Bridge College

BRIDGE 101

General Session

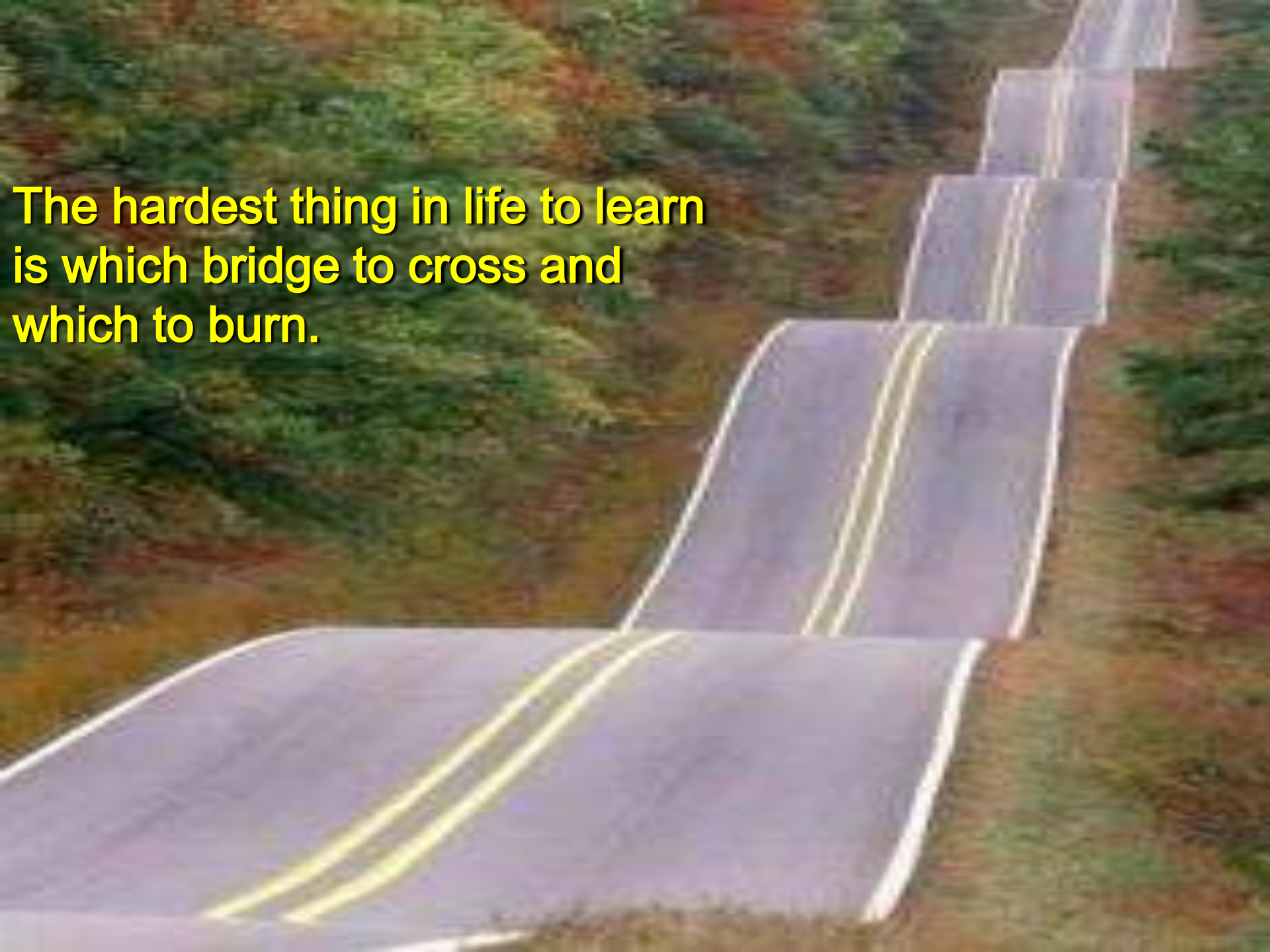
Bridge Types & Nomenclature

Overview

- Definition of a Bridge & Minor Span
- Who owns/maintains the bridges
- Who inspects the bridges
- Bridge types & nomenclature
- What to look for

Breakout Sessions

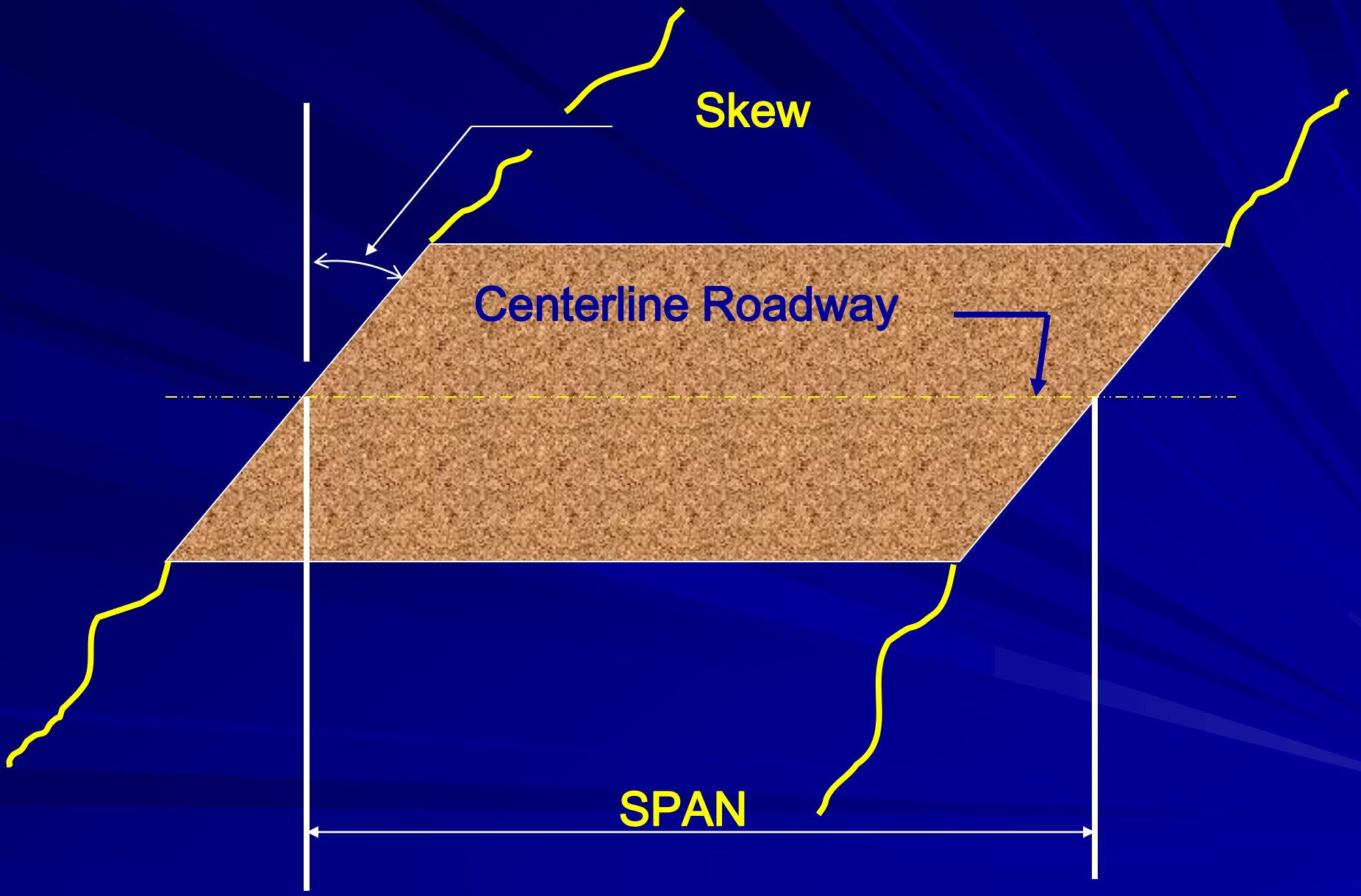
- Bridge Preservation Techniques
- Bearings and Beam Ends
- Reinforcing Steel
- Wearing Surface Maintenance
- Bridge Rail
- Bridge Joints


The hardest thing in life to learn
is which bridge to cross and
which to burn.

What is a Bridge?

- Federal definition – A structure that provides passage on a public way that is 20 feet in span or longer measured along the centerline.

- State definition – A structure that provides passage on a public way that is 10 feet or greater in span measured along the centerline. Structures 10 feet to less than 20 feet are referred to as minor spans while structures 20 feet or greater are referred to as bridges.


Skew
Centerline Roadway
SPAN

Who Owns and Maintains these Bridges?

- MaineDOT owns and maintains all bridges and minor spans on state and state aide highways.
- MaineDOT owns and maintains all bridges on the local network that are not Low Use or Redundant Bridges (LURB). Check with the Region Management staff if you're not sure of ownership.
- These bridges will require you to travel on local roadways that you normally wouldn't travel.
- Municipalities own and maintain all minor spans and LURBs on the local system.

Bridges & Minor Spans

Region	Number	%	Deck Area Million SF	%
1	565	20.7	3.81	31.3
2	572	21.0	3.06	25.0
3	630	23.0	1.43	11.8
4	624	22.9	2.58	21.2
5	338	12.4	1.30	10.7
Total	2729		12.18	

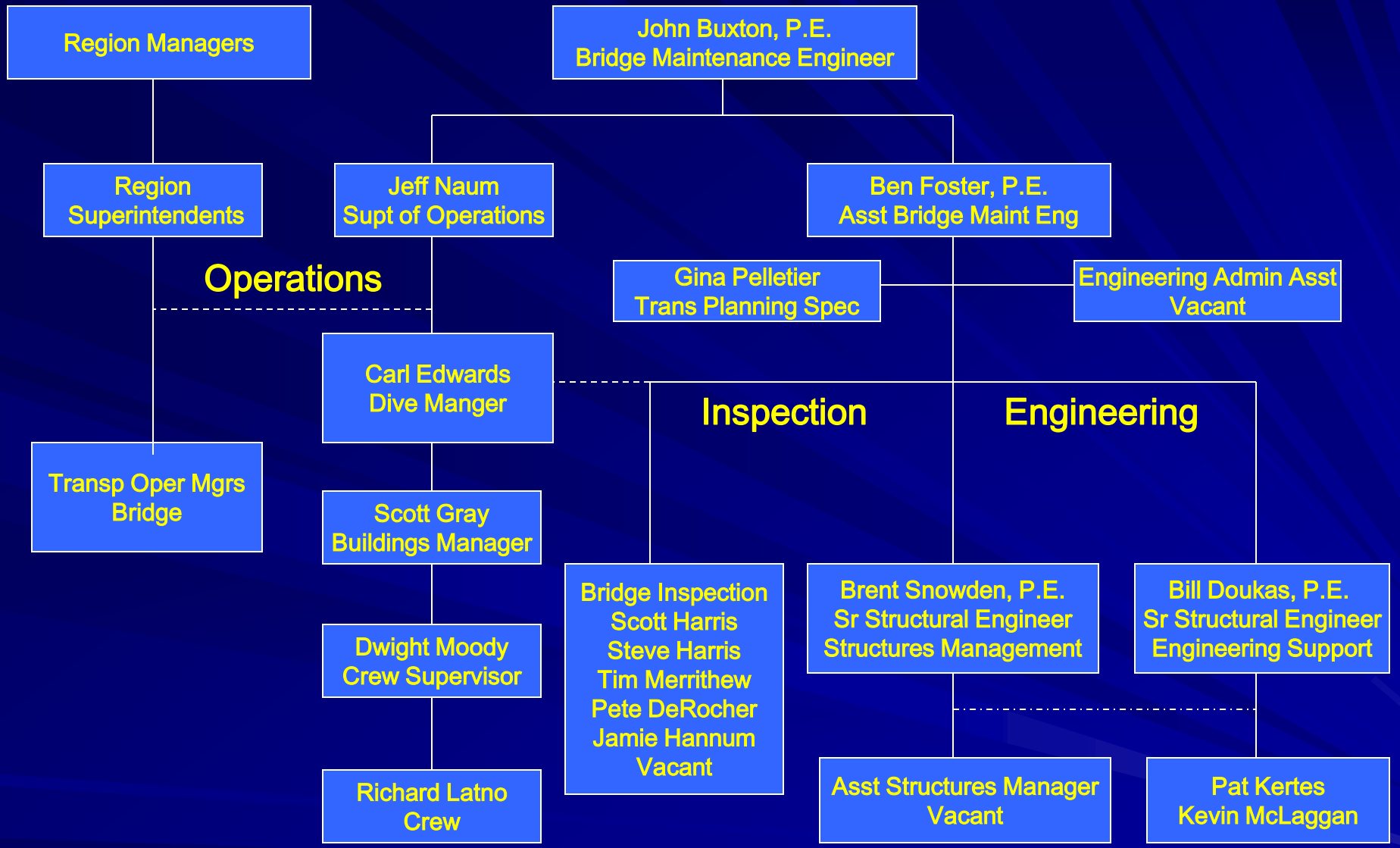
Total Bridges & Minor Spans

- 2395 Conventional Bridges
- 334 Metal Pipes
- 11 Ferry Transfer Bridges
- 8 Movable Bridges
- 9 Covered Bridges
- 2 Suspension Bridges
- 220 Railroad Bridges

Bridges and Structures Maintenance Division

Who are they?

What do they do?



Bridges and Structures Maintenance Division

Bridges and Structures Maintenance

- Inspect
- Evaluate
- Rate
- Evaluate overloads
- Load test
- Document Management
- Work with municipalities
- Structural design
- Falsework design
- Field inspections
- Post & close bridges
- Evaluate accident damage
- Develop Work Plan
- Participants in Bridge Community

What does MaineDOT inspect?

- All minor spans and bridges on public ways are inspected by MaineDOT and the data for **bridges** only is submitted to the Federal Highway Administration annually. The Maine Turnpike Authority inspects their own bridges but MaineDOT submits the data to FHWA.

Bridge Inspection Program

- 6 Bridge inspectors statewide
- 2300± bridge inspections per year
- Generally bridges are inspected every 24 months
- Some bridges are inspected more frequently due in general to poor condition

MaineDOT Dive Team

- 140 underwater bridge inspections per year
- 6-8 Underwater grout projects
- Underwater inspections of ferry terminals
- Underwater construction inspection
- Environmental surveys


No Snappers!
No Snappers!
Please
No Snappers!


No its not…
its cold!
Diving is Cool

We Need Your Eyes

Call the Office!


For
Sale
02/14/2006
DailyCognition.com

Bridge Numbers

- All bridges and minor spans have a unique 4 digit number
- You must use all four digits

0456 = Yes 456 = No

Bridge Number

Dead Bridge Number

What are the different types of bridges?

