RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

06/28/2013

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 1025-7092 REVISION 3**
SRP SECTION:	**03.07.02 – Seismic System Analysis**
APPLICATION SECTION:	**3.7.2**
DATE OF RAI ISSUE:	**04/29/2013**

QUESTION NO. 03.07.02-226:

Section 2.3 of MUAP-11007 (R2) indicates that the Poisson's ratio used in developing the Pwave velocity of the saturated soil profiles approaches values close to 0.48, and that this value is low enough "not to compromise the numerical stability of the SASSI results."

The applicant is requested to provide (i) the basis for concluding that the numerical stability of the SASSI results is not compromised and (ii) the details of any specific sensitivity study that show that the ACS-SASSI results for APWR SSI analysis are numerically stable for the selected site-independent soil profiles and the assumed values of Poisson's ratio.

ANSWER:

As described in Section 2.3 of Technical Report MUAP-11007, Rev 2, the generic soil profiles 270-200, 270-500 and 560-500 used for site-independent soil-structure interaction (SSI) analyses the of US-APWR standard plant are representative of saturated soil properties and have values of the Poisson ratio (nu) approaching but not exceeding 0.48. The top layers of the corresponding unsaturated soil profiles have compression wave velocities (VP) reduced to reflect dynamic properties of unsaturated soil. As shown in Tables 3-1, and 3-2 of Technical Report MUAP-11007, Rev 2, the reduced VP for the generic unsaturated soil profiles 270 resulted in values of Poisson ratio that do not exceed 0.45 for 270-200Dry and 270-500Dry profiles. The value of the Poisson ratio for the generic unsaturated soil profile 560-500Dry is below 0.41. In addition to serving to illustrate the effects of ground water on the response, the comparison of the transfer functions obtained from the SSI analyses of saturated and unsaturated generic soil profiles serves to demonstrate that the use of soil Poisson ratio approaching value of 0.48 did not compromise the numerical stability of the results. The abrupt changes or spurious peaks in the transfer functions as well as inconsistencies between the results obtained from SSI analyses of saturated profiles having values of Poisson ratio approaching 0.48 and unsaturated profiles with lower values of the Poison ratio are used as indicators of possible numerical instabilities.

Figure 1 through Figure 12 below present comparisons of transfer functions results for the response of the Reactor Building (R/B) complex in the direction of the applied control motion for saturated generic profiles 270-500 and 560-500 and unsaturated generic profiles 270-

500Dry and 560-500Dry. Transfer function results obtained from the SSI analyses of structural models with full and reduced stiffness properties are presented for two nodes, located at basemat bottom and plant grade elevations, where possible numerical instabilities in the SSI results due to high value of the soil Poisson ratio would be most apparent. Figure 1 through Figure 6 show the amplitude of the transfer functions at the center of the containment foundation bottom. Figure 7 through Figure 12 present transfer function results for the response at the center of the Auxiliary Building (A/B) basement at plant grade elevation. The interpolated transfer function results obtained from the SSI analyses of saturated and unsaturated profiles with higher and lower values of the soil Poisson ratio are shown with solid and dashed lines, respectively. The plots show the calculated values of the transfer functions with dots.

The figures show that the transfer function results do not indicate numerical instabilities in the results of the SSI analyses. The transfer functions obtained from SSI analyses of saturated profiles with a soil Poisson ratio approaching a value of 0.48 are very close and consistent with those obtained from the SSI analyses of unsaturated profiles with lower values of the soil Poisson ratio that remain below 0.45. The interpolated transfer functions are smooth curves without abrupt changes or spurious peaks, which would be indicators of possible numerical instabilities in the SASSI results.

