Earthquake Simulation and Near-Fault Ground Motions

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NCREE

Effect of ground motion on collapse behavior



Column detailing



Sample results

Typical Modern Column



Typical Older Column



Sample results

Modern Details





Shin, Galanis, Moehle, EESD 2016

Sample results – Modern columns Haselton et al (2006) model



Sample results – Modern columns Haselton et al (2006) model



Seismic hazard analysis



Seismic hazard analysis



ARUP, based on Shahi and Baker (2011)

Seismic hazard analysis



Reinforced Concrete Frames with High-Strength Reinforcement Under Near-Fault Ground Motions

To and Moehle, ongoing, Pankow Foundation



Beam and column tests (Grade 60 to 100)



Test setups



Beam Test

Column Test

Material properties



Spread of plasticity



Test results - Column bond failure



Sokoli and Ghannoum, ACI Structural Journal, 2016.

Test results – Column bond failure





Archetype building design



Archetype Frame Building (Visnjic 2014) Conventional Grade 60 Reinforcement

Seismic hazard



Hypothetical location of archetype buildings from United States Geological Survey report (marked with bull's eye)

Pseudo-Acceleration Design Spectra

Selected and scaled ground motions



Near-Fault Ground Motions



Station: El Centro Imp. Co. Cent



Station: El Centro Imp. Co. Cent



Station: El Centro Imp. Co. Cent



Station: El Centro Imp. Co. Cent

Dynamic analysis results: Mean drifts for different reinforcement



Dynamic analysis results: Mean story drift ratios for different reinforcement



Column shears

— Nonlinear Dynamic



(c) beam hinging

ACI 318-19 Code Changes (tentative) **High seismic** 100 to 150 mm *h*/4 • Permit Grade 80 (550) $6d_{h}$ (5d_h) as required for shear $-T/Y \ge 1.17$ $2.5I_d$ - elongation ≥ 0.10 • Details as shown ΛΙ - Grade 60 150 mm $\vdash \mathbf{s} \leq \left\{ 6d_b \left(\mathbf{5d}_b \right) \right\}$ - Grade 80 d/4

 $\geq 20d_{h}$ (26d_h)

Hoops

along $2h_h$

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