst Products Co.
 - 5. KOBOLD Instruments, Inc.
 - 6. Marsh Bellofram.
 - 7. Miljoco Corp.
 - 8. Noshok, Inc.
 - 9. Palmer - Wahl Instruments Inc.
 - 10. REO TEMP Instrument Corporation.
 - 11. Trerice, H. O. Co.
 - 12. Weiss Instruments, Inc.
 - 13. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
 - 14. WIKA Instrument Corporation.
 - 15. Winters Instruments.
- B. Pressure-Gage Fittings:
 - 1. Valves: NPS 1/4 brass or stainless-steel needle type.
 - 2. Snubbers: ASME B40.5, NPS 1/4 brass bushing with corrosion-resistant, porous-metal disc of material suitable for system fluid and working pressure.

PART 3 - EXECUTION

3.1 THERMOMETER APPLICATIONS

- A. Install thermometers in the outlet of each domestic, hot-water storage tank.
- B. Install bimetallic-actuated dial thermometers at suction and discharge of each pump.
- C. Provide the following temperature ranges for thermometers:
 - 1. Domestic Hot Water: 30 to 180 deg F, with 2-degree scale divisions.
 - 2. Domestic Cold Water: 0 to 100 deg F, with 2-degree scale divisions.

3.2 GAGE APPLICATIONS

- A. Install dry-case-type pressure gages for discharge of each pressure-reducing valve.
- B. Install pressure gages at suction and discharge of each pump.

3.3 INSTALLATIONS

- A. Install direct-mounting thermometers and adjust vertical and tilted positions.
- B. Install thermowells with socket extending to center of pipe and in vertical position in piping tees where thermometers are indicated.
- C. Install direct-mounting pressure gages in piping tees with pressure gage located on pipe at most readable position.
- D. Install needle-valve and snubber fitting in piping for each pressure gage.
- E. Install thermometers and gages adjacent to machines and equipment to allow service and maintenance for thermometers, gages, machines, and equipment.
- F. Adjust faces of thermometers and gages to proper angle for best visibility.

END OF SECTION 15126

SECTION 15140

DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Under-building slab and aboveground domestic water pipes, tubes, fittings, and specialties inside the building.
 - 2. Specialty valves.
 - 3. Flexible connectors.
 - 4. Escutcheons.
 - 5. Sleeves and sleeve seals.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control reports.

1.3 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14 for plastic, potable domestic water piping and components. Include marking "NSF-pw" on piping.
- C. Comply with NSF 61 for potable domestic water piping and components.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.
 - 1. Cast-Copper Solder-Joint Fittings: ASME B16.18, pressure fittings.
 - 2. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
 - 3. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
 - 4. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
- B. Soft Copper Tube: ASTM B 88, Type K water tube, annealed temper.
 - 1. Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

2.3 GALVANIZED-STEEL PIPE AND FITTINGS

- A. Galvanized-Steel Pipe: ASTM A 53/A 53M, Type E, Grade B, Standard Weight. Include ends matching joining method.
 - 1. Galvanized-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106/A 106M, Standard Weight, seamless steel pipe with threaded ends.
 - 2. Galvanized, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.
 - 3. Malleable-Iron Unions: ASME B16.39, Class 150, hexagonal-stock body with ball-and-socket, metal-to-metal, bronze seating surface, and female threaded ends.
 - 4. Flanges: ASME B16.1, Class 125, cast iron.

2.4 CPVC PIPING

- A. CPVC Tubing System: ASTM D 2846/D 2846M, SDR 11, tube and socket fittings.

2.5 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free, unless otherwise indicated; full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.
- E. Solvent Cements for Joining CPVC Piping and Tubing: ASTM F 493.
- F. Plastic, Pipe-Flange Gaskets, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.6 SPECIALTY VALVES

- A. CPVC Union Ball Valves:
 - 1. Description:
 - a. Standard: MSS SP-122.
 - b. Pressure Rating: 125 psig at 73 deg F.
 - c. Body Material: CPVC.
 - d. Body Design: Union type.
 - e. End Connections for Valves NPS 2 and Smaller: Detachable, socket.
 - f. End Connections for Valves NPS 2-1/2 to NPS 4: Detachable, socket.
 - g. Ball: CPVC; full port.
 - h. Seals: PTFE or EPDM-rubber O-rings.
 - i. Handle: Tee shaped.
- B. CPVC Ball Check Valves:
 - 1. Description:
 - a. Pressure Rating: 125 psig at 73 deg F.
 - b. Body Material: CPVC.
 - c. Body Design: Union-type ball check.
 - d. End Connections for Valves NPS 2 and Smaller: Detachable, socket.
 - e. End Connections for Valves NPS 2-1/2 to NPS 4: Detachable, socket.
 - f. Ball: CPVC.
 - g. Seals: EPDM- or FKM-rubber O-rings.

- C. CPVC Gate Valves:
 - 1. Description:
 - a. Pressure Rating: 125 psig at 73 deg F.
 - b. Body Material: CPVC.
 - c. Body Design: Nonrising stem.
 - d. End Connections for Valves NPS 2 and Smaller: Socket.
 - e. End Connections for Valves NPS 2-1/2 to NPS 4: Socket.
 - f. Gate and Stem: Plastic.
 - g. Seals: EPDM rubber.
 - h. Handle: Wheel.

2.7 TRANSITION FITTINGS

- A. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
- B. Sleeve-Type Transition Coupling: AWWA C219.
- C. Plastic-to-Metal Transition Fittings:
 - 1. Description: CPVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert and one solvent-cement-socket end.
- D. Plastic-to-Metal Transition Unions:
 - 1. Description: CPVC four-part union. Include brass or stainless-steel threaded end, solvent-cement-joint plastic end, rubber O-ring, and union nut.

2.8 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.
- B. Dielectric Unions:
 - 1. Description:
 - a. Pressure Rating: 150 psig at 180 deg F.
 - b. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric Flanges:
 - 1. Description:
 - a. Factory-fabricated, bolted, companion-flange assembly.
 - b. Pressure Rating: 150 psig.
 - c. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- D. Dielectric-Flange Kits:
 - 1. Description:
 - a. Nonconducting materials for field assembly of companion flanges.
 - b. Pressure Rating: 150 psig.
 - c. Gasket: Neoprene or phenolic.
 - d. Bolt Sleeves: Phenolic or polyethylene.
 - e. Washers: Phenolic with steel backing washers.
- E. Dielectric Couplings:
 - 1. Description:
 - a. Galvanized-steel coupling.
 - b. Pressure Rating: 300 psig at 225 deg F.
 - c. End Connections: Female threaded.
 - d. Lining: Inert and noncorrosive, thermoplastic.
- F. Dielectric Nipples:

1. Description:
 - a. Electroplated steel nipple complying with ASTM F 1545.
 - b. Pressure Rating: 300 psig at 225 deg F.
 - c. End Connections: Male threaded or grooved.
 - d. Lining: Inert and noncorrosive, propylene.

2.9 FLEXIBLE CONNECTORS

- A. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
 1. Working-Pressure Rating: Minimum 200 psig.
 2. End Connections NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.
 3. End Connections NPS 2-1/2 and Larger: Flanged copper alloy.
- B. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.
 1. Working-Pressure Rating: Minimum 200 psig.
 2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.
 3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

2.10 ESCUTCHEONS

- A. General: Manufactured ceiling, floor, and wall escutcheons and floor plates.
- B. One Piece, Cast Brass: Polished, chrome-plated finish with setscrews.
- C. One Piece, Deep Pattern: Deep-drawn, box-shaped brass with chrome-plated finish.
- D. One Piece, Stamped Steel: Chrome-plated finish with setscrew.
- E. Split Casting, Cast Brass: Polished, chrome-plated finish with concealed hinge and setscrew.
- F. Split Plate, Stamped Steel: Chrome-plated finish with concealed hinge, setscrew.
- G. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.
- H. Split-Casting Floor Plates: Cast brass with concealed hinge.

2.11 SLEEVES

- A. Cast-Iron Wall Pipes: Fabricated of cast iron, and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- C. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
- D. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc-coated, with plain ends.
- E. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 1. Underdeck Clamp: Clamping ring with setscrews.

2.12 SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, used to fill annular space between pipe and sleeve.
 - 1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

2.13 GROUT

- A. Standard: ASTM C 1107, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."
- C. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance. Comply with requirements in Division 15 Section "Meters and Gages for Plumbing Piping" for pressure gages and Division 15 Section "Domestic Water Piping Specialties" for drain valves and strainers.
- D. Install shutoff valve immediately upstream of each dielectric fitting.
- E. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements in Division 15 Section "Domestic Water Piping Specialties" for pressure-reducing valves.
- F. Install domestic water piping level without pitch and plumb.
- G. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- H. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- I. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- J. Install piping adjacent to equipment and specialties to allow service and maintenance.
- K. Install piping to permit valve servicing.
- L. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.

- M. Install piping free of sags and bends.
- N. Install fittings for changes in direction and branch connections.
- O. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- P. Install pressure gages on suction and discharge piping from each plumbing pump and packaged booster pump.
- Q. Install thermostats in hot-water circulation piping.
- R. Install thermometers on outlet piping from each water heater.

3.2 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 1. Apply appropriate tape or thread compound to external pipe threads.
 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Braze Joints" Chapter.
- E. Soldered Joints: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- F. Pressure-Sealed Joints: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.
- G. Copper-Tubing, Push-on Joints: Clean end of tube. Measure insertion depth with manufacturer's depth gage. Join copper tube and push-on-joint fittings by inserting tube to measured depth.
- H. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.
 2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
- J. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.3 VALVE INSTALLATION

- A. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball or gate valves for piping NPS 2 and smaller. Use butterfly or gate valves for piping NPS 2-1/2 and larger.
- B. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping. Drain valves are specified in Division 15 Section "Domestic Water Piping Specialties."
 1. Hose-End Drain Valves: At low points in water mains, risers, and branches.
 2. Stop-and-Waste Drain Valves: Instead of hose-end drain valves where indicated.

- C. Install balancing valve in each hot-water circulation return branch and discharge side of each pump and circulator. Set balancing valves partly open to restrict but not stop flow. Use ball valves for piping NPS 2 and smaller and butterfly valves for piping NPS 2-1/2 and larger. Comply with requirements in Division 15 Section "Domestic Water Piping Specialties" for balancing valves.

3.4 TRANSITION FITTING INSTALLATION

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Underground Domestic Water Piping:
 - 1. NPS 1-1/2 and Smaller: Fitting-type coupling.
 - 2. NPS 2 and Larger: Sleeve-type coupling.
- C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition fittings.

3.5 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

3.6 FLEXIBLE CONNECTOR INSTALLATION

- A. Install flexible connectors in suction and discharge piping connections to each domestic water pump.
- B. Install bronze-hose flexible connectors in copper domestic water tubing.
- C. Install stainless-steel-hose flexible connectors in steel domestic water piping.

3.7 HANGER AND SUPPORT INSTALLATION

- A. Support vertical piping and tubing at base and at each floor.
- B. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.
- C. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
 - 2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
 - 3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
 - 4. NPS 2-1/2: 108 inches with 1/2-inch rod.
 - 5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
 - 6. NPS 6: 10 feet with 5/8-inch rod.
- D. Install supports for vertical steel piping every 15 feet.
- E. Install vinyl-coated hangers for CPVC piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1 and Smaller: 36 inches with 3/8-inch rod.
 - 2. NPS 1-1/4 to NPS 2: 48 inches with 3/8-inch rod.
- F. Install supports for vertical CPVC piping every 60 inches for NPS 1 and smaller, and every 72 inches for NPS 1-1/4 and larger.
- G. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.8 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment and machines to allow service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
 - 1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
 - 2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
 - 3. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Comply with requirements in Division 15 plumbing fixture Sections for connection sizes.
 - 4. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.9 ESCUTCHEON INSTALLATION

- A. Install escutcheons for penetrations of walls, ceilings, and floors.

3.10 SLEEVE INSTALLATION

- A. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls.
- B. Sleeves are not required for core-drilled holes.
- C. Permanent sleeves are not required for holes formed by removable PE sleeves.
- D. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.
- E. Install sleeves in new partitions, slabs, and walls as they are built.
- F. For interior wall penetrations, seal annular space between sleeve and pipe or pipe insulation using joint sealants appropriate for size, depth, and location of joint. Comply with requirements in Division 7 Section "Joint Sealants" for joint sealants.
- G. For exterior wall penetrations above grade, seal annular space between sleeve and pipe using joint sealants appropriate for size, depth, and location of joint. Comply with requirements in Division 7 Section "Joint Sealants" for joint sealants.
- H. For exterior wall penetrations below grade, seal annular space between sleeve and pipe using sleeve seals specified in this Section.
- I. Seal space outside of sleeves in concrete slabs and walls with grout.
- J. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation unless otherwise indicated.
- K. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements in Division 7 Section "Through-Penetration Firestop Systems" for firestop materials and installations.

3.11 SLEEVE SEAL INSTALLATION

- A. Install sleeve seals in sleeves in exterior concrete walls at water-service piping entries into building.
- B. Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble sleeve seal components and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.12 IDENTIFICATION

- A. Identify system components. Comply with requirements in Division 15 Section "Identification for Plumbing Piping and Equipment" for identification materials and installation.
- B. Label pressure piping with system operating pressure.

3.13 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Piping Inspections:
 - 1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
 - 2. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
 - 3. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
 - 4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- C. Piping Tests:
 - 1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
 - 2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
 - 3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - 4. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 - 5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
 - 6. Prepare reports for tests and for corrective action required.
- D. Domestic water piping will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.14 CLEANING

- A. Clean and disinfect potable domestic water piping as follows:
 - 1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.

2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system according to either of the following:
 - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
 - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
 - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- B. Prepare and submit reports of purging and disinfecting activities.
- C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.
 1. Galvanized-steel pipe and nipples; galvanized, gray-iron threaded fittings; and threaded joints.

END OF SECTION 15140

SECTION 15145

DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following domestic water piping specialties:
 - 1. Vacuum breakers.
 - 2. Backflow preventers.
 - 3. Water pressure-reducing valves.
 - 4. Balancing valves.
 - 5. Temperature-actuated water mixing valves.
 - 6. Strainers.
 - 7. Hose bibbs.
 - 8. Wall hydrants.
 - 9. Drain valves.
 - 10. Water hammer arresters.
 - 11. Trap-seal primer valves.

1.2 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control test reports.
- C. Operation and maintenance data.

1.4 QUALITY ASSURANCE

- A. NSF Compliance:
 - 1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components.
 - 2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

PART 2 - PRODUCTS

2.1 VACUUM BREAKERS

- A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Ames Co.
 - b. Cash Acme.

- c. Conbraco Industries, Inc.
 - d. FEBCO; SPX Valves & Controls.
 - e. Rain Bird Corporation.
 - f. Toro Company (The); Irrigation Div.
 - g. Watts Industries, Inc.; Water Products Div.
 - h. Zurn Plumbing Products Group; Wilkins Div.
- 2. Standard: ASSE 1001.
 - 3. Size: NPS 1/4 to NPS 3, as required to match connected piping.
 - 4. Body: Bronze.
 - 5. Inlet and Outlet Connections: Threaded.

B. Hose-Connection Vacuum Breakers:

- 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Arrowhead Brass Products, Inc.
 - b. Cash Acme.
 - c. Conbraco Industries, Inc.
 - d. Legend Valve.
 - e. MIFAB, Inc.
 - f. Prier Products, Inc.
 - g. Watts Industries, Inc.; Water Products Div.
 - h. Woodford Manufacturing Company.
 - i. Zurn Plumbing Products Group; Light Commercial Operation.
 - j. Zurn Plumbing Products Group; Wilkins Div.
- 2. Standard: ASSE 1001.
- 3. Body: Bronze, nonremovable, with manual drain.
- 4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.

2.2 BACKFLOW PREVENTERS

A. Intermediate Atmospheric-Vent Backflow Preventers:

- 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cash Acme.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; SPX Valves & Controls.
 - d. Honeywell Water Controls.
 - e. Legend Valve.
 - f. Watts Industries, Inc.; Water Products Div.
 - g. Zurn Plumbing Products Group; Wilkins Div.
- 3. Standard: ASSE 1012.
- 4. Operation: Continuous-pressure applications.
- 5. Body: Bronze.

B. Reduced-Pressure-Principle Backflow Preventers:

- 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Ames Co.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; SPX Valves & Controls.
 - d. Flomatic Corporation.
 - e. Watts Industries, Inc.; Water Products Div.
 - f. Zurn Plumbing Products Group; Wilkins Div.
- 2. Standard: ASSE 1013.
- 3. Operation: Continuous-pressure applications.

C. Double-Check Backflow-Prevention Assemblies:

- 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Ames Co.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; SPX Valves & Controls.
 - d. Flomatic Corporation.
 - e. Watts Industries, Inc.; Water Products Div.
 - f. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1015.
 3. Operation: Continuous-pressure applications, unless otherwise indicated.

D. Backflow-Preventer Test Kits :

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Conbraco Industries, Inc.
 - b. FEBCO; SPX Valves & Controls.
 - c. Flomatic Corporation.
 - d. Watts Industries, Inc.; Water Products Div.
 - e. Zurn Plumbing Products Group; Wilkins Div.
2. Description: Factory calibrated, with gages, fittings, hoses, and carrying case with test-procedure instructions.

2.3 WATER PRESSURE-REDUCING VALVES

A. Water Regulators:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cash Acme.
 - b. Conbraco Industries, Inc.
 - c. Honeywell Water Controls.
 - d. Watts Industries, Inc.; Water Products Div.
 - e. Zurn Plumbing Products Group; Wilkins Div.
3. Standard: ASSE 1003.
4. Pressure Rating: Initial working pressure of 150 psig.

2.4 BALANCING VALVES

A. Memory-Stop Balancing Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Conbraco Industries, Inc.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Div.
 - e. Hammond Valve.
 - f. Milwaukee Valve Company.
 - g. NIBCO INC.
 - h. Red-White Valve Corp.
2. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
3. Pressure Rating: 400-psig minimum CWP.
4. Size: NPS 2 or smaller.
5. Body: Copper alloy.
6. Port: Standard or full port.
7. Ball: Chrome-plated brass.
8. Seats and Seals: Replaceable.
9. End Connections: Solder joint or threaded.
10. Handle: Vinyl-covered steel with memory-setting device.

2.5 TEMPERATURE-ACTUATED WATER MIXING VALVES

- A. Water-Temperature Limiting Devices:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Armstrong International, Inc.
 - b. Cash Acme.
 - c. Conbraco Industries, Inc.
 - d. Honeywell Water Controls.
 - e. Legend Valve.
 - f. Leonard Valve Company.
 - g. Powers; a Watts Industries Co.
 - h. Symmons Industries, Inc.
 - i. Taco, Inc.
 - j. Watts Industries, Inc.; Water Products Div.
 - k. Zurn Plumbing Products Group; Wilkins Div.
 2. Standard: ASSE 1017.
 3. Pressure Rating: 125 psig.
 4. Type: Thermostatically controlled water mixing valve.
 5. Material: Bronze body with corrosion-resistant interior components.
- B. Primary, Thermostatic, Water Mixing Valves:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Armstrong International, Inc.
 - b. Lawler Manufacturing Company, Inc.
 - c. Leonard Valve Company.
 - d. Powers; a Watts Industries Co.
 - e. Symmons Industries, Inc.
 2. Standard: ASSE 1017.
 3. Pressure Rating: 125 psig.

2.6 HOSE BIBBS

- A. Hose Bibbs:
1. Standard: ASME A112.18.1 for sediment faucets.
 2. Body Material: Bronze.
 3. Seat: Bronze, replaceable.
 4. Supply Connections: NPS 3/4 threaded or solder-joint inlet.
 5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
 6. Pressure Rating: 125 psig.
 7. Vacuum Breaker: Integral or field-installation, nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.

2.7 WALL HYDRANTS

- A. Moderate-Climate Wall Hydrants:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company.
 - b. MIFAB, Inc.
 - c. Prier Products, Inc.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - e. Tyler Pipe; Wade Div.
 - f. Watts Drainage Products Inc.
 - g. Woodford Manufacturing Company.
 - h. Zurn Plumbing Products Group; Light Commercial Operation.
 - i. Zurn Plumbing Products Group; Specification Drainage Operation.

3. Pressure Rating: 125 psig.
4. Operation: Loose key.
5. Inlet: NPS 3/4.
6. Outlet: Concealed, with integral vacuum breaker or nonremovable hose-connection vacuum breaker complying with ASSE 1011; and garden-hose thread complying with ASME B1.20.7.
7. Box: Deep, flush mounting with cover.
8. Box and Cover Finish: Polished nickel bronze.
- 9.

2.8 DRAIN VALVES

- A. Ball-Valve-Type, Hose-End Drain Valves:
1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
 2. Pressure Rating: 400-psig minimum CWP.
 3. Size: NPS 3/4.
 4. Body: Copper alloy.
 5. Ball: Chrome-plated brass.
 6. Seats and Seals: Replaceable.
 7. Handle: Vinyl-covered steel.
 8. Inlet: Threaded or solder joint.
 9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.9 WATER HAMMER ARRESTERS

- A. Water Hammer Arresters:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. AMTROL, Inc.
 - b. Josam Company.
 - c. MIFAB, Inc.
 - d. PPP Inc.
 - e. Sioux Chief Manufacturing Company, Inc.
 - f. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - g. Tyler Pipe; Wade Div.
 - h. Watts Drainage Products Inc.
 - i. Zurn Plumbing Products Group; Specification Drainage Operation.
 2. Standard: ASSE 1010 or PDI-WH 201.
 3. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

2.10 TRAP-SEAL PRIMER VALVES

- A. Supply-Type, Trap-Seal Primer Valves:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. MIFAB, Inc.
 - b. PPP Inc.
 - c. Sioux Chief Manufacturing Company, Inc.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - e. Watts Industries, Inc.; Water Products Div.
 2. Standard: ASSE 1018.
 3. Pressure Rating: 125 psig minimum.
 4. Body: Bronze.
 5. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
 6. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
 7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for piping joining materials, joint construction, and basic installation requirements.
- B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
 - 1. Locate backflow preventers in same room as connected equipment or system.
 - 2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
 - 3. Do not install bypass piping around backflow preventers.
- C. Install water regulators with inlet and outlet shutoff valves. Install pressure gages on inlet and outlet.
- D. Install balancing valves in locations where they can easily be adjusted.
- E. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
 - 1. Install thermometers and water regulators if specified.
 - 2. Install cabinet-type units recessed in or surface mounted on wall as specified.
- F. Install water hammer arresters in water piping according to PDI-WH 201.
- G. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.
- H. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping and specialties.
- I. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
 - 1. Intermediate atmospheric-vent backflow preventers.
 - 2. Reduced-pressure-principle backflow preventers.
 - 3. Double-check backflow-prevention assemblies.
 - 4. Water pressure-reducing valves.
 - 5. Primary, thermostatic, water mixing valves.
 - 6. Supply-type, trap-seal primer valves.
- J. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 15 Section "Mechanical Identification."

