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# INSPECTION AND ASSESSMENT OF LOCALLY OWNED BRIDGES

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Prior to the collapse of the Silver Bridge between Point Pleasant, W.Va., and Gallipolis, Ohio, in December 1967, a comprehensive, nationwide database on the number, type, location, and condition of the nation's bridges did not exist. The collapse, which killed 46 people, generated national concern about bridge safety and prompted legislation that mandated the National Bridge Inspection Standards and the creation of the National Bridge Inventory.

This tech sheet, the second in a three-part series on locally owned bridges, will review inspection and assessment of bridges.

## National Bridge Inventory and Inspection

The Federal Highway Administration (FHWA) is required to maintain a complete inventory of all bridges on public highways. A bridge is defined as a vehicle-carrying structure that has a total span greater than 20 feet measured along the centerline of the highway. One major function of the National Bridge Inventory (NBI) is to maintain data related to the location, type and geometry, features intersected, responsible owner, age, material type, and design-load capacity for each bridge.

Another major purpose of the NBI is to maintain condition or bridge inspection data, which describes the condition and capacity of the major components of each bridge. The NBIS requires all bridges on public roadways to be inspected by qualified inspectors. Inventory information is verified or updated, and the inspectors rate the condition of the bridge elements on a scale from 0 (failed condition) through 9 (new or excellent condition). Information is provided every year by each state department of transportation (DOT), which enables FHWA to update the NBI database and assess the status of bridges on a state-by-state basis or on a national level.

The National Bridge Inspection Standards (NBIS) regulate the inspection of all publicly owned bridges greater than 20 feet in length on public roadways. According to PennDOT's website (March 2016), 2,141 of the 6,487 locally owned bridges in Pennsylvania, or 33 percent of the total, are structurally deficient. Pennsylvania administers the federal National Bridge Inspection Standards, as they pertain to bridges within the commonwealth, through the use of its own Bridge Management System (BMS2). PennDOT employees or private consultants who are certified bridge safety inspectors (CBSI) inspect and manage the inventory and inspection information by using BMS2.

Although bridges less than 20 feet in length are not required to be inspected and inventoried by federal requirements, these bridges should be inspected using the same inspection criteria. Exclusion from the federal program does not release bridge owners from safety and liability issues or from the bridge owners' responsibility to the traveling public. For example, PennDOT inspects 10,000

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bridges and culverts with span lengths between 8 and 20 feet in length. PennDOT is also coordinating with the Metropolitan Planning Organizations (MPOs) and Rural Planning Organizations (RPOs) to inventory locally owned bridges with spans from 8 to 20 feet in length; this inventory is nearly 90 percent complete statewide.

Typically, consultants qualified to perform bridge safety inspections are contracted with PennDOT on a district-wide or countywide basis or by county governments with PennDOT oversight. Municipal governments that own bridges within a county that enters into an umbrella safety inspection contract may be invited to participate in the inspection program through their county's contract. Municipalities that do not participate in either PennDOT's engineering agreements or their county's inspection program are still responsible for inspecting their bridges. PennDOT's Engineering and Construction Management System (ECMS) must be used for all third-party federal aid agreements, including bridge inspection agreements, advertised after November 30, 2014.

A local bridge owner using engineering consultants through a PennDOT engineering agreement will benefit from reduced administration and upfront costs. Since the local 20 percent share of the cost is deducted from liquid fuels allocations, a municipality does not have to pay 100 percent of the costs upfront and then afterwards submit for the 80 percent federal reimbursement. The deduction of liquid fuels allocation occurs in the state fiscal year following the date of the inspection. For example, for a bridge inspected between July 2016 and June 2017 the owner's 20 percent portion of the costs will be deducted from the municipality's liquid fuels allocation in March 2018.

## Pennsylvania's Bridge Program

PennDOT, in coordination with MPOs, RPOs, and independent county and local officials, develops prioritized lists of bridge project candidates. PennDOT submits the recommended bridge program to the State Transportation Commission for review and adoption. Subsequently, the commission submits the program to the governor, the General Assembly, and the secretary of transportation for approval. The program is also submitted to and approved by FHWA.

> Local bridge projects listed in the approved Bridge Bill capital budget and the commonwealth's 12-Year Transportation Program are eligible for reimbursement with federal and/or state funds.

Pennsylvania's bridge program is funded by the state legislature's passage of Act 235 in 1982, which become known as the Billion Dollar Bridge Bill. This law allocated funding for the programming of 979 state, local, and orphan bridges in the commonwealth's 12-Year Transportation Program. A dedicated source of funding was established from registration fees and fuel taxes. The bridge program uses a combination of federal, state, and local funds and gives priority to projects that address closed and weight-restricted bridges.

