3E.3 Essential Service Water Buildings

Description of the Essential Service Water Building Analysis and Design

Four Essential Service Water Buildings (ESWB) are located adjacent to the NI Common Basemat Structures and in the general vicinity of the Emergency Power Generating Buildings (EPGB).

Cross sections and plans associated with each typical ESWB are provided in Section 3.8.4, Figure 3.8-95, Figure 3.8-96, Figure 3.8-97, Figure 3.8-98, Figure 3.8-99, Figure 3.8-100, Figure 3.8-101, and Figure 3.8-102. A general description of the structure, including descriptions of functional equipment at all floor levels, is provided in Section 3.8.4.1.5.

The lateral load resisting system primarily consists of interior and exterior reinforced concrete shear walls and a concrete basemat foundation situated at approximately 22 ft – 0 in below grade. The structural elements pertaining to the ESWBs are described in Sections 3.8.4.1.5 and 3.8.5.1.3.

Upon evaluation of the ESWBs, the following critical sections have been identified:

- Basemat Foundation at Elevation -16 ft – 0 in (3E.3.1).
- Shear Wall at Column Line 4 (3E.3.2).
- Fan Deck Slab at Elevation 63 ft – 0 in (3E.3.3).

Materials

Concrete for the ESWB excluding basemat will have compressive strength f'_c = 5000 psi, modulus of elasticity, E= 4031 ksi, shear modulus, G = 1722 ksi, and Poisson's ratio is 0.17.

Reinforcing Steel – deformed steel bars conforming to ASTM A615 Grade 60 with minimum yield strength of F_y = 60 ksi, and minimum tensile strength F_u = 90 ksi. Minimum bar elongation is based on ASTM A615.

Structural Steel – conforms to the requirements specified in Table 3.8-8 3.

Floor Live and Dead Load Distribution

Dead loads include self weight of the structure, platforms, electric equipments, conduits, small bore pipes, and permanent equipment loads. Live loads include design live load. Design snow loads are provided in Section 3.8.4.3.1 and Table 2.1-1.

- Concrete self weight - based on concrete density of 150 pcf.

- Beams self weight – based on cross section area and concrete density of 150 pcf.
- Uniform floor live load = 100 psf.
- Pump area slab live load at El. 14’-0” = 100 psf.
- Fan deck live load at El. 63’-0” = 100 psf.
- Walkways and access areas live load at El. 14’-0” = 100 psf.
- Steel beam and grating load at El. 80’-0” = 4.1 kip/ft.
- Missile shield load at El. 80’-0” = 4.5 kip/ft.

Equipment Loads

The weight of all major equipment is applied as point load throughout the building.

Equipment	Elevation	Weight (kips)
Fan	63’-0”	85.00 each
Fill	47’-0”	953.4 each
Eliminator	47’-0”	54.00 each
Equipment in pump area	14’-0”	41.50
Pumphouse platform	33’-0”	93.00
6.9KV Switchgear	33’-0”	10.00
6.9KV/480V Transformer	33’-0”	9.00
480V LC Switchgear	33’-0”	6.00
480V MCC	33’-0”	3.00

Foundation Stability

The ESWB is evaluated for stability against overturning, sliding, and floatation for the generic soil profiles used in establishing the certified plant design. The calculated factors of safety against overturning, sliding, and floatation satisfy the acceptance criteria.

Minimum Factors of Safety					
Sliding		Overturning		Floatation	
Required	Calculated	Required	Calculated	Required	Calculated
1.10	1.42	1.10	1.71	1.10	2.28

The sliding and overturning factors are determined using load combination containing dead load (D), lateral earth pressure (H), SSE (E’), hydrostatic load (F), and buoyant force (F_b). It is conservatively assumed that the E’ and F_b occur simultaneously. The floatation factor of safety is determined based on dead load (D) and buoyant force (F_b).

The dead load used in the analysis includes 25 percent of the live load, which is consistent with the generation of total base shear resultants and total overturning moment due to SSE.

Design Criteria

SSI analysis by the Bechtel Code SASSI 2000 (v. 3.1) is used to determine enveloping structural response accelerations for development of equivalent static SSE loads for the GT STRUDL FEM.

The use of GT STRUDL for the design of the critical sections is described in Sections 3.8.4.4.4 and 3.8.5.4.4. Design forces and moments are extracted from GT STRUDL analyses for basemat foundation and superstructure component design.

All applicable loads used for the design of the critical sections located within the ESWBs are described in Sections 3.8.4.3.1 and 3.8.5.3; the applicable loading combinations are described in Sections 3.8.4.3.2 and 3.8.5.3. The design also accommodates the soil analysis cases shown in Table 3.7.1-6.

Reinforced concrete components are designed in accordance with the applicable codes, standards, and specifications described in Sections 3.8.4.2and 3.8.5.2.

The planar reference system for the GT STRUDL finite element analysis output is provided in Figure 3E.3-1—Finite Element Planar Reference Frame Systems. The positive direction of the finite element bending moments M_{xx}, M_{yy} and M_{xy} and out-of-plane shear forces V_{xx} and V_{yy} are shown in a) Plate Bending, included on Figure 3E.3-1. The positive direction of the finite element in-plane forces N_{xx}, N_{yy} and N_{xy} are the same as the positive orientation of the plane stresses S_{xx}, S_{yy} and S_{xy} shown in b) Plane Stress/Strain, included on Figure 3E.3-1.

3E.3.1 Basemat Foundation at Elevation -16 ft – 0 in (Top of Concrete)

This critical section presents the structural design of the reinforced concrete basemat required to support the ESWBs. The ESWBs are composed of a 6 ft – 0 in thick reinforced concrete basemat foundation. The basemat foundation of the ESWB is a safety-related, Seismic Category I structure, as described in Section 3.8.5.

Description of the Critical Section and Computer Model

The overall layout and dimensions of each ESWB basemat foundation are described in Section 3.8.5.1.3. ESWBs 1, 2, 3, and 4 are essentially identical; therefore, only one of the ESWBs is evaluated as a critical section.

As described in Section 3.8.5.1.3, GT STRUDL is used to create a FEM to analyze the ESWBs for the forces and moments applied to the ESWB basemat foundation.

Figure 3E.3-2—ESWB Basemat Foundation - FEM shows a GT STRUDL FEM view of the ESWB basemat foundation. The typical element size for the elements shown in Figure 3E.3-2 ranges between approximately 4 ft and 7 ft with the aspect ratio kept between 1 and 3.

The reinforcement sketch for ESWB basemat foundation is provided as Figure 3E.3-3—Reinforcement Sketch for ESWB Basemat Foundation.

Applicable Loadings, Analysis, and Design Methods

In addition to the loads described in Section 3.8.5.3, the GT STRUDL finite element analysis for the basemat foundation for the ESWB incorporates:

- Buoyant forces associated with the high water level (Elevation -1 ft – 0 in, or 21 ft – 0 in of hydrostatic head) for stability design.
- Finite elements representing the superstructure, for accurate load transfer to the basemat foundation.

Results of Critical Section Design

The structural design for the critical section provides reinforcement to resist element forces and moments as described below.

