

Load combinations are a way of considering the maximum (or minimum) forces on a structural element considering the combined effects of gravity loads (e.g., dead load, floor live load, roof live load, rain load, snow load) and other load effects as a result of earthquake, wind, flood, earth pressure, fluid pressure, etc.

Notations –

- D = Dead load
 E = Combined effect of *horizontal and vertical earthquake* induced forces as defined in *ASCE 7-16 – §12.4.2*
 F = Load due to fluids with well-defined pressures and maximum heights
 F_a = Flood load in accordance with *ASCE 7-16 – Chapter 5*
 H = Load due to lateral earth pressures, ground water pressure, or pressure of bulk materials
 L = Floor live load, ~~and roof live load > 20 psf~~
 L_r = Roof live load ~~≤ 20 psf~~
 R = Rain load
 S = Snow load
 T = Cumulative effect of self-straining load forces and effects (e.g., contraction or expansion resulting from temperature change, shrinkage, moisture change, creep in component materials, movement due to differential settlement or combinations thereof)
 W = Load due to wind pressure

Load Combinations for Strength Design

ASCE 7 – §2.3

All applicable *Strength Design* (SD/LRFD) load combinations must be considered since the most critical load effect may occur when one or more of the contributing loads (e.g., D , E , L , L_r , S) are not acting.

- $1.4D$ *ASCE 7 (2.3-1)*
- $1.2D + 1.6L + 0.5(L_r \text{ or } S \text{ or } R)$ *ASCE 7 (2.3-2)*
- $1.2D + 1.6(L_r \text{ or } S \text{ or } R) + (L \text{ or } 0.5W)$ *ASCE 7 (2.3-3)*
- $1.2D + 1.0W + L + 0.5(L_r \text{ or } S \text{ or } R)$ *ASCE 7 (2.3-4)*
- $0.9D + 1.0W$ *ASCE 7 (2.3-5)*

SD/LRFD Load Combinations with Seismic Load Effects

ASCE 7 – §2.3.6

When a structure is subject to seismic load effects, the following load combinations shall be considered in addition to the basic SD/LRFD load combinations of *ASCE 7 – §2.3.1*:

- $1.2D + E_v + E_h + L + 0.2S$ *ASCE 7 (2.3-6)*
 or ... $(1.2 + 0.2S_{DS})D + \rho Q_E + L + 0.2S$
- $0.9D - E_v + E_h$ *ASCE 7 (2.3-7)*
 or ... $(0.9 - 0.2S_{DS})D - \rho Q_E$

NOTE: See *ASCE 7-16 – §2.3.6 - Exception 1 & 2* for additional requirements on the equations above (e.g., use of $0.5L$ in *ASCE 7 (2.3-6)* where $L_o \leq 100$ psf except for garages or areas occupied as places of public assembly, etc.).

9.5 Wood-Frame Shear Walls

SDPWS §4.3

Application Requirements

SDPWS §4.3.1

Sheathed wood-frame *shear walls* are permitted to resist lateral forces provided the deflection of the shear wall ... does not exceed the maximum permissible deflection limit (i.e., drift limits of *ASCE 7 – §12.12.1*).

Framing members, blocking, and connections shall extend into the shear wall a sufficient distance to develop the force transferred into the shear wall.

Shear Wall Types

SDPWS §4.3.2

Individual Full-Height Wall Segments

SDPWS §4.3.2.1

Where individual full-height wall segments are designed as shear walls (without openings), the aspect ratio limitations of *SDPWS §4.3.3* shall apply to each full height wall segment as illustrated in *SDPWS Figure 4.D* – see Figure 9.5. The following limitations shall apply:

1. Openings shall be permitted to occur beyond the ends of a shear wall ... but the length of the shear wall segments shall exclude the length of any openings.
2. Where out-of-plane (wall) offsets occur, portions of the wall on each side of the offset shall be considered as separate shear wall lines.
3. Collectors for shear transfer to individual full-height wall segments shall be provided.

