ORLANDO WEST FIRE STATION

ARCH 5226
SPRING 2021

HONORS THESIS

REBECCA DEMPEWOLF

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PRELIMINARY DESIGN

PROJECT INTRODUCTION

THE JOHANNESBURG EMERGENCY MANAGEMENT DEPARTMENT IS SEEKING A DESIGN FOR A NEW FIRE STATION IN ORLANDO WEST, SOWETO, SOUTH AFRICA.

SERVING INFORMAL AND FORMAL SETTLEMENTS THE STATION WILL SERVE THE DIVERSE POPULATION OF THE AREA WHICH LARGELY HAS POOR RELATIONSHIPS WITH GOVERNMENTAL ORGANIZATIONS. THIS STRAIN DUE TO THE APARTHEID, WHICH HAS ONLY RECENTLY BEEN ABOLISHED, ALSO CONTRIBUTED TO THE STARK POLARIZATION OF WEALTH IN THE AREA.

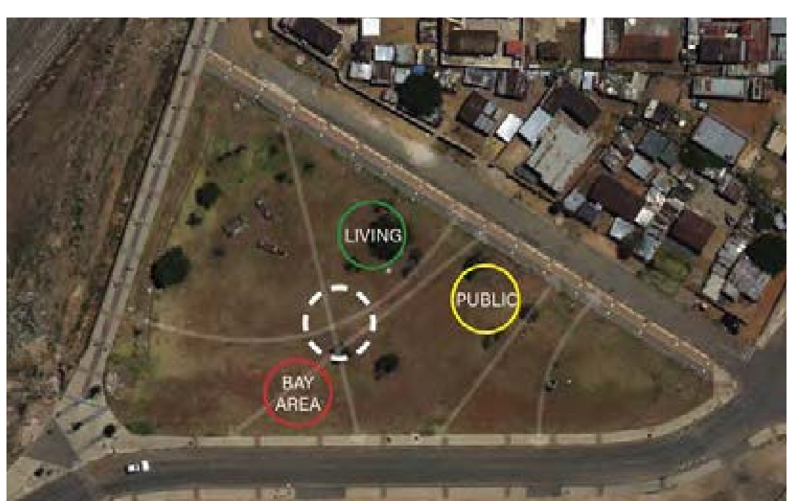
WHILE THE APARTHEID HAS BEEN ABOLISHED, INFORMAL SETTLEMENTS STILL REMAIN AND POSE MANY DANGERS TO THOSE LIVING IN THEM, ESPECIALLY FIRE HAZARDS. THE FLAMMABLE BUILDING MATERIALS USED, DENSELY POPULATED SPACES UNREACHABLE BY FIRE FIGHTERS, AND UNSAFE METHODS OF COOKING ALL CREATE GREAT RISKS THAT CAN DESTROY ENTIRE SETTLEMENTS AND DISPLACE THOUSANDS OF PEOPLE IF FIRE STARTS. FURTHERMORE, RELATIONSHIPS BETWEEN THOSE LIVING IN INFORMAL SETTLEMENTS AND FIRE FIGHTERS HAS BEEN STRAINED, SO COOPERATION WITH OFFICIALS IS NOT COMMON AND DETRIMENTAL TO A RAPID EXTINGUISHING OF A FIRE.

THIS PROPOSAL FOR THE ORLANDO WEST FIRE STATION SEEKS TO BUILD CONNECTIONS BETWEEN THE COMMUNITY AND THE FIRE FIGHTERS THROUGH A CONTEXTUALLY INSPIRED DESIGN THAT CATERS TO THE NEEDS OF THE COMMUNITY, ENSURES A HEALTHY ENVIRONMENT FOR THE FIRE FIGHTERS, AND SERVES AS A NODE OF INTERACTION BETWEEN THE COMMUNITY AND FIRE FIGHTERS.

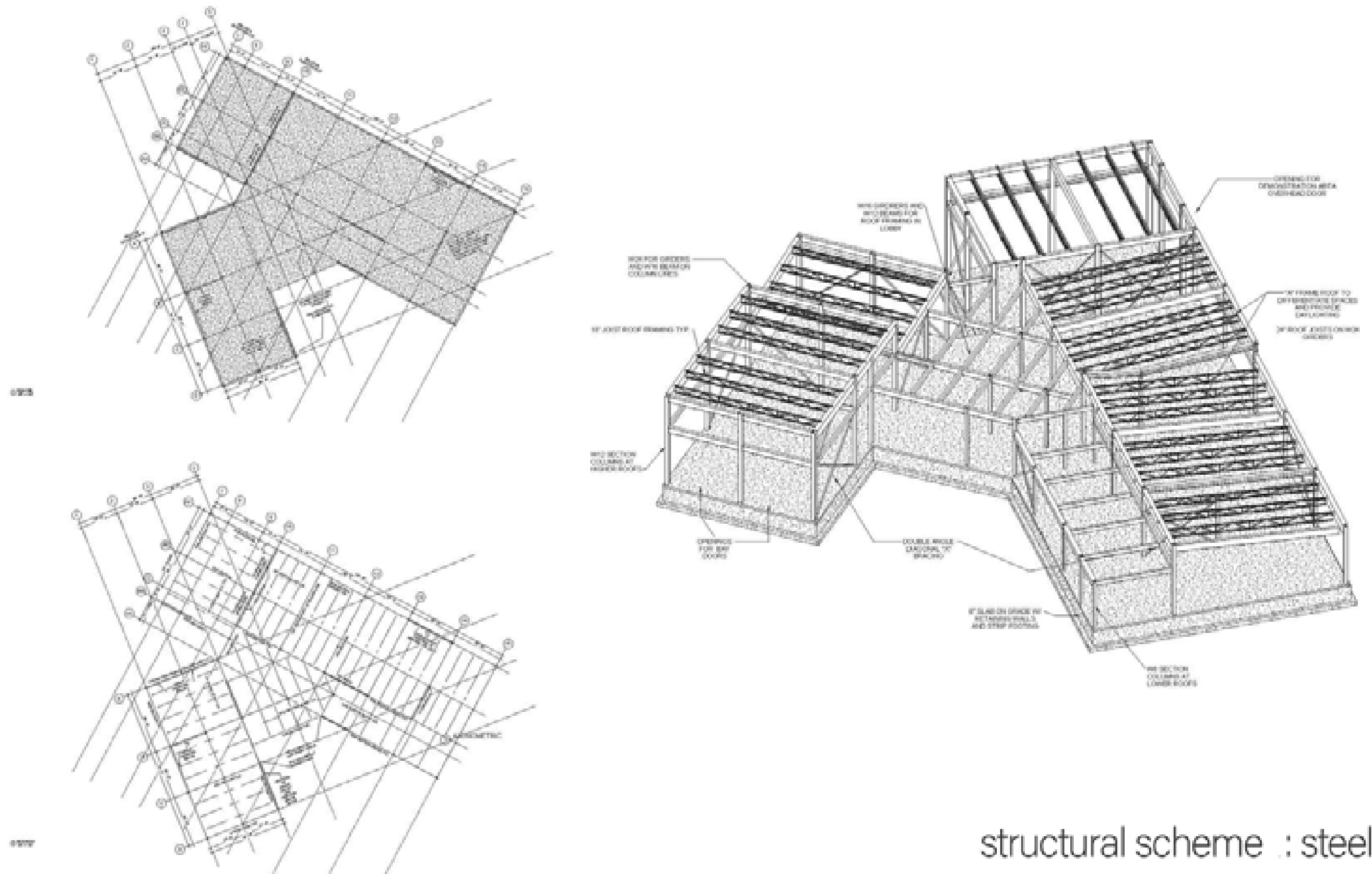
DESIGN APPROACH

UPON CONTEXTUAL RESEARCH AND SITE EXPLORATION, LARGE TESSELLATED PATTERNS BECAME A CONTEXTUAL MOTIF, EVEN VISIBLE IN THE SITE'S HISTORIC INFORMAL SETTLEMENT. THE NODES WITHIN THESE PATTERNS BECAME AN INSPIRATION FOR PATHS CONVERGING AND DIVERGING, AN INTERSECTION OF TWO THINGS DISTINCT THAT LEAVE THE NODE AND ARE CHANGED BECAUSE OF THE INTERACTION THAT OCCURRED THERE.

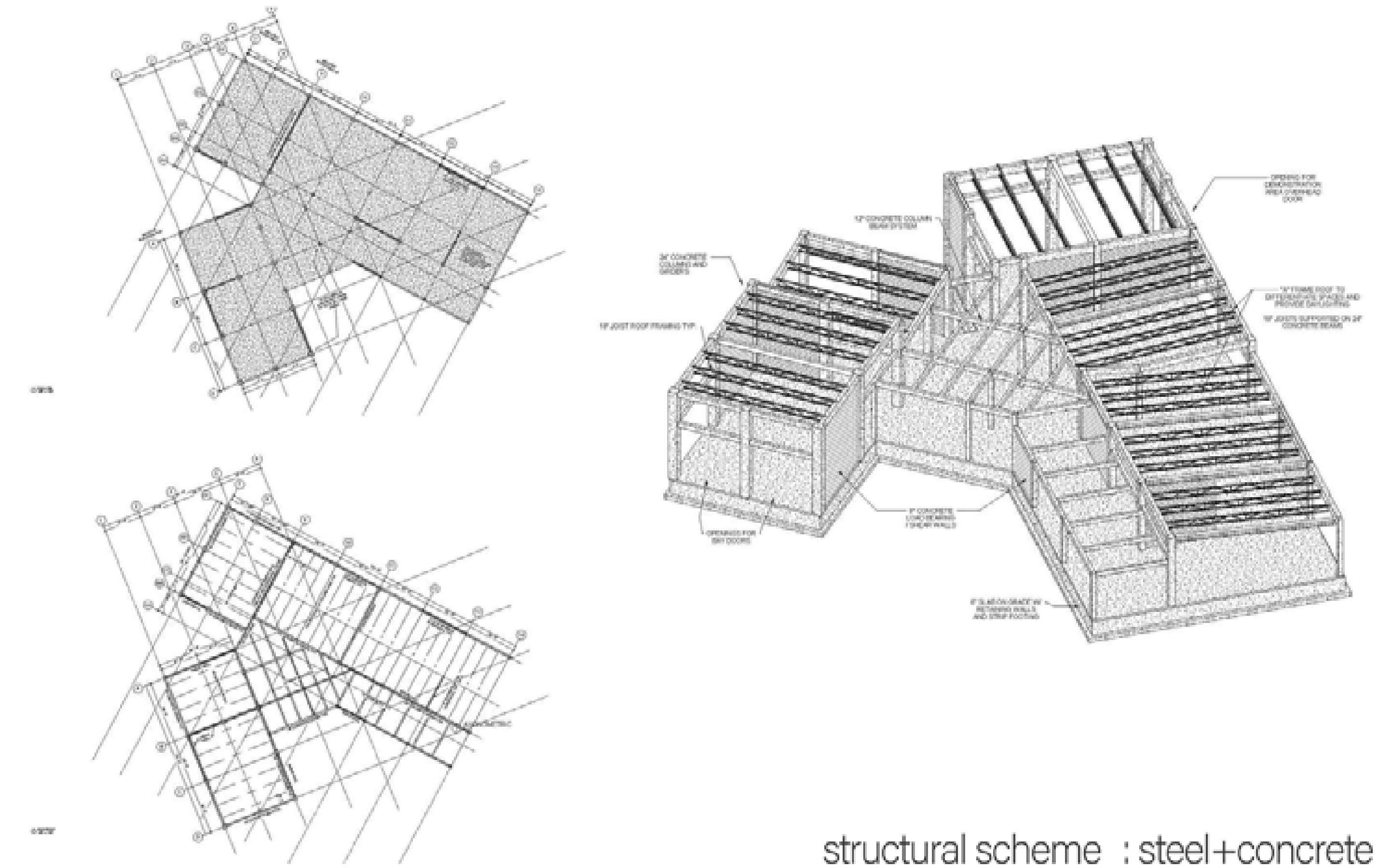
FROM THIS INSPIRATION THE FORM OF THE BUILDING WAS MOLDED BY PLACING THE NODES WITHIN HISTORIC SITE PATHS AND MASSAGING THE RESULT TO CREATE AN EFFICIENT YET UNIQUE LAYOUT THAT RESPONDED TO PROGRAMMATIC NEEDS AND IN SITU DEMANDS. REFLECTING THE DESIGN GOAL OF INTERACTION AND INTERSECTION, MULTIPLE STRUCTURAL MATERIALS AND SYSTEMS WERE CHOSEN TO INTERACT THROUGHOUT THE DESIGN TO VISUALLY ENTICE OR EXEMPLIFY SUCH CONNECTIONS.



STRUCTURE



structural scheme : steel



structural scheme : steel+concrete

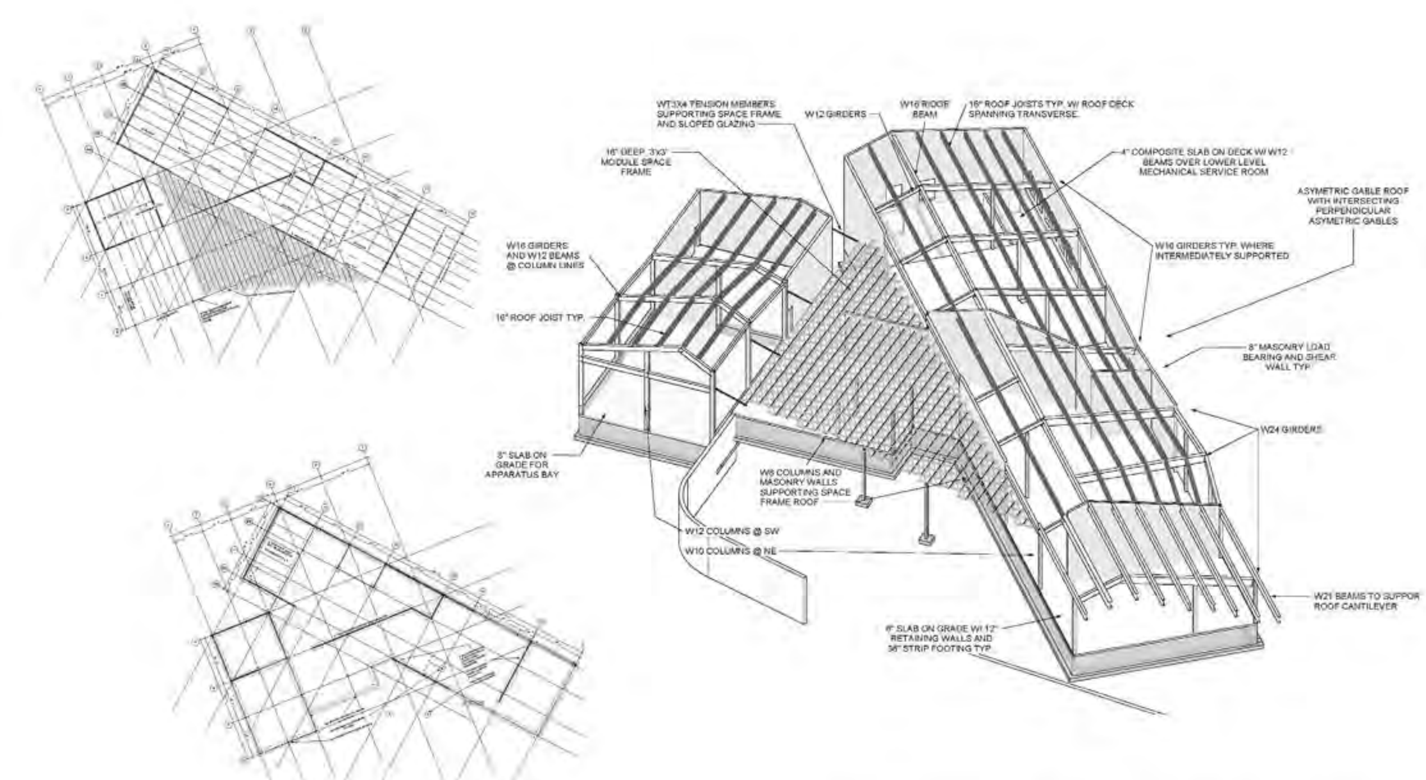
DURING PRELIMINARY DESIGN, THREE STRUCTURAL SYSTEMS WERE EXPLORED.

STEEL : WIDE FLANGE COLUMNS AND BEAMS WORKING WITH DIAGONAL X BRACING SUPPORTING LOW SLOPE ROOF TRUSSES.

STEEL AND CONCRETE : CONCRETE BEAMS AND COLUMNS WITH STEEL ROOF JOISTS TO SPAN LONGER DISTANCES AT SHORTER DEPTHS.

STEEL AND MASONRY (SELECTED SYSTEM) : MASONRY SHEAR AND LOAD BEARING WALLS WORKING WITH THE STEEL FRAMING, ROOF JOISTS, AND A SPACE FRAME AIM TO RELATE TO CONVERGING PATHS IN THE INTERSECTING MATERIALS AND TO DEFINE SPACES THROUGH MATERIALITY.

THE SPACE FRAME WAS INSPIRED BY THE DESIRE FOR A LIGHT UNIFORM STRUCTURE CONNECTING THE TWO ADJACENT FORMS ABOVE THE ENTRANCE NODE. THE FACT THAT THE SPACE FRAME MEMBERS MEET AT NODES WAS FURTHER DESIGN MOTIVATION.

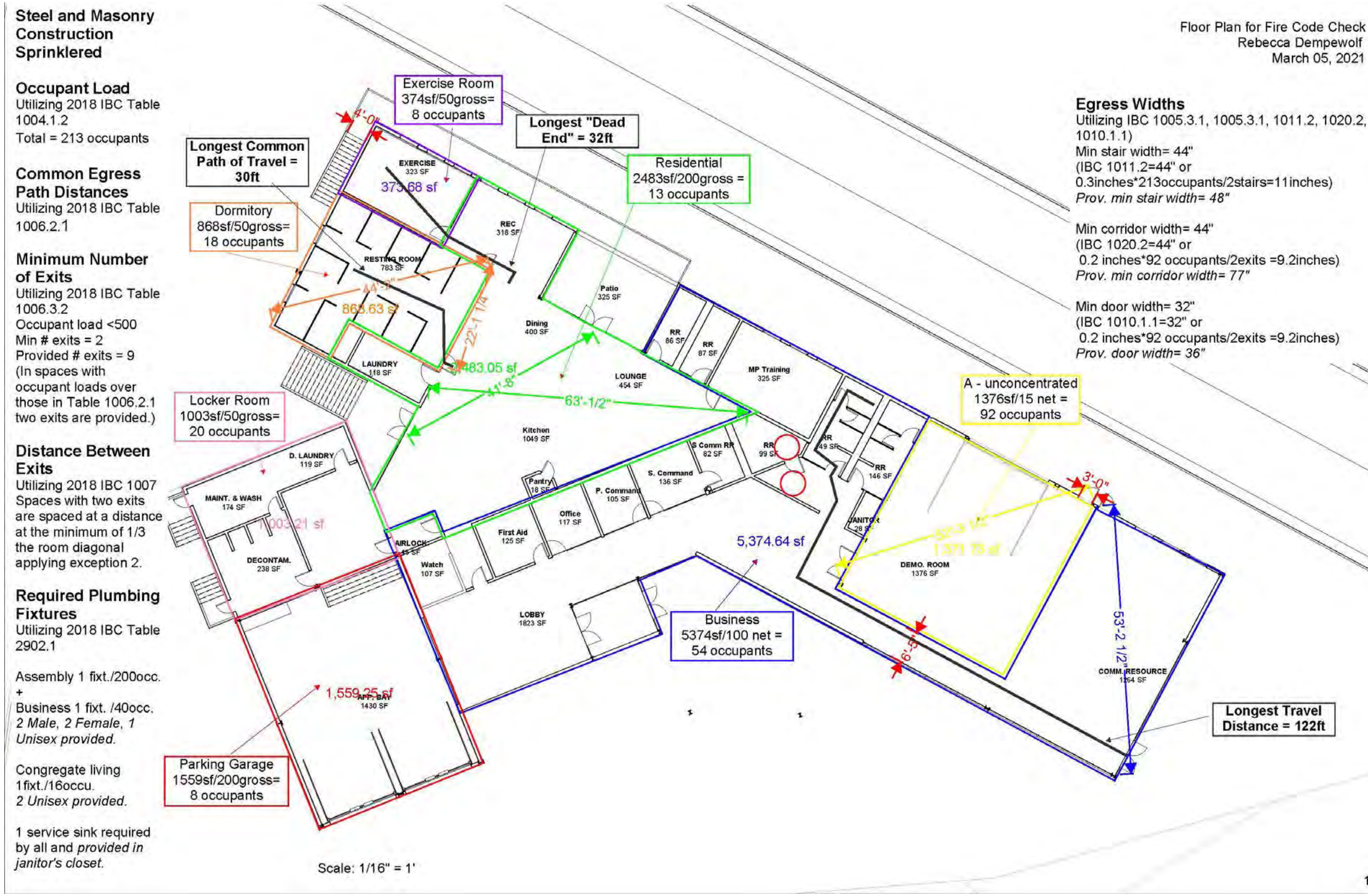


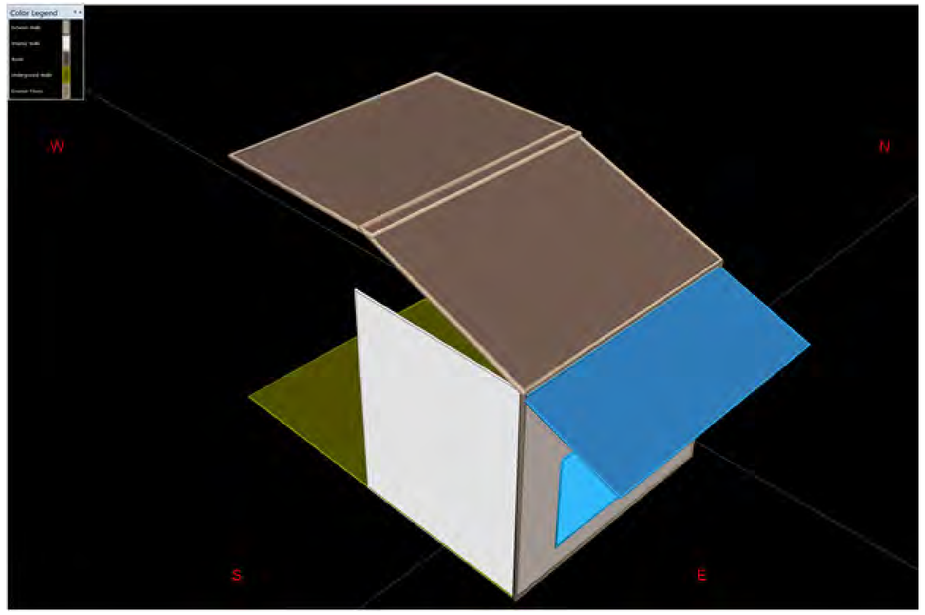
structural scheme : steel+masonry

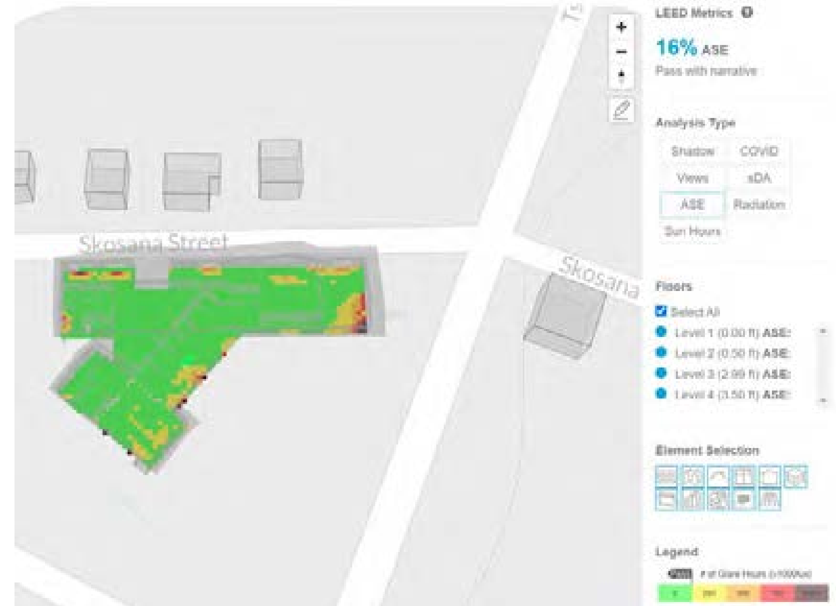
CODE COMPLIANCE
BUILDING

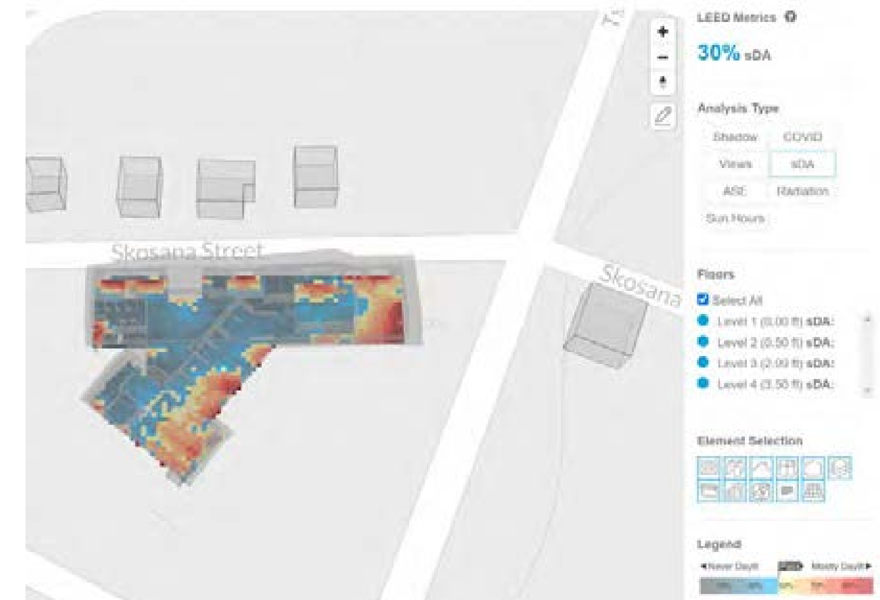
DURING DESIGN, COMPLIANCE WITH THE IBC 2018 WAS CHECKED.

