

## Technical Memo

From: Binod Tiwari, Ph.D., P.E., CSU Fullerton

To: Diego Villegas, Cell-Crete Corporation

Re: Study Report, Study on applicability of Cell-Crete material as an appropriate backfill material for MSE wall Phase II

Date: 2/17/2017

Dear Mr. Villegas,

Please find attached the report on the shaking table experiments we conducted on a segment of the lightweight cellular concrete (LCC) MSE Wall backfill. In a separate email, I will provide you access to the video clips of the shake table experiments.

Many thanks for the opportunity to work with you in such important project.

Please let me know if you have any questions.

# Study on Behavior of Lightweight Cellular Concrete MSE Wall under Seismic Loading

## 1. Background

Construction of infrastructure on soft ground poses significant geotechnical challenges including excessive elastic and consolidation settlements, substantial amplification of seismic motions, and considerably low bearing capacity. These issues frequently cause unnecessary construction delays and high seismic demand on structures. Such demands increase the construction cost significantly, especially, on roads and railway embankment projects. One among the alternates for construction on these conditions, which has recently been adopted, is the use of lightweight cellular concrete (LCC) material as the soil in-fill in the MSE wall. As the LCC materials are very light, almost one-third of the unit weight of water, it has been effectively used in many construction sites in California. Pradel and Tiwari (2015) illustrated a few of those LCC material application sites.

Static and dynamic properties of the LCC materials have been reported in literature. With an extensive laboratory testing program, Tiwari et al. (2017) and Tiwari (2016) reported the relationship between density and drained as well as undrained shear strength, consolidation, and hydraulic conductivity of LCC materials of densities ranging from 20 to 48 pcf. Tiwari et al. (2017) and Tiwari (2016) also presented the dynamic properties of different types of LCC materials with the densities ranging from 20 to 48 pcf. Trend in the variation in  $G/G_{max}$ , cyclic shear stress and damping ratio with shear strains, according to Tiwari et al. (2017), differ with the density of the materials.

Although the LCC materials have been used as in-fill material for the MSE Wall construction, the concrete-geogrid behavior has not been studied so far. Pradel and Tiwari (2015) presented the results of numerical analysis performed with FLAC 7.0 on the deformation behavior of a LCC MSE wall constructed on soft clays. According to Pradel and Tiwari (2015), on soft clay sites, LCC MSE walls move in a quasi-rigid manner during earthquakes, without developing a significant total or differential permanent vertical seismic movements. Failure of the LCC materials in either compressive, tensile or shear modes was not predicted. According to Pradel and Tiwari (2015), the role of the geogrid reinforcement during earthquake loading is mainly to hold the side panels and to be used for crack control purposes, specifically for the cracks resulting from material shrinkage and/or minor differential movements resulting from varying bearing conditions. They recommended the designers to consider limiting both the reinforcement lengths and type, while designing LCC MSE Wall.

This study was performed to evaluate the horizontal differential deformation of LCC MSE wall at different locations and at the concrete-geogrid interface.

## **2. Materials and Methods**

A 5' 8" long, 3' 8" wide and 4' tall LCC block was fabricated by the Cell Crete Corporations with Type II cellular concrete and cured for 28 days. Please refer to Tiwari et al. (2017) for the detailed geotechnical properties of Type II LCC material. A layer of geo-grid was installed at the height of 2' across the LCC block, as presented in Figure 1. The entire block was carefully transported to CSU Fullerton for this study. The LCC block was later carefully transferred to the shake table and secured tightly in position, as presented in Figure 2 and Appendix A.

A special loading platform was fabricated to load the model. To avoid equipment damage and potential hazard during shaking, the total vertical load to be applied on the model was limited to 2460 lbs, which provides the surcharge stress of 118.8 psf for 5'8" x 3'8" LCC block, referred hereafter as Model 1, for consolidation and shaking. This surcharge stress is equivalent to 6 ft of self-weight of the LCC MSE wall, considering the unit weight of LCC material as 19.7 pcf (Tiwari et al. 2017). This additional surcharge provides the effective vertical stress of the wall height of 8 ft. above the geo-grid reinforcement. The second model was prepared by trimming 6 inches at all four edges that yielded into the model dimension of 4'8" x 2'8". With the same surcharge load applied through the dead weights as presented in Figure 3, the surcharge stress used for the second model (here in after referred to as Model 2) was 198.5 psf, equivalent to a surcharge pressure of 10 ft. of LCC material. This provides an equivalent surcharge height of 12 ft. above the geo-grid reinforcement. The entire assembly was caged safely within the shake table, as presented in Figures 2 and 3 and Appendix A. The cage prevented abrupt failure, but still allowed the model to freely deform during the application of the cyclic loads. In order to measure the acceleration time history and the displacement time history at different locations, three triaxial accelerometers and four strain gauges were installed as presented in Figures 4 and 5 for Models 1 and Model 2, respectively. The third model at the plan area of 3'8" x 1'8" was also prepared as shown in Figure 3. However, due to the excessive slenderness of the model and potential breakage risk during cyclic shaking, that model was not tested for cyclic loading.

All the models were subjected to 5 different seismic motions on the shake table, as presented in Table 1. Each motion was applied, separately, for three times. Accelerometers  $A_1$  through  $A_3$  and strain gauges  $S_1$  through  $S_4$  recorded the seismic motions at different heights from the table, as presented in Figures 4 and 5.



Figure 1: Unwrapping the model and setting up on the Shake table.



Figure 2: Protection of the model from abrupt failure and installation of vertical surcharge load in Model 1.



Figure 3: Overall view of Model 2 with dimensions 4'8" x 2'8" and Model 3 with dimensions 3'8" x 1'8" model; the former is set-up for testing with the surcharge load.

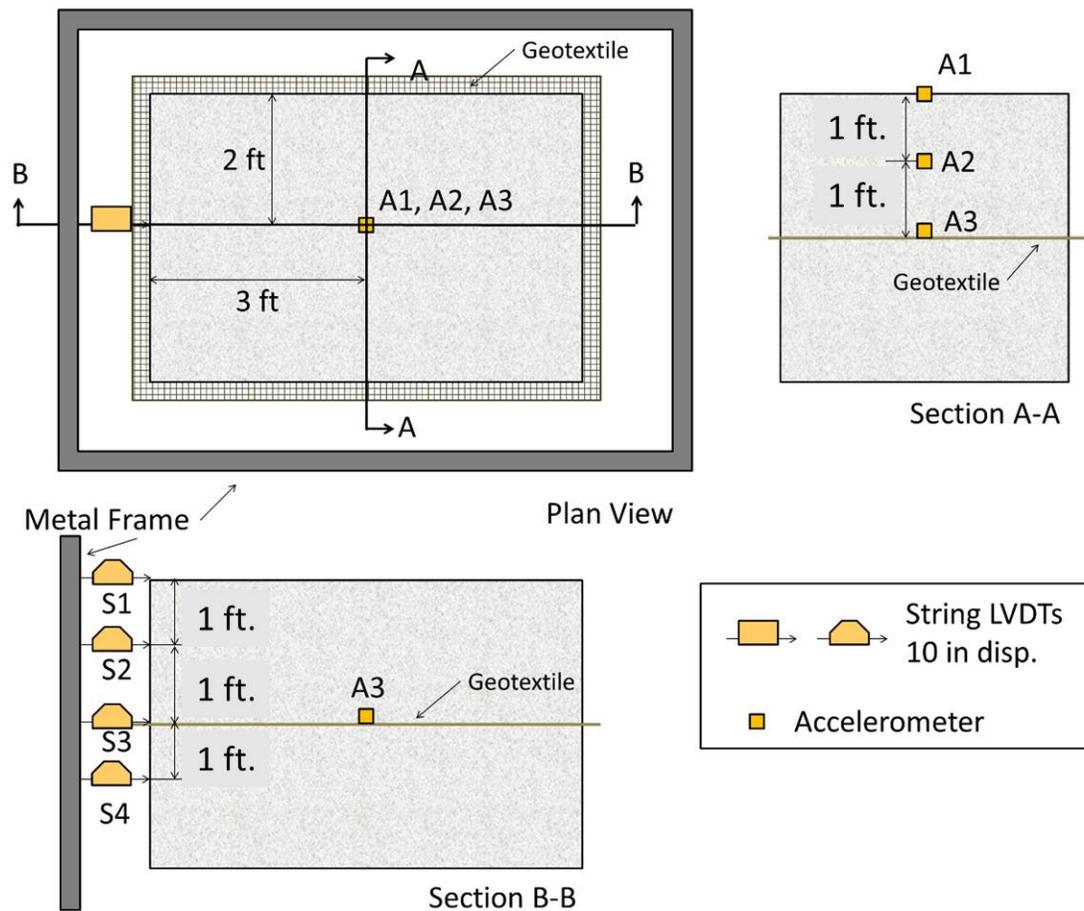


Figure 4: Locations of accelerometers and strain gauges in Model 1.

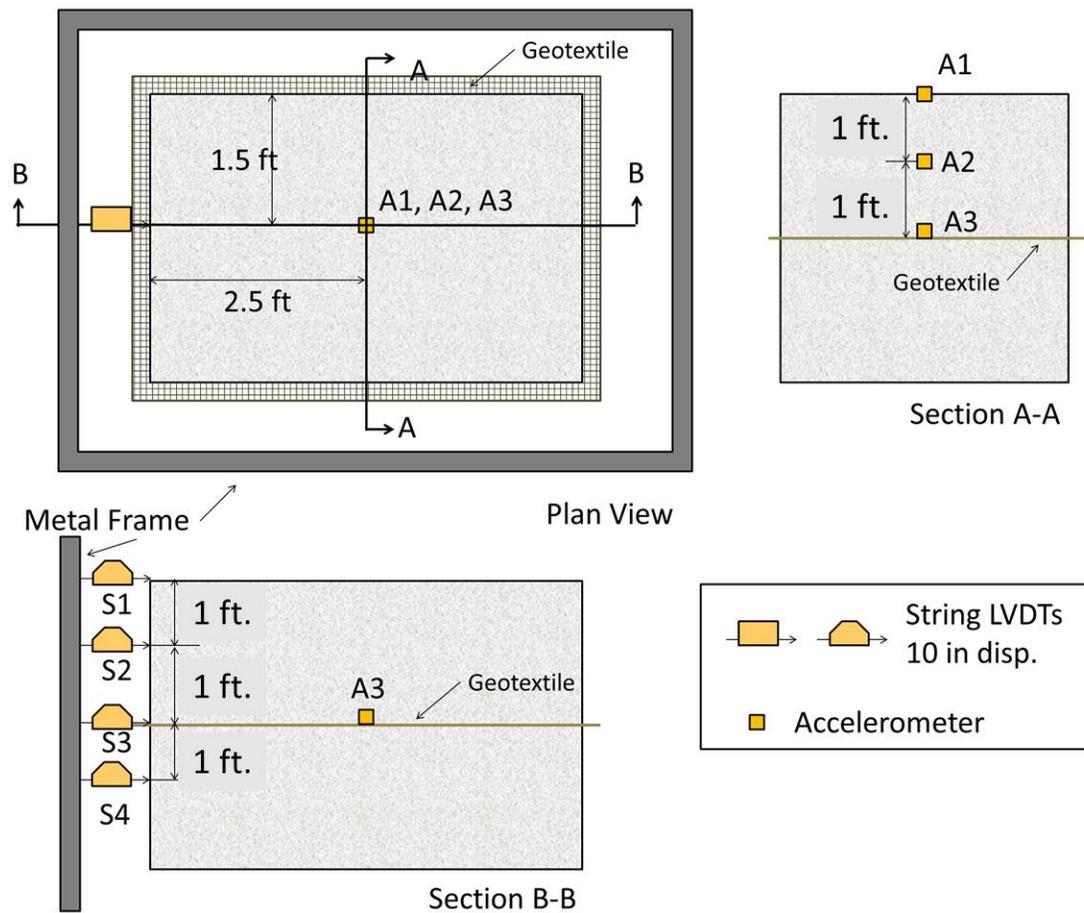


Figure 5: Locations of accelerometers and strain gauges in Model 2.

Table 1: Different motions applied on the shake table to evaluate the response of geo-grid reinforced LCC block on those motions.

Test #	Motion Type	Frequency (Hz)	Acceleration (x g)	# of tests
1	Sinusoidal	2	0.1	3
2	Sinusoidal	3	0.1	3
3	Sinusoidal	2	0.2	3
4	Sinusoidal	3	0.2	3
5	Northridge Earthquake	Variable	Variable with max of 0.24	3

### 3. Results

The motions recorded by all three triaxial accelerometers after the application of the table motion were analyzed to evaluate the relative displacement of the geo-grid and the LCC materials. The recorded acceleration time histories were subjected to linear baseline corrections and filtered using a Butterworth Bandpass filter. The corrected acceleration-time histories obtained from the accelerometer data are presented in Appendix B.

In this section and for the remainder of the report, the displacement-time histories are described, as they were most relevant to the objective of this study. Therefore, the baseline corrected acceleration-time history was double integrated to obtain the displacement-time history. Figures 6 to 8 show the displacement-time histories for Motions 1, 4, and 5, respectively for Model 1, recorded in the z-direction, which is at the direction of shaking. Displacement-time plots for all other motions are presented in Appendix C. As can be observed in all of these motions, displacements observed at 2 ft above the geo-grid is slightly larger than that observed in the LCC near the geo-grid, although the differences were negligible. This trend was consistent for all models. The relative difference in shear strain at the top and bottom of the model was less than 0.01%.

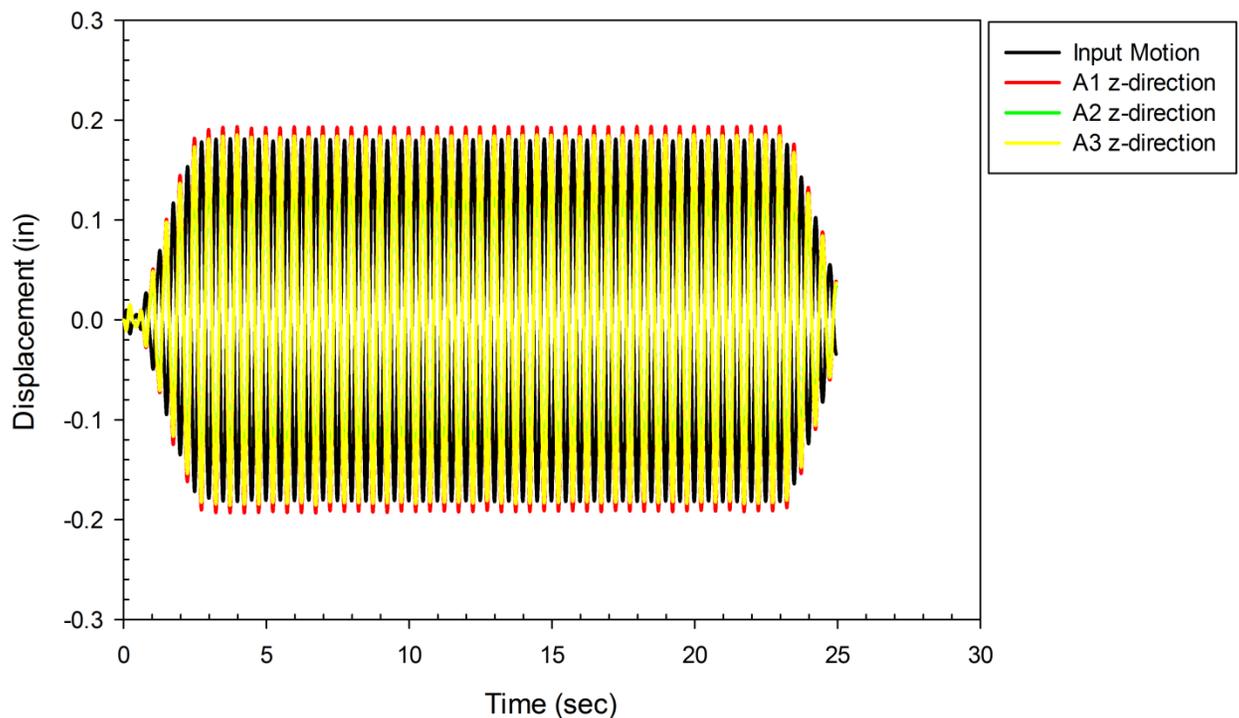


Figure 6: Comparison of displacement-time history at three different locations observed measured with accelerometers for the Table Motion #1 in Model 1.

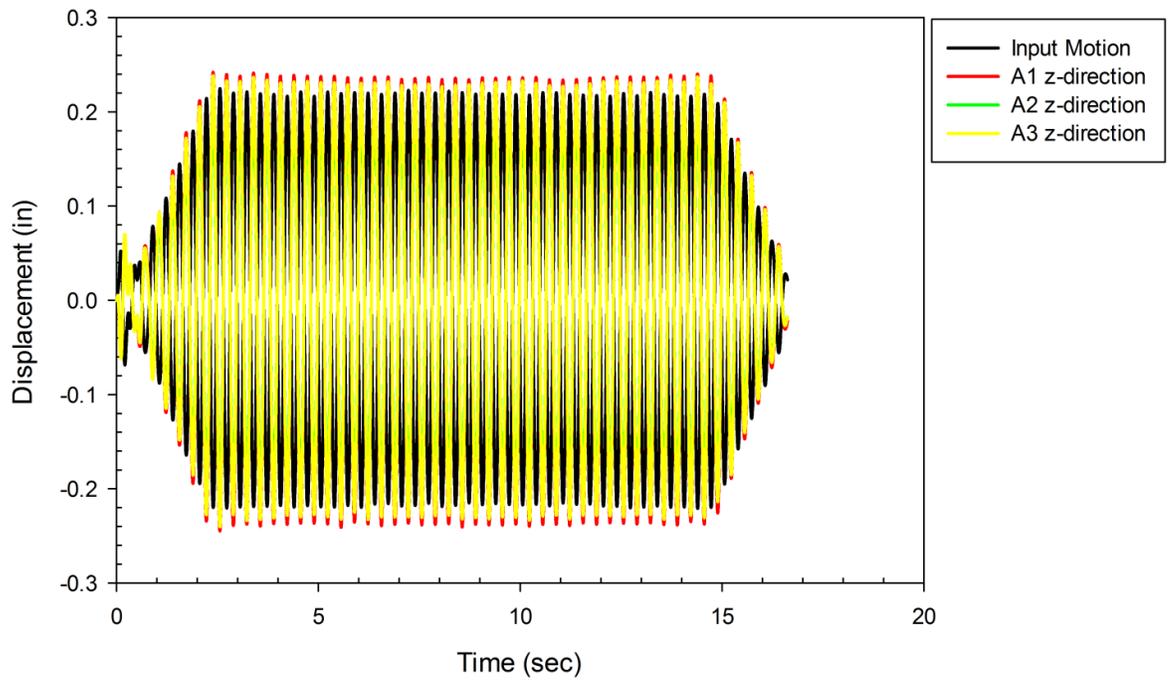


Figure 7: Comparison of displacement-time history at three different locations observed measured with accelerometers for the Table Motion #4 in Model 1.

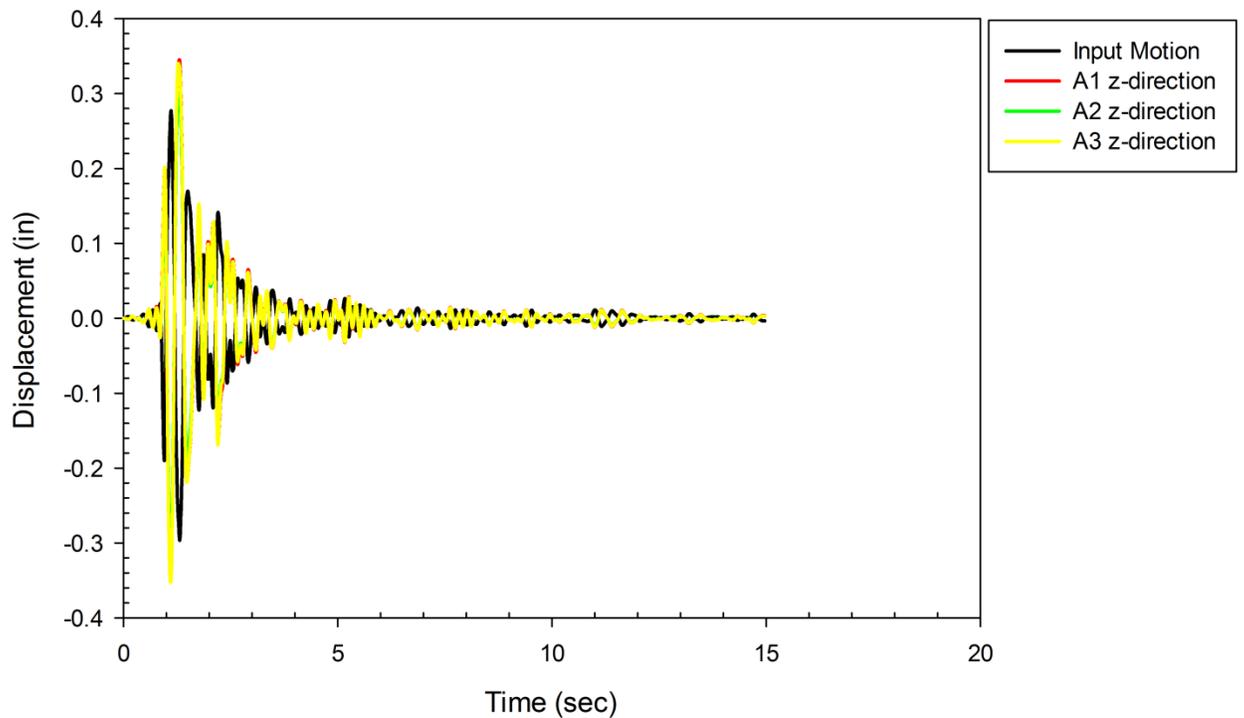


Figure 8: Comparison of displacement-time history at three different locations measured with accelerometers observed for the Table Motion #5 in Model 1.

Shown in Figures 9 to 11 are the time history of displacement recorded at accelerometers A1, A2, and A3 in z-direction when Motions 1, 4 and 5 were applied on the table. The results obtained were very much consistent with the results obtained for Model 1, i.e. the recorded horizontal displacements were nearly identical. This shows that the entire wall was moving monolithically while different motions were applied on the table, as observed in Model 1. As such, irrespective of the location of the geo-grid layer, i.e. either 8 ft. or 12 ft. below the top surface, the geo-grid seemed to move monolithically with the LCC material. Displacement time-histories obtained for both models subjected to all five different seismic motions are presented in Appendix C.

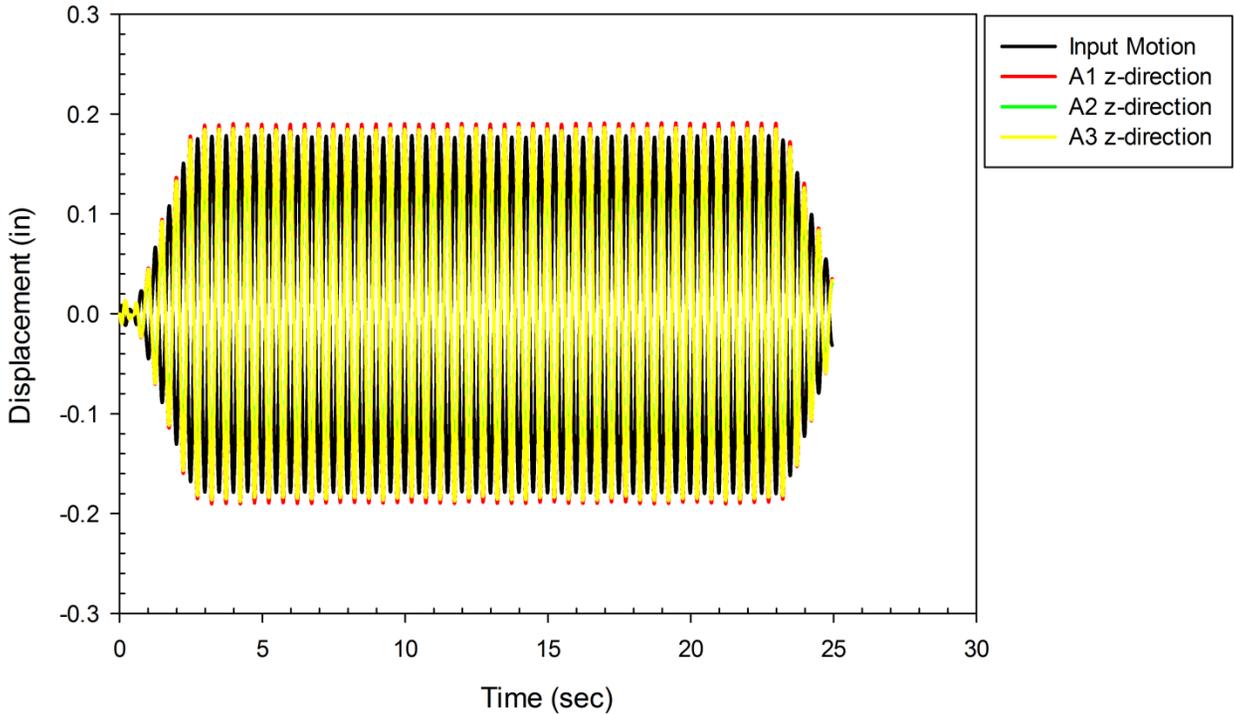


Figure 9: Comparison of displacement-time history at three different locations measured with accelerometers observed for the Table Motion #1 in Model 2.

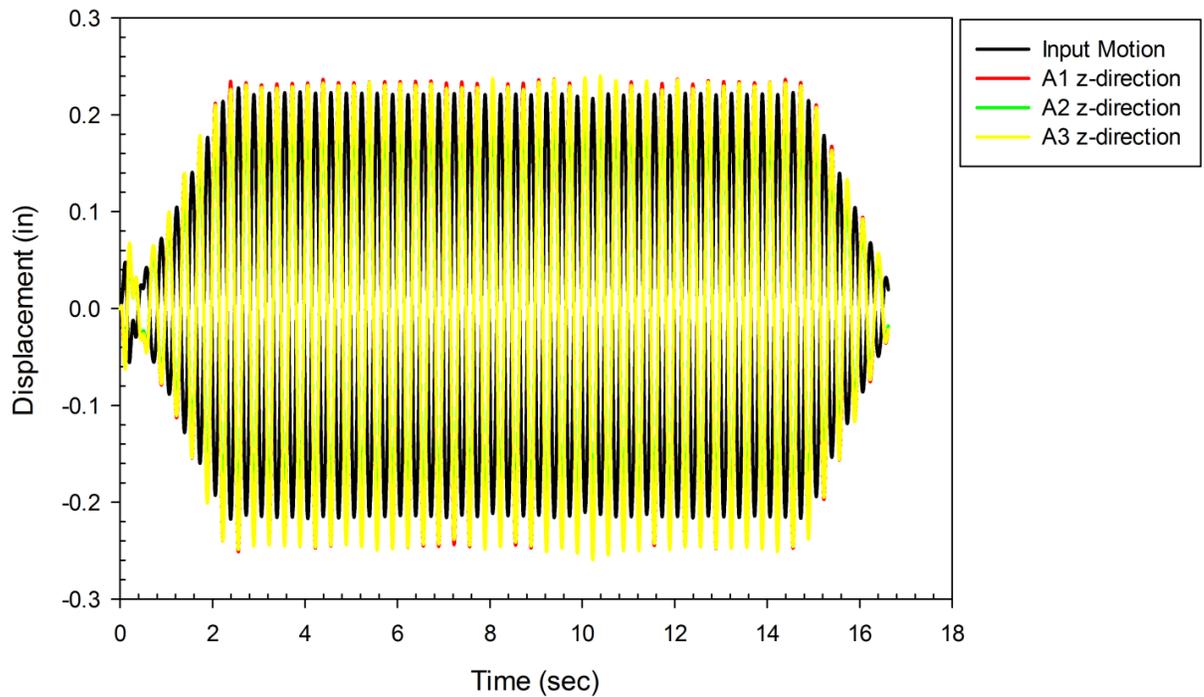


Figure 10: Comparison of displacement-time history at three different locations measured with accelerometers observed for the Table Motion #4 in Model 2.

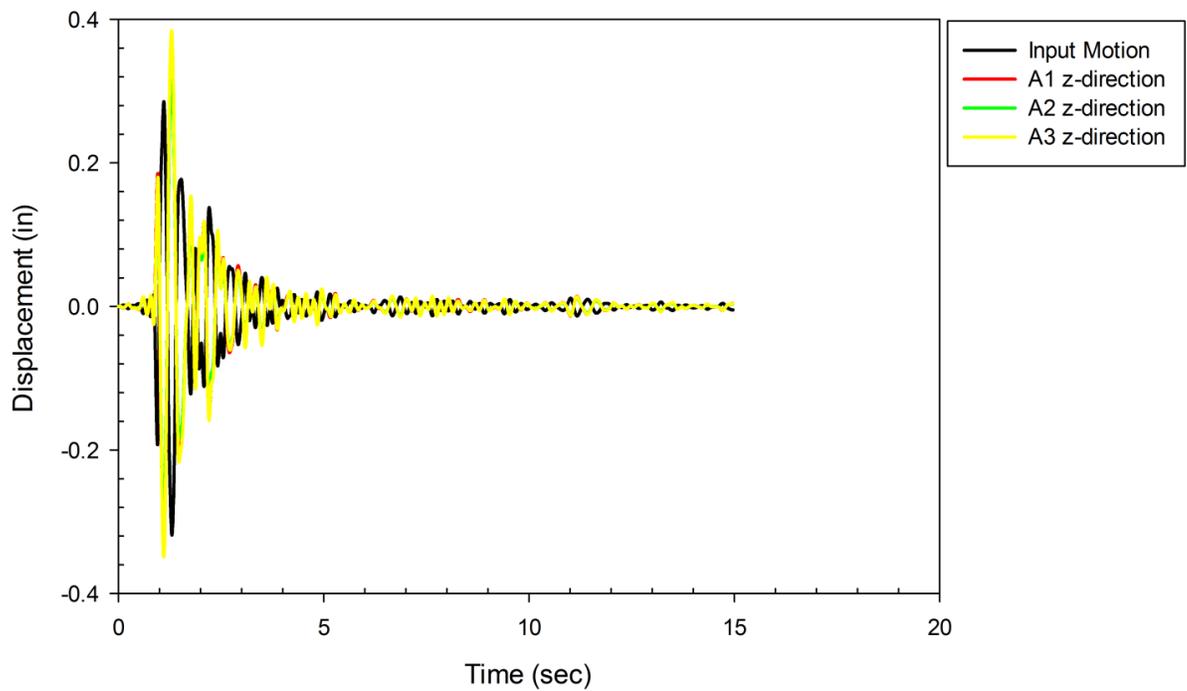


Figure 11: Comparison of displacement-time history at three different locations measured with accelerometers observed for the Table Motion #5 in Model 2.

To directly observe the relative displacements within the LCC block as well as the geo-grid, four strain gauges, S1 through S4, were installed at the locations presented in Figure 4. As the strain gauges were mounted on the metal frame attached to the shake table, the strain gauges measured the relative displacement between the table and the LCC block. Figure 12 shows that displacements recorded by strain gauges S3 and S4 (i.e., at the geo-grid and 1 ft. below the geo-grid). As can be observed in Figure 12, the difference in relative displacement between the geo-grid and the LCC block was less than 0.002 inches, which is negligible for such a large model. Presented in Figures 13 and 14 are the relative displacements between the table and at the location of accelerometers or strain gauges measured by either accelerometer or the strain gauges. As can be observed in these figures, the relative displacements measured with the strain gauges were similar to the relative displacements observed with the accelerometers. This shows that the LCC block and the geo-grid were moving monolithically in both models. Results obtained from both models subjected to all five different seismic shaking motions are presented in Appendix C.

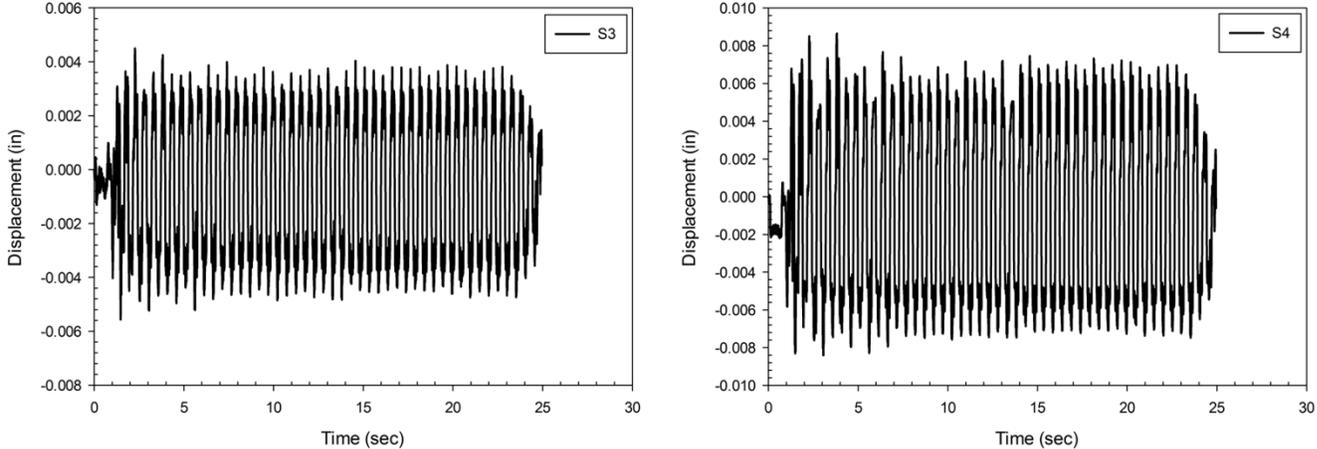


Figure 12: Comparison of displacement-time history at locations S3 (at the geo-grid) and S4 (in the LCC material 1 ft. below the geo-grid) measured with strain gauge for the Table Motion #1 in Model 1.

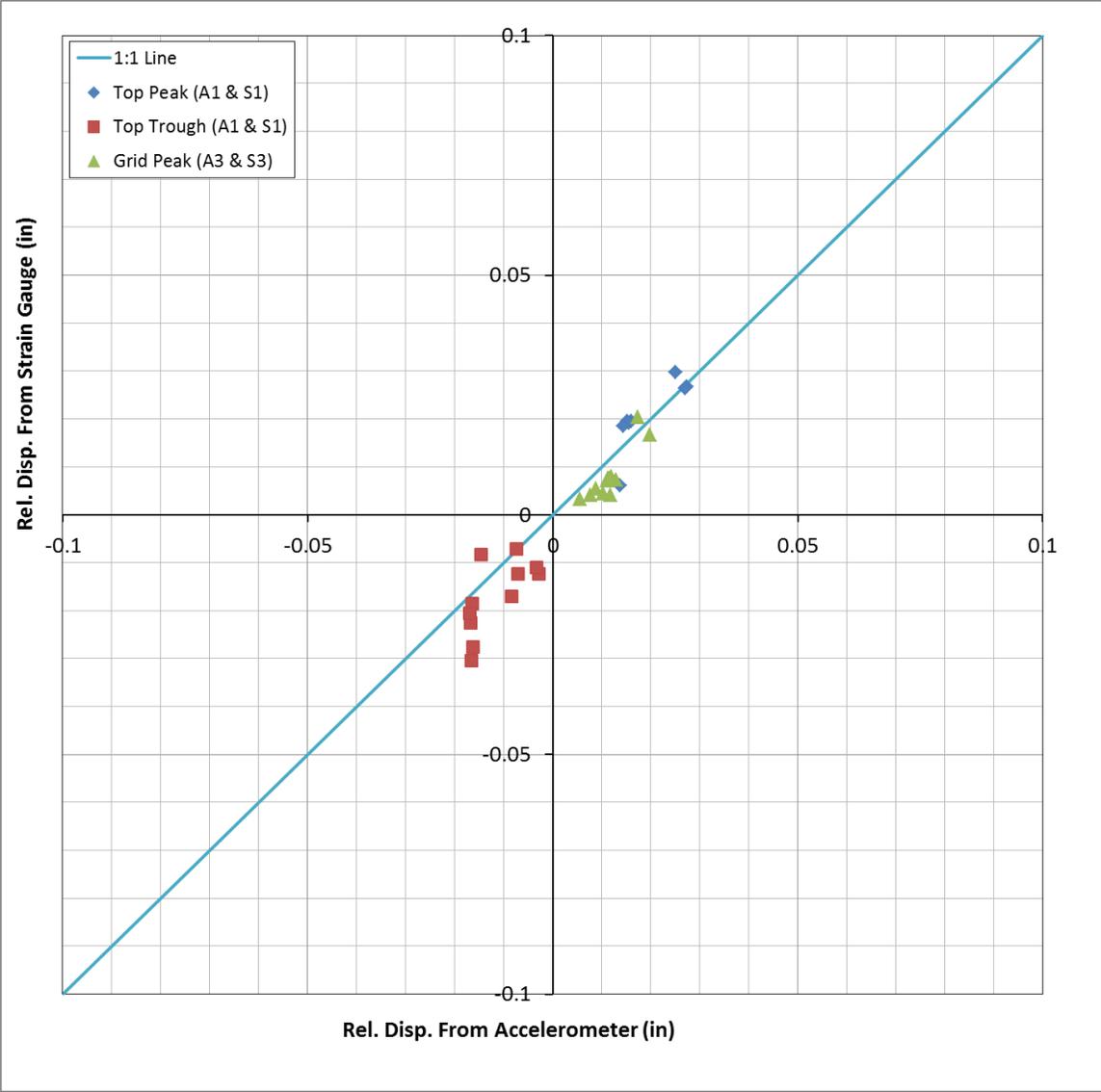


Figure 13: Comparison of displacements obtained from the strain gauges and the accelerometers in Model 1.

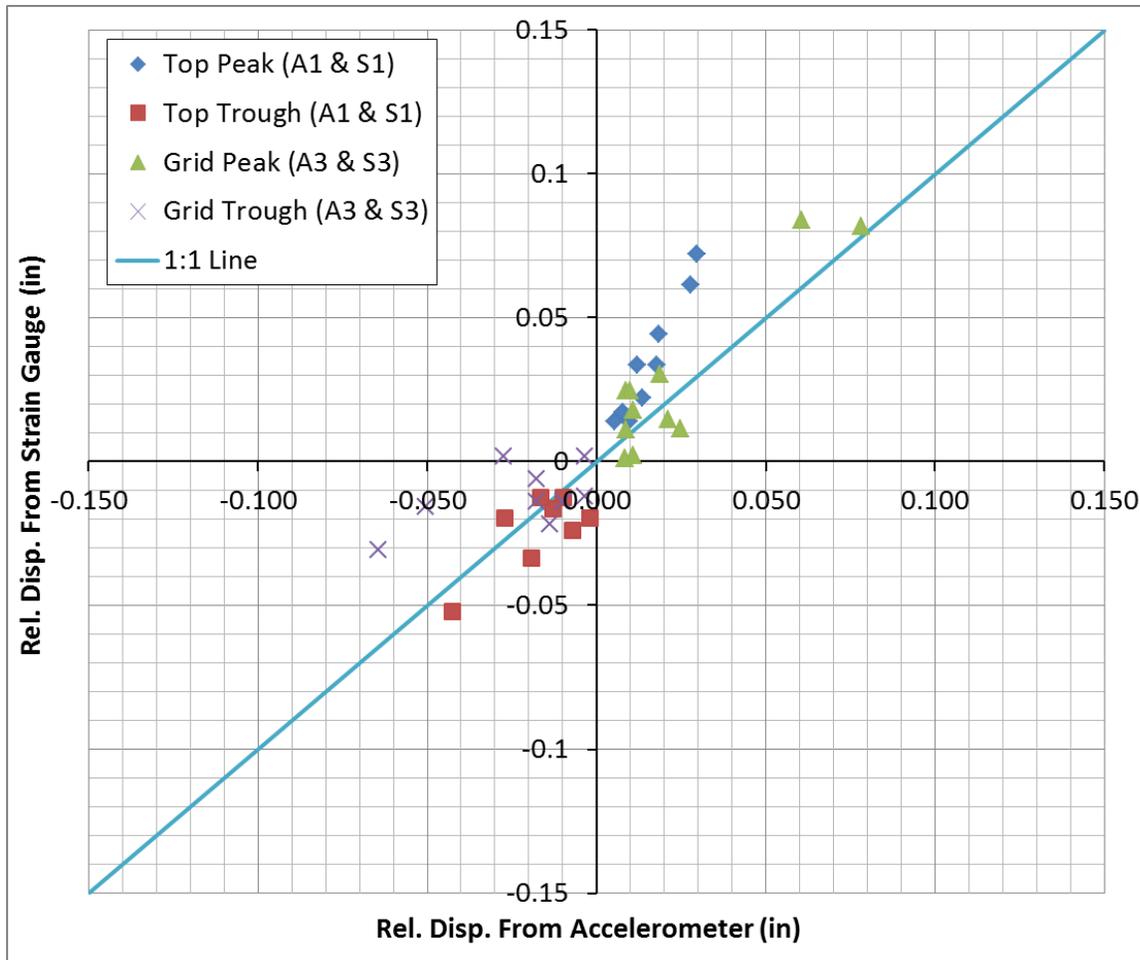


Figure 14: Comparison of displacements obtained from the strain gauges and the accelerometers in Model 2.

The results presented above shows that despite the depth of geo-grid in the MSE wall, the relative displacement between the geo-grid and the LCC block is expected to be negligible. This demonstrates that the geo-grid used in the LCC block moves monolithically with the concrete block. As such, the effect of geo-grid will be only on reducing crack propagation as well as to hold the facing material, not as the soil reinforcement. This verifies the numerical analysis results presented by Pradel and Tiwari (2015) mentioned. As such, the application of geo-grid for MSE wall application can be limited to the edges of the MSE wall only. This will save a huge amount of geo-grid reinforcement.

#### 4. Summary and Conclusion

Two different LCC models, approximately 6 ft. x 4 ft. X 4 ft., and 5 ft. x 3 ft. x 4 ft. were prepared by placing a geo-grid reinforcement at the center of the LCC material i.e., at 2 ft. height. The models were cured for more than 28 days and placed on a shake table. Additional surcharge vertical stress corresponding to 6 ft. and 10 ft. of LCC material were applied, separately, on those models prior to subjecting them to seismic loading. Then, both models were subjected to

five different seismic motions. Accelerations (with accelerometers) and displacements (with strain gauges) were measured at top, middle, and bottom of the blocks including at the geo-grid while the models were subjected to those cyclic motions in order to measure the relative displacement of geo-grid and the LCC block. The test results show that the relative displacement of geo-grid and the LCC block were negligible irrespective of the seismic motion and effective surcharge load. This demonstrates that the function of the geo-grid in the MSE wall will be just to prevent crack propagation and support the facing, but not as the soil reinforcement.

### **5. Acknowledgement**

The author would like to thank graduate students at CSUF, Michael Mann, Florentino Ostrova, Smriti Dhital, Mohammed Khalid, Mohammed Al-Behadili, and Murtdha Hashim for preparing the model for testing. Moreover, the help of Mr. Hector Zazueta and Mr. John Woodland, laboratory support staffs at CSUF in preparing the experimental set up is highly appreciated.

### **6. References**

- Pradel, D., and Tiwari, B. (2015). "The use of MSE walls backfilled with Lightweight Cellular Concrete in soft ground seismic areas," *Proceedings of the 3<sup>rd</sup> International Conference of Deep Foundations*, 1, 107-114.
- Tiwari, B. (2016). "A report on the Study on applicability of Cell-Crete material as an appropriate backfill material for MSE wall," Submitted to Cell-Crete Corporation.
- Tiwari, B., Ajmera, B., and Villegas, D. (2017) "Dynamic Characteristics of Lightweight Cellular Concrete," *Geotechnical Special Publication 2017* (In Press).
- Tiwari, B., Ajmera, B., Maw, R., Cole, R., Villegas, D., and Palmerson, P. (2017),. "Mechanical Properties of Lightweight Cellular Concrete for Geotechnical Applications," *ASCE Journal of Materials in Civil Engineering* (in press).

# **APPENDIX A**

## **FIGURES**















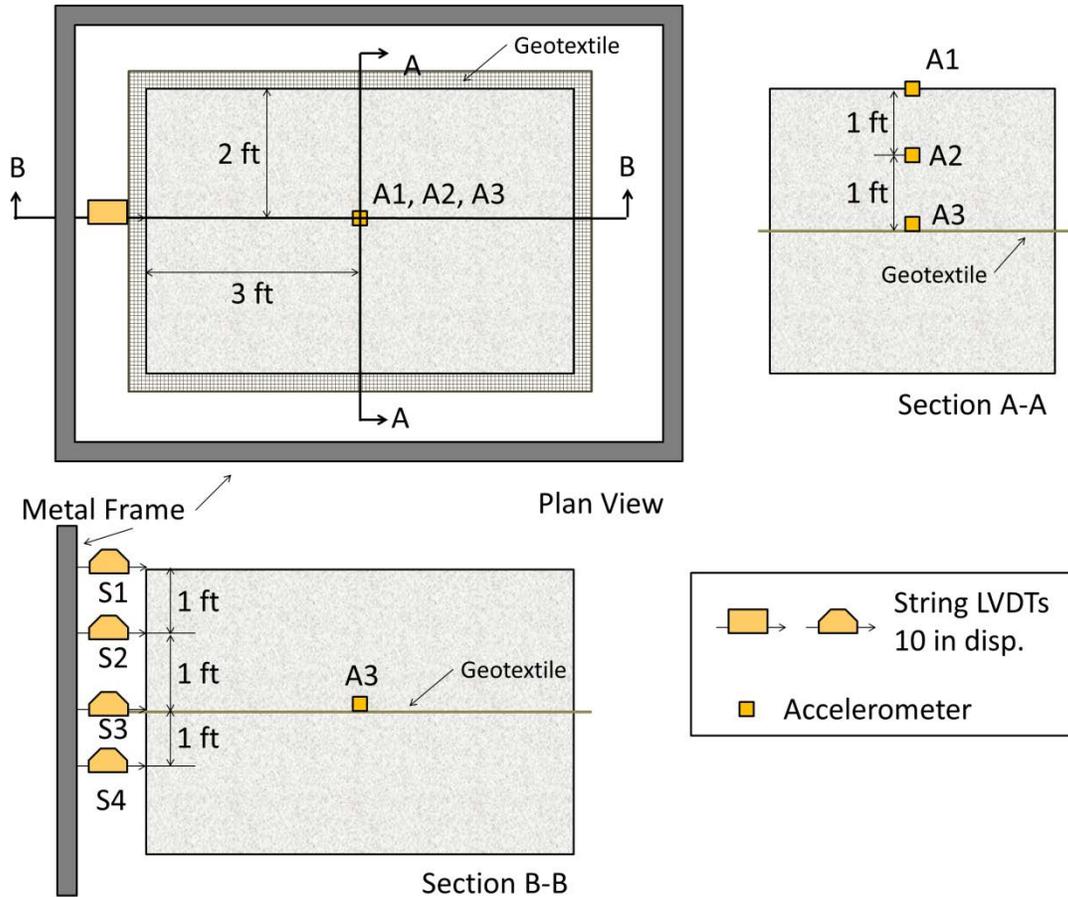


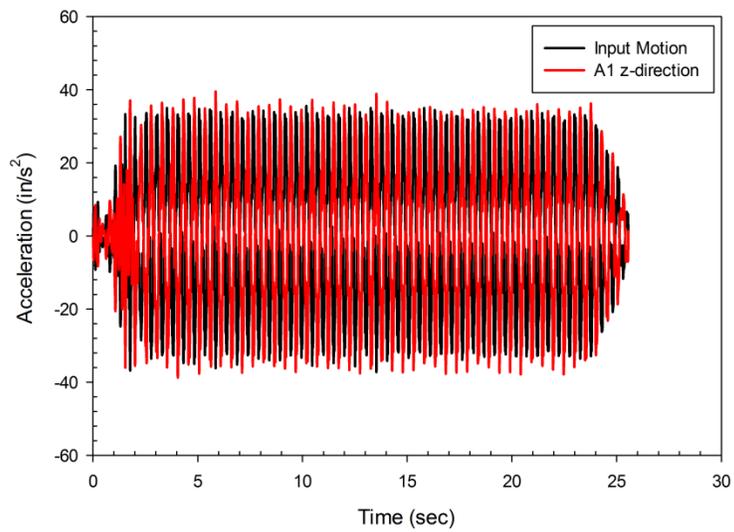
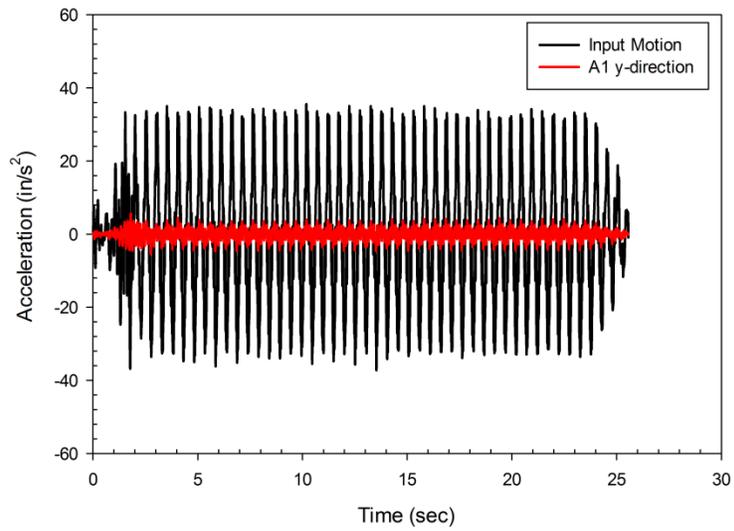
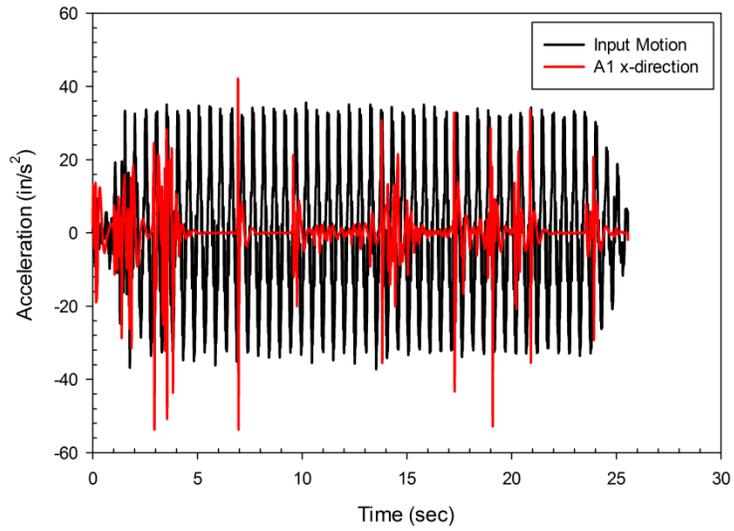
**APPENDIX B**  
**ACCELERATION – TIME**  
**HISTORY**

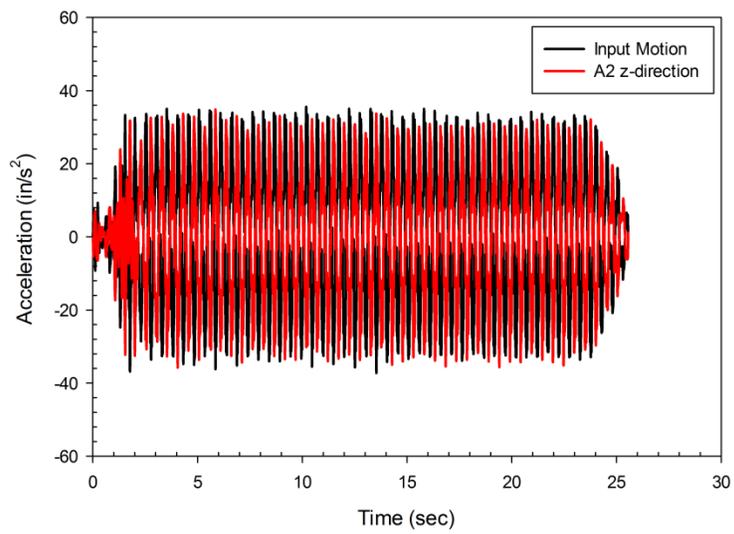
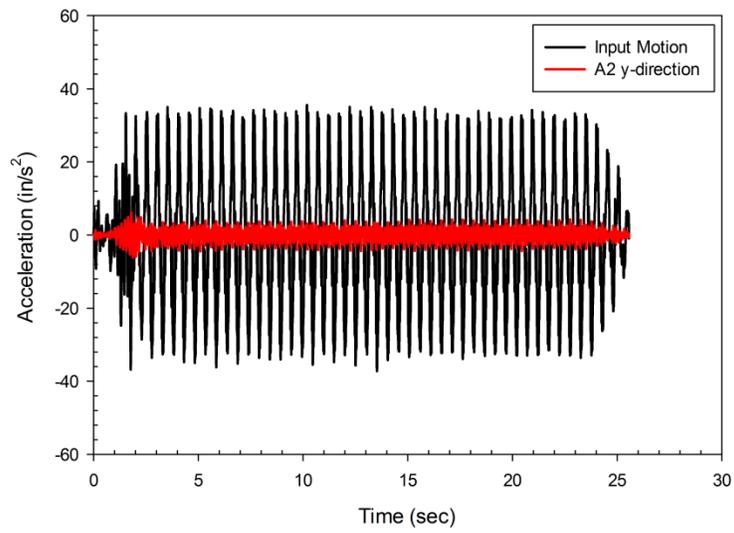
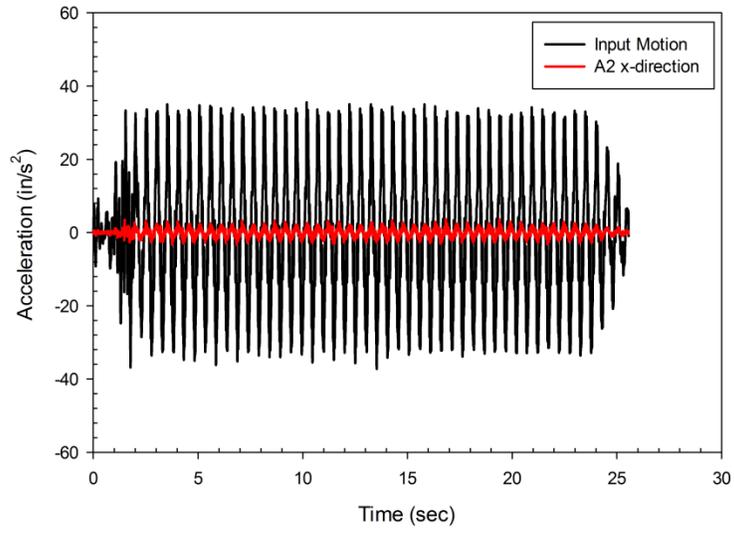
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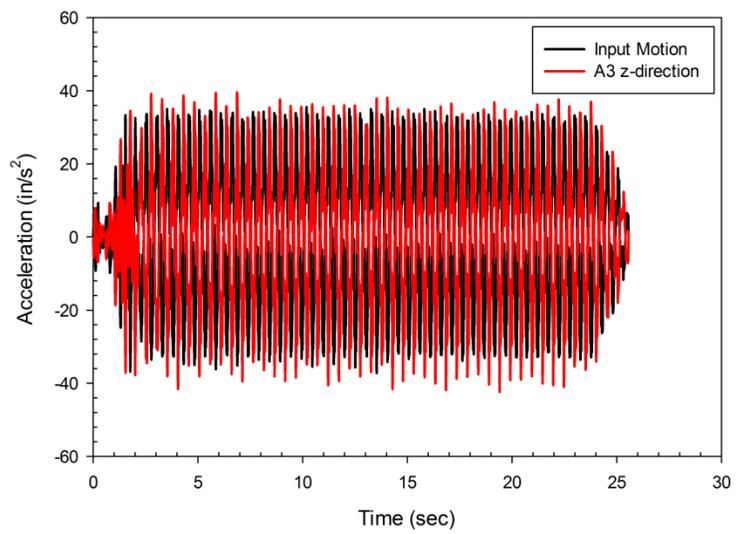
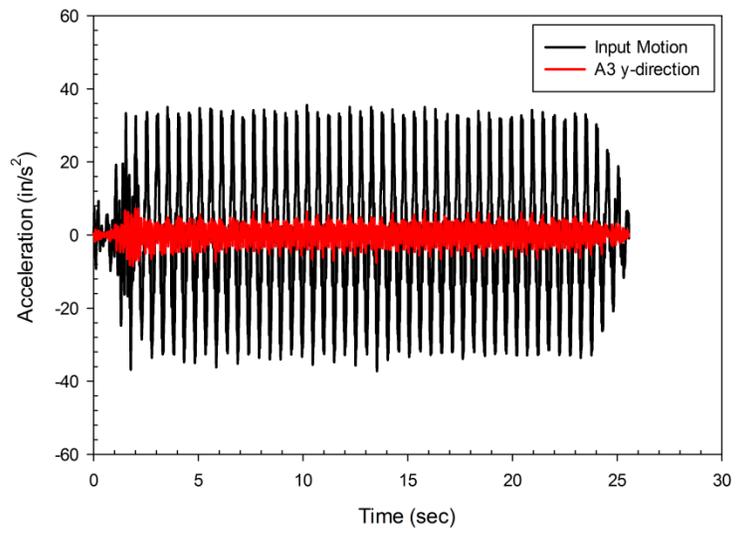
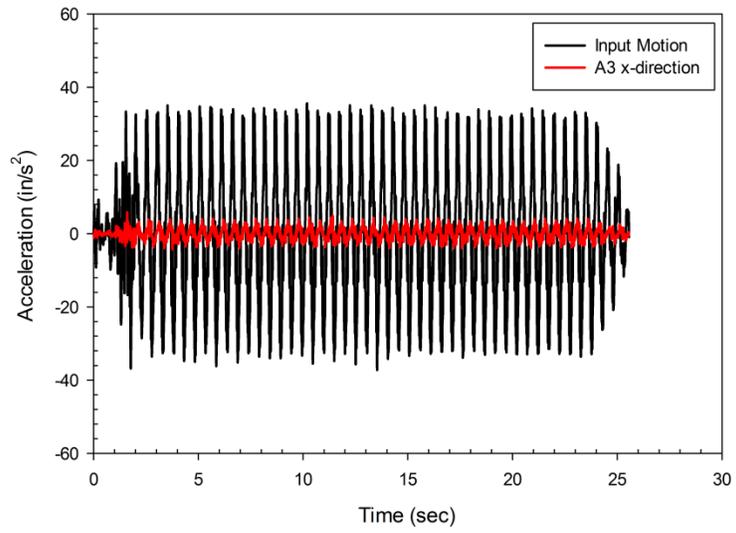


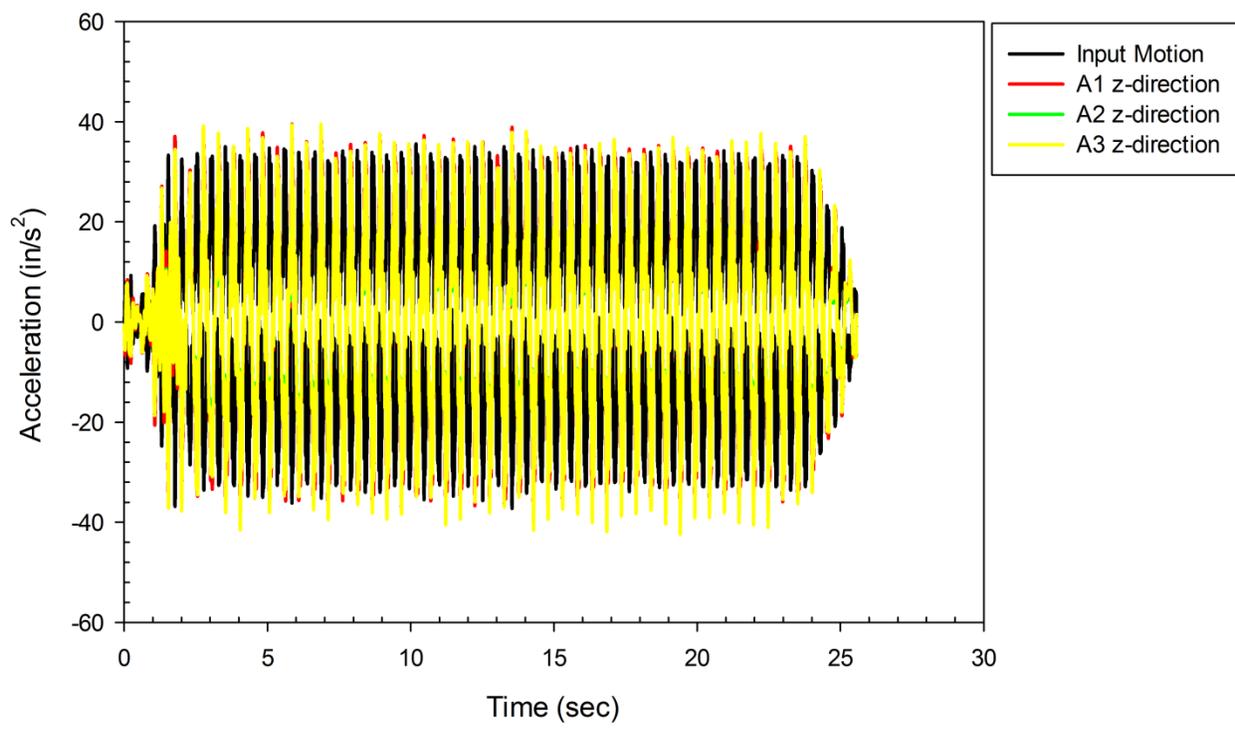
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Model Height:	4 ft	Geogrid Depth:	2 ft
Motion Type:	Sinusoidal	Characteristics:	0.1g 2Hz







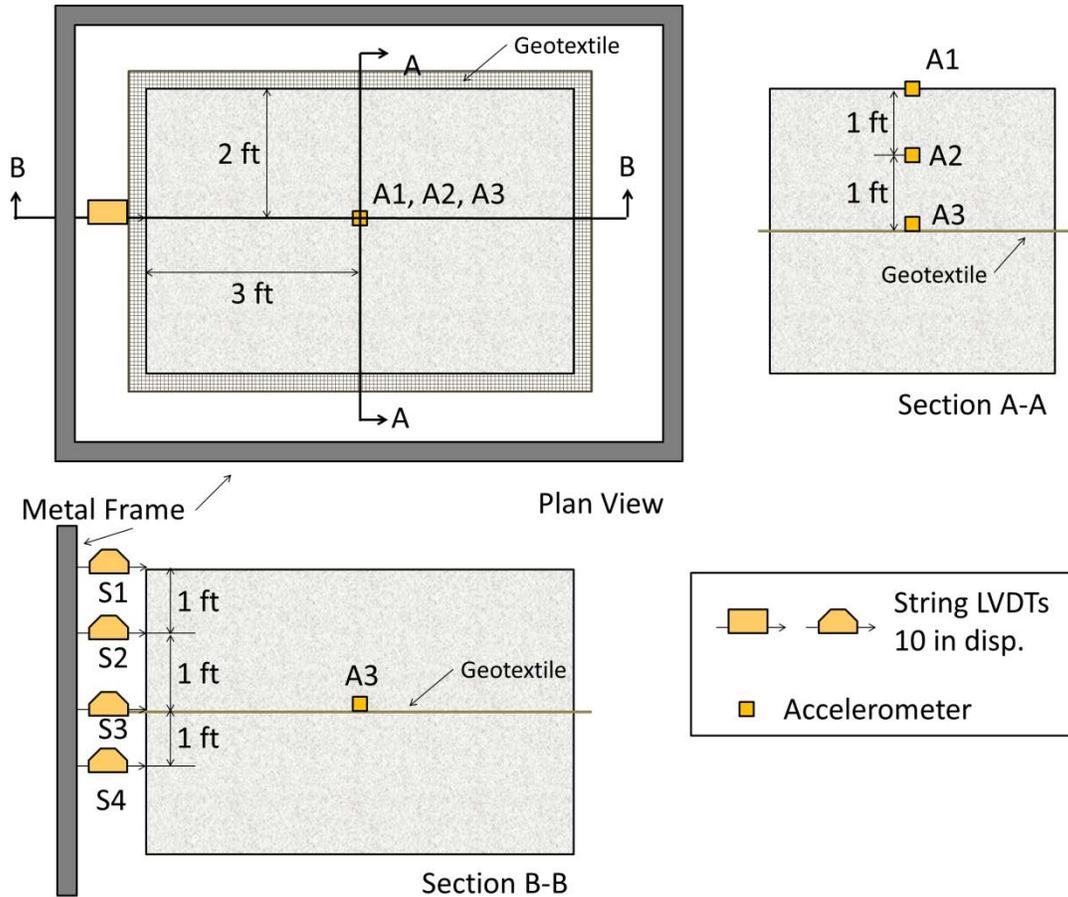


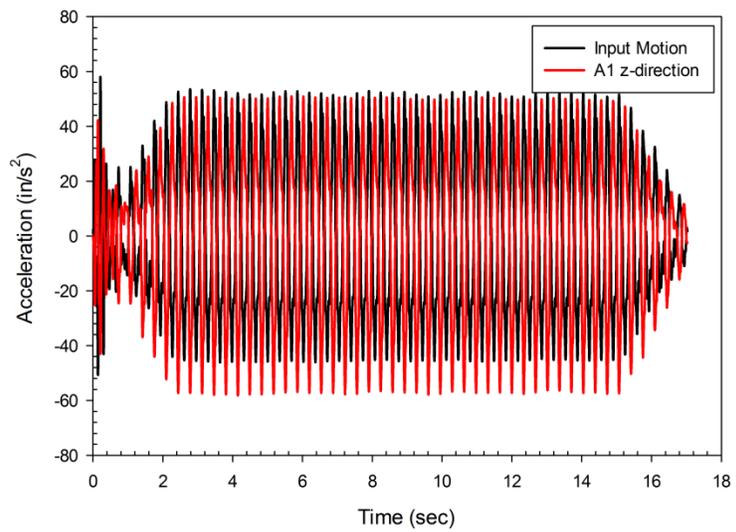
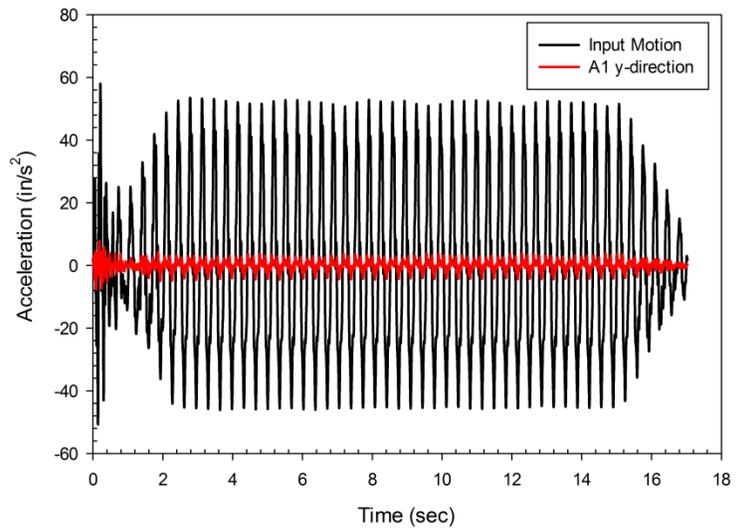
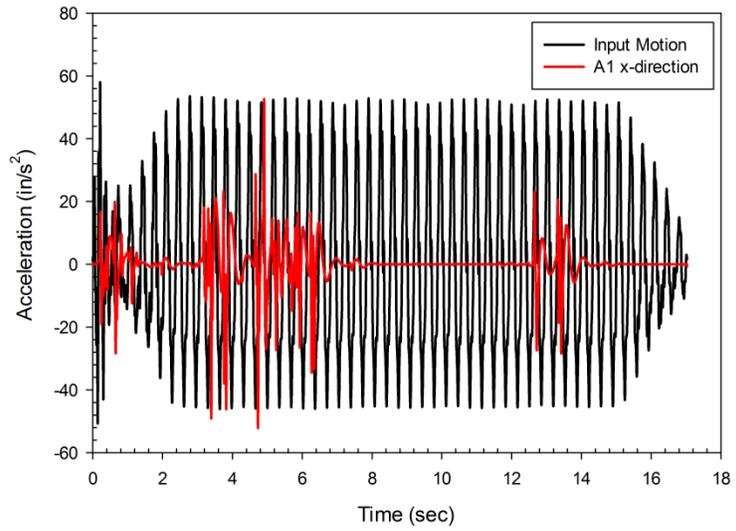


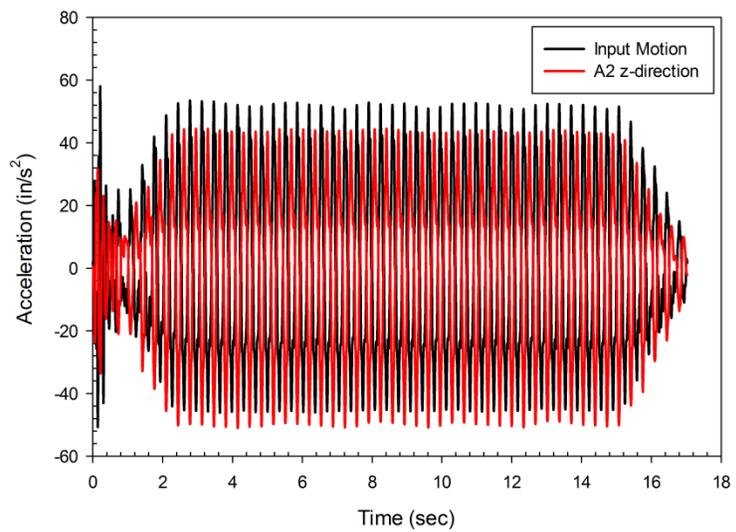
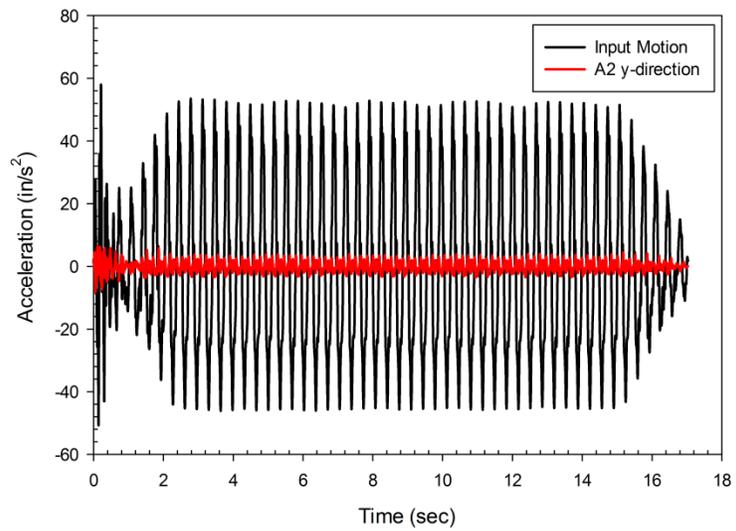
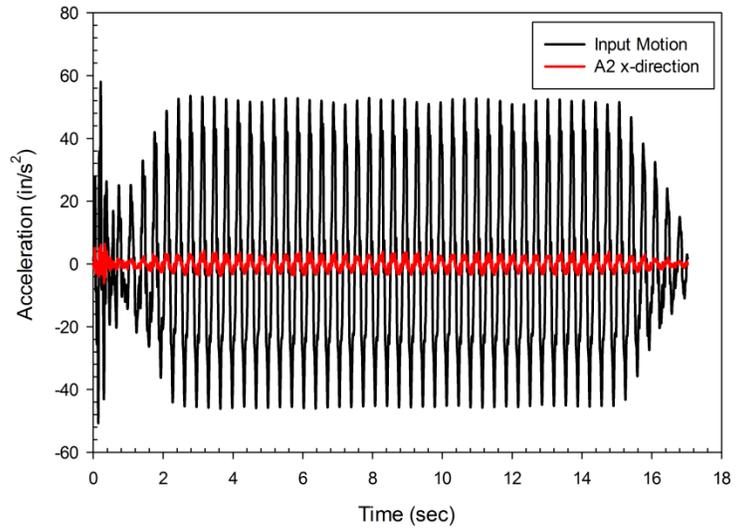
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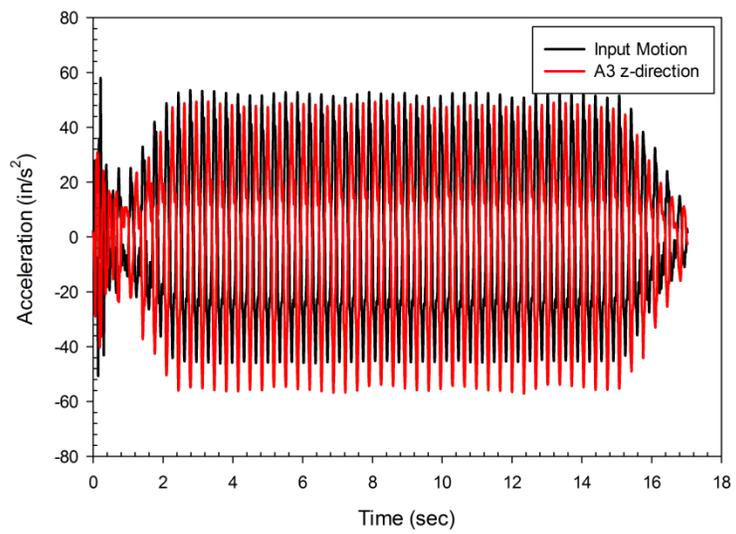
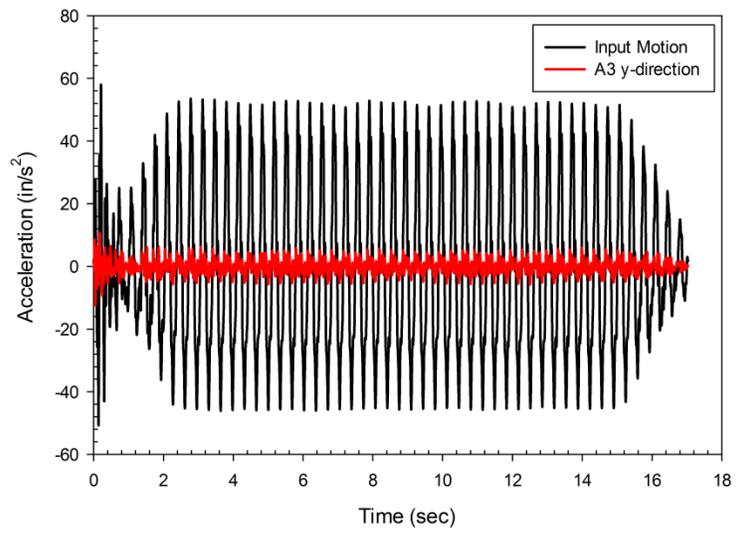
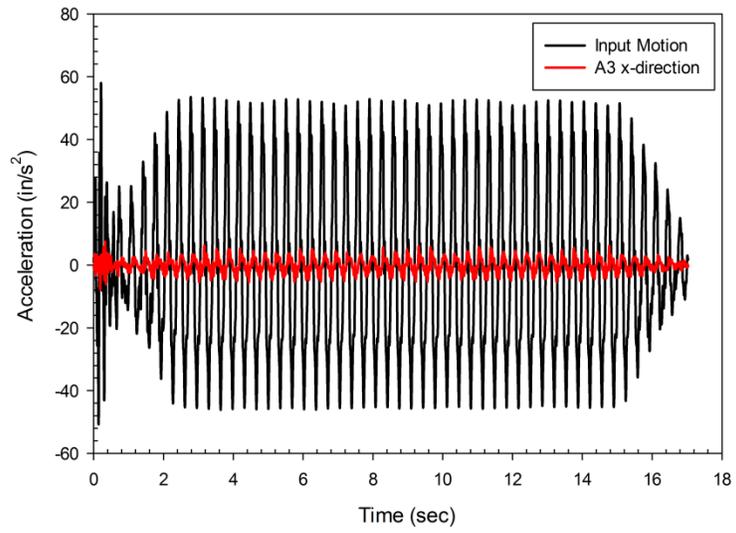


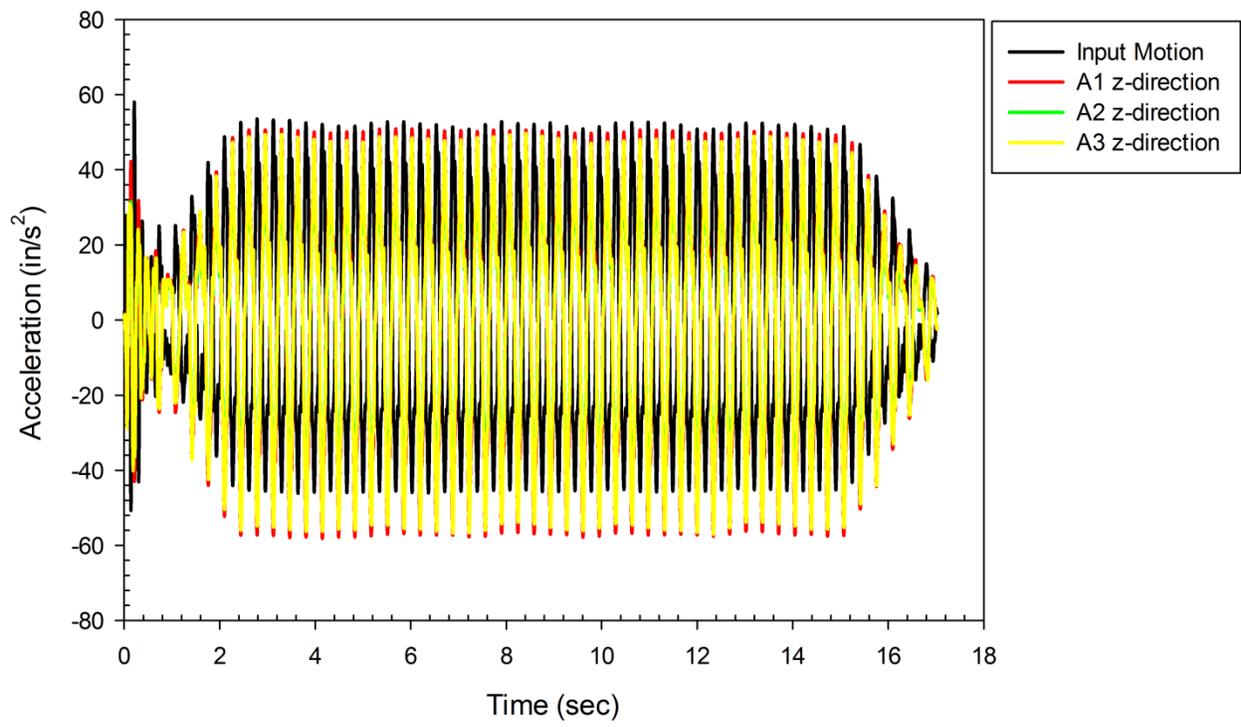
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Model Height:	4 ft	Geogrid Depth:	2 ft
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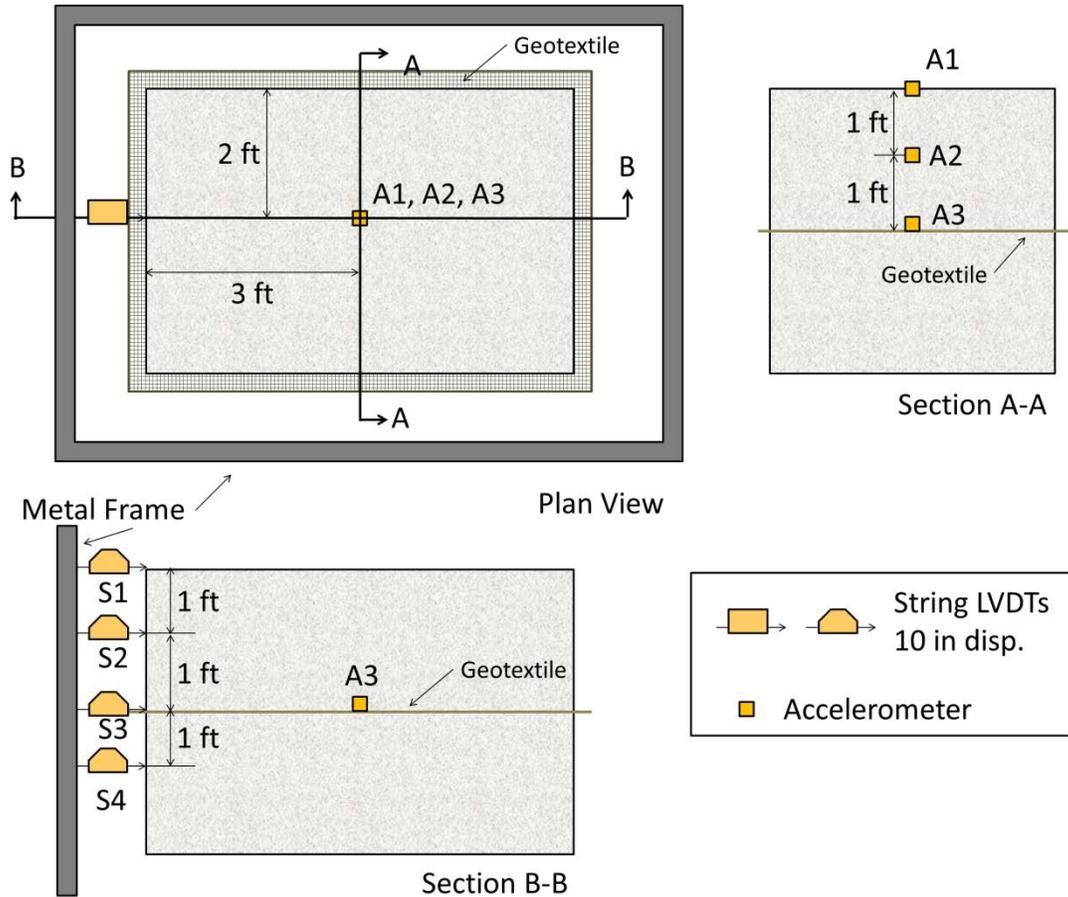


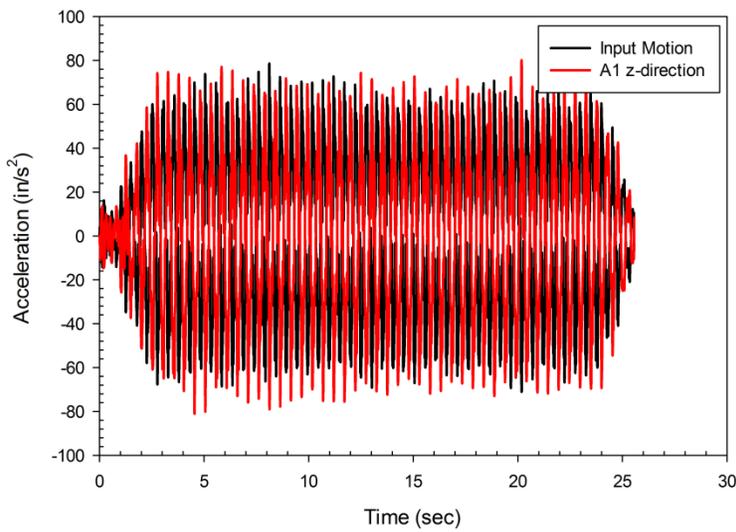
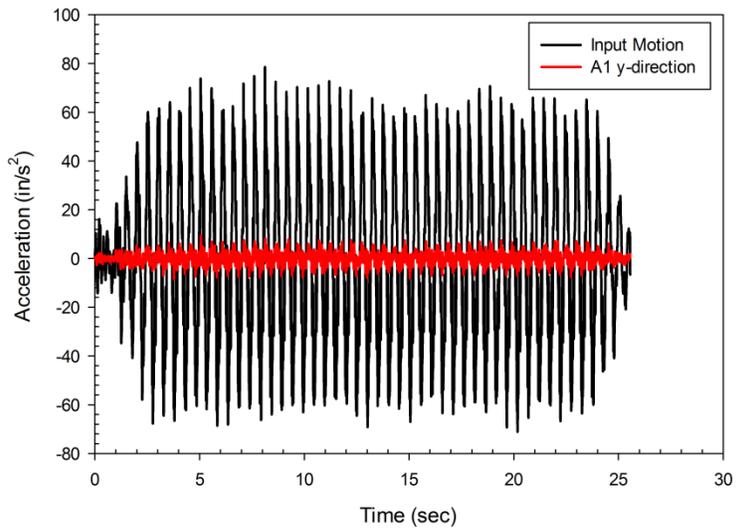
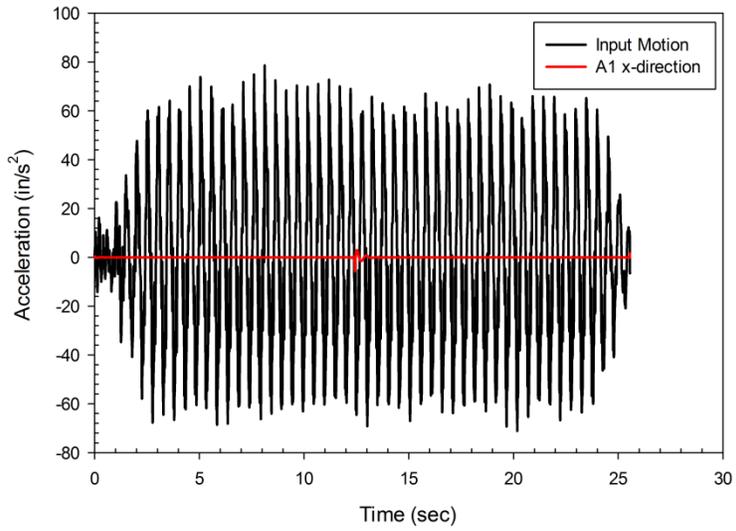


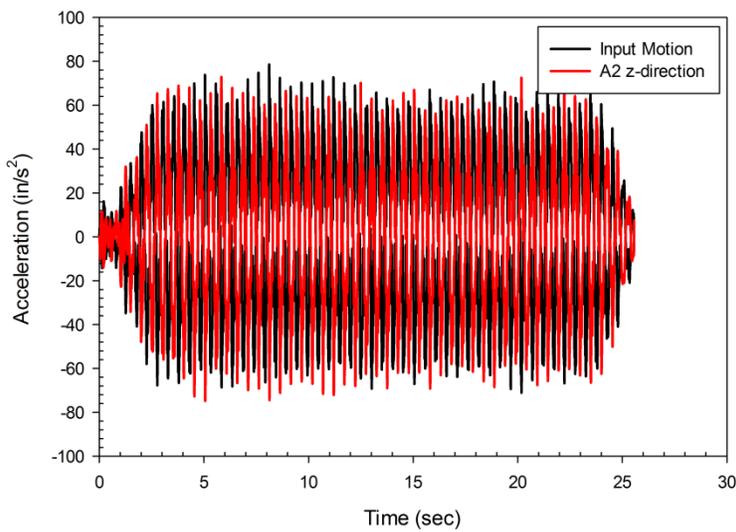
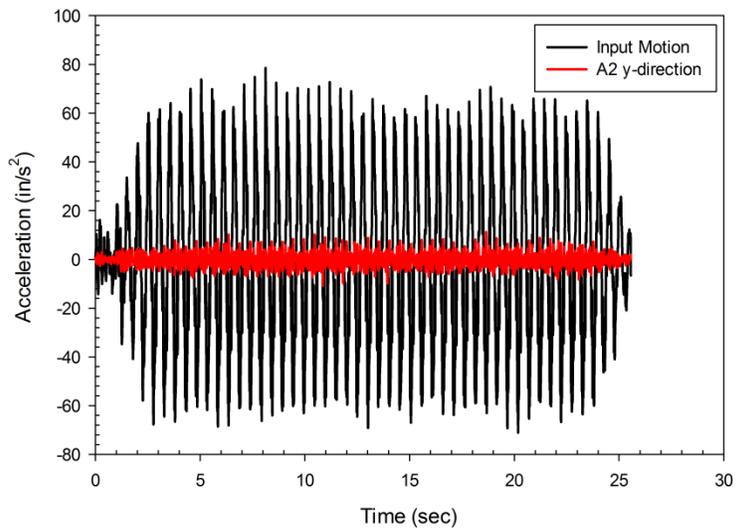
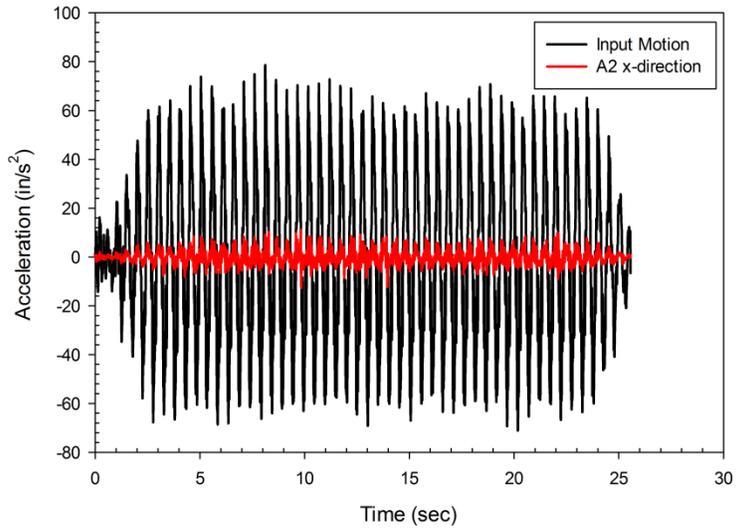
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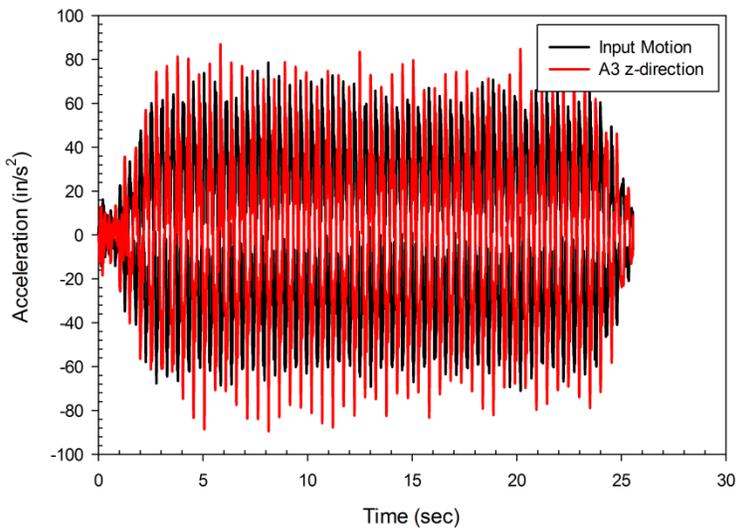
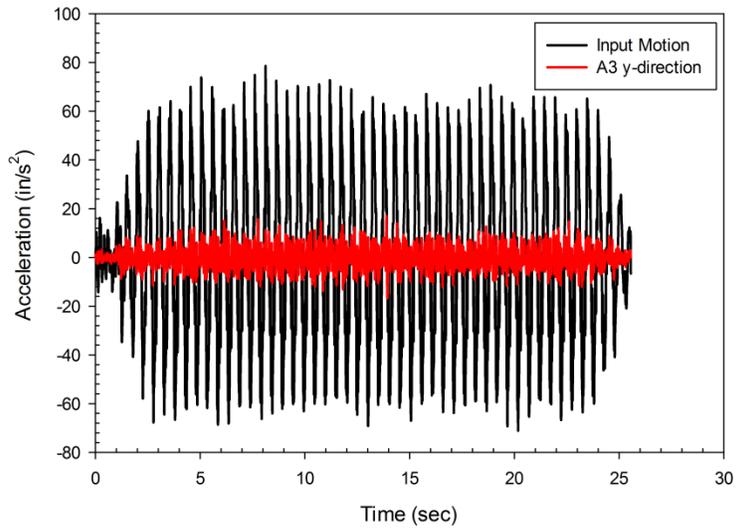
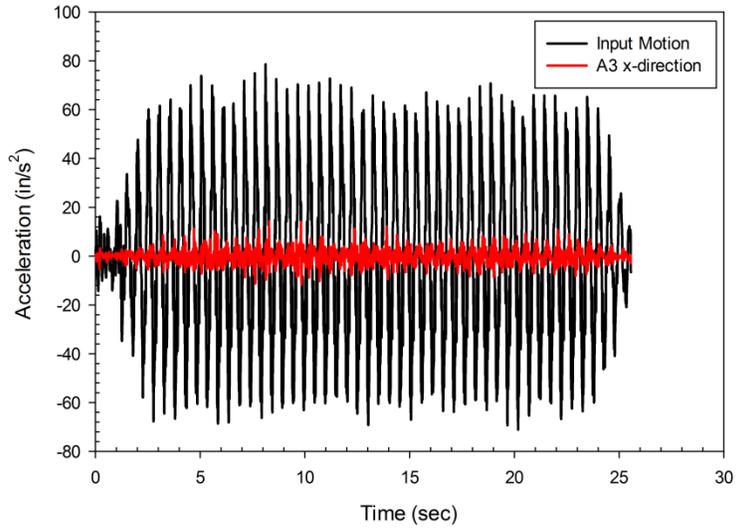


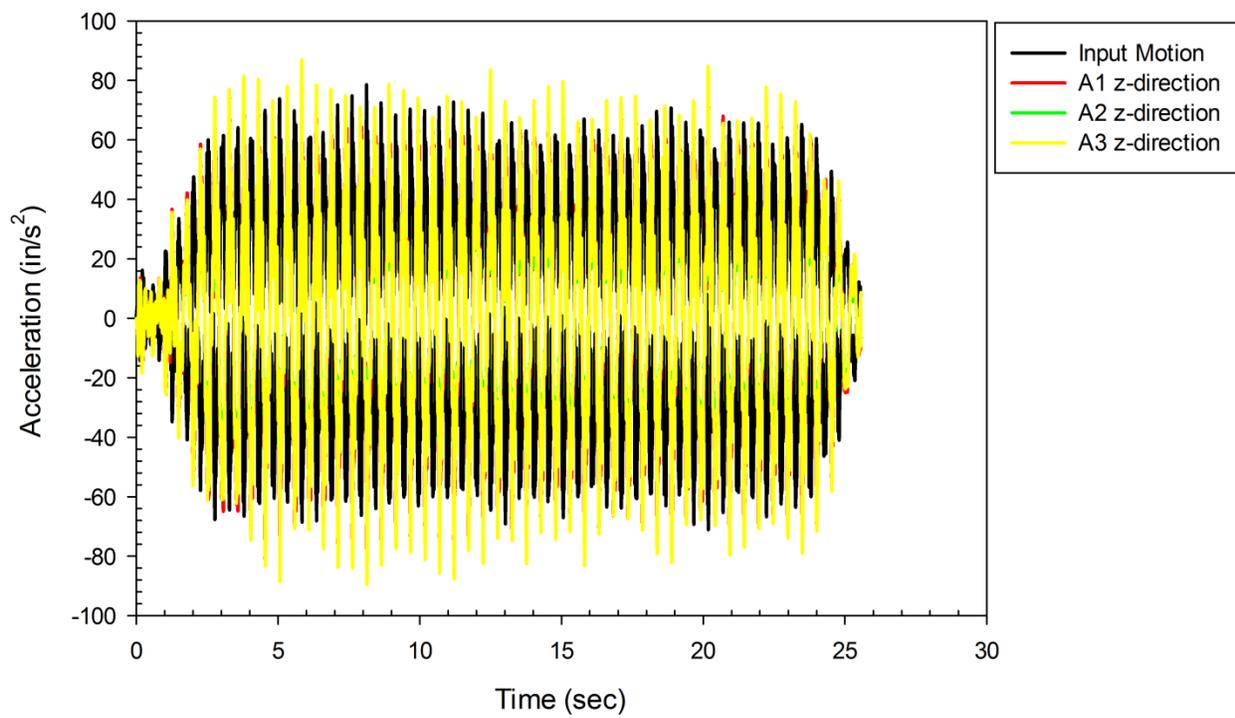
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Location:	----	Test No.:	1
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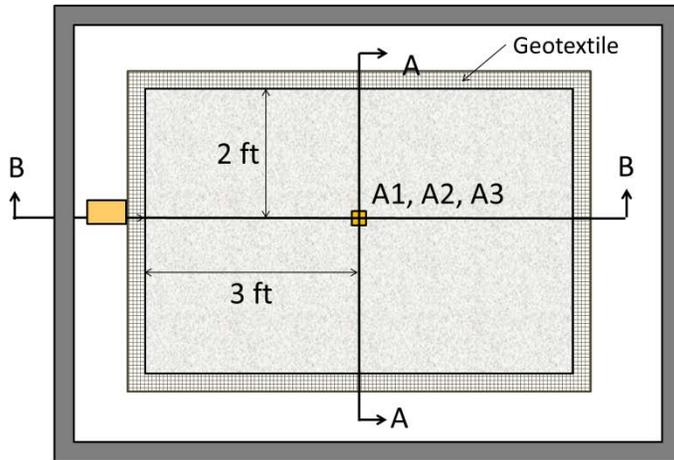




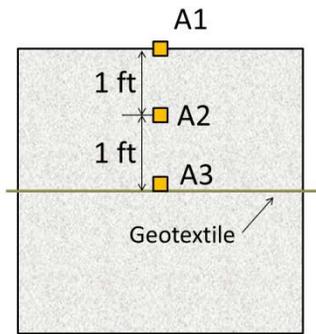
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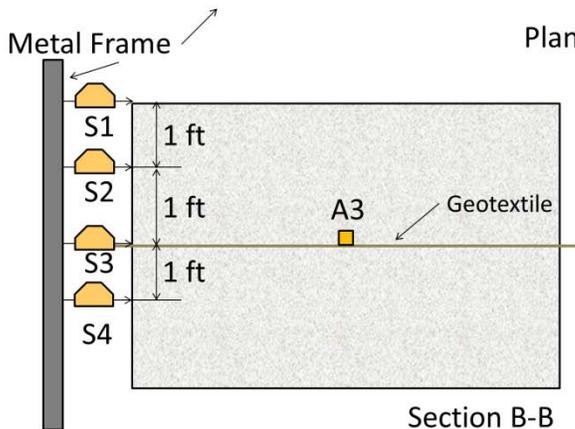
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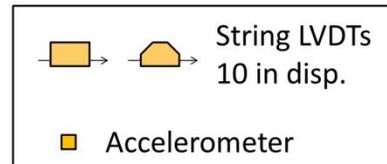
Plan View

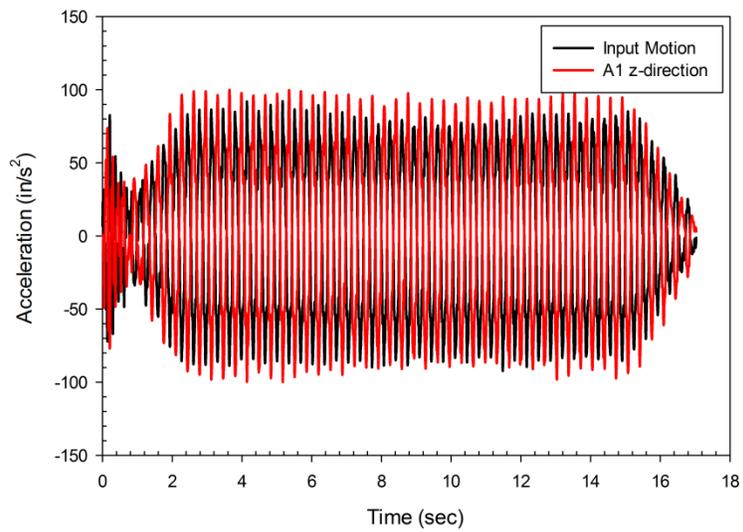
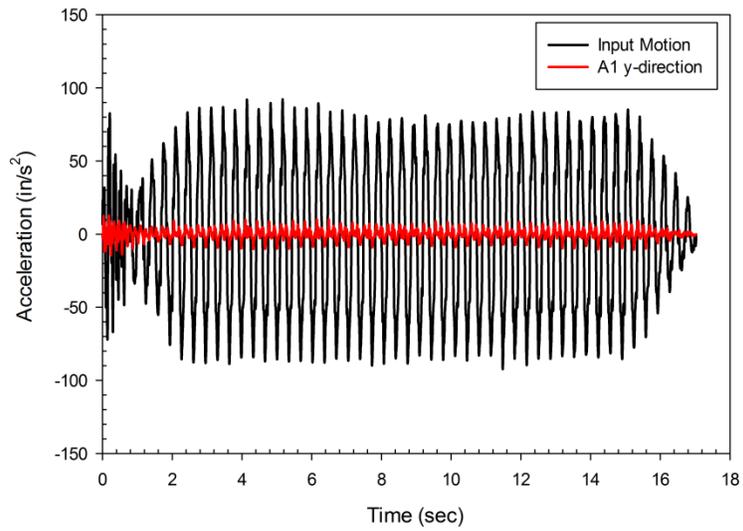
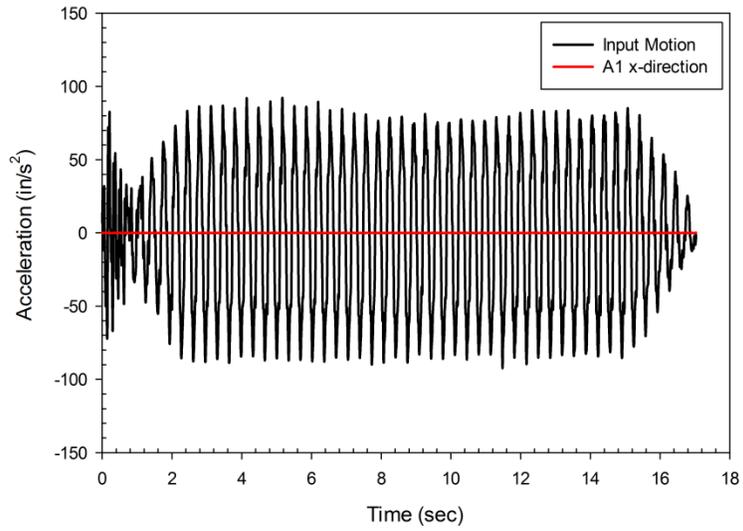


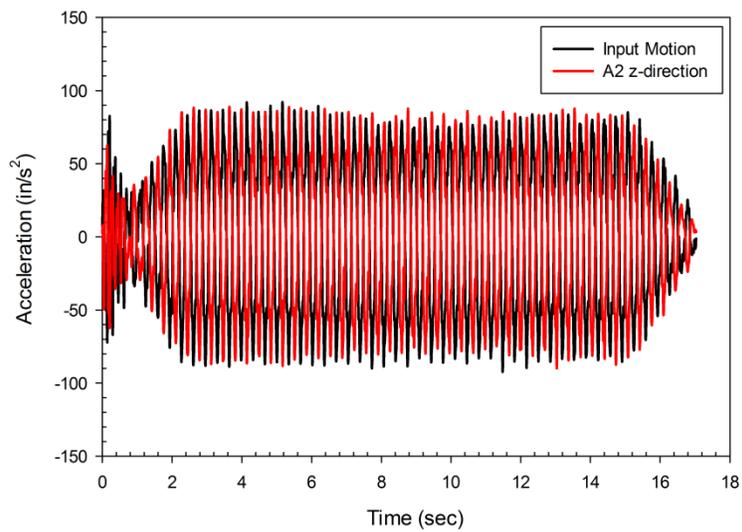
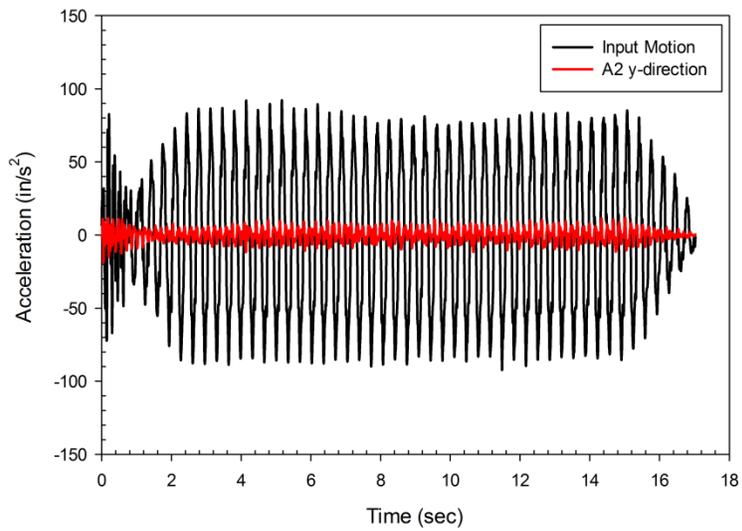
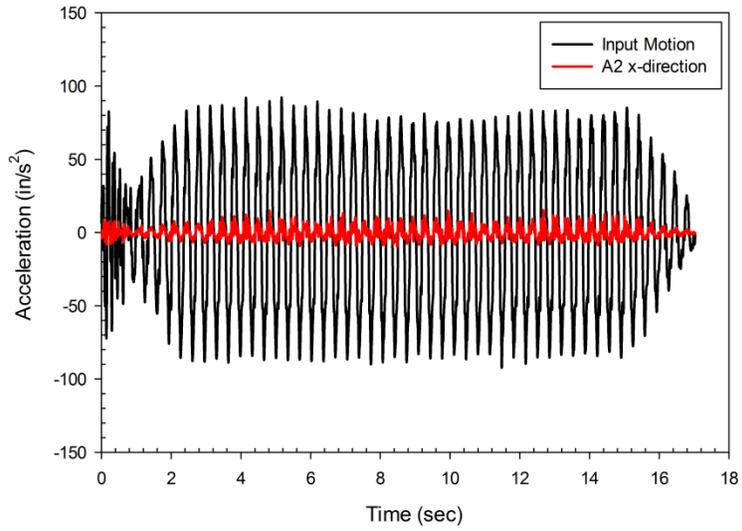
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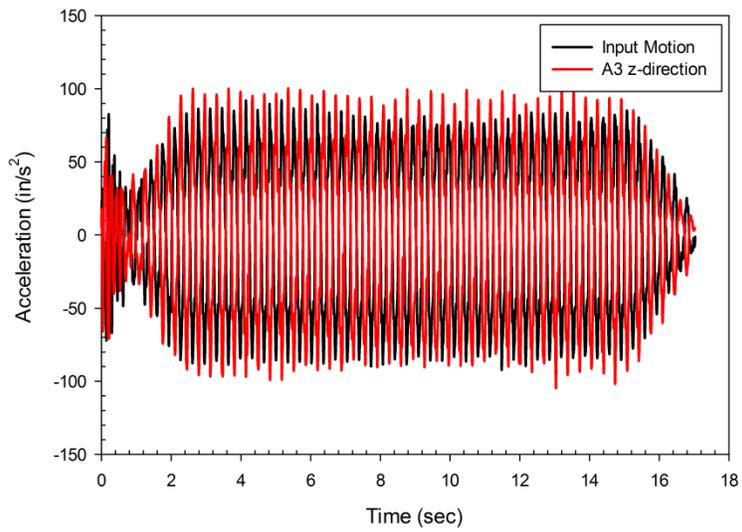
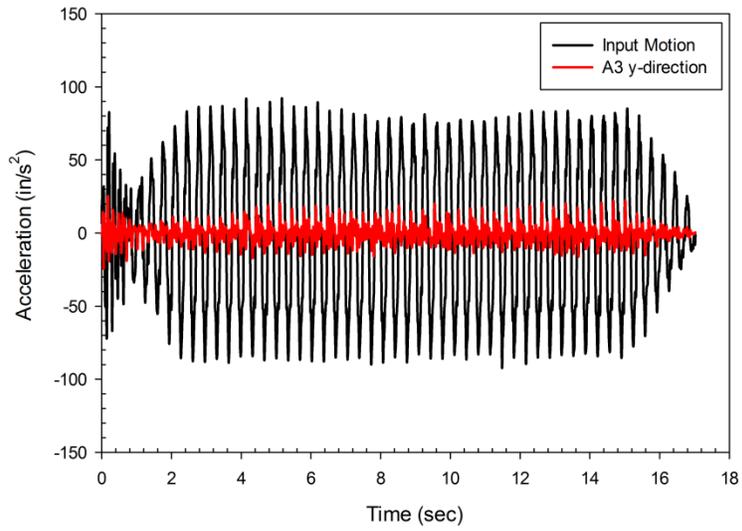
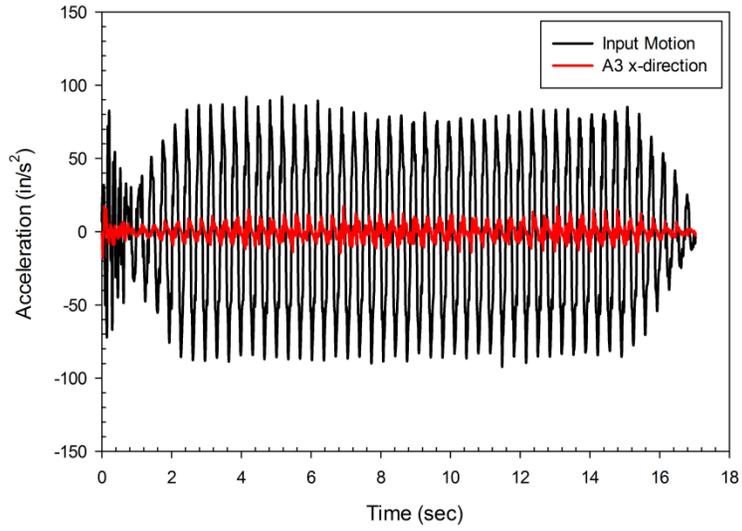


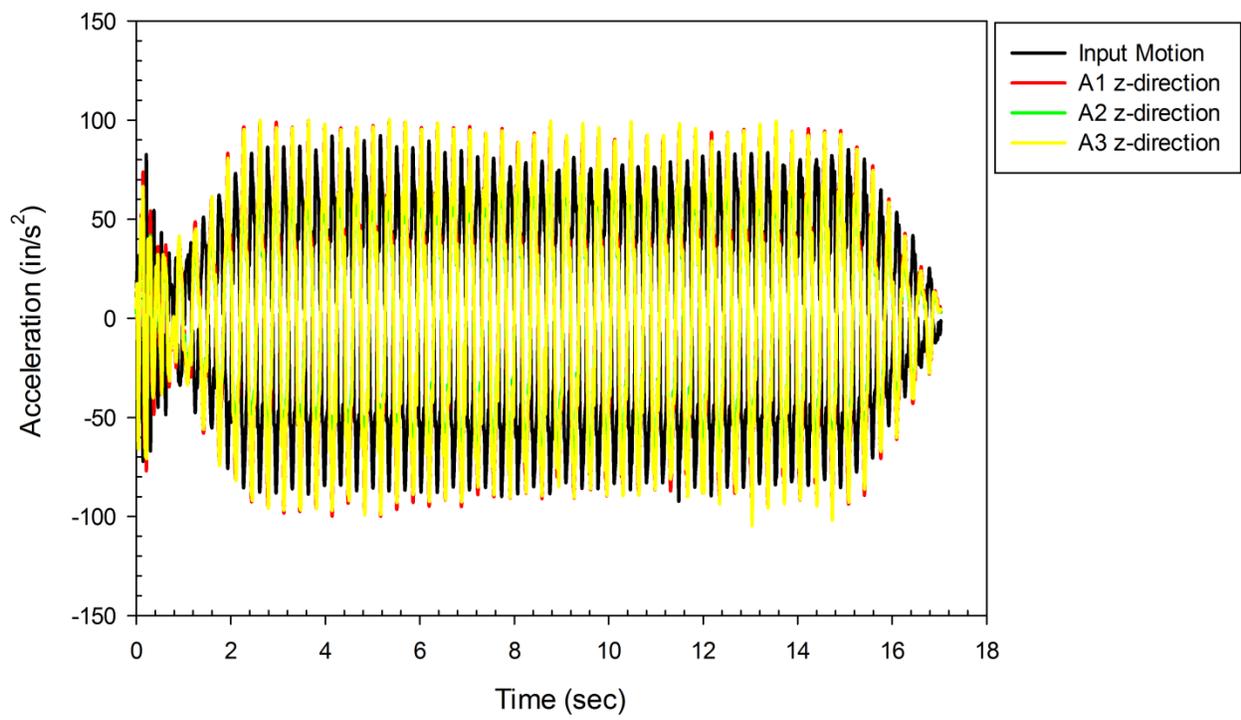
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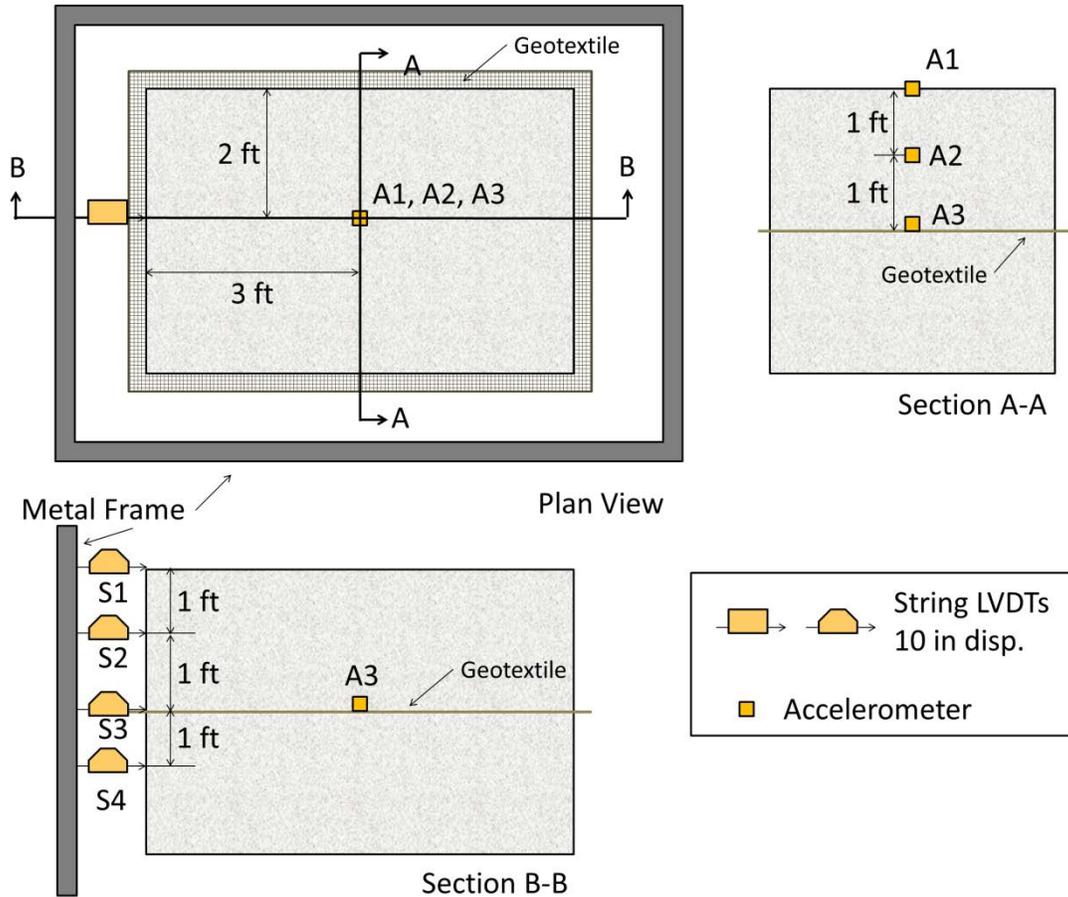


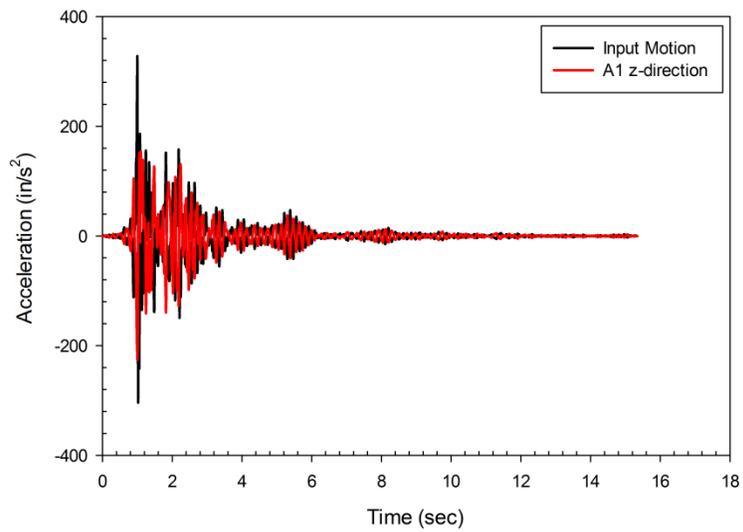
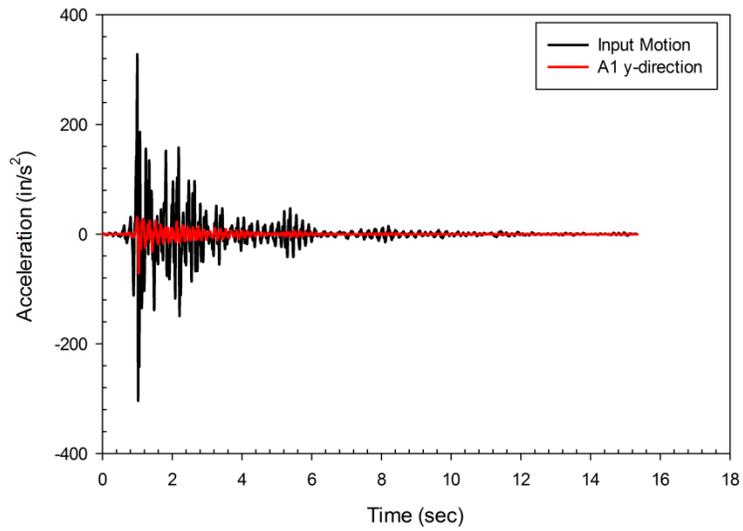
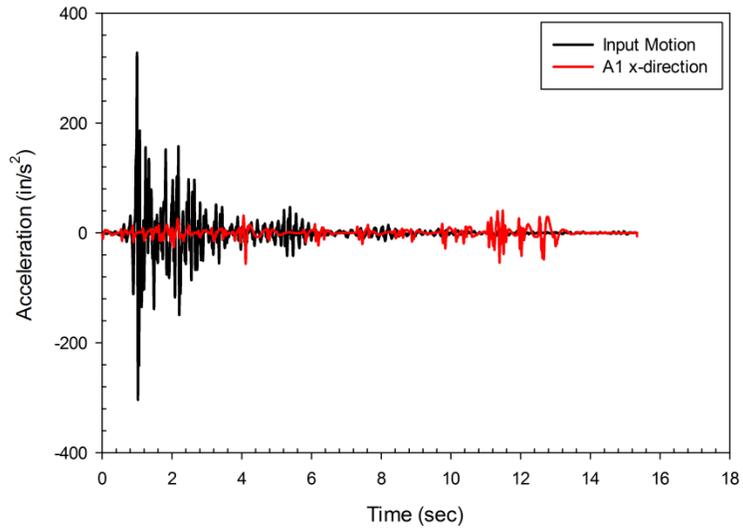


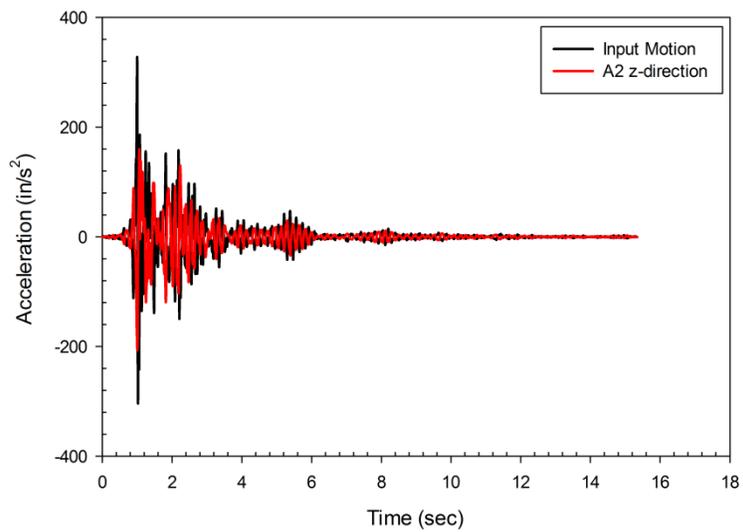
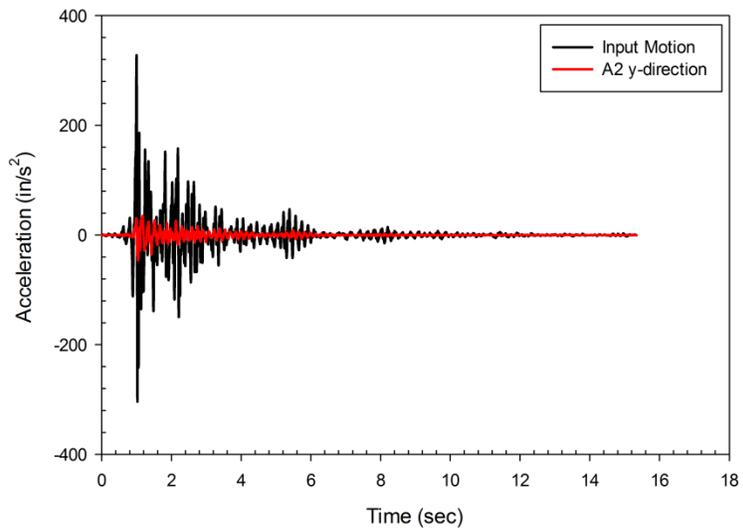
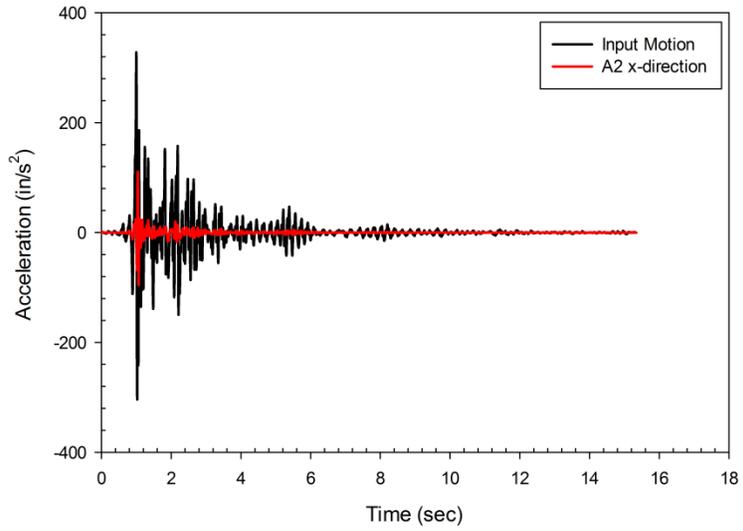
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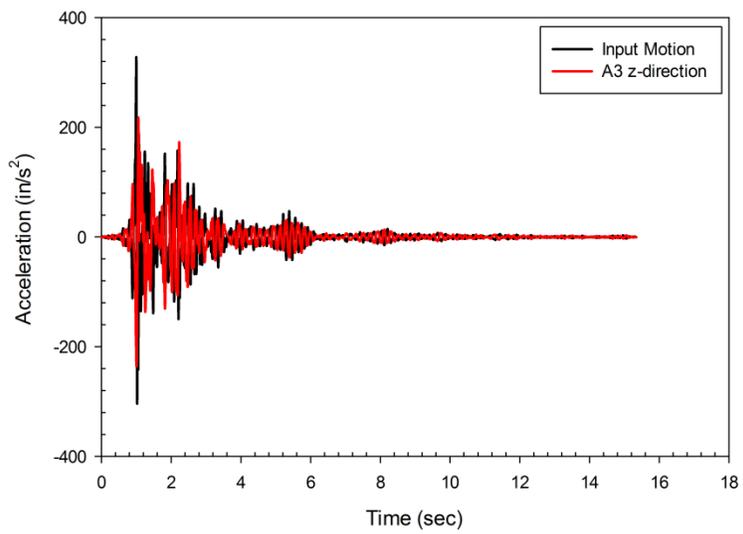
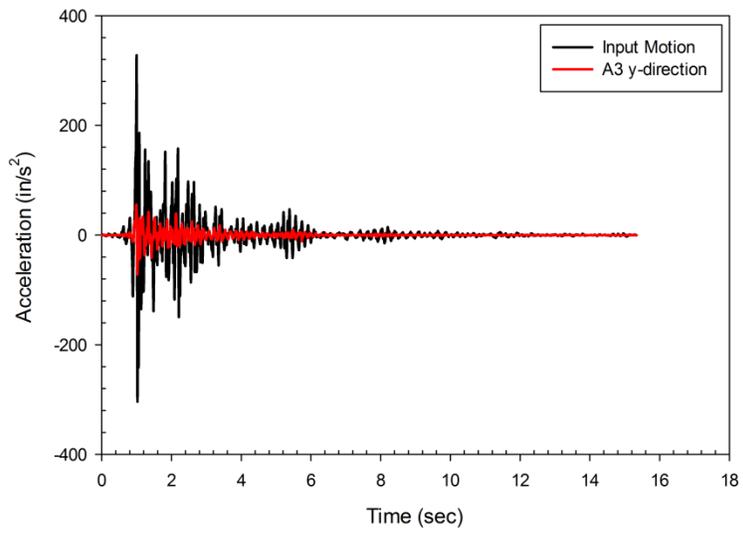
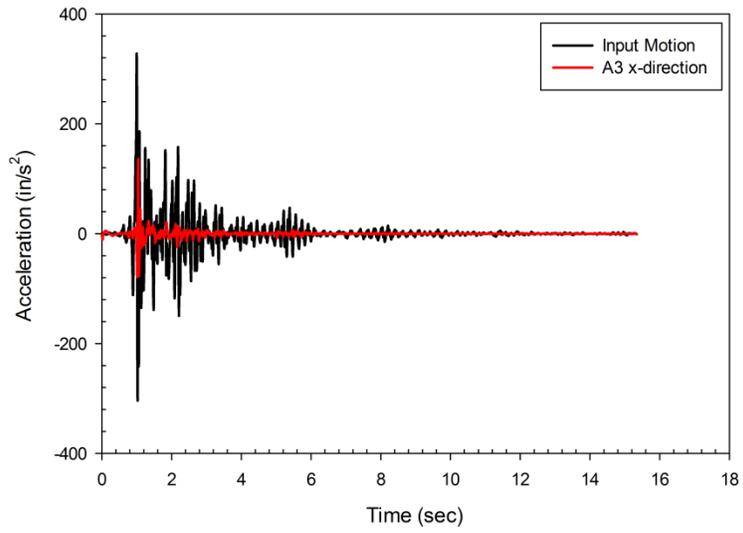


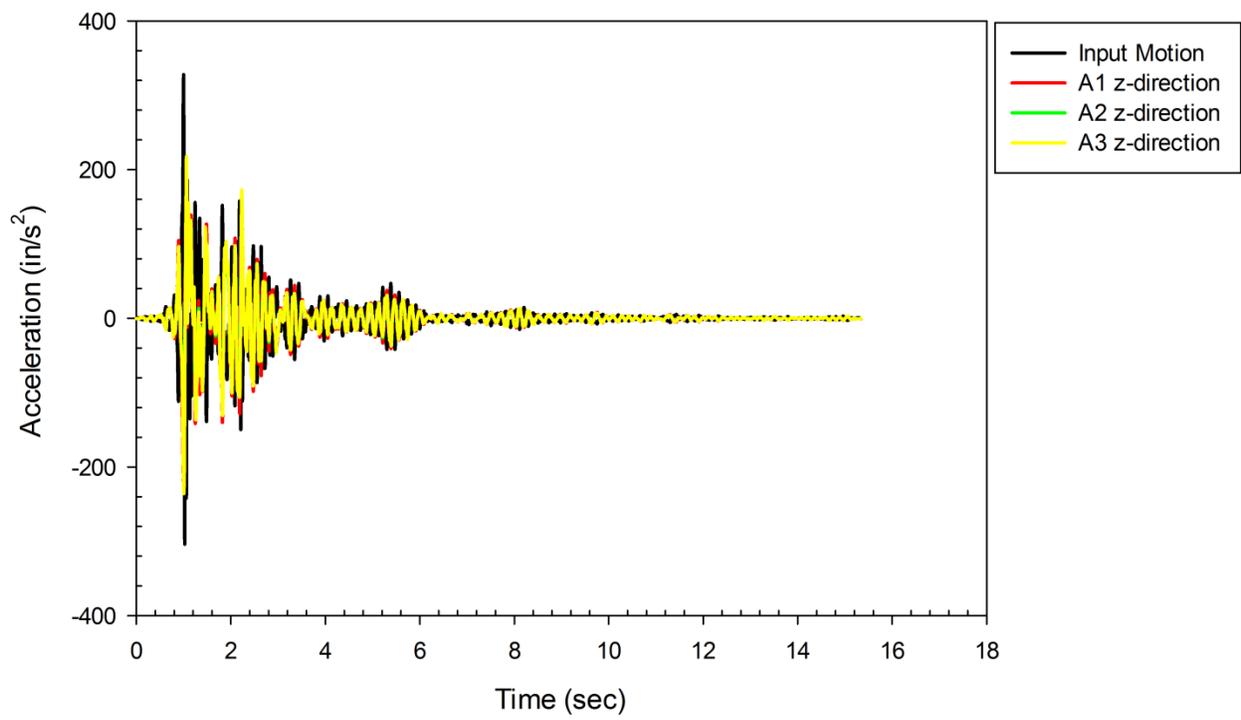
Project:	Cell Crete (Cellular Concrete)	Test Date:	9/2/16
Location:	----	Test No.:	1
Model Size:	4 ft by 6 ft	Vertical Stress:	102.5 psf
Model Height:	4 ft	Geogrid Depth:	2 ft
Motion Type:	1994 Northridge Earthquake	Characteristics:	N/A







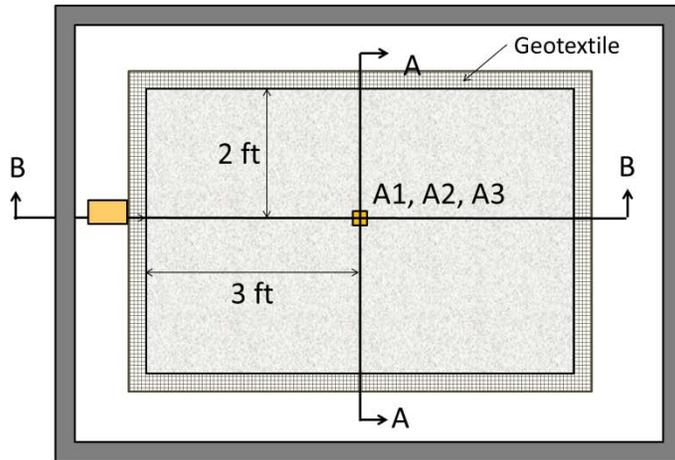




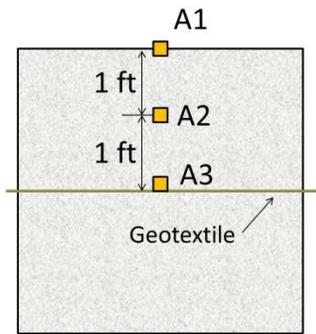
# Shake Table Test



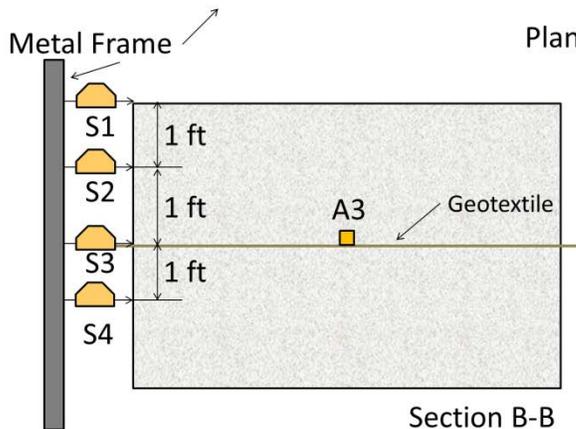
Project:	Cell Crete (Cellular Concrete)	Test Date:	9/2/16
Location:	----	Test No.:	2
Model Size:	4 ft by 6 ft	Vertical Stress:	102.5 psf
Model Height:	4 ft	Geogrid Depth:	2 ft
Motion Type:	Sinusoidal	Characteristics:	0.1g 2Hz



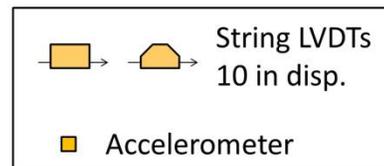
Plan View

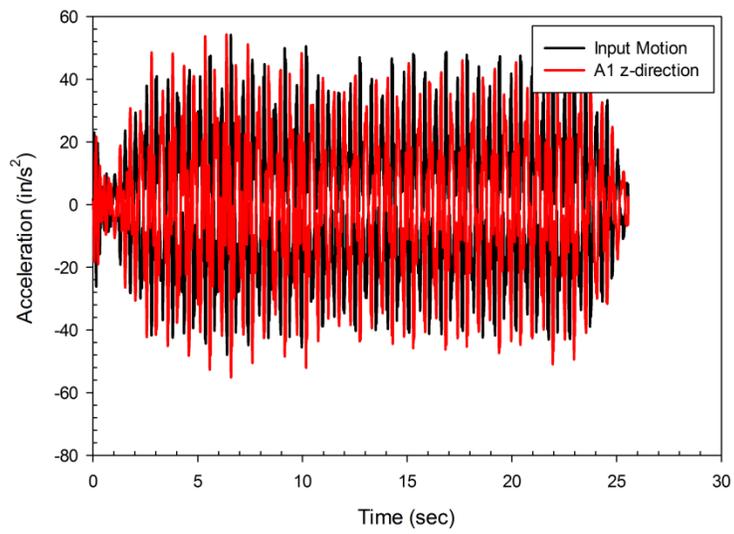
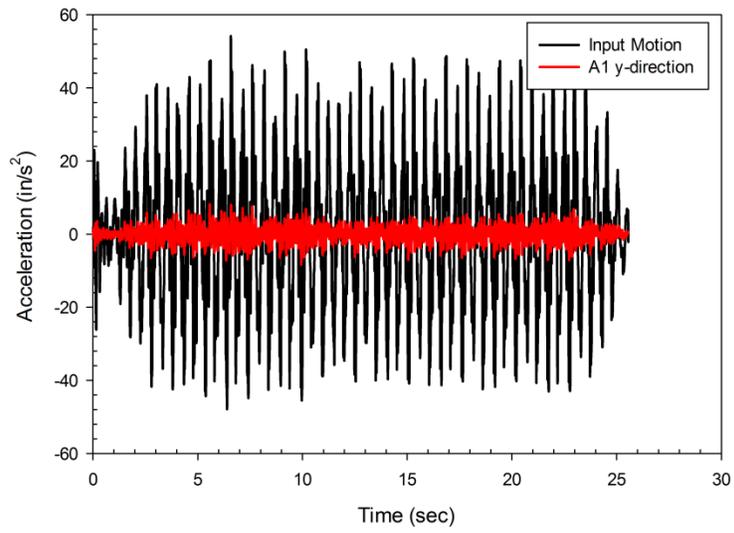
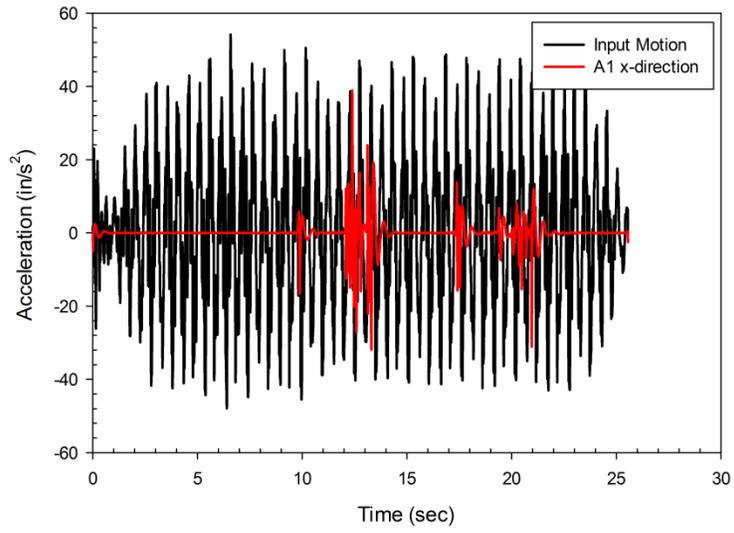


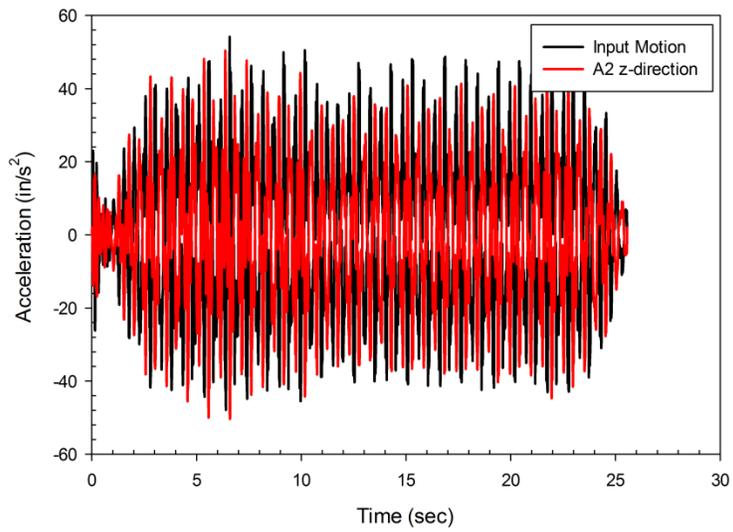
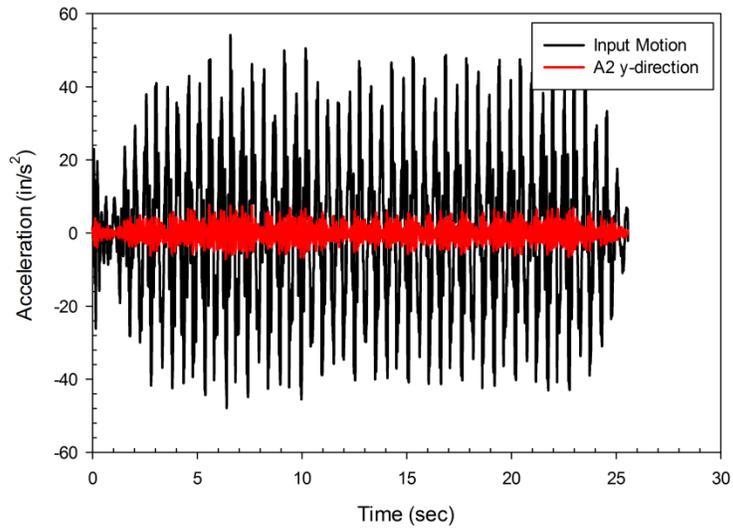
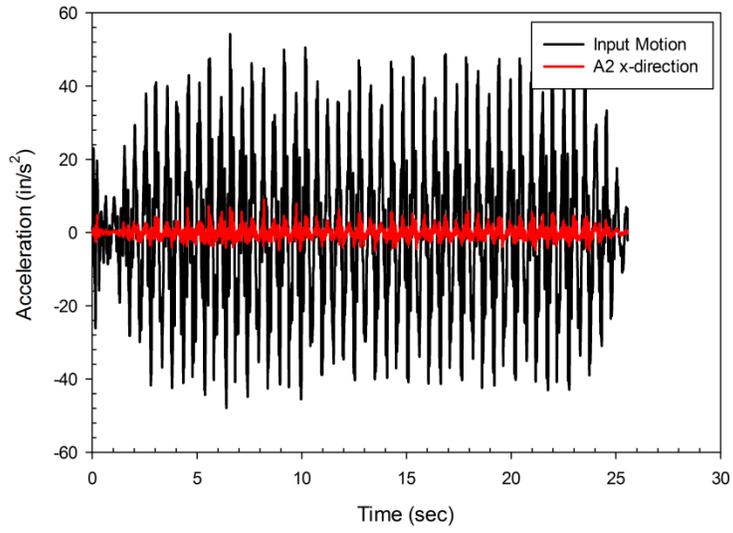
Section A-A

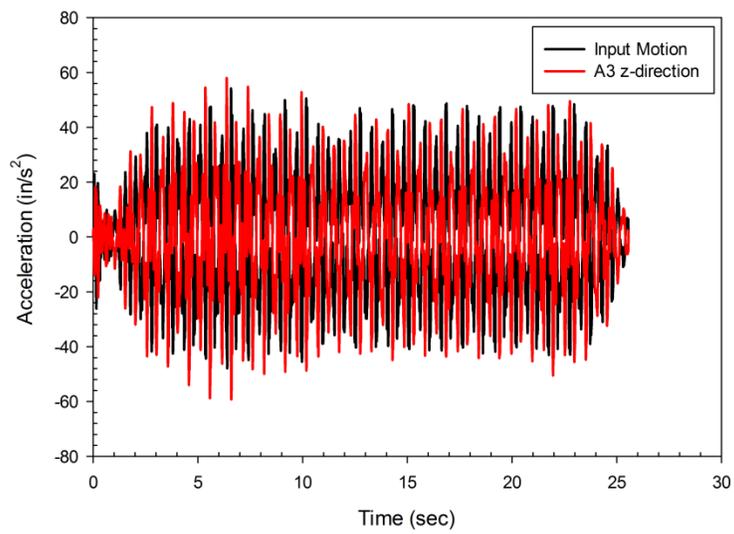
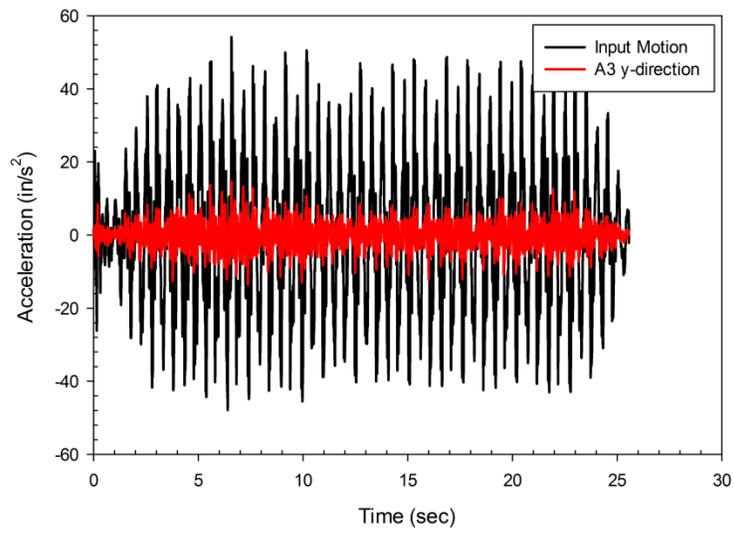
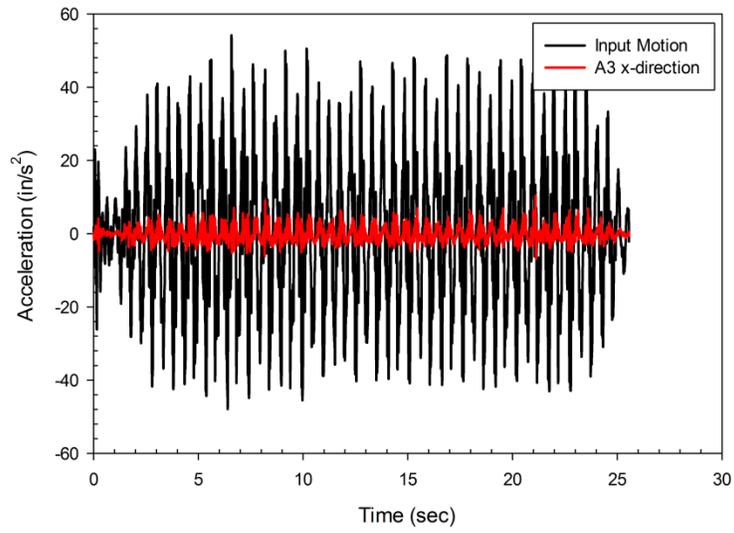


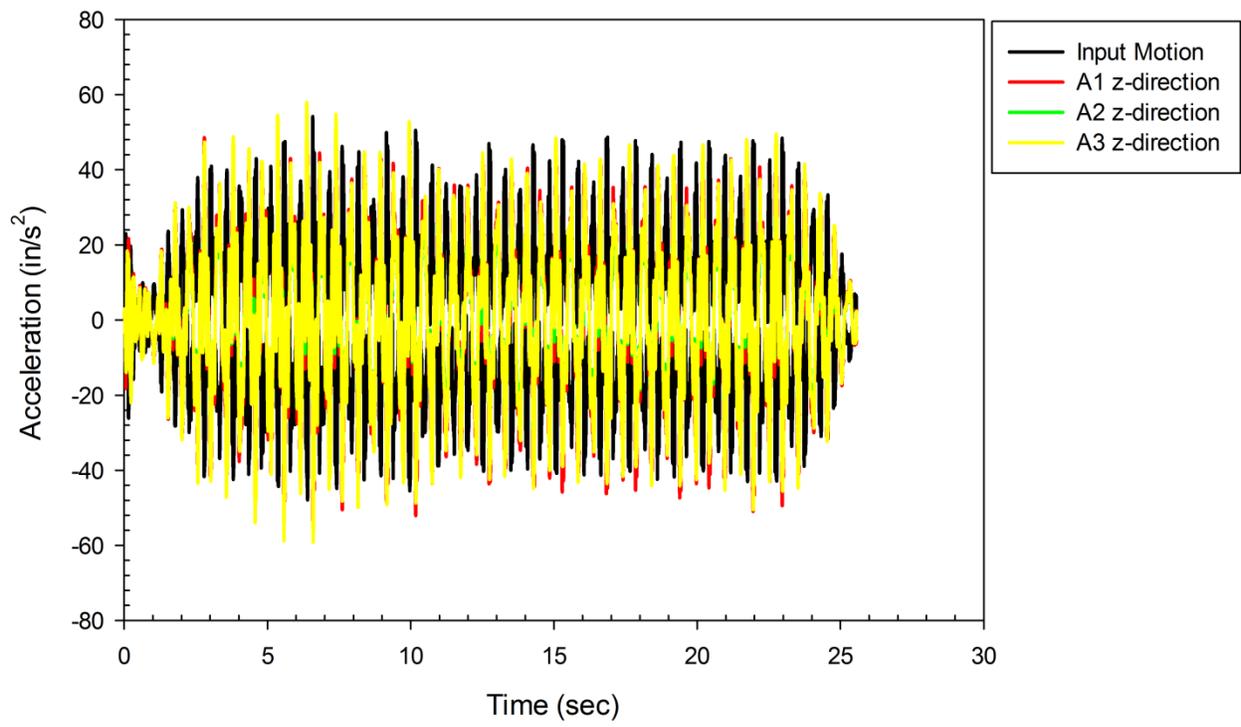
Section B-B







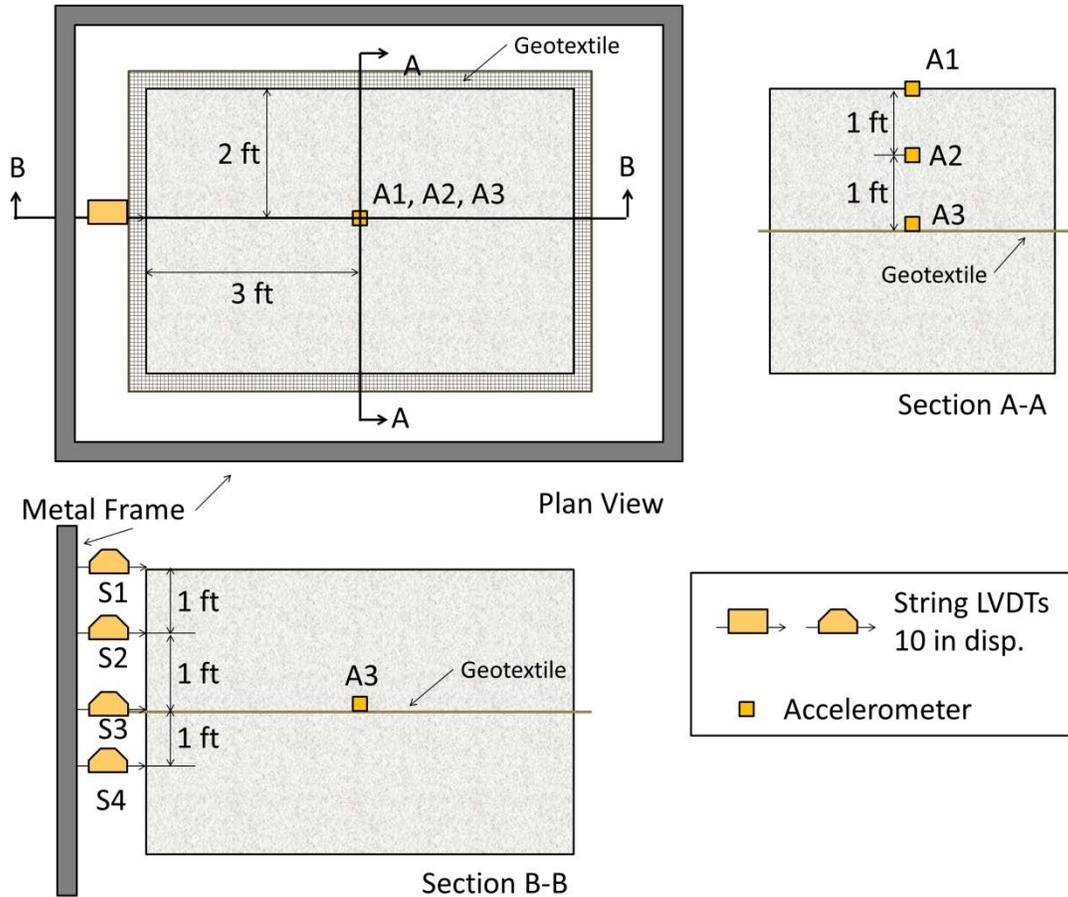


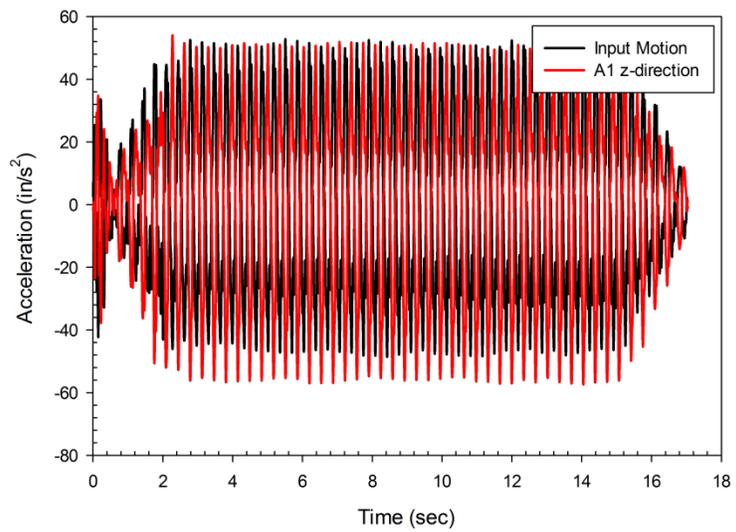
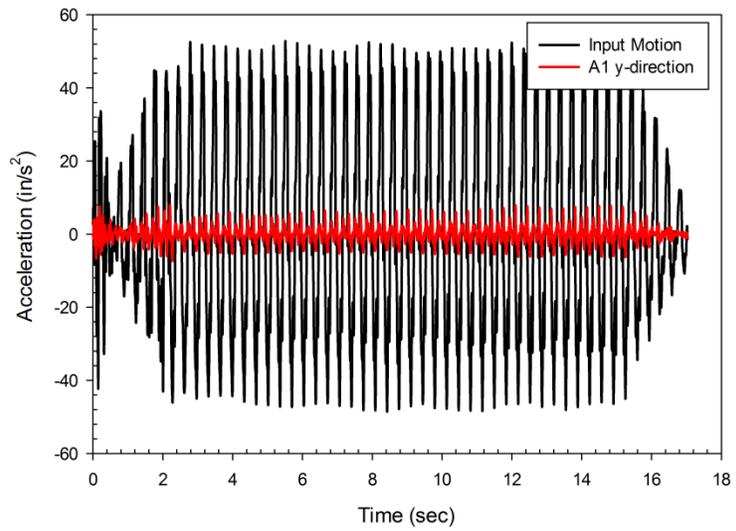
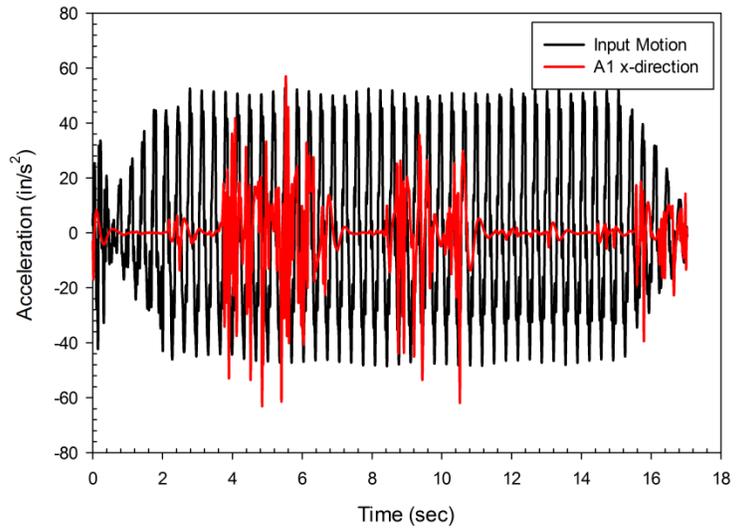


