PROPOSED BEAM STABILITY SUBMITTAL REQUIREMENTS
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OVERVIEW

• PURPOSE & NEED
• RESPONSIBILITIES
• DESIGN
• STABILITY CLASSIFICATIONS
• CONTRACTOR SUBMITTALS
• DETAILS
• REFERENCES
• QUESTIONS
PURPOSE & NEED
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• NEW CHALLENGES
  • Design
PURPOSE & NEED

• NEW CHALLENGES
  • Fabrication
PURPOSE & NEED

• NEW CHALLENGES
  • Transportation
PURPOSE & NEED

• NEW CHALLENGES
  • *Lifting*
PURPOSE & NEED

• NEW CHALLENGES
  • Site
    • Storage Conditions
    • Erection
    • Wind
    • Sweep Effects
PURPOSE & NEED
“Lateral stability must be considered for all stages in the life of a prestressed girder, including lifting, storage, transport, erection, support of construction loads during casting of the bridge deck, and in the future during deck removal and replacement.”

- PCI
“For the purposes of this specification, erection is the process of transporting, handling and assembling the bridge components to result in a bridge structure that meets all the geometric and structural requirements of the Contract Documents.”

- KANSAS DOT SPECIFICATIONS
“For the purposes of this specification, **erection operations** is a process including the transportation, handling and assembling the bridge components that meet all of the geometric and structural requirements of the Contract Documents.”

- VDOT SPECIAL PROVISION
RESPONSIBILITIES

• DESIGNER
  • Consideration of:
    o Reasonable Means & Methods:
      • Lifting
      • Erection
    o Potential Route Restrictions
    o Potential Site Restrictions

• PROVIDE:
  • Constructable Design
  • Details required for bid
RESPONSIBILITIES

• CONTRACTOR
  • Means & Methods
    o Where conditions/dimensions differ, engineering calcs req’d
  • Maintain Stability During Erection Operations:
    o Fabrication
    o Yard Handling
    o Storage
    o Transportation
    o Lifting
    o Erection
    o Prior to deck concrete reaching required strength
“If plans do not indicate lifting and support points, the Contractor shall lift and support units at locations not less than 6 inches or more than the depth of the unit from the end of the unit. . . . Requests by the Contractor to use lifting or support points other than those indicated must be accompanied by computations showing that stresses are within allowable range using 50% of the dead load as an impact factor.”

- VDOT SECTION 405.05(5)
WHAT EXACTLY DOES THIS MEAN?
• DESIGNER

• Lifting/Support Analysis
  o “Implied Responsibility”
    o Designer: Checks supports within zone defined in specs
    o Contractor: Checks supports not within zone defined in specs
DESIGN SUBMITTALS

• DESIGNER
  • Lifting Analysis
    o “Implied Responsibility”
      o **Designer**: Check supports within zone defined in specs
      o **Contractor**: Check supports not within zone defined in specs
• DESIGN SUBMITTALS
  
  • DESIGNER:
    • Lifting Analysis
      o "Implied Responsibility"
        o Designer: Check supports within zone defined in specs
        o Contractor: Check supports not within zone defined in specs
DESIGN SUBMITTALS

- Lifting Analysis
  - "Implied Responsibility"
- Designer: Check supports within zone defined in specs
- Contractor: Check supports not within zone defined in specs
STABILITY CLASSIFICATIONS

• STABILITY CLASSIFICATIONS
  • Stability Class SA
  • Stability Class SB

• REQUIRED SUBMITTALS
  • Determined by stability classification

• APPLICATIONS
  • Prestressed concrete
  • Post-tensioned concrete
  • CIP concrete
  • Structural steel
## STABILITY CLASSIFICATIONS

### Stability Class SA

**Geometry:**
- Longest span length is 130’ or less
- Concrete Only: \[
  \frac{b}{L} > 0.03 \quad \text{and} \quad \frac{w}{H} > 0.32
\]
- Girder radius of curvature is greater than 20 times the span length (angle < 0.05 radians)
- Span to depth ratio for beam only meets AASHTO rec’d minimums
- Skew angle < 30°