3.2 FIELD QUALITY CONTROL

- A. Perform the following tests and prepare test reports:
 - 1. Test each reduced-pressure-principle backflow preventer and double-check backflow-prevention assembly according to authorities having jurisdiction and the device's reference standard.
- B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.3 ADJUSTING

- A. Set field-adjustable pressure set points of water pressure-reducing valves.
- B. Set field-adjustable flow of balancing valves.
- C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION 15145

SECTION 15150

SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following soil and waste, sanitary drainage and vent piping inside the building:
 - 1. Pipe, tube, and fittings.
 - 2. Special pipe fittings.

1.2 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:
 - 1. Soil, Waste, and Vent Piping: 10-foot head of water.

1.3 SUBMITTALS

- A. Field quality-control inspection and test reports.

1.4 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; and "NSF-drain" for plastic drain piping.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Hub-and-Spigot, Cast-Iron Pipe and Fittings: ASTM A 74, Service class.
 - 1. Gaskets: ASTM C 564, rubber.
- B. Hubless Cast-Iron Pipe and Fittings: ASTM A 888 or CISPI 301.
 - 1. Solvent Stack Fittings: ASME B16.45 or ASSE 1043, hubless, cast-iron aerator and deaerator drainage fittings.
 - 2. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.
 - a. Standard, Shielded, Stainless-Steel Couplings: CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.
 - b. Heavy-Duty, Shielded, Stainless-Steel Couplings: With stainless-steel shield, stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve.
- C. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.
 - 1. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought-copper, solder-joint fittings.

- D. Solid-Wall PVC Pipe: ASTM D 2665, solid-wall drain, waste, and vent.
 - 1. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Special pipe fittings with pressure ratings at least equal to piping pressure ratings may be used in applications below, unless otherwise indicated.
- B. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.
- C. Aboveground, soil, waste, and vent piping shall be any of the following:
 - 1. Service class, hub-and-spigot, cast-iron soil pipe and fittings; gaskets; and compression joints.
 - 2. Hubless cast-iron soil pipe and fittings and solvent stack fittings; heavy-duty shielded, stainless-steel couplings; and hubless-coupling joints.
 - 3. Copper DWV tube, copper drainage fittings, and soldered joints.
 - 4. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
- D. Underground, soil, waste, and vent piping shall be **any of** the following:
 - 1. Service class, hub-and-spigot, cast-iron soil pipe and fittings; gaskets; and compression joints.
 - 2. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel couplings; and hubless-coupling joints.
 - 3. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

3.2 PIPING INSTALLATION

- A. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.
- B. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 15 Section "Basic Mechanical Materials and Methods."
- C. Install wall penetration system at each service pipe penetration through foundation wall. Make installation watertight. Wall penetration systems are specified in Division 15 Section "Basic Mechanical Materials and Methods."
- D. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
- E. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- F. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- G. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
 - 1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
 - 2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.

3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

- H. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
- I. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.
- J. Install underground PVC soil and waste drainage piping according to ASTM D 2321.
- K. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.3 JOINT CONSTRUCTION

- A. Cast-Iron, Soil-Piping Joints: Make joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
 - 1. Gasketed Joints: Make with rubber gasket matching class of pipe and fittings.
 - 2. Hubless Joints: Make with rubber gasket and sleeve or clamp.
- B. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.
- C. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

3.4 VALVE INSTALLATION

- A. Shutoff Valves: Install shutoff valve on each sewage pump discharge.
 - 1. Use gate or full-port ball valve for piping NPS 2 and smaller.
 - 2. Use gate valve for piping NPS 2-1/2 and larger.
- B. Check Valves: Install swing check valve, downstream from shutoff valve, on each sewage pump discharge.
- C. Backwater Valves: Install backwater valves in piping subject to sewage backflow.
 - 1. Horizontal Piping: Horizontal backwater valves. Use normally closed type, unless otherwise indicated.
 - 2. Floor Drains: Drain outlet backwater valves, unless drain has integral backwater valve.
 - 3. Install backwater valves in accessible locations.
 - 4. Backwater valves are specified in Division 15 Section "Plumbing Specialties."

3.5 HANGER AND SUPPORT INSTALLATION

- A. Pipe hangers and supports are specified in Division 15 Section "Hangers and Supports." Install the following:
 - 1. Vertical Piping: MSS Type 8 or Type 42, clamps.
 - 2. Individual, Straight, Horizontal Piping Runs: According to the following:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.
 - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Support vertical piping and tubing at base and at each floor.
- C. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.
- D. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.

2. NPS 3: 60 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
4. NPS 6: 60 inches with 3/4-inch rod.
5. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.

E. Install supports for vertical cast-iron soil piping every 15 feet.

F. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 48 inches with 3/8-inch rod.
2. NPS 3: 48 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
4. NPS 6: 48 inches with 3/4-inch rod.

G. Install supports for vertical PVC piping every 48 inches.

H. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.6 CONNECTIONS

A. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

B. Connect drainage and vent piping to the following:

1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
4. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.

3.7 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction.

1. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
2. Prepare reports for tests and required corrective action.

3.8 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.9 PROTECTION

- A. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

END OF SECTION 15150

SECTION 15155

SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following sanitary drainage piping specialties:
 - 1. Backwater valves.
 - 2. Cleanouts.
 - 3. Floor drains.
 - 4. Roof flashing assemblies.
 - 5. Miscellaneous sanitary drainage piping specialties.
 - 6. Flashing materials.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories for grease interceptors.

1.3 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 BACKWATER VALVES

- A. Horizontal, Cast-Iron Backwater Valves:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfr. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
 - 2. Standard: ASME A112.14.1.
 - 3. Size: Same as connected piping.
 - 4. Body: Cast iron.
- B. Drain-Outlet Backwater Valves:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Josam Company; Josam Div.
 - b. Smith, Jay R. Mfr. Co.; Division of Smith Industries, Inc.
 - c. Watts Drainage Products Inc.
 - d. Zurn Plumbing Products Group; Specification Drainage Operation.
 - 2. Size: Same as floor drain outlet.
 - 3. Body: Cast iron or bronze made for vertical installation in bottom outlet of floor drain.

4. Check Valve: Removable ball float.
5. Inlet: Threaded.
6. Outlet: Threaded or spigot.

2.2 CLEANOUTS

- A. Exposed Cast-Iron Cleanouts:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
- B. Cast-Iron Floor Cleanouts:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Josam Company; Josam Div.
 - b. Oatey.
 - c. Sioux Chief Manufacturing Company, Inc.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - e. Tyler Pipe; Wade Div.
 - f. Watts Drainage Products Inc.
 - g. Zurn Plumbing Products Group; Light Commercial Operation.
 - h. Zurn Plumbing Products Group; Specification Drainage Operation.
- C. Cast-Iron Wall Cleanouts:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.

2.3 FLOOR DRAINS

- A. Cast-Iron Floor Drains:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Commercial Enameling Co.
 - b. Josam Company; Josam Div.
 - c. MIFAB, Inc.
 - d. Prier Products, Inc.
 - e. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - f. Tyler Pipe; Wade Div.
 - g. Watts Drainage Products Inc.
 - h. Zurn Plumbing Products Group; Light Commercial Operation.
 - i. Zurn Plumbing Products Group; Specification Drainage Operation.

2.4 ROOF FLASHING ASSEMBLIES

- A. Roof Flashing Assemblies:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

2.5 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

- A. Open Drains:
 1. Description: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-iron, soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C 564, rubber gaskets.
 2. Size: Same as connected waste piping with increaser fitting of size indicated.
- B. Deep-Seal Traps:
 1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
 2. Size: Same as connected waste piping.
 - a. NPS 2: 4-inch- minimum water seal.
 - b. NPS 2-1/2 and Larger: 5-inch- minimum water seal.
- C. Floor-Drain, Trap-Seal Primer Fittings:
 1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
 2. Size: Same as floor drain outlet with NPS 1/2 side inlet.
- D. Air-Gap Fittings:
 1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
 2. Body: Bronze or cast iron.
 3. Inlet: Opening in top of body.
 4. Outlet: Larger than inlet.
 5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.
- E. Sleeve Flashing Device:
 1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 1 inch above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
 2. Size: As required for close fit to riser or stack piping.
- F. Stack Flashing Fittings:
 1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
 2. Size: Same as connected stack vent or vent stack.
- G. Vent Caps:
 1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
 2. Size: Same as connected stack vent or vent stack.

2.6 FLASHING MATERIALS

- A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:
 1. General Use: 4.0-lb/sq. ft., 0.0625-inch thickness.
 2. Vent Pipe Flashing: 3.0-lb/sq. ft., 0.0469-inch thickness.
 3. Burning: 6-lb/sq. ft., 0.0938-inch thickness.
- B. Fasteners: Metal compatible with material and substrate being fastened.

- C. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- D. Solder: ASTM B 32, lead-free alloy.
- E. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install backwater valves in building drain piping. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.
- B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
 - 1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
 - 2. Locate at each change in direction of piping greater than 45 degrees.
 - 3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
 - 4. Locate at base of each vertical soil and waste stack.
- C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- E. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
 - 1. Position floor drains for easy access and maintenance.
 - 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
 - a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
 - b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
 - c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.
 - 3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
 - 4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- F. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.
- G. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.
- H. Assemble open drain fittings and install with top of hub 1 inch above floor.
- I. Install deep-seal traps on floor drains and other waste outlets, if indicated.
- J. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
 - 1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
 - 2. Size: Same as floor drain inlet.
- K. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- L. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

- M. Install vent caps on each vent pipe passing through roof.
- N. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.
- O. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.

3.3 FLASHING INSTALLATION

- A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
 - 1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
 - 1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
 - 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
 - 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.
- D. Secure flashing into sleeve and specialty clamping ring or device.
- E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Division 7 Section "Sheet Metal Flashing and Trim."
- F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

3.4 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each grease interceptor.
- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 15 Section "Identification for Plumbing Piping and Equipment."

3.5 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 15155

SECTION 15183

REFRIGERANT PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes refrigerant piping used for air-conditioning applications.

1.2 PERFORMANCE REQUIREMENTS

- A. Line Test Pressure for Refrigerant R-410A:
 - 1. As recommended by manufacturer and/or ASHRAE..

1.3 SUBMITTALS

- A. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop based on manufacturer's test data.
- B. Shop Drawings: Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, oil traps, double risers, wall and floor penetrations, and equipment connection details. Show interface and spatial relationships between piping and equipment.
 - 1. Refrigerant piping indicated on Drawings is schematic only. Size piping and design actual piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.
- C. Field quality-control test reports.
- D. Operation and maintenance data.

1.4 QUALITY ASSURANCE

- A. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."
- B. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

1.5 PRODUCT STORAGE AND HANDLING

- A. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

- A. Copper Tube: **ASTM B 88, Type L**.
- B. Wrought-Copper Fittings: ASME B16.22.
- C. Wrought-Copper Unions: ASME B16.22.
- D. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.
- E. Brazing Filler Metals: AWS A5.8.
- F. Flexible Connectors:
 - 1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
 - 2. End Connections: Socket ends.
 - 3. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch- long assembly.
 - 4. Pressure Rating: Factory test at minimum 500 psig.
 - 5. Maximum Operating Temperature: 250 deg F.

2.2 VALVES AND SPECIALTIES

- A. Diaphragm Packless Valves:
 - 1. Body and Bonnet: Forged brass or cast bronze; globe design with straight-through or angle pattern.
 - 2. Diaphragm: Phosphor bronze and stainless steel with stainless-steel spring.
 - 3. Operator: Rising stem and hand wheel.
 - 4. Seat: Nylon.
 - 5. End Connections: Socket, union, or flanged.
 - 6. Working Pressure Rating: 500 psig.
 - 7. Maximum Operating Temperature: 275 deg F.
- B. Packed-Angle Valves:
 - 1. Body and Bonnet: Forged brass or cast bronze.
 - 2. Packing: Molded stem, back seating, and replaceable under pressure.
 - 3. Operator: Rising stem.
 - 4. Seat: Nonrotating, self-aligning polytetrafluoroethylene.
 - 5. Seal Cap: Forged-brass or valox hex cap.
 - 6. End Connections: Socket, union, threaded, or flanged.
 - 7. Working Pressure Rating: 500 psig.
 - 8. Maximum Operating Temperature: 275 deg F.
- C. Check Valves:
 - 1. Body: Ductile iron, forged brass, or cast bronze; globe pattern.
 - 2. Bonnet: Bolted ductile iron, forged brass, or cast bronze; or brass hex plug.
 - 3. Piston: Removable polytetrafluoroethylene seat.

4. Closing Spring: Stainless steel.
5. Manual Opening Stem: Seal cap, plated-steel stem, and graphite seal.
6. End Connections: Socket, union, threaded, or flanged.
7. Maximum Opening Pressure: 0.50 psig.
8. Working Pressure Rating: 500 psig.
9. Maximum Operating Temperature: 275 deg F.

D. Service Valves:

1. Body: Forged brass with brass cap including key end to remove core.
2. Core: Removable ball-type check valve with stainless-steel spring.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Copper spring.
5. Working Pressure Rating: 500 psig.

E. Solenoid Valves: Comply with ARI 760 and UL 429; listed and labeled by an NRTL.

1. Body and Bonnet: Plated steel.
2. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Threaded.
5. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch conduit adapter, and **24/115/208/240-V** ac coil as required
6. Working Pressure Rating: 400 psig.
7. Maximum Operating Temperature: 240 deg F.
8. Manual operator.

F. Safety Relief Valves: Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.

1. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.
2. Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Seat Disc: Polytetrafluoroethylene.
4. End Connections: Threaded.
5. Working Pressure Rating: 400 psig.
6. Maximum Operating Temperature: 240 deg F.

G. Thermostatic Expansion Valves: Comply with ARI 750.

1. Body, Bonnet, and Seal Cap: Forged brass or steel.
2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Packing and Gaskets: Non-asbestos.
4. Capillary and Bulb: Copper tubing filled with refrigerant charge.
5. Suction Temperature: **40 deg F**.
6. Superheat: **Adjustable**.
7. Reverse-flow option (for heat-pump applications).
8. End Connections: Socket, flare, or threaded union.
9. Working Pressure Rating: **700 psig**.

H. Straight-Type Strainers:

1. Body: Welded steel with corrosion-resistant coating.
2. Screen: 100-mesh stainless steel.
3. End Connections: Socket or flare.
4. Working Pressure Rating: 500 psig.

5. Maximum Operating Temperature: 275 deg F.

I. Angle-Type Strainers:

1. Body: Forged brass or cast bronze.
2. Drain Plug: Brass hex plug.
3. Screen: 100-mesh monel.
4. End Connections: Socket or flare.
5. Working Pressure Rating: 500 psig.
6. Maximum Operating Temperature: 275 deg F.

J. Moisture/Liquid Indicators:

1. Body: Forged brass.
2. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
3. Indicator: Color coded to show moisture content in ppm.
4. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
5. End Connections: Socket or flare.
6. Working Pressure Rating: 500 psig.
7. Maximum Operating Temperature: 240 deg F.

K. Replaceable-Core Filter Dryers: Comply with ARI 730.

1. Body and Cover: Painted-steel shell with ductile-iron cover, stainless-steel screws, and neoprene gaskets.
2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
3. Designed for reverse flow (for heat-pump applications).
4. End Connections: Socket.
5. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
6. Maximum Pressure Loss: **2 psig**.
7. Working Pressure Rating: 500 psig.
8. Maximum Operating Temperature: 240 deg F.

L. Permanent Filter Dryers: Comply with ARI 730.

1. Body and Cover: Painted-steel shell.
2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
3. Designed for reverse flow (for heat-pump applications).
4. End Connections: Socket.
5. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
6. Maximum Pressure Loss: **2 psig**.
7. Working Pressure Rating: 500 psig.
8. Maximum Operating Temperature: 240 deg F.

M. Liquid Accumulators: Comply with ARI 495.

1. Body: Welded steel with corrosion-resistant coating.
2. End Connections: Socket or threaded.
3. Working Pressure Rating: 500 psig.
4. Maximum Operating Temperature: 275 deg F.

2.3 REFRIGERANTS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Atofina Chemicals, Inc.
 - 2. DuPont Company; Fluorochemicals Div.
 - 3. Honeywell, Inc.; Genetron Refrigerants.
 - 4. INEOS Fluor Americas LLC.
- C. ASHRAE 34, R-410A

PART 3 - EXECUTION

3.1 VALVE AND SPECIALTY APPLICATIONS

- A. Install service valves for gage taps at strainers if they are not an integral part of strainers.
- B. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.
- C. Install a full-sized, three-valve bypass around filter dryers.
- D. Install solenoid valves upstream from each expansion valve. Install solenoid valves in horizontal lines with coil at top.
- E. Install thermostatic expansion valves as close as possible to distributors on evaporators.
 - 1. Install valve so diaphragm case is warmer than bulb.
 - 2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
 - 3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.
- F. Install safety relief valves where required by ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.
- G. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.
- H. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for device being protected:
 - 1. Solenoid valves.
 - 2. Thermostatic expansion valves.
 - 3. Compressor.
- I. Install filter dryers in liquid line between compressor and thermostatic expansion valve, and in the suction line at the compressor.

- J. Install flexible connectors at compressors.

3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.
- B. Install refrigerant piping according to ASHRAE 15.
- C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping adjacent to machines to allow service and maintenance.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Select system components with pressure rating equal to or greater than system operating pressure.
- J. Refer to Division 15 Sections "HVAC Instrumentation and Controls" and "Sequence of Operation" for solenoid valve controllers, control wiring, and sequence of operation.
- K. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
- L. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Division 8 Section "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.
- M. Install refrigerant piping in protective conduit where installed belowground.
- N. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.
- O. Slope refrigerant piping as follows:
 - 1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
 - 2. Install horizontal suction lines with a uniform slope downward to compressor.
 - 3. Install traps and double risers to entrain oil in vertical runs.
 - 4. Liquid lines may be installed level.
- P. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.
- Q. Install pipe sleeves at penetrations in exterior walls and floor assemblies.

- R. Seal penetrations through fire and smoke barriers according to Division 7 Section "Through-Penetration Firestop Systems."
- S. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.
- T. Install sleeves through floors, walls, or ceilings, sized to permit installation of full-thickness insulation.
- U. Seal pipe penetrations through exterior walls according to Division 7 Section "Joint Sealants" for materials and methods.
- V. Identify refrigerant piping and valves according to Division 15 Section "Mechanical Identification."

3.3 PIPE JOINT CONSTRUCTION

- A. Soldered Joints: Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."
- B. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
 - 1. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe.
 - 2. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.

3.4 HANGERS AND SUPPORTS

- A. Hanger, support, and anchor products are specified in Division 15 Section "Hangers and Supports."
- B. Install the following pipe attachments:
 - 1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet long.
 - 2. Roller hangers and spring hangers for individual horizontal runs 20 feet or longer.
 - 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
 - 4. Spring hangers to support vertical runs.
 - 5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
- C. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:
 - 1. NPS 1/2: Maximum span, 60 inches; minimum rod size, 1/4 inch.
 - 2. NPS 5/8: Maximum span, 60 inches; minimum rod size, 1/4 inch.
 - 3. NPS 1: Maximum span, 72 inches; minimum rod size, 1/4 inch.
 - 4. NPS 1-1/4: Maximum span, 96 inches; minimum rod size, 3/8 inch.
 - 5. NPS 1-1/2: Maximum span, 96 inches; minimum rod size, 3/8 inch.
 - 6. NPS 2: Maximum span, 96 inches; minimum rod size, 3/8 inch.
 - 7. NPS 2-1/2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
 - 8. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.
 - 9. NPS 4: Maximum span, 12 feet; minimum rod size, 1/2 inch.
- D. Support multifloor vertical runs at least at each floor.

3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. Comply with ASME B31.5, Chapter VI.
2. Test refrigerant piping and specialties. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in Part 1 "Performance Requirements" Article.
 - a. Fill system with nitrogen to the required test pressure.
 - b. System shall maintain test pressure at the manifold gage throughout duration of test.
 - c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
 - d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

3.6 SYSTEM CHARGING

A. Charge system using the following procedures:

1. Install core in filter dryers after leak test but before evacuation.
2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
4. Charge system with a new filter-dryer core in charging line.

3.7 ADJUSTING

- A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.
- B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.
- C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.
- D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:
 1. Open shutoff valves in condenser water circuit.
 2. Verify that compressor oil level is correct.
 3. Open compressor suction and discharge valves.
 4. Open refrigerant valves except bypass valves that are used for other purposes.
 5. Check open compressor-motor alignment and verify lubrication for motors and bearings.
- E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION 15183

SECTION 15410

PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Faucets for lavatories, bathtubs, bathtub/showers, showers and sinks.
 - 2. Flushometers.
 - 3. Toilet seats.
 - 4. Protective shielding guards.
 - 5. Fixture supports.
 - 6. Dishwasher air-gap fittings.
 - 7. Disposers.
 - 8. Hot-water dispensers.
 - 9. Water closets.
 - 10. Urinals.
 - 11. Lavatories.
 - 12. Bathtubs.
 - 13. Individual showers.
 - 14. Kitchen sinks.
 - 15. Service sinks.
 - 16. Laundry trays.

1.2 DEFINITIONS

- A. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
- B. FRP: Fiberglass-reinforced plastic.
- C. PMMA: Polymethyl methacrylate (acrylic) plastic.
- D. PVC: Polyvinyl chloride plastic.
- E. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Operation and maintenance data.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

- B. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities", Florida Accessibility Code for plumbing fixtures for people with disabilities.
- C. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
- D. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- E. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.
- F. Comply with the following applicable standards and other requirements specified for plumbing fixtures:
 1. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.
 2. Plastic Laundry Trays: ANSI Z124.6.
 3. Plastic Shower Enclosures: ANSI Z124.2.
 4. Plastic Sinks: ANSI Z124.6.
 5. Porcelain-Enameled, Formed-Steel Fixtures: ASME A112.19.4M.
 6. Slip-Resistant Bathing Surfaces: ASTM F 462.
 7. Solid-Surface-Material Lavatories and Sinks: ANSI/ICPA SS-1.
 8. Stainless-Steel Residential Sinks: ASME A112.19.3.
 9. Vitreous-China Fixtures: ASME A112.19.2M.
 10. Water-Closet, Flush Valve, Tank Trim: ASME A112.19.5.
 11. Water-Closet, Flushometer Tank Trim: ASSE 1037.
- G. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:
 1. Backflow Protection Devices for Faucets with Side Spray: ASME A112.18.3M.
 2. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
 3. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
 4. Faucets: ASME A112.18.1.
 5. Hose-Connection Vacuum Breakers: ASSE 1011.
 6. Hose-Coupling Threads: ASME B1.20.7.
 7. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
 8. NSF Potable-Water Materials: NSF 61.
 9. Pipe Threads: ASME B1.20.1.
 10. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
 11. Supply Fittings: ASME A112.18.1.
 12. Brass Waste Fittings: ASME A112.18.2.
- H. Comply with the following applicable standards and other requirements specified for bathtub, bathtub/shower, and shower faucets:
 1. Backflow Protection Devices for Hand-Held Showers: ASME A112.18.3M.
 2. Combination, Pressure-Equalizing and Thermostatic-Control Antiscald Faucets: ASSE 1016.
 3. Faucets: ASME A112.18.1.
 4. Hand-Held Showers: ASSE 1014.
 5. High-Temperature-Limit Controls for Thermal-Shock-Preventing Devices: ASTM F 445.
 6. Hose-Coupling Threads: ASME B1.20.7.
 7. Manual-Control Antiscald Faucets: ASTM F 444.
 8. Pipe Threads: ASME B1.20.1.
 9. Pressure-Equalizing-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
 10. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
 11. Thermostatic-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
- I. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:
 1. Atmospheric Vacuum Breakers: ASSE 1001.
 2. Brass and Copper Supplies: ASME A112.18.1.
 3. Dishwasher Air-Gap Fittings: ASSE 1021.
 4. Manual-Operation Flushometers: ASSE 1037.
 5. Plastic Tubular Fittings: ASTM F 409.
 6. Brass Waste Fittings: ASME A112.18.2.
 7. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.

