September 27, 2011

Western Bridge Engineers' Seminar

Phoenix, AZ

Overview of FHWA Tunnel Operations, Maintenance, Inspection and Evaluation (TOMIE) Manual

Brian J. Leshko, PE
HDR Engineering, Inc.

Outline

- Background Information
- TOMIE Manual Workshop
- TOMIE Manual Table of Contents
- TOMIE Manual Project Team
- TOMIE Manual Chapters:
  - 1, 2, 3…5, 6, 7 Synopses
  - 4 (Inspection) Highlight
- TOMIE Manual Status

Background Information

- Tunnel Operations, Maintenance, Inspection and Evaluation (TOMIE) Manual:
  - Objective – provide guidance to tunnel owners and operators to use Best Practices to operate, maintain, inspect, and evaluate their tunnels

Background Information

- **FHWA has available three interrelated documents regarding tunnel inspection, maintenance and rehabilitation:**
  - *Highway and Rail Transit Tunnel Inspection Manual*, 2005 Edition;
  - *Highway and Rail Transit Tunnel Maintenance and Rehabilitation Manual*, 2004 Edition; and
  - *ONE DOT Tunnel Management System (**TMS**)*, computer software, Version 1.0
- **All three documents have been utilized in the development of the TOMIE Manual**

Background Information

- **Workshop Objective:**
  - Technical Directive, TD 002, involved a 'workshop' "to further coordinate and better define the scope and breadth of the TOMIE Manual based upon input provided to the ANPRM and the needs of the tunnel owners."
- **Workshop Duration:**
  - A day and a half meeting
- **Workshop Location:**
  - Washington, D.C.

TOMIE Manual Workshop

- **March 17-18, 2010**
- **U.S. DOT Headquarters Building**
  1200 New Jersey Avenue, SE
  Washington, DC 20590

Workshop Attendees

- Federal Highway Administration (FHWA):
  - Myint Lwin, P.E., S.E.
  - Butch Wlaschin, P.E.
  - Jesús M. Rohena, P.E.
  - John R. Thiel, P.E.
  - Shyan-Yung Pan, P.E.
  - Stephen Gaj
  - Steven Ernst, P.E.
  - Krishna Verma

Workshop Attendees

- **Support Staff (HDR/GF/HMM):**
  - **Brian J. Leshko, P.E.** (HDR - Workshop Facilitator)
  - **Chester L. (Chet) Allen, P.E.** (Gannett Fleming)
  - **Rick N. Patrick, P.E.** (Gannett Fleming)
  - **Lee W. Abramson, P.E.** (Hatch Mott MacDonald)

Workshop Attendees

- **Tunnel Owners via AASHTO T-20:**
  - **Kevin J. Thompson, P.E.** (CA AASHTO)
  - **Louis Ruzzi, P.E.** (PA DOT)
  - **Harry A. Capers Jr., P.E.** (former NJ DOT)
  - **Donald F. Dwyer, P.E.** (NYS DOT)
    - **By teleconference (Part-time)**

Workshop Attendees

- **The Research Community via TRB AFF60:**
  - **Brian H. Zelenko, P.E.** (Parsons Brinckerhoff)
  - **Lee W. Abramson, P.E.** (Hatch Mott MacDonald)

- **Consultant Community via ACEC and ASCE:**
  - **Henry A. Russell, P.E.** (Parsons Brinckerhoff)
  - **Paul A. Roy, P.E.** (AECOM USA)

