2.0 Evaluation Requirements

2.1 General

Prior to conducting a seismic evaluation, the evaluation requirements of this Chapter shall be met.

2.2 Level of Investigation Required

Prior to conducting a Tier 1 Evaluation, all available documents shall be collected and reviewed. A complete examination of all available documents pertaining to the design and construction of the building shall be conducted. If construction documents are available, the examination shall include verification that the building was constructed in accordance with the documents. All alterations and deviations shall be noted. The information collected shall be sufficient to define the level of performance desired in accordance with Section 2.4, the region of seismicity in accordance with Section 2.5, and the building type in accordance with Section 2.6. In addition, the level of investigation shall be sufficient to complete the Tier 1 Checklists. Destructive examination shall be conducted as required to complete the Checklists for buildings being evaluated to the Immediate Occupancy Performance Level; judgment shall be used regarding the need for destructive evaluation for buildings being evaluated to the Life-Safety Performance Level. Non-destructive examination of connections and conditions, shall be performed for all Tier 1 Evaluations. Default values may be used for material properties for a Tier 1 Evaluation.

In addition to the information required for a Tier 1 Evaluation, sufficient information shall be collected for a Tier 2 Evaluation to complete the required Tier 2 Procedures. Destructive examination shall be conducted as required to complete the Procedures for buildings being evaluated to the Immediate Occupancy Performance Level and for buildings in regions of high seismicity as defined in Table 2-1. Non-destructive examination of connections and conditions shall be performed for all Tier 2 Evaluations. While material testing is not required for a Tier 2 Evaluation, default values for material properties shall not be used. Material property data shall be obtained from building codes from the year of construction of the building being evaluated, from as-built plans, or from physical tests.

Exception: Unreinforced masonry bearing wall buildings with flexible diaphragms using the Tier 2 Special Procedure of Section 4.2.6 shall have destructive tests conducted to determine the average bed-joint shear strength, v_{te}, and the strength of the anchors.

Detailed information about the building is required for a Tier 3 Evaluation. If no documents are available, an as-built set of drawings shall be created indicating the existing lateral-force-resisting system. Non-destructive and destructive examination and testing shall be conducted for a Tier 3 Evaluation to establish:

- the expected strength of all materials that participate in the lateral-force-resisting system of the building; deterioration shall be taken into account;
- the composition and configuration of all primary components and conditions in the lateral-force-resisting system.

Commentary:

Building evaluation involves many substantial difficulties. One is the matter of uncovering the structure since plans and calculations often are not available. In many buildings the structure is concealed by architectural finishes, and the design professional will have to get into attics, crawl spaces, and plenums to investigate. Some intrusive testing may be necessary to determine material quality and allowable stresses. If reinforcing plans are available, some exposure of critical reinforcement may be necessary to verify conformance with the plans. The extent of investigation required depends on the level of evaluation because the conservatism inherent in both the Tier 1 and Tier 2 analysis covers the lack of detailed information in most cases. The evaluating deisgn professional is encouraged to balance the investigation with the sophistication of the evaluation technique.

The design professional in responsible charge should be consulted if possible. In addition, the evaluating design professional may find it helpful to do some research on historical building systems, consult old handbooks and building codes, and perhaps consult with older engineers who have knowledge of early structural work in the community or region.

The evaluation should be based on facts, as opposed to assumptions, to the greatest extent possible.

One of the more important factors in any evaluation is the material properties and strengths. For a Tier 1 Evaluation, the following default values may be assumed: f'_c of 3000 psi for concrete, F_y of 40 ksi for reinforcing steel, F_y of 36 ksi for structural steel, f'_m of 1500 psi for masonry. For a Tier 2 Evaluation, the material strengths can be determined by existing documentation or material testing. For a Tier 3 Evaluation, material testing is required to verify the existing documentation or establish the strengths if existing documentation is not available.

Prior to evaluating a building using this handbook, the design professional should:

- Look for an existing geotechnical report on site soil conditions;
- Establish site and soil parameters;
- Assemble building design data including contract drawings, specifications, and calculations;
- Look for other data such as assessments of the building performance during past earthquakes; and
- Select and review the appropriate sets of evaluation statements included in Chapter 3.

