

Specifying Equipment Racks for Seismic Environments

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What constitutes a potential seismic environment? Well, just about anywhere on earth is subject to seismic events. It has happened in the past and will definitely happen again in the future, it is just a matter of time and pressure. On any given day, per the National Earthquake Information Center (NEIC) the earth experiences approximately 25 earthquakes with a magnitude of 2.5 or above on the Richter scale. They may not all be felt but with today's seismic instrumentation most are measured and recorded. The NEIC now locates approximately 14,000 earthquakes per year. Of those, approximately 18 per year are expected to be in the major earthquake category of between 7.0 to 7.9 and 1 catastrophic earthquake per year above 8.0. The vast majority of these earthquakes occur at the boundaries of our earth's plate tectonics. Ever hear of the term "the ring of fire"? Chances are high you have, if you live anywhere around the Pacific Ocean where the Pacific plate comes in contact with several other plates. Anywhere around the boundaries of tectonic plates are considered seismically active environments as can be seen in the World Seismicity Map below.

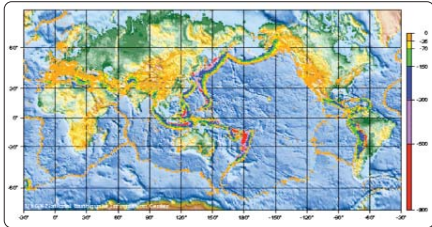


Figure 1: Earthquakes depicted on the 1990 to 2000 World Seismicity Map are taken from the USGS/NEIC PDE catalog

How important is it to you that your datacom and telecommunication equipment survives during a seismic event? It is not a question about "if" a seismic event will occur; it is a question about "when and where". The highest risk areas within the United States are Hawaii, the entire west coast including the southern region of Alaska, the area around St. Louis, Missouri, the border between Utah, Idaho, Wyoming and Montana and areas around Charleston, South Carolina. Internationally, the west coast of Central and South America, Japan and the islands in the western Pacific Ocean south of Asia and east of Australia,

central and western China, the area around Afghanistan, Turkey, Greece and southern Europe are the highest risk areas. Data centers built within these seismically active environments require specialized equipment and racks with special mounting specifications to improve their survival during these seismic events. The Uniform Building Codes (UBC) and the International Building Codes (IBC) define the various seismic zones and probabilistic maps for the likelihood and severity of seismic events.

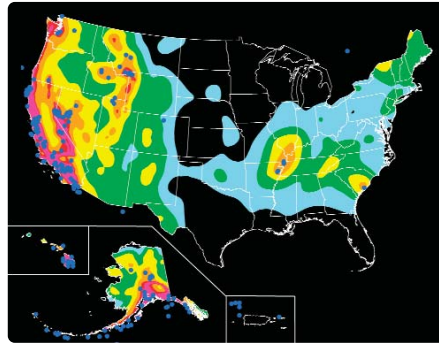


Figure 2: This map shows the areas representing seismic activity (red: high probability, yellow: moderate probability, light blue: low probability). Please use this map for illustrative purposes only. Refer to the Website for the complete set of maps and seismic design values. Source: 2008, USGS, www.usgs.gov/hazards/earthquakes.

These zones were first defined in the 1994 UBC. Zones range from 0 to 4, with zone 0 being defined as having little to no risk and zone 4 as having a high probability of future seismic events. This 1994 UBC was updated with a 1997 UBC where zones were still used, but consideration was given to the actual distance from seismic events. The 2000 IBC further defined the seismic risks via a probabilistic map based on 100 square foot increments to further define the seismicity of a particular site.

Zone 4 has been defined as having the highest seismic risk or potential and is what most manufacturers refer to when offering seismically certified products. The commonly accepted standard test to certify compliance with zone 4 seismic events is defined by Section 4.4, "Earthquake, Office Vibration and Transportation Vibration" of Telcordia Technologies, Inc. GR-63-CORE Network Equipment Building Systems (NEBS) require-

ments for Physical Protection. The racks are tested in a fully loaded condition on a seismic "shaker" table to simulate a zone 4 (up to 8.3 on the Richter scale) seismic event. The shaker table generates random movement of varying intensity in all X, Y and Z planes (front-to-back, side-to-side and up-down). Varieties of accelerometers are attached to measure and record the amount of deflection and vibration exhibited by the rack under test. The rack under test passes if/when the readings are within the NEBS specifications and no permanent damage has occurred to the seismic rack.

