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MFN 09-382 Docket No. 52-010

June 9, 2009

U.S. Nuclear Regulatory Commission
Document Control Desk
Washington, D.C. 20555-0001

Subject: **Response to Portion of NRC RAI Letter No. 278 Related to ESBWR Design Certification Application – DCD Tier 2 Section 3.8 – Seismic Category I Structures; RAI Number 3.8-121 S02**

The purpose of this letter is to submit the GE Hitachi Nuclear Energy (GEH) response to a portion of the U.S. Nuclear Regulatory Commission (NRC) Request for Additional Information (RAI) letter number 278 sent by NRC letter dated December 4, 2008 (Reference 1). RAI Number 3.8-121 S02 is addressed in Enclosure 1. Enclosure 2 contains the DCD changes to Tier 2 as a result of GEH's response to this RAI. Verified DCD changes associated with these RAI responses are identified in the enclosed DCD markups by enclosing the text within a black box.

If you have any questions or require additional information, please contact me.

Sincerely,

Lee F. Dougherty for

Richard E. Kingston
Vice President, ESBWR Licensing

Reference:

1. MFN 08-956 Letter from U.S. Nuclear Regulatory Commission to R. E. Brown, GEH, *Request For Additional Information Letter No. 278 Related to ESBWR Design Certification* dated December 4, 2008

Enclosures:

1. Response to Portion of NRC RAI Letter No. 278 Related to ESBWR Design Certification Application - DCD Tier 2 Section 3.8 – Seismic Category I Structures; RAI Number 3.8-121 S02
2. Response to Portion of NRC RAI Letter No. 278 Related to ESBWR Design Certification Application - DCD Markups for RAI Number 3.8-121 S02

cc:	AE Cubbage	USNRC (with enclosures)
	JG Head	GEH/Wilmington (with enclosures)
	DH Hinds	GEH/Wilmington (with enclosures)
	eDRF Section	0000-0088-8880 (RAI 3.8-121 S02)

ENCLOSURE 1

MFN 09-382

Respone to Portion of NRC RAI Letter No. 278
Related to ESBWR Design Certification Application[1]

DCD Tier 2 Section 3.8 – Seismic Category I Structures

RAI Number 3.8-121 S02

[1] Original Response and Supplement 1 previously submitted under MFNs 08-243 and 08-243 S02 are included to provide historical continuity during review.

NRC RAI 3.8-121

DCD Revision 4, Sections 3.8.4.1.1 and 3.8.4.6.5 have been revised to describe the use of composite structures for most reactor building slabs. These composite structures are constructed from reinforcing bars, steel plates, steel beams, concrete, and studs. The strength of the slab is calculated using reinforced concrete design methodology except that the steel plate is treated as being equivalent to two orthogonal rebars with the same sectional area as the plate. The studs are designed to ANSI/AISC N690 and the stresses in the rebar, steel plates, and concrete meet the allowable stresses in ASME Code Section III, Division 2, Subsection CC. Since there is essentially no guidance on the design of such composite floor members in Subsection CC of the Code, describe the approach being used in greater detail. This should include the basis for treating the steel plates as two orthogonal rebars, since the steel plates are subjected to biaxial tension and the individual rebars are not. Explain how the forces acting in different directions are determined for designing the studs. How are the allowable stresses for the steel beams and steel plates determined since allowables for these steel members are not presented in Subsection CC of the Code? Explain whether temporary shoring is provided beneath the entire steel slab section until the concrete develops its full strength. If not, explain how the initial stresses during construction (based on only the steel section) are considered in the design for all other load combinations (where the full composite section properties are relied upon). Also, identify any test data and/or peer reviewed articles that support the design approach being used for the composite floor slab configurations presented in the DCD.

GEH Response

(a) The design of the composite floor slabs is performed in accordance with the following procedure.

1. Steel plate is converted to two orthogonal rebars with the same sectional area as the steel plate.
2. Stress calculations are performed using SSDP-2D.
3. It is verified that calculated stresses of concrete and plate-equivalent rebars are less than allowable values.
4. Since the steel plate is subjected to bi-axial tension its combined stress is evaluated according to the following equation, and it is verified that the value is less than the allowable stress:

$$\sigma_e = \sqrt{\sigma_x{}^2 + \sigma_y{}^2 - \sigma_x \cdot \sigma_y}$$

where,

σ_e: combined stress of steel plate

σ_x, σ_y: stresses of orthogonal rebars equivalent to steel plate calculated in Step 2

(b) Studs are required to connect the steel plates with concrete rigidly. Shear forces on the studs for each orthogonal direction is calculated by analyzing the composite section. These shear forces are combined by the vector sum method as follows.

$$V_n = \sqrt{V_x^{\ 2} + V_y^{\ 2}}$$

where,

V_n: Shear force used in design

V_x, V_y: Shear forces in X and Y directions, respectively

(c) The allowable stresses of the steel plates are determined in accordance with the specifications for rebars in ASME Code Section III, Division 2, Subsection CC. The minimum yield strength of A-36, 36 ksi (250 MPa), which is specified in ASTM is used as the design yield strength, fy, in the Code. The steel beams are designed as temporary structures which support only the loads during construction including concrete pressure.

(d) As stated above, the steel beams are used to support the construction loads. Therefore, a temporary shoring is not provided beneath the slabs. Since the steel beams are designed to carry the full construction loads, the steel plates are not affected by initial stresses during construction.

(e) A series of tests has been performed in Japan for the composite floor slab configurations presented in the DCD. References and technical guidelines established based on the tests are listed below.

- "Technical Guidelines for Aseismic Design of Steel Plate Reinforced Concrete Structures - Building and Structures-", JEAG4618-2005, December 2005 (in Japanese)
- "Experimental Study on A Concrete Filled Steel Structure", Part.1 through 43, Architectural Institute of Japan (AIJ) 1996 through 2000 (in Japanese)

Papers published in U.S. based on tests for a composite wall with plates on both sides are listed below:

- "Study on Steel Plate Reinforced Concrete Bearing Wall for Nuclear Power Plants Part 1; Shear and Bending Loading Tests of SC Walls," Ozaki, M., Akita, S., Niwa, N., Matsuo, I., and Usami, S, Proceedings of the 16th International Conference on Structural Mechanics in Reactor Technology SMiRT 16, Washington DC, USA, August 12-17, 2001, IASMIRT, North Carolina State University, Raleigh, NC.
- "Study on Steel Plate Reinforced Concrete Bearing Wall for Nuclear Power Plants Part.2 ; Analytical method to evaluate response of SC walls," Akita, S., Ozaki, M., Niwa, N., Matsuo, I. and Hara, K., Proceedings of the 16th International Conference on Structural Mechanics in Reactor Technology

SMiRT 16, Washington DC, USA, August 12-17, 2001, IASMIRT, North Carolina State University, Raleigh, NC.

- "Study on steel plate reinforced concrete panels subjected to cyclic in-plane shear," Osuga H., Nakayama T., and Akita S., Proceedings of the 16th International Conference on Structural Mechanics in Reactor Technology SMiRT 16, Washington DC, USA, August 12-17, 2001., IASMIRT, North Carolina State University, Raleigh, NC.
- "Study on steel plate reinforced concrete panels having a opening subjected to cyclic in-plane shear," Ozaki M., Osuga H., Nakayama T.,and Adachi N., Proceedings of the 16th International Conference on Structural Mechanics in Reactor Technology SMiRT 16, Washington DC, USA, August 12-17, 2001, IASMIRT, North Carolina State University, Raleigh, NC.
- "Response of Modular Composite Walls to Combined Thermal & Mechanical Load," Booth, P.N., Varma, A.H., Malushte, S., and Johnson, W. (2007), Proceedings of the 19th International Conference on Structural Mechanics in Reactor Technology SMiRT 19, Toronto, CN, August 12-17, 2007, IASMIRT, North Carolina State University, Raleigh, NC.

DCD Impact

No DCD change was made in response to this RAI.

NRC RAI 3.8-121, Supplement 1

The RAI response dated April 3, 2008, provided additional information related to the analysis and design of the composite floor slabs. This was needed because the analysis and design method being used is a unique approach to design composite floor slabs. The following parts (a) through (e), noted in the GEH's response require further information:

(a) As requested in the original RAI, the technical basis (justification) for treating the steel plates as two orthogonal rebars and also designing the composite floor slabs using ASME Code Section III, Division 2, Subsection CC criteria was not provided. GEH is requested to provide this information. Also, how does this approach compare to other more conventional methods for design of composite floor slabs such as Section Q1.11 – Composite Construction of ANSI/AISC N690 or the International Building Code (IBC) which references ANSI/AISC 341?

(b) How are the forces developed at the studs for design? What are the allowable values? Is the material and design of the studs performed in accordance with ANSI/AISC N690; If so, what sections of N690? If not, explain why.

(c) If the design code of record for the composite floor slabs is ANSI/AISC N690, then why are the allowable values for the concrete, rebar, and steel plate of the ASME Code utilized. How do these compare to a design done in accordance with N690 for steel and ACI-349 for concrete?

(d) If temporary shoring is not used, why is the statement made that the steel plates are not affected by the initial stress during construction (e.g., concrete pour). How is this initial stress addressed in design of the composite floor steel plates.

(e) The series of tests listed as references for composite floor slabs tested in Japan, as noted in the response, are in Japanese which is not useful. The other papers that are listed in the response as references are for composite walls (not floors), have plates on both sides (not one side as in the ESBWR design), and it is not evident if they include out of plane loading test results. Thus, it is not clear that there is any useful information in these papers to support the design approach being used. As requested in the original RAI, provide any test data and/or peer reviewed articles that could support the design approach being used. To expedite the review, the actual paper should be provided (not just a reference) and an explanation should be provided to show that the configuration of the specimens (e.g., wall thickness, plate thickness, anchorage type), material properties, and loading (bending, membrane, and shear) used for testing or the article are similar to or in the range of the design condition used for the ESBWR.

GEH Response

(a) US Codes and Standards do not currently provide design rules for modular composite construction where steel plate which supports the weight of the concrete slab prior to the hardening during construction also acts as two orthogonal rebars. AISC Subcommittee on Modular Composite Structures is currently in the process of developing these design rules. The technical basis for treating the steel plates as two orthogonal rebars for reinforced concrete design is based on Japanese design practice and associated test data.

Section 3.3.1 (1) a. of the Japanese design guideline (NRC RAI 3.8-121, Supplement 1, Reference 1) states:

> "Stresses of a steel plate and concrete, when subjected to bending moment, shall be calculated in accordance with the cross sectional calculation against bending of a beam prescribed in Article 13 of the Japanese design guideline provided for reinforced concrete (NRC RAI 3.8-121, Supplement 1, Reference 2), which assumes the retention of a plane."

Thus, the design methodology for rebars of a reinforced concrete structure (RC) is applicable to the design of steel plates of a steel concrete (SC) structure. The design stresses for the SC floor slabs are derived from the global FEM model in the same manner as for RC floor slabs.

Conventional method delineated in ANSI/AISC N690, Section Q1.11.1 is for designing a composite steel beam not for a concrete slab. By definition per ANSI/AISC N690, "Composite Construction shall consist of steel beams or girders supporting a reinforced concrete slab, so interconnected that the steel beam and the concrete act together to resist bending of the steel beam." The ACI 318 or 349, as applicable, govern the design of the concrete slab.

The stress calculations performed using SSDP-2D are consistent with the ASME Code and ACI 349 as shown in NRC RAI 3.8-4, Supplement 2 transmitted to the NRC on November 6, 2007 via MFN 06-298, Supplement 4.

(b) The method by which forces are calculated in the studs and associated requirements for material, size, and spacing meet the requirements of Section Q1.11.4 of ANSI/AISC N690-1994 including up to Supplement 2 dated 2004.

(c) The ANSI/AISC N690 code is applied only for the design of stud shear connectors. The other components are designed as discussed above.

(d) During the construction period it is required to provide a temporary supporting system, shoring and/or steel beam for SC floor slab modules. The embedded support beams shown in DCD Tier 2 Figure 3.8-12 work as a temporary supporting system. Additionally, angle or channel-shaped steel beams are provided to stiffen the steel plate as shown in Figure 3.8-121(1). The initial stress in the steel plate is insignificant as shown in Table 3.8-121(1), which is below 5 percent of allowable

stresses. The construction stresses in the floor support beams will be evaluated in the detailed design stage.

(e) A document entitled "Outline of the Experimental Study on Steel Plate Reinforced Concrete Structure," attached as Attachment 3.8-121(1), summarizes the experimental study performed to confirm the structural characteristics of strength of half SC (H-SC) structure, which is published as Part 18 and 28 of NRC RAI 3.8-121, Supplement 1, Reference 3. Part 18 summarizes the experimental study plan and result on behavior of shear deformation, and Part 28 summarizes the experimental study plan and result on behavior under out-of-plane loads.

A document entitled "Outline of the Japanese Technical Guideline of Steel Plate Reinforced Concrete Structure," attached as Attachment 3.8-121(2), summarizes the provisions for H-SC floor slabs in NRC RAI 3.8-121, Supplement 1, Reference 1. As summarize in Section 2.1.1 of Attachment 3.8-121(2), the test data under out-of-plane loading shows that yielding load of SC is similar to the calculated value, which is based on the same manner of RC, and the behavior of SC and H-SC is also similar up to the maximum load.

References:

1. "Technical Guidelines for a Seismic Design of Steel Plate Reinforced Concrete Structures – Building and Structures," JEAG4618-2005, December 2005.
2. "Standard for Structural Calculation of Reinforced Concrete Structures – Based on Allowable Stress Concept," Architectural Institute of Japan (AIJ), 1999.
3. "Experimental Study on a Concrete Filled Steel Structure," Part 1 through 43, Architectural Institute of Japan (AIJ), 1996 through 2000.

