Transferring Forces (Suspended Equipment)

In order for a restraint system to do its job, all elements of the connections need to be sized and installed properly. Because of the large variety and quantity of interfacing conditions in any given installation, suspended systems in general are prone to problems in this area.

The next several sections of this manual will deal with specific components used to clamp cable ends together or anchor cables or struts to steel members, wood members, and concrete or masonry. There are several types of connections used for each of these conditions, and each type of connection requires some degree of care and understanding to achieve full capacity.

There are a few general rules that apply when adding restraints to systems. These are listed below along with a few comments meant to provide a basic understanding or rationale.

1) Friction generally cannot be counted on when dealing with dynamic, seismic load conditions. Connections, with the following exceptions, should be positive in nature and not require friction to ensure their continued long-term operation.

   Exceptions:

   A) Cable end connections (swaged ends, u-bolts, Gripple clips, and cable nuts can be used with appropriate installation procedures).

   B) Toothed strut nuts used in conjunction with a purpose-designed strut material (Unistrut, for example).

   (Rationale: Permitted friction connections have been well researched and deal with a narrow range of applications. In addition, once properly tightened, the components are such that the likelihood of their coming loose as a result of seismic load conditions is very low.)

2) Anchors used for the support of overhead equipment cannot also be used for the anchorage of seismic restraints. *(Rationale: The loads used to size hanger rods and anchors are based on the weight loads generated by the piping system. Seismic forces can increase the tensile loads significantly, and the combination of loads can cause the anchorage to fail.)*

3) Anchors to concrete must comply with minimum edge distance, spacing, and slab thickness requirements. To achieve full capacity ratings they must further not be installed into a surface containing significant tensile forces. *(Rationale: All anchorage must be in compliance with ICC allowables for seismic applications. Unless otherwise noted, it is assumed that connections are not made to the underside of structural concrete beams.)*

4) Screws attached to wood must comply with minimum edge distance, spacing, and

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embedment requirements, and must further not be embedded into the end grain of the wooden member. *(Rationale: All wood anchorage must be in compliance with NDS allowables for seismic applications. Full capacity can only be achieved with adequate embedment, end, and edge distances into the side grain of structural wood members.)*

5) Connections that have the potential to expose open bar joist chords to significant lateral loads are not permitted. *(Rationale: Open joists are notoriously weak in their lateral axis. They are not designed to take loads, particularly on the lower cord, and even light lateral loads can generate buckling and quickly cause catastrophic failure.)*

6) Connections that have the potential to generate significant lateral loads on the weak axis of I-beams or channels used as joists or columns are not permitted unless approved by the structural engineer of record. *(Rationale: Floor or roof support beams are significantly weaker in their minor axis than in their major axis. While they can, under some conditions, withstand some lateral loads, the engineer of record should be consulted to ensure that capacity exists on particular members to withstand the anticipated loads. If these loads are exceeded, catastrophic failures can quickly result.)*

7) Holes should not be added to key structural members without prior authorization from the engineer of record. *(Rationale: The addition of holes, particularly in flanges, can greatly reduce the structural capacity.*

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