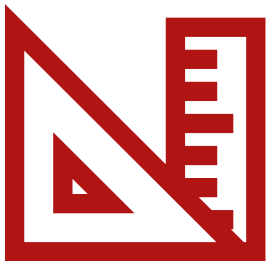


Outline

- BOBS Organization Structure
- **Bridge Type and Composition/Terminology**
- Asset Management
- Bridge Maintenance
- Bridge Design Process
- Bridge Plans
- Road and Bridge Coordination
- Request for Action (RFA) Projects
- Design in Construction
- Accelerated Bridge Construction (ABC)
- Wrap up



1



Bridge Design Basics

Bridge Terminology
Bridge Types

2

Bridge Terminology and Types



BRIDGE TERMINOLOGY & COMPONENTS



TYPES OF BRIDGES

3

Terminology



What is a bridge?

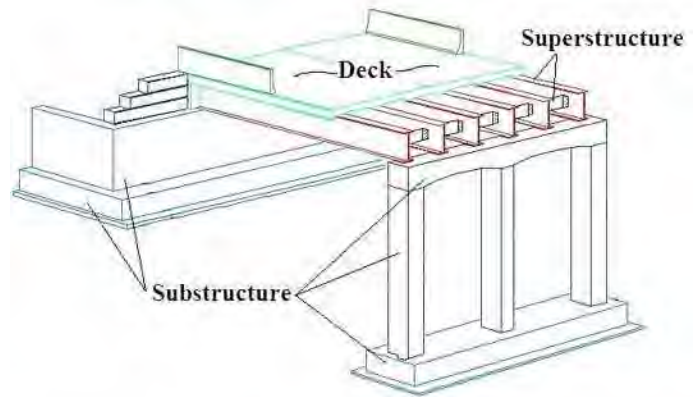


FHWA A305-4

A bridge is defined in section 650.305 as "A structure including supports erected over a depression or an obstruction, such as water, a highway, or railway, and having a track or passageway for carrying traffic or other moving loads, and having an opening measured along the center of the roadway of more than 20 feet between under copings of abutments or spring lines of arches, or extreme ends of openings for multiple boxes; it may also include multiple pipes, where the clear distance between openings is less than half of the smaller contiguous opening."

4

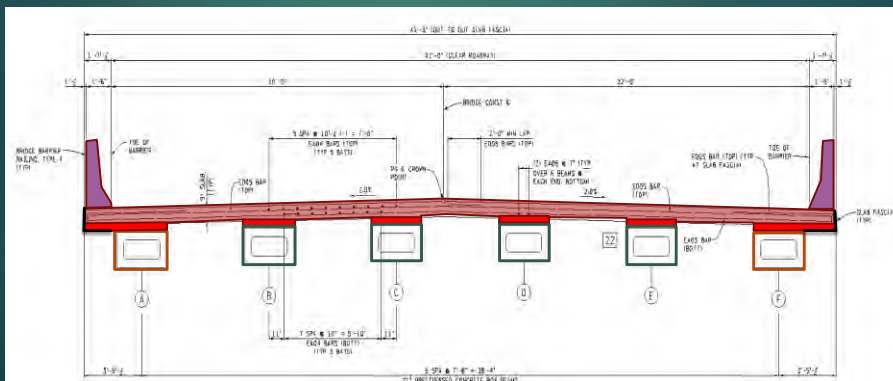
Bridge Terminology



5

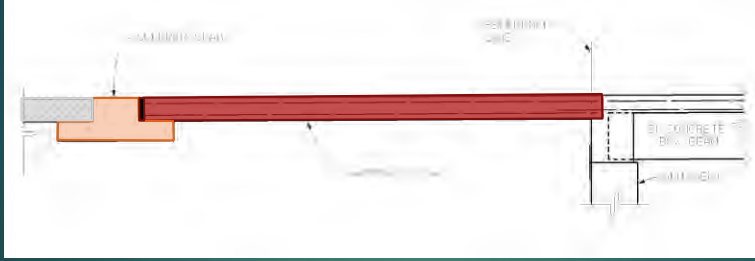
Superstructure

► Bridge Deck



6

Superstructure



Section thru sleeper Slab and sliding slab

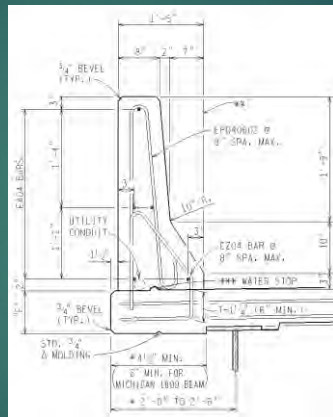
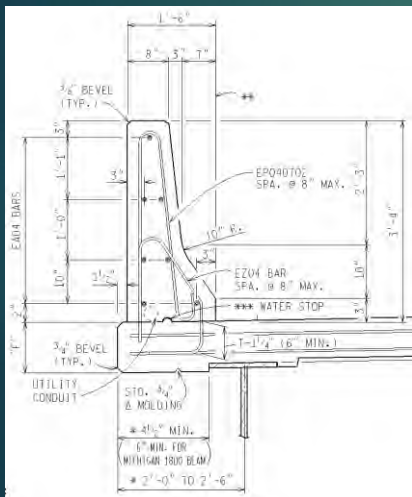
Plan view bridge deck and approaches