- J. Comply with the following applicable standards and other requirements specified for miscellaneous components:
1. Disposers: ASSE 1008 and UL 430.
 2. Dishwasher Air-Gap Fittings: ASSE 1021.
 3. Flexible Water Connectors: ASME A112.18.6.
 4. Grab Bars: ASTM F 446.
 5. Hose-Coupling Threads: ASME B1.20.7.
 6. Hot-Water Dispensers: ASSE 1023 and UL 499.
 7. Off-Floor Fixture Supports: ASME A112.6.1M.
 8. Pipe Threads: ASME B1.20.1.
 9. Plastic Toilet Seats: ANSI Z124.5.
 10. Supply and Drain Protective Shielding Guards: ICC A117.1.

PART 2 - PRODUCTS

2.1 LAVATORY FAUCETS

- A. Lavatory Faucets:
- B.
1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings LAV

2.2 SHOWER FAUCETS

- A. Shower Faucets:
1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings: SHWR.

2.3 SINK FAUCETS

- A. Sink Faucets:
- a.
 - b. 1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings: SK

2.4 FLUSHOMETERS

- A. Flushometers:
1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings: WC, HWC or UR.

2.5 TOILET SEATS

- A. Toilet Seats:
1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings: WC OR HWC

2.6 PROTECTIVE SHIELDING GUARDS

- A. Protective Shielding Pipe Covers, <Insert drawing designation>:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Engineered Brass Co.
 - b. Insul-Tect Products Co.; a Subsidiary of MVG Molded Products.
 - c. McGuire Manufacturing Co., Inc.
 - d. Plumberex Specialty Products Inc.
 - e. TCI Products.
 - f. TRUEBRO, Inc.
 - g. Zurn Plumbing Products Group; Tubular Brass Plumbing Products Operation.

2.7 FIXTURE SUPPORTS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. Josam Company.
 2. MIFAB Manufacturing Inc.
 3. Smith, Jay R. Mfg. Co.
 4. Tyler Pipe; Wade Div.
 5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
 6. Zurn Plumbing Products Group; Specification Drainage Operation.
- B. Water-Closet Supports:
 1. Description: Combination carrier designed for accessible or standard mounting height of wall-mounting, water-closet-type fixture. Include single or double, vertical or horizontal, hub-and-spigot or hubless waste fitting as required for piping arrangement; faceplates; couplings with gaskets; feet; and fixture bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space.
- C. Urinal Supports:
 1. Description: Type I, urinal carrier with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture for wall-mounting, urinal-type fixture. Include steel uprights with feet.
 2. Accessible-Fixture Support: Include rectangular steel uprights.
- D. Lavatory Supports:
 1. Description: Type I, lavatory carrier with exposed arms and tie rods for wall-mounting, lavatory-type fixture. Include steel uprights with feet.
 2. Accessible-Fixture Support: Include rectangular steel uprights.
- E. Sink Supports:
 1. Description: Type I, sink carrier with exposed arms and tie rods for sink-type fixture. Include steel uprights with feet.

2.8 DISHWASHER AIR-GAP FITTINGS

- A. Dishwasher Air-Gap Fittings:
 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. B & K Industries, Inc.
 - b. Brass Craft Mfg. Co.; a Subsidiary of Masco Corporation.
 - c. Brasstech Inc.; Newport Brass Div.
 - d. Dearborn Brass; a div. of Moen, Inc.
 - e. Geberit Manufacturing, Inc.
 - f. JB Products; a Federal Process Corporation Company.
 - g. Sioux Chief Manufacturing Company, Inc.
 - h. Watts Brass & Tubular; a division of Watts Regulator Co.
 2. Description: Fitting suitable for use with domestic dishwashers and for deck mounting; with plastic body chrome-plated brass cover; and capacity of at least 5 gpm; and inlet pressure of at least 5 psig at a temperature of at least 140 deg F. Include 5/8-inch- ID inlet and 7/8-inch- ID outlet hose connections.

3. Hoses: Rubber and suitable for temperature of at least 140 deg F.
 - a. Inlet Hose: 5/8-inch ID and 48 inches long.
 - b. Outlet Hose: 7/8-inch ID and 48 inches long.

2.9 DISPOSERS

- A. Disposers:
 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. American Standard Companies, Inc.
 - b. Franke Consumer Products, Inc.; Kitchen Systems Div.
 - c. In-Sink-Erator; a div. of Emerson Electric Co.
 - d. KitchenAid.
 - e. Maytag Co.
 - f. American Standard Companies, Inc.
 - g. Anaheim Manufacturing, Inc.; a Subsidiary of Western Industries, Inc.
 - h. Franke Consumer Products, Inc.; Kitchen Systems Div.
 - i. In-Sink-Erator; a div. of Emerson Electric Co.
 - j. KitchenAid.
 - k. Maytag Co.
 - l. WhiteRock Corp.

2.10 WATER CLOSETS

- A. Water Closets:
 1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings: WC or HWC.

2.11 URINALS

- A. Urinals:
 1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings: UR

2.12 LAVATORIES

- A. Lavatories:
 1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings: LAV or HLAV.

2.13 KITCHEN SINKS

- A. Kitchen Sinks:
 1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings: SK

2.14 SERVICE SINKS

- A. Service Sinks:
 1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings: MOP SINK.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.
- B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.
 - 1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
 - 2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
 - 3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.
- C. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.
- D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.
- E. Install wall-mounting fixtures with tubular waste piping attached to supports.
- F. Install fixtures level and plumb according to roughing-in drawings.
- G. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
- H. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
- I. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
- J. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.
- K. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.
- L. Install toilet seats on water closets.
- M. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- N. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.
- O. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- P. Install shower flow-control fittings with specified maximum flow rates in shower arms.
- Q. Install traps on fixture outlets.
 - 1. Exception: Omit trap on fixtures with integral traps.
 - 2. Exception: Omit trap on indirect wastes, unless otherwise indicated.
- R. Install disposer in outlet of each sink indicated to have disposer. Install switch where indicated or in wall adjacent to sink if location is not indicated.
- S. Install escutcheons at piping wall and ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 15 Section "Basic Mechanical Materials and Methods."

- T. Set bathtubs and showers in leveling bed of cement grout. Grout is specified in Division 15 Section "Basic Mechanical Materials and Methods."
- U. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 7 Section "Joint Sealants."

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- C. Ground equipment according to Division 16 Section "Grounding and Bonding."
- D. Connect wiring according to Division 16 Section "Conductors and Cables."

3.3 FIELD QUALITY CONTROL

- A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.
- B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.
- C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.
- D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.
- E. Install fresh batteries in sensor-operated mechanisms.

3.4 PROTECTION

- A. Provide protective covering for installed fixtures and fittings.
- B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 15410

SECTION 15415

DRINKING FOUNTAINS AND WATER COOLERS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Style F, freestanding drinking fountains.
 - 2. Style W, wall-mounting drinking fountains.
 - 3. Type PB, pressure with bubbler, Style F, freestanding water coolers.
 - 4. Type PB, pressure with bubbler, Style W, wall-mounting water coolers.
 - 5. Fixture supports.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities", Florida Accessibility Code or fixtures for people with disabilities.
- C. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- D. ARI Standard: Comply with ARI's "Directory of Certified Drinking Water Coolers" for style classifications.
- E. ARI Standard: Comply with ARI 1010, "Self-Contained, Mechanically Refrigerated Drinking-Water Coolers," for water coolers and with ARI's "Directory of Certified Drinking Water Coolers" for type and style classifications.
- F. ASHRAE Standard: Comply with ASHRAE 34, "Designation and Safety Classification of Refrigerants" for water coolers. Provide HFC 134a (tetrafluoroethane) refrigerant unless otherwise indicated.

PART 2 - PRODUCTS

2.1 DRINKING FOUNTAINS

- A. Drinking Fountains:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings: DF or HDF.

2.2 PRESSURE WATER COOLERS

- A. Water Coolers:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings: EWC or HEWC.

2.3 FIXTURE SUPPORTS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Josam Co.
 - 2. MIFAB Manufacturing, Inc.
 - 3. Smith, Jay R. Mfg. Co.
 - 4. Tyler Pipe; Wade Div.
 - 5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
 - 6. Zurn Plumbing Products Group; Specification Drainage Operation.
- B. Description: ASME A112.6.1M, water cooler carriers. Include vertical, steel uprights with feet and tie rods and bearing plates with mounting studs matching fixture to be supported.
 - 1. Type I: Hanger-type carrier with two vertical uprights.
 - 2. Type II: Bilevel, hanger-type carrier with three vertical uprights.
 - 3. Supports for Accessible Fixtures: Include rectangular, vertical, steel uprights instead of steel pipe uprights.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Use carrier off-floor supports for wall-mounting fixtures, unless otherwise indicated.
- B. Set freestanding and pedestal drinking fountains on floor.
- C. Use chrome-plated brass or copper tube, fittings, and valves in locations exposed to view.

3.2 INSTALLATION

- A. Install off-floor supports affixed to building substrate and attach wall-mounting fixtures, unless otherwise indicated.
- B. Install fixtures level and plumb. For fixtures indicated for children, install at height required by authorities having jurisdiction.
- C. Install water-supply piping with shutoff valve on supply to each fixture to be connected to water distribution piping. Use ball, gate, or globe valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Division 15 Section "Valves."
- D. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.
- E. Install pipe escutcheons at wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding pipe fittings. Escutcheons are specified in Division 15 Section "Basic Mechanical Materials and Methods."
- F. Seal joints between fixtures and walls and floors using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 7 Section "Joint sealants."

3.3 CONNECTIONS

- A. Connect fixtures with water supplies, traps, and risers, and with soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Ground equipment according to Division 16 Section "Grounding and Bonding."
- C. Connect wiring according to Division 16 Section "Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. Water Cooler Testing: After electrical circuitry has been energized, test for compliance with requirements. Test and adjust controls and safeties.
 - 1. Remove and replace malfunctioning units and retest as specified above.
 - 2. Report test results in writing.

3.5 ADJUSTING

- A. Adjust fixture flow regulators for proper flow and stream height.
- B. Adjust water cooler temperature settings.

END OF SECTION 15415

SECTION 15485

ELECTRIC WATER HEATERS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - I. Light-commercial electric water heaters.

1.2 SUBMITTALS

- A. Product Data: For each type and size of water heater indicated. Include rated capacities, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Operation and maintenance data.
- D. Warranty.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. ASME Compliance: Where ASME-code construction is indicated, fabricate and label commercial water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- C. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9" for all components that will be in contact with potable water.

1.4 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of electric water heaters that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including storage tank and supports.
 - b. Faulty operation of controls.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal use.
 - d.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 LIGHT COMMERCIAL ELECTRIC WATER HEATERS

- A. Storage Electric Water Heaters: Comply with UL 174.
 1. Available Manufacturers:
 - a. American Water Heater Company.
 - b. Bradford White Corporation.
 - c. Electric Heater Company (The); Hubbell Heaters Division.
 - d. GSW Water Heating Company.
 - e. Heat Transfer Products, Inc.
 - f. HESco Industries, Inc.
 - g. Lochinvar Corporation.
 - h. Maytag Corp.; Water Heating Appliances Div.
 - i. Rheem Water Heater Div.; Rheem Manufacturing Company.
 - j. Ruud Water Heater Div.; Rheem Manufacturing Company.
 - k. Smith, A. O. Water Products Company.
 - l. State Industries, Inc.
 - m. Vaughn Manufacturing Corporation.
 2. Storage-Tank Construction: Steel.
 - a. Tappings: ASME B1.20.1 pipe thread.
 - b. Pressure Rating: 150 psig.
 - c. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending lining material into tappings.
 3. Factory-Installed Storage-Tank Appurtenances:
 - a. Anode Rod: Replaceable magnesium.
 - b. Dip Tube: Provide unless cold-water inlet is near bottom of tank.
 - c. Drain Valve: ASSE 1005.
 - d. Insulation: Comply with ASHRAE/IESNA 90.1 or ASHRAE 90.2.
 - e. Jacket: Steel with enameled finish.
 - 1) Standard: Cylindrical shape.
 - 2) Tabletop: Rectangular shape, with flat-top work surface and raised back.
 - f. Heat Trap Fittings: Inlet type in cold-water inlet and outlet type in hot-water outlet.
 - g. Heating Elements: Two; electric, screw-in immersion type with 12 kW or less total, and wired for nonsimultaneous operation, unless otherwise indicated.
 - h. Temperature Control: Adjustable thermostat for each element.
 - i. Safety Control: High-temperature-limit cutoff device or system.
 - j. Relief Valve: ASME rated and stamped and complying with ASME PTC 25.3 for combination temperature and pressure relief valves. Include relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select relief valve with sensing element that extends into storage tank.

2.3 WATER HEATER ACCESSORIES

- A. Water Heater Stands: Water heater manufacturer's factory-fabricated steel stand for floor mounting and capable of supporting water heater and water. Include dimension that will support bottom of water heater a minimum of 18 inches above the floor.
- B. Water Heater Mounting Brackets: Water heater manufacturer's factory-fabricated steel bracket for wall mounting and capable of supporting water heater and water.
- C. Drain Pans: Corrosion-resistant metal with raised edge. Include dimensions not less than base of water heater and include drain outlet not less than NPS 3/4.

- D. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1 or ASHRAE 90.2.
- E. Water Regulators: ASSE 1003, water-pressure reducing valve. Set at 25-psig- maximum outlet pressure, unless otherwise indicated.
- F. Shock Absorbers: ASSE 1010 or PDI WH 201, Size A water hammer arrester.

PART 3 - EXECUTION

3.1 WATER HEATER INSTALLATION

- A. Install commercial water heaters on concrete bases.
 - 1. Exception: Omit concrete bases for commercial water heaters if installation on stand, bracket, suspended platform, or direct on floor is indicated.
- B. Install water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
- C. Install combination temperature and pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial, water-heater, relief-valve outlet, with drain piping same as domestic water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- D. Install water heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for water heaters that do not have tank drains. Refer to Division 15 Section "Plumbing Specialties" for hose-end drain valves.
- E. Install thermometer on outlet piping of water heaters.
- F. Install water regulator, with integral bypass relief valve, in booster-heater inlet piping and water hammer arrester in booster-heater outlet piping.
- G. Install piping-type heat traps on inlet and outlet piping of water heater storage tanks without integral or fitting-type heat traps.
- H. Fill water heaters with water.

3.2 CONNECTIONS

- A. Install piping adjacent to water heaters to allow service and maintenance. Arrange piping for easy removal of water heaters.

3.3 FIELD QUALITY CONTROL

- A. Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including connections.
- B. Perform the following field tests and inspections:
 - 1. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Test: After electrical circuitry has been energized, confirm proper operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

- C. Remove and replace water heaters that do not pass tests and inspections and retest as specified above.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain commercial electric water heaters. END OF SECTION 15485

SECTION 15671

CONDENSING UNITS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes air-cooled condensing units.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Wiring diagrams.
- C. Operation and maintenance data.
- D. LEED Submittal:
 - 1. Product Data for Credit EA 4: Documentation required by Credit EA 4 indicating that equipment and refrigerants comply.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Fabricate and label refrigeration system according to ASHRAE 15, "Safety Code for Mechanical Refrigeration."
- C. ASHRAE/IESNA 90.1-2007 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2007, Section 6 - "Heating, Ventilating, and Air-Conditioning."

1.4 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of condensing units that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period (Compressor Only): Five years from date of Substantial Completion.
 - 2. Warranty Period (Condenser Coil Only): Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 CONDENSING UNITS, AIR COOLED, 1 TO 5 TONS

- A. Manufacturers:
1. Carrier Corporation; Carrier Air Conditioning Div.
 2. Lennox Industries Inc.
 3. Rheem Manufacturing Air Conditioning Div.
 4. Trane Co. (The); Worldwide Applied Systems Group.
 5. Weatherking Air Conditioning Div.
 6. York International Corp.
- B. Description: Factory assembled and tested, consisting of compressor, condenser coil, fan, motors, refrigerant reservoir, and operating controls.
- C. Compressor: Scroll, hermetically sealed, with rubber vibration isolators.
1. Motor: Single speed, and includes thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
 2. Two-Speed Compressor: Include manual-reset, high-pressure switch and automatic-reset, low-pressure switch.
 3. Accumulator: Suction tube.
 4. Refrigerant Charge: R-410A.
 5. Refrigerant: R-407C or R-410A.
- D. Condenser Coil: Seamless copper-tube, aluminum-fin coil; circuited for integral liquid subcooler, with removable drain pan and brass service valves with service ports.
- E. Condenser Fan: Direct-drive, aluminum propeller fan; with permanently lubricated, totally enclosed fan motor with thermal-overload protection and ball bearings.
- F. Accessories:
1. Coastal Filter: Mesh screen to protect condenser coil from salt damage.
 2. Crankcase heater.
 3. Cycle Protector: Automatic-reset timer to prevent rapid compressor cycling.
 4. Electronic programmable thermostat to control condensing unit and evaporator fan.

5. Evaporator Freeze Thermostat: Temperature-actuated switch that stops unit when evaporator reaches freezing temperature.
 6. Filter-dryer.
 7. High-Pressure Switch: Automatic-reset switch cycles compressor off on high refrigerant pressure.
 8. Liquid-line solenoid.
 9. Low Ambient Controller: Cycles condenser fan to permit operation down to 0 deg F.
 10. Low-Pressure Switch: Automatic-reset switch cycles compressor off on low refrigerant pressure.
 11. PE mounting base to provide a permanent foundation.
 12. Precharged and insulated suction and liquid tubing.
 13. Sound Hood: Wraps around sound attenuation cover for compressor.
 14. Thermostatic expansion valve.
 15. Time-Delay Relay: Continues operation of evaporator fan after compressor shuts off.
- G. Unit Casing: Galvanized steel, finished with baked enamel; with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Mount service valves, fittings, and gage ports on exterior of casing.
- II. Verification of Performance: Rate condensing units according to ARI 210/240.

2.3 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate condensing units according to ARI 210/240, ARI 340/360, or ARI 365.
1. Energy Efficiency: Equal to or greater than prescribed by ASHRAE/IESNA 90.1-2007, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."
- B. Testing Requirements: Factory test sound-power-level ratings according to ARI 270.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install units level and plumb, firmly anchored in locations indicated; maintain manufacturer's recommended clearances.
- B. Install condensing units on concrete base. Concrete base is specified in Division 15 Section "Basic Mechanical Materials and Methods," and concrete materials and installation requirements are specified in Division 3.
- C. Install roof-mounting units on equipment supports specified in Division 7.
- D. Vibration Isolation: Mount condensing units on rubber and cork isolators with a minimum

deflection of 1". Vibration isolation devices and installation requirements are specified in Division 15 Section "Mechanical Vibration and Seismic Controls."

- E. Maintain manufacturer's recommended clearances for service and maintenance.
- F. Connect precharged refrigerant tubing to unit's quick-connect fittings. Install tubing so it does not interfere with access to unit. Install furnished accessories.
- G. Connect refrigerant piping to air-cooled condensing units; maintain required access to unit. Install furnished field-mounted accessories. Refrigerant piping and specialties are specified in Division 15 Section "Refrigerant Piping."

3.2 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Perform electrical test and visual and mechanical inspection.
 - 2. Leak Test: After installation, charge systems with refrigerant and oil and test for leaks. Repair leaks, replace lost refrigerant and oil, and retest until no leaks exist.
 - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation, product capability, and compliance with requirements.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 5. Verify proper airflow over coils.
- B. Verify that vibration isolation and flexible connections properly dampen vibration transmission to structure.
- C. Remove and replace malfunctioning condensing units and retest as specified above.

END OF SECTION 15671

SECTION 15815

METAL DUCTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Rectangular ducts and fittings.
2. Round ducts and fittings.
3. Sheet metal materials.
4. Sealants and gaskets.
5. Hangers and supports.

B. Related Sections:

1. Division 15 Section "Nonmetal Ducts" for fibrous-glass ducts, thermoset fiber-reinforced plastic ducts, thermoplastic ducts, PVC ducts, and concrete ducts.
2. Division 15 Section "HVAC Casings" for factory- and field-fabricated casings for mechanical equipment.
3. Division 15 Section "Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.
4. Division 15 Section "Testing, Adjusting, and Balancing" for testing, adjusting, and balancing requirements for metal ducts.

1.2 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated.

1. Static-Pressure Classes:

- a. Supply Ducts (in Auditorium Rooms): 1-inch wg.
- b. Supply Ducts (Upstream from Air Terminal Units): 2-inch wg.
- c. Supply Ducts (Downstream from Air Terminal Units): 1-inch wg.
- d. Ducts (Outside Air Duct): 1-inch wg.
- e. Return Ducts (Negative Pressure): 1-inch wg.
- f. Exhaust Ducts (Negative Pressure): 1-inch wg.

2. Leakage Class:

- a. Round Supply-Air Duct: 3 cfm/100 sq. ft. at 1-inch wg.
- b. Rectangular Supply-Air Duct: 6 cfm/100 sq. ft. at 1-inch wg.
- c. Flexible Supply-Air Duct: 6 cfm/100 sq. ft. at 1-inch wg.

B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible".

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings:
 - 1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
 - 2. Factory- and shop-fabricated ducts and fittings.
 - 3. Duct layout indicating sizes, configuration, and static-pressure classes.
 - 4. Elevation of top of ducts.
 - 5. Dimensions of main duct runs from building grid lines.
 - 6. Fittings.
 - 7. Reinforcement and spacing.
 - 8. Seam and joint construction.
 - 9. Penetrations through fire-rated and other partitions.
 - 10. Equipment installation based on equipment being used on Project.
 - 11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
 - 12. Hangers and supports, including methods for duct and building attachment and vibration isolation.
- C. Delegated-Design Submittal:
 - 1. Sheet metal thicknesses.
 - 2. Joint and seam construction and sealing.
 - 3. Reinforcement details and spacing.
 - 4. Materials, fabrication, assembly, and spacing of hangers and supports.
 - 5. .
- D. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
 - 2. Suspended ceiling components.
 - 3. Structural members to which duct will be attached.
 - 4. Size and location of initial access modules for acoustical tile.
 - 5. Penetrations of smoke barriers and fire-rated construction.
 - 6. Items penetrating finished ceiling including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 - f. Perimeter moldings.
- E. Welding certificates.

