American Concrete Institute®
Advancing concrete knowledge

The Art of Designing Ductile Concrete in the Past 50 Years: The Impact of the PCA Book and Mete A. Sozen, Part 2

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WEB SESSIONS

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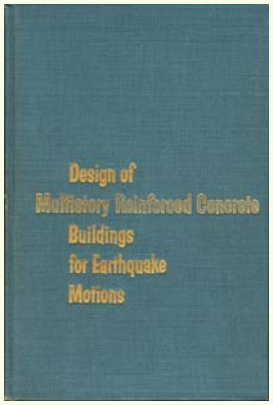
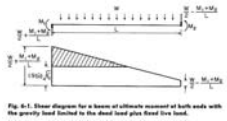
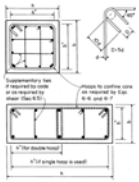
WEB SESSIONS

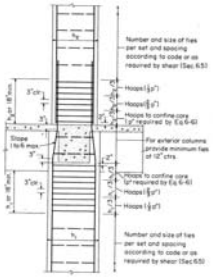


Creating an option for concrete buildings

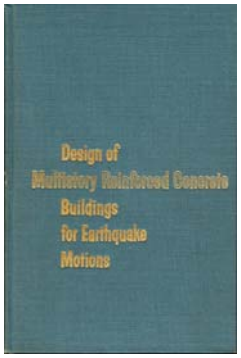
Moment-resisting frames







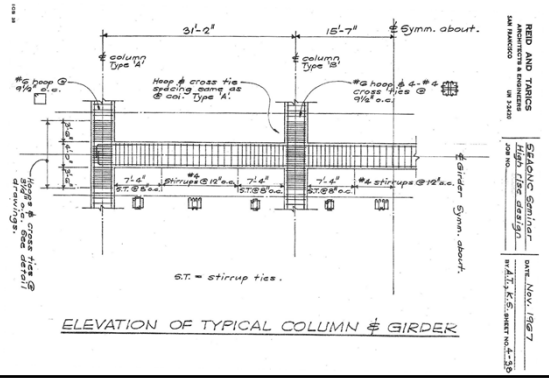
Setting a direction for 50 years of development



Setting a direction for 50 years of development

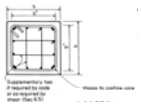
- 1963 SEAOC Blue Book
  - For buildings over 160 ft tall and using K=0.67, "…the frame shall be made of a ductile material or a ductile combination of materials such as a steel frame with moment-resistant connections or by other systems proven by tests and studies to provide equivalent energy absorption."
- 1965 SEAOC Blue Book
  - **Ductile moment-resisting space frame**
    - **concrete** and **reinforcement** materials restrictions
    - **beam** reinforcement ratios, splice locations, anchorage provisions, capacity design for shear, web reinforcement
    - **column** laps at midheight, special transverse reinforcement
    - **joints**
      - design specified
      - column/beam moment strength ratio established
  - **Walls**
    - confined boundary elements

Setting a direction for 50 years of development



Columns

PCA

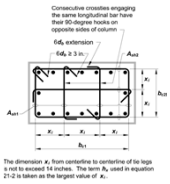


$$A_{hoop} \geq \frac{h'' s}{2} \rho_{spiral}$$

Equivalent to ….

$$A_{sh} \geq 0.45 s b_c \left(\frac{A_g}{A_{ch}} - 1\right) \frac{f'_c}{f_{yt}}$$

ACI 318-77 through 318-11

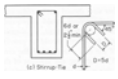


$$A_{sh} \geq 0.3 s b_c \left(\frac{A_g}{A_{ch}} - 1\right) \frac{f'_c}{f_{yt}}$$

Beams

PCA

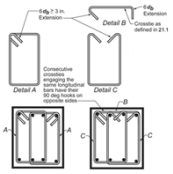
s_{max} = $d/2$
≤ $16d_b$
≤ 12 in.