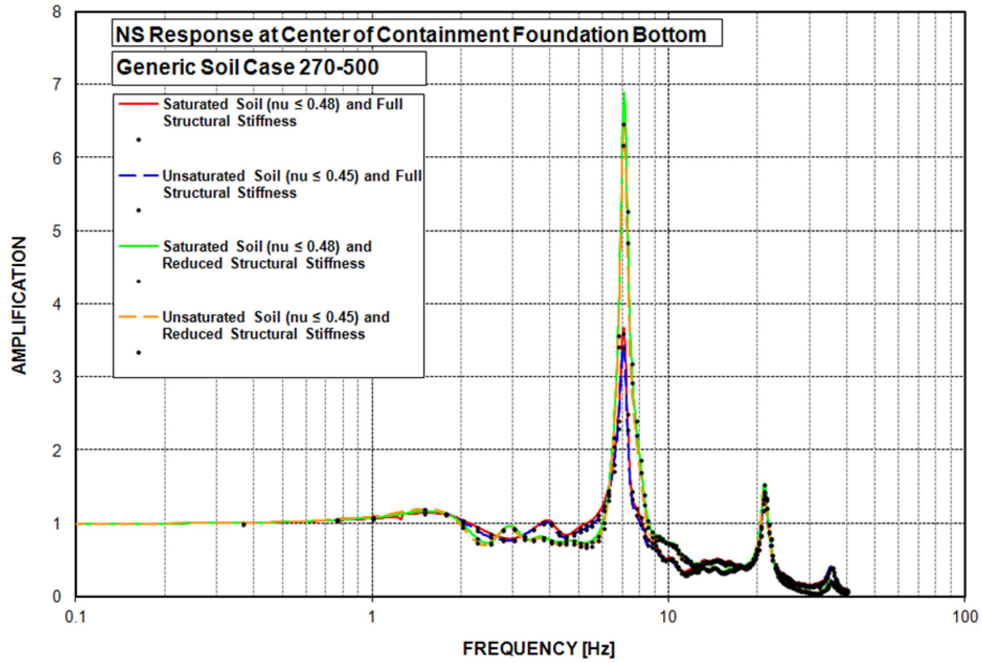

Figure 1 Transfer Function Results from SSI Analyses of Generic Profiles 270-500 - NS Response Basemat Bottom

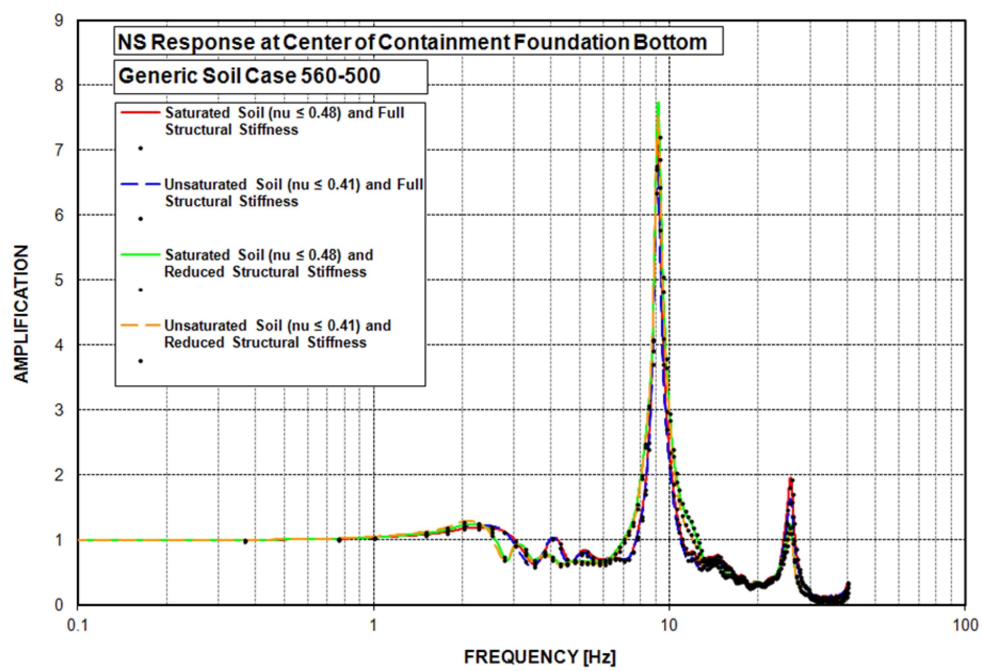

Figure 2 Transfer Function Results from SSI Analyses of Generic Profiles 560-500 - NS Response at Basemat Bottom

