

Research Summary

Simple for Dead, Continuous for Live Load Steel Superstructure



The Missouri Department of Transportation (MoDOT) is using a bridge design method known as Simple for Dead Load, Continuous for Live Load (SDCL) on several steel bridges in Missouri. In this method, steel beams are designed to act as simple spans while the concrete deck is being built and then act more like a continuous bridge after the concrete has hardened. MoDOT currently has approximately 55 bridges in its inventory using this design method, including 50 constructed as part of Design-Build bridge bundles.

To validate the EPG procedures, the research team reviewed the literature to develop an understanding of critical issues, materials, and other DOT guidance and experience, policies, developed details, and past research results. The review showed that formal design provisions for SDCL steel bridges are limited, with only a few states mentioning SDCL or similar concepts. Previous research showed that, after the bridge is complete, slab reinforcement in tension and steel connection blocks in compression were the main contributors to the negative flexural resistance. Previous studies also showed that some continuity can develop during construction.

Field testing was conducted on an SDCL bridge during construction and after completion. A bridge with an ideal span configuration and no skew was selected. Strain and deflection readings

were collected under dead-load conditions, during wet concrete placement, and under live-load conditions, using loaded trucks on the completed bridge. The data showed that some continuity developed during deck placement. Under live loading, the measured strains and deflections were small and well within design tolerances.

The field measurements were used to calibrate detailed finite element models of the bridge. The models agreed well with the measured response and were used to estimate the degree of continuity. The models predicted a degree of continuity of 42% to 23% under the dead load conditions, and 92% under live load conditions.

The validated modeling framework was then used to analyze four bridge configurations with different span lengths, span ratios, skew, diaphragm conditions, and bond breaker plate details. In total, 96 models were created and analyzed. Results showed that the proposed deck reinforcement and compression block details were adequate for the design loads considered. The bond breaker plate did not significantly change continuity under either dead or live load, while pinned instead of fixed diaphragm connections changed continuity by about 10%. Under live load, continuity was generally above 90%, except for the skewed bridge, which had values around 80%.



Based on the research findings, the team developed proposed EPG guidance for SDCL steel bridges. The guidance includes procedures for designing the deck reinforcement in tension and sizing the compression blocks on the girder ends. The use of a bond breaker plate is treated as optional when crack control is desired. Although the original project scope considered adding this guidance to EPG Section 751.14, the research team recommended creating a standalone Section 751.15 because SDCL steel bridges have a different construction sequence and design approach than conventional continuous steel bridges. The proposed Section 751.15 incorporates the applicable portions of Section 751.14, with modifications and additions where needed for SDCL steel bridge design.

The results of this research showed that the proposed design equations produce the intended force couple and provide a conservative design approach for steel bridges using the SDCL methodology. The study also identified that the sheet metal plate in the intermediate diaphragm does not significantly affect continuity under dead load, but it may be useful in certain situations to help control cracking during deck dead load placement.

“These results confirm that the SDCL system can provide substantial continuity after completion.”



Bridge Live Load Testing

Project Information

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