IMPLEMENTATION OF BRIDGE MANAGEMENT PROGRAM FOR IAIS

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ABSTRACT

The Iowa Interstate Railroad, LTD (IAIS) is a Regional Railroad, Class II, making connections to the entire Class I Railroads system at multiple locations. In order to comply with FRA Part 237, an updated Bridge Management Program (BMP) was necessary for the tracking of inspections and ratings of the railroad’s 330 structures. IAIS was also interested in tracking the timing of repairs, maintenance and rehabilitation, which is critical to extending the useful life of their bridges. Alfred Benesch & Company (Benesch) was retained to provide these services.

While locating existing bridge records can sometimes be a difficult task, the information they provide significantly expedites the inspection process. Extensive time was spent up front reviewing and organizing existing plans into sets that could then be used for inspection and rating. Detailed lists were also developed for the bridges, which further decreased inspection times and improved the project team’s efficiency.

Overall, the development of a BMP for IAIS consisted of detailed inspections, numerical rating and, finally, creating an electronic database for tracking inspections, repair history and costs. Developed by Benesch, the software utilized to achieve the project’s goals allows easy access to the bridge condition and maintenance costs for users in the field through a wireless connection.
Together, the Bridge Management Program and electronic database allow the IAIS to effectively manage their bridge assets and meet full compliance with FRA Part 237.

INTRODUCTION

The IAIS was founded in 1984, operating on the former Chicago, Rock Island and Pacific mainline between Omaha, Nebraska, and Chicago, Illinois, as shown in Figure 1. IAIS ships all types of freight and is a leading carrier in the ethanol/feed market, sending many unit trains of product to market throughout the U.S. each week.

![Figure 1: IAIS System Map](image)

The IAIS operates over 330 bridges which vary between timber, concrete and steel. One of the largest bridges is an eight-span steel Pratt truss structure crossing the Mississippi River. Built in 1887, this is one of the only two existing bridges in the world to carry two railroad tracks over a roadway (as shown in Figure 2).
The eastern end of the line between Wyanet, Illinois, and the Quad Cities is currently in the design phase for Amtrak high-speed passenger rail service.

In order to facilitate compliance with FRA Part 237 and help IAIS prepare for future bridge inspection and repairs, Benesch was retained to update the existing IAIS Bridge Management Program and conduct detailed bridge inspections and strength ratings along 600 miles of IAIS track. Through a brief exploration of this project’s key components, the benefits of a successful BMP are immediately apparent. Many opportunities for centralizing bridge data were taken advantage of during the inspection and rating process of the project, which was made possible through the use of bridge management software. Our highlighted case study provides a first-hand look at the balance of field inspection and rating results, followed by a discussion of recommendations and costs based on the detailed inspection and strength rating results.

INSPECTION/RATING PROCESS
IAIS had a sizable percentage of existing plans on hand when the project began. These existing plans are particularly helpful for bridge rating and performing future work on bridges. Benesch organized the plans and made lists of outstanding superstructure elements to confirm during inspection process. After the inspections were completed, field data was recorded in an electronic database. Inspection photos, field sketches, existing plans and Google Maps were then linked through the database to the bridge report. This allows access to all important bridge data
from one place. Finally, bridge ratings were completed using Excel spreadsheets for most bridges. LUSAS Software was used for modeling all trusses.

ADVANTAGES OF USING BRIDGE MANAGEMENT SOFTWARE

Accessibility and Convenience – Creating a “One-Stop-Shop”
FRA Part 237 requires all pertinent bridge documents and files to be maintained in one central location. Keeping these documents in hard copy format in a specific physical location may work well for some; however, these documents must be updated as changes or modifications occur. An online bridge management software meets the requirement of maintaining all documents in one location, but has the significant advantage of being accessible from any place with an internet connection. Required bridge documents under FRA Part 237, such as the inventory list of bridges, inspection reports, rating records, existing plans and more, can all be securely stored in this one location. Photos can be linked to inspection reports, plans can be connected to rating records, and any important information can be retrieved to accompany any bridge data that is being accessed. In addition, the software will automatically update all reports within the database when changes are made to any of the documents, removing the potential for error, or questions concerning whether the reports are up-to-date.

Planning for the Future
Bridge management software can be a critical planning tool for making decisions in a BMP. Maintenance recommendations can be linked to specific inspection observations that are made during the routine inspection schedule and these maintenance recommendations can be given a priority level and a projected cost. A bridge owner can then use this information in a variety of ways, including determining which bridge repairs should be scheduled first or which sections of track have a higher associated maintenance need. Software applications can also use previous inspection dates to alert owners when their next inspections are due, as shown in Figure 3.
Recording History

All key events and information input into a database are recorded and may be utilized at any time. For example, a bridge management software allows you to access all repairs and key events that have occurred during the life of the structure. This data can be viewed online at any time or even added to the routine inspection reports for additional information.

