CODE BASED EXEMPTIONS FOR PIPE AND DUCT

S4.1 – Introduction:

The International Building Codes (IBC's) allow certain exemptions to be made for pipe and duct from the need for seismic restraint. These exemptions are based on the Seismic Design Category, the Component Importance Factor, and the size and weight, of the pipe or duct. This section will discuss the exemptions that may be applied to pipe and duct and will try to clear up some of the confusion that surrounds several of the exemptions as stated in the IBC.

S4.2 – General Exemptions for Pipe and Duct – ASCE/SEI 7-05 Section 13.1.4:

1. Pipe and duct in or attached to buildings assigned to Seismic Design Categories A or B do not required seismic restraints.
2. Pipe and duct in or attached to buildings assigned to Seismic Design Category C, and which have a Component Importance Factor equal to 1.0, do not required seismic restraint.
3. Pipe and duct that are in or attached to buildings assigned to Seismic Design Categories D, E, or F, that have a Component Importance Factor equal to 1.0, and that weigh 5 lbs/ft or less do not require seismic restraints.

The seismicity of a large portion of the United States is such that items 1 and 2 may be employed to great advantage. A lot of time money and effort may be saved if Seismic Design Category and the Component Importance Factor are known.

S4.3 – Pipe Specific Exemptions (Single Clevis Supported Pipe) – ASCE/SEI 7-05 Section 13.6.8:

The exemptions discussed in this section do not apply to elevator piping or fire protection piping designed in accordance with NFPA 13.

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1. Piping which is supported by hanger rods does not require seismic restraints if all of the following conditions are met.
    a. Hangers in the run of pipe are all 12 in. in length from the top of the pipe top of the pipe to the supporting structure. It should be noted here that the intent of this requirement is that all of the attachments to the supporting structure are at the same elevation. Also, if just one hanger rod exceeds 12 in. in length, the entire run must be seismically restrained. This is commonly referred to as the 12 Inch Rule, see Section S12.0 of this manual for information concerning the implementation of the 12 Inch Rule.
    b. Hangers are detailed and constructed to avoid bending of hangers and their attachments. The implication here is that the attachment of the hanger to the structure needs to be a non-moment generating (free swinging) connection.
    c. There must be sufficient clearance between the piping, to which this exemption is being applied, and surrounding pipe, duct, equipment, and building structure. The pipe needs to be able to swing like a pendulum, without contacting any other components or the building structure.
        i. The attachment to the building structure should be designed to the same level as that called for in ASCE/SEI 7-05 Section 13.6.1. The design load for the piping attachment shall be equal to 1.4 times the operating weight load acting in the downward direction with a simultaneous horizontal load equal to 1.4 times the operating weight. This is in recognition of the fact that the connection of the hanger rod to the building must not only support the weight of the pipe and its contents, but must also be able to resist the cyclic horizontal forces that are required to keep the pipe moving with the building.
2. High deformability piping (welded steel or brazed copper piping) and where provisions are made to avoid impact with adjacent pipe, duct, equipment, or building structure, or to protect the pipe from such impact, may be exempted from the requirement for seismic restraint if the following conditions are met.

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a. The piping is in or attached to a building that is assigned to Seismic Design Categories D, E, or F, and;
    i. The piping has a Component Importance Factor that is equal to 1.5.
    ii. The nominal pipe size is 1.0 in. or less.
b. The piping is in or attached to a building that is assigned to Seismic Design Category C, and;
    i. The piping has a Component Importance Factor that is equal to 1.5.
    ii. The nominal pipe size is 2 in. or less.
c. The Piping is in or attached to a building that is assigned to Seismic Design Categories D, E, or F, and;
    i. The piping has a Component Importance Factor equal to 1.0.
    ii. The nominal pipe size is 3 in. or less.

