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Subject: Sensitivity Study on Mesh Size Related to ESBWR DCD Section 3.7

As a result of GE's commitment to resolve DCD Section 3.7 RAIs by performing additional seismic analysis to demonstrate the adequacy of the results submitted in DCD Section 3.7 and Appendix 3A, a study of Soil Structure Interaction (SSI) effects using the SASSI computer code was undertaken and is now in progress.

Enclosure 1 is a sensitivity study performed to determine the effect of using 4 to 1 or 2 to 1 aspect ratios for the soil elements in the SASSI model. The results indicate that the use of 4 to 1 is adequate to capture the energy of the single time history input with high frequency contents. Most of the energy in the high frequency range is damped out by the soft soil.

If an aspect ratio of 2 to 1 is used, the size of the model becomes inordinately large, even after simplifying it by using half the 4 to 1 model with symmetry assumption. This obviously neglects some of the non-symmetric characteristics that the 4 to 1 model has. It also significantly impacts the time required to run the analysis.

Therefore, in light of the above, GE is proceeding with the 4 to 1 model. If the NRC has any questions or needs further clarification, please contact us as soon as possible as our capability to meet the committed date for submittal of the response to the remaining Section 3.7 RAIs will be impacted.

Doc 8

Sincerely,

Kathy Seaney for

David H. Hinds
Manager, ESBWR

Enclosure:

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Section 3.7

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AE Cabbage USNRC (with enclosures)
LA Dudes USNRC (w/o enclosures)
GB Stramback GE/San Jose (with enclosures)
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ENCLOSURE 1

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**Sensitivity Study on Mesh Size
Related to ESBWR DCD Section 3.7**

Sensitivity Study of SASSI Mesh Size

1. Objective

For a 300 m/sec shear wave velocity (V_s) soft soil layer capable of capturing frequencies up to 50 Hz (f_{\max}), the maximum soil mesh size in SASSI analysis should not exceed:

$$V_s/(5*f_{\max}) = 1.2 \text{ m}$$

This will result in a model, due to the large embedded volume of ESBWR buildings (especially the RB and FB), which is too large to run in a reasonable amount of time using the existing capabilities of SASSI 2000. To circumvent these difficulties requires a consideration of coarser mesh. The purpose of this study is to investigate response sensitivity to mesh size. Two mesh sizes with aspect ratio equal to 1:2 and 1:4 are evaluated for the CB model for Case 2 layered site (300 m/sec top 20 m, 800 m/sec middle 20m and 1700 m/sec bedrock as shown in Figure 1). The element size is kept 1.1m maximum in the vertical direction. The horizontal dimension of the element is two and four times larger for aspect ratio 1:2 and 1:4, respectively. The CB stick model used is the existing model in the DCD. The input ground motion considered is a preliminary time history compatible with the single envelope ground response spectrum.

2. Analysis Results

The response spectra at the CB top and bottom masses are shown in Figure 2. The two curves in the figure show the results for the mesh aspect ratio of 1:2 and 1:4. They are identical up to about 10 Hz and very close to each other beyond 10 Hz. The reason is that the predominant response of the building is below 10 Hz, which is in the frequency range where all the transfer functions are identical (see Figure 3). Although the differences are more pronounced at few frequencies above 10 Hz, they have no effect on the end results in term of response spectra, as evidenced by the good comparison shown in Figure 2.

The Fourier amplitude spectra at various locations are shown in Figures 4 through 6. The Fourier amplitude spectra of the free-field in-column motion at the CB foundation level are further compared to that of basemat response in Figure 7, from which it can be inferred that the high-frequency energy in the ground motion is not transmitted into the basemat, thus not affecting the building response regardless of the aspect ratio of the mesh. The corresponding power spectra at various locations are shown in Figures 8 through 10.

3. Conclusions

Based on the sensitivity study results, it can be concluded that the aspect ratio of 1:4 is

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adequate to use for CB. The same conclusion is expected to be valid for RB and FB as well since their fixed based fundamental frequencies are less than 10 Hz and the predominant SSI frequencies will be less than 10 Hz, below which the transfer functions are identical for any aspect ratio as demonstrated for CB.