1.4 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

- B. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
 - 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
 - 3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

PART 2 - PRODUCTS

2.1 RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, "Transverse (Girth) Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-5, "Longitudinal Seams - Rectangular Ducts," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 2, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 ROUND DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Lindab Inc.
 - b. McGill AirFlow LLC.
 - c. SEMCO Incorporated.
 - d. Sheet Metal Connectors, Inc.
 - e. Spiral Manufacturing Co., Inc.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.

- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

- 1. Fabricate round ducts larger Than 90 inches in diameter with butt-welded longitudinal seams.

- D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

- 1. Galvanized Coating Designation: G90.
 - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.

- C. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.

- D. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.

- E. Aluminum Sheets: Comply with ASTM B 209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.

- F. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

- 1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

- G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.4 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

- B. Two-Part Tape Sealing System:

- 1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.

2. Tape Width: 3 inches.
3. Sealant: Modified styrene acrylic.
4. Water resistant.
5. Mold and mildew resistant.
6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
7. Service: Indoor and outdoor.
8. Service Temperature: Minus 40 to plus 200 deg F.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.

C. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.

E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

F. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.5 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."
- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

- E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
- F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- H. Trapeze and Riser Supports:
 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
 2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
 3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install round ducts in maximum practical lengths.
- D. Install ducts with fewest possible joints.
- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
- K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 15 Section "Duct Accessories" for fire and smoke dampers.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines."

3.2 SEAM AND JOINT SEALING

- A. Seal duct seams and joints for duct static-pressure and leakage classes specified in "Performance Requirements" Article, according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 1-2, "Standard Duct Sealing Requirements," unless otherwise indicated.
- B. Seal Classes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 1-2, "Standard Duct Sealing Requirements."

3.3 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Where practical, install concrete inserts before placing concrete.
 - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
 - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
 - 5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.4 SEISMIC-RESTRAINT-DEVICE INSTALLATION

3.5 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Division 15 Section "Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.6 DUCT SCHEDULE

- A. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel.

B. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."
 - a. Velocity 1000 fpm or Lower:
 - 1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
 - 2) Mitered Type RE 4 without vanes.
 - b. Velocity 1000 to 1500 fpm:
 - 1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
 - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
 - c. Velocity 1500 fpm or Higher:
 - 1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-3, "Round Duct Elbows."
 - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
 - 1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
 - 2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
 - 3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
 - b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
 - c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam or Welded.

C. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-6, "Branch Connections."
 - a. Rectangular Main to Rectangular Branch: 45-degree entry.
 - b. Rectangular Main to Round Branch: Spin in.

2. Round: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees." Saddle taps are permitted in existing duct.
 - a. Velocity 1000 fpm or Lower: 90-degree tap.
 - b. Velocity 1000 to 1500 fpm: Conical tap.
 - c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION 15815

SECTION 15820

DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Manual volume dampers.
 - 2. Control dampers.
 - 3. Fire dampers.
 - 4. Smoke dampers.
 - 5. Flange connectors.
 - 6. Turning vanes.
 - 7. Duct-mounted access doors.
 - 8. Flexible connectors.
 - 9. Flexible ducts.
 - 10. Duct accessory hardware.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.
 - 1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
 - a. Special fittings.
 - b. Manual volume damper installations.
 - c. Control damper installations.
 - d. Fire-damper and smoke-damper installations, including sleeves; and duct-mounted access doors.
 - e. Wiring Diagrams: For power, signal, and control wiring.
- C. Operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with AMCA 500-D testing for damper rating.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: **G90**.
 - 2. Exposed-Surface Finish: Mill phosphatized.
- C. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.2 MANUAL VOLUME DAMPERS

- A. Standard, Steel, Manual Volume Dampers:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Air Balance Inc.; a division of Mestek, Inc.
 - b. American Warming and Ventilating; a division of Mestek, Inc.
 - c. Flexmaster U.S.A., Inc.
 - d. McGill AirFlow LLC.
 - e. METALAIRE, Inc.
 - f. Nailor Industries Inc.
 - g. Pottorff; a division of PCI Industries, Inc.
 - h. Ruskin Company.
 - i. Trox USA Inc.
 - j. Vent Products Company, Inc.
 - 2. Standard leakage rating.
 - 3. Suitable for horizontal or vertical applications.
 - 4. Frames:
 - a. Hat-shaped, galvanized -steel channels, 0.064-inch minimum thickness.
 - b. Mitered and welded corners.
 - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
 - 5. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Galvanized-steel, 0.064 inch thick.

6. Blade Axles: Galvanized steel
7. Bearings:
 - a. Oil-impregnated bronze.
 - b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
8. Tie Bars and Brackets: Galvanized steel.
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Roll-Formed Aluminum Blades: 0.10-inch- thick aluminum sheet.
 - e. Extruded-Aluminum Blades: 0.050-inch- thick extruded aluminum.

B. Jackshaft:

1. Size: 1-inch diameter.
2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

C. Damper Hardware:

1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch- thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
2. Include center hole to suit damper operating-rod size.
3. Include elevated platform for insulated duct mounting.

2.3 CONTROL DAMPERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. American Warming and Ventilating; a division of Mestek, Inc.
2. Arrow United Industries; a division of Mestek, Inc.
3. Cesco Products; a division of Mestek, Inc.
4. Duro Dyne Inc.
5. Flexmaster U.S.A., Inc.
6. Greenheck Fan Corporation.
7. Lloyd Industries, Inc.
8. M&I Air Systems Engineering; Division of M&I Heat Transfer Products Ltd.
9. McGill AirFlow LLC.
10. METALAIRE, Inc.
11. Metal Form Manufacturing, Inc.
12. Nailor Industries Inc.
13. NCA Manufacturing, Inc.
14. Ruskin Company.
15. Vent Products Company, Inc.
16. Young Regulator Company.

B. Frames:

1. **Galvanized**-steel channels, 0.064 inch thick.

2. Mitered and welded corners.

C. Blades:

1. Multiple blade with maximum blade width of 8 inches.
2. Galvanized steel.
3. 0.064 inch thick.
4. Blade Edging: Closed-cell neoprene edging.
5. Blade Edging: Inflatable seal blade edging, or replaceable rubber seals.

D. Blade Axles: 1/2-inch- diameter; galvanized steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.

1. Operating Temperature Range: From minus 40 to plus 200 deg F.

E. Bearings:

1. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
2. Thrust bearings at each end of every blade.

2.4 FIRE DAMPERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Air Balance Inc.; a division of Mestek, Inc.
2. Arrow United Industries; a division of Mestek, Inc.
3. Cesco Products; a division of Mestek, Inc.
4. Greenheck Fan Corporation.
5. McGill AirFlow LLC.
6. METALAIRE, Inc.
7. Nailor Industries Inc.
8. NCA Manufacturing, Inc.
9. PHL, Inc.
10. Pottorff; a division of PCI Industries, Inc.
11. Prefco; Perfect Air Control, Inc.
12. Ruskin Company.
13. Vent Products Company, Inc.
14. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Type: Dynamic; rated and labeled according to UL 555 by an NRTL.

C. Closing rating in ducts up to 2-inch wg static pressure class and minimum 2000-fpm velocity.

D. Fire Rating: 1-1/2 and 2 hours.

E. Frame: Curtain type with blades outside airstream fabricated with roll-formed, 0.034-inch- thick galvanized steel; with mitered and interlocking corners.

F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.

1. Minimum Thickness: 0.052 or 0.138 inch thick, as indicated, and of length to suit application.

2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.

G. Mounting Orientation: Vertical or horizontal as indicated.

H. Blades: Roll-formed, interlocking, 0.034-inch- thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- thick, galvanized-steel blade connectors.

I. Horizontal Dampers: Include blade lock and stainless-steel closure spring.

J. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.

2.5 SMOKE DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Air Balance Inc.; a division of Mestek, Inc.
2. Cesco Products; a division of Mestek, Inc.
3. Greenheck Fan Corporation.
4. Nailor Industries Inc.
5. PHL, Inc.
6. Ruskin Company.

B. General Requirements: Label according to UL 555S by an NRTL.

C. Smoke Detector: Integral, factory wired for single-point connection.

D. Frame: Multiple-blade type; fabricated with roll-formed, 0.034-inch- thick galvanized steel; with mitered and interlocking corners.

E. Blades: Roll-formed, horizontal, interlocking, 0.034-inch- thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- thick, galvanized-steel blade connectors.

F. Leakage: Class I.

G. Rated pressure and velocity to exceed design airflow conditions.

H. Mounting Sleeve: Factory-installed, 0.052-inch- thick, galvanized sheet steel; length to suit wall or floor application.

I. Damper Motors: two-position action.

J. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 15 Section "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections.
3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.

4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf and breakaway torque rating of 150 in. x lbf.
5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.
6. Nonspring-Return Motors: For dampers larger than 25 sq. ft., size motor for running torque rating of 150 in. x lbf and breakaway torque rating of 300 in. x lbf.
7. Electrical Connection: 208 V, single phase, 60 Hz.

K. Accessories:

1. Auxiliary switches for fan control.
2. Test and reset switches mounted.

2.6 TURNING VANES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. METALAIRE, Inc.
4. SEMCO Incorporated.
5. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

C. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

D. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-3, "Vaness and Vane Runners," and 2-4, "Vane Support in Elbows."

E. Vane Construction: Single or Double wall.

F. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

2.7 DUCT-MOUNTED ACCESS DOORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American Warming and Ventilating; a division of Mestek, Inc.
2. Cesco Products; a division of Mestek, Inc.
3. Ductmate Industries, Inc.
4. Flexmaster U.S.A., Inc.
5. Greenheck Fan Corporation.
6. McGill AirFlow LLC.
7. Nailor Industries Inc.

8. Pottorff; a division of PCI Industries, Inc.
9. Ventfabrics, Inc.
10. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-10, "Duct Access Doors and Panels," and 2-11, "Access Panels - Round Duct."

1. Door:
 - a. Double wall, rectangular.
 - b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
 - c. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
 - d. Fabricate doors airtight and suitable for duct pressure class.
2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
3. Number of Hinges and Locks:
 - a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
 - b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
 - c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches.
 - d. Access Doors Larger Than 24 by 48 Inches: Four hinges and two compression latches with outside and inside handles.

2.8 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Ductmate Industries, Inc.
 2. Duro Dyne Inc.
 3. Ventfabrics, Inc.
 4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Materials: Flame-retardant or noncombustible fabrics.
- C. Coatings and Adhesives: Comply with UL 181, Class 1.
- D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches or 5-3/4 inches wide attached to 2 strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Provide metal compatible with connected ducts.
- E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
1. Minimum Weight: 26 oz./sq. yd..
 2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
 3. Service Temperature: Minus 40 to plus 200 deg F.
- F. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
1. Minimum Weight: 24 oz./sq. yd..
 2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
 3. Service Temperature: Minus 50 to plus 250 deg F.

G. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.

1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
2. Outdoor Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

2.9 FLEXIBLE DUCTS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Flexmaster U.S.A., Inc.
2. McGill AirFlow LLC.
3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
4. Insulated, Flexible Duct: UL 181, Class I, multiple layers of aluminum laminate supported by helically

B. Flexible Duct Connectors:

1. Clamps: Nylon strap in sizes 3 through 18 inches, to suit duct size.

2.10 DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

- C. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
 - 1. Install steel volume dampers in steel ducts.
 - 2. Install aluminum volume dampers in aluminum ducts.
- D. Set dampers to fully open position before testing, adjusting, and balancing.
- E. Install test holes at fan inlets and outlets and elsewhere as indicated.
- F. Install fire and smoke dampers according to UL listing.
- G. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
 - 1. On both sides of duct coils.
 - 2. Downstream from manual volume dampers, control dampers, turning vanes, and equipment.
 - 3. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors; and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
 - 4. At each change in direction and at maximum 50-foot spacing.
 - 5. Upstream of turning vanes.
 - 6. Elsewhere as indicated.
- H. Install access doors with swing against duct static pressure.
- I. Access Door Sizes:
 - 1. One-Hand or Inspection Access: 8 by 5 inches.
 - 2. Two-Hand Access: 12 by 6 inches.
 - 3. Head and Hand Access: 18 by 10 inches.
 - 4. Head and Shoulders Access: 21 by 14 inches.
 - 5. Body Access: 25 by 14 inches.
 - 6. Body plus Ladder Access: 25 by 17 inches.
- J. Label access doors according to Division 15 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- K. Install flexible connectors to connect ducts to equipment.
- L. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
- M. Connect terminal units to supply ducts directly or with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.
- N. Connect diffusers or light troffer boots to low-pressure ducts with maximum 60-inch lengths of flexible duct clamped or strapped in place.
- O. Connect flexible ducts to metal ducts with draw bands.
- P. Install duct test holes where required for testing and balancing purposes.

- Q. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Operate fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.

END OF SECTION 15820

SECTION 15855

DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes ceiling- and wall-mounted diffusers, registers, and grilles.

1.2 SUBMITTALS

- A. Product Data: For each product indicated, include the following:
 - 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
 - 2. Diffuser, Register, and Grille Schedule: Indicate Drawing designation, room location, quantity, model number, size, and accessories furnished.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
 - 2. Products: Subject to compliance with requirements, provide one of the products specified.
 - 3. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
 - 4. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified on drawings.

2.2 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb.

- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practicable. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.2 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 15855

SECTION 15950

TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes TAB to produce design objectives for the following:
 - 1. Air Systems:
 - a. Constant-volume air systems.
 - b. Variable-air-volume systems.
 - 2. HVAC equipment quantitative-performance settings.
 - 3. Existing systems TAB.
 - 4. Verifying that automatic control devices are functioning properly.
 - 5. Reporting results of activities and procedures specified in this Section.

1.2 SUBMITTALS

- A. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.
- B. Warranties specified in this Section.

1.3 QUALITY ASSURANCE

- A. TAB Firm Qualifications: Engage a TAB firm certified by **AABC, NEBB or TABB**.
- B. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:
 - 1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
 - 2. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.

1.4 PROJECT CONDITIONS

- A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.
- B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.5 COORDINATION

- A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.
- B. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.6 WARRANTY

- A. National Project Performance Guarantee: Provide a guarantee on AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" forms stating that AABC will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee includes the following provisions:
 - 1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
 - 2. Systems are balanced to optimum performance capabilities within design and installation limits.

- B. Special Guarantee: Provide a guarantee on NEBB forms stating that NEBB will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee shall include the following provisions:
 - 1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
 - 2. Systems are balanced to optimum performance capabilities within design and installation limits.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
 - 1. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.

- B. Examine approved submittal data of HVAC systems and equipment.

- C. Examine Project Record Documents described in Division 1 Section "Project Record Documents."

- D. Examine design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.

- E. Examine equipment performance data including fan and pump curves. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.

- F. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Sections have been performed.

- G. Examine system and equipment test reports.

- H. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.

- I. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.

- J. Examine HVAC equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- K. Examine terminal units, such as variable-air-volume boxes, to verify that they are accessible and their controls are connected and functioning.
- L. Examine plenum ceilings used for supply air to verify that they are airtight. Verify that pipe penetrations and other holes are sealed.
- M. Examine strainers for clean screens and proper perforations.
- N. Examine equipment for installation and for properly operating safety interlocks and controls.
- O. Examine automatic temperature system components to verify the following:
 - 1. Dampers, valves, and other controlled devices are operated by the intended controller.
 - 2. Dampers and valves are in the position indicated by the controller.
 - 3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.
 - 4. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
 - 5. Sensors are located to sense only the intended conditions.
 - 6. Sequence of operation for control modes is according to the Contract Documents.
 - 7. Controller set points are set at indicated values.
 - 8. Interlocked systems are operating.
 - 9. Changeover from heating to cooling mode occurs according to indicated values.
- P. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Complete system readiness checks and prepare system readiness reports. Verify the following:
 - 1. Permanent electrical power wiring is complete.
 - 2. Automatic temperature-control systems are operational.
 - 3. Equipment and duct access doors are securely closed.
 - 4. Balance, smoke, and fire dampers are open.
 - 5. Isolating and balancing valves are open and control valves are operational.
 - 6. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
 - 7. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" or SMACNA's TABB "HVAC Systems - Testing, Adjusting, and Balancing" and this Section.
- B. Cut insulation, ducts and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to insulation Specifications for this Project.
- C. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, to show final settings.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. For variable-air-volume systems, develop a plan to simulate diversity.
- D. Determine the best locations in main and branch ducts for accurate duct airflow measurements.
- E. Check airflow patterns from the outside-air louvers and dampers and the return- and exhaust-air dampers, through the supply-fan discharge and mixing dampers.
- F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- G. Verify that motor starters are equipped with properly sized thermal protection.
- H. Check dampers for proper position to achieve desired airflow path.
- I. Check for airflow blockages.
- J. Check condensate drains for proper connections and functioning.
- K. Check for proper sealing of air-handling unit components.
- L. Check for proper sealing of air duct system.

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
 - 1. Measure fan static pressures to determine actual static pressure as follows:
 - a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.
 - b. Measure static pressure directly at the fan outlet or through the flexible connection.
 - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.
 - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
 - 2. Measure static pressure across each component that makes up a rooftop unit.
 - a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.
 - 3. Measure static pressures entering and leaving other devices such as sound traps, heat recovery equipment, and air washers, under final balanced conditions.
 - 4. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Compare actual system effect factors with calculated system effect factors to identify where variations occur. Recommend corrective action to align design and actual conditions.
 - 5. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes.
 - 6. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full cooling, full heating, economizer, and any other operating modes to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
 - 1. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.

- a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
 2. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
- C. Measure terminal outlets and inlets without making adjustments.
1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
- D. Adjust terminal outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using volume dampers rather than extractors and the dampers at air terminals.
1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
 2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.6 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

- A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a maximum set-point airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced airflow terminal units so they are distributed evenly among the branch ducts.
- B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Set outside-air dampers at minimum, and return- and exhaust-air dampers at a position that simulates full-cooling load.
 2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
 3. Measure total system airflow. Adjust to within indicated airflow.
 4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units as described for constant-volume air systems.
 5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow as described for constant-volume air systems.
 - a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.
 6. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outside airflow. Adjust the fan and balance the return-air ducts and inlets as described for constant-volume air systems.
 7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
 8. Record the final fan performance data.

3.7 PROCEDURES FOR TEMPERATURE MEASUREMENTS

- A. During TAB, report the need for adjustment in temperature regulation within the automatic temperature-control system.
- B. Measure indoor wet- and dry-bulb temperatures every other hour for a period of two successive eight-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied.
- C. Measure outside-air, wet- and dry-bulb temperatures.

3.8 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

- A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.
 - 1. Measure and record the operating speed, airflow, and static pressure of each fan.
 - 2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
 - 3. Check the condition of filters.
 - 4. Check the condition of coils.
 - 5. Check the operation of the drain pan and condensate drain trap.
 - 6. Check bearings and other lubricated parts for proper lubrication.
 - 7. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.

- B. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished.
 - 1. New filters are installed.
 - 2. Coils are clean and fins combed.
 - 3. Drain pans are clean.
 - 4. Fans are clean.
 - 5. Bearings and other parts are properly lubricated.
 - 6. Deficiencies noted in the preconstruction report are corrected.

- C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.
 - 1. Compare the indicated airflow of the renovated work to the measured fan airflows and determine the new fan, speed, filter, and coil face velocity.
 - 2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
 - 3. If calculations increase or decrease the airflow and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated airflow and water flow rates. If 5 percent or less, equipment adjustments are not required.
 - 4. Air balance each air outlet.

3.9 TEMPERATURE-CONTROL VERIFICATION

- A. Verify that controllers are calibrated and commissioned.
- B. Check transmitter and controller locations and note conditions that would adversely affect control functions.
- C. Record controller settings and note variances between set points and actual measurements.
- D. Check the operation of limiting controllers (i.e., high- and low-temperature controllers).
- E. Check free travel and proper operation of control devices such as damper and valve operators.
- F. Check the sequence of operation of control devices. Note air pressures and device positions and correlate with airflow and water flow measurements. Note the speed of response to input changes.
- G. Check the interaction of electrically operated switch transducers.
- H. Check the interaction of interlock and lockout systems.
- I. Check main control supply-air pressure and observe compressor and dryer operations.
- J. Record voltages of power supply and controller output. Determine whether the system operates on a grounded or nongrounded power supply.
- K. Note operation of electric actuators using spring return for proper fail-safe operations.

3.10 TOLERANCES

- A. Set HVAC system airflow and water flow rates within the following tolerances:
1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus 5 to plus 10 percent.
 2. Air Outlets and Inlets: 0 to minus 10 percent.

3.11 FINAL REPORT

- A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.
- B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.
1. Include a list of instruments used for procedures, along with proof of calibration.
- C. Final Report Contents: In addition to certified field report data, include the following:
1. Fan curves.
 2. Manufacturers' test data.
 3. Field test reports prepared by system and equipment installers.
 4. Other information relative to equipment performance, but do not include Shop Drawings and Product Data.
- D. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:
1. Title page.
 2. Name and address of TAB firm.
 3. Project name.
 4. Project location.
 5. Architect's name and address.
 6. Engineer's name and address.
 7. Contractor's name and address.
 8. Report date.
 9. Signature of TAB firm who certifies the report.
 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 11. Summary of contents including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
 12. Nomenclature sheets for each item of equipment.
 13. Data for terminal units, including manufacturer, type size, and fittings.
 14. Notes to explain why certain final data in the body of reports varies from indicated values.
 15. Test conditions for fans performance forms including the following:
 - a. Settings for outside-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Face and bypass damper settings at coils.
 - e. Fan drive settings including settings and percentage of maximum pitch diameter.
 - f. Settings for supply-air, static-pressure controller.
 - g. Other system operating conditions that affect performance.
- E. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outside, supply, return, and exhaust airflows.
 2. Duct, outlet, and inlet sizes.
 3. Terminal units.
 4. Balancing stations.
 5. Position of balancing devices.

3.12 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional testing, inspecting, and adjusting during near-peak summer and winter conditions.

END OF SECTION 15950END OF SECTION 15950

SECTION 16050 - BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Supporting devices for electrical components.
 - 2. Electrical identification.
 - 3. Electricity-metering components.
 - 4. Concrete equipment bases.
 - 5. Electrical demolition.
 - 6. Apparatus or other trades.
 - 7. Cutting and patching for electrical construction.
 - 8. Touchup painting.

1.3 SUBMITTALS

- A. Product Data: For electricity-metering equipment.
- B. Shop Drawings: Dimensioned plans and sections or elevation layouts of electricity-metering equipment.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

1.5 COORDINATION

- A. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange in building structure during progress of construction to facilitate the electrical installations that follow.
 - 1. Set inserts and sleeves in poured-in-place concrete, masonry work, and other structural components as they are constructed.
- B. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning before closing in the building.
- C. Coordinate electrical service connections to components furnished by utility companies.

