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

THE INFORMATION IN THIS STANDARD APPLIES ONLY TO COMPLETELY ERECTED STEEL SUPERSTRUCTURE, INCLUDING THE DECK. THE STABILITY OF PARTIAL AND/OR COMPLETED SUPERSTRUCTURE IS THE RESPONSIBILITY OF THE CONTRACTOR AS SPECIFIED IN THE CRITERIA APPLICABLE TO COMPLETELY ERECTED STEEL SUPERSTRUCTURE (REFERENCE MANUAL, OCTOBER 2013, NHI COURSE NUMBER 130102).

1. PROVIDE LATERAL BRACING FOR BRIDGES WITH SPANS IN EXCESS OF 200 FT. TO 400 FT. 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 DEFORMATION.
3. GIRDERS SHALL BE DESIGNED SO THAT NO LATERAL BRACING IS NEEDED FOR SPANS LESS THAN OR EQUAL TO 200 FT. OF STRUCTURAL BRACING WHERE GIRDERS DEPTH LESS THAN OR EQUAL TO 30 FT. PROVIDED THERE IS A BRIDGE CROSS SECTION WITH 4 OR MORE GIRDERS, THE ENGINEER WILL ENSURE THE STABILITY OF THE SUPERSTRUCTURE IS ENSURED AT THE COMMENCED TOP PLATE, AND IF NEEDED, MODIFY THE LATERAL BRACING DESIGN.
4. LATERAL DEFORMATION OF STEEL SUPERSTRUCTURE FOR A PERMISSIBLE DEFORMATION OF 1/800. PROVIDE BRACING IF DEFORMATION LIMIT IS EXCEEDED. AN ACCEPTABLE ANALYSIS METHOD IS A HAND ANALYSIS FOR A SINGLE DESIGN SUPERSTRUCTURE AND/OR A GRID ANALYSIS FOR THE COMPLETE SUPERSTRUCTURE FRAMING. THE EQUIVALENT STRESS OF THE 1/800 PLANE SHALL BE RECALCULATED. FINALLY, IF A GRID ANALYSIS IS USED, THE DISSIPATION/DISPERSAL CONNECTION SHALL BE ASSEMBLED FOR THE DIMENSIONAL CONNECTIONS CONFORMING TO THE CONSTRUCTION DETAILS CONFORMING TO THE CONSTRUCTION DETAILS.
5. USE MINIMUM DESIGN WIND LOAD SPECIFIED IN THE TABLE ON THIS SHEET, EXCEPT FOR SPANS LESS THAN 200 FT. INCREASED PRESSURES BY 50%.
6. WIND LOAD PER FOOT OF BRIDGE IS GIRDERS DEPTH X DECK THICKNESS AT BASE LAYER A DESIGN WIND PRESSURE. ONLY THE BASE LAYER WILL BE LOADED.
7. MINIMUM DESIGN WIND PRESSURES (PSF):

<table>
<thead>
<tr>
<th>CONSTRUCTION DURATION</th>
<th>DESIGN WIND LOAD</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-6 WEEKS</td>
<td>1.0xDC + 1.0xCDL + 1.0xCW</td>
</tr>
<tr>
<td>6-12 WEEKS</td>
<td>1.0xDC + 1.0xCDL + 1.0xCW</td>
</tr>
<tr>
<td>1-2 YEARS</td>
<td>1.0xDC + 1.0xCDL + 1.0xCW</td>
</tr>
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NOTES:
1. LINEAR INTERPOLATION FOR INTERMEDIATE VALUES OF HEIGHT IS ACCEPTABLE.
2. BASIC WIND SPEED IS 115 MPH BASED ON A PROBABILITY OF EXCEEDANCE IN 50 YEARS.
3. EXPOSURE CONDITION IS CATEGORY C APPLICABLE TO OPEN GRASSLAND AND SCATTERED OBSTRUCTION.
4. FOR BRIDGES NOT EXPOSED TO CATEGORY C, THESE WIND PRESSURES NEED TO BE ADJUSTED ACCORDINGLY. USE REFERENCE IN NOTE AS A GUIDELINE.