Testing of Masonry

Different types of masonry require different tests to determine the shear capacity. The design professional should use the following as a general guide for selecting the correct test method:

- Multi-wythe masonry laid with headers should use the in-place shear push test;
- For modern masonry, the design professional should consider using a core tested as prescribed in ASTM C 496-90 to determine the tensile-splitting stress. The tensile-splitting stress is the same as the horizontal shear stress. The mortar joints should be at 45° to the load. This should be modified for axial stress by Mohr's procedures;
- Another method is to use a square prism extracted from the wall that is tested as prescribed in ASTM E 519-74 to determine the tensile-splitting stress. The method of relating the test to tensile-splitting in ASTM E 519-74 requires verification. The effect of axial loading on the tensile-splitting stress must be added for the expected horizontal shear stress;
- Use a prism extracted from the wall to determine f'_m. Then use f'_m in empirical formulas to determine the expected shear strength;
- Trace the source of the masonry units for the unit compressive strength. Then use the unit compressive strength with the mortar class on the available construction. documents to determine f'_m.

2.3 Site Visit

A site visit shall be conducted by the evaluating design professional to verify existing data or collect additional data, determine the general condition of the building, and verify or assess the site conditions.

Commentary:

Relevant building data that should be determined through a site visit includes:

- General building description - number of stories, year(s) of construction, and dimensions.
- Structural system description - framing, lateral-force-resisting system(s), floor and roof diaphragm construction, basement, and foundation system.
- Nonstructural element description - nonstructural elements that could interact with the structure and affect seismic performance.
- Building type(s) - Categorize the building as one or more of the Common Building Types, if possible.
- Performance Level - Note the performance level required in the evaluation.
- Region of Seismicity - Identify the seismicity of the site to be used for the evaluation.
- Soil type - Note the soil type.
- Building Occupancy - The occupancy of the building should be noted.
- Historic Significance - Identify any historic elements in the building. Any impacts or areas of the building affected by the evaluation should be noted.

A first assessment of the evaluation statements may indicate a need for more information about the building. The design professional may need to re-visit the site to do the following:

1. Verify existing data;
2. Develop other required data;
3. Verify the vertical and lateral-force-resisting systems;
4. Check the condition of the building;
5. Look for special conditions and anomalies;
6. Address the evaluation statements again while in the field; and
7. Perform material tests, as necessary.

Commentary:

FEMA 178 addressed only the Life Safety Performance Level for buildings. This Handbook addresses both the Life Safety and Immediate Occupancy Performance Levels.

The seismic analysis and design of buildings has traditionally focused on one performance level; reducing the risk to life loss in the largest expected earthquake. Building codes for new buildings and the wide variety of evaluation guidelines developed in the last 30 years have based their provisions on the historic performance of buildings and the deficiencies that caused life safety concerns to develop. Beginning with the damage to hospitals in the 1971 San Fernando earthquake, there has been a growing desire to design and construct certain "essential facilities" that that are needed immediately after an earthquake. In addition, there has been a growing recognition that new buildings should have some measure of damaged resistance built in while existing buildings need to be held only to a minimum safety standard. During this time, a new style of design guidelines began appearing that promised a variety of performance levels. At one extreme, the ABK Methodology was developed to better understand when URM buildings needed to be strengthened to achieve a minimum level of safety. At the other extreme, the California Building Code for Hospital Design and Construction set the

Construction set the criteria for buildings that need to remain operational.

The extensive and expensive, non-life threatening damage that occurred in the Northridge Earthquake brought these various performance levels to the point of formalization. Performance Based Engineering was rigorously described by the Structural Engineers Association of California in their Vision 2000 document. At the same time, the Earthquake Engineering Research Center published a research and development plan for the development of Performance Based Engineering Guidelines and Standards. The first formal application in published guidelines occurred in FEMA 273, where the range of possible performance levels and hazard levels were combined to define specific performance objectives to be used to rehabilitate buildings.

This Handbook defines and uses performance levels in a manner consistent with FEMA 273. The Life Safety and Immediate Occupancy Performance Levels are the same as defined in FEMA 273. The hazard level used is the third in a series of four levels defined in FEMA 273. The level chosen is consistent with the hazard traditionally used for seismic analysis and similar to that used in FEMA 178. For other performance levels and/or hazard levels, the design professional should perform a Tier 3 analysis.

The process for defining the appropriate level of performance is the responsibility of the design professional or the authority having jurisdiction. Considerations in choosing an appropriate level of performance should include achieving basic safety, a cost-benefit analysis, the building occupancy type, economic constraints, etc.

