

New Jersey Department of Transportation  
Bureau of Research

## Technical Brief



### Steel Erection Out of Plumb

This study reviews available research papers, reports, presentations, as well as design and construction guidelines from various agencies and universities related to the design and construction engineering of curved and/or skewed steel I-girder highway bridges, with a main focus on the recently published NCHRP Report 725 - Guidelines for Analysis Methods and Construction Engineering of Curved and Skewed Steel Girder Bridges. This study also provides guidelines to address out-of-plumb issues based on literature review and the authors' project experience in both design and construction inspection projects of curved and/or skewed steel I-girder bridges.

### Background

Currently, NJDOT does not have specific guidance on how designers and contractors are to address out-of-plumb girders associated with curved and/or skewed steel I-girder bridges as part of design and during construction. Other state DOTs offer guidance on design, detailing, and fabrication policies but guidance varies from state to state and may even be contradictory on certain issues. AASHTO/NSBA has guidelines related to the erection of curved and/or skewed steel I-girder bridges, covered under three different AASHTO/NSBA documents - Steel Bridge Girder Analysis, Guidelines for Design for Constructability, and Steel Bridge Erection Guide Specification mingled with guidelines for other issues, instead of under a single document. However, these AASHTO/NSBA guidelines have not been formally adopted by NJDOT, as the recently published NCHRP Report 725 has not been adopted by AASHTO or NJDOT. Therefore, NJDOT construction personnel in the field often have no guidelines to follow when out-of-plumb issues arise.

### Research Objectives and Approach

The objective of this work is to generate and compile guidelines and checklists for design and construction in order to address the out-of-plumb issues typical to curved and highly skewed bridges. These guidelines are recommended to be incorporated within the NJDOT Design Manual for implementation on future projects involving the design and construction of curved and/or skewed steel I-girder bridges.

To accomplish these objectives, the following work is to be completed: 1) perform a literature review including NCHRP Report 725 - Guidelines for Analysis Methods and Construction Engineering of Curved and Skewed Steel Girder Bridges; AASHTO LRFD Bridge Design Specifications, Section 6; NSBA G13.1 – Guidelines for Steel Bridge

Girder Analysis; NSBA G12.1-2003 – Guidelines for Design for Constructability; NSBA S10.1-2007 – Steel Bridge Erection Guide Specification; FHWA-PA-2010-013-PSU 009 – Guidelines for Analyzing Curved and Skewed Bridges and Designing Them for Construction; Ohio DOT Summary of Skewed Bridge Issues; and NYSDOT Steel Construction Manual Sections 204 and 1403; 2) review the authors’ five past projects related to curved and/or skewed steel I-girder bridges.

## Findings

Based on this study, the following guidelines and checklists have been compiled and/or developed to address out-of-plumb issues:

- Guidelines for Design and Contract Documents for Skewed and/or Curved Steel I-girder Bridges:
  - Design - Evaluation Methods, Out-of-Plumb Tolerance, Girder End-twist and Cross Frame Detailing Method (NLF, SDLF, TDLF), Other Analysis Requirements, and Problematic Characteristics and Details to Avoid
  - Contract Plan Additional Notes
  - Deck Pour Sequence Consideration
- Erection Plan and Procedures Checklist – including Work Area, Erection Sequence and Locations, Crane Information, Crane Pick Information, Details of Lifting Devices, Bolting Requirements, Bearing Blocking and Tie-down Devices, Load Restrictions, Temporary Supports, Jacking Devices and Erection Notes.
- Erection Engineering Calculation Checklist – including Method of Analysis, Girder Transportation Layout, Support Conditions, Design Criteria, Load and Load Combinations, Girder and Bridge System Stability Check, Girder Uplift Check, Temporary Hold Crane Loads, Temporary Support Loads, Bearing Rotational Capacity Check, Field Splice Connection Alignment Check, and Cross-frame Connection Alignment Check.

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A final report is available online at: <http://www.state.nj.us/transportation/refdata/research/>. If you would like a copy of the full report, send an e-mail to: [Research.Bureau@dot.state.nj.us](mailto:Research.Bureau@dot.state.nj.us).

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