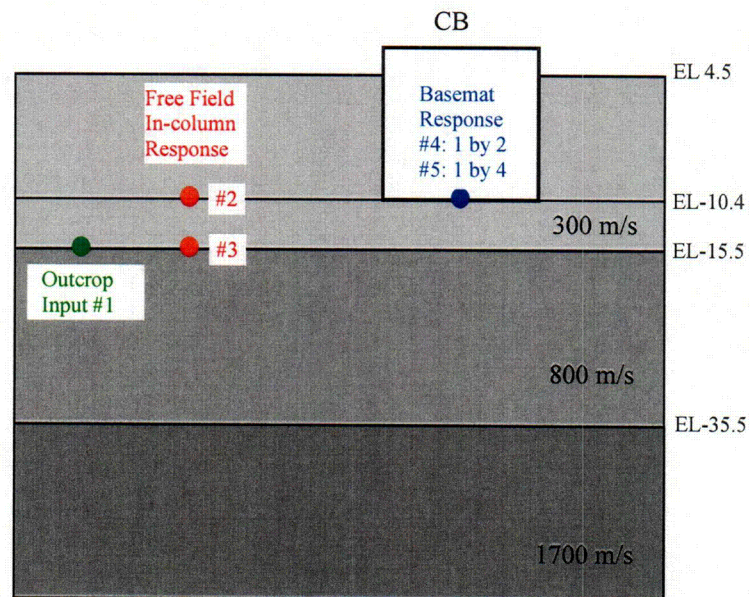
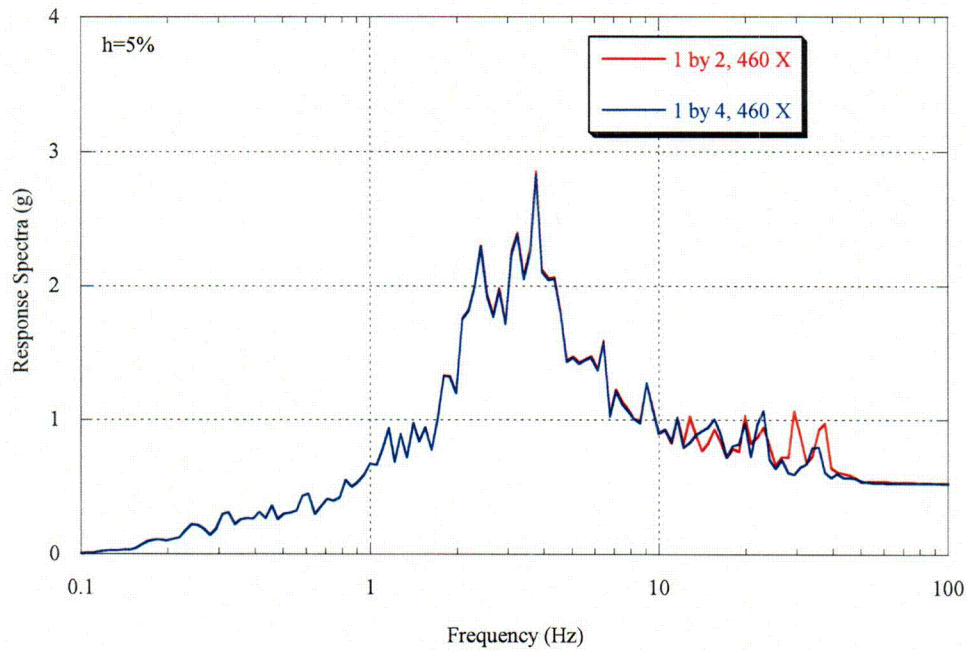


