# SEISMIC PERFORMANCE OF COLUMN BASE CONNECTIONS IN STEEL MOMENT FRAMES: EXPERIMENTAL AND BEHAVIORAL INSIGHTS

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## OVERVIEW

Column base connections are used in steel moment frames to transfer loads from the superstructure into the supporting concrete foundation. Conventionally, these are categorized as Exposed connections and Embedded Connections. Despite their importance, several aspects of their response warrant further study; this includes details prevalent in current practice (missing experimental data) and prospective details designed for ductility.

The current practice for designing base connections is inhibited by knowledge gaps in several areas, with serious implications for the performance and economy of critical infrastructures resulting in extremely expensive base connections. Recent experimental research shows that the base connection may be highly ductile, whereas the columns have limited rotation capacity (due to local and/or lateral torsional buckling).

In this regard, this study seeks to develop a design paradigm quantifying the interactive effects of base connection strength and ductility on structural performance through a coordinated plan of testing and simulations.
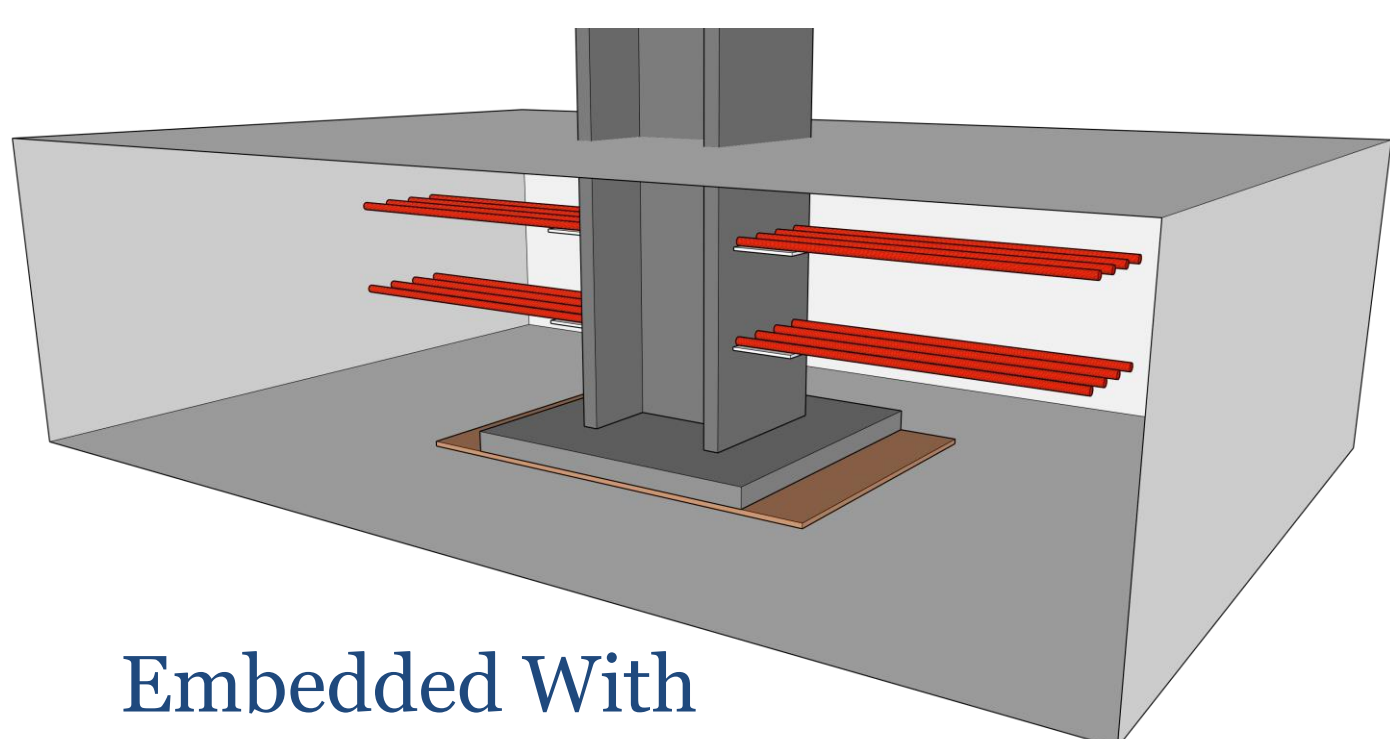
## DISSIPATIVE BASE CONNECTIONS – NONLINEAR SIMULATIONS

