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MFN 06-252
Revision 1

Docket No. 52-010

September 13, 2006

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

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

Enclosure 1 contains the subject revised Sensitivity Study in response to the NRC comments made during NRC/GE teleconference on August 14, 2006. The Sensitivity Study was originally transmitted to the NRC via the Reference 1 letter and has been revised to include a discussion of frequency transmissibility of ground motion for rock sites.

If you have any questions about the information provided here, please let me know.

Sincerely,

Kathy Sedney for

David H. Hinds
Manager, ESBWR

D068

Reference:

1. MFN 06-252, Letter from David Hinds to U.S. Nuclear Regulatory Commission, *Sensitivity Study on Mesh Size Related to ESBWR DCD Section 3.7,* August 4, 2006

Enclosure:

MFN 06-252, Revision 1 – Revised Sensitivity Study on Mesh Size Related to ESBWR DCD Section 3.7

cc: AE Cubbage USNRC (with enclosures)
GB Stramback GE/San Jose (with enclosures)
eDRF 0000-0056-8543

ENCLOSURE 1

MFN 06-252, Revision 1

Revised 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 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.

The same mesh size of 1:4 aspect ratio (i.e., 1.1m vertical and 4.09m horizontal) is capable of transmitting 50 Hz ground motion for rock sites with shear wave velocity of 1023 m/sec minimum;

$$V_s = 4.09*5*50 = 1023 \text{ m/sec}$$

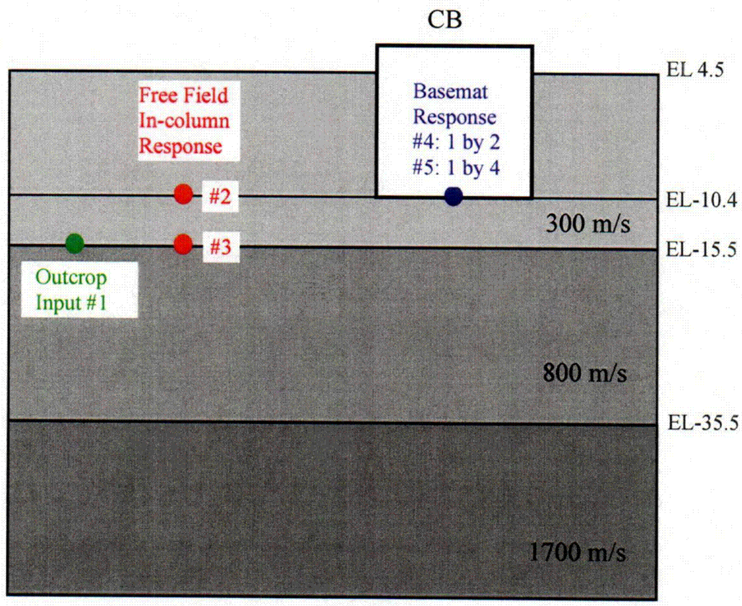
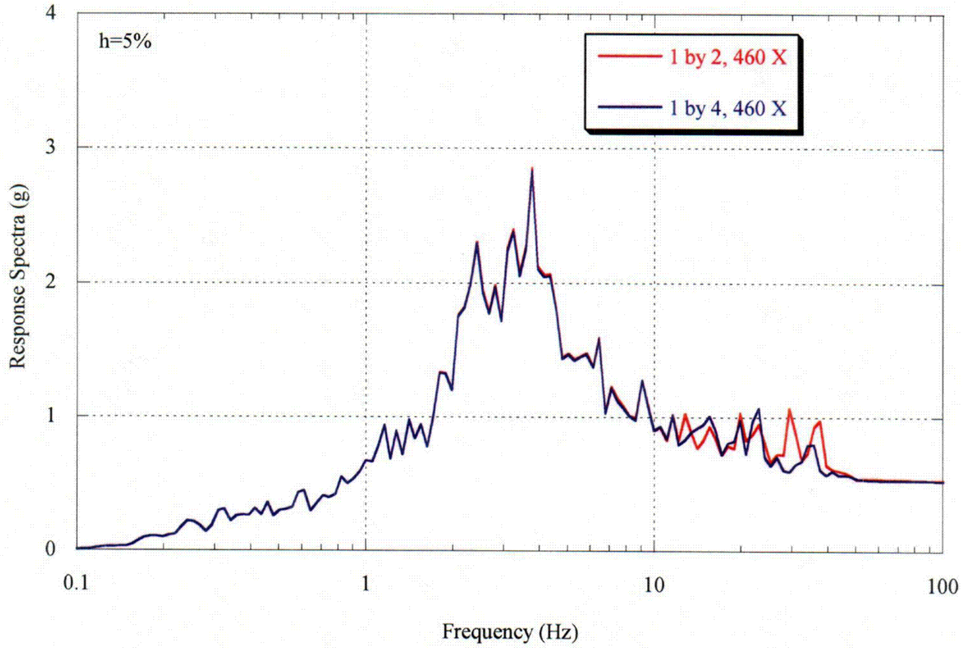
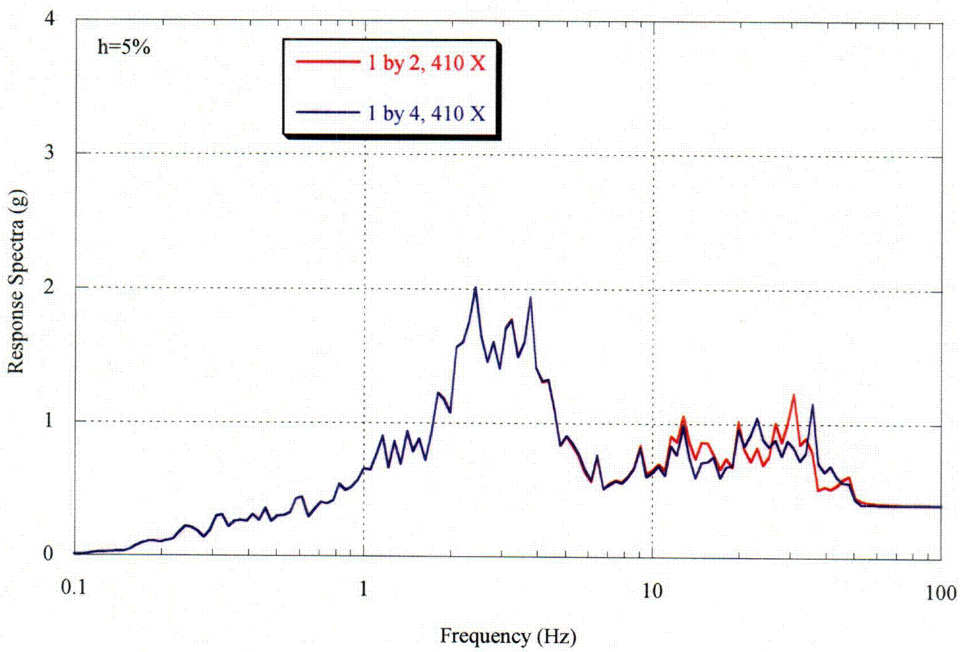


