Integral Abutment Bridges

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Outline

- Foundation Concepts
- Foundation Types
- Design Methods

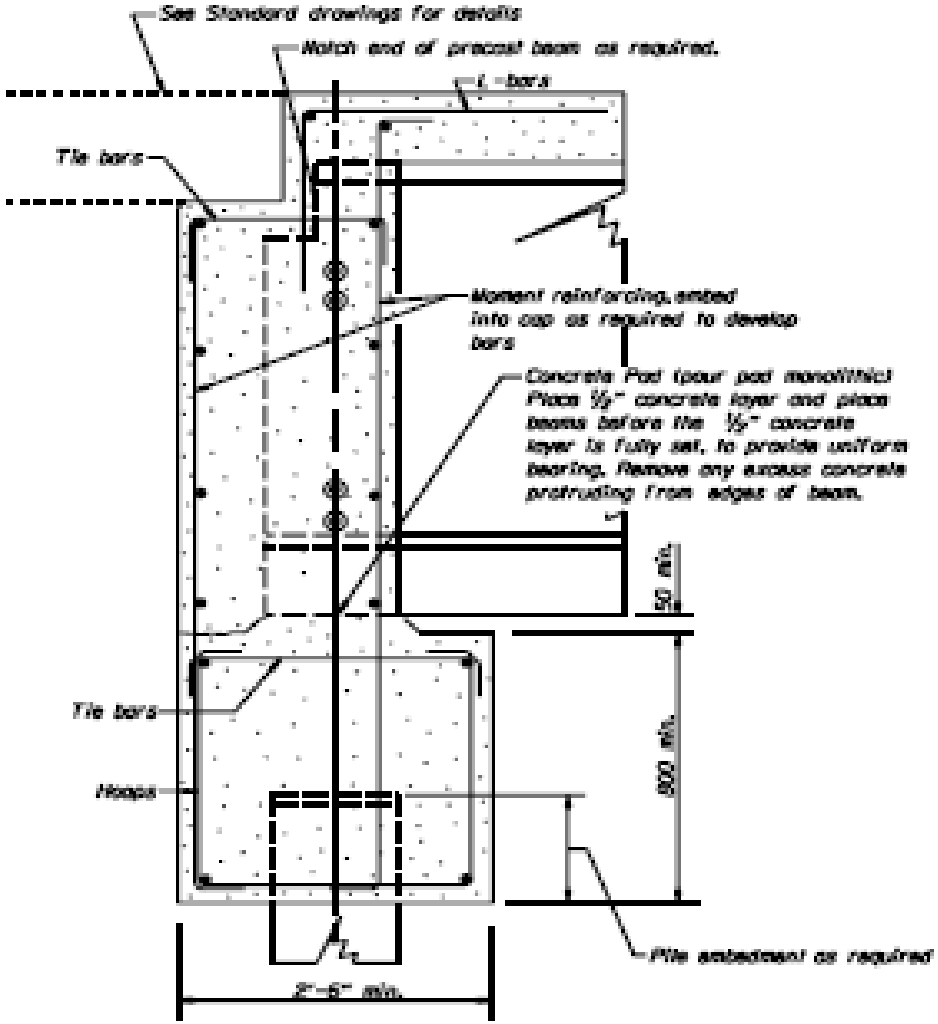
Integral Abutments

- Eliminate expansion joints
- Eliminate expansion bearings
- Increase design efficiency
- Add redundancy and capacity for catastrophic events
- Speed up construction
- Reduce tolerance problems

