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.
Centerline Roadway

Skew

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

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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

- 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
Diving is Cool

No its not... its cold!
We Need Your Eyes
Call the Office!

OOOPS
For Sale
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

BR # 2321
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

Normal high flow
Steel Pipe

Holes
Concrete Invert

The bottom places are the first to deteriorate.

Concrete
Upstream Plates Folded

It will soon be reclassified as a dam
Aluminum Multiplate Pipe Arch
Aluminum Box
Hey… That doesn’t look right!
$200,000 Later
Plate Arch on Concrete Footings

Steel Plate Arch

Concrete Footings
Plate Arch on Concrete Footing
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

- **Bridge Rail**
- **Bridge Curb**
- **Wearing Surface**
- **Waterproofing Membrane** (under bituminous)
- **Deck**
- **Beams or Stringers**
- **Flange**
- **Web**
- **Fascia**
- **Diaphragm**
- **Bearings**
- **Pier Cap**
- **Pier Columns**
- **Pier Footing**
- **Superstructure**
- **Substructure**
Every Bridge will have two and only two abutments

A Multispan bridge may have one or many piers
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

Overfill
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

Leaky Slab
Arched Concrete Slab
Concrete Rigid Frame

- Slab
- Haunch
- Breastwall
Filled Concrete Arch
Concrete T-Beam

- T-Beam Stems
- Concrete Cap
- Grouted Granite Abutment
Concrete T-Beam

Deck

Stem
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

Longitudinal Cracks
Voided Box Beam

Shear Key

Tensioning Strands

Void

3’ to 4’
Butted Precast Box Beam

Longitudinal Joint

Butted Boxes
Prestressed Spread Box Beam
Segmental Concrete Box
Inside Segmental Box

- Segment Joint
- External Post Tensioning Ducts
- Utility Conduit
Double Cell Segmental Box
Precast Bulb-T

Girders

Diaphragms
Steel Superstructures

- Multi-beam I-beam or girder
- Thru girder
- Thru Truss
- Deck Truss
- Pony Truss
- Arches
Built up Steel Girder

Riveted Girder

Unidentified Sea Creature
Riveted Steel Girder

- Cross Frame
- Web Stiffeners
- Lateral Wind Bracing
Weathering Steel Girder

- Precast Deck Panel
- Welded Girders
- Cross Frames
Rolled Beam Stringer

Bolted Field Splice

Steel Cover Plate
Steel Thru Girder
Steel Thru Girder

Floor Beam

Thru Girder
Thru Girder
Multipurpose Bridge
Basic Truss

- Top Chord (Compression)
- Vertical
- Diagonal
- Bottom Chord (Tension)
Thru Truss

Portal

Generally Lowest Point of Underclearance
Truss Floor System

- Stringers
- Bottom Chord of Truss
- Diagonal Bracing
- Floor Beam
Gusset Plate Top Chord

- Top Chord
- Gusset Plate
- Lattice
Gusset Plate Bottom Chord
Gusset Plate Bottom Chord
Houston, We Have a Problem
The Iron Boot
Gusset Plate
Timber Superstructures

- Sawn timber beam
- Glulam timber beam
- Covered Bridges
Sawn Timber

Beams

Cap

Piles

Cross Bracing
Timber Glulaminated Beam
Timber Glulaminated Beam
Bridge Decks

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

Cast-in-Place Concrete Deck
Delaminated Concrete Deck
Delamination Removal
Blocking Margin Failure

Blocking Margin

Look Here
Look Up
See Any Cracks?
Precast Deck Panes

Precast Deck Panel
Transverse Glulam Timber Decking

Diaphragms

Rolled Steel Beams

Bridge Seat

Transverse Timber Decking
Sawn Timber Deck
Open Steel Grid Decking

Steel Plate Patches

Open 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

08/31/2011
Concrete Wearing Surface

- Maine Rail
- Bridge Connection (Michigan Shoe)
- Tine Marks
Deck Thickness

Separate Concrete Wearing Surface

Two Placements

3”

Top Mat
Reinforcing Steel

2”

One Placement

1”

Integral Concrete Wearing Surface

Deck Thickness

2”

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

- Footing
- Toe
- Heel
- Batter
- Backwall
- Bridge Seat
- Breastwall

Footings may be pile supported or be a spread footing.
Mass Abutments
Undermined Pile Supported Abutment
Undermined Abutment w/ Exposed Timber Piles
Grout Bags and Grout Tube
Cantilevered Abutment

- Backwall
- Bridge Seat
- Breastwall
- Footing
- Heel
- Toe

Footing May Be Pile Supported or be a Spread Footing
Integral Abutments

Blocking Margin
Integral Abutment
Widened Stone Abutment

Concrete Cap

Mass Wings

Weep Holes
Piers

- Solid shaft pier
- Column and cap
- Hammerhead pier
- Pile Bents
Mass Piers
Cracked Pier
Post Tensioned Rehabilitation “The Doughnut”
Failed Joint Seal Above

Southerly End
Pier Rehabilitation
Hammerhead Pier
Pile Bent Pier

Concrete Cap
Circular Steel Pipe Piles
Plumb Pile
Battered Pile
Jacketed H-Pile Pier Bent
Rehabilitated Jackets
Stone Piers Capped with Concrete
Substructure Undermining

SCOURE – More to Come
Bridge Washing
Plugged Drain
Spalled Concrete – Southerly Face
Salt Brine

23.5% Chlorides

Most Corrosive 4.5%
Steel Rusts!!!!

It's our job to protect it!
Bearing Needing Your Help
Plated & Painted
Bridge Joints
Misaligned Finger Joint

Deck Side

Backwall Side
Failed Compression Seal
Compression Seal Installation

Wrestling the Anaconda
No Header on Deck Side
New Headers
Plow Damaged Bridge Rail Post

Don’t Do This!
Vehicle Impact

I see a quarter!
Impact Damage
Cracked I-Beam
Beam Separated from Deck
Impact Damage

Beam Sweep
Impact Damage

Birds Mouth
Grind to make smooth
Traffic Control
Move the Vehicles Over to the Next Beam
Ready to Reach New Heights?