AISC Live Webinars

Thank you for joining our live webinar today.
We will begin shortly. Please standby.

Thank you.

Need Help?
Call ReadyTalk Support: 800.843.9166

Bridge Erection –
A Construction Engineer's Perspective
January 21, 2020

Smarter. Stronger. Steel.

AISC Live Webinars

Today's live webinar will begin shortly. Please stand by.

As a reminder, all lines have been muted. Please type any questions or comments through the chat feature on the left portion of your screen.

Today's audio will be broadcast through the internet.
Alternatively, to hear the audio through the phone, dial:

(888)-378-4398
Passcode: 717907

Smarter. Stronger. Steel.

AISC Live Webinars

Audio Options

Today's audio will be broadcast through the internet.

Alternatively, to hear the audio through the phone, dial:

(888)-378-4398
Passcode: 717907

Smarter.
Stronger.
Steel.

AISC Live Webinars

AIA Credit

AISC is a Registered Provider with The American Institute of Architects Continuing Education Systems (AIA/CES). Credit(s) earned on completion of this program will be reported to AIA/CES for AIA members. Certificates of Completion for both AIA members and non-AIA members are available upon request.

This program is registered with AIA/CES for continuing professional education. As such, it does not include content that may be deemed or construed to be an approval or endorsement by the AIA of any material of construction or any method or manner of handling, using, distributing, or dealing in any material or product.

Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.

Smarter.
Stronger.
Steel.

AISC Live Webinars

Copyright Materials

The information presented herein is based on recognized engineering principles and is for general information only. While it is believed to be accurate, this information should not be applied to any specific application without competent professional examination and verification by a licensed professional engineer. Anyone making use of this information assumes all liability arising from such use.

Smarter.
Stronger.
Steel.

AISC Live Webinars

Course Description

Bridge Erection – A Construction Engineer's Perspective
January 21, 2020

To properly bid a bridge project, contractors have the responsibility to evaluate the site, the structure, and the specifications to develop a process for how they are going to build it. There can be confusion about the division of responsibility for ensuring a bridge is constructable. The speakers will review the thinking, planning, and strategies behind the development of a bid from a contractor/construction engineering team's perspective. They will also discuss how the current AASHTO specifications divide the responsibilities for ensuring bridge constructability, and the development of design loads for temporary structures during bridge erection.

Smarter.
Stronger.
Steel.

AISC Live Webinars

Learning Objectives

- List the issues that the construction engineer must consider when assessing the constructability of a bridge.
- Describe the responsibilities for the design engineer and contractor when documenting the erection plans for both conventional and complex steel bridges.
- Identify sources of construction loads and how to determine their load demands.
- Explain how the variables of environmental load duration and risk affect the stability of bridges and temporary structures during construction.

Smarter.
Stronger.
Steel.

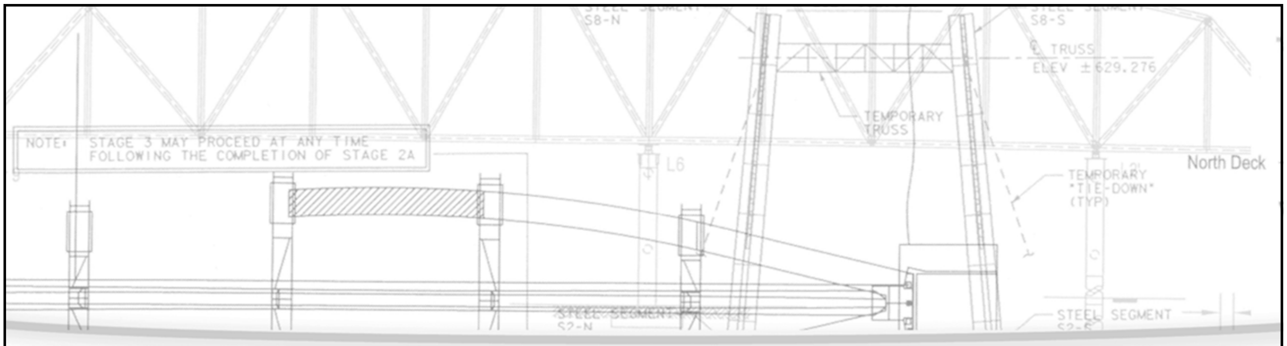
Bridge Erection – A Construction Engineer's Perspective

January 21, 2020

Dave Rogowski, PE
Principal / Owner
Genesis Structures
Kansas City, MO

Josh Crain, PE, SE
Senior Engineer
Genesis Structures
Kansas City, MO

Smarter.
Stronger.
Steel.



BRIDGE ERECTION

A CONSTRUCTION ENGINEER'S PERSPECTIVE

American Institute of Steel Construction (AISC)

GENESIS STRUCTURES

Presentation Overview

- Contractors and the 3-C's
- Constructability of Superstructures
- Design Loads for Temporary Structures
- Bridge Demolition and/or Re-decking
- Conclusions/Suggestions

10

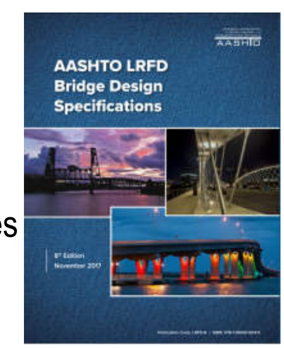
Presentation Overview

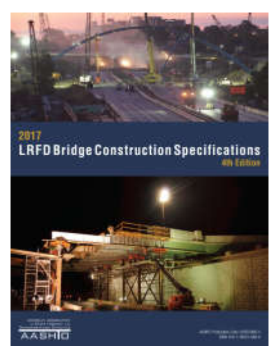
- Contractors and the 3-C's
  - Constructability
  - Costs
  - Competition
- Constructability of Superstructures
- Design Loads for Temporary Structures
- Bridge Demolition and/or Re-decking
- Conclusions/Suggestions

11

Presentation Overview

- Contractors and the 3-C's
- Constructability of Superstructures
  - Review of AASHTO Expectations
  - Review of Minimum Checks
- Design Loads for Temporary Structures
- Bridge Demolition and/or Re-decking
- Conclusions/Suggestions





12

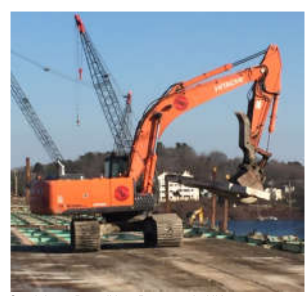
Presentation Overview

- Contractors and the 3-C's
- Constructability of Superstructures
- Design Loads for Temporary Structures
  - Equipment
  - Environment
- Bridge Demolition and/or Re-decking
- Conclusions/Suggestions

13

Presentation Overview

- Contractors and the 3-C's
- Constructability of Superstructures
- Design Loads for Temporary Structures
- Bridge Demolition and/or Re-decking
  - Stability of girders with equipment removing concrete decks
  - Most Demos/Re-decking for Bridges Designed with ASD
  - How will LRFD designed bridges hold up?
- Conclusions/Suggestions



Sarah Long Demolition, Portsmouth, NH

I-75 Deck Replacement, Detroit, MI

14

Presentation Overview

- Contractors and the 3-C's
- Constructability of Superstructures
- Design Loads for Temporary Structures
- Bridge Demolition and/or Re-decking
- Conclusions/Suggestions

Owners
Designer Engineers

Construction Engineers
Contractors

15

Presentation Overview

- Contractors and the 3-C's
- Constructability of Superstructures
- Design Loads for Temporary Structures
- Bridge Demolition and/or Re-decking
- Conclusions/Suggestions

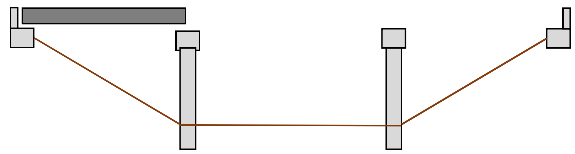
Owners
Designer Engineers

Construction Engineers
Contractors

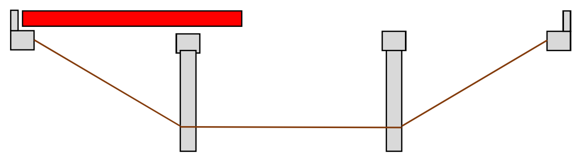
16

Side Note

- Steel/Precast



Simple 3-Span Precast Girder Bridge

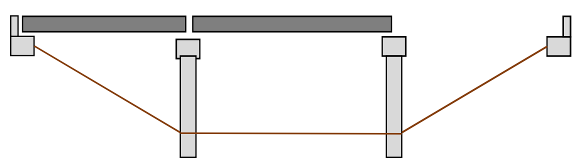


Simple 3-Span Continuous Steel Girder Bridge

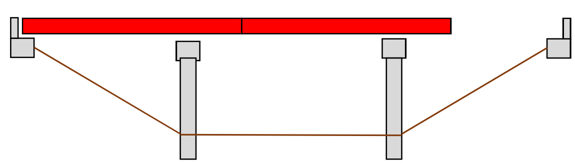
17

Side Note

- Steel/Precast
- Similar
  - Short Spans (<200 ft) / Conventional



Simple 3-Span Precast Girder Bridge

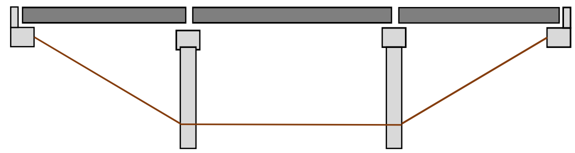


Simple 3-Span Continuous Steel Girder Bridge

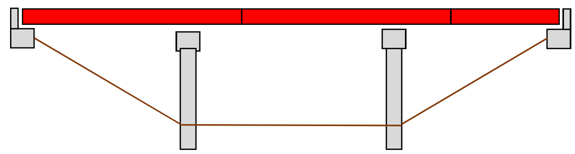
18

Side Note

- Steel/Precast
- Similar
  - Short Spans (<200 ft) / Conventional



Simple 3-Span Precast Girder Bridge



Simple 3-Span Continuous Steel Girder Bridge

19

Side Note

- Steel/Precast
- Similar ….. But Different
  - Short Spans (<200 ft) / Conventional
  - Long Spans (>200 ft) / Complex

Spliced Precast

Spliced Steel

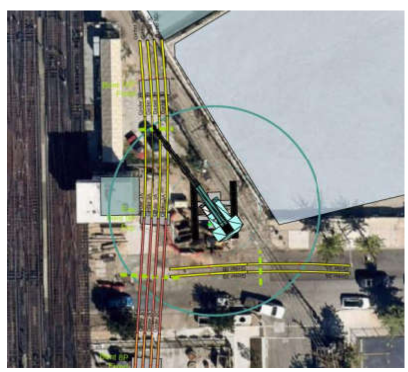
20

Contractors & the 3-C's

Constructability / Costs / Competition

Contractors & The 3-C's

- Constructability
  - Assessing site to determine direction and sequence of construction
    - Work from fixed pier preferred but not always possible
    - Working from one abutment to the other preferred but not always possible
    - Crane locations may be limited so girder erection must be planned ahead
    - Access may not be available so it has to be created
    - Access may not be available therefore dictating the construction method
    - Worker access must also be considered
  - Crane Sizing and Access
  - Girder Delivery

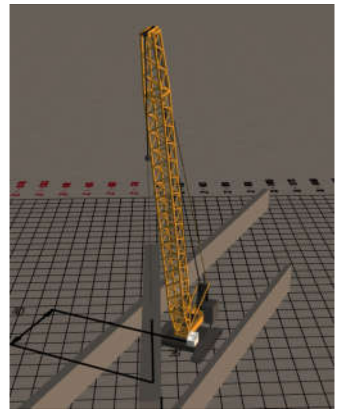


nearmap.com

22

Contractors & The 3-C's

- Constructability
  - Assessing site to determine direction and sequence of construction
    - Work from fixed pier preferred but not always possible
    - Working from one abutment to the other preferred but not always possible
    - Crane locations may be limited so girder erection must be planned ahead
    - Access may not be available so it has to be created
    - Access may not be available therefore dictating the construction method
    - Worker access must also be considered
  - Crane Sizing and Access
  - Girder Delivery



3D Lift Plan

23

Contractors & The 3-C's

- Constructability
  - Assessing site to determine direction and sequence of construction
    - Work from fixed pier preferred but not always possible
    - Working from one abutment to the other preferred but not always possible
    - Crane locations may be limited so girder erection must be planned ahead
    - Access may not be available so it has to be created
    - Access may not be available therefore dictating the construction method
    - Worker access must also be considered
  - Crane Sizing and Access
  - Girder Delivery

Whittier Memorial Bridge, Newburyport and Amesbury, MA

24

Contractors & The 3-C's

- Constructability
  - Assessing site to determine direction and sequence of construction
    - Work from fixed pier preferred but not always possible
    - Working from one abutment to the other preferred but not always possible
    - Crane locations may be limited so girder erection must be planned ahead
    - Access may not be available so it has to be created
    - Access may not be available therefore dictating the construction method
    - Worker access must also be considered
  - Crane Sizing and Access
  - Girder Delivery

Kate Shelly Replacement Bridge, Boone,IA

25

Contractors & The 3-C's

- Constructability
  - Assessing site to determine direction and sequence of construction
    - Work from fixed pier preferred but not always possible
    - Working from one abutment to the other preferred but not always possible
    - Crane locations may be limited so girder erection must be planned ahead
    - Access may not be available so it has to be created
    - Access may not be available therefore dictating the construction method
    - Worker access must also be considered
  - Crane Sizing and Access
  - Girder Delivery

US 20 – Iowa River Bridge

26

Contractors & The 3-C's

- Constructability
  - Assessing site to determine direction and sequence of construction
    - Work from fixed pier preferred but not always possible
    - Working from one abutment to the other preferred but not always possible
    - Crane locations may be limited so girder erection must be planned ahead
    - Access may not be available so it has to be created
    - Access may not be available therefore dictating the construction method
    - Worker access must also be considered
  - Crane Sizing and Access
  - Girder Delivery

Crum Creek Viaduct, Swarthmore, PA

27

Contractors & The 3-C's

- Constructability
  - Assessing site to determine direction and sequence of construction
    - Work from fixed pier preferred but not always possible
    - Working from one abutment to the other preferred but not always possible
    - Crane locations may be limited so girder erection must be planned ahead
    - Access may not be available so it has to be created
    - Access may not be available therefore dictating the construction method
    - Worker access must also be considered
  - Crane Sizing and Access
  - Girder Delivery

Crum Creek Viaduct, Swarthmore, PA

28

Contractors & The 3-C's

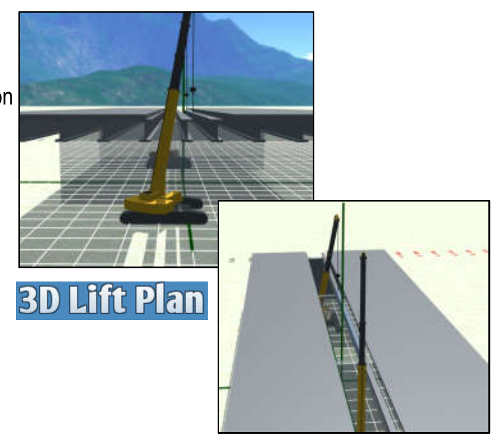
- Constructability
  - Assessing site to determine direction and sequence of construction
  - Crane Sizing and Access
    - What are the maximum picks?
    - What is the maximum pick radius?
    - Does the crane have clearance to make the pick?
    - Does a traditional crane even make sense?
    - How high are the girders from the base of the crane and what is the length of the required reach?
    - Land vs. water (same cranes have different capacities)?
    - Sometimes it takes an assist crane to set up the main crane
    - At the end of the day, safety is #1 priority
  - Girder Delivery

K7 over US24, Blue Springs, KS

29

Contractors & The 3-C's

- Constructability
  - Assessing site to determine direction and sequence of construction
  - Crane Sizing and Access
    - What are the maximum picks?
    - What is the maximum pick radius?
    - Does the crane have clearance to make the pick?
    - Does a traditional crane even make sense?
    - How high are the girders from the base of the crane and what is the length of the required reach?
    - Land vs. water (same cranes have different capacities)?
    - Sometimes it takes an assist crane to set up the main crane
    - At the end of the day, safety is #1 priority
  - Girder Delivery