ACI 318-83 through 318-08

s_{max} = $d/4$
≤ $8d_{b,\ long}$
≤ $24d_{b,\ ties}$
≤ 12 in.

$V_c = 0$ in plastic hinge



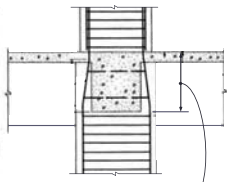
ACI 318 11

s_{max} = $d/4$
≤ $6d_b$
≤ 6 in.

$V_c = 0$ in plastic hinge

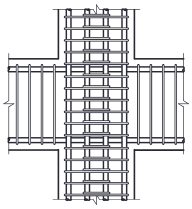
Beam-column joints

PCA



For exterior columns provide minimum ties at 12" ctrs.

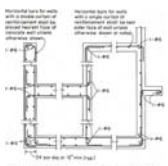
ACI 318-83 through 318-11



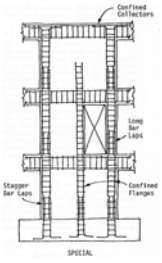
$$\Sigma \phi M_{nc} \geq (6/5) \Sigma \phi M_{ng}$$

Structural (shear) walls

PCA

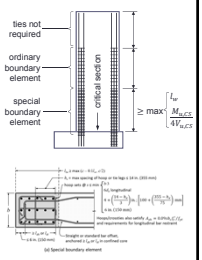


Blue Book 1965
UBC 1973
ACI 318-1983

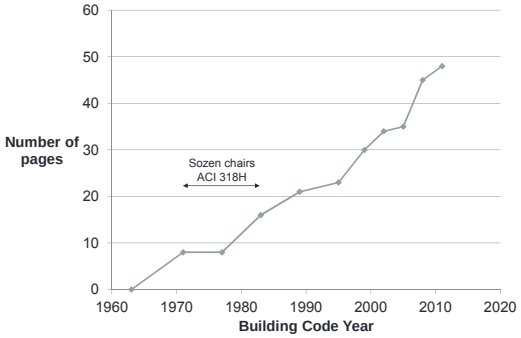


(Elsesser, 1978)

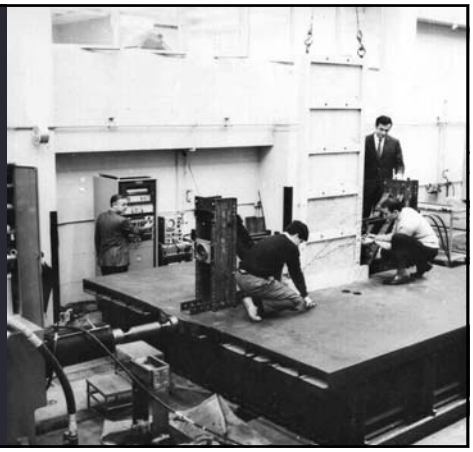
ACI 318-95 through 318-11



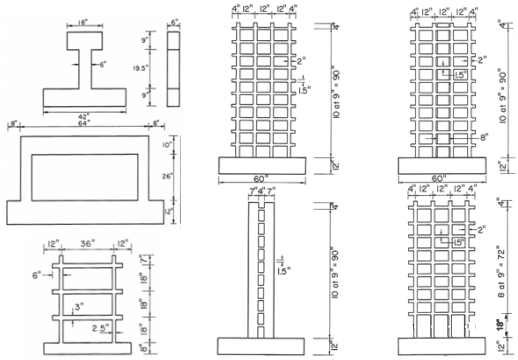
ACI 318 Seismic Code and Commentary pages