Figure 1. Case 2 Layered Soil

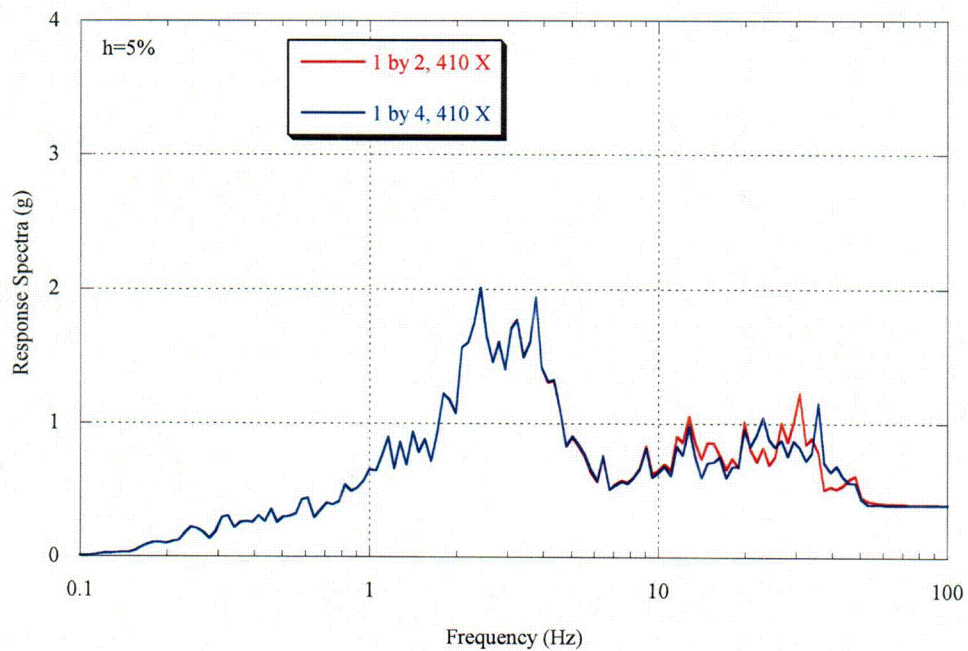
- Comparison of Ratio

- Response Spectra

- 1 by 2 vs. 1 by 4 X-dir



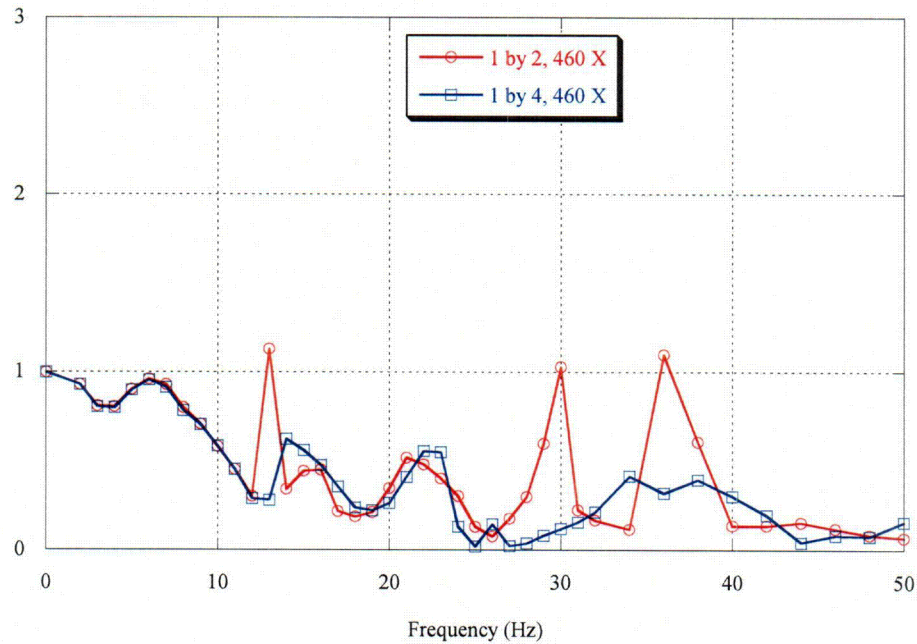
(a) CB TOP



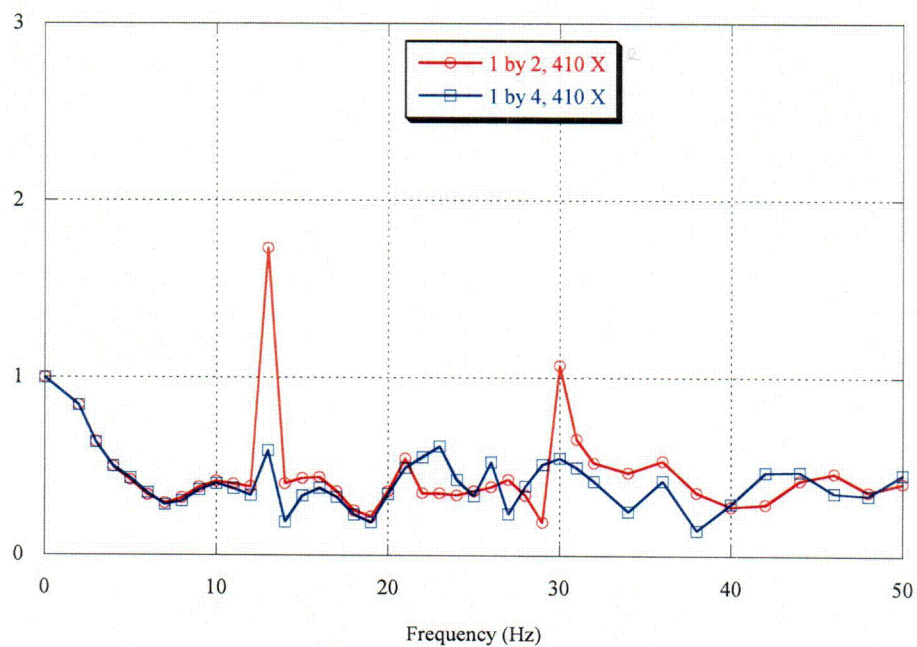
(b) CB BOTTOM

Figure 2. Comparison of Response Spectra

- Comparison of Ratio
- Transfer Function
- 1 by 2 vs. 1 by 4 X-dir



(a) CB TOP



(b) CB BOTTOM

Figure 3. Comparison of Transfer Function

FOURIER AMPLITUDE

- Input Wave

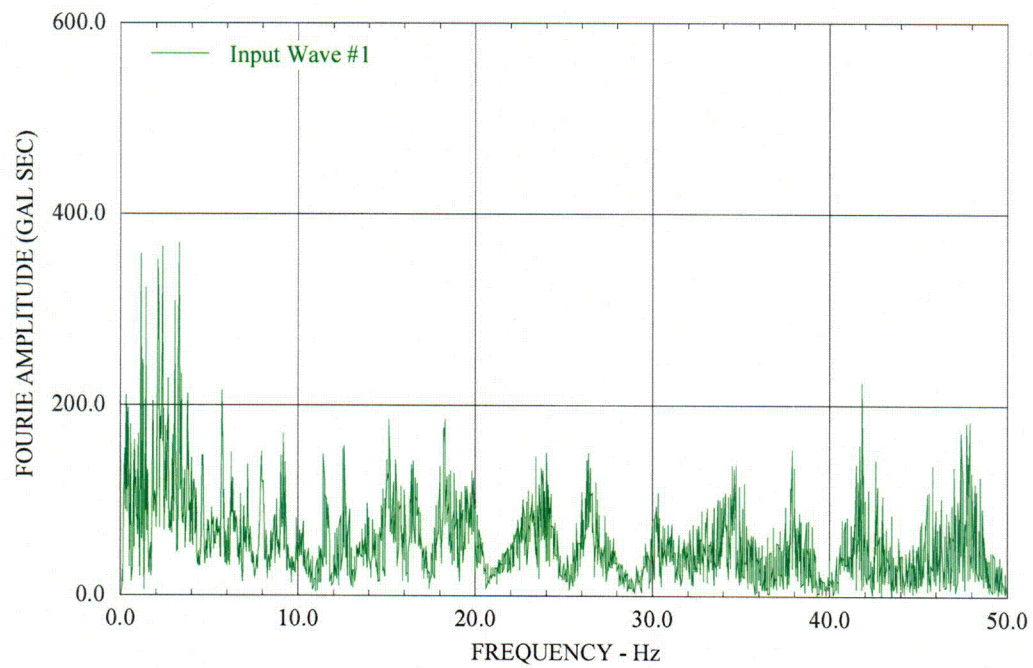


Figure 4. Fourier Amplitude Spectrum – Outcrop Input Motion

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FOURIER AMPLITUDE

- In-column Wave (SASSI Results)