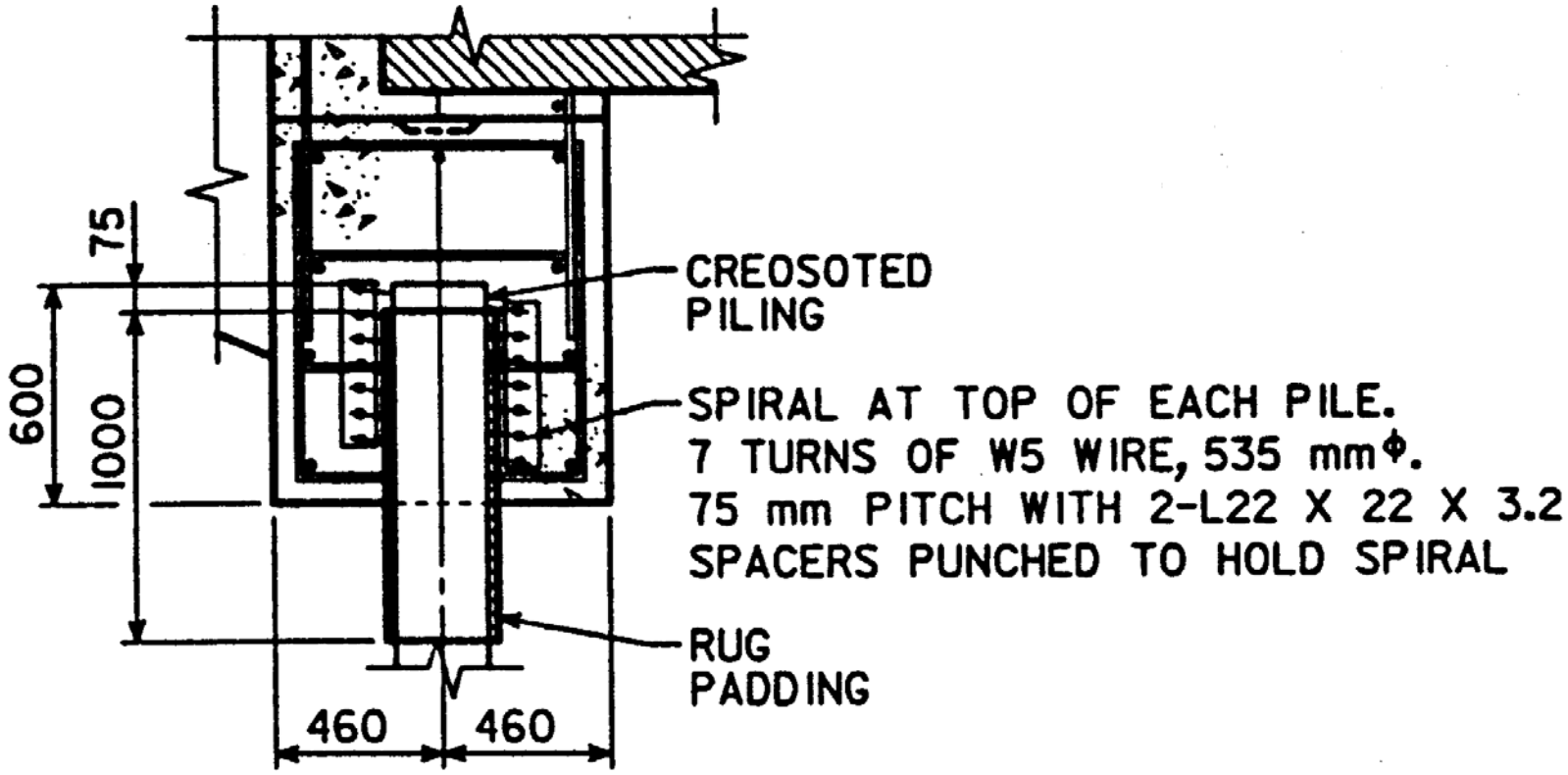
Foundation Concepts

- Fixed-head pile
- Pinned-head pile
- Hinged abutment
- Fixed-base pile
- Prebored hole
- Sleeved pile