OCCUPANCY LOADS WERE CALCULATED TO DETERMINE REQUIRED EXITS, EGRESS WIDTHS, TRAVEL DISTANCES, NUMBER OF PLUMBING FIXTURES, AND MORE.









DURING DESIGN, COMPLIANCE WITH THE IECC 2021 WAS ENSURED THROUGH THE USE OF MULTIPLE SOFTWARES.

COVETOOL WAS UTILIZED TO ANALYZE THE DAYLIGHTING AND GLARE POTENTIAL IN THE BUILDING, AS WELL AS DETERMINE BASELINE ENERGY USAGES BASED ON ENVELOPE PROPERTIES AND MECHANICAL SYSTEM SELECTIONS. COMPARED TO BASELINE, THIS DESIGN REDUCES CO2 EMISSIONS BY 51% AND IS 9% MORE ENERGY EFFICIENCY THAN BASELINE CONDITIONS.

EQUEST HELPED DETERMINE PERIMETER AND INTERIOR THERMAL ZONE LOADS BASED ON DIFFERENT SHADING, VOLUME, AND MATERIAL PROPERTIES INPUTS. COMPARED TO BASELINE, THIS DESIGN REDUCES THE PERIMETER THERMAL LOAD BY OVER 40%

DETAILED **CALCULATIONS** FOR ENVELOPE R AND U VALUES WAS ACCOMPLISHED FOR USE IN THESE PREDICTIVE MODELING SOFTWARES.

Envelope Compliance Dempewolf

All other, Climate Zone 3A, Orlando West Fire Station

	Code Compliance	approx.	Outside Air (R or R/in)	total	Exterior Finish (R)	thickness	total	Continuous Rigid Insulation (R/in)	thickness	total	Sheathing (R)	total	Cavity Insulation (R)	total	Interior Finish board (R)	total	Interior Air Film *	total	Total R	Total U
Roof	R-25ci U-0.039	25 0.039	15mph summer 0.25	0.25	Standing Seam Metal Roof 0		0	Extruded Polystyrene 5	5	25	Structural Decking 0	0	0 THERM BRIDGE FOR U	0 0	0	0	horizontal surface downward heat flow, 0.92	0.92	R 26.17 sf.°F/Btuh	U 0.038 Btuh/sf.°F
Wall	R-13+R-7.5ci U - 0.064	21.5 0.064	15mph summer 0.25	0.25	4" Clay Face Brick 0.24	3.68	0.88	Extruded Polystyrene Board 5	1.5	7.5	Plywood 3/4" 0.93	0.93	Rockwool Batt Insulation 5" 19 THERM BRIDGE FOR U	19 7.03	Gypsum Board 5/8" 0.59	0.59	Vertical surface, horiz heat flow 0.68	0.68	R 29.832 sf.°F/Btuh	U 0.056 Btuh/sf.°F
Wall Below Grade	C - calculation NR C-1.14	 NR 1.14	soil 0.041	0.04	12" CMU 1.28		1.28	Extruded Polystyrene Board 5	2	10	0	0	0	0	0	0	Vertical surface, horiz heat flow 0.68	0.68	R 12.0005 sf.°F/Btuh	C 0.084 Btuh/sf.°F
Slab	U/F - calculation NR F-0.73	 NR 0.73	soil 0.021	0.02				Extruded Polystyrene Board from perimeter insulation 5	2	10	0	0	0	0	0	0	horizontal surface upward heat flow 0.61	0.61	R 10.631 sf.°F/Btuh	F* 0.560 Btuh/sf.°F

*F-factor from ASHRAE 90.1 Table A6.3.1 for Unheated slab with R-10 @ 24" vertical

			Glazing
Skylight	U - 0.55	0.55	0.33
	SHGC - 0.35	0.35	0.24
Windows	U - 0.46	0.46	0.33
	SHGC - 0.30	0.3	0.27

Insulation Compliance

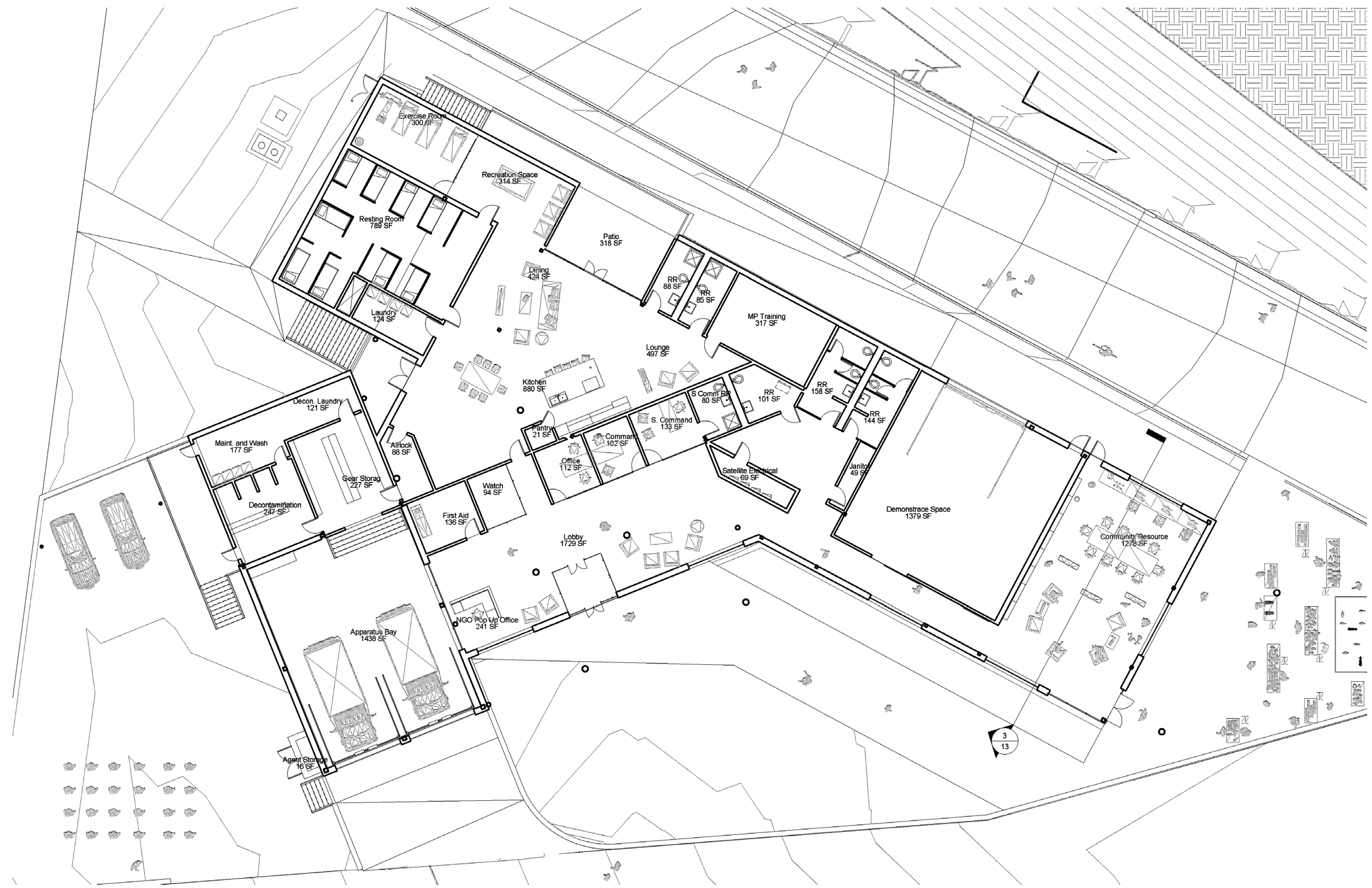
	Wall above grade: R13+7.5ci	**Roof: R-25ci, U-0.039**
	**Wall Cavity Insulation= 19 y **Wall ci = 7.5 y **Wall U = 0.0560	*Roof ci = 25 *Roof U = 0.0382
Compliance?	Yes	Yes
	Walls below grade: R-NR, C-1.14	**Slab on grade: NR, F-0.73**
	*Wall ci = 10 *Wall C = 0.0836	*Slab Perimeter ci = 10 *Slab F = 0.5600
	Yes	Yes

FINAL DESIGN

FINAL ARCHITECTURAL DESIGN OF THE FIRE STATION INCORPORATED REVISIONS FROM PRELIMINARY DESIGN, UPDATES FROM ENERGY ANALYSIS, AND CODE UPDATES.

FURTHERMORE, STRUCTURE AND BUILDING SYSTEMS HAVE BEEN INTEGRATED TO ENSURE SYSTEMS DO NOT CLASH.

MATERIALITY AND PROGRAM SPACES HAVE BEEN REVISITED TO MEET NEEDS AND DESIGN GOALS.



1 Main Floor Plan
3/32" = 1'-0"

EXTERIOR PERSPECTIVE

INTERIOR PERSPECTIVE

SYSTEMS DESIGN

HVAC

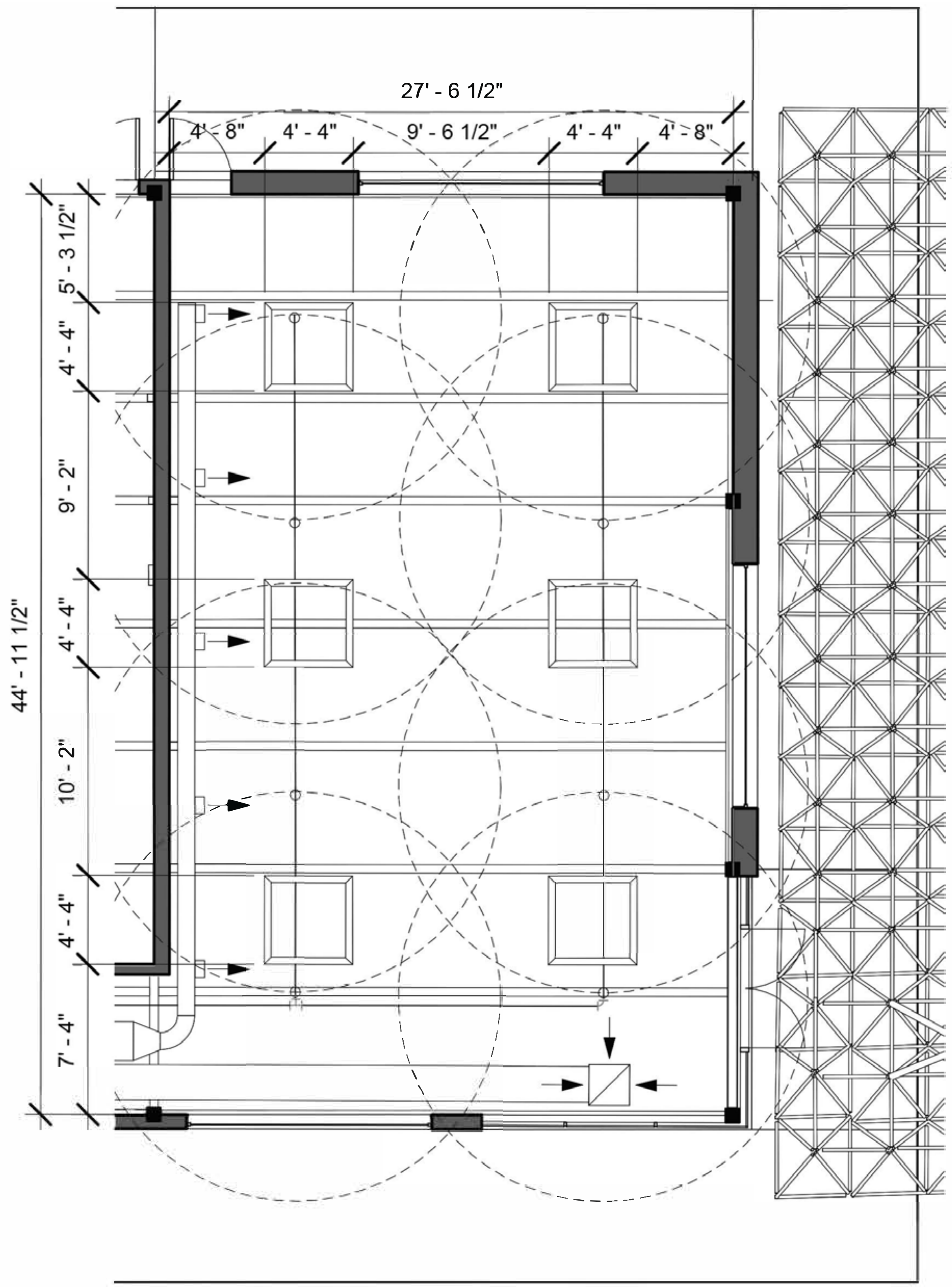
UTILIZING A VRF HEAT PUMP SYSTEM, ONLY FRESH AIR IS NEEDED TO BE SUPPLIED TO EACH SPACE BASED ON AREA AND OCCUPANCY. DUE TO VRF'S LIMITATIONS, DUCTWORK NEEDS TO BE CLOSER TO THE GROUND PLANE TO ENSURE THE AIR WILL EFFICIENTLY MIX WITH THE NEARBY WATER PIPES OF THE AUXILLARY VRF COMPONENTS. HOWEVER, WITH EXPOSED CEILING PLANES IN A GABLED FORM,

THE DUCTWORK IS RUN ALONG THE WALLS OF THE IMPORTANT SPACES, OR NODES. THIS WORKED WELL IN COMBINATION WITH THE MASONRY AND STEEL STRUCTURE BECAUSE FEWER LARGE DUCTS CUT THROUGH THE WALL PLANES.

IN THE CONTAMINATED ZONES OF THE FIRE STATION, SEPARATE SYSTEMS ARE USED TO SUPPLY FRESH AIR AND REMOVE EXHAUST. EXHAUST FROM KITCHEN AND WATER CLOSETS WAS INCLUDED.

THE VRF VARIABLE REFRIGERANT FLOW SYSTEM IS TYPICALLY A MORE ENERGY EFFICIENT SYSTEM DUE TO THE CONTROL OVER THE REFRIGERANT DELIVERED TO EACH TERMINAL SUPPLYING THE ZONES DIFFERING DEMANDS EFFECTIVELY.

LIGHTING



RCP - Focus Space
1/8" = 1'-0"

RENNA SUSPENDED SQUARE LED FIXTURE

RETURN AIR GRILL AND DUCT

SUPPLY AIR DUCT AND SPOT DIFFUSER

FIRE SPRINKLER SYSTEM (THROW @ 10' O.C.)

IN A SELECTED FOCUS SPACE, THE SYSTEM DESIGN WAS DEVELOPED FURTHER AND INCORPORATED THE FIRE SUPPRESSION SYSTEMS AND LIGHTING DESIGN WITH THE HVAC SYSTEM.

THE REFLECTED CEILING PLAN SHOWS THESE SYSTEMS COORDINATED.

THE LUMEN METHOD WORKSHEET SHOWS THE LIGHTING DESIGN WHICH PROVIDES THE DESIRED LUMINANCE AT 30% MORE EFFICIENT THAN CODE.

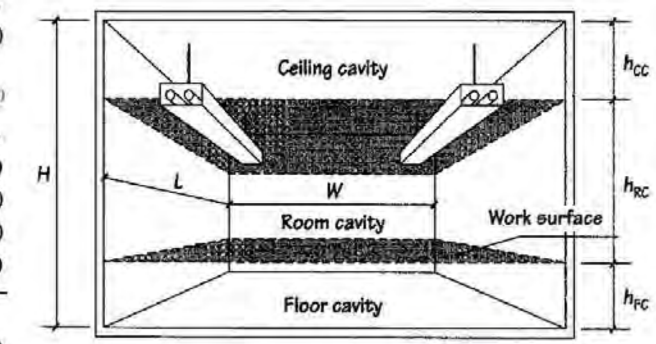
AVERAGE ILLUMINANCE WORKSHEET-ELECTRIC LIGHTING [LUMEN METHOD-SIMPLIFIED]

Designer: .... Space type: ....

PHOTOMETRIC DATA

lux=300

IESNA Illuminance category: P
IESNA Recommended illuminance (average): 27 (fc)
[*Refer to IESNA tables*]
Lamp type: RNNAD 90CRI TUWH PROR 40K 700LMF 4FT SQ, 30
Recommended spacing ratio 0@1.23; 90@1.24
Lumen output from one lamp (initial): 2861.4 (lumens)
Number of lamps per luminaire: 4 (lamps)
Fixture efficiency: 100 (%)
Lumen output from one luminaire: 11,445.6 (lumens)



ROOM DESIGN

L = 45 (ft)
W = 30 (ft)
H = 18 (ft)
Ceiling cavity reflectance = CCR = 80 (%)
Room cavity reflectance (walls) = RCR = 70 (%)
Assumed floor cavity reflectance = FCR = 20 (%)

h_{CC} = 7.5 (average) (ft)
h_{RC} = 9 (ft)
h_{FC} = 2.5 (ft)

SIZING OF THE SYSTEM

a. Effect of room geometry: Determine equivalent-square room length (W_{sq}), and the Room Cavity Ratio (RCR).

W_{sq} = W + [(L-W) / 3] = 35 ft
RCR = (10 x h_{RC}) / W_{sq} = 2.57

From manufacturer's data, obtain the Coefficient of Utilization (CU) of this luminaire in this space.

CU = 0.97

b. Effect of maintenance conditions of the space and the system (includes ballast factor): Estimate LLF.

Light Loss Factor = **LLF** = Good conditions = 0.65 (Circle one)
Average conditions = 0.55
Poor conditions = 0.45

c. Calculate useful lumens from one luminaire (on the workplane):

Useful lumens from one luminaire = Lumen output from one luminaire x CU x LLF
= 7216.45 lumens/luminaire

d. Determine total lumens needed on the workplane:

Total lumens needed on the workplane = Recommended illuminance x area
= 27fc*45ft*30ft = 36450

e. Determine needed number of luminaires:

Number of luminaires = Total lumens needed on the workplane/useful lumens from one luminaire

Number of luminaires = 36450/7216.45 = 5.05 => 6

Actual illumination level provided = 27 * (6/5.05) = 32.07

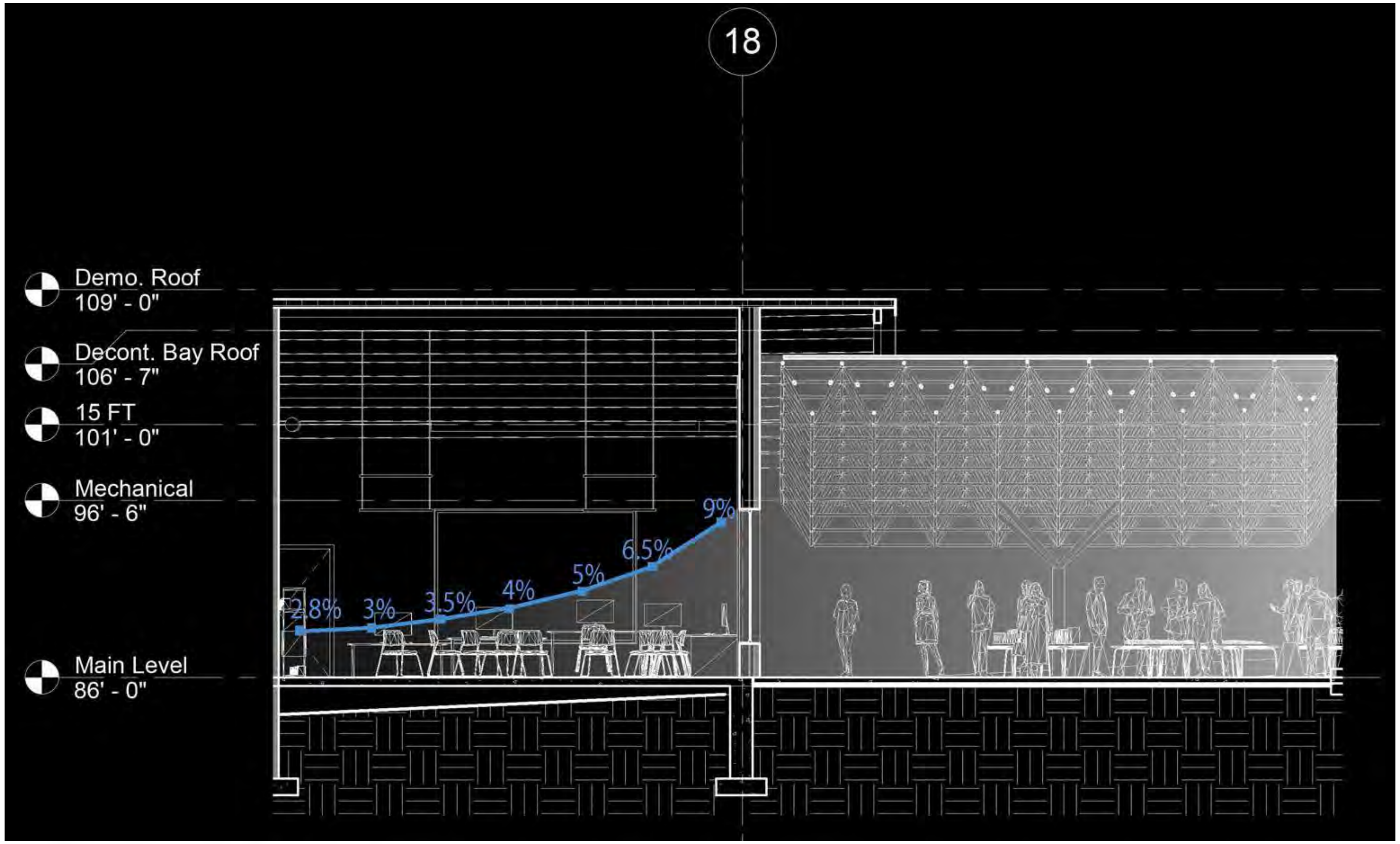
Light load = 6 luminaires *4 lamps * 29 watts / (45ft * 30ft) = 0.5156 W/sf << 0.85 for code compliance -good!