FEMA P695 Parametric Study of 160 Nonlinear Push Over and Time History Simulations of Frames with Dissipative Bases.
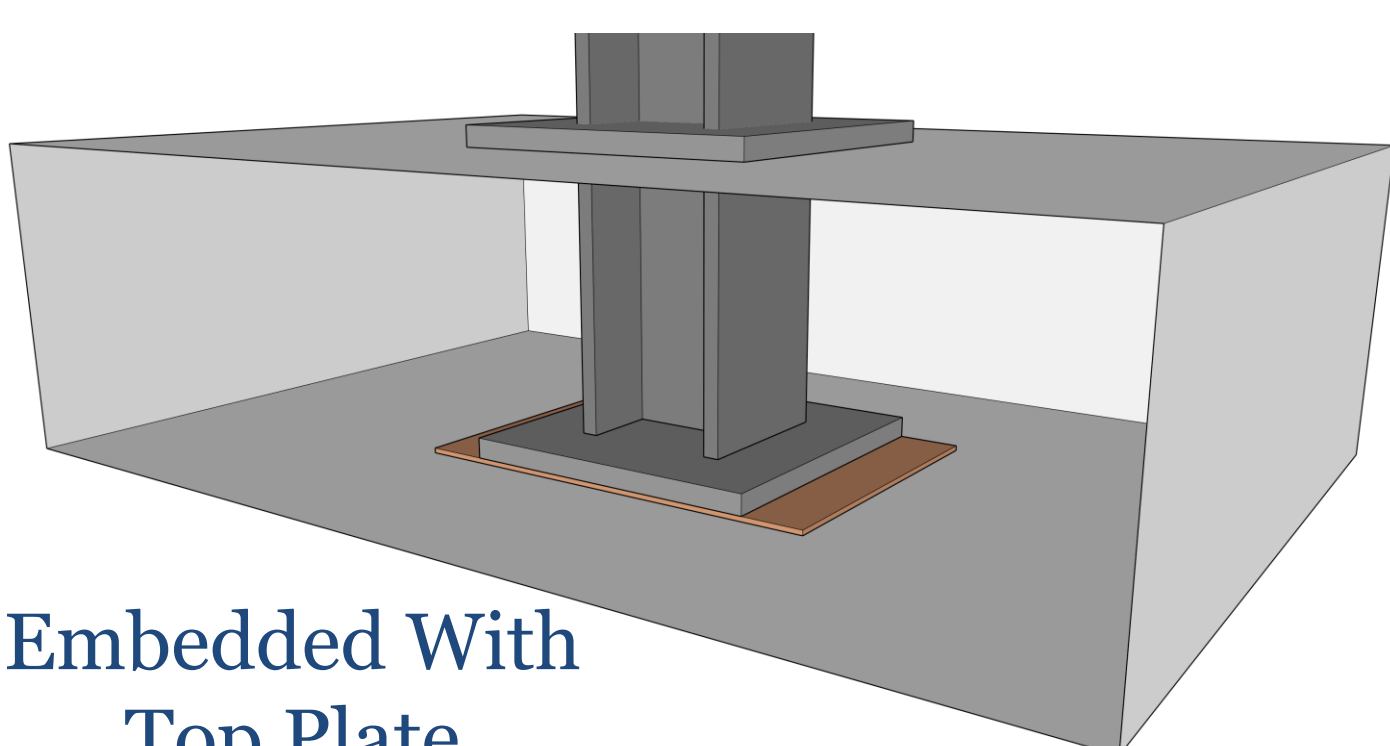- Weak Base Design Feasible with $\Omega_o=3$
- Rotation capacity of 0.05 radians needed (Achievable based on past data).

## BASE CONNECTIONS – COMPONENT EXPERIMENTS



Exposed Base

Embedded Base

gravity loads



truss elements

bilinear hysteretic springs at RBS locations

P-Delta columns

two springs in series

**BASE STRENGTH LEVEL $\Omega=3$ AND $\beta=1$**



Base Rotation Limit: 1% 2% 4% 5% Unlimited
Courtesy of Falborski et al. (2020 – in press)

