

ISO●BaseTM

Seismic Isolation Platform

JQA Test Report

November 2002

WorkSafe Technologies

Manufacturer of ISO-BaseTM Seismic Isolation Technology.



**ISO-Base™
Seismic Isolation Platform
JQA Test Report**

**Prepared for:
WorkSafe Technologies**

**Reports by:
WST Japan: JOEMAC
WST HQ: Don Hubbard
Synodynamic: J.R. Tsao
Vistek: Zoltan Kemeny
NCREE: Professor Hwang.**

This document may not be reproduced
without the express written permission
of WorkSafe Technologies.

Copyright ©2002, WorkSafe Technologies
All rights reserved.

For additional copies please contact:
WorkSafe Technologies
25133 Ave. Tibbitts #F • Valencia, CA • 91355
Phone: 661/257-2527 • E-Mail: sales@worksafetech.com

WorkSafe Technologies

Manufacturer of ISO-Base Seismic Isolation Technology.

Who is the JQA?

The Japan Quality Assurance Organization (JQA) is a non-profit organization specializing in registration services for ISO management systems as well as safety testing and certification for compliance to a variety of standards, both national and international. It started its operation in 1957, initially as a designated inspection body under Japan's Export Inspection Law. Their work contributed to the postwar recovery of and export-oriented Japanese economy by testing and certifying products destined for overseas markets.

JQA is a leading international quality assurance body with direct ties to the METI (Ministry of Economic Trade and Industry), part of the Japanese national government. The JQA works with other renowned international quality and testing organizations (UL, FCC in the USA and CE in Europe).

The Facility

The NCREC (National Center for Research on Earthquake Engineering), located in Taipei, Taiwan was chosen because of its Tri-Axial Seismic Shake Table and Reaction Wall and Strong Floor Test System. These systems provide for large-scale structural and earthquake engineering experiments. This facility is capable of performing large or full scale seismic tests by using various methods, such as traditional quasi-static tests, cyclic loading tests and pseudodynamic tests. There are 18 sets of static hydraulic actuators and 6 sets of dynamic hydraulic actuators in this laboratory.

The JQA Test:

The test consisted of three replays of earthquakes using shake tables, an acceleration test and a strength test.

The ISO-Base obtained the JQA certification seal for selling in Japan

Test #1	Replay of Taft 100%	X= 0.18 g	Y= 0.15 g	Z= 0.11 g
Test #2	Replay of El Centro 100%	X= 0.35 g	Y= 0.19 g	Z= 0.17 g
Test #3	Replay of Kobe 100%	X= 0.81g	Y= 0.59 g	Z= 0.33 g
Test #4	Acceleration Reduction of *Chi Chi	X= 1.00 g	Y= 0.50 g	Z= 0.50 g
Test #5	Acceleration Reduction of Kobe	X= 1.00 g	Y= 0.50g	Z= 0.50 g
		Reduction of 80%		

The tests were all successful, and the JQA Representative Mr. Kurashima was very impressed with the performance of the ISO-Base.

*Chi Chi is the name of an area in central Taiwan where a devastating earthquake (M 7.5) hit in September of 1999

Additional Tests

After the JQA testing was completed, the coordinators decided to take the opportunity of being in the NCREE lab and conduct some additional testing of the ISO-Base.

“Live” Server Test:

The first test was a "live" server test where they placed a Sun server inside the rack on an ISO-Base platform. They began the shake table test with 60% amplitude of Kobe, they then increased the test to 80%, and finally up to 100%. After each test, they performed a server check through a computer to verify the server was still running. The screen would read: "OK", "I am still", and "I am here". They then performed a Chi Chi earthquake simulation at 100% amplitude and had the same successful result.

Rubber Liner Test:

The second test was conducted with rubber liners placed on the dishes. The rack placed on the ISO-Base platform weighed 600 kg (approx. 1,200 lbs). The test began with a Kobe earthquake simulation at 80% amplitude; then the amplitude was increased to 100%. The third simulation in this sequence was Chi Chi at 100% amplitude.

After successfully completing all these tests, the rack weight was increased to 1,200 kg (approx. 2,500 lbs). A Kobe simulation was conducted at 100% amplitude and a Chi Chi simulation at 100%. The top platform was lifted to check the condition of the liners after these tests. There was some damage by the ball isolator leaving tracks on the rubber liners, but the ball was resting in the center of the dish in its correct position.

Bolting vs. ISO-Base Test:

The third test was conducted to compare fastening methods and to prove the effectiveness of the ISO-Base. A rack that weighed 1,200 kg (2,500 lbs) was bolted down to the floor of the shake table. A Kobe earthquake simulation was conducted at 100% amplitude and a ChiChi simulation at 100%. In these both tests the rack shook and twisted violently causing the servers and other equipment to fall out of the rack.

This final shake table test proved the fragility of the bolted down fastening method and solidified our belief in the ISO-Base Seismic Isolation Platforms' superiority.

Specifications Inspection Test

After returning to Japan and the USA, the coordinators were required to submit data and graphs for the final report submission. BSI (Best Solutions, Inc.), the importing distributor to Japan, had to complete material and inspection testing criteria based on the following JQA requirements:

- Material Strength Test
- Paint Quality Test
- Paint Adhesive Strength Test
- Rust Test
- Fire Hazard Risk

These tests met the criteria of JQA and were approved.

The final report (some 300 plus pages in Japanese) was submitted to JQA on November 13th, 2002

Final JQA approval and certification was received on November 25th, 2002.

Material Strength Test

The maximum load of 1,500 kg (about 3,300 lbs.) on one platform had to be moved 20,000 times over the Ball 'N Cone dishes. A motion sensor was set up and the load was hand pushed back-and-forth 20,000 times to make sure the ISO-Base would withstand the load and the maximum motions expected during the lifetime usage of the ISO-Base. The requirement is actually based on structural seismic protection meaning buildings (not building contents which are less). The 20,000 movements were calculated at 5 earthquakes per year times 50 movements per earthquake or 250 movements per year. This times 80 years equals 20,000 movements!!! Though Dr. Zoltan Kemeny informed us that it was pure overkill, the good news is that ISO-Base passed with very subtle trace markings left on the dishes. Although there may be new inventions in the next 80 years, the ISO-Base passed a test which says it could possibly be used for that long.

Paint Quality Test

Paint thickness to be less than 20 mm was tested at 100 points on the ISO-Base and passed.

Paint Adhesive Strength Test

Scratches were made in 1x1 mm squares on various points of the ISO-Base and adhesive was touched to see if the paint would come off in the peripheral area of the scratches. The paint remained, and the test passed.

Rust Test

A 3% saltwater solution was applied to the ISO-Base plank for 100 hours. No rust was detected and the test passed.

Fire Hazard Risk

A torch was applied to the ISO-Base to see if any parts would burn. The test passed and the ISO-Base was determined to be heat resistant.



No.1414029

JQA

適合証

株式会社 Bestソリューションズ 殿

製品名： 機器用免震台

製品の型式： 除震装置 ISO-Base™

BEST-IBP 1039

上記の製品は、当機構による検査の結果、「情報処理サービス業
情報システム安全対策実施事業所認定基準」（平成9年通商産業省
告示第406号）、「情報システム安全対策基準」（平成7年通商産
業省告示第518号）及びコンピュータ・セキュリティ関連設備・
機器等検査基準に規定する安全対策処置を講じたものでありコンピ
ュータ・セキュリティ対策製品として有効に機能するものである
ことを認めます。

認定年月日 2002年11月22日

発行年月日 2002年11月27日

財団法人 日本品質保証機構

理事長 佐久間謙司



WorkSafe Technologies would like to thank the team at BSI completing this exhausting work:

Mr. Toru Yamaguchi - Planning & Support Manager
Mr. Tetsuo Watanabe - ISO-Base Senior Consultant
Mr. Yasuaki Sakurai - ISO-Base Engineer

The detail required by JQA was endlessly changing and these three gentlemen worked constantly until the requirements were all satisfied. A job well done and an approval well deserved.

WorkSafe Technologies would like to thank the coordinators and the following individuals for their hospitality and excellent work during the JQA Testing in Taipei:

Synodynamics Enterprise Co. Ltd.	Vincent Chen J.R. Tsao
National Center for Research on Earthquake Engineering	Jenn-Shin Hwang Chin-Hsiung Loh Yin-Nan Huang
KunSin Information Co, Ltd.	Allen Huang Alliy Lu
Japan Quality Assurance Organization.	Tadanori Kurashima
Best Solutions, Inc.	Toru Yamaguchi

INTRODUCTION

The purpose of this testing was to establish product viability to a specified application by the quality control agency indicated on the cover sheet of this report. Specifically, to qualify the IsoBase® Seismic Isolation Platform for use in Japan to isolate server cabinets and similar electronics cabinets or equipment from the harmful accelerations of a worst-case expected seismic event in Japan. Historical earthquakes were replicated on the shake table with a cabinet resting on the isolation platform as noted in the cover sheet.

JQA established the following test criteria:

- 1) The cabinet-platform system shall survive three major earthquakes without failure in either part, overall or overturning. The three quakes selected were:

- a) Taft
- b) El Centro
- c) Kobe

Each was tested at 100% amplitude (intensity).

- 2) The isolation platform shall reduce the input acceleration peak measured on the shake table to an output acceleration peak by at least 80% in the main direction in which direction the selected quakes are to be magnified to 1.0 g peak level. In the other two orthogonal directions, the wave components are to be scaled up to 0.5 g peak level. The main direction shall be horizontal. The selected quake files were:

- a) Kobe
- b) Chi Chi.

- 3) Test results were positive in all respects:

The IsoBase® passed all five tests satisfying the test criteria. The cabinet payload was not specified by JQA, but the cabinet was loaded up to its load bearing capacity. The cabinet's rated load was 700 kg/1544 lbs and its maximum recommended load was 1000 kg/2205 lbs. The five shake table tests were carried out with at least 1500 kg/3308 lbs payload.

JQA set the test criteria to rate the seismic isolation platform and not the cabinet above. Yet, JQA requested that the cabinet as the payload, needed to be a real cabinet, typically used today and that it be tested in the worst-case configuration, i.e. standing alone and not ganged with other cabinets or equipment. Such ganging is common in the industry, but results in much better seismic response than isolated units. The single, stand a lone,

cabinet is more prone to overturning. The isolated cabinet did not over turn in any of the five tests. JQA has set other acceptance criteria (e.g., fatigue) not discussed here.

CABINET SPECIFICATION

Type: MD-8541-30
Make: SinoDynamics, Taiwan
Size: 70 cm wide, 85 cm deep and 203 cm tall
Weight: 140 kg
Materials: Aluminum extruded profiles, sheets (painted tan smooth)
Steel screws and small accessories
Configuration: The lower three shelves were removed to give room for the payload.
Four upper shelves were left with smaller payloads representing servers
Four 12 mm leveler legs were removed to avoid collapse under overload
Main axis: Parallel with the 85 cm sides
Capacity: Rated 700 kg (allowable max. with legs on 1000 kg)

PLATFORM SPECIFICATION

Type: IsoBase®
Make: WorkSafe Technologies, USA
Size: 91 cm wide, 99 cm deep and 7.5 cm tall
Weight: 40 kg
Materials: Tubular steel framing (powder coated black wrinkle), 2 per platform
Stainless steel dishes (26.67 cm square, 3.18 mm thick with ϕ 20.6 cm x 1.59 cm deep central conical recess with cone slope 1:10), 8 per platform
Chrome steel balls (ϕ 4.45 cm), 4 per platform
Configuration: Four corner dishes in 2 coupled planks without rubber dish liners
Plank gripping rubber liners, four under the bottom dishes
Equipment gripping rubber liners, four above the top dishes
Easy assembly framing with field screw attachments
No plank to floor and cabinet to plank bolting, just gravity load
Concentric payload placement
Main axis: Parallel to the 99 cm side
Capacity: 1500 kg gravity load as payload rated (2000 kg max. dynamic overload)
Performance: 1.0 g input max. with 0.2 g output max.

TEST SETUP

The cabinet was equipped with loose lifting straps to an overhead crane in case it overturns. During testing no sign of significant uplift or overturning were observed, and slack in lifting straps was maintained.

The cabinet was loaded over its capacity for anticipating higher and worst-case overloads. 90 % of the 1400 kg/3087 lbs payload was located in the lower half of the cabinet and 10 % in the upper half, both distributed roughly evenly. The lower load was representing the customary lead based batteries, which are always located on the bottom of the cabinets to prevent electronics damage due to acid leaking. The upper load blocks represented servers or other similar electronic equipments. The lower load was stacked up with 54 kg lead slugs and the upper load with 22 kg steel plates. The payload blocks were not bolted to the cabinet shelves. Construction tape was used to monitor payload shifting. At 1g input acceleration level, some payload shifting were observed, and measured to be under 14 mm on the lower level and under 1mm on the upper levels.

INSTRUMENTATION AND PROCESSING

The shake table had its own built in accelerometers in X, Y and Z directions. X was the main horizontal, Y the secondary horizontal (parallel with North) and Z is the vertical axis. Yet accelerometers were used in x, y and z directions on the lower frame of the platform to verify that no slip occurred during the 1.0 g or higher shaking and that the input acceleration of the isolator was the same as the shake table acceleration. After this verification, the accelerometers were either removed from the bottom platform framing, or simply were not recorded, or the recordings were not used. This verification took place on the day before this qualification testing and its details are not reported here. All unreported verification data is kept on file in the laboratory.

The top of the platform have received x, y and z accelerometers in two opposite corners. Data from these two measurements were then averaged to remove torsion from the output data, and the remaining translational data is reported here. Note, that the shake table had no torsional input components. Original files, before averaging of these channels are also kept on file in the lab.

At JQA's request, the cabinet was instrumented with 3D accelerometers at the bottom, at the mid height and at the top (shelf). For the x, y and z directions and the channel designations of the setup (platform and cabinet) instrumentation, please see Fig.1. Please notice, that the cabinet mounted accelerometers were located at one corner --not at the center-- thus these channels contain torsional accelerations, which amplifies the translational ones. The cabinet mounted accelerometers were mounted just for reference and curiosity. These measurements are not part of this qualification process. Never the less, when comparing these measurements, it is apparent that --due to the cabinet flexibility--the accelerations received at the cabinet based are amplified on any higher elevation, but not more than twice. At JQA's request, time histories of these cabinet accelerations are also reported here.

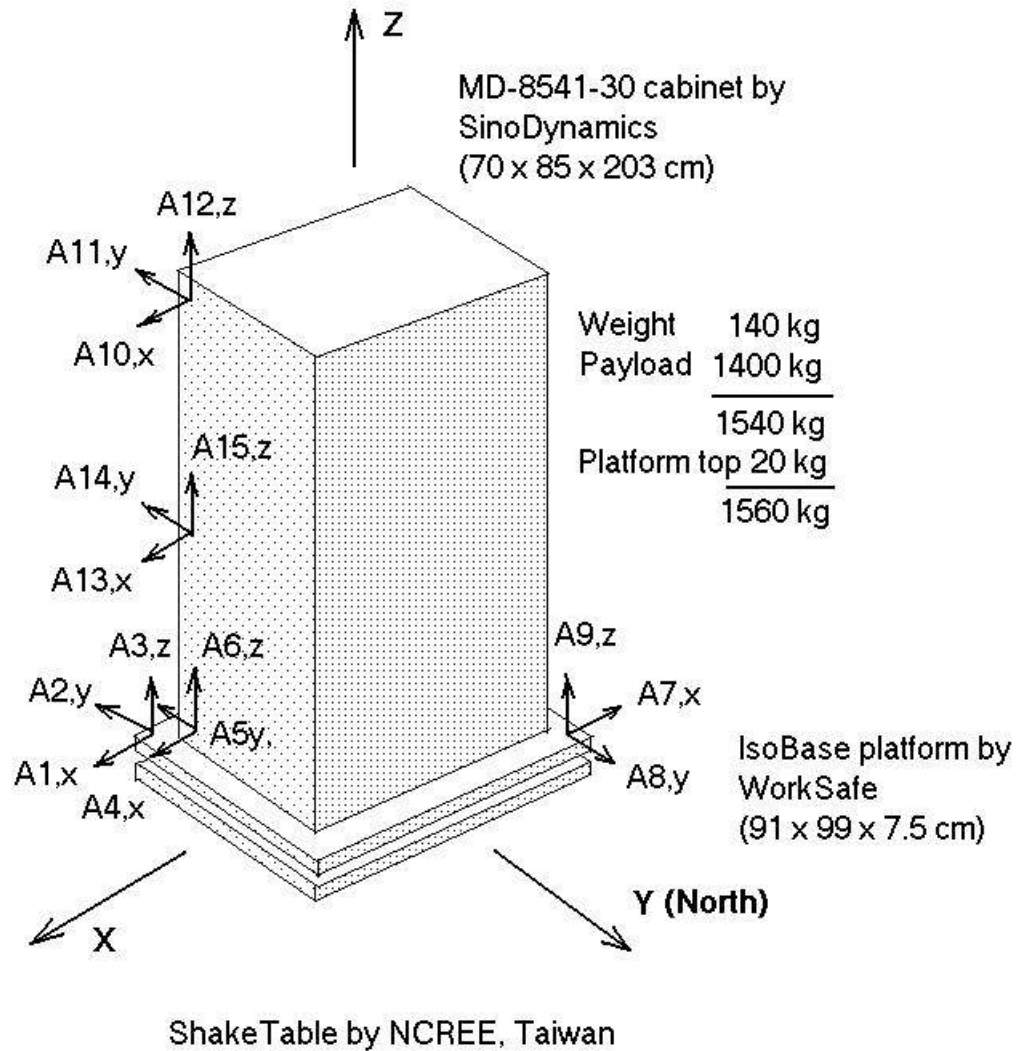


Figure 1. General Layout and Instrumentation Designation

Since the preliminary and calibration test results demonstrated an isolator response having a long period, slow oscillation of high amplitude with superimposed short period, quick oscillation, data fidelity had to be restored by filtering out the high frequency cabinet response from the low frequency isolator response. This processing did not affect the response amplitudes in any significant magnitude, but resulted in a true, smooth isolator response, and the one, which was obtained before with rigid payload. Fig. 2 illustrates this filtering effect. Again, the original, unfiltered files are kept on file as customary.

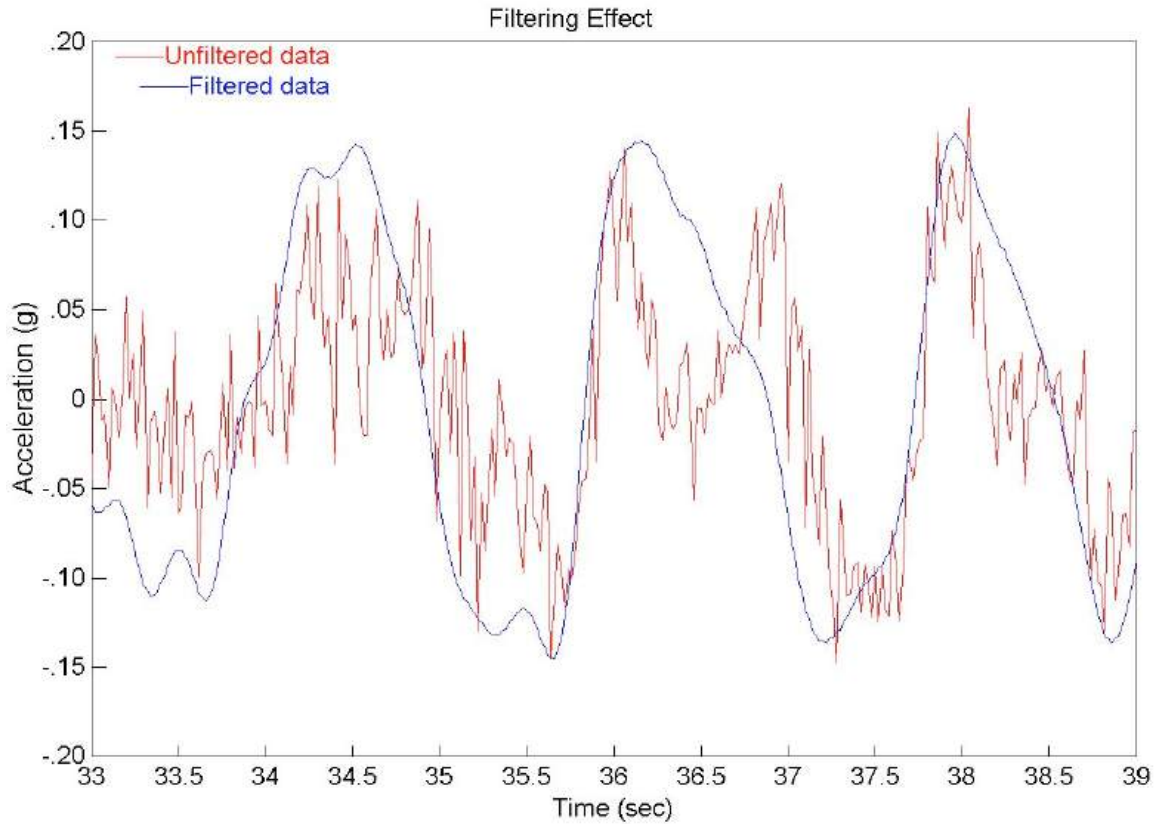


Figure 2. The Marginal Effect of Data Filtering for Data Fidelity Restoration

TEST RESULTS

The IsoBase® Seismic Isolation Platform passed the test, satisfying all shake table test requirements set by JQA.

As a result of being recorded in the northern hemisphere, all the ground shaking followed cloverleaf-like quick orbit in counterclockwise fashion. As a result of having central symmetric restoring capacity, the isolation platform responded to all these excitements with a right-handed elliptical slow orbital movement. That is, the instantaneous and the cumulative isolator movements were opposing that of the ground movements. Typical orbital movements are shown in Fig. 3.

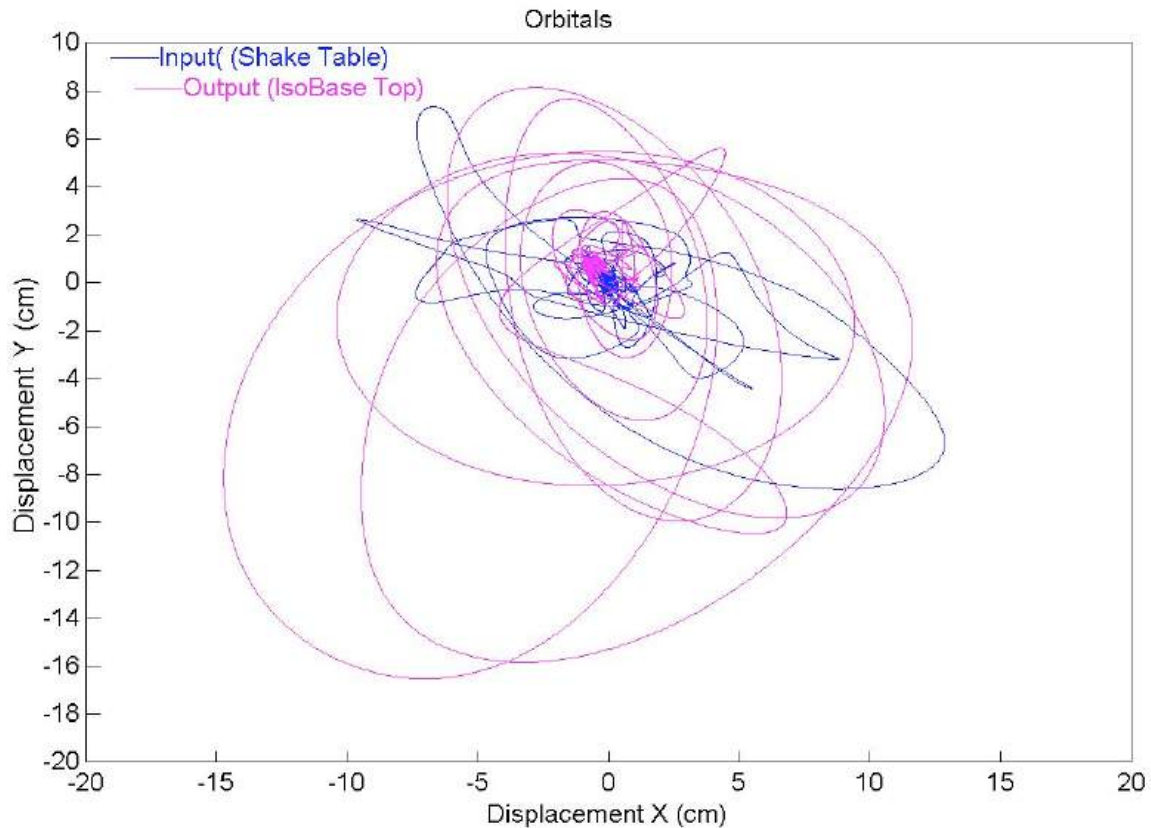


Figure 3. Typical Ground Shaking and Isolator Movement Orbits Compared

The typical ground shaking hysteresis were crown like and the isolator hysteresis were showing characteristics of an elasto-plastic isolator with high damping. Fig. 4 illustrates the input and output hysteresis superimposed. Notice the large (over 80%) seismic force reduction on the cabinet base due to isolation. The isolator hysteresis is enlarged in Fig. 5 for demonstrating its characteristics. The virtually zero tangential stiffness at high secant stiffness appears to be a slip characteristic, but in the IsoBase®, it is the result of rolling “friction” (resistance), which is due to the Ball-N-Cone® isolation bearing’s natural mechanism. The source of damping is not friction, but the yielding of the dish at ball tracking.