30

Contractors & The 3-C's

- Constructability
  - Assessing site to determine direction and sequence of construction
  - Crane Sizing and Access
    - What are the maximum picks?
    - What is the maximum pick radius?
    - Does the crane have clearance to make the pick?
    - Does a traditional crane even make sense?
    - How high are the girders from the base of the crane and what is the length of the required reach?
    - Land vs. water (same cranes have different capacities)?
    - Sometimes it takes an assist crane to set up the main crane
    - At the end of the day, safety is #1 priority
  - Girder Delivery


Whittier Memorial Bridge, Newburyport and Amesbury, MA

31

Contractors & The 3-C's

- Constructability
  - Assessing site to determine direction and sequence of construction
  - Crane Sizing and Access
    - What are the maximum picks?
    - What is the maximum pick radius?
    - Does the crane have clearance to make the pick?
    - Does a traditional crane even make sense?
    - How high are the girders from the base of the crane and what is the length of the required reach?
    - Land vs. water (same cranes have different capacities)?
    - Sometimes it takes an assist crane to set up the main crane
    - At the end of the day, safety is #1 priority
  - Girder Delivery


Cleveland Innerbelt, Cleveland, OH

32

Contractors & The 3-C's

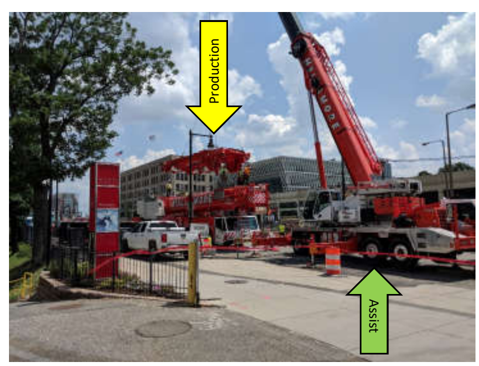
- Constructability
  - Assessing site to determine direction and sequence of construction
  - Crane Sizing and Access
    - What are the maximum picks?
    - What is the maximum pick radius?
    - Does the crane have clearance to make the pick?
    - Does a traditional crane even make sense?
    - How high are the girders from the base of the crane and what is the length of the required reach?
    - Land vs. water (same cranes have different capacities)?
    - Sometimes it takes an assist crane to set up the main crane
    - At the end of the day, safety is #1 priority
  - Girder Delivery

South Omaha Bridge – 4100 Ringer Crane

33

Contractors & The 3-C's

- Constructability
  - Assessing site to determine direction and sequence of construction
  - Crane Sizing and Access
    - What are the maximum picks?
    - What is the maximum pick radius?
    - Does the crane have clearance to make the pick?
    - Does a traditional crane even make sense?
    - How high are the girders from the base of the crane and what is the length of the required reach?
    - Land vs. water (same cranes have different capacities)?
    - Sometimes it takes an assist crane to set up the main crane
    - At the end of the day, safety is #1 priority
  - Girder Delivery



34

Contractors & The 3-C's

- Constructability
  - Assessing site to determine direction and sequence of construction
  - Crane Sizing and Access
    - What are the maximum picks?
    - What is the maximum pick radius?
    - Does the crane have clearance to make the pick?
    - Does a traditional crane even make sense?
    - How high are the girders from the base of the crane and what is the length of the required reach?
    - Land vs. water (same cranes have different capacities)?
    - Sometimes it takes an assist crane to set up the main crane
    - At the end of the day, safety is #1 priority
  - Girder Delivery

Images Courtesy of: www.cranesy.com

35

Contractors & The 3-C's

- Constructability
  - Assessing site to determine direction and sequence of construction
  - Crane Sizing and Access
  - Girder Delivery
    - Trucks deliver directly within reach of the crane
    - Cranes may have to receive load and then walk with a load
      Crawler – Yes
      Hydraulic on Outriggers – No
    - How are girders delivered to the site?
    - Girder length, weight or delivery position may require two cranes
    - Sometimes the girders are too tall so they are delivered horizontally and require to be unloaded, set down and then tripped to vertical (two extra crane moves)

Boone County, IA

36

Contractors & The 3-C's

- Constructability
  - Assessing site to determine direction and sequence of construction
  - Crane Sizing and Access
  - Girder Delivery
    - Trucks deliver directly within reach of the crane
    - Cranes may have to receive load and then walk with a load
      Crawler – Yes
      Hydraulic on Outriggers – No
    - How are girders delivered to the site?
    - Girder length, weight or delivery position may require two cranes
    - Sometimes the girders are too tall so they are delivered horizontally and require to be unloaded, set down and then tripped to vertical (two extra crane moves)

Sandy Hook Sub Division, UPRR, MO

37

Contractors & The 3-C's

Prairie Star Parkway, Lenexa, KS

- Constructability
  - Assessing site to determine direction and sequence of construction
  - Crane Sizing and Access
  - Girder Delivery
    - Trucks deliver directly within reach of the crane
    - Cranes may have to receive load and then walk with a load
      Crawler – Yes
      Hydraulic on Outriggers – No
    - How are girders delivered to the site?
    - Girder length, weight or delivery position may require two cranes
    - Sometimes the girders are too tall so they are delivered horizontally and require to be unloaded, set down and then tripped to vertical (two extra crane moves)

38

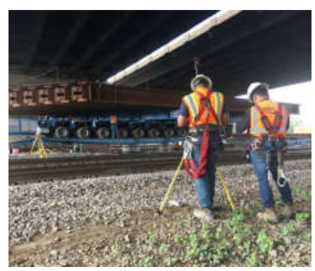
Contractors & The 3-C's

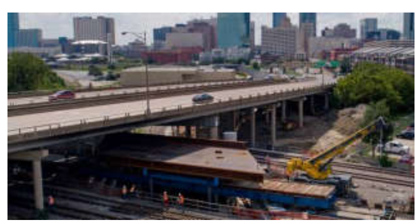
- Constructability
  - Assessing site to determine direction and sequence of construction
  - Crane Sizing and Access
  - Girder Delivery
    - Trucks deliver directly within reach of the crane
    - Cranes may have to receive load and then walk with a load
      Crawler – Yes
      Hydraulic on Outriggers – No
    - How are girders delivered to the site?
    - Girder length, weight or delivery position may require two cranes
    - Sometimes the girders are too tall so they are delivered horizontally and require to be unloaded, set down and then tripped to vertical (two extra crane moves)

39

Contractors & The 3-C's

- Constructability
  - Assessing site to determine direction and sequence of construction
  - Crane Sizing and Access
  - Girder Delivery
    - Trucks deliver directly within reach of the crane
    - Cranes may have to receive load and then walk with a load
      Crawler – Yes
      Hydraulic on Outriggers – No
    - How are girders delivered to the site?
    - Girder length, weight or delivery position may require two cranes
    - Sometimes the girders are too tall so they are delivered horizontally and require to be unloaded, set down and then tripped to vertical (two extra crane moves)





Hole In The Wall, Fort Worth, TX

40

Contractors & The 3-C’s

- Constructability
  - Assessing site to determine direction and sequence of construction
  - Crane Sizing and Access
  - Girder Delivery
    - Trucks deliver directly within reach of the crane
    - Cranes may have to receive load and then walk with a load
      Crawler – Yes
      Hydraulic on Outriggers – No
    - How are girders delivered to the site?
    - Girder length, weight or delivery position may require two cranes
    - Sometimes the girders are too tall so they are delivered horizontally and require to be unloaded, set down and then tripped to vertical (two extra crane moves)

MLK Bridge Replacement, Toledo, OH

41

Contractors & The 3-C’s

- Constructability
  - Assessing site to determine direction and sequence of construction
  - Crane Sizing and Access
  - Girder Delivery
    - Trucks deliver directly within reach of the crane
    - Cranes may have to receive load and then walk with a load
      Crawler – Yes
      Hydraulic on Outriggers – No
    - How are girders delivered to the site?
    - Girder length, weight or delivery position may require two cranes
    - Sometimes the girders are too tall so they are delivered horizontally and require to be unloaded, set down and then tripped to vertical (two extra crane moves)

Fore River, Quincy, MA

42

Contractors & The 3-C's

- Constructability
  - Assessing site to determine direction and sequence of construction
  - Crane Sizing and Access
  - Girder Delivery
    - Trucks deliver directly within reach of the crane
    - Cranes may have to receive load and then walk with a load
      Crawler – Yes
      Hydraulic on Outriggers – No
    - How are girders delivered to the site?
    - Girder length, weight or delivery position may require two cranes
    - Sometimes the girders are too tall so they are delivered horizontally and require to be unloaded, set down and then tripped to vertical (two extra crane moves)

KY 152 over Herrington Lake, Mercer and Garrard Counties, KY

43

Contractors & The 3-C's

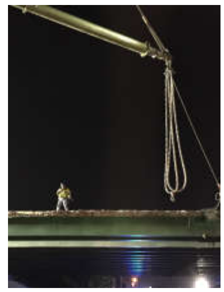
- Constructability
  - Assessing site to determine direction and sequence of construction
  - Crane Sizing and Access
  - Girder Delivery
    - Trucks deliver directly within reach of the crane
    - Cranes may have to receive load and then walk with a load
      Crawler – Yes
      Hydraulic on Outriggers – No
    - How are girders delivered to the site?
    - Girder length, weight or delivery position may require two cranes
    - Sometimes the girders are too tall so they are delivered horizontally and require to be unloaded, set down and then tripped to vertical (two extra crane moves)

Cleveland Innerbelt, Cleveland, OH

44

Contractors & The 3-C's

- Constructability (Cont.)
  - Rigging and Segment Stability
    - Picking girders (flange grabs, underslung slings, bolted/welded picking eyes)
    - Picking girders (spreader beams and picking trees)
    - Single Girder Picks vs. Paired Girder Picks
    - Temporary Top Flange Lateral Bracing (Stability Truss) to Erect
    - Temporary Lateral Bracing to Stabilize before Decking
  - Temporary Towers
  - Environmental Conditions
  - Overhangs
  - Demolition



45

Contractors & The 3-C's

- Constructability (Cont.)
  - Rigging and Segment Stability
    - Picking girders (flange grabs, underslung slings, bolted/welded picking eyes)
    - Picking girders (spreader beams and picking trees)
    - Single Girder Picks vs. Paired Girder Picks
    - Temporary Top Flange Lateral Bracing (Stability Truss) to Erect
    - Temporary Lateral Bracing to Stabilize before Decking
  - Temporary Towers
  - Environmental Conditions
  - Overhangs
  - Demolition

Cleveland Innerbelt, Cleveland, OH

46

Contractors & The 3-C's

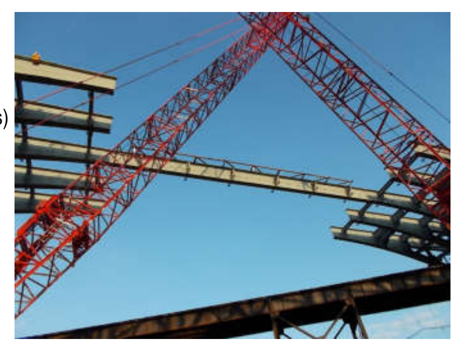
- Constructability (Cont.)
  - Rigging and Segment Stability
    - Picking girders (flange grabs, underslung slings, bolted/welded picking eyes)
    - Picking girders (spreader beams and picking trees)
    - Single Girder Picks vs. Paired Girder Picks
    - Temporary Top Flange Lateral Bracing (Stability Truss) to Erect
    - Temporary Lateral Bracing to Stabilize before Decking
  - Temporary Towers
  - Environmental Conditions
  - Overhangs
  - Demolition

Comm. Ave Bridge, Boston, MA

47

Contractors & The 3-C's

- Constructability (Cont.)
  - Rigging and Segment Stability
    - Picking girders (flange grabs, underslung slings, bolted/welded picking eyes)
    - Picking girders (spreader beams and picking trees)
    - Single Girder Picks vs. Paired Girder Picks
    - Temporary Top Flange Lateral Bracing (Stability Truss) to Erect
    - Temporary Lateral Bracing to Stabilize before Decking
  - Temporary Towers
  - Environmental Conditions
  - Overhangs
  - Demolition

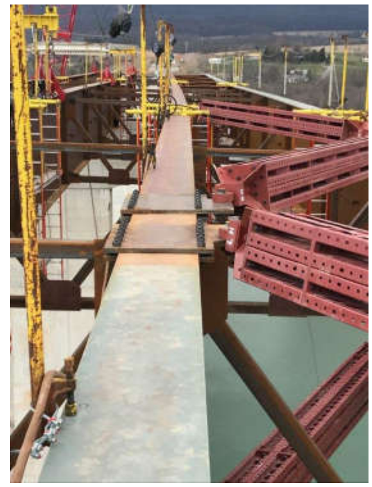


Cleveland Innerbelt, Cleveland, OH

48

Contractors & The 3-C's

- Constructability (Cont.)
  - Rigging and Segment Stability
    - Picking girders (flange grabs, underslung slings, bolted/welded picking eyes)
    - Picking girders (spreader beams and picking trees)
    - Single Girder Picks vs. Paired Girder Picks
    - Temporary Top Flange Lateral Bracing (Stability Truss) to Erect
    - Temporary Lateral Bracing to Stabilize before Decking
  - Temporary Towers
  - Environmental Conditions
  - Overhangs
  - Demolition

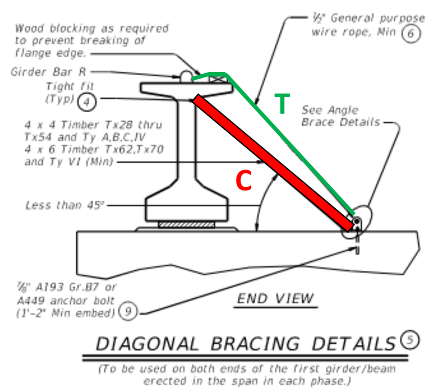


CSVT Project, Pennsylvania

49

Contractors & The 3-C's

- Constructability (Cont.)
  - Rigging and Segment Stability
    - Picking girders (flange grabs, underslung slings, bolted/welded pickir
    - Picking girders (spreader beams and picking trees)
    - Single Girder Picks vs. Paired Girder Picks
    - Temporary Top Flange Lateral Bracing (Stability Truss) to Erect
    - Temporary Lateral Bracing to Stabilize before Decking
  - Temporary Towers
  - Environmental Conditions
  - Overhangs
  - Demolition



50

Contractors & The 3-C's

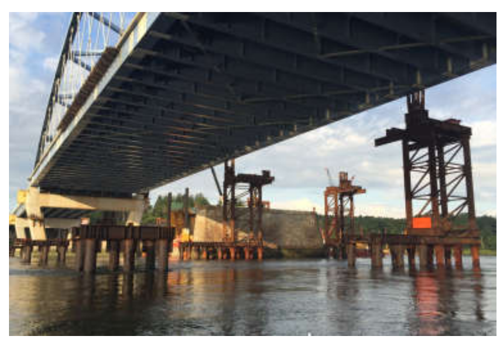
- Constructability (Cont.)
  - Rigging and Segment Stability
  - Temporary Towers
    - Length of spans, number of girder segments in a span, the curvature of the girder, crane size, crane and delivery access all factor into the need
    - Pre-Manufactured
    - Built to fit the Need
    - Some are so unique there may not be a possible re-use
  - Environmental Conditions
  - Overhangs
  - Demolition


I-94 & I-69 Interchange, Port Huron, MI

51

Contractors & The 3-C's

- Constructability (Cont.)
  - Rigging and Segment Stability
  - Temporary Towers
    - Length of spans, number of girder segments in a span, the curvature of the girder, crane size, crane and delivery access all factor into the need
    - Pre-Manufactured
    - Built to fit the Need
    - Some are so unique there may not be a possible re-use
  - Environmental Conditions
  - Overhangs
  - Demolition


