Thoughts on minimum strength & stiffness requirements for seismic design

Greg Deierlein
Stanford University

PEER/SF-AB Tall Building Discussion
Feb. 23, 2007
20 Story RC SMF Perimeter Frame (Haselton et al., 2006)

Design Information (ASCE 7-02)

\[ \frac{V_d}{W} = 0.044 \]
\[ \frac{V_u}{W} = 0.086 \text{ (pushover)} \]
\[ T = 2.6 \text{ sec} \]

IDR Collapse (median quantities)

\[ Sa(T_1) = 0.48g \text{ (median intensity at collapse)} \]
\[ \text{IDR}_{\text{max}} = 0.051 \text{ (about } = \frac{3}{4} \times \frac{V_u}{W} = 0.057) \]
\[ \text{RDR}_{\text{max}} = 0.013 \]

Observations:

1. \( \text{IDR}_{\text{max}} = 0.051 \text{ = about } \frac{3}{4} \times \frac{V_u}{W} = 0.057 \)
2. \( \text{Sd}(T_1) = (T/2\pi)^2 Sa(T_1) = 32 \text{ in.} \)
3. System Collapse Drift = 0.051 \text{ x 4 stories } = 32 \text{ in.} \)
4. Additional Study: ASCE 7-05 design with \( \frac{V_d}{W} = 0.022 \) has about one-half the collapse margin of ASCE 7-02.
Building Code Criteria (SEI/ASCE 7-02)

- **Minimum Strength:** \( V_d = C_s W \)
- **Minimum Stiffness:**
  - Drift: 
  - Stability: 
- **Mechanism Controls:** SCWB, capacity design, …
- **Toughness:** component detailing, …
Minimum Stiffness & Stability

Strength: \( V_d = C_s W \)

Stiffness: 

Identities: 

Combine & Rearrange:

Observation: Based on conventional drift (stiffness) requirements, the 0.1 limit on the stability coefficient becomes significant at \( C_s < 0.04 \) to 0.05.