Florida Department of Transportation Research

Half-Round Bearing Stiffeners for Skewed Steel I-Girders

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Project Number
BED65

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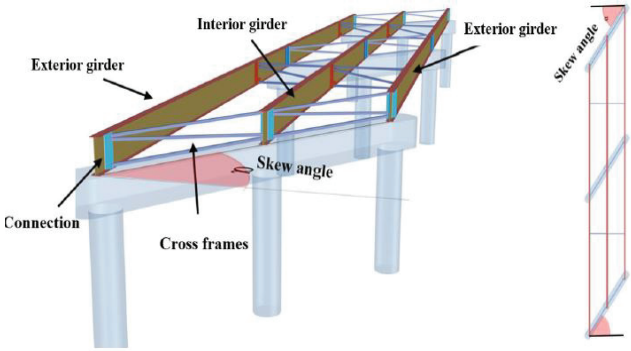
Current Situation

Skewed steel I-girder bridges present unique structural challenges due to their angled geometry, which affects load distribution and increases potential for fatigue and stress concentrations. Traditional connection methods, such as bent plate connections, can introduce flexibility, leading to reduced stability. FDOT is exploring Half-Round Bearing Stiffeners (HRBS) as an alternative connection method to improve girder stability and reduce the risk of fatigue.



An overall view of a skewed bridge.

However, the HRBS's fatigue behavior and its long-term performance, particularly at intermediate supports, need further investigation before widespread adoption.

Research Objectives

The project aimed to evaluate the fatigue behavior of HRBS connections in skewed steel I-girder bridges. The specific goals included developing a testing program to assess the fatigue sensitivity of HRBS connections over intermediate supports; investigating the effects of welding the stiffener plate to the flange; categorizing the HRBS connection using AASHTO LRFD fatigue categories based on test results; and developing a corrosion study to understand the impacts of material types, coatings, fillers, and venting on the HRBS performance.

Project Activities

The Florida International University research team first reviewed existing literature on skewed bridge and cross-frame connections. They then selected a range of Florida bridges for parametric studies. The team developed a detailed fatigue testing plan, focusing on the HRBS connection. The team used finite element modeling (FEM) for both global and local analyses of the bridge systems and HRBS connections. Level I analyses assessed overall stress variations, while Level II analyses focused on local stress distributions at the HRBS connections. Additionally, a corrosion study was proposed, covering material properties, coating applications, and corrosion prevention methods. The test plan for fatigue involved different specimen configurations to determine the appropriate fatigue category.

Project Conclusions and Benefits

Welding HRBS stiffener plates to the girder flanges significantly reduces stress and strain in the connection compared to unwelded conditions. Fatigue testing highlighted that welded stiffeners improve the long-term performance and reduce the likelihood of failure in HRBS connections. HRBS connections are more effective in skewed bridge applications than traditional bent plate connections, offering better stability and reduced girder warping. The corrosion study will further enhance the understanding of HRBS performance under various environmental conditions, ensuring better durability. The results will guide future bridge designs and help FDOT improve the structural integrity and lifespan of skewed steel I-girder bridges.

For more information, please see fdot.gov/research.