SEISMIC DESIGN PROVISIONS FOR ANCHORS: CONCEPT AND IMPLEMENTATION IN THE U.S

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Agenda

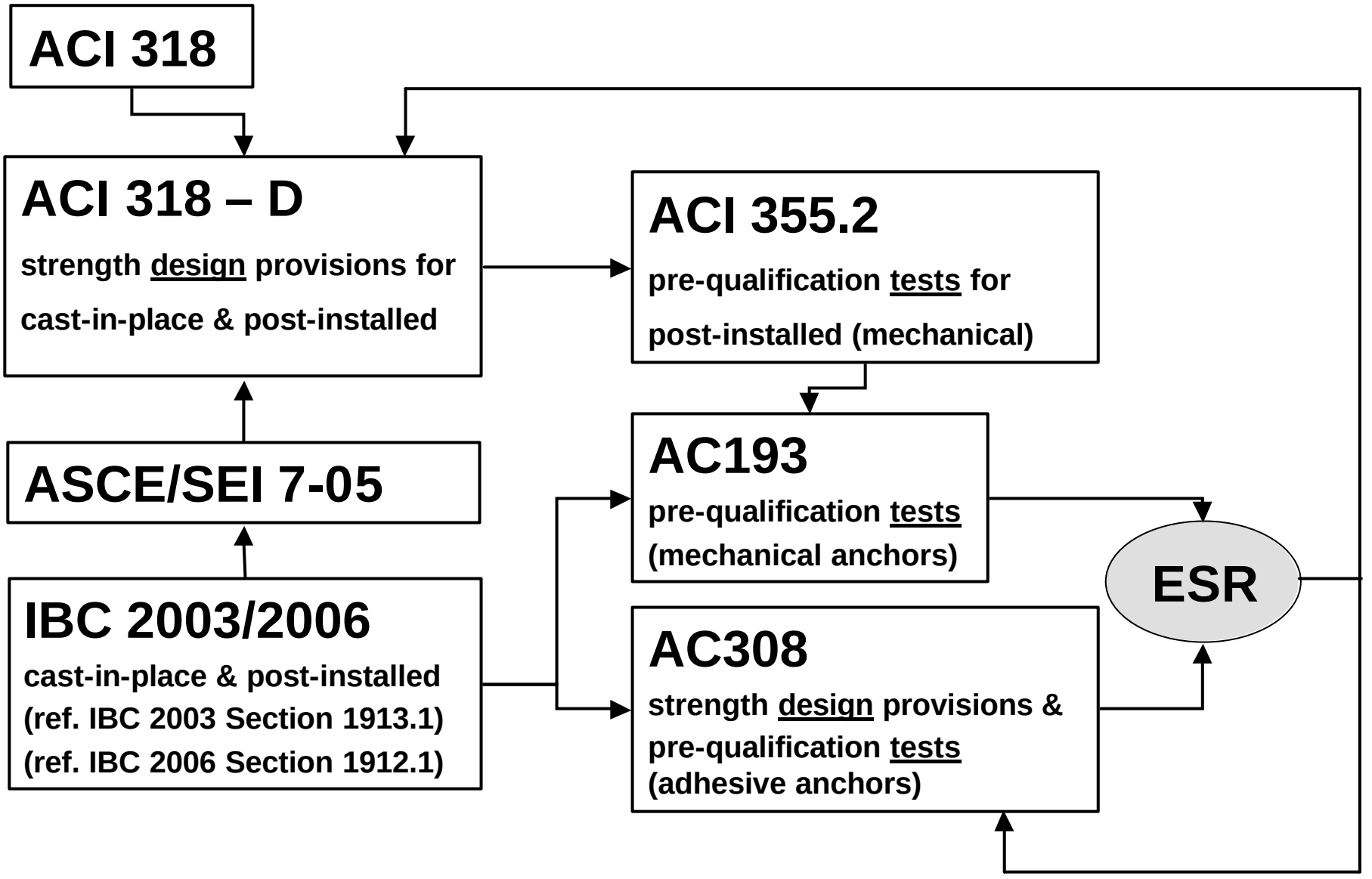
US code overview

Seismic design methodology

Seismic Design Category & Seismic Use Group definitions

Conclusions

U.S. code overview



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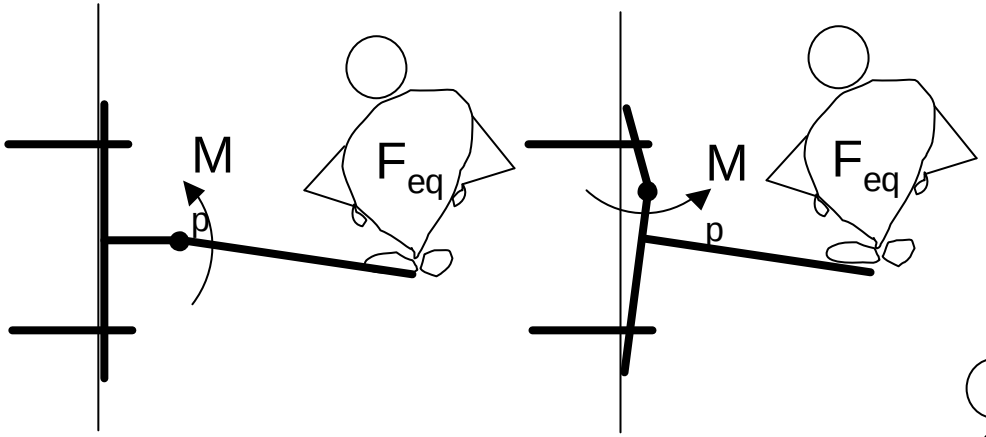

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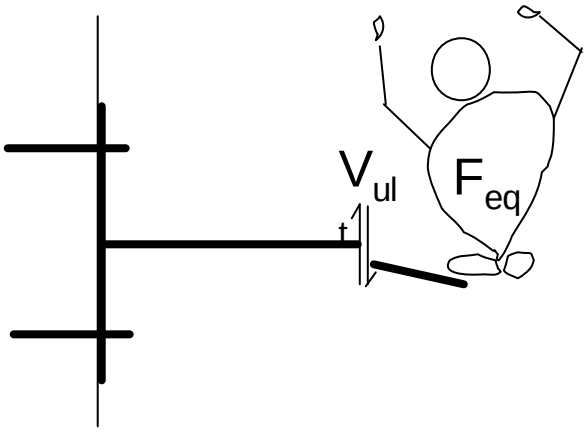

