

1.0 INTRODUCTION

Several areas of the U.S. are designated as higher areas of seismic activity (see diagram one). System designers have to consider the installation codes applicable to designated areas of seismic activity.

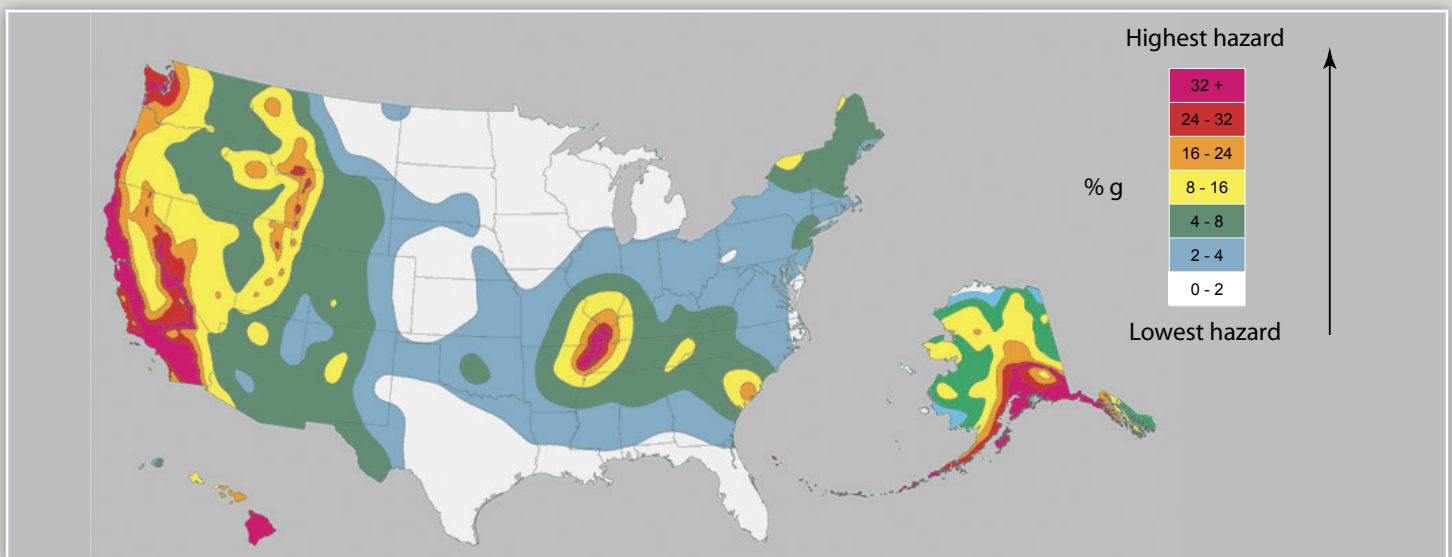
A system designer must consider the behavior of non-structural elements during seismic activity/earth quakes. For reference visit: <http://www.fema.gov/earthquake-publications/fema-e-74-reducing-risks-nonstructural-earthquake-damage>

2.0 NON-STRUCTURAL ELEMENTS

Within commercial buildings, multi-unit housing, and government buildings such as schools, there are three categories of components that are effected by high levels of seismic activity.

- **Architectural** - This covers non-structural components built into the structure such as ceilings, windows, doors, panels and lighting
- **Building Utility Systems** - Within this category falls engine driven generator set systems because it covers non-structural components that form part of the building including mechanical and electrical equipment, distribution systems, HVAC systems, conduit, roof mounted solar panels, etc.
- **Furniture** - This covers many items such as computers, shelving, communication equipment, etc.

DIAGRAM ONE - US SEISMIC AREAS



To fulfill our commitment to be the leading supplier in the power generation industry, the Loftin Equipment team ensures they are always up-to-date with the current power industry standards as well as industry trends. As a service, our **Information Sheets** are circulated on a regular basis to existing and potential power customers to maintain their awareness of changes and developments in standards, codes and technology within the power industry.