1. Coordinate installation and connection of exterior underground or overhead utilities and services, including provision for electricity-metering components.
2. Comply with requirements of authorities having jurisdiction and of utility company providing electrical power and other services.

- D. Coordinate location of access panels and doors for electrical items that are concealed by finished surfaces. Access doors and panels are specified in Division 8 Section "Access Doors."
- E. Where electrical identification devices are applied to field-finished surfaces, coordinate installation of identification devices with completion of finished surface.
- F. Where electrical identification markings and devices will be concealed by acoustical ceilings and similar finishes, coordinate installation of these items before ceiling installation.

1.6 SUBSTITUTIONS (APPLY TO ALL SECTIONS OF DIVISION 16000)

A. Trade Names:

1. When reference is made in the contract documents to trade names, brand names, or to the name of manufacturers, such references are made solely to indicate that products of that description may be furnished and are not intended to restrict competitive bidding. If it is desired to use products of trade or brand names or manufacturer's names which are different from those mentioned in the contract documents, application for the approval of the use of such products must reach the hands of the Engineer at least ten days prior to the date set for the opening of bids.
2. The burden of providing acceptability of a proposed product for use in place of a product or products designated in the contract documents rests on the party submitting the request for approval. The written application for approval of a proposed product must be accompanied by technical data, which the party requesting approval desired to submit in support of his application.
3. To be approved, a proposed product must also meet or exceed all express requirements of the contract documents. If the submittal is accepted by the Engineer, an addendum will be issued to all prospective bidders.
4. Unless requests for approval of other products have been received and approvals have been published by addendum in accordance with the above procedure, the successful bidder may furnish no products of any trade names, brand names, or manufacturer's names except those designated in the contract documents.

B. No claims by the Contractor as to the special fitness of any material or apparatus specified or his inability to produce first-class work with the same, shall be entertained unless such claim is referred to the Engineer before the work is started.

C. If any equipment proposed is of larger size than the designed selection or involves larger controls, or any contingent difference which requires additional space, equipment, apparatus, and the like, its use is not permitted.

PART 2 - PRODUCTS

2.1 SUPPORTING DEVICES

- A. Material: Cold-formed steel, with corrosion-resistant coating acceptable to authorities having jurisdiction.
- B. Metal Items for Use Outdoors or in Damp Locations: Hot-dip galvanized steel.
- C. Slotted-Steel Channel Supports: Flange edges turned toward web, and 9/16-inch- diameter slotted holes at a maximum of 2 inches o.c., in webs.
 - 1. Channel Thickness: Selected to suit structural loading.
 - 2. Fittings and Accessories: Products of the same manufacturer as channel supports.
- D. Raceway and Cable Supports: Manufactured clevis hangers, riser clamps, straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring-steel clamps or click-type hangers.
- E. Pipe Sleeves: ASTM A 53, Type E, Grade A, Schedule 40, galvanized steel, plain ends.
- F. Cable Supports for Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug for electrical cables in riser conduits. Plugs have number and size of conductor gripping holes as required to suit individual risers. Body constructed of malleable-iron casting with hot-dip galvanized finish.
- G. Expansion Anchors: Carbon-steel wedge or sleeve type.
- H. Toggle Bolts: All-steel springhead type.
- I. Powder-Driven Threaded Studs: Heat-treated steel.

2.2 ELECTRICAL IDENTIFICATION

- A. Identification Devices: A single type of identification product for each application category. Use colors prescribed by ANSI A13.1, NFPA 70, and these Specifications.
- B. Raceway and Cable Labels: Comply with ANSI A13.1, Table 3, for minimum size of letters for legend and minimum length of color field for each raceway and cable size.
 - 1. Type: Preprinted, flexible, self-adhesive, vinyl. Legend is overlaminated with a clear, weather- and chemical-resistant coating.
 - 2. Color: Black letters on background with surface color as specified for the system in paragraph 2.2.G.
 - 3. Legend: Indicates voltage.
- C. Colored Adhesive Marking Tape for Raceways, Wires, and Cables: Self-adhesive vinyl tape, not less than 1 inch wide by 3 mm thick.
- D. Underground warning tape: permanent, bright-colored, continuous-printed vinyl tape with the following features:
 - 1. Not less than 6 inches wide by 4 mils thick.
 - 2. Compounded for permanent direct-burial service.
 - 3. Embedded continuous metallic strip or core.
 - 4. Printed legend that indicates type of underground line.

- E. Tape Markers for Wire: Vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters.
- F. Cable Ties: Type 6/6 nylon, self-locking type.
- G. Engraved-Plastic Labels, Signs, and Instruction Plates: Engraving stock, melamine plastic laminate punched or drilled for mechanical fasteners 1/16-inch minimum thickness for signs up to 20 sq. in. and 1/8-inch minimum thickness for larger sizes.

- 1. Engraved legend in block style black letters with surface color and letter height as specified below:

<u>Surface Color</u>	<u>System</u>
White:	Normal (commercial) Branch
Green:	Equipment Branch

- 2. Engraved legends with the following letter size shall be provided for each piece of equipment listed below:

Automatic Transfer Switch	¼"
Branch Circuit Panels:	3/16"

- 3. Engraved legends shall include the designation shown on the drawings along with the supply voltage rating to the equipment mains.

- H. Interior Warning and Caution Signs: Comply with 29 CFR, Chapter XVII, Part 1910.145. Preprinted, aluminum, baked-enamel-finish signs, punched or drilled for mechanical fasteners, with colors, legend, and size appropriate to the application.
- I. Exterior Warning and Caution Signs: Comply with 29 CFR, Chapter XVII, Part 1910.145. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch, galvanized-steel backing, with colors, legend, and size appropriate to the application. ¼-inch grommets in corners for mounting.
- J. Fasteners for Nameplates and Signs: Self-tapping, stainless-steel screws or No. 10/32 stainless-steel machine screws with nuts and flat and lock washers.

2.3 EQUIPMENT FOR UTILITY COMPANY'S ELECTRICITY METERING

- A. Current-Transformer Cabinets: Comply with requirements of electrical power utility company.
- B. Meter Sockets: Comply with requirements of electrical power utility company.
- C. Modular Meter Centers: Factory-coordinated assembly of a main meter center circuit-breaker unit with wireways, tenant meter socket modules, and tenant branch circuit breakers arranged in adjacent vertical sections, complete with interconnecting buses.
 - 1. Housing: NEMA 250, Type 1 enclosure.
 - 2. Tenant Branch Circuit Breakers: Series combination rated to protect circuit breakers in downstream panelboards that have 10,000-A interrupting capacity, minimum.

2.4 TOUCHUP PAINT

- A. For Equipment: Equipment manufacturer's paint selected to match installed equipment finish.
- B. Galvanized Surfaces: Zinc-rich paint recommended by item manufacturer.

PART 3 - EXECUTION

3.1 ELECTRICAL EQUIPMENT INSTALLATION

- A. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide the maximum possible headroom.
- B. Materials and Components: Install level, plumb, and parallel and perpendicular to other building systems and components, unless otherwise indicated.
- C. Equipment: Install to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.
- D. Right of Way: Give to raceways and piping systems installed at a required slope.

3.2 ELECTRICAL SUPPORTING DEVICE APPLICATION

- A. Damp Locations and Outdoors: Hot-dip galvanized materials or nonmetallic, U-channel system components.
- B. Dry Locations: Steel materials with corrosion-resistant coating.
- C. Support Clamps for PVC Raceways: Click-type clamp system.
- D. Selection of Supports: Comply with manufacturer's written instructions.
- E. Strength of Supports: Adequate to carry present and future loads, times a safety factor of at least four; minimum of 200-lb design load.

3.3 SUPPORT INSTALLATION

- A. Install support devices to securely and permanently fasten and support electrical components.
- B. Install individual and multiple raceway hangers and riser clamps to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assemblies and for securing hanger rods and conduits.
- C. Support parallel runs of horizontal raceways together on trapeze- or bracket-type hangers.
- D. Size supports for multiple raceway installations so capacity can be increased by a 25 percent minimum in the future.

- E. Support individual horizontal raceways with separate, malleable-iron pipe hangers or clamps.
- F. Install 1/4-inch- diameter or larger threaded steel hanger rods, unless otherwise indicated.
- G. Spring-steel fasteners specifically designed for supporting single conduits or tubing may be used instead of malleable-iron hangers for 1-1/2-inch and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings and for fastening raceways to slotted channel and angle supports.
- H. Arrange supports in vertical runs so the weight of raceways and enclosed conductors is carried entirely by raceway supports, with no weight load on raceway terminals.
- I. Simultaneously install vertical conductor supports with conductors.
- J. Separately support cast boxes that are threaded to raceways and used for fixture support. Support sheet-metal boxes directly from the building structure or by bar hangers. If bar hangers are used, attach bar to raceways on opposite sides of the box and support the raceway with an approved fastener not more than 24 inches from the box.
- K. Install metal channel racks for mounting cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices unless components are mounted directly to structural elements of adequate strength.
- L. Install sleeves for cable and raceway penetrations of concrete slabs and walls unless core-drilled holes are used. Install sleeves for cable and raceway penetrations of masonry and fire-rated gypsum walls and of all other fire-rated floor and wall assemblies. Install sleeves during erection of concrete and masonry walls.
- M. Securely fasten electrical items and their supports to the building structure, unless otherwise indicated. Perform fastening according to the following unless other fastening methods are indicated:
 - 1. Wood: Fasten with wood screws or screw-type nails.
 - 2. Masonry: Toggle bolts on hollow masonry units and expansion bolts on solid masonry units.
 - 3. New Concrete: Concrete inserts with machine screws and bolts.
 - 4. Existing Concrete: Expansion bolts.
 - 5. Instead of expansion bolts, threaded studs driven by a powder charge and provided with lock washers may be used in existing concrete.
 - 6. Steel: Welded threaded studs or spring-tension clamps on steel.
 - a. Field Welding: Comply with AWS D1.1.
 - 7. Welding to steel structure may be used only for threaded studs, not for conduits, pipe straps, or other items.
 - 8. Light Steel: Sheet-metal screws.
 - 9. Fasteners: Select so the load applied to each fastener does not exceed 25 percent of its proof-test load.

3.4 IDENTIFICATION MATERIALS AND DEVICES

- A. Install at locations for most convenient viewing without interference with operation and maintenance of equipment.
- B. Coordinate names, abbreviations, colors, and other designations used for electrical identification with corresponding designations indicated in the Contract Documents or required by codes and standards. Use consistent designations throughout Project.

- C. Self-Adhesive Identification Products: Clean surfaces before applying.
- D. Tag and label circuits designated to be extended in the future. Identify source and circuit numbers in each cabinet, pull and junction box, and outlet box. Color-coding shall be used for voltage and phase identification.
- E. Install continuous underground plastic markers during trench backfilling, for exterior underground power, control, signal, and communication lines located directly above power and communication lines. Locate 6 to 8 inches below finished grade. If width of multiple lines installed in a common trench or concrete envelope does not exceed 16 inches, overall, use a single line marker.
- F. Color-code 208/120-V system secondary service, feeder, and branch-circuit conductors throughout the secondary electrical system as follows:
 - 1. Phase A: Black.
 - 2. Phase B: Red.
 - 3. Phase C: Blue.
 - 4. Neutral: White.
 - 5. Ground: Green.
- G. Install warning, caution, and instruction signs where required to comply with 29 CFR, Chapter XVII, Part 1910.145, and where needed to ensure safe operation and maintenance of electrical systems and of items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions are needed for system or equipment operation. Install metal-backed butyrate signs for outdoor items.
- H. Install engraved-laminated emergency-operating signs with white letters on red background with minimum 3/8-inch- high lettering for emergency instructions on power transfer, load shedding, and other emergency operations.

3.5 UTILITY COMPANY ELECTRICITY-METERING EQUIPMENT

- A. Install equipment according to utility company's written requirements. Provide grounding and empty conduits as required by utility company.

3.6 FIRESTOPPING

- A. Apply firestopping to cable and raceway penetrations of fire-rated floor and wall assemblies to achieve fire-resistance rating of the assembly. Firestopping materials and installation requirements are specified in Division 7 Section "Firestopping."

3.7 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated, but not less than 4 inches larger, in both directions, than supported unit. Follow supported equipment manufacturer's anchorage recommendations and setting templates for anchor-bolt and tie locations, unless otherwise indicated. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 3 Section "Cast-in-Place Concrete."

3.8 APPARATUS OF OTHER TRADES

- A. Install all manual and magnetic starters and contactors, which are not integral with equipment, including those furnished under other Divisions.
- B. Mechanical equipment control devices, such as thermostats, firestats and similar devices for equipment controlled by magnetic starters and contactors, are to be furnished and installed under another division. The power wiring provided under this division for equipment not controlled by magnetic starters or contactors shall also include wiring through manual line voltage control devices, such as thermostats and firestats, furnished and mounted under another division.
- C. Provide all power wiring to equipment as shown on the drawings and according to approved wiring diagrams furnished by the respective trades and provide disconnect switches, or motor starters as noted on the electrical drawings. Power wiring shall include correct phase connections for proper motor shaft rotation and shall include wiring through starters and contactors furnished under another division.
- D. All electric motor and electric heater sizes and locations indicated are approximate. Make connections to equipment as actually installed. Before connecting to any piece of such equipment, check the nameplate data against the information shown on the drawings and report any discrepancies that are discovered.
- E. Make all electrical connections to exhaust fans required for operation.

3.9 DEMOLITION

- A. Protect existing electrical equipment and installations indicated to remain. If damaged or disturbed in the course of the Work, remove damaged portions and install new products of equal capacity, quality, and functionality.
- B. Accessible Work: Remove exposed electrical equipment and installations, indicated to be demolished, in their entirety.
- C. Abandoned Work: Cut and remove buried raceway and wiring, indicated to be abandoned in place, 2 inches below the surface of adjacent construction. Cap raceways and patch surface to match existing finish.
- D. Remove demolished material from Project site.
- E. Remove, store, clean, reinstall, reconnect, and make operational components indicated for relocation, or replace if required.

3.10 CUTTING AND PATCHING

- A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces required to permit electrical installations. Perform cutting by skilled mechanics of trades involved.
- B. Repair and refinish disturbed finish materials and other surfaces to match adjacent undisturbed surfaces. Install new fireproofing where existing firestopping has been disturbed. Repair and refinish materials and other surfaces by skilled mechanics of trades involved.
- C. Do not cut work of other trades without their explicit consent and arrangement for repairs.

3.11 FIELD QUALITY CONTROL

- A. Inspect installed components for damage and faulty work, including the following:
 - 1. Raceways.
 - 2. Building wire and connectors.
 - 3. Supporting devices for electrical components.
 - 4. Electrical identification.
 - 5. Electricity-metering components.
 - 6. Concrete bases.
 - 7. Electrical demolition.
 - 8. Cutting and patching for electrical construction.
 - 9. Touchup painting.
- B. Test Owner's electricity-metering installation for proper operation and accuracy.

3.12 REFINISHING AND TOUCHUP PAINTING

- A. Refinish and touch up paint. Paint materials and application requirements are specified in Division 9 Section "Painting."
 - 1. Clean damaged and disturbed areas and apply primer, intermediate, and finish coats to suit the degree of damage at each location.
 - 2. Follow paint manufacturer's written instructions for surface preparation and for timing and application of successive coats.
 - 3. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 4. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.13 CLEANING AND PROTECTION

- A. On completion of installation, including outlets, fittings, and devices, inspect exposed finish. Remove burrs, dirt, paint spots, and construction debris.
- B. Protect equipment and installations and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

END OF SECTION 16050

SECTION 16060 - GROUNDING AND BONDING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes grounding of electrical systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.
- B. Related Sections include the following:
 - 1. Division 16 Section "Conductors and Cables for Requirements" for grounding conductors.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Product Data: For the following:
 - 1. Ground rods.
 - 2. Connectors and Fittings
 - 3. Exothermic Weld Systems

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
 - 1. Comply with UL 467.
- B. Comply with NFPA 70.
- C. Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Grounding Conductors, Cables, Connectors, and Rods:
 - a. Chance/Hubbell.
 - b. Thermoweld Inc.
 - c. Cadweld Inc.
 - d. Erico Inc.
 - e. Heary Brothers Lightning Protection Co.
 - f. Thompson Lightning Protection
 - g. ILSCO.
 - h. Kearney/Cooper Power Systems.
 - i. O-Z/Gedney Co.; a business of the EGS Electrical Group.
 - j. Thomas & Betts, Electrical.
 - k. Burndy

2.2 GROUNDING CONDUCTORS

- A. For insulated conductors, comply with Division 16 Section "Conductors and Cables."
- B. Material: Copper.
- C. Equipment Grounding Conductors: Insulated with green-colored insulation.
- D. Grounding Electrode Conductors: Stranded cable.
- E. Underground Conductors: Bare, tinned, stranded, or solid as indicated.
- F. Bare Copper Conductors: Comply with the following:
1. Solid Conductors: ASTM B 3.
 2. Assembly of Stranded Conductors: ASTM B 8.
 3. Tinned Conductors: ASTM B 33.
- G. Copper Bonding Conductors: As follows:
1. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG copper conductor, 1/4 inch in diameter.
 2. Bonding Conductor: No. 4 or No. 6 AWG, stranded copper conductor as required.
 3. Bonding Jumper: Bare copper tape, braided bare copper conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
- H. Grounding Bus: Bare, annealed copper bars of rectangular cross section, with insulators.

2.3 CONNECTOR PRODUCTS

- A. Comply with IEEE 837 and UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.
- B. Connectors: Bolted-pressure-type connectors, or compression type as indicated.
 - 1. Pressure Connectors: High-conductivity plated
 - 2. Bolted Clamps: Heavy-duty bronze
- C. Welded Connectors: Exothermic-welded type, in kit form, and selected per manufacturer's written instructions.

2.4 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel.
- B. Ground Rods: Sectional type; copper-clad steel.
 - 1. Size: 3/4" in diameter by 120 inches.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Use only copper conductors for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone, and similar materials.
- B. In raceways, use insulated equipment grounding conductors.
- C. Exothermic-Welded Connections: Use for connections to structural steel and for underground connections.
- D. Equipment Grounding Conductor Terminations: Use bolted pressure clamps with at least two bolts.
 - 1. Use insulated spacer; space 1 inch from wall and support from wall 6 inches above finished floor, unless otherwise indicated.
- E. Underground Grounding Conductors: Use bare tinned copper conductor, No. 2/0 AWG minimum. Unless otherwise indicated, bury at least 24 inches below grade.

3.2 EQUIPMENT GROUNDING CONDUCTORS

- A. Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.

- B. Install insulated equipment grounding conductor with circuit conductors for the following items, in addition to those required by NEC:
 - 1. Feeders and branch circuits.
 - 2. Lighting circuits.
 - 3. Receptacle circuits.
 - 4. Single-phase motor and appliance branch circuits.
 - 5. Three-phase motor and appliance branch circuits.
 - 6. Flexible raceway runs.
- C. Nonmetallic Raceways: Install an equipment grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.
- D. Water Heater: Install a separate equipment grounding conductor to each electric water heater. Bond conductor to heater units, piping, connected equipment, and components.
- E. Signal and Communication Systems: For telephone, alarm, voice and data, and other communication systems, provide No. 6 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
 - 1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-12-inch grounding bus.
 - 2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.
- F. Poles Supporting Outdoor Lighting Fixtures: Provide a grounding electrode in addition to installing a separate equipment grounding conductor with supply branch-circuit conductors.

3.3 INSTALLATION

- A. Ground Rods: Install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes.
 - 1. Drive ground rods until tops are 2 inches below finished floor or final grade, unless otherwise indicated.
 - 2. Interconnect ground rods with grounding electrode conductors. Use exothermic welds, except at test wells and as otherwise indicated. Make connections without exposing steel or damaging copper coating.
- B. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- C. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation hangers and supports is not transmitted to rigidly mounted equipment. Use exothermic-welded connectors for outdoor locations, unless a disconnect-type connection is required; then, use a bolted clamp. Bond straps directly to the basic structure taking care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.
- D. Metal Water Service Pipe: Provide insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes by grounding clamp connectors. Where a dielectric main water fitting is installed, connect grounding conductor to street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.

- E. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters where required. Connect to pipe with grounding clamp connectors.
- F. Bond interior metal piping systems and metal air ducts to equipment grounding conductors of associated pumps, fans, blowers, electric heaters, and air cleaners. Use braided-type bonding straps.
- G. Bond each aboveground portion of gas and fuel oil piping systems upstream from equipment shutoff valve.
- H. Concrete-Encased Grounding Electrode: Fabricate according to NFPA 70, using a minimum of 20 feet of electrically conductive steel reinforcing bars at bottom of foundation and bond grounding electrode conductor to reinforcing steel.

3.4 CONNECTIONS

- A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
 - 1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
 - 2. Make connections with clean, bare metal at points of contact.
 - 3. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
- B. Exothermic-Welded Connections: Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.
- C. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.
- D. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- E. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.
- F. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

3.5 FIELD QUALITY CONTROL

- A. Testing: Perform the following field quality-control testing:
 - 1. After installing grounding system but before permanent electrical circuitry has been energized, test for compliance with requirements.
 - 2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and separately derived A/C systems. Measure ground resistance not less than two full days after the last trace of precipitation, and

without the soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance. Perform tests, by the fall-of-potential method according to IEEE 81.

- a. Equipment Rated 500 kVA and Less: 5 ohms.
- b. Equipment Rated More Than 500 kVA: 3 ohms.

3.6 GRADING AND PLANTING

- A. Restore surface features, including vegetation, at areas disturbed by Work of this Section. Reestablish original grades, unless otherwise indicated. If sod has been removed, replace it as soon as possible after backfilling is completed. Restore areas disturbed by trenching, storing of dirt, cable laying, and other activities to their original condition. Include application of topsoil, fertilizer, lime, seed, sod, sprig, and mulch. Comply with Division 2 Section "Landscaping." Maintain restored surfaces. Restore disturbed paving as indicated.

END OF SECTION 16060

SECTION 16075 - ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes electrical identification materials and devices required to comply with ANSI C2, NFPA 70, OSHA standards, and authorities having jurisdiction.

1.3 SUBMITTALS

- A. Product Data: For each electrical identification product indicated.
- B. Schedule of Nomenclature: An index of electrical equipment and system components used in identification signs and labels.
- C. Samples: For each type of label and sign to illustrate color, lettering style, and graphic features of identification products.

1.4 QUALITY ASSURANCE

- A. Comply with ANSI C2.
- B. Comply with NFPA 70.
- C. Comply with ANSI A13.1 and NFPA 70 for color-coding.

PART 2 - PRODUCTS

2.1 RACEWAY AND CABLE LABELS

- A. Comply with ANSI A13.1, Table 3, for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
 - 1. Color: Black letters on orange field.
 - 2. Legend: Indicates [**voltage**] [**voltage and service**].
- B. Adhesive Labels: Preprinted, flexible, self-adhesive vinyl with legend overlaminated with a clear, weather- and chemical-resistant coating.