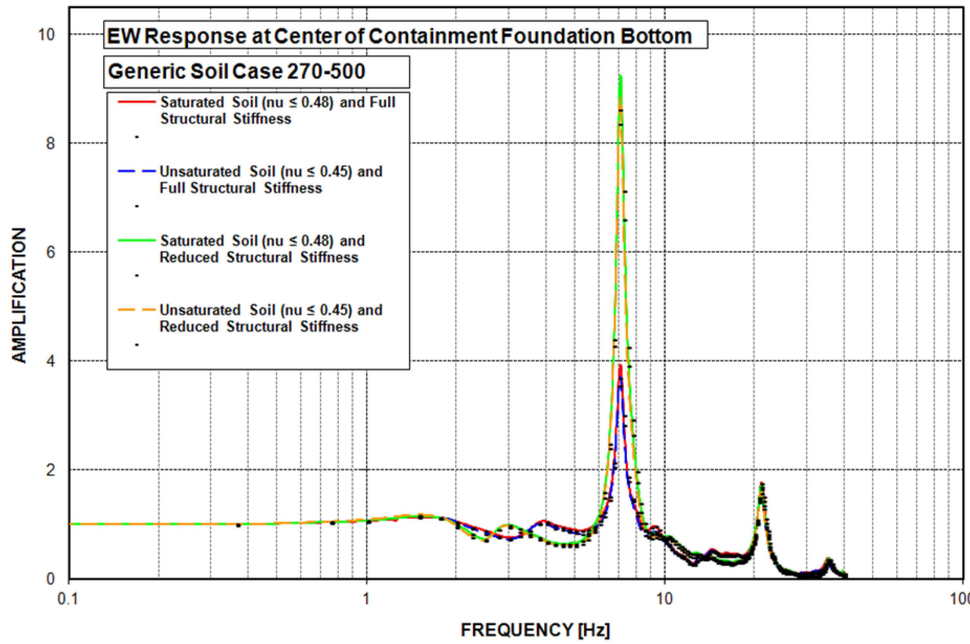

Figure 3 Transfer Function Results from SSI Analyses of Generic Profiles 270-500 - EW Response at Basemat Bottom

