## PROPER PRIOR PLANNING PREVENTS POOR PERFORMANCE

### I2.1 – The Need for a Plan:

The need for seismic restraints on a run of pipe or duct will impact many trades and building design professionals. Typically, the first trade on a project will have little or no trouble installing their pipe or duct and the seismic restraints that may be required. They basically have all of the available space to work with. As the project progresses it becomes more and more difficult to install the various pipe and duct runs, and especially more difficult to install the required seismic restraints. Many times, the last contractor on the project is just plain out-of-luck. If there is enough space to install the pipe or duct, it may be impossible to install the seismic restraints. Heaven forbid that the first contractor on the project find out that seismic restraint will be required for their pipe or duct after everything is installed. They may not be able to even see their pipe or duct from the floor, much less be able to get to it to install the restraints.

So, a plan is needed by the MEP (Mechanical, Electrical, and Plumbing) coordinator for the scheduling of the trades so that the installation of the pipe and duct along with the seismic restraints will be more possible. Also, before each contractor begins the installation of their pipe or duct, they need to walk each run of pipe or duct and determine where the pipe or duct is to be installed relative to other components already in place, what type of seismic restraint will be required for each run, and where the anchorage for the seismic restraint to the building structure will be possible.

This section will provide the MEP coordinator and contractors with guidelines for planning the installation of the seismic restraints for the pipe and duct. These guidelines are in the form of a checklist. They are general and are by no means complete for every project. Since every project has its own special issues that must be dealt with, these guidelines may not address all conditions, but they should be a good start.



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**I2.2 – What the MEP Coordinator Needs to Consider:**

1. Determine which runs of pipe and duct will require seismic restraint, and which ones won't.
   a. For Seismic Design Categories A and B seismic restraint for pipe and duct is not required by the code.
   b. For Seismic Design Category C, if the pipe or duct has a Component Importance Factor of 1.0, seismic restraint is not required by the code.
   c. For all other cases there may be certain pipe and duct runs that fall under a code exemption or a local jurisdictional exemption. A detailed breakdown of other code based exemptions can be found in Section S-4.0 of the manual.
2. Assume that seismic restraint will be required for the project, there may be instances where a run of pipe or duct that would normally be exempt from the need for restraints would need to be restrained because of its close proximity to equipment or other runs of pipe or duct that do require seismic restraint. A run of pipe or duct that would normally be exempt from seismic restraint will require seismic restraints if;
   a. If it can swing back and for and impact and damage a critical piece of equipment or run of pipe or duct that is seismically restrained.
   b. If a run of pipe or duct that has a Component Importance Factor of 1.0 is installed above a run of pipe or duct that has a component Importance Factor of 1.5, then it must be seismically restrained as thought it had a Component Importance Factor of 1.5.
3. When coordinating between different MEP professionals and trades, give careful consideration to the following.
   a. Position pipe and duct in elevation to allow seismic restraints of adjacent pipe, duct and components to be placed without interference.
   b. Position suspended equipment so that seismic restraints do not interfere with adjacent pieces of equipment, pipe, and duct.
   c. Seismic restraints must be attached directly to building structure that has sufficient capacity to resist the expected seismic loads plus the design service loads.



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d. Equipment in-line with the ductwork may be restrained as part of the ductwork if the following are true.
   i. The in-line equipment weighs 75 lbs, or less.
   ii. At least one end of the in-line equipment is rigidly attached to the duct.
   iii. Piping or other services attached to the in-line equipment are done so with connections that can allow any relative motion to occur without damage.

***e. Exception to "d." for duct in buildings assigned to Seismic Design Categories D, E, and F, with a Component Importance Factor equal to 1.0, a cross-sectional area less than 6 ft$^2$ and in-line equipment weighing more than 20 lbs: Any restraint exemption that is applicable to the duct is NOT applicable to the in-line equipment which must still be individually restrained!***

4. The following issues must be considered when anchoring the seismic restraints to the building structure.
   a. Component attachments must be connected to the building structure by bolting, welding, or other positive attachment means. The frictional resistance due to the dead weight of the component may not be considered as part of the attachment means.
   b. Post installed concrete anchors should be prequalified in accordance with ACI 355.2. The post installed anchors should have an ICC-ES Report issued for them stating that they are for use with the code that is in force, and in the proper Seismic Design Category.
   c. Power actuated fasteners, such as powder shot pins, may not be used for tension loadings in Seismic Design Categories D, E, or F, unless approved by the code official, Authority having jurisdiction, for those applications.
   d. Friction clips are not permitted for seismic anchorage attachment.
   e. Beam clamps that are used for seismic anchorage attachments must be equipped with retaining straps, also know as retainer straps or safety straps capable of resisting the expected seismic loads.



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**I2.3 – What the Contractor Needs to Consider:**

By the time the contractor has the final set of plans for the piping and ductwork, the following issues should be decided.

1. The runs of pipe and duct that require seismic restraint.
2. The approximate restraint locations and types, either longitudinal, transverse, or both.
3. The restraint capacity required at each location, and a possible anchorage to the building structure.

Before the pipe or duct is installed, the contractor should walk the run to see if there are any locations where a strut restraint will be required in place of a set of cable restraints. This decision will set the type of restraint for rest of the run. Some of the things that will require the use of strut over cable restraints are;

1. Other pipe or duct runs in the path of one of the restraint cables.
2. Suspended equipment in the path of one of the restraint cables.
3. No competent structure for the attachment of one of the restraint cables to the building.

It is absolutely imperative that seismic restraint cables ***do not*** come in to contact with any other pipe, duct, piece of equipment, or structural component in the path between the component being restrained and the attachment point on the building structure. This is because any seismic activity would place tremendous forces on the component that the seismic restraint cable had been wrapped around, potentially damaging it or the restraint.

2006 IBC requires that there be a clear and well defined load path from the pipe or duct being restrained to the building structure. In general, it is not acceptable to attach seismic restraints to stud walls unless the installation has been approved by the architect and/or structural engineer of record. Some of the stud walls may be load bearing and not have enough extra capacity to handle



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the design seismic loads from a run of pipe or duct. Other stud walls may be non-load bearing walls and not be adequately attached to the load bearing portion of the structure at the top of the wall, and thus not be capable of carrying large loads perpendicular to the wall.

It may be a good idea to install the seismic restraints as the run of pipe or duct is being installed to be sure that the seismic restraints can be placed in the locations that were planned, and that the types of restraints planned for are used. On some jobs, if the contractor waits until the entire pipe or duct run is up to install the restraints, other components may be in the path of the planned restraints, or the building structure may be completely inaccessible.

**I2.4 – Final Word on the Use of Strut Type Restraints:**

In general the use of strut type restraints over cable type restraints will call for a decrease in the restraint spacing and/or an increase in hanger rod size and hanger rod anchor capacity. Be aware that, if a previously installed run of pipe or duct is being fitted with seismic restraints, and some of the restraint locations require the use of struts rather than cables, all of the existing restraints will need to be changed out to struts and the hanger rod and anchors most likely will need to be increased in size and capacity. Therefore, it is very important to plan ahead to avoid costly surprises.

**I2.5 – Summary:**

Proper prior planning will indeed lead to the best possible outcome for any project. This planning must be done, not only by the contractor and MEP coordinator, but also by all of the design professionals responsible for the pipe, duct and structure.

It is the close co-ordination of all disciplines and trades that will lead to a smoother execution of a building design. This planning co-ordination is implied in the code, and must be driven from the top down by the building owner and architect.



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