

CHAPTER 2.5 – SAFETY

2.5.1 HEALTH & SAFETY PLAN

A movable highway bridge user or inspector is subject to the hazards common to fixed highway bridges, as well as safety hazards unique to movable bridges. The hazards that can occur during the inspection, operation or maintenance of a movable bridge should be understood and controlled prior to planning or conducting any activity involving the bridge. If a health and safety plan has been developed for the individual bridge or group of bridges to be inspected as outlined below in Section 2.5.4, all members of the inspection crew should receive a copy of the plan and should be required to read and understand the plan. The inspection team leader and/or other supervisory personnel should meet with the field crew prior to the start of work to discuss the plan sufficiently to determine that the crew understands the potential hazards that are unique to the structure(s) to be inspected. General health and safety plan information may be distributed in the same way or by regularly scheduled training courses. Untrained personnel should not be part of an inspection crew unless a specific program of on-the-job health and safety training has been completed. The following sections identify a number of potential personnel and public safety hazards, offer recommendations to minimize these hazards in the bridge environment, and provide guidelines to develop a bridge specific safety and health plan.

2.5.2 PERSONNEL SAFETY

The basic concerns for safety and health protection of bridge personnel should be addressed on three levels: (1) adherence to a set of straightforward rules and regulations designed to provide a safe and healthy work place; (2) an understanding of the actual hazards, as determined through a hazard assessment, involved at individual structures and the methods available to minimize the risk of injury or other undesirable consequences; (3) the development of a group of trained personnel and other problem response capabilities to minimize the effects of a hazard should an accident or unplanned event occur.

Personal Protective Equipment (PPE) is required while on a bridge. PPE can include a hard hat, ANSI Class II or III high visibility vest, adequate foot protection, eye protection, hearing protection, gloves, respirator, personal floatation device (PFD), and fall protection. Specific PPE may be required depending on the trade working on the bridge.

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The number of safety, health, and environmental standards associated with the inspection, operation and maintenance activities performed on a movable bridge cannot be readily organized into a format tailored to the diverse needs of each bridge owner. Bridge owners are encouraged to develop and implement a written plan specifically designed for their movable bridge inventory that identifies and minimizes specific safety and health hazards, addresses the well-being of operators, inspectors, maintainers, and the public, and provides contingency plans in case of personnel, public or bridge emergencies. Section 2.5.4 of this chapter is intended to assist the bridge owner in the development of such a program, and to provide an outline of the minimum guidelines.

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For a general discussion on bridge inspection safety equipment and clothing the reader is referred to Bridge Inspector's Reference Manual (BIRM) (Reference 69) and any bridge-specific safety plan as established by the state.

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2.5.2.1 OSHA and Standard Requirements

General requirements for safety and health standards in the work place have been developed by the Occupational Safety and Health Administration (OSHA) and are found in the Code of Federal Regulations (CFR) in Title 29 1910 (Reference 55). State OSHA regulations may have more stringent requirements than federal OSHA. Industry standards related to specific activities such as NFPA 70E for electrical safety, or as identified by Federal or state requirements by subpart.

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There are no specific OSHA requirements defined for maintenance activities, including bridge inspection. The OSHA regulations apply to all industries. OSHA provides useful guidance on the avoidance of hazards in the work place. In addition, there are state OSHA regulations that may have state specific requirements that are more stringent than Federal OSHA.

2.5.2.2 Hazard Assessment and Elimination of Personnel Hazards

Hazards result from potentially dangerous conditions that can exist on a movable bridge work site or the unsafe actions of personnel. Personnel accidents can be reduced through the identification of the specific conditions that lead to an unsafe situation, training, and by initiating corrective actions to promote a safe work environment. A job hazard activity assessment can help to identify the hazards and mitigations associated with the work being performed. Some examples of typical problems and corrective actions include:

- Inadequately trained inspection, operational and maintenance personnel do not use proper safety procedures while conducting their work.