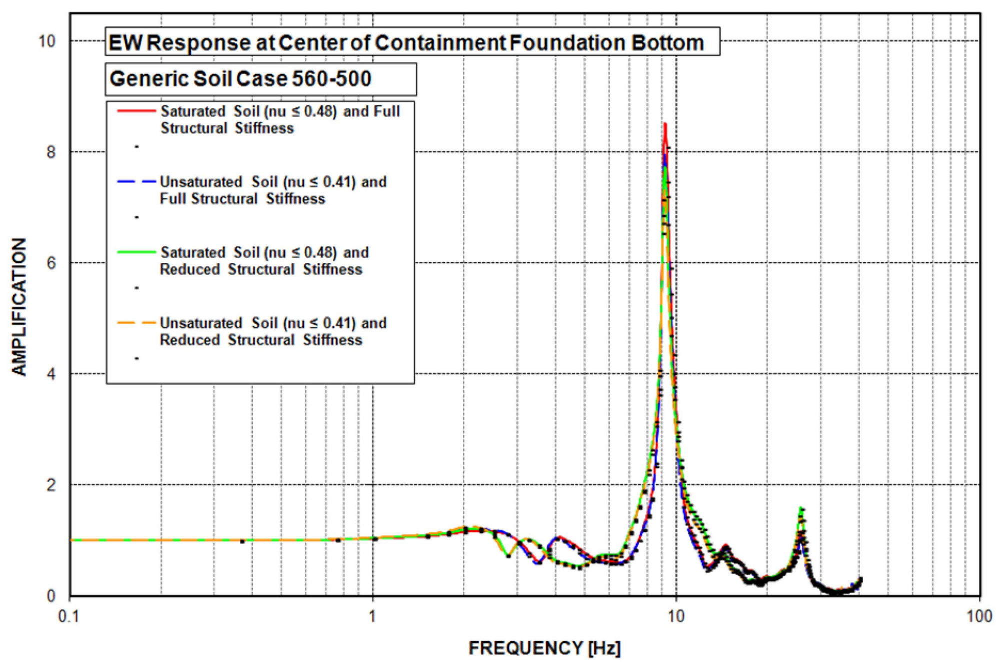

Figure 4 Transfer Function Results from SSI Analyses of Generic Profiles 560-500 - EW Response at Basemat Bottom

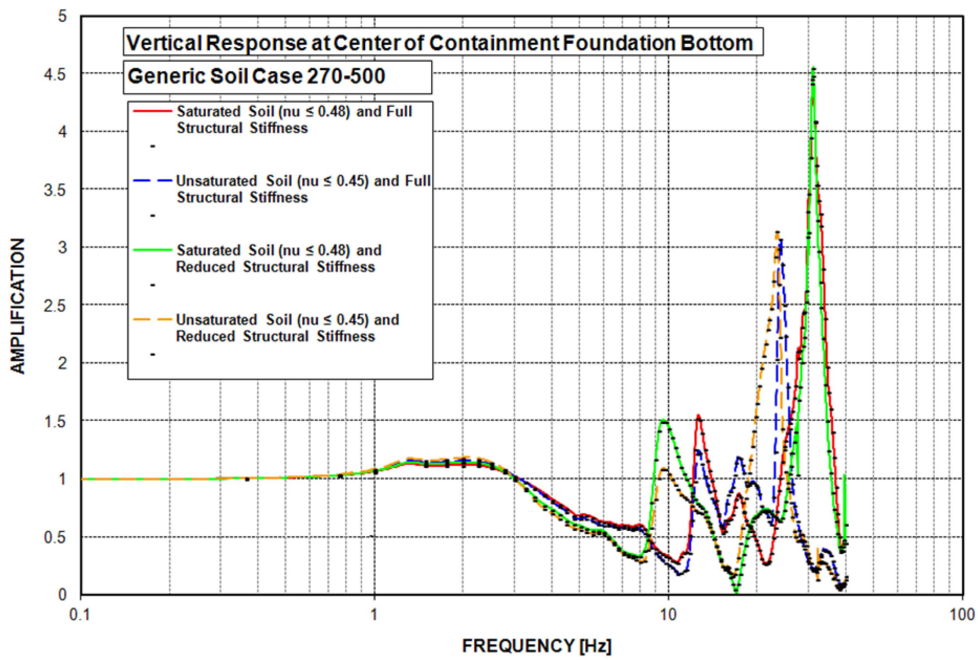

Figure 5 Transfer Function Results from SSI Analyses of Generic Profiles 270-500 – Vertical Response at Basemat Bottom