Light load index = (0.5156 W/sf) / 32.07fc = 0.0161 W/sf*fc

Area covered per luminaire = (45ft * 30ft) / 6 luminaires = 225 sf

System's overall efficiency = 100*0.97*0.65 = 63.05% efficiency

Last updated October, 18th, 2019



Daylighting Calculations

$IL_{predicted} = IL_{standard} \times DF \times Vt_{glass} \times M_{glass}$

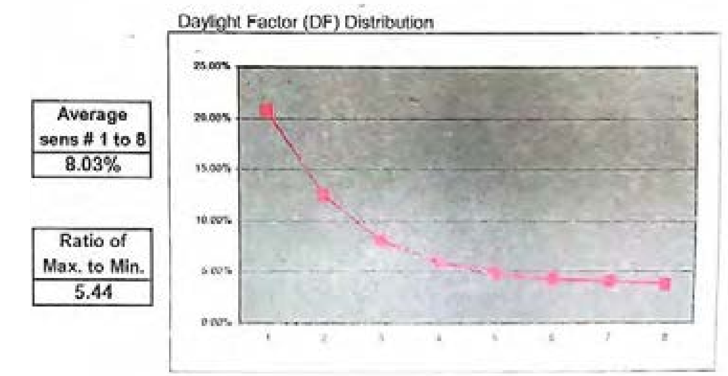
$IL_{standard}$	1239 fc
DF	5%
Vt_{glass}	23%
M_{glass}	85%

$IL_{predicted} =$ **11.77211 fc**

NUMEROUS STUDIES OF A SPACE IN THE BUILDING WERE CONDUCTED IN THE DAYLIGHTING LAB WHICH INFLUENCED SHADING DESIGN AND GLARE REDUCTION MEASURES. UNEVEN DISTRIBUTION OF DAYLIGHT WITHIN THE SPACE WAS ALSO ADDRESSED THROUGH EXTENDED OVERHANGS AND CANOPY COVER.

DAYLIGHTING LAB TRIALS

#1



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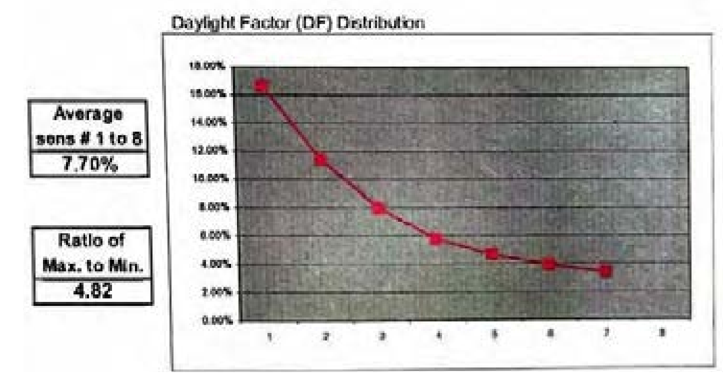

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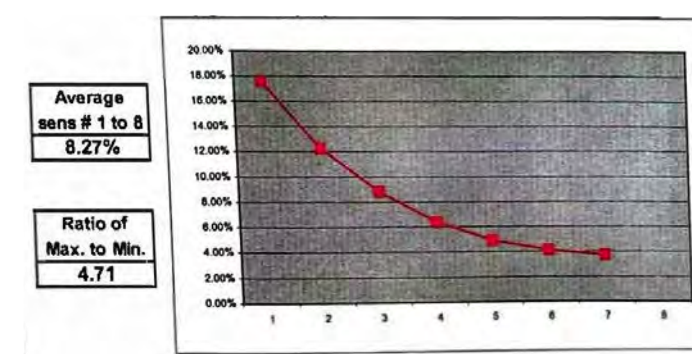
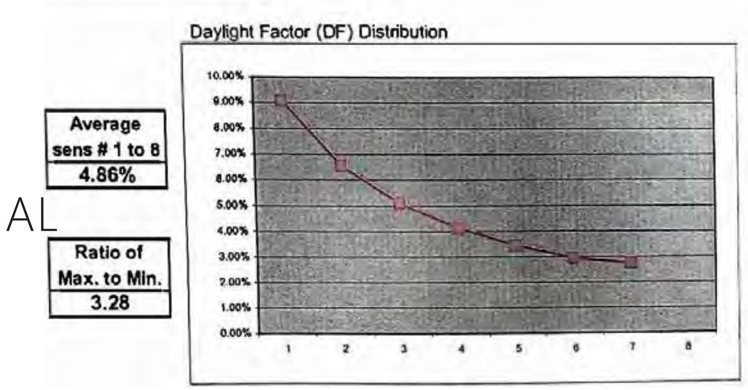
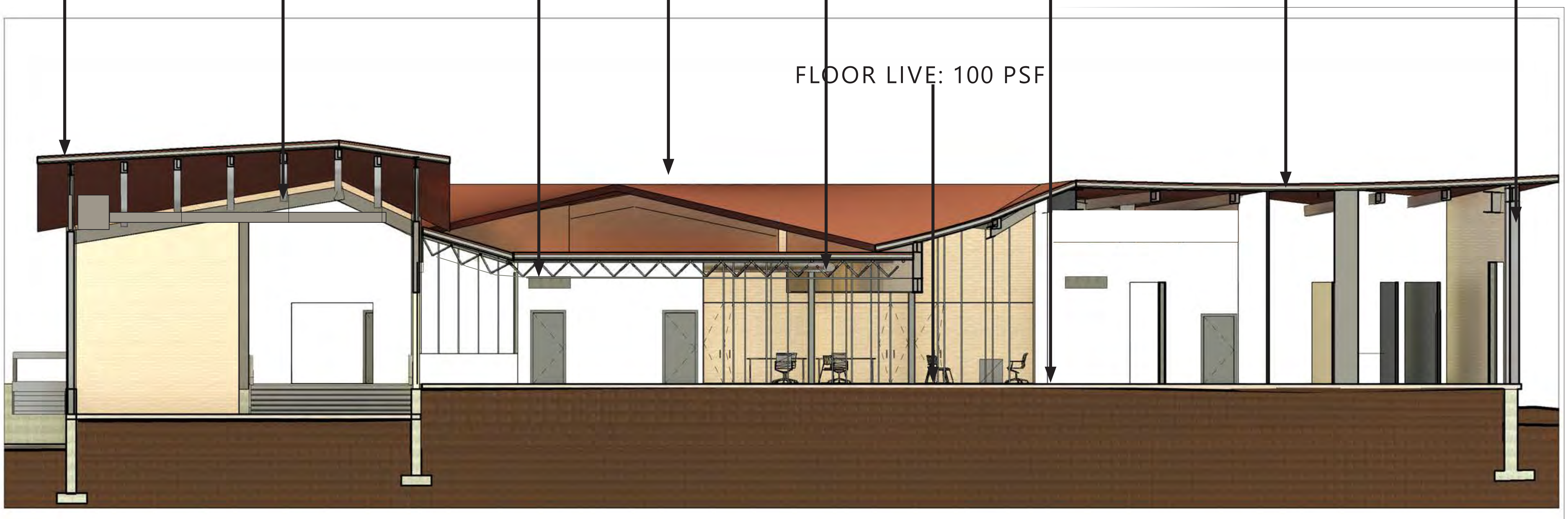


#4 - FINAL



STRUCTURAL DESIGN

GRAVITY LOADS



Dead Loads	
Roof Dead Load:	
HSS Structure	9.0 psf
Roofing System	8.0
Mech, Elec, Plumb	4.0
Sprinklers	3.0
Collateral	3.0
Total	27.0 psf
Adjusted for slope :	35.2 psf

Space Frame	8.0
Roofing System	8.0
Mech, Elec, Plumb	4.0
Sprinklers	3.0
Collateral	3.0
Total	26.0 psf

Floor Dead Load:	
Con/Metal Decking (2" conc on 3" deck)	45.0 psf
Structure	7.0
Finish Flooring	3.0
Mech, Elec, Plumb	4.0
Sprinklers	3.0
Collateral	3.0
Total	65.0 psf

Façade Dead Load:	
Wall Framing	
6" Metal Stud @ 16" O.C.	4.0
Sheathing and Gypsum	5.0
Insulation	2.0
Collateral	2.0
Total	13.0 psf
Face brick	42.0 psf
with wall framing	55.0 psf
Glass	15.0 psf

Live Loads from ASCE 7-10	
Roof Live Load:	
Roof live on horizontal:	20.0 psf
Floor Live Load:	
R (private) room =	40.0 psf
R (public) room =	100.0 psf
Rec. rooms=	100.0 psf
Floor live load:	100.0 psf

WIND LOAD

Wind Calculations	
Location	Orlando West, South Africa
Importance	IV
Exposure	B
Basic Wind Speed	120 mph

Variables:

WW & LW		Canopy
$p=qGC_p$	WW	$p=q_hGC_n$
Cp	0.8	

Controlling variables in green

Roof
$p=qGC_p-q_i(GC_{pi})$

Building Region	B (ll gable)	L (gable)	L/B	h_{roof}	z_{walls}	θ_{max}	h/L	$d_{min,}$ ridge from WW
A (ne-sw)	72	34	0.472	20	24	62	0.588	12
A (nw-se)	34	72	2.118	20	24	40	0.278	30
B	70	53	0.757	15	13	2	0.283	70
C (n-s)	188	42	0.223	20	22	24	0.476	15
C (e-w)	42	188	4.476	17	22	67	0.090	50
Canopy	35	53	1.514	16	-	24	0.302	12

Building Region	Walls		Roof gable		Roof ll gable, Cp			
	WW, Cp	LW, Cp	Cp+	Cp-	0-h/2*	h/2-h	h-2h	2h<
A (ne-sw)	0.8	-0.5	0.62	-0.6	-1.17	-0.7	-0.7	-0.7
A (nw-se)	0.8	-0.3	0.4	-0.6	-0.9	-0.9	-0.5	-0.3
B	0.8	-0.5	-0.3	-0.3	-0.9	-0.9	-0.5	-0.3
C (n-s)	0.8	-0.5	0.25	-0.6	-0.9	-0.9	-0.5	-0.3
C (e-w)	0.8	-0.2	0.67	-0.6	-0.9	-0.9	-0.5	-0.3
Canopy			Cn (+/-)		Cn (+/-)			
			1.3	0.3	0.8	0.8	0.6	0.3

* A(ne-sw) 0-h/2 uses area reduction of 0.9

Windward Walls

$q=.00256K_zK_{zt}K_dV^2$	
V=	120
Kz=	vaires see below
Kzt=	1.000137
Kd=	0.85

Topographical Factor, Figure 26.8-1&2			
K1	0.75	z	12
Υ	2.5	μ	4
x	7	LH	3.5
K2	0.5		
K3	0.000182		

Terrain Exposure, Table 26.9-1	
α	zg
7	1200

G=	0.85	section 26.9.4
C_p=	0.8	figure 27-4.1

Velocity Exposure Coefficients		
h	Kh	Kz
0-15	0.57	0.57
20	0.62	0.62
22	0.636	0.64
24	0.652	0.66
25	0.66	0.67
30	0.7	0.70

Tabel 27.3-1
Exposure B →

Velocity Pressure Calculated		
q=	31.33868 *Kz	
0-15	$qz_{@h}$=	18.01
20		19.55
22		20.09
24		20.60
25		20.84
30		21.96

$p_z= qGCp = q_z$* 0.68	Net Design Pressure
Height (ft)	p_{WW}
0-15	12.24744901
20	13.29665565
22	13.66371841
24	14.00766139
25	14.17199522
30	14.92980757

Leeward Walls

$p=qGC_p$ G= 0.85

Building Region	From figure 27.4-1		q_h=.00256K	Net Design Pressure	
	Cp_{trans}	Cp_{long}	q_h	$P_{(LW-trans)}$	$P_{(LW-Long)}$
A	-0.5	-0.3	19.55	-8.31041	-4.986246
B	-0.5	-0.43	18.01	-7.654656	-6.583004
C	-0.5	-0.2	19.55	-8.31041	-3.324164

Roof

$p=q_hGC_p-q_i(GC_{pi})$	$q=.00256K_hK_{zt}K_dV^2$	
	G=	0.85
	GC_{pi}=	0.18

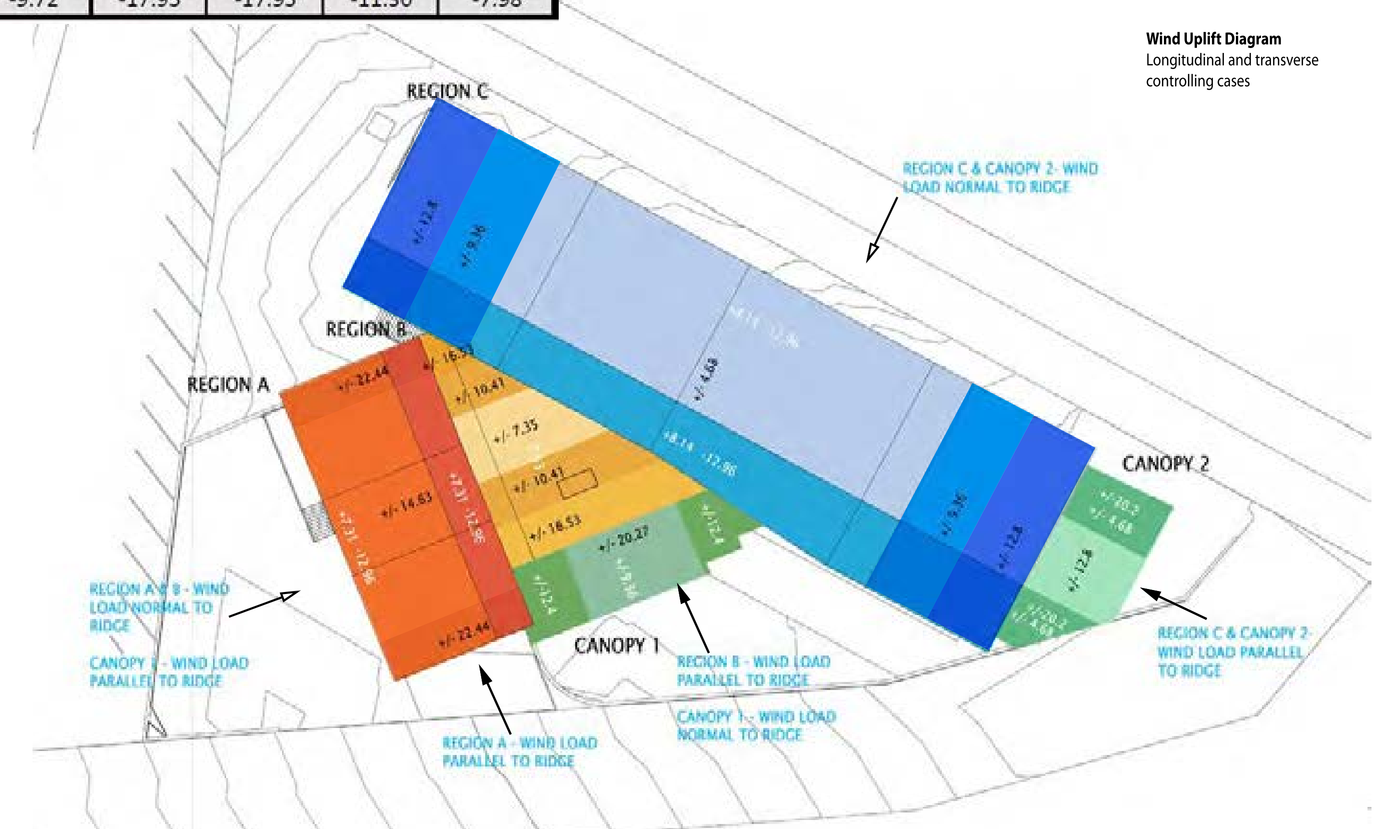
Table 26.11-1

Canopy	
$p=q_hGC_n$	
G=	0.85

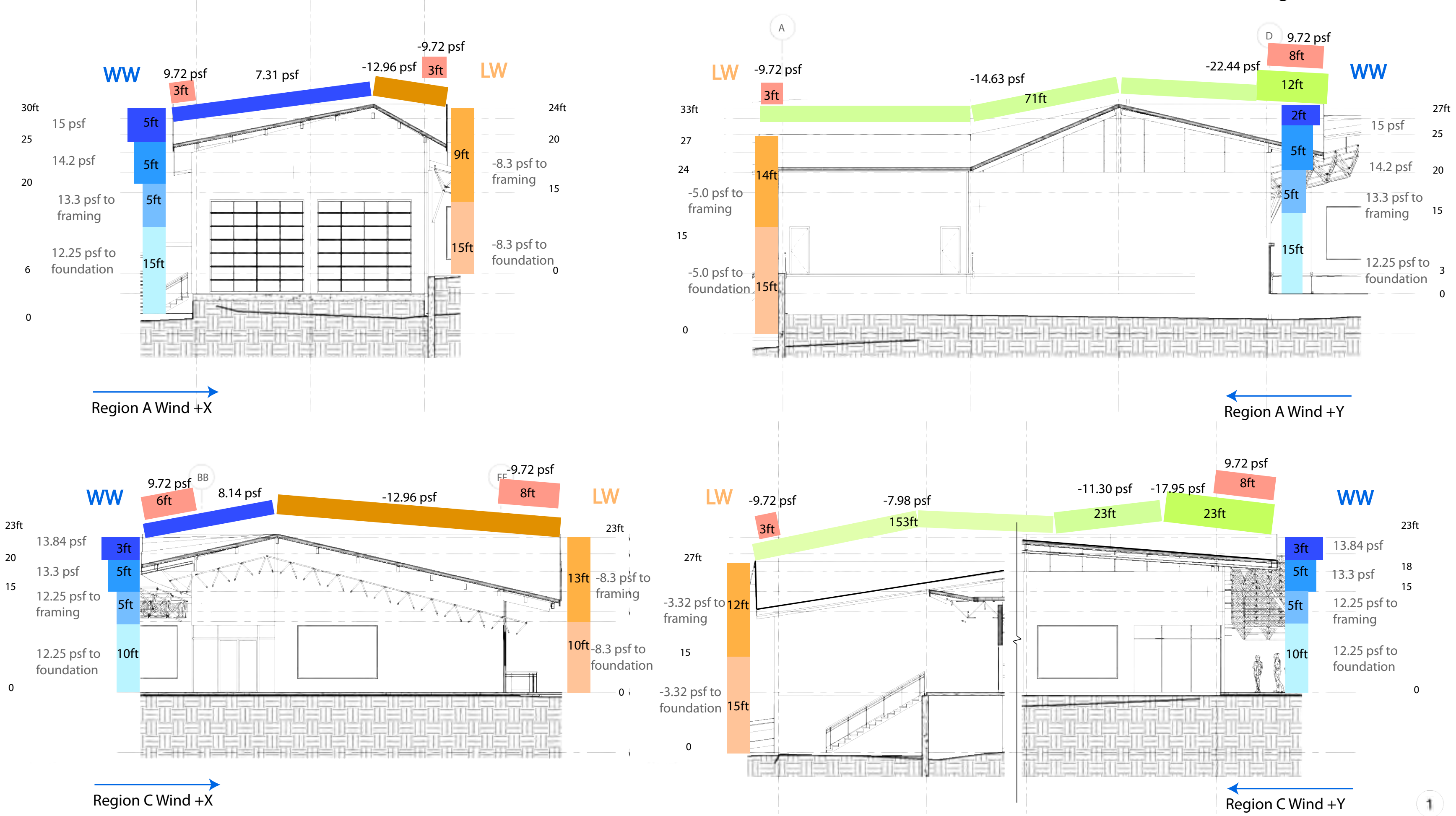
Building Region	Net Design Pressure (psf)							
		Wind to roof gable			Wind ll to roof gable			
	q_h	$P_{(+)}$	$P_{(-)}$	$P_{ovh}=0.75P_{(+/-)}$	$P_{0-h/2}$	$P_{h/2-h}$	P_{h-2h}	$P_{2h<}$
A	19.55	7.31	-12.96	-9.72	-22.44	-14.63	-14.63	-14.63
B	18.01	-7.35	-7.35	-5.51	-16.53	-16.53	-10.41	-7.35
C	19.55	8.14	-12.96	-9.72	-17.95	-17.95	-11.30	-7.98

THE FIRE STATION WAS DESIGN AS IMPORTANCE IV WITH TERRAIN EXPOSURE B AND A BASIC WIND SPEED OF 120 MPH. THE WIND WAS APPLIED IN THE WORST CASE DIRECTION BASED ON THE LOCAL AXES OF THE BUILDING'S REGION. (IE. PERPENDICULAR TO TRANSVERSE FACE OF REGION, LONGITUDINAL FACE OF REGION, AND AT CORNERS).

Wind Uplift Diagram
Longitudinal and transverse controlling cases

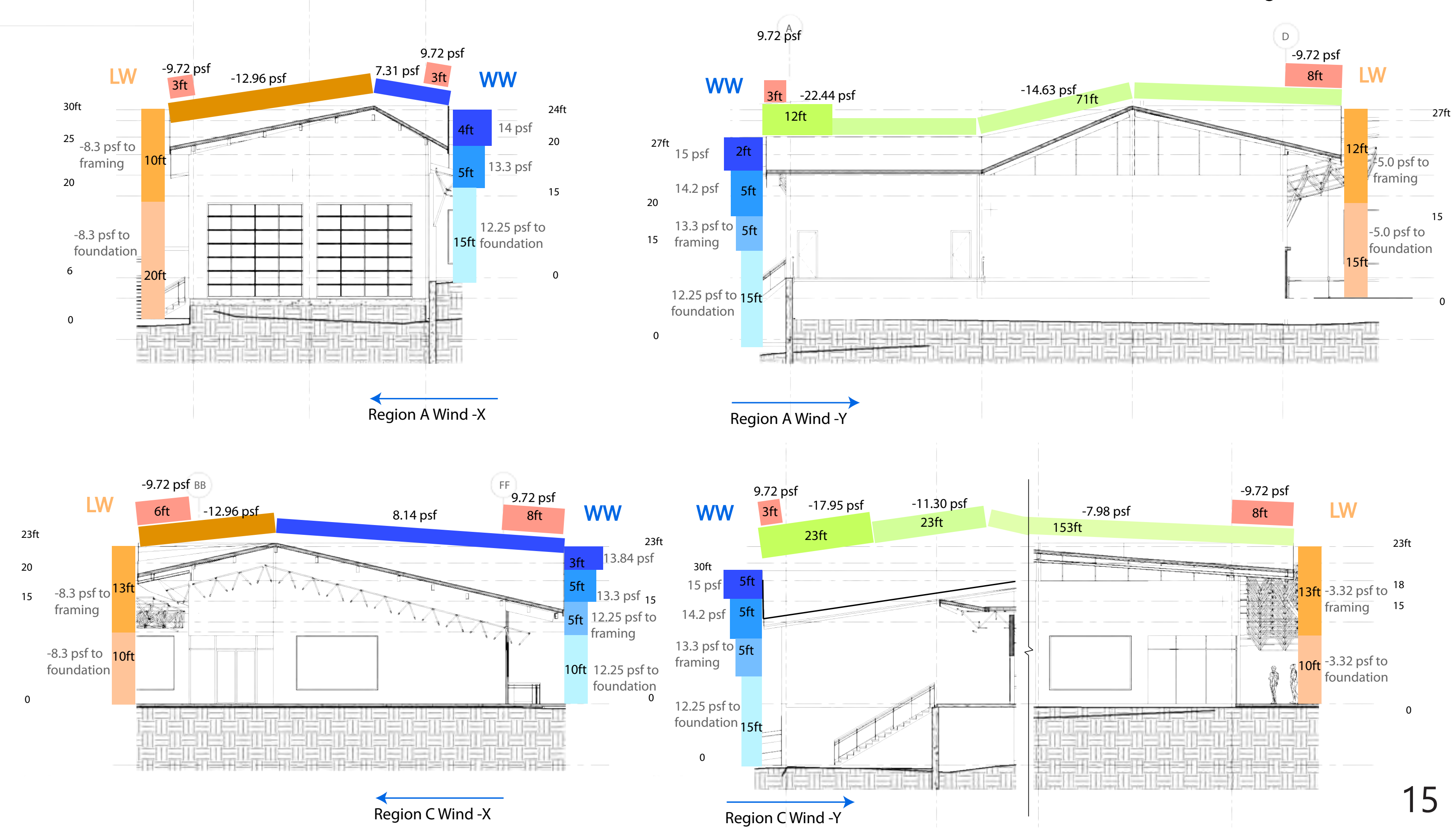


Windward and Leeward Wind forces
In relative +X (transverse) and +Y (longitudinal) directions



THESE WIND LOAD DIAGRAMS SHOW THE CHANGE OF WIND LOAD BASED ON THE REGION OF THE STRUCTURE, ITS HEIGHT, AND THE DIRECTION OF THE WIND.