### Prevalent Untested Details



**Embedded With Welded Reinforcement**
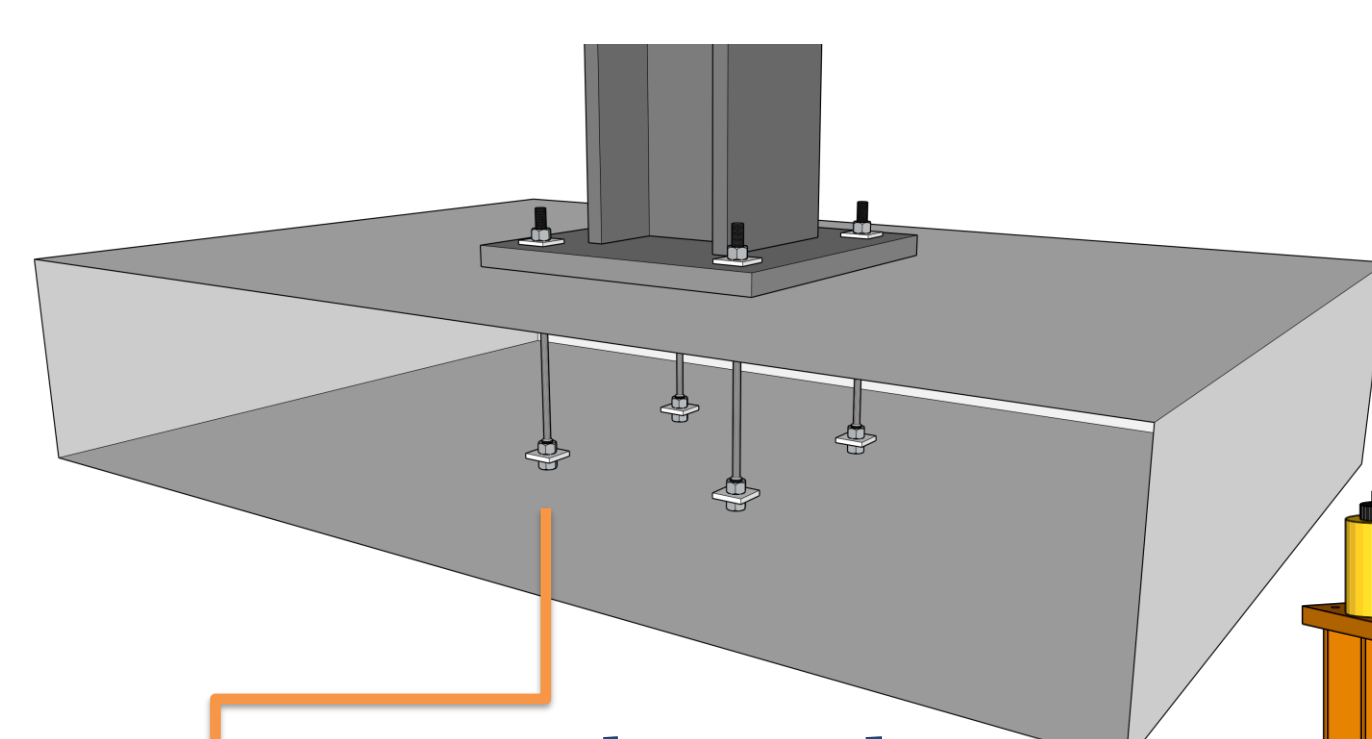