

SECTION 753.4: Inspection Policy

This section of the BIRM provides the general policy for bridge and culvert inspections in Missouri, regardless of the ownership of the structure. This inspection policy applies to all structures that are part of the National Bridge Inventory (NBI) in Missouri. It may be used at the discretion of the owner for structures that are not part of the NBI.

Section 753.4.1: General Qualifications and Training

The qualifications and training required for the various members of an inspection team will vary depending upon which system (state or local) is being inspected as well as the type of inspection that is being performed. The policies that apply to the different inspection types are covered in the sections that follow. The definitions listed below are provided to aid in the discussion of the requirements presented in this section.

Section 753.4.1.1: Definitions

Bridge Inspection Related Experience—Bridge experience that is not directly related to the actual inspection of structures in accordance with NBIS regulations. Examples would include but not necessarily be limited to design of bridges, maintenance/repair of bridges, detailing of bridges, and construction inspection of bridges.

Damage Inspection—Inspection performed on structures after some type of event (such as vehicular collision) has resulted in damage to a structure.

Data Collection Inspection—Non-NBIS related field visit done to collect or update data that is kept as part of the management and operation of a bridge.

Fracture Critical Inspection—Detailed inspection performed on the members of a bridge that are determined to be fracture critical. A fracture critical member would be a steel structural member in axial tension or with some element in tension whose failure would result in the partial or total collapse of the bridge. The 2022 update to the NBIS regulations changed from using fracture critical terminology to calling these members Nonredundant Steel Tension Members (NSTM). For the purpose of MoDOT practice and data systems, NSTM and Fracture Critical should be considered to mean the same thing.

In-Depth Inspection—A close-up more detailed inspection performed on elements of a structure to identify problems that may not be easily detected during a normal routine inspection. This may include visual only observations or the use of non-destructive inspection techniques to better assess the condition of an element. This inspection may be done in conjunction with a routine inspection, or it may be done outside of the normal routine inspection schedule at an interval that is different than the routine inspection.

Initial/Inventory Inspection—Inspection performed on a new structure to assess conditions and collect inventory data when the structure is completed and open to traffic. The inspection may also be done after the completion of a major rehabilitation whenever the normal scheduled routine inspection is more than three months from the completion of the rehabilitation project. For the purposes of the various requirements in this manual, Initial or Inventory Inspections will be considered Routine Inspections.

Inspection Team Member—An individual that is participating on an inspection team but is not participating in recording of conditions or assignment of condition ratings. This person will typically be present for safety reasons. For the nonstate system, the local agency representative that goes along on inspections would be considered a Team Member.

Inspection Experience—Time spent performing actual inspections on structures in accordance with NBIS regulations. This time will include actual field inspection as well as the time necessary to document and enter data in computer systems and address questions and problems related to the inspection.

Inspector—An individual that has been trained to inspect bridges and culverts in accordance with NBIS regulations but does not meet the requirements of a Team Leader. This person may be assisting with the recording of conditions and the assignment of condition ratings on a structure during an inspection and under the direction of a Team Leader.

Inspector Diver—An individual that possesses the appropriate training and experience to be able to perform Deep Wade or Dive underwater inspections on bridge and culvert structures in accordance with NBIS regulations to assess the condition of components of a structure that are under water and to assign condition ratings based on the findings of the inspection. This person would be designated as the diver for the underwater inspection.

Nonredundant Steel Tension Member (NSTM) Inspection—The 2022 NBIS regulation update switched to using this term for fracture critical inspections. The primary difference is that NSTM allows for a more detailed look at the redundancies that a member may have, which include internal, system, and load path. A detailed engineering analysis could be completed on structures to prove that redundancies are present that would prevent a full or partial collapse of a structure from a member failure, which would allow the state to not perform the “hands on” inspection required for fracture critical members. With the age and makeup of the fracture critical bridges in Missouri as well as the cost of performing this type of detailed engineering analysis, MoDOT will stick with the more traditional definition of a fracture critical member and perform inspections likewise.

Nonstate System—The structure is owned and maintained by another public agency other than MoDOT, with the most common owners being cities, counties, and road districts.

Outfall Inspection—Non-NBIS inspection related to storm water issues that is done to monitor specific structures for environmental purposes. This inspection type is only applicable to state system structures.

Program Manager—Person in charge of the bridge inspection program in Missouri to ensure that inspections are being completed in accordance with NBIS regulations.

Quality Control/Quality Assurance Inspection—Inspection or field review done to assess the accuracy and quality of inspection work that is being done by various individuals on a structure. An inspection may include a complete review of the previous inspection on a structure, or it may include a review of selected inspection or inventory items.

Routine Inspection—General inspection performed on a bridge or culvert to assess the condition of the various components of a structure and assign overall condition ratings, where appropriate.

Safety Diver—An individual that participates for safety reasons in a Deep Wade or Dive underwater dive inspection on a structure. This person would not be directly involved in the assessment of conditions and the assignment of condition ratings for the portions of a structure that are under water.

Scour Monitoring Inspection—Inspection done on scour critical bridges to review or monitor the structure for scour during or after a flood event. This inspection should be done in accordance with the requirements in the scour action plan.

Service Inspection—Interim inspection completed between extended interval routine inspections whenever the extended interval is based on Method 2 in the NBIS regulations for determining Risk Based Inspection intervals. Missouri won't be implementing Method 2 for Risk Based Inspections, so this type of inspection is unlikely to be performed in Missouri.

Special Inspection—A special inspection used to review/monitor an individual element of a structure outside of a normally scheduled routine inspection. Special Inspections also may be scheduled in lieu of a reduced interval routine inspection. This type of inspection shouldn't be used in lieu of a reduced interval fracture critical inspection without explicit approval from the Program Manager.

State System—The structure is owned and maintained by MoDOT. In some situations, a structure that is not owned by MoDOT may be inventoried on the state system because the structure crosses MoDOT right of way and has an impact on traffic that is traveling on a MoDOT roadway.

Team Leader—An individual that possesses the appropriate training and experience to serve as the lead inspector on bridge and culvert inspections done in accordance with NBIS regulations.

Underwater Inspection—Detailed inspection performed on the substructure elements of a structure that are either directly in the waterway or are adjacent to the waterway, but close enough that normal stream flow activity has a direct impact on that element of the structure. These inspections will be performed using some combination of visual techniques, wading/probing techniques, diving techniques, depth soundings, or other appropriate techniques.

Section 753.4.1.2: Qualifying as a Team Leader—Routine Inspections

Federal law defines the requirements for a person to qualify as a Team Leader for the purpose of performing inspections on bridges and culverts. To qualify as a Team Leader, the person must possess the appropriate combination of experience and training as outlined below. To maintain Team Leader status, an individual must satisfy the continuing training requirements and any continuing experience requirements as presented in this section.

To be certified as a Team Leader for performing inspections in Missouri, the person must submit their qualifications along with the appropriate documentation to the Program Manager for review and approval prior to acting as a Team Leader on an inspection. It shall be the responsibility of each individual Team Leader to ensure that they are meeting the requirements of this section and provide the Program Manager with the appropriate documentation to verify that they meet Team Leader requirements.