Table 3E.3-1—Governing Forces and Moments for the ESWB Basemat Foundation shows the governing forces and moments for the design of the ESWB basemat foundation. The section cuts locations are shown in Figure 3E.3-2—ESWB Basemat Foundation - FEM. The sign convention describing the nomenclature for horizontal and vertical cuts applicable to this critical section is shown on Figure 3E.3-10.

Based on the governing values shown in Table 3E.3-1, the basemat foundation typical reinforcement configuration is shown in Figure 3E.3-3.

Section thicknesses and reinforcing quantities may be optimized based on subsequent analysis results.

3E.3.2 Shear Wall at Column Line 4

This critical section presents the structural design of the reinforced concrete shear wall at column line 4. The typical wall along column line 4 in the ESWB is a safety-related, Seismic Category I structure, as described in Section 3.8.4.

Description of the Critical Section and Computer Model

The reinforced concrete shear wall at column line 4 is selected as a critical section because the wall spans from the basemat foundation elevation at -16 ft – 0 in to the roof elevation at 96 ft - 0 in and has two large openings. The shear wall at column line

4 is shown in Figure 3E.3-7—Reinforcement Configuration for ESWB Wall at Column Line 4.

As described in Section 3.8.3.4.4, GT STRUDL is used to create a FEM to analyze the ESWBs for all forces and moments applied to the ESWB wall at column line 4. The mesh of GT STRUDL elements is established at dimensions ranging approximately between 4 ft and 7 ft with the aspect ratio kept between 1 and 3. A FEM view of the reinforced concrete shear wall at column line 4 is shown in Figure 3E.3-4—ESWB Wall at Column Line 4 - FEM.

Applicable Loadings, Analysis, and Design Methods

All applicable loads and loading combinations applied to reinforce concrete shear wall at column line 4 are described in Sections 3.8.4.3.1 and 3.8.4.3.2, respectively. The soil analysis cases shown in Table 3E.3-6 are incorporated into the design.

Section cuts are used to determine the forces and moments throughout the reinforced concrete shear wall at column line 4. Section cut locations are determined through a review of enveloping distributions of forces and moments. The sign convention describing the nomenclature for horizontal and vertical cuts applicable to this critical section is shown in Figure 3E.3-5—Sign Convention for ESWB Horizontal and Vertical Cuts at Column Line 4; the section cut locations are shown in Figure 3E.3-6—Vertical and Horizontal Section Cuts for ESWB Wall at Column Line 4.

Results of Critical Section Design

The structural design for the critical section provides reinforcement to resist element forces and moments as described below.

Governing design data is determined from local section cuts for vertical reinforcement, horizontal reinforcement, and shear friction, which is shown in Table 3E.3-2—Governing Design Data for ESWB Wall at Column Line 4 (Local Section Cut for Vertical Reinforcement), Table 3E.3-3—Governing Design Data for ESWB Wall at Column Line 4 (Local Section Cut for Horizontal Reinforcement), and Table 3E.3-4—Governing Design Data for ESWB Wall at Column Line 4 (Local Section Cut for Shear Friction Design), respectively. Governing design data for in-plane shear is determined from a long section cut for horizontal reinforcement, and is shown in Table 3E.3-5—Governing Design Data for ESWB Wall at Column Line 4 (Long Section Cut for Horizontal Reinforcement).

Due to the varying reinforcement configurations determined throughout the reinforced concrete shear wall at column line 4, the reinforcement required to support this critical section is shown in several locations throughout Figure 3E.3-7.

Section thicknesses and reinforcing quantities may be optimized based on subsequent analysis results.

3E.3.3 Fan Deck Slab at Elevation 63 ft – 0 in

This critical section presents the structural design of the reinforced concrete fan deck slab at elevation 63 ft – 0 in. The fan deck slab of the ESWB is a safety-related, Seismic Category I structure, as described in Section 3.8.4.

Description of the Critical Section and Computer Model

The ESWB fan deck is a 2 ft – 6 in thick reinforced concrete slab, which is located at elevation 63 ft – 0 in.

As described in Section 3.8.4.4.4, GT STRUDL is used to create a FEM to analyze the ESWBs for all forces and moments applied to the ESWB fan deck slab at elevation 63 ft – 0 in. The mesh of GT STRUDL elements is established at dimensions ranging between 4 ft and 7 ft approximately with the aspect ratio kept between 1 and 3. A FEM view of the fan deck slab at elevation 63 ft – 0 in is shown in Figure 3E.3-8—ESWB Fan Deck Slab at Elevation 63'-0" - FEM.

Applicable Loadings, Analysis, and Design Methods

All applicable loads and loading combinations applied to the fan deck slab at elevation 63 ft – 0 in are described in Sections 3.8.4.3.1 and 3.8.4.3.2, respectively. The soil analysis cases shown in Table 3.7.1-6 are incorporated into the design.

In addition to the loads described in Section 3.8.4.3.1, the equipment weight of the two fans is included in both the Bechtel Code SASSI 2000 SSI analysis and the GT STRUDL finite element analysis. In-Structure Acceleration Response Spectra are obtained at the fan mounting locations, as described in Section 3.7.2.

Results of Critical Section Design

The structural design for the critical section provides reinforcement to resist element forces and moments as described below.

Governing forces and moments for out-of-plane design for the x-axis and z-axis are shown in Table 3E.3-6—Governing Design Data for ESWB Fan Deck Slab at Elevation 63 ft – 0 in (Out-of-Plane Design, X-Axis), and Table 3E.3-7—Governing Design Data for ESWB Fan Deck Slab at Elevation 63 ft – 0 in (Out-of-Plane Design, Z-Axis), respectively. Governing design data for tension and in-plane shear is shown in Table 3E.3-8—Governing Design Data for ESWB Fan Deck Slab at Elevation 63 ft – 0 in (Tension), and Table 3E.3-9—Governing Design Data for ESWB Fan Deck Slab at Elevation 63 ft – 0 in (In-Plane Shear), respectively.

The typical required reinforcement configuration for the fan deck slab at elevation 63 ft – 0 in is shown in Figure 3E.3-9—Reinforcement Sketch for ESWB Fan Deck Slab at Elevation 63'-0".

Section thicknesses and reinforcing quantities may be optimized based on subsequent analysis results.

Table 3E.3-1—Governing Forces and Moments for the ESWB Basemat Foundation
Sheet 1 of 2