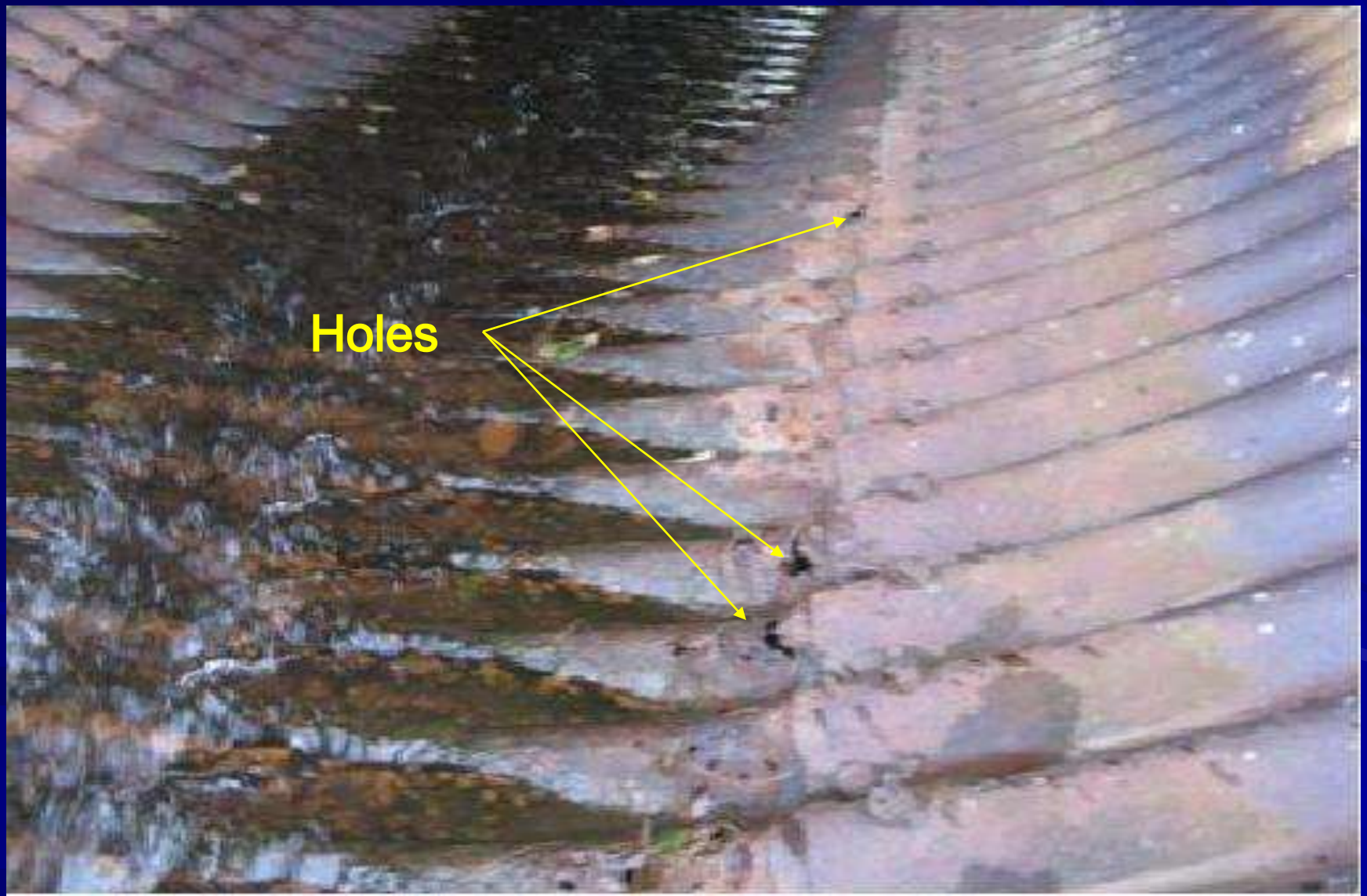
Minor Spans - General

- Metal Circular pipes
- Metal multiplate pipe arches
- Metal plate arches on footings
- Concrete boxes
- Precast concrete frames

Circular Aluminum Pipe

Galvanized Steel Pipe

Steel Pipe



Concrete Invert

Upstream Plates Folded

Aluminum Multiplate Pipe Arch

Aluminum Box

Hey…That doesn't look right!

$200,000 Later

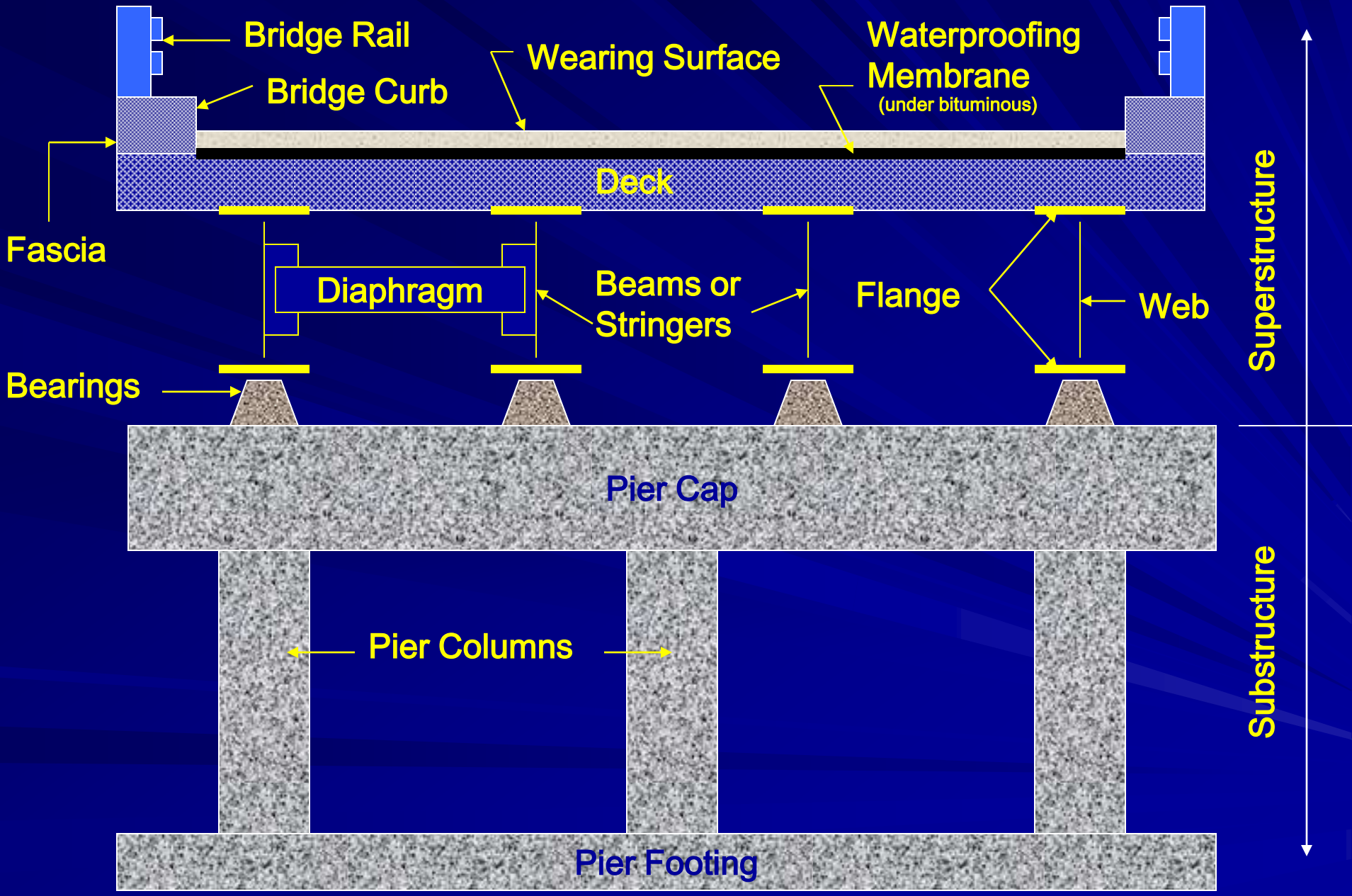
Plate Arch on Concrete Footings

Plate Arch on Concrete Footing

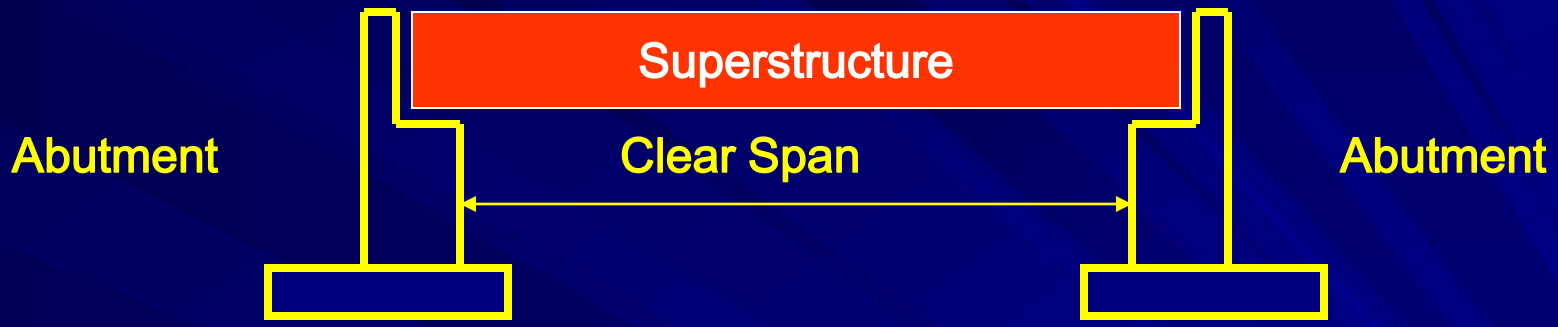
Precast Frame/Arch

Precast Concrete is:
Concrete components which are cast and partly matured in a factory or on the site before being lifted into their final position on a structure.

Basic Bridge Anatomy

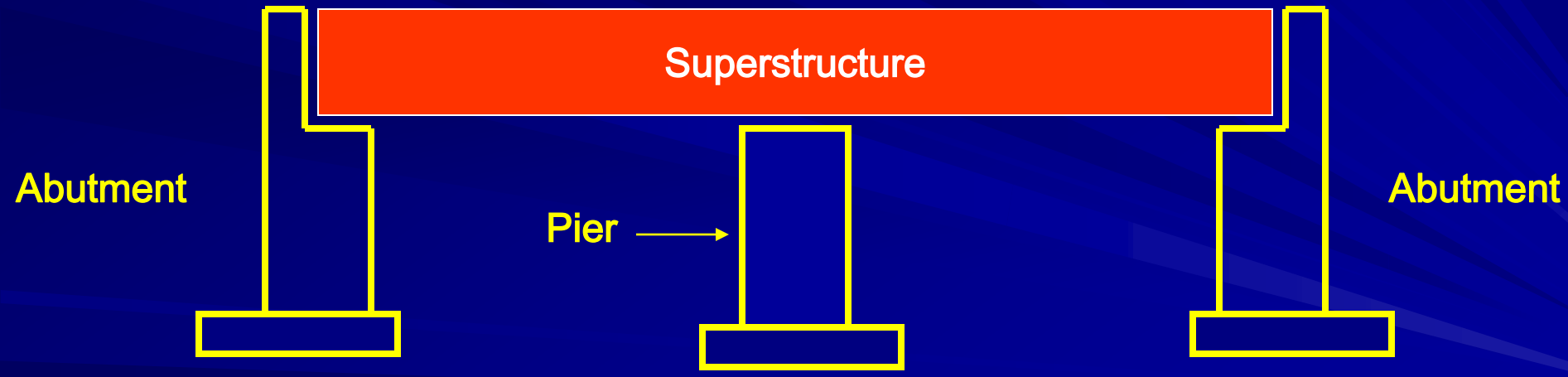


Every Bridge will have two and only two abutments



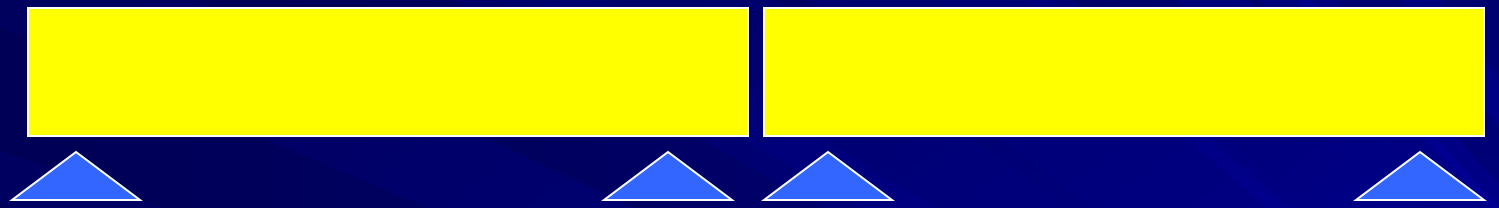
Single Span

A Multispan bridge may have one or many piers

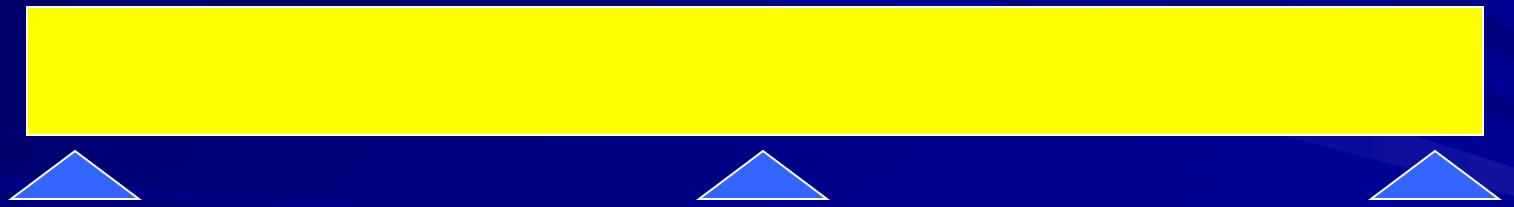


Multispan Bridge

Multispan Bridges



Simple Spans
(Two rows of bearings on a pier)



Continuous Spans
(One row of bearings on a pier)

Bridge Superstructures

Concrete Superstructures

- Direct span concrete slab
- Concrete rigid frames
- Concrete arches
- Precast prestressed voided slabs
- Precast prestressed butted box beams
- Precast segmental box beams
- Precast AASHTO Bulb-T
- Concrete T-Beams

Buried Slab-No Curb

Buried Slab


This is what happens
Spalling: *the word used for concrete that is chipping, flaking, or scaling damage along its surface.*