Section 753.4.1.2.1: Initial Training Requirement

To be certified as a Team Leader, a person must successfully complete an FHWA approved comprehensive bridge inspection training course. In Missouri, this comprehensive training class requirement is met by taking the 2-week bridge inspection training class: *NHI 130055-Safety Inspection of In-Service Bridges*. For licensed professional engineers, this training requirement may also be met by taking *NHI 130056 Safety Inspection of In-Service Bridges for Professional Engineers*.

Section 753.4.1.2.2: Initial Experience Requirements

A. Professional Engineer—Licensed professional engineers and licensed structural engineers are required to have six months of bridge inspection related experience to qualify as a Team Leader. This bridge inspection related experience should include time performing bridge inspections with the exact makeup of the six months of experience at the discretion of the Program Manager.

Licensed PE's or SE's shall provide a copy of their PE or SE license to the Program Manager when submitting qualifications for Team Leader certification. Additionally, information on their bridge inspection related experience should be provided to the Program Manager for review. If an individual allows their PE or SE license to lapse, they should contact the Program Manager before performing any inspections to get confirmation that they would still meet the experience requirements to be Team Leader certified.

B. Engineer in Training—To qualify as an engineer in training, an individual must have a degree in engineering or engineering technology from an institution that is accredited by the Accreditation Board for Engineering and Technology (ABET). Additionally, they must have successfully taken the *Fundamentals of Engineering Examination* (EIT), which is offered by the National Council of Examiners for Engineering and Surveying. To qualify as a Team Leader, an EIT must have two years of experience with a minimum of one year being actual inspection experience and the remaining being bridge inspection related experience. A copy of their EIT certificate along with details about their experience should be provided to the Program Manager when submitting qualifications for Team Leader certification.

C. Technicians—To qualify as a technician, an individual must have an associate's degree or greater in engineering or engineering technology from an institution that is accredited by the Accreditation Board for Engineering and Technology (ABET). To qualify as a Team Leader, a technician must have four years of experience with a minimum of two years being actual inspection experience and the remaining being bridge inspection related experience. A copy of their diploma or some type of transcript along with details about their bridge experience should be provided to the Program Manager when submitting qualifications for Team Leader certification.

D. Non-Degreed—Individuals that don't fall into one of the three categories listed above may have experience that would allow them to become a Team Leader. To qualify as a Team Leader, they must have five years of experience with a minimum of 2-½ years being actual inspection experience and the remaining being bridge inspection related experience. Details about their experience should be provided to the Program Manager when submitting qualifications for Team Leader certification.

Section 753.4.1.2.3: Continuing Training Requirements

To remain certified as a Team Leader, a person must successfully complete some type of bridge inspection refresher training totaling 18 hours every five years. In Missouri, this refresher training requirement will typically be met by taking the 3-day bridge inspection refresher training class—*NHI 130053-Bridge Inspection Refresher Training*. This requirement can also be met by re-taking the 2-week NHI bridge inspection class or the 1-week NHI bridge inspection class for professional engineers. Bridge inspection refresher training classes sponsored by other states or organizations entities may also meet the intent of this requirement when they have been approved by FHWA as an

alternate training class. Documentation showing approval of the alternate training must be provided to the Program Manager when utilizing this option. It will be the responsibility of the Team Leader to provide copies of certificates from refresher training classes to the Program Manager as proof that this continuing training requirement is being met.

Section 753.4.1.2.4: Continuing Experience Requirements

It is recommended that all Team Leaders maintain an active bridge inspection status through participation in some bridge inspections or other aspects of the bridge inspection program each year. Individuals that are Team Leader qualified but have not participated in any bridge inspections or other aspects of the bridge inspection program for more than a year should contact the District Bridge Engineer or the Bridge Management Engineer for discussion of their most recent inspection experience and guidance on whether they need to spend some time with a currently active Team Leader prior to performing inspections again as a Team Leader. If there have been significant changes in the bridge inspection program since the person last inspected, they may be required to spend some time with a current Team Leader before they can resume inspecting as a Team Leader.

Section 753.4.1.3: Qualifying as an Inspector

An Inspector will be serving on an inspection team under the guidance of a Team Leader. There are no experience requirements for a person to qualify as an Inspector. However, to qualify as an Inspector, the person must complete the training requirement of EPG 753.4.1.2.1. If an Inspector has the goal of eventually becoming Team Leader qualified, then they should be keeping track of the amount of inspection experience that they are gaining each year as this will need to be submitted whenever they request to be Team Leader certified by the Program Manager.

Section 753.4.1.4: Qualifying as Inspection Team Member

Inspection Team Members for a bridge inspection will typically be participating for safety reasons, or assisting with aspects of the inspection that one person is not able to perform. There are no specific training or experience requirements for an Inspection Team Member. However, if there is any training that would be beneficial for the role that they are undertaking on the inspection team, then it is recommended that they complete this training.

Section 753.4.1.5: Qualifying as an Inspector Diver

The 2022 update to the NBIS regulations established a minimum training requirement for inspectors that are performing inspections that require a Diver. For the purposes of this section, MoDOT classifies these individuals as an Inspector Diver. In Missouri, this new NBIS requirement would apply to underwater inspections that are categorized as a Deep

Wade or Dive. This requirement wouldn't apply to underwater inspections categorized as Dry or a Shallow Wade.

Individuals that were actively performing as an Inspector Diver prior to June 6, 2024, can meet this training requirement by showing proof that they successfully completed either *NHI 130055-Safety Inspection of In-Service Bridges* or *NHI 130091-Underwater Bridge Inspection*. The course completion dates for either of these courses must be prior to June 6, 2024, and the individual must provide to the Program Manager a copy of the course completion certificate and information demonstrating that they were acting as an Inspector Diver prior to this date.

New individuals that desire to act as an Inspector Diver on underwater inspections after June 6, 2024, can only meet this training requirement by showing proof that they successfully completed *NHI 130091-Underwater Bridge Inspection*. The individual must provide a copy of the course completion certificate to the Program Manager for review and approval.

MoDOT employees acting in the capacity of an Inspector Diver or a Safety Diver must successfully complete a training course to obtain a *PADI Certification-SCUBA-Open Water* and the individual must pass a yearly physical in accordance with MoDOT requirements and comply with any other MoDOT requirements that have been established.

Consultant personnel that are performing underwater dive inspections for MoDOT must meet the NBIS regulation training requirements as specified above in addition to what is specified in the contract. Diving operations shall be conducted in conformance with *29 CFR, Part 1910 - Occupational Safety and Health Standards, Subpart T - Commercial Diving Operations*.

At least one individual involved in the diving operation on Deep Wade or Dive underwater inspections must be a Team Leader in accordance with the requirements defined in EPG 753.4.1.2. The Team Leader is not required to also be an Inspector Diver if they are not actively participating in that capacity during the inspection.