7

Superstructure - Barriers

Type 4 Barrier



Type 5 Barrier

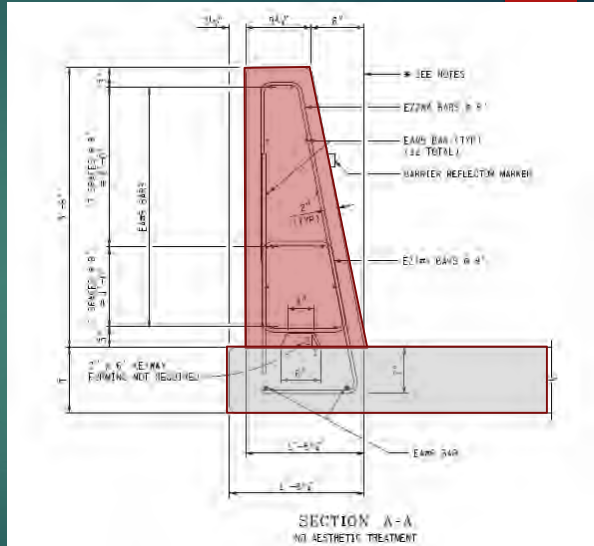


8

Superstructure - Barriers



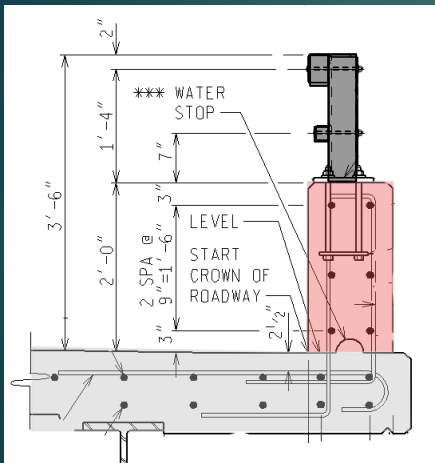
Single Slope Barrier



Type 6 Barrier

9

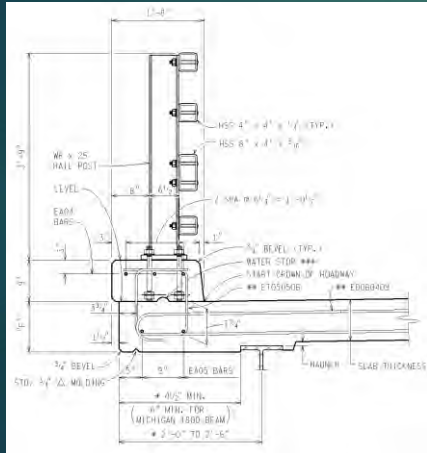
Superstructure - Railings



Aesthetic Parapet Tube Railing

10

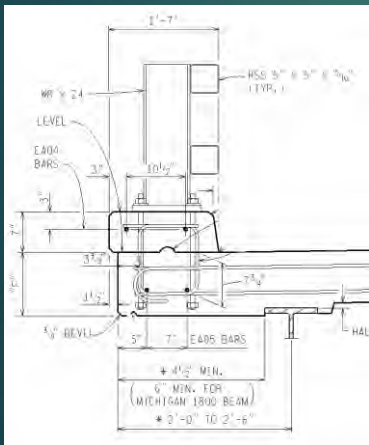
Superstructure - Railings



4 Tube Railing

11

Superstructure - Railings



2 Tube Railing

12

Superstructure

Girders and Beams

- ▶ Steel
 - ▶ Welded Plate Girders
 - ▶ Rolled Shapes
- ▶ Concrete
 - ▶ AASHTO PCI-beams
 - ▶ Prestressed Concrete Box Beams
 - ▶ Prestressed Concrete Bulb T Beam