Windward and Leeward Wind Forces
In relative - X (transverse) and - Y (longitudinal) directions



SEISMIC LOAD

Location	Orlando West, South Africa
Importance	IV
Site Class	D - Stiff Soil

Basic Parameters:

S_S=	0.263
S_1=	0.077
S_{MS}=	0.418
S_{M1}=	0.185
S_{DS}=	0.279
S_{D1}=	0.123

Additional Information:

SDC	C	Seismic design category
Fa=	1.59	Site amplification factor at 0.2s
Fv=	2.4	Site amplification factor at 1.0s
CRS=	0.859	Coefficient of risk (0.2s)
CR1=	0.882	Coefficient of risk (1.0s)
I_e=	1.5	ASCE 7-10, Table 1.5-2

Table 12.6-1: Equivalent Lateral Force Analysis Permitted

SEISMIC LOAD WAS NOT CONTROLLING EXCEPT WHERE THE CENTER OF MASS AND CENTER OF RIGIDITY WERE DISTANT FROM EACH OTHER WHICH INDUCED A LARGE TORSIONAL MOMENT, AS OCCURRED IN THE WEST REGION OF THE STRUCTURE.

SEISMIC DESIGN CATEGORY C WAS UTILIZED WITH IMPORTANCE IV AND SITE CLASS D.

THE SEISMIC WEIGHTS WERE BROKEN UP BY THE BUILDING REGIONS AND C_S VARIED BASED ON THE LATERAL FORCE RESISTING SYSTEM OF THE REGION.

Ord. Steel Cantilevered Columns (Region B & Canopy)

ASCE 7-10, Table 12.2-1, G - detail req. in 14.1

R= 1.25 NL

$T = C_u T_a$

$T_a = C_t h_n^{\,x}$

ASCE 7-10, Table 12.8-2

Ct=	0.02	x=	0.75
h_n=	24		
	T_a=	0.2	

ASCE 7-10, Table 12.8-1

Cu=	1.6877
T=	0.366002

ASCE 7-10, Figure 22-12

T_L= 12

$T \le T_L$ Use corresponding Cs upper limit

Cs Calculated ASCE 7-10, 12.8.1

$Cs = \dfrac{S_{DS}}{\frac{R}{I_e}}$

Cs= 0.3348

Cs Upper Limit $Cs_{up} = \dfrac{S_{DS}}{T \cdot \frac{R}{I_e}}$

Cs= 0.403276

Check Cs Lower Limit $C_{slow} = 0.044 \cdot S_{DS}.I_e \ge 0.01$

Cslow= 0.018414

		≤ Csup	0.403
Use Cs=	0.335	≥ Cslow=	0.018

Ord. Reinf. Masonry Shear Walls (Region A & C)

ASCE 7-10, Table 12.2-1, A - detail req. in 14.4

R= 2 NL

$T = C_u T_a$

$T_a = C_t h_n^{\,x}$

ASCE 7-10, Table 12.8-2

Ct=	0.02	x=	0.75
h_n=	24		
	T_a=	0.2	

ASCE 7-10, Table 12.8-1

Cu=	1.6877
T=	0.366002

ASCE 7-10, Figure 22-12

T_L= 12

$T \le T_L$ Use corresponding Cs upper limit

Cs Calculated ASCE 7-10, 12.8.1

$Cs = \dfrac{S_{DS}}{\frac{R}{I_e}}$

Cs= 0.20925

Check Cs Upper Limit $Cs_{up} = \dfrac{S_{DS}}{T \cdot \frac{R}{I_e}}$

Cs= 0.252048

Check Cs Lower Limit $Cs_{low} = 0.044 \cdot S_{DS}.I_e \ge 0.01$

Cs_{low}= 0.018414

		≤ Csup	0.252
Cs=	0.209	≥ Cs_{low}=	0.018

Seismic Weight

Façade Weights and Loads

Façade Distributed Weight (plf)

	Region A 20 ft			Region B 14 ft			Region C 20 ft		
Level	Roof	Framing	Found.	Roof	Framing	Found.	Roof	Framing	Found.
VenBrick	-	510.00	510.00	-	-	-	-	510.00	510.00
VenStud	550.00	-	550.00	220.00	-	550.00	550.00	-	550.00
Clerestory	-	230	550.00	-	-	-	-	390	550.00
Curtain wall	-	-	-	220.00	-	150.00	550.00	-	150.00
Roof Dead Load	35.246	psf							

Total Dead Load

Load	Dead	Façade	Floor	Total	
Region A	120.7914	87.67	-	208.46	k
Region B	66.95	18.10	-	85.05	k
Region C	412.5191	251.33	64.35	728.20	k
	TOTAL Dead Load			2,043.40	k

Cantilevered Columns (Region B & Canopy)

Region B

Base Shear $V = C_s \cdot W$

V= 28.47 kips

Ord. Reinf. Masonry Shear Walls (Region A & C)

Region A

Base Shear $V = C_s \cdot W$

V= 43.62 kips

Vertical Distribution

ASCE 7-10, Equation 12.8-12 $C_{vx} = \dfrac{w_x h_x^{\,k}}{\Sigma w_i h_i^{\,k}}$

ASCE 7-10, 12.8.3 interpolate for k if 0.5<T<2.5 else, k = 1 (T<0.5) or 2 (T>2.5)

T	k
0.5	1
0.366002	0.933001
2.5	2
k=	1

interpolate for k if 0.5<T<2.5 else, k = 1 (T<0.5) or 2 (T>2.5)

T	k
0.5	1
0.366002	0.933001
2.5	2
k=	1

Region B:

Level	Wx	hx	$w_x(h_x^k)$	Cvx
Roof	66.95	14	937.3	1
		$\Sigma w_i h_i^k$=	937.3	

Region A:

Level	Wx	hx	$w_x(h_x^k)$	Cvx
Roof	208.46	20	4169.162	1
		$\Sigma w_i h_i^k$=	4169.162	

Cantilevered Columns $F_x = C_{vx} \cdot V$

Level	Fx	
Roof	28.47307	k

Ord. Reinf. Masonry Shear Walls $F_x = C_{vx} \cdot V$

Level	Fx	
Roof	43.62	k

ρ= 1 ASCE 12.3.4.1

Level	Eh	Ev	
Roof	28.47	3.73581	k

ρ= 1 ASCE 12.3.4.1

Level	Eh	Ev	
Roof	43.62	11.631962	k

Canopy

Base Shear $V = C_s \cdot W$

V= 14.36 kips

Level	Wx	hx	$w_x(h_x^k)$	Cvx
Roof	0	17	0	0
		$\Sigma w_i h_i^k$=	0	

Cantilevered Columns $F_x = C_{vx} \cdot V$

Level	Fx	
Roof	0	k

ρ= 1 ASCE 12.3.4.1

Level	Eh	Ev	
Roof	-	0	k

Region C

Base Shear $V = C_s \cdot W$

V= 152.37 kips

Level	Wx	hx	$w_x(h_x^k)$	Cvx
Roof	663.85	20	13,276.92	1.00
Floor	64.35	0	-	
		$\Sigma w_i h_i^k$=	13,276.92	

Ord. Reinf. Masonry Shear Walls $F_x = C_{vx} \cdot V$

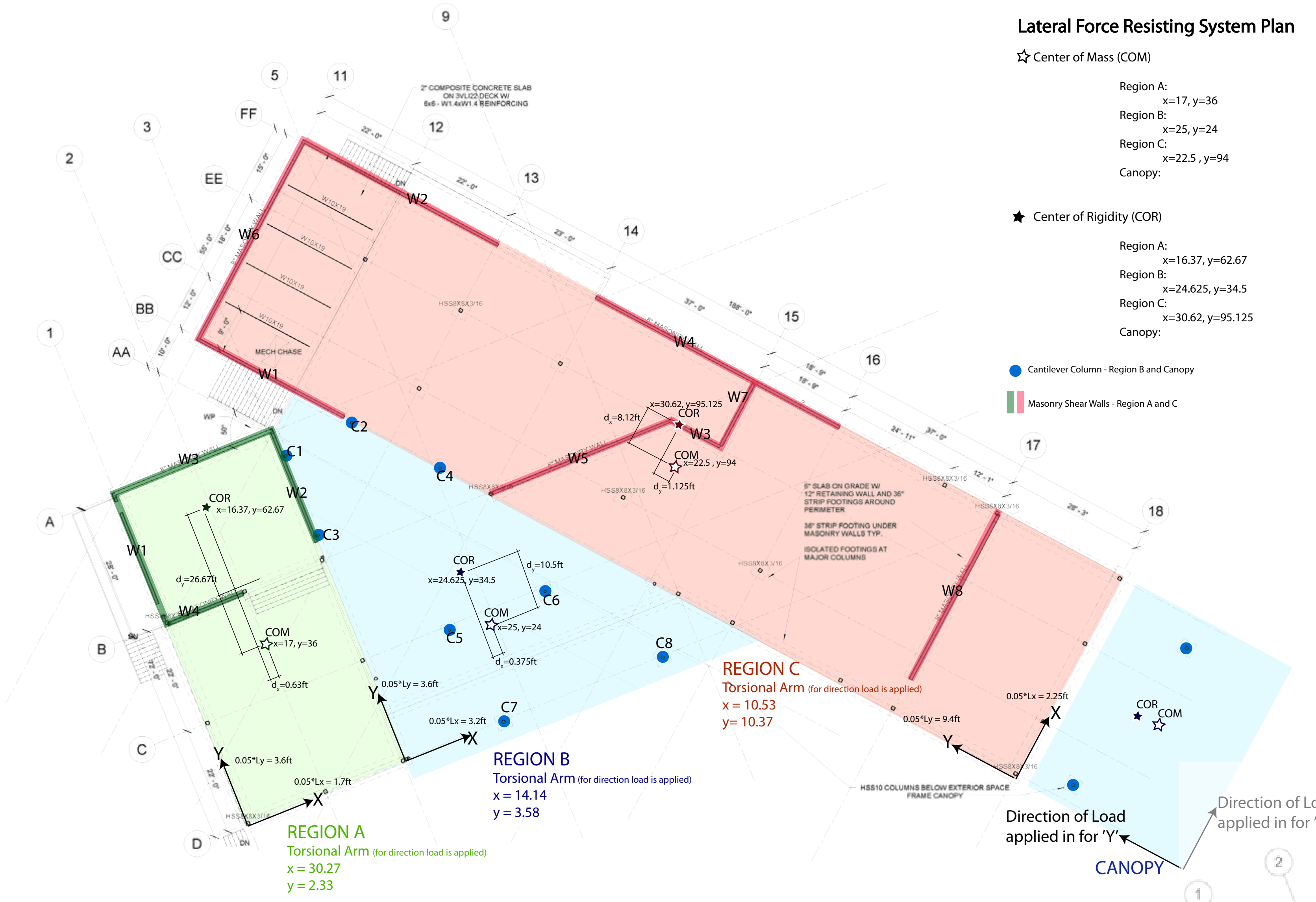
Level	Fx	
Roof	43.61986	k

ρ= 1 ASCE 12.3.4.1

Level	Eh	Ev	
Roof	43.62	37.04	k

Vertical Seismic Load Effect - Ev [12.4.2.2] requires that a vertical load effect equal to 0.2 Sds be applied to dead load. It is applied as a Dead Load Factor adjustment and may act downward or upward. No Ie, Ip, nor Rho is applied to Ev. (NCSEA, "...Common errors in Seismic ...") 51

EV Factor 0.0558



LATERAL FORCE RESISTING ELEMENTS TRANSFER LOADS TO THE FOUNDATION. THE LOCATION OF THESE ELEMENTS AND THEIR STIFFNESSES AFFECTS THE RIGIDITY OF THE STRUCTURE AND ITS NATURAL TENDENCY TO ROTATE UNDER LATERAL LOADS.

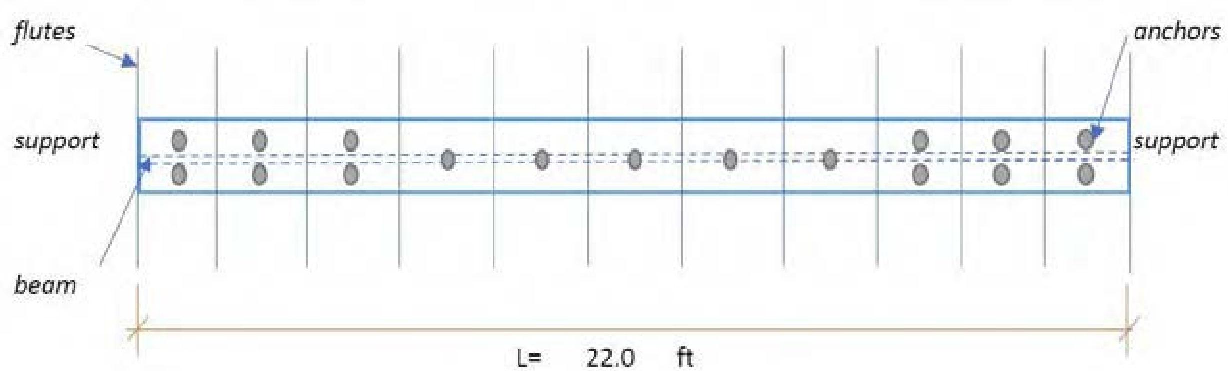
THE CENTER OF RIGIDITY WAS USED TO CALCULATE THE INHERENT TORSION DUE TO THE SEPARATION BETWEEN THE CENTER OF MASS AND CENTER OF RIGIDITY THAT OCCURS DURING LATERAL LOADING.

SEISMIC LOADS ARE APPLIED TO A REGION OF A STRUCTURE BASED ON THE WEIGHT OF THE STRUCTURE IN THAT AREA. FACADE AND FLOOR STRIP PLANS EXPRESS THE VARIOUS WEIGHT CONDITIONS THAT WERE CONSIDERED.

STRUCTURAL CALCULATIONS

COMPOSITE BEAMS, EXAMPLE SUMMARY

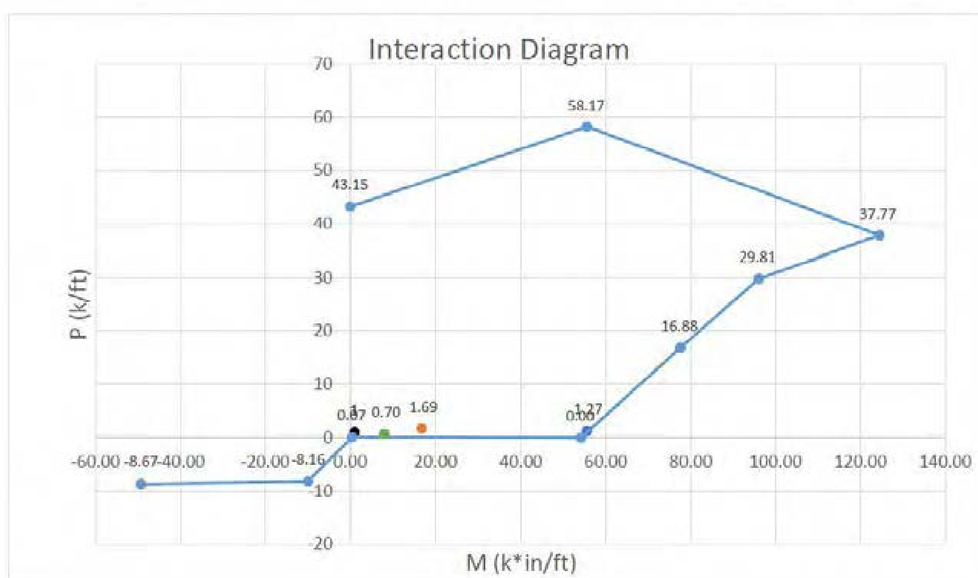
01 Beam: W10x19 - 0.75" Camber with 17 - 3/4" Φ H.S.A.	
first 3 flutes on each side need 2 anchors the middle 5 flutes have 1 anchor	2" Composite Slab on 3VLI22 Deck w/ 6x6 - W1.4xW1.4 reinforcing



MASONRY SHEAR AND LOAD BEARING WALLS, EXAMPLE SUMMARY

		1	2	3	
	P (k/ft)	1.27	1.69	0.70	k
Applied Loads	M (k*in/ft)	55.50	16.83	8.02	k-in

Point	Label	P (k/ft)	M (k*in/ft)	Point	Label	P (k/ft)	M (k*in/ft)
Pure Axial	1	43.15	0	k=.25kd	5	-8.67	-49.35
Pure Moment	2	0	54.11	Balanced Cond.	3	-8.16	-9.92
Balanced Cond.	3	(8.16)	-9.92292277	k=.5kd	4	0.07	0.39
k=.5kd	4	0.07	0.387029282	Pure Moment	2	0.00	54.11
k=.25kd	5	(8.67)	-49.3536602	kd=d	6	16.88	77.51
kd=d	6	16.88	77.50921119	kd=.75h	7	29.81	95.95
kd=.75h	7	29.81	95.95	kd=h	8	37.77	124.37
kd=h	8	37.77	124.37	kd=2h	9	58.17	55.51
kd=2h	9	58.17	55.51	Pure Axial	1	43.15	0.00



Required Load falls within Interaction Diagram - Design works

HAND CALCULATIONS WERE UTILIZED TO DESIGN SPECIAL MEMBERS UNABLE TO BE DESIGNED THROUGH SOFTWARE.

Space Frame Cantilever Columns

Space Frame System Forces

Horizontal forces
- Wind 11 k
- Seismic 27 k

distributing 2/3 total lateral load to individual column for max condition approximation

Vertical Forces
- Wind Uplift -16.5 psf
- DL 26 psf
- LL 20 psf

330 ft2 per column
15 ft avg column height

Factored Loads

1.2 D + 1.6 L
- 20.856 k

1.2D + 1.6 L + 0.5 W
- gravity 15.411 k
- lateral 3.666666667 k
- M from lat 55 k-ft

1.2D + 1W + 1L
- gravity 11.451 k
- lateral 7.333333333 k
- M from lat 110 k-ft

0.9 D + 1W
- gravity 2.277 k
- lateral 7.333333 k
- M from lat 110 k-ft

1.2D + 1E + L
- gravity 16.896 k
- lateral 18 k
- M from lat 270 k-ft

0.9 D + 1W
- gravity 7.722 k
- lateral 18 k
- M from lat 270 k-ft

Maximum Forces
- gravity 20.856 k
- lateral 18 k
- Moment from lat 270 k-ft

Round HSS 14x0.5 — AISC Tables
- Flexure 294 k-ft
- Tension 820 k
- Compressic 745 k

Chapter H
Pr/Pc 0.027994631 less than 1 assuming half moment goes x axis half goes to y axis

unity equation 0.932365 <1

HSS14x0.5 works

SPACE FRAME MEMBER CAPACITY

Round HSS

Fy	46 ksi		E	29000 ksi
L	42 in		r	0.543 in2
D	1.66 in		Ag	0.635 in2
t	0.13 in			

Compression

Section E3

D/t (slenderness) 12.76923 < Slenderness limit 69.35 B4.1a

Member is nonslender: good

Lc/r = 77.34807 < Effective slenderness limit 118.26

Use $Fcr = 0.658^{\left(\frac{Fy}{Fe}\right)} * Fy$

- Fe 47.84 ksi
- Fcr 31.97 ksi
- ΦP=ΦFcr*Ag 18.27 kips

Tension

Table 5-7
- ΦPn yeild 25.90 k
- ΦPn rupture 21.8 k

HSS 1.66X0.14
ΦPn= 18.27 k (compression)
21.80 k (tension)

Slab on Grade w = 12 in_{strip}

6" TYP. U.N.O. h = 6 in

CRSI Design Method

$F_{roughness}$=	1.5	Typ.
L =	20	ft_{max}
w =	100	$psf_{occupancy\ live\ load}$
fs =	40000	psi, 2/3fy
As =	0.0375	in^2/ft

Max spacing: 5h or 18in; 30; Use 18

	A_{bar}	s_{max}	$s_{controlling}$
#3 bars	0.11	35.2	18
#4 bars	0.2	64	18

Temperature and Cracking

As_{temp} = 0.0018*h*w= 0.1296 in^2/ft

Max spacing: 5h or 18in; 30; Use 18

	A_{bar}	s_{max}	$s_{controlling}$	As/ft
#3 bars	0.11	10.18519	10.18519	0.1296
#4 bars	0.2	18.51852	18	0.133333

Design Summary:

As_{temp} Controls Design 0.1296 in^2/ft

Use #3 bars @ 10 in O.C. E.W.

w/ As = 0.132 in^2/ft

or W6.5xW6.5 @ 6 in O.C.

w/ As = 0.13 in^2/ft

Spread footing Design

		HSS6x6x4	HSS9x9x4	HSS8x8x4	
Square Base Plate	B X N	12	15	14	in
	t	0.5	0.5	0.5	in
Square Footing	ft, B X L	4	4	4	ft
	height (in)	16	16	16	in
each way:	w/	4	4	4	bars
	sizr	#6 bar	#6 bar	#6 bar	
	bar spacing	14	14	14	in, with 3" cc.