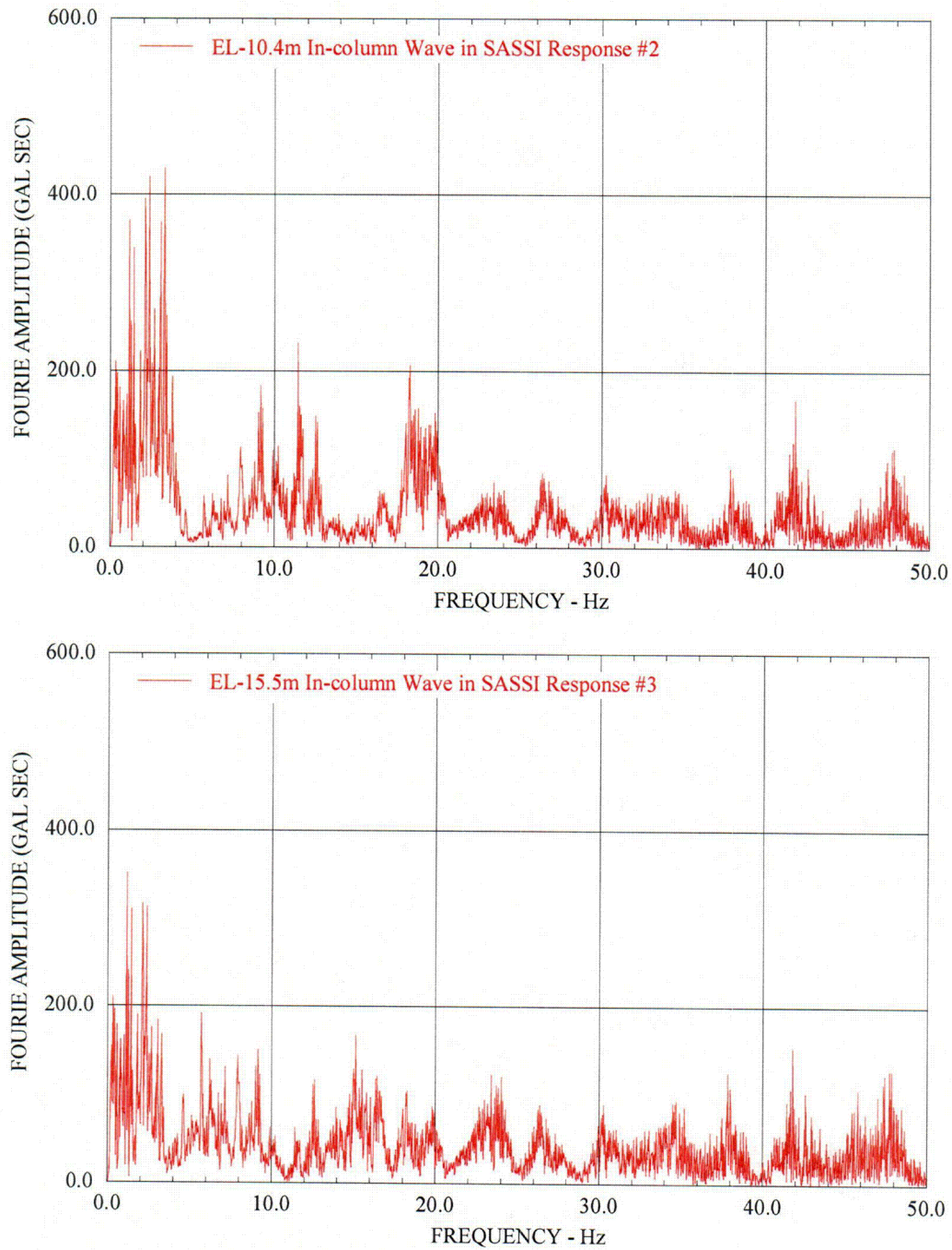


Figure 5. Fourier Amplitude Spectrum – In-Column Soil Motion

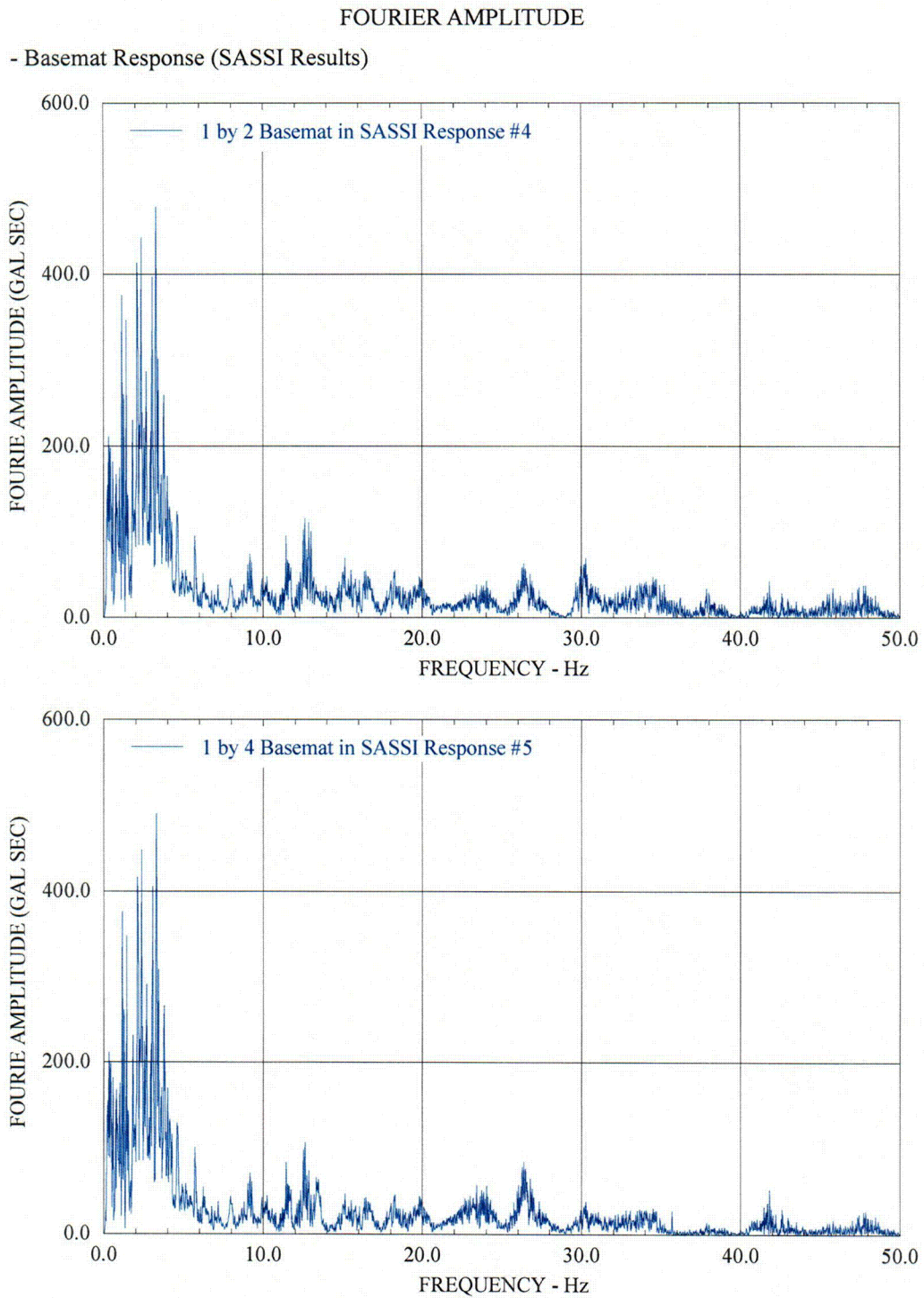