This is More Like It

Efflorescence

Arched Concrete Slab

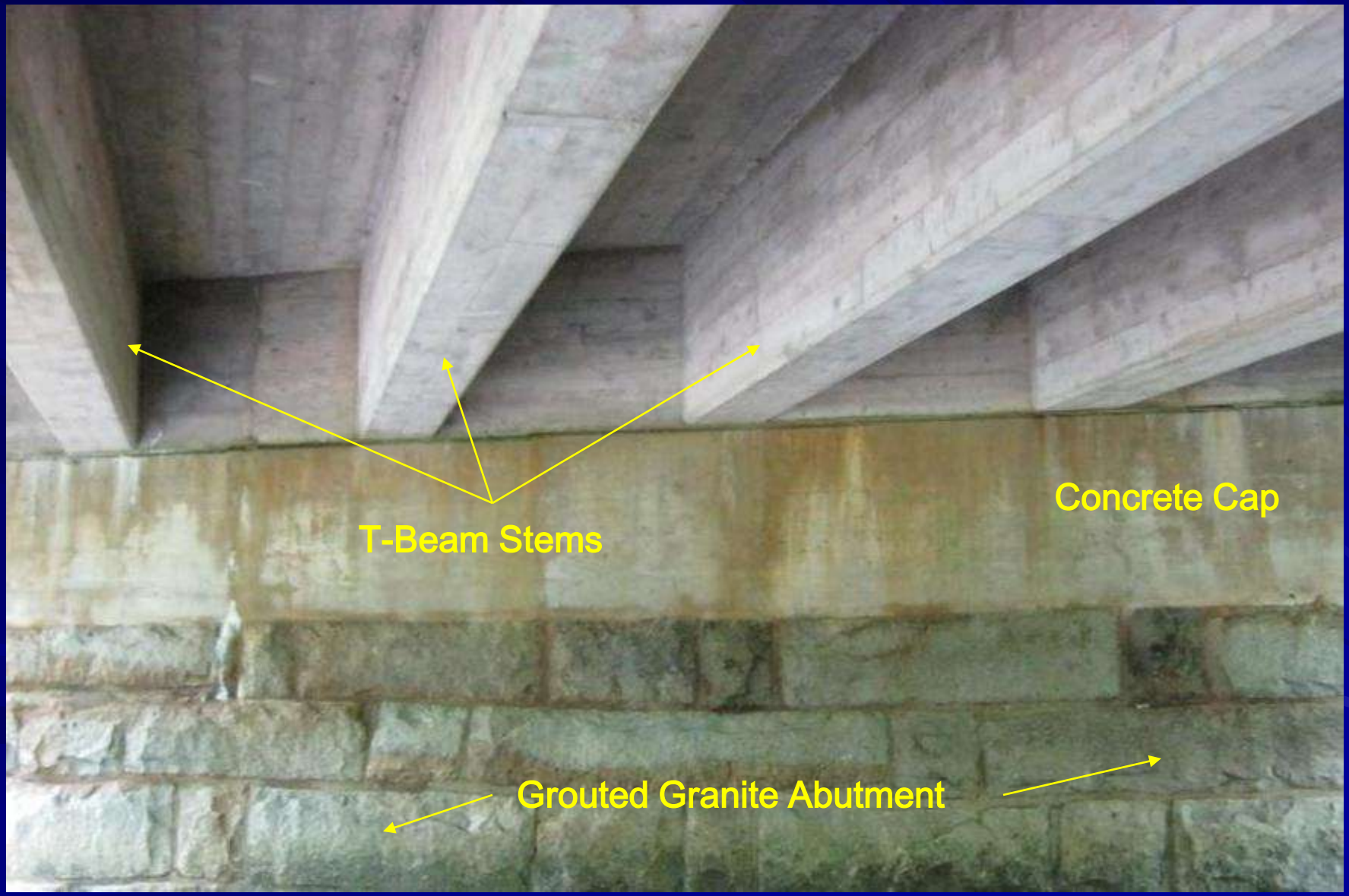
Concrete Rigid Frame

Slab

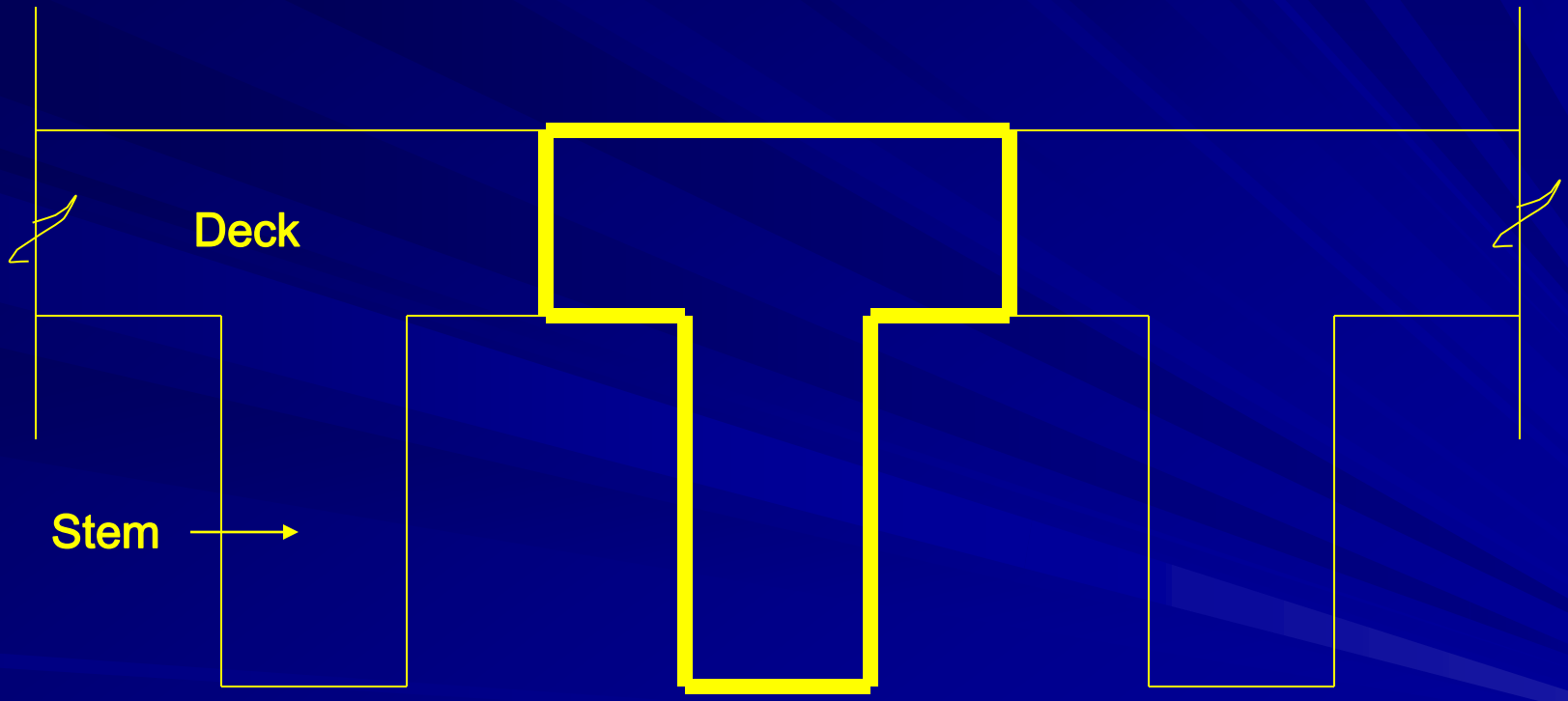
Rigid Frame

Filled Concrete Arch

Concrete T-Beam



Concrete T-Beam



Spall at Bridge Drain

What is prestressed concrete?

Concrete reinforced by either pretensioning or posttensioning, allowing it to carry a greater load or span a greater distance than ordinary reinforced concrete. In pretensioning, lengths of steel wire or cables are laid in the empty mold and stretched. The concrete is placed and allowed to set, and the cables are released, placing the concrete into compression as the steel shrinks back to its original length. In posttensioning, the steel in the concrete is stretched after the curing process. Prestressing places a concrete member in compression; these compressive stresses counteract the tensile bending stresses of an applied load.

Precast Prestressed Bridges

Rule #1

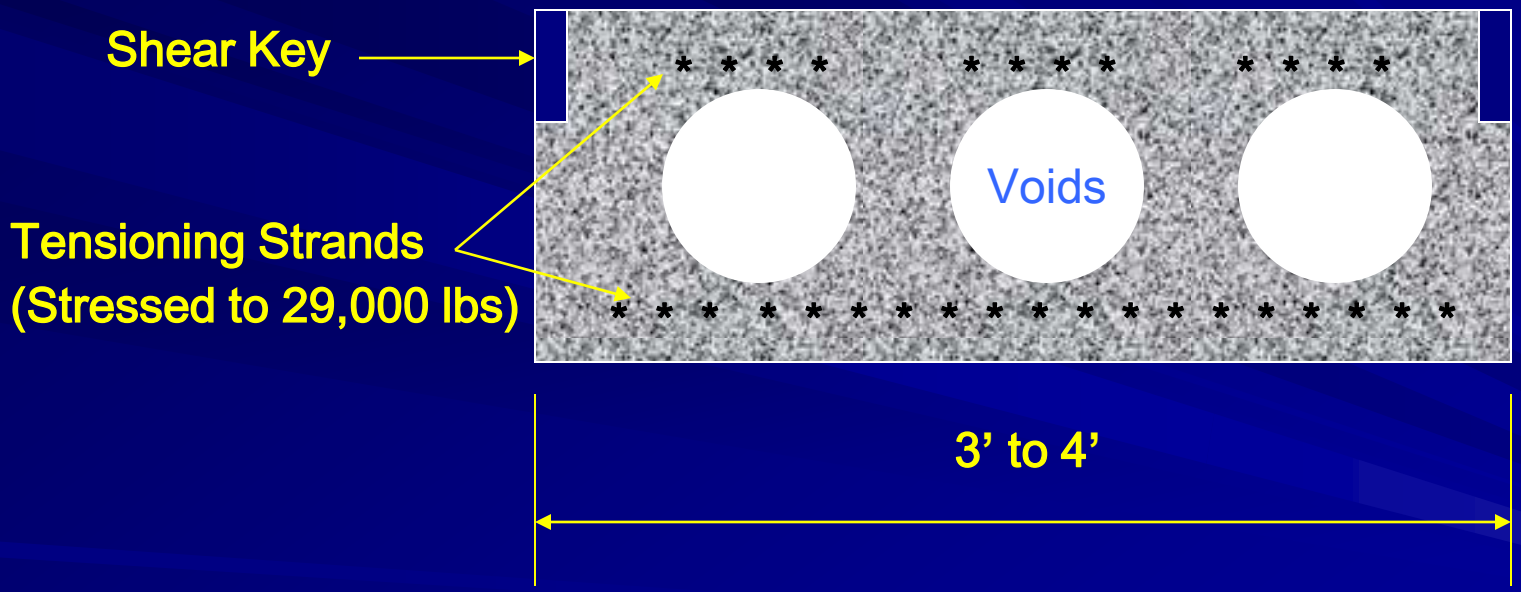
- Do not ever cut into any precast prestressed bridges or bridge elements without consulting a bridge engineer….evah!

Rule #2

- If you don’t follow Rule #1 there is no need for Rule #2

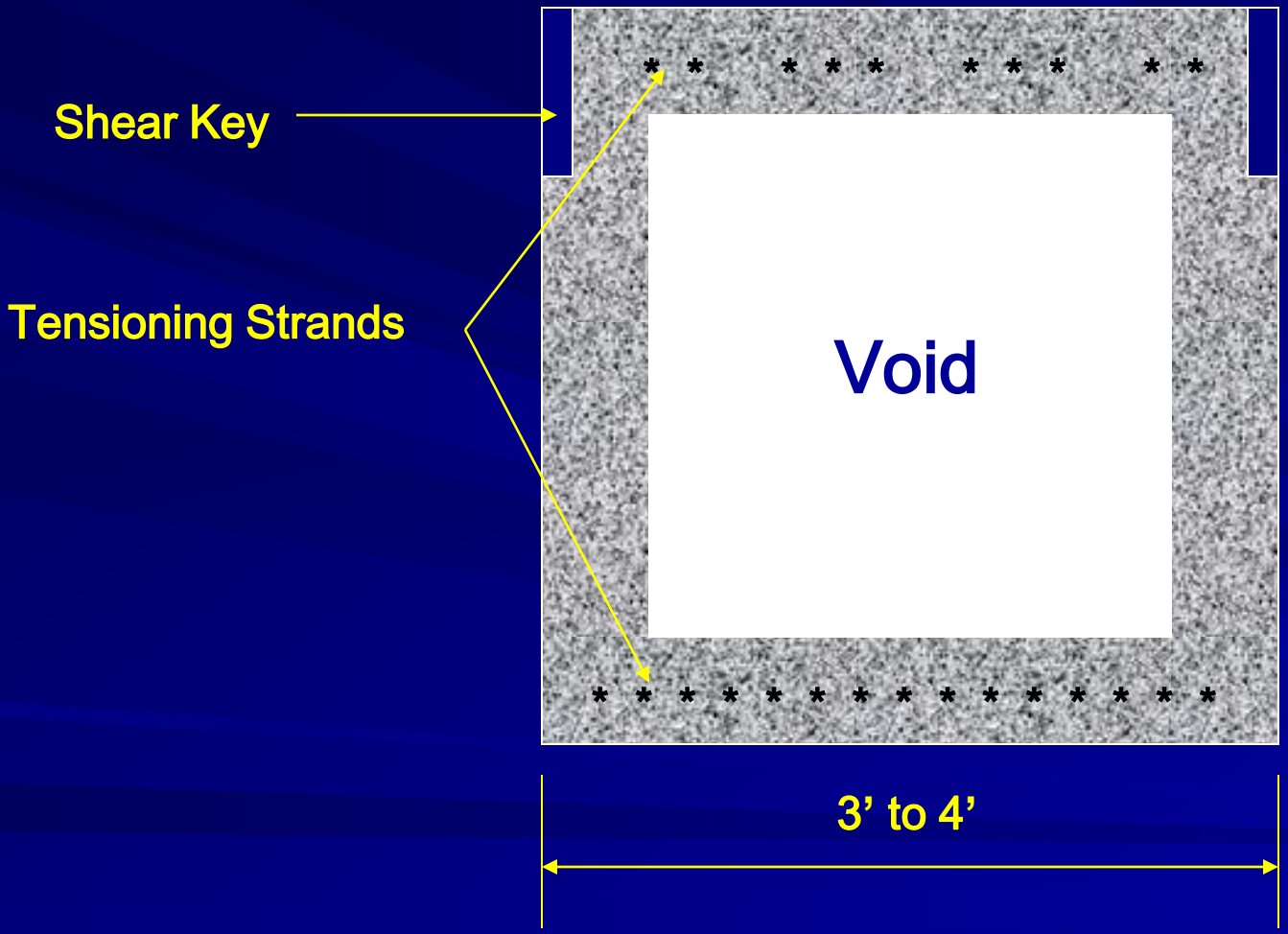
Voided Slabs

Voided Slab


Shear Key
Tensioning Strands
(Stressed to 29,000 lbs)
Voids
3’ to 4’

