3A Seismic Soil Structure Interaction Analysis

The information in the appendix of the reference ABWR DCD, including all subsections, tables, and figures, is incorporated by reference with the following site-specific supplement.

3A.12 Site-Specific SSI Analysis

This appendix presents the soil-structure interaction (SSI) analysis performed for STP 3 & 4 site conditions for the Reactor Building (RB) and Control Building (CB) of the STP 3 & 4 ABWR plant under the safe shutdown earthquake (SSE) excitation. The free field SSE design response spectra assumed for this analysis is based on Regulatory Guide 1.60 anchored to 0.15g. This design response spectra was selected since it bounds the site-specific response spectra presented in 2.5S.2 in the frequency range of interest, namely frequencies greater than 1hz. This analysis was performed to account for the soil layers with shear wave velocities below 305m/s (1000fps) that are present at STP 3 & 4, which is less than the site parameter specified in the Reference DCD.

In the standard plant design of ABWR, the analysis has been performed over a range of site parameters. The site parameters considered and their ranges together form the generic site conditions. The generic site conditions are selected to provide an adequate seismic design margin for the standard plant located at any site with site parameters within the range of parameters. This appendix demonstrates that the seismic analysis results obtained for the site-specific parameters of STP 3 & 4 site are within the standard design envelope.

This appendix details the basis for STP 3 & 4 site conditions, the analysis, and the method of seismic soil-structure interaction analysis. Descriptions of the input motion, damping values, the structural model, and the soil model are included.

3A.13 Applicable Documents

3A.13.1 Codes and Standards

(1) ASCE 4-98: ASCE Standard for Seismic Analysis of Safety Related Nuclear Structures, 1998.

(2) ASCE 43-05: ASCE Seismic Design Criteria for Structures, Systems and Components Nuclear Facilities, 2005

3A.13.2 Regulation and Regulatory Requirements

(1) RG 1.60 “Design Response Spectra for Seismic Design of Nuclear Power Plants”

(2) RG 1.61 “Damping Values for Seismic Design of Nuclear Power Plants”

(3) RG 1.92 “Combining Modal Responses and Spatial Components in Seismic Response Analysis”

(4) RG 1.122 “Development of Floor Design Response Spectra for Seismic Design of Floor-Supported Equipment or Components”

(5) NUREG-0800 “USNRC Standard Review Plan for Review of Safety Analysis Reports for Nuclear Power Plants Light Water Reactor Edition”

3A.14 Structural Outline

The RB and CB are safety related and Seismic Category I structures. RB is integrated with the reinforced concrete containment vessel (RCCV), which is lined with a steel liner for leak tightness. These structural features are shown in Figures 3A-229 and 3A-230.

In modeling the buildings, the 0°-180° and 90°-270° directions are designated as X- and Y axes, respectively. The Z axis is in the vertical direction.

Figure 3A-231 shows the configuration of both buildings including embedment depth.

3A.15 Site Conditions

SSI analyses were performed using the STP 3 & 4 site-specific soil properties.

3A.15.1 Soil Properties for Equivalent Linearization Analysis with SHAKE

The free field site response analysis was performed using computer program SHAKE, which employs the principle of one-dimensional propagation of waves in the vertical direction for system of homogeneous, visco-elastic soil layers. An equivalent linear method is used to compute strain-compatible shear modulus and material damping for each soil layer. The analyses were performed using the horizontal input motion at the ground surface.

3A.15.2 STP 3 & 4 Site Conditions

Soil properties of STP 3 & 4 used in SHAKE equivalent linearization analysis are shown in Tables 3A-29. Strain-dependent normalized shear modulus reduction (G/G0~?) and damping ratio (h~?) are shown in Tables 3A-30 through 3A-33.

Results of SHAKE for STP 3 & 4 soil properties are shown in Table 3A-34.

3A.16 Input Motion and Damping Values

3A.16.1 Input Motion

Earthquake input motion in the form of synthetic acceleration time histories are generated as described in the RG 1.60 (Subsection 3A.13.2(1)) for three orthogonal components designated as H1, H2, and V. with peak value 0.15g. The H1 and H2 are the two horizontal components mutually perpendicular to each other. In the SSI analyses, H1 and H2 components are used in the horizontal X-(0°) and Y-(90°) directions, respectively. The V component is used in the vertical Z-direction. The input motions are treated as the ground surface control motions.

Vertically propagating plane seismic shear waves for the horizontal components and compression waves for the vertical component are assumed to generate the input motion.

3A.16.2 Damping Values

The structural components damping values used in the seismic SSI analysis are in accordance with those specified in Regulatory Guide 1.61 (Subsection 3A.13.2(2)).

3A.17 Soil-Structure Interaction Analysis Method

The linear finite element computer program SASSI2000 is used for the soil-structure interaction. The program uses finite elements with complex moduli for modeling the structure and foundation properties and is based on the subtraction method and the frequency domain complex response method. The lumped mass-beam model is coupled with finite element soil model. The model details are described in Section 3A.18. Structural responses in terms of accelerations, forces, and moments, are computed directly. Floor response spectra are obtained from the calculated response acceleration time histories.

The SSI analyses for the three directional earthquake components are performed separately. The maximum co-directional responses to each of the three earthquake components are combined using algebraic sum in the time domain.

In the seismic analysis using the complex response method in the frequency domain, material damping can be included in the formulation of the complex stiffness matrix:

$$[k_j^*] = [k_j](1 + 2i\lambda_j)$$

where

$[k_j^*]$ = complex stiffness matrix of element j

$[k_j]$ = stiffness matrix of element j

λ_j = material damping ratio of element j

i = $\sqrt{-1}$

3A.18 Analysis Models

The RB model is a three-dimensional lumped mass-beam model that considers shear, bending, torsion and axial deformations.

3A.18.1 Outline of Structural Model

The RB is modeled by multiple stick models that represent the RB, RCCV and pedestal wall. The building model is also coupled to the reactor shield wall (RSW) and the reactor pressure vessel (RPV). They are symmetric in both horizontal directions. These stick models are interconnected by horizontal links representing the floor diaphragm at respective elevations. These links are modeled as rigid springs for floor in-plane translational displacement and having no stiffness for all other deformations. The CB is represented by a single stick.

The vertical floor frequencies are obtained at major floor locations by independent modal analysis of the respective floor finite element model. These frequencies are included in the stick model by a series of vertical single degree-of-freedom oscillators at the corresponding floor elevations.

To obtain the mass properties for the stick model, the dead load, 25% of the respective live load and an additional load for piping and cable trays, etc. were used to compute the lumped mass properties.

Based on the methodology described above, the lumped mass-beam stick model for SSI is developed as described in Section 3A.18.2.

3A.18.2 SSI Model for SASSI Analysis

In the SASSI model, the exterior walls below grade and the foundation basemat along with the supporting soil medium are modeled. For this reason, the sectional properties of the stick model are modified to subtract the stiffness properties corresponding to subgrade and outer walls. In this model, the basemat and the exterior walls are modeled by plate elements.

The stick model is connected to the basemat and sidewalls at ground floor level and basement floors by a set of rigid links. At the base of the model, a rigid link is used to connect all the stick models to the middle of the basemat.

The SASSI soil model was assumed to be the half space condition at the bottom boundary (GL -121.41m). The soil properties used for the SASSI model are the results of SHAKE analysis shown in Table 3A-34.

The SSI model of RB is a half model taking advantage of a plane of symmetry shown in Figures 3A-232 through 3A-234. Figure 3A-235 shows the excavated soil models. Similarly Figures 3A-236 through 3A-239 show the CB SSI model.

3A.19 Analysis Results

In this section, SSI results of STP 3 & 4 are compared with one of the DCD UB soil conditions in terms of unbroadened acceleration response spectra and seismic forces.

3A.19.1 RB SASSI Analysis Result

The results in terms of acceleration are compared in Table 3A-35. As shown in this table, the results using the DCD UB case envelope the seismic responses of the STP 3 & 4 site soil properties case.

The results in terms of maximum loads on the RB are compared in Tables 3A-36. As shown in this table, the obtained results using the DCD UB Case envelope the seismic responses of the STP 3 & 4 soil property case.

The results in terms of unbroadened acceleration response spectra are compared in Figures 3A-240 through 3A-253. As shown in these figures, the results using the DCD UB case envelope the STP 3 & 4 site soil properties case.

3A.19.2 CB SASSI Analysis Result

The results in terms of acceleration are compared in Table 3A-37. As shown in this table, the results using the DCD UB case envelope the seismic responses of the STP 3 & 4 site soil properties case.

The results in terms of maximum load of CB are compared in Tables 3A-38. As shown in this table, the obtained results using the DCD UB Case envelope the seismic responses of the STP 3 & 4 soil property case.

The results in terms of acceleration response spectra are compared in Figures 3A-254 through 3A-259. As shown in these figures, the results using the DCD UB case envelope the STP 3 & 4 site soil properties case.

3A.20 Conclusion

The SSI analyses were performed using the STP 3 & 4 site soil properties. It was confirmed that the seismic forces, moments, accelerations, and unbroadened response spectra based on the DCD UB case envelope the seismic forces, moments, accelerations, and unbroadened resonse spectra of the STP 3 & 4 site specific soil case. Furthermore, since the DCD SSI results envelope the DCD UB case, it can be concluded that the DCD SSI results envelope the STP 3 & 4 SSI results.

Table 3A-29 Site-specific Properties for SHAKE Analysis (STP 3 & 4 condition)

Soil Stratum	Layer	Elevation Range		Thickness (m)	Vs (m/s)	Vp (m/s)	Unit Weight (N/m^3)	¼	Note
		Top (m)	Bottom (m)						
	1	10.16	9.14	1.02	137.2	369.4	19300	0.42	
A	2	9.14	7.86	1.28	137.2	369.4	19300	0.42	EL 25.8ft (7.86m)
	3	7.86	7.62	0.24	137.2	576.7	19300	0.47	Groundwater table
	4	7.62	6.10	1.52	166.1	698.1	19300	0.47	
	5	6.10	4.57	1.53	182.9	768.8	19300	0.47	
	6	4.57	3.05	1.52	195.1	820.0	19300	0.47	
B	7	3.05	1.52	1.53	214.9	903.3	18900	0.47	
	8	1.52	0.00	1.52	230.1	967.2	18900	0.47	
C	9	0.00	-1.52	1.52	230.1	967.2	19300	0.47	
	10	-1.52	-3.05	1.53	245.4	1031.5	19300	0.47	
	11	-3.05	-4.57	1.52	251.5	1057.1	19300	0.47	
	12	-4.57	-6.10	1.53	233.2	980.2	19300	0.47	
D	13	-6.10	-7.62	1.52	213.4	897.0	19300	0.47	
	14	-7.62	-9.14	1.52	257.6	1082.7	19300	0.47	
	15	-9.14	-10.67	1.53	312.4	1313.1	19300	0.47	
	16	-10.67	-12.19	1.52	365.8	1537.5	19300	0.47	
E	17	-12.19	-13.72	1.53	364.2	1530.8	19200	0.47	EL -41ft CB bottom of mat
	18	-13.72	-15.24	1.52	335.3	1409.3	19200	0.47	
	19	-15.24	-16.76	1.52	315.5	1326.1	19200	0.47	EL -51ft CB bottom of mat
	20	-16.76	-18.29	1.53	292.6	1229.8	19200	0.47	
F	21	-18.29	-19.81	1.52	275.8	1159.2	19800	0.47	
	22	-19.81	-21.34	1.53	291.1	1223.5	19800	0.47	
	23	-21.34	-22.86	1.52	301.8	1268.5	19800	0.47	
H	24	-22.86	-24.38	1.52	327.7	1377.4	20100	0.47	
	25	-24.38	-25.91	1.53	329.2	1383.7	20100	0.47	
	26	-25.91	-27.43	1.52	326.1	1370.7	20100	0.47	
J CLAY 1	27	-27.43	-28.96	1.53	298.7	1255.5	19600	0.47	
	28	-28.96	-30.48	1.52	321.6	1351.7	19600	0.47	
	29	-30.48	-32.00	1.52	324.6	1364.4	19600	0.47	
	30	-32.00	-33.53	1.53	397.8	1672.0	19600	0.47	
	31	-33.53	-35.05	1.52	406.9	1710.3	19600	0.47	
	32	-35.05	-36.58	1.53	384.0	1614.0	19600	0.47	
	33	-36.58	-38.10	1.52	358.1	1505.2	19600	0.47	
J SAND/SILT	34	-38.10	-39.62	1.52	394.7	1659.0	19600	0.47	
	35	-39.62	-41.15	1.53	388.6	1633.4	19600	0.47	
	36	-41.15	-42.67	1.52	378.0	1588.8	19600	0.47	
J CLAY 2	37	-42.67	-44.20	1.53	376.4	1582.1	19600	0.47	
	38	-44.20	-45.72	1.52	315.5	1326.1	19600	0.47	
	39	-45.72	-47.24	1.52	321.6	1351.7	19600	0.47	
	40	-47.24	-48.77	1.53	313.9	1319.4	19600	0.47	
	41	-48.77	-50.29	1.52	315.5	1326.1	19600	0.47	
	42	-50.29	-51.82	1.53	294.1	1236.2	19600	0.47	
	43	-51.82	-53.34	1.52	294.1	1236.2	19600	0.47	
	44	-53.34	-54.86	1.52	286.5	1204.2	19600	0.47	
	45	-54.86	-56.39	1.53	285.0	1197.9	19600	0.47	
K CLAY	46	-56.39	-57.91	1.52	338.3	1421.9	20000	0.47	
	47	-57.91	-59.44	1.53	339.9	1428.7	20000	0.47	
	48	-59.44	-60.96	1.52	327.7	1377.4	20000	0.47	
	49	-60.96	-61.87	0.91	460.2	1934.3	20000	0.47	

Table 3A-29 Site-specific Properties for SHAKE Analysis (STP 3 & 4 condition) (Continued)

Soil Stratum	Layer	Elevation Range		Thickness (m)	Vs (m/s)	Vp (m/s)	Unit Weight (N/m^3)	¼	Note
		Top (m)	Bottom (m)						
K SAND/SILT	50	-61.87	-63.40	1.53	408.4	1716.6	20000	0.47	
	51	-63.40	-64.92	1.52	478.5	2011.2	20000	0.47	
	52	-64.92	-66.45	1.53	411.5	1729.6	20000	0.47	
	53	-66.45	-67.97	1.52	410.0	1723.3	20000	0.47	
	54	-67.97	-69.49	1.52	378.0	1588.8	20000	0.47	
L	55	-69.49	-71.02	1.53	297.2	1249.2	19600	0.47	
M	56	-71.02	-72.54	1.52	408.4	1716.6	19600	0.47	
	57	-72.54	-74.07	1.53	309.4	1300.5	19600	0.47	
	58	-74.07	-75.59	1.52	338.3	1421.9	19600	0.47	
N CLAY 1	59	-75.59	-77.11	1.52	291.1	1223.5	19300	0.47	
	60	-77.11	-78.64	1.53	457.2	1921.7	19300	0.47	
	61	-78.64	-80.16	1.52	460.2	1934.3	19300	0.47	
	62	-80.16	-81.69	1.53	393.2	1652.7	19300	0.47	
	63	-81.69	-83.21	1.52	320.0	1345.0	19300	0.47	
	64	-83.21	-84.73	1.52	315.5	1326.1	19300	0.47	
	65	-84.73	-86.26	1.53	294.1	1236.2	19300	0.47	
	66	-86.26	-87.78	1.52	338.3	1421.9	19300	0.47	
	67	-87.78	-89.31	1.53	428.2	1799.8	19300	0.47	
	68	-89.31	-90.83	1.52	463.3	1947.3	19300	0.47	
	69	-90.83	-92.35	1.52	414.5	1742.2	19300	0.47	
	70	-92.35	-93.57	1.22	347.5	1460.6	19300	0.47	
N SAND 1	71	-93.57	-95.10	1.53	467.9	1966.7	19300	0.47	
	72	-95.10	-96.62	1.52	560.8	2357.1	19300	0.47	
	73	-96.62	-98.15	1.53	492.3	2069.2	19300	0.47	
	74	-98.15	-98.76	0.61	472.4	1985.6	19300	0.47	
N CLAY 2	75	-98.76	-100.28	1.52	518.2	2178.1	19300	0.47	
	76	-100.28	-101.19	0.91	403.9	1697.7	19300	0.47	
N SAND 2	77	-101.19	-102.72	1.53	499.9	2101.2	19300	0.47	
	78	-102.72	-104.24	1.52	513.6	2158.7	19300	0.47	
	79	-104.24	-105.77	1.53	501.4	2107.5	19300	0.47	
	80	-105.77	-107.29	1.52	498.3	2094.4	19300	0.47	
	81	-107.29	-108.81	1.52	475.5	1998.6	19300	0.47	
	82	-108.81	-110.34	1.53	507.5	2133.1	19300	0.47	
	83	-110.34	-111.25	0.91	667.5	2805.6	19300	0.47	
N CLAY 3	84	-111.25	-113.69	2.44	563.9	2370.2	19300	0.47	
N SAND 3	85	-113.69	-119.48	5.79	478.5	2011.2	19300	0.47	
N CLAY 4	86	-119.48	-128.63	9.15	367.3	1543.8	19300	0.47	
N SAND 4	87	-128.63	-131.06	2.43	416.1	1748.9	19300	0.47	
N CLAY 5	88	-131.06	-147.52	16.46	371.9	1563.2	19300	0.47	
N SAND 5	89	-147.52	-153.01	5.49	562.4	2363.9	19300	0.47	
N CLAY 6	90	-153.01	-175.26	22.25	410.0	1723.3	19300	0.47	
M1P2					483.1	336.3	20300	1.47	

Table 3A-30 Shear Modulus Reduction for Cohesionless Soils ($G/G_0\gamma$)

Cohesionless Soil Strata										
Strain (%)	B Depth=30 FT	C Depth=45 FT	E Depth=85 FT	H Depth=120 FT	J Sand/Silt Depth=170 FT	K Sand/Silt Depth=250 FT	M Depth=250 FT	N Sand Depth=500 FT	Penisular <50 FT	Penisular > 50 FT
	G/Gmax									
1.00E+00	0.08	0.09	0.11	0.12	0.14	0.15	0.15	0.2	0.09	0.2
0.316	0.17	0.2	0.23	0.26	0.27	0.32	0.32	0.4	0.22	0.4
1.00E-01	0.37	0.4	0.46	0.49	0.51	0.56	0.56	0.64	0.43	0.64
0.0316	0.61	0.65	0.69	0.72	0.74	0.78	0.78	0.84	0.67	0.84
1.00E-02	0.83	0.85	0.87	0.89	0.9	0.91	0.91	0.95	0.85	0.95
3.16E-03	0.96	0.97	0.98	0.98	0.98	0.985	0.985	0.99	0.97	0.99
1.00E-03	1	1	1	1	1	1	1	1	1	1
3.16E-04	1	1	1	1	1	1	1	1	1	1
1.00E-04	1	1	1	1	1	1	1	1	1	1

Table 3A-31 Shear Modulus Reduction for Cohesive Soils ($G/G_0\gamma$)

Cohesionless Soil Strata							
Strain (%)	A PI=35	D PI=40	F PI=60	J PI=60	K PI=45	L PI=70	N PI=70
	G/Gmax						
1.00E+00	0.09	0.11	0.22	0.22	0.13	0.30	0.30
0.316	0.19	0.26	0.42	0.42	0.28	0.53	0.53
1.00E-01	0.45	0.49	0.70	0.70	0.52	0.78	0.78
0.316	0.69	0.75	0.88	0.88	0.77	0.94	0.94
1.00E-02	0.88	0.92	0.98	0.98	0.93	1	1
3.16E-03	0.98	0.99	1	1	0.99	1	1
1.00E-03	1	1	1	1	1	1	1
3.16E-04	1	1	1	1	1	1	1
1.00E-04	1	1	1	1	1	1	1

Table 3A-32 Damping Ratio for Cohesionless Soils (h~γ)

Cohesionless Soil Strata										
Strain (%)	B Depth=30 FT	C Depth=45 FT	E Depth=85 FT	H Depth=120 FT	J Sand/Silt Depth=170 FT	K Sand/Silt Depth=250 FT	M Depth=250 FT	N Sand Depth=500 FT	Penisular <50 FT	 > 50 FT
	G/Gmax									
1.00E+00	24.5	23.2	22.1	21	20.5	19.4	19.4	16.6	22.8	16.5
5.00E-01	21	19.6	18.5	17.3	16.6	15.5	15.5	13	---	---
0.0316	18.5	17.2	16	14.8	14	13	13	10.5	16.5	10.3
1.00E-01	12	10.8	9.6	8.7	8	7	7	5.4	10.3	5.5
0.0316	6.7	6.1	5.4	4.7	4.2	3.7	3.7	2.5	5.5	2.6
1.00E-02	3.8	3.4	2.7	2.4	2.2	2	2	1.4	3	1.4
3.16E-03	2.3	1.8	1.6	1.4	1.6	1	1	1	1.6	0.9
1.00E-03	1.8	1.7	1	0.9	0.8	0.8	0.8	0.6	1.3	0.5
3.16E-04	1.4	1.35	1	0.8	0.8	0.8	0.8	0.6	1.1	0.5
1.00E-04	1.4	1.35	1	0.8	0.8	0.8	0.8	0.6	1.1	0.5

Table 3A-33 Shear Damping Ratio for Cohesive Soils (h~γ)

Cohesionless Soil Strata							
Strain (%)	A PI=35	D PI=40	F PI=60	J PI=60	K PI=45	L PI=70	N PI=70
	Damping Ratio (%)						
1.00E+00	18.6	18.3	15.8	15.8	18.0	13.8	13.8
5.00E-01	17.5	16.7	13.2	13.2	16.1	11.1	11.1
0.316	15.3	14.7	11.1	11.1	14.0	9.3	9.3
1.00E-01	9.8	9.4	6.5	6.5	8.7	5.4	5.4
0.0316	5.5	5.3	3.9	3.9	4.8	3.3	3.3
1.00E-02	3.4	3	2.8	2.8	2.9	2.7	2.7
3.16E-03	2.4	2	2.6	2.6	2.5	2.6	2.6
1.00E-03	1.7	1.8	2.4	2.4	1.9	2.6	2.6
3.16E-04	1.6	1.7	2.4	2.4	1.8	2.6	2.6
1.00E-04	1.6	1.7	2.4	2.4	1.8	2.6	2.6

