GROUND MOTION SITE EFFECTS IN THE WABASH VALLEY REGION FROM THE 18 JUNE 2002 DARMSTADT EARTHQUAKE

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INVESTIGATIONS UNDERTAKEN

On June 18, 2002, a moderate, M4.6 (5.0 $m_{b,Lg}$), earthquake occurred in southwestern Indiana. This event triggered forty-six free-field blast monitors (Figure 1). The resulting peak particle velocities and accelerations correlate poorly with the current NEHRP provisions for seismic hazard amplification in the area; consequently, this investigation is performing detailed dynamic site investigations at the blast monitor sites to determine the role of the site effects in the June 18, 2002 ground motions. The field investigations include S-wave refraction/reflection velocity measurements and horizontal-to-vertical spectral ratios (HVSR) of ambient noise at the blast monitor sites. The measured field data are being incorporated into one-dimensional site response modeling and compared to the June 18, 2002 earthquake free-field observations.

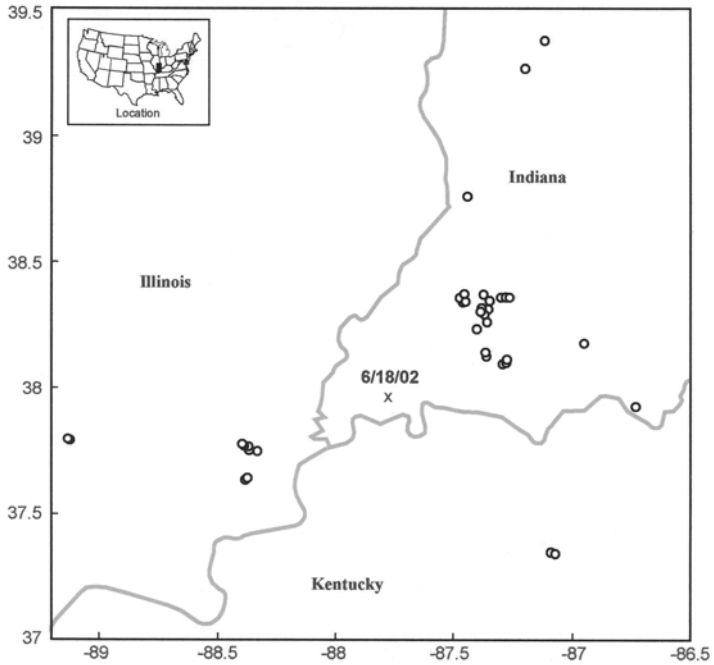

Figure 1. Location of the 18 June 2002 M4.6 epicenter (cross) in relation to the blast monitor sites (open circles).

RESULTS

The dynamic properties at forty-two sites in the Wabash Valley area have been defined by S-wave refraction/reflection and ambient HVSR methods. Bedrock depth and S-wave velocity ranged between 2 and 73 m (average 12 m), and 745 and 2320 m/s (average 1200 m/s), respectively. The average S-wave soil velocity was ~300 m/s. Six of the site responses have been completed, and compared to observations. This process included velocity model construction in SHAKE91, synthetic stochastic time history generation, and model–observation comparison. Initial indicators suggest a reasonable correlation between the models and observations. Figures 2 through 7 show the results for Site 15 in southern Indiana.

