DRISI
CALTRANS DIVISION OF RESEARCH, INNOVATION AND SYSTEM INFORMATION
TRANSFORMING IDEAS INTO SOLUTIONS

Research Notes

Efficient Strengthening of Steel Girder Bridges with Bolted Cover Plates

Develop testings for composite girders retrofitted with bolted cover plates, correlate with finite element analysis, generalize results, recommend design procedure.

Geotechnical/ Structures

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Project Title: Efficient Strengthening of Steel Girder Bridges with Bolted Cover Plates

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WHAT IS THE NEED?

With the introduction of the California permit design live load P-13 in the early 1970's, and California permit load P-15 since 2006, many steel girder bridges built before that time are now rated structurally deficient in live load capacity for permit trucks. Steel girder bridges on the newly designated freight corridor routes are in the process of being strengthened to full permit, P-15 capacity. One common problem is the insufficient flexural capacity for live load.

Adding cover plates to the tension flange is a very efficient way to retrofit steel girders of existing bridges and improve the load rating. While very efficient for retrofit, one major obstacle of using the bolted cover plate is that the AASHTO Load and Resistance Factor Design (LRFD) Specifications and Caltrans Structure Technical Policy 16.6 prescriptively limit the usable moment capacity due to the presence of bolt holes in the tension flange. This limitation can prevent utilizing the full available capacity of the retrofitted girder and reduces the economy of the retrofit, even though test observations and past indicate that more capacity may exist than currently permitted by the prescriptive provisions. There is an urgent need to conduct experimental and numerical studies to better quantify this available capacity and develop an improved design procedure that addresses both safety and economy for strengthening existing steel girders with bolted cover plates in the tension flange.

WHAT ARE WE DOING?

1. Perform a literature review and collect available test data on steel girders with bolted covered plate or splice plate.

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2. Develop and conduct an experimental testing of composite girders retrofitted with bolted cover plates.

3. Perform a correlation study with finite element analysis and then generalize the experimental results with a parametric study.

4. Recommend an improved design procedure for strengthening steel girders with cover plates that address both safety and economy.

WHAT IS OUR GOAL?

The goal of this research is to:

1. Provide adequate support and rational to the California Amendment to the AASHTO and the California Department of Transportation (Caltrans) Structure Technical Policy for strengthening steel girders with bolted cover plates.

2. Recommend an improved design procedure that addresses both safety and economy.

WHAT IS THE BENEFIT?

California Bridges and Structures strategic mission is to design safe and economic bridges. Caltrans does not have adequate experimental or analytical data to support California amendment to AASHTO and Caltrans Structure Technical Policy for strengthening steel girders with cover plates.

Although adding cover plates to the tension flange is a very efficient way to improve the live load rating but limiting its moment capacity to the yield moment make this strengthening method with very limited application. If plastic capacity, instead of elastic capacity, can be used, then strengthening may not be necessary, and cover plate strengthening will become a real effective method. This could be a huge cost saving and eliminate the traffic interruption due to unnecessary strengthening.

WHAT IS THE PROGRESS TO DATE?

Phase 2 of the project has advanced through the full fabrication, delivery, and testing of the six steel girder specimens that were planned for this stage. These specimens incorporated welded cover plates on the compression flange, and once they arrived at the University of California San Diego (UCSD) Powell Laboratory, the research team completed the test setup, instrumentation, and execution of the full testing program. The Phase 2 Test Results Report documenting this work was submitted in February 2026.

With the physical testing portion of Phase 2 complete, the project has moved into analysis and documentation. The UCSD team is currently reviewing and organizing the test data, conducting finite-element comparison work, and preparing the final design and instrumentation details for the remaining composite girder test. These activities make up the next portion of the planned Phase 2 effort.

A request for a no-cost time extension has been submitted by the research team to allow adequate time for the remaining analytical tasks and the composite specimen testing. This request is presently under the Caltrans Division of Procurement and Contracts review.