# PART 2 – INSPECTION

## CHAPTER 2.1 – GENERAL

### 2.1.1 GENERAL

Inspection of any bridge structure requires that the use of personnel, equipment, tools, and access methods be coordinated in an efficient, logical manner. An inspection should be planned considering typical seasonal variations in site conditions; vehicular, pedestrian, and vessel traffic; weather; and numerous other factors that may only become apparent during a pre-inspection site visit.

Information gathered during the condition inspection of a movable bridge provides the necessary data for evaluating the physical and functional condition of the structure, establishing priorities for maintenance and repair programs, and providing assurance that the structure is safely performing as designed. A thorough inspection plan anticipates problems that may be encountered, streamlines the inspection operation and can also result in early detection of significant defects or deficiencies.

Element-level condition assessment methods have been adopted by the FHWA. Element-level inspections collect information in a format that is focused on bridge management. This supplements the previous inspections methods for the National Bridge Inventory.

This Chapter provides an overview of the process for a typical movable bridge inspection. Reference 69 contains additional information on bridge inspection planning.

**COMMENTARY**

*C2.1.1*

*The planning stage for a movable bridge goes beyond gathering available bridge plans and reports, preparing field sketches, and organizing the proper tools, equipment, and personnel. The engineer/inspector should consider the need for one or more specialists, possible disassembly and/or cleaning of mechanical or electrical components prior to inspection, and the coordination of the work within traffic and navigational restrictions.*

*The planning operation should focus on objectives such as establishing priorities for maintenance, etc. and should also determine the methodology, equipment, means of access and personnel requirements needed to conduct the inspection.*

# PART 2 – INSPECTION

## CHAPTER 2.2 – TYPES AND SCOPES OF INSPECTION

### 2.2.1 TYPES AND SCOPES OF INSPECTION

The *AASHTO Manual for Bridge Evaluation* (Reference 9) lists seven types of inspections: Initial, Routine, Damage, In-Depth, Fracture Critical, Underwater, and Special. These inspection types apply to movable bridges with specific modifications and additions as described herein.

The following inspection examination methods may be included in an inspection:

**Visual Examination:** Condition information is gathered and documented on individual components by the inspector based on external signs of deterioration or defects, (e.g. corrosion, wear, abrasion, cracking, misalignment, allowable clearances, fluid levels, proper lubrication, exposed wiring, etc.)

**Operational Examination:** The component or system is inspected during operation of the bridge. The inspector observes the component, noting overall performance, unusual sounds, vibrations, temperature increase, unusual odors, and/or excessive clearance in shafts, bearings, etc.

**Measurement Examination:** The component or system is measured, with the measurements documented and compared to standard or previous measurements. For example mechanical measurements may include gear tooth backlash and wear; bearing clearances; coupling alignment; brake reserve stroke, shoe contact, and shoe wear; rope diameter, lay and crown wear; hydraulic pressures and flows, etc. Example electrical measurements include megger testing and motor current.

**Special Examination:** The component or system is disassembled and/or investigated by various nondestructive techniques (magnetic particle, ultrasonic, radiography, etc.).

There are three main types of movable bridge mechanical and electrical inspections: Routine, In-depth, and Special. Each type of inspection requires different levels of intensity. Many new mechanical and electrical systems experience adjustment or break-in problems. Therefore, it is recommended that the initial inspections on new mechanical and electrical systems of new or rehabilitated movable bridges be performed to the In-Depth level of intensity.

### 2.2.2 ROUTINE INSPECTION

Routine inspections include visual and operational examination. Measurement or special examinations are typically not included in a routine inspection.

## COMMENTARY

*C2.2.1*

*One of the goals of an initial inspection should be to identify existing system conditions and operating parameters to facilitate distinguishing between stable conditions and defects that continue to deteriorate further in subsequent inspections.*

*C2.2.2*

*Trial openings should be made as necessary to verify that all components and systems are functioning properly. Trial openings for the purpose of inspection should be made separately from openings for passage*

# PART 2 – INSPECTION

## CHAPTER 2.2 – TYPES AND SCOPES OF INSPECTION

Routine inspection of the structural systems should conform to Reference 9 and any additional owner requirements. Routine inspection of the mechanical, hydraulic, and electrical systems should include visual and operational examination of primary components without major disassembly and evaluation of the function of each primary component and system. Routine inspections should, however, include checking movable span balance by the ammeter method (see Chapter 2.10) on bascules and vertical-lift spans. Swing spans should also be checked for unusual variations in power required to drive the span, but would not normally be checked for "balance." If the ammeter method is not feasible or does not provide useful data due to an unusual electrical configuration, consideration should be given to checking balance by other more complex methods (see Chapter 2.10).

Chapter 2.9 Condition Evaluation Coding proposes a system of numerical coding based on observed condition of components, and describes two methods of coding sealed units of electrical, mechanical, or hydraulic components: the predicted life method and the engineering evaluation method. Visual inspection is sufficient to establish coding using the predicted life tables. To justify increasing the predicted life of a component beyond that shown in the tables, an engineering evaluation should be conducted. The results of the evaluation should be based on an in-depth inspection.

The text in Chapter 2.8 discusses the procedures for routine inspection in detail for various systems and components.

### 2.2.3 IN-DEPTH INSPECTIONS

In-depth inspections should include all of the scope of a routine inspection and, in addition, should include measurement examinations and disassembly of selected components for internal inspection.

