Ultimate Guide to Seismic Loads as Per Latest Standards ASCE7-22 — Part 2

An Online Continuing Education Course for Engineers

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Ultimate Guide to Seismic Loads as Per Latest Standards ASCE7-22 Part 2 [including more than 180 solved examples]

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1. Analysis Methods:

By ASCE7-22-Section 12.6, it is permitted to select one of the following methods:

- Equivalent Lateral Force Procedure. (ELF)
- Modal Response Spectrum Analysis. (MRSA)
- Linear Response History Analysis. (LRHA)
- Analysis procedure approved by the Authority Having Jurisdiction.
- Nonlinear Response History Analysis. (NLRHA)

2. Redundancy Factor (ρ):

The "Redundancy Factor" (ρ) is a factor that decreases the effect of loss of story shear strength during the earthquake, when some of the bays of seismic force-resisting systems fail, and due to the effect of the high torsional irregularity by increasing the seismic forces.

There are two possible values of the "Redundancy Factor" (ρ), 1.0 and 1.30.

Table (07) summarizes the conditions where the value of (ρ) is 1.0 or 1.30.

Table (07). Conditions of Redundancy Factor (ρ)		
SDC	**(ρ) = 1.0**	**(ρ) = 1.3**
All	● Drift calculation and P-delta effects. ● Nonstructural components. ● Nonbuilding structures that are not similar to buildings. ● Design of collector elements, splices, and their connections for which the seismic load effects including overstrength are used. ● Design of members or connections where the seismic load effects, including overstrength, are ● required for design. (e.g.: strut and columns of steel braced frames). ● Diaphragm seismic design forces. ● Structures with damping systems designed by ASCE7-22-Chapter 18. ● Design of structural walls for out-of-plane forces, including their anchorage.	N/A
B or C	All structures.	N/A
D, E, or F	● Group I of conditions: For each story resisting more than 35% of the base shear, after the notional removal of one bay of the seismic force-resisting system, the following conditions shall be met:	● In all structures, except where one of the two groups of conditions (I or II) is met, the redundancy factor is permitted to be 1.0. ● Structured assigned to SDC "D, E, or F", that have a TIR >1.4 in

	a) There are at least 2 bays of seismic force-resisting systems on each side of the center of mass. b) The reduction in lateral strength of the story in the direction under consideration does not exceed 35%. (Figure XX). c) The resulting system after removal does not result in horizontal torsional irregularity type (1) "Torsional Irregularity" with Torsional Irregularity Ratio (TIR) > 1.4. ● Group II of conditions: a) The structure does not have any type of horizontal irregularity in the direction under consideration in all stories. b) There are at least two bays of seismic force-resisting systems on each side of the structure at each story resisting more than 35% of the base shear.	both orthogonal directions at any given level.

Figure (33) demostrates of the reduction of lateral strength of the story for several seismic force-resisting systems.

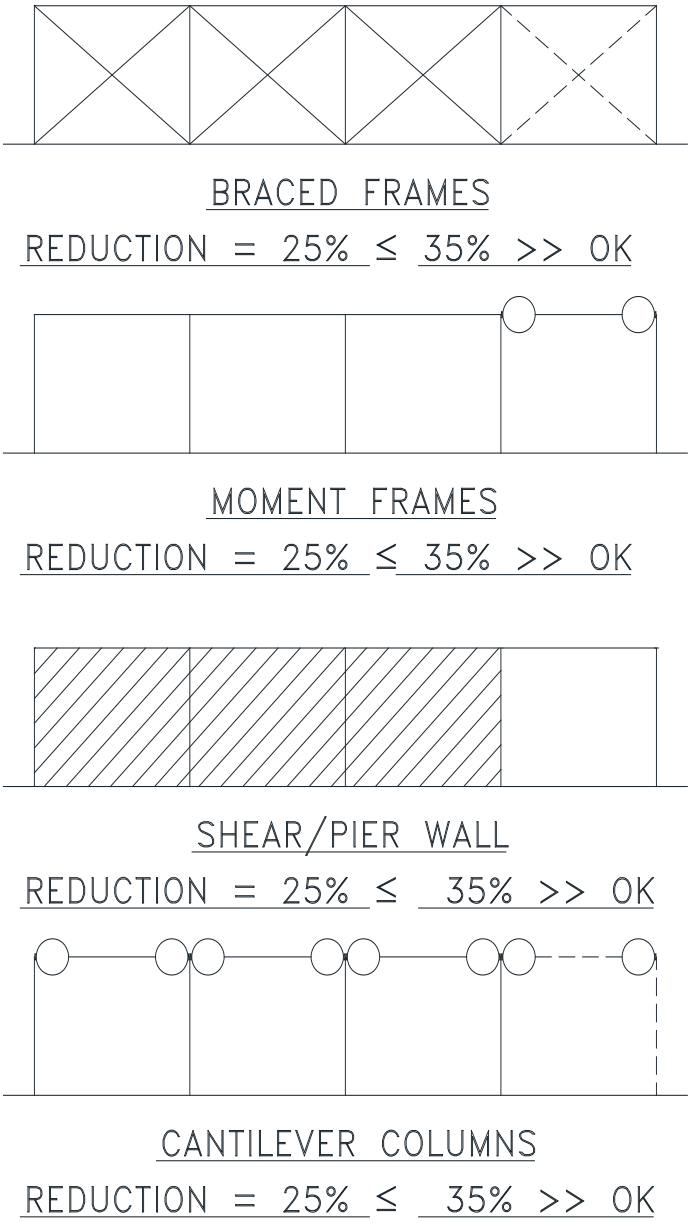

Figure (33). Reduction of Story Lateral Strength for Different Types of SFRS

The reduction in the lateral strength of each story resisting more than 35% of the base shear, is determined as follows:

- For braced frames or light-frame walls with flat straps, the removal of individual brace or its connections, shall not result in more than 35% reduction in the story lateral strength.

- For the moment frame, removing a one-m[illegible]nt connection at the end of the frame beam, shall not result in more tha[illegible]% reduction in the story [illegible] strength.
- For shear walls or wall piers with a[illegible] wall bay, shall no[illegible]

3. Seism[illegible]

The [illegible]

- [illegible]
- [illegible]

This se[illegible] chords, [illegible]

To deter[illegible] system, th[illegible]

1. Det[illegible]
2. Dete[illegible]
3. Dete[illegible]
4. Dete[illegible] each level (F_x).
5. Deter[illegible] force acting in each SFRS (V_x).
6. Deter[illegible] orizontal seismic force acting in each diaphragm (F_{px}).
7. Determination of horizontal seismic force acting in collectors of each diaphragm ($F_{collector,\ x}$).
8. Determination of vertical seismic force (E_v).

a. Determination of Fundamental Period (T):

The fundamental period is the period of the first mode of oscillation of the structure, which commonly results in the highest seismic base shear.