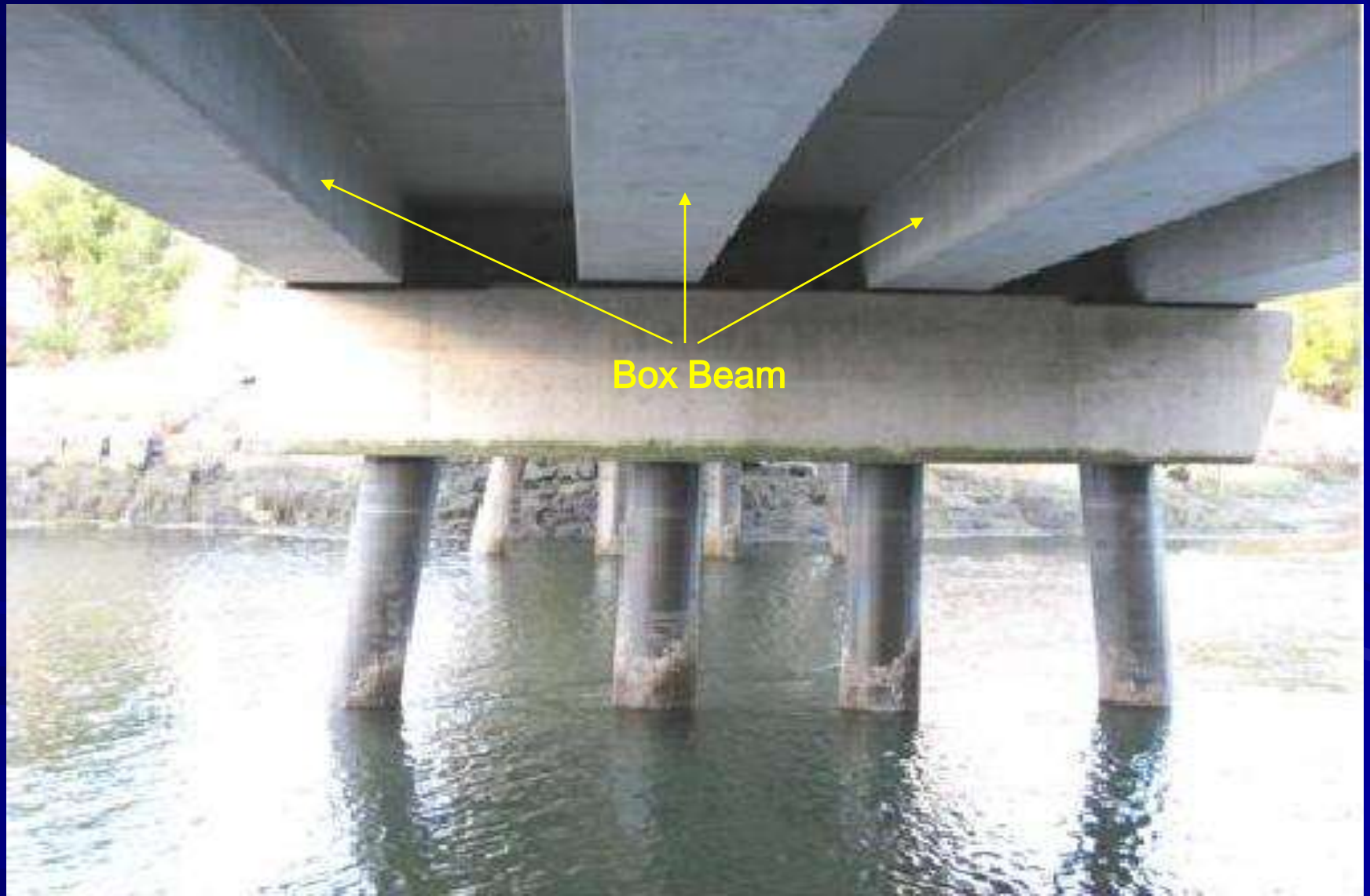
Cracks at Slab Joints

Voided Box Beam



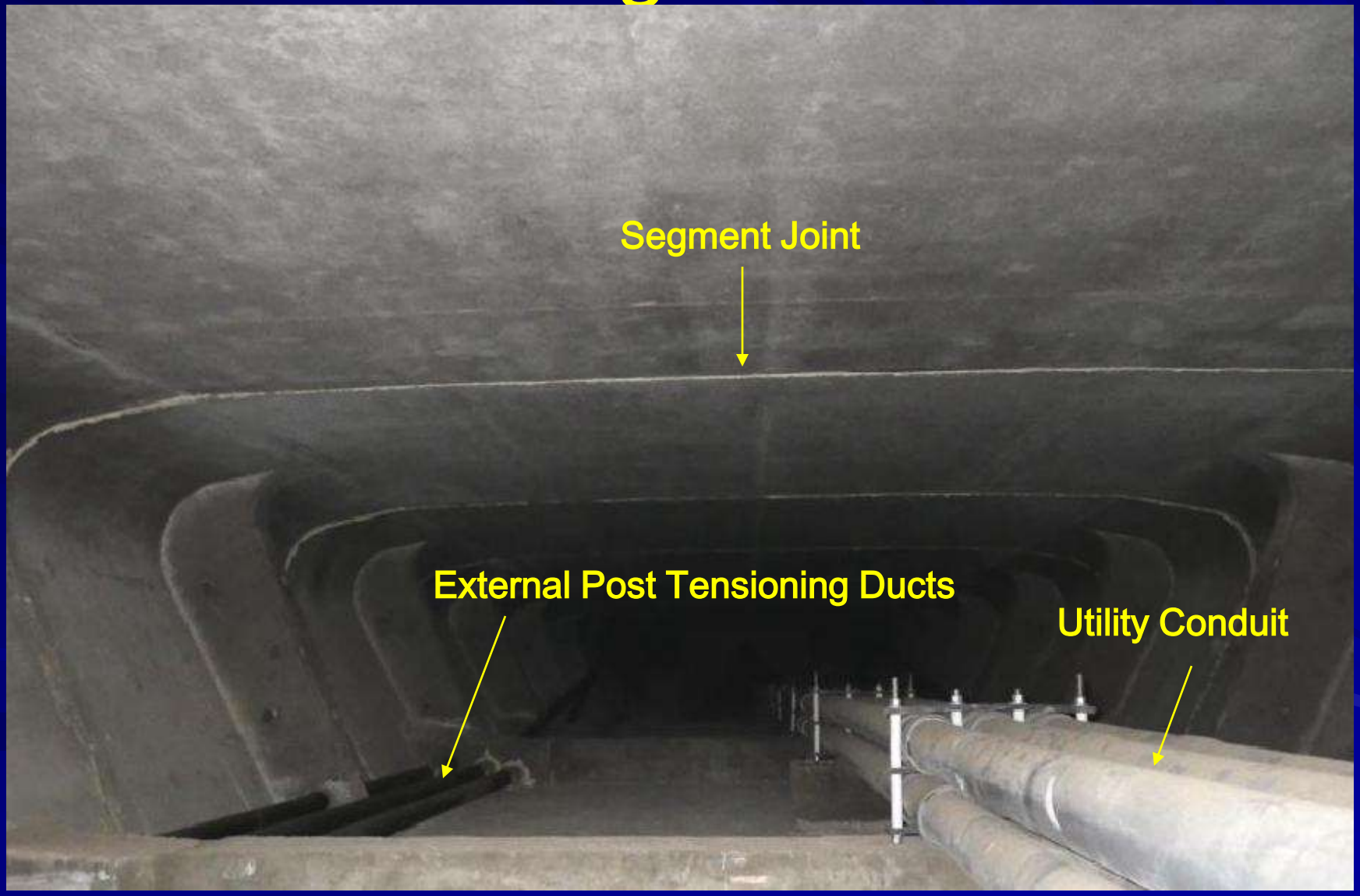
Butted Precast Box Beam

Prestressed Spread Box Beam



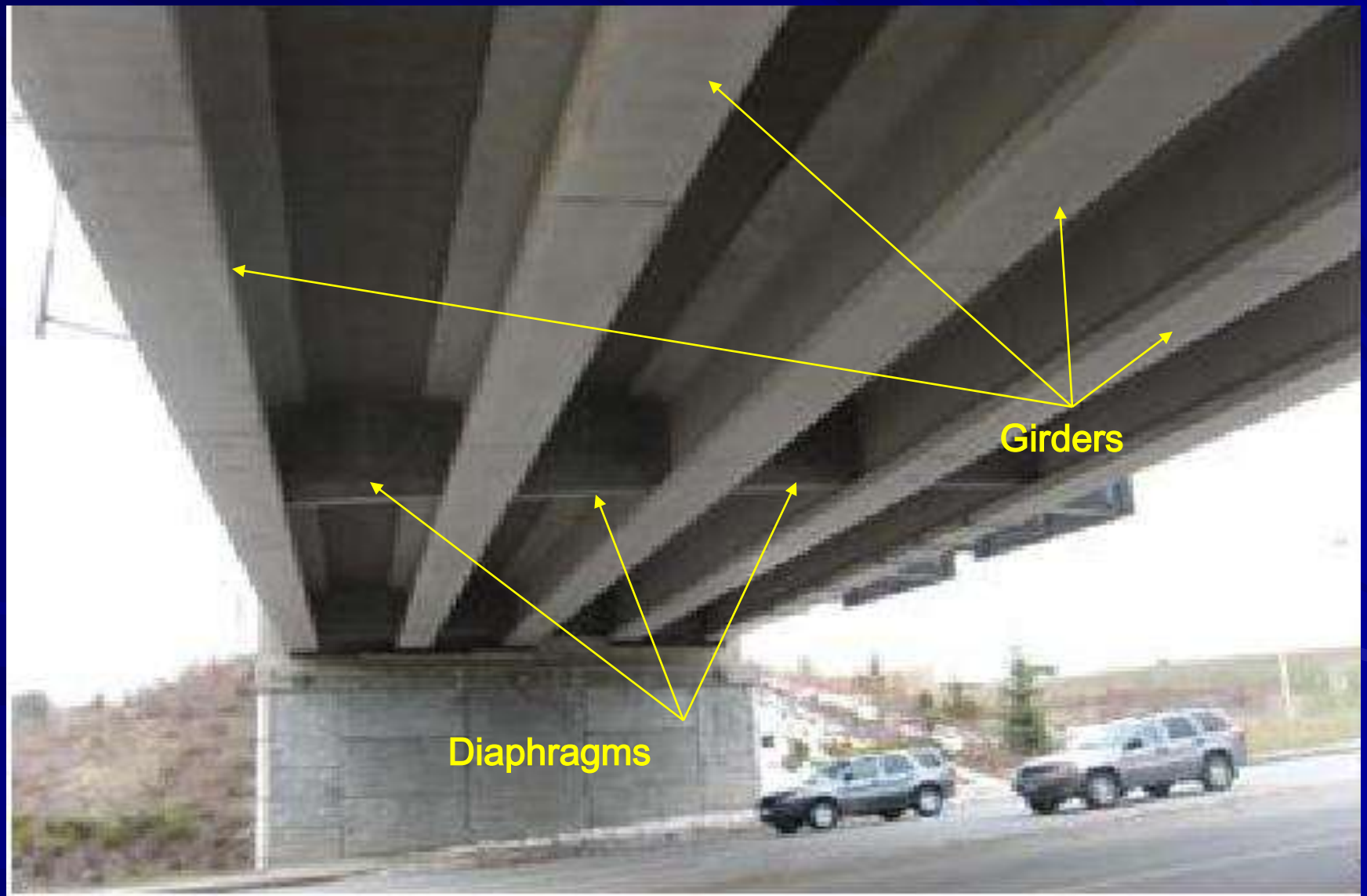
Segmental Concrete Box

Inside Segmental Box



Double Cell Segmental Box

Precast Bulb-T

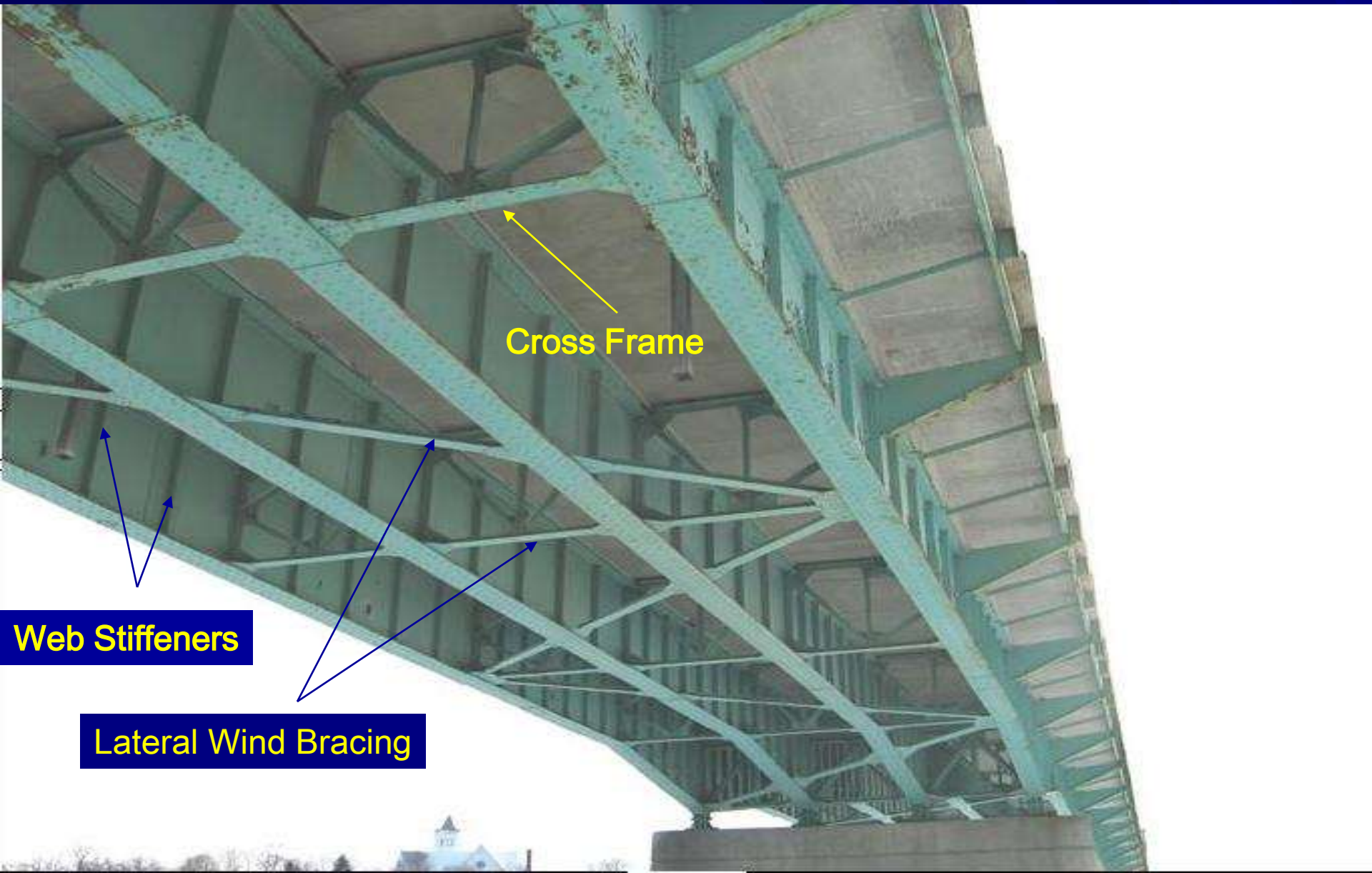


Steel Superstructures

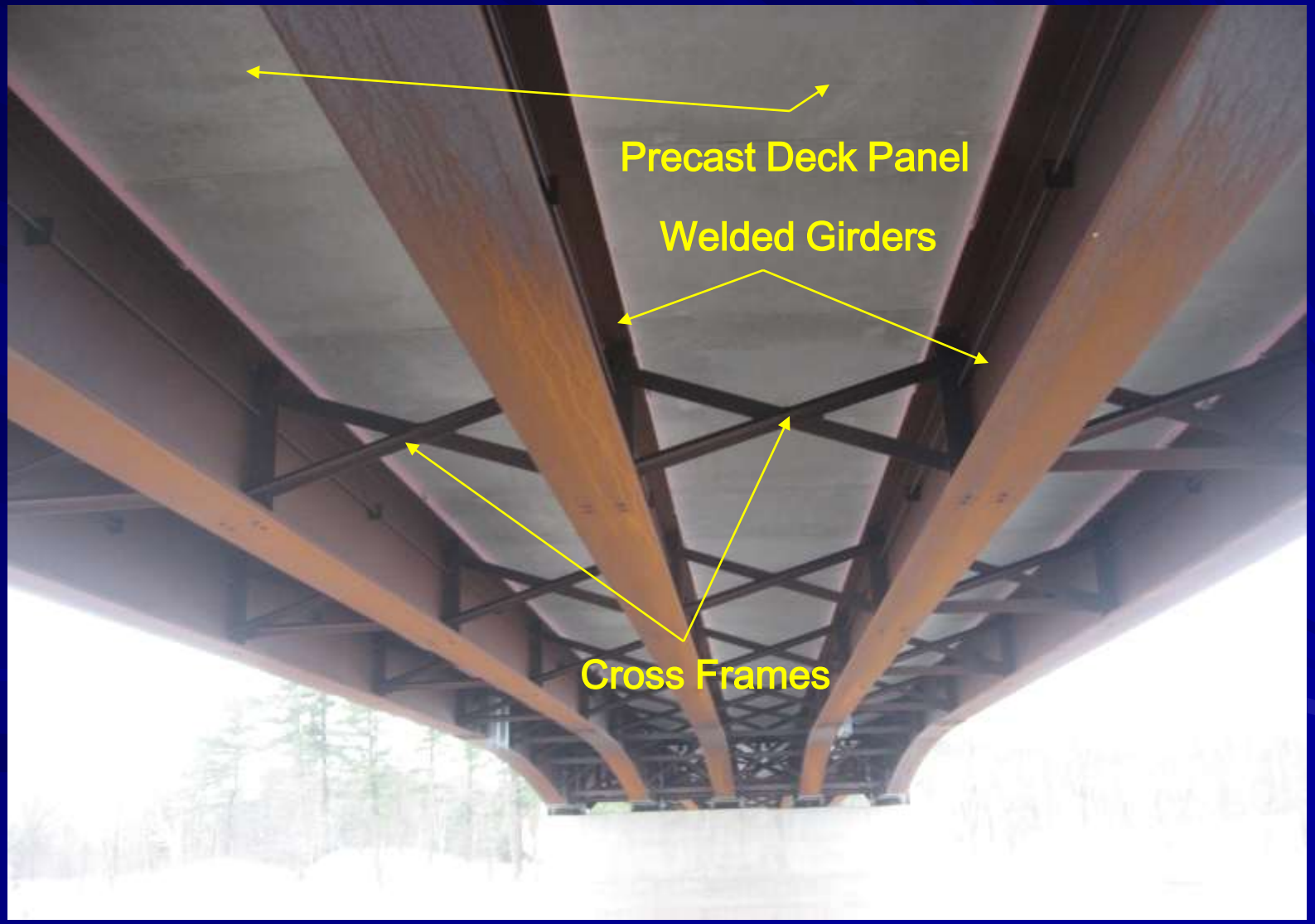
- Multi-beam I-beam or girder
- Thru girder
- Thru Truss
- Deck Truss
- Pony Truss
- Arches