Table 3A-34 Results of SHAKE for STP 3 & 4 Soil Properties

Soil Layer ID	Upper-Depth (m)	Lower-Depth (m)	Layer Depth (m)	Unit Weight ^{3} (N/m^3)	Poisson's Ratio ¼	Equivalent Shear Modulus G ($k/N/m^2$)	Equivalent Damping Ratio h (%)	Equivalent Shear Wave Velocity Vs (m/s)	Equivalent Compression Wave Velocities Vp (m/s)
A	0.00	-1.02	1.02	19300	0.42	36400	2.30	136.0	366.1
	-1.02	-2.30	1.28	19300	0.42	32800	3.40	129.1	347.5
	-2.30	-2.54	0.24	19300	0.47	30500	4.10	124.4	522.7
	-2.54	-4.06	1.52	19300	0.47	45700	3.80	152.3	639.9
	-4.06	-5.59	1.53	19300	0.47	53600	4.10	164.9	693.1
	-5.59	-7.11	1.52	19300	0.47	59300	4.40	173.6	729.7
B	-7.11	-8.64	1.53	18800	0.47	62900	5.40	181.1	761.0
	-8.64	-10.16	1.52	18800	0.47	71800	5.50	193.3	812.5
C	-10.16	-11.68	1.52	19300	0.47	75100	5.20	195.2	820.5
	-11.68	-13.21	1.53	19300	0.47	85700	5.10	208.7	877.0
	-13.21	-14.73	1.52	19300	0.47	88900	5.20	212.5	893.0
	-14.73	-16.26	1.53	19300	0.47	71200	5.90	190.2	799.3
D	-16.26	-17.78	1.52	19300	0.47	65700	5.60	182.6	767.5
	-17.78	-19.30	1.52	19300	0.47	104000	4.70	229.8	965.9
	-19.30	-20.83	1.53	19300	0.47	164500	3.90	289.0	1214.5
	-20.83	-22.35	1.52	19300	0.47	238300	3.20	347.9	1462.1
E	-22.35	-23.88	1.53	19100	0.47	216000	3.20	332.8	1398.8
	-23.88	-25.40	1.52	19100	0.47	175300	3.80	299.8	1260.1
	-25.40	-25.70	.30	19100	0.47	150200	4.10	277.6	1166.8
	-25.70	-26.92	1.22	19100	0.47	149800	4.20	277.2	1164.9
	-26.92	-28.45	1.53	19100	0.47	123400	4.70	251.5	1057.1
F	-28.45	-29.97	1.52	19800	0.47	140200	3.60	263.4	1107.1
	-29.97	-31.50	1.53	19800	0.47	157400	3.50	279.1	1173.1
	-31.50	-33.02	1.52	19800	0.47	170000	3.50	290.2	1219.6
H	-33.02	-34.54	1.52	20100	0.47	176400	3.60	293.4	1233.0
	-34.54	-36.07	1.53	20100	0.47	177500	3.70	294.3	1237.0
	36.07	-37.59	-1.52	20100	0.47	172800	3.70	290.3	1220.2
J CLAY 1	-37.59	-39.12	1.53	19600	0.47	163000	3.50	285.5	1199.8
	-39.12	-40.64	1.52	19600	0.47	191400	3.40	309.4	1300.3
	-40.64	-42.16	1.52	19600	0.47	194900	3.40	312.2	1312.0
	-42.16	-43.69	1.53	19600	0.47	304300	3.00	390.1	1639.5
	-43.69	-45.21	1.52	19600	0.47	319200	3.00	399.5	1679.2
	-45.21	-46.74	1.53	19600	0.47	280400	3.10	374.5	1573.9
	-46.74	-48.26	1.52	19600	0.47	240000	3.30	346.5	1456.2
J SAND/SILT	-48.26	-49.78	1.52	19600	0.47	262400	2.90	362.2	1522.4
	-49.78	-51.31	1.53	19600	0.47	251900	3.00	354.9	1491.7
	-51.31	-52.83	1.52	19600	0.47	234900	3.20	342.7	1440.2
J CLAY 2	-52.83	-54.36	1.53	19600	0.47	265800	3.30	364.6	1532.5
	-54.36	-55.88	1.52	19600	0.47	179800	3.70	299.8	1259.9
	-55.88	-57.40	1.52	19600	0.47	187200	3.60	305.9	1285.8
	-57.40	-58.93	1.53	19600	0.47	177100	3.70	297.6	1250.7
	-58.93	-60.45	1.52	19600	0.47	178800	3.70	299.0	1256.8
	-60.45	-61.98	1.53	19600	0.47	152300	3.90	276.0	1159.9
	-61.98	-63.50	1.52	19600	0.47	151800	4.00	275.5	1157.8
	-63.50	-65.02	1.52	19600	0.47	142400	4.10	266.9	1121.6
‘	-65.02	-66.55	1.53	19600	0.47	140000	4.20	264.6	1112.2
K CLAY	-66.55	-68.07	1.52	19900	0.47	183900	4.60	301.0	1265.0
	-68.07	-69.60	1.53	19900	0.47	185100	4.60	302.0	1269.4
	-69.60	-71.12	1.52	19900	0.47	168900	4.70	288.5	1212.4
	-71.12	-72.03	0.91	19900	0.47	379400	3.50	432.3	1817.1

Table 3A-34 Results of SHAKE for STP 3 & 4 Soil Properties (Continued)

Soil Layer ID	Upper-Depth (m)	Lower-Depth (m)	Layer Depth (m)	Unit Weight ^{3} (N/m^3)	Poisson's Ratio ¼	Equivalent Shear Modulus G ($k/N/m^2$)	Equivalent Damping Ratio h (%)	Equivalent Shear Wave Velocity Vs (m/s)	Equivalent Compression Wave Velocities Vp (m/s)
K SAND/SILT	-72.03	-73.56	1.53	19900	0.47	283500	3.00	373.7	1570.7
	-73.56	-75.08	1.52	19900	0.47	407200	2.50	447.9	1882.6
	-75.08	-76.61	1.53	19900	0.47	287400	3.00	376.3	1581.5
	-76.61	-78.13	1.52	19900	0.47	287400	3.00	374.4	1573.7
	-78.13	-79.65	1.52	19900	0.47	235700	3.30	340.8	1432.3
L	-79.65	-81.18	1.53	19600	0.47	163700	3.50	286.2	1202.8
M	-81.18	-82.70	1.52	19600	0.47	276600	3.10	371.9	1563.2
	82.70	-84.23	1.53	19600	0.47	142200	4.30	266.7	1121.0
	-84.23	-85.75	1.52	19600	0.47	178800	3.70	299.0	1256.5
N CLAY 1	-85.75	-87.27	1.52	19300	0.47	153200	3.60	278.9	1172.3
	-87.27	-88.80	1.53	19300	0.47	404100	2.90	453.0	1903.8
	-88.80	-90.32	1.52	19300	0.47	409500	2.90	455.9	1916.2
	-90.32	-91.85	1.53	19300	0.47	293400	3.10	385.9	1622.0
	-91.85	-93.37	1.52	19300	0.47	189400	3.30	310.1	1303.2
	-93.37	-94.89	1.52	19300	0.47	183200	3.40	305.0	1282.0
	-94.89	-96.42	1.53	19300	0.47	155100	3.70	280.6	1179.4
	-96.42	-97.94	1.52	19300	0.47	212900	3.30	328.8	1381.8
	-97.94	-99.47	1.53	19300	0.47	350000	3.00	421.6	1771.9
	-99.47	-100.99	1.52	19300	0.47	413200	2.90	458.0	1924.9
	-100.99	-102.51	1.52	19300	0.47	326300	3.10	407.0	1710.7
	-102.51	-103.73	1.22	19300	0.47	224600	3.30	337.7	1419.2
N SAND 1	-103.73	-105.26	1.53	19300	0.47	388400	1.90	444.1	1866.5
	-105.26	-106.78	1.52	19300	0.47	580600	1.50	542.9	2281.7
	-106.78	-108.31	1.53	19300	0.47	433700	1.80	469.2	1971.9
	-108.31	-108.92	0.61	19300	0.47	395300	1.90	448.0	1882.8
N CLAY 2	-108.92	-110.44	1.52	19300	0.47	521500	2.80	514.6	2162.8
	-110.44	-111.35	0.91	19300	0.47	308000	3.10	395.5	1662.2
N SAND 2	-111.35	-112.88	1.53	19300	0.47	448300	1.80	477.1	2005.2
	-112.88	-114.40	1.52	19300	0.47	476200	1.80	491.7	2066.5
	-114.40	-115.93	1.53	19300	0.47	451300	1.80	478.7	2011.9
	-115.93	-117.45	1.52	19300	0.47	445100	1.80	475.3	1997.8
	-117.45	-118.97	1.52	19300	0.47	400700	1.90	451.0	1895.4
	-118.97	-120.50	1.53	19300	0.47	463300	1.80	485.0	2038.4
	-120.50	-121.41	0.91	19300	0.47	839600	1.30	652.9	2744.1

Table 3A-35 RB Maximum Acceleration

Node No.	EL. (m)	Maximum Acceleration (g)					
		DCD UB*			STP 3&4†		
		X-Dir	Y-Dir	Z-Dir‡	X-DIR	Y-Dir	Z-Dir‡
R/B							
95	49.70	0.37	0.47	0.43	0.14	0.13	0.17
96	38.20	0.31	0.36	0.38	0.11	0.11	0.15
98	31.70	0.27	0.32	0.37	0.11	0.11	0.15
100	23.50	0.27	0.28	0.35	0.09	0.11	0.14
102	18.10	0.27	0.26	0.34	0.09	0.09	0.14
103	12.30	0.26	0.25	0.31	0.09	0.08	0.14
104	4.80	0.24	0.24	0.30	0.08	0.08	0.13
105	-1.70	0.22	0.23	0.29	0.08	0.08	0.13
88	-8.20	0.21	0.22	0.29	0.07	0.07	0.13
9601-9603(107)	31.70			0.39			0.19
9501-9503(108)	23.50			0.37			0.16
9401(109)	18.10			0.34			0.14
9301-9303(110)	12.30			0.34			0.15
9201-9202(111)	4.80			0.31			0.13
9101(112)	-1.70			0.29			0.12
RCCV							
89	31.70	0.27	0.32	0.42	0.11	0.11	0.15
90	23.50	0.27	0.28	0.44	0.09	0.11	0.16
91	18.10	0.27	0.26	0.41	0.09	0.09	0.15
92	12.30	0.26	0.25	0.37	0.09	0.08	0.15
93	4.80	0.24	0.24	0.34	0.08	0.08	0.13
94	-1.70	0.22	0.23	0.30	0.08	0.08	0.12
88	-8.20	0.21	0.22	0.28	0.07	0.07	0.12

* DCD UBID150 soil condition, RG1.60 0.3g input
† STP 3&4 soil condition, RG1.60 0.15g input
‡ Veritcal values include the coupling effect due to horizontal shaking

Table 3A-35 RB Maximum Acceleration (Continued)

Node No.	EL. (m)	Maximum Acceleration (g)					
		DCD UB*			STP 3&4†		
		X-Dir	Y-Dir	Z-Dir‡	X-DIR	Y-Dir	Z-Dir‡
RSW/PED							
70	21.20	0.31	0.32	0.30	0.10	0.10	0.13
78	18.44	0.31	0.30	0.30	0.10	0.09	0.13
79	17.02	0.28	0.29	0.30	0.09	0.09	0.13
80	15.60	0.28	0.28	0.29	0.09	0.09	0.13
81	13.95	0.27	0.27	0.29	0.09	0.08	0.13
82	12.30	0.26	0.25	0.30	0.09	0.08	0.13
71	8.20	0.26	0.24	0.30	0.08	0.08	0.13
83	7.00	0.25	0.24	0.29	0.08	0.08	0.13
72	4.50	0.25	0.23	0.28	0.08	0.08	0.13
84	3.50	0.25	0.24	0.28	0.08	0.08	0.13
73	1.70	0.24	0.22	0.28	0.08	0.08	0.12
85	-0.18	0.23	0.22	0.28	0.08	0.08	0.12
86	-2.10	0.23	0.21	0.27	0.08	0.07	0.12
87	-4.70	0.22	0.22	0.27	0.08	0.07	0.12
88	-8.20	0.21	0.22	0.27	0.07	0.07	0.12
RCCV							
17	16.48	0.31	0.34	0.31	0.10	0.11	0.13
18	15.68	0.30	0.33	0.31	0.09	0.12	0.13
25	9.65	0.27	0.27	0.30	0.09	0.08	0.13
27	6.75	0.26	0.25	0.30	0.08	0.08	0.13
28	26.06	0.37	0.38	0.29	0.11	0.15	0.13
33	20.49	0.34	0.34	0.30	0.10	0.10	0.13
36	17.18	0.29	0.31	0.30	0.09	0.09	0.13
38	15.68	0.29	0.29	0.30	0.10	0.09	0.13
46	9.29	0.26	0.25	0.29	0.09	0.08	0.13
50	5.95	0.25	0.24	0.29	0.08	0.08	0.13
51	5.49	0.25	0.24	0.29	0.08	0.08	0.13
52	4.82	0.25	0.23	0.30	0.08	0.08	0.13
60	1.65	0.31	0.32	0.30	0.09	0.10	0.13
66	1.65	0.30	0.32	0.29	0.09	0.10	0.13

* DCD UBID150 soil condition, RG1.60 0.3g input
† STP 3&4 soil condition, RG1.60 0.15g input
‡ Veritcal values include the coupling effect due to horizontal shaking

Table 3A-36 RB Seismic Load

Element No.	Node No.	EL. (m)	Max. Shear (MN)				Max. Moment (MN * m)				Max. Torsion (MN * m)			
			DCD UB*		STP 3&4†		DCD UCB*		STP 3&4‡		DCD UCB*		STP 3&4‡	
			X-Dir	Y-Dir	X-DIR	Y-Dir	X-Dir	Y-Dir	X-DIR	Y-Dir	X-DIR	Y-Dir	X-Dir	Y-Dir
RB														
93	95	49.70	26.62	30.66	8.83	7.99	214.18	128.02	67.21	36.54	79.85	87.37	26.48	22.78
	96	38.20	26.62	30.66	8.83	7.99	505.04	437.57	149.16	112.44				
94	96	38.20	48.03	59.02	17.81	14.92	722.16	696.27	209.08	242.22	144.10	168.20	53.43	42.52
	98	31.70	48.03	59.02	17.81	14.92	1038.92	1088.15	306.75	292.83				
96	98	31.70	70.57	91.55	26.81	24.69	1205.43	1359.40	352.25	457.77	211.71	260.93	80.43	70.38
	100	23.50	70.57	91.55	26.81	24.69	1793.44	2043.71	558.39	527.21				
98	100	23.50	107.27	140.94	36.60	49.05	1923.28	2179.04	601.54	611.54	321.80	401.68	109.80	139.80
	102	18.10	107.27	140.94	36.60	49.05	2377.13	2704.67	789.44	666.66				
99	102	18.10	140.04	166.85	46.86	63.35	2457.55	2812.55	821.80	722.75	420.12	475.52	140.57	180.55
	103	12.30	140.04	166.85	46.86	63.35	3004.76	3718.68	1080.69	913.59				
100	103	12.30	165.71	175.01	54.90	44.50	1387.05	1609.66	471.70	488.96	497.14	498.78	164.69	126.83
	104	4.80	165.71	175.01	54.90	44.50	2312.41	2720.36	828.27	598.60	497.14	498.78	164.69	126.83
101	104	4.80	151.20	146.12	39.15	36.56	1022.25	1321.74	444.05	482.68	453.60	416.44	117.44	104.19
	105	-1.70	151.20	146.12	39.15	36.56	1885.43	2098.62	636.65	600.95				
102	105	-1.70	194.64	152.83	42.09	34.89	661.16	1014.60	313.22	478.96	583.93	435.56	126.27	99.44
	88	-8.20	194.64	152.83	42.09	34.89	1629.87	1674.78	479.74	525.83				
RCCV														
87	89	31.70	29.97	28.95	9.05	7.22	351.86	38.27	114.13	11.93	23.98	23.16	7.24	5.78
	90	23.50	29.97	28.95	9.05	7.22	427.37	256.15	137.49	55.43				
88	90	23.50	54.58	47.21	17.52	14.68	412.08	446.99	114.56	151.32	90.06	77.90	28.91	24.22
	91	18.10	54.58	47.21	17.52	14.68	167.67	633.51	57.15	187.97				
89	91	18.10	61.62	63.00	18.59	18.13	433.85	791.79	142.16	247.13	101.68	103.95	30.67	29.91
	92	12.30	61.62	63.00	18.59	18.13	562.71	1117.17	162.34	295.38				
90	92	12.30	56.49	61.23	15.42	15.08	913.00	1295.26	272.43	370.50	93.20	101.03	25.45	24.89
	93	4.80	56.49	61.23	15.42	15.08	1007.73	1690.67	336.17	409.33				
91	93	4.80	55.56	74.12	13.45	13.65	1230.34	1746.76	403.25	430.90	91.68	122.30	22.20	22.52
	94	-1.70	55.56	74.12	13.45	13.65	1249.17	2012.32	453.85	463.27				
92	94	-1.70	99.50	112.84	38.09	27.11	1372.73	2157.46	510.34	490.72	164.17	186.18	62.85	44.72
	88	-8.20	99.50	112.84	38.09	27.11	1811.48	2741.94	624.88	588.79				

* DCD UBID150 soil condition, RG1.60 0.3g input
† STP 3&4 soil condition, RG1.60 0.15g input
‡ Vertical values include the coupling effect due to horizontal shaking

Table 3A-36 RB Seismic Load (Continued)

Element No.	Node No.	EL. (m)	Max. Shear (MN)				Max. Moment (MN * m)				Max. Torsion (MN * m)			
			DCD UB*		STP 3&4†		DCD UCB*		STP 3&4‡		DCD UCB*		STP 3&4‡	
			X-Dir	Y-Dir	X-DIR	Y-Dir	X-Dir	Y-Dir	X-DIR	Y-Dir	X-DIR	Y-Dir	X-Dir	Y-Dir
RSW														
74	70	21.20	0.20	0.22	0.06	0.05	0.00	0.00	0.00	0.00	0.10	0.11	0.03	0.02
	78	18.44	0.20	0.22	0.06	0.05	0.55	0.61	0.16	0.13				
75	78	18.44	1.64	1.79	0.51	0.45	0.55	0.61	0.16	0.13	0.82	0.89	0.25	0.23
	79	17.02	1.64	1.79	0.51	0.45	2.87	3.13	0.88	0.76				
76	79	17.02	1.89	2.06	0.57	0.51	2.87	3.13	0.88	0.76	0.94	1.03	0.28	0.26
	80	15.60	1.89	2.06	0.57	0.51	5.55	6.05	1.68	1.60				
77	80	15.60	2.62	2.83	0.77	0.64	5.55	6.05	1.68	1.60	1.31	1.41	0.38	0.32
	81	13.95	2.62	2.83	0.77	0.64	9.89	10.71	2.93	2.51				
78	81	13.95	2.90	3.11	0.83	0.70	9.89	10.71	2.93	2.51	1.45	1.55	0.42	0.35
	82	12.30	2.90	3.11	0.83	0.70	14.69	15.84	4.33	3.65				
79	82	12.30	4.92	6.08	1.77	2.07	14.69	15.84	4.33	3.65	3.44	4.26	1.24	1.45
	71	8.20	4.92	6.08	1.77	2.07	31.89	35.58	10.33	10.39				
80	71	8.20	9.35	10.00	2.93	2.10	49.90	53.60	15.17	10.55	6.55	7.00	2.05	1.47
	83	7.00	9.35	10.00	2.93	2.10	61.27	65.78	18.63	13.06				
81	83	7.00	10.08	10.77	3.06	2.25	61.27	65.78	18.63	13.06	7.05	7.54	2.14	1.57
	72	4.50	10.08	10.77	3.06	2.25	86.49	92.77	26.07	18.61				
103	72	4.50	10.78	11.35	3.17	2.43	86.49	92.77	26.07	18.61	7.55	7.94	2.22	1.70
	84	3.50	10.78	11.35	3.17	2.43	97.13	104.13	29.22	20.87				
82	84	3.50	11.14	11.70	3.24	2.55	97.13	104.13	29.22	20.87	7.80	8.19	2.27	1.78
	73	1.70	11.14	11.70	3.24	2.55	117.01	125.13	35.03	25.07				
83	73	1.70	12.25	12.60	3.30	2.88	117.01	125.13	35.03	25.07	8.57	8.82	2.31	2.02
	85	-0.18	12.25	12.60	3.30	2.88	140.14	149.83	41.36	29.83				
84	85	-0.18	12.25	12.60	3.30	2.88	140.14	149.83	41.36	29.83	8.57	8.82	2.31	2.02
	86	-2.10	12.25	12.60	3.30	2.88	163.75	174.07	47.86	35.44				
85	86	-2.10	13.91	13.52	3.33	3.37	163.75	174.07	47.86	35.44	9.74	9.46	2.33	2.36
	87	-4.70	13.91	13.52	3.33	3.37	198.09	212.22	57.07	44.33				
86	87	-4.70	15.91	14.63	3.40	3.91	198.09	212.22	57.07	44.33	11.14	10.24	2.38	2.74
	88	-8.20	15.91	14.63	3.40	3.91	251.44	257.33	71.12	58.21				
RPV														
28	56	7.39	1.12	1.16	0.34	0.28	6.28	6.79	1.93	1.58	0.45	0.46	0.13	0.11
	27	6.75	1.12	1.16	0.34	0.28	6.99	7.58	2.20	1.76				
69	48	9.29	4.07	4.39	0.92	0.94	13.62	15.41	3.72	3.93	3.26	3.51	0.74	0.75
	71	8.20	4.07	4.39	0.92	0.94	18.08	20.22	4.77	4.27				

* DCD UBID150 soil condition, RG1.60 0.3g input
† STP 3&4 soil condition, RG1.60 0.15g input
‡ Vertical values include the coupling effect due to horizontal shaking

Table 3A-37 CB Maximum Acceleration

Node No.	EL. (m)	Maximum Acceleration (g)					
		DCD UB*			STP 3&4†		
		X-Dir	Y-Dir	Z-Dir‡	X-DIR	Y-Dir	Z-Dir‡
CB							
1(108)	22.20	0.33	0.25	0.33	0.13	0.11	0.14
2(107)	17.15	0.27	0.23	0.32	0.10	0.09	0.14
3(106)	12.30	0.26	0.22	0.32	0.09	0.08	0.13
4(105)	7.60	0.29	0.22	0.30	0.09	0.08	0.13
5(104)	2.90	0.21	0.23	0.30	0.09	0.08	0.13
6(103)	-1.85	0.21	0.23	0.30	0.08	0.08	0.13
7(102)	-8.20	0.22	0.21	0.29	0.08	0.08	0.12
9501-9506(113)	17.15			0.76			0.29
9401-9405(112)	12.30			0.71			0.19
9301-9305(111)	7.60			0.70			0.20
9201-9204(110)	2.90			0.47			0.16
9101-9106(109)	-1.85			0.80			0.36

* DCD UBID150 soil condition, RG1.60 0.3g input
† STP 3&4 soil condition, RG1.60 0.15g input
‡ Veritcal values include the coupling effect due to horizontal shaking

Table 3A-38 CB Seismic Load

Element No.	Node No.	EL. (m)	Max. Shear (MN)				Max Moment (MN *m)				Max Torsion (MN *m)			
			DCD UB*		STP 3&4†		DCD UB*		STP 3&4†		DCD UB*		STP 3&4‡	
			X-Dir	Y-Dir	X-Dir	Y-Dir	X-Dir	Y-Dir	X-Dir	Y-Dir	X-Dir	Y-Dir	X-Dir	Y-Dir
CB														
11(7)	1(108)	22.20	14.81	13.05	6.11	4.97	29.77	43.80	11.31	14.57	18.07	36.81	7.45	14.02
	2(107)	17.15	14.81	13.05	6.11	4.97	84.14	78.98	43.91	35.85	18.07	36.81	7.45	14.02
12(6)	2(107)	17.15	33.40	29.73	12.22	9.80	111.70	120.96	55.27	53.74	40.75	83.85	14.91	27.63
	3(106)	12.30	33.40	29.73	12.22	9.80	250.85	217.90	120.52	96.69	40.75	83.85	14.91	27.63
13(5)	3(106)	12.30	56.11	46.01	15.15	12.76	290.67	455.22	113.89	119.60	68.46	129.76	18.48	35.98
	4(105)	7.60	56.11	46.01	15.15	12.76	433.65	612.92	167.77	169.01	68.46	129.76	18.48	35.98
14(4)	4(105)	7.60	41.82	39.95	15.82	12.15	230.46	277.53	109.80	98.85	51.01	112.67	19.30	34.27
	5(104)	2.90	41.82	39.95	15.82	12.15	370.69	401.09	168.52	139.63	51.01	112.67	19.30	34.27
15(3)	5(104)	2.90	66.84	59.02	25.30	21.46	214.57	291.45	76.94	104.93	81.55	166.43	30.87	60.51
	6(103)	-1.85	66.84	59.02	25.30	21.46	462.48	559.18	191.43	189.78	81.55	166.43	30.87	60.51
16(2)	6(103)	-1.85	89.16	82.42	30.79	29.13	196.72	263.60	68.20	99.40	108.78	232.41	37.57	79.31
	7(102)	-8.20	89.16	82.42	30.79	28.13	381.28	730.01	157.57	221.18	108.78	232.41	37.57	79.31

* DCD UBID150 soil condition, RG1.60 0.3g input\
† STP 3&4 soil condition, RG1.60 0.15g input
‡ Veritcal values include the coupling effect due to horizontal shaking

