Additional Info

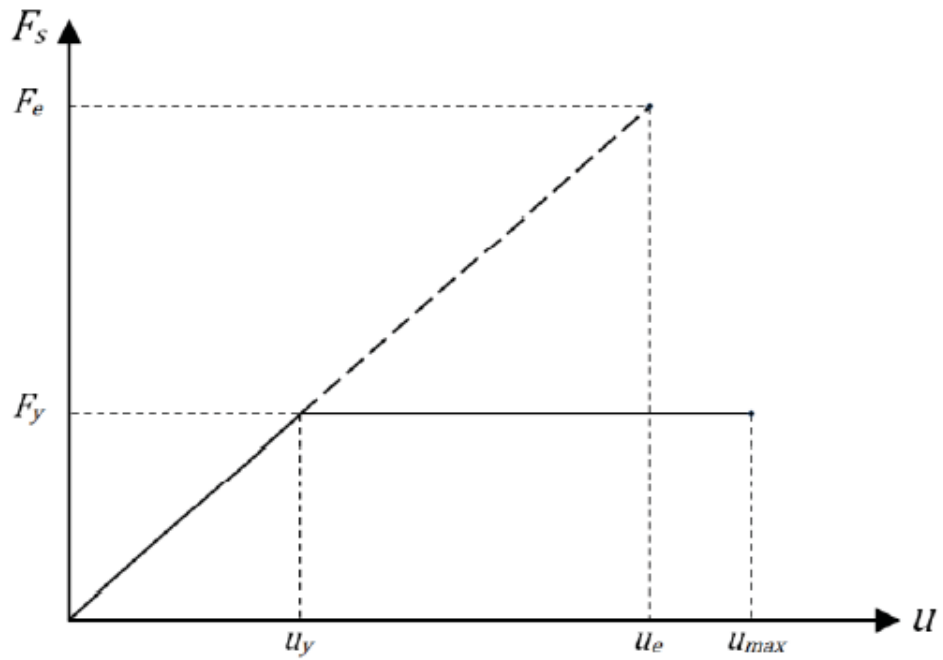
Site Class	$\bar{v}_s$
A. Hard rock	>5,000 ft/s
B. Rock	2,500 to 5,000 ft/s
C. Very dense soil and soft rock	1,200 to 2,500 ft/s
D. Stiff soil	600 to 1,200 ft/s
E. Soft clay soil	<600 ft/s
	Any profile with more than 10 ft (
	— Plasticity index $PI > 20$, — Moisture content $w \geq 40\%$, — Undrained shear strength $\bar{s}_u$
F. Soils requiring site response analysis in accordance with Section 21.1	See Section 20.3.1

Note: For SI: 1 ft = 0.3048 m; 1 ft/s = 0.3048 m/s; 1 lb/ft^2 = 0.0479 kN/m^2.

Use or Occupancy of Buildings and Structures	Risk Category
Buildings and other structures that represent low risk to human life in the event of failure	I
All buildings and other structures except those listed in Risk Categories I, III, and IV	II
Buildings and other structures, the failure of which could pose a substantial risk to human life	III
Buildings and other structures, not included in Risk Category IV, with potential to cause a substantial economic impact and/or mass disruption of day-to-day civilian life in the event of failure	III
Buildings and other structures designated as essential facilities	IV
Buildings and other structures, the failure of which could pose a substantial hazard to the community Buildings and other structures (including, but not limited to, facilities that manufacture, process, handle, store, use, or dispose of such substances as hazardous fuels, hazardous chemicals, or hazardous waste) containing sufficient quantities of highly toxic substances where the quantity of the material exceeds a threshold quantity established by the Authority Having Jurisdiction and is sufficient to pose a threat to the public if released[a]	IV

Response modification coefficient (R) and displacement amplification factor (Cd)