Figure 1. Case 2 Layered Soil

- Comparison of Ratio
  - Response Spectra
    - 1 by 2 vs. 1 by 4 X-dir



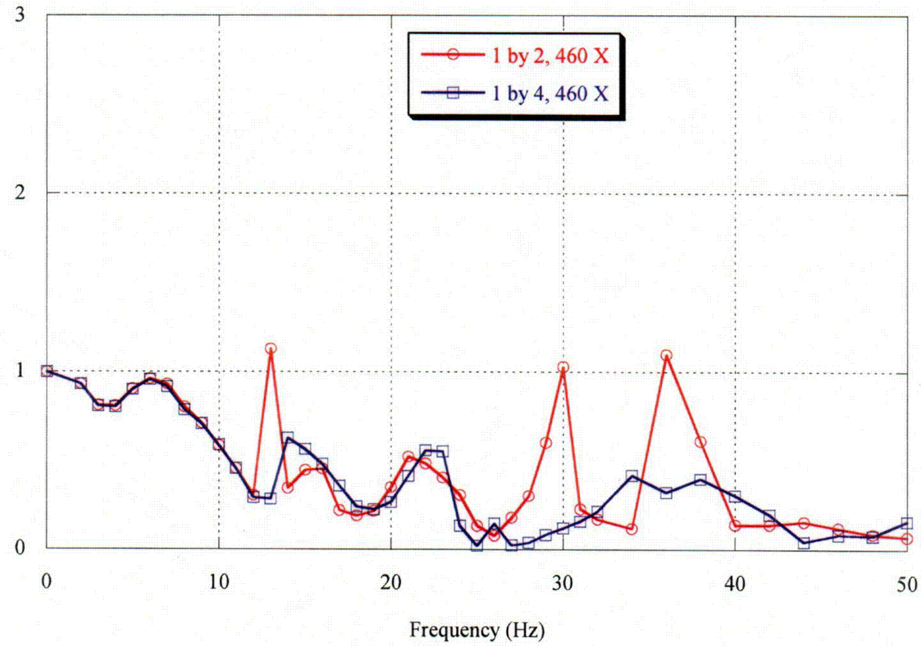
(a) CB TOP