13

Superstructure

- ▶ Welded Plate Girders



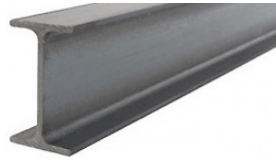
M-20 over Tittabawassee River



14

Superstructure

▶ Rolled Beams



15

Superstructure

▶ Concrete Box Beams



Spread Box superstructure

16

Superstructure



► Bulb T Beams



MI 1800 Girders



AASHTO I-Beams

17

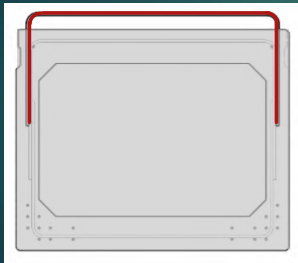
Superstructure



18

Superstructure

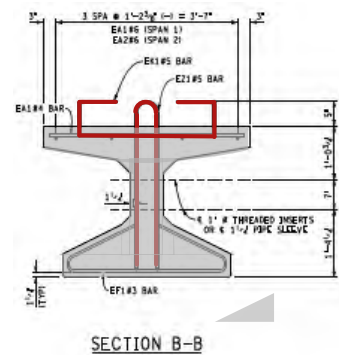
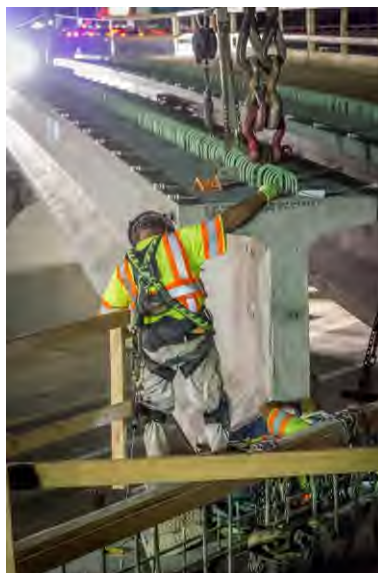
- ▶ COMPOSITE DECKS
Thru shear connection



19

Superstructure

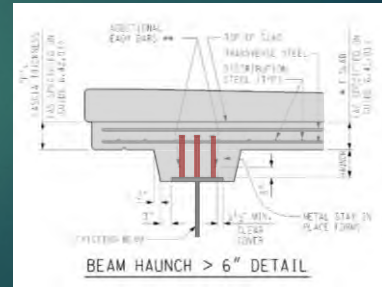
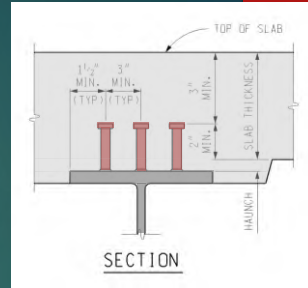
- ▶ Slab Ties



20

Superstructure

► Shear Developers

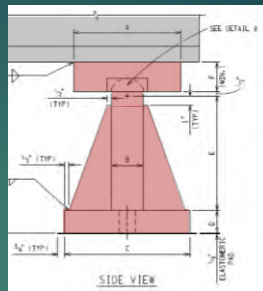


21

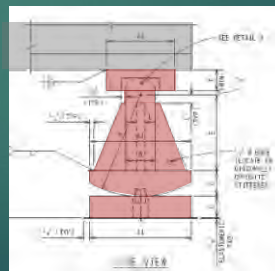
Superstructure

► Bearings for Steel Beams

- Steel Rockers
- Steel Fixed Shoes
- Steel Pedestals
- Elastomeric



Steel Pedestals



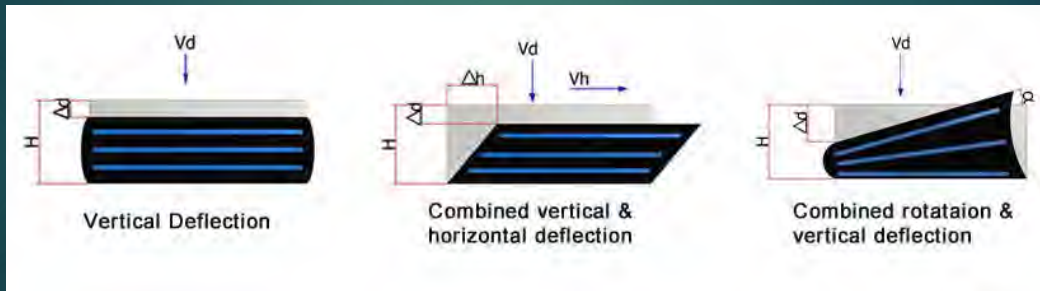
Steel Rockers



Steel Rockers

22

Superstructure Elastomeric Bearings



23

Superstructure Elastomeric Bearings



Elastomeric bearing on an abutment



Steel beam on an elastomeric bearing



Section of Elastomeric showing steel shims

24

Substructures

ABUTMENTS

PIERS

25

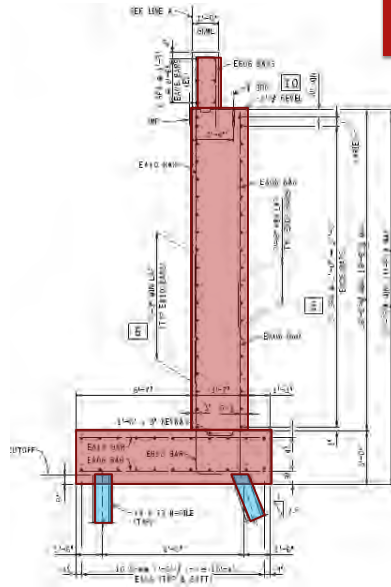
Abutment Types

- ▶ Cantilever
- ▶ Curtain Wall/Gravity Wall
- ▶ Stub Abutment
 - ▶ Integral
 - ▶ Semi-Integral