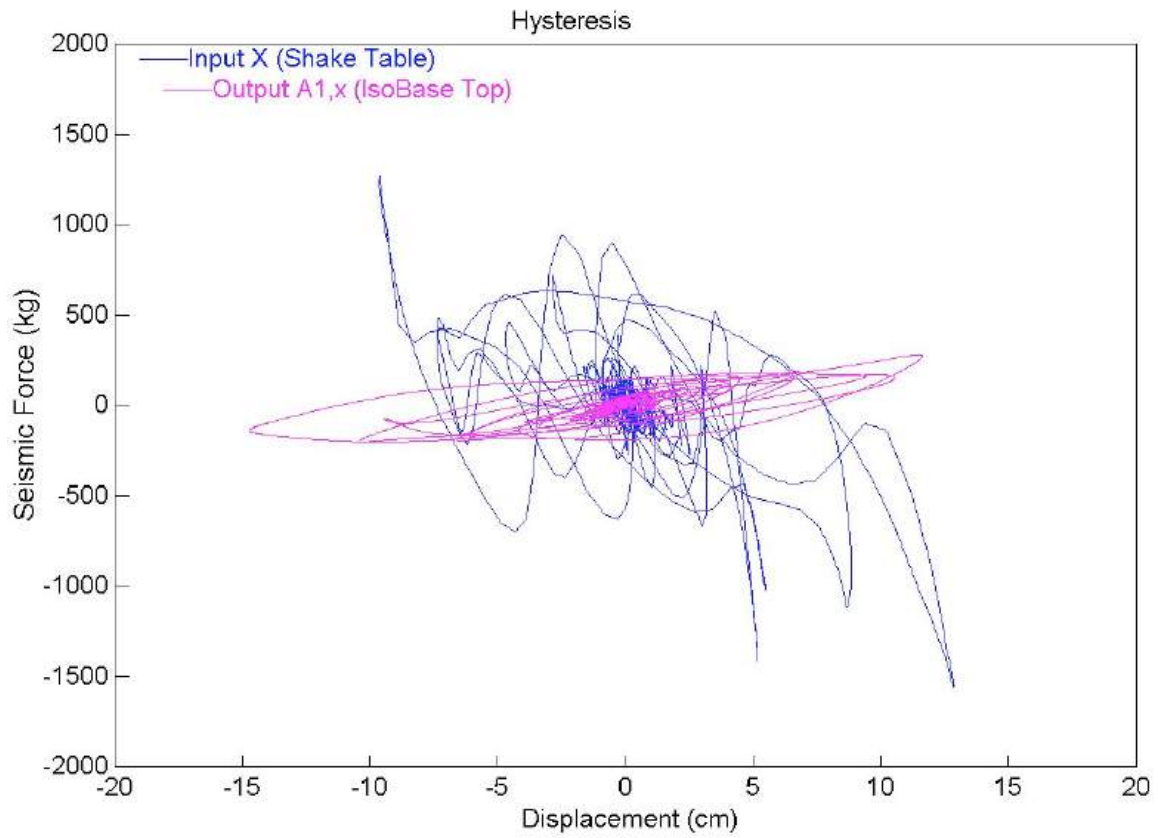


Figure 4. Ground and Isolator Seismic Force-Deformation Plots Superimposed

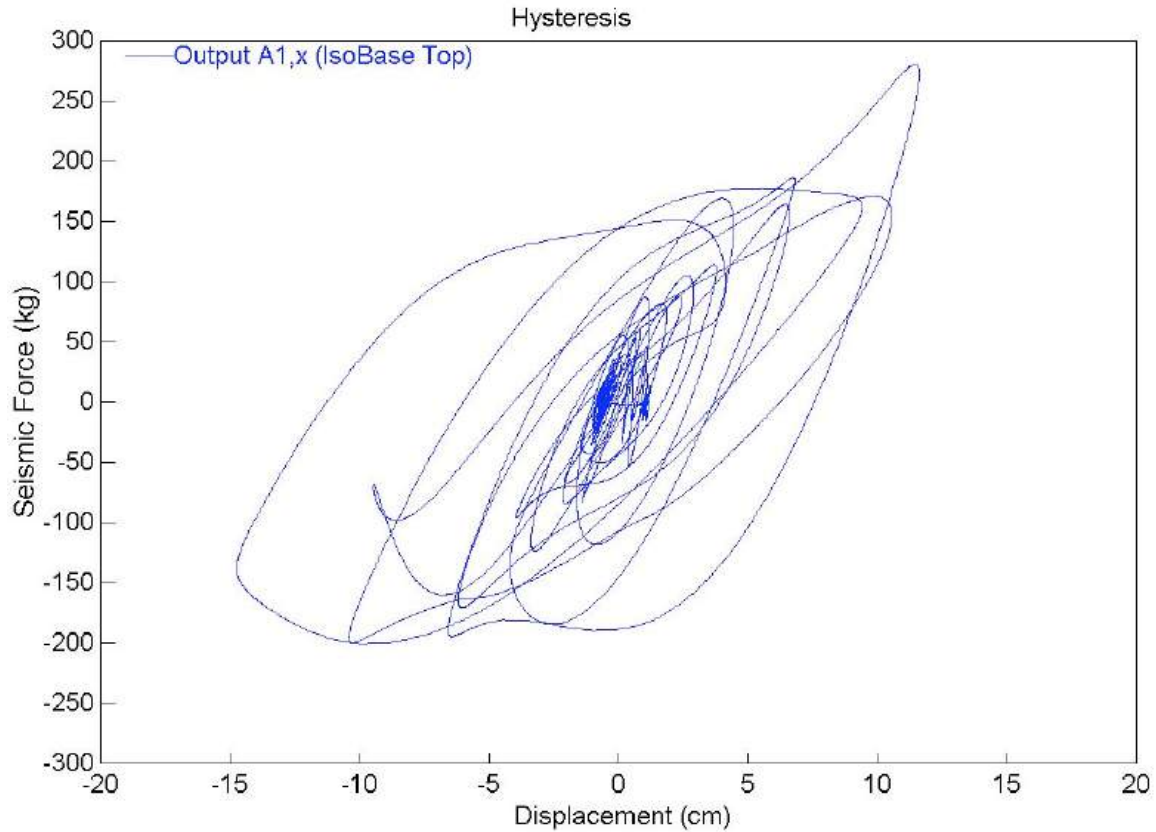


Figure 5. Isolator Hysteresis for Revealing True Isolator Characteristics

The typical acceleration input and output time histories are compared in Fig. 6 and 7. Again, notice the large amplitude reduction due to isolation. Remember that acceleration, times mass, equals force. (See Newton's Second Law of Motion.) Thus, in reality, all acceleration plots are seismic load (force) plots. Fig. 6 illustrates the main and Fig. 7 the secondary direction recordings.

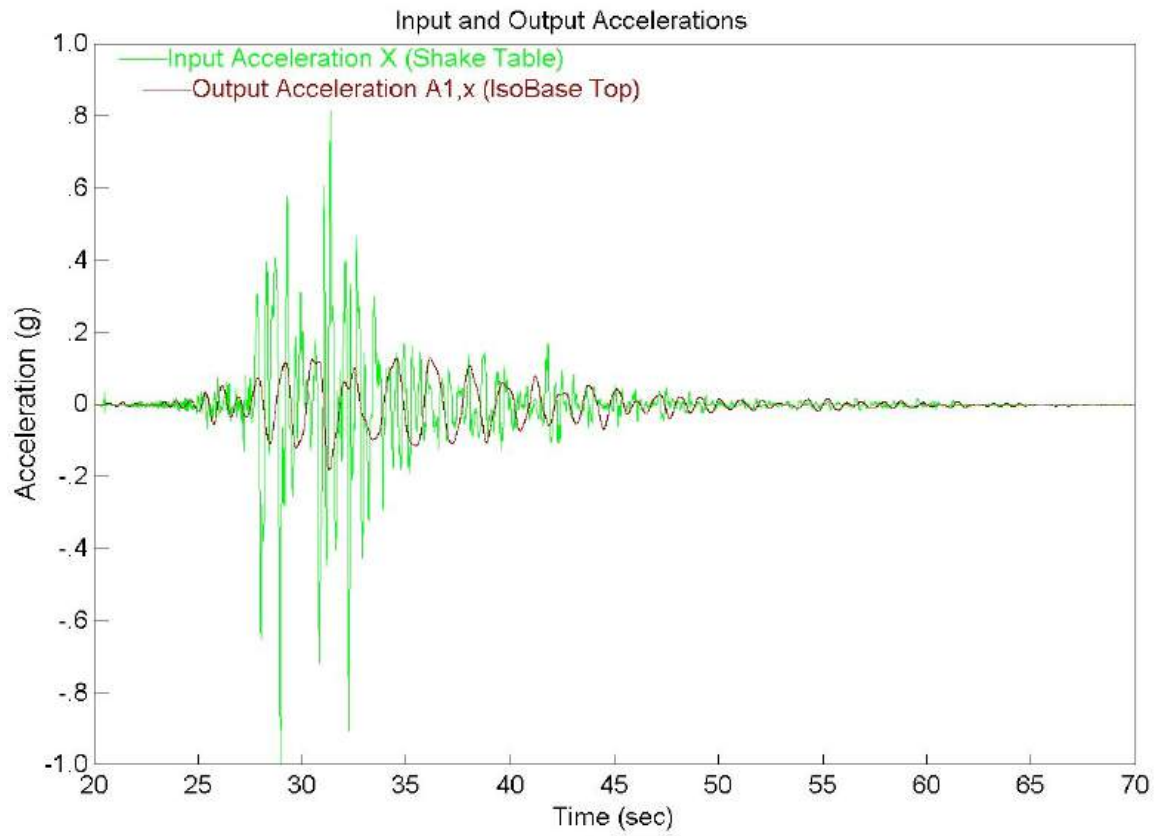


Figure 6. Typical Main Direction Input-Output Accelerations Compared

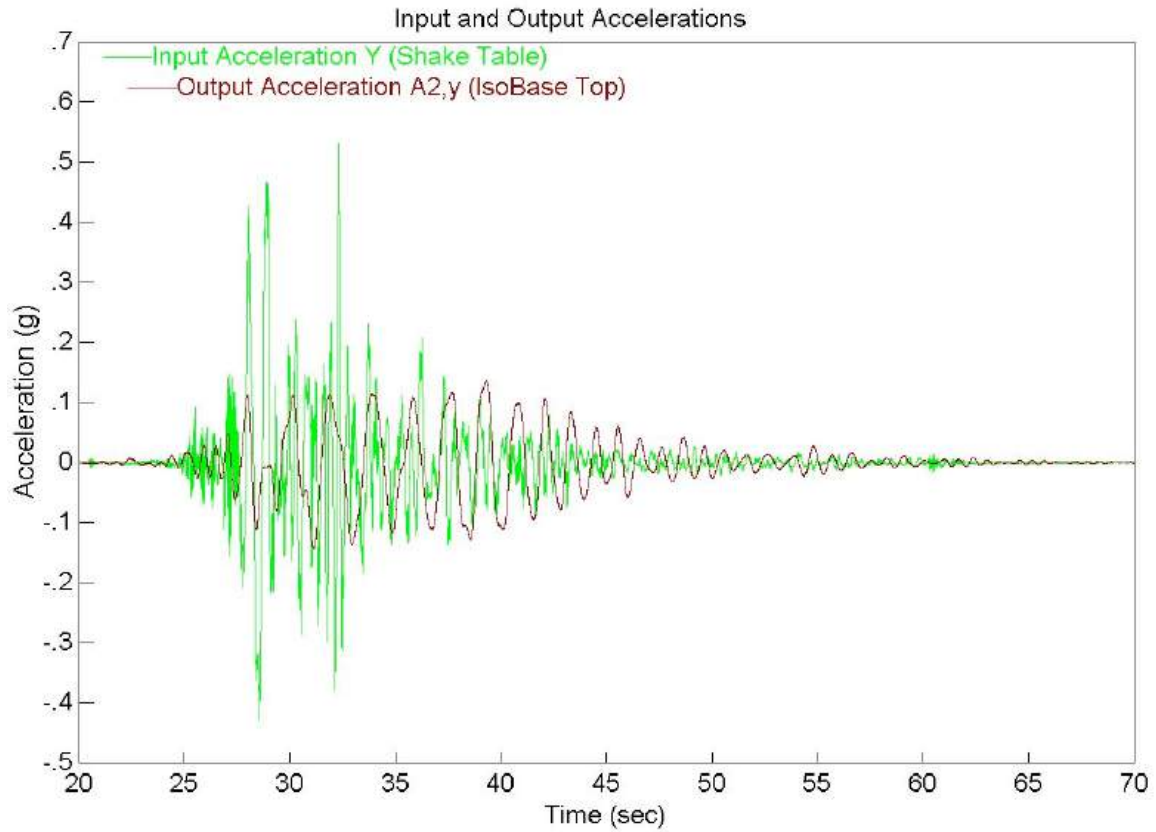


Figure 7. Typical Secondary Direction Input-Output Accelerations Compared

The frequency contents of these four recordings are illustrated in Fig. 8 and 9. The directions are clearly labeled in the plots. Please, refer to Fig. 1 for channel designations. These spectra demonstrate excellent seismic isolator response. For convenience, all spectra reported here are plot in PSD (Power Spectral Density) scale.

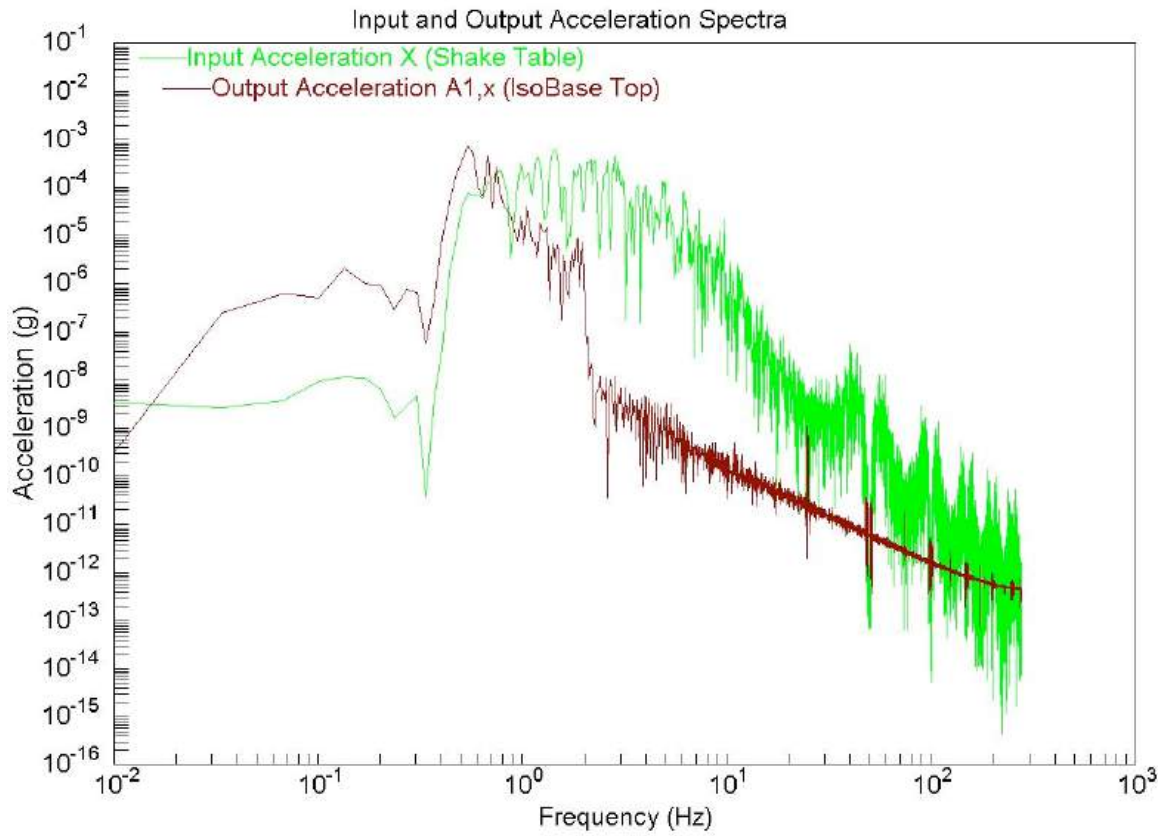


Figure 8. Spectral Content of Typical Main Direction Input-Output Accelerations

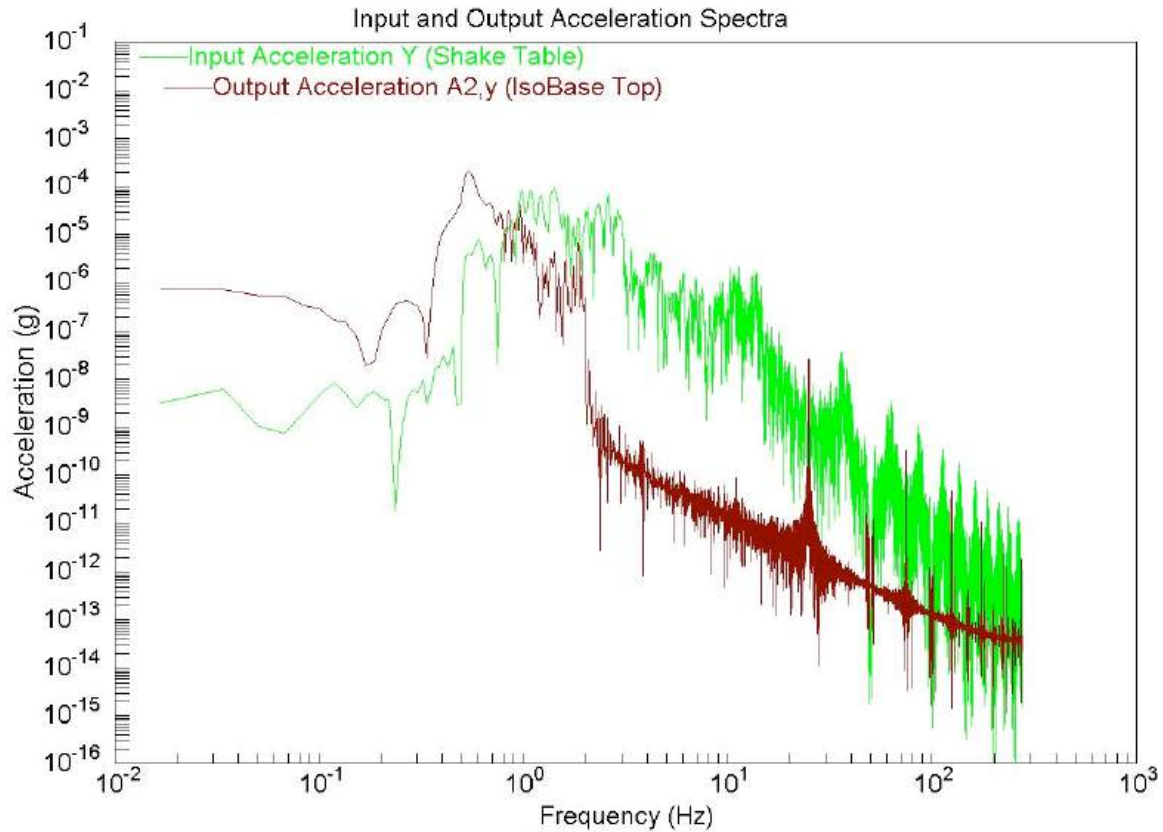


Figure 9. Spectral Content of Typical Secondary Direction Input-Output Accelerations

For all practical purposes, all building codes neglect the effect of vertical seismicity on structures, including seismic isolators. However, since the IsoBase® is not a building isolator, at JQA's request, the vertical isolator responses are also reported here.

Fig. 10 illustrates the vertical input-output accelerations compared, and Fig. 11 their spectra. Again, although it is not claimed, the isolator greatly reduces vertical seismic accelerations and thus seismic forces. These forces add or subtract to the payload weight, and for having less than 1.0 g peak, for all practical purposes, have inconsequential weight differences during seismicity.

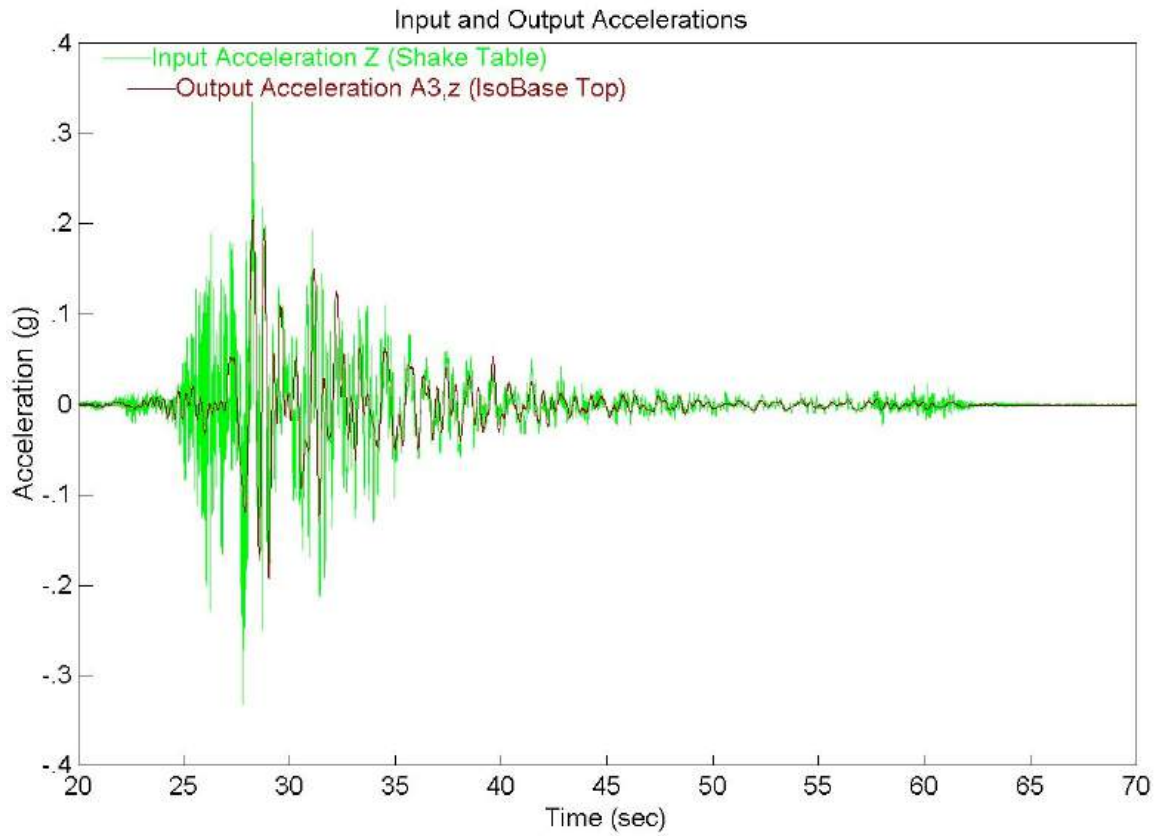


Figure 10. Typical Vertical Input-Output Accelerations Compared

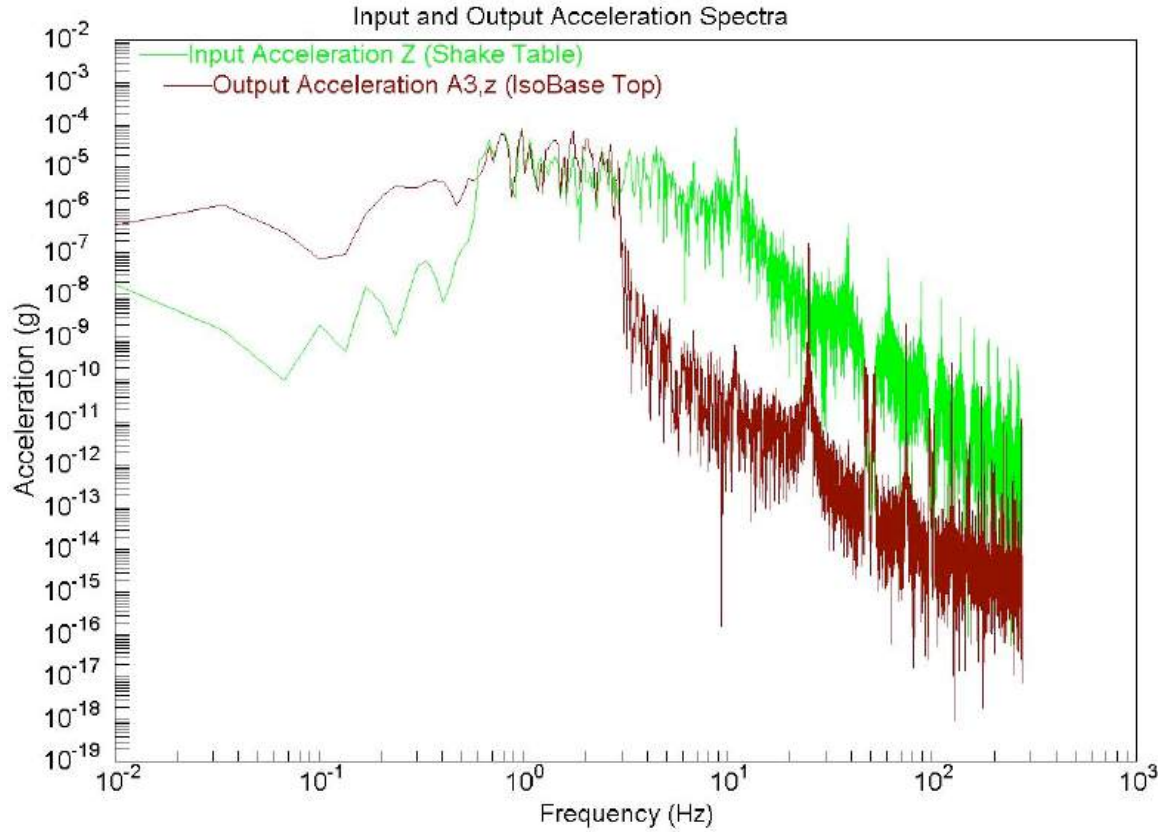
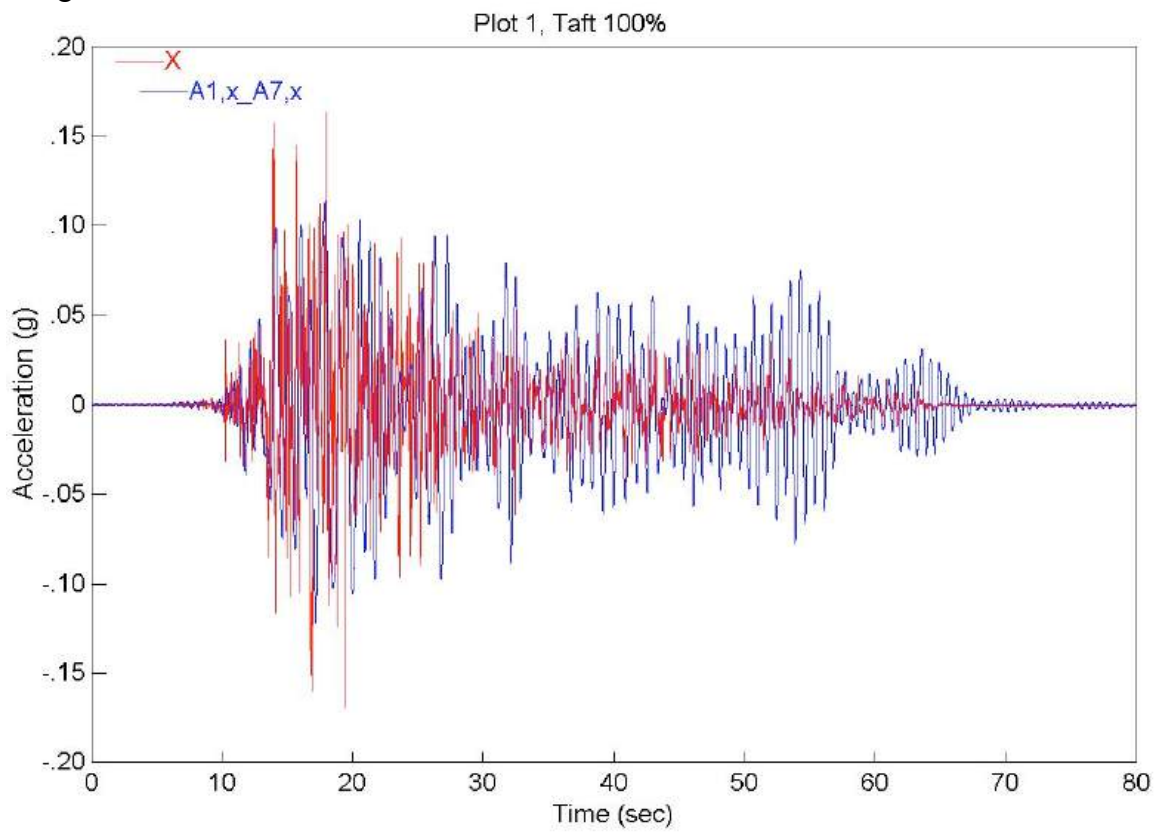