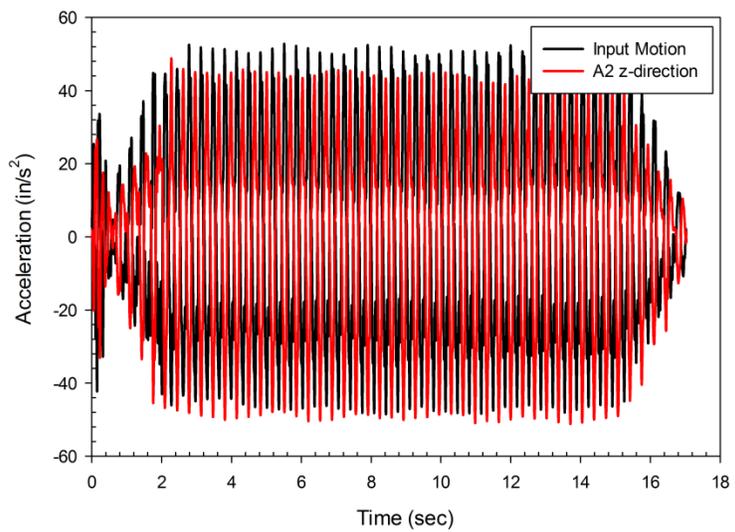
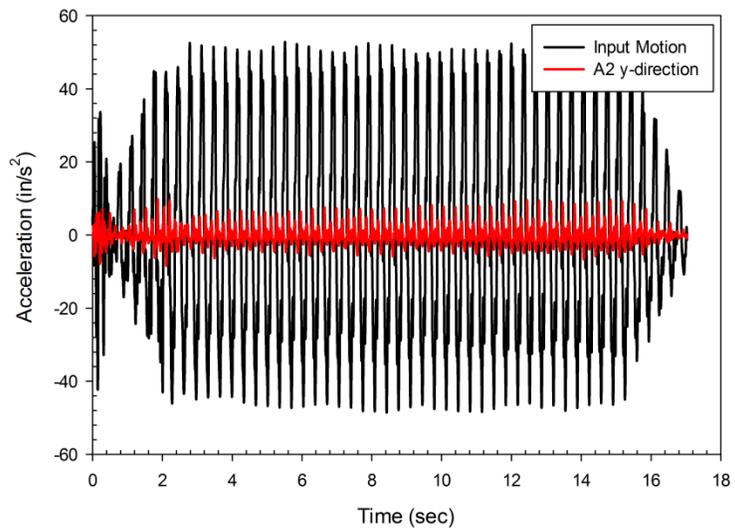
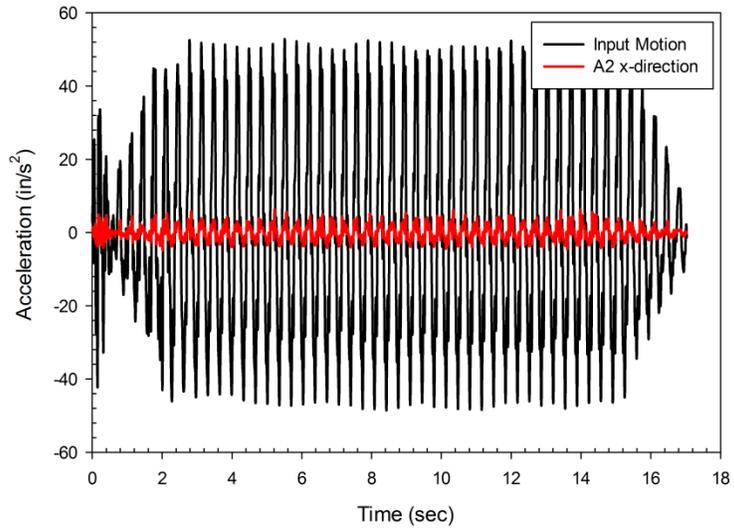
# Shake Table Test

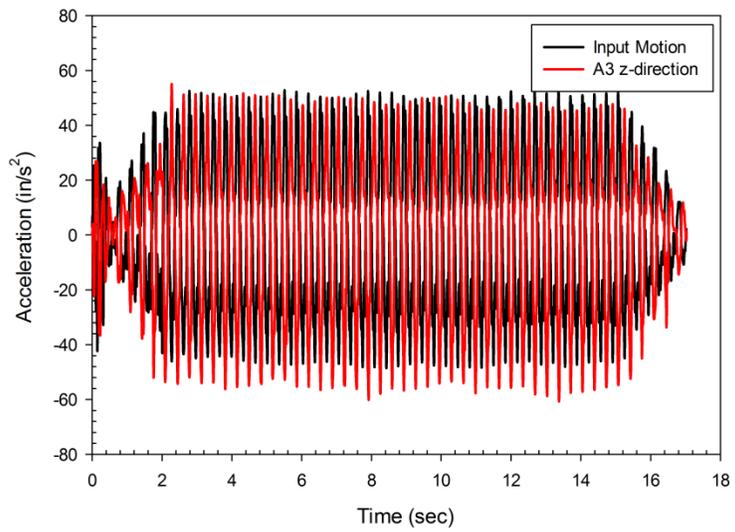
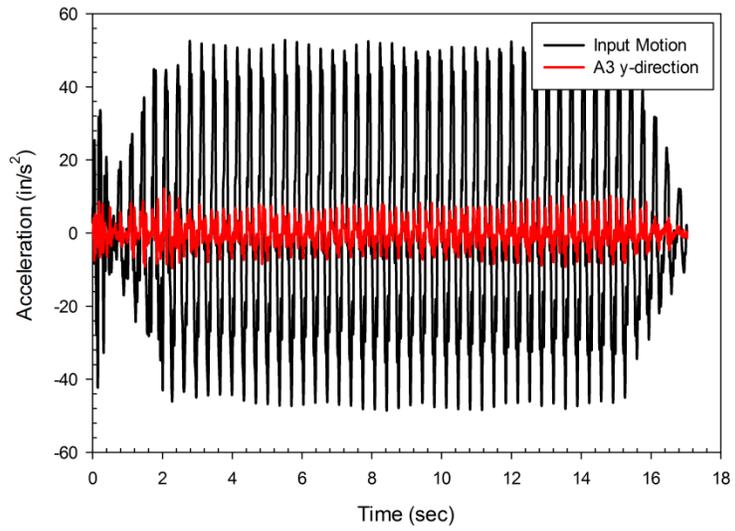
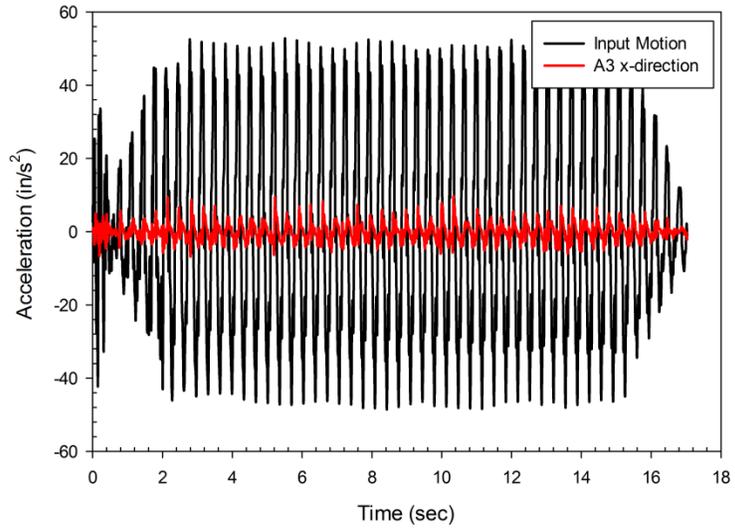


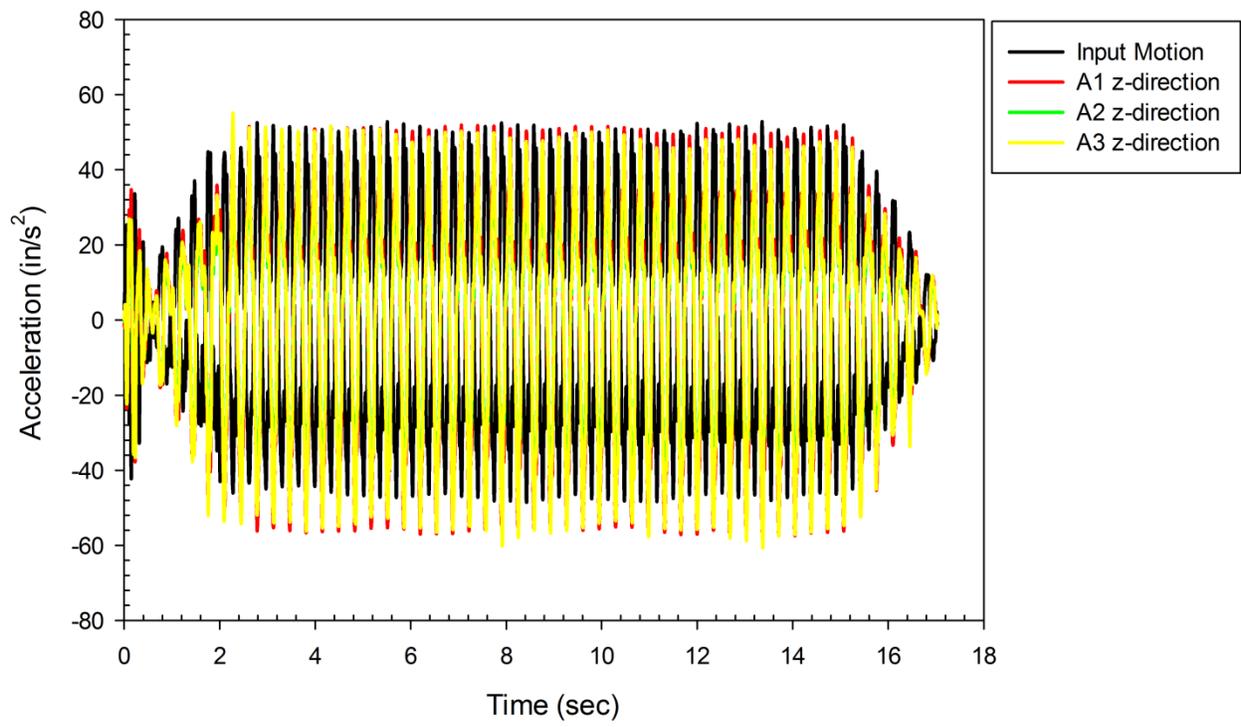
Project:	Cell Crete (Cellular Concrete)	Test Date:	9/2/16
Location:	----	Test No.:	2
Model Size:	4 ft by 6 ft	Vertical Stress:	102.5 psf
Model Height:	4 ft	Geogrid Depth:	2 ft
Motion Type:	Sinusoidal	Characteristics:	0.1g 3Hz







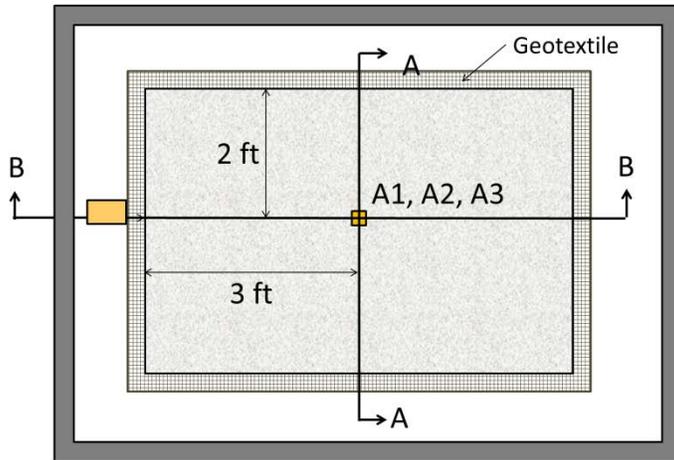




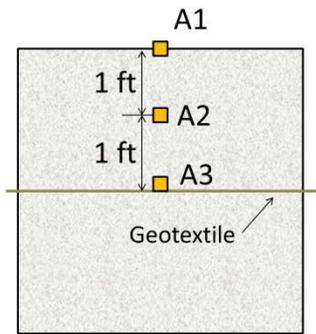
# Shake Table Test



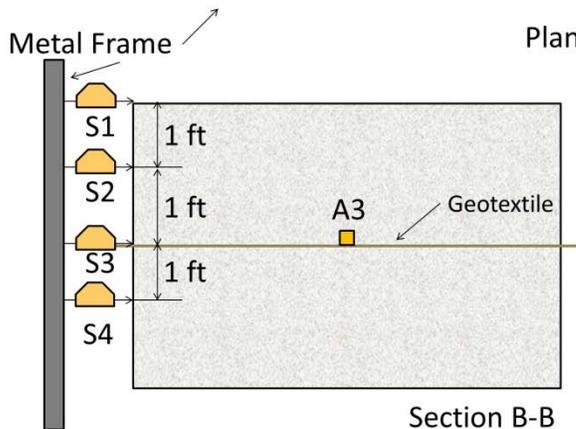
Project:	Cell Crete (Cellular Concrete)	Test Date:	9/2/16
Location:	----	Test No.:	2
Model Size:	4 ft by 6 ft	Vertical Stress:	102.5 psf
Model Height:	4 ft	Geogrid Depth:	2 ft
Motion Type:	Sinusoidal	Characteristics:	0.2g 2Hz



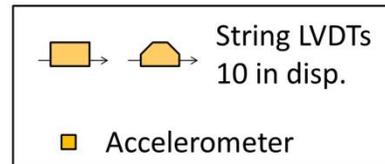
Plan View

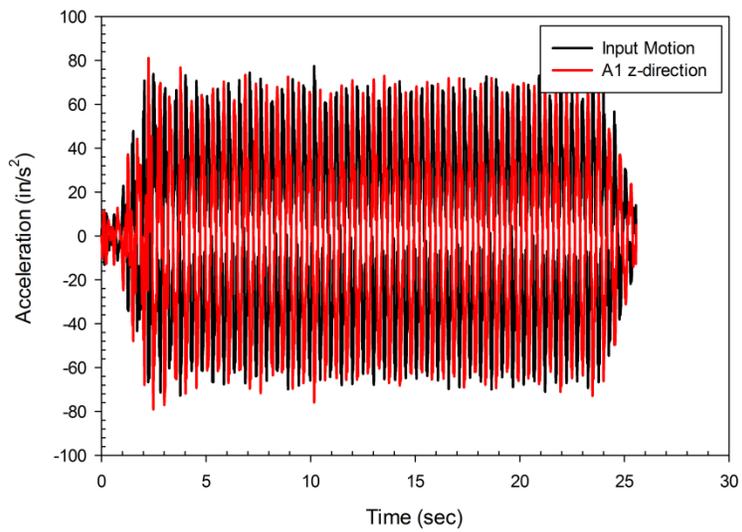
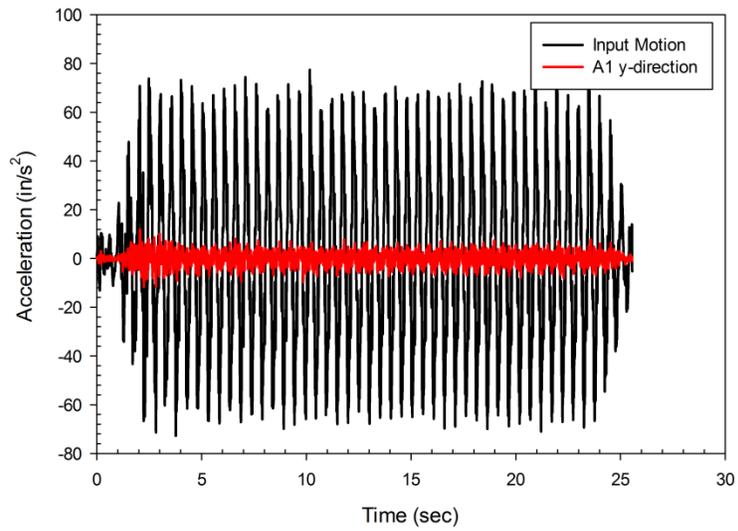
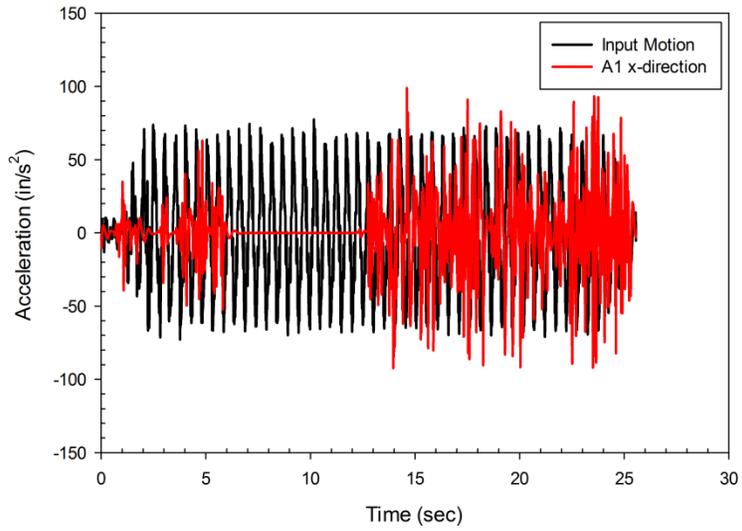


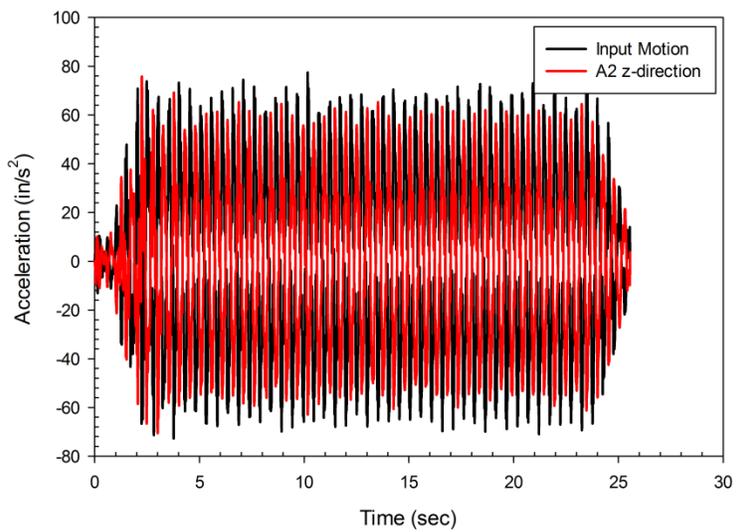
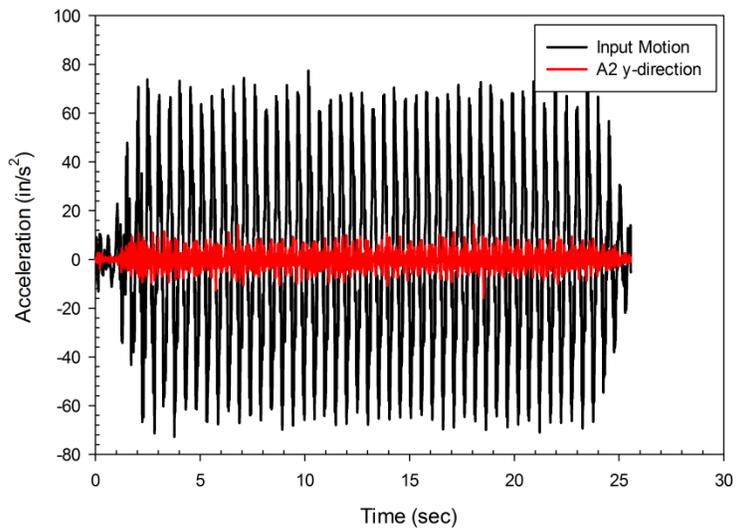
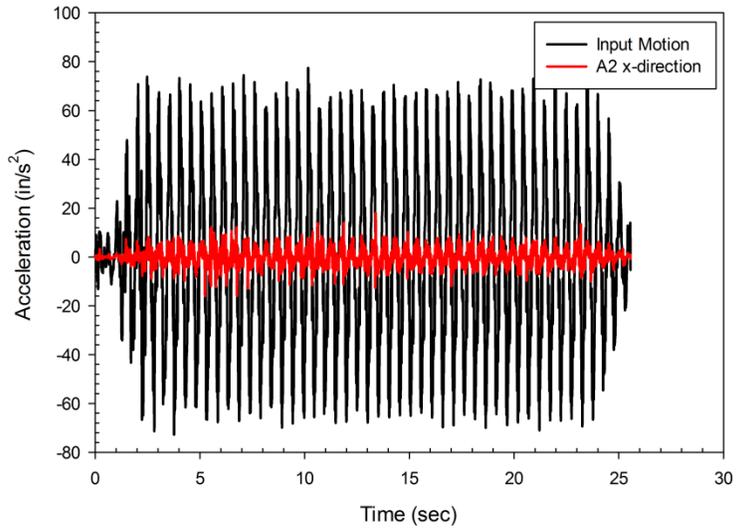
Section A-A

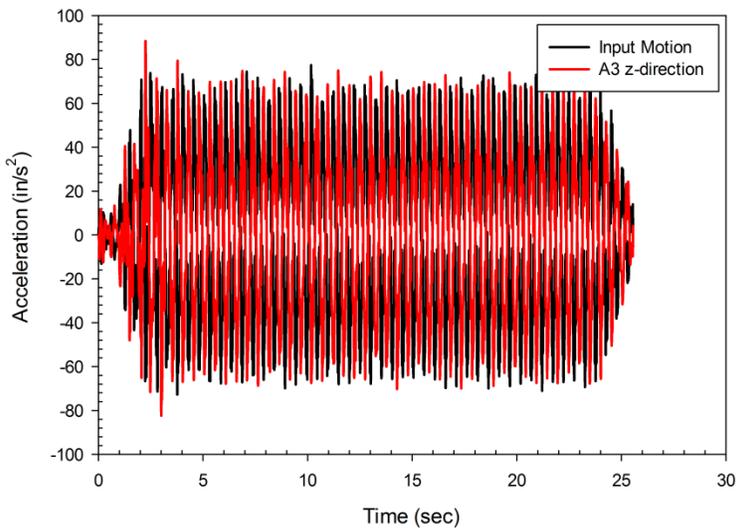
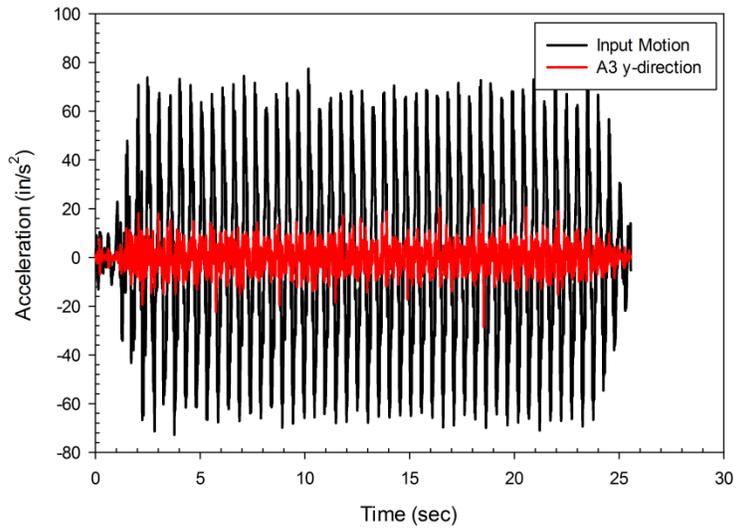
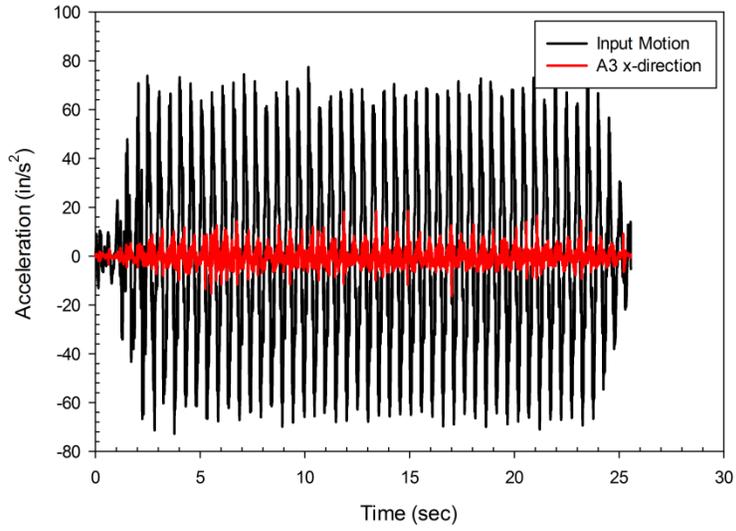


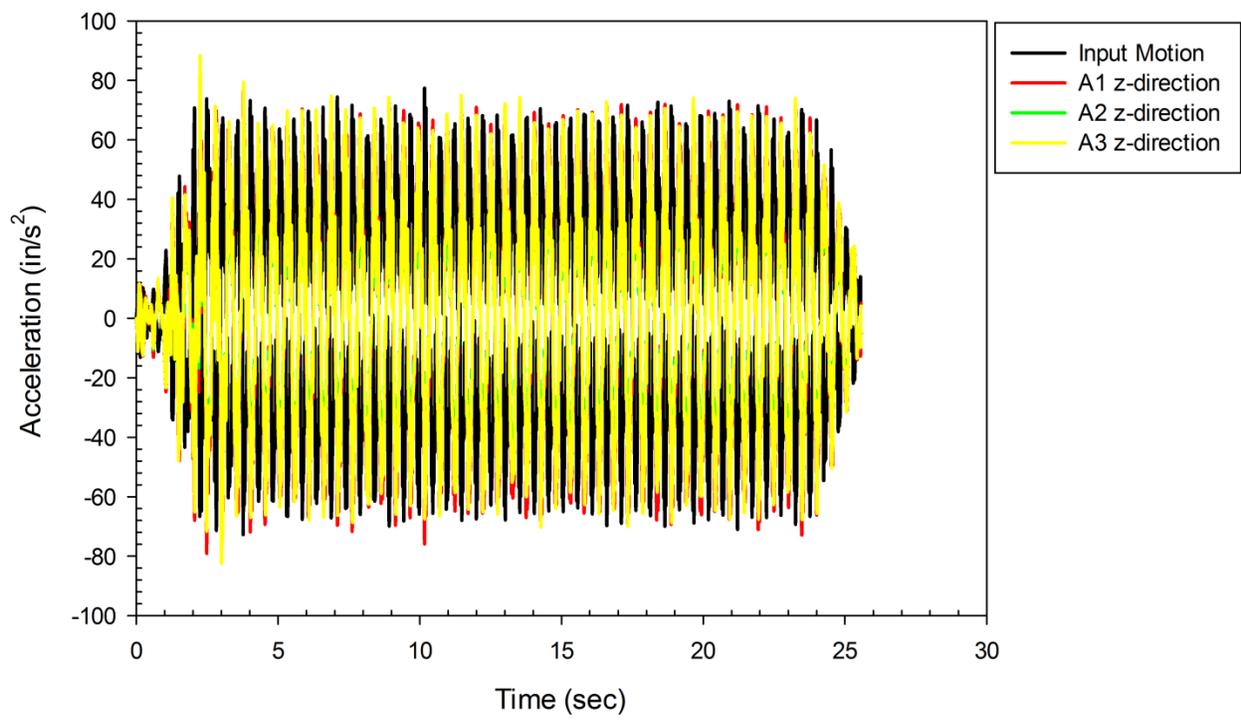
Section B-B







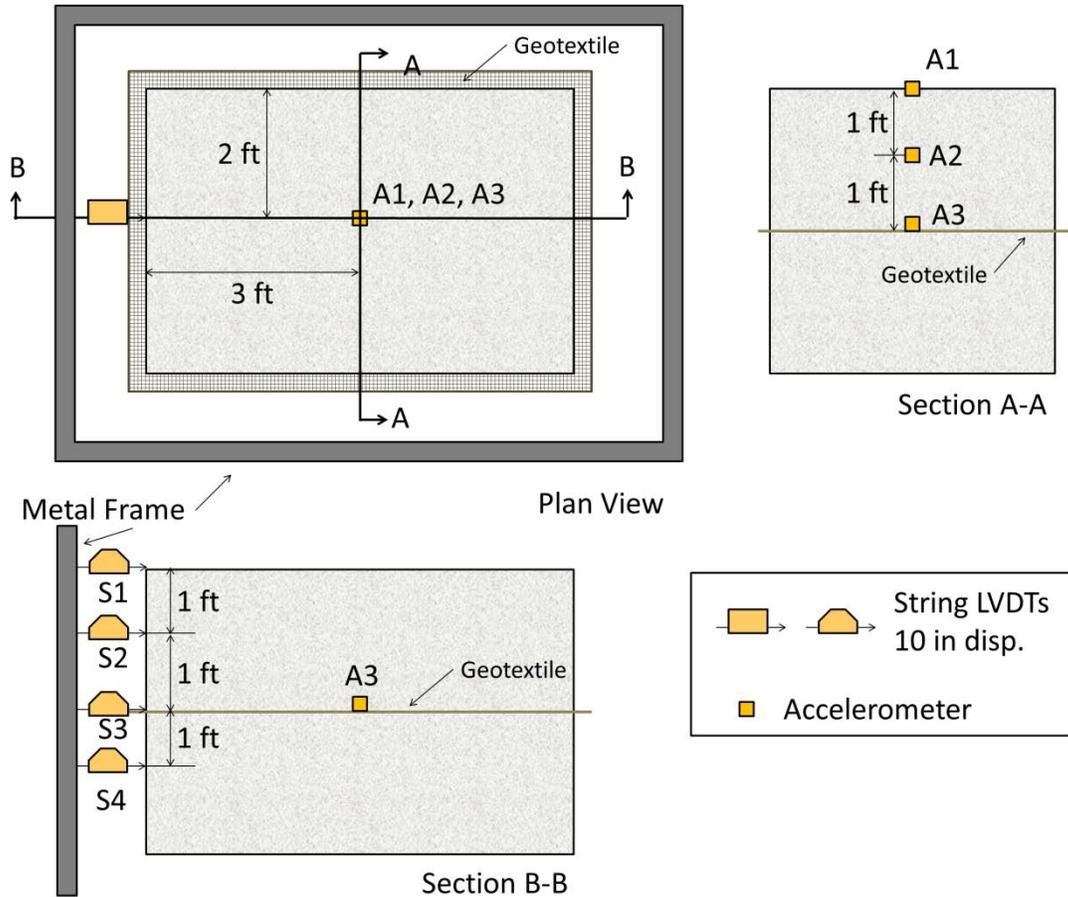


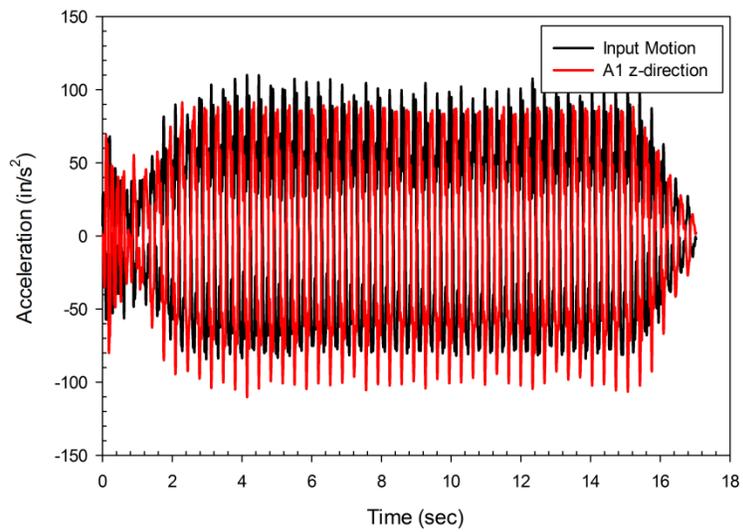
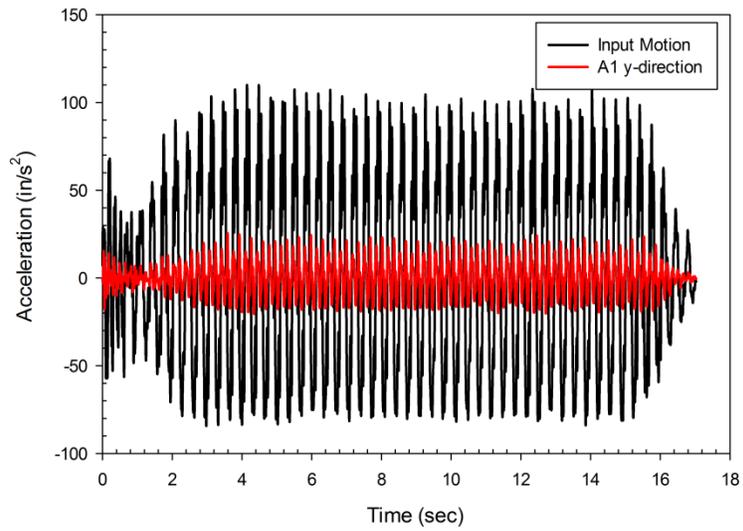
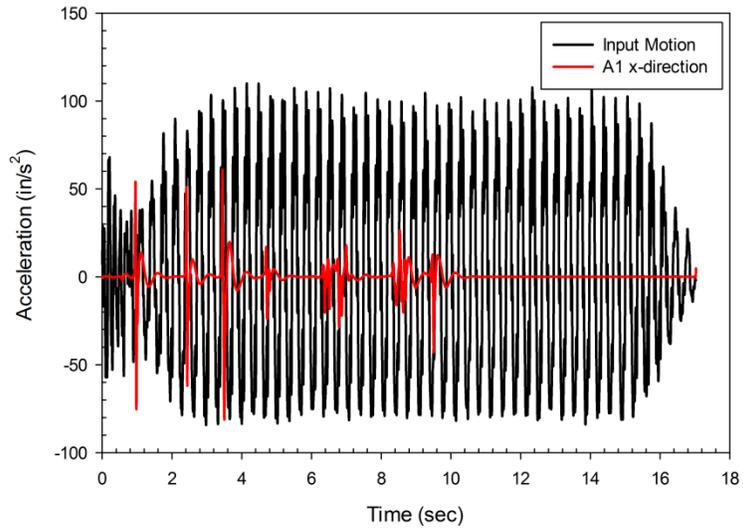


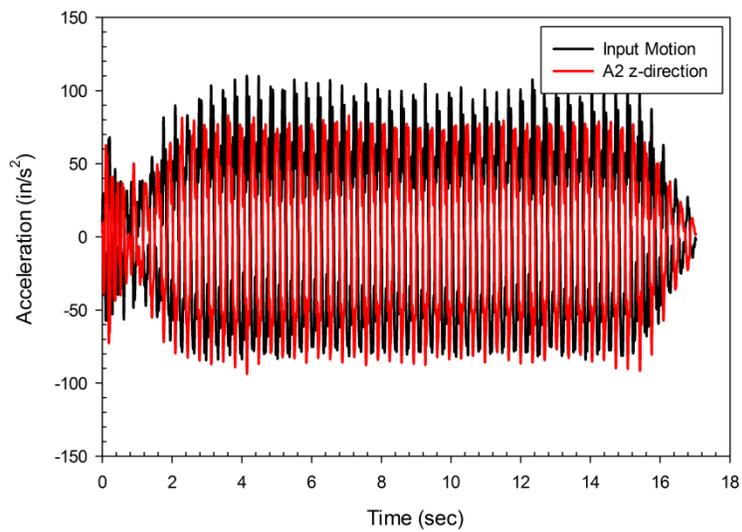
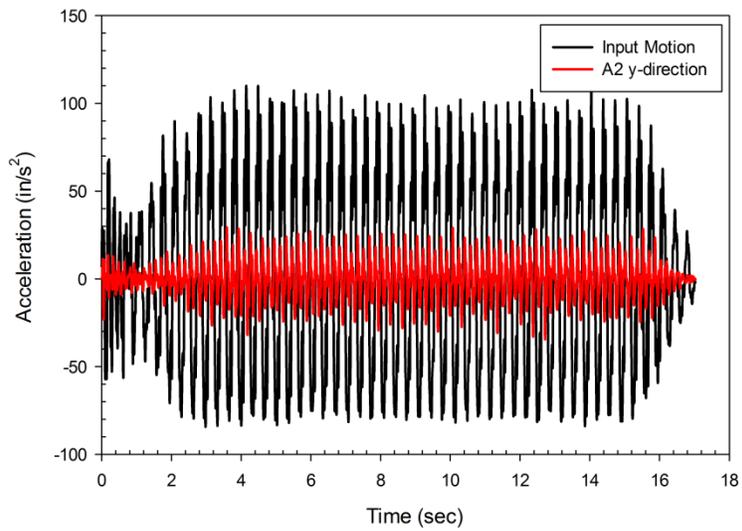
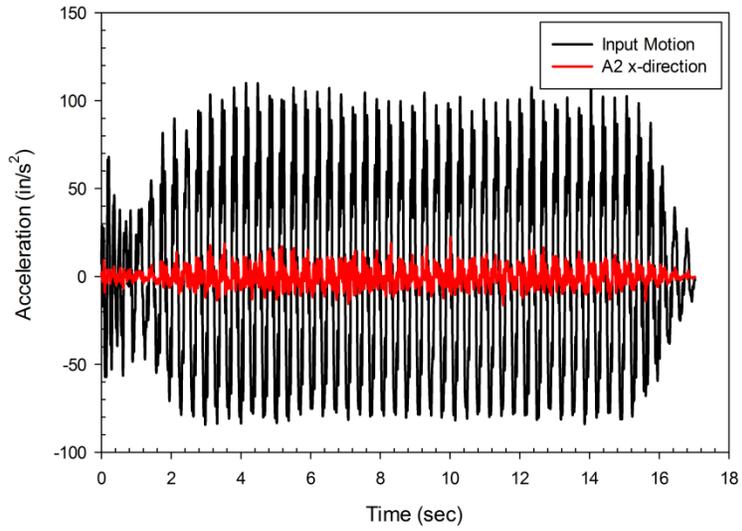
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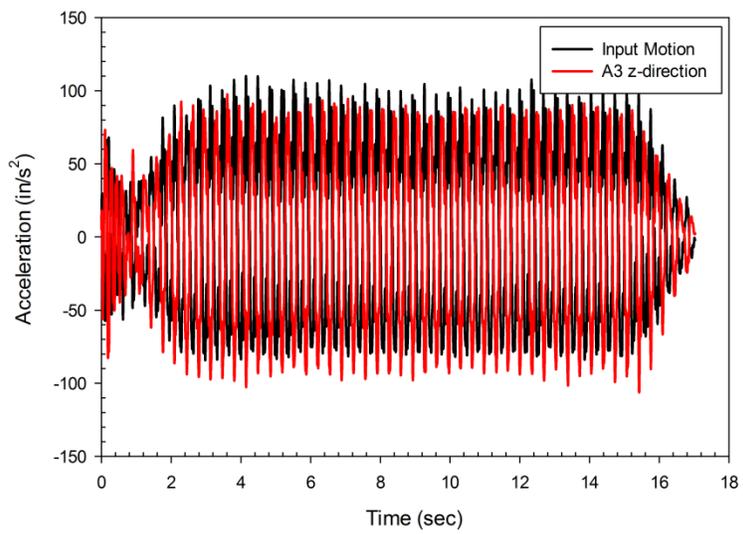
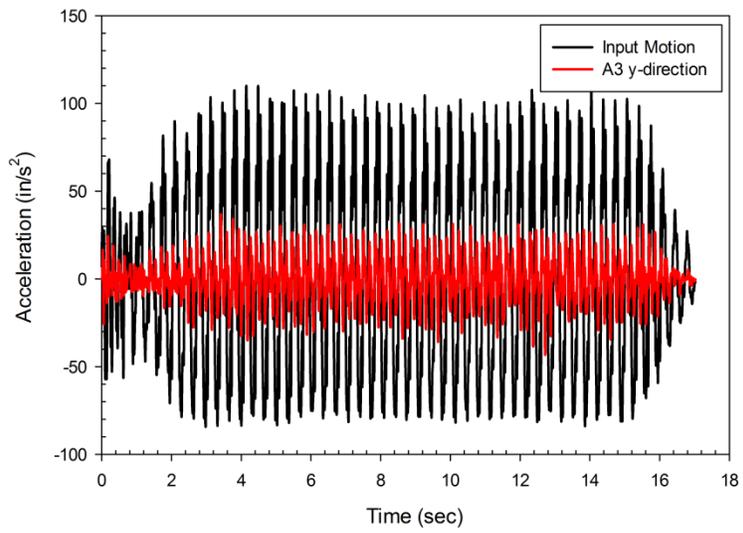
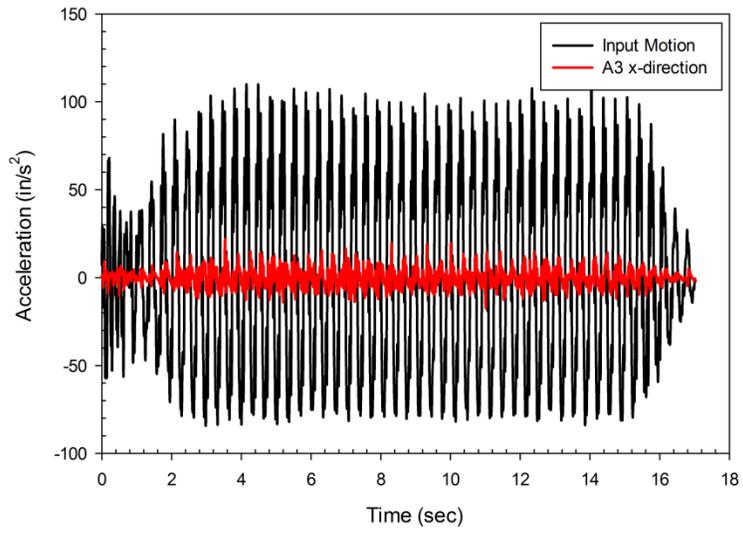


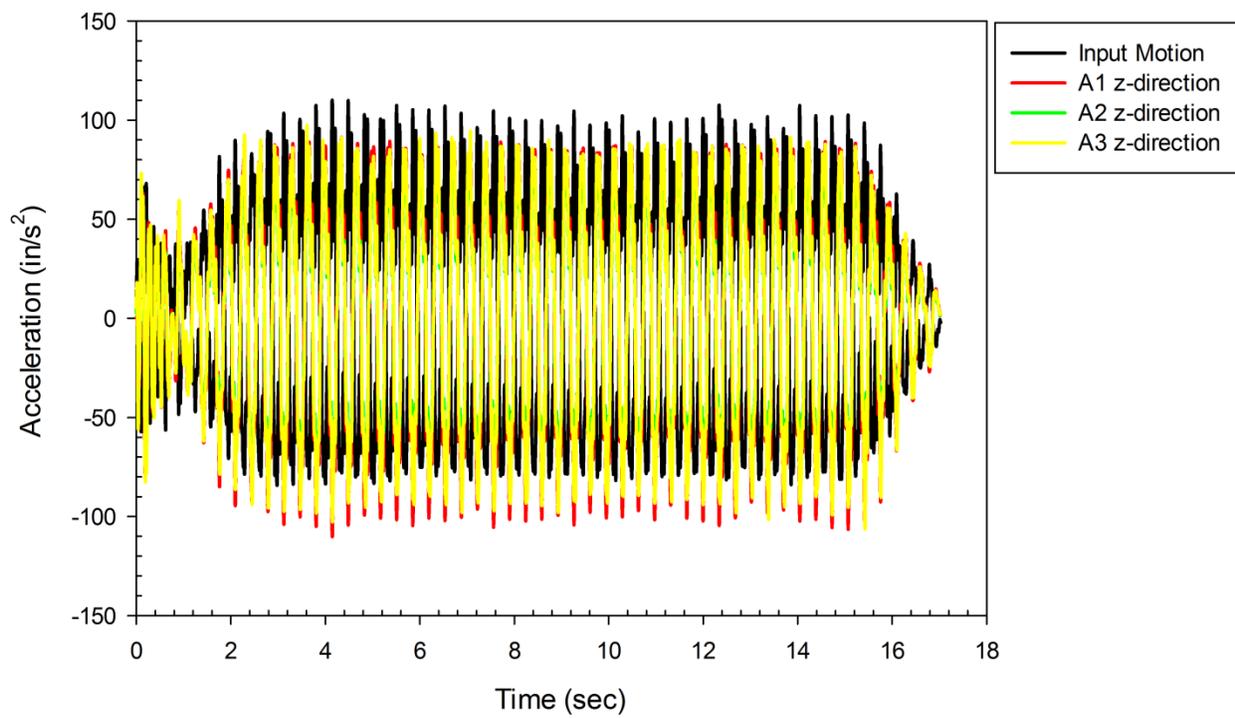
Project:	Cell Crete (Cellular Concrete)	Test Date:	9/2/16
Location:	----	Test No.:	2
Model Size:	4 ft by 6 ft	Vertical Stress:	102.5 psf
Model Height:	4 ft	Geogrid Depth:	2 ft
Motion Type:	Sinusoidal	Characteristics:	0.2g 3Hz







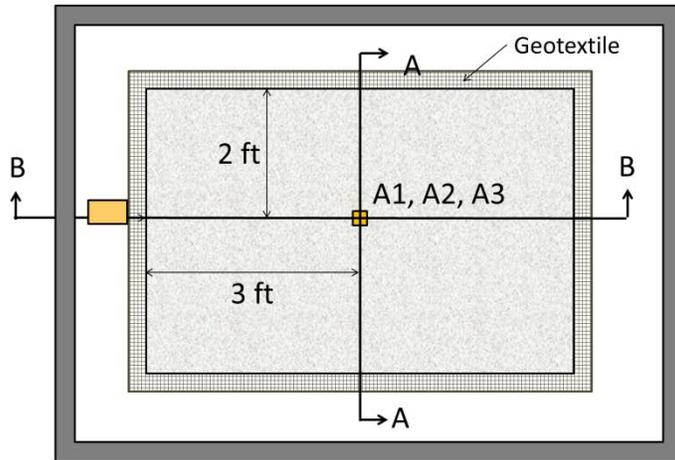




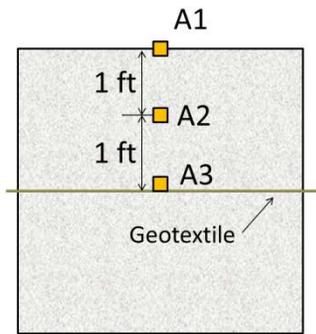
# Shake Table Test



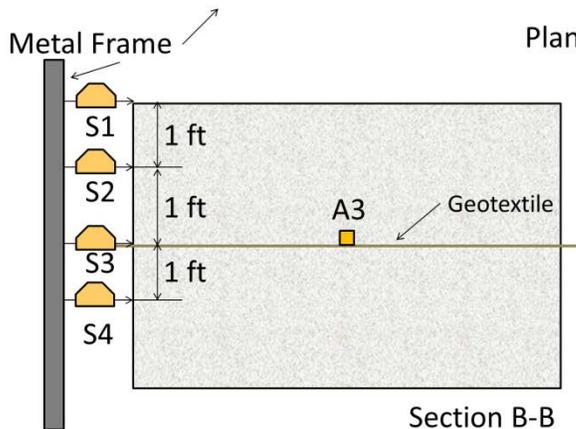
Project:	Cell Crete (Cellular Concrete)	Test Date:	9/2/16
Location:	----	Test No.:	2
Model Size:	4 ft by 6 ft	Vertical Stress:	102.5 psf
Model Height:	4 ft	Geogrid Depth:	2 ft
Motion Type:	1994 Northridge Earthquake	Characteristics:	N/A



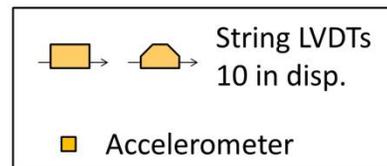
Plan View

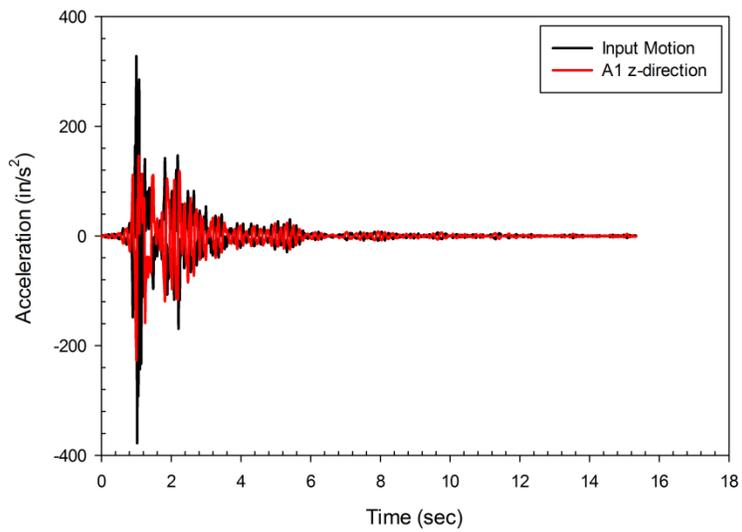
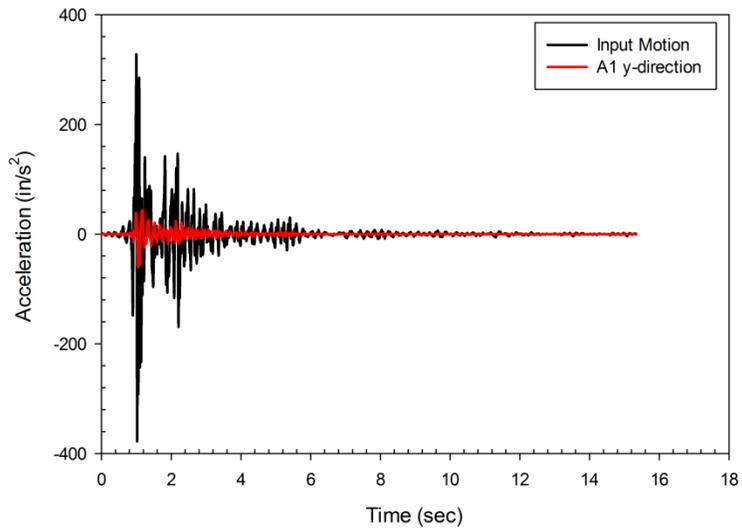
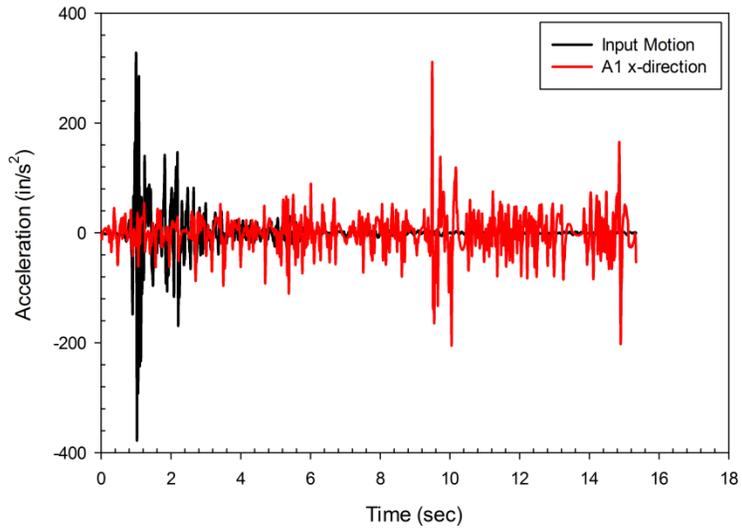


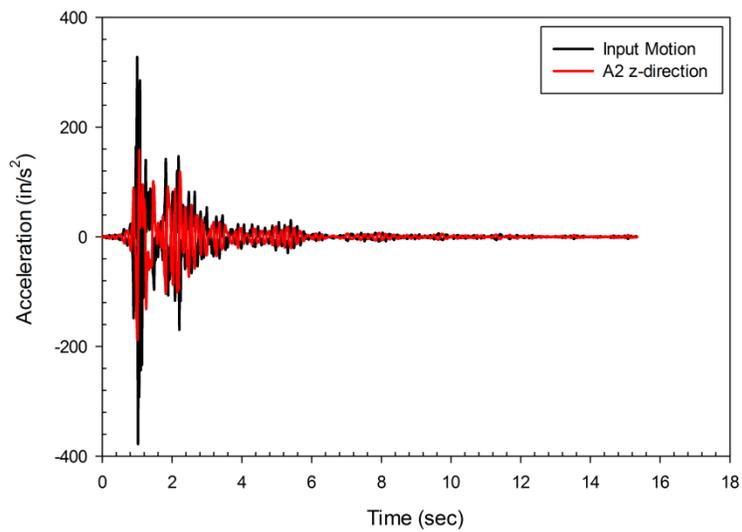
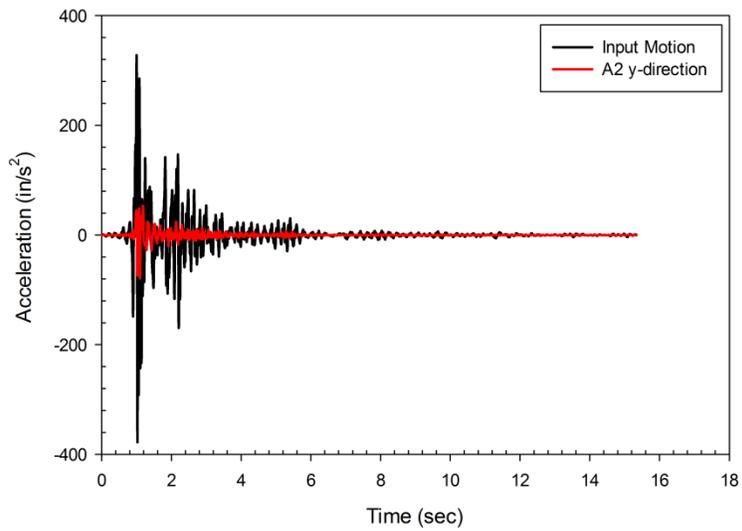
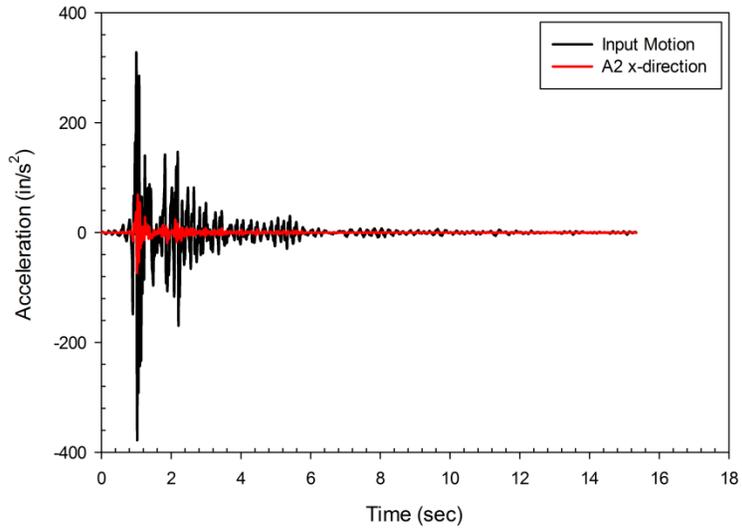
Section A-A

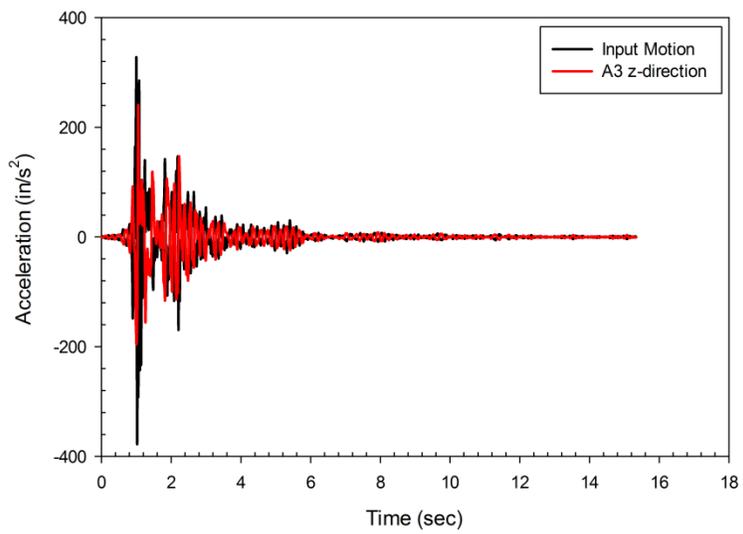
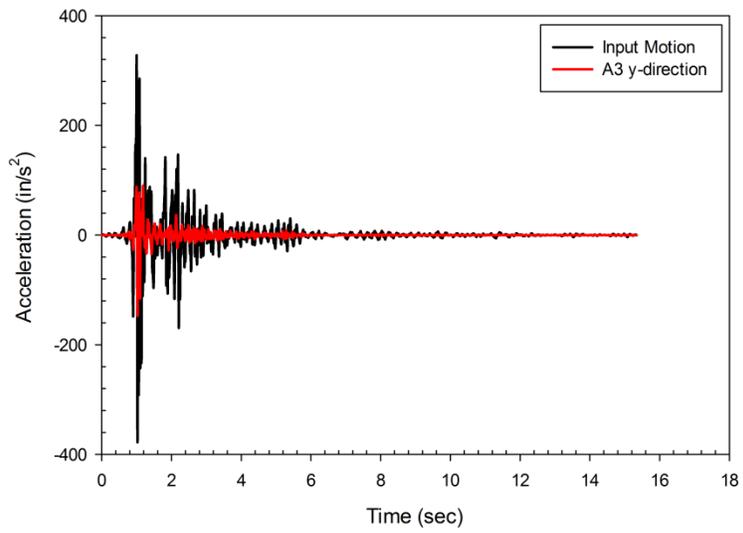
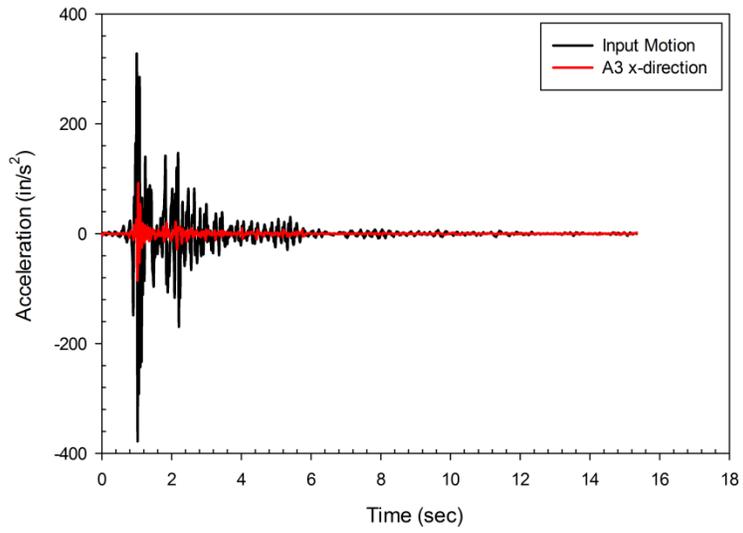


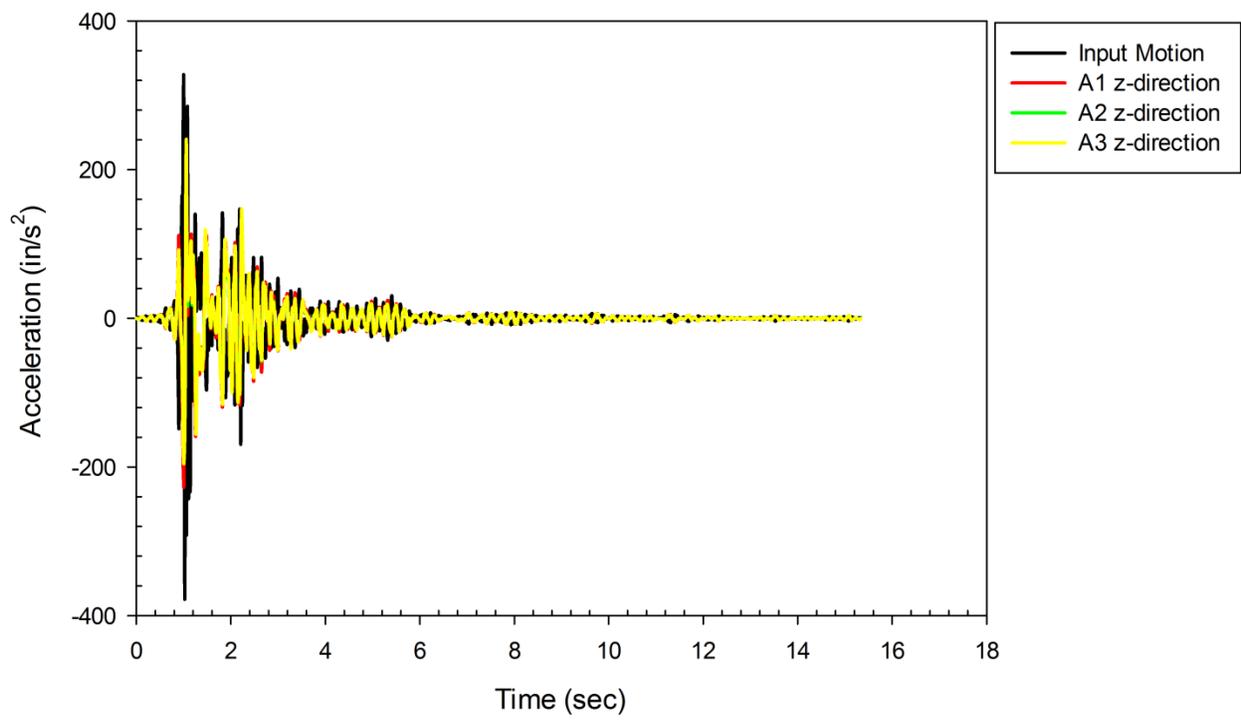
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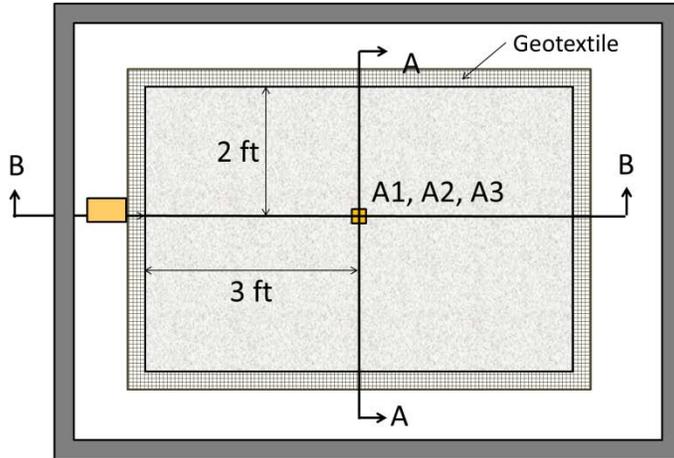




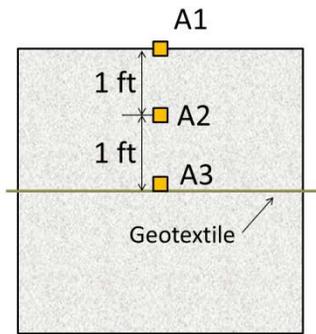
# Shake Table Test



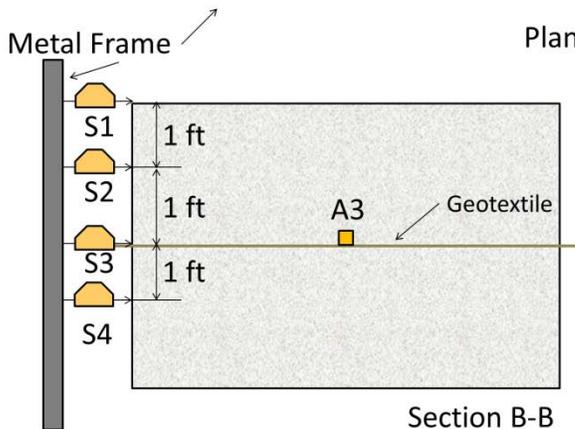
Project:	Cell Crete (Cellular Concrete)	Test Date:	9/2/16
Location:	----	Test No.:	3
Model Size:	4 ft by 6 ft	Vertical Stress:	102.5 psf
Model Height:	4 ft	Geogrid Depth:	2 ft
Motion Type:	Sinusoidal	Characteristics:	0.1g 2Hz



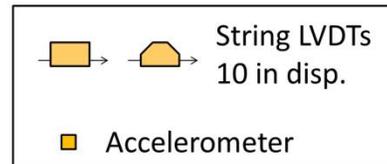
Plan View

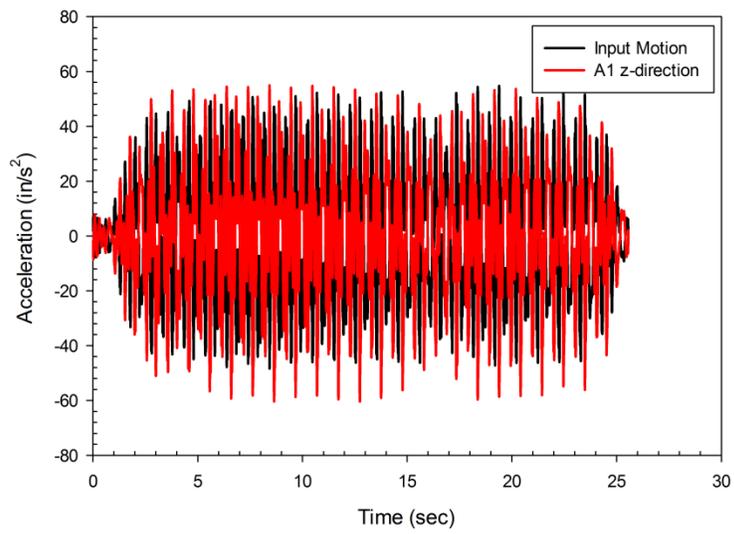
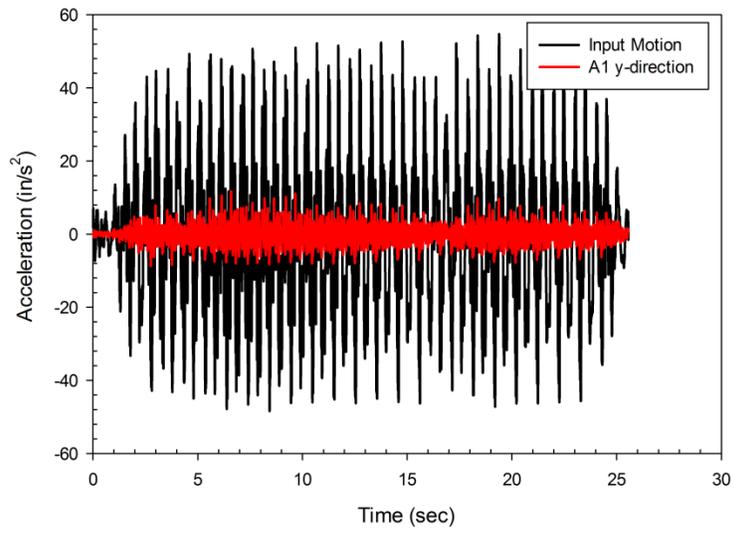
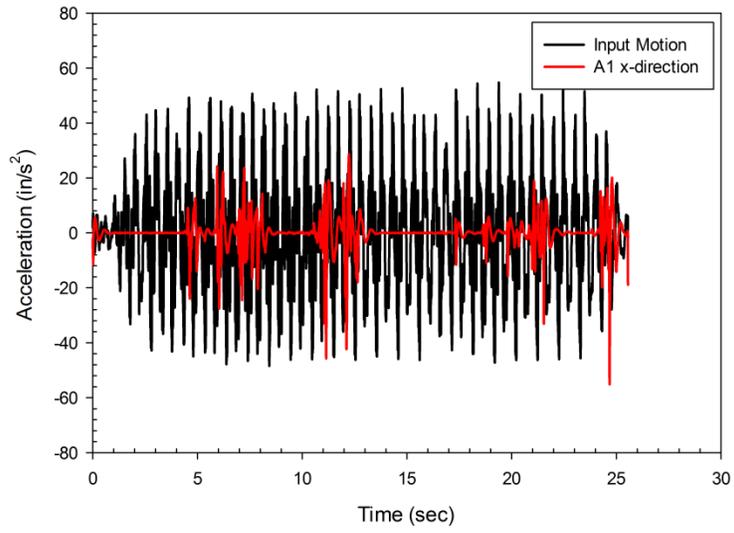


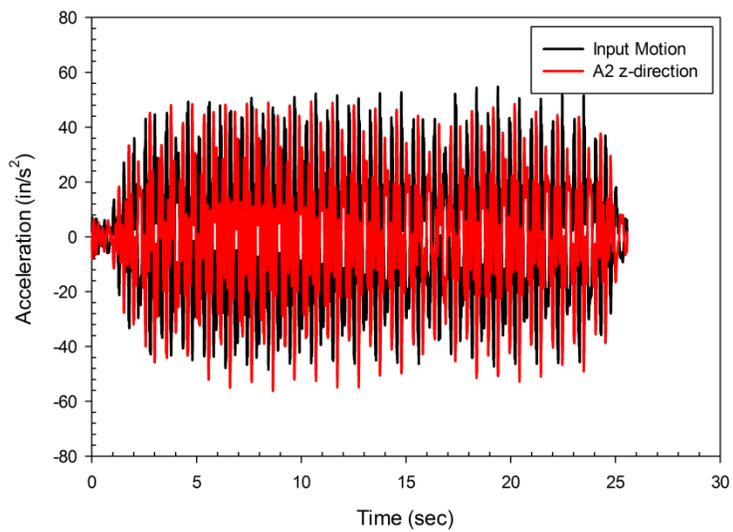
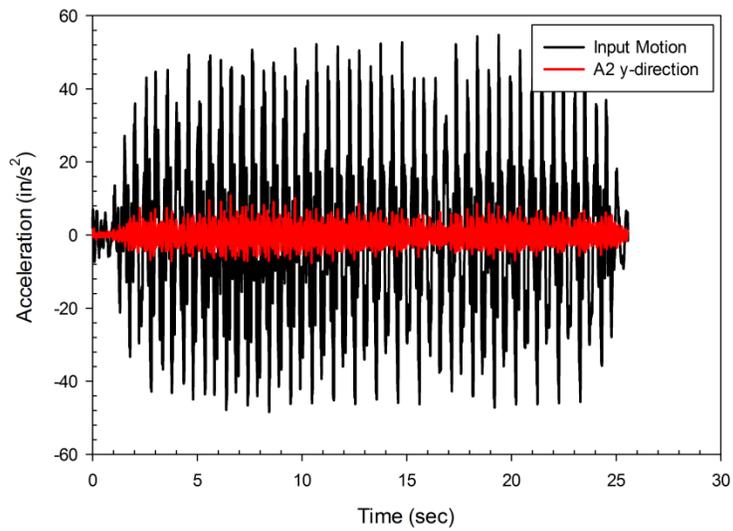
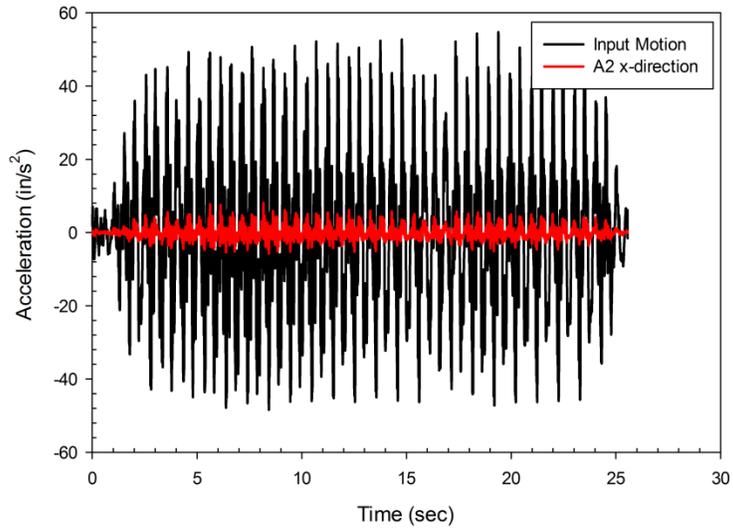
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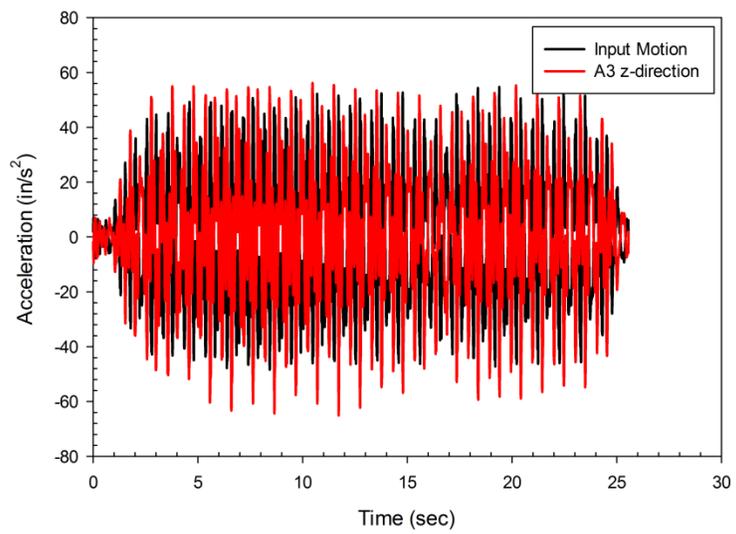
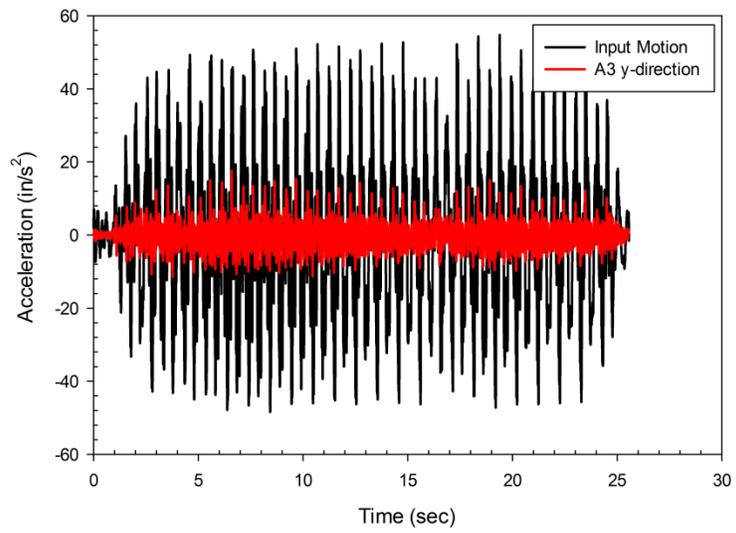
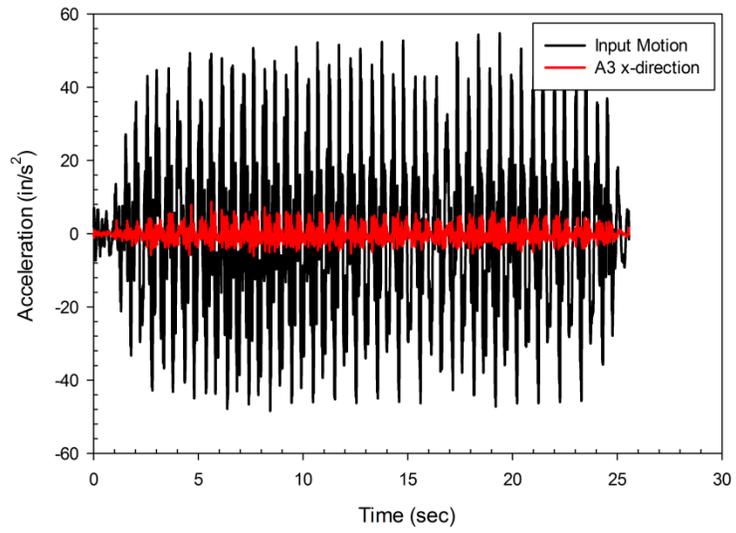


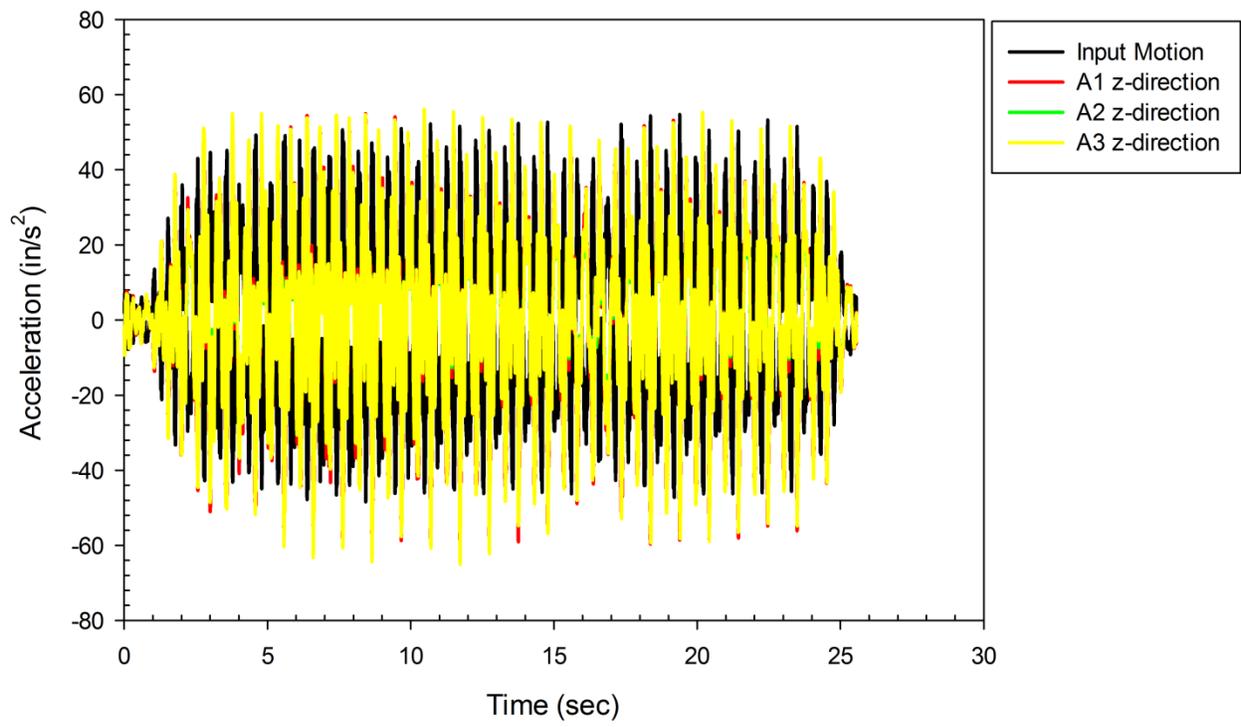
Section B-B







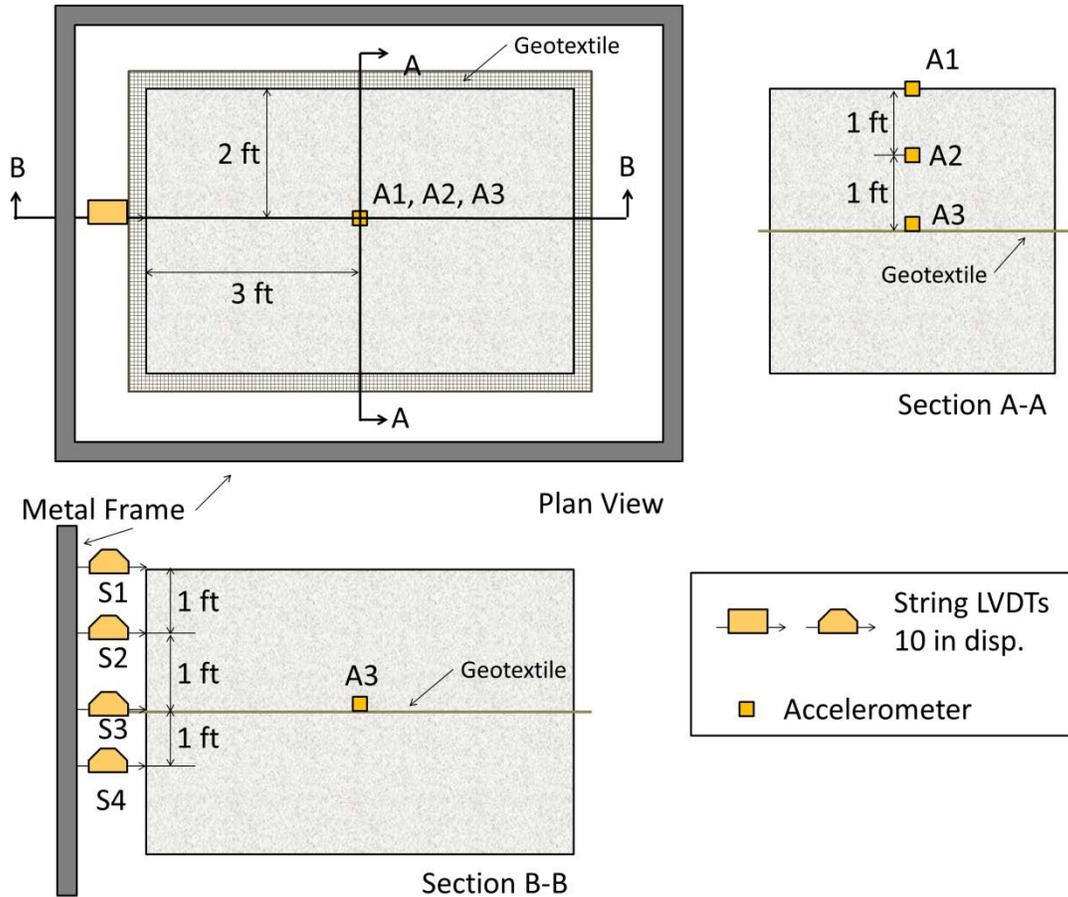


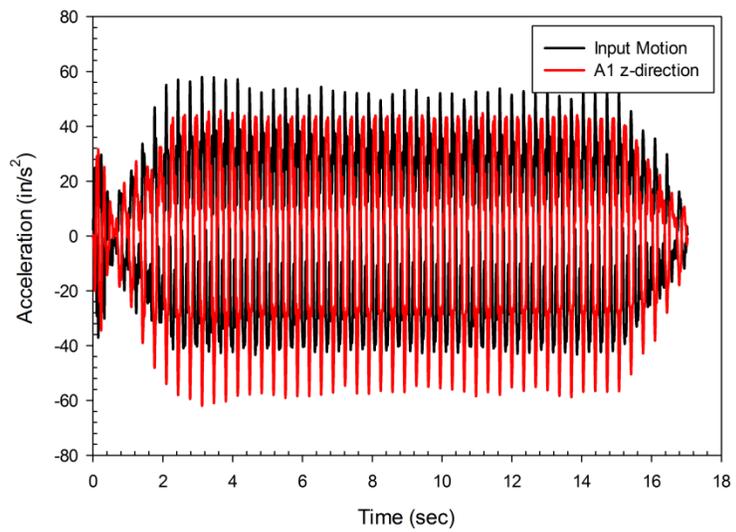
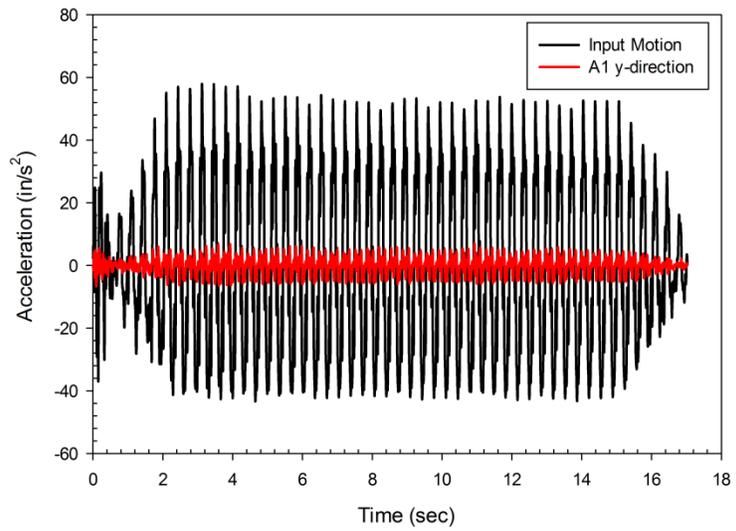
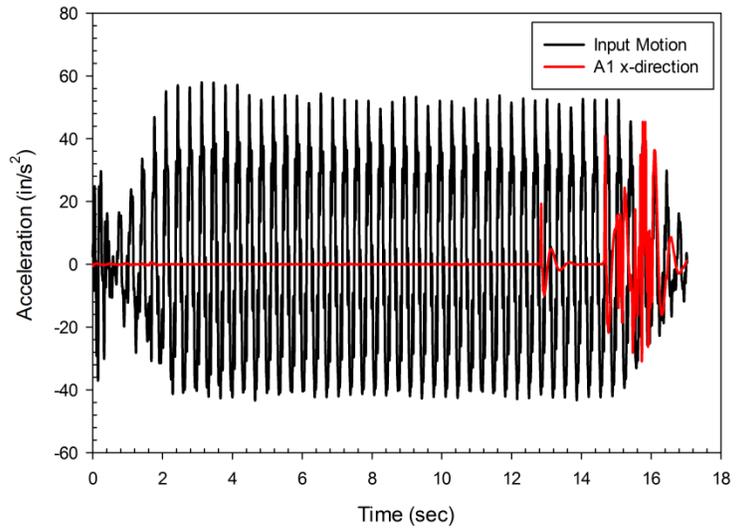


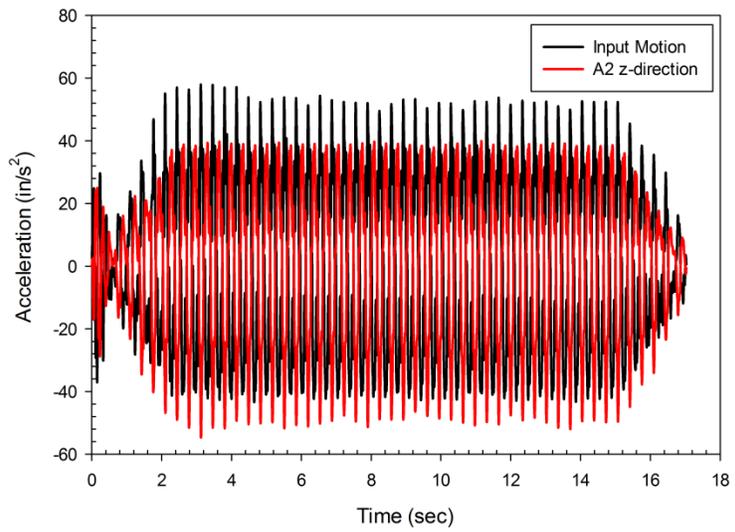
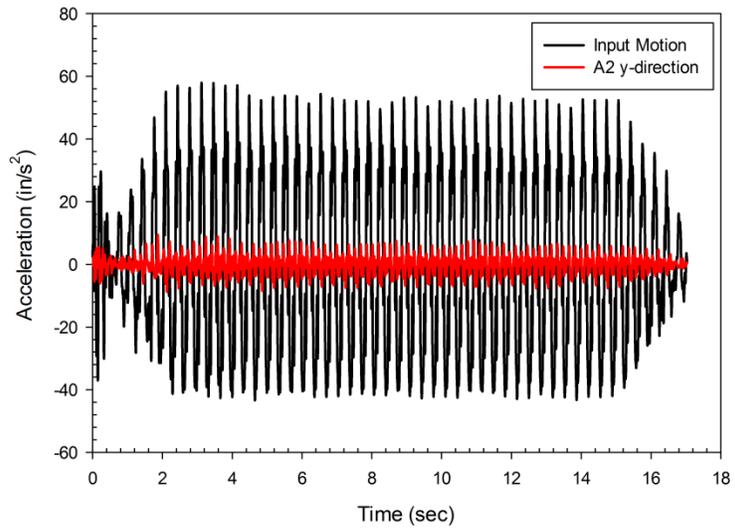
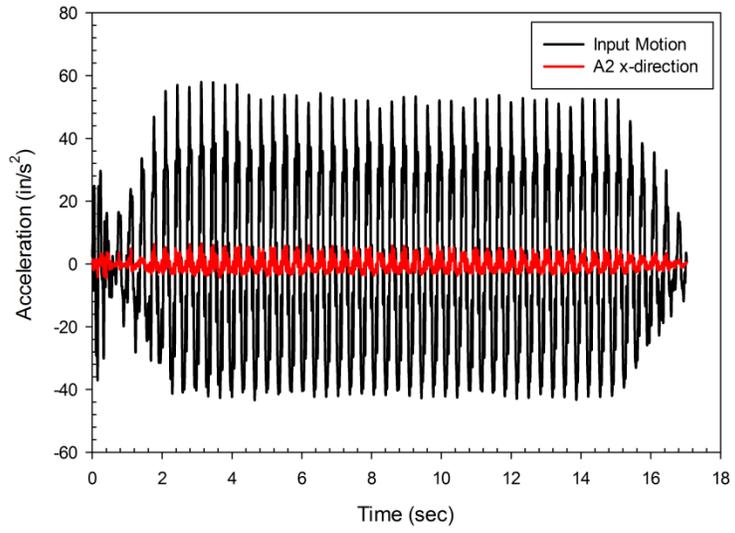
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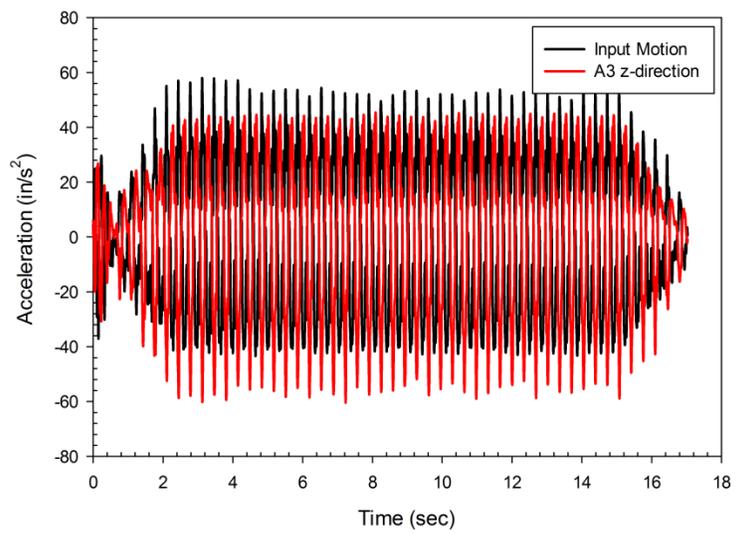
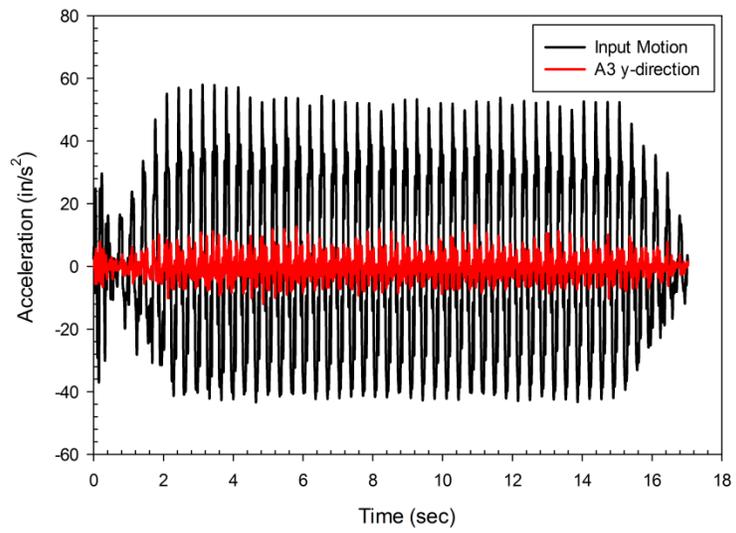
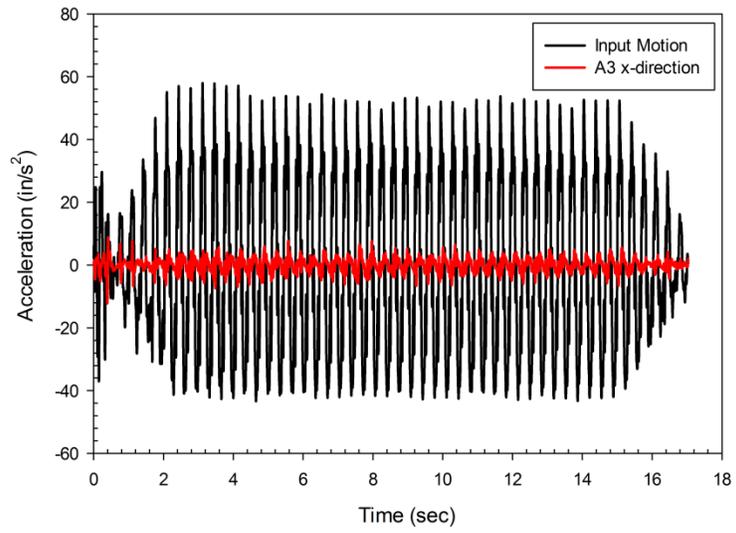


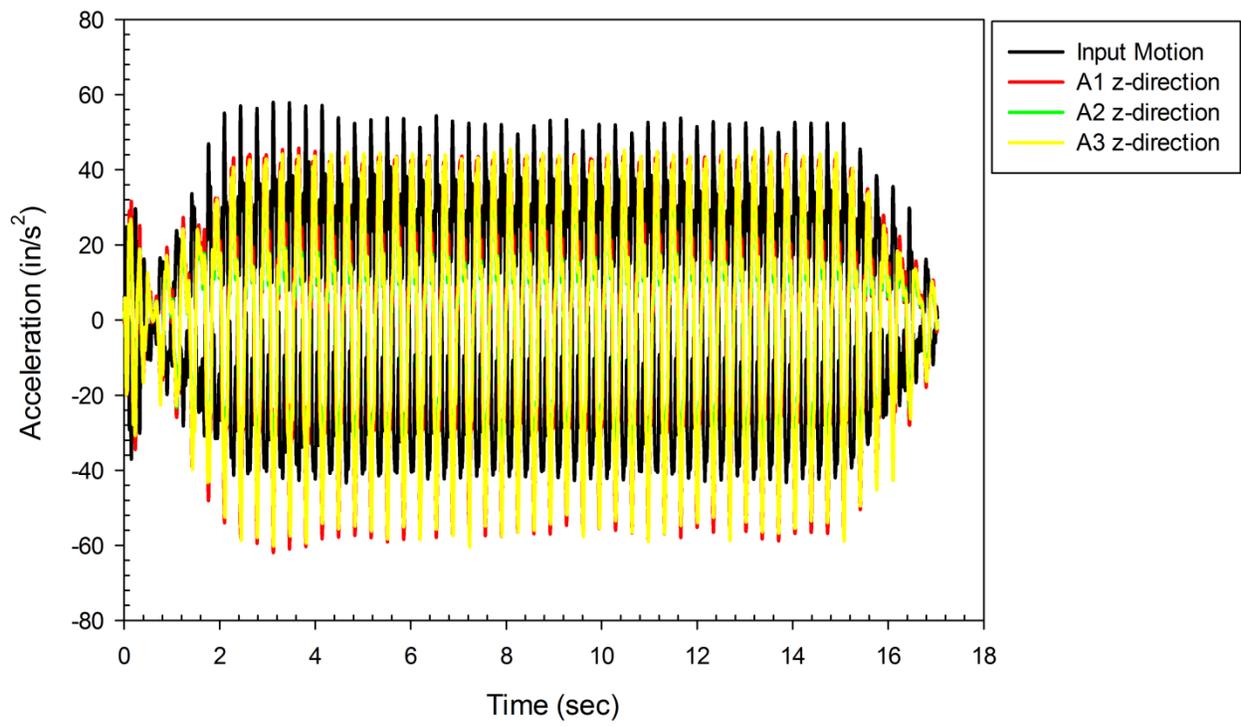
Project:	Cell Crete (Cellular Concrete)	Test Date:	9/2/16
Location:	----	Test No.:	3
Model Size:	4 ft by 6 ft	Vertical Stress:	102.5 psf
Model Height:	4 ft	Geogrid Depth:	2 ft
Motion Type:	Sinusoidal	Characteristics:	0.1g 3Hz







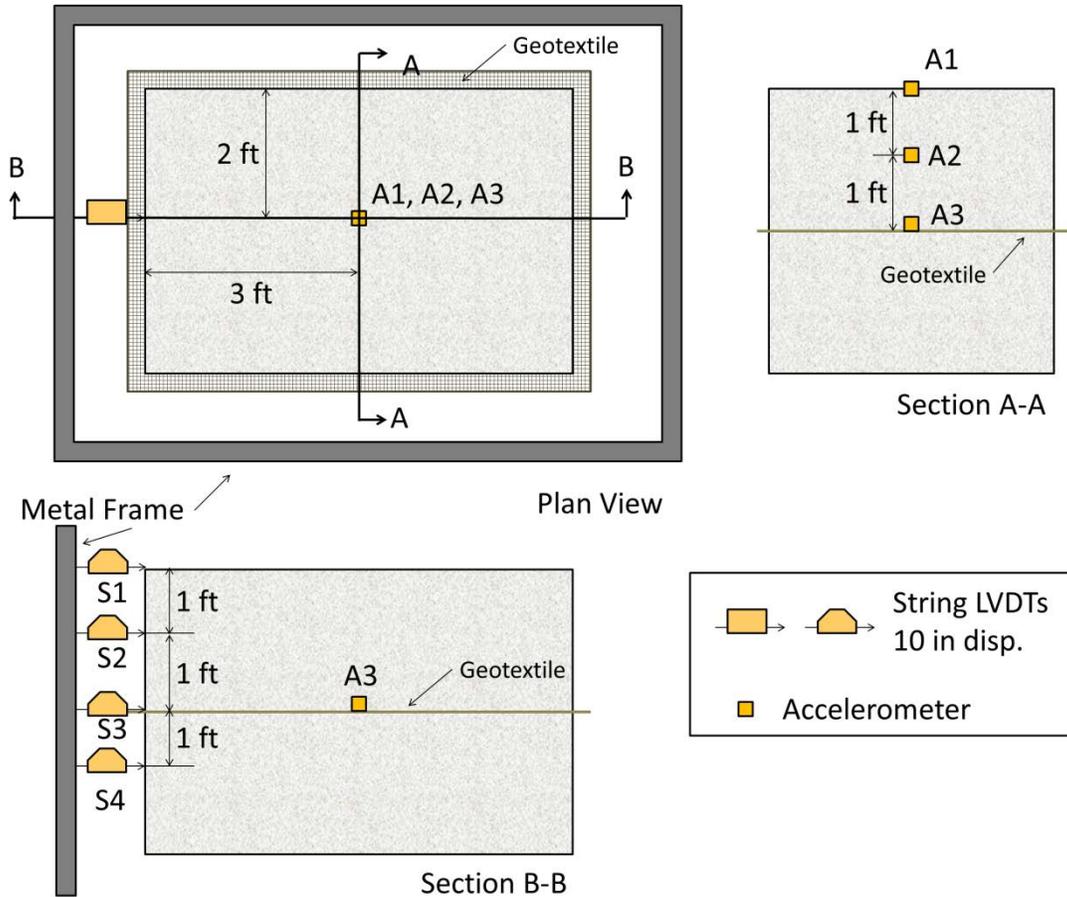


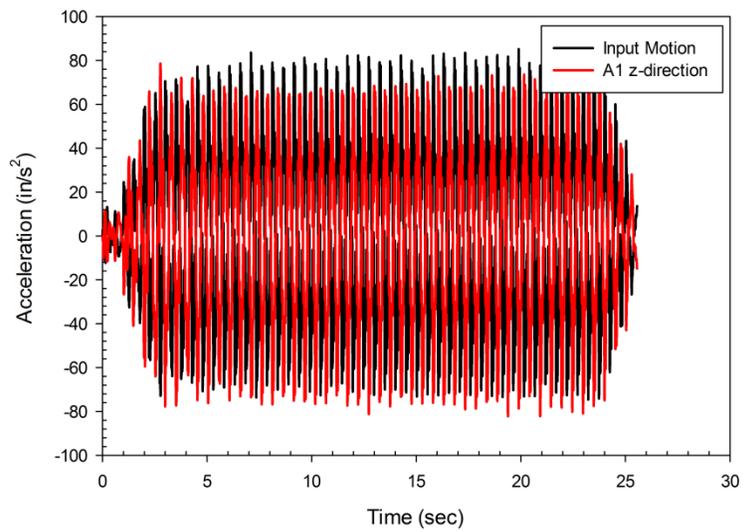
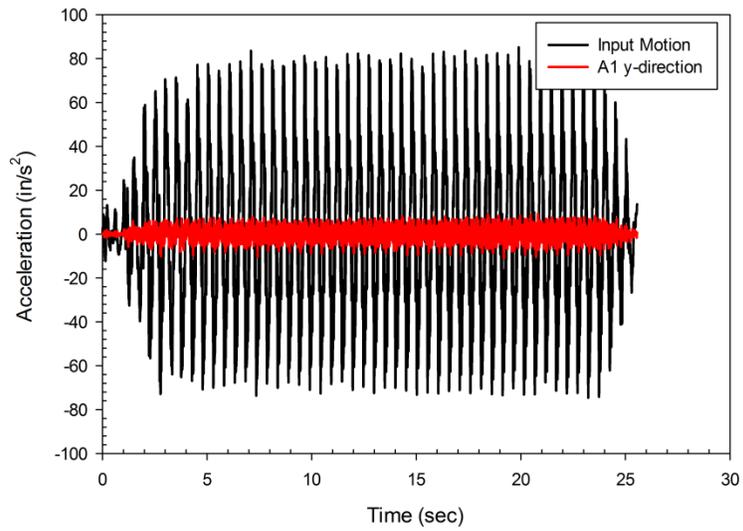
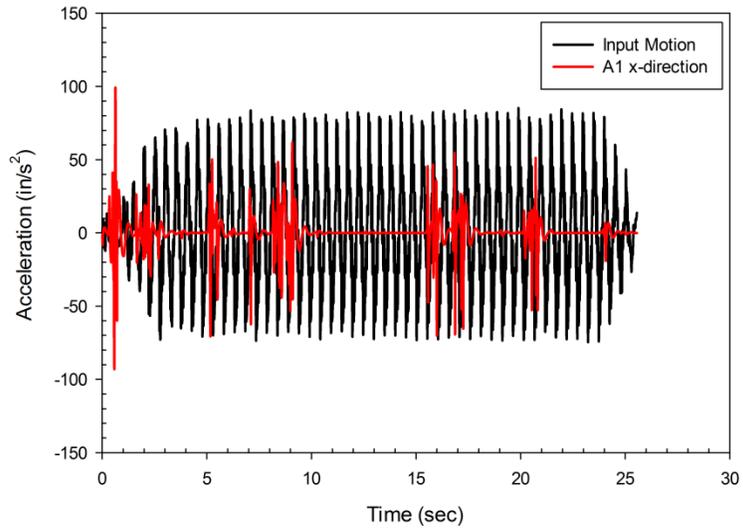


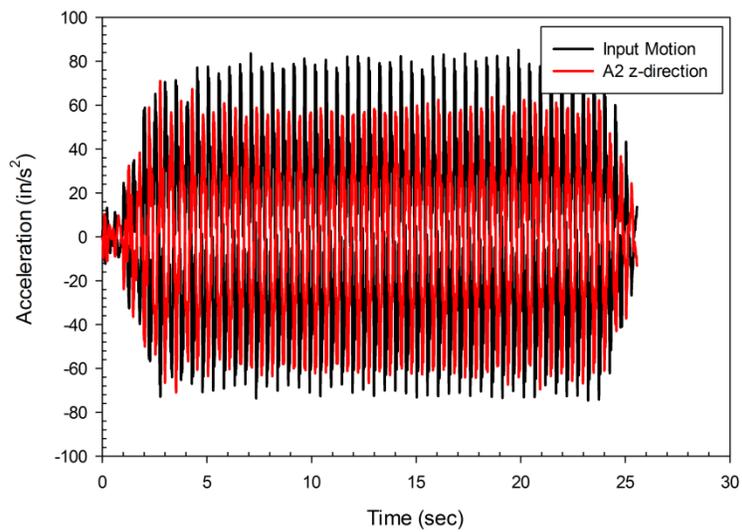
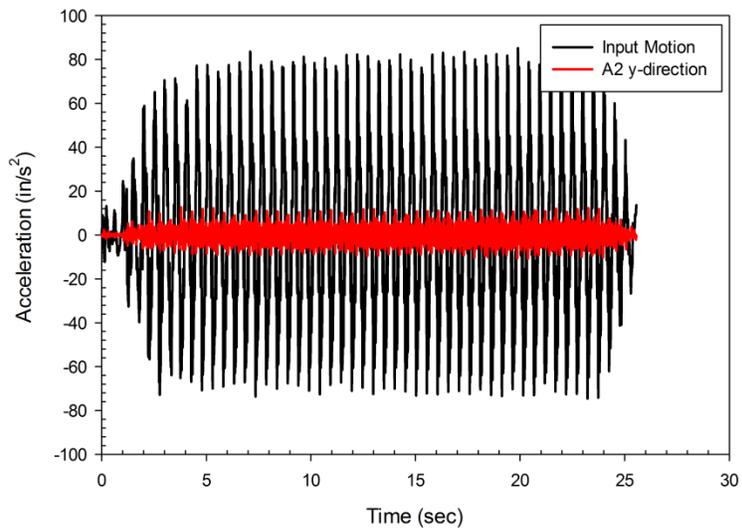
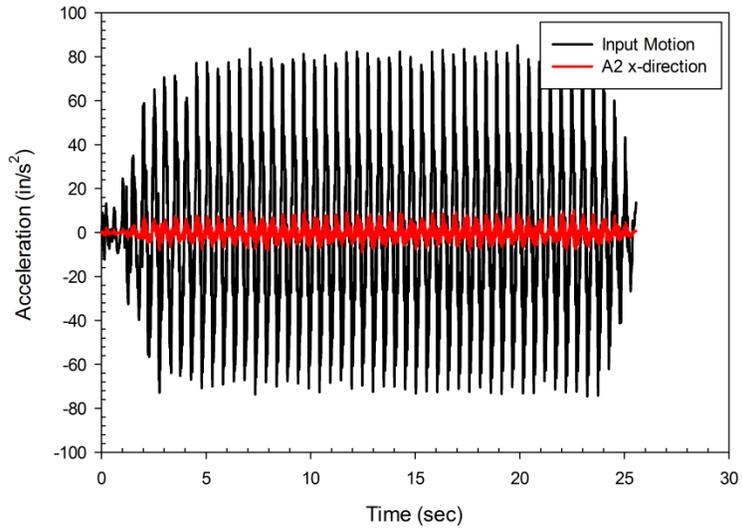
# Shake Table Test

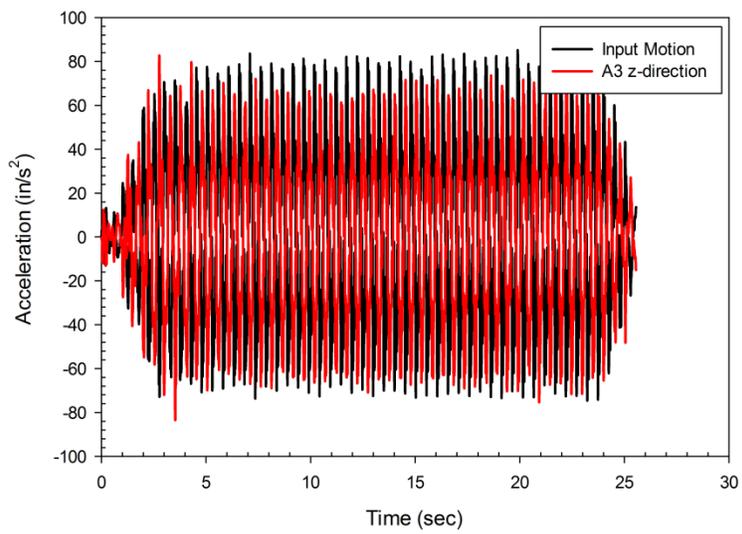
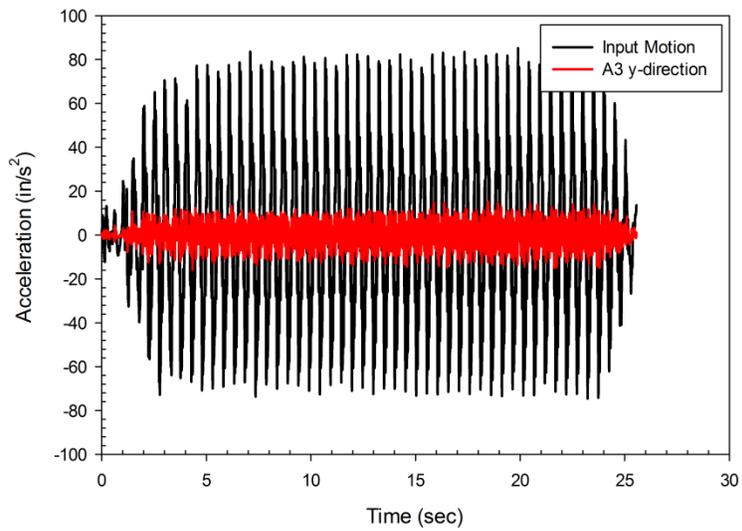
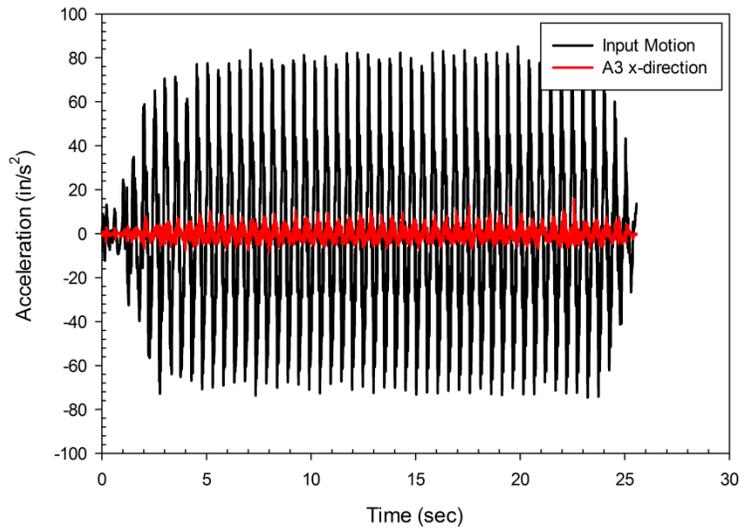


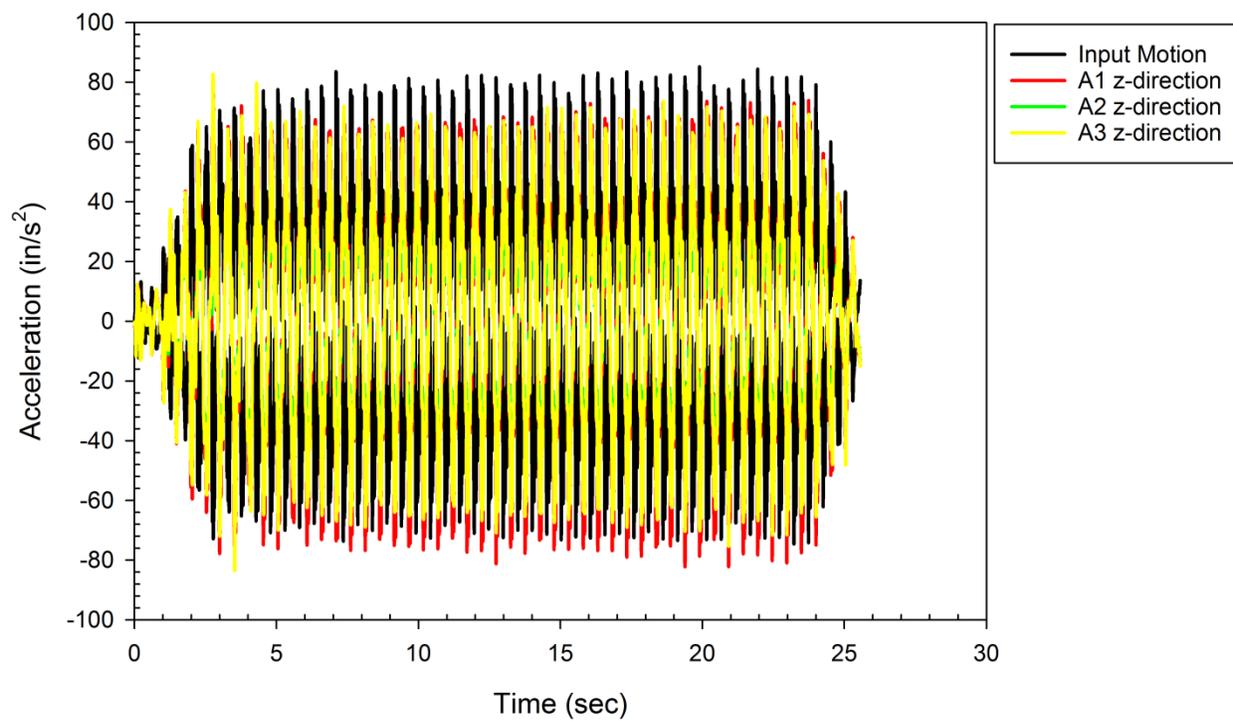
Project:	Cell Crete (Cellular Concrete)	Test Date:	9/2/16
Location:	----	Test No.:	3
Model Size:	4 ft by 6 ft	Vertical Stress:	102.5 psf
Model Height:	4 ft	Geogrid Depth:	2 ft
Motion Type:	Sinusoidal	Characteristics:	0.2g 2Hz







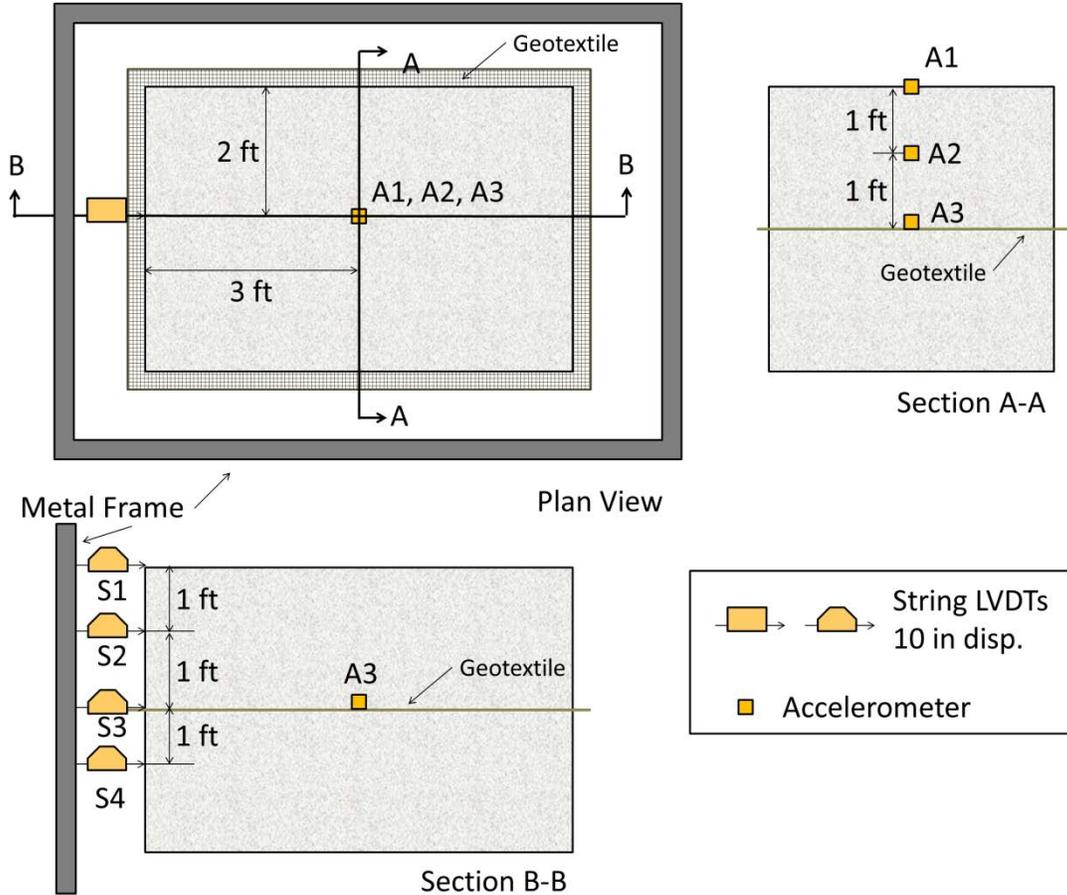


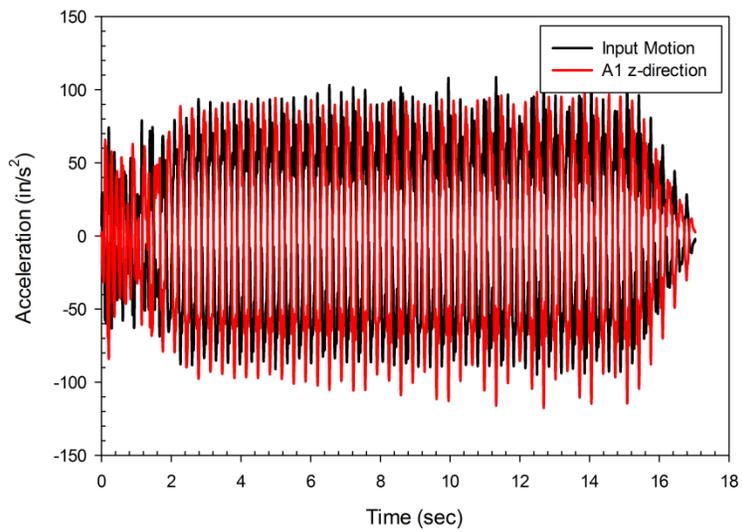
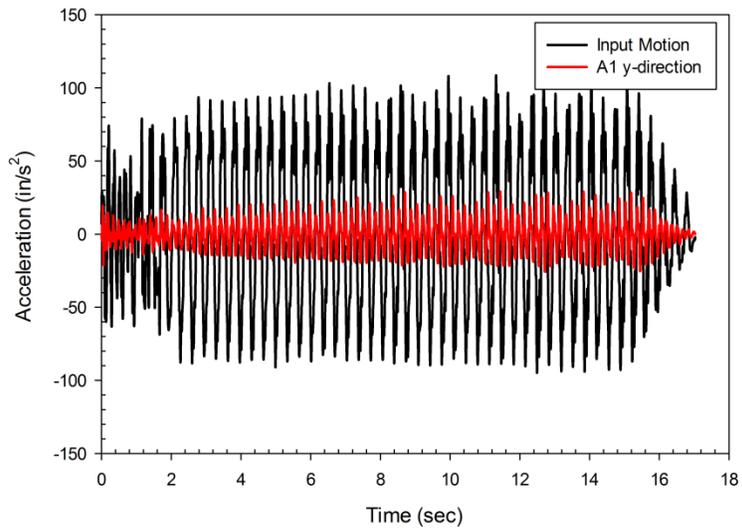
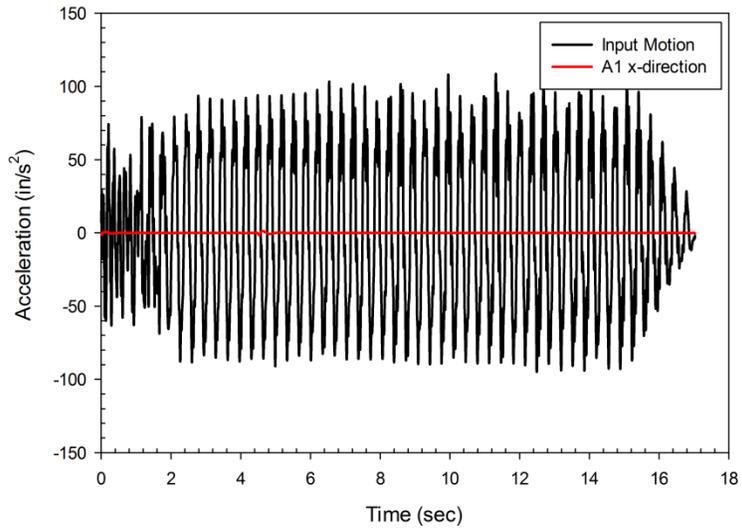


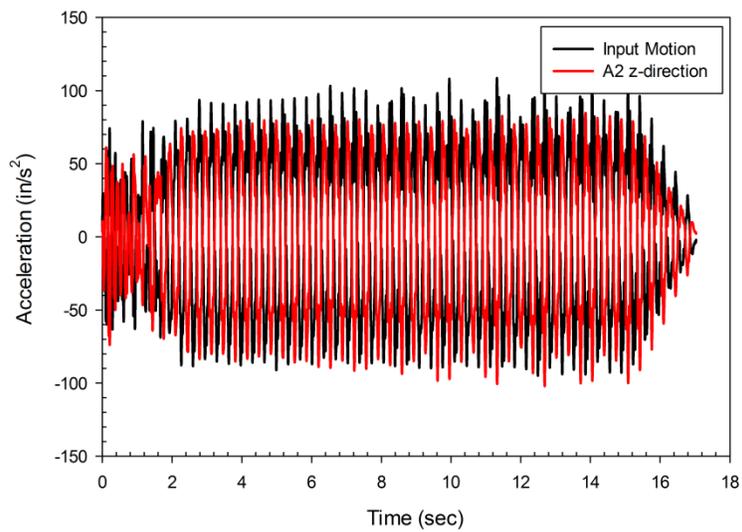
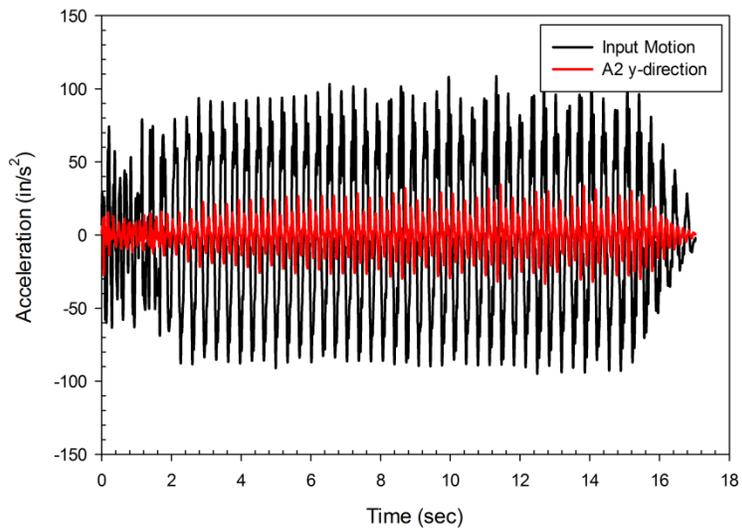
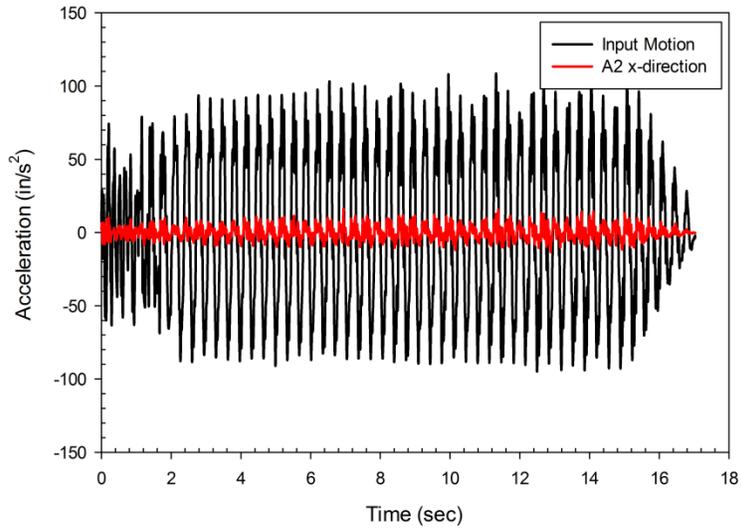
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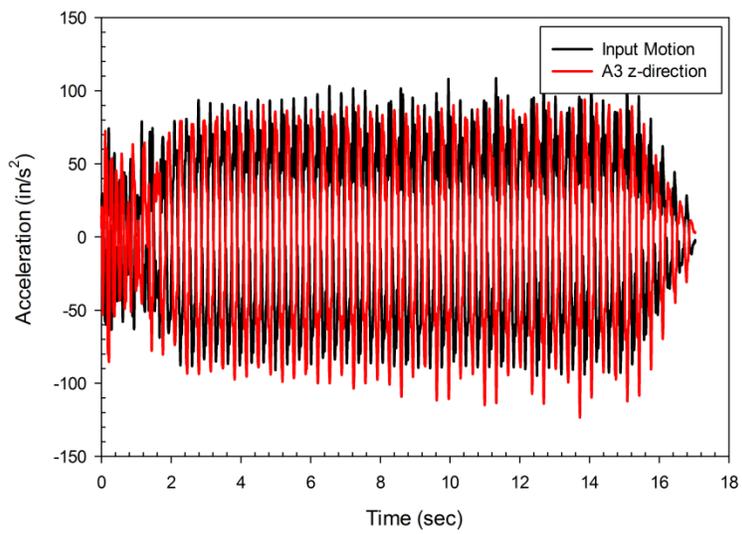
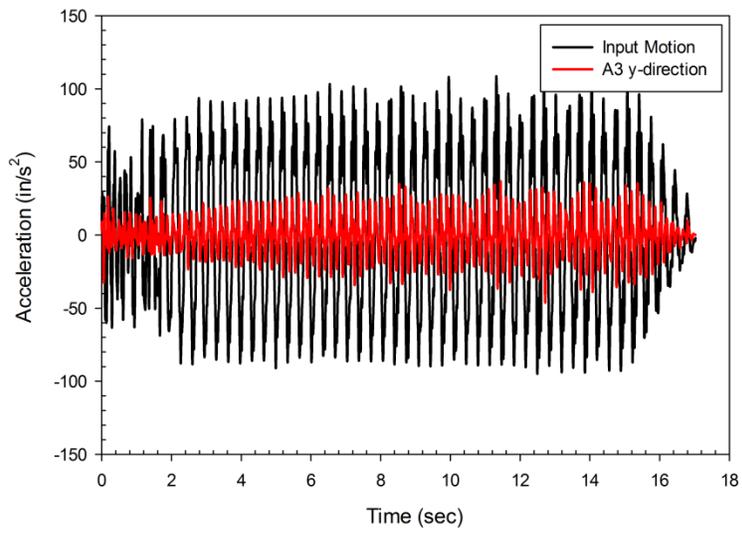
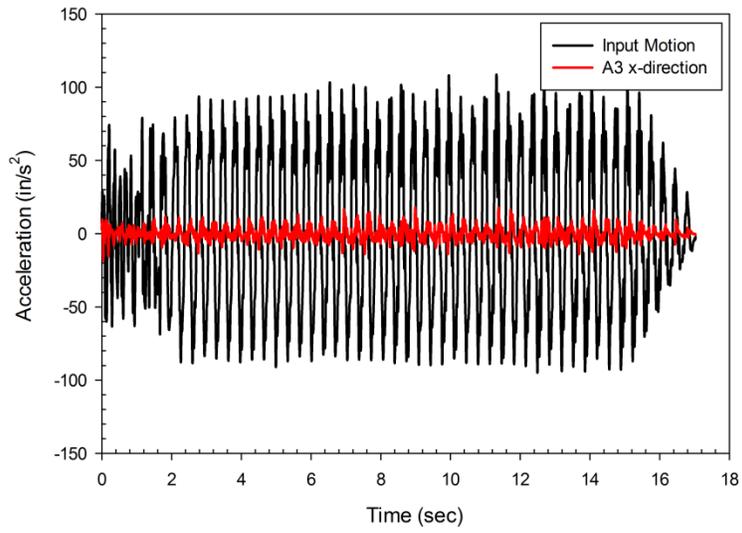


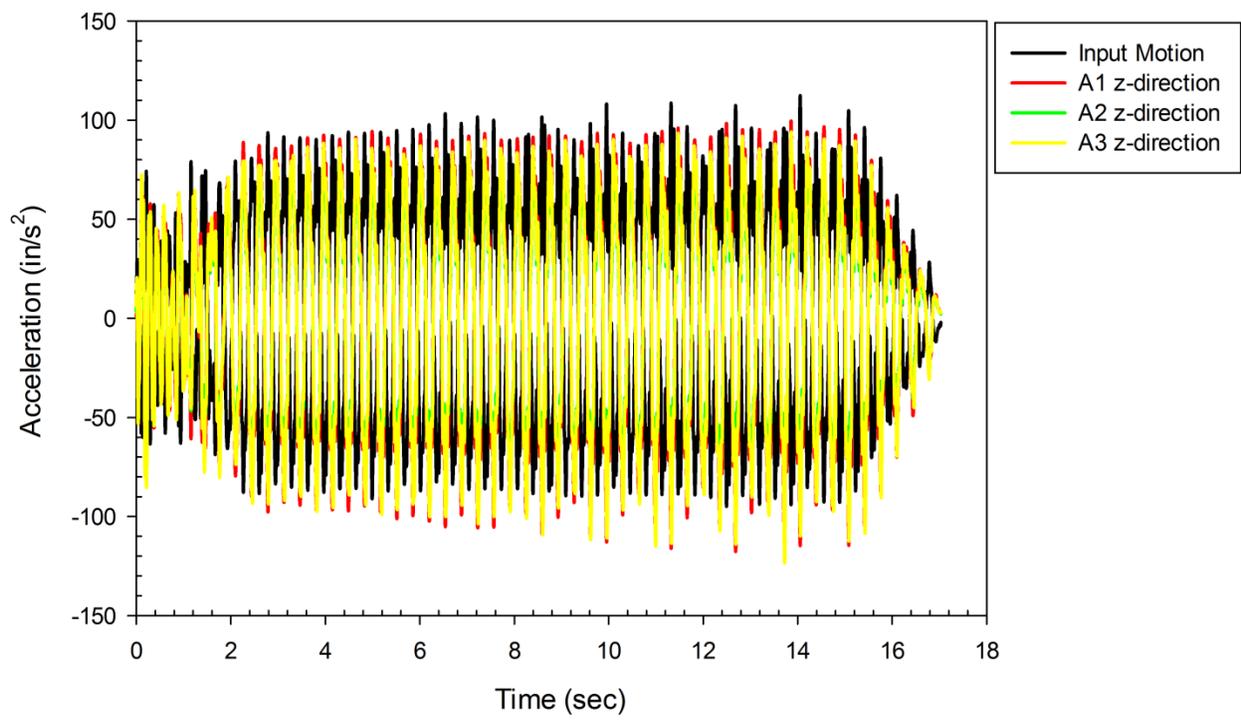
Project:	Cell Crete (Cellular Concrete)	Test Date:	9/2/16
Location:	----	Test No.:	3
Model Size:	4 ft by 6 ft	Vertical Stress:	102.5 psf
Model Height:	4 ft	Geogrid Depth:	2 ft
Motion Type:	Sinusoidal	Characteristics:	0.2g 3Hz







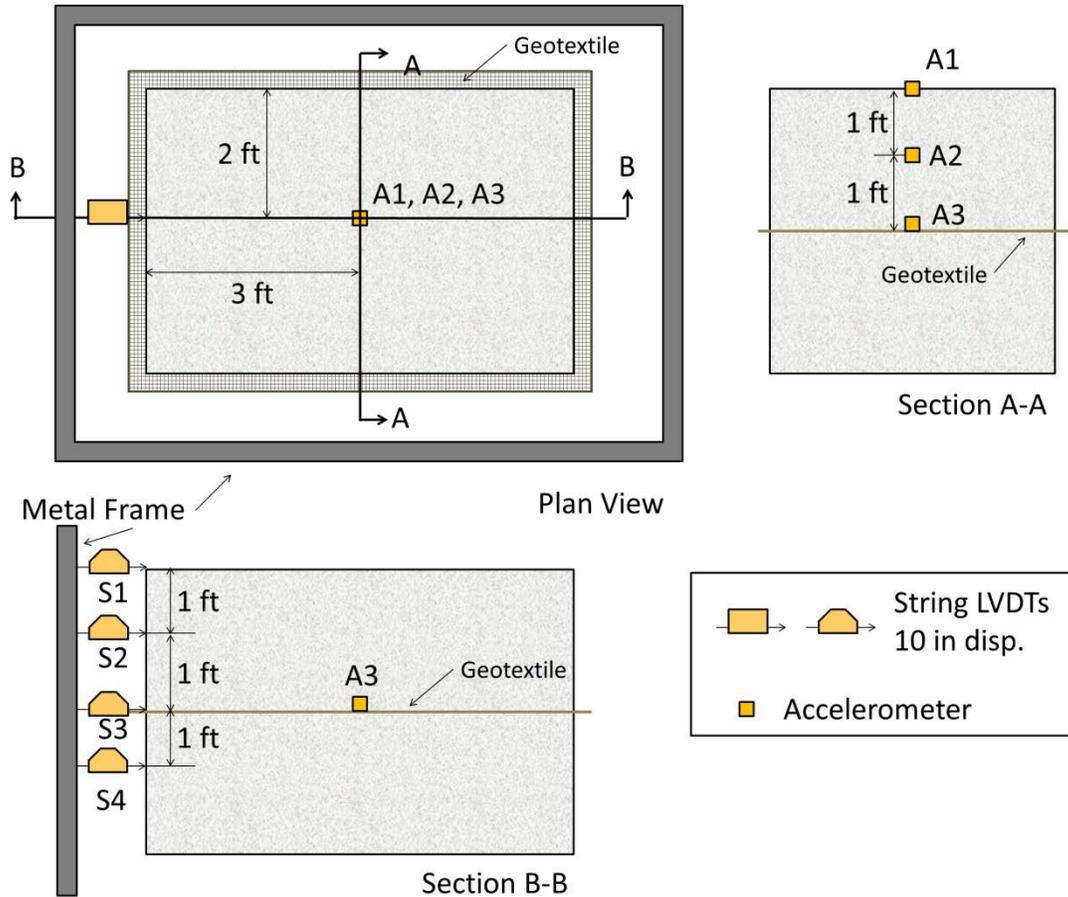


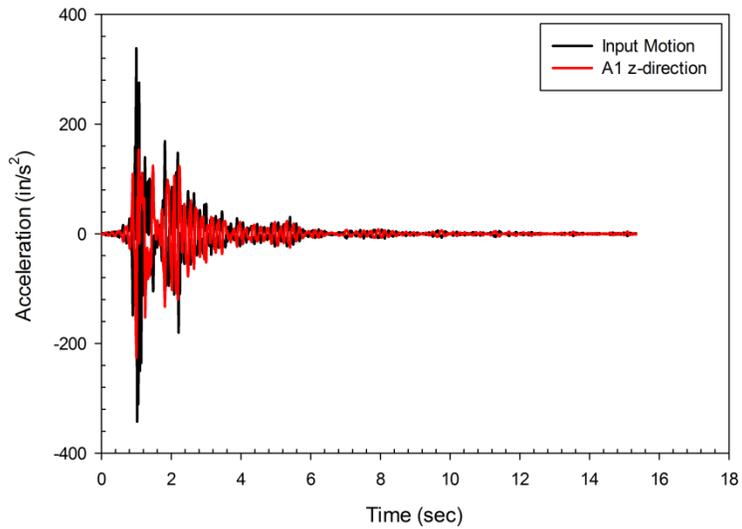
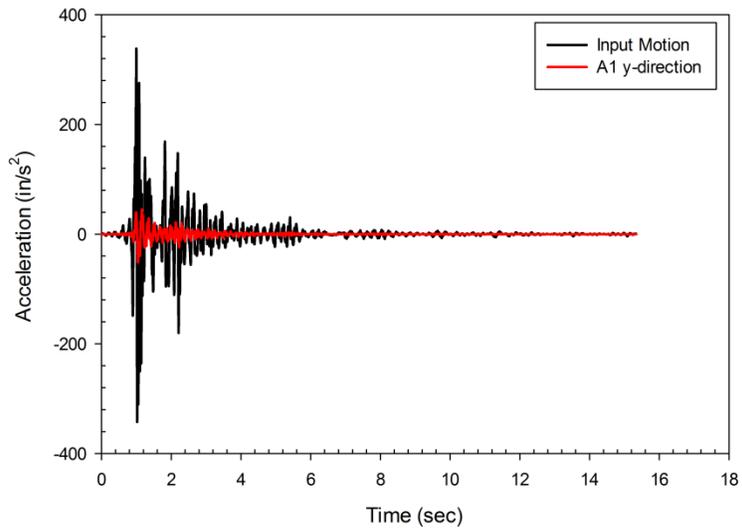
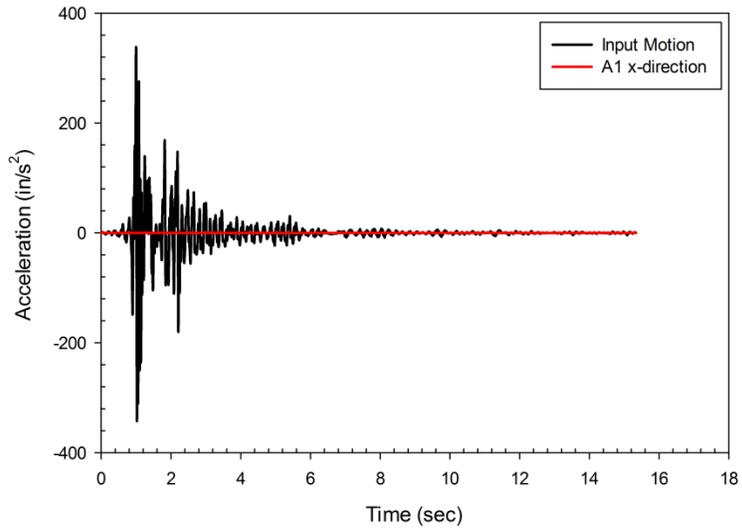


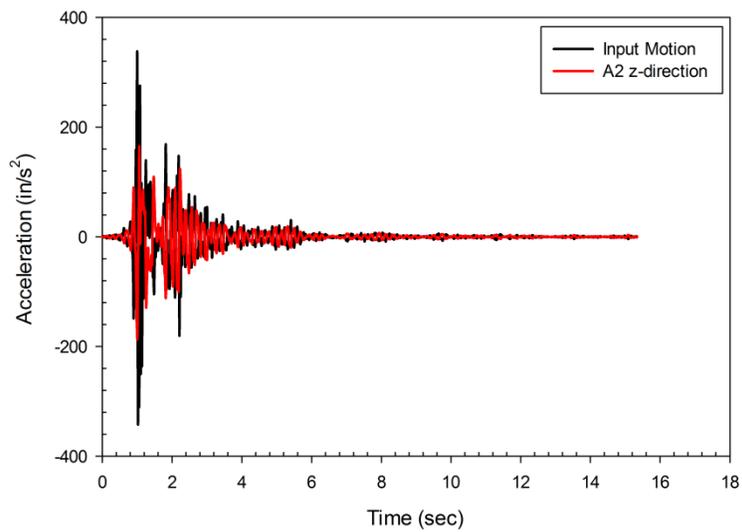
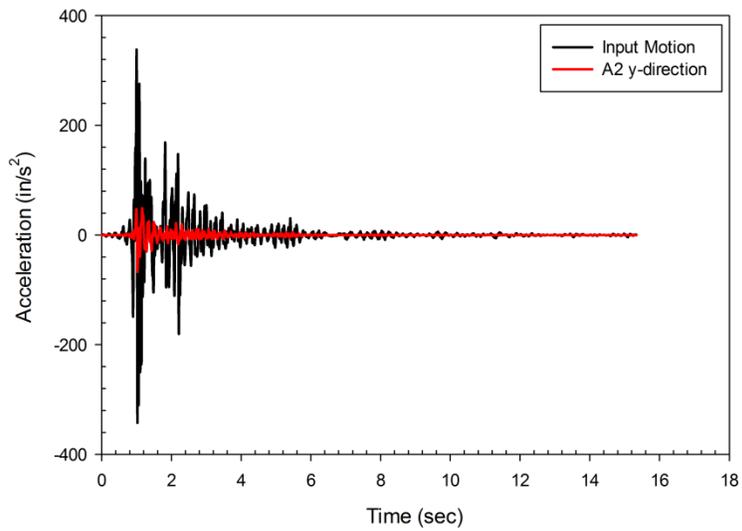
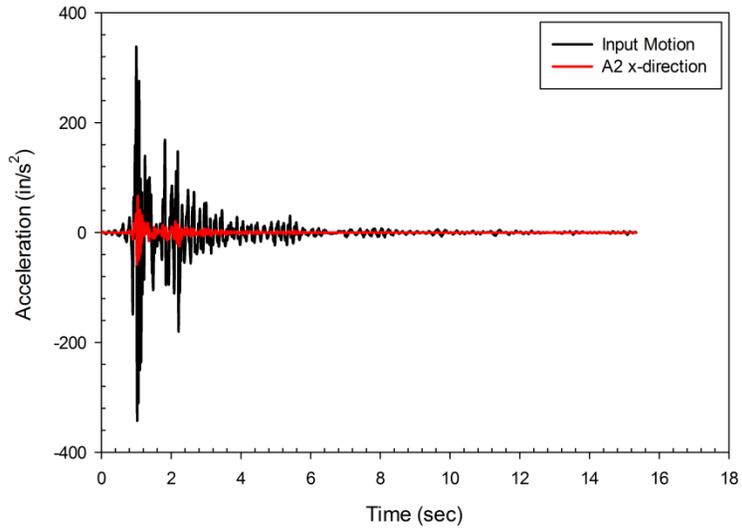
# Shake Table Test

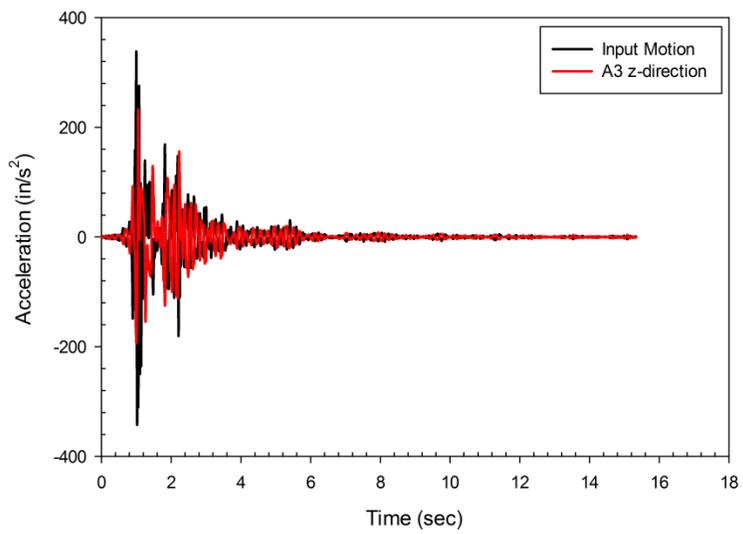
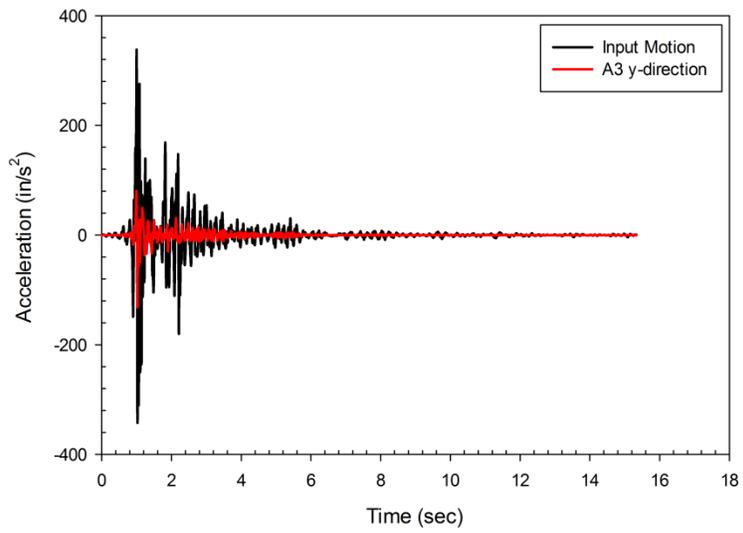
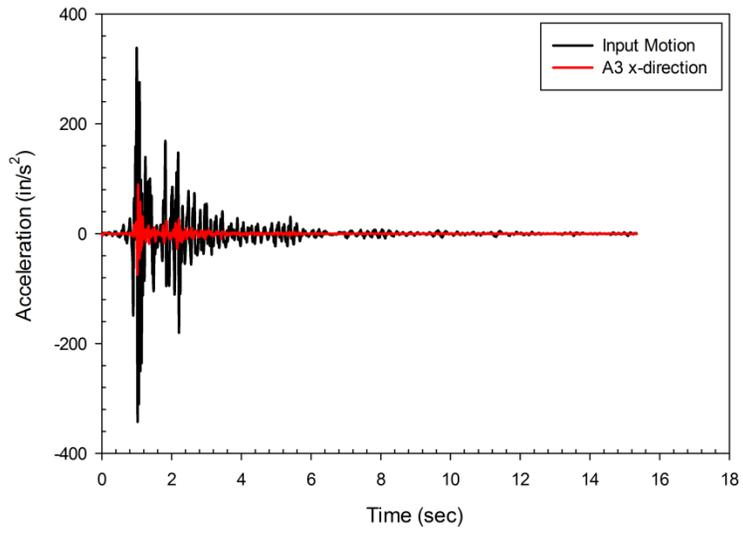


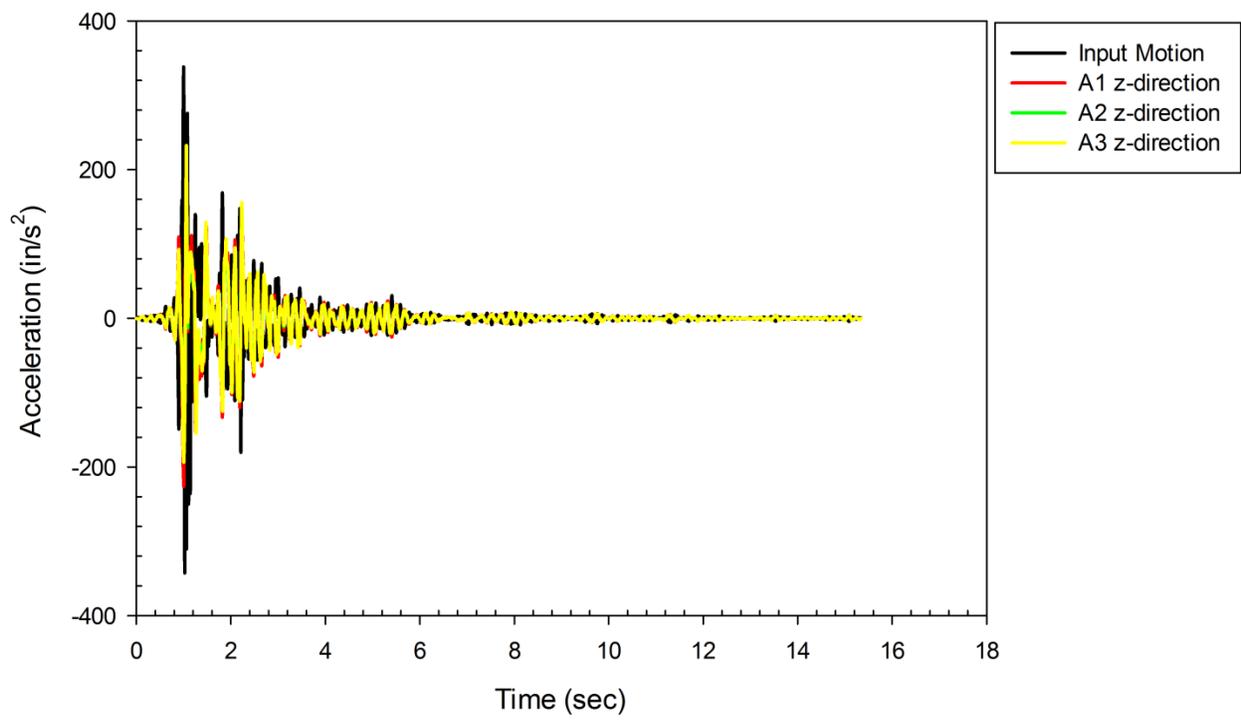
Project:	Cell Crete (Cellular Concrete)	Test Date:	9/2/16
Location:	----	Test No.:	3
Model Size:	4 ft by 6 ft	Vertical Stress:	102.5 psf
Model Height:	4 ft	Geogrid Depth:	2 ft
Motion Type:	1994 Northridge Earthquake	Characteristics:	N/A