Figure 6. Fourier Amplitude Spectrum – Basemat Response Motion

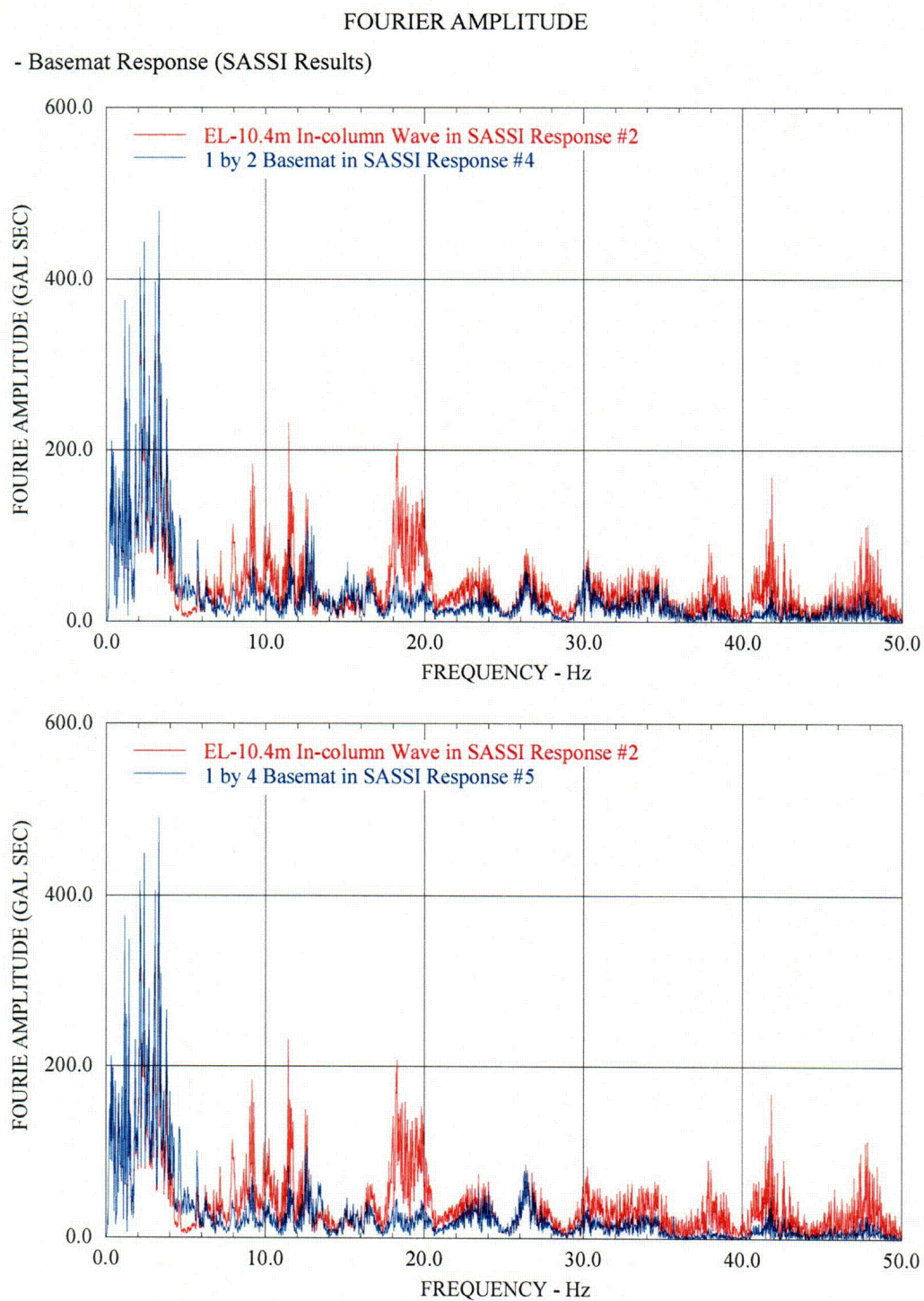


Figure 7. Comparison of Fourier