- C. Pretensioned, Wraparound Plastic Sleeves: Flexible, preprinted, color-coded, acrylic band sized to suit the diameter of the line it identifies and arranged to stay in place by pretensioned gripping action when placed in position.
- D. Colored Adhesive Tape: Self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.
- E. Underground-Line Warning Tape: Permanent, bright-colored, continuous-printed, vinyl tape.
 - 1. Not less than 6 inches wide by 4 mils thick.
 - 2. Compounded for permanent direct-burial service.
 - 3. Embedded continuous metallic strip or core.
 - 4. Printed legend indicating type of underground line.
- F. Tape Markers: Vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters.
- G. Aluminum, Wraparound Marker Bands: Bands cut from 0.014-inch- thick aluminum sheet, with stamped or embossed legend, and fitted with slots or ears for permanently securing around wire or cable jacket or around groups of conductors.
- H. Plasticized Card-Stock Tags: Vinyl cloth with preprinted and field-printed legends. Orange background, unless otherwise indicated, with eyelet for fastener.
- I. Aluminum-Faced, Card-Stock Tags: Weather-resistant, 18-point minimum card stock faced on both sides with embossable aluminum sheet, 0.002 inch thick, laminated with moisture-resistant acrylic adhesive, punched for fasteners, and preprinted with legends to suit each application.
- J. Brass or Aluminum Tags: 2 by 2 by 0.05-inch metal tags with stamped legend, punched for fastener.

2.2 NAMEPLATES AND SIGNS

- A. Safety Signs: Comply with 29 CFR, Chapter XVII, Part 1910.145.
- B. Engraved Plastic Nameplates and Signs: Engraving stock, melamine plastic laminate, minimum 1/16 inch thick for signs up to 20 sq. in. and 1/8 inch thick for larger sizes.
 - 1. Engraved legend with black letters on white face.
 - 2. Punched or drilled for mechanical fasteners.
- C. Baked-Enamel Signs for Interior Use: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for the application. 1/4-inch grommets in corners for mounting.
- D. Exterior, Metal-Backed, Butyrate Signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for the application. 1/4-inch grommets in corners for mounting.
- E. Fasteners for Nameplates and Signs: Self-tapping, stainless-steel screws or No. 10/32, stainless-steel machine screws with nuts and flat and lock washers.

2.3 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Cable Ties: Fungus-inert, self-extinguishing, one-piece, self-locking, Type 6/6 nylon cable ties.
 - 1. Minimum Width: 3/16 inch.

2. Tensile Strength: 50 lb minimum.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: According to color-coding.

B. Paint: Formulated for the type of surface and intended use.

1. Primer for Galvanized Metal: Single-component acrylic vehicle formulated for galvanized surfaces.
2. Primer for Concrete Masonry Units: Heavy-duty-resin block filler.
3. Primer for Concrete: Clear, alkali-resistant, binder-type sealer.
4. Enamel: Silicone-alkyd or alkyd urethane as recommended by primer manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Identification Materials and Devices: Install at locations for most convenient viewing without interference with operation and maintenance of equipment.
- B. Lettering, Colors, and Graphics: Coordinate names, abbreviations, colors, and other designations with corresponding designations in the Contract Documents or with those required by codes and standards. Use consistent designations throughout Project.
- C. Sequence of Work: If identification is applied to surfaces that require finish, install identification after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before applying.
- E. Circuits with More Than 600 V: Identify raceway and cable with "DANGER--HIGH VOLTAGE" in black letters 2 inches high, stenciled with paint at 10-foot intervals over a continuous, painted orange background. Identify the following:
 1. Entire floor area directly above conduits running beneath and within 12 inches of a basement or ground floor that is in contact with earth or is framed above unexcavated space.
 2. Wall surfaces directly external to conduits concealed within wall.
 3. All accessible surfaces of concrete envelope around conduits in vertical shafts, exposed in the building, or concealed above suspended ceilings.
 4. Entire surface of exposed conduits.
- F. Install painted identification according to manufacturer's written instructions and as follows:
 1. Clean surfaces of dust, loose material, and oily films before painting.
 2. Prime surfaces using type of primer specified for surface.
 3. Apply one intermediate and one finish coat of enamel.
- G. Color Banding Raceways and Exposed Cables: Band exposed and accessible raceways of the systems listed below:
 1. Bands: Pretensioned, wraparound plastic sleeves; colored adhesive tape; or a combination of both. Make each color band 2 inches wide, completely encircling conduit, and place adjacent bands of two-color markings in contact, side by side.
 2. Band Locations: At changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

3. Apply the following colors to the systems listed below:
 - a. Fire Alarm System: Red.
 - b. Fire-Suppression Supervisory and Control System: Red and yellow.
 - c. Combined Fire Alarm and Security System: Red and blue.
 - d. Security System: Blue and yellow.
 - e. Mechanical and Electrical Supervisory System: Green and blue.
 - f. Telecommunication System: Green and yellow.

H. Caution Labels for Indoor Boxes and Enclosures for Power and Lighting: Install pressure-sensitive, self-adhesive labels identifying system voltage with black letters on orange background. Install on exterior of door or cover.

I. Circuit Identification Labels on Boxes: Install labels externally.

1. Exposed Boxes: Pressure-sensitive, self-adhesive plastic label on cover.
2. Concealed Boxes: Plasticized card-stock tags.
3. Labeling Legend: Permanent, waterproof listing of panel and circuit number or equivalent.

J. Paths of Underground Electrical Lines: During trench backfilling, for exterior underground power, control, signal, and communication lines, install continuous underground plastic line marker located directly above line at 6 to 8 inches below finished grade. Where width of multiple lines installed in a common trench or concrete envelope does not exceed 16 inches overall, use a single line marker. **[Limit use of line markers to direct-buried cables] [Install line marker for underground wiring, both direct-buried cables and cables in raceway].**

K. Secondary Service, Feeder, and Branch-Circuit Conductors: Color-code throughout the secondary electrical system.

1. Color-code 208/120-V system as follows:

- a. Phase A: Black.
- b. Phase B: Red.
- c. Phase C: Blue.
- d. Neutral: White.
- e. Ground: Green.

2. Color-code 480/277-V system as follows:

- a. Phase A: Yellow.
- b. Phase B: Brown.
- c. Phase C: Orange.
- d. Neutral: White with a colored stripe or gray.
- e. Ground: Green.

3. Factory apply color the entire length of conductors, except the following field-applied, color-coding methods may be used instead of factory-coded wire for sizes larger than No. 10 AWG:

- a. Colored, pressure-sensitive plastic tape in half-lapped turns for a distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Use 1-inch-wide tape in colors specified. Adjust tape bands to avoid obscuring cable identification markings.
- b. Colored cable ties applied in groups of three ties of specified color to each wire at each terminal or splice point starting 3 inches from the terminal and spaced 3 inches apart. Apply with a special tool or pliers, tighten to a snug fit, and cut off excess length.

- L. Power-Circuit Identification: Metal tags or aluminum, wraparound marker bands for cables, feeders, and power circuits in vaults, pull and junction boxes, manholes, and switchboard rooms.
1. Legend: 1/4-inch- steel letter and number stamping or embossing with legend corresponding to indicated circuit designations.
 2. Tag Fasteners: Nylon cable ties.
 3. Band Fasteners: Integral ears.
- M. Apply identification to conductors as follows:
1. Conductors to Be Extended in the Future: Indicate source and circuit numbers.
 2. Multiple Power or Lighting Circuits in the Same Enclosure: Identify each conductor with source, voltage, circuit number, and phase. Use color-coding to identify circuits' voltage and phase.
 3. Multiple Control and Communication Circuits in the Same Enclosure: Identify each conductor by its system and circuit designation. Use a consistent system of tags, color-coding, or cable marking tape.
- N. Apply warning, caution, and instruction signs as follows:
1. Warnings, Cautions, and Instructions: Install to ensure safe operation and maintenance of electrical systems and of items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions are needed for system or equipment operation. Install metal-backed butyrate signs for outdoor items.
 2. Emergency Operation: Install engraved laminated signs with white legend on red background with minimum 3/8-inch- high lettering for emergency instructions on power transfer, load shedding, and other emergency operations.
- O. Equipment Identification Labels: Engraved plastic laminate. Install on each unit of equipment, including central or master unit of each system. This includes power, lighting, communication, signal, and alarm systems, unless units are specified with their own self-explanatory identification. Unless otherwise indicated, provide a single line of text with 1/2-inch- high lettering on 1-1/2-inch-high label; where two lines of text are required, use labels 2 inches high. Use white lettering on black field. Apply labels for each unit of the following categories of equipment using mechanical fasteners:
1. Panelboards, electrical cabinets, and enclosures.
 2. Access doors and panels for concealed electrical items.
 3. Electrical switchgear and switchboards.
 4. Electrical substations.
 5. Emergency system boxes and enclosures.
 6. Motor-control centers.
 7. Disconnect switches.
 8. Enclosed circuit breakers.
 9. Motor starters.
 10. Push-button stations.
 11. Power transfer equipment.
 12. Contactors.
 13. Remote-controlled switches.
 14. Dimmers.
 15. Control devices.
 16. Transformers.
 17. Inverters.
 18. Rectifiers.
 19. Frequency converters.
 20. Battery racks.
 21. Power-generating units.
 22. Telephone switching equipment.

23. Clock/program master equipment.
24. Call system master station.
25. TV/audio-monitoring master station.
26. Fire alarm master station or control panel.
27. Security-monitoring master station or control panel.

END OF SECTION 16075

SECTION 16120 - CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes building wires and cables and associated connectors, splices, and terminations for wiring systems rated 600 V and less.

1.3 SUBMITTALS

- A. Product Data: For wire and cable and associated splices and connectors..

1.4 QUALITY ASSURANCE

- A. Listing and Labeling: Provide wires and cables specified in this Section that are listed and labeled.
 - 1. The Terms "Listed" and "Labeled": As defined in NFPA 70, Article 100.
- B. Comply with NFPA 70.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver wires and cables according to NEMA WC 26.

1.6 COORDINATION

- A. Coordinate layout and installation of cables with other installations.
- B. Revise locations and elevations from those indicated, as required to suit field conditions and as approved.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Wires and Cables:
 - a. Carol Cable Co., Inc.

- b. Senator Wire & Cable Company.
- c. Southwire Company.
- d. Rome Cable.
- e. AFC Cable Systems.

2. Connectors for Wires and Cables:

- a. AMP Incorporated.
- b. General Signal; O-Z/Gedney.
- c. ILSCO.
- d. Burndy.
- e. 3M Company.

2.2 BUILDING WIRES AND CABLES

- A. UL-listed building wires and cables with conductor material, insulation type, cable construction, and rating as specified in Part 3 "Wire and Insulation Applications" Article.
- B. Thermoplastic Insulation Material: Comply with NEMA WC 5.
- C. Cross-Linked Polyethylene Insulation Material: Comply with NEMA WC 7.
- D. Conductor Material: Copper.
- E. Stranding: Solid conductor for No. 10 AWG and smaller; stranded conductor for larger than No. 10 AWG.

2.3 CONNECTORS AND SPLICES

- A. UL-listed, factory-fabricated wiring connectors of size, ampacity rating, material, type, and class for application and service indicated. Comply with Project's installation requirements and as specified in Part 3 "Wire and Insulation Applications" Article.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine raceways and building finishes to receive wires and cables for compliance with requirements for installation tolerances and other conditions affecting performance of wires and cables. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 WIRE AND INSULATION APPLICATIONS

- A. Service Entrance: Type XHHW or THWN, in raceway.
- B. Feeders: Type THHN/THWN, in raceway.
- C. Branch Circuits: Type THHN/THWN, in raceway.

- D. Branch Circuits: Type MC cable, 75C insulation. Where specifically approved for use by the authority having jurisdiction type "MC" cable with aluminum armor and internal ground is acceptable for use in general lighting and receptacle branch circuits not to exceed 20 amperes (#12 wire). All homeruns and multi-wire, multi-circuit branch circuits shall be wire in raceway.
- E. Class 1 Control Circuits: Type THHN/THWN, in raceway.
- F. Class 2 Control Circuits: Type THHN/THWN, in raceway.

3.3 INSTALLATION

- A. Install wires and cables as indicated, according to manufacturer's written instructions and NECA's "Standard of Installation."
- B. Pull Conductors: Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage cables or raceway.
- D. Identify wires and cables according to Division 16 Section "Basic Electrical Materials and Methods."

3.4 CONNECTIONS

- A. Conductor Splices: Keep to minimum.
- B. Install splices and tapes that possess equivalent or better mechanical strength and insulation ratings than conductors being spliced.
- C. Use splice and tap connectors compatible with conductor material.
- D. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches of slack.
- E. Connect outlets and components to wiring and to ground as indicated and instructed by manufacturer.
- F. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.5 FIELD QUALITY CONTROL

- A. Testing: On installation of wires and cables and before electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
 - 1. Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA ATS, Section 7.3.1. Certify compliance with test parameters.
- B. Correct malfunctioning conductors and cables at Project site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units and re-test.

END OF SECTION 16120

SECTION 16130 - RACEWAYS AND BOXES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

- 1. Raceways include the following:

- a. RMC.
 - b. EMT.
 - c. FMC.
 - d. LFMC.
 - e. RNC.
 - f. Wireways.
 - g. Surface raceways.

- 2. Boxes, enclosures, and cabinets include the following:

- a. Device boxes.
 - b. Floor boxes.
 - c. Outlet boxes.
 - d. Pull and junction boxes.
 - e. Cabinets and hinged-cover enclosures.

- B. Related Sections include the following:

- 1. Division 16 Section "Basic Electrical Materials and Methods" for raceways and box supports.
 - 2. Division 16 Section "Wiring Devices" for devices installed in boxes and for floor-box service fittings.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. FMC: Flexible metal conduit.
- C. LFMC: Liquidtight flexible metal conduit.
- D. RMC: Rigid metal conduit.
- E. RNC: Rigid nonmetallic conduit.

1.4 SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: Include layout drawings showing components and wiring for nonstandard boxes, enclosures, and cabinets.

1.5 QUALITY ASSURANCE

- A. Listing and Labeling: Provide raceways and boxes specified in this Section that are listed and labeled.
 - 1. The Terms "Listed" and "Labeled": As defined in NFPA 70, Article 100.
- B. Comply with NECA's "Standard of Installation."
- C. Comply with NFPA 70.

1.6 COORDINATION

- A. Coordinate layout and installation of raceways and boxes with other construction elements to ensure adequate headroom, working clearance, and access.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Metal Conduit and Tubing:
 - a. Anaconda Metal Hose.
 - b. Allied Tube and Conduit Div.
 - c. Triangle PWC, Inc.
 - d. Wheatland Tube Co.
 - 2. Nonmetallic Conduit and Tubing:
 - a. Carlon Electrical Products.
 - b. Thomas & Betts Corp.
 - 3. Conduit Bodies and Fittings:
 - a. Appleton Electric Co.
 - b. O-Z/Gedney.
 - c. Spring City Electrical Manufacturing Co.
 - d. Carlon Electrical Products.
 - 4. Metal Wireways:
 - a. Wiremold Co.
 - b. Walkerduct Inc.

5. Surface Metal Raceways:
 - a. Wiremold Co. (The); Electrical Sales Division.
 - b. Walkerdut, Inc.

6. Boxes, Enclosures, and Cabinets:
 - a. Hoffman Engineering Co.
 - b. Raco, Inc.
 - c. Thomas & Betts Corp.
 - d. Appleton Electric Co.

2.2 METAL CONDUIT AND TUBING

- A. Rigid Steel Conduit: ANSI C80.1.
- B. EMT Couplings and Fittings: ANSI C80.3.
 1. Select 1 of 3 subparagraphs below.
 2. Fittings: All steel concrete tight set-screw or all steel raintight compression type (cast alloy couplings and fittings are not acceptable).
- C. FMC: Zinc-coated steel.
- D. LFMC: Flexible steel conduit with PVC jacket.

2.3 NONMETALLIC CONDUIT AND TUBING

- A. RNC: NEMA TC 2, Schedule 40 PVC.
- B. RNC Fittings: NEMA TC 3; match to conduit or conduit type and material.

2.4 METAL WIREWAYS

- A. Material: Sheet metal sized and shaped as indicated.
- B. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- C. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70.
- D. Wireway Covers: Screw-cover type.
- E. Finish: Manufacturer's standard enamel finish.

2.5 SURFACE RACEWAYS

- A. Surface Metal Raceways: Galvanized steel with snap-on covers. Finish with manufacturer's standard prime coating.

- B. Types, sizes, and channels as indicated and required for each application, with fittings that match and mate with raceways.

2.6 OUTLET AND DEVICE BOXES

- A. Sheet Metal Boxes: NEMA OS 1.
- B. Cast-Metal Boxes: NEMA FB 1, Type FD, cast box with gasketed cover.
- C. Nonmetallic Boxes: NEMA OS 2.

2.7 FLOOR BOXES

- A. Floor Boxes: Cast metal, fully adjustable, rectangular.

2.8 PULL AND JUNCTION BOXES

- A. Small Sheet Metal Boxes: NEMA OS 1.
- B. Cast-Metal Boxes: NEMA FB 1, cast aluminum with gasketed cover.

2.9 ENCLOSURES AND CABINETS

- A. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous hinge cover and flush latch.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces to receive raceways, boxes, enclosures, and cabinets for compliance with installation tolerances and other conditions affecting performance of raceway installation. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 WIRING METHODS

- A. Outdoors: Use the following wiring methods:
 - 1. Exposed: Rigid steel.
 - 2. Concealed: Rigid steel or RNC.
 - 3. Underground, Single Run: RNC.
 - 4. Underground, Grouped: RNC.
 - 5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
 - 6. Boxes and Enclosures: NEMA 250, Type 3R or Type 4.
- B. Indoors: Use the following wiring methods:

1. Exposed: EMT.
2. Concealed: EMT, RNC, or "MC" cable.
3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC; except in wet or damp locations, use LFMC.
4. Damp or Wet Locations: Rigid steel conduit or RNC.
5. Boxes and Enclosures: NEMA 250, Type 1, except as follows:
 - a. Damp or Wet Locations: NEMA 250, Type 3R.

3.3 INSTALLATION

- A. Install raceways, boxes, enclosures, and cabinets as indicated, according to manufacturer's written instructions.
- B. Minimum Raceway Size: 1/2-inch trade size (DN16).
- C. Minimum Homerun Size: 3/4-inch trade size (DN21).
- D. EMT shall be concealed within new finished walls, and above suspended ceilings.
- E. RNC shall be concealed below slabs and grade.
- F. Install raceways level and square and at proper elevations. Provide adequate headroom.
- G. Complete raceway installation before starting conductor installation.
- H. Support raceways as specified in Division 16 Section "Basic Electrical Materials and Methods."
- I. Use temporary closures to prevent foreign matter from entering raceways.
- J. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portion of bends is not visible above the finished slab.
- K. Make bends and offsets so ID is not reduced. Keep legs of bends in the same plane and straight legs of offsets parallel, unless otherwise indicated.
- L. Use raceway fittings compatible with raceways and suitable for use and location. For rigid steel conduit, use threaded rigid steel conduit fittings, for EMT use all steel set screw or compression fittings.
- M. Run concealed raceways, with a minimum of bends, in the shortest practical distance considering the type of building construction and obstructions, unless otherwise indicated.
- N. Install exposed raceways parallel to or at right angles to nearby surfaces or structural members, and follow the surface contours as much as practical.
 1. Run parallel or banked raceways together, on common supports where practical.
 2. Make bends in parallel or banked runs from same centerline to make bends parallel. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.
- O. Join raceways with fittings designed and approved for the purpose and make joints tight.
 1. Make raceway terminations tight. Use bonding bushings or wedges at connections subject to vibration. Use bonding jumpers where joints cannot be made tight.

2. Use insulating bushings to protect conductors.
- P. Tighten set screws of threadless fittings with suitable tools.
- Q. Terminations: Where raceways are terminated with locknuts and bushings, align raceways to enter squarely and install locknuts with dished part against the box. Where terminations are not secure with 1 locknut, use 2 locknuts: 1 inside and 1 outside the box.
- R. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align raceways so the coupling is square to the box and tighten the chase nipple so no threads are exposed.
- S. Install pull wires in empty raceways. Use No. 14 AWG zinc-coated steel or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of the pull wire.
- T. Telephone and Signal System Raceways, 2-Inch Trade Size (DN53) and Smaller: In addition to the above requirements, install raceways in maximum lengths of 150 feet (45 m) and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements.
- U. Install raceway sealing fittings according to manufacturer's written instructions. Locate fittings at suitable, approved, and accessible locations and fill them with UL-listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
 1. Where conduits pass from warm to cold locations, such as the boundaries of refrigerated spaces.
 2. Where otherwise required by NFPA 70.
- V. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment. Install with an adjustable top or coupling threaded inside for plugs set flush with the finished floor. Extend conductors to equipment with rigid steel conduit; FMC may be used 6 inches (150 mm) above the floor. Install screwdriver-operated, threaded flush plugs flush with floor for future equipment connections.
- W. Flexible Connections: Use maximum of 6 feet (1830 mm) of flexible conduit for recessed and semirecessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for all motors. Use liquidtight flexible conduit in wet or damp locations. Install separate ground conductor across flexible connections.
- X. Surface Raceways: Install a separate, green, ground conductor in raceways from junction box supplying the raceways to receptacle or fixture ground terminals.
- Y. Set floor boxes level and trim after installation to fit flush to finished floor surface.
- Z. Install hinged-cover enclosures and cabinets plumb. Support at each corner.

3.4 PROTECTION

- A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure coatings, finishes, and cabinets are without damage or deterioration at the time of Substantial Completion.
1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

3.5 CLEANING

- A. On completion of installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish, including chips, scratches, and abrasions.

END OF SECTION 16130

SECTION 16140 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes receptacles, connectors, switches, and finish plates.

1.3 DEFINITIONS

- A. GFCI: Ground-fault circuit interrupter.

1.4 SUBMITTALS

- A. Product Data: For each product specified.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.
- B. Comply with NEMA WD 1.
- C. Comply with NFPA 70.

1.6 COORDINATION

- A. Receptacles for Owner-Furnished Equipment: Match plug configurations.
 - 1. Cord and Plug Sets: Match equipment requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Wiring Devices:
 - a. Bryant Electric, Inc.

- b. Eagle Electric Manufacturing Co., Inc.
- c. GE Company; GE Wiring Devices.
- d. Hubbell, Inc.; Wiring Devices Div.
- e. Leviton Manufacturing Co., Inc.
- f. Pass & Seymour/Legrand; Wiring Devices Div.

2.2 RECEPTACLES

- A. Straight-Blade and Locking Receptacles: Heavy-Duty (specification) grade.
- B. GFCI Receptacles: Feed-through type, with integral NEMA WD 6, Configuration 5-20R duplex receptacle for installation in a 2-3/4-inch- (70-mm-) deep outlet box without an adapter.
- C. Isolated-Ground Receptacles: Equipment grounding contacts connected only to the green grounding screw terminal of the device with inherent electrical isolation from mounting strap.
 - 1. Devices: Listed and labeled as isolated-ground receptacles.
 - 2. Isolation Method: Integral to receptacle construction and not dependent on removable parts.
- D. Industrial Heavy-Duty Receptacle: Comply with IEC 309-1.