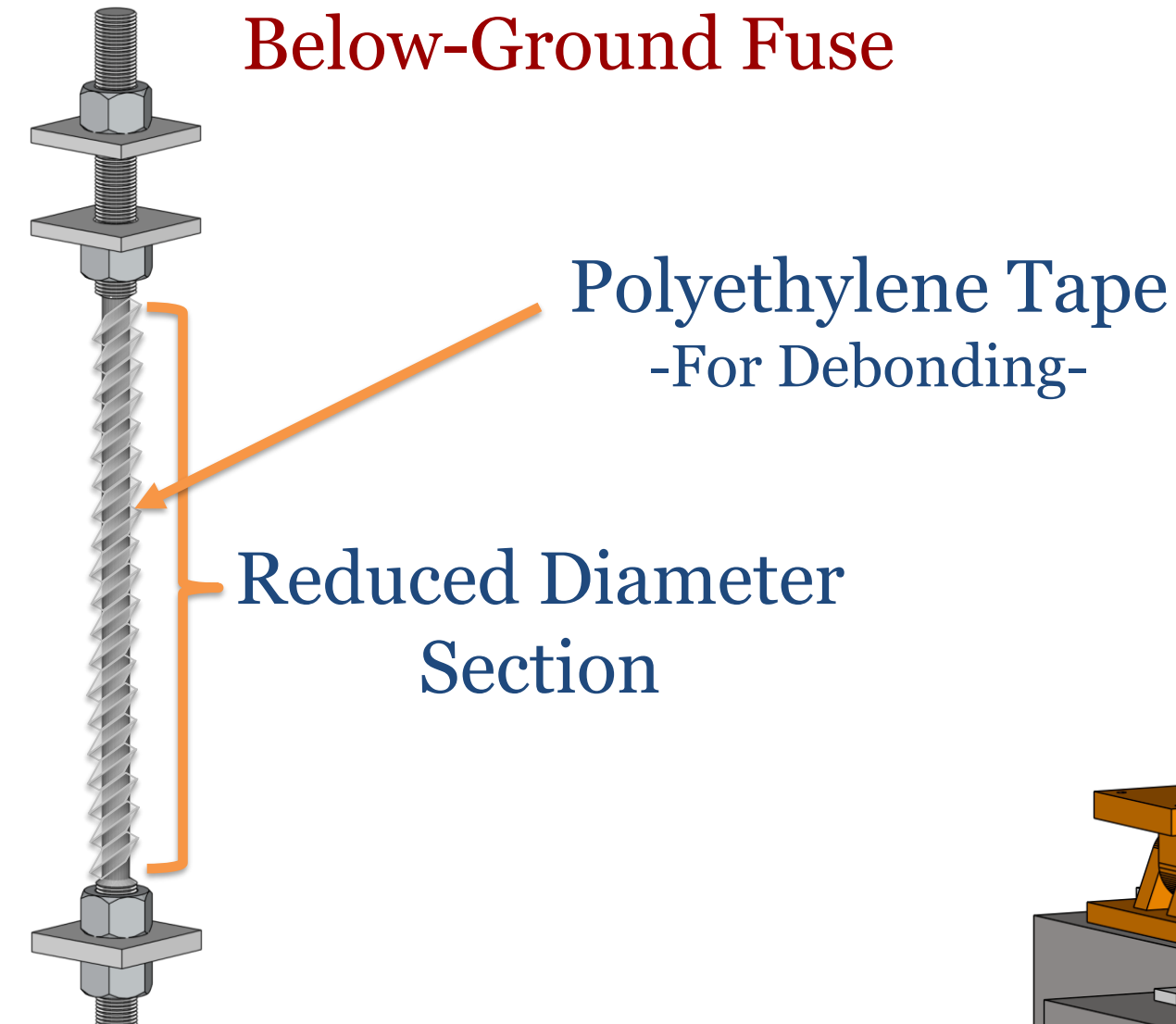


**Embedded With Top Plate**