A representative sample of bearing caps and couplings should be removed for shaft and bearing inspection. Shafts and bearings clearances should be measured with feeler gauges to precisely determine clearances. The inspection should include rope size and tension measurements, gear backlash measurements, and counterweight pocket cap removed. Electrical components should be inspected and tested. Motors should be vibration tested. Electric insulation should be meggered, controls should be examined, wiring and wiring connections should be examined and checked for deterioration, corrosion and connection tightness. Hydraulic and pneumatic systems should be performance tested, and systems that have a

**COMMENTARY**

*of navigational traffic so as not to divert the bridge operator's attention or extend the duration of the openings. It may not be possible to perform a trial opening if it is not safe to open the bridge. In this case, or other unusual circumstances, the inspector should make note of why a trial opening could not be performed.*

*It is recommended that each inspector—Structural, Mechanical, and Electrical—witness each significant component in operation; this typically requires several span openings during each inspection. For bridges with significant traffic, consider performing the span openings at night or during off-peak hours. For bridges with infrequent operations, operational concerns, or history of operational problems ("getting stuck"), consider making arrangements to have maintenance staff on-site during the test span operations.*

history of operational problems, should be disassembled by qualified hydraulic or air motor technicians for internal inspection.

In-depth inspections should, in general, include the scope contained in Chapter 2.8 for routine component inspection, but typically, should be more extensive, cover a larger number of areas, and involve more cleaning and direct measurement of corrosion losses and other defects. In-depth inspections should also include some specific nondestructive testing and disassembly of selected components based upon the results of previous inspections for the purpose of quantifying the actual nature of defects that were evaluated in a qualitative or more approximate manner during routine inspections. Chapter 2.8 contains expanded scopes for in-depth inspection of individual components.

### 2.2.4 SPECIAL INSPECTIONS

These types of inspections remain unchanged from the definitions stated in Reference 9. These inspections may include any combination of the three inspection examination method appropriate for the evaluation.

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## CHAPTER 2.3 – FREQUENCY

The inspection frequency requirements of References 8g and 9 for fixed bridges should also apply to the structural, mechanical, and electrical systems of movable bridges. Specifically, the following maximum inspection intervals for mechanical, hydraulic, and electrical movable bridge inspections are recommended:

- Routine Inspections: 24 months
- In-depth Inspections: 6 years, in place of a Routine Inspection
- Special Inspections: as necessary

**COMMENTARY**

*C2.3*

*It is not uncommon for the mechanical, hydraulic, or electrical systems on some bridges to require more frequent inspections in order to maintain reliability. Individual owners may perform more frequent inspections where past experience justifies a shorter interval.*

# PART 2 – INSPECTION

## CHAPTER 2.4 – INSPECTOR QUALIFICATIONS

Inspection of movable bridges requires a coordinated team of experienced structural, mechanical, hydraulic, and electrical inspectors.

The provisions of the AASHTO Manual for Bridge Evaluation (Reference 9, Section 4.4) relating to qualifications and responsibilities of inspection personnel are applicable with additional emphasis on movable bridge experience.

The inspection team leader should meet the requirements of References 8g and 9, and not less than three years of that experience should be in movable bridge design, inspection, or maintenance.

The lead inspectors for mechanical, hydraulic, and electrical inspections should meet the requirements of References 8g and 9 for team leader in their areas of expertise and not less than three years of the experience required in Reference 9 may be in design, inspection, or maintenance on movable bridges within their area of expertise. The inspection team leaders and lead inspectors should actually perform the inspection and/or be personally on site supervising the inspection for the full duration of the field work.

If the inspection team leader or lead inspector's qualifications are based upon experience rather than engineering certification, completion of a comprehensive movable bridge inspection training course based upon References 9, 69, and this Manual should be required. A fluid power engineer certification from the National Fluid Power Association may be substituted for 4 years of the experience requirements for hydraulic engineers.

If an individual is responsible for more than one area of expertise, the individual should qualify for each field and have not less than two years of movable bridge-specific experience in each area of expertise.

## COMMENTARY

### CHAPTER 2.4 – INSPECTOR QUALIFICATIONS *C2.4*

*Reference 9 is based upon the requirements of Reference 8g, The Code of Federal Regulations, Title 23, Part 650, National Bridge Inspection Standards.*

*The intent of this section is to certify that individuals involved in movable bridge inspection have some of the experience required in References 8g and 9 in the specialized area of movable bridges. It is not intended that the experience cited in Section 2.4 be an addition to the experience required by References 8g and 9. Overlaps are permissible. References 8g and 9 do not recognize time spent in design or maintenance as meeting the experience requirement (except as they may contribute to qualification for registration as a professional engineer). For movable bridge experience, design experience and maintenance experience are recognized. The required movable bridge training course may be either separate from, or combined with the course requirements of References 8g and 9 for a bridge inspector.*

*The inspection team leader should meet the requirements of References 8g and 9 and not less than three years of that experience should be in movable bridge design, inspection, or maintenance.*

*The lead inspectors for mechanical, hydraulic, and electrical inspections should be registered professional engineers in the respective discipline, meet the requirements of References 8g and 9 for team leader in their areas of expertise and not less than three years of the experience required in Reference 9 maybe in design, inspection, or maintenance on movable bridges within their area of expertise. The inspection team leaders and lead inspectors should actually perform the inspection and/or be personally on-site supervising the inspection for the full duration of the field work.*

### CHAPTER 2.4 – INSPECTOR QUALIFICATIONS *C2.4*

## COMMENTARY

*If the inspection team leader or lead inspector's qualifications are based upon experience, rather than engineering certification, completion of a comprehensive movable bridge inspection training course based upon References 9, 69, and this Manual should be required. A fluid power engineer certification from the National Fluid Power Association may be substituted for 4 years of the experience requirements for hydraulic engineers.*

*If an individual is responsible for more than one area of expertise, the individual should qualify for each field and have not less than two years of movable bridge-specific experience in each area of expertise.*