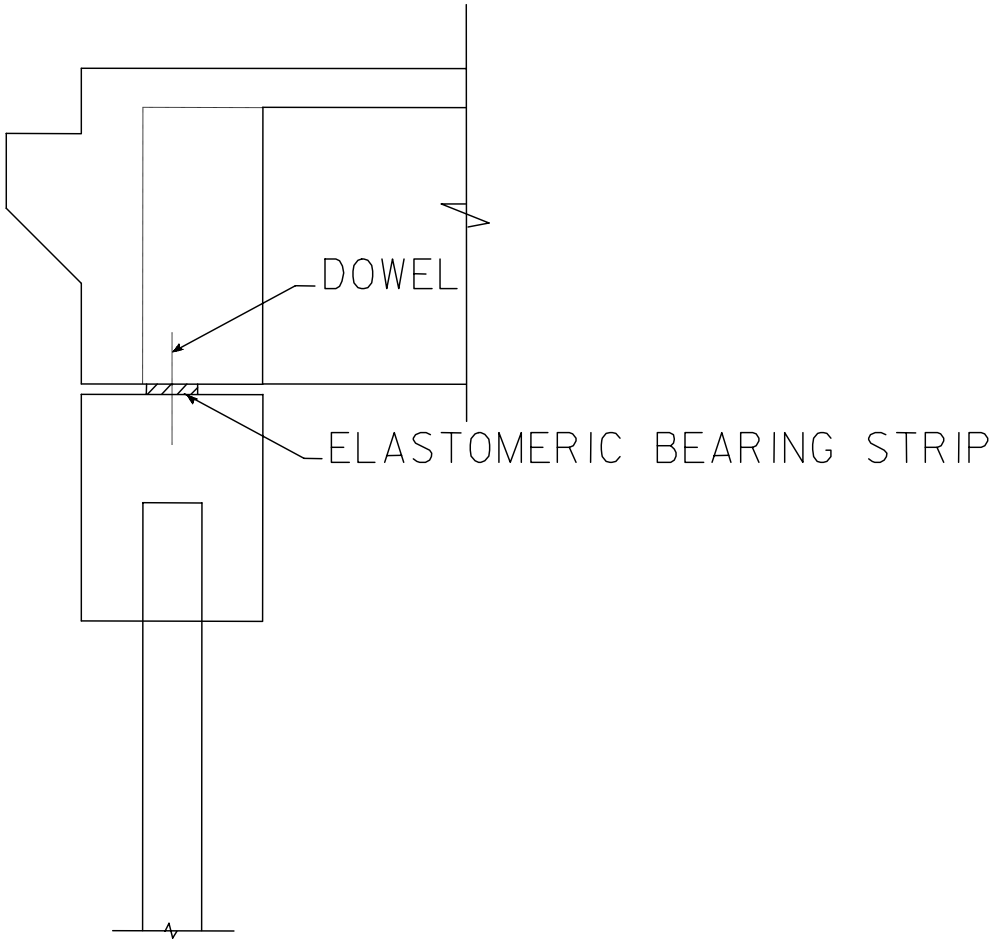
Fixed-Pile Head



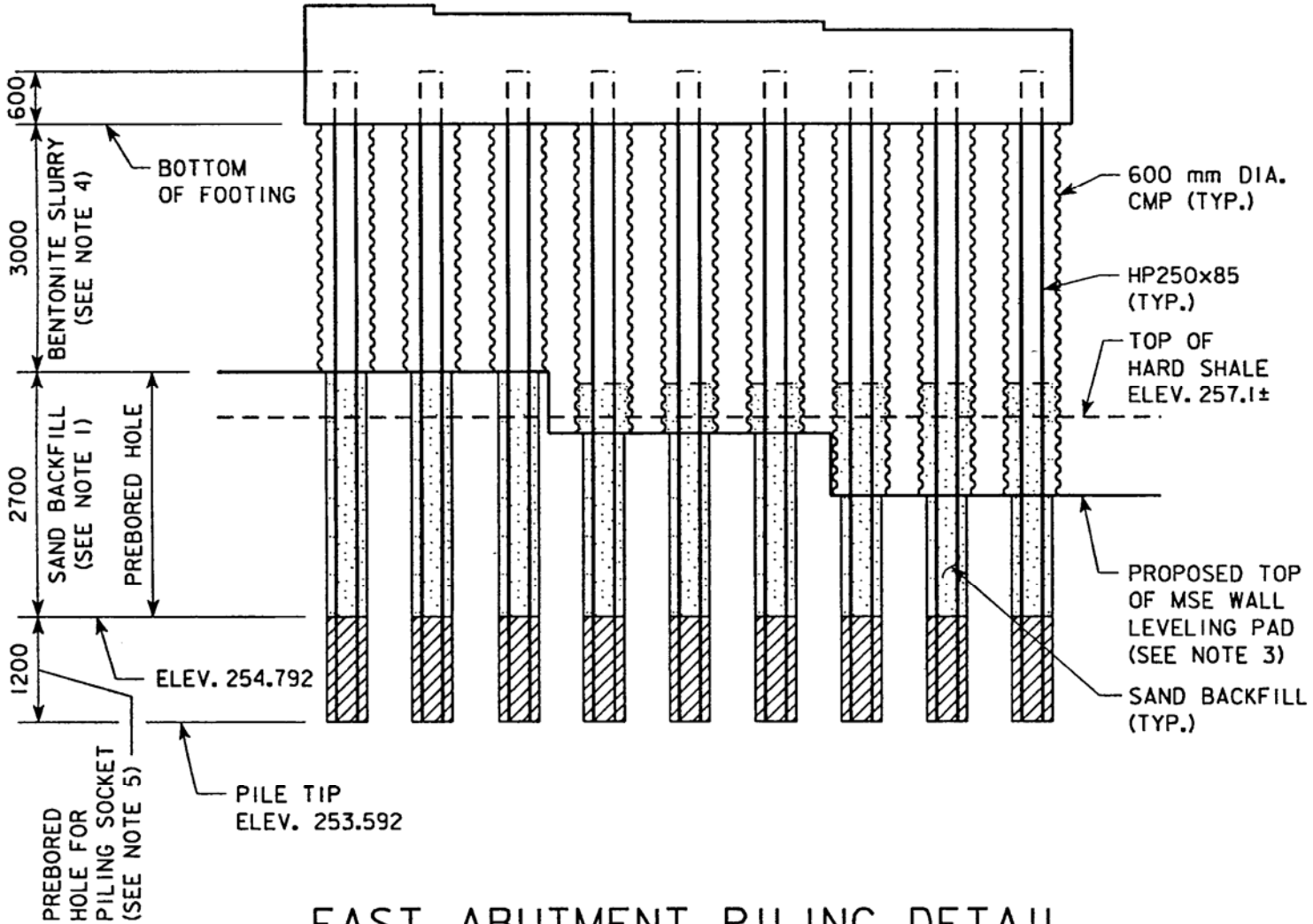
Pinned-Pile Head



Hinged-Abutment Concept



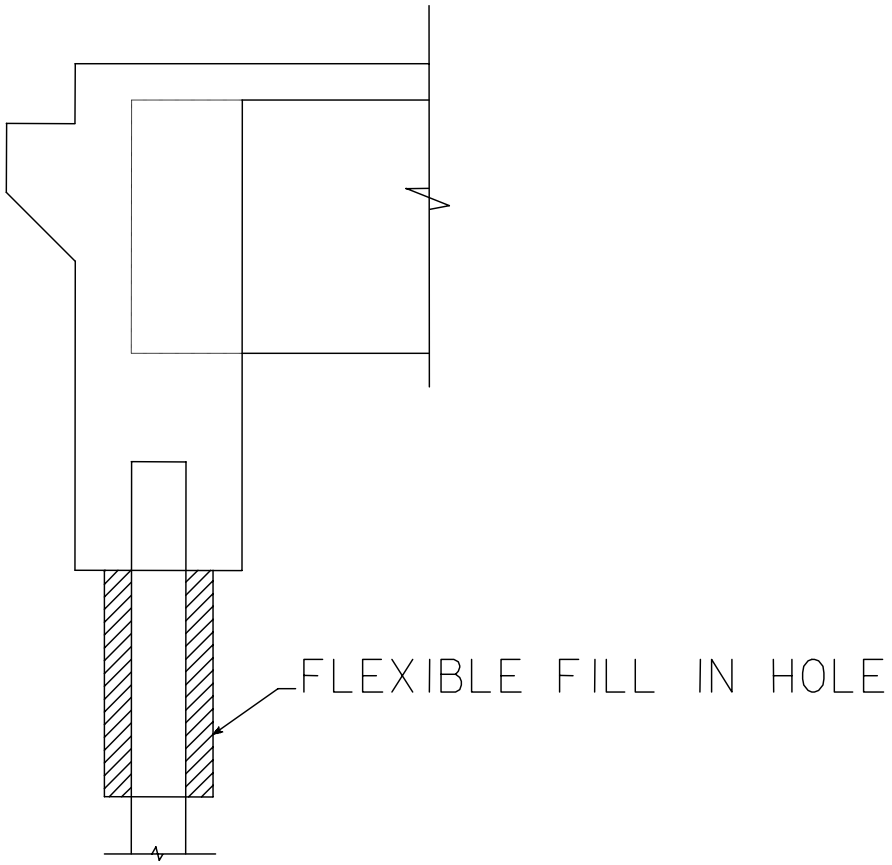
Fixed-Base and Sleeved-Pile



EAST ABUTMENT PILING DETAIL

(LOOKING EAST)

Prebored-Hole Concept



Foundation Types

- Steel H-pile
- Precast prestressed-concrete pile
- Pipe pile (steel encased concrete pile or metal shell pile)