	Area	Section Cut	Load Combination	FX (kip)	FY (kip)	FZ (kip)	MX (k-ft)	MY (k-ft)	MZ (k-ft)
Out-of-Plane Shear	A1	X6-1	D+L+F (high water) + H(saturated)+EX+0.4EY+0.4EZ	248.6	341.8	186.0	-328.0	NA	43.6
	A2	X1-11	D+L+F (high water) + H(saturated)-0.4EX -0.4EY-0.4EZ	-256.3	-1001.1	-361.0	-5189.0	NA	474.2
	A3	X6-11	1.4D+1.7L+1.4F(high water) + 1.7H(Dry)	0.0	1053.3	0.0	-6481.6	NA	905.6
	A1	Z1-1	D+L+F (high water) + H(saturated)+EX+0.4EY+0.4EZ	370.0	841.5	84.7	20.4	NA	-671.3
	A2	Z13-2	D+L+F (high water) + H(saturated)+EX+0.4EY+EZ	644.2	272.9	362.1	58.3	NA	263.2
	A3	Z25-1	1.4D+1.7L+1.4F(high water) + 1.7H(saturated)	0.0	-1029.3	0.0	1140.9	NA	-3209.4
Compression	A1	X1-1	D+L+F (high water) + H(saturated)-EX -0.4EY-0.4EZ	-102.9	-23.3	-406.9	103.2	NA	-34.4
	A2	X1-12	D+L+F (high water) + H(saturated)-EX -0.4EY-0.4EZ	-263.8	-661.4	-496.4	-2930.6	NA	1039.2
	A3	X6-12	D+L+F (high water) + H(saturated)-EX -0.4EY-0.4EZ	-320.3	146.6	-464.4	-3284.1	NA	1032.5
	A1	Z7-3	D+L+F (high water) + H(saturated)-0.4EX -0.4EY-EZ	-434.7	-520.6	-459.0	-401.5	NA	-2947.3
	A2	Z13-2	D+L+F (high water) + H(saturated)-0.4EX -0.4EY-EZ	-644.2	-273.0	-362.1	-179.8	NA	-1652.4
	A3	Z18-3	D+L+F (high water) + H(saturated)-EX -0.4EY-0.4EZ	-420.9	55.7	-412.6	-835.4	NA	577.5

Table 3E.3-1—Governing Forces and Moments for the ESWB Basemat Foundation
Sheet 2 of 2

	Area	Section Cut	Load Combination	FX (kip)	FY (kip)	FZ (kip)	MX (k-ft)	MY (k-ft)	MZ (k-ft)
Tension	A1	X1-1	D+L+F (high water) + H(saturated)+EX+0.4EY+0.4EZ	102.9	-1.5	406.9	502.6	NA	39.8
	A2	X1-12	D+L+F (high water) + H(saturated)+EX+0.4EY+0.4EZ	263.8	-32.1	496.4	-1297.6	NA	1559.0
	A3	X6-12	D+L+F (high water) + H(saturated)+EX+0.4EY+0.4EZ	320.3	598.3	464.4	-1751.4	NA	1657.8
	A1	Z7-3	D+L+F (high water) + H(saturated)+EX+0.4EY+EZ	434.7	-98.0	459.0	52.5	NA	-1749.8
	A2	Z13-2	D+L+F (high water) + H(saturated)+EX+0.4EY+EZ	644.2	272.9	362.1	58.3	NA	263.2
	A3	Z18-3	D+L+F (high water) + H(saturated)+EX+0.4EY+0.4EZ	420.9	338.1	412.6	-494.6	NA	1739.1
Out-of-Plane Moment	A1	X1-3	1.4D+1.7L+1.4F(high water) + 1.7H(dry)	0.0	226.8	0.0	1534.5	NA	19.1
	A2	X1-11	1.4D+1.7L+1.4F(high water) + 1.7H(dry)	0.0	-866.2	0.0	-5713.4	NA	830.9
	A3	X6-11	1.4D+1.7L+1.4F(high water) + 1.7H(dry)	0.0	1053.3	0.0	-6481.6	NA	905.6
	A1	Z7-1	1.4D+1.7L+1.4F(high water) + 1.7H(saturated)	0.0	-594.4	0.0	-425.9	NA	-5275.1
	A2	Z13-1	D+L+F (high water) + H(saturated) -0.4EX-0.4EY-0.4EZ	-238.4	-189.5	-477.4	-232.2	NA	-2078.2
	A3	Z13-1	1.4D+1.7L+1.4F(high water) + 1.7H(saturated)	0.0	41.1	0.0	-164.3	NA	-9531.0

F (high water): - Loading due to high water level (total water depth = 26 ft).
H (dry): - Loading due to dry soil (dry soil unit weight = 110 pcf).
H (saturated): - Loading due to saturated soil (saturated soil weight = 134 pcf).

Table 3E.3-2—Governing Design Data for ESWB Wall at Column Line 4 (Local Section Cut for Vertical Reinforcement)

Critical LC	Local Cut at (Long Cut)	Thickness	Cut Length	Effects of Seismic	FX (k)	FY (k)	FZ (k)	MX (k-ft)	MY (k-ft)	MZ (k-ft)
				Factored Load for Local Design						
D + F + L + H + 0.4EX - 0.4EY – EZ (7170: high water)	H1	3 ft – 0 in	6 ft – 9 in	GLOBAL	-524	-579	286	1789	1569	1626
				LOCAL	-6	-60	57	383	281	30
D + F + L + H + 0.4EX + 0.4EY – EZ (7169: high water)	H2	3 ft – 0 in	12 ft – 8 $^3/_8$ in	GLOBAL	429	-27	-151	1824	92	610
				LOCAL	14	-3	16	334	17	23
D + F + L + H + 0.4EX + 0.4EY - EZ (7169: high water)	H3 at (HJ)	3 ft – 0 in	12 ft – 8 $^3/_8$ in	GLOBAL	509	-310	299	-2981	75	1042
				LOCAL	20	12	107	-956	37	44
D + F + L + H - 0.4EX - 0.4EY - EZ (7172: high water)	H4	3 ft – 0 in	3 ft – 3 in	GLOBAL	236	-470	208	1078	-691	-565
				LOCAL	-2	-26	40	224	-125	1
D + F + L + H - 0.4EX + 0.4EY + EZ (7119: high water + buoyancy)	H5	2 ft – 0 in	6 ft – 6 in	GLOBAL	93	248	-104	-968	-9	-268
				LOCAL	-5	8	-57	-428	6	14
D + F + L + H - 0.4EX + 0.4EY + EZ (7167: high water)	H6	2 ft – 0 in	6 ft – 6 in	GLOBAL	-99	-114	9	-420	-50	-303
				LOCAL	1	9	-19	-170	12	6
D + F + L + H + EX - 0.4EY - 0.4EZ (7104: high water + buoyancy)	H7 at (HD)	3 ft – 0 in	5 ft – 9 in	GLOBAL	-461	-1383	107	252	52	990
				LOCAL						

Note:

1. Global effect of seismic addresses structural response while local effect of seismic address local flexibilities.

Table 3E.3-3—Governing Design Data for ESWB Wall at Column Line 4 (Local Section Cut for Horizontal Reinforcement)