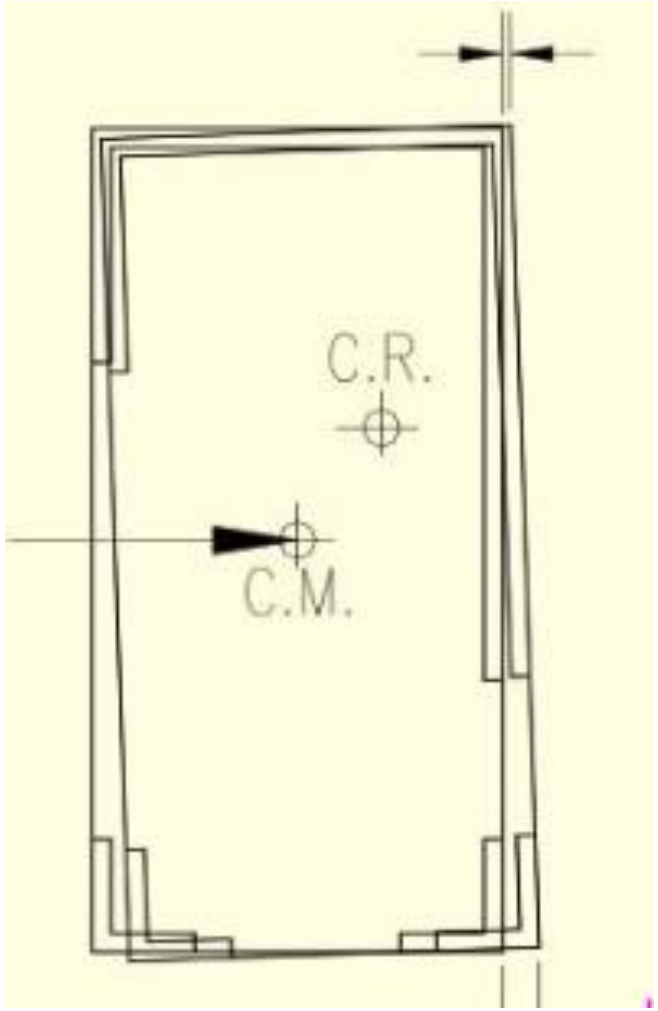
$$R_\mu = \frac{F_e}{F_y}$$



There is a corresponding ductility demand $\mu = \frac{u_{max}}{u_y}$ from the nonlinear system

Source: ASCE 7-05 Seismic Provisions. A Beginner's Guide to ASCE 7-05 Dr. T. Bart Quimby, P.E.

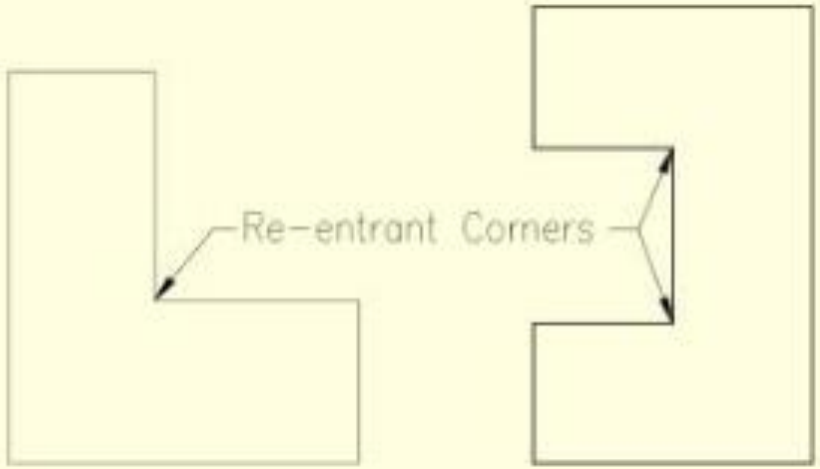
- 1a - **Torsional Irregularity**
  - larger story drift more than 1.2 times average story drift
- 1b - **Extreme Torsional Irregularity**
  - larger story drift more than 1.4 times average story drift
  - Not permitted in Design Categories E & F



Source: ASCE 7-05 Seismic Provisions. A Beginner's Guide to ASCE 7-05 Dr. T. Bart Quimby, P.E.

