ELECTRICAL DISTRIBUTION SYSTEMS

S15.1 – Introduction:

The exemptions mentioned in ASCE 7-05 are actually implied exemptions that are stated as requirements. This section will attempt to more fully define these provisions for the design professional responsible for the design of the electrical components and distribution systems, and also for the installing contractor who is responsible for bidding and installing the restraints. Also, the component amplification and response modification factors for electrical distribution systems will be tabulated.

S15.2 – "Implied" Blanket Exemption Based on Component Importance Factor I_P

Section 13.6.4 of ASCE 7-05, reads as follows;

> "Electrical components with I_P greater than 1.0 shall be designed for the seismic forces and relative displacements defined in Sections 13.3.1 and 13.3.2 …."

ASCE 7-05 Section 13.6.5 states the following;

> "Mechanical and electrical component supports (including those with $I_P = \mathbf{1.0}$) and the means by which they are attached to the component shall be designed for the forces and displacements determined in Sections 13.3.1 and 13.3.2. Such supports including structural members, braces, frames, skirts, legs, saddles, pedestals, cables, guys, stays, snubbers, and tethers, as well as elements forged or cast as part of the mechanical or electrical component."

ASCE 7-05 Section 13.6.4 implies that electrical components that have been assigned a Component Importance Factor equal to 1.0, regardless of the Seismic Design Category to which they have been assigned, will not require seismic restraints beyond the attachment provisions normally included with the component, provided that a qualified component is selected. This

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means that if the component has four mounting feet with holes for Φ3/8″ mounting hardware, then the component should be attached to the structure with four Φ3/8″ bolts, or anchors. Beyond that nothing further is required.

However, ASCE 7-05 Section 13.6.5 insists that the supports must be designed to withstand the code mounted forces and displacements. So, this is not a general blanket exemption. The manufacturer of the component must be able to certify that the supports designed as part of the component will withstand the seismic requirements for the project using hardware of the appropriate size and strength.

So, while additional analysis and restraint may not be required for electrical components with $I_P = 1.0$, the supports for this equipment must be designed by the manufacturer with sufficient strength to meet the code mandated forces and displacements. After this the design professional of record for a project and the contractor may provide attachment hardware of the appropriate type, size, and strength, as recommended by the manufacturer of the equipment, without doing any further analysis, or providing any further restraint.

While this sounds rather "wishy-washy", it's really not. If the manufacturer of the equipment and its supports certifies that is was design to handle accelerations in excess of the design acceleration for the project, then it may be exempted from the need for further seismic restraint or analysis.

S15.3 – Single Supported Conduit Size Exemption:

There is a size based exemption in ASCE 7-05 Section 13.6.5.5.6a for electrical conduit. They seem to follow the exemptions, in terms size, that are used for piping. Seismic restraints are not required for conduit that has been assigned a Component Importance Factor equal to 1.5, and whose trade size is 2.5 in. (64mm) or less. When sizing and selecting restraints for electrical conduit, that the weight per linear foot of conduit varies greatly depending on the exact type of conduit being used. Also, when computing the total weight per foot of the conduit plus the cabling, it standard practice to assume that there will be ~40% copper fill for the cabling. For conduit

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weights, see Appendix A8.1. Single supported conduit is restrained in the same fashion as single clevis supported pipe. Note that the seismic restraint products supplied by Kinetics Noise Control do not often work well for wall supported conduit as the wall structures and conduit mounts are counted on for both dead weight support and resisting the seismic loads. Each support point will need to be evaluated for its ability to carry both the dead weight load and the design horizontal seismic force.

S15.4 – Trapeze Supported Electrical Distribution Systems:

Per ASCE 7-05 Section 13.6.5.5.6b, no restraints are required for conduit, bus ducts, or cable trays that are supported on trapeze bars, that have been assigned a Component Importance Factor equal to 1.5, and that have a total weight that is 10 lb/ft (146 N/m) or less. This total weight includes not only the conduit, bus duct, or cable trays, but also includes the trapeze bars as well. Trapeze supported electrical distribution systems are restrained in the same way as trapeze supported pipe and duct. It is necessary for the conduit, bus ducts, and cable trays to be attached to the trapeze bars sufficiently to resist the design horizontal seismic forces, both transverse (T) and longitudinal (L).