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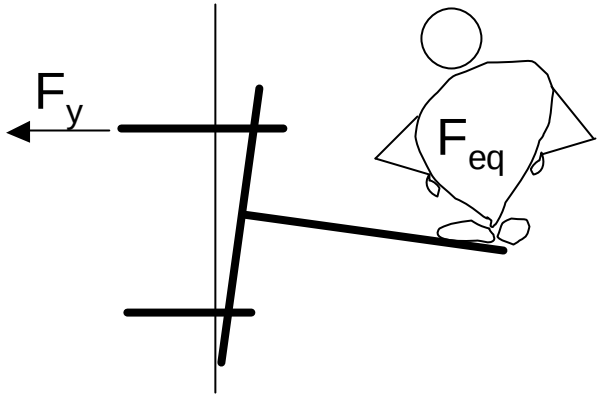
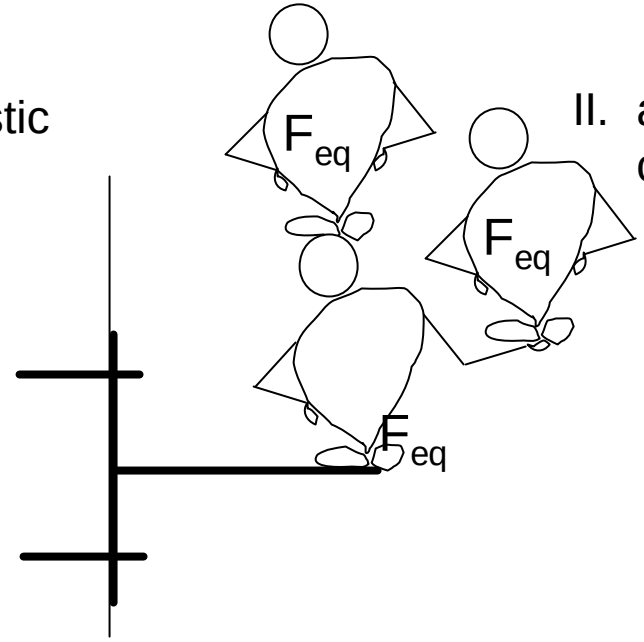


III. anchor resistance governed by ductile anchor yield



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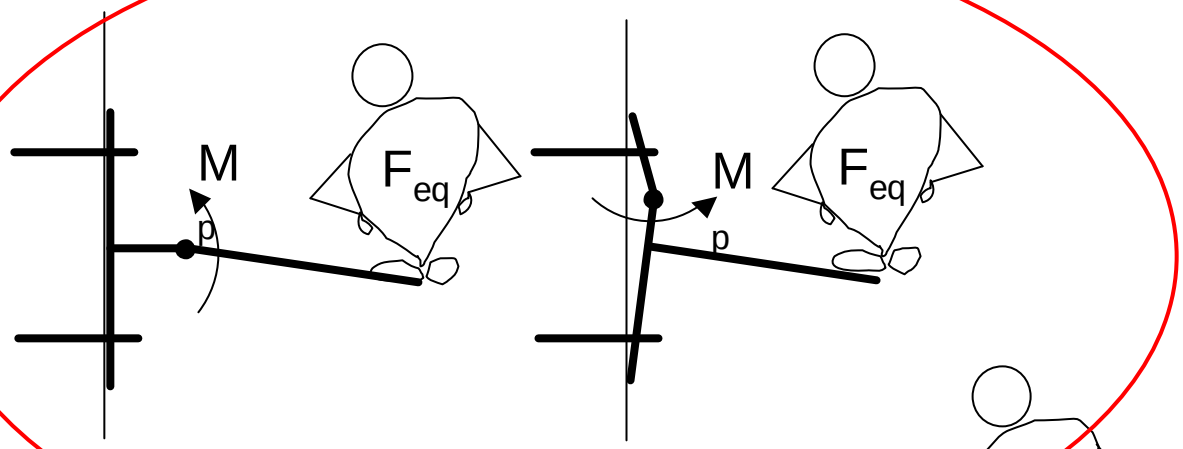

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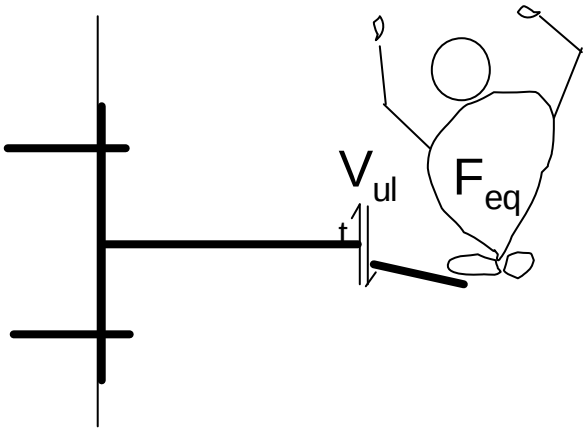

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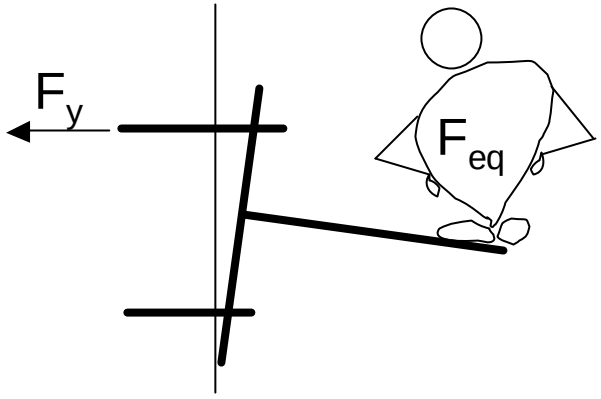