In general, buildings classified as essential facilities should be evaluated to the Immediate Occupancy Performance Level. The *1997 NEHRP Recommended Provisions for Seismic Regulations for New Buildings* categorizes the following buildings as essential facilities "...required for post-earthquake recovery":

- Fire or rescue and police stations,
- Hospitals or other medical facilities having surgery or emergency treatment facilities,
- Emergency preparedness centers including the equipment therein,
- Power generating stations or other utilities required as emergency back-up facilities for other facilities listed here,
- Emergency vehicle garages,
- Communication centers, and
- Buildings containing sufficient quantities of toxic or explosive substances deemed to be dangerous to the public if released.

2.4 Level of Performance

A desired level of performance shall be defined prior to conducting a seismic evaluation using this Handbook. The level of performance shall be determined by the design professional and by the authority having jurisdiction. The following two performance levels for both structural and nonstructural components are defined in Section 1.3 of this handbook: Life Safety (LS) and Immediate Occupancy (IO). For both performance levels, the seismic demand is based on Maximum Considered Earthquake (MCE) spectral response acceleration values. Buildings complying with the criteria of this Handbook shall be deemed to meet the specified performance level.

2.5 Region of Seismicity

The region of seismicity of the building shall be defined as low, moderate, or high in accordance with Table 2-1. Regions of seismicity are defined in terms of mapped response acceleration values and site amplification factors.

Commentary:

The successful performance of buildings in areas of high seismicity depends on a combination of strength, ductility (manifested in the details of construction) and the presence of a fully interconnected, balanced, and complete lateral-force-resisting system. As these fundamentals are applied in regions of lower seismicity, the need for strength and ductility reduces substantially and, in fact, strength can substitute for a lack of ductility. Very brittle lateral-force-resisting systems can be excellent performers as long as they are never pushed beyond their elastic strength.

ATC-14, the first generation version of FEMA 178 recognized this fact and defined separate provisions for regions of low and high seismicity. Based in part on work sponsored by the Nation Center for Earthquake Engineering Research (NCEER, 1987) FEMA 178 eliminated the separate provisions and elected to permit the lateral force calculations to determine when there was sufficient strength to make up for a lack of detailing and ductility.

The collective experience of the engineers using FEMA 178 is that the requirements too often require calculations for deficiencies that are never a problem because of the low lateral forces. This Handbook took this experience and has develop three separate Tier 1 procedures for the three fundamental regions of seismicity. The regions are defined in terms of the expected spectral response for the site under consideration. Thus the criteria for an area bepends both on the expected MCE accelerations and on the site adjustment factors. This will cause area in the transition zone between regions to have sub-areas that are in one region immediately adjacent to a sub-area in another region. This is an intentional result and the experience at the Marina District in the Loma Prieta Earthquake is ample evidence of its credibility.

Table 2-1. Regions of Seismicity Definitions

Region of Seismicity[1]	S_{DS}	S_{D1}
Low	< 0.167g	< 0.067g
Moderate	< 0.500g > 0.167g	< 0.200g > 0.067g

Commentary:

Fundamental to the Tier 1 analysis of buildings is the grouping of buildings into sets that have similar behavioral characteristics. These groups of "building types" were first defined in ATC-14 and have been used in most of the FEMA guideline documents since. During the development of FEMA 273, it was determined that a number of additional types of buildings were needed to cover all common styles of construction. These were fully developed and presented in that document. The added building types included a Northridge-style apartment building, and a number of variations on diaphragm type for the basic building systems. The new types are included as subtypes to the original fifteen, so there remains fifteen model building types.

The common building types are defined in Table 2-2. Because most structures are unique in some fashion, judgment should be used when selecting the building type, with the focus on the lateral-force-resisting system and elements.

Separate checklists for each of the Common Building Types are included in this Handbook as well as General Structural Checklists for buildings that may not be classified as one of the Common Building Types. Procedures for using the General Checklists are provided in Section 3.3.