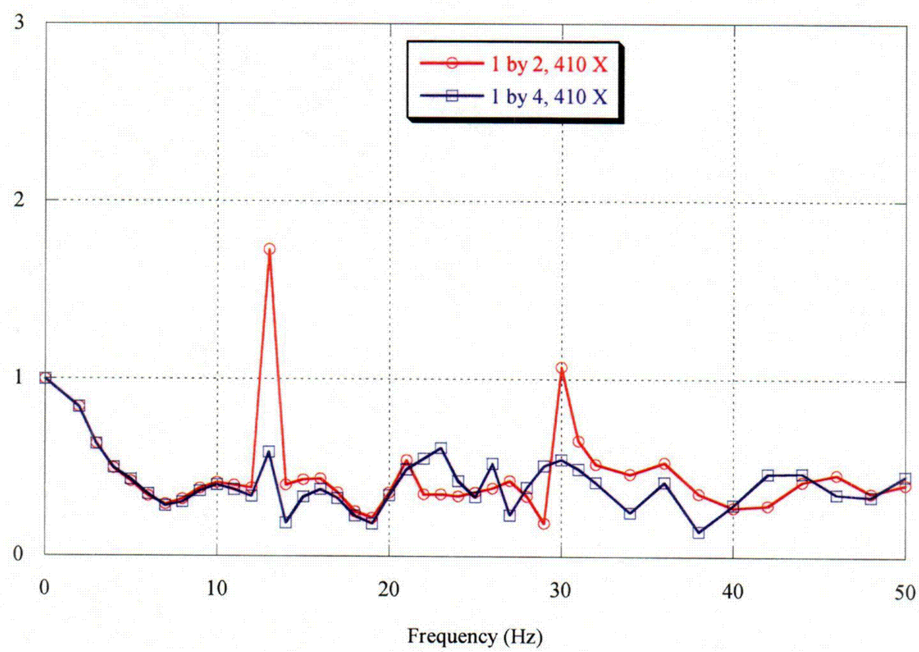
(b) CB BOTTOM

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

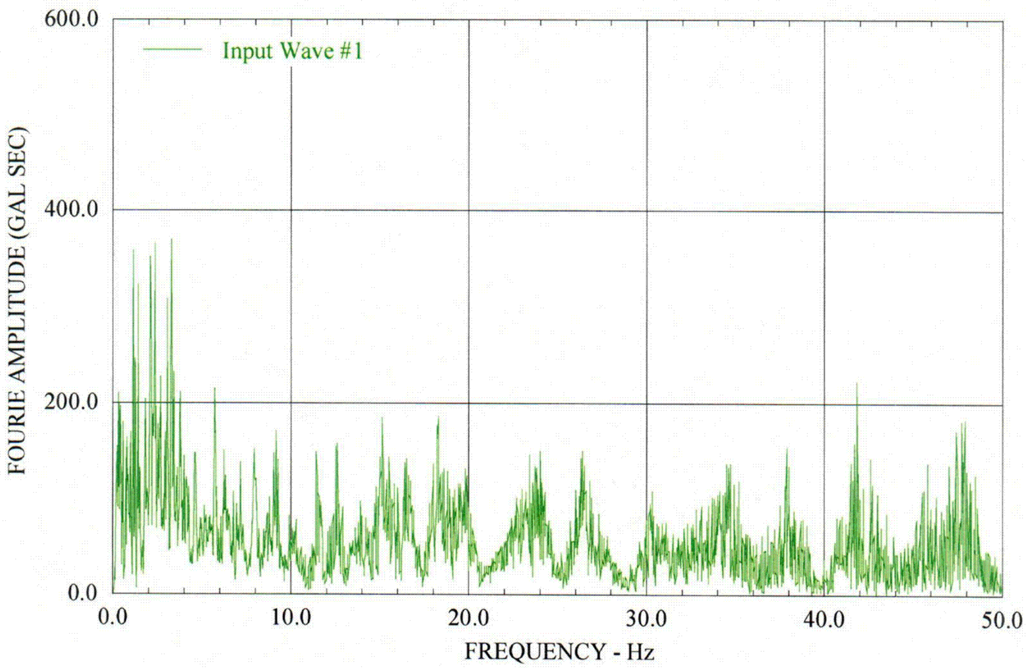
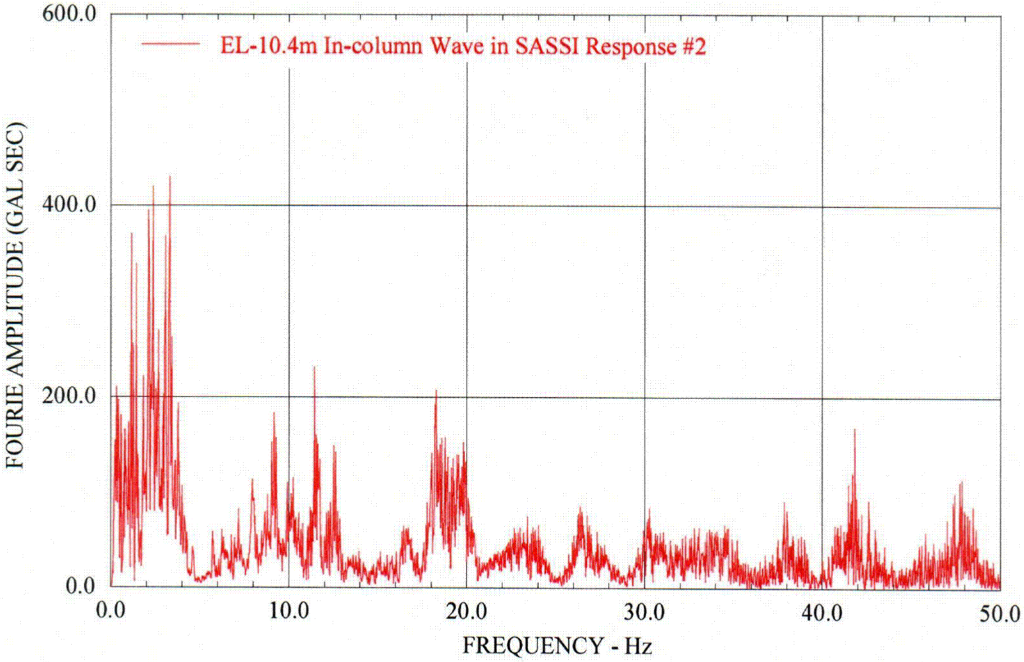