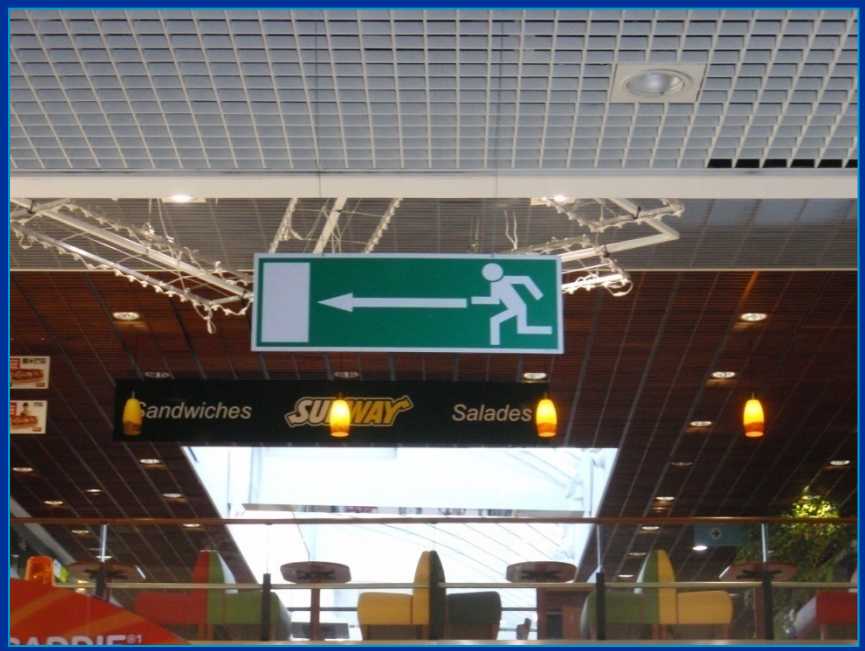
Expectations from Attendees

- Develop partnership with Rail and Transit Stakeholders
  - Tunnels: 3 kinds - Highway, Freight Rail, and Commuter Rail
  - Agencies: FHWA, FRA and FTA
- Differentiate Critical vs. Non-Critical Items
- Standards for lighting & fire safety equipment
- Signs should be in the tunnels, if possible, should be part of the Manual…

Tunnel Signage

- "Running Man" Sign
  - Prevalent in Europe
  - Recent Unique Examples

Zermatt, Switzerland



Annecy, France

Geneva, Switzerland

TOMIE Manual Table of Contents

- Chapter 1 – Intro., Background and Overview
- Chapter 2 – Operations
- Chapter 3 – Maintenance
- Chapter 4 – Inspection
- Chapter 5 – Evaluation
- Chapter 6 – Tunnel Data Management
- Chapter 7 – Training

Deliverable from TOMIE Manual Workshop

TOMIE Manual Project Team

- HDR Engineering, Inc.
  - Brian Leshko
  - Mark Pavlick
  - Nick Burdette
- Gannett Fleming, Inc.
  - Chet Allen
  - Rick Patrick
  - Brian Seip
  - Ben Margerum

TOMIE Manual Chapter Synopsis

- Chapter 1 – Introduction, Background and Overview
  - Discuss scope / purpose of TOMIE Manual.
  - Provide working definition of a tunnel.
  - Introduce training and experience qualification program for tunnel inspectors.
  - Discuss background information on tunnels, both domestic and international.

TOMIE Manual Chapter Synopsis

- Describe groups that deal with tunnels;
  - FHWA
  - AASHTO (T-20)
  - TRB (AFF60)
- Discuss European and Domestic Tunnel Scans.
- Provide overview of existing tunnel manuals, management systems and technical advisories.
- Discuss tunnel fundamentals and basic elements.
- Provide overview of TOMIE Manual Chapters.