Figure 11. Spectral Content of Typical Vertical Input-Output Accelerations

The difference between the seismic forces measured on the isolator top and on the cabinet bottom is the force, which if it exceeds the cabinet weight times the friction coefficient of the isolator top, it would result in cabinet slip over the unanchored isolator. These forces have been found to be marginal, far from the level of force ensured by static friction. Therefore, slip did not occur and were not observed. To illustrate this, Fig. 12 and 13 is presented, illustrating marginal acceleration differences in the main and in the secondary direction respectively.

numbered and labeled within. Please refer to Fig. 1 for channel directions and designations.



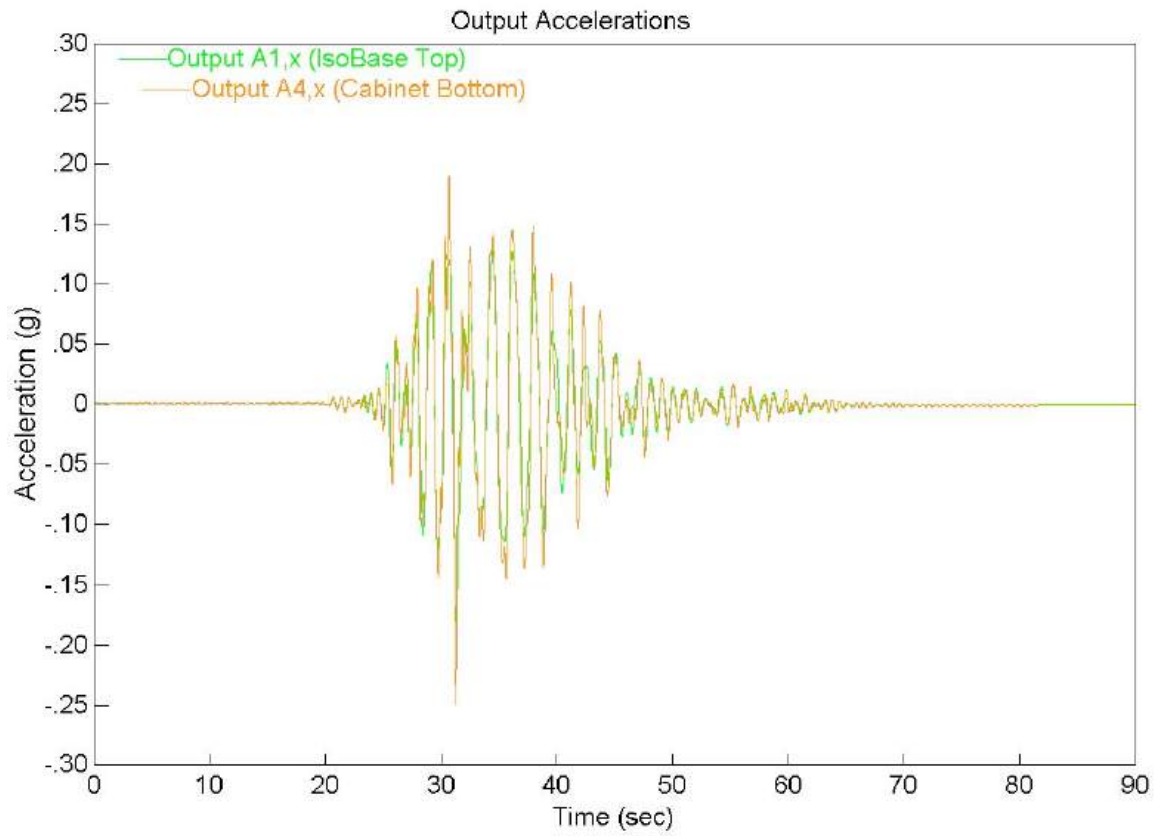


Figure 12. No Cabinet Slip in the Main Direction over the Isolation Platform

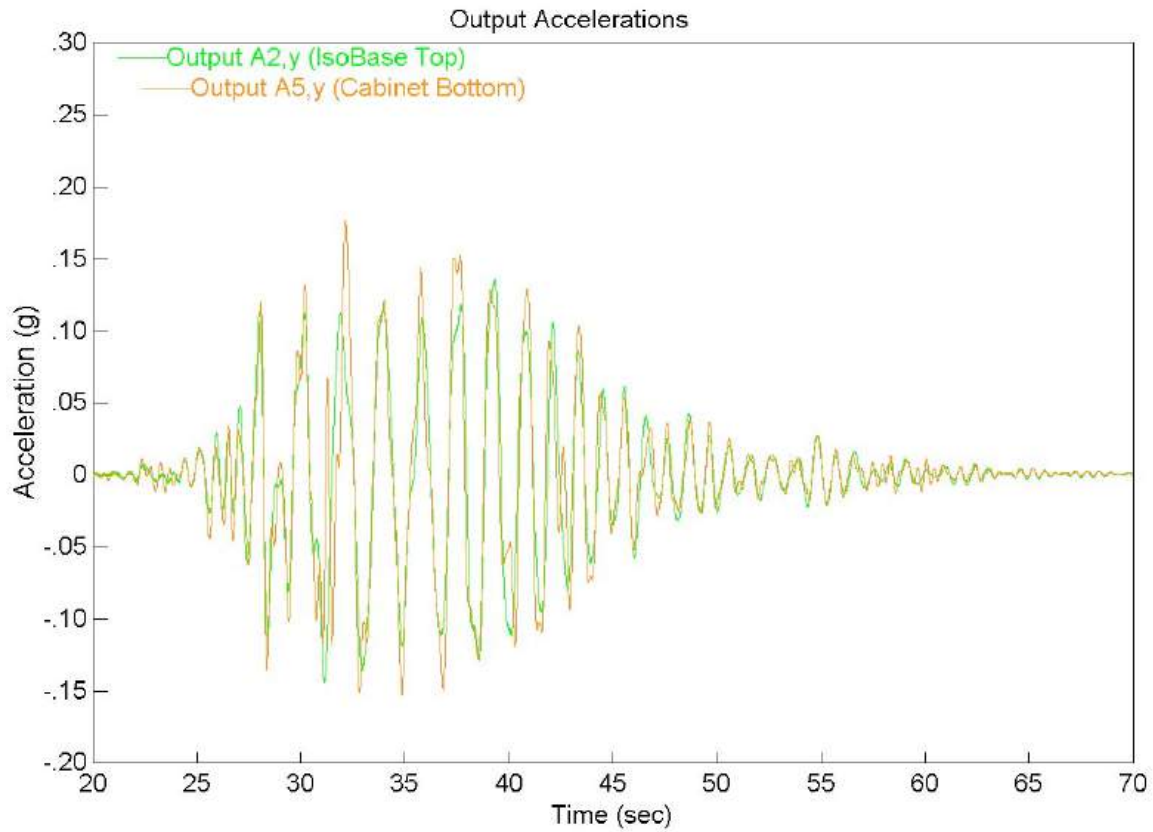


Figure 13. No Cabinet Slip in the Secondary Direction over the Isolation Platform

Similarly, there was no cabinet uplift (measurable or observable) over the isolation platform. See Fig. 14.

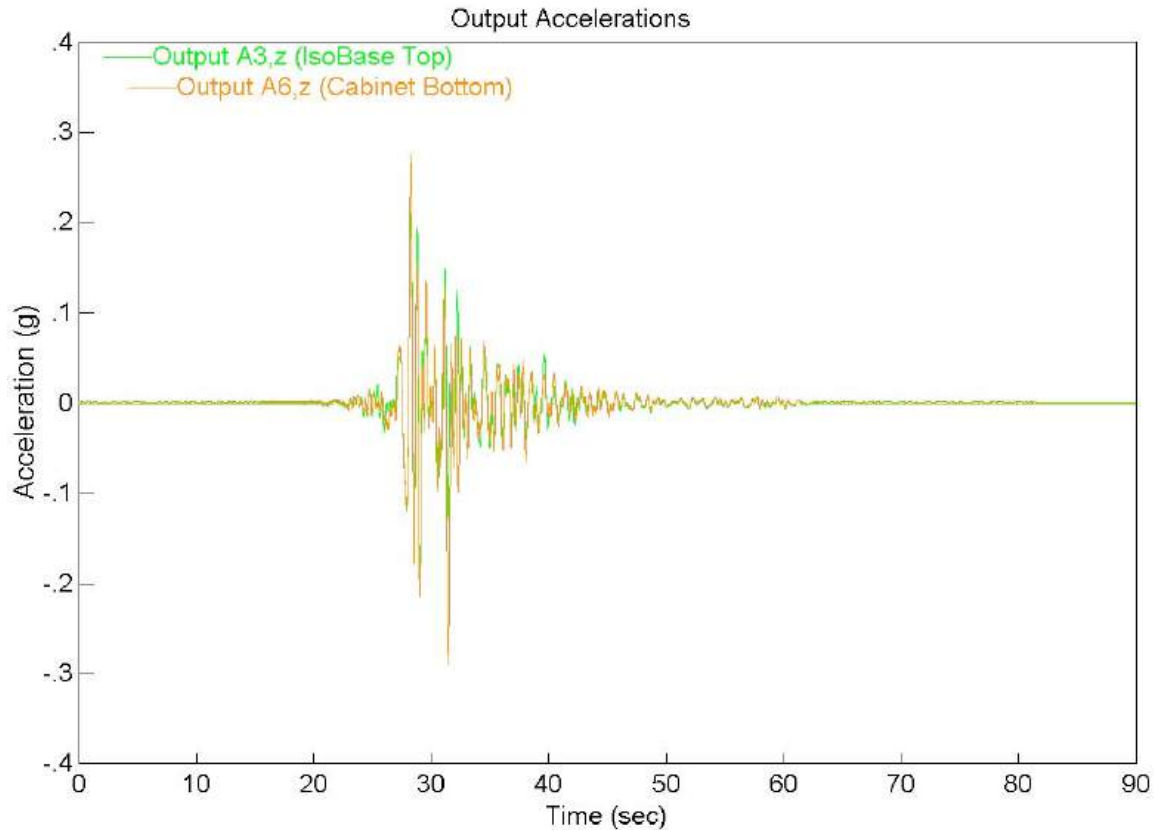
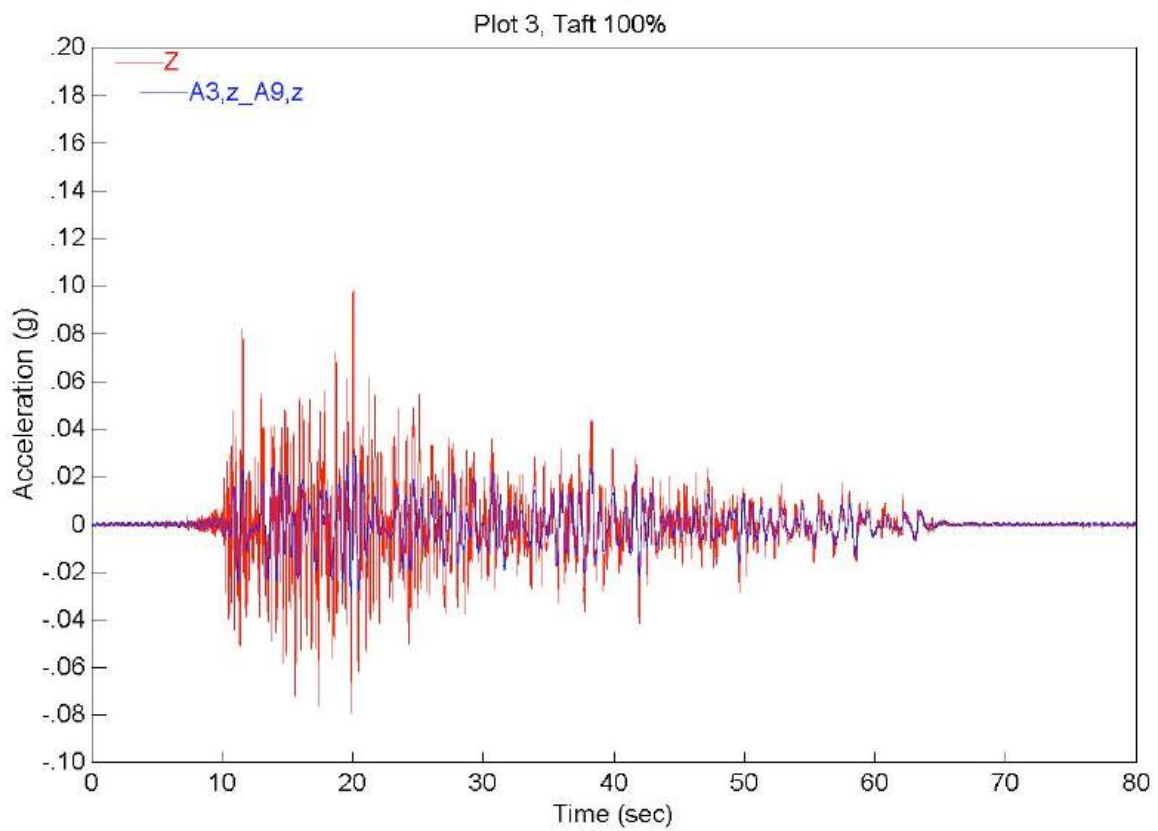
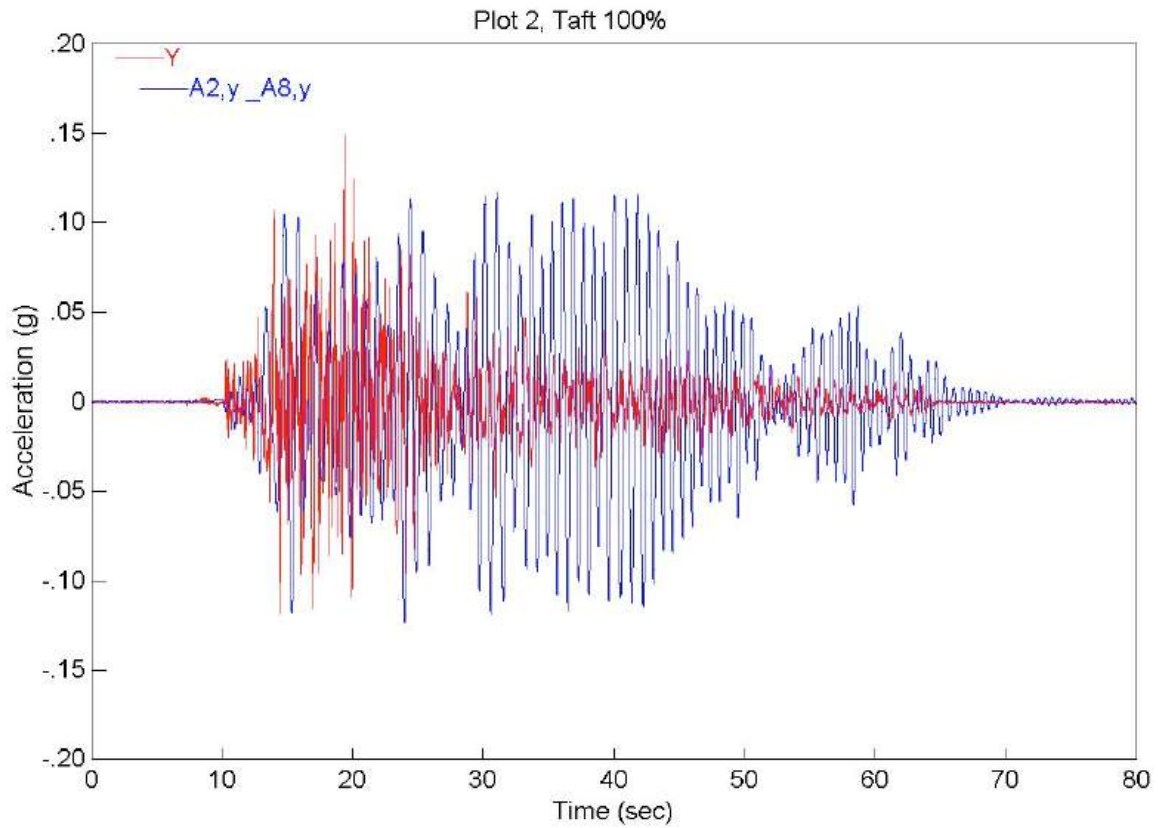


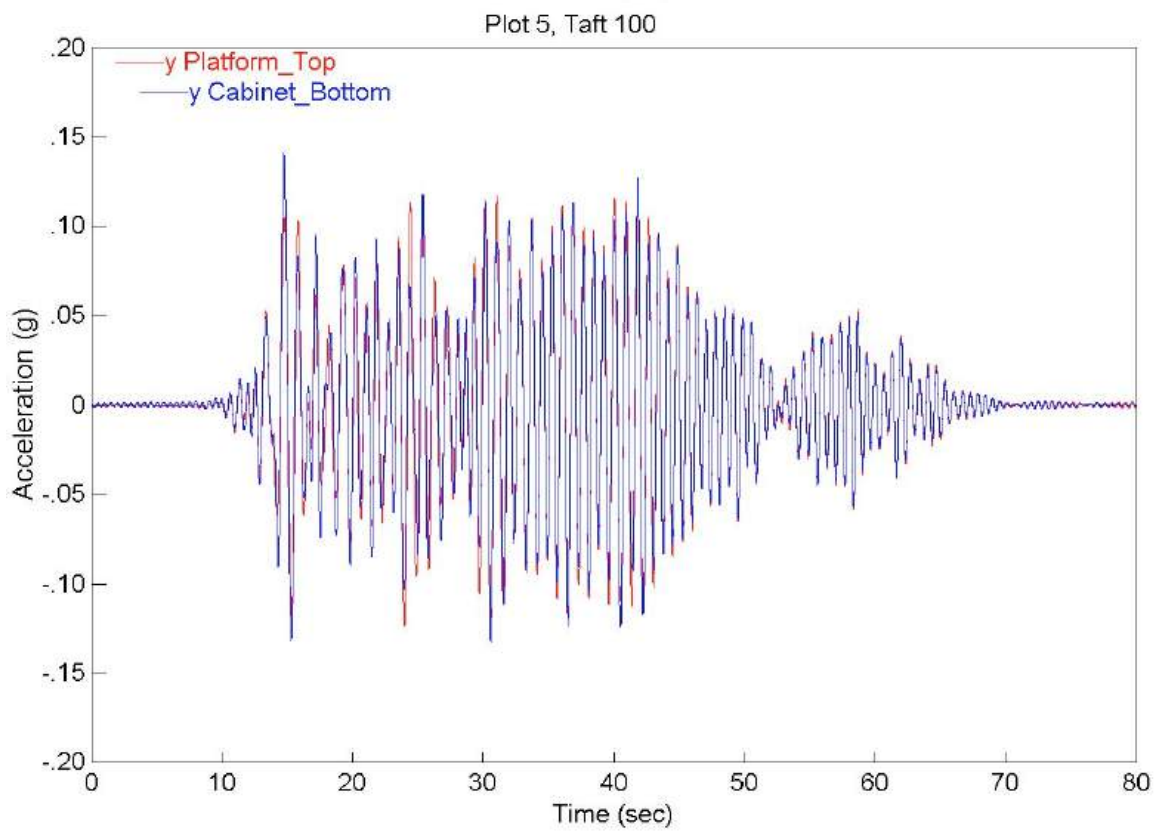
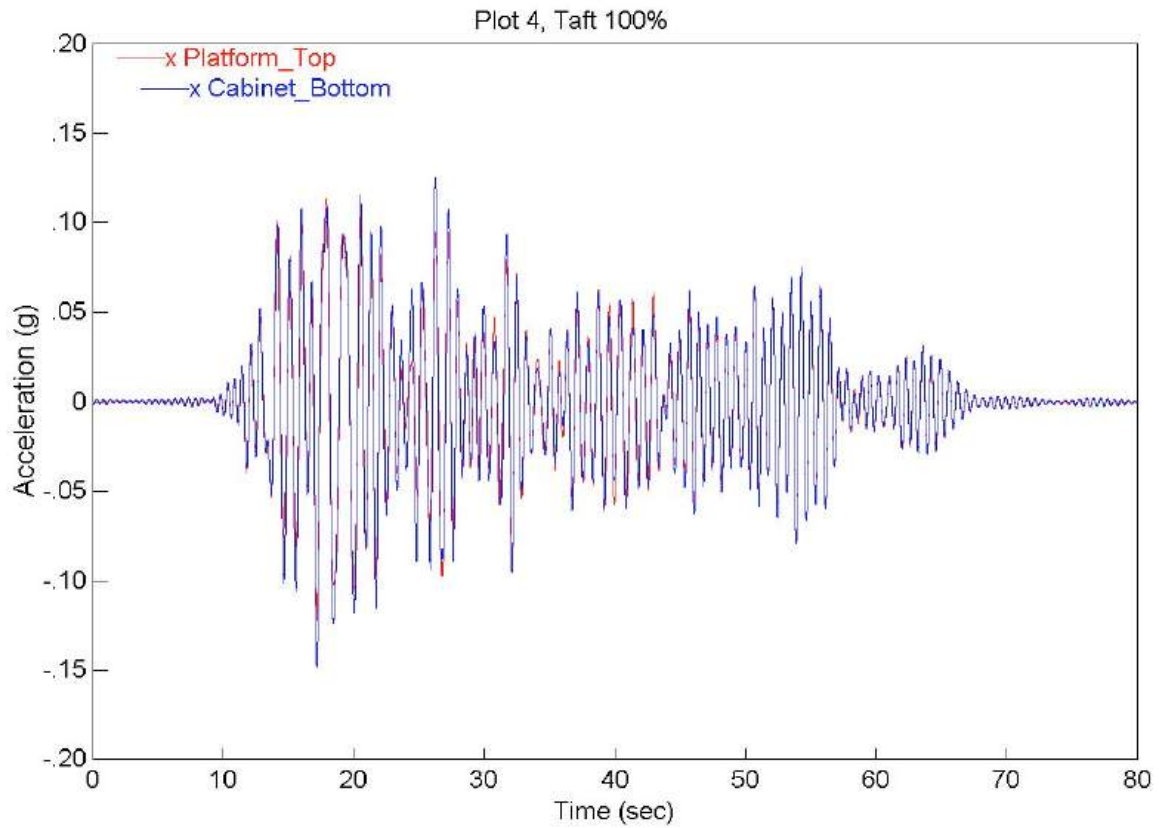
Figure 14. No Cabinet Uplift over the Isolation Platform

