Bridge Load Rating

Introduction

Bridge load rating is typically performed by utilizing critical information available on the bridge plans. This includes information about the span lengths, the sizes and dimensions of the bridge members, the type of materials used to construct the bridge, and other relevant information. This information is used to perform a structural analysis to determine the forces or stresses caused by Indiana legal loads. These forces or stresses are then compared with the strength limit states of the bridge to determine the corresponding load rating. Decisions on the need to post a particular bridge can then be made if the operating rating factor is determined to be less than unity.

While the load rating process is logical and can be implemented for many of the bridges in Indiana, some bridges cannot be easily evaluated because they are poorly documented or do not have plans. Initial estimates provided by INDOT indicated that there are 53 bridges in the state inventory of bridges that fall into this category. If the bridges in the counties and cities were included, there would be hundreds of bridges that could not be readily load rated and evaluated.

Currently, INDOT does not have a prescribed methodology to load rate and evaluate bridges without plans. Consequently, a standardized procedure is needed for such bridges. Hence, the primary objective of this study was to develop a general procedure for load rating bridges without plans.

The evaluation of an open-spandrel reinforced concrete arch bridge was also examined as part of this study. This bridge, referred to as the Roaring Creek Bridge, was load-posted based on a simplified structural evaluation conducted for INDOT. This bridge is a main route for conventional traffic. Consequently, there was a need to examine the adequacy of the posting load to avoid costly detours.

Findings

A general procedure for load rating bridges without plans was developed. It was concluded that the procedure required four critical parts. These included bridge characterization, bridge database, field survey and inspection, and bridge load rating.

The bridge characterization is used to create a list of variables required for the load rating calculations. These variables include but are not limited to material strength properties, geometric features, and strength and service limit states.

The bridge database provides guidelines and recommendations for obtaining the unknown information discerned from the bridge characterization. It requires one to examine past and current historical inspection reports, conduct a survey of comparable bridge plans, and examine past standards used at the original time of construction. If the value of a parameter remains unclear, the most conservative value of that parameter is assumed based upon comparable historical information. The previous performance of the bridge should also be considered.

The field survey supplements the unknown bridge information by collecting field measurements. A field inspection is also required to account for the condition of the structure during the load rating process. Drawings of the structure can be created by using the collected information. The drawings can then be used as the layout for the structural modeling to perform the bridge load rating.

It was found that buried structures were among the most predominant type of bridges without plans in the Indiana state inventory of bridges. The research team identified particular bridge structures that would be utilized to evaluate the general procedure. The general procedure was evaluated on a flexible and rigid buried structure without plans. It was demonstrated that the general procedure can
be utilized to successfully complete the bridge load rating of poorly documented structures.

It was found that the controlling strength limit state for the flexible buried corrugated steel pipe bridge was the minimum of the wall area, buckling strength, and seam resistance. The controlling strength limit state for the rigid buried reinforced concrete arch bridge was the coupled action of axial compression load and flexure. The load rating of the latter bridge was performed using an iterative load rating method that required the use of an interaction diagram.

The Roaring Creek Bridge was initially load-posted based upon a simplified structural analysis that showed that the controlling rating members were the floor beams. An experimental evaluation performed on one of the critical members of the bridge was performed and the results were compared with those obtained analytically. Both the experimental and analytical results showed that the bridge exhibited a higher load-carrying capacity than the initial restrictive load estimated for this bridge.

**Implementation**

The general procedure developed for use by INDOT can be applied to state-, county-, and city-owned bridges. As a result, INDOT now has a load rating methodology for the hundreds of bridges without plans in Indiana. A flowchart describing the general procedure was created to make the load rating process more user-friendly. Additional flowcharts that summarize the general procedure for different types of bridges were also provided. These flowcharts can then be used by the load rating engineer to ease the load rating process.

The methodology adopted to perform the load rating of bridges without plans or other critical information could potentially lead to significant cost savings. If the load rating results in an operating rating factor greater than unity, there is no need to post the bridge. This allows a bridge rehabilitation or replacement to be scheduled in a more timely fashion if needed. Moreover, this could prevent possible detours that result in delays and inconvenience for the traveling public. Alternatively, it is also possible that the general procedure could lead to necessary bridge posting or closing; however, the end result would be improved safety for the public.

**Recommended Citation for Report**


View the full text of this technical report here: https://doi.org/10.5703/1288284316650

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