Source/Reference Documentation

- Chapter 1 – Introduction, Background and Overview
  - Task 261 – *Best Practices for Implementing Quality Control and Quality Assurance for Tunnel Inspection*
  - Task 276 – *Outline for Proposed Guidelines for Rehabilitation of Existing Highway and Rail Transit Tunnels*
  - Tunnel Scan Executive Summaries (European and Domestic)

Source/Reference Documentation

- *Highway and Rail Transit Tunnel Inspection Manual*
- *Highway and Rail Transit Tunnel Maintenance and Rehabilitation Manual*
- *NFPA 502 – Standard for Road Tunnels, Bridges, and Other Limited Access Highways*
- *ONE DOT Tunnel Management System (TMS),* computer software, V1.0

TOMIE Manual Chapter Synopsis

- Chapter 2 – Operations
  - Discuss operations of tunnels.
  - Describe tunnel health and safety issues for operations personnel and traveling public.
  - Introduce tunnel operations staff.
  - Discuss types of tunnel operations organizations, functional duties and unique issues.
  - Describe normal operations, types of closures, incident management, and operations protocols.

Source/Reference Documentation

- Chapter 2 – Operations
  - Normal and Emergency Operations - Examples from Henry Russell (Parsons Brinckerhoff)

TOMIE Manual Chapter Synopsis

- Chapter 3 – Maintenance
  - Discuss maintenance of tunnels.
  - Describe tunnel health and safety issues for maintenance personnel and traveling public.
  - Introduce tunnel maintenance staff.
  - Discuss types of tunnel maintenance:
    - Preventative Maintenance
    - On-demand
    - Preservation/Repair & Replace

TOMIE Manual Chapter Synopsis

- Describe tunnel systems:
  - Structures
  - Drainage
  - Mechanical
  - Electrical
  - Lighting
  - Security
  - Signs
  - Incident Detection, Overheight Vehicle Detection
  - Traffic Management, Information Management
  - Fire Control/Suppression

Source/Reference Documentation

- Chapter 3 – Maintenance
  - *Highway and Rail Transit Tunnel Maintenance and Rehabilitation Manual*
  - ITA Study of Methods for Repair of Tunnel Linings, June 2001
  - ITA Guidelines for Structural Fire Resistance for Road Tunnels, May 2004

TOMIE Manual Chapter Synopsis

- Chapter 5 – Evaluation
  - Discuss evaluation of tunnels.
  - Describe material testing and field tests (concrete, steel, timber, and unlined rock).
  - Discuss material sampling, special testing, laboratory tests, interpretation & evaluation of test results, and testing reports.
  - Introduce and describe Load and Resistance Factor Rating (roadway slab, suspended ceiling or exposed roof).

TOMIE Manual Chapter Synopsis

- Discuss loads for evaluation, structural analyses methods, load rating procedures, posting of tunnels, and special topics.
- Describe unique attributes for evaluating tunnel materials (concrete, steel, timber, and ashlar stone).

Source/Reference Documentation

- Chapter 5 – Evaluation
  - *Highway and Rail Transit Tunnel Maintenance and Rehabilitation Manual*
  - FHWA Road Tunnel Design Guidelines
  - Technical Manual for Design and Construction of Road Tunnels - Civil Elements
  - AASHTO LRFD Guide Specifications for Rehabilitation and Strengthening of Existing Highway and Rail Transit Tunnels

Source/Reference Documentation

- Task 276 – *Outline for Proposed Guidelines for Rehabilitation of Existing Highway and Rail Transit Tunnels*
- National Bridge Inspection Standards (NBIS)
- The Manual for Bridge Evaluation (MBE)
- Technical Advisory 5140.30 - *Use and Inspection of Adhesive Anchors in Federal-Aid Projects*

TOMIE Manual Chapter Synopsis

- Chapter 6 – Tunnel Data Management
  - Discuss tunnel data management.
  - Describe attributes of tunnel data management.
  - Discuss elements of tunnel data management: data storage (field condition documentation, element rating, maintenance recommendations), data reporting and tracking.
  - Provide tunnel management examples (*One DOT Tunnel Management System*, Pontis-based, others).