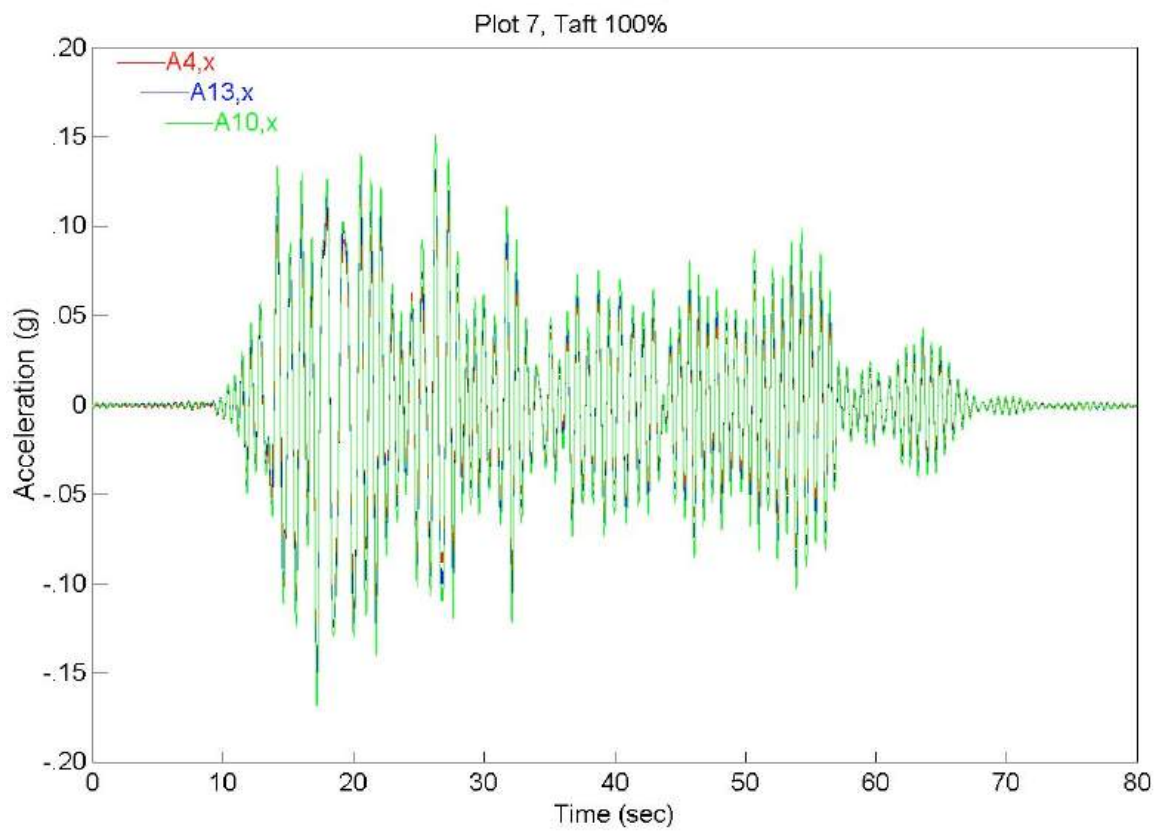
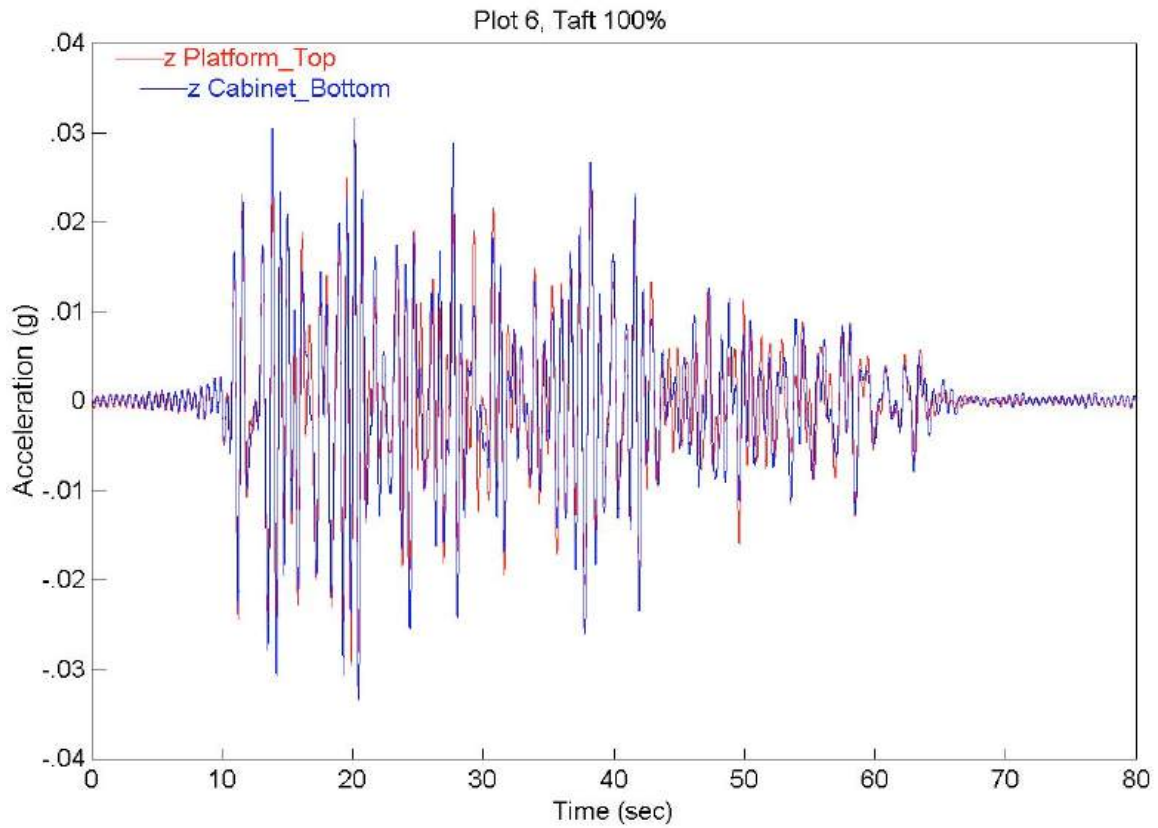
Please note, that slip could have occurred only if the difference between the accelerations measured in the same direction would have been larger than 0.45 g. All such differences were less than 0.07 g. Similarly, uplift would have occurred if the difference between the accelerations measured on the isolator top and on the cabinet bottom would have been larger than 1.0 g. All such differences were less than 0.08 g.

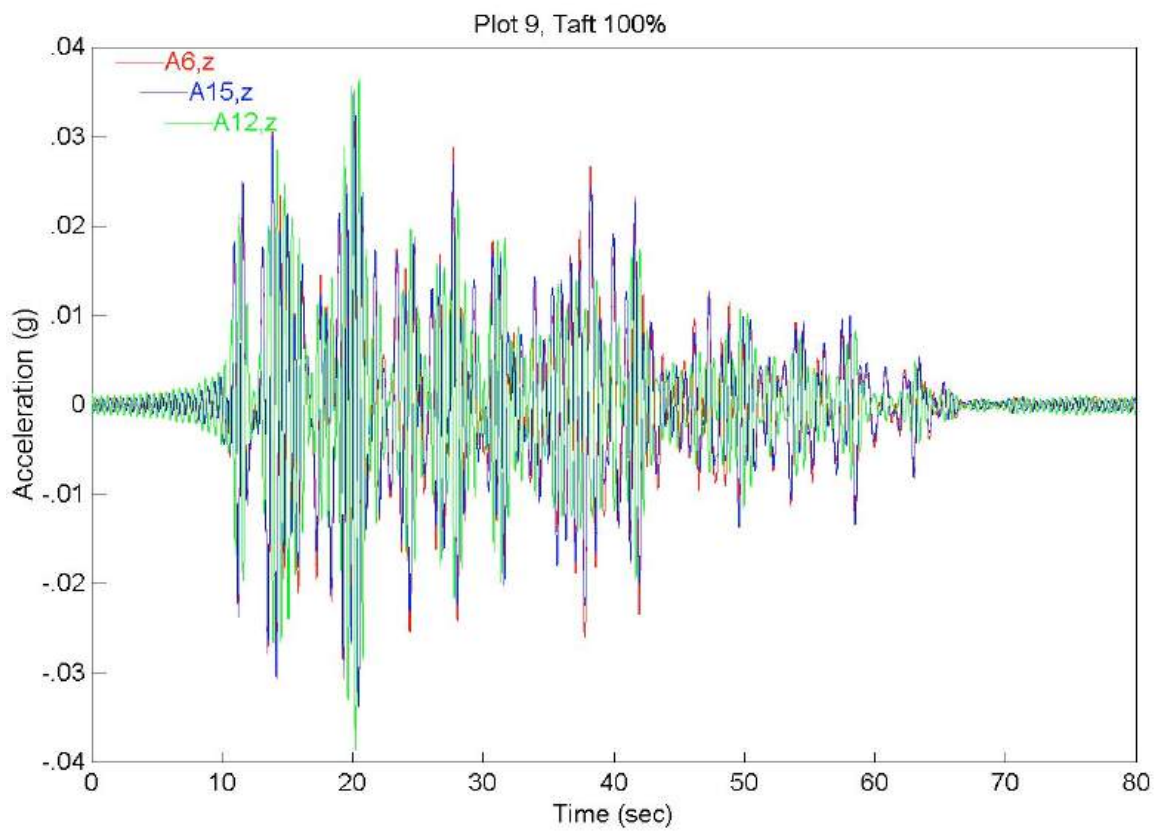
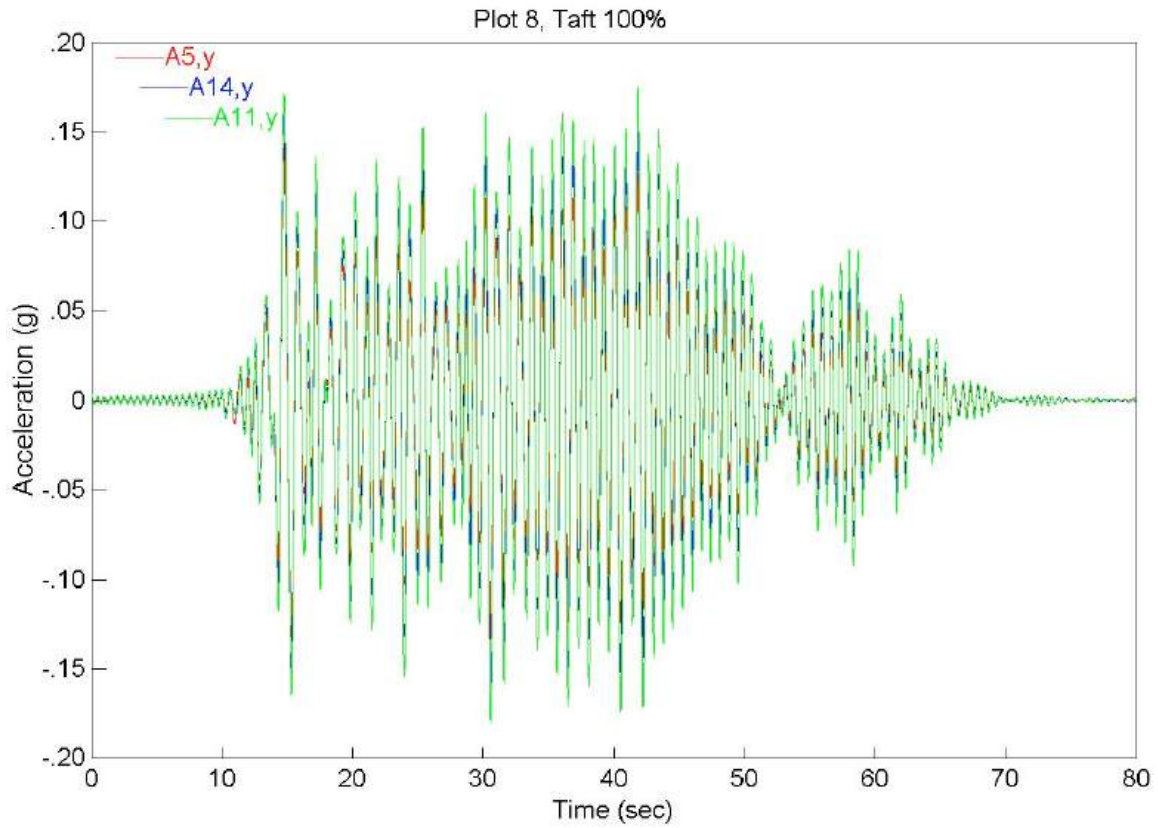
These measurements and plots illustrate, why the IsoBase® Seismic Isolation Platform need no anchorage on neither its bottom (to the ground or floor), nor on its top (to the cabinet or payload).

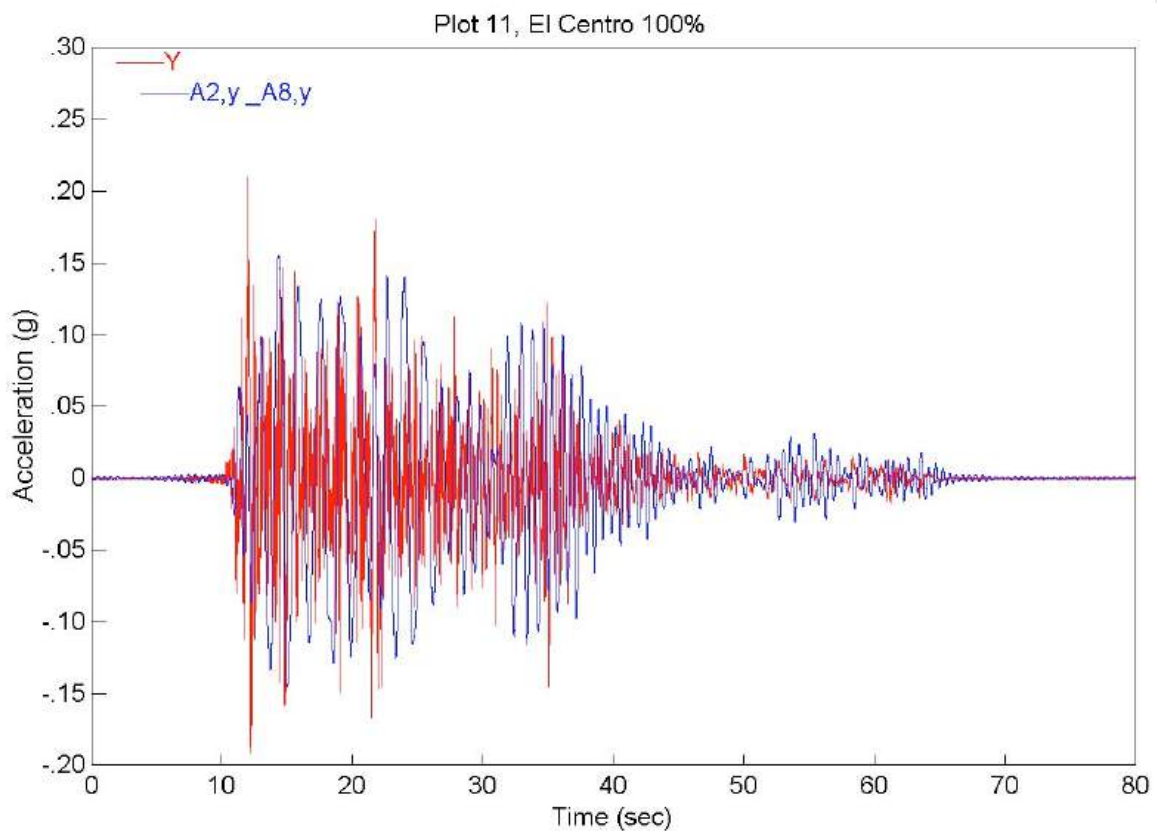
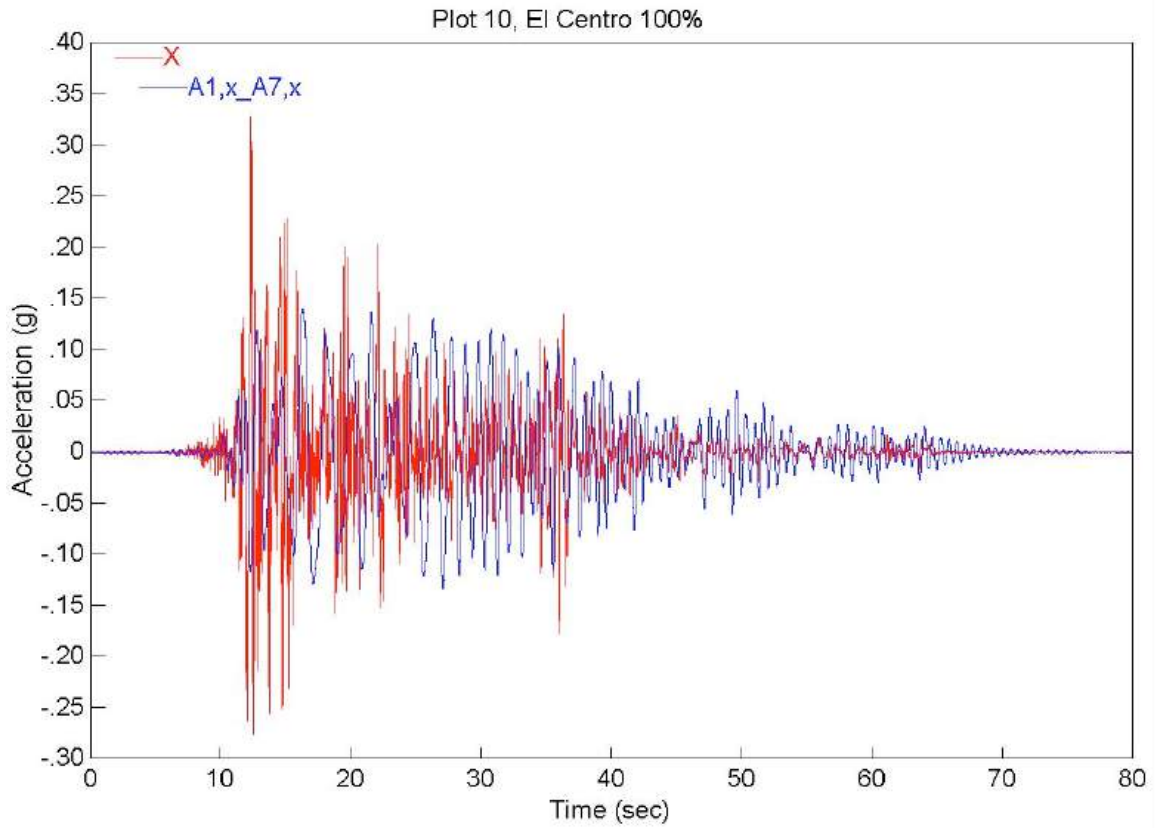
The typical isolation responses have been demonstrated using the Kobe 1.0 g testing files. The Chi Chi files would show the same even more favorably. Instead of repeating such a demonstration, in the following we will present all the channel recordings compared or alone as needed in time history plots. When the real time recording was long, we have truncated the head and tail as needed to cut out zero excitation and response. That way the plots are usable for comparisons. Please note, that all plots use auto scaling for convenience. In order to not break the logic of the sequence of these plots, some plots from the Kobe 1.0 g testing will be repeated. The plots will not be annotated, but

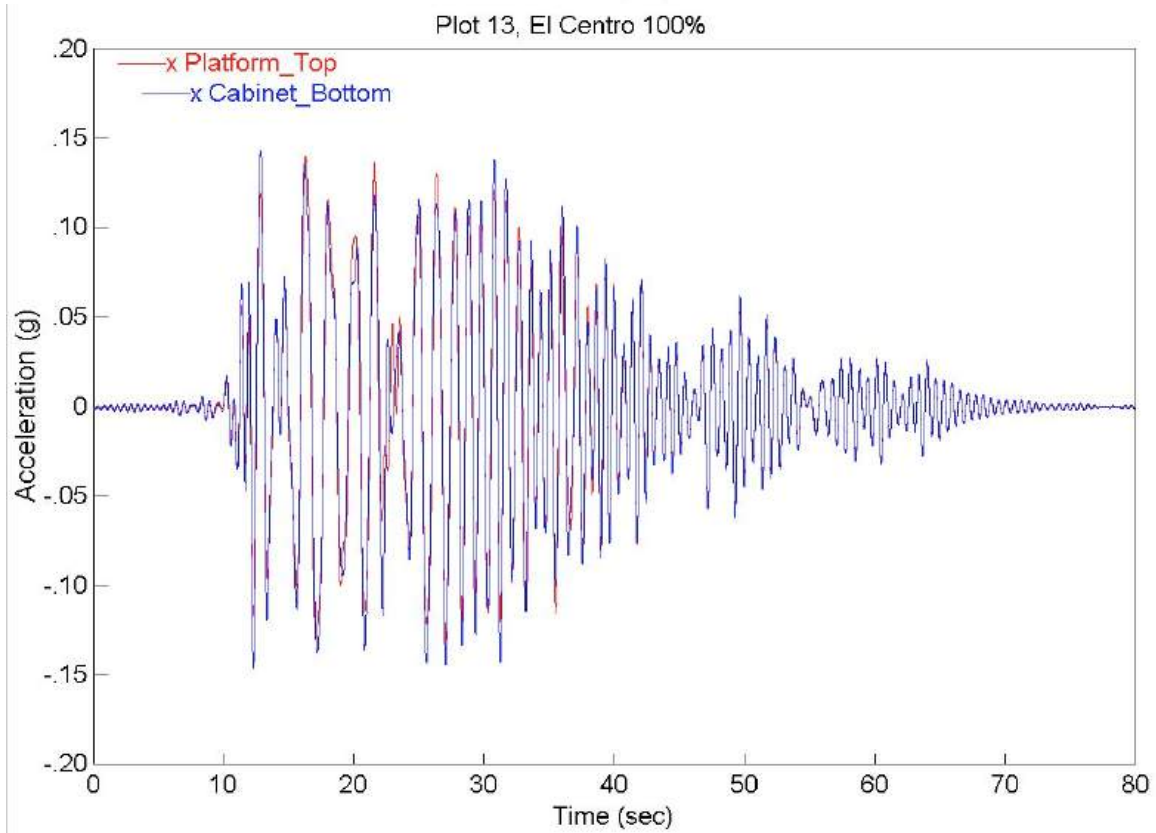
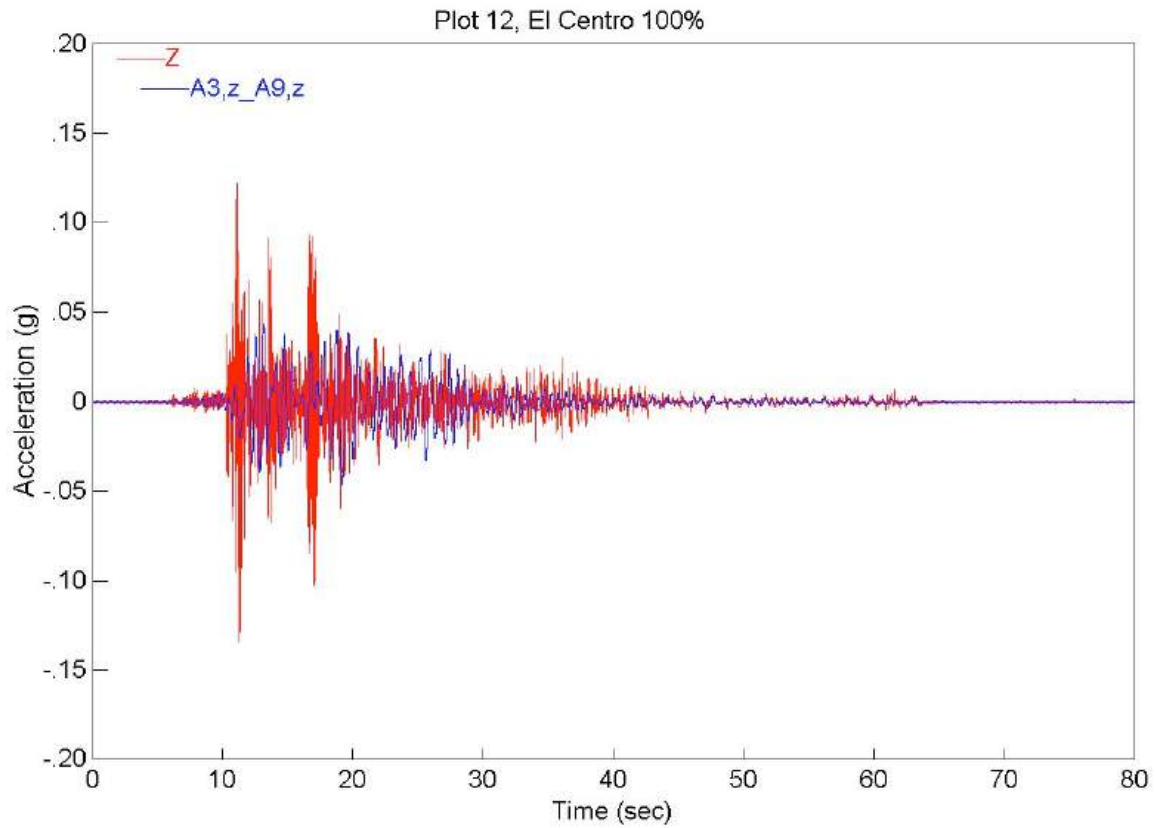