Type 2: Re-entrant Corners

- Both projections beyond the corner are more than 15% of the plan dimension of the structure in the same direction



Source: ASCE 7-05 Seismic Provisions. A Beginner's Guide to ASCE 7-05 Dr. T. Bart Quimby, P.E.

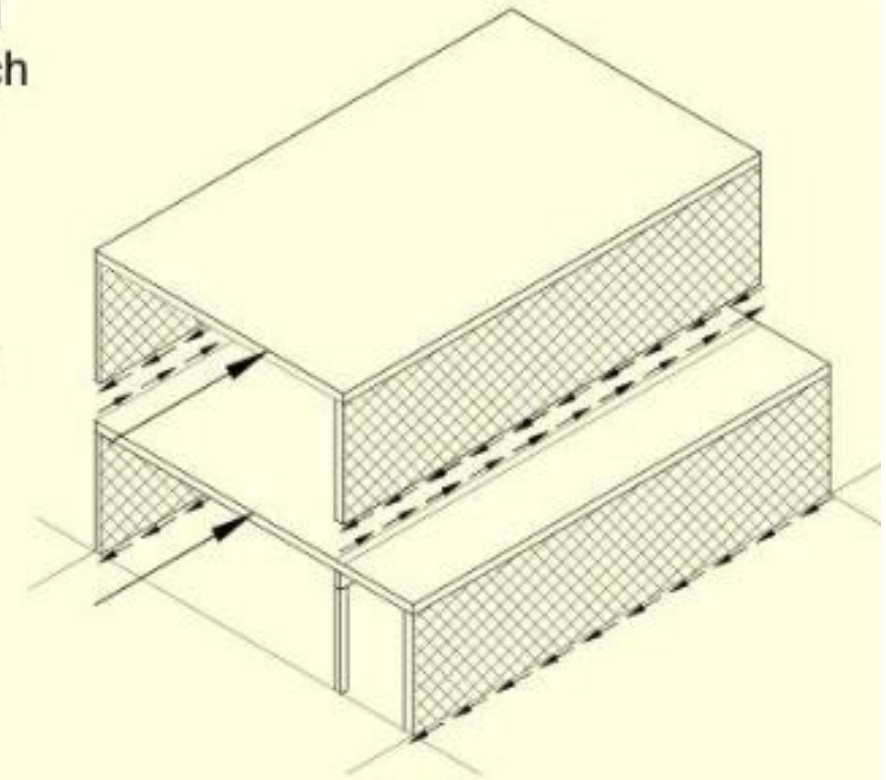
Type 3: Diaphragm Discontinuities

- Diaphragms with abrupt discontinuities or variations in stiffness, including those having cutout or open areas greater than 50% of the gross enclosed diaphragm area, or changes in effective diaphragm stiffness of more than 50% from one story to the next.
- Design forces for lateral force connections to be increased 25% in Design Categories D, E, & F.

Source: ASCE 7-05 Seismic Provisions. A Beginner's Guide to ASCE 7-05 Dr. T. Bart Quimby, P.E.