Source/Reference Documentation

- Chapter 6 – Tunnel Data Management
  - Task 261 – *Best Practices for Implementing Quality Control and Quality Assurance for Tunnel Inspection*
  - *ONE DOT Tunnel Management System (TMS)*, computer software, V1.0

TOMIE Manual Chapter Synopsis

- Chapter 7 – Training
  - Discuss tunnel training requirements.
  - Describe basic and refresher tunnel inspection training (civil/structural, mechanical and electrical).
  - Discuss tunnel manuals for training (TOMIE Manual, *Highway and Rail Transit Tunnel Inspection Manual*, *Highway and Rail Transit Tunnel Maintenance and Rehabilitation Manual*, and *NFPA 502 – Standard for Road Tunnels, Bridges, and Other Limited Access Highways*).

TOMIE Manual Chapter Synopsis

- Describe tunnel inspector qualifications (Inspection Program Manager, Inspection Team Leader, and Inspection Team Member).
- Inspectors need to be trained to inspect civil/structural, mechanical, electrical and other systems related to tunnels.
- Discuss training frequency and qualifications.
- Describe tunnel operations training (owner-specific, emergency responder plan, first responder awareness coordination).

Source/Reference Documentation

- Chapter 7 – Training
  - Task 261 – *Best Practices for Implementing Quality Control and Quality Assurance for Tunnel Inspection*
  - Task 276 – *Outline for Proposed Guidelines for Rehabilitation of Existing Highway and Rail Transit Tunnels*
  - *Highway and Rail Transit Tunnel Inspection Manual*

Source/Reference Documentation

- *Highway and Rail Transit Tunnel Maintenance and Rehabilitation Manual*
- *ONE DOT Tunnel Management System (TMS),* computer software, V1.0
- *NFPA 502 – Standard for Road Tunnels, Bridges, and Other Limited Access Highways*
- Tunnel Scan Executive Summaries (European and Domestic)
- National Bridge Inspection Standards (NBIS)
- Bridge Inspector's Reference Manual (BIRM)

TOMIE Manual Chapter Highlight

- Chapter 4 – Inspection
  - Inspection of Tunnels:

Chapter 4

4.0 Inspection

This chapter will discuss methods for inspecting tunnels, including inspection types and frequency; inspector qualifications and responsibilities; health and safety; planning, scheduling and equipment; survey control; inspection forms; inspection procedures; critical deficiency procedures; guidelines for condition ratings; condition codes; inspection documentation, reports; glossary; and references.

TOMIE Manual Chapter Highlight

- Chapter 4 – Inspection
  - Tunnel Inspection Staff:
    - Inspection Program Manager
    - Inspection Team Leaders
      - Civil/Structural Team Leader
      - Mechanical Team Leader
      - Electrical Team Leader
    - Inspection Team Members
      - Civil/Structural Team Member(s)
      - Mechanical Team Member(s)
      - Electrical Team Member(s)
      - Special Testing Agencies

TOMIE Manual Chapter Highlight

- Chapter 4 – Inspection
  - Types of Tunnel Inspections:
    - Initial Inspection
    - Routine Inspection
    - Damage Inspection
      - Impact Event
      - Fire Event
      - Flood Event
      - Seismic Event
      - Blast Event
    - In-Depth Inspection
    - Special Monitoring Inspection

TOMIE Manual Chapter Highlight

- Chapter 4 – Inspection
  - Inspection Frequency and Criticality Guidelines:
    - Initial Inspection – under review
    - Routine Inspection – under review
    - Structural – under review
    - Other Systems
      - Mechanical, Electrical, Hydraulic and Ventilation
      - At least as frequently as the tunnel structure
    - Risk-Based – petition FHWA based upon analysis
    - Minimum/Maximum:
      - Minimum = under review
      - Maximum based upon Risked-Based Analysis (see above)

TOMIE Manual Chapter Highlight

- Chapter 4 – Inspection
  - Qualifications of Inspection Personnel
    - Program Manager
      - Be a registered Professional Engineer or have at least 10 years of tunnel or bridge inspection experience
    - Team Leader
      - Be a registered Professional Engineer
      - Experience – under review
    - Team Member
      - Be trained in general tunnel or mechanical or electrical inspection requirements
      - Experience – under review

TOMIE Manual Chapter Highlight

- Chapter 4 – Inspection
  - Tunnel Health and Safety Issues:

While completing the inspection in a timely and efficient manner is important, safety is also a major concern in the field. Tunnel inspection is inherently dangerous and therefore requires continual watchfulness on the part of each member of the inspection team. Attitude, alertness, and common sense are three important factors in maintaining safety. To reduce the possibility of accidents, all personnel need to be concerned about safety.