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

- R1. EXPERIENCE INDICATES THAT SPANS IN EXCESS OF 300 FT. GENERALLY HAVE WIND ISSUES DURING CONSTRUCTION.
- R2. EXPERIENCE INDICATES THAT WIND MAY AFFECT THE STEEL SUPERSTRUCTURE IN A MANAGER THAT WOULD REQUIRE MANDATORY BRACING FOR SPANS FROM 200 TO 300 FT.
- R3. EXPERIENCE OF THE APC BRIDGE COMMITTEE, STEEL SUPERSTRUCTURE STABILITY SUBCOMMITTEE INDICATES THAT SPANS LESS THAN 200 FT. HAVE NOT HAD WIND ISSUES DURING CONSTRUCTION.
- R4. L/150 IN 300 FT. IS 2 FT. THIS WAS FELT TO BE ACCEPTABLE TO BOTH DESIGN PERSONAL AND CONTRACTORS.
- R5. AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS
- R6. ENGINEERING FOR STRUCTURAL SAFETY IN CONSTRUCTION OF BRIDGE SUPERSTRUCTURE RECOMMENDATIONS, REFER TO SUPERSTRUCTURE (REFERENCE MANUAL, OCTOBER 2013, NHI COURSE NUMBER DESIGN).
- R7. PROFESSIONAL EXPERIENCE
- R8. CONTRACTOR PREFERENCE
- R9. PROFESSIONAL EXPERIENCE
- R10. CONTRACTOR PREFERENCE
- R11. DESIGN SPECIFICATION FOR THE PERMANENT CONDITION
- R12. EXPERIENCE INDICATES THAT SPANS IN EXCESS OF 300 FT. GENERALLY HAVE WIND ISSUES DURING CONSTRUCTION.
- R13. EXPERIENCE OF THE APC BRIDGE COMMITTEE, STEEL SUPERSTRUCTURE STABILITY SUBCOMMITTEE INDICATES THAT SPANS LESS THAN 200 FT. HAVE NOT HAD WIND ISSUES DURING CONSTRUCTION.
- R14. L/150 IN 300 FT. IS 2 FT. THIS WAS FELT TO BE ACCEPTABLE TO BOTH DESIGN PERSONAL AND CONTRACTORS.
- R15. AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS
- R16. ENGINEERING FOR STRUCTURAL SAFETY IN CONSTRUCTION OF BRIDGE SUPERSTRUCTURE RECOMMENDATIONS, REFER TO SUPERSTRUCTURE (REFERENCE MANUAL, OCTOBER 2013, NHI COURSE NUMBER DESIGN).
**ADDITIONAL LATERAL STABILITY CRITERIA FOR SKewed STEEL BRIDGES**

1. The design engineer shall check skewed bridges for the following loading conditions:
   
   A) Wind loading on the steel superstructure prior to deck placement - The procedure shall follow that used for the straight, unskewed bridge. The loaded area shall be the vertical plane area of the fascia girder.
   
   B) Partial width loading under staged construction for future deck replacement as directed by the department.
   
   C) Vertical and lateral deflections shall be evaluated for steel self-weight and the deck dead load.

2. Bearings shall be designed to accommodate girder rotation during the deck pour in and out of the girder plane. Girders and their bearing stiffeners shall be vertical at the bearings under full dead load. Uplift shall be checked at each bearing for worst loading condition in each construction phase.

3. Include lateral wind bracing in the design of girders that do not meet the criteria as shown on Sheet 1. Design lateral bracing to carry wind loads only and detail the bracing so that it will not participate in carrying primary structure forces.

4. The engineer shall identify the need for and location of falsework and provide information as per DM4 D2.5.3 1P; however, the design and foundation of the falsework is the responsibility of the contractor. Foundation of the falsework is the responsibility of the contractor.

5. Use top or bottom flange bracing for straight girders. For girders with narrow top flange width, it is recommended to use bottom flange lateral bracing.

**ADDITIONAL LATERAL STABILITY CRITERIA FOR CURVED STEEL GIRDERS BRIDGES**

1. The design engineer shall check curved steel girder bridges for the following loading conditions:
   
   A) Wind loading on the steel superstructure prior to deck placement - The procedure shall follow that used for the straight, unskewed bridge. The loaded area in the surface area of the longest girder. Allowable horizontal deflections shall be based on criteria for straight unskewed girders and bridges prior to deck placement.
   
   B) Partial width loading under staged construction for future deck replacement as directed by the department.
   
   C) Vertical and lateral deflections shall also be evaluated for steel self-weight and the deck dead load.

2. Bearings shall be designed to accommodate girder rotation during the deck pour in and out of the girder plane. Girders and their bearing stiffeners shall be vertical at the bearings under full dead load. Uplift shall be evaluated at each bearing for worst loading condition in each construction phase.

3. Include lateral wind bracing in the design of girders that do not meet the criteria as shown on Sheet 1. Design lateral bracing to carry wind loads only and detail the bracing so that it will not participate in carrying primary structure forces.

4. The engineer shall identify the need for and location of falsework and provide information as per DM4 D2.5.3 1P; however, the design and foundation of the falsework is the responsibility of the contractor.

5. Design lateral bracing for wind loads. Design and detail the lateral bracing so that it will not participate in carrying primary structure forces.

**ADDITIONAL LATERAL STABILITY CRITERIA FOR STRAIGHT STEEL GIRDERS BRIDGES**

1. Use top or bottom flange bracing for straight girders. For girders with narrow top flange width, it is recommended to use bottom flange lateral bracing.

2. The engineer shall identify the need for and location of falsework and provide information as per DM4 D2.5.3 1P; however, the design and foundation of the falsework is the responsibility of the contractor.