Stem Wall Design

	Wall thickness	12	12	8	in
	d	10.75	10.75	6.75	in
	h	12	12	8	in
	Wall height	10	6	3.5	ft
each way:	# bars	1	1	1	bars
	size	#5 bar	#5 bar	#4 bar	
	db	0.625	0.625	0.5	
	bar spacing	12	12	12	in, with 3" cc.
	As =	0.31	0.31	0.2	in^2/ft

Strip Footing Design

h	16	12	12	inches
d	13.5	9.5	9.5	inches
L square	4	4	4	ft
#bars	#4 bars	#4 bars	#4 bars	@
spacing	8	11	11	inches O.C. EW

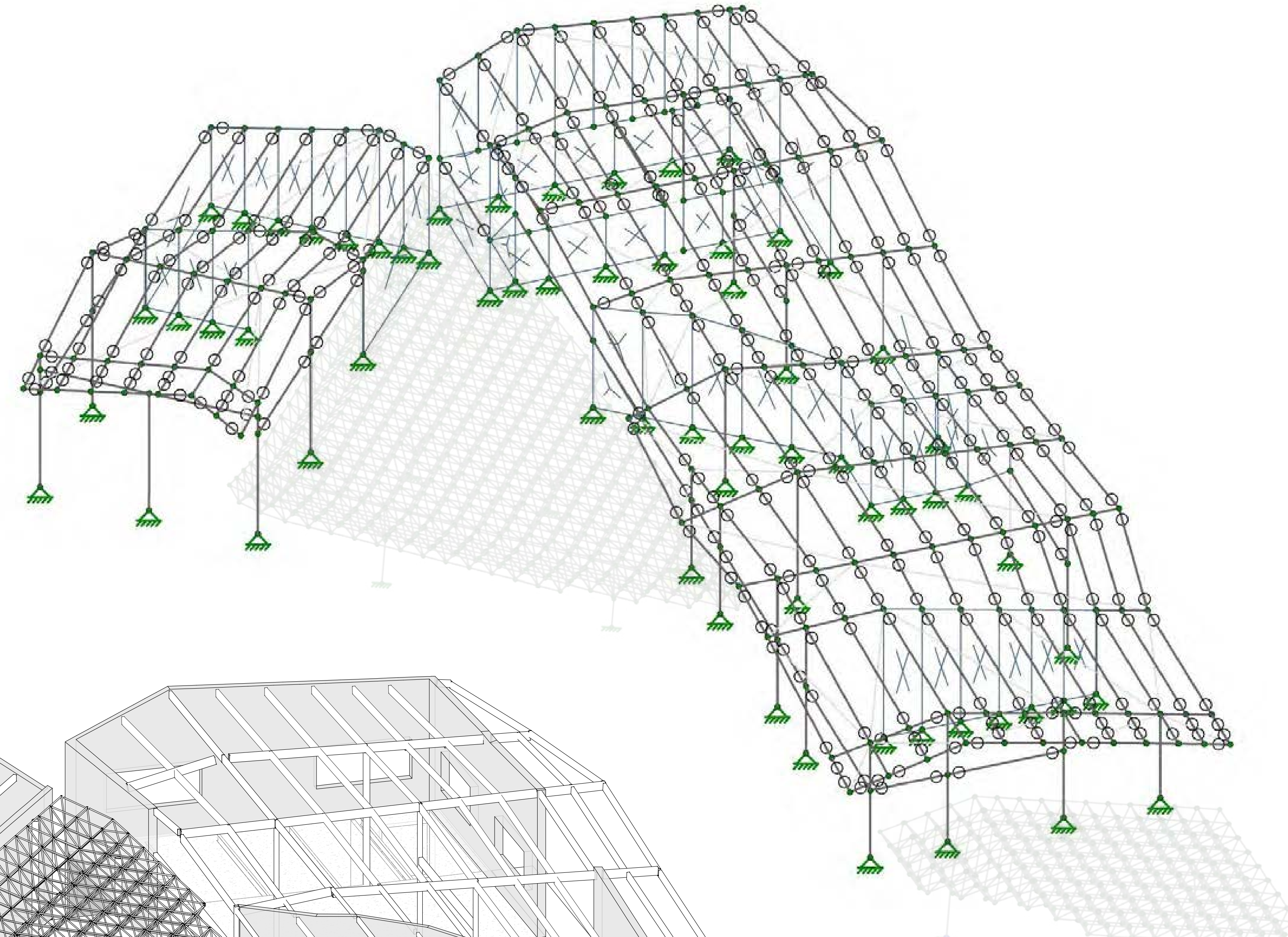
RISA ANALYSIS

THE STEEL STRUCTURE WAS ANALYZED AND DESIGN USING RISA 3D, A STRUCTURAL MODELING SOFTWARE. THE MASONRY WALLS AND FOUNDATIONS WERE DESIGN FROM LOADS RECEIVED FROM PLACE HOLDERS WITHIN THE RISA MODEL.

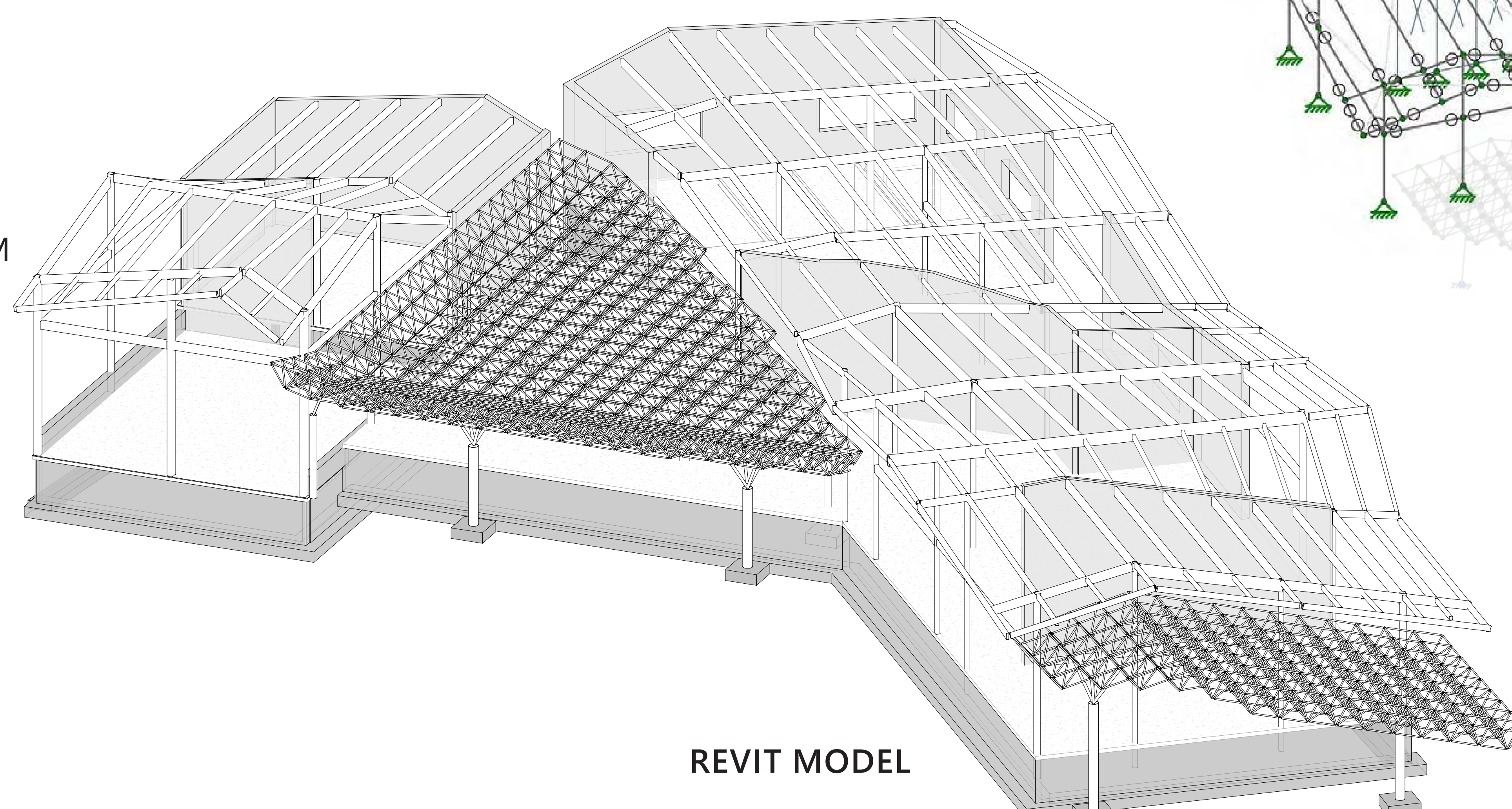
THE STEEL FRAME SYSTEM WAS MODELED SEPARATELY FROM THE SPACE FRAME SYSTEM DUE TO THE COMPLEXITY OF THE SPACE FRAME SYSTEM.

THE SPACE FRAME WAS PRELIMINARILY DESIGNED AND WILL BE COMPLETED BY A SPECIALTY ENGINEER.

THE RESULTS OF THE DESIGN FROM RISA AND HAND CALCULATIONS IS COMPILED IN THE CONSTRUCTION DOCUMENTS FOLLOWING.



RISA MODEL



REVIT MODEL

CONSTRUCTION DOCUMENTATION

SECTION 1: GENERAL INFORMATION AND DESIGN CRITERIA

SECTION 1.1 - DOCUMENTS

1.1.1 Structural Construction Documents consist of Project Specifications and Structural Drawings. Structural drawings include General Notes and Typical details in addition to plans, sections and details.

1.1.2 General Notes and Typical Details describe general criteria that apply to all similar conditions throughout the project regardless of whether or not they are specifically referenced in the plans or details.

1.1.3 Do not scale plans, details and sections for quantity, length or fit of materials.

1.1.4 The structural documents are protected by U.S.A. Copyright Laws. They shall not be used for any purpose other than construction of the structure shown on the site indicated on the Architectural Drawings.

1.1.5 The design represented by these documents is valid only for the building site and the purposes shown on the Architectural Drawings.

1.1.6 The GEOTECHNICAL REPORT is a separate document (not part of contract documents) furnished by the project owner. The contractor is urged to obtain a copy of the report for reference as it describes sub-surface conditions that may be encountered during installation of foundations and contains other information pertinent to construction of the project.

1.1.7 The contractor must coordinate Structural Documents with other trades and disciplines including; architectural, mechanical, electrical, HVAC and fire protection. Every attempt is made to coordinate drawings prior to issue, however, some requirements are not known prior to issue, and change may occur during construction as layout and fabrication drawings are developed.

1.1.8 Promptly report deviations and interferences with structural components for resolution by the Engineer.

1.1.9 Verify dimensional location and depth of slab recesses and offsets with Architectural Drawings.

1.1.10 Verify weights, location and details of structurally supported mechanical equipment prior to construction of the supporting structure. Report deviations from assumed conditions to the Engineer prior to fabricating materials.

1.1.11 Verify the location, size and detail of roof openings and curbs for mechanical equipment prior to fabricating materials. Report deviations from assumed conditions to the Engineer before proceeding with work.

1.1.12 Verify location and size of floor and roof penetrations and sleeves for mechanical and electrical components. Openings in beams, girders, columns and slabs must be submitted for approval.

1.1.13 Verify dimensions, details, plumbness and squareness of existing structures meeting or tieing into new construction.

1.1.14 Heights of floor and roof decks and various framing components are given on the drawings relative to a reference elevation of 100'-0". This reference elevation is equivalent to a Mean Sea Level Elevation of 909'.

SECTION 1.2 - CODES AND STANDARDS

1.2.1 Building Code: 2015 International Building Code (IBC)

1.2.2 Concrete Code: American Concrete Institute ACI 318-14

1.2.3 Steel Code: AISC Steel Construction Manual, 15th edition

SECTION 1.3 - DESIGN LOADS

1.3.1 Live Loads:

Living, Assemb, Floor	125	psf
Offices, Typical Floors	50	psf (1)
Roof, Slope Less than 4:12	20	psf

Notes:
(1) Plus partition loading (see Dead Loads)
(2) Minimum load, or weight of equipment (the heavier)

1.3.2 Dead Loads:

2" Slab	45.0	psf
Flooring	3	psf
Typical Ceilings	4	psf
Mech, Elec, Plumbing	4	psf
Floor Collateral	3	psf (1)
Floor Sprinklers	3	psf (3)
Floor System	7	psf
Partition Loading	15	psf (4)
Roof Collateral	3	psf (1)
Roof Insulation	8	psf
Roof Sprinklers	3	psf (3)
Roofing System	9	psf (2)

Notes:
(1) Collateral loads include: lighting, ductwork, miscellaneous framing.
(2) Roofing system weight is the maximum unit weight of roofing materials and ballast (where applicable) for which the roof structure is designed.
(3) Sprinkler loadings are for distribution lines and heads, exclusive of mains, which are included Separately as concentrated dead loads.
(4) Applied where noted under "Live Loads".

1.3.3 Wind Loads: MWFRS

Base Mean Wind Velocity	120 mph
Wind Exposure Classification	B
Occupancy Category	IV
Analysis Procedure -	Analytical Method

1.3.4 Seismic Loads:

Mapped Spectral Response Acceleration, Ss	0.263
Mapped Spectral Response Acceleration, S1	0.077
Spectral Response Coefficient, Sds	0.279
Spectral Response Coefficient, Sd1	0.123
Site Class	D
Seismic Importance Factor, Ie	1.5
Seismic Use Group	IV
Seismic Design Category, SDC	C
Seismic Response Coefficient, Cs	0.209
Basic Seismic Force Resisting System	ORMSW
Response Modification Factor, R	2.0
Deflection Amplification Factor, Cd	1 3/4
System Over Strength, Ωo	2 1/2
Design Base Shear 43.62/152.37 K	

Analysis Procedure - Equivalent Lateral Force Procedure

SECTION 2: FOUNDATIONS AND RELATED EARTHWORK

GEOTECHNICAL REPORT

2.1 Design of foundations and structural components in contact with soil is based on the recommendations given in the following:

Report by	: Geotechnical Services Inc.
Date of Report	: February 7, 2011
Report Reference	: GSI Project No. 116023

2.2 Refer to the geotechnical report for subsoil conditions that may be encountered in the installation of foundations, and other information relevant to foundations and site preparation.

2.3 Design of soil-supported building slabs is based on a range of soil movement of 0 to 1 inch(es), based on the recommendations of Geotechnical Report.

2.4 Refer to Specifications for soil stabilization under soil-supported building slabs.

2.6 Design Criteria:
Bearing Material:
Bearing Elevation:
(For Bidding Purposes Only)
Spread Footing Bearing Capacity: 4000 psf
Continuous Footing Bearing Capacity: 4000 psf

2.7 Required footing thickness is minimum and shall be adjusted as necessary to achieve required bearing conditions.

2.8 Steel dowels at tops of footings shall extend 30 bar diameters above and shall be hooked 3" above bottom of footing unless noted otherwise.

2.9 Top of footing elevations given are relative to reference elevation of 100'-0" at top of slab at grade level.

SECTION 3: STRUCTURAL CONCRETE

3.0.1 Concrete shall have a min. compressive strength at 28 days of 4000psi UNO.

SECTION 3.1 - CONCRETE FORMS

3.1.1 Formed Voids - Provide retained void spaces between bottom of structural members and sub grade as follows:
Grade Beams 4 inches

3.1.2 Grade Beams - shall be formed both sides unless specifically shown or noted otherwise in the details.

SECTION 3.2 - STEEL REINFORCING

STEEL REINFORCING

3.2.1 All bars shall be deformed in accordance with ASTM A615. Reinforcing indicated to be welded shall conform to ASTM A706.

3.2.2 Strength of bars shall be as follows:

All Bars Grade 60

SPLICING OF REINFORCING BARS

3.2.3 Top bars in beams, slabs or joists shall be spliced at midspan between supports, unless noted otherwise.

3.2.4 Bottom bars in beams, slabs or joists shall be spliced at supports, unless noted otherwise.

3.2.5 Column reinforcing shall be spliced at top of concrete above floors, unless noted otherwise.

LAPPED SPLICE LENGTHS

3.2.6 Lap reinforcing 30 bar diameters at splices unless noted or detailed otherwise.

CONCRETE COVER TO REINFORCING

3.2.7 Clearance from face of concrete to face of reinforcing:

Footings	3"
Formed Grade Beams	1-1/2" top, 2" sides, 3" bottom
Columns	1-1/2" interior, 2" exterior exposure
Slabs	3/4"
Beams	1-1/2" interior, 2" exterior exposure

PLACEMENT OF REINFORCING

3.2.8 Offsets in reinforcing bars shall be bent at a ratio of 1 (normal to bar axis) to 6 (parallel to bar axis).

3.2.9 Provide dowels from grade beams or foundation equal in size and spacing to vertical bars in walls or pilasters and extend one splice length above and below joint line, unless noted otherwise.

3.2.10 Place first bar of slab reinforcing parallel to side 2 inches from a free edge or half of required bar spacing from face of edge beam.

3.2.11 Single layer reinforcing in walls shall be placed at center of walls unless noted otherwise.

SECTION 3.3 - CONCRETE MIX DESIGNS

3.3.1 Concrete Mix Schedule:

a) "HRC" refers to hardrock concrete having air dry unit weight of approximately 145 PCF.
b) Where w/c ratio is not indicated in the Concrete Mix Schedule, it shall be as necessary to meet strength requirements.
c) Where the w/c ratio is shown, it shall be adhered to regardless of strength requirements.
d) "Strength" is required compressive cylinder strength at 28 days.

Conc. Class	Strength psi	Agg. Type	Agg. Size	Slump Inches	Max w/c	Notes
A	3000	HRC	1-1/2"	5-7	---	
B	3000	HRC	1"	3-5	---	
C	3500	HRC	1"	2-4	---	
D	4500	HRC	1"	3-5	---	
E	3000	HRC	3/4"	2-4	---	
F	4000	HRC	1"	3-5	---	

3.3.2 Mix Usage Schedule:

Concrete Description of Use	Class	Air Content
Drilled Piers	A	------
Footings	A	------
Grade Beams	B	4.5-6%
Interior Slab-on-Grade	C	------
Basement Slab	D	------
Basement Walls	D	------
Retaining Walls	D	4.5-6%
Elevator Pit Walls	B	------
Slab on Composite Metal Deck	E	------
Structural Beams and Slab	F	------
Structural Columns	F	------
PCN Walls, Columns & Slabs	F	------

SECTION 3.4 - CONCRETE SLABS

3.4.1 Slabs Placed on Grade

Location	Thickness	Reinforcing
S1	6 inches	W6.5X26.5 @ 6in O.C.
S2	8 inches	W9XW9 @ 6 in O.C.

a) Reinforcement shall be placed 2 inches from top of slab, unless detailed otherwise.
b) Provide construction joints in slabs where indicated on Plans. Allow minimum of 4-day interval between placing adjacent sections of slab.

3.4.2 Elevated Slabs

Location	Thickness	Reinforcing
S3	2 inches	3" composite deck W1.4XW.14 @ 6in O.C.

a) Reinforcement shall be placed 2 inches from top of slab, unless detailed otherwise.
b) Provide construction joints in slabs where indicated on Plans. Allow minimum of 4-day interval between placing adjacent sections of slab.

SECTION 4.2 - REINFORCING

4.2.1 Horizontal joint reinforcing shall be truss type 9 ga. welded wire spaced at 16 inches on center vertically. Provide units with 2 horizontal wires. Provide special "L" and "T" shaped sections at wall intersections. Lap horizontal wires at least 12" at splices.

4.2.2 Provide corner bars at intersections of reinforced trough tiles equal in size and number to horizontal reinforcing lapped 30 bar diameters each way.

4.2.3 Horizontal reinforcing in trough tiles shall be lapped 30 bar diameters at splices. Stagger splices in adjacent bars at least 4'-0".

4.2.4 Cells at corners, end of walls, and each side of openings of interior and exterior walls shall be grouted and reinforced with 1 #6 minimum unless noted otherwise.

4.2.5 Vertical reinforcing in grouted cells and pilasters shall be held in place by bar positioners set in masonry joints. Lap splices shall be as follows:

Upper and lower 1/4 of height: 40 bar diameters
Middle 1/2 height of wall: 60 bar diameters

4.2.6 Refer to Architectural layout and Drawings and Specifications for details and exact dimensions of masonry work including, weep holes, waterproofing and flashing.

4.2.7 Reference Schedule for Wall Vertical Reinforcing.

SECTION 5: STRUCTURAL STEEL

SECTION 5.1 - STRUCTURAL FRAME

5.1.1 Structural Steel Properties:

W-shapes and Tees	ASTM A992
Angles, Channels, Plates, uno	ASTM A36
HSS Rectangular	ASTM A500, Grade B
HSS Round	ASTM A500, Grade B
Erection Bolts	ASTM A307
High Strength Bolts	ASTM A325N
Anchor Bolts	ASTM A36 or A307
High Strength Anchor Bolts	ASTM A193 Grade B7
Headed Stud Anchors	ASTM A108

WELDING

5.1.2 Unless otherwise noted, angles, plates, rods, and miscellaneous framing shall be welded at contact joints and supports. Weld sizes shall conform to AWS D1.1 minimum, except where noted otherwise.

5.1.3 Where fillet weld sizes are not indicated on weld symbols, fillet size shall be 1/16th inch smaller than thickness of thinner of materials being joined.

5.1.4 Complete penetration welds are indicated by notation "CP" on weld symbols, partial penetration by "PP".

5.1.5 Edge angles at perimeters of floors and roofs noted as "CHORD MEMBERS" or "CONTINUOUS" on details shall be butt welded at splices to develop full allowable tensile strength of member.

5.1.6 Edge angles supporting floor or roof deck shall be spliced only over supports.

STRUCTURAL BOLTS

5.1.7 Bolts indicated on details shall be ¾" diameter, unless noted otherwise.

5.1.8 Bolts shall be tightened by the AISC "Snug Tight" method unless noted otherwise.

5.1.9 Shelf angles supporting masonry shall have ¼" wide expansion joints spaced not more than 40 feet apart.

SECTION 5.2 - METAL ROOF DECK

5.2.1 Metal Deck Schedule:

Deck Gauge	SDI Deck Type	Deck Depth (In.)	Sheet Width (In.)	Min. Ix (In.4)	Min. Sx(top) (In.3)	Min. Sx(bot) (In.3)
22	B	1.5	36	0.1.83	0.192	0.186

5.2.2 Metal Deck Connection Schedule:

Mark	Conn. @ Supports (W/N)	Conn. @ Parallel Edges (In.)	Sidelap Conn. (#/span)	Req'd Shear Capacity (lb/ft)
I	36/5	12	4	287
II	36/7			

5.2.3 Support and parallel edge connections shall be 5/8-inch diameter puddle welds. Sidelap connections shall be #10 hex screws. W/N = sheet width / # connections each sheet.