Section 753.4.1.6: Qualifying as a Safety Diver

Individuals participating in an underwater inspection only as a Safety Diver shall meet the requirements of EPG 753.4.1.5 with the exception that they do not have to meet the requirements of EPG 753.4.1.2 or EPG 753.4.1.3.

Section 753.4.1.7: Other Training and Qualification Requirements

The following sections detail additional training that is either available or required for specific inspection types. This section also provides more detail on any additional qualifications that are needed for performing the various inspection types. All these

additional training and qualification requirements can be waived at the discretion of the Program Manager except for the additional requirements on fracture critical inspections which are required by NBIS regulations. The Program Manager may also approve alternative training classes as satisfying these requirements in lieu of the specific NHI classes mentioned in this section.

Section 753.4.1.7.1: Fracture Critical Inspections

The individual that is acting as the Team Leader on a fracture critical inspection is required to have successfully taken either the older class *NHI—130078-Fracture Critical Inspection Techniques for Steel Bridges* or the recently updated and renamed class *NHI—130078-Bridge Inspection Techniques for Nonredundant Steel Tension Members (NSTM)*. After June 6, 2024, this training is mandatory for all Team Leaders on fracture critical inspections. This requirement is in addition to the normal Team Leader requirements for bridge inspections defined in EPG 753.4.1.2.

It is recommended that the other members of the inspection team complete this training class if they are directly participating in the assessment of the condition of the structure. For Team Leaders that took the older version of *NHI-130078*, it is recommended that they complete the web-based NHI training course: *130078A-Bridge Inspection Techniques for Nonredundant Steel Tension Members Refresher*, which is accessible at no cost on the NHI website.

Section 753.4.1.7.2: Special Inspections

Special inspections will typically be conducted using techniques similar to what is needed during a routine or fracture critical inspection and require that a Team Leader be present during the inspection. Individuals should either meet the training and experience requirements for routine inspection or for fracture critical inspections, as appropriate for the type of inspection work and the role they will be undertaking while performing the inspection.

Section 753.4.1.7.3: In-Depth Inspections

Individuals performing an in-depth inspection on a structure shall meet the same experience and training requirements for Team Leader and Inspectors as outlined for routine inspections.

Section 753.4.1.7.4: Underwater Inspections

It is recommended that the individual that is acting as the Team Leader on Deep Wade or Dive underwater inspections has successfully completed *NHI—130091-Underwater Bridge Inspection*. It is also recommended that the other members of the inspection team complete this training class if they are directly participating in the assessment of the condition of the structure and are not participating as an Inspector Diver.

Section 753.4.1.7.5: Damage Inspections

It is recommended that individuals performing a damage inspection be Team Leader certified. In some emergency type situations, a Team Leader may not be available to perform a damage inspection. When these situations happen, the person performing the inspection should have a bridge related background and should be in direct contact with the District Bridge Engineer to discuss their findings and receive direction on how to proceed. In the absence of the District Bridge Engineer, the individual may contact one of the following Bridge Division personnel: Supervising Bridge Inspection Engineer, Bridge Management Engineer, Structural Resource Manager, Assistant State Bridge Engineer, State Bridge Engineer, or one of the Structural Liaison Engineers.

Section 753.4.1.7.6: QC/QA Inspections

Individuals participating in quality control/quality assurance inspections should have qualifications consistent with the tasks that they are performing. If the purpose of the inspection is to assess aspects of one of the other types of inspections performed on a structure, then the persons doing this inspection should generally meet the requirements for the inspection type that they are reviewing. No minimum qualifications are required when the purpose of the inspection is to review or verify geometric/location data or other bridge inventory related data on a structure.

Section 753.4.1.7.7: Service Inspections

MoDOT won't be implementing Method 2 for Risk Based Inspection Intervals as defined in the NBIS regulations. In the event that this method is later adopted, the individuals performing service inspections should meet the same requirements for individuals performing routine inspections.

Section 753.4.1.7.8: Data Collection Inspections

There are no training or experience requirements for individuals doing a field visit to a structure to collect new or updated data that is kept for the management or operation of a bridge.

Section 753.4.1.7.9: Outfall Inspections

There are no training or experience requirements for individuals performing outfall inspections on structures. However, they should possess the knowledge to be able to identify outfalls and properly assign a classification to any defined outfalls.

Section 753.4.1.7.10: Scour Monitoring Inspections

There are no training or experience requirements for individuals performing scour monitoring field visits on scour critical bridges during or after a flood event. The District Bridge Engineer will be responsible for ensuring that any individual actively engaged in monitoring a scour critical structure during a flood event understands the items that need to be monitored and the documentation needed to demonstrate that the monitoring took place.

Section 753.4.1.8: Inspection Team Makeup—Nonstate System

For safety reasons, the inspection team shall consist of a minimum of two people, with one of those individuals being a Team Leader. For inspections performed by MoDOT personnel, the local agency will be required to provide a person to participate in these inspections. This person provides the second person needed for safety reasons and provides someone that is knowledgeable about the county or city and can assist with locating structures as well as answering general questions that the inspector may have about a particular structure or about the topography of the area. For inspections performed by consultants, it is recommended that a representative of the local agency participate in the inspections, but it is not required. The person provided by the local agency to participate in inspections should meet the training and experience requirements defined in EPG 753.4.1.2 that are appropriate for their level of participation in the inspection. In most situations, the local agency participant will not be required to have any experience or training.

Section 753.4.1.9: Inspection Team Makeup—State System

Typically, inspection teams should consist of a minimum of two people, with one of those individuals being a Team Leader. In situations where an inspection can't be safely performed with only two people, the number of people required to safely perform the inspection should be predetermined by the Team Leader and be present during the inspections.

Section 753.4.1.10: Inspection Team Makeup—Consultant Inspections

For some situations, consultants may be hired to perform inspections. The consultant may be hired by MoDOT, or they may be hired by a local agency. A Team Leader is required to be on site for all consultant performed inspections. Other individuals on site during the inspection shall meet the qualifications defined in this section that are appropriate for their role during the inspection.

For some specialized situations, a company or consultant specializing in material testing or evaluation may be hired to perform a specific function. A good example of this situation would be a company that is hired to come in and do ultrasonic testing on pins. In these situations, the company that is hired to provide this service will not have to meet

the qualifications outlined in this section provided there is someone meeting these requirements from the local agency or MoDOT present during the inspection. In situations where this company is contracted to provide this service by a prime consultant that is under contract with MoDOT or a local agency, the prime consultant will be required to have someone present at the site that meets the requirements of this section while the specialized service is being provided.

Section 753.4.1.11: Inspections Requiring a Team Leader on Site

In accordance with federal law, a Team Leader qualified person must be present at all times for some inspection types. The inspection types that this applies to are Routine, Initial/Inventory, Underwater, Fracture Critical, Special, and In-Depth.

Section 753.4.1.12: Additional Training/Qualification Suggestions

Individuals actively involved in the inspection of bridges and culverts are encouraged to act on opportunities to further enhance their knowledge about inspections as well as learn about new technology that is available to assist them with inspections. The following NHI classes are suggested for the inspector to further enhance their skills.