Figure 4. Fourier Amplitude Spectrum – Outcrop Input Motion

FOURIER AMPLITUDE

- In-column Wave (SASSI Results)



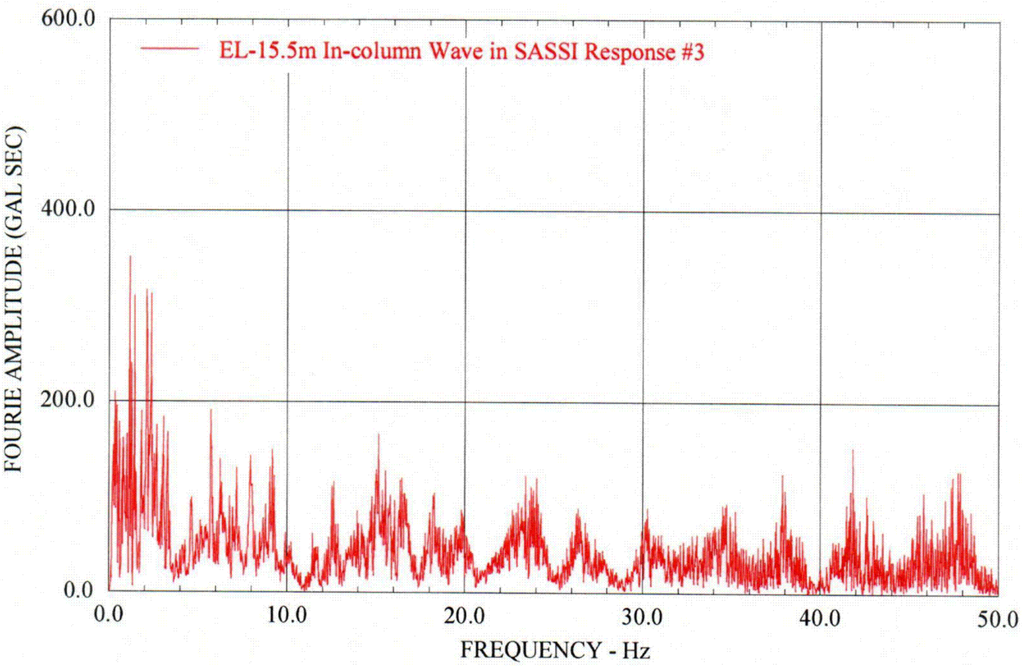


Figure 5. Fourier Amplitude Spectrum – In-Column Soil Motion

FOURIER AMPLITUDE

- Basemat Response (SASSI Results)