Table 3.8-121(1) Construction Stress of Floor Slab Steel Plate

Floor Slab Steel Plate Thickness (mm)	Floor Slab Thickness (mm)	Length between Angle or Channel Beams (mm)	Construction Load (kN/m^2)	Maximum Moment of Simply-supported Beam (kN·mm/m)	Calculated Construction Stress of Steel Plate (MPa)	Allowable Tensile Stress of Steel Plate (MPa)
16	1000	400	27.1	542.6	12.7	250
25	1000	400	27.8	556.5	5.3	250

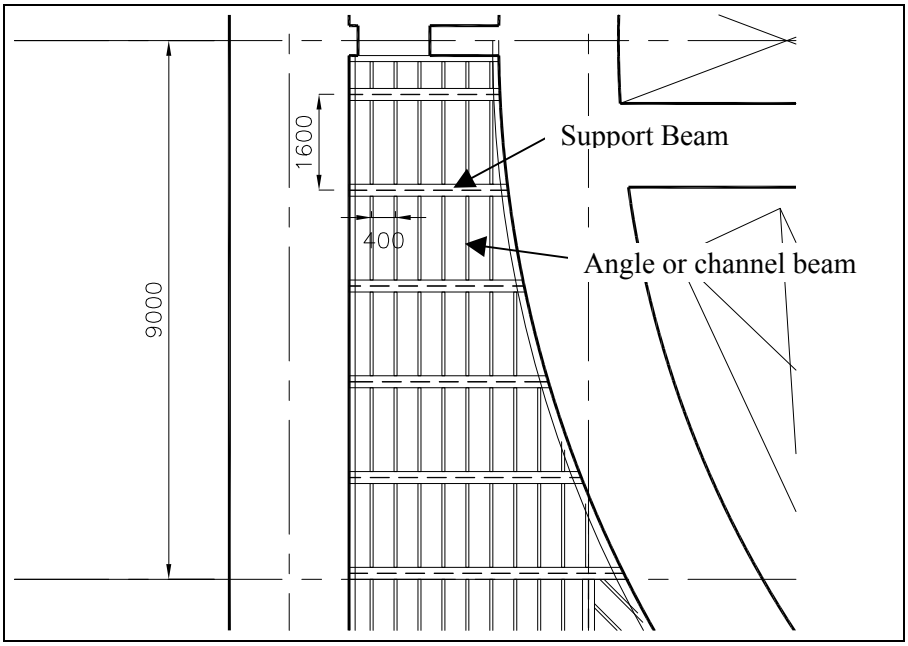


Figure 3.8-121(1) Assumed Support System of Floor Slab Module

DCD Impact

No DCD change was made in response to this RAI Supplement.

NRC RAI 3.8-121, Supplement 2

As a result of the staff's review of the GEH response transmitted in GEH letter MFN 08-243, Supplement 2, dated October 13, 2008, supplemental information is needed for some of the responses provided. Therefore, GEH is requested to respond to the following two items:

Part (a):

The GEH response acknowledged that US Codes and Standards do not currently address modular composite construction where steel plates act as two orthogonal rebars. To justify the design approach used for the ESBWR plant, the RAI response indicated that the method used is based on the Japanese design guideline JEAG4618-2005, "Technical Guidelines for a Seismic Design of Steel Plate Reinforced Concrete Structures – Building and Structures," December 2005. This guideline has not been endorsed by the NRC staff for design of composite construction in US NPPs. If this approach is the basis for design of the ESBWR composite construction floor slabs, then GEH needs to present the sufficient technical basis for this approach, as was requested in the prior RAI 3.8-121, Supplement 2, Part (a), and the basis will have to be reviewed by the staff on an application-specific basis. This justification should include the actual Japanese guideline in English; a complete and self explanatory summary description of the design approach in the Japanese guideline; explanation of assumptions; description of the range of applicable parameters; justification for the particular equations and methods; comparison of the test configuration parameters (e.g., steel floor plate thickness, steel thickness to floor thickness ratios; stud diameters, diameter to length ratios of studs, stud spacing, etc.; reinforcement ratios for rebars at the top, and other key parameters) to the ESBWR design configuration. The technical basis should include test results as discussed later under Part (e) of this RAI. The test results should clearly show that the stiffness (bending and shear), yield, ultimate capacity, and ductility of the ESBWR composite configuration are comparable to or more conservative than those for the equivalent configuration of reinforced concrete members. Furthermore, the same equations in the Japanese guideline, if identical to those used in the ESBWR design, should be used to predict the section yield, capacity, and deformation in order to demonstrate the acceptability or conservatism of the design approach.

Part (e):

The RAI response provided a short summary of two experimental studies performed in Japan to establish the design code for NPP using a steel plate reinforced concrete (SC) structural element. In Part 18, "Behavior of Shear Deformation (Half Steel Plate Reinforced Concrete Structure)," of "Experimental Study on a Concrete Filled Steel Structure," Architectural Institute of Japan (AIJ), 1998, a short summary of testing done on a Half SC (H-SC), SC, and reinforced concrete specimens for shear loading is given. Some configuration details are provided only for the H-SC test specimen, which are not compared to the ESBWR design configuration. The design details for the other specimens are not given and not compared to the H-SC specimen or to the ESBWR design configuration. Some test results and hand calculations are tabulated, but no explanation is given as to the basis of the equations used in the hand calculations. Also,

no discussion is given on how these test and calculation results compare to the results using the design approach contained in the Japanese guideline or the ESBWR DCD method. Separately, Part 28, "Behavior Under Out of Plane Load (Outline of Experimental Study Plan and Result), of "Experimental Study on a Concrete Filled Steel Structure," Architectural Institute of Japan (AIJ), 1999, provides a short summary of testing done on many specimens for out of plane loading. Most of these do not appear to be similar to the H-SC type structure used in the ESBWR plant. Very limited details are provided on the test specimen configurations and designs, many of the labeled text on the figures are not legible, and the three test specimens on Figure 3 do not appear to match the H-SC design used in the ESBWR plant. From the results provided in several figures, it is not clear how these demonstrate the adequacy of the design approach being used for the ESBWR plant. Also, no testing or demonstration of design adequacy is provided for connections of H-SC structural elements at the boundary of the floor slabs. In addition to the above, a short outline of the design guide for floor slabs in the Japanese guideline of steel plate reinforced concrete (SC) structures is given. From the limited information given in this outline, it is not possible to determine the technical basis for the design approach being used. Under each subsection of the outline, reference is made to an "Article" which is not provided, then some design approach is given with another reference to "Experimental Study" which is also not provided. Then additional information is given by reference for other Parts of the Japanese guideline, which are also not provided.

Based on the above discussion and the information provided in the current RAI response, sufficient information has not been provided for the staff to review the design approach to obtain a reasonable assurance that the design methodology used for the ESBWR composite structural elements is technically acceptable. Therefore, if the GEH methodology will still rely on the Japanese guideline and the two tests described in the RAI response, then GEH needs to develop the technical basis in a rational and complete description which can stand on its own merit. Some of the needed elements to achieve this are described in the requested information under Part (a) above.

GEH Response

In DCD Revision 6, the Half-SC floor slabs will be replaced with conventional reinforced concrete slabs.

DCD Impact

DCD Tier 2 Subsections 3.8.4.1.1, 3.8.4.6.5, 3G.1.3.1.1, 3G.1.5.2.3.3, 3G.1.5.4.3.3, Tables 3G.1-50 through 3G.1-56 and Figure 3G.1-47 will be revised in Revision 6 as noted in the attached markups.

DCD Tier 2 Figure 3.8-12 will be deleted in Revision 6 as noted in the attached markup.

Enclosure 2

MFN 09-382

Response to Portion of NRC Request for

Additional Information Letter No. 278

Related to ESBWR Design Certification Application

DCD Markups for RAI Number 3.8-121 S02

The RB is a rigid box type shear wall building constructed of reinforced concrete. Vertical loads are carried by a system of external walls box-shaped surrounding a large cylindrical shaped concrete containment.

Lateral loads are resisted by external shear walls as well as the internal concentric cylindrical structure.

These structures are tied together by a system of internal concrete bearing walls and concrete floor slabs. ~~Floor slabs are designed, in general, as composite structures supported by embedded beams during construction.~~

The load resisting characteristic of the building is that of a concrete box type shear wall structure.

The summary report for the RB is in Appendix 3G Section 3G.1. This report contains a description of the RB, the loads, load combinations, reinforcement stresses, and concrete reinforcement details for the basemat, seismic walls, and floors.

3.8.4.1.2 Control Building

The CB is adjacent to but structurally independent of the RB (see Figures 1.2-2 through 1.2-5 and Figure 1.2-11). The key dimensions of the CB are summarized in Table 3.8-8.

The CB houses the safety-related electrical, control and instrumentation equipment, the control room for the RB and TB and the CB HVAC equipment. The CB is a Seismic Category I structure that houses control equipment and operation personnel.

The CB is a reinforced concrete box type shear wall structure consisting of walls and slabs and is supported on a foundation mat. Steel framing is composite with concrete slab and is used to support the slabs for vertical loads. The CB is a shear wall structure designed to accommodate all seismic loads with its walls and connected floors. Therefore, frame members such as beams or columns are designed to resist vertical loads and to accommodate deformations of the walls in case of earthquake conditions.

The summary report for the CB is in Appendix 3G Section 3G.2. This report contains a description of the CB, the loads, load combinations, reinforcement stresses, and concrete reinforcement details for the basemat, seismic walls, and floors.

3.8.4.1.3 Fuel Building

The FB is integrated with the RB, sharing a common wall between the RB and the FB and a large common foundation mat (see Section 1.2). The key dimensions of the FB are summarized in Table 3.8-8.

The FB houses the spent fuel pool facilities and their supporting system and HVAC equipment. The FB is a Seismic Category I structure except for the penthouse that houses HVAC equipment. The penthouse is a Seismic Category II structure.

The FB is a reinforced concrete box type shear wall structure consisting of walls and slabs and is supported on a foundation mat. Concrete and/or steel framing is composite with a concrete slab and is used to support the slabs for vertical loads. The FB is a shear wall structure designed to accommodate all seismic loads with its walls and connected floors. Therefore, frame members

3.8.4.5.5 Firewater Service Complex

The acceptance criteria for the design of the FWSC are the same as the CB, which is discussed in Subsection 3.8.4.5.2.

3.8.4.6 Material, Quality Control and Special Construction Techniques

This subsection contains information related to the materials, QC and special construction techniques used in the construction of other Seismic Category I structures.

3.8.4.6.1 Concrete

The specified compressive strength of concrete at 28 days, or earlier, is 4000 psi for the foundation mat and 5000 psi for other structures. Concrete material is the same as described in Subsection 3.8.1.6.1 with the following exception: Concrete is batched and placed according to ACI 349-01.

3.8.4.6.2 Reinforcing Steel

Reinforcing steel is the same as in Subsection 3.8.1.6.2.

3.8.4.6.3 Splices of Reinforcing Steel

Splices of reinforcing steel are the same as in Subsection 3.8.1.6.3 except that placing and splicing is in accordance with ACI 349-01. Welding of reinforcing bars complies with all the applicable requirements of ASME Code Section III, Division 2.

3.8.4.6.4 Quality Control

QC is the same as in Subsection 3.8.1.6.5 except that the Construction Specifications reference ACI 349-01 and applicable Regulatory Guides. For welding of reinforcing bars, inspection and documentation requirements conform to ASME Code Section III, Division 2 also.

3.8.4.6.5 Special Construction Techniques

~~Composite construction is used in other Seismic Category I structures.~~ No special construction techniques are employed other than that s~~S~~ome of the components, such as rebar cages, are pre-assembled and lifted into place. ~~As described in Subsection 3.8.4.1.1, the composite structures, which are composed of reinforcing bars, steel plates, and concrete, are used for most RB floor slabs. The structural pieces are assembled in discrete segments and are lifted into place. Concrete is poured in-place. See Figure 3.8-12.~~

~~The strength of the slab is calculated using reinforced concrete design methodology except that the steel plate is treated as being equivalent to two orthogonal rebars with the same sectional area as the plate. The stud material, geometry, and spacing meet the requirements of ANSI/AISC N690. The stresses in concrete, rebar and steel plate conform to the allowable stresses in ASME Code Section III, Division 2, Subsection CC.~~

3.8.4.6.6 Structural Steel Including Plates

Structural steel conforms to ASTM A-36, A-500 Gr. B HSS, A-572 Gr. 50 or A-992 W Shapes. Plates conform to ASTM A-36 or ASME SA-516 Gr. 70.

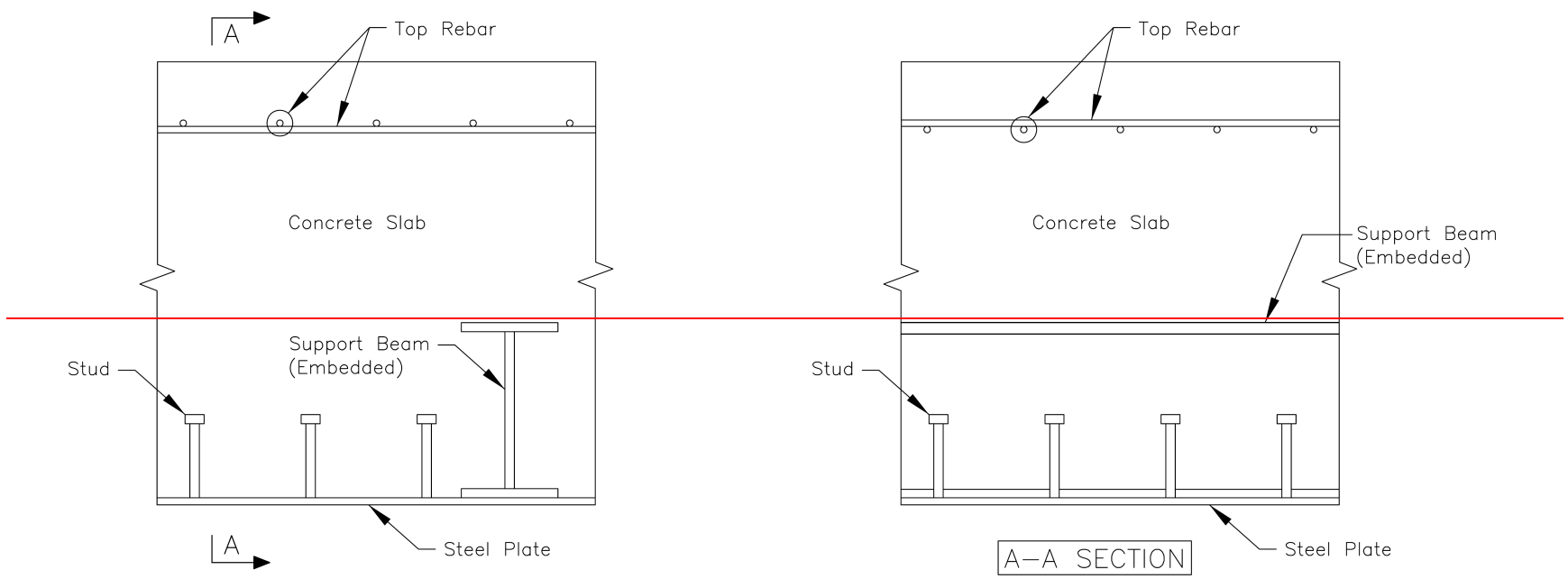


Figure 3.8-12. (Deleted)~~RB Floor Composite Slab~~

3G.1.3 Structural Description

3G.1.3.1 Description of the Reactor Building

3G.1.3.1.1 Reactor Building Structure

The RB structure and the containment structure share the same wall structure which encloses the Gravity-Driven Cooling System (GDCS) pools and the Suppression pool. The RB structure consists of the following areas that are not part of the containment structure.

- RB super structure at and above the refueling floor, up to the support for the bridge crane, including the roof, is made of reinforced concrete floors and walls ~~(floor slabs can also be composite structure)~~. Roof trusses and their supporting columns are made of structural steel.
- IC/PCCS pools (including expansion pools), the equipment storage pool, the reactor well and the buffer pool.
- Rooms at several elevation levels outside the containment but attaching to the containment structure.
- The main steam tunnel that consists of reinforced concrete walls and floor.

The key dimensions of the RB are summarized in Table 3.8-8. Figures 3G.1-1 through 3G.1-7 show the configurations of the RB.