26

Cantilever Abutment

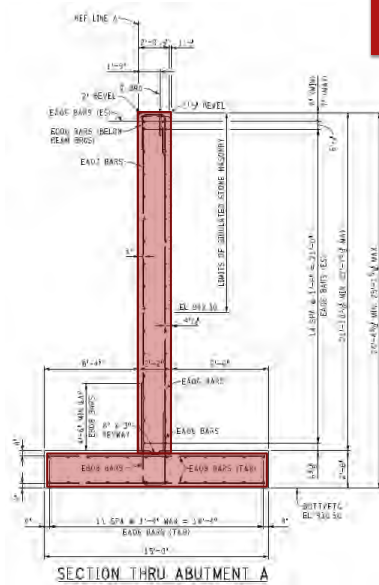
- ▶ With footing on Driven Piles



27

Cantilever Abutment

- ▶ On Spread Footing



28

Return Walls



Cooper St. over I-94

29

Return Walls

IN-LINE RETURNWALL



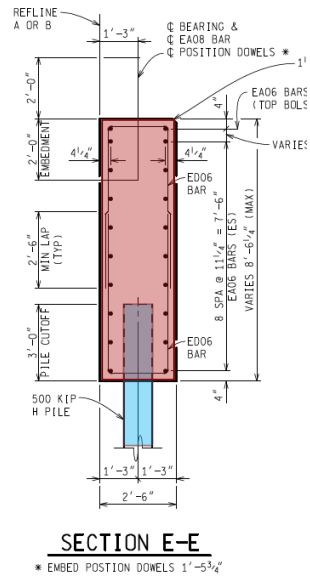
WING WALL



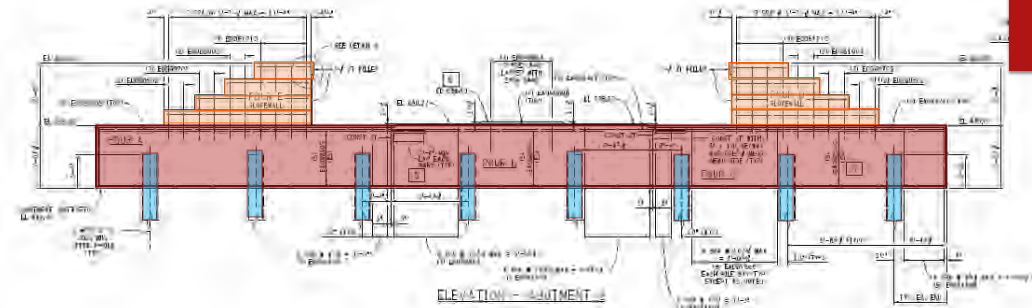
30

Stub Abutments

- ▶ Single Row of Piles
- ▶ Integral or Semi-Integral
- ▶ Used with MSE Walls
 - ▶ (Mechanically Stabilized Earth)



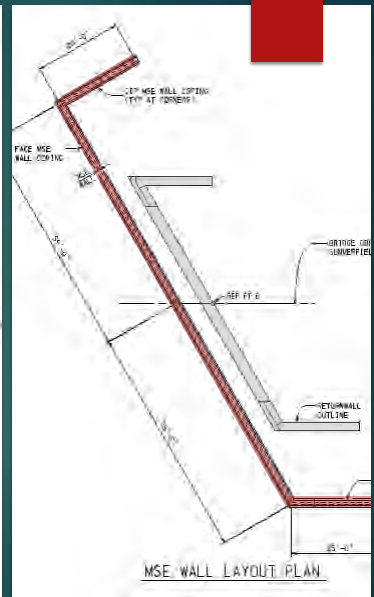
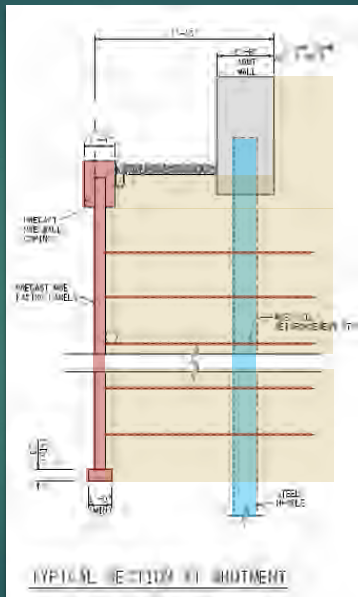
33