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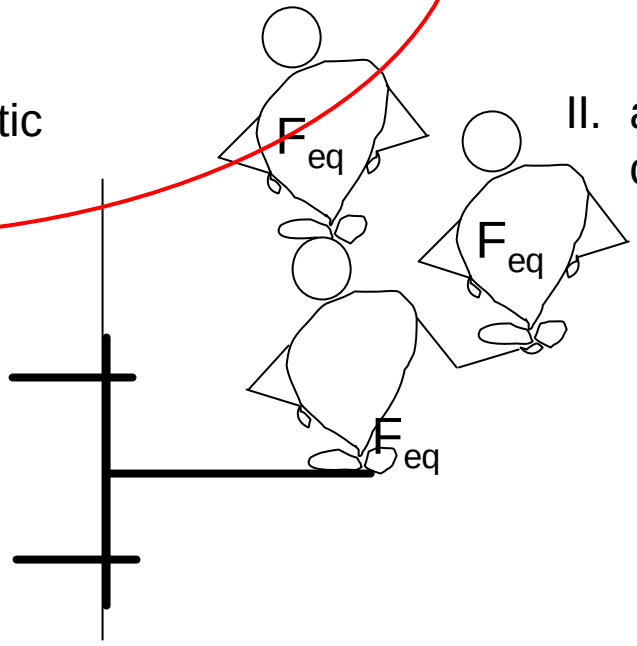

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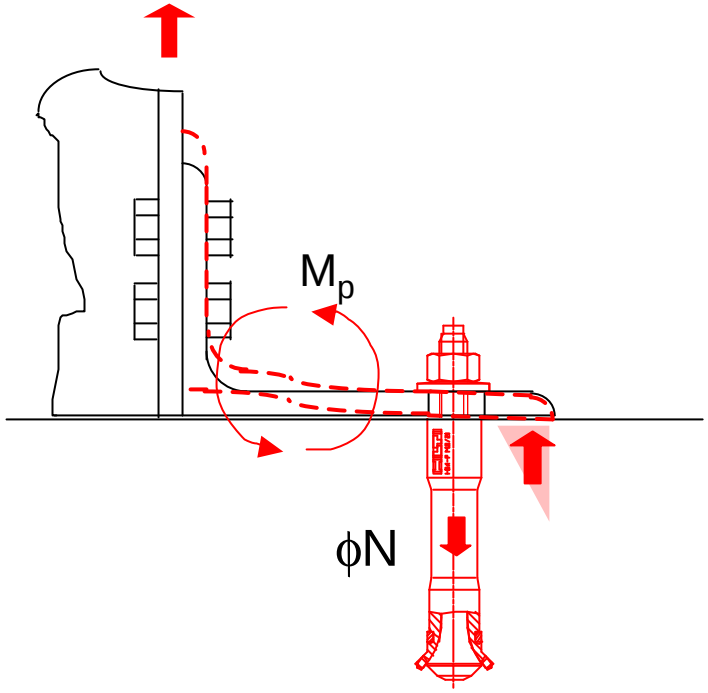
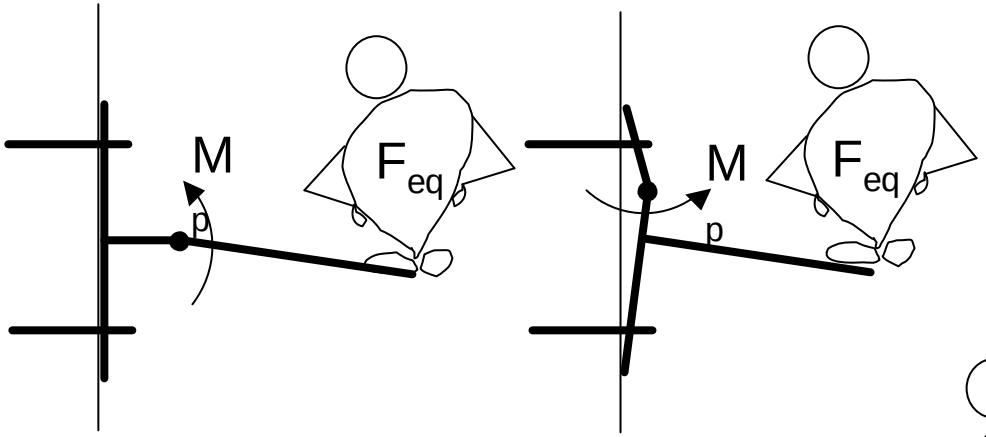


yielding attachment

overload protection strategies for anchor connections

Options for the seismic design of anchorages



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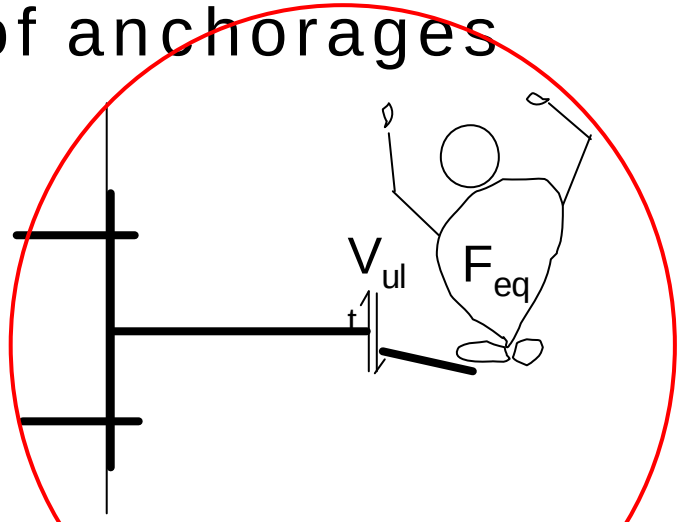

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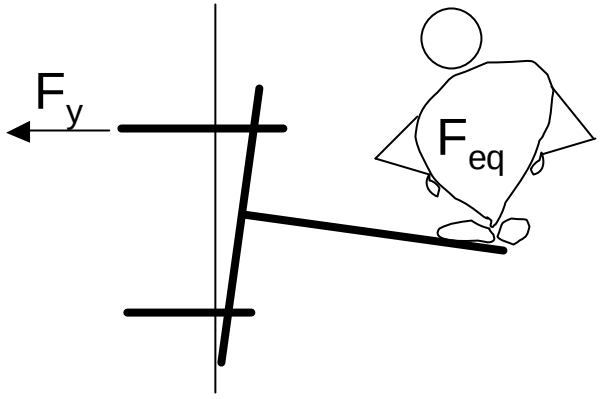