Type 4: Out-of-Plane Offsets

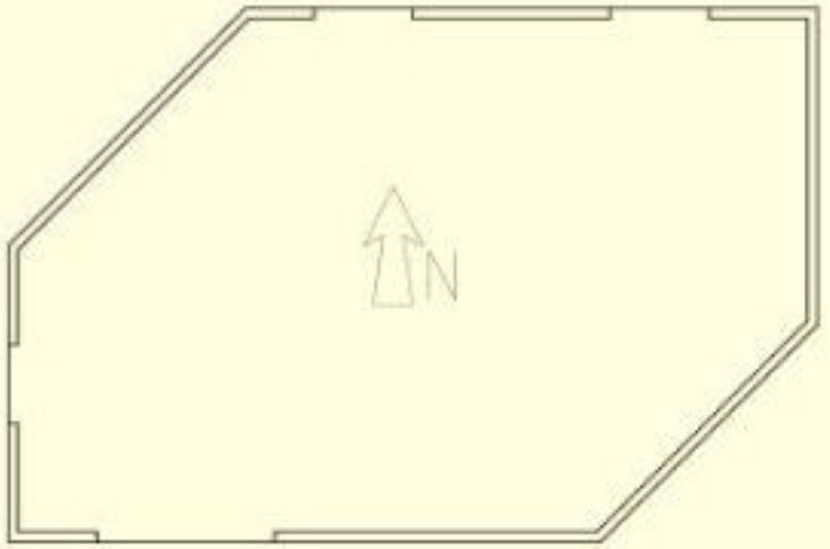
- Discontinuities in a lateral force resistance path, such as out-of-plane offsets of the vertical elements.
- Design forces for lateral force connections to be increased 25% in Design Categories D, E, & F.



Source: ASCE 7-05 Seismic Provisions. A Beginner's Guide to ASCE 7-05 Dr. T. Bart Quimby, P.E.

Type 5: Nonparallel Systems

- The vertical lateral force-resisting elements are not parallel to or symmetric about the major orthogonal axes of the lateral force resisting system.
- Analyze for forces applied in the direction that causes the most critical load effect for Design Categories C - F.



Source: ASCE 7-05 Seismic Provisions. A Beginner's Guide to ASCE 7-05 Dr. T. Bart Quimby, P.E.

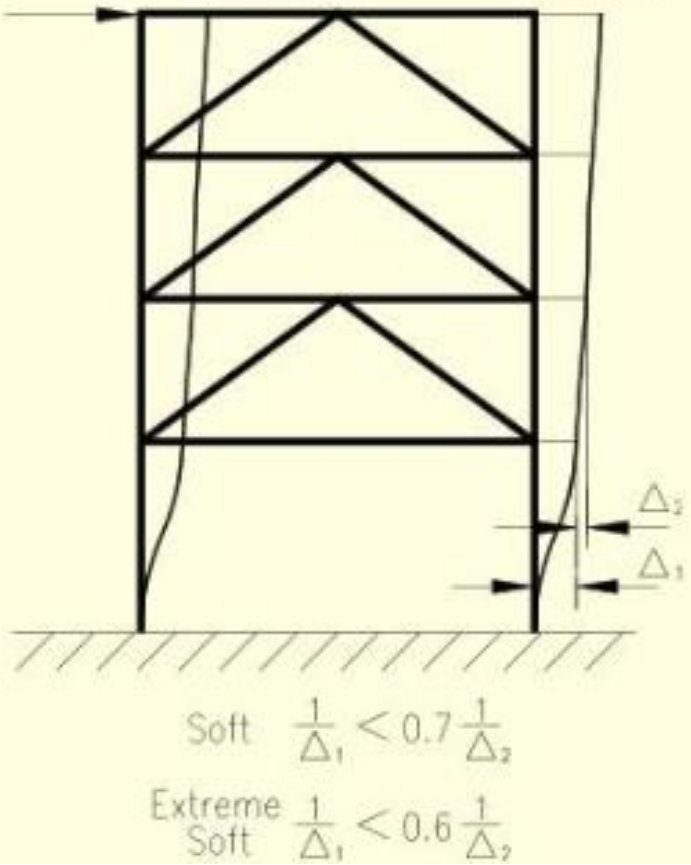
Type 1: Stiffness Irregularities

1a - Soft Story

- the lateral stiffness is less than 70% of that in the story above or less than 80% of the average stiffness of the three stories above.