Critical LC	Local Cut at (Long Cut)	Thickness	Cut Length	Effects of Seismic	FX (k)	FY (k)	FZ (k)	MX (k-ft)	MY (k-ft)	MZ (k-ft)
D + F + L + H + 0.4EX + 0.4EY + EZ (7141: low water + buoyancy)	V1 at (HK)	3 ft – 0 in	15 ft – 9 15/16 in	GLOBAL	270	250	-560	-373	-6126	-2928
				LOCAL	30	-34	-103	-102	-1164	-1
D + F + L + H + 0.4EX + 0.4EY + EZ (7165: high water)	V2 at (HK)	3 ft – 0 in	11 ft – 0 in	GLOBAL	-455	-193	136	-493	-3088	-1367
				LOCAL	-16	10	-44	-123	-470	27
D + F + L + H + EX - 0.4EY - 0.4EZ (7152: high water)	V3 at (HK)	3 ft – 0 in	3 ft – 0 in	GLOBAL	-806	-303	106	-284	-372	-1264
				LOCAL						
D + F + L + H + 0.4EX + 0.4EY + EZ (7141: low water + buoyancy)	V4 at (HK)	3 ft – 0 in	8 ft – 0 in	GLOBAL	106	-182	-215	-170	-2569	-53
				LOCAL	10	-18	-42	-54	-462	18
D + F + L + H + 0.4EX + 0.4EY + EZ (7165: high water)	V5 at (HG)	2 ft – 0 in	5 ft – 6 ½ in	GLOBAL	83	-10	-47	-7	-272	59
				LOCAL	8	-10	-15	7	-134	32
D + F + L + H + EX + 0.4EY - 0.4EZ (7150: high water)	V6 at (HL)	3 ft – 0 in	3 ft – 6 in	GLOBAL	1158	280	22	-103	40	-1380
				LOCAL						
D + F + L + H - EX - 0.4EY - 0.4EZ (7132: low water + buoyancy)	V7 at (HA)	3 ft – 0 in	3 ft – 3 in	GLOBAL	-19	-526	55	-10	642	856
				LOCAL						
D + F + L + H + EX + 0.4EY - 0.4EZ (7108: high water + buoyancy)	V8 at (HL)	3 ft – 0 in	2 ft – 4 ½ in	GLOBAL	-8	-104	11	-38	83	230
				LOCAL						

(Factored Load for Local Design spans columns Effects of Seismic through MZ.)

Note:

1. Global effort of seismic addresses structural response while local effort of seismic address local flexibilities.

Table 3E.3-4—Governing Design Data for ESWB Wall at Column Line 4 (Local Section Cut for Shear Friction Design)

				Factored Load for Shear Friction Design						
Critical LC	Long cut at (Local Cut)	Thickness	Cut Length	Effects of Seismic	FX (k)	FY (k)	FZ (k)	MX (k-ft)	MY (k-ft)	MZ (k-ft)
D + F + L + H + 0.4EX + 0.4EY - EZ (7169: high water)	HJ at (H3)	3 ft – 0 in	161 ft – 6 in	GLOBAL	3157	-3251	1706	-17334	-24386	-59323
D + F + L + H + EX - 0.4EY - 0.4EZ (7104: high water + buoyancy)	HD at (H7)	3 ft – 0 in	63 ft – 0 in	GLOBAL	-5987	-1092	706	2749	1719	124190

Table 3E.3-5—Governing Design Data for ESWB Wall at Column Line 4 (Long Section Cut for Horizontal Reinforcement)

				Factored Load for In-plane Shear Design						
Critical LC	Long Cut at (Local Cut)	Thicknes s	Cut Length	Effects of Seismic	FX (k)	FY (k)	FZ (k)	MX (k-ft)	MY (k-ft)	MZ (k-ft)
D + F + L + H + 0.4EX + 0.4EY + EZ (7141: low water + buoyancy)	HK at (V1)	3 ft – 0 in	161 ft – 6 in	GLOBAL	-3945	12986	-1172	4017	17903	66852
D + F + L + H + 0.4EX + 0.4EY + EZ (7165: high water)	HK at (V2)	3 ft – 0 in	161 ft – 6 in	GLOBAL	-3937	13013	-1174	3960	17925	65669
D + F + L + H + EX - 0.4EY - 0.4EZ (7152: high water)	HK at (V3)	3 ft – 0 in	161 ft – 6 in	GLOBAL	-11147	162	521	-1928	-5747	204910
D + F + L + H + 0.4EX + 0.4EY + EZ (7141: low water + buoyancy)	HK at (V4)	3 ft – 0 in	161 ft – 6 in	GLOBAL	-3945	12986	-1172	4017	17903	66852
D + F + L + H + 0.4EX + 0.4EY + EZ (7165: high water)	HG at (V5)	2 ft – 0 in	127 ft – 0 in	GLOBAL	-1269	5863	-1227	-11099	185	10758
D + F + L + H + EX + 0.4EY - 0.4EZ (7150: high water)	HL at (V6)	3 ft – 0 in	161 ft – 6 in	GLOBAL	-13853	7266	382	-201	-5447	253772
D + F + L + H - EX - 0.4EY - 0.4EZ (7132: low water + buoyancy)	HA at (V7)	3 ft – 0 in	26 ft – 6 in	GLOBAL	4368	-91	199	1376	-1657	-29438
D + F + L + H + EX + 0.4EY - 0.4EZ (7108: high water + buoyancy)	HL at (V8)	3 ft – 0 in	161 ft – 6 in	GLOBAL	13592	1775	382	-461	-4657	-192320

Table 3E.3-6—Governing Design Data for ESWB Fan Deck Slab at Elevation 63 ft – 0 in (Out-of-Plane Design, X-Axis)

			Results for Out-of-Plane Shear and Moment Design						
Critical LC	Local Cut	Cut Length	Effects of Seismic	FX (k)	FY (k)	FZ (k)	MX (k-ft)	MY (k-ft)	MZ (k-ft)
D + L + EY (LC 8000)	Mx1	6 ft – 3 $^{5}/_{8}$ in	Vertical	18	181	0	-47	-3	1271
0.4EX (0.4 × LC 500)			Horizontal	64	42	34	-57	-92	420
D + L + EY (LC 8000)	Mx2	6 ft – 3 $^{5}/_{8}$ in	Vertical	26	-160	6	-13	20	1047
0.4EX (0.4 × LC 500)			Horizontal	63	-16	-22	22	-77	173

Table 3E.3-7—Governing Design Data for ESWB Fan Deck Slab at Elevation 63 ft – 0 in (Out-of-Plane Design, Z-Axis)

			Results for Out-of-Plane Shear and Moment Design						
Critical LC	Local Cut	Cut Length	Effects of Seismic	FX (k)	FY (k)	FZ (k)	MX (k-ft)	MY (k-ft)	MZ (k-ft)
D + L + EY (LC 8000)	My1	6 ft – 6 in	Vertical	-10	168	17	-1038	-25	33
0.4EZ (0.4 × LC 700)			Horizontal	-66	18	90	-178	-164	-23

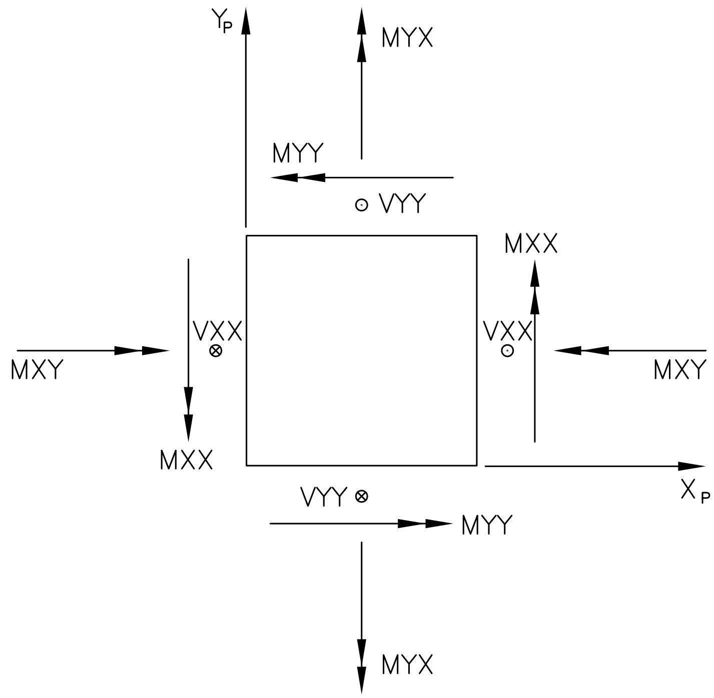
Table 3E.3-8—Governing Design Data for ESWB Fan Deck Slab at Elevation 63 ft – 0 in (Tension)