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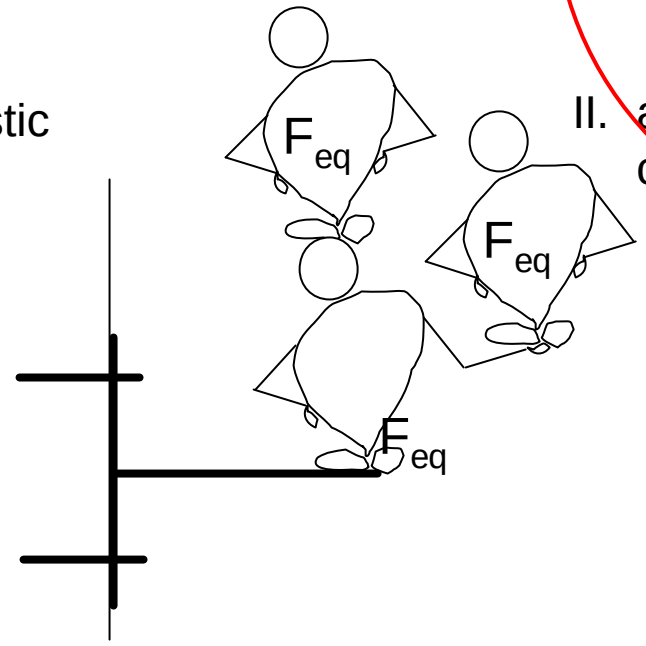

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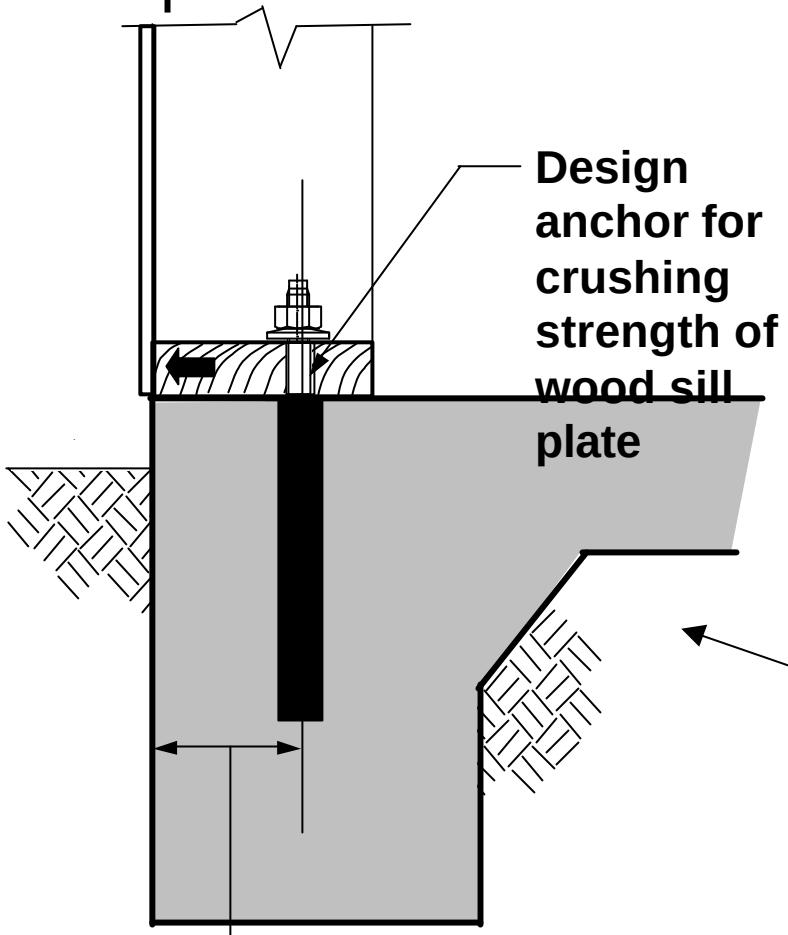
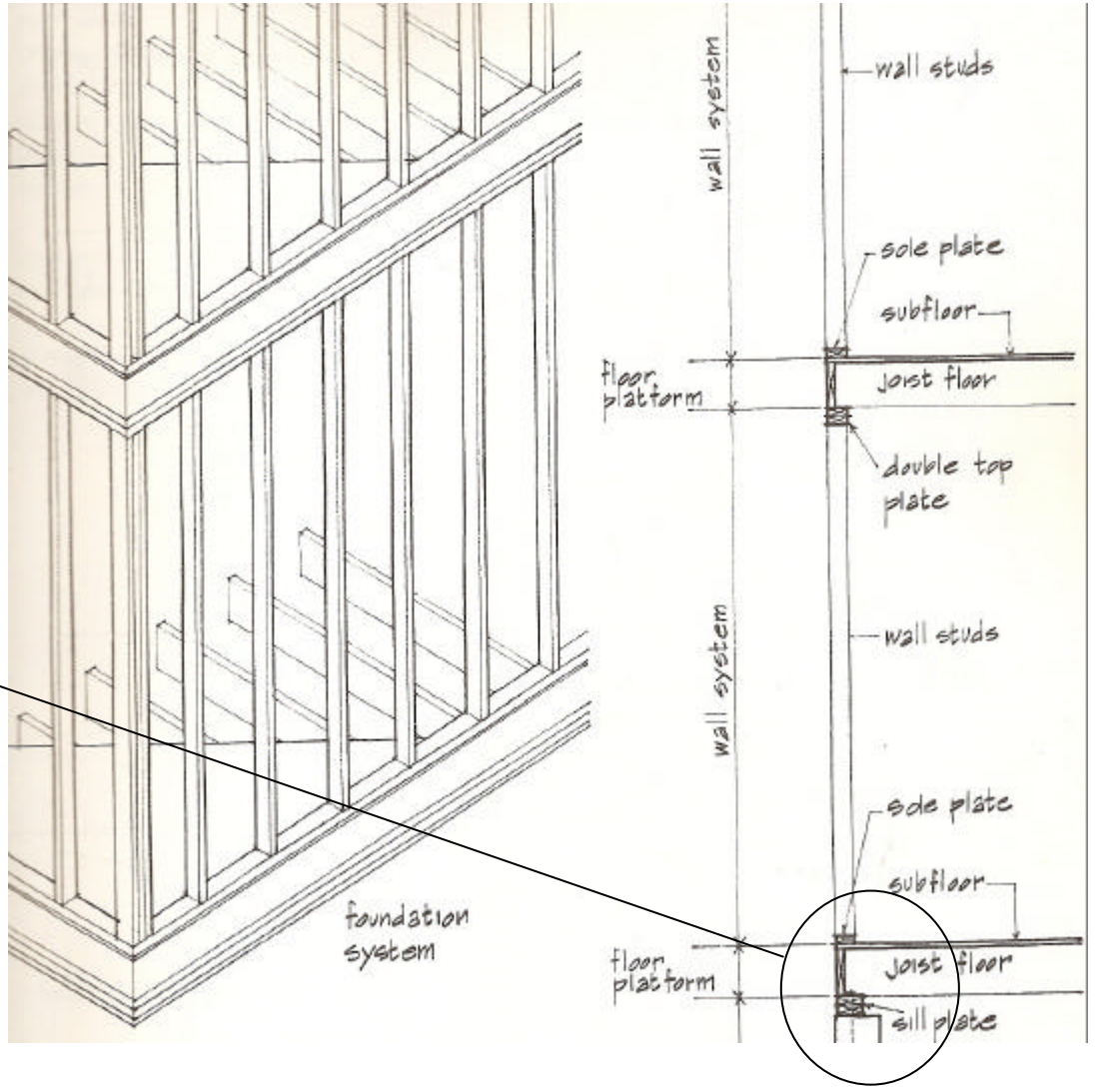