- Caisson wall or drilled shaft
- Combined H-pile (or W-section) and drilled shaft
- Timber pile, sheet pile and spread footing

H-Pile Orientation

- 2004 survey - Nearly half of the states preferred steel H-piles oriented for weak axis bending
- Oregon, Iowa, New York, Pennsylvania, etc.

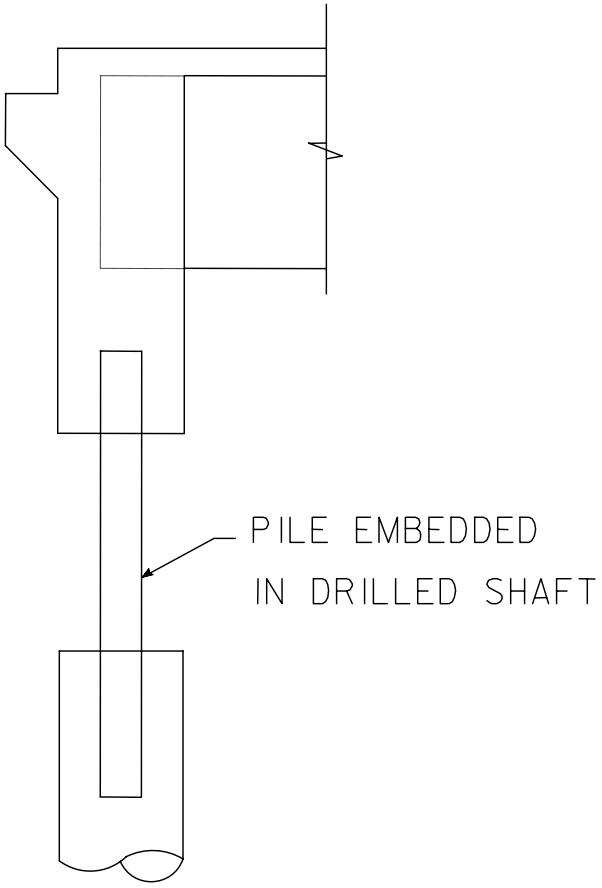
- One-third preferred the piles oriented for strong axis bending
- Idaho, Tennessee, Colorado, Illinois, etc.