The FB is integrated with the RB in the ESBWR standard plant. The RB and FB share a common wall between them and a large common basemat. The summary of the FB design is described in Section 3G.3.

3G.1.3.1.2 Containment and Containment Structure

The containment is a reinforced concrete containment vessel (RCCV), which encloses the reactor pressure vessel (RPV) and its related systems and components. The containment is divided into a drywell region and a wetwell region with an interconnecting vent system.

The key dimensions of the RCCV are summarized in Table 3.8-1. Figure 3.8-1 shows the configuration of the RCCV.

The containment structure boundary consists of the containment top slab with removable drywell head, the containment cylindrical wall that is also the outer wall of the suppression pool, the suppression pool floor slab, the RPV pedestal that encloses the volume under the RPV, and the basemat. The concrete containment is lined with a steel liner for leak-tightness. The containment cylindrical outer wall extends below the suppression pool floor slab to the basemat. This extension is not part of the containment pressure boundary, however, it supports the upper containment cylinder. The reinforced concrete basemat foundation supports the entire containment system, which includes the RPV pedestal, and extends to support the RB surrounding the containment. The outline drawings are shown in Figures 3G.1-1 through 3G.1-7.

Reinforcing steel also has tendency to decrease in strength at elevated temperatures. The reduction of reinforcing steel strength is based upon the following equation excerpted from Reference 3G.1-1.

- Reduction Factor
  - $\phi = 1.0 - 0.000873\ (T-21.1)$ $\quad 21.1°C\ (70°F) \leq T \leq 204.4°C\ (400°F)$

3G.1.5.2.3.3 Structural Steel

Properties of structural steel used for the design analyses are included in Table 3G.1-12. ~~ASTM A-36 is used for the steel plates of the composite floor slabs.~~

3G.1.5.3 Stability Requirements

The RB foundation has the following safety factors against overturning and sliding. Because the impact on the stability by seismic load is larger than wind and tornado, the load combinations for W and W_t, which are shown in Table 3.8-14, are excluded.

Load Combination	Overturning	Sliding	Floatation
D + H + E'	1.1	1.1	
D + F'			1.1

Where

D = Dead Load, F' = Buoyant forces of design basis flood

H = Lateral soil pressure, E' = Safe Shutdown Earthquake

3G.1.5.4 Structural Design Evaluation

The evaluation of the containment structure, the containment internal structures, and the RB structures is based on the results from the load combinations indicated in Subsection 3G.1.5.2.2.

Figure 3G.1-28 shows the location of the sections that are selected for evaluation of reinforced concrete structures. They are selected, in principle, from the center and both ends of walls and slabs, where it is reasonably expected that the critical stresses appear based on engineering experience and judgment. The computer program SSDP-2D is used for the evaluation of stresses in rebar and concrete. The input to SSDP-2D consists of rebar ratios, material properties, and element geometry at the section under consideration together with the forces and moments from the NASTRAN analysis, which are shown in Tables 3G.1-13 through 3G.1-21. Element forces and moments listed in the tables are defined with relation to the element coordinate system shown in Figure 3G.1-29. Figures 3G.1-30 through 3G.1-38 indicate deformations of structures obtained by NASTRAN analyses for the loads corresponding to Table 3G.1-13 through 3G.1-21.

Figure 3G.1-39 shows a flow chart for the structural analysis and design. Figures 3G.1-40 through 3G.1-47 and Figures 3G.1-67 through 3G.1-70 present the design drawings used for the evaluation of the containment and the RB structural design. Figures 3G.1-48 through 3G.1-50 show the design details of containment liner plate. Figures 3G.1-51 through 3G.1-54 show the design details of containment major penetrations. Figures 3G.1-55 through 3G.1-59 show the details of containment internal structures. Figures 3G.1-71a and 3G.1-71b show the details of the passive containment cooling system (PCCS) condenser and supports.

3G.1.5.4.3.2 RB Foundation Mat Outside Containment

Section 24 is selected for the foundation mat outside the containment at the junction with the cylindrical wall below the RCCV wall. The maximum rebar stress of 327.4 MPa (47.49 ksi) is found in the top rebar as shown in Table 3G.1-54. The maximum bottom rebar stress is found to be 133.6 MPa (19.38 ksi) also as shown in Table 3G.1-54. The maximum transverse shear force is found to be 10.74 MN/m (61.30 kips/in) against the shear strength of 16.03 MN/m (91.50 kips/in).

3G.1.5.4.3.3 RB Floor Slabs

Sections 25 to 27 are selected for the floor slabs at elevations EL 4650, EL 17500 and EL 27000 (see Figure 3G.1-28) at their junction with the RCCV. ~~Floor slabs are composite structures, which are reinforced by rebars at their top surfaces and by steel plates at the bottom surfaces, as described in Subsection 3.8.4.1.1. However, the slabs surrounding the Main Steam (MS) tunnel are constructed of conventional reinforced concrete. Among the elements at Sections 26 and 27, Element #96113 and 98424 are included in the MS tunnel slabs.~~

The maximum rebar stress of 274.0~~346.1~~ MPa (39.74~~50.20~~ ksi) is found at Section 26 as shown in ~~Table 3G.1-53, whereas the maximum stress of steel plate is found to be 150.2 MPa (21.78 ksi) at Section 26 as shown in~~ Table 3G.1-55. The maximum transverse shear force is found to be 8.16 MN/m (46.60 kips/in) against the shear strength of 9.08 MN/m (51.80 kips/in).

3G.1.5.4.3.4 Pool Girders

The maximum rebar stress of 263.4 MPa (38.20 ksi) is found in the horizontal rebar at Section 29 as shown in Table 3G.1-55, whereas the maximum vertical rebar stress is found to be 249.0 MPa (36.11 ksi) at Section 28 as shown in Table 3G.1-55. The maximum transverse shear force is found to be 1.10 MN/m (6.28 kips/in) against the shear strength of 5.31 MN/m (30.30 kips/in).

3G.1.5.4.3.5 Main Steam Tunnel Floors and Walls

Section 31 is selected for the MS tunnel wall (Element #150122) and slabs (Elements #96611 and #98614). The MS tunnel is composed of the reinforced concrete structures as described in Subsection 3G.1.5.4.3.3.

The maximum rebar stress is found to be 220.5 MPa (31.98 ksi) in Table 3G.1-51, and the maximum transverse shear force is found to be 0.47 MN/m (2.68 kips/in) against the shear strength of 3.70 MN/m (21.1 kips/in).

3G.1.5.5 Foundation Stability

The RB, the concrete containment and the FB share a common foundation. The stabilities of the foundation against overturning, sliding and floatation are evaluated. The energy approach is used in calculating the factor of safety against overturning.

The factors of safety against overturning, sliding and floatation are given in Table 3G.1-57. All of these meet the acceptance criteria given in Table 3.8-14. ~~In the sliding evaluation the gap between the building and excavated soil is backfilled with concrete up to the top level of the basemat as shown in Figure 3G.1-65.~~

Table 3G.1-50

Sectional Thicknesses and Rebar Ratios of RB Used in the Evaluation (Continued)

Location	Element ID	Thickness (m)	Primary Reinforcement					Shear Tie	
			Position	Direction 1*1		Direction 2*1			
				Arrangement*2	Ratio (%)	Arrangement*2	Ratio (%)	Arrangement	Ratio (%)
22 Exterior Wall @ EL4.65 ~6.60m	42011	1.5	Inside	3-#11@200	1.006	3-#11@200	1.006	#7@400x400	0.242
			Outside	4-#11@200 (+1-#11@200)	1.677	4-#11@200 (+1-#11@200)	1.677		
23 Exterior Wall @ EL22.50 ~24.60m	24211	1.5	Inside	3-#11@200 +1-#11@400	1.174	4-#11@200 (+1-#11@200)	1.677	#7@400x200	0.484
			Outside	3-#11@200 +1-#11@400	1.174	4-#11@200	1.342		
	24224	1.5	Inside	3-#11@200 +1-#11@400	1.174	4-#11@200 (+1-#11@200)	1.677	#7@200x200	0.968
			Outside	3-#11@200 +1-#11@400	1.174	4-#11@200 (+1-#11@200)	1.677		
	34210	1.5	Inside	3-#11@200	1.006	3-#11@200	1.006	#6@400x400	0.177
			Outside	3-#11@200 (+2-#11@200)	1.677	3-#11@200 (+2-#11@200)	1.677		
	34220	1.5	Inside	3-#11@200	1.006	3-#11@200	1.006	#6@200x200	0.710
			Outside	3-#11@200	1.006	3-#11@200	1.006		
	44201	1.5	Inside	3-#11@200	1.006	3-#11@200	1.006	#7@200x200	0.968
			Outside	4-#11@200	1.342	4-#11@200	1.342		
24 Basemat @ Wall Below RCCV	90140 90182 90111	4.0	Top	5-#11@0.9°	0.401	4-#11@200 +1-#11@400	0.566	#11@0.9x400	0.801
			Bottom	5-#11@200	0.629	5-#11@200	0.629		
25 Slab EL4.65m @ RCCV	93140 93182 93111	1.0	Top	2-#11@200	1.006	2-#11@200	1.006	#5@200x200	0.500
			Bottom	2-#11@200 ~~PLATE t=16~~	1.006~~-~~	2-#11@200 ~~PLATE t=16~~	1.006~~-~~		
26 Slab EL17.5m @ RCCV	96144 96186	1.0	Top	2-#11@200	1.006	2-#11@200	1.006	#5@200x200	0.500
			Bottom	2-#11@200 ~~PLATE t=16~~	1.006~~-~~	2-#11@200 ~~PLATE t=16~~	1.006~~-~~		
	96113	1.6	Top	2-#11@200	0.629	2-#11@200	0.629	#5@200x200	0.500
			Bottom	3-#11@200	0.944	3-#11@200	0.944		

Note *1: Wall Below RCCV — Direction 1: Hoop — Direction 2: Vertical
Exterior Wall — Direction 1: Horizontal — Direction 2: Vertical
Slab/MS Tunnel Slab — Direction 1: N-S — Direction 2: E-W
Pool Girder — Direction 1: Horizontal — Direction 2: Vertical
MS Tunnel Wall — Direction 1: Horizontal — Direction 2: Vertical
Basemat — Direction 1: Top; Radial; Bottom; N-S, — Direction 2: Top; Circumferential; Bottom; E-W

Note *2: Rebar in parenthesis indicates additional bars locally required.

Table 3G.1-50

Sectional Thicknesses and Rebar Ratios of RB Used in the Evaluation (Continued)

Location	Element ID	Thickness (m)	Primary Reinforcement					Shear Tie	
			Position	Direction 1*1		Direction 2*1			
				Arrangement*2	Ratio (%)	Arrangement*2	Ratio (%)	Arrangement	Ratio (%)
27 Slab EL27.0m @ RCCV	98472 98514	1.0	Top	3-#11@200	1.510	3-#11@200	1.510	#5@200x200	0.500
			Bottom	2-#11@200 ~~PLATE t=25~~	1.006~~-~~	2-#11@200 ~~PLATE t=25~~	1.006~~-~~		
	98424	2.4	Top	4-#11@200	0.839	4-#11@200	0.839	#6@200x200	0.71
			Bottom	4-#11@200	0.839	4-#11@200	0.839		
28 Pool Girder @ Storage Pool	123054 123154	1.6	Inside	3-#11@200	0.944	3-#11@200	0.944	#7@400x200	0.484
			Outside	3-#11@200	0.944	3-#11@200	0.944		
29 Pool Girder @ Cavity	123062 123162	1.6	Inside	3-#11@200	0.944	3-#11@200	0.944	#7@400x400	0.242
			Outside	3-#11@200	0.944	3-#11@200	0.944		
30 Pool Girder @ Fuel Pool	123067 123167	1.6	Inside	3-#11@200	0.944	3-#11@200	0.944	#7@400x200	0.484
			Outside	3-#11@200	0.944	3-#11@200	0.944		
	123167	1.6	Inside	3-#11@200	0.944	3-#11@200	0.944	#7@400x200	0.484
			Outside	3-#11@200	0.944	3-#11@200	0.944		
31 MS Tunnel Wall and Slab	150122	1.3	Inside	2-#11@200	0.774	2-#11@200	0.774	#6@400x400	0.177
			Outside	2-#11@200 +1-#11@400	0.968	2-#11@200 +1-#11@400	0.968		
	96611	1.6	Top	2-#11@200	0.629	2-#11@200	0.629	#5@200x200	0.500
			Bottom	3-#11@200	0.944	3-#11@200	0.944		
	98614	2.4	Top	4-#11@200	0.839	4-#11@200	0.839	#5@200x200	0.500
			Bottom	3-#11@200	0.629	3-#11@200	0.629		

Note *1: Wall Below RCCV — Direction 1: Hoop — Direction 2: Vertical
Exterior Wall — Direction 1: Horizontal — Direction 2: Vertical
Slab/MS Tunnel Slab — Direction 1: N-S — Direction 2: E-W
Pool Girder — Direction 1: Horizontal — Direction 2: Vertical
MS Tunnel Wall — Direction 1: Horizontal — Direction 2: Vertical
Basemat — Direction 1: Top; Radial; Bottom; N-S — Direction 2: Top: Circumferential; Bottom; E-W

Note *2: Rebar in parenthesis indicates additional bars locally required.