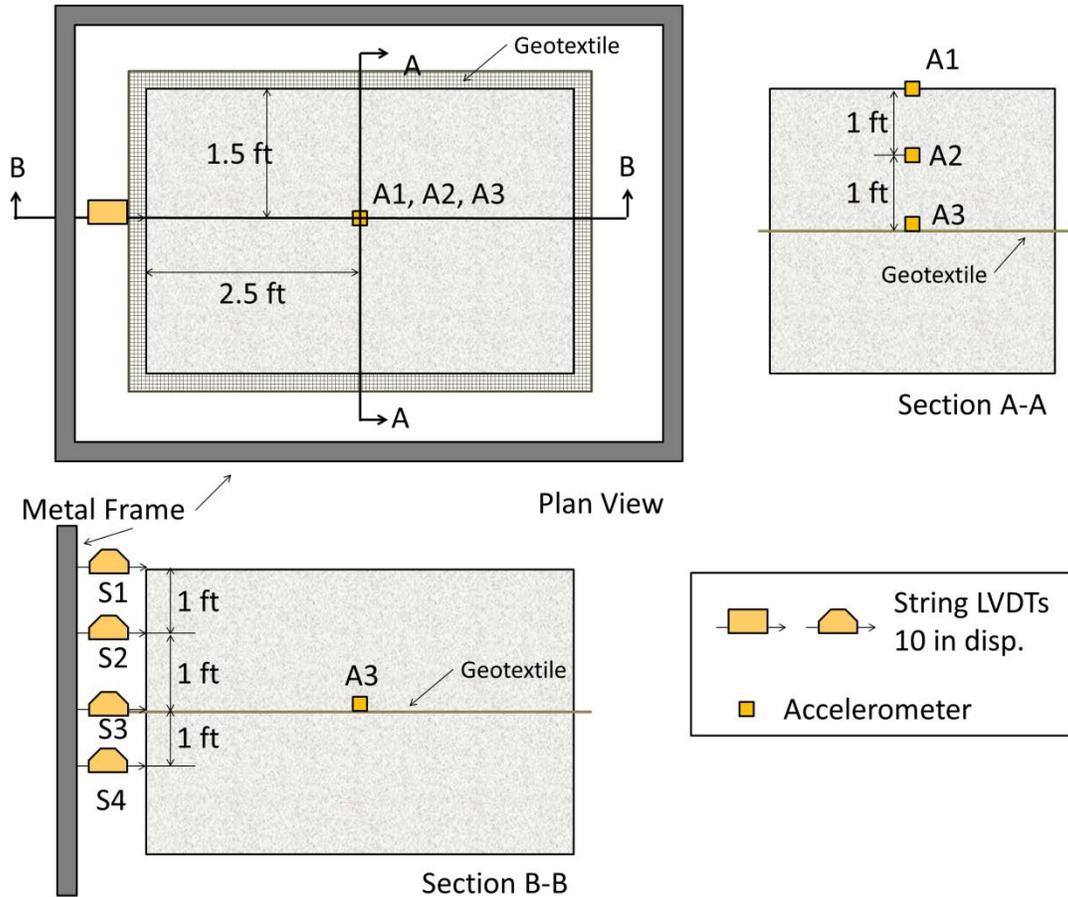


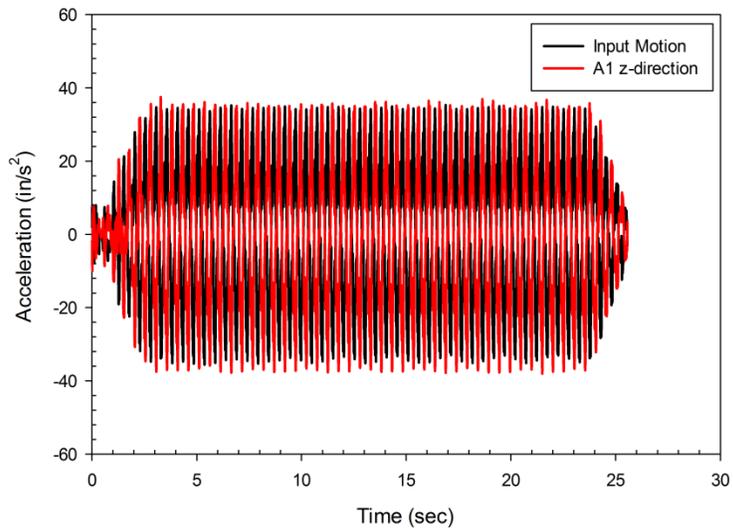
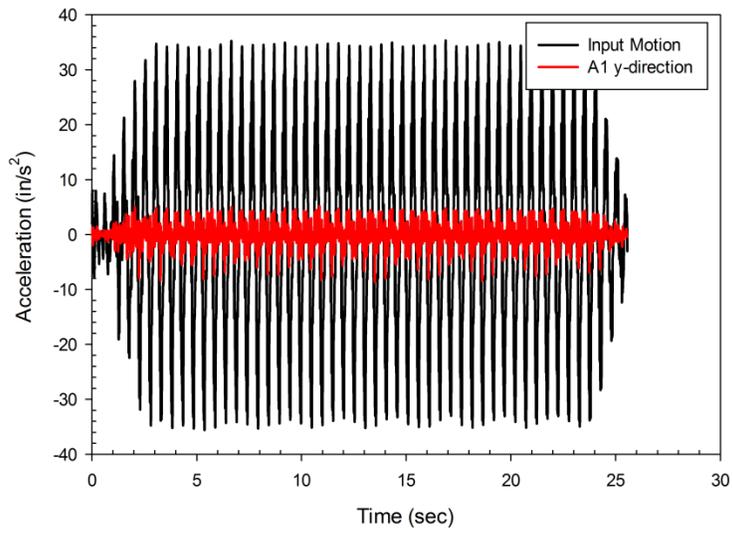
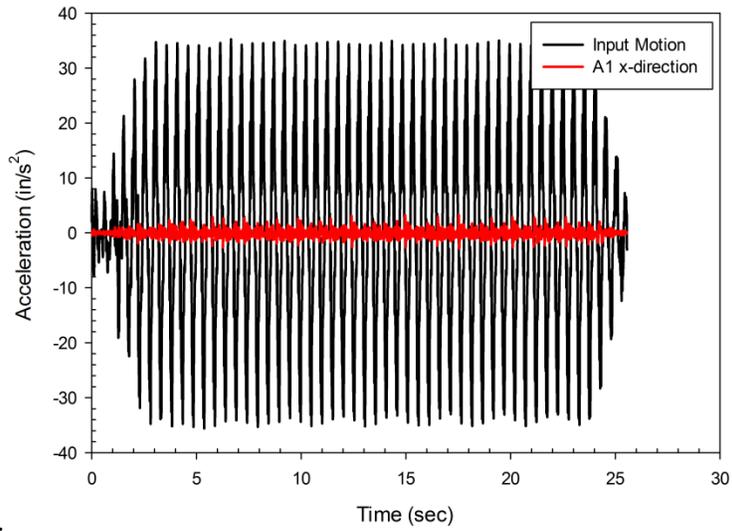


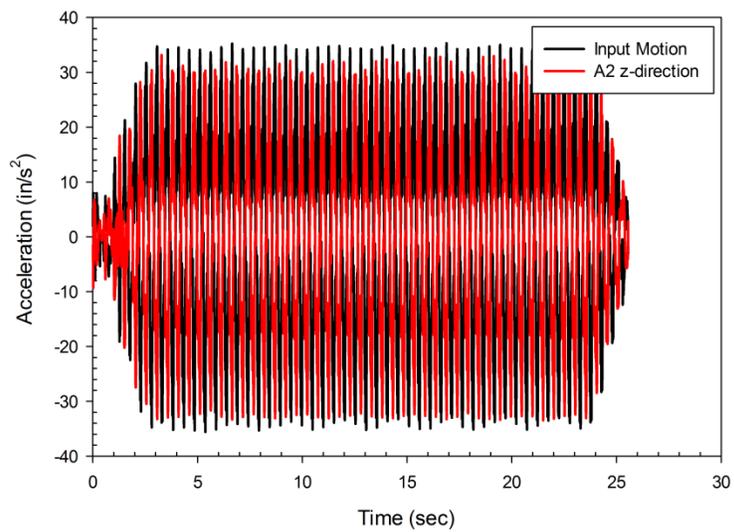
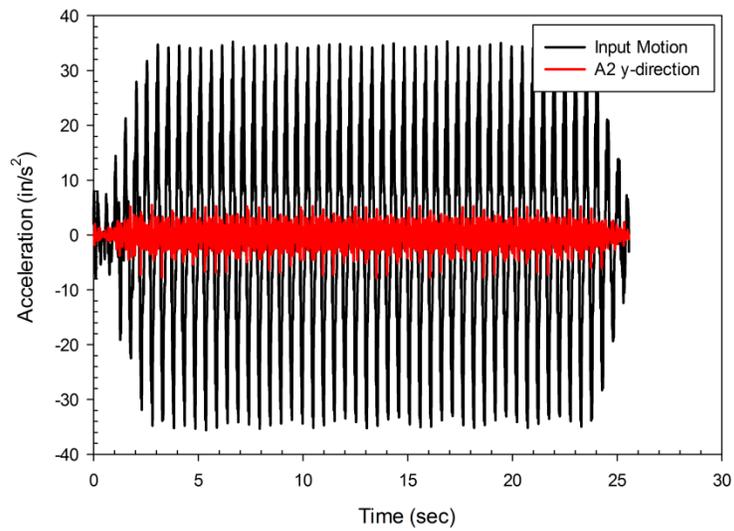
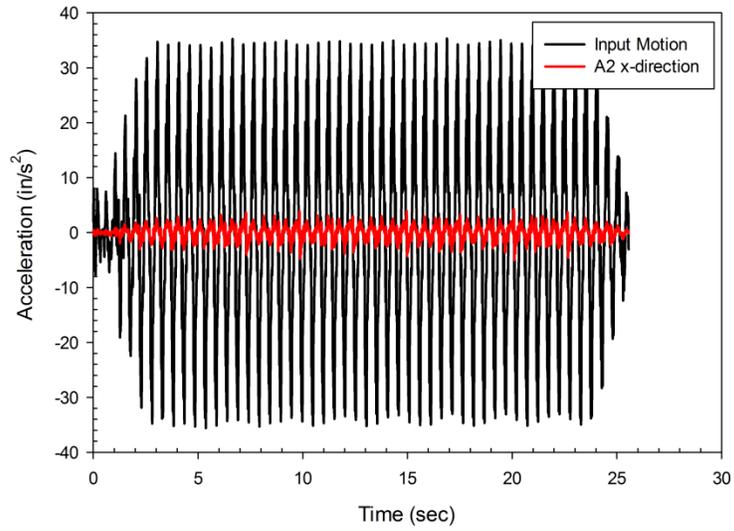
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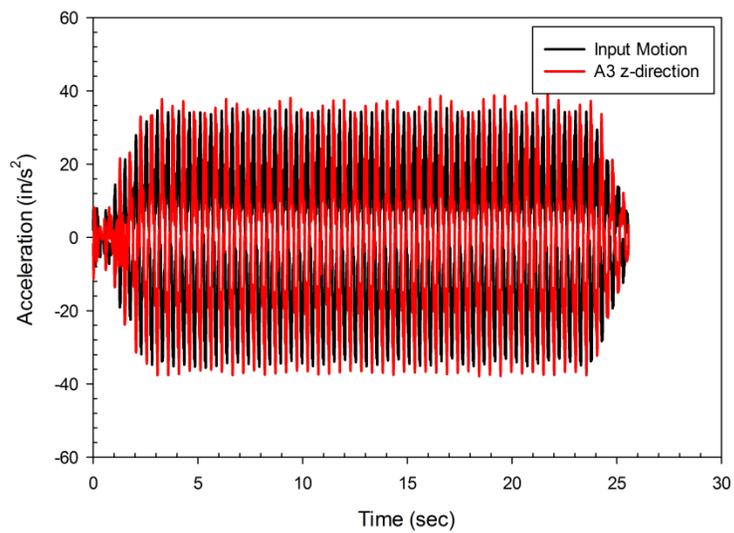
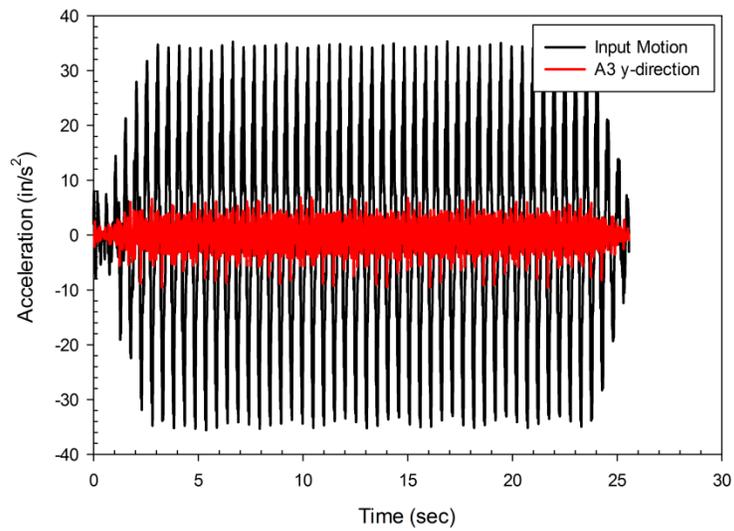
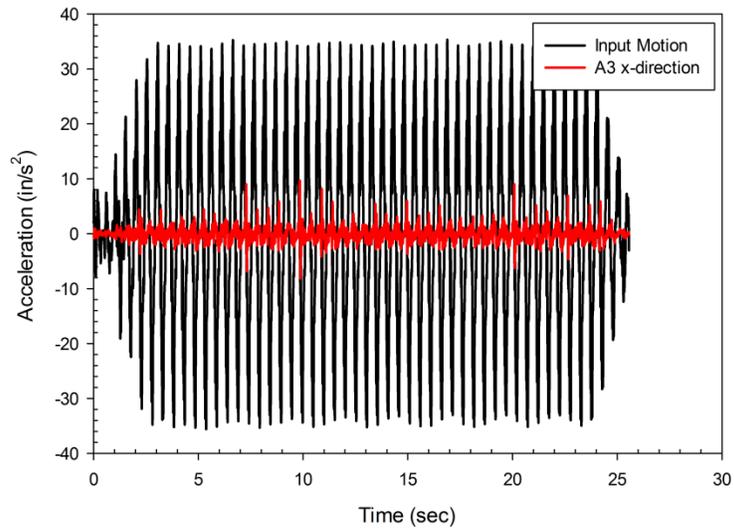


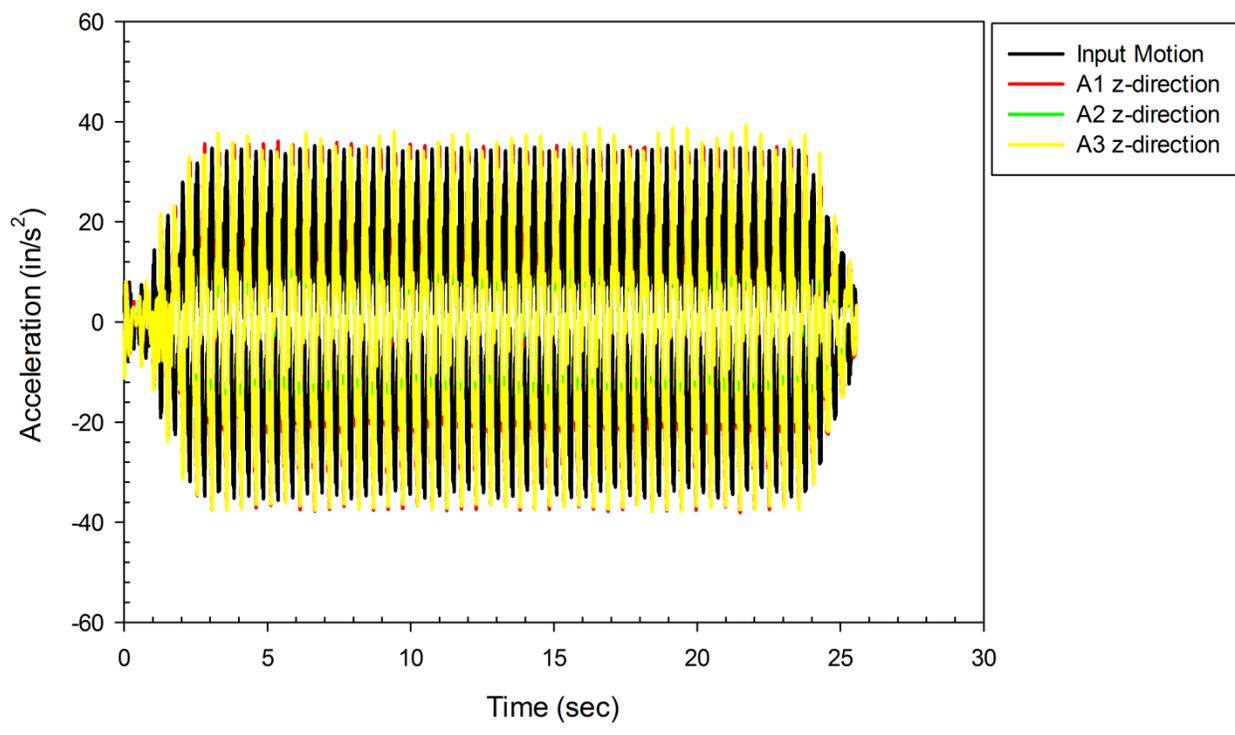
Project:	Cell Crete (Cellular Concrete)	Test Date:	9/14/16
Location:	----	Test No.:	1
Model Size:	3 ft by 5 ft	Vertical Stress:	164.0 psf
Model Height:	4 ft	Geogrid Depth:	2 ft
Motion Type:	Sinusoidal	Characteristics:	0.1g 2Hz







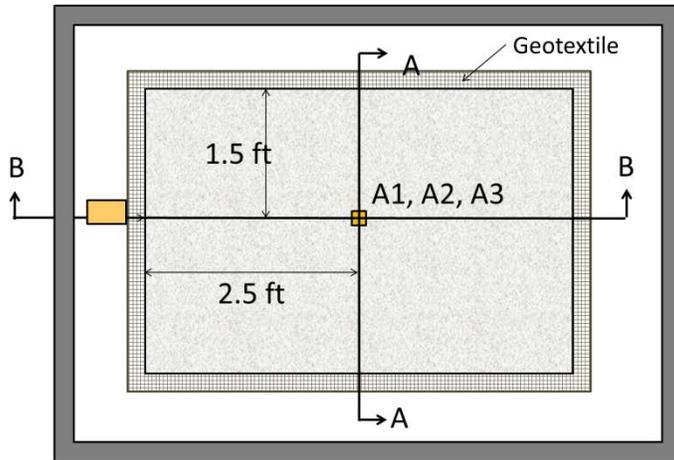




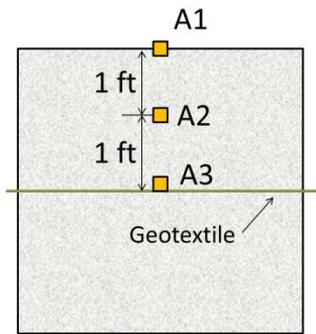
# Shake Table Test



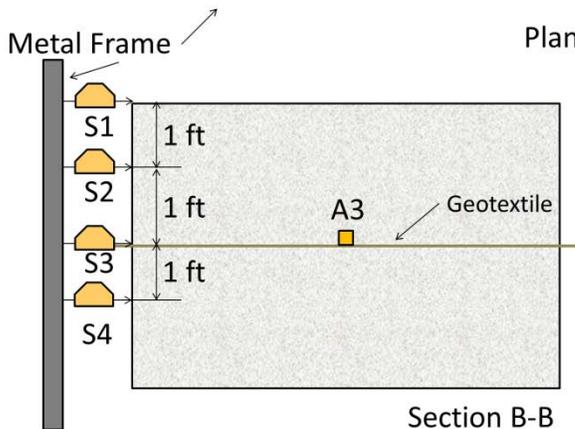
Project:	Cell Crete (Cellular Concrete)	Test Date:	9/14/16
Location:	----	Test No.:	1
Model Size:	3 ft by 5 ft	Vertical Stress:	164.0 psf
Model Height:	4 ft	Geogrid Depth:	2 ft
Motion Type:	Sinusoidal	Characteristics:	0.1g 3Hz



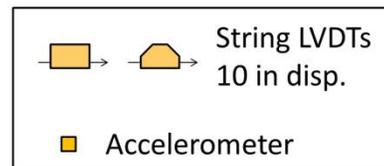
Plan View

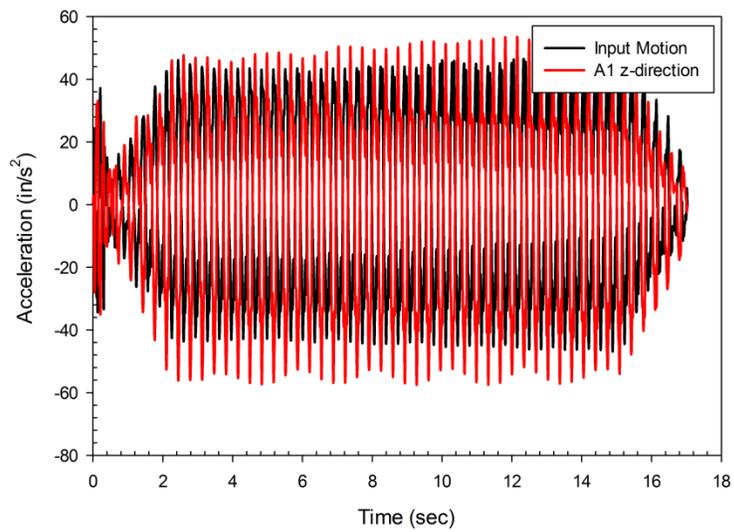
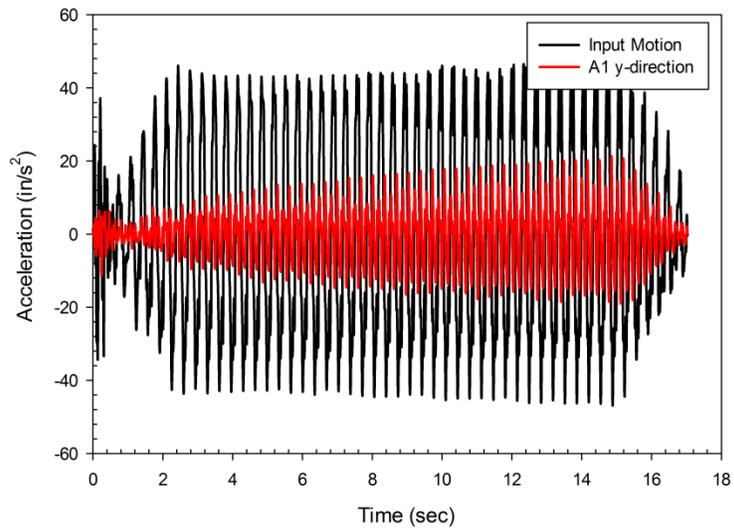
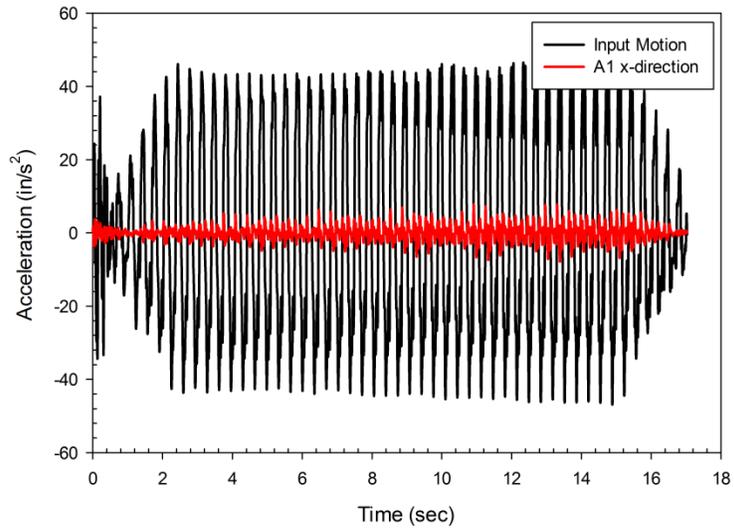


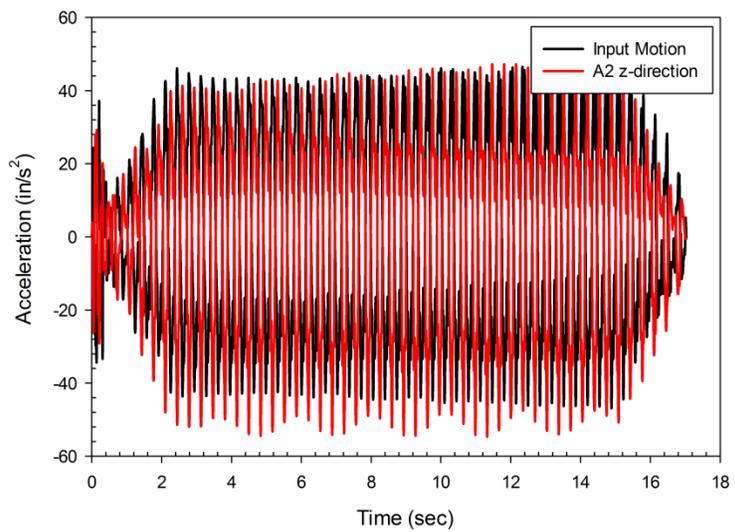
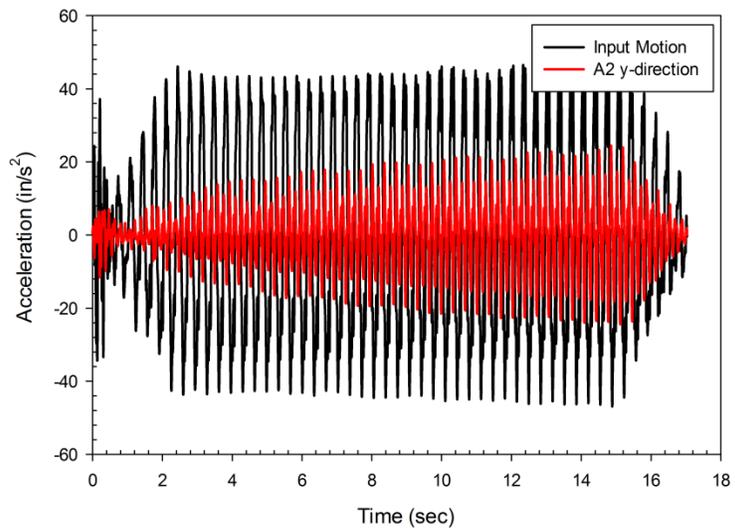
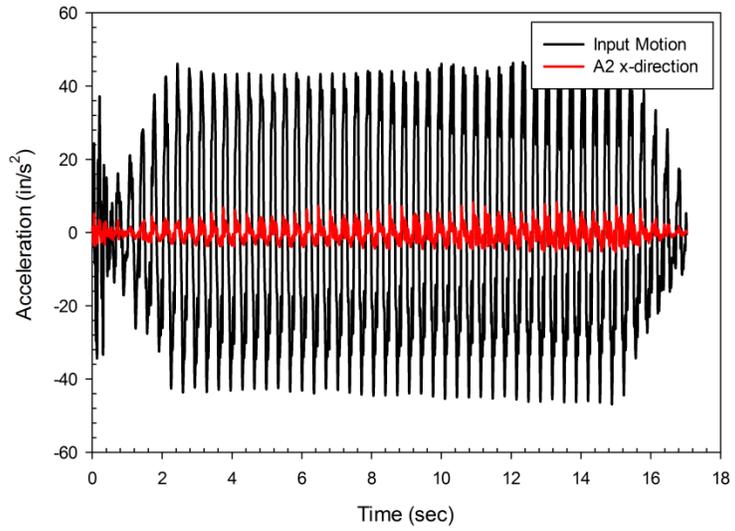
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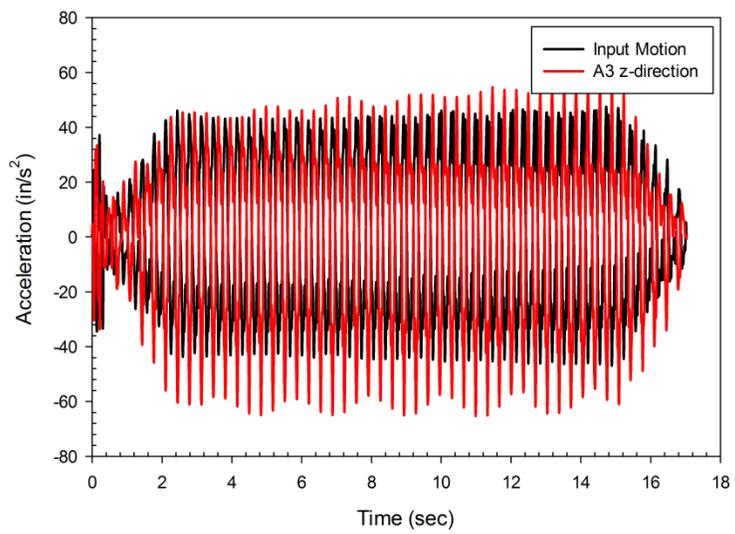
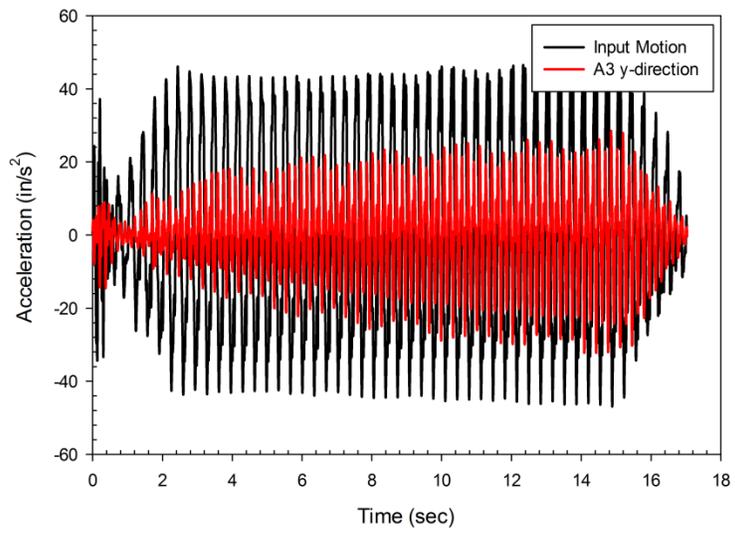
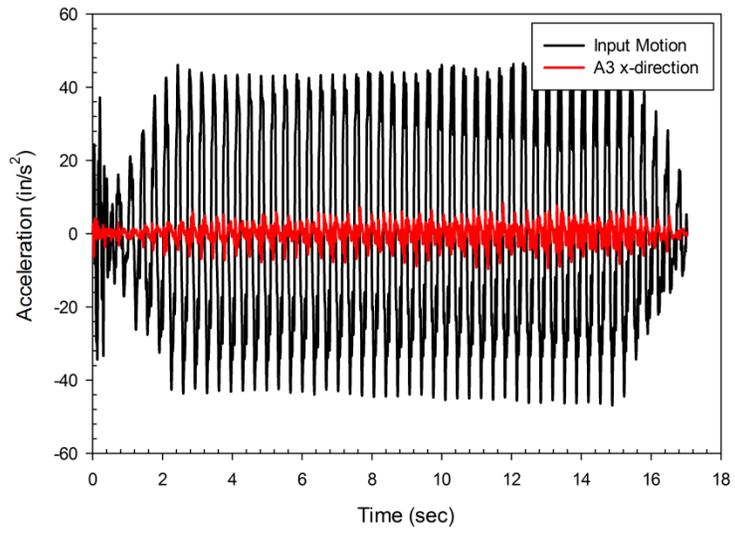


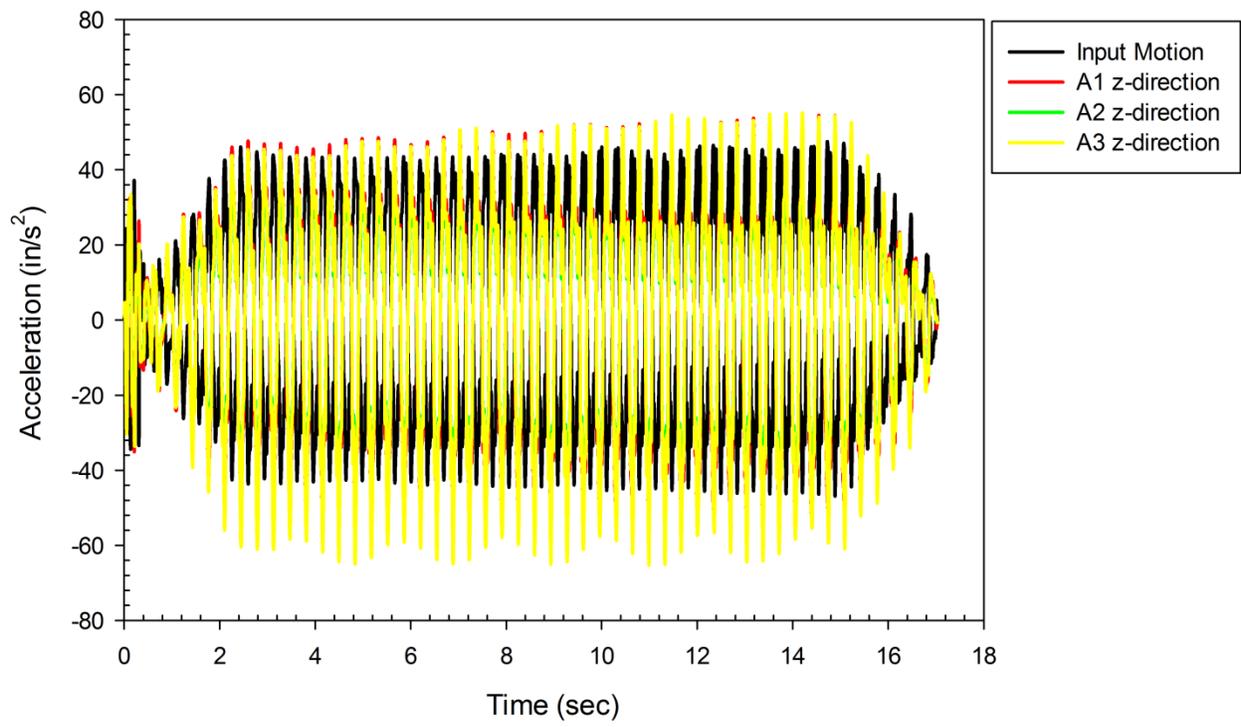
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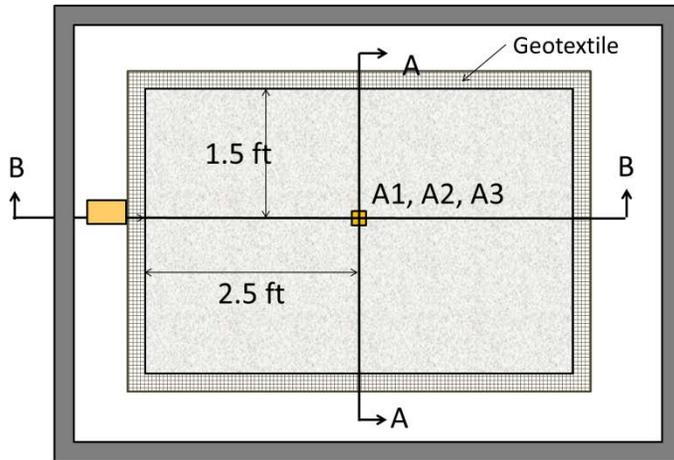




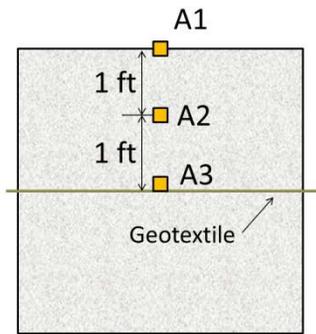
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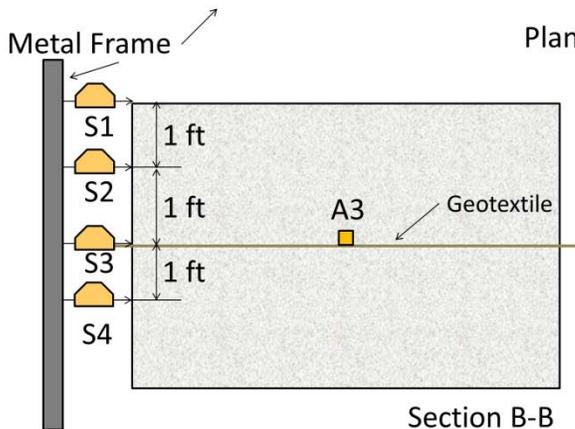
Project:	Cell Crete (Cellular Concrete)	Test Date:	9/14/16
Location:	----	Test No.:	1
Model Size:	3 ft by 5 ft	Vertical Stress:	164.0 psf
Model Height:	4 ft	Geogrid Depth:	2 ft
Motion Type:	Sinusoidal	Characteristics:	0.2g 2Hz



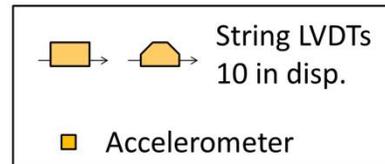
Plan View

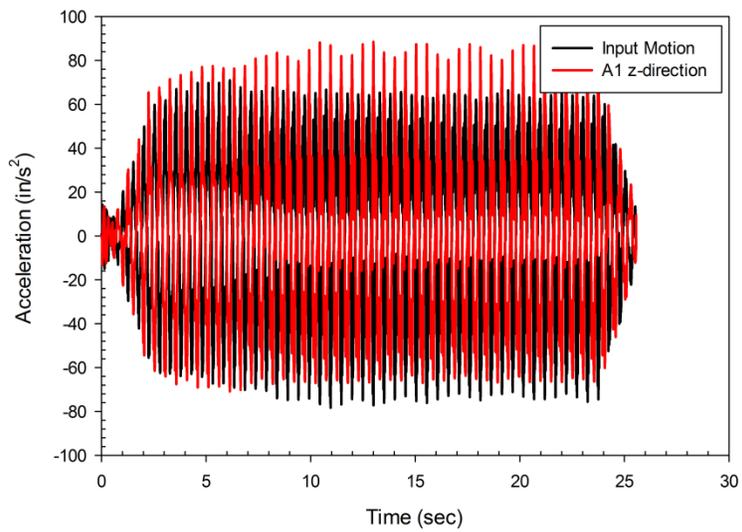
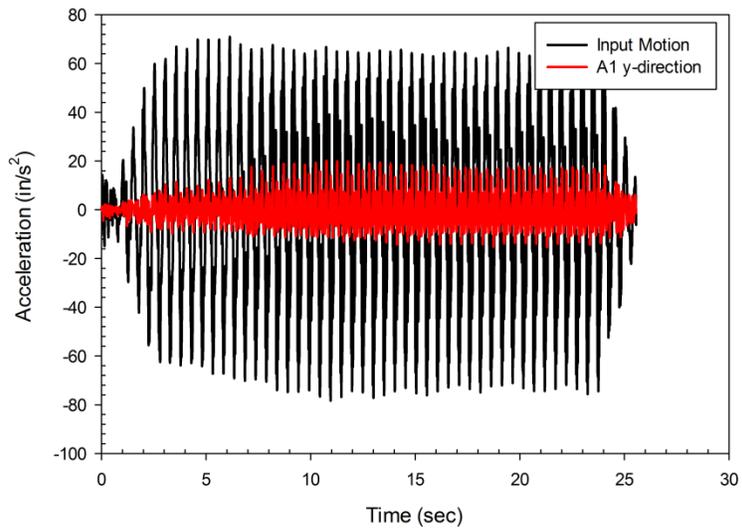
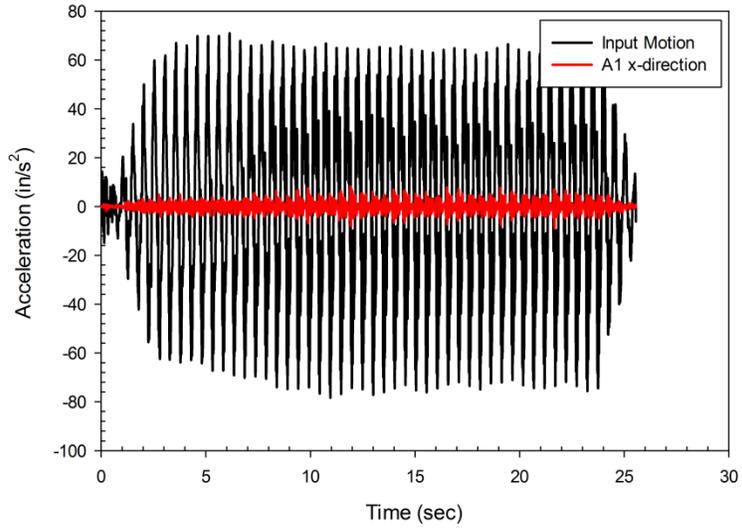


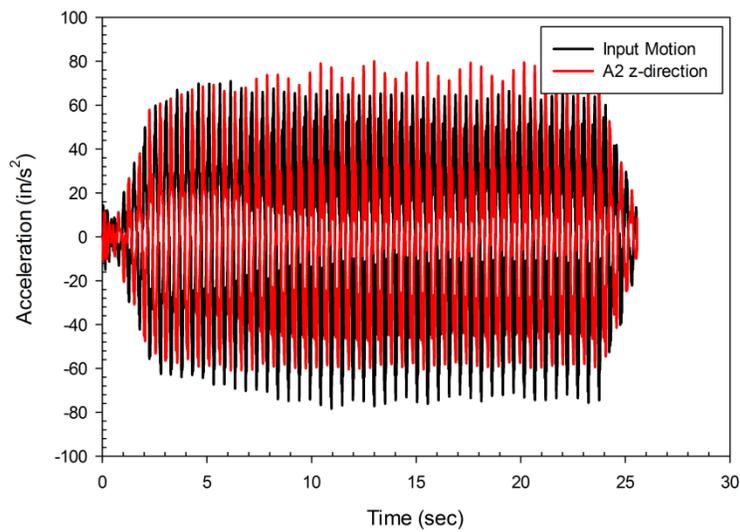
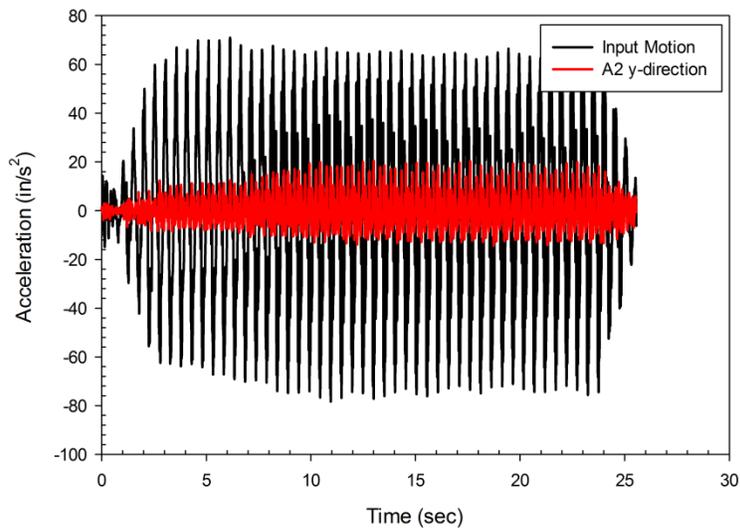
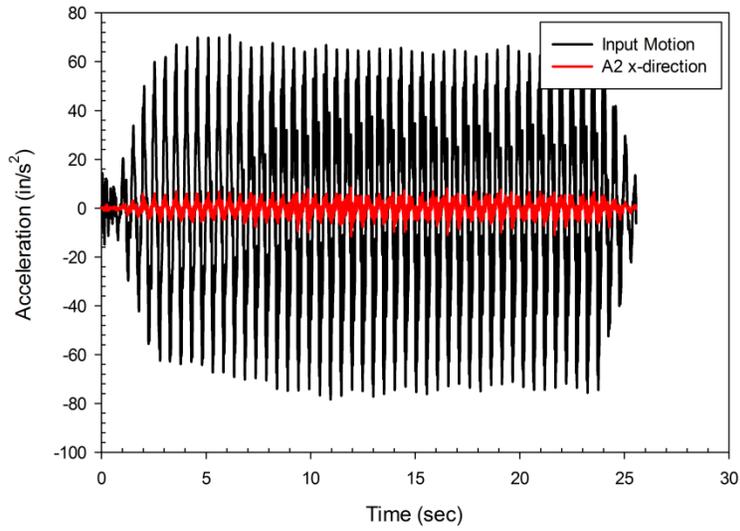
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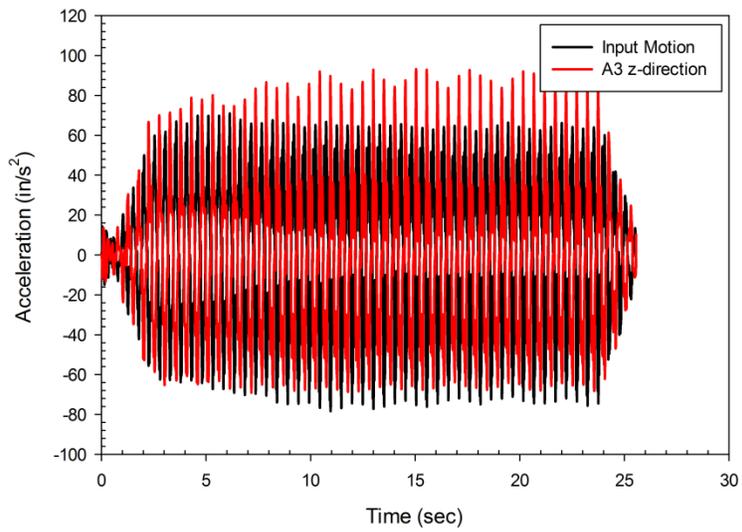
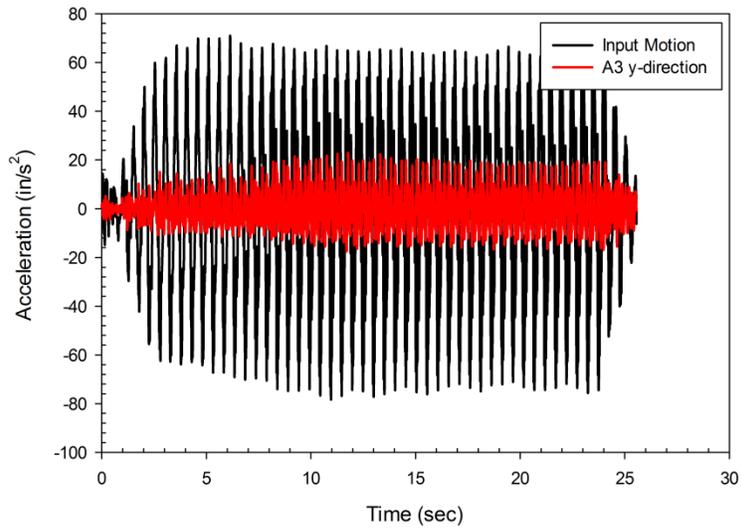
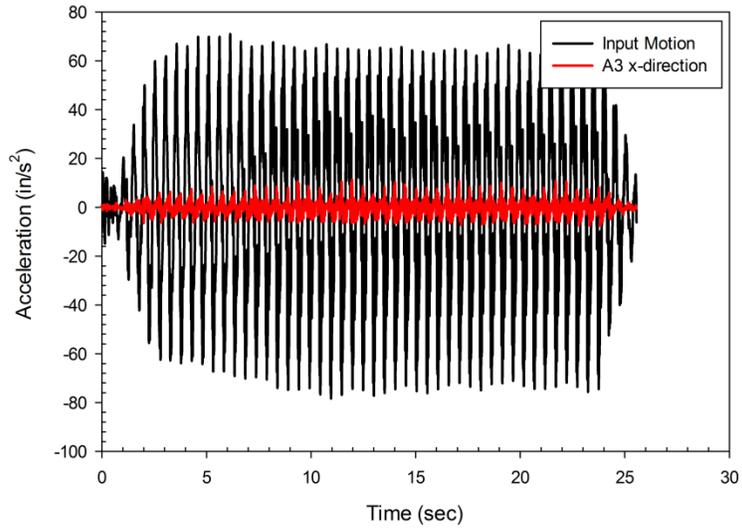


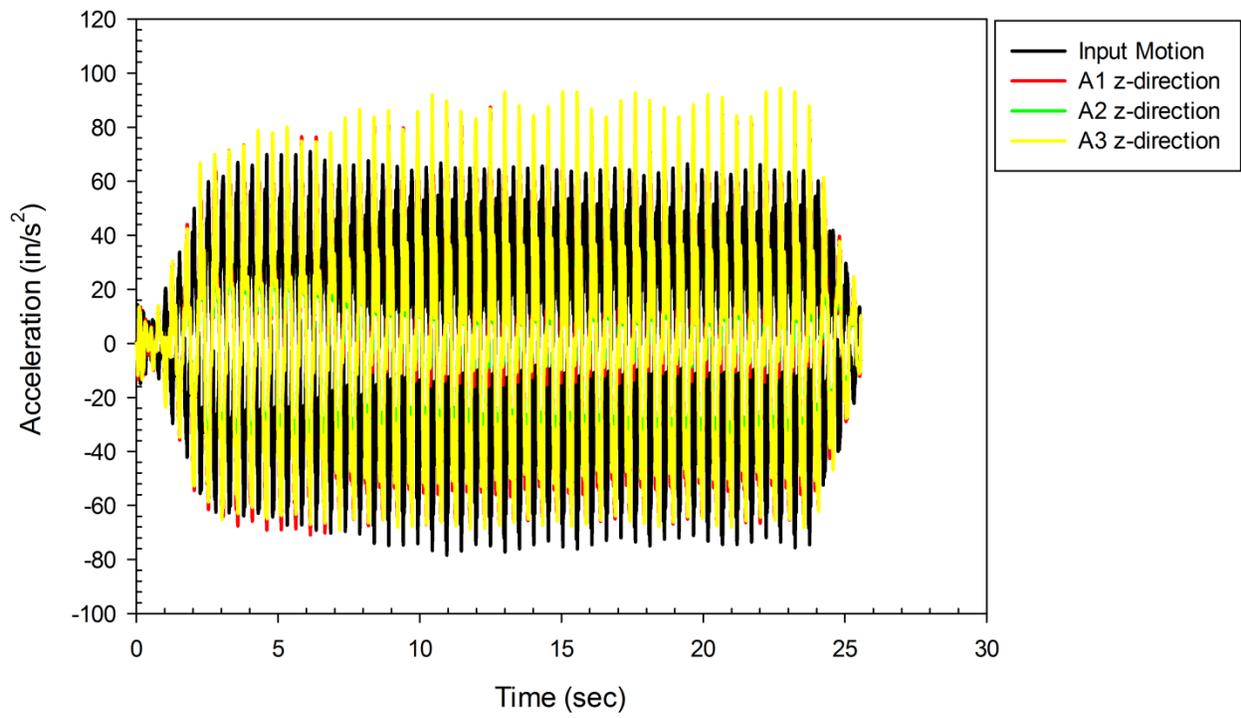
Section B-B







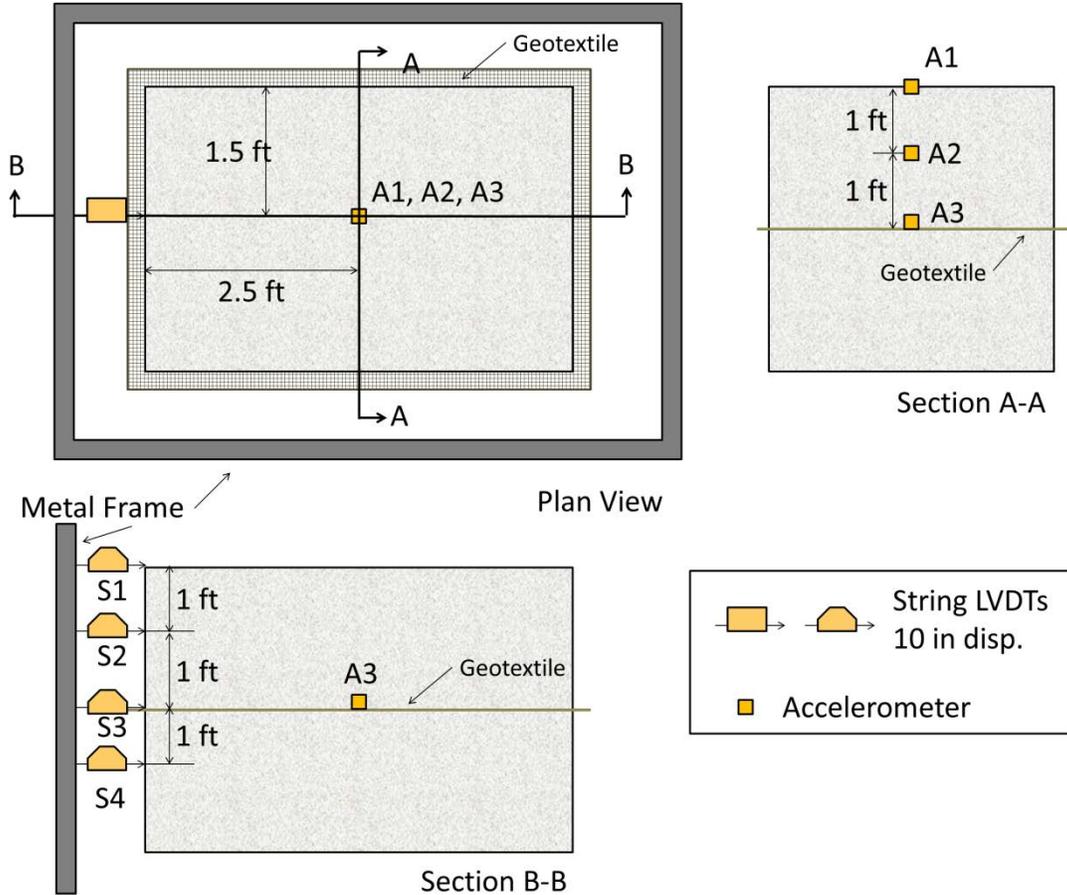


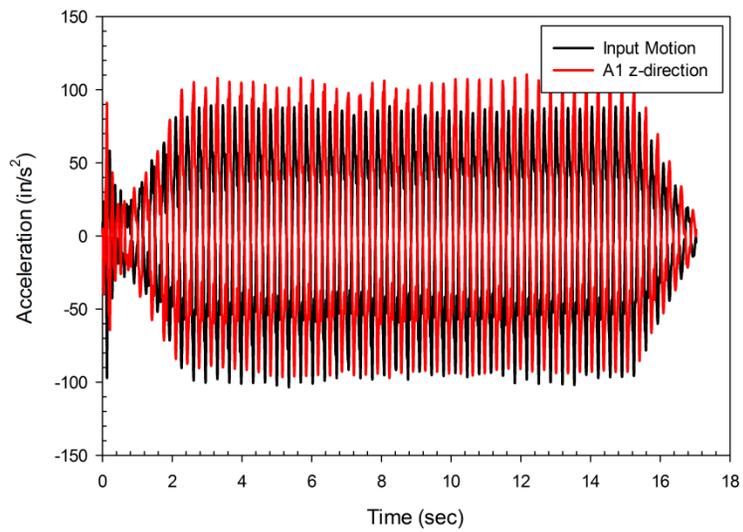
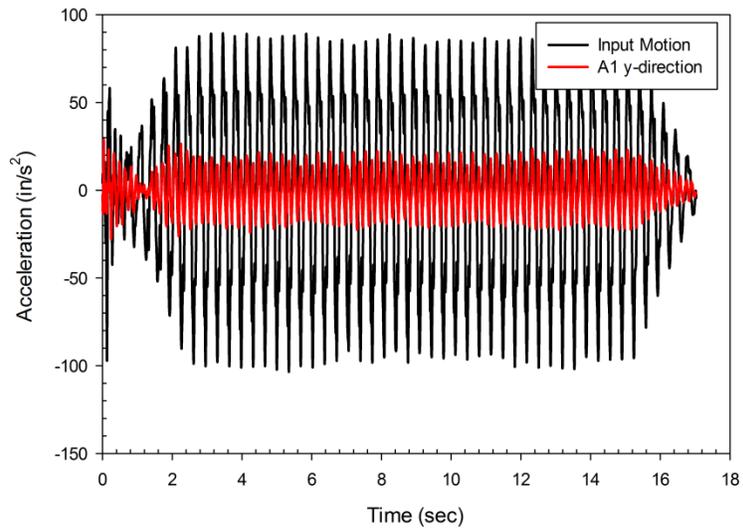
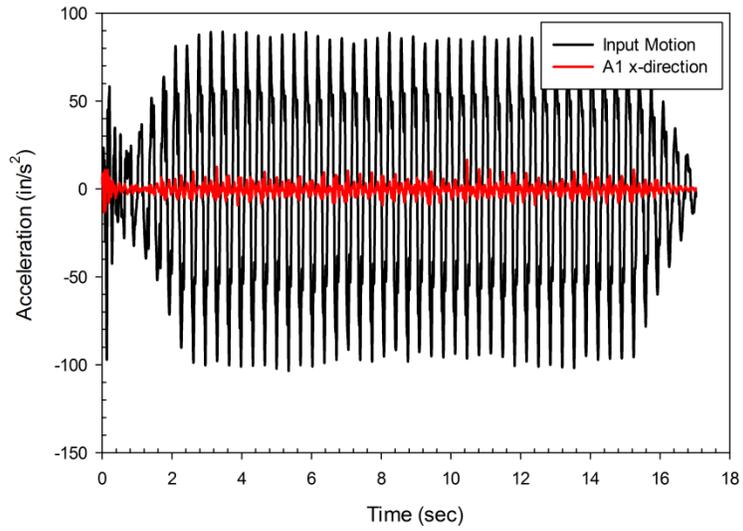


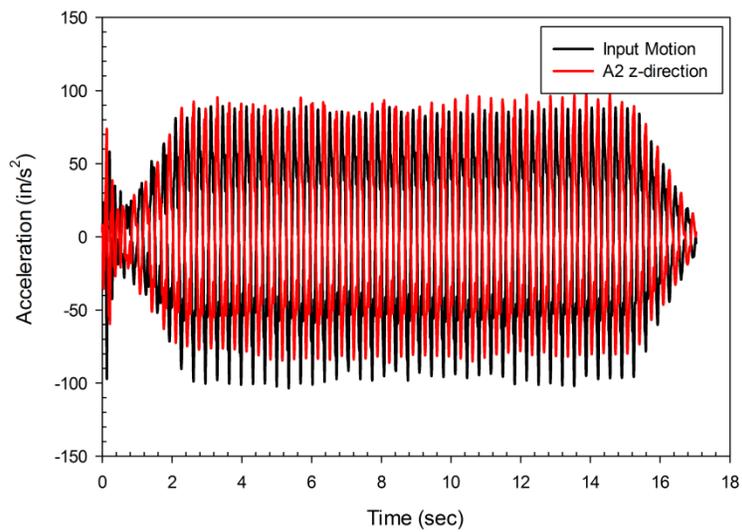
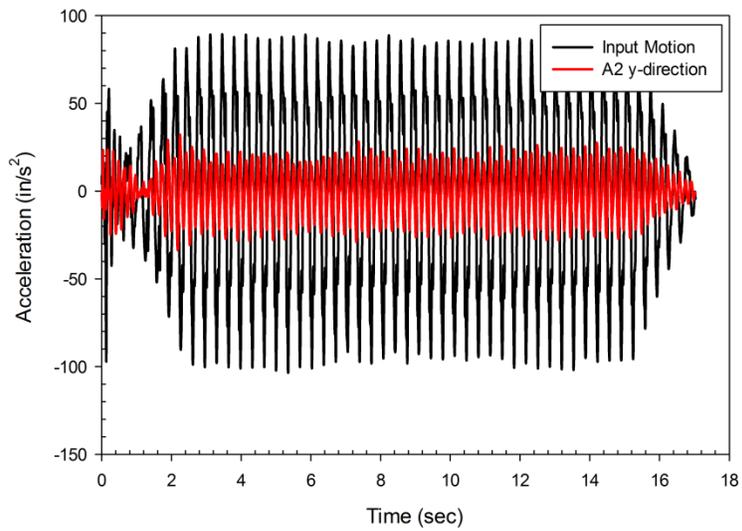
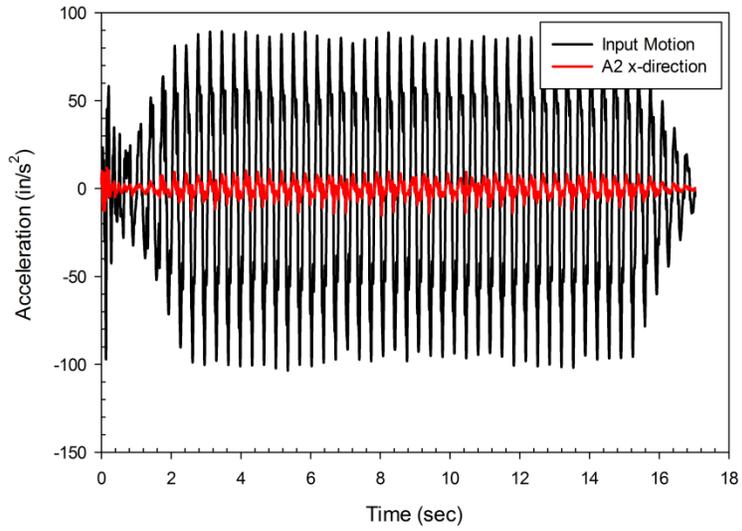
# Shake Table Test

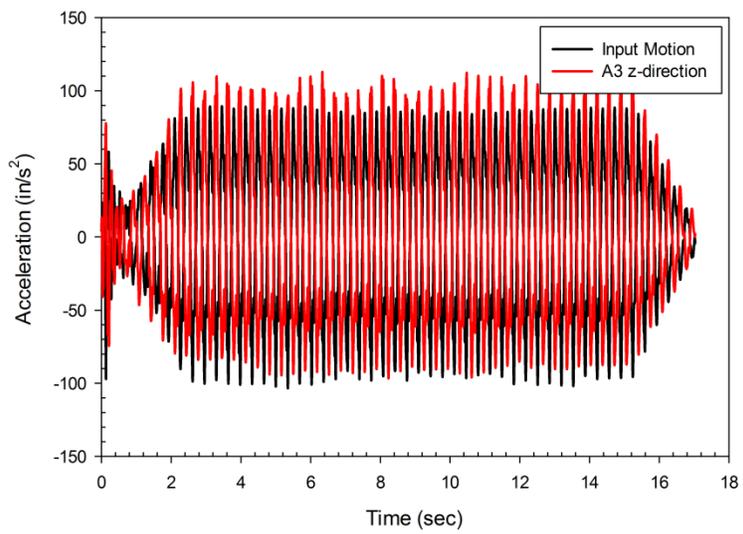
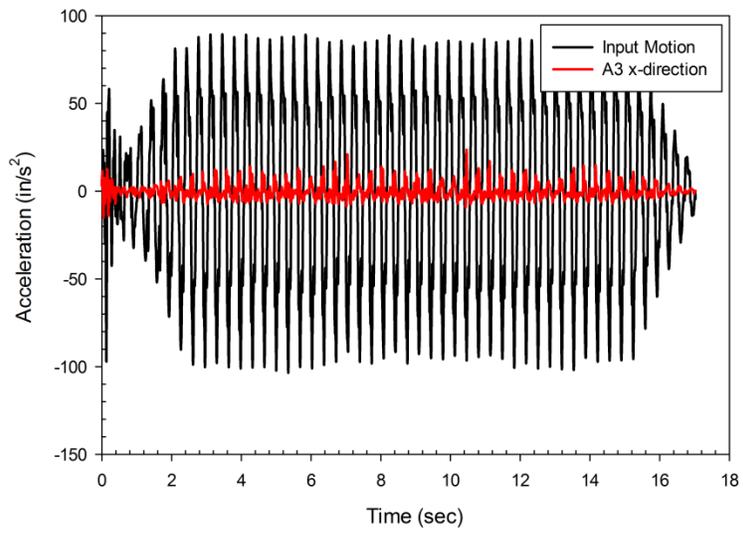
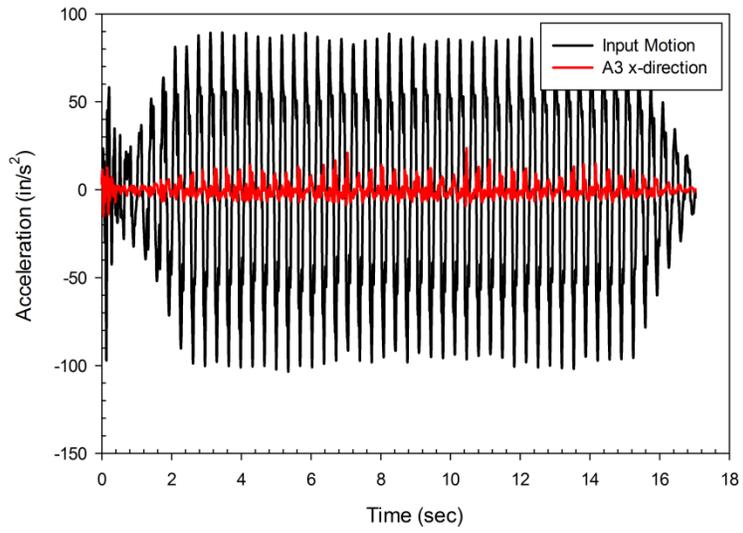


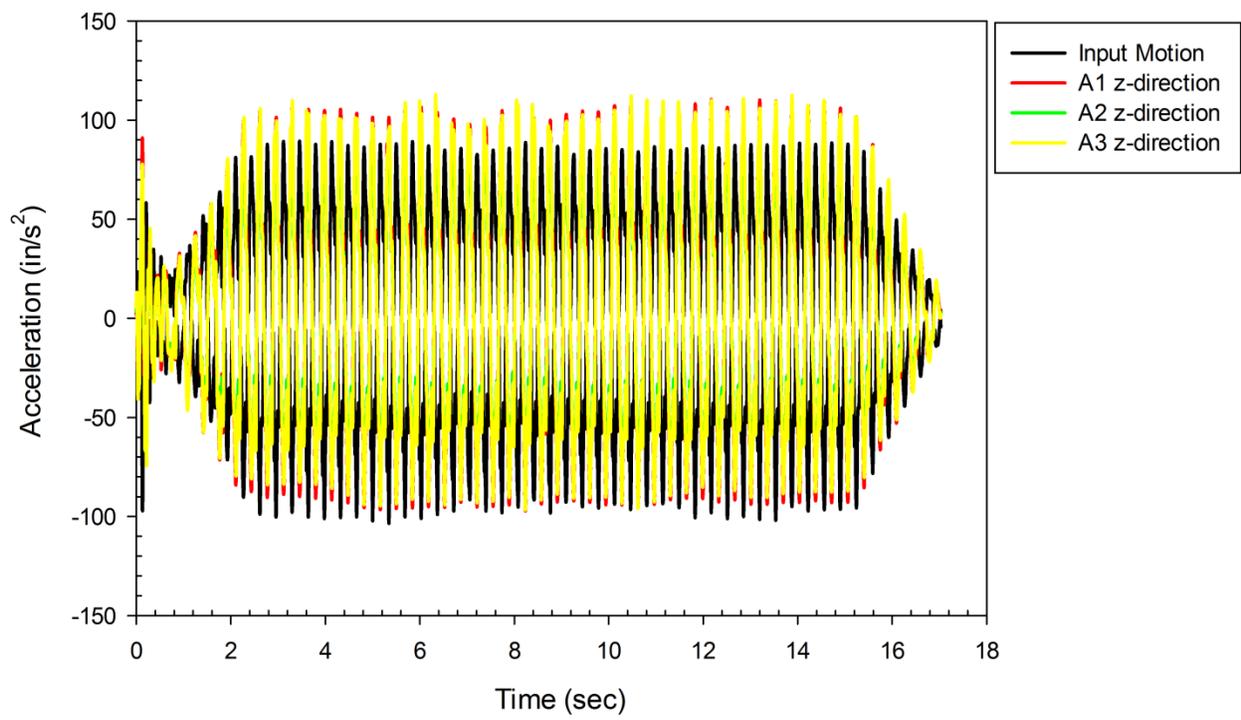
Project:	Cell Crete (Cellular Concrete)	Test Date:	9/14/16
Location:	----	Test No.:	1
Model Size:	3 ft by 5 ft	Vertical Stress:	164.0 psf
Model Height:	4 ft	Geogrid Depth:	2 ft
Motion Type:	Sinusoidal	Characteristics:	0.2g 3Hz







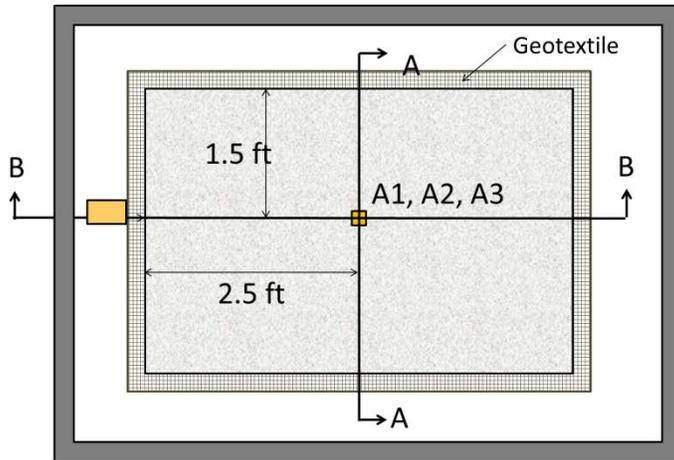




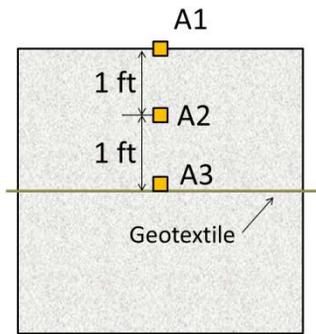
# Shake Table Test



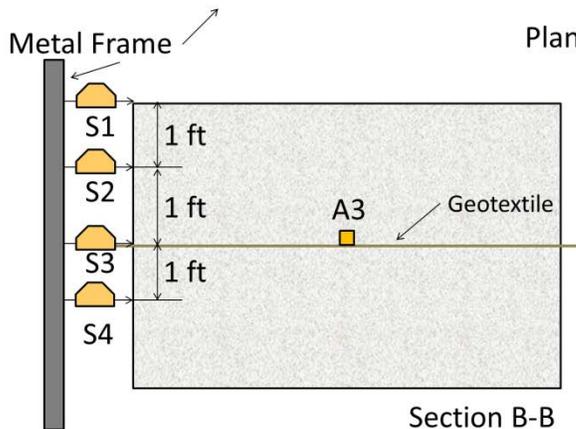
Project:	Cell Crete (Cellular Concrete)	Test Date:	9/14/16
Location:	----	Test No.:	1
Model Size:	3 ft by 5 ft	Vertical Stress:	164.0 psf
Model Height:	4 ft	Geogrid Depth:	2 ft
Motion Type:	1994 Northridge Earthquake	Characteristics:	N/A



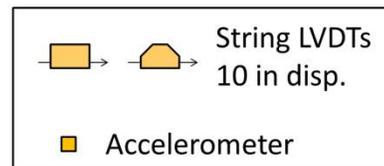
Plan View

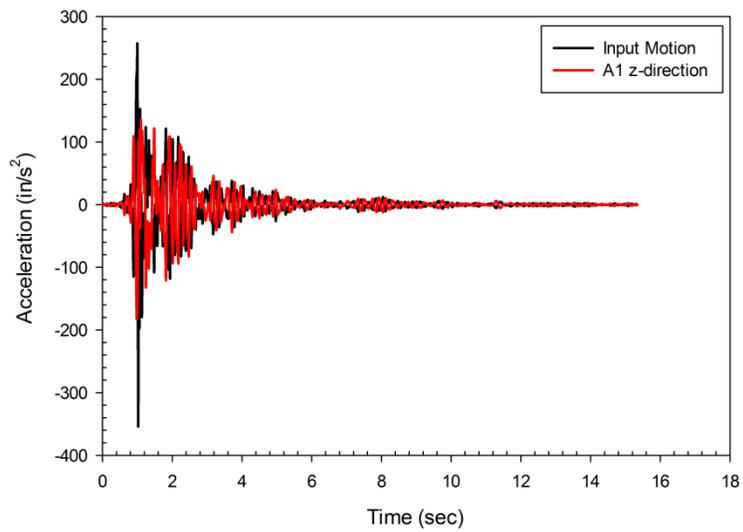
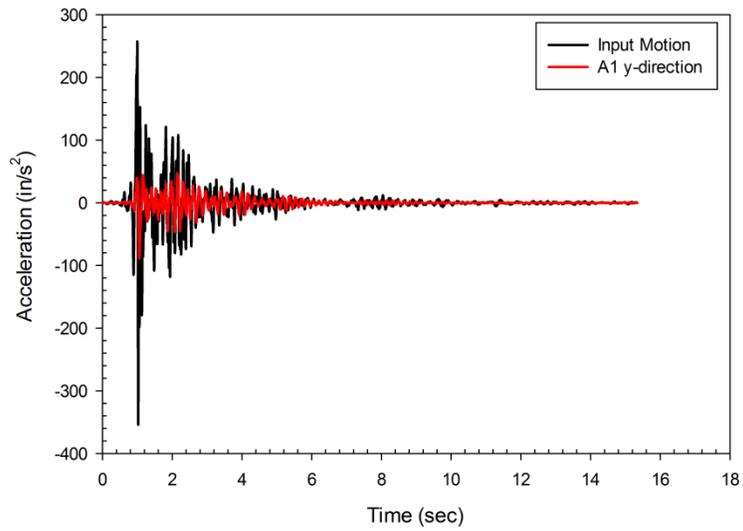
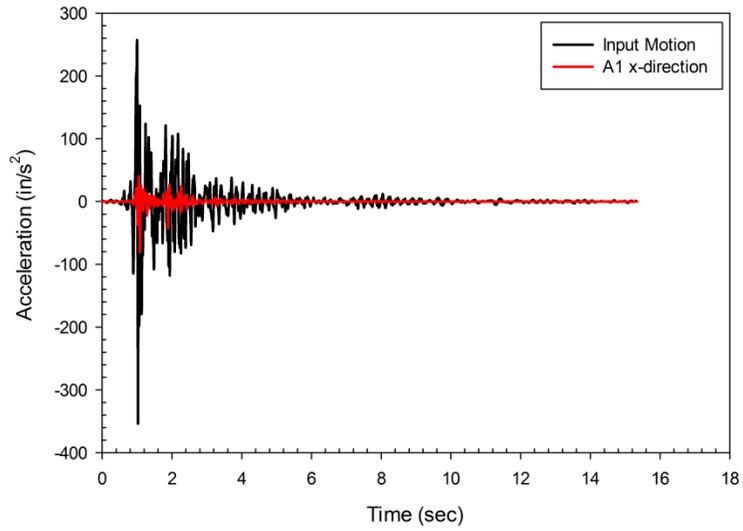


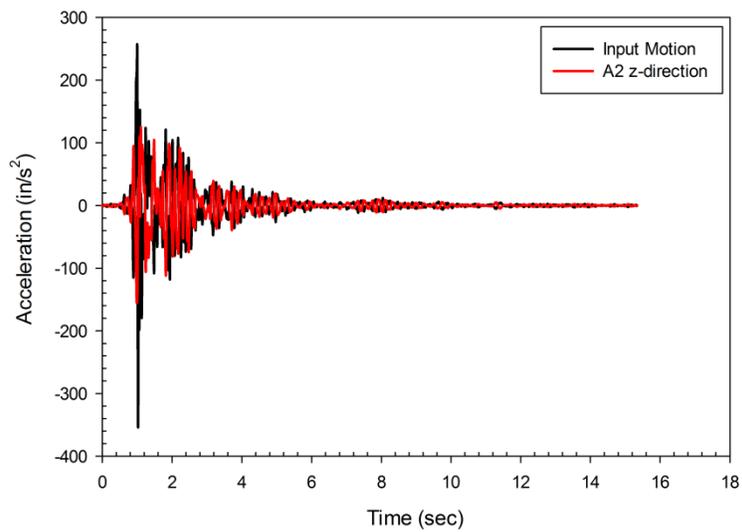
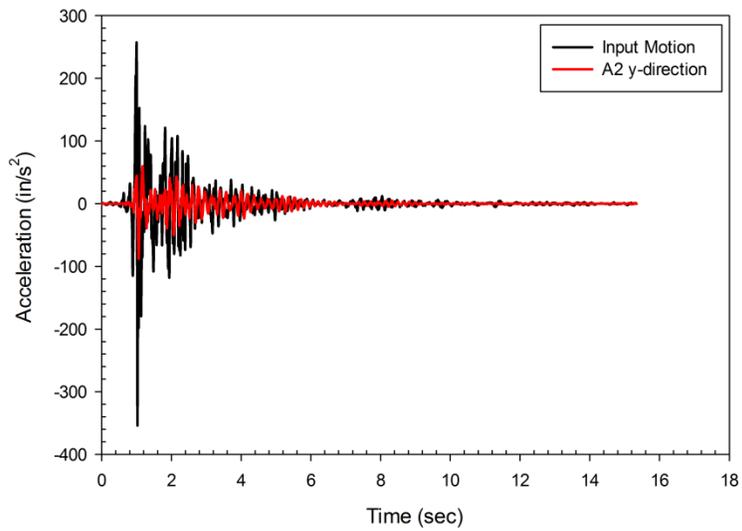
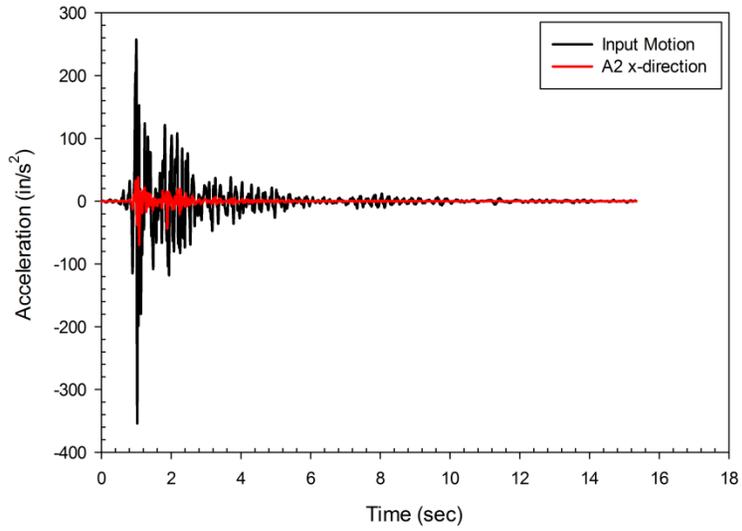
Section A-A

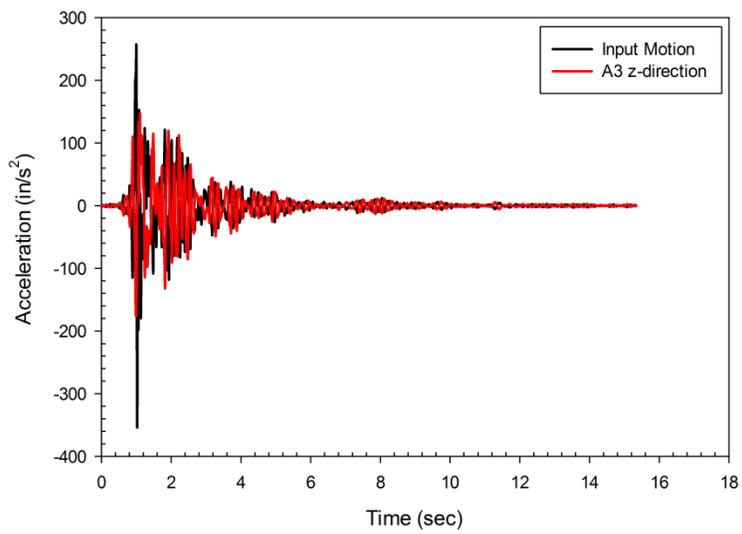
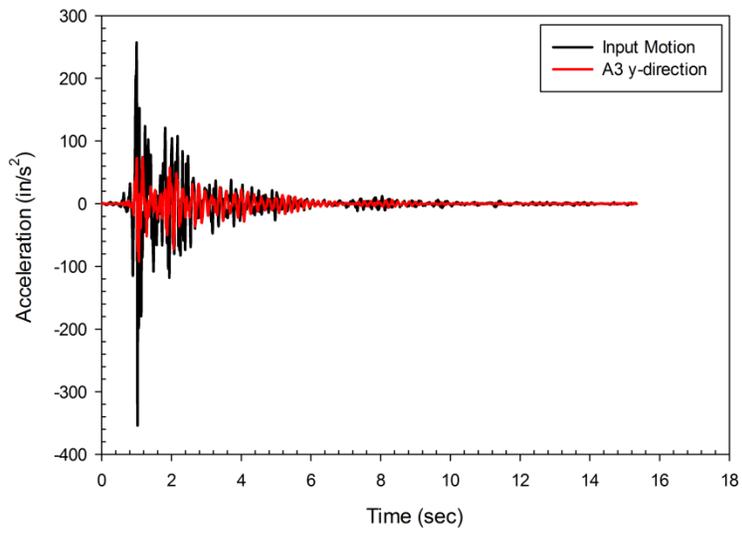
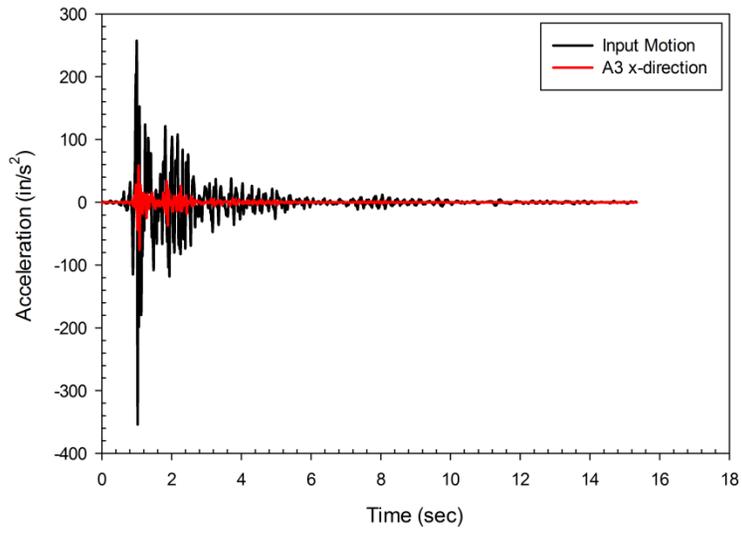


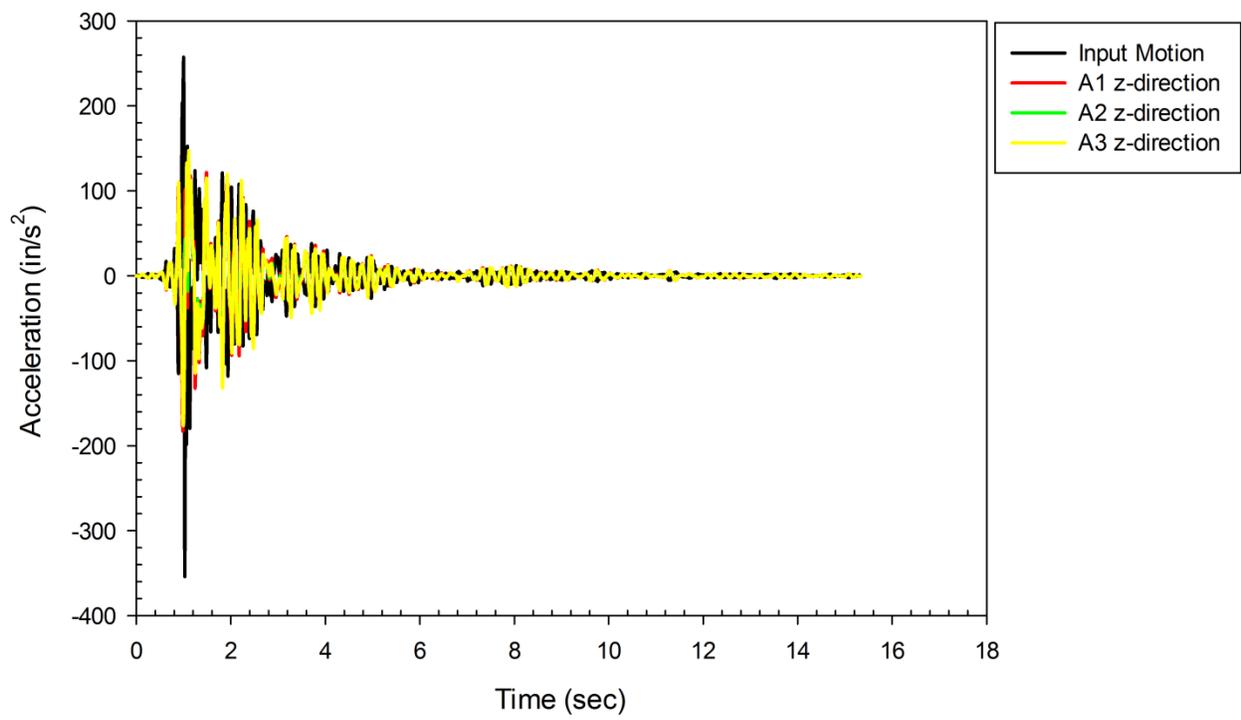
Section B-B







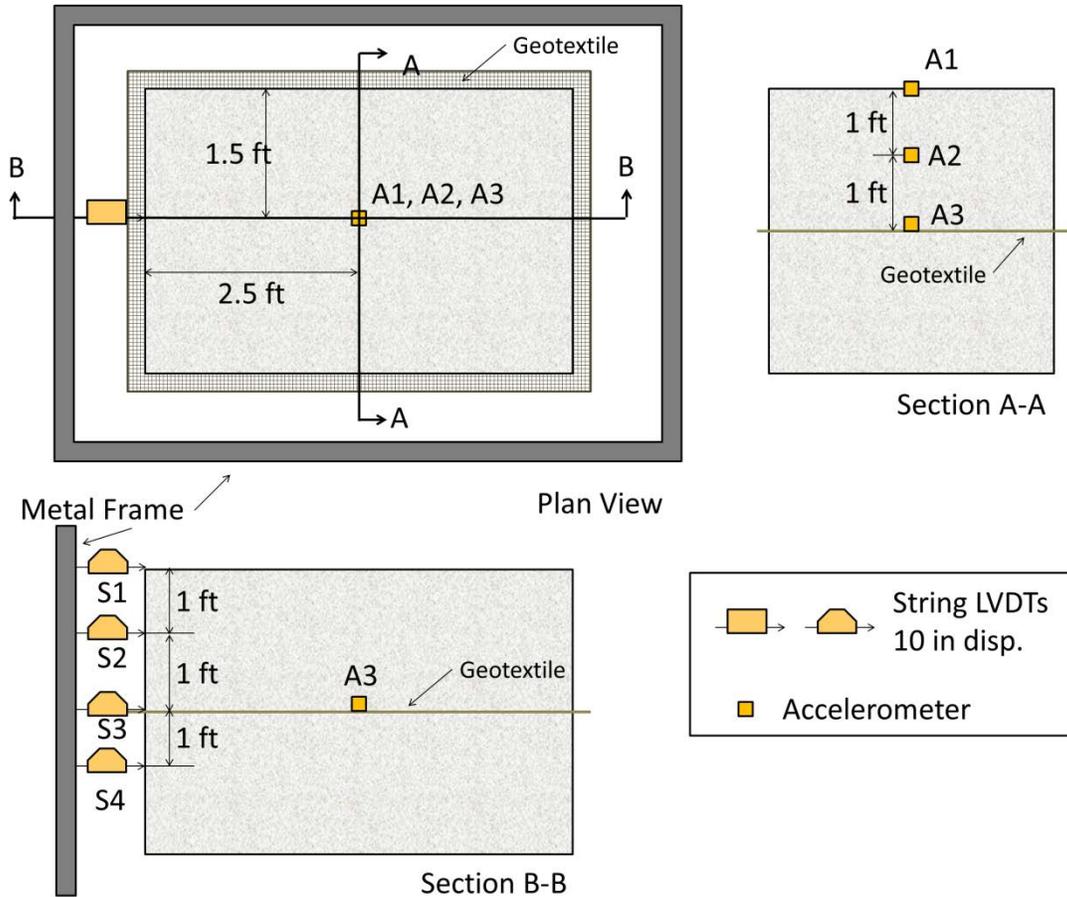


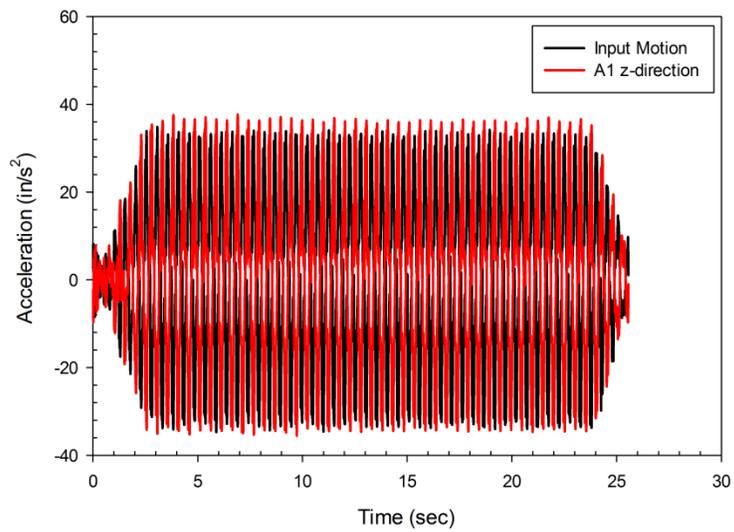
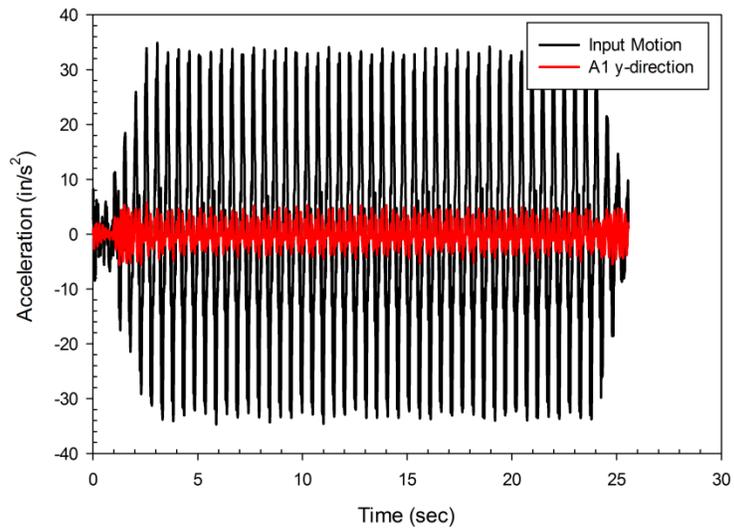
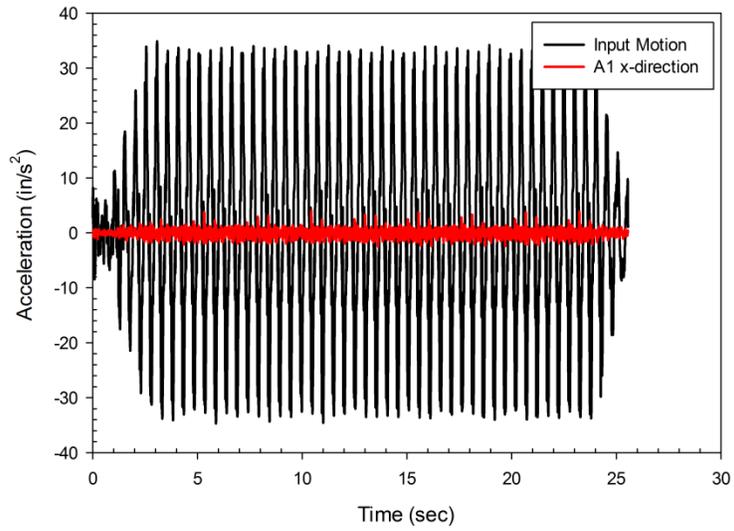


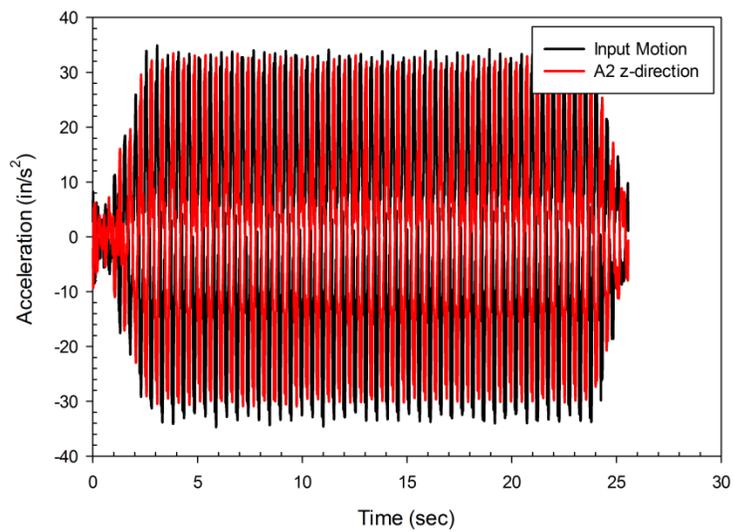
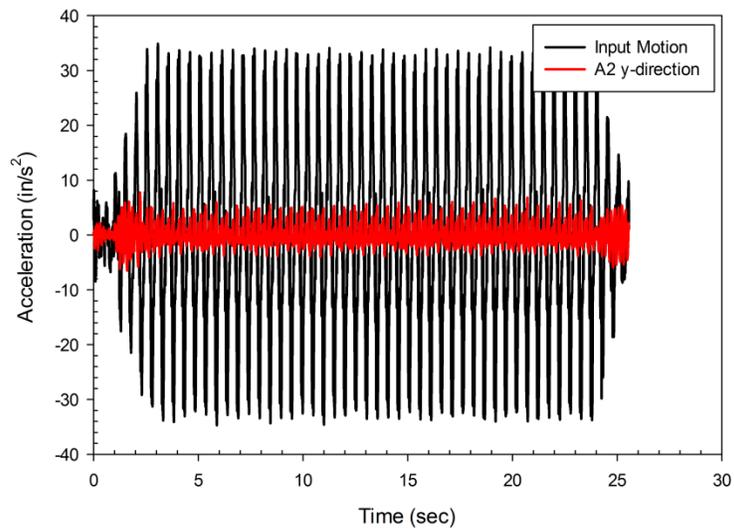
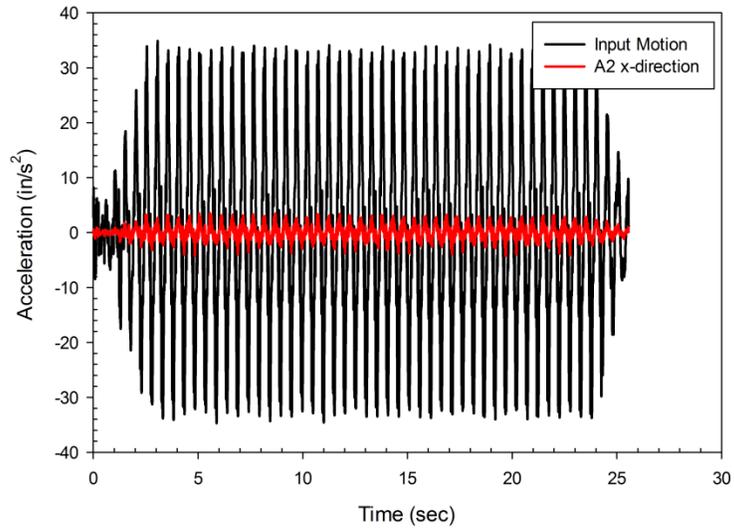
# Shake Table Test

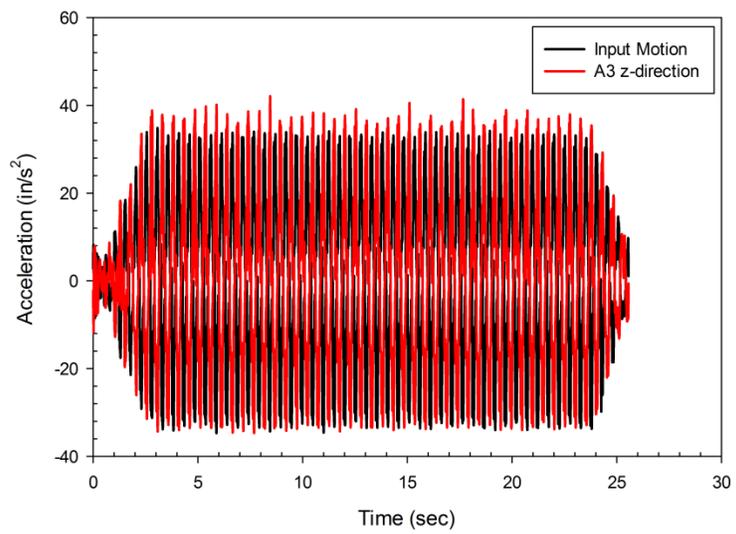
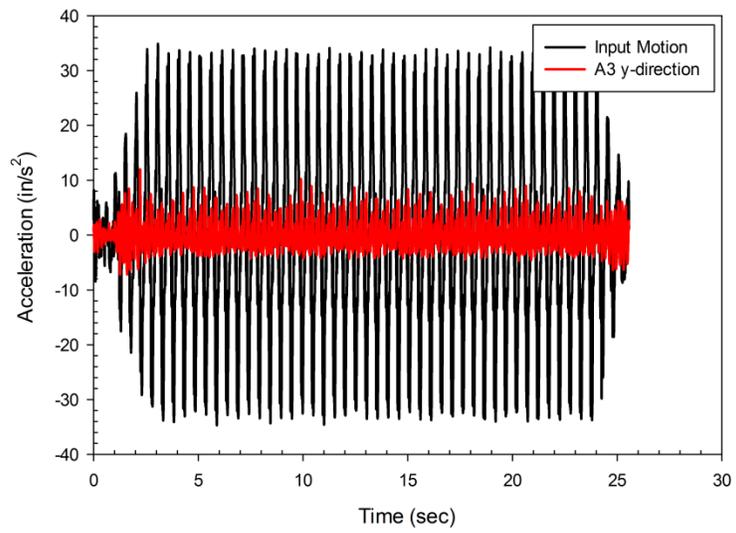
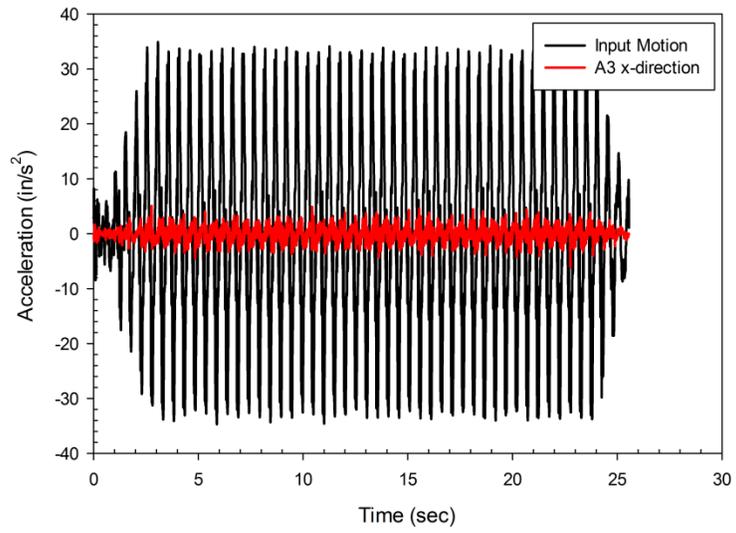


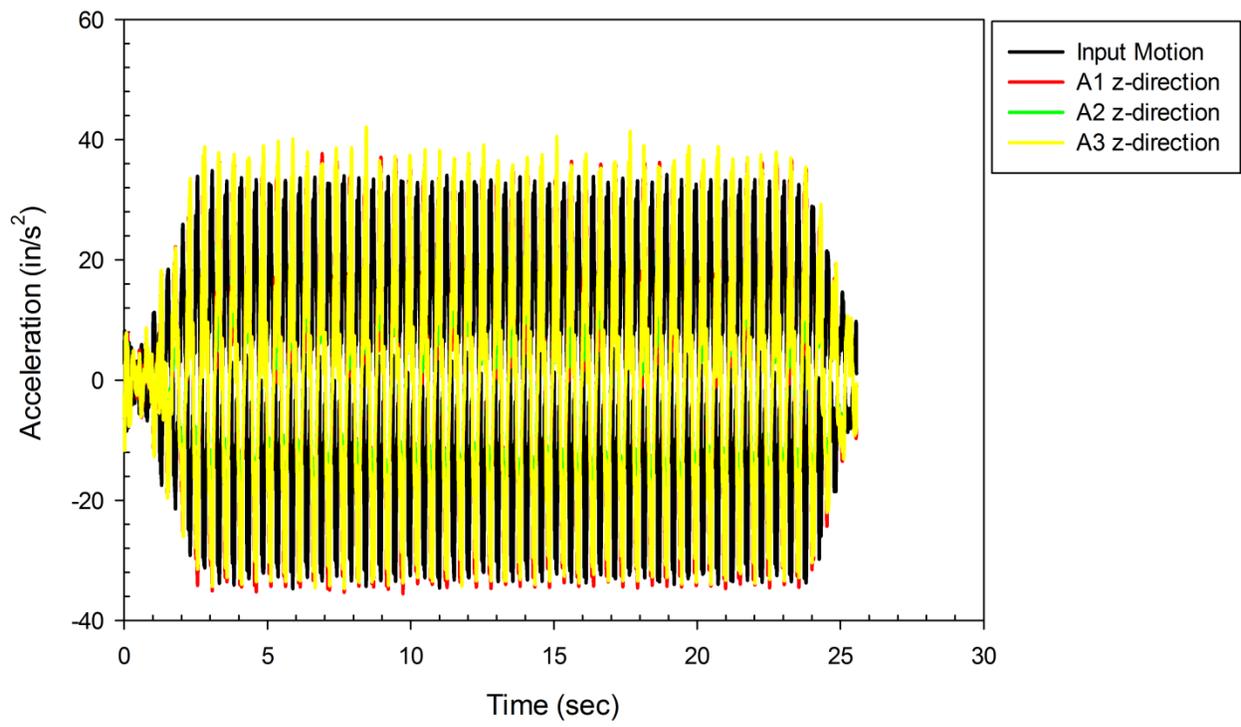
Project:	Cell Crete (Cellular Concrete)	Test Date:	9/14/16
Location:	----	Test No.:	2
Model Size:	3 ft by 5 ft	Vertical Stress:	164.0 psf
Model Height:	4 ft	Geogrid Depth:	2 ft
Motion Type:	Sinusoidal	Characteristics:	0.1g 2Hz







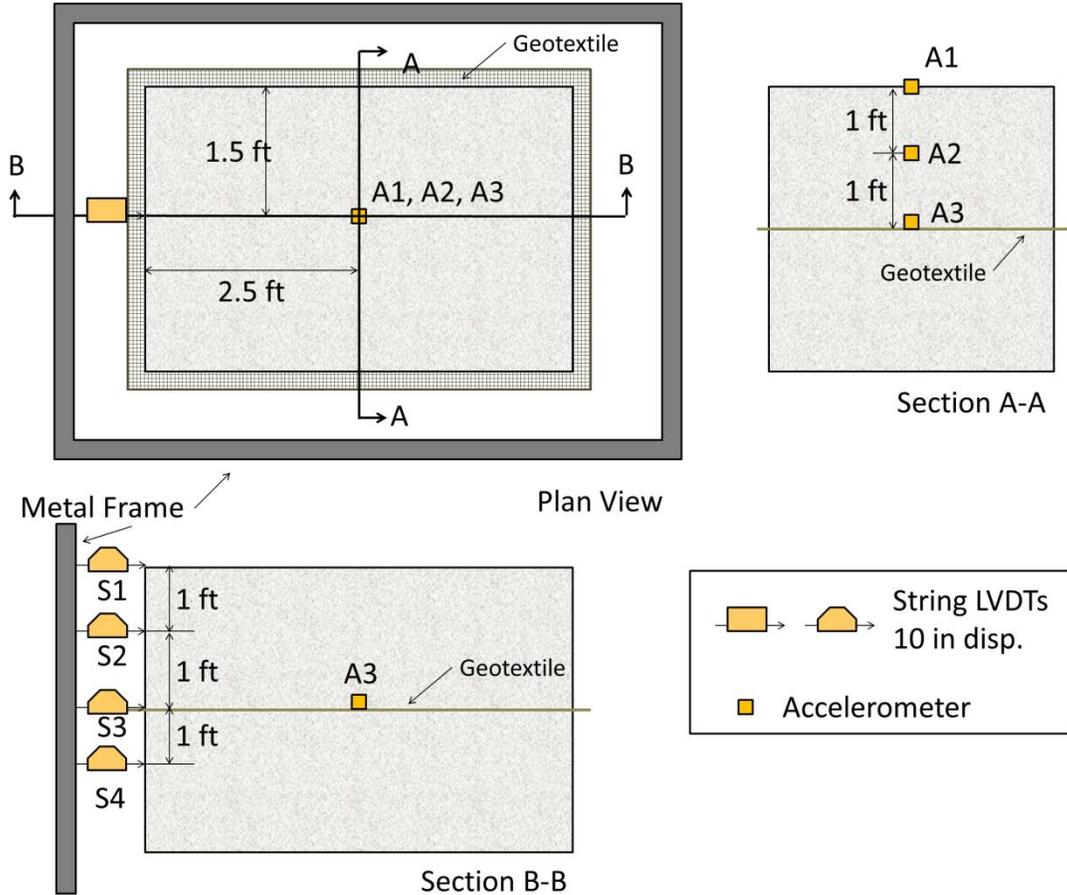


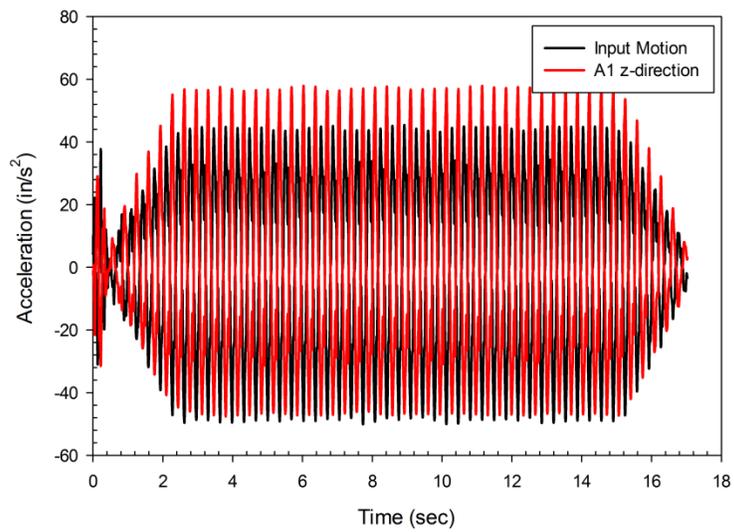
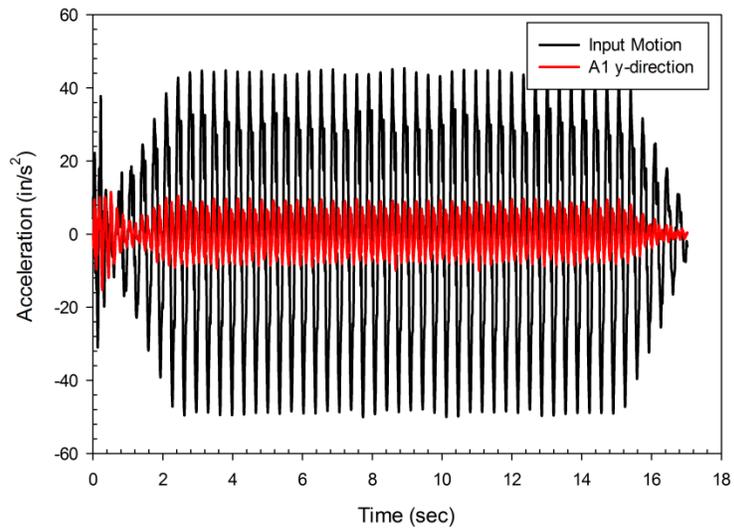
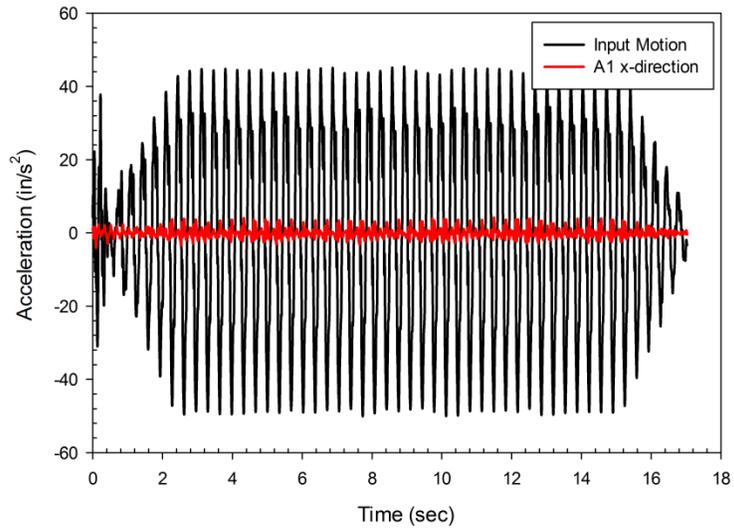


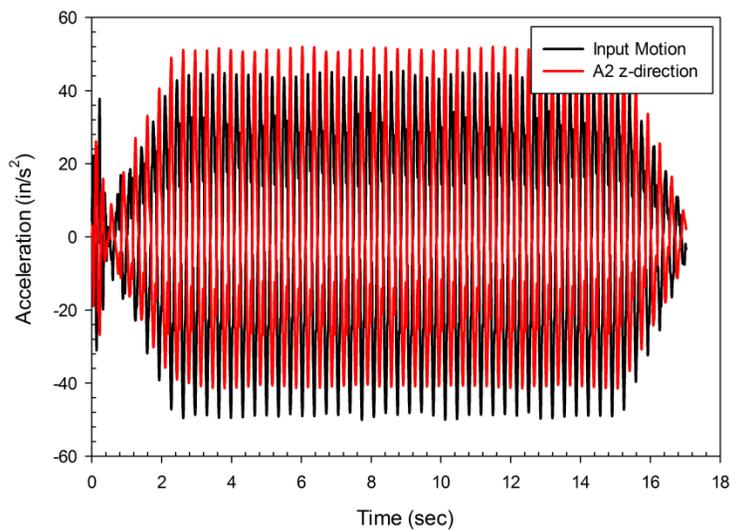
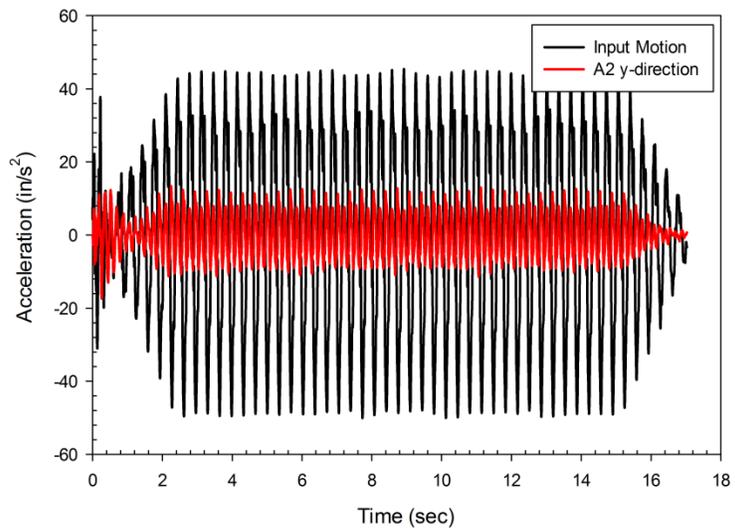
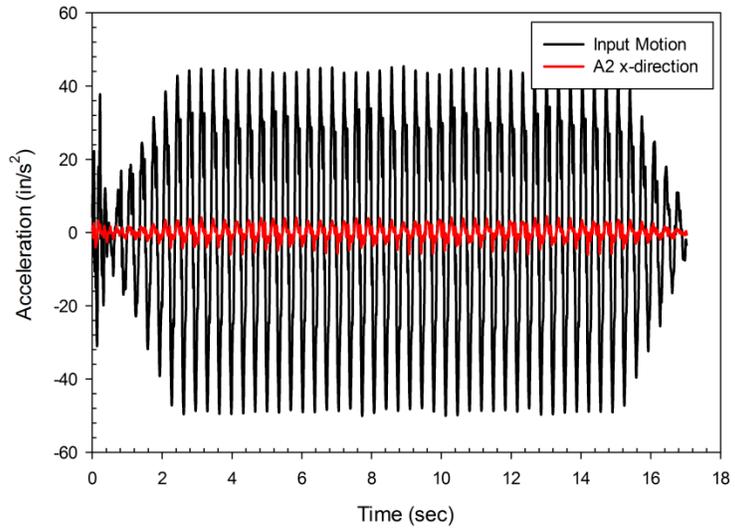
# Shake Table Test

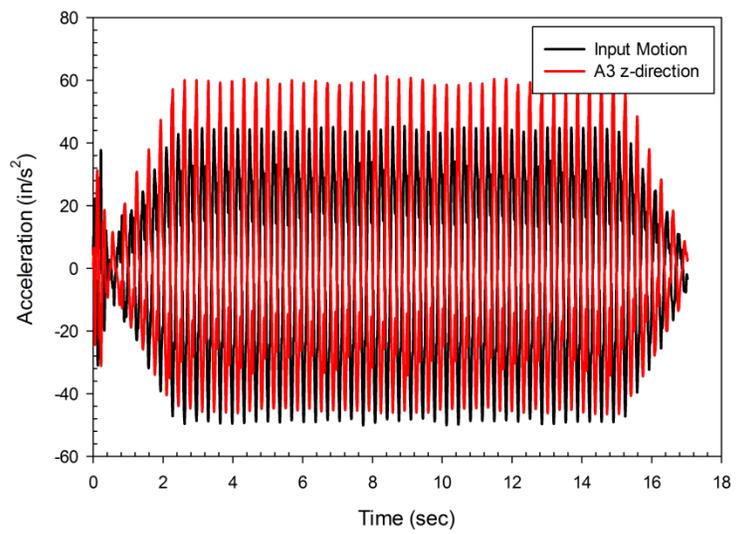
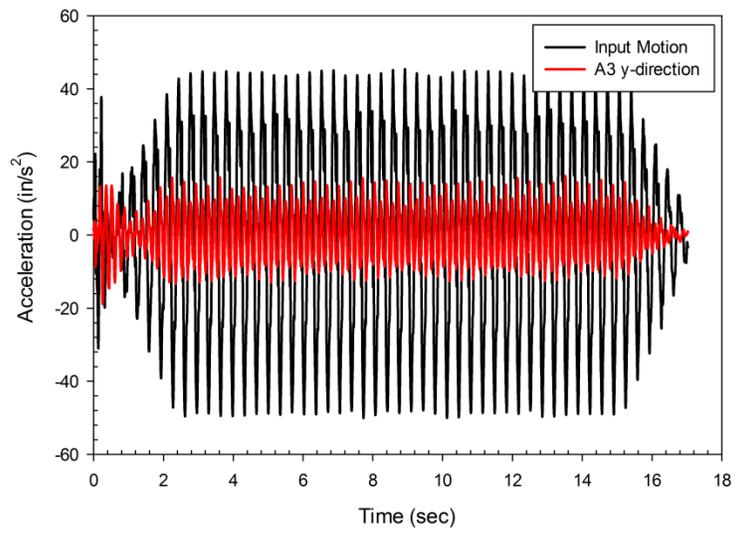
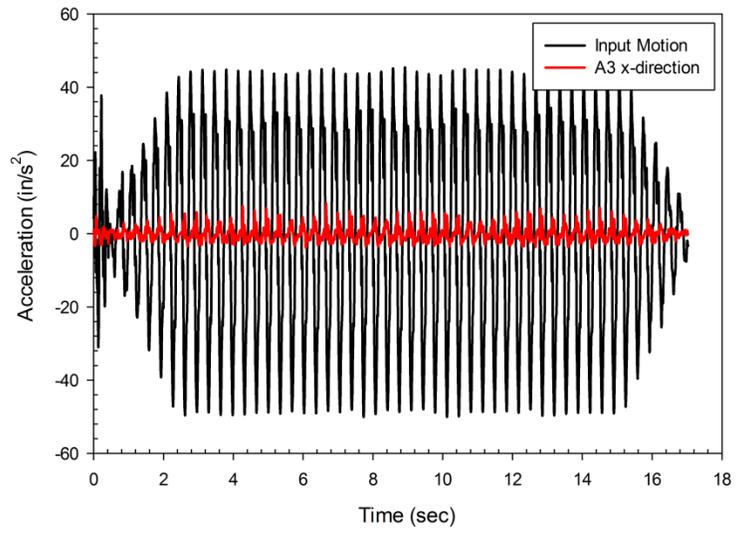


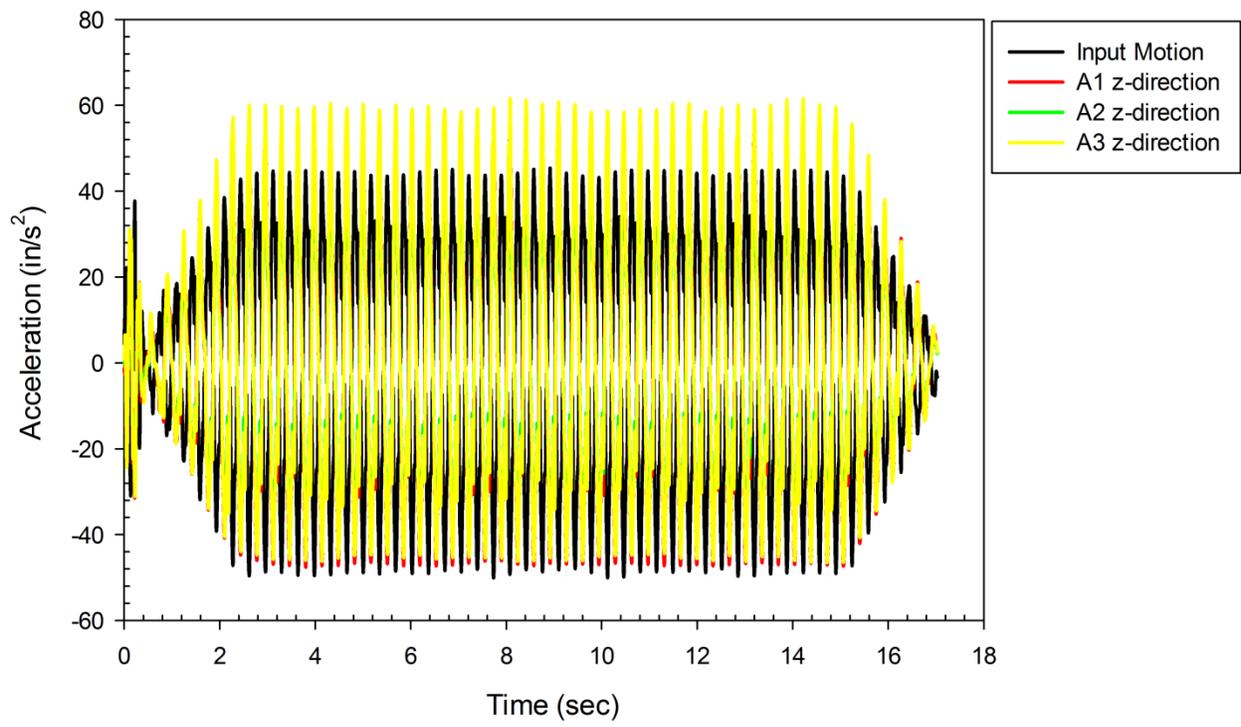
Project:	Cell Crete (Cellular Concrete)	Test Date:	9/14/16
Location:	----	Test No.:	2
Model Size:	3 ft by 5 ft	Vertical Stress:	164.0 psf
Model Height:	4 ft	Geogrid Depth:	2 ft
Motion Type:	Sinusoidal	Characteristics:	0.1g 3Hz







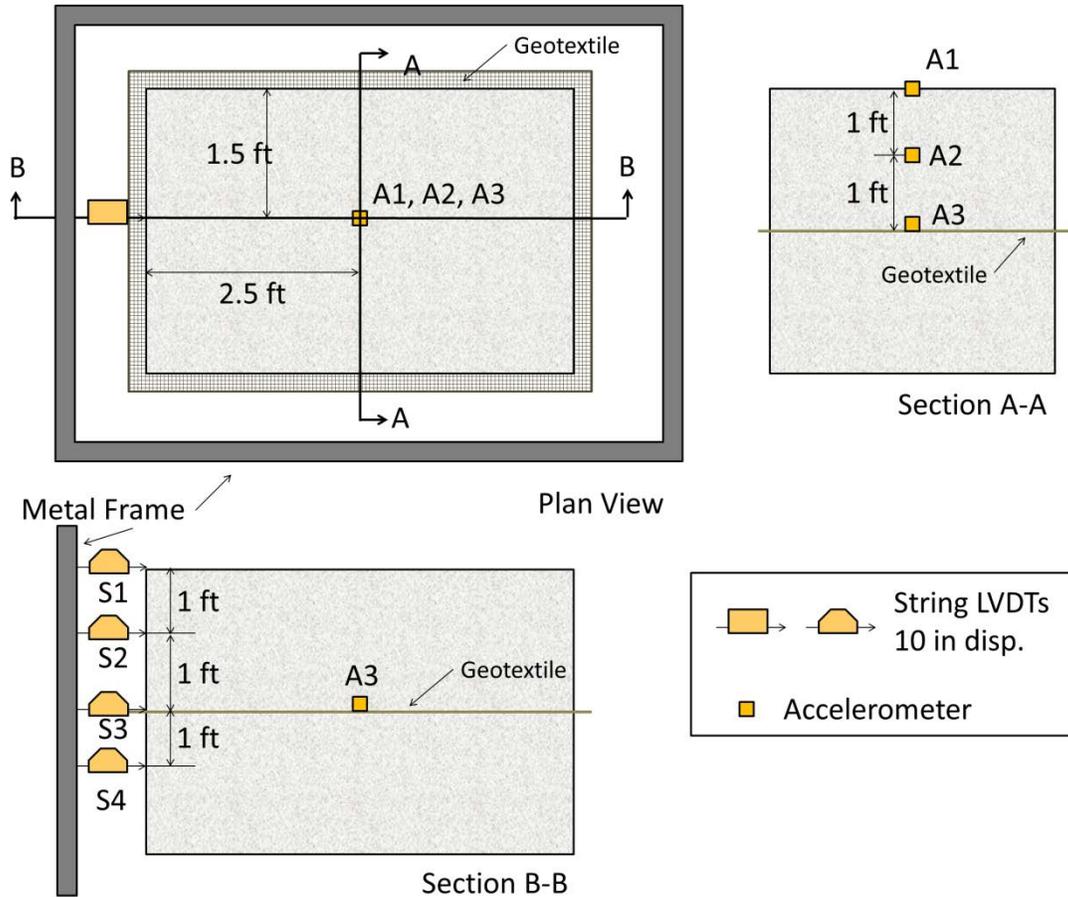


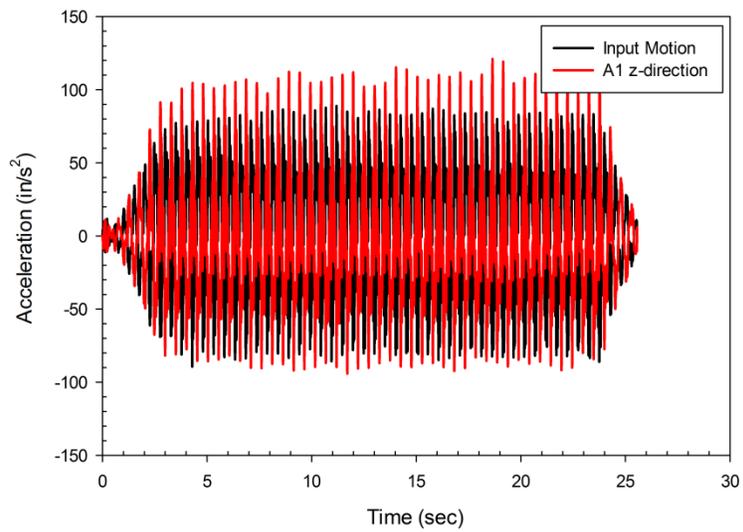
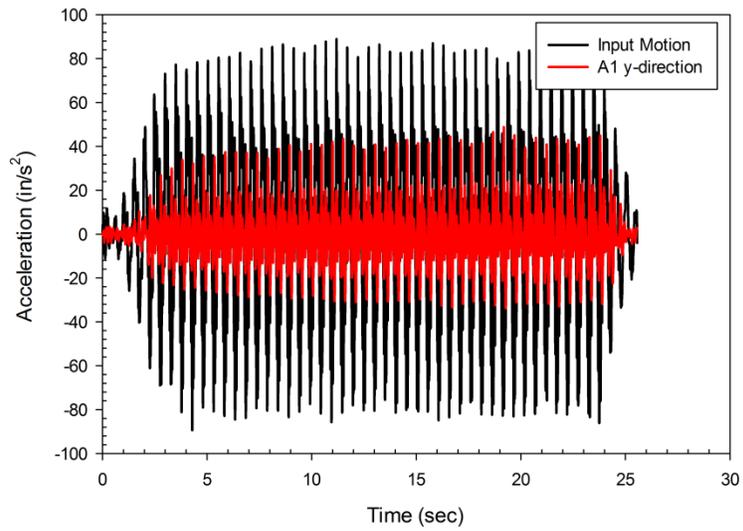
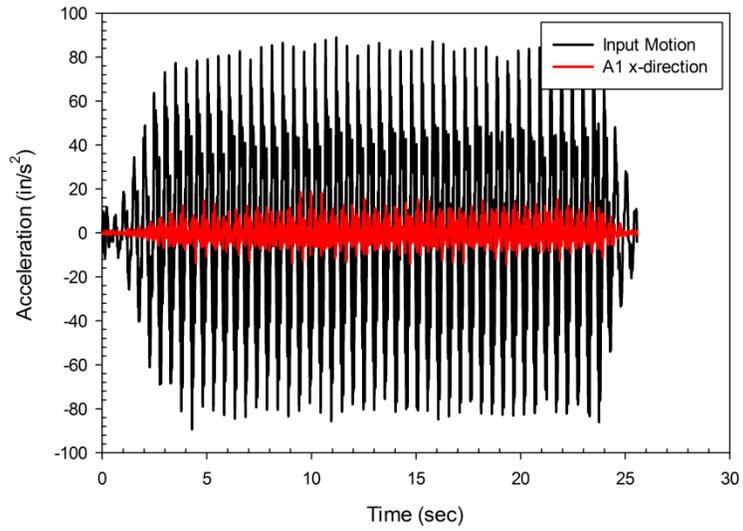


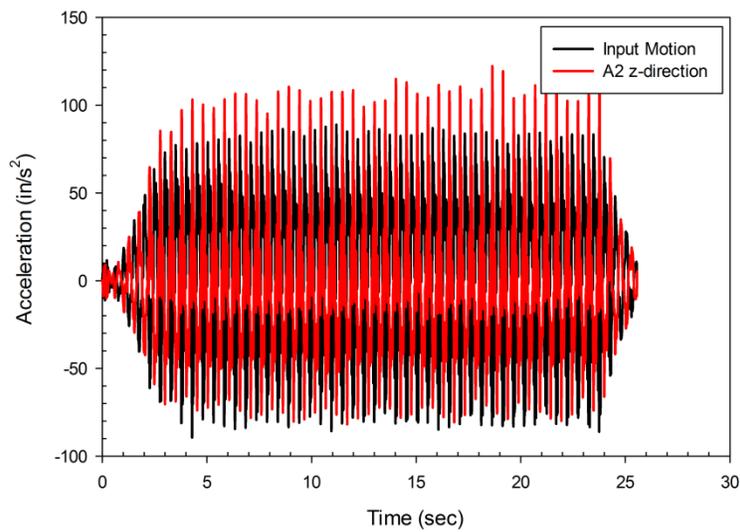
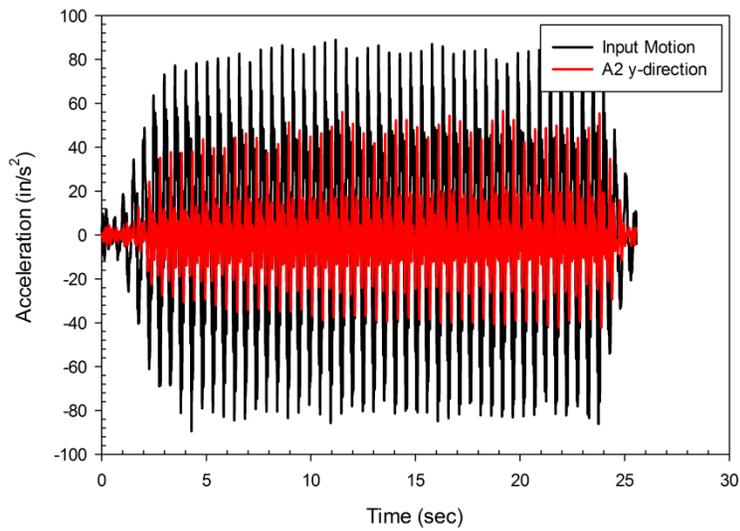
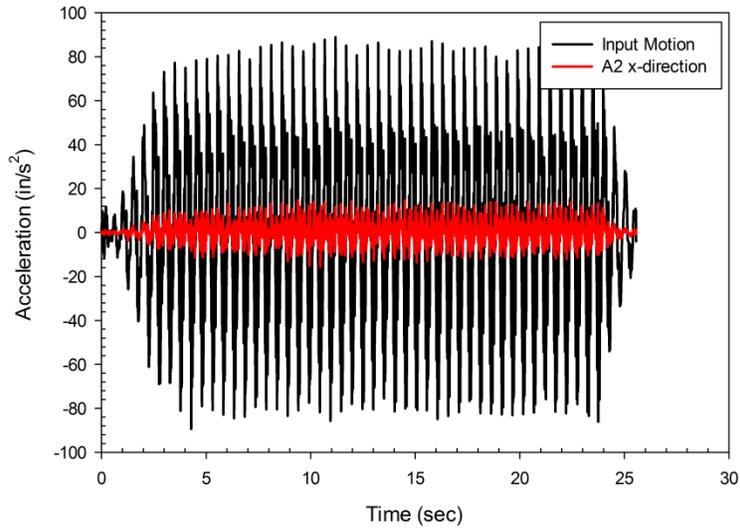
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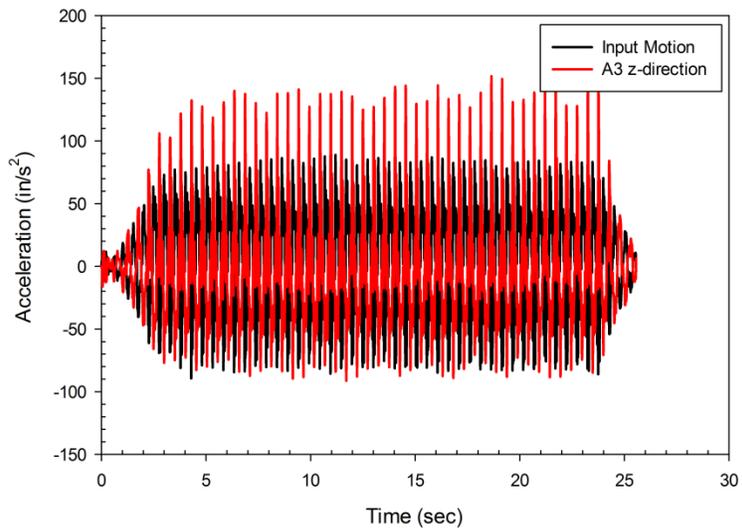
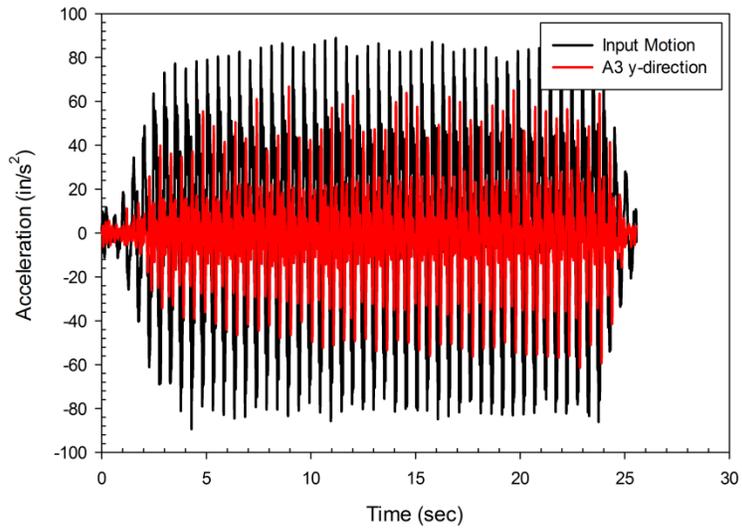
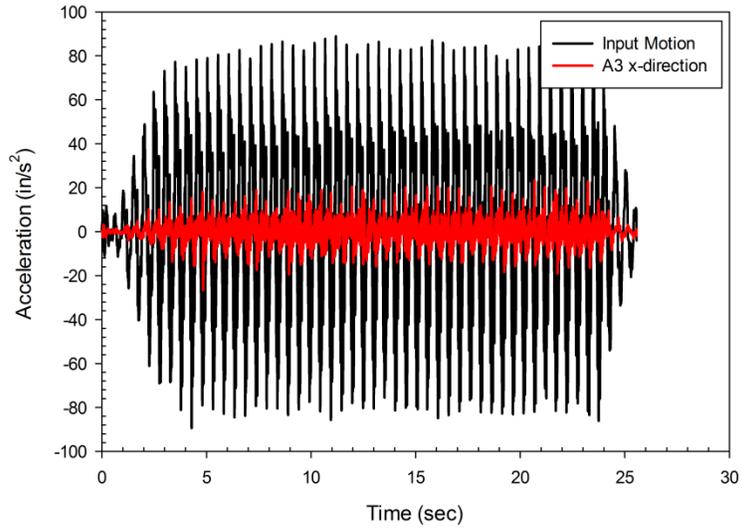


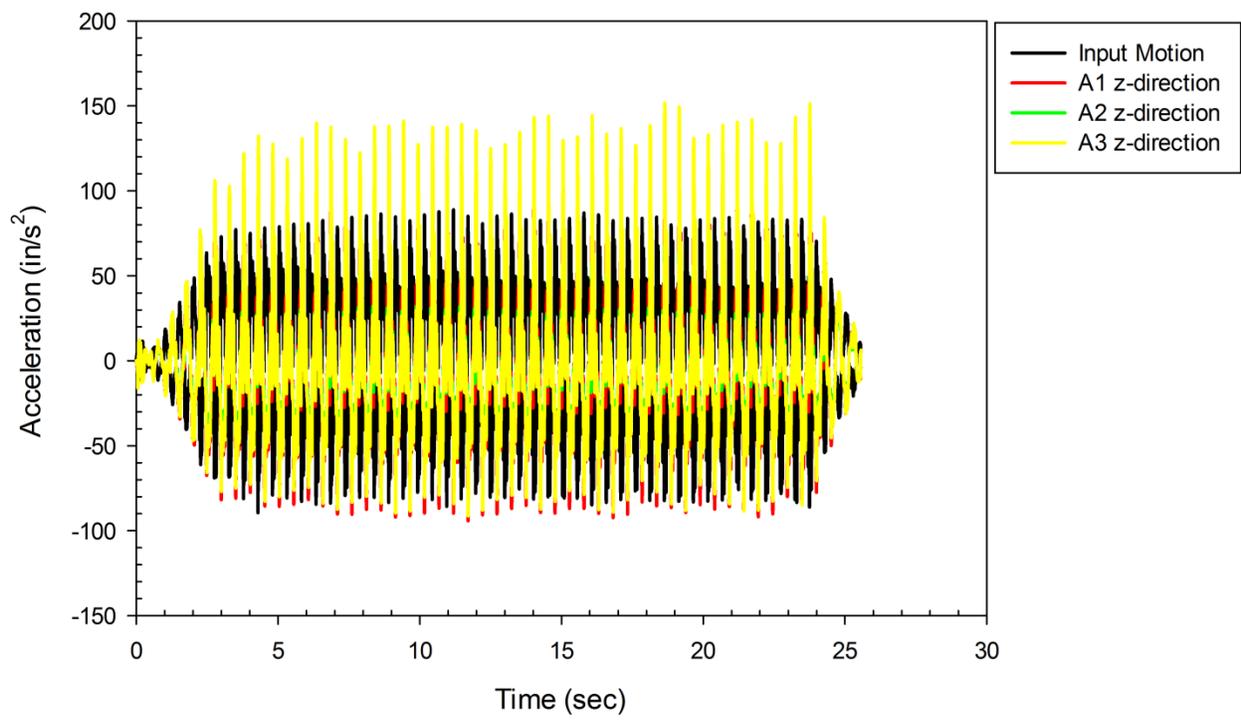
Project:	Cell Crete (Cellular Concrete)	Test Date:	9/14/16
Location:	----	Test No.:	2
Model Size:	3 ft by 5 ft	Vertical Stress:	164.0 psf
Model Height:	4 ft	Geogrid Depth:	2 ft
Motion Type:	Sinusoidal	Characteristics:	0.2g 2Hz







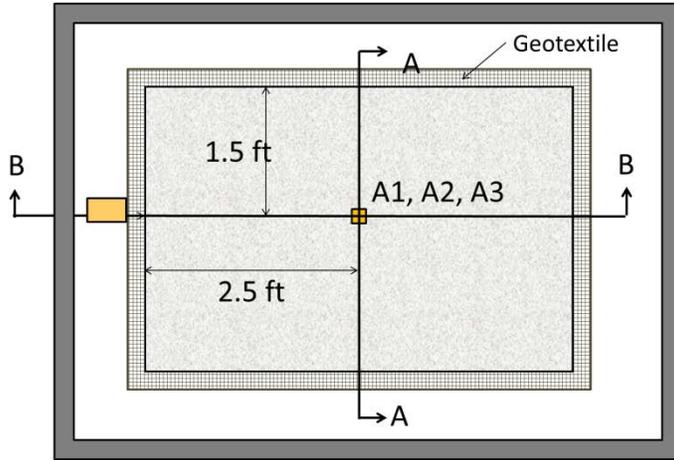




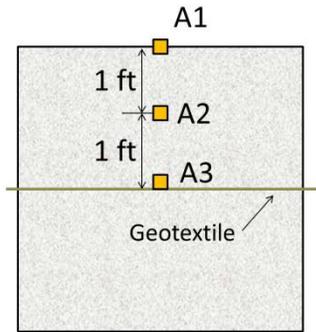
# Shake Table Test



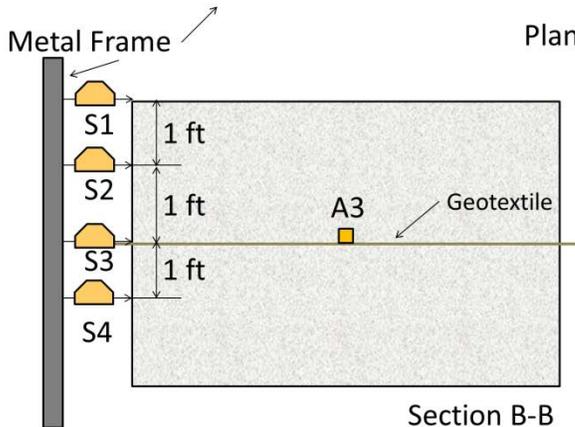
Project:	Cell Crete (Cellular Concrete)	Test Date:	9/14/16
Location:	----	Test No.:	2
Model Size:	3 ft by 5 ft	Vertical Stress:	164.0 psf
Model Height:	4 ft	Geogrid Depth:	2 ft
Motion Type:	Sinusoidal	Characteristics:	0.2g 3Hz



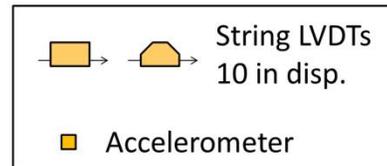
Plan View

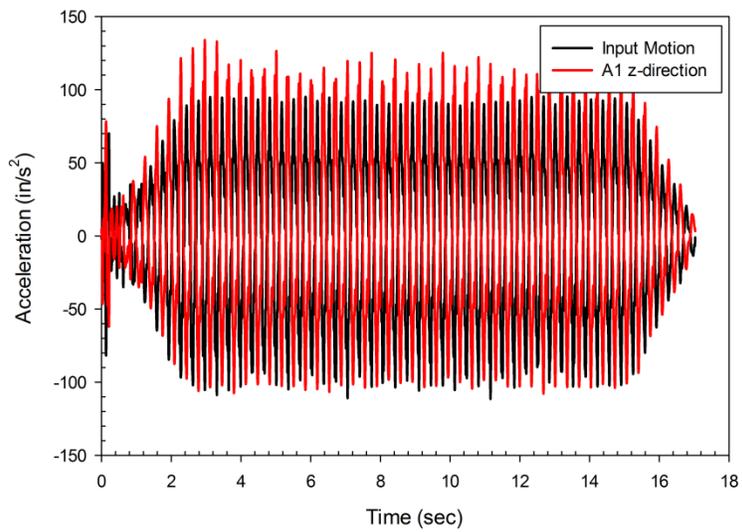
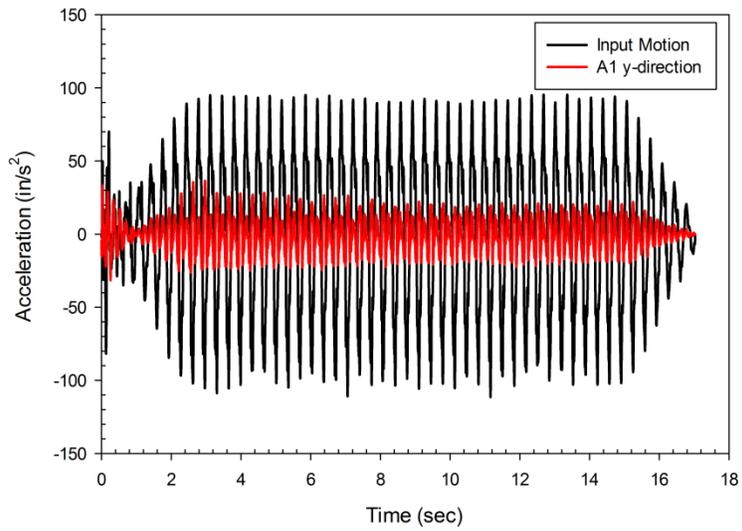
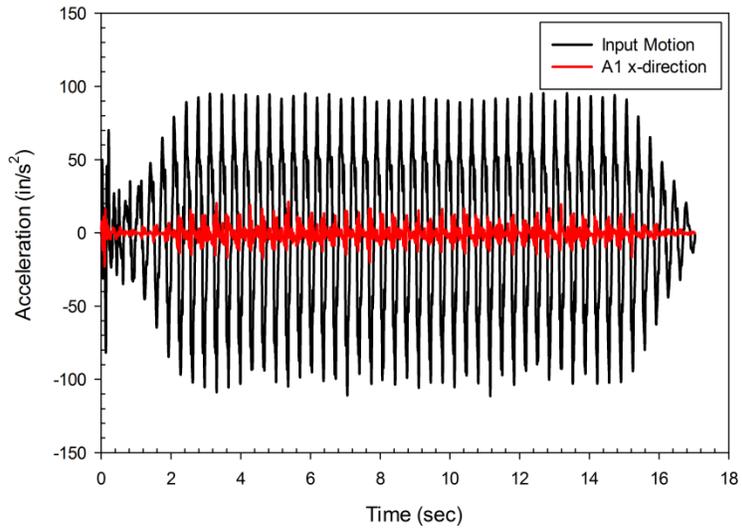


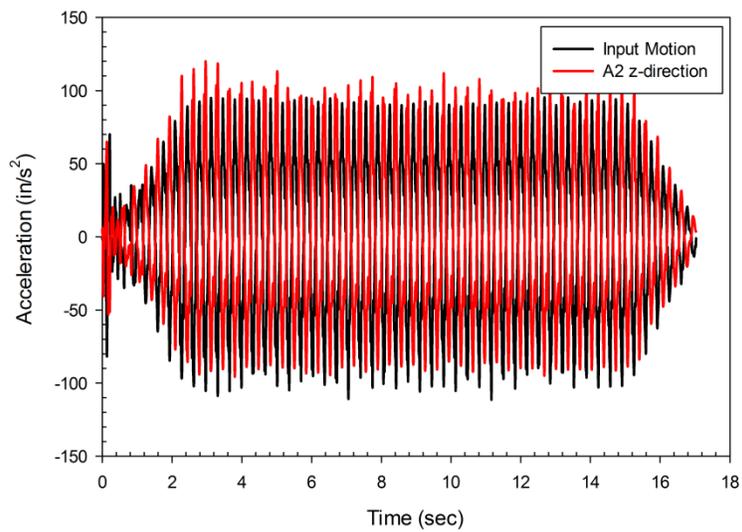
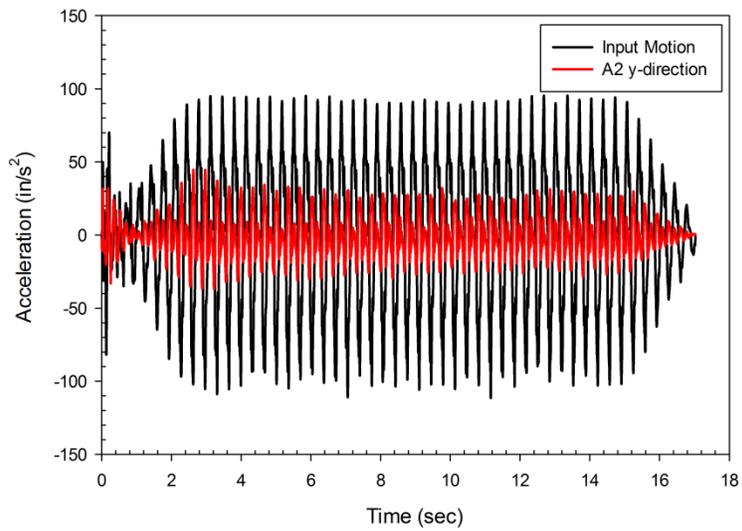
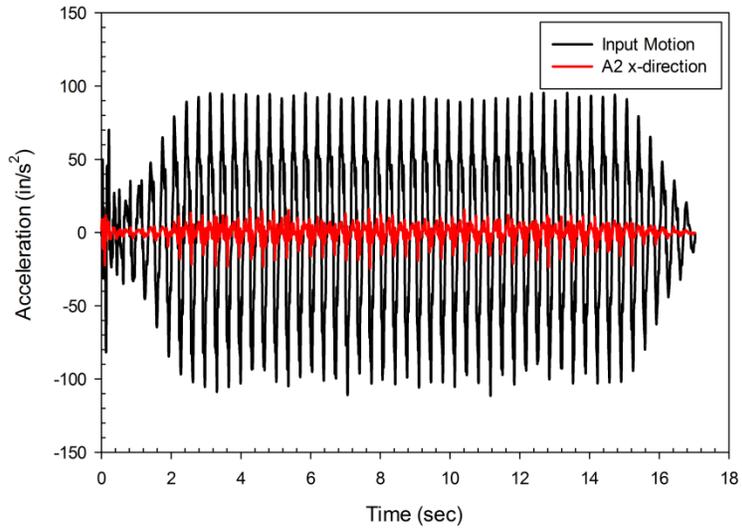
Section A-A

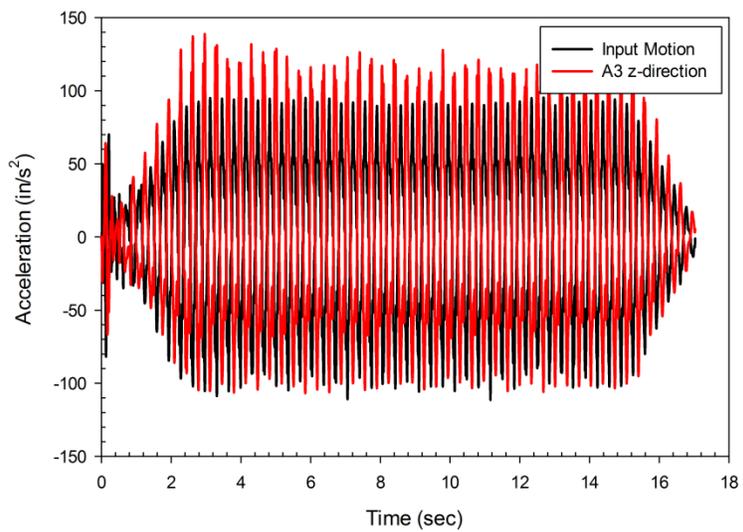
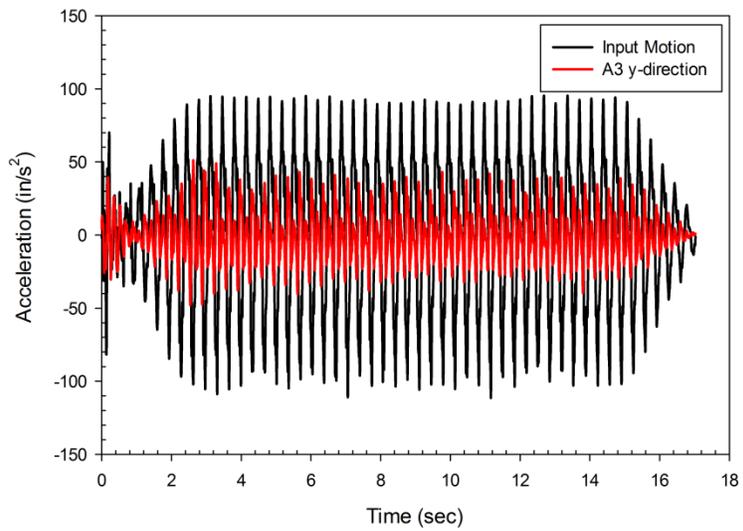
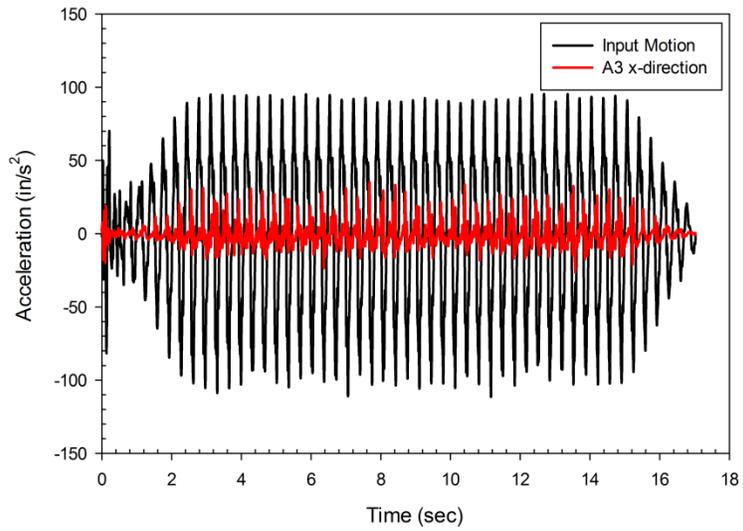