Amplitude Spectra of Basemat Response

POWER SPECTRUM

- Input Wave

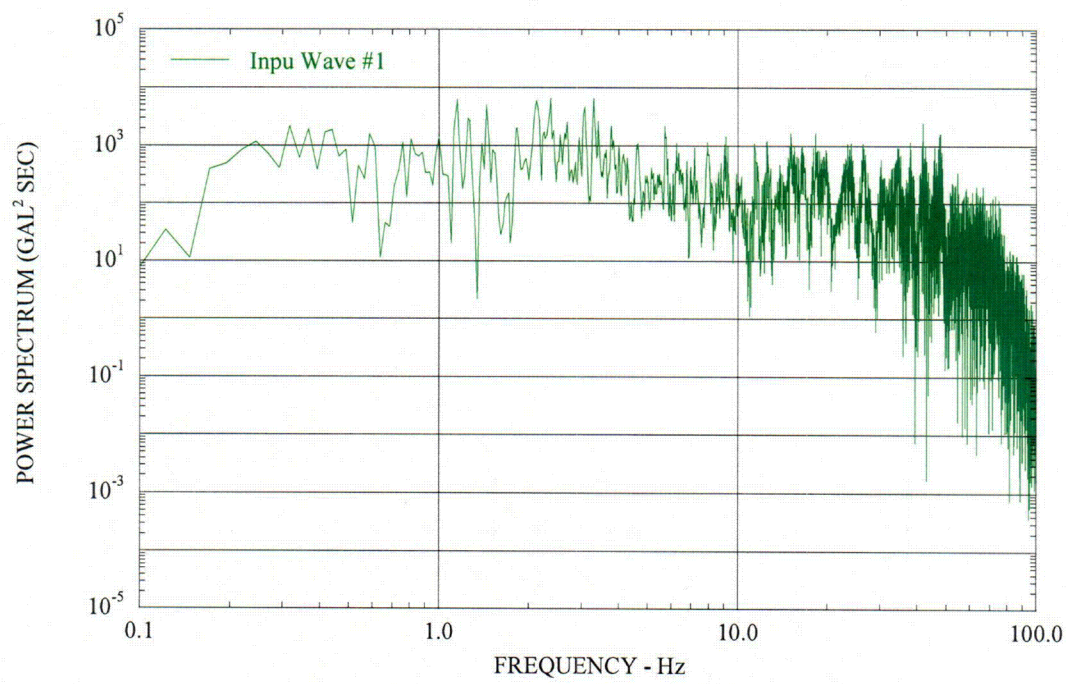


Figure 8. Power Spectrum - Outcrop Input Motion