where: $S_{DS} = \frac{2}{3} F_a S_s$
= design short-period spectral response

Table 2-2. Common Building Types

Building Type 1 : Wood Light Frames	
W1	These buildings are single or multiple family dwellings of one or more stories in height. Building loads are light and the framing spans are short. Floor and roof framing consists of closely spaced wood joists or rafters on wood studs. The first floor framing is supported directly on the foundation, or is raised up on cripple studs and post and beam supports. The foundation consists of spread footings constructed of concrete, concrete masonry block, or brick masonry in older construction. Chimneys, when present, consist of solid brick masonry, masonry veneer, or wood frame with internal metal flues. Lateral forces are resisted by wood frame diaphragms and shear walls. Floor and roof diaphragms consist of straight or diagonal wood sheathing, tongue and groove planks, or plywood. Shear walls consist of straight or diagonal wood sheathing, plank siding, plywood, stucco, gypsum board, particle board, or fiberboard. Interior partitions are sheathed with plaster or gypsum board.
W1A	These buildings are multi-story, multi-unit residences similar in construction to W1 buildings, but with open front garages at the first story. The first story consists of wood floor framing on wood stud walls and steel pipe columns, or a concrete slab on concrete or concrete masonry block walls.
Building Type 2: Wood Frames, Commercial and Industrial	
W2	These buildings are commercial or industrial buildings with a floor area of 5,000 square feet or more. Building loads are heavier than light frame construction, and framing spans are long. There are few, if any, interior walls. The floor and roof framing consists of wood or steel trusses, glulam or steel beams, and wood posts or steel columns. Lateral forces are resisted by wood diaphragms and exterior stud walls sheathed with plywood, stucco, plaster, straight or diagonal wood sheathing, or braced with rod bracing. Large openings for storefronts and garages, when present, are framed by post-and-beam framing. Lateral force resistance around openings is provided by steel rigid frames or diagonal bracing.
Building Type 3 : Steel Moment Frame s	
S1	These buildings consist of a frame assembly of steel beams and steel columns. Floor and roof framing consists of cast-in-place concrete slabs or metal deck with concrete fill supported on steel beams, open web joists or steel trusses. Lateral forces are resisted by steel moment frames that develop their stiffness through rigid or semi-rigid beam-column connections. When all connections are moment resisting connections, the entire frame participates in lateral force resistance. When only selected connections are moment resisting connections, resistance is provided along discrete frame lines. Columns are oriented so that each principal direction of the building has columns resisting forces in strong axis bending. Diaphragms consist of concrete or metal deck with concrete fill and are stiff relative to the frames. When the exterior of the structure is concealed, walls consist of metal panel curtain walls, glazing, brick masonry, or precast concrete panels. When the interior of the structure is finished, frames are concealed by ceilings, partition walls and architectural column furring. Foundations consist of concrete spread footings or deep pile foundations.
S1A	These buildings are similar to S1 buildings, except that diaphragms consist of wood framing or untopped metal deck, and are flexible relative to the frames.

Table 2-2. Common Building Types (cont'd)

Building Type 4 : Steel Braced Frame s	
S2	These buildings consist of a frame assembly of steel beams and steel columns. Floor and roof framing consists of cast-in-place concrete slabs or metal deck with concrete fill supported on steel beams, open web joists or steel trusses. Lateral forces are resisted by tension and compression forces in diagonal steel members. When diagonal brace connections are concentric to beam column joints, all member stresses are primarily axial. When diagonal brace connections are eccentric to the joints, members are subjected to bending and axial stresses. Diaphragms consist of concrete or metal deck with concrete fill and are stiff relative to the frames. When the exterior of the structure is concealed, walls consist of metal panel curtain walls, glazing, brick masonry, or precast concrete panels. When the interior of the structure is finished, frames are concealed by ceilings, partition walls and architectural furring. Foundations consist of concrete spread footings or deep pile foundations.
S2A	These buildings are similar to S2 buildings, except that diaphragms consist of wood framing or untopped metal deck, and are flexible relative to the frames.
Building Type 5: Steel Light Frame s	
S3	These buildings are pre-engineered and prefabricated with transverse rigid steel frames. They are one-story in height. The roof and walls consist of lightweight metal, fiberglass or cementitious panels. The frames are designed for maximum efficiency and the beams and columns consist of tapered, built-up sections with thin plates. The frames are built in segments and assembled in the field with bolted or welded joints. Lateral forces in the transverse direction are resisted by the rigid frames. Lateral forces in the longitudinal direction are resisted by wall panel shear elements or rod bracing. Diaphragm forces are resisted by untopped metal deck, roof panel shear elements, or a system of tension-only rod bracing.
Building Type 6: Steel Frames with Concrete Shear Walls	
S4	These buildings consist of a frame assembly of steel beams and steel columns. The floors and roof consist of cast-in-place concrete slabs or metal deck with or without concrete fill. Framing consists of steel beams, open web joists or steel trusses. Lateral forces are resisted by cast-in-place concrete shear walls. These walls are bearing walls when the steel frame does not provide a complete vertical support system. In older construction the steel frame is designed for vertical loads only. In modern dual systems, the steel moment frames are designed to work together with the concrete shear walls in proportion to their relative rigidity. In the case of a dual system, the walls shall be evaluated under this building type and the frames shall be evaluated under S1 or S1A, Steel Moment Frames. Diaphragms consist of concrete or metal deck with or without concrete fill. The steel frame may provide a secondary lateral-force-resisting system depending on the stiffness of the frame and the moment capacity of the beam-column connections.