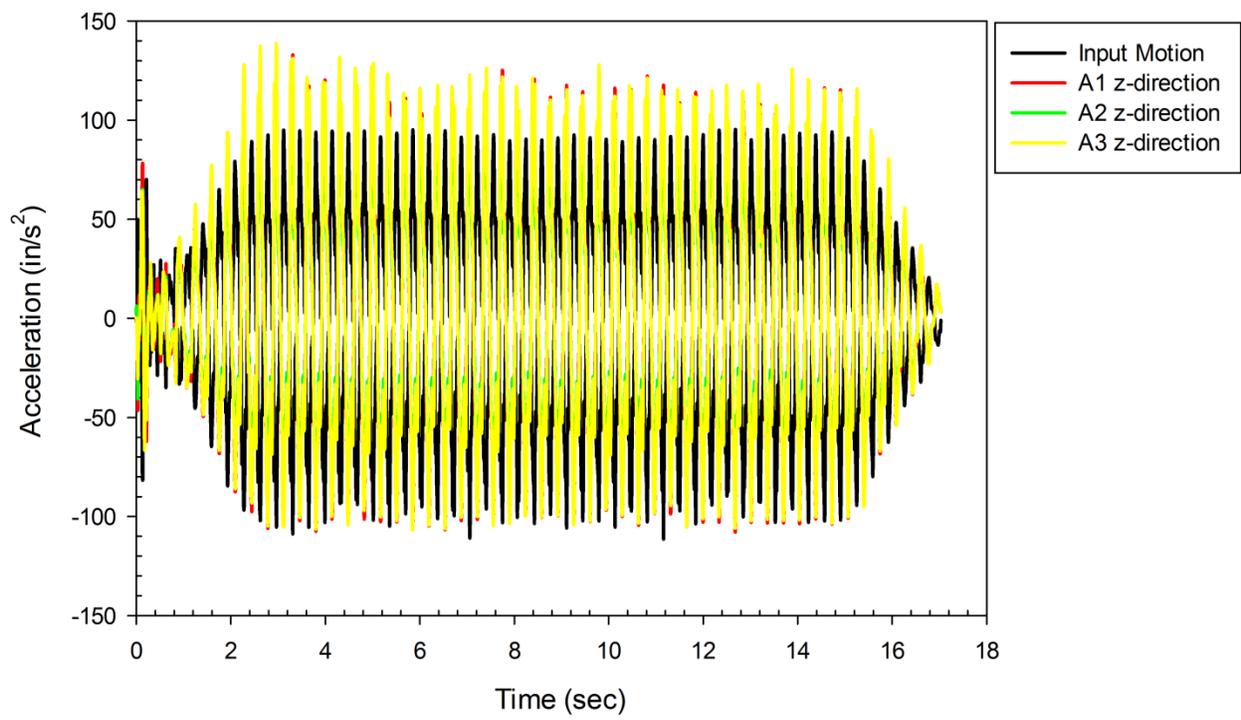
Section B-B







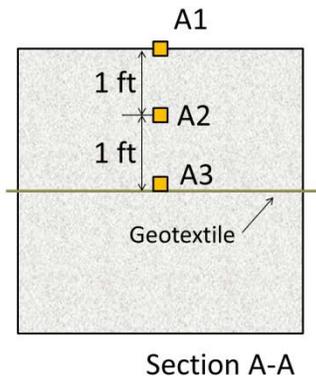
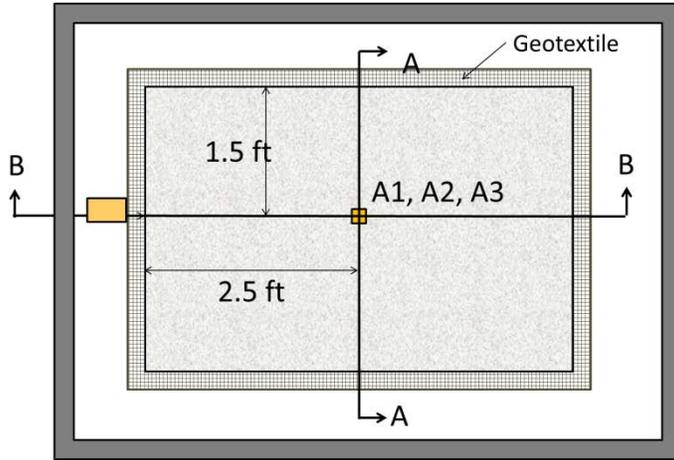




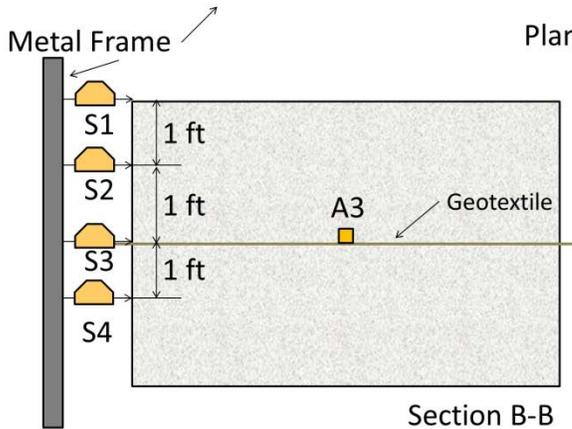
# Shake Table Test



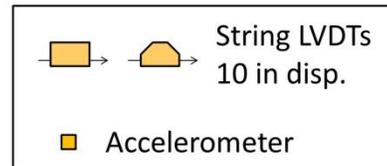
Project:	Cell Crete (Cellular Concrete)	Test Date:	9/14/16
Location:	----	Test No.:	2
Model Size:	3 ft by 5 ft	Vertical Stress:	164.0 psf
Model Height:	4 ft	Geogrid Depth:	2 ft
Motion Type:	1994 Northridge Earthquake	Characteristics:	N/A

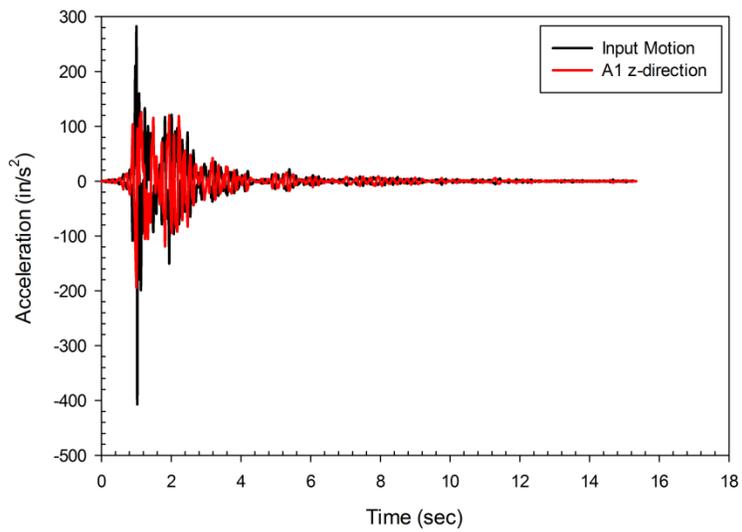
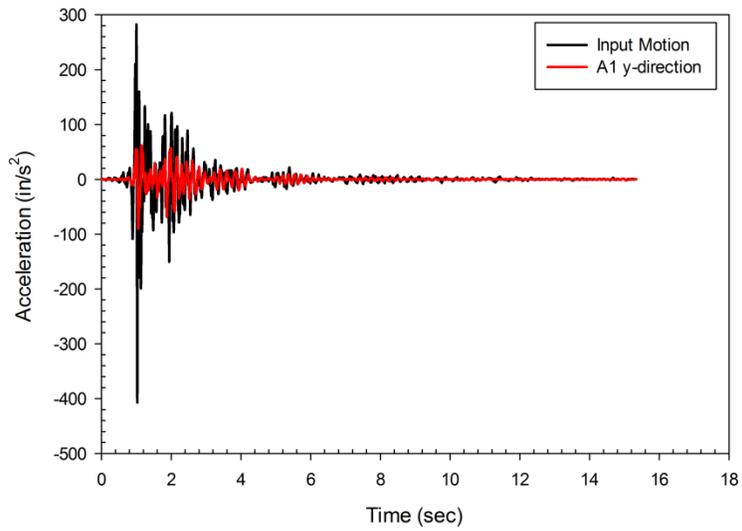
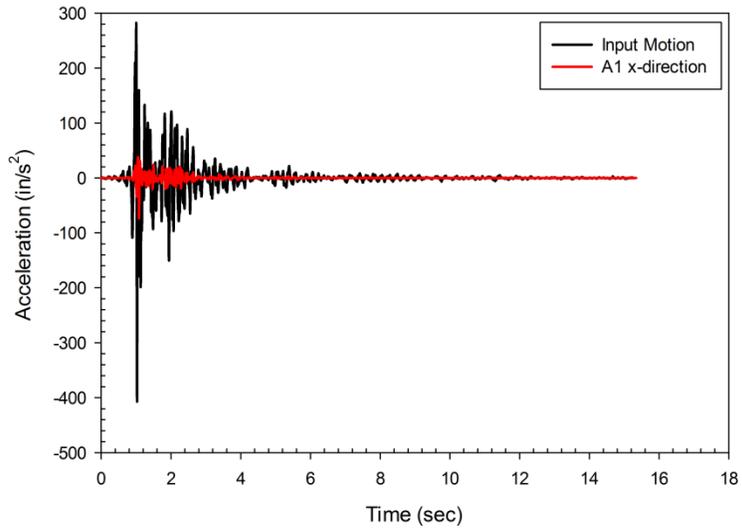


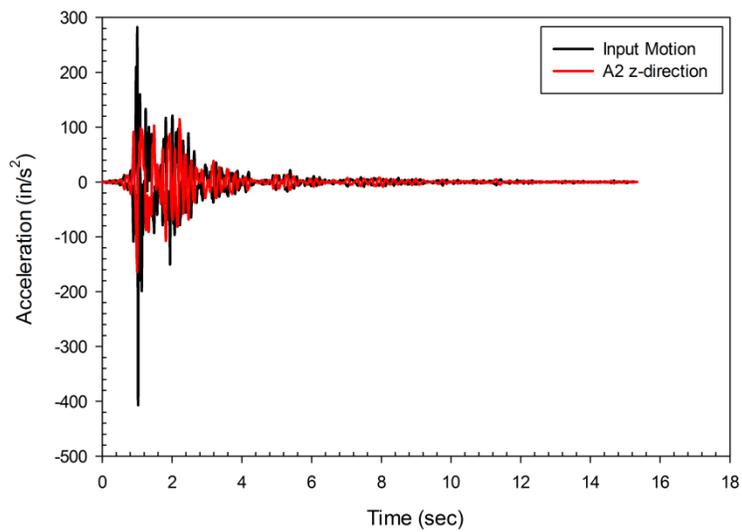
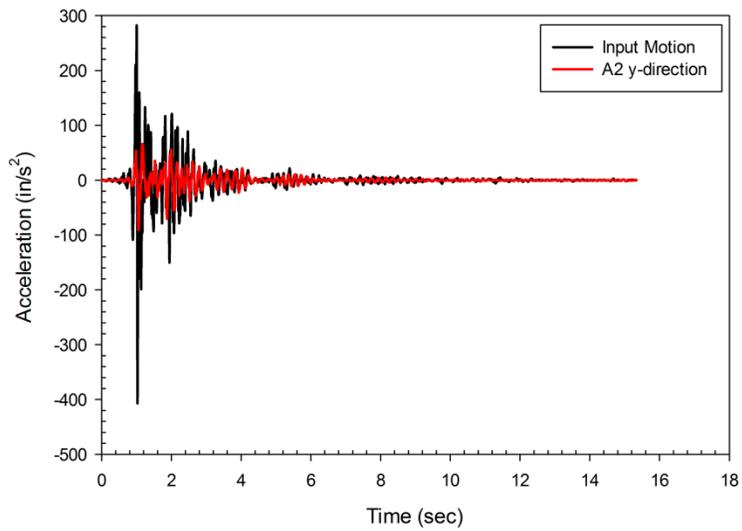
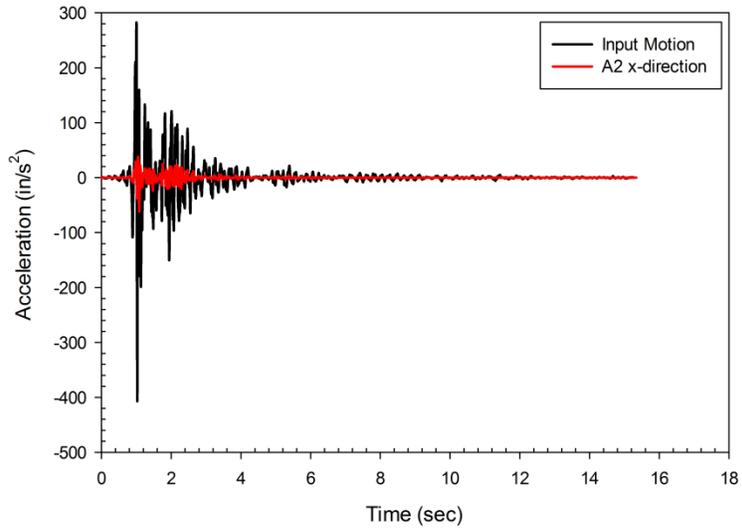
Plan View

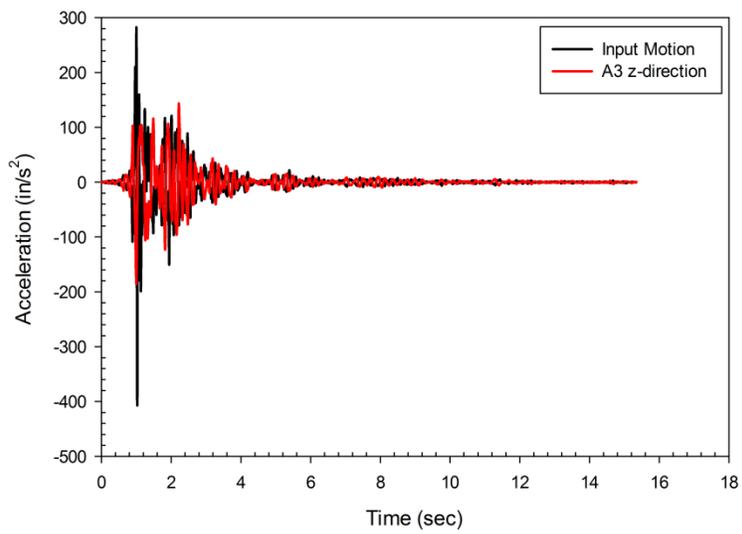
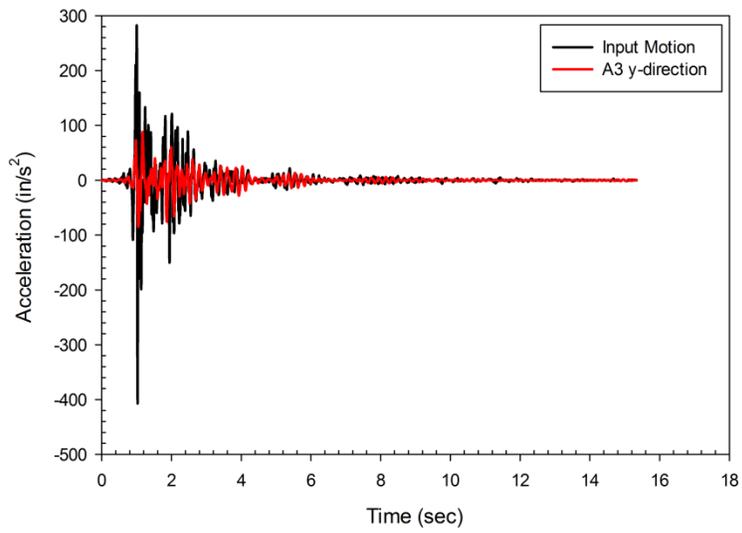
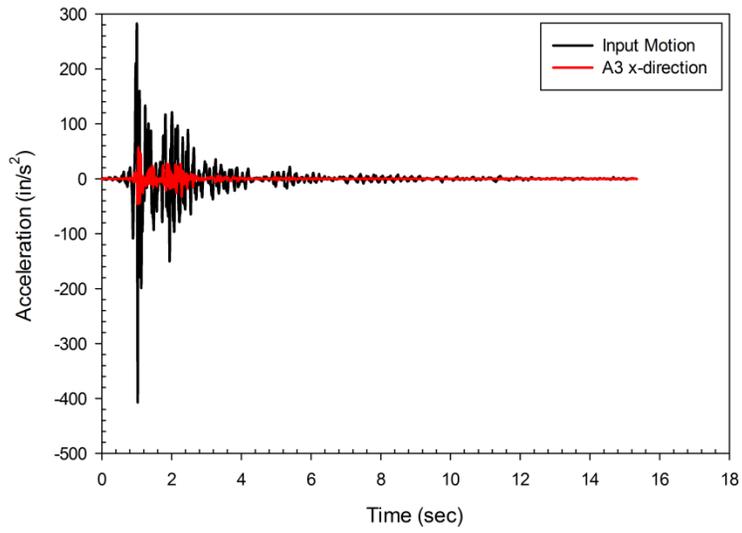


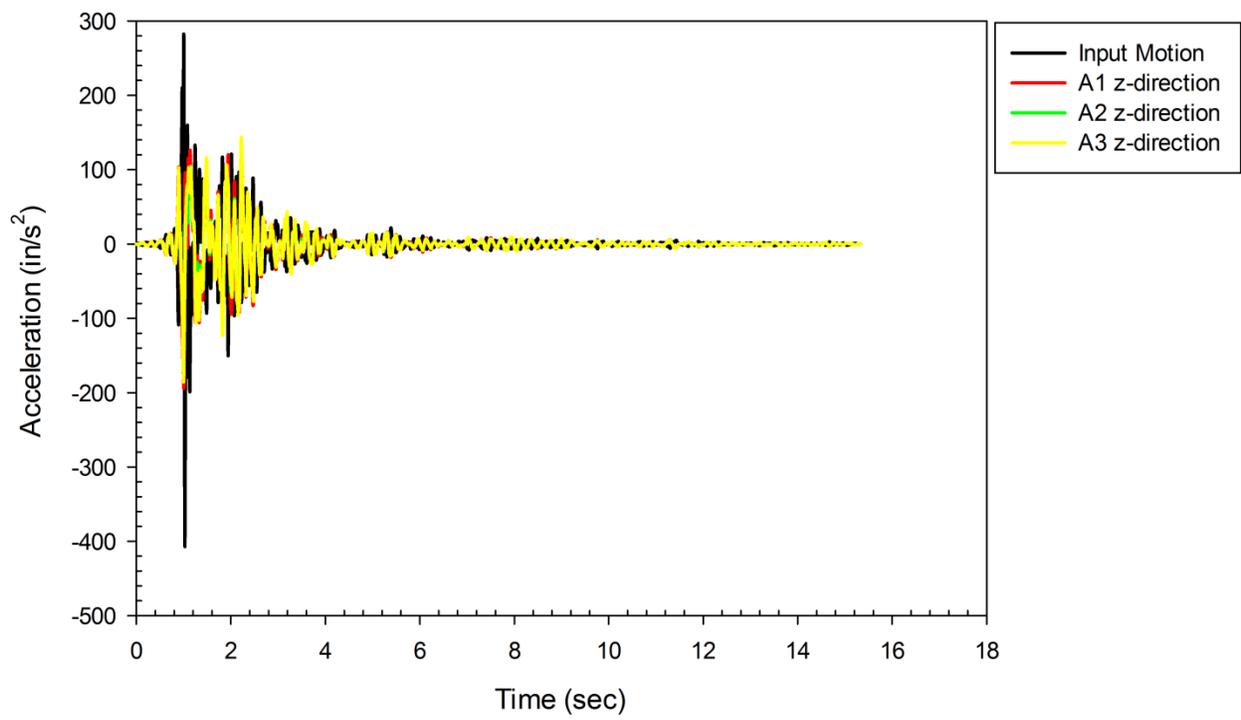
Section B-B







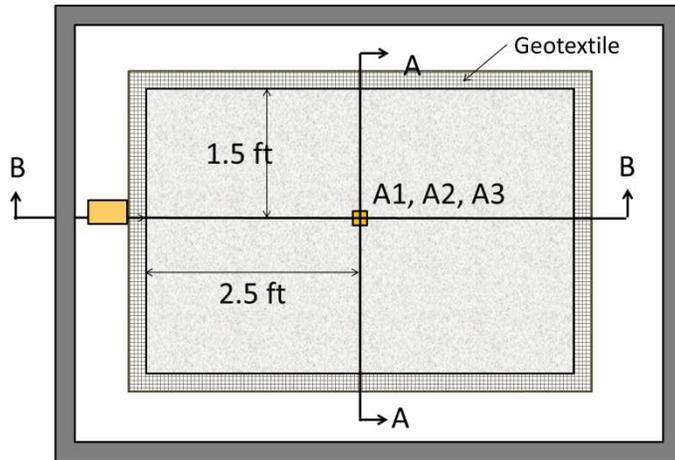




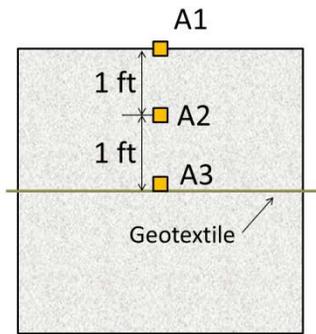
# Shake Table Test



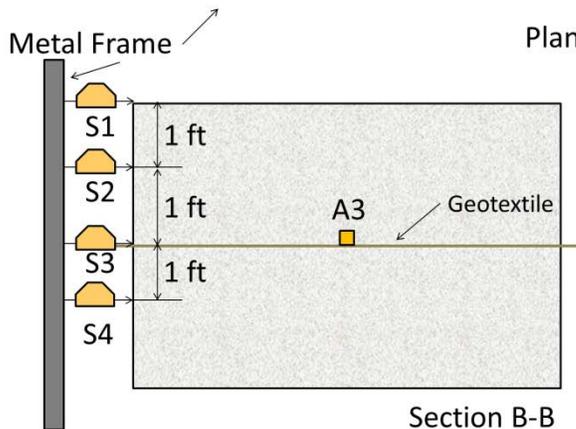
Project:	Cell Crete (Cellular Concrete)	Test Date:	9/14/16
Location:	----	Test No.:	3
Model Size:	3 ft by 5 ft	Vertical Stress:	164.0 psf
Model Height:	4 ft	Geogrid Depth:	2 ft
Motion Type:	Sinusoidal	Characteristics:	0.1g 2Hz



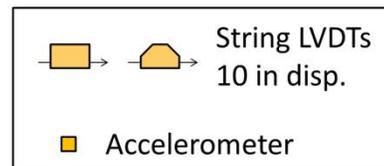
Plan View

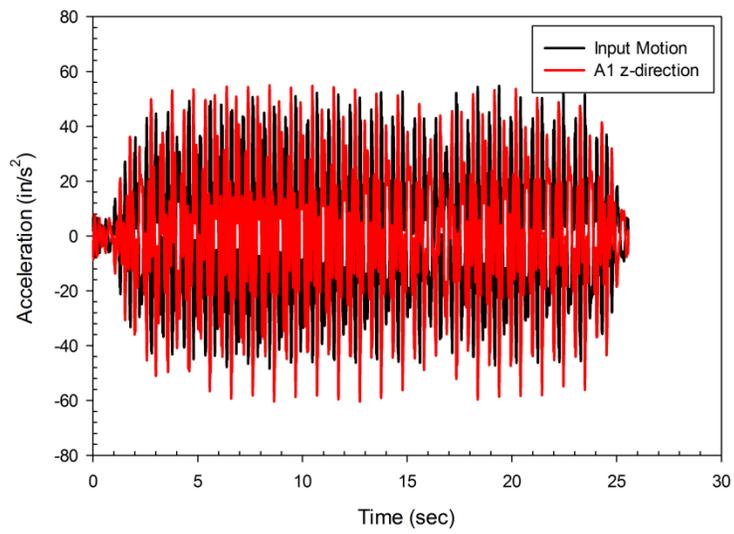
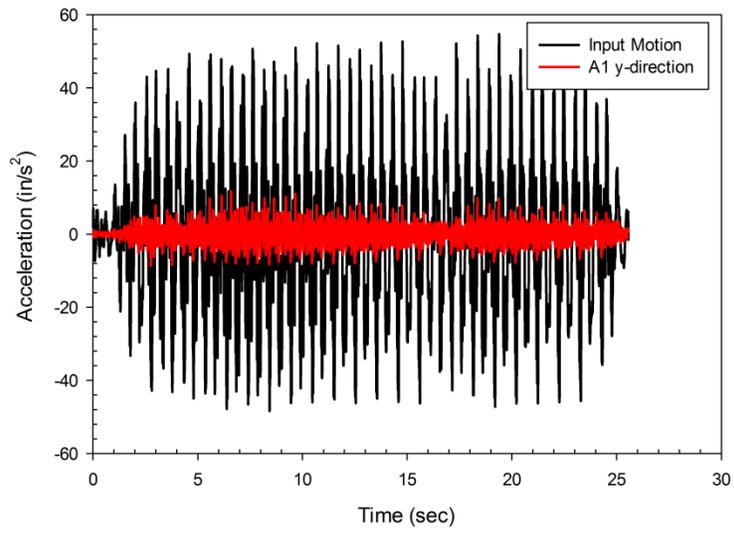
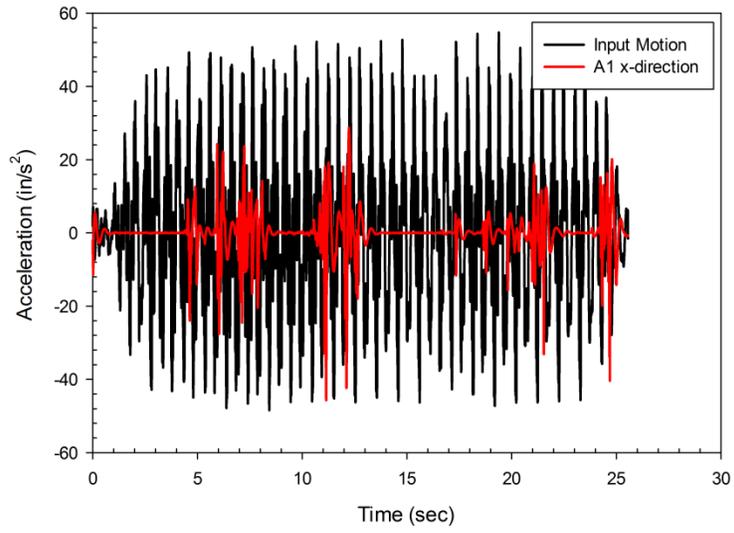


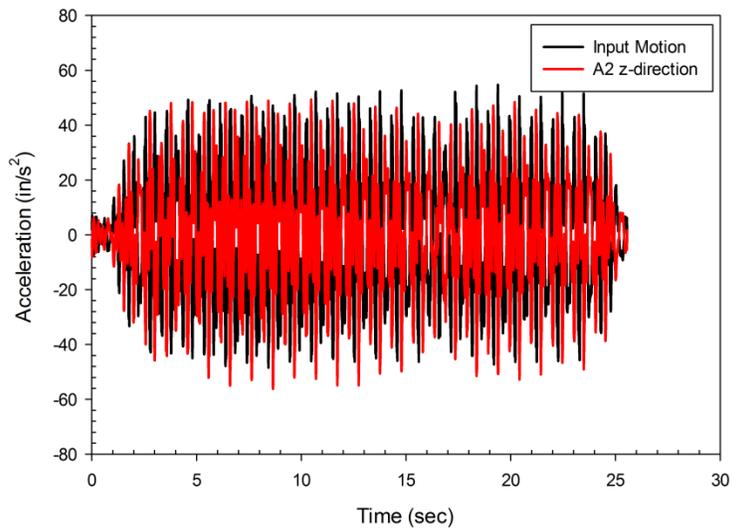
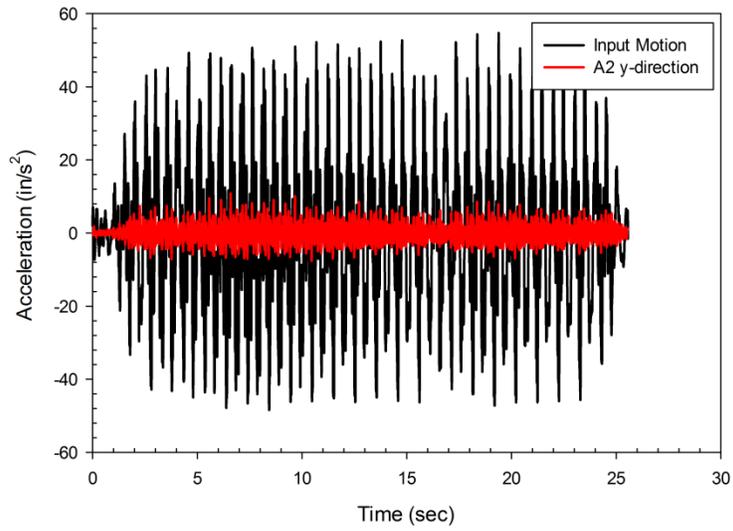
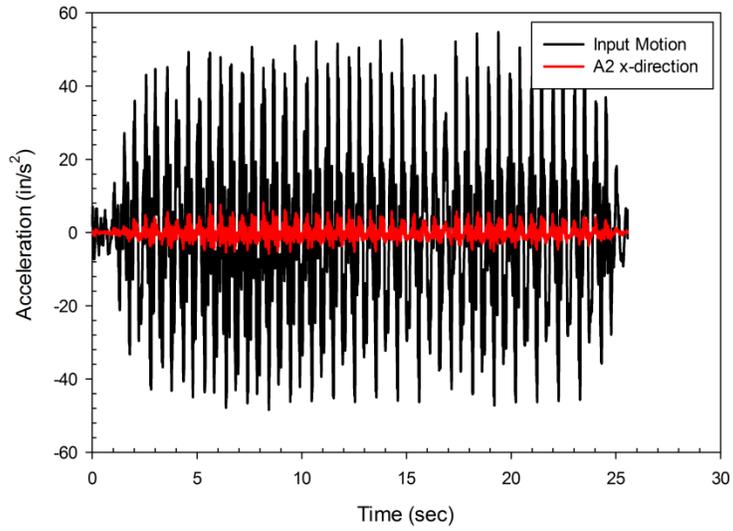
Section A-A

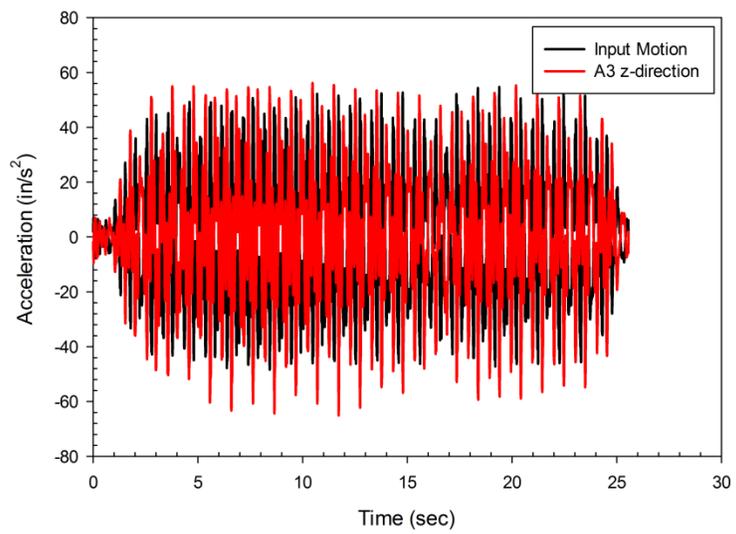
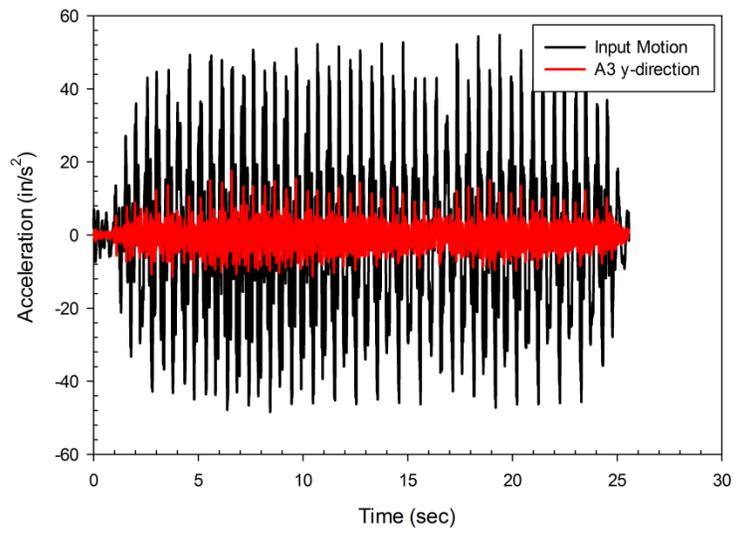
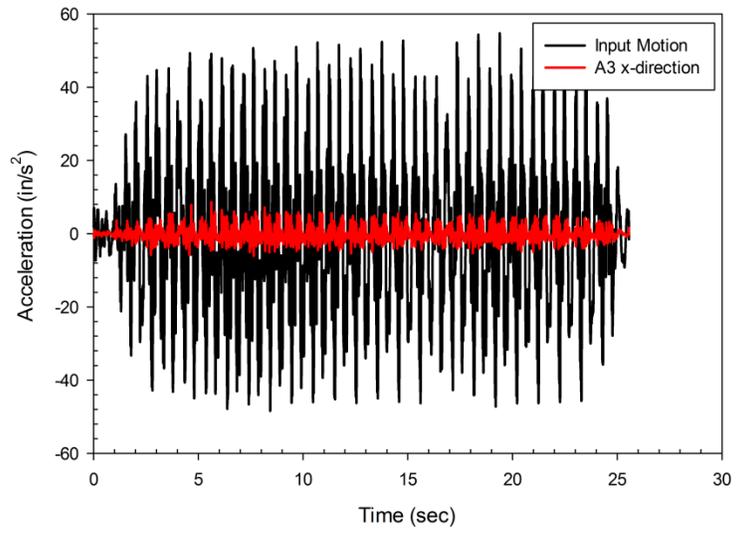


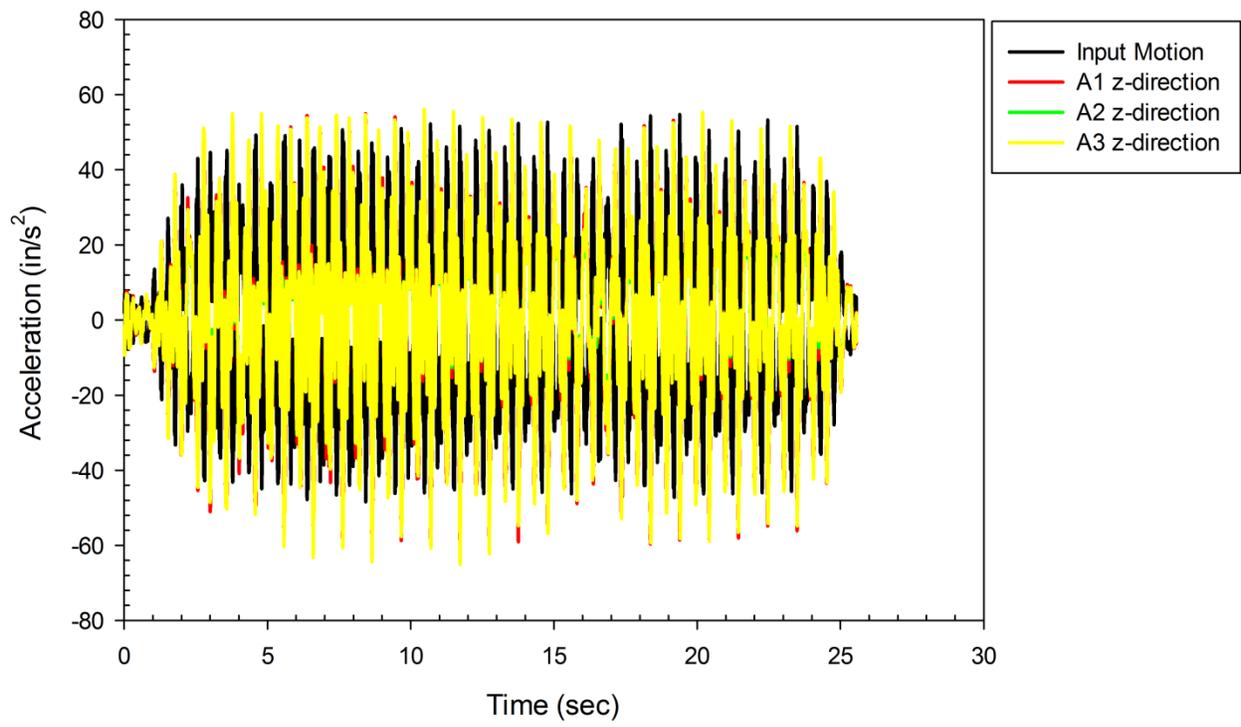
Section B-B







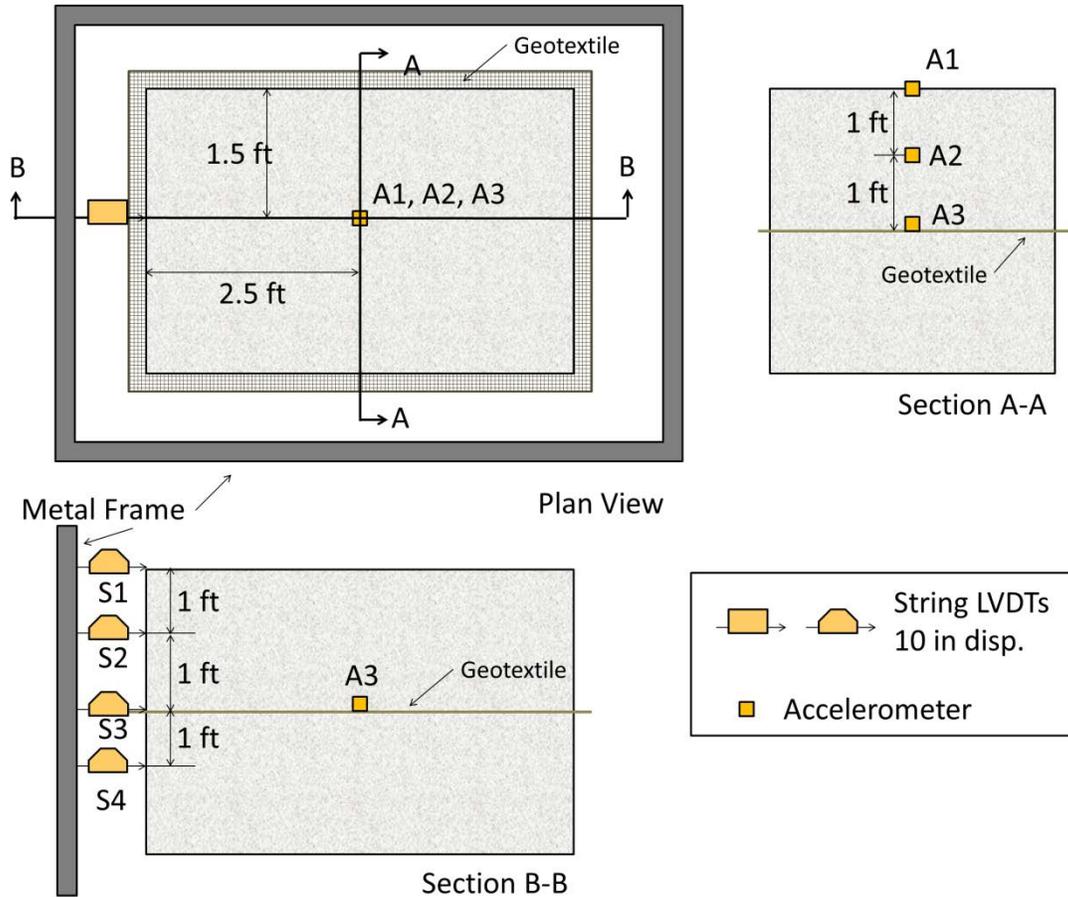


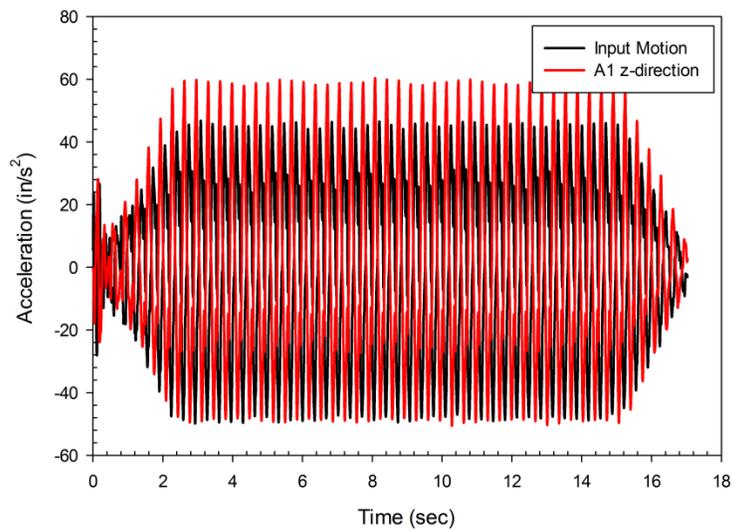
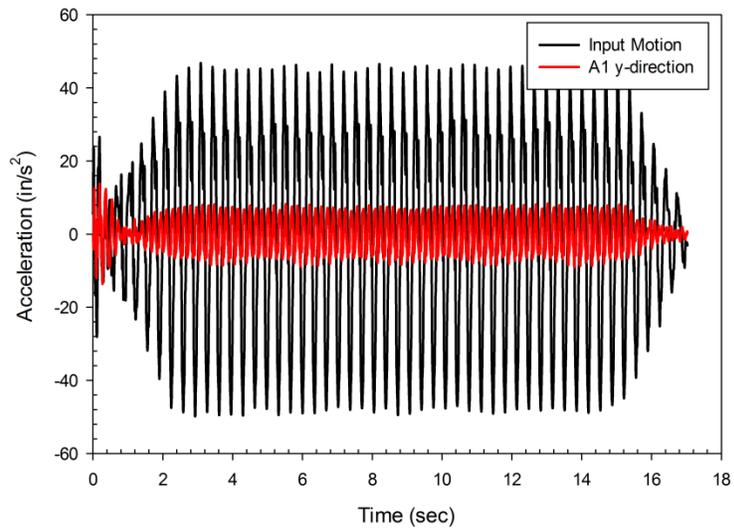
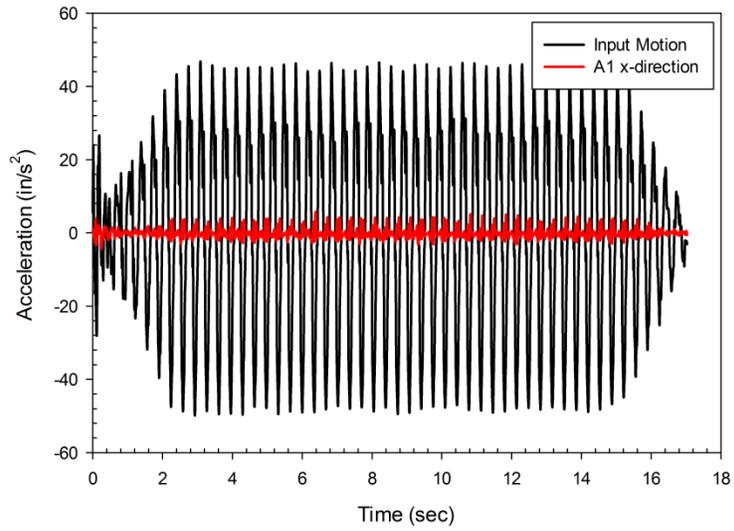


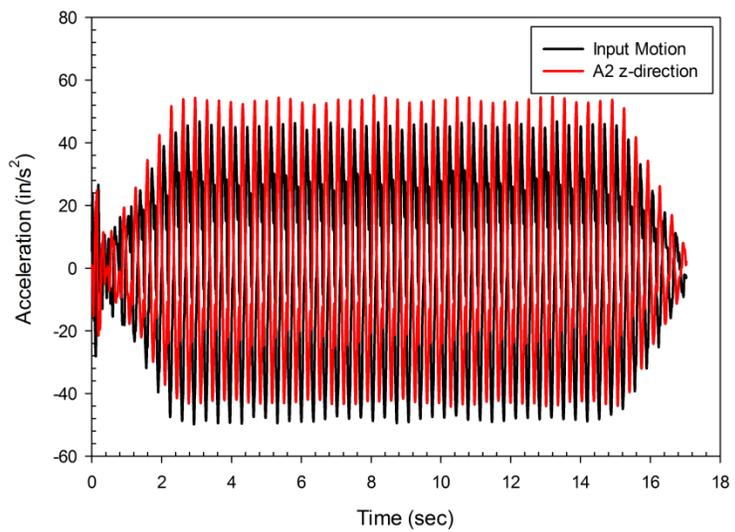
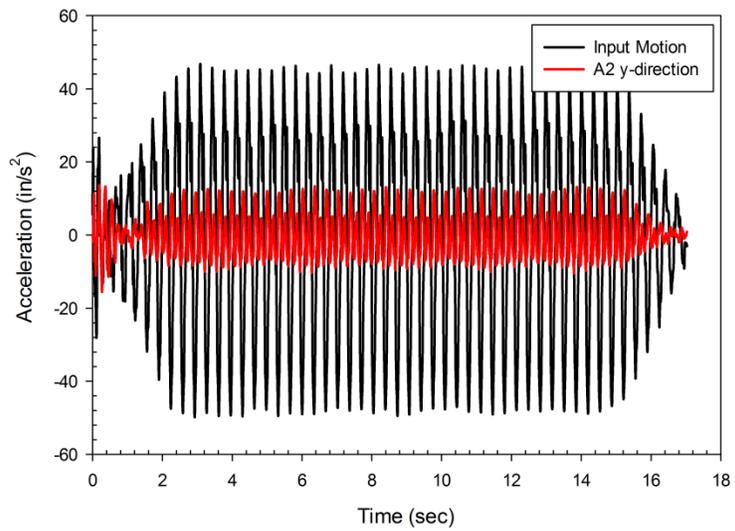
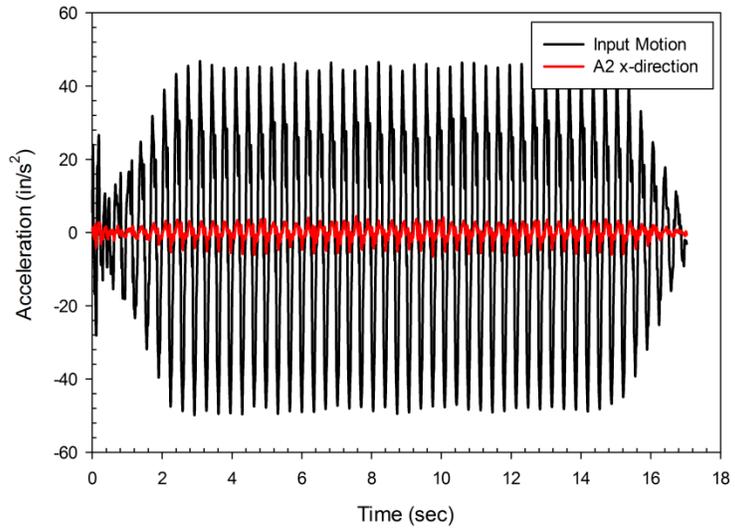
# Shake Table Test

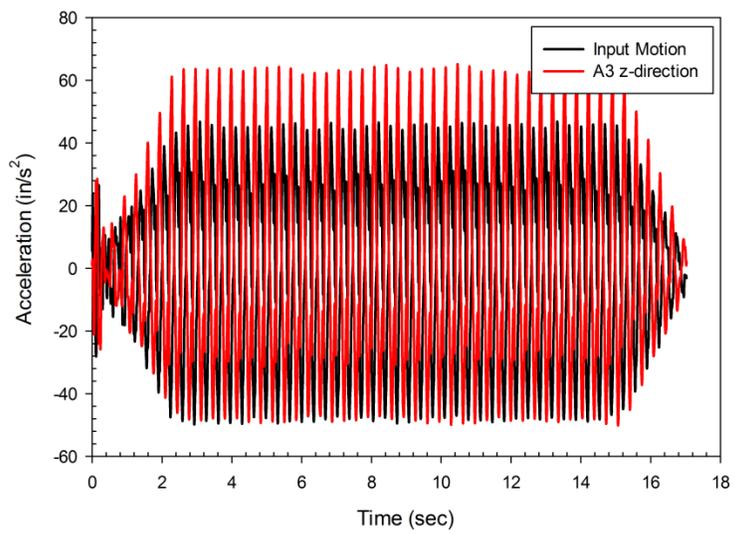
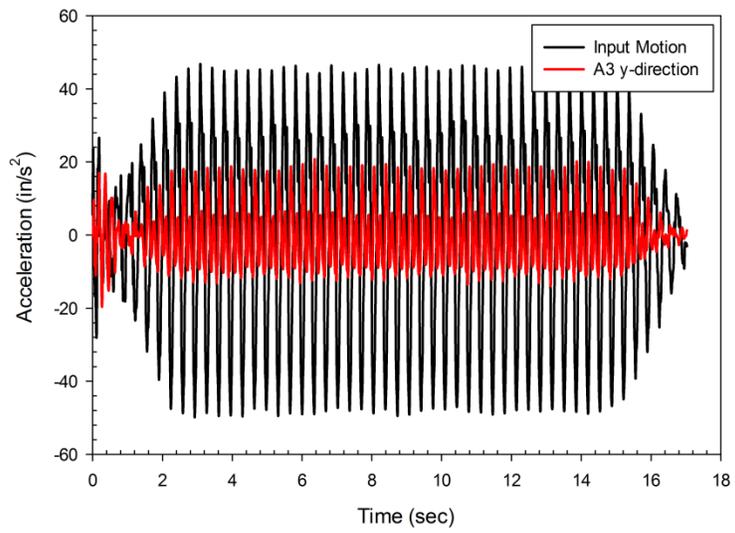
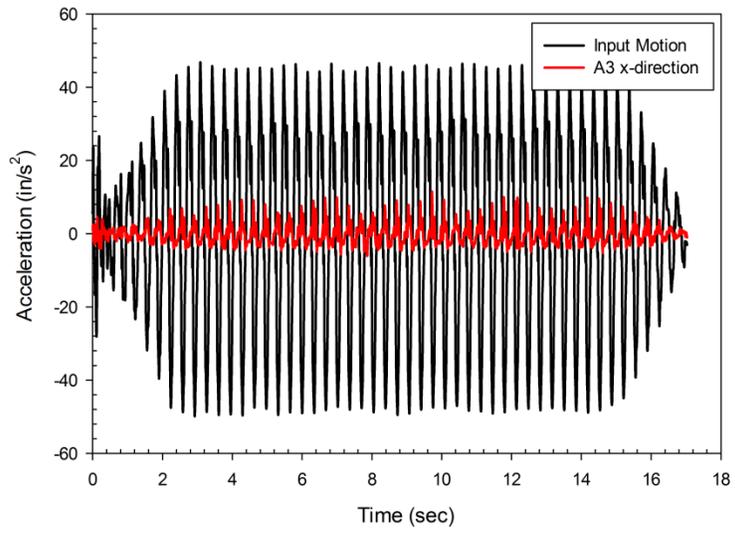


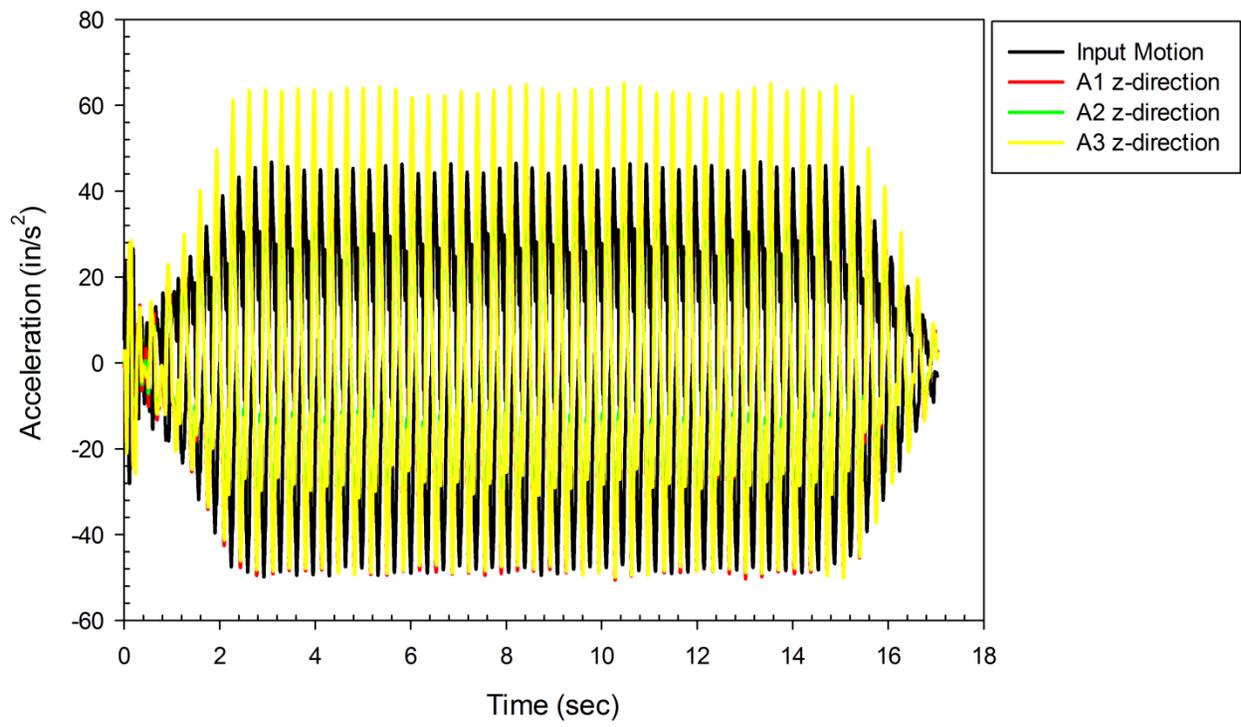
Project:	Cell Crete (Cellular Concrete)	Test Date:	9/14/16
Location:	----	Test No.:	3
Model Size:	3 ft by 5 ft	Vertical Stress:	164.0 psf
Model Height:	4 ft	Geogrid Depth:	2 ft
Motion Type:	Sinusoidal	Characteristics:	0.1g 3Hz







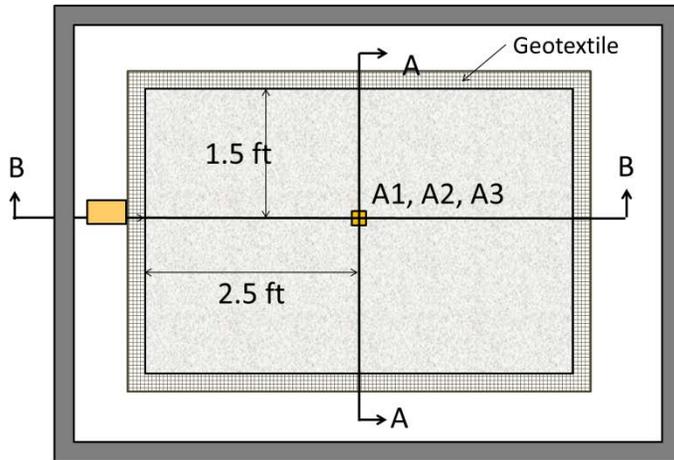




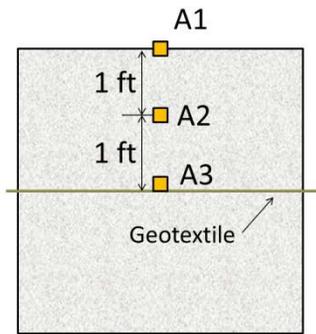
# Shake Table Test



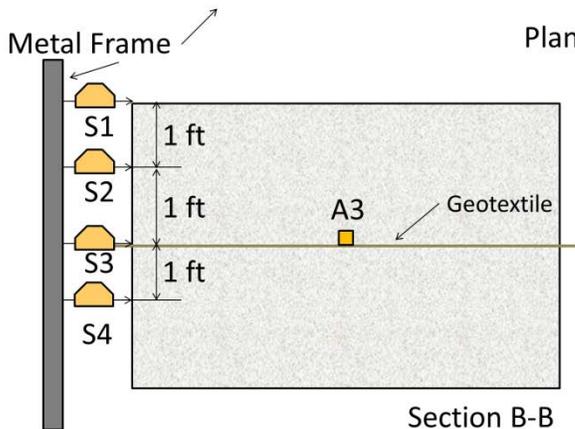
Project:	Cell Crete (Cellular Concrete)	Test Date:	9/14/16
Location:	----	Test No.:	3
Model Size:	3 ft by 5 ft	Vertical Stress:	164.0 psf
Model Height:	4 ft	Geogrid Depth:	2 ft
Motion Type:	Sinusoidal	Characteristics:	0.2g 2Hz



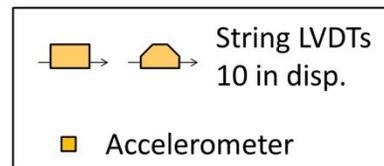
Plan View

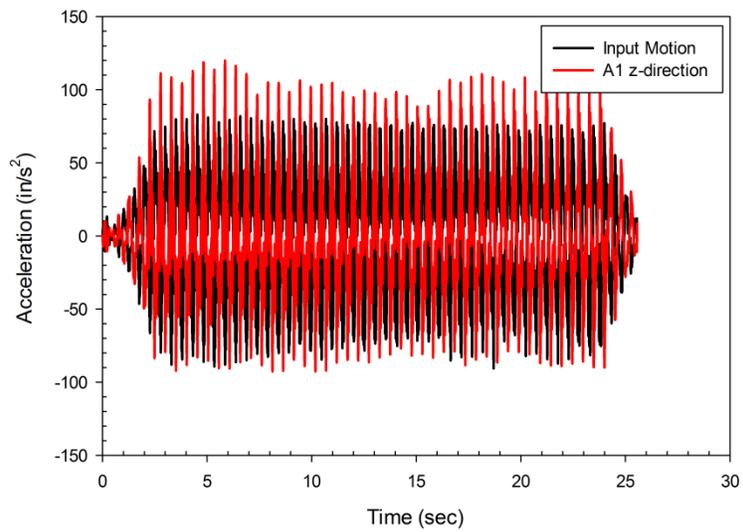
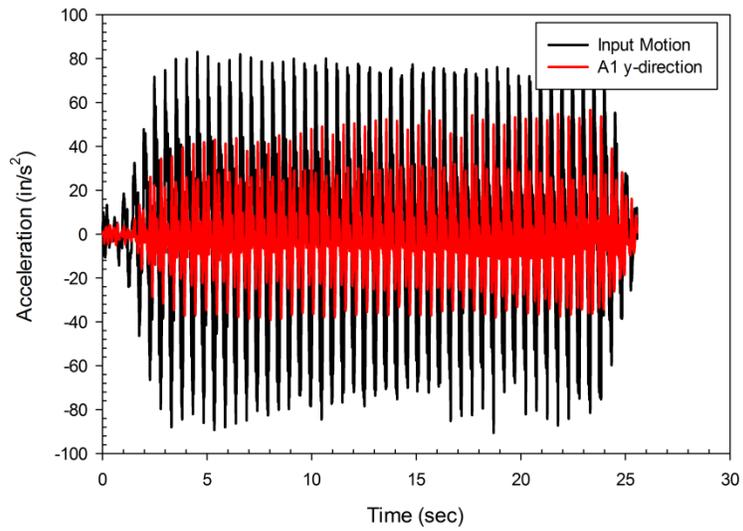
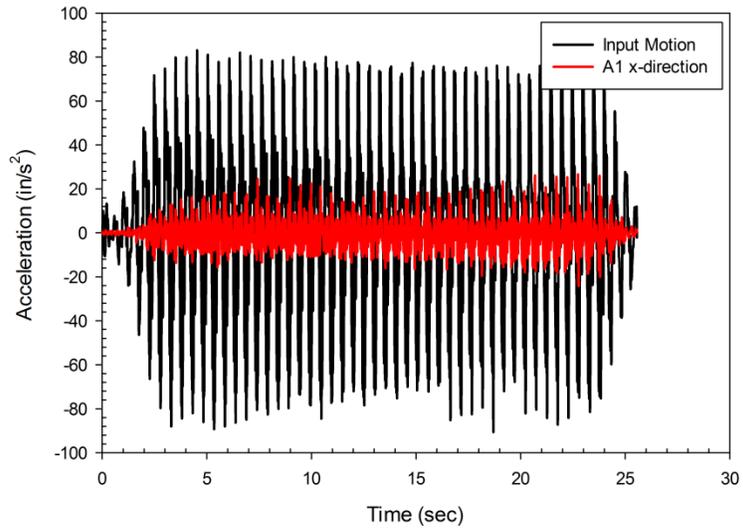


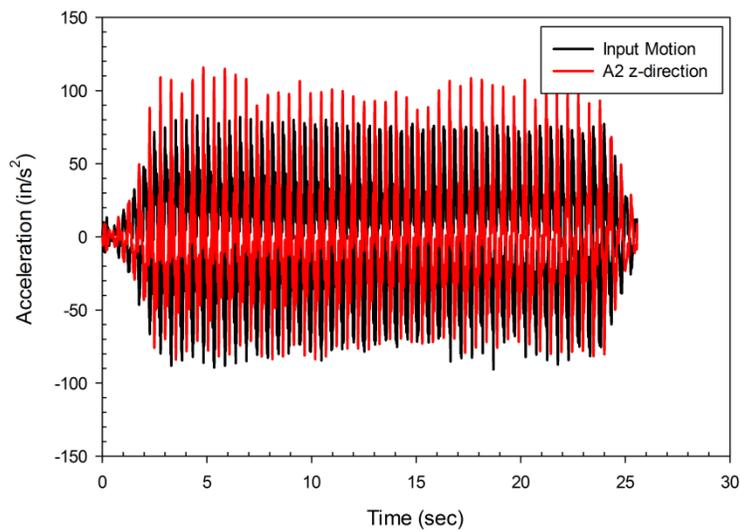
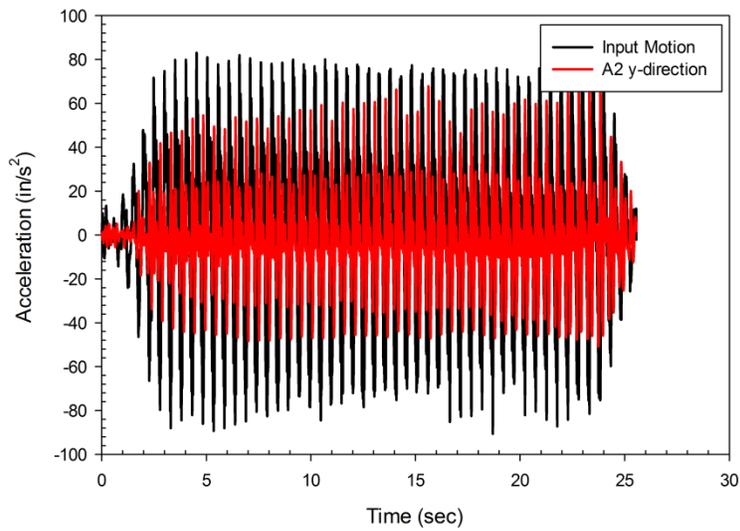
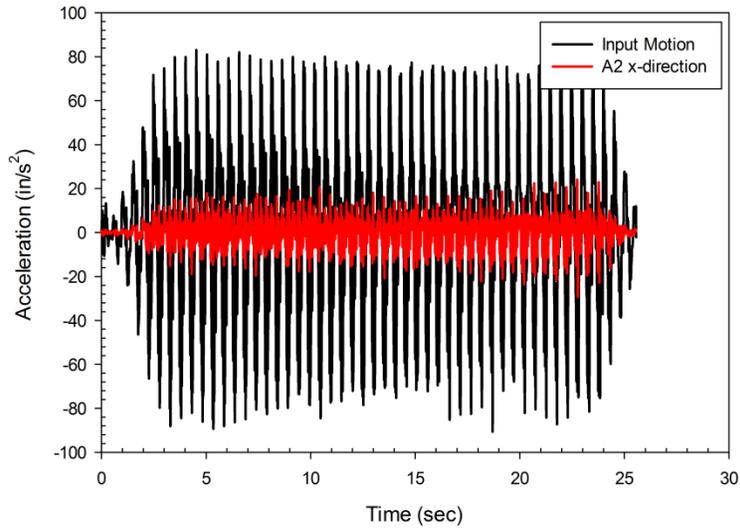
Section A-A

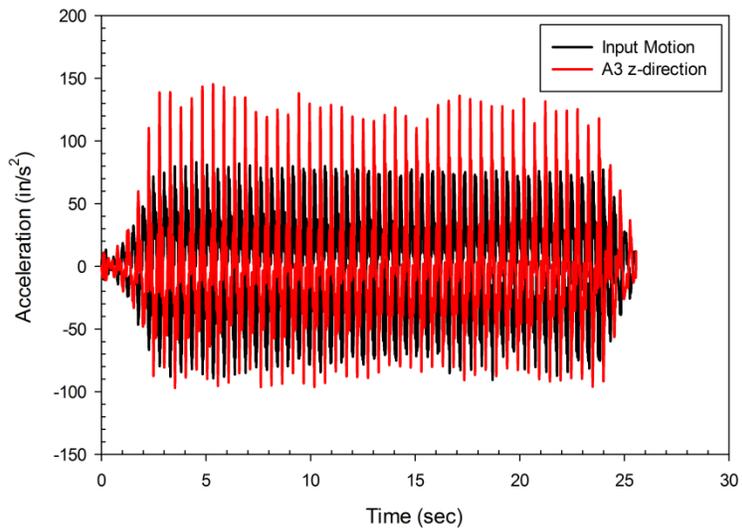
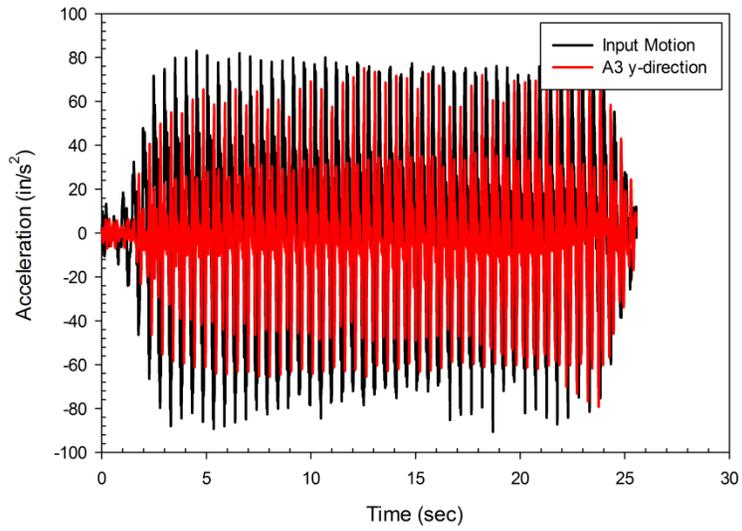
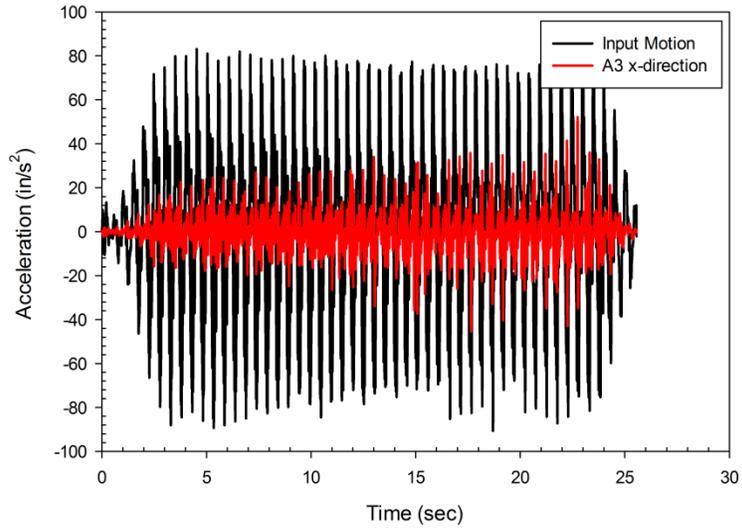


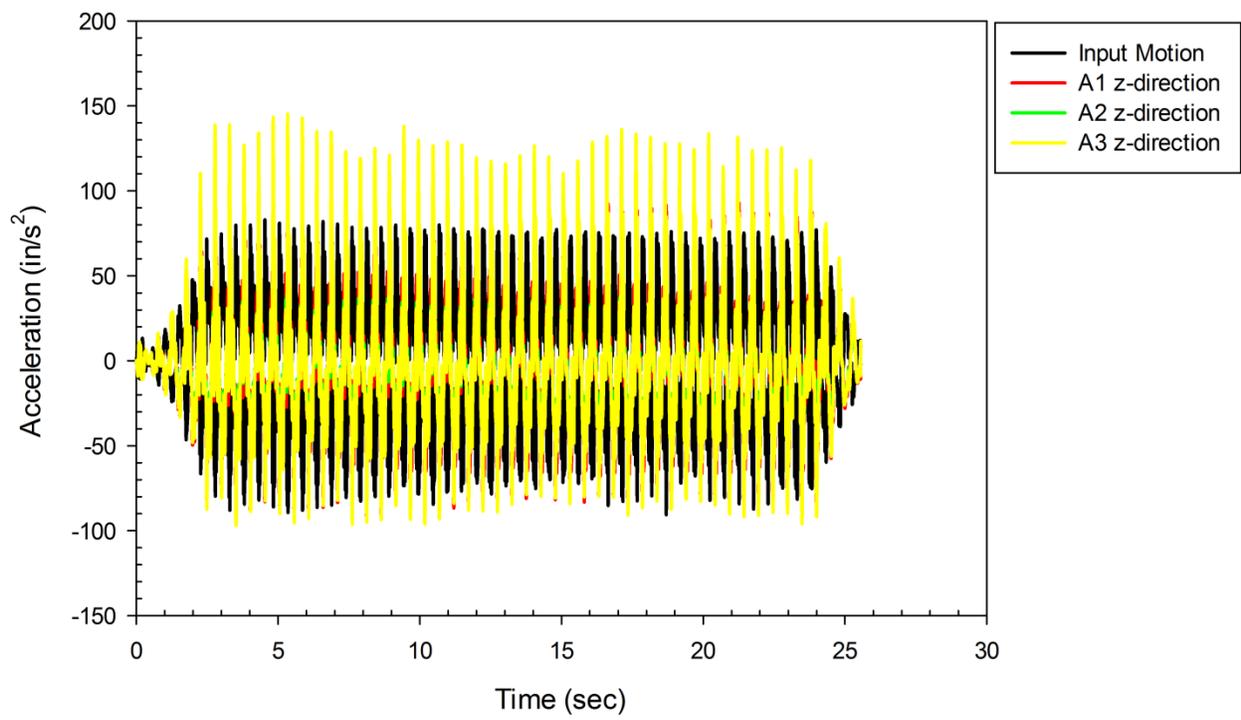
Section B-B







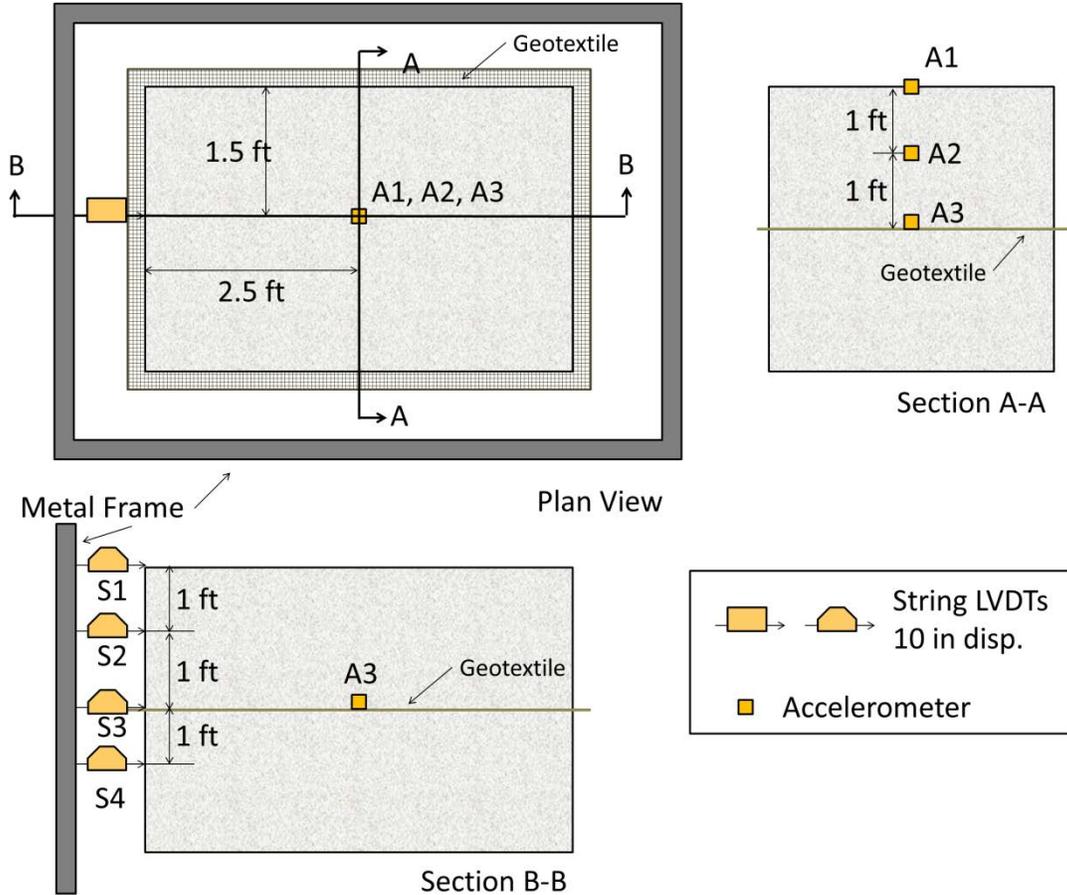


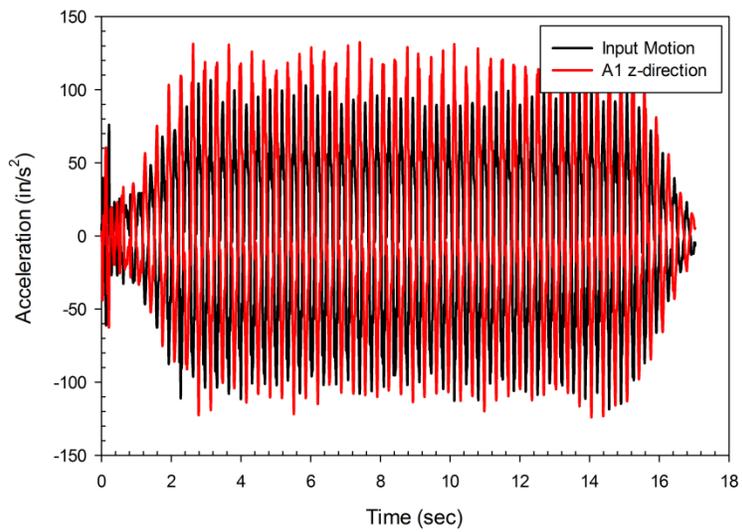
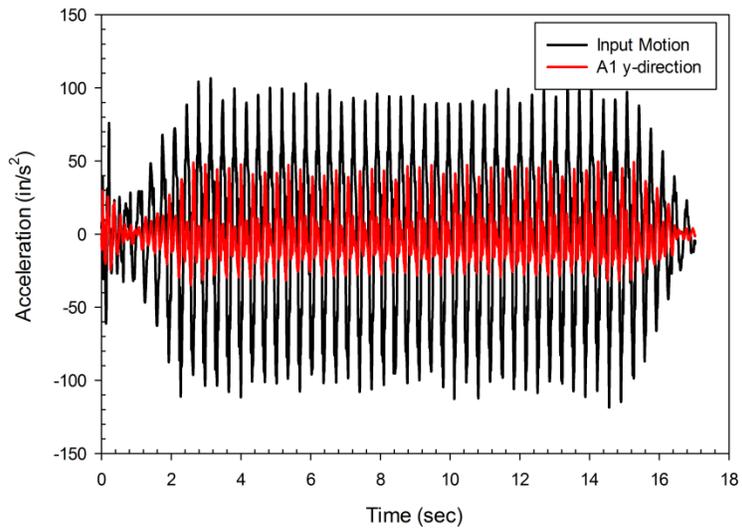
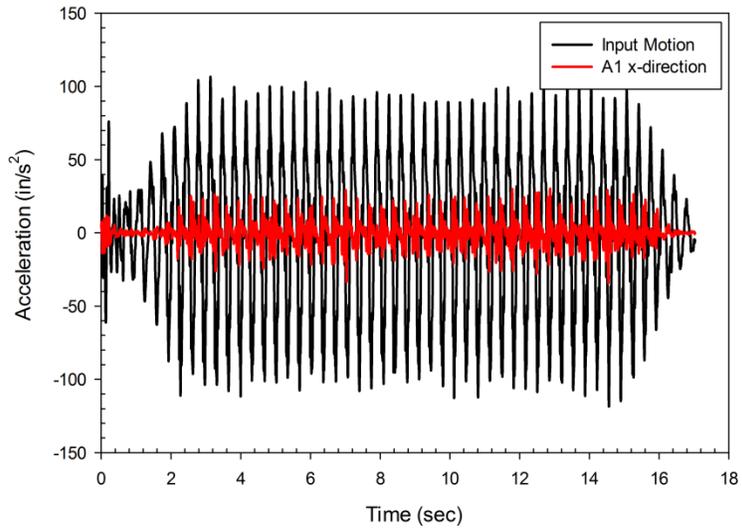


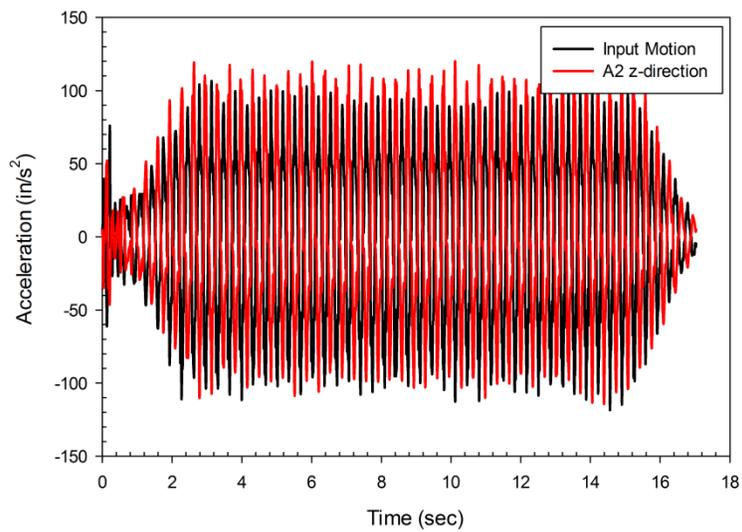
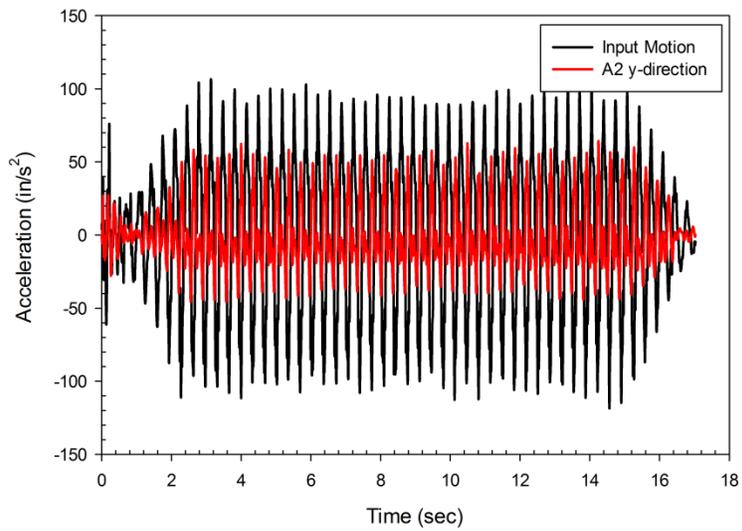
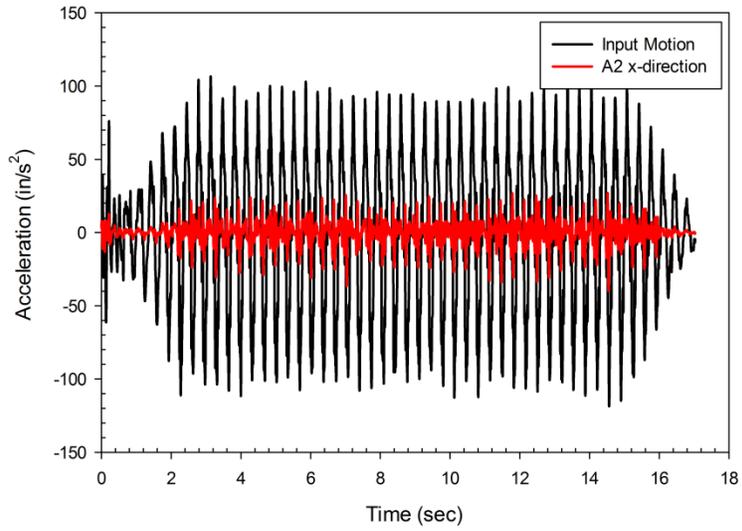
# Shake Table Test

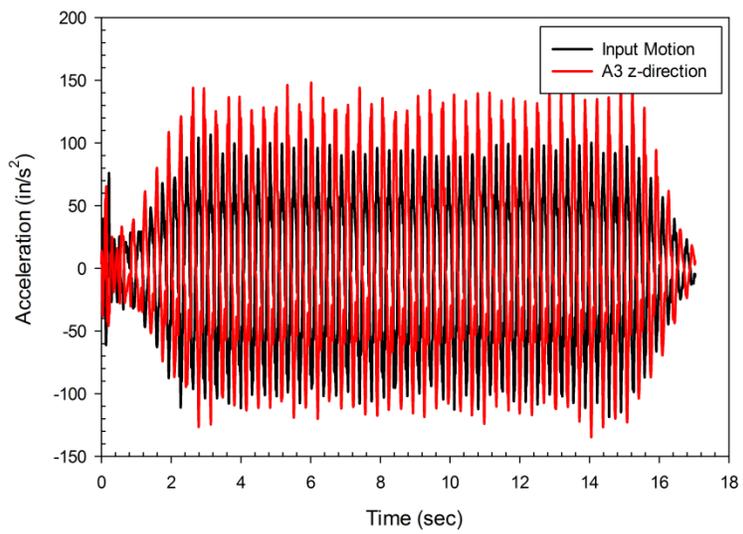
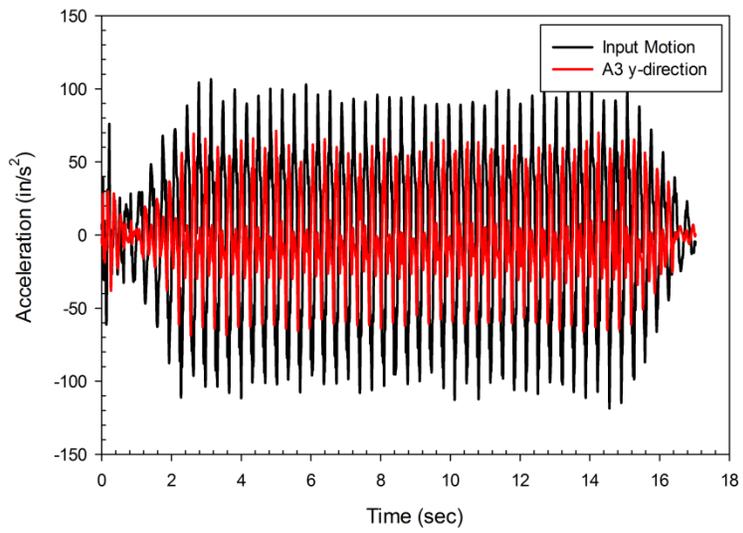
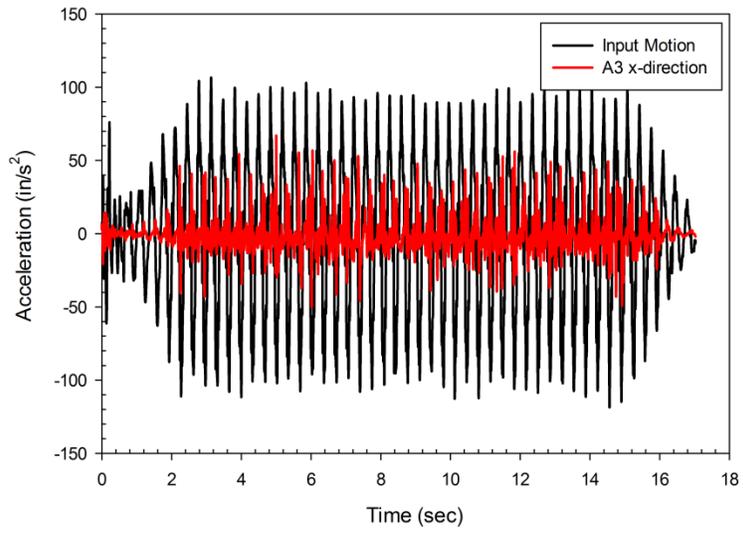


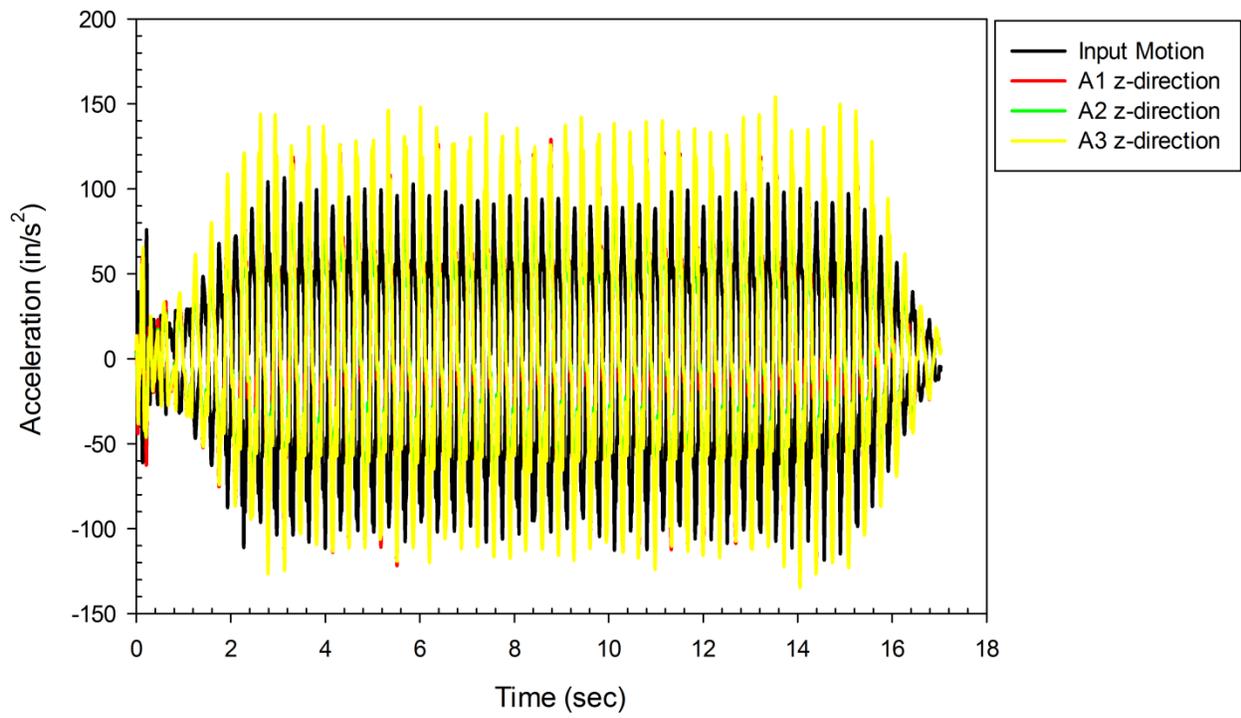
Project:	Cell Crete (Cellular Concrete)	Test Date:	9/14/16
Location:	----	Test No.:	3
Model Size:	3 ft by 5 ft	Vertical Stress:	164.0 psf
Model Height:	4 ft	Geogrid Depth:	2 ft
Motion Type:	Sinusoidal	Characteristics:	0.2g 3Hz







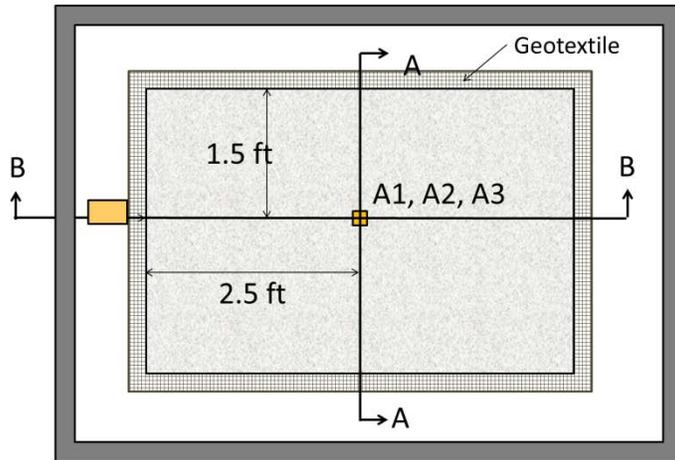




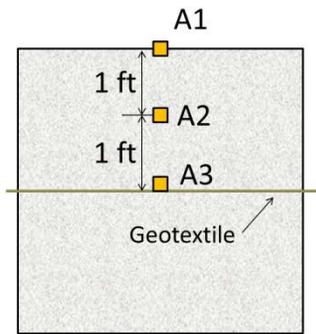
# Shake Table Test



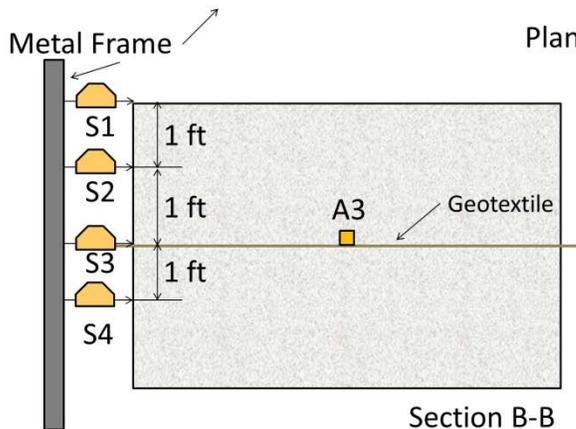
Project:	Cell Crete (Cellular Concrete)	Test Date:	9/14/16
Location:	----	Test No.:	3
Model Size:	3 ft by 5 ft	Vertical Stress:	164.0 psf
Model Height:	4 ft	Geogrid Depth:	2 ft
Motion Type:	1994 Northridge Earthquake	Characteristics:	N/A



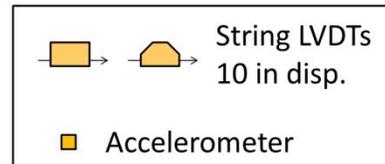
Plan View

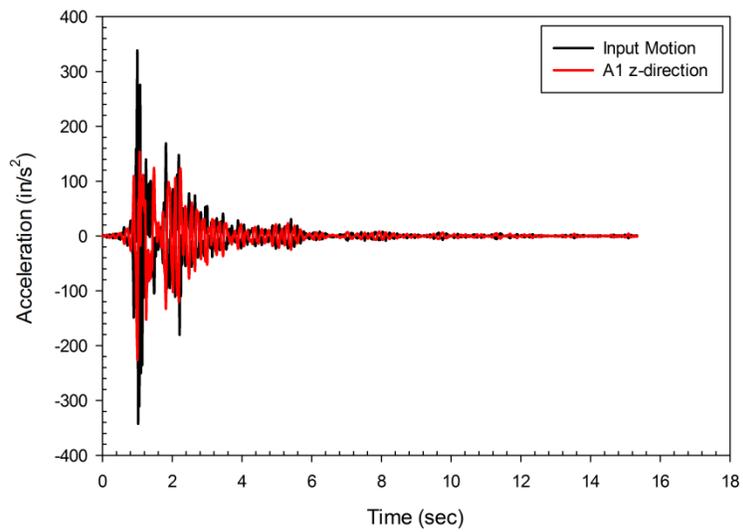
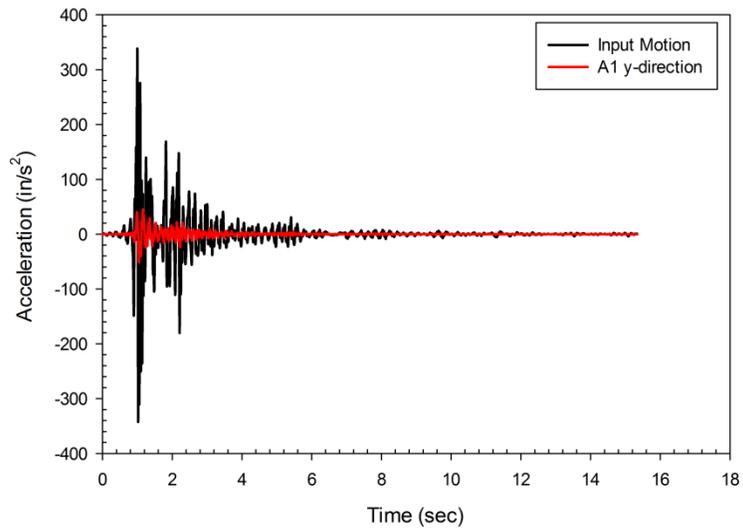
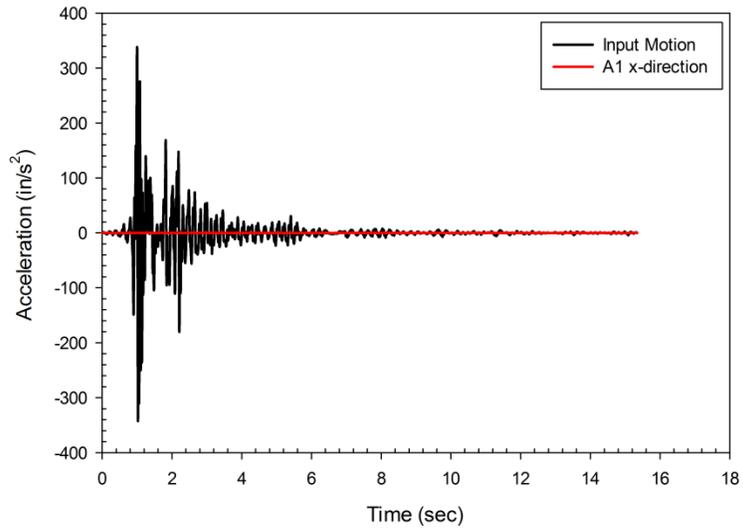


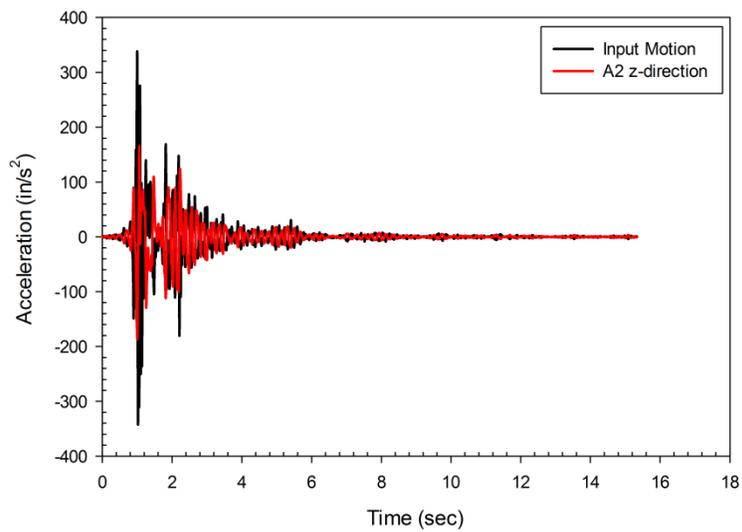
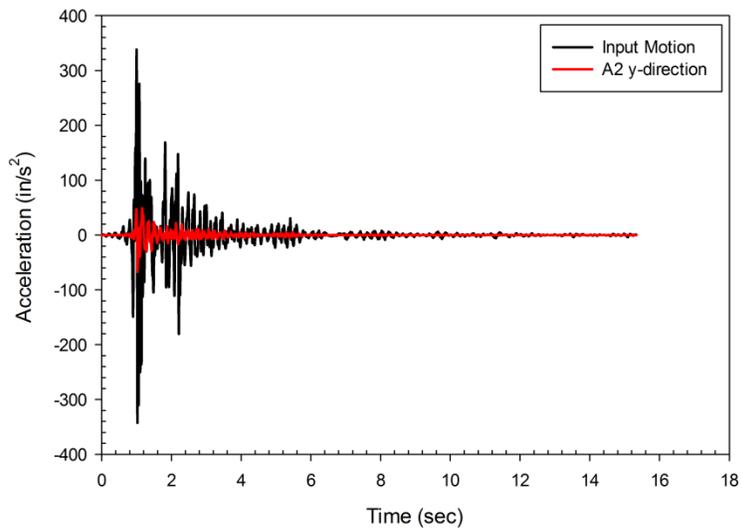
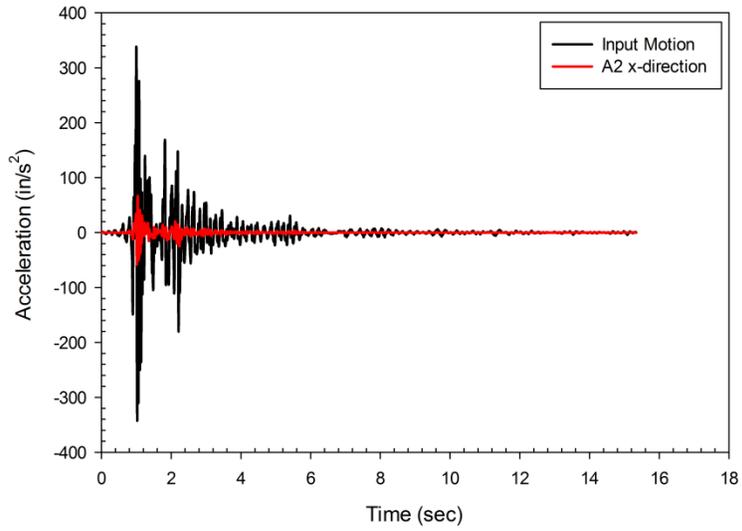
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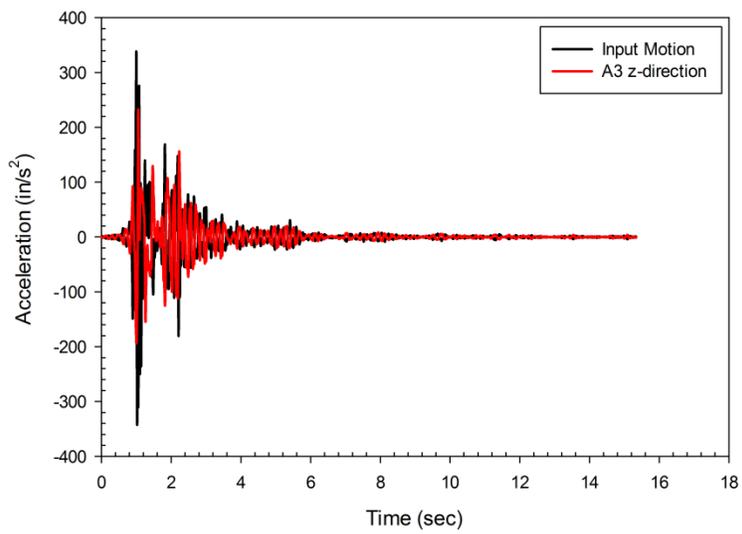
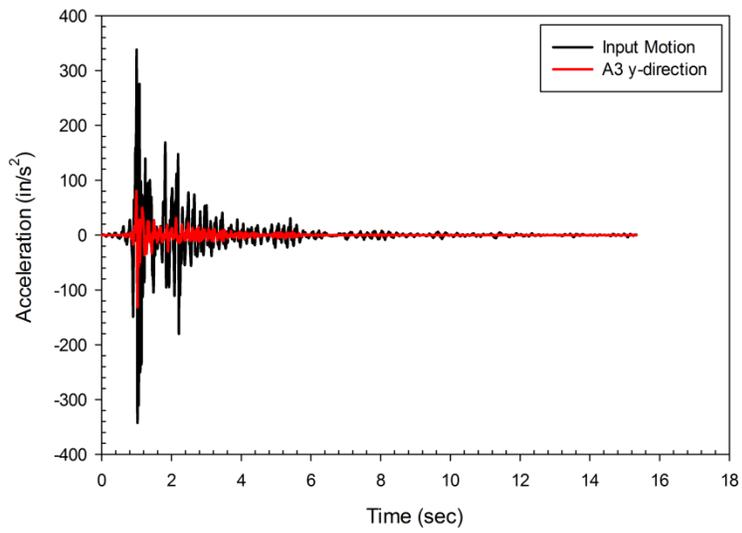
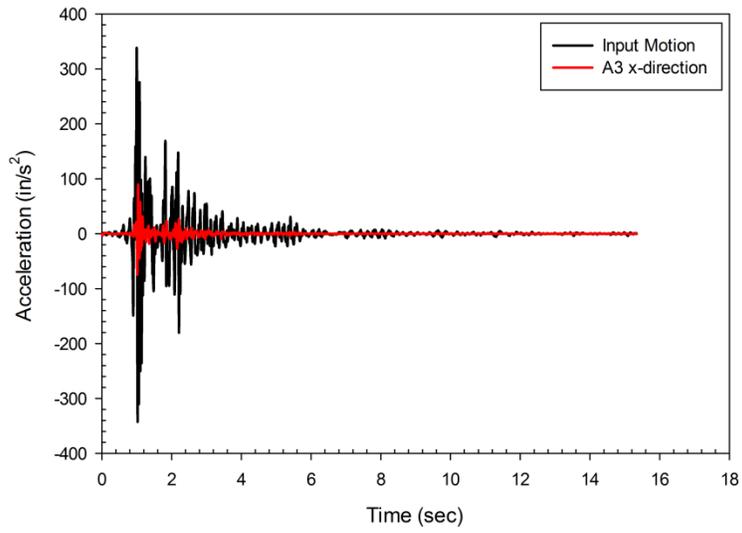


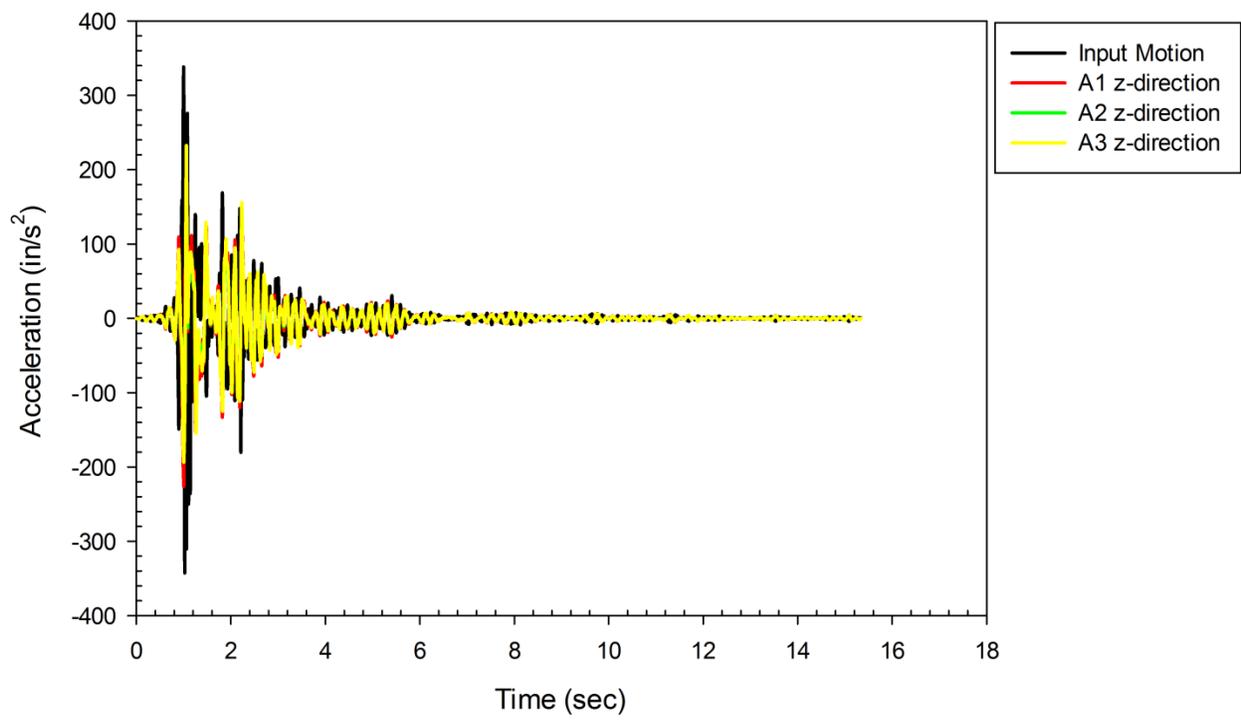
Section B-B









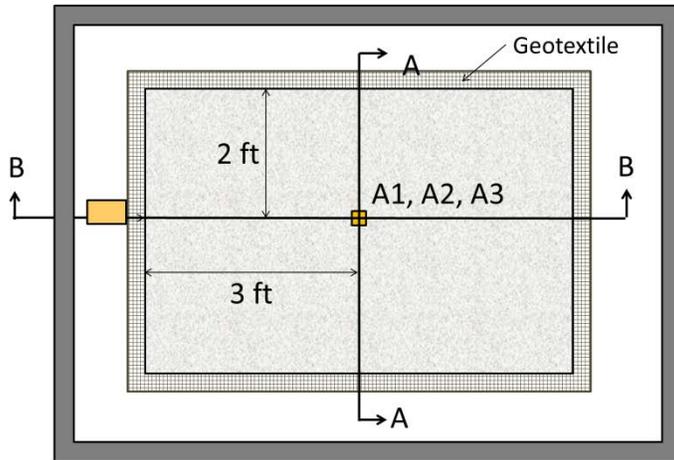


**APPENDIX C**  
**DISPLACEMENT – TIME**  
**HISTORY**

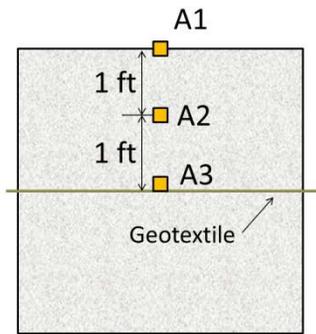
# Shake Table Test



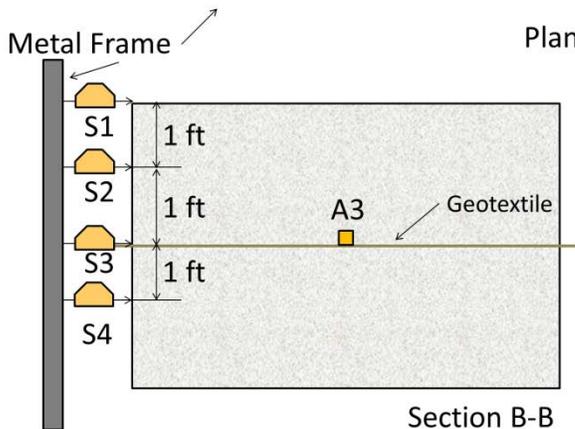
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Location:	----	Test No.:	1
Model Size:	4 ft by 6 ft	Vertical Stress:	102.5 psf
Model Height:	4 ft	Geogrid Depth:	2 ft
Motion Type:	Sinusoidal	Characteristics:	0.1g 2Hz



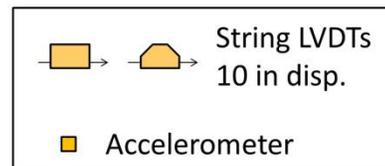
Plan View

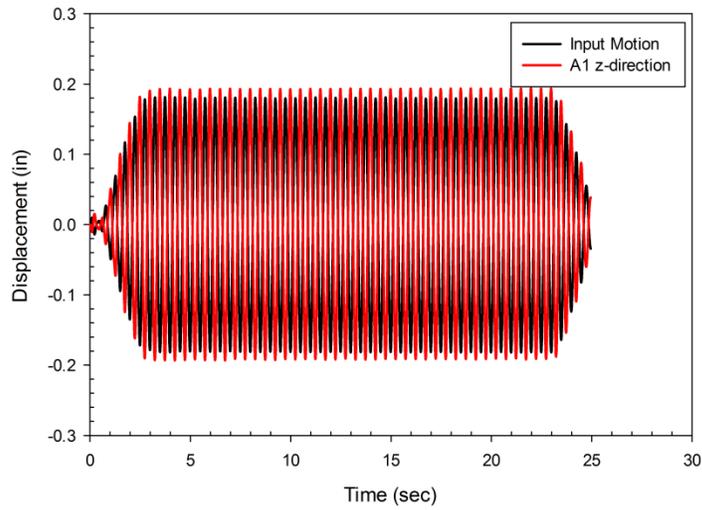
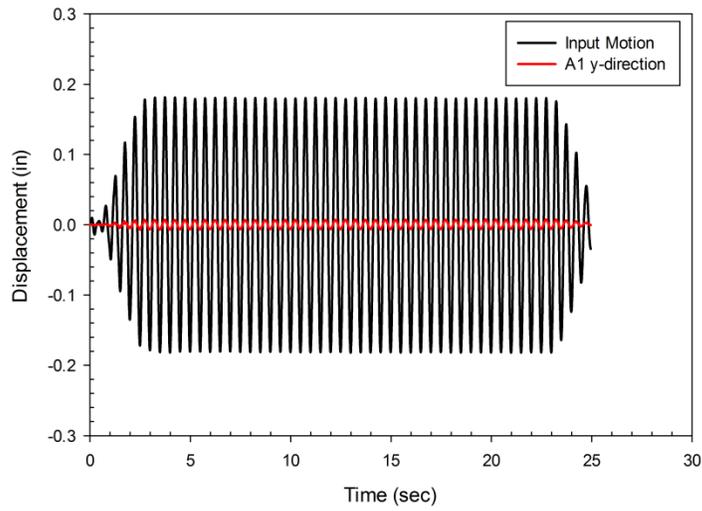
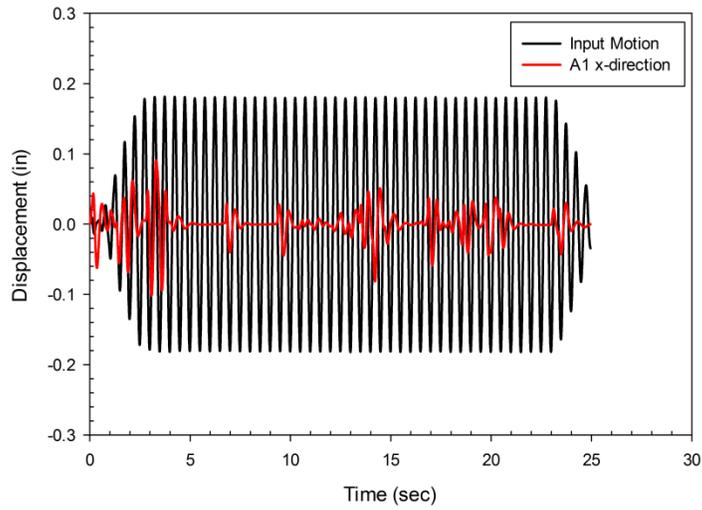


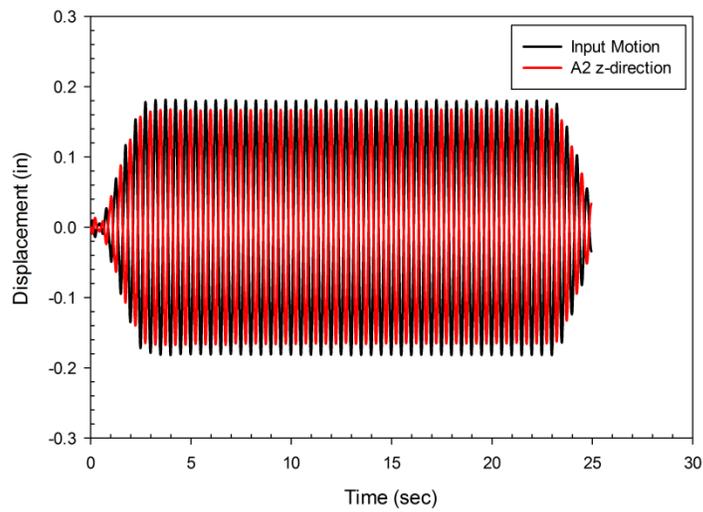
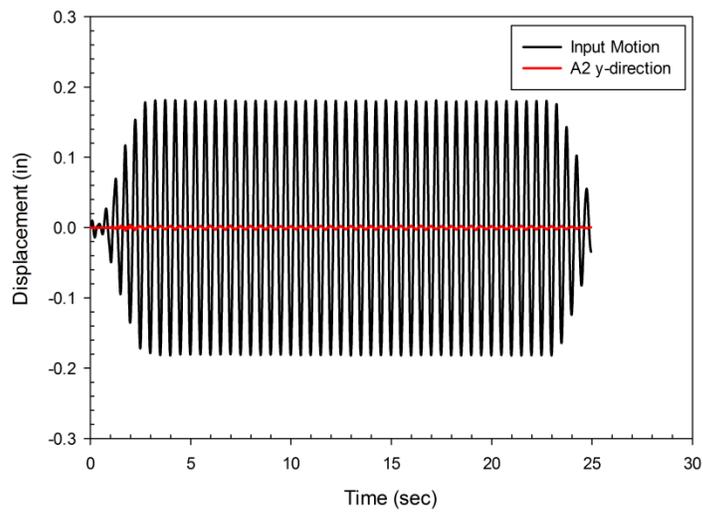
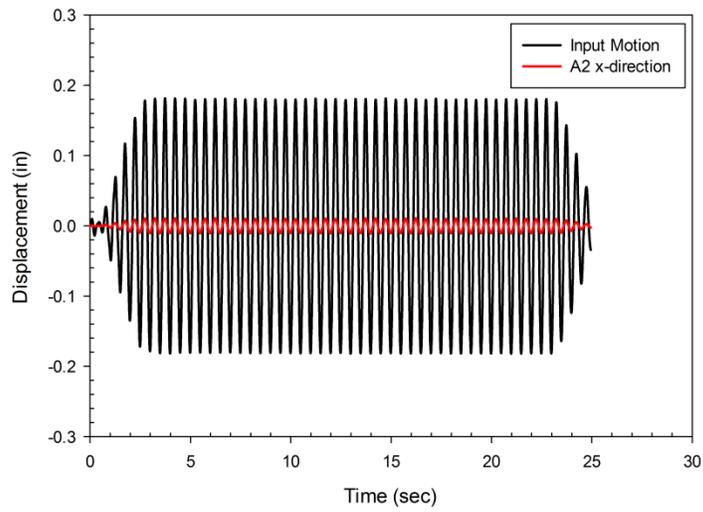
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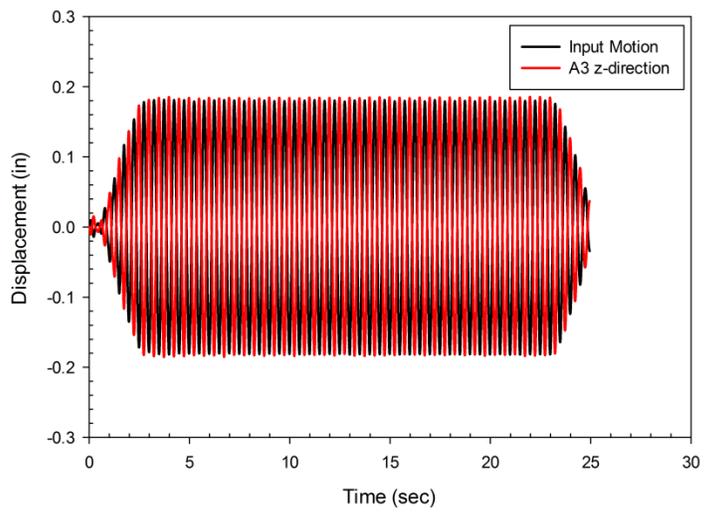
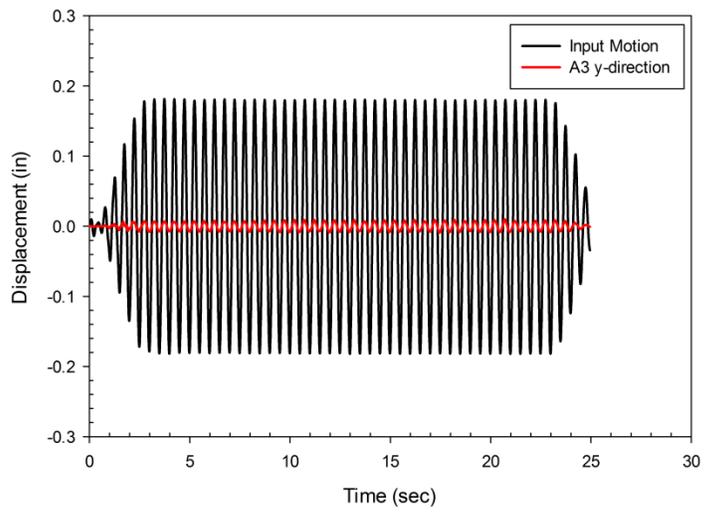
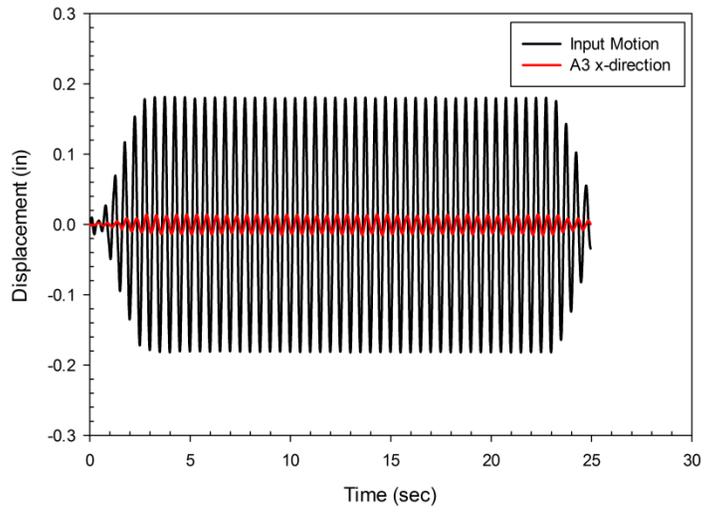


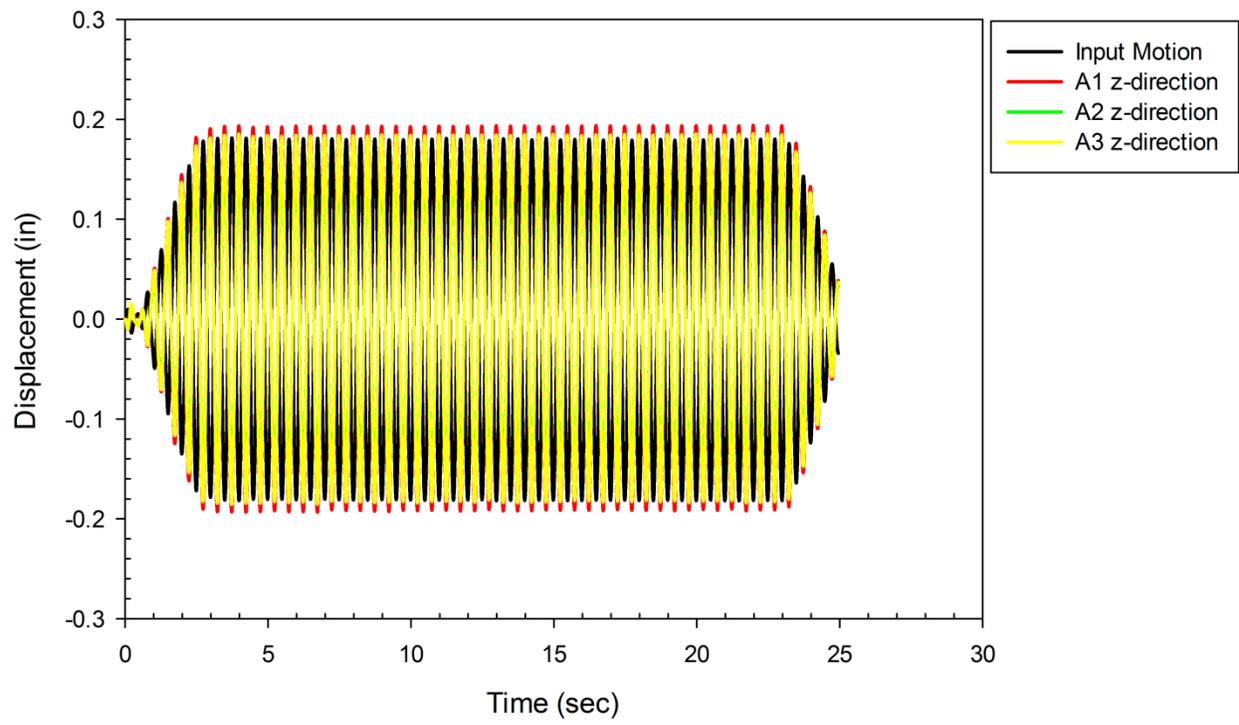
Section B-B

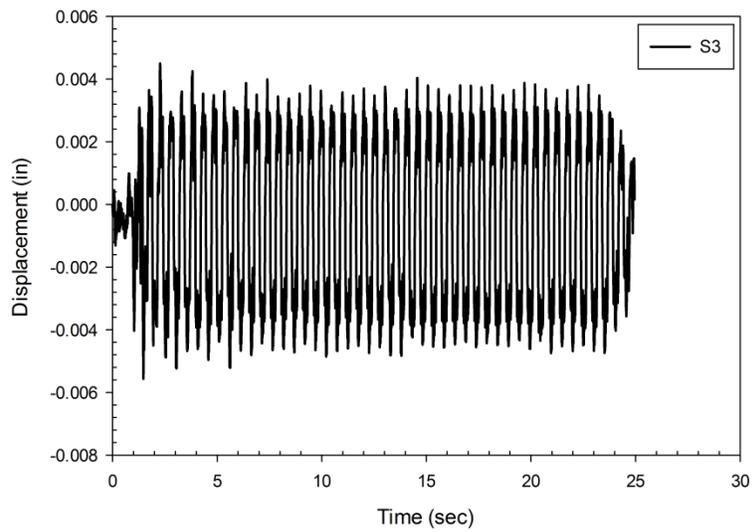
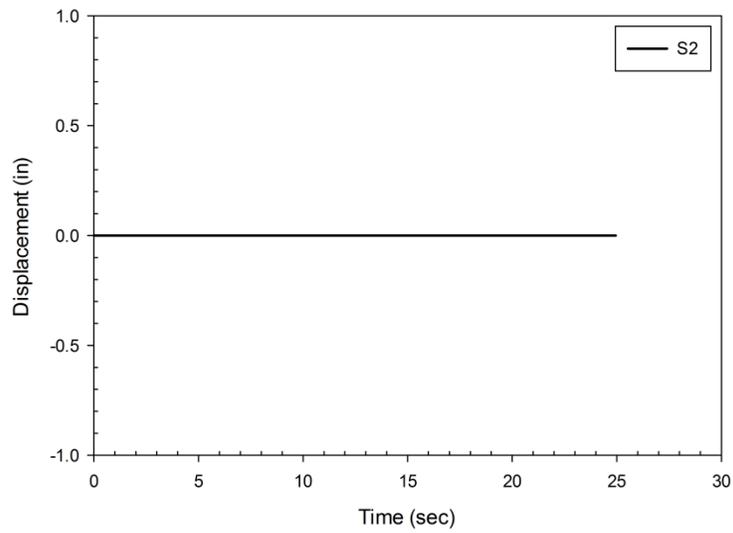
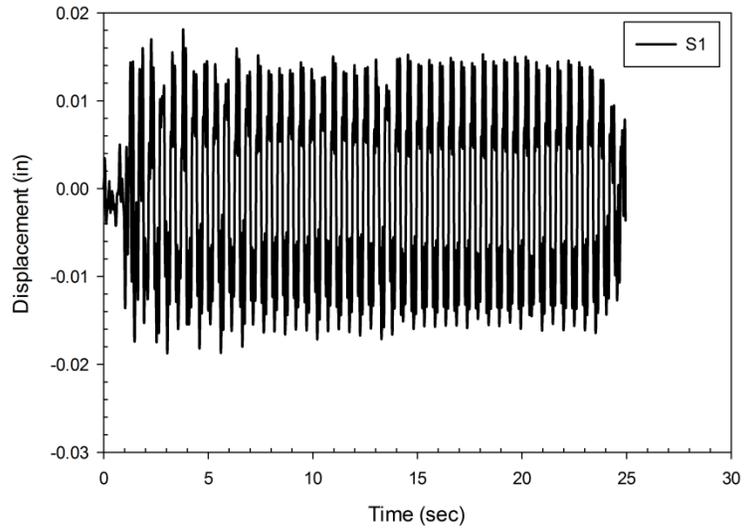


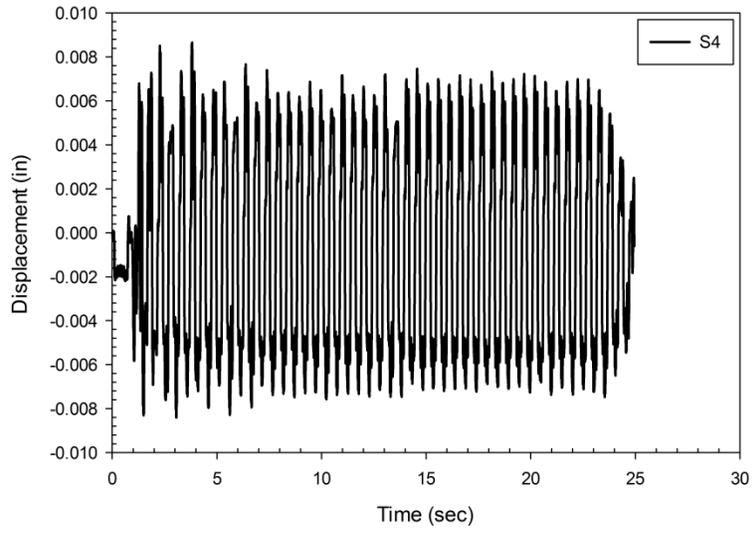








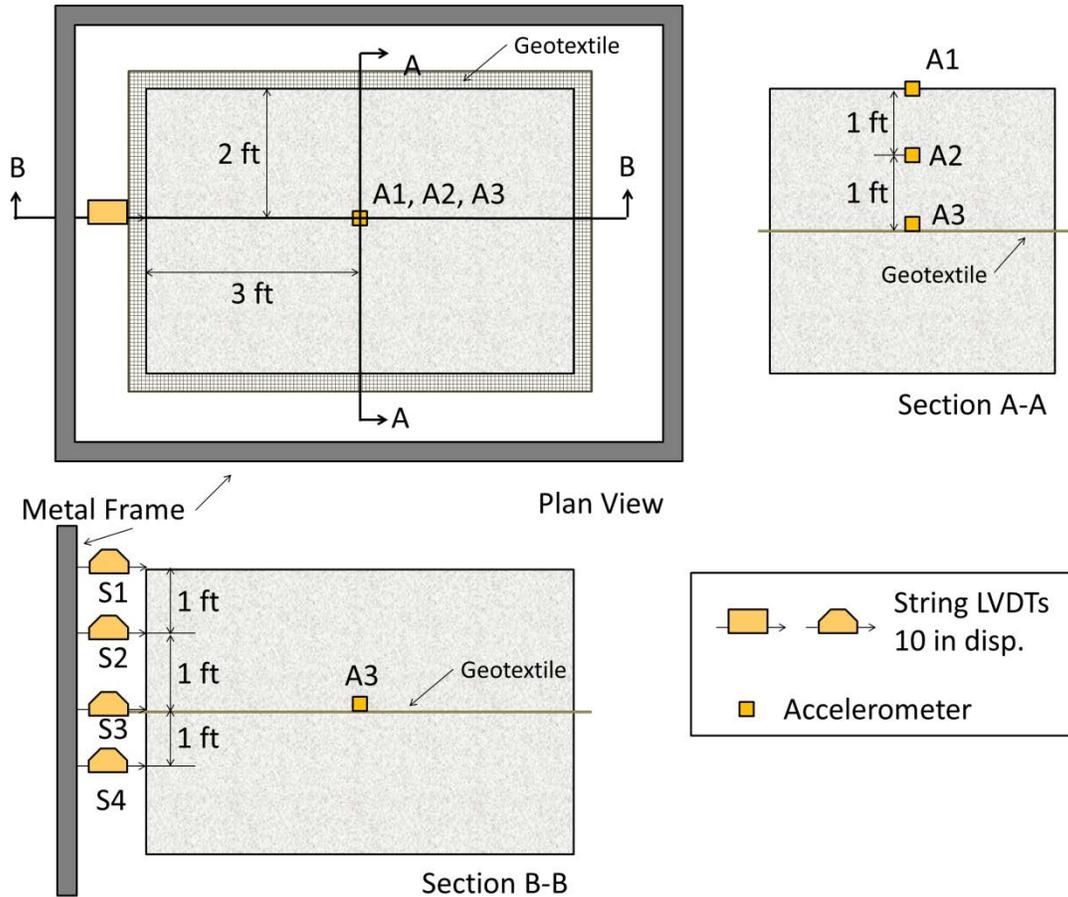


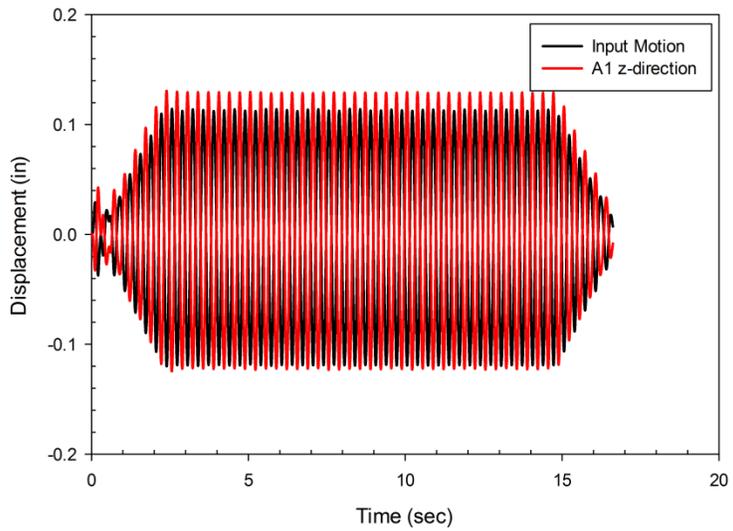
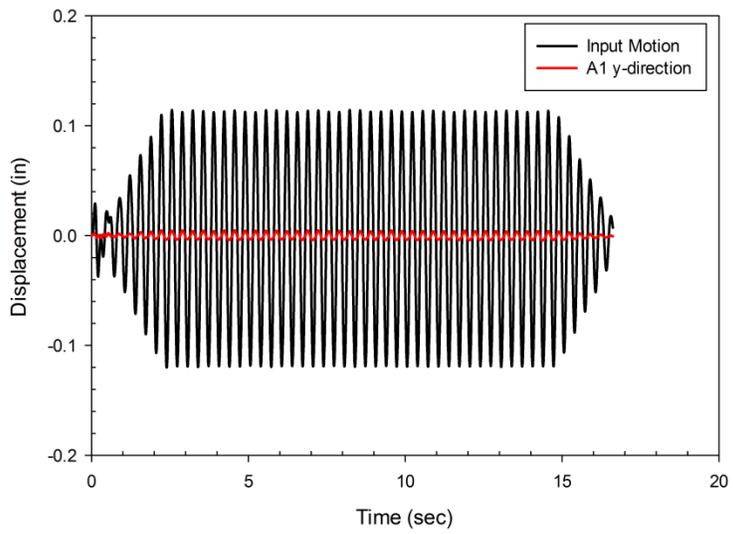
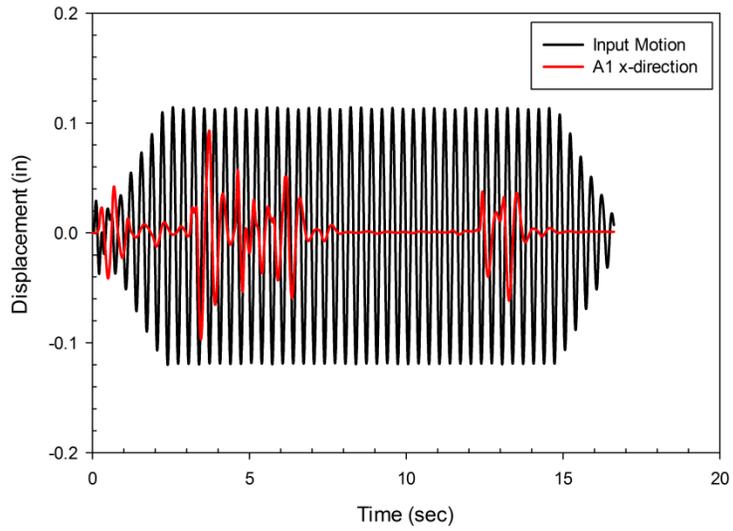


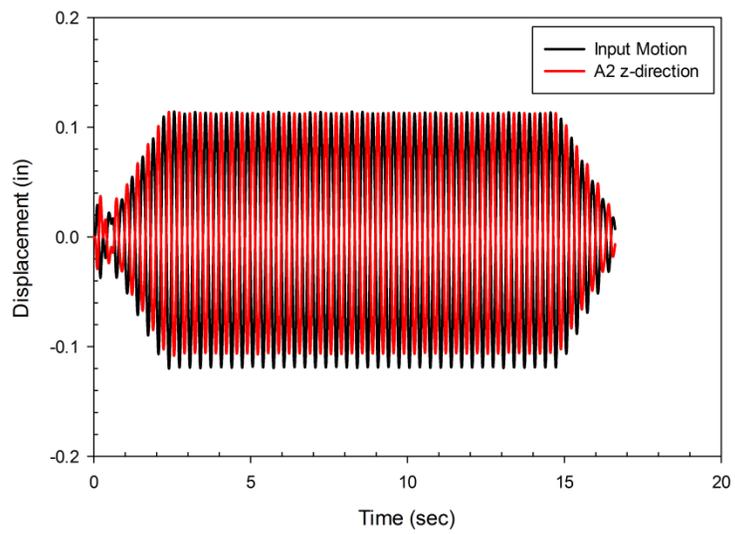
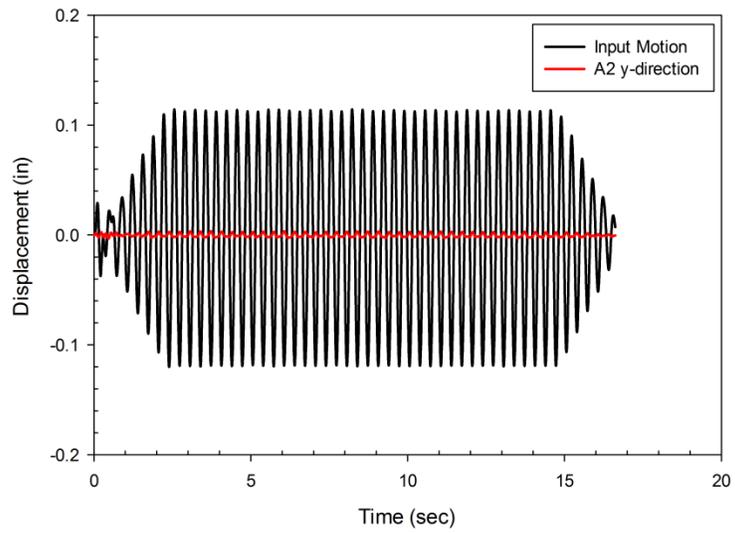
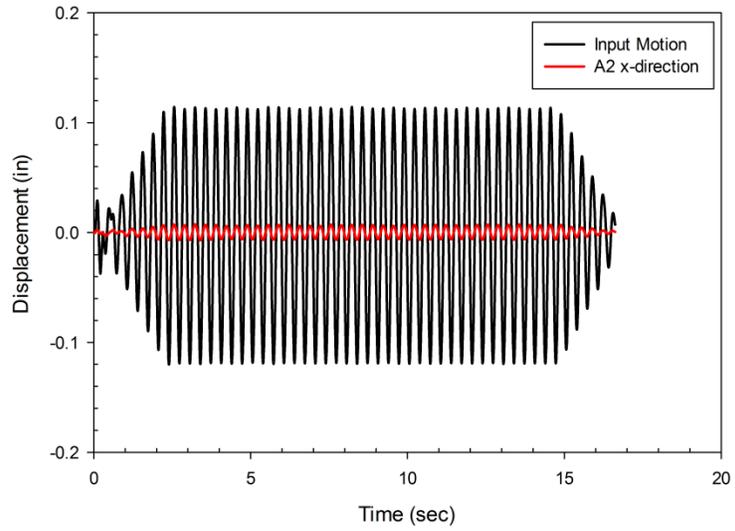
# Shake Table Test

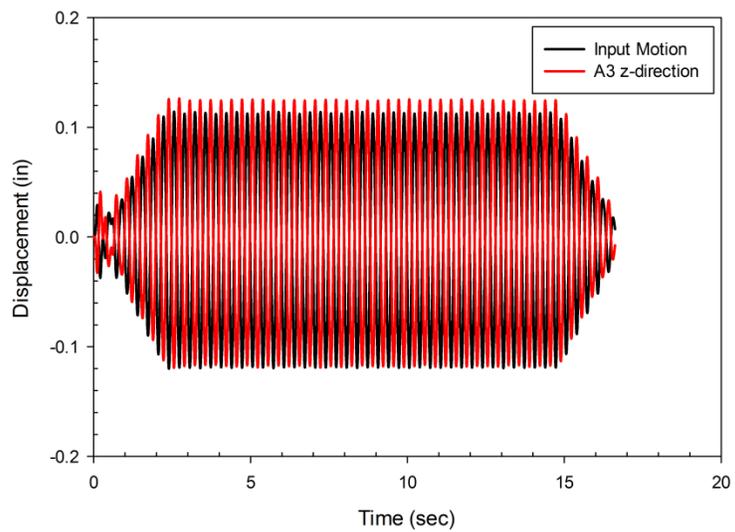
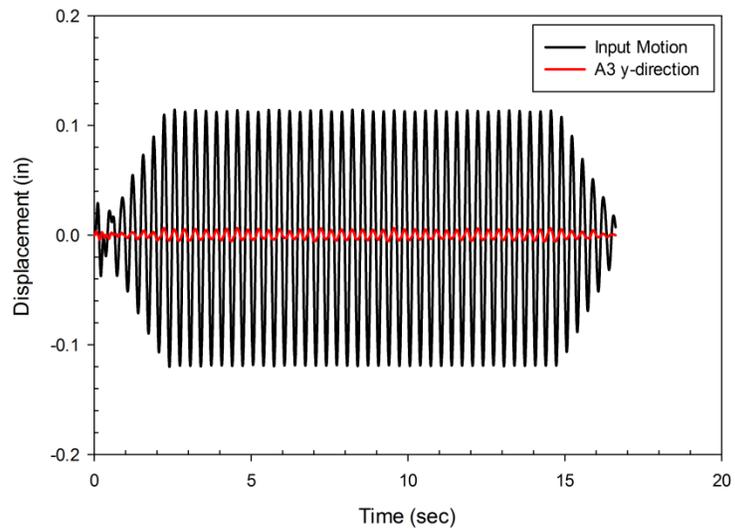
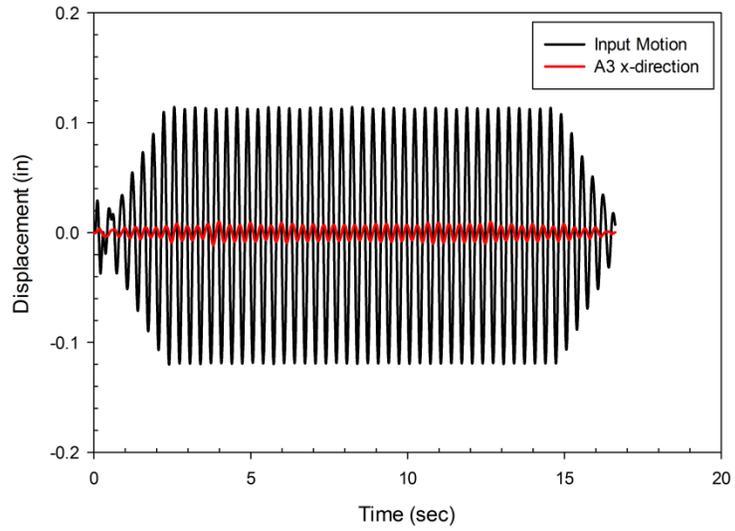


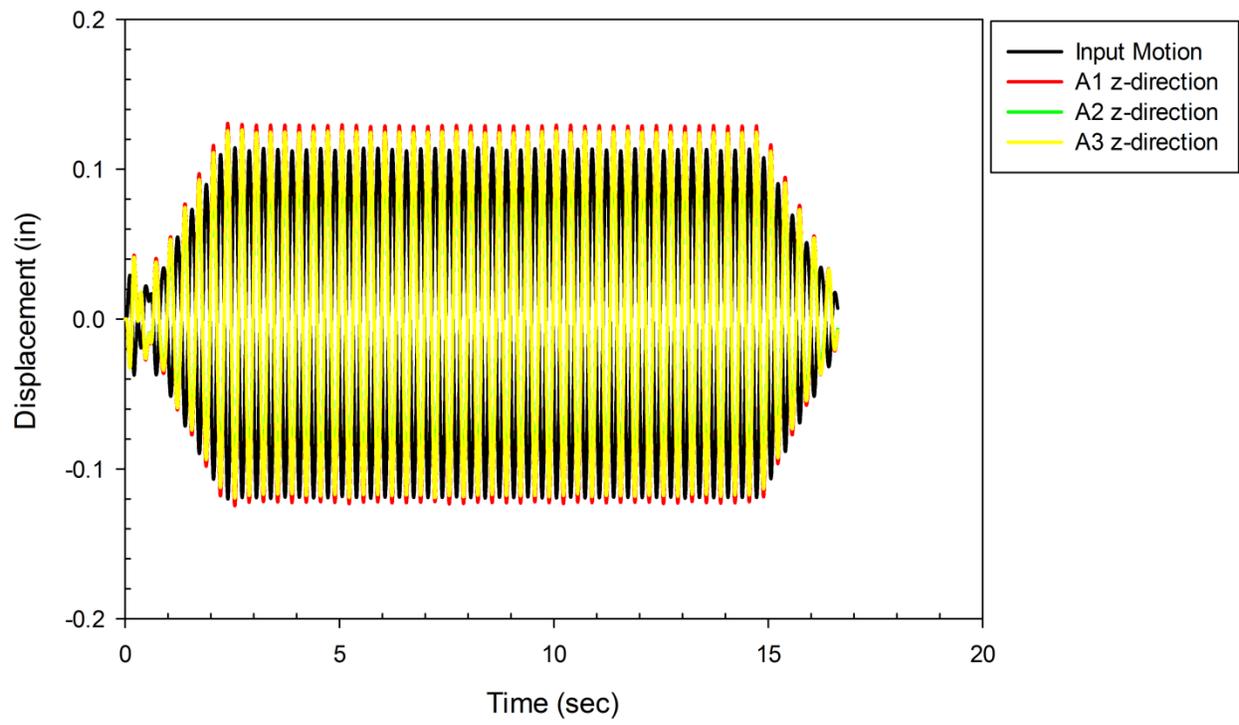
Project:	Cell Crete (Cellular Concrete)	Test Date:	9/2/16
Location:	----	Test No.:	1
Model Size:	4 ft by 6 ft	Vertical Stress:	102.5 psf
Model Height:	4 ft	Geogrid Depth:	2 ft
Motion Type:	Sinusoidal	Characteristics:	0.1g 3Hz

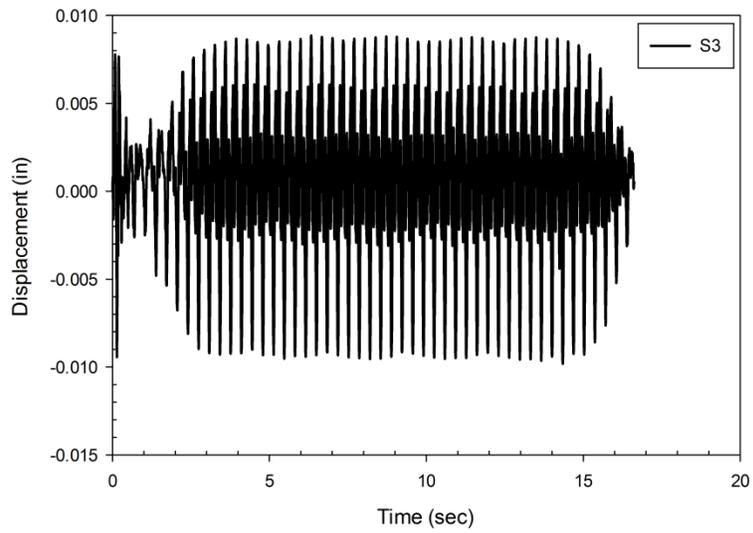
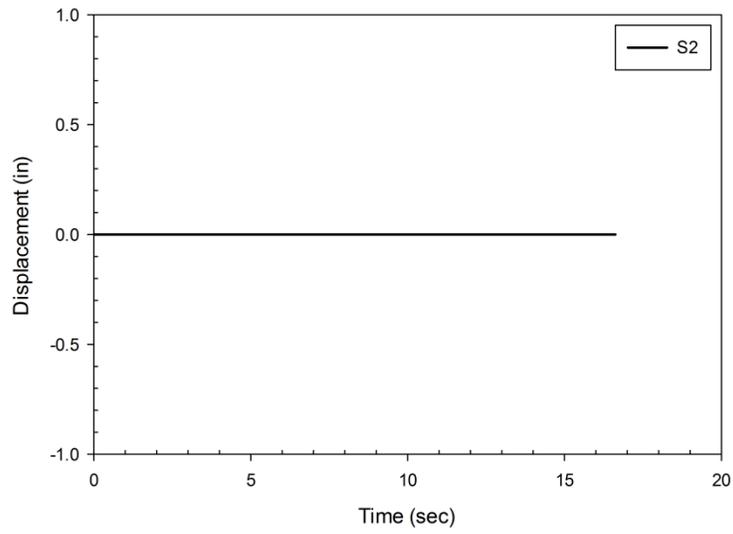
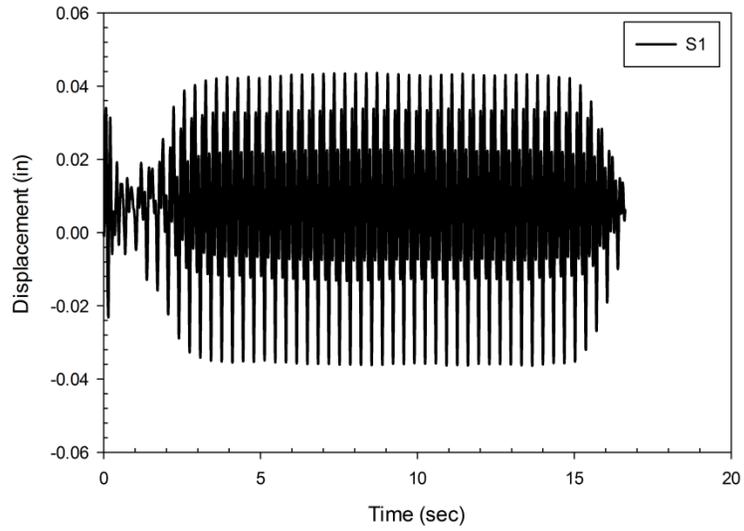