Corrective Action: Institute movable bridge safety training programs to keep personnel up-to-date with recognized safety and health considerations. Involve the personnel in the hazard assessment process to help identify hazards and mitigation for their work activities. Conduct safety meetings prior to the start of an inspection or maintenance operation. Meeting agendas should cover bridge-specific safety practices, any unusual features or hazards of the individual bridge, and contingency plans in the event of an emergency.

- Inspectors and maintenance workers must often closely observe, touch or partially disassemble mechanical equipment (gears, shafts, bearings, motors, locks, etc.) during routine inspection. This presents an immediate hazard if the equipment is inadvertently activated or if stored energy is released during such work.

Corrective Action: Install lockout devices at the point of power disconnect for each trade/craft to prevent inadvertent bridge operation during inspection or maintenance. The team leader of each trade/craft or an authorized crew member should be responsible for setting the lock and

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Sources of personnel hazards can include: rigging, climbing or lifting equipment, moving machinery, confined spaces, tripping hazards, slippery conditions, petrochemicals and other potentially toxic substances. The typical problems and solutions presented in the text are intended to illustrate a number of common problems encountered on movable bridges and to provide guidelines on how such typical problems have been successfully corrected. It is not intended to provide a complete or exhaustive list of hazards and readers should not interpret the listed corrective actions as the only solution.

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determining that each crew member is safely located before removing the lockout devices.

- Discarded objects and debris (e.g. loose rust flakes, road gravel, bolt heads, scrap welding rods, pieces of lumber, empty paint cans, etc.) can accumulate on the structure. These objects are potential tripping or falling hazards, and may cause damage to open machinery.

Corrective Action: Extraneous objects and debris should be removed at the end of any repairs, lubrication or other contractual or maintenance work, and the structure should be regularly cleaned and inspected for loose parts, debris, and structural bolts by maintainers.

- Original catwalks, platforms, ladders and machinery room floors that are constructed of metal grating or wood may be near the end of their useful life in a harsh environment.

Corrective Action: Institute a program of regular inspection and maintenance of ladders, platforms, scaffolds and walkways. Do not use access platforms, catwalks, ladders etc. without properly inspecting the devices first.

- Inspection or maintenance of the bridge in dark or poorly lit areas exacerbates other hazards such as tripping or falling.

Corrective Action: Install permanent lighting or weatherproof electrical outlets for temporary lights. Where lighting or power is not permanently installed, be prepared to take in adequate lighting for the work involved.

- Lubrication or hydraulic oil, vital for maintaining the service life of moving parts, can cause slipping hazards on walking surfaces or ladders.

Corrective Action: Walking surfaces and ladders should be regularly cleaned. Maintenance workers or others performing lubrication work should be cautioned to clean up any spills or excess lubrication.

- Exposed, substandard, or deteriorated electrical conduits, wiring cabinets, or boxes create a potential shock hazard.

Corrective Action: Regular inspection and maintenance should identify and repair older systems. Replace, enclose, cover, or otherwise create an insulation or barrier between live electricity and workers as part of the bridge maintenance program.

- Many movable bridges were designed before OSHA safety rules and/or FHWA inspection standards were developed and have catwalks, ladders and other access provisions designed for maintenance, rather than inspection and are not in conformance with current, enlightened safety standards.

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Corrective Action: Install new permanently mounted access equipment and lifeline attachments to provide for safe inspection access as needed on each individual bridge. This can include the installation of safety cables, inspection walkways, mounting brackets for staging or scaffolding, anchored attachments for temporary safety cables or climbing ropes, etc. Regular inspection and certification of these devices is required prior to use.

- Several bridge locations are covered in pigeon excrement.

Corrective Action: These areas should be cleaned prior to maintenance and inspections.

2.5.2.3 Personnel Training Programs

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Inspectors, operators, and maintainers should be given comprehensive movable bridge safety training, as well as training on the equipment being used.

Regular instruction of inexperienced workers by supervisors and experienced co-workers can have a major impact upon the overall identification and elimination of hazards on movable bridge structures.

At present, no national training program exists. Some states have developed their own local programs. Local program courses should be based upon this Manual, References 55 and 69, and the specific requirements of the individual owners and work sites.