Direction	Tension (k/ft)
X-axis	30
Z-axis	40

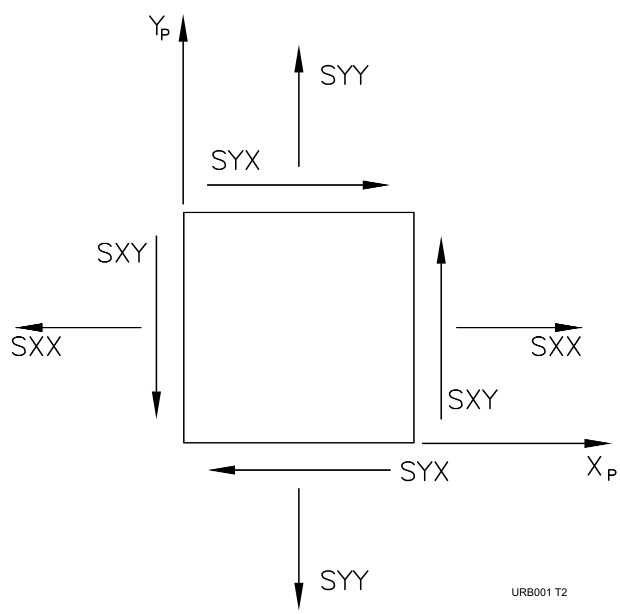
Table 3E.3-9—Governing Design Data for ESWB Fan Deck Slab at Elevation 63 ft – 0 in (In-Plane Shear)

			Results for In-Plane Shear Check					
Critical LC	Long Cut	Cut Length	FX (k)	FY (k)	FZ (k)	MX (k-ft)	MY (k-ft)	MZ (k-ft)
D + F + L + H + 0.4EX - 0.4EY - EZ (7122)	FANDECK_IN-PLANE SHEAR	63 ft – 0 in	413	127	2628	979	6499	-257

