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PBEE Needs from the Buildings Perspective

Craig D. Comartin

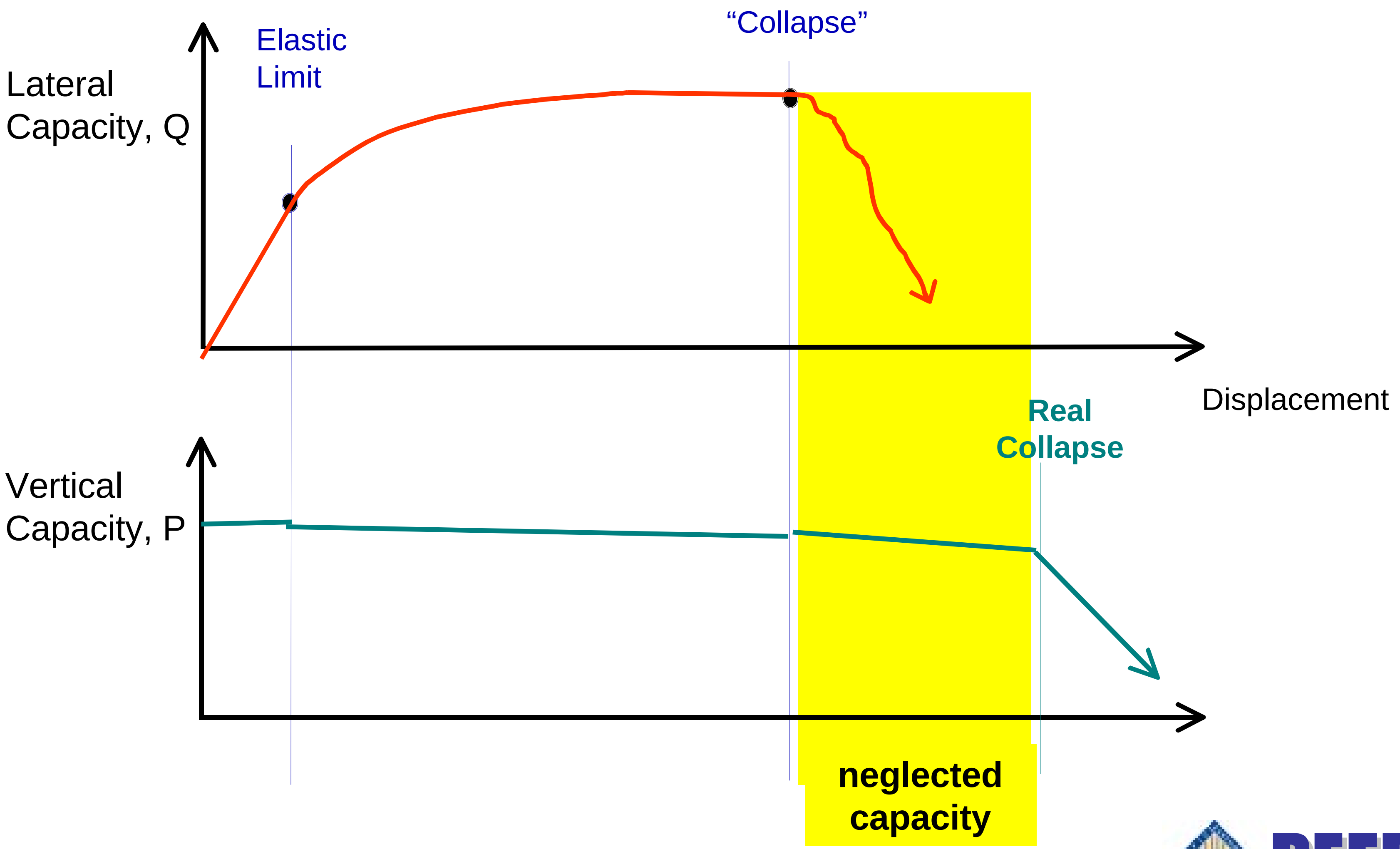
A look across the performance spectrum

Low end:	We need a better understanding of, and procedures for identifying, future **collapses**.
High end:	We need a rational and reliable procedure for estimating **downtime**.
Across the board:	We need inelastic force-deformation relationships for **geotechnical** components.