Table 3G.1-51

Rebar and Concrete Stresses of RB: Selected Load Combination RB-4

Location	Element ID	Concrete Stress (Mpa)		Primary Reinforcement Stress (MPa)				
				Calculated				Allowable
		Calculated	Allowable	Direction 1*		Direction 2*		
				In/Top	Out/Bottom	In/Top	Out/Bottom	
18 Wall	6	-3.5	-29.3	2.6	3.4	-23.8	-21.1	372.2
Below RCCV	13	-4.0	-29.3	0.4	0.9	-26.7	-24.5	372.2
Bottom	24	-5.1	-29.3	3.2	3.1	-32.8	-22.8	372.2
19 Wall Below	806	-4.5	-29.3	2.6	3.3	-17.7	-27.5	372.2
Below RCCV	813	-5.2	-29.3	-0.7	0.7	-20.4	-31.5	372.2
Mid-Height	824	-6.1	-29.3	-1.1	-1.0	-21.1	-35.9	372.2
20 Wall	1606	-5.8	-29.3	16.8	18.4	-33.5	-12.6	372.2
Below RCCV	1613	-8.2	-29.3	13.5	16.9	-45.6	-8.6	372.2
Top	1624	-9.3	-29.3	13.7	22.0	-51.3	-11.1	372.2
21 Exterior Wall	20011	-1.6	-29.3	4.2	0.6	6.0	-7.4	372.2
@ EL-11.50	20023	-5.9	-29.3	14.8	-16.8	23.7	-20.6	372.2
~-10.50m	30010	-1.7	-29.3	0.6	-9.4	1.8	-1.8	372.2
	30020	-2.1	-29.3	-7.5	1.4	-4.7	-12.2	372.2
	40001	-1.8	-29.3	-4.2	-0.9	-6.4	-10.0	372.2
	40011	-1.0	-29.3	0.1	-4.2	1.4	-4.7	372.2
22 Exterior Wall	22011	-1.3	-29.3	37.0	32.6	10.4	3.4	372.2
@ EL4.65	22023	-5.0	-29.3	13.0	13.2	-13.1	-38.2	372.2
~6.60m	32010	-3.3	-29.3	19.4	97.5	-7.6	35.1	372.2
	32020	-3.6	-29.3	5.7	46.1	-5.4	54.3	372.2
	42001	-3.3	-29.3	7.8	32.4	-10.3	27.0	372.2
	42011	-4.1	-29.3	27.3	89.4	-12.8	20.1	372.2
23 Exterior Wall	24211	-1.9	-29.3	5.9	14.7	-6.4	10.0	372.2
@ EL22.50	24224	-2.5	-29.3	31.1	-0.3	9.1	8.9	372.2
~24.60m	34210	-4.7	-29.3	53.2	184.5	7.9	152.8	372.2
	34220	-4.0	-29.3	26.6	4.5	-13.2	51.7	372.2
	44201	-0.6	-29.3	53.4	34.5	6.3	72.2	372.2
24 Basemat	90140	-1.7	-23.5	-11.3	-3.3	1.6	-0.1	372.2
@ Wall	90182	-2.4	-23.5	-12.6	-4.6	-0.9	9.0	372.2
Below RCCV	90111	-3.1	-23.5	-18.5	6.5	3.0	-0.9	372.2
25 Slab	93140	-7.0	-29.3	26.5	70.5	62.5	87.5	372.2
EL4.65m	93182	-11.1	-29.3	19.2	19.6	-48.7	40.5	372.2
@ RCCV	93111	-11.0	-29.3	-47.1	47.9	33.3	37.3	372.2
26 Slab	96144	-4.3	-29.3	68.6	82.2	90.5	96.5	372.2
EL17.5m	96186	-5.5	-29.3	31.4	59.6	-36.3	28.1	372.2
@ RCCV	96113	-11.1	-29.3	-46.8	77.0	-30.2	57.0	372.2
27 Slab	98472	-10.1	-29.3	146.5	121.9	139.3	94.8	372.2
EL27.0m	98514	-5.9	-29.3	7.5	38.2	-13.5	13.1	372.2
@ RCCV	98424	-6.7	-29.3	-16.0	-36.3	-30.0	-24.6	372.2
28 Pool Girder	123054	-8.8	-29.3	14.1	69.2	-43.6	-2.8	372.2
@ Storage Pool	123154	-3.5	-29.3	28.6	120.8	5.1	68.3	372.2
29 Pool Girder	123062	-1.9	-29.3	-13.3	-11.1	33.1	10.9	372.2
@ Cavity	123162	-2.7	-29.3	-19.4	-19.0	15.4	3.3	372.2
30 Pool Girder	123067	-5.8	-29.3	-13.6	-3.5	-34.9	-28.9	372.2
@ Fuel Pool	123167	-4.2	-29.3	-13.2	-7.5	-6.7	-18.4	372.2
31 MS Tunnel	150122	-13.6	-29.3	13.9	169.6	-22.8	220.5	372.2
Wall and Slab	96611	-8.6	-29.3	1.4	5.1	-21.2	193.7	372.2
	98614	-6.3	-29.3	2.8	2.6	-3.7	151.3	372.2

Location	Element ID	Concrete Stress (MPa)		Primary Reinforcement Stress (MPa)				
		Calculated	Allowable	Calculated				Allowable
				Direction 1*		Direction 2*		
				In/Top	Out/Bottom	In/Top	Out/Bottom	
18 Wall	6	-3.5	-29.3	2.6	3.4	-23.8	-21.1	372.2
Below RCCV	13	-4.0	-29.3	0.4	0.9	-26.7	-24.5	372.2
Bottom	24	-5.1	-29.3	3.2	3.1	-32.8	-22.8	372.2
19 Wall Below	806	-4.5	-29.3	2.6	3.3	-17.7	-27.5	372.2
Below RCCV	813	-5.2	-29.3	-0.7	0.7	-20.4	-31.5	372.2
Mid-Height	824	-6.1	-29.3	-1.1	-1.0	-21.1	-35.9	372.2
20 Wall	1606	-5.8	-29.3	16.8	18.4	-33.5	-12.6	372.2
Below RCCV	1613	-8.2	-29.3	13.5	16.9	-45.6	-8.6	372.2
Top	1624	-9.3	-29.3	13.7	22.0	-51.3	-11.1	372.2
21 Exterior Wall	20011	-1.6	-29.3	4.2	0.6	6.0	-7.4	372.2
@ EL-11.50	20023	-5.9	-29.3	14.8	-16.8	23.7	-20.6	372.2
~-10.50m	30010	-1.7	-29.3	0.6	-9.4	1.8	-1.8	372.2
	30020	-2.1	-29.3	-7.5	1.4	-4.7	-12.2	372.2
	40001	-1.8	-29.3	-4.2	-0.9	-6.4	-10.0	372.2
	40011	-1.0	-29.3	0.1	-4.2	1.4	-4.7	372.2
22 Exterior Wall	22011	-1.3	-29.3	37.0	32.6	10.4	3.4	372.2
@ EL4.65	22023	-5.0	-29.3	13.0	13.2	-13.1	-38.2	372.2
~6.60m	32010	-3.3	-29.3	19.4	97.5	-7.6	35.1	372.2
	32020	-3.6	-29.3	5.7	46.1	-5.4	54.3	372.2
	42001	-3.3	-29.3	7.8	32.4	-10.3	27.0	372.2
	42011	-4.1	-29.3	27.3	89.4	-12.8	20.1	372.2
~~23 Exterior Wall~~	~~24211~~	~~-1.9~~	~~-29.3~~	~~5.9~~	~~14.7~~	~~-6.4~~	~~10.0~~	~~372.2~~
@ EL22.50	24224	-2.5	-29.3	31.1	-0.3	9.1	8.9	372.2
~24.60m	34210	-4.7	-29.3	53.2	184.5	7.9	152.8	372.2
	34220	-4.0	-29.3	26.6	4.5	-13.2	51.7	372.2
	44201	-0.6	-29.3	53.4	34.5	6.3	72.2	372.2
24 Basemat	90140	-1.7	-23.5	-11.3	-3.3	1.6	-0.1	372.2
@ Wall	90182	-2.4	-23.5	-12.6	-4.6	-0.9	9.0	372.2
Below RCCV	90111	-3.1	-23.5	-18.5	6.5	3.0	-0.9	372.2
25 Slab	93140	-7.0	-29.3	42.9	37.3	75.5	47.5	372.2 (223.3)
EL4.65m	93182	-13.0	-29.3	16.4	23.9	-61.2	64.8	372.2 (223.3)
@ RCCV	93111	-12.9	-29.3	-60.0	69.1	34.1	34.8	372.2 (223.3)
26 Slab	96144	-4.2	-29.3	84.8	38.6	117.3	46.4	372.2 (223.3)
EL17.5m	96186	-5.2	-29.3	47.0	36.1	-28.7	25.3	372.2 (223.3)
@ RCCV	96113	-11.1	-29.3	-46.8	77.0	-30.2	57.0	372.2
27 Slab	98472	-10.1	-29.3	164.0	41.0	158.3	23.8	372.2 (222.2)
EL27.0m	98514	-5.5	-29.3	-3.2	31.4	-16.7	8.1	372.2 (222.2)
@ RCCV	98424	-6.7	-29.3	-16.0	-36.3	-30.0	-24.6	372.2
28 Pool Girder	123054	-8.8	-29.3	14.1	69.2	-43.6	-2.8	372.2
@ Storage Pool	123154	-3.5	-29.3	28.6	120.8	5.1	68.3	372.2
29 Pool Girder	123062	-1.9	-29.3	-13.3	-11.1	33.1	10.9	372.2
@ Cavity	123162	-2.7	-29.3	-19.4	-19.0	15.4	3.3	372.2
30 Pool Girder	123067	-5.8	-29.3	-13.6	-3.5	-34.9	-28.9	372.2
@ Fuel Pool	123167	-4.2	-29.3	-13.2	-7.5	-6.7	-18.4	372.2
31 MS Tunnel	150122	-13.6	-29.3	13.9	169.6	-22.8	220.5	372.2
Wall and Slab	96611	-8.6	-29.3	1.4	5.1	-21.2	193.7	372.2
	98614	-6.3	-29.3	2.8	2.6	-3.7	151.3	372.2

Note: Negative value means compression.

Note *1:	Wall Below RCCV	Direction 1: Hoop,	Direction 2: Vertical
	Exterior Wall	Direction 1: Horizontal,	Direction 2: Vertical
	Slab/MS Tunnel Slab	Direction 1: N-S,	Direction 2: E-W
	Pool Girder	Direction 1: Horizontal,	Direction 2: Vertical
	MS Tunnel Wall	Direction 1: Horizontal,	Direction 2: Vertical
	Basemat	Direction 1: Top; Radial, Bottom; N-S,	Direction 2: Top; Circumferential, Bottom; E-W

~~Note *2: Value in parenthesis indicates the allowable stress of the steel plate.~~

Table 3G.1-52

Rebar and Concrete Stresses of RB: Selected Load Combination RB-8a

Location	Element ID	Concrete Stress (Mpa)		Primary Reinforcement Stress (MPa)				
				Calculated				Allowable
		Calculated	Allowable	Direction 1*		Direction 2*		
				In/Top	Out/Bottom	In/Top	Out/Bottom	
18 Wall	6	-6.9	-29.3	7.8	20.4	-15.3	-38.2	372.2
Below RCCV	13	-6.9	-29.3	-1.6	-2.1	-16.1	-39.4	372.2
Bottom	24	-6.1	-29.3	2.5	2.4	-21.9	-37.3	372.2
19 Wall Below	806	-5.6	-29.3	13.8	6.5	-17.8	-33.0	372.2
Below RCCV	813	-6.3	-29.3	2.0	2.7	-21.7	-37.5	372.2
Mid-Height	824	-6.9	-29.3	1.2	1.2	-21.8	-40.5	372.2
20 Wall	1606	-15.9	-29.3	34.2	81.9	-63.2	41.7	372.2
Below RCCV	1613	-17.0	-29.3	31.7	78.5	-72.9	45.1	372.2
Top	1624	-16.6	-29.3	41.3	91.6	-80.9	45.6	372.2
21 Exterior Wall	20011	-5.3	-29.3	32.8	21.0	52.0	-16.6	372.2
@ EL-11.50	20023	-4.9	-28.9	10.3	-13.6	16.0	-19.6	368.9
~-10.50m	30010	-3.2	-29.3	7.5	-7.2	29.5	12.3	372.2
	30020	-2.5	-29.3	-6.0	3.7	-7.7	-14.5	372.2
	40001	-2.3	-29.3	-3.8	1.4	-8.6	-13.4	372.2
	40011	-3.2	-29.3	11.7	-5.0	21.2	-14.2	372.2
22 Exterior Wall	22011	-2.6	-29.3	78.5	65.3	25.0	20.3	372.2
@ EL4.65	22023	-5.0	-29.3	43.7	11.2	-9.6	-25.2	372.2
~6.60m	32010	-0.7	-29.3	99.7	128.5	53.6	88.2	372.2
	32020	-3.4	-29.3	9.5	40.6	-9.3	44.7	372.2
	42001	-2.8	-29.3	10.9	31.0	-12.3	35.0	372.2
	42011	-4.8	-29.3	34.4	92.9	-13.8	48.0	372.2
23 Exterior Wall	24211	-0.8	-29.3	62.4	42.0	44.7	10.5	372.2
@ EL22.50	24224	-1.9	-29.3	27.3	13.8	4.1	21.2	372.2
~24.60m	34210	-0.4	-29.3	84.1	140.0	26.6	88.9	372.2
	34220	-3.0	-29.3	33.9	-6.5	-12.1	29.0	372.2
	44201	-3.2	-29.3	51.8	7.5	-10.2	57.2	372.2
24 Basemat	90140	-1.8	-23.5	-11.7	-5.7	10.2	6.3	372.2
@ Wall	90182	-1.8	-23.5	-9.5	23.1	5.8	5.1	372.2
Below RCCV	90111	-2.4	-23.5	-13.7	3.7	31.8	10.8	372.2
25 Slab	93140	-8.7	-29.3	81.5	120.6	124.1	151.8	372.2
EL4.65m	93182	-11.9	-29.3	60.5	72.8	-57.6	28.9	372.2
@ RCCV	93111	-11.0	-29.3	-52.6	28.7	72.6	84.1	372.2
26 Slab	96144	-9.9	-29.3	199.3	217.4	267.3	210.2	372.2
EL17.5m	96186	-7.1	-29.3	114.3	132.1	-27.3	-23.0	372.2
@ RCCV	96113	-13.6	-28.8	-87.8	28.4	83.9	115.3	368.2
27 Slab	98472	-9.8	-29.1	140.2	117.5	149.6	114.6	370.3
EL27.0m	98514	-6.0	-29.1	38.4	86.8	-3.7	53.1	370.3
@ RCCV	98424	-5.2	-28.1	-18.5	-30.7	-13.6	-8.5	363.0
28 Pool Girder	123054	-6.8	-29.0	35.9	158.0	2.2	119.9	369.8
@ Storage Pool	123154	-3.0	-29.0	40.9	89.8	48.7	60.5	369.8
29 Pool Girder	123062	-2.8	-28.4	36.1	49.4	17.1	51.3	365.0
@ Cavity	123162	-2.1	-28.4	95.4	103.3	60.5	52.6	365.0
30 Pool Girder	123067	-5.2	-28.4	2.4	28.5	-16.7	20.0	365.0
@ Fuel Pool	123167	-5.6	-28.4	32.0	42.2	46.6	28.7	365.0
31 MS Tunnel	150122	-11.4	-29.3	14.7	142.1	-21.5	174.5	372.2
Wall and Slab	96611	-6.7	-29.3	-1.9	6.3	-9.3	189.5	372.2
	98614	-6.4	-29.3	2.2	11.6	-7.0	137.5	372.2

