Seismic Damage Estimation of High-Rise RC Box-type Bearing Wall Wall Structures in Korea

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Analytical Calibration of Prototype Building

Prototype model
- Wall thick: 180/160mm
- Slab thick: 200mm
- Height: 40.5m (15-story)
- $f'_c=24$ MPa, $f_y=400$ MPa
- $A_w/A_f$ (X-dir.)=2.67%
- $A_w/A_f$ (Y-dir.)=4.71%

PERFORM-3D Modeling
- Nonlinear time history analysis
- Wall: “Inelastic shear wall”
- Slab: “Inelastic beam” with plastic hinges ($M-\phi$)
- Coupling beam: “Inelastic beam” with $M-\phi$, and shear hinges

Shake-table test
- Full scale 15-story box-type wall building model (PERFORM-3D)

Plotted image information:
- Wall thick = 15~20cm
- Ratio of total wall area to floor plan area ≈ 3%
- 2010 Chile EQ.
Behaviors of wall, coupling beam, and slab at each limit state

- Axial strain, LS1
  - Coalinga, 1983
  - Parkfield, 1966
  - Whittier N., 1987

- Axial strain, LS2
  - Kobe, 1995
  - Loma Prieta, 1989
  - Westmorland, 1981

- Axial strain, LS3
  - Northridge, 1994
  - Concepcion, 2010
  - Gazli, 1976

- Coupling beam
  - Concepcion

- Slab
  - Concepcion

- Earthquake record number
  - Concepcion

Yielding of rebar
Seismic Fragility Relationship (2/2)

- Fragility curves for all IMs

\[
P(EDP \geq LS \mid IM) = \Phi \left( \frac{\ln IM - \lambda}{\zeta} \right)\]

- Probabilities exceeding at the \( Sa = 0.22g \) (T=1.0s) (MCE in Korea)
  - LS1 (Serviceability): 27.9%
  - LS2 (Damage control): 2.8%
  - LS3 (Collapse prevention): 0.55%