

## Design of instrumented bearings for direct measure of bridge live loads

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### Abstract

A long span steel through truss was scheduled for expansion bearing replacement as part of an overall rehabilitation project. At the time, a Structural Health Monitoring (SHM) system was being designed to investigate how overloaded trucks were affecting the performance of the bridge. Due to the opportunity presented by the bearing replacement project, the concept of instrumenting the new bearings with load cells was accepted by the bridge owner and a formal design was commissioned. A prototype bearing was constructed and evaluated through rigorous testing in a laboratory setting to ensure that the addition of sensors in the load path of the bearings would not compromise the integrity or safety of the bridge. Upon completion of the acceptance testing of the prototype bearing, the full construction of the bearing assemblies and their subsequent installation was started. The paper discusses the various challenges associated with the design, construction, maintenance, and processing/interpretation of the measurements for such a system.

**Keywords:** Steel, truss, load cell, bearings, structural health monitoring, instrumentation

### 1 Introduction

A long span structure in the United States was slated for replacement of its expansion bearings in an effort to increase its sufficiency ratings to acceptable levels. The existing expansion bearings were original to the eighty-year-old structure and their performance was suspect due to significant corrosion and documented lack of free movement. While the new expansion bearings were under design, the bridge owner was also exploring the design and installation of a structural health monitoring (SHM) system to provide better understanding of bridge performance and to streamline bridge maintenance operations. During the initial SHM design stages, it was suggested that the new expansion bearings be fitted with load cells to directly measure both the dead and live loads at each of the supports. This suggestion was embraced by the owner and a collaborative design of an instrumented bearing was commenced.

Given the recent academic and industry interest in bridge weigh-in-motion (B-WIM) [1, 2, 3] and a unique opportunity to instrument the expansion bearings of a multi-span steel truss structure, the objectives of this paper are to present the approach towards designing such a bearing assembly, bearing assembly deployment, and to discuss the challenges faced during such an application and what recommendations would be made for future applications.

The remainder of the paper is organized into six sections and will present the description of the bridge, the design approach towards the instrumented bearings, how the assemblies were installed on the structure, the usage of the bearings and analytical challenges, and finally conclusions and general recommendations for broader applications.