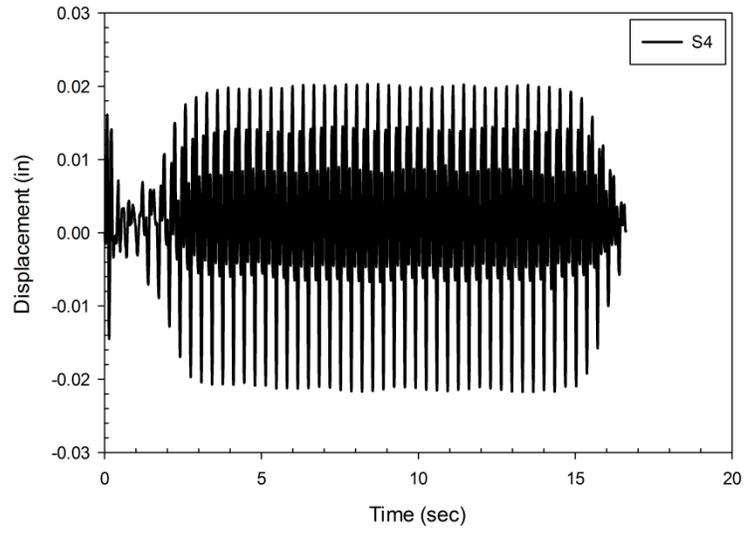








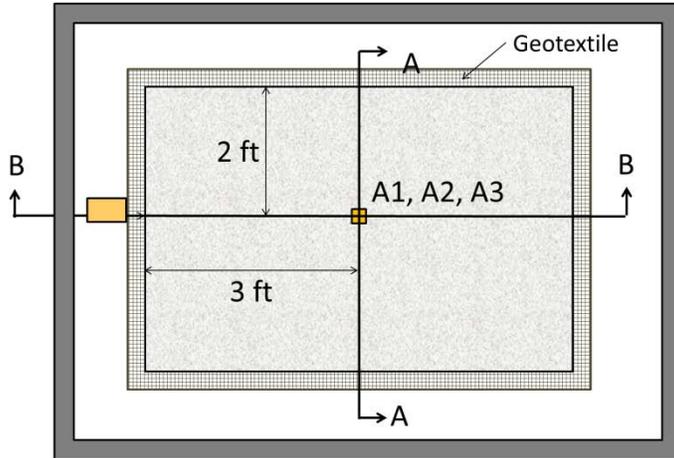




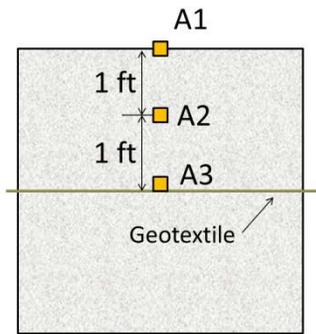
# Shake Table Test



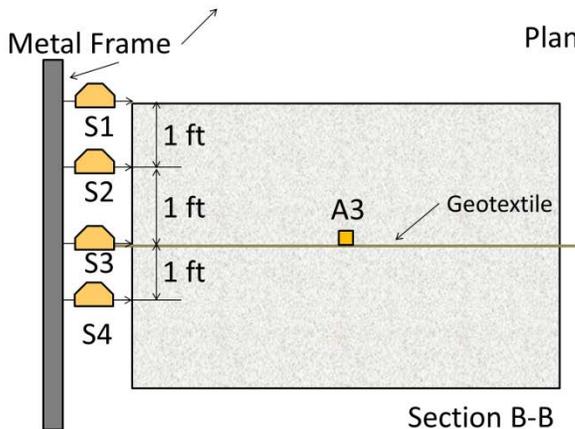
Project:	Cell Crete (Cellular Concrete)	Test Date:	9/2/16
Location:	----	Test No.:	1
Model Size:	4 ft by 6 ft	Vertical Stress:	102.5 psf
Model Height:	4 ft	Geogrid Depth:	2 ft
Motion Type:	Sinusoidal	Characteristics:	0.2g 2Hz



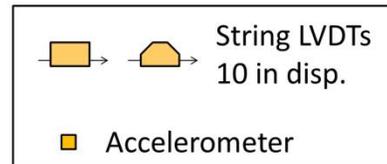
Plan View

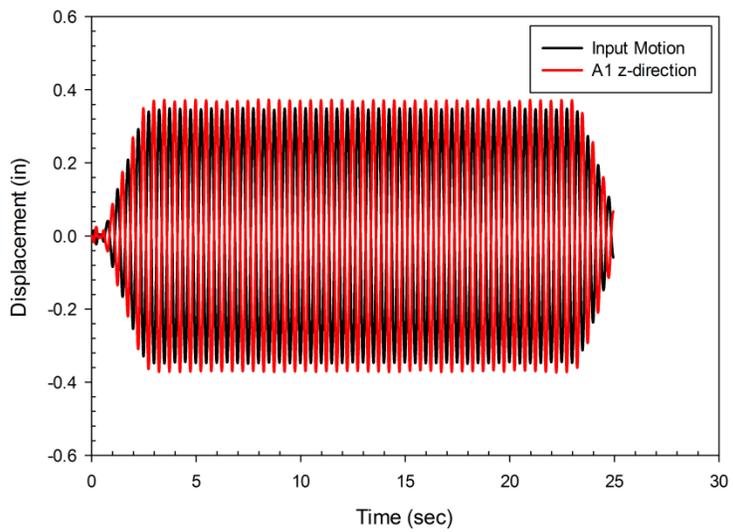
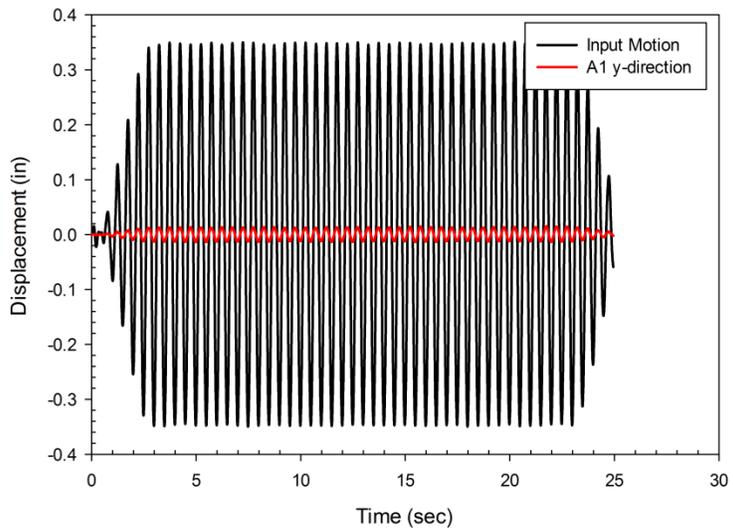
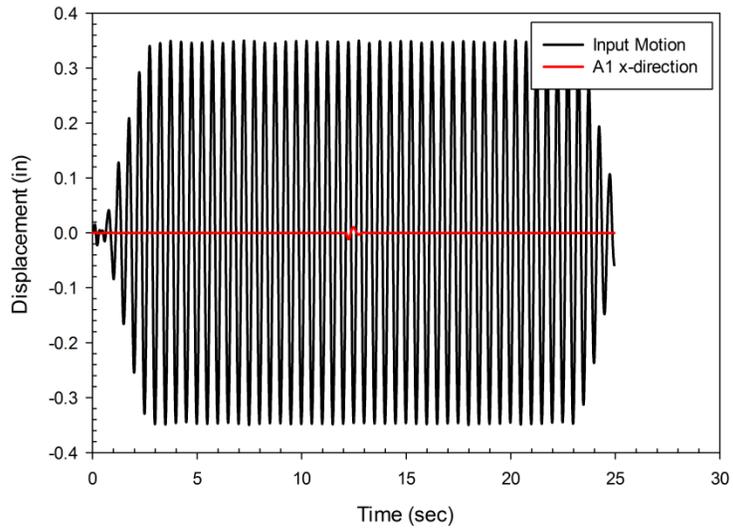


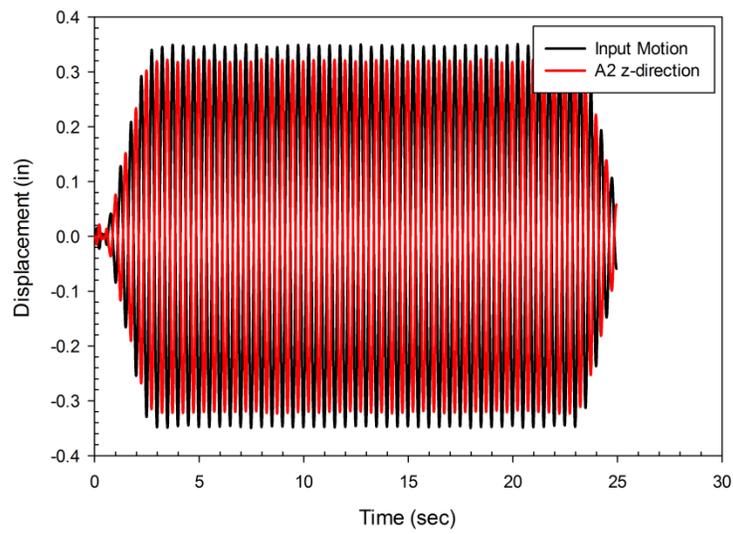
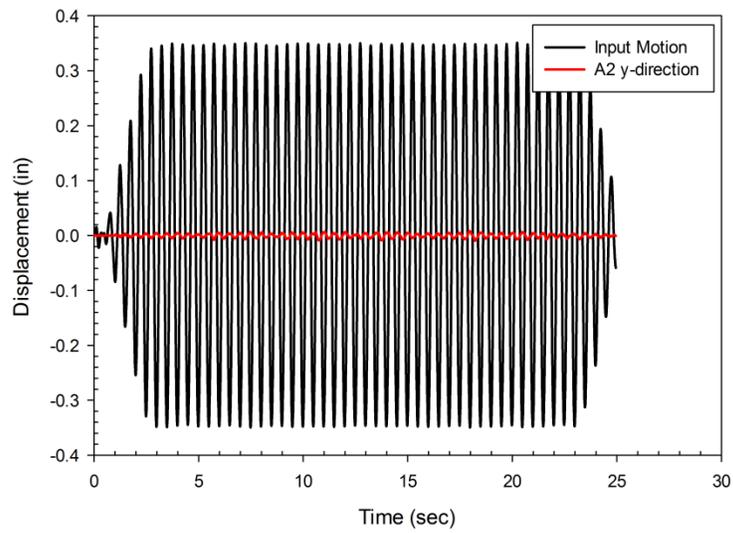
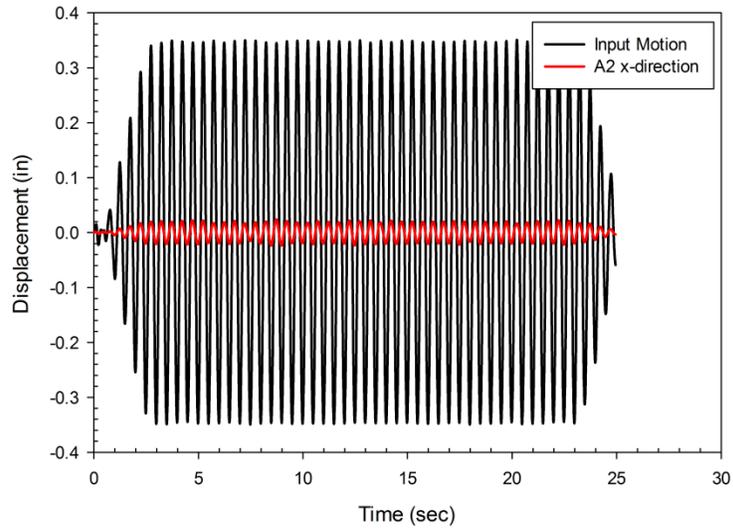
Section A-A

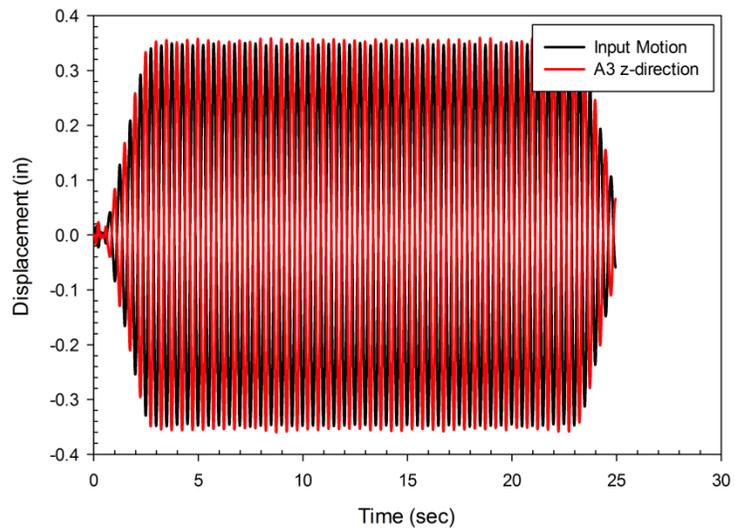
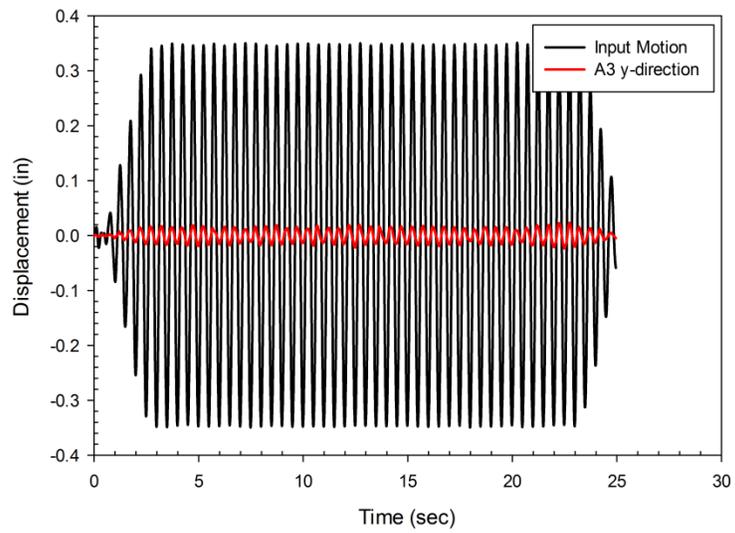
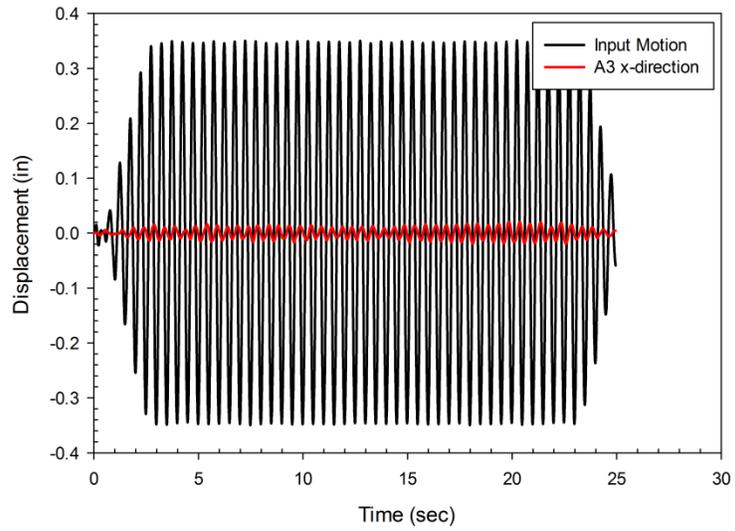


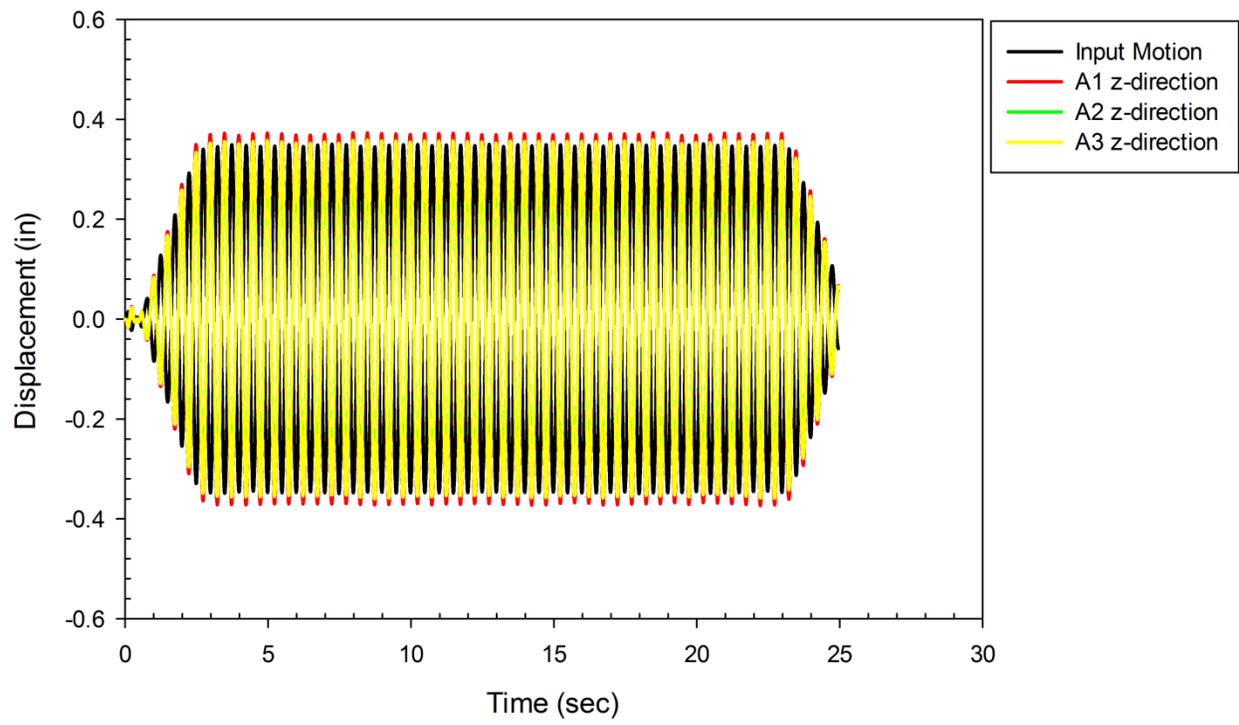
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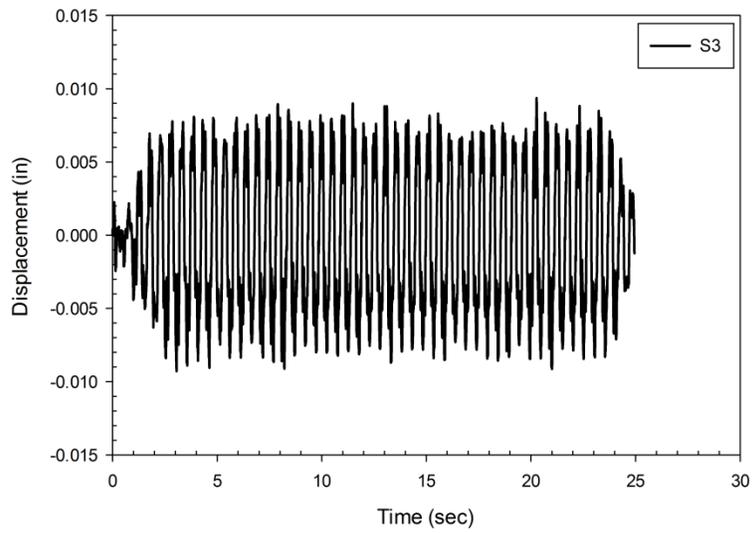
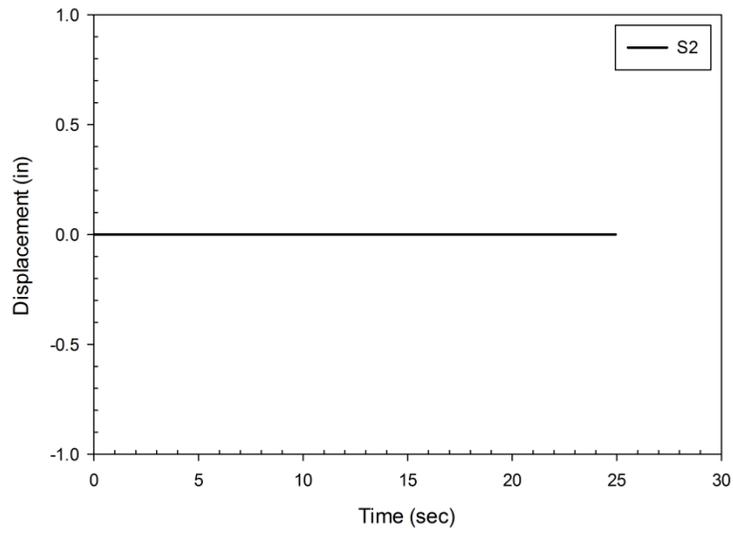
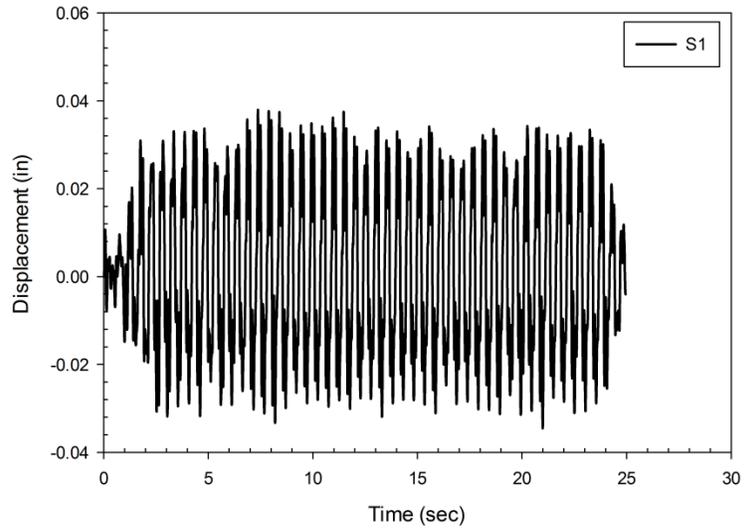


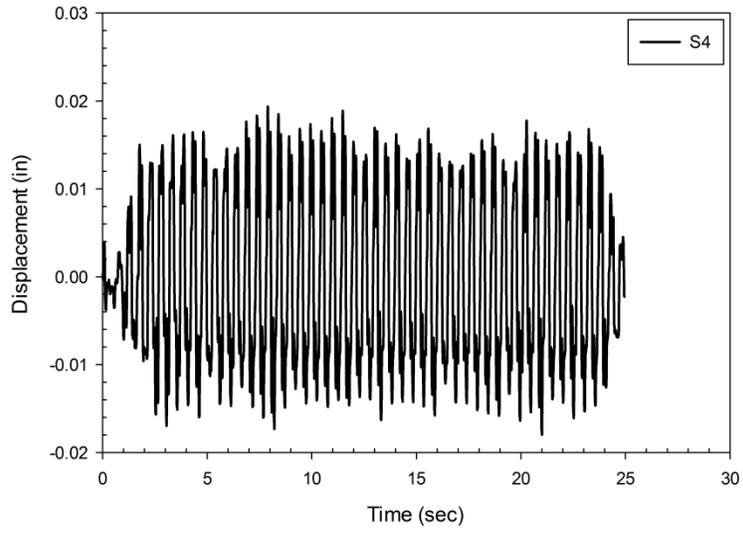








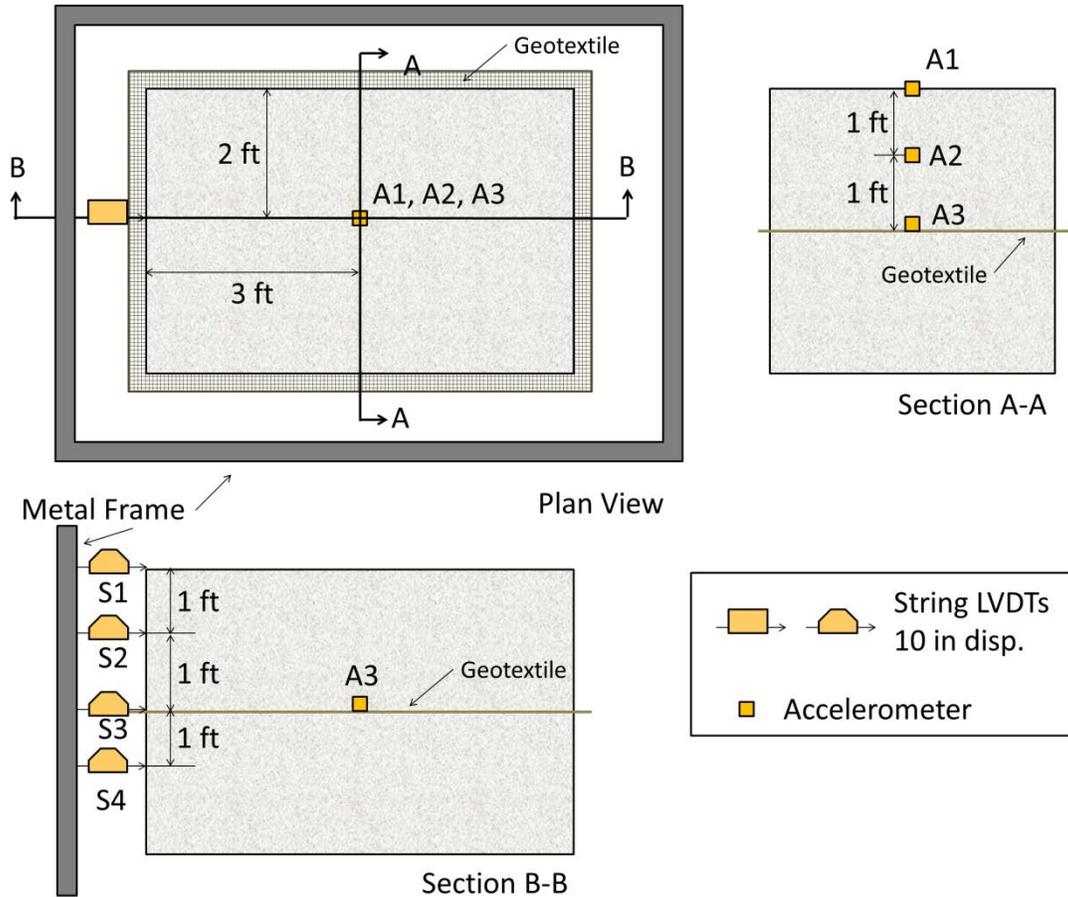


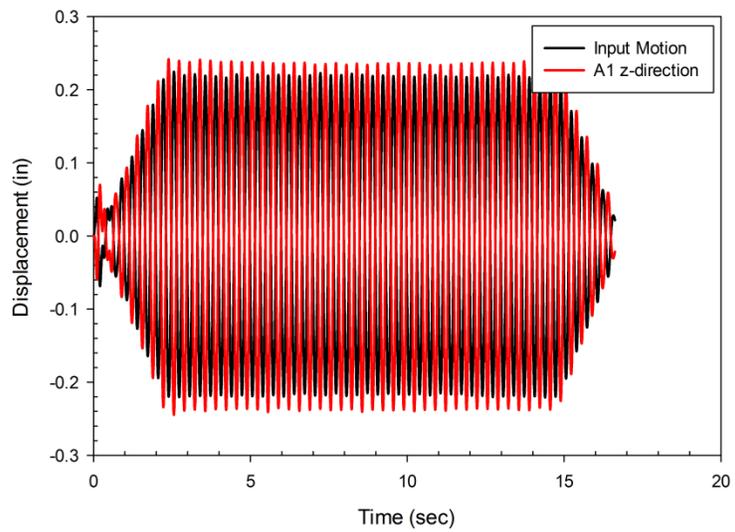
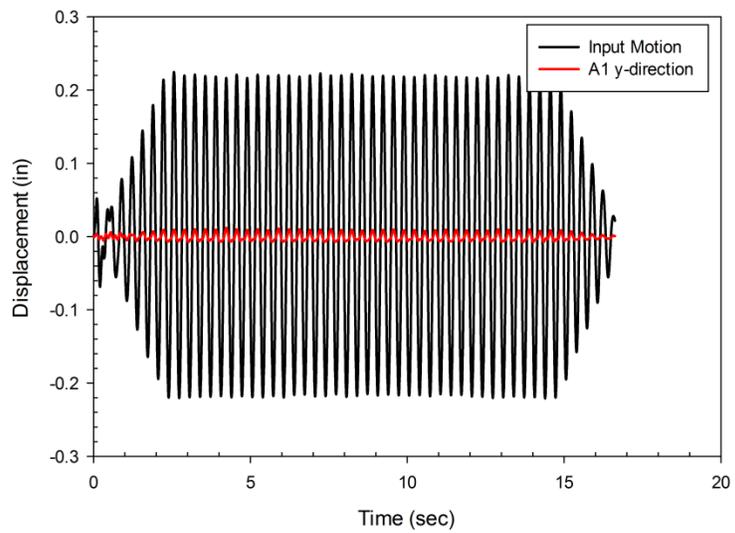
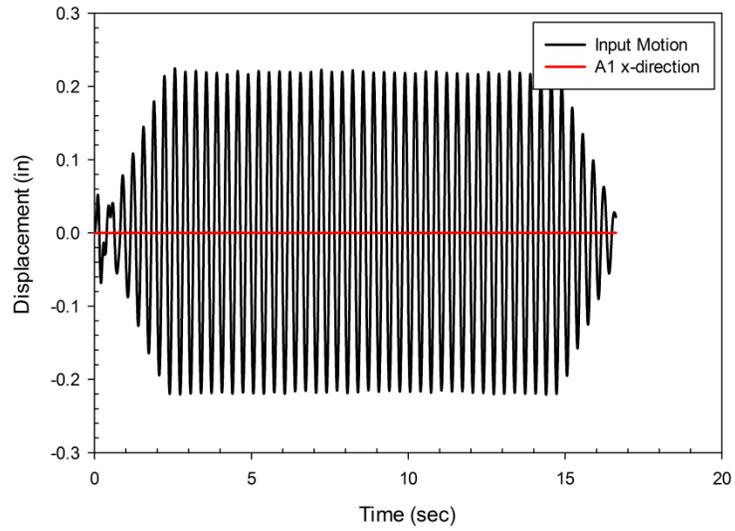


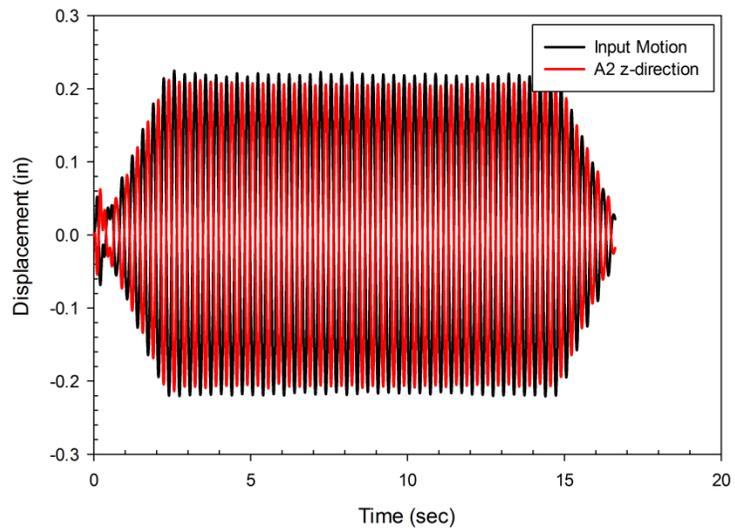
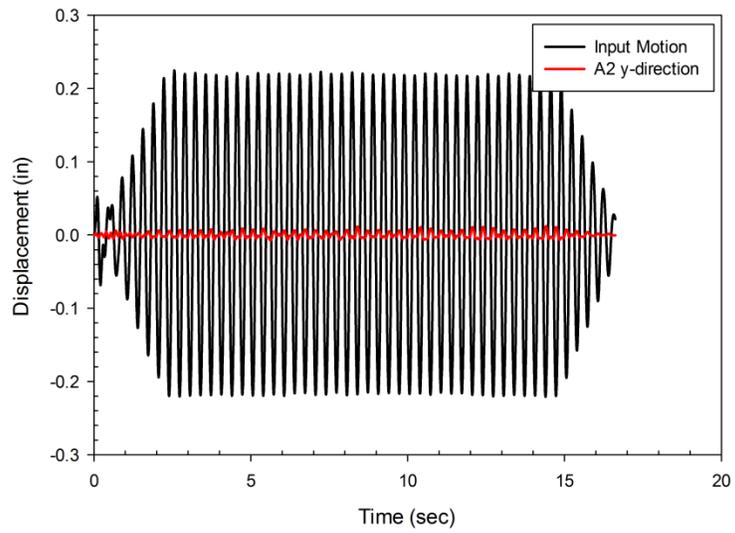
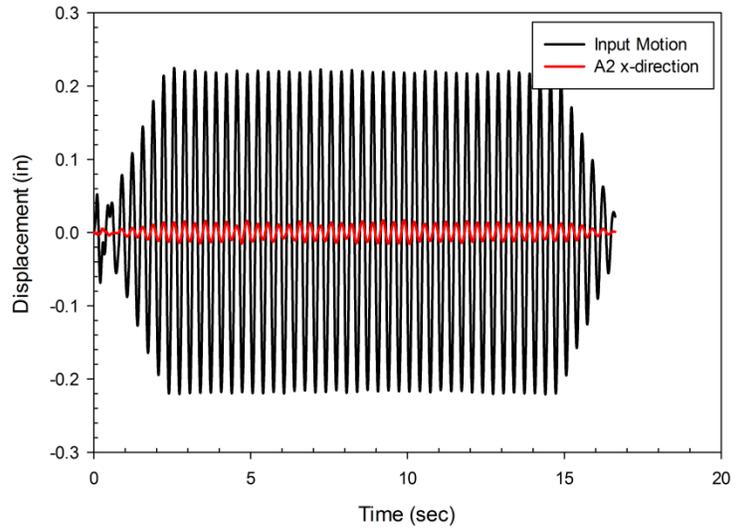
# Shake Table Test

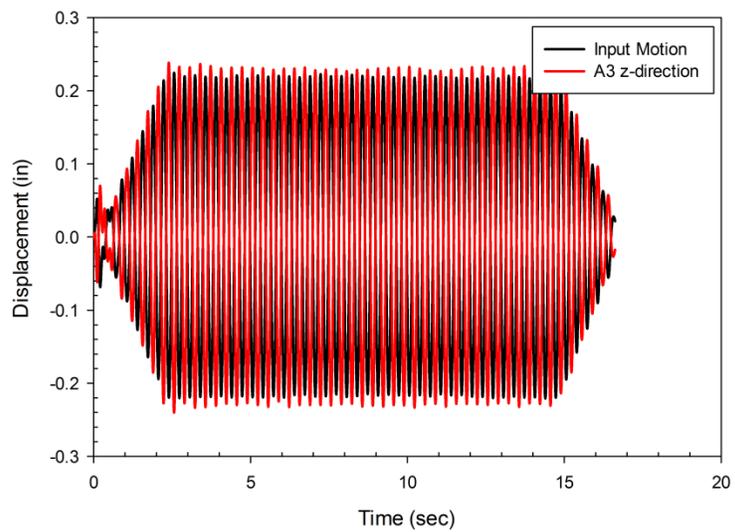
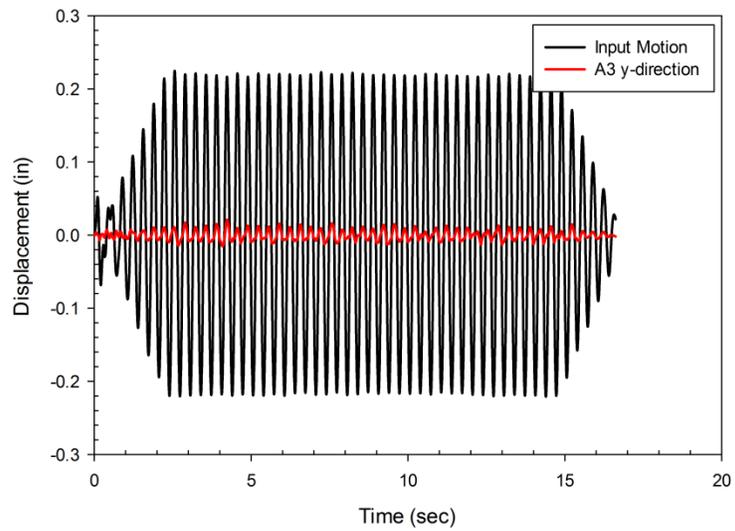
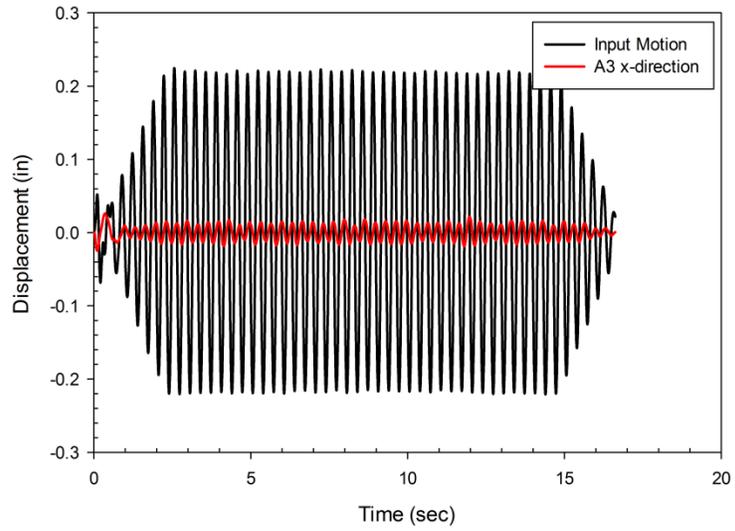


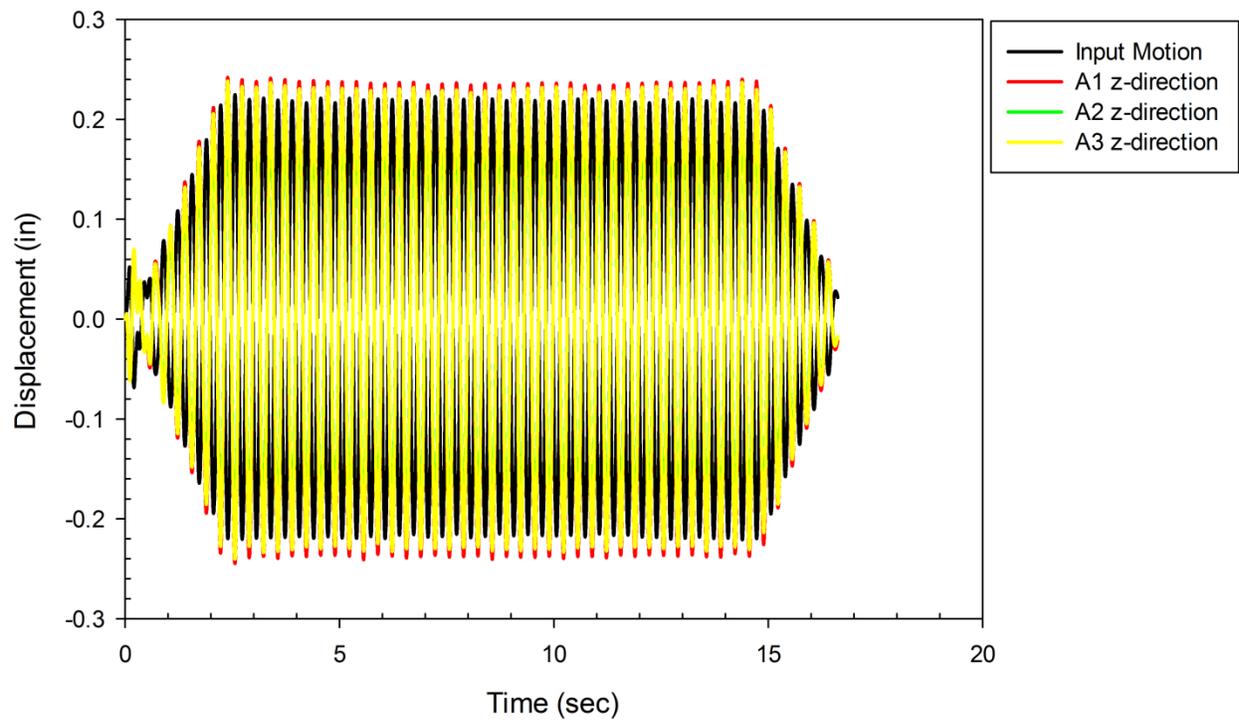
Project:	Cell Crete (Cellular Concrete)	Test Date:	9/2/16
Location:	----	Test No.:	1
Model Size:	4 ft by 6 ft	Vertical Stress:	102.5 psf
Model Height:	4 ft	Geogrid Depth:	2 ft
Motion Type:	Sinusoidal	Characteristics:	0.2g 3Hz

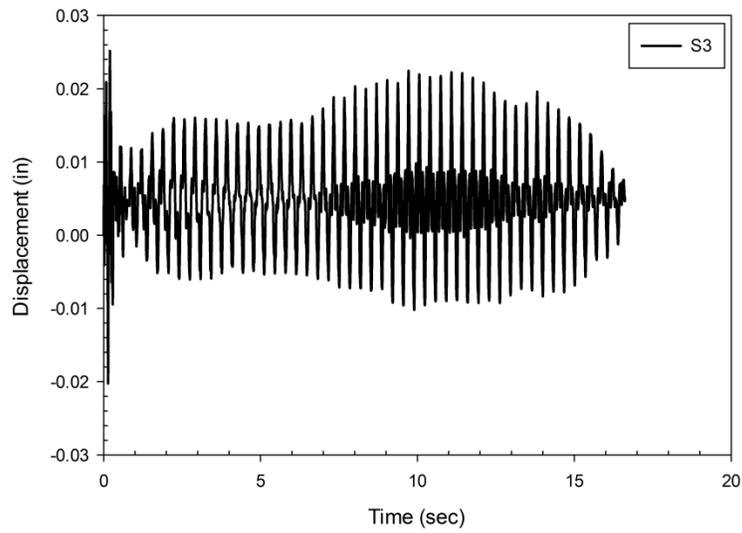
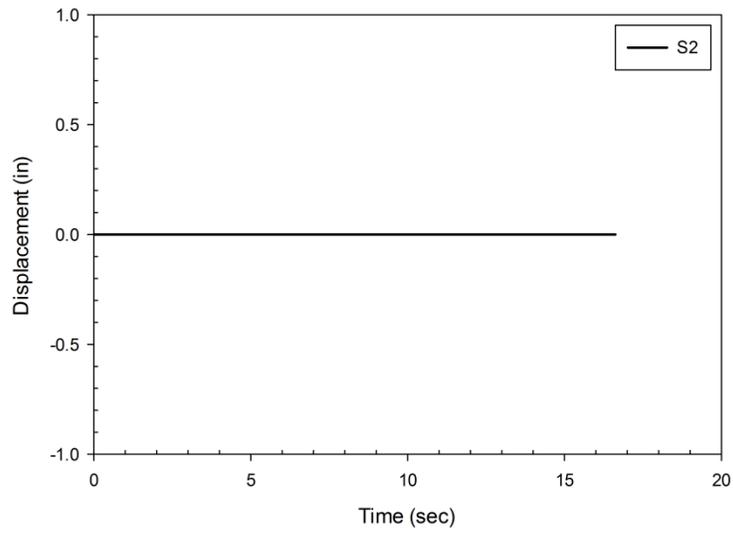
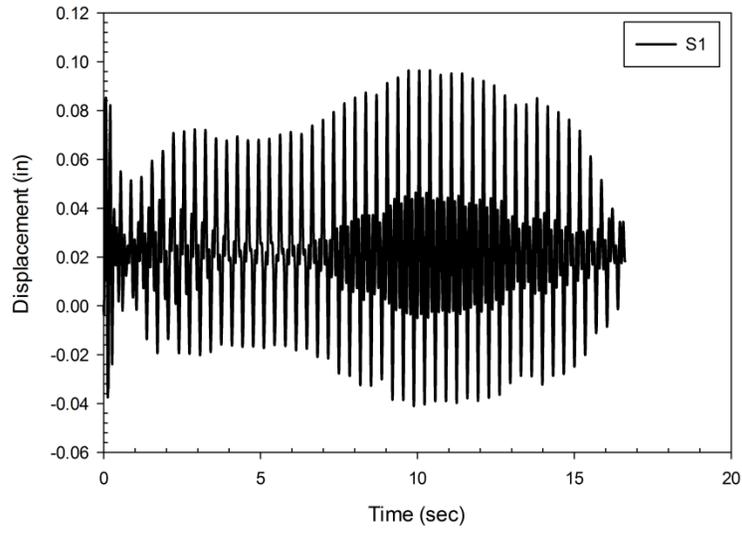


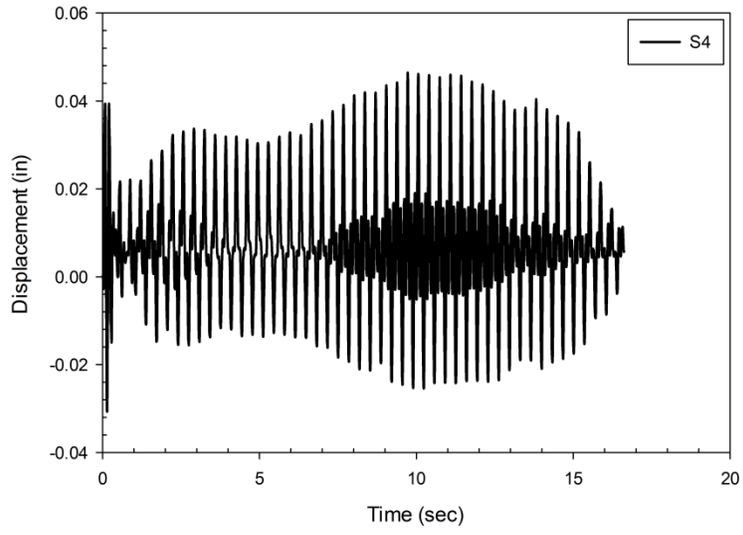








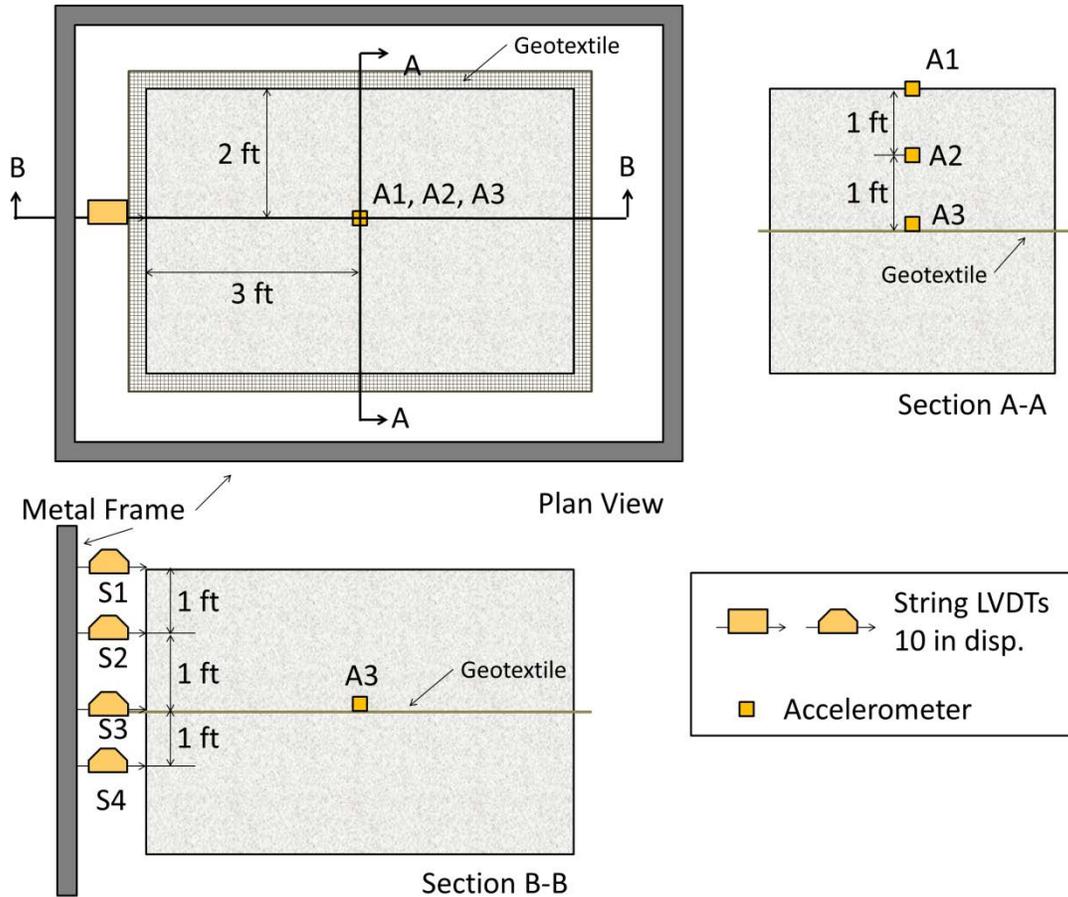


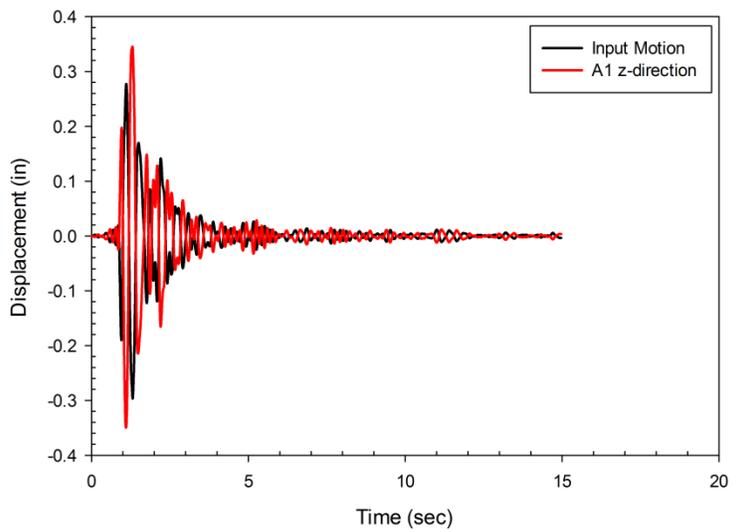
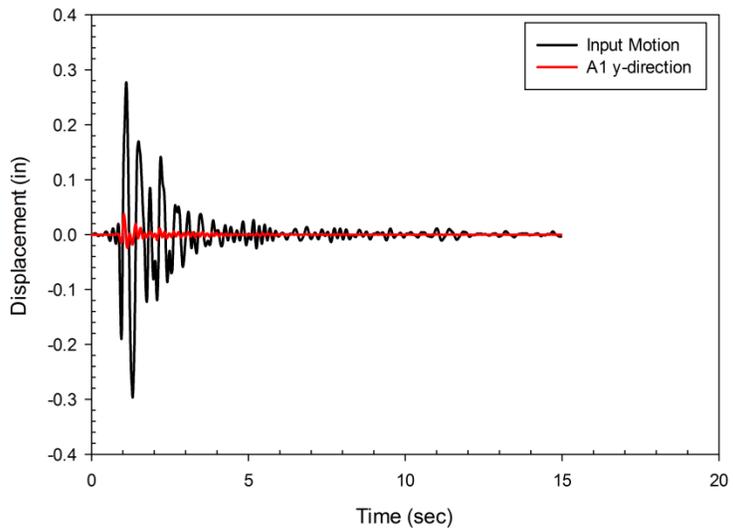
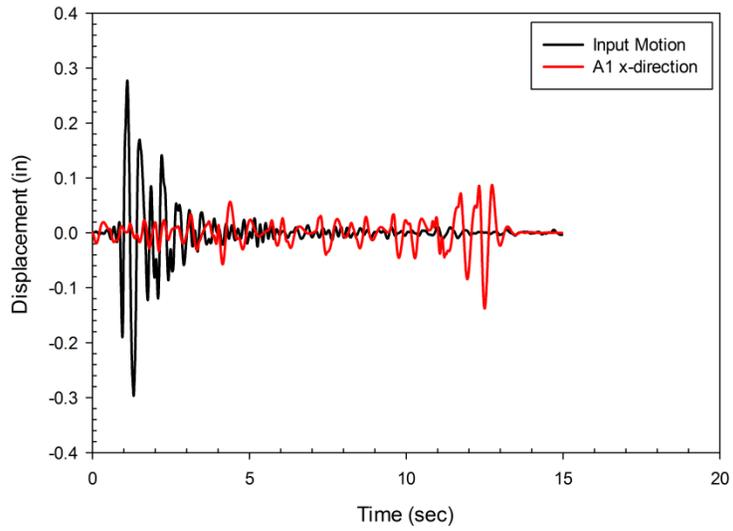


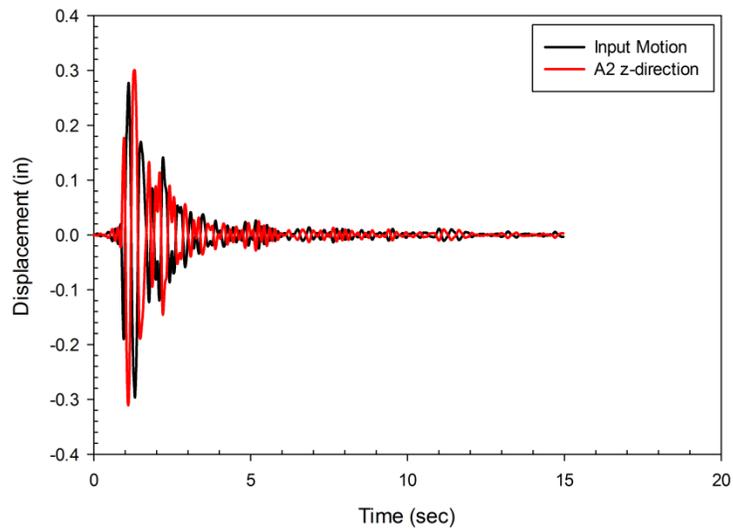
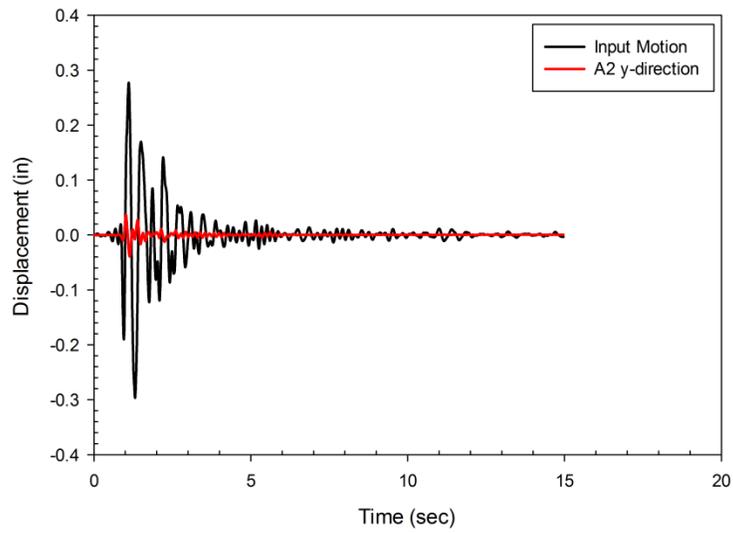
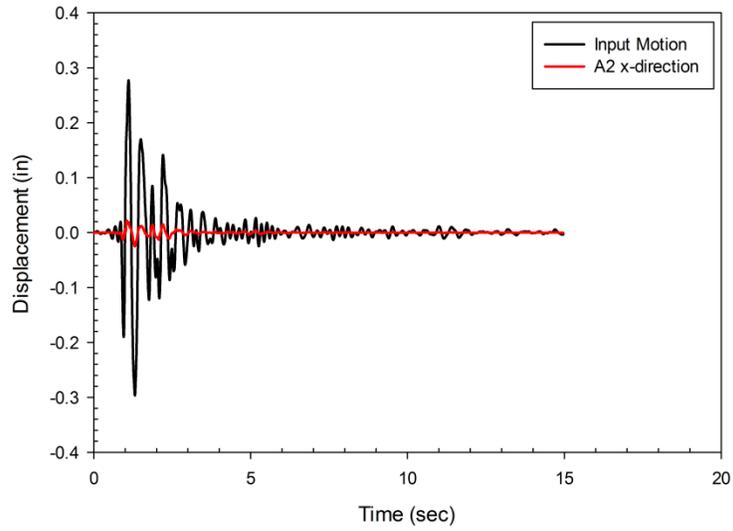
# Shake Table Test

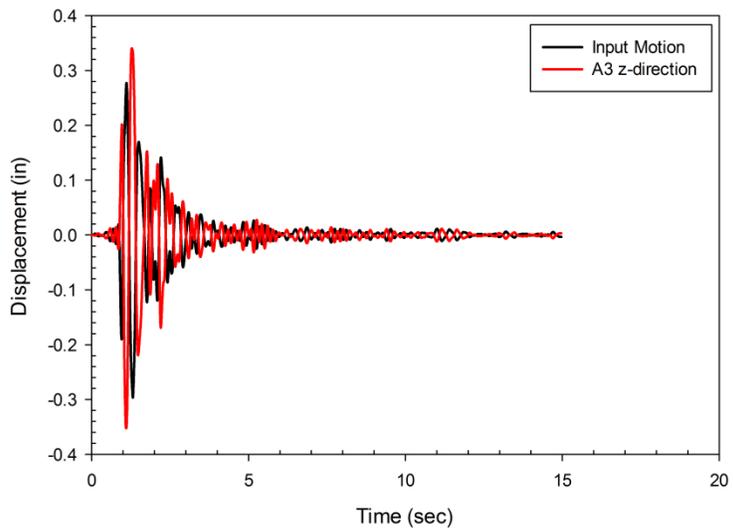
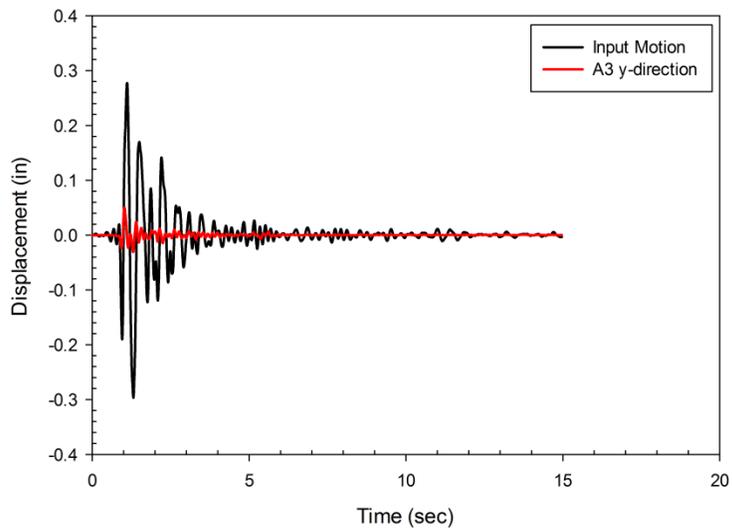
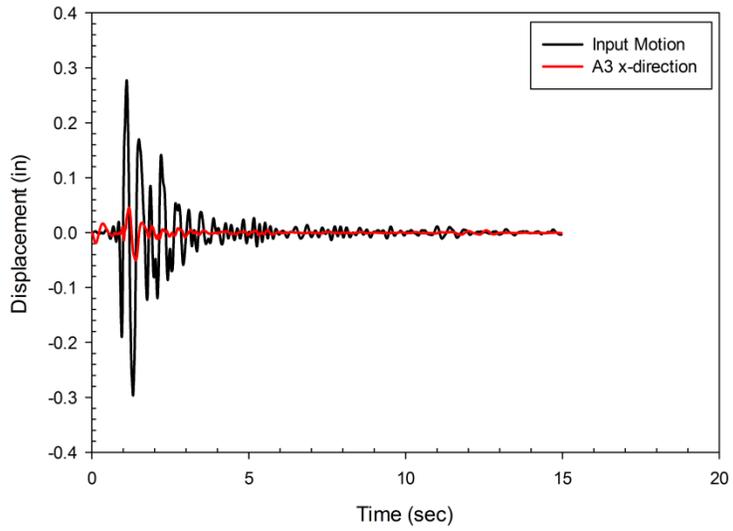


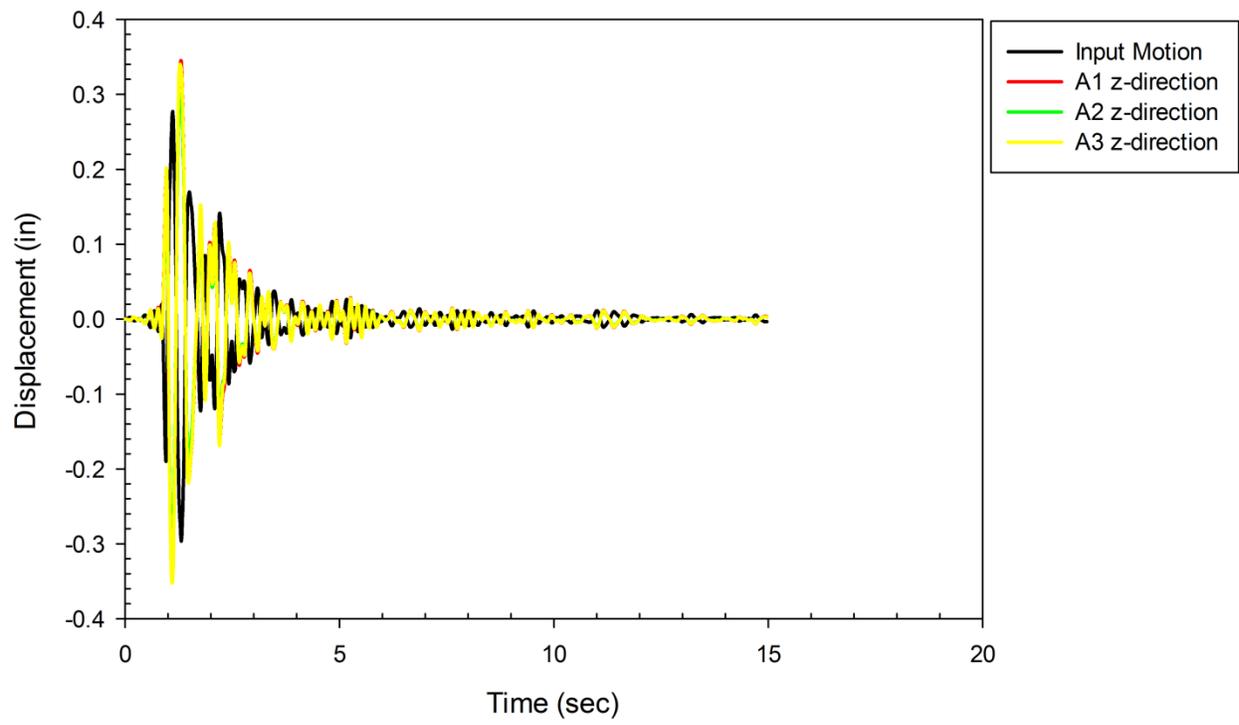
Project:	Cell Crete (Cellular Concrete)	Test Date:	9/2/16
Location:	----	Test No.:	1
Model Size:	4 ft by 6 ft	Vertical Stress:	102.5 psf
Model Height:	4 ft	Geogrid Depth:	2 ft
Motion Type:	1994 Northridge Earthquake	Characteristics:	N/A

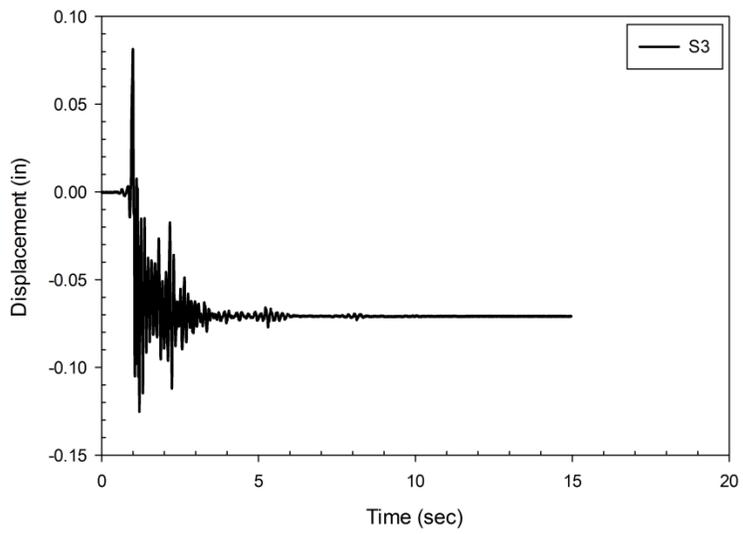
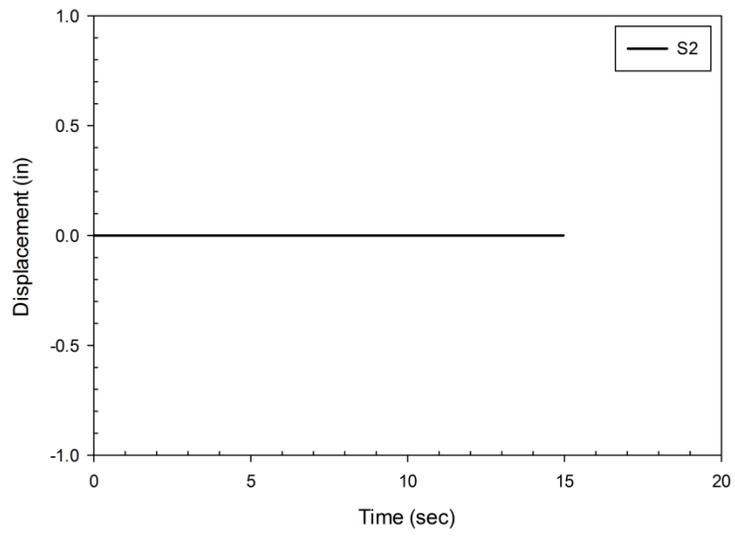
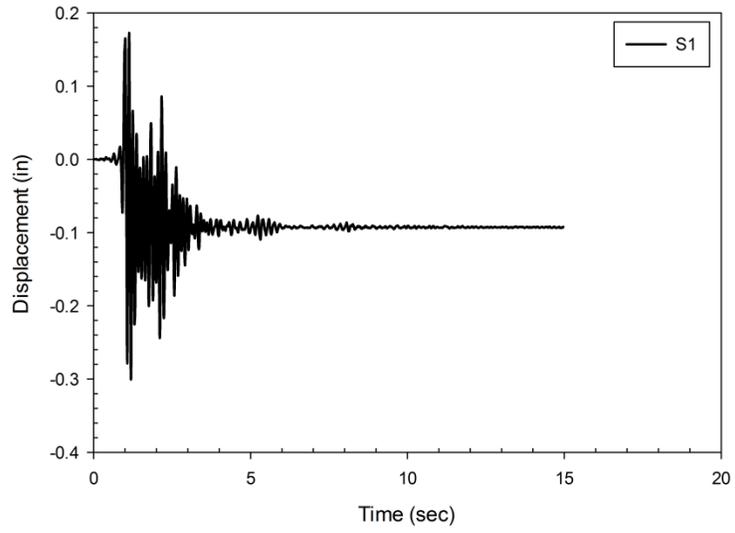


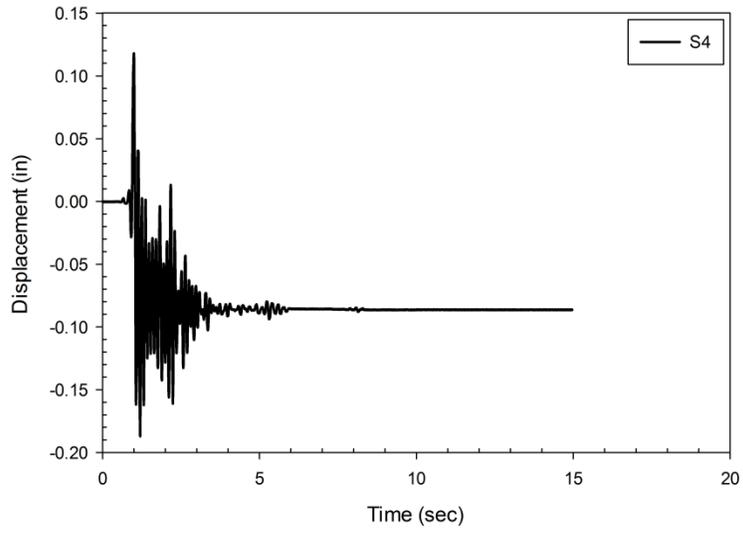








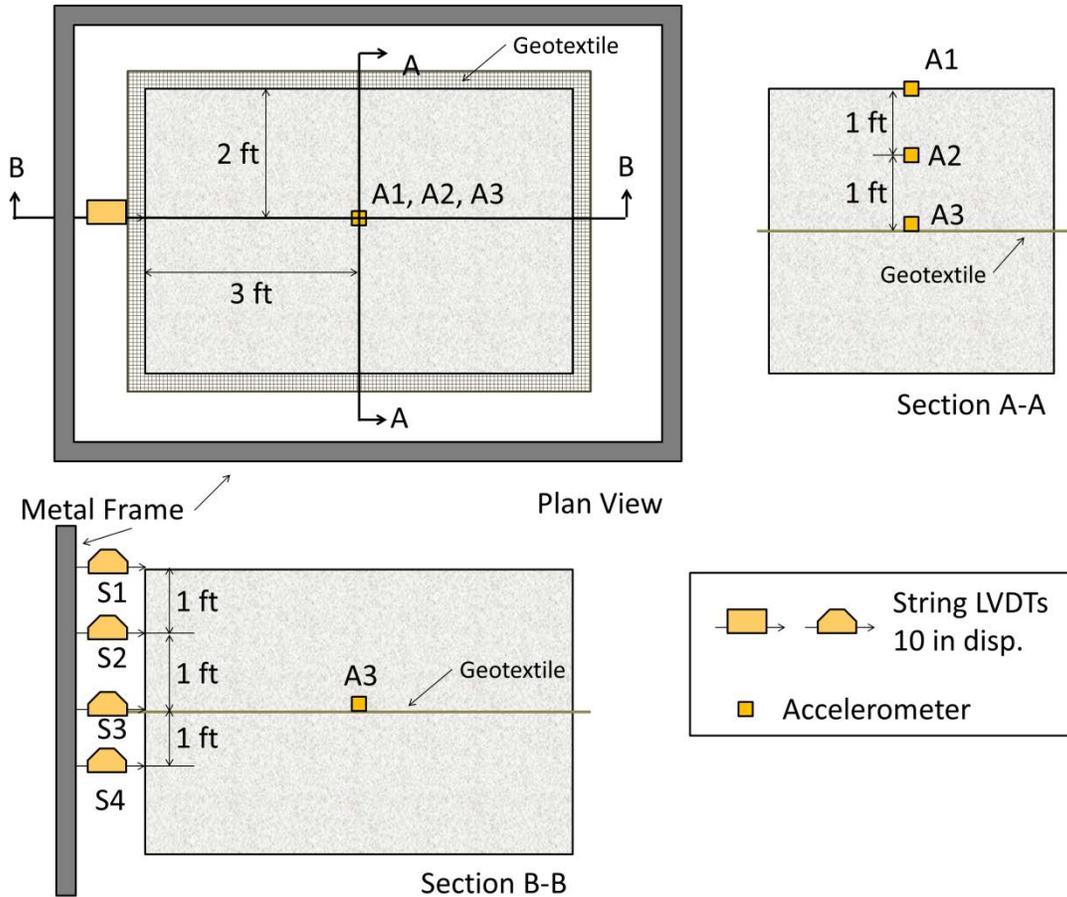


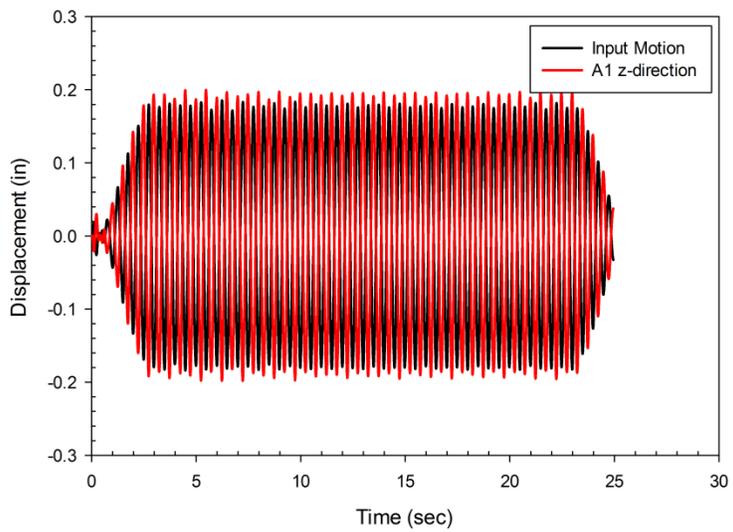
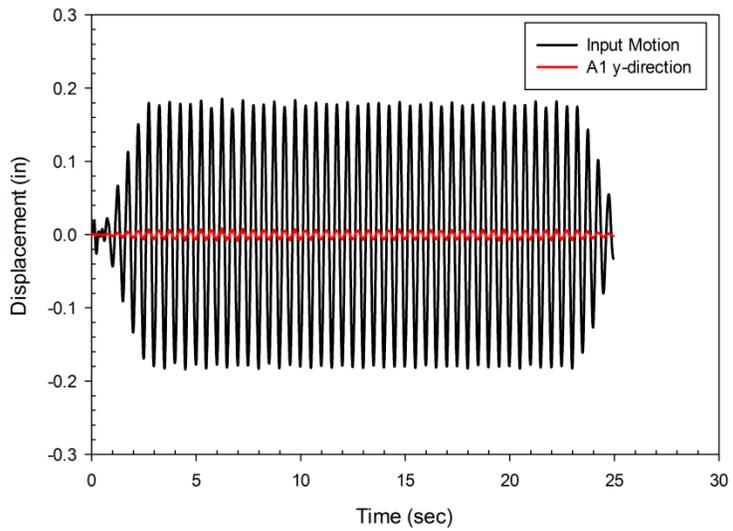
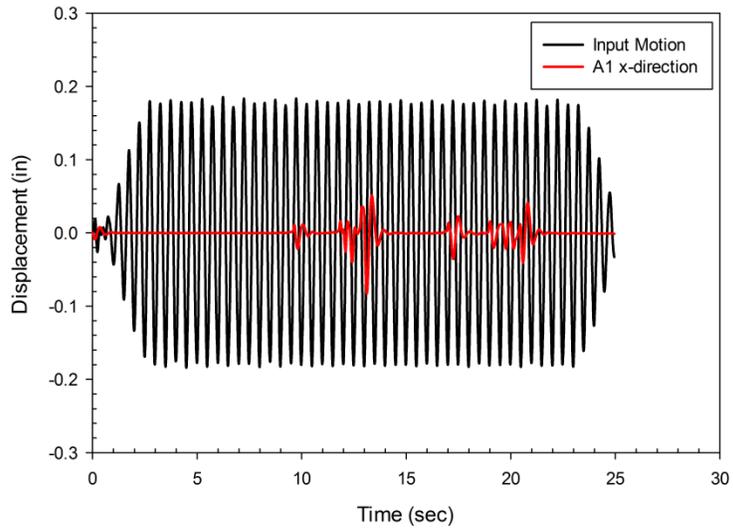


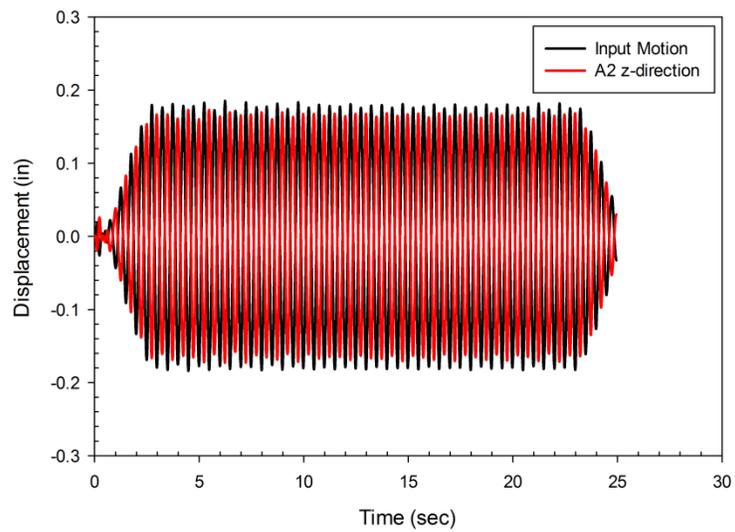
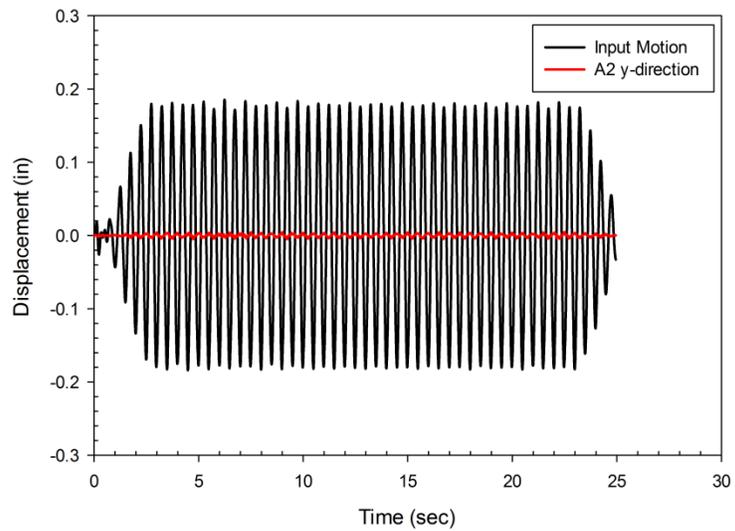
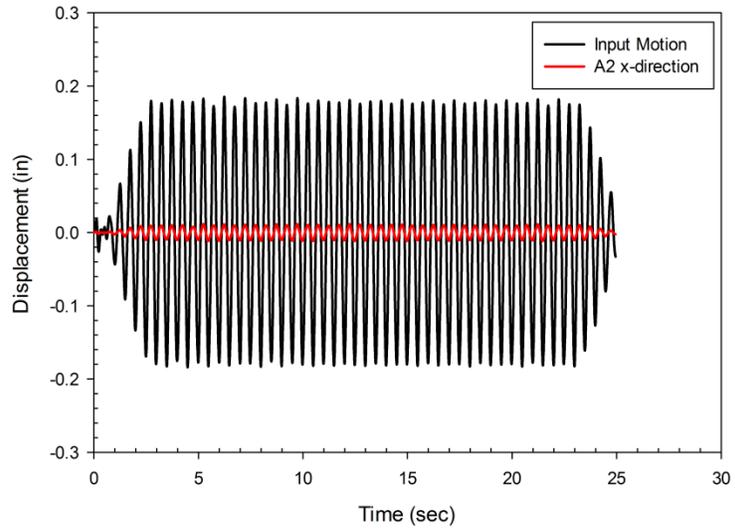
# Shake Table Test

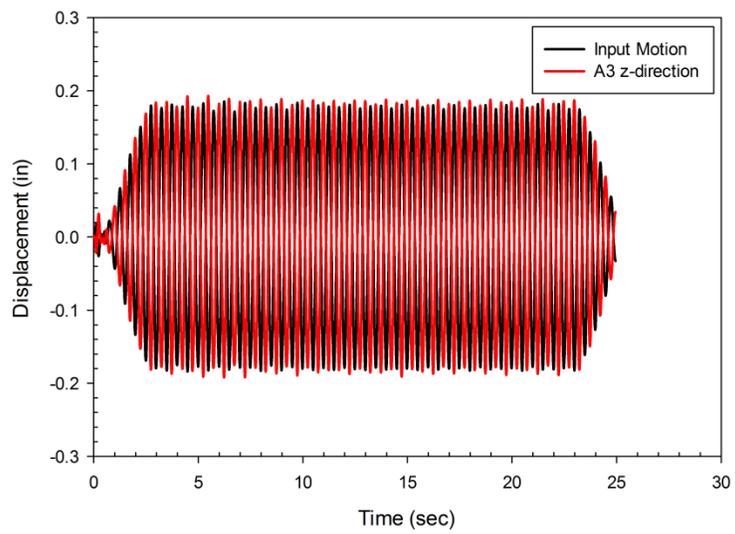
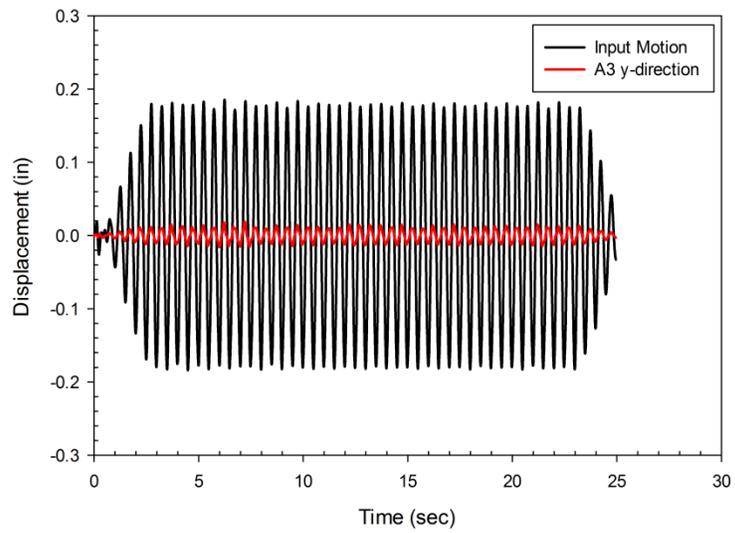
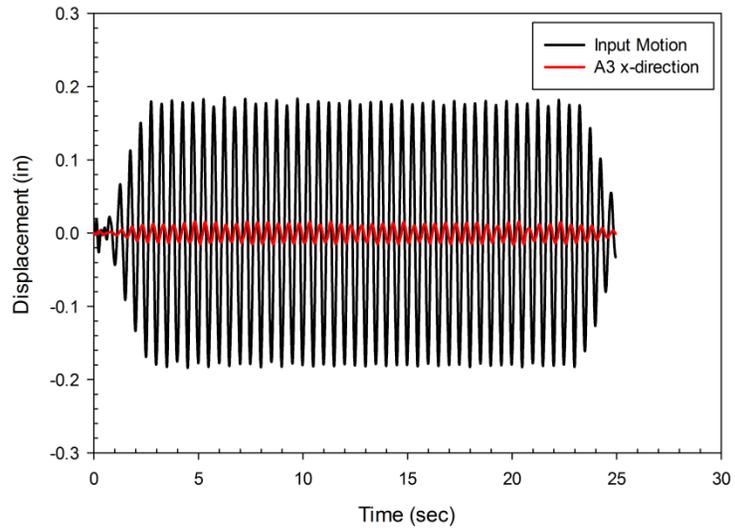


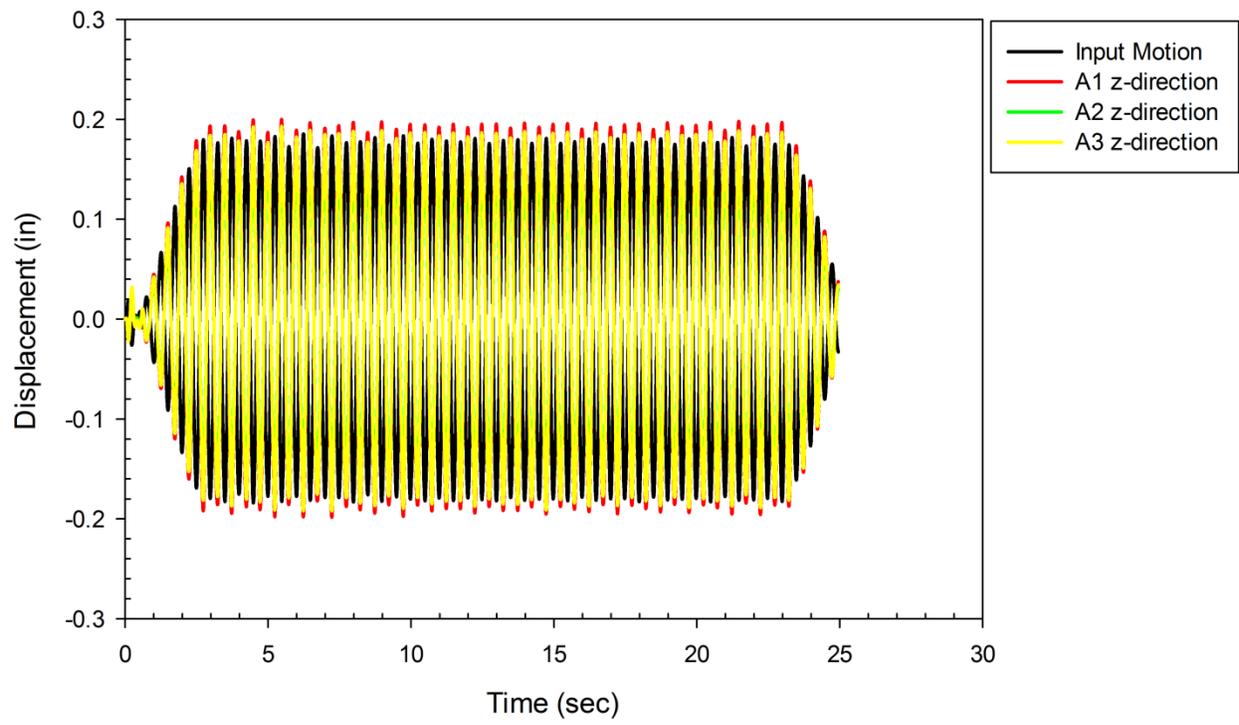
Project:	Cell Crete (Cellular Concrete)	Test Date:	9/2/16
Location:	----	Test No.:	2
Model Size:	4 ft by 6 ft	Vertical Stress:	102.5 psf
Model Height:	4 ft	Geogrid Depth:	2 ft
Motion Type:	Sinusoidal	Characteristics:	0.1g 2Hz

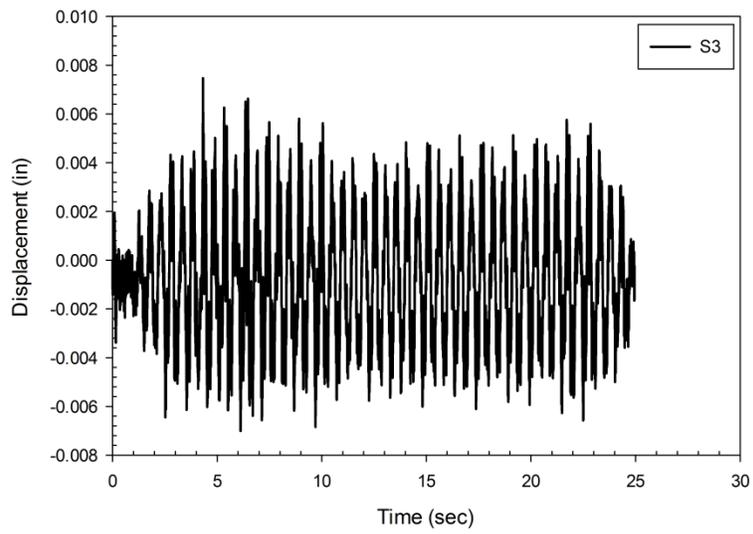
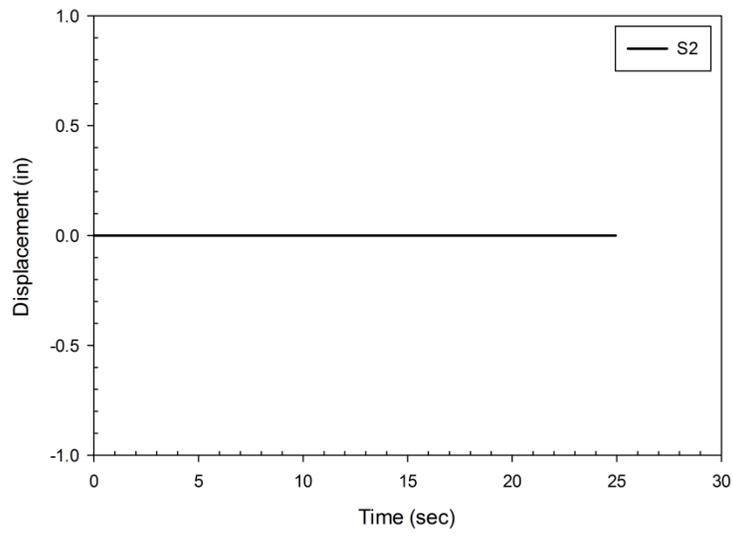
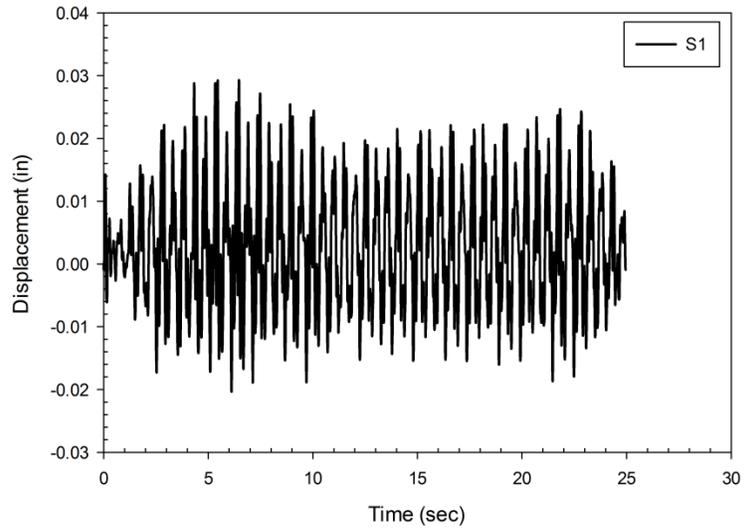


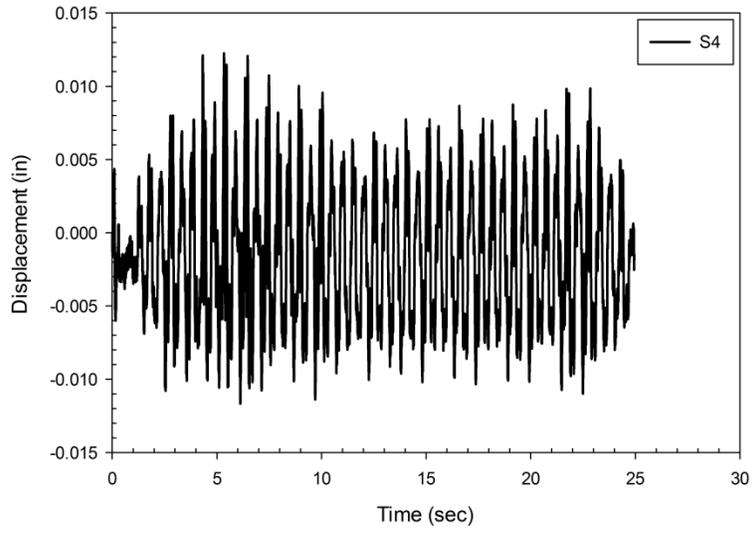








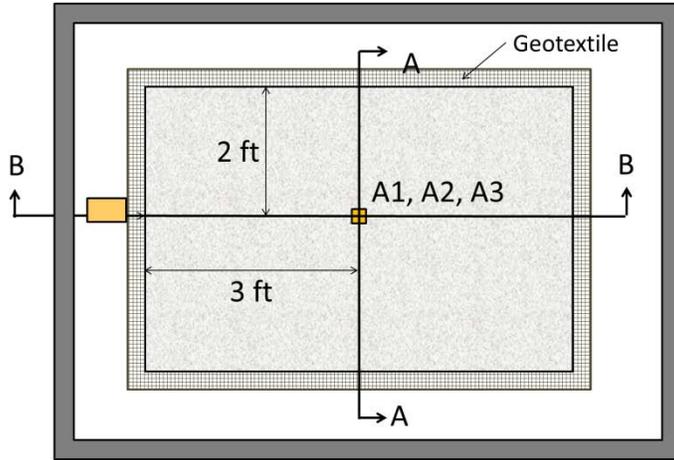




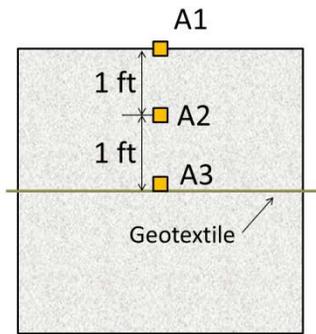
# Shake Table Test



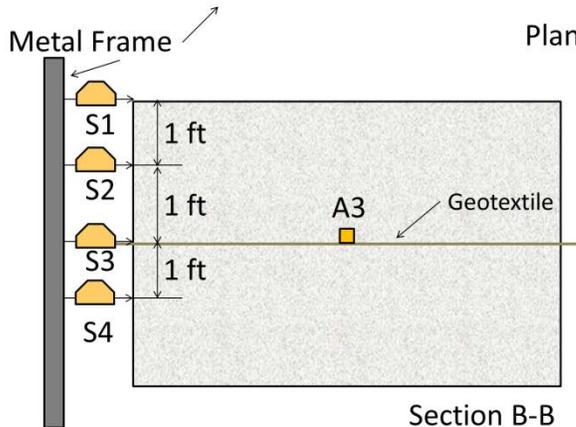
Project:	Cell Crete (Cellular Concrete)	Test Date:	9/2/16
Location:	----	Test No.:	2
Model Size:	4 ft by 6 ft	Vertical Stress:	102.5 psf
Model Height:	4 ft	Geogrid Depth:	2 ft
Motion Type:	Sinusoidal	Characteristics:	0.1g 3Hz



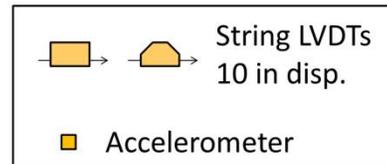
Plan View

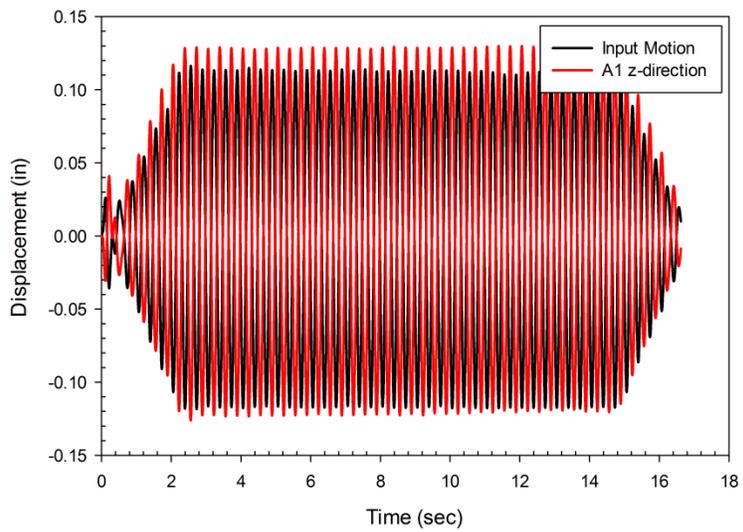
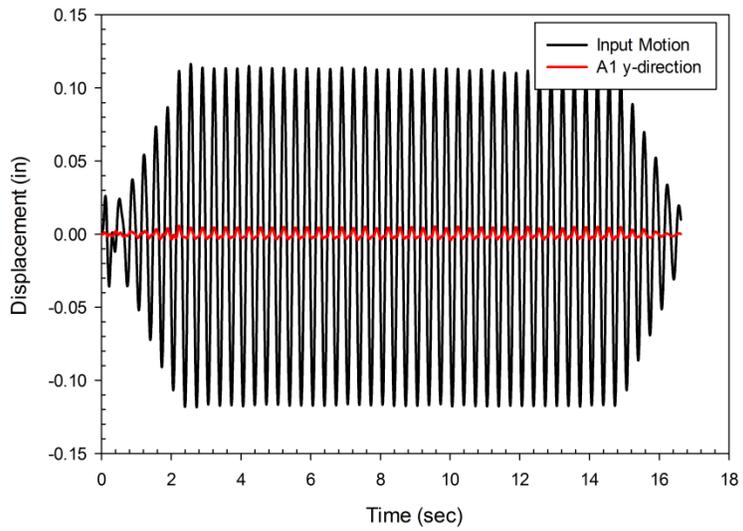
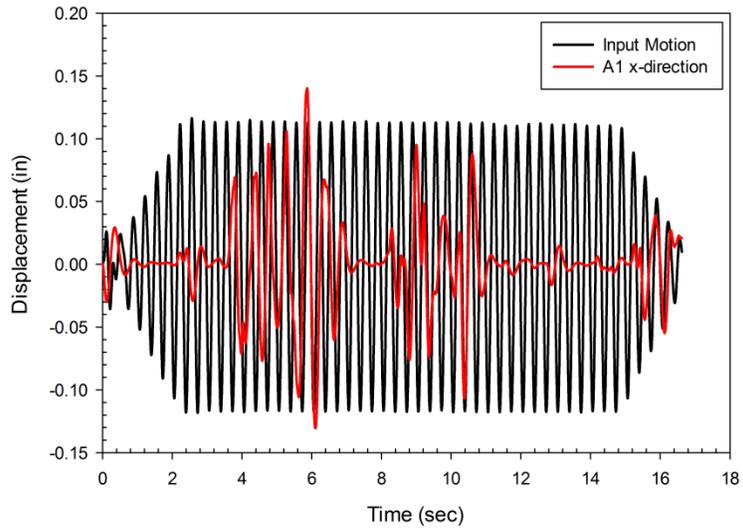


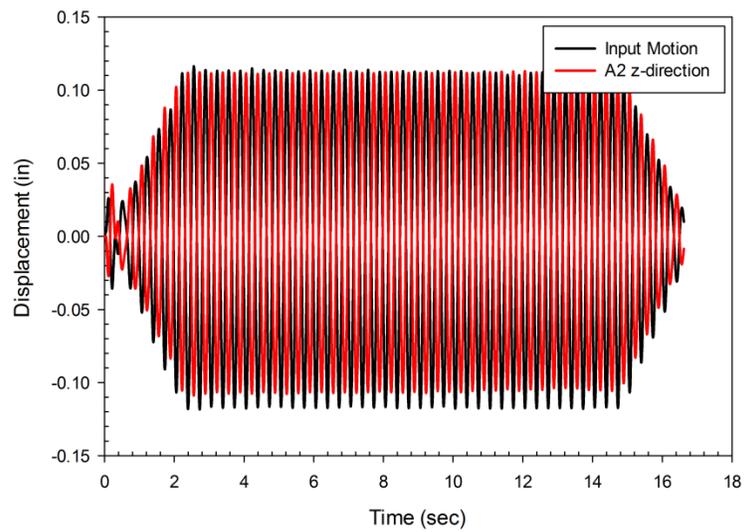
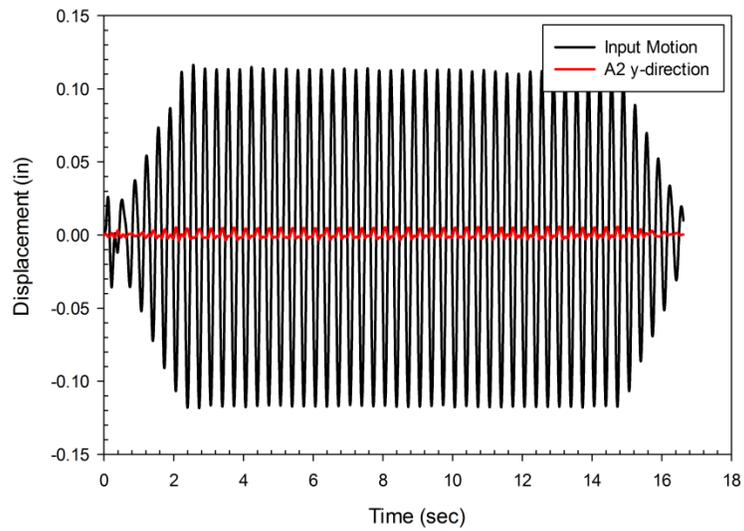
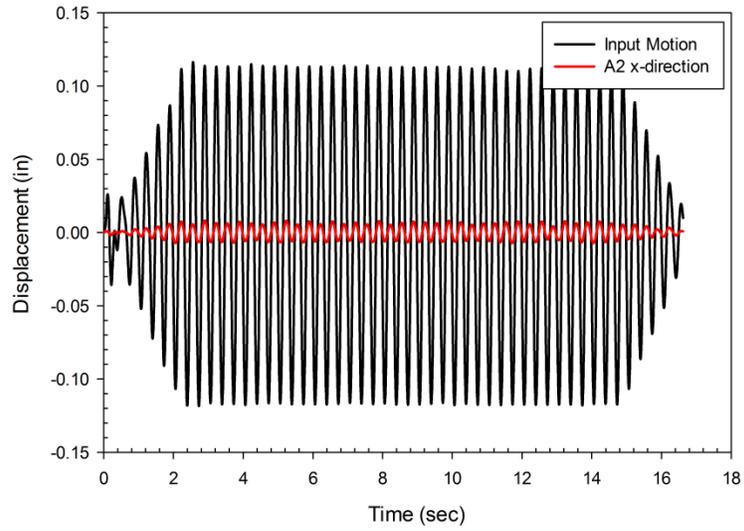
Section A-A

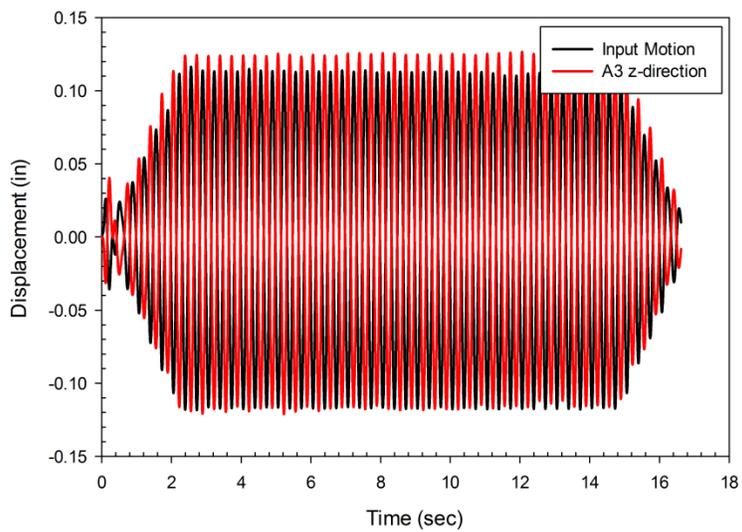
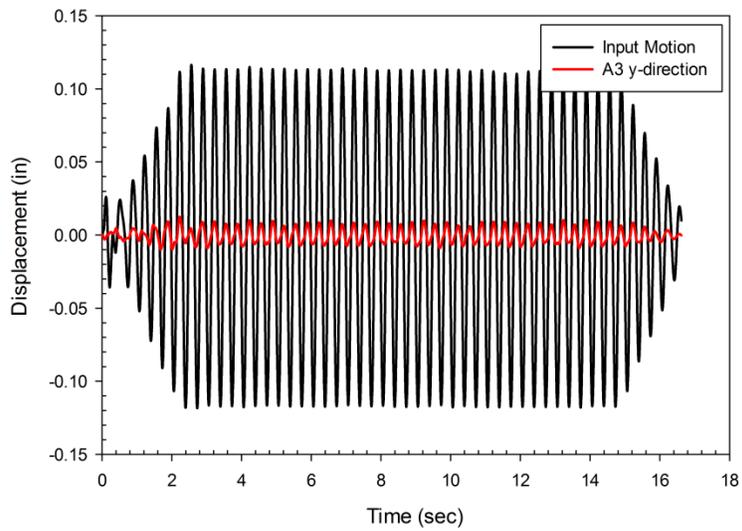
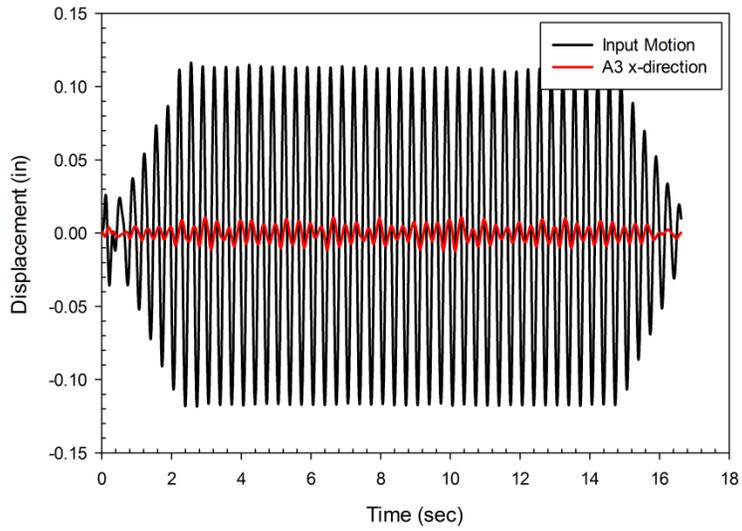


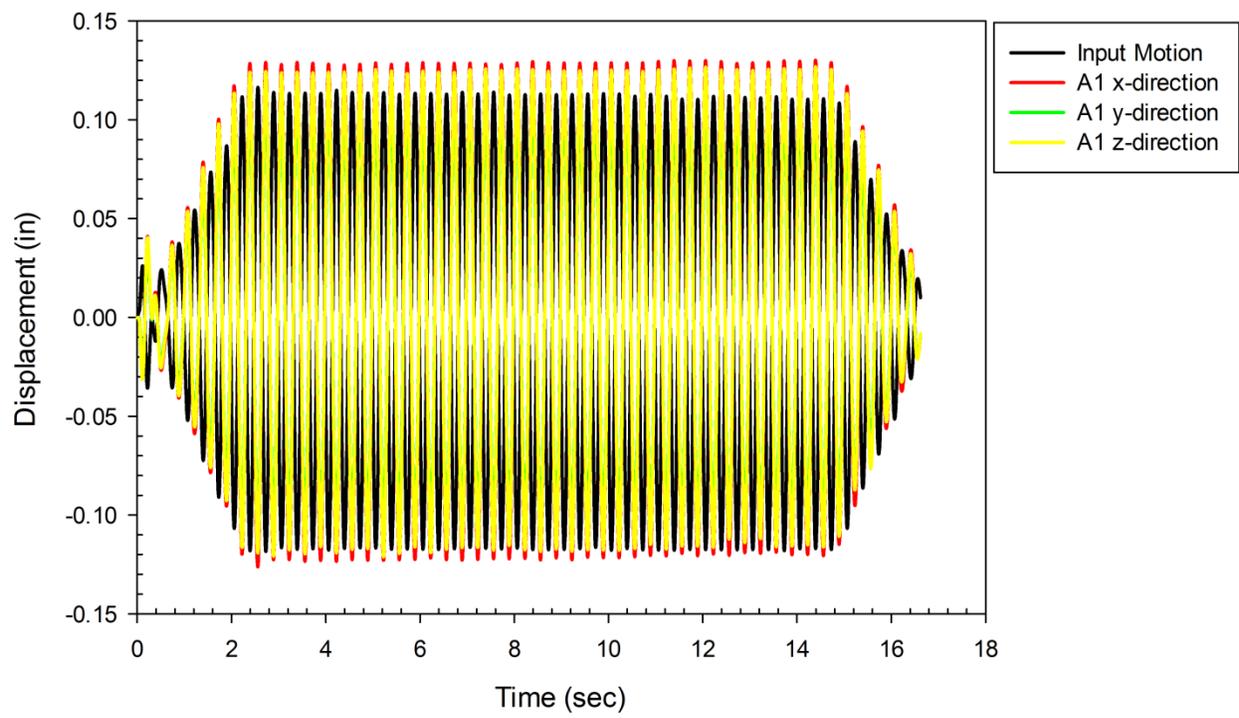
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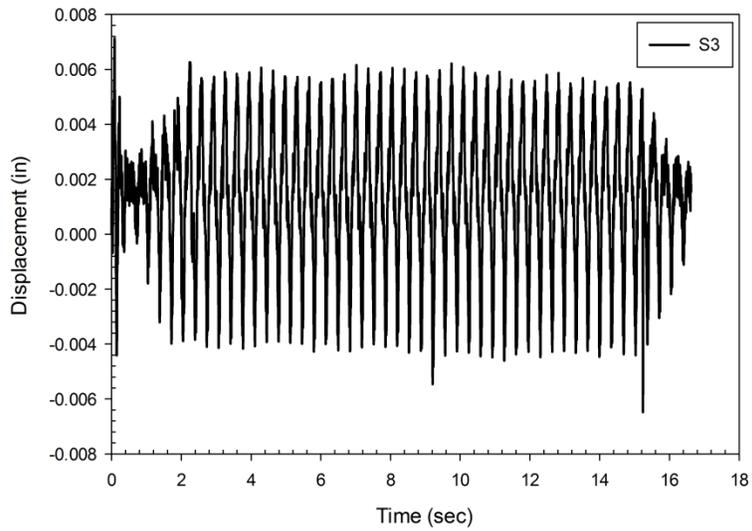
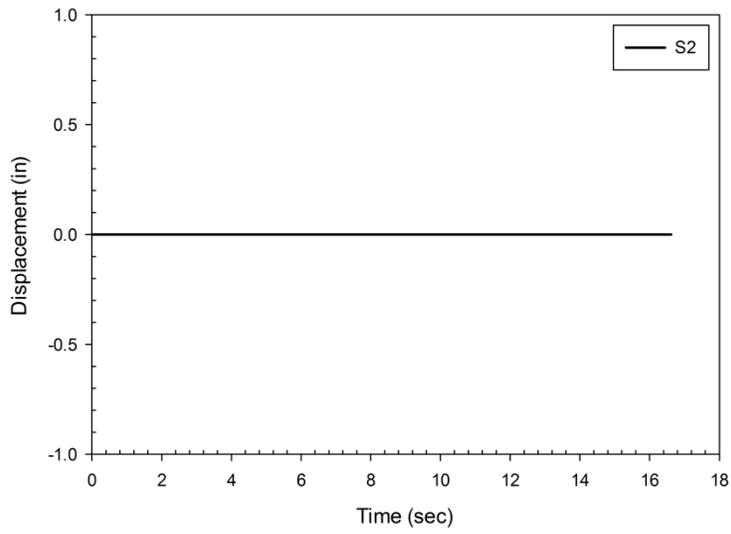
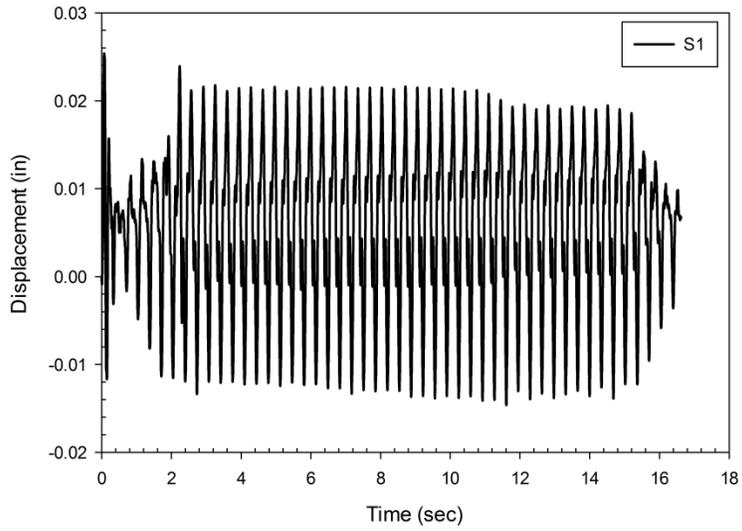


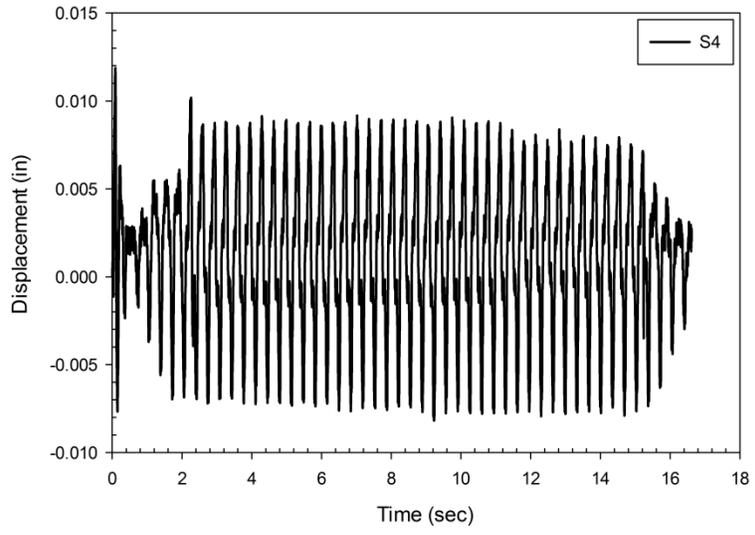








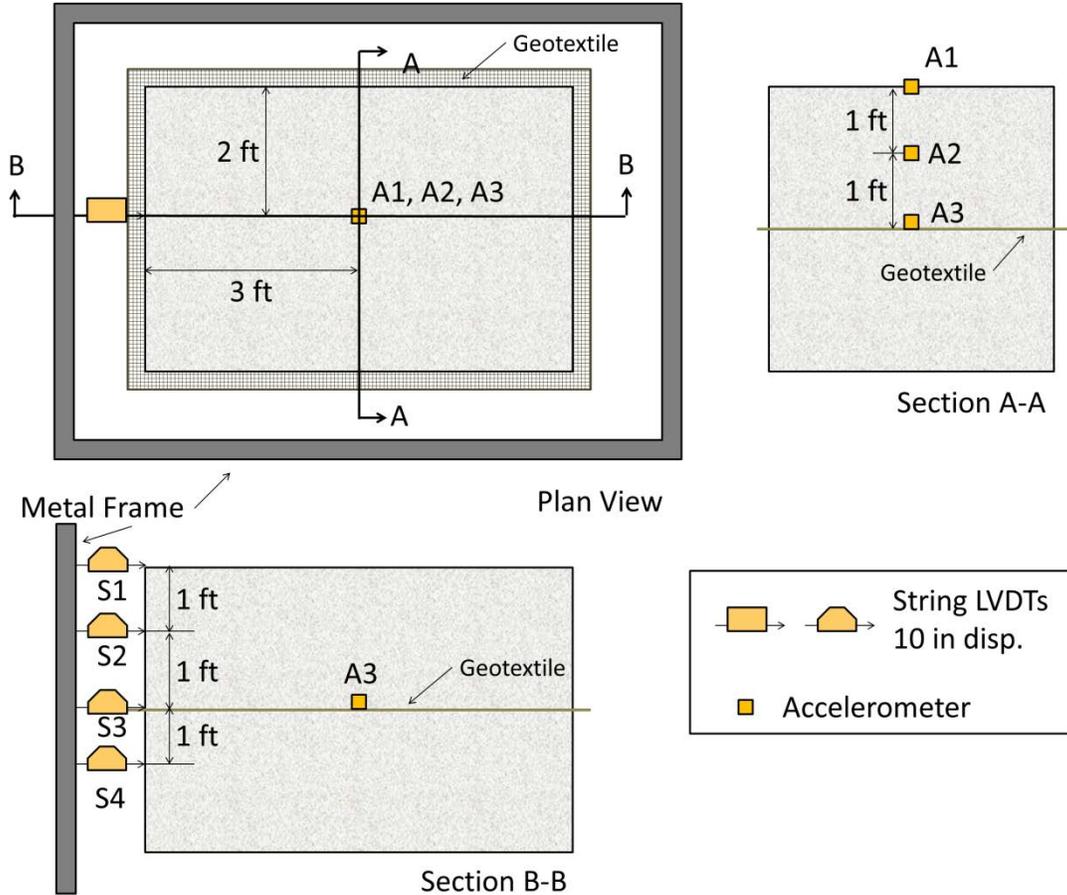


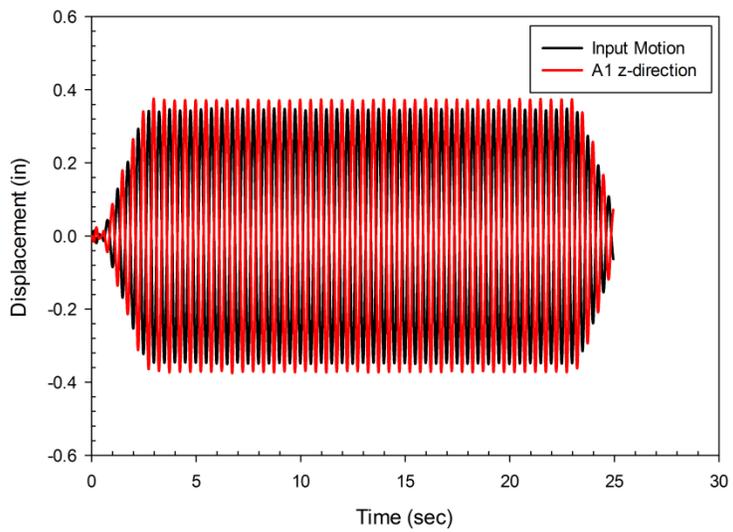
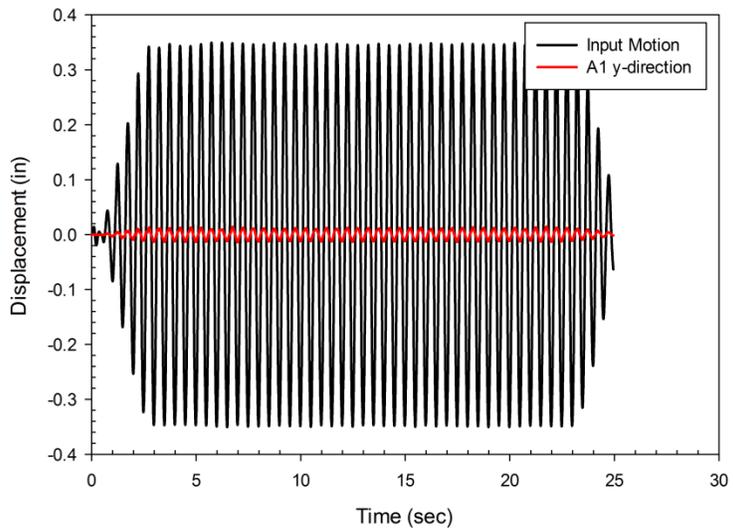
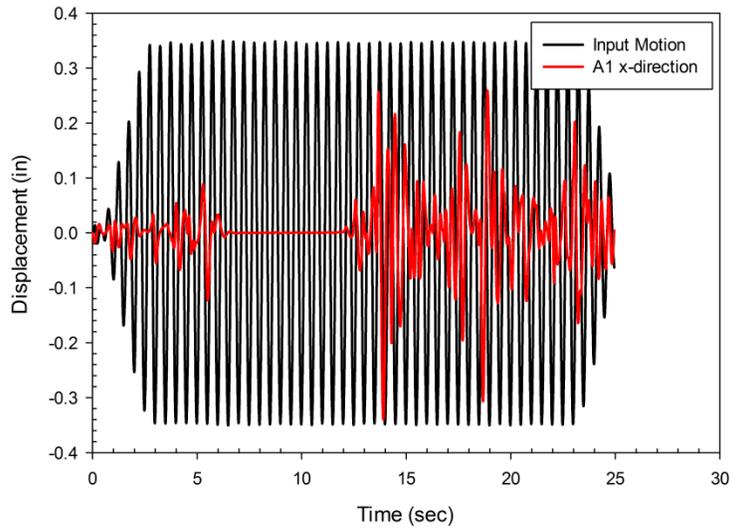


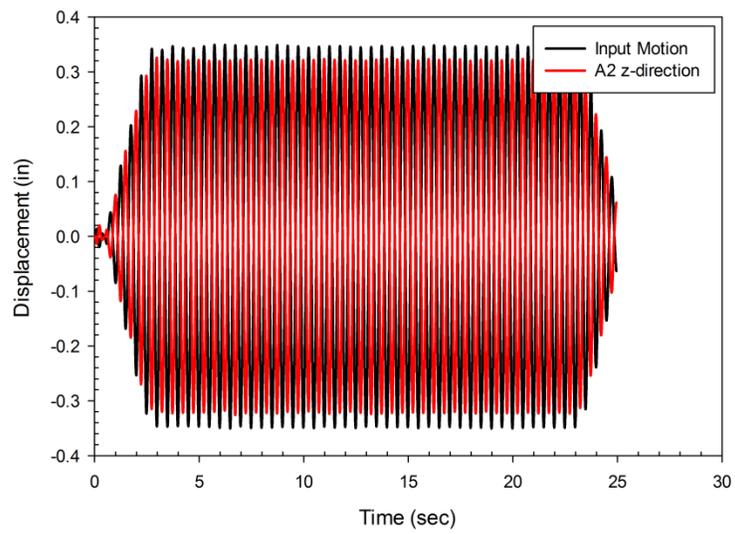
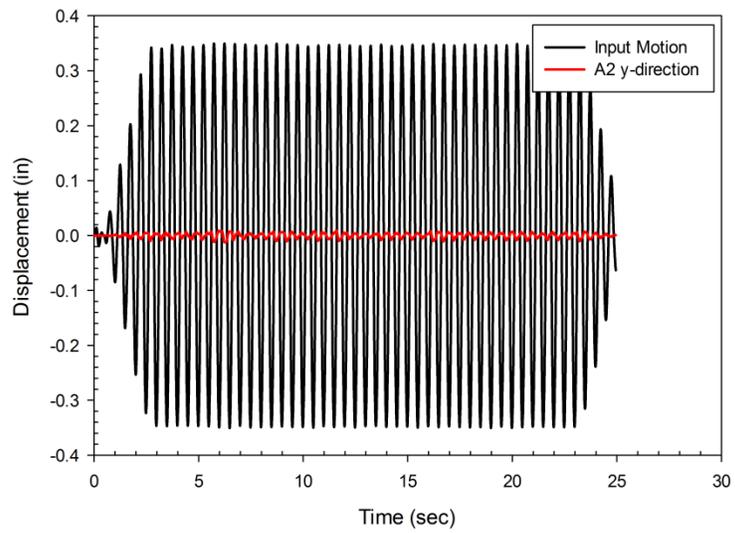
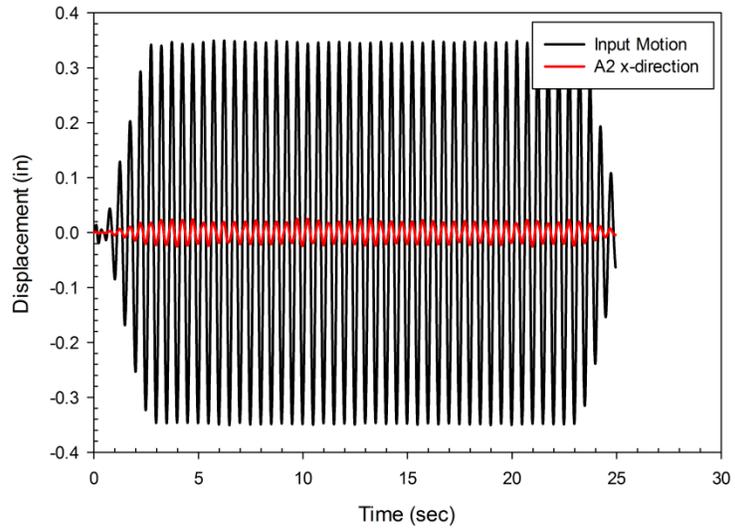
# Shake Table Test

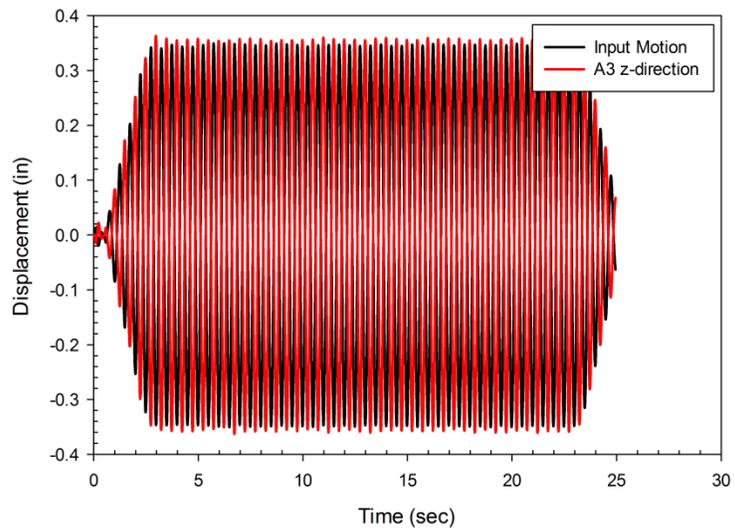
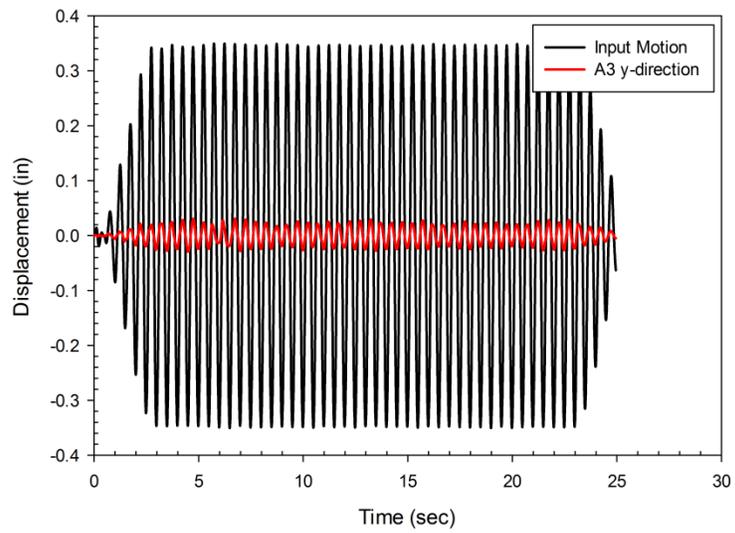
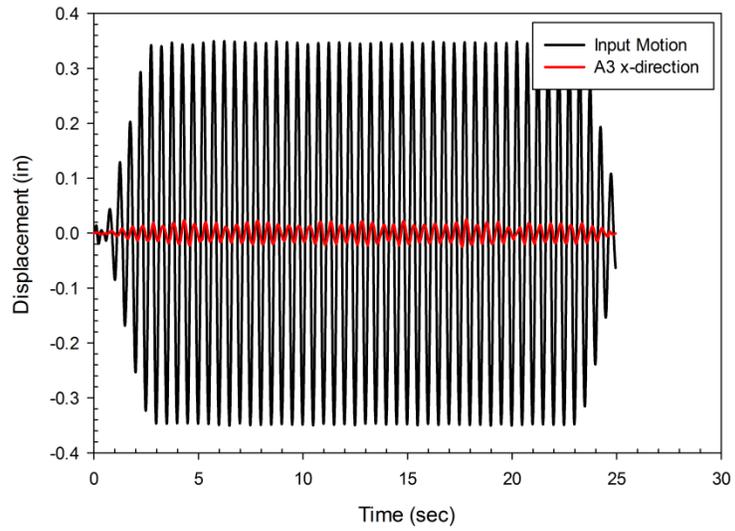


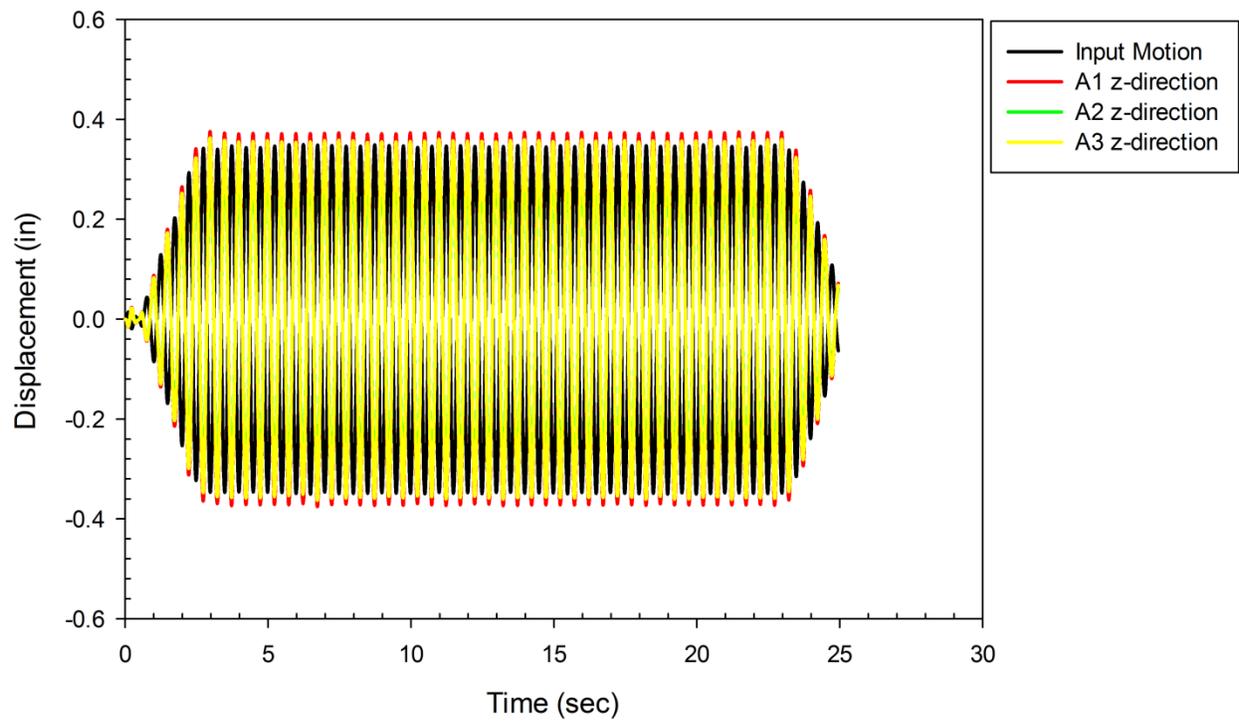
Project:	Cell Crete (Cellular Concrete)	Test Date:	9/2/16
Location:	----	Test No.:	2
Model Size:	4 ft by 6 ft	Vertical Stress:	102.5 psf
Model Height:	4 ft	Geogrid Depth:	2 ft
Motion Type:	Sinusoidal	Characteristics:	0.2g 2Hz

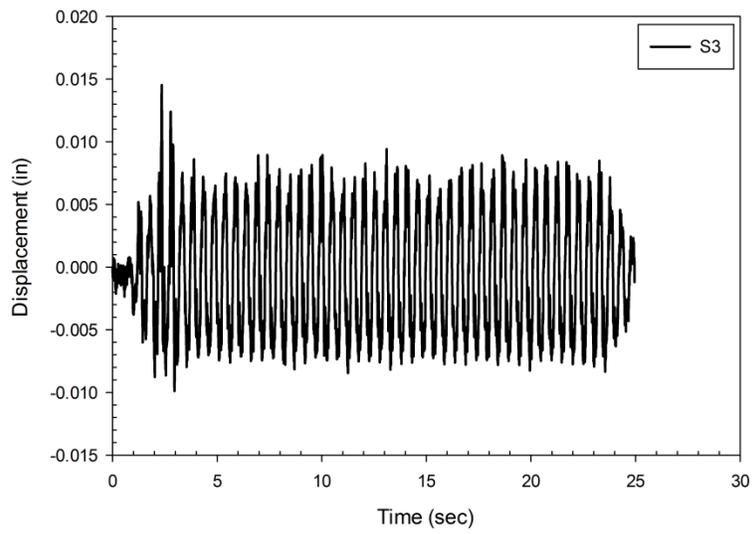
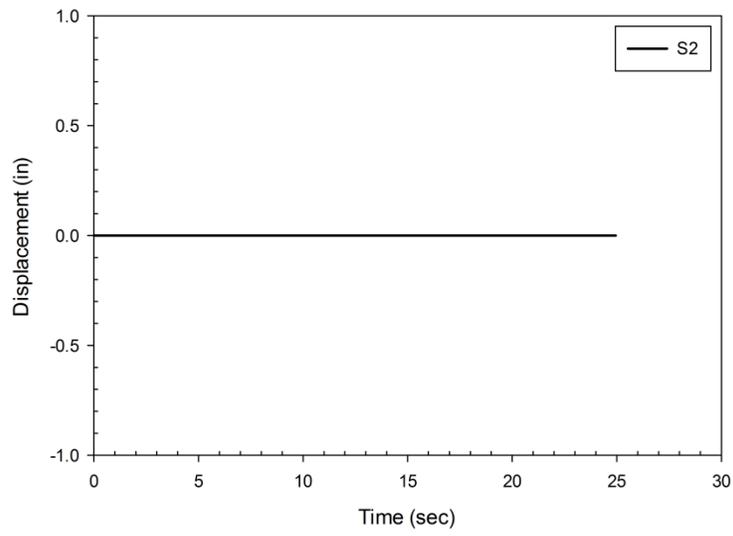
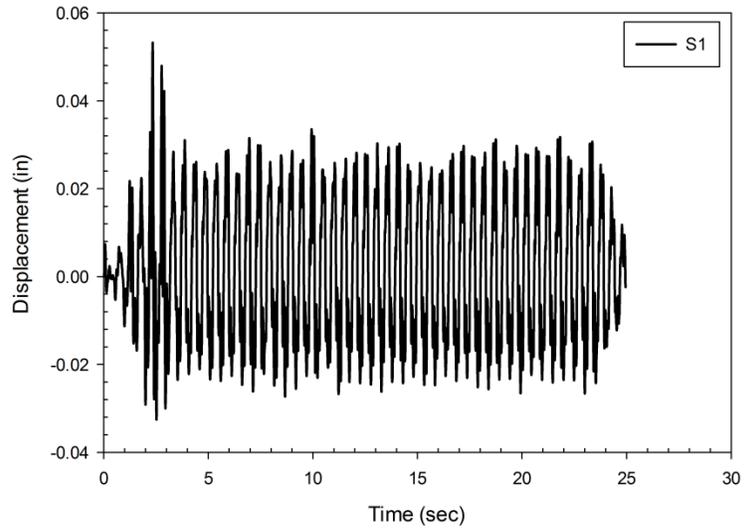


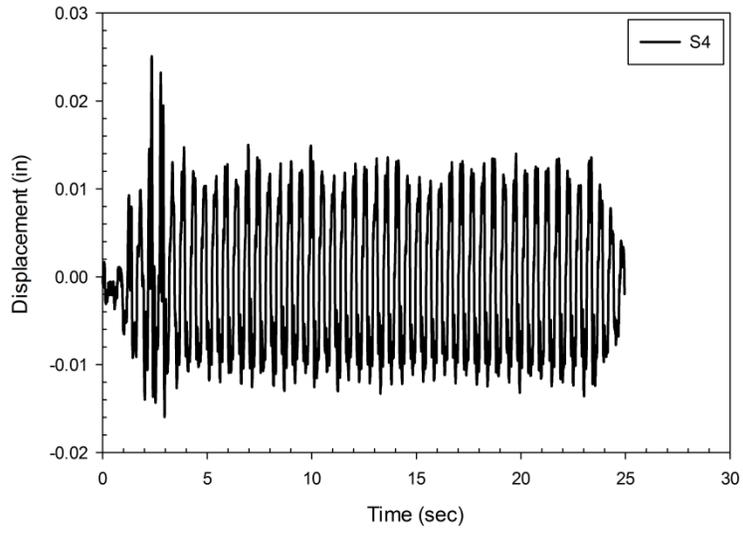








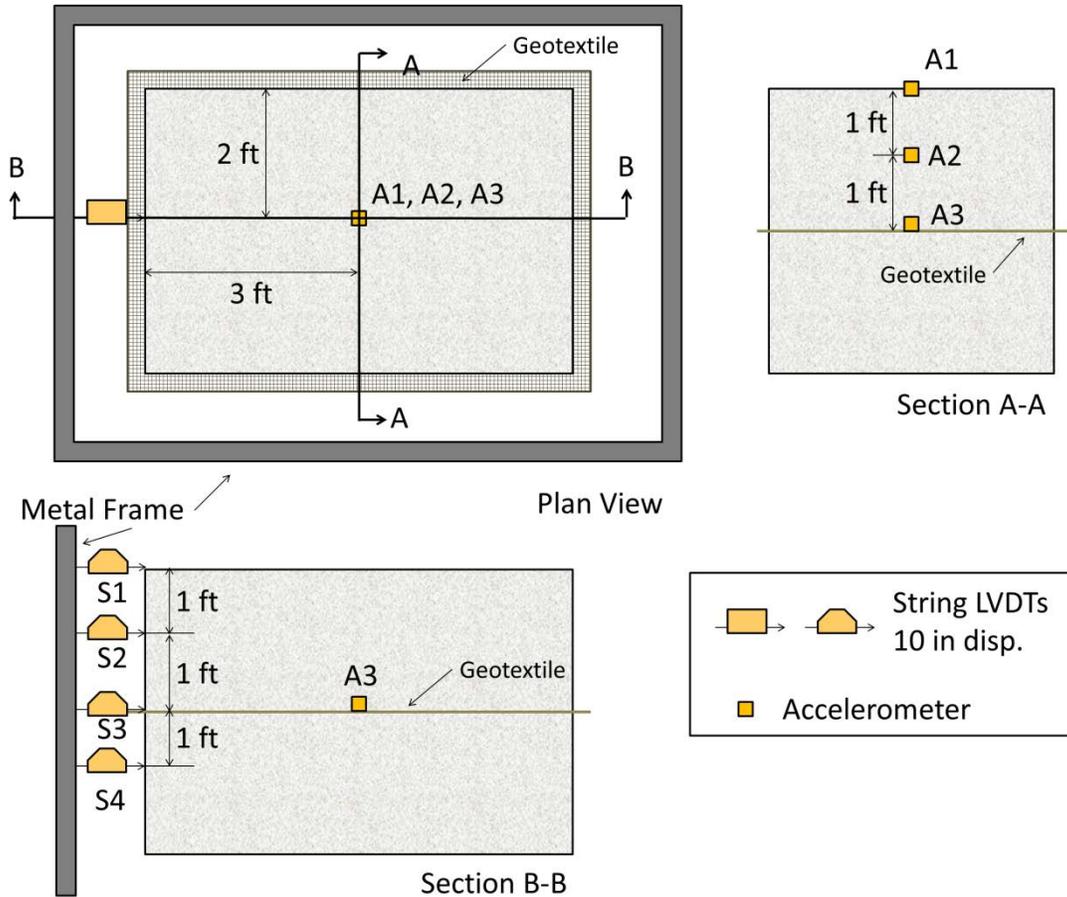


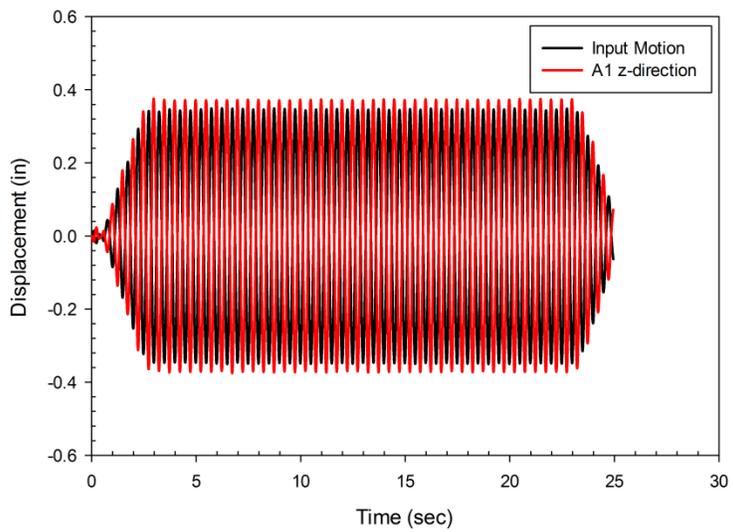
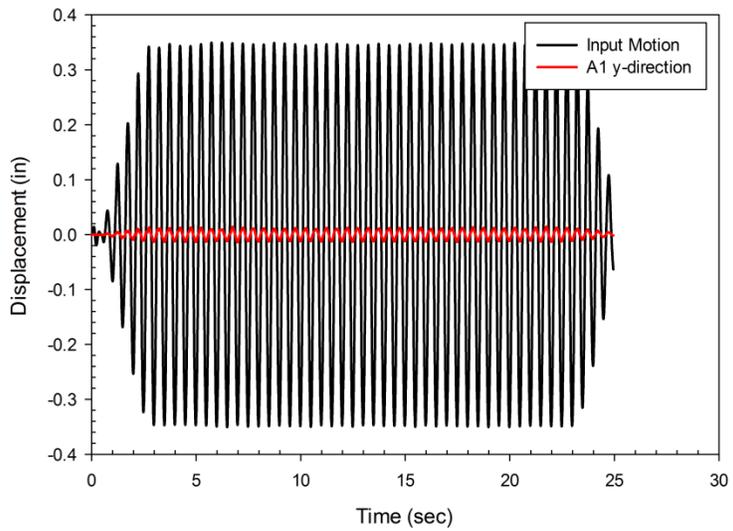
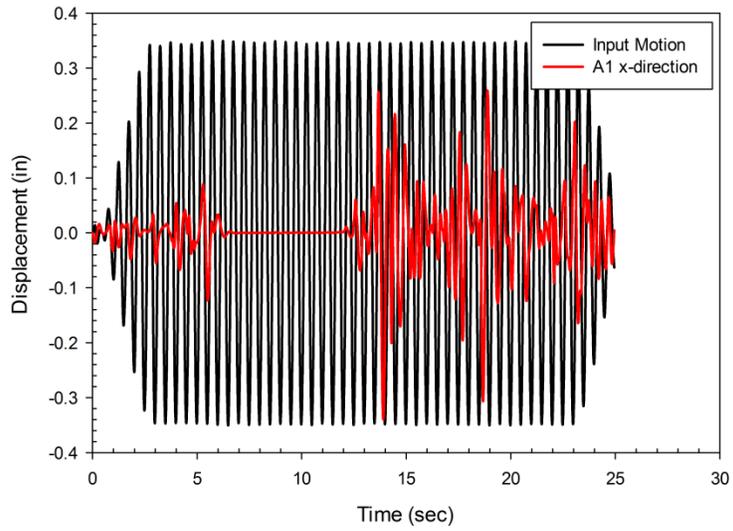


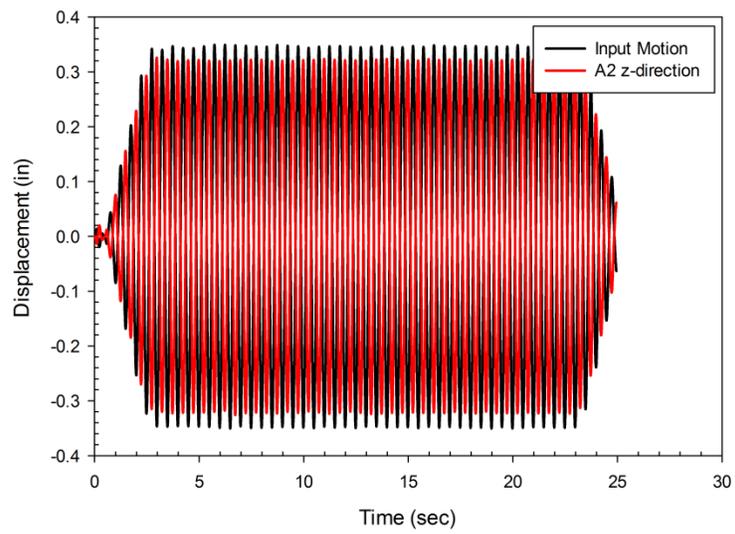
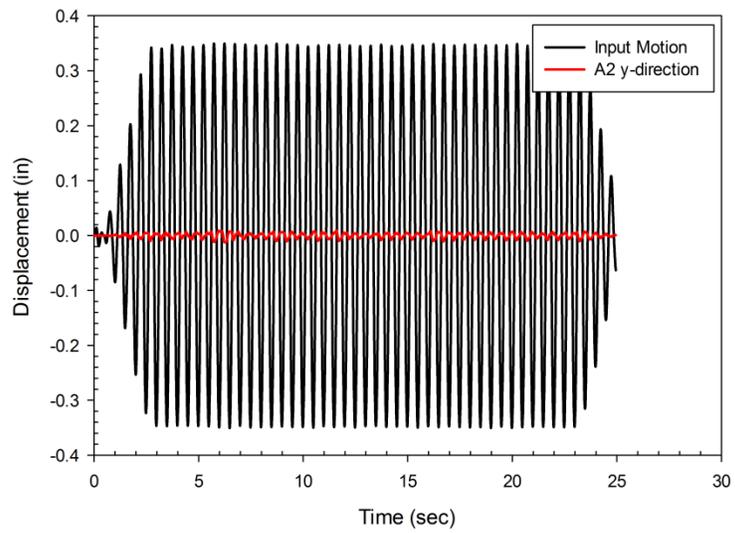
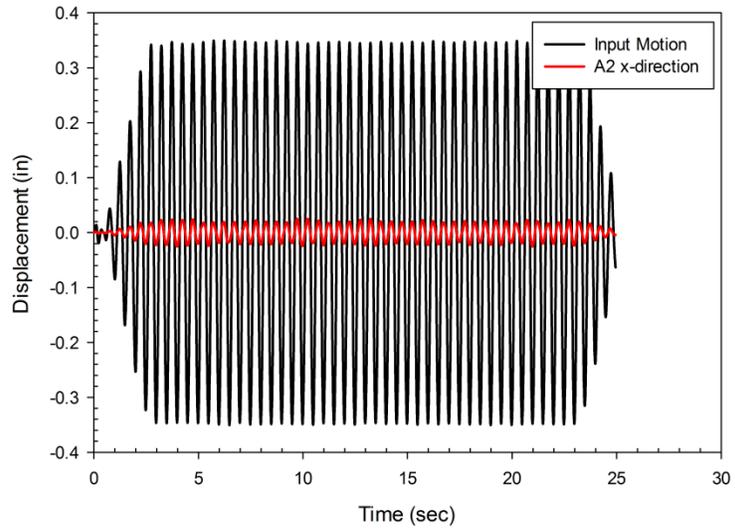
# Shake Table Test

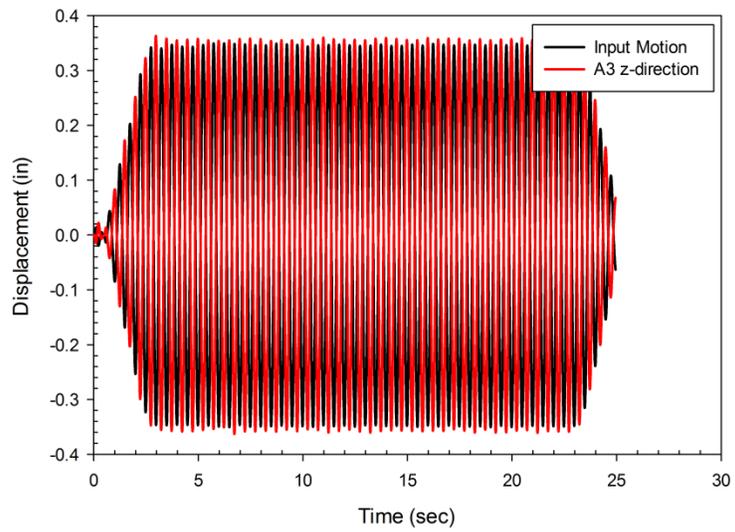
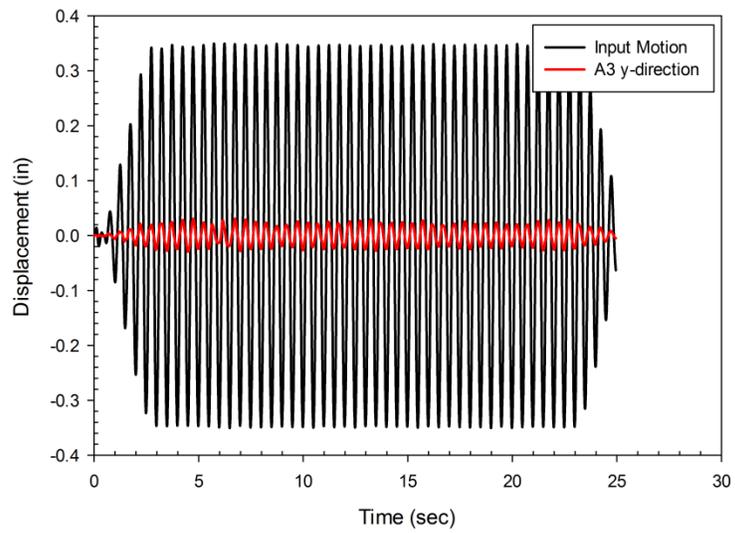
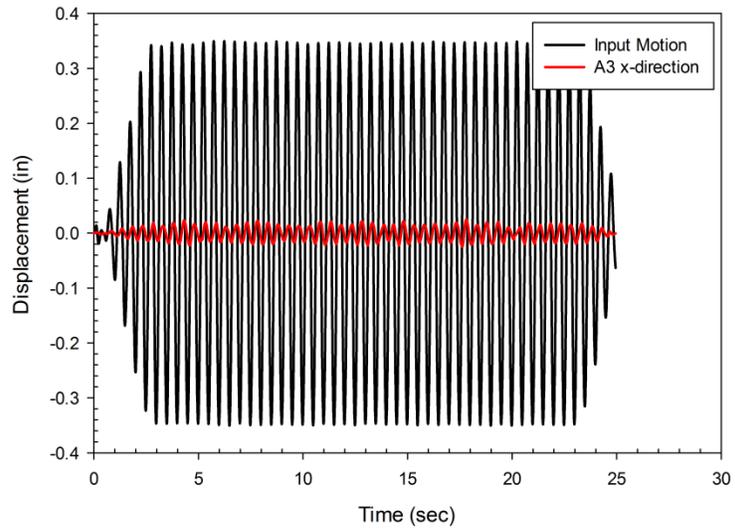


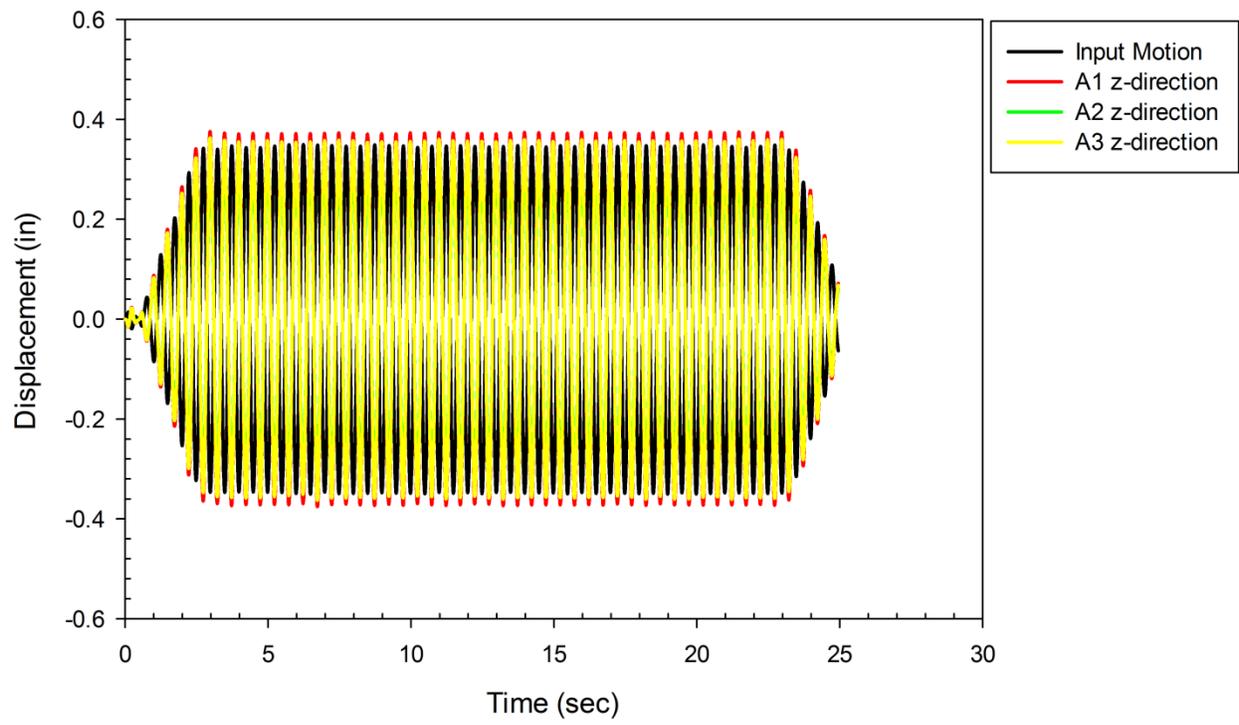
Project:	Cell Crete (Cellular Concrete)	Test Date:	9/2/16
Location:	----	Test No.:	2
Model Size:	4 ft by 6 ft	Vertical Stress:	102.5 psf
Model Height:	4 ft	Geogrid Depth:	2 ft
Motion Type:	Sinusoidal	Characteristics:	0.2g 3Hz