3. Bearings shall be designed to accommodate girder rotation during the deck pour. Girders and their bearing stiffeners shall be vertical at the bearings under full dead load. Uplift shall be checked at each bearing for worst loading condition in each construction phase.

4. Include lateral wind bracing in the design of girders that do not meet the criteria as shown on Sheet 1. Design lateral bracing to carry wind loads only and detail the bracing so that it will not participate in carrying primary structure forces.

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**COMMONWEALTH OF PENNSYLVANIA**

**DEPARTMENT OF TRANSPORTATION**

**STANDARD**

**STEEL GIRDER BRIDGES LATERAL BRACING CRITERIA AND DETAILS**

*Recommended: Nov. 21, 2014*
LATERAL BRACING (PREFERRED)

FOR ODD NUMBER OF GIRDERS, OFFSET BRACING ONE BAY.
TYPICAL SKewed STRUCTURE WHEN DESIGN IS NOT
CONTROLLED BY WIND LOADING OR FLANGE.

NOTES:
1. USE INTERMEDIATE BRACING POINT (DETAIL B, SM. 4) AS NEEDED IF
   DESIGN IS CONTROLLED BY LATERAL FLEXURAL DESIGN AT FASCIA GIRDERS
   AND LATERAL STABILITY.
2. USE ANGLE OR STRUCTURAL STEEL BRACING MEMBERS WHEREVER POSSIBLE.
3. LATERAL BRACING FIELD CONNECTIONS SHALL BE MADE WITH AT LEAST
   TWO BOLTS PER CONNECTION, Minimum 2 BOLTS, ALONG GUSSET PLATE HOLE.
4. FOR ODD NUMBER OF GIRDERS, CENTER GIRDERS OR SYMMETRICAL,
   LAYOUT IS ACCEPTABLE. FOR ODD NUMBER OF GIRDERS, EITHER SINGLE
   ROW BRACING ALONG CENTER OR CENTER GIRDERS, BOTH ROWS
   ALONG CENTER GIRDERS, LAYOUT IS ACCEPTABLE.
5. PARTIAL LENGTH LATERAL BRACING IS PERMITTED.
TOP FLANGE LATERAL BRACING CONNECTIONS

NOTE: PREFERRED ARRANGEMENT IS TO ATTACH LATERAL BRACING TO THE BOTTOM FLANGE PER BC-754M. THE TOP FLANGE ATTACHMENT DETAILS ARE SHOWN FOR THE INFREQUENT SITUATIONS THAT NECESSITATE ATTACHMENT TO THE TOP FLANGE.

TABLE 1

<table>
<thead>
<tr>
<th>CLEAR DISTANCE BETWEEN GIRDER FLANGES</th>
<th>DIM.</th>
<th>&quot;A&quot;</th>
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<tbody>
<tr>
<td>6'-0&quot; TO 9'-0&quot;</td>
<td>6&quot;</td>
<td></td>
</tr>
<tr>
<td>6'-0&quot; TO 8'-0&quot;</td>
<td>6&quot;</td>
<td></td>
</tr>
<tr>
<td>UNDER 6'-0&quot;</td>
<td>6&quot;</td>
<td></td>
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[Diagram and text related to bridge engineering, lateral bracing criteria, and details for steel girder bridges.]
STANDARD

ALTERNATE LATERAL BRACING - TYPE 2

TYPICAL CURVED STRUCTURE

NOTES:

1. USE INTERMEDIATE BRACING POINT DETAIL E. ON SHEET 6 AS NEEDED TO PREVENT SLIDING OF GIRDER ENDS DUE TO ACTING LATERAL STABILITY.

2. USE ANGLE OR STRUCTURAL TEE BRACING MEMBERS WHENEVER POSSIBLE.

3. LATERAL BRACING FIELD CONNECTIONS SHALL BE MADE WITH 1/4"-20 SHEET METAL SCREW BOLTS USING OVERSIZED HOLES IN THE GUSSET PLATES. MINIMUM 2 BOLTS PER CONNECTION.

4. FOR EVEN NUMBER OF GIRDER, CENTER GIRDER SET OF SYMMETRICAL LAYOUT IS ACCEPTABLE. FOR ODD NUMBER OF GIRDER, EITHER SINGLE GIRDER ADJACENT TO CENTER girder, LAYOUT IS ACCEPTABLE.

5. PARTIAL LENGTH LATERAL BRACING IS PERMITTED.
TOP FLANGE LATERAL BRACING CONNECTIONS

NOTE: BOTTOM FLANGE LATERAL BRACING IS NOT PERMITTED WITHOUT PRIOR APPROVAL OF CHIEF BRIDGE ENGINEER SINCE THE BRACING WILL CHANGE THE BEHAVIOR OF THE GIRDERS TO BEHAVE AS A PSEUDO-BOX GIRDER.

SECTION G-G
FIELD BOLTED BRACE

ALTERNATE SECTION G-G
SHOP WELDED, FIELD BOLTED BRACE