Five Story Example Buildings

Component damage

Component behavior



Ground motion variability

Near field effects

Basin edge effects

Site conditions

- materials
- stratigraphy
- topography

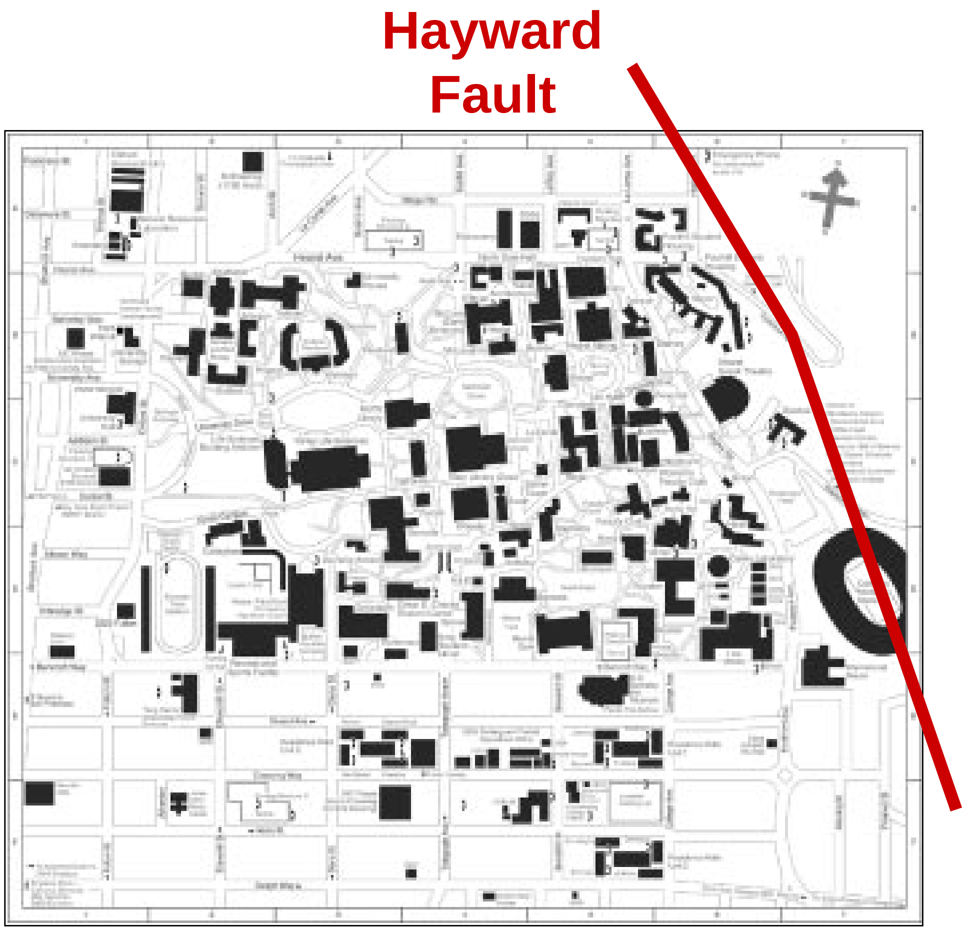
Microzonation is essential to realistic behavior prediction for individual buildings

Istanbul Problem

700,000 buildings adjacent to a long overdue segment of the fault

	Current PBEE prediction	More likely outcome
“Collapses”	~ **500,000**	**40,000-70,000**
Retrofit cost	**20%**	**10%**
Size of problem	**$ 25 billion**	**$ 2 billion**

UC Berkeley Campus



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Disaster Resistant University Project