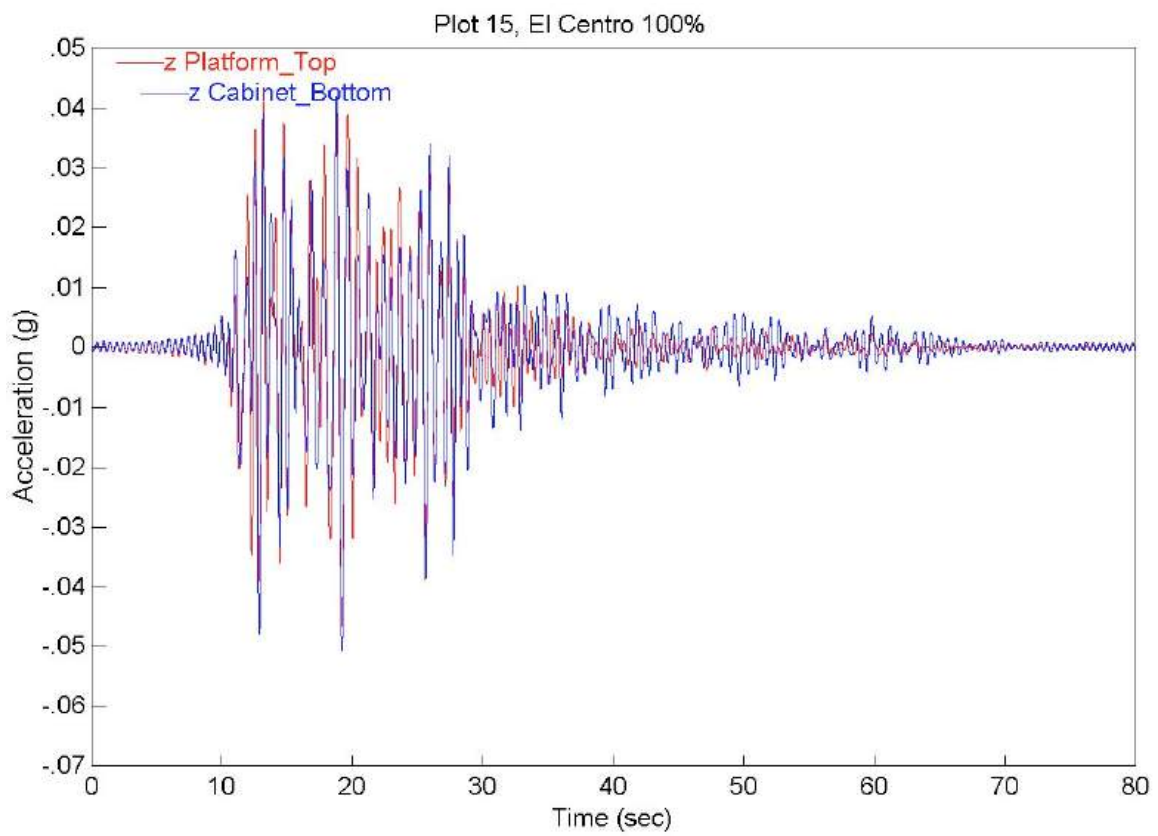
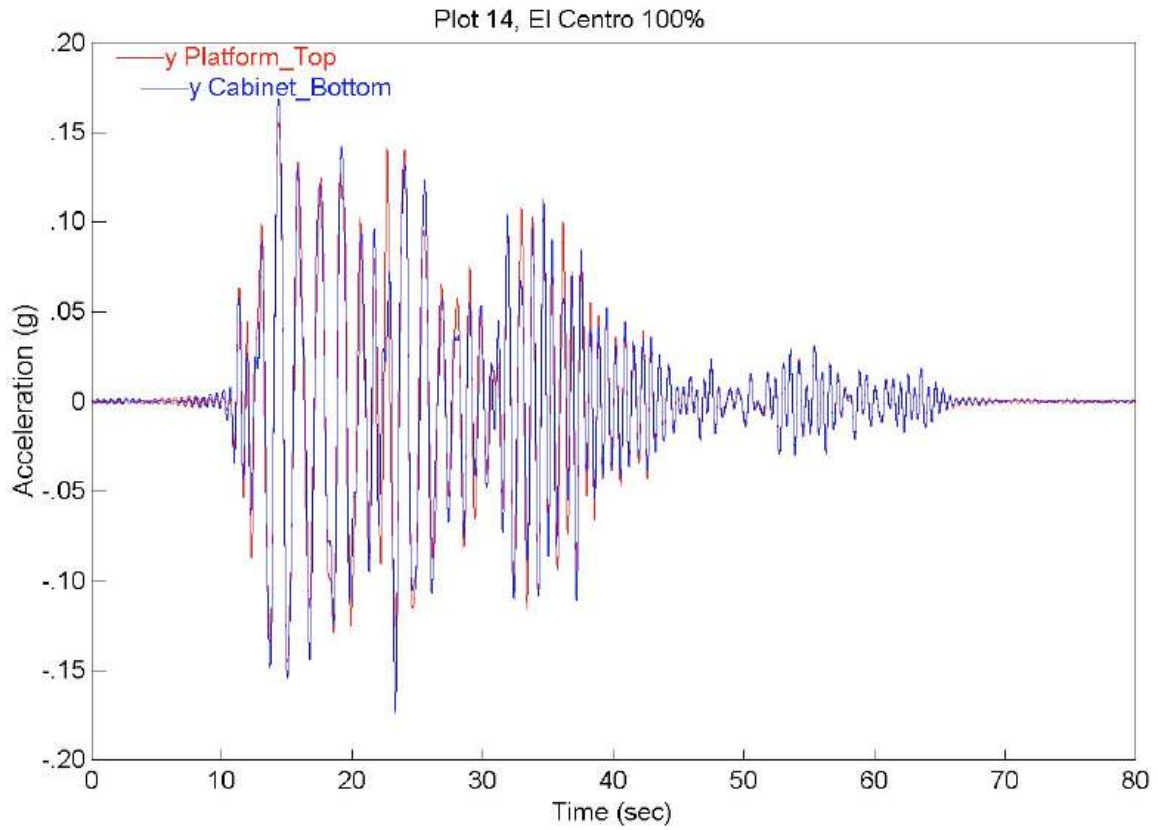


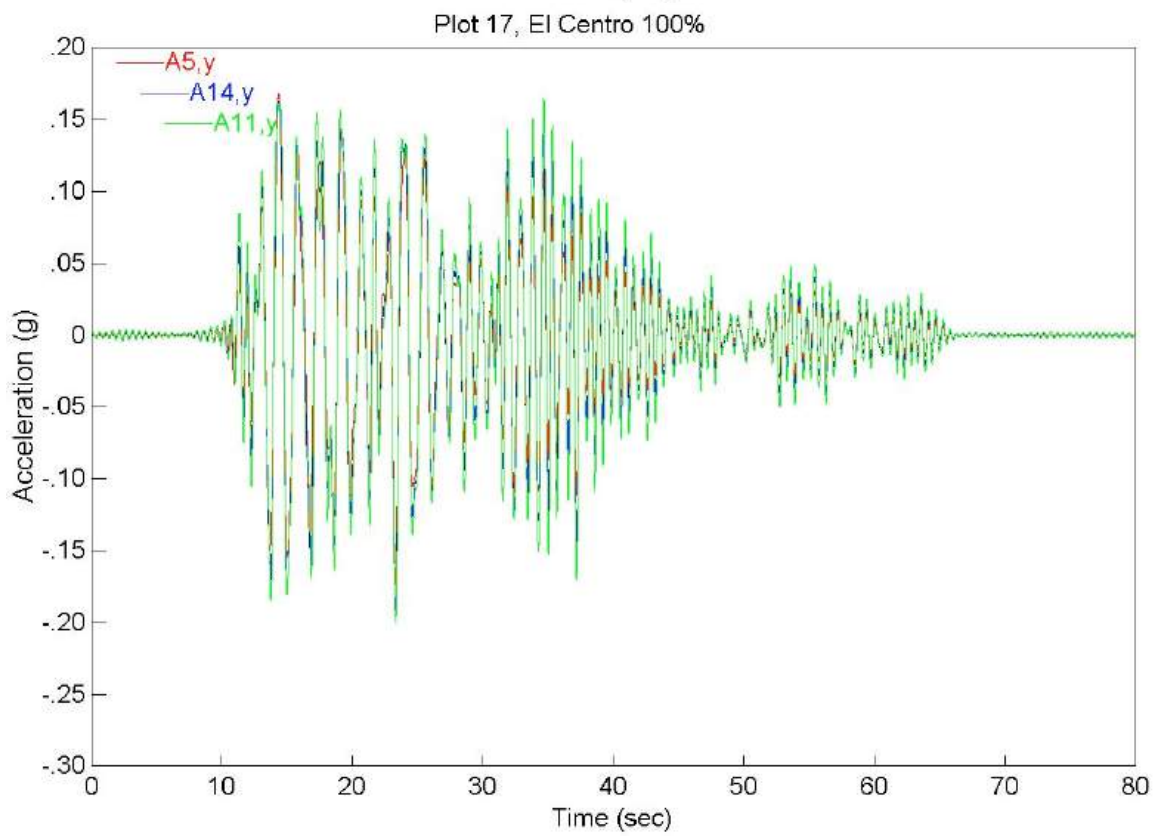
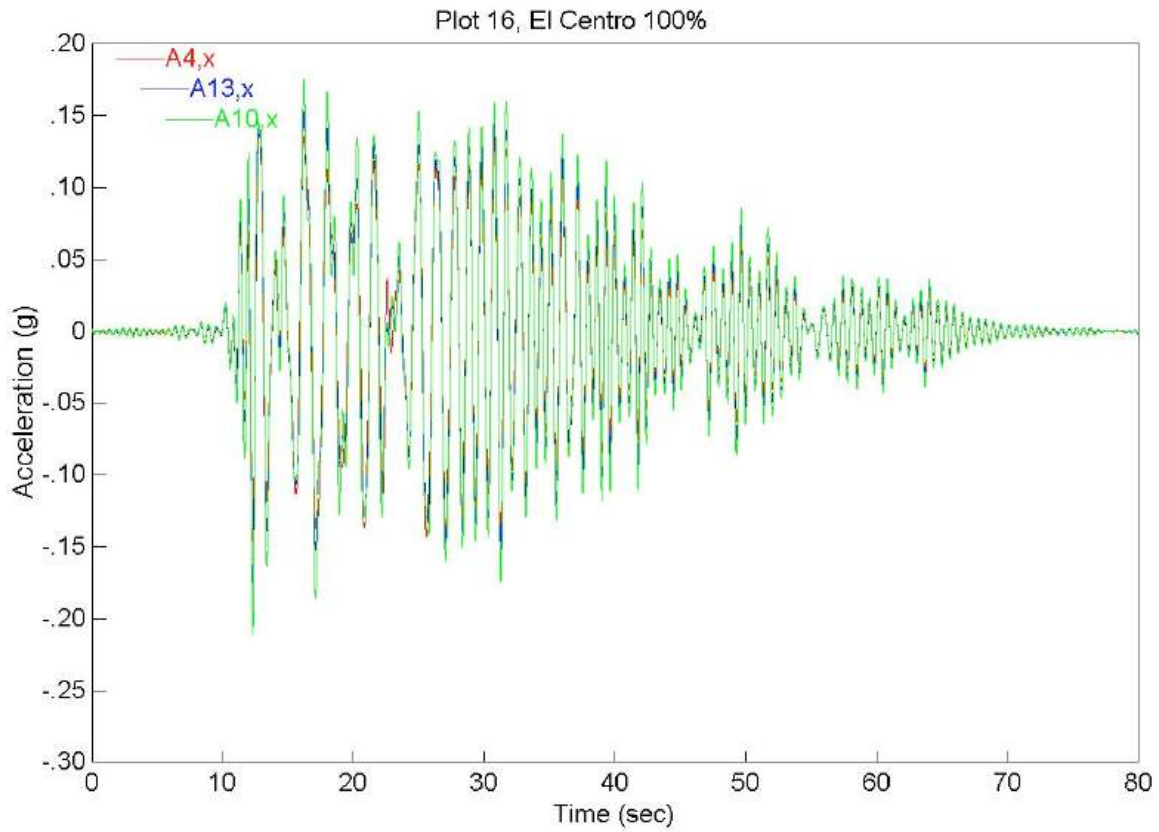


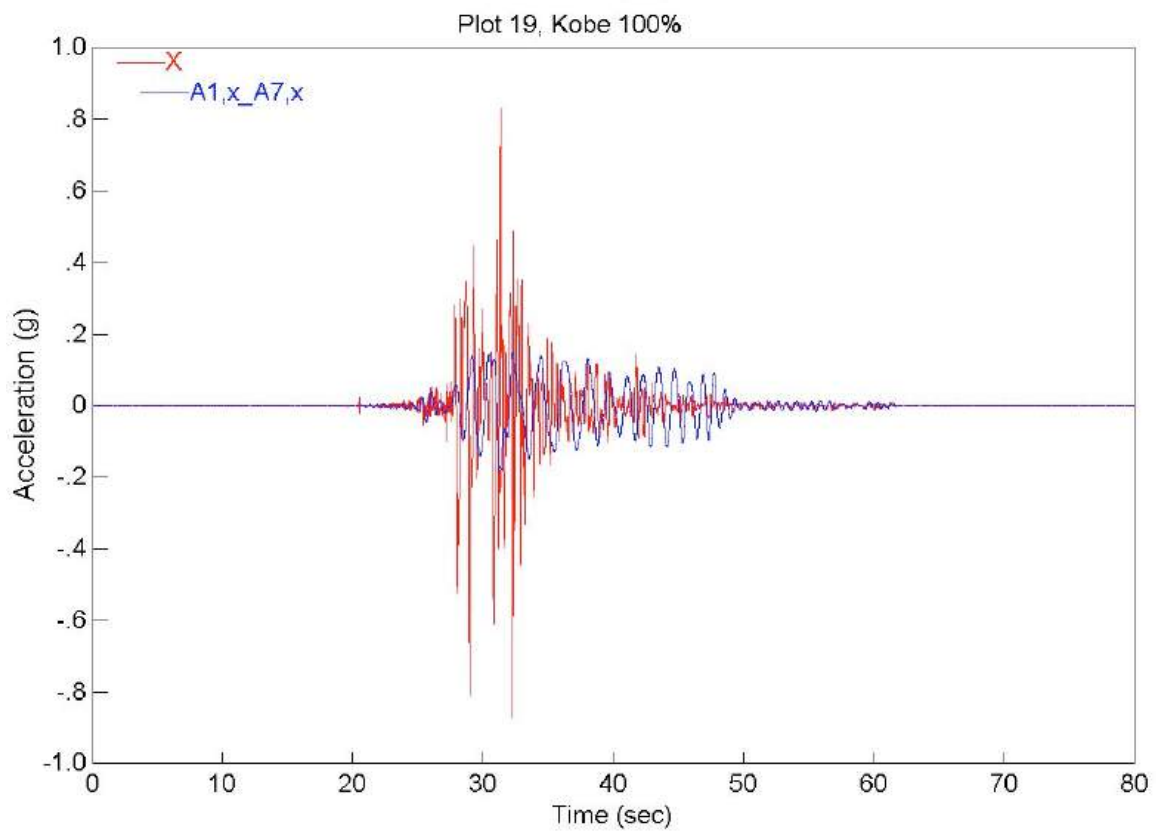
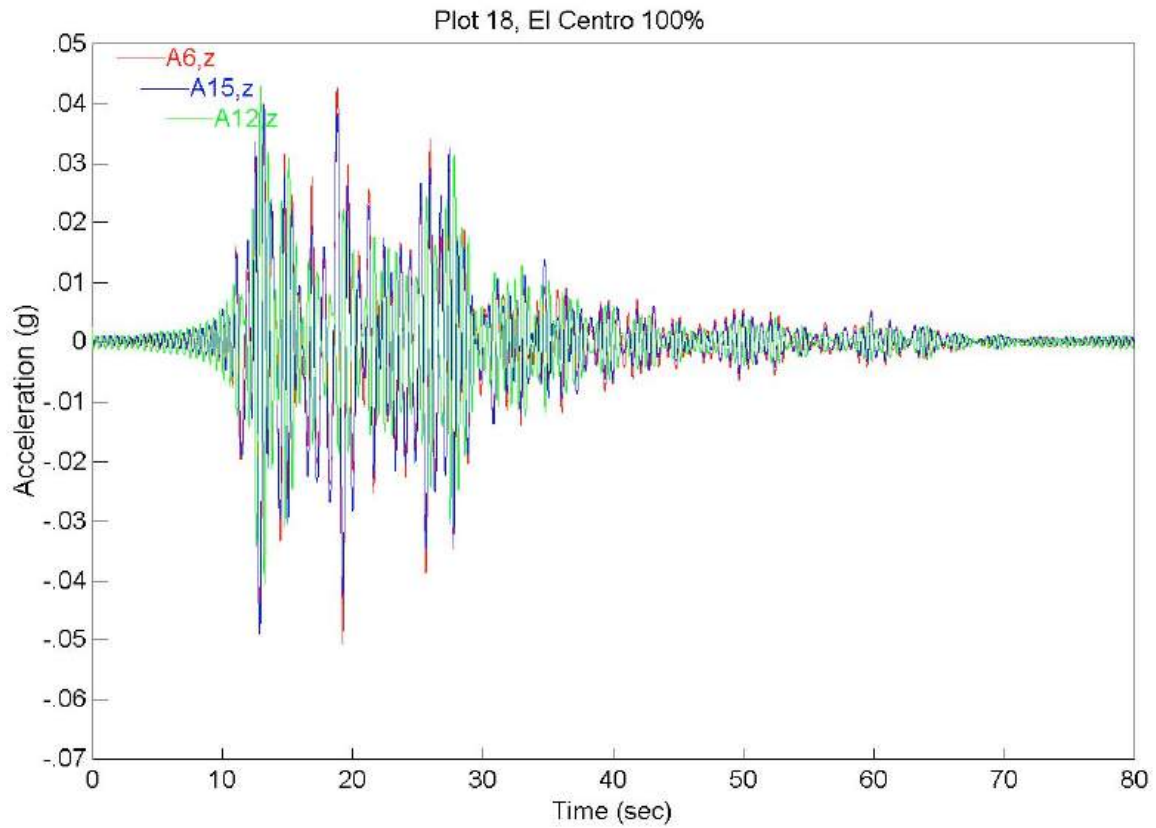


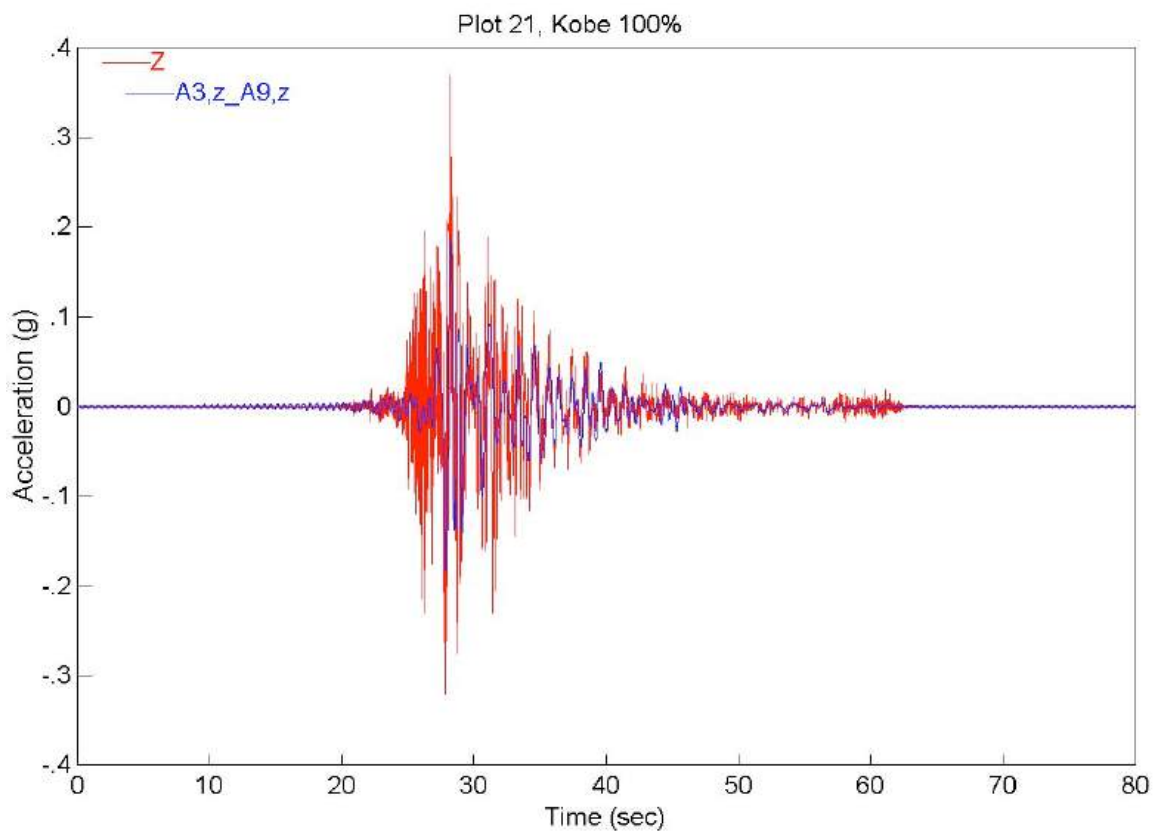
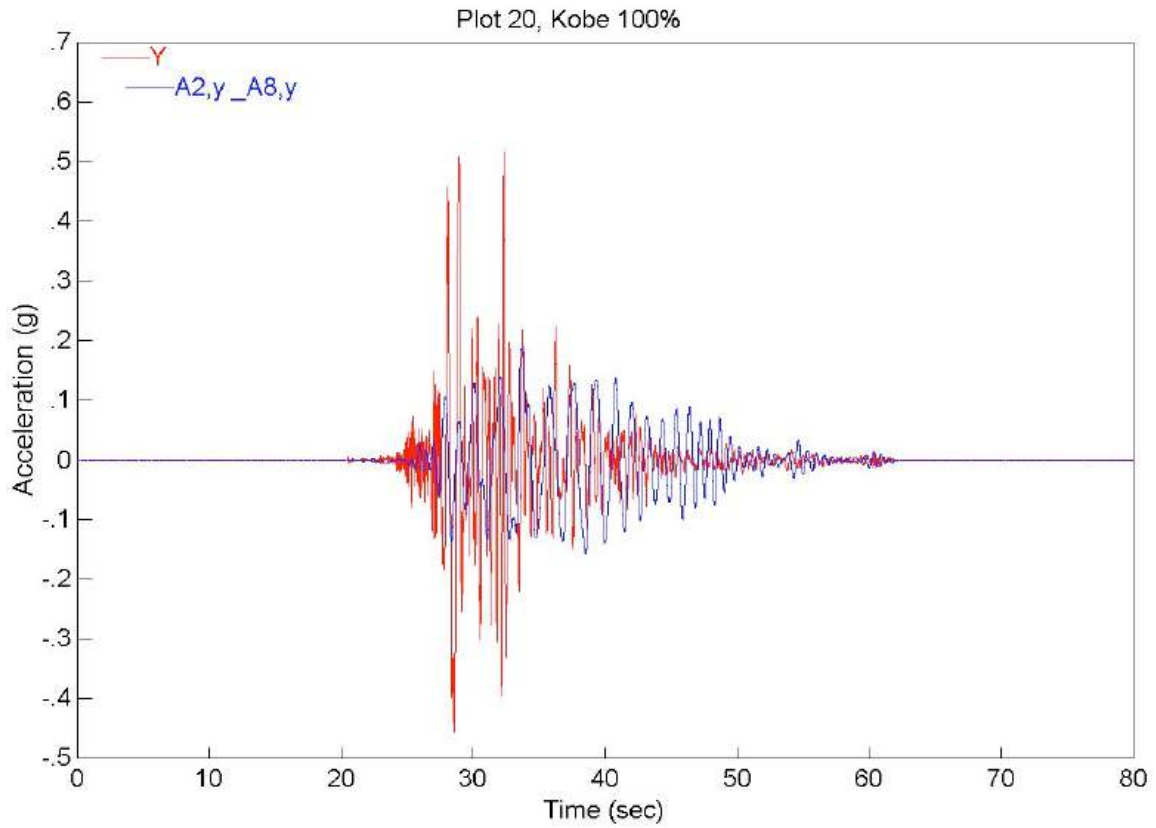