Built up Steel Girder

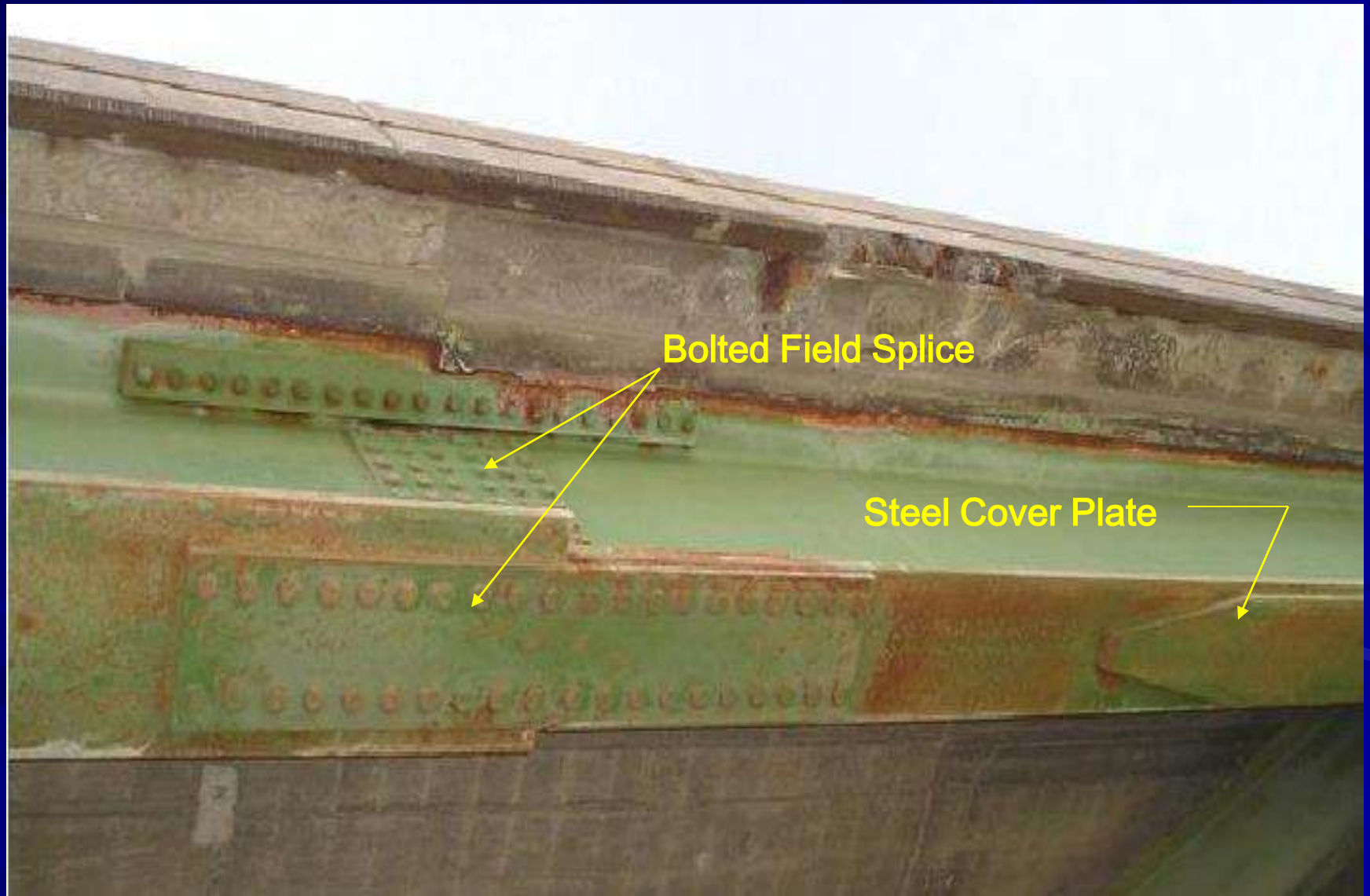
Riveted Steel Girder



Weathering Steel Girder

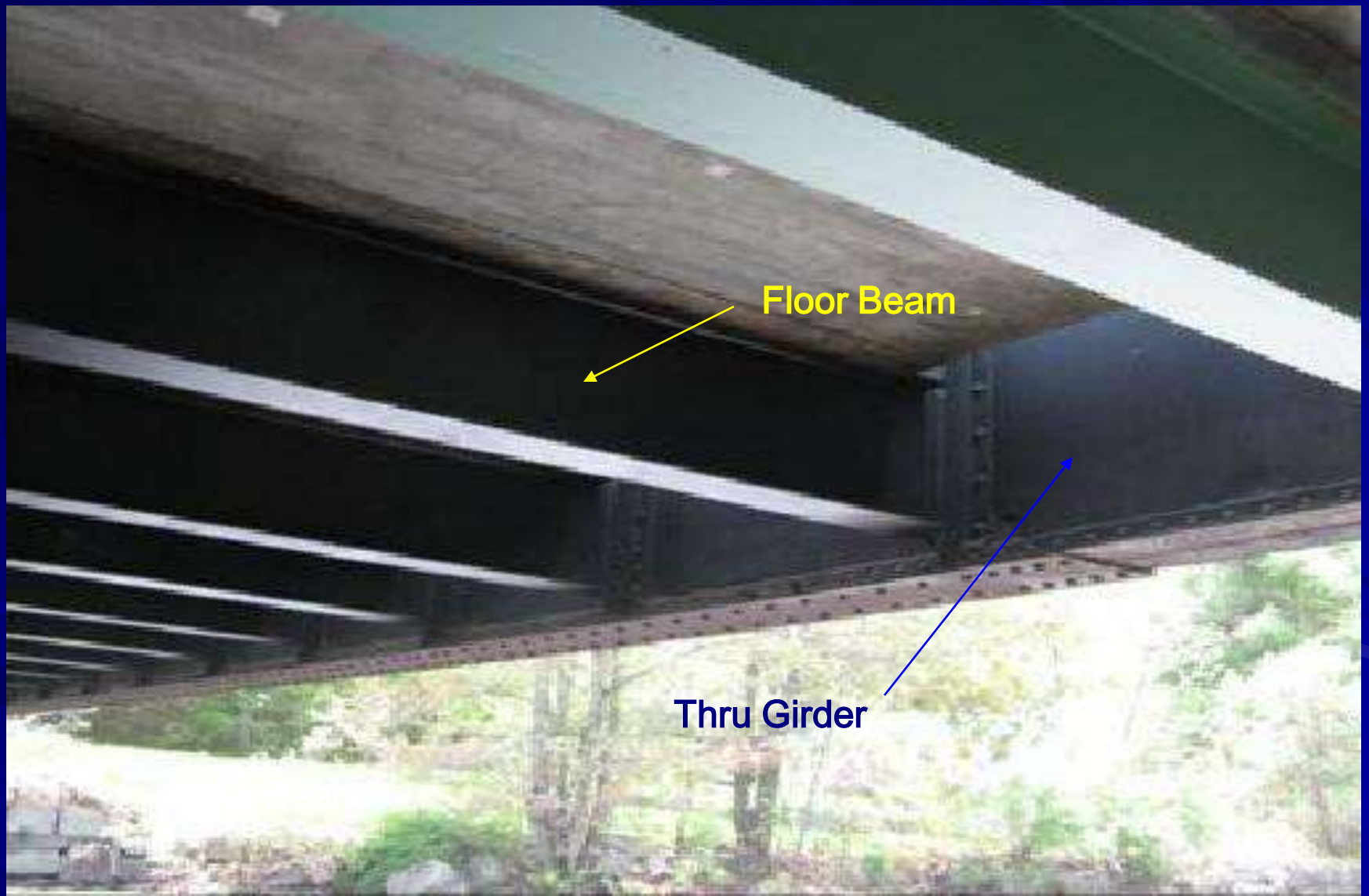


Rolled Beam Stringer



Steel Thru Girder

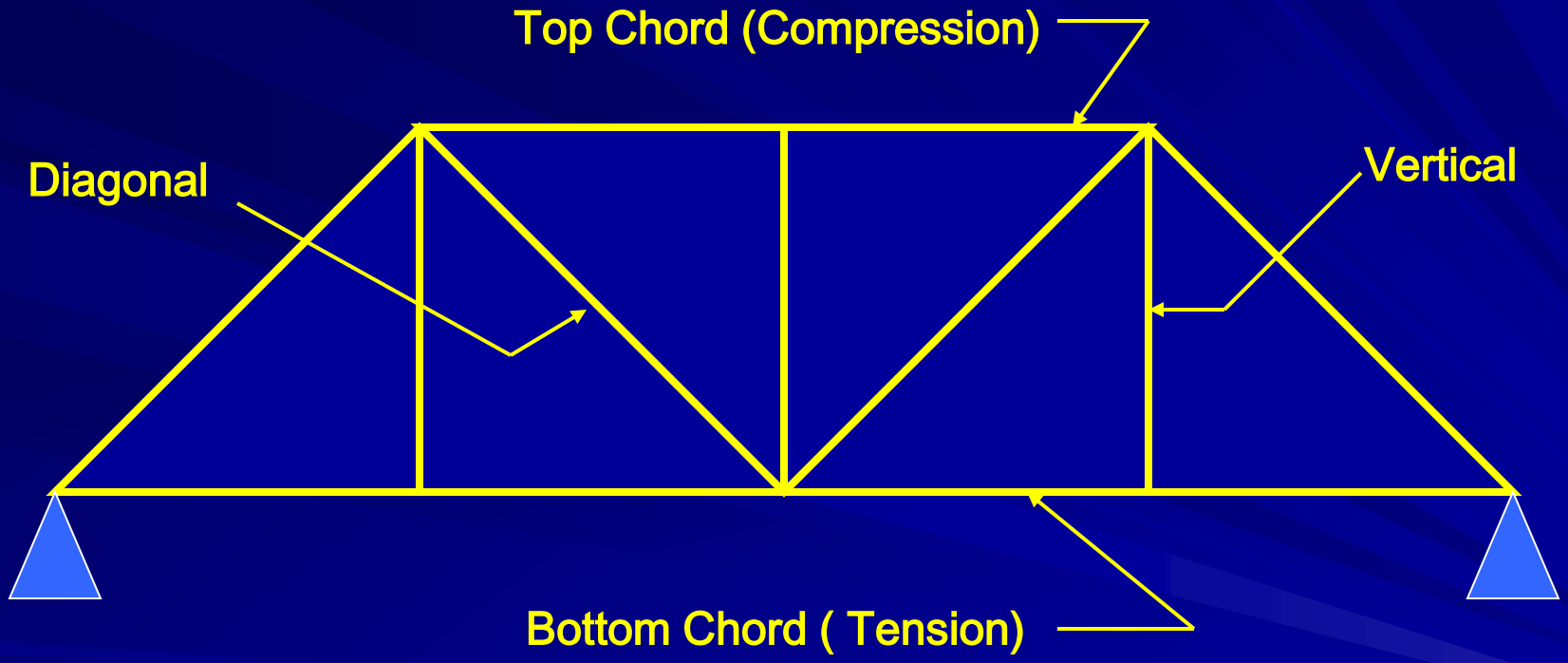
Steel Thru Girder

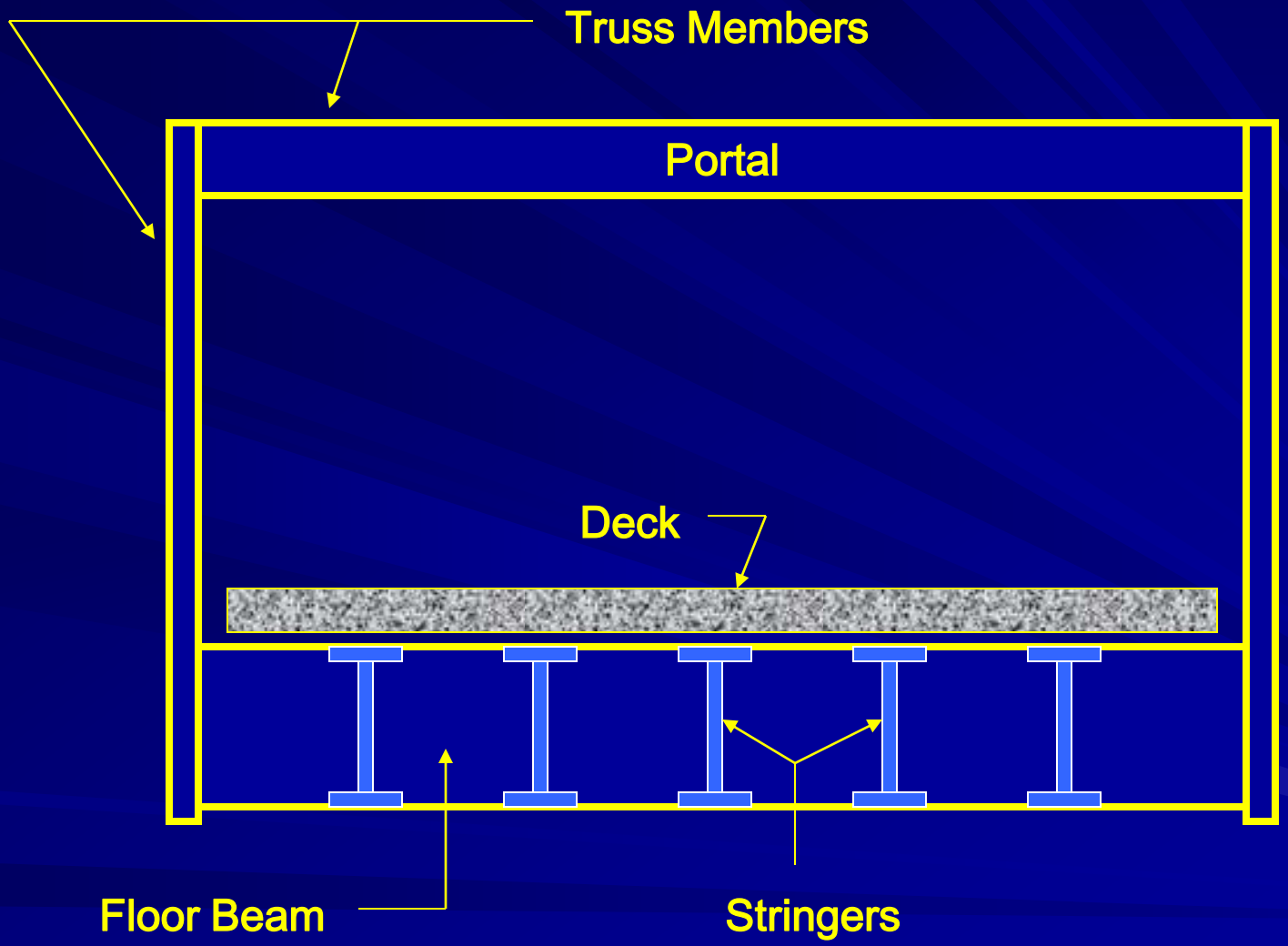


Thru Girder

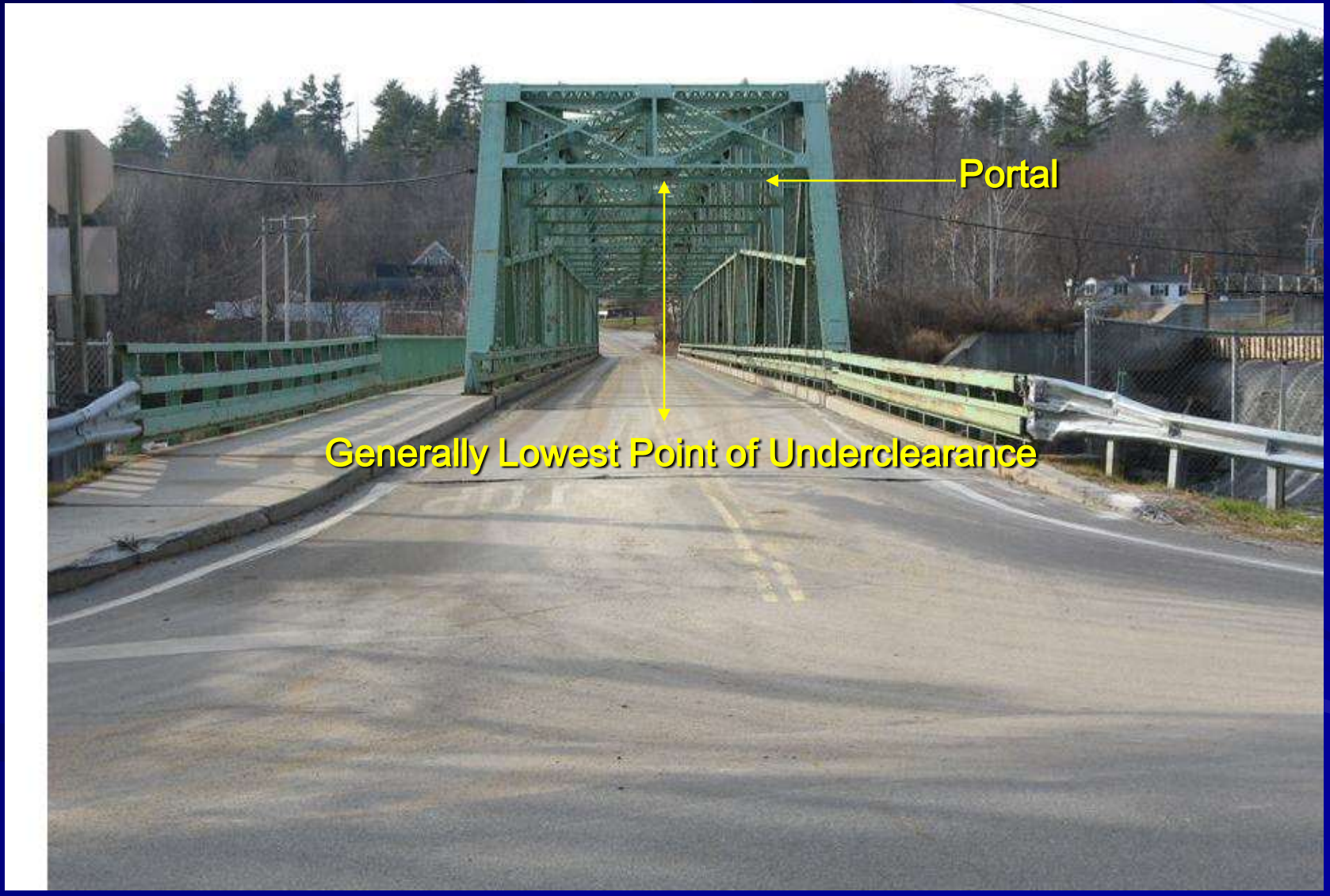
Multipurpose Bridge

Basic Truss


Top Chord (Compression)
Diagonal
Vertical
Bottom Chord (Tension)