Whittier Memorial Bridge, Newburyport and Amesbury, MA

52

Contractors & The 3-C's

- Constructability (Cont.)
  - Rigging and Segment Stability
  - Temporary Towers
    - Length of spans, number of girder segments in a span, the curvature of the girder, crane size, crane and delivery access all factor into the need
    - Pre-Manufactured
    - Built to fit the Need
    - Some are so unique there may not be a possible re-use
  - Environmental Conditions
  - Overhangs
  - Demolition

Cleveland Innerbelt, Cleveland, OH

53

Contractors & The 3-C's

- Constructability (Cont.)
  - Rigging and Segment Stability
  - Temporary Towers
    - Length of spans, number of girder segments in a span, the curvature of the girder, crane size, crane and delivery access all factor into the need
    - Pre-Manufactured
    - Built to fit the Need
    - Some are so unique there may not be a possible re-use
  - Environmental Conditions
  - Overhangs
  - Demolition

Cleveland Innerbelt, Cleveland, OH

54

Contractors & The 3-C's

- Constructability (Cont.)
  - Rigging and Segment Stability
  - Temporary Towers
  - Environmental Conditions
    - Temperature can affect the erected structure (especially orientation of the girders and time of day)
    - Wind impacts on erected girders (initial release, fully erected during deck forming)
  - Overhangs
  - Demolition

55

Contractors & The 3-C's

- Constructability (Cont.)
  - Rigging and Segment Stability
  - Temporary Towers
  - Environmental Conditions
    - Temperature can affect the erected structure (especially orientation of the girders and time of day)
    - Wind impacts on erected girders (initial release, fully erected during deck forming)
  - Overhangs
  - Demolition

Blennerhasset Island Bridge, Parkersburg, WV

56

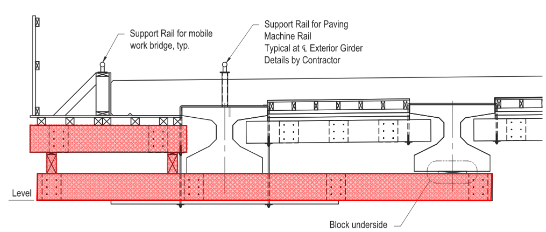
Contractors & The 3-C's

- Constructability (Cont.)
  - Rigging and Segment Stability
  - Temporary Towers
  - Environmental Conditions
  - Overhangs
    - Bracket Type
    - Special Conditions
    - Finishing Machine
  - Demolition

57

Contractors & The 3-C's

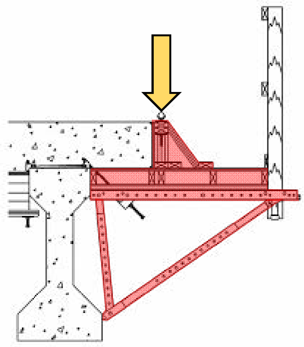
- Constructability (Cont.)
  - Rigging and Segment Stability
  - Temporary Towers
  - Environmental Conditions
  - Overhangs
    - Bracket Type
    - Special Conditions
    - Finishing Machine
  - Demolition

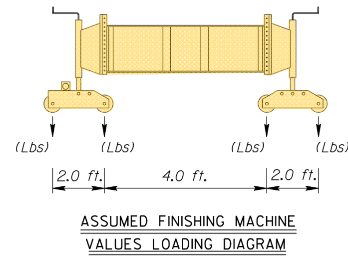


58

Contractors & The 3-C's

- Constructability (Cont.)
  - Rigging and Segment Stability
  - Temporary Towers
  - Environmental Conditions
  - Overhangs
    - Bracket Type
    - Special Conditions
    - Finishing Machine
  - Demolition

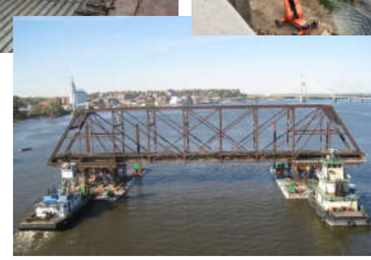




59

Contractors & The 3-C's

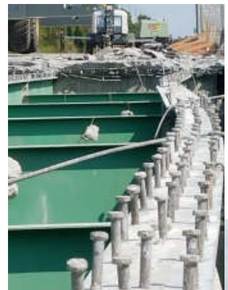
- Constructability (Cont.)
  - Rigging and Segment Stability
  - Temporary Towers
  - Environmental Conditions
  - Demolition
    - How do we need to remove the bridge?
    - How does this bridge want to come down? …. Safely!!!
    - How do we get rid of the debris?



60

Contractors & The 3-C's

- Constructability (Cont.)
  - Rigging and Segment Stability
  - Temporary Towers
  - Environmental Conditions
  - Demolition
    - How do we need to remove the bridge?
    - How does this bridge want to come down? …. Safely!!!
    - How do we get rid of the debris?




61

Contractors & The 3-C's

- Constructability (Cont.)
  - Rigging and Segment Stability
  - Temporary Towers
  - Environmental Conditions
  - Demolition
    - How do we need to remove the bridge?
    - How does this bridge want to come down? …. Safely!!!
    - How do we get rid of the debris?



62

Contractors & The 3-C's

- Costs
  - Crane Rental/Mobilization
    - Size of crane
    - Duration of time on site
    - Shared needs vs. multiple crane sizes
  - Material
  - Labor Forces
  - Temporary Structures
  - Crane Work Platforms
  - Finishes/Coatings
  - Schedule

63

Contractors & The 3-C's

- Costs
  - Crane Rental/Mobilization
  - Material
    - Costs can fluctuate with demand
    - Expediting delivery schedules will generally increase costs
    - When contractors are asked to hold prices for extended periods cost can increase
  - Labor Forces
  - Temporary Structures
  - Crane Work Platforms
  - Finishes/Coatings
  - Schedule

64

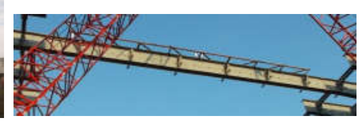
Contractors & The 3-C's

- Costs
  - Crane Rental/Mobilization
  - Material
  - Labor Forces
    - Union vs. Non-Union Locations
    - Laborers, Operators, Project Managers, Project Engineers
  - Temporary Structures
  - Crane Work Platforms
  - Finishes/Coatings
  - Schedule

65

Contractors & The 3-C's

- Costs
  - Crane Rental/Mobilization
  - Material
  - Labor Forces
  - Temporary Structures
    - Foundations, Erect, Remove, Temporary Lane Closures
    - Top Flange Bracing (stability trusses)
    - Bottom Flange Lagging – DOT requirements
  - Crane Work Platforms
  - Finishes/Coatings
  - Schedule



66

Contractors & The 3-C's

- Costs
  - Crane Rental/Mobilization
  - Material
  - Labor Forces
  - Temporary Structures
  - Crane Work Platforms
    - Crane Mats
    - Grading to Level Zones/Temporary Access Roads
    - Barges/Bulkheads/Trestles for water operations
  - Finishes/Coatings
  - Schedule




67

Contractors & The 3-C's

- Costs
  - Crane Rental/Mobilization
  - Material
  - Labor Forces
  - Temporary Structures
  - Crane Work Platforms
  - Finishes/Coatings
    - Steel – Weathering, Primed & Painted, Metalized, Primed, Painted over Metalized (extreme cases)
    - Precast - Some DOT's paint precast for aesthetics
  - Schedule


68

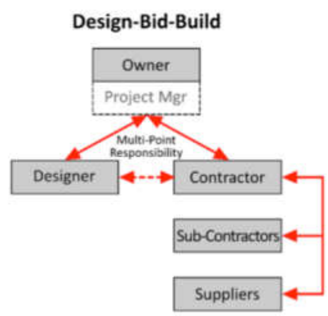
Contractors & The 3-C's

- Costs
  - Crane Rental/Mobilization
  - Material
  - Labor Forces
  - Temporary Structures
  - Crane Work Platforms
  - Finishes/Coatings
  - Schedule
    - Time is money >>> the more temporary works, the longer the erection schedule
    - Time is money >>> the more special care required in the field, the longer the erection schedule
    - Time is money >>> repairs to steel finishes or precast concrete corners can be expensive and extend the project schedule

69

Contractors & The 3-C's

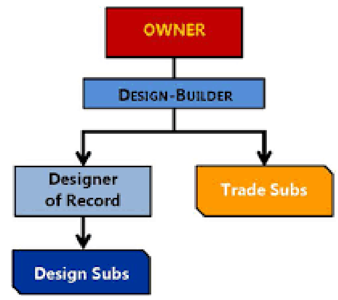
- Competition
  - Traditional Design-Bid-Build Project Delivery
    - What are my competitors doing?
    - What special equipment do my competitors own that I have to lease/purchase?
    - What location advantages do my competitors have?
  - Design Build Project Delivery
  - Construction Manager General Contractor (CMGC) Project Delivery



70

Contractors & The 3-C's

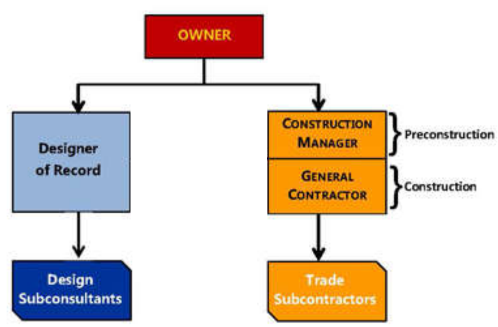
- Competition
  - Traditional Design-Bid-Build Project Delivery
  - Design Build Project Delivery
    - Best Idea and Price will win
    - The idea phase is pre-bid and may or may not be fully disclosed to the DOT's (ATC's)
    - Contractors/Designers
    - Sometimes missing is the Construction Engineer that is "bi-lingual"
      - Engineer who can speak the language of the Designer and the Contractor
  - Construction Manager General Contractor (CMGC) Project Delivery



71

Contractors & The 3-C's

- Competition
  - Traditional Design-Bid-Build Project Delivery
  - Design Build Project Delivery
  - Construction Manager General Contractor (CMGC) Project Delivery
    - Best Ideas are Discussed between Contractor/Designer/Owners after team selection
    - The idea phase is pre-final bid but costs and schedule and design are discussed with the owner's full knowledge



72

Constructability of Superstructures

Who is responsible for what and when?

TYPICAL DESIGN BID BUILD

Owner / DOT → Engineer of Record → Contractor

74

Who is responsible for what and when?

TYPICAL DESIGN BID BUILD

Owner / DOT → Engineer of Record → Contractor

We need a bridge

Has to be:
- **Affordable**
- **Safe**
- **Durable**

Don't want any unforeseen issues in construction

75

Who is responsible for what and when?

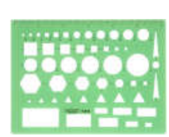
TYPICAL DESIGN BID BUILD

Owner / DOT → Engineer of Record → Contractor

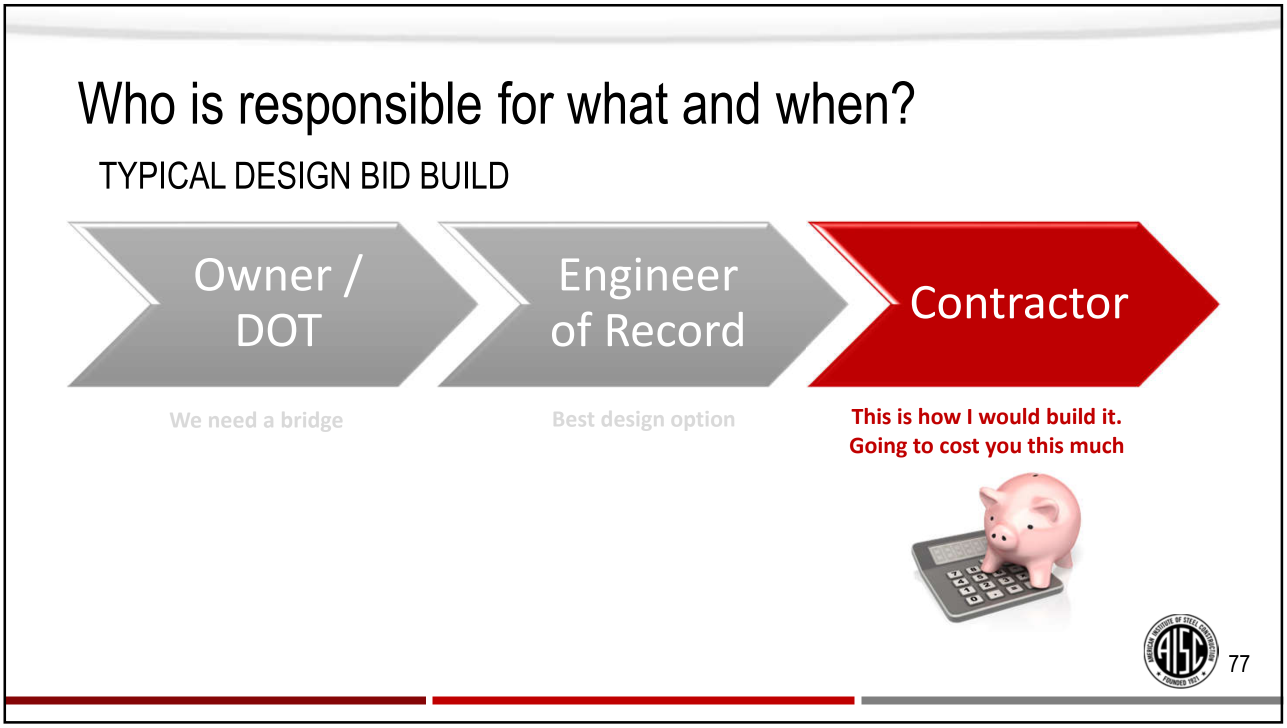
We need a bridge

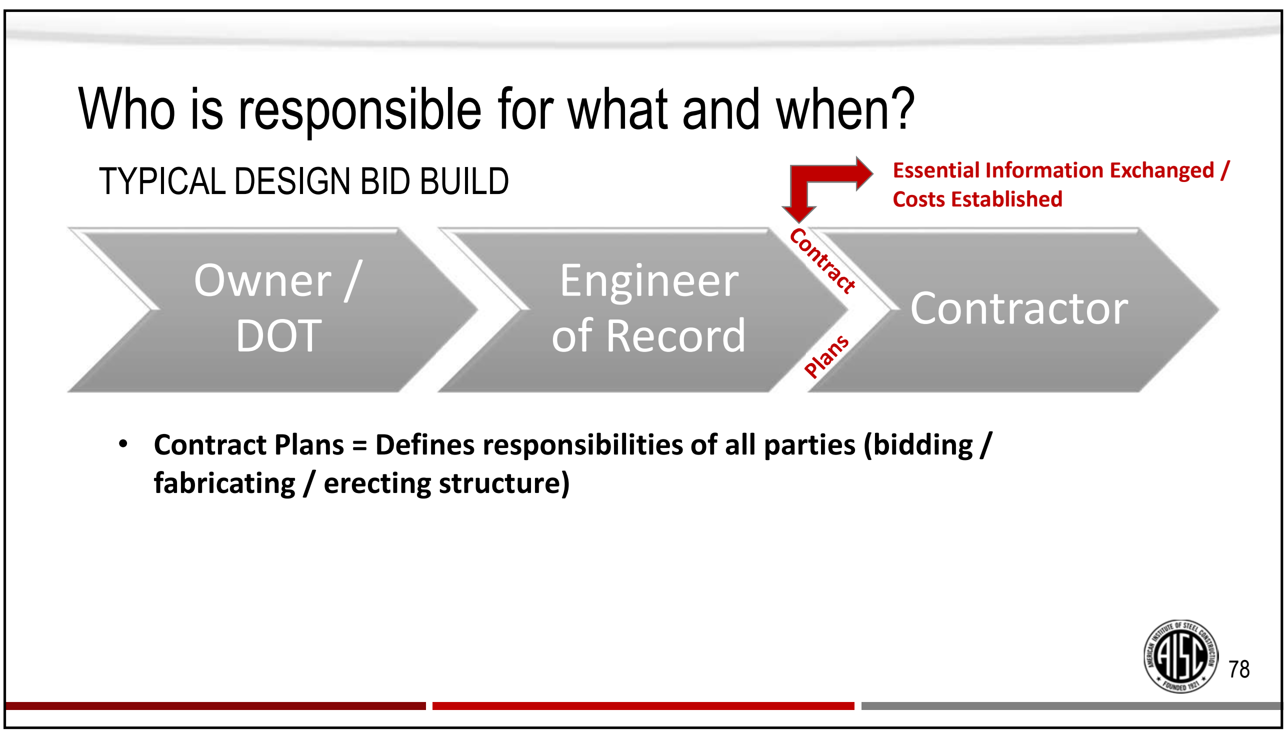
Best design option

(3) 250-ft steel girders spans.
Needs to have an 800-ft Radius

76


Who is responsible for what and when?
TYPICAL DESIGN BID BUILD
Owner / DOT
Engineer of Record
Contractor
We need a bridge
Best design option
This is how I would build it.
Going to cost you this much
77

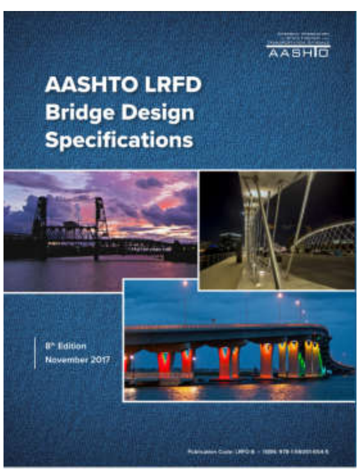

Who is responsible for what and when?
TYPICAL DESIGN BID BUILD
Essential Information Exchanged / Costs Established
Owner / DOT
Engineer of Record
Contract Plans
Contractor
• Contract Plans = Defines responsibilities of all parties (bidding / fabricating / erecting structure)
78

Who is responsible for what and when?