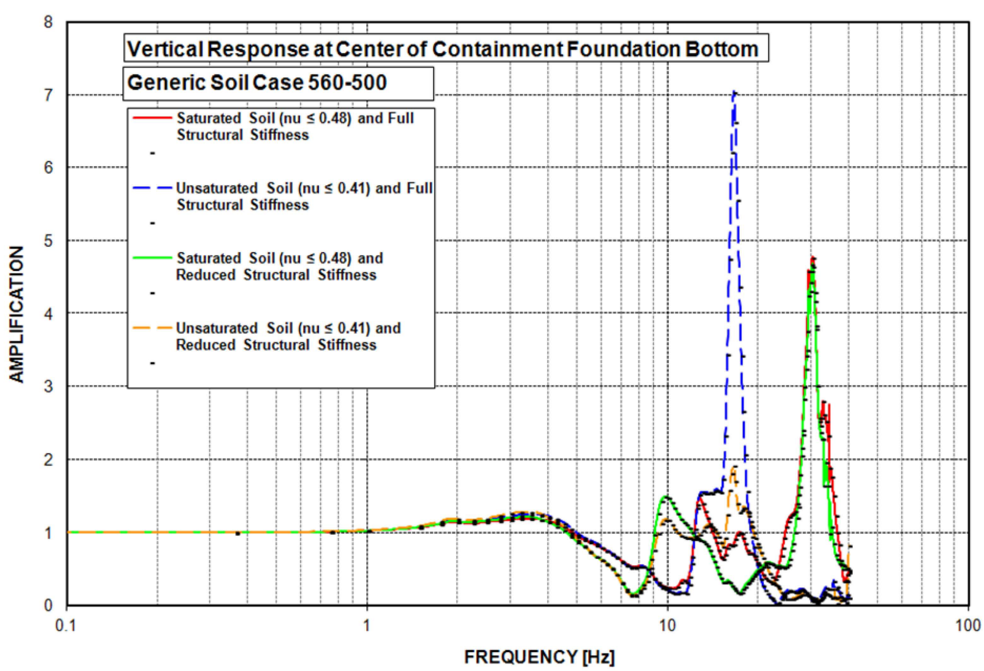

Figure 6 Transfer Function Results from SSI Analyses of Generic Profiles 560-500 – Vertical Response at Basemat Bottom

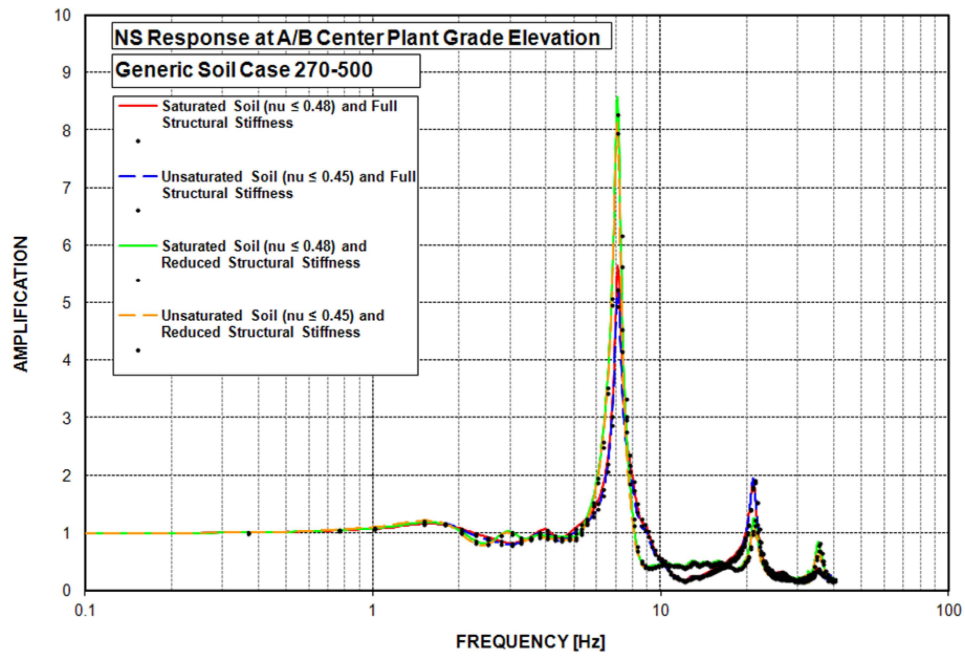

Figure 7 Transfer Function Results from SSI Analyses of Generic Profiles 270-500 - NS Plant Grade Elevation

