LATERAL STABILITY BRACING
DESIGN CRITERIA FOR GIRDER BRIDGES

PRIOR TO DECK COMPLETION

The criteria in this standard applies only to completely erected steel superstructures. The stability of the girder or composite girder is the responsibility of the prime contractor. The prime contractor is responsible for the connections as specified in Publication 48 Section 1050.3(e). (Applies to tangent, skewed and curved bridges.)

1. Provide lateral bracing for bridges with spans in excess of 200 ft. to aid in construction of the bridge. Design the bracing for the specified wind loads.

2. Evaluate the need for lateral bracing for spans in excess of 200 ft. based on lateral deflection.

3. Girders shall be designed so that no lateral bracing is necessary for spans less than 200 ft. Due to lateral bracing required, additional girders shall be provided. The engineer shall evaluate the use of bracing in the area of the pile cap. It is necessary to complete the design.

4. Provide lateral bracing for the entire steel superstructure for a permissible deflection of 1/160. Provide bracing if deflection limits are exceeded. An acceptable analysis method is a wind calculation for a single section length (composite of a grid). The wind analysis of the entire steel superstructure shall be performed. The wind action of the entire steel superstructure shall be considered. The analysis includes the bracing and the wind forces acting on the frame as a whole. The analysis is performed on the wind forces acting on the wind forces acting on the entire steel superstructure.

5. Design the girder sections for combined steel superstructure lateral stability and wind loads using the following load combinations:
   - Live Load - 1.4 x Dead Load + 0.25 x Wind Load
   - Dead Load - 1.0 x Dead Load + 0.25 x Wind Load
   - Wind Load - 1.0 x Dead Load + 0.25 x Wind Load

6. The minimum design wind load specified on the table in this sheet, except for spirals over 50 ft. for designs that are capable of being braced at 0.3 psf.

7. Provide wind load at the end of the girder to allow for the design to be completed.

8. Use oversided or sloping miles to design the girder plates.

9. Design the connections of the bracing to prevent slip from wind loads using the permissible deflection in allowable slip forces. Design connections for actual forces. Provide oversided or sloping miles to design the connection for wind loads only.

10. Provide lateral bracing arrangement in the connections as specified. Provide the connection protection in the design.

11. Provide lateral bracing for the final condition. Provide the connection protection in the design.

STATEMENT OF CRITERIA:

LATERAL STABILITY CRITERIA FOR GIRDER BRIDGES

- Design the girder sections for combined steel superstructure lateral stability and wind loads using the following load combinations:
  - Live Load - 1.4 x Dead Load + 0.25 x Wind Load
  - Dead Load - 1.0 x Dead Load + 0.25 x Wind Load
  - Wind Load - 1.0 x Dead Load + 0.25 x Wind Load

- The minimum design wind load specified on the table in this sheet, except for spirals over 50 ft.

- Provide wind load at the end of the girder to allow for the design to be completed.

- Use oversided or sloping miles to design the girder plates.

- Design the connections of the bracing to prevent slip from wind loads using the permissible deflection in allowable slip forces. Design connections for actual forces. Provide oversided or sloping miles to design the connection for wind loads only.

- Provide lateral bracing arrangement in the connections as specified. Provide the connection protection in the design.

- Provide lateral bracing for the final condition. Provide the connection protection in the design.

MINIMUM DESIGN WIND PRESSURE (PSF)

<table>
<thead>
<tr>
<th>SUPERSTRUCTURE HEIGHT</th>
<th>0-6 WEEKS</th>
<th>6 WEEKS-3 YEAR</th>
<th>1-2 YEARS</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-20 FT.</td>
<td>40</td>
<td>35</td>
<td>30</td>
</tr>
<tr>
<td>20-40 FT.</td>
<td>35</td>
<td>30</td>
<td>25</td>
</tr>
<tr>
<td>40-60 FT.</td>
<td>30</td>
<td>25</td>
<td>20</td>
</tr>
<tr>
<td>60-100 FT.</td>
<td>25</td>
<td>20</td>
<td>15</td>
</tr>
<tr>
<td>100-200 FT.</td>
<td>20</td>
<td>15</td>
<td>10</td>
</tr>
<tr>
<td>200-300 FT.</td>
<td>15</td>
<td>10</td>
<td>5</td>
</tr>
</tbody>
</table>

NOTES:

1. Wind pressure includes intermediate values of wind speed.

2. Load factor is applied to the dead load and wind loads using the following load combinations:
   - Live Load - 1.4 x Dead Load + 0.25 x Wind Load
   - Dead Load - 1.0 x Dead Load + 0.25 x Wind Load
   - Wind Load - 1.0 x Dead Load + 0.25 x Wind Load

3. Provide wind load at the end of the girder to allow for the design to be completed.

4. Use oversided or sloping miles to design the girder plates.

5. Design the connections of the bracing to prevent slip from wind loads using the permissible deflection in allowable slip forces. Design connections for actual forces. Provide oversided or sloping miles to design the connection for wind loads only.

6. Provide lateral bracing arrangement in the connections as specified. Provide the connection protection in the design.

7. Provide lateral bracing for the final condition. Provide the connection protection in the design.

8. Use oversided or sloping miles to design the girder plates.

9. Design the connections of the bracing to prevent slip from wind loads using the permissible deflection in allowable slip forces. Design connections for actual forces. Provide oversided or sloping miles to design the connection for wind loads only.

10. Provide lateral bracing arrangement in the connections as specified. Provide the connection protection in the design.