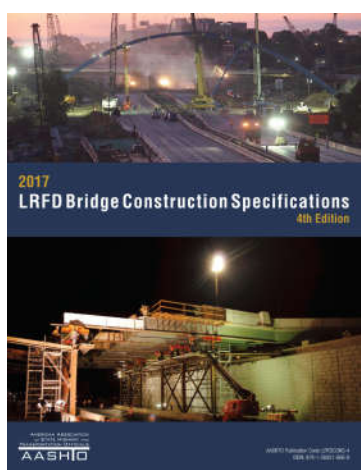
- When is a bridge complex enough so engineering is required to ensure constructability or stability during erection?
- When should a Department of Transportation (DOT) / Engineer of Record (EOR) make Contractors aware of limitations during construction?
- When does the DOT / EOR owe a Contractor a suggested erection sequence?
- What do the AASHTO Specifications say?

79

AASHTO Specifications



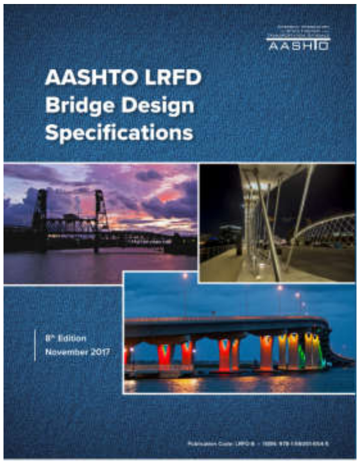
AASHTO Bridge Design Spec.



AASHTO Bridge Construction Specs.

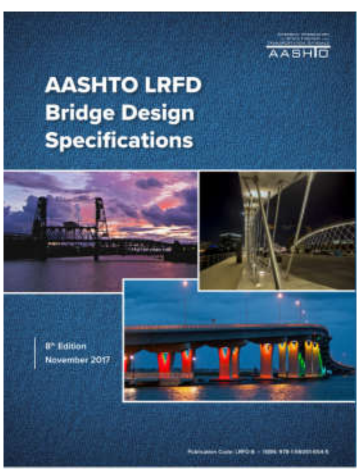
80

AASHTO Bridge Design Specifications



81

AASHTO Bridge Design Specifications



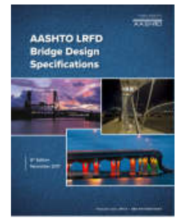
Key Sections:

Chapter	Sections
Chapter 2 General Design and Location Features	• 2.5.3 – Constructibility
Chapter 5 Concrete Structures	• 5.12 – Provisions for Structure Components and Types
Chapter 6 Steel Structures	• 6.10.3 – Steel I-Section Constructibility • 6.11.3 – Box Section

82

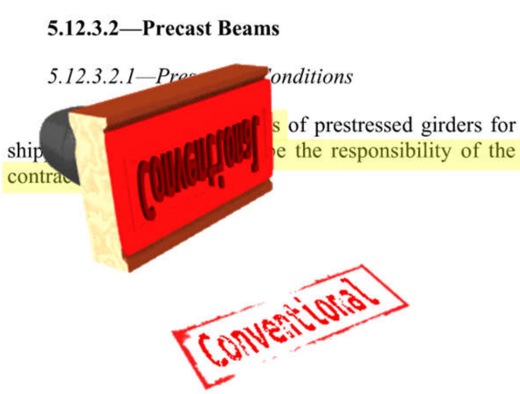
AASHTO – Constructibility

- 2.5.3: This section specifies, "Bridges should be designed in a manner such that fabrication and erection can be performed without undue difficulty or distress and that locked in construction force effects are within tolerable limits."
- 2.5.3 (Cont.): Where the bridge is of unusual complexity, such as that would be unreasonable to expect an experienced contractor to predict and estimate a suitable method of construction while bidding the project, at least one feasible construction method shall be indicated in the contract documents. If the design requires some strengthening and/or temporary bracing or support during erection by the selected method, indication of the need thereof shall be indicated in the contract documents.



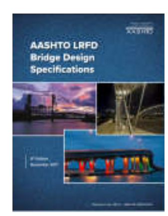
83

Precast Beams


5.12.3.2—Precast Beams

5.12.3.2.1—Pre... ...onditions

...s of prestressed girders for ship... ...e the responsibility of the contra...



84

Spliced Precast Girders

5.12.3.4—Spliced Precast Girders

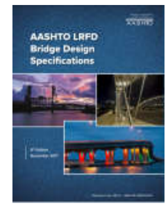
The method of construction assumed for the design shall be shown in the contract documents. All supports required prior to the splicing of the girder shall be shown on the contract docum... uding elevations and reactions. The ... on during which the tempo... hall also be shown on the co...

Th... l indicate alternative methods o... and the Contractor's responsibili... s are chosen. Any changes by the Con... construction method or to the design shall ... y with the requirements of Article 5.12.5.5.

Complex

Complex

Images Courtesy of: www.post-tensioning.org



85

Segmental Concrete Bridges

5.12.5—Segmental Concrete Bridges

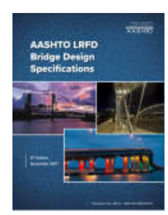
The method of construction assumed for the design shall be shown in the contract documents. Temporary supports required prior to the time the structure, or component thereof, is ... f supporting itself and subsequently ... also be shown in the contr...

... ll indicate alternative meth... l and the Contractor's responsi... ds are chosen. Any changes b... ne construction method or in the des... mply with the requirements of Article 5.12...

Complex

Complex

Images Courtesy of: http://www.asbi-assoc.org/

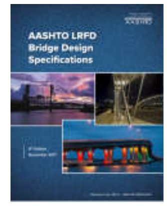


86

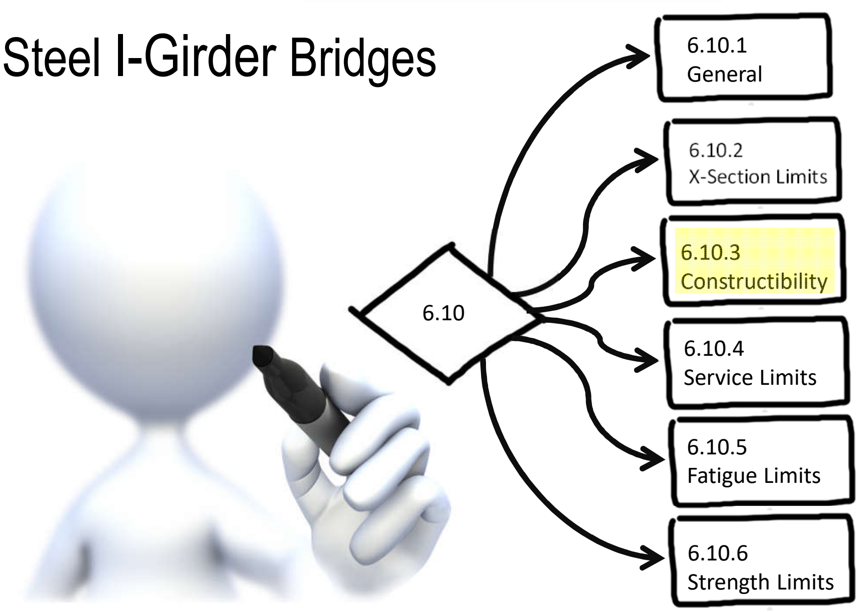
Segmental Concrete Bridges

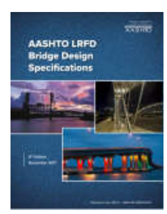
Table 5.12.5.3.3-1—Load Factors and Tensile Stress Limits for Construction Load Combinations

Load Combination	LOAD FACTORS																STRESS LIMITS				See Note
	Dead Load			Live Load			Wind Load			Other Loads					Earth Loads		Flexural Tension		Principal Tension		
	DC *DW*	*DIFF*	*U*	*CEQ* *CLL*	*IE*	*CLE*	*WS*	*WUP*	*WE*	*CR*	*SH*	*TU*	*TG*	A AI *WA*	*EH* *EV* *ES*		Excluding "Other Loads"	Including "Other Loads"	Excluding "Other Loads"	Including "Other Loads"	
a	1.0	1.0	0.0	1.0	1.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	γ_{TG}	1.0	1.0		$0.190\sqrt{f'_c}$	$0.220\sqrt{f'_c}$	$0.110\sqrt{f'_c}$	$0.126\sqrt{f'_c}$	—
b	1.0	0.0	1.0	1.0	1.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	γ_{TG}	1.0	1.0		$0.190\sqrt{f'_c}$	$0.220\sqrt{f'_c}$	$0.110\sqrt{f'_c}$	$0.126\sqrt{f'_c}$	—
c	1.0	1.0	0.0	0.0	0.0	0.0	0.7	0.7	0.0	1.0	1.0	1.0	γ_{TG}	1.0	1.0		$0.190\sqrt{f'_c}$	$0.220\sqrt{f'_c}$	$0.110\sqrt{f'_c}$	$0.126\sqrt{f'_c}$	—
d	1.0	1.0	0.0	1.0	0.0	0.0	0.7	1.0	0.7	1.0	1.0	1.0	γ_{TG}	1.0	1.0		$0.190\sqrt{f'_c}$	$0.220\sqrt{f'_c}$	$0.110\sqrt{f'_c}$	$0.126\sqrt{f'_c}$	1
e	1.0	0.0	1.0	1.0	1.0	0.0	0.3	0.0	0.3	1.0	1.0	1.0	γ_{TG}	1.0	1.0		$0.190\sqrt{f'_c}$	$0.220\sqrt{f'_c}$	$0.110\sqrt{f'_c}$	$0.126\sqrt{f'_c}$	2
f	1.0	0.0	0.0	1.0	1.0	1.0	0.3	0.0	0.3	1.0	1.0	1.0	γ_{TG}	1.0	1.0		$0.190\sqrt{f'_c}$	$0.220\sqrt{f'_c}$	$0.110\sqrt{f'_c}$	$0.126\sqrt{f'_c}$	3



Steel I-Girder Bridges





Steel I-Girder Bridges - Constructibility

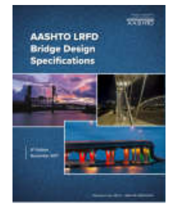
6.10.3—Constructibility

6.10.3.1—General

The provisions of Article 2.5.3 shall apply. In addition to providing adequate strength, nominal yielding or reliance on post-buckling resistance shall not be permitted for main load-carrying members during critical stages of construction, except for yielding of the web in hybrid sections. This shall be accomplished by satisfying the requirements of Articles 6.10.3.2 and 6.10.3.3 at each critical construction stage. For sections in positive flexure that are composite in the final condition, but are noncomposite during construction, the provisions of Article 6.10.3.4 shall apply. For investigating the constructibility of flexural members, all loads shall be factored as specified in Article 3.4.2. For the calculation of deflections, the load factors shall be taken as 1.0.

Potential uplift at bearings shall be investigated at each critical construction stage.

Webs without bearing stiffeners at locations subjected to concentrated loads not transmitted through a deck or deck system shall satisfy the provisions of Article D6.5.



89

Steel I-Girder Bridges - Constructibility

6.10.3.2.1—Discretely Braced Flanges in Compression

For critical stages of construction, each of the following requirements shall be satisfied. For sections with slender webs, Eq. 6.10.3.2.1-1 shall not be checked when f_ℓ is equal to zero. For sections with compact or noncompact webs, Eq. 6.10.3.2.1-3 shall not be checked.

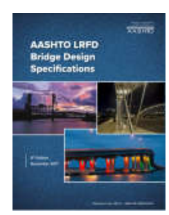
$$f_{bu} + f_\ell \leq \phi_f R_h F_{yc}, \quad (6.10.3.2.1\text{-}1)$$

$$f_{bu} + \frac{1}{3} f_\ell \leq \phi_f F_{nc}, \quad (6.10.3.2.1\text{-}2)$$

and

$$f_{bu} \leq \phi_f F_{crw} \quad (6.10.3.2.1\text{-}3)$$

What are critical stages of construction?



90

Steel I-Girder Bridges - Constructibility

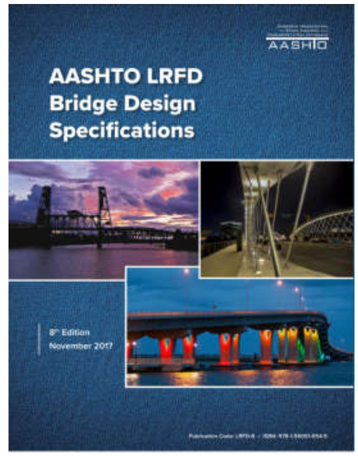
6.10.3.4—Deck Placement

6.10.3.4.1—General

Sections in positive flexure that are composite in the final condition, but are noncomposite during construction, shall be investigated for flexure according to the provisions of Article 6.10.3.2 during the various stages of the deck placement.

Geometric properties, bracing lengths and stresses used in calculating the nominal flexural resistance shall be for the steel section only. Changes in load, stiffness and bracing during the various stages of the deck placement shall be considered.

The effects of forces from deck overhang brackets acting on the fascia girders shall be considered.



91

Steel I-Girder Bridges - Constructibility

6.10.3.4—Deck Placement

6.10.3.4.1—General

Sections in positive flexure that are composite in the final condition, but are noncomposite during construction, shall be investigated for flexure according to the provisions of Article 6.10.3.2 during the various stages of the deck placement.

Geometric properties, bracing lengths and stresses used in calculating the nominal flexural resistance shall be for the steel section only. Changes in load, stiffness and bracing during the various stages of the deck placement shall be considered.

The effects of forces from deck overhang brackets acting on the fascia girders shall be considered.

Following pour sequence is important!

Images Courtesy of: www.sellwoodbridge.org

92

Steel I-Girder Bridges - Constructibility

6.10.3.4—Deck Placement

6.10.3.4.1—General

Sections in positive flexure that are composite in the final condition, but are noncomposite during construction, shall be investigated for flexure according to the provisions of Article 6.10.3.2 during the various stages of the deck placement.

Geometric properties, bracing lengths and stresses used in calculating the nominal flexural resistance shall be for the steel section only. Changes in load, stiffness and bracing during the various stages of the deck placement shall be considered.

The effects of forces from deck overhang brackets acting on the fascia girders shall be considered.