Location	Element ID	Concrete Stress (MPa)		Primary Reinforcement Stress (MPa)				
		Calculated	Allowable	Calculated				Allowable
				Direction 1*		Direction 2*		
				In/Top	Out/Bottom	In/Top	Out/Bottom	
18 Wall	6	-6.9	-29.3	7.8	20.4	-15.3	-38.2	372.2
Below RCCV	13	-6.9	-29.3	-1.6	-2.1	-16.1	-39.4	372.2
Bottom	24	-6.1	-29.3	2.5	2.4	-21.9	-37.3	372.2
19 Wall Below	806	-5.6	-29.3	13.8	6.5	-17.8	-33.0	372.2
Below RCCV	813	-6.3	-29.3	2.0	2.7	-21.7	-37.5	372.2
Mid-Height	824	-6.9	-29.3	1.2	1.2	-21.8	-40.5	372.2
20 Wall	1606	-15.9	-29.3	34.2	81.9	-63.2	41.7	372.2
Below RCCV	1613	-17.0	-29.3	31.7	78.5	-72.9	45.1	372.2
Top	1624	-16.6	-29.3	41.3	91.6	-80.9	45.6	372.2
21 Exterior Wall	20011	-5.3	-29.3	32.8	21.0	52.0	-16.6	372.2
@ EL-11.50	20023	-4.9	-28.9	10.3	-13.6	16.0	-19.6	368.9
~-10.50m	30010	-3.2	-29.3	7.5	-7.2	29.5	12.3	372.2
	30020	-2.5	-29.3	-6.0	3.7	-7.7	-14.5	372.2
	40001	-2.3	-29.3	-3.8	1.4	-8.6	-13.4	372.2
	40011	-3.2	-29.3	11.7	-5.0	21.2	-14.2	372.2
22 Exterior Wall	22011	-2.6	-29.3	78.5	65.3	25.0	20.3	372.2
@ EL4.65	22023	-5.0	-29.3	43.7	11.2	-9.6	-25.2	372.2
~6.60m	32010	-0.7	-29.3	99.7	128.5	53.6	88.2	372.2
	32020	-3.4	-29.3	9.5	40.6	-9.3	44.7	372.2
	42001	-2.8	-29.3	10.9	31.0	-12.3	35.0	372.2
	42011	-4.8	-29.3	34.4	92.9	-13.8	48.0	372.2
~~23 Exterior Wall~~	~~24211~~	~~-0.8~~	~~-29.3~~	~~62.4~~	~~42.0~~	~~44.7~~	~~10.5~~	~~372.2~~
@ EL22.50	24224	-1.9	-29.3	27.3	13.8	4.1	21.2	372.2
~24.60m	34210	-0.4	-29.3	84.1	140.0	26.6	88.9	372.2
	34220	-3.0	-29.3	33.9	-6.5	-12.1	29.0	372.2
	44201	-3.2	-29.3	51.8	7.5	-10.2	57.2	372.2
24 Basemat	90140	-1.8	-23.5	-11.7	-5.7	10.2	6.3	372.2
@ Wall	90182	-1.8	-23.5	-9.5	23.1	5.8	5.1	372.2
Below RCCV	90111	-2.4	-23.5	-13.7	3.7	31.8	10.8	372.2
25 Slab	93140	-8.6	-29.3	108.1	60.9	156.5	74.1	372.2 (223.3)
EL4.65m	93182	-13.1	-29.3	68.8	53.5	-65.7	49.4	372.2 (223.3)
@ RCCV	93111	-12.5	-29.3	-61.9	51.0	83.3	61.0	372.2 (223.3)
26 Slab	96144	-9.8	-29.3	253.2	102.7	318.3	99.3	372.2 (223.3)
EL17.5m	96186	-6.7	-29.3	157.9	74.8	-23.3	-22.8	372.2 (223.3)
@ RCCV	96113	-13.6	-28.8	-87.8	28.4	83.9	115.3	368.2
27 Slab	98472	-9.8	-29.1	161.9	32.5	170.8	31.1	370.3 (222.2)
EL27.0m	98514	-3.8	-29.1	35.7	32.4	-6.1	24.0	370.3 (222.2)
@ RCCV	98424	-5.2	-28.1	-18.5	-30.7	-13.6	-8.5	363.0
28 Pool Girder	123054	-6.8	-29.0	35.9	158.0	2.2	119.9	369.8
@ Storage Pool	123154	-3.0	-29.0	40.9	89.8	48.7	60.5	369.8
29 Pool Girder	123062	-2.8	-28.4	36.1	49.4	17.1	51.3	365.0
@ Cavity	123162	-2.1	-28.4	95.4	103.3	60.5	52.6	365.0
30 Pool Girder	123067	-5.2	-28.4	2.4	28.5	-16.7	20.0	365.0
@ Fuel Pool	123167	-5.6	-28.4	32.0	42.2	46.6	28.7	365.0
31 MS Tunnel	150122	-11.4	-29.3	14.7	142.1	-21.5	174.5	372.2
Wall and Slab	96611	-6.7	-29.3	-1.9	6.3	-9.3	189.5	372.2
	98614	-6.4	-29.3	2.2	11.6	-7.0	137.5	372.2

Note: Negative value means compression.

Note *1: Wall Below RCCV — Direction 1: Hoop, Direction 2: Vertical
Exterior Wall — Direction 1: Horizontal, Direction 2: Vertical
Slab/MS Tunnel Slab — Direction 1: N-S, Direction 2: E-W
Pool Girder — Direction 1: Horizontal, Direction 2: Vertical
MS Tunnel Wall — Direction 1: Horizontal, Direction 2: Vertical
Basemat — Direction 1: Top; Radial, Bottom; N-S, Direction 2: Top; Circumferential, Bottom; E-W

~~Note *2: Value in parenthesis indicates the allowable stress of the steel plate.~~

Table 3G.1-53

Rebar and Concrete Stresses of RB: Selected Load Combination RB-8b

Location	Element ID	Concrete Stress (Mpa)		Primary Reinforcement Stress (MPa)				
				Calculated				Allowable
		Calculated	Allowable	Direction 1*		Direction 2*		
				In/Top	Out/Bottom	In/Top	Out/Bottom	
18 Wall	6	-7.7	-29.3	0.4	2.7	-9.6	-40.7	372.2
Below RCCV	13	-8.2	-29.3	-2.1	-3.1	-11.4	-44.7	372.2
Bottom	24	-7.3	-29.3	1.3	-2.3	-15.4	-41.5	372.2
19 Wall Below	806	-6.0	-29.3	12.4	6.6	-14.3	-34.5	372.2
Below RCCV	813	-6.8	-29.3	2.5	4.6	-19.8	-39.8	372.2
Mid-Height	824	-7.3	-29.3	1.6	2.7	-18.5	-41.5	372.2
20 Wall	1606	-14.2	-29.3	52.6	97.4	-68.0	48.3	372.2
Below RCCV	1613	-16.7	-29.3	46.5	94.5	-81.0	52.0	372.2
Top	1624	-17.9	-29.3	62.3	108.0	-82.1	55.4	372.2
21 Exterior Wall	20011	-4.7	-29.3	37.4	7.9	55.3	-13.0	372.2
@ EL-11.50	20023	-4.7	-28.9	8.5	-13.4	14.4	-18.8	368.9
~-10.50m	30010	-3.0	-29.3	9.6	-5.5	30.2	-8.7	372.2
	30020	-2.6	-29.3	-6.2	5.0	-7.5	-14.9	372.2
	40001	-2.4	-29.3	-4.1	3.1	-8.5	-13.9	372.2
	40011	-2.3	-29.3	7.2	-3.7	12.3	-10.4	372.2
22 Exterior Wall	22011	-1.9	-29.3	105.6	88.2	59.7	59.7	372.2
@ EL4.65	22023	-4.6	-29.3	45.1	9.5	-6.4	-22.2	372.2
~6.60m	32010	-0.5	-29.3	98.6	162.4	13.6	114.7	372.2
	32020	-4.1	-29.3	18.6	18.1	-14.7	42.6	372.2
	42001	-1.8	-29.3	32.6	13.0	-4.0	22.5	372.2
	42011	-4.4	-29.3	36.4	99.8	-11.2	46.8	372.2
23 Exterior Wall	24211	-0.6	-29.3	83.4	53.2	62.5	17.9	372.2
@ EL22.50	24224	-3.0	-29.3	54.8	-5.3	22.1	14.9	372.2
~24.60m	34210	-0.3	-29.3	147.3	238.5	46.4	176.2	372.2
	34220	-2.4	-29.3	76.3	-20.0	-18.3	39.6	372.2
	44201	-2.8	-29.3	82.0	-8.1	19.4	40.0	372.2
24 Basemat	90140	-1.8	-23.5	-11.9	-4.4	1.0	7.5	372.2
@ Wall	90182	-1.9	-23.5	-9.0	6.8	18.5	6.0	372.2
Below RCCV	90111	-2.4	-23.5	-13.8	4.6	18.1	9.8	372.2
25 Slab	93140	-11.1	-29.3	114.9	175.0	150.2	198.1	372.2
EL4.65m	93182	-15.5	-29.3	75.9	85.8	-73.2	42.6	372.2
@ RCCV	93111	-14.1	-29.3	-65.6	43.0	86.9	95.8	372.2
26 Slab	96144	-9.8	-29.3	206.8	216.8	271.2	267.5	372.2
EL17.5m	96186	-8.9	-29.3	143.4	165.8	-34.0	16.1	372.2
@ RCCV	96113	-13.9	-28.8	-88.4	19.7	103.3	128.7	368.2
27 Slab	98472	-13.2	-27.6	46.0	186.6	57.0	180.9	359.4
EL27.0m	98514	-18.3	-27.6	9.3	119.3	18.1	152.7	359.4
@ RCCV	98424	-6.4	-28.1	6.8	-43.6	66.2	33.3	363.0
28 Pool Girder	123054	-7.4	-29.0	33.1	198.9	42.2	213.2	369.8
@ Storage Pool	123154	-4.9	-29.0	49.0	102.9	71.2	67.1	369.8
29 Pool Girder	123062	-13.2	-27.4	35.8	208.1	-2.9	189.5	358.3
@ Cavity	123162	-9.3	-27.4	64.3	262.0	13.5	188.3	358.3
30 Pool Girder	123067	-11.8	-27.4	24.2	160.6	-17.5	146.0	358.3
@ Fuel Pool	123167	-7.2	-27.4	33.7	177.1	21.9	149.9	358.3
31 MS Tunnel	150122	-11.7	-29.3	16.5	133.9	-25.7	166.0	372.2
Wall and Slab	96611	-6.4	-29.3	-2.2	3.2	-6.8	192.5	372.2
	98614	-6.7	-29.3	2.4	5.9	-10.5	125.5	372.2

Location	Element ID	Concrete Stress (MPa)		Primary Reinforcement Stress (MPa)				
		Calculated	Allowable	Calculated				Allowable
				Direction 1*		Direction 2*		
				In/Top	Out/Bottom	In/Top	Out/Bottom	
18 Wall	6	-7.7	-29.3	0.4	2.7	-9.6	-40.7	372.2
Below RCCV	13	-8.2	-29.3	-2.1	-3.1	-11.4	-44.7	372.2
Bottom	24	-7.3	-29.3	1.3	-2.3	-15.4	-41.5	372.2
19 Wall Below	806	-6.0	-29.3	12.4	6.6	-14.3	-34.5	372.2
Below RCCV	813	-6.8	-29.3	2.5	4.6	-19.8	-39.8	372.2
Mid-Height	824	-7.3	-29.3	1.6	2.7	-18.5	-41.5	372.2
20 Wall	1606	-14.2	-29.3	52.6	97.4	-68.0	48.3	372.2
Below RCCV	1613	-16.7	-29.3	46.5	94.5	-81.0	52.0	372.2
Top	1624	-17.9	-29.3	62.3	108.0	-82.1	55.4	372.2
21 Exterior Wall	20011	-4.7	-29.3	37.4	7.9	55.3	-13.0	372.2
@ EL-11.50	20023	-4.7	-28.9	8.5	-13.4	14.4	-18.8	368.9
~-10.50m	30010	-3.0	-29.3	9.6	-5.5	30.2	-8.7	372.2
	30020	-2.6	-29.3	-6.2	5.0	-7.5	-14.9	372.2
	40001	-2.4	-29.3	-4.1	3.1	-8.5	-13.9	372.2
	40011	-2.3	-29.3	7.2	-3.7	12.3	-10.4	372.2
22 Exterior Wall	22011	-1.9	-29.3	105.6	88.2	59.7	59.7	372.2
@ EL4.65	22023	-4.6	-29.3	45.1	9.5	-6.4	-22.2	372.2
~6.60m	32010	-0.5	-29.3	98.6	162.4	13.6	114.7	372.2
	32020	-4.1	-29.3	18.6	18.1	-14.7	42.6	372.2
	42001	-1.8	-29.3	32.6	13.0	-4.0	22.5	372.2
	42011	-4.4	-29.3	36.4	99.8	-11.2	46.8	372.2
~~23 Exterior Wall~~	~~24211~~	~~-0.6~~	~~-29.3~~	~~83.4~~	~~53.2~~	~~62.5~~	~~17.9~~	~~372.2~~
@ EL22.50	24224	-3.0	-29.3	54.8	-5.3	22.1	14.9	372.2
~24.60m	34210	-0.3	-29.3	147.3	238.5	46.4	176.2	372.2
	34220	-2.4	-29.3	76.3	-20.0	-18.3	39.6	372.2
	44201	-2.8	-29.3	82.0	-8.1	19.4	40.0	372.2
24 Basemat	90140	-1.8	-23.5	-11.9	-4.4	1.0	7.5	372.2
@ Wall	90182	-1.9	-23.5	-9.0	6.8	18.5	6.0	372.2
Below RCCV	90111	-2.4	-23.5	-13.8	4.6	18.1	9.8	372.2
25 Slab	93140	-11.1	-29.3	151.5	89.6	194.8	94.9	372.2 (223.3)
EL4.65m	93182	-17.5	-29.3	83.5	67.9	-86.4	72.7	372.2 (223.3)
@ RCCV	93111	-16.4	-29.3	-79.7	73.9	96.9	74.1	372.2 (223.3)
26 Slab	96144	-10.1	-29.3	265.8	106.9	346.1	129.5	372.2 (223.3)
EL17.5m	96186	-8.5	-29.3	199.2	96.1	-30.6	13.4	372.2 (223.3)
@ RCCV	96113	-13.9	-28.8	-88.4	19.7	103.3	128.7	368.2
27 Slab	98472	-11.2	-27.6	-2.6	96.5	14.7	82.5	359.4 (215.6)
EL27.0m	98514	-13.8	-27.6	-20.6	76.0	-19.7	83.9	359.4 (215.6)
@ RCCV	98424	-6.4	-28.1	6.8	-43.6	66.2	33.3	363.0
28 Pool Girder	123054	-7.4	-29.0	33.1	198.9	42.2	213.2	369.8
@ Storage Pool	123154	-4.9	-29.0	49.0	102.9	71.2	67.1	369.8
29 Pool Girder	123062	-13.2	-27.4	35.8	208.1	-2.9	189.5	358.3
@ Cavity	123162	-9.3	-27.4	64.3	262.0	13.5	188.3	358.3
30 Pool Girder	123067	-11.8	-27.4	24.2	160.6	-17.5	146.0	358.3
@ Fuel Pool	123167	-7.2	-27.4	33.7	177.1	21.9	149.9	358.3
31 MS Tunnel	150122	-11.7	-29.3	16.5	133.9	-25.7	166.0	372.2
Wall and Slab	96611	-6.4	-29.3	-2.2	3.2	-6.8	192.5	372.2
	98614	-6.7	-29.3	2.4	5.9	-10.5	125.5	372.2

Note: Negative value means compression.