5.2.4 Roof deck shall be connected as indicated for Mark I unless noted otherwise.

No.	Description	Date

ORLANDO WEST FIRE STATION

SHEET INDEX AND GENERAL NOTES

Project number	5226
Date	Issue Date
Drawn by	Author
Checked by	Checker

000

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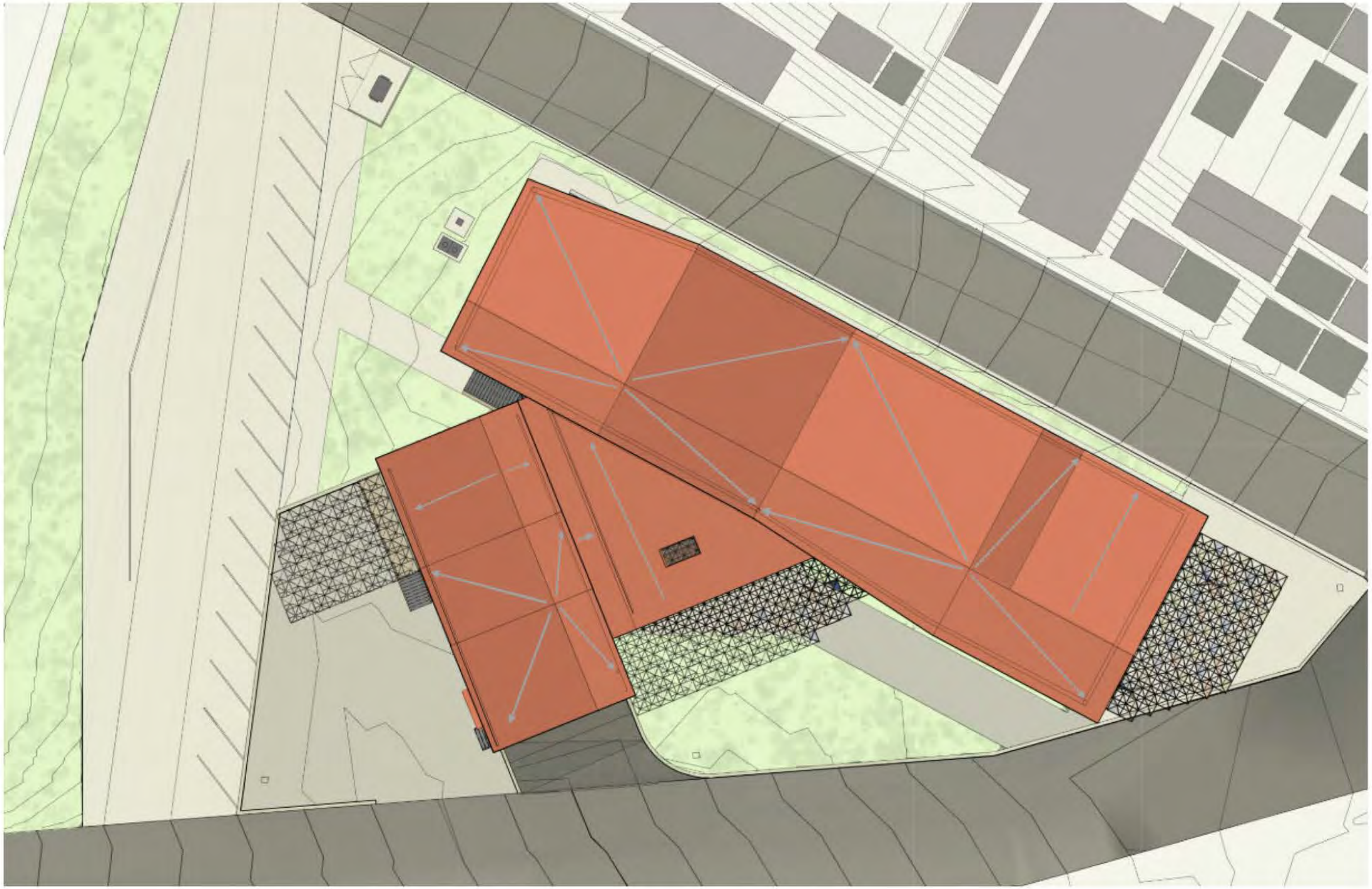

No.	Description	Date

ORLANDO WEST FIRE STATION SITE

Project number	5226
Date	Issue Date
Drawn by	Author
Checked by	Checker

A101

Scale

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1 Main Floor Plan
3/32" = 1'-0"

No.	Description	Date

ORLANDO WEST FIRE STATION

GROUND FLOOR PLAN

Project number	5226
Date	Issue Date
Drawn by	Author
Checked by	Checker

A102

Scale 3/32" = 1'-0"

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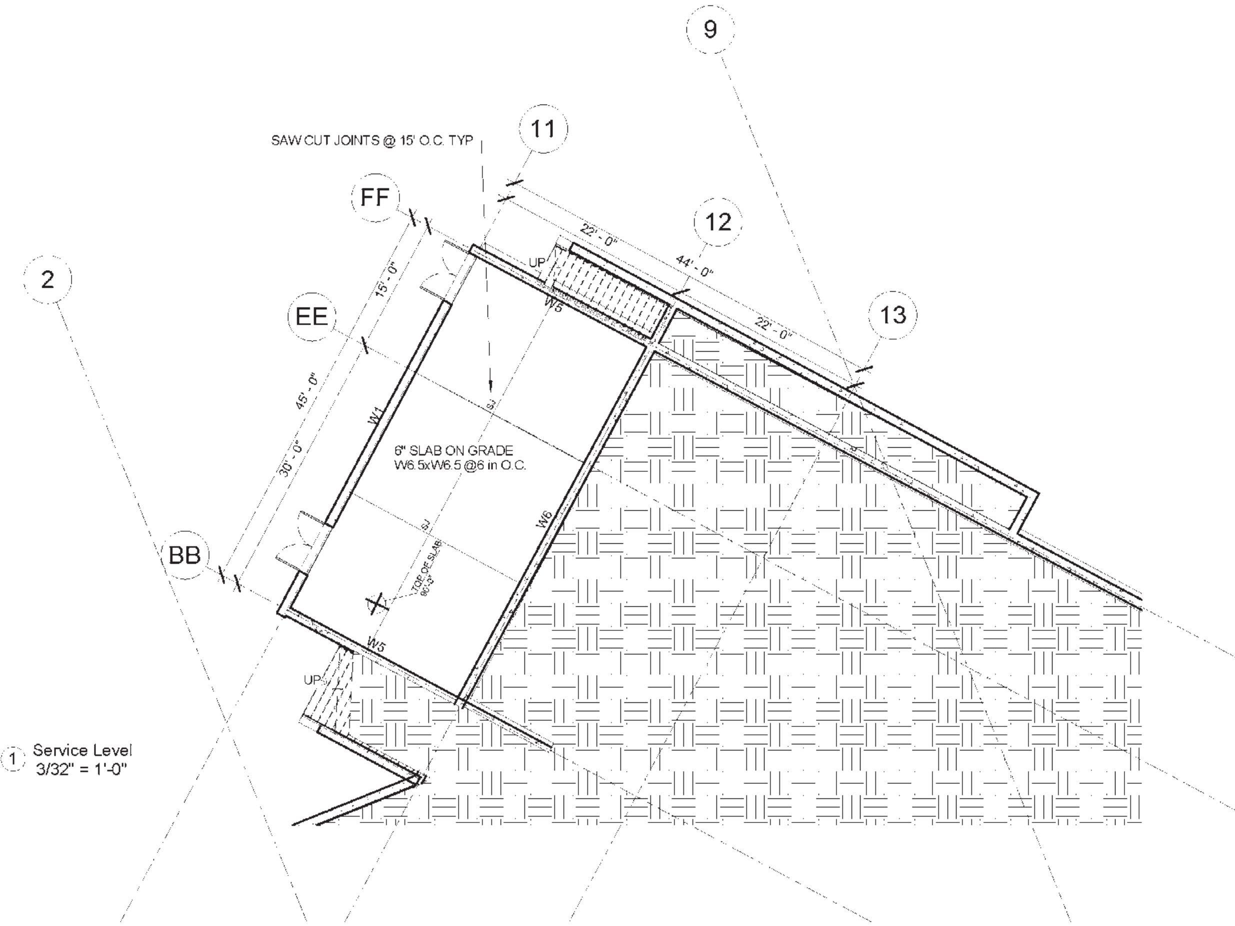

1 Service Level
3/32" = 1'-0"

FOUNDATION PLAN NOTES

1. FINISH FLOOR ELEVATION IS 100'-0" (RELATIVE TO DATUM 100-0).
2. TOP OF CONCRETE SLAB IS FINISH FLOOR UNLESS SHOWN OTHERWISE.
3. TYPICAL CONCRETE SLAB THICKNESS IS 6", REINFORCED W6.5X26.5 @ 6in O.C..E.W. UNLESS NOTED OTHERWISE.
4. SHEET INDEX:

GENERAL STRUCTURAL NOTES	000
FOOTING SCHEDULE	S601
COLUMN SCHEDULE	S601
BEAM SCHEDULE	S601
TYPICAL DETAILS	S501

No.	Description	Date

ORLANDO WEST FIRE STATION

BASEMENT FOUNDATION PLAN

Project number	5226
Date	Issue Date
Drawn by	Author
Checked by	Checker

S101

Scale 3/32" = 1'-0"

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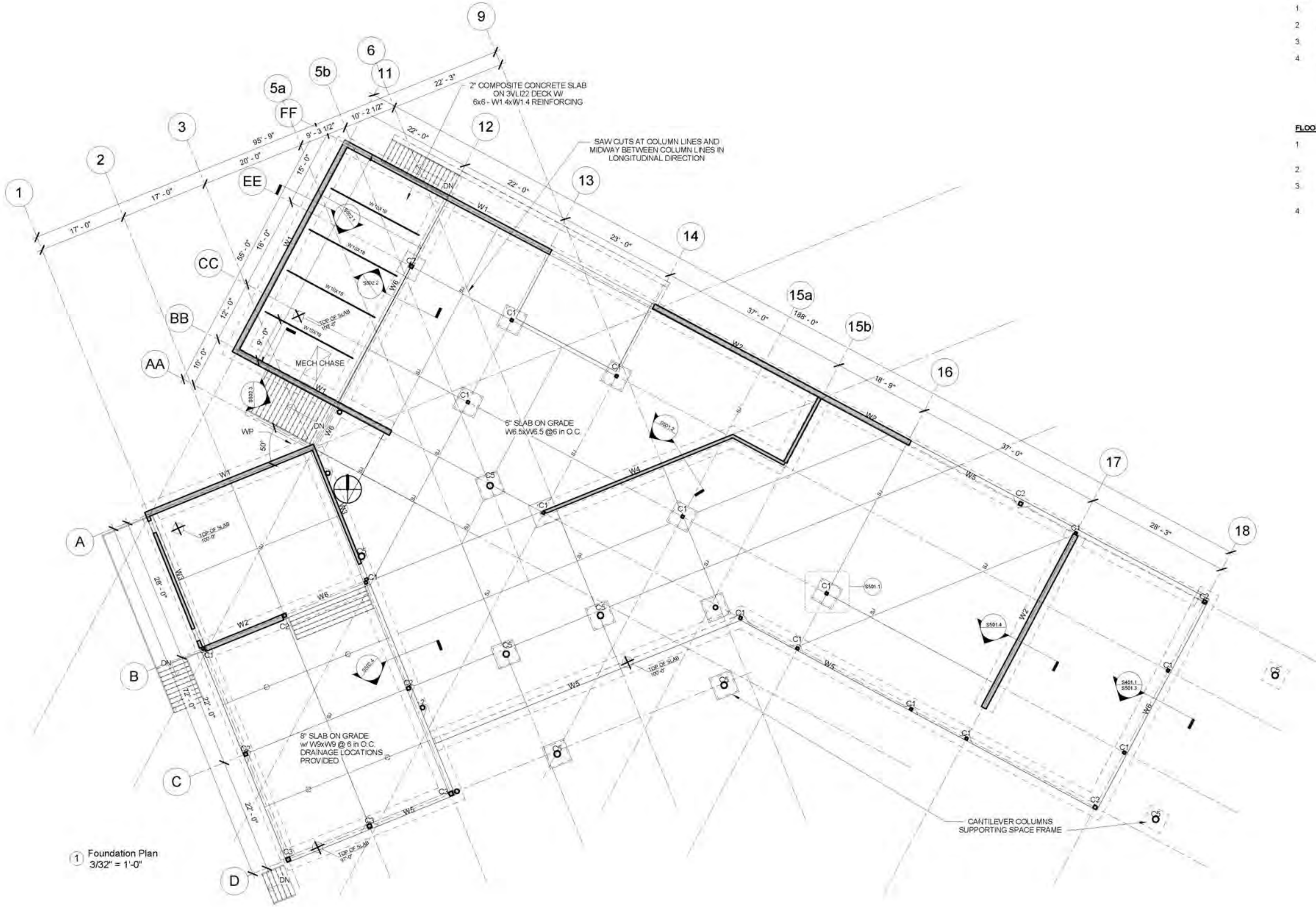

1 Foundation Plan
3/32" = 1'-0"

FOUNDATION PLAN NOTES

1. FINISH FLOOR ELEVATION IS 100'-0" (RELATIVE TO DATUM 100-0).
2. TOP OF CONCRETE SLAB IS FINISH FLOOR UNLESS SHOWN OTHERWISE.
3. TYPICAL CONCRETE SLAB THICKNESS IS 6", REINFORCED W6.5X26.5 @ 6in O.C. E.W. UNLESS NOTED OTHERWISE.
4. SHEET INDEX:

GENERAL STRUCTURAL NOTES	000
FOOTING SCHEDULE	S601
COLUMN SCHEDULE	S601
BEAM SCHEDULE	S601
TYPICAL DETAILS	S501, S502, S503

FLOOR FRAMING PLAN NOTES

1. TOP OF SLAB ELEVATION (RELATIVE TO DATUM 100-0) IS:

REGION B ROOF HEIGHT	115-0
REGION A AND C ROOF HEIGHT	120-0

2. TOP OF CONCRETE SLAB IS FINISH FLOOR UNLESS SHOWN OR NOTED OTHERWISE.
3. SLAB THICKNESS IS 2" NORMAL WEIGHT CONCRETE REINFORCED WITH ONE LAYER OF W1.4xW1.4 @ 6X6 IN O.C. ON 3" COMPOSITE DECK UNLESS NOTED OTHERWISE.
4. SHEET INDEX:

GENERAL STRUCTURAL NOTES	000
SCHEDULES	S601
TYPICAL DETAILS	S501, S502, S503

No.	Description	Date

ORLANDO WEST FIRE STATION

FOUNDATION PLAN

Project number	5226
Date	Issue Date
Drawn by	Author
Checked by	Checker

S102

Scale	As indicated

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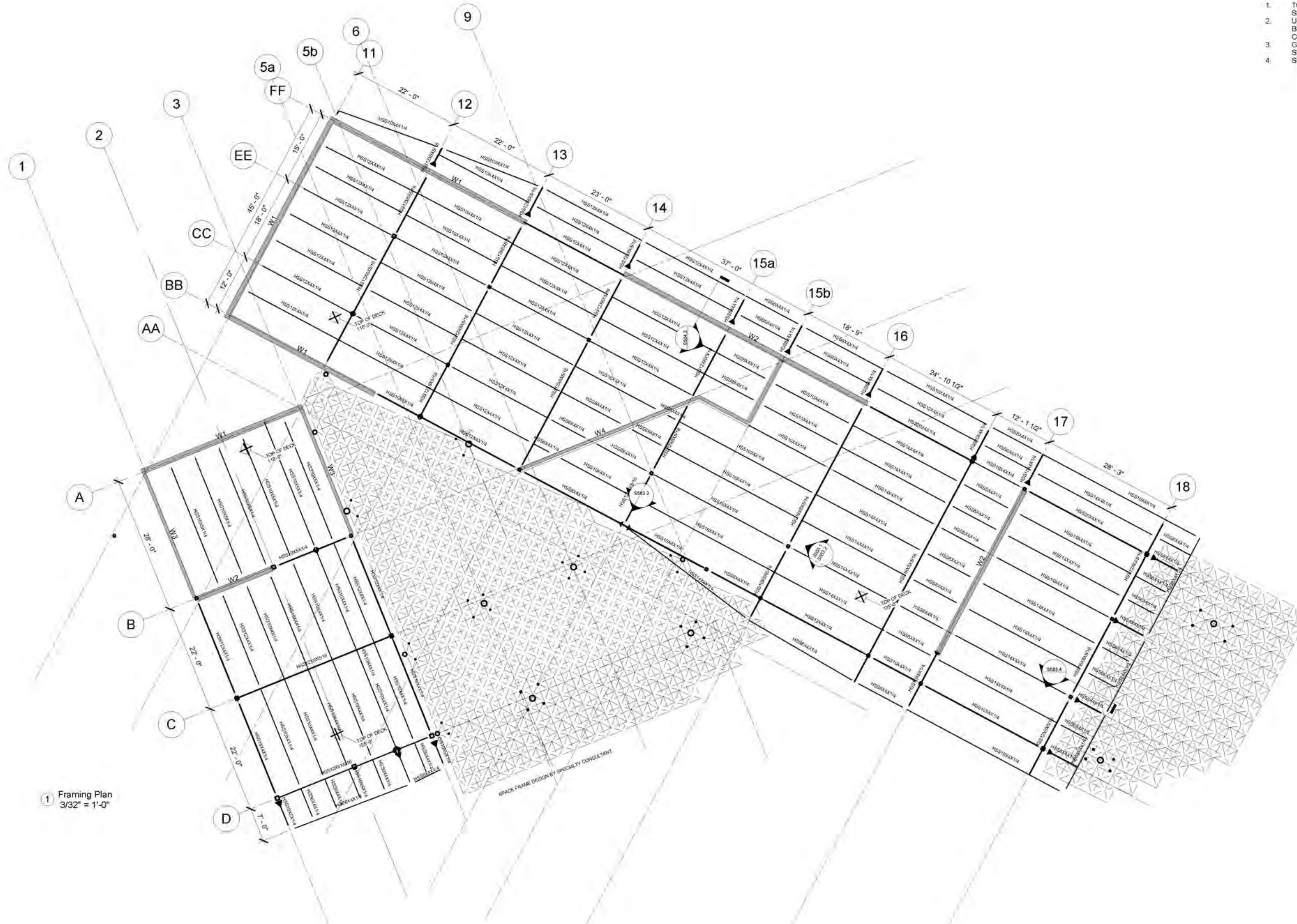

1 Framing Plan
3/32" = 1'-0"

ROOF FRAMING PLAN NOTES

1. TOP OF ROOF STRUCTURE IS SLOPED FOR DRAINAGE. SEE ELEVATIONS NOTED ON PLAN.
2. UNLESS NOTED OTHERWISE, STEEL FRAMING SHALL BE CENTERED ON AND EQUALLY SPACED BETWEEN COLUMN CENTERLINES.
3. GABLE FRAMING AND SPACE FRAME SYSTEMS ARE SEPARATED WITH DISTINCT LFRS.
4. SHEET INDEX:

GENERAL STRUCTURAL NOTES	000
SCHEDULES	S601
TYPICAL DETAILS	S501, S502, S503

No.	Description	Date

ORLANDO WEST FIRE STATION

ROOF FRAMING PLAN

Project number	5226
Date	Issue Date
Drawn by	Author
Checked by	Checker

S103

Scale 3/32" = 1'-0"

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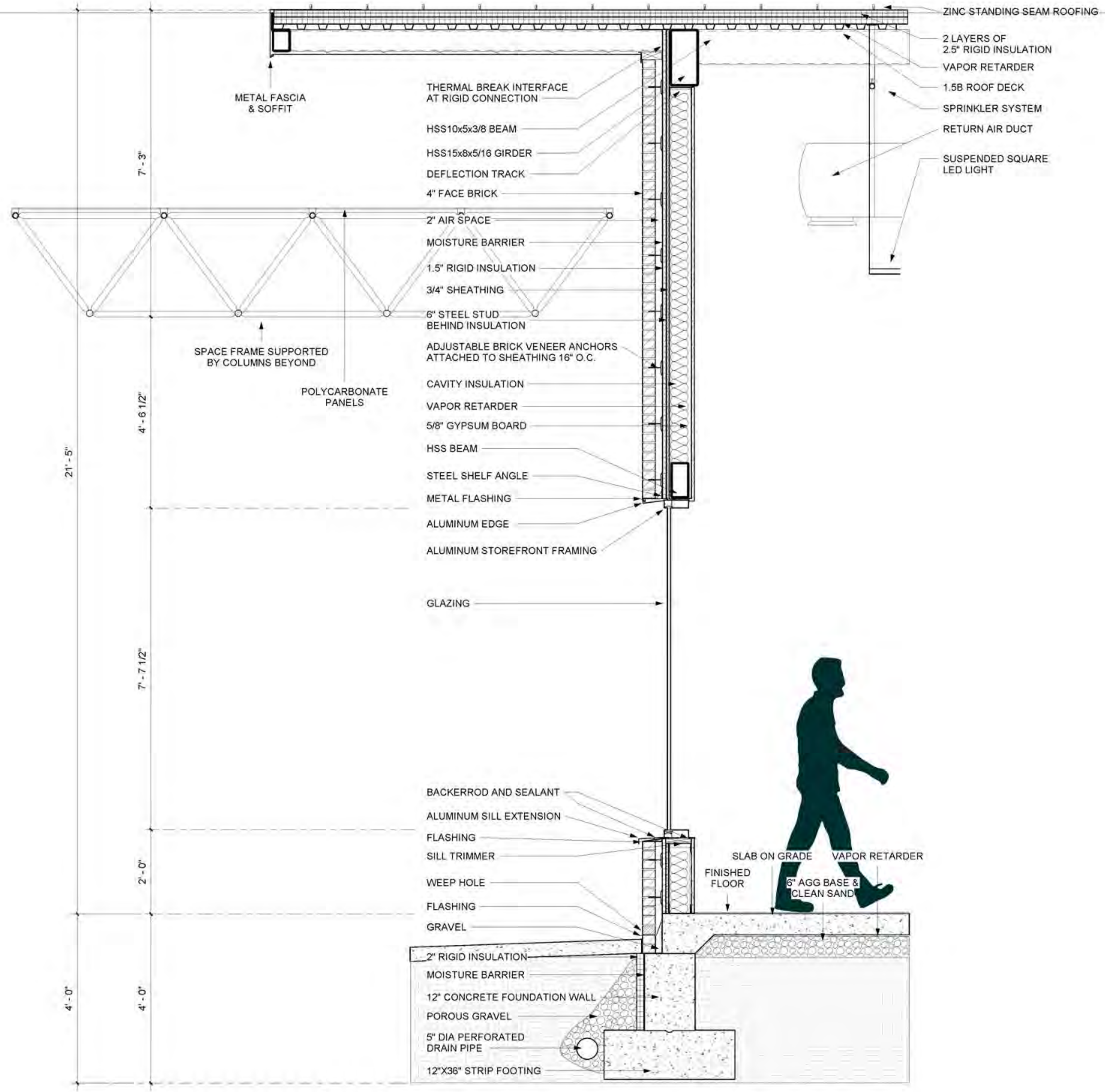

1 Wall Section
3/4" = 1'-0"

No.	Description	Date

ORLANDO WEST FIRE STATION WALL SECTION

Project number	5226
Date	Issue Date
Drawn by	Author
Checked by	Checker

S401

Scale	3/4" = 1'-0"

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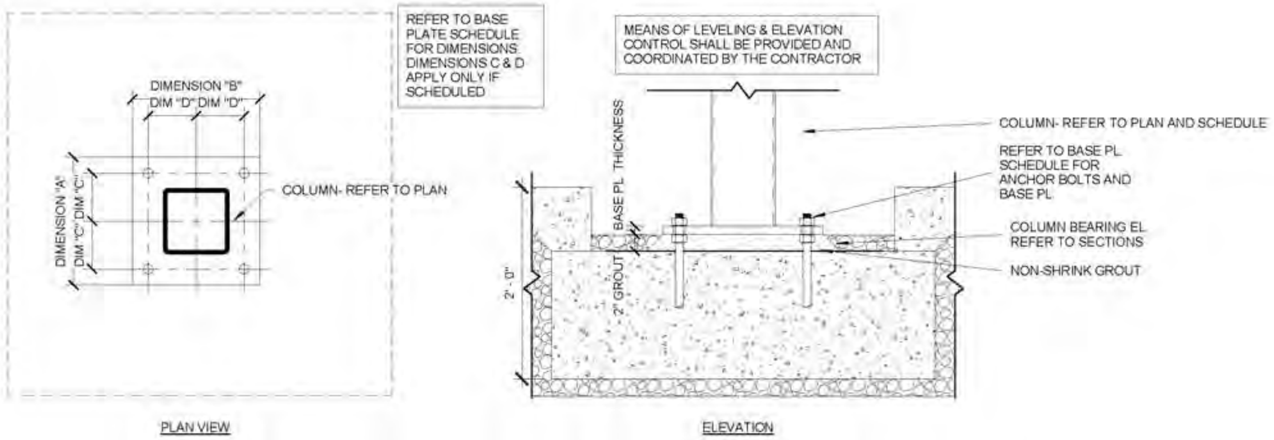
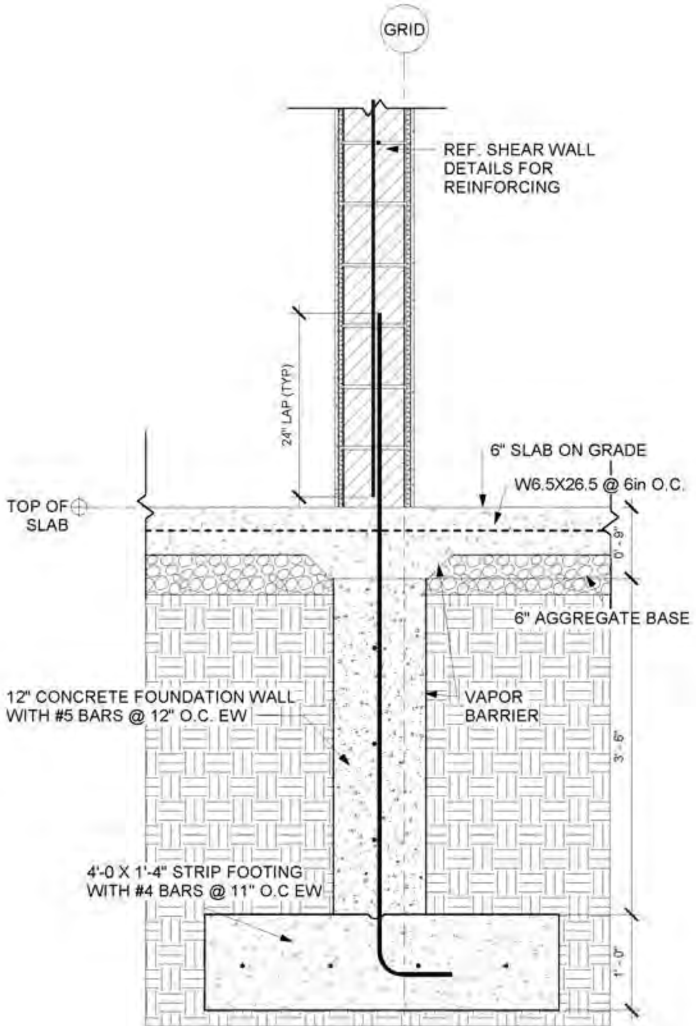
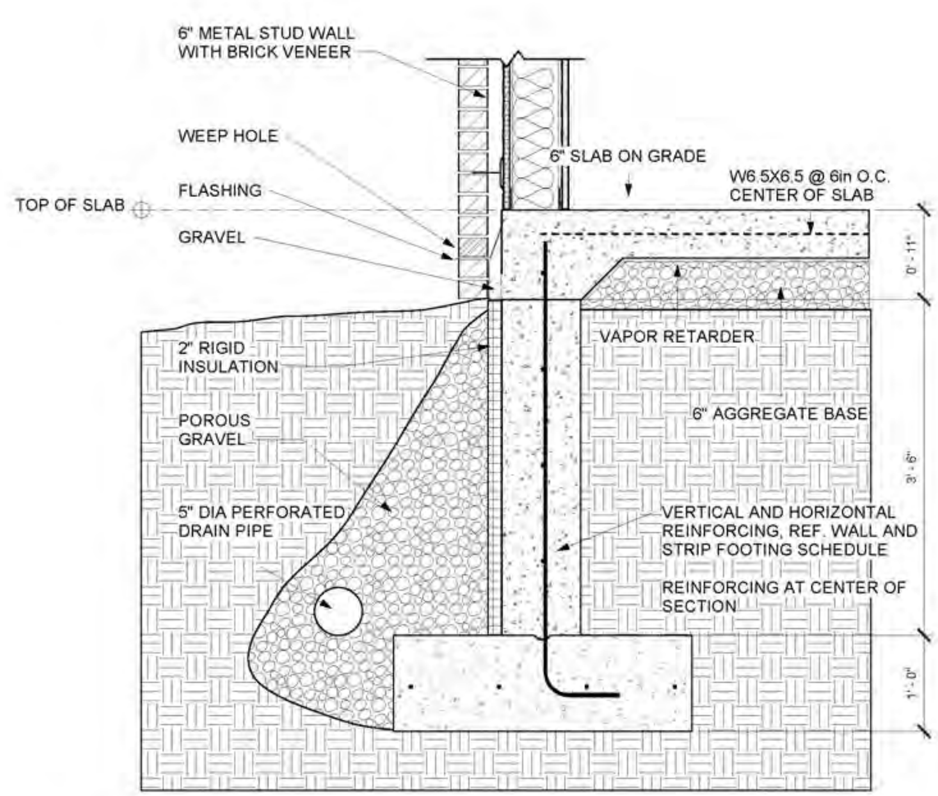


