Evaluation of Existing Dock Facilities for Allowable Loading

Facilities Engineering Seminar, April 24, 2019

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JACOBS®

AAPA American Association of Port Authorities

Alliance of the Ports of Canada, the Caribbean, Latin America and the United States

Loadings on Marine Structures

UFC 4-152-01 Design: Piers and Wharves

UFC 4-159-03 Design: Moorings

ASCE 7 Minimum Design Loads for Buildings and Other Structures

ASCE 61-14 Seismic Design of Piers and Wharves

OCIMF

MOTEMS

Others

In Service Loadings

How well the load is defined

Do we know the structural details of the dock

Condition of the dock structure

Deciding when too much is too much

Crane Request Program

Not Daily Operation

Truck Mounted Cranes

Small Independent Operators

Propping Load Calculations (?)

Minimum Size Outrigger Pad

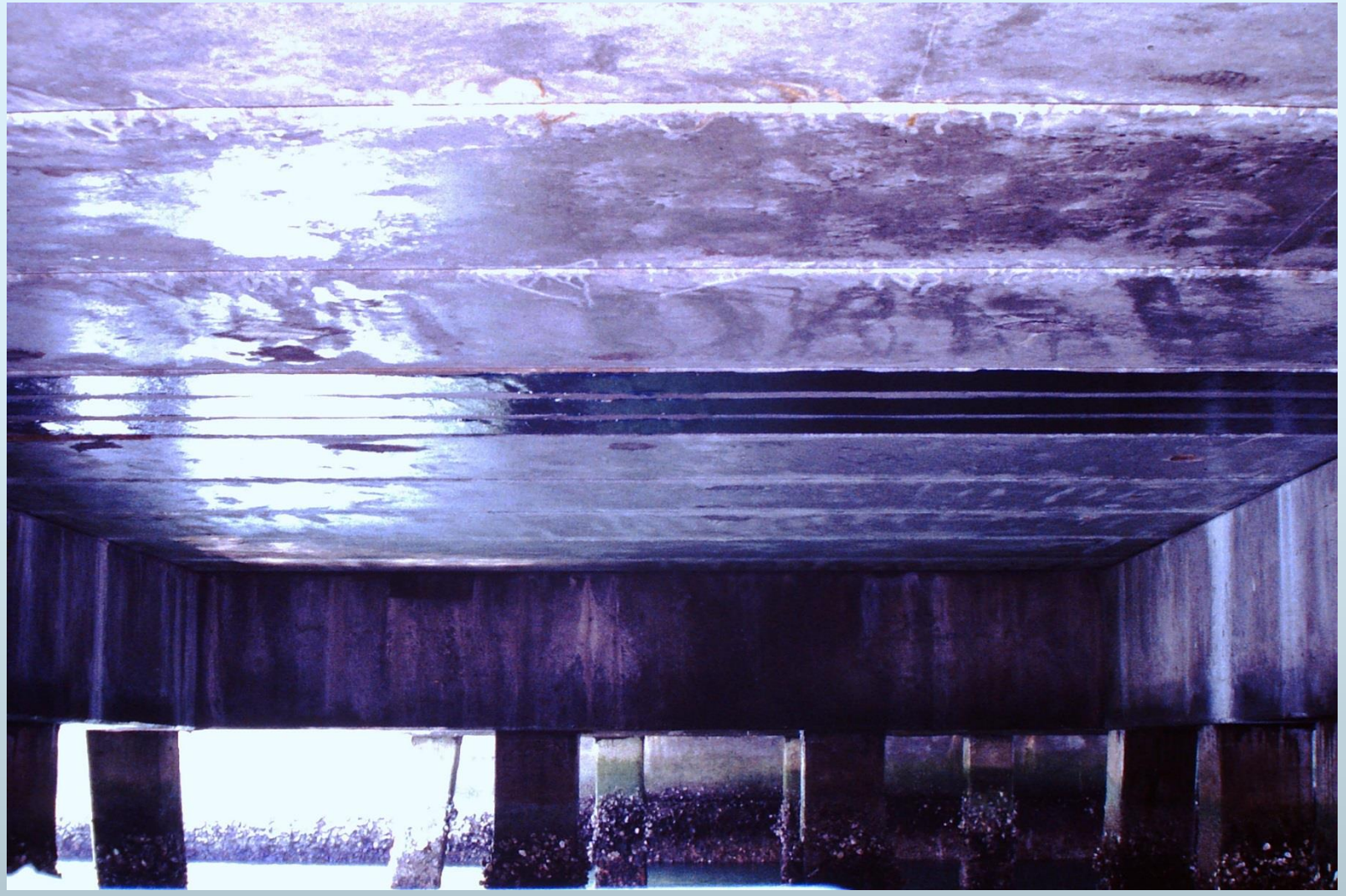
Evaluation needed ASAP

Damage to Open Pile Wharf Deck

Underside of prestressed concrete deck units

No topside damage

CFRP Strips in service since 1998



Crane Request Form

For CPA use only:
R# _____

Canaveral Port Authority
Crane Data Sheet

New CR# _____
Prior CR Approval# _____

Crane Data must be provided by the crane operator or crane manufacture *48 Hours* prior to crane setup. It is the shipping agents responsibility to get this information to the port authority.

*** If crane is required to set up/tear down 24hrs before or after lift, it must be approved by Harbormaster.**

Set up Date/Time:_____ Operation Date/Time:_____ Tear Down Date /Time:_____