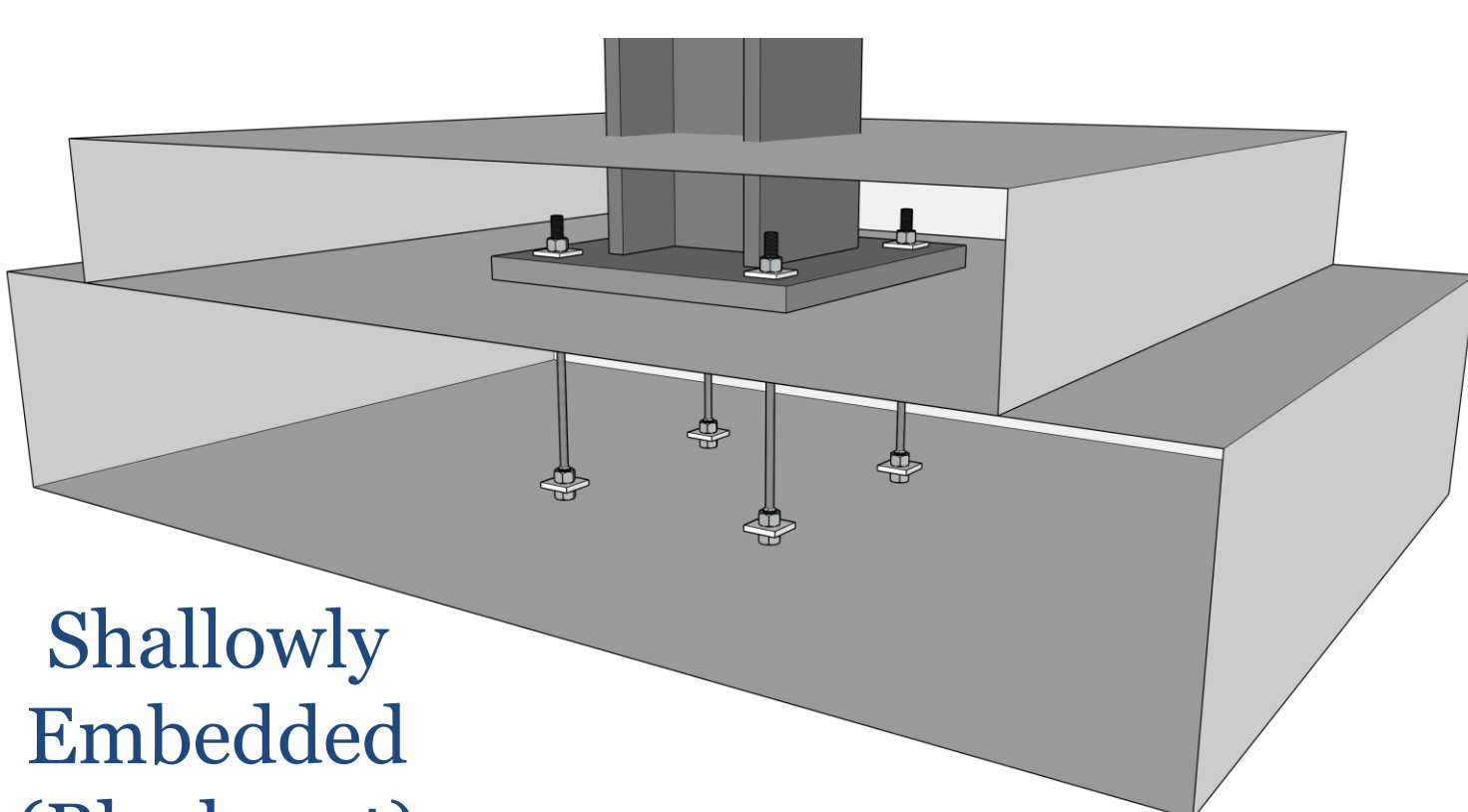


**Shallowly Embedded (Block-out)**