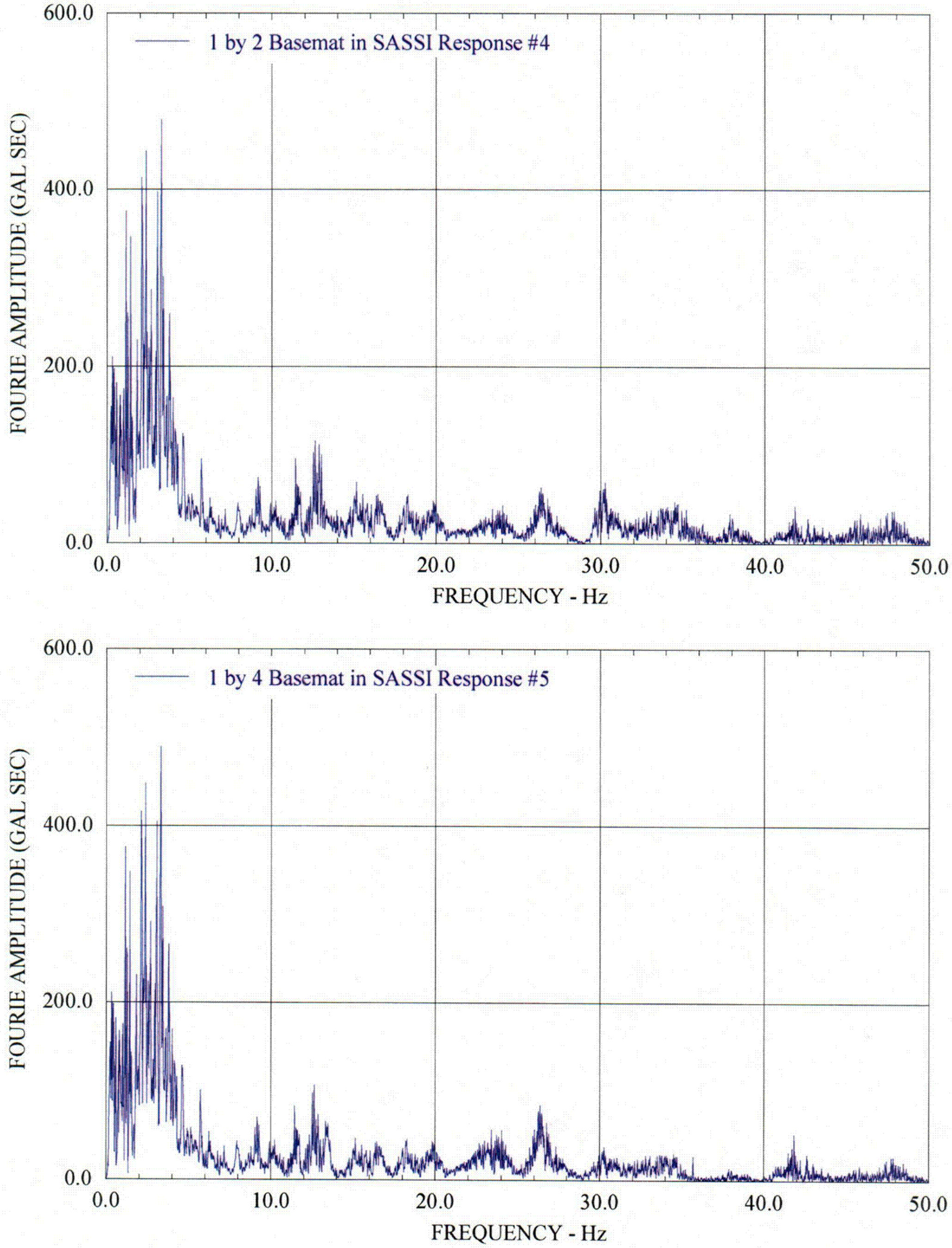
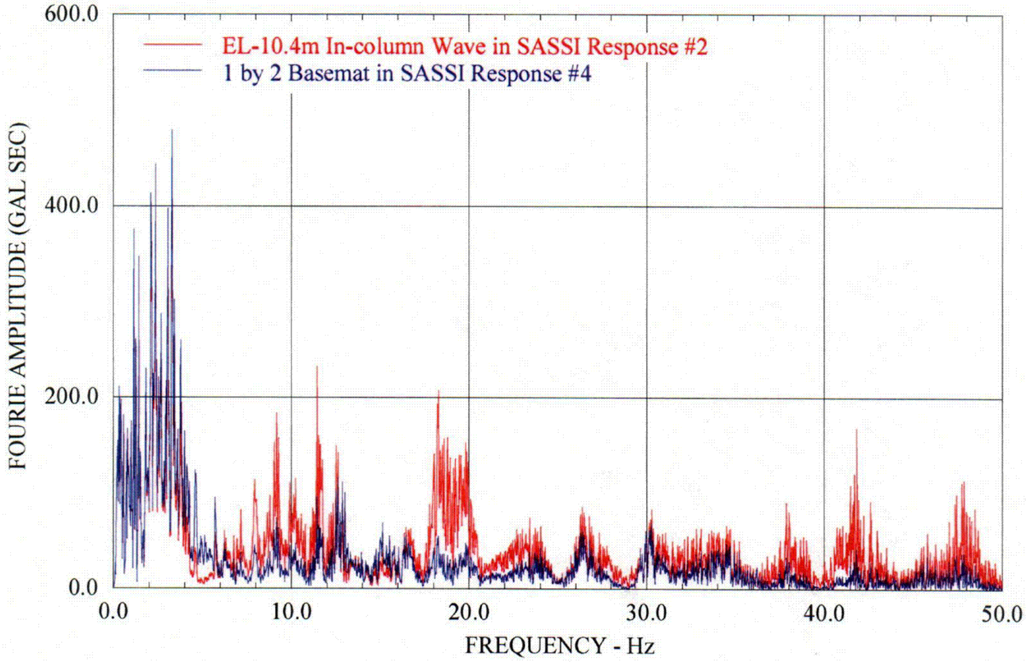