Ship Name:_____ Pier to be used:_____

Crane location on Pier (provide *sketch/drawing*):_____

Items to be lifted:_____

Make of Crane & Model No:_____

Gross Vehicle Weight:_____ Load Block Weight:_____

Counter Weight:_____

Outrigger Base Weight:_____ Outrigger Base Size:_____x_____x_____

Outrigger Pad Weight:_____ Outrigger Pad Size:_____x_____x_____

Type of Pad Material: Steel or Wood or _____

Number of Outriggers:_____

Load to be lifted:_____

Total Weight on Pier:_____

Center Line Distance between Outriggers:
Longitudinal_____(provide sketch) Transverse_____(provide sketch)

Maximum Outrigger Load:_____(provide backup calculations)

Number of Axles:_____Axle Load:_____Axle Spacing:_____
Axle Loads include Counter Weight: YES or NO _____

Crane Company: _____ Phone: _____
Submitted by: _____ Phone: _____
Operator on dock: _____ Phone: _____
**** (Operator must have CR and Restrictions present at time of lift)**
24hr Emergency Contact: _____ Phone: _____
Received by Harbormaster: _____ Date: _____ Time: _____
Comments:

rev. 1/03/19

Crane Request Form

Outrigger Pad Weight: 4000 lbs Outrigger Pad Size: 8' x 12' x _____

Type of Pad Material: Steel or Wood or Steel

Number of Outriggers: 4

Load to be lifted: 100,000 lbs

Total Weight on Pier: 444,300 lbs

Center Line Distance between Outriggers:

Longitudinal 31'7" (provide sketch) Transverse 31'6" (provide sketch)

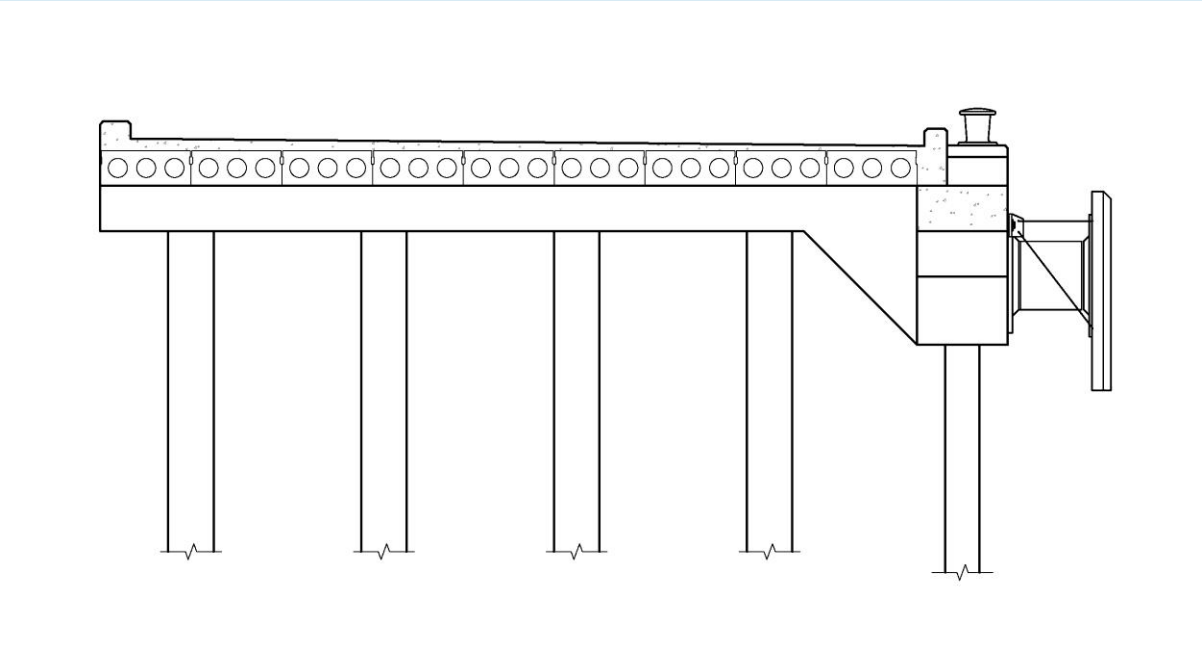
Maximum Outrigger Load: 222,752 lbs (provide backup calculations)