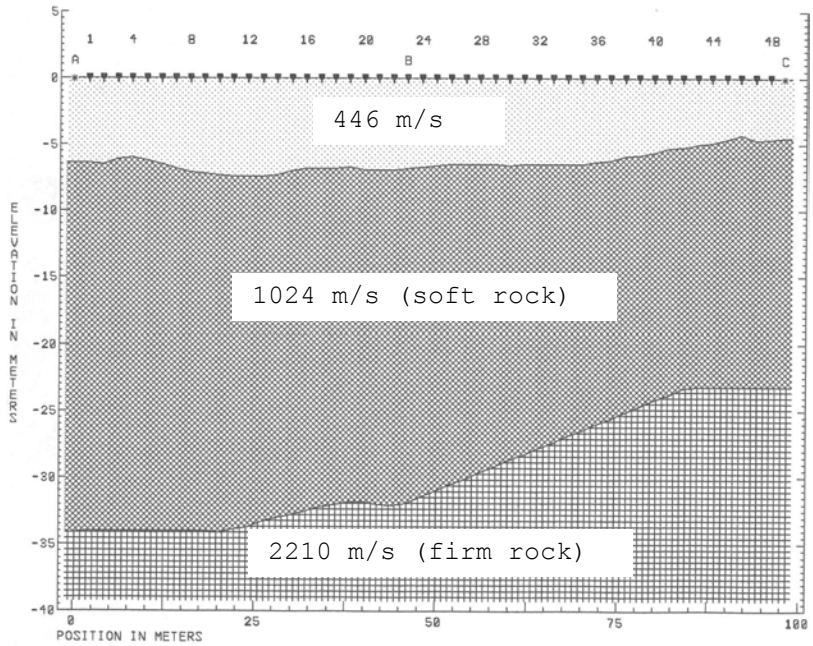

Figure 2. S-wave velocity model derived from refraction survey.

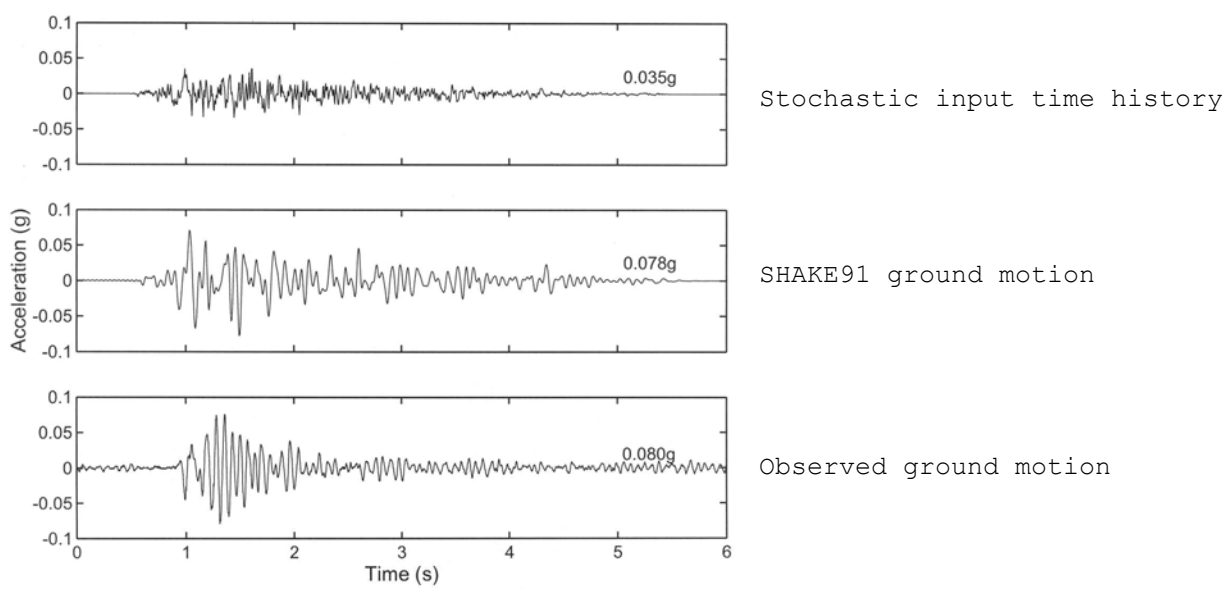

Figure 3. Comparison of modeled and observed time histories and their peak motions.