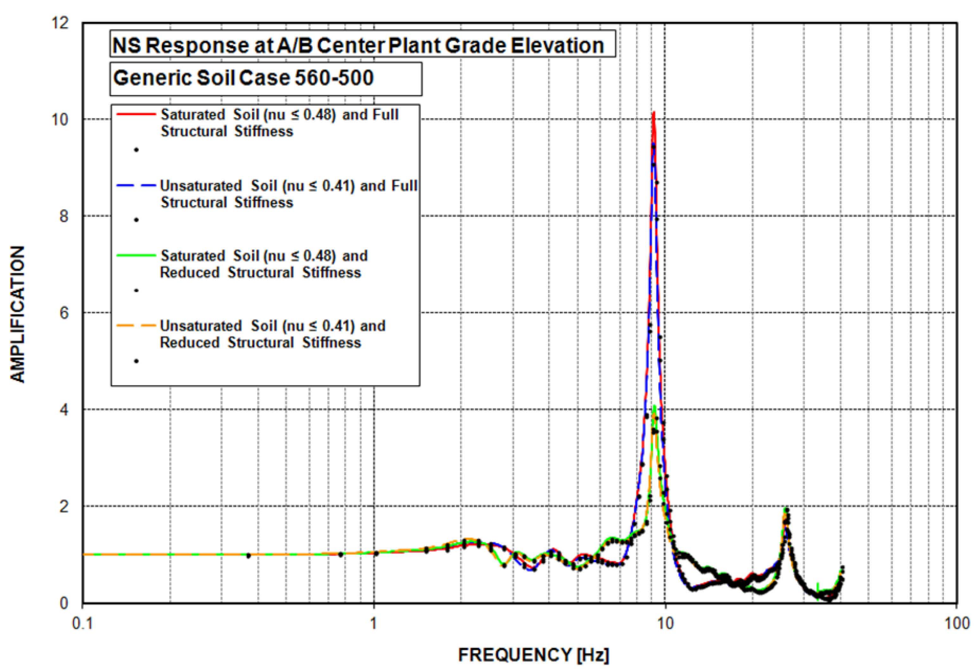

Figure 8 Transfer Function Results from SSI Analyses of Generic Profiles 560-500 - NS Response at Plant Grade Elevation

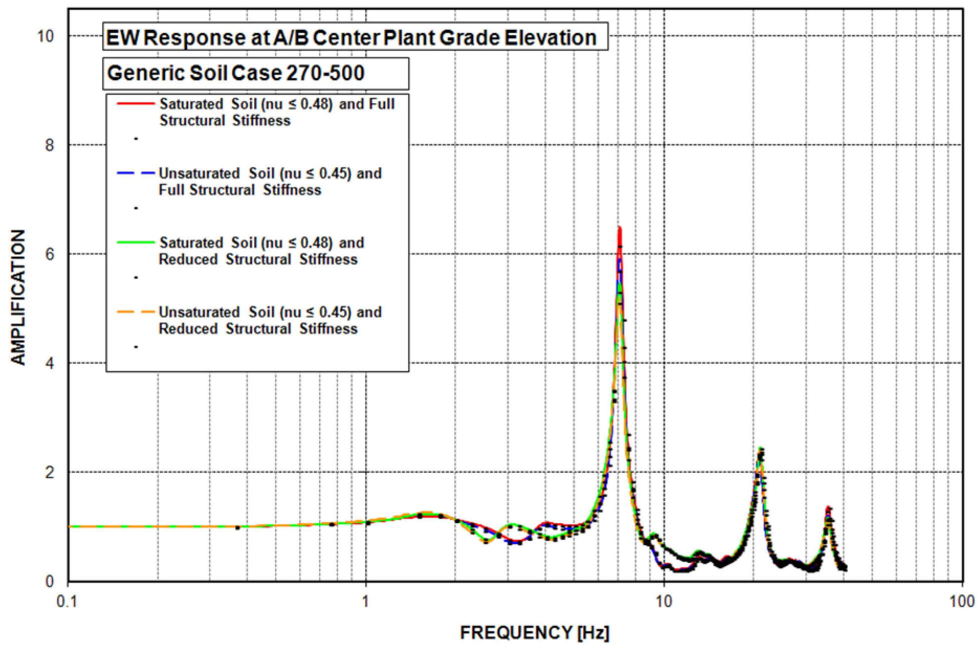

Figure 9 Transfer Function Results from SSI Analyses of Generic Profiles 270-500 - EW Response at Plant Grade Elevation