Figure 6. Fourier Amplitude Spectrum – Basemat Response Motion

FOURIER AMPLITUDE

- Basemat Response (SASSI Results)



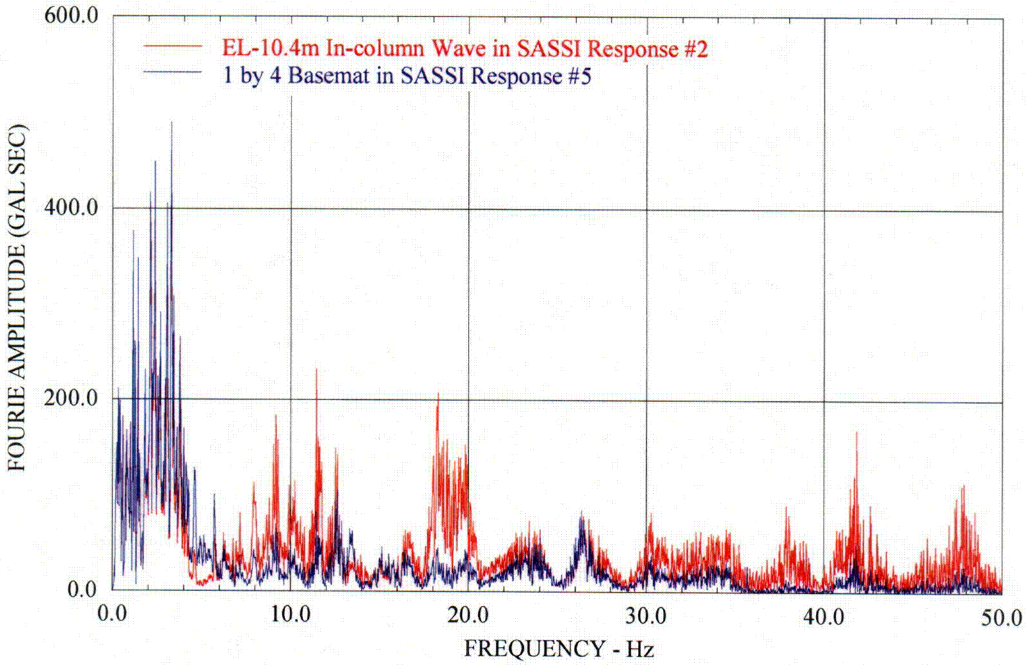


Figure 7. Comparison of Fourier Amplitude Spectra of Basemat Response