Limitations

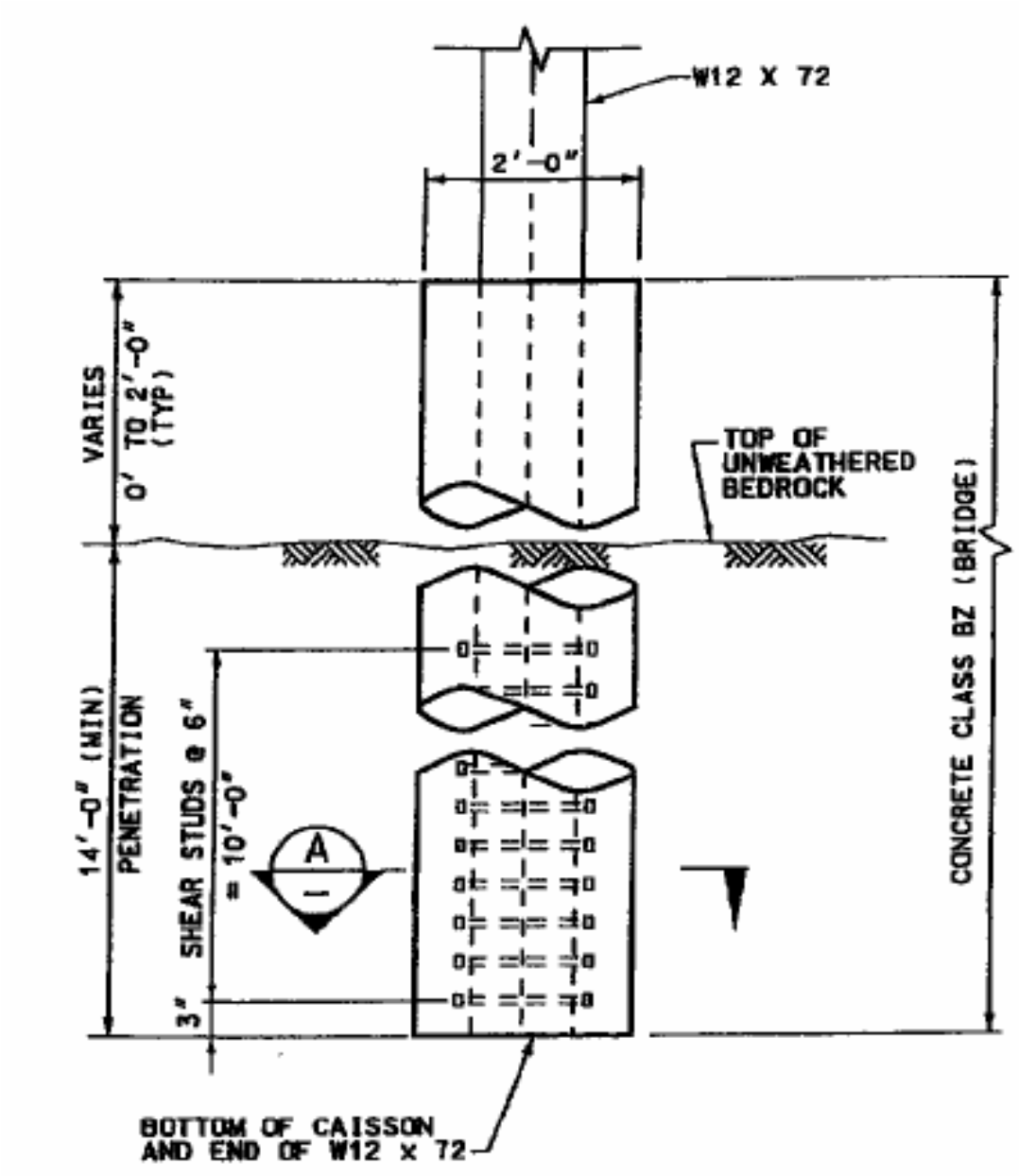
- Max 2-inch thermal movement
- Skew <= 30 degrees (or 45 degrees)
- Straight bridges (Oregon, R=1200 ft min)