Images Courtesy of: https://www.gamcoform.com/overhang-bracket

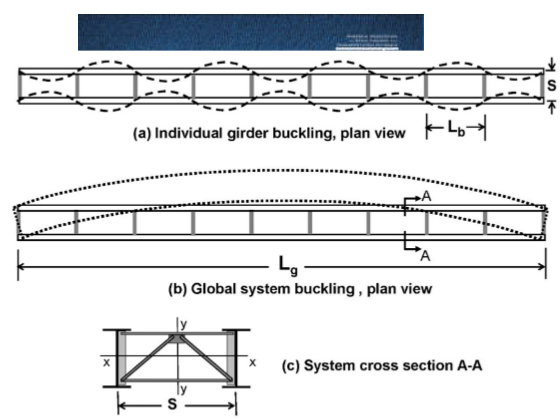
93

Steel I-Girder Bridges– System Stability

6.10.3.4.2—Global Displacement Amplification in Narrow I-Girder Bridge Units

$$M_{gs} = C_{bs} \frac{\pi^2 w_g E}{L^2} \sqrt{I_{eff} I_x} \qquad (6.10.3.4.2\text{-}1)$$

- AASHTO check of narrow 2 or 3 girder system stability during deck pouring
- If Mult > 0.7 Mgs design has following options:
  - Add flange lateral bracing
  - Increase system stiffness
  - Verify with owner that second order displacements are within acceptable tolerances

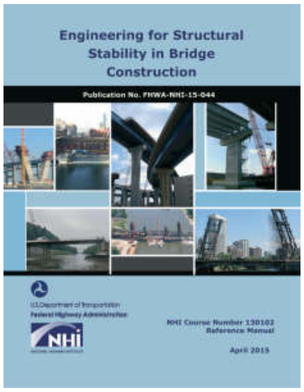


Images Courtesy of: Engineering for Structural Stability in Bridge Construction

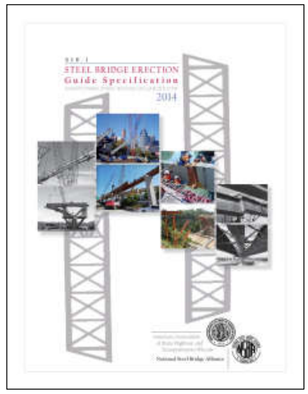
94

Useful Resources - Erection Analysis

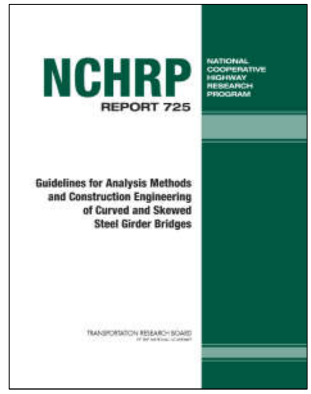
DETOUR



FHWA-NHI-15-044
ALL MATERIAL TYPES



NSBA / AASHTO S10.1



NCHRP Report 725

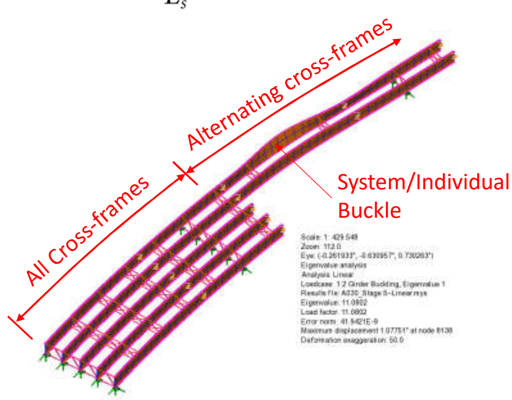
STEEL BRIDGE SPECIFIC GUIDES

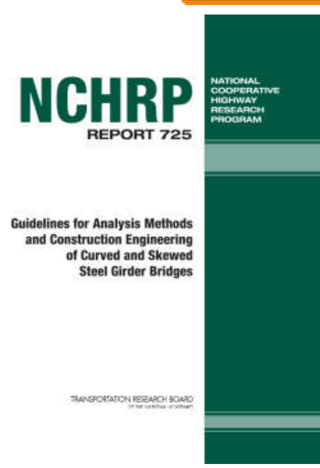
95

Steel I-Girder Bridges - System Stability

DETOUR

$$M_{crG} = C_b \frac{\pi^2 sE}{L_s^2} \sqrt{I_{ye} I_x} \qquad \text{Eq. 3}$$





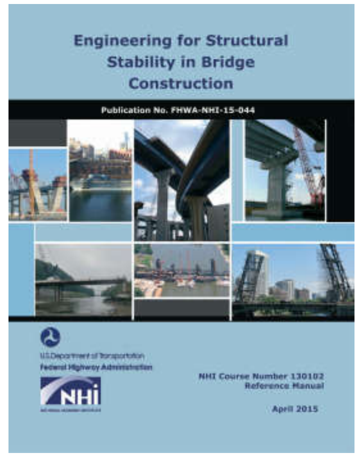
96

Steel I-Girder Bridges - System Stability

DETOUR

$$M_{gs} = \frac{\pi^2 SE}{L_g^2}\sqrt{I_y I_x}$$

Equation 5-12



97

Critical Stages of Construction

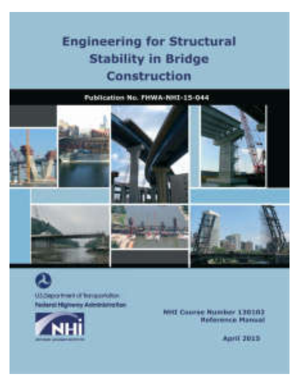
DETOUR

7.2.2 Critical Erection Stages

The erection plan and supporting engineering calculations must address both strength and stability at each stage of erection. Deformations associated with each stage should also be evaluated. Critical erection stages for the girder bridge structure during construction normally consist of at least the following:

Contractor / Construction Engineer

- Lifting of girders/members
- Placement of the initial girder and any associated temporary bracing used to hold the girder in place
- First pair of girders set with permanent bracing installed
- All girders and bracing installed prior to the deck placement *[total structure stable in wind]*
- All girders and bracing installed during the deck placement
- Application of the deck overhang bracket loads to the fascia girders during the deck placement



98

Critical Stages of Construction

DETOUR

7.2.2 Critical Erection Stages

The erection plan and supporting engineering calculations must address both strength and stability at each stage of erection. Deformations associated with each stage should also be evaluated. Critical erection stages for the girder bridge structure during construction normally consist of at least the following:

Contractor / Construction Engineer

- Lifting of girders/members
- Placement of the initial girder and any associated temporary bracing used to hold the girder in place
- First pair of girders set with permanent bracing installed
- All girders and bracing installed prior to the deck placement *[total structure stable in wind]*
- All girders and bracing installed during the deck placement
- Application of the deck overhang bracket loads to the fascia girders during the deck placement


Fulbright Expressway, Fayetteville, AR

99

Critical Stages of Construction

DETOUR

7.2.2 Critical Erection Stages

The erection plan and supporting engineering calculations must address both strength and stability at each stage of erection. Deformations associated with each stage should also be evaluated. Critical erection stages for the girder bridge structure during construction normally consist of at least the following:

Contractor / Construction Engineer

- Lifting of girders/members
- Placement of the initial girder and any associated temporary bracing used to hold the girder in place
- First pair of girders set with permanent bracing installed
- All girders and bracing installed prior to the deck placement *[total structure stable in wind]*
- All girders and bracing installed during the deck placement
- Application of the deck overhang bracket loads to the fascia girders during the deck placement


KY 152 over Herrington Lake, Mercer and Garrard Counties, KY

100

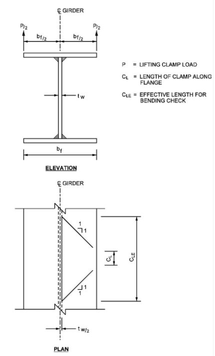
Critical Stages of Construction

7.2.2 Critical Erection Stages

The erection plan and supporting engineering calculations must address both strength and stability at each stage of erection. Deformations associated with each stage should also be evaluated. Critical erection stages for the girder bridge structure during construction normally consist of at least the following:

Contractor / Construction Engineer

- Lifting of girders/members
- Placement of the initial girder and any associated temporary bracing used to hold the girder in place
- First pair of girders set with permanent bracing installed
- All girders and bracing installed prior to the deck placement *[total structure stable in wind]*
- All girders and bracing installed during the deck placement
- Application of the deck overhang bracket loads to the fascia girders during the deck placement



101

Critical Stages of Construction

7.2.2 Critical Erection Stages

The erection plan and supporting engineering calculations must address both strength and stability at each stage of erection. Deformations associated with each stage should also be evaluated. Critical erection stages for the girder bridge structure during construction normally consist of at least the following:

Contractor / Construction Engineer

- Lifting of girders/members
- Placement of the initial girder and any associated temporary bracing used to hold the girder in place
- First pair of girders set with permanent bracing installed
- All girders and bracing installed prior to the deck placement *[total structure stable in wind]*
- All girders and bracing installed during the deck placement
- Application of the deck overhang bracket loads to the fascia girders during the deck placement

Gateway Interchange Flyovers, Johnson County, KS

102

Critical Stages of Construction

7.2.2 Critical Erection Stages

The erection plan and supporting engineering calculations must address both strength and stability at each stage of erection. Deformations associated with each stage should also be evaluated. Critical erection stages for the girder bridge structure during construction normally consist of at least the following:

- Lifting of girders/members
- Placement of the initial girder and any associated temporary bracing used to hold the girder in place
- First pair of girders set with permanent bracing installed
- All girders and bracing installed prior to the deck placement *[total structure stable in wind]*
- All girders and bracing installed during the deck placement
- Application of the deck overhang bracket loads to the fascia girders during the deck placement

Contractor / Construction Engineer

KY 152 over Herrington Lake, Mercer and Garrard Counties, KY

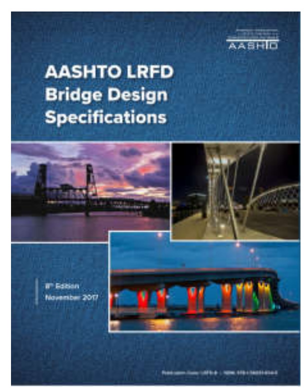
103

Critical Stages of Construction

7.2.2 Critical Erection Stages

The erection plan and supporting engineering calculations must address both strength and stability at each stage of erection. Deformations associated with each stage should also be evaluated. Critical erection stages for the girder bridge structure during construction normally consist of at least the following:

- Lifting of girders/members
- Placement of the initial girder and any associated temporary bracing used to hold the girder in place
- First pair of girders set with permanent bracing installed
- All girders and bracing installed prior to the deck placement *[total structure stable in wind]*
- All girders and bracing installed during the deck placement
- Application of the deck overhang bracket loads to the fascia girders during the deck placement



AASHTO dictates these stages shall be considered by Design Engineer

Should be considered by Design Engineer
What design reference should a designer use to evaluate?

104

Check of Completed Bridge Prior to Deck Pour

- AASHTO design specifications currently do not include section on winds on a completed structure prior to pouring deck
- Designer could refer to "AASHTO Guide Specifications for Wind Loads on Bridges During Construction"

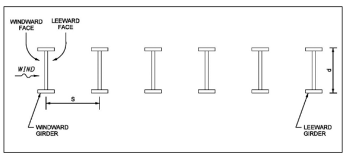
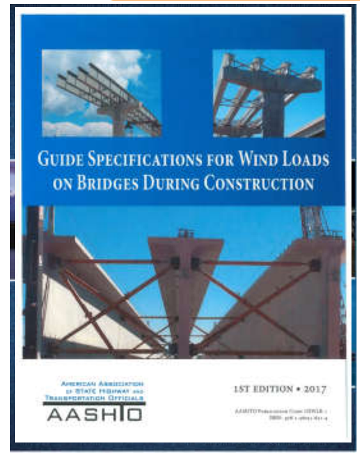


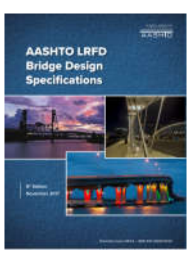
Figure 7-12 Girder Wind Load Terminology

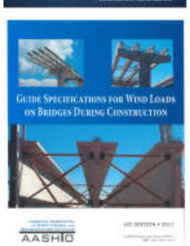
COMPONENT TYPE	CONSTRUCTION CONDITION	FORCE COEFFICIENT (C_f)
I-Shaped Girder Superstructure	Deck forms not in place	2.2 (1)
	Deck forms in place	1.1
U-Shaped and Box-Girder Superstructure	Deck forms not in place	1.5
	Deck forms in place	1.1
Flat Slab or Segmental Box-Girder Superstructure	Any	1.1

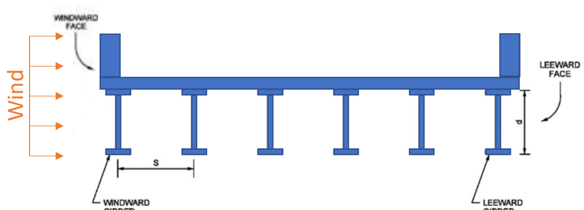


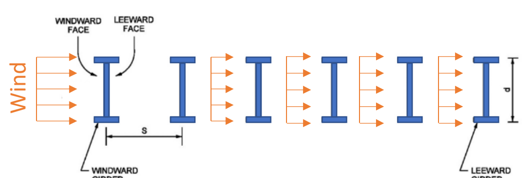
105

Wind During Erection









106

Wind During Erection

DETOUR

$$P_Z = 2.56 \times 10^{-6} V^2 K_z G C_D$$

$$P_Z = 2.56 \times 10^{-6} V^2 R^2 K_z G C_D$$

Component		Drag Coefficient, C_D Windward	Leeward
I-Girder and Box-Girder Bridge Superstructures		1.3	N/A
Trusses, Columns, and Arches	Sharp-Edged Member	2.0	1.0
	Round Member	1.0	0.5
Bridge Substructure		1.6	N/A
Sound Barriers		1.2	N/A

	R
0-6 weeks	0.65
6 weeks to 1 year	0.73
>1-2 years	0.75
>2-3 years	0.77
>3-7years	0.84

Rolled I-Beams	2.2
Concrete I-Beams	2.0
Closed and Open Box-Girders	2.1
Round Members	1.0

107

Wind During Erection

DETOUR

Final Structure
S/D = 1.0 < 3

Construction (0 to 6 weeks)
R = 0.65

Construction (6 weeks to 1 year)
R = 0.73

108

PennDOT Requirements

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF TRANSPORTATION
BUREAU OF PROJECT DELIVERY

STANDARD

STEEL GIRDER BRIDGES
LATERAL BRACING CRITERIA
AND DETAILS

LATERAL STABILITY BRACING DESIGN CRITERIA FOR GIRDER BRIDGES PRIOR TO DECK COMPLETION:

THE CRITERION IN THIS STANDARD APPLIES ONLY TO COMPLETELY ERECTED STEEL SUPERSTRUCTURE, WITHOUT THE DECK. THE STABILITY OF PARTIAL AND COMPLETED GIRDERS IN THE VARIOUS STAGES OF ERECTION PRIOR TO INSTALLATION OF ALL GIRDERS AND DIAPHRAGMS IS THE RESPONSIBILITY OF THE CONTRACTOR AS SPECIFIED IN PUBLICATION 408 SECTION 1050.3(c). (APPLIES TO TANGENT, SKEWED AND CURVED BRIDGES. APPLIES TO SINGLE AND MULTI-SPAN BRIDGES.)

PennDOT Requirements

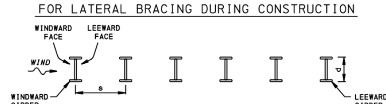
COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF TRANSPORTATION
BUREAU OF PROJECT DELIVERY

STANDARD

STEEL GIRDER BRIDGES
LATERAL BRACING CRITERIA
AND DETAILS

Provides Design Wind Pressures & Load Combinations

MINIMUM DESIGN WIND PRESSURE(PSF)
FOR LATERAL BRACING DURING CONSTRUCTION



CONSTRUCTION DURATION	0-6 WEEKS		6 WEEKS-1 YEAR		1-2 YEARS	
SUPERSTRUCTURE HEIGHT ABOVE GROUND LEVEL (FT.)	$s/d \leq 2$	$2 < s/d \leq 4$	$s/d \leq 2$	$2 < s/d \leq 4$	$s/d \leq 2$	$2 < s/d \leq 4$
0-15	19	21	26	28	29	32
20	20	22	27	30	31	34
25	21	23	28	31	32	35
30	22	24	30	32	34	37
40	24	26	31	34	36	39
50	25	27	33	36	38	41
60	26	28	34	37	39	42
70	27	29	35	39	40	44
80	28	30	37	40	42	45
90	28	31	38	41	43	47
100	29	31	38	42	43	47

PennDOT Requirements

DETOUR

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF TRANSPORTATION
BUREAU OF PROJECT DELIVERY

STANDARD

STEEL GIRDER BRIDGES
LATERAL BRACING CRITERIA
AND DETAILS

Lateral Bracing Requirements Based on Span Length

1. PROVIDE LATERAL BRACING FOR BRIDGES WITH SPANS IN EXCESS OF 300 FT. TO AID IN CONSTRUCTION OF THE BRIDGE. DESIGN BRACING FOR THE SPECIFIED WIND LOADS.