**General:**
- Does not cross highway or railroad traffic
- No multi-crane lifts or erection from floating equipment
## STABILITY CLASSIFICATIONS

### Stability Class SA (cont’d)

<table>
<thead>
<tr>
<th>General</th>
</tr>
</thead>
<tbody>
<tr>
<td>Movable cranes do not travel during lift</td>
</tr>
<tr>
<td>Shoring towers, falsework and strong backs not required during erection</td>
</tr>
</tbody>
</table>

### Beam end conditions:

<table>
<thead>
<tr>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rectangular elastomeric bearing pads normal to the beam axis</td>
</tr>
<tr>
<td>Elastomeric Bearing width &gt; 22”</td>
</tr>
<tr>
<td>Beam ends externally braced or connected by secondary member</td>
</tr>
</tbody>
</table>

### Class SA-1: 75’ < Span Length ≤ 130’

### Class SA-2: Span Length ≤ 75’
STABILITY CLASSIFICATIONS

• STABILITY CLASS SB INCLUDES:
  • All other bridges
  • Some Stability Class SA bridges:
    o With unique construction conditions
    o With unusual or complex site conditions
    o Based upon engineering judgement
CONTRACTOR SUBMITTALS

• TRANSPORTATION & SHIPPING PLAN
  • Required for all stability classifications

• ERECTION PLAN & PROCEDURES
  • Fully-integrated documents
  • Procedures address any items not addressed in the Erection Plan
  • Work Area Plan
  • All classifications
    o There are risk related distinctions separating level
CONTRACTOR SUBMITTALS

• SAFETY PLAN
  • *Class SA-1 & SB*

• ERECTION ENGINEERING CALCULATIONS
  • *Class SA-1 & SA-2*
    o NOT REQUIRED FOR CONCRETE
  • *Class SB*
    o *Cranes and Temporary Support Structures:*
    o *Operations*

• SUPPORTING DOCUMENTATION
• TIE-DOWNS
  • *Through web*
    o Planned (shop drawings)
    o RFI request
• TIE-DOWNS
  • *Through web*
  • *Over flange*
    - *Used often, sometimes inappropriately*
    - *Chains damage flange*
    - *Loose chains $\rightarrow$ girder may rotate under the chains*
    - *Chains too tight $\rightarrow$ crack and spall top flange*
• **LIFTING**
  
  • *w/o Spreader Beam*
    
    o Use of slings induces additional loading in beam
    o Additional lifting analysis required
    o Longer girders generally require spreader bars/beam
• **LIFTING**
  
  • *w/o Spreader Beam*
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DETAILS

• LIFTING
  • w/o Spreader Beam
  • w/ Spreader Beam
    ○ Increased stability
    ○ Decreased loads to beam due to hoisting
    ○ Distribute lifting loads across multiple points
• **LIFTING**
  - w/o Spreader Beam
  - w/ Spreader Beam
  - Through top flange
    - Lifting load applied through axis of member
    - No eccentricity
    - Increased stability
    - Resistance to twist at lift points
    - Detail coordinated between Fabricator, Contractor and Transporter
DETAILS

- **BRACING**
  - Various types
  - Provide calculations
 DETAILS

• **BRACING**
  • *Various types*
  • *Provide calculations*
DETAILS

• BRACING
  • Various types
  • Provide calculations
• **BRACING**

• **STORAGE**
  - *Duration of storage*
  - *Storage orientation*
  - *Dunnage*
    - Appropriate
    - Level ground

• **SITE ACCESS**
DETAILS

• BRACING
• STORAGE
• SITE ACCESS
REFERENCES

• National Highway Institute (NHI)
  • NHI Course No. 130102(A)
  • Engineering for Structural Stability in Bridge Construction

• Prestressed/Precast Concrete Institute (PCI)
  • Recommended Practice for Lateral Stability of Precast, Prestressed Concrete Bridge Girders, 1st Ed.

• AASHTO
  • Guide Specifications for Wind Loads on Bridges During Construction, 2017