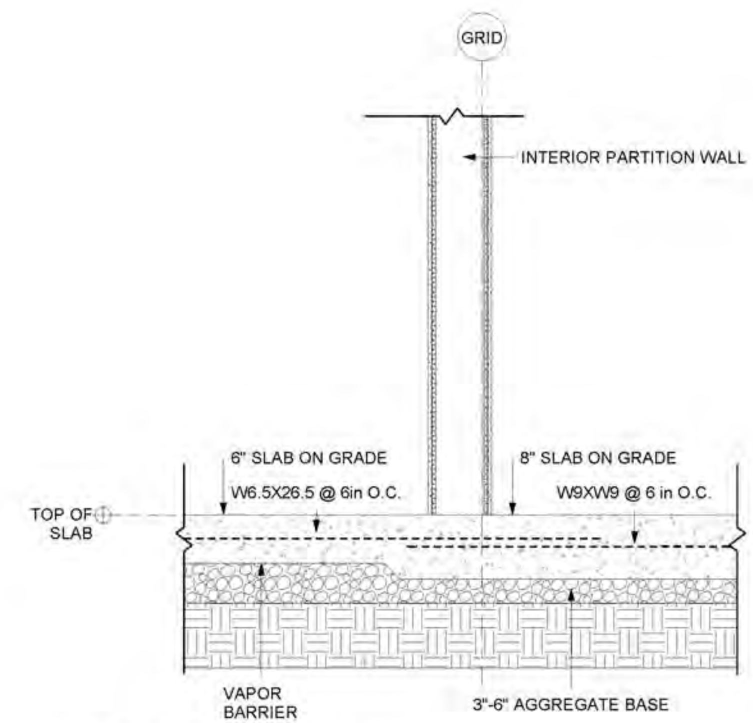
1 COLUMN TO BASE PLATE DETAIL
1" = 1'-0"



2 FOUNDATION AT INTERIOR LOAD BEARING WALL
1" = 1'-0"



3 STEM WALL AT CURTAIN WALL
1" = 1'-0"



4 SLAB THICKNESS TRANSITION
1" = 1'-0"

No.	Description	Date

ORLANDO WEST FIRE STATION

FOUNDATION DETAILS

Project number	5226
Date	Issue Date
Drawn by	Author
Checked by	Checker

S501

Scale	1" = 1'-0"

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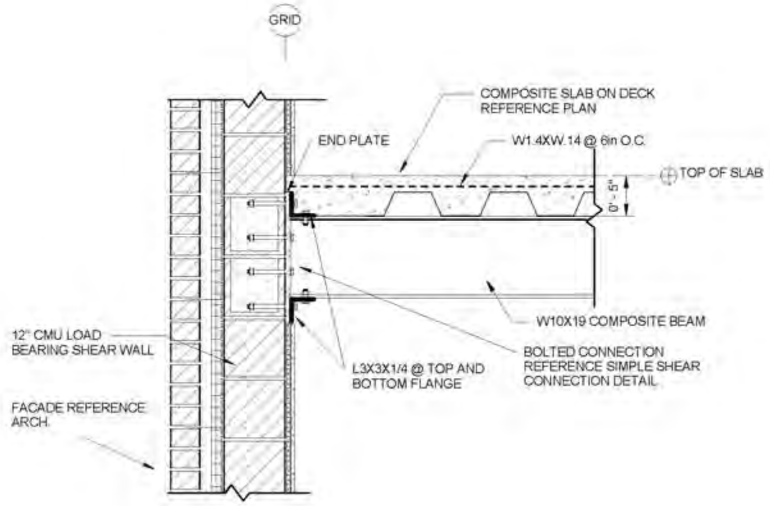
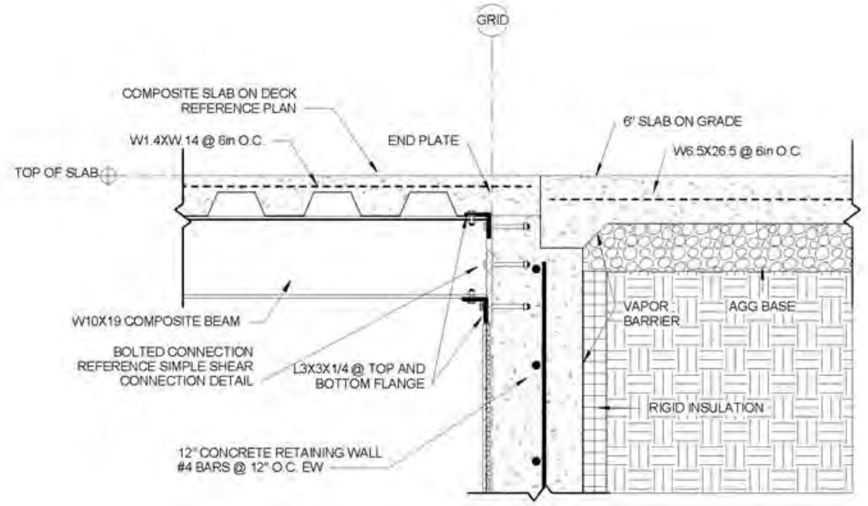
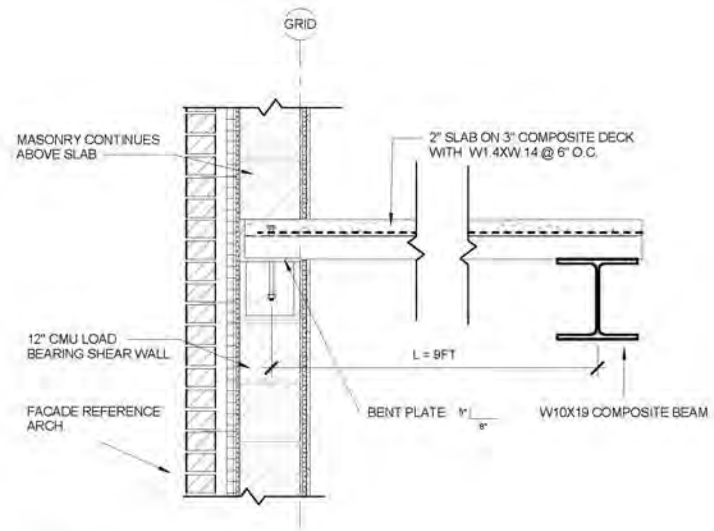


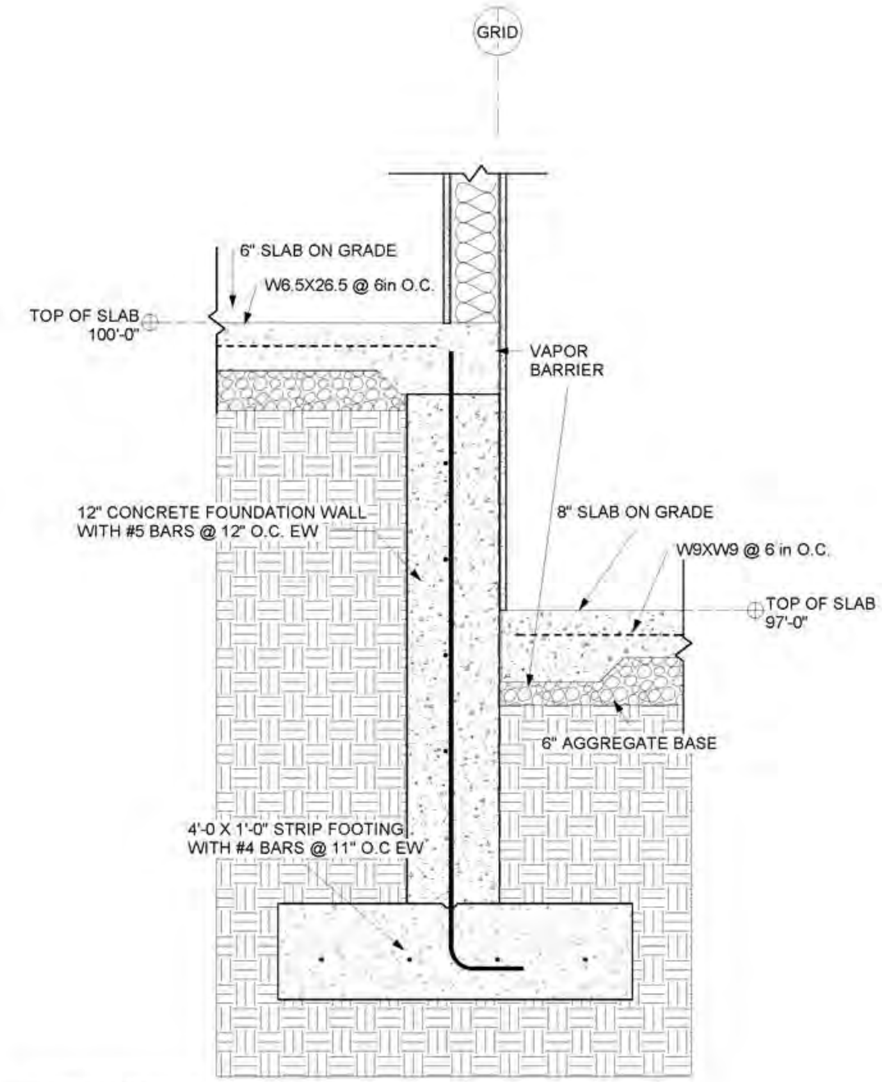
1 COMPOSITE BEAM TO MASONRY WALL
1" = 1'-0"



2 COMPOSITE SLAB TO SLAB ON GRADE
DETAIL
1" = 1'-0"



3 COMPOSITE SLAB TO MASONRY WALL
1" = 1'-0"



4 INTERIOR RETAINING WALL DETAIL
1" = 1'-0"

No.	Description	Date

ORLANDO WEST
FIRE STATION
FLOOR DETAILS

Project number	5226
Date	Issue Date
Drawn by	Author
Checked by	Checker

S502

Scale	1" = 1'-0"

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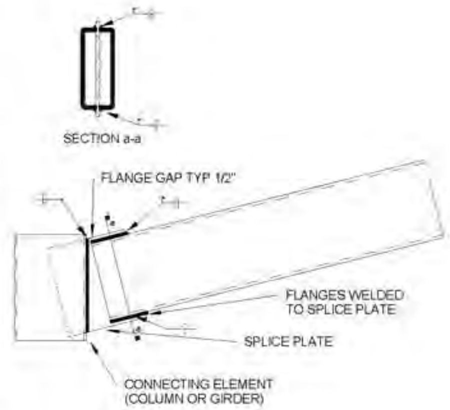
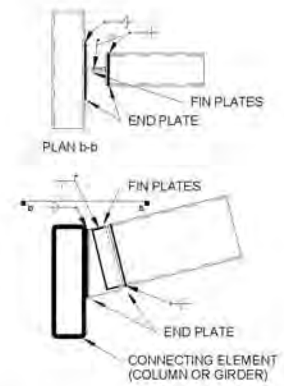
NOTES:

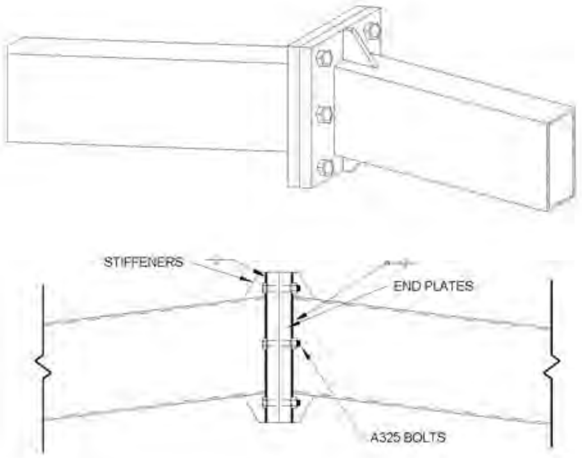
1. BOLTS ARE ASTM A325N AND WELDS E70xx U.N.O.
2. BEAM CONNECTIONS ARE STANDARD UNLESS DENOTED BY AN ASTERICK (*) ON PLAN
3. ELEMENTS ARE SPLICED DURING FABRICATION TO ENSURE ACCURACY



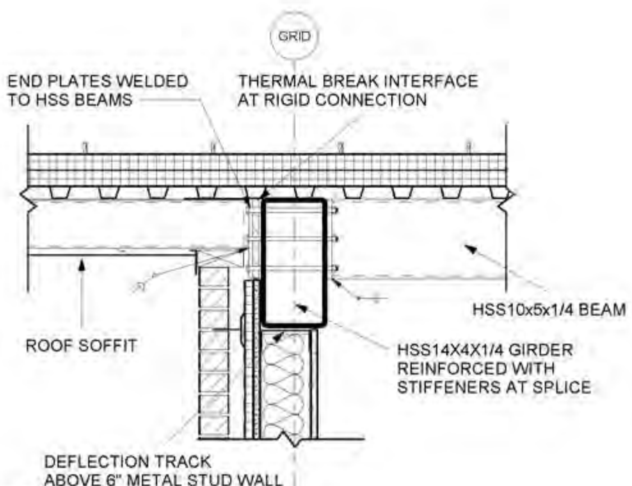
1 SIMPLE SPLICE CONNECTION
1" = 1'-0"



2 SIMPLE FIN CONNECTION
1" = 1'-0"



3 BEAM RIGID CONNECTION
1" = 1'-0"



4 MOMENT CONNECTION WITH THERMAL BREAK
1" = 1'-0"

No.	Description	Date

ORLANDO WEST FIRE STATION
ROOF DETAILS

Project number	5226
Date	Issue Date
Drawn by	Author
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S503

Scale	1" = 1'-0"

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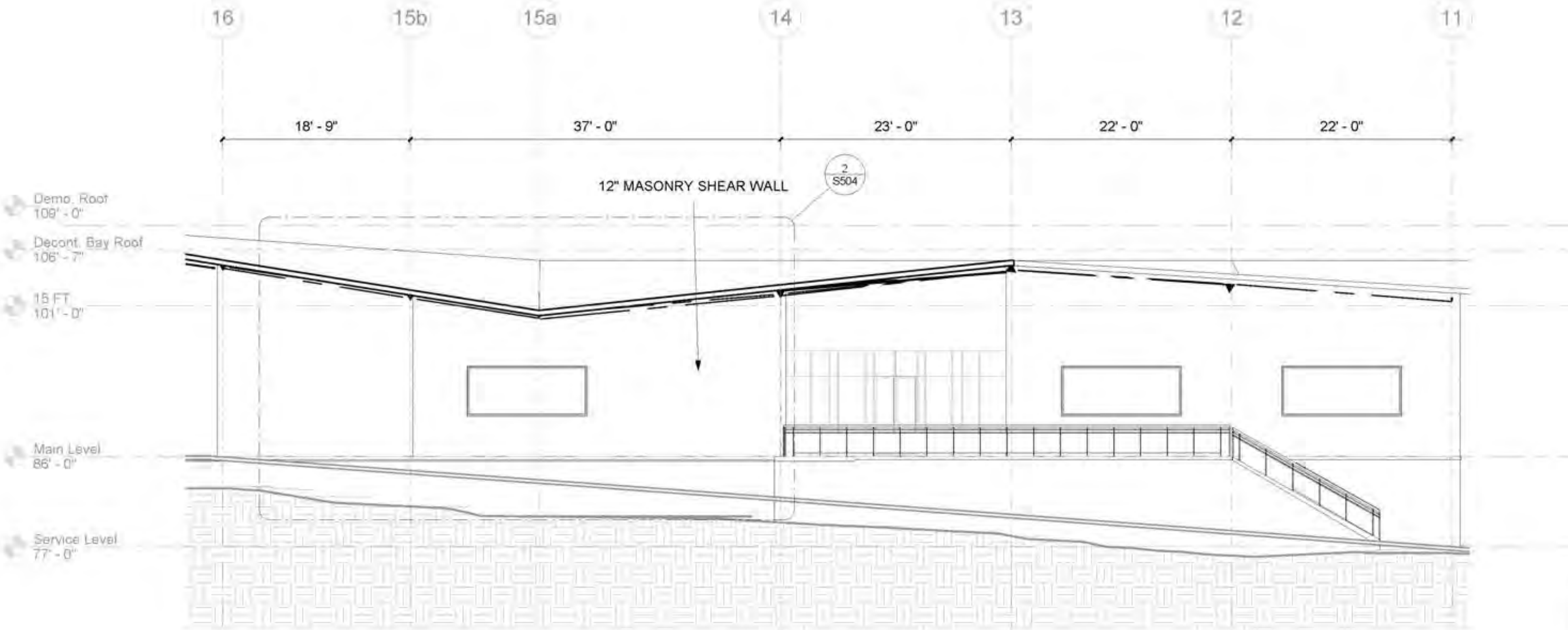
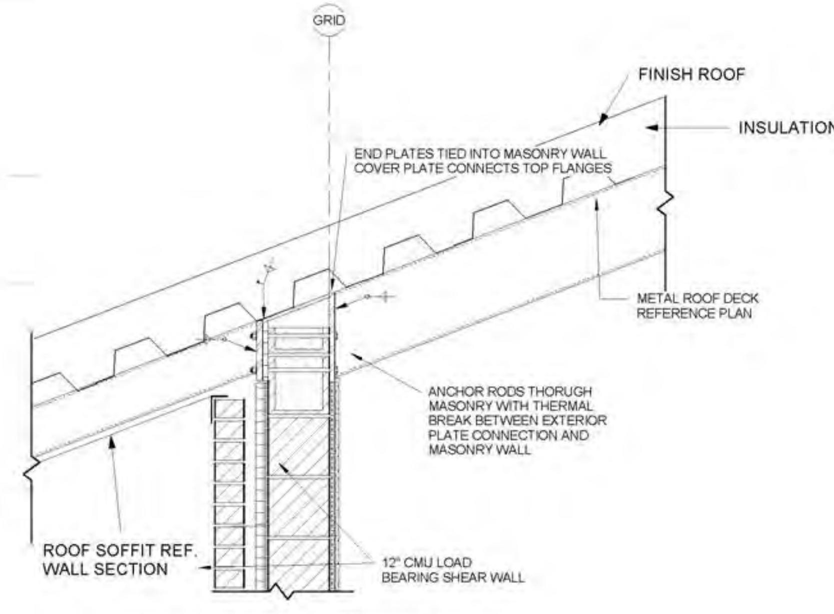
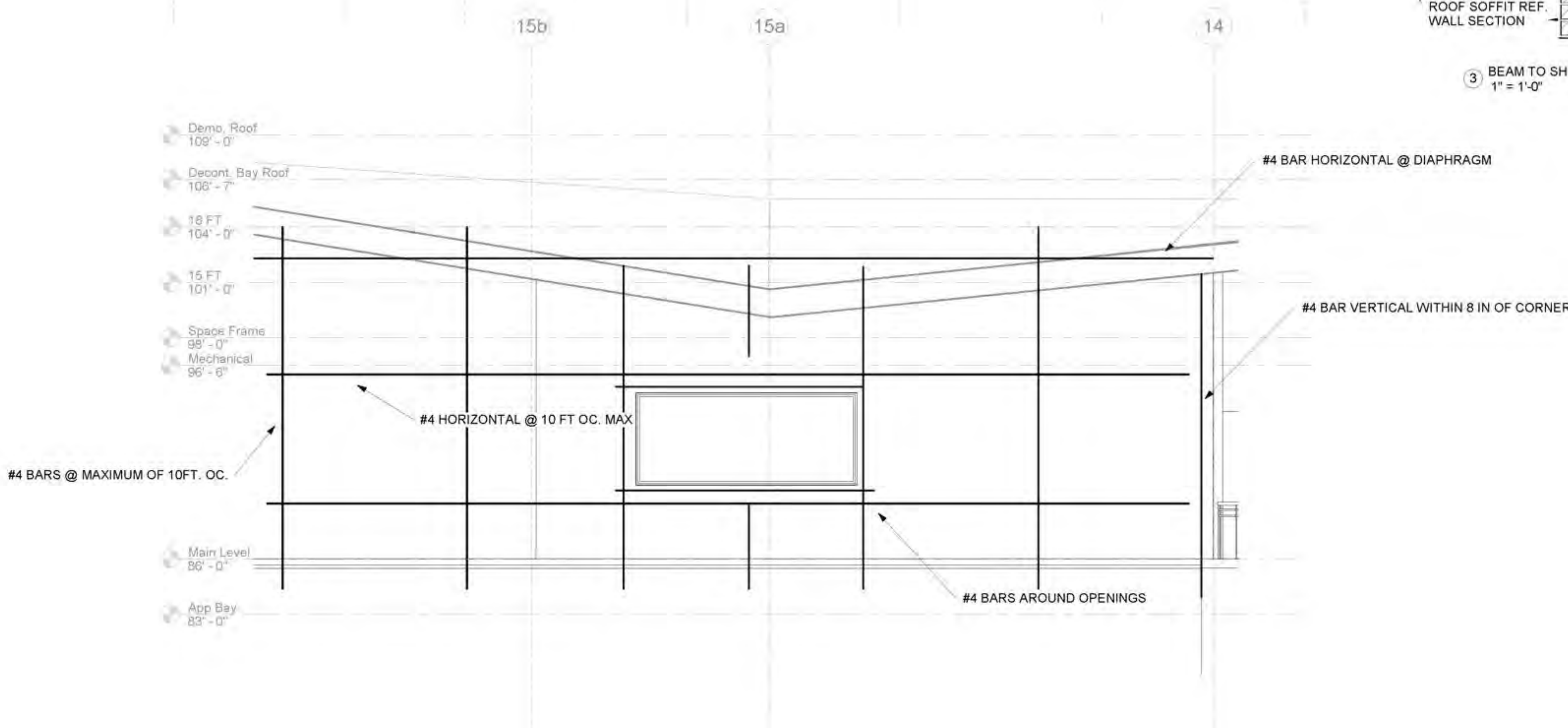