Note *1:		
Wall Below RCCV	Direction 1: Hoop,	Direction 2: Vertical
Exterior Wall	Direction 1: Horizontal,	Direction 2: Vertical
Slab/MS Tunnel Slab	Direction 1: N-S,	Direction 2: E-W
Pool Girder	Direction 1: Horizontal,	Direction 2: Vertical
MS Tunnel Wall	Direction 1: Horizontal,	Direction 2: Vertical
Basemat	Direction 1: Top; Radial; Bottom; N-S,	Direction 2: Top; Circumferential; Bottom;E-W

~~Note *2: Value in parenthesis indicates the allowable stress of the steel plate.~~

Table 3G.1-54

Rebar and Concrete Stresses of RB: Selected Load Combination RB-9a

Location	Element ID	Concrete Stress (Mpa)		Primary Reinforcement Stress (MPa)				
		Calculated	Allowable	Calculated				Allowable
				Direction 1*		Direction 2*		
				In/Top	Out/Bottom	In/Top	Out/Bottom	
18 Wall	6	-19.3	-29.3	217.6	230.5	11.2	331.3	372.2
Below RCCV	13	-15.8	-29.3	142.1	158.4	-22.7	235.2	372.2
Bottom	24	-12.8	-29.3	193.3	164.1	216.3	42.3	372.2
19 Wall Below	806	-10.4	-29.3	193.7	95.0	208.1	145.8	372.2
Below RCCV	813	-11.4	-29.3	213.7	132.7	171.2	129.2	372.2
Mid-Height	824	-12.7	-29.3	272.4	163.0	202.5	132.7	372.2
20 Wall	1606	-13.2	-29.3	204.2	177.3	120.2	159.5	372.2
Below RCCV	1613	-23.9	-29.3	139.0	129.0	-104.9	138.3	372.2
Top	1624	-15.3	-29.3	188.2	173.0	-112.3	191.2	372.2
21 Exterior Wall	20011	-20.2	-29.3	252.9	309.2	305.3	355.6	372.2
@ EL-11.50	20023	-8.8	-28.9	26.3	-23.3	72.0	-39.7	368.9
~-10.50m	30010	-10.6	-29.3	185.6	209.3	77.1	331.0	372.2
	30020	-5.8	-29.3	27.9	35.6	10.8	99.0	372.2
	40001	-6.1	-29.3	56.2	15.6	-8.5	148.5	372.2
	40011	-9.4	-29.3	243.2	264.8	160.8	357.7	372.2
22 Exterior Wall	22011	-13.2	-29.3	250.8	199.6	327.7	210.7	372.2
@ EL4.65	22023	-10.1	-29.3	126.1	93.6	132.8	95.1	372.2
~6.60m	32010	-6.2	-29.3	285.5	258.4	306.2	283.4	372.2
	32020	-7.2	-29.3	143.4	123.8	193.3	274.8	372.2
	42001	-7.5	-29.3	148.3	100.0	213.2	230.4	372.2
	42011	-8.6	-29.3	207.7	178.9	269.2	206.0	372.2
23 Exterior Wall	24211	-8.3	-29.3	228.3	206.3	272.1	215.0	372.2
@ EL22.50	24224	-10.7	-29.3	150.0	149.1	297.3	185.6	372.2
~24.60m	34210	-5.2	-29.3	234.8	224.0	174.4	196.8	372.2
	34220	-4.5	-29.3	120.7	90.4	146.8	174.5	372.2
	44201	-5.1	-29.3	156.3	112.0	148.8	192.3	372.2
24 Basemat	90140	-6.9	-23.5	327.4	57.6	88.0	42.9	372.2
@ Wall	90182	-3.6	-23.5	72.2	131.5	135.6	15.4	372.2
Below RCCV	90111	-3.4	-23.5	58.7	-11.7	129.4	133.6	372.2
25 Slab	93140	-11.9	-29.3	172.5	162.7	94.7	164.6	372.2
EL4.65m	93182	-16.2	-29.3	52.0	104.4	-82.5	114.5	372.2
@ RCCV	93111	-13.4	-29.3	-60.7	55.6	62.2	79.8	372.2
26 Slab	96144	-11.7	-29.3	212.7	203.6	211.5	237.0	372.2
EL17.5m	96186	-9.8	-29.3	111.5	168.1	-46.2	-38.0	372.2
@ RCCV	96113	-14.1	-28.8	-94.5	49.0	101.8	133.6	368.2
27 Slab	98472	-13.3	-29.1	144.3	144.3	136.6	150.0	370.3
EL27.0m	98514	-9.5	-29.1	50.2	114.2	12.8	84.5	370.3
@ RCCV	98424	-10.4	-28.1	23.7	-50.6	-17.9	-10.8	363.0
28 Pool Girder	123054	-8.9	-29.0	30.4	149.3	-28.1	108.7	369.8
@ Storage Pool	123154	-3.0	-29.0	83.7	184.9	70.1	103.8	369.8
29 Pool Girder	123062	-2.9	-28.4	40.2	37.6	40.9	47.0	365.0
@ Cavity	123162	-2.1	-28.4	88.2	63.8	45.2	50.6	365.0
30 Pool Girder	123067	-7.5	-28.4	-4.3	29.2	-38.4	-19.7	365.0
@ Fuel Pool	123167	-6.6	-28.4	7.9	40.2	32.9	14.8	365.0
31 MS Tunnel	150122	-12.4	-29.3	16.7	159.7	-22.0	194.2	372.2
Wall and Slab	96611	-8.2	-29.3	-2.1	18.2	-11.1	216.4	372.2
	98614	-7.6	-29.3	4.7	30.7	-6.2	165.1	372.2

Location	Element ID	Concrete Stress (MPa)		Primary Reinforcement Stress (MPa)				
		Calculated	Allowable	Calculated				Allowable
				Direction 1*		Direction 2*		
				In/Top	Out/Bottom	In/Top	Out/Bottom	
18 Wall	6	-19.3	-29.3	217.6	230.5	11.2	331.3	372.2
Below RCCV	13	-15.8	-29.3	142.1	158.4	-22.7	235.2	372.2
Bottom	24	-12.8	-29.3	193.3	164.1	216.3	42.3	372.2
19 Wall Below	806	-10.4	-29.3	193.7	95.0	208.1	145.8	372.2
Below RCCV	813	-11.4	-29.3	213.7	132.7	171.2	129.2	372.2
Mid-Height	824	-12.7	-29.3	272.4	163.0	202.5	132.7	372.2
20 Wall	1606	-13.2	-29.3	204.2	177.3	120.2	159.5	372.2
Below RCCV	1613	-23.9	-29.3	139.0	129.0	-104.9	138.3	372.2
Top	1624	-15.3	-29.3	188.2	173.0	-112.3	191.2	372.2
21 Exterior Wall	20011	-20.2	-29.3	252.9	309.2	305.3	355.6	372.2
@ EL-11.50	20023	-8.8	-28.9	26.3	-23.3	72.0	-39.7	368.9
~-10.50m	30010	-10.6	-29.3	185.6	209.3	77.1	331.0	372.2
	30020	-5.8	-29.3	27.9	35.6	10.8	99.0	372.2
	40001	-6.1	-29.3	56.2	15.6	-8.5	148.5	372.2
	40011	-9.4	-29.3	243.2	264.8	160.8	357.7	372.2
22 Exterior Wall	22011	-13.2	-29.3	250.8	199.6	327.7	210.7	372.2
@ EL4.65	22023	-10.1	-29.3	126.1	93.6	132.8	95.1	372.2
~6.60m	32010	-6.2	-29.3	285.5	258.4	306.2	283.4	372.2
	32020	-7.2	-29.3	143.4	123.8	193.3	274.8	372.2
	42001	-7.5	-29.3	148.3	100.0	213.2	230.4	372.2
	42011	-8.6	-29.3	207.7	178.9	269.2	206.0	372.2
~~23 Exterior Wall~~	~~24211~~	~~-8.3~~	~~-29.3~~	~~228.3~~	~~206.3~~	~~272.1~~	~~215.0~~	~~372.2~~
@ EL22.50	24224	-10.7	-29.3	150.0	149.1	297.3	185.6	372.2
~24.60m	34210	-5.2	-29.3	234.8	224.0	174.4	196.8	372.2
	34220	-4.5	-29.3	120.7	90.4	146.8	174.5	372.2
	44201	-5.1	-29.3	156.3	112.0	148.8	192.3	372.2
24 Basemat	90140	-6.9	-23.5	327.4	57.6	88.0	42.9	372.2
@ Wall	90182	-3.6	-23.5	72.2	131.5	135.6	15.4	372.2
Below RCCV	90111	-3.4	-23.5	58.7	-11.7	129.4	133.6	372.2
25 Slab	93140	-11.8	-29.3	189.3	69.1	134.7	80.9	372.2 (223.3)
EL4.65m	93182	-15.6	-29.3	68.0	67.8	-83.6	97.9	372.2 (223.3)
@ RCCV	93111	-14.0	-29.3	-68.3	67.1	71.6	58.9	372.2 (223.3)
26 Slab	96144	-11.6	-29.3	254.6	98.6	271.7	109.7	372.2 (223.3)
EL17.5m	96186	-9.0	-29.3	164.5	90.8	-37.2	-41.8	372.2 (223.3)
@ RCCV	96113	-14.1	-28.8	-94.5	49.0	101.8	133.6	368.2
27 Slab	98472	-13.3	-29.1	174.8	39.5	168.1	41.2	370.3 (222.2)
EL27.0m	98514	-4.4	-29.1	38.8	40.9	-15.1	44.5	370.3 (222.2)
@ RCCV	98424	-10.4	-28.1	23.7	-50.6	-17.9	-10.8	363.0
28 Pool Girder	123054	-8.9	-29.0	30.4	149.3	-28.1	108.7	369.8
@ Storage Pool	123154	-3.0	-29.0	83.7	184.9	70.1	103.8	369.8
29 Pool Girder	123062	-2.9	-28.4	40.2	37.6	40.9	47.0	365.0
@ Cavity	123162	-2.1	-28.4	88.2	63.8	45.2	50.6	365.0
30 Pool Girder	123067	-7.5	-28.4	-4.3	29.2	-38.4	-19.7	365.0
@ Fuel Pool	123167	-6.6	-28.4	7.9	40.2	32.9	14.8	365.0
31 MS Tunnel	150122	-12.4	-29.3	16.7	159.7	-22.0	194.2	372.2
Wall and Slab	96611	-8.2	-29.3	-2.1	18.2	-11.1	216.4	372.2
	98614	-7.6	-29.3	4.7	30.7	-6.2	165.1	372.2

Note: Negative value means compression.

Note *1: Wall Below RCCV — Direction 1: Hoop, Direction 2: Vertical
Exterior Wall — Direction 1: Horizontal, Direction 2: Vertical
Slab/MS Tunnel Slab — Direction 1: N-S, Direction 2: E-W
Pool Girder — Direction 1: Horizontal, Direction 2: Vertical
MS Tunnel Wall — Direction 1: Horizontal, Direction 2: Vertical
Basemat — Direction 1: Top; Radial; Bottom; N-S, Direction 2: Top; Circumferential; Bottom; E-W

~~Note *2: Value in parenthesis indicates the allowable stress of the steel plate.~~

Table 3G.1-55

Rebar and Concrete Stresses of RB: Selected Load Combination RB-9b

Location	Element ID	Concrete Stress (Mpa)		Primary Reinforcement Stress (MPa)				
				Calculated				Allowable
		Calculated	Allowable	Direction 1*		Direction 2*		
				In/Top	Out/Bottom	In/Top	Out/Bottom	
18 Wall	6	-21.1	-29.3	203.9	213.6	28.6	295.0	372.2
Below RCCV	13	-17.8	-29.3	137.0	139.3	-16.5	189.3	372.2
Bottom	24	-15.2	-29.3	182.9	159.3	51.2	184.3	372.2
19 Wall Below	806	-10.9	-29.3	194.4	93.1	205.7	114.1	372.2
Below RCCV	813	-12.2	-29.3	213.0	134.5	172.2	98.8	372.2
Mid-Height	824	-13.6	-29.3	269.2	161.1	210.4	110.0	372.2
20 Wall	1606	-14.2	-29.3	201.0	193.5	-98.0	187.6	372.2
Below RCCV	1613	-17.1	-29.3	138.7	146.2	-126.0	170.0	372.2
Top	1624	-16.3	-29.3	185.8	189.9	-118.2	218.0	372.2
21 Exterior Wall	20011	-20.3	-29.3	333.7	240.6	335.8	339.9	372.2
@ EL-11.50	20023	-8.7	-28.9	24.9	-18.6	75.8	-39.6	368.9
~-10.50m	30010	-10.6	-29.3	190.9	216.5	84.4	334.6	372.2
	30020	-6.1	-29.3	22.5	30.0	-9.6	83.2	372.2
	40001	-6.4	-29.3	52.0	20.1	-8.8	131.0	372.2
	40011	-9.3	-29.3	246.6	256.7	185.0	366.1	372.2
22 Exterior Wall	22011	-11.5	-29.3	352.0	272.6	313.2	356.7	372.2
@ EL4.65	22023	-10.0	-29.3	135.4	93.8	143.5	105.1	372.2
~6.60m	32010	-6.3	-29.3	302.1	268.8	310.7	277.2	372.2
	32020	-6.4	-29.3	109.7	161.6	195.9	274.2	372.2
	42001	-7.8	-29.3	127.9	128.4	194.9	225.9	372.2
	42011	-8.5	-29.3	212.6	187.7	276.7	212.7	372.2
23 Exterior Wall	24211	-8.1	-29.3	293.3	195.1	304.3	228.9	372.2
@ EL22.50	24224	-8.3	-29.3	252.4	50.2	255.1	292.4	372.2
~24.60m	34210	-5.2	-29.3	298.3	333.3	193.2	300.3	372.2
	34220	-6.7	-29.3	161.3	67.2	161.1	122.2	372.2
	44201	-5.0	-29.3	209.1	79.4	198.3	196.7	372.2
24 Basemat	90140	-7.2	-23.5	303.4	57.4	87.0	41.3	372.2
@ Wall	90182	-4.1	-23.5	47.2	91.2	198.5	17.9	372.2
Below RCCV	90111	-4.0	-23.5	66.7	11.8	181.0	89.8	372.2
25 Slab	93140	-14.3	-29.3	188.3	201.0	156.2	212.5	372.2
EL4.65m	93182	-20.2	-29.3	68.4	120.7	-97.3	130.3	372.2
@ RCCV	93111	-16.6	-29.3	-74.0	71.0	76.8	93.6	372.2
26 Slab	96144	-11.7	-29.3	195.6	254.3	257.4	274.0	372.2
EL17.5m	96186	-11.8	-29.3	137.9	206.5	-58.6	52.9	372.2
@ RCCV	96113	-15.0	-28.8	-97.7	39.0	122.4	150.2	368.2
27 Slab	98472	-17.7	-27.6	96.9	210.3	129.0	207.7	359.4
EL27.0m	98514	-21.8	-27.6	10.6	122.0	18.8	187.0	359.4
@ RCCV	98424	-10.4	-28.1	163.7	-38.5	241.7	120.9	363.0
28 Pool Girder	123054	-6.8	-29.0	32.7	222.9	81.8	249.0	369.8
@ Storage Pool	123154	-3.1	-29.0	72.1	212.7	78.2	117.9	369.8
29 Pool Girder	123062	-12.4	-27.4	37.0	221.5	7.7	194.7	358.3
@ Cavity	123162	-9.6	-27.4	58.6	263.4	12.2	161.4	358.3
30 Pool Girder	123067	-14.4	-27.4	9.2	121.5	-48.9	73.7	358.3
@ Fuel Pool	123167	-8.1	-27.4	23.7	154.2	9.7	133.3	358.3
31 MS Tunnel	150122	-12.7	-29.3	18.3	151.6	-26.1	185.7	372.2
Wall and Slab	96611	-8.0	-29.3	-2.3	16.2	-8.9	220.3	372.2
	98614	-7.6	-29.3	5.1	18.4	-12.2	136.9	372.2