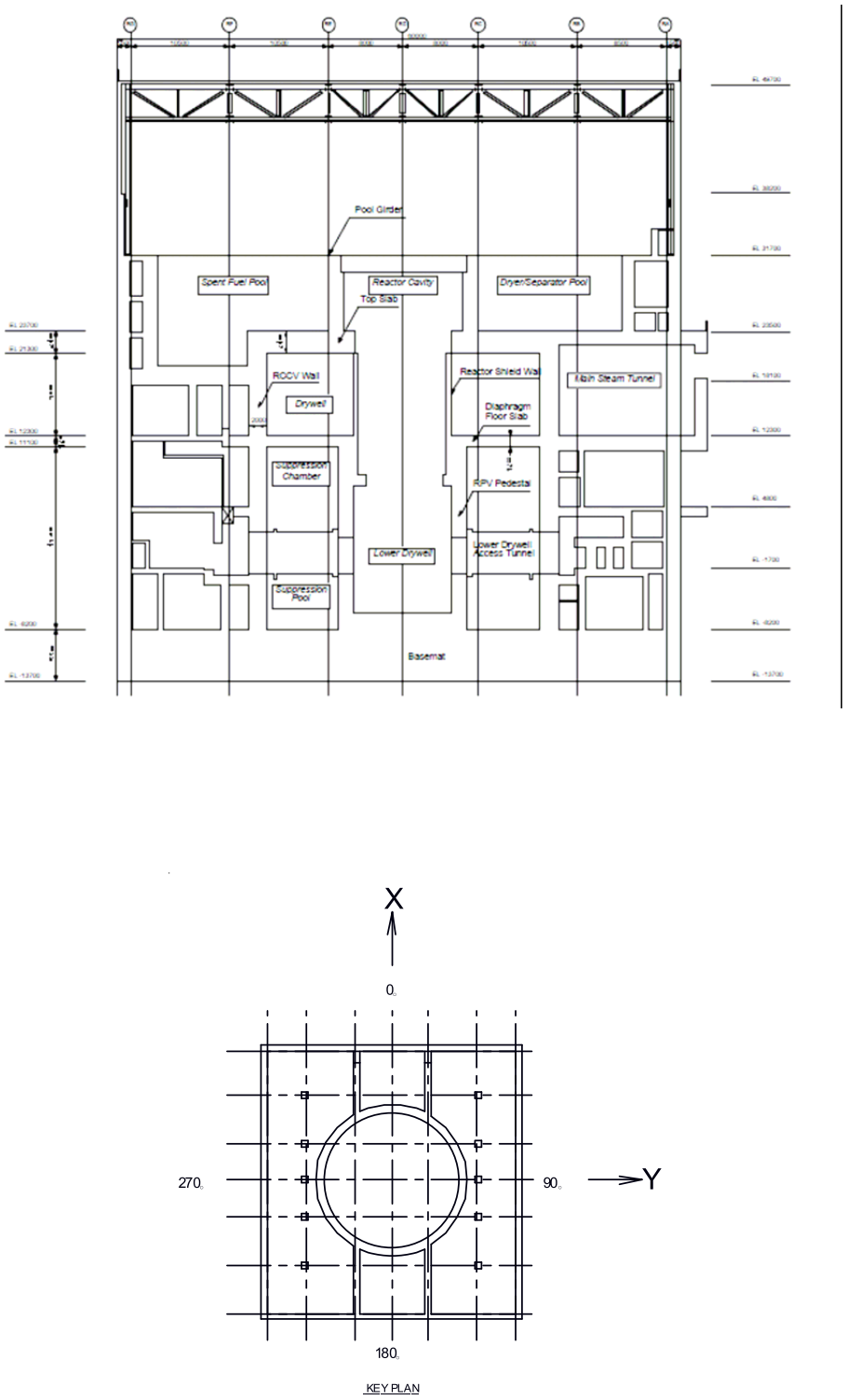


Figure 3A-229 Reactor Building Section

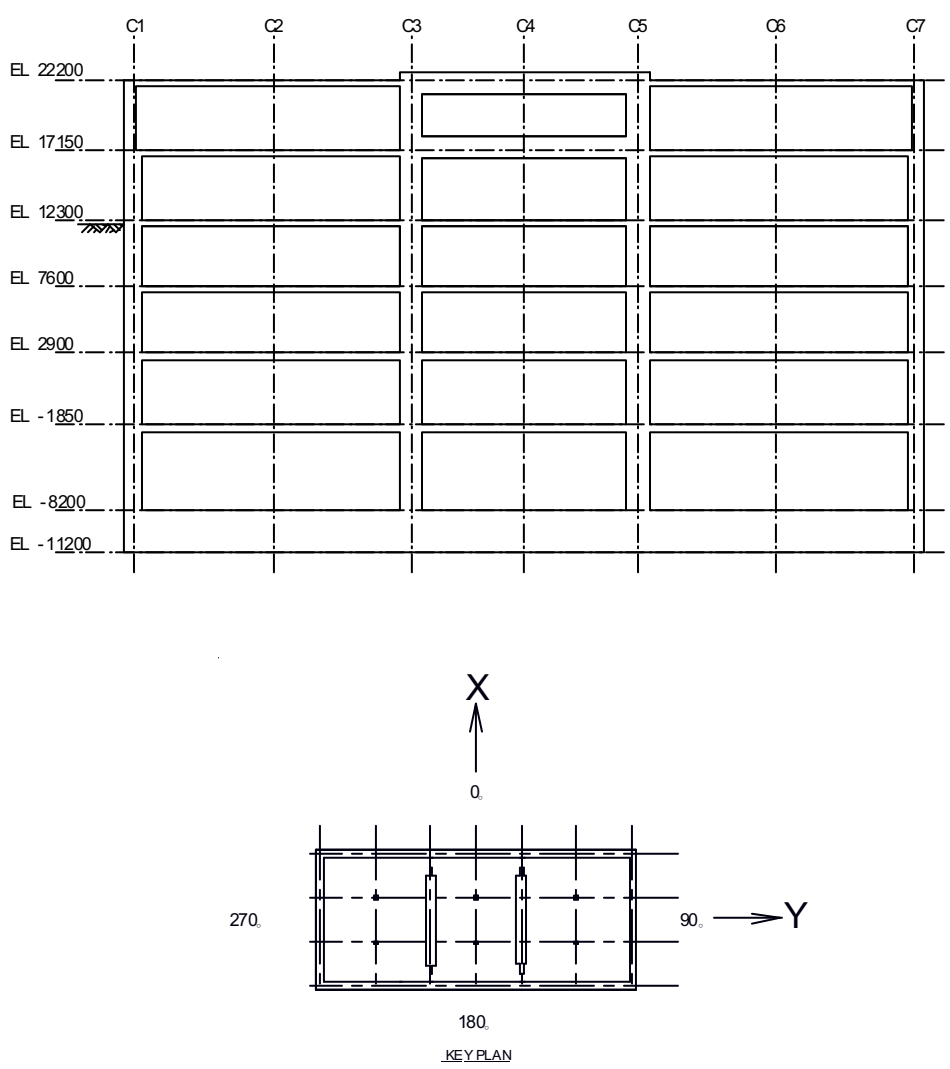


Figure 3A-230 Control Building Section

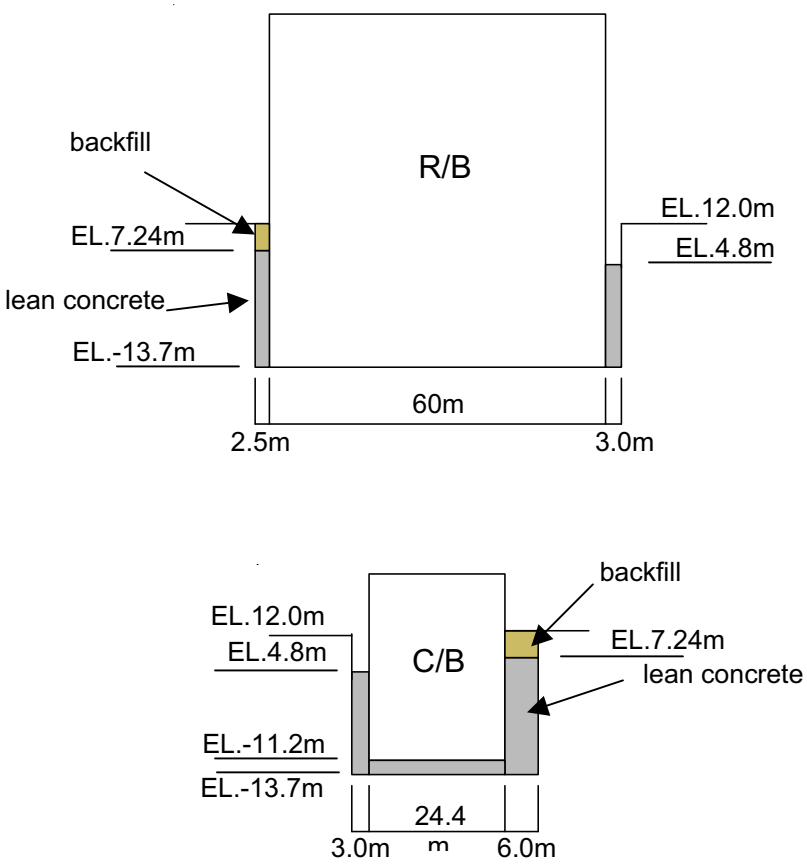
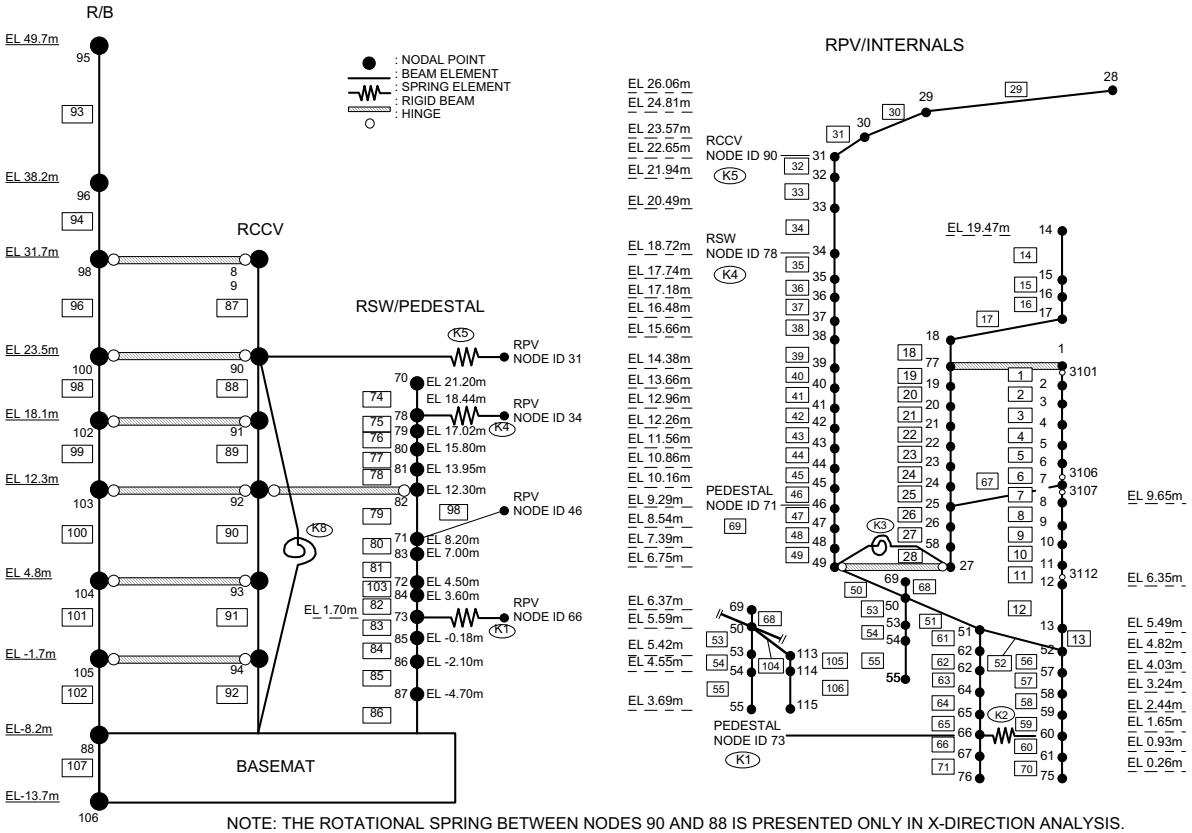


Figure 3A-231 Configuration of Buildings



NOTE: THE ROTATIONAL SPRING BETWEEN NODES 90 AND 88 IS PRESENTED ONLY IN X-DIRECTION ANALYSIS.

Figure 3A-232 RB Stick Model (Horizontal Analysis)

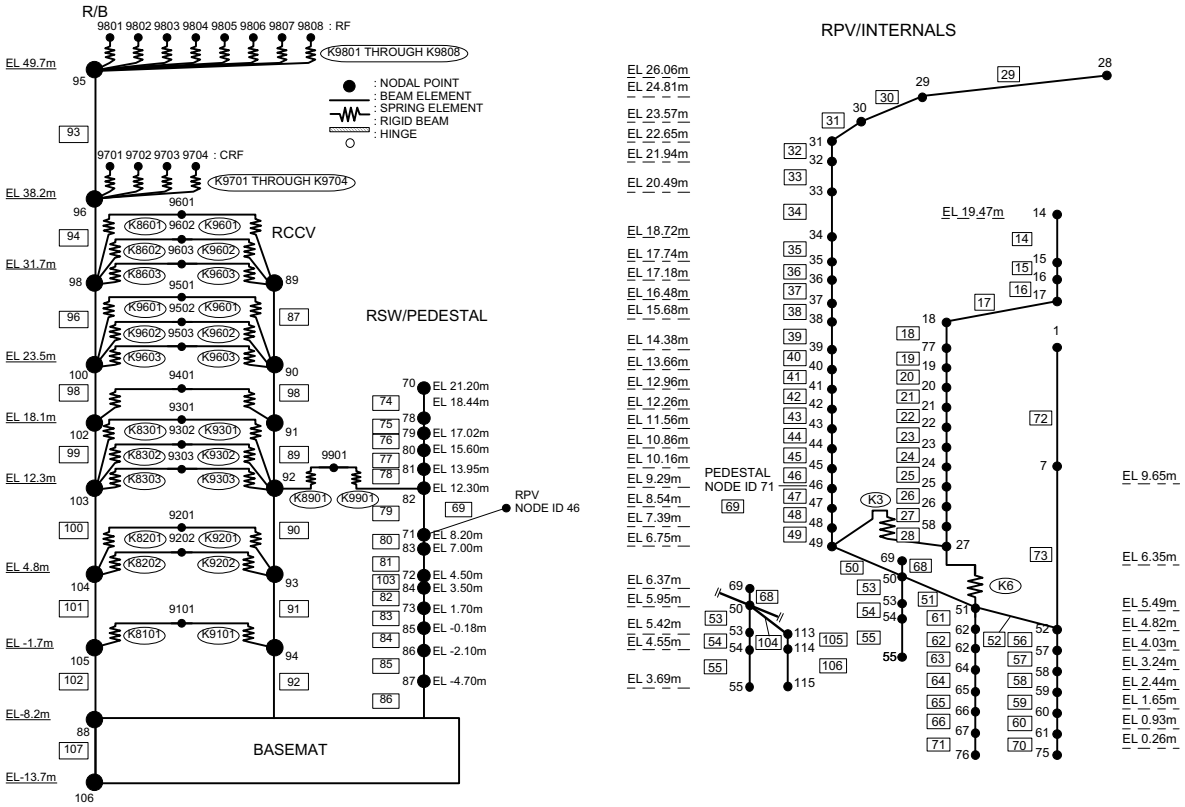


Figure 3A-233 RB Stick Model (Vertical analysis)

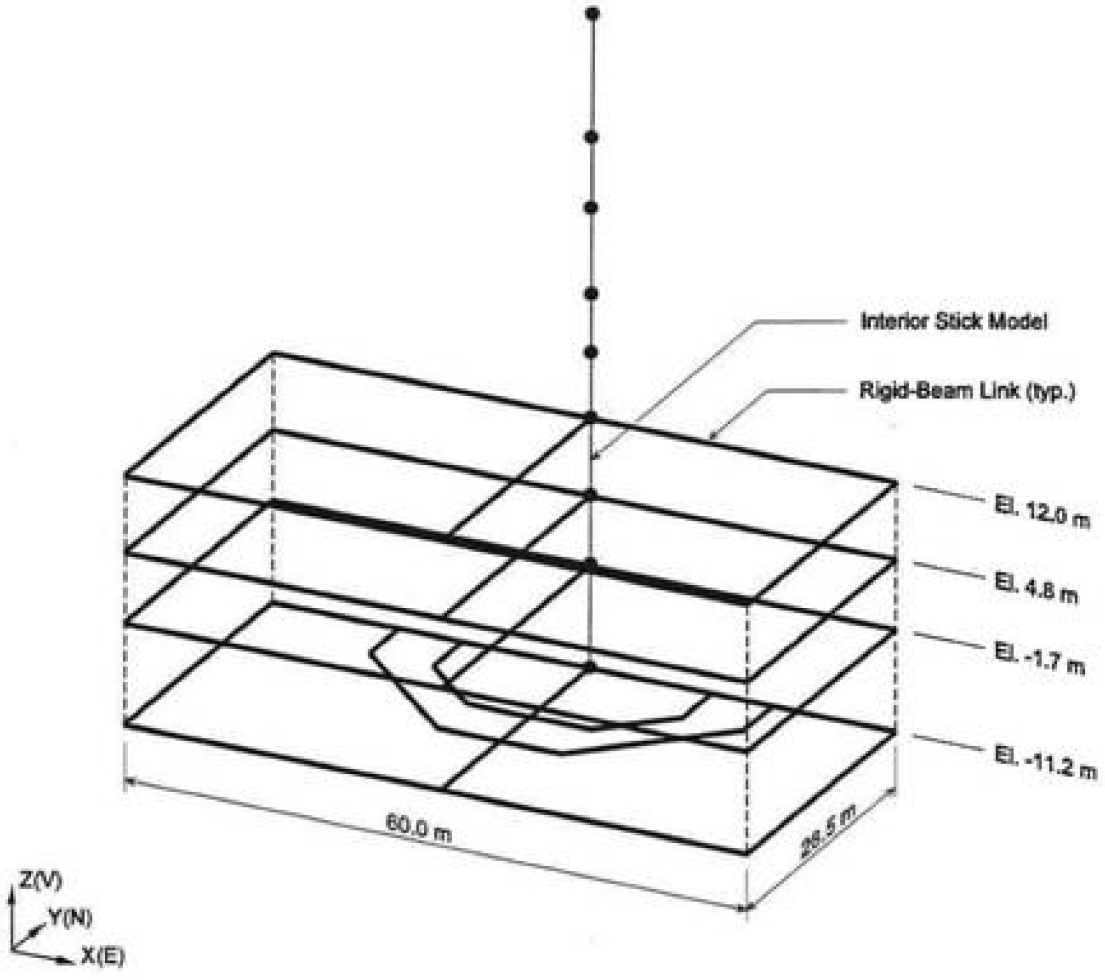


Figure 3A-234 RB SASSI model

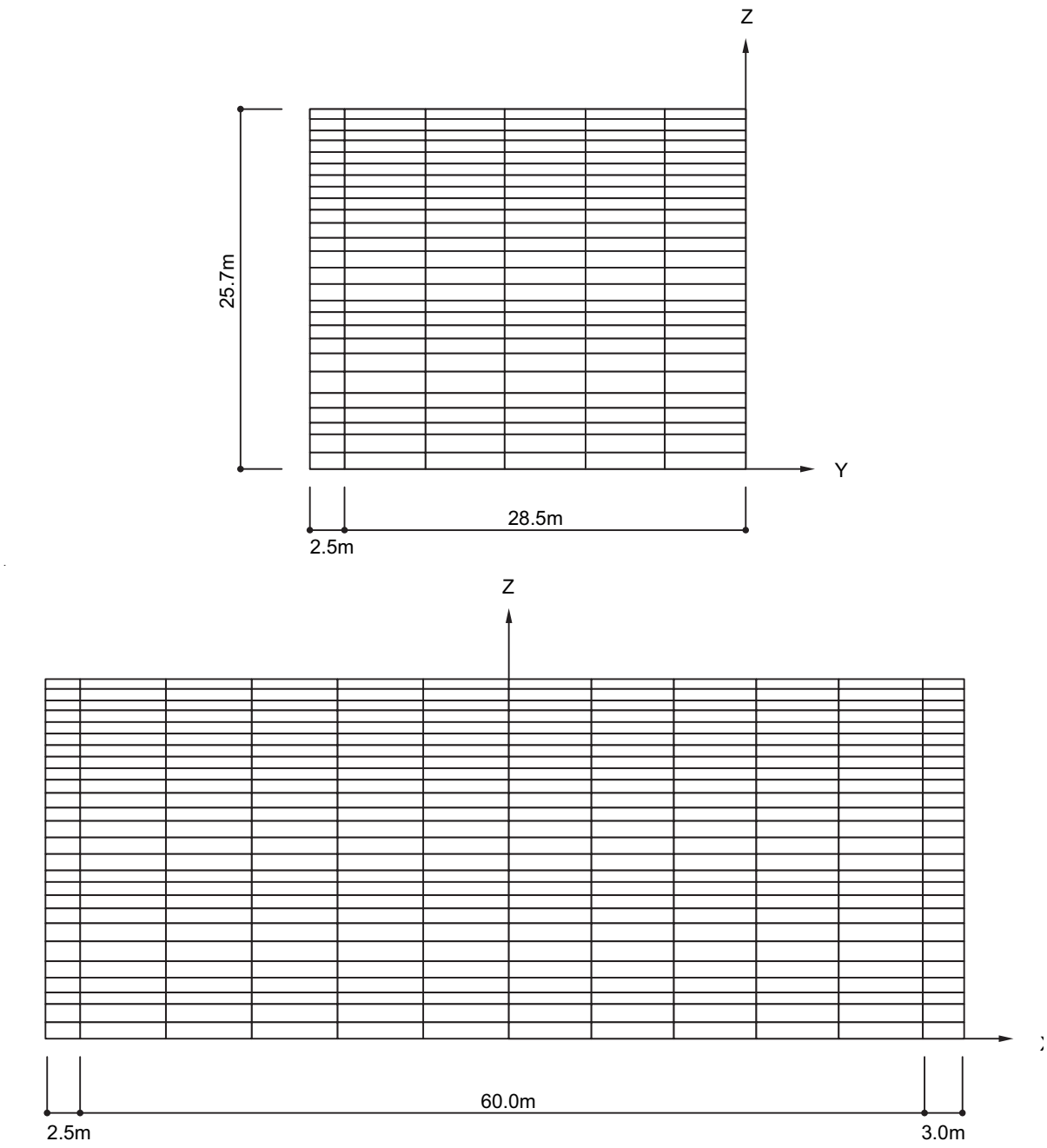


Figure 3A-235 RB Excavated Soil Model

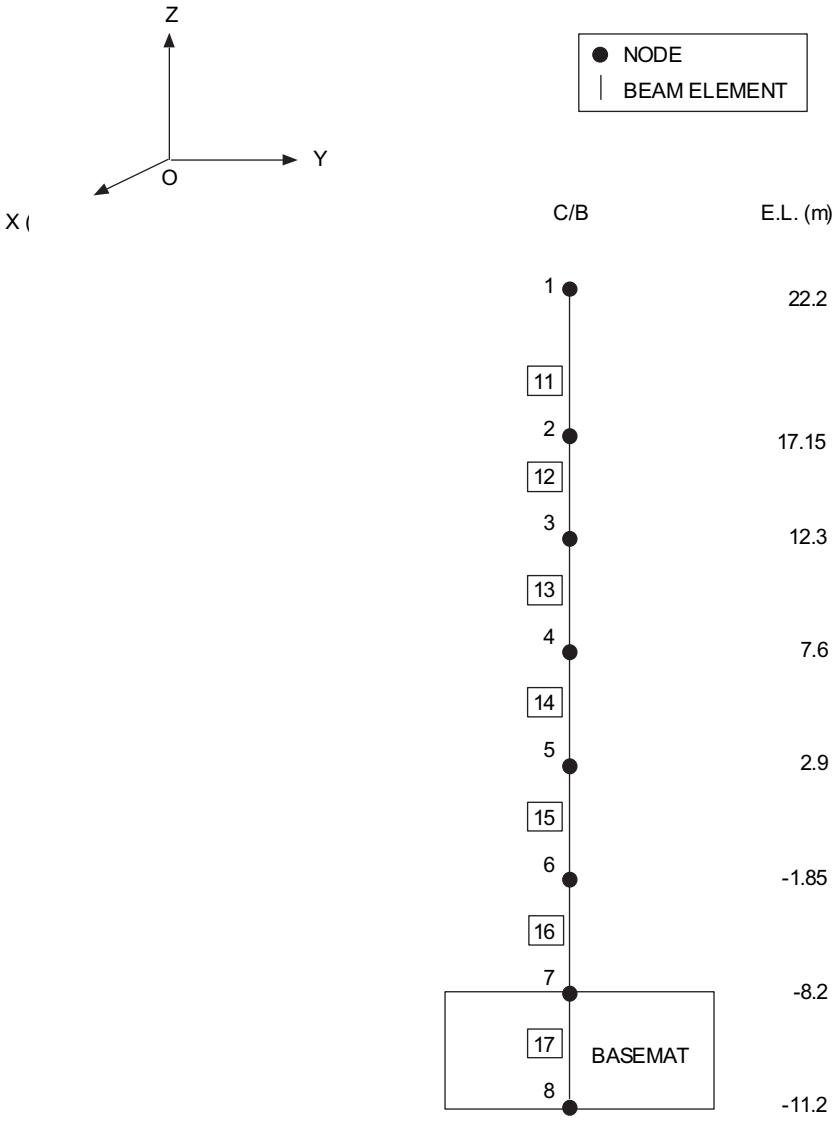


Figure 3A-236 CB Stick Model (Horizontal Analysis)