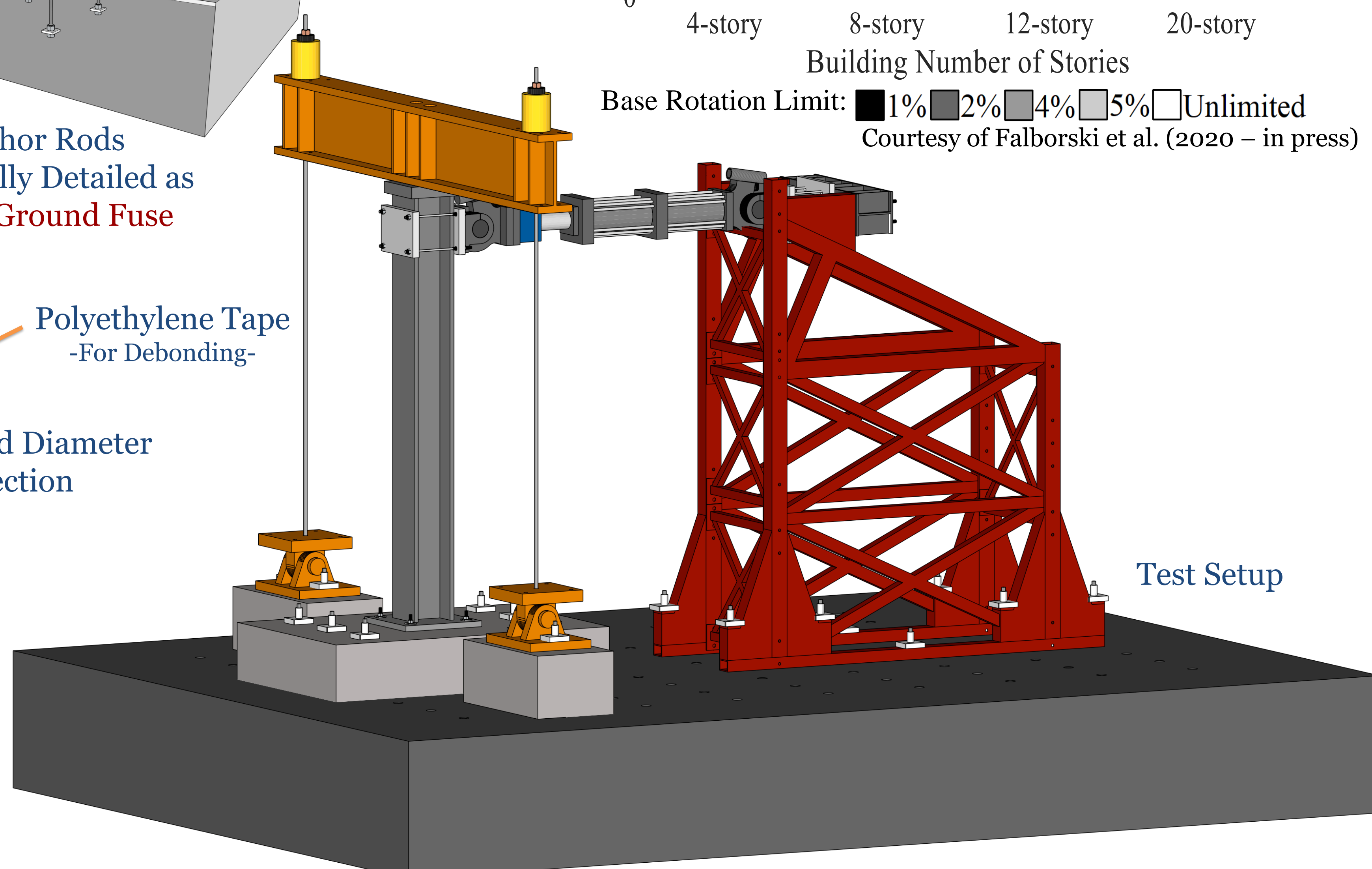### Reliably Ductile Detail
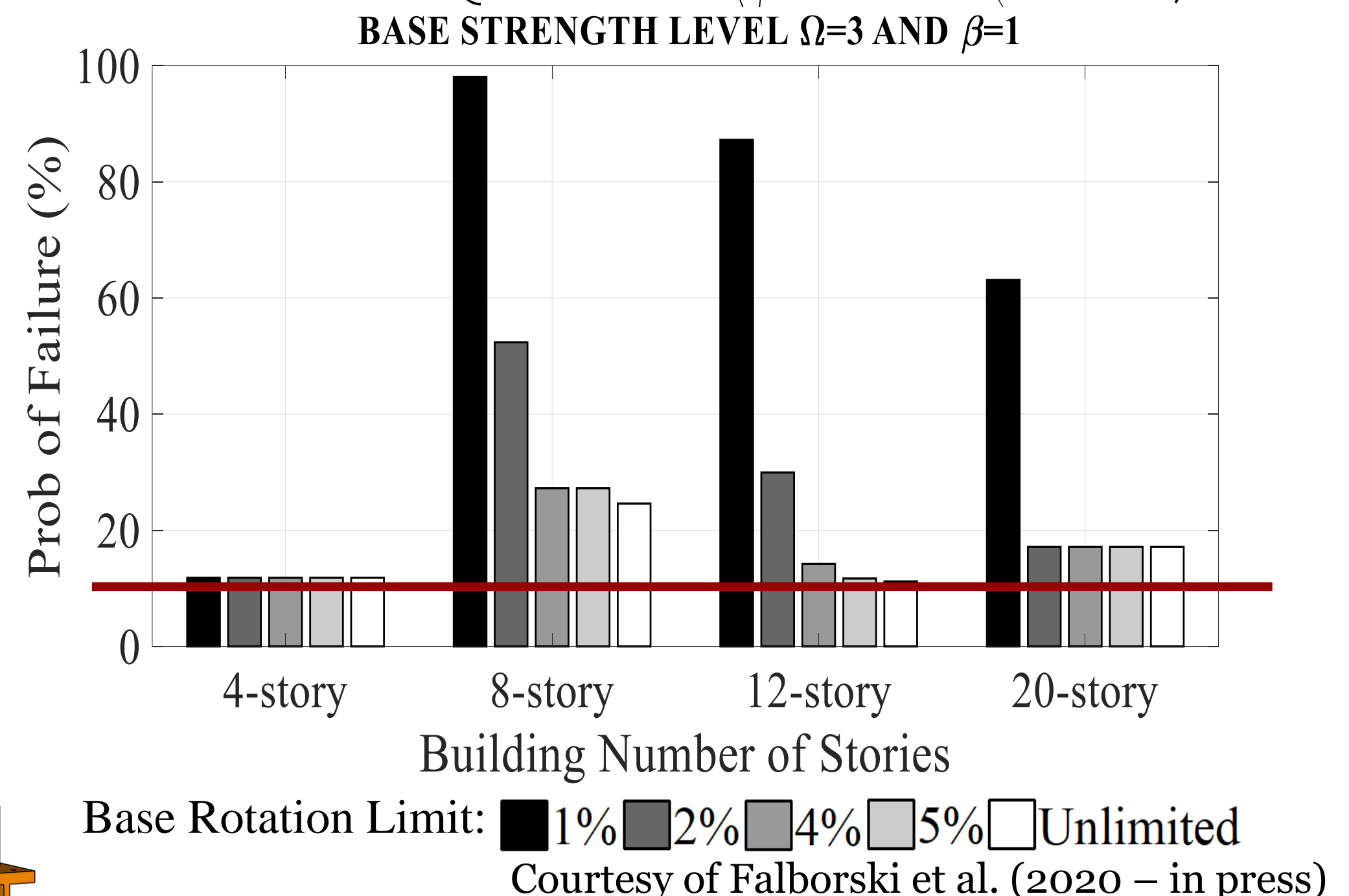