NHI—130054-Engineering Concepts for Bridge Inspectors

NHI—130101-Introduction to Safety Inspection of In-Service Bridges (Web Based Training)

NHI—130101A-Prerequisite Assessment for Safety Inspection of In-Service Bridges (Web Based Assessment)

NHI—130087-Inspection and Maintenance of Ancillary Highway Structures

NHI—130129-Bridge Construction Inspection

NHI—130091B-Underwater Bridge Repair, Rehabilitation and Countermeasures

NHI—130099-Bridge Inspection Non-Destructive Evaluation Showcase

NHI—134029-Bridge Maintenance Training

NHI—135046-Stream Stability and Scour at Highway Bridges

NHI—135047-Stream Stability and Scour at Highway Bridges for Bridge Inspectors

NHI—135048-Countermeasure Design for Bridge Scour and Stream Instability

NHI—130110-Tunnel Safety Inspection

NHI—130125-Tunnel Safety Inspection Refresher

NHI—130124-Tunnel Safety Inspection Refresher Prerequisite (Web Based)

NHI—130078A-Bridge Inspection Techniques for Nonredundant Steel Tension Members Refresher (Web Based)

NHI—130112C-NDE for Timber and Other Material Bridge Elements (Web Based)

NHI—130112A-NDE for Concrete Bridge Elements (Web Based)

NHI—130112B-NDE for Steel Bridge Elements (Web Based)

NHI—130111-Nondestructive Evaluation Fundamentals for Bridge Inspection (Web Based)

Other opportunities are available for individuals to further enhance their knowledge related to structural matters. This includes non-NHI courses as well as seminars and conferences put on by MoDOT and other entities. The *Midwest Bridge Working Group* meeting held each year is a good opportunity to gain knowledge on inspections and interact with inspectors from other states. MoDOT also typically holds a statewide *Bridge Inspection Meeting* each year, which is typically attended by the District Bridge Engineers, but is open to other MoDOT inspectors as well. Other MoDOT training classes are periodically scheduled and will be communicated to the DBE's when they are being offered. In some cases, a MoDOT training class may require mandatory attendance for some or all inspection related personnel. If a training class has mandatory attendance, this requirement will be communicated to the individuals that are required to attend.

EPG 753.4.2: Inspection Intervals

The National Bridge Inspection Standards (NBIS) are federal regulations that define requirements for bridge inspections on structures that are part of the National Bridge Inventory (NBI). The regulations define the various types of inspections that must be performed on NBI length structures and layout the requirements for the intervals for each inspection type. The inspection intervals defined in the regulation vary based on the inspection type as well as the condition of the structure. This section provides guidance on MoDOT's policies and procedures for ensuring that all inspections are completed within the designated inspection intervals so that they comply with NBIS regulations. These policies will apply to all MoDOT owned structures as well as locally owned structures that are on the NBI, unless otherwise specified.

EPG 753.4.2.1: Risk Based Methods for Inspection Intervals

The 2022 update to the NBIS regulations allows for the use of a risk-based approach for determining inspection interval requirements for Routine, Underwater, and Fracture Critical inspections. The regulations define two methods that can be used: Method 1 or Method 2.

Method 1: This method uses a simplified approach for determining inspection intervals. Requirements and the data items used for determining the inspection intervals are defined in the regulation for the applicable inspection types. Missouri has adopted this simplified approach for determining regular, reduced, and extended inspection intervals.

Method 2: This method uses a more rigorous approach for determining inspection intervals. This approach requires states to have a risk assessment panel that establishes criteria for classifying bridges into one of four groups. The inspection interval would be established based on the group a structure was assigned to. Detailed requirements for the various items to be considered are provided in the regulation and the approach used by the panel must be approved by FHWA. Even with an approved approach for assigning inspection intervals, the regulation requires states to complete service inspection on structures in between the normal extended inspection intervals. FHWA also requires states to setup criteria for service inspections and qualifications for the individuals performing the service inspection. Although this approach does provide desirable options for extending inspection intervals to better fit with the risk profile on structures, the positive benefits of this approach are eliminated by the service inspection requirements. As a result, Missouri will not use Method 2 for determining inspection intervals on structures within the state.

EPG 753.4.2.2: Complying with Inspection Interval Requirements

The District Bridge Engineers (DBE) are responsible for ensuring that all structure inspections that are the responsibility of the district are completed in a timely manner. For local agency owned structures that are inspected by the local agency, the DBE is

responsible for working with the Program Manager to ensure that the structures are inspected on time. For structures that are the responsibility of the Bridge Division, Dive Team, or Consultant Contract, the Program Manager will be responsible for ensuring that the inspections are completed in a timely manner.

The general deadline for completing a given inspection will be the previous inspection date plus the inspection interval. An inspection will be considered compliant with inspection interval requirements when it is completed in the month that the inspection is due or within inspection interval tolerances defined in the NBIS regulations.

There are standard reports available in TMS that DBE's can use to track the upcoming inspection due dates for structures within their district. Bridge Division also produces monthly compliance reports showing inspections that are due within the next 60 days and inspections that show as overdue. The areas responsible for the different bridge inspections should review the monthly compliance reports every month to ensure they are completing all inspections on time.

EPG 753.4.2.3: Inspection Interval Tolerances

The 2022 update to the NBIS regulations established tolerances for inspection intervals. The tolerances are tied to the established interval, inspection type, and the condition of the structure. Structures inspected within this inspection interval tolerance are considered compliant with NBIS regulations. Structures inspected outside of the inspection interval tolerance are considered non-compliant with NBIS regulations and will result in Missouri being assessed as non-compliant during the yearly review that FHWA completes on the inspection program in Missouri.

In general, the inspection interval tolerance for inspections with an interval that is greater than or equal to 24 months will be three months. For inspections with an interval that is less than 24 months, the inspection interval tolerance will be two months. The acceptable inspection interval requirements are defined for each inspection type later in this section.

EPG 753.4.2.4: Delinquent Inspection Requirements

For the inspection program in Missouri, the expectation is established that all inspection shall be completed within the designated inspection interval and the applicable inspection interval tolerance in the NBIS regulations for each inspection type. When the District Bridge Engineer or Bridge Division staff determine that a structure inspection will be completed outside of the inspection interval tolerance, the Program Manager shall be immediately notified so that they can communicate the situation to FHWA. The communication about the delinquent inspection to the Program Manager shall happen two to three weeks in advance of the delinquency happening to allow the Program Manger time to discuss the issue with FHWA.

With proper planning and scheduling of inspections, extreme weather, safety issues, schedule optimization, and inspection quality concerns should never result in an inspection being delinquent. Basically, all structures will have a three or four month window for an inspection to be completed and still be compliant with NBIS regulations. As a result, delinquent inspections should be rare.

At the present time, the only approved situation for an inspection to be completed outside of the inspection window is when a structure is open and under construction in a manner that doesn't allow any portion of a bridge inspection to be safely completed. This situation should be reported to the Program Manager as soon as it is known by the area in charge of the inspection. After review of the submitted information, the Program Manager will provide direction on how to proceed.