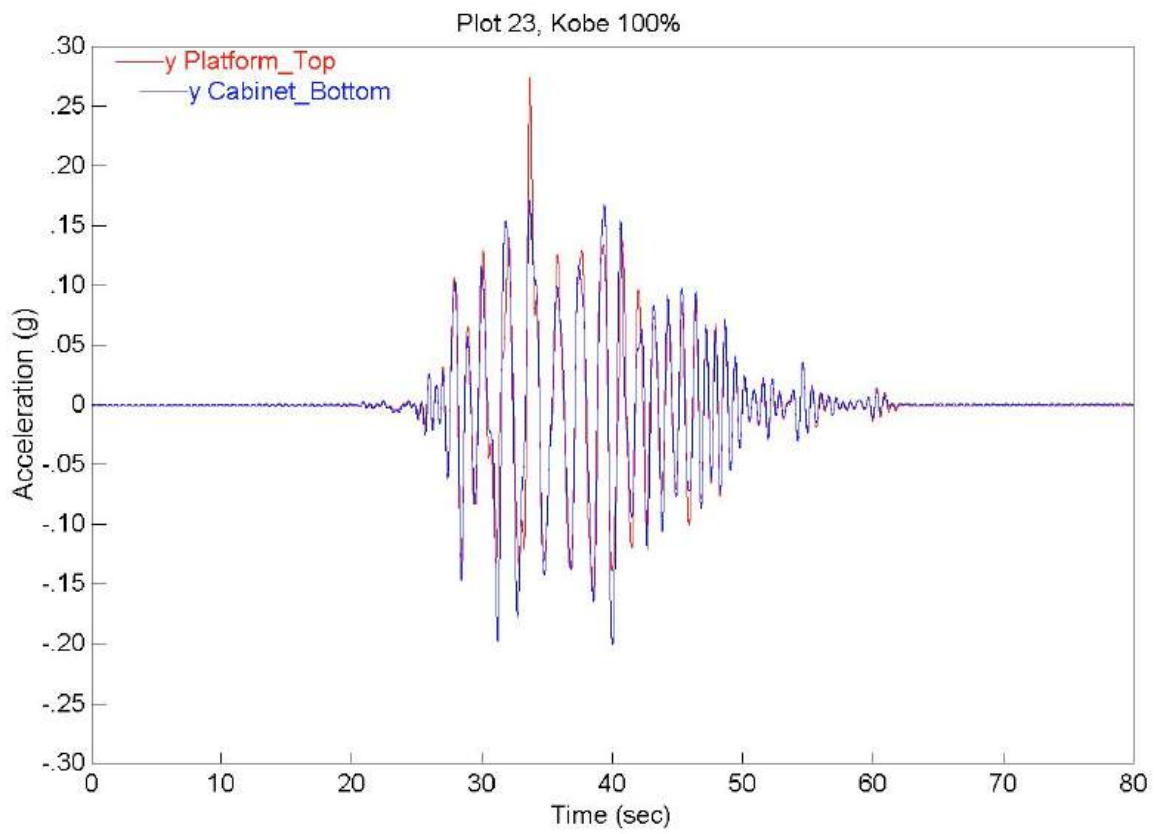
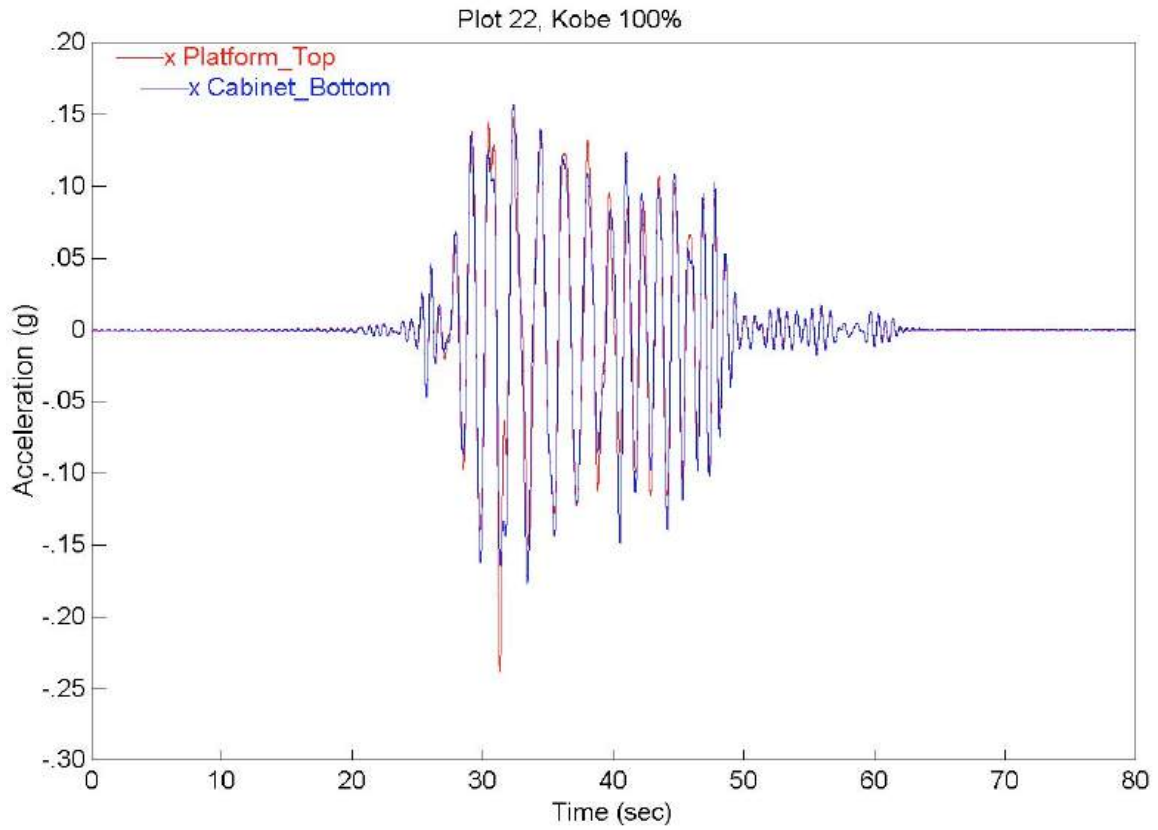


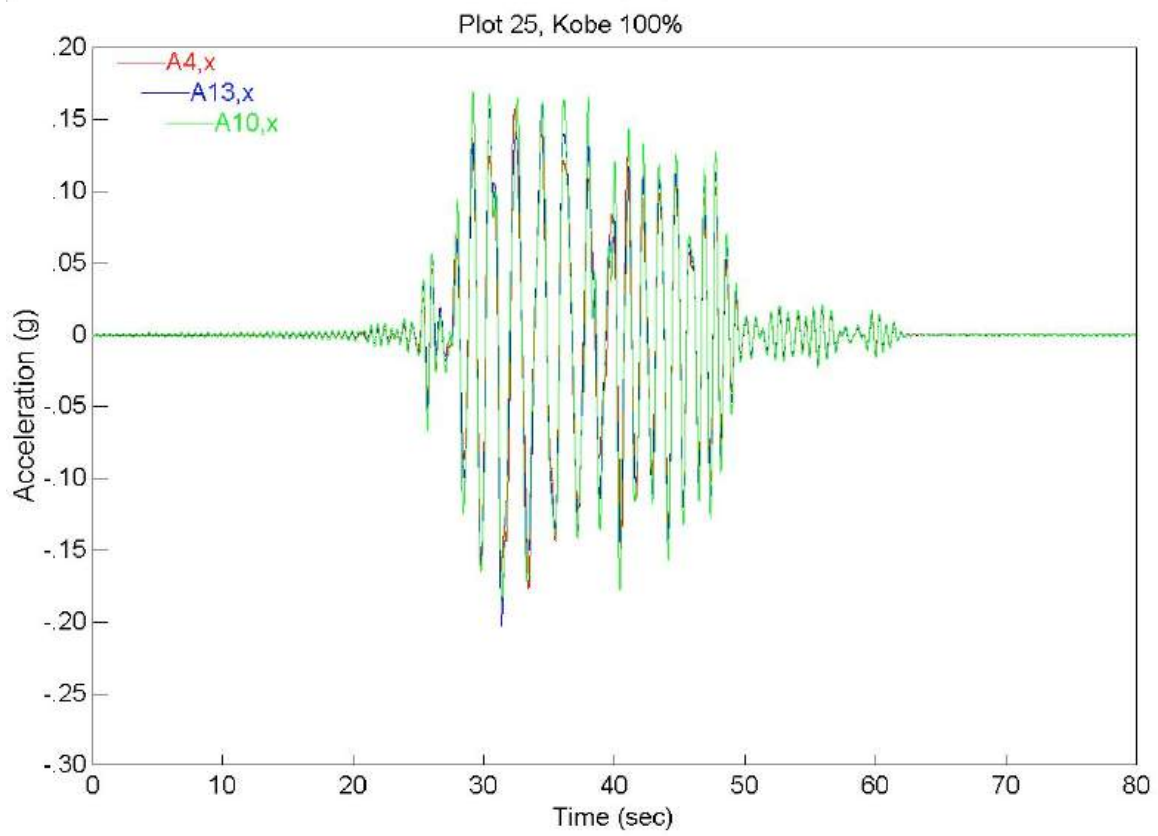
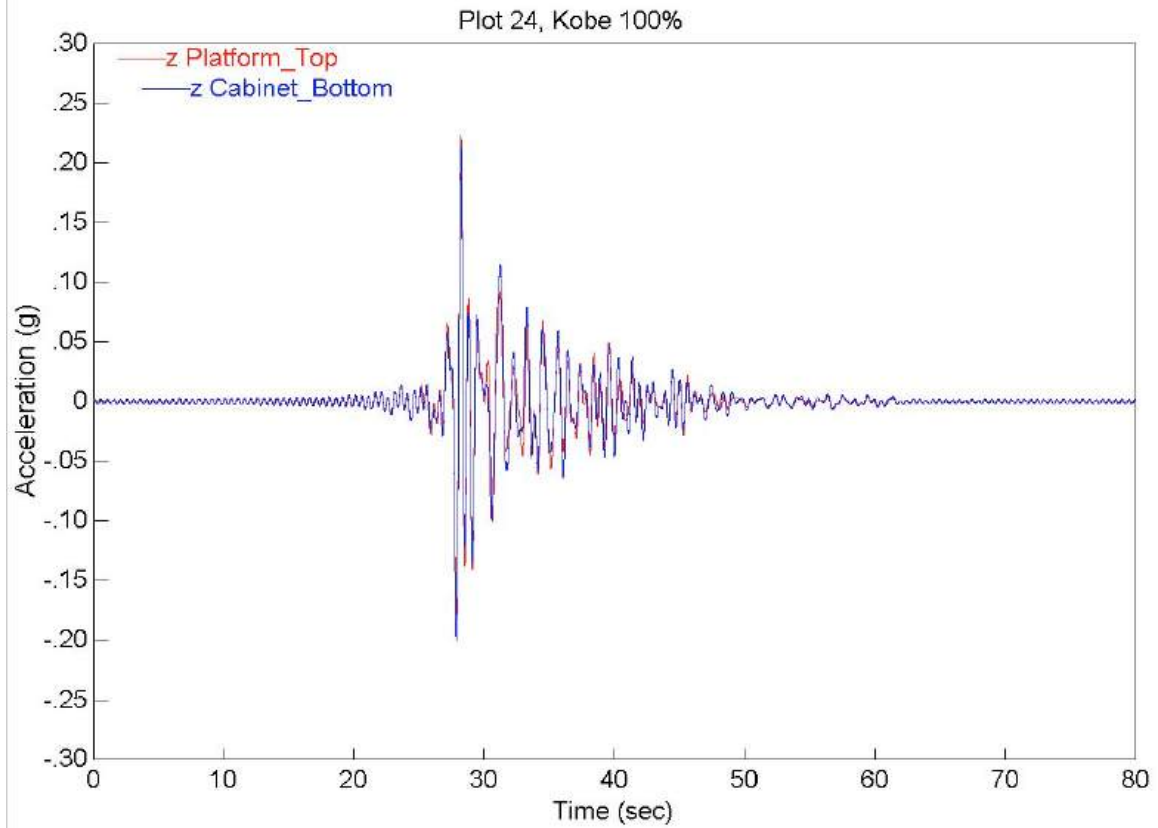


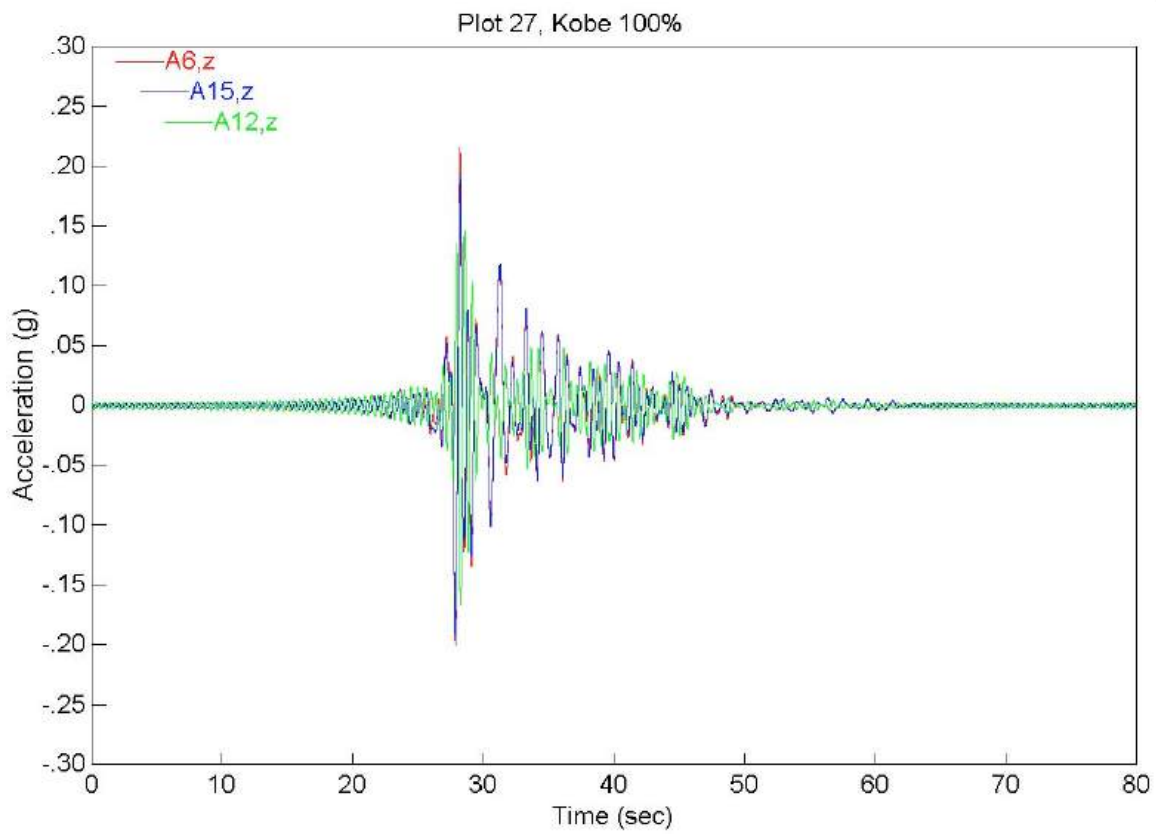
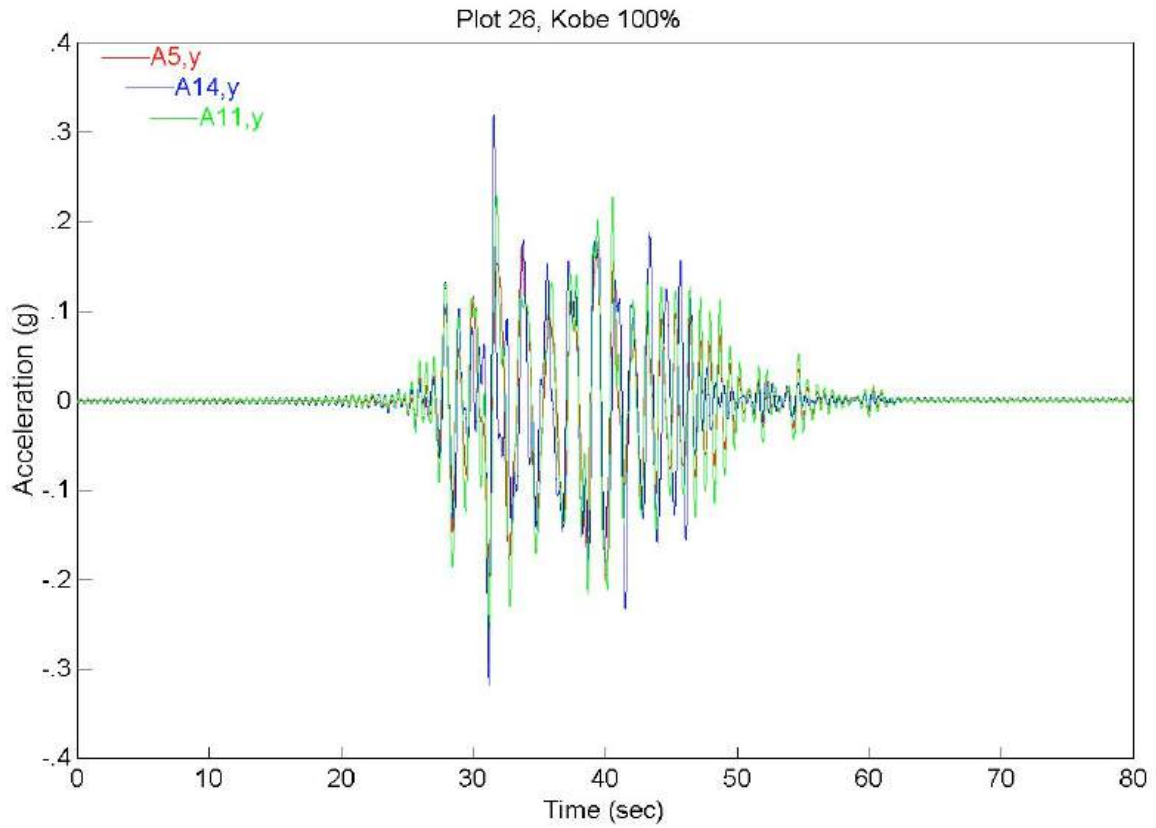


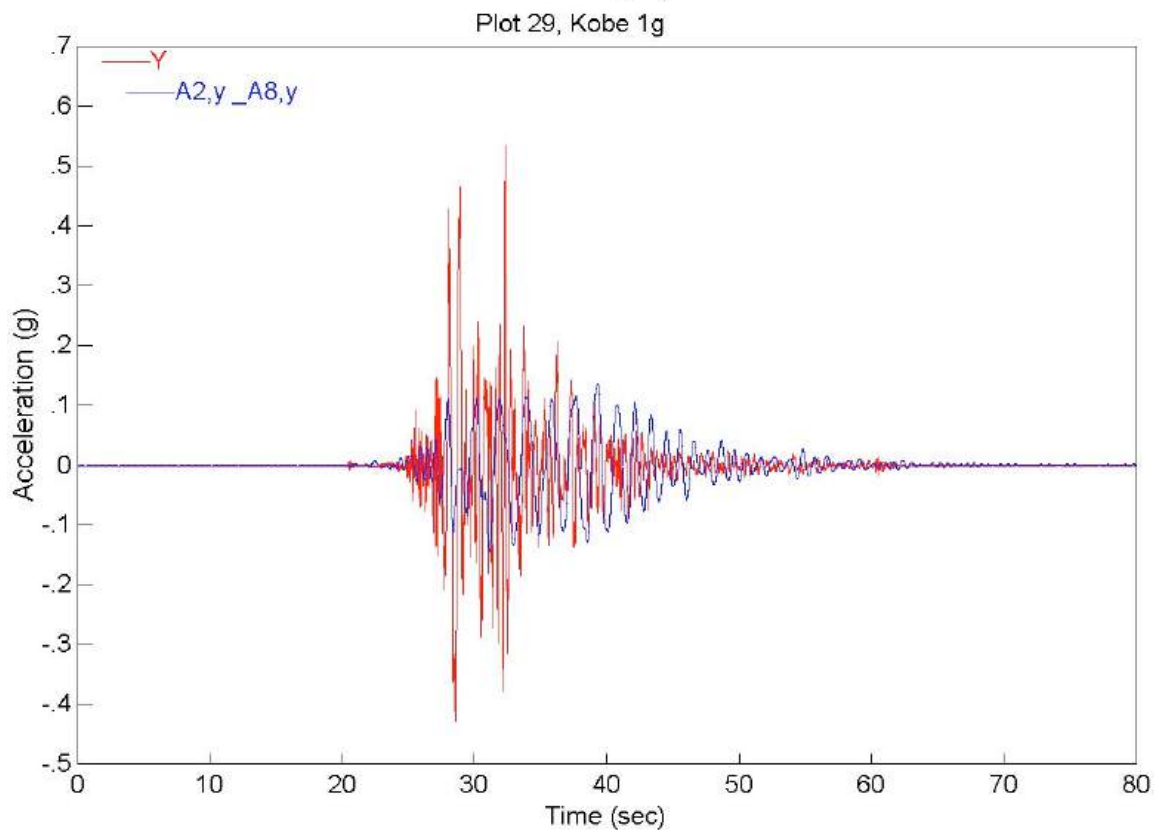
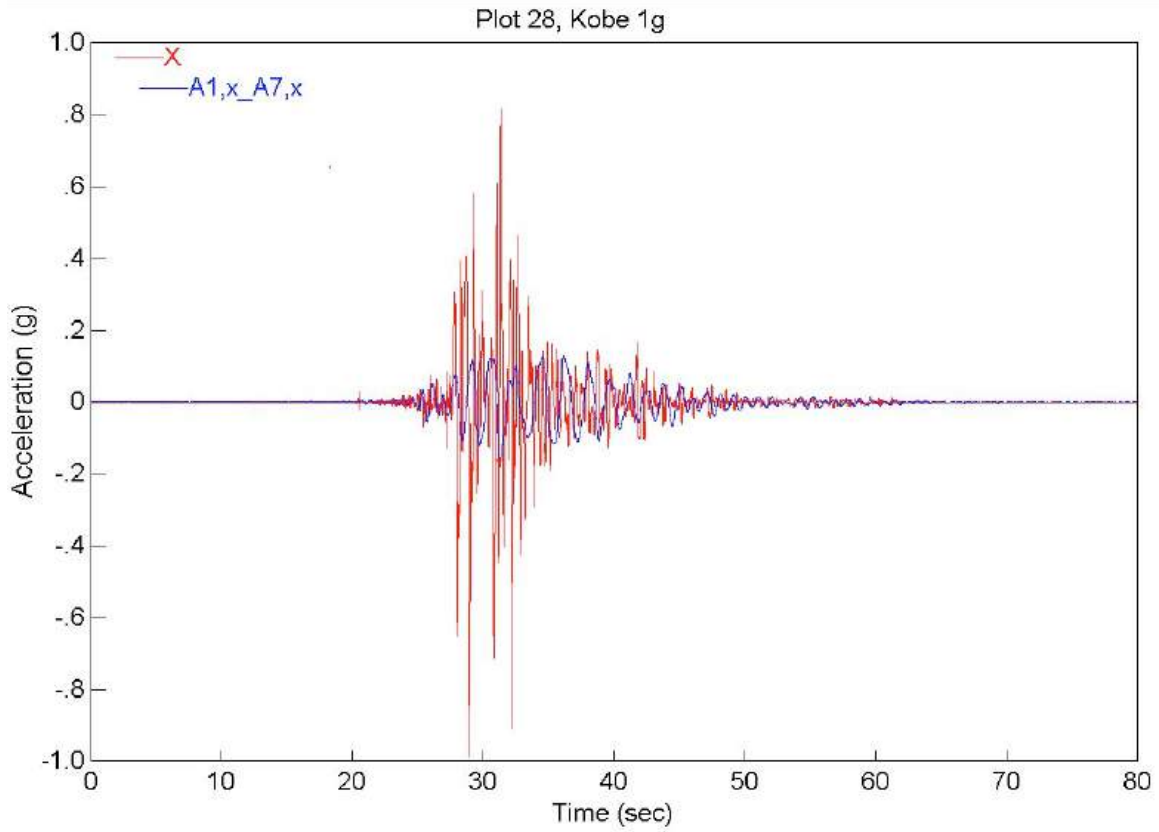