POWER SPECTRUM

- Input Wave

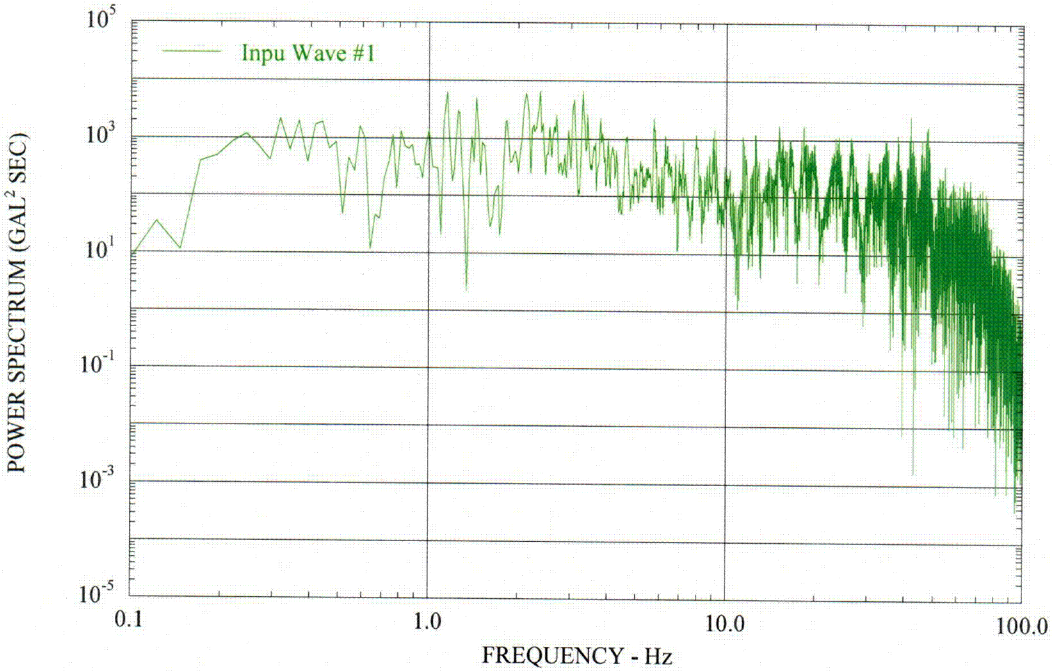
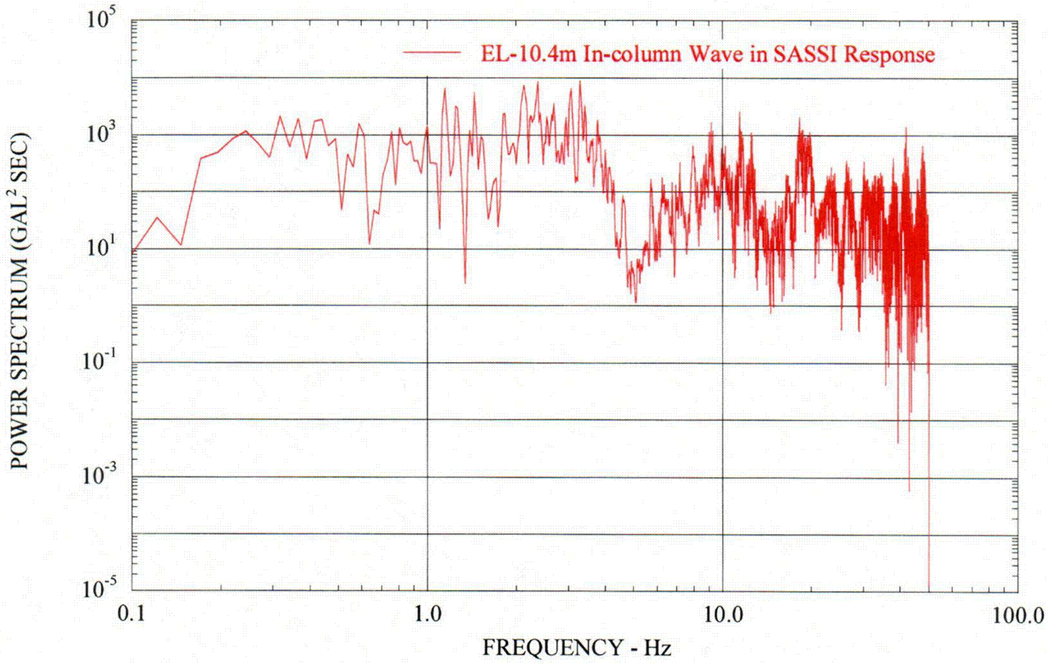


Figure 8. Power Spectrum - Outcrop Input Motion

POWER SPECTRUM

- In-column Wave (SASSI Results)