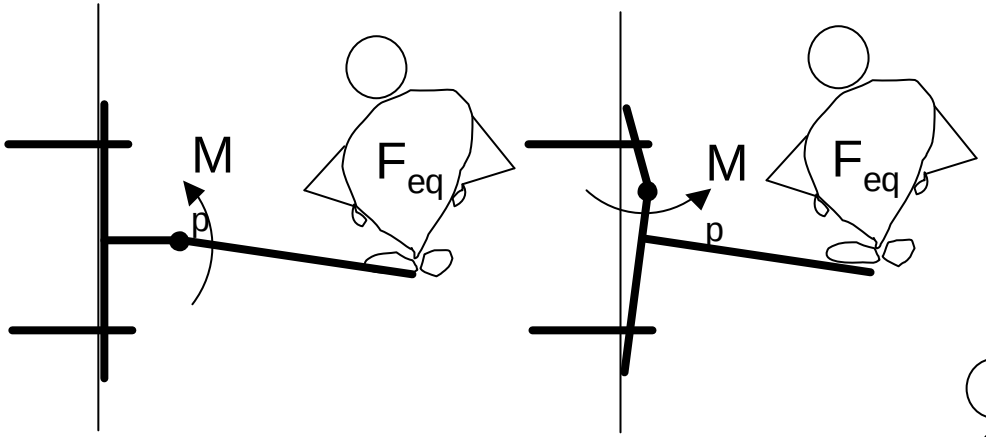
Design anchor for crushing strength of wood sill plate

Edge distance too small to satisfy ductility criteria based on steel strength



Building Construction Illustrated, F. D.K. Ching

Options for the seismic design of anchorages



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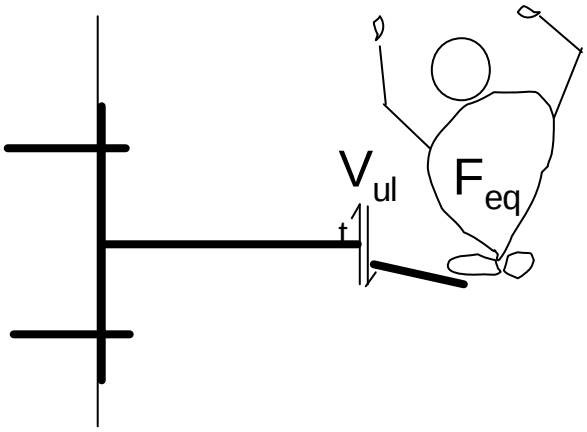

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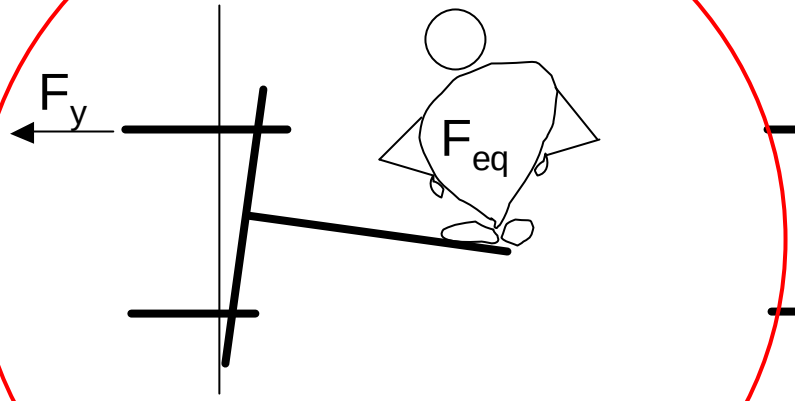

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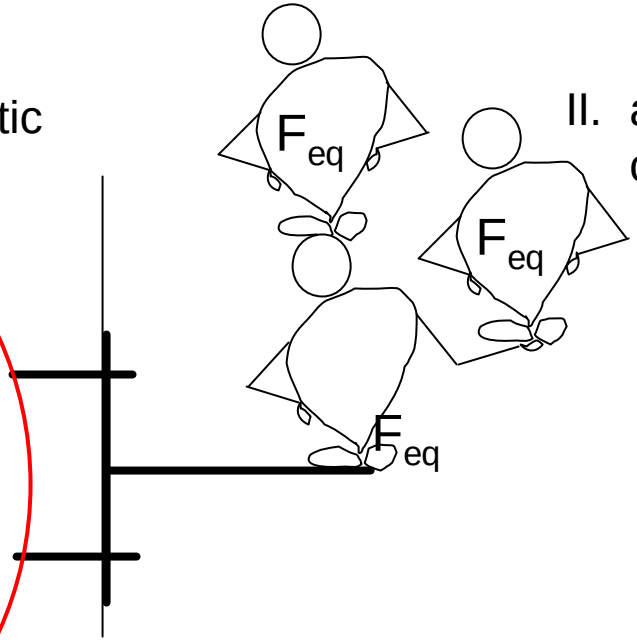