Location	Element ID	Concrete Stress (MPa)		Primary Reinforcement Stress (MPa)				
		Calculated	Allowable	Calculated				Allowable
				Direction 1*		Direction 2*		
				In/Top	Out/Bottom	In/Top	Out/Bottom	
18 Wall	6	-21.1	-29.3	203.9	213.6	28.6	295.0	372.2
Below RCCV	13	-17.8	-29.3	137.0	139.3	-16.5	189.3	372.2
Bottom	24	-15.2	-29.3	182.9	159.3	51.2	184.3	372.2
19 Wall Below	806	-10.9	-29.3	194.4	93.1	205.7	114.1	372.2
Below RCCV	813	-12.2	-29.3	213.0	134.5	172.2	98.8	372.2
Mid-Height	824	-13.6	-29.3	269.2	161.1	210.4	110.0	372.2
20 Wall	1606	-14.2	-29.3	201.0	193.5	-98.0	187.6	372.2
Below RCCV	1613	-17.1	-29.3	138.7	146.2	-126.0	170.0	372.2
Top	1624	-16.3	-29.3	185.8	189.9	-118.2	218.0	372.2
21 Exterior Wall	20011	-20.3	-29.3	333.7	240.6	335.8	339.9	372.2
@ EL-11.50	20023	-8.7	-28.9	24.9	-18.6	75.8	-39.6	368.9
~-10.50m	30010	-10.6	-29.3	190.9	216.5	84.4	334.6	372.2
	30020	-6.1	-29.3	22.5	30.0	-9.6	83.2	372.2
	40001	-6.4	-29.3	52.0	20.1	-8.8	131.0	372.2
	40011	-9.3	-29.3	246.6	256.7	185.0	366.1	372.2
22 Exterior Wall	22011	-11.5	-29.3	352.0	272.6	313.2	356.7	372.2
@ EL4.65	22023	-10.0	-29.3	135.4	93.8	143.5	105.1	372.2
~6.60m	32010	-6.3	-29.3	302.1	268.8	310.7	277.2	372.2
	32020	-6.4	-29.3	109.7	161.6	195.9	274.2	372.2
	42001	-7.8	-29.3	127.9	128.4	194.9	225.9	372.2
	42011	-8.5	-29.3	212.6	187.7	276.7	212.7	372.2
~~23 Exterior Wall~~	~~24211~~	~~-8.1~~	~~-29.3~~	~~293.3~~	~~195.1~~	~~304.3~~	~~228.9~~	~~372.2~~
@ EL22.50	24224	-8.3	-29.3	252.4	50.2	255.1	292.4	372.2
~24.60m	34210	-5.2	-29.3	298.3	333.3	193.2	300.3	372.2
	34220	-6.7	-29.3	161.3	67.2	161.1	122.2	372.2
	44201	-5.0	-29.3	209.1	79.4	198.3	196.7	372.2
24 Basemat	90140	-7.2	-23.5	303.4	57.4	87.0	41.3	372.2
@ Wall	90182	-4.1	-23.5	47.2	91.2	198.5	17.9	372.2
Below RCCV	90111	-4.0	-23.5	66.7	11.8	181.0	89.8	372.2
25 Slab	93140	-14.2	-29.3	233.7	100.4	185.0	101.9	372.2 (223.3)
EL4.65m	93182	-20.2	-29.3	84.2	83.7	-104.2	122.2	372.2 (223.3)
@ RCCV	93111	-18.0	-29.3	-86.3	90.6	86.2	73.0	372.2 (223.3)
26 Slab	96144	-12.0	-29.3	261.0	124.4	337.1	133.3	372.2 (223.3)
EL17.5m	96186	-11.0	-29.3	204.8	113.8	-46.6	42.3	372.2 (223.3)
@ RCCV	96113	-15.0	-28.8	-97.7	39.0	122.4	150.2	368.2
27 Slab	98472	-13.2	-27.6	57.3	105.0	91.1	94.2	359.4 (215.6)
EL27.0m	98514	-15.8	-27.6	-21.8	77.9	-23.6	97.7	359.4 (215.6)
@ RCCV	98424	-10.4	-28.1	163.7	-38.5	241.7	120.9	363.0
28 Pool Girder	123054	-6.8	-29.0	32.7	222.9	81.8	249.0	369.8
@ Storage Pool	123154	-3.1	-29.0	72.1	212.7	78.2	117.9	369.8
29 Pool Girder	123062	-12.4	-27.4	37.0	221.5	7.7	194.7	358.3
@ Cavity	123162	-9.6	-27.4	58.6	263.4	12.2	161.4	358.3
30 Pool Girder	123067	-14.4	-27.4	9.2	121.5	-48.9	73.7	358.3
@ Fuel Pool	123167	-8.1	-27.4	23.7	154.2	9.7	133.3	358.3
31 MS Tunnel	150122	-12.7	-29.3	18.3	151.6	-26.1	185.7	372.2
Wall and Slab	96611	-8.0	-29.3	-2.3	16.2	-8.9	220.3	372.2
	98614	-7.6	-29.3	5.1	18.4	-12.2	136.9	372.2

Note: Negative value means compression.

Note *1:

Wall Below RCCV	Direction 1: Hoop,	Direction 2: Vertical
Exterior Wall	Direction 1: Horizontal,	Direction 2: Vertical
Slab/MS Tunnel Slab	Direction 1: N-S,	Direction 2: E-W
Pool Girder	Direction 1: Horizontal,	Direction 2: Vertical
MS Tunnel Wall	Direction 1: Horizontal,	Direction 2: Vertical
Basemat	Direction 1: Top; Radial; Bottom; N-S,	Direction 2: Top; Circumferential; Bottom; E-W

~~Note *2: Value in parenthesis indicates the allowable stress of the steel plate.~~

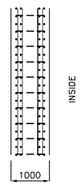
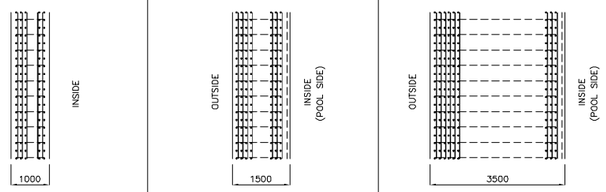
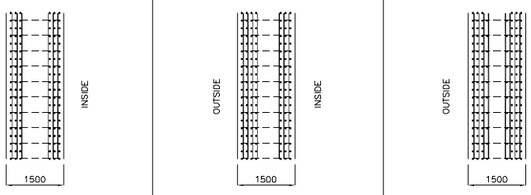
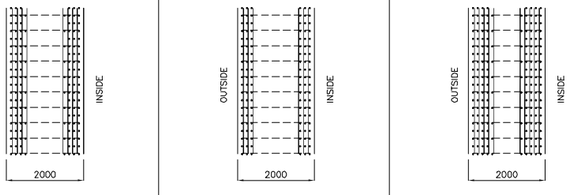
Table 3G.1-56

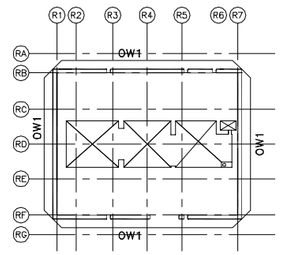
Transverse Shear of RB

Location	Element ID	Load ID	d (m)	pv (%)	Shear Force (MN/m)				Vu/ϕVn
					Vu	Vc	Vs	ϕVn	
18 Wall	6	RB-9b	1.62	0.721	3.03	5.60	4.84	8.88	0.342
Below RCCV	13	RB-9b	1.62	0.721	2.46	5.59	4.84	8.86	0.278
Bottom	24	RB-9a	1.59	0.721	1.42	5.02	4.73	8.29	0.171
19 Wall Below	806	RB-9b	1.57	0.270	0.43	5.24	1.75	5.95	0.073
Below RCCV	813	RB-9b	1.57	0.270	0.95	5.28	1.75	5.98	0.159
Mid-Height	824	RB-9b	1.57	0.270	0.87	4.98	1.75	5.72	0.152
20 Wall	1606	RB-8b	1.57	0.540	4.04	4.02	3.50	6.39	0.633
Below RCCV	1613	RB-8b	1.57	0.540	4.69	4.26	3.50	6.59	0.711
Top	1624	RB-8b	1.57	0.540	4.95	4.27	3.50	6.60	0.750
21 Exterior Wall	20011	RB-9b	1.63	0.484	3.81	1.96	3.27	4.44	0.856
@ EL-11.50	20023	RB-9b	1.59	0.484	2.06	3.31	3.18	5.52	0.373
~-10.50m	30010	RB-9b	1.65	0.177	0.83	0.59	1.21	1.53	0.543
	30020	RB-9a	1.69	0.177	0.82	3.26	1.24	3.82	0.214
	40001	RB-9a	1.73	0.177	1.07	3.52	1.27	4.07	0.262
	40011	RB-9a	1.73	0.177	0.16	0.19	1.27	1.24	0.128
22 Exterior Wall	22011	RB-9b	1.19	0.484	1.11	0.00	2.38	2.02	0.549
@ EL4.65	22023	RB-9a	1.18	0.484	0.75	3.71	2.36	5.16	0.146
~6.60m	32010	RB-9b	1.24	0.177	0.33	0.00	0.91	0.77	0.424
	32020	RB-8a	1.24	0.177	0.11	0.13	0.90	0.88	0.123
	42001	RB-4	1.19	0.242	0.18	0.21	1.19	1.19	0.150
	42011	RB-4	1.22	0.242	0.03	0.04	1.22	1.07	0.031
23 Exterior Wall	24211	RB-9a	1.15	0.484	1.50	0.00	2.30	1.96	0.769
@ EL22.50	24224	RB-9b	1.19	0.968	1.30	0.02	4.65	3.97	0.327
~24.60m	34210	RB-9b	1.24	0.177	0.26	0.00	0.91	0.77	0.340
	34220	RB-8a	1.26	0.710	0.24	0.28	3.69	3.37	0.070
	44201	RB-4	1.26	0.968	2.41	0.95	4.89	4.96	0.485
24 Basemat	90140	RB-9b	3.53	0.801	10.74	7.16	11.69	16.03	0.670
@ Wall	90182	RB-9b	3.51	0.801	7.41	6.13	11.64	15.10	0.491
Below RCCV	90111	RB-9b	3.37	0.801	2.64	1.67	11.15	10.90	0.242
25 Slab	93140	RB-9b	0.80	0.500	0.37	0.22	1.65	1.58	0.231
EL4.65m	93182	RB-9b	0.80	0.500	2.35	1.50	1.65	2.68	0.877
@ RCCV	93111	RB-9b	0.80	0.500	1.68	2.05	1.65	3.14	0.533
26 Slab	96144	RB-9a	0.80	0.500	0.07	0.08	1.65	1.47	0.046
EL17.5m	96186	RB-9b	0.80	0.500	1.15	2.13	1.65	3.21	0.359
@ RCCV	96113	RB-4	1.34	0.500	0.82	1.54	2.76	3.66	0.225
27 Slab	98472	RB-9a	0.63	0.500	1.45	1.69	1.29	2.53	0.572
EL27.0m	98514	RB-9b	0.80	0.500	1.26	0.91	1.65	2.17	0.579
@ RCCV	98424	RB-9b	1.95	0.710	8.16	4.95	5.74	9.08	0.899
28 Pool Girder	123054	RB-8b	1.24	0.484	0.10	0.12	2.48	2.21	0.046
@ Storage Pool	123154	RB-4	1.25	0.484	0.16	0.19	2.50	2.28	0.069
29 Pool Girder	123062	RB-9b	1.24	0.242	0.22	1.33	1.24	2.18	0.103
@ Cavity	123162	RB-8a	1.23	0.242	0.09	0.11	1.23	1.13	0.081
30 Pool Girder	123067	RB-9b	1.25	0.484	1.10	3.75	2.49	5.31	0.207
@ Fuel Pool	123167	RB-8a	1.24	0.484	0.21	0.25	2.48	2.32	0.092
31 MS Tunnel	150122	RB-9a	1.04	0.177	0.04	0.04	0.76	0.68	0.053
Wall and Slab	96611	RB-9a	1.34	0.500	0.47	1.60	2.76	3.70	0.126
	98614	RB-9b	2.14	0.500	0.23	0.27	4.42	3.99	0.058