11. Provide lateral bracing for the final condition. Provide the connection protection in the design.

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF TRANSPORTATION
BUREAU OF PROJECT DELIVERY

STANDARD
STEEL GIRDER BRIDGES
LATERNAL BRACING CRITERIA AND DETAILS

REFERENCE DRAWINGS

BD-620M
BD-732M
BD-753M
ADDITIONAL LATERAL STABILITY CRITERIA
FOR SKewed STEEL BRIDGES

APPLIES TO STRAIGHT AND CURVED BRIDGES

1. THE DESIGN ENGINEER SHALL CHECK CURVEd STEEL 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 BOTH IN AND OUT OF THE GIRDER PLANE. GIRDER AND THEIR BEARING STIFFENERS SHALL BE VERTICAL AT THE BEARINGS UNDER FULL DEAD LOAD. UPLIFT SHALL BE CHECKED AT EACH BEARING FOR MOST 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. 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.

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 GIRDER 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 DESIGN ENGINEER SHALL IDENTIFY THE NEED FOR AND LOCATION OF FALSEWORK AND PROVIDE INFORMATION AS PER THE 20.3.2.1 FOR STRAIGHT BRIDGES. THE DESIGN AND FOUNDATION OF THE FALSEWORK IS THE RESPONSIBILITY OF THE CONTRACTOR.

3. 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.

4. THE DESIGN ENGINEER SHALL IDENTIFY THE NEED FOR AND LOCATION OF FALSEWORK AND PROVIDE INFORMATION AS PER THE 20.3.2.1 FOR STRAIGHT BRIDGES. THE DESIGN AND 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 GIRDER 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 IS THE SURFACE AREA OF THE LONGEST CURVED. ALTERNATIVE 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 BOTH IN AND OUT OF THE GIRDER PLANE. GIRDER AND THEIR BEARING STIFFENERS SHALL BE VERTICAL AT THE BEARINGS UNDER FULL DEAD LOAD. UPLIFT SHALL BE CHECKED AT EACH BEARING FOR MOST 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. 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.

5. DESIGN LATERAL BRACING FOR WIND LOADS. DESIGN AND DETAIL THE LATERAL BRACING SO THAT IT WILL NOT PARTICIPATE IN CARRYING PRIMARY STRUCTURE FORCES.
COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF TRANSPORTATION

STANDARD LATERAL BRACING - TYPE 2
(PREFERRED)

NOTES:
1. USE INTERMEDIATE BRACING POINT (DETAIL B, SHT. 4) AS NEEDED IF DESIGN IS CONTROLLED BY LATERAL PLANE BENDING AT FACIA GIRDERS AND LATERAL STABILITY.
2. USE ANGLE OR STRUCTURALTEE BRACING MEMBERS WHENEVER POSSIBLE.
3. LATERAL BRACING FIELD CONNECTIONS SHALL BE MADE FOR 3/4" DIA. METAL PLATE WELDS USING OVERSIZED HOLES IN THE GUSSET PLATES, MINIMUM 2 BOLTS PER CONNECTION.
4. FOR ODD NUMBER OF GIRDERS, CENTER GIRDERS ARE SYMMETRICAL, BOTH BAYS ADJACENT TO CENTER GIRDERS ARE SYMMETRICAL. FOR EVEN NUMBER OF GIRDERS, CENTER BAY IS ACCEPTABLE. FOR ODD NUMBER OF GIRDERS, EITHER SINGLE BAY BRACING ALONG CENTER GIRDERS IS SYMMETRICAL, BOTH BAYS ADJACENT TO CENTER GIRDERS, LAYOUT IS ACCEPTABLE.
5. PARTIAL LENGTH LATERAL BRACING IS PERMITTED.

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF TRANSPORTATION
BUREAU OF PROJECT DELIVERY

STANDARD
STEEL GIRDER BRIDGES
LATERAL BRACING CRITERIA AND DETALS
(STRAIGHT GIRDERs)
TOP FLANGE LATERAL BRACING CONNECTIONS

NOTE: PREFERRED ARRANGEMENT IS TO ATTACH LATERAL BRACING TO THE BOTTOM FLANGE PER BC-754. 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>
</tr>
</thead>
<tbody>
<tr>
<td>6'-0&quot; TO 9'-0&quot;</td>
<td>4&quot;</td>
<td></td>
</tr>
<tr>
<td>9'-0&quot; TO 12'-0&quot;</td>
<td>2 1/2&quot;</td>
<td></td>
</tr>
<tr>
<td>UNDER 6'-0&quot;</td>
<td>2&quot;</td>
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</table>

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

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF TRANSPORTATION
STANDARD
STEEL GIRDER BRIDGES
LATERAL BRACING CRITERIA AND DETAILS (STRAIGHT GIRDERs)

BD-620M
STANDARD

ALTERNATE LATERAL BRACING - TYPE 2

NOTES:

1. USE INTERMEDIATE BRACING POINT DETAIL E, ON SHEET 6 AS NEEDED IF DESIGN IS CONTROLLED BY LATERAL FLANGE BENDING AT FACIA GIRDERS AND LATERAL STABILITY.

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

3. LATERAL BRACING FIELD CONNECTIONS SHALL BE MADE WITH 3/8" X 1" 2 HAAS H.S. BOLTS USING CHASED HOLES IN THE GUSSET PLATE. MINIMUM 2 BOLTS PER CONNECTION.

4. FOR ODD NUMBER OF GIRDERS, CENTER GIRDERS BE CIRCULAR. LAYOUT IS ACCEPTABLE. FOR EVEN NUMBER OF GIRDERS, EITHER SINGLE BAY BRACING ADJACENT TO CENTER GIRDERS OR SYMMETRICAL, BOTH BAY ADJACENT TO CENTER GIRDERS, 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