When inspections become delinquent, documentation of the issues that will result in the delinquency shall be included either in the TMS Media for a structure or as a general comment on the impacted inspection type coded within the TMS data system.

EPG 753.4.2.5: Data Entry Requirements

The 2022 NBIS update also established a timeline for data entry after inspections are completed. Information on completed inspections needs to be entered into the TMS data system within 90 days of the inspection being completed. This applies to all inspection types that are reported on the NBI. Beginning with the 2026 data submittal to FHWA, one of the data items that will be reported is the Data Update Date. Failure to comply with the 90-day update timeframe may result in a non-compliance finding for Missouri on the annual inspection program review done by FHWA.

EPG 753.4.2.6: New and Rehabilitated Structures

New structures are required to have an initial inspection completed within 90-days of the structure opening to traffic. Existing structures that have a major rehabilitation completed shall have a routine inspection completed on the structure within 90-days of the completion of the rehabilitation project.

Newly built structures that can be classified as fracture critical shall have the first fracture critical inspection completed within 12-months of the structure opening to traffic. For structures that are rehabilitated, and the rehabilitation includes modifications to a fracture critical member, a new fracture critical inspection shall be completed within 12 months of the rehabilitation project being completed. Since these structures will typically require an initial inspection with 90-days of the project being completed, the fracture critical inspection should be completed in the same timeframe as the initial inspection.

Newly built structures that are over waterways and have stream characteristics that would require a Deep Wade or Dive underwater inspection, an underwater inspection shall be completed within 12 months of the structure opening to traffic. For structures that

require Deep Wade or Dive underwater inspections and have a rehabilitation completed that involves portions of the substructure units that are below the waterline, a new underwater inspection shall be completed within 12 months of the rehabilitation project being completed.

EPG 753.4.2.7: Routine Inspection Intervals

Once an initial inspection is completed on a new structure or a structure that has undergone a major rehabilitation, the next inspection on the structure will be classified as a routine inspection. NBIS regulations establish a default interval for the completion of routine inspections. The regulations also establish minimum requirements for reduced interval routine inspections and extended interval routine inspections. The following sections define the interval requirements for routine inspections. Additionally, the acceptable tolerance for completion of a routine inspection in compliance with NBIS regulations is provided. The inspection due date will be the previous inspection date plus the inspection interval.

EPG 753.4.2.7.1: Default Routine Inspection Interval

The default interval for routine inspections is 24 months for structures that don't meet the criteria to require a reduced interval routine inspection. Inspections should be completed in the 24th month. Inspections can be completed in the 25th, 26th, and 27th months and still be compliant with NBIS regulations. Inspections outside of the 24th month should not be a common occurrence, and the tolerance months shouldn't be used as a method to extend inspection timelines on a regular basis.

Routine Inspection Default Interval Requirements	
Default Interval	Compliant Inspection Range
24 th Month	24 th thru 27 th Months

EPG 753.4.2.7.2: Reduced Interval Routine Inspections

NBIS regulations section 650.311 establishes the minimum requirements for reduced interval routine inspections. For inspections with intervals less than 24 months, the compliance tolerance is two months instead of three months. Missouri has adopted this same requirement, which establishes a maximum inspection interval of 12 months for all structures meeting the criteria in the regulation. Inspections should be completed in the 12th month but can be completed in the 13th and 14th months and be compliant with NBIS regulations. When a structure requires a reduced interval routine inspection because of localized deficiencies, inspectors have the option of coding a special inspection to focus on the members with the localized deficiencies. Structures with widespread general deterioration that places a structure in the reduced interval category should have routine inspections done at the reduced interval instead of special inspections.

Routine Inspection Reduced Interval Requirements	
Maximum Interval	Compliant Inspection Range
12 th Month	12 th thru 14 th Months

Reduced Interval Required (Meets one or more)	
Deck Rating	≤ 3
Superstructure Rating	≤ 3
Substructure Rating	≤ 3
Culvert Rating	≤ 3
Scour Rating	≤ 3

EPG 753.4.2.7.3: Extended Interval Routine Inspections

NBIS regulations section 650.311 provides options for states to implement extended interval routine inspections. The option chosen by Missouri is Method 1, which would allow the use of a 48-month inspection interval on structures that meet the criteria established by the state. The regulation provides for the minimum requirements that each structure must meet, and states are allowed to establish additional requirements that must be met for a structure to be eligible for the 48-month inspection interval.

Structures that have been switched to an extended interval routine inspection are still subject to regularly scheduled other inspections that may be required since the extended interval only applies to the routine inspection. Required fracture critical, special, in-depth, and underwater inspections should all be done in accordance with the guidelines established in EPG Section 753.4.2.

Each year after the NBI submittal, Bridge Division will review all structures that are currently being inspected with an extended frequency to verify that they are still eligible for the extended frequency inspection. This review will be based on the NBI, SNBI, and other criteria designated in this section. A listing of structures no longer eligible for the extended frequency will be generated and distributed to the District Bridge Engineers. These bridges will be switched to a 24-month inspection frequency at that time using an automated process. When this switch happens, the District Bridge Engineers should schedule and complete the newly required inspections as soon as practical.

Bridge Division will also generate a listing each year of structures that are eligible to be inspected with an extended routine inspection frequency. This listing will be provided to the District Bridge Engineers for their review and consideration. The use of extended routine inspection frequencies will be at the discretion of the District Bridge Engineer and will not be mandatory. When reviewing the listing, the District Bridge Engineers need to determine if there are any other factors that would preclude a structure from being a candidate for the extended inspection frequency. Additionally, as part of normal inspection process the inspectors should be looking for structures that have vehicular

collision damage since this would preclude the structure from being eligible for extended frequency inspections.

Major bridges are not eligible for extended frequency routine inspections, which is captured with the length limit in one of the criteria tables listed below. Many major bridges have high traffic volumes, have more complex construction details, or are over major water bodies, so the best practice will be to inspect these structures at regular or reduced interval inspections because of the importance of these structures.

At the present time, locally owned structures will not be eligible for extended interval routine inspections. Eligibility of these structures will be reviewed at some point in the future after the SNBI is fully implemented on the structure inventory data for Missouri.

The sections and tables below define the requirements for structures to be eligible for routine extended interval inspections. Since many inspectors are not familiar with the new SNBI requirements, the tables present eligibility requirements based off the old NBI data and the new SNBI data. The NBI references will eventually be removed from the tables after SNBI is fully implemented and the data is considered stable.

Component Condition Criteria

Structures must meet the applicable condition requirements provided below to be eligible for extended frequency routine inspections.

Condition Item	Criteria	NBI Reference	SNBI Reference
Deck	≥ 6	Item 58	B.C.01
Superstructure	≥ 6	Item 59	B.C.02
Substructure	≥ 6	Item 60	B.C.03
Culvert	≥ 6	Item 62	B.C.04
Channel	≥ 6	Item 61	B.C.09
Channel Protection	≥ 6		B.C.10

Scour Criteria

Structures must meet the applicable scour related requirements provided below to be eligible for extended frequency routine inspections.