	Thermal	Concrete	Steel	Skew
Idaho		650’	350’	
Oregon	2”			30^{o}

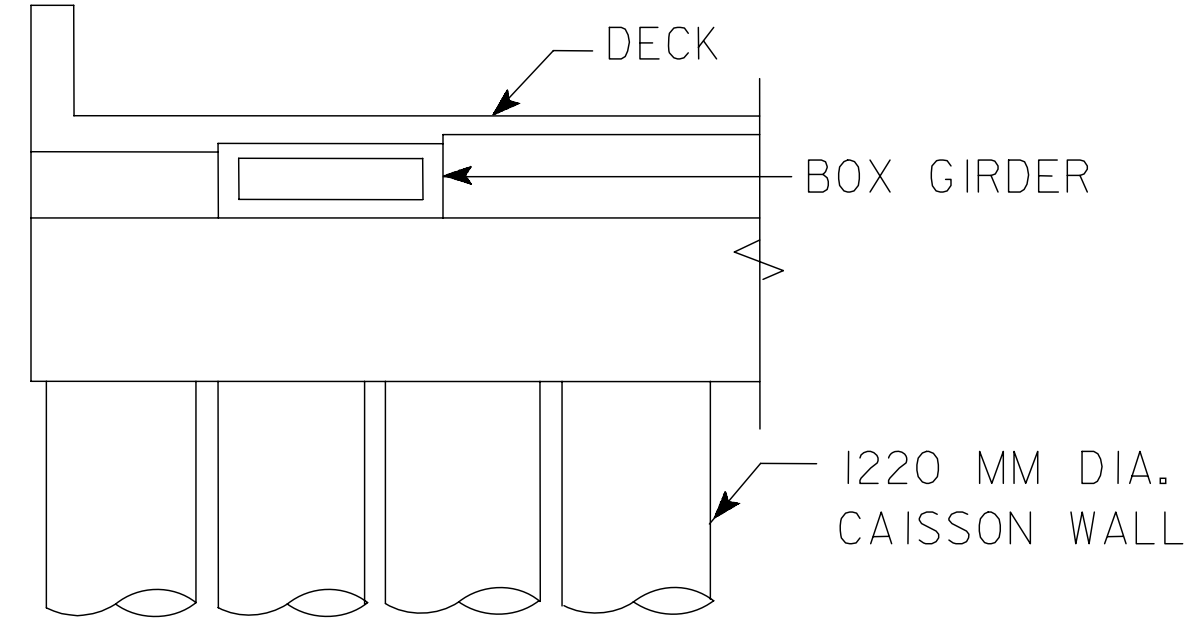
Stabbed-Shaft Foundation Concept



Composite Section (Colorado)

