

Chapter 5 - Structural Design Standards

5.1 Introduction

The requirements of this Chapter apply to the structural phase of every applicable design project performed for Sandia National Laboratories New Mexico (SNL/NM).

The requirements of this Chapter apply to nuclear and non-nuclear facilities that have a Performance Category of PC-1 to PC-4 as determined by DOE-STD-1021-93. For all nuclear facilities and for all non-nuclear facilities of PC-3 or PC-4, this Chapter shall be supplemented with the requirements of an applicable project specific Design Criteria. Information contained in a project specific Design Criteria shall take precedence over the design requirements of this Chapter.

For all general requirements associated with the design phase of a project, see Chapter 2, General Design Standards and Procedures.

For all product specifications, see the Facilities Construction Standard Specifications.

5.2 Design Requirements

5.2.1 General

The following is an outline summary of the general structural requirements that the Engineer of Record (EOR) shall consider for each project design. At design completion, the EOR shall use two methods to document all applicable structural design information. The first method is to submit to SNL/NM the information required in Section 5.2.9 of this Chapter. The second method is to record the information on the General Structural Notes sheet of the project's construction drawings, which shall include the following details:

- Brief narrative description of the building's substructure and superstructure
- Brief narrative of all special structural features
- Codes and Manuals used for design and construction
- Building Type of Construction
- Building Performance Category per DOE-STD-1021-93
- Design loading criteria with detailed coefficients and factors
- Geotechnical Report reference
- Brief narrative of key geotechnical information used for design and construction
- Outline specifications of construction materials and methods
- Statement of Special Inspections required to verify construction complies with design
- List of all mechanical/electrical/other equipment that has been seismically protected
- Fall protection structural information
- Identify load capacities for all conveying systems such as elevators, cranes, and hoists.
- Schedules, Tables, Diagrams that enhance the presentation of the scope of work
- List of computer files used for design, including archive location information
- Abbreviations
- All other pertinent structural information

5.2.2 Building Type of Construction

Note the building's Type of Construction is obtained from either the project's Architectural Code Analysis or the latest version of the International Building Code (IBC).

5.2.3 Building Performance Category

The criteria for determining a building's Performance Category (PC) is described in DOE-STD-1021-93. For a preliminary PC determination, the following SNL/NM Structural Department guidelines can be used:

- PC-1 General use buildings such as office buildings, cafeterias, storage buildings, etc.
- PC-2 Emergency operation centers, hospitals, fire stations, low-hazard laboratories, etc. and a Building with an occupant load of 300 or more.
- PC-3 Building that may release significant amounts of hazardous materials on site only.
- PC-4 Building that may release significant amounts of hazardous materials to the public.

The SNL Project Manager shall determine the building PC and obtain DOE concurrence.

5.2.4 Design Loads

Use the design loads set forth in the current edition of DOE Standard 1020-2002. In this Standard, the design loads for PC-1 and PC-2 are the same as those published in the latest edition of the IBC as adopted by the State of New Mexico which references the American Society of Civil Engineers' (ASCE 7) Criteria for *Minimum Design Loads for Buildings and Other Structures*.

For PC-3 and PC-4, a project specific Design Criteria document must be created by the EOR that supplements the requirements of this Chapter. Use the design loads set forth in the current edition of DOE Standard 1020-2002 and other special loads as applicable.

All interior partition walls shall be designed and detailed to support attached commercial shelving units. The EOR shall design and detail new partition walls comprised of metal stud with gypboard. For modular walls, such as Dowcraft™ or similar, the EOR may use the following SNL/NM Structural Department guidelines:

- No more than four (4) shelves per 2' to 3' panel.
- No more than twelve (12) shelves per 12' clear non-braced panel run.
- Shelf weight to be 40 lbs/linear foot (typical shelf full of books).

5.2.5 Geotechnical Information

The IBC utilizes the geotechnical Site Class for determining the Seismic Design Category for a specific project location. At SNL, there is a direct correlation between Site Class and Seismic Design Category. Site Class C yields Design Category C and Site Class D yields Design Category D. Establishing the proper Design Category makes a significant economic impact to the project because ASCE 7 requires seismic protection for systems and equipment in Category D but does not require seismic protection for systems and equipment in Category C, provided the IBC Importance Factor is 1.0. Thus, it is essential for the geotechnical engineer to accurately determine the Site Class for each SNL project site.

Note, Seismic Design Category D shall be used if a geotechnical report is not available or if the project's Importance Factor is greater than 1.0.

5.2.6 Seismic Protection for Systems and Equipment

Seismic protection for systems and equipment shall be provided for all new buildings.

Seismic protection for systems and equipment in existing buildings shall be determined by the EOR based on the IBC criteria for Seismic Design Category and for the extent of renovation. The EOR may use a current SNL/NM Structural Department guideline that exempts existing buildings constructed before 1988 from the requirement of providing seismic protection for systems and equipment when minor renovations are performed. See Attachment A for a comprehensive list of all potential exempt buildings.

When the EOR determines that seismic protection for systems and equipment is required, detailed design shall be accomplished by the following two phases:

Phase 1 requires the EOR to design seismic protection for all major systems and equipment that normally must be considered in the design of the structure as a whole. Large and/or heavy systems and equipment with known weights and locations that are input criteria for the analysis and design of their supporting structures shall have their seismic protection designed concurrently. Anchorages that resist seismic overturning and sliding forces shall include, but not limited to, anchor bolts, vibration isolators, and multi-directional snubbers. Products that resist lateral and longitudinal seismic forces and/or accommodate building drift or other displacements shall include, but not limited to, sway braces, spacers, pipe sleeves, and flexible joints or couplings. The EOR shall clearly identify all the systems and equipment in the General Structural Notes that required special design and detailing. The EOR shall clearly detail all seismic protection within the project's construction drawings and is encouraged to edit SNL Standard Specification 13085 "Seismic Protection" to specify these special seismic protection products and/or special requirements. The EOR shall also identify required seismic bracing submittals on the SNL Descriptive Submittal Lists.