2.3 PENDANT CORD/CONNECTOR DEVICES

- A. Description: Matching, locking type, plug and receptacle body connector, NEMA WD 6, Configuration, Heavy-Duty grade, as indicated on the electrical drawings.
 - 1. Body: Nylon with screw-open cable-gripping jaws and provision for attaching external cable grip.
 - 2. External Cable Grip: Woven wire-mesh type made of high-strength galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

2.4 CORD AND PLUG SETS

- A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.
 - 1. Cord: Rubber-insulated, stranded-copper conductors, with type SOW-A jacket. Green-insulated grounding conductor, and equipment-rating ampacity plus a minimum of 30 percent.
 - 2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.5 SWITCHES

- A. Snap Switches: Heavy-duty, specification grade, quiet type.
- B. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on/off switches and audible and electromagnetic noise filters.
 - 1. Control: Continuously adjustable slide, toggle, or rotary knob. Single-pole or three-way switch to suit connections.

2. Incandescent Lamp Dimmers: Modular, 120 V, 60 Hz with continuously adjustable rotary knob, toggle, or slide; single pole with soft tap or other quiet switch; electromagnetic filter to eliminate noise, RF, and TV interference; and 5-inch wire connecting leads.
3. Fluorescent Lamp Dimmers: Modular; compatible with dimmer ballasts; trim potentiometer to adjust low-end dimming; dimmer-ballast combination capable of consistent dimming to a maximum of 1 percent of full brightness.

2.6 WALL PLATES

- A. Single and combination types match corresponding wiring devices.
 1. Plate-Securing Screws: Metal with head color to match plate finish.
 2. Material for Finished Spaces: Smooth nylon, white color.
 3. Material for Unfinished Spaces: Galvanized steel.

2.7 FINISHES

- A. Color: White, unless otherwise indicated or required by Code.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install devices and assemblies plumb and secure.
- B. Install wall plates when painting is complete.
- C. Install wall dimmers to achieve indicated rating after derating for ganging as instructed by manufacturer.
- D. Do not share neutral conductor on load side of dimmers.
- E. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical, and grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.
- F. Protect devices and assemblies during painting.
- G. Adjust locations at which floor service outlets and telephone/power service poles are installed to suit arrangement of partitions and furnishings.

3.2 IDENTIFICATION

- A. Comply with Division 16 Section "Basic Electrical Materials and Methods."
 1. Switches: Where three or more switches are ganged, and elsewhere as indicated, identify each switch with approved legend engraved on wall plate.
 2. Receptacles: Identify panelboard and circuit number from which served. Use machine-printed, pressure-sensitive, abrasion-resistant label tape on face of plate and durable wire markers or tags within outlet boxes.

3.3 CONNECTIONS

- A. Connect wiring device grounding terminal to outlet box with bonding jumper.
- B. Connect wiring device grounding terminal to branch-circuit equipment grounding conductor.

3.4 FIELD QUALITY CONTROL

- A. Test wiring devices for proper polarity and ground continuity. Operate each device at least six times.
- B. Test GFCI operation with both local and remote fault simulations according to manufacturer's written instructions.
- C. Replace damaged or defective components.

3.5 CLEANING

- A. Internally clean devices, device outlet boxes, and enclosures. Replace stained or improperly painted wall plates or devices.

END OF SECTION 16140

SECTION 16145 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes time switches and occupancy sensors.
- B. Related Sections include the following:
 - 1. Division 13 Section "Lighting Controls" for low-voltage, manual and programmable lighting control systems.
 - 2. Division 16 Section "Wiring Devices" for wall-box dimmers and manual light switches.

1.3 SUBMITTALS

- A. Product Data: Include dimensions and data on features, components, and ratings for lighting control devices.
- B. Samples: Occupancy sensors for color selection and evaluation of technical features.
- C. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
- D. Maintenance Data: For lighting control devices to include in maintenance manuals specified in Division 1.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain lighting control devices from a single source with total responsibility for compatibility of lighting control system components specified in this Section, in Division 13 Section "Lighting Controls."
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, for their indicated use and installation conditions by a testing agency acceptable to authorities having jurisdiction.
- C. Comply with 47 CFR 15, Subparts A and B, for Class A digital devices.
- D. Comply with NFPA 70.

1.5 COORDINATION

- A. Coordinate features of devices specified in this Section with systems and components specified in other Sections to form an integrated system of compatible components. Match components and interconnections for optimum performance of specified functions. Include coordination with the following:
1. Division 13 Section "Lighting Controls."
 2. Division 16 Section "Panelboards."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Contactors and Relays:
 - a. Automatic Switch Co.
 - b. Challenger Electrical Equipment Corp.
 - c. Cutler-Hammer Products; Eaton Corporation.
 - d. Furnas Electric Co.
 - e. GE Lighting Controls.
 - f. Hubbell Lighting, Inc.
 - g. Siemens Energy and Automation, Inc.
 - h. Square D Co.; Power Management Organization.
 - i. Zenith Controls, Inc.
 2. Time Switches:
 - a. Diversified Electronics, Inc.
 - b. Grasslin Controls Corp.
 - c. Intermatic, Inc.
 - d. Leviton Manufacturing.
 - e. Paragon Electric Co., Inc.
 - f. Tork, Inc.
 - g. Zenith Controls, Inc.
 3. Occupancy Sensors:
 - a. Arrow Hart Wiring Devices.
 - b. BRK Electronics.
 - c. Bryant Electric.
 - d. Honeywell, Inc.; Home and Building Controls.
 - e. Hubbell Lighting, Inc.
 - f. Lightolier.
 - g. Lithonia Control Systems.
 - h. MyTech Corporation.
 - i. Novitas, Inc.
 - j. RAB Electric Manufacturing Co., Inc.
 - k. SenTec, Inc.
 - l. Sterner Lighting Systems, Inc.
 - m. Tork, Inc.

- n. Touchplate.
- o. Unenco Electronics (A Hubbell Co.).
- p. Watt Stopper, Inc. (The).

2.2 GENERAL LIGHTING CONTROL DEVICE REQUIREMENTS

- A. Line-Voltage Surge Protection: Include in all 120- and 277-V solid-state equipment. Comply with UL 1449 and with ANSI C62.41 for Category A locations.

2.3 TIME SWITCHES

- A. Description: Solid-state programmable units with alphanumeric display complying with UL 917.
- B. Description: Electromechanical-dial type complying with UL 917.
 - 1. Astronomic dial.
 - 2. Two contacts, rated 30 A at 277-V ac, unless otherwise indicated.
 - 3. Two pilot-duty contacts, rated 2 A at 240-V ac, unless otherwise indicated.
 - 4. Eight-day program uniquely programmable for each weekday and holidays.
 - 5. Skip-day mode.

2.4 OCCUPANCY SENSORS

- A. Ceiling-Mounting Units: Unit receives control power from a separately mounted auxiliary power and control unit, and operates power switching contacts in that unit.
- B. Ceiling-Mounting Units: Unit receives 24-V dc power from a remote source and, on sensing occupancy, closes contacts that provide signal input to a remote microprocessor-based lighting control system.
- C. Switch-Box-Mounting Units: Unit receives power directly from switch leg of the 120- or 277-V ac circuit it controls and operates integral power switching contacts rated 800 W at 120-V ac, and 1000 W at 277-V ac, minimum.
- D. Operation: Turns lights on when room or covered area is occupied and off when unoccupied, unless otherwise indicated.
 - 1. Time Delay for Turning Lights Off: Adjustable over a range from 1 to 15 minutes, minimum.
 - 2. Manual Override Switch: Turns lights off manually regardless of elapsed time delay.
 - 3. Ambient-Light-Level Control: Adjustable for setting a level of ambient illumination above which sensor will not turn lights on when occupancy is sensed.
 - 4. Isolated Relay Contact: Operates on detection of occupancy or vacancy, as indicated, to activate an independent function.
- E. Auxiliary Power and Control Units: As follows:
 - 1. Relays rated for a minimum of 20-A normal ballast load or 13-A tungsten filament or high-inrush ballast load.
 - 2. Sensor Power Supply: Rated to supply the number of connected sensors.
- F. Passive-Infrared Type: Detects occupancy by a combination of heat and movement in zone of coverage. Each sensor detects occupancy anywhere in an area of 1000 sq. ft. by detecting occurrence of 6-inch

minimum movement of any portion of a human body that presents a minimum target of 36 sq. in. to the sensor.

- G. Ultrasonic Type: Emits a beam of ultrasonic energy and detects occupancy through use of Doppler's principle in discerning movement in zone of coverage by sensing a change in pattern of reflected ultrasonic energy.
- H. Dual-Technology Type: Uses a combination of passive-infrared and ultrasonic detection methods to distinguish between occupied and unoccupied conditions for area covered. Particular technology or combination of technologies that controls each function (on or off) is selectable in the field by operating controls on unit.

2.5 MULTIPOLE CONTACTORS AND RELAYS

- A. Description: Electrically operated and mechanically held, and complying with UL 508 and NEMA ICS 2.
 - 1. Current Rating for Switching: UL listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballasts with 15 percent or less total harmonic distortion of normal load current).
 - 2. Control Coil Voltage: Match control power source.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install equipment level and plumb and according to manufacturer's written instructions.
- B. Mount lighting control devices according to manufacturer's written instructions and requirements in Division 16 Section "Basic Electrical Materials and Methods."
- C. Mounting heights indicated are to bottom of unit for suspended devices and to center of unit for wall-mounting devices.

3.2 CONTROL WIRING INSTALLATION

- A. Install wiring between sensing and control devices according to manufacturer's written instructions and as specified in Division 16 Section "Conductors and Cables" for low-voltage connections and Division 16 Section "Voice and Data Systems" for digital circuits.
- B. Wiring Method: Install all wiring in raceway as specified in Division 16 Section "Raceways and Boxes."
- C. Wiring Method: Install all wiring in raceway as specified in Division 16 Section "Raceways and Boxes," unless run in accessible ceiling space and gypsum board partitions.
- D. Bundle, train, and support wiring in enclosures.
- E. Ground equipment.
- F. Connections: Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.

3.3 IDENTIFICATION

- A. Identify components and power and control wiring according to Division 16 Section "Basic Electrical Materials and Methods."
- B. Identify components and power and control wiring according to Division 16 Section "Electrical Identification."

3.4 FIELD QUALITY CONTROL

- A. Schedule visual and mechanical inspections and electrical tests with at least seven days' advance notice.
- B. Inspect control components for defects and physical damage, testing laboratory labeling, and nameplate compliance with the Contract Documents.
- C. Check tightness of electrical connections with torque wrench calibrated within previous six months. Use manufacturer's recommended torque values.
- D. Verify settings of photoelectric devices with photometer calibrated within previous six months.
- E. Electrical Tests: Use particular caution when testing devices containing solid-state components. Perform the following according to manufacturer's written instructions:
 - 1. Continuity tests of circuits.
 - 2. Operational Tests: Set and operate devices to demonstrate their functions and capabilities in a methodical sequence that cues and reproduces actual operating functions.
 - a. Include testing of devices under conditions that simulate actual operational conditions. Record control settings, operations, cues, and functional observations.
- F. Correct deficiencies, make necessary adjustments, and retest. Verify that specified requirements are met.
- G. Test Labeling: After satisfactory completion of tests and inspections, apply a label to tested components indicating test results, date, and responsible agency and representative.
- H. Reports: Written reports of tests and observations. Record defective materials and workmanship and unsatisfactory test results. Record repairs and adjustments.

3.5 CLEANING

- A. Cleaning: Clean equipment and devices internally and externally using methods and materials recommended by manufacturers, and repair damaged finishes.

3.6 DEMONSTRATION

- A. Coordinate with training for low-voltage, programmable lighting control system specified in Division 13 Section "Lighting Controls."
- B. Engage a factory-authorized service representative to train Owner's maintenance personnel as specified below:

1. Train Owner's maintenance personnel on troubleshooting, servicing, adjusting, and preventive maintenance. Provide a minimum of three hours' training.
2. Training Aid: Use the approved final version of maintenance manuals as a training aid.
3. Schedule training with Owner, through Architect, with at least seven days' advance notice.

3.7 ON-SITE ASSISTANCE

- A. Occupancy Adjustments: Within one year of date of Substantial Completion, provide up to three Project site visits, when requested, to adjust light levels, make program changes, and adjust sensors and controls to suit actual conditions.

END OF SECTION 16145

SECTION 16415 - TRANSFER SWITCHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes transfer switches rated 600 V and less, including the following:
 - 1. Automatic transfer switch.

1.3 SUBMITTALS

- A. Product Data: Include ratings and dimensioned plans, sections, and elevations showing minimum clearances, conductor entry provisions, gutter space, installed features and devices, and material lists for each switch specified.
- B. Wiring Diagrams: Detail wiring for transfer switches and differentiate between manufacturer-installed and field-installed wiring. Show both power and control wiring.
- C. Maintenance Data: Include all features and operating sequences, both automatic and manual. List all factory settings of relays and provide relay-setting and calibration instructions.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, for emergency service under UL 1008, by a testing agency acceptable to authorities having jurisdiction.
- B. Comply with NEMA ICS 1.
- C. Comply with NFPA 70.
- D. Comply with NFPA 110.
- E. Comply with UL 1008.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Conventional Transfer Switches:
 - a. Caterpillar, Inc.; Engine Division.
 - b. Automatic Switch Co. (ASCO).
 - c. Kohler Co.
 - d. Onan Corp.; Electrical Products Division.
 - e. Spectrum Detroit Diesel.
 - f. Lakeshore Electric Corporation.

2.2 GENERAL TRANSFER-SWITCH PRODUCT REQUIREMENTS

- A. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading.
- B. Tested Fault-Current Closing and Withstand Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.
- C. Solid-State Controls: Repetitive accuracy of all settings is plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.
- D. Resistance to Damage by Voltage Transients: Components meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.41. Components meet or exceed voltage-impulse withstand test of NEMA ICS 1.
- E. Switched, Overlapping, Neutral Contacts or solid and fully rated, as indicated.
- F. Enclosures: General-purpose NEMA 250, Type 1, complying with NEMA ICS 6; UL 508, unless otherwise indicated.
- G. Factory Wiring: Train and bundle factory wiring and label consistent with Shop Drawings, either by color code or by numbered or lettered wire and cable tape markers at terminations.
 1. Designated Terminals: Pressure type suitable for types and sizes of field wiring indicated.
 2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.
 3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.
- H. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism, mechanically and electrically interlocked in both directions.
- I. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.
 1. Limitation: Switches using molded-case switches or circuit breakers or insulated-case circuit-breaker components are not acceptable.
 2. Switch Action: Double throw; mechanically held in both directions.
 3. Contacts: Silver composition or silver alloy for load-current switching. Conventional automatic transfer-switch units rated 225 A and greater have separate arcing contacts.

2.3 AUTOMATIC TRANSFER SWITCHES

- A. Comply with Level 1 equipment according to NFPA 110.

- B. Switching Arrangement: Double-throw type, incapable of pauses or intermediate position stops during normal functioning, unless otherwise indicated.
- C. Manual Switch Operation: Control circuit automatically disconnects from electrical operator during manual operation.
- D. Signal-before-Transfer Contacts: A set of normally open/normally closed dry contacts operates in advance of retransfer to normal source. Interval is adjustable from 1 to 30 seconds.

2.4 AUTOMATIC TRANSFER-SWITCH FEATURES

- A. Undervoltage Sensing for Each Phase of Normal Source: Senses low phase-to-ground voltage on each phase. Pickup voltage is adjustable from 85 to 100 percent of nominal, and dropout voltage is adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.
- B. Time delay for override of normal-source voltage sensing delays transfer and engine start signals. Adjustable from zero to six seconds, and factory set for one second.
- C. Voltage/Frequency Lockout Relay: Prevents premature transfer to generator set. Pickup voltage is adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency is adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.
- D. Time Delay for Retransfer to Normal Source: Adjustable from 0 to 30 minutes; factory set for 10 minutes. Provides automatic defeat of delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
- E. Test Switch: Simulates normal-source failure.
- F. Switch-Position Pilot Lights: Indicate source to which load is connected.
- G. Source-Available Indicating Lights: Supervise sources via transfer-switch, normal- and emergency-source sensing circuits.
 1. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
 2. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."
- H. Unassigned Auxiliary Contacts: Two normally open single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.
- I. Transfer Override Switch: Overrides automatic retransfer control so automatic transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.
- J. Engine Starting Contacts: One isolated, normally closed and one isolated, normally open, rated 10A at 48-V dc minimum.
- K. Engine Shutdown Contacts: Time delay adjustable from zero to five minutes; factory set for five minutes. Initiates shutdown at remote engine-generator controls after retransfer of load to normal source.
- L. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine-generator set and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a

preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods are adjustable from 10 to 30 minutes. Factory settings are for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:

2.5 FINISHES

- H. Enclosures: Manufacturer's standard enamel over corrosion-resistant pretreatment and primer.

2.6 SOURCE QUALITY CONTROL

- A. Factory Test Components, Assembled Switches, and Associated Equipment: Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Four-Pole Switches: Where four-pole switches are indicated, install neutral switching.

3.2 INSTALLATION

- A. Floor-Mounted Switch: Level and anchor unit to floor.
- B. Identify components according to Division 16 Section "Basic Electrical Materials and Methods".

3.3 CONNECTIONS

- A. Ground equipment as indicated and as required by NFPA 70.

3.4 FIELD QUALITY CONTROL

- A. Testing: Perform the following field quality-control testing under the supervision of the manufacturer's factory-authorized service representative in addition to tests recommended by the manufacturer.
 1. Before energizing equipment, after transfer-switch products have been installed:
 - a. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Meet manufacturer's specified minimum resistance.
 - b. Check for electrical continuity of circuits and for short circuits.
 - c. Inspect for physical damage; proper installation and connection; and integrity of barriers, covers, and safety features.
 - d. Verify that manual transfer warnings are properly placed.
 - e. Perform manual transfer operation.
 2. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.
 - a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
 - b. Simulate loss of phase-to-ground voltage for each phase of normal source.

- c. Verify time-delay settings.
- d. Verify pickup and dropout voltages by data readout or inspection of control settings.
- e. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for one pole deviating by more than 50 percent from other poles.
- f. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown sequence.

B. Coordinate tests with tests of generator plant and run them concurrently.

C. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.

3.5 CLEANING

A. After completing equipment installation, inspect unit components. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

B. Clean equipment internally, on completion of installation, according to manufacturer's written instructions.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's personnel to adjust, operate, and maintain transfer switches and related equipment as specified below:

- 1. Coordinate this training with that for generator equipment.
- 2. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment.
- 3. Review data in maintenance manuals.
- 4. Schedule training with at least seven days' advance notice.

END OF SECTION 16415

SECTION 16442 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes load centers and panelboards, overcurrent protective devices, and associated auxiliary equipment rated 600 V and less for the following types:
 - 1. Lighting and appliance branch-circuit panelboards.

1.3 SUBMITTALS

- A. Product Data: For each type of panelboard, overcurrent protective device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings. Include the following:
 - a. Enclosure types and details for types other than NEMA 250, Type 1.
 - b. Bus configuration, current, and voltage ratings.
 - c. Short-circuit current rating of panelboards and overcurrent protective devices.
 - d. UL listing for series rating of installed devices.
 - e. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
- C. Field Test Reports: Submit written test reports and include the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
- D. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.
- E. Maintenance Data: For panelboards and components to include in maintenance manuals specified in Division 1.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

- B. Comply with NEMA PB 1.
- C. Comply with NFPA 70.

1.5 COORDINATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, and encumbrances to workspace clearance requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Panelboards, Overcurrent Protective Devices, Controllers, Contactors, and Accessories:
 - a. Cutler-Hammer Products.
 - b. General Electric Co.
 - c. Siemens Energy & Automation, Inc.
 - d. Square D Co.

2.2 FABRICATION AND FEATURES

- A. Enclosures: Flush- or surface-mounted cabinets as indicated on the electrical drawings. NEMA PB 1, Type 1, to meet environmental conditions at installed location.
 - 1. Outdoor Locations: NEMA 250, Type 3R.
- B. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
- C. Hinged Front Cover: Front trim bolted to box with standard door within hinged trim cover.
- D. Finish: Manufacturer's standard enamel finish over corrosion-resistant treatment or primer coat.
- E. Directory Card: With transparent protective cover, mounted inside metal frame, inside panelboard door.
- F. Bus: Hard-drawn copper, 98 percent conductivity.
- G. Main and Neutral Lugs: Mechanical type suitable for use with conductor material.
- H. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductors; bonded to box.
- I. Service Equipment Label: UL labeled for use as service equipment for panelboards with main service disconnect where indicated on the electrical drawings.
- J. Future Devices: Mounting brackets, bus connections, and necessary appurtenances required for future installation of devices.

2.3 PANELBOARD SHORT-CIRCUIT RATING

- A. UL label indicating series-connected rating with integral or remote upstream devices. Include size and type of upstream device allowable, branch devices allowable, and UL series-connected short-circuit rating.

2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units. (Plug-in breakers are not acceptable.)
- B. Doors: Front mounted with concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.5 OVERCURRENT PROTECTIVE DEVICES

- A. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 400 A and larger.
- B. Molded-Case Circuit-Breaker Features and Accessories. Standard frame sizes, trip ratings, and number of poles.
 - 1. Lugs: Mechanical style, suitable for number, size, trip ratings, and material of conductors.
 - 2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
 - 3. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - 4. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install panelboards and accessories according to NEMA PB 1.1.
- B. Mounting Heights: Top of trim 74 inches (1880 mm) above finished floor, unless otherwise indicated.
- C. Mounting: Plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish.
- D. Circuit Directory: Create a directory to indicate installed circuits. Obtain approval before installing. Use a computer generated or typewritten directory; handwritten directories are not acceptable.
- E. Install filler plates in unused spaces.
- F. Provision for Future Circuits at Flush Panelboards: Stub four 3/4-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 3/4-inch empty conduits into raised floor space.

- G. Wiring in Panelboard Gutters: Arrange conductors into groups and bundle and wrap with wire ties after completing load balancing.

3.2 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 16 Section "Basic Electrical Materials and Methods."
- B. Panelboard Nameplates: Label each panelboard with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

3.3 CONNECTIONS

- A. Install equipment grounding connections for panelboards with ground continuity to main electrical ground bus.
- B. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486.

3.4 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows:
 - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- B. Testing: After installing panelboards and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
 - 1. Procedures: Perform each visual and mechanical inspection and electrical test indicated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.5 ADJUSTING

- A. Set field-adjustable circuit-breaker trip ranges.

3.6 CLEANING

- A. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION 16442

SECTION 16485 - ELECTRIC DOMESTIC WATER HEATERS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Light-commercial electric water heaters.
 - 2. Commercial electric booster heaters.
 - 3. Commercial, storage electric water heaters.
 - 4. Water heater accessories.