Mary Comerio et al

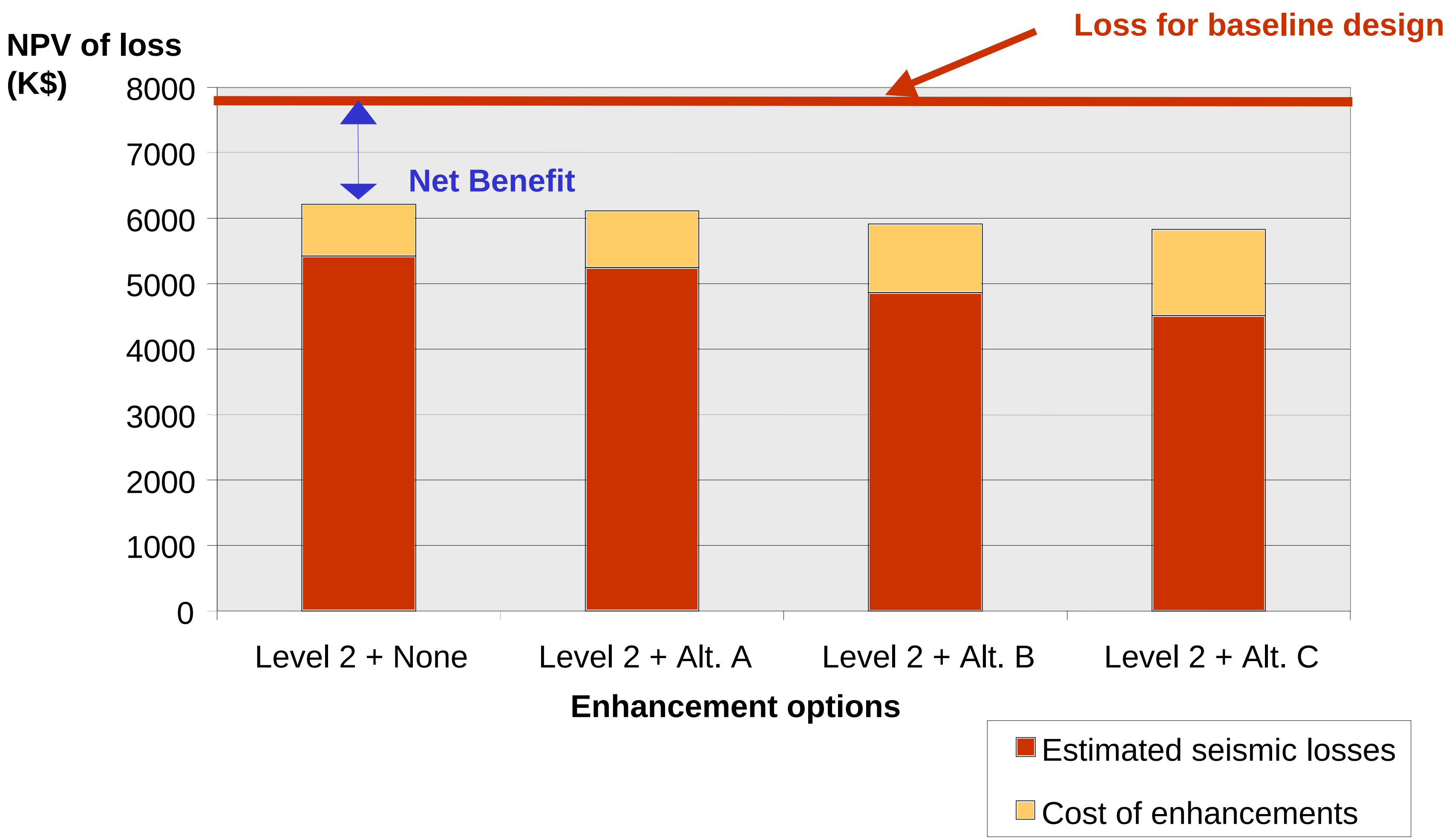
Event	Projected capital losses
Occasional	$ 0.7 B
Rare	$ 1.7 B
Very Rare	$ 2.9 B

UC Berkeley-Seismic Design Criteria

- California Building Code for minimum strength
- Life Safety Performance for shaking with 10% chance of being exceeded in 50 years (minimum)
- Cost efficient performance enhancements

