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.

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.

Floor Live and Dead Load Distribution

Dead loads include self weight of the structure, platforms, electric equipment, 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.

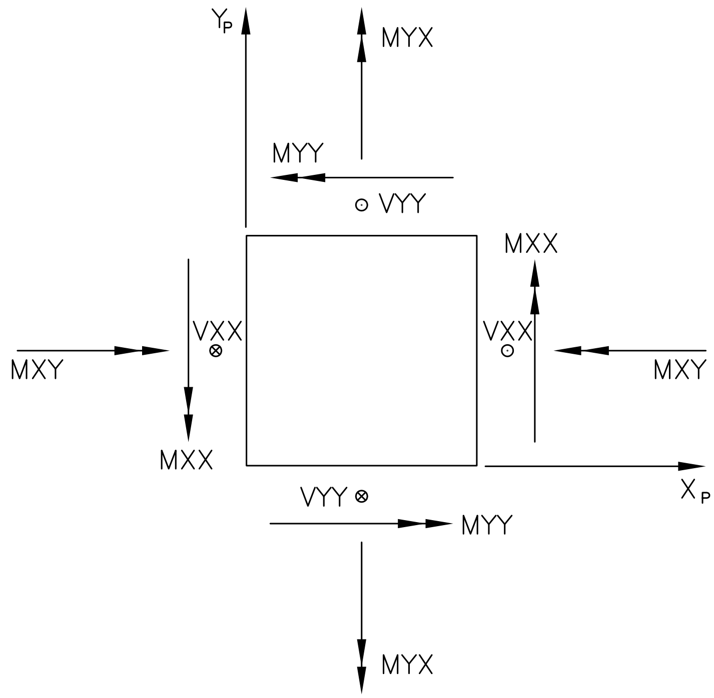
The use of GT STRUDL for the design of the critical sections is described in Sections 3.8.4.4.4 and 3.8.5.4.4. Design forces and moments are extracted from GT STRUDL analyses for basemat foundation and superstructure component design.

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.

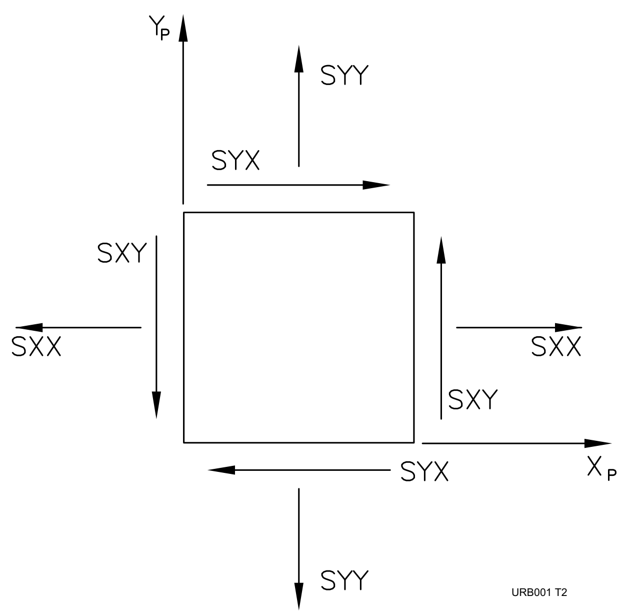
Reinforced concrete components are designed in accordance with the applicable codes, standards, and specifications described in Sections 3.8.4.2 and 3.8.5.2.

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.

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



A) PLATE BENDING



B) PLANE STRESS/STRAIN