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| **UTC Project Information** | |
| Project Title | MPC-366 – Structural Health Monitoring of Highway Bridges Subjected to Overweight Trucks, Phase I – Instrumentation Development and Validation |
| University | University of Wyoming |
| Principal Investigator | Richard J. Schmidt  Robert G. Erikson |
| PI Contact Information | Richard J. Schmidt, Professor and Department Head  Phone: (307) 766-5255  Email: [schmidt@uwyo.edu](mailto:schmidt@uwyo.edu)  Robert G. Erikson, Academic Professional / Lecturer  Phone: (307) 399-0101  Email: [erikson@uwyo.edu](mailto:erikson@uwyo.edu) |
| Funding Agencies | USDOT, Research and Innovative Technology Administration |
| Agency ID or Contract Number | DTRT12-G-UTC08 |
| Project Cost | $162,318 |
| Start and End Dates | January 1, 2012 – December 31, 2013 |
| Project Duration | 2 Years |
| Brief Description of Research Project | State DOTs in the West are under increasing pressure to permit and route overweight trucks transporting machinery and equipment for the energy sector through their state and interstate highway systems. DOT engineers are called upon daily to rate their bridges for overweight trucks to determine appropriate truck routing and to assess the impacts of the trucks on bridge safety and durability. Many of these overweight trucks have nonstandard configurations, which further complicates the rating and permitting process. Hence, it is critical that bridge engineers in the DOTs develop confidence that their bridge analysis and rating software accurately predicts the response of bridges to overweight trucks, especially for those bridges on the most frequently traveled routes. This confidence can be gained through the proposed project, in which software analysis and rating results for overweight trucks will be correlated to direct field measurements of the response of bridges when loaded by those same trucks.  **Research Objectives:**  The long-term objectives of the proposed project are to develop, install, and operate a field instrumentation package for structural health monitoring (SHM) of bridges subjected to overweight trucks and to correlate field performance data to the behavior of the bridges predicted by analysis and rating software. The field instrumentation package will incorporate use of optical fiber sensors to monitor strains at critical locations in bridges that are considered most vulnerable to overweight truck loads and are most difficult to effectively rate with currently used software.  Phase I of the project will involve a laboratory investigation, the objectives of which are to develop the instrumentation package, remote data collection, processing, and transmission capabilities, and field installation and operations methods suitable for long-term SHM of bridges in remote locations. Methods appropriate for both steel and concrete girder bridges will be developed, but the primary emphasis will be on SHM of steel plate-girder bridges. The monitoring system will be capable of observing bridge behavior under both static and dynamic (wheel impact) loadings. Phase I is expected to have a duration of two years.  Phase II of the project will extend the laboratory developments to field application and operations. It will further include correlation of field measurements with analysis results from bridge rating software. The monitoring system will be particularly valuable for assessing the effects of overweight trucks with unusual configurations, the majority of which serve energy development in the West. These trucks often have wide loads, a condition that increases the importance of accurate determination of wheel fractions. Moreover, during inclement weather conditions, road closures on the interstate highway system (I-80 in particular) cause long backups of trucks. When the closures are lifted, it is common for long trains of trucks to progress nearly bumper to bumper, filling all traffic lanes as travel resumes. Such situations raise serious questions about the possibility of bridge overload and durability under high-density truck traffic with normal configurations and loads. Phase II will have a duration of at least two years in order to provide the opportunity to observe a sufficient number of overweight trucks or high density traffic events and to refine the operation and durability of the SHM network. Continuation of Phase II to incorporate wide-ranging installation of sensing networks on critical bridges will be pursued. |
| Describe Implementation of Research Outcomes (or why not implemented)  Place Any Photos Here | FBG sensors are shown to be effective, economical, and longlasting components of an SHM system for bridges. The system developed in this research includes an innovative radio-frequency identification (RFID) triggering system that will be important for activating the SHM system when a permit vehicle approaches a bridge. Bridge response data is then automatically recorded and transmitted to a server so that postprocessing can be performed for comparison to bridge rating analysis software. |
| Impacts/Benefits of Implementation  (actual, not anticipated) | The project has made direct contributions to the following strategic goals. 1. State of Good Repair: An effective SHM system for highway bridges will improve the ability of bridge engineers to predict the effect of overweight vehicles on the condition of bridges. 2. Safety: Accurate real-time monitoring of bridge response will improve the operational safety of bridges during overload events by controlling the magnitude of the overload. 3. Economic Competitiveness: The SHM system will provide the initial economic advantage to the project. The second advantage is in improved predictions of bridge durability and lifecycle. |
| Web Links   * Reports * Project Website | <http://www.ugpti.org/resources/reports/details.php?id=844> |