

## Roof-Mounted Equipment Applications

Mounting and seismically restraining equipment on the roofs of structures has always required special treatment. Today, with the advent of multipliers based on the elevation of equipment within the structure, these connections have become even more critical as well as more difficult.

Depending on the code used, a multiplier of 2, 3, or 4 is applied to the seismic design force level at the ground level before applying it to roof-mounted equipment. This is true whether or not the structure involved has one story or 100. These high forces must be effectively transferred to what is often a relatively light structure and the entire arrangement must be weatherproofed. In most coastal regions of the country, hurricane-force winds must also be withstood. Often the forces generated by these winds is significantly higher than the seismic design forces.

When working with roof-supported systems it is important to be aware, and to make those responsible for the structure's design aware, of the issues regarding equipment restraint as early as possible. It is not uncommon, particularly on concrete roofs, to come across situations where conventional anchorage does not work. To be more specific, large diameter anchors are frequently required to achieve the needed capacity. These large diameter anchors require significant embedment (as much as 10 inches) into a contiguous (uninterrupted) concrete slab. It is rare that this much concrete exists on the roof and when it does not the addition of this much additional concrete would overload the structure.

Under these conditions, through bolts with backer plates, although not ideal, are the only viable option.

Narrow concrete perimeter roof curbs also pose significant problems in that they will typically not allow enough edge distance to properly install seismically rated anchors. For seismic applications, these should be avoided.

Large penetrations in concrete roof decks for ducts or the like can also result in awkward situations in placing anchors. As much as possible, openings should be held away from the interior edge of the roof curb by at least 12 inches

For optimum performance dedicated steel structural members should be used to support large pieces of equipment. These can be located above or below the roof deck, but in any case must have an interface to which the equipment can be directly connected. For maximum capacity a welded connection between these members and the supported equipment is frequently desirable. Particular caution should be exercised in this area to ensure that twisting moments, which can be put into this structure by loads applied to the supported equipment, are adequately addressed.

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Under some less heavily loaded conditions seismic connections to sheet metal roof decking may be possible. Under no circumstances, however, should seismic connections to sheet metal decking be attempted without a complete review of the application, appropriate reinforcement, and adequate connection capacity between the decking and structural roof support members.

See also later sections of this manual relating to curb-mounted equipment for more detailed information.

A frequent design issue with roof-mounted equipment fit with seismic restraints is that light winds tend to push the equipment against the seismic snubber. This can result in a minor short, decreasing isolator performance. To avoid this condition a perimeter wind barrier around the equipment or a soft wind cushion element that can minimize these occurrences is recommended.

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