

| <b>UTC Project Information</b>        |  |
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| Project Title                         | MPC-501 – Development of an Alternative to the Double Tee Bridge System  |
| University                            | South Dakota State University  |
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| Funding Agencies                      | USDOT, Research and Innovative Technology Administration   |
| Agency ID or Contract Number          | DTRT13-G-UTC38   |
| Project Cost                          | \$159,999  |
| Start and End Dates                   | September 30, 2013 to September 30, 2018   |
| Project Duration                      | September 30, 2013 to September 30, 2018   |
| Brief Description of Research Project | <p>Many bridges on the South Dakota local highway system need replacement due to deterioration or increased traffic demands. Local governments rely on the South Dakota Department of Transportation (SDDOT) to help replace them but, with limited resources, SDDOT can only help replace about 30 bridges statewide each year, causing a backlog of local bridges in need of replacement.</p> <p>The current standard bridge used in these replacements is the double tee precast girder bridge for its relatively low construction cost, outsourced design, and short construction duration. The expected design life of these bridges was 50 to 70 years, but some built less than 40 years ago already need replacement. The most common problem is that longitudinal joints become damaged over time, most likely due to inadequate shear transfer between the girders, allowing water and debris to enter the joints. It is only a matter of time before the joint begins to spall, creating a path for moisture to reach the prestressing steel, initiate corrosion, and degrade the structural capacity of the bridge. It should also be noted that the double tee should be designed for girder continuity, often achieved by a reinforced concrete overlay or transverse post tensioning. Many local bridges are not designed for girder continuity, however, resulting in longitudinal joint deterioration and a non-redundant structure.</p> <p>Routine maintenance of these bridges does increase the life span, but is not a feasible long-term solution. The amount of routine maintenance required to keep the joints sealed is too costly for local governments. Other methods, such as asphalt overlays, are also</p> |

expensive and can cause increased damage over time by trapping moisture that eventually reaches the prestressing steel. Thus an alternative solution for this problem should be proposed at the design stage to reduce joint movements and increase girder continuity. The solution can be developed as a new connection detail between girders or a more robust precast girder prototype for precast bridges in South Dakota.

Bridges on the local system in the State of South Dakota carry millions of dollars of agricultural products to market, as well as tourists, outdoor adventurers, school buses, and everyday travelers. If budgets of local governments cannot increase and the cost of a bridge replacement does not decrease, the only option will be to close bridges, raising the cost of getting products to market will rise and increasing inconvenience to the traveling public. If fewer routes are available due to closed bridges, emergency vehicles will experience increased response times to rural incidents. The number of structurally deficient bridges on the local system only continues to grow due to the cost of replacement and limited local government budgets. These bridges are vital for agriculture and the traveling public and cannot be allowed to close without adverse effects on local communities. An immediate solution is desirable.

Due to the poor serviceability performance of longitudinal joints in precast double tee bridge girders on South Dakota roads, an experimental research project, SD2013-01, was conducted at SDSU to investigate the performance of the currently used longitudinal joint detail and to assess the adequacy of a proposed new joint detail for use with double tee girders (Konrad, M. 2014). The study involved fatigue and strength testing of two full-scale specimens, one representing the as-built conditions and the other representing a modified joint detailing. The fatigue load was determined using AASHTO specifications (AASHTO 2012). The modified joint detailing specimen involved overlapping the steel mesh in the joint region of adjacent girders. The grouted joint is 6 inches wide and requires some flat formwork during the placement of the grout. Results from fatigue and strength testing of the as-built and modified specimens revealed that the current joint detailing is severely inadequate if the bridge is to last for 50 years or more, while the modified joint detail provided adequate performance under fatigue loading equivalent to more than 70 years of service.

Currently, there is only one supplier for the double tee bridge girder system in South Dakota. Alternative precast concrete and other type bridge systems may prove to provide potential options for local governments when making a bridge type selection based on performance and cost. Therefore, a study is needed to identify potential alternative systems and assess the construction feasibility, structural performance, and durability of those systems that have potential for implementation in South Dakota.

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|   | <p><b>Research Objectives</b></p> <ol style="list-style-type: none"> <li>1) Determine bridge system alternatives to the double tee precast girder system meeting HL93 load requirements and 75-year design life for single span bridges less than 70 feet.</li> <li>2) Perform ultimate and fatigue load testing on alternative bridge system(s).</li> <li>3) Compare cost, construction process, and performance of alternative bridge system(s) to the revised double tee girder system from SD2013-01.</li> </ol> |
| <p>Describe Implementation of Research Outcomes (or why not implemented)</p> <p>Place Any Photos Here</p> | <p>Design and construction guidelines were recommended for all three proposed prefabricated bridge systems to further help bridge engineers and to facilitate the field implementation. Local governments in South Dakota will now have three more options, full-depth deck panels supported on inverted tee girders and two glulam timber bridges, when planning to construct a new bridge or to replace an old one.</p>  |
| <p>Impacts/Benefits of Implementation (actual, not anticipated)</p>                                       | <ol style="list-style-type: none"> <li>1) Development of new alternatives to Double-Tee bridges,</li> <li>2) Providing three prove-tested, durable, and easy to construct, bridge alternatives for local governments</li> <li>3) A final report to disseminate the findings to DOTs, bridge engineers, local governments, and bridge owners,</li> <li>4) Education of two MS students,</li> <li>5) Integration of the experimental findings in the graduate and undergraduate level courses.</li> </ol>              |
| <p>Web Links</p> <ul style="list-style-type: none"> <li>• Reports</li> <li>• Project Website</li> </ul>   | <p><a href="https://www.ugpti.org/resources/reports/details.php?id=934">https://www.ugpti.org/resources/reports/details.php?id=934</a></p>   |