2. EVALUATE THE NEED FOR LATERAL BRACING FOR SPANS IN EXCESS OF 200 FT. BASED ON LATERAL DEFLECTION.

111

Critical Stages Deflection Criteria

DETOUR

- State Specific (PennDOT)

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF TRANSPORTATION
BUREAU OF PROJECT DELIVERY

STANDARD

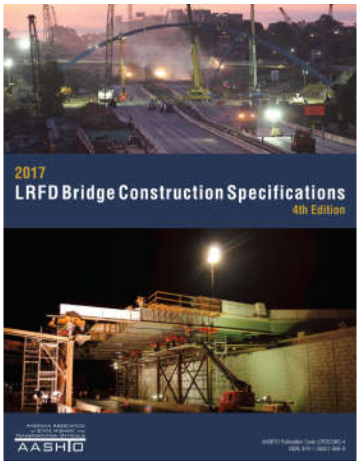
STEEL GIRDER BRIDGES
LATERAL BRACING CRITERIA
AND DETAILS

4. EVALUATE LATERAL DEFLECTION OF STEEL SUPERSTRUCTURE FOR A PERMISSIBLE DEFLECTION OF L/150. PROVIDE BRACING IF DEFLECTION LIMIT IS EXCEEDED. AN ACCEPTABLE ANALYSIS METHOD IS A HAND CALCULATION FOR A SINGLE FASCIA GIRDER (NON COMPOSITE) OR A GRID ANALYSIS FOR THE ENTIRE STEEL SUPERSTRUCTURE FRAMING. THE DIAPHRAGM ACTION OF THE STAY-IN-PLACE FORMS SHALL BE NEGLECTED. FINALLY, IF A GRID ANALYSIS IS USED, THE DIAPHRAGM/GIRDER CONNECTION SHALL BE MODELED AS A PIN IN THE PLANE OF THE GRID. IT IS CONSERVATIVE TO ASSUME PINNED DIAPHRAGM TO GIRDER CONNECTIONS. A MORE RIGOROUS ANALYSIS MODELING PARTIAL FIXITY AT THE CONNECTIONS CONSISTENT WITH THE CONNECTION DETAILING IS ACCEPTABLE.

- No AASHTO Criteria

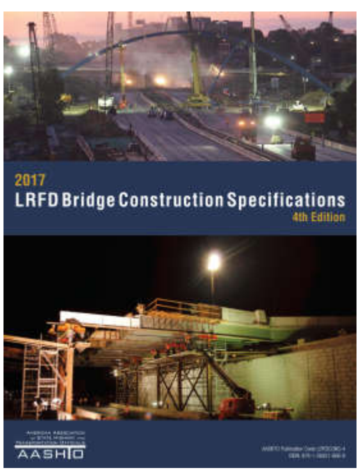
112

AASHTO Bridge Construction Specifications



113

AASHTO Bridge Construction Specifications



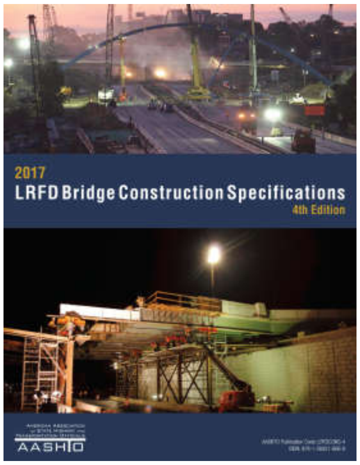
Key Sections:

Chapter 8 Concrete Structures

- 8.13 – Precast Concrete Members
- 8.16 – Special Provisions for Segmental Bridges

114

AASHTO Bridge Construction Specifications



Key Sections:

Chapter 8 Concrete Structures
- 8.13 – Precast Concrete Members
- 8.16 – Special Provisions for Segmental Bridges

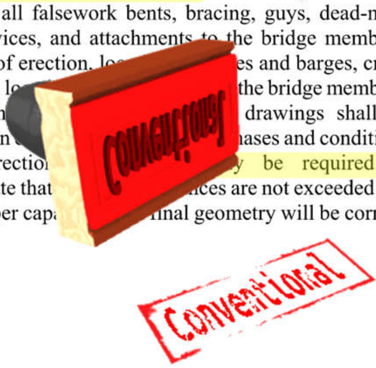
Chapter 11 Steel Structures
- 11.2 – Erection Drawings
- 11.8 – Additional Provisions for Curved Girders

115

Steel Girder Bridges

11.2.2—Erection Drawings

The Contractor shall submit drawings illustrating fully the proposed method of erection. The drawings shall show details of all falsework bents, bracing, guys, dead-men, lifting devices, and attachments to the bridge members: sequence of erection, lo... ...es and barges, crane capacities, lo... ...the bridge members, and weigh... ...drawings shall be complete in... ...ases and conditions during erectio... ...y be required to demonstrate that... ...ces are not exceeded and that member cap... ...inal geometry will be correct.



Comm. Ave Bridge, Boston, MA

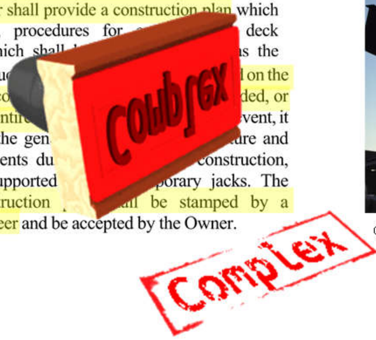
116

Curved Steel Girder Bridges

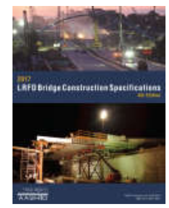
11.8—ADDITIONAL PROVISIONS FOR CURVED STEEL GIRDERS

11.8.2—Contractor's Construction Plan for Curved Girder Bridges

The Contractor shall provide a construction plan which details fabrication, procedures for [illegible] deck placement, and which shall [illegible] as the Contractor's constru[illegible] on the plan shown in the co[illegible]ded, or may be developed entir[illegible]vent, it shall demonstrate the gen[illegible]ure and individual components du[illegible] construction, including while supported [illegible]porary jacks. The Contractor's construction [illegible]all be stamped by a Professional Engineer and be accepted by the Owner.



Gateway Interchange Flyovers, Johnson County, KS



117

Constructability Summary

Structure Classification	Material	Structure Type
Conventional	Concrete	Precast Beams
	Steel	Shorter Straight Spans (< 200-ft)
Complex	Concrete	Spliced Prestressed Beams / Segmental
	Steel	Long Spans (> 200-ft) / Curved / High Skew

118

Constructability Summary

			EOR Responsibility
Structure Classification	Material	Structure Type	Suggested Construction Plan
Conventional	Concrete	Precast Beams	No
	Steel	Shorter Straight Spans (< 200-ft)	No
Complex	Concrete	Spliced Prestressed Beams / Segmental	Yes
	Steel	Long Spans (> 200-ft) / Curved / High Skew	Sometimes

119

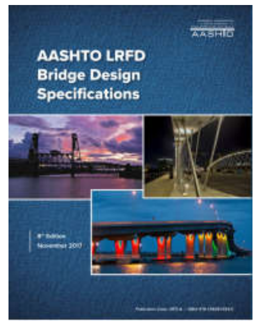
Constructability Summary

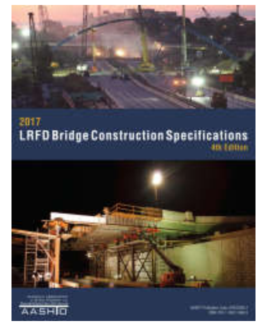
			EOR Responsibility	Contractor Responsibility	
Structure Classification	Material	Structure Type	Suggested Construction Plan	Erection Plan Required?	Engineering Required?
Conventional	Concrete	Precast Beams	No	Yes	DOT Dependent
	Steel	Shorter Straight Spans (< 200-ft)	No	Yes	DOT Dependent
Complex	Concrete	Spliced Prestressed Beams / Segmental	Yes	Yes	Yes
	Steel	Long Spans (> 200-ft) / Curved / High Skew	Sometimes	Yes	Yes

120

Constructability Summary

- AASHTO Specifications clearly distinguish between complex and conventional for concrete girder bridges
- AASHTO Specifications are not as clear for steel girder bridges (I-Girder / Box Girder)
- DOT guides have made effort to address

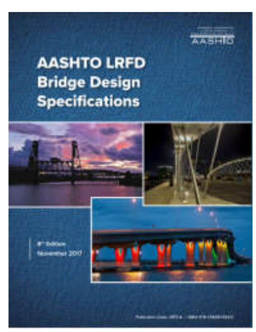


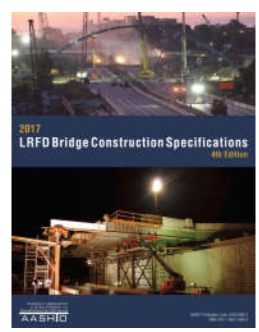


121

Constructability Summary

- AASHTO Specifications clearly distinguish between complex and conventional for concrete girder bridges …Mostly out of necessity
- AASHTO Specifications are not as clear for steel girder bridges (I-Girder / Box Girder)
- DOT guides have made effort to address





122

Erection Classification Example - KDOT

- KDOT Section 737 provides erection category system based on complexity
- Accounts for span length, skew and curvature
- Based on category, which designer can indicate on Contract Plans, the level of erection considerations may be required.
- Everyone is on even playing field during bid phase

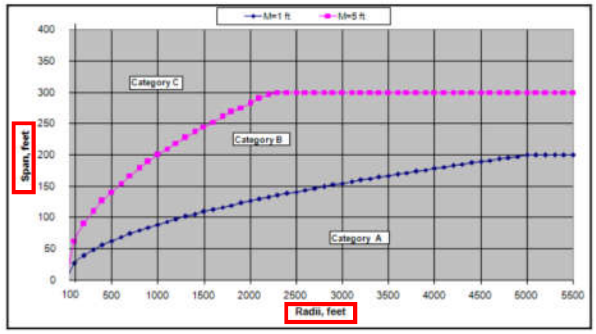


FIGURE 736-1
Special Requirements for Bridge Designers to Designate Erection Plan Categories

The initial Category is based on the chart which considers the length of the longest span, the curvature of the bridge and the skew angle.

If skew is greater than 30°, move up one Category (A to B or B to C).

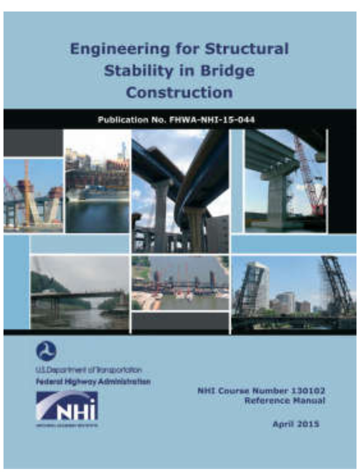
If a structure crosses traffic or a railroad, require Category B as a minimum.

If the Contractor uses falsework bents or strong-backs for the field erection, Category C Erection Plans are required.

The designer may elevate a structure to the necessary Category based upon engineering judgment and unique circumstances.

123

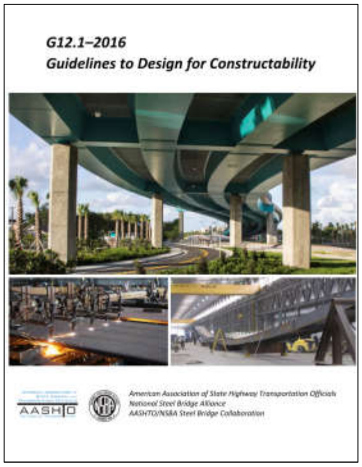
Erection Classification - Survey



- Survey of AASHTO member states for engineering requirements for structural safety during erection
- 33 states responded to survey
- Past issues related to girder erection
- Threshold for when submittal of erection plans required for review

124

Useful Resources - Constructability



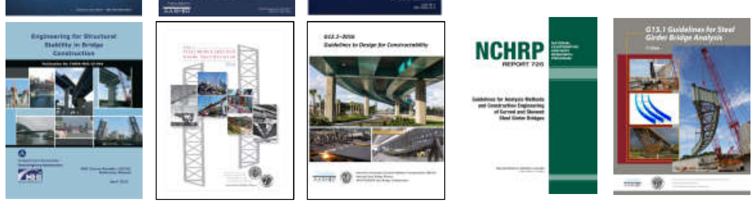
- G12.1-2016 - NSBA / AASHTO Collaboration
- Great resource to ensure a bridge is easy to fabricate and connections are constructable
- Does not cover erection analysis

125

Construction Engineer's Literature Review

Design Specifications

Erection Guides/Specifications



Design Loads

126

Construction Engineer's Literature Review

Temporary Works

Rigging Hardware

Demolition Guides

127

Design Loads for Temporary Structures

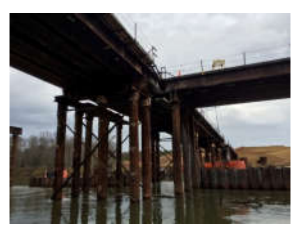
Equipment Loads

- Almost every bridge structure requires some form of temporary works to erect
- All temporary works require design and planning to accommodate construction loads
- Construction loads are not as easily defined as perhaps for a permanent structure
- Construction Engineers must follow a set of base guidelines and principles but many times work together with their contractor clients to properly educate them on the pro's/con's of a minimum design level vs. risk

129

Equipment Loads

- Almost every bridge structure requires some form of temporary works to erect
- All temporary works require design and planning to accommodate construction loads
- Construction loads are not as easily defined as perhaps for a permanent structure
- Construction Engineers must follow a set of base guidelines and principles but many times work together with their contractor clients to properly educate them on the pro's/con's of a minimum design level vs. risk



130

Equipment Loads

- Almost every bridge structure requires some form of temporary works to erect
- All temporary works require design and planning to accommodate construction loads
- Construction loads are not as easily defined as perhaps for a permanent structure
- Construction Engineers must follow a set of base guidelines and principles but many times work together with their contractor clients to properly educate them on the pro's/con's of a minimum design level vs. risk

131

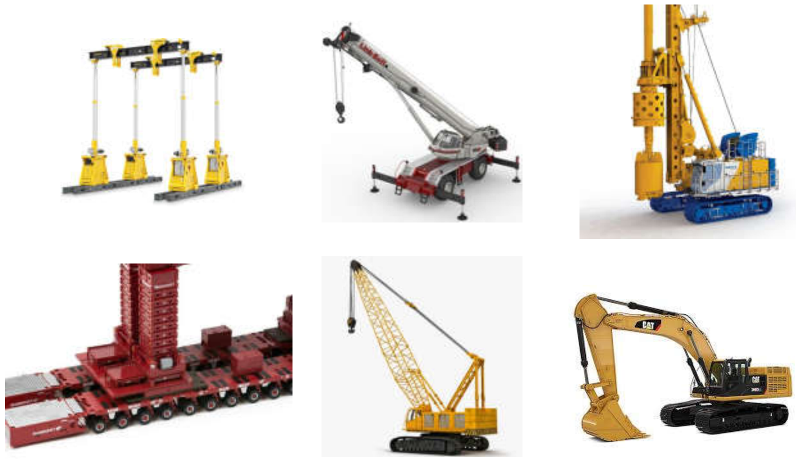
Equipment Loads

- Almost every bridge structure requires some form of temporary works to erect
- All temporary works require design and planning to accommodate construction loads
- Construction loads are not as easily defined as perhaps for a permanent structure
- Construction Engineers must follow a set of base guidelines and principles but many times work together with their contractor clients to properly educate them on the pro's/con's of a minimum design level vs. risk

"*Calculated risks are* **risks with a plan.**"

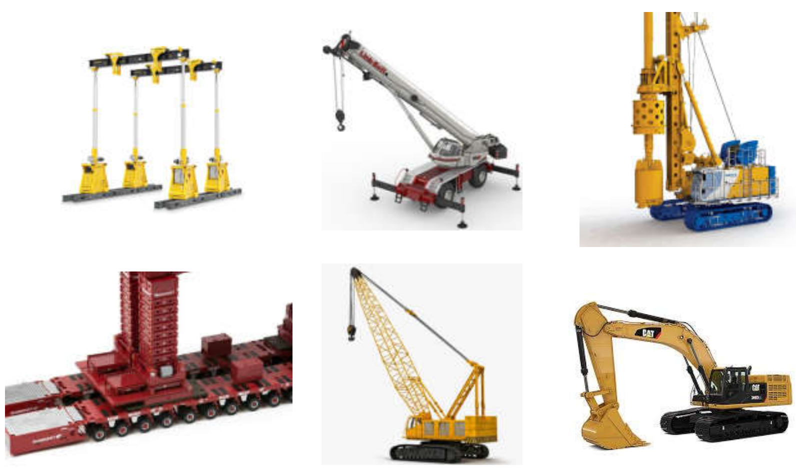
132

Equipment Loads



133

Equipment Loads Manufacturer's Provide Data ….. Right?