Number of Axles: 8 Axle Load: 26,500 lbs Axle Spacing: 4'11";5'1";6'7";4'11";7'10";4

Muti-Beam Deck

Open pile wharfs – 1970's thru 1990's

15 or 18 inch thick by 4 foot wide prestressed concrete deck units



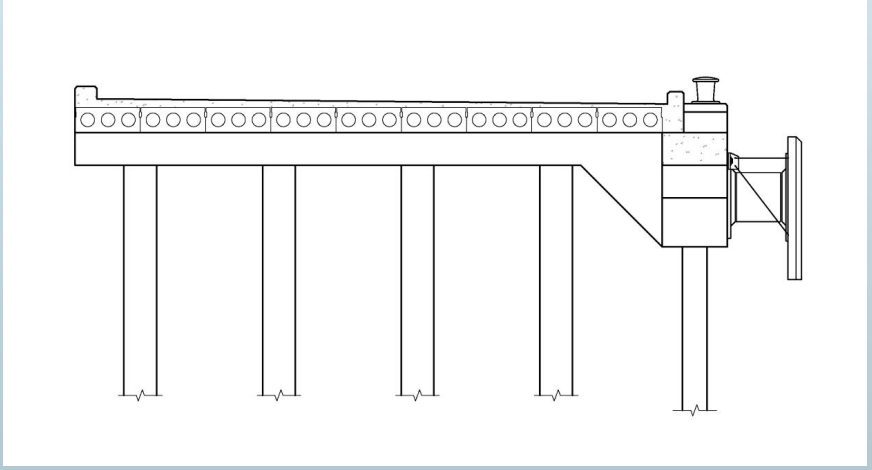
Muti-Beam Deck

CIP concrete topping: 3 to 9 inches thick

Pile cap spacing ranged from 20 to 30 feet on center

Post tensioned together at mid-span or third points

Load sharing among deck units?



AASHTO

Load Distribution Factor

Simple equation based on number of lanes of traffic.

Apply to multi-axle cranes and outrigger pad loads?

What was the basis for the equation?

$$\text{Load Fraction} = \frac{S}{D} \qquad (3\text{-}11)$$

where

$$S = \frac{12N_L + 9}{N_g} \qquad (3\text{-}12)$$

$$D = 5 + \frac{N_L}{10} + \left(3 - \frac{2N_L}{7}\right)\left(1 - \frac{C}{3}\right)^2 \quad \text{when } C \leq 3 \qquad (3\text{-}13)$$

$$D = 5 + \frac{N_L}{10} \quad \text{when } C > 3 \qquad (3\text{-}14)$$

N_L = total number of traffic lanes from Article 3.6
N_g = number of longitudinal beams
C = $K(W/L)$, a stiffness parameter
W = overall width of bridge
L = span length in feet

VALUES OF K TO BE USED IN C = K(W/L)

Bridge Type	Beam Type and Deck Material	K
Multi-beam	Non-voided rectangular beams	0.7
	Rectangular beams with circular voids	0.8
	Box section beams	1.0
	Channel beams	2.2