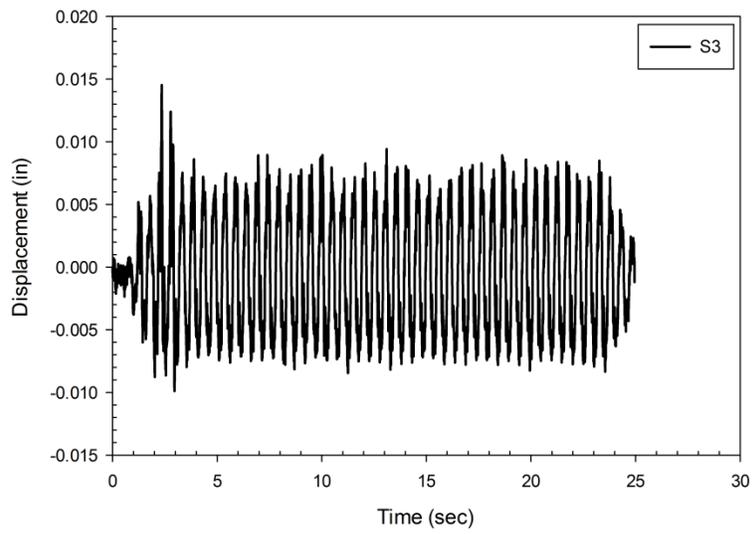
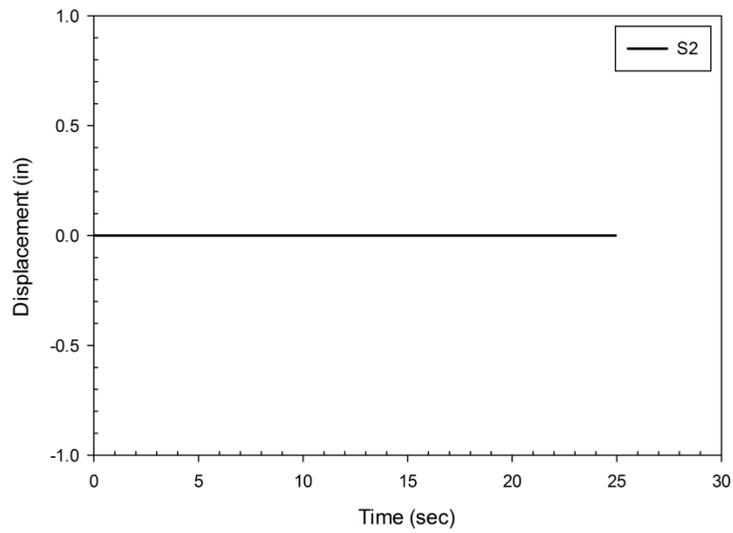
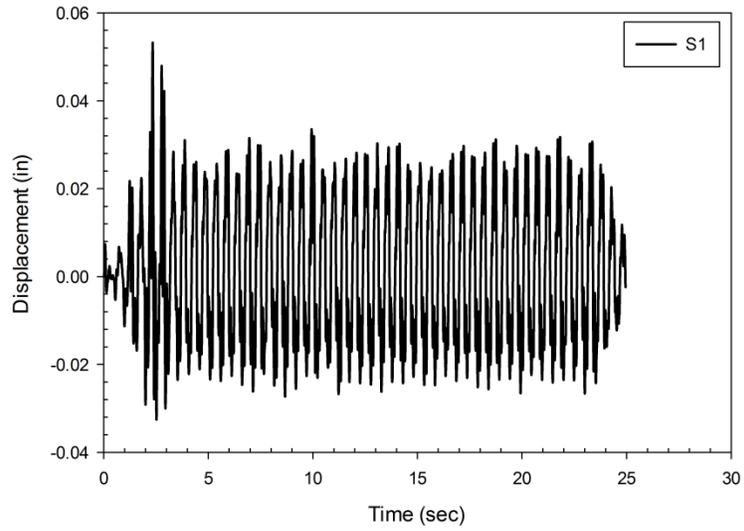


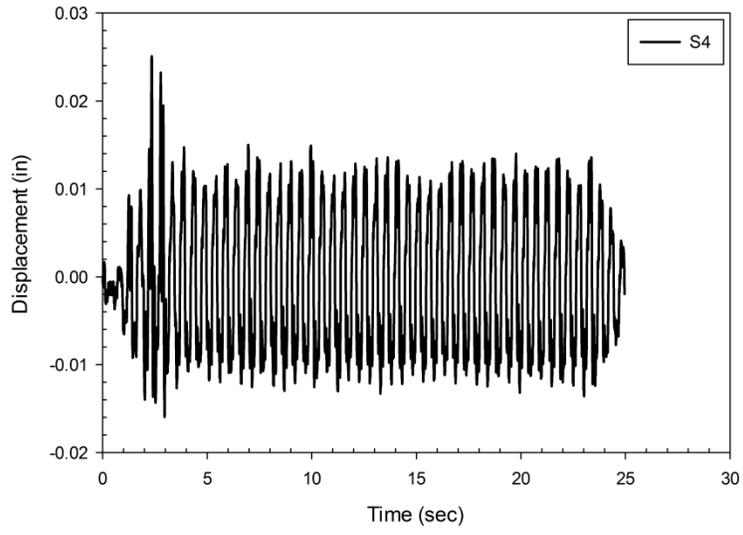








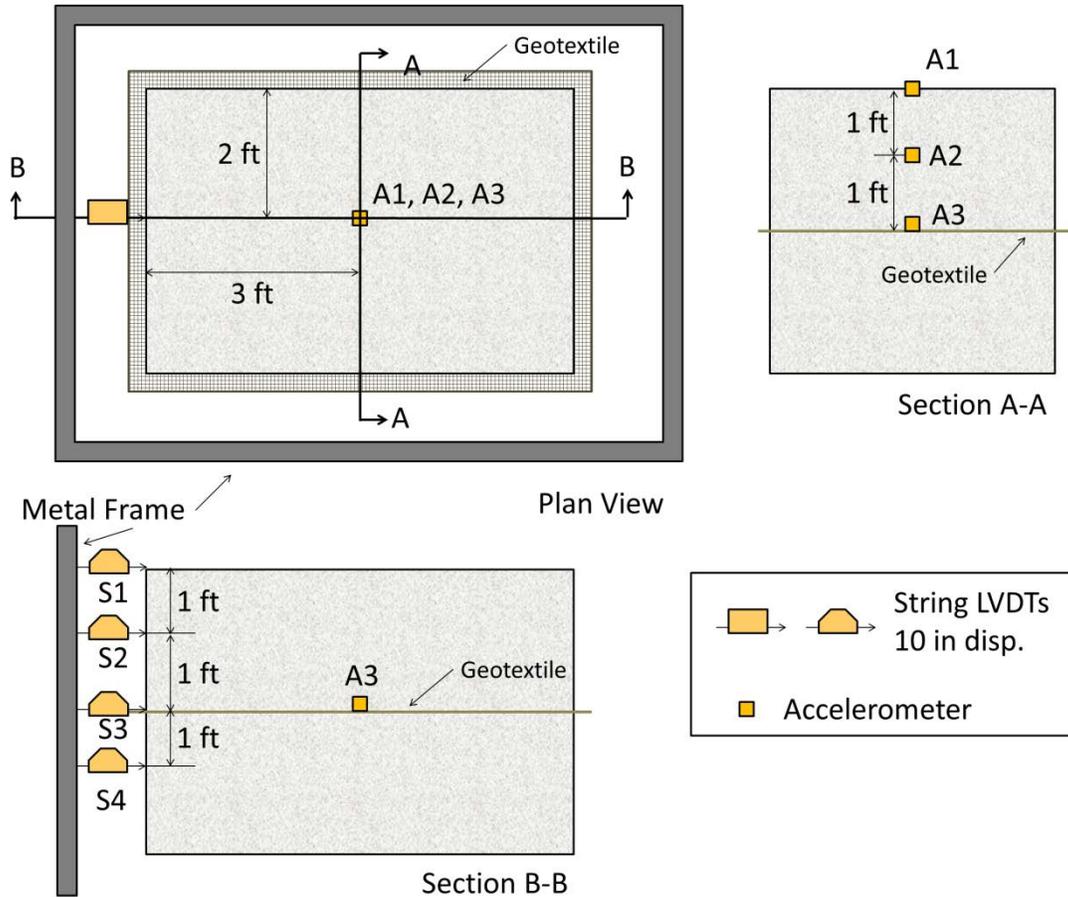


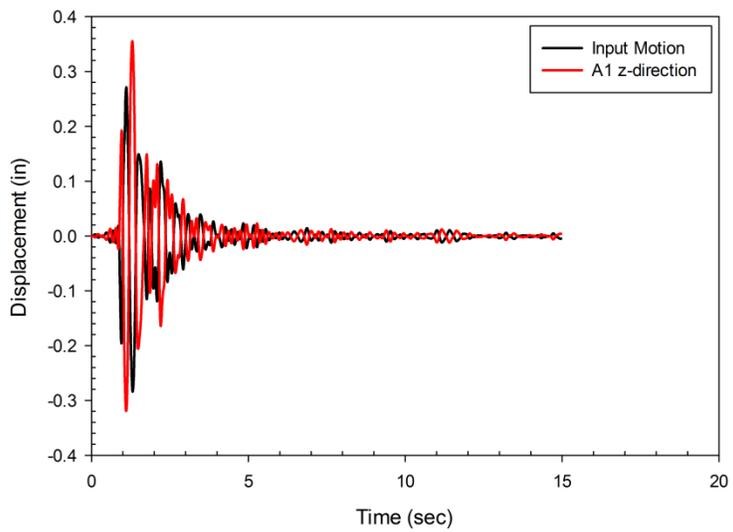
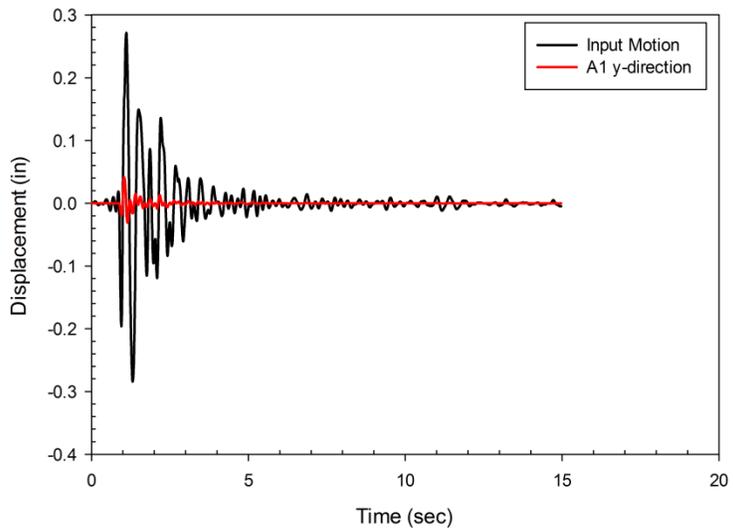
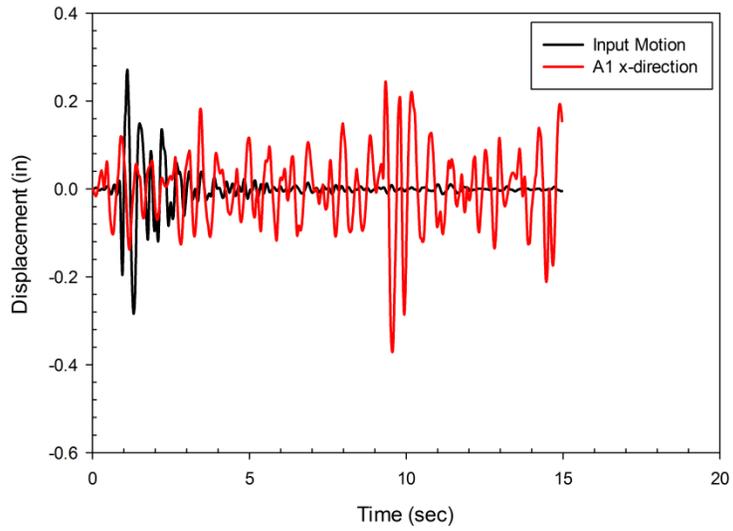


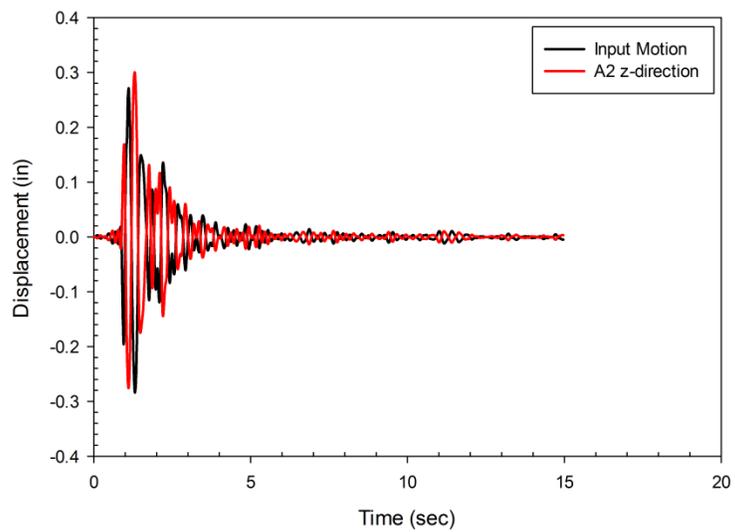
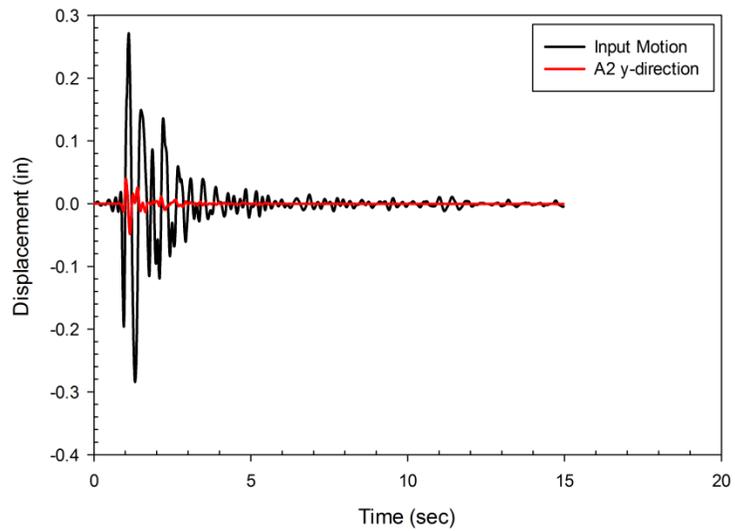
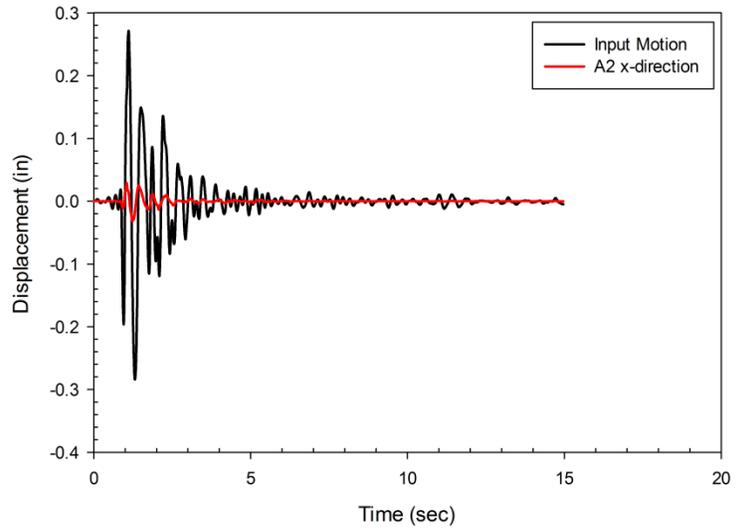
# Shake Table Test

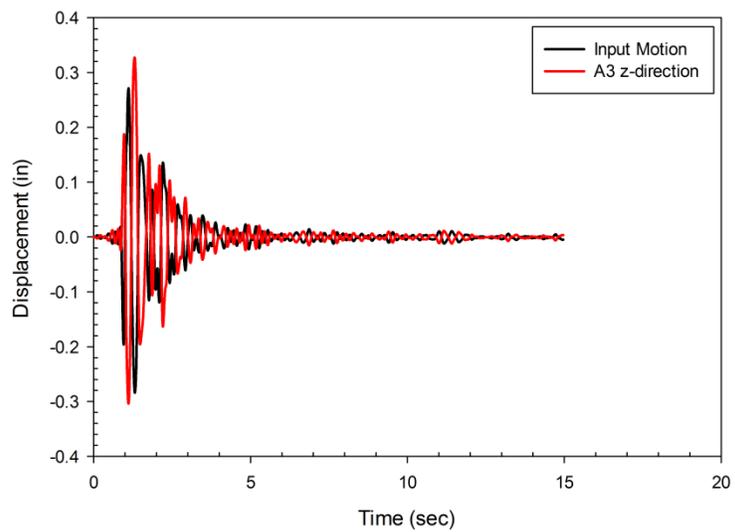
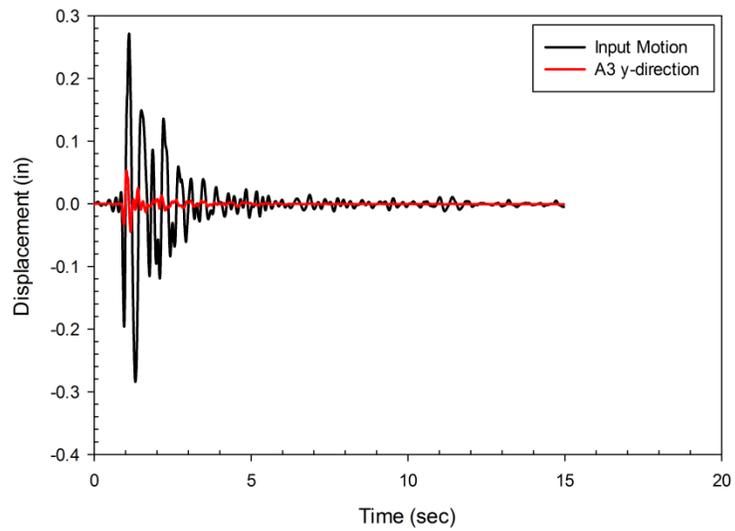
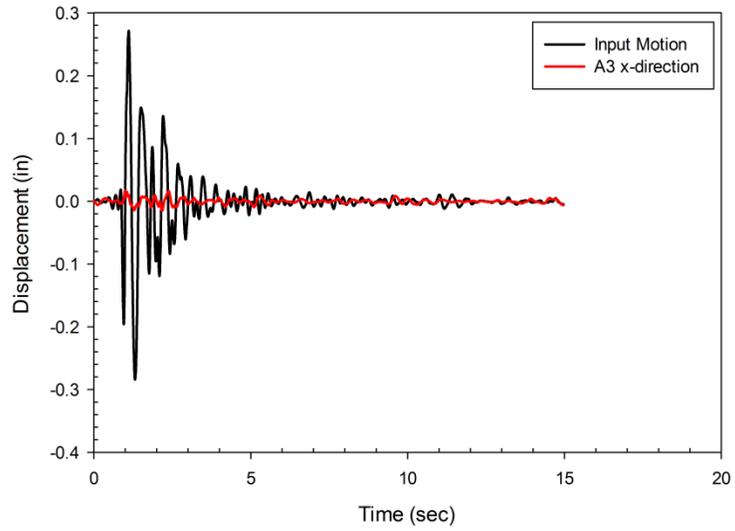


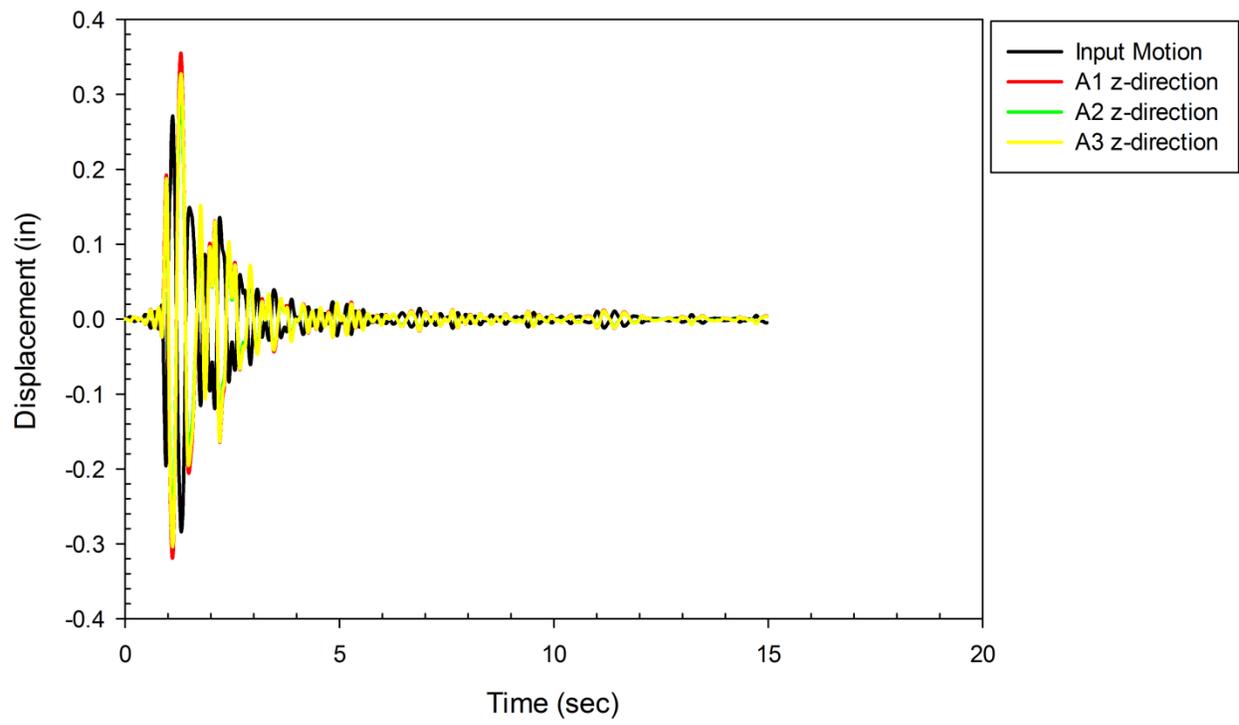
Project:	Cell Crete (Cellular Concrete)	Test Date:	9/2/16
Location:	----	Test No.:	2
Model Size:	4 ft by 6 ft	Vertical Stress:	102.5 psf
Model Height:	4 ft	Geogrid Depth:	2 ft
Motion Type:	1994 Northridge Earthquake	Characteristics:	N/A

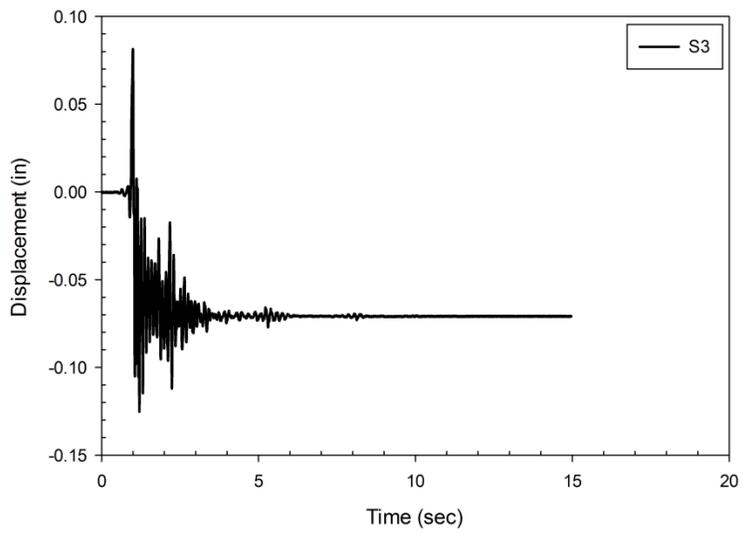
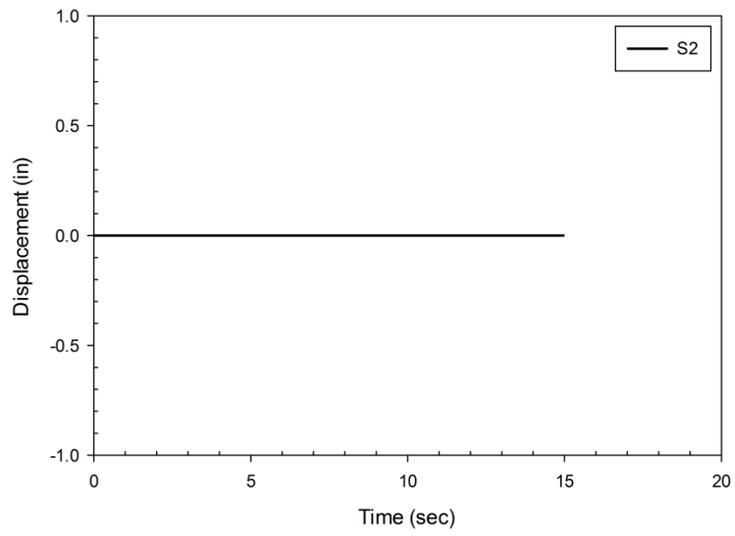
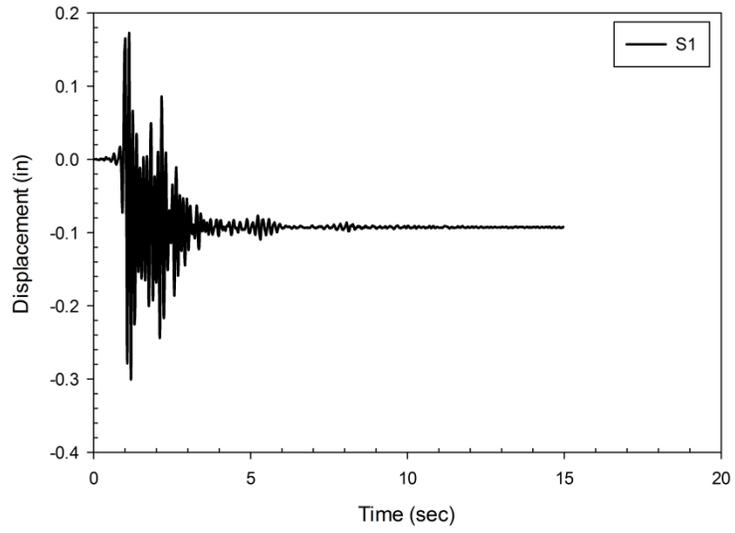


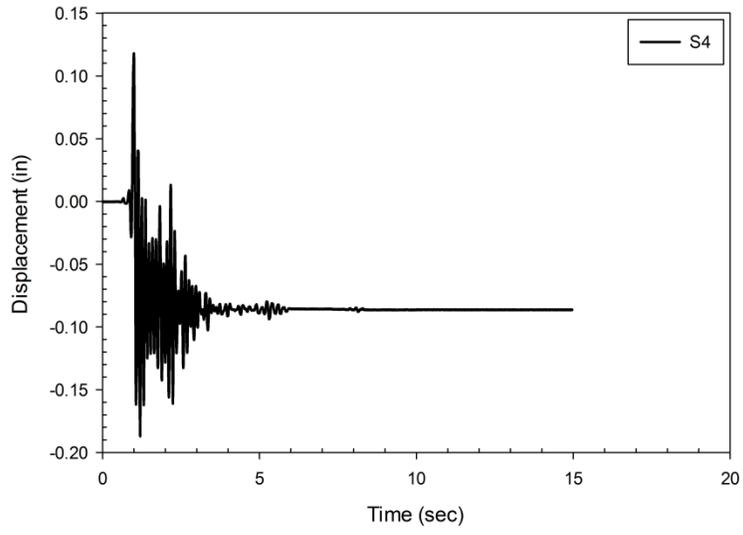








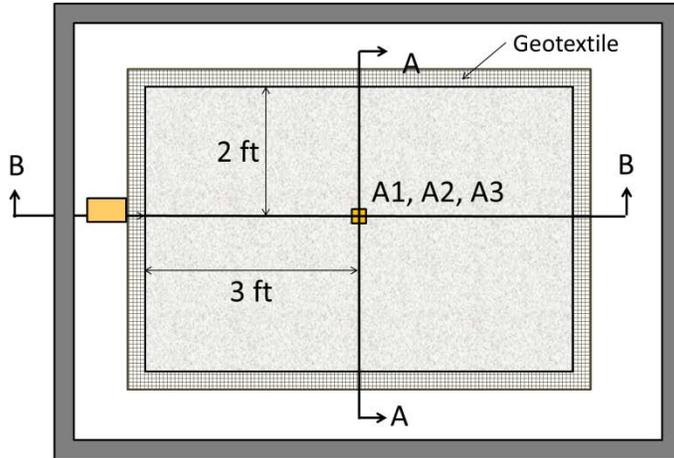




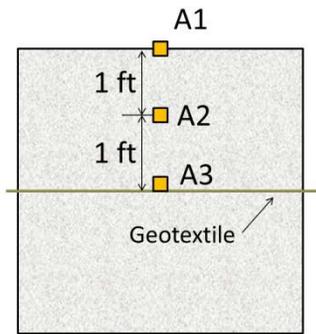
# Shake Table Test



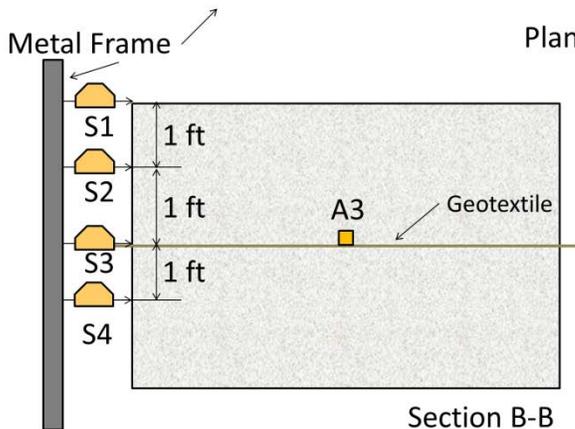
Project:	Cell Crete (Cellular Concrete)	Test Date:	9/2/16
Location:	----	Test No.:	3
Model Size:	4 ft by 6 ft	Vertical Stress:	102.5 psf
Model Height:	4 ft	Geogrid Depth:	2 ft
Motion Type:	Sinusoidal	Characteristics:	0.1g 2Hz



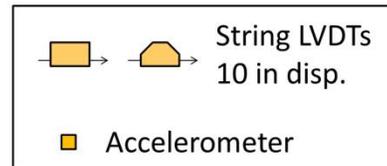
Plan View

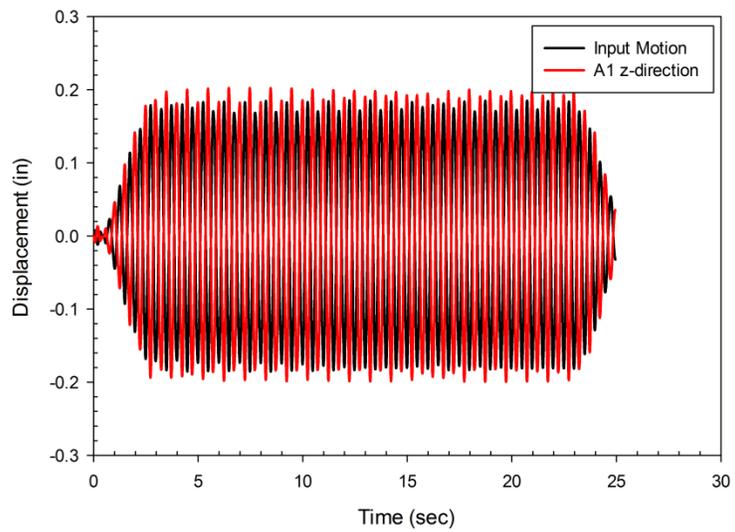
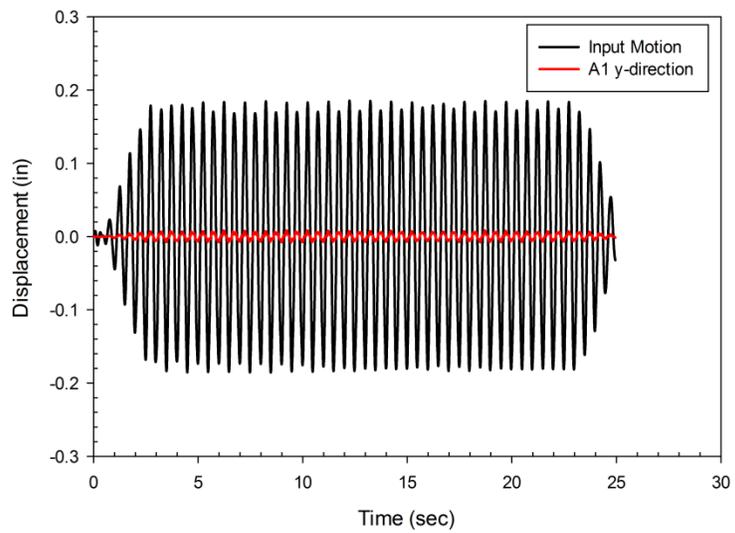
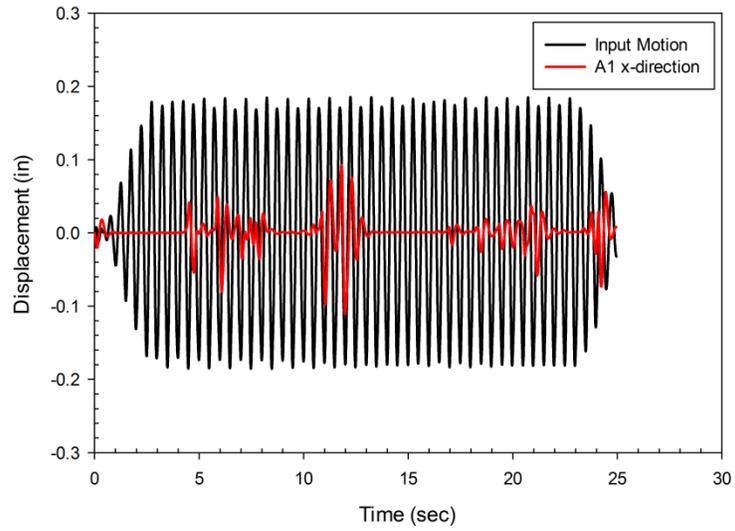


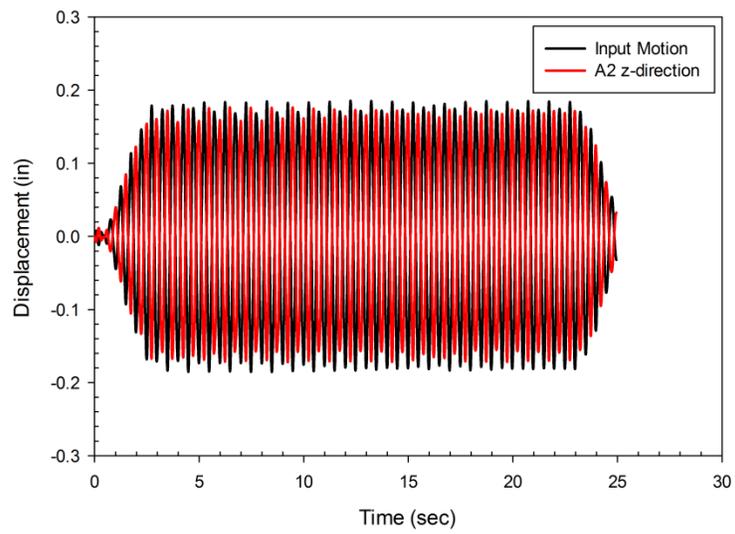
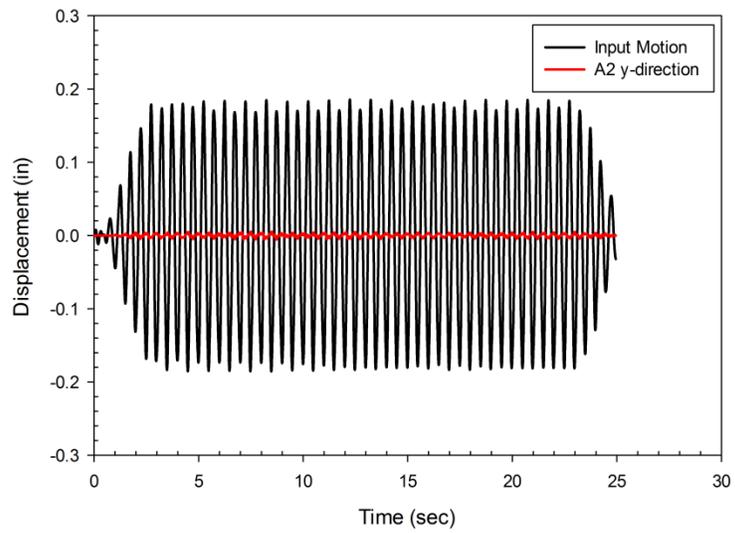
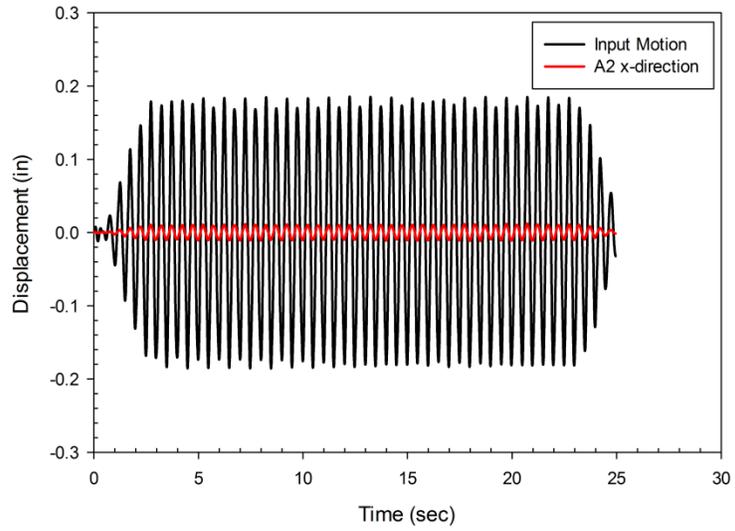
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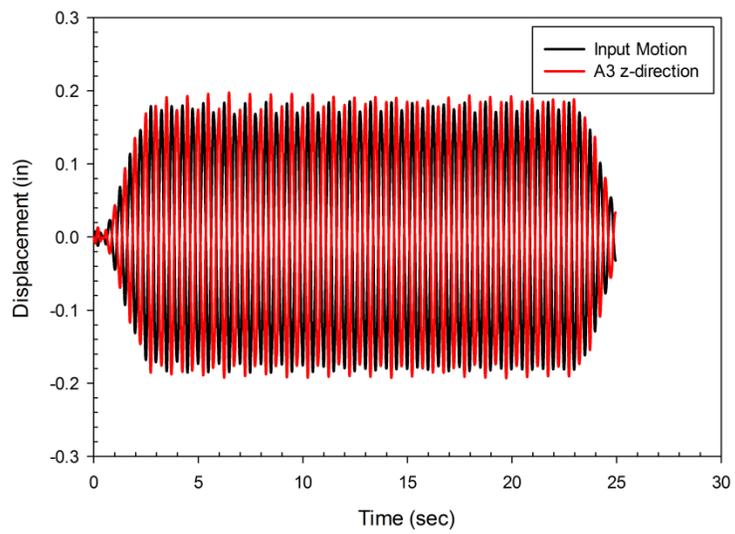
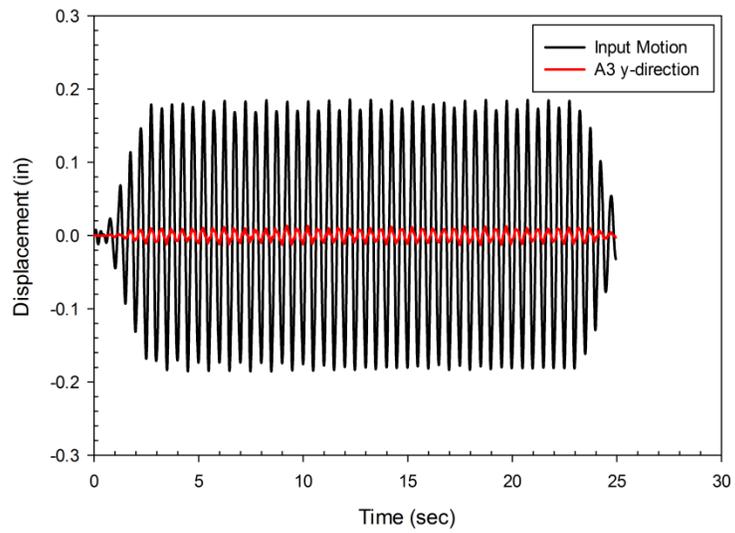
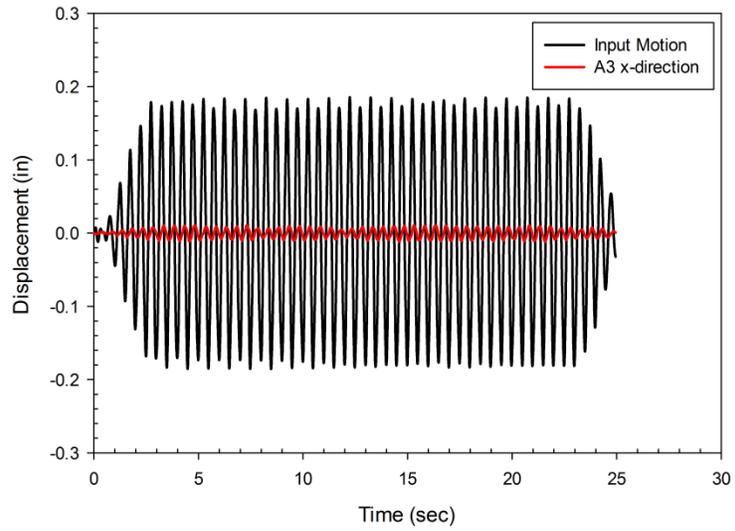


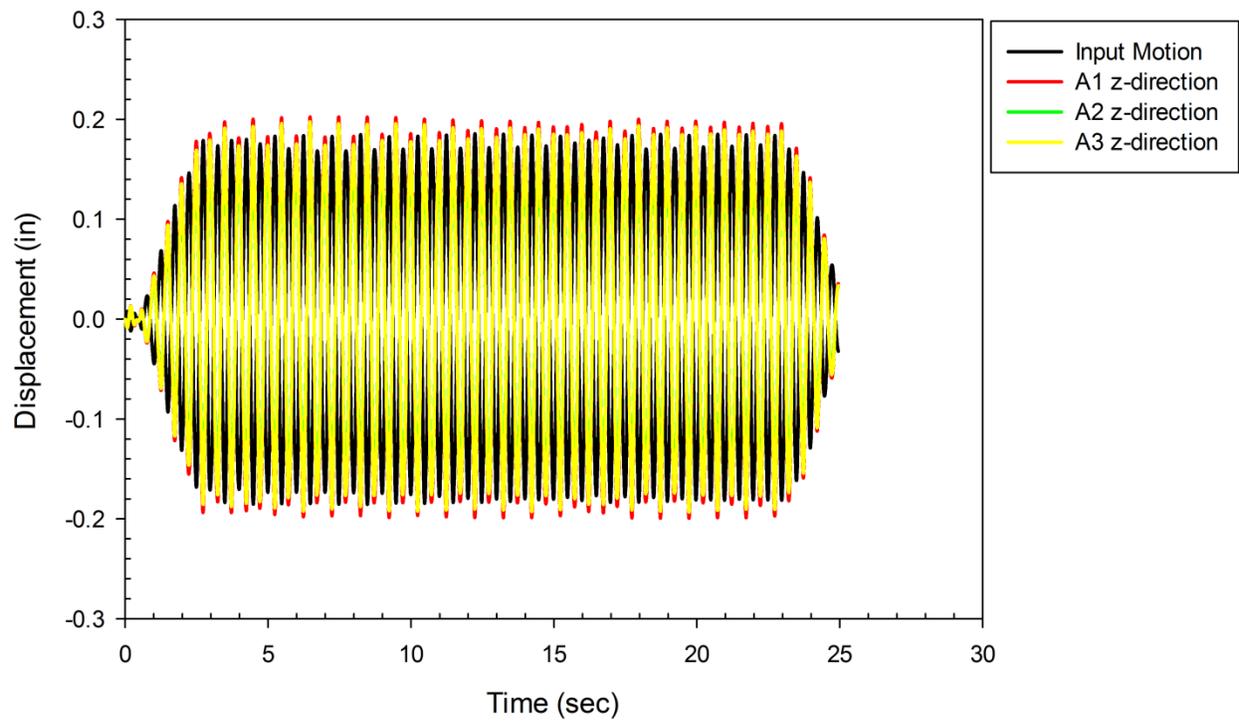
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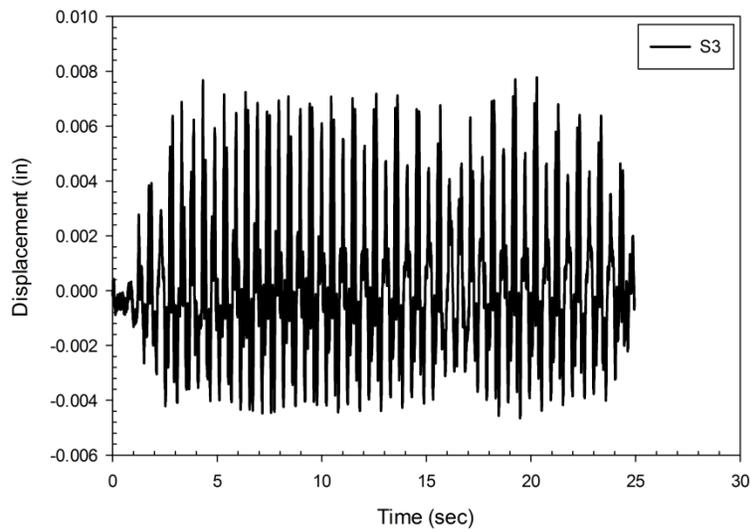
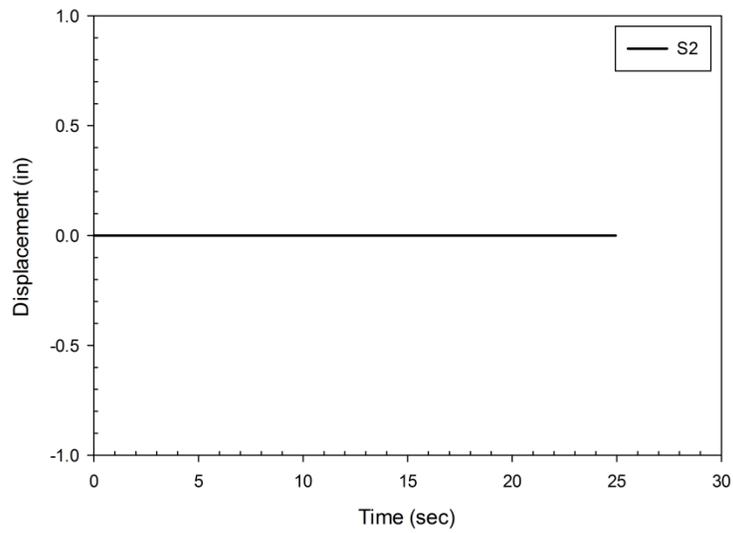
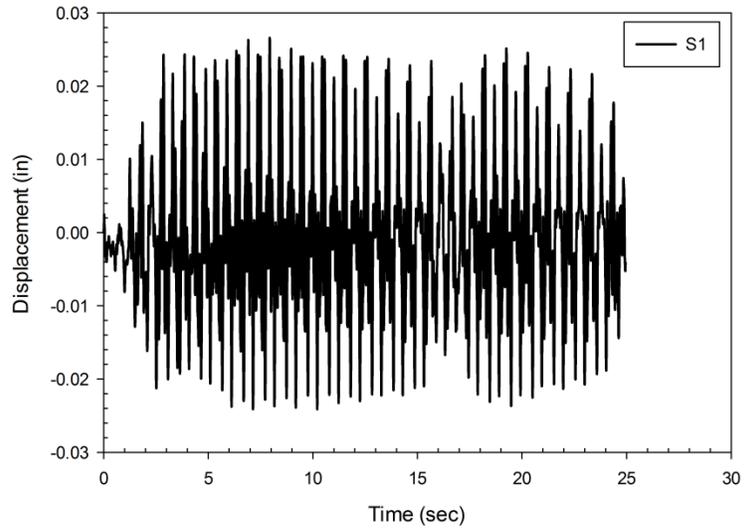


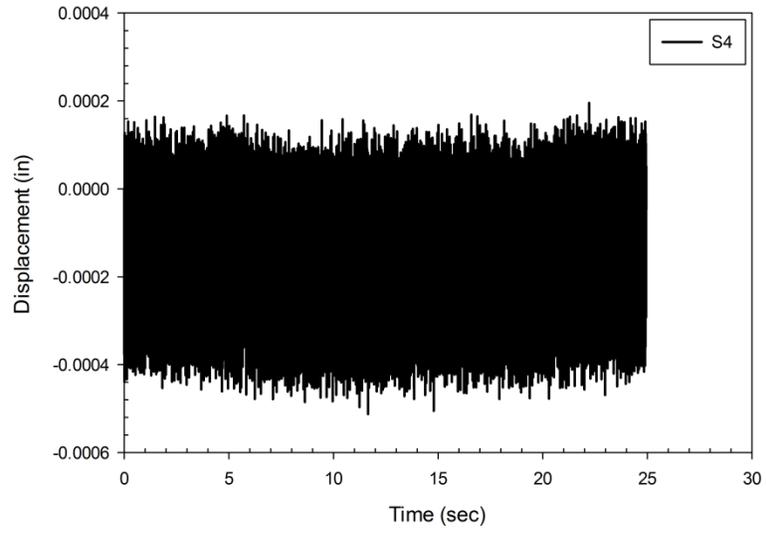








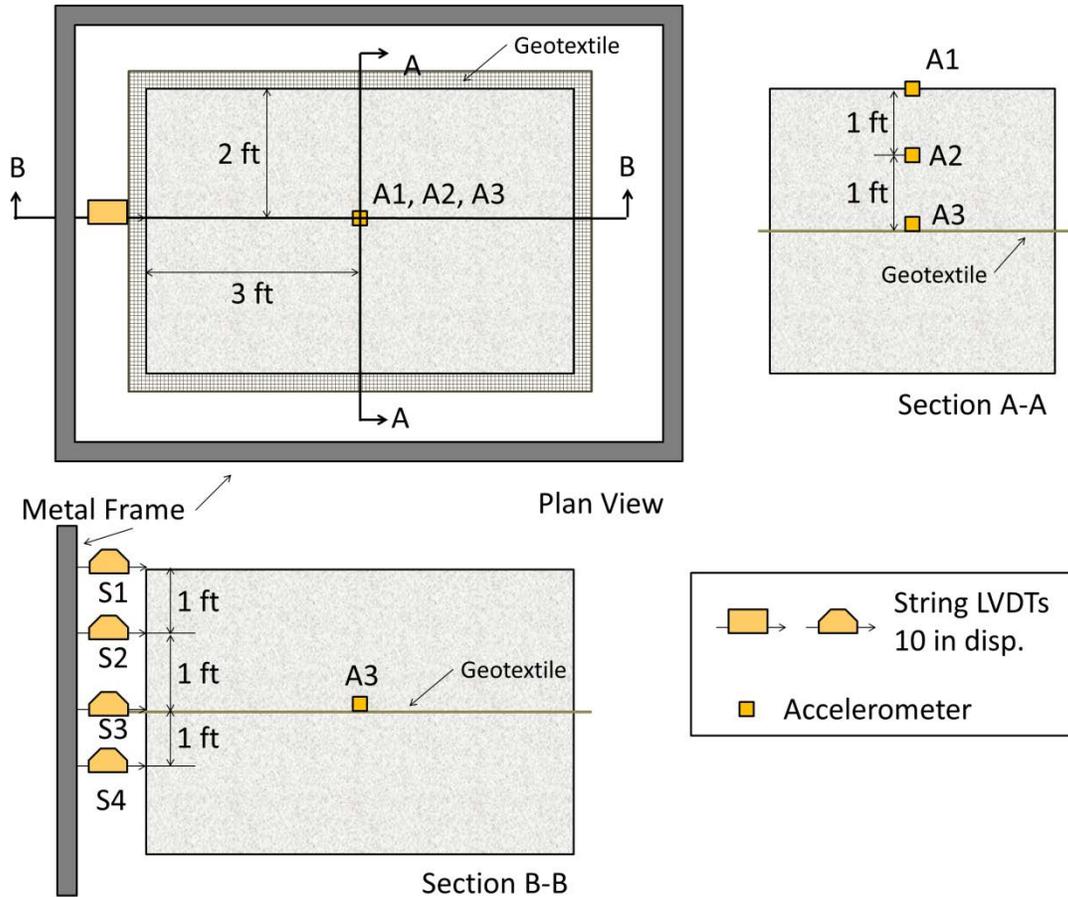


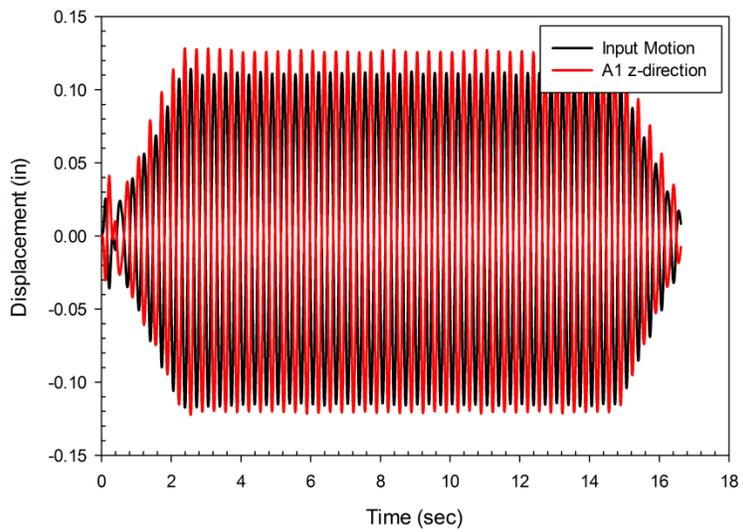
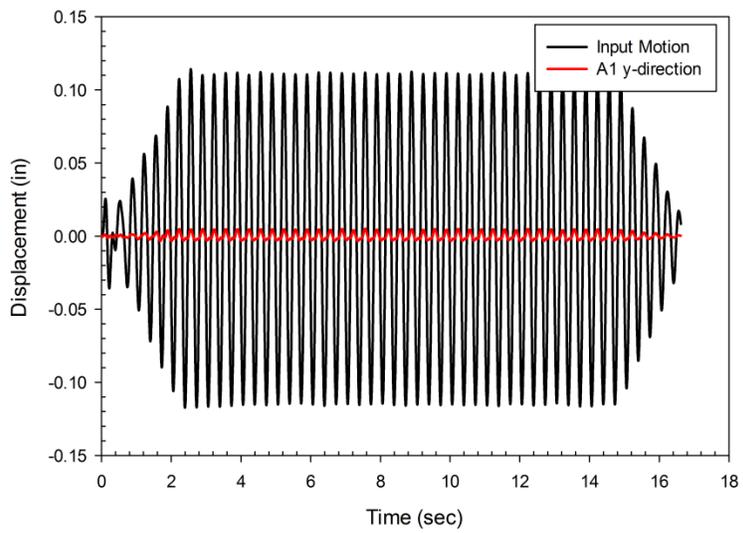
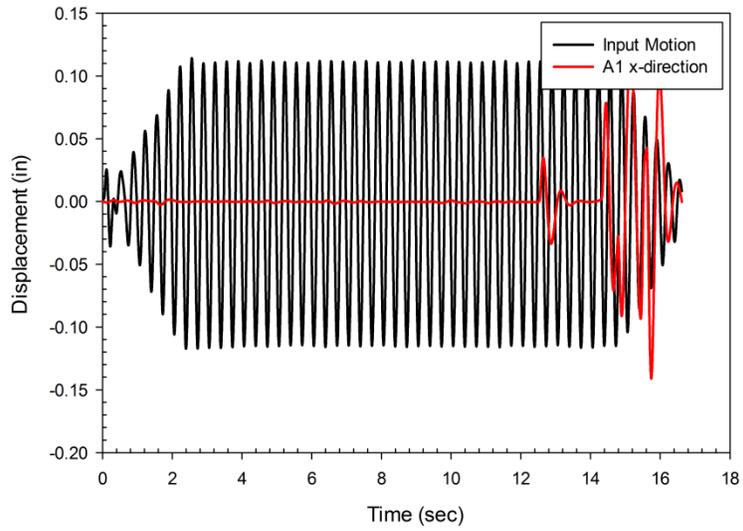


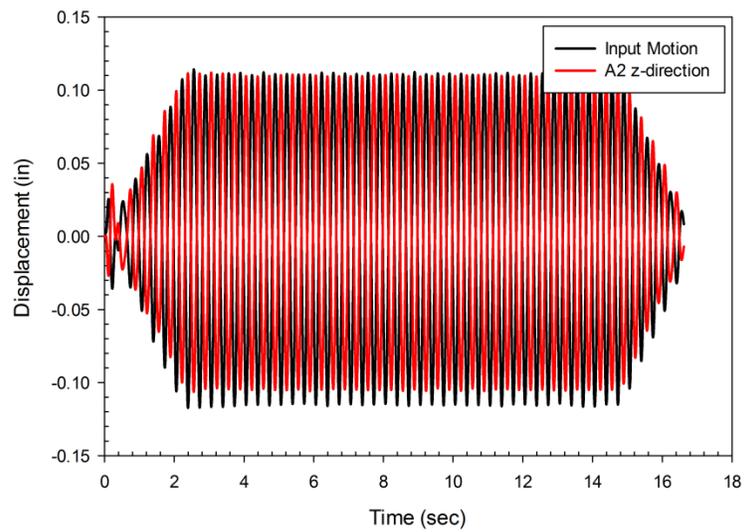
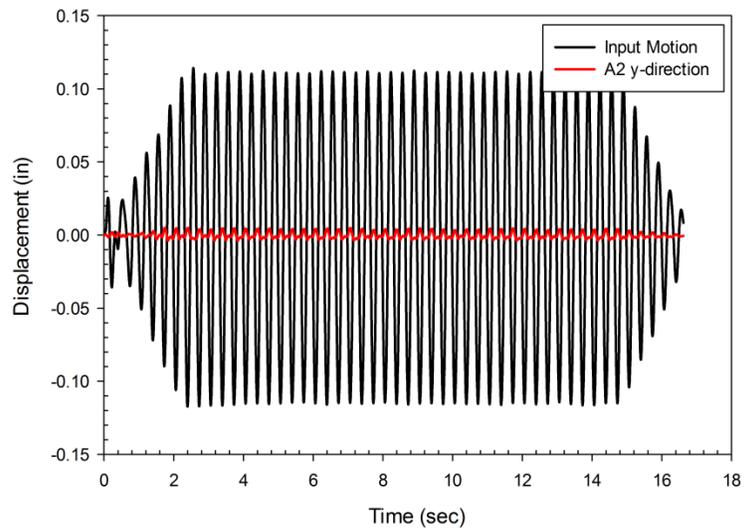
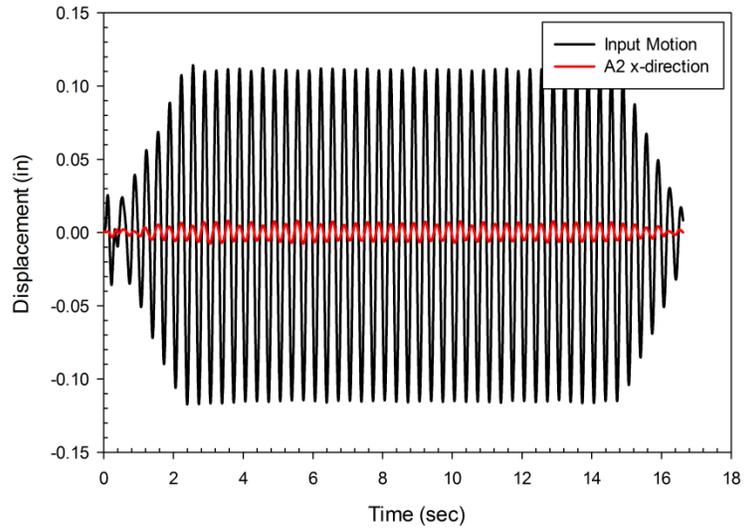
# Shake Table Test

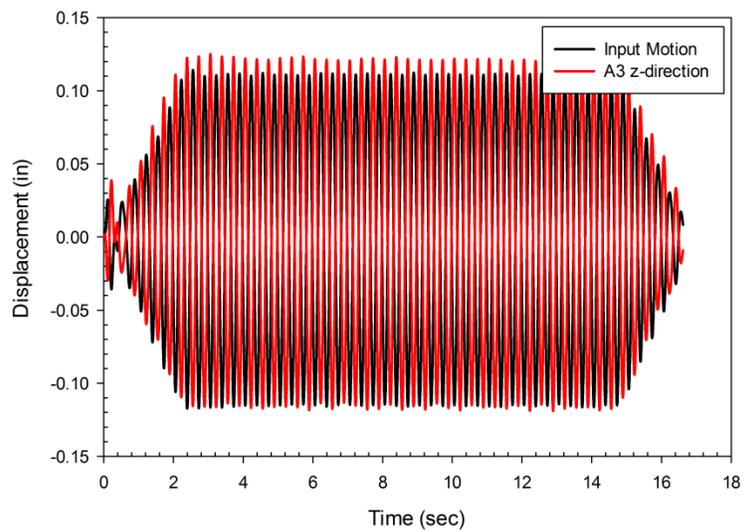
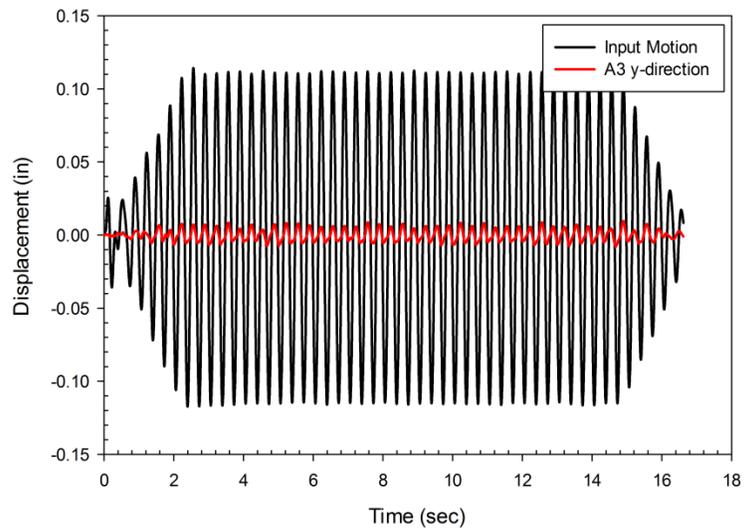
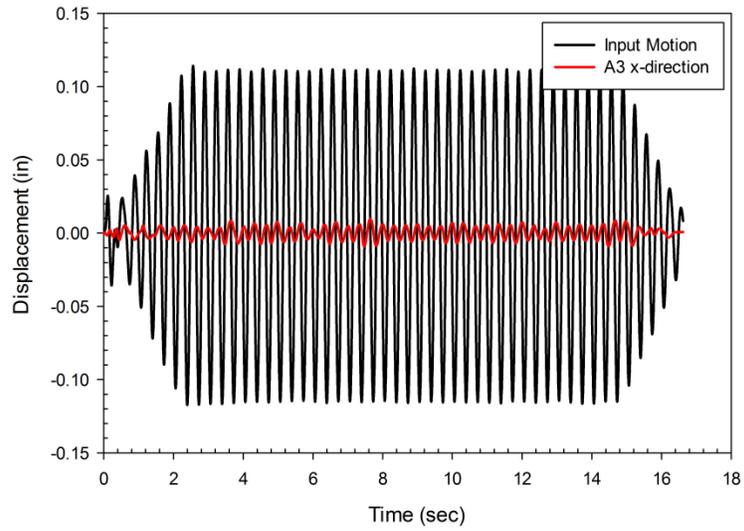


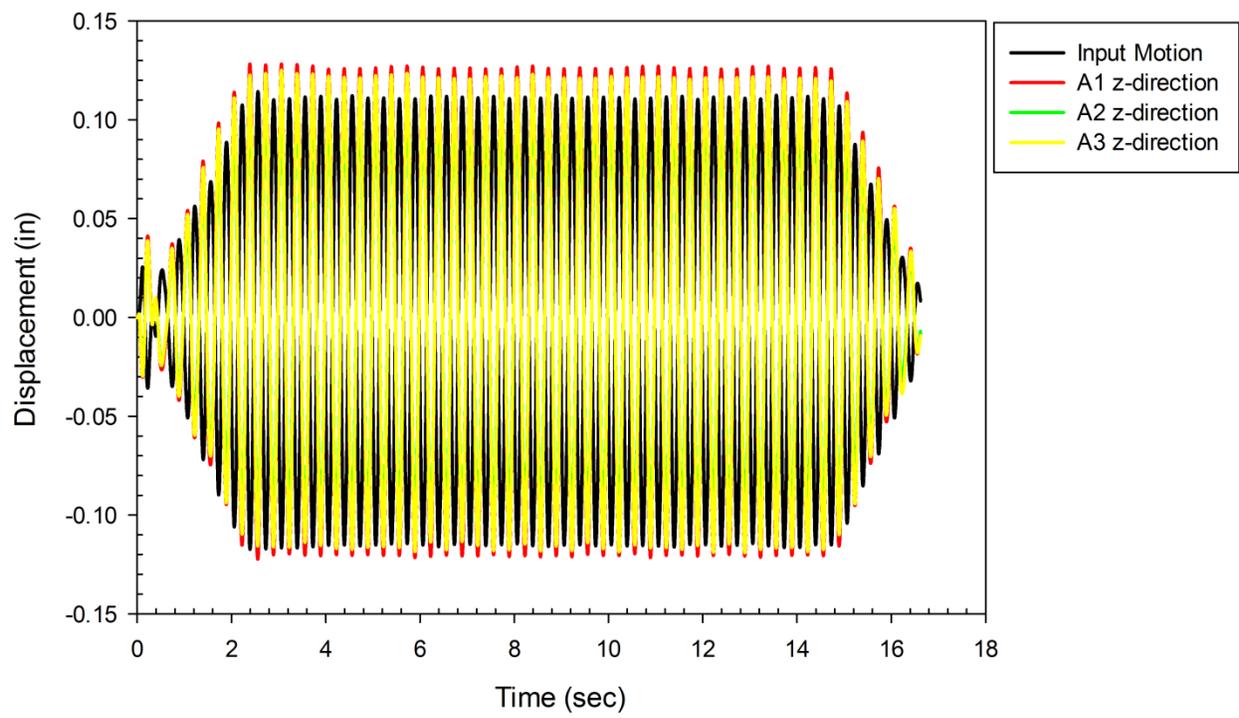
Project:	Cell Crete (Cellular Concrete)	Test Date:	9/2/16
Location:	----	Test No.:	3
Model Size:	4 ft by 6 ft	Vertical Stress:	102.5 psf
Model Height:	4 ft	Geogrid Depth:	2 ft
Motion Type:	Sinusoidal	Characteristics:	0.1g 3Hz

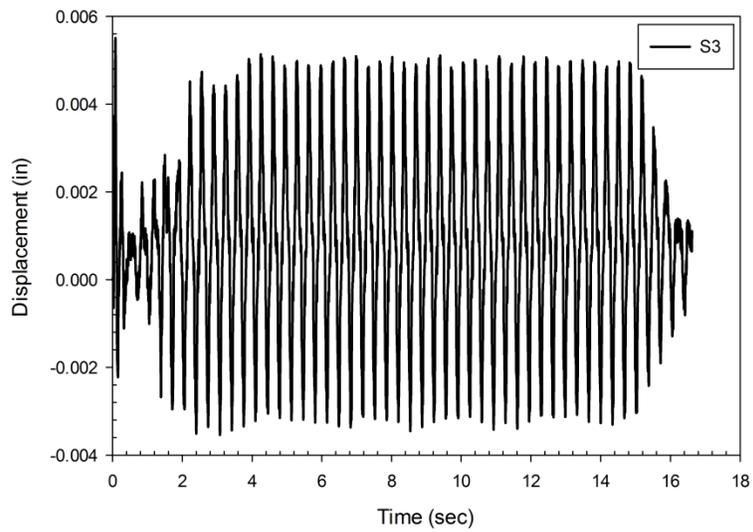
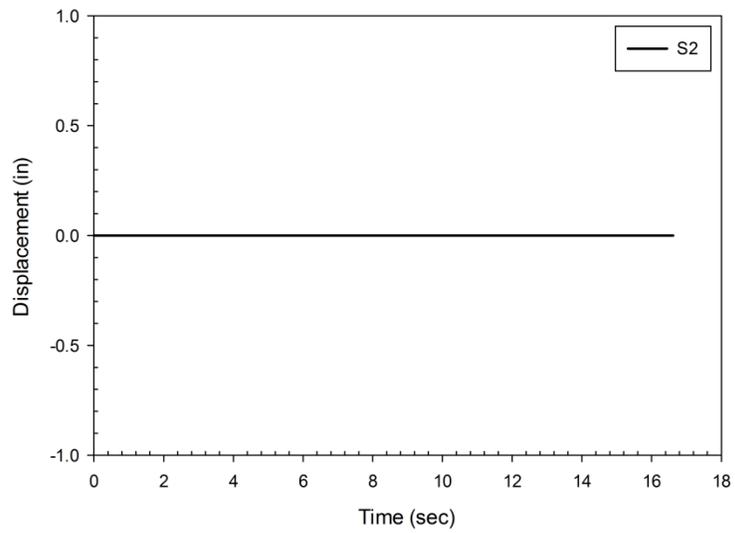
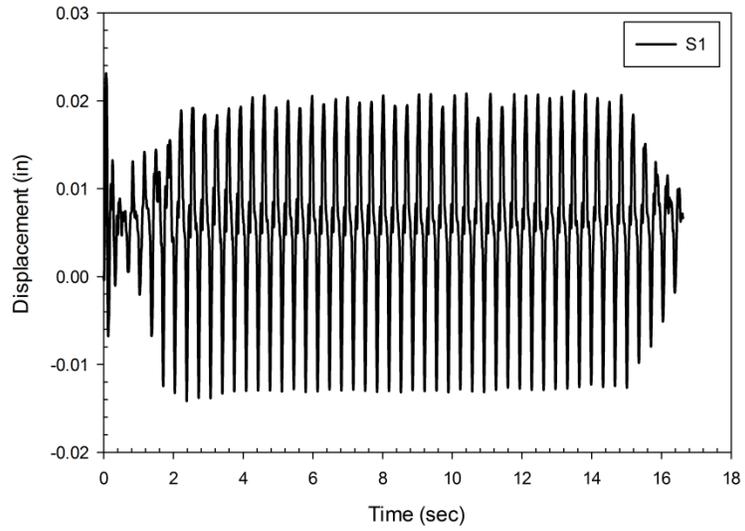


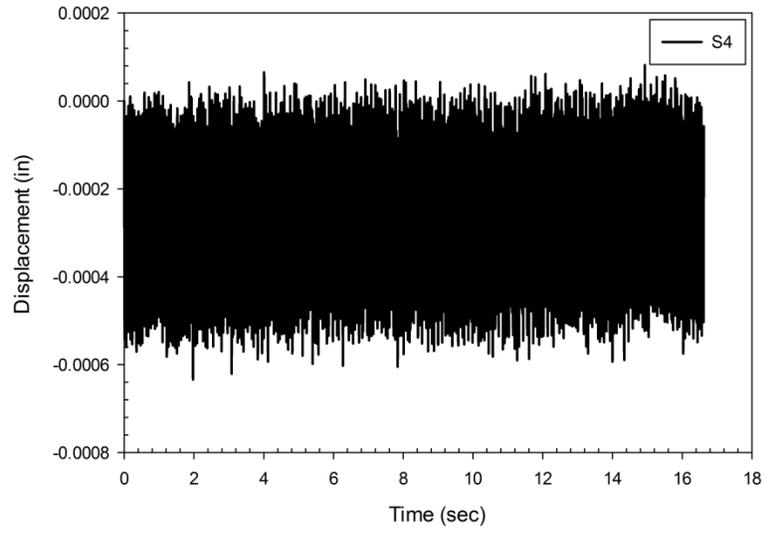








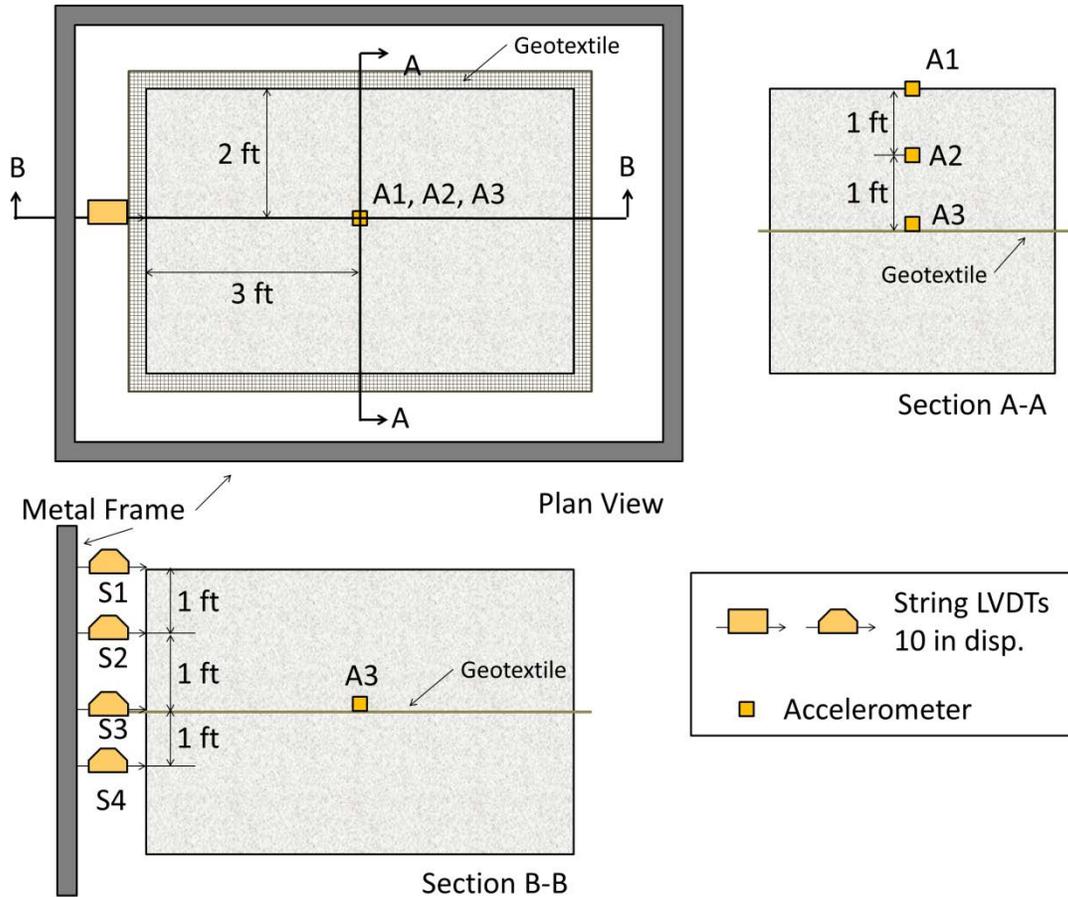


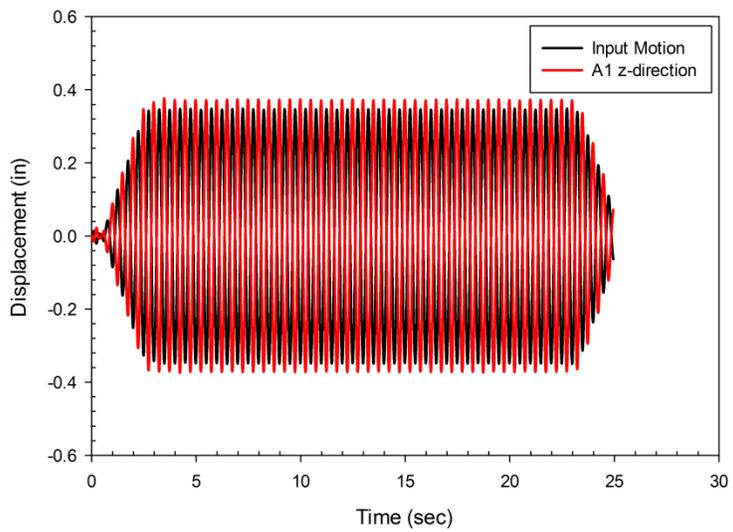
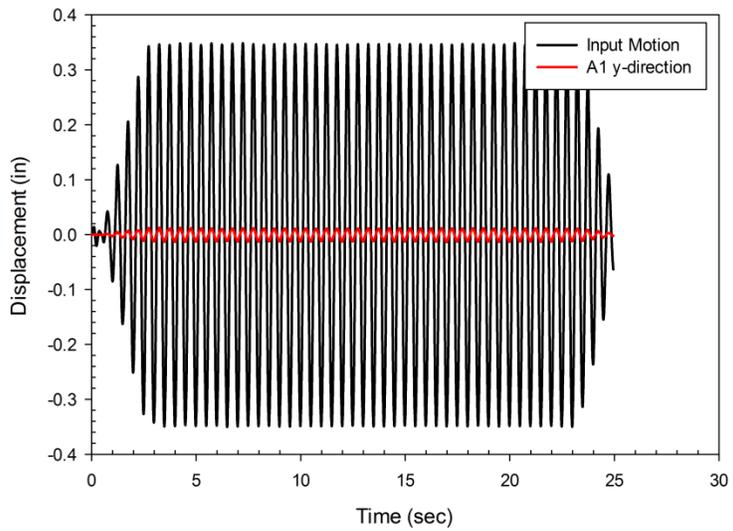
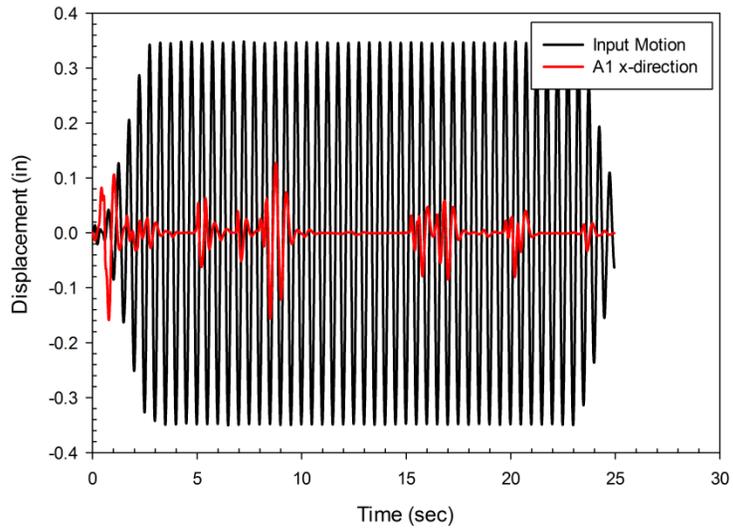


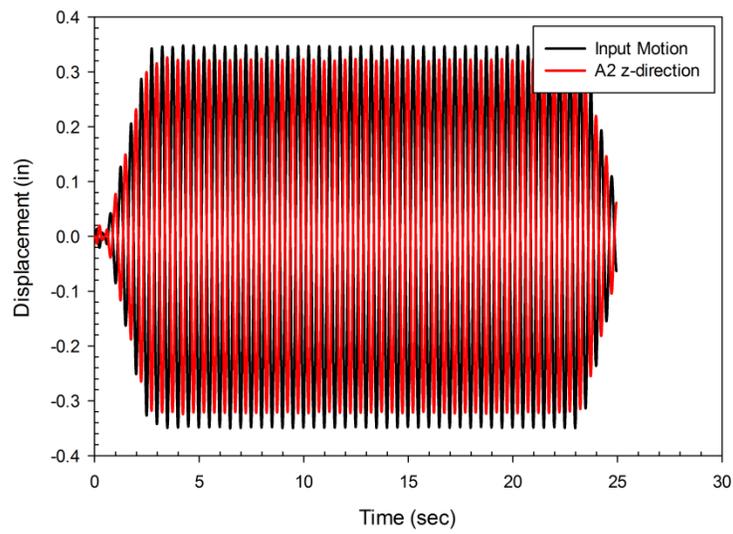
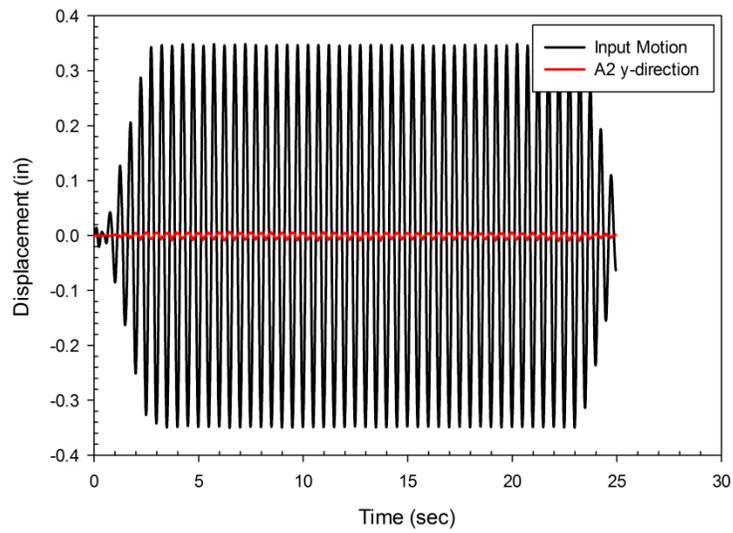
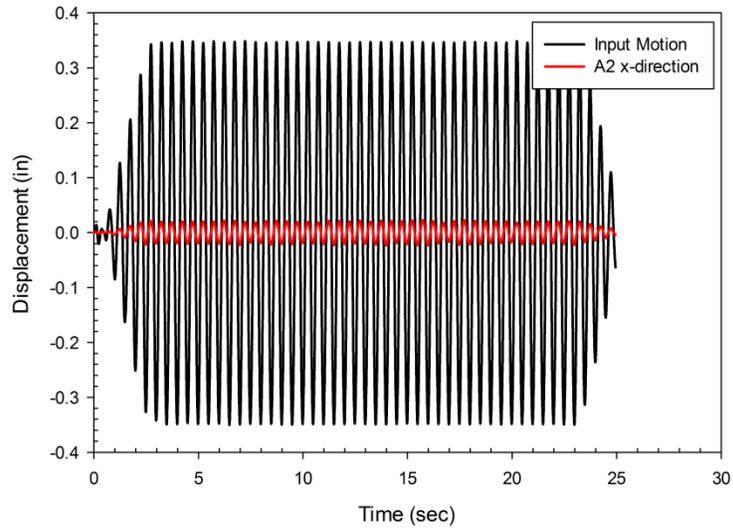
# Shake Table Test

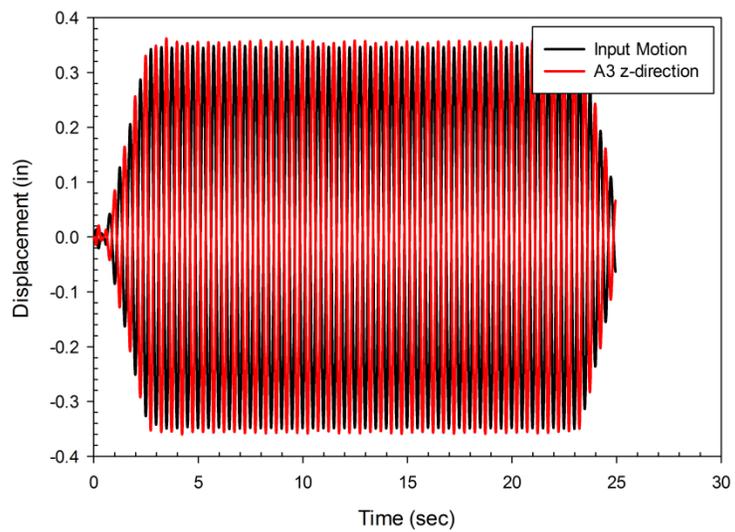
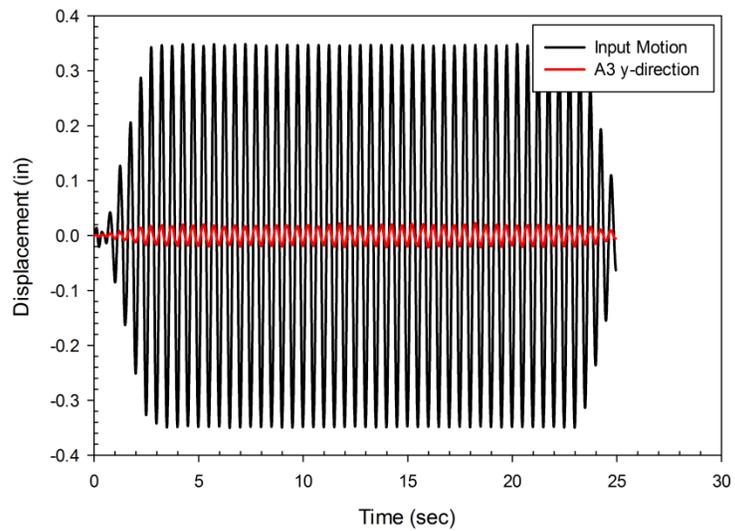
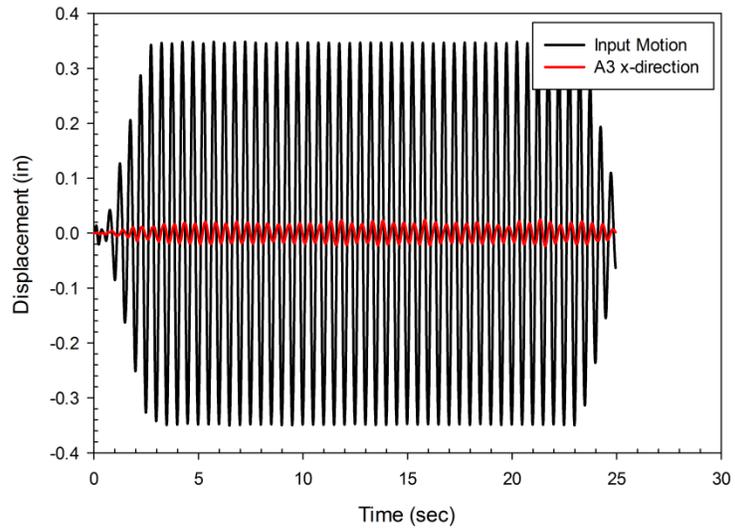


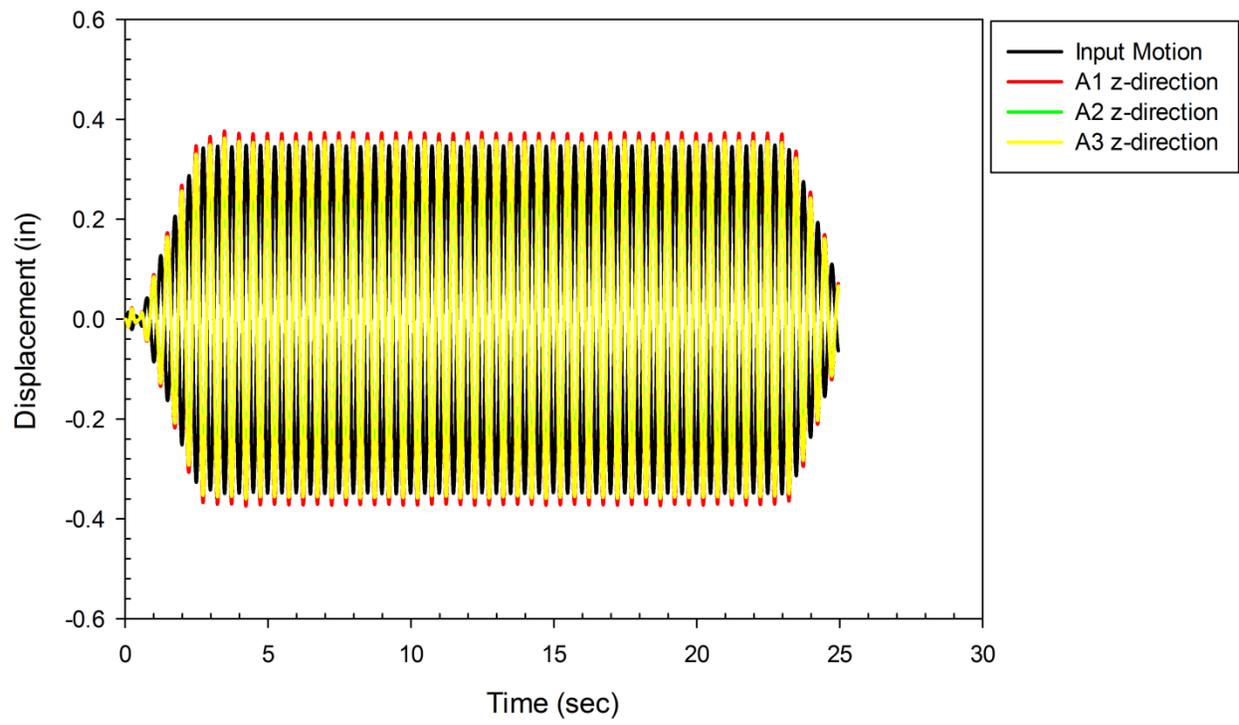
Project:	Cell Crete (Cellular Concrete)	Test Date:	9/2/16
Location:	----	Test No.:	3
Model Size:	4 ft by 6 ft	Vertical Stress:	102.5 psf
Model Height:	4 ft	Geogrid Depth:	2 ft
Motion Type:	Sinusoidal	Characteristics:	0.2g 2Hz

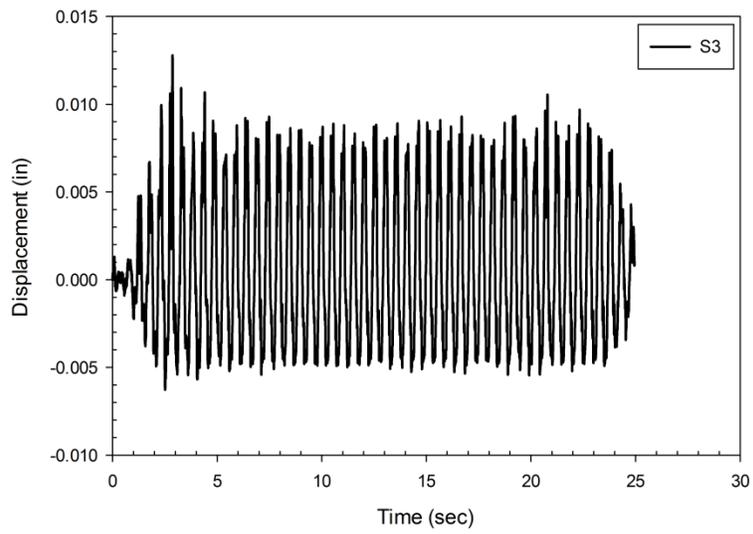
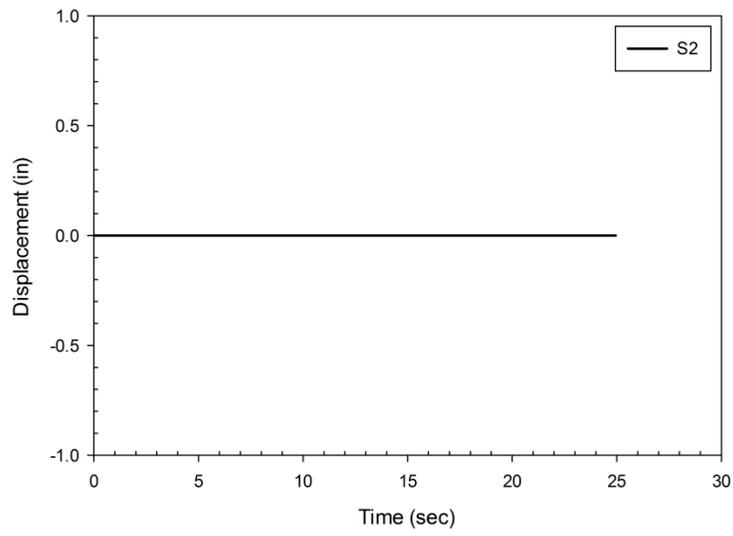
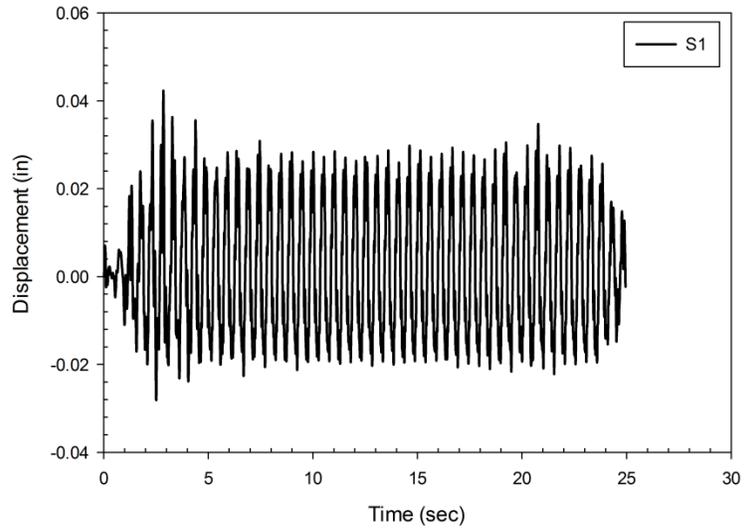


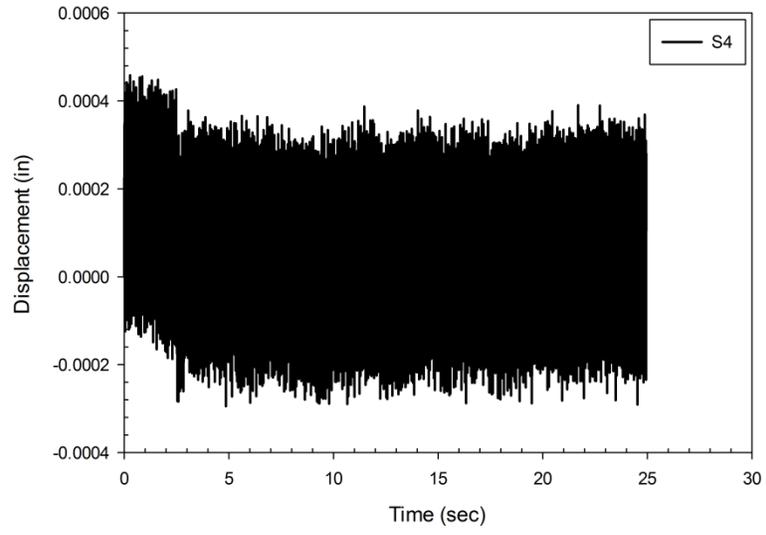








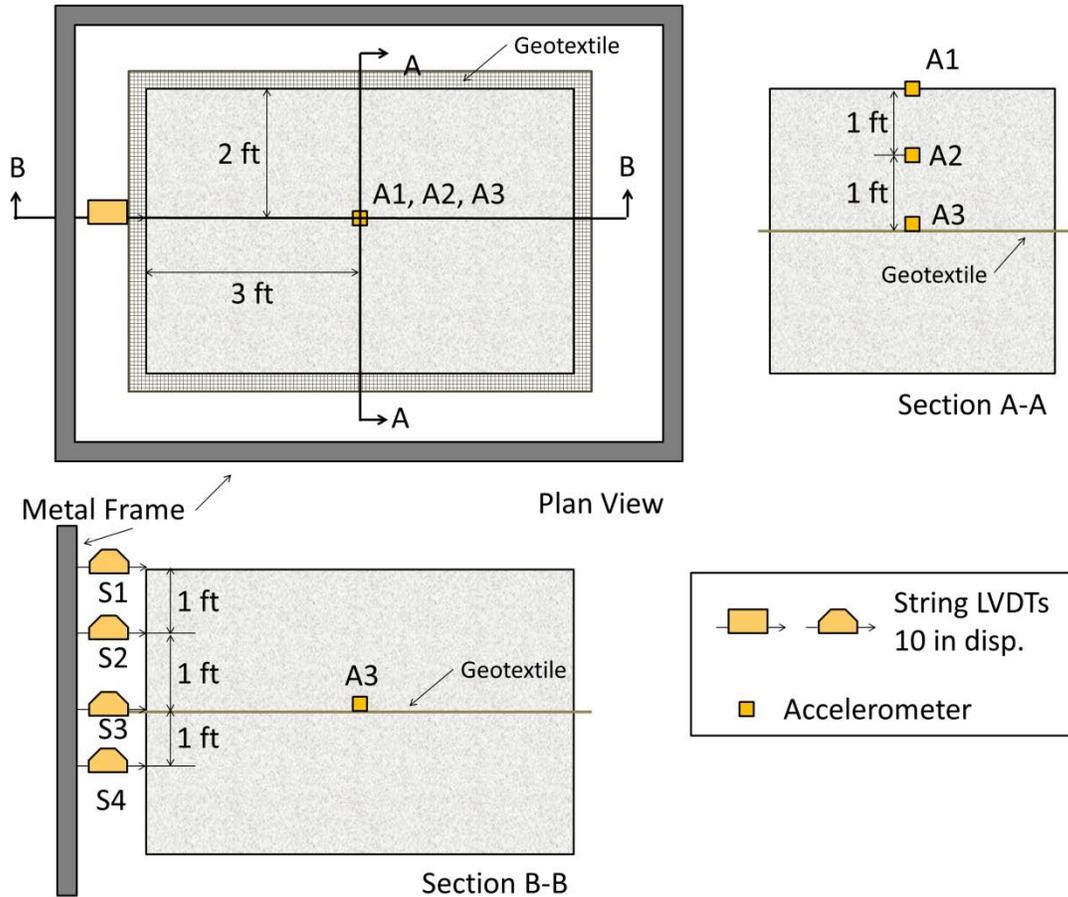


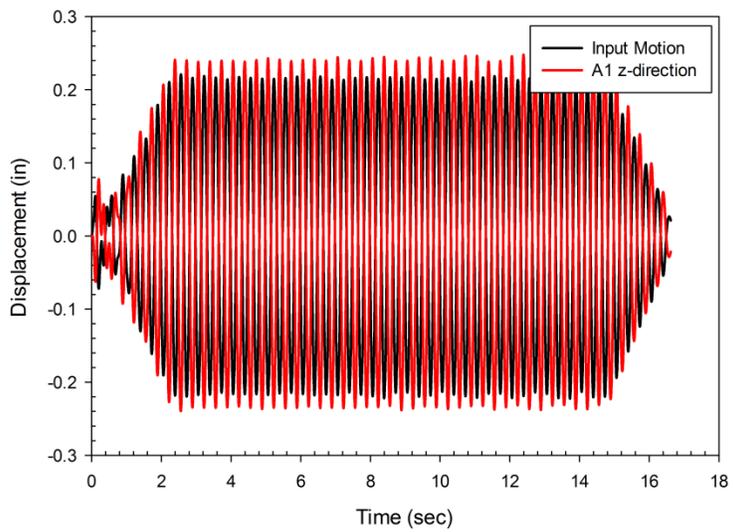
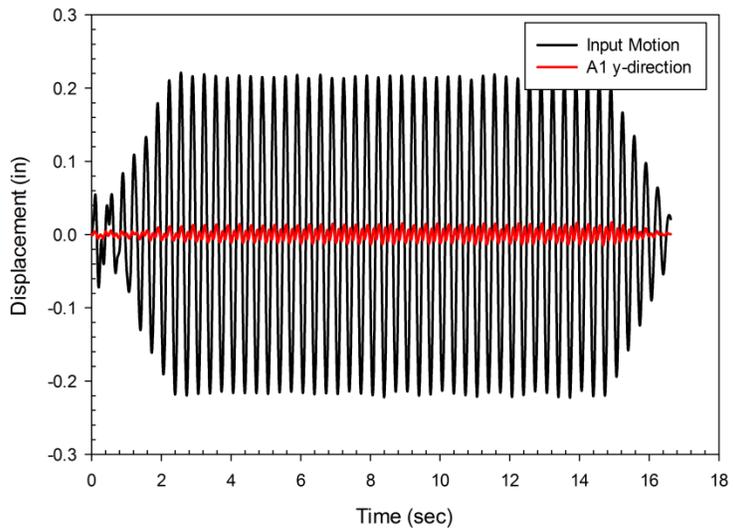
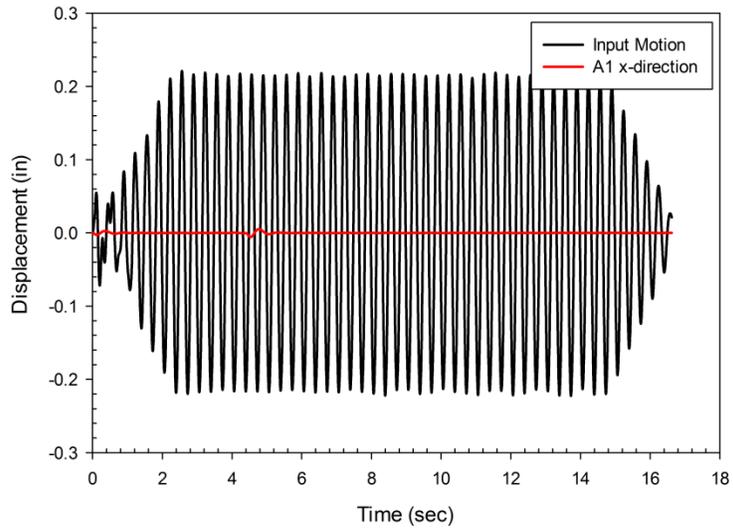


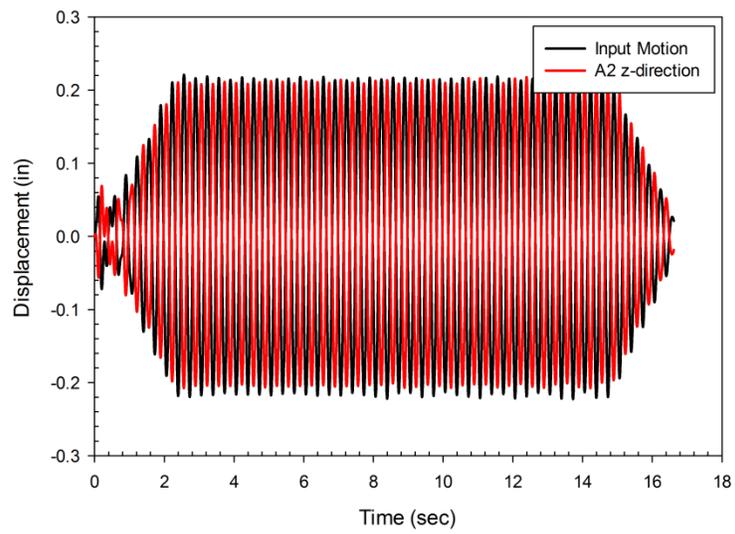
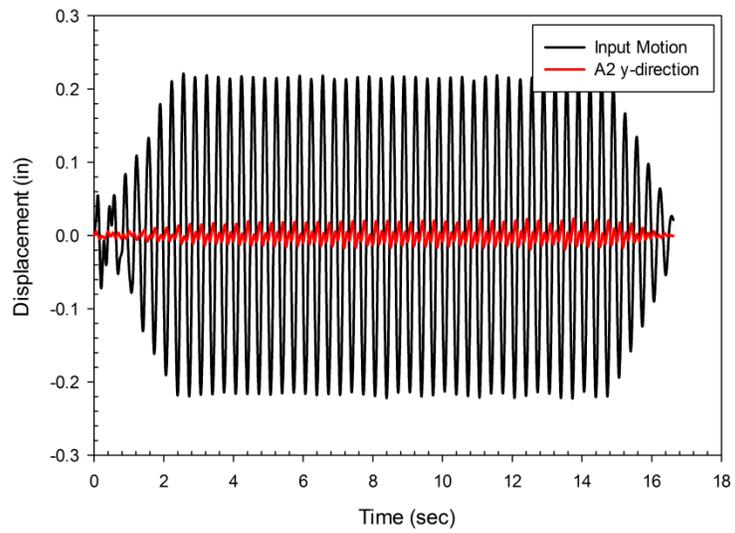
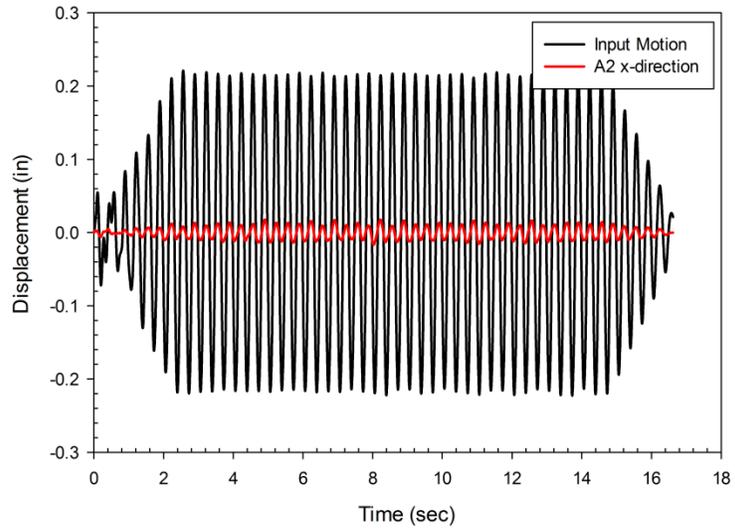
# Shake Table Test

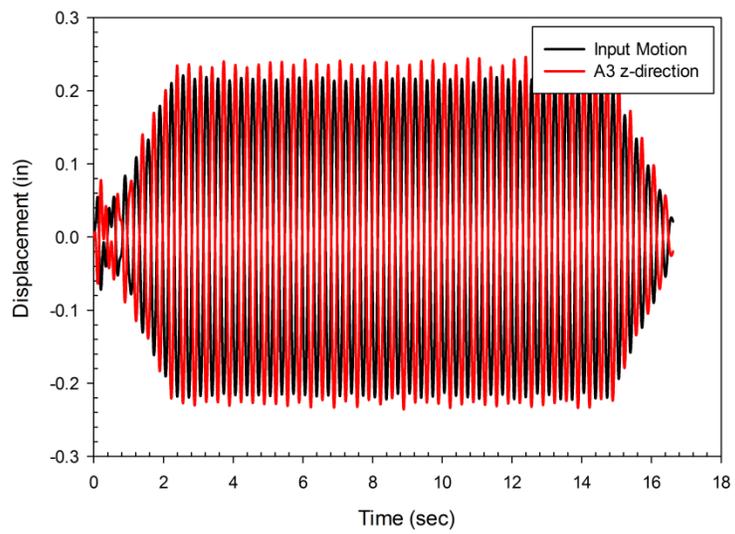
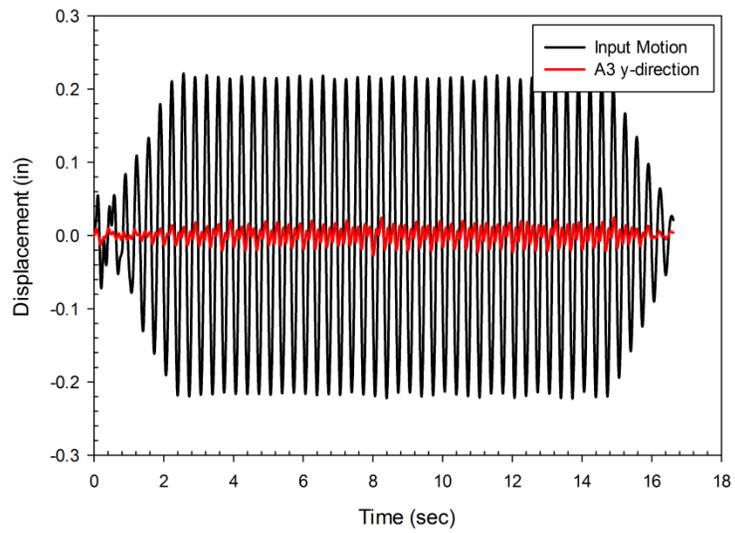
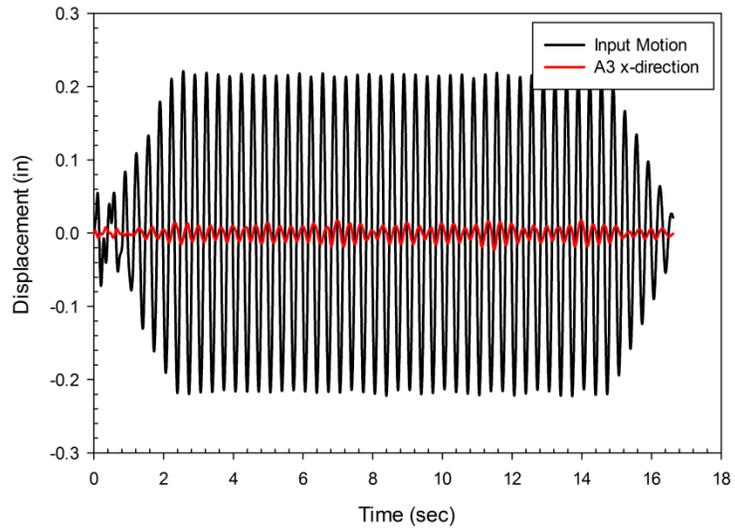


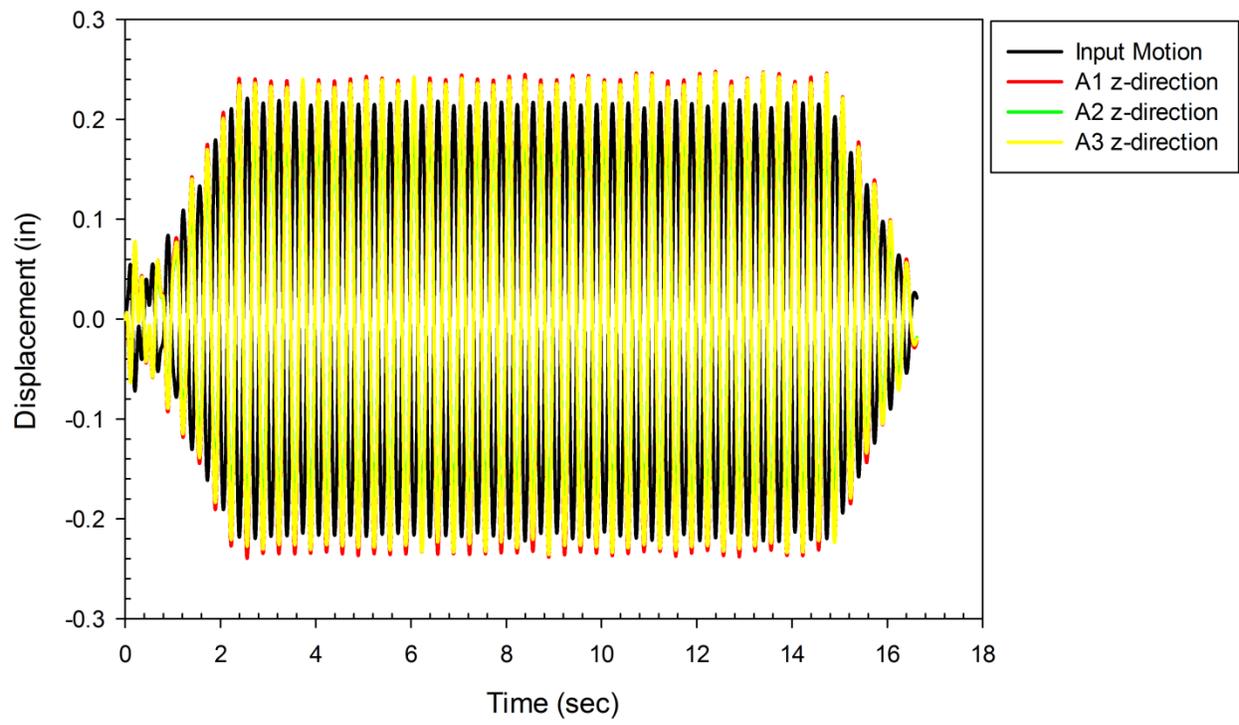
Project:	Cell Crete (Cellular Concrete)	Test Date:	9/2/16
Location:	----	Test No.:	3
Model Size:	4 ft by 6 ft	Vertical Stress:	102.5 psf
Model Height:	4 ft	Geogrid Depth:	2 ft
Motion Type:	Sinusoidal	Characteristics:	0.2g 3Hz

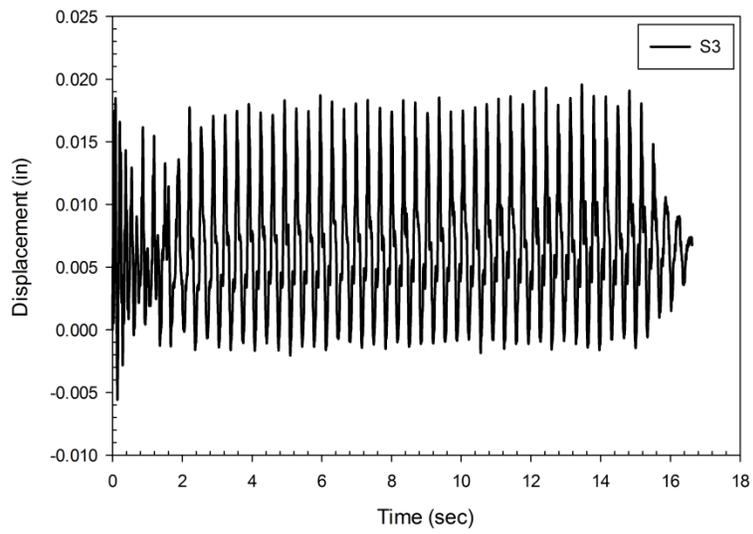
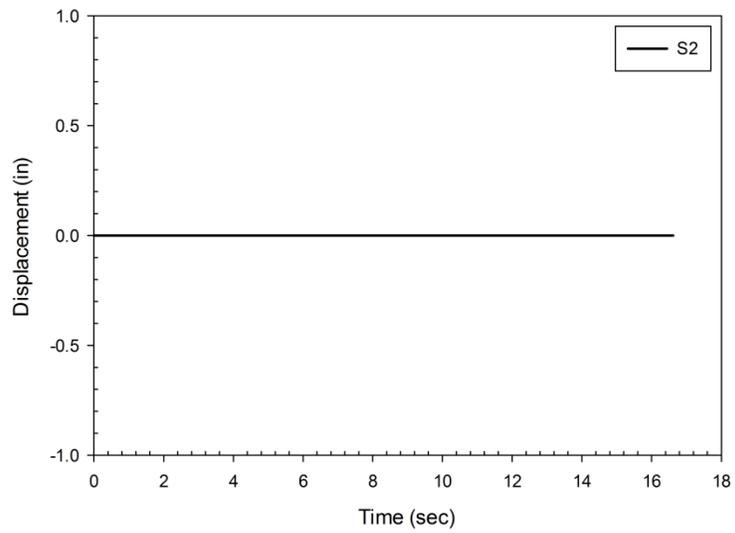
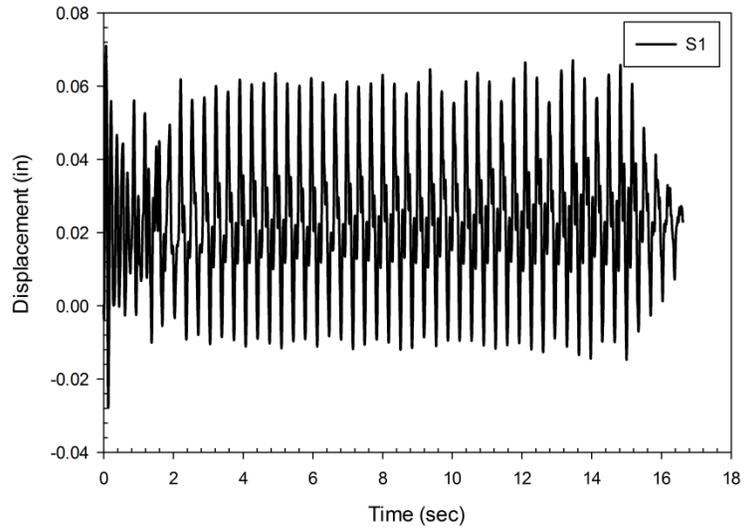


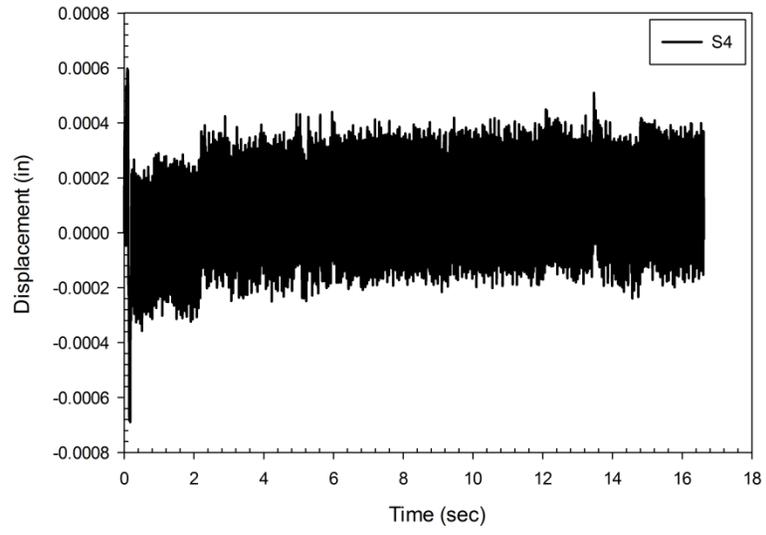










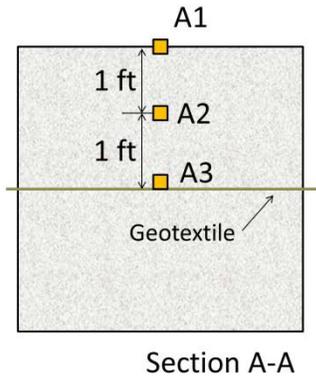
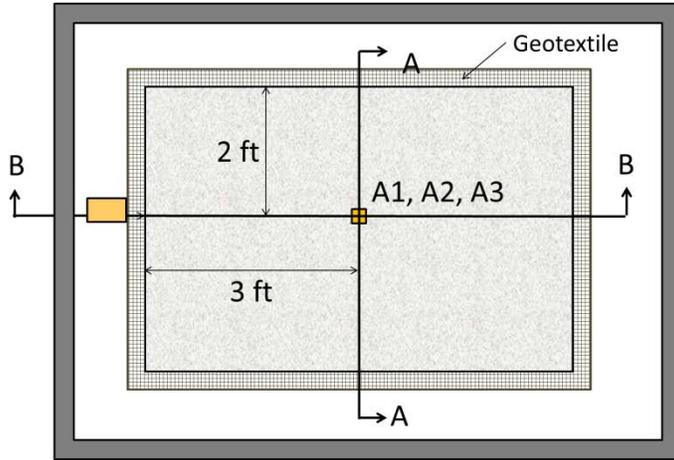


# Shake Table Test

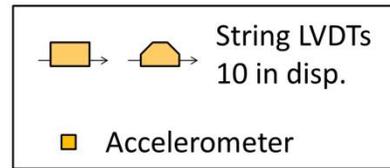
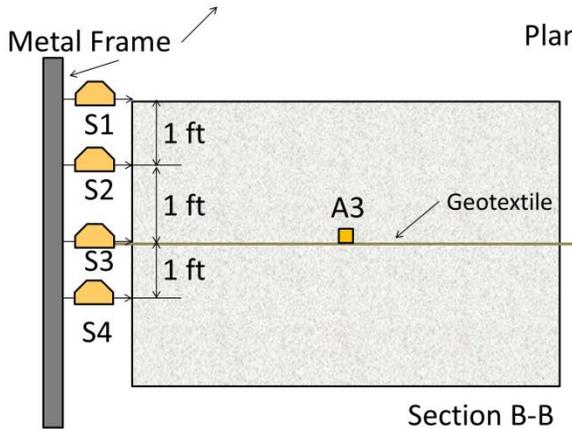


Project: Cell Crete (Cellular Concrete)  
 Location: ----  
 Model Size: 4 ft by 6 ft  
 Model Height: 4 ft  
 Motion Type: 1994 Northridge Earthquake

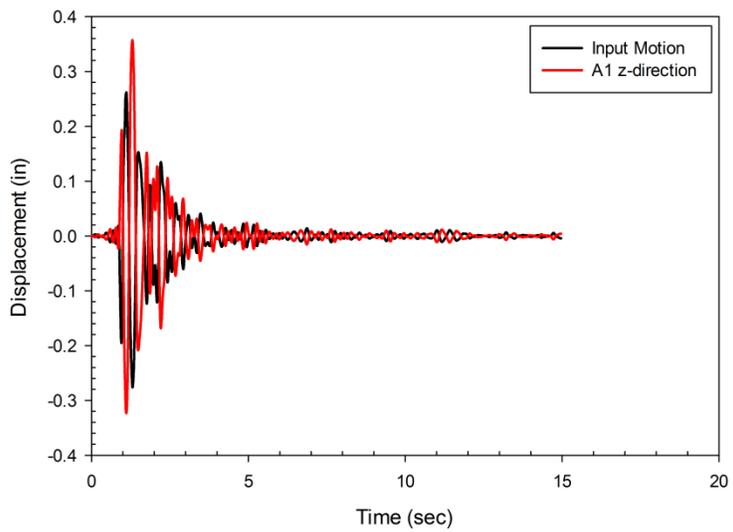
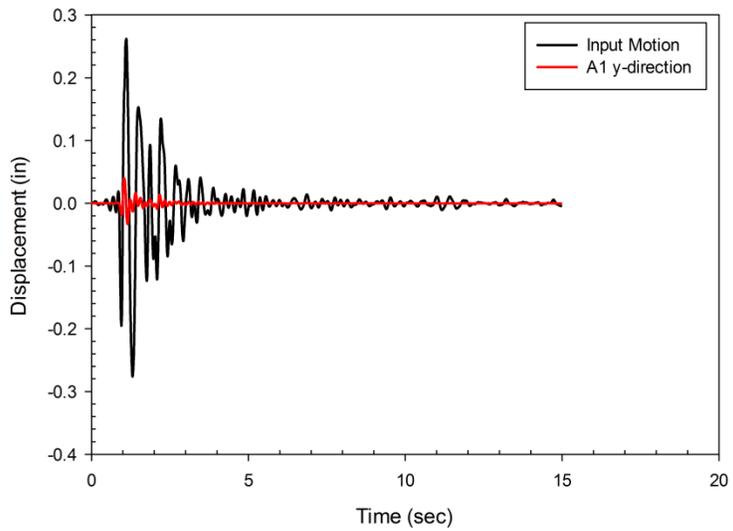
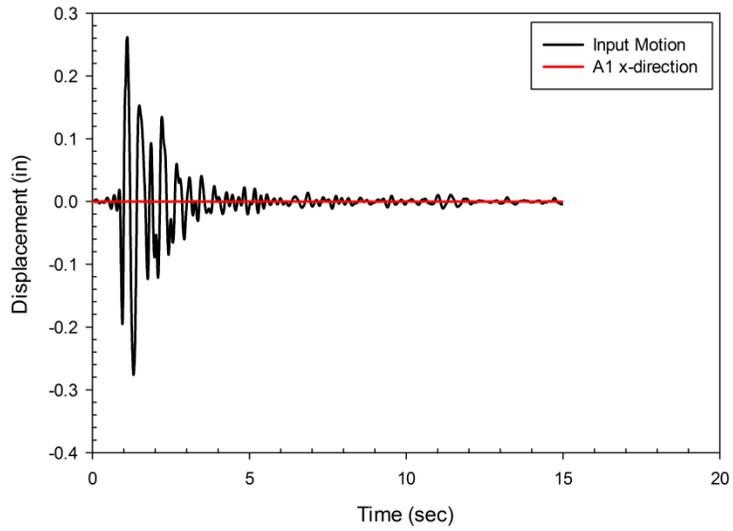
Test Date: 9/2/16  
 Test No.: 3  
 Vertical Stress: 102.5 psf  
 Geogrid Depth: 2 ft  
 Characteristics: N/A

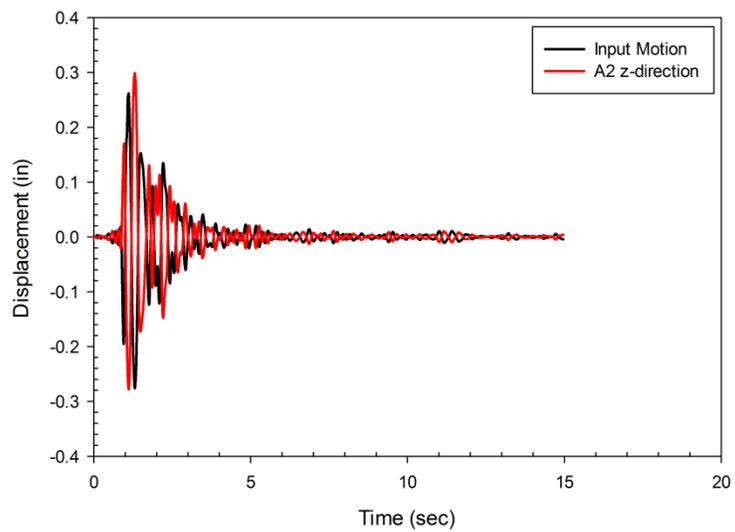
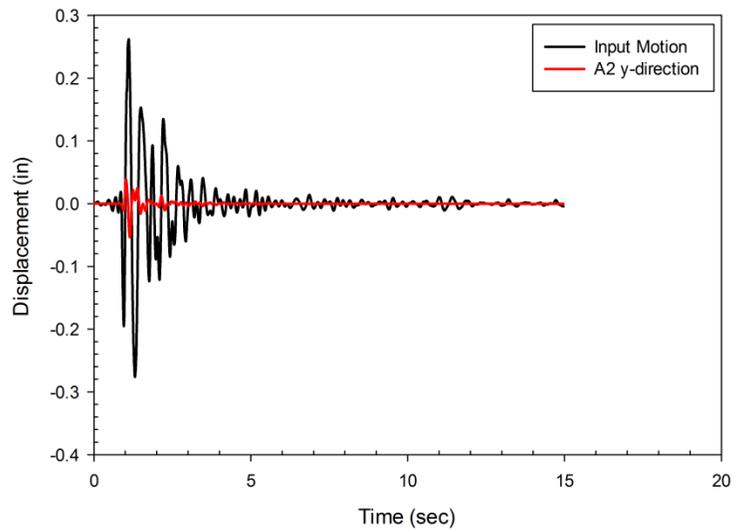
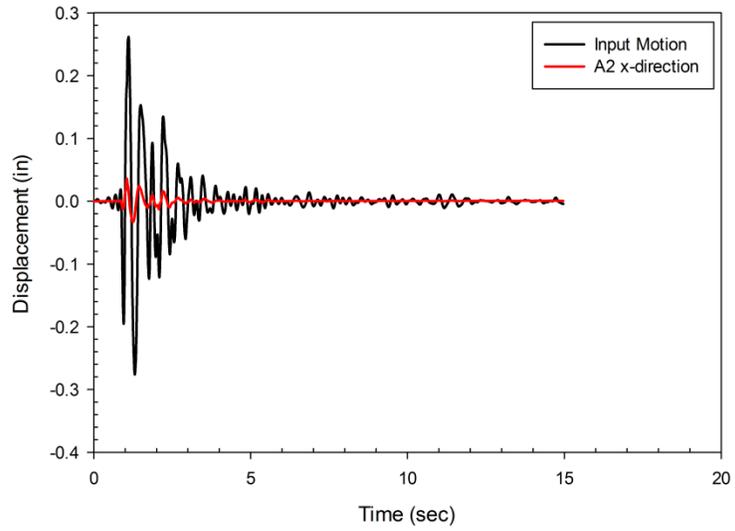


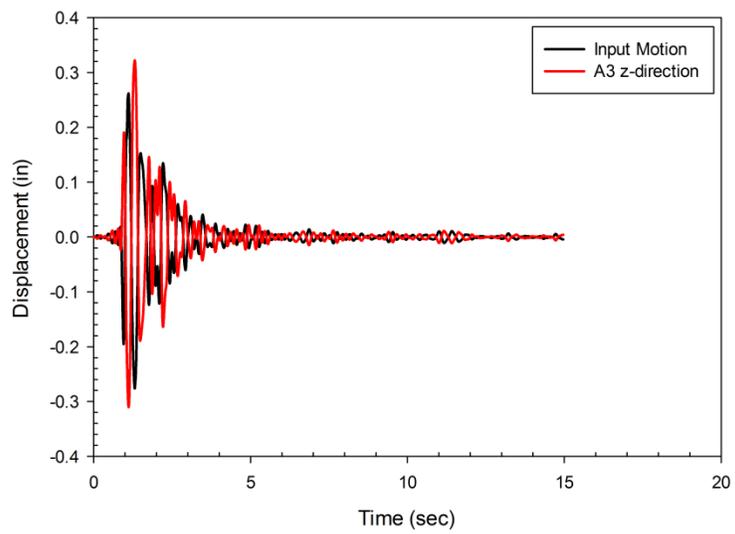
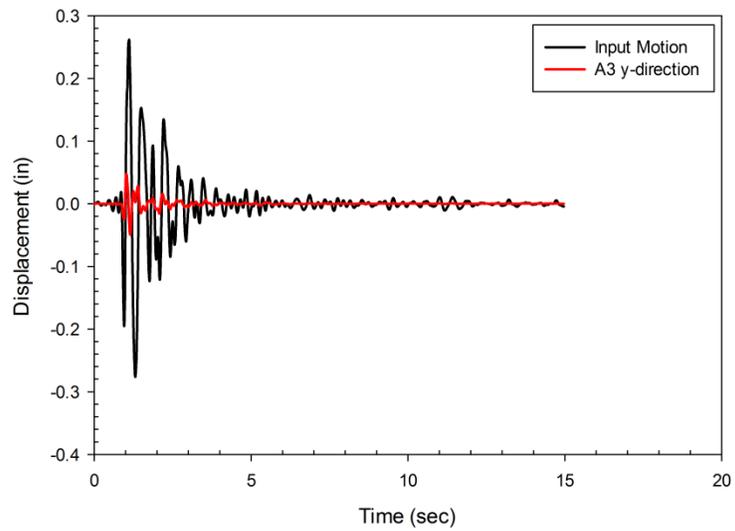
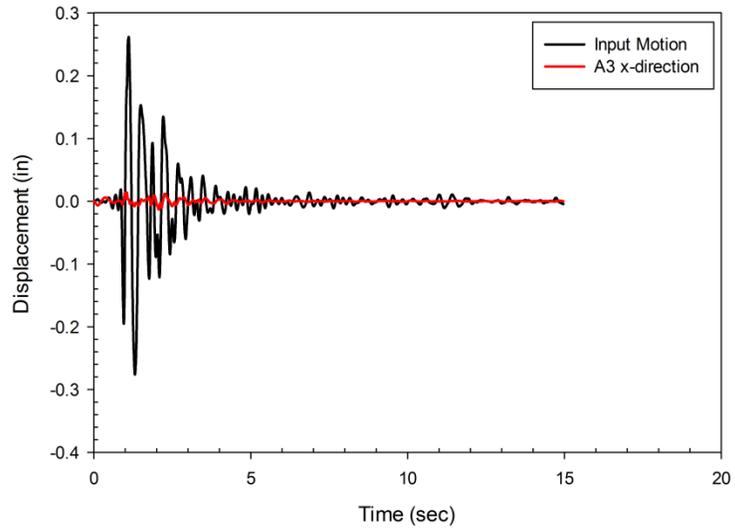
Plan View

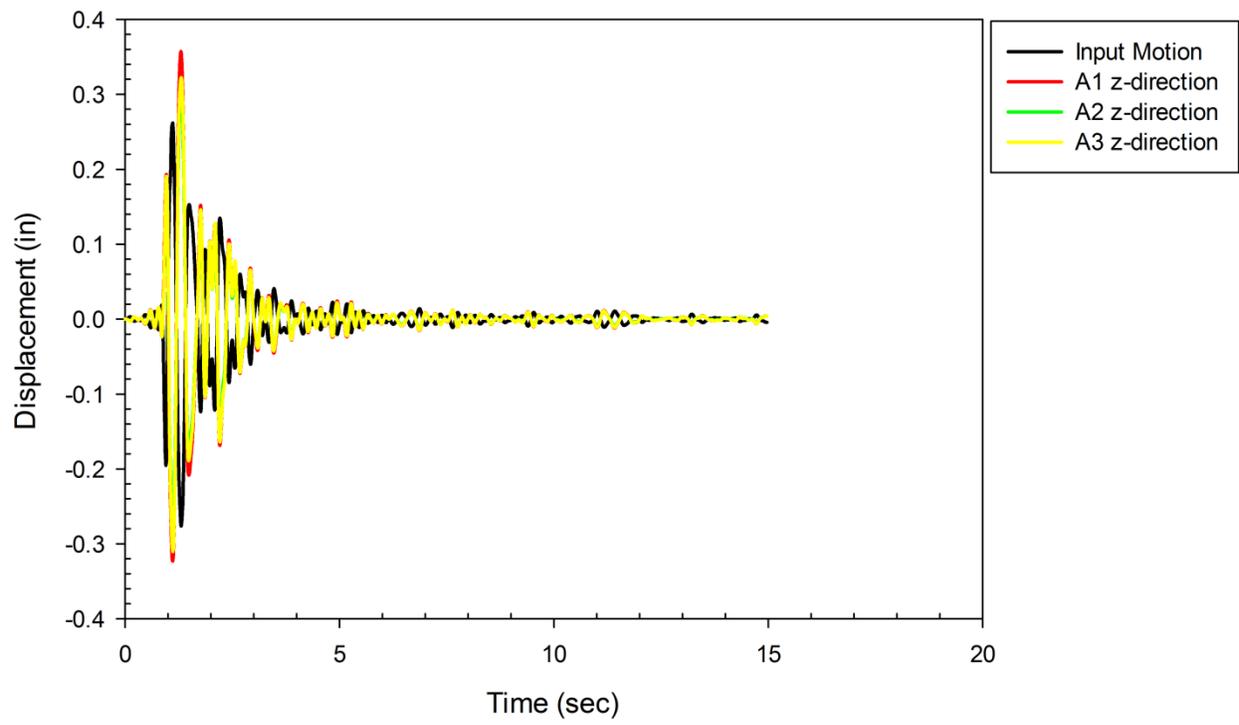


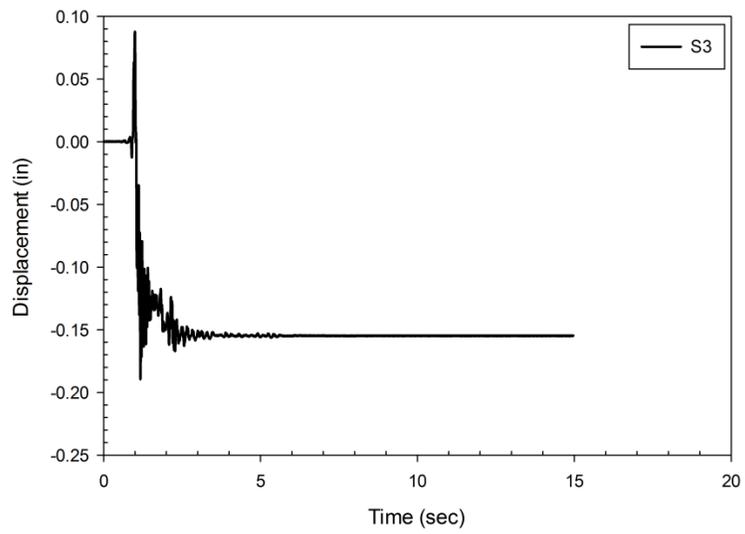
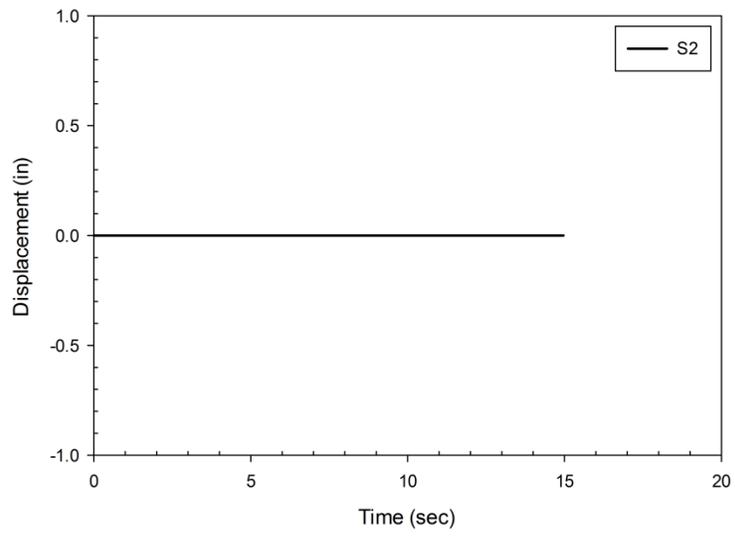
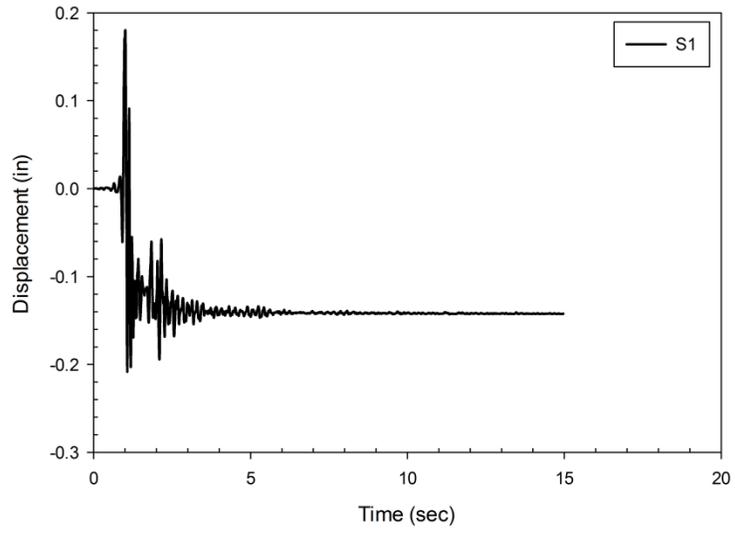
Section B-B

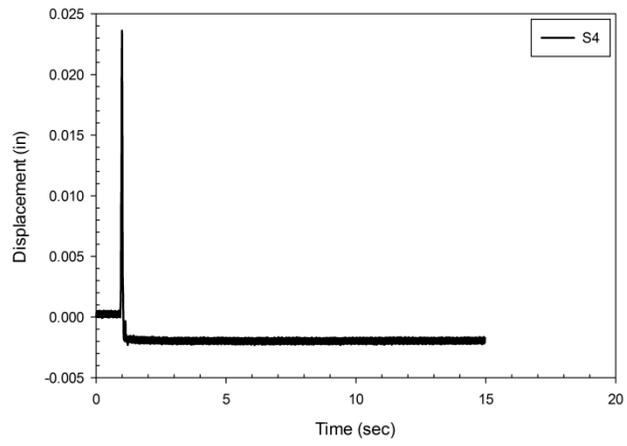








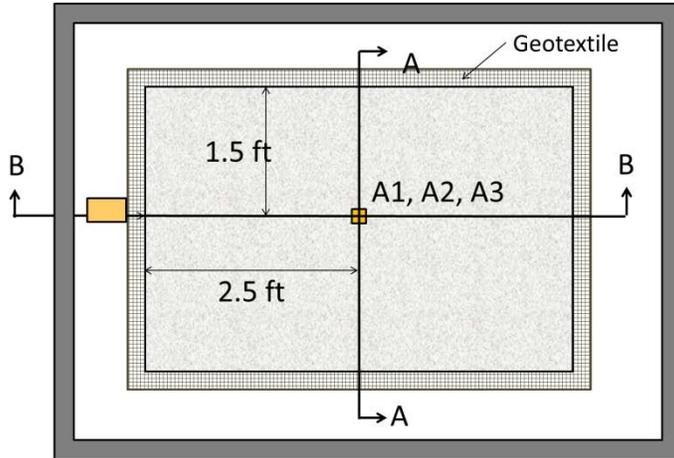




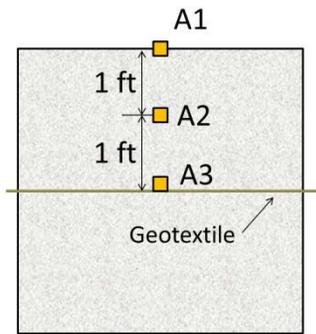
# Shake Table Test



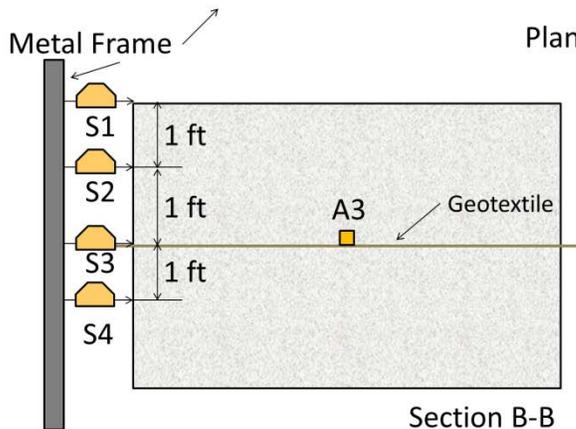
Project:	Cell Crete (Cellular Concrete)	Test Date:	9/14/16
Location:	----	Test No.:	1
Model Size:	3 ft by 5 ft	Vertical Stress:	164.0 psf
Model Height:	4 ft	Geogrid Depth:	2 ft
Motion Type:	Sinusoidal	Characteristics:	0.1g 2Hz



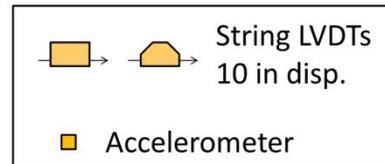
Plan View

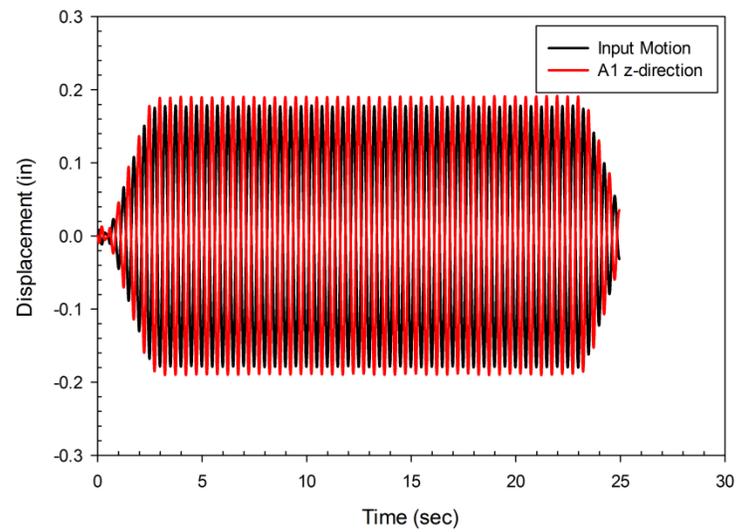
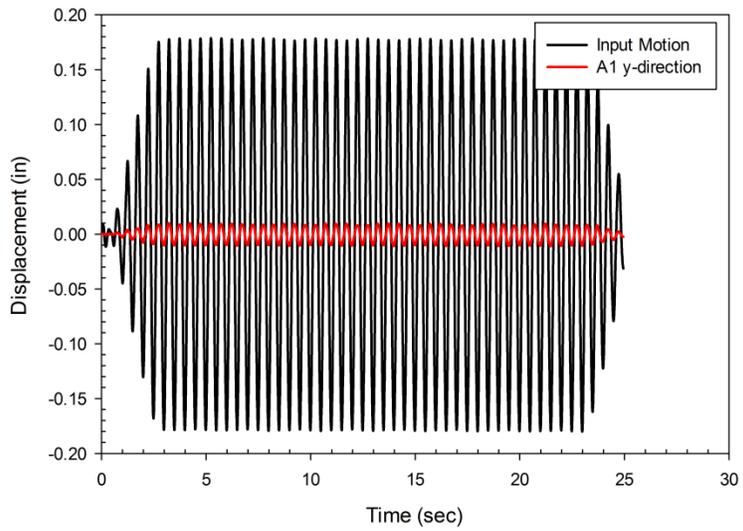
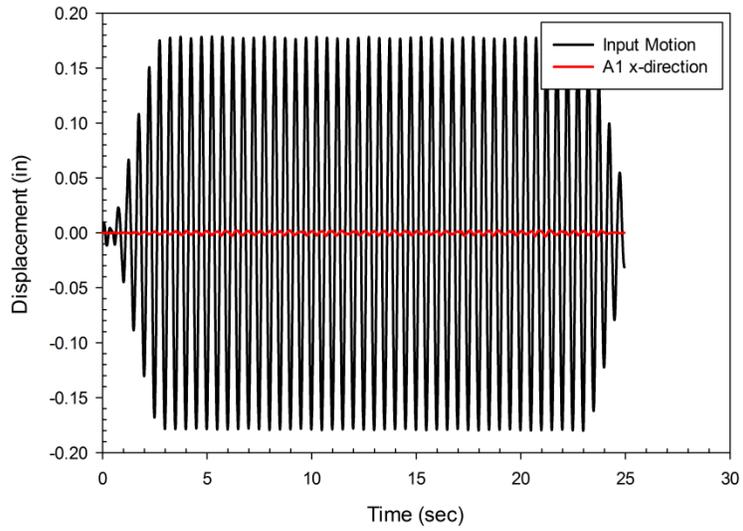