1b - Extreme Soft Story

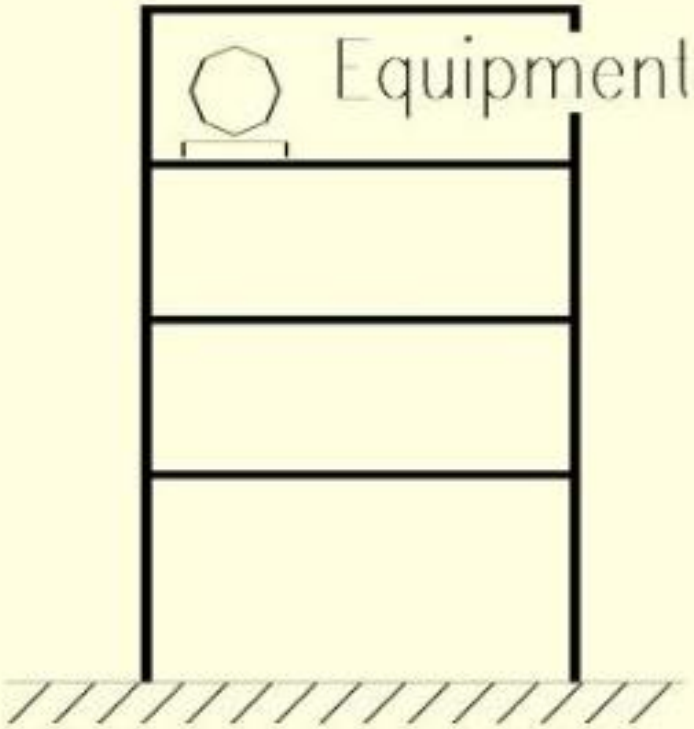
- the lateral stiffness is less than 60% of that in the story above or less than 70% of the average stiffness of the three stories above.
- Not permitted in Design Categories E & F



Source: ASCE 7-05 Seismic Provisions. A Beginner's Guide to ASCE 7-05 Dr. T. Bart Quimby, P.E.

Type 2: Weight (Mass) Irregularity

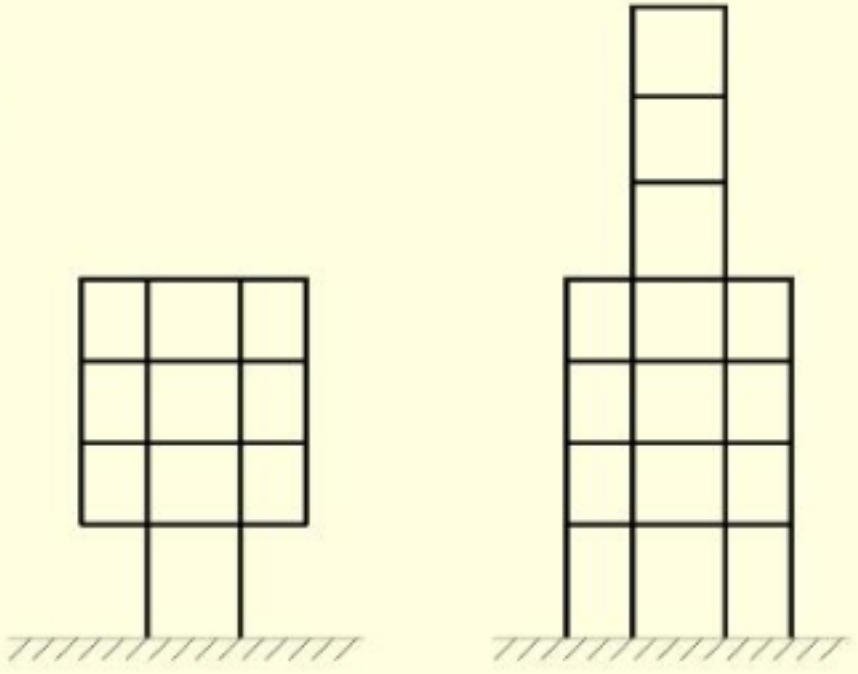
- Mass irregularity shall be considered to exist where the effective mass of any story is more than 150% of the effective mass of an adjacent story. A roof that is lighter than the floor below need not be considered.



Source: ASCE 7-05 Seismic Provisions. A Beginner's Guide to ASCE 7-05 Dr. T. Bart Quimby, P.E.