Cable trays present certain issues when seismic restraints are applied.

1. The construction of certain types of cable trays, such as the “wire basket” type, is designed to carry the dead weight of the cabling over a certain span. They are not necessarily designed to carry the horizontal seismic loads in either the transverse (T) or longitudinal (L) directions over longer spans than the dead weight supports. The manufacturer of the cable trays will need to verify the ability of the cable trays to resist the expected design horizontal seismic forces over the spans specified for the transverse (T) and longitudinal (L) seismic restraint. If the manufacturer of the cable tray hasn’t provided transverse (T) and longitudinal (L) load carrying data for their cable trays, assume that the transverse (T) and longitudinal (L) seismic restraint spacings will be equal to the cable tray support spacing.

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2. Cables are typically simply laid in the cable trays. To ensure that the seismic forces are transferred properly to the restraint points, the cables should be strapped either individually or in bundles to the cable tray at regular intervals. A good rule of thumb for the strapping spacing might be one half the cable tray support spacing. This will make sure that the seismic forces are evenly distributed to all of the restraint points.
3. As with the conduit, the seismic restraint products supplied by Kinetics Noise Control do not often work well with wall mounted cable trays. All of the attachments to the wall must be designed to carry both the dead weight and the horizontal seismic forces in the transverse (T) and longitudinal (L) directions.

S15.5 – Seismic Application Factors for Electrical Distribution Systems:

The portion of Table 13.6-1 of ASCE 7-05 relevant to electrical distribution systems is reproduced below.

Table S15-1; Component Amplification and Response Modification Factors for 2006/2009 IBC (ASCE 7-05)

Component	a_P	R_P
Electrical Components	-----	-----
Generators, batteries, inverters, motors, transformers, & other electrical components constructed of high deformability materials	1.0	2.5
Motor control centers, panel boards, switch gear, instrumentation cabinets, and other components with sheet metal framing	2.5	6.0
Communication equipment, computers, instrumentation, & controls	1.0	2.5
Lighting fixtures	1.0	1.5
Other electrical components	1.0	1.5
Distribution Systems	-----	-----
Electrical conduit, bus ducts and, rigidly mounted cable trays	1.0	2.5
Suspended cable trays.	2.5	6.0

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S15.6 – Summary:

1. Single supported conduit and trapeze supported conduit, bus duct, and cable trays are seismically restrained in a manner similar to pipe and duct. The information in this manual pertaining to the restraint of pipe and duct, and the attachment of restraints to pipe, duct, trapeze bars, and the building structure will apply to electrical distribution systems.
2. Unless otherwise specified, use the weights for rigid conduit from Table A8.1-3 when sizing restraints for electrical conduit, both single supported and trapeze supported.
3. Weight per unit length for cable trays and bus duct will need to be supplied by the engineer of record for the electrical distribution system.
4. Unless transverse (T) and longitudinal (L) load carrying capacities are provided by the manufacturer for cable trays and bus ducts locate the transverse (T) and longitudinal (L) seismic restraints at the cable tray and bus duct support points.
5. Strap cables, either individually or in bundles, to the cable tray at a spacing equal to one half the support spacing to spread the seismic loads evenly to all restraint points.
6. The seismic restraint components provided by Kinetics Noise Control are intended to be used with suspended single supported conduit and trapeze supported conduit, cable trays, and bus ducts. They are not easily applied to wall mounted conduit, cable trays, and bus ducts. The wall mounts and their attachments need to be designed and evaluated for both the dead weight load and the design horizontal seismic load. Certification of these mounts and their attachments to the building would need to be by others.

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