Item	Criteria	NBI Reference	SNBI Reference
Scour Critical Bridges	≥ 7 or = N	Item 113	Not Applicable
Scour Condition Rating	≥ 6 or = N	Not Applicable	B.C.11
Scour Vulnerability*	= N, A, or B	Not Applicable	B.AP.03

* MoDOT assigns a value of N for structures with no waterway.

Clearance, Load Capacity, and Traffic Criteria

Structures must meet the applicable clearance and load carrying capacity requirements provided below to be eligible for extended frequency routine inspections.

Item	Criteria	NBI Reference	SNBI Reference
Inventory Rating Factor	$HS20 \geq 1$	Item 66	B.LR.05
	$HL93 \geq 1$	Item 66	B.LR.05
No Load Posting-Legal Loads	= A	Item 41	Not Applicable
Controlling Legal Load Factor	≥ 1	Not Applicable	B.LR.07
Load Posting Status	= PO	Not Applicable	B.PS.01
Routine Permit Loads	= A or N	Not Applicable	B.LR.08
Vertical Clearance Over	≥ 14.0 ft	Item 53	B.H.13
Vertical Clearance Under	≥ 14.0 ft	Item 54	
AADT	$\leq 10,000$	Item 29	B.H.09
AADTT	$\leq 2,000$	Item 109	B.H.10

Miscellaneous Criteria

Structures must meet the miscellaneous criteria provided below to be eligible for extended frequency routine inspections.

Item	Criteria	NBI Reference	SNBI Reference
Fracture Critical (NSTM) Inspection Required	= N	Item 92A	B.IR.01
Category E or E' Details on a Steel Structure	= N	Not Applicable	B.IR.02
Structure Length	$\leq 1,000$ ft	Item 49	B.G.02
Structure Class	= STATBR or STATCUL	Not Applicable	Not Applicable
Collision Damage	Structure has no history of vehicular collision damage to primary load carrying members. This is not captured on the NBI or the SNBI, so it will only be known thru inspector knowledge.		

Construction or Work Criteria

Structures must meet the applicable criteria provided below to be eligible for extended frequency routine inspections. The regulation states that newly built structures or structures that have had major rehabilitation work completed, must be in service for 24 months and have the next routine inspection completed prior to becoming eligible for an

extended routine inspection interval. This essentially means that if the structure has had any major work done in the last four years, it doesn't qualify for an extended interval inspection.

Item	Criteria	NBI Reference	SNBI Reference
Year Built	\geq (Current Year – 50)	Item 27	B.W.01
	\leq (Current Year – 4)		
Year Reconstructed	\leq (Current Year – 4)	Item 106	Not Applicable
Work Performed Year (and)	\leq (Current Year – 4)	Not Applicable	B.W.02
Work Performed Codes	\neq IP1, IP2, IP3, IP4, DK1, SP1, SB1, DK2, SP2, SB2, or CU2	Not Applicable	B.W.03

Material and Structure Type Criteria

The regulation limits the use of the extended frequency inspections to specific superstructure materials and span types for all the span configurations coded on the SNBI or the predominate main series and approach series construction types coded on the NBI. The superstructures must be constructed with prestressed concrete, reinforced concrete, or steel materials. For span types, the superstructure must be classified as certain arches, box girders/beams, frames, girders/beams, slab, and culverts. From a more practical standpoint, this would be the filled arch, stringer, girder, and culvert type structures that are in widespread use. Less common ones such as segmental, cable stayed, and truss structures are not eligible for extended interval inspections.

Item	Criteria	NBI Reference	SNBI Reference
Superstructure Material	= 1 thru 6	Item 43A or 44A	Not Applicable
Superstructure Material	= C01 thru C05 or S01 thru S05	Not Applicable	B.SP.02
Superstructure Construction Type for Approach/Main Series	= 01, 02, 04, 05, 06, 07, 19, or 22	Item 43B or 44B	Not Applicable
Span Type Configuration	= A01, B02, B03, F01, F02, G01 thru G08, S01, S02, P01, or P02	Not Applicable	B.SP.06

EPG 753.4.2.8: Fracture Critical Inspections

The NBIS regulations define inspection interval requirements for structure with fracture critical members, also called non-redundant steel tension members (NSTM). The regulations include a default interval as well as the minimum requirements for reduced interval fracture critical inspections and extended interval fracture critical inspections. The following sections define the interval requirements for fracture critical inspections. Additionally, the acceptable tolerance for completion of a fracture critical inspection in compliance with NBIS regulations is provided. The inspection due date will be the previous inspection date plus the inspection interval.

EPG 753.4.2.8.1: Default Fracture Critical Inspection Interval

The default interval for fracture critical inspections is 24 months for structures that don't meet the criteria to require a reduced interval fracture critical inspection. Inspections should be completed in the 24th month. Inspections can be completed in the 25th, 26th, and 27th months and still be compliant with NBIS regulations. Inspections outside of the 24th month should not be a common occurrence, and the tolerance months shouldn't be used as a method to extend inspection timelines on a regular basis.

Fracture Critical Inspection Default Interval Requirements	
Default Interval	Compliant Inspection Range
24 th Month	24 th thru 27 th Months

EPG 753.4.2.8.2: Reduced Interval Fracture Critical Inspections

NBIS regulations section 650.311 establishes the minimum requirements for reduced interval fracture critical inspections. For inspections with intervals less than 24 months, the compliance tolerance is two months instead of three months. Missouri has adopted this same requirement, which establishes a maximum inspection interval of 12 months for all structures meeting the criteria in the regulation. Inspections should be completed in the 12th month but can be completed in the 13th and 14th months and be compliant with NBIS regulations. Unlike routine inspections, the NBIS regulation doesn't allow for an option of using a special inspection to focus on specific members in lieu of a full-blown fracture critical inspection.

Fracture Critical Inspection Reduced Interval Requirements	
Maximum Interval	Compliant Inspection Range
12 th Month	12 th thru 14 th Months

Reduced Interval Required	
Any Fracture Critical Member Condition	≤ 4 (Poor Condition)

EPG 753.4.2.8.3: Extended Interval Fracture Critical Inspections

NBIS regulations section 650.311 includes an option for extended interval fracture critical inspections and provides criteria that a structure must comply with for an extended interval inspection. Structures meeting the requirements in the regulation could have fracture critical inspections completed at 48-month intervals instead of 24-month intervals. Missouri has not adopted the extended interval options in the regulations, so all fracture critical inspections in Missouri must be completed at intervals of 24-months or less.

EPG 753.4.2.9: Underwater Inspections

The NBIS regulations define inspection interval requirements for structure that require underwater inspections. The regulations include a default interval as well as the minimum requirements for reduced interval underwater inspections and extended interval underwater inspections. The following sections define the interval requirements for underwater inspections. Additionally, the acceptable tolerance for completion of an underwater inspection in compliance with NBIS regulations is provided. The inspection due date will be the previous inspection date plus the inspection interval.