POWER SPECTRUM

- In-column Wave (SASSI Results)

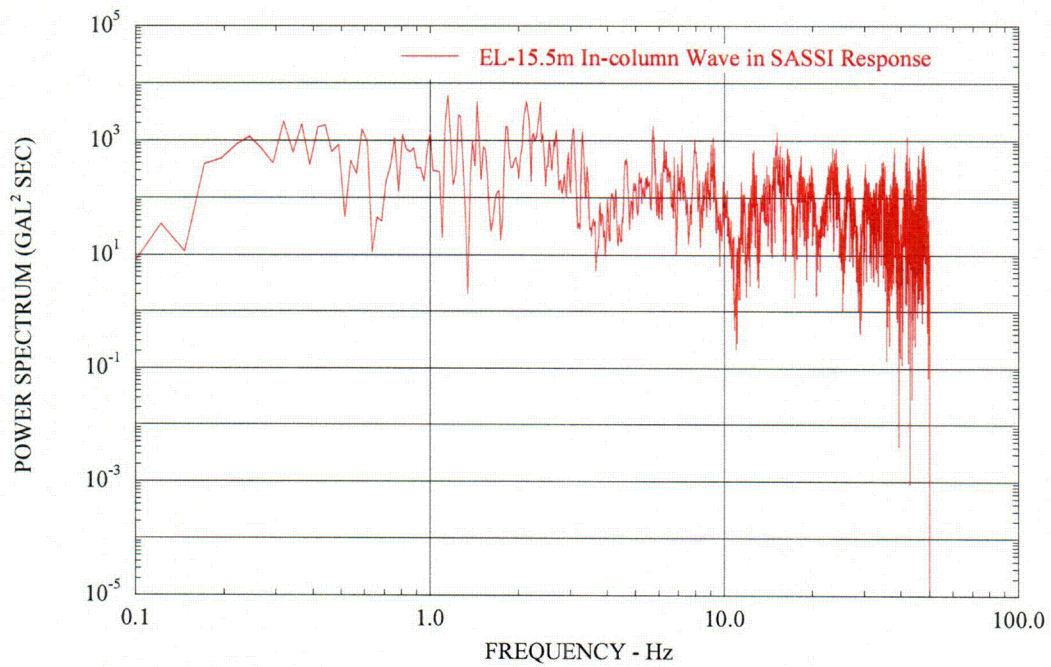
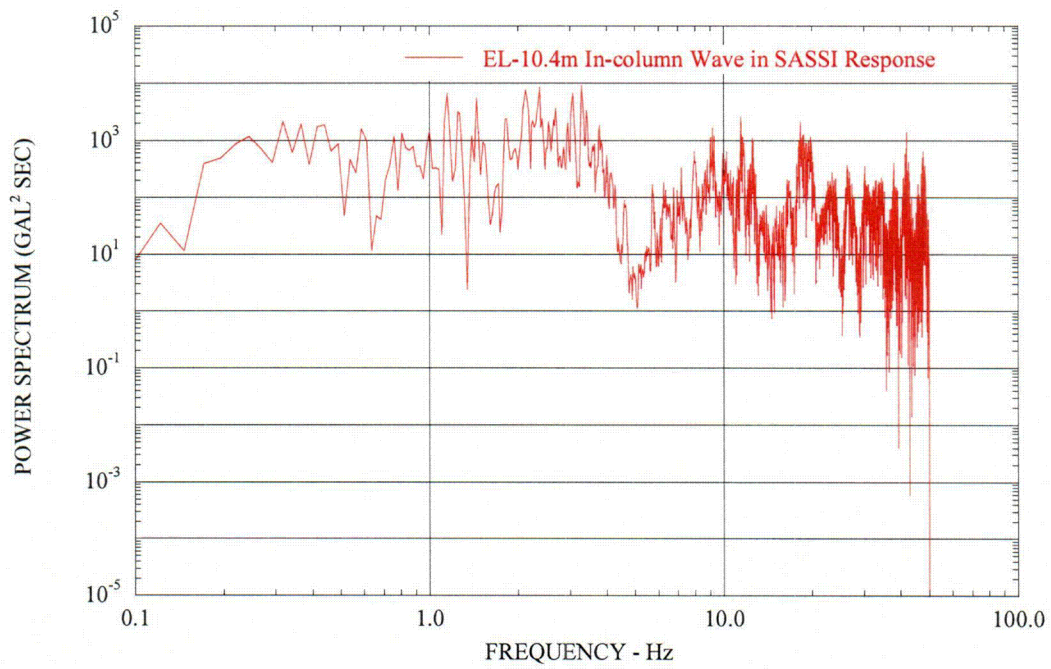