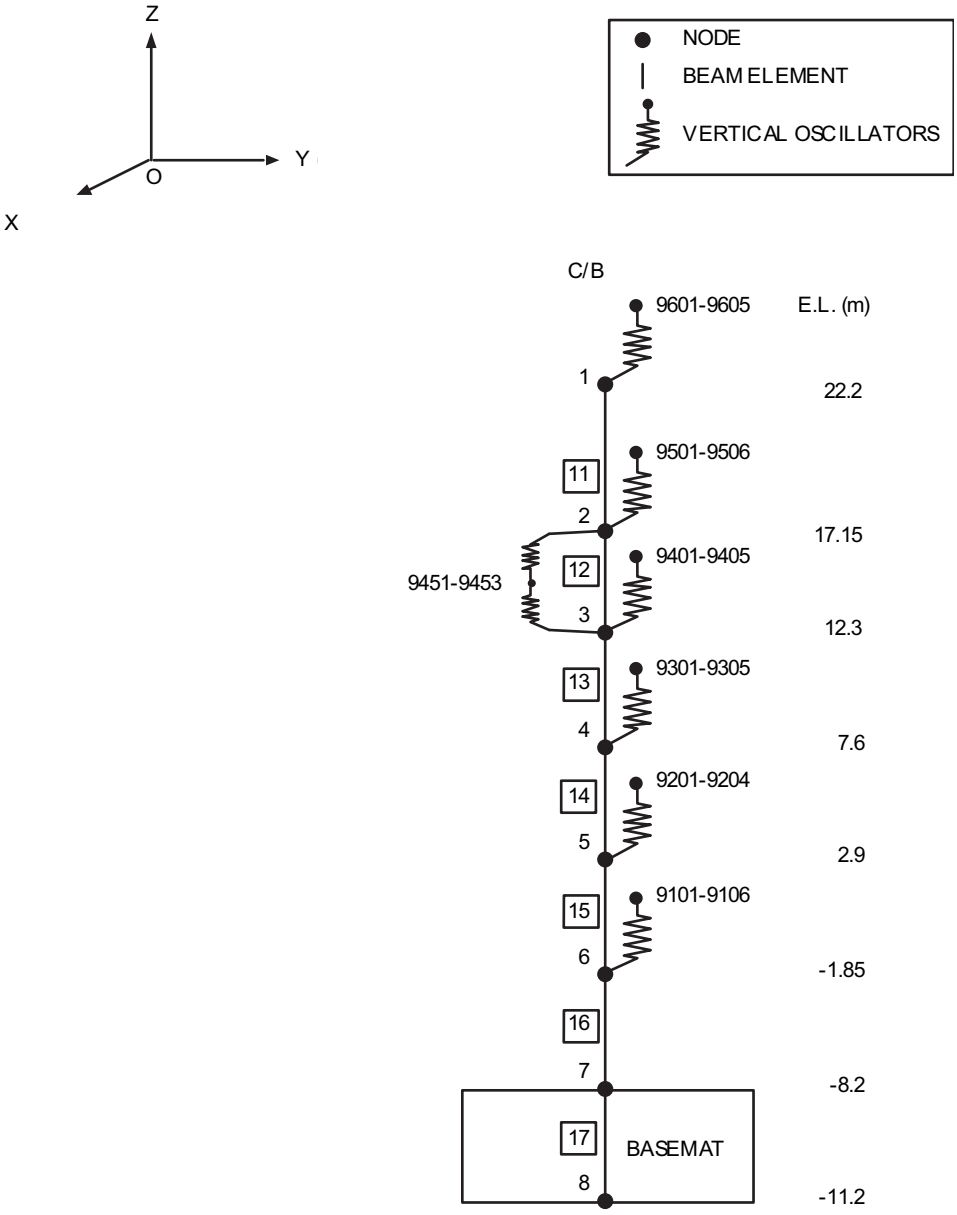


Figure 3A-237 CB Stick Model (Vertical analysis)

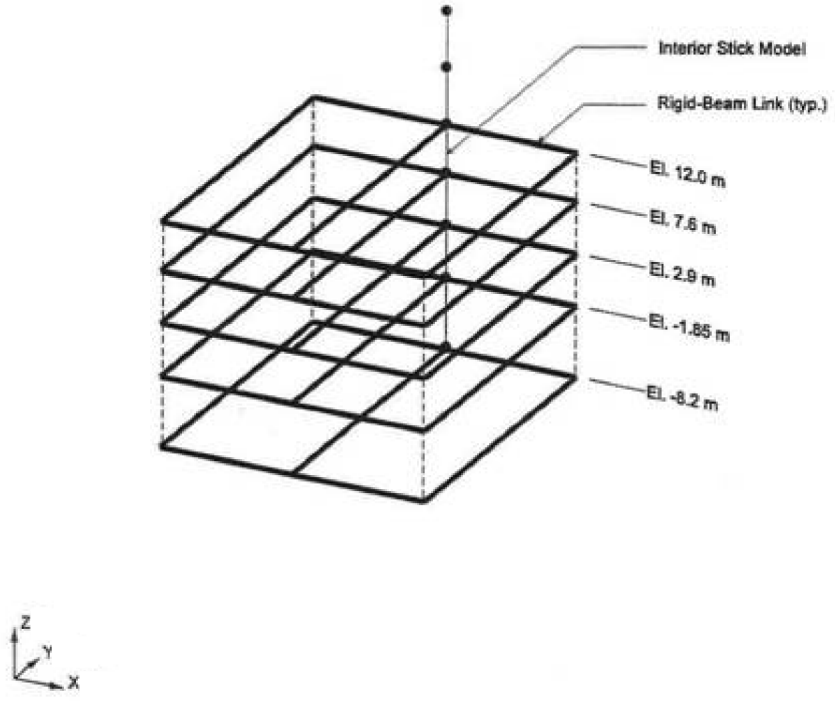


Figure 3A-238 CB SASSI model

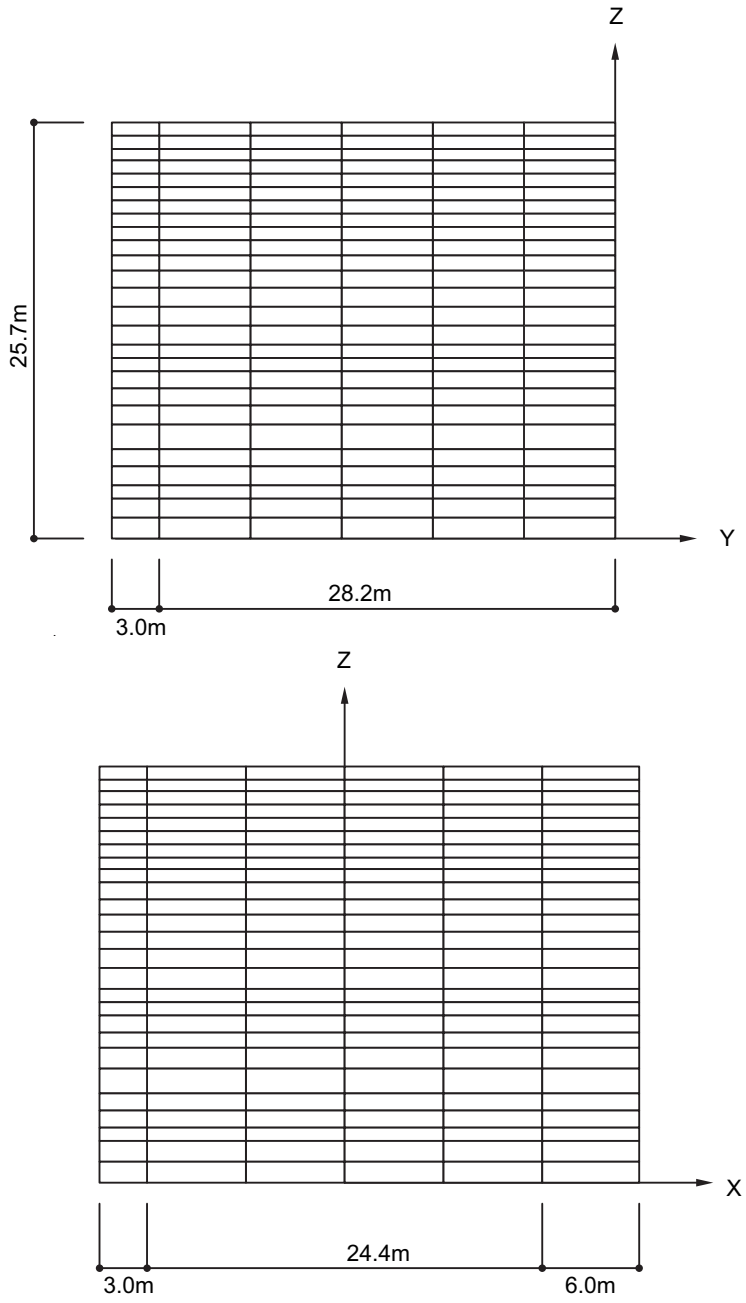
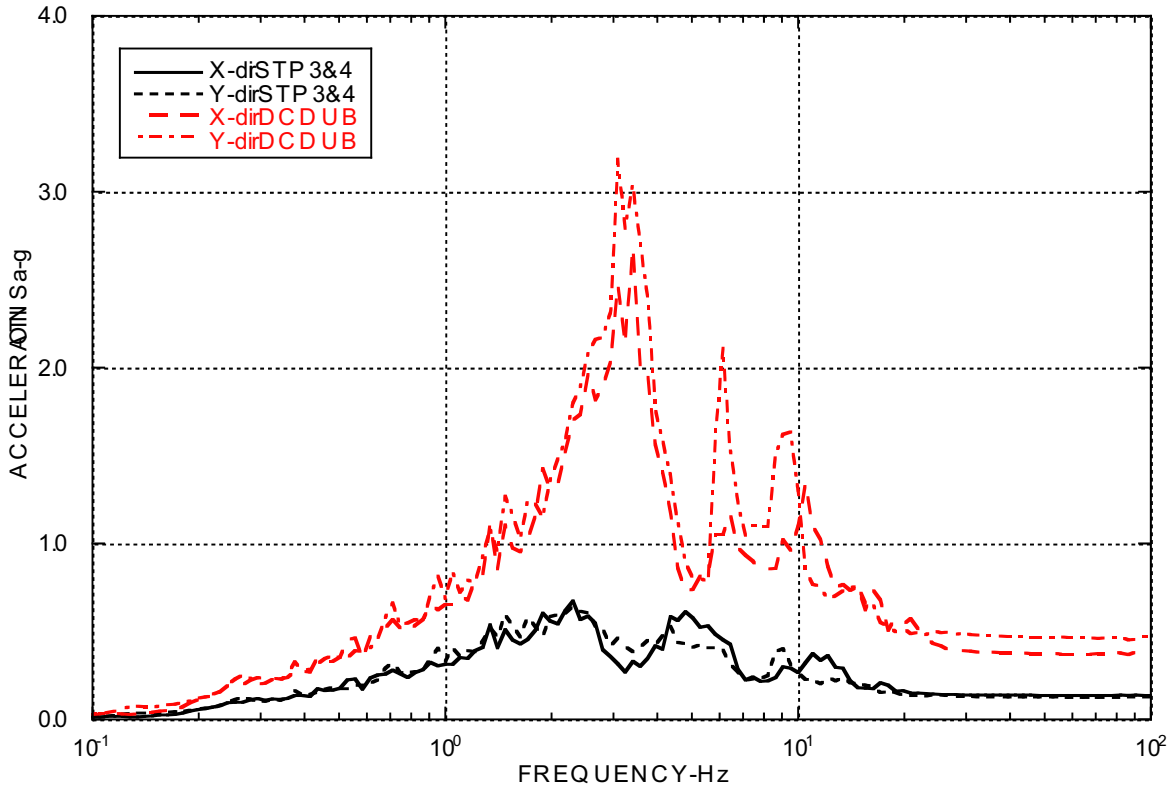


Figure 3A-239 CB Excavated Soil Model



STP3 & 4 : STP 3 & 4 soil condition, RG1.60 0.15g input
DCD UB : DCD UB1D150 soil condition, RG1.60 0.3g input

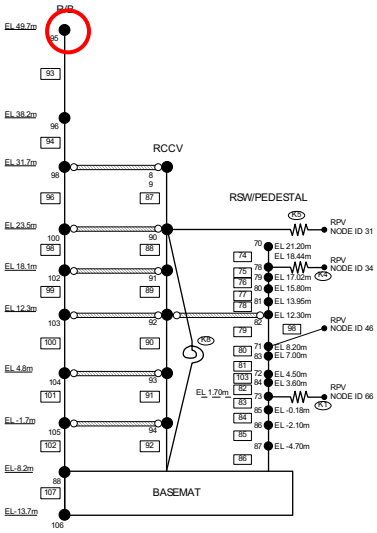
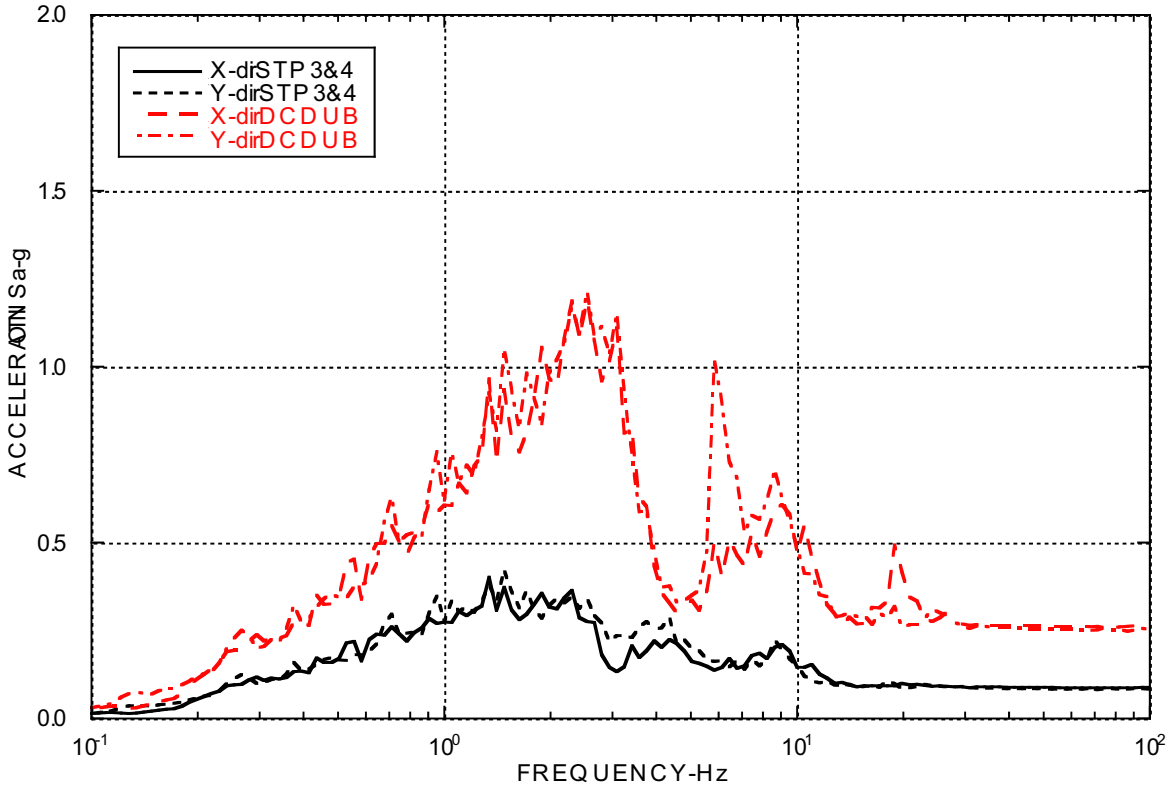


Figure 3A-240 FRS RB Top Node 95 - Horizontal, 2% Damping



STP3 & 4 : STP 3 & 4 soil condition, RG1.60 0.15g input
DCD UB : DCD UB1D150 soil condition, RG1.60 0.3g input

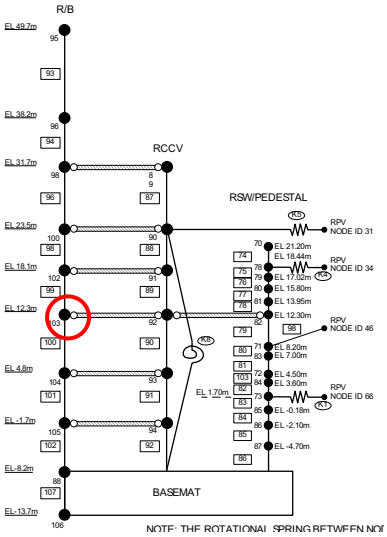
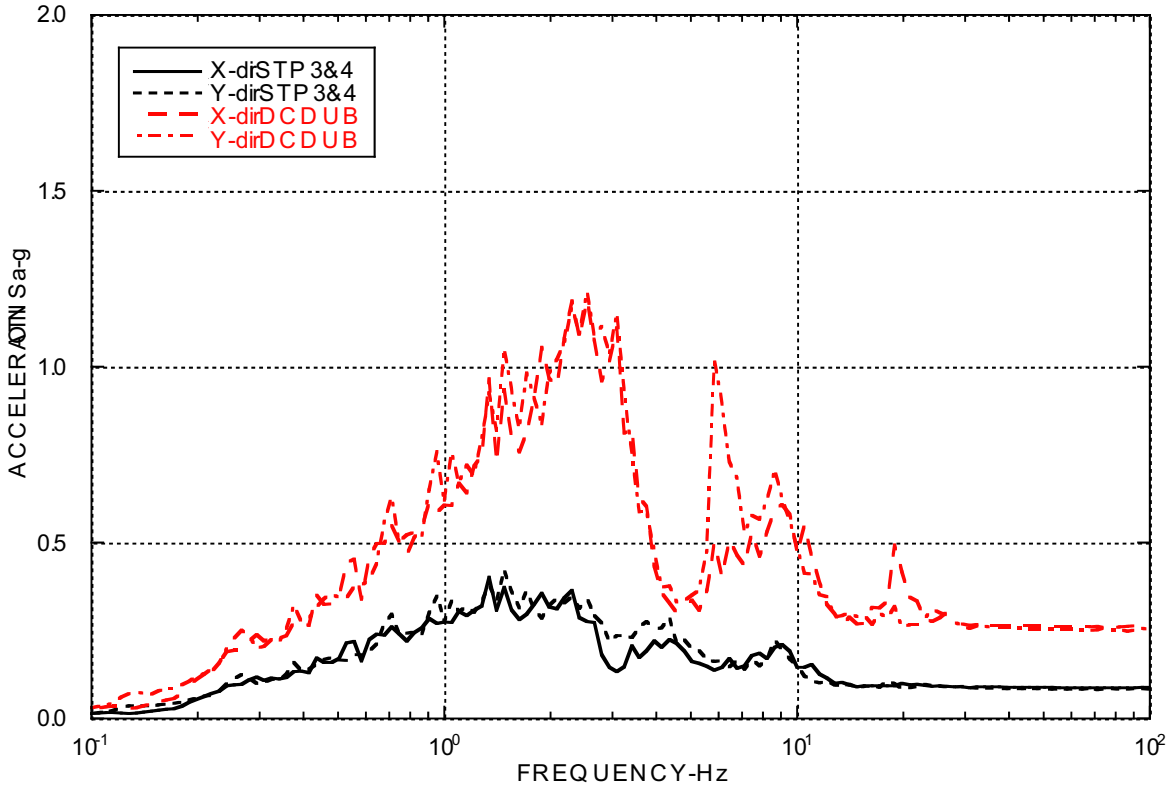


Figure 3A-241 FRS RB Node 103 - Horizontal, 2% Damping



STP3 & 4 : STP 3 & 4 soil condition, RG1.60 0.15g input
DCD UB : DCD UB1D150 soil condition, RG1.60 0.3g input

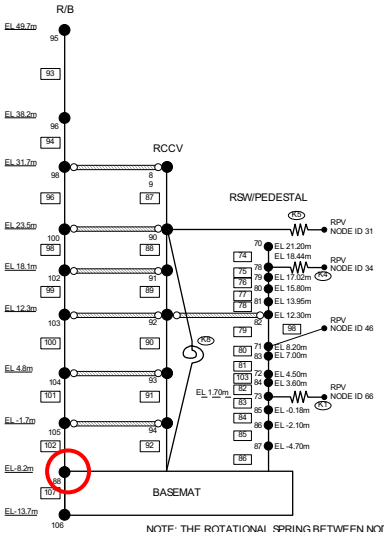
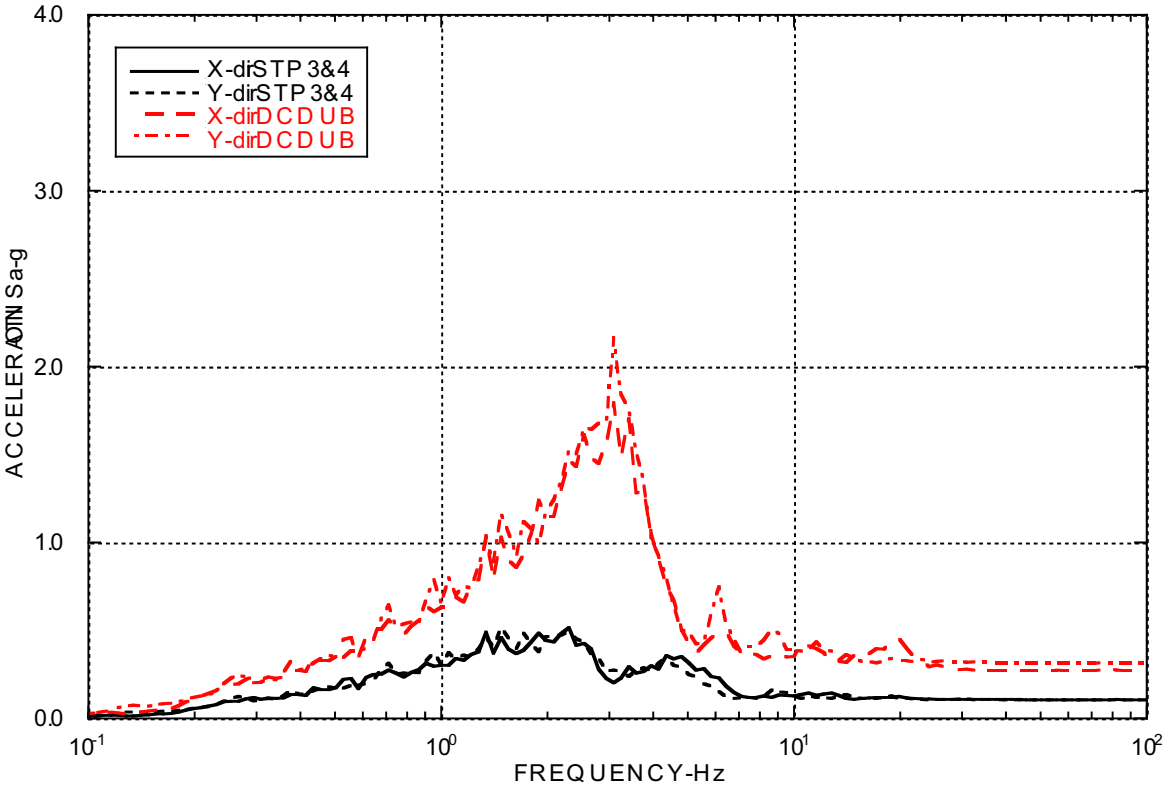


Figure 3A-242 FRS RB Basemat Top Node 88- Horizontal, 2% Damping



STP3 & 4 : STP 3 & 4 soil condition, RG1.60 0.15g input
DCD UB : DCD UB1D150 soil condition, RG1.60 0.3g input

