



# Consistency of New York State Bridge Inspections: A Research Project In-Progress

Sreenivas Alampalli<sup>1</sup>

<sup>1</sup> New York State Department of Transportation, Albany, NY, USA

**ABSTRACT:** A Federal Highway Administration (FHWA) study completed in 2001 reported that bridge inspection ratings on a national level have high variability and questioned the quality and reliability of visual based inspection procedures. This is a potential vulnerability in New York State (NYS) although the results of the FHWA study may not be applicable in NYS. The NYS bridge inspection program is more robust and detailed than what is mandated by FHWA and differs in several aspects from inspections conducted in other states, including the number of components inspected, rating scale, personnel qualifications, the quality control and quality assurance (QC/QA) program, and training provided to bridge inspection related personnel. Research is required to confirm that the New York State bridge inspection program provides reliable results using common practice in bridge inspections. Thus, a research project has been initiated to quantitatively document the variability associated with the bridge inspection program, suggesting improvements to policy and procedures and areas requiring further training, if needed, to reduce the variability and improve the reliability/consistency of the program. This paper gives some background details and the scope of the on-going project.

## 1 INTRODUCTION

Most bridge inspections are predominantly visual in nature supported by detailed investigations, as needed, when identified by bridge inspectors and owners. National Bridge Inspection Standards (NBIS) require most highway bridges in the United States to be inspected at least once every two years to ensure public safety (National 2004). The NBIS mandates minimum standards for the inspection of highway bridges in the United States located on all public roads. NBIS address several issues including inspection personnel qualifications, inspection types and frequencies, QC/QA procedures, and documentation. The main emphasis of the national inspection standards are to maintain a bridge inventory, ensure bridge safety, and collect data to make certain bridge management decisions at the national level. Thus, most bridge owners collect more data to effectively manage their bridges that include supporting bridge preservation, rehabilitation, and replacement decisions. Typically, these requirements are set at State level by State highway agencies. Thus, there is wide variation from state to state. It is also a necessary practice of any structural inspection to identify serious deficiencies, both structural and non-structural, affecting public safety so that owners can take appropriate action



in a timely fashion. Thus, NBIS also requires establishment of a statewide procedure to ensure that critical findings are addressed in a timely manner. It further requires periodically notifying the Federal Highway Administration (FHWA) of the actions taken to resolve or monitor critical findings (National 2004).

## 2 FHWA STUDY ON VISUAL INSPECTION CONSISTENCY

Several years ago, FHWA conducted a comprehensive study of the reliability of Visual Inspection to provide overall measures of the accuracy and reliability of routine and in-depth visual inspections, study the influence of several key factors that affect these inspections, and study the differences between State inspection procedures and reports (Moore et al 2001a and 2001b). Ten inspection tasks were performed at seven test bridges using State bridge inspectors with 49 inspectors from 25 State agencies participating in the study. Results concluded that routine inspections were completed with significant variability with only 68 percent of the Condition Ratings within one rating point of the average and 95 percent within two points on a scale of 1 to 9. In-Depth Inspections using Visual Inspection alone are not likely to detect or identify the specific types of defects for which the inspection is prescribed and may not reveal deficiencies beyond those that could be noted during a Routine Inspection. The State procedural and reporting tasks indicated that most States follow similar procedural and reporting criteria. Several inconsistencies were noted with the use of the element-level inspection systems, but it is not known if these variations are the result of State practices or inspector use. The report also states that Professional Engineers are typically not present onsite for bridge inspections and sixty percent of State respondents indicated that a Professional Engineer was on site for less than 40 percent of the inspections.

Based on the distribution of the Condition Ratings and observations made during the study, the study recommends that the National Bridge Inspection Standards Condition Rating definitions may not be refined enough to allow for reliable Routine Inspection results. Based on the State-dependent inspection tasks, it appears that most States follow similar inspection procedures and provide the same general information in their inspection reports. From the State-dependent Routine Inspection, it appears that few inspection teams perform an in-depth level inspection of bridge decks as part of their Routine Inspection. When inspection teams were asked to perform an in-depth level inspection of a bridge deck, it was found that significant inaccuracies existed (Moore 2001a and 2001b).

## 3 NYS BRIDGE INSPECTIONS

The NYS Bridge Inspection system (Bridge 1997) is very robust and detailed. NYS exceeds NBIS requirements for Bridge Inspection Team Leaders by stipulating that they have a minimum of 3 years of bridge related experience and a NYS Professional Engineer's license. Thus, a Professional Engineer is always present at all inspections and takes complete responsibility for all inspections and findings documented in the inspection report. These inspection reports go through the quality control process and the quality control engineer has at least equal or better experience and qualifications than the Bridge Inspection Team Leader. All the reports after Quality Control go through Quality Assurance – an automatic software check and a review by a Quality Assurance Engineer. All QA Engineers are also Professional Engineers with considerable bridge experience. The QC/QA process also involves field visits to ensure the quality of bridge inspections.