➤ Shear Wall Height, h

The height of a shear wall segment (h) is defined as the:

- maximum clear height from the top of the foundation to bottom of the diaphragm framing above; or
- maximum clear height from the top of the diaphragm below to bottom of the diaphragm framing above

➤ Shear Wall Width, b

The width (i.e., length) of a shear wall (b) is defined as the sheathed dimension of the shear wall in the direction of application of force ... excluding openings.

Refer to Figure 9.5 for example height-to-width ratios of individual full-height wall segment shear walls.

Force-Transfer Around Openings (FTAO) Shear Walls

SDPWS §4.3.2.2

Where shear walls *with openings* are designed for force transfer around the openings ... the design shall be based on a rational analysis and shall meet *SDPWS §4.3.2.2*.

Perforated Shear Walls

SDPWS §4.3.2.3

Where wood structural panel (WSP) shear walls *with openings* are not designed for force transfer around openings, they shall be designed as perforated shear walls and shall meet *SDPWS §4.3.2.3*.

Shear Wall Aspect Ratios

SDPWS §4.3.3

A *Shear wall* aspect ratio refers to the height to width (i.e., length) ratio of the individual shear wall element. Size and shape of shear walls shall be limited to the aspect ratios in *SDPWS Table 4.3.3* (see Table 9.4 below).

A final report documenting required special inspections and tests, and correction of any discrepancies noted in the inspections or tests, shall be submitted at a point in time agreed upon prior to the start of work by the owner or the owner's authorized agent to the *building official*.

11.4 Statement of Special Inspections

IBC §1704.3

Where *special inspections* or *tests* are required by IBC §1705, the *registered design professional in responsible charge* (i.e., engineer or architect) shall prepare a statement of special inspections in accordance with IBC §1704.3.1 for submittal by the (permit) applicant in accordance with IBC §1704.2.3.

Content of Statement of Special Inspections

IBC §1704.3.1

The statement of special inspections shall identify the following:

1. The materials, systems, components and work required to have *special inspections* or *tests* by the *building official* or by the *registered design professional* responsible for each portion of the work.
2. The type and extent of each *special inspection*.
3. The type and extent of each *test*.
4. Additional requirements for *special inspections* or *tests* for seismic or wind resistance as specified in IBC §1705.12, §1705.13, and §1705.14.
5. For each type of *special inspection*, identification as to whether it will be continuous special inspection, periodic special inspection, or performed in accordance with the notation in the referenced standard (e.g., *ACI 318-19*, *AISC 360-16*, *AISC 341-16*, *TMS 402-16*, etc.).

Seismic Requirements

IBC §1704.3.2

Where IBC §1705.13 or §1705.14 specifies *special inspection* or *tests* for seismic resistance, the statement of special inspections shall identify the *designated seismic systems* and seismic force-resisting systems (SFRS) that are subject to *special inspections* or *tests*.

- **Designated Seismic System** - refers to those nonstructural (i.e., architectural, electrical and mechanical systems) components that require design in accordance with *ASCE 7-16 – Chapter 13* and for which the component importance factor $I_p > 1$ (i.e., $I_p = 1.5$) in accordance with *ASCE 7-16 – §13.1.3*.

11.5 Required Special Inspections & Tests

IBC §1705

Typically, the following types of work may require *special inspections* and/or *tests*:

- **Special cases** - required for proposed work that is, in the opinion of the *building official*, unusual in its nature, such as, but not limited to, the following examples:
 - Construction materials and systems that are alternatives to materials and systems prescribed by the *IBC*
 - Unusual design applications of materials described in the *IBC*
 - Materials and systems required to be installed in accordance with additional manufacturer's instructions that prescribe requirements not contained in the *IBC* or in standards referenced by the *IBC*
- **Steel construction** - *special inspections* and non-destructive *testing* of steel construction in buildings, structures, and portions thereof per IBC §1705.2
 - Structural steel per IBC §1705.2.1 ... in accordance with the quality assurance inspection

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