Program Consistency

An important element of a BMP is consistency. Pull-down menus can be created to ensure that bridge elements are identified by a specific naming convention and are given a rating that follows a pre-described system as shown in Figure 4. This eliminates the possibility of different individuals within the bridge management team using different terminology or rating systems. It is also helpful in the future if you would be searching through data for “key words.”
DETERMINING SEVERITY OF CRITICAL RATINGS

One approach to prioritizing strengthening work is to compare the Required Rating for the working train loads to the Normal and Maximum Ratings of the structure. The severity of a Critical Rating – a rating in which the Required Rating is higher than the Normal Rating of the structure – can be determined by comparing the Required/Normal (R/N) ratio to the Maximum/Normal (M/N) ratio. The closer an R/N ratio is to the M/N ratio, the more severe the Critical Rating.

A chart such as the one shown in Figure 5 can be used to graphically represent the severity of a Critical Rating. The blue bar indicates the Required Rating of the structure and the orange-to-red gradient bar designates the Normal (orange) to Maximum (red) rating corresponding to the structure. The closer the blue bar is to the Maximum rating, the more severe the Critical Rating.
Case Study – Using Ratings to Determine Severity

When ratings are calculated using actual field conditions, including any corresponding section loss, the bridge owner is given a numerical value that gives a clear representation of the bridge’s capacity. This capacity can reveal critical rating issues that were not apparent by visual inspection. The following case study provides an example of how ratings can reveal more information than a typical visual inspection:

Introduction

Bridge A is a 10-span timber stringer bridge with an open deck and ten stringers in each span. This bridge is currently on next year’s span replacement plan because the outside stringers in each span exhibit 90% decay. The remaining eight stringers in each span exhibit little to no section loss.

Bridge B is a single span rolled beam span with a ballasted deck and four beam lines. This bridge was built in early 1900. There is no apparent section loss on the beams and no work is planned at this location in the near future.

Rating Results

The timber stringers of Bridge A were rated assuming that only eight stringers are present in each span due to the extensive decay in the exterior stringers. The rating calculations indicate that the Normal Rating capacity of the spans is greater than the Required Rating
for the train loads, despite only considering eight stringers. The steel beams of Bridge B were rated based on existing plans with no section loss noted from inspection. The rating calculations indicate that the Normal Rating capacity of the spans is less than the Required Rating for the train loads.

**Conclusion**

The rating results for Bridge A indicated that the timber stringers have adequate capacity, despite the loss of the two stringers therefore span replacement is not necessary at this time. Inspectors should continue to monitor the condition of the remaining stringers and a new rating calculation should be performed is conditions change.

The rating results for Bridge B revealed that the beam span does not have adequate capacity for Normal rating. No section loss was recorded, therefore the most likely reason for the Critical Rating is that the beams were designed for smaller loads or the bridge was changed from an open deck to ballast deck and the beams are undersized for the current loads. Based on this information, the spans at Bridge B should be reinforced or replaced in order to address this Critical Rating.

**RECOMMENDATIONS/COSTS**

The recommended bridge work was based on the results of both strength rating and detailed inspections. This recommended work was given relative prioritization and estimated cost based on the current conditions. Also, a framework was developed to assist in the planning of inspections outside of the general or detailed inspections that are performed on an annual basis.

**Work Groups**

Future bridge work and costs were divided into three distinct groups: Strengthening; Maintenance; and Inspection. Work in the Strengthening group was related specifically to strengthening or replacing bridge spans to increase the strength rating. Work included in the Maintenance group consisted of addressing substandard conditions revealed during the inspections. Work in the Inspection group is specifically related to “specialized” inspections such as underwater, scour, or snooper inspections.

**Strengthening**

The Strengthening group was presented in table format on a scale of relative priority. This priority was determined based on the magnitude of Normal and Maximum ratings in relation to the required rating for 286K.
**Maintenance**
All substandard conditions were noted and given a level of priority based on the severity. The Maintenance group listed all work necessary to eliminate all Priority 2 and 3 maintenance items, depending on the severity of the observed condition. This work was presented in tables, which projected the work out over five years.

**Inspection**
The Inspection group was presented to show specialized inspections. For example: interim inspections at six-month intervals; snooper truck inspections; and underwater inspection.

**CONCLUSION**
Completing the necessary inspections and ratings, while developing an updated BMP for IAIS, proved to be a challenging project. Completed in just nine months, the outcome of the project is streamlined BMP and an electronic database which allows the IAIS the ability to effectively manage their bridge assets and extend the useful life of their bridges. From its centralized data location with wireless accessibility to providing timelines for future recommended repairs and inspections, the benefits of this project will continue to manifest for years to come.