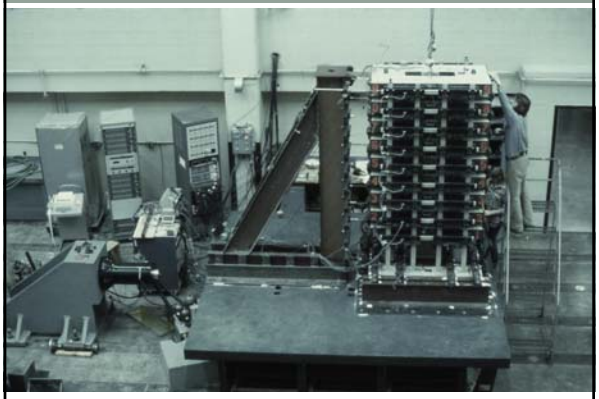


Asking the right questions



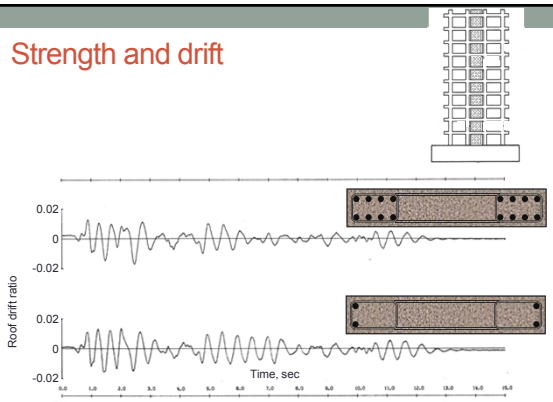
U of I test frames





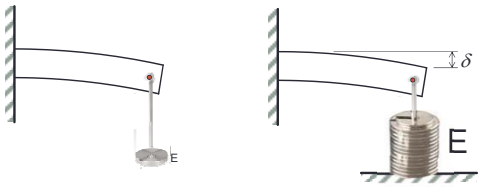
Moehle, 1980

Strength and drift



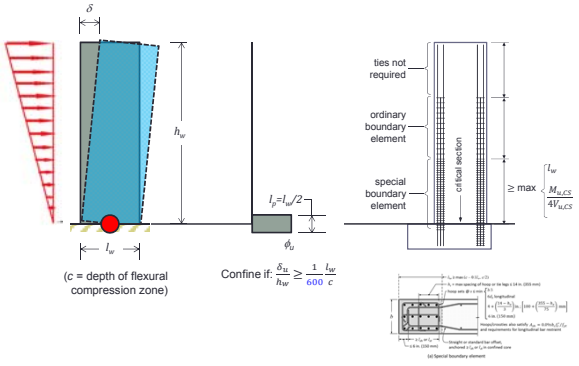
Abrams, 1979

Asking the right questions

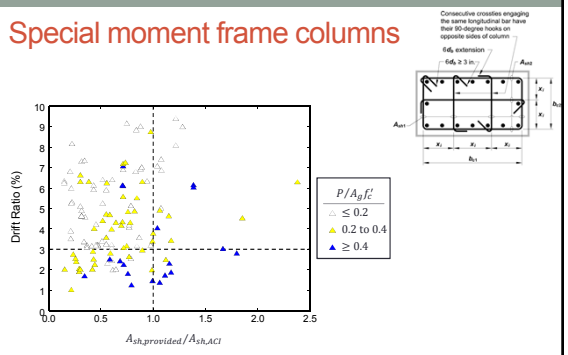


Sozen, 20th century

Special structural walls



Special moment frame columns



Elwood, 21st century

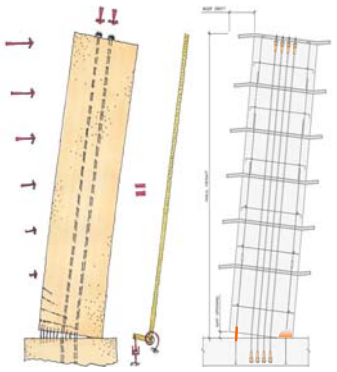
Christchurch – One year after

Ross Becker

New systems/ details

PT Concrete Core

- Immediate Occupancy
  - *Green Tag*
  - *Minimal Repair Cost and Time*
- Self Centering Response
  - *No Permanent Tilt*
  - *Tough & Damage Resistant*
- Small Interstory Drift
  - *Protects Façade*
  - *Protects Gravity Frame*



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