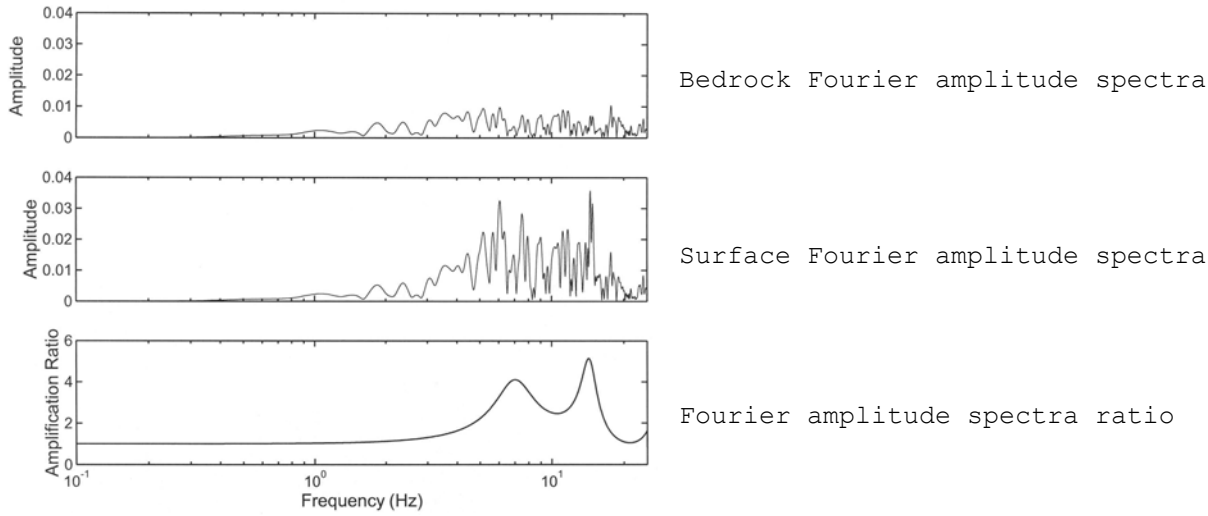

Figure 4. Discrete input and output spectra and their ratio.

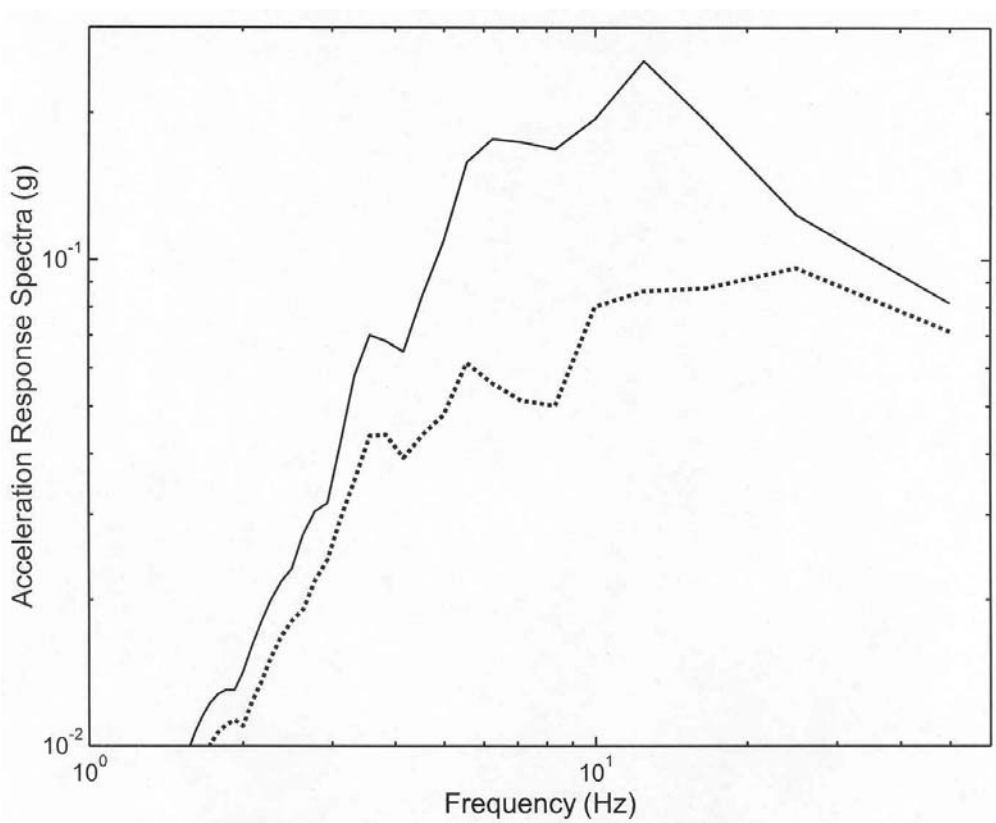

Figure 5. 5%-damped response spectra of the input (dashed) and output (solid) motions.