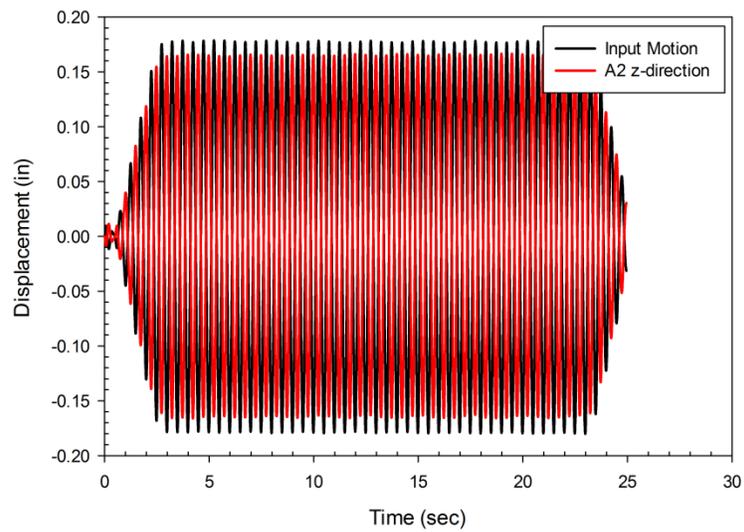
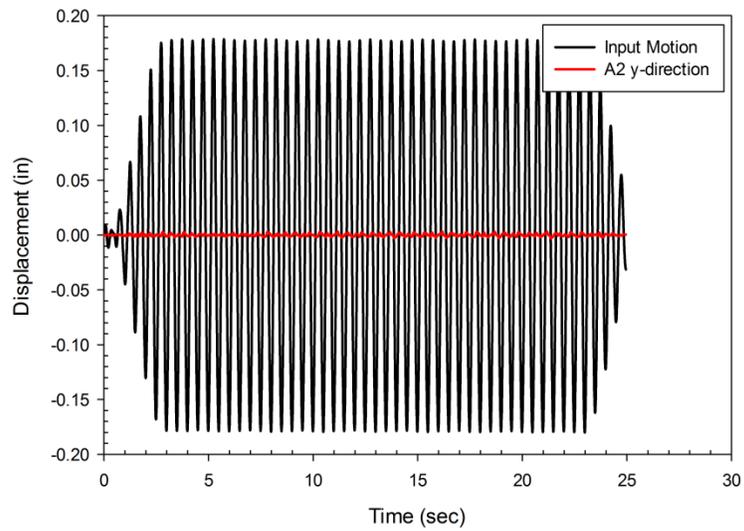
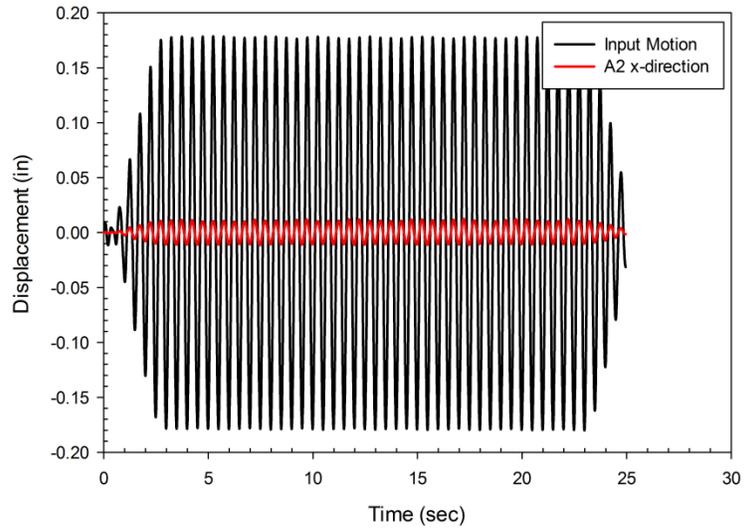
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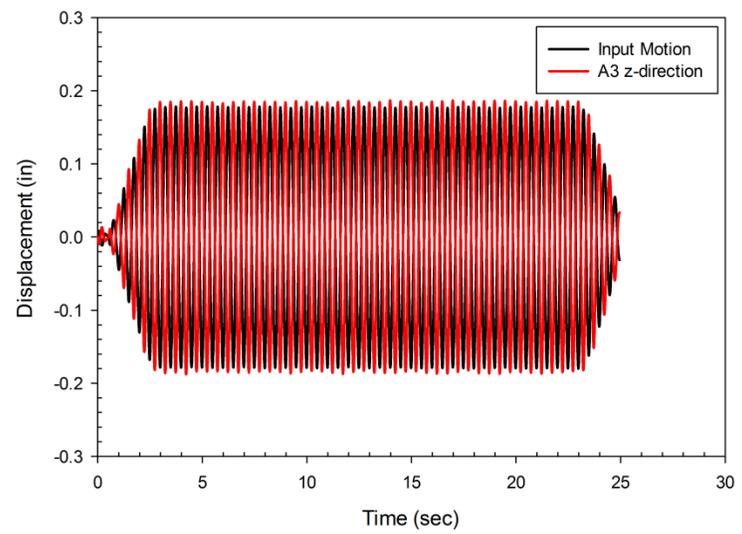
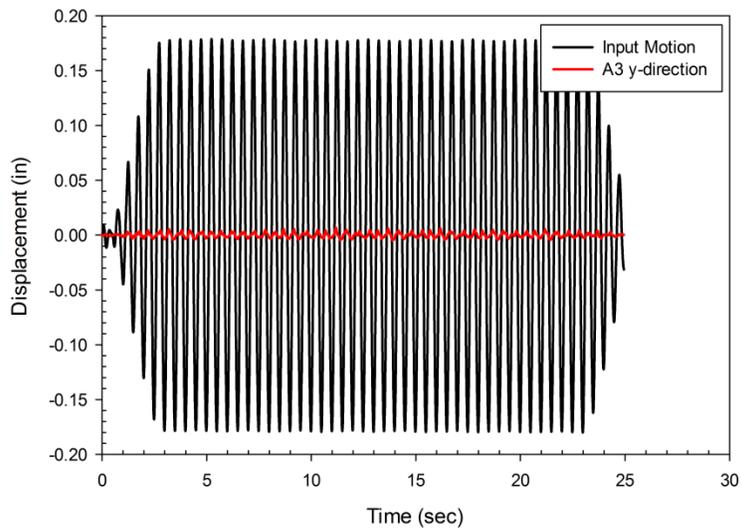
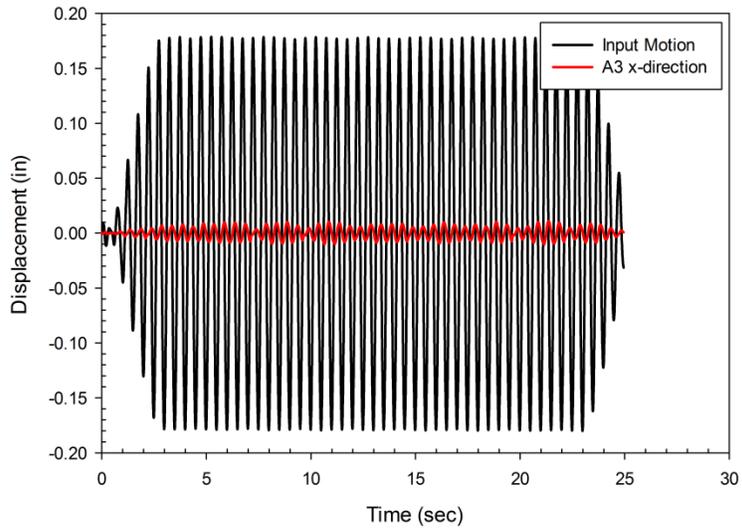


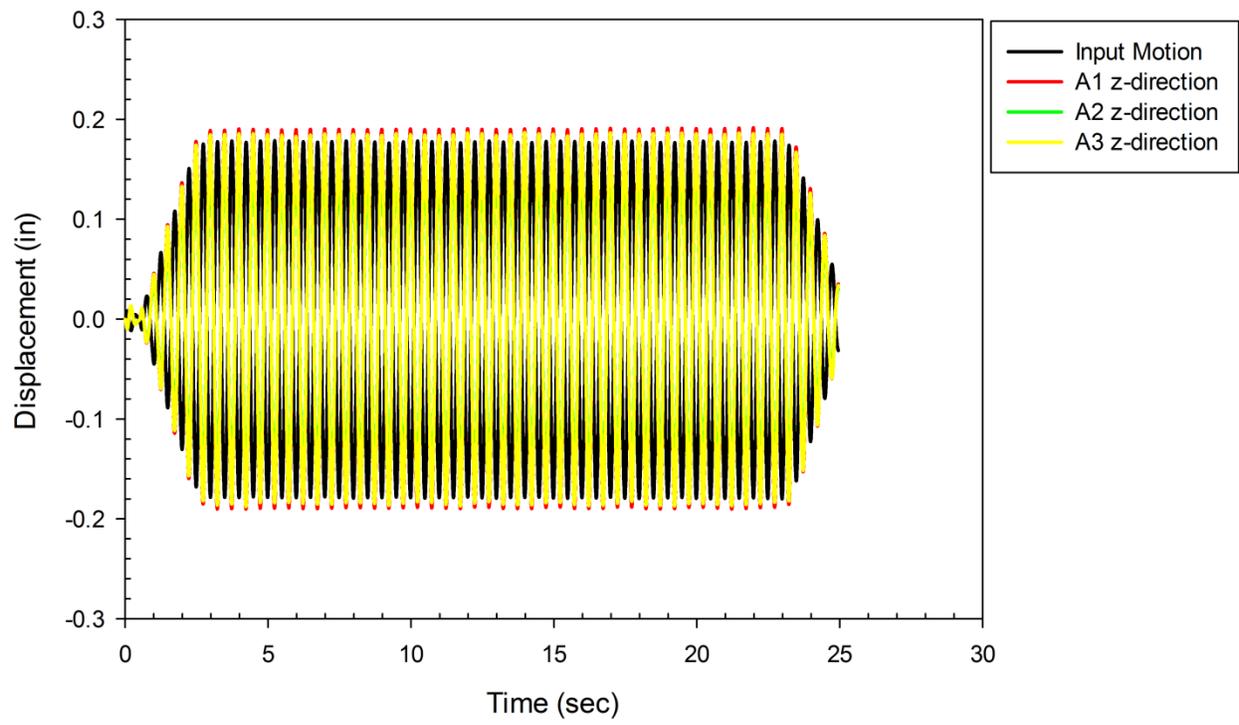
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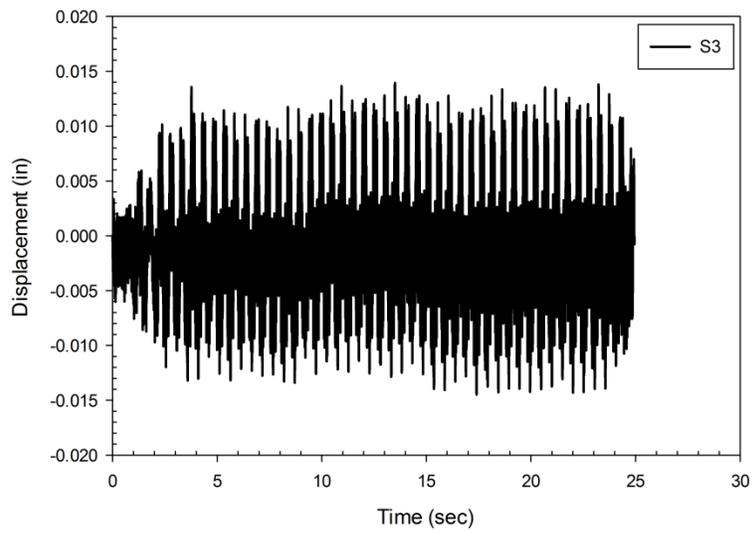
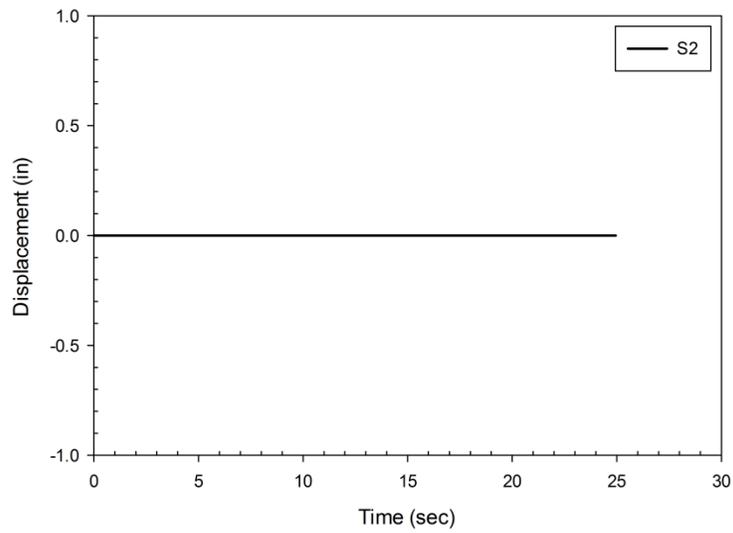
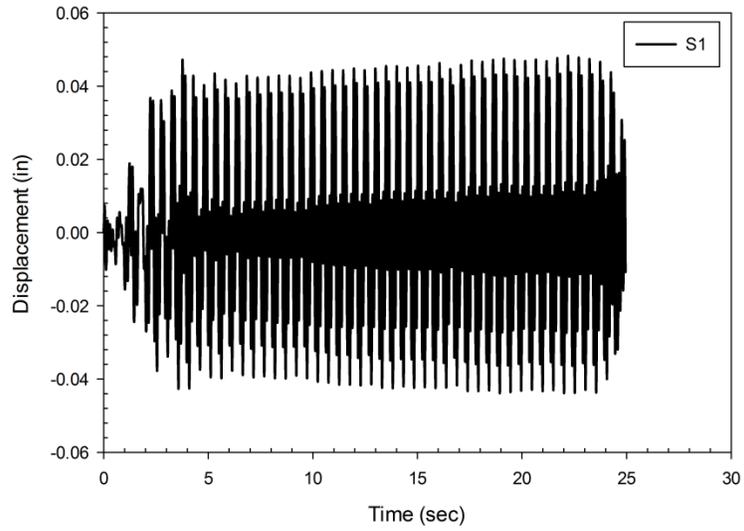


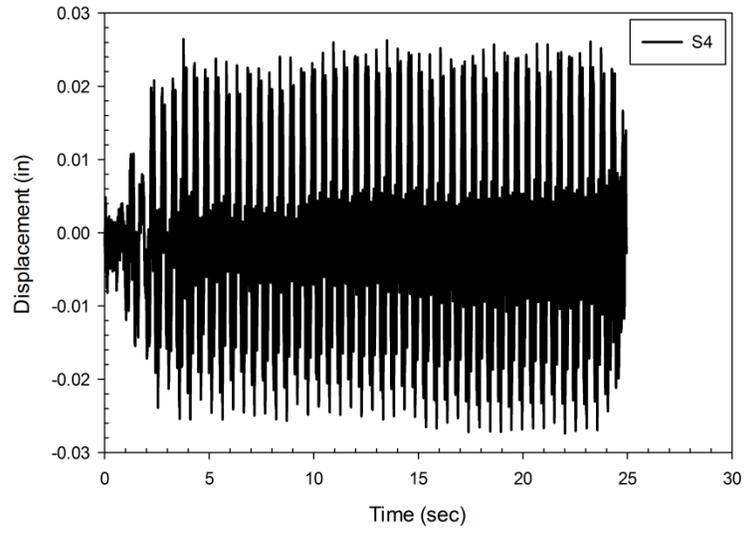








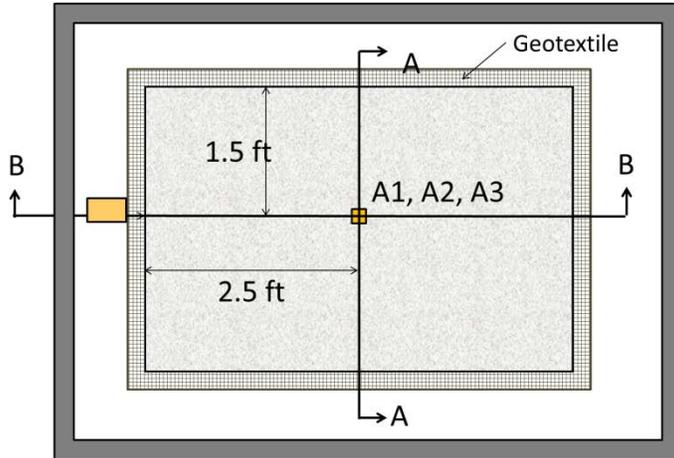




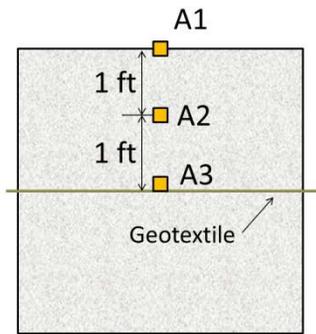
# Shake Table Test



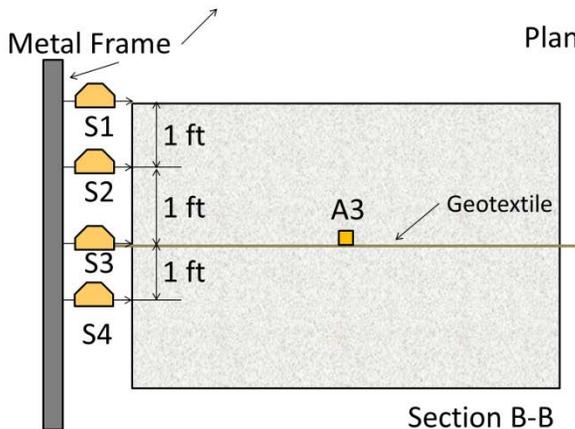
Project:	Cell Crete (Cellular Concrete)	Test Date:	9/14/16
Location:	----	Test No.:	1
Model Size:	3 ft by 5 ft	Vertical Stress:	164.0 psf
Model Height:	4 ft	Geogrid Depth:	2 ft
Motion Type:	Sinusoidal	Characteristics:	0.1g 3Hz



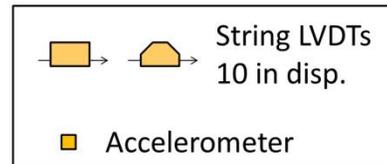
Plan View

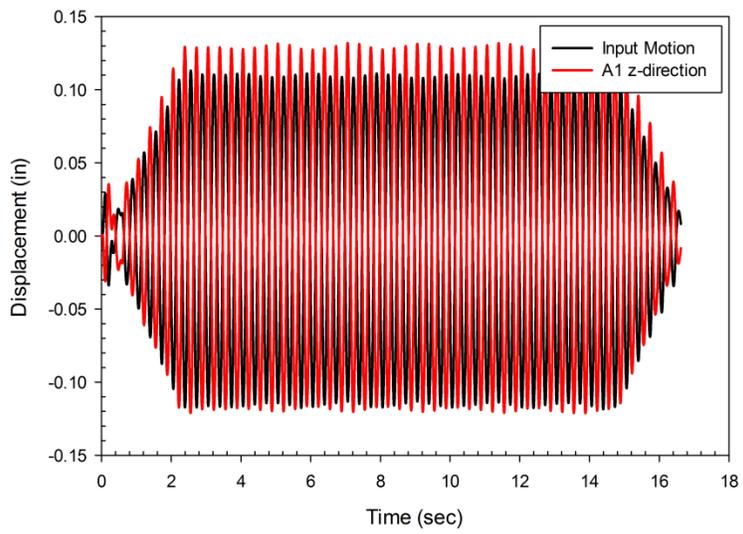
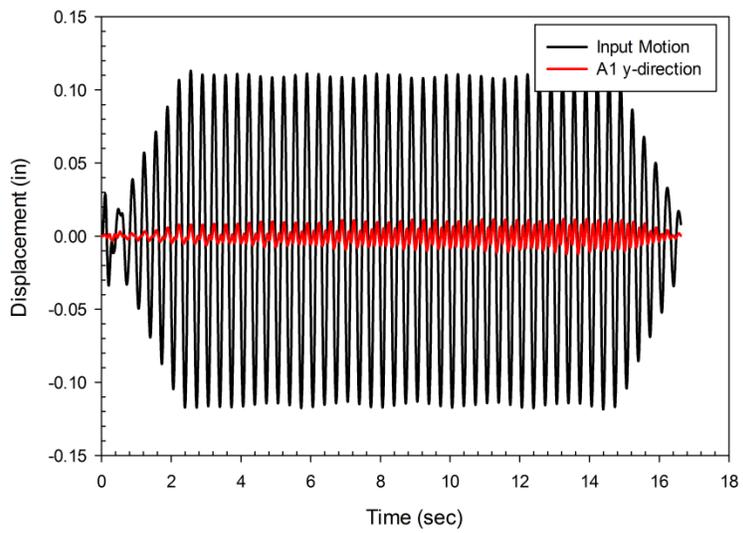
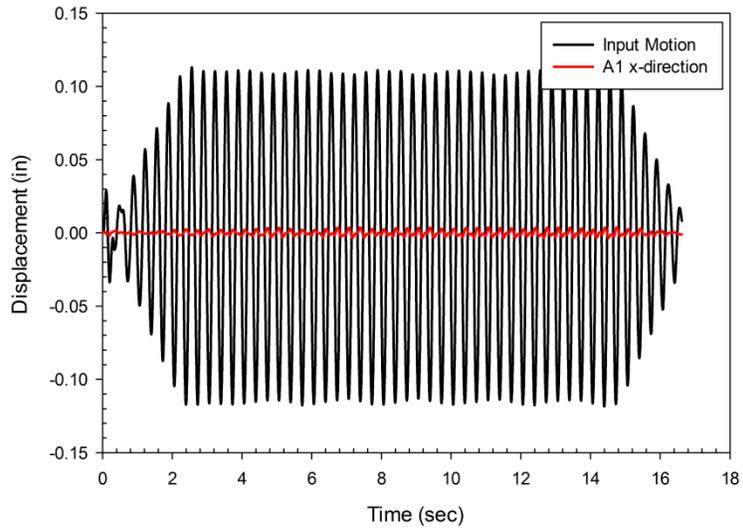


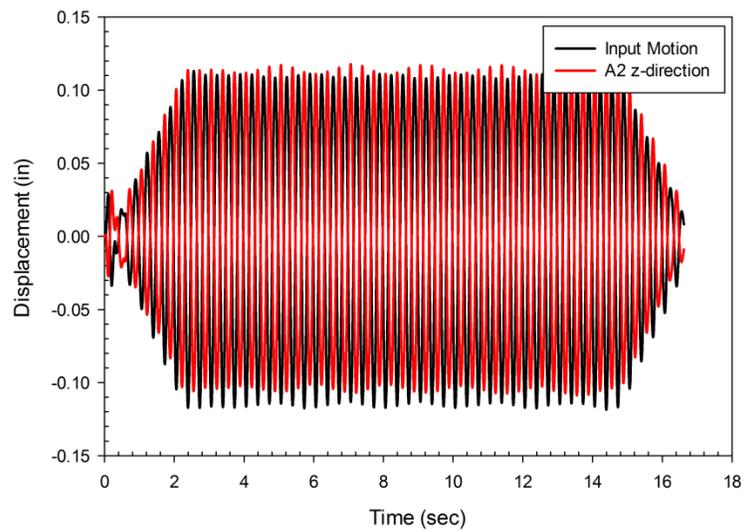
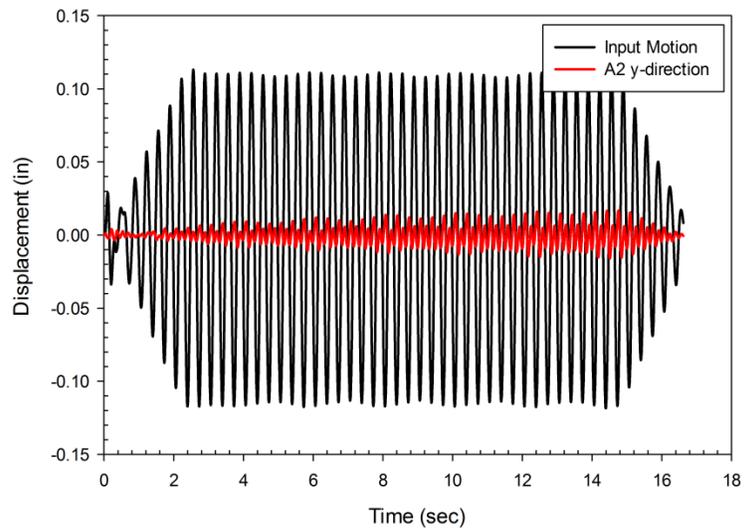
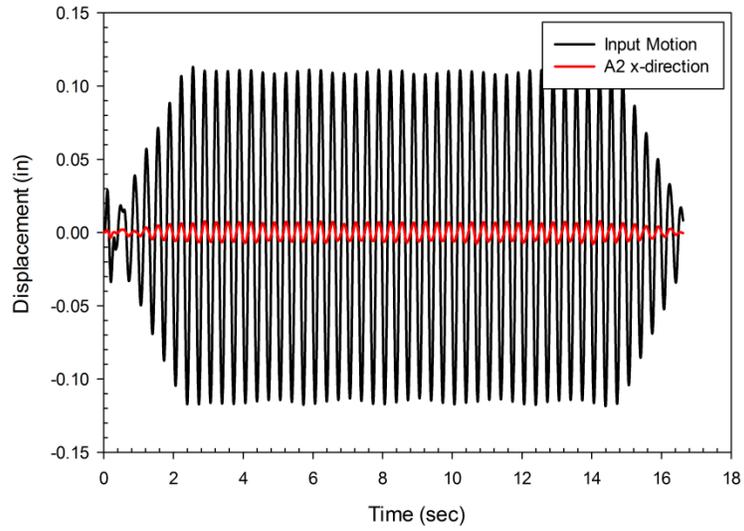
Section A-A

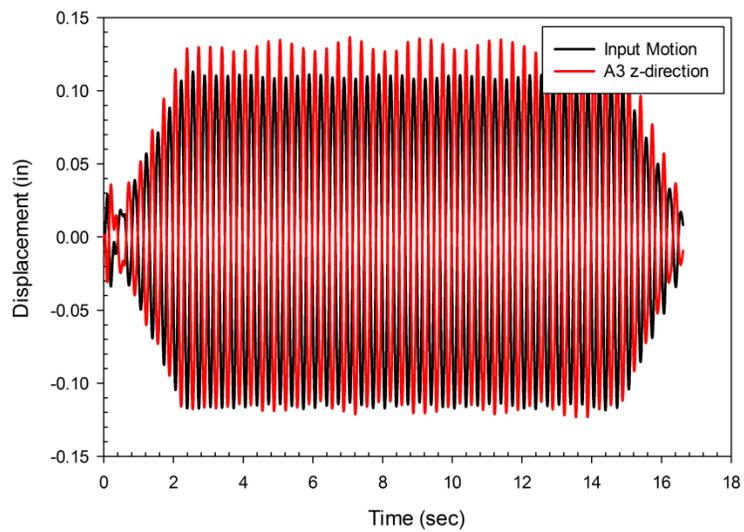
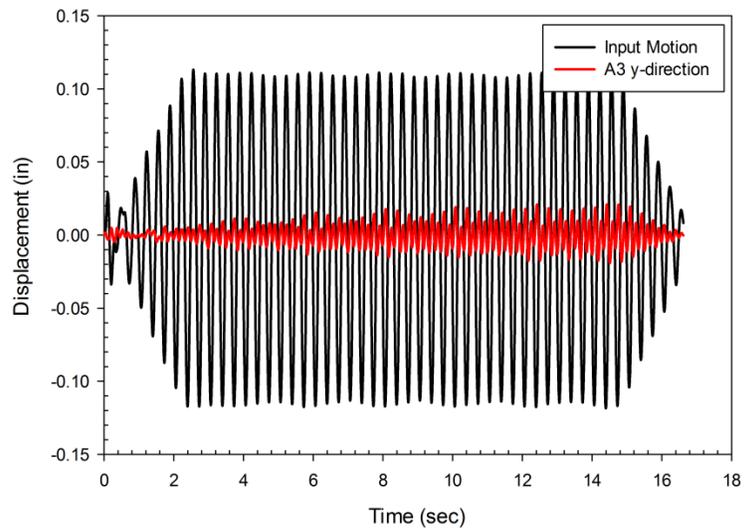
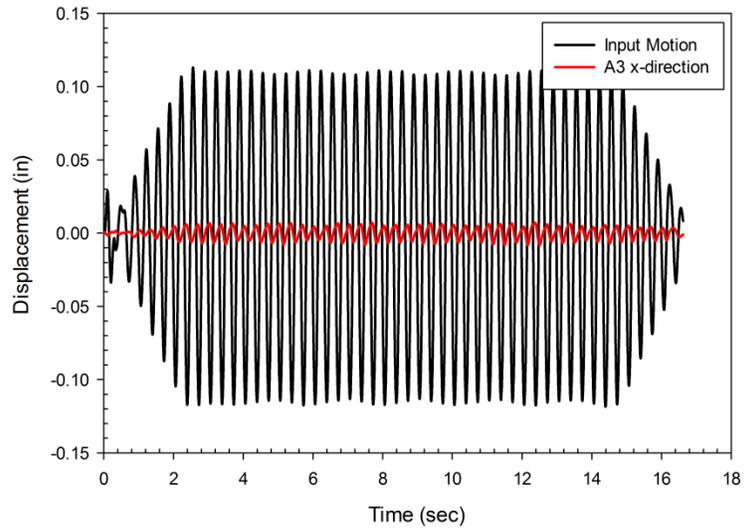


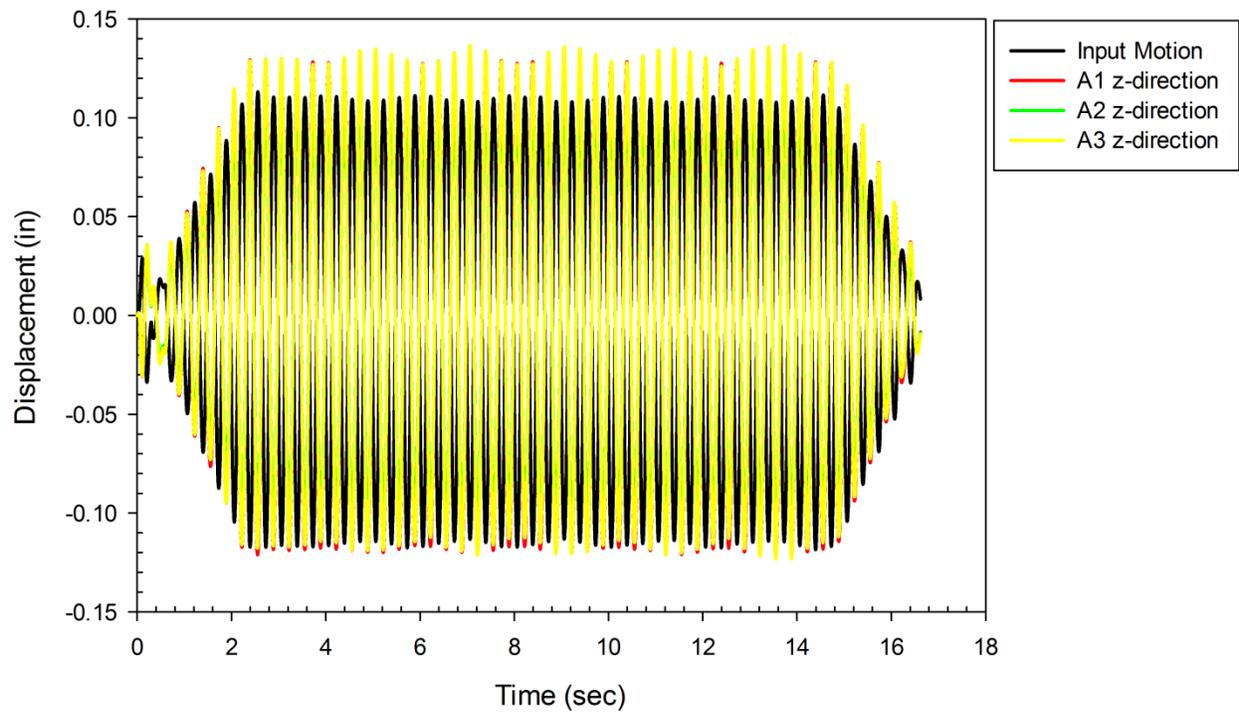
Section B-B

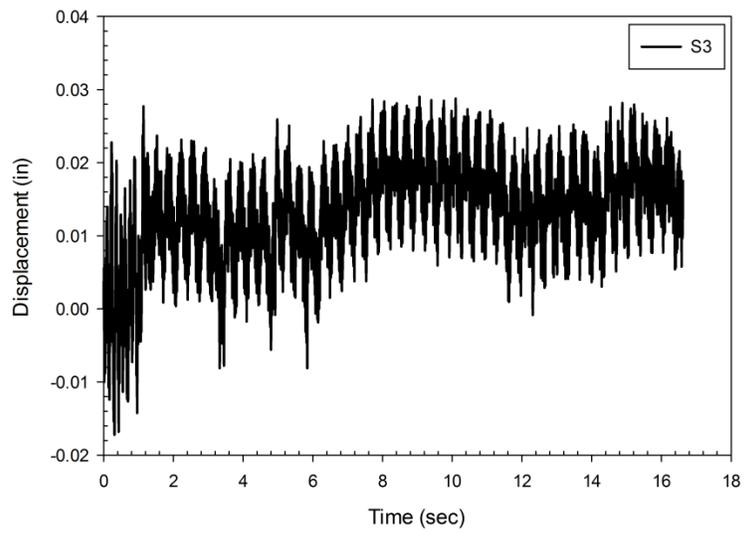
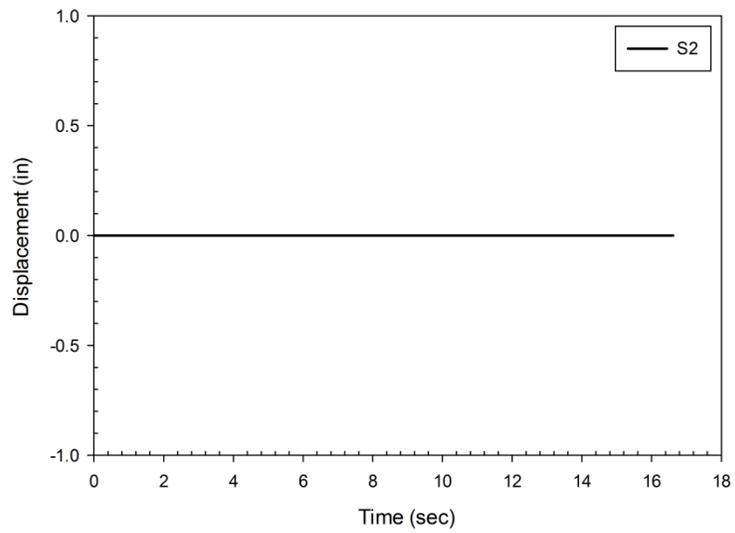
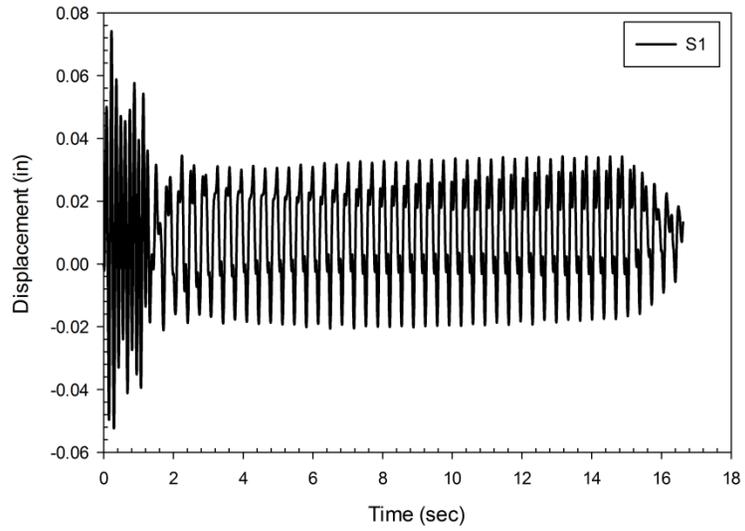


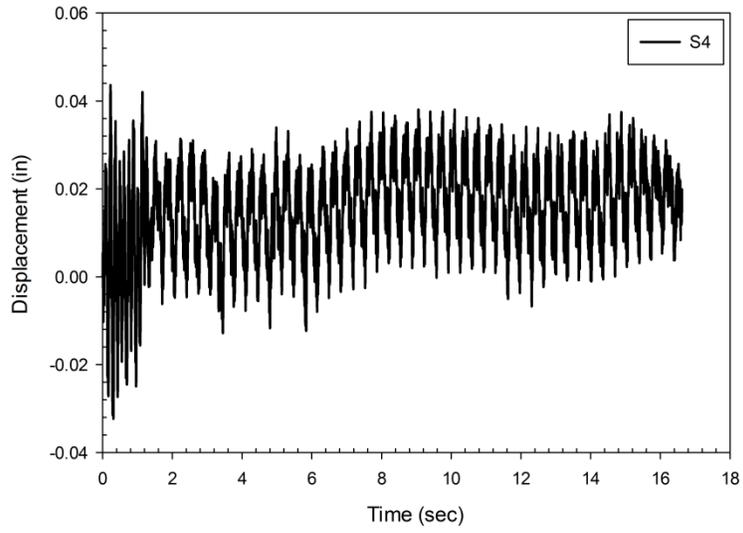








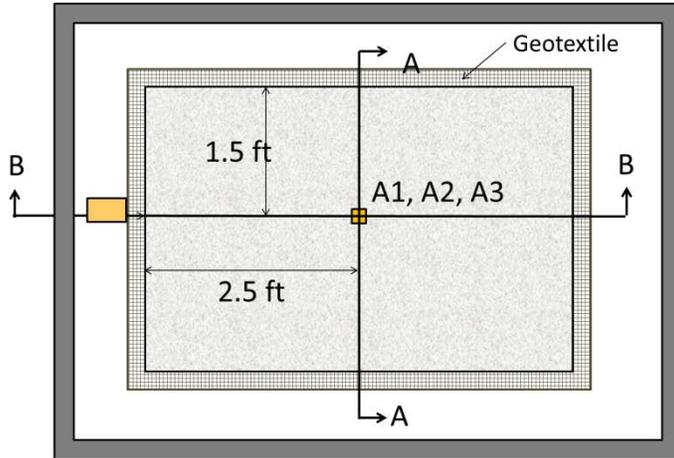




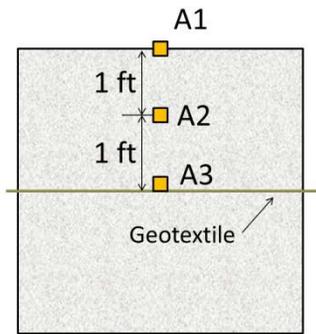
# Shake Table Test



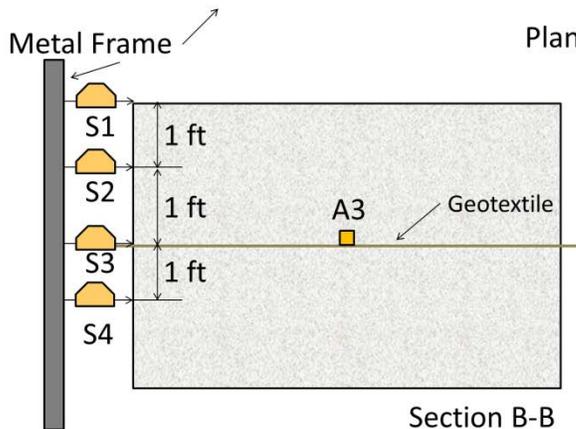
Project:	Cell Crete (Cellular Concrete)	Test Date:	9/14/16
Location:	----	Test No.:	1
Model Size:	3 ft by 5 ft	Vertical Stress:	164.0 psf
Model Height:	4 ft	Geogrid Depth:	2 ft
Motion Type:	Sinusoidal	Characteristics:	0.2g 2Hz



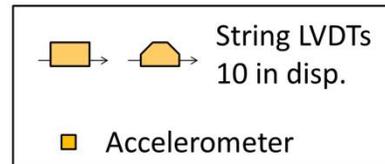
Plan View

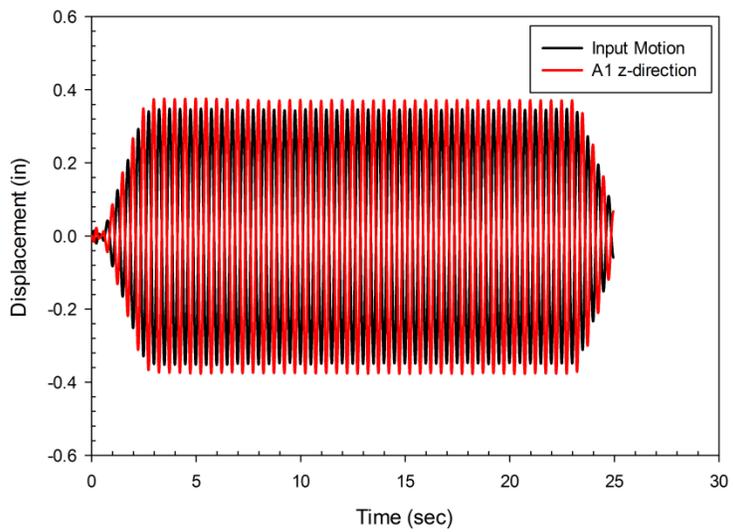
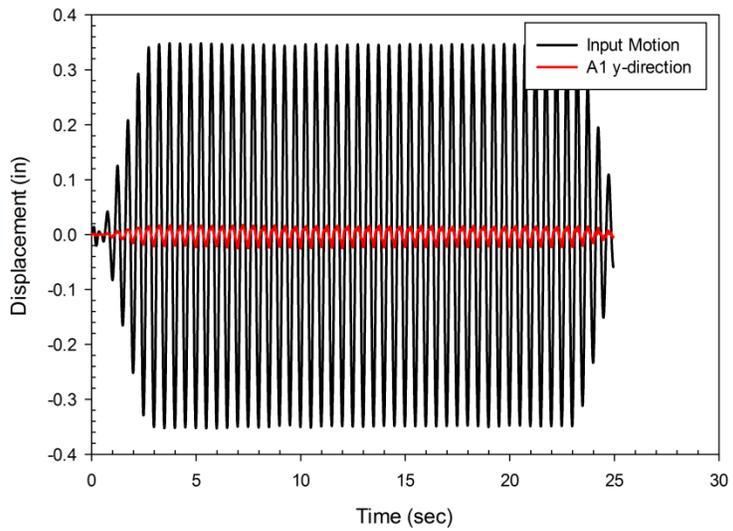
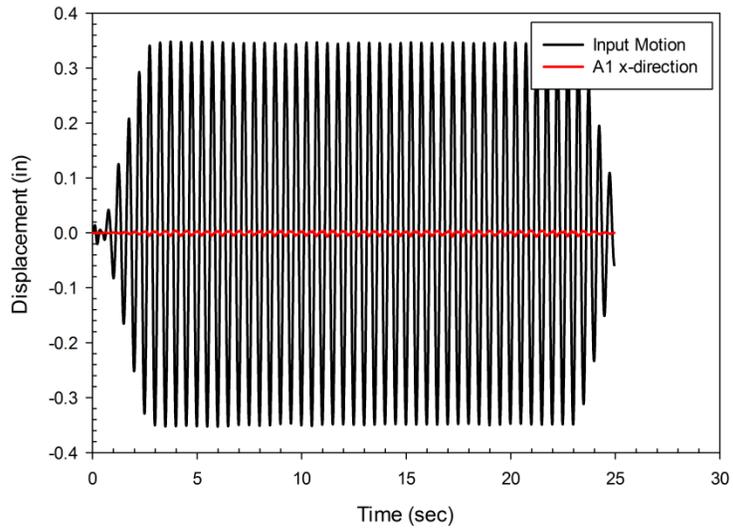


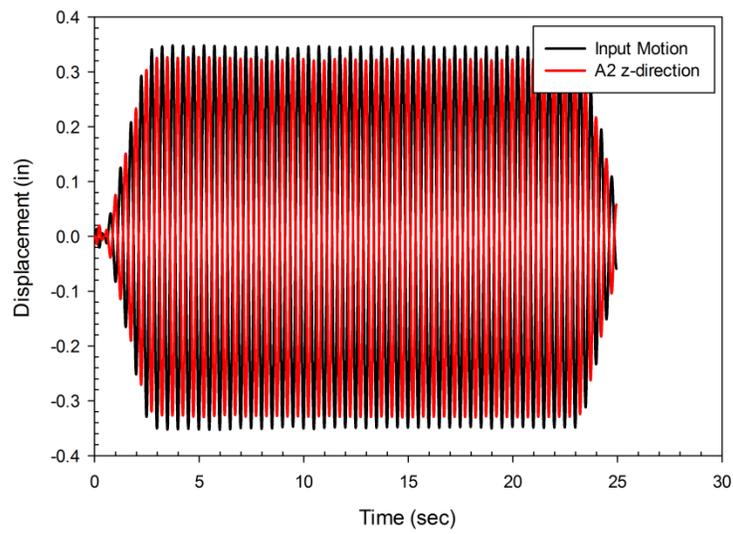
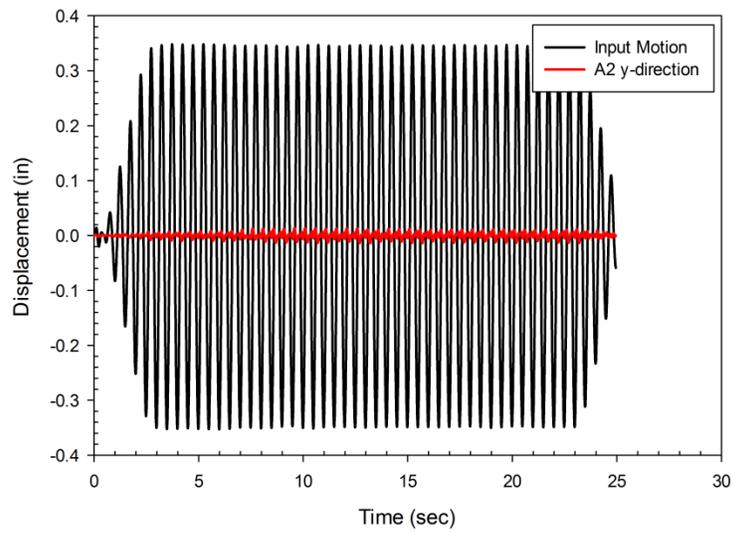
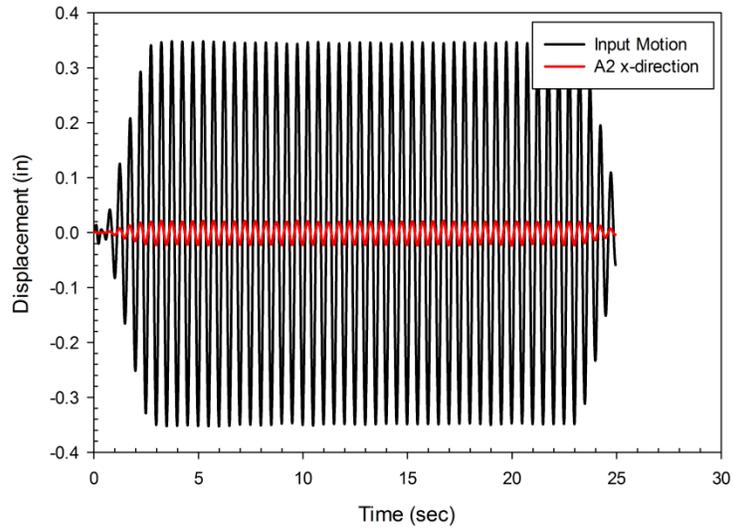
Section A-A

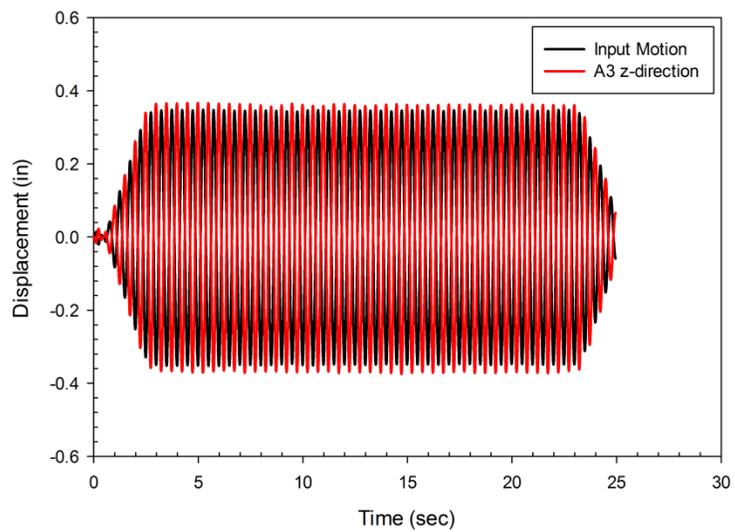
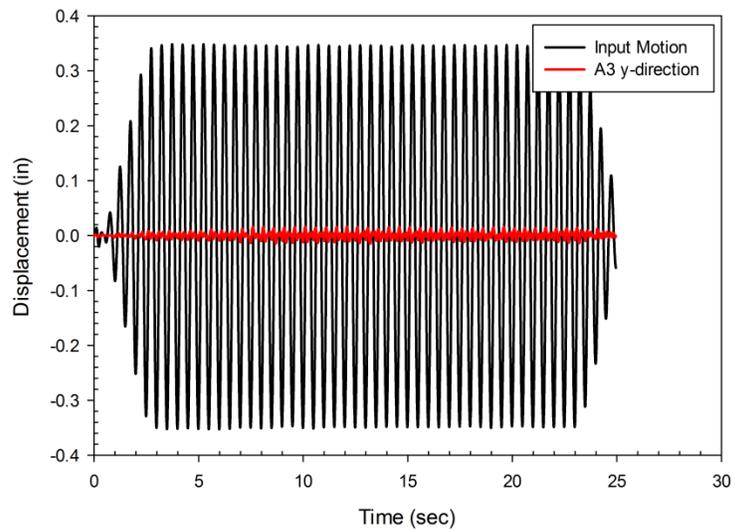
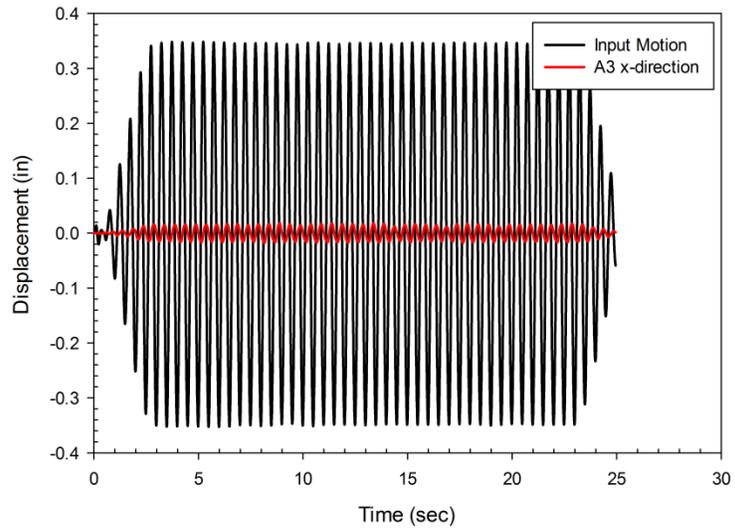


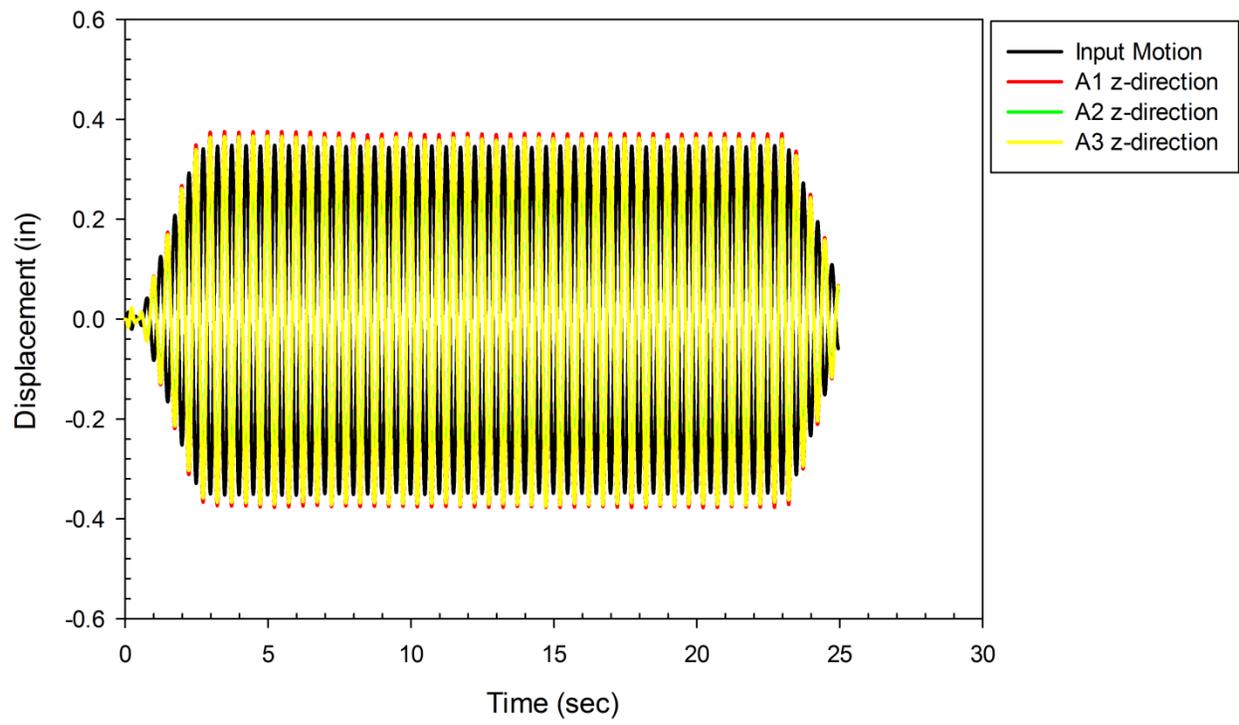
Section B-B

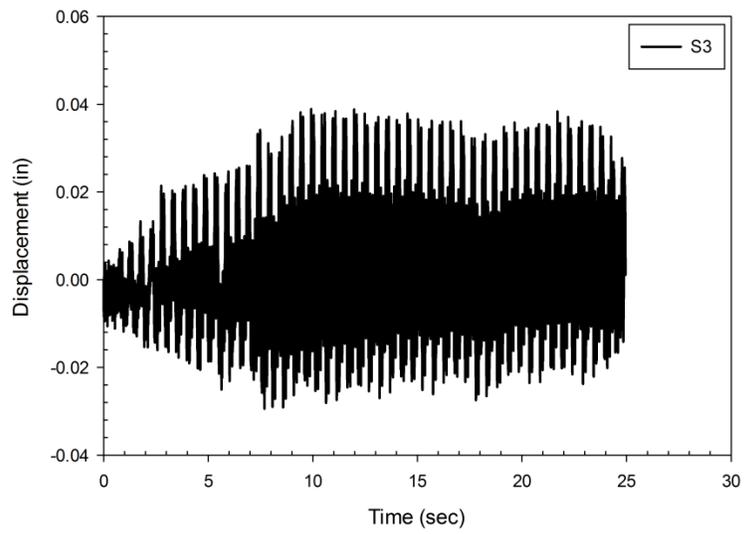
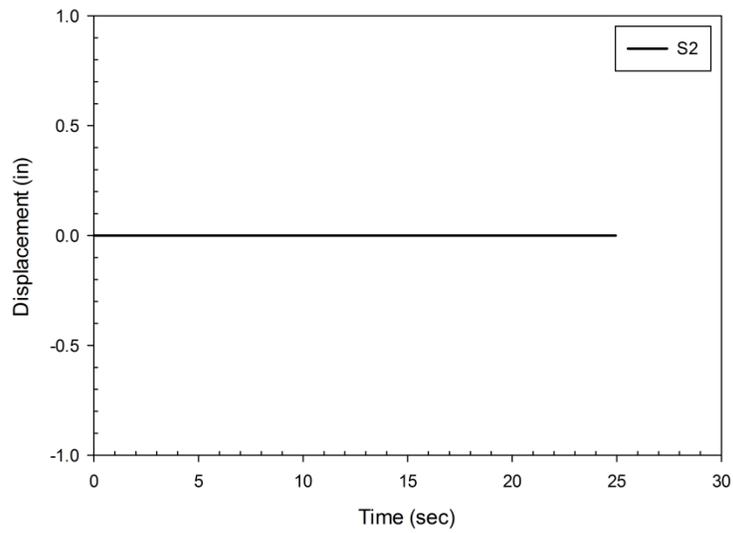
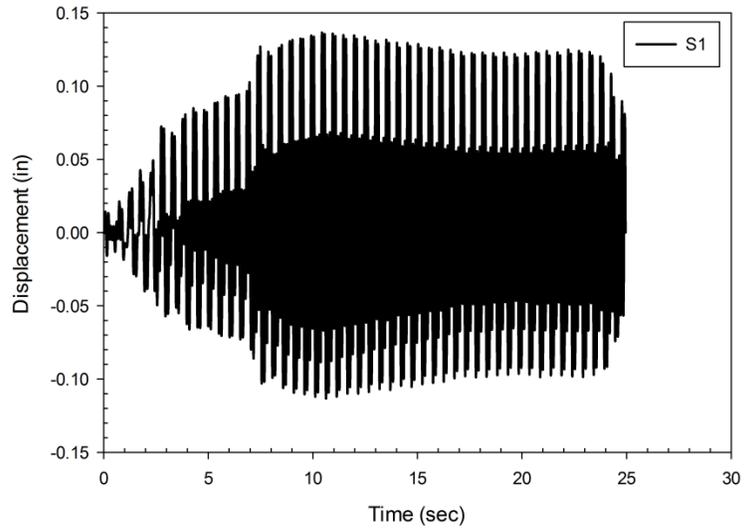


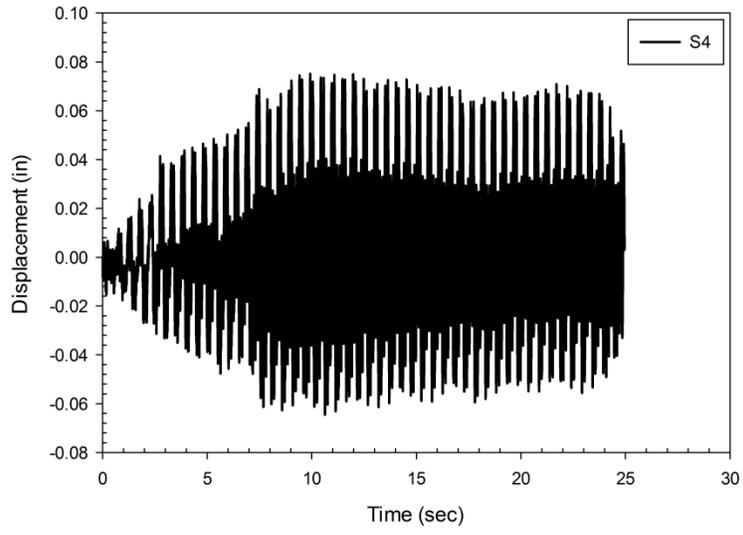








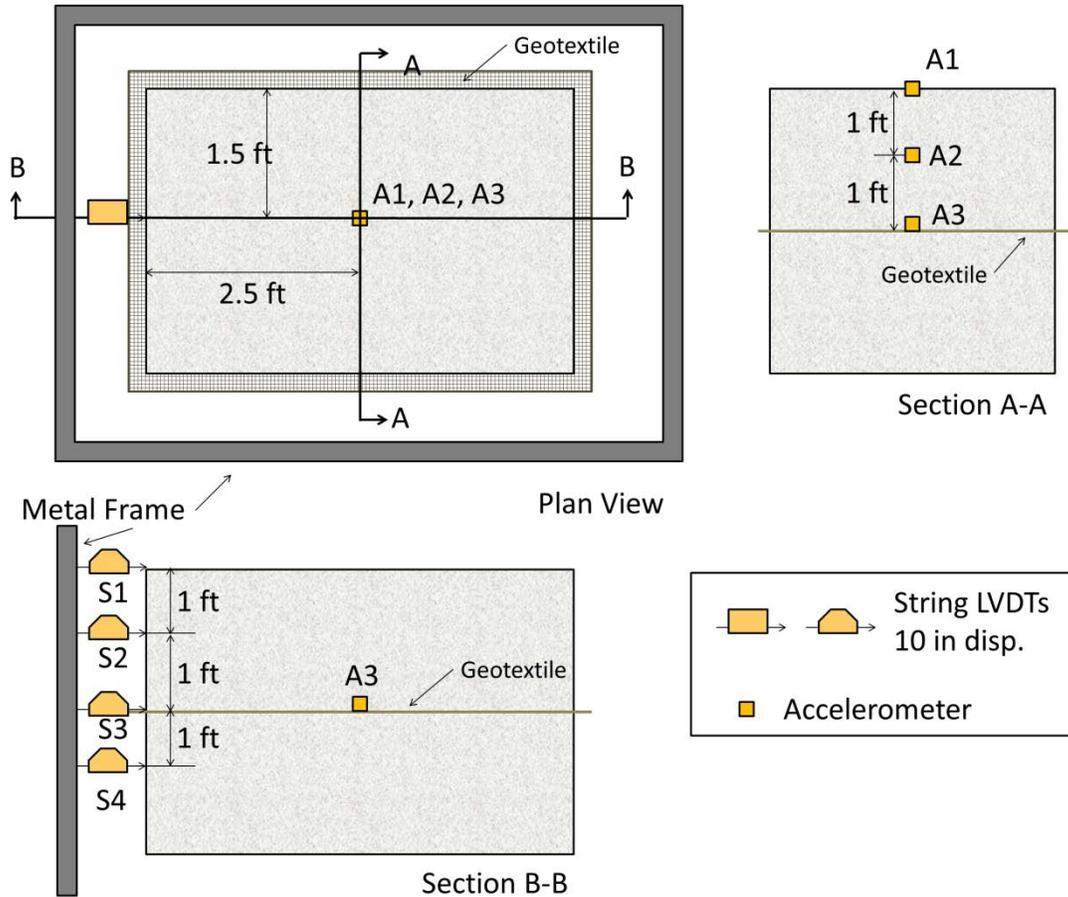


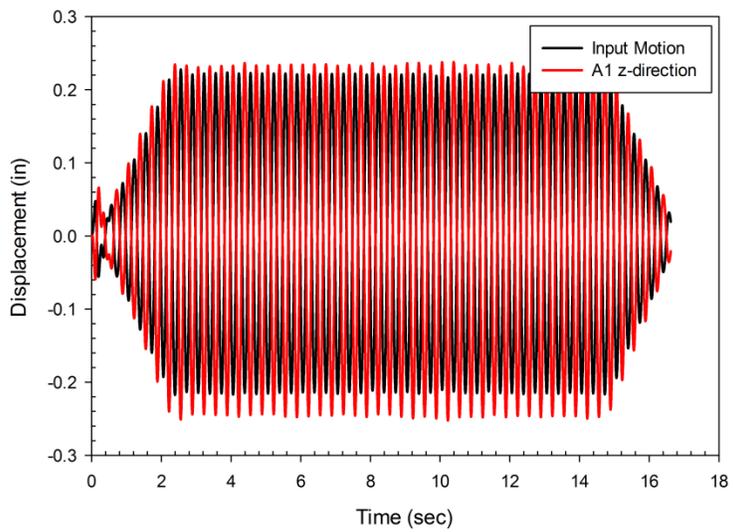
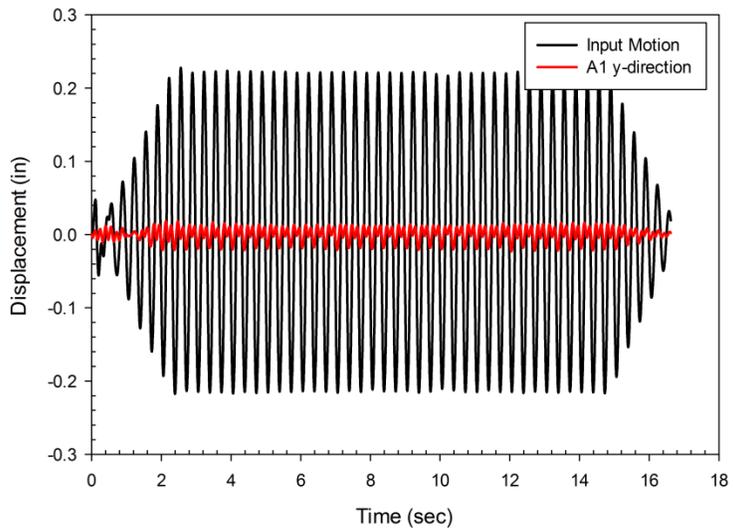
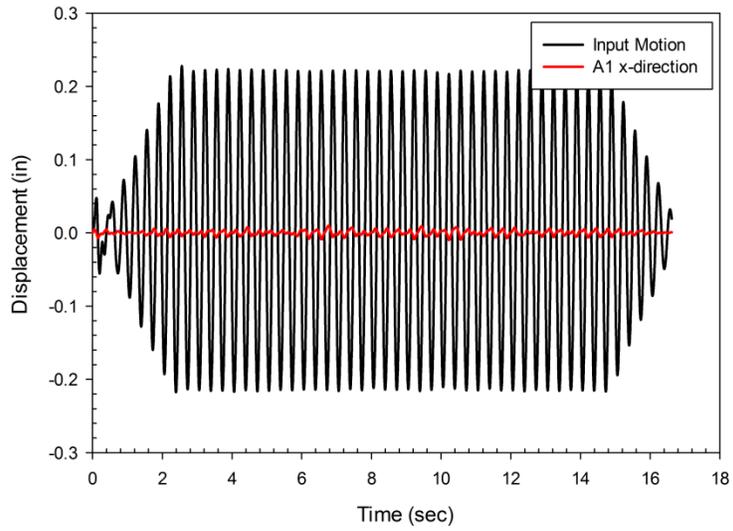


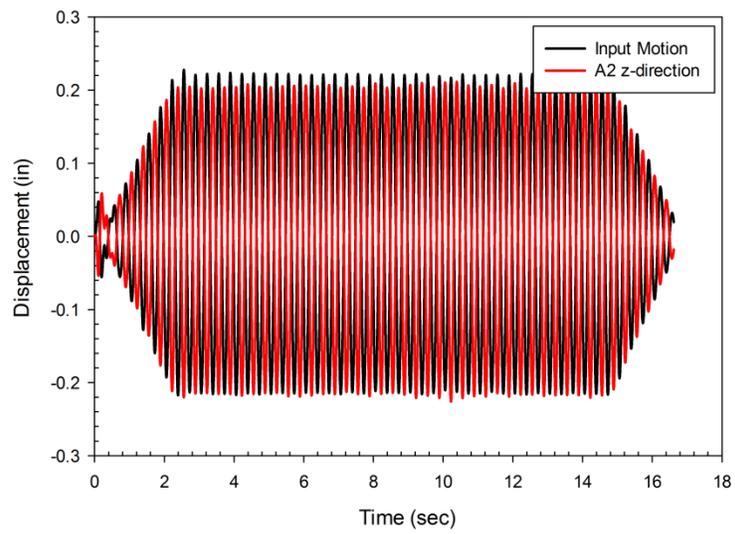
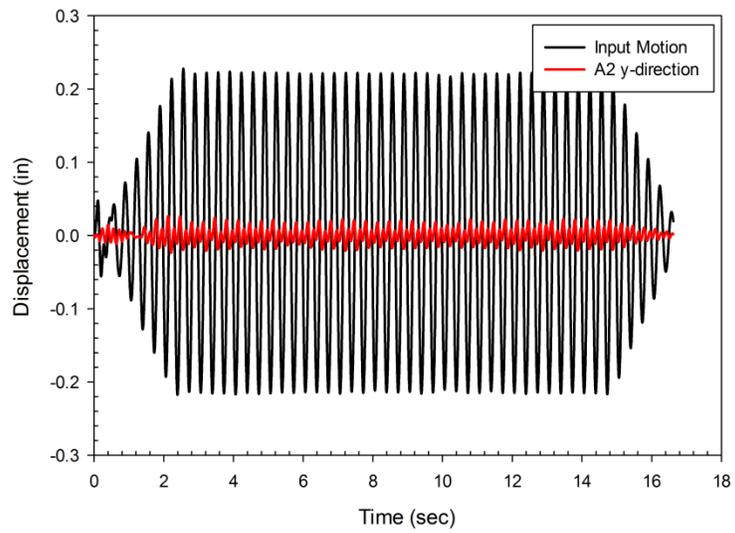
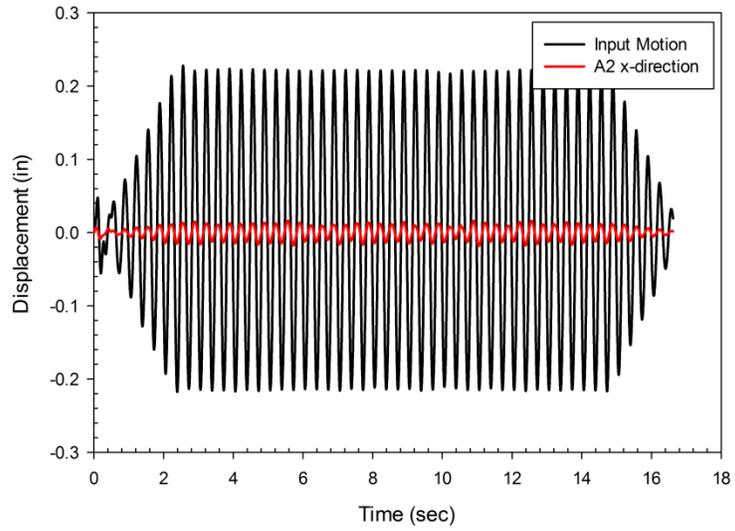
# Shake Table Test

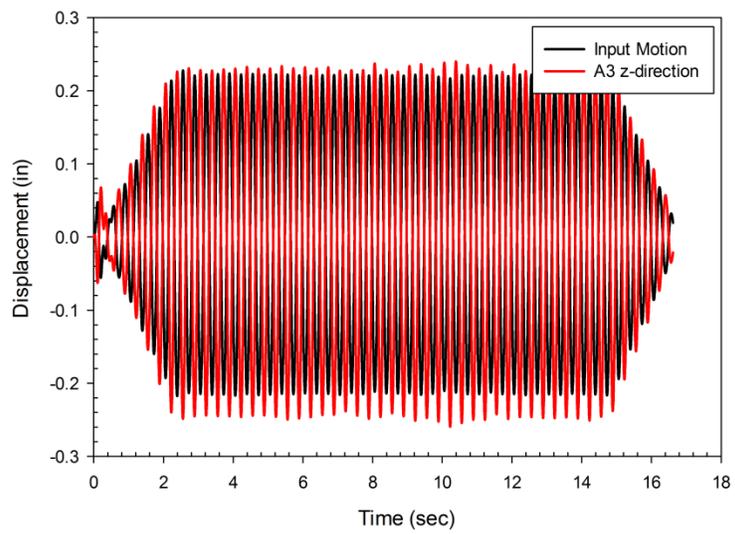
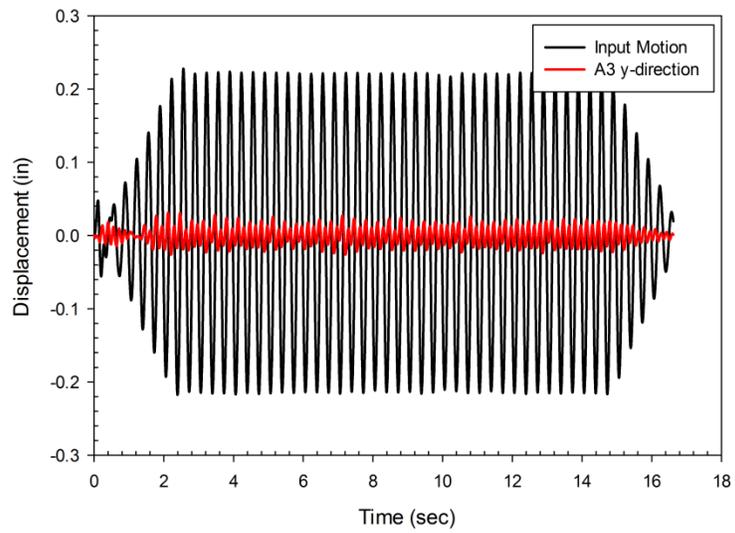
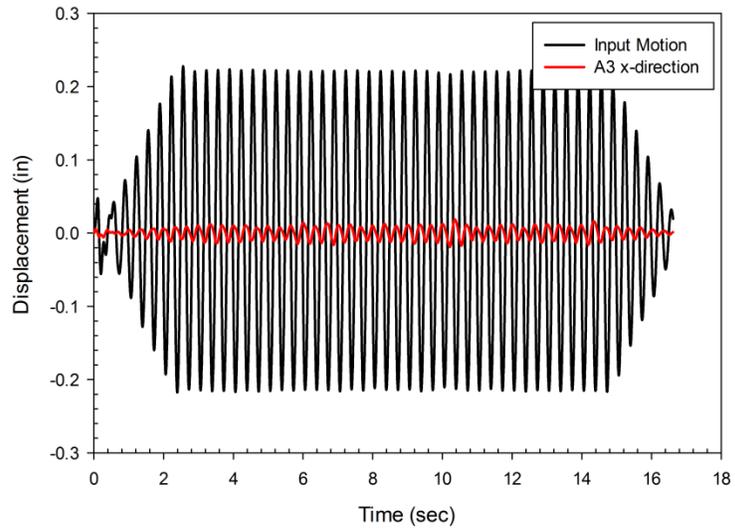


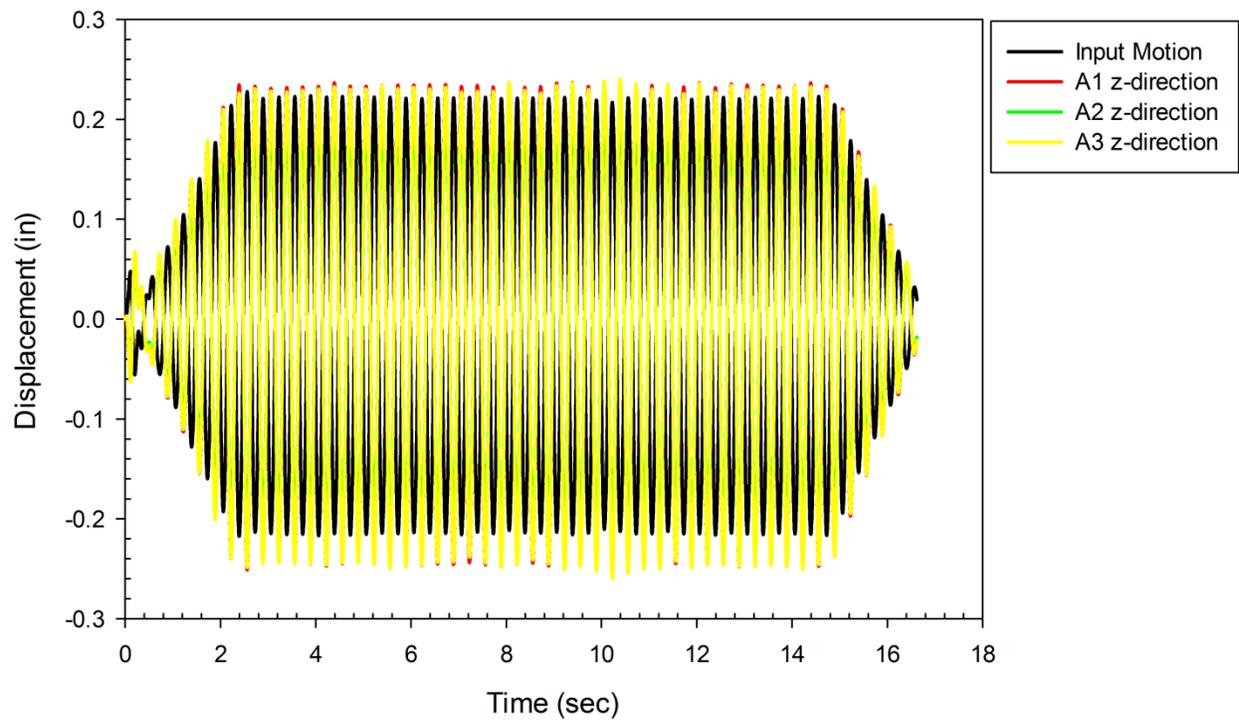
Project:	Cell Crete (Cellular Concrete)	Test Date:	9/14/16
Location:	----	Test No.:	1
Model Size:	3 ft by 5 ft	Vertical Stress:	164.0 psf
Model Height:	4 ft	Geogrid Depth:	2 ft
Motion Type:	Sinusoidal	Characteristics:	0.2g 3Hz

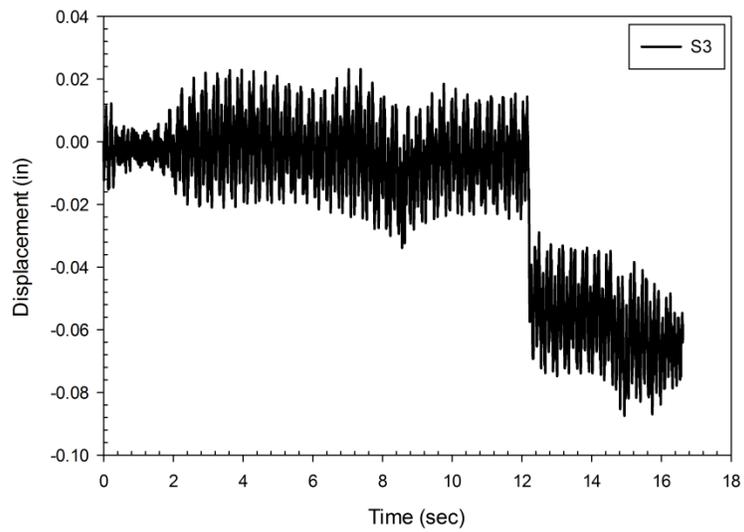
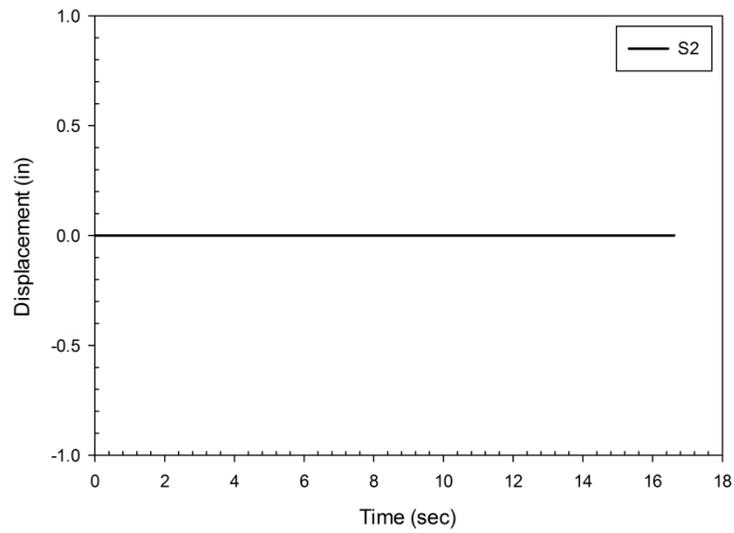
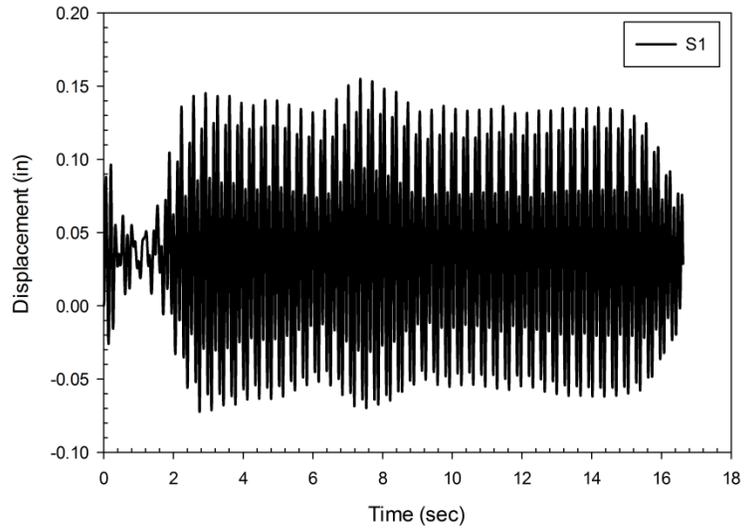


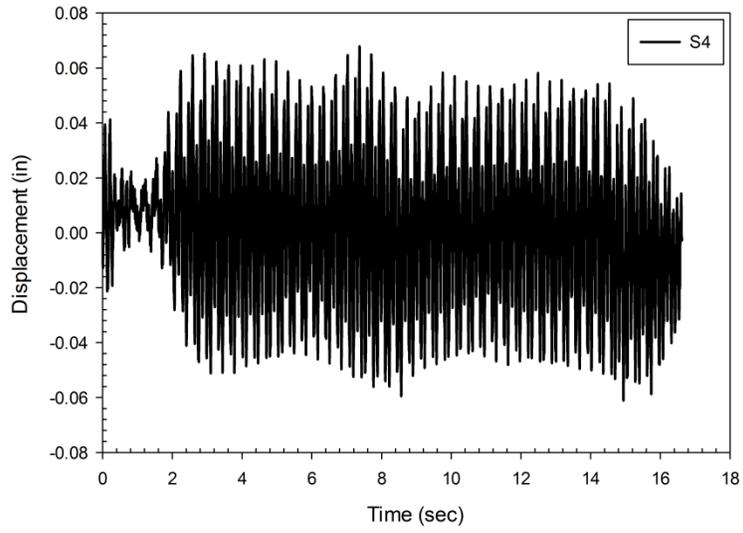








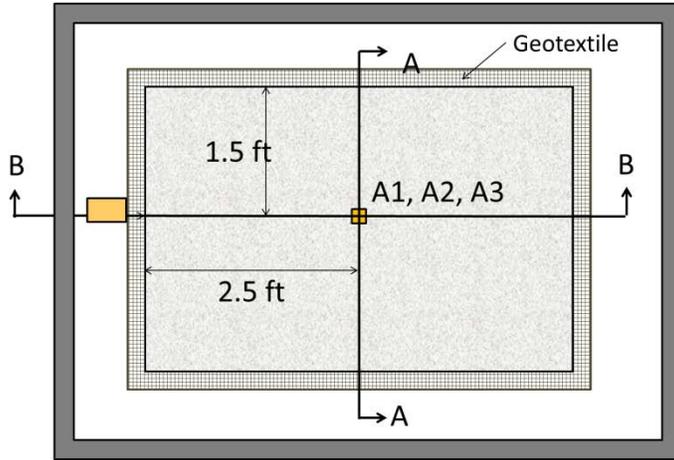




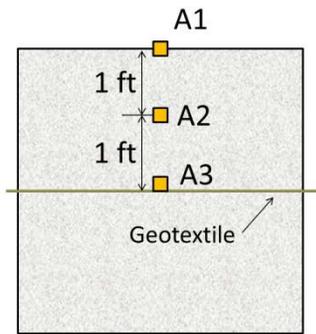
# Shake Table Test



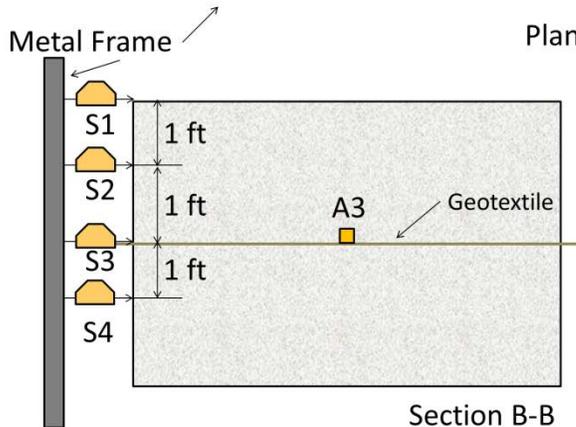
Project:	Cell Crete (Cellular Concrete)	Test Date:	9/14/16
Location:	----	Test No.:	1
Model Size:	3 ft by 5 ft	Vertical Stress:	164.0 psf
Model Height:	4 ft	Geogrid Depth:	2 ft
Motion Type:	1994 Northridge Earthquake	Characteristics:	N/A



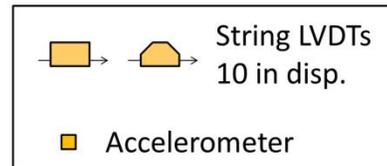
Plan View

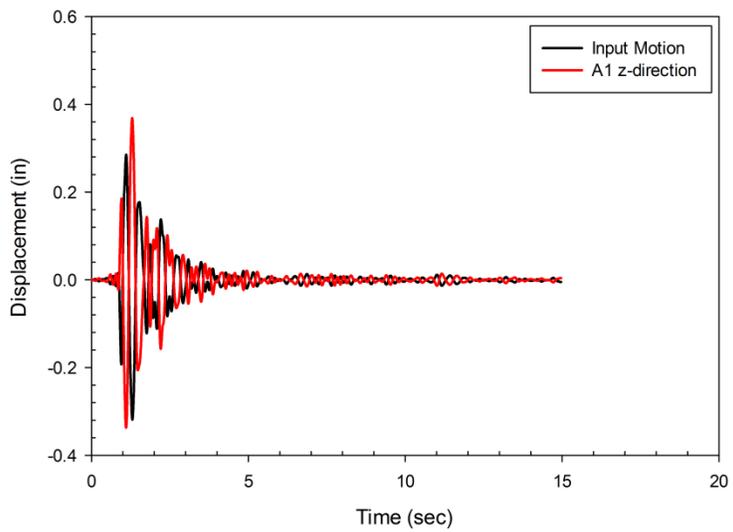
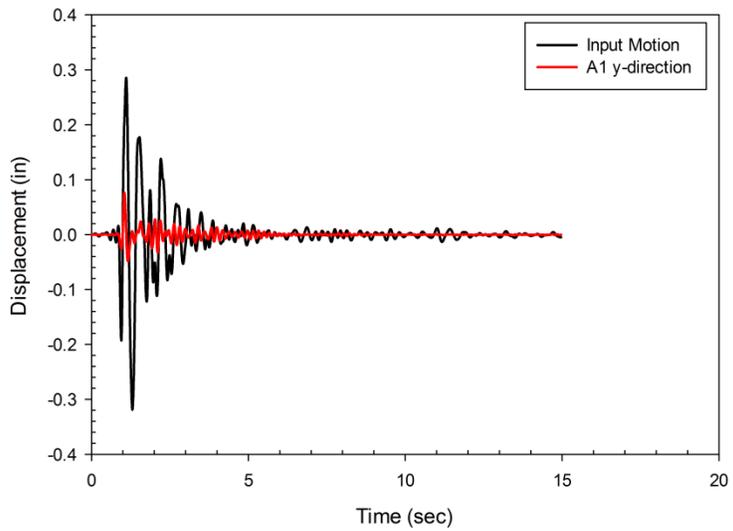
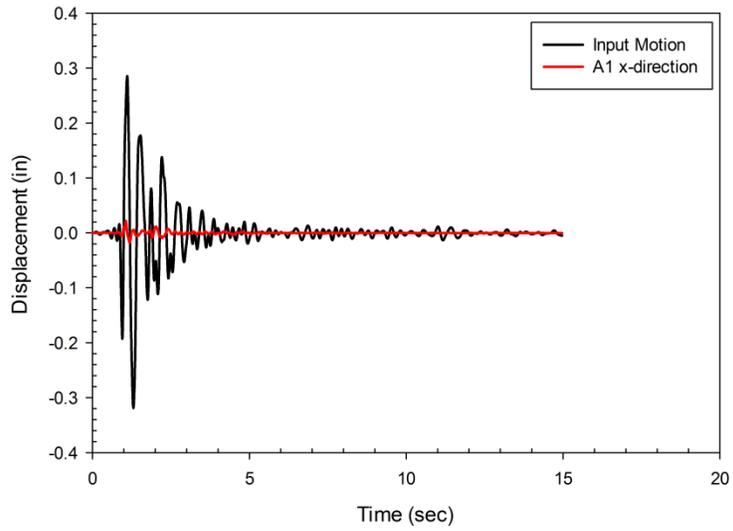


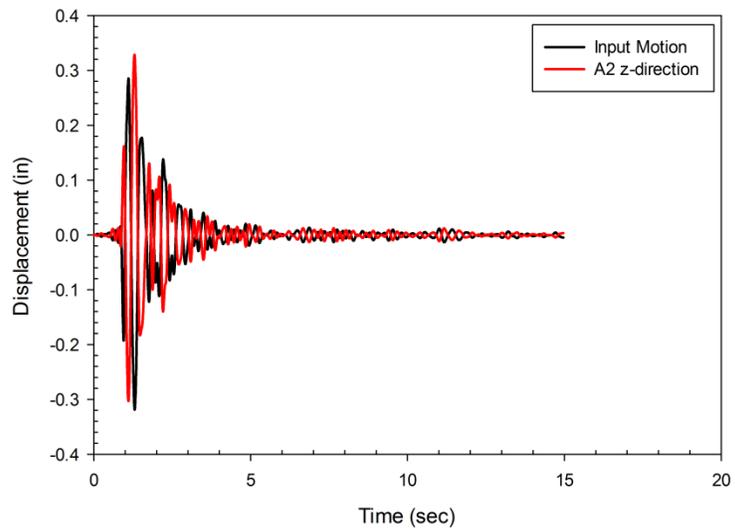
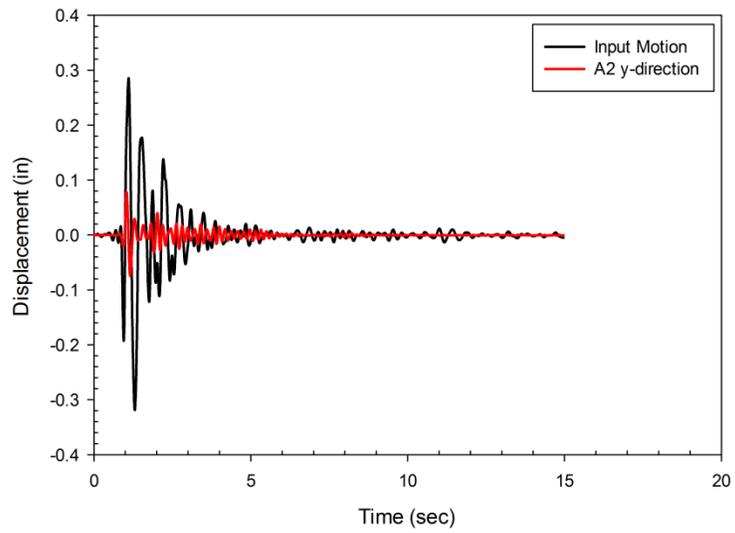
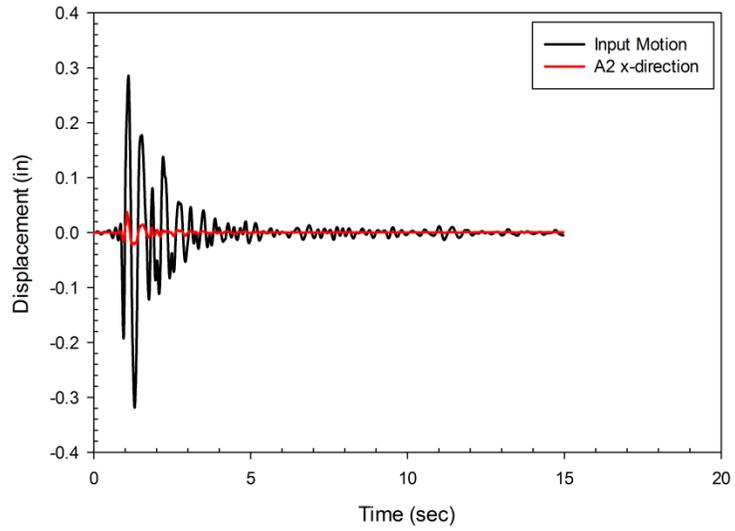
Section A-A

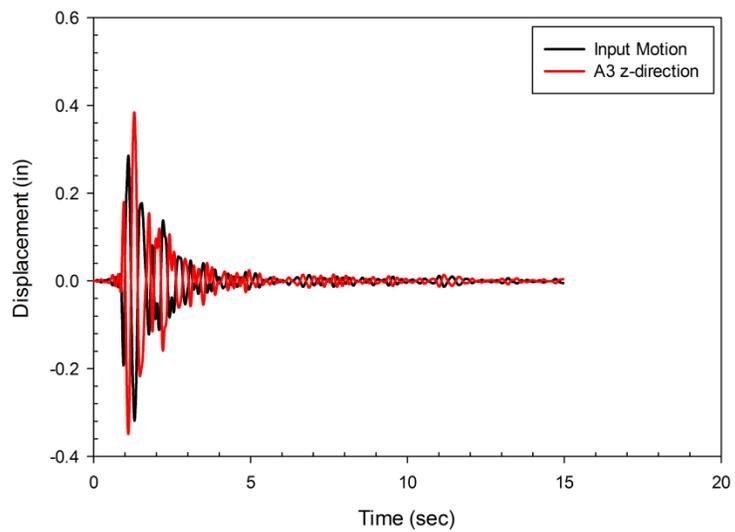
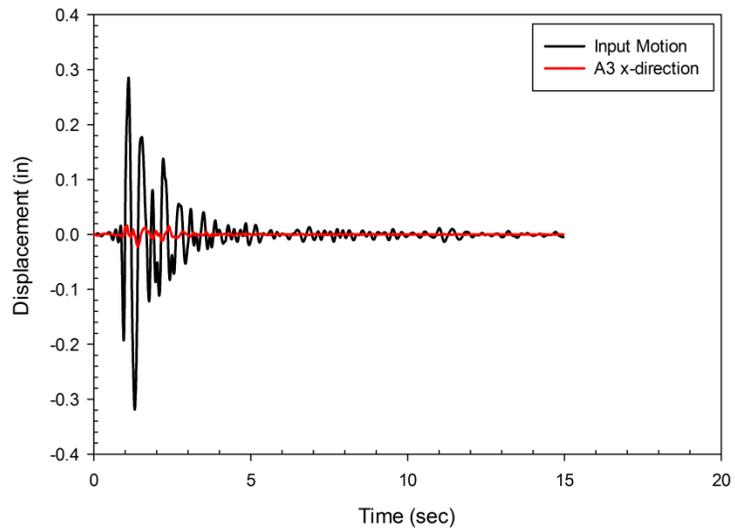
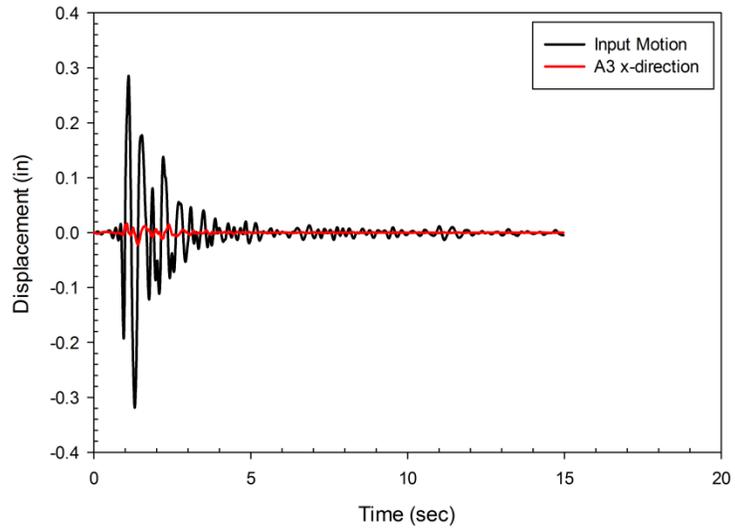


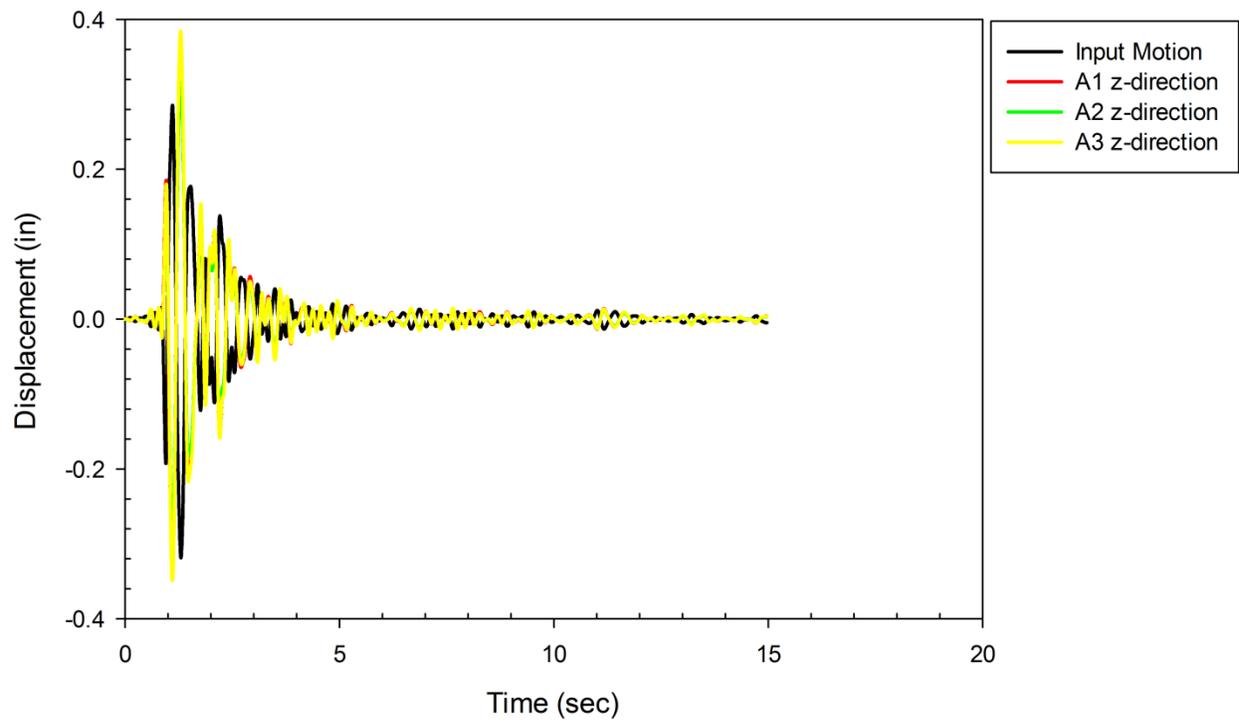
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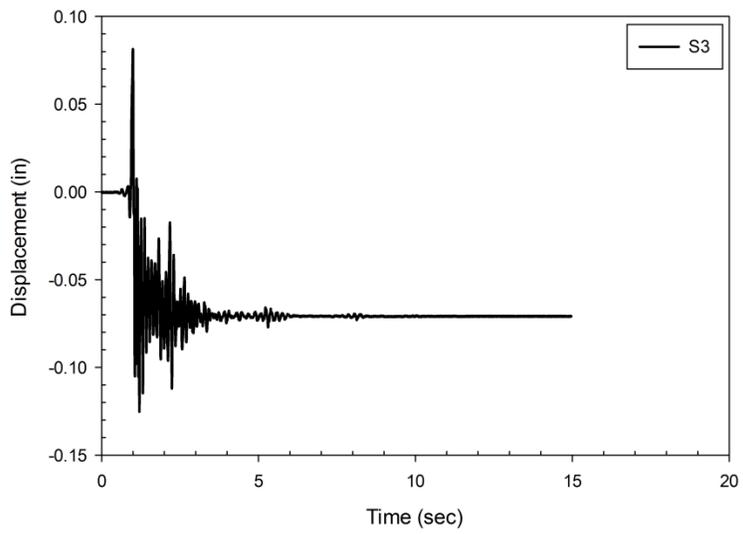
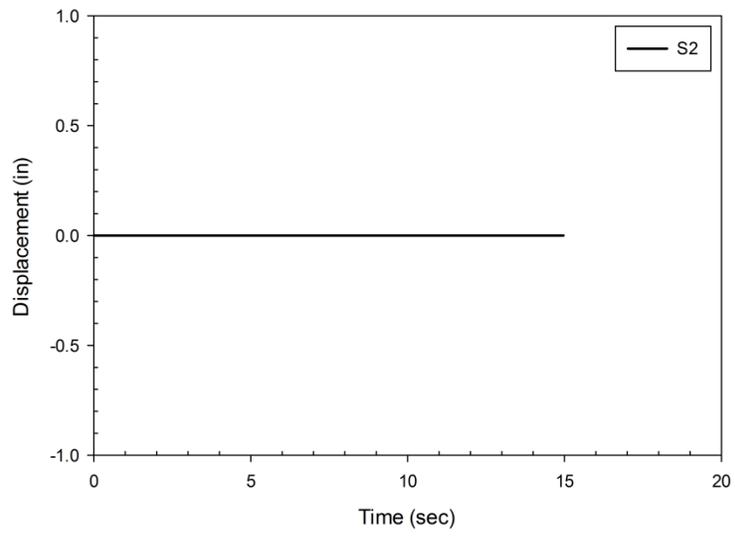
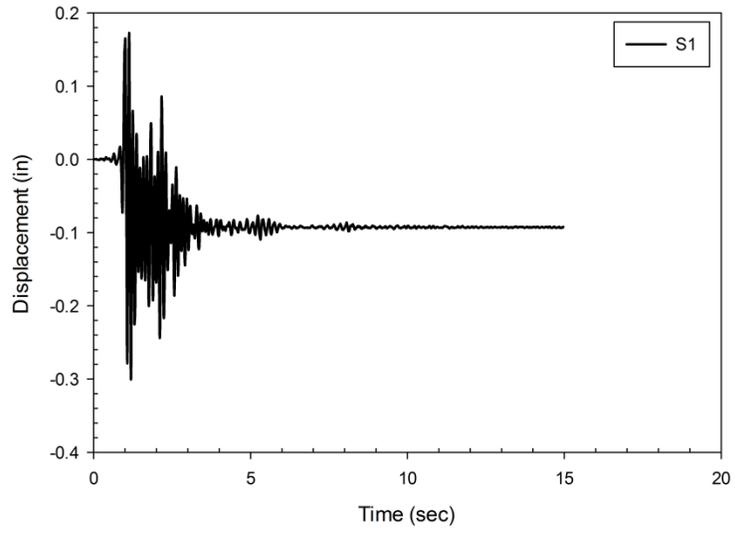


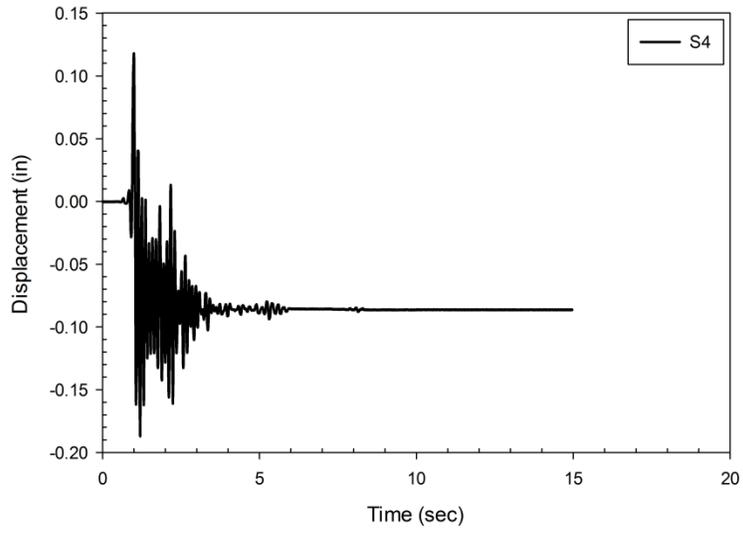








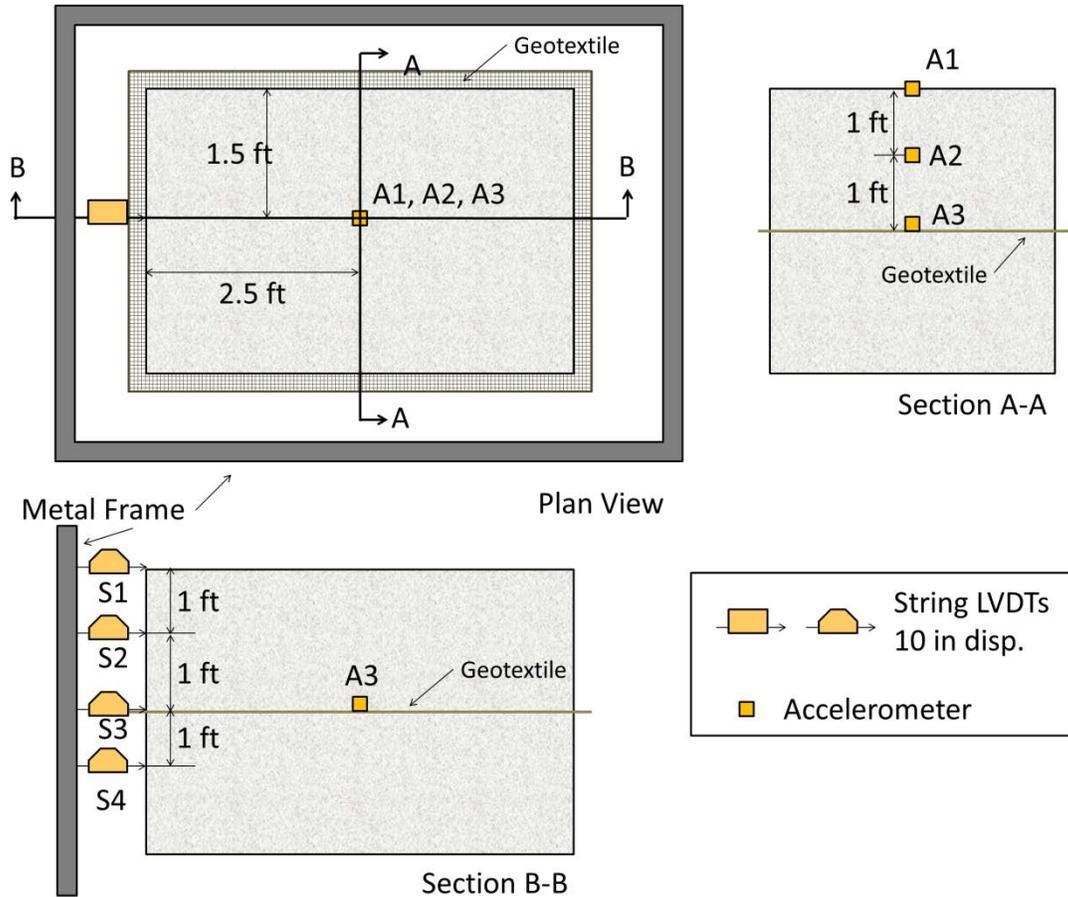


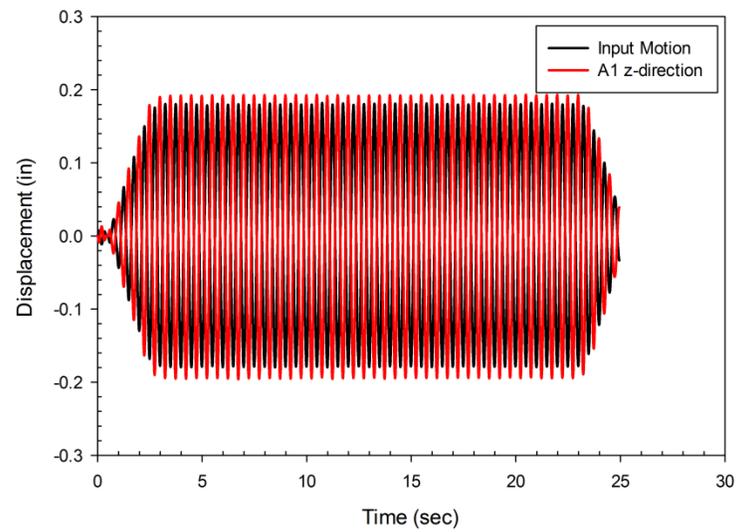
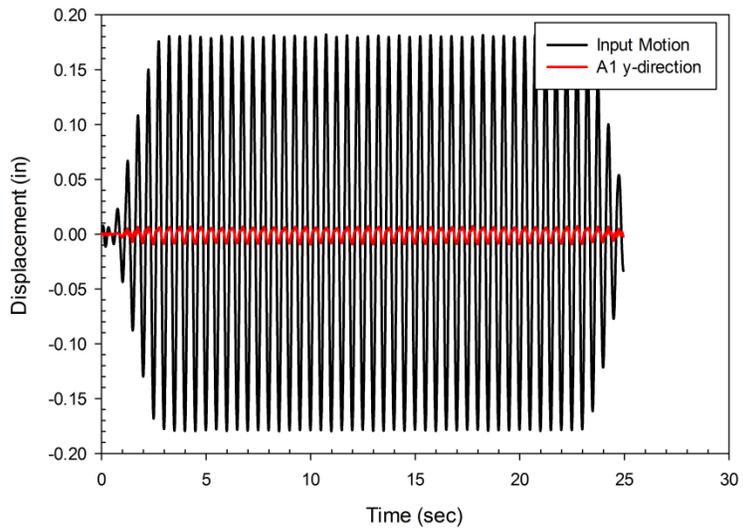
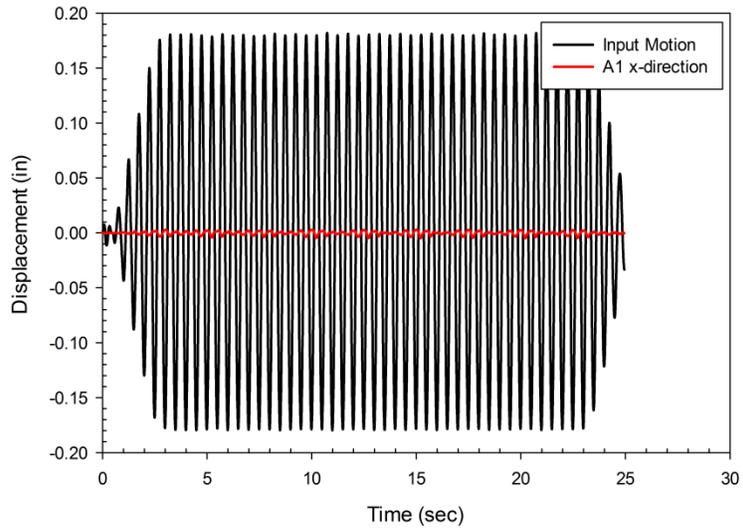


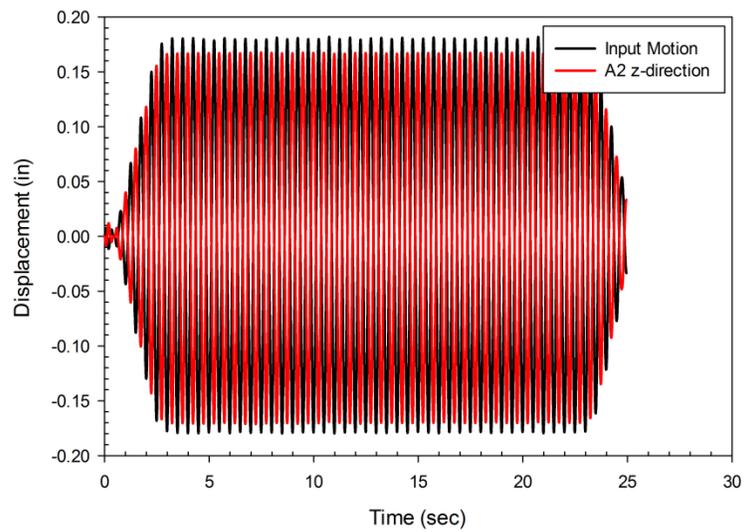
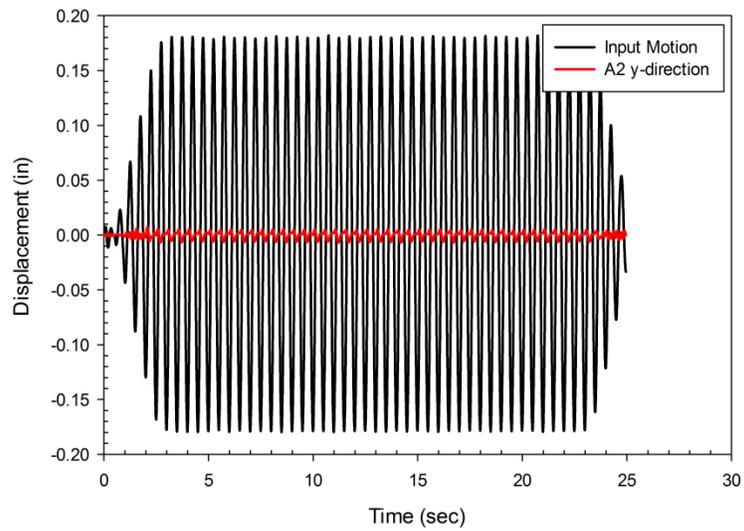
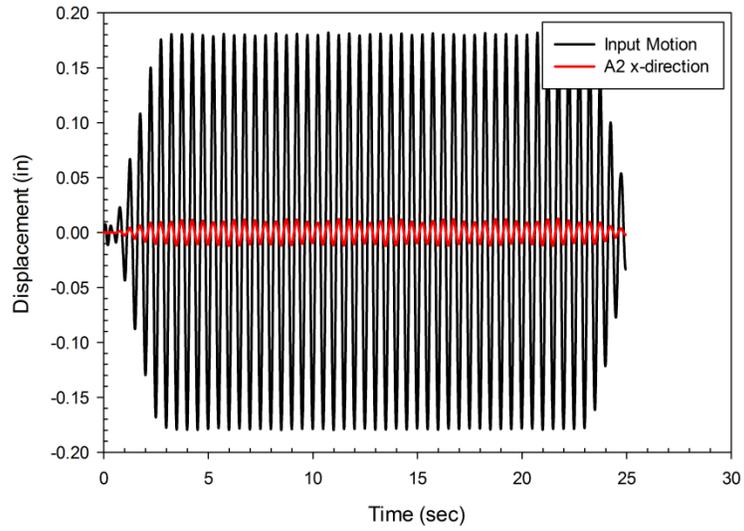
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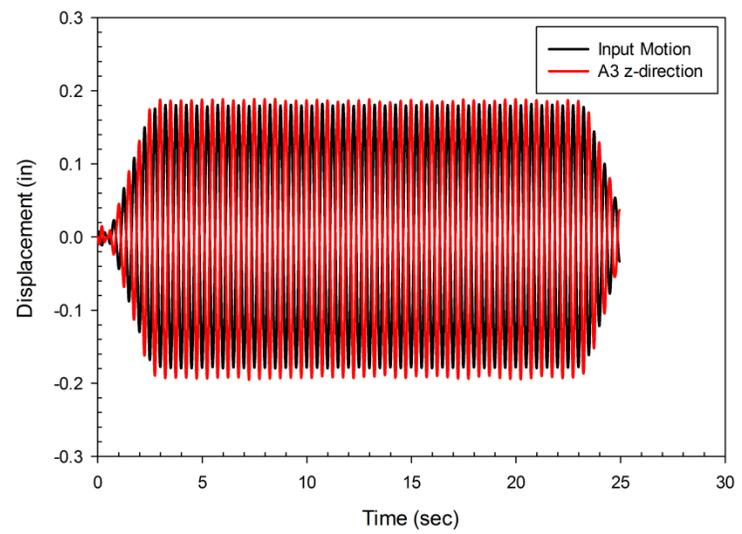
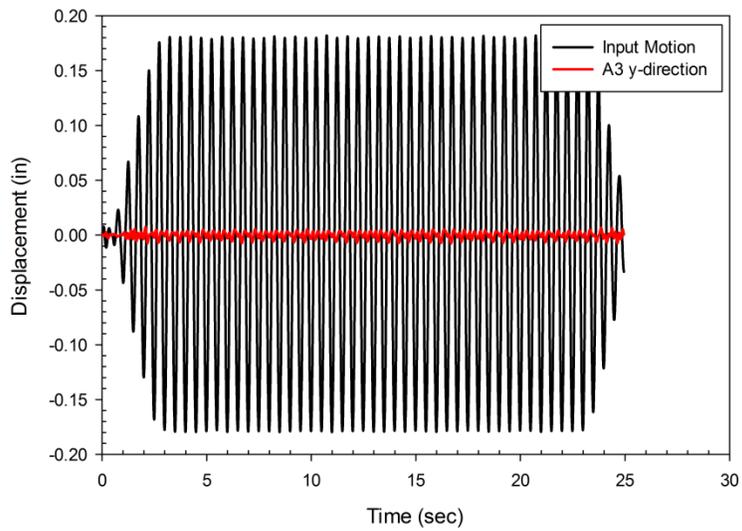
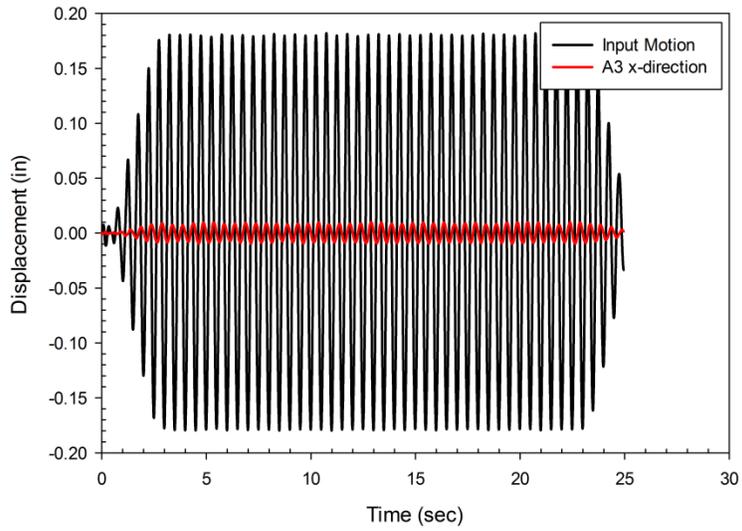


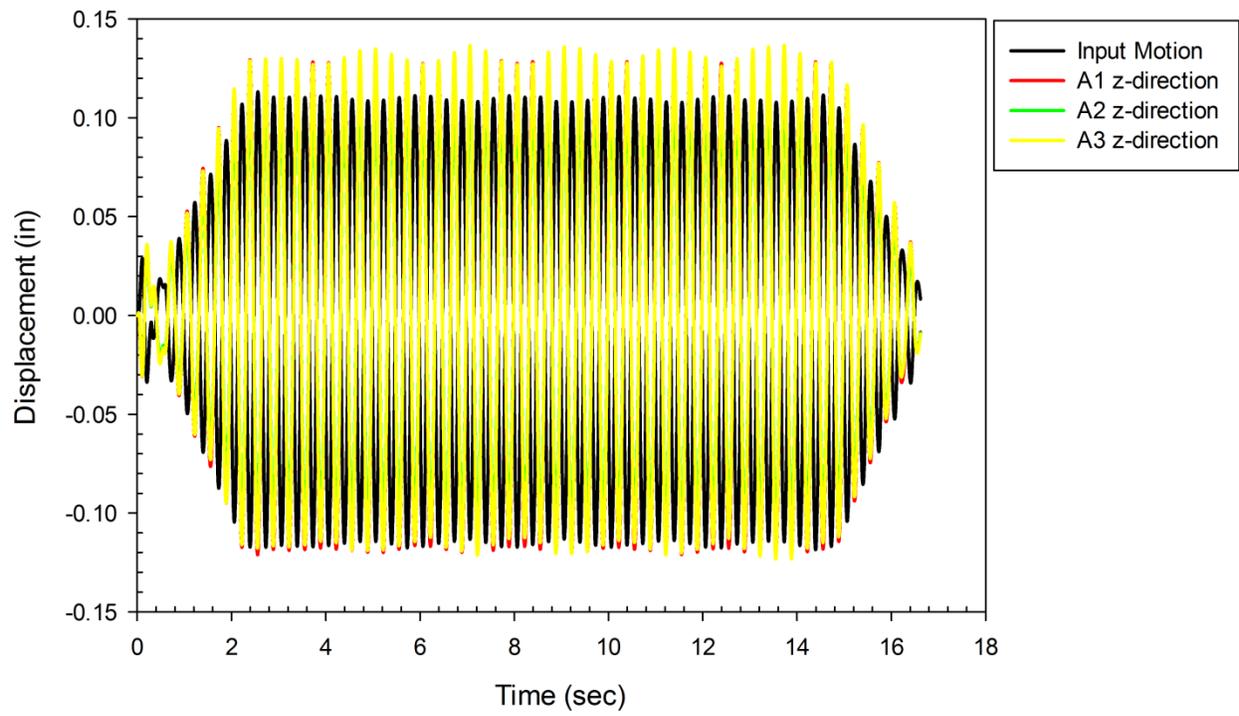
Project:	Cell Crete (Cellular Concrete)	Test Date:	9/14/16
Location:	----	Test No.:	2
Model Size:	3 ft by 5 ft	Vertical Stress:	164.0 psf
Model Height:	4 ft	Geogrid Depth:	2 ft
Motion Type:	Sinusoidal	Characteristics:	0.1g 2Hz

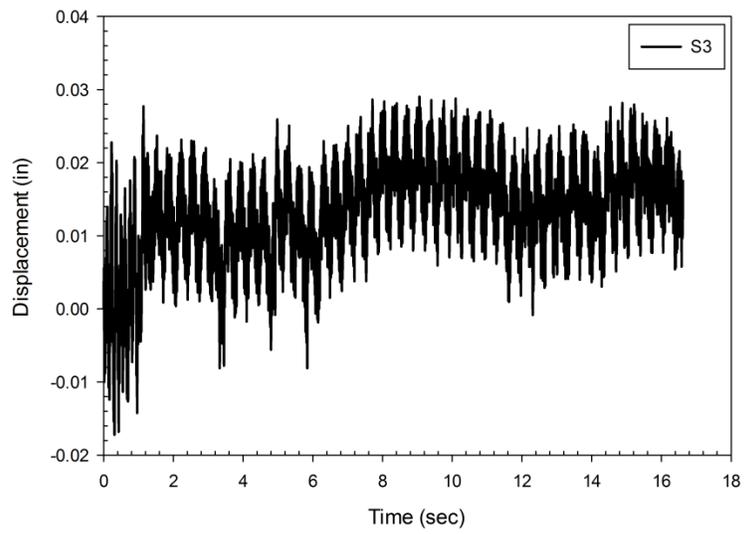
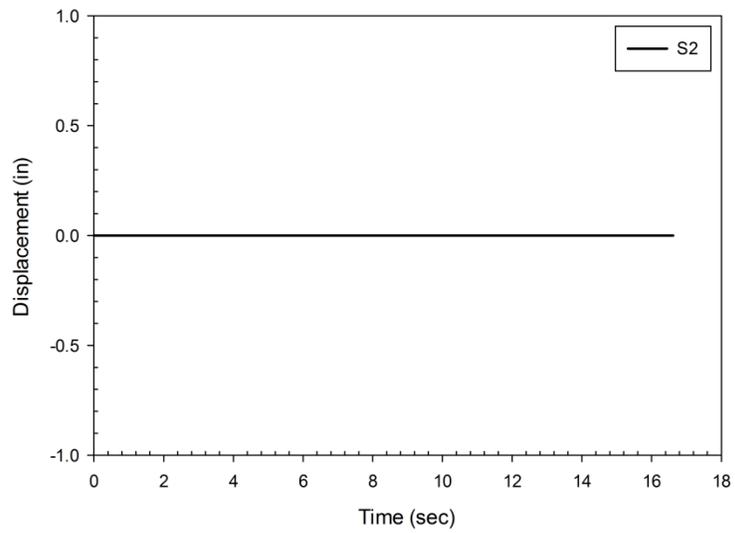
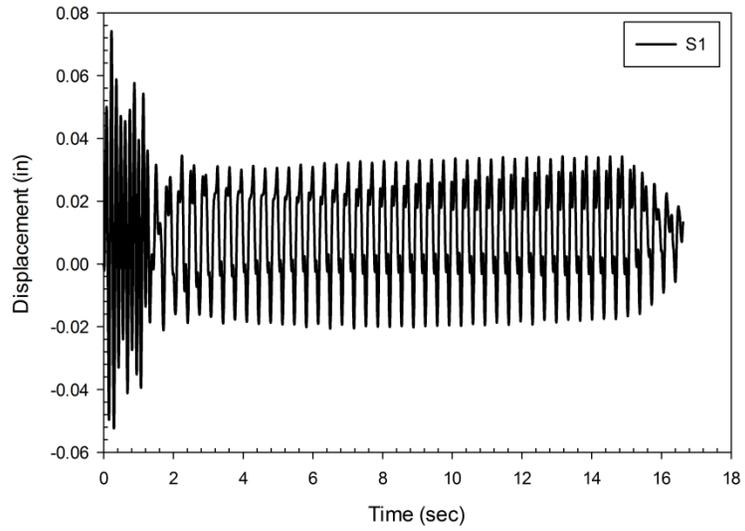


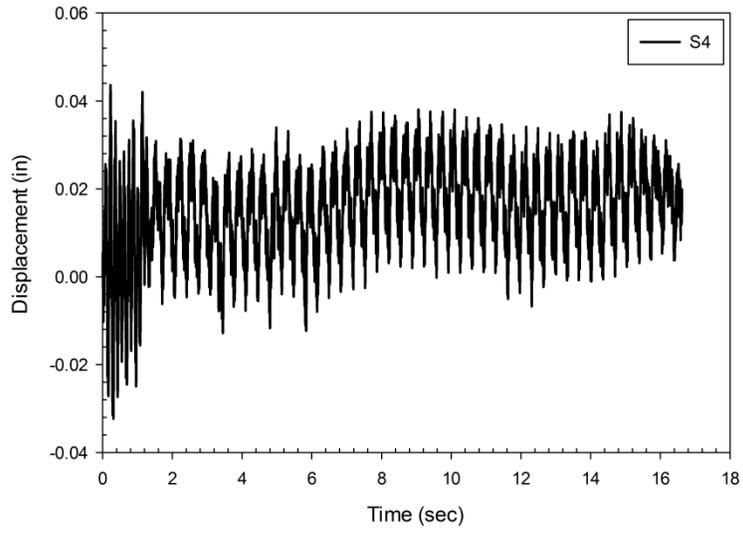








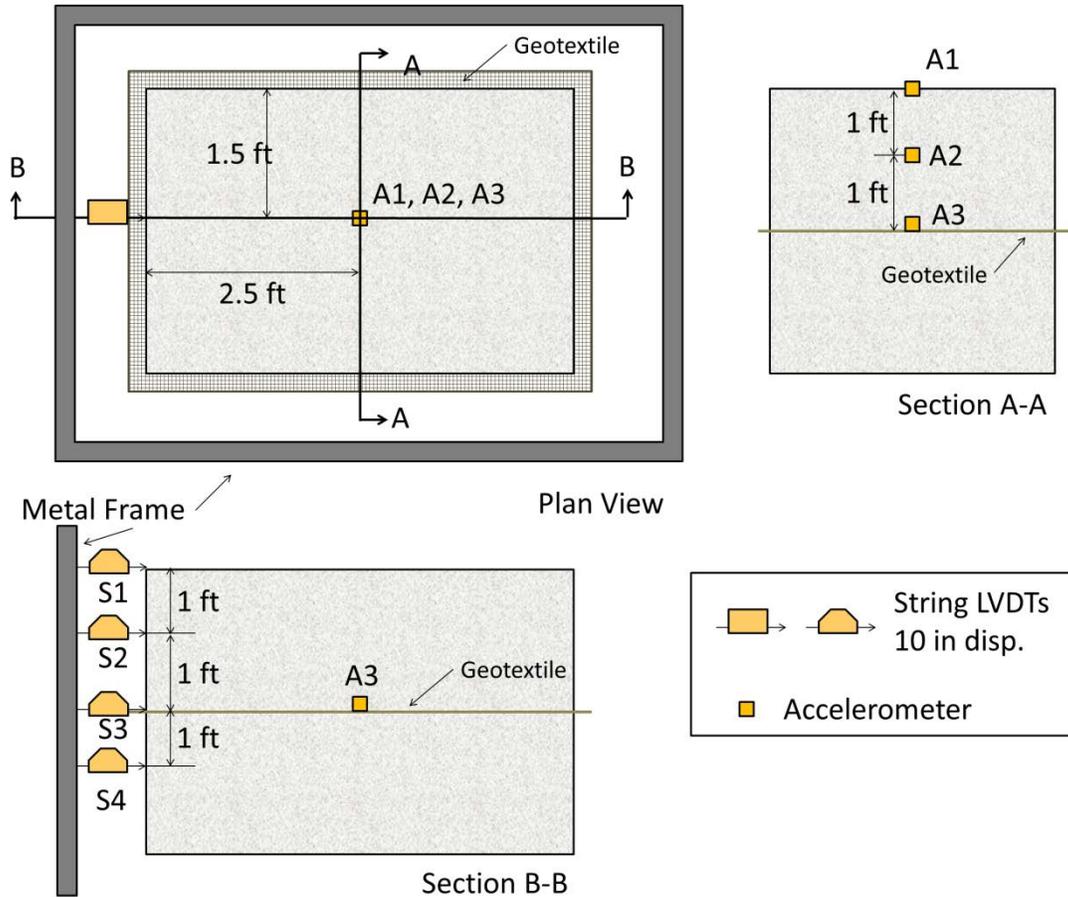


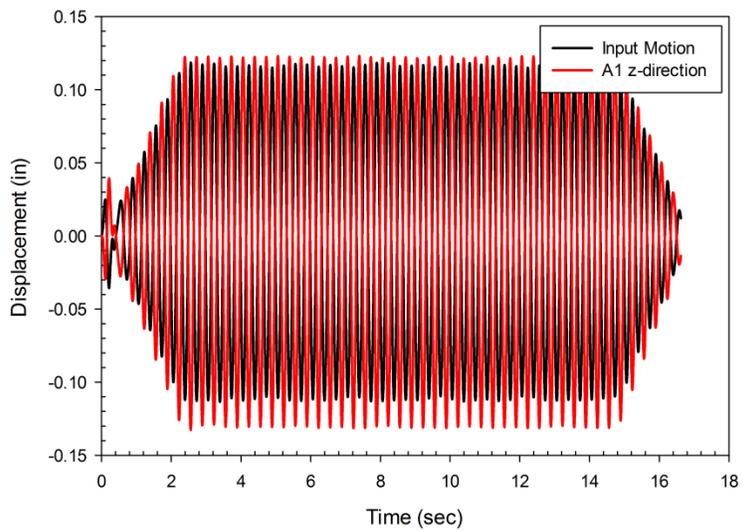
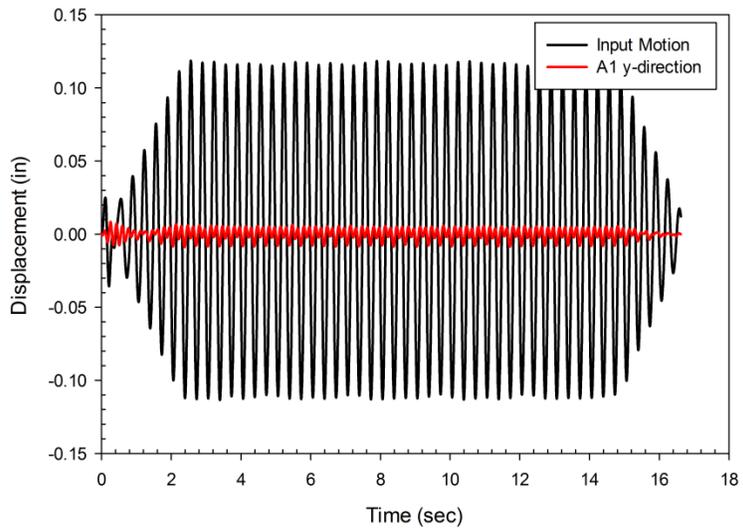
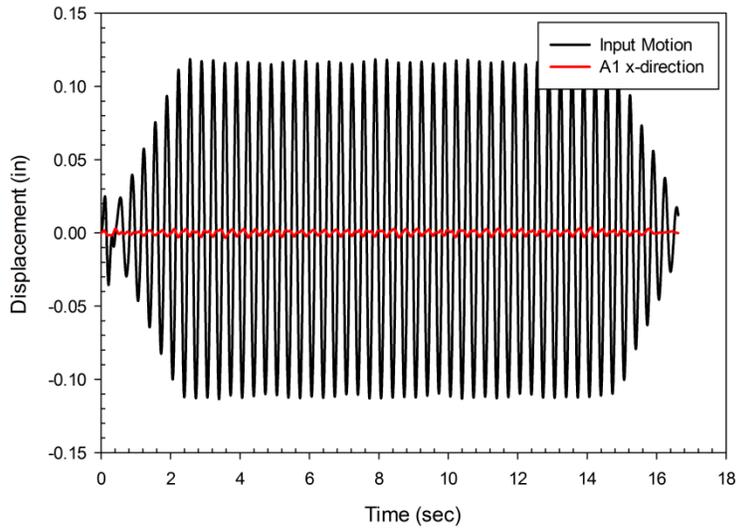


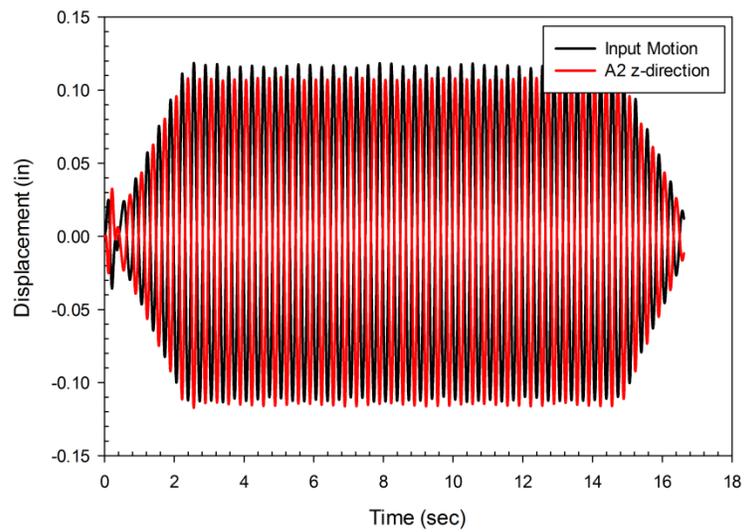
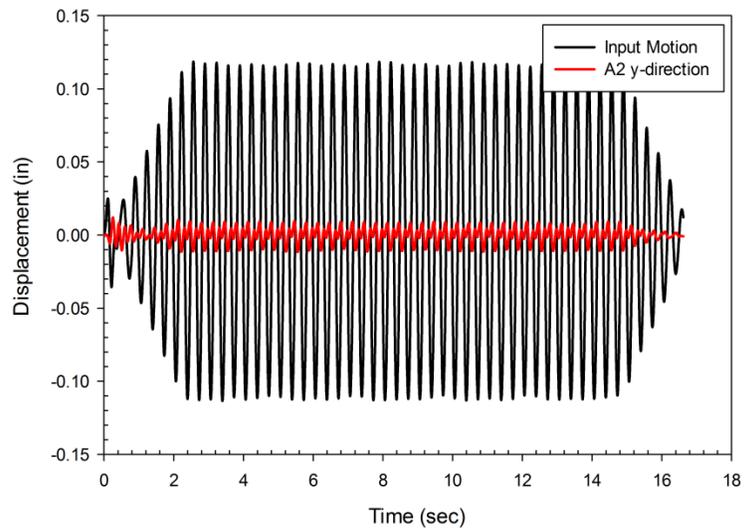
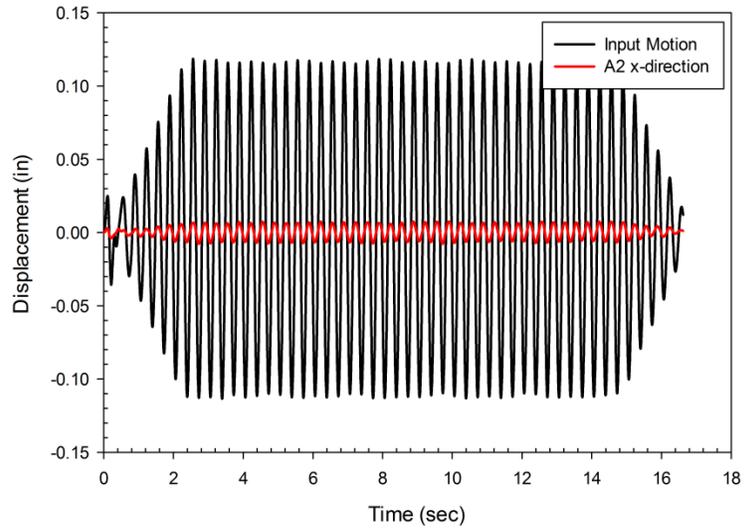
# Shake Table Test

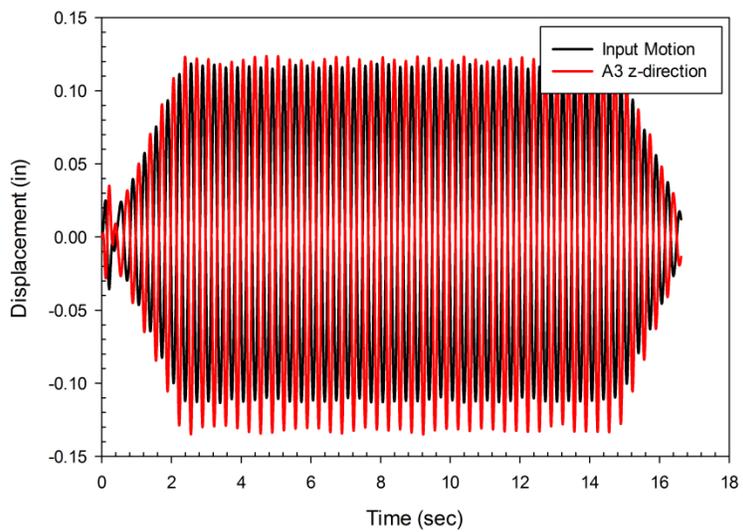
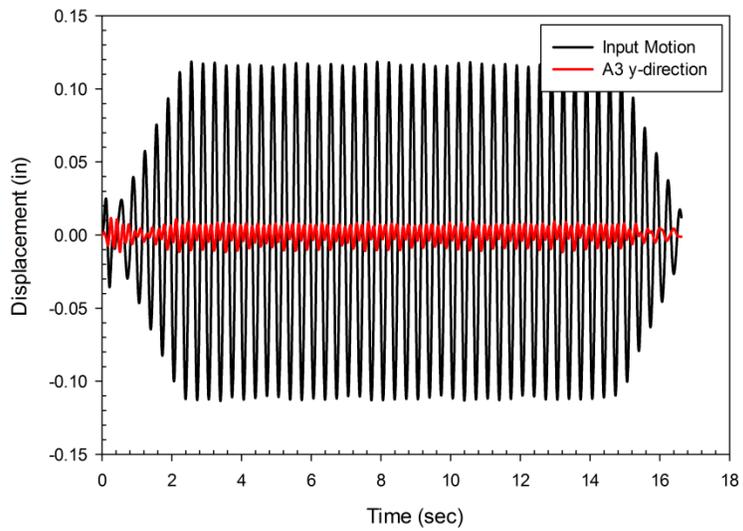
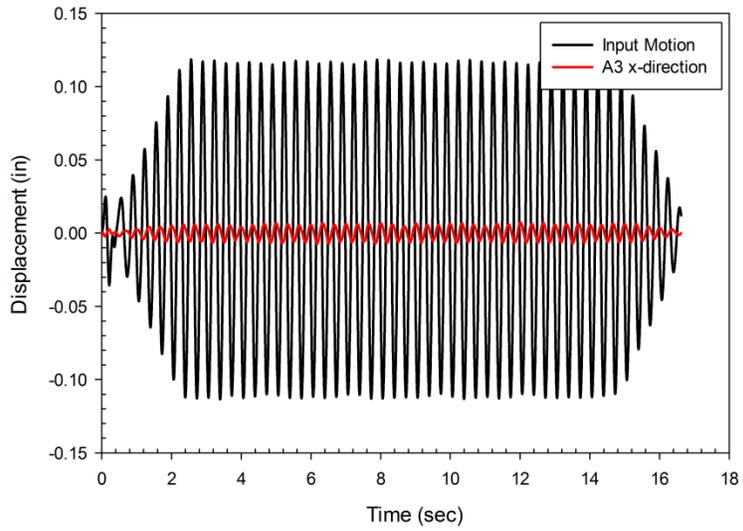


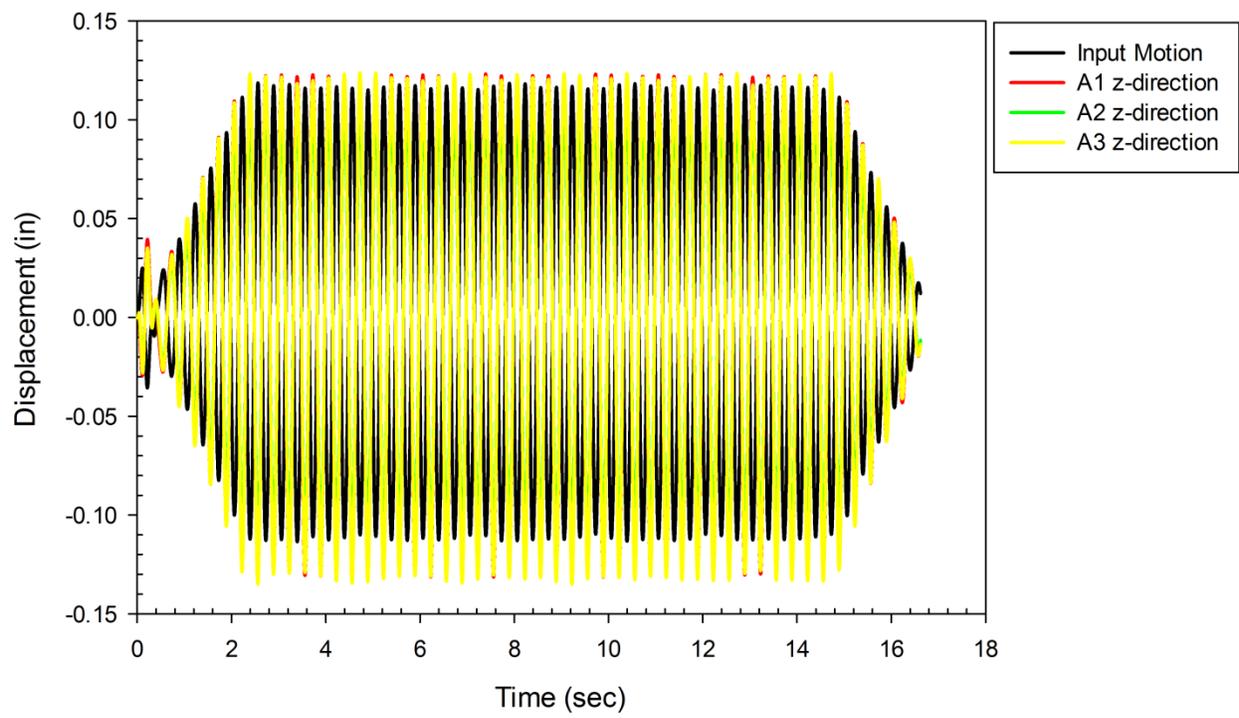
Project:	Cell Crete (Cellular Concrete)	Test Date:	9/14/16
Location:	----	Test No.:	2
Model Size:	3 ft by 5 ft	Vertical Stress:	164.0 psf
Model Height:	4 ft	Geogrid Depth:	2 ft
Motion Type:	Sinusoidal	Characteristics:	0.1g 3Hz

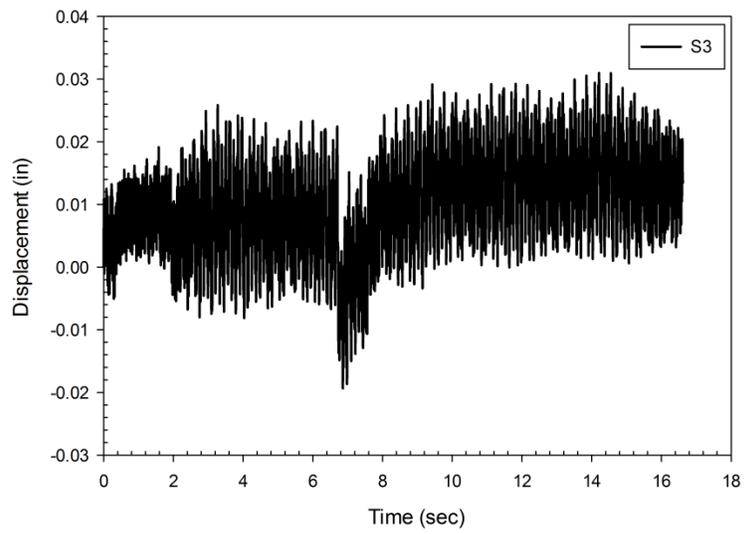
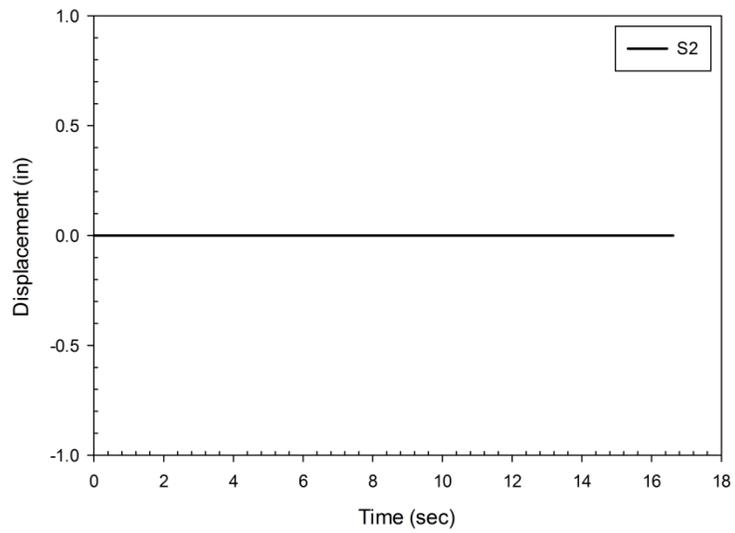
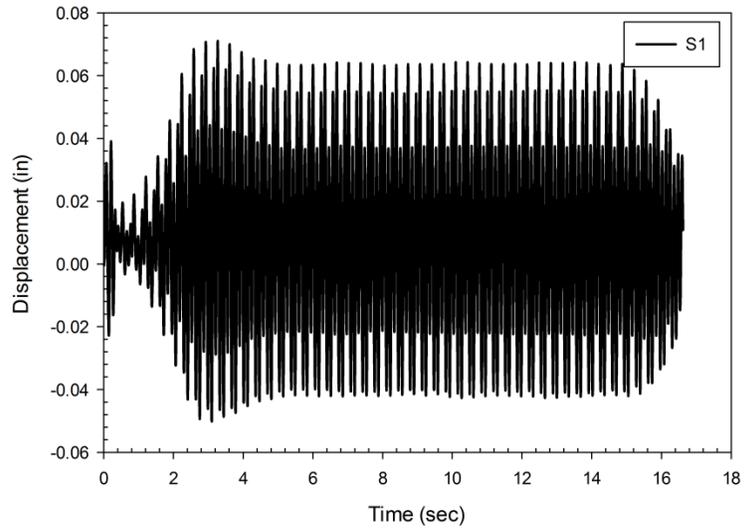


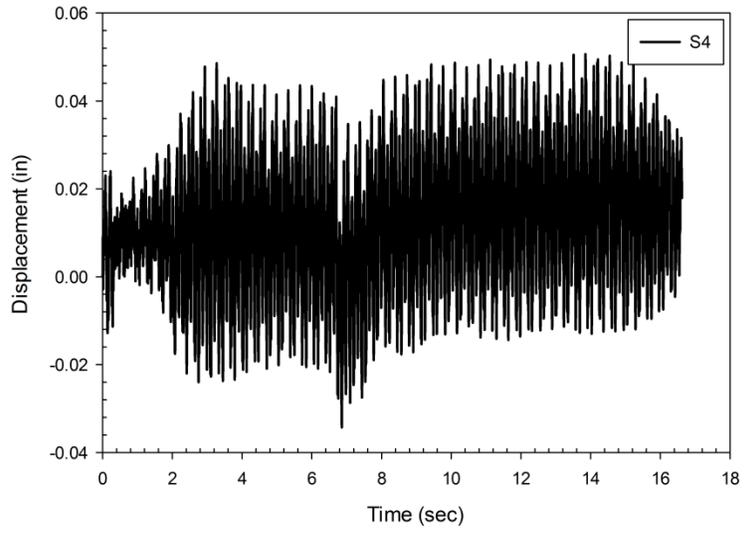








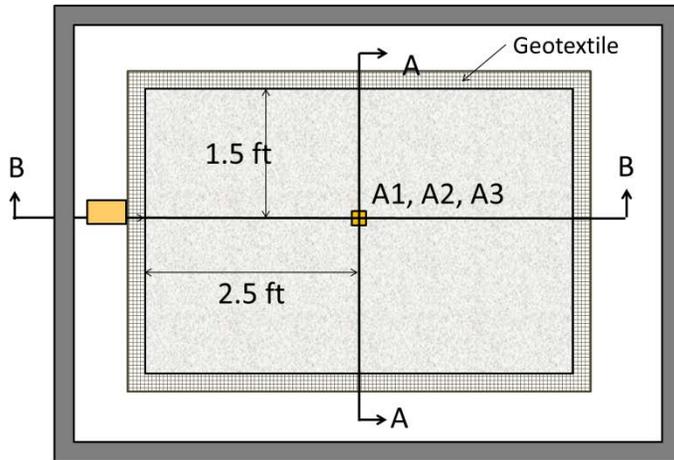




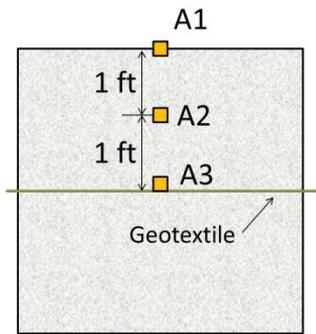
# Shake Table Test



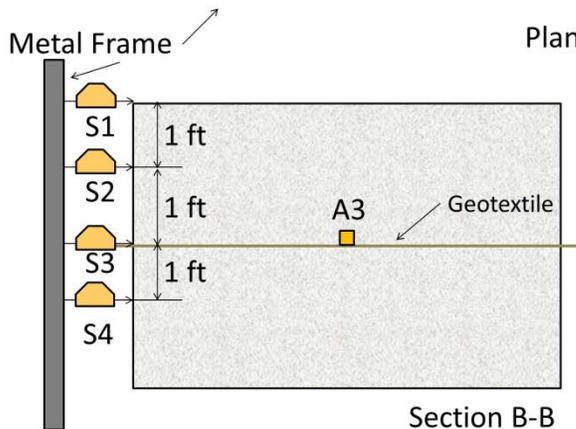
Project:	Cell Crete (Cellular Concrete)	Test Date:	9/14/16
Location:	----	Test No.:	2
Model Size:	3 ft by 5 ft	Vertical Stress:	164.0 psf
Model Height:	4 ft	Geogrid Depth:	2 ft
Motion Type:	Sinusoidal	Characteristics:	0.2g 2Hz



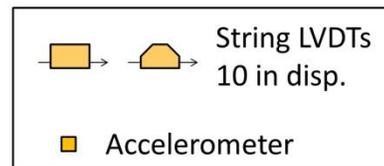
Plan View

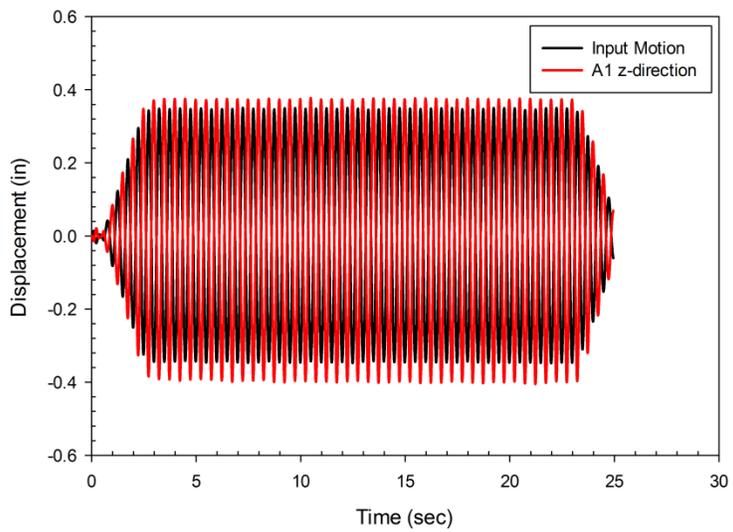
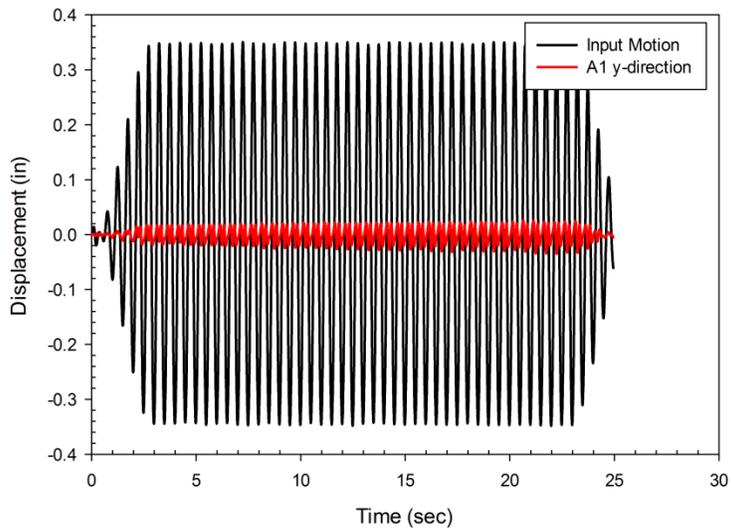
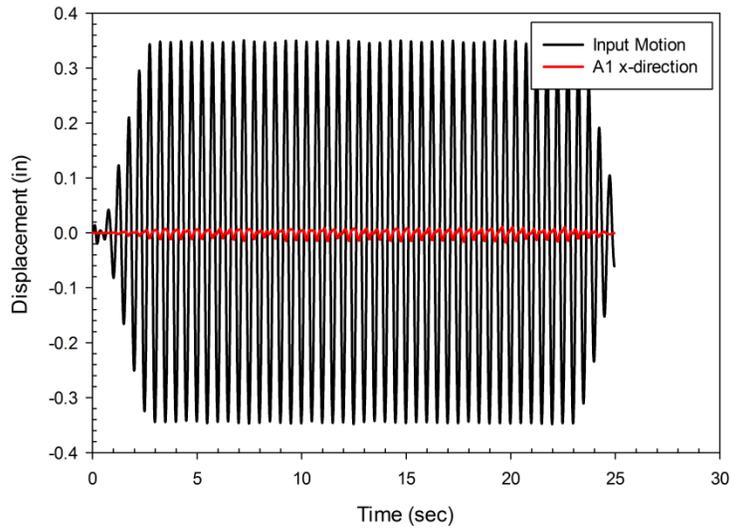