All local bridge projects included in an approved Bridge Bill capital budget are eligible for funding with Bridge Bill funds. Bridge projects that meet federal eligibility criteria can be funded with 80 percent federal, 15 percent state, and 5 percent local money. Bridge projects that don't meet federal criteria can be funded with 80 percent state and 20 percent local funds.

In 1991, the state legislature approved Act 26, which provided a dedicated state funding source for eligible county-owned bridges. All county-owned covered bridges are eligible for Act 26 funding, which is used in lieu of the local match. Other county-owned bridges are eligible for Act 26 funding only if included on the county eligibility list.

Local bridge projects listed in the approved Bridge Bill capital budget and the commonwealth's 12-Year Transportation Program are eligible for reimbursement with federal and/or state funds. Projects included in an approved Bridge Bill capital budget but not included in the 12-Year Program are not eligible for reimbursement. Any questions concerning eligibility and funding requirements for local bridge projects can be directed to PennDOT's Municipal Service Representatives at http://www.penndot.gov/Doing-Business/LocalGovernment/MunicipalServicesRepresentatives/Pages/default.aspx.

## Inspection Cycles

Commonly, bridge inspection contracts allow for at least one 24-month cycle. Therefore, the routine inspections are performed during the first year of the two-year cycle, with interim inspections of bridges performed the second year. The second year can also be used as a maintenance year since not all bridges on the contract will require interim inspections and this should allow personnel to focus on maintenance.

All weight-restricted, or posted, bridges are inspected on a 12-month interval. Bridges with significant deterioration or problem areas can have inspection frequencies less than one year, such as every six or even every three months, but they are typically the minority.

## Inspection Report

A PennDOT-administered bridge safety inspection will produce a report showing the condition of a bridge on the day it was inspected. These inspection reports contain narrative descriptions of the bridge components, photographs, and maintenance recommendations, depending upon the agency performing the inspection. Every bridge inspection report will include a set of the PennDOT iForms, also known as Form D-450. This set of iForms contains condition codes and detailed descriptions representing the inspectors' assessment of the various bridge components at the time of inspection. The iForms enable inspectors to seamlessly upload the revised inspection data into PennDOT's BMS2 database.

The condition codes used by the commonwealth in its BMS2 program are from FHWA's Recording and Coding Guide for the Structural Inventory and Appraisal of the Nation's Bridges. The BMS2 rating codes and their descriptions are shown in the table below.

> Proper interpretation of the iForms is important for understanding the condition of a bridge and its components as well as developing a meaningful maintenance program that extends the life and maintains the safe use of a bridge.

| Rating Codes | Description |
|---|---|
| N | Not Applicable. |
| 9 | Excellent Condition. |
| 8 | Very Good Condition – No problems noted. |
| 7 | Good Condition – Some minor problems. |
| 6 | Satisfactory Condition – Structural elements show some minor deterioration. |
| 5 | Fair Condition – All primary structural elements are sound but may have minor section loss, cracking, spalling, or scour. |
| 4 | Poor Condition – Advanced section loss, deterioration, spalling, or scour. |
| 3 | Serious Condition – Loss of section, deterioration, spalling, or scour may have seriously affected primary structural components. Local failures are possible. Fatigue cracks in steel or shear cracks in concrete may be present. |
| 2 | Critical Condition – Advanced deterioration of primary structural elements. Fatigue cracks in steel or shear cracks in concrete may be present, or scour may have removed substructure support. Unless closely monitored, it may be necessary to close the bridge until corrective action is taken. |
| 1 | "Imminent" Failure Condition – Major deterioration or section loss present in critical structural components of obvious vertical or horizontal movement affecting structure stability. Bridge is closed to traffic, but corrective action may put it back in light service. |
| 0 | Failed Condition – Out of service; beyond corrective action. |

***Reference:*** *FHWA's Recording and Coding Guide for the Structural Inventory and Appraisal of the Nation's Bridges (FHWA Green Book).*

The use of iForms allows PennDOT to administer program oversight and maintain consistency and quality control among PennDOT inspectors and private consultants who perform inspections across the state.

## Interpreting Field Sheets

Proper interpretation of the iForms is important for understanding the condition of a bridge and its components as well as developing a meaningful maintenance program that extends the life and maintains the safe use of a bridge.

