REQUIRED BASIC PROJECT INFORMATION

S2.1 – Introduction:

As with any design job, there is certain basic information that is required before seismic restraints can be selected and placed. The building owner, architect, and structural engineer make the decisions that form the basis for the information required to select the seismic restraints for the pipe and duct systems in the building. This is information that should be included in the specification and bid package for the project. It also should appear on the first sheet of the structural drawings. For consistency, it is good practice to echo this information in the specification for each building system, and on the first sheet of the drawings for each system. In this fashion, this information is available to all of the contractors and suppliers that will have a need to know.

S2.2 – Building Use – Nature of Occupancy:

How a building is to be used greatly affects the level of seismic restraint that is required for the MEP (Mechanical, Electrical, and Plumbing) components. In the 2006/2009 IBC the building use is defined through the Occupancy Category, which ranges from I to IV. Occupancy Category I is applied to buildings where failure presents a low hazard to human life. At the other end of the range, Occupancy Category IV is applied to buildings which are deemed to be essential. In the previous two versions of the IBC (2000/2003), the building use was defined though the Seismic Use Group which varied from I to III. Table 1-1 of ASCE/SEI 7-05 describes which types of buildings are assigned to which Occupancy Category. Table S2-1 below summarizes the information in Table 1-1 of ASCE/SEI 7-05, and ties the Seismic Use Group from the previous versions of the IBC to the Occupancy Category. The nature of the building use, or its Occupancy Category, is determined by the building owner and the architect of record.

S2.3 – Site Class – Soil Type:

The Site Class is related to the type of soil and rock strata that directly underlies the building site.

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The Site Class ranges from A to F progressing from the stiffest to the softest strata. Table S2-2 lists the various Site Classes and their corresponding strata.

Table S2-1; Building Use vs. Occupancy Category & Seismic Use Group

Occupancy Category 2006/2009 IBC	Seismic Use Group 2000/2003 IBC	Building Use or Nature of Occupancy
I	I	Buildings and structures in which failure would pose a low hazard to human life. These buildings include, but are not limited to: Ø Agricultural buildings and structures. Ø Certain temporary buildings and structures. Ø Minor storage buildings and structures.
II		Buildings and structures that are not listed as Occupancy Category I, III, or IV. Also, cogeneration power plants that do not supply power to the national power grid.
III	II	Buildings and structures, in which failure would pose a substantial hazard to human life, have the potential to create a substantial economic impact, and/or cause a mass disruption of day-to-day civilian life. These buildings include, but are not limited to: Ø Where more than 300 people congregate in one area. Ø Daycare facilities with a capacity greater than 50. Ø Elementary and Secondary school facilities with a capacity greater than 250 and colleges and adult educational facilities with a capacity greater than 500. Ø Healthcare facilities with 50 or more resident patients that do not have surgery or emergency treatment facilities. Ø Jails, prisons, and detention facilities. Ø Power generation stations. Ø Water and sewage treatment facilities. Ø Telecommunication centers. Buildings and structures which are not in Occupancy Category IV which contain enough toxic or explosive materials that would be hazardous to the public if released.
IV	III	Buildings and structures which are designated as essential facilities which include but are not limited to: Ø Hospitals & healthcare facilities with surgical or emergency treatment facilities. Ø Fire, rescue, ambulance, police stations, & emergency vehicle garages. Ø Designated emergency shelters. Ø Facilities designated for emergency preparedness & response. Ø Power generating stations and other public utilities required for emergency response and recovery. Ø Ancillary structures required for the continued operation of Occupancy Category IV buildings and structures. Ø Aviation control towers, air traffic control centers, and emergency aircraft hangers. Ø Water storage facilities and pumping stations required for fire suppression. Ø Buildings and structures required for national defense. ø Buildings and structures that contain highly toxic and/or explosive materials in sufficient quantity to pose a threat to the public.

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Table S2-2; Site Class vs. Soil Type

Site Class	Soil Type
A	Hard Rock
B	Rock
C	Very Dense Soil & Soft Rock
D	Stiff Soil (Default Site Class)
E	Soft Clay Soil
F	Liquefiable Soils, Quick Highly Sensitive Clays, Collapsible Weakly Cemented Soils, & etc. These require site response analysis.

Generally the structural engineer is responsible for determining the Site Class for a project. If the structural engineer's firm does not have a geotechnical engineer on staff, this job will be contracted to a geotechnical firm. The Site Class is determined in accordance with Chapter 20 of ASCE/SEI 7-05. The site profile is normally obtained by drilling several cores on the property. If there is insufficient information concerning the soil properties, then the default Site Class D is assigned to the project.

S2.4 – Mapped Acceleration Parameters:

The United States Geological Survey, USGS, has mapped all of the known fault lines in the United States and its possessions. They have assigned ground level acceleration values to each location based on the Maximum Considered Earthquake, MCE, for two earthquake periods, 0.2 sec and 1.0 sec, at 5% damping. The mapped values are listed in terms of %g, where 1g is 32.2 ft/sec^2, 386.4 in/sec^2, 9.8 m/sec^2. The long period values are generally applied to the buildings and other structures since they react more strongly to the long period excitation due to their relatively high mass and low stiffness. The short period values are generally used with the non-structural components, which include pipe and duct, as they respond more strongly to the short period excitation due to their relatively low mass and high stiffness.