UC Berkeley-Central Housing and Dining

Benefit-Cost Study

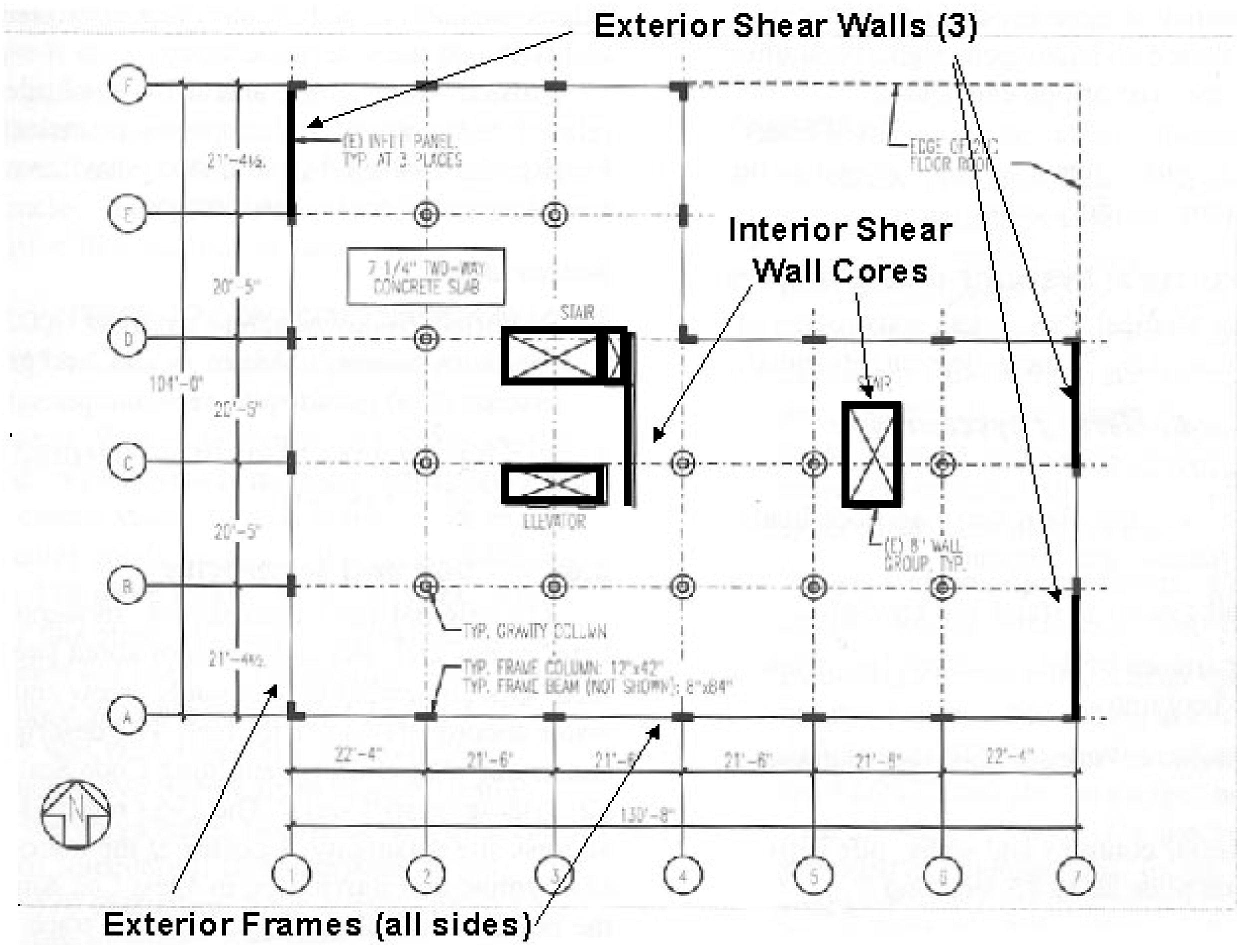


Benefit cost ratios

	Structural performance objective	Operational performance upgrades			
		none	A	B	C
Capital losses only	LS in 10/50	baseline	0.6	0.7	0.5
	IO in 10/50	0.1	0.2	0.3	0.4
Including downtime costs	LS in 10/50	baseline	1.1	1.2	1.0
	IO in 10/50	2.7	2.6	2.5	2.2

Barrington Medical Office Building

Barrington plan



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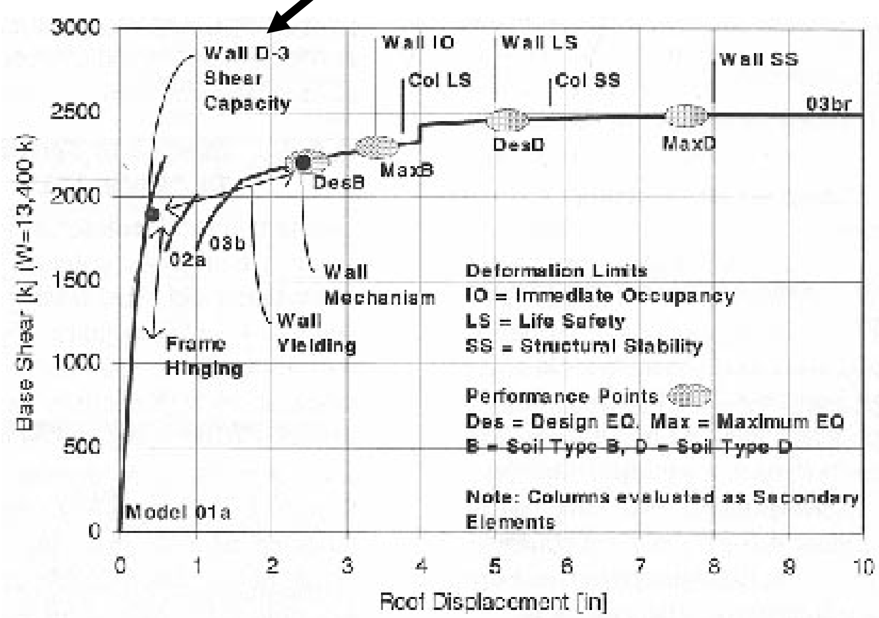
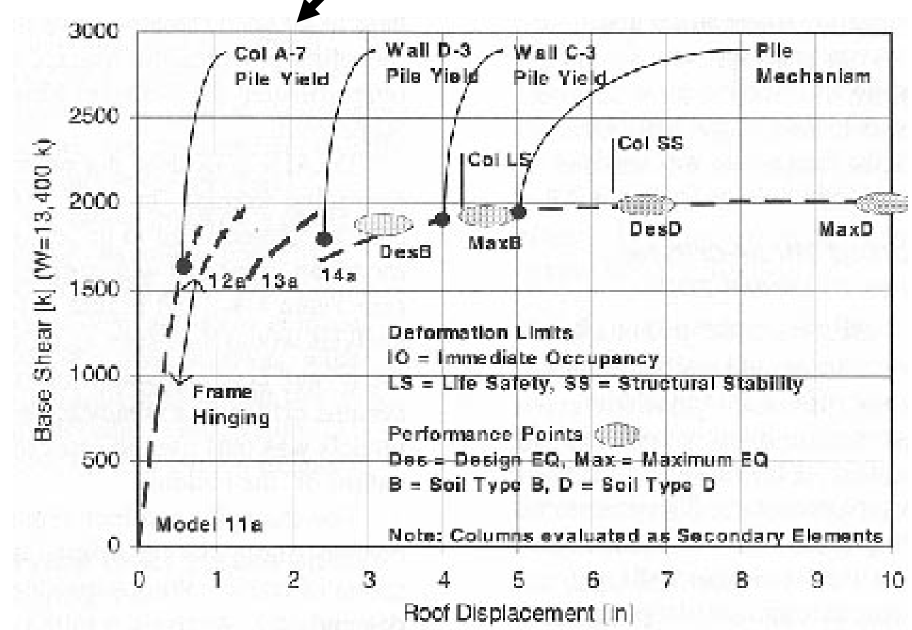
Stiff/strong vs. flexible/weak