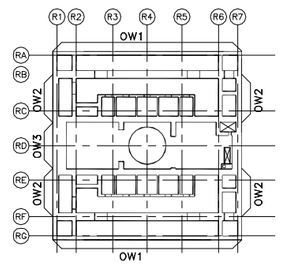
Location	Element ID	Load ID	d (m)	pv (%)	Shear Force (MN/m) Vu	Vc	Vs	ϕVn	Vu/ϕVn
18 Wall	6	RB-9a	1.59	0.721	2.73	0.30	4.73	4.28	0.637
Below RCCV	13	RB-9a	1.59	0.721	2.09	0.57	4.73	4.51	0.464
Bottom	24	RB-9b	1.59	0.721	1.08	0.94	4.74	4.83	0.223
19 Wall Below	806	RB-9a	1.57	0.270	0.12	0.14	1.75	1.61	0.075
Below RCCV	813	RB-9b	1.57	0.270	0.18	0.22	1.75	1.67	0.109
Mid-Height	824	RB-9a	1.57	0.270	0.22	0.25	1.75	1.71	0.126
20 Wall	1606	RB-9b	1.57	0.540	2.68	1.46	3.50	4.21	0.636
Below RCCV	1613	RB-8b	1.57	0.540	4.69	4.26	3.50	6.59	0.711
Top	1624	RB-9b	1.57	0.540	3.41	2.34	3.50	4.96	0.689
21 Exterior Wall	20011	RB-9b	1.63	0.484	3.81	1.96	3.27	4.44	0.856
@ EL-11.50	20023	RB-9b	1.59	0.484	2.06	3.31	3.18	5.52	0.373
~-10.50m	30010	RB-9b	1.65	0.177	0.83	0.59	1.21	1.53	0.543
	30020	RB-9a	1.69	0.177	0.82	3.26	1.24	3.82	0.214
	40001	RB-9a	1.73	0.177	1.07	3.52	1.27	4.07	0.262
	40011	RB-9a	1.73	0.177	0.16	0.19	1.27	1.24	0.128
22 Exterior Wall	22011	RB-9b	1.19	0.484	1.11	0.00	2.38	2.02	0.549
@ EL4.65	22023	RB-9a	1.18	0.484	0.75	3.71	2.36	5.16	0.146
~6.60m	32010	RB-9b	1.24	0.177	0.33	0.00	0.91	0.77	0.424
	32020	RB-8a	1.24	0.177	0.11	0.13	0.90	0.88	0.123
	42001	RB-4	1.19	0.242	0.18	0.21	1.19	1.19	0.150
	42011	RB-4	1.22	0.242	0.03	0.04	1.22	1.07	0.031
23 Exterior Wall	24211	RB-9a	1.15	0.484	1.50	0.00	2.30	1.96	0.769
~~@ EL22.50~~	~~24224~~	~~RB-9b~~	~~1.19~~	~~0.968~~	~~1.30~~	~~0.02~~	~~4.65~~	~~3.97~~	~~0.327~~
~24.60m	34210	RB-9b	1.24	0.177	0.26	0.00	0.91	0.77	0.340
	34220	RB-8a	1.26	0.710	0.24	0.28	3.69	3.37	0.070
	44201	RB-4	1.26	0.968	2.41	0.95	4.89	4.96	0.485
24 Basemat	90140	RB-9b	3.53	0.801	10.74	7.16	11.69	16.03	0.670
@ Wall	90182	RB-9b	3.51	0.801	7.41	6.13	11.64	15.10	0.491
Below RCCV	90111	RB-9b	3.37	0.801	2.64	1.67	11.15	10.90	0.242
25 Slab	93140	RB-9b	1.00	0.500	0.37	0.27	2.07	1.99	0.184
EL4.65m	93182	RB-9b	1.00	0.500	2.54	1.57	2.07	3.09	0.822
@ RCCV	93111	RB-9b	1.00	0.500	1.84	1.57	2.07	3.09	0.594
26 Slab	96144	RB-9a	0.80	0.500	0.07	0.08	1.65	1.47	0.046
EL17.5m	96186	RB-9b	1.00	0.500	1.15	2.68	2.07	4.03	0.286
@ RCCV	96113	RB-4	1.34	0.500	0.82	1.54	2.76	3.66	0.225
27 Slab	98472	RB-9a	0.63	0.500	1.45	1.69	1.29	2.53	0.572
EL27.0m	98514	RB-9b	1.00	0.500	1.33	1.28	2.07	2.84	0.467
@ RCCV	98424	RB-9b	1.95	0.710	8.16	4.95	5.74	9.08	0.899
28 Pool Girder	123054	RB-8b	1.24	0.484	0.10	0.12	2.48	2.21	0.046
@ Storage Pool	123154	RB-4	1.25	0.484	0.16	0.19	2.50	2.28	0.069
29 Pool Girder	123062	RB-9a	1.25	0.242	0.12	0.15	1.25	1.19	0.105
@ Cavity	123162	RB-8a	1.23	0.242	0.09	0.11	1.23	1.13	0.081
30 Pool Girder	123067	RB-9b	1.25	0.484	1.10	3.75	2.49	5.31	0.207
@ Fuel Pool	123167	RB-8a	1.24	0.484	0.21	0.25	2.48	2.32	0.092
31 MS Tunnel	150122	RB-9a	1.04	0.177	0.04	0.04	0.76	0.68	0.053
Wall and Slab	96611	RB-9a	1.34	0.500	0.47	1.60	2.76	3.70	0.126
	98614	RB-9b	2.14	0.500	0.23	0.27	4.42	3.99	0.058

RB SEISMIC WALLS REINFORCING SCHEDULE EL-11500 ~ EL34000

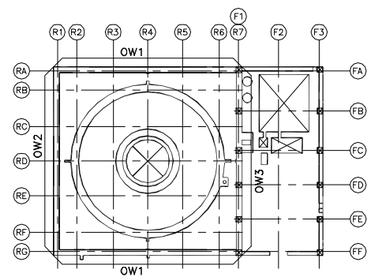
EL 52700 ~ EL 34000	TYPE	OW1		
	SECTION			
	VERT BAR	2-#11 @200 (EF)		
	HORIZ BAR	2-#11 @200 (EF)		
	SHEAR TIE	#5 @400x400		
EL 34000 ~ EL 27000	TYPE	OW1	OW2	OW3
	SECTION			
	VERT BAR	3-#11@200 (OUT) 2-#11@200 (IN)	4-#11@200 (OUT) 3-#11@200 (IN)	6-#11@200 (OUT) 3-#11@200 (IN)
	HORIZ BAR	3-#11@200 (OUT) 2-#11@200 (IN)	4-#11@200 (OUT) 3-#11@200 (IN)	6-#11@200 (OUT) 3-#11@200 (IN)
	SHEAR TIE	#6 @400x400	#7 @400x200	#7 @400x200
EL 27000 ~ EL 4650	TYPE	OW1	OW2	OW3
	SECTION			
	VERT BAR	3-#11 @200 (EF)	4-#11@200 (OUT) 3-#11@200 (IN)	4-#11 @200 (EF)
	HORIZ BAR	3-#11 @200 (EF)	4-#11@200 (OUT) 3-#11@200 (IN)	3-#11@200+1-#11@400 (EF)
	SHEAR TIE	#6 @400x400	#7 @400x400	#7 @400x200
EL 4650 ~ EL -11500	TYPE	OW1	OW2	OW3
	SECTION			
	VERT BAR	4-#11 @200 (EF)	3-#11 @200 (EF)	5-#11 @200 (EF)
	HORIZ BAR	3-#11@200+1-#11@400 (EF)	3-#11 @200 (EF)	4-#11@200+1-#11@400 (EF)
	SHEAR TIE	#6 @400x400	#6 @400x400	#7 @400x200



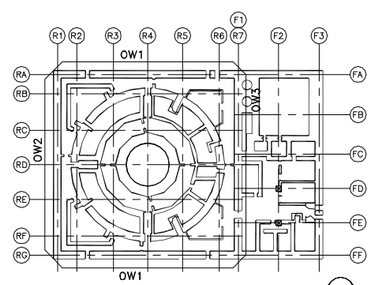
FLOOR EL 34000



FLOOR EL 27000



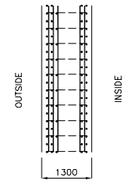
FLOOR EL 4650

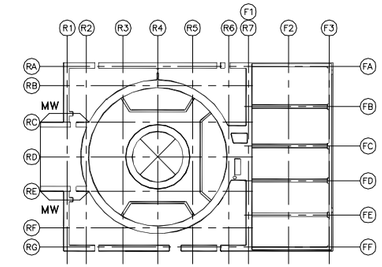


FLOOR EL -11500

KEY PLAN FOR WALL TYPE

MS TUNNEL WALL REINFORCING SCHEDULE

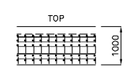
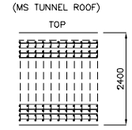
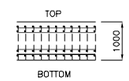
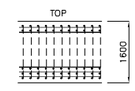
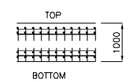
EL 17500	TYPE	MW
	SECTION	
	VERT BAR	2-#11 @200(IN) 2-#11@200+1-#11@400(OUT)
	HORIZ BAR	2-#11 @200(IN) 2-#11@200+1-#11@400(OUT)
	SHEAR TIE	#6 @400x400



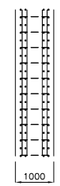
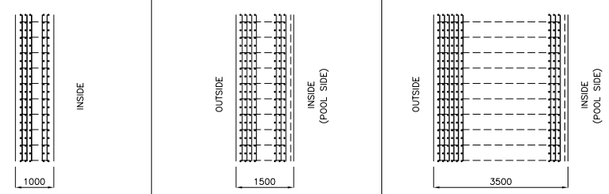
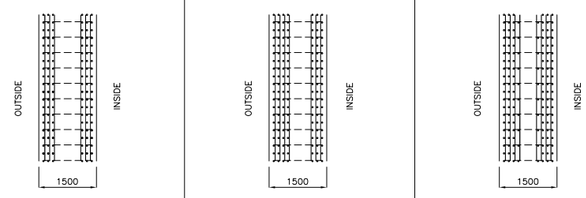
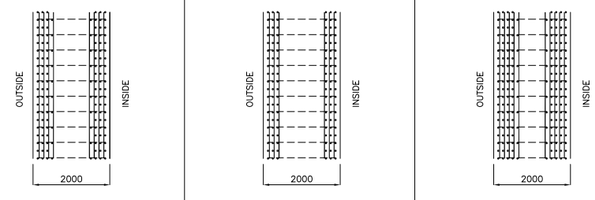
FLOOR EL 17500

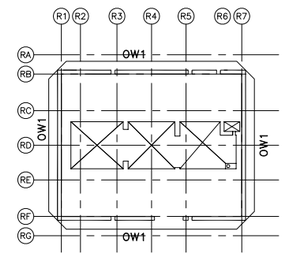
KEY PLAN FOR MS WALL

SLAB REINFORCING SCHEDULE

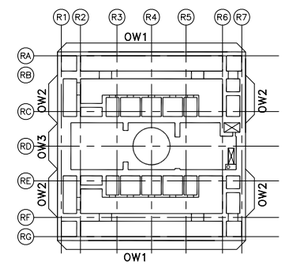
EL 27000	SECTION		(MS TUNNEL ROOF) 
	TOP	3-#11 @200 (EW)	4-#11 @200 (EW)
	BOTTOM	2-#11@200(EW)	4-#11 @200 (EW)
	SHEAR TIE	#5 @200x200	#5 @200x200
EL 17500	SECTION		(MS TUNNEL SLAB) 
	TOP	2-#11 @200 (EW)	2-#11 @200 (EW)
	BOTTOM	2-#11@200(EW)	3-#11 @200 (EW)
	SHEAR TIE	#5 @200x200	#5 @200x200
EL 4650	SECTION		
	TOP	2-#11 @200 (EW)	
	BOTTOM	2-#11@200(EW)	
	SHEAR TIE	#5 @200x200	

RB SEISMIC WALLS REINFORCING SCHEDULE EL−11500 ~ EL34000

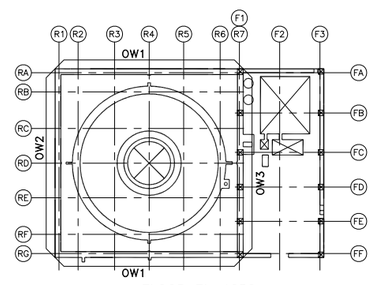
EL 52700 ~ EL 34000	TYPE	OW1		
	SECTION			
	VERT BAR	2−#11 @200 (EF)		
	HORIZ BAR	2−#11 @200 (EF)		
	SHEAR TIE	#5 @400x400		
EL 34000 ~ EL 27000	TYPE	OW1	OW2	OW3
	SECTION			
	VERT BAR	3−#11@200 (OUT) 2−#11@200 (IN)	4−#11@200 (OUT) 3−#11@200 (IN)	6−#11@200 (OUT) 3−#11@200 (IN)
	HORIZ BAR	3−#11@200 (OUT) 2−#11@200 (IN)	4−#11@200 (OUT) 3−#11@200 (IN)	6−#11@200 (OUT) 3−#11@200 (IN)
	SHEAR TIE	#6 @400x400	#7 @400x200	#7 @400x200
EL 27000 ~ EL 4650	TYPE	OW1	OW2	OW3
	SECTION			
	VERT BAR	3−#11 @200 (EF)	4−#11@200 (OUT) 3−#11@200 (IN)	4−#11 @200 (EF)
	HORIZ BAR	3−#11 @200 (EF)	4−#11@200 (OUT) 3−#11@200 (IN)	3−#11@200+1−#11@400 (EF)
	SHEAR TIE	#6 @400x400	#7 @400x400	#7 @400x200
EL 4650 ~ EL −11500	TYPE	OW1	OW2	OW3
	SECTION			
	VERT BAR	4−#11 @200 (EF)	3−#11 @200 (EF)	5−#11 @200 (EF)
	HORIZ BAR	3−#11@200+1−#11@400 (EF)	3−#11 @200 (EF)	4−#11@200+1−#11@400 (EF)
	SHEAR TIE	#6 @400x400	#6 @400x400	#7 @400x200



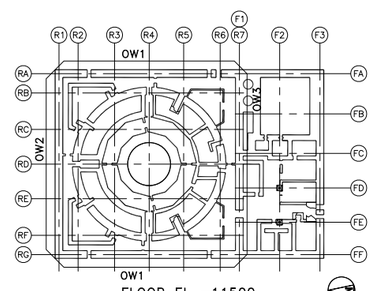
FLOOR EL 34000



FLOOR EL 27000



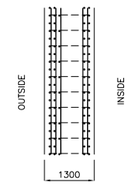
FLOOR EL 4650

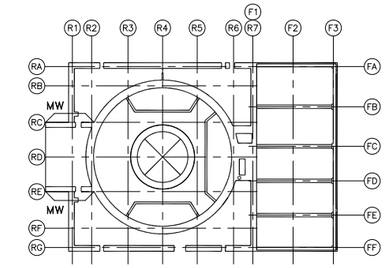


FLOOR EL −11500

KEY PLAN FOR WALL TYPE

MS TUNNEL WALL REINFORCING SCHEDULE

EL 17500	TYPE	MW
	SECTION	
	VERT BAR	2−#11 @200(IN) 2−#11@200+1−#11@400(OUT)
	HORIZ BAR	2−#11 @200(IN) 2−#11@200+1−#11@400(OUT)
	SHEAR TIE	#6 @400x400



FLOOR EL 17500

KEY PLAN FOR MS WALL

SLAB REINFORCING SCHEDULE

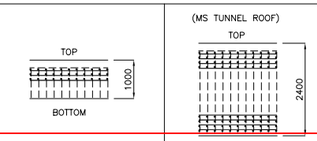
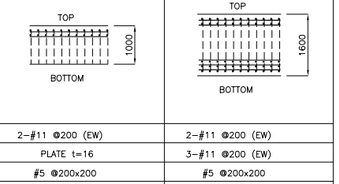
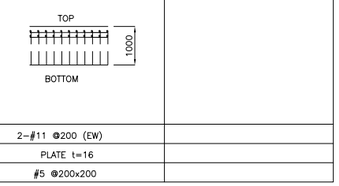
EL 27000	SECTION		
	TOP	3−#11 @200 (EW)	4−#11 @200 (EW)
	BOTTOM	PLATE t=25	4−#11 @200 (EW)
	SHEAR TIE	#5 @200x200	#5 @200x200
EL 17500	SECTION		
	TOP	2−#11 @200 (EW)	2−#11 @200 (EW)
	BOTTOM	PLATE t=16	3−#11 @200 (EW)
	SHEAR TIE	#5 @200x200	#5 @200x200
EL 4650	SECTION		
	TOP	2−#11 @200 (EW)	
	BOTTOM	PLATE t=16	
	SHEAR TIE	#5 @200x200	

Figure 3G.1-47. List of RB Wall and Slab Reinforcement