Figure 3E.3-1—Finite Element Planar Reference Frame Systems



A) PLATE BENDING



B) PLANE STRESS/STRAIN

Figure 3E.3-2—ESWB Basemat Foundation - FEM

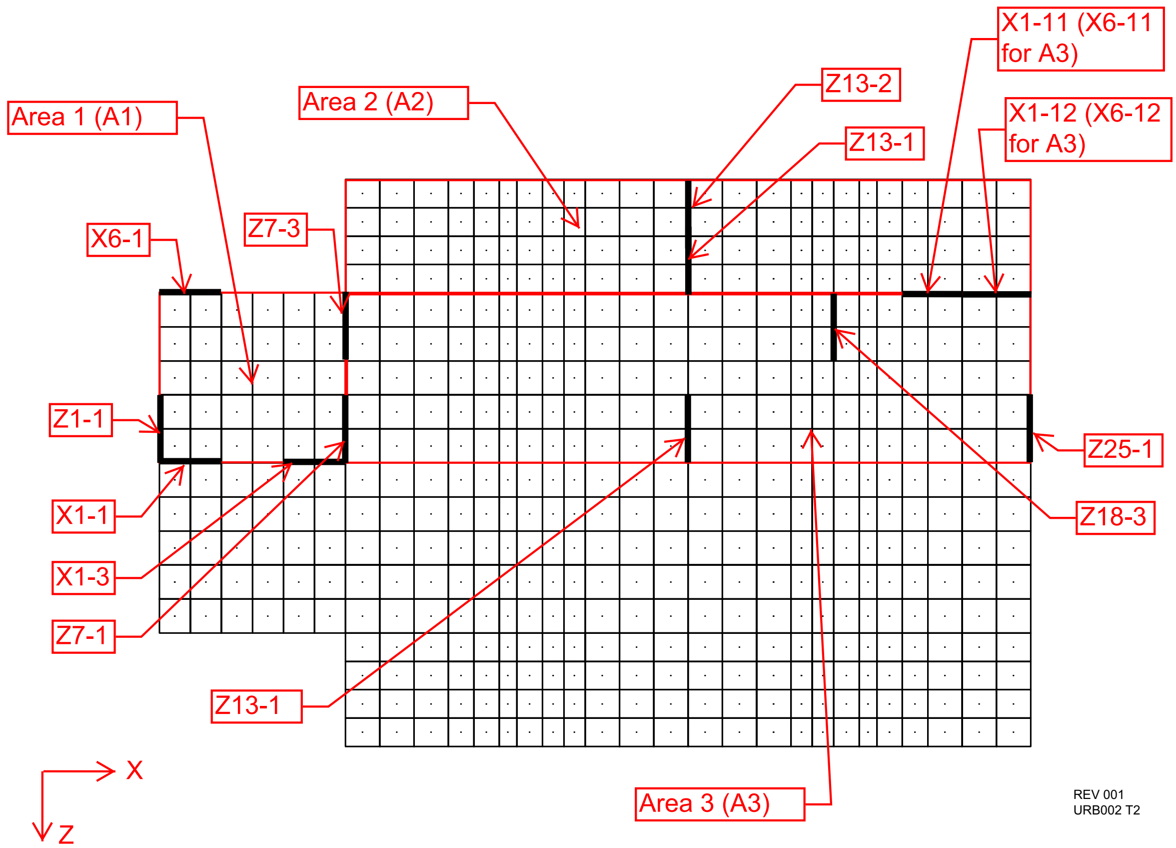


Figure 3E.3-3—Reinforcement Sketch for ESWB Basemat Foundation

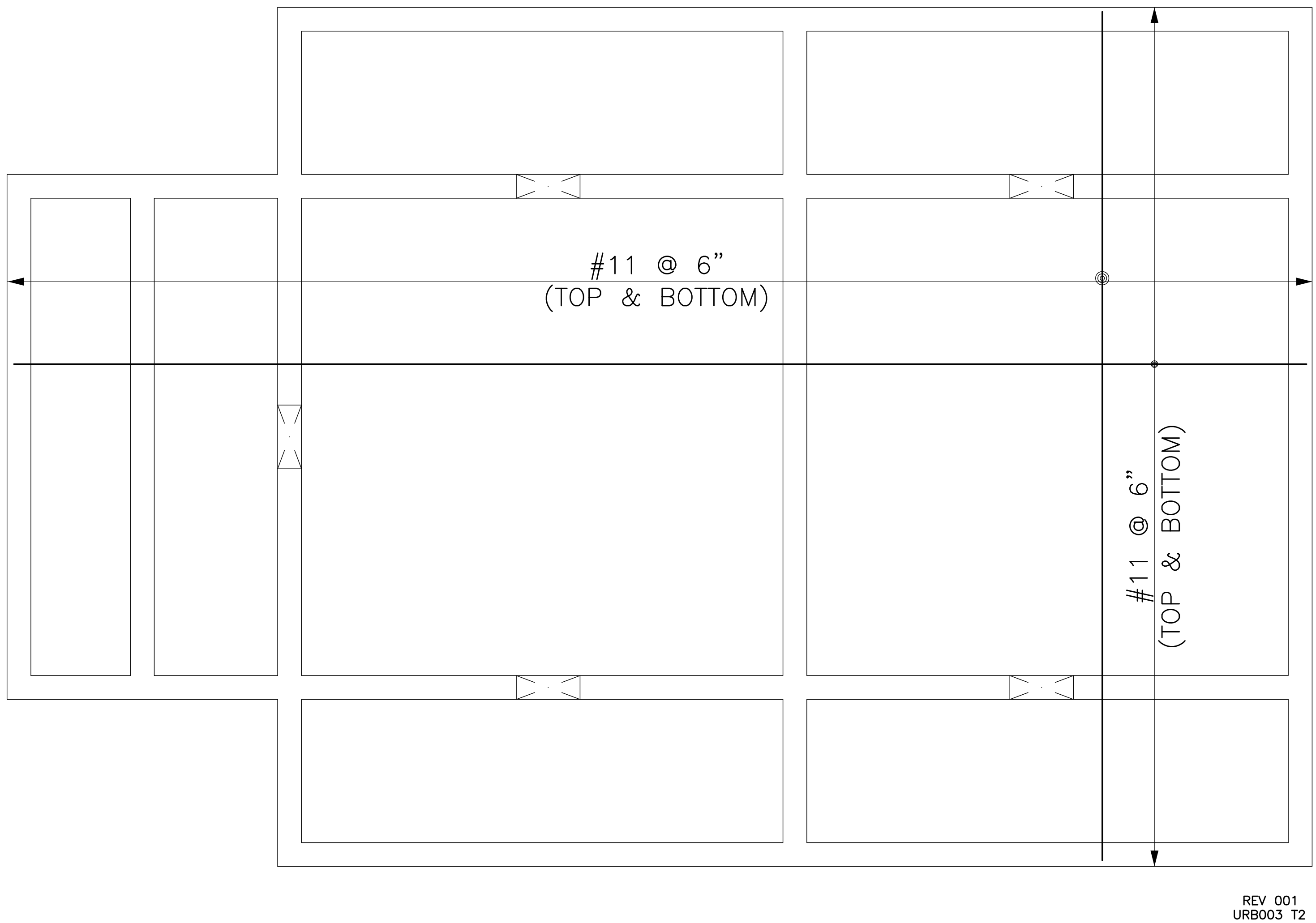


Figure 3E.3-4—ESWB Wall at Column Line 4 - FEM

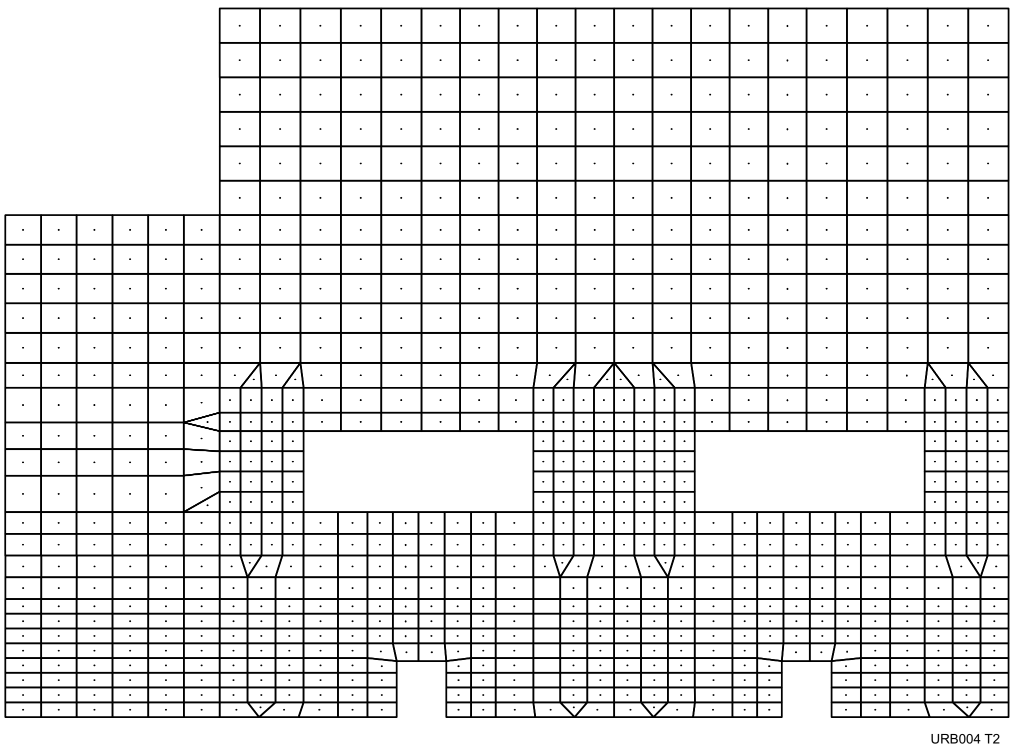


Figure 3E.3-5—Sign Convention for ESWB Horizontal and Vertical Cuts at Column Line 4