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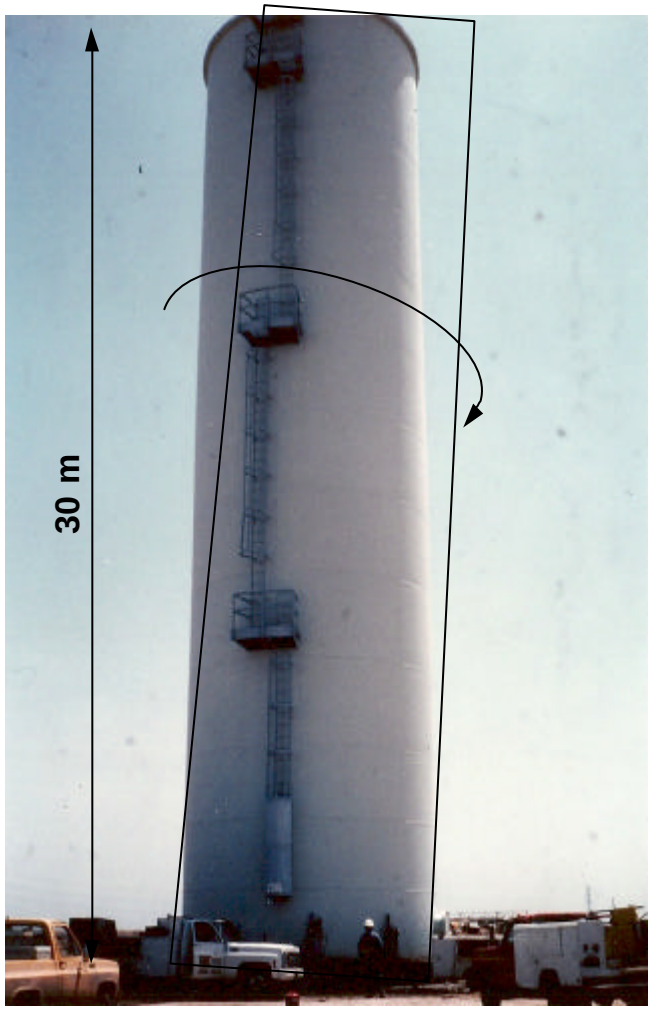

H. J. Degenkolb

Coalinga earthquake of May 1983

Surge tank ABs: 38 mm A307 bolts stretched uniformly 25 to 40 mm

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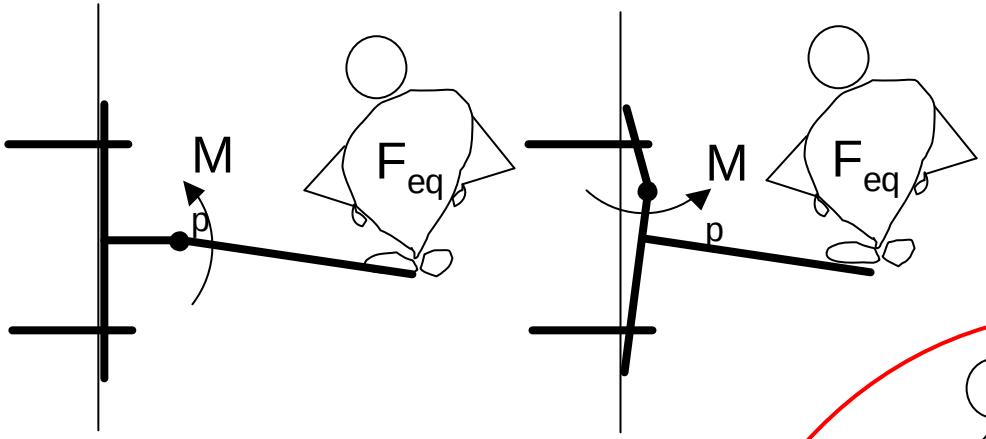

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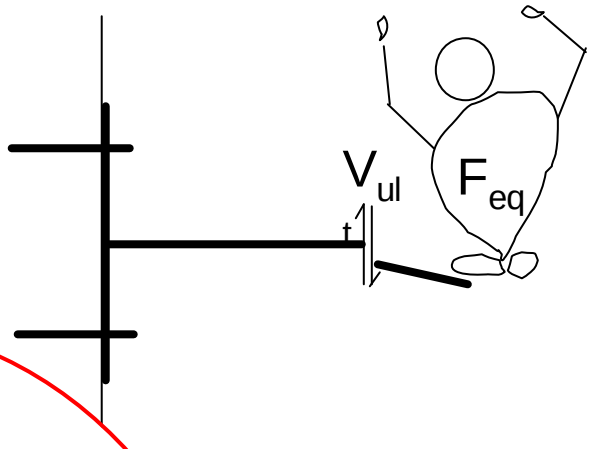

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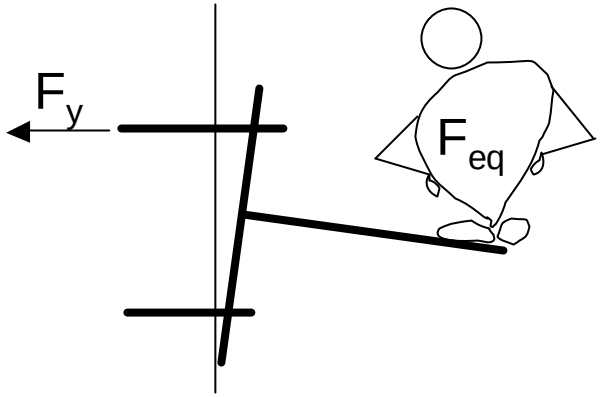

