RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

3/24/2014

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 1060-7285 REVISION 0**
SRP SECTION:	**03.07.02 – Seismic System Analysis**
APPLICATION SECTION:	**3.7.2**
DATE OF RAI ISSUE:	**11/15/2013**

QUESTION NO. 03.07.02-239:

In Section 02.4.1.1.2 “Discretization Considerations: Mesh Size,” of MUAP-10006, "Soil-Structure Interaction Analysis and Results for the US-APWR Standard Plant," Revision 3, the applicant presents an adequate description of its approach to ensuring that the ANSYS dynamic model is capable of accurately picking up out-of-plane slab vibration modes up to 70 Hz, for uncracked concrete properties. However, the staff needs additional information relating to modeling of flexible walls before it can complete its evaluation of the adequacy of the ANSYS dynamic model. To assist the staff, the applicant is requested to submit comparisons between fundamental frequencies based on classical plate vibration formulas and those computed using the ANSYS detailed model and the ANSYS dynamic model, for all walls that have out-of-plane fundamental frequencies below 70 Hz, in order to demonstrate that the ANSYS dynamic model discretization is adequate to predict the out-of-plane flexural deformation. If the element mesh for a particular wall is not adequate, discuss how the additional amplification at the center of the wall will be calculated.

ANSWER:

The analyses of the flexible walls to determine the amplification at the locations of interest for equipment design/qualification will be completed in a later design phase of the project.

The discretization of the walls in the dynamic model for soil-structure interaction analysis is adequate for the following specific case. In order to demonstrate that the mesh size for the out-of-plane frequencies of the uncracked walls with a fundamental frequency below 70 Hz is reasonable, one of the most flexible wall (55' long x 29' tall x 1'-8" thick) located at column line 7R in the west Power Source Building (PS/B) is examined as an example. The results of modal analysis performed on the west PS/B, as part of the work to validate the dynamic model documented in Technical Report MUAP-10006, Rev. 3, are shown in Figures 1 and 2 for the first local out-of-plane mode from both the benchmark detailed model and the dynamic model, respectively. The fundamental frequencies for the examined wall segment are also calculated using classical plate vibration formulas from Roark's for two support conditions at the four edges (Table 16.1, cases 15 and 16, Roark’s Formulas for Stress and Strain, Seventh Edition): fixed and pinned. Table 1 lists the calculated frequencies and the ANSYS results. The ANSYS results from the dynamic and detailed models match very well

with each other, and they are bounded by the classical solutions for the fixed and pinned conditions as expected. Thus, the responses of this wall from the dynamic model will provide accurate in-structure response spectra for the design of equipment that may be attached to the wall.

Analyses, similar to that described above, will be considered for the walls in the design phase of the project as necessary. This will depend on the location and function of the walls and attached equipment. An appropriate analysis approach will be employed to determine the out-of-plane amplification at locations where the equipment is attached using global seismic responses at the wall panel edges obtained from soil-structure interaction analysis as input.