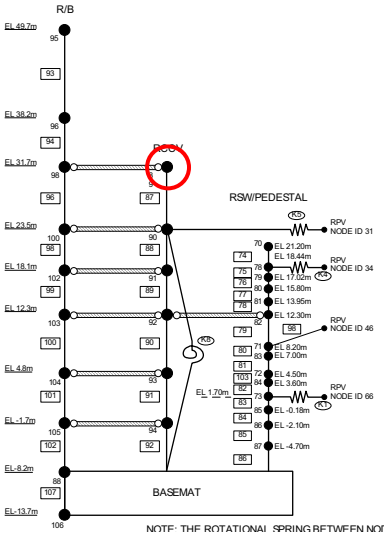
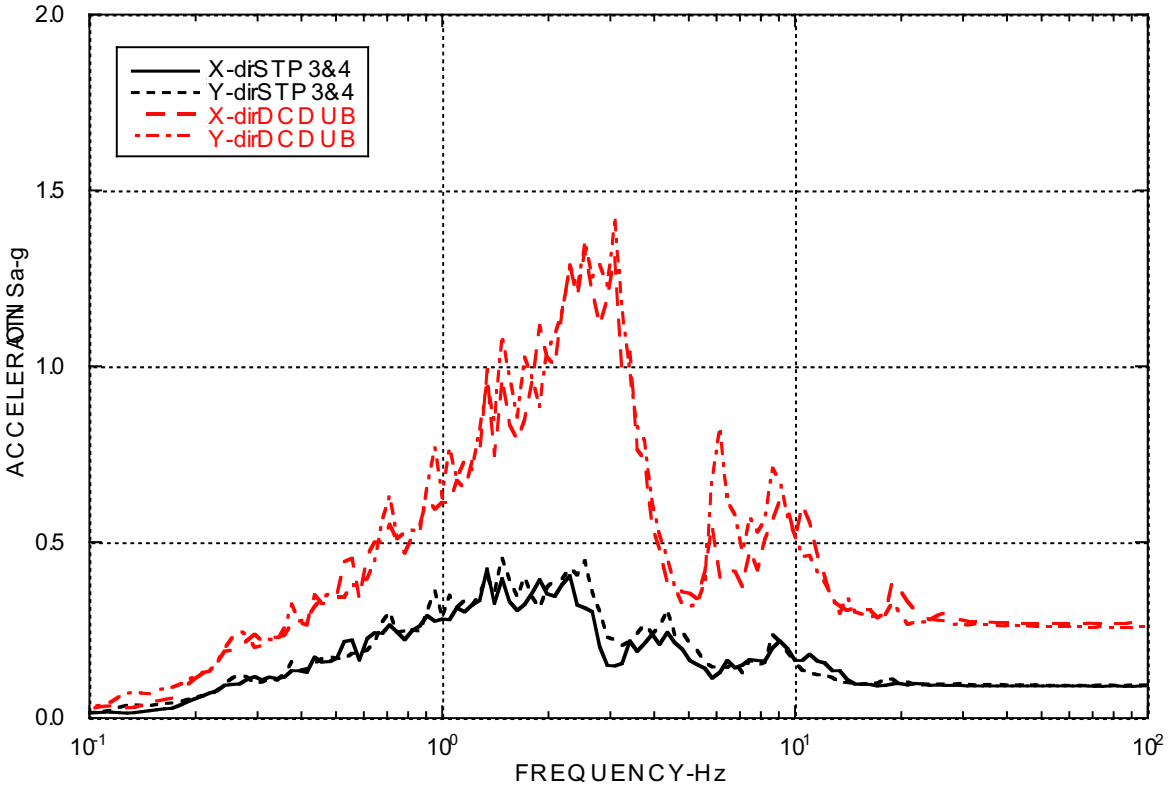


Figure 3A-243 FRS RCCV Top Node 89- Horizontal, 2% Damping



STP3 & 4 : STP 3 & 4 soil condition, RG1.60 0.15g input
DCD UB : DCD UB1D150 soil condition, RG1.60 0.3g input

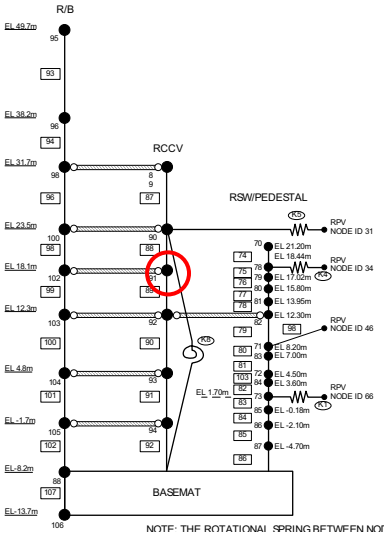
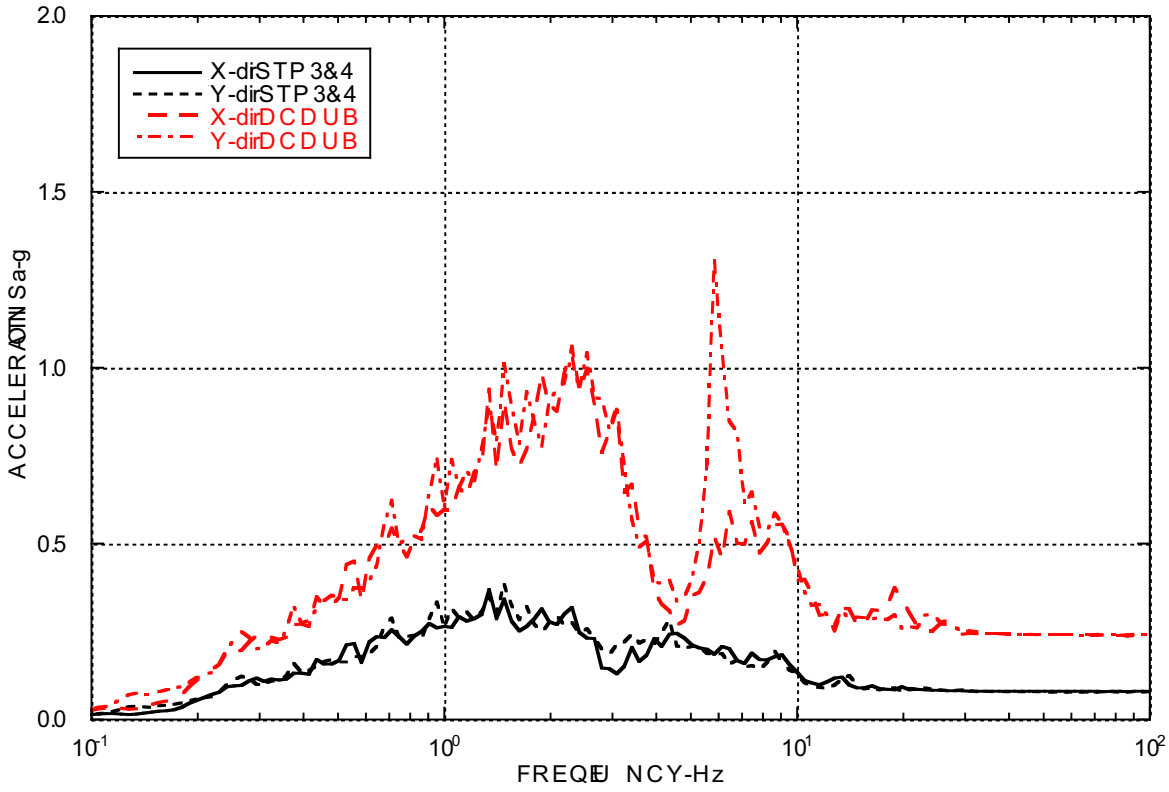


Figure 3A-244 FRS RCCV Node 91- Horizontal, 2% Damping



STP3 & 4 : STP 3 & 4 soil condition, RG1.60 0.15g input
DCD UB : DCD UB1D150 soil condition, RG1.60 0.3g input

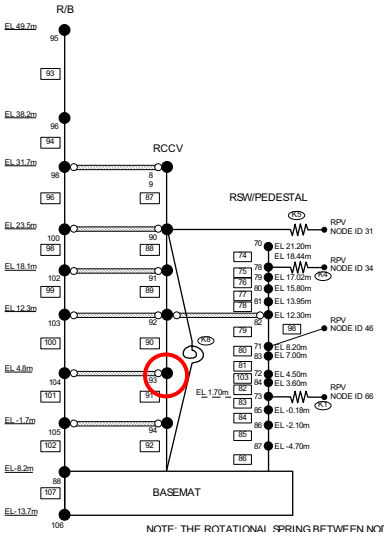
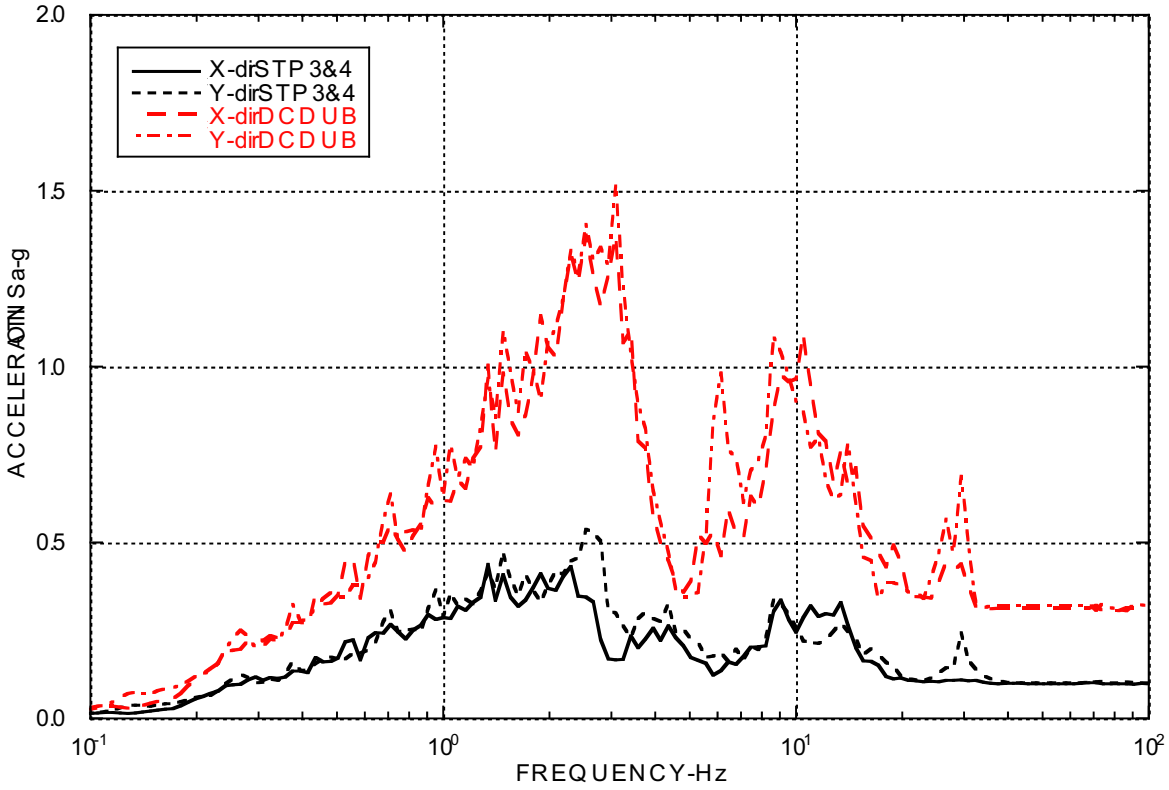


Figure 3A-245 FRS RCCV Node 93- Horizontal, 2% Damping



STP3 & 4 : STP 3 & 4 soil condition, RG1.60 0.15g input
DCD UB : DCD UB1D150 soil condition, RG1.60 0.3g input

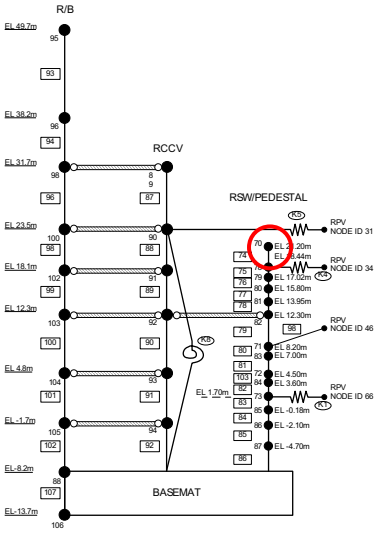
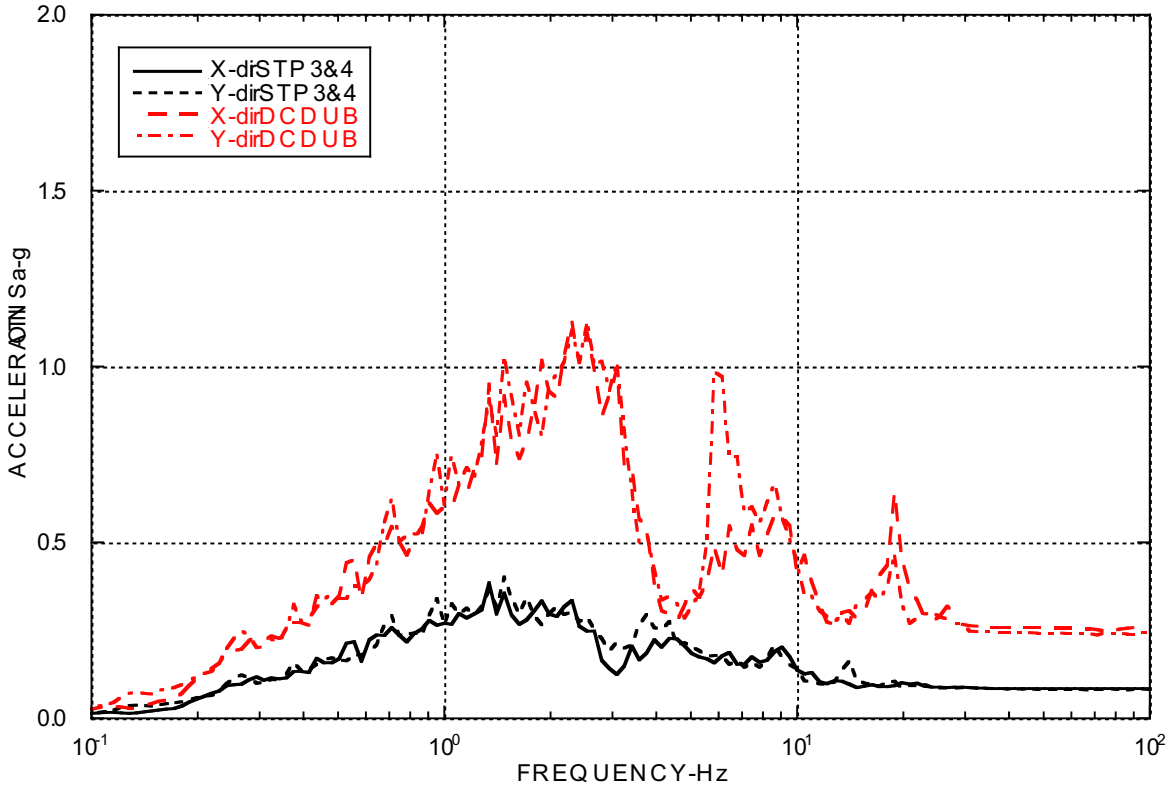


Figure 3A-246 FRS RSW/Pedestal Top Node 70- Horizontal, 2% Damping



STP3 & 4 : STP 3 & 4 soil condition, RG1.60 0.15g input
DCD UB : DCD UB1D150 soil condition, RG1.60 0.3g input

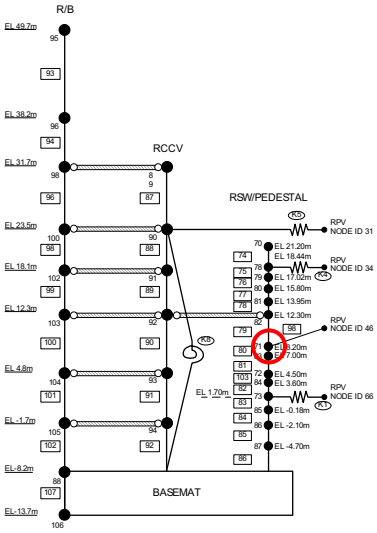
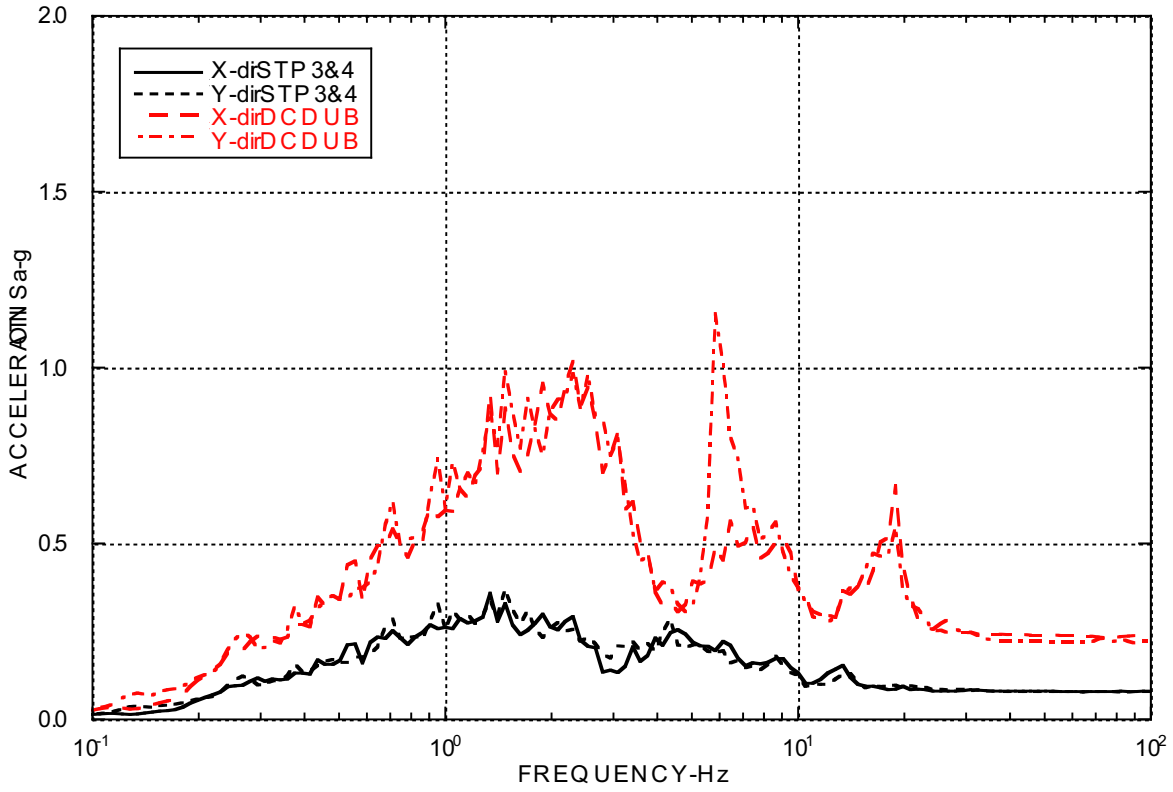


Figure 3A-247 FRS RSW/Pedestal Node 71- Horizontal, 2% Damping



STP3 & 4 : STP 3 & 4 soil condition, RG1.60 0.15g input
DCD UB : DCD UB1D150 soil condition, RG1.60 0.3g input

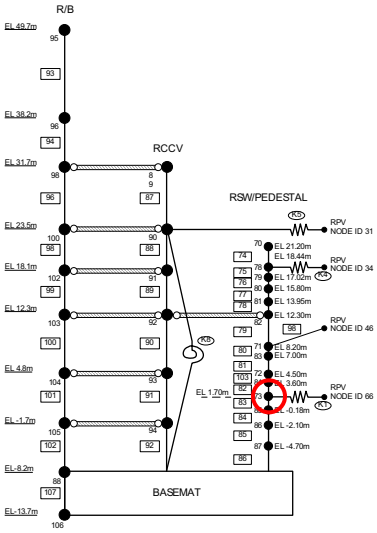
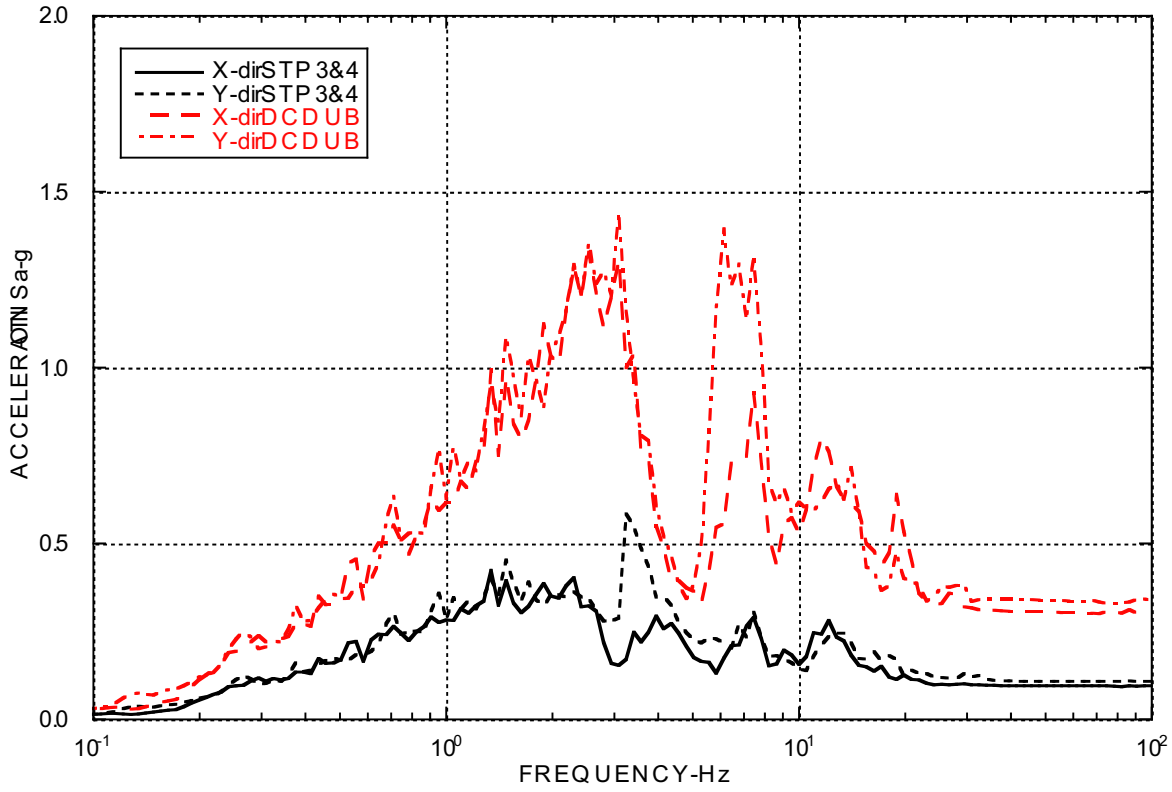


Figure 3A-248 FRS RSW/Pedestal Node 73- Horizontal, 2% Damping



STP3 & 4 : STP 3 & 4 soil condition, RG1.60 0.15g input
DCD UB : DCD UB1D150 soil condition, RG1.60 0.3g input

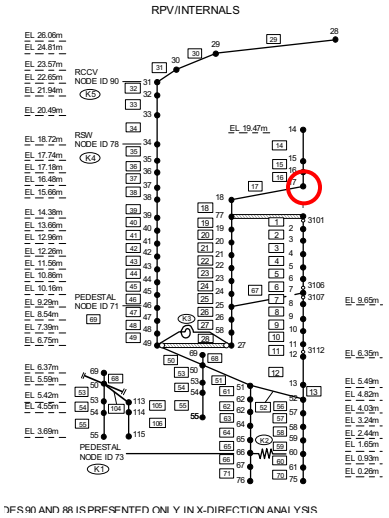
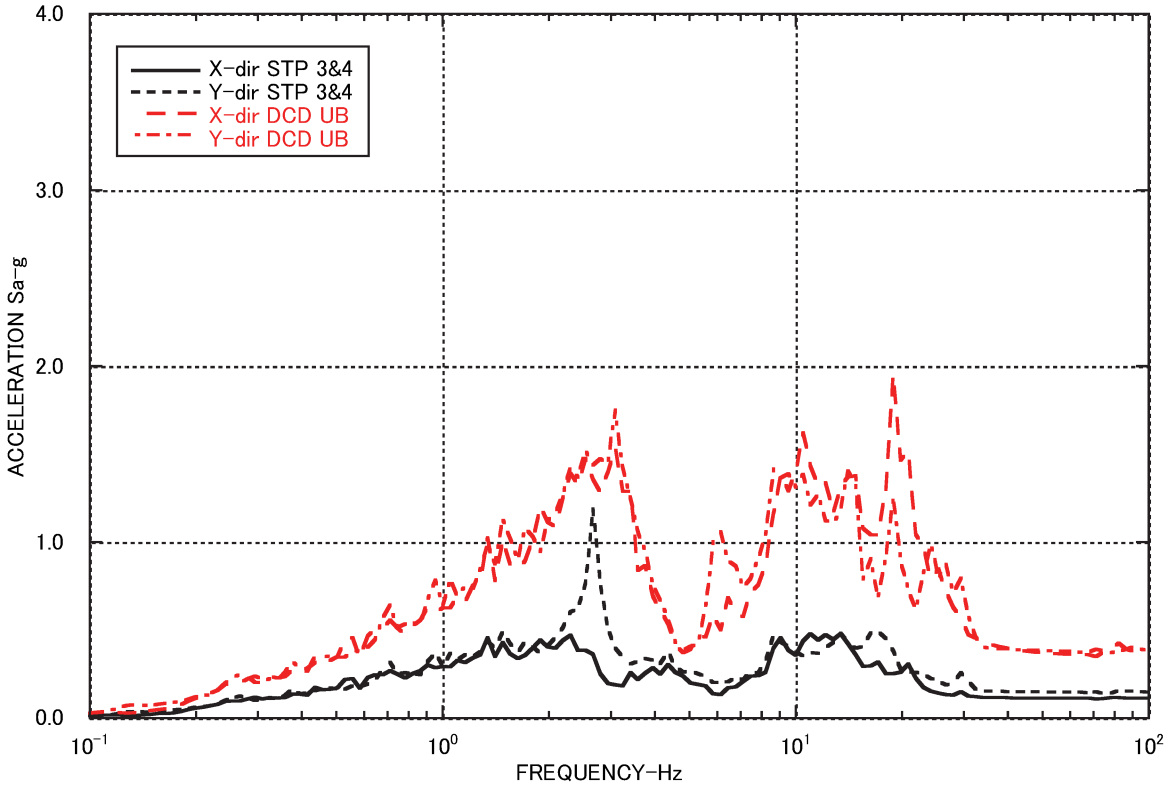