Inelastic mechanism controlled by shear in walls

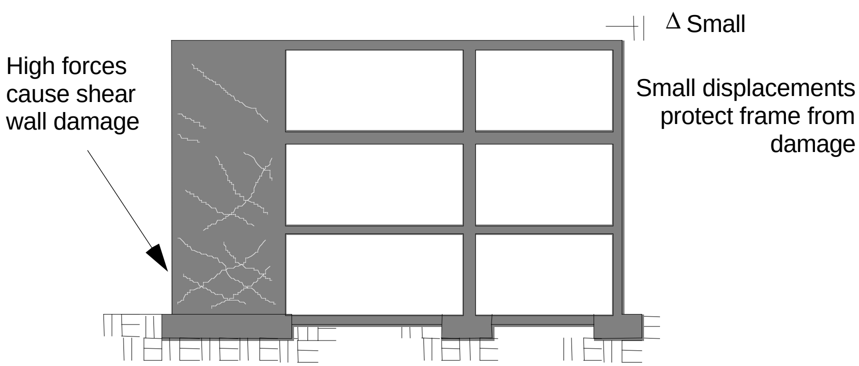


Inelastic mechanism controlled by pile yielding

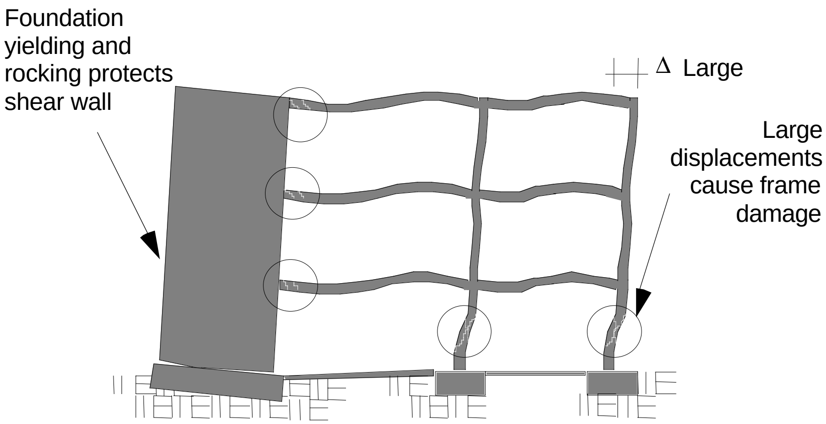


Effects of Foundations on Performance

Foundation stiffness and strength affect various structural components differently.



Stiff/Strong Foundation



Flexible/Weak Foundation

Stiff/strong is not always favorable; nor is flexible/weak always conservative.

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A question

Are we doing enough to solve the the biggest problems?