Table of Contents

Contents

6.1.1 Introduction

There are numerous types of inspections, each designed to obtain specific information. For example, an Initial Inspection is performed after a tunnel is constructed to document the as-built conditions, whereas Routine Inspections are used to monitor the condition of a tunnel at regular intervals. Damage Inspections are used to assess damage resulting from events such as deterioration, impacts, fires, or floods. These inspections help create a complete picture of a tunnel's condition and are described in detail in this chapter.

Visual inspection is the primary examination method for all inspections. Nondestructive testing (NDT) techniques may be required to identify internal flaws or hard-to-see external defects in critical members.

6.1.2 Inspection Procedures

Section 650.513(a) of the NTIS requires that tunnel structural elements and functional systems be inspected in accordance with the inspection guidance provided in the TOMIE manual.

Section 650.513(c) of the NTIS requires that tunnel-specific inspection procedures be prepared and documented for each NTIS tunnel. These inspection procedures shall consider the design assumptions and the tunnel complexity.

Tunnel specific inspection procedures shall be developed for each tunnel and stored in the WisDOT NTI file system.

6.1.3 Inspection Types

The NTIS defines five types of tunnel inspections:

1) Initial Inspection
2) Routine Inspection
3) Damage Inspection
4) In-Depth Inspection
5) Special Inspection

All inventory and inspection data shall be entered into the Tunnel Inventory Database within 90 days of the completion of the inspection (or construction of new tunnels) per NTIS requirements.

6.1.3.1 Initial Inspections

6.1.3.1.1 Purpose

An Initial Inspection is the baseline inspection that should be completed on every new tunnel, after a major rehabilitation, or when the configuration or geometry of a tunnel changes significantly (e.g., when a tunnel is widened). An Initial

Inspection is a fully documented inspection using the plans to determine basic data which will be stored in the Tunnel Inventory Database. Initial Inspections are also used when a tunnel is discovered that has not been previously inventoried. In this case, the tunnel plans may not be available. As part of the Initial Inspection, inspectors evaluate the tunnel and decide what other foreseeable inspections will be required throughout its life, which include Special, and In-depth Inspection.

As a part of the Initial Inspection, Inspectors must review the "Tunnel File" and research and look for all missing documents and have any that are found scanned and uploaded into the Tunnel Inventory Database.

6.1.3.1.2 Precision

The Initial Inspection should be a fully documented investigation. Inspectors must be able to identify any deficiencies and verify the geometric data. All observed deficiencies, cracks, construction errors, and alignment problems should be documented. Hands-on inspection of components shall be used, when possible.

At least one NTIS Team Leader must be present during an initial inspection.

An Initial Inspection should be performed in accordance with the inspection guidance provided in the TOMIE manual and should include:

1. Verify and record all tunnel inventory data required by federal and state regulations.
2. Gather relevant information required to maintain an accurate Tunnel file, scan and uploaded in the Tunnel Inventory Database.
3. Ensure that all tunnel systems are noted and evaluated in accordance with the TOMIE which may include the following:
    - Emergency generator system
    - Miscellaneous mechanical systems
    - Electrical distribution systems
    - Electrical and lighting systems
    - Fire and life safety, emergency systems
    - Emergency communication systems
    - Tunnel security and operation systems
    - Tunnel ventilation systems
    - Other tunnel systems that need special consideration
4. Determine and evaluate the baseline structural condition, as well as systems.

5. Identify the location and condition of any details that may require a Special Inspection.
6. Verify that all clearances and geometric dimensions are noted in the Tunnel Inventory Database.
7. Identify any critical findings and notify the appropriate individuals and agencies identified in this manual.

All inspection results should be fully documented and filed in the Tunnel Inventory Database.

6.1.3.1.3 Frequency

The Initial Inspection shall be completed before the new construction or rehabilitation construction contract is finalized and the tunnel is open to traffic.

6.1.3.2 Routine Inspection

6.1.3.2.1 Purpose

Routine Inspections are regularly scheduled inspections consisting of observations and/or measurements needed to determine the physical and functional condition of the tunnel, and to identify any changes from previously recorded conditions. The Routine Inspection also ensures that the tunnel continues to satisfy present service requirements.

The NTIS requires that routine tunnel inspection be performed in accordance with the TOMIE Manual. Tunnel specific inspection procedures are required for each NTIS tunnel inspection. At least one NTIS Team Leader must be present during a routine inspection.