1 N. ELEVATION SHEAR WALLS
1/8" = 1'-0"



3 BEAM TO SHEAR WALL CONNECTION
1" = 1'-0"



2 N. ELEVATION SHEAR WALLS - Callout 1
1/4" = 1'-0"

No.	Description	Date

ORLANDO WEST
FIRE STATION
LFRS DETAILS

Project number	5226
Date	Issue Date
Drawn by	Author
Checked by	Checker

S504

Scale As indicated

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SLAB SCHEDULE

MARK	DEPTH	FEXURAL REINFORCING	TEMPERATURE REINFORCING	NOTES
S1	6"	NA	W6.5X6.5 @ 6in O.C.	
S2	8"	NA	W9XW9 @ 6 in O.C.	
S3	2"	NA	W1.4XW.14 @ 6in O.C.	COMPOSITE

Notes:
1) Slabs are designed for one layer of reinforcing
2) Refer to S501 foundation details for placement of reinforcing in slab
3) Refer to details for reinforcement transition between slabs

COLUMN AND FOOTING SCHEDULE

ELEMENT	COLUMN	BASE PLATE DIMENSIONS	FOOTING DIMENSIONS	REINFORCEMENT	DEPTH OF FOUNDATION
C1	HSS6X6X4	12"x12"x1/2"	4'-0" X 4'-0" X 1'-4"	#6 @ 14" o.c.	2'-6"
C2	HSS8X8X4	14"x14"x1/2"	4'-0" X 4'-0" X 1'-4"	#6 @ 14" o.c.	2'-6"
C3	HSS9X9X4	15"x15"x1/2"	4'-0" X 4'-0" X 1'-4"	#6 @ 14" o.c.	2'-6"
C4	HSS14X0.5	20"x20"x0.5"	6'-0" X 6'-0" X 2'-0"	#8 @ 9" o.c.	3'-6"
C5					

Notes:
1) Refer to S501 for Foundation Details

WALL AND STRIP FOOTING SCHEDULE

ELEMENT	MASONRY WALL		STEM WALL WIDTH	REINFORCEMENT	FOOTING DIMENSIONS	REINFORCEMENT	DEPTH OF FOUNDATION
W1	12" CLAY BRICK	#6 bars and groutig @16" o.c.	12"	#5 @ 12" o.c.	4'-0" X 1'-4"	#4 @ 8" o.c.	14'-10"
W2	12" CLAY BRICK	#6 bars and groutig @16" o.c.	12"	#5 @ 12" o.c.	4'-0" X 1'-0"	#4 @ 11" o.c.	9'-6"
W3	8" CLAY BRICK	#5 bars and groutig @32" o.c.	12"	#5 @ 12" o.c.	4'-0" X 1'-4"	#4 @ 8" o.c.	14'-10"
W4	8" CLAY BRICK	#5 bars and groutig @32" o.c.	8"	#4 @ 12" o.c.	4'-0" X 1'-0"	#4 @ 11" o.c.	4'-6"
W5	-	-	8"	#4 @ 12" o.c.	4'-0" X 1'-0"	#4 @ 11" o.c.	4'-6"
W6	-	-	12"	#5 @ 12" o.c.	4'-0" X 1'-4"	#4 @ 8" o.c.	14'-10"

Notes:
1) Refer to S501 for Foundation Details
2) W4 at slab perimeter where there is no exterior structural wall
3) W6 basement wall below slab on grade with no structural wall above

DEVELOPMENT LENGTH (in)

BAR		#4 BAR	#5 BAR	#6 BAR
DEV. LENG.	ld	11.4	14.8	29
DEV. HOOK	ldh	7.6	9.9	15
HOOK DIA	dh	3	3.9	6
HOOK EXT.	lext	2.5	2.6	9

No.	Description	Date

ORLANDO WEST FIRE STATION

SCHEDULES

Project number	5226
Date	Issue Date
Drawn by	Author
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S601

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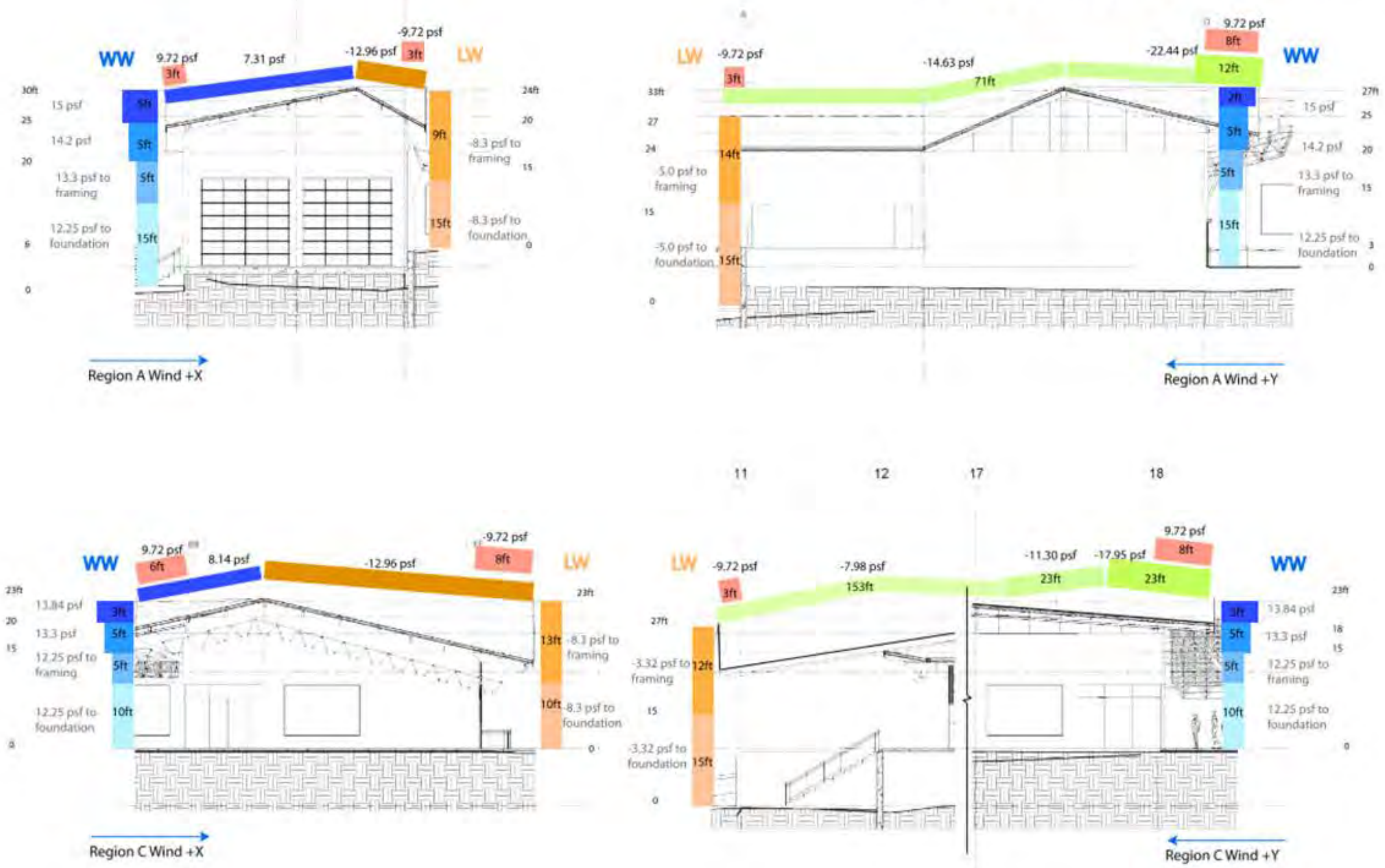
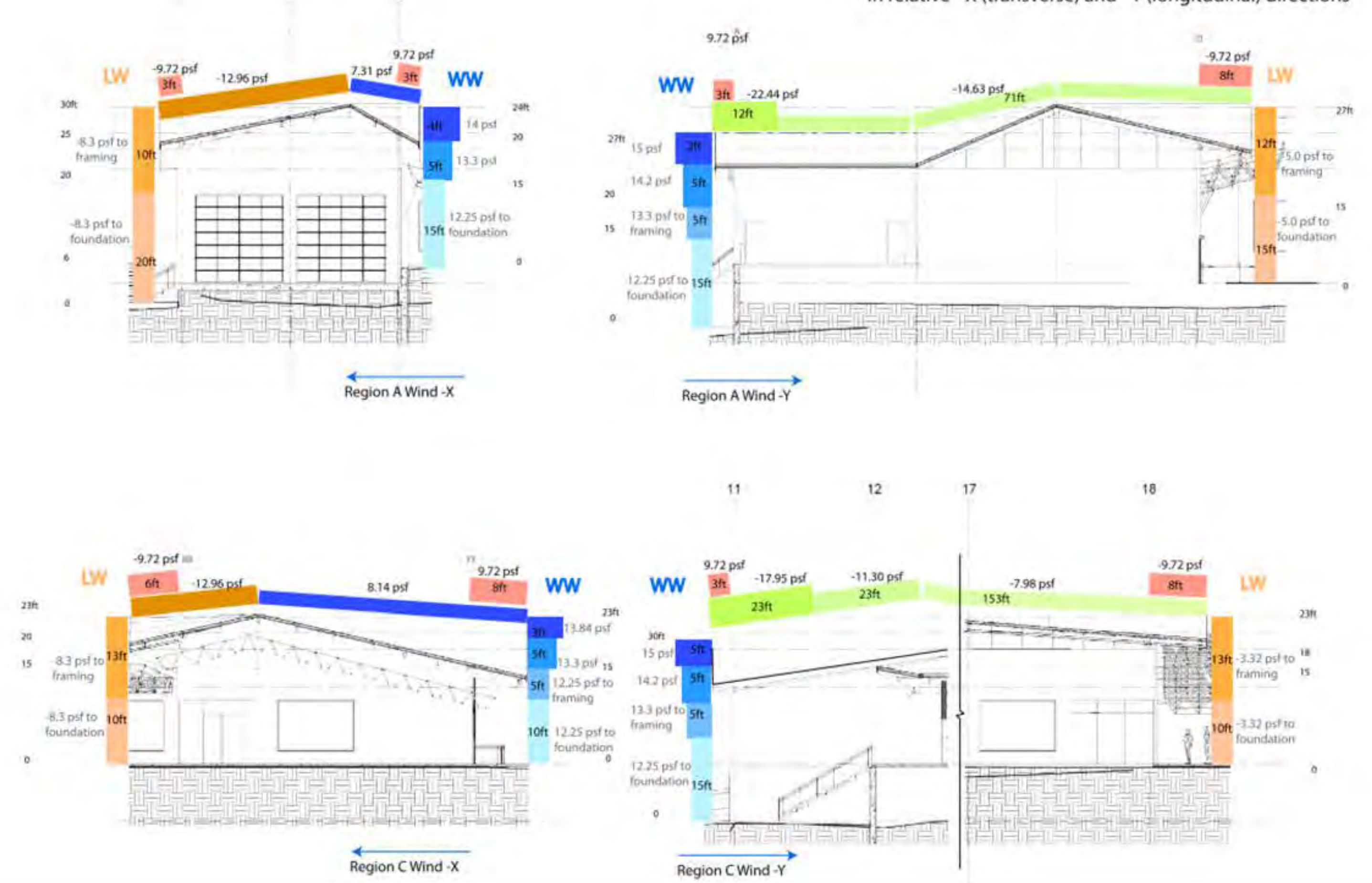
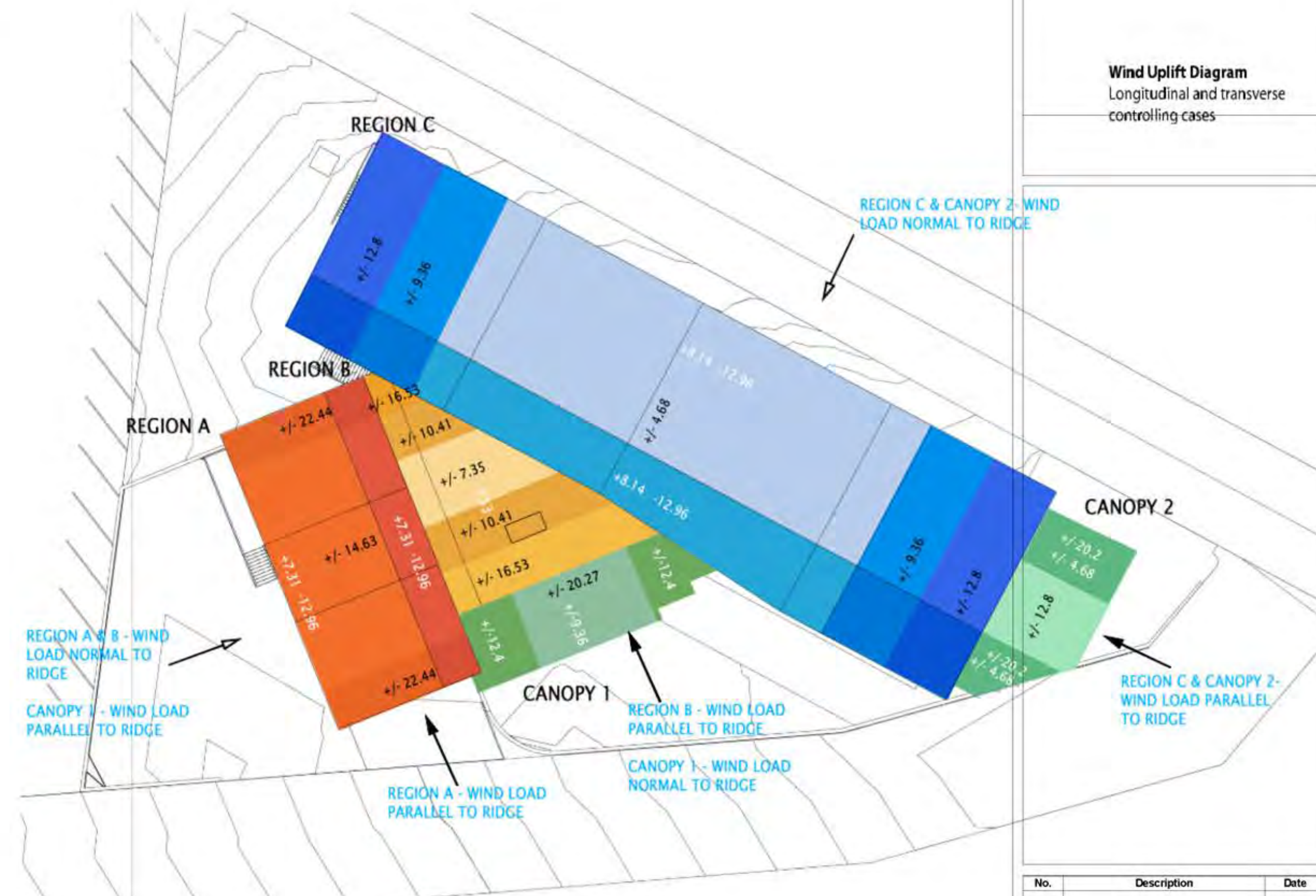
Windward and Leeward Wind forces
In relative +X (transverse) and +Y (longitudinal) directions



Windward and Leeward Wind Forces
In relative - X (transverse) and - Y (longitudinal) directions





Wind Uplift Diagram
Longitudinal and transverse controlling cases

No.	Description	Date

ORLANDO WEST
FIRE STATION
WIND DIAGRAMS

Project number	5226
Date	Issue Date
Drawn by	Author
Checked by	Checker

S602

Scale

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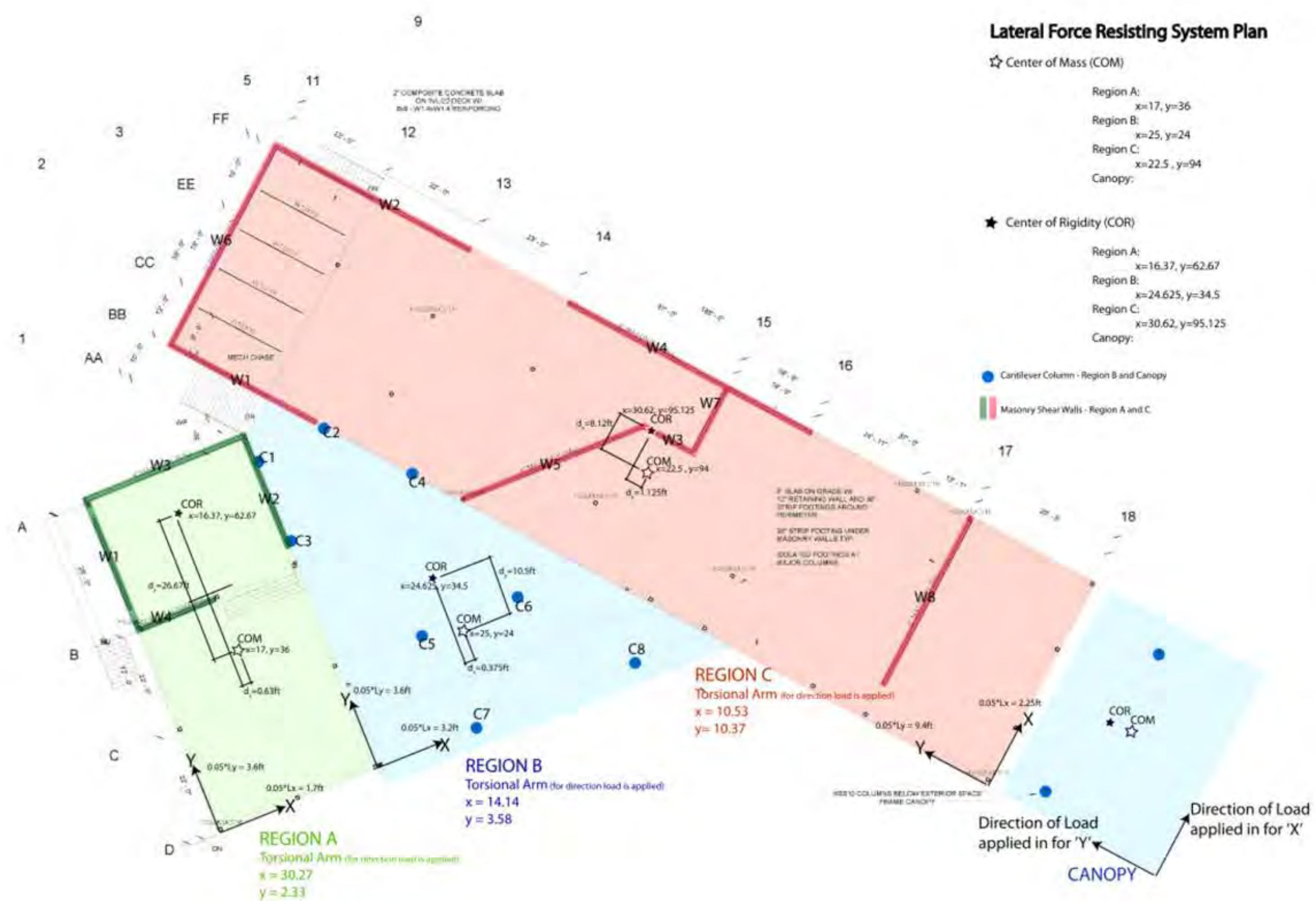
Facade Plan and Seismic Load Sections

Lateral Force Resisting System Plan



No.	Description	Date

ORLANDO WEST FIRE STATION

SEISMIC DIAGRAMS

Project number	5226
Date	Issue Date
Drawn by	Author
Checked by	Checker

S603

Scale

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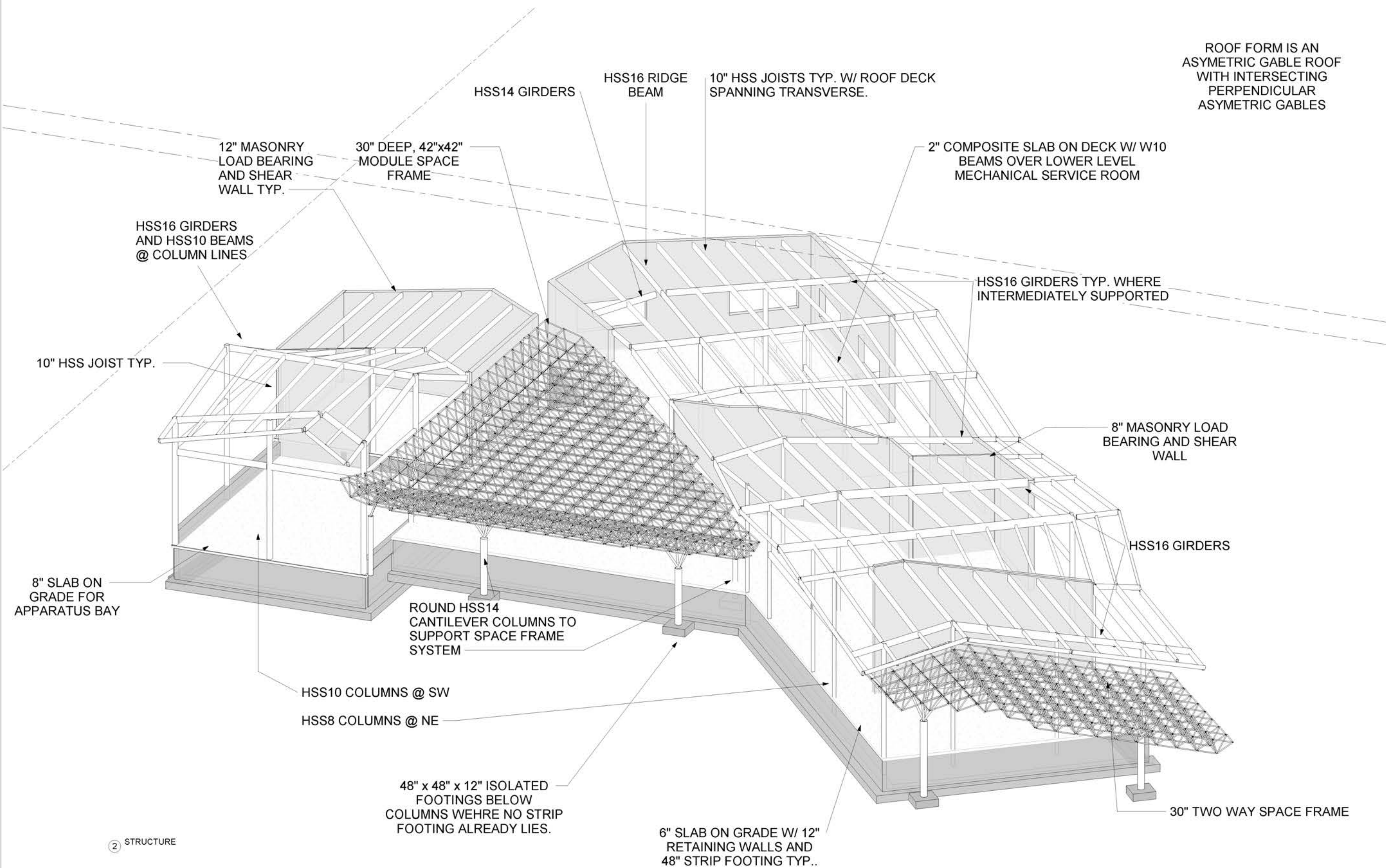

2 STRUCTURE

No.	Description	Date

ORLANDO WEST
FIRE STATION

STRUCTURAL
AXONOMETRIC

Project number	5226
Date	Issue Date
Drawn by	RDempewolf
Checked by	Checker

S901

Scale

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