Phase 2 requires the General Contractor (GC) to design seismic protection for 1) the fire protection system and 2) all other minor systems and equipment. Fire protection systems shall be designed according to NFPA 13 Specification Section 9.3. SNL Standard Specification 13085 "Seismic Protection" shall be the basis of seismic design for all the other minor systems and equipment. These two Specifications, plus the seismic design criteria listed in the General Structural Notes by the EOR, will give the GC sufficient information to either contract the design and detailing of the seismic protection to a Registered Professional Engineer or to follow the seismic detailing as illustrated on the SNL Standard Drawings. These Standard Drawings graphically summarize the latest seismic protection requirements listed in the applicable codes and are usually included within the project's construction drawing package. Construction compliance with these Standard Drawings usually eliminates the need for a Registered Professional Engineer to design the seismic protection for minor systems and equipment.

5.2.7 Fall Protection Anchor Points

Fall protection anchor points for all new and existing buildings, for exterior and interior applications, shall be determined by the EOR based on project specific criteria and shall be in compliance with ANSI/ASSE Z359.1 Section 7.

For exterior roof-top applications, fall protection anchor points are not required for buildings with a continuous perimeter parapet or guardrail of at least 42” minimum height measured vertically from roof surface level nor where all serviceable equipment is a minimum of 15’ from the edges of the roof.

For all other exterior and interior applications, fall protection anchor points shall be designed for project specific conditions. At SNL/NM, anchor points may be specifically required during the building construction phase or for the final operational phase. The EOR shall use the following SNL/NM Structural Department loading guidelines when designing and detailing fall protection anchor points:

- Anchor points for fall protection in new structures shall be designed for an ultimate load capacity of 5000 lbs (3600 lbs service load) applied in any direction.
- Anchor points for fall protection in existing structures shall be designed for an ultimate load capacity of 1800 lbs (1300 lbs service load) applied in any direction.
- Temporary anchor points for fall restraint shall be designed for an ultimate load capacity of 800 lbs (575 lbs service load) applied in any direction.

5.2.8 Cranes, Monorails, and Hoists

Cranes, monorails, and hoists shall comply with the latest edition of CMAA 70 as applicable for the type of device. The EOR shall be responsible for coordinating the design and detailing of all cranes, monorails and hoists. The design shall address DOE-Standard-1090 and the following SNL/NM Structural Department guideline list of criteria and features, as applicable for the type of device:

- Crane capacity
- Crane class
- Top running or under hung
- Bridge crane clearances
- Girder type
- Bridge speeds
- Bridge drive type
- Hook height
- Trolley speeds
- Hoist class
- Hoist lift
- Hoist speeds
- Pushbutton pendant stations.

Other features that may need to be addressed include the following:

- Effects to any existing building structural system (foundations, columns, etc.)
- Remote control (radio)
- Special Pendant Travel System
- Pendant Retractor System
- Personnel catwalk along the bridge
- Ladder with platform to the catwalk.

5.2.9 Elevators

Elevators shall be in compliance with the latest edition of ASME 17.1. The EOR shall be responsible for coordinating the design and detailing of all elevators. As a minimum, the EOR shall address the design criteria as described in Chapter 6 Architectural Design Standards Section 6.3.5.1 and also as contained in Construction Standard Specification 14240 Hydraulic Elevators.

5.2.10 Structural Calculation Requirements

At design completion, the EOR shall copy, neatly index and bind, and submit all structural calculations and related documentation required for and resulting from the project's structural design and detailing, to the SNL/NM Structural Department. This information will be archived in the SNL/NM Facilities' Library for permanent record.

In addition to the information summarized in the General Structural Notes, the submittal should capture information such as:

- Project requirements, criteria sources, and references
- Allowances for future loads
- Working or ultimate stresses and factors of safety
- Codes, manuals, special investigations, and reports used
- Calculations with loading, shear, and moment diagrams
- Computer input and output with forces and stresses tabulated
- Explanations for assumptions used and conclusions drawn
- Deflection calculations and tabulated results
- Applicable expansion, contraction, and crack-control measures
- Geotechnical report discussions
- Alternative superstructure and substructure systems or materials considered

5.3 Construction Drawings

5.3.1 Structural Drawings

Accurately prepare structural drawings to scale with all plans at the same orientation and scale. Refer to the Facilities CADD Standards Manual for all CADD requirements.

Present sections, details, and/or other unique graphical presentations on separate drawing sheets.

5.3.2 Drawings Required for Building Construction

The following is an outline list of drawings required for the typical project. Additional drawings may be necessary. Arrange drawings in the order listed.

1. General Structural Notes Sheet: Describes the structural design intent of the project.
2. Foundation Plan(s): All structural work for the foundation and footing construction. Use the highest elevation of the major ground floor slab as the reference place for drawing the foundation plan.
3. Foundation Section(s): Detail(s) and Schedules: All structural work for the foundation and footing sections and details. All sections and details must be labeled descriptively, and cross-referenced to the applicable Plan drawings.
4. Framing Plan(s): All structural framing (including cold form steel framing) by floor (including roof) and general structural notes.

5. Framing Plan Section(s), Detail(s) and Schedules: All structural work for the framing plan requiring sections and details, which must be labeled descriptively and cross-referenced to the applicable Plan drawings.
6. Miscellaneous: Elevations (Braced Frames, etc.).

- End of Chapter -