The set of iForms consists of a series of sheets labeled alphabetically. Each sheet contains data about a particular component of the bridge. The table below illustrates the common form designations with their titles. Other forms with differently numbered series are sometimes used for specific applications, but the forms noted in the table represent the most common.

| iForm | Form Title | Includes |
|---|---|---|
| Form A | Site Data | Signing, railing, approaches |
| Form B | Deck and Superstructure Data | Deck, wearing surface, superstructure |
| Form C | Abutment Data | Abutment, wings, scour, undermining |
| Form D | Pier Data | Pier, scour, undermining |
| Form E | Element Level Data | Element level inventory and assessment |
| Form F | Fracture Critical | Fracture critical members and fatigue categories |
| Form G | Underwater Inspection | Determination of scour rating |
| Form H | Culvert Data | Deck, culvert, ratings |
| Form J | Channel and Waterway Data | Channel condition and appraisal |
| Form K | Paint, Structure Appraisal, and Load Ratings | Paint, inventory, and operating ratings |
| Form M | Maintenance Needs Data | Table of needs by structural unit |
| Form P | Inspection Administration | Inspection type, schedule, and effort |

Within each form are codes and short-phrase descriptions for the various components of the inspected bridge. The codes have specific meanings, which may vary by structural component. Often, these codes have little or nothing to do with condition but rather are shorthand for component types or material. For condition codes for bridge members, such as the deck, deck wearing surface, superstructure, substructure, and approaches, generally the higher the numerical code, the better the condition of the component.

## Near and Far

The iForms, as well as other portions of a bridge inspection report, will contain the terms “near” and “far” with regard to abutments of a bridge, with left and right referenced from the near and far abutments. For the purposes of orientation to a bridge, near and far are referenced by the offset, station, or milepoint of the roadway along which the bridge is located, typically by a west-to-east or a south-to-north orientation of the bridge.

For bridges located along a roadway with known offsets, stationing, or milepoints, the near abutment of the bridge is that abutment toward the lower numbered offset, station, or milepoint, while the far abutment is that abutment toward the higher numbered offset, station, or milepoint.

For bridges that lie in a west-east orientation, the western-most abutment is the near abutment, while the eastern-most abutment is the far abutment. Likewise, for bridges that lie in a south-north orientation, the southern-most abutment is the near abutment, while the northern-most abutment is the far abutment. For all bridges, right and left are determined by looking from the near end toward the far end.

## Maintenance Needs Data

For local governments with an effective bridge maintenance program, the most useful of the iForms is Form M – Maintenance Needs Data. This form lists categories of bridge components and more specific maintenance items within those categories. For each maintenance item, the location of a recommended repair (near, far, left, right, entire span, etc.) is noted as well as an estimated quantity and a priority code.

The priority code indicates the maintenance tasks that should be performed immediately and those that may be planned for the future.

## Maintenance Priorities

Maintenance priority codes are listed on Form M. Applicable codes are:

0 – Critical Priority, prompt action required
1 – High Priority, as soon as work can be scheduled
2 – Priority, review work plan and adjust schedule as needed
3 – Add to Scheduled Work
4 – Routine Structural, can be delayed until funds are available
5 – Routine Nonstructural, can be delayed until programmed

Engineers responsible for inspection services will often send a “critical or high-priority deficiency” letter to municipal officials for maintenance items requiring immediate attention, such as obscured, damaged, or missing weight-limit posting signs or other regulatory signs affecting the safe maintenance of traffic over the bridge. Maintenance items coded a “0” or “1” should be considered critical or high-priority maintenance items requiring immediate attention.

For structural maintenance items identified as priority “0” and “1,” a plan of action (POA) must be completed by the engineering consultant in conjunction with the bridge owner within three and seven days, respectively. The timeframe for completing or mitigating a priority “0” is seven days; however, if closure of the bridge is necessary, it should be completed as soon as possible.

As can be seen from the list of priority codes, those items with higher priority code numbers may be added to the municipality’s bridge maintenance plan as the budget allows. ***However, the luxury of time to plan bridge maintenance should not be interpreted as an opportunity to ignore bridge maintenance.*** Time for planning can be best used by coordinating contracts that will maximize resources and provide economies of scale for the municipality, such as paving, painting, or debris-removal contracts to be performed in multiple locations municipality-wide. Bridge maintenance and repairs generally cost less the sooner they are done. Putting off maintenance and repairs will not only increase the cost of the maintenance item, but delayed maintenance on one bridge component can rapidly affect other parts of the bridge, further increasing costs.

> The luxury of time to plan bridge maintenance should not be interpreted as an opportunity to ignore bridge maintenance.

## A Valuable Tool

The BMS2 program administered by PennDOT provides county and municipal bridge owners with valuable tools, including the Bridge Inspection Report produced for each bridge more than 20 feet in length. While these reports may contain different components, depending upon the agreement between the parties under contract, all reports should contain the iForms. Understanding the information provided in these field sheets means municipal bridge owners have one more tool for knowing the condition of their bridges and a means for planning maintenance, all of which leads to an efficient use of available funding.

### Sources:

- PennDOT. www.penndot.gov. 2016.
- Federal Highway Administration. National Bridge Inventory. 2016.