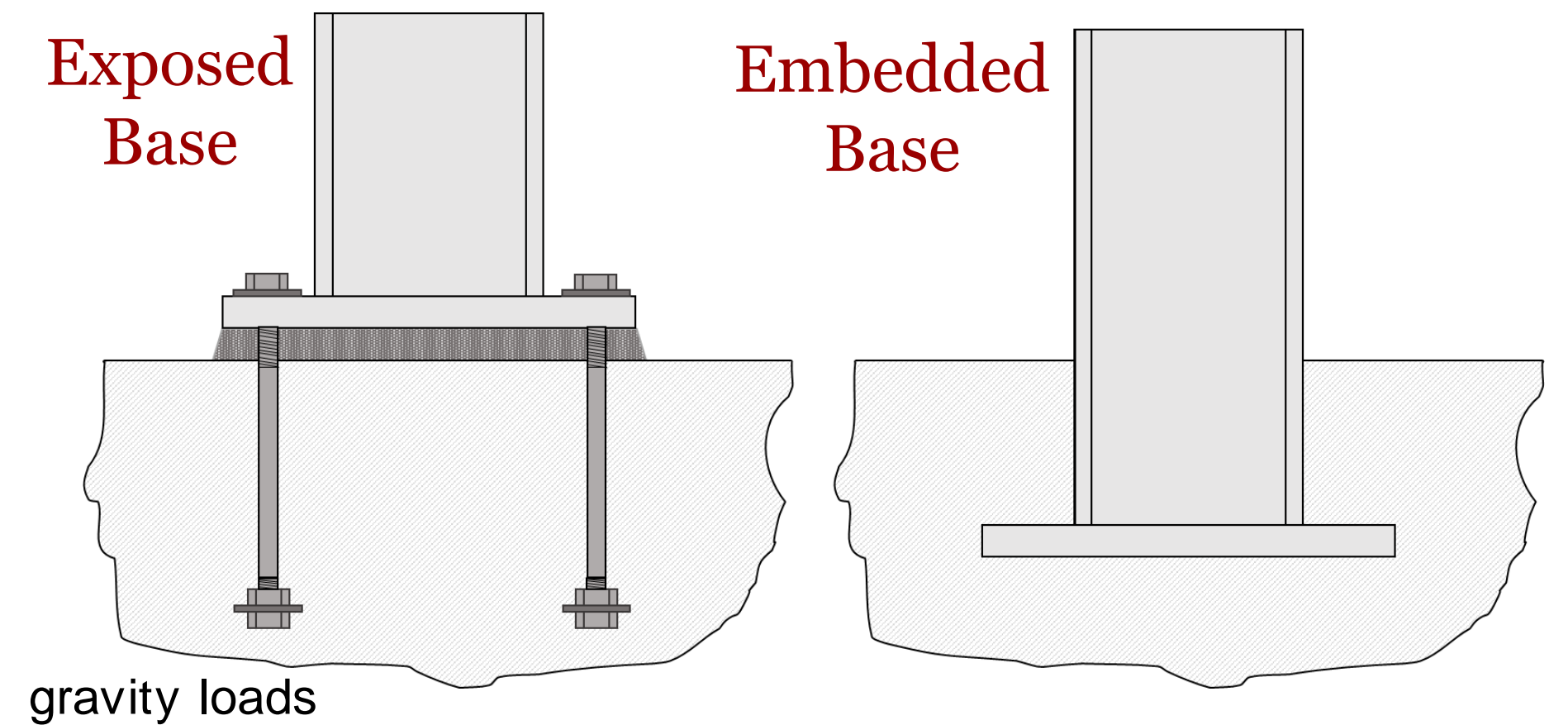Anchor Rods Specifically Detailed as Below-Ground Fuse