Figure 3A-249 FRS RPV/Internals Node 17- Horizontal, 2% Damping



STP 3 & 4 : STP 3 & 4 soil condition, RG 1.60 0.15g input
DCD UB : DCD UB1D150 soil condition, RG 1.60 0.3g input

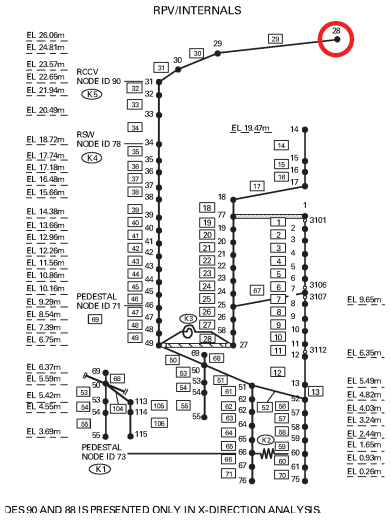
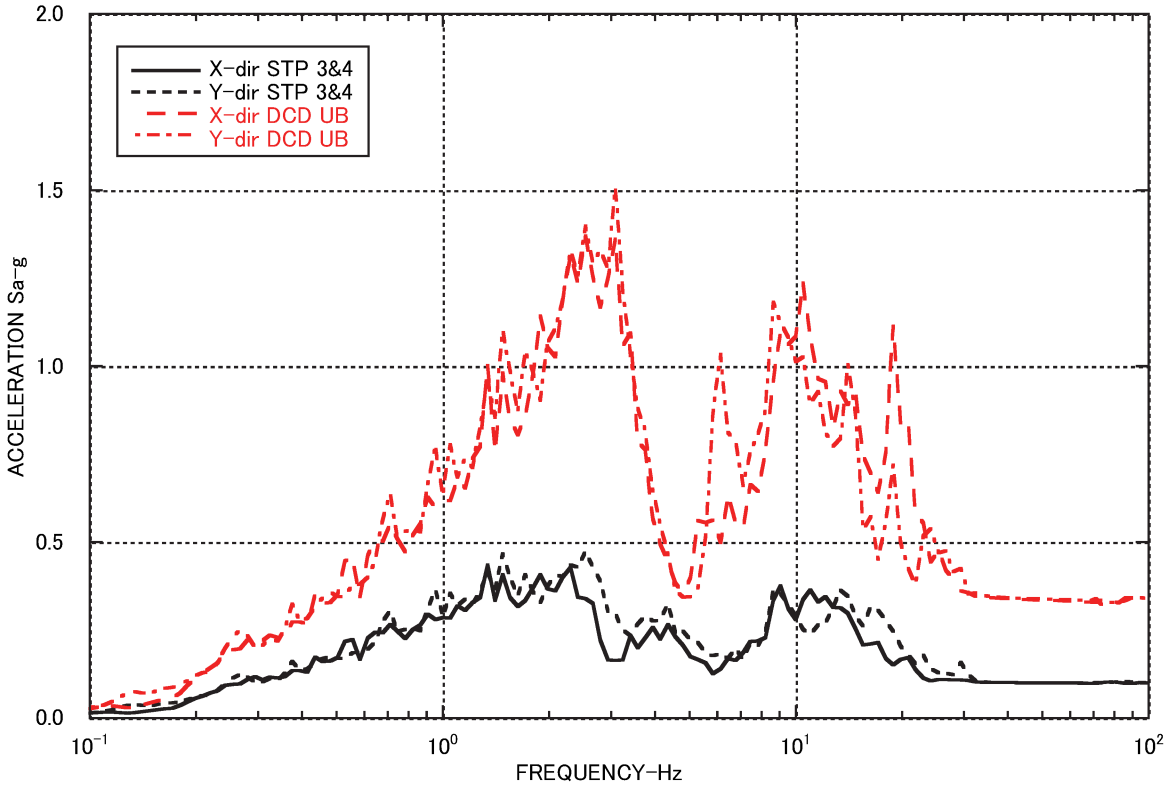


Figure 3A-250 FRS RPV/Internals Node 28- Horizontal, 2% Damping



STP 3 & 4 : STP 3 & 4 soil condition, RG 1.60 0.15g input
DCD UB : DCD UB1D150 soil condition, RG 1.60 0.3g input

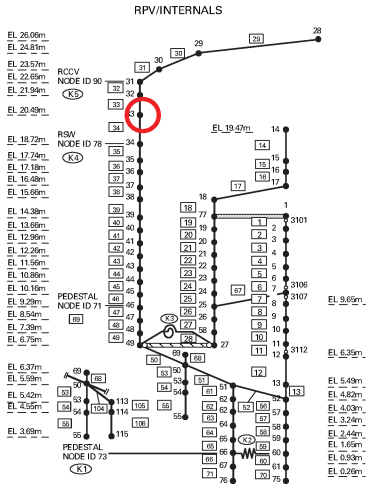
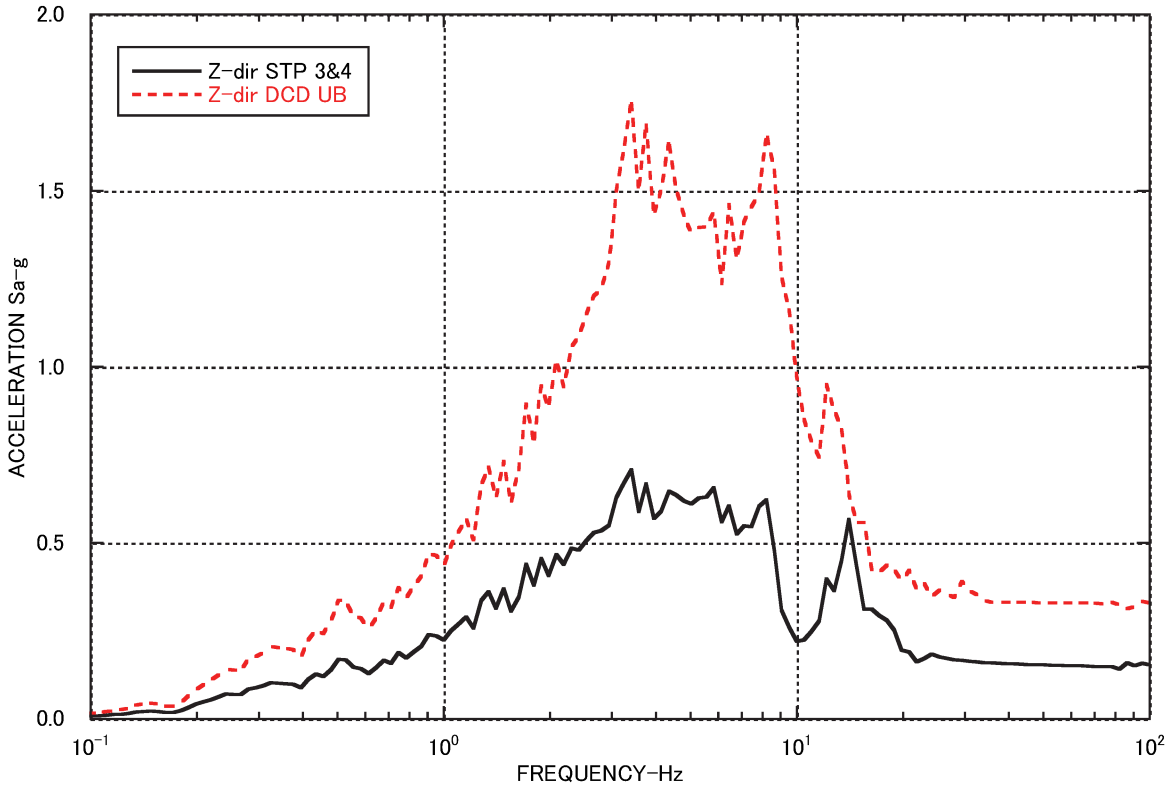


Figure 3A-251 FRS RPV/Internals Node 33- Horizontal, 2% Damping



STP 3 & 4 : STP 3 & 4 soil condition, RG 1.60 0.15g input
DCD UB : DCD UB1D150 soil condition, RG 1.60 0.3g input

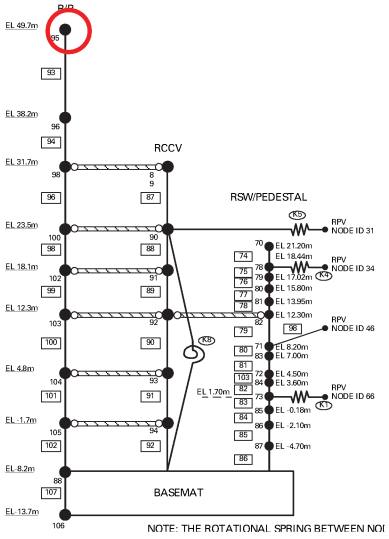
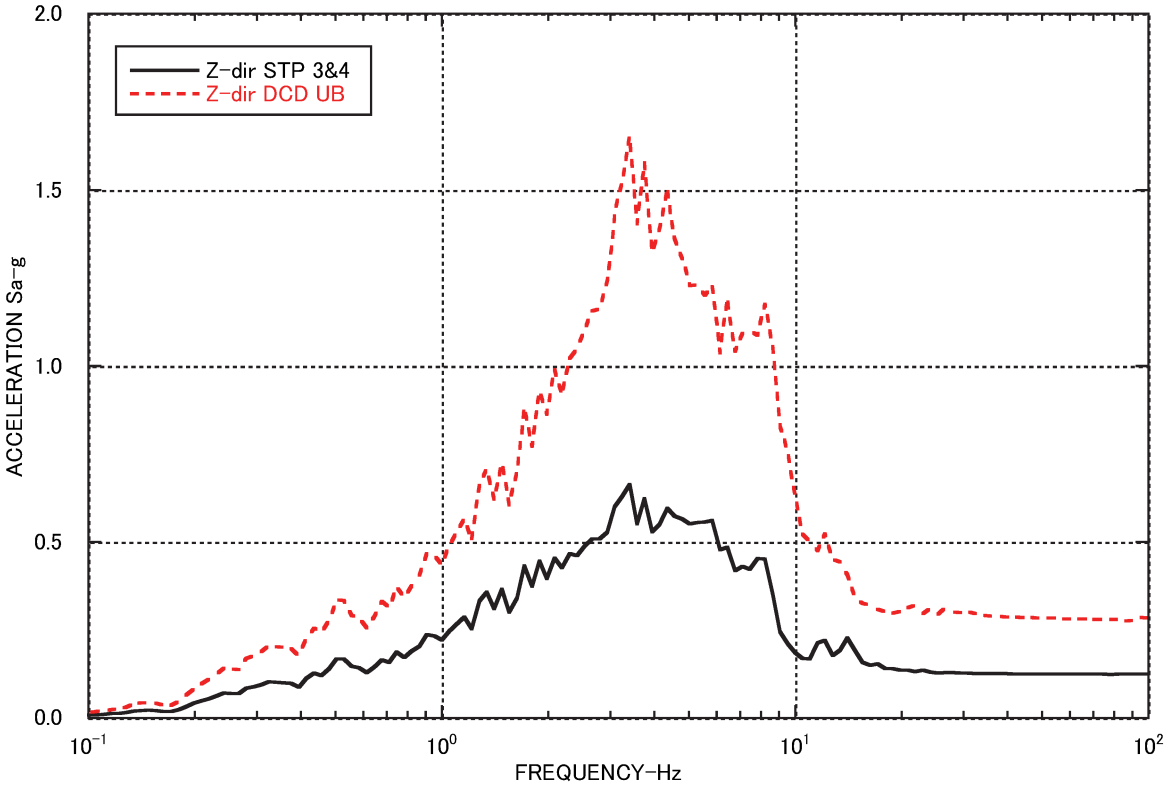


Figure 3A-252 FRS RB Top Node 95 - Vertical, 2% Damping



STP 3 & 4 : STP 3 & 4 soil condition, RG 1.60 0.15g input
DCD UB : DCD UB1D150 soil condition, RG 1.60 0.3g input

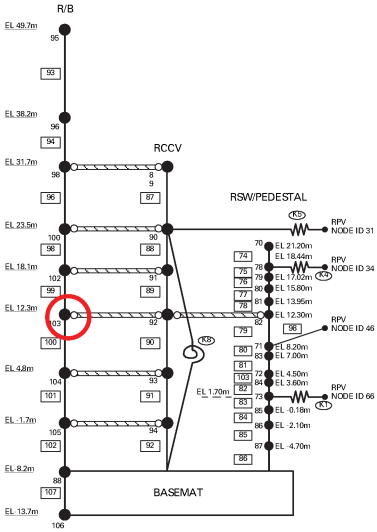
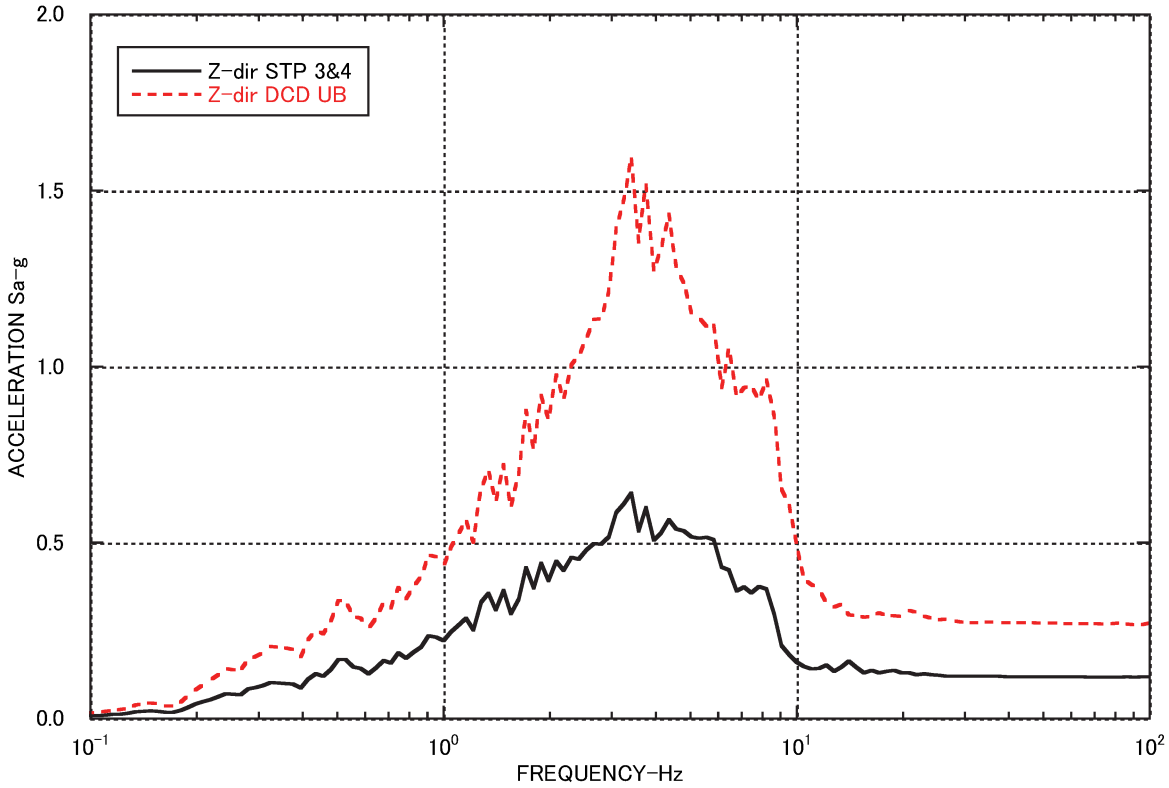


Figure 3A-253 FRS RB Node 103 - Vertical, 2% Damping



STP 3 & 4 : STP 3 & 4 soil condition, RG 1.60 0.15g input
DCD UB : DCD UB1D150 soil condition, RG 1.60 0.3g input

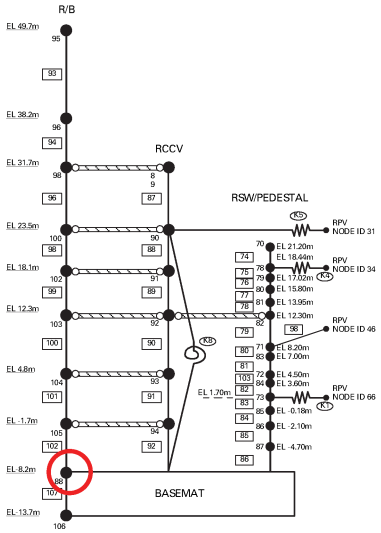
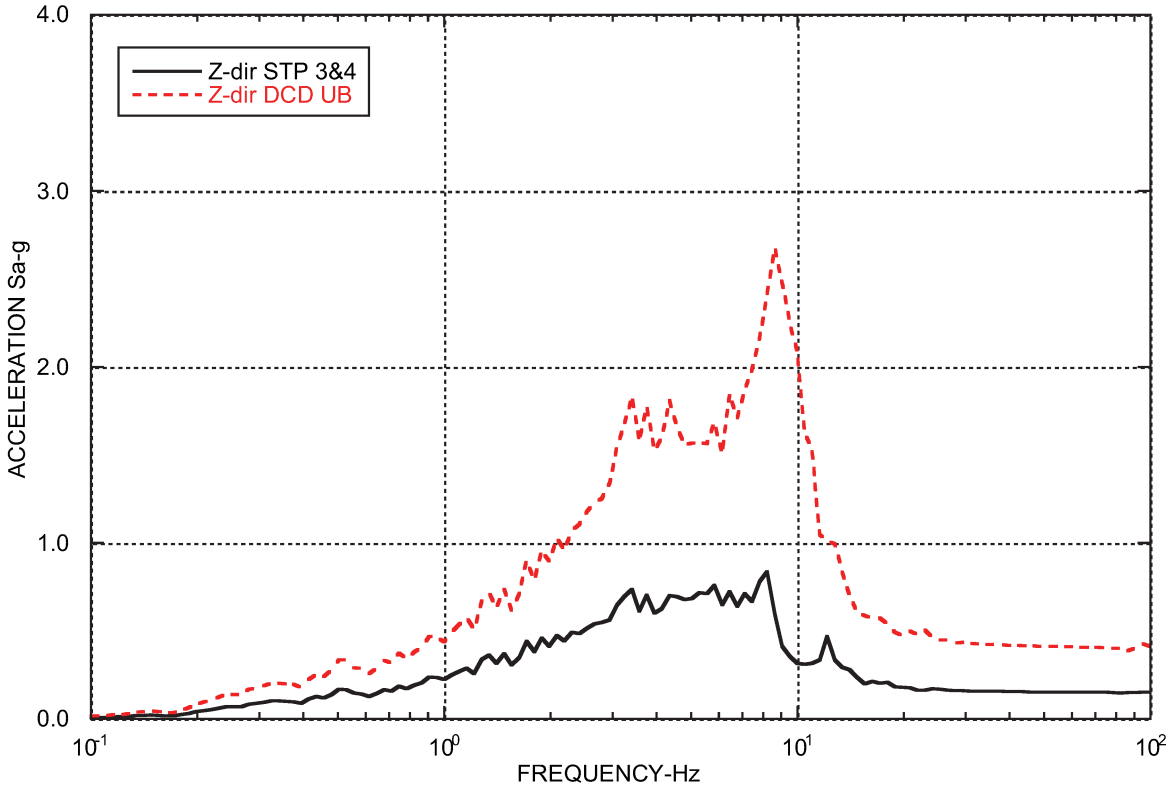


Figure 3A-254 FRS RB Basemat Top Node 88- Vertical, 2% Damping



STP 3 & 4 : STP 3 & 4 soil condition, RG 1.60 0.15g input
DCD UB : DCD UB1D150 soil condition, RG 1.60 0.3g input

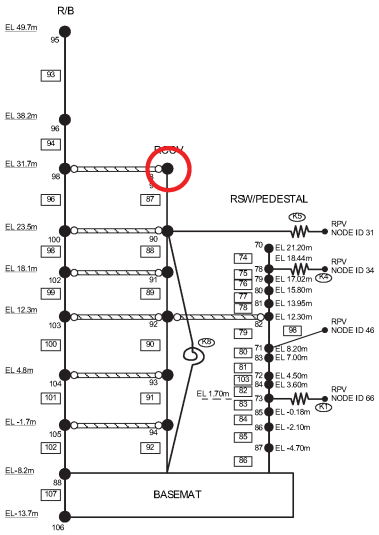
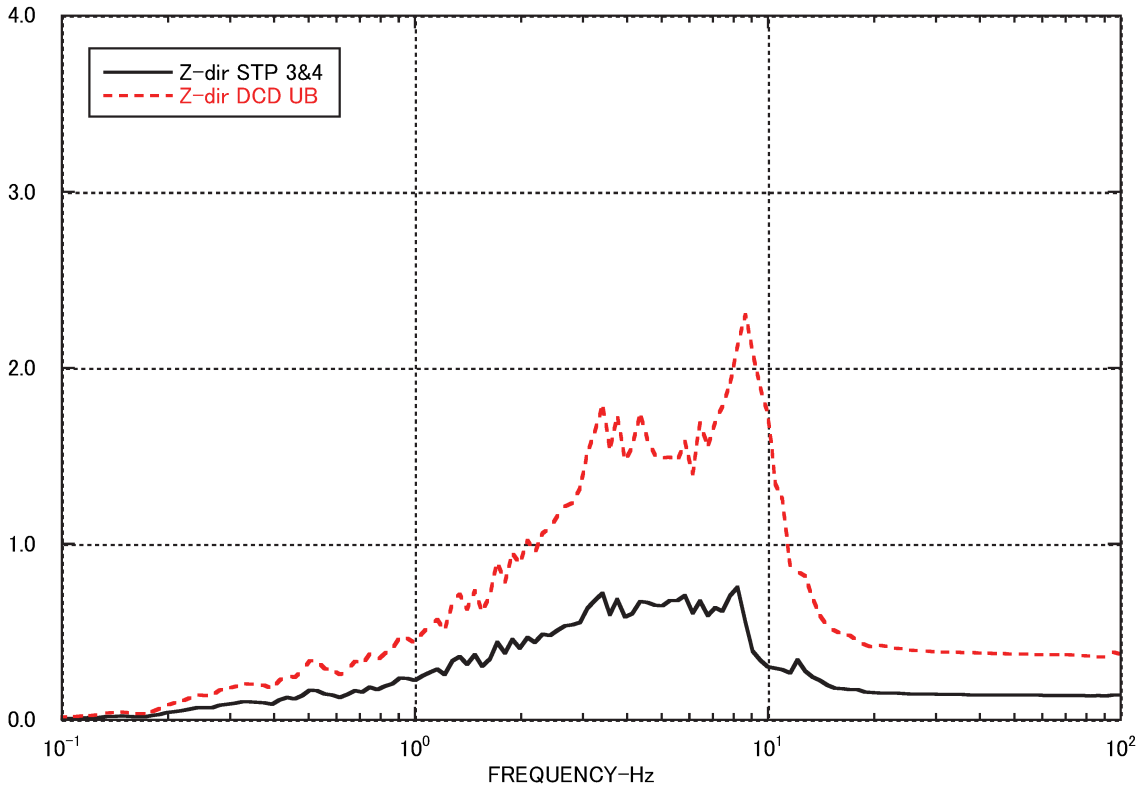


Figure 3A-255 FRS RCCV Top Node 89- Vertical, 2% Damping



STP 3 & 4 : STP 3 & 4 soil condition, RG 1.60 0.15g input
DCD UB : DCD UB1D150 soil condition, RG 1.60 0.3g input