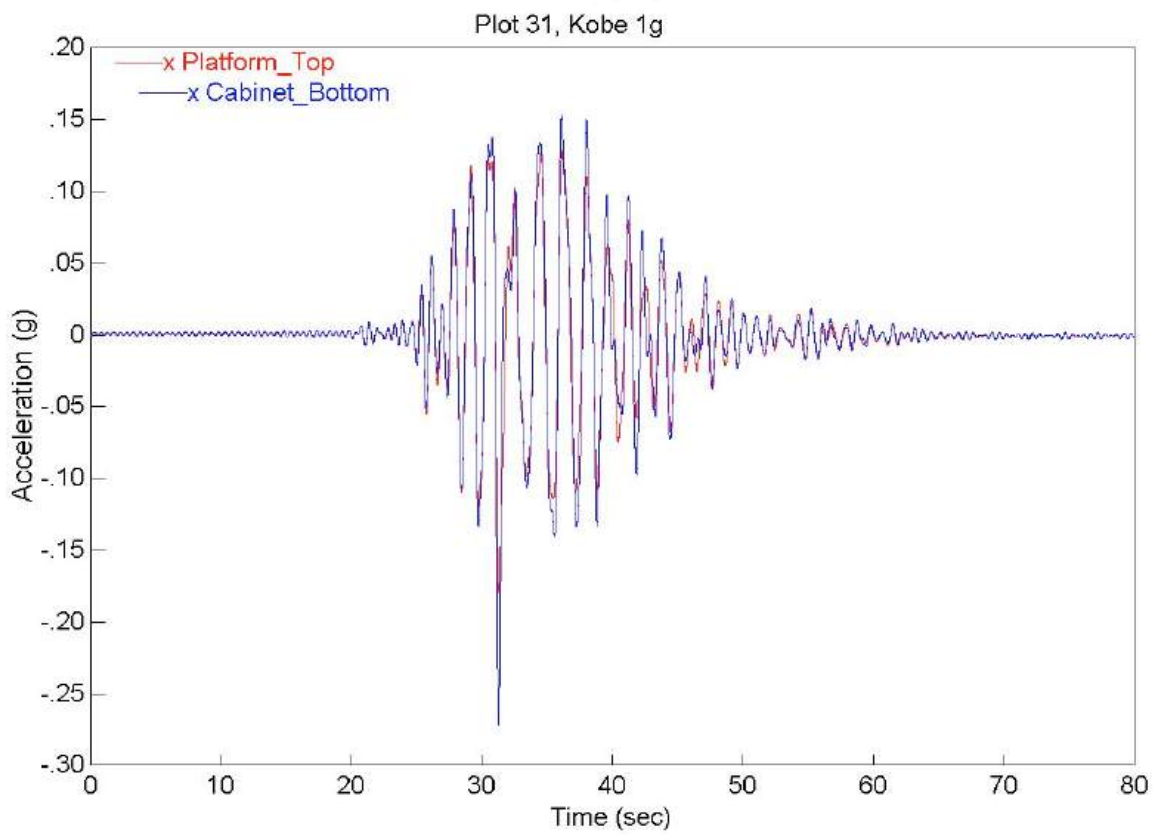
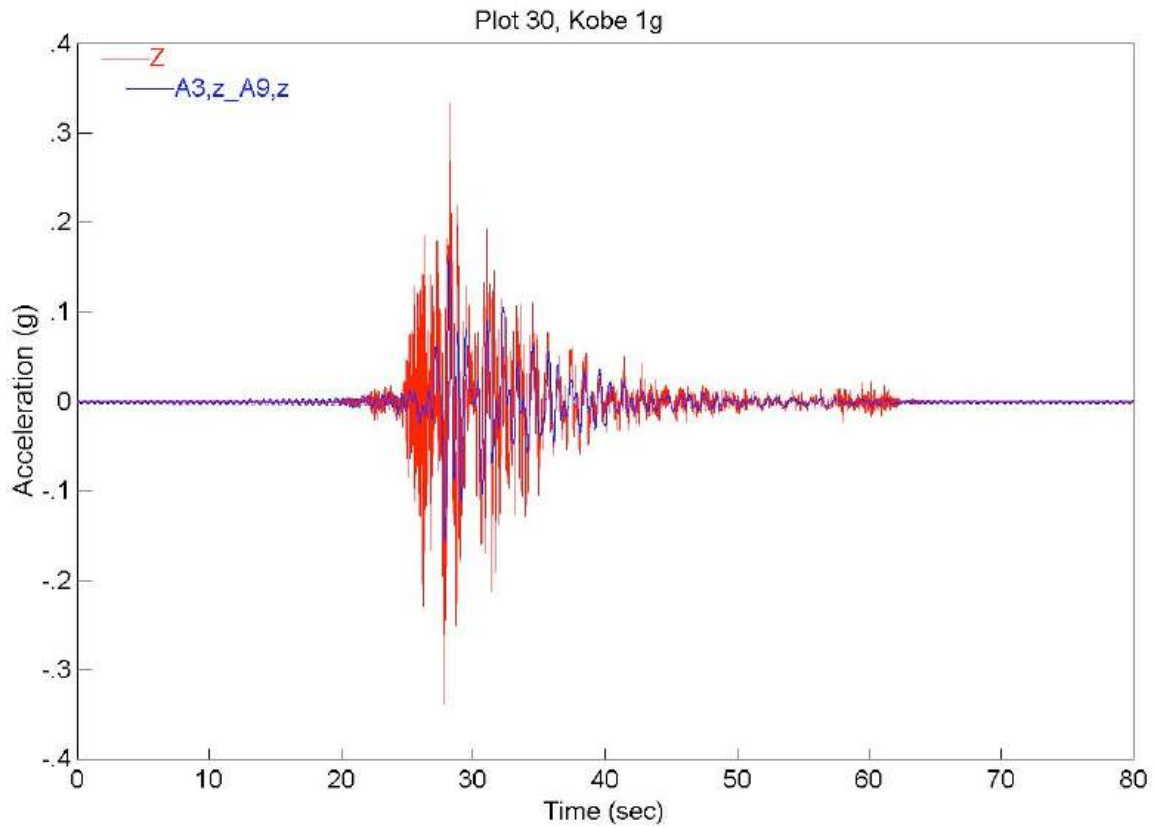


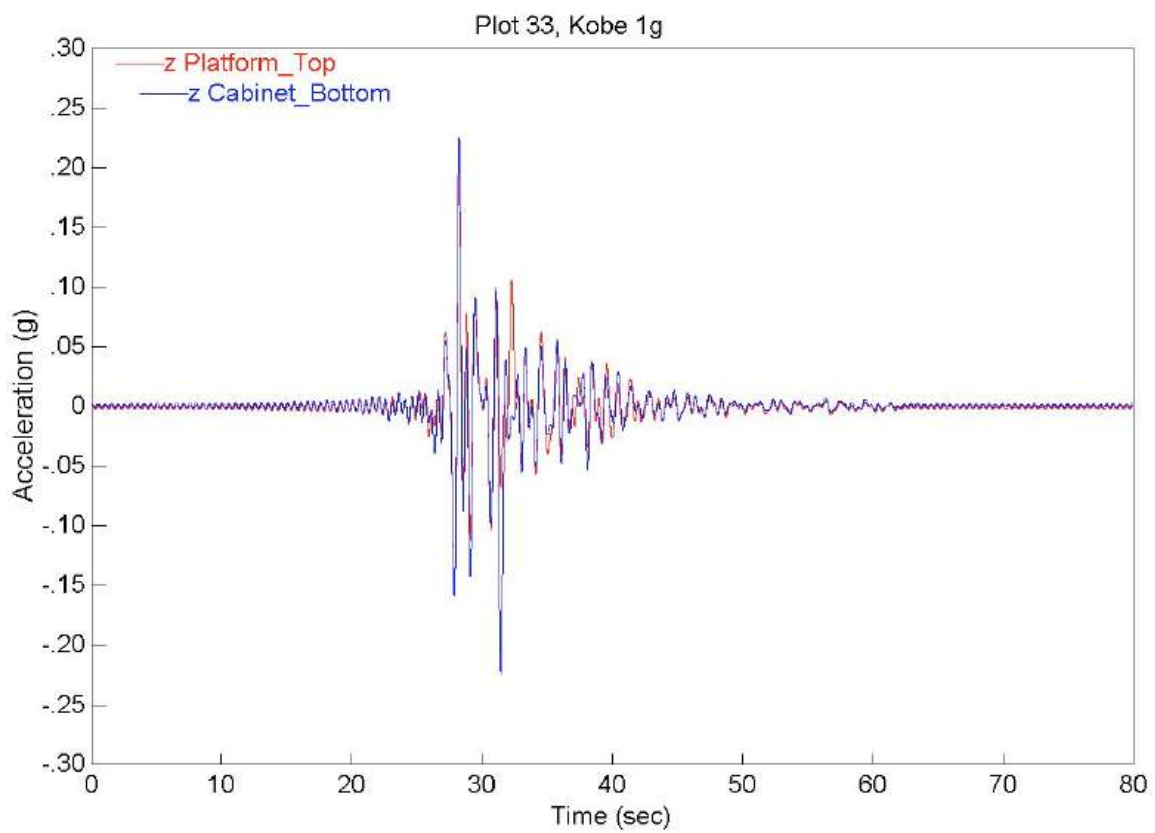
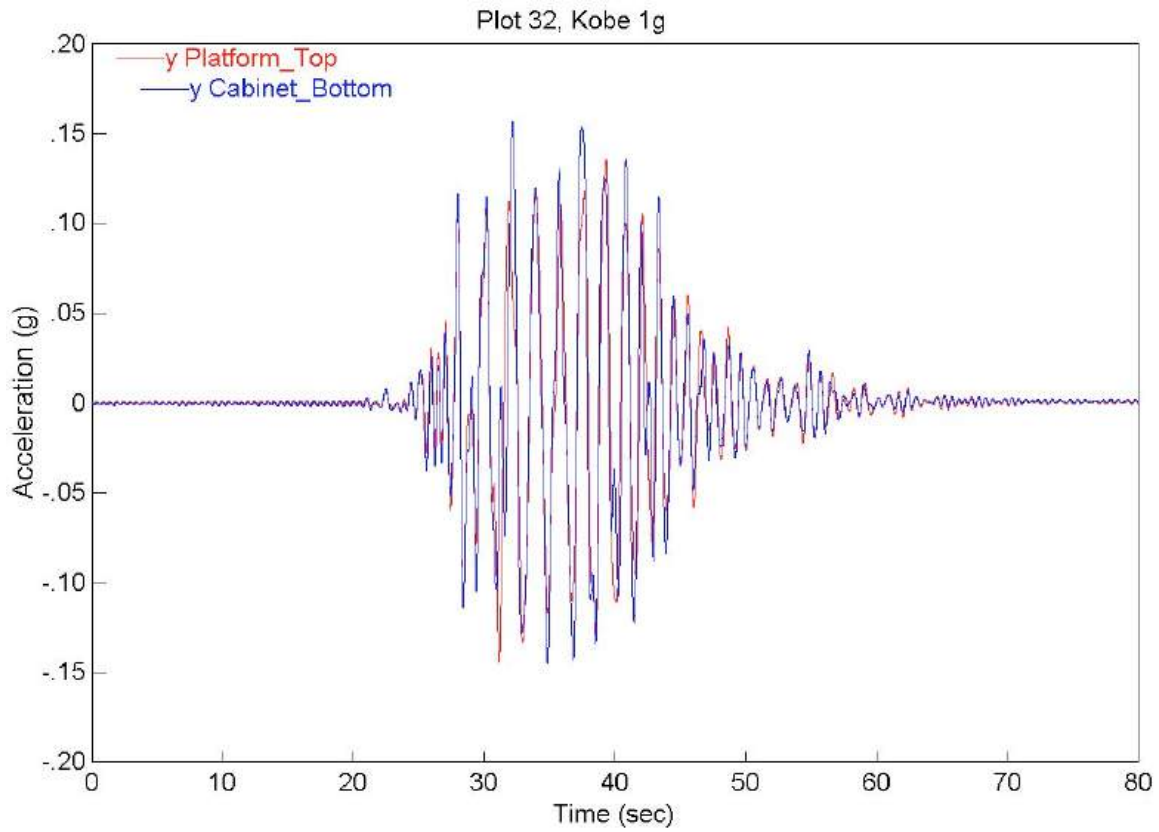


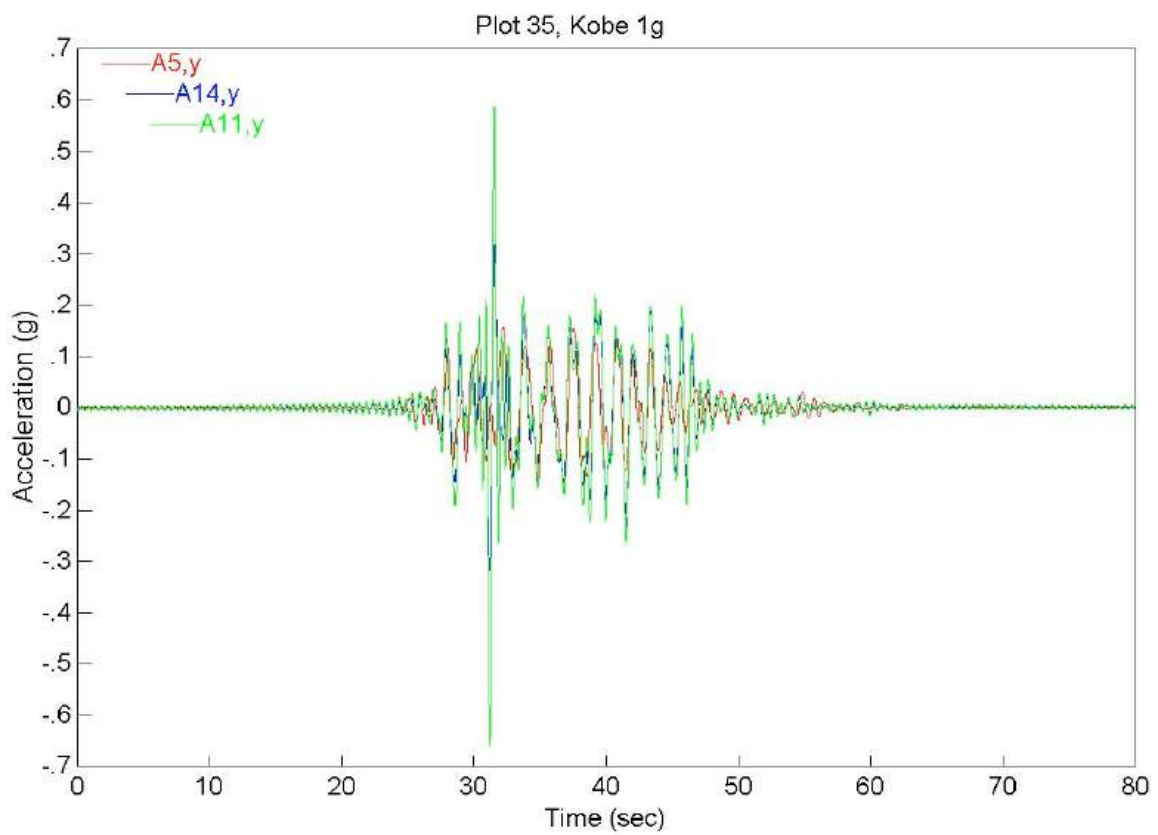
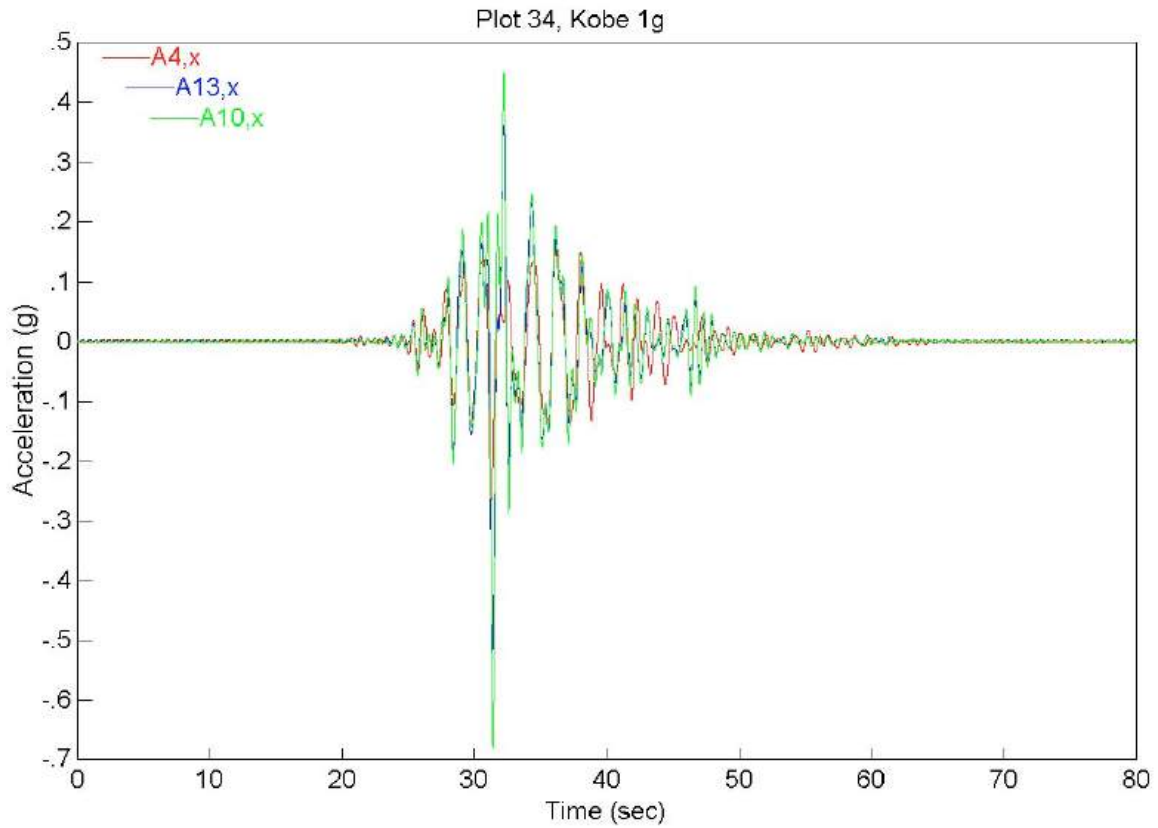


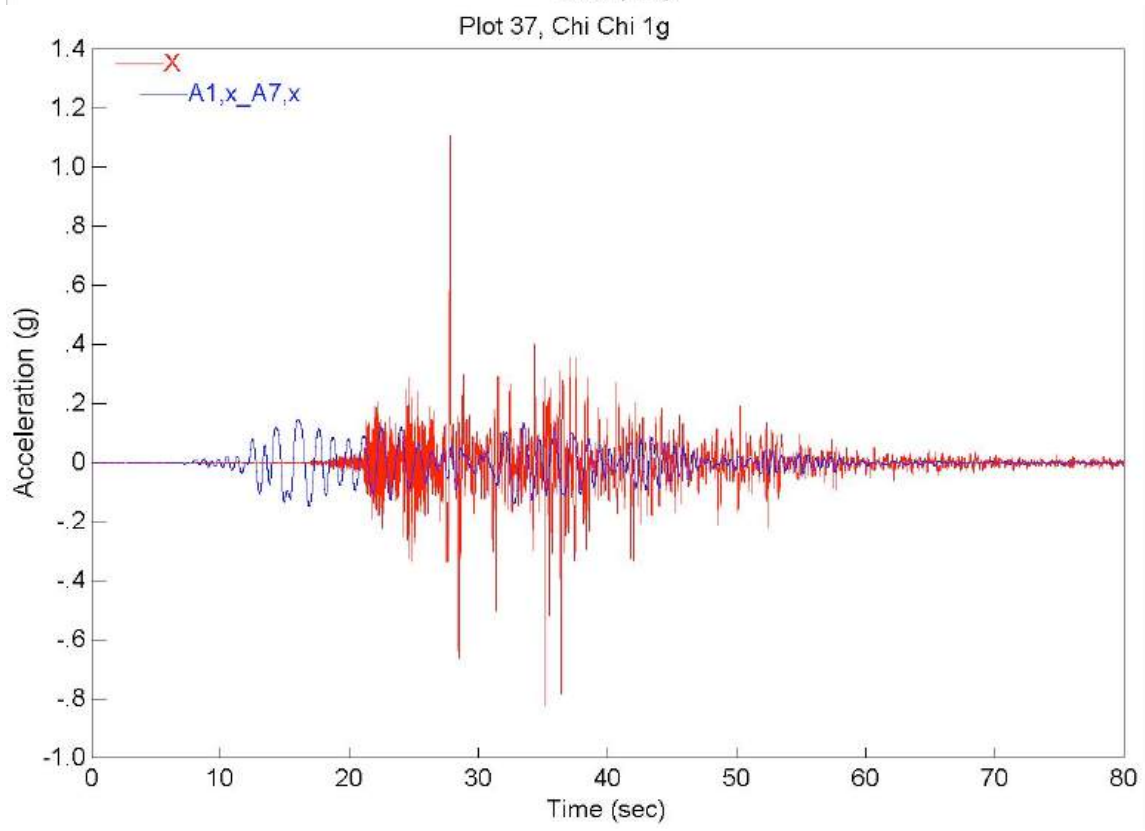
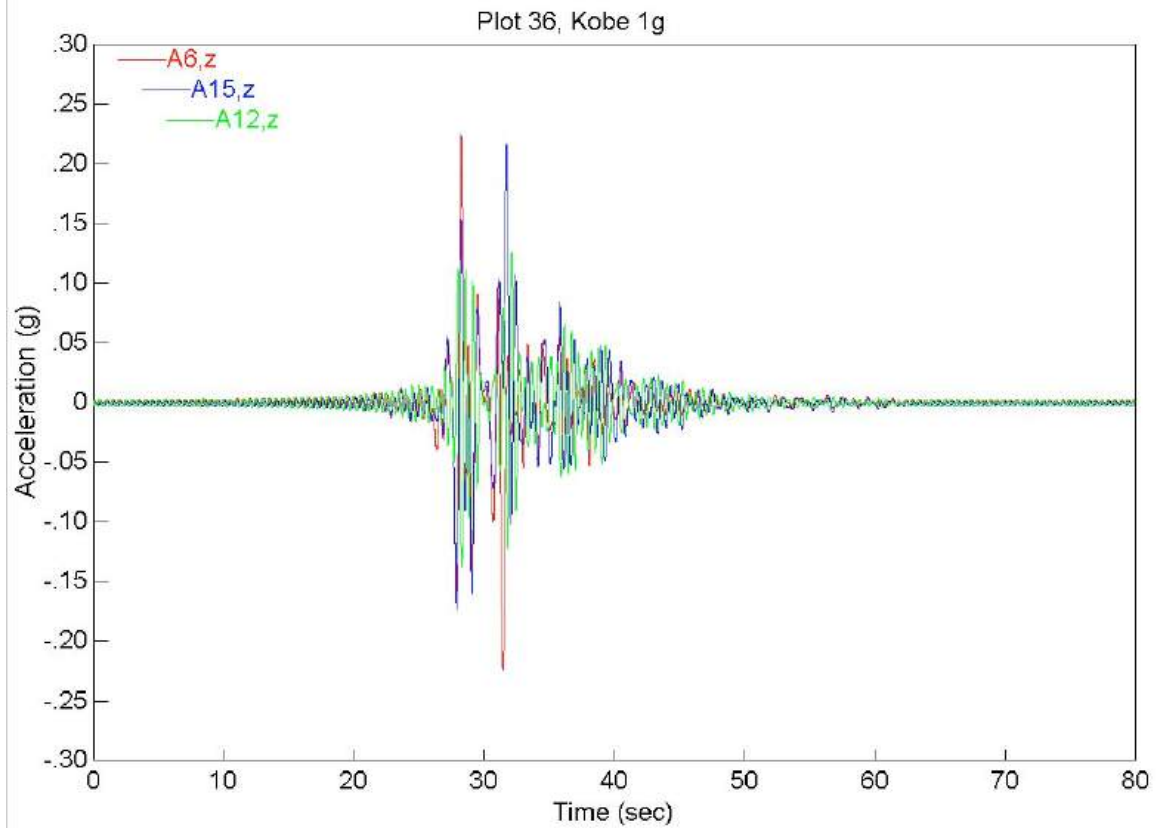


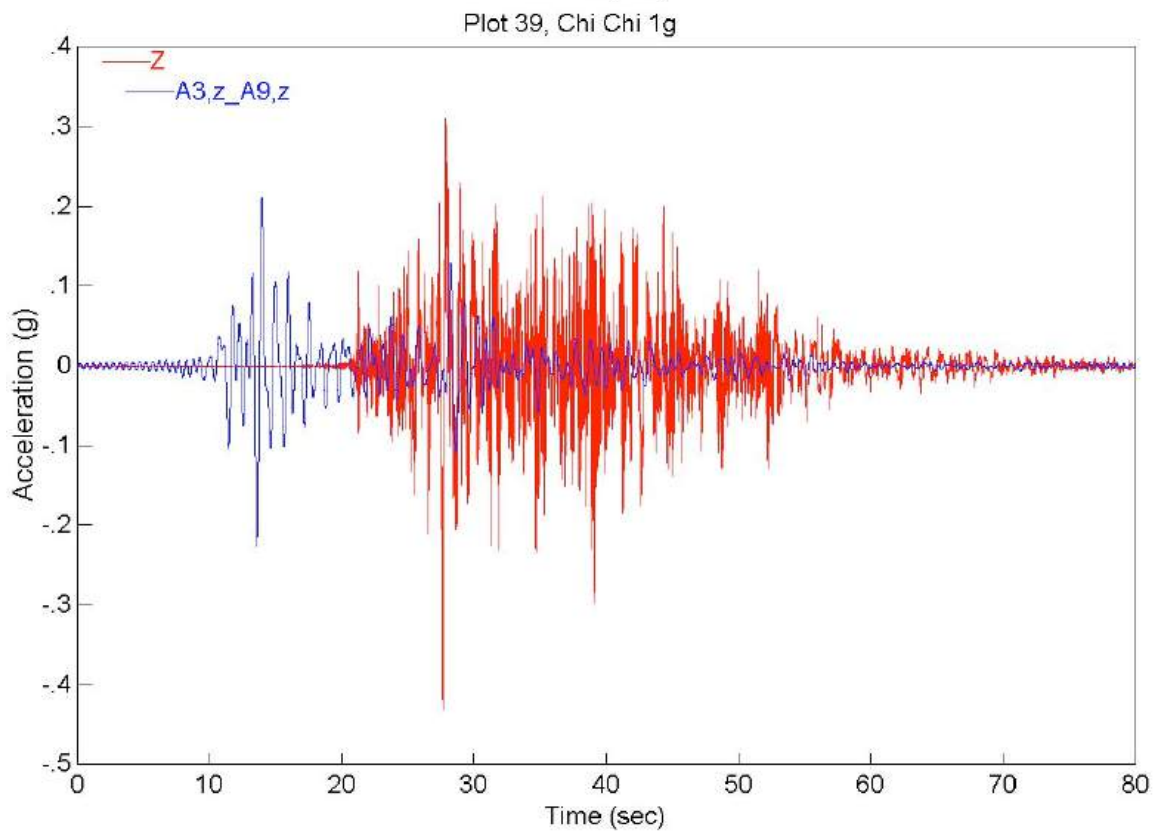
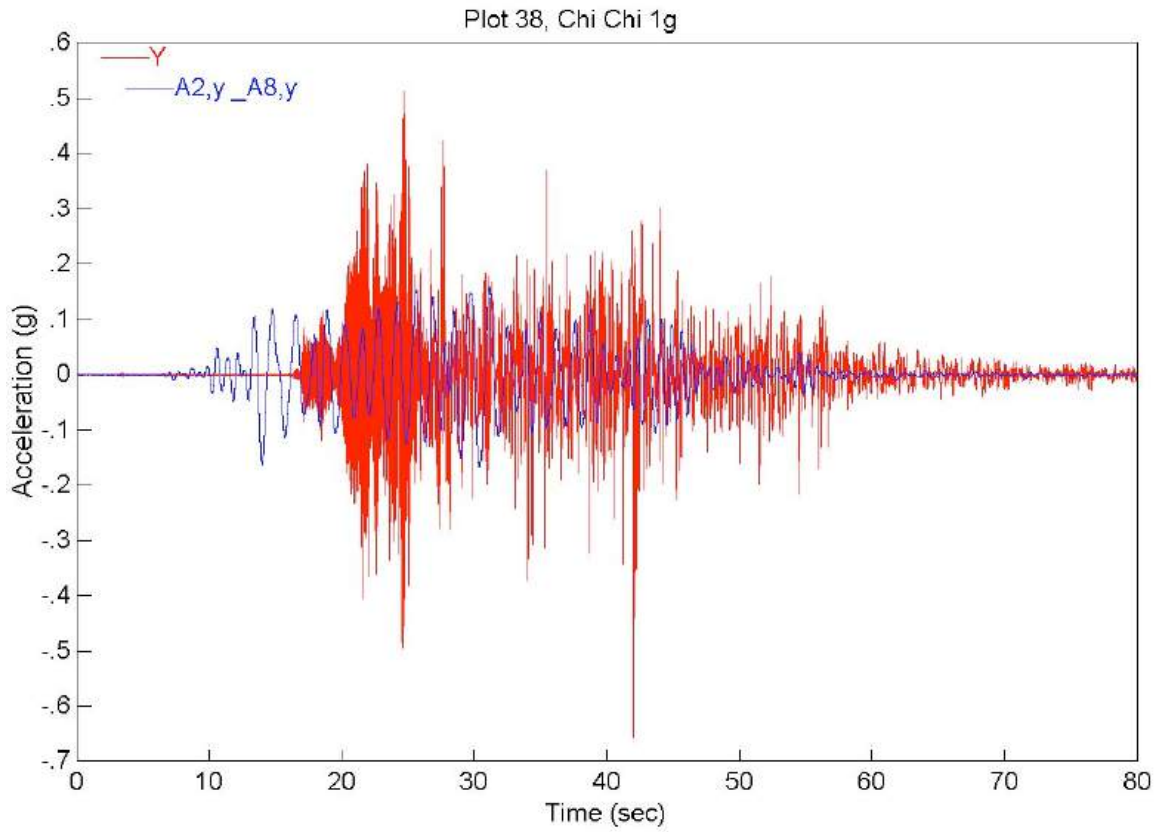