Type 3: Vertical Geometry Irregularity

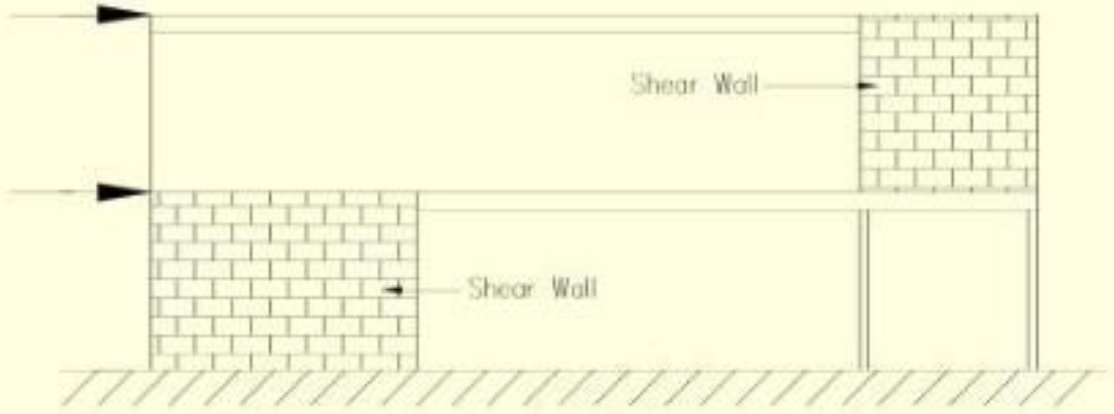
- Vertical geometry irregularity shall be considered to exist where the horizontal dimension of the lateral force-resisting system in any story is more than 130% of that in an adjacent story.



Source: ASCE 7-05 Seismic Provisions. A Beginner's Guide to ASCE 7-05 Dr. T. Bart Quimby, P.E.

Type 4: In-Plane Discontinuity in Vertical Lateral Force Resisting Elements

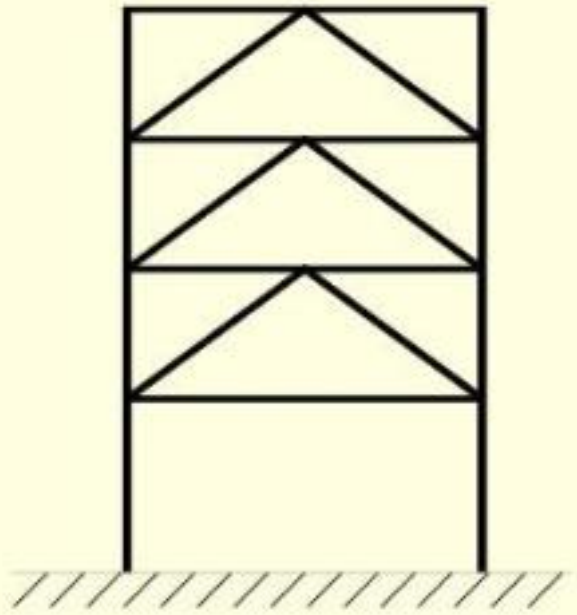
- An in-plane offset of the lateral force-resisting elements greater than the length of those elements or a reduction in stiffness in the resisting element in the story below.
- Design forces for lateral force connections to be increased 25% in Design Categories D, E, & F.