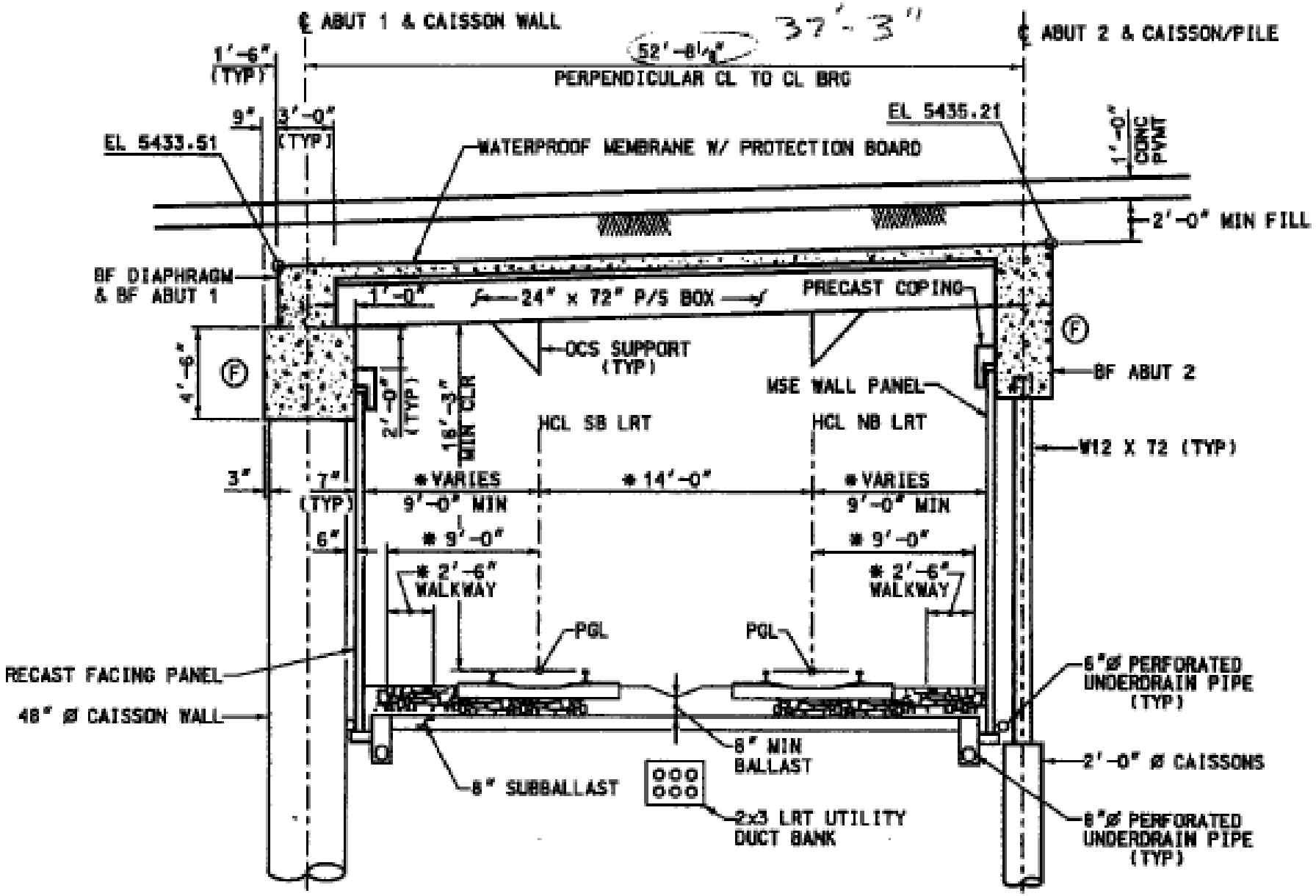


Caisson Wall Foundation



ABUTMENT ELEVATION

Caisson Wall & W12x72 in Caissons



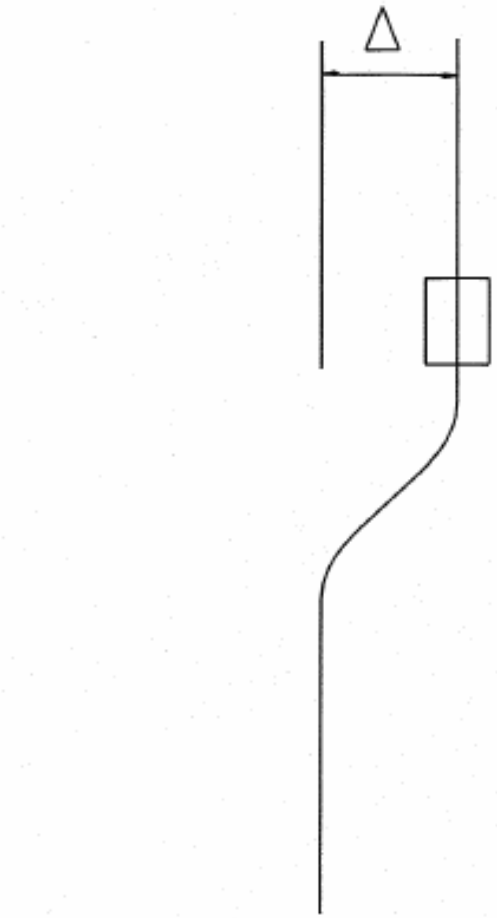
Design Methods

- Equivalent cantilever model, hand calcalation - Greimann et al. 1987, Iowa State University
- Equivalent column model, COM624P software - Wasserman 2001

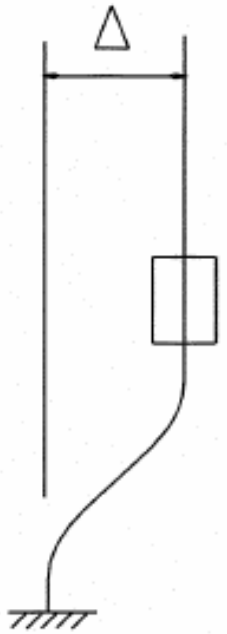
Equivalent Pile Cantilever Model

- *Final Report HR-273 and Addendum to HR-273* – Greimann et al. 1987
- Alternate one - elastic behavior for shorter spans
- Alternate two – plastic behavior for longer spans
- Step by step hand solutions