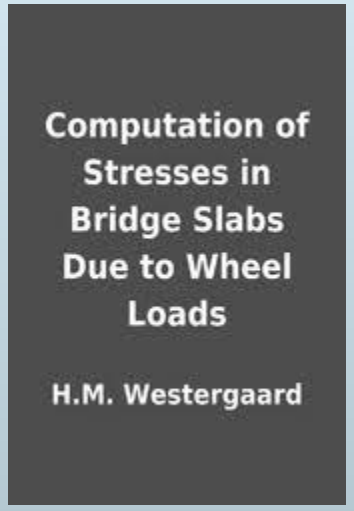
H. M. Westergaard

Computation of Stresses in Bridge Slabs Due to Wheel Loads

Public Roads, March 1930

University of Illinois

The United States Bureau of Public Roads

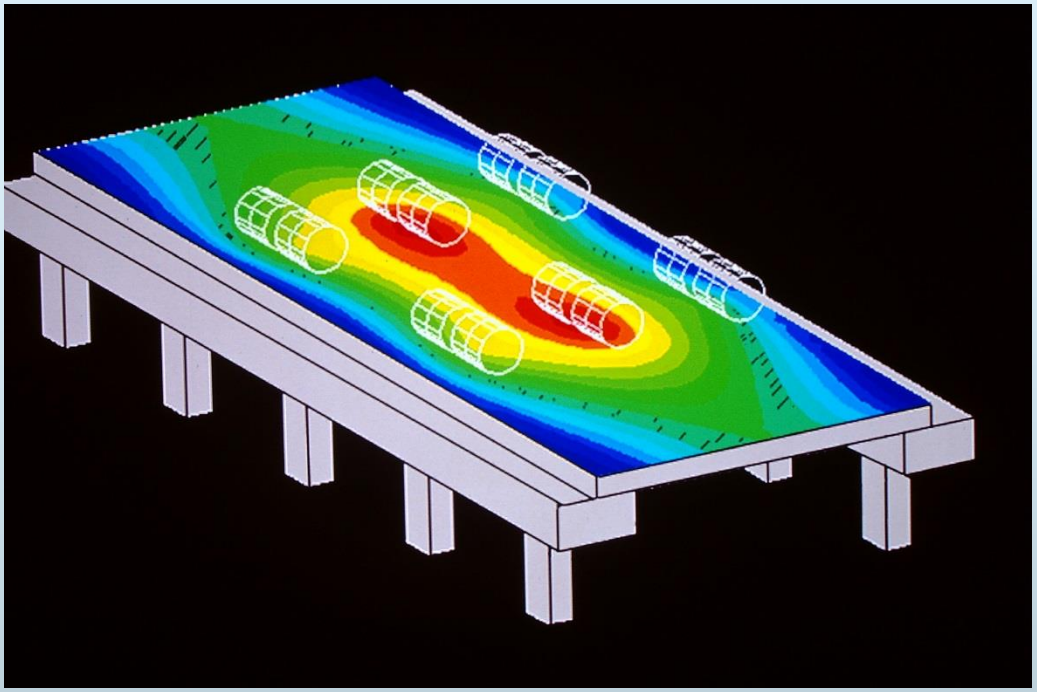


Load Distribution in Multi-Beam Deck

Finite Element Model

Good Agreement with the AASHTO Distribution Factor

No evidence of longitudinal cracking in the topping



Truck Crane Loads

Continue to use the DF

Require maximum loaded outrigger pad be located over a pile cap

Avoid trench drains, etc.