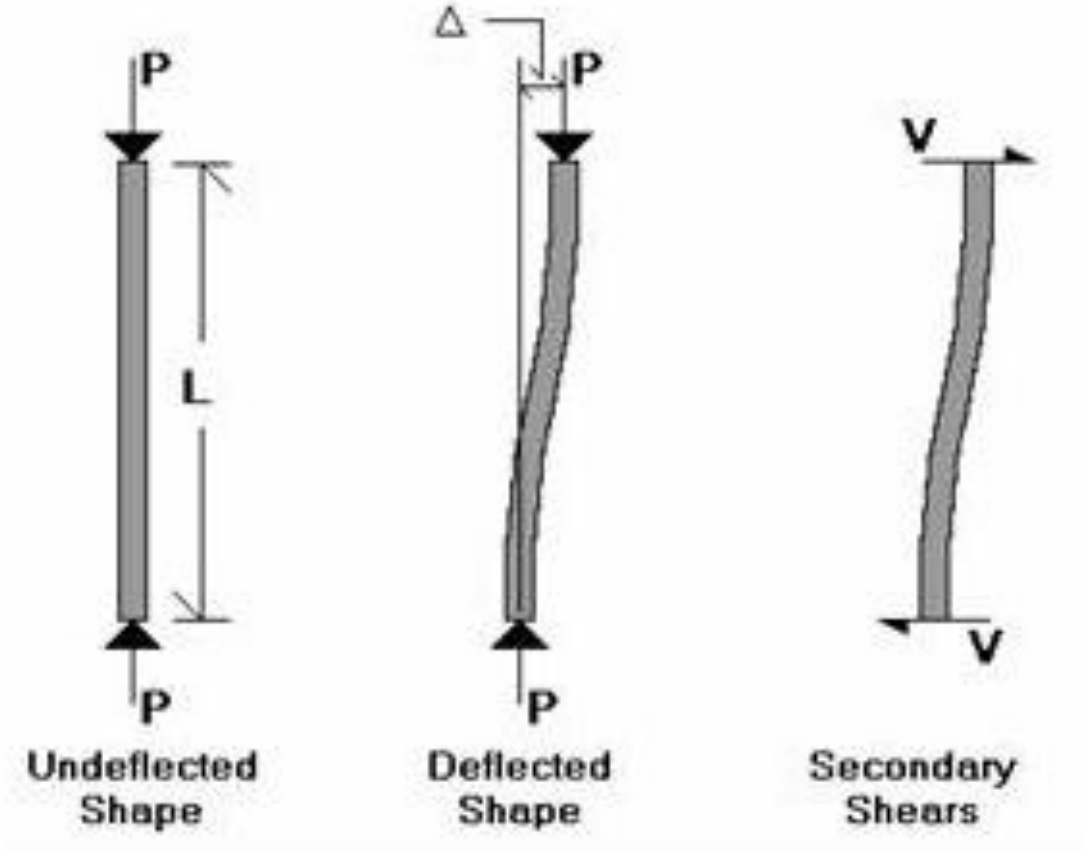
Source: ASCE 7-05 Seismic Provisions. A Beginner's Guide to ASCE 7-05 Dr. T. Bart Quimby, P.E.

Type 5: Discontinuity in Capacity - Soft Story

- A weak story is one in which the story lateral *strength* is less than 80% of that in the story above. The story strength is the total strength of all seismic-resisting elements sharing the story shear for the direction under consideration.
- Do not confuse STIFFNESS with STRENGTH.
- Not permitted in Design Categories E & F.



Source: https://risa.com/risahelp/risa3d/Content/3D_2D_Only_Topics/P-Delta%20-%20Analysis.htm



$$P * \Delta = V * L$$

$$\text{so, } V = P * \Delta / L$$

Allowable Story drift

Table 12.12-1 Allowable Story Drift, Δ_a [a,b]

Structure	Risk Category		
	I or II	III	IV
Structures, other than masonry shear wall structures, four stories or less above the base as defined in Section 11.2, with interior walls, partitions, ceilings, and exterior wall systems that have been designed to accommodate the story drifts	$0.025h_{sx}$ [c]	$0.020h_{sx}$	$0.015h_{sx}$
Masonry cantilever shear wall structures[d]	$0.010h_{sx}$	$0.010h_{sx}$	$0.010h_{sx}$
Other masonry shear wall structures	$0.007h_{sx}$	$0.007h_{sx}$	$0.007h_{sx}$
All other structures	$0.020h_{sx}$	$0.015h_{sx}$	$0.010h_{sx}$

[a] h_{sx} is the story height below level x.