S4.4 – Pipe Specific Exemptions (Trapeze Supported Pipe) – ASCE/SEI 7-05 Section 13.6.8 per VISCMA Recommendations:

Neither ASCE/SEI 7-05, nor its predecessors, specifies how the piping is to be supported. The point is that many pipes of the exempted size may be supported on a common trapeze bar using hanger rods of the same size as would be specified for a single clevis supported pipe. Keep in mind that the purpose of the seismic restraints is to make sure the pipe moves with the building. The amount of force that the hanger rod must carry will be a direct function of the weight of pipe being supported. It is apparent that there must be some limit to how much weight a trapeze bar can support for a given hanger rod size before seismic restraint is required. VISCMA (Vibration Isolation and Seismic Control Manufacturer's Association) has investigated this issue and can make the following recommendations on the application of the exemptions in item 2 in the preceding section to trapeze supported pipe, www.viscma.com.

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As with the previous case, the exemptions discussed in this section do not apply to elevator piping or fire protection piping designed in accordance with NFPA 13. The following basic provisions must apply.

1. The hangers must be ASTM A36 all-thread rod.
2. The threads must be roll formed.
3. The pipes must be rigidly attached to the hanger rods.
4. Provisions must be made to avoid impact with adjacent pipe, duct, equipment, or building structure, or to protect the pipe from such impact.

Trapeze supported pipes that meet the preceding provisions may be exempted from the need for seismic restraint if the following additional conditions are met.

1. Trapeze supported piping that is in or attached to a building that is assigned to Seismic Design Category C, and;
    a. The trapeze bar is supported by 3/8-16 UNC, or larger, hanger rods.
    b. The maximum hanger spacing is 10 ft. on center.
    c. The Component Importance Factor is greater than or equal to 1.0.
    d. The maximum nominal pipe size is 2 in.
    e. The total weight supported by the trapeze bar is 15 lbs/ft or less.
2. Trapeze supported piping that is in or attached to a building that is assigned to Seismic Design Category D, and;
    a. The trapeze bar is supported by 1/2-13 UNC, or larger, hanger rods.
    b. The maximum hanger spacing is 10 ft. on center.
    c. The Component Importance Factor is equal to 1.0.
    d. The maximum nominal pipe size is 3 in.
    e. The total weight supported by the trapeze bar is 25 lbs/ft or less.
3. Trapeze supported piping that is in or attached to a building that is assigned to Seismic Design Categories E or F, and;

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a. The trapeze bar is supported by 1/2-13 UNC, or larger, hanger rods.
b. The maximum hanger spacing is 10 ft. on center.
c. The Component Importance Factor is equal to 1.0.
d. The maximum nominal pipe size is 3 in.
e. The total weight supported by the trapeze bar is 11 lbs/ft or less.

4. Trapeze supported piping that is in or attached to a building that is assigned to Seismic Design Categories D, E or F, and;
   a. The trapeze bar is supported by 3/8-16 UNC, or larger, hanger rods.
   b. The maximum hanger spacing is 7 ft. on center.
   c. The Component Importance Factor is greater than or equal to 1.0.
   d. The maximum nominal pipe size is 1 in.
   e. The total weight supported by the trapeze bar is 4 lbs/ft or less.

S4.5 – Duct Specific Exemptions – ASCE/SEI 7-05 Section 13.6.7:

There are not as many exemptions for ductwork in the code as there are for pipe, and the ones specifically mentioned are somewhat more restrictive. Seismic restraints are not required for ducts that have a Component Importance Factor equal to 1.0 if either of the following conditions is met for the entire run of the duct.

1. The ducts are suspended from hangers that are 12 in., or less in length, and the hangers have been detailed and constructed to avoid bending of the hangers or their attachments. As with the piping, the attachment of the hangers to the structure should be made with a non-moment generating (free swinging) connector. The connector should be designed to carry 1.4 times the supported weight of the duct in the downward direction, and 1.4 times the supported weight of the duct in the horizontal direction. This in normally referred to as the 12 Inch Rule, see Section S12.0 of this manual for information pertaining to the implementation of this rule.
2. The ducts have a cross-sectional area of less than 6 ft^2.

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ASCE/SEI 7-02 (2003 IBC) and ASCE/SEI 7-05 (2006/2009 IBC) make an interesting statement concerning the fabrication and installation of ductwork, which will be quoted below.