Stub Abutment Elevation

34

MSE WALLS



35



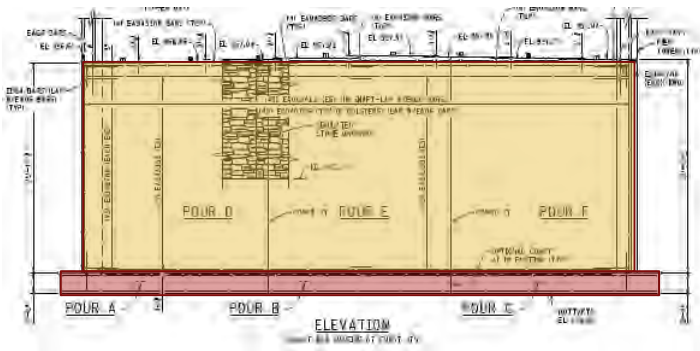
MSE Walls

36



Column – Cap Type Piers

39



Solid Wall Pier

40

Bridge Slope Treatments

- ▶ Concrete Slope Paving
- ▶ Articulated Concrete Block (ACB)
- ▶ Riprap



41

Articulated Concrete Block

- ▶ ACB on M-19 over the S. Fork of the Cass River



42

Summary of Terminology

- ▶ Superstructure
 - ▶ Everything from the bearings up
 - ▶ Bearings, Beams, Deck, Railing
- ▶ Substructure
 - ▶ Everything that supports the superstructure
 - ▶ Abutments, Piers, Returnwalls



43

QUESTIONS?

44



BREAK TIME

45

Major Bridge Types

Cable Stayed Bridges

Suspension Bridges

Segmental Bridges

Arches & Tied Arches

Truss Bridges

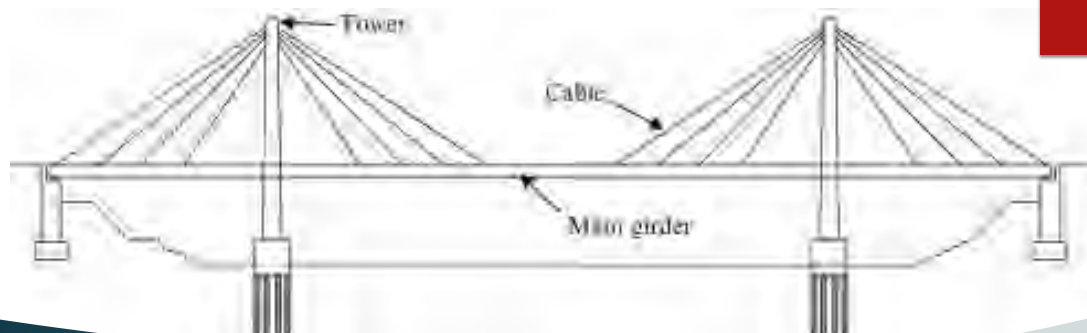
Moveable bridges

Beam/Girder Bridges

46

Cable Stayed Bridges

47



Cable Stayed Bridges

- * Tall Towers
- * Long Spans
- * Diagonal cables
- * Deep Foundations

48

Cable Stayed Bridges in Michigan

?

49



Bagley
Pedestrian
Bridge,
Detroit

50



Gordie Howe International Bridge

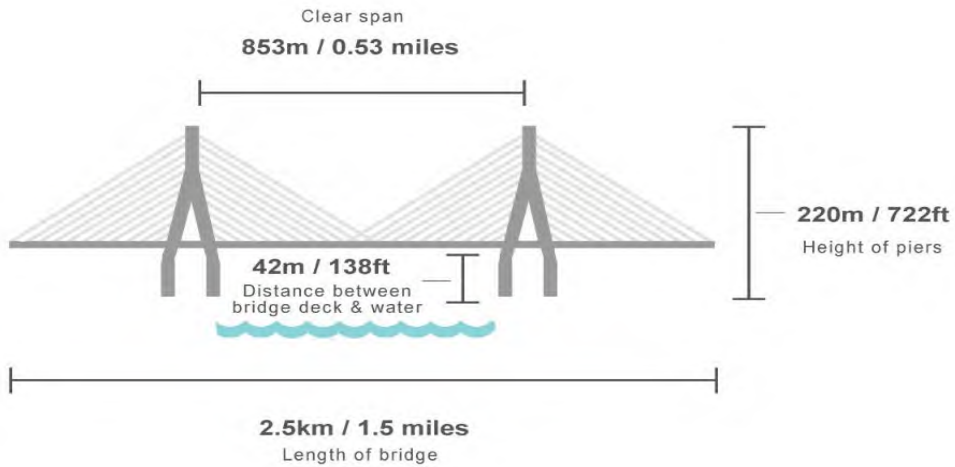
51



GORDIE HOWE INTERNATIONAL BRIDGE

CONCEPTUAL

52

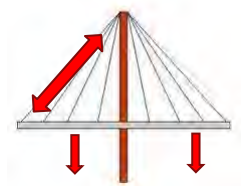


multi-use path

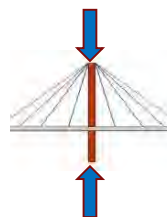
GHB by the Numbers

53

Cable Stayed Characteristics



Cables carry loads in tension to the towers.