- Personnel Safety
- Lockout/Tag-out
- Confined Space Entry
- Public Safety

TOMIE Manual Chapter Highlight

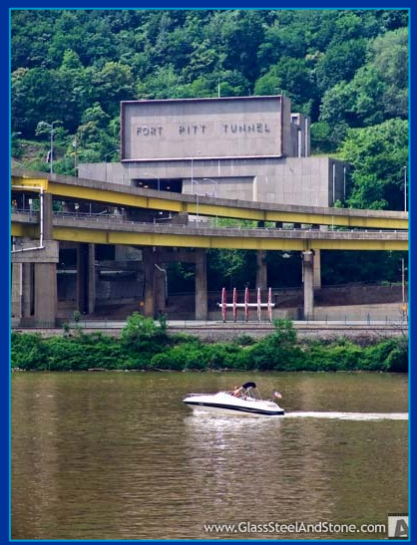
- Chapter 4 – Inspection
  - Tunnel Inspection Activities:
    - Planning, Scheduling and Equipment
    - Survey Control
    - Inspection Forms
    - Inspection Procedures
    - Critical Deficiency Procedures
    - Guidelines for Condition Ratings
    - Condition Codes
    - Inspection Documentation
    - Inspection Reports

Source/Reference Documentation

- Chapter 4 – Inspection
  - *Highway and Rail Transit Tunnel Inspection Manual*
  - Task 261 – *Best Practices for Implementing Quality Control and Quality Assurance for Tunnel Inspection*
  - National Bridge Inspection Standards (NBIS)
  - Bridge Inspector's Reference Manual (BIRM)

TOMIE Manual Status

- **Task Order 006 / Technical Directive 002:**
  - TOMIE Manual Workshop Submission (April 2010)
- **Task Order 006 / Technical Directive 003:**
  - TOMIE Manual Chapter 4 (50% Nov. 2010 / 95% March 2011)
  - TOMIE Manual Chapters 1, 2, 3, 5, 6 & 7 (50% March 2011)
  - TOMIE Manual Chapters 1, 2, 3, 4, 5, 6 & 7 (Final Sept. 2011)



Acknowledgements

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  - **Myint Lwin, P.E., S.E.** (Director, OBT)
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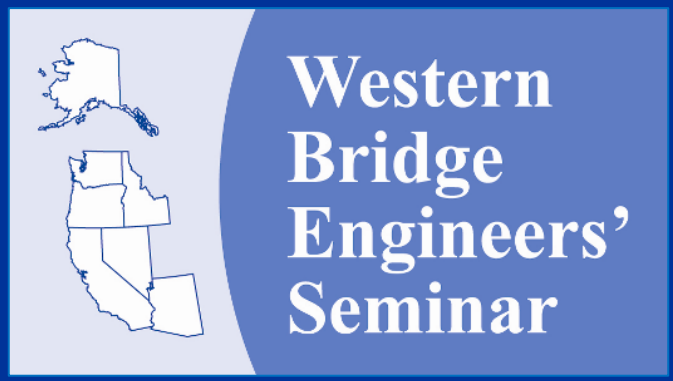
  - **Jesús M. Rohena, P.E.** (Task Manager)
- HDR Engineering, Inc. (IDIQ Contract)
  - **John Yadlosky, P.E.** (Contract Manager)



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Thank You!

HDR

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