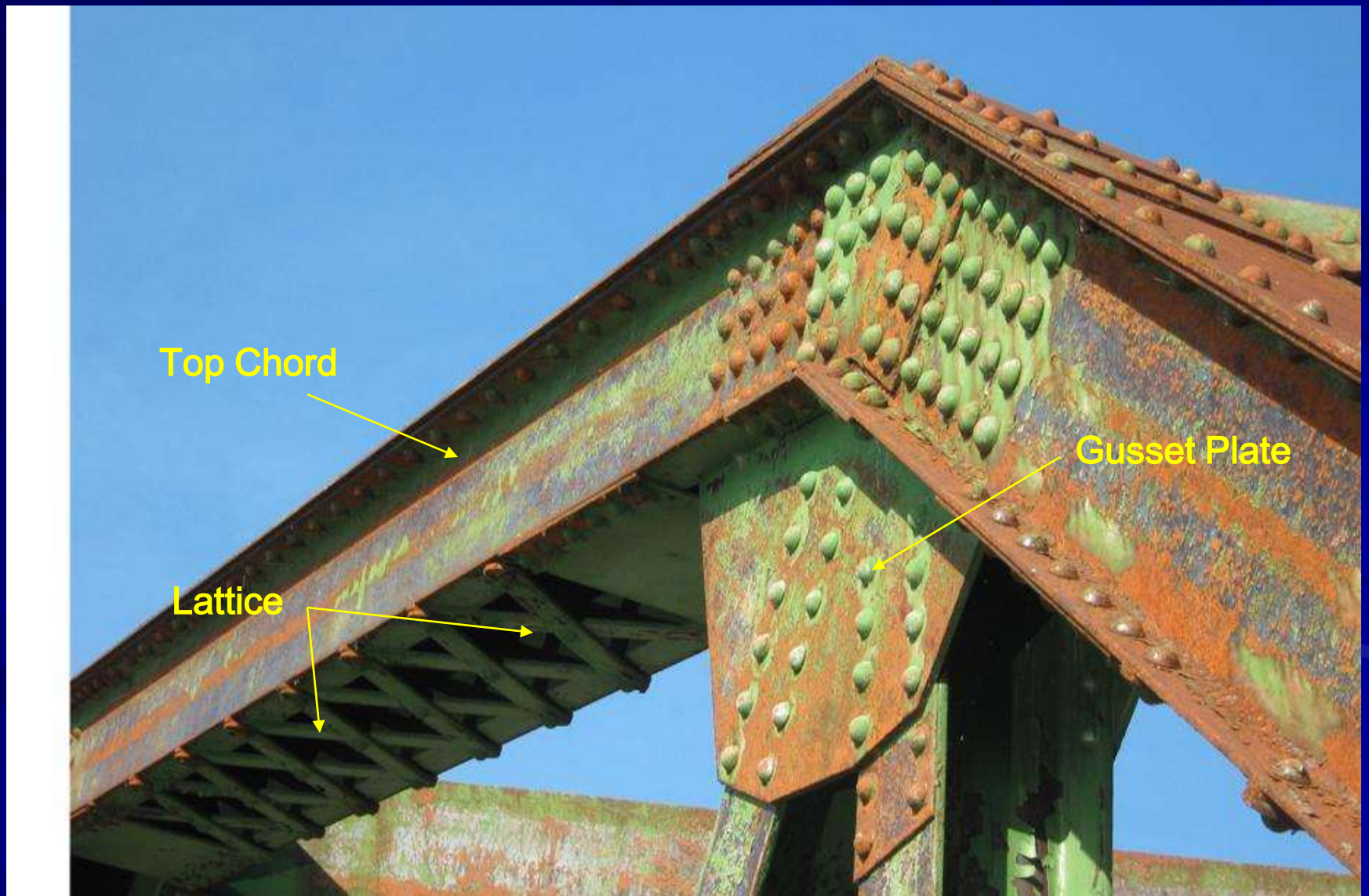

Truss Members
Portal
Deck
Floor Beam
Stringers

Thru Truss



Truss Floor System

Gusset Plate Top Chord



Gusset Plate Bottom Chord

Gusset Plate Bottom Chord


Houston, We Have a Problem

The Iron Boot

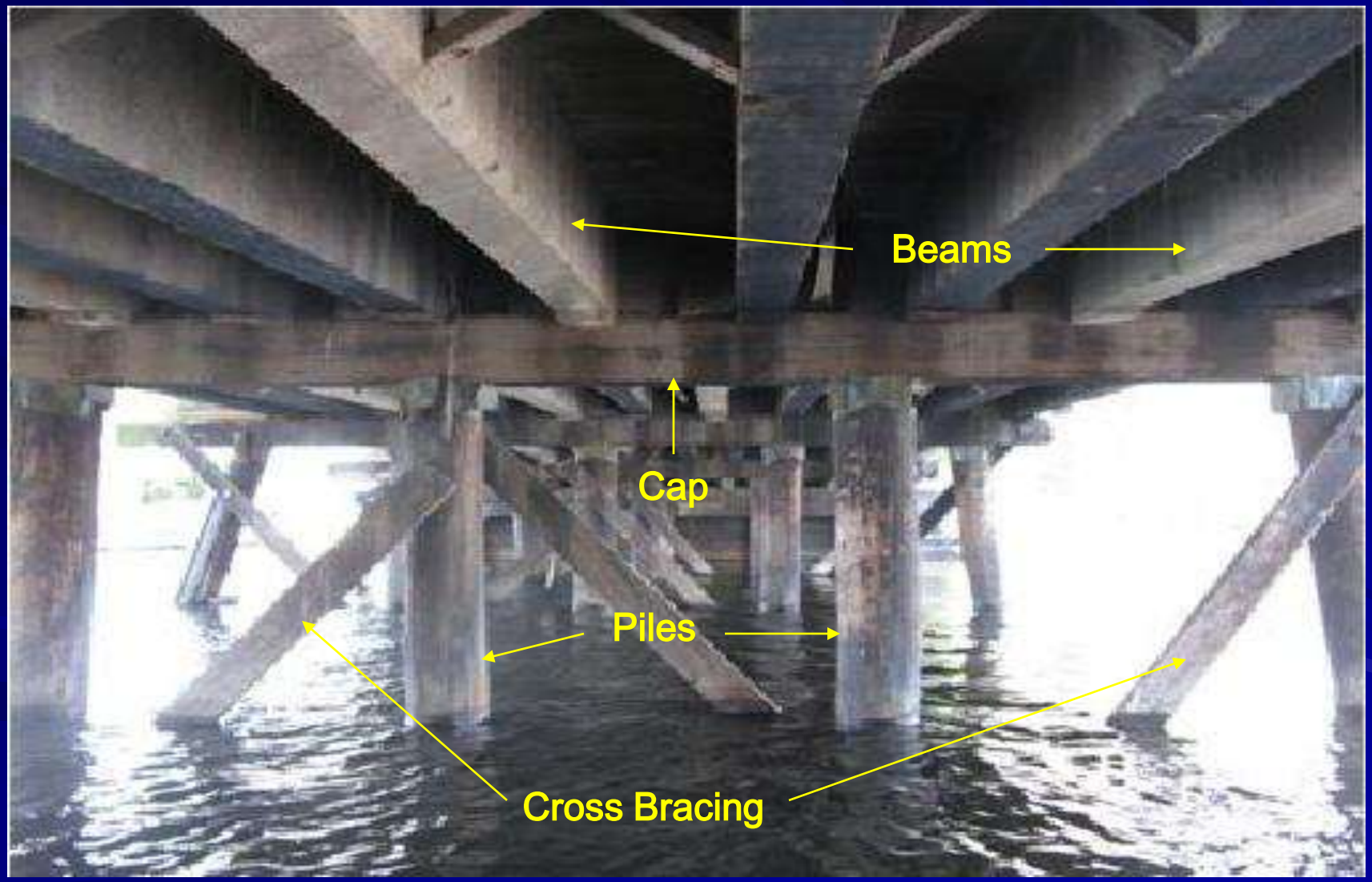
Gusset Plate

Deck Truss

Timber Superstructures

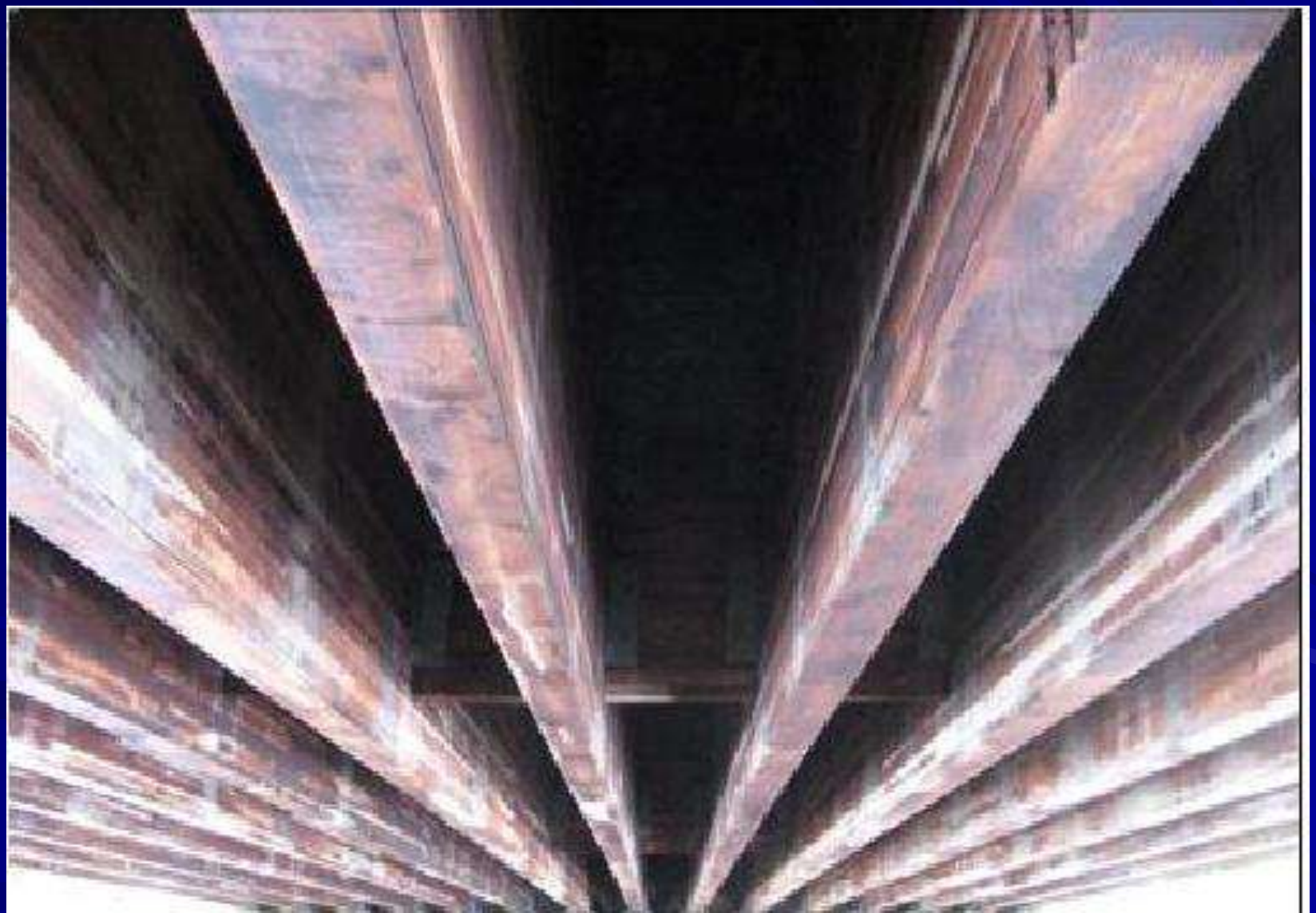
- Sawn timber beam
- Glulam timber beam
- Covered Bridges

Sawn Timber



Timber Glulaminated Beam

Timber Glulaminated Beam



Covered Bridges

Bridge Decks

- Cast-in-Place Concrete
- Precast Concrete
- Timber
- Open Steel Grid
- Concrete Filled Steel Grid