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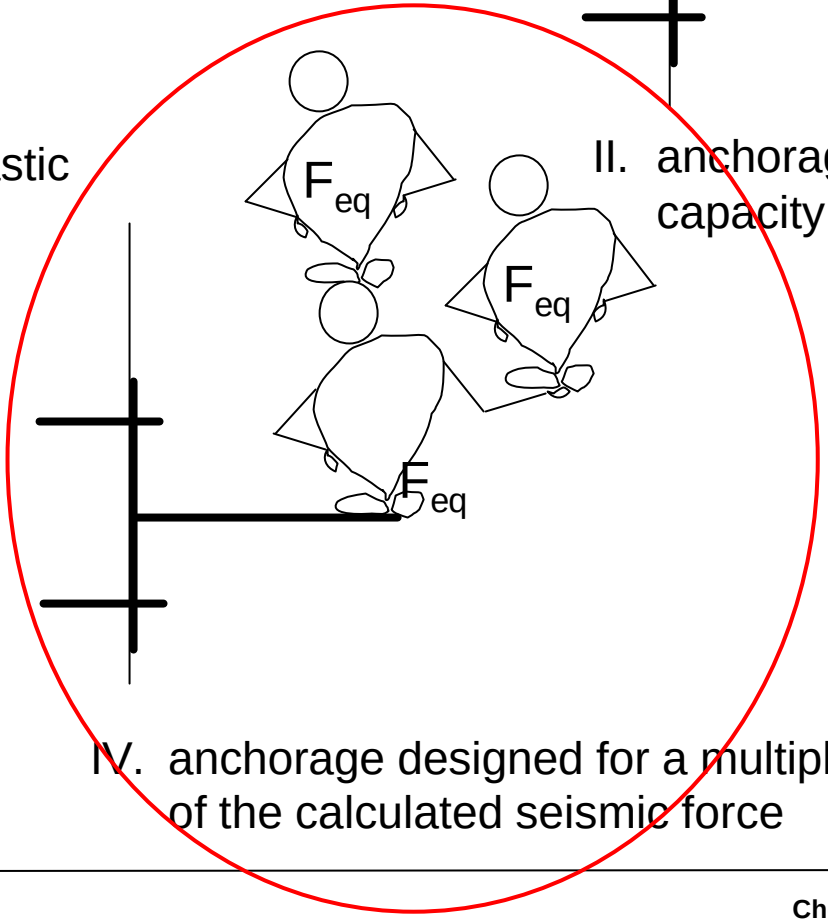

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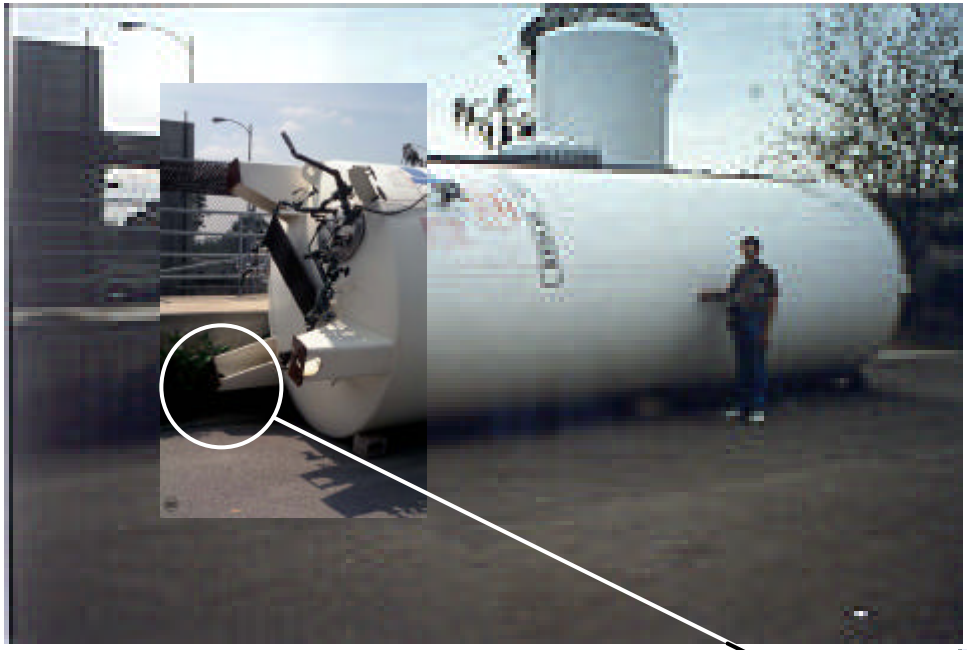
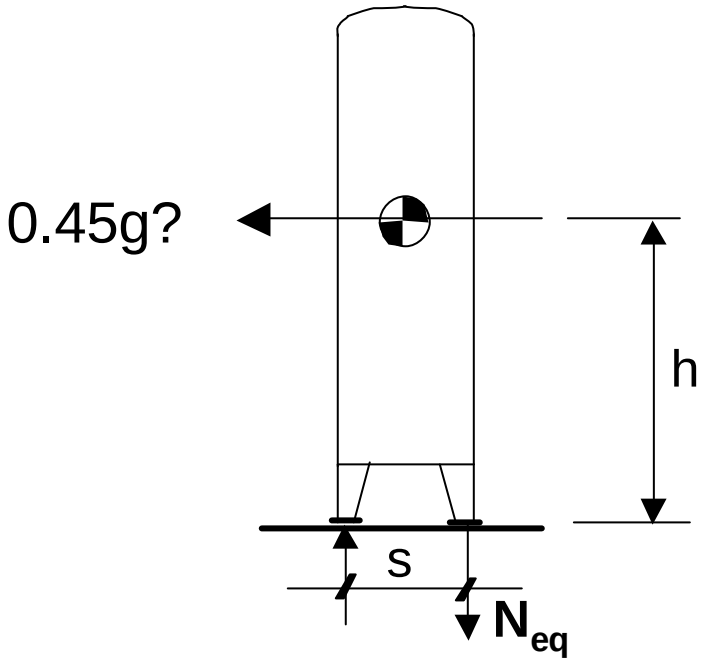
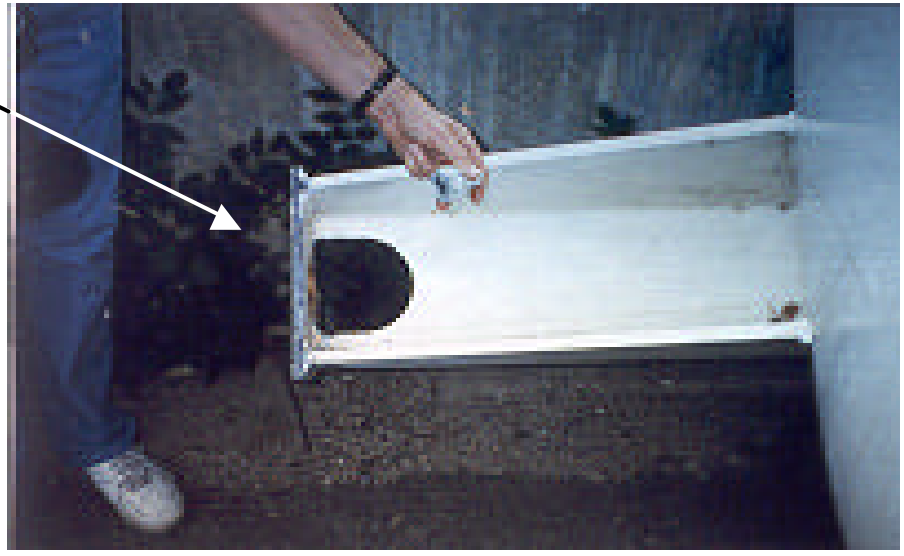