Table 1 - First Out-of-Plane Fundamental Frequency of West PS/B Wall

ANSYS (Hz)		Classical (Hz)	
Detailed	Dynamic	Pinned	Fixed
22.5	22.1	12.3	24.5

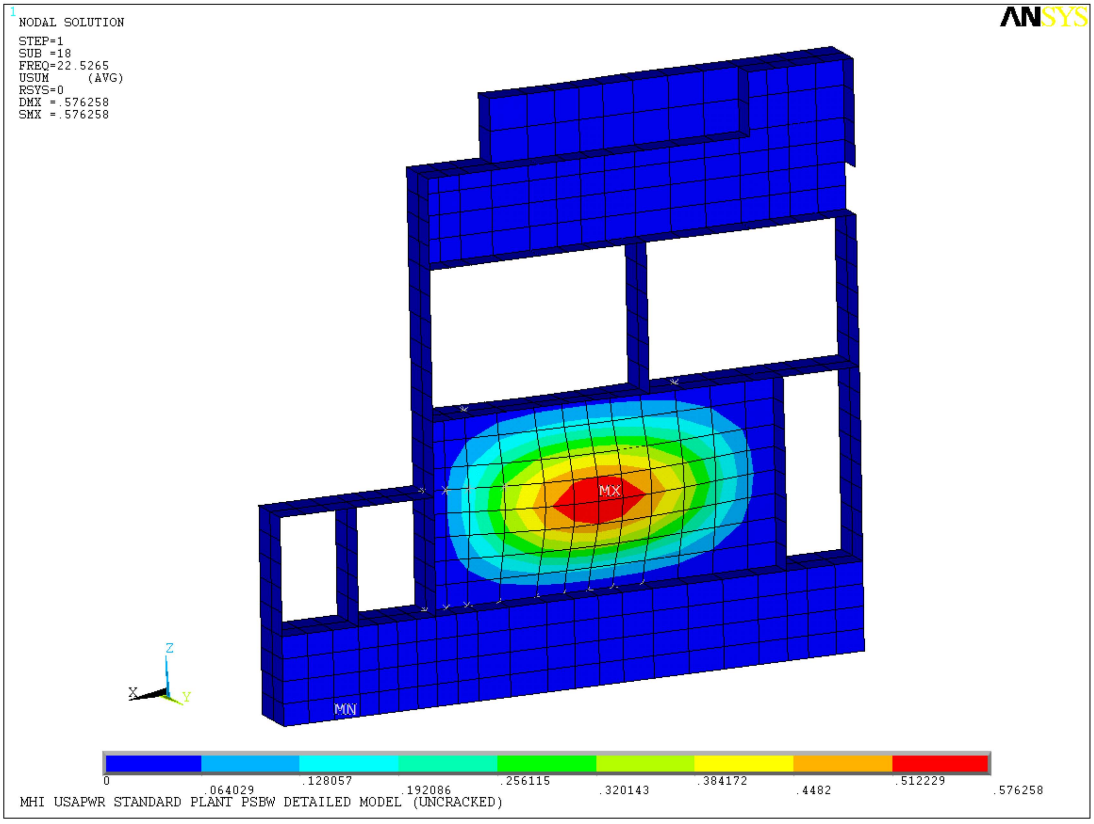

Figure 1 - First Out-of-Plane Mode from ANSYS Detailed Model (uncracked) of the West PS/B Wall

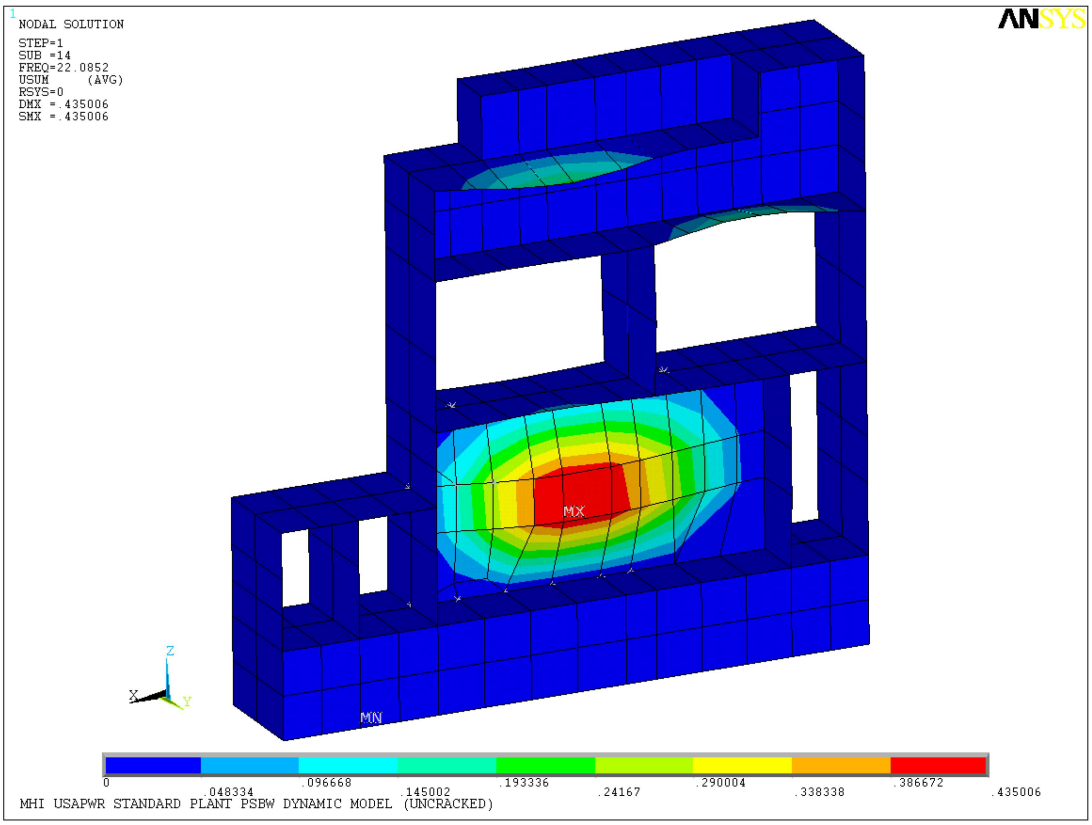

Figure 2 - First Out-of-Plane Mode from ANSYS Dynamic Model (uncracked) of the West PS/B Wall

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

Technical report MUAP-10006 Revision 3 will be revised to include this analysis.

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