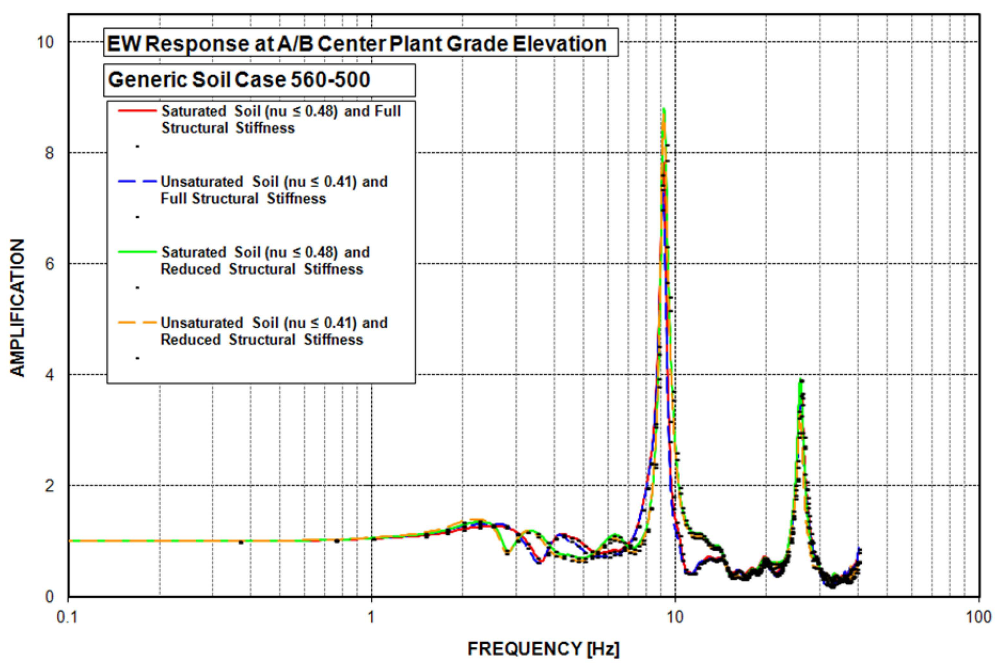

Figure 10 Transfer Function Results from SSI Analyses of Generic Profiles 560-500 - EW Response at Plant Grade Elevation