6.1.3.2.2 Precision

Routine Inspections will follow the inspection procedures document for the structure, as documented in the Tunnel Inventory Database. A specific inspection procedure for each tunnel must be documented in the database.

Routine Inspections are generally conducted from the portal to portal or from permanent work platforms and walkways, if present. A complete visual inspection of all components of the structure and adjacent roadway is required. A complete visual inspection of all tunnel systems is required, such as:

A Routine Inspection should include the following system inspections in accordance with the TOMIE Manual, if present:

- Emergency generator system
- Miscellaneous mechanical systems
- Electrical distribution systems
- Electrical and lighting systems
- Fire and life safety, emergency systems
- Emergency communication systems
- Tunnel security and operation systems
- Tunnel ventilation systems
- Other tunnel systems that need special consideration, including inspection of structural supports/anchorages of any systems directly over traffic.

1. Complete an inspection and evaluation of all required data identified in accordance with this manual.
2. Verify tunnel inventory data.
3. Gather other relevant information required to maintain an accurate tunnel file.
4. Note any existing problems or components.
5. Identify the location and condition of details that may require a Special Inspection.
6. Required Photos:
    - Alignment photos from both ends of the tunnel.
    - Photos looking at the portal entrance (north or east entrance) and exit (south or west entrance).
    - Closing, posting, and/or restriction signs should be visible and legible in the photos.
    - Elevation photos, preferably of both ends of the tunnel, (as a minimum on one side of the tunnel).
    - Photos of all tunnel elements with a condition state of 3 or 4.
    - Photos under each superstructure type, clearly showing details.
    - Photo of any detail that requires a Special Inspection.
    - Photos of significant deterioration and collision damage.
7. Note if a new load rating is warranted.
8. Identify any Critical Findings and notify the appropriate individuals and agencies identified in this manual.
9. Provide maintenance recommendations to tunnel owner.

6.1.3.2.3 Inspection Frequency

The NTIS requires routine tunnel inspections to be conducted on a 24-month interval. Certain deterioration may require more frequent inspections; If only a portion of a tunnel needs more frequent inspections, a Special Inspection is required.

For more information, refer to Chapters 4 and 5 of the TOMIE manual and the SNTI.

6.1.3.3 Special Inspections

6.1.3.3.1 Purpose

As defined by the NTIS, a "special inspection" is an inspection scheduled at the discretion of the tunnel owner. A special inspection is typically performed after an initial, routine, damage or in-depth inspection when significant deficiencies have been discovered and need to be monitored. Special inspections might continue until the deficiency is repaired or further inspections are no longer deemed necessary. The scope, frequency, and duration of special inspections are up to the discretion of the tunnel owner. The qualifications of personnel performing a special inspection is at the discretion of the tunnel owner.

6.1.3.3.2 Precision

Special Inspections may include a special inspection procedure, if required. The qualifications of personnel performing a special inspection is at the discretion of the tunnel owner.

6.1.3.3.3 Frequency

The scope, frequency, and duration of special inspections are up to the discretion of the tunnel owner. The qualifications of personnel performing a special inspection is at the discretion of the tunnel owner.

6.1.3.4 In-Depth Inspection

6.1.3.4.1 Purpose

An "in-depth inspection" is a close-up inspection of one, several, or all tunnel structural elements or functional systems to identify any deficiencies not readily detectable using routine inspection procedures. In-depth inspections may use non-destructive testing or other advanced methods. In-depth inspections may involve testing of tunnel system, components, and materials. Access equipment may be necessary to facilitate hands-on inspection at some locations.

6.1.3.4.2 Precision

The scope of an In-Depth Inspection should be dependent on the purpose of the inspection and shall be coordinated by the tunnel owner, TTL, RPM, and the SPM. This is a relatively infrequent inspection scheduled for structures that typically do not require a scheduled inspection beyond the routine inspection. This inspection will give the inspector the opportunity to make sure that all the components of the structure are performing as intended.

At least one NTIS Team Leader must be present during an in-depth inspection.

6.1.3.4.3 Frequency

In-depth inspections are scheduled based on the needs of the tunnel facility, inspection findings, and established written procedures. In-depth inspections may occur more frequently or less frequently than routine inspections, as outlined in the tunnel-specific inspection procedures.