No further damage since 2001

Bulkhead Walls

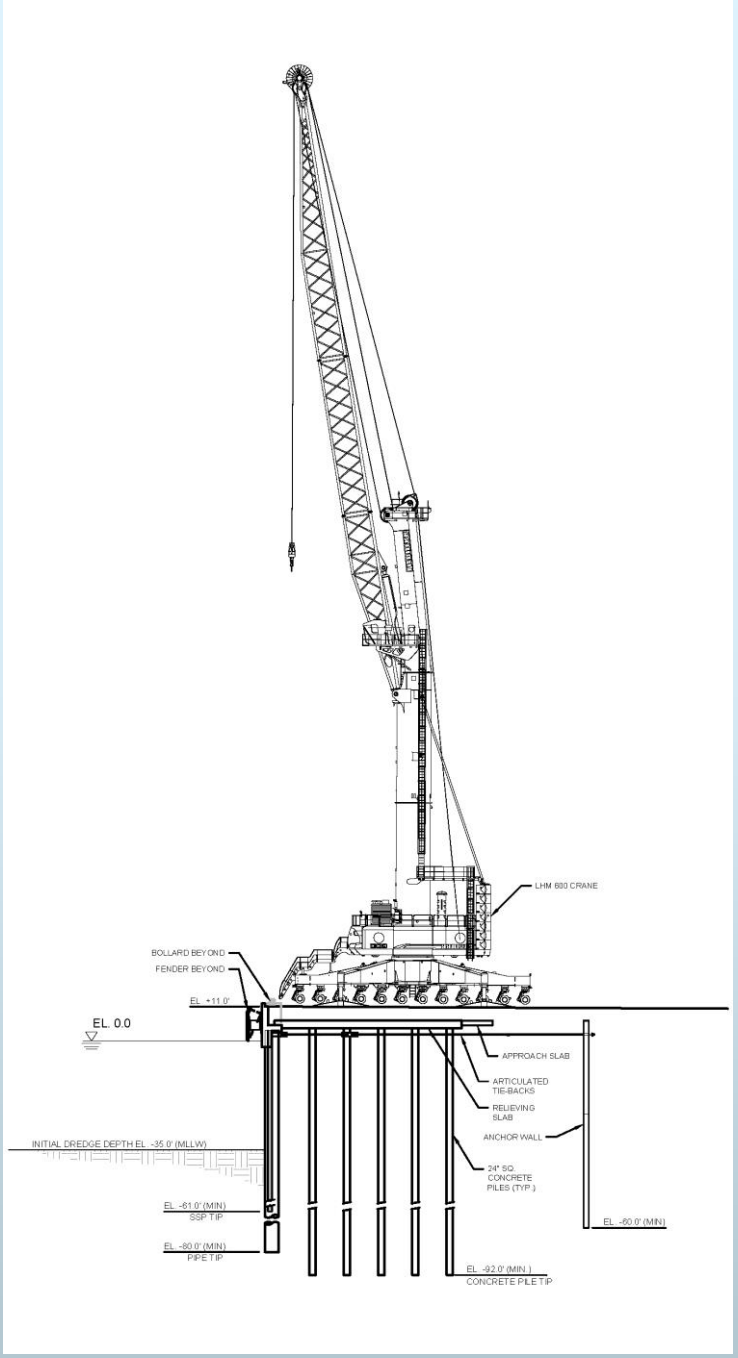
Without Relieving Platforms

Truck Mounted Crane Position

Failure Wedge

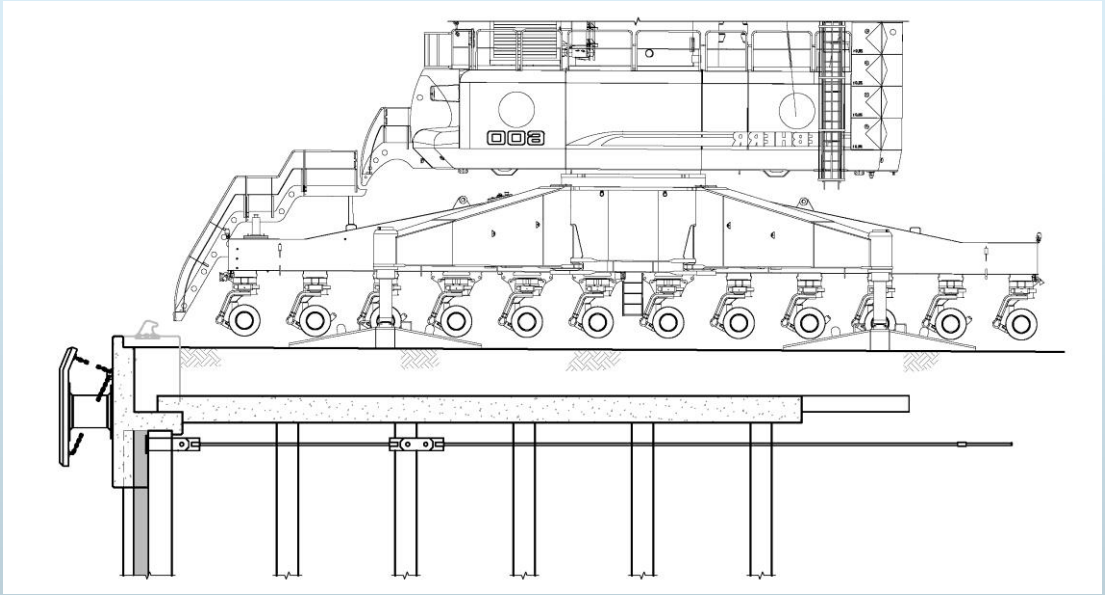
Classical Analysis Methods

No Go



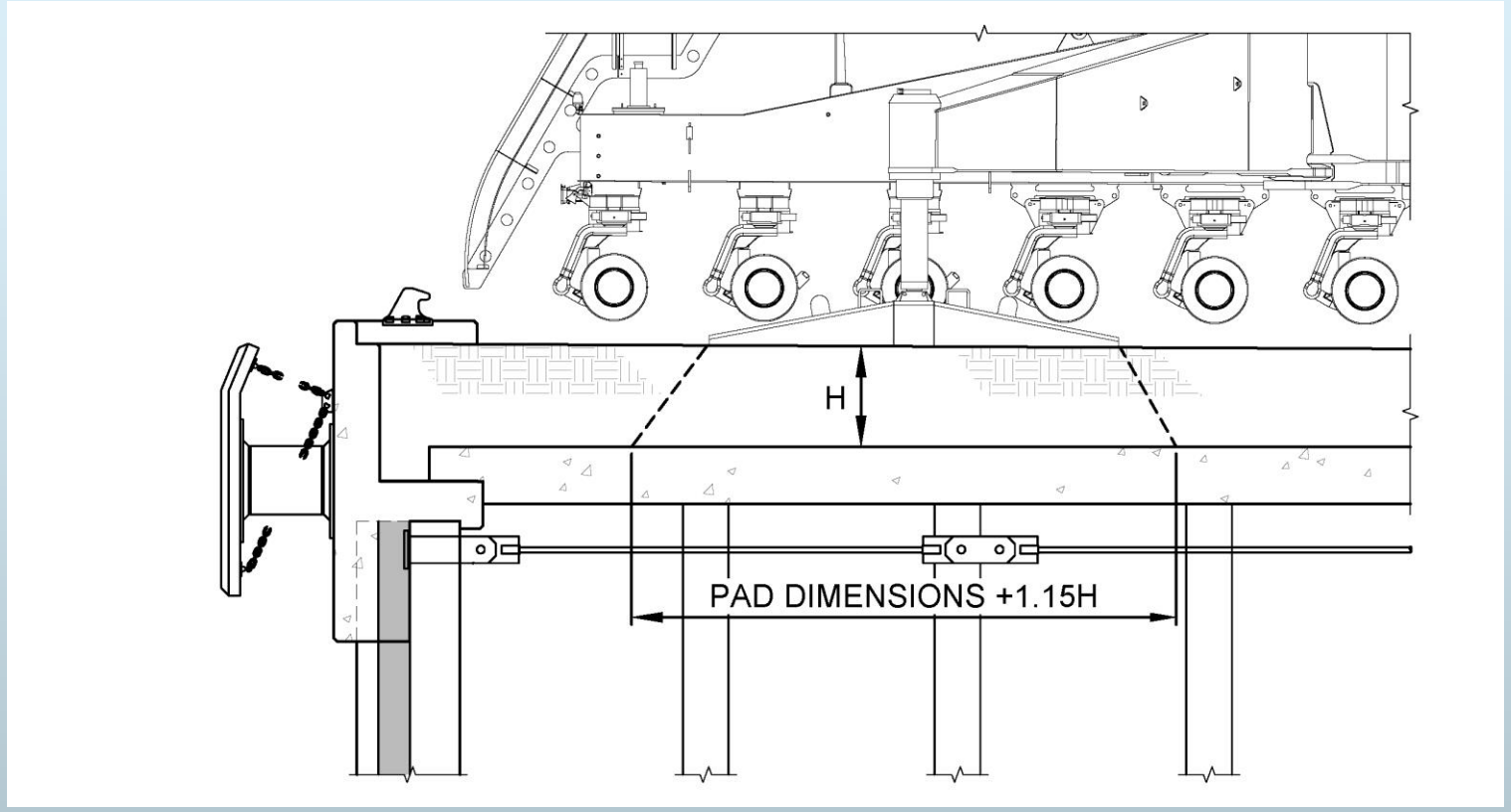
Bulkhead Walls with Relieving Platforms