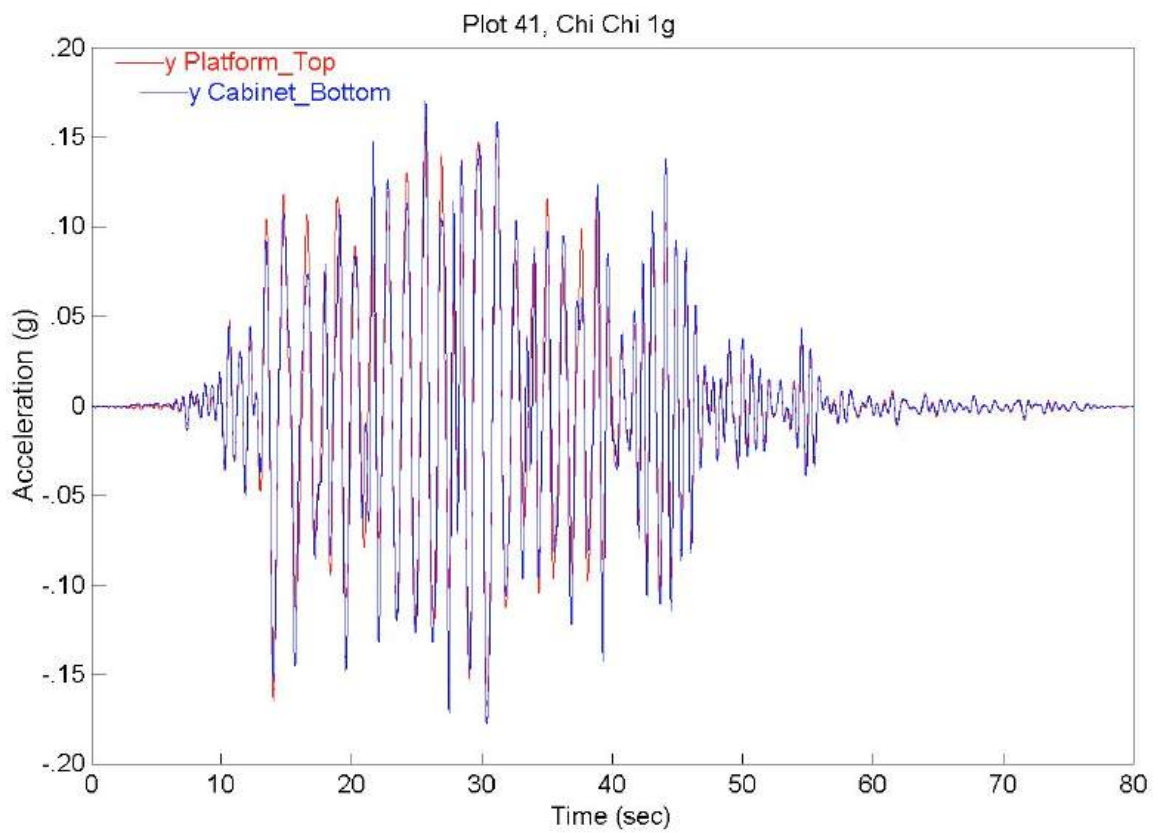
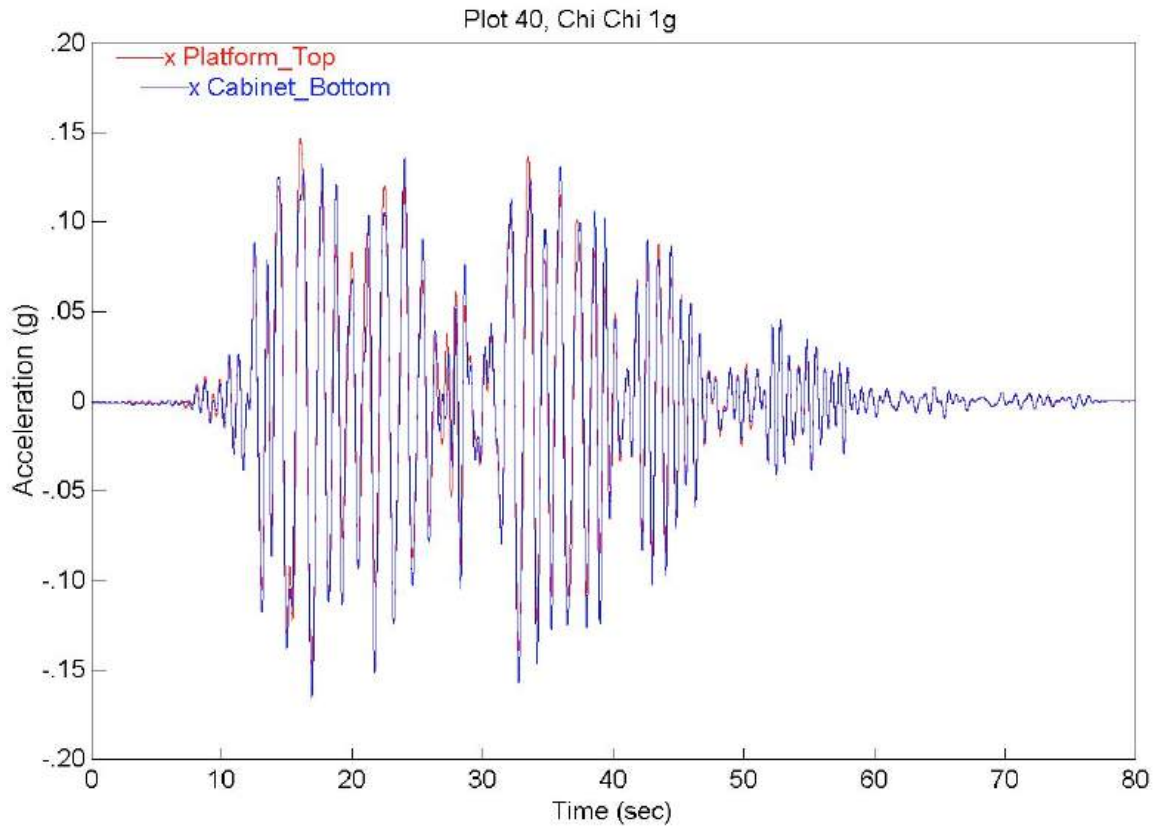


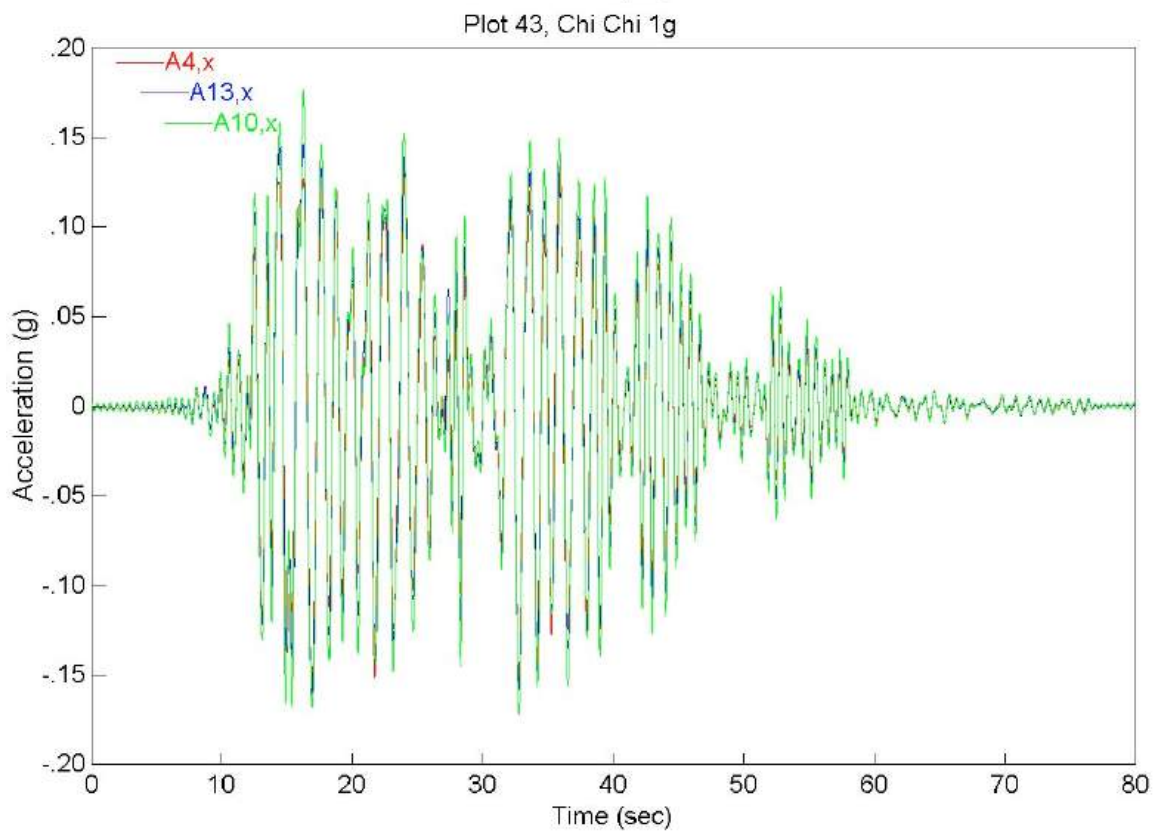
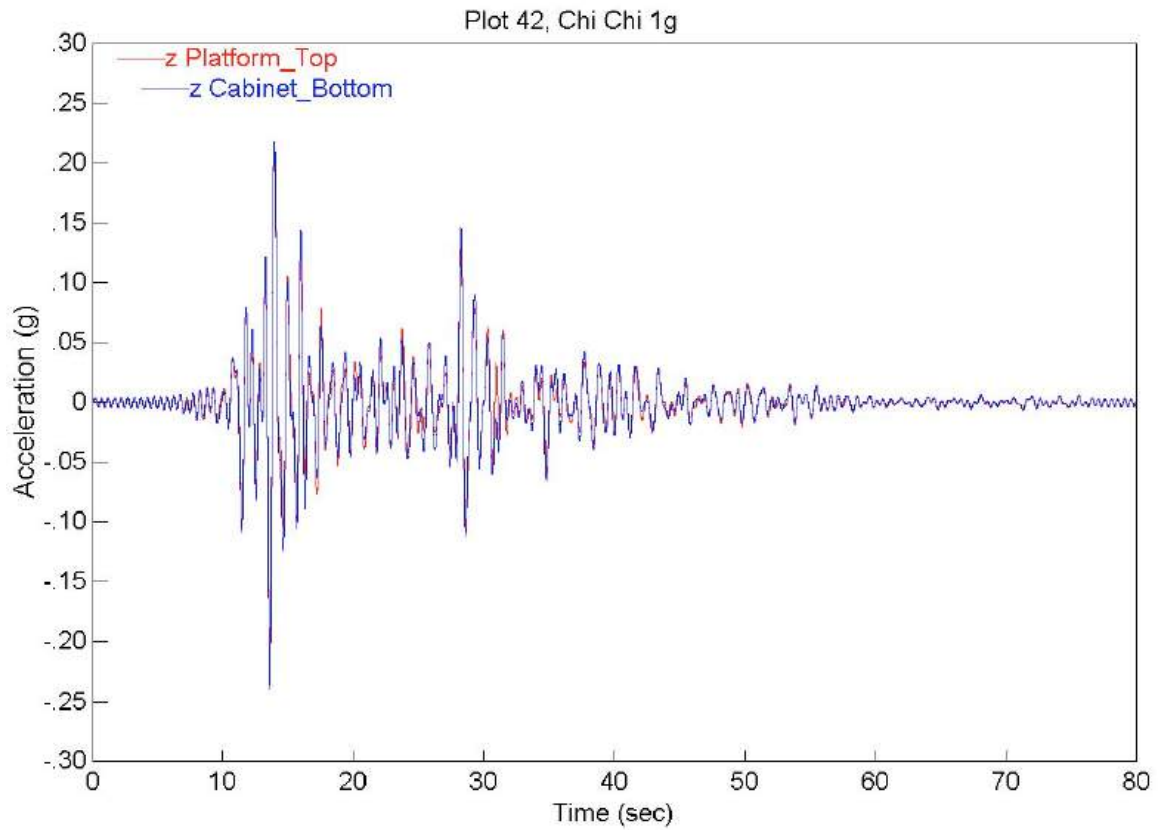


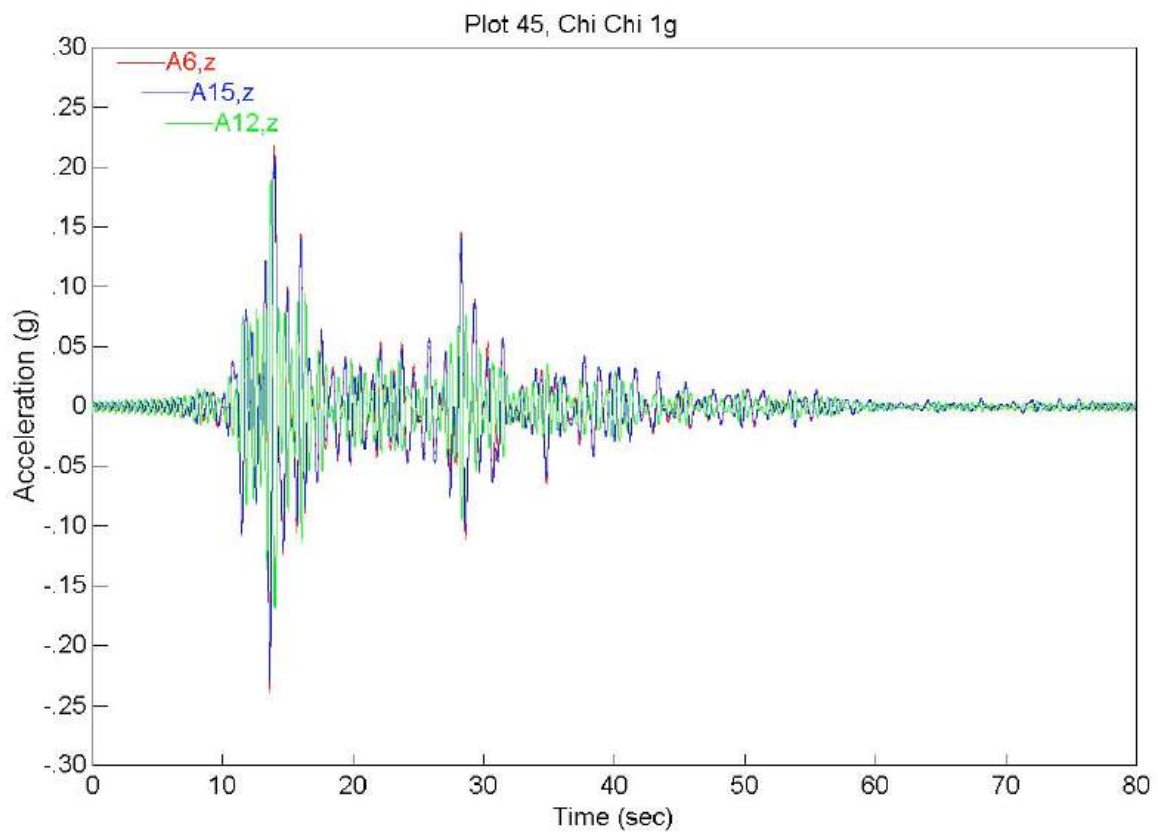
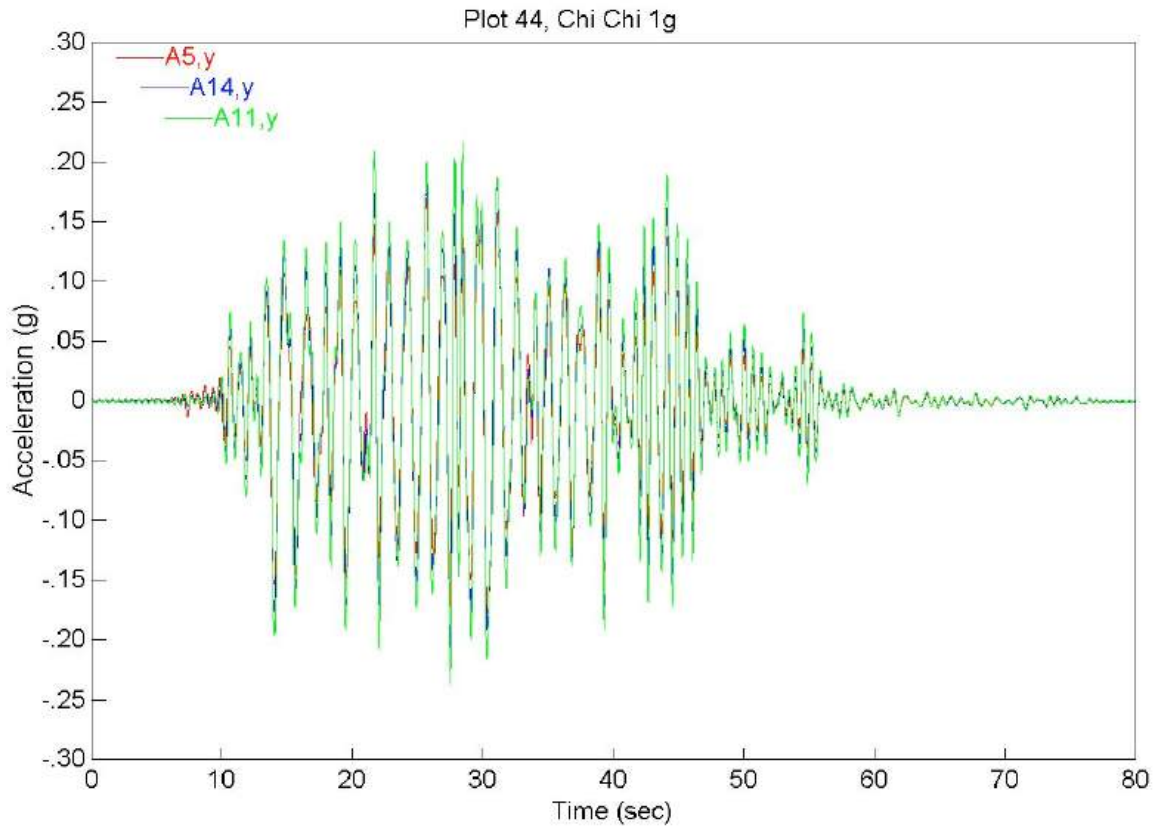












Please note that out of the five tests, Chi Chi was the most serious one, being the most demanding in both the real time and the frequency domain. Plot 37 shows that the achieved Peak Ground Acceleration (PGA) was 1.2 g, although it was targeted to be 1 g. Nevertheless, the isolation platform did not pass more than 0.2 g peaks, because its Ball-N-Cone® isolation bearing physically limit output accelerations by geometry (conical dish). Therefore, the larger the input acceleration (PGA), the higher is the IsoBase® Seismic Isolation Platform's peak acceleration reduction, which is minimum 80% at 1 g PGA.

Note also, that the above output acceleration limit is more important for seismic isolation of equipment, cabinets and electronics, than the actually achieved peak acceleration reduction. One can appreciate this fact by observing Plot 37 through 39, where between about 7 and 17 seconds, the input acceleration is smaller than the output. That is, in that range, the isolator amplifies and not deamplifies seismic forces, yet serves as an excellent isolator for not passing more than 0.2 g accelerations. When the ground motion has too high energy content and density, like it had at Chi Chi (TCU 129), some seismic isolators, including the IsoBase® Seismic Isolation Platform, leads the head and lags the tail of the ground acceleration. The head of a time history of an earthquake is the initial part with small amplitude and the tail is the last part with decaying amplitude. Between the head and tail is the body. Thus, the Ball-N-Cone® isolation bearing's motion may build up and decay early. This way it may amplify or deamplify the PGA but its seismic output force remain limited by physics, thus cannot be overloaded. It acts like a fuse in an electric circuit.

QUAKE IDENTIFIER

1st: Taft Earthquake, Sept. 21, 1952 ($M_m 7.2$)

Station Taft, California, USA, 0453 Kern County, Epicentral distance 42.0 km, Uncorrected accelerogram

X component: File name: 203e53ta.f0a
 Component: 021 degree
 Peak acceleration: -173.3 cm/s/s (0.177 g)
 Relative to Cabinet: left-to-right (facing the cabinet)

Y component: File name: 203e53ta.f0b
 Component: 111 degree
 Peak acceleration: -192.7 cm/s/s (0.196 g)
 Relative to cabinet: front-to-back

Z component: File name: 203e53ta.f0c
 Component: up
 Peak acceleration: -119.2 cm/s/s (0.122 g)

Relative to cabinet: up (vertical)

2nd: El Centro Earthquake, May 18, 1940 (M_m 7.0)

Station, Imperial Valley Irrigation District, 2037 El Centro, California, USA,
Epicentral distance 12.0 km, Uncorrected accelerogram

X component: File name: 139u37el.c0a
Component: 180 degree
Peak acceleration: -349.8 cm/s/s (0.357 g)
Relative to Cabinet: front-to-back

Y component: File name: 139u37el.c0b
Component: 270 degree
Peak acceleration: -218.5 cm/s/s (0.222 g)
Relative to cabinet: left-to-right (facing the cabinet)

Z component: File name: 139u37el.c0c
Component: up
Peak acceleration: 265.3 cm/s/s (0.270 g)
Relative to cabinet: up (vertical)

3rd: Kobe (Hyogo-ken-Nanbu) Earthquake (05:46), Jan. 17, 1995 (also known as the Great Hashin-Awaji Earthquake, M_m 7.2)

Station JMA (Japan Meteorological Agency), Kobe, Hyogo prefecture, Japan as recorded by CEORKA (Committee on Earthquake Observation and research in the Kansai Area) in reclaimed island (worst case soft soil data)

Peak horizontal acceleration: 818 cm/cm (0.8337 g)
Relative to cabinet: front-to-back

4th: The Chi Chi Earthquake is identified by its station number TCU 129 (PGA ~ 1g).

These earthquake accelerograms are downloadable from the USGS (United states Geological Survey) NSMP home page: <http://nsmp.wr.usgs.gov/> or from <http://peer.berkeley.edu/svbin/Download?qid=133&sid=706> or can be obtained from the NCEER lab in Taiwan (see the cover).

CONCLUSION

On September 10, 2002, in the NCREE lab in Taiwan, the IsoBase® Seismic Isolation Platform passed the seismic shake table test requirements established by JQA.

Witnessed by:

Zoltan A. Kemeny, PhD
VP, Chief Engineer, Dynamic Assets Corporation

A handwritten signature in black ink, appearing to read 'Zoltan A. Kemeny', written in a cursive style.

Tempe, AZ, USA in September 30, 2002

ACKNOWLEDGEMENTS

Special thanks is due to Mr. Yin-Nan Huang at the NCREE in Taipei, Taiwan for his heroic effort to make all testing possible by controlling the shake table and recording and processing all data. Also for Mr. J.R. Tsao, Mr. Allen Huang and Mr. Joe McFatridge for their excellent organizing efforts related to this testing.

End of Report.