EPG 753.4.2.9.1: Underwater Inspection Categories

For the NBIS regulations, an underwater inspection is required on structures where normal visual or probing techniques are not adequate for determining the condition of underwater components of a structure. Structures that don't meet this requirement are not considered as requiring an underwater inspection, even though they are over a waterway.

Missouri more generally classifies underwater inspections as being required for any structure that crosses over a waterway. Four categories of underwater inspection are defined: Dry, Shallow Wade, Deep Wade, and Dive.

Dry: All the substructure units are not in the waterway, or one or more substructure units are in the waterway and the waterway is dry at the time of inspection or has minimal water that allows for easy visual observation of the condition of structure components that are in the waterway. In general, easy visual observation would be for water depths up to 12 inches. Dry underwater inspections are typically performed as part of the routine inspection each cycle, even though the inspection interval may be different than the routine inspection.

Shallow Wade: Some substructure units are in the waterway at the time of inspection with portions of the substructure units below the waterline. The portions of the substructure units below the waterline can be inspected with a combination of visual observation and wading or probing techniques. This category would typically apply for water depths of three feet or less and sites where probing rods and hip waders can be used to perform the inspection. Shallow Wade underwater inspections are typically performed

as part of the routine inspection each cycle, even though the inspection interval may be different than the routine inspection.

Deep Wade: Some substructure units are in the waterway at the time of inspection with portions of the substructure units below the waterline. The portions of the substructure units below the waterline can still be inspected using wading or probing techniques to assess the condition of the underwater portions of the substructure units, but typical inspection equipment is not sufficient to do the inspection, or another person is required to safely inspect the underwater portions of the structure. The use of more specialized equipment such as a boat may be needed to properly access the substructure units in the waterway. This category would typically apply for water depths greater than three feet, but no more than ten feet, when the inspection Team Leader determines that wading and probing techniques are appropriate. Deep Wade underwater inspections are typically performed independent of the routine inspection and are performed by the Dive Team from Bridge Division or by consultant contract. In some rare situations, properly trained district personnel may be able to perform a Deep Wade underwater inspection.

Dive: Substructure units are in the waterway where the water depth exceeds three feet and wading and probing techniques have been eliminated as an option for inspection of the underwater portions of the units. A boat, scuba gear, or other dive equipment are typically needed to access and inspect the portions of the substructure units in the waterway. Dive underwater inspections are typically performed independent of the routine inspection and are performed by the Dive Team from Bridge Division or by consultant contract. District and local agency personnel are not properly equipped to safely perform Dive underwater inspections, so they should not attempt to perform one. In some situations, a District or local agency person may be asked to assist the Dive Team whenever they are completing a dive inspection but will not be tasked with performing or assisting on any activities that they are not appropriately trained for.

EPG 753.4.2.9.2: Default Underwater Inspection Interval

The default interval for underwater inspections is 60 months for structures that don't meet the criteria to require a reduced interval underwater inspection. Inspections should be completed in the 60th month. Inspections can be completed in the 61st, 62nd, and 63rd months and still be compliant with NBIS regulations. Inspections outside of the 60th month should not be a common occurrence, and the tolerance months shouldn't be used as a method to extend inspection timelines on a regular basis.

Underwater Inspection Default Interval Requirements	
Default Interval	Compliant Inspection Range
60 th Month	60 th thru 63 rd Months

EPG 753.4.2.9.3: Reduced Interval Underwater Inspections

NBIS regulations section 650.311 establishes the minimum requirements for reduced interval underwater inspections. For inspections with intervals less than 24 months, the compliance tolerance is two months instead of three months. Missouri has adopted this same requirement, which establishes a maximum inspection interval of 24 months for all structures meeting the criteria in the regulation. Inspections should be completed in the 24th month, but can be completed in the 25th, 26th, and 27th months and still be compliant with NBIS regulations.

On rare occasions the Team Leader for an underwater inspection may determine that the maximum inspection interval should be set at 12 months instead of 24 months. If the inspection interval gets changed to 12 months, the inspections should be completed in the 12th month but can be completed in the 13th and 14th months and be compliant with NBIS regulations.

Underwater Inspection Reduced Interval Requirements	
Maximum Interval	Compliant Inspection Range
24 th Month	24 th thru 27 th Months
12 th Month	12 th thru 14 th Months

Reduced 24 Month Interval Required	
Underwater Portions of Substructure Units	≤ 3 (Serious Condition)
Channel Condition Rating	≤ 3 (Serious Condition)
Channel Protection Condition Rating	≤ 3 (Serious Condition)
Scour Assessment Rating	≤ 3 (Serious Condition)

EPG 753.4.2.9.4: Extended Interval Underwater Inspections

NBIS regulations section 650.311 includes an option for extended interval underwater inspections and provides criteria that a structure must comply with for an extended interval inspection. Structures meeting the requirements in the regulation could have underwater inspections completed at 72-month intervals instead of 60-month intervals. Missouri has not adopted the extended interval options in the regulations, so all underwater inspections in Missouri must be completed at intervals of 60-months or less.

EPG 753.4.2.10: Special Inspections

Special inspections are used to monitor specific deficiencies that may be present on a structure. The deficiencies may be significant but are not widespread or not at the level that a complete routine inspection needs to be performed at a reduced interval. As an example, a timber deck may be in serious condition, but the superstructure and substructure are in good condition. The NBIS regulation would require a routine inspection at a 12-month interval but would also allow a special inspection of the deck to

be performed at an interval between the routine inspection. This provides bridge owners with a way to better manage inspection resources across their bridge inventory.

The NBIS regulation doesn't provide specific criteria for establishing inspection intervals for structures but requires bridge owners to establish criteria for the level and interval for special inspections. Extended intervals won't apply to special inspections. Special inspections will have criteria for the regular and reduced intervals as presented below with the next inspection due date being the previous inspection date plus the inspection interval.

EPG 753.4.2.10.1: Default Special Inspection Interval

When a special inspection is warranted on a structure, the default interval will be 24 months. With this default interval, the inspection will typically be setup to be completed in the off years between regular interval routine inspections. Inspections should be completed in the 24th month. Inspections can be completed in the 25th, 26th, and 27th months and still be compliant with NBIS regulations. Inspections outside of the 24th month should not be a common occurrence, and the tolerance months shouldn't be used as a method to extend inspection timelines on a regular basis.

Special Inspection Default Interval Requirements	
Default Interval	Compliant Inspection Range
24 th Month	24 th thru 27 th Months

EPG 753.4.2.10.2: Reduced Interval Special Inspections

Special inspection intervals less than 24 months will have a compliance tolerance of two months instead of three months. In Missouri, reduced interval special inspections may be completed at intervals of 12 months, 6 months, or 3 months. When an inspector believes a special inspection interval below 12 months is needed, the issues on the structure should be discussed with the Program Manager for inspections in Missouri to agree upon an appropriate inspection interval.