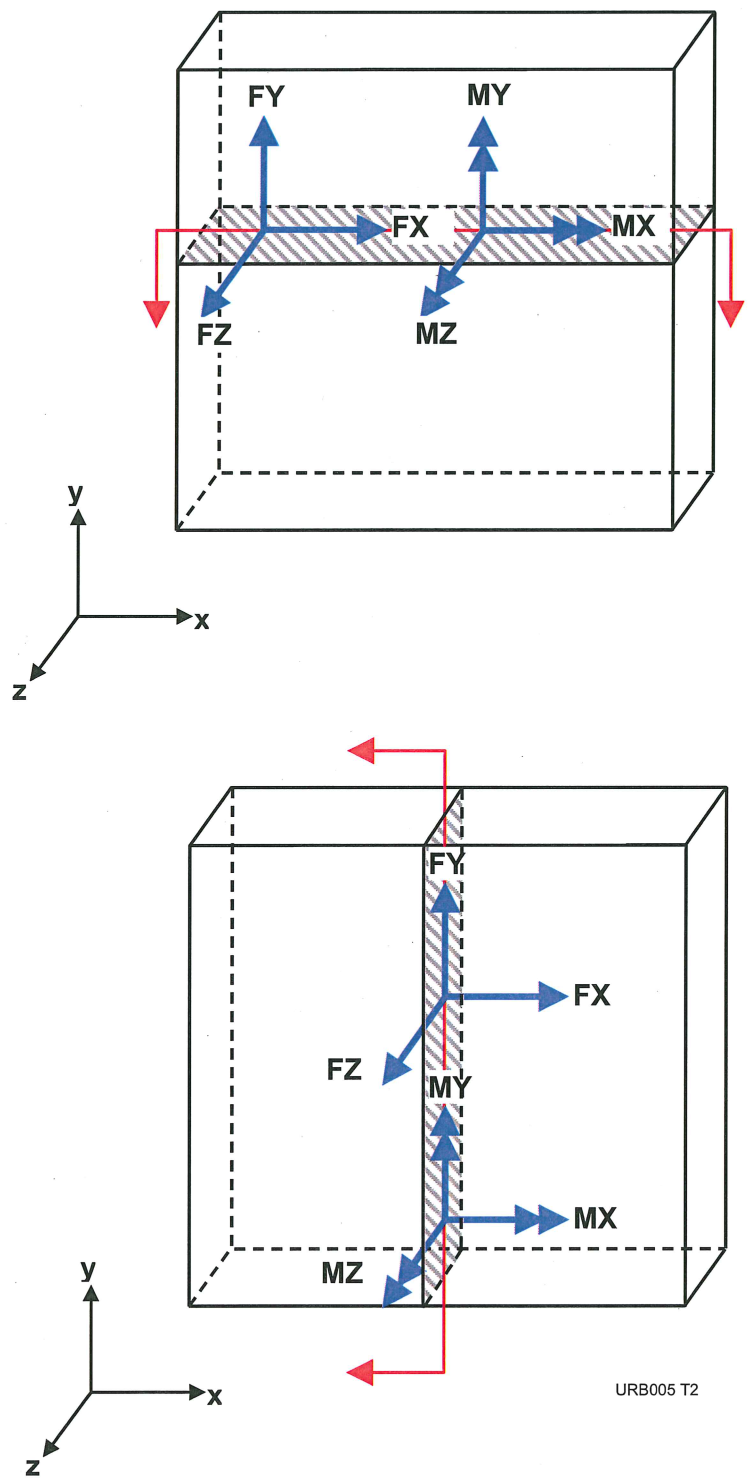


Figure 3E.3-6—Vertical and Horizontal Section Cuts for ESWB Wall at Column Line 4

