

# Thoughts on minimum strength & stiffness requirements for seismic design

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PEER/SF-AB Tall Building Discussion  
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# 20 Story RC SMF Perimeter Frame (Haselton et al., 2006)

## Design Information (ASCE 7-02)

$$V_d/W = 0.044$$

$$V_u/W = 0.086 \text{ (pushover)}$$

$$T = 2.6 \text{ sec}$$

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## IDA Collapse (median quantities)

$$S_a(T_1) = 0.48g \text{ (median intensity at collapse)}$$

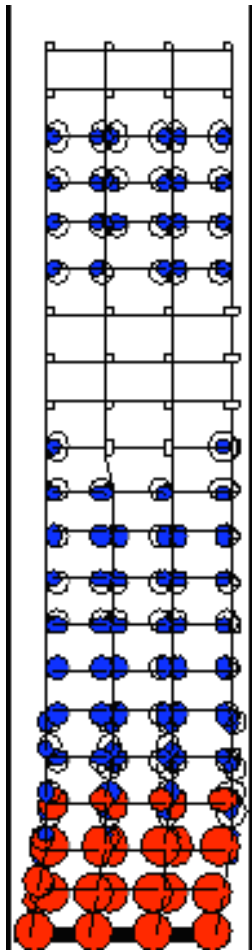
$$IDR_{max} = 0.051 \text{ (about } = \frac{3}{4} \times V_u/W = 0.057)$$

$$RDR_{max} = 0.013$$

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## Observations:

1.  $IDR_{max} = 0.051 = \text{about } \frac{3}{4} \times V_u/W = 0.057$
2.  $S_d(T_1) = (T/2\pi)^2 S_a(T_1) = 32 \text{ in.}$
3. System Collapse Drift =  $0.051 \times 4 \text{ stories} = 32 \text{ in.}$
4. Additional Study: ASCE 7-05 design with  $V_d/W = 0.022$  has about one-half the collapse margin of ASCE 7-02.



*IDA collapse mechanism*

# Building Code Criteria (SEI/ASCE 7-02)

- **Minimum Strength:**  $V_d = C_s W$
- **Minimum Stiffness:**

Drift:

$$\Delta = \frac{V_d}{k} \leq \Delta_{allow}$$

Stability:

$$P - \frac{P_c}{\gamma} \leq P_{allow}$$

- **Mechanism Controls:** SCWB, capacity design, ...
- **Toughness:** component detailing, ...

# Minimum Stiffness & Stability

**Strength:**  $V_d = C_s W$

**Stiffness:**  $\frac{V_d}{C_s} = \frac{W}{C_s}$

**Identities:**  $\frac{V_d}{C_s} = \frac{W}{C_s} \quad \& \quad \frac{V_d}{C_s} = \frac{W}{C_s}$

**Combine & Rearrange:**  $\frac{V_d}{C_s} = \frac{W}{C_s}$