Mobile Harbor Cranes



AASHTO Guidance

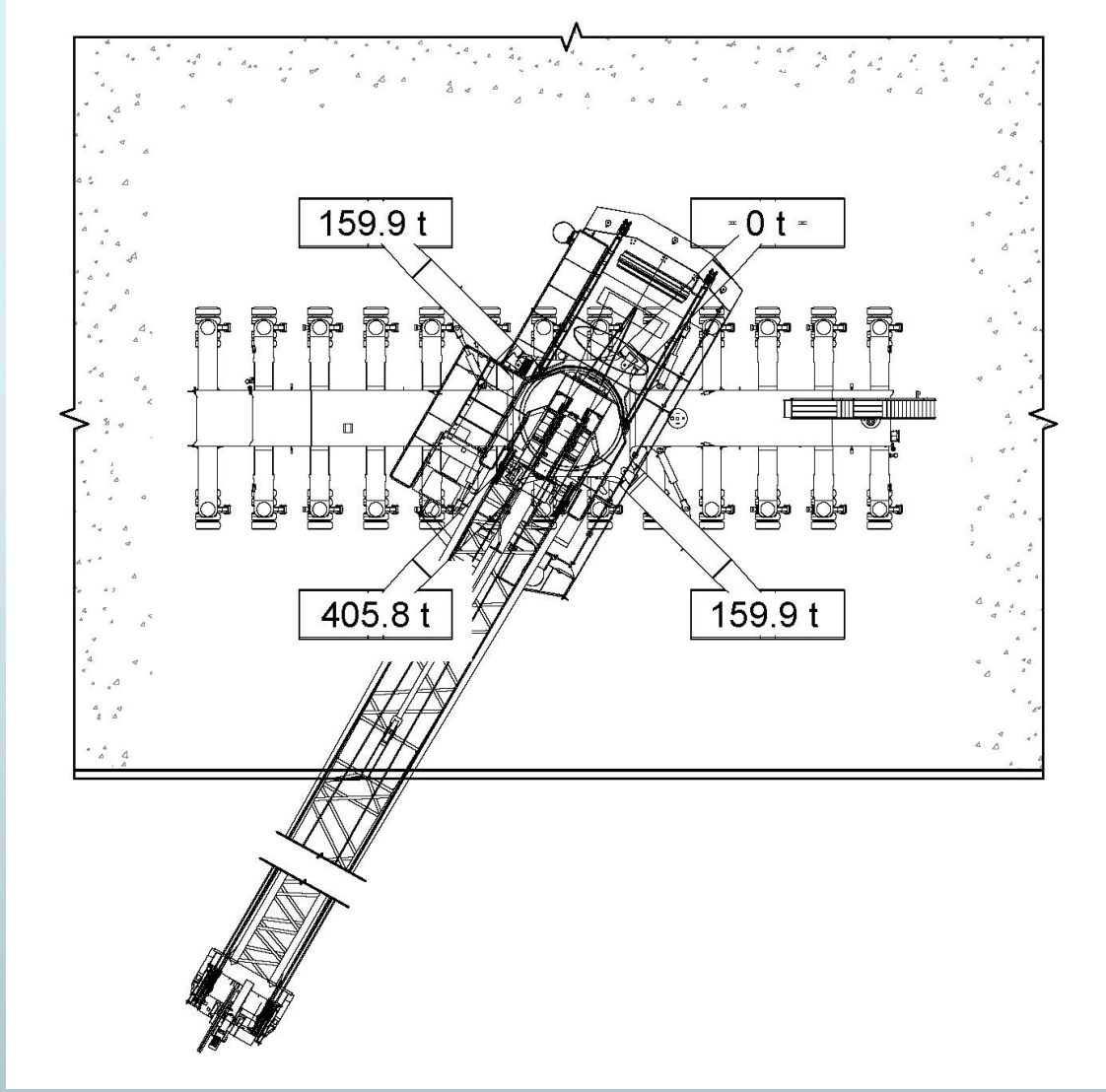
Add to width and length of pad dimensions 15% times the depth to the top of the relieving platform



Maximum Propping Load

Safety factor on tipping load?

Not if it includes dynamic and wind effects



Heavy Cargo Loads

Unusual Loads

Unusual Loads

Redistribution of Dead Load

Evaluation of Allowable Loads

How well the load is defined

Do we know the structural details of the dock

Condition of the dock structure

Deciding when too much is too much

Reoccurring events – formal evaluation procedure

Authority to enforce the results of the evaluation

Mitigate Risk

Thank You