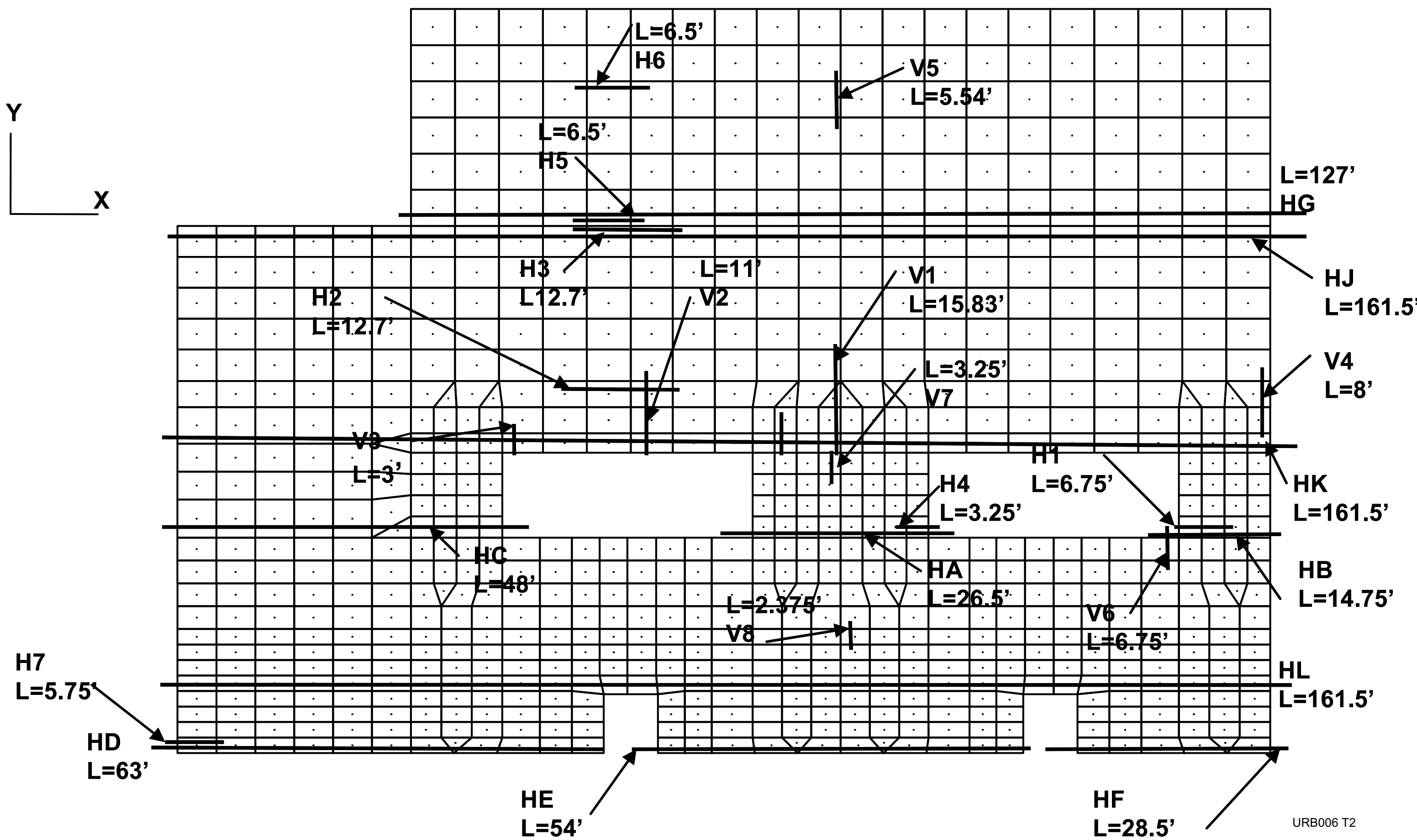


Figure 3E.3-7—Reinforcement Configuration for ESWB Wall at Column Line 4

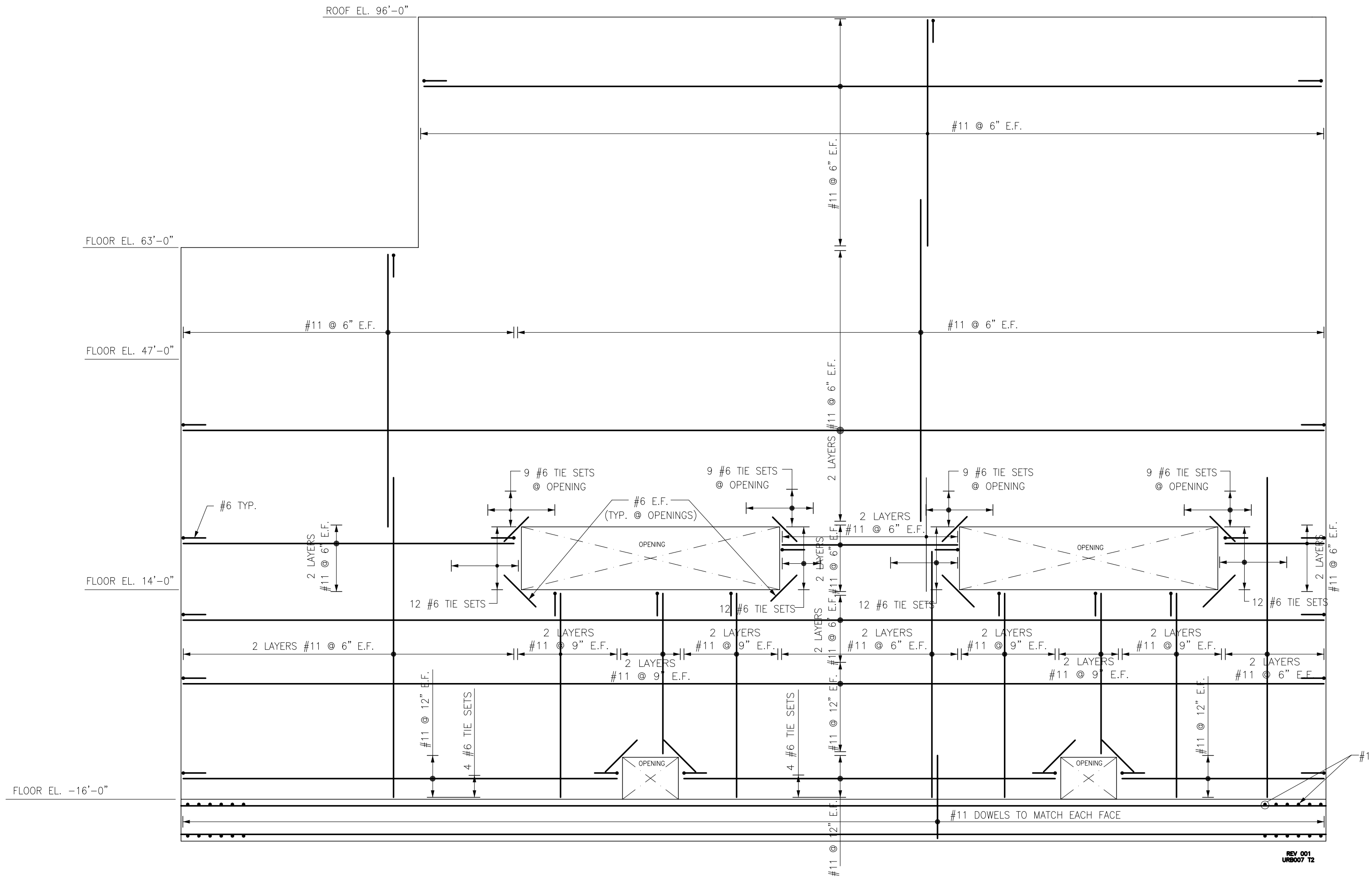


Figure 3E.3-8—ESWB Fan Deck Slab at Elevation 63'-0" - FEM

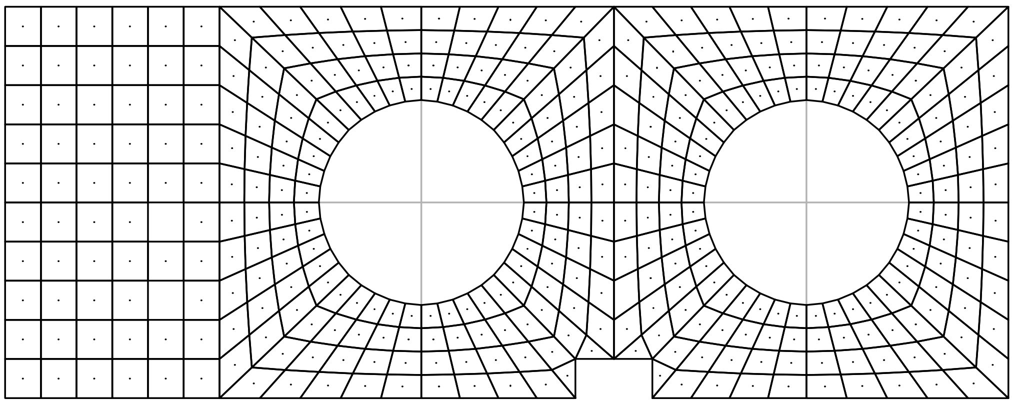


Figure 3E.3-9—Reinforcement Sketch for ESWB Fan Deck Slab at Elevation 63'-0"

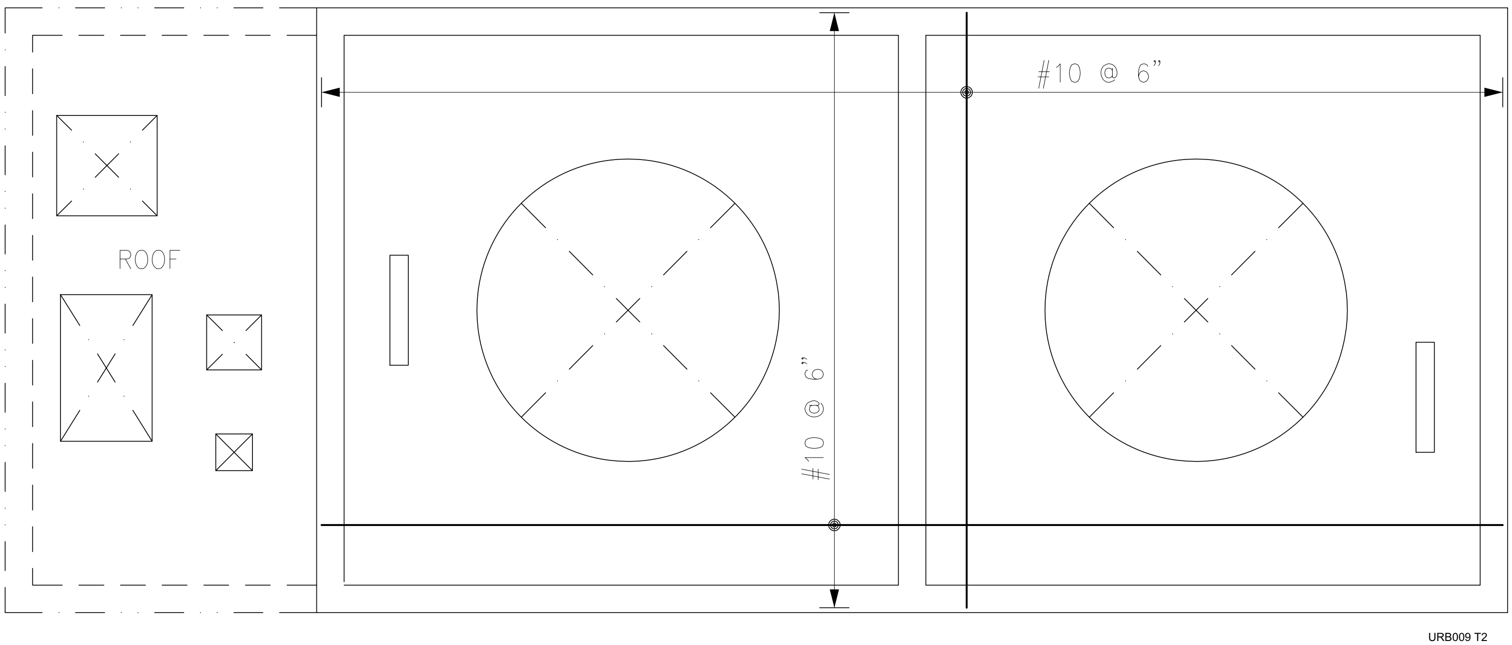


Figure 3E.3-10—Orientation of Positive Axis