

VIBRATION ISOLATION OF ROOFTOP EQUIPMENT

Mechanical equipment mounted on the roofs of buildings are the most complained-about pieces of equipment in a building. Many times, this is due to the upper floors being occupied by top level executives in commercial buildings and by tenants of high-end condominiums in residential buildings, both of whom expect a certain level of quiet in their areas. Because of this, it is best to plan for the isolation of this equipment during the construction of the building. Adding it later can be very expensive.

The equipment located on the roof can range from small, packaged air conditioners to massive cooling towers. In between, are condensers, large, custom air conditioners and fluid coolers. Other equipment may be located on the roof as well when no other place in the building is available or suitable.

The roof, in most buildings, is the flimsiest floor in the building. Improperly selecting the isolator deflection can cause a resonant condition if not properly coordinated. An acoustical consultant will look at the span of the unsupported roof where the equipment is located and the operating speed of the equipment's internal components and base his recommendations on these factors. The amount of additional deflection in the roof structure when supporting the weight of the equipment also must be considered when selecting the type of isolation. Keep in mind, isolation efficiency equations all assume the equipment is supported by an infinitely stiff structure, which rarely occurs in the upper levels of a building. Longer unsupported spans can easily be set into motion, thus requiring larger than anticipated isolator deflection.

Often, rooftop air conditioners are furnished with internal isolation, usually in the form of fans mounted on rubber mounts or inertia bases which are in turn mounted on spring isolators. In some cases, these may be the only method to provide vibration isolation for vary large units where a vibration isolated roof curb is not practical due to the unit's excessive width. When isolating equipment containing internal isolation with some sort of external isolation, the internal isolators should be locked out to preventing the two isolation systems from interfering

with each other which could possibly create a resonant condition. The shipping blocks under the internally isolated components, furnished with the equipment, can be left in place to accomplish this.

There are several ways of preventing annoying vibration emanating from the equipment from being transmitted into the building structure and then into other parts of the building. Various types of spring isolators, isolation pads and isolation roof curbs are available in today's market.

For the purposes of this discussion, we will consider rooftop equipment as falling into one of two categories, curb mounted and non-curb mounted. Roof curbs are required for equipment that will have large openings cut through the roof to accommodate ductwork under the equipment. The curb provides a raised wall around the area of the openings to prevent water from entering the building through the duct openings. Curbs are almost always required for air conditioners, which typically have one or two ducts under them that penetrate the roof. These ducts will require a flexible connector, usually located directly under the unit, to prevent the duct from acting as a pathway for vibration to by-pass the isolation, thus "shorting" it.

Non-curb mounted equipment normally requires small roof penetrations to accommodate plumbing going into and out of the building, and these are easily sealed by the roofer, so no roof curb is required. Like the ductwork, the plumbing will need flexible connections between the equipment and the roof to prevent the isolators from being shorted out. Many of these units are designed to stand on legs or feet to allow air circulation under, around and out the top of the equipment, so mounting them on a roof curb is impractical, as there is no way to prevent rainwater, snowmelt or animals from getting in the roof curb since it is not enclosed.

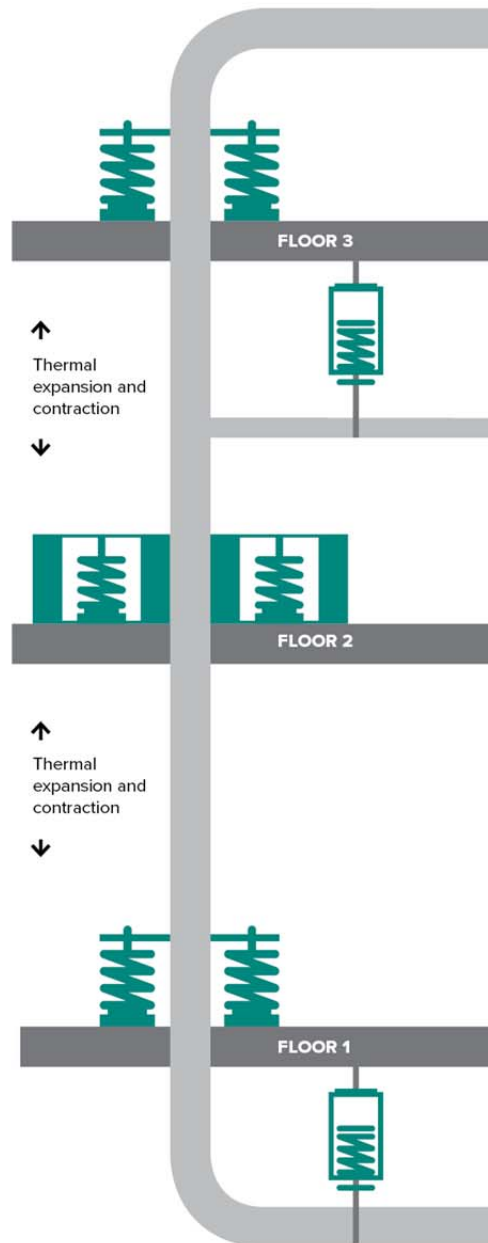
The simplest and least expensive way to isolate rooftop equipment, is with some sort of pad isolators. These can be attached around the perimeter of a sheet metal roof curb in the case of curb mounted equipment or placed under the support feet or legs for point-loaded equipment. The pads may have to also serve as an air and weather seal between a sheet metal curb and the underside of the equipment. Pads may not provide enough deflection to effectively isolate the equipment, but it is considered better than not isolating the equipment at all.

Add-on spring isolation rails can also be installed on sheet metal roof curbs to provide isolation. These are typically available with 1" or 2" deflection springs, and in most cases, will adequately isolate small to medium sized (up to 15,000 pounds) rooftop air handlers. Since these add-on rails usually do not provide any adjustment of the springs (other than adding, removing or relocating springs), they may not be accepted if the project specifications dictate that the spring isolation system have adjustable springs. On the other hand, these rails, plus a sheet metal roof curb are less expensive than many all-in-one isolation curbs described below. These rails are not suitable for point loaded and non-curb mounted equipment.

There are many all-in-one isolation curbs on the market today. Some are simple sheet metal curbs with a built-in isolation rail attached to the top. These usually have the same size limitations as add-on isolation rails. Others are more complex designs and incorporate individual, adjustable spring isolators. Available spring deflections range from 1" up to 4". These curbs are typically intended for large and very large air handlers (up to 50,000 pounds). Depending on the size and options required, they can be costly.

Non-curb mounted equipment can be easily isolated with individual spring isolators placed under the equipment at its support points, typically feet or legs, or located at support points indicated by the unit manufacturer, depending on its design. These isolators are available with spring deflections ranging from 1" through 4". There may be a structural steel frame attached to the roof at this location which can support the isolators.

In all cases of isolating rooftop equipment, remember, the equipment must be sufficiently restrained against wind and seismic forces. The project structural engineer and/or the local code enforcement officials may need to be consulted to determine what needs to be done. Frequently, in high seismic or wind areas, the quantity of isolators required may be more than that needed to support the dead weight of the equipment. This is due to the isolators also serving as the seismic and wind restraints, more isolators being required to meet the restraint requirements.



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VISCMA is a non-profit association representing the manufacturers of seismic restraint, vibration isolation and noise control equipment. The primary objectives of the organization are to educate the construction industry on the proper use and application of vibration isolation and seismic restraint and to develop standards to continually improve the industry.

In partnership with FEMA and ASCE, VISCMA also publishes three Seismic Installation and Inspection Manuals designed to assist field personnel.

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