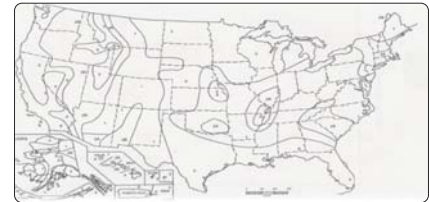


Figure 3: Seismic Zone Map of the United States

Seismic equipment racks are typically designed to secure 500 pounds (227 kg) with some models available up to 1000 pounds (454 kg) of evenly distributed equipment. Most non-seismic racks have a load rating defined as a static load while seismic racks define their load rating as a dynamic load. The chart below is from an actual GR-63-CORE test on a Chatsworth Product, Inc. (CPI) seismic rack (the Seismic Frame Two-Post Rack). It depicts the amount of rack side-to-side deflection observed over the test period. The maximum deflection allowed per GR-53-CORE is +/- 3.0 inches of rack movement from its original position. The chart below shows the actual tested deflection at only 1.0 inch, which is well within the NEBS maximum allowed specifications.

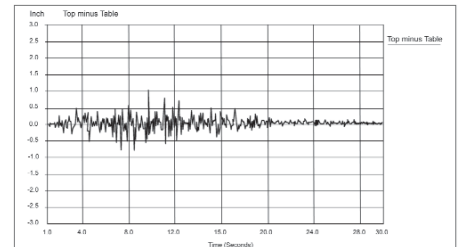


Figure 4: This chart shows the side-to-side, zone 4, displacement time history for CPI's Seismic Frame Two-Post Rack.

OSHPD

Within the State of California, the Office of Statewide Health Planning and Development (OSHPD) works closely with major hospitals to ensure that their facilities can withstand a major earthquake or other disaster. According to OSHPD, scientists estimate a repeat of the 1906, 7.8 San Francisco earthquake would cause more than \$54 billion of economic loss due to building damage. Similarly should a 7.1 earthquake occur in Southern California on the Puente Hills fault, they estimate the building loss damages in be more than \$69 billion. Products with OSHPD OPA (OSHPD Pre-Approval) numbers have been reviewed and certified by structural engineers for recommended mounting and load capacities and are pre-approved by OSHPD. It is vitally important that hospitals and critical data centers have equipment that has been seismically rated and installed per the manufacturer's and structural engineers recommendations.

Anchoring

As important as the standalone rack design and certifications are, it is equally important to ensure that the rack is properly mounted within the particular building. Most high-end seismic racks are designed as a fully welded steel rack to meet the demands of the dynamic loads. Fasteners and

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anchors with a high shear and high tensile strength rating should be selected to secure the racks. When mounting to concrete floors it is extremely important to choose seismically rated floor anchors that have been rated to support the load of the rack, equipment and overhead cable pathways. There is a minimum recommended thickness for concrete floors (up to 6 inches) and the concrete should have a structural compressive minimum of at least 2,000 psi. A minimum of (4) floor anchors (one at each corner) are typically required for a two-post equipment rack installation.

When installing multiple racks in a row it is important that each rack is separated by a minimum distance to ensure that the concrete breakout strength is not reduced or weakened by adjacent rack anchor holes. The installation of seismic equipment within a data center is typically defined and documented by a certified Structural Engineer to ensure that all local codes have been incorporated into the design. You may also want to consider the manufacturers availability of a floor drilling template to allow for accurately positioning the placement of the concrete anchor holes. There are several other installation factors, product options and features that should be considered when specifying a seismic rack for your application.

Grounding/Bonding

To guarantee that modern data center equipment is operating at its highest efficiency, it must be properly grounded. In addition to the typical electrical power grounding, it has become increasingly more important to ensure that all your equipment is properly grounded/bonded within your racks. Grounding/bonding is not simply for safety concerns, although that is important, but a properly grounded/bonded rack will reduce the electrical effects of Electrostatic Discharge (ESD), Radio Frequency Interference (RFI) and Electromagnetic Interference (EMI), thus resulting in more equipment uptime and faster, uncorrupted data rates. Look for racks that have built-in grounding attachment points and terminal blocks, simplifying the installation procedure. There are even some manufacturers that can offer non-painted equipment mounting rails (zinc plated rails) which provide a more reliable grounding path from your equipment to the grounded rack.

Cable Management and Pathways

What type of vertical and horizontal cable management will you utilize? How will these products be attached to your seismic rack? Most seismic racks have features to accommodate vertical cable management products but some will require several bolts, washers and nuts for installation. A well designed seismic product will have pre-installed PEM nuts built into the rack, thereby allowing for easy installations of cable management products.