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**REFERENCES**
- FRA 49 CFR Part 237 Bridge Safety Standards; Final Rule

**LIST OF FIGURES**
- Figure 1: IAIS System Map
- Figure 2: Elevation View of Government Bridge
- Figure 3: Program – Inventory of Bridges, Highlighting Future Inspection Dates
- Figure 4: Program – Pull-down Menu Example
- Figure 5: Example of a Bridge Rating Summary used to determine Critical Rating Severity
BRIDGE MANAGEMENT PROGRAM IMPLEMENTATION
for the Iowa Interstate Railroad, LTD.

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Today’s presentation will highlight:

- Background of the IAIS
- BMP update process
- Benefits of utilizing management software

BACKGROUND
IAIS

- 3 states  • 330 structures  • 600 miles of track

BACKGROUND
Illinois Passenger Rail Program

- Service between Chicago and Quad Cities
- Upgrades to track, signal & bridges
- 79mph for passenger rail, vs. 25-40mph for freight

BACKGROUND
Timber Structures

- Typical bridge age: 50 years +
- End of useful life
- Bridges rate close to limit; minor defects impact rating
- Replace with concrete/steel

BACKGROUND
Concrete/Masonry Structures

- Several different structure types
- Current plan to replace aging arches with pipes

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BACKGROUND

Steel Structures

Key Issues
- Majority of current bridges rate
- Long-term plan – replace as required

Steel Structures – Government Bridge

Key Issues
- 8-span steel Pratt truss over Mississippi River
- Built in 1887, one of only two bridges in the world to carry RR and roadway

BRIDGE MANAGEMENT PROGRAM

- Bridge inspection
- Strength rating
- Database entry

Goal: FRA Part 237 compliance

INSPECTION & RATING

Pre-Inspection Tasks
- Review existing plans
- Organize plans
- List outstanding superstructure elements
- Scan existing plans

In the Field
- Complete detailed inspections
- Snooper and climbing
- Collect field data

DOCUMENTING INSPECTION REPORTS

Database Entry

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INSPECTION & RATING

“One Stop Shop”

- All linked to the Bridge Report

Inspection photos  Plans/field sketches  Google Map images

BRIDGE MANAGEMENT SOFTWARE

“One Stop Shop”

- Accessible
  - Can be viewed from any place with an internet connection

- Efficient
  - Automatic updates occur whenever any file within the database is altered

BRIDGE MANAGEMENT SOFTWARE

Planning for the Future

BRIDGE MANAGEMENT SOFTWARE

Recording History

- Element names follow AREMA handbook or RR naming convention
- Eliminates different terminology from being used
- Allows for “key word” searches within the database

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BRIDGE MANAGEMENT PROGRAM

Determining Critical Rating Severity

CASE STUDY

Determining Critical Rating Severity

Bridge A
- 10-span timber
- 90% decay in exterior stringer

Bridge B
- Single-span, rolled beam
- No measurable section loss

CASE STUDY

Determining Critical Rating Severity

Bridge A
- 102
- 74
- 57
- 73
- 71
- 59
- 69

Bridge B
- 68
- 57
- 73
- 71
- 59

CASE STUDY

Determining Critical Rating Severity

Bridge A
- Rates for required rating based on only 8-stringers
- Rated with no section loss – does not have adequate capacity for normal rating

Bridge B
- 102
- 74

CASE STUDY

Determining Critical Rating Severity

Applying the rating results

Bridge A
- Span replacement not necessary
- Reinforcement/Replacement necessary

Bridge B
- 74
- 50

MAKING RECOMMENDATIONS

Applying data from the BMP

- Recommendations based on data collected during inspection
- WORK GROUPS developed based on future bridge work/costs

WORK GROUPS

Applying data from the BMP

- Strengthening
  - Strengthen or replace bridge spans
- Maintenance
  - Address substandard conditions
- Inspection
  - “specialized inspections” as-needed
WORK GROUPS

Strengthening

• Table presentation of bridges, based on scale of relative priority

NORMAL MAXIMUM

WORK GROUPS

Maintenance

• Substandard conditions’ priority ratings based on severity

Work required is projected over 5 years

2015 2016 2017 2018 2019

WORK GROUPS

Inspection

• Outlines structures which require specialized inspections

Interim inspections (six-month intervals)
Snooper truck inspections
Underwater inspections

CONCLUSION

Benefits of utilizing software as part of BMP

Manages inspection, maintenance and rehabilitation information
Bridge information is stored in one location
Extends the useful life of bridges

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THANK YOU!
Contact us with any questions

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