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The Mapped Acceleration Parameters are available in ASCE/SEI 7-05, or may be obtained from the USGS cataloged by ZIP Code. The short period Mapped Acceleration Parameter is usually denoted as S_S and the Long period Mapped Acceleration Parameter is denoted as S_1.

The Site Class information is then used to determine the Design Spectral Acceleration Parameters, S_{DS} and S_{D1}, for the short and long period MCE respectively. Equations S2-1 and S2-2 may be used to estimate the Design Spectral Acceleration Parameters.

$$S_{DS} = \frac{2}{3} F_a S_S \qquad \textbf{Equation S2-1}$$

And

$$S_{D1} = \frac{2}{3} F_v S_1 \qquad \textbf{Equation S2-2}$$

Where:

F_a = the short period Site Coefficient which is listed in Table S2-3. The values for F_a which correspond to values of S_S that fall between those listed in Table S2-3 may be obtained through linear interpolation.
F_v = the long period Site Coefficient which is listed in Table S2-4. The values for F_v which correspond to values of S_1 that fall between those listed in Table S2-4 may be obtained through linear interpolation.
S_{DS} = the Design Short Period Spectral Acceleration Parameter which has been corrected for the Site Class.
S_{D1} = the Design Long Period Spectral Acceleration Parameter which has been corrected for the Site Class.
S_S = the Mapped Short Period Acceleration Parameter for the MCE @ 5% damping.
S_1 = the Mapped Long Period Acceleration Parameter for the MCE @ 5% damping.

The structural engineer will have the values of S_{DS} and S_{D1} available. It is required to determine the Seismic Design Category for the building, which will be discussed next.

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Table S2-3; Short Period Site Coefficient, F_a

Site Class	Mapped MCE Short Period Spectral Response Acceleration Parameter				
	$S_S \leq 0.25$	$S_S = 0.50$	$S_S = 0.75$	$S_S = 1.00$	$S_S \geq 1.25$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.2	1.2	1.1	1.0	1.0
D	1.6	1.4	1.2	1.1	1.0
E	2.5	1.7	1.2	0.9	0.9
F	These values to be determined by site response analysis.				

Table S2-4; Long Period Site Coefficient, F_v

Site Class	Mapped MCE Long Period Spectral Response Acceleration Parameter				
	$S_1 \leq 0.10$	$S_1 = 0.20$	$S_1 = 0.30$	$S_1 = 0.40$	$S_1 \geq 0.50$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.7	1.6	1.5	1.4	1.3
D	2.4	2.0	1.8	1.6	1.5
E	3.5	3.2	2.8	2.4	2.4
F	These values to be determined by site response analysis.				

S2.5 – Seismic Design Category:

This parameter is of great importance to everyone involved with pipe and duct. The Seismic Design Category to which a building has been assigned will determine whether seismic restraints are required or not, and if they qualify for exemption, which pipes and ducts may be exempted, and which will need to have seismic restraints or bracing selected and installed. There are six Seismic Design Categories, A, B, C, D, E, and F. The level of restraint required increases from Seismic Design Category A through F. Up through Seismic Design Category D, the Seismic

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Design Category to which a building or structure is assigned is determined though the use of Tables S2-5 and S2-6.

To determine the Seismic Design Category both the Long (S_{D1}) and Short (S_{DS}) Period Design Response Acceleration Parameter must be determined. The most stringent Seismic Design Category, resulting from the two acceleration parameters, will be assigned to the project.

Table S2-5; Seismic Design Category Based on the Short Period Design Response Acceleration Parameter

Value of S_{DS}	Occupancy Category (Seismic Use Group)		
	I or II (I)	III (II)	IV (III)
S_{DS} < 0.167	A	A	A
0.167 ≤ S_{DS} < 0.33	B	B	C
0.33 ≤ S_{DS} < 0.50	C	C	D
0.50 ≤ S_{DS}	D	D	D

Table S2-6; Seismic Design Category Based on the Long Period Design Response Acceleration Parameter

Value of S_{D1}	Occupancy Category (Seismic Design Category)		
	I or II (I)	III (II)	IV (III)
S_{D1} < 0.067	A	A	A
0.067 ≤ S_{D1} < 0.133	B	B	C
0.133 ≤ S_{D1} < 0.20	C	C	D
0.20 ≤ S_{D1}	D	D	D

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For Occupancy I, II, or III structures, if the Mapped Spectral Response Acceleration Parameter is greater than or equal to 0.75, $S_1 \geq 0.75$, then the structure will be assigned to Seismic Design Category E. For Occupancy Category IV structures, if the Mapped Spectral Response Acceleration Parameter is greater than or equal to 0.75, $S_1 \geq 0.75$, then the structure will be assigned to Seismic Design Category F. To ensure consistency, the Seismic Design Category should be determined by the structural engineer.

S2.6 – Summary:

The following parameters will be required by the design professionals having responsibility for pipe and duct systems in a building, and should be provided by the structural engineer of record.

1. Occupancy Category (Seismic Use Group for 2000/2003 IBC): This defines the building use and specifies which buildings are required for emergency response or disaster recovery.
2. Seismic Design Category: This determines whether or not seismic restraint is required for pipe and duct.
3. Short Period Design Response Acceleration Parameter (S_{DS}): This value is used to compute the horizontal seismic force used to design and/or select seismic restraints for pipe and duct.

These parameters should be repeated on the drawings for the pipe and duct systems to maintain consistency, and provide this information to contractors and suppliers who may have a need to know.

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