2.5.3 PUBLIC SAFETY

Public safety encompasses the use of accepted practices and adherence to national, state, and local standards that were developed in the interest of protecting pedestrian, vehicular, and navigational traffic. *The Manual of Uniform Traffic Control Devices* (MUTCD) and any state supplement should be used when planning traffic control.

2.5.3.1 Pedestrian And Vehicular Safety

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In the open position, a movable bridge creates a large opening in the roadway. Traffic should be stopped and held in a safe location prior to opening. Further, movable bridge openings can be an unexpected event for inattentive drivers. A proper system of warning devices, traffic guidance and control, and protective gates is basic to public safety. Traffic controls and advance warning devices must be visible over a long enough distance to provide for a safe stopping distance for the forward drivers and for the entire line of traffic that accumulates during a normal opening duration. On high traffic roadways (1,000 vehicles/hour/lane) accumulation of a large number of vehicles in a ten-minute opening will mean that the area where a stop is necessary may extend up to two or three thousand feet back from the traffic control gates in each lane.

It is not possible to list all of the complex eventualities that could lead to an unsafe condition on such structures, because each site and each structure have unique features of design, construction and maintenance that make most movable bridges unique. It is possible, however, to generalize a number of potential hazards to the bridge, the public and workers. These fall into a few general categories as follows:

System Error: *Item 1 is an example. The mechanism works in an unexpected and hazardous way.*

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Pedestrian and vehicular safety issues on movable bridges are varied and require identification and corrective action by experienced personnel. Examples of typical problems and corrective actions include:

- **Item 1.** Unexpected span motion can occur without setting off warning devices and traffic control.
Corrective Action: Inspectors and maintainers should give careful attention to testing and adjusting span balance on bascules and lift-spans and to checking tread plates on rolling-lift bascules and rim bearing swings for out of level surfaces. They should also file a deficiency report on any structures without positive mechanical locks or centering devices to hold the movable unit in the closed position. Such structures require special attention in order to prevent uncontrolled span motion.
- **Item 2.** Pedestrians, bicyclists, and some motorists have a tendency to try to “beat the light.”
Corrective Action: The sequence of lights turning red and traffic gates closing should be timed to avoid trapping or impacting stragglers within the traffic and/or resistance gates. In urban areas with high pedestrian, bicyclist or motorcycle usage of movable bridges it may become necessary to place an emergency stop button at critical locations and to station personnel at some or all four corners on the approaches. This is done to control traffic and prevent inadvertent damage to stragglers by implementing manual intervention via the emergency stop. Operator visibility is key to safe operation in such areas if the use of additional personnel is not feasible. The use of closed circuit television or other means may be advisable if direct vision is obstructed.
- **Item 3.** An uneven floor break area on movable bridges is a potential tripping hazard for pedestrians and can cause a loss of control of vehicles, bicycles, and motorcycles.
Corrective Action: High visibility yellow coatings and localized improvements in lighting can serve to alert the public crossing the floor break.
- **Item 4.** Many existing movable bridges have wooden plank sidewalks and open metal grid roadway decks that can have poor traction characteristics in wet or icy conditions.
Corrective Action: Wooden walkways can be painted with sand paint or other grit-type coatings that enhance traction and also increase the life of the planks by preventing moisture damage. Open metal grid can be grooved, studs added, or the deck can be replaced. Warning signs can be placed on the bridge approaches and variable message signs can be utilized to warn of poor road conditions in bad weather.

Human Error: Item 2 is an example. Humans do not react as anticipated during design, creating a hazard.

The recommended delay is intended to provide reaction time for drivers to notice that the lights have turned red prior to actuation of the traffic gates. This system works well where drivers observe traffic controls and are not prone to “run the light”. In some urban sites, it may be advisable to give the operator the option to lower gates immediately by bypassing the delay to prevent a line of drivers from “running the light” and thereby making it impossible to lower the gate. This is not a feature to be incorporated without due consideration of potential hazards, and should only be done after the owner has attempted to alter driver behavior by increasing law enforcement presence at the bridge to issue fines to vehicles “running the light”.