acceleration parameter;

Table 2-2. Common Building Types (cont'd)

Building Type 7 : Steel Frames with Infill Masonry Shear Walls	
S5	This is an older type of building construction that consists of a frame assembly of steel beams and steel columns. The floors and roof consist of cast-in-place concrete slabs or metal deck with concrete fill. Framing consists of steel beams, open web joists or steel trusses. Walls consist of infill panels constructed of solid clay brick, concrete block, or hollow clay tile masonry. Infill walls may completely encase the frame members, and present a smooth masonry exterior with no indication of the frame. The seismic performance of this type of construction depends on the interaction between the frame and infill panels. The combined behavior is more like a shear wall structure than a frame structure Solidly infilled masonry panels form diagonal compression struts between the intersections of the frame members. If the walls are offset from the frame and do not fully engage the frame members, the diagonal compression struts will not develop. The strength of the infill panel is limited by the shear capacity of the masonry bed joint or the compression capacity of the strut. The post-cracking strength is determined by an analysis of a moment frame that is partially restrained by the cracked infill. The diaphragms consist of concrete floors and are stiff relative to the walls.
S5A	These buildings are similar to S5 buildings, except that diaphragms consist of wood sheathing or untopped metal deck, or have large aspect ratios and are flexible relative to the walls.
Building Type 8: Concrete Moment Frame s	
C1	These buildings consist of a frame assembly of cast-in-place concrete beams and columns. Floor and roof framing consists of cast-in-place concrete slabs, concrete beams, one-way joists, two-way waffle joists, or flat slabs. Lateral forces are resisted by concrete moment frames that develop their stiffness through monolithic beam-column connections. In older construction, or in regions of low seismicity, the moment frames may consist of the column strips of two-way flat slab systems. Modern frames in regions of high seismicity have joint reinforcing, closely spaced ties, and special detailing to provide ductile performance. This detailing is not present in older construction. Foundations consist of concrete spread footings or deep pile foundations.
Building Type 9 : Concrete Shear Wall Buildings	
C2	These buildings have floor and roof framing that consists of cast-in-place concrete slabs, concrete beams, one-way joists, two-way waffle joists, or flat slabs. Floors are supported on concrete columns or bearing walls. Lateral forces are resisted by cast-in-place concrete shear walls. In older construction, shear walls are lightly reinforced, but often extend throughout the building. In more recent construction, shear walls occur in isolated locations and are more heavily reinforced with boundary elements and closely spaced ties to provide ductile performance. The diaphragms consist of concrete slabs and are stiff relative to the walls. Foundations consist of concrete spread footings or deep pile foundations.
C2A	These buildings are similar to C2 buildings, except that diaphragms consist of wood sheathing, or have large aspect ratios, and are flexible relative to the walls.

Table 2-2. Common Building Types (cont'd)