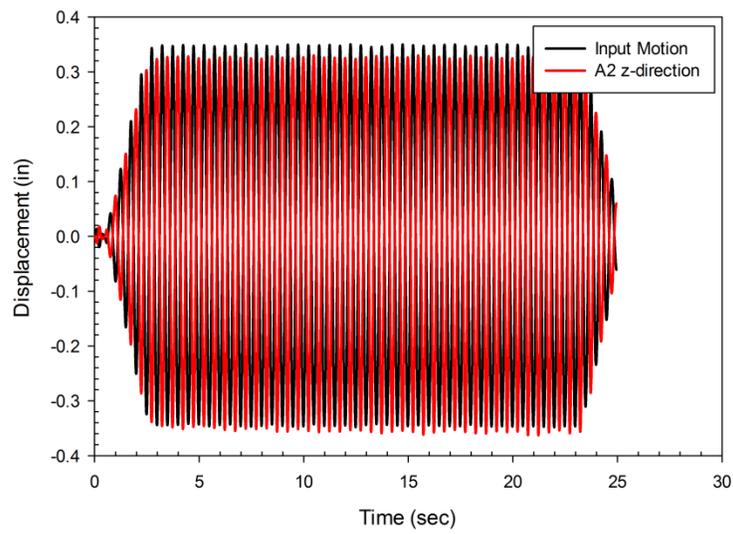
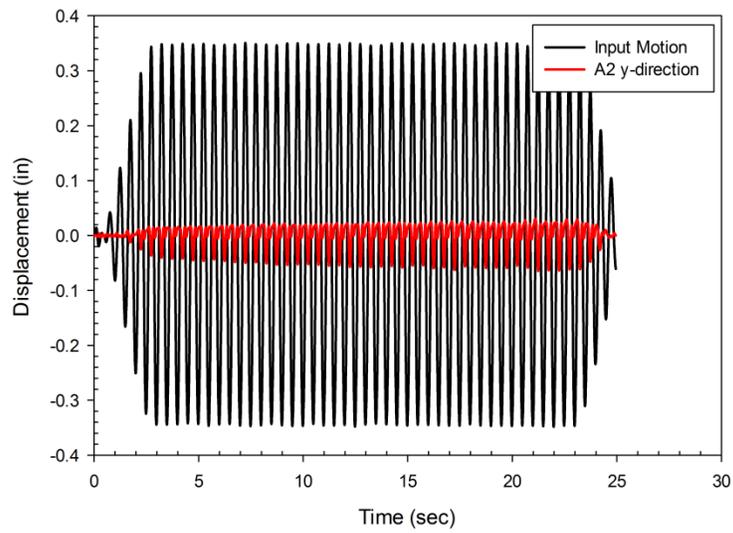
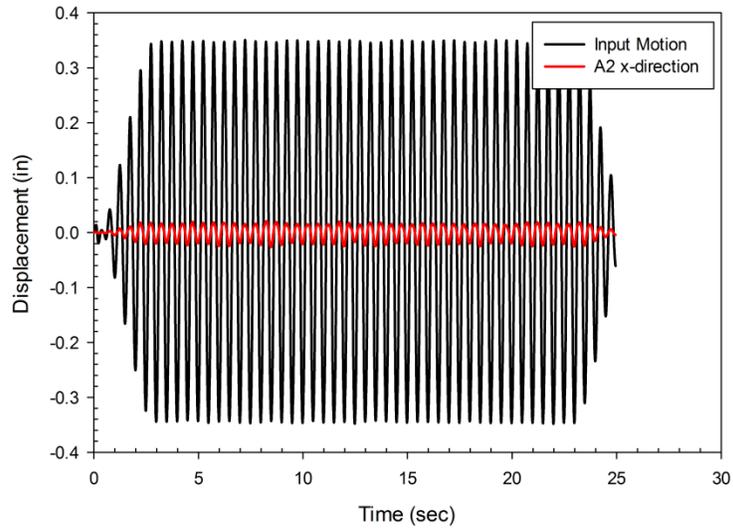
Section A-A

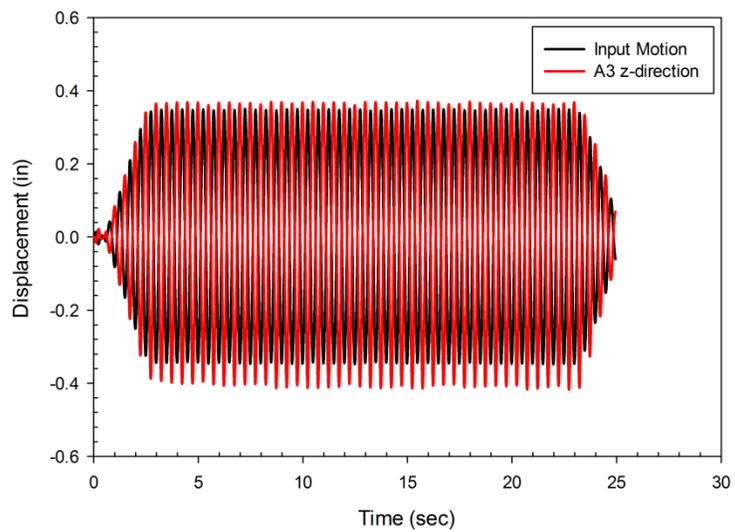
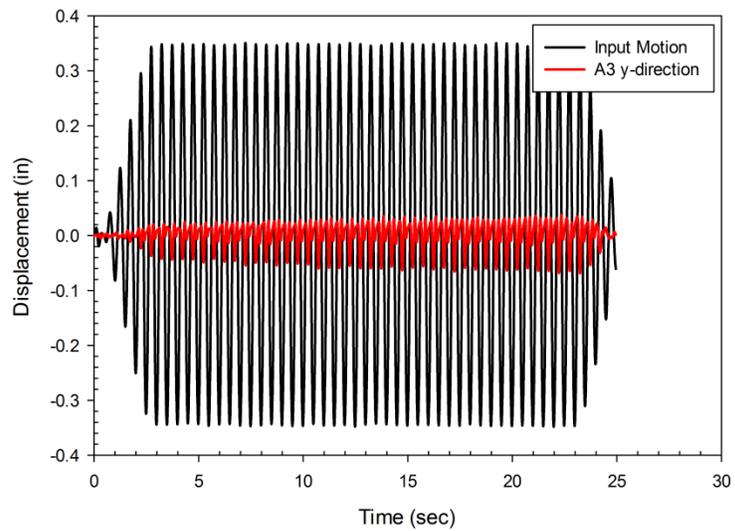
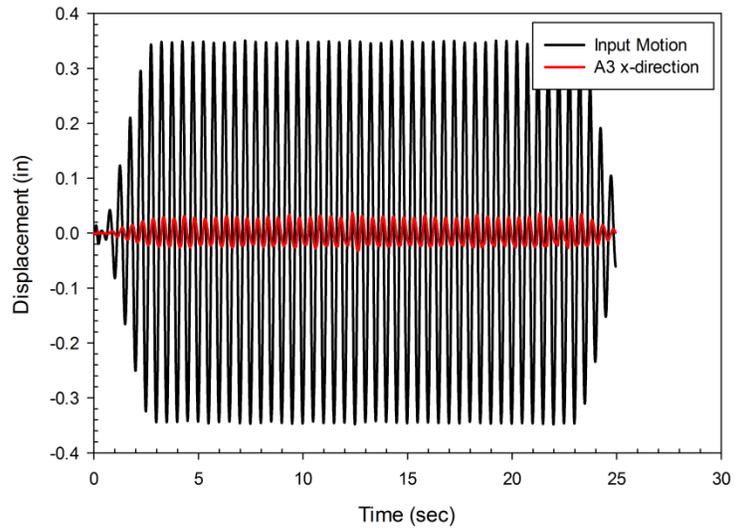


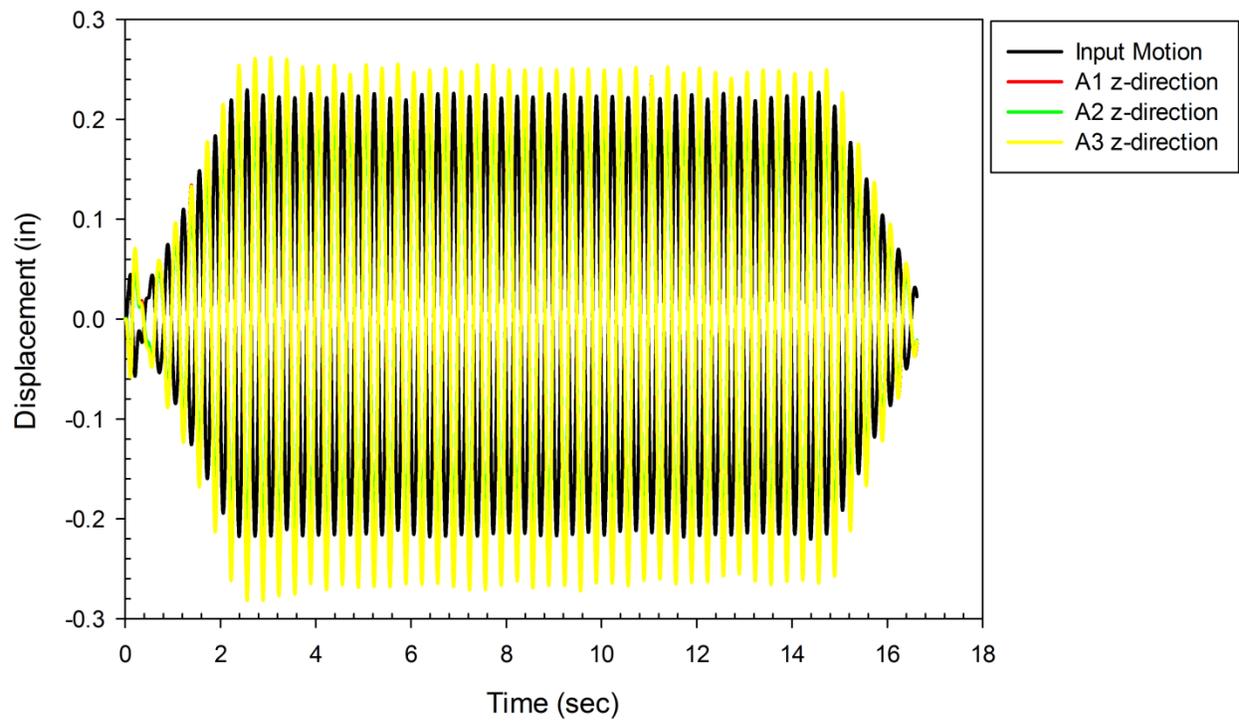
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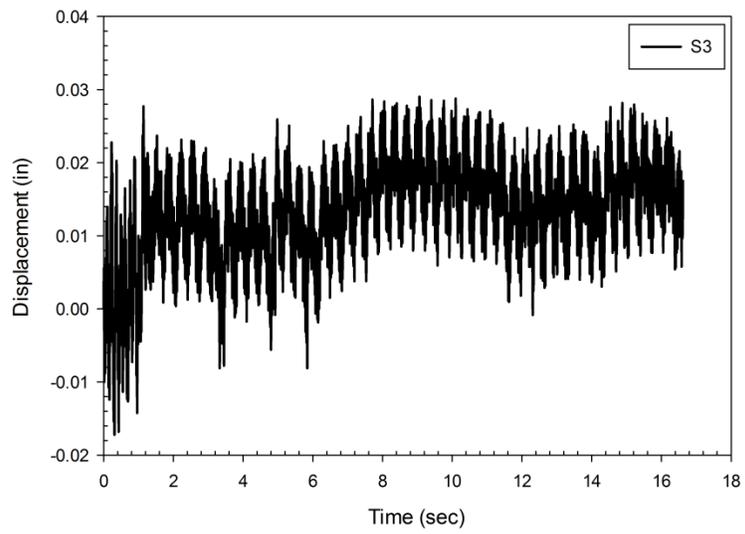
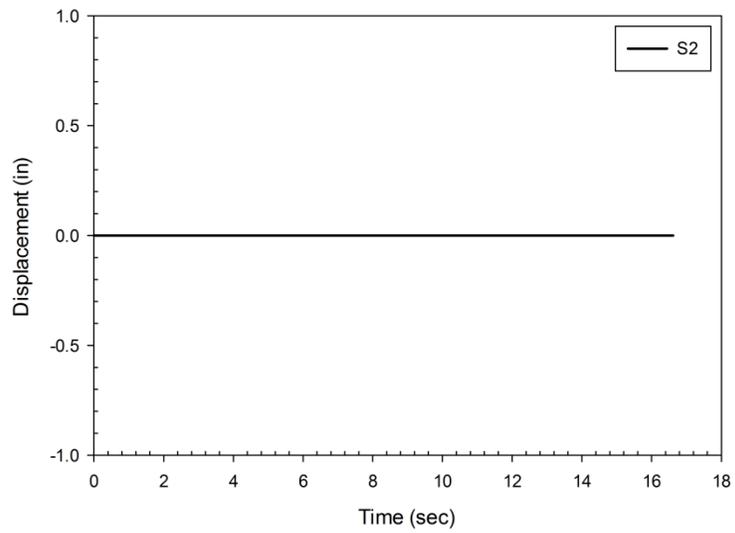
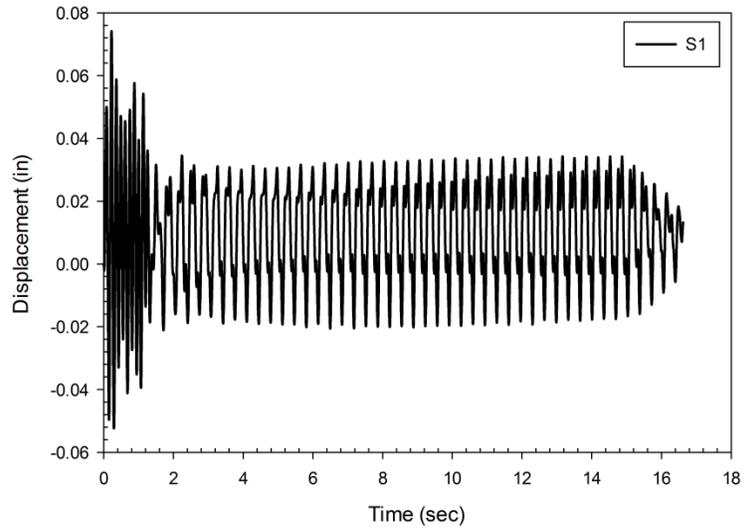


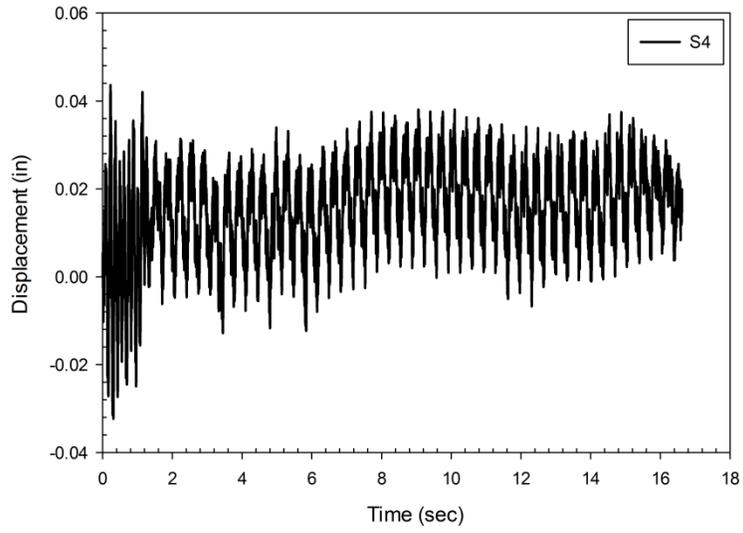








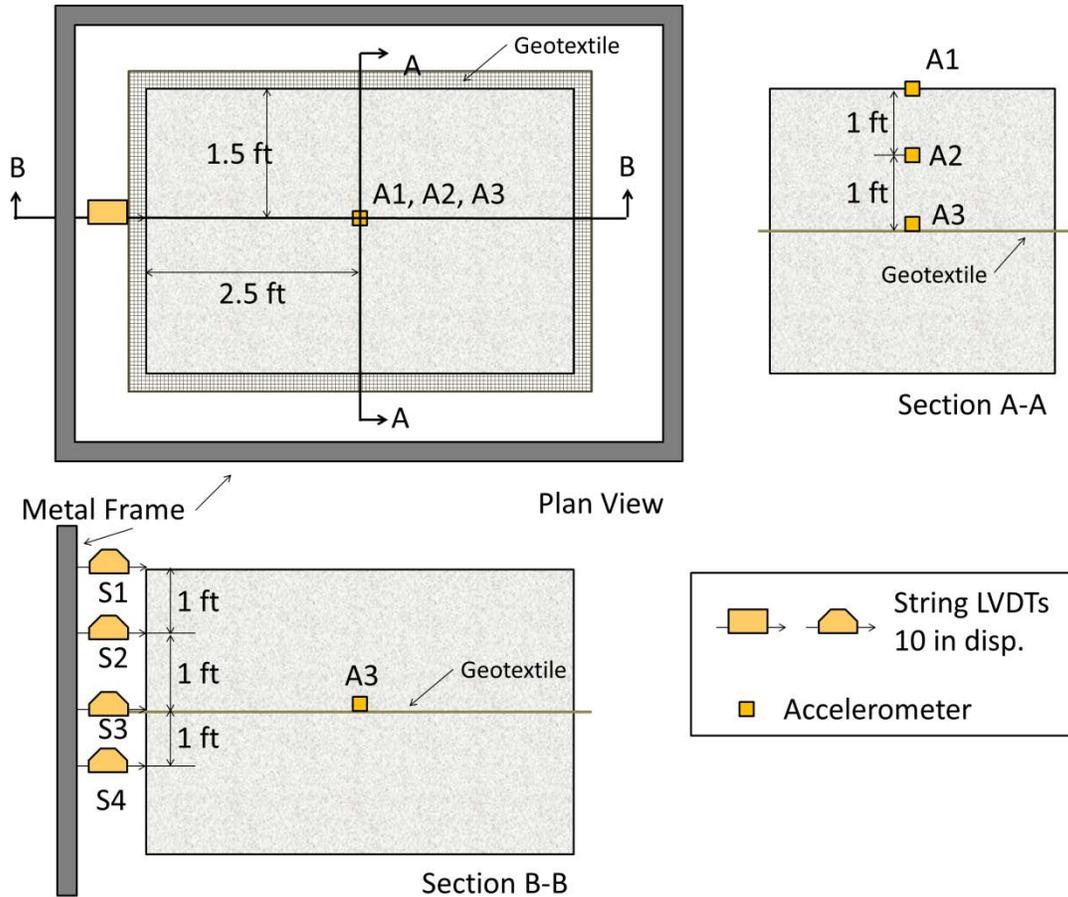


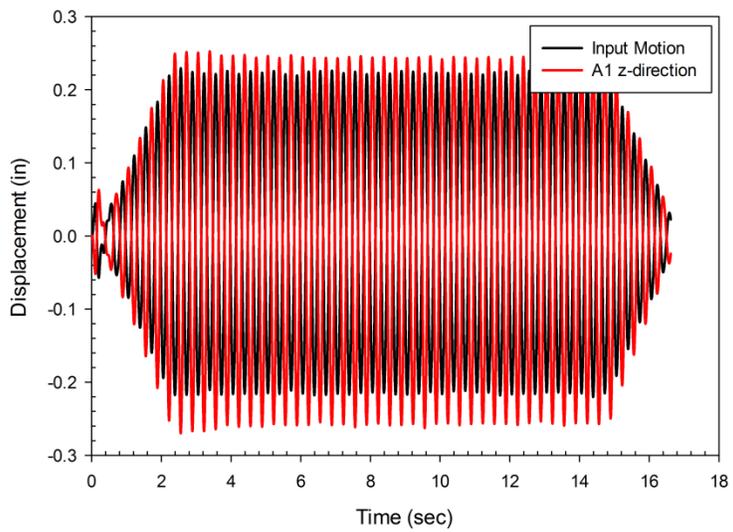
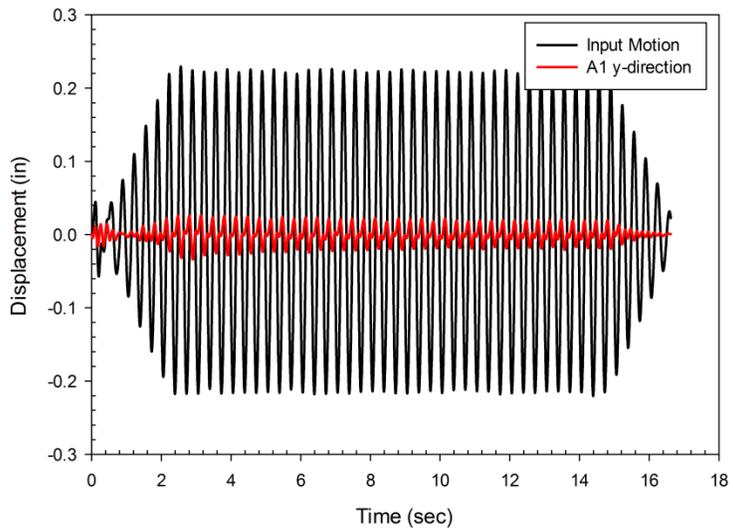
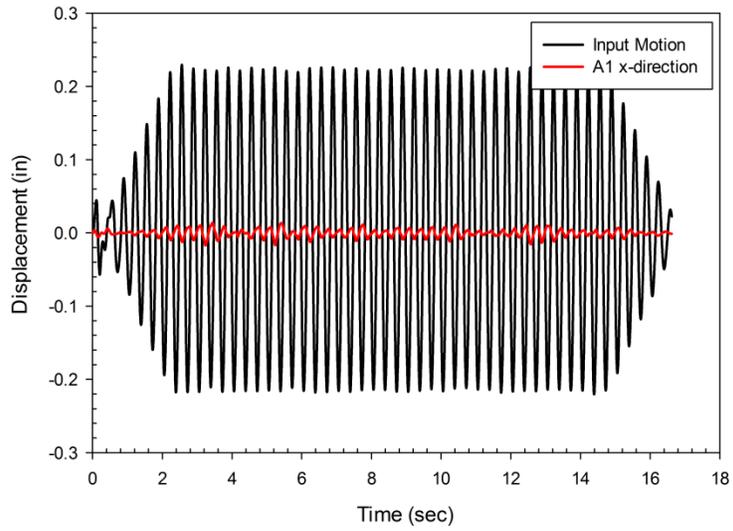


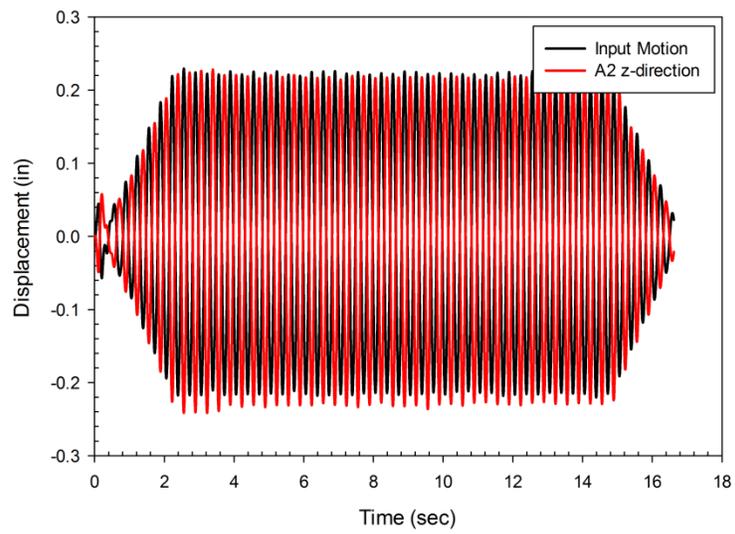
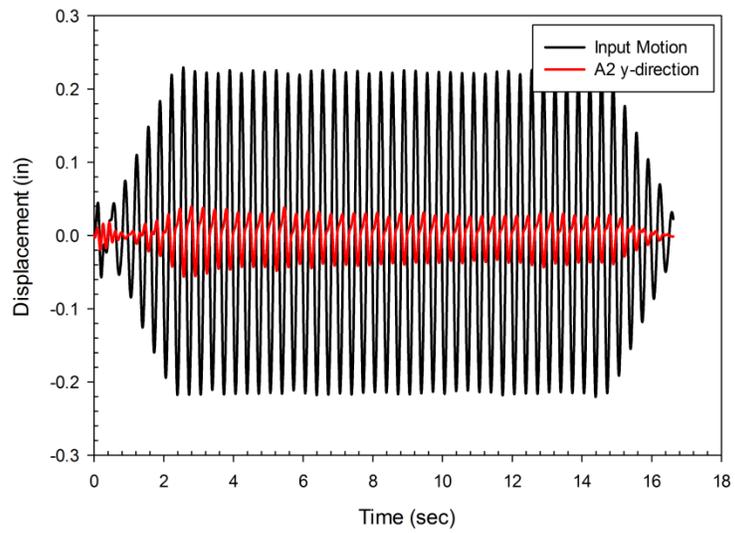
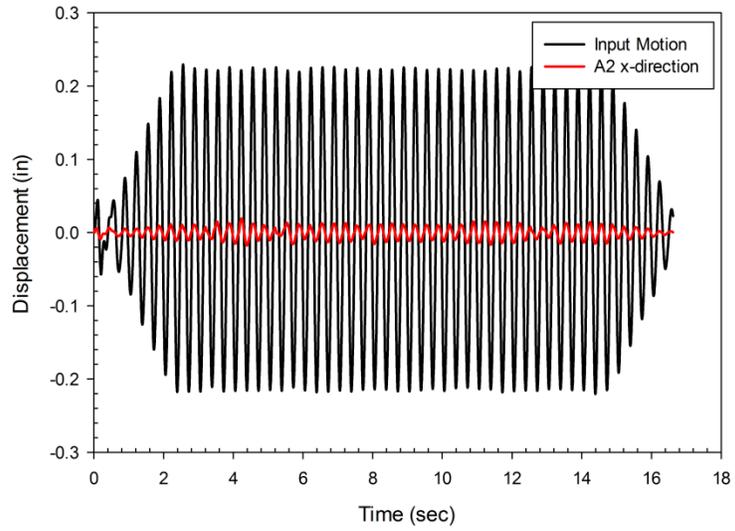
# Shake Table Test

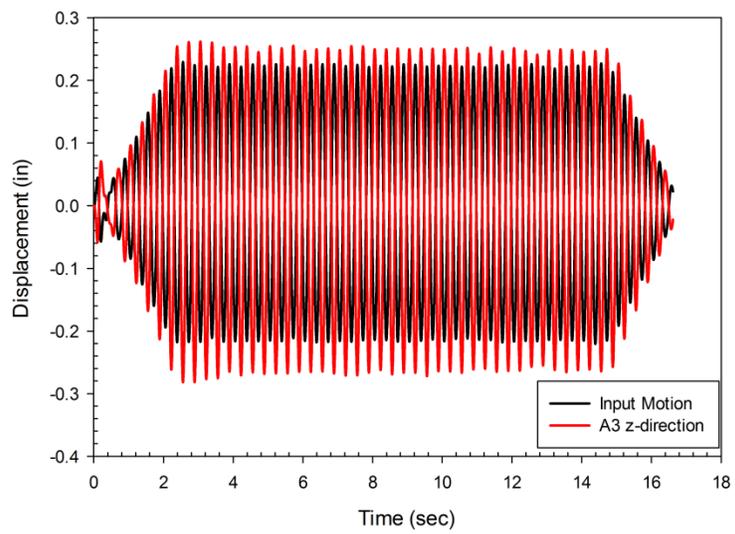
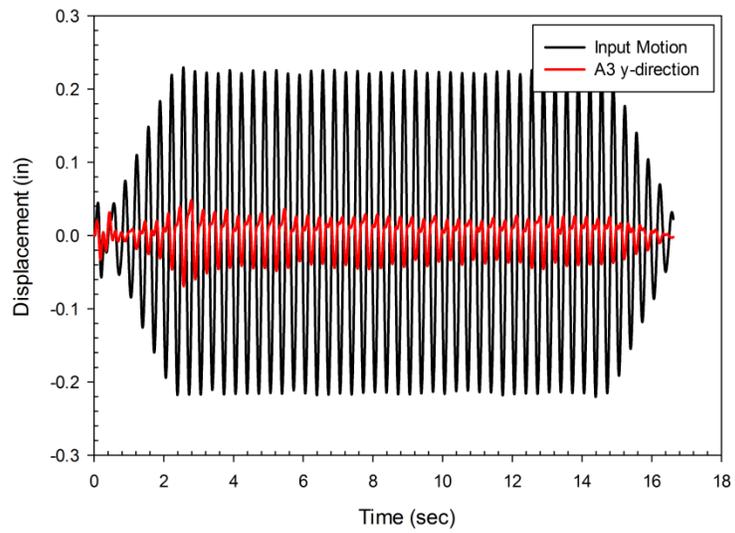
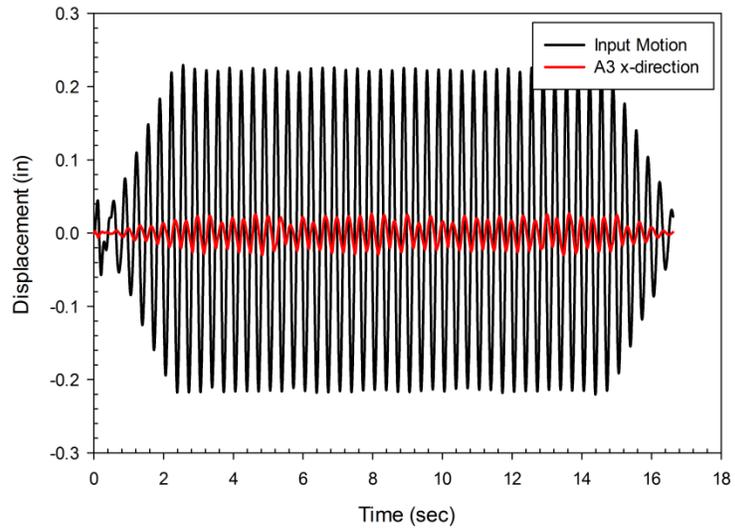


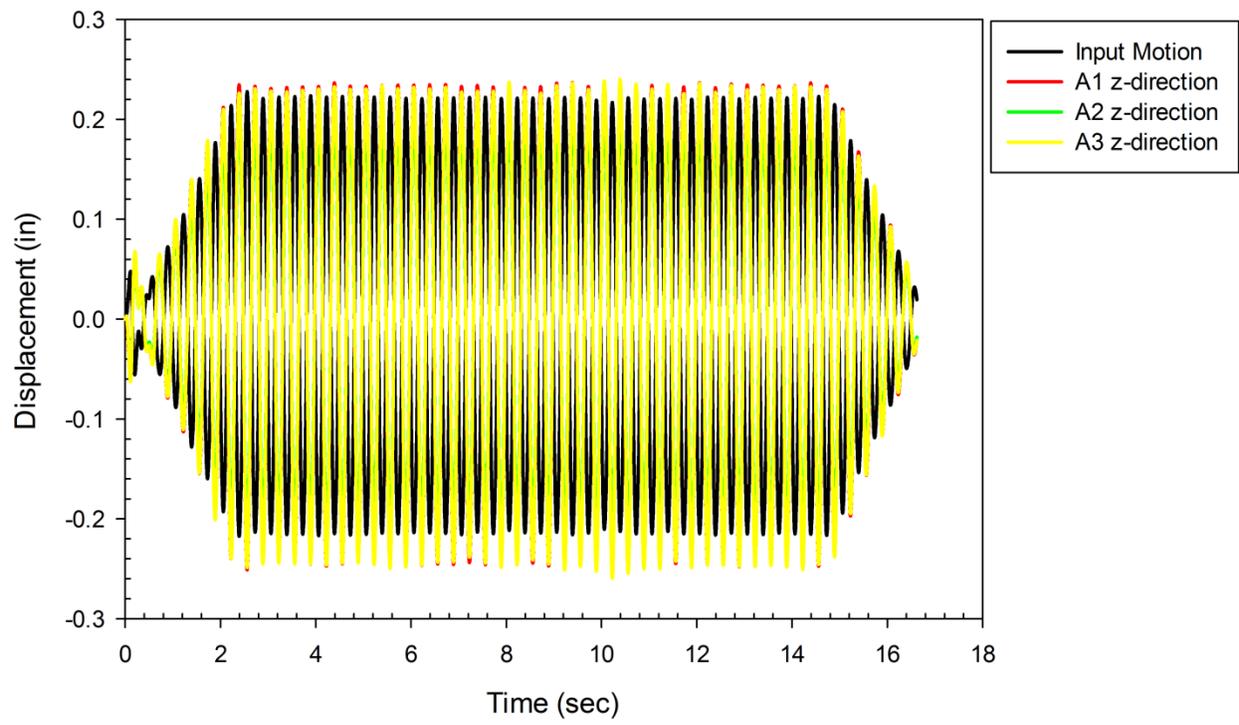
Project:	Cell Crete (Cellular Concrete)	Test Date:	9/14/16
Location:	----	Test No.:	2
Model Size:	3 ft by 5 ft	Vertical Stress:	164.0 psf
Model Height:	4 ft	Geogrid Depth:	2 ft
Motion Type:	Sinusoidal	Characteristics:	0.2g 3Hz

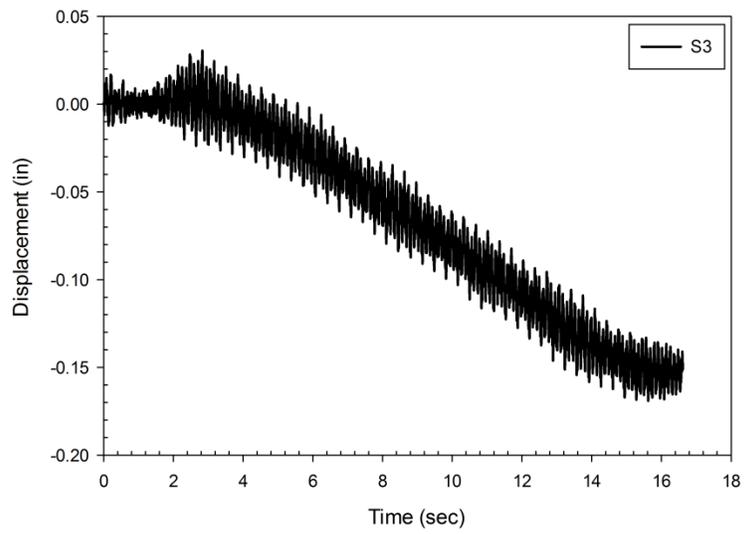
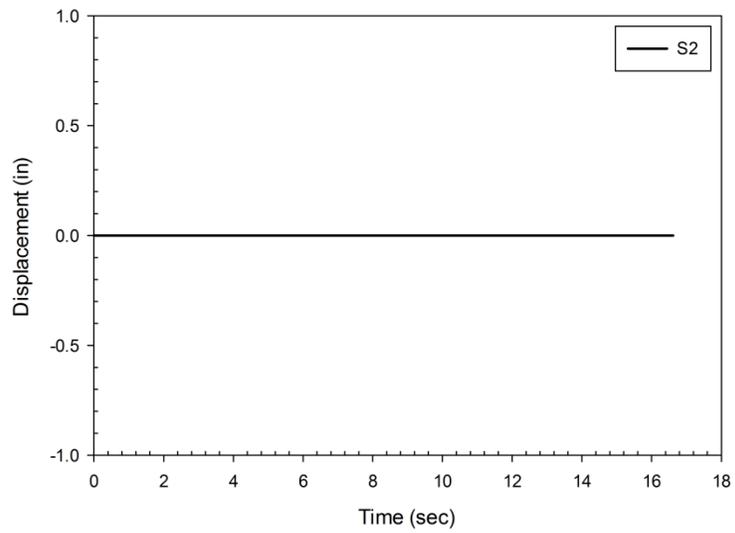
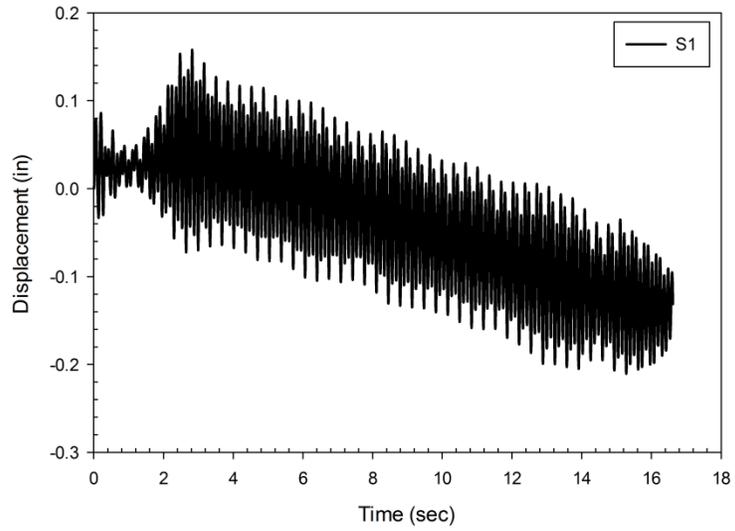


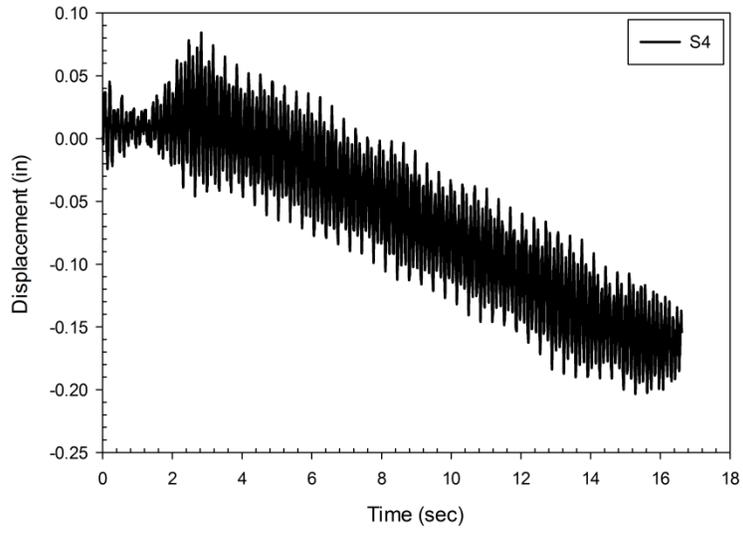








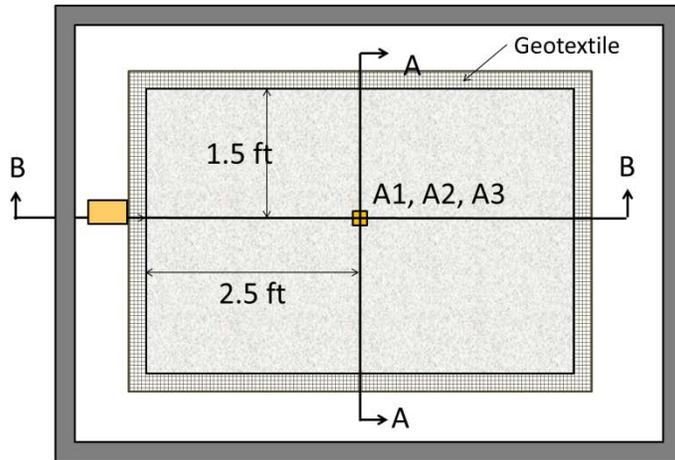




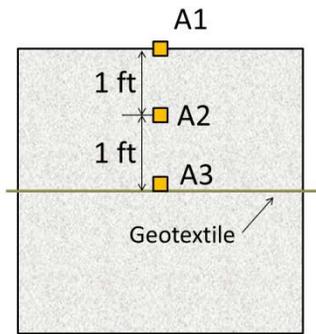
# Shake Table Test



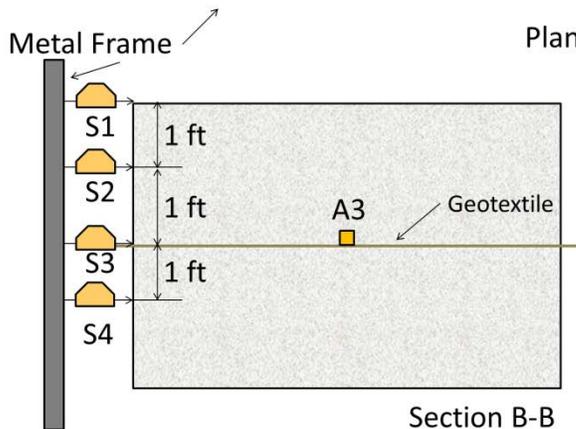
Project:	Cell Crete (Cellular Concrete)	Test Date:	9/14/16
Location:	----	Test No.:	2
Model Size:	3 ft by 5 ft	Vertical Stress:	164.0 psf
Model Height:	4 ft	Geogrid Depth:	2 ft
Motion Type:	1994 Northridge Earthquake	Characteristics:	N/A



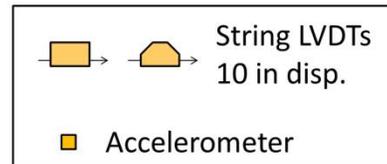
Plan View

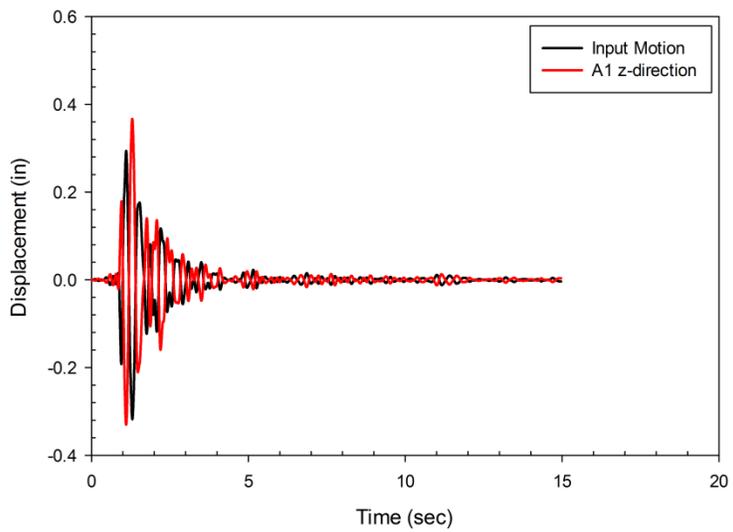
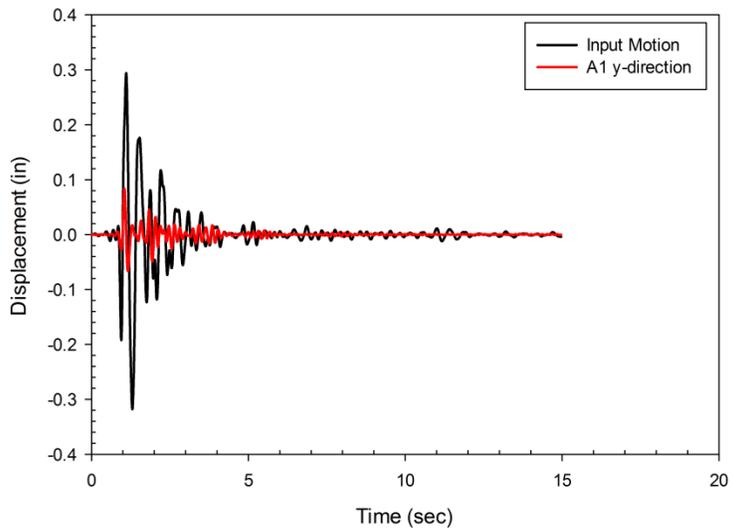
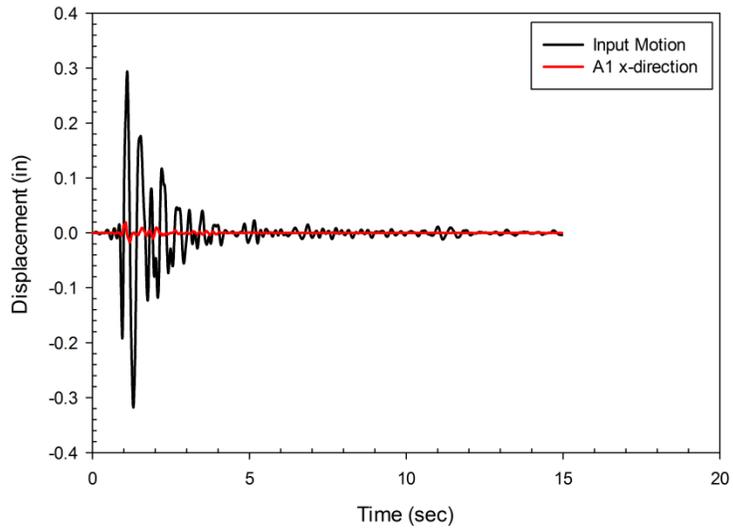


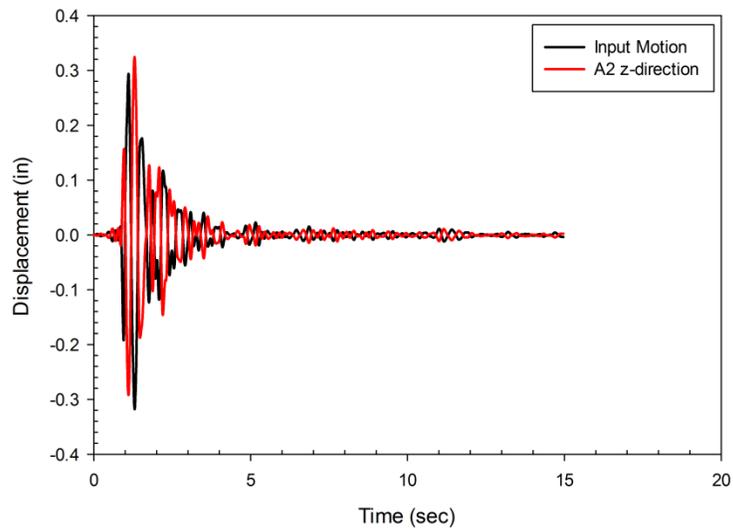
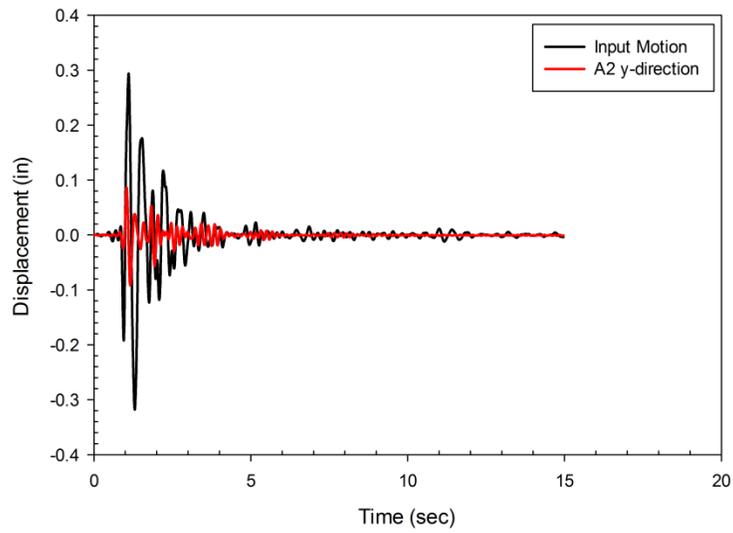
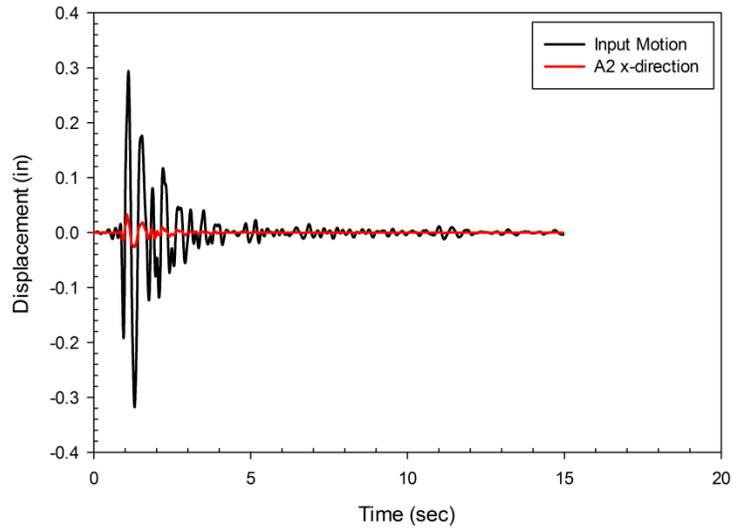
Section A-A

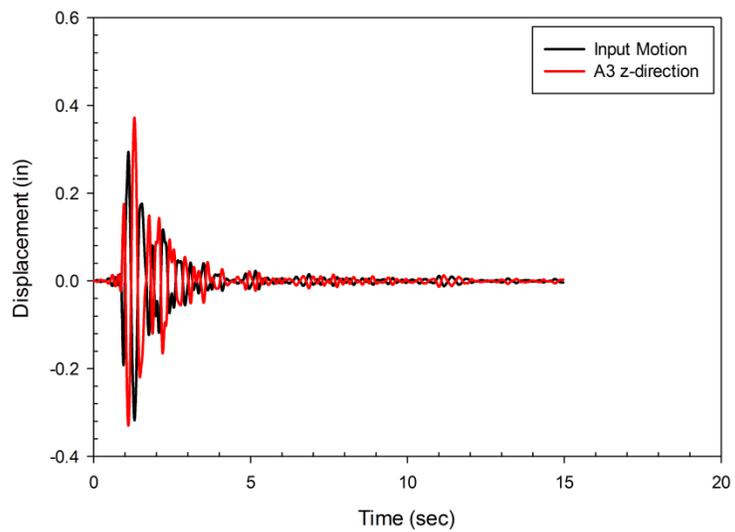
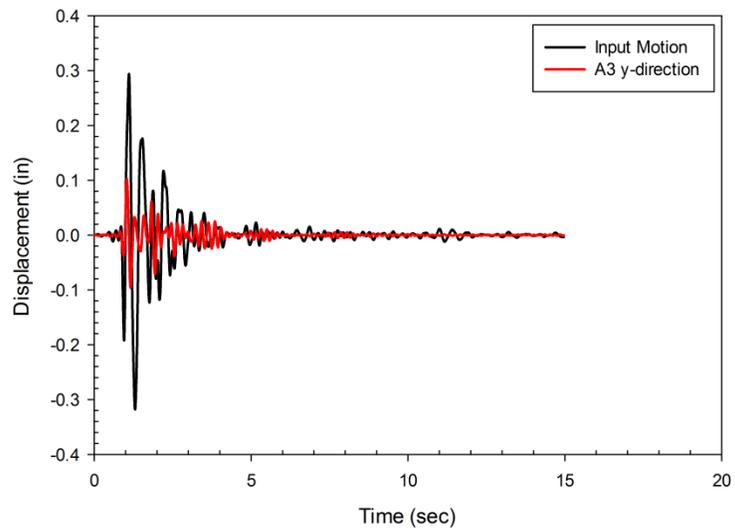
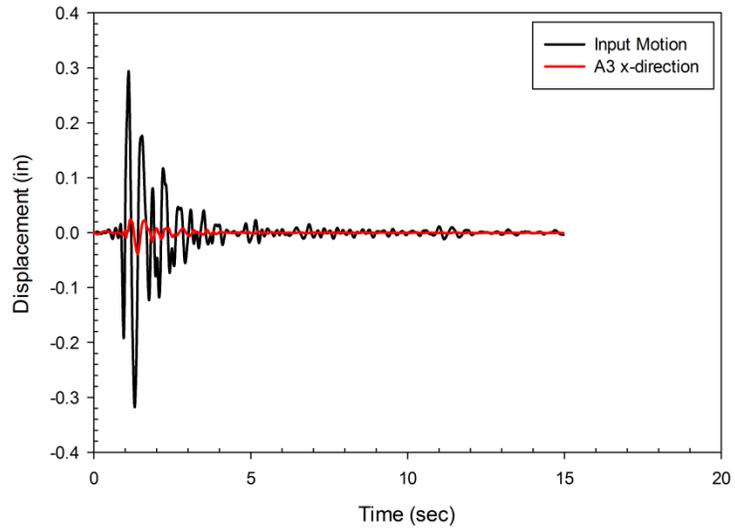


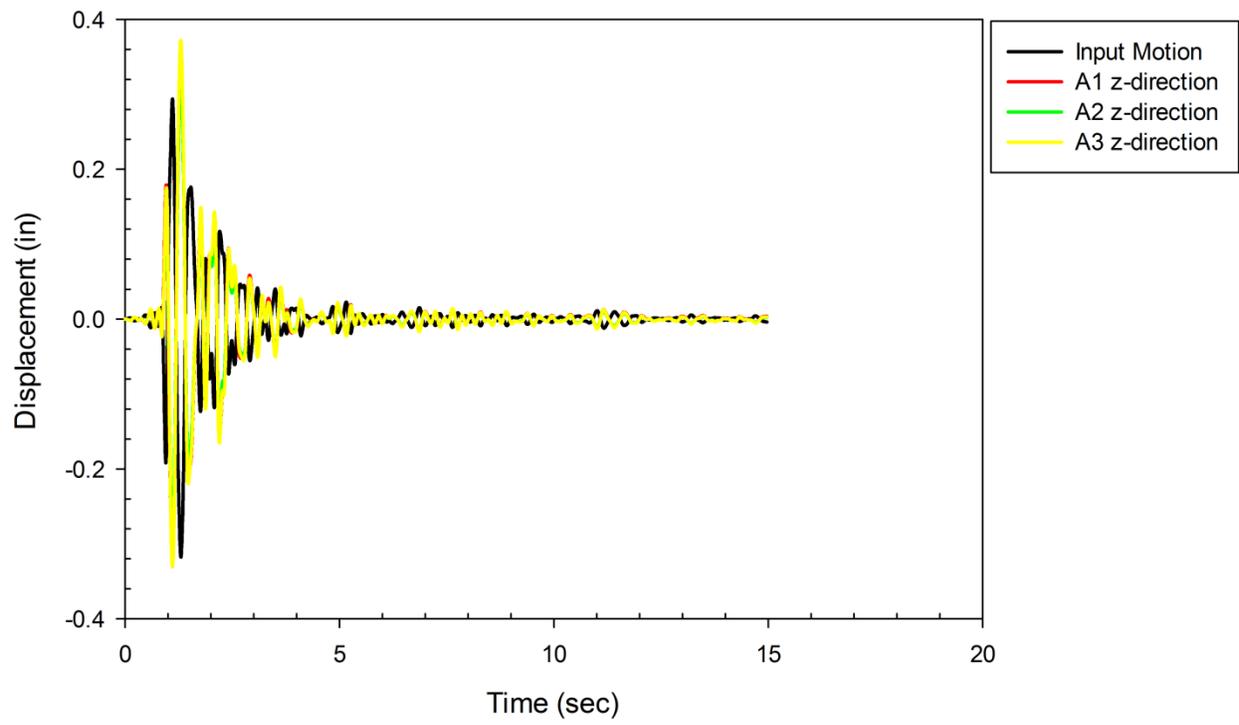
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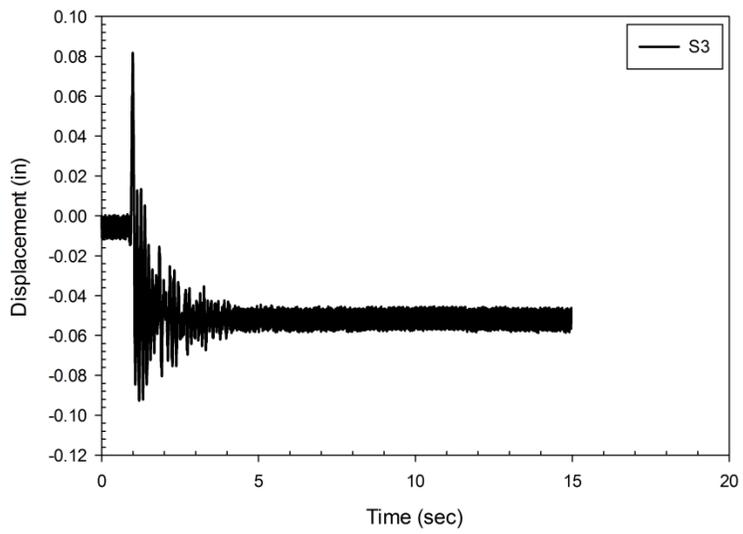
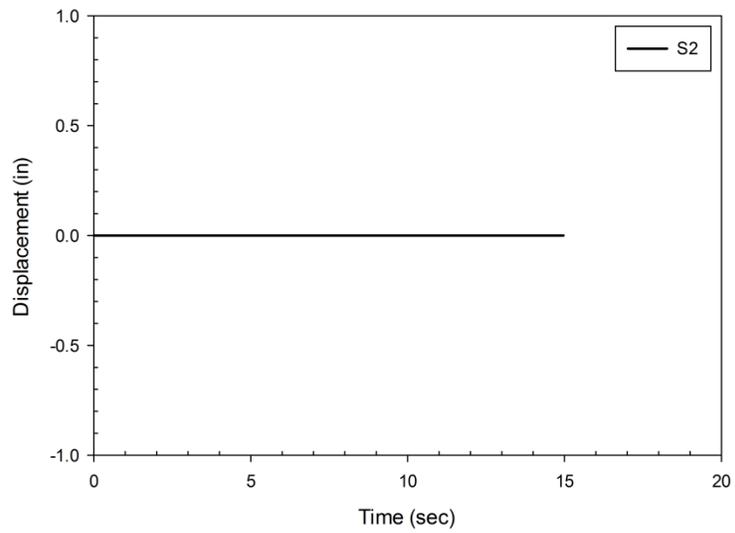
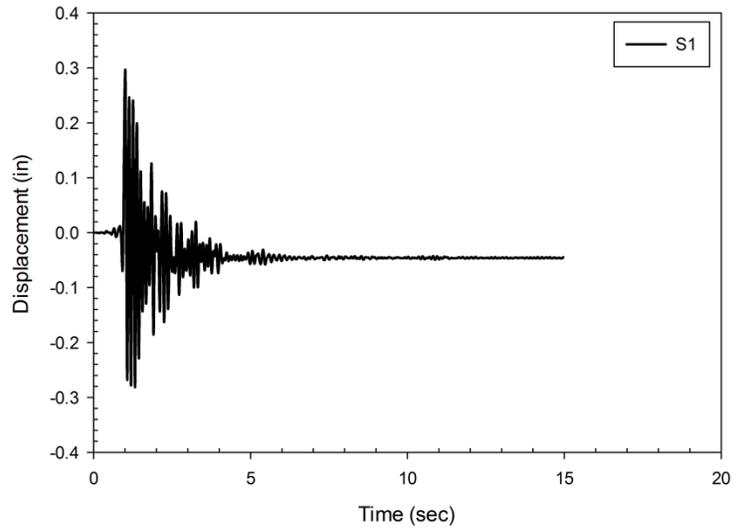


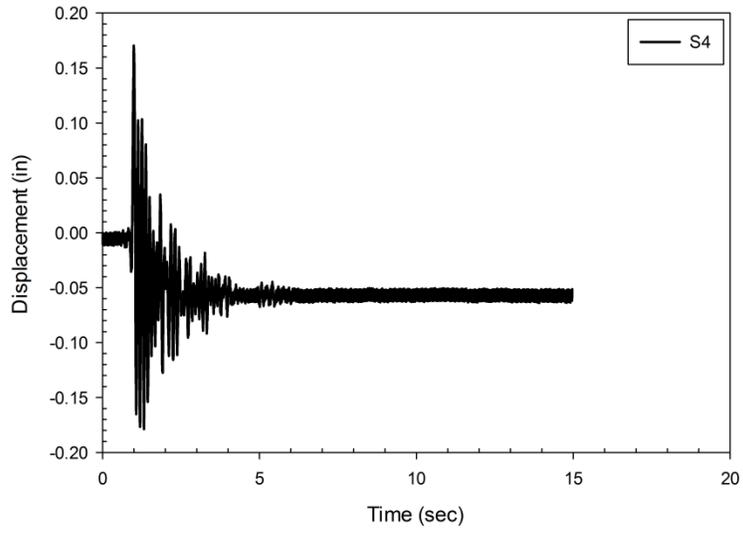








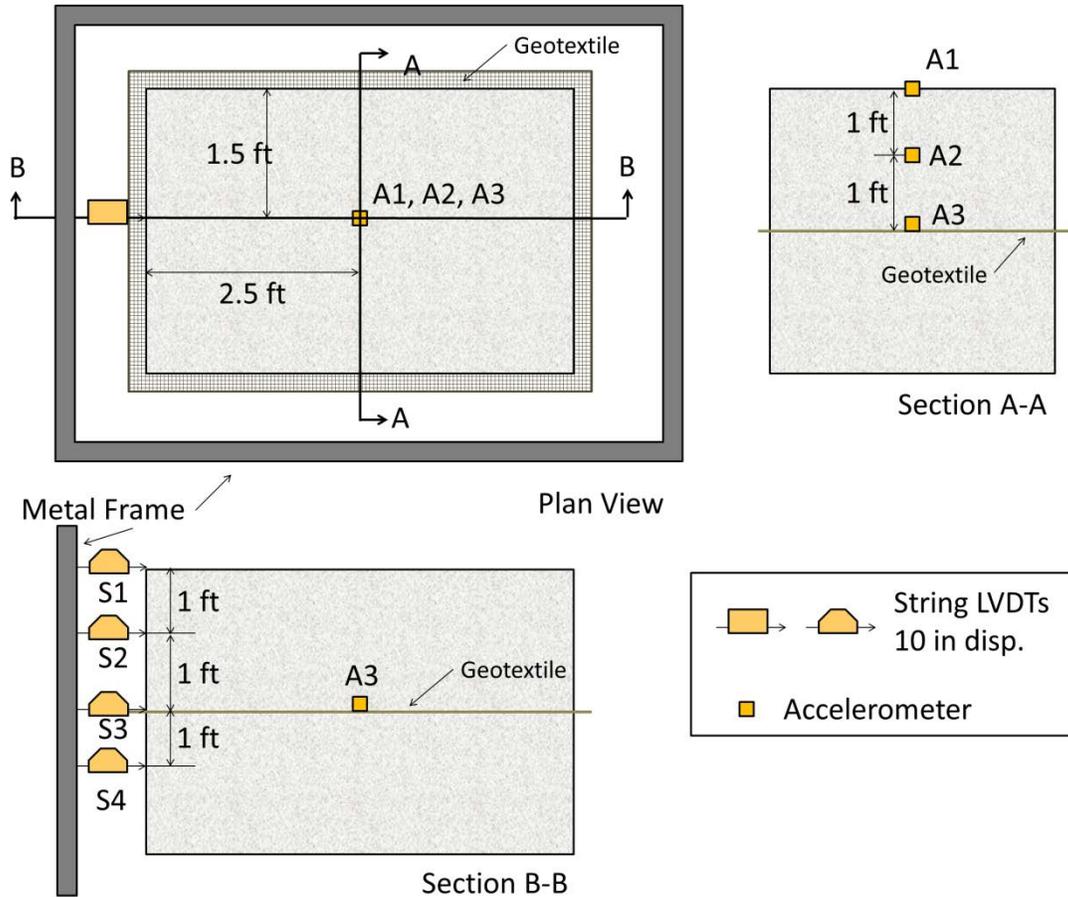


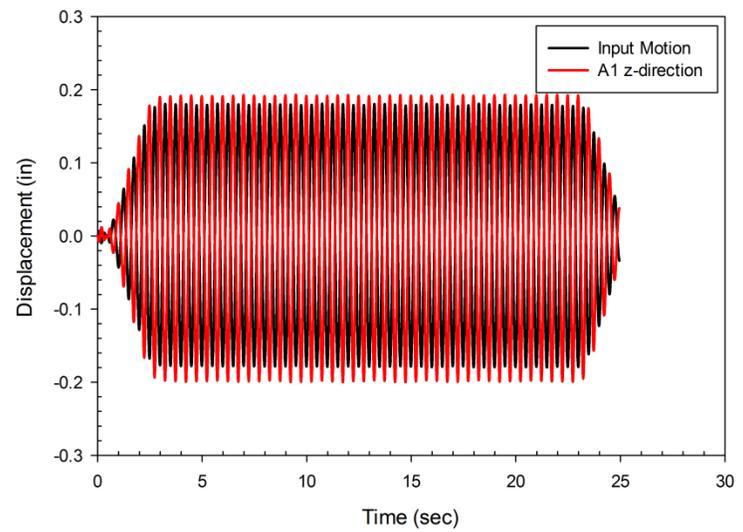
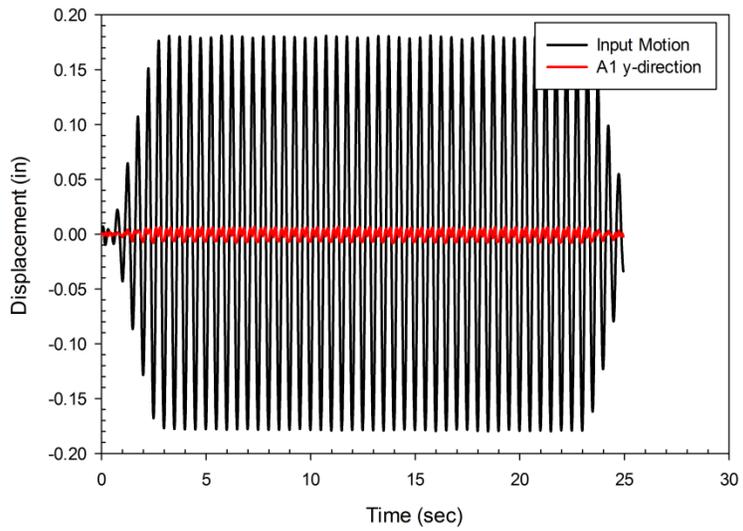
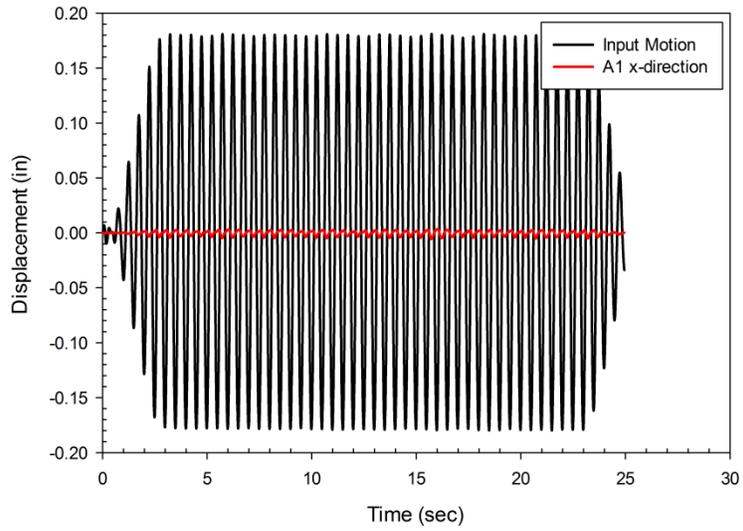


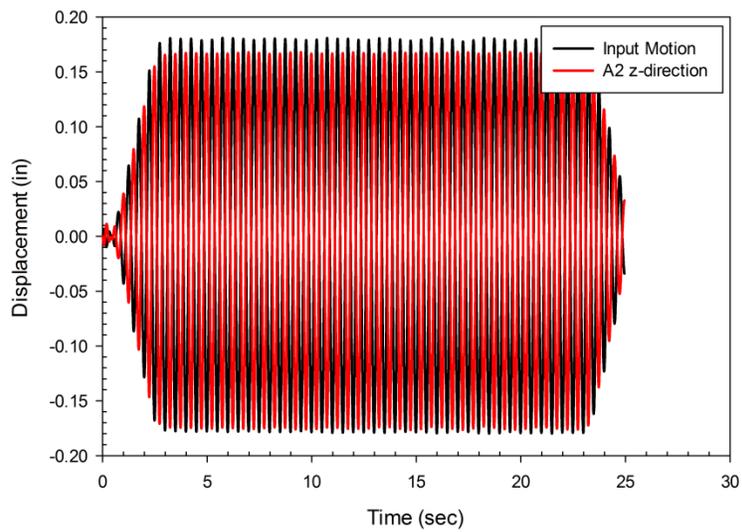
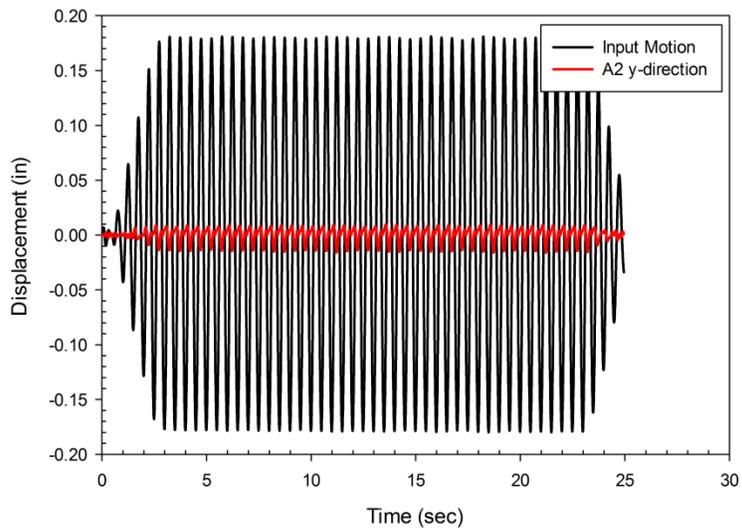
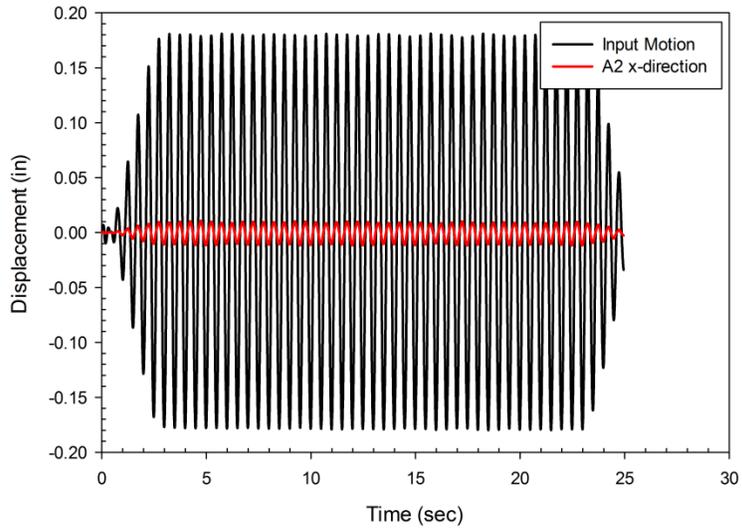
# Shake Table Test

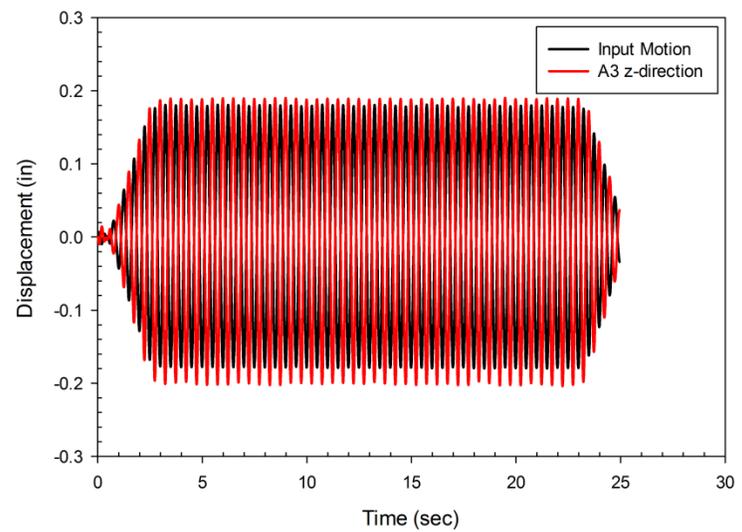
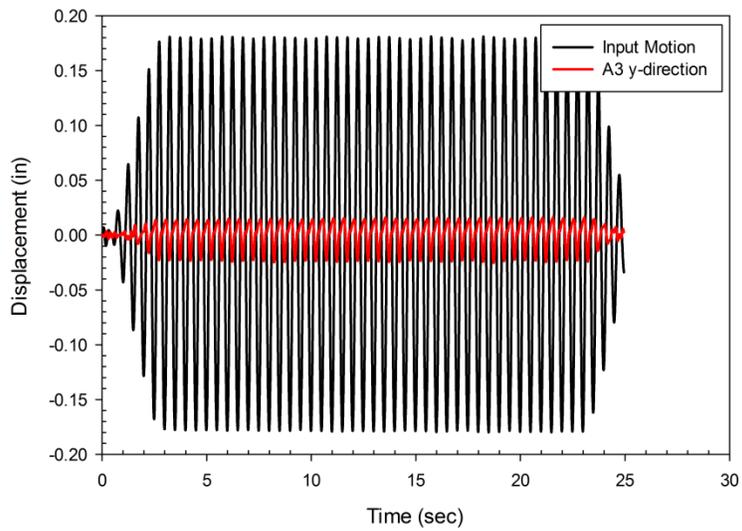
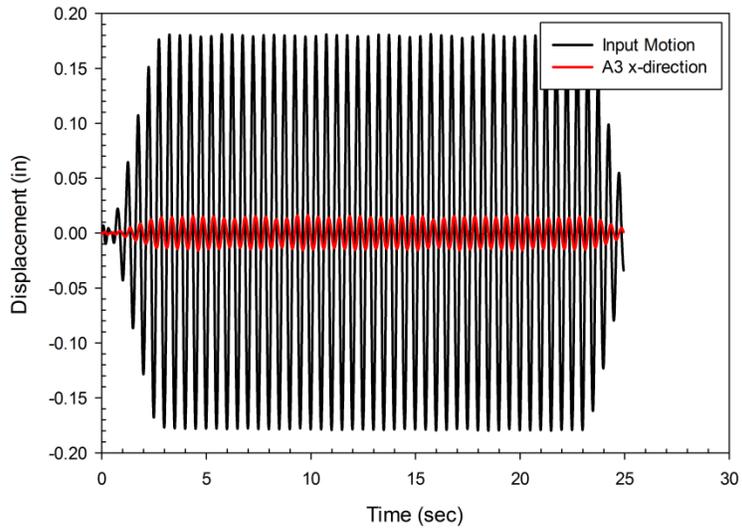


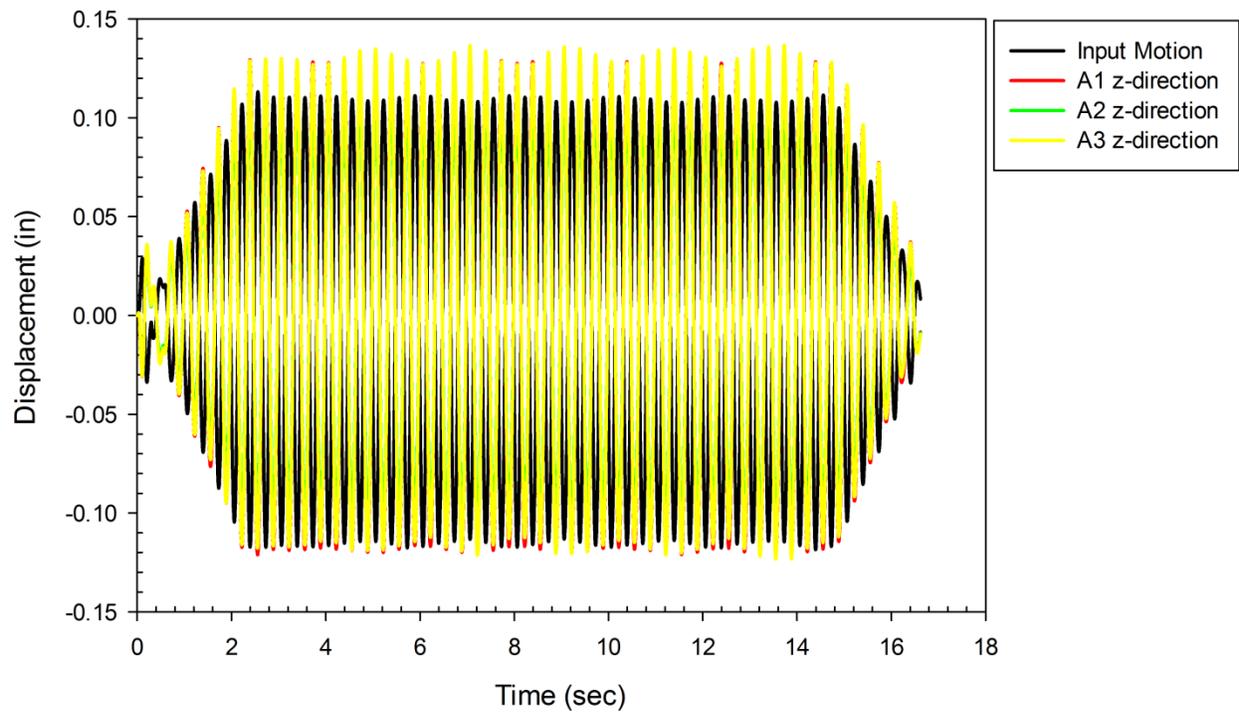
Project:	Cell Crete (Cellular Concrete)	Test Date:	9/14/16
Location:	----	Test No.:	3
Model Size:	3 ft by 5 ft	Vertical Stress:	164.0 psf
Model Height:	4 ft	Geogrid Depth:	2 ft
Motion Type:	Sinusoidal	Characteristics:	0.1g 2Hz

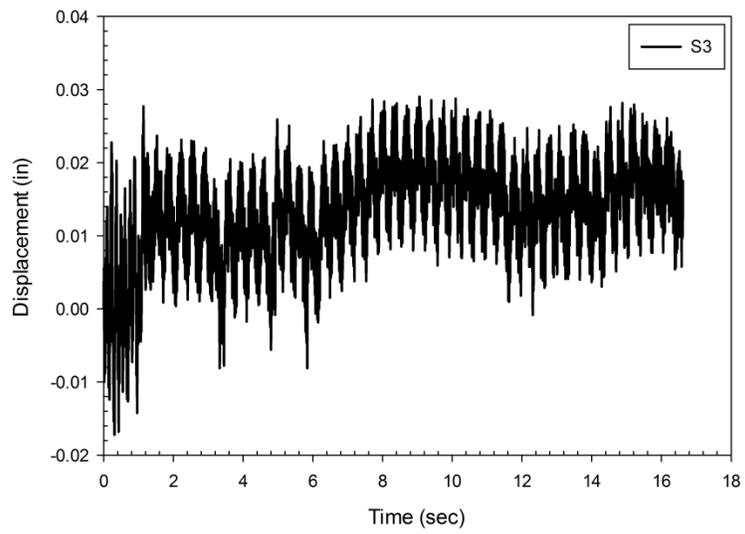
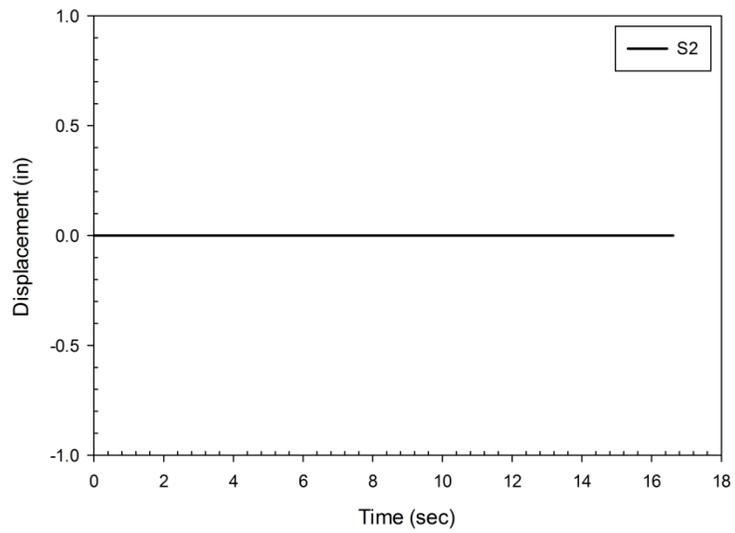
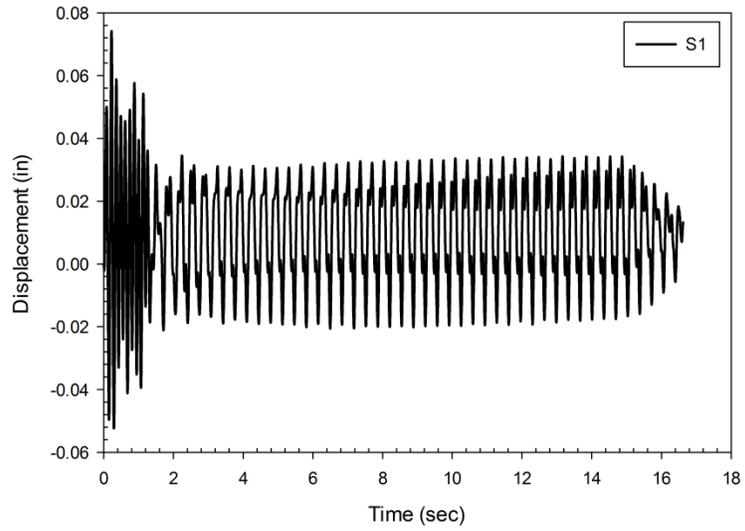


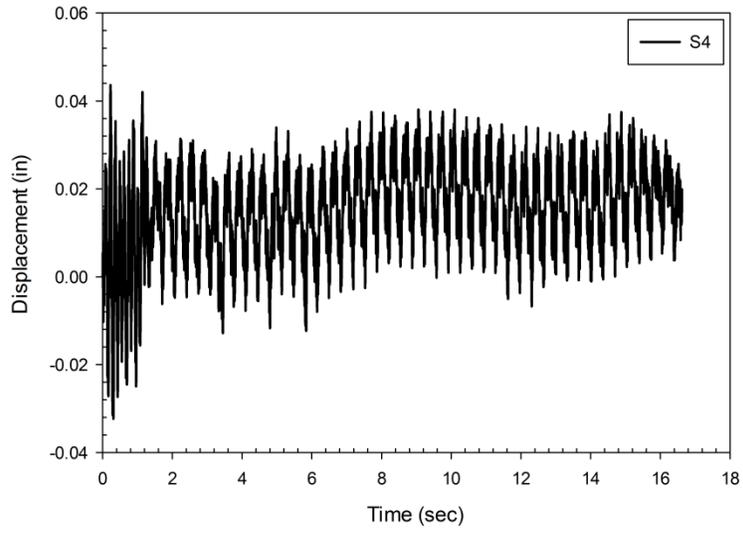








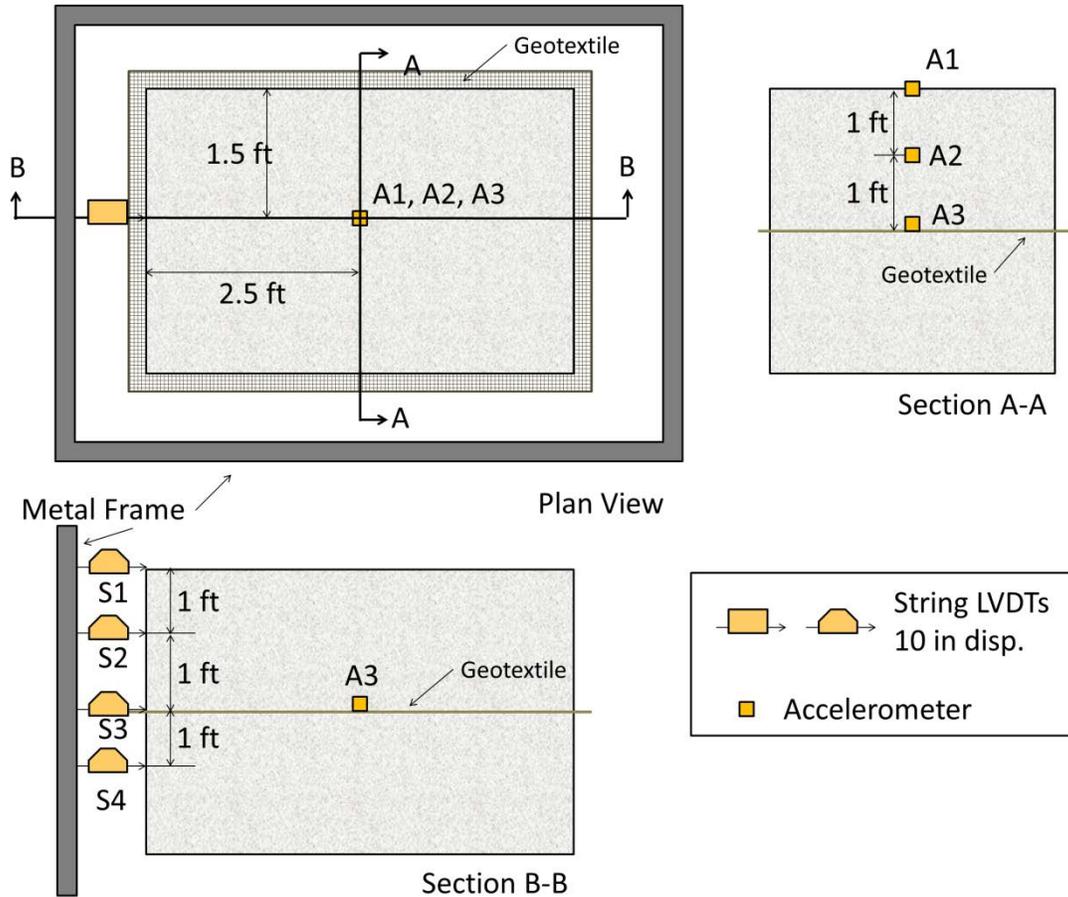


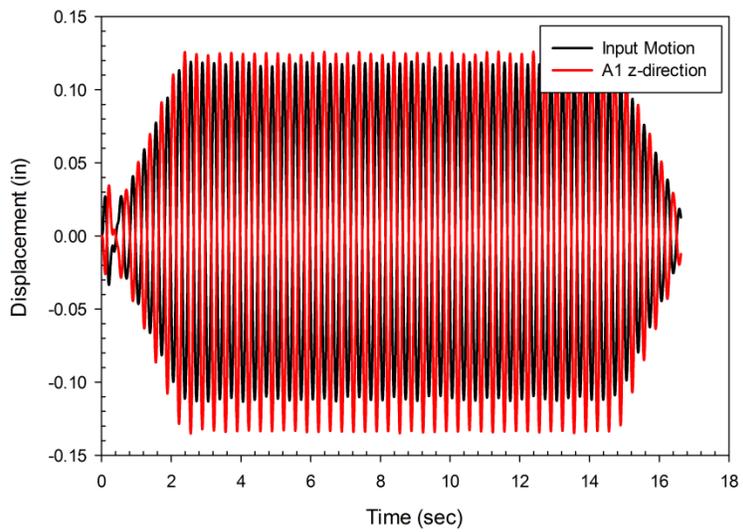
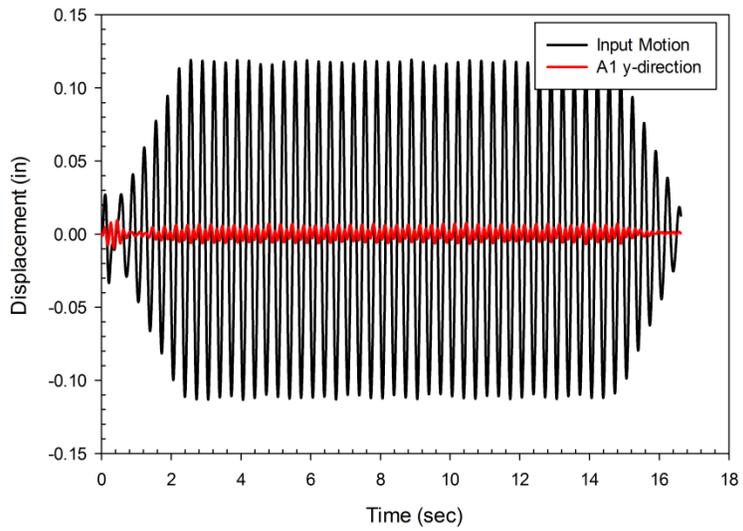
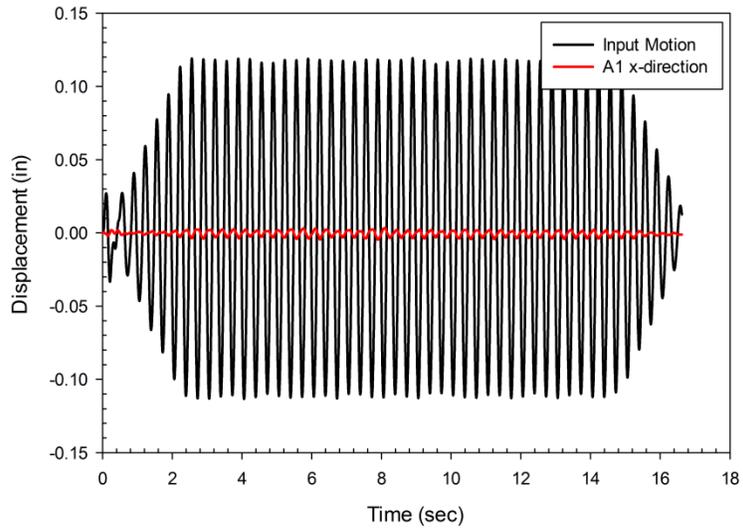


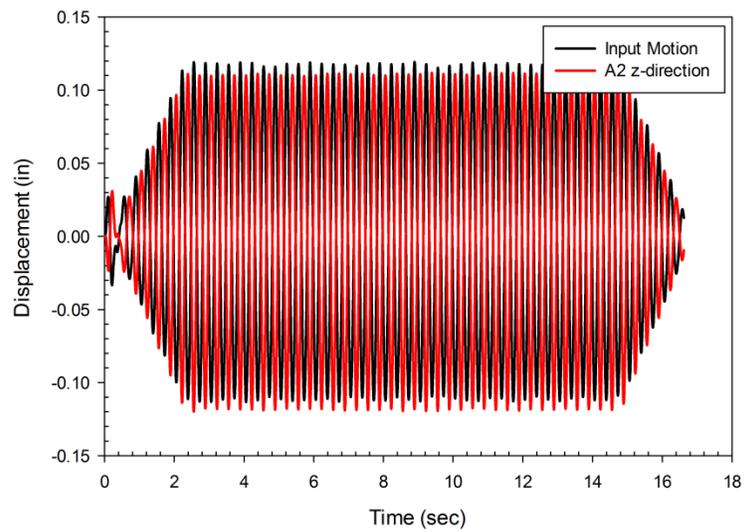
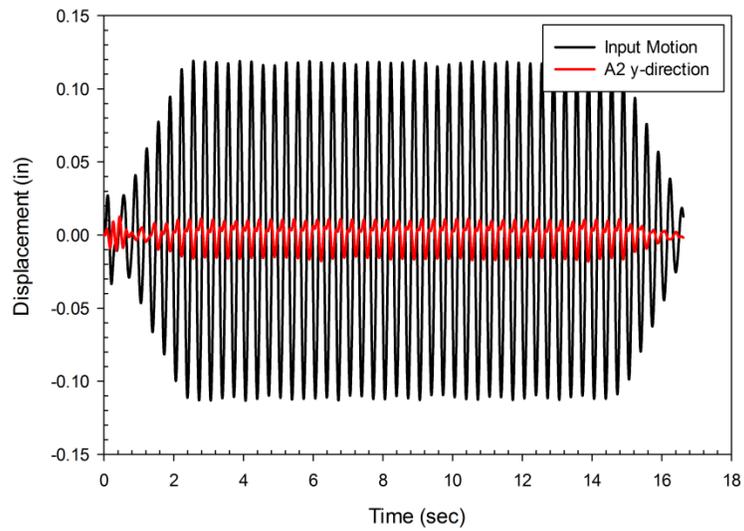
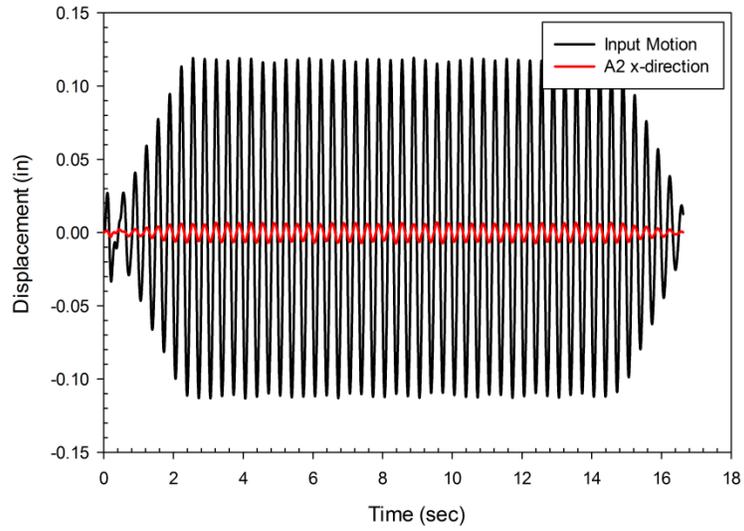
# Shake Table Test

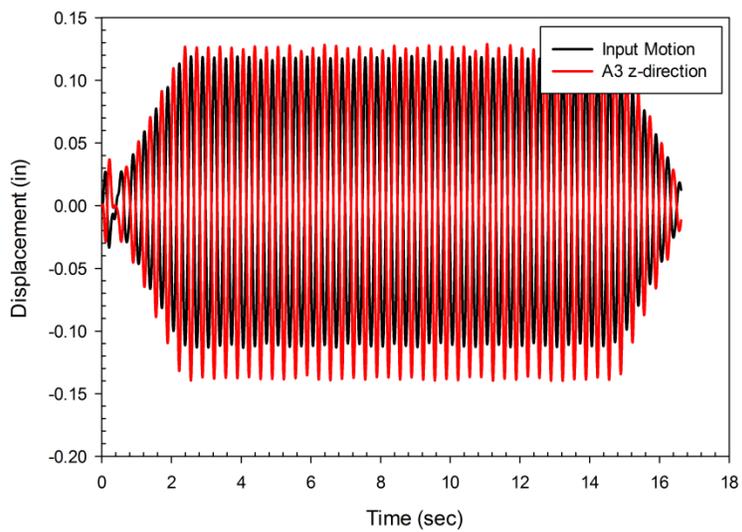
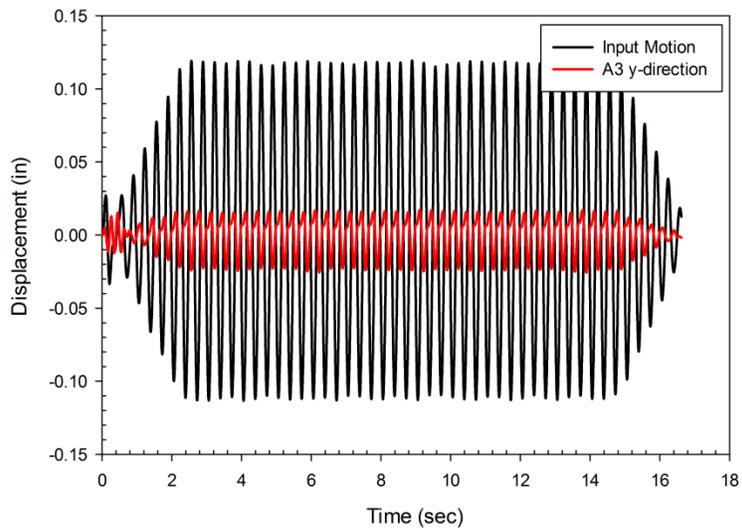
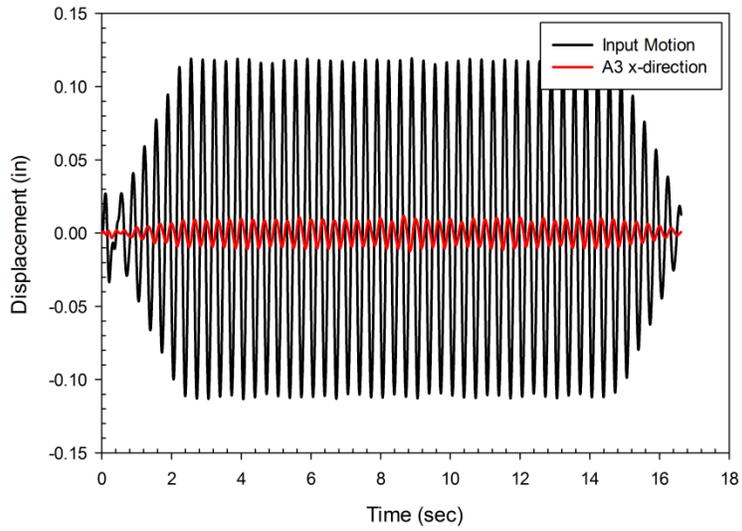


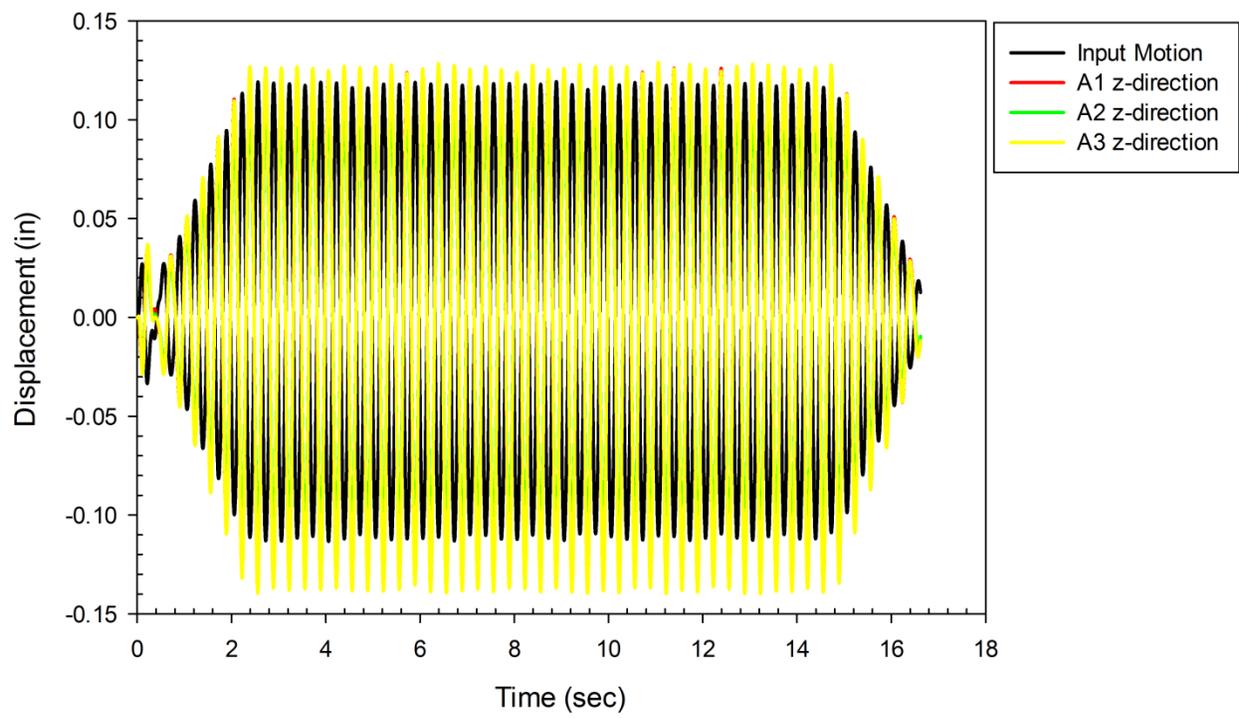
Project:	Cell Crete (Cellular Concrete)	Test Date:	9/14/16
Location:	----	Test No.:	3
Model Size:	3 ft by 5 ft	Vertical Stress:	164.0 psf
Model Height:	4 ft	Geogrid Depth:	2 ft
Motion Type:	Sinusoidal	Characteristics:	0.1g 3Hz

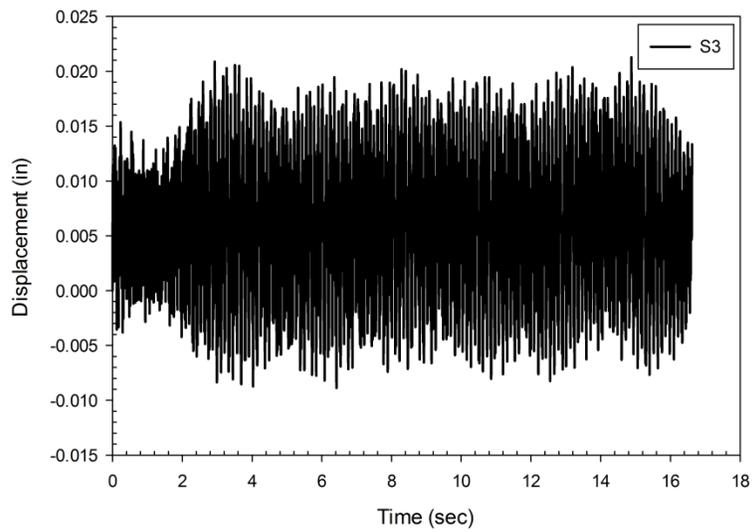
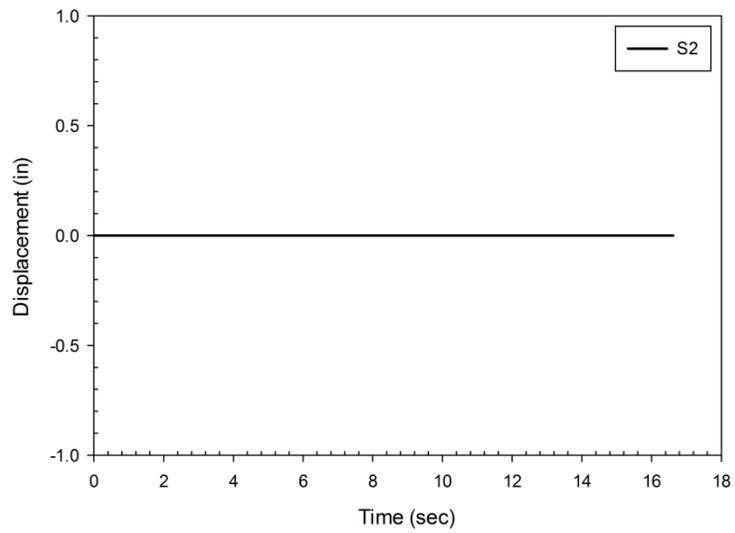
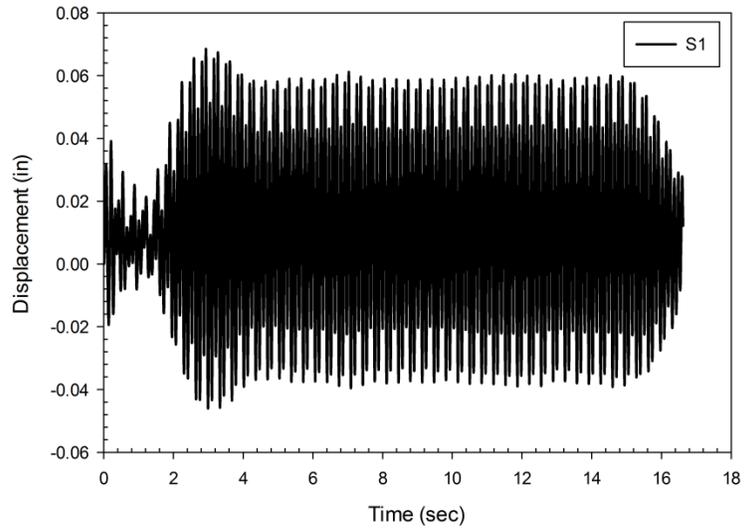


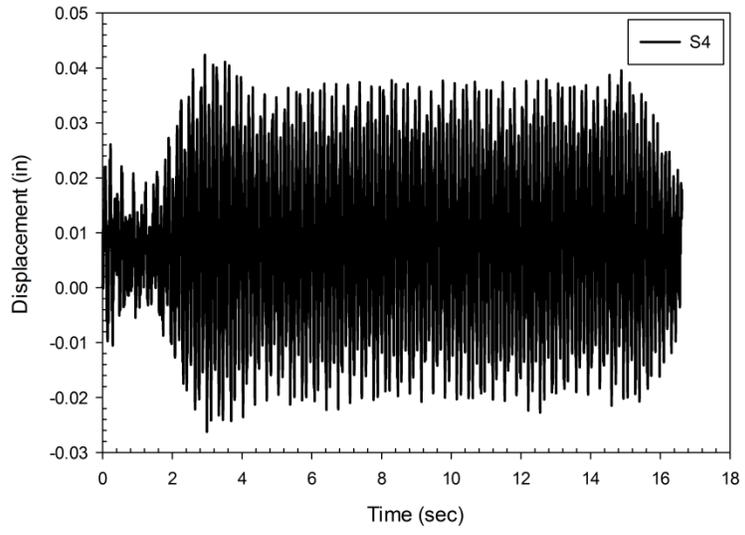








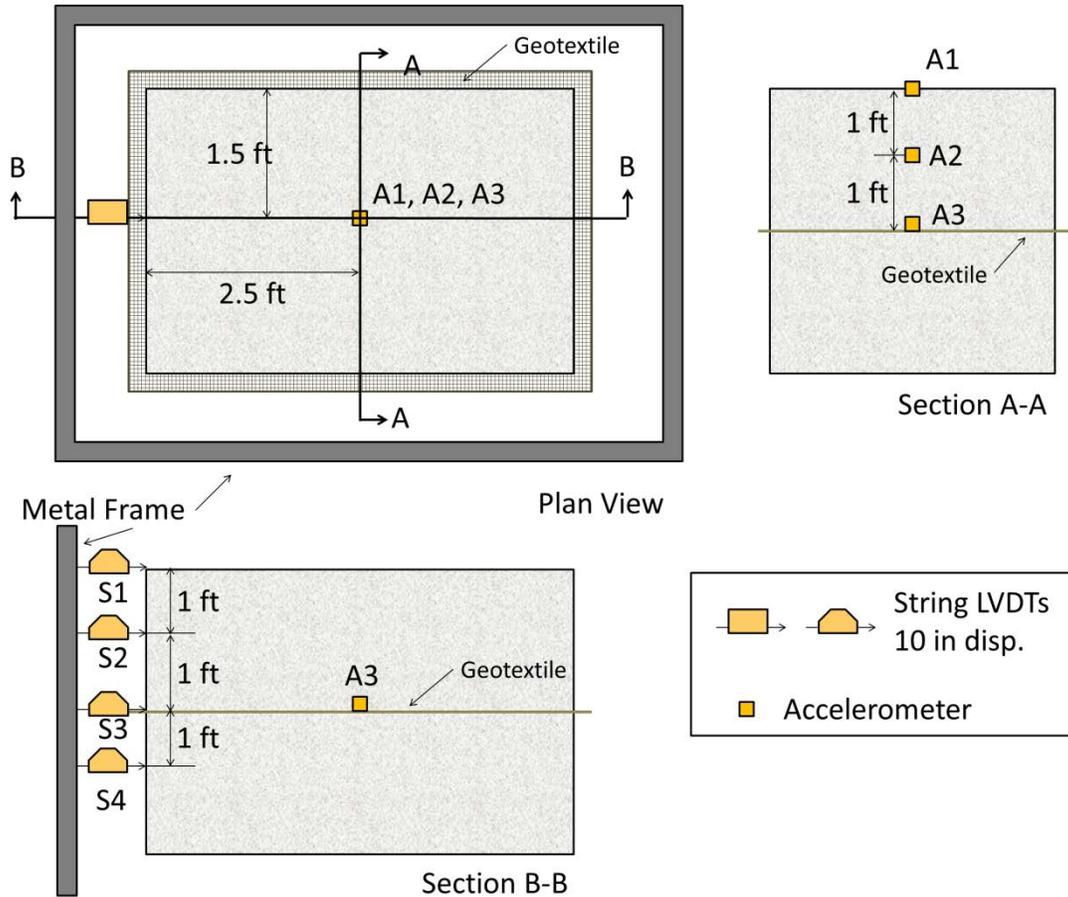


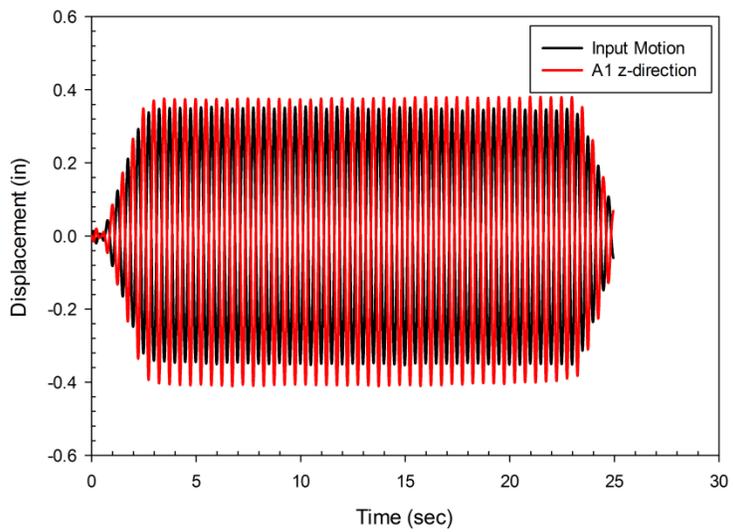
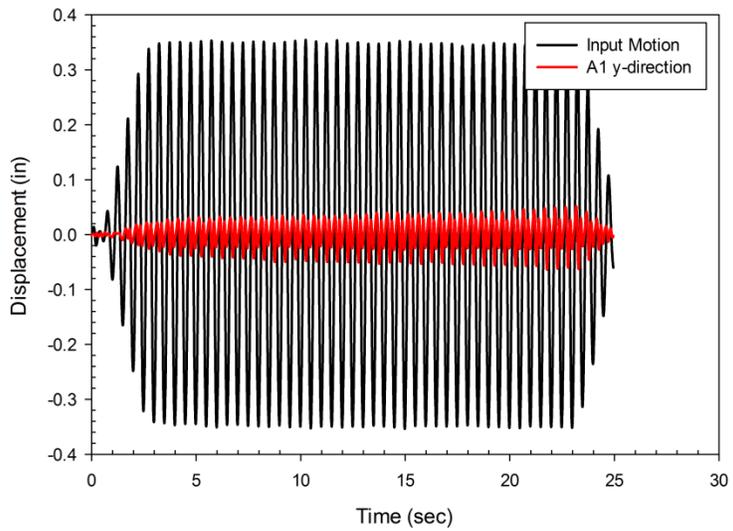
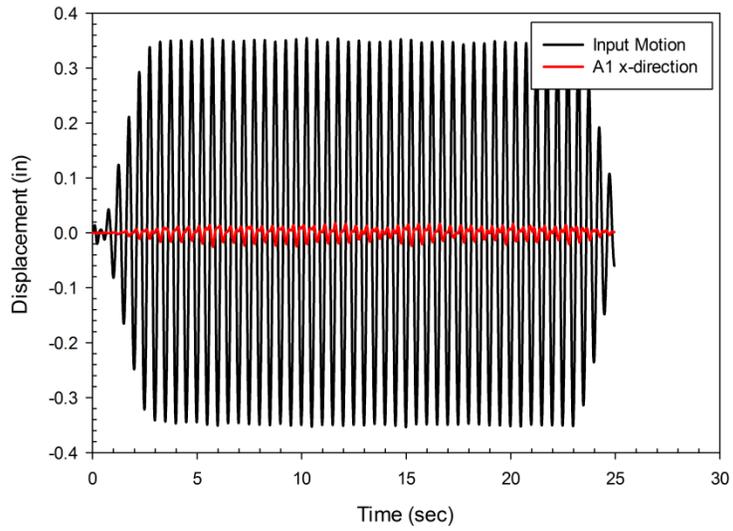


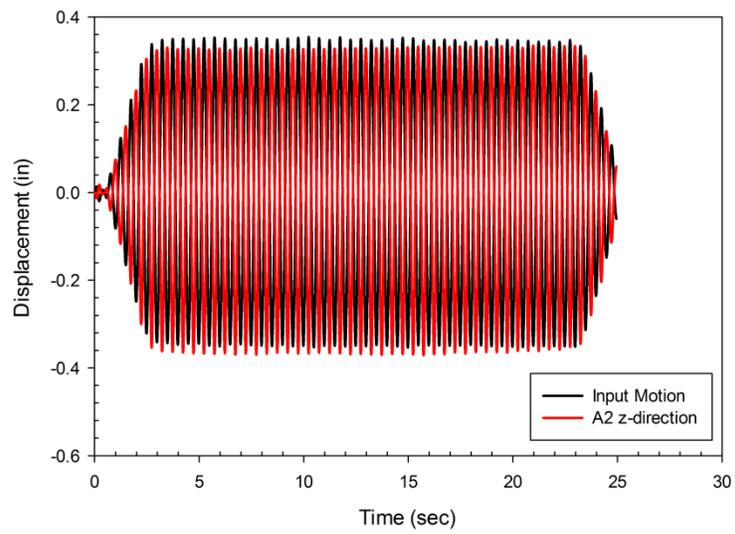
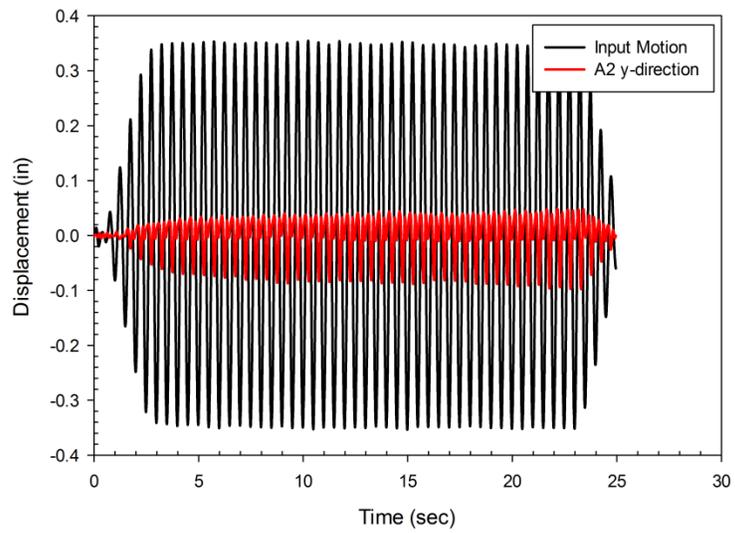
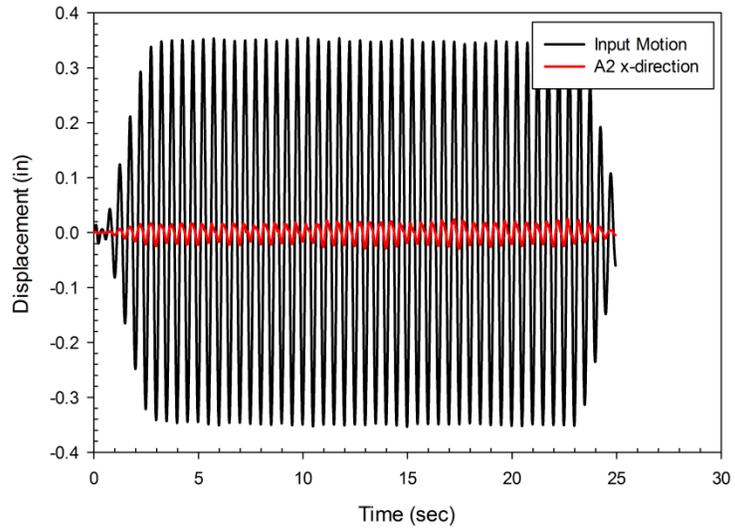
# Shake Table Test

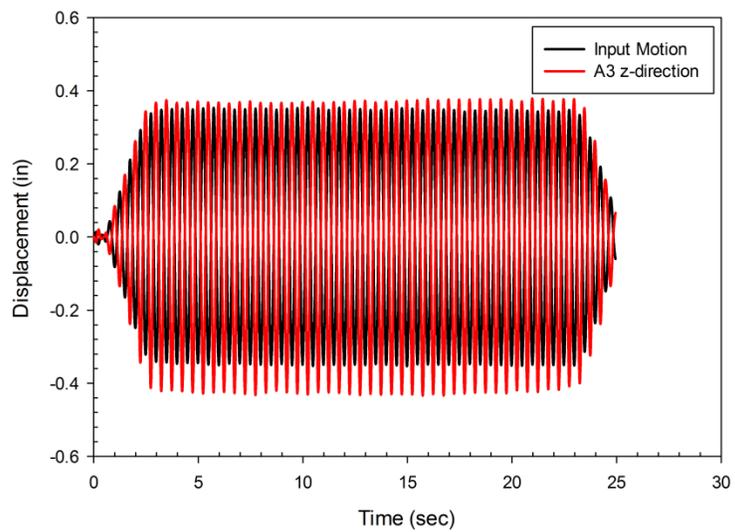
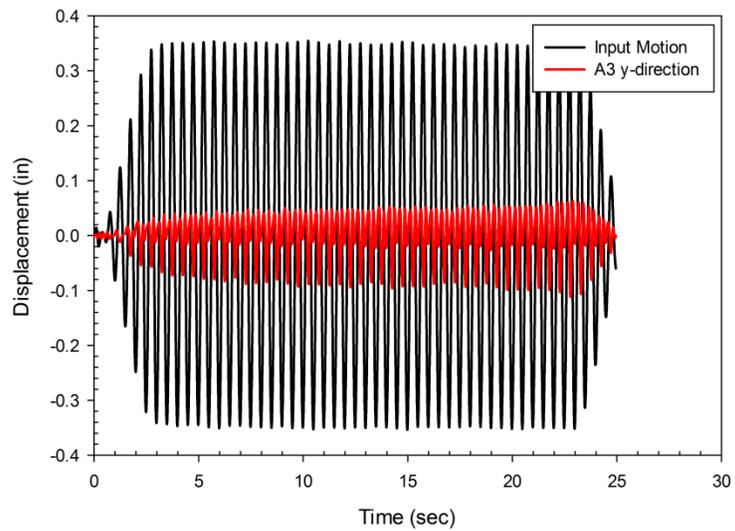
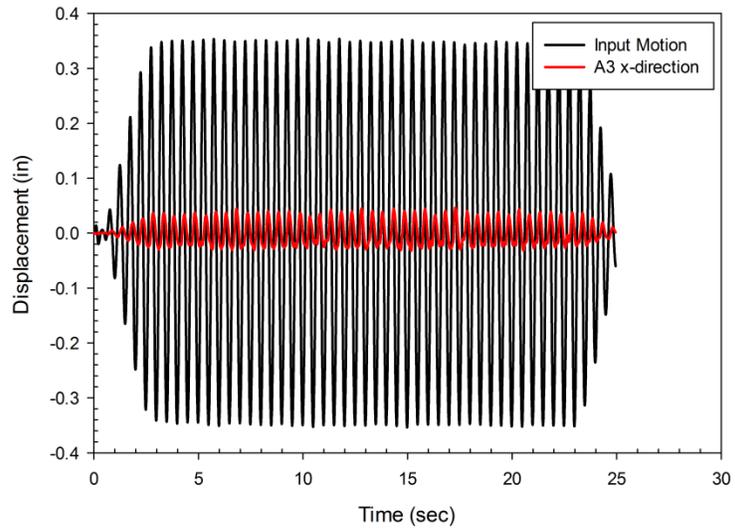


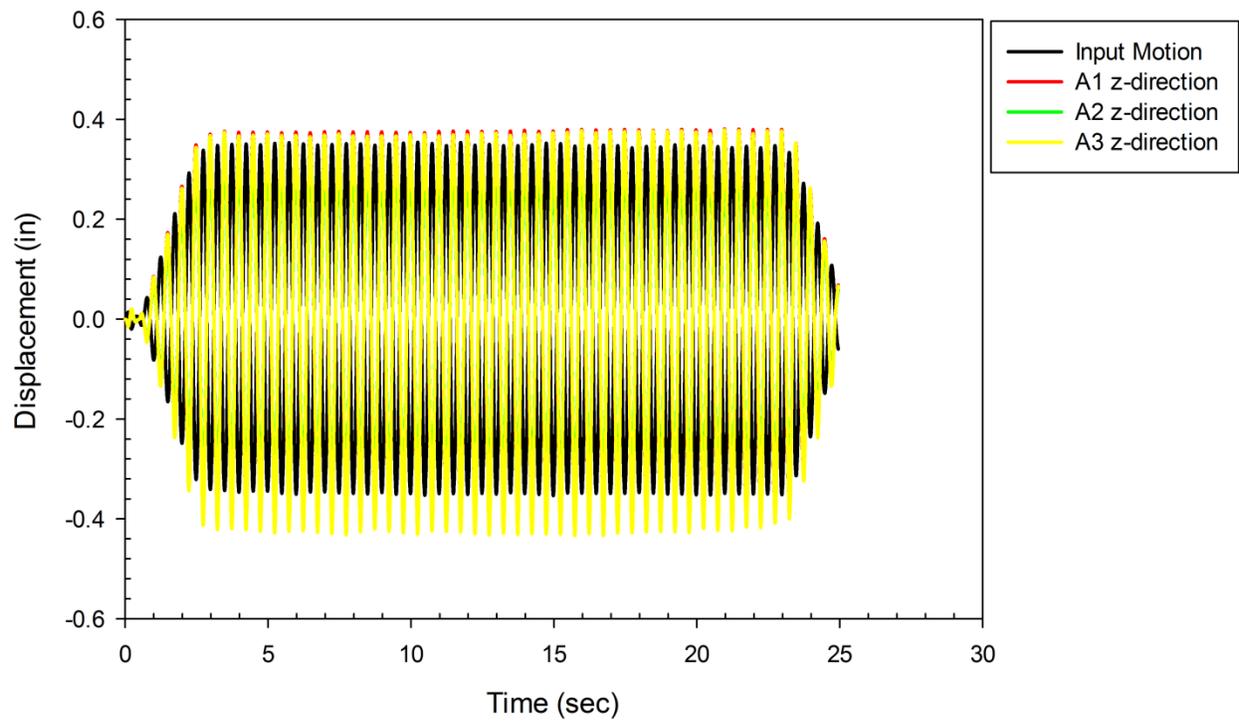
Project:	Cell Crete (Cellular Concrete)	Test Date:	9/14/16
Location:	----	Test No.:	3
Model Size:	3 ft by 5 ft	Vertical Stress:	164.0 psf
Model Height:	4 ft	Geogrid Depth:	2 ft
Motion Type:	Sinusoidal	Characteristics:	0.2g 2Hz

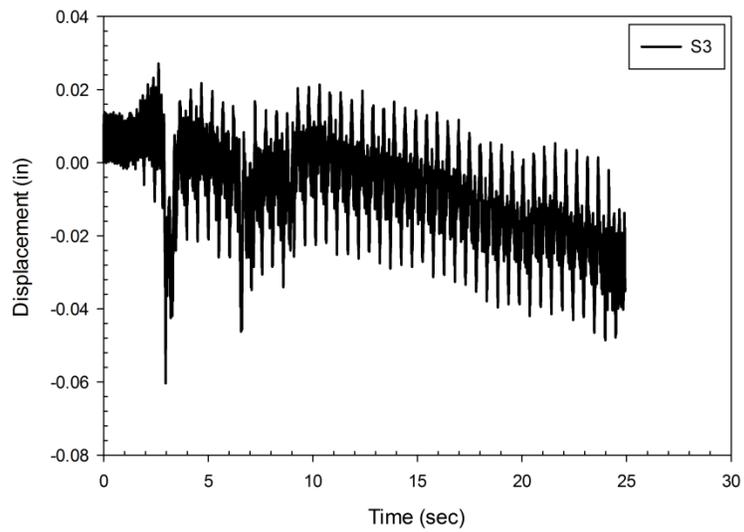
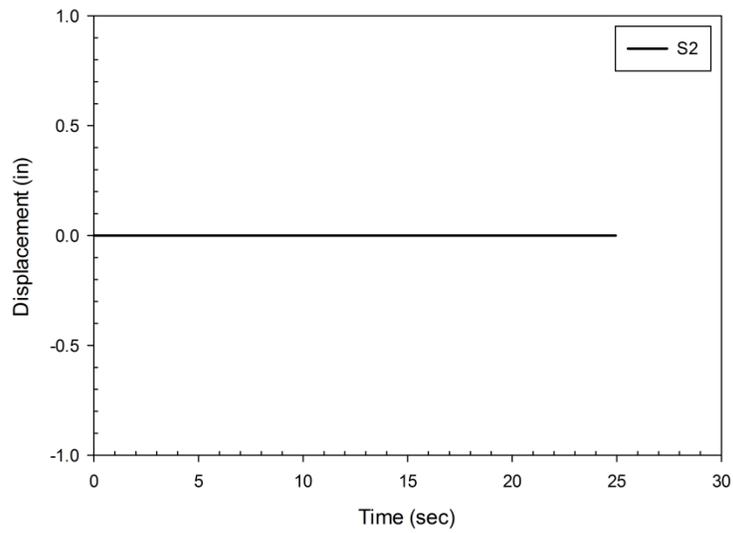
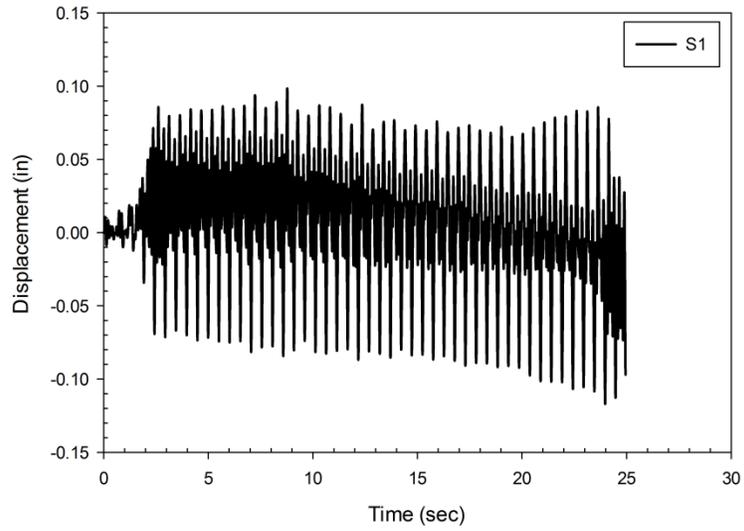


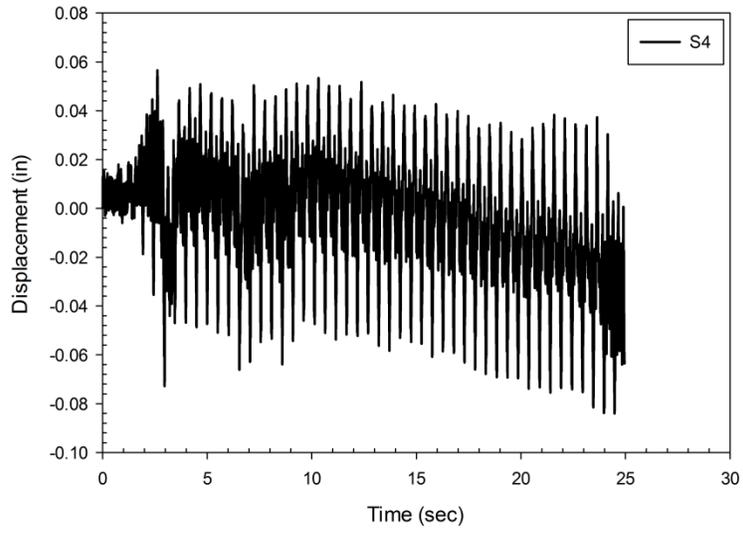








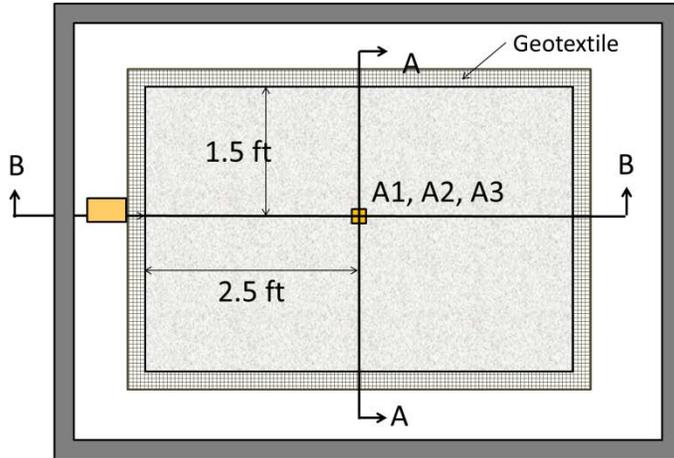




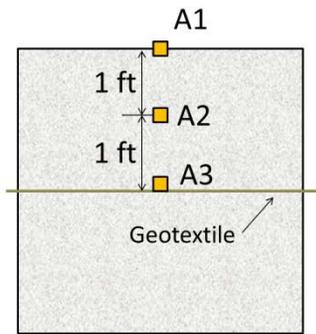
# Shake Table Test



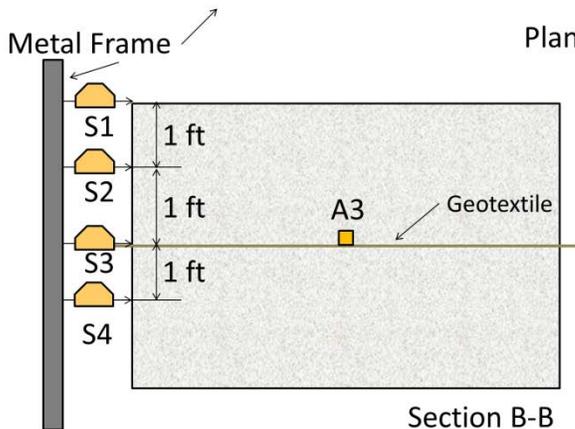
Project:	Cell Crete (Cellular Concrete)	Test Date:	9/14/16
Location:	----	Test No.:	3
Model Size:	3 ft by 5 ft	Vertical Stress:	164.0 psf
Model Height:	4 ft	Geogrid Depth:	2 ft
Motion Type:	Sinusoidal	Characteristics:	0.2g 3Hz



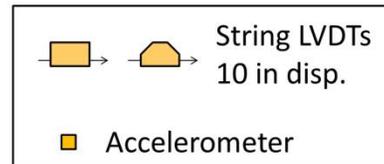
Plan View

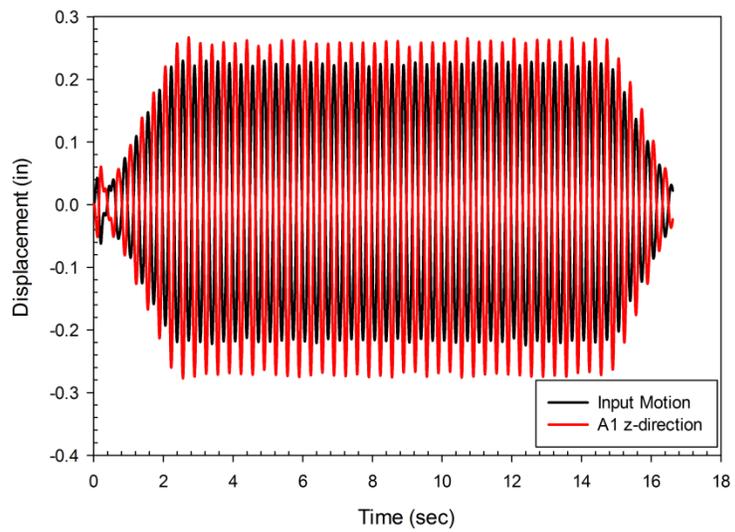
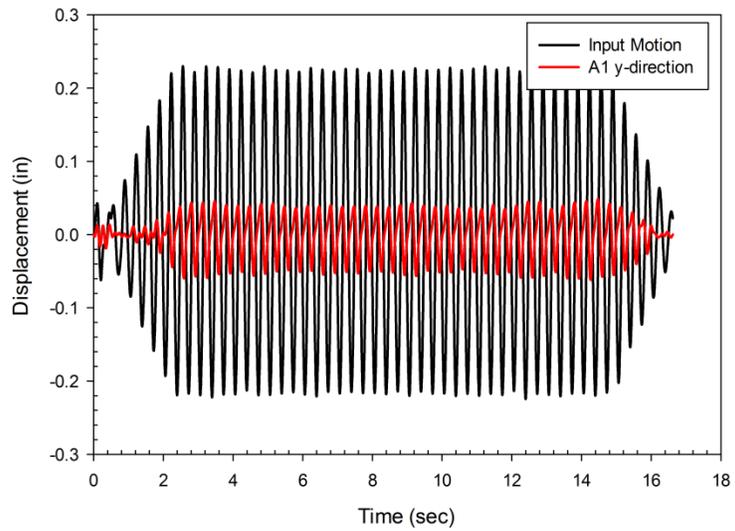
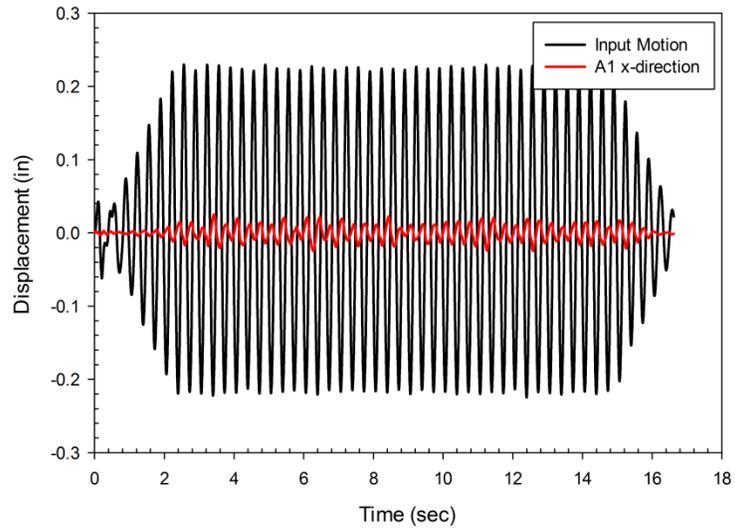


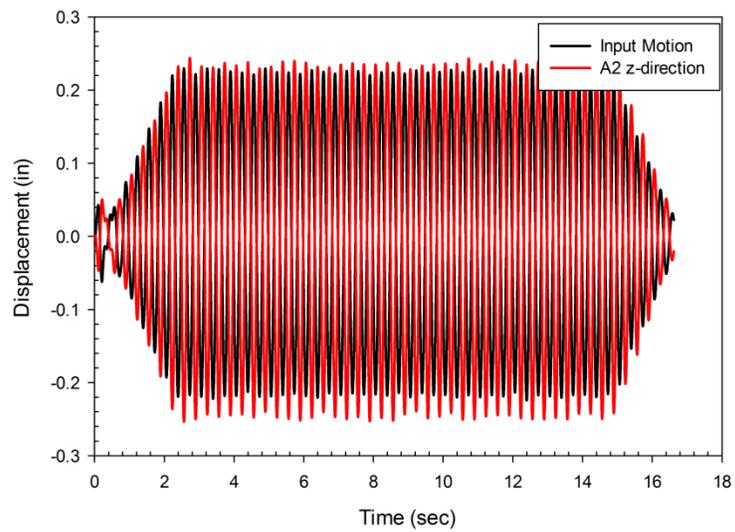
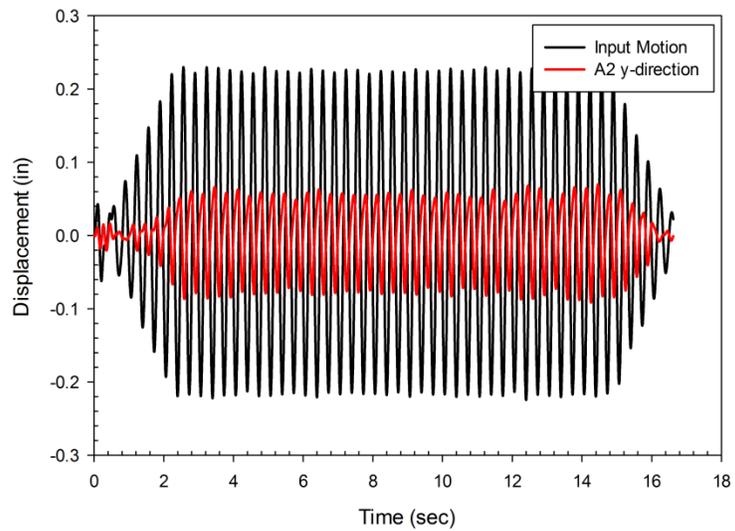
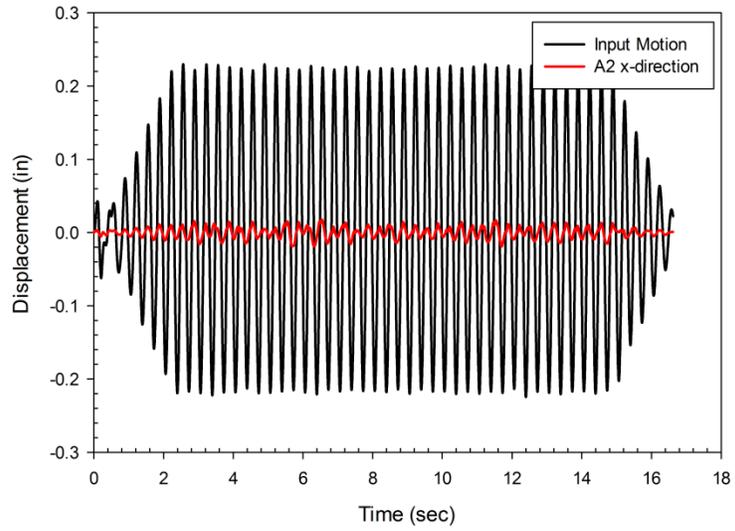
Section A-A

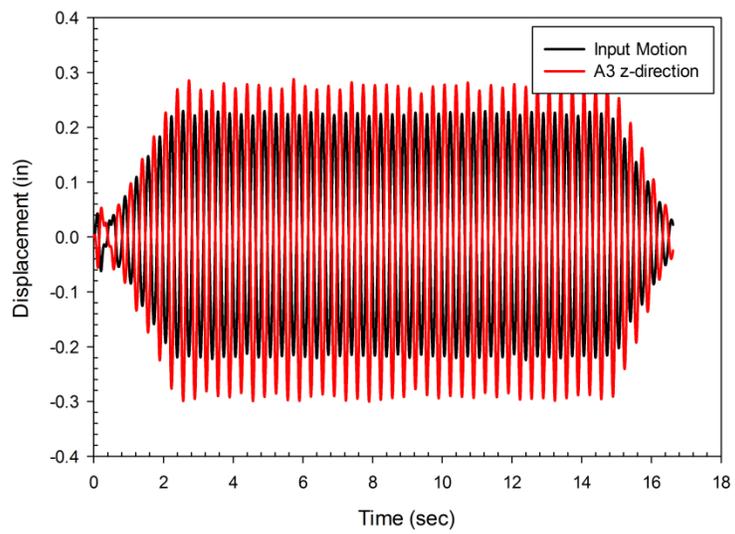
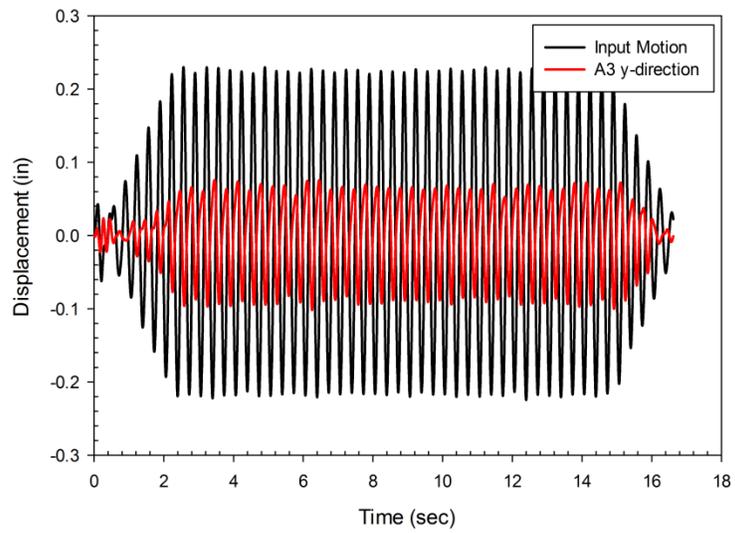
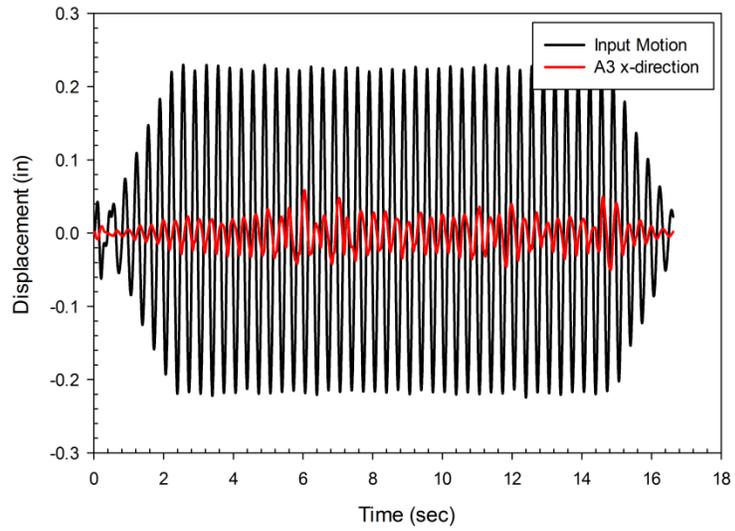


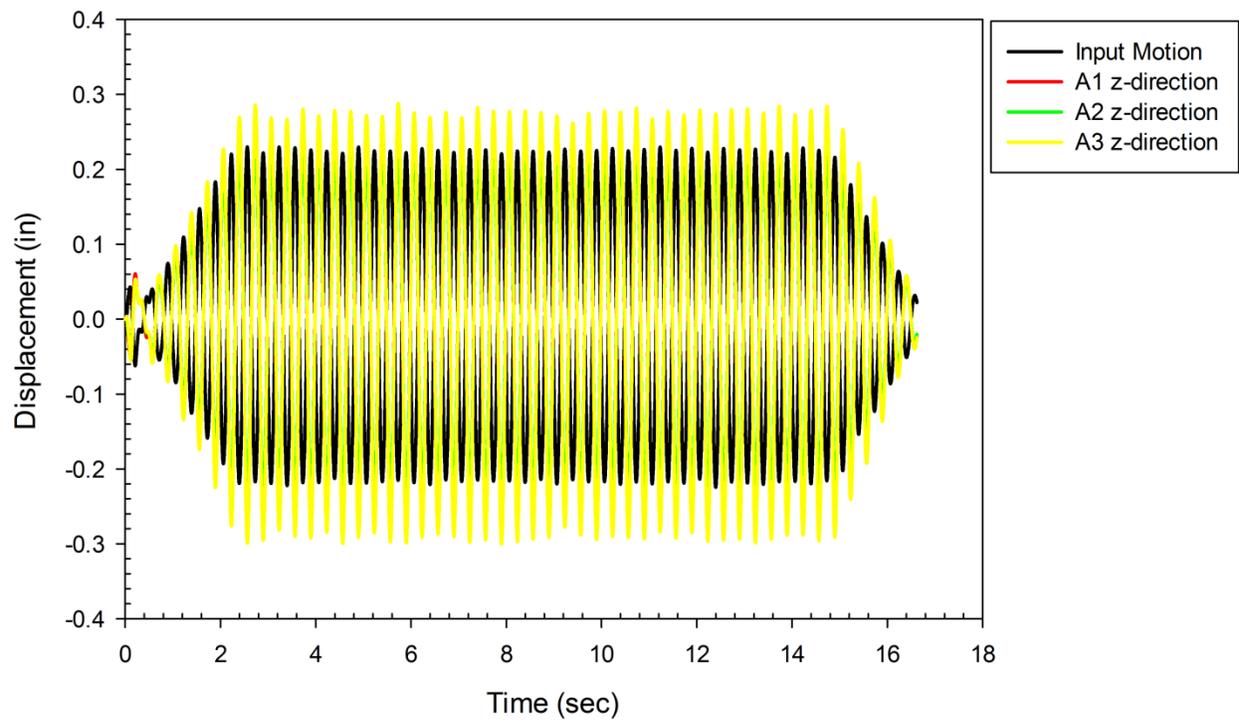
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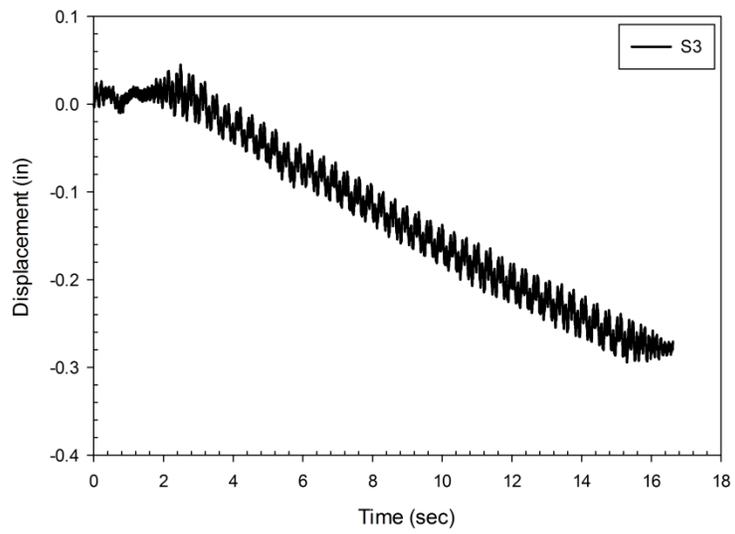
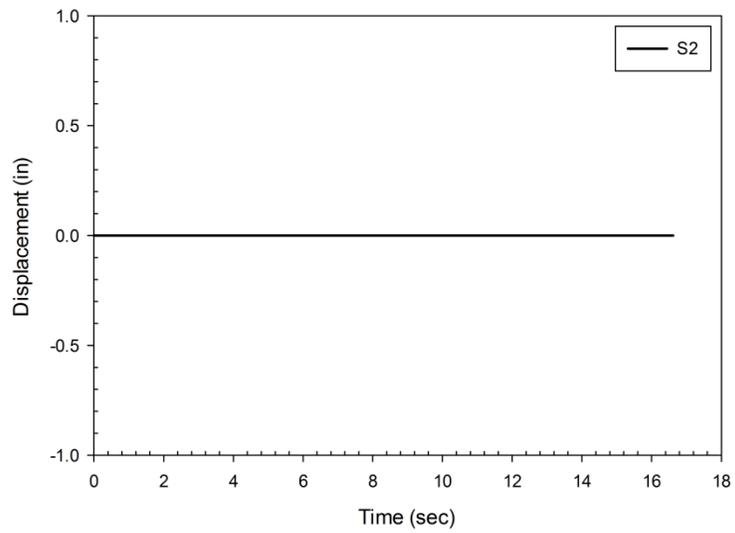
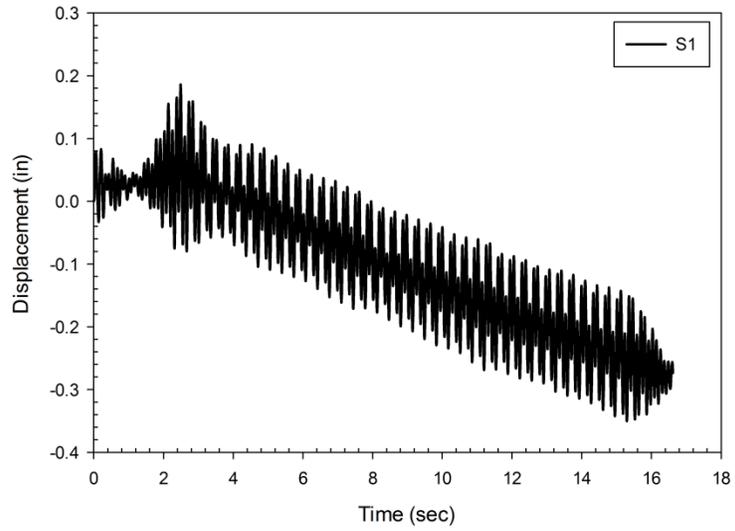


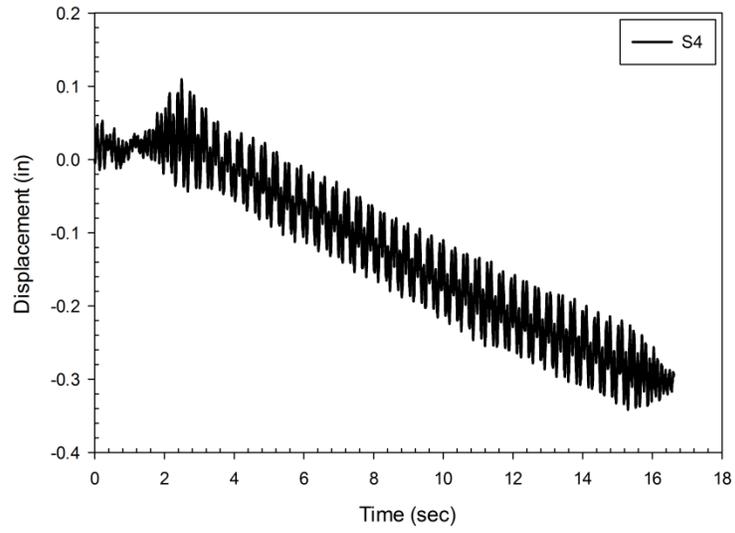












# Shake Table Test



Project:	Cell Crete (Cellular Concrete)	Test Date:	9/14/16
Location:	----	Test No.:	3
Model Size:	3 ft by 5 ft	Vertical Stress:	164.0 psf
Model Height:	4 ft	Geogrid Depth:	2 ft
Motion Type:	1994 Northridge Earthquake	Characteristics:	N/A