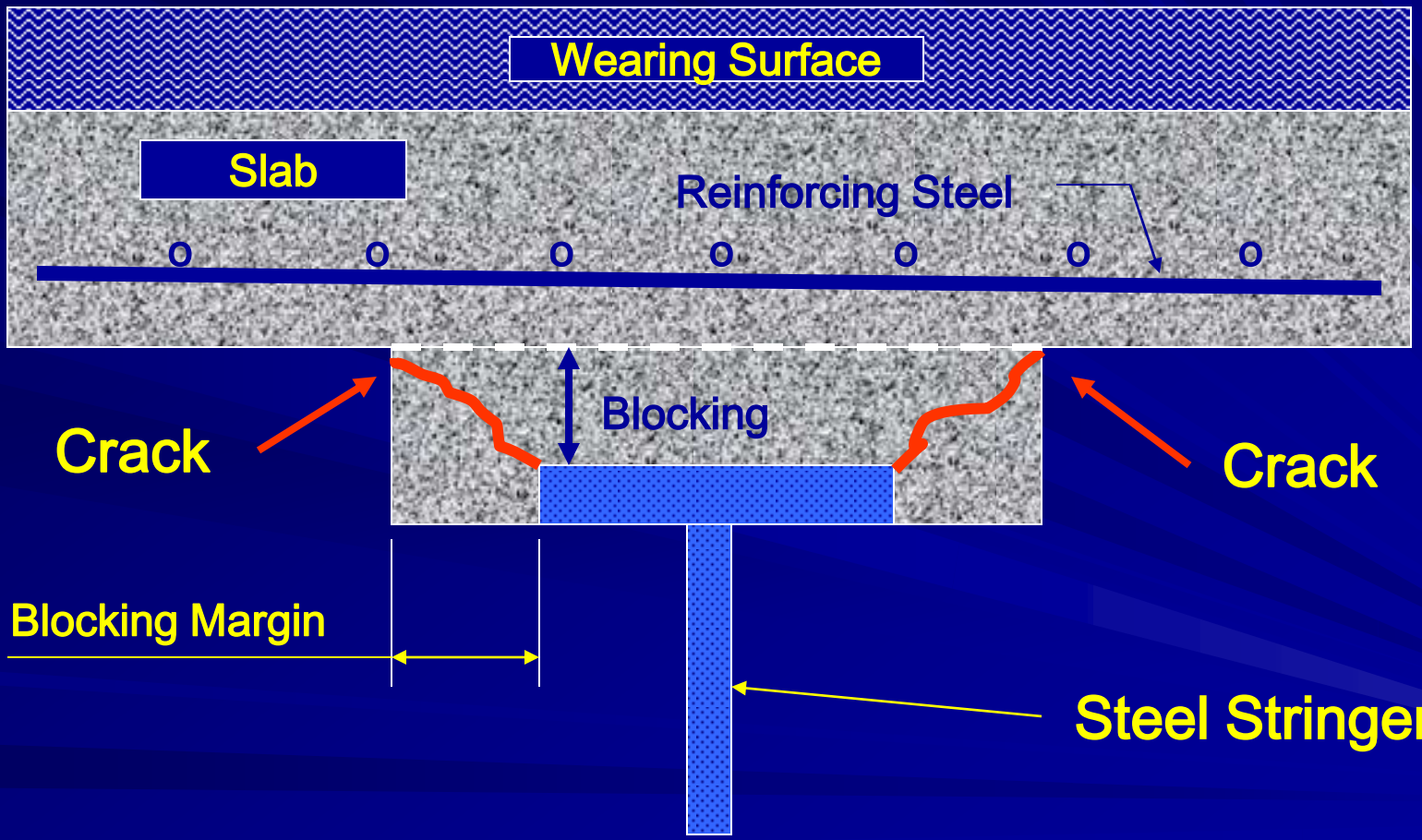
Concrete Deck

Delaminated Concrete Deck

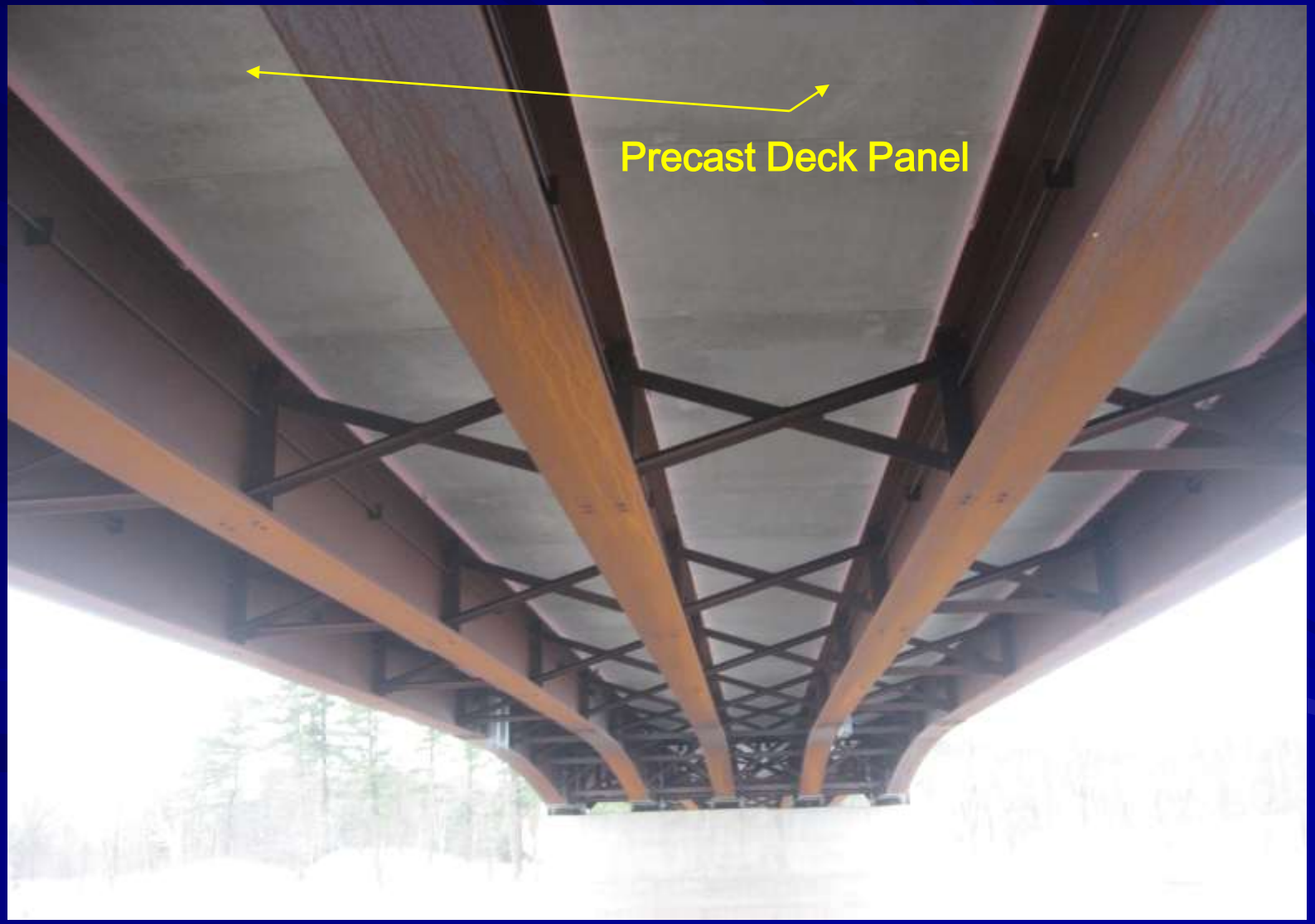
Delamination Removal

Blocking Margin Failure

Look Up
See Any Cracks?



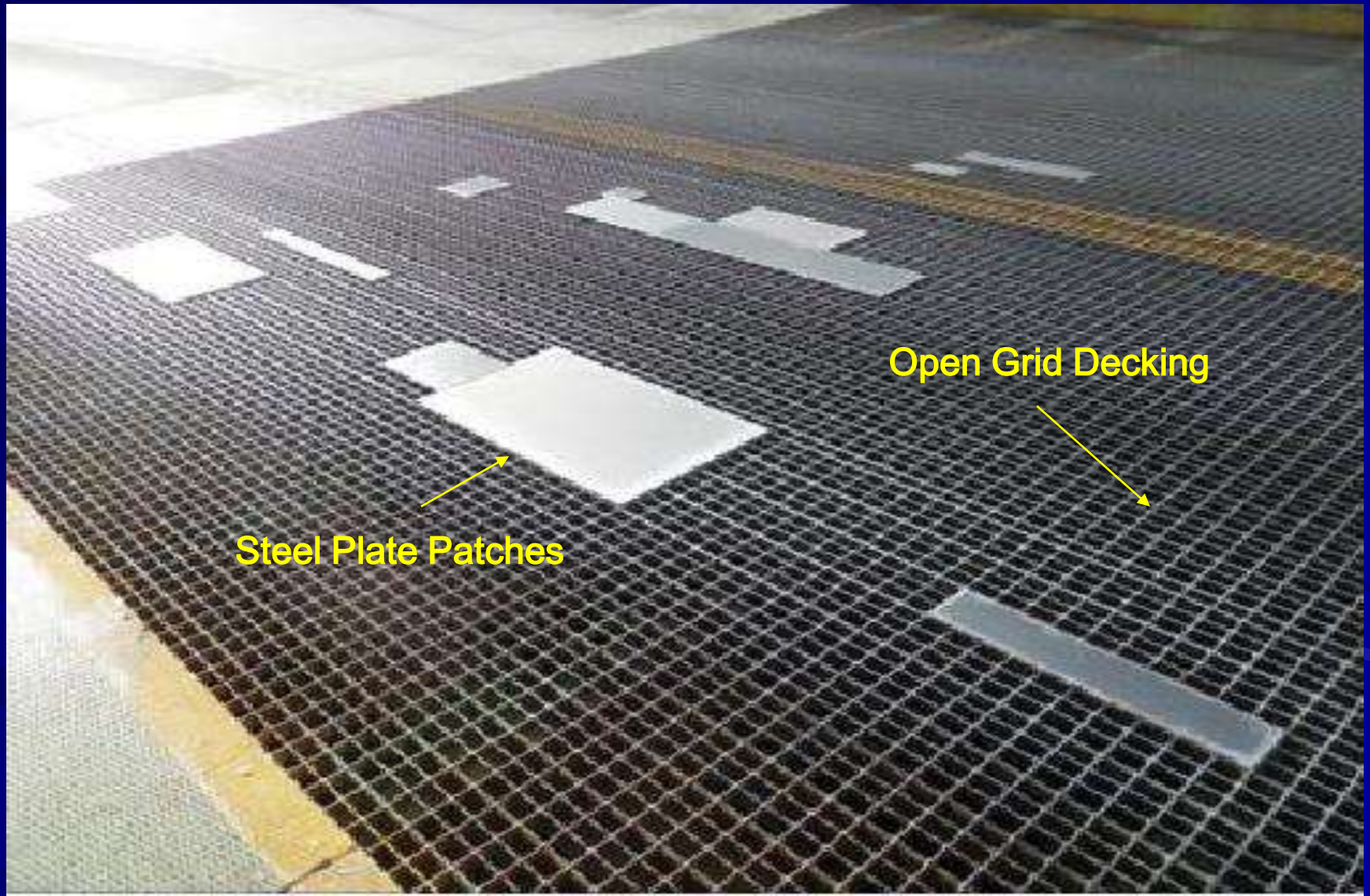
Precast Deck Panes



Transverse Glulam Timber Decking

Sawn Timber Deck

Open Steel Grid Decking



Wearing Surfaces

Bridge Wearing Surfaces

- Integral Concrete
- Separate Concrete
- Bituminous and Waterproofing Membrane
- Timber Running Planks

Concrete Wearing Surfaces

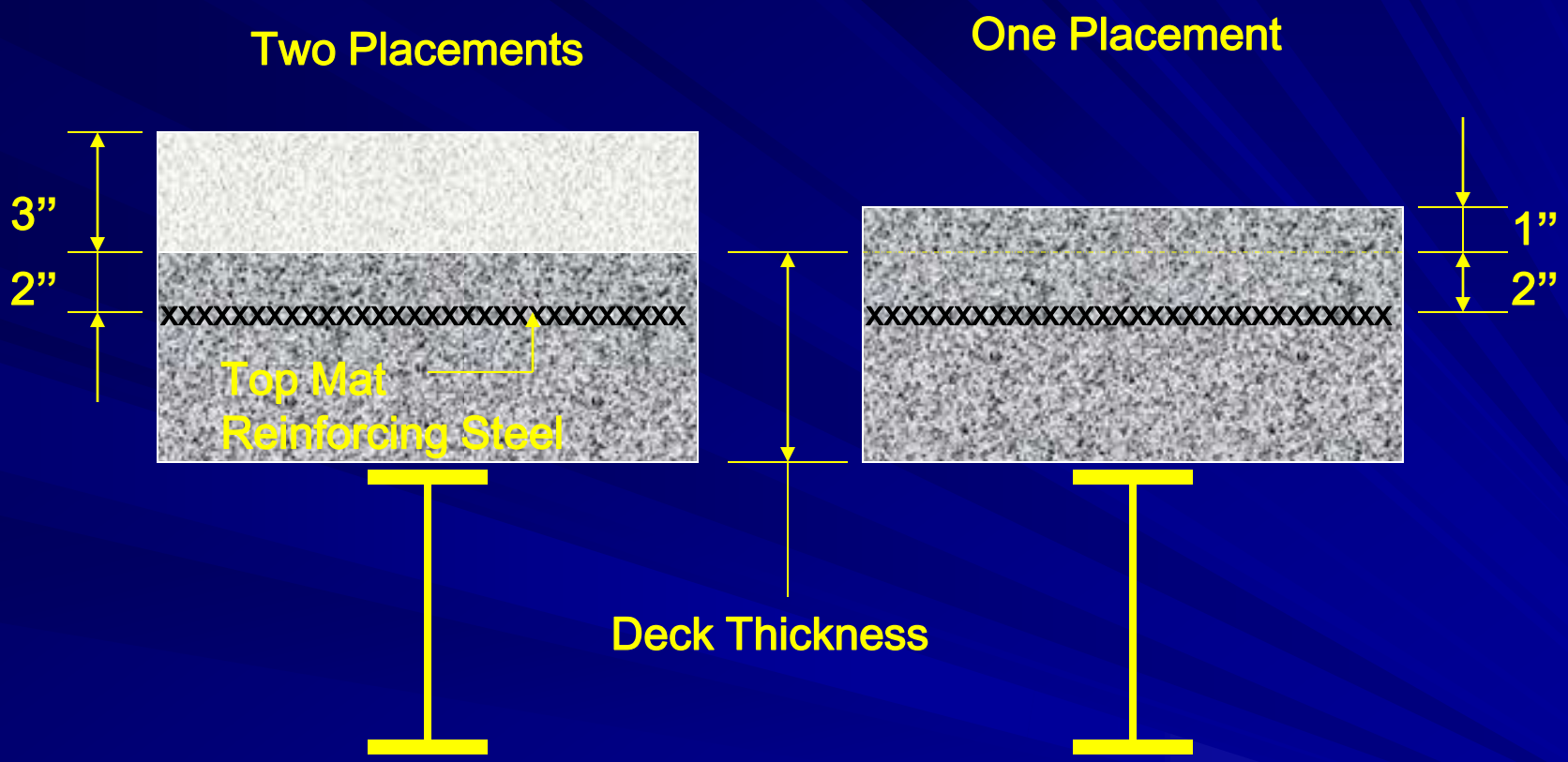
- Provide smooth but noisy riding surface
- Protects the deck from chloride intrusion by being a sacrificial layer
- Will provide structural integrity to a deck that is in marginal condition
- Will last 30-40 years depending on location and use
- Should be treated occasionally to extend life

Alligator Cracking

Deck Prepared for Concrete Wearing Surface


Vibratory Screed

Concrete Wearing Surface


Two Placements
One Placement
3”
2”
1”
2”
Top Mat
Reinforcing Steel
Deck Thickness
Separate Concrete
Wearing Surface
Integral Concrete
Wearing Surface

Bituminous Wearing Surfaces

- Provide very smooth riding surface
- Are permeable so a membrane must be applied to the top of the deck
- Normally are installed at 3 inches
- Should be milled and filled 1½ inches after 15 years
- Should be replaced along with membrane after 30 years.

Bituminous Wearing Surface

Distressed Wearing Surface

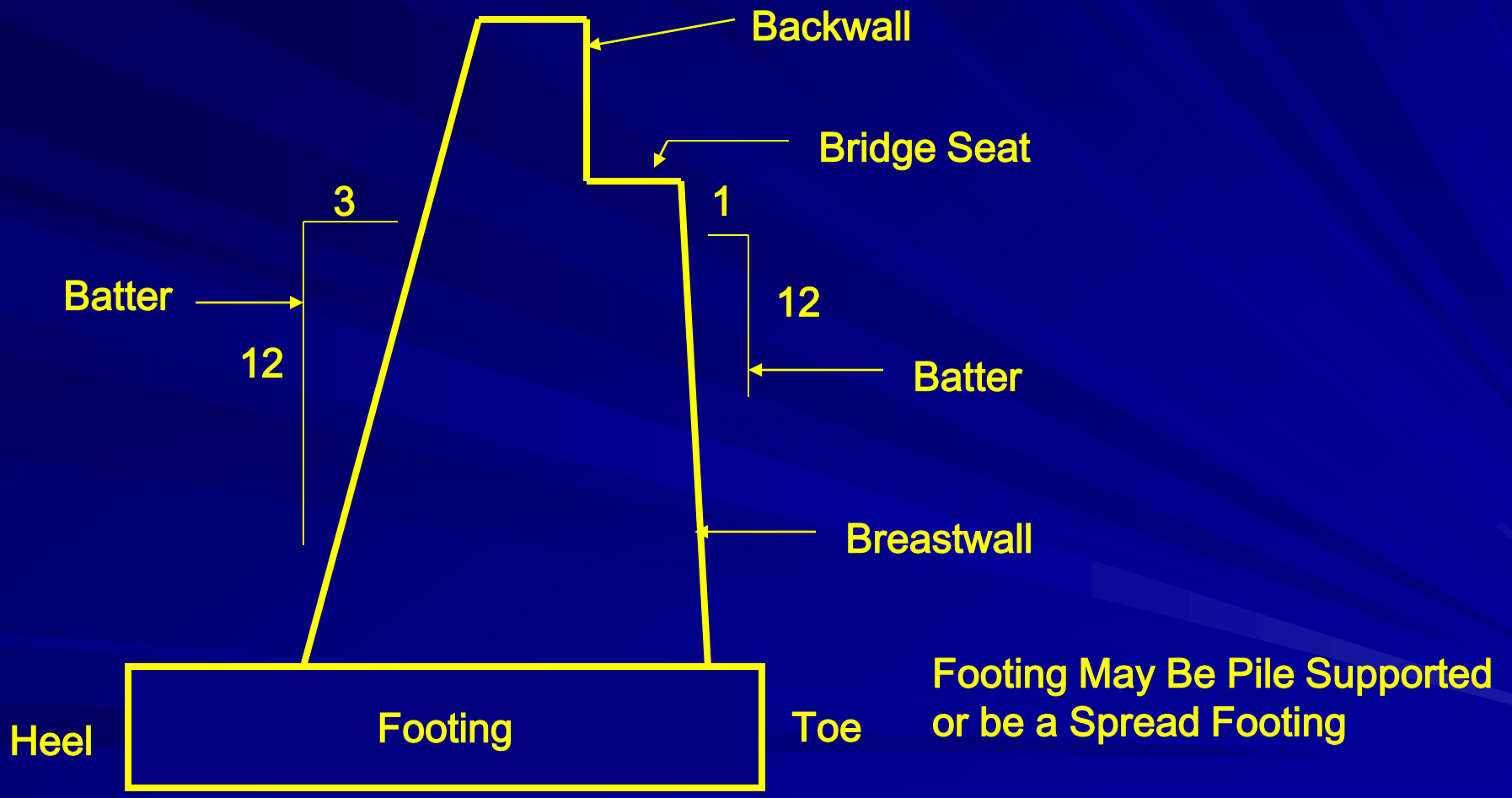
Bridge Substructures

- Every bridge will have an abutment at each end
- Piers are intermediate supports

Abutments

- Mass concrete
- Full height cantilevered
- Integral
- Capped Stone
- Stub
- MSE Walls

