BrIM Implementation for Documentation of Bridge Element Condition for Inspection

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Abstract

• Bridge condition inspection data provide critical and rich information for assessing structural condition. Currently, the majority of bridge inspection methods use printed checklists, and their interpretation is labor intensive, subject to personal judgment, and prone to error. To realize the full benefits of bridge inspections, there is a need to automate the data management process. This study implements Bridge Information Modeling (BrIM) technology for bridge inspections and compare it to the conventional approach of paper checklists through the combination of 3D representations of the infrastructure, and by allowing the integration of inspection data, such as the presence of damages, types of damages, severity, localization and previous maintenance decisions. In this study, the acronym BrIM refers to the database that integrates a 3D bridge model and bridge element condition data. The BrIM based inspection methodology was tested with Iowa DOT engineers and bridge inspectors, who confirmed that BrIM can be used to automatically query, sort, evaluate and send information to decision makers. In addition, a short survey was conducted with several DOT engineers and bridge inspectors.

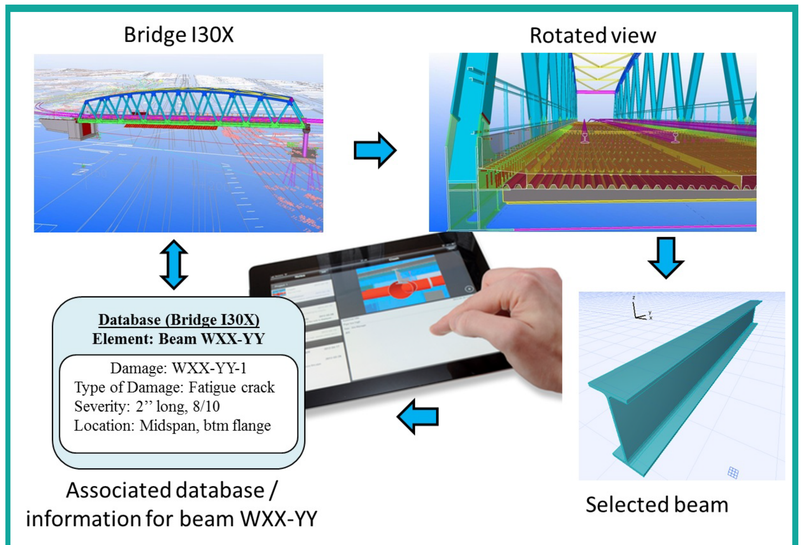

Figure 1: Research Approach

Figure 2: Bridges Location

Research Methodology

• Two dimensional (2D) drawings of two bridges located in Ames, Iowa, and their past inspection data were provided by Iowa DOT in electronic pdf format.

• The drawings were transferred into a 3D BrIM model using Autodesk® Revit® software package.

• Model elements are divided into similar groups such as deck, super structure, sub-structure, channel and piers in order to mimic the traditional method.

• Each group is given a specific color, and each element is provided with details that are pinned to that element, and each note of detail contained the previous inspection information with technical details.

• Models were synced using cloud based solution and became accessible from the site.

• The new inspection method was tested with Iowa DOT engineers and bridge inspectors.

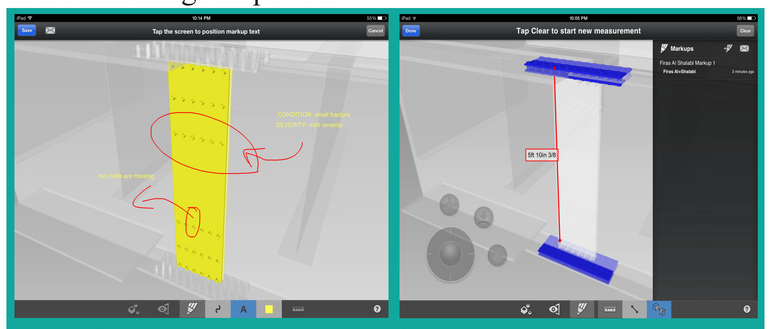

Figure 2: Entering inspection data directly in the model

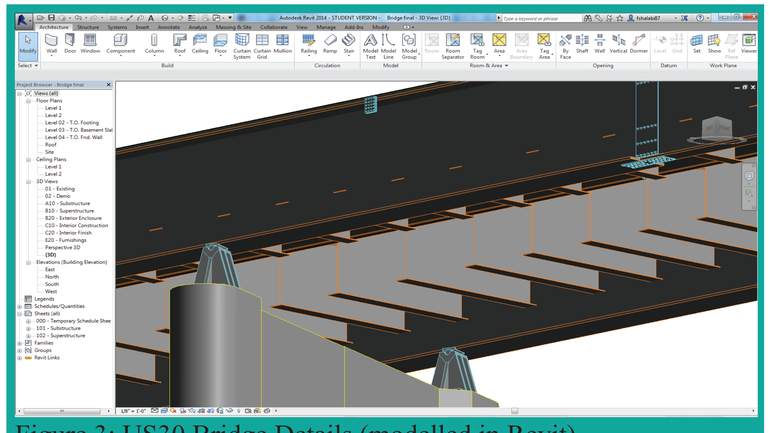

Figure 3: US30 Bridge Details (modelled in Revit)

• A web survey: The survey was sent to 8 DOTs around the Midwest in addition to New York and Pennsylvania DOTs. Eight personnel ranging from bridge engineer to a director of bureau of structures from 8 different DOTs participated in the survey.

Task	Results	Remarks
Inspection means	71 % paper based 14% PDA 14% others	
Number of inspectors	15 - 75	The number can reach up to 650 with all qualified consultants
No. of inspectors in each inspection	2-4	Can reach 7 for major over water bridges
BrIM usage in design and construction	33% used it	
Challenges in the current practice	60% have challenges	- Close observation and management to stay on compliance - Training inspectors - Inadequate staff - Aging staff - New problems with new bridge designs.
Future use of BrIM in inspection	71% denied any future plans	
BrIM staff knowledge	62% poor – fair 13% good 25% V.Good - Exc	
Usefulness of BrIM for inspection	71% neutral	29% sees it as useful
BrIM Improve the speed and precision of inspection	71% disapproved	
BrIM implementation challenges		- Damaging portable electronic devices - Cell phone signals - Sturdy equipment to handle rain, sunshine and extremely cold weather. - Initial cost - Time invested in creating models
Institutional barriers		- Training - Digital signatures issues - Integrity of data during transmission. - Confidential information.

Table 1: Survey Results

Conclusions

• It is concluded that this methodology will substantially improve bridge assessment and maintenance operations.

• It will also improve structural resiliency by enabling more effective maintenance and repairs process.

• Many challenges were noted for future research.

References

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[2] Wi, H. J., Lee, J. H., Blumenstein, M., Guan, H., & Loo, Y. C. (2013). "Development of Methodology for Enhancing Visual Bridge Condition Assessment Using Image Processing Techniques." Applied Mechanics and Materials, 256, 1563-1570.

[3] Roberts, J. E., & Shepard, R. (2000). "Bridge management for the 21st century." Transportation Research Record: Journal of the Transportation Research Board, 1696(1), 197-203.