134

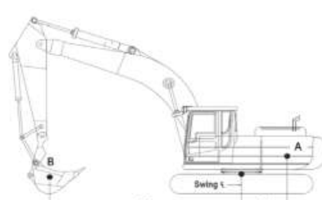
Equipment Loads Manufacturer's Provide Data ….. Right?

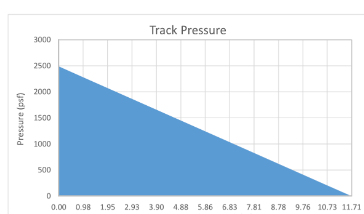
135

Excavator/Drill Rigs – Need to Develop Loading

Ground Pressure General Operation =	1150	psf (impact included)
=	7.986	psi
Max. Pressure Under Track =	2488	psf (impact included)
=	17.277	psi
Min. Pressure Under Track =	0	psf (impact included)
=	0.000	psi

Back Calculate an "Effective" Track Pressure for Different Loads/Reaches/Swings





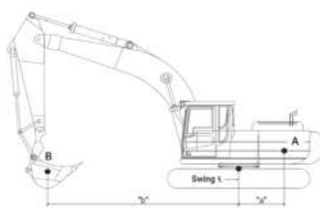
136

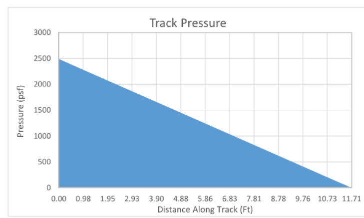
Excavator/Drill Rigs – Need to Develop Loading

What is the attachment/pick weight?

Ground Pressure General Operation =	1150	psf	(impact included)
=	7.986	psi	
Max. Pressure Under Track =	2488	psf	(impact included)
=	17.277	psi	
Min. Pressure Under Track =	0	psf	(impact included)
=	0.000	psi	

Back Calculate an "Effective" Track Pressure for Different Loads/Reaches/Swings





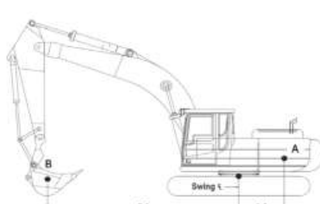
137

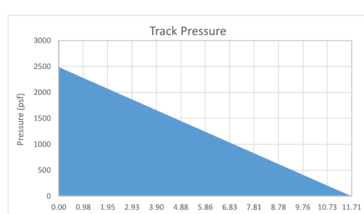
Excavator/Drill Rigs – Need to Develop Loading

What is the attachment/pick weight?
Where is Center of Gravity?

Ground Pressure General Operation =	1150	psf	(impact included)
=	7.986	psi	
Max. Pressure Under Track =	2488	psf	(impact included)
=	17.277	psi	
Min. Pressure Under Track =	0	psf	(impact included)
=	0.000	psi	

Back Calculate an "Effective" Track Pressure for Different Loads/Reaches/Swings





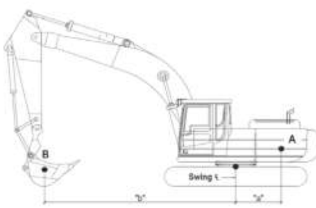
138

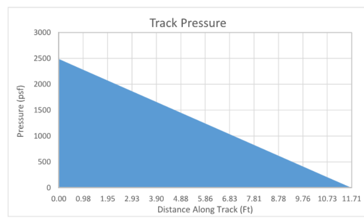
Excavator/Drill Rigs – Need to Develop Loading

What is the attachment/pick weight?
Where is Center of Gravity?
What is Machine Capacity?

Ground Pressure General Operation =	1150	psf	(impact included)
=	7.986	psi	
Max. Pressure Under Track =	2488	psf	(impact included)
=	17.277	psi	
Min. Pressure Under Track =	0	psf	(impact included)
=	0.000	psi	

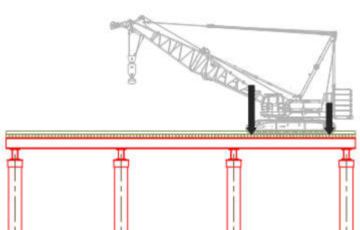
Back Calculate an "Effective" Track Pressure for Different Loads/Reaches/Swings

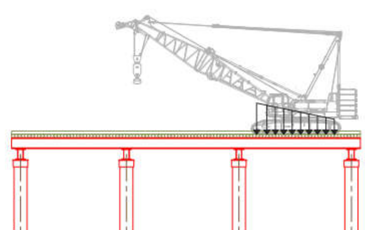




139

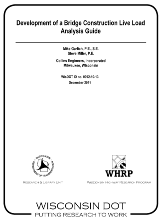
Track Loads >>> Uniform Load or Point Loads





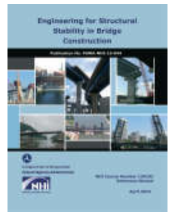
140

IMPACT



Excavator
Vertical = Up to 40%
Lateral = 10% Equip Wt

Crane
Vertical = 10% Load New
Vertical = 20% Load Demo
Lateral = None



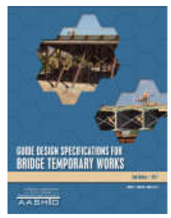
Excavator
Vertical = Per Manuf
Lateral = 10% Equip Wt

Crane
Vertical = 0% Load New
Vertical = 20% Load Demo
Lateral = None

Excavator
Vertical = 30% *
Lateral = Silent

Crane
Vertical = 30% *
Lateral = Silent

* Or Per Manuf



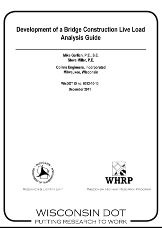
Excavator
Vertical = 30% *
Lateral = Silent

Crane
Vertical = 30% *
Lateral = Silent

* Or Per Manuf

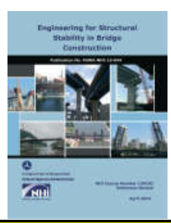
141

IMPACT



Excavator
Vertical = Up to 40%
Lateral = 10% Equip Wt

Crane
Vertical = 10% Load New
Vertical = 20% Load Demo
Lateral = None



Excavator
Vertical = Per Manuf
Lateral = 10% Equip Wt

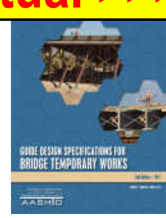
Crane
Vertical = 0% Load New
Vertical = 20% Load Demo
Lateral = None

IMPACT >>> Ideal vs…. Actual >>> Up to Operations

Excavator
Vertical = 30% *
Lateral = Silent

Crane
Vertical = 30% *
Lateral = Silent

* Or Per Manuf



Vertical = 30% *
Lateral = Silent

Crane
Vertical = 30% *
Lateral = Silent

* Or Per Manuf

142

Environmental Loads

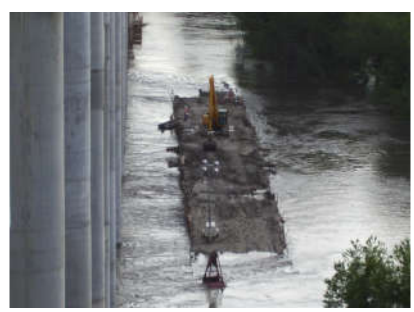
- Mother Nature
  - Affects Permanent Structures
  - Affects Temporary Structures
- All temporary works require design and planning to accommodate environmental loads
  - Unless specified, what level of design is required?
  - Duration vs. Risk Assessment?
- Construction Engineers must follow a set of base guidelines and principles but many times work together with their contractor clients to properly educate them on the pros/cons of a minimum design level vs. risk

Wind
Temperature
Seismic
Stream Flow
Ice
Debris
Scour

143

Environmental Loads

- Mother Nature
  - Affects Permanent Structures
  - Affects Temporary Structures
- All temporary works require design and planning to accommodate environmental loads
  - Unless specified, what level of design is required?
  - Duration vs. Risk Assessment?
- Construction Engineers must follow a set of base guidelines and principles but many times work together with their contractor clients to properly educate them on the pros/cons of a minimum design level vs. risk



144

Environmental Loads

- Mother Nature
  - Affects Permanent Structures
  - Affects Temporary Structures
- All temporary works require design and planning to accommodate environmental loads
  - Unless specified, what level of design is required?
  - Duration vs. Risk Assessment?
- Construction Engineers must follow a set of base guidelines and principles but many times work together with their contractor clients to properly educate them on the pros/cons of a minimum design level vs. risk

145

Environmental Loads

- Mother Nature
  - Affects Permanent Structures
  - Affects Temporary Structures
- All temporary works require design and planning to accommodate environmental loads
  - Unless specified, what level of design is required?
  - Duration vs. Risk Assessment?
- Construction Engineers must follow a set of base guidelines and principles but many times work together with their contractor clients to properly educate them on the pros/cons of a minimum design level vs. risk

146

Environmental Loads

- Mother Nature
  - Affects Permanent Structures
  - Affects Temporary Structures
- All temporary works require design and planning to accommodate environmental loads
  - Unless specified, what level of design is required?
  - Duration vs. Risk Assessment?
- Construction Engineers must follow a set of base guidelines and principles but many times work together with their contractor clients to properly educate them on the pros/cons of a minimum design level vs. risk

> "Calculated risks are risks with a plan."

147

Bridge Demolition and Re-Decking

Bridge Demolition and Re-Decking

- Thousands of bridges in our current infrastructure need to be replaced and/or rehabilitated
- This *"need"* for bridge replacement generates a need for safe demolition practices
- Currently is no "formal" code that specifically addresses any minimum design criteria to properly analyze a structure that is being taken out of service.
- Genesis is part of a group of engineers and contractors working towards the development of a "Best Practices" guideline for starters

149

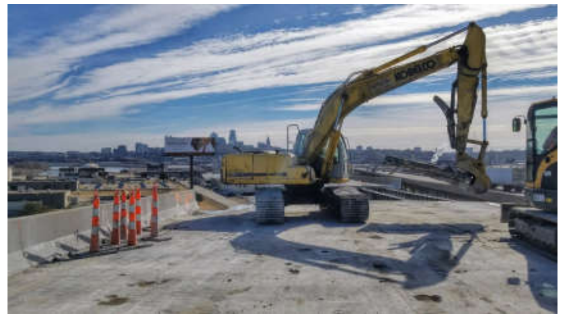
Bridge Demolition and Re-Decking

- Thousands of bridges in our current infrastructure need to be replaced and/or rehabilitated
- This *"need"* for bridge replacement generates a need for safe demolition practices
- Currently is no "formal" code that specifically addresses any minimum design criteria to properly analyze a structure that is being taken out of service.
- Genesis is part of a group of engineers and contractors working towards the development of a "Best Practices" guideline for starters

150

Bridge Demolition and Re-Decking

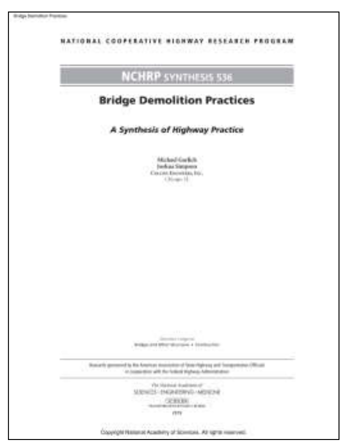
- Thousands of bridges in our current infrastructure need to be replaced and/or rehabilitated
- This *"need"* for bridge replacement generates a need for safe demolition practices
- Currently is no "formal" code that specifically addresses any minimum design criteria to properly analyze a structure that is being taken out of service.
- Genesis is part of a group of engineers and contractors working towards the development of a "Best Practices" guideline for starters


Lewis and Clark Viaduct, Kansas City, MO

151

Bridge Demolition and Re-Decking

- Thousands of bridges in our current infrastructure need to be replaced and/or rehabilitated
- This *"need"* for bridge replacement generates a need for safe demolition practices
- Currently is no "formal" code that specifically addresses any minimum design criteria to properly analyze a structure that is being taken out of service.
- Genesis is part of a group of engineers and contractors working towards the development of a "Best Practices" guideline for starters


NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

NCHRP SYNTHESIS 536

Bridge Demolition Practices

A Synthesis of Highway Practice

NCHRP Demo Practice Guides

152

Bridge Demolition and Re-Decking

- Thousands of bridges in our current infrastructure need to be replaced and/or rehabilitated
- This *"need"* for bridge replacement generates a need for safe demolition practices
- Currently is no "formal" code that specifically addresses any minimum design criteria to properly analyze a structure that is being taken out of service.
- Genesis is part of a group of engineers and contractors working towards the development of a "Best Practices" guideline for starters

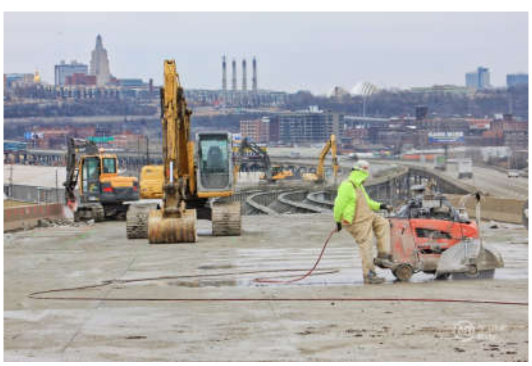
ASCE
AMERICAN SOCIETY OF CIVIL ENGINEERS

CONSTRUCTION INSTITUTE

153

Complications of Bridge Demolition

- Similar to erecting a bridge, structure stiffness and resistance change depending on stage



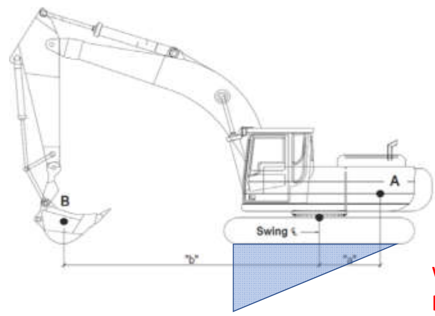
Lewis and Clark Viaduct, Kansas City, MO

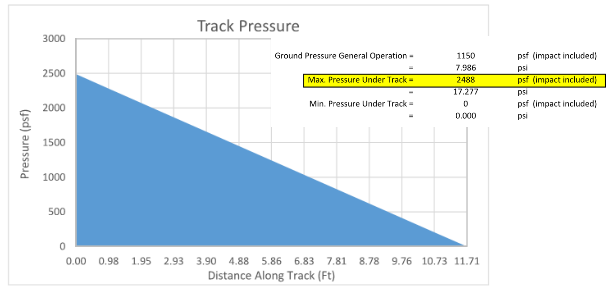
I-75 Deck Replacement, Detroit, MI

154

Complications of Bridge Demolition

- Similar to erecting a bridge, structure stiffness and resistance change depending on stage
- Method for determination of load effects from equipment demolishing a structure is not standardized

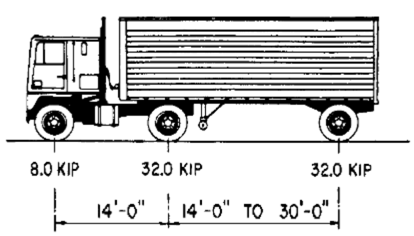




What level of dynamic effects do you include?
Does it vary by deck removal method?