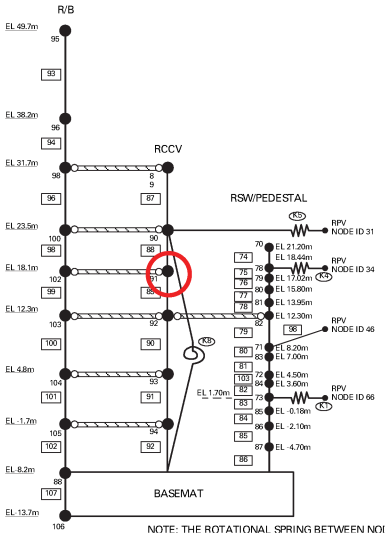
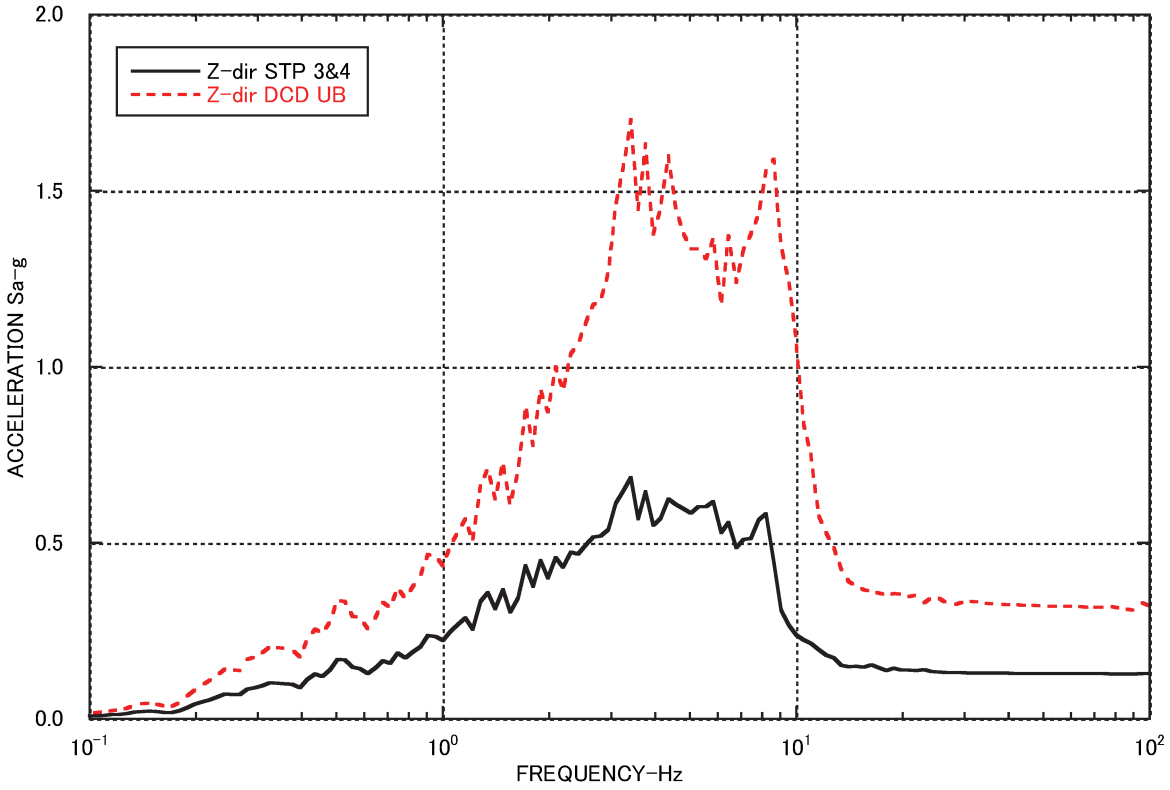


Figure 3A-256 FRS RCCV Node 91- Vertical, 2% Damping



STP 3 & 4 : STP 3 & 4 soil condition, RG 1.60 0.15g input
DCD UB : DCD UB1D150 soil condition, RG 1.60 0.3g input

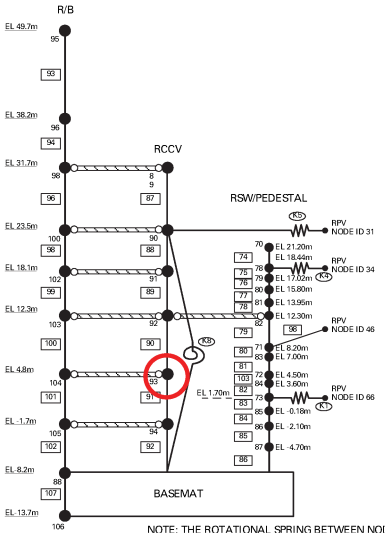
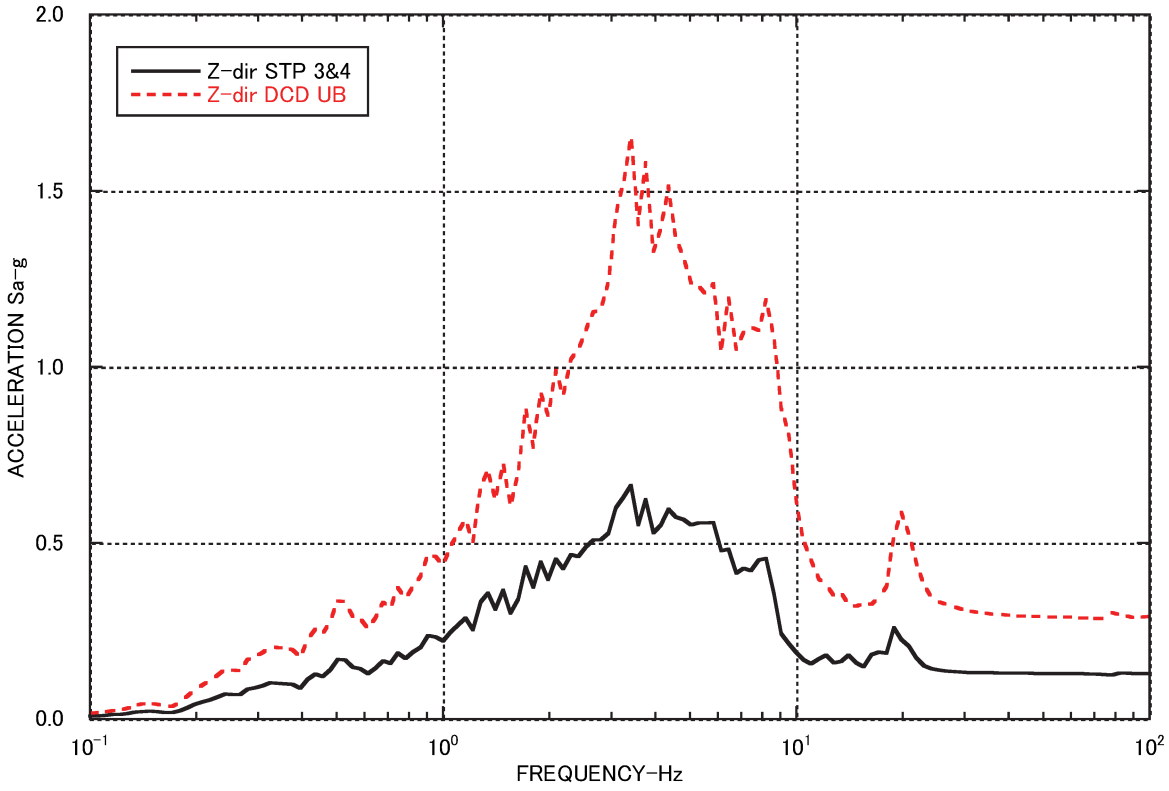


Figure 3A-257 FRS RCCV Node 93- Vertical, 2% Damping



STP 3 & 4 : STP 3 & 4 soil condition, RG 1.60 0.15g input
DCD UB : DCD UB1D150 soil condition, RG 1.60 0.3g input

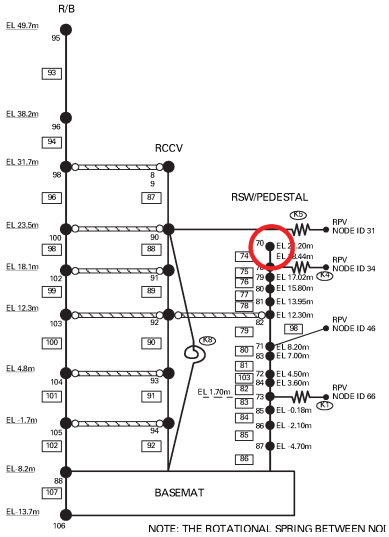
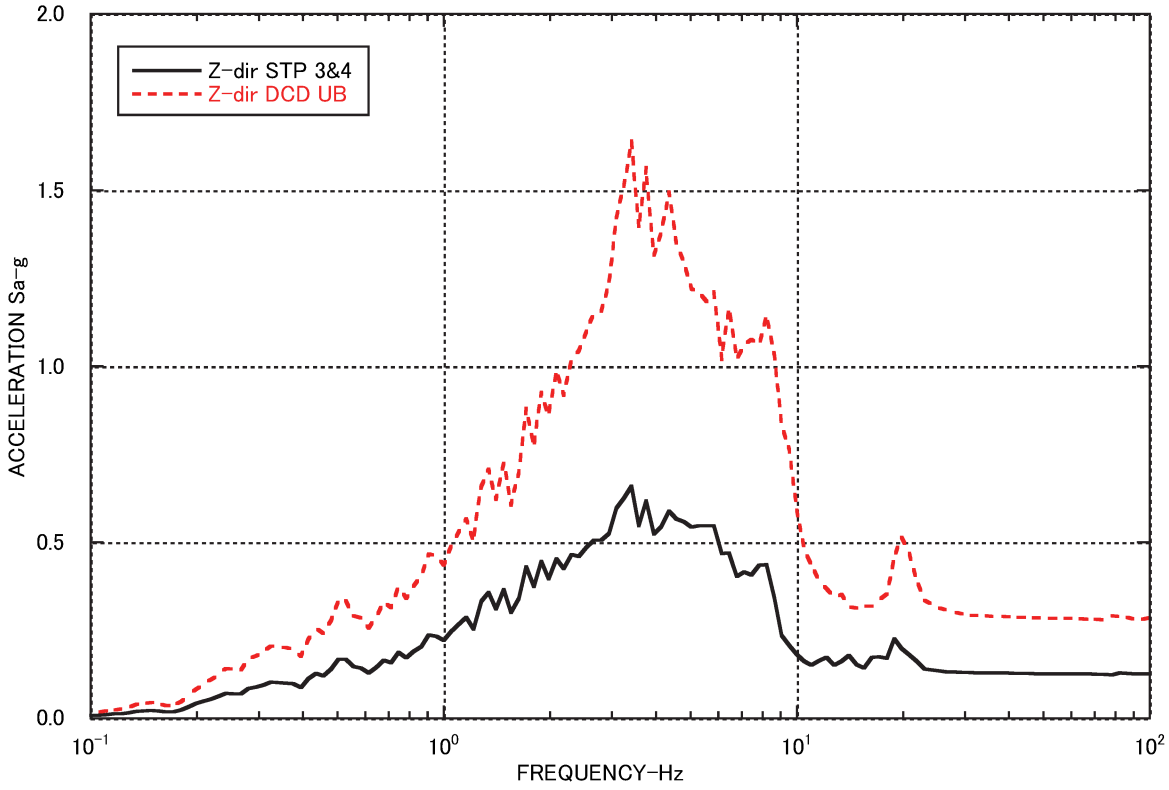


Figure 3A-258 FRS RSW/Pedestal Top Node 70- Vertical, 2% Damping



STP 3 & 4 : STP 3 & 4 soil condition, RG 1.60 0.15g input
DCD UB : DCD UB1D150 soil condition, RG 1.60 0.3g input

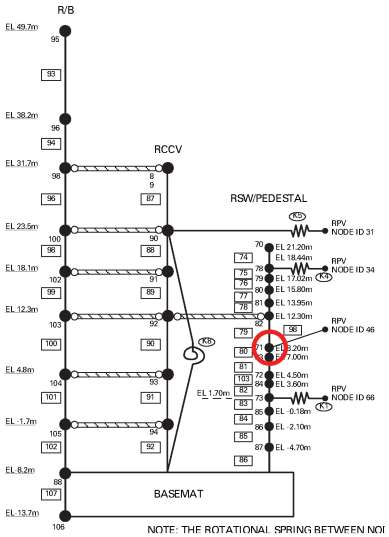
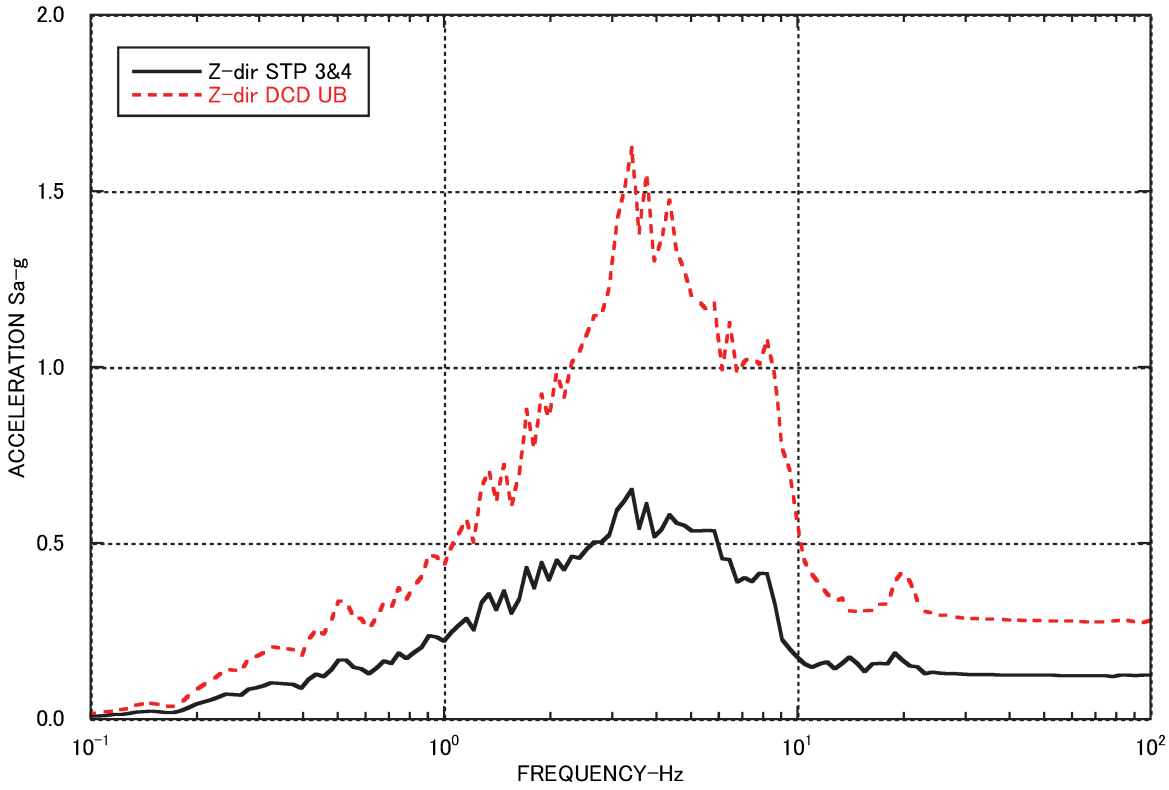


Figure 3A-259 FRS RSW/Pedestal Node 71- Vertical, 2% Damping



STP 3 & 4 : STP 3 & 4 soil condition, RG 1.60 0.15g input
DCD UB : DCD UB1D150 soil condition, RG 1.60 0.3g input

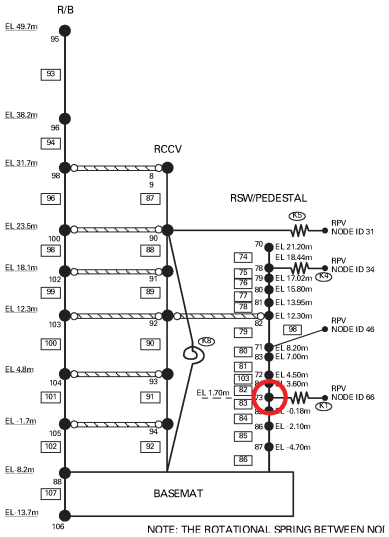
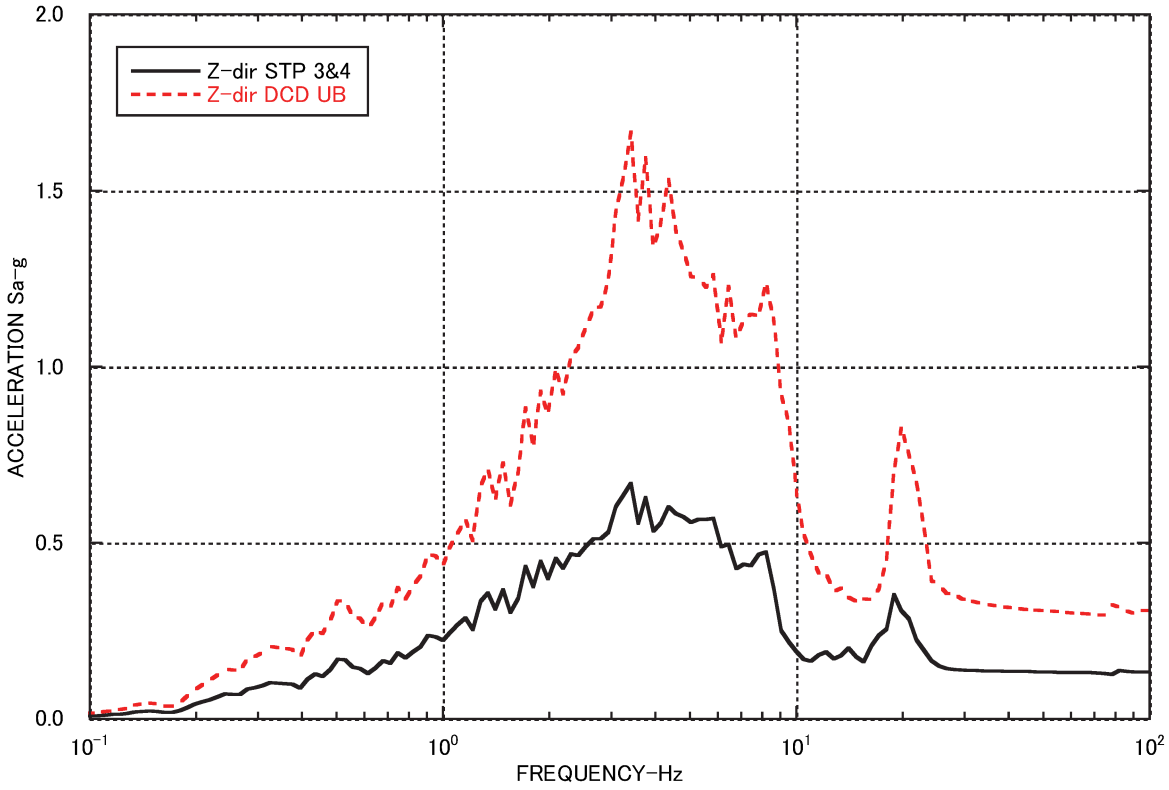


Figure 3A-260 FRS RSW/Pedestal Node 73- Vertical, 2% Damping



STP 3 & 4 : STP 3 & 4 soil condition, RG 1.60 0.15g input
DCD UB : DCD UB1D150 soil condition, RG 1.60 0.3g input

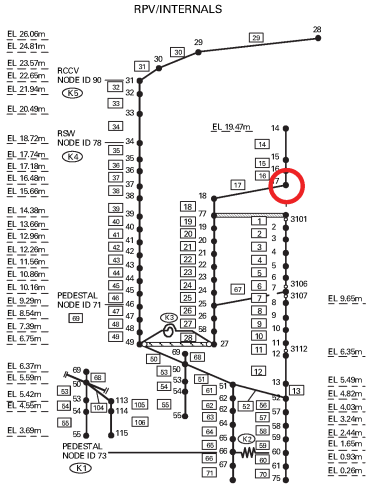
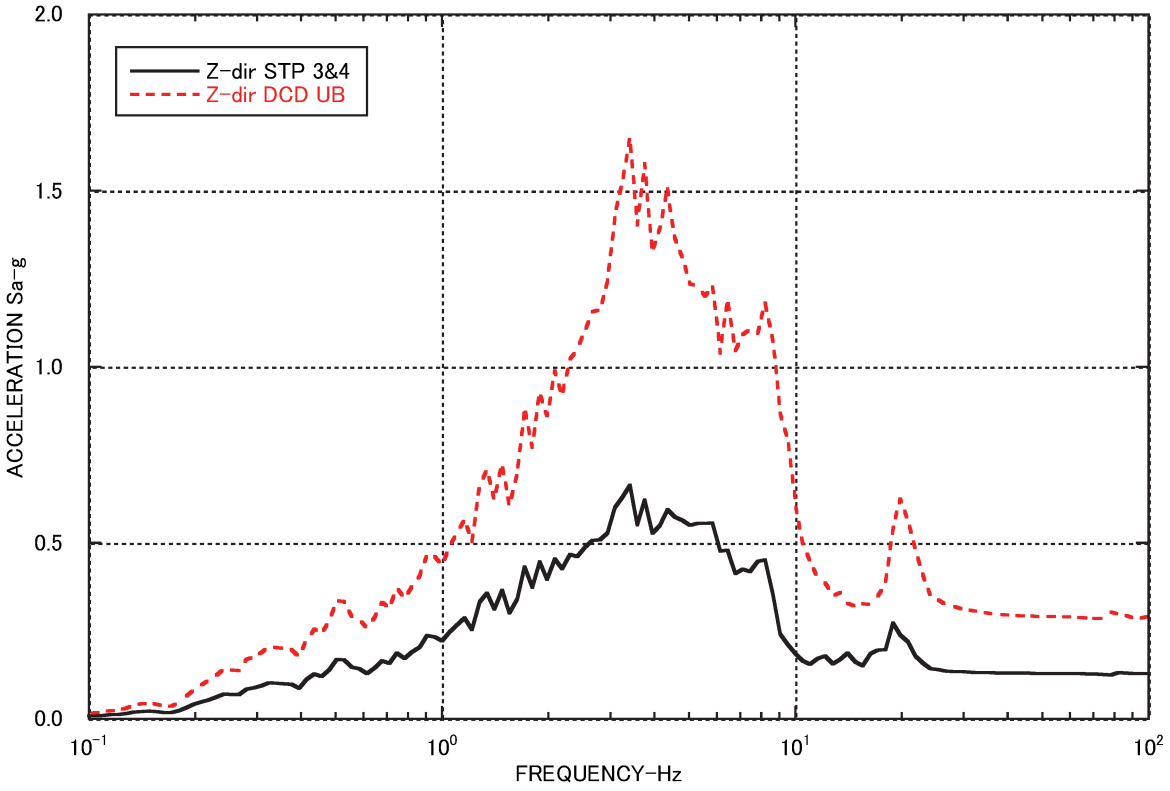


Figure 3A-261 FRS RPV/Internals Node 17- Vertical, 2% Damping



STP 3 & 4 : STP 3 & 4 soil condition, RG 1.60 0.15g input
DCD UB : DCD UB1D150 soil condition, RG 1.60 0.3g input

