Numerical Simulation of Structural Response

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The Goal
Simulating Beam-Column Joint Response

A General Beam-Column Joint Model
Conceptual Model

Joint Shear Distortion

Joint Shear Stress

Bar Stress

Bar Slip

bond-slip springs

interface-shear springs

shear panel

column

beam

PEER
Calibration - Shear Panel

Shear-Panel Action

Observed Response Envelopes

Simulated Response

Monotonic Envelope

Cyclic Response

- Effect of cycling

Modified Compression-Field Theory

Monotonic Envelope for Joint Element

Shear stress (MPa)

Shear strain (radians)

ρ = 0.025

ρ = 0.025
Calibration - Bar Slip

Anchorage Failure

Bar Stress vs. Slip Model

Bar Stress vs. Slip Response - Monotonic

Bar Stress vs. Slip Response - Cyclic

Bond stress, $\tau$

Bar stress, $f_s$

Slip (mm)

Bar Stress (MPa)

exp. data - monotonic
exp. data - cyclic
numerical model

$\tau_E$

$A_b \cdot \tilde{f_s}$

$\tilde{f_s}$

$\tilde{f_s}$

$f_s \leq f_y$

$\tilde{f_y}$

$\tilde{f_y}$

$\tilde{f_s} > f_y$
Uniaxial Material Model

Stiffness Degradation

Strength Degradation
Validation

Park & Ruitong (1988)

Laboratory Test Specimen

Simulated Response

Observed Response

Shear Force (kN)

Displacement, δ, (mm)

Displacement, δ, (mm)