Towers transfer the cable forces to the foundations

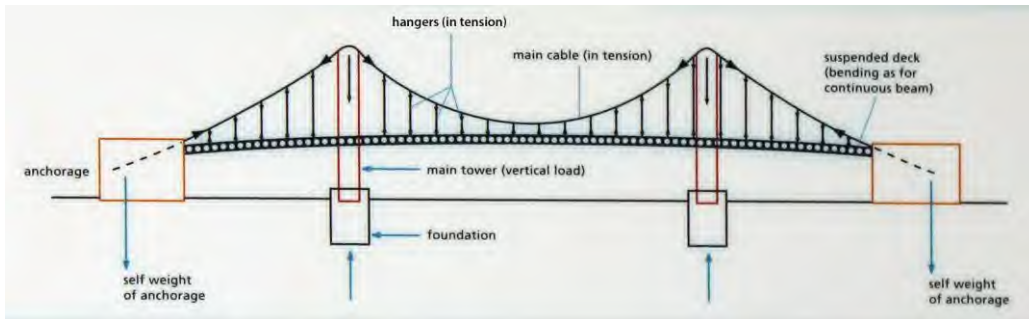


Tensile forces in cables put the deck into compression.

54

Suspension Bridges

55



Suspension Bridges

- * Tall Towers
- * Long Spans
- * Main cables
- * Vertical cables connect the deck to the main cables
- * Towers are supported on deep foundations (Caissons)

56

Mackinac Bridge



57

Ambassador Bridge

- ▶ Constructed: 1927 – 1929
- ▶ Longest Bridge in the world in 1929
- ▶ Main cables & center span replaced



58

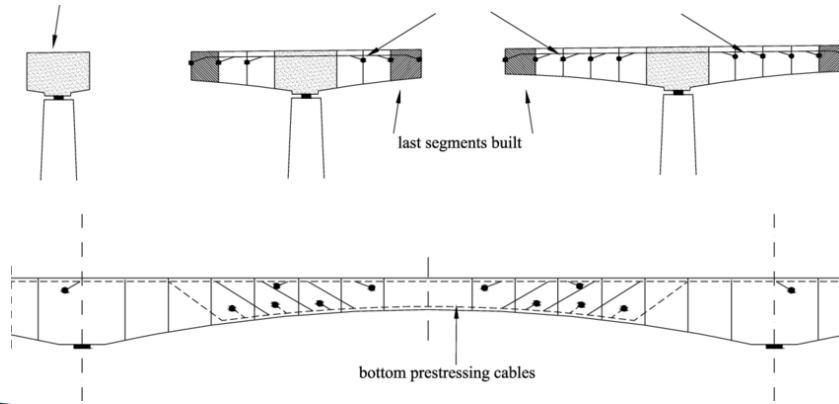
Can you name this
“not so famous”
suspension bridge?



59

Segmental Bridges

60



Segmental Bridges

- * Constructed of multiple segments
- * Can be pre-cast or cast in place
- * Post-tensioned
- * Capable of spanning long lengths
- * Good for horizontally curved Bridges

61

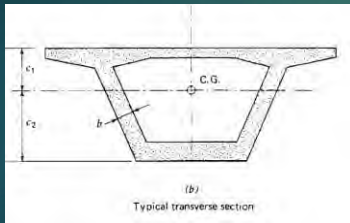
Zilwaukee Bridge

- ▶ Completed 1988
- ▶ 25 spans
- ▶ Max span length 392 Ft
- ▶ Overall structure length 8061 Ft



62

Launching gantry



Section thru Segment



63

Construction Accident August 28, 1982



➤ Rotation of cantilevers 11N & 11S

64

Z-Bridge Repair



Segment Hauler



65

Balanced Cantilever Erection with Launching Gantries



66



Curved Segmental Bridge

67

Segmental Bridge Characteristics

Constructed of many segments

Segments are pre-cast or cast in place

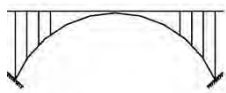
Post-tensioned

Capable of long spans

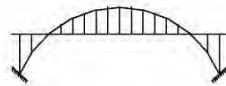
68

Arches and Tied Arches

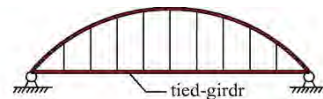
69



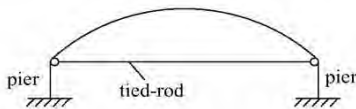
(a) Deck (true) arch



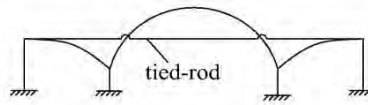
(b) Half-through true arch



(c) Through deck-stiffened arch



(d) Through rigid-framed tied arch



(e) Fly-bird-type' arch

Arch Bridges Types

70

Fixed Arch Bridge

- ▶ Deck/traffic loads distributed to the arch through spandrels
- ▶ Arch is put into compression by these forces
- ▶ The compressive forces in the arch are resisted by the foundation