Federal coding requirements emphasize 5 major bridge components and their condition. NYS documents 8 groups of components encompassing 47 elements, including rating 25 components of each span of a bridge in addition to general components common to all bridges, thereby



giving more comprehensive documentation of the structure's ability to function as designed. NYS exceeds NBIS requirements for inspection types by introducing an In-Depth inspection. This inspection is typically used to provide detailed findings to assist in programmatic decision making. NYS exceeds NBIS requirements for Fracture Critical Member Inspection by requiring "Hands-On" inspections of structural details that may not be Fracture Critical, yet essential to the structural integrity of the bridge.

New York State is one of the states that also has a systematic procedure in place to identify both structural and non-structural deficiencies (flags) which can affect public safety (Bridge 1997). The flagging procedure outlines responsibilities, timeframes, and actions to be taken for the respective flag types. The Bridge Inspection Manual is very detailed and updated to reflect the state-of-the-knowledge as problems are identified. All bridge inspectors are also trained by the experienced staff from the New York State Department of Transportation. Any bridge inspection team leader and QC engineer, interested in performing highway bridge inspection in New York, should take the detailed one week training provided by the NYS Department of Transportation. Annual refresher training is given to all bridge inspection personnel to refresh their knowledge in key areas identified through quality assurance field visits and on the problems observed during the previous year's bridge inspections to maintain quality, uniformity, and consistency of bridge inspections.

Thus, comparison of the FHWA study and key features of New York State mandated inspections show that the FHWA study results may not be applicable to New York State inspection ratings and variability.

#### 4 PREVIOUS STUDY ON BRIDGE INSPECTION CONSISTENCY

NYSDOT employs both state employees as well as consultants to conduct bridge inspections. In 1993, NYSDOT initiated a project to determine if there were any systematic or large differences between bridge inspection ratings of consultants and state inspectors (Perry 1995). A random sample of bridges were inspected by both state and consultant inspectors during 1993 and 1994. The results were analyzed to determine the magnitude and direction of the differences between the ratings.

The results indicated that the agreement between the state and consultant inspectors' ratings was satisfactory. Of the 698 ratings used in the study, the ratings were within +/-1 in 96% of the cases and were the same in 70% of the cases. The cases with major differences were in the ratings of scuppers, bridge seat and pedestals, etc., that did not significantly influence the bridge condition index calculated and used by the Department. Even though the scope of this study is limited, it gave a good indication of the consistency and uniformity of NYS bridge inspection ratings by various inspectors and consistency and uniformity of the training, manual, and QC/QA procedures in place.

#### 5 ON-GOING RESEARCH EFFORTS

As reported earlier, the FHWA study showed that bridge inspection ratings on a national level have high variability and questioned the quality and reliability of visual based inspection procedures. These results may not be applicable in New York State (NYS) considering the NYS bridge inspection program is more robust and detailed. The previous study also gives a good indication of the consistency of the NYS bridge inspection program. But, due to its limited scope, more research is required to confirm that the New York State bridge inspection program provides reliable results using common practice in bridge inspections. Thus, a research project has been initiated with an objective to quantitatively document the variability associated with the bridge inspection program, suggesting improvements to policy and procedures and areas



requiring further training, if needed, to reduce the variability and improve the reliability/consistency of the program.

The various tasks include:

- Reviewing the National Bridge Inspection Standards, New York State Bridge inspection policy and procedures, FHWA visual inspection study reports, recent studies available in the bridge inspection area on reliability and variability of the bridge inspection methods (both visual and routine nondestructive methods), quality control and quality assurance, reference bridges, and inspector certification.
- Developing a methodology to quantitatively evaluate the consistency of the New York State Bridge Inspection rating scores as well as inspection procedures (both visual inspection, flagging procedure, and use of routine nondestructive testing methods such as sounding, chain drag, etc.) to reflect the actual condition of bridges. The study will include field testing, use of several inspection teams currently used by the Department, and data mining and analysis of existing data.
- If additional funding becomes available, the study will also investigate how well current inspection procedures reliably identify conditions compared to advanced NDT methods, such as Ground Penetrating Radar, Impact Echo, and Infrared Thermography.
- Develop a process or tools to periodically evaluate the variability and consistency of the New York State bridge inspection system and the evaluation process using the current bridge inspection operations.

## 6 SUMMARY

A Federal Highway Administration (FHWA) study completed in 2001 reported that bridge inspection ratings on a national level have high variability and questioned the quality and reliability of visual based inspection procedures. But, the NYS bridge inspection program is more robust and detailed than what is mandated by FHWA and differs in several aspects from inspections conducted in other states. Thus, a research project has been initiated to quantitatively document the variability associated with the bridge inspection program, suggesting improvements to policy and procedures and areas requiring further training, if needed, to reduce the variability and improve the reliability/consistency of the program. This paper gives some background details and the scope of the on-going project.

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