6.1.3.5 Damage Inspections

6.1.3.5.1 Purpose

A Damage Inspection is an unscheduled inspection to assess structural damage resulting from environmental factors or human actions. Flood damage, fire damage and vehicle impact are examples of events that may call for a Damage Inspection.

6.1.3.5.2 Precision

The scope of a Damage Inspection should be sufficient to determine whether there is a need for emergency load restriction, or closure of part or all of the tunnel to traffic. The amount of effort expended on this type of inspection may vary significantly and depends on the extent of the damage. If major damage has occurred, the inspector shall document the damage, including measuring section loss or misalignment, and any loss of foundation support.

This inspection may be supplemented by a timely Special Inspection to more fully document the extent of damage and the urgency and scope of repairs. A more refined analysis, to establish or adjust interim load restrictions, may also be required as follow-up for a Damage Inspection. A structural engineer may need to be consulted for the inspection or analysis. If the inspection identifies a Critical Finding, the inspector must follow the notification procedures outlined in Chapter 4 of this manual.

A damage inspection is required for all tunnels in which the event has left permanent physical evidence. The damage inspection data and pictures shall be entered into the Tunnel Inventory Database as soon as possible and no more than seven (7) days after the inspection.

The Inspector of state-owned or state-assigned tunnels should gather data on the vehicles and drivers involved and any police report after a crash. This information will be used to bill the appropriate insurance company for damages.

A damage inspection of an NTIS tunnel should be performed by an NTIS Team Leader, NBIS Team Leader, or a Professional Engineer.

6.1.3.5.3 Frequency

A Damage Inspection is an unscheduled inspection that is performed to determine if significant damage has been done to the tunnel. Based on the findings of the damage inspection, the inspector will determine if the damage warrants placing the structure on a special inspection. Pictures of any damage will be uploaded into Tunnel Inventory Database with a complete description of the event. Generally, a law enforcement officer on the site of an accident involving a tunnel will notify the owner who will request a Damage Inspection be performed to determine if the tunnel should be closed.

6.1.4 Tunnels Closed To Traffic

If a tunnel is closed to all traffic for construction when an inspection is due, the inspection team shall:

1. Document the tunnel is properly closed with photos.
2. Note that the inspection date was changed in the Tunnel Inventory Database.
3. Verify the estimated date of completion of the construction.
4. Schedule a new Initial Inspection and all other required inspections for the estimated completion date. The initial inspection shall be completed prior to opening to traffic.
5. All rescheduled Routine inspections should be completed ± two months of the original inspection date. Routine Inspections should remain in the month that it had been prior to construction. If the construction schedule will not allow for this, the initial inspection shall be a full Routine inspection.
6. Leave other NTI data items unchanged, until the initial inspection is conducted.

If a tunnel is only partially closed to traffic during construction, then a tunnel inspection is required. On WisDOT tunnels, the contractor is required to provide a time and access for inspectors to conduct all needed inspections.

If a tunnel has been closed permanently when inspection is due, the inspection team shall:

1. Document the tunnel is properly closed with photos. No other inspection work is required. If the tunnel is not properly closed, a critical finding must be immediately submitted.
2. A memorandum will be published stating that the tunnel is permanently closed. The memorandum will be electronically stored on the Tunnel Inventory Database.
3. Code the appropriate NTI Date Item(s) with the date the inspectors were at the tunnel.
4. Note that the inspection dates were changed in the Tunnel Inventory Database.
5. Leave other NTI data items unchanged.
6. Recommend the removal of the tunnel be scheduled as soon as possible.

Permanently closed tunnels are generally not eligible to use federal tunnel inspection funds to conduct inspection activities.

6.1.5 Complex Tunnels

The NTIS defines a “complex tunnel" as a tunnel characterized by advanced or unique structural elements or functional systems.

WisDOT has defined a “complex tunnel” as follows:

> *A “complex tunnel" is a tunnel with advanced or unique structural elements or functional systems. Specific examples include tunnels passing below waterways, tunnels with multiple traffic levels, tunnels with ventilation systems that must operate continuously to ventilate exhaust, or any tunnel designated as “complex” by the Wisconsin Program Manager.*

Based upon this definition, WisDOT does not currently consider any of the NTIS tunnels to be “complex”.