71



72

Tied Arch



73

Tied Arch



- ▶ Gateway Arch Bridge
- ▶ Carries I-94 traffic over US-24, Telegraph Road

74

Blue water Bridge



75



October 1, 2019

76

Earth Filled Arch



D. R.
MI

77

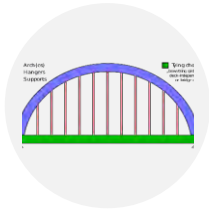
Concrete Cantilever Arch



Parke Lane Bridge
Over Thorofare Canal
Grosse Ile, Wayne County

78

Arch Bridge Characteristics



ARCH IN COMPRESSION



CAN BE TIED OR TRUE



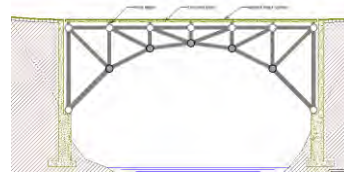
DECK OVER OR THRU

79

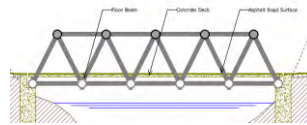
Truss Bridges

80

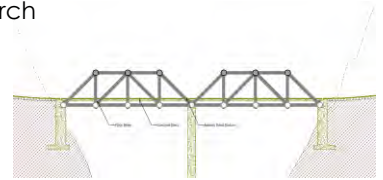
Truss Types



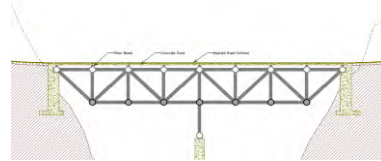
Pratt Deck Arch



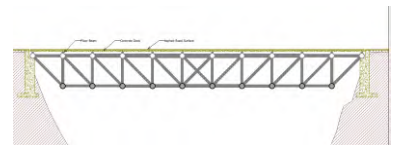
Warren Thru



Howe Thru

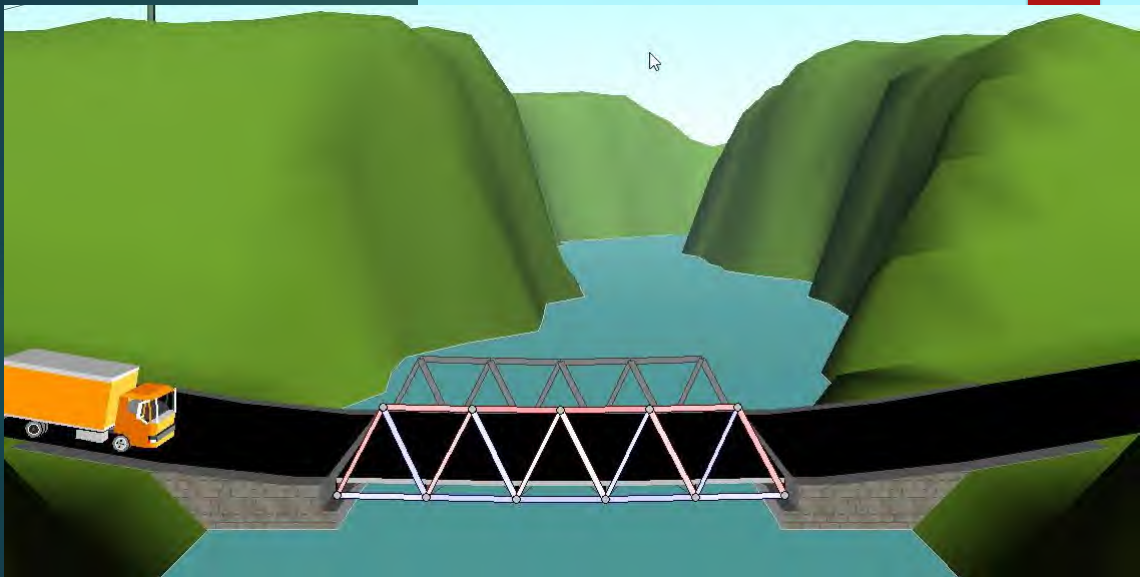


Warren Deck



Pratt Deck

81



82

Cut River Bridge



83

Cut River Bridge



84

Cooley Bridge