Fixed-Head Condition

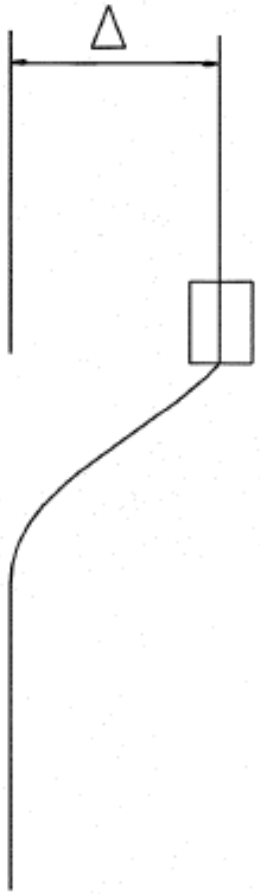


Actual System

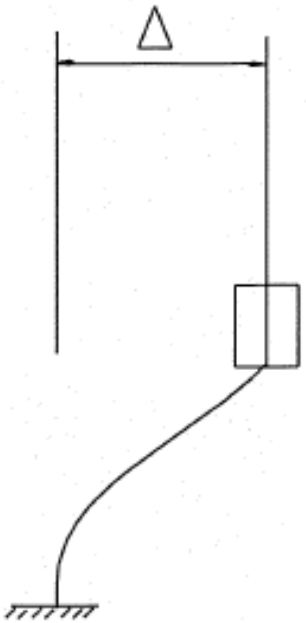


Equivalent Cantilever

Pinned-Head Condition



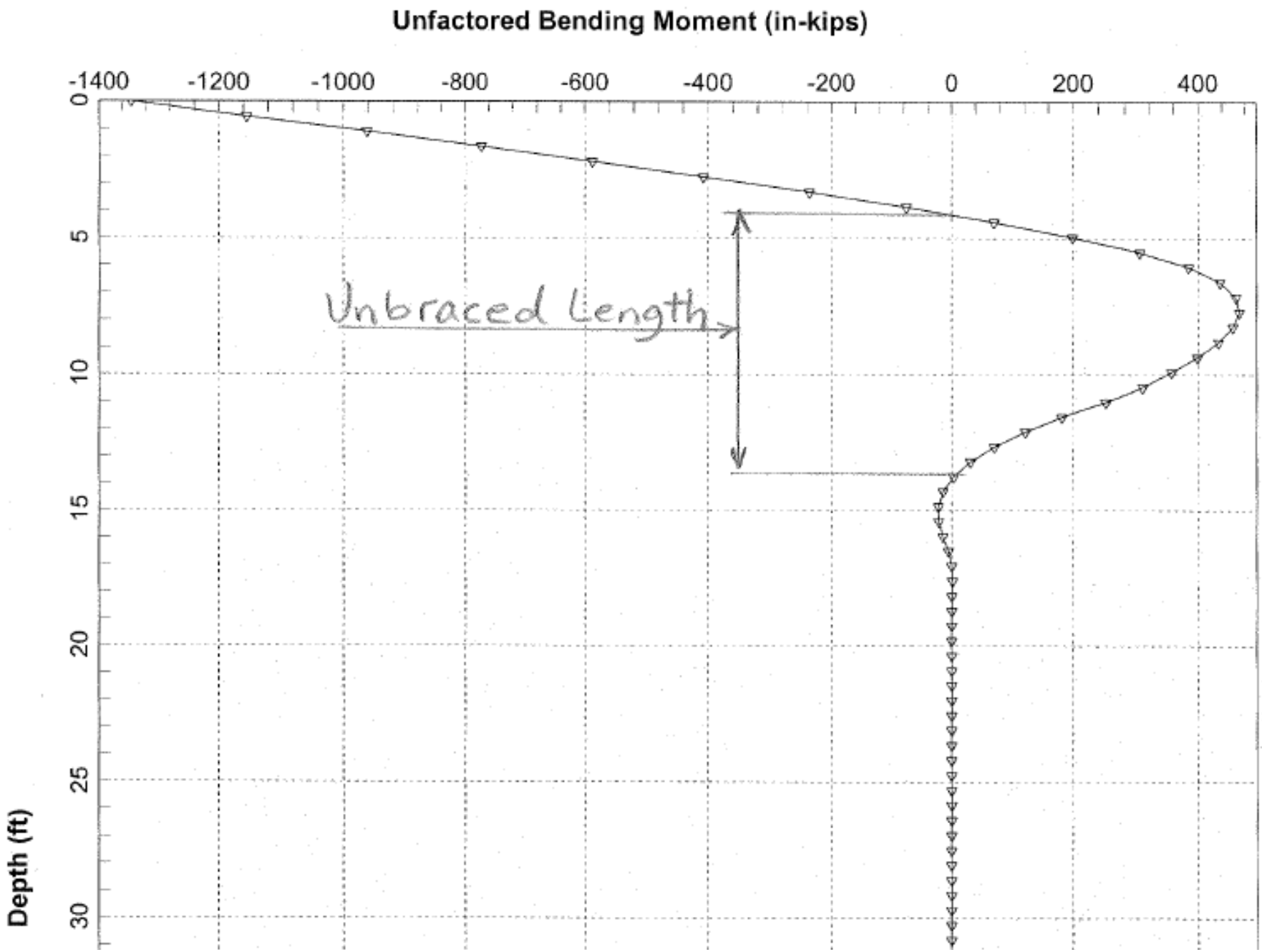
Actual System



Equivalent Cantilever

DESIGN PROCEDURE
Equivalent Column Model

- Wasserman and Walker 1996, Wasserman 2001
- COM624P software to determine points of inflection
- Pile between those points treated as a column subject to buckling
- Pile checked with usual column procedure


Unfactored Bending Moment (in-kips)
-1400
-1200
-1000
-800
-600
-400
-200
0
200
400
Depth (ft)
0
5
10
15
20
25
30
Unbraced Length

H-Pile with CMP (Iowa)

Stabbed H-Pile (Iowa)

Stabbed H-Pile (Iowa)

Stabbed H-Pile (Iowa)

T-REX (Colorado)

T-REX (Colorado)

Foundations for Integral Abutments

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Questions?