Built-in Condition: Item 3 is an example. An existing feature is inherently a potential hazard to the unwary. Some of these conditions are permanent and unavoidable in the short term; others can and should be corrected. All of these conditions are made safer if attention is drawn to them by bright colors, warning signs or other methods used to make users aware of the potential hazard.

Environmental Condition: Item 4 is an example. An existing condition is a hazard at times due to adverse environmental conditions such as fog, ice or snow. These conditions are just a special case of a built-in condition, but are harder to detect since they are intermittent.

Other examples of a few likely errors of each type include:

System error

- Operation of motors with brakes or locks not fully disengaged.
- Mechanical failure leading to uncontrolled motion.

Human error

- Operation of bridge with vehicles or pedestrians on the movable span.

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- *Failure to open the bridge soon enough to clear a vessel that cannot hold position due to currents.*

Built-in condition

- *Resistance gates and other roadside obstructions that are not protected by railings or attenuators.*
- *Poor sight distance to traffic controls on the approach roadways.*

Environmental condition

- *Bridge is not visible to mariners in poor visibility conditions such as rain or fog.*
- *Ice or snow accumulates on the movable span and adversely affects span balance, causing machinery overload.*

2.5.3.2 Navigational Safety Practices

Safety issues that should be considered by inspectors during on-site work relating to navigational guidance systems are covered in Chapter 4.5. Signals and signs should adhere to USCG, USACOE, and CFR regulations.

Navigational safety is a topic covered extensively in USCG and USACOE regulations and other documents.

The navigation equipment and aids to navigation on a bridge must meet USCG requirements, and are generally described by the USCG on the permit for each bridge. The requirements may be revised over time to accommodate changing usage and site conditions. The owner should review the navigation equipment present at the site for conformance with the permit and any revisions thereof.

The owner should notify the USCG of each incident involving a marine vessel impacting the bridge. Repetition of similar incidents may initiate a reaction by the USCG requesting modification of the navigation equipment.

In addition, any navigational lighting deficiency should be considered a condition that requires immediate repair.

2.5.4 BRIDGE-SPECIFIC SAFETY PLAN

A health and safety plan specific for movable bridges can enhance the general well-being and safety of bridge personnel and the general public, minimize unsafe or hazardous conditions, and provide personnel with guidelines for procedures and standard practices to be followed to avoid recognized hazards.

Movable bridge health and safety plans should be prepared as a supplement to any general health and safety plans owners

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Some owners prefer to develop a movable bridge health and safety plan for each individual structure, while others may choose to develop a general document to cover all their movable bridges.

Movable bridge safety is a complex subject. It is rare to find one source that contains the necessary combination of information and

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have in place. It is not necessary to duplicate material already covered elsewhere, but the existing plan and the supplement for movable bridges should, at a minimum, cover the following areas:

- Statement of general health and safety policies.
- Administrative responsibilities for implementing the safety plan: identification and accountability of personnel responsible for accident prevention, hazard assessment, and safety aspects of the movable bridge environment.
- Employee responsibilities for adherence to the health and safety plan.
- Means for controlling and checking on procedures used for inspection and maintenance activities of in-house personnel and outside entities.
- Procedures to be used to maintain safe access to various areas of the bridge.
- Procedures to be used for safety indoctrination of new personnel and continued safety training.
- Personnel protective equipment requirements for personnel involved in inspection, operation and maintenance.
- Provisions for periodic unscheduled inspections of bridge site to determine compliance with the plan.
- Responsibilities and procedures for reporting and investigating accidents, and unsafe or hazardous conditions.
- Contingency plans in the event of bridge shutdown due to hazardous structural, mechanical, electrical, or operating conditions.

experience to predict all possible hazards or to develop corrective measures for each bridge. The group developing bridge-specific health and safety plans should include representatives who are experienced in design, inspection, and maintenance as practiced by the owning agency and others who have a background in hazard assessment and safety programs. Health and safety plans should not be static documents, but rather should evolve to react to new information and problems. The plan should be reexamined and may need to be amended in response to any safety-related incidents.