Figure 9. Power Spectrum – In-Column Soil Motion

POWER SPECTRUM

- Basemat Response (SASSI Results)

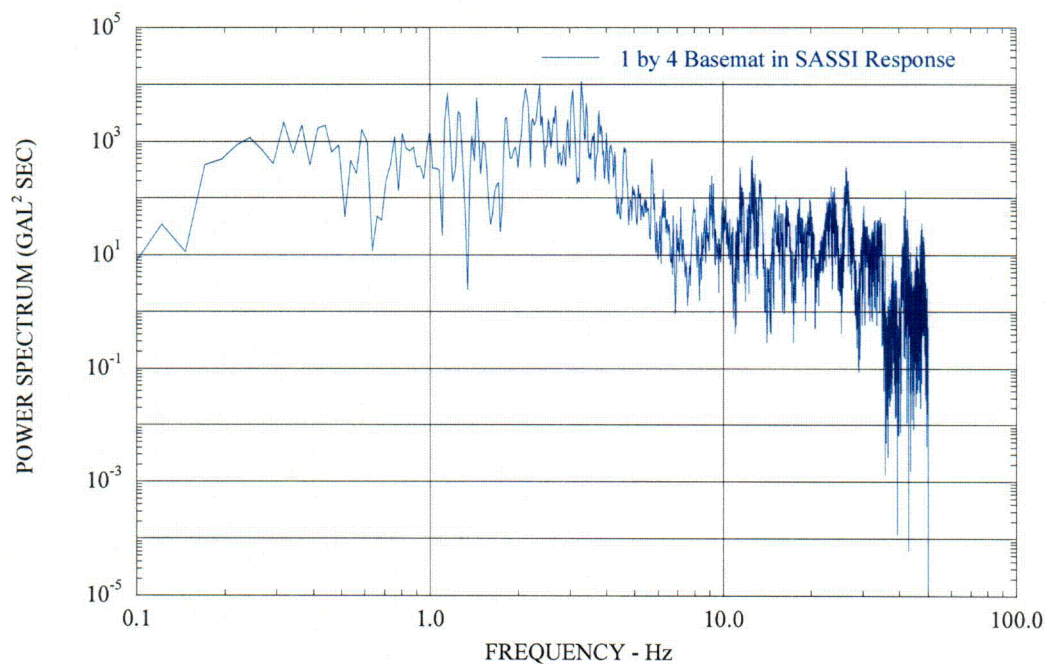
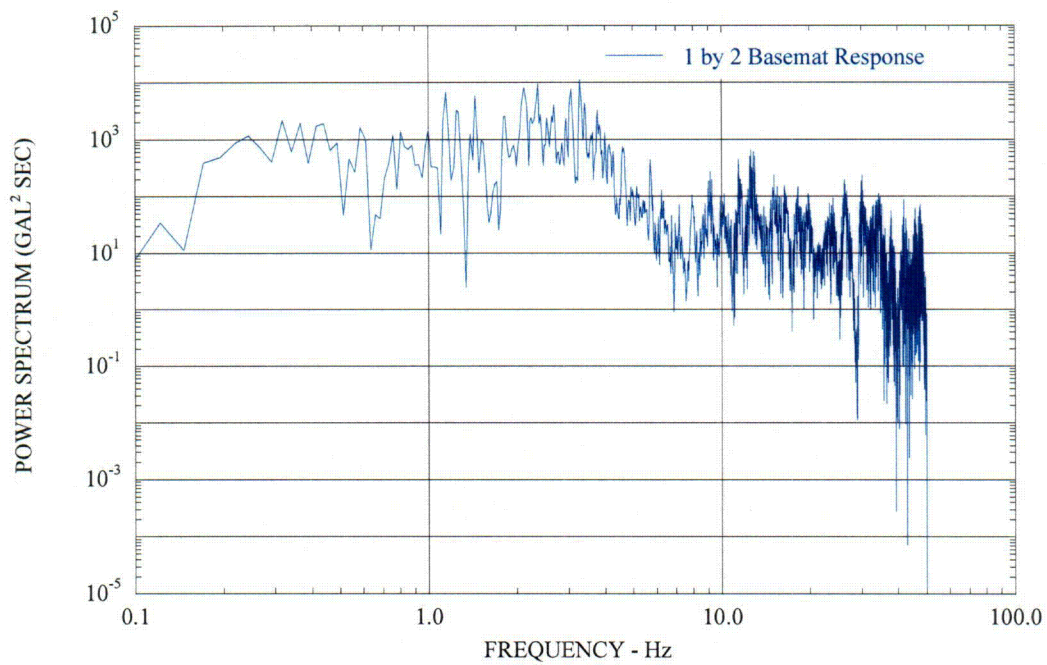


Figure 10. Power Spectrum – Basemat Response Motion