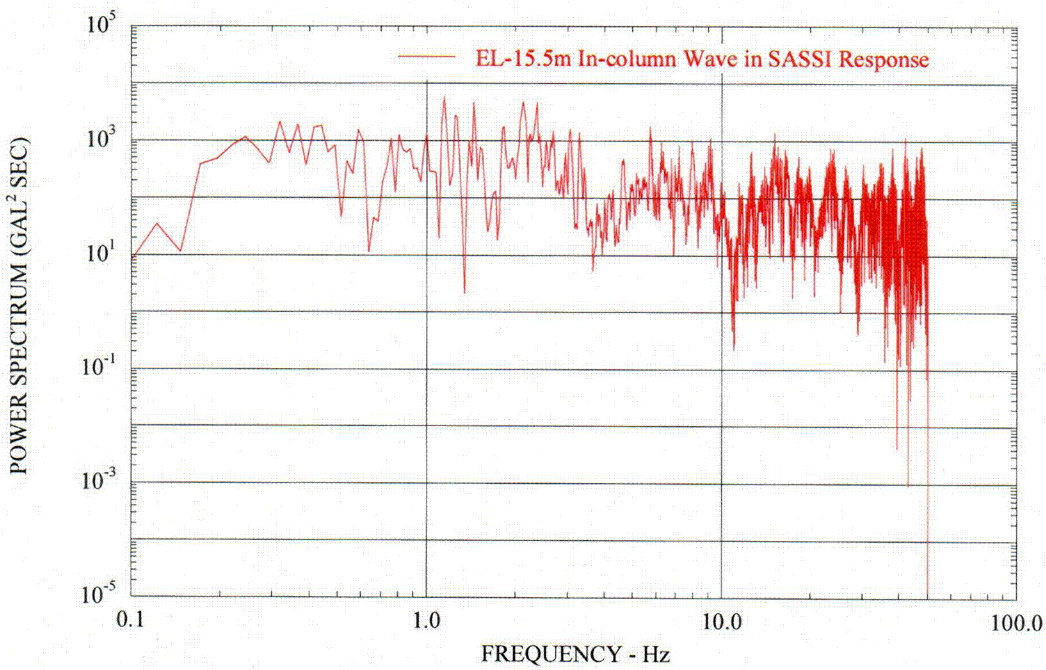
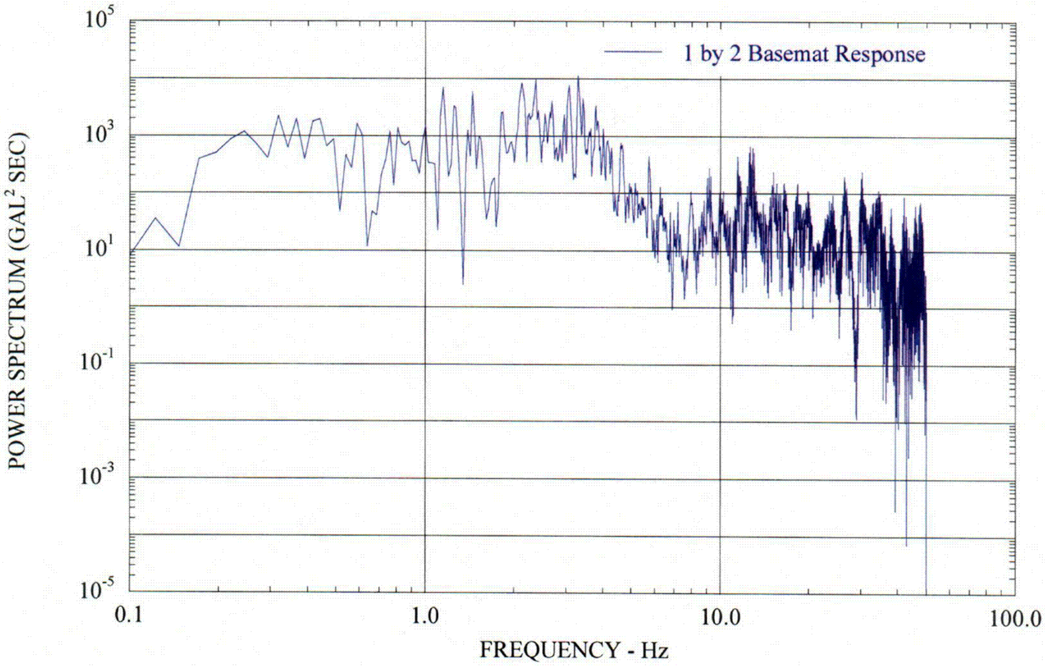


Figure 9. Power Spectrum – In-Column Soil Motion

POWER SPECTRUM

- Basemat Response (SASSI Results)



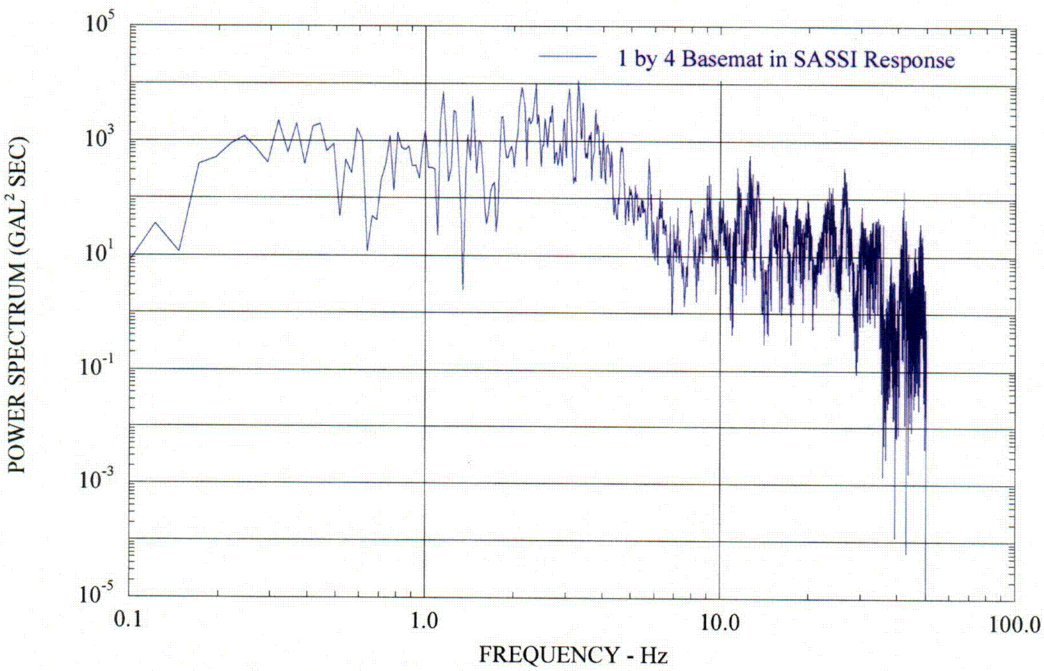


Figure 10. Power Spectrum – Basemat Response Motion