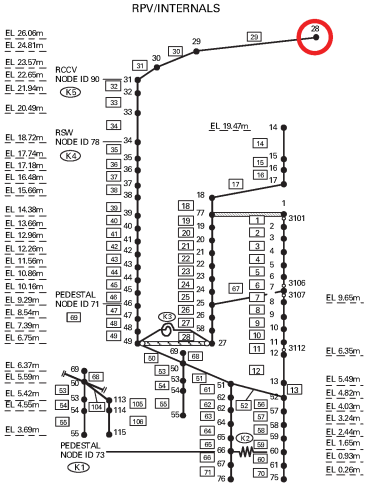
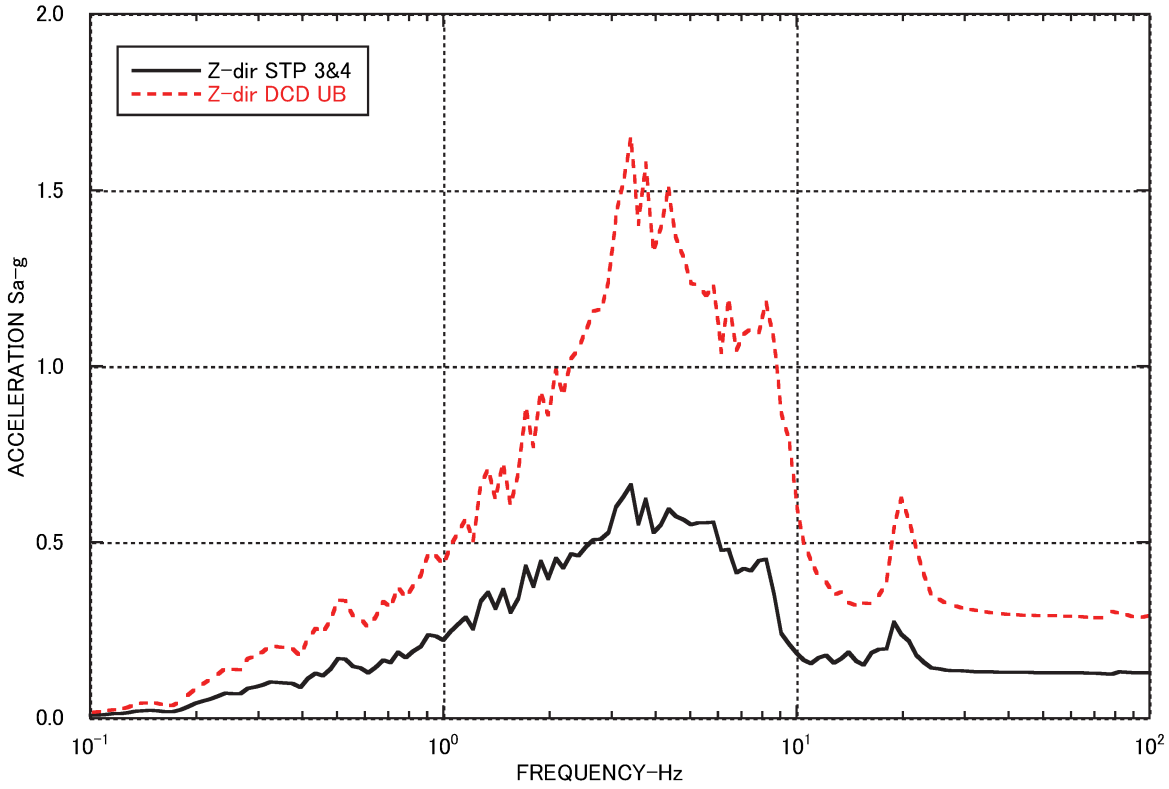


Figure 3A-262 FRS RPV/Internals Node 28- Vertical, 2% Damping



STP 3 & 4 : STP 3 & 4 soil condition, RG 1.60 0.15g input
DCD UB : DCD UB1D150 soil condition, RG 1.60 0.3g input

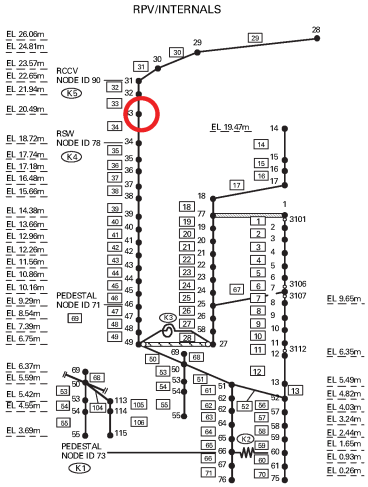
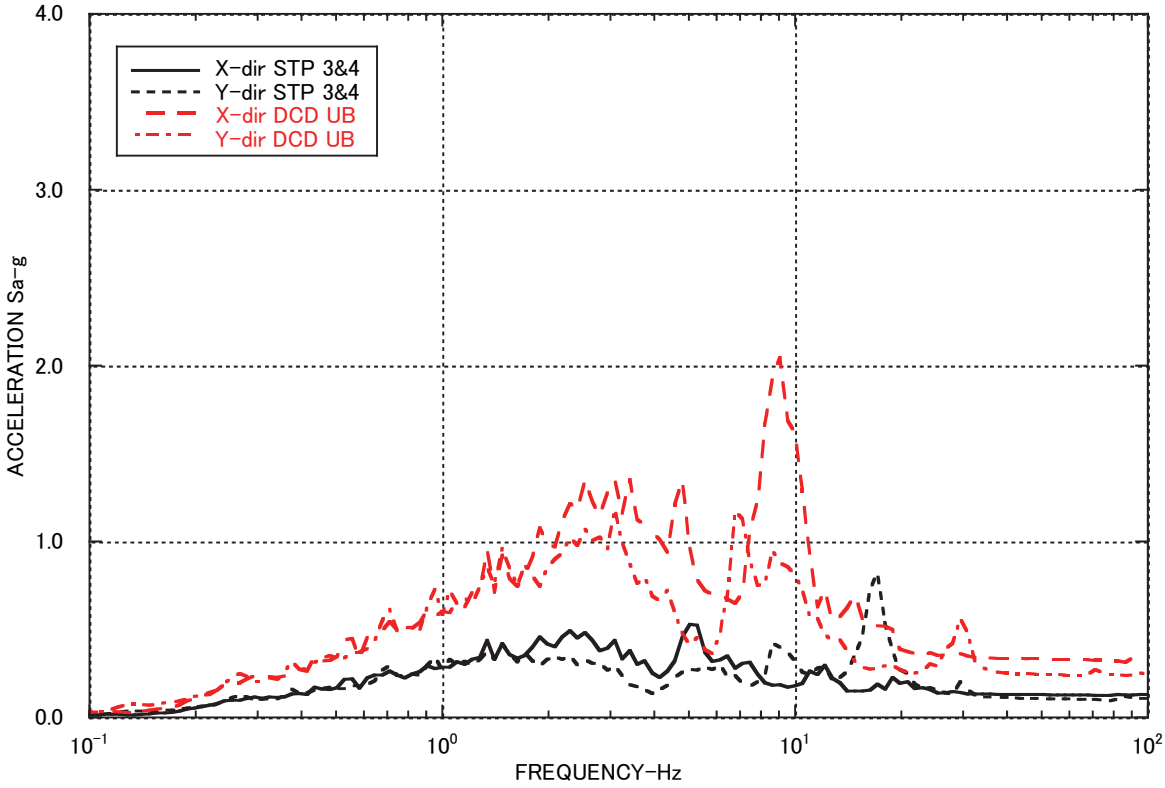


Figure 3A-263 FRS RPV/Internals Node 33- Vertical, 2% Damping



STP 3 & 4 : STP 3 & 4 soil condition, RG 1.60 0.15g input
DCD UB : DCD UB1D150 soil condition, RG 1.60 0.3g input

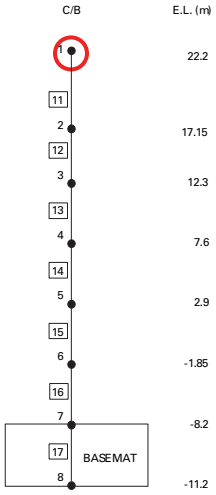
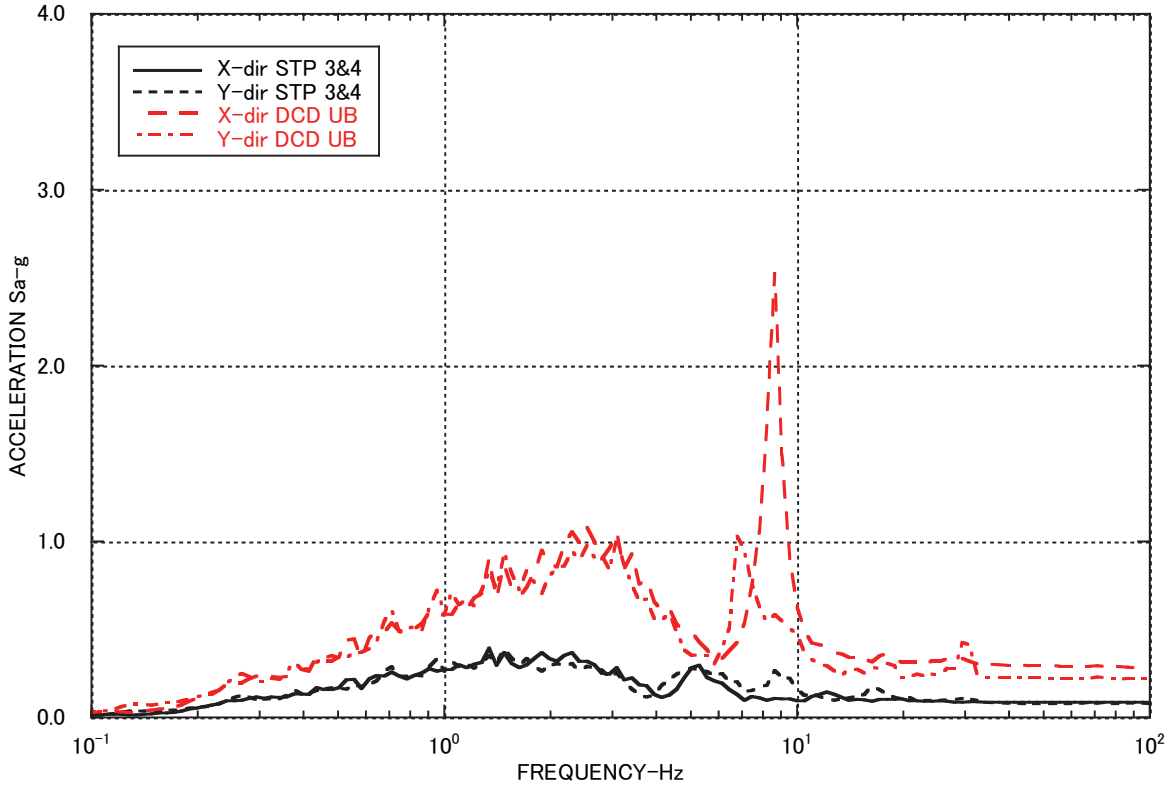


Figure 3A-264 FRS CB Top Node 1- Horizontal, 2% Damping



STP 3 & 4 : STP 3 & 4 soil condition, RG 1.60 0.15g input
DCD UB : DCD UB1D150 soil condition, RG 1.60 0.3g input

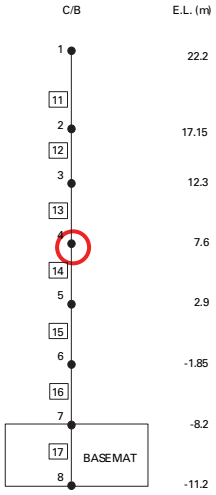
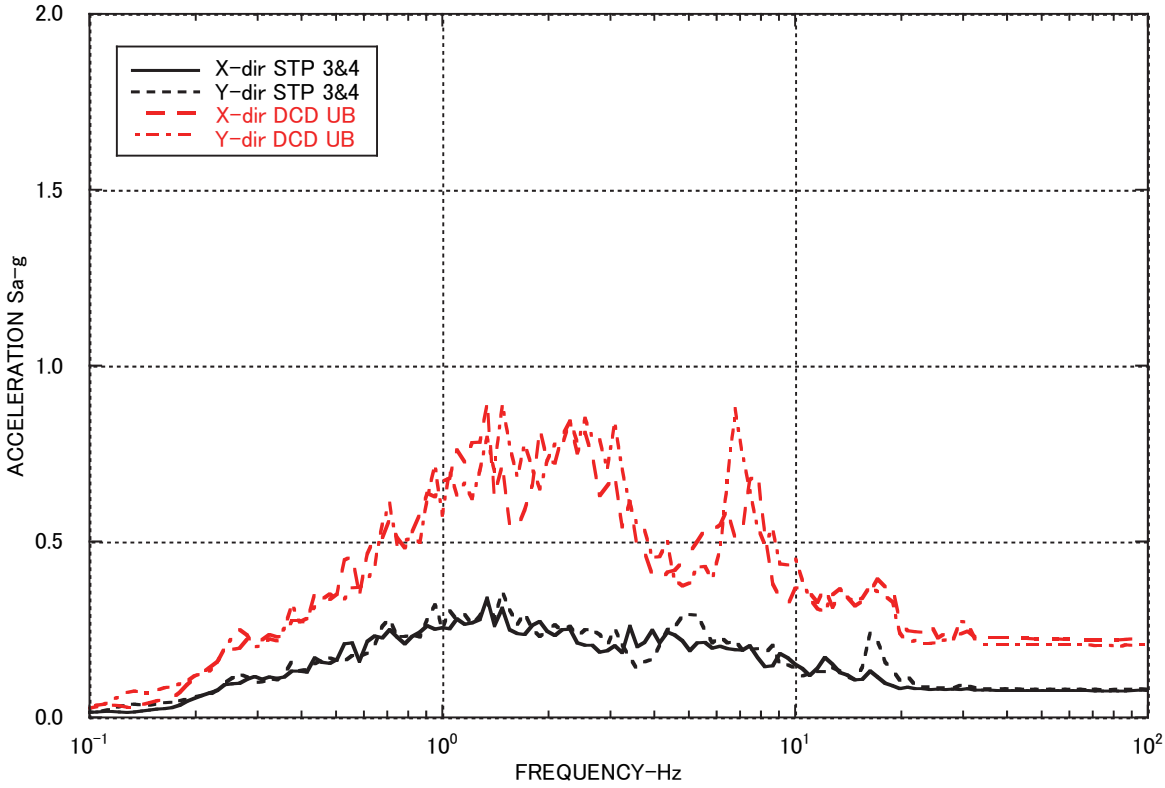


Figure 3A-265 FRS CB Node 4- Horizontal, 2% Damping



STP 3 & 4 : STP 3 & 4 soil condition, RG 1.60 0.15g input
DCD UB : DCD UB1D150 soil condition, RG 1.60 0.3g input

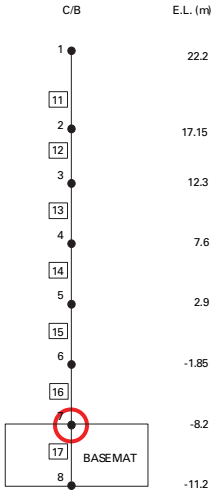
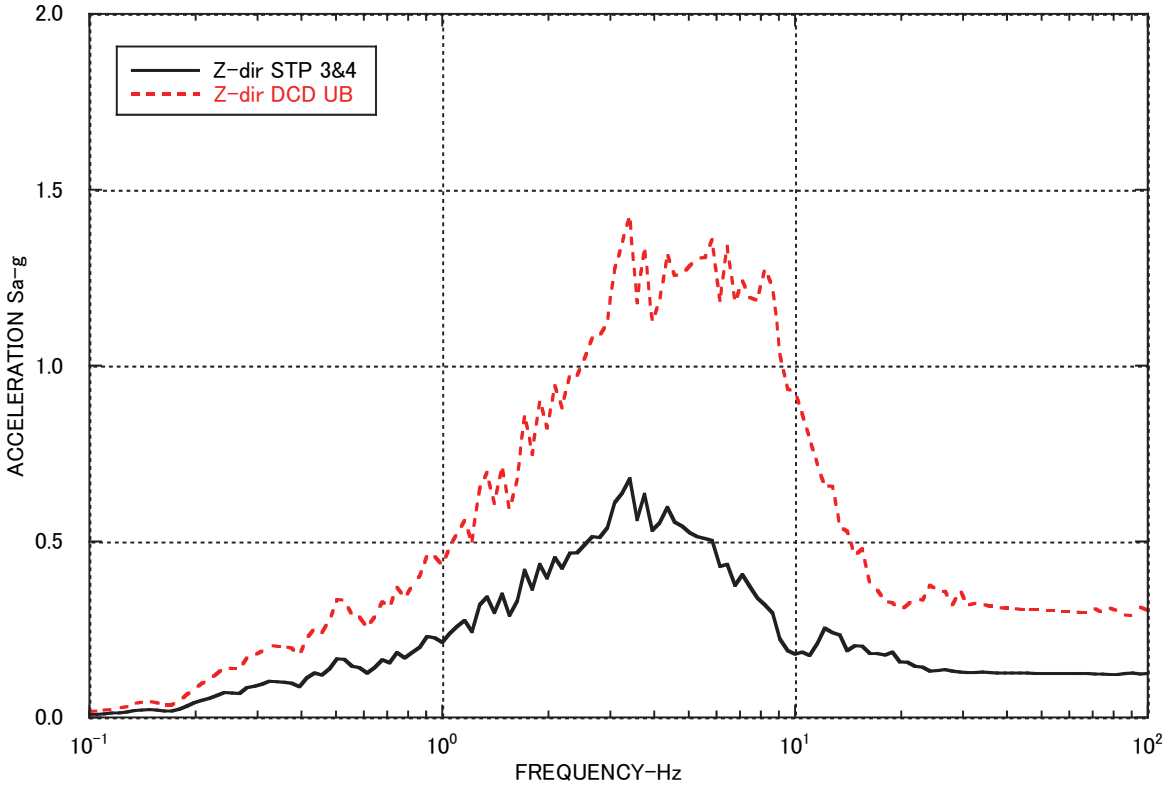


Figure 3A-266 RS CB Basemat Top Node 7- Horizontal, 2% Damping



STP 3 & 4 : STP 3 & 4 soil condition, RG 1.60 0.15g input
DCD UB : DCD UB1D150 soil condition, RG 1.60 0.3g input

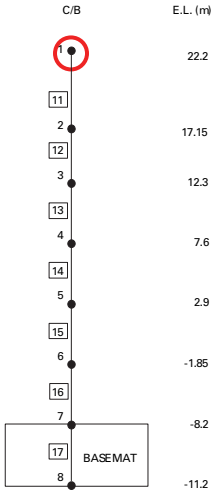
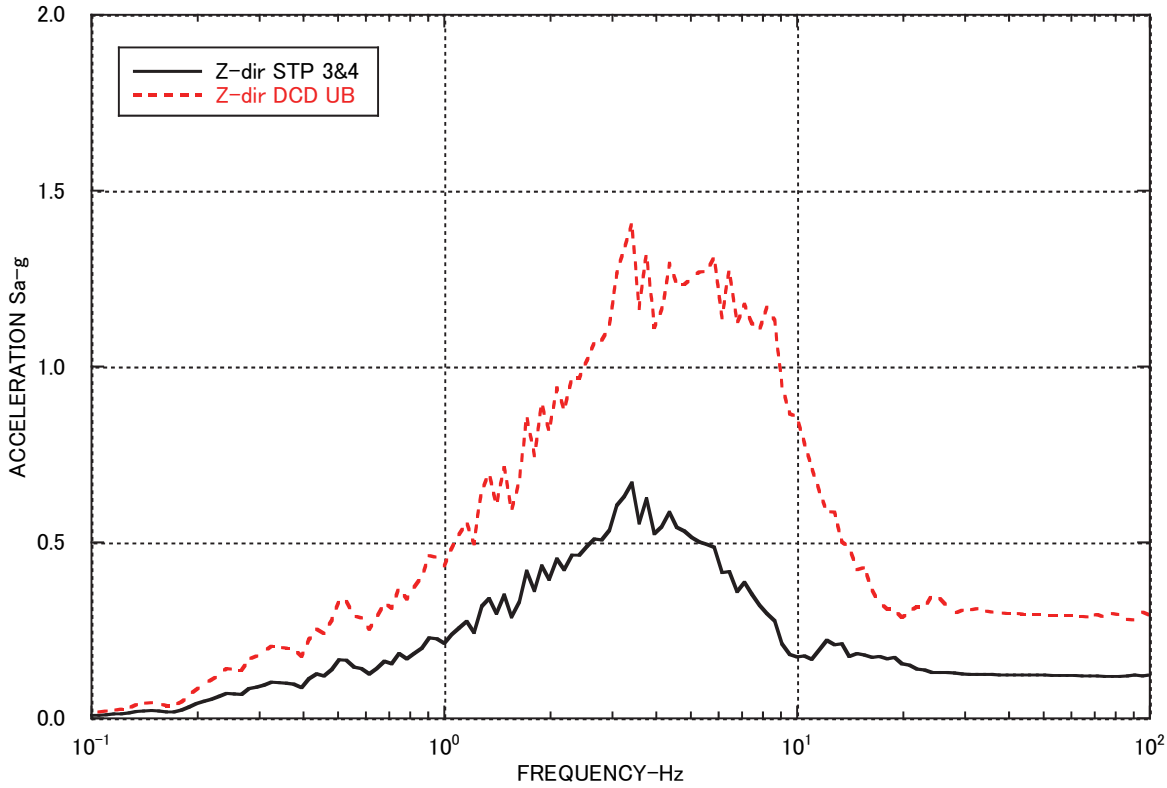


Figure 3A-267 FRS CB Top Node 1- Vertical, 2% Damping



STP 3 & 4 : STP 3 & 4 soil condition, RG 1.60 0.15g input
DCD UB : DCD UB1D150 soil condition, RG 1.60 0.3g input

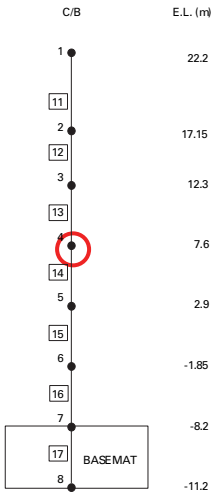
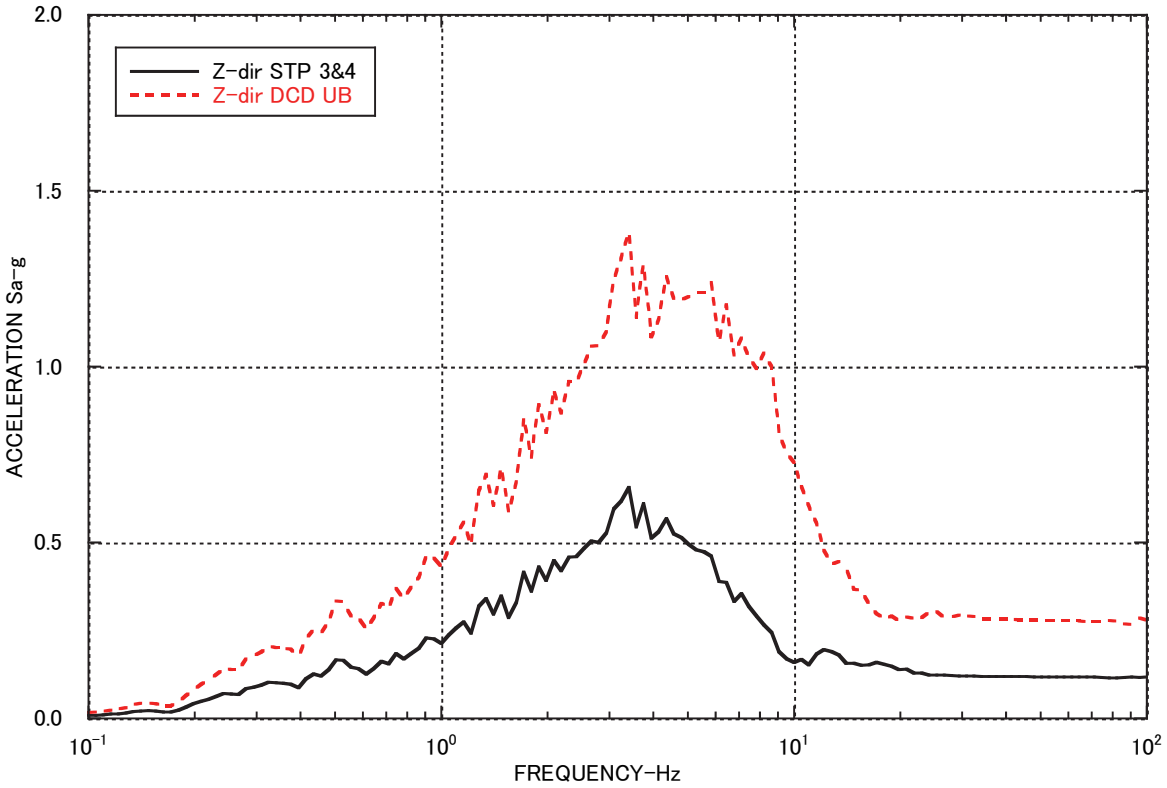


Figure 3A-268 FRS CB Node 4- Vertical, 2% Damping



STP 3 & 4 : STP 3 & 4 soil condition, RG 1.60 0.15g input
DCD UB : DCD UB1D150 soil condition, RG 1.60 0.3g input

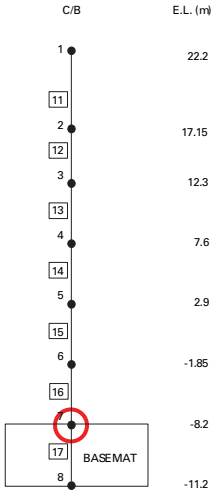


Figure 3A-269 FRS CB Basemat Top Node 7- Vertical, 2% Damping