> HVAC duct systems which are fabricated and installed in accordance with standards approved by the authority having jurisdiction shall be deemed to meet the lateral bracing requirements of this section.

The same statement as worded in 2000 IBC reads as follows;

> HVAC duct systems fabricated and installed in accordance with the SMACNA duct construction standards (SMACNA-HVAC and SMACNA –Seismic) and including Appendix B of the SMACNA Seismic Restraint Manual Guidelines for Mechanical Systems shall be deemed to meet the lateral bracing requirements of this section.

As originally published 2000 IBC directly referenced the SMACNA standards as being acceptable for meeting the seismic requirements of the code. The SMACNA Seismic Restraint Guidelines for Mechanical Systems allows the "less than 6 ft^2" for ducts that are assigned a Component Importance Factor Greater Than or equal to 1.0.

The later versions of the code by way of ASCE/SEI 7 documents indicate that it is up to the local authority having jurisdiction over a project to decide whether SMACNA is the approved standard for fabricating and installing the duct systems. Generally speaking, SMACNA is the recognized authority on the design, fabrication, and installation of duct systems, but the designer responsible for selecting the seismic restraints for a duct system needs to check with the local building authorities for verification of the SMACNA standards.

While there are no specific exemptions for duct assigned a Component Importance Factor of 1.5 in ASCE 7-05 or 2006 IBC, 2009 IBC does have the following exemptions for Duct assigned a Component Importance Factor of 1.5 in Section 1613.6.8.

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1. HVAC ducts that are suspended from hangers 12 inches (305 mm) or less in length which have been detailed to avoid significant bending of the hangers or their attachments.
2. HVAC ducts that have a cross-sectional area of less than 6 ft^2 (0.557 m^2).

There is another “exemption”, or rather an allowance, which will reduce the number of restraints a duct system may require. This allowance deals with in-line components such as fans, heat exchangers, humidifiers, VAV boxes, silencers, and etc. These devices may be supported and restrained as part of the duct system if the following conditions are met.

1. They are rigidly, hard, connected to the duct on one or both ends, so that the device moves with the duct.
2. They have an operating weight that is less than or equal to 75 lbs.
3. Appurtenances such as louvers, dampers, diffusers, and etc. are rigidly attached with mechanical fasteners.
4. Piping that serves these devices and is not seismically restrained must be attached to the device with a flexible connector that will handle the expected relative movement between the pipe and the device.
5. Sufficient clearance around the duct and the in-line equipment must be maintained to prevent damage to adjacent components and building structure.

Normally the weight of these in-line devices is small when compared to the weight of the duct being restrained at each restraint location. However, in some cases it may be necessary to include the weight of the device. In these cases the weight of the device should be assumed to be distributed equally over the length of the duct being restrained at each restraint location.

Any seismic restraint exemption that applies to a run of duct also extends to in-line components that are hard connected to the duct on at least one end and that weigh 75 lbs or less. However, if the in-line component weighs more than 20 lbs, and is not hard connected to the duct on at least one end end, it will need to be individually restrained.

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S4.6 – Summary:

The exemptions and allowances outlined in this section can, with careful planning save a lot of time and money. They may also mean the difference between making a profit on a project and breaking even, or worse, losing money. In order to take proper advantage of these exemptions, the Seismic Design Category to which the project has been assigned must be known. This is readily available from the structural engineer. Also, the design professional who is responsible for the piping or duct system must assign a Component Importance Factor to the system.

As a sidebar to the previous statement, it should be noted that the specification for the building may increase the Seismic Design Category in order to ensure an adequate safety margin and the continued operation of the facility. This is a common practice with schools, government buildings, and certain manufacturing facilities. Also, the building owner has the prerogative, through the specification, to require all of the piping systems, and/or all of the duct systems to be seismically restrained. So, careful attention to the specification must be paid, as some or all of the exemptions in this section may be nullified by specification requirements that are more stringent than those provided by the code.

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