UTC Project Information

Project Title	MPC-512 – Pre-stress Losses and Development of Short-Term Data Acquisition System for Bridge Monitoring
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Project Cost	$110,071
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Project Duration	September 30, 2013 to September 30, 2018
Brief Description of Research Project	As a national trend, DOTs are faced with difficult financial decisions. The age of the infrastructure is increasing and deteriorating, needing maintenance and in some cases replacement. This does not include the additional needs of infrastructure expansion due to the population increasing. However, there simply is not enough money available to meet the required needs. As a result, judicious decisions need to be made based on accurate assessment of bridge performance. Bridge performance is dependent on many factors and therefore is often different than the assumed designed behavior. Factors such as prestress losses, loading frequency and magnitude, load distribution, support conditions and environment are critical variables that can lead to changes in bridge performance. The appropriateness of applying current design methods to calculate prestress losses needs to be evaluated. For example, elastic shortening and creep are two major components of the total prestress loss. With higher strength concretes available today, girders will almost certainly be more highly stressed than one made with conventional concrete, the magnitude of those loss components will probably increase. It is unknown whether this difference in prestress loss is adequately taken into account by present methods of analysis. In response to these concerns, several research projects have been performed in order to quantify the response of prestress concrete girder bridges fabricated with high performance concrete. Ahlborn et al. (1995) compared the AASHTO LRFD design provisions with the measured response of two long-span, high-strength composite prestressed bridge girders. They found that the design specifications overestimated the high-strength concrete modulus of elasticity

resulting in under predicted elastic shortening losses and over predicted the creep and shrinkage losses. Roller et al. (1995) performed an experimental investigation with four high strength concrete bridge girders. Two of the girders were used to evaluate the early-age flexural properties and the remaining two were used to determine the long-term behavior. The researchers concluded that prestress concrete girders made with high strength concrete can be expected to adequately perform if designed according to the AASHTO Standard Specifications. Kowalsky et al. (2001) instrumented four prestress high-performance concrete bridge girders in North Carolina. These researchers found that the elastic shortening and creep losses were major contributors to the total losses with shrinkage losses much less so. The larger than expected elastic shortening and creep losses were attributed to a lower modulus of elasticity than predicted. The total prestress losses ranged from 12.9% to 19.1% of the initial jacking stress. Other prestress loss bridge research can be found in Shams and Kahn (2000), Lopez et al. (2003) and Waldron (2004).

This second focus of the proposed research will be to obtain the critical bridge live load performance factors by developing a self contained, rapidly deployable data acquisition system that can be applied to a bridge and and monitor the required data. It is proposed that this system will be deployed on a bridge in northern Utah. The data gathered from this system will be compared with assumed design parameters. This information can aid engineers in determining actual bridge behavior. This information can aid in bridge maintenance and replacement decisions.

This research will work with two leading companies, Campbell Scientific and Bridge Diagnostic Inc. to obtain high-quality data to address these uncertainties in bridge behavior.

Describe Implementation of Research Outcomes (or why not implemented) Place Any Photos Here	The expected outcome of the research will be: 1) high quality data set of changes in prestress losses of precast, prestressed concrete bridge girders over an extended period of time, 2) comparison of measure and predicted bridge prestress values, 3) evaluation of the accuracy of the current AASHTO LRFD Methodology for predicting prestress losses and 4) the development of a short term data acquisition system that can aid state DOTs to effectively and economically determining the behavior of in-situ bridges.
Impacts/Benefits of Implementation (actual, not anticipated)	It is anticipated that one MS student will be employed on the project and an undergraduate will assist on an hourly basis. This research will also be incorporated into the Bridge Design Class I teach at USU.
Web Links • Reports • Project Website	https://www.ugpti.org/resources/reports/details.php?id=950