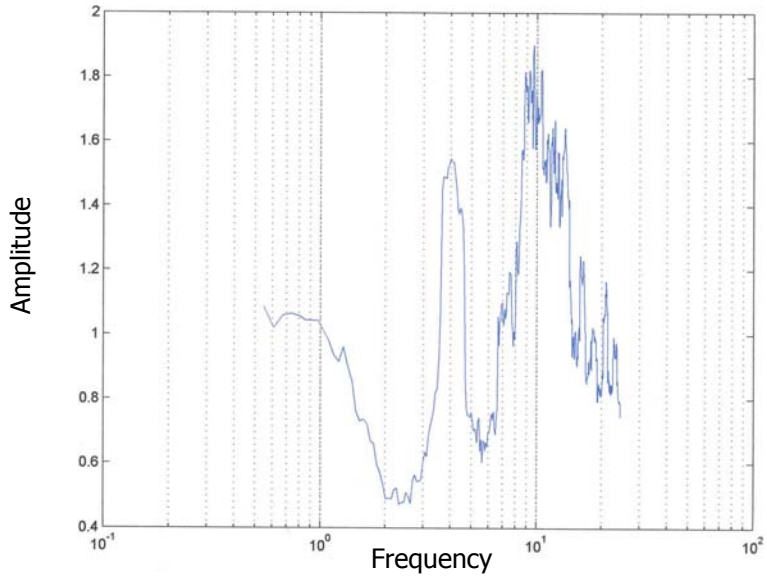

Figure 6. Results from the first of two HVSR ambient noise measurements at the site.

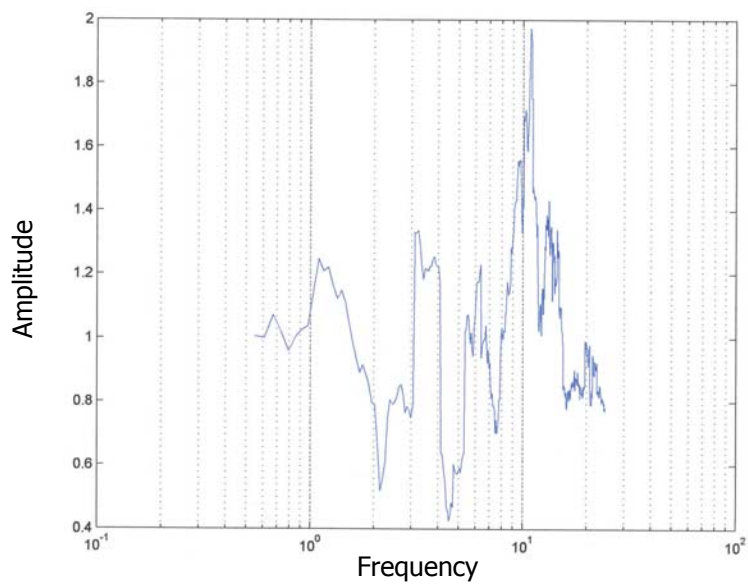

Figure 7. Results from the second of two HVSR ambient noise measurements at the site.

NONTECHNICAL SUMMARY

The M4.6 southwestern Indiana (Darmstadt) earthquake of 18 June 2002 triggered 46 blast monitors in Indiana, Illinois, and Kentucky. The resulting free-field records are providing a unique opportunity to assess the role of seismic hazard amplification in this area of the central United States. This study is integrating *in situ* dynamic soil/rock measurements at the blast monitor sites with one-dimensional site response modeling to assess the role of ground motion site effects in the context of the June 18, 2002 earthquake observations.

PUBLICATIONS/PRESENTATIONS

None.

DATA AVAILABILITY

SH-wave seismic reflection/refraction velocity and ambient HVSR data acquired, as well as derived ground motion models, in this study are being organized by site, and will be archived at the Kentucky Geological Survey. There will also be information as to the location of the site, recording parameters, and other pertinent information. The seismic field data will be stored in standard SEG-Y format at the completion of the study, and available upon request. Requests for information should be directed to the PI.