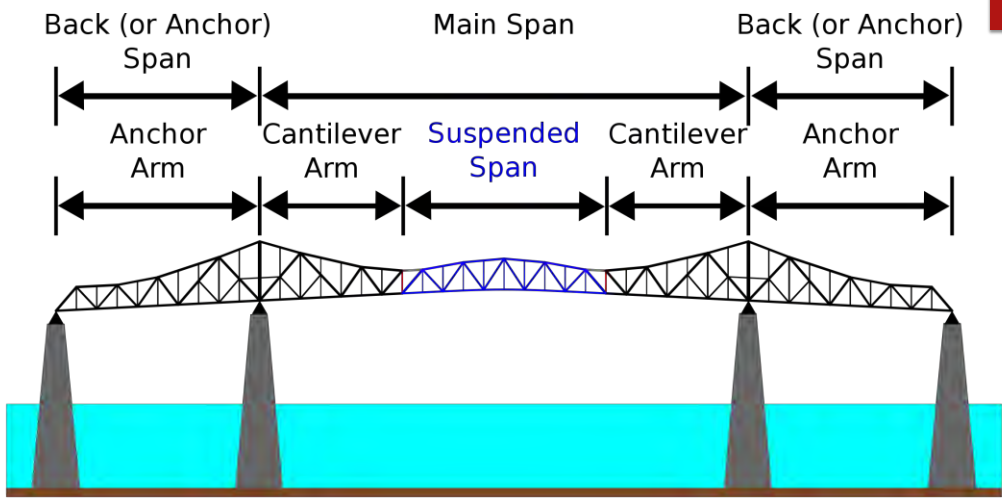
85

Cantilever Truss

- ▶ Name that bridge....you've seen it today.



86



87

Moveable Bridges

88

Fort Street Bascule Bridge



89

Fort Street Bascule Bridge



90

US-31 over the Grand River



91

Portage Lake Lift Bridge



92

Portage Lake Lift Bridge



93

Movable Bridge Characteristics



THEY MOVE

94

Beam/Girder Bridges

95

Beam and Girder Materials



Steel



Concrete



Wood

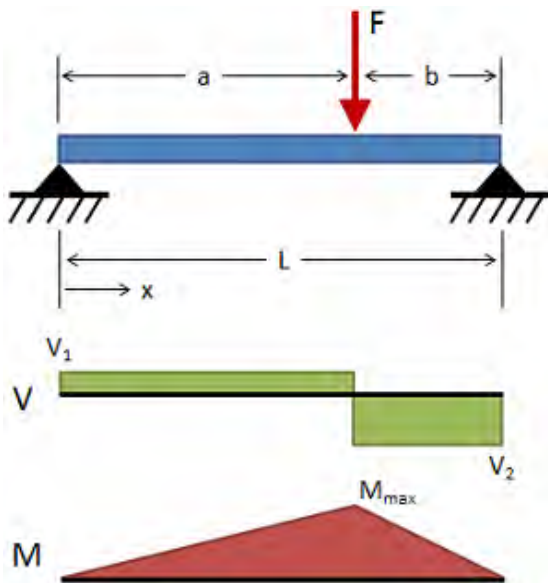
96

Beam/Girder

Simple span



97



Simply Supported Beams/Girders

98

Continuous Girders

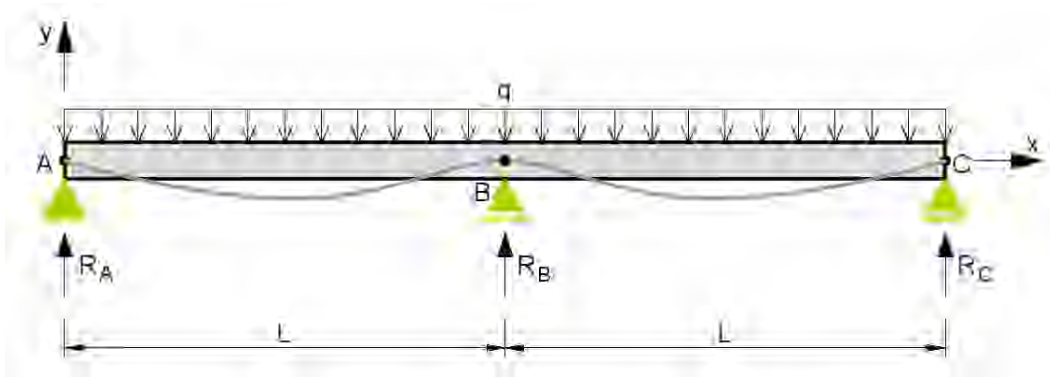


99

Continuous Girders



100



Continuous Girders

101

Prestressed Concrete Beams

- ▶ Bulb-T beams
- ▶ Michigan 1800



102

Pin & Hanger Bridges

- ▶ Older design
- ▶ Moves Joint away from substructure
- ▶ Still allows beam ends to deteriorate



103



QUESTIONS ? ? ?

104