Polyethylene Tape -For Debonding-

Reduced Diameter Section

Upset Threaded Rods

Test Setup
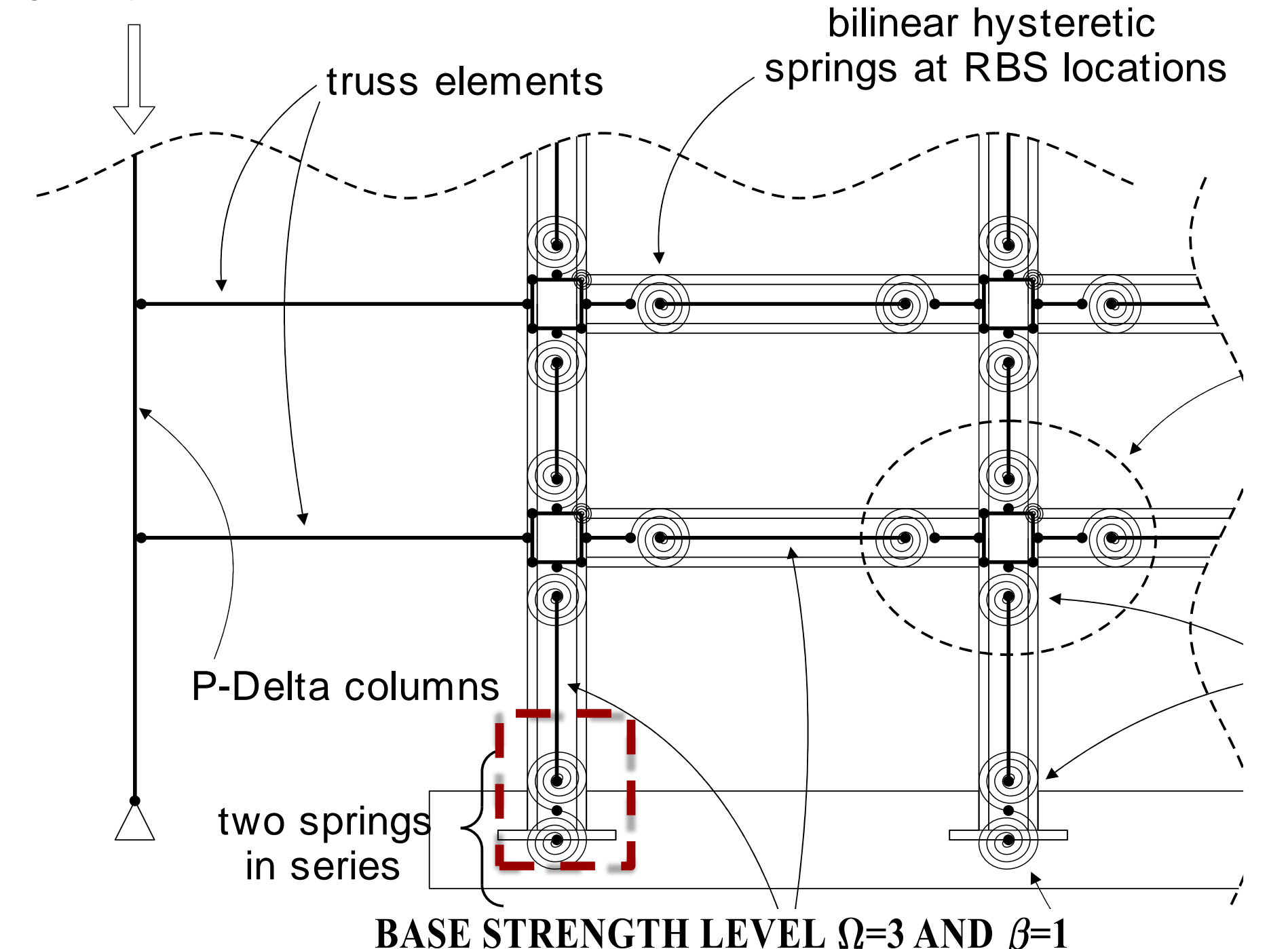
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