Be sure to review the cable management depths and mounting configurations of your seismic rack so that there are no potential mounting interferences with the cable management doors and pathways. Consider how you plan to provide power and data cable runs to your rack. Will you provide overhead cable pathways? If so, then pathway mounting configurations need to be taken into account.

How about top-mounted cable waterfalls? Some manufacturers offer their products with built-in cable waterfalls, others provide separate individual products that allow the customer the flexibility to mount these products exactly where they are required. Verify your seismic rack has the options and features to allow for pathway/runway mounting without having to drill holes.

Adjustability

The ability to adjust the equipment mounting rails on your seismic rack is another considera-

tion. Some racks have fixed depth rails while others have multiple adjustable positions. The most common rail depth for a non-seismic two-post rack is 3 inches however for seismic applications; rails are typically positioned at a 6 inch depth. A seismic rack with adjustable rails will provide you with the flexibility to determine or re-adjust the seismic rail depths on site.

RMU Markings

To simplify equipment installation make sure that your seismic rack has RMU marked equipment rails. There is nothing more frustrating than mounting equipment in the wrong equipment rail hole and having to redo the work. RMU marked rails can save installation time by getting it right the first time.

Screws or Cage Nuts

Threaded equipment mounting rails are punched with round holes and then tapped for #12-24 screws. Square-punched equipment mounting rails have square openings that accept cage nuts of various thread sizes. Both styles are punched in accordance with the EIA-310-D hole spacing standard of 1 3/8 inch RMU spaces and attachment points spaced on 5/8-5/8-1/2-inch intervals. Use threaded equipment mounting rails for quick installation of panel-mounted equipment such as patch panels, servers and switches. Use square-punched mounting rails where multiple screw/thread sizes are desirable within a single rack.

Rack Height / Widths

No mystery here, do you need a 7 or 8 foot tall rack? A 7 foot rack will provide up to 45 RMU equipment mounting spaces while an 8 foot rack will increase the equipment mounting space to 51 RMU. Because of the amount of testing required for seismic certifications, most seismic rack manufacturers offer the most common rack height configuration of the 7 foot, 44-45 RMU versions. Several manufacturers also offer these 7 foot racks in both a standard 19 inch width EIA configuration and a 23 inch width legacy version. The 19 and 23 inch widths refer to the distance between the equipment mounting rails and the actual overall product footprint will be several inches larger. When selecting a seismic rack ensure the product footprint fits within your data center requirements.

Electrical Boxes

Some legacy racks used in the telecommunication industry have provisions to allow the mounting of a duplex electrical outlet box at the bottom of the rack.

This may or may not be an important option for your seismic rack application. Ensure that the seismic rack manufacturer has designed in provisions to allow for these electrical duplex boxes, if required.

Shelves / Trays

Since seismic racks are individually engineered, no two manufacturers offer the same "form, fit and function" products. Each seismic rack will have different dimensions, features and compatibilities with existing equipment, shelves and trays. Look for shelf/tray configurations that have been specifically designed and tested to be acceptable and installable within the seismic rack.

Cable Fingers

For those applications where a full vertical cable manager is not required, plastic 7 RMU plug in cable fingers can be provided to allow for data and power cable management in some seismic racks.

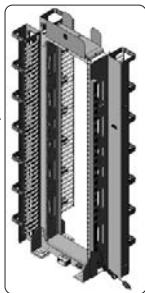
Vertical Power Strips

Some seismic racks are available with built-in features that allow for the installation of vertical power strips using a toolless mounting configuration. These configuration use a pair of metal buttons attached to the back of the power strips that simply slide into the mounting holes designed into the seismic rack.



Cable Management Fingers shown on CPI's Seismic Frame Two-Post Rack.

Chatsworth Products, Inc. (CPI) is a manufacturer of systems designed to organize, store and secure IT infrastructure equipment. CPI Products provide structural support that exceeds customer expectations through innovation, function and performance. Unequaled customer service and technical support, as well as a global network of industry-leading distributors, assures our customers that CPI is dedicated to delivering IT infrastructure solutions designed to meet their needs. Headquartered in Westlake Village, Calif., CPI has manufacturing facilities in Chatsworth, Calif.; Georgetown, Texas, New Bern, N.C. and the Asia Pacific region. For information about CPI's Seismic Racks and other Seismic Protection Systems please visit www.chatsworth.com/seismic.



Seismic Frame Two-Post Rack with Cable Managers and Top-Mount Cable Waterfall Tray.

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