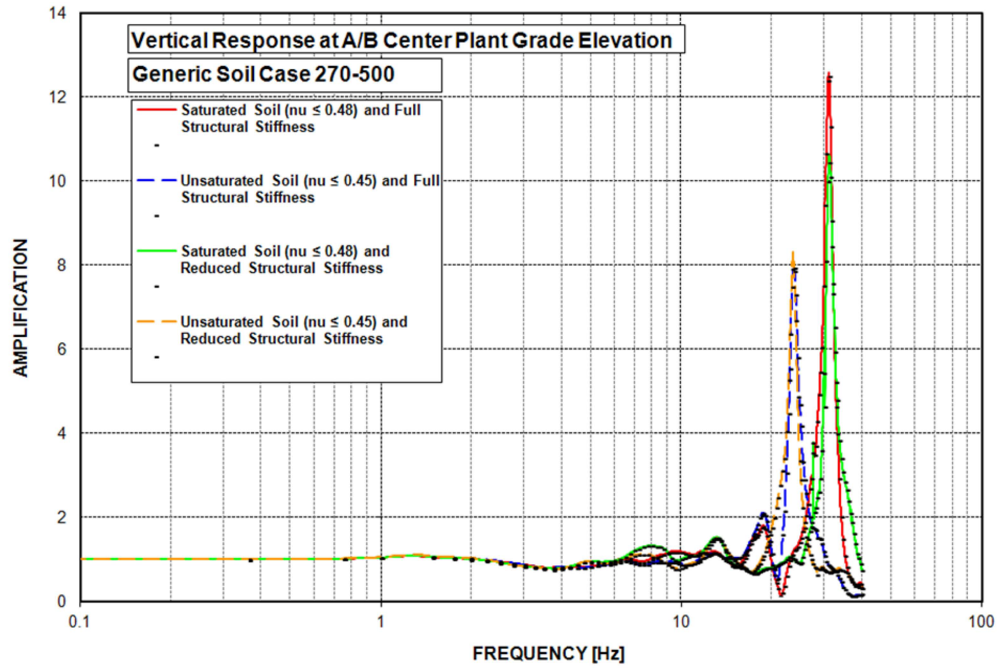

Figure 11 Transfer Function Results from SSI Analyses of Generic Profiles 270-500 – Vertical Response at Plant Grade Elevation

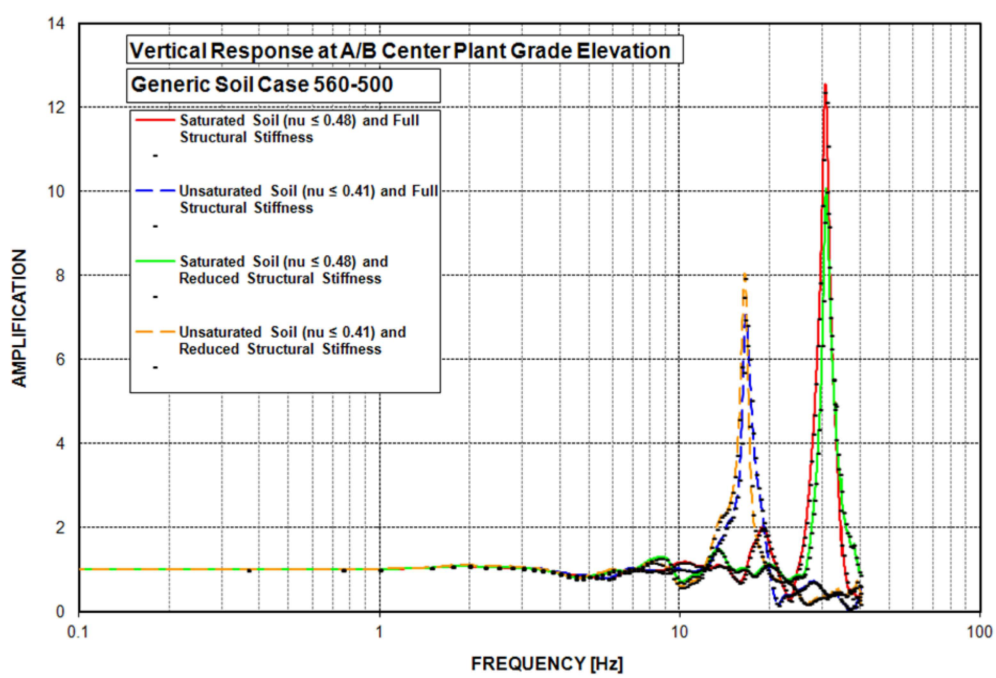

Figure 12 Transfer Function Results from SSI Analyses of Generic Profiles 560-500 – Vertical Response at Plant Grade Elevation

Impact on DCD

There is no impact on the DCD.

Impact on R-COLA

There is no impact on the R-COLA.

Impact on PRA

There is no impact on the PRA.

Impact on Technical/Topical Report

There is no impact on a Technical/Topical Report.

This completes MHI’s response to the NRC’s question.