Degenkolb Engineers



Overturned medical gasses tank, Olive View Hospital

Northridge 1994



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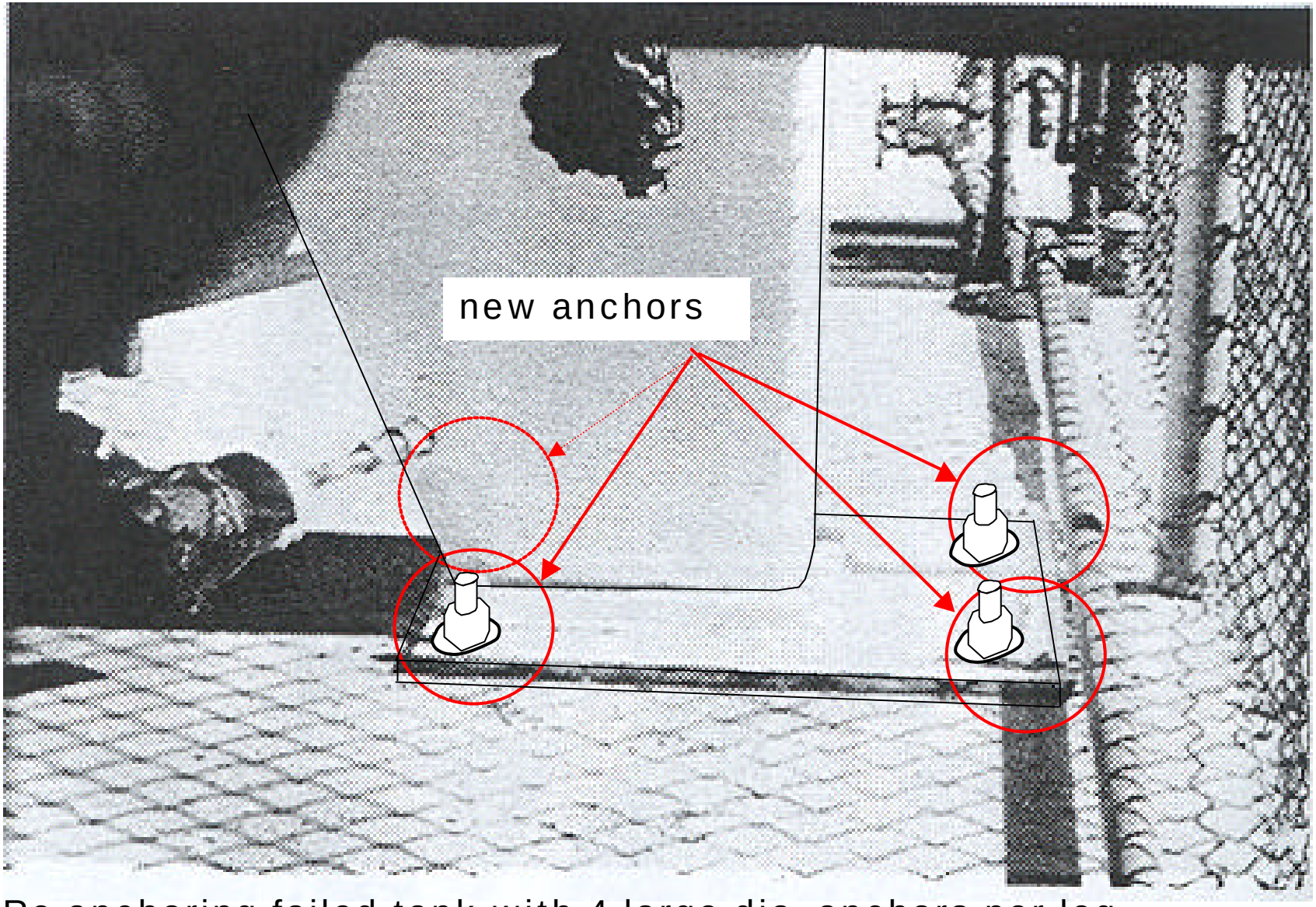

Re-anchoring failed tank with 4 large dia. anchors per leg

ATC 29-1 1998

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Seismic design categories (SDC)

Seismic Design Category (SDC)	Description[1]
A	Structures in regions where anticipated ground motions are minor, even for very long return periods.
B	Seismic Use Group I and II structures in regions of seismicity where only moderately destructive ground shaking is anticipated.
C	Seismic Use Group III structures in regions where moderately destructive ground shaking may occur as well as Seismic Use Group I and II structures in regions with somewhat more serve ground shaking potential.
D	Seismic Use Group I, II and III structures in regions expected to experience destructive ground shaking but not located very near major active fault lines
E	Seismic Use Group I and II structures in regions located very close to major active fault lines
F	Seismic Use Group III structures in regions located very close to major active fault lines

1) Paraphrased from FEMA 450-2/2003 edition, Part 2, **Commentary on NEHRP Recommended Provisions for Seismic Regulations for New Buildings and Other Structures, pp. 8-9**

Seismic use groups

Seismic use group	Description[1]
I	Structures not assigned to Group II and III, representing as lesser life hazard only insofar as there is probability of fewer occupants in the structure and the structure are lower and/or smaller.
II	Structures having a large number of occupants or where the occupants' ability to exit is restricted.
III	Essential facilities, e.g. Hospitals, Emergency Repose Facilities, required for post-earthquake recovery.

1) Paraphrased from FEMA 450-2/2003 edition, Part 2, **Commentary on NEHRP Recommended Provisions for Seismic Regulations for New Buildings and Other Structures, pp. 4-5**

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- The present methods for seismic qualification of anchor systems in the U.S. are generally simple, however they are developing and evolving.
- Wherever possible, the design of connections involving discrete anchors should strive to protect the anchor against premature and sudden failure.
- Codes in the U.S. have up until recently focused on the loading side of the anchoring connection.
- The design of anchors for earthquake forces requires attention to detailing and consideration of stiffness (load path) and displacement demand as well as strength.
- There is no substitution for sound engineering judgment when designing and detailing for seismic applications