Building Type 10: Concrete Frames with Infill Masonry Shear Walls	
C3	This is an older type of building construction that consists of a frame assembly of cast-in-place concrete beams and columns. The floors and roof consist of cast-in-place concrete slabs. Walls consist of infill panels constructed of solid clay brick, concrete block, or hollow clay tile masonry. The seismic performance of this type of construction depends on the interaction between the frame and infill panels. The combined behavior is more like a shear wall structure than a frame structure Solidly infilled masonry panels form diagonal compression struts between the intersections of the frame members. If the walls are offset from the frame and do not fully engage the frame members, the diagonal compression struts will not develop. The strength of the infill panel is limited by the shear capacity of the masonry bed joint or the compression capacity of the strut. The post-cracking strength is determined by an analysis of a moment frame that is partially restrained by the cracked infill. The shear strength of the concrete columns, after cracking of the infill, may limit the semiductile behavior of the system. The diaphragms consist of concrete floors and are stiff relative to the walls.
C3A	These buildings are similar to C3 buildings, except that diaphragms consists of wood sheathing, or have large aspect ratios, and are flexible relative to the walls.
Building Type 11 : Precast/Tilt-up Concrete Shear Wall Buildings	
PC1	These buildings are one or more stories in height and have precast concrete perimeter wall panels that are cast on site and tilted into place. Floor and roof framing consists of wood joists, glulam beams, steel beams or open web joists. Framing is supported on interior steel columns and perimeter concrete bearing walls. The floors and roof consist of wood sheathing or untopped metal deck. Lateral forces are resisted by the precast concrete perimeter wall panels. Wall panels may be solid, or have large window and door openings which cause the panels to behave more as frames than as shear walls. In older construction, wood framing is attached to the walls with wood ledgers. Foundations consist of concrete spread footings or deep pile foundations.
PC1A	These buildings are similar to PC1 buildings, except that diaphragms consist of precast elements, cast-in-place concrete, or metal deck with concrete fill, and are stiff relative to the walls.
Building Type 12 : Precast Concrete Frame s	
PC2	These buildings consist of a frame assembly of precast concrete girders and columns with the presence of shear walls. Floor and roof framing consists of precast concrete planks, tees or double-tees supported on precast concrete girders and columns. Lateral forces are resisted by precast or cast-in-place concrete shear walls. Diaphragms consist of precast elements interconnected with welded inserts, cast-in-place closure strips, or reinforced concrete topping slabs.
PC2A	These buildings are similar to PC2 buildings, except that concrete shear walls are not present. Lateral forces are resisted by precast concrete moment frames that develop their stiffness through beam-column joints rigidly connected by welded inserts or cast-in-place concrete closures. Diaphragms consist of precast elements interconnected with welded inserts, cast-in-place closure strips, or reinforced concrete topping slabs. This type of construction is not permitted in regions of high seismicity for new construction.

Table 2-2. Common Building Types (cont'd)

Building Type 13: Reinforced Masonry Bearing Wall Buildings with Flexible Diaphragms	
RM1	These buildings have bearing walls that consist of reinforced brick or concrete block masonry. Wood floor and roof framing consists of wood joists, glulam beams and wood posts or small steel columns. Steel floor and roof framing consists of steel beams or open web joists, steel girders and steel columns. Lateral forces are resisted by the reinforced brick or concrete block masonry shear walls. Diaphragms consist of straight or diagonal wood sheathing, plywood, or untopped metal deck, and are flexible relative to the walls. Foundations consist of brick or concrete spread footings.
Building Type 14: Reinforced Masonry Bearing Wall Buildings with Stiff Diaphragms	
RM2	These buildings are similar to RM1 buildings, except the diaphragms consist of metal deck with concrete fill, precast concrete planks, tees, or double-tees, with or without a cast-in-place concrete topping slab, and are stiff relative to the walls. The floor and roof framing is supported on interior steel or concrete frames or interior reinforced masonry walls.
Building Type 15 : Unreinforced Masonry Bearing Wall Buildings	
URM	These buildings have perimeter bearing walls that consist of unreinforced clay brick masonry. Interior bearing walls, when present, also consist of unreinforced clay brick masonry. In older construction floor and roof framing consists of straight or diagonal lumber sheathing supported by wood joists, on posts and timbers. In more recent construction floors consist of structural panel or plywood sheathing rather than lumber sheathing. The diaphragms are flexible relative to the walls. When they exist, ties between the walls and diaphragms consist of bent steel plates or government anchors embedded in the mortar joints and attached to framing. Foundations consist of brick or concrete spread footings.
URMA	These buildings are similar to URM buildings, except that the diaphragms are stiff relative to the unreinforced masonry walls and interior framing. In older construction or large, multistory buildings, diaphragms consist of cast-in-place concrete. In regions of low seismicity, more recent construction consists of metal deck and concrete fill supported on steel framing.

S_{D1} = $\frac{2}{3}F_v S_1$
= design spectral response acceleration parameter at a one second period;

F_v, F_a = site coefficients defined in Tables 3-5 and 3-6, respectively;

S_s = short-period spectral response acceleration parameter (Sec. 3.5.2.3.1);

S_1 = spectral response acceleration parameter at a one second period (Sec. 3.5.2.3.1).

2.6 Building Type

The building being evaluated shall be classified as one or more of the building types listed in Table 2-2 based on the lateral force-resisting system(s) and the diaphragm type. Two separate building types shall be used for buildings with different lateral-force-resisting systems in each of the two orthogonal directions.