Diagram two- Restraints to prevent upward and lateral movement

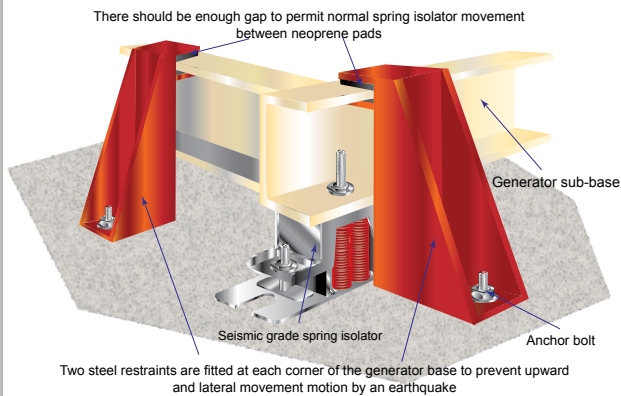


Diagram three- Propane tank installation

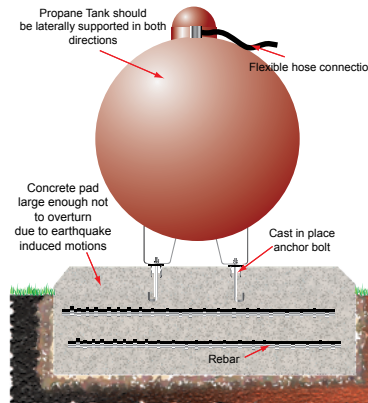


Diagram four - Mounting electrical equipment

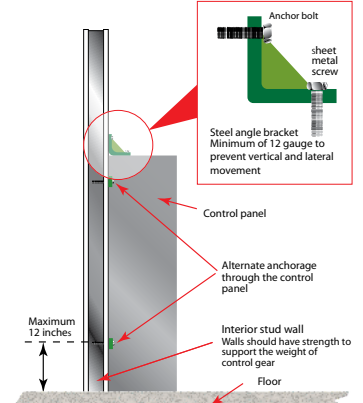
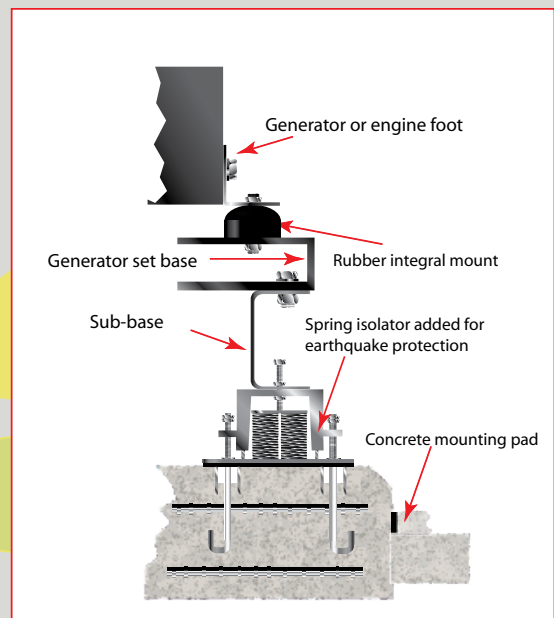
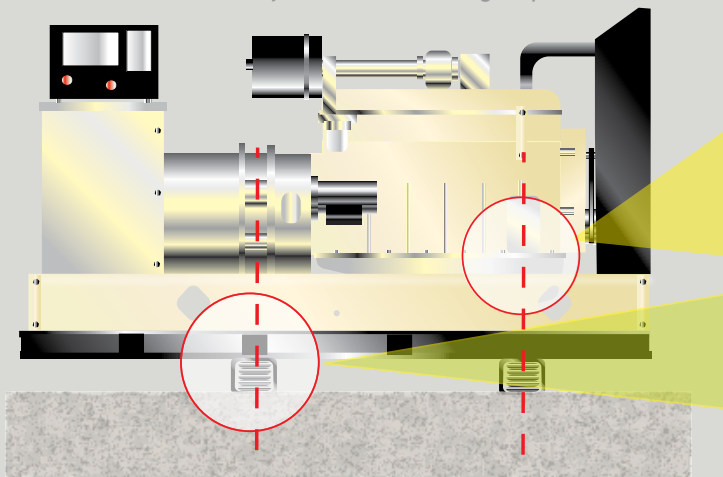


DIAGRAM FIVE - SEISMIC ARRANGEMENT FOR VIBRATION ISOLATORS

Some state and local codes require vibration isolators that provide protection for seismic or earthquake ground effects. If the generator set is already fitted with integral neoprene mounts, the addition of spring mounts for earthquake conditions should be as detailed. The spring mounts should equal the integral mounts and be located in the skid rails vertically inline with the existing neoprene isolators.



3.0 CODES COVERING GENERATOR EQUIPMENT IN SEISMIC AREAS

The designer of an electrical system should consult local codes covering the standards for generator set installation and whether there are special considerations due to increased levels of seismic activity.

The US Geological Survey (USGS) website can be used to determine the seismicity of a location. It can be found at:

<http://www.usgs.gov/>

4.0 EARTHQUAKE HAZARD MITIGATION

The following are recommended good work practices when installing generator sets and associated equipment in areas of high seismic activity. Also consult applicable local codes.

- **Restraints** - To prevent upward and lateral earthquake motion, two steel Z's or other restraints on each corner of the base should be installed firmly anchored to the concrete pad. (see diagram two)
- **Batteries, battery rack restraint** - Batteries should be securely attached to the battery rack. Ensure the battery rack is cross-braced in both directions and the rack has anchor bolts securing it to the pad. The concrete pad should be large enough to keep the rack from sliding or tipping.
- **Diesel fuel and propane tanks** - The tank should be securely attached to the supports which should be laterally supported in both directions. Each support is firmly anchored to the pad. (see diagram three)

In many areas, seismic codes specify the propane system has to be fitted with an automatic, earthquake-triggered shut-off valve. Only qualified personnel should make modifications to gas piping.

- **Fuel lines, water lines and exhaust flues** - Local codes will apply, but good practice is to attach these with flexible connections that permit movement at the junctions to spring mounted equipment and any structural expansion joints within the building that are required to meet code or design.
- **Electrical equipment and distribution** - The switchgear should be properly anchored to the floor or supported by a wall. The wall should have adequate strength to restrain the switchgear.

All electrical cables or conduits in the event of an earthquake must be able to safely distort at the connections to equipment or where they transfer seismic joints between buildings.

At the bus, ducts and cable conduits should be laterally braced. (see diagram four)

- **Vibration isolation** - When state or local codes specify seismic or earthquake-proof mounts in addition to any neoprene isolators installed between the generator set and the sub-base, spring type isolators should be installed under the generator skid. Vendor should confirm isolators are seismic models.

The quantity of spring isolators used should match that of neoprene mounts and be located in the generator base vertically in line with the existing neoprene isolators. (see diagram five)

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