1.2 SUBMITTALS

- A. Product Data: For each type and size of water heater indicated. Include rated capacities, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Operation and maintenance data.
- D. Warranty.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. ASME Compliance: Where ASME-code construction is indicated, fabricate and label commercial water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- C. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9" for all components that will be in contact with potable water.

1.4 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of electric water heaters that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including storage tank and supports.
 - b. Faulty operation of controls.

- c. Deterioration of metals, metal finishes, and other materials beyond normal use.
2. Warranty Period(s): From date of Substantial Completion:
- a. Household Electric Water Heaters: Six years.
 - b. Commercial Electric Water Heaters: Three years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
- 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 HOUSEHOLD ELECTRIC WATER HEATERS

- A. Household, Standard, Storage Electric Water Heaters: Comply with UL 174.
- 1. Available Manufacturers:
 - a. American Water Heater Company.
 - b. Bradford White Corporation.
 - c. Electric Heater Company (The); Hubbell Heaters Division.
 - d. GSW Water Heating Company.
 - e. Heat Transfer Products, Inc.
 - f. HESco Industries, Inc.
 - g. Lochinvar Corporation.
 - h. Maytag Corp.; Water Heating Appliances Div.
 - i. Rheem Water Heater Div.; Rheem Manufacturing Company.
 - j. Ruud Water Heater Div.; Rheem Manufacturing Company.
 - k. Smith, A. O. Water Products Company.
 - l. State Industries, Inc.
 - m. Vaughn Manufacturing Corporation.
 - 2. Storage-Tank Construction: Steel.
 - a. Tappings: ASME B1.20.1 pipe thread.
 - b. Pressure Rating: 150 psig.
 - c. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending lining material into tappings.
 - 3. Factory-Installed Storage-Tank Appurtenances:

- a. Anode Rod: Replaceable magnesium.
- b. Dip Tube: Provide unless cold-water inlet is near bottom of tank.
- c. Drain Valve: ASSE 1005.
- d. Insulation: Comply with ASHRAE/IESNA 90.1 or ASHRAE 90.2.
- e. Jacket: Steel with enameled finish.
 - 1) Standard: Cylindrical shape.
 - 2) Tabletop: Rectangular shape, with flat-top work surface and raised back.
- f. Heat Trap Fittings: Inlet type in cold-water inlet and outlet type in hot-water outlet.
- g. Heating Elements: Two; electric, screw-in immersion type with 12 kW or less total, and wired for nonsimultaneous operation, unless otherwise indicated.
- h. Temperature Control: Adjustable thermostat for each element.
- i. Safety Control: High-temperature-limit cutoff device or system.
- j. Relief Valve: ASME rated and stamped and complying with ASME PTC 25.3 for combination temperature and pressure relief valves. Include relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select relief valve with sensing element that extends into storage tank.

2.3 LIGHT-COMMERCIAL ELECTRIC WATER HEATERS

- A. Description: Comply with UL 174 for household, storage electric water heaters.

- 1. Available Manufacturers:

- a. American Water Heater Company.
- b. Bradford White Corporation.
- c. Electric Heater Company (The); Hubbell Heaters Division.
- d. GSW Water Heating Company.
- e. Heat Transfer Products, Inc.
- f. Lochinvar Corporation.
- g. Rheem Water Heater Div.; Rheem Manufacturing Company.
- h. Ruud Water Heater Div.; Rheem Manufacturing Company.
- i. Smith, A. O. Water Products Company.
- j. State Industries, Inc.

- 2. Storage-Tank Construction: Steel, vertical arrangement.

- a. Tappings: ASME B1.20.1 pipe thread.
- b. Pressure Rating: 150 psig.
- c. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending lining material into tappings.

- 3. Factory-Installed Storage-Tank Appurtenances:

- a. Anode Rod: Replaceable magnesium.

- b. Dip Tube: Provide unless cold-water inlet is near bottom of tank.
- c. Drain Valve: ASSE 1005.
- d. Insulation: Comply with ASHRAE/IESNA 90.1 or ASHRAE 90.2.
- e. Jacket: Steel with enameled finish.
- f. Heat Trap Fittings: Inlet type in cold-water inlet and outlet type in hot-water outlet.
- g. Heating Elements: Two; electric, screw-in immersion type; wired for simultaneous operation, unless otherwise indicated.
- h. Temperature Control: Adjustable thermostat for each element.
- i. Safety Control: High-temperature-limit cutoff device or system.
- j. Relief Valve: ASME rated and stamped and complying with ASME PTC 25.3 for combination temperature and pressure relief valves. Include relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select relief valve with sensing element that extends into storage tank.

4. Special Requirements: NSF 5 construction with legs for off-floor installation.

2.4 COMMERCIAL ELECTRIC WATER HEATERS

A. Commercial Electric Booster Heaters: Comply with UL 1453 requirements for booster-type water heaters.

1. Available Manufacturers:

- a. Bradford White Corporation.
- b. Coates Heater Co.
- c. Electric Heater Company (The); Hubbell Heaters Division.
- d. Hatco Corporation.
- e. Lochinvar Corporation.
- f. Rheem Water Heater Div.; Rheem Manufacturing Company.
- g. Ruud Water Heater Div.; Rheem Manufacturing Company.
- h. Smith, A. O. Water Products Company.

2. Storage-Tank Construction: Corrosion-resistant metal.

- a. Tappings: ASME B1.20.1 pipe thread.
- b. Pressure Rating: 150 psig.
- c. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending lining material into tappings.

3. Factory-Installed Storage-Tank Appurtenances:

- a. Anode Rod: Replaceable magnesium.
- b. Drain Valve: Corrosion-resistant metal complying with ASSE 1005.
- c. Insulation: Comply with ASHRAE/IESNA 90.1.
- d. Jacket: Rectangular shaped, with stainless-steel front panel, unless otherwise indicated.
- e. Heating Elements: Electric, screw-in or bolt-on immersion type arranged in multiples of three.

- 1) Option: Booster heaters with 9 kW or less total may have 2 or 3 elements.
 - f. Temperature Control: Adjustable thermostat, to setting of at least 180 deg F.
 - g. Safety Controls: High-temperature-limit and low-water cutoff devices or systems.
 - h. Relief Valve: ASME rated and stamped and complying with ASME PTC 25.3, combination temperature and pressure relief valve. Include relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select relief valve with sensing element that extends into storage tank.
 - i. Gages: Combination temperature and pressure type or separate thermometer and pressure gage.
4. Special Requirements: NSF 5 construction with brackets for undercounter and legs for floor installation.
- B. Commercial, Storage Electric Water Heaters: Comply with UL 1453 requirements for storage-tank-type water heaters.
1. Available Manufacturers:
 - a. American Water Heater Company.
 - b. Bock Water Heaters, Inc.
 - c. Bradford White Corporation.
 - d. Cemline Corporation.
 - e. Electric Heater Company (The); Hubbell Heaters Division.
 - f. GSW Water Heating Company.
 - g. HESco Industries, Inc.
 - h. Lochinvar Corporation.
 - i. Precision Boilers.
 - j. PVI Industries, LLC.
 - k. RECO USA.
 - l. Rheem Water Heater Div.; Rheem Manufacturing Company.
 - m. Ruud Water Heater Div.; Rheem Manufacturing Company.
 - n. Smith, A. O. Water Products Company.
 - o. State Industries, Inc.
 - p. Vaughn Manufacturing Corporation.
 2. Storage-Tank Construction: ASME-code, steel horizontal or vertical arrangement.
 - a. Tappings: Factory fabricated of materials compatible with tank and piping connections. Attach tappings to tank before testing.
 - 1) NPS 2 and Smaller: Threaded ends according to ASME B1.20.1.
 - 2) NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges, and according to ASME B16.24 for copper and copper-alloy flanges.

- b. Pressure Rating: 150 psig.
 - c. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending lining material into tappings.
3. Factory-Installed Storage-Tank Appurtenances:
- a. Anode Rod: Replaceable magnesium.
 - b. Drain Valve: Corrosion-resistant metal complying with ASSE 1005.
 - c. Insulation: Comply with ASHRAE/IESNA 90.1.
 - d. Jacket: Steel with enameled finish.
 - e. Heating Elements: Electric, screw-in or bolt-on immersion type arranged in multiples of three.
 - f. Temperature Control: Adjustable thermostat.
 - g. Safety Controls: High-temperature-limit and low-water cutoff devices or systems.
 - h. Relief Valves: ASME rated and stamped and complying with ASME PTC 25.3, for combination temperature and pressure relief valves. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.
4. Special Requirements: NSF 5 construction.
5. Energy Management System Interface: Normally closed dry contacts for enabling and disabling water heater.

2.5 WATER HEATER ACCESSORIES

- A. Water Heater Stands: Water heater manufacturer's factory-fabricated steel stand for floor mounting and capable of supporting water heater and water. Include dimension that will support bottom of water heater a minimum of 18 inches above the floor.
- B. Water Heater Mounting Brackets: Water heater manufacturer's factory-fabricated steel bracket for wall mounting and capable of supporting water heater and water.
- C. Drain Pans: Corrosion-resistant metal with raised edge. Include dimensions not less than base of water heater and include drain outlet not less than NPS 3/4.
- D. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1 or ASHRAE 90.2.
- E. Water Regulators: ASSE 1003, water-pressure reducing valve. Set at 25-psig-maximum outlet pressure, unless otherwise indicated.
- F. Shock Absorbers: ASSE 1010 or PDI WH 201, Size A water hammer arrester.

PART 3 - EXECUTION

3.1 WATER HEATER INSTALLATION

- A. Install commercial water heaters on concrete bases.
 - 1. Exception: Omit concrete bases for commercial water heaters if installation on stand, bracket, suspended platform, or direct on floor is indicated.
 - 2. Concrete base construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- B. Install water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
- C. Install combination temperature and pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial, water-heater, relief-valve outlet, with drain piping same as domestic water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- D. Install water heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for water heaters that do not have tank drains. Refer to Division 22 Section "Domestic Water Piping Specialties" for hose-end drain valves.
- E. Install thermometer on outlet piping of water heaters. Refer to Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers.
- F. Install water regulator, with integral bypass relief valve, in booster-heater inlet piping and water hammer arrester in booster-heater outlet piping.
- G. Install piping-type heat traps on inlet and outlet piping of water heater storage tanks without integral or fitting-type heat traps.
- H. Fill water heaters with water.

3.2 CONNECTIONS

- A. Install piping adjacent to water heaters to allow service and maintenance. Arrange piping for easy removal of water heaters.
- B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

- A. Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including connections.
- B. Perform the following field tests and inspections:
 - 1. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Test: After electrical circuitry has been energized, confirm proper operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Remove and replace water heaters that do not pass tests and inspections and retest as specified above.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain commercial electric water heaters. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 16485

SECTION 16491 - FUSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes cartridge fuses, rated 600 V and less.

1.3 SUBMITTALS

- A. Product Data: Include dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings for each fuse type indicated.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Provide fuses from a single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NEMA FU 1.
- D. Comply with NFPA 70.

1.5 COORDINATION

- A. Coordinate fuse ratings with HVAC and refrigeration equipment nameplate limitations of maximum fuse size.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Cooper Industries, Inc.
 2. General Electric Co.
 3. Gould Shawmut.
 4. Littelfuse, Inc.

2.2 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, nonrenewable cartridge fuse; class and current rating indicated; voltage rating consistent with circuit voltage.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

3.2 FUSE APPLICATIONS

- A. Motor Branch Circuits: Class RK5, time delay.
- B. Other Branch Circuits: Class RK1, time delay.

3.3 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

3.4 IDENTIFICATION

- A. Install labels indicating fuse replacement information on inside door of each fused switch.

END OF SECTION 16491

SECTION 16511 - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes interior lighting fixtures, lighting fixtures mounted on exterior building surfaces, lamps, ballasts, and accessories.

1.3 SUBMITTALS

- A. Product Data: For each type of lighting fixture indicated, arranged in order of fixture designation. Include data on features, accessories, and the following:
 - 1. Dimensions of fixtures.
 - 2. Certified results of laboratory tests for fixtures and lamps for photometric performance.
 - 3. Fluorescent and high-intensity-discharge ballasts.
 - 4. Types of lamps.

1.4 QUALITY ASSURANCE

- A. Fixtures, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.
- B. Comply with NFPA 70.
- C. NFPA 101 Compliance: Comply with visibility and luminance requirements for exit signs.

1.5 COORDINATION

- A. Fixtures, Mounting Hardware, and Trim: Coordinate layout and installation of lighting fixtures with ceiling system and other construction.

1.6 WARRANTY

- A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Special Warranties for Fluorescent Ballasts: Written warranty, executed by manufacturer agreeing to replace fluorescent ballasts that fail in materials or workmanship within specified warranty period.

1. Special Warranty Period for Electronic Ballasts: Five years from date of manufacture, but not less than four years from date of Substantial Completion.
2. Special Warranty Period for Electromagnetic Ballasts: Manufacturers' standard warranty, but not less than two years from date of manufacture.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Lamps: 10 for every 100 of each type and rating installed. Furnish at least one of each type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products indicated in the Lighting Fixture Schedule on the electrical drawings.

2.2 FIXTURES AND FIXTURE COMPONENTS, GENERAL

- A. Metal Parts: Free from burrs, sharp corners, and edges.
- B. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.
- C. Doors, Frames, and Other Internal Access: Smooth operating, free from light leakage under operating conditions, and arranged to permit relamping without use of tools. Arrange doors, frames, lenses, diffusers, and other pieces to prevent accidental falling during relamping and when secured in operating position.
- D. Reflecting Surfaces: Minimum reflectance as follows, unless otherwise indicated:
 1. White Surfaces: 85 percent.
 2. Specular Surfaces: 83 percent.
 3. Diffusing Specular Surfaces: 75 percent.
- E. Lenses, Diffusers, Covers, and Globes: 100 percent virgin acrylic plastic, unless otherwise indicated.
 1. Acrylic Plastic: High resistance to yellowing and other changes due to aging, exposure to heat, and ultraviolet radiation.
 2. Lens Thickness: 0.125 inch (3 mm) minimum, unless greater thickness is indicated.

2.3 FLUORESCENT LAMP BALLASTS

- A. General Requirements: Unless otherwise indicated, features include the following:
 1. Designed for type and quantity of lamps indicated at full light output.
 2. Total Harmonic Distortion Rating: Less than 20 percent.

3. Sound Rating: A.

B. Electronic Ballasts for Linear Lamps: Unless otherwise indicated, features include the following, besides those in "General Requirements" Paragraph above:

1. Certified Ballast Manufacturer Certification: Indicated by label.
2. Encapsulation: Without voids in potting compound.
3. Parallel Lamp Circuits: Multiple lamp ballasts connected to maintain full light output on surviving lamps if one or more lamps fail.

C. Ballasts for Compact Lamps: Unless otherwise indicated, additional features include the following:

1. Type: Electronic or electromagnetic, fully encapsulated in potting compound.
2. Power Factor: 90 percent, minimum.

D. Encapsulation: Manufacturer's standard epoxy-encapsulated model designed to minimize audible fixture noise.

2.4 EXIT SIGNS

A. General Requirements: Comply with UL 924 and the following:

1. Sign Colors and Lettering Size: Comply with authorities having jurisdiction.

B. Internally Lighted Signs: As follows:

1. Lamps for AC Operation: Fluorescent, two for each fixture, 20,000 hours rated lamp life or light-emitting diodes, 70,000 hours minimum rated lamp life as indicated on the electrical drawings.

C. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.

1. Battery: Sealed, maintenance-free, nickel-cadmium type with special warranty.
2. Charger: Fully automatic, solid-state type with sealed transfer relay.
3. Operation: Relay automatically energizes lamp from unit when circuit voltage drops to 80 percent of nominal or below. When normal voltage is restored, relay disconnects lamps, and battery is automatically recharged and floated on charger.

2.5 LAMPS

A. Fluorescent Color Temperature and Minimum Color-Rendering Index: 3500 K and 85 CRI, unless otherwise indicated.

B. Noncompact Fluorescent Lamp Life: Rated average is 20,000 hours at 3 hours per start when used on rapid-start circuits.

C. Metal-Halide Color Temperature and Minimum Color-Rendering Index: 3600 K and 70 CRI, unless otherwise indicated.

2.6 FIXTURE SUPPORT COMPONENTS

- A. Comply with Division 16 Section "Basic Electrical Materials and Methods," for channel- and angle-iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch (12-mm) steel tubing with swivel ball fitting and ceiling canopy. Finish same as fixture.
- C. Rod Hangers: 3/16-inch- (5-mm-) minimum diameter, cadmium-plated, threaded steel rod.
- D. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

2.7 FINISHES

- A. Fixtures: Manufacturer's standard, unless otherwise indicated.
 - 1. Paint Finish: Applied over corrosion-resistant treatment or primer, free of defects.
 - 2. Metallic Finish: Corrosion resistant.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Fixtures: Set level, plumb, and square with ceiling and walls, and secure according to manufacturer's written instructions and approved submittal materials. Install lamps in each fixture.
- B. Support for Fixtures in or on Grid-Type Suspended Ceilings: Use grid for support.
 - 1. Support Clips: Fasten to fixtures and to ceiling grid members at or near each fixture corner.
 - 2. Fixtures of Sizes Less Than Ceiling Grid: Arrange as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.
- C. Suspended Fixture Support: As follows:
 - 1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
 - 2. Stem-Mounted, Single-Unit Fixtures: Suspend with single-stem hangers at each end of fixture.
 - 3. Continuous Rows: Suspend from cable installed according to fixture manufacturer's written instructions and details on Drawings.

3.2 CONNECTIONS

- A. Ground equipment.
 - 1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3 FIELD QUALITY CONTROL

- A. Inspect each installed fixture for damage. Replace damaged fixtures and components.
- B. Advance Notice: Give dates and times for field tests.
- C. Tests: As follows:
 - 1. Verify normal operation of each fixture after installation.
- D. Malfunctioning Fixtures and Components: Replace or repair, then retest. Repeat procedure until units operate properly.
- E. Corrosive Fixtures: Replace during warranty period.

3.4 CLEANING AND ADJUSTING

- A. Clean fixtures internally and externally after installation. Use methods and materials recommended by manufacturer.
- B. Adjust aimable fixtures to provide required light intensities.

END OF SECTION 16511

SECTION 16521 - EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes exterior lighting units with luminaires, lamps, ballasts, poles/support structures, and accessories.
- B. Related Sections include the following:
 - 1. Division 16 Section "Interior Lighting" for interior fixtures, lamps, ballasts, and accessories; and for exterior luminaires normally mounted on buildings.

1.3 DEFINITIONS

- A. Lighting Unit: A luminaire or an assembly of luminaires complete with a common support, including pole, post, or other structure, and mounting and support accessories.
- B. Luminaire (Light Fixture): A complete lighting device consisting of lamp(s) and ballast(s), when applicable, together with parts designed to distribute light, to position and protect lamps, and to connect lamps to power supply.

1.4 SUBMITTALS

- A. Product Data: For each type of lighting unit indicated, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:
 - 1. Materials and dimensions of luminaires and poles.
 - 2. Certified results of laboratory tests for fixtures and lamps for photometric performance.
- B. Product Certificates: Signed by manufacturers of lighting units certifying that products comply with requirements.

1.5 QUALITY ASSURANCE

- A. Luminaires and Accessories: Listed and labeled as defined in NFPA 70, Article 100, for their indicated use, location, and installation conditions by a testing agency acceptable to authorities having jurisdiction
- B. Comply with ANSI C2.
- C. Comply with NFPA 70.

1.6 WARRANTY

- A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Special Warranty: Written warranty, signed by manufacturer and Installer agreeing to replace external parts of luminaires and poles exhibiting a failure of finish as specified below. This warranty is in addition to, and not a limitation of, other rights and remedies Owner may have under requirements of the Contract Documents.
 - 1. Protection of Metal from Corrosion: Warranty against perforation or erosion of finish due to weathering.
 - 2. Color Retention: Warranty against fading, staining, and chalking due to effects of weather and solar radiation.
 - 3. Warranty Period: Manufacturer's standard, but not less than three years from date of Substantial Completion.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Lamps: Furnish at least one of each type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products indicated in the Exterior Lighting Unit Schedule and details on the electrical drawings.

2.2 LUMINAIRES

- A. Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.
- B. Metal Parts: Free from burrs, sharp corners, and edges.
- C. Sheet Metal Components: Corrosion-resistant aluminum, unless otherwise indicated. Form and support to prevent warping and sagging.
- D. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.
- E. Doors, Frames, and Other Internal Access: Smooth operating, free from light leakage under operating conditions, and arranged to permit relamping without use of tools. Arrange doors, frames, lenses, diffusers, and other pieces to prevent accidental falling during relamping and when secured in operating position. Provide for door removal for cleaning or replacing lens. Arrange to disconnect ballast when door opens.
- F. Exposed Hardware Material: Stainless steel.

- G. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and ultra-violet radiation.
- H. Reflecting Surfaces: Minimum reflectance as follows, unless otherwise indicated:
 - 1. White Surfaces: 85 percent.
 - 2. Specular Surfaces: 83 percent.
 - 3. Diffusing Specular Surfaces: 75 percent.
- I. Lenses and Refractors: Materials as indicated. Use heat- and aging-resistant, resilient gaskets to seal and cushion lens and refractor in luminaire doors.
- J. High-Intensity-Discharge Ballasts: Comply with ANSI C82.4. Constant wattage autotransformer or regulating high-power-factor type, unless otherwise indicated.
 - 1. Ballast Fuses: One in each ungrounded supply conductor. Voltage and current ratings as recommended by ballast manufacturer.
 - 2. Single-Lamp Ballasts: Minimum starting temperature of minus 40 deg C.
 - 3. Open-circuit operation will not reduce average life.
 - 4. Noise: Uniformly quiet operation, with a noise rating of B or better.
- K. Lamps: Comply with the standard of the ANSI C78 series that is applicable to each type of lamp. Provide luminaires with indicated lamps of designated type, characteristics, and wattage. Where a lamp is not indicated for a luminaire, provide medium wattage lamp recommended by manufacturer for luminaire.
 - 1. Metal-Halide Color Temperature and Minimum Color-Rendering Index: 3600 K and 70 CRI, unless otherwise indicated.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

- A. Inspect each installed unit for damage. Replace damaged units.
- B. Tests and Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source, and as follows:
 - 1. Measure light intensities at night if specific illumination performance is indicated. Use photometers with calibration referenced to NIST standards.
 - 2. Check intensity and uniformity of illumination.
 - 3. Check excessively noisy ballasts.
- C. Prepare a written report of tests, inspections, observations and verifications indicating and interpreting results.
- D. Malfunctioning Fixtures and Components: Replace or repair, then retest. Repeat procedure until units operate properly.

3.2 CLEANING AND ADJUSTING

- A. Clean units after installation. Use methods and materials recommended by manufacturer.

- B. Adjust amiable luminaires and luminaires with adjustable lamp position to provide required light distributions and intensities.

END OF SECTION 16521