

JOINT TRANSPORTATION RESEARCH PROGRAM

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Structural Impact of Construction Loads

Introduction

Numerous bridge construction accidents have occurred because of construction loadings, which are an under-emphasized topic in many specifications and design manuals. Bridge girders are least stable during the construction phase, so it is important for bridge designers and contractors to understand and design for conditions during this phase. The Indiana Department of Transportation's current Standard Specifications contain limited construction load provisions and temporary bracing requirements; therefore this study was performed to identify and implement new requirements to proactively prevent construction accidents from occurring in Indiana.

Various documents were examined in this study, including AASHTO and ASCE standards and the standard specifications and design manuals of other departments of transportation. Based on these documents, new falsework and formwork design loads, including horizontal loads, impact loads, and wind load, were developed and proposed. INDOT currently specifies only construc-

tion dead load and live loads. A set of drawings showing proposed minimum lateral bracing requirements was also created to help ensure the stability of prestressed concrete and steel girders during construction.

Findings

To develop new proposed falsework and formwork design loads, the results of the literature review were studied and then discussed with a committee consisting of INDOT bridge engineers, consulting engineers, and Indiana contractors in a series of meetings. For various construction load types, appropriate specification language was developed, and if needed, analysis performed. For some of the design loads, it was agreed to simply adopt the corresponding provision in the *AASHTO Guide Design Specifications for Bridge Temporary Works*.

The following provisions are recommended for inclusion in INDOT's *Standard Specifications*:

- A dead load of 150 pcf for concrete and reinforcing steel, plus 15 psf for formwork, consistent with a current INDOT design memo.
- A live load consisting of known construction loads, a 20 psf uniform load, and a 75 plf load at overhangs, also consistent with the current design memo.
- A minimum vertical load of 100 psf and a minimum horizontal load equal to 2% of the dead load.
- An impact load requirement for falsework, potentially affected by placement or lifting operations, and of any falsework over or adjacent to traffic.
- A new wind load provision, including tables that provide a wind pressure table and a reduction factor.
- Minimum bracing requirements for prestressed and steel girders. Proposed standard drawings would require girders to be adequately braced during erection and before slab placement.



Collapsed C-470 girder in 2004 (MatDL, 2011).

Implementation

- The new design load requirements are proposed additions to the appropriate sections of INDOT's Standard Specifications and Design Manual. Provisions would require falsework and formwork to be designed for dead load, live load, impact load, wind load, and minimum horizontal and vertical loads.
- The minimum bracing requirements for prestressed concrete and steel girders are proposed as standard drawings. Some provisions in the notes section of the drawings would be appropriate for inclusion in the Standard Specifications.
- Use of the bracing requirements would not relieve the contractor of responsibility for the adequacy of the bracing system and the safety of the structure.

It is recommended that bracing systems must be designed by an engineer according to the minimum bracing

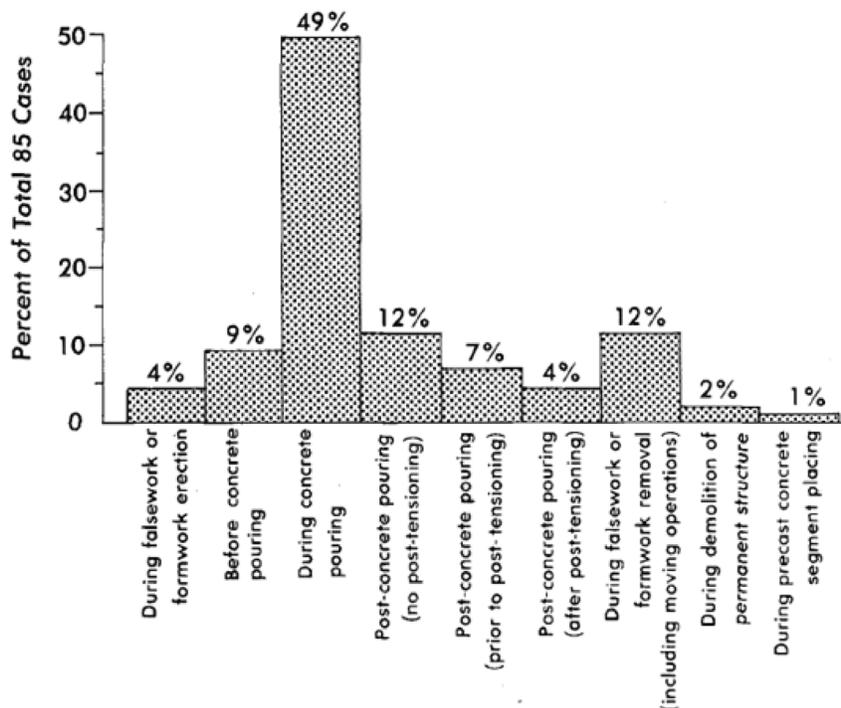
requirements, and proposed details must be submitted to INDOT for review prior to erection.

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Falsework collapse by construction stage (Hadipriono, Wang, 1986).