Vibration Isolation and Seismic Control
Manufacturer's Association
994 Old Eagle School Road -- Suite 1019
Wayne, PA 19087-1866
www.viscma.com

Structural Steel Frame Bases

Often isolated equipment is not of adequate strength or of an appropriate design to be mounted directly to the structure with isolators. For example, cooling towers are often provided with a base that will require continuous support and if attempts are made to localize the support points (as is the case with isolators), the relatively fragile sheet metal perimeter cooling tower frame can buckle.

It is not uncommon, particularly with belt driven fans, that the equipment might be made up of multiple modules that must be held into alignment with one another and in order to work properly, a frame must be designed to support and align the whole collection of components which can then be isolated.

In still other cases, the overall height of the equipment might be an issue that prevents the fitting of isolators directly under the supported equipment. In these cases, a frame is designed that is lower in profile than would be the isolators by themselves and special offset brackets are used to allow the equipment overall profile to be lowered.

When working with structural steel frames it is important to recognize that they are not as rigid as are concrete inertia bases. Because of this, the first thing that must be addressed is to ensure that the base is rigid enough to distribute the distributed equipment loads to the support points defined by the isolator locations while maintaining a flatness tolerance at the equipment mounting surface in line with the manufacturer's specifications.

The second item that must be considered for frames that support a multitude of inter-reacting components, the relationship between the components must remain constant within acceptable limits for all load conditions. For example, if there are shafts that are to be aligned, the alignment be maintained. If there are pulleys and belts involved, the span between the pulley centers must remain constant independent of the torque generated by the motor.

The third item is that the base must be strong enough to carry and distribute seismic or wind loads from the equipment back to the restraint points.

Vibration Isolation and Seismic Control
Manufacturer's Association
994 Old Eagle School Road -- Suite 1019
Wayne, PA 19087-1866
www.viscma.com

On the surface, simply making a base very strong and very stiff would seem to accomplish the desired goals and this is a good starting point. From a practical standpoint however, minimizing the size of the steel members is important both from a cost as well as from a geometry standpoint. Having said that, designing to meet all the above criteria is still not a major hurdle for a competent engineer. There is however one last item that is frequently overlooked and is key to having a successful design.

The various members that make up the frame will each resonate at its own natural frequency. Typically, frames are made up of a simple rectangular beam layout with the long axis members of a different section and length than the short axis members. In some cases, frames will include some form of cantilever that might result from the need to support a motor that is offset from the primary equipment (ie: a belt driven fan) or that isolator placement is such that the equipment (and frame) will overhang the end isolator support points. Each span, cantilever and beam section will define a resonant frequency. The primary frequency is typically simple flexure of the beams however or in some cases rotation or twisting in the beams can also develop torsional modes.

Driving these members, the supported equipment can also have multiple frequencies based on the motor speed, fan speed and the relationship between the belt length and the pulley diameters/spacing (in the case of belt driven equipment). On variable speed drive systems, the problem becomes more complex. As a final factor, the supporting isolators also have their own natural frequency.

The net result is that the base should be designed to not only meet the global stiffness needs, but also be made up of members that will not be excited by the driving frequencies of the various mechanical components. These relationships can impact the beam profiles, weights and even the overall frame geometry.

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

The association office is located at 994 Old Eagle School Road, Suite 1019, Wayne, PA 19087-1866 and can be reached at 610-971-4850 or info@viscma.com.