155

Demolition Equipment - Weight

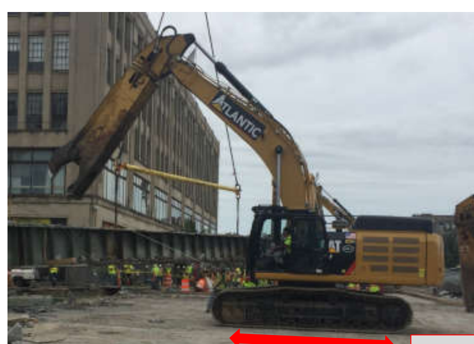


Axle Length 28-ft to 44-ft

AASHTO 3.6.1.2.2 - DESIGN TRUCK

(72,000 lbs)

On a composite structure



Tumbler Spacing
14-ft to 16-ft

EXCAVATOR

CAT 349 (120,000 lb)

On a partially composite to noncomposite structure

156

Deck Removal Methods

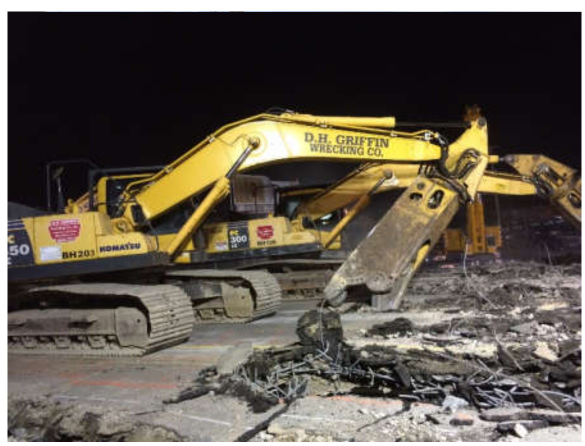
- Breaker / Hammer
  - Contractor preference (quick)
  - Can damage flanges / cross frames
  - Protection under bridge may be required

Comm. Ave Bridge, Boston, MA

157

Deck Removal Methods

- Shear
  - Punch hole in deck with breaker/hammer and shear the rest
  - Multiple Uses:
    - Deck removal
    - Girder/material picking
    - Girder Processing



I40 Fast Fix 8, Nashville, TN

158

Deck Removal Methods

- Slab Crab / Bucket with Thumb
  - Time Consuming (Deck Cutting)
  - More Controlled
  - Protection under bridge minimal
  - Common for more complex bridges

Slab Crab

Bucket with Thumb

Paseo Suspension Bridge, Kansas City, MO

159

Deck Removal Methods

- Slab Crab / Bucket with Thumb
  - Time Consuming (Deck Cutting)
  - More Controlled
  - Protection under bridge minimal
  - Common for more complex bridges

Slab Crab

Bucket with Thumb

I-75 Deck Replacement, Detroit, MI

160

Changing Structural Integrity – Intentional

Comm. Ave Bridge, Boston, MA

I-75 Deck Replacement, Detroit, MI

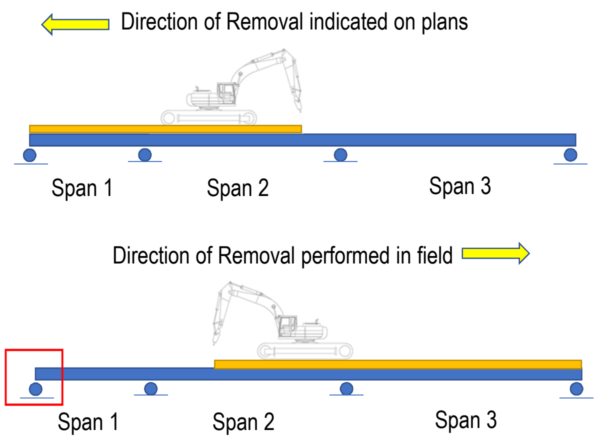
161

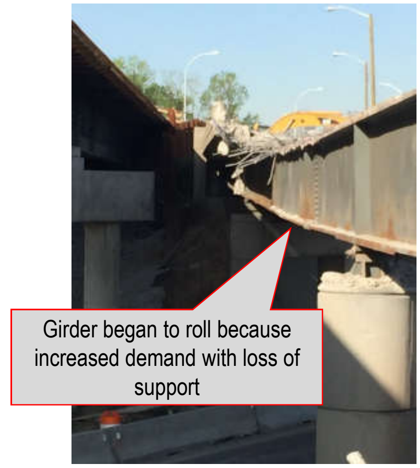
Changing Structural Integrity – Unintentional

ORB Downtown, Louisville, KY

162

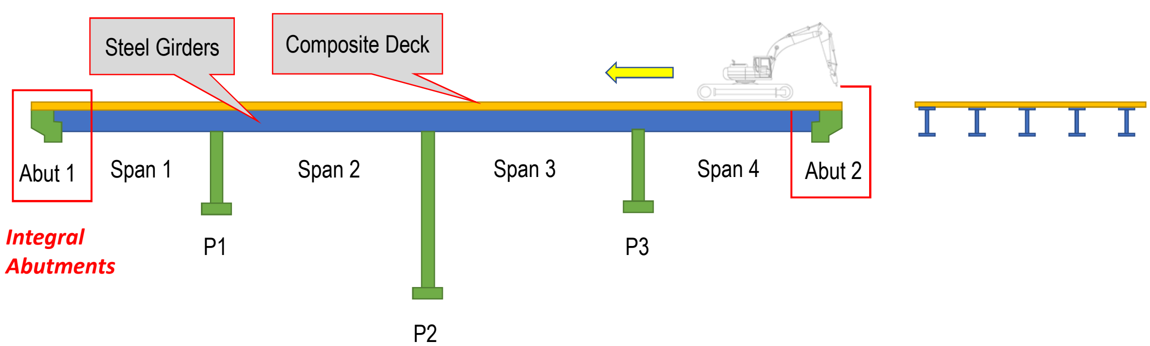
Direction of Removal Matters!





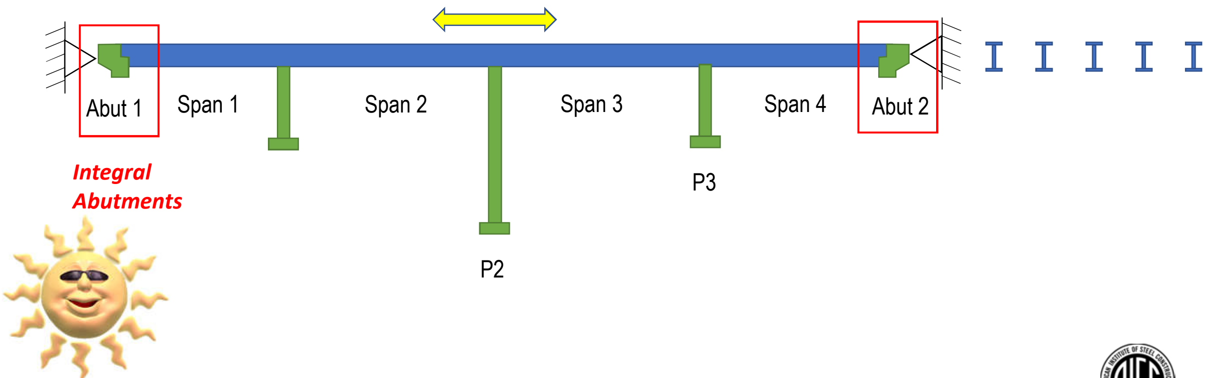
163

Changing Structural Integrity – Unintentional



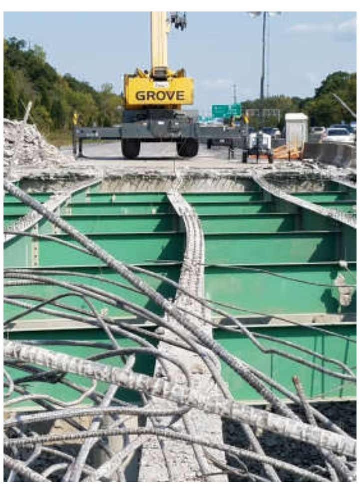
164

Changing Structural Integrity – Unintentional



165

Changing Structural Integrity – Unintentional



I470 Bridge Re-decking, Kansas City, MO

166

Demolition Summary

- Demolition is often an overlooked portion of projects with minimal formalized requirements
- Demolition engineering / analysis can be as complicated as erection engineering, and at times can be higher risk
- Goal to establish minimum requirements to increase quality and safety across industry

White River Truss Demolition, Prairie County, AR

167

Demolition Summary

- Demolition is often an overlooked portion of projects with minimal formalized requirements
- Demolition engineering / analysis can be as complicated as erection engineering, and at times can be higher risk
- Goal to establish minimum requirements to increase quality and safety across industry

Fore River Lift Span Demolition, Quincy, MA

168

Demolition Summary

- Demolition is often an overlooked portion of projects with minimal formalized requirements
- Demolition engineering / analysis can be as complicated as erection engineering, and at times can be higher risk
- Goal to establish minimum requirements to increase quality and safety across industry

K Bridge Lift Span Demolition, New York, NY

169

Conclusions / Thoughts

Conclusions/Thoughts – Const. Eng. Perspective

- Perfect World
- Design-Bid-Build Contract Plans
- Temporary Works are NOT permanent structures

171

Conclusions/Thoughts – Const. Eng. Perspective

- Perfect World
  - Design Engineers need to be experts in design and be aware of construction engineering challenges
  - Construction engineers need to be experts in temporary works and maintain an understanding of AASHTO
  - Design Engineers/Owners should not be afraid to reach out to construction engineering firms
  - AASHTO could formally categorize steel girder bridges into erection categories…currently up to DOTs
- Design-Bid-Build Contracts
- Temporary Works are NOT permanent structures

172

Conclusions/Thoughts – Const. Eng. Perspective

- Perfect World
  - Design Engineers need to be experts in design and be aware of construction engineering challenges
  - Construction engineers need to be experts in temporary works and maintain an understanding of AASHTO
  - Design Engineers/Owners should not be afraid to reach out to construction engineering firms
  - AASHTO could formally categorize steel girder bridges into erection categories…currently up to DOTs
- Design-Bid-Build Contracts
- Temporary Works are NOT permanent structures

173

Conclusions/Thoughts – Const. Eng. Perspective

- Perfect World
  - Design Engineers need to be experts in design and be aware of construction engineering challenges
  - Construction engineers need to be experts in temporary works and maintain an understanding of AASHTO
  - Design Engineers/Owners should not be afraid to reach out to construction engineering firms
    - The industry can benefit from a front end and back end service
  - AASHTO could formally categorize steel girder bridges into erection categories…currently up to DOTs
- Design-Bid-Build Contracts
- Temporary Works are NOT permanent structures

174

Conclusions/Thoughts – Const. Eng. Perspective

- Perfect World
  - Design Engineers need to be experts in design and be aware of construction engineering challenges
  - Construction engineers need to be experts in temporary works and maintain an understanding of AASHTO
  - Design Engineers/Owners should not be afraid to reach out to construction engineering firms
  - AASHTO could formally categorize steel girder bridges into erection categories…currently up to DOTs
- Design-Bid-Build Contracts
- Temporary Works are NOT permanent structures

175

Conclusions/Thoughts – Const. Eng. Perspective

- Perfect World
- Design-Bid-Build Contract Plans
  - Contractor is responsible for erecting parts and pieces to achieve a fully erected structure
  - Contract plans should provide a design that is stable and safe once the superstructure is fully erected
  - Contract plans should provide a viable "suggested" erection sequence (or at a min deck pour sequence)
  - If the contractor strays from the "suggested", all engineering is on them
- Temporary Works are NOT permanent structures

176

Conclusions/Thoughts – Const. Eng. Perspective

- Perfect World
- Design-Bid-Build Contract Plans
  - Contractor is responsible for erecting parts and pieces to achieve a fully erected structure
  - Contract plans should provide a design that is stable and safe once the superstructure is fully erected
  - Contract plans should provide a viable "suggested" erection sequence (or at a min deck pour sequence)
  - If the contractor strays from the "suggested", all engineering is on them
- Temporary Works are NOT permanent structures

177

Conclusions/Thoughts – Const. Eng. Perspective

- Perfect World
- Design-Bid-Build Contract Plans
  - Contractor is responsible for erecting parts and pieces to achieve a fully erected structure
  - Contract plans should provide a design that is stable and safe once the superstructure is fully erected
  - Contract plans should provide a viable "suggested" erection sequence (or at a min deck pour sequence)
  - If the contractor strays from the "suggested", all engineering is on them
- Temporary Works are NOT permanent structures

178

Conclusions/Thoughts – Const. Eng. Perspective

- Perfect World
- Design-Bid-Build Contract Plans
  - Contractor is responsible for erecting parts and pieces to achieve a fully erected structure
  - Contract plans should provide a design that is stable and safe once the superstructure is fully erected
  - Contract plans should provide a viable "suggested" erection sequence (or at a min deck pour sequence)
  - If the contractor strays from the "suggested", all engineering is on them
- Temporary Works are NOT permanent structures

179

Conclusions/Thoughts – Const. Eng. Perspective

- Perfect World
- Design-Bid-Build Contract Plans
- Temporary Works are NOT permanent structures
  - Temporary works support the structure in their most unstable periods of time as well as equipment needed to erect the structure
  - Temporary works may only need to work for 15 minutes or could work as long as six to twelve months (or longer in the case of trestles/barges supporting equipment)
  - The design loads/guidelines of temporary works are not as well defined as those for the permanent structures ... This needs to be recognized by the EOR when developing erection submittal specifications and reviewing contractor submittals.

180

Conclusions/Thoughts – Const. Eng. Perspective

- Perfect World
- Design-Bid-Build Contract Plans
- Temporary Works are NOT permanent structures
  - Temporary works support the structure in their most unstable periods of time as well as equipment needed to erect the structure
  - Temporary works may only need to work for 15 minutes or could work as long as six to twelve months (or longer in the case of trestles/barges supporting equipment)
  - The design loads/guidelines of temporary works are not as well defined as those for the permanent structures ... This needs to be recognized by the EOR when developing erection submittal specifications and reviewing contractor submittals.

181

Conclusions/Thoughts – Const. Eng. Perspective

- Perfect World
- Design-Bid-Build Contract Plans
- Temporary Works are NOT permanent structures
  - Temporary works support the structure in their most unstable periods of time as well as equipment needed to erect the structure
  - Temporary works may only need to work for 15 minutes or could work as long as six to twelve months (or longer in the case of trestles/barges supporting equipment)
  - The design loads/guidelines of temporary works are not as well defined as those for the permanent structures ... This needs to be recognized by the EOR when developing erection submittal specifications and reviewing contractor submittals.

182

Questions?

Dave Rogowski PE, Principal/Owner: drogowski@genesisstructures.com
Josh Crain PE/SE, Senior Engineer: jcrain@genesisstructures.com

AISC | Questions?

Smarter.
Stronger.
Steel.

CEU / PDH Certificates

- You will receive an email on how to report attendance from: registration@aisc.org.
- Be on the lookout: Check your spam filter! Check your junk folder!
- Completely fill out online form. Don’t forget to check the boxes next to each attendee’s name!

Smarter.
Stronger.
Steel.

CEU / PDH Certificates

- Reporting site (URL will be provided in the forthcoming email).
- Username: Same as AISC website username.
- Password: Same as AISC website password.

Smarter.
Stronger.
Steel.

AISC | Thank you

Smarter.
Stronger.
Steel.