Mass Abutment



Mass Abutments

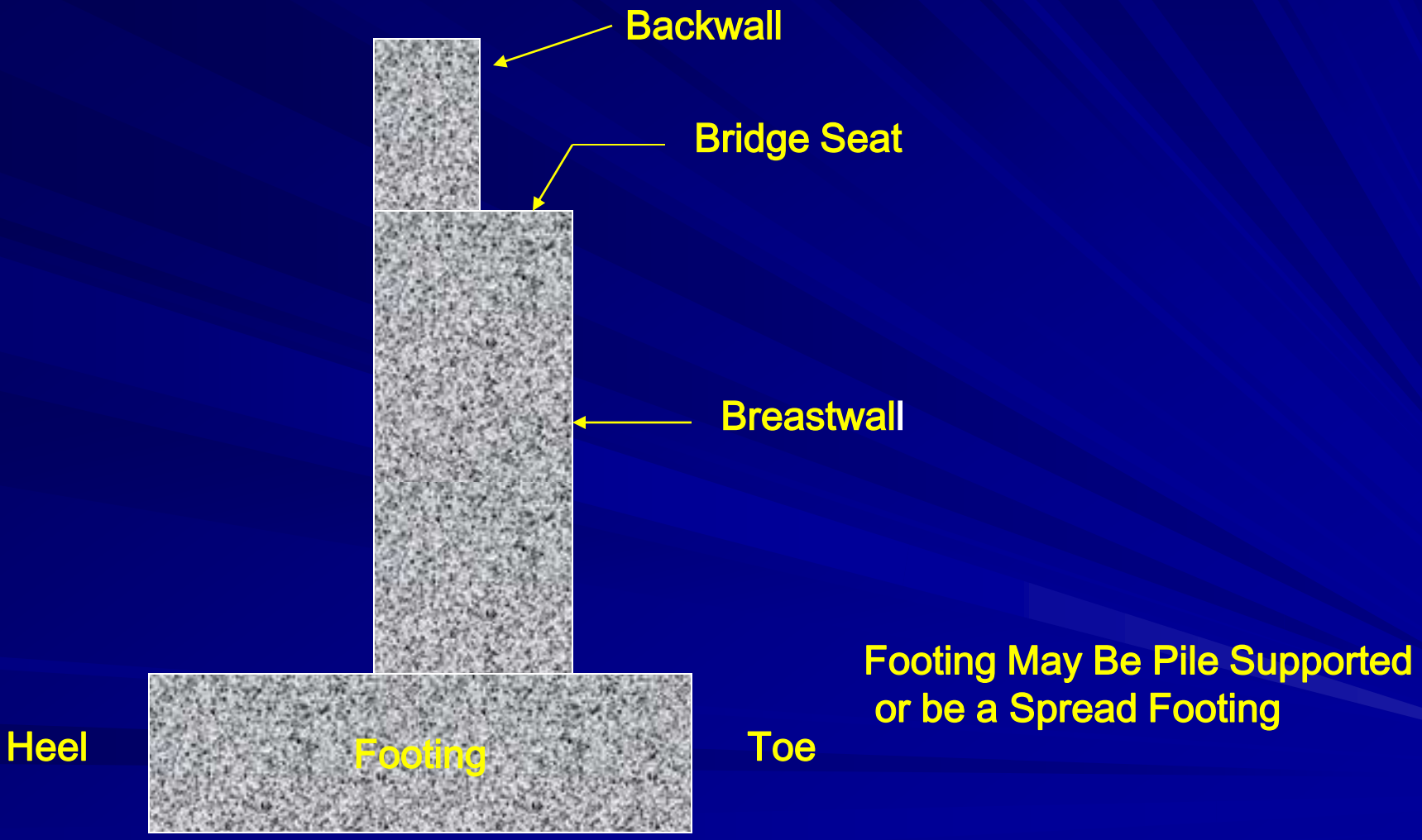
Undermined Pile Supported Abutment

Undermined Abutment w/ Exposed Timber Piles

Grout Bags and Grout Tube

Grouted Abutment

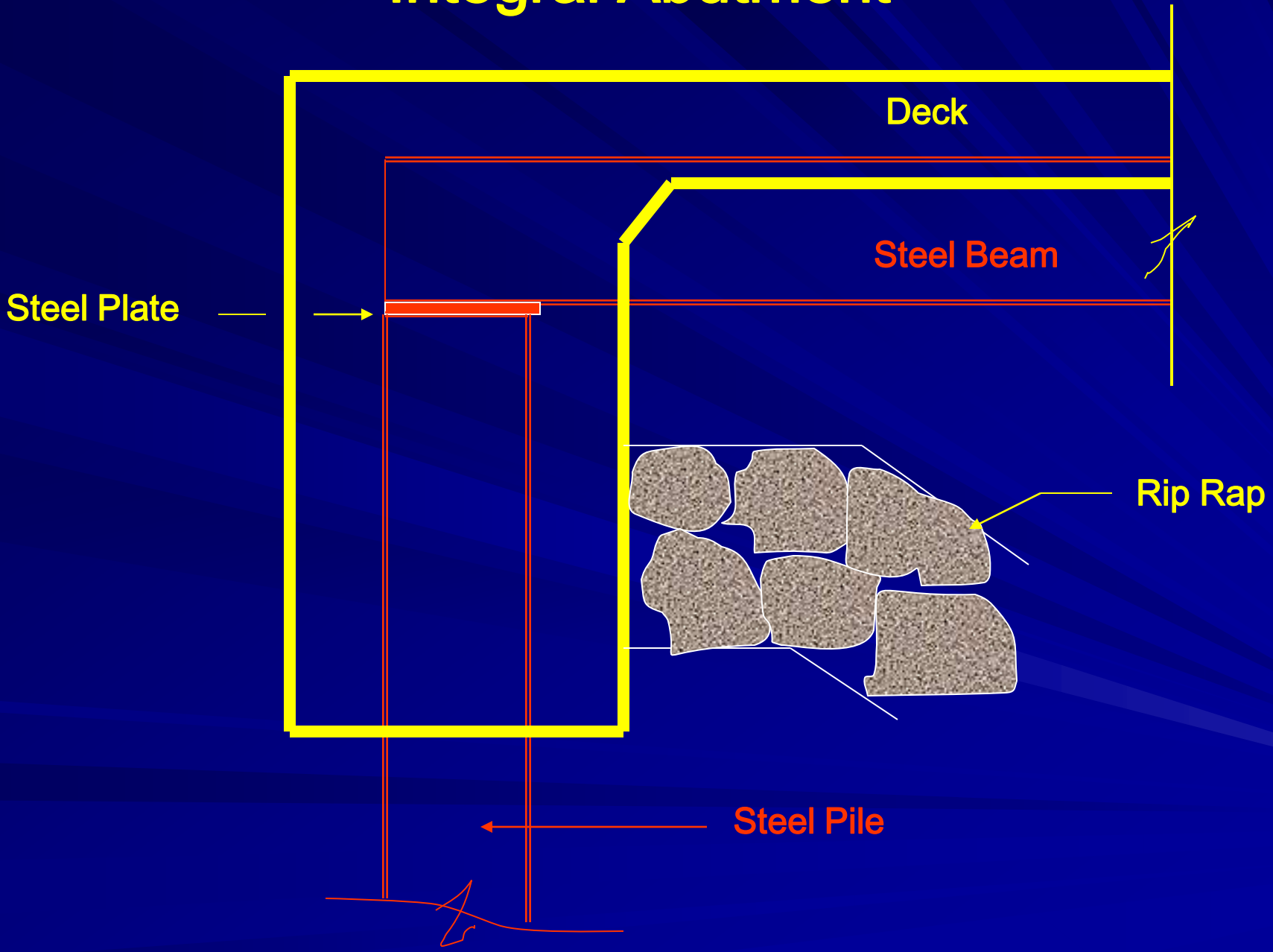
Cantilevered Abutment



Integral Abutments

Integral Abutment

Integral Abutment



Widened Stone Abutment

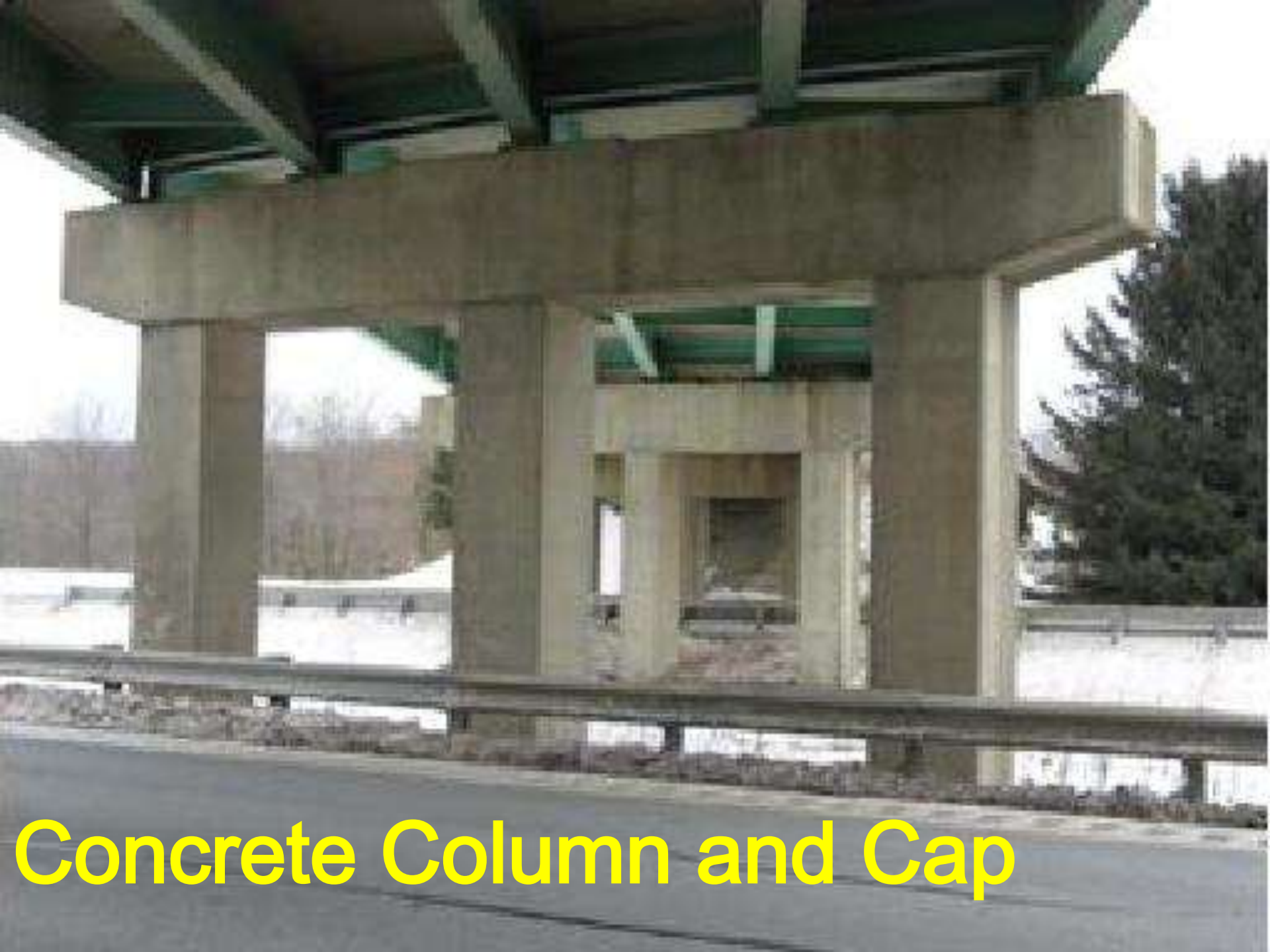
Piers

- Solid shaft pier
- Column and cap
- Hammerhead pier
- Pile Bents

Mass Piers

Cracked Pier


Post Tensioned Rehabilitation "*The Doughnut*"


Concrete Column and Cap


Failed Joint Seal Above
Southerly End

Pier Rehabilitation

Hammerhead Pier

Pile Bent Pier

Jacketed H-Pile Pier Bent

Rehabilitated Jackets

Stone Piers Capped with Concrete

Substructure Undermining

Bridge Washing

Plugged Drain

Spalled Concrete – Southerly Face


PLEASE
DO NOT

Salt Brine

23.5% Chlorides

Most Corrosive 4.5%

Steel Rusts!!!!

Its our job to protect it!

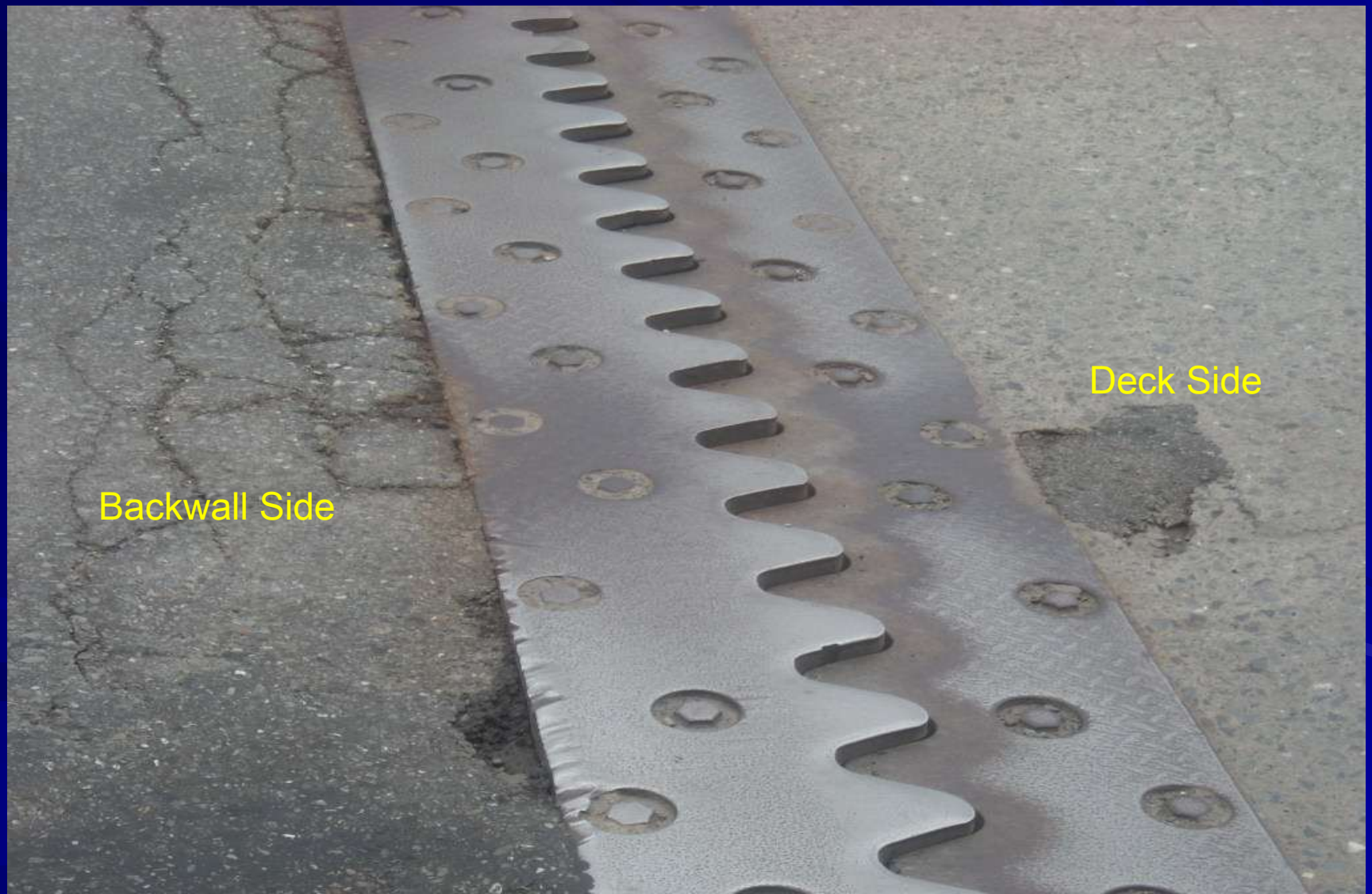
Bearing Needing Your Help

Plated & Painted

Bridge Joints


Finger Joint

Misaligned Finger Joint



Failed Compression Seal

Compression Seal Installation

No Header on Deck Side

New Headers

Plow Damaged Bridge Rail Post

Vehicle Impact

Impact Damage

Cracked I-Beam

Beam Separated from Deck

Impact Damage

Impact Damage

Traffic Control
Move the Vehicles Over to the Next Beam

Ready to Reach New Heights?