Special Inspection Reduced Interval Requirements	
Designated Interval	Compliant Inspection Range
12 th Month	12 th thru 14 th Months
6 th Month	6 th thru 8 th Months
3 rd Month	3 rd thru 5 th Months

EPG 753.4.2.11: In-Depth Inspections

In-depth inspections are used to more closely examine specific areas of a structure that historical experience has shown tend to develop problems as a structure ages. In-depth inspections may also generally be performed on larger structures, structures that are over

large lakes or rivers where an inspector can't perform a complete inspection without access equipment, and structures that are elevated enough to limit what an inspector can see from the ground.

The NBIS regulation doesn't provide specific criteria for establishing inspection intervals for structures but requires bridge owners to establish criteria for the intervals on in-depth inspections. Inspection intervals can vary for in-depth inspections and the tables in this section are provided as guidance on typical and maximum inspection intervals for specific categories of in-depth inspections.

Table 1 outlines situations where in-depth inspections are typically required to focus on specific areas of a structure. The inspection due date will be the previous inspection date plus the inspection interval.

Table 1: Focused In-Depth Inspections			
In Depth Category	Description	Typical Frequency	Maximum Frequency
Pins	Standalone pins at joints connecting primary members on a structure.	24	48
Straps	Hanger type strap assemblies, including the pins, straps, and surrounding areas.	24	48
Pin Plates	Fixed plates bolted or welded to girders with an adjoining span suspended by a pin connection.	24	48
Cantilever Bearing Areas	Cantilever bearings not supported by a substructure unit. The bearings may be elevated requiring a UBI unit to access, or they may be accessible from the ground using a ladder.	24	48
Hanger Plates	Bolted web plates connecting a suspended span to another span.	24	48

Table 2 outlines situations where a more general in-depth inspection is recommended. The need for the in-depth inspection will be at the discretion of the Team Leader, and they should discuss the need for an in-depth inspection with the Program Manger before adding or removing one on a structure. The inspection due date will be the previous inspection date plus the inspection interval.

Table 2: General In-Depth Inspections			
In Depth Category	Description	Typical Frequency	Maximum Frequency
River-Major	Structures over major rivers where portions of the structure are not adequately observed from the ground during a routine inspection.	24	48
Lake-Major	Structures over major rivers where portions of the structure are not adequately observed from the ground during a routine inspection.	24	48
Open Spandrel Arch	Longer open spandrel arches that can't be adequately observed from the ground during a routine inspection.	24	48
Closed Spandrel Arch	Longer closed spandrel arches that can't be adequately observed from the ground during a routine inspection.	24	48
Complex Bridge	Structures that have more complicated structural details that may require specific inspection procedures for examination of those details. Cable Stayed and Segmental Post Tensioned structures fall in this category. Steel tied arches with hanger cable assemblies would fall into this category as well.	24	24
Elevated Superstructure	Structures with spans that are elevated and have areas that should be periodically inspected closely to monitor areas know to develop deterioration as a structure ages.	24	48
Hoan- Like Details	Structures that have hoan-like details where horizontal welds are intersecting vertical welds in high stress areas.	24	24

EPG 753.4.2.11.1: Default In-Depth Inspection Interval

When an in-depth inspection is warranted on a structure, the default interval will be the typical interval as shown in Table 1 or Table 2. The maximum interval is also defined in Table 1 and Table 2 for the different inspection categories. Inspections should be completed in the 24th month or the 48th month. Inspections can be completed in the 25th, 26th, and 27th months for the typical interval and in the 49th, 50th, and 51st months for the maximum interval, and still be compliant with NBIS regulations. Inspections outside of the 24th month or 48th month should not be a common occurrence, and the tolerance months shouldn't be used as a method to extend inspection timelines on a regular basis.

In-Depth Inspection Interval Requirements	
Designated Interval	Compliant Inspection Range
48 th Month	48 th thru 51 st Months
24 th Month	24 th thru 27 th Months

EPG 753.4.2.11.2: Reduced Interval In-Depth Inspections

In-depth inspection intervals less than 24 months will have a compliance tolerance of two months instead of three months. Reduced intervals for in-depth inspections should typically align with the routine inspection interval. If the structure condition is to the level that a reduced interval routine inspection is required, then associated in-depth inspections should also be completed at 12-month intervals. In-depth inspection intervals below 12 months should not be used without the approval of the Program Manager for inspections in Missouri.

In-Depth Inspection Reduced Interval Requirements	
Designated Interval	Compliant Inspection Range
12 th Month	12 th thru 14 th Months

EPG 753.4.2.12: Damage Inspections

The NBIS regulation doesn't provide specific criteria for establishing inspection intervals for damage inspections on structures but requires bridge owners to establish criteria for the intervals. In Missouri, damage inspections are typically done for structures that have been impacted by vehicular traffic resulting in obvious damage to the structure. Damage inspections may also be done on major river structures after barge collisions with substructure units. On rare occasions, a damage inspection may be warranted after railroad traffic such as trains or track repair equipment impact a structure resulting in minor damage.

A damage inspection will involve the minimal amount of effort that is needed to assess that a structure is safe to remain open or be opened back up after an event. The District Bridge Engineer, Supervising Bridge Inspection Engineer, and the Program Manager should be made aware of damage inspections that are completed so that the structure can be properly assessed for any additional follow up that is needed.

Since a damage inspection is in response to some event, there are no established minimum/maximum or compliance ranges established for inspection intervals. Damage inspections should be coded with an inspection interval of 999 months.

EPG 753.4.2.13: Scour Monitoring Inspections

The SNBI coding guide defines an inspection type of Scour Monitoring. This inspection type is setup to document the monitoring process for structures that are scour critical and require active monitoring of a structure during flood events. Since this type of inspection only happens during major flood events that trigger the scour action plan, no inspection interval requirements are established in the NBIS regulations. With no established required inspection interval, no compliance range will exist. Scour Monitoring inspections should be coded with an inspection interval of 999 months.

EPG 753.4.2.14: Outfall Inspections

Outfall inspections are not covered by the NBIS regulations. They are a specific type of inspection only done in Missouri as part of monitoring of flows that may be coming into a stream at a structure site. This inspection type is only completed within designated stormwater compliance areas defined by the environmental section at MoDOT and is only done for state owned structures. Outfall inspections should be completed at the same interval as the Routine Inspection.

EPG 753.4.2.15: Data Collection Events

Structures may periodically require review or data collection that is typically outside of the normal inspections that are completed on a structure. These are events that are not required as part of the NBIS regulations, so inspection intervals are recommendations and not part of a compliance review on inspections. Table 3 defines the types of data collection events that may have historically existed on a structure or currently exist and may actively be completed at designated times.

Table 3: Data Collection Events	
Category	Designated Interval
Channel Cross Sections*	24, 48, 72, 120 Months
Joint River	999 Months
Quality Assurance	999 Months
Scour Action Plan	999 Months
Drone	999 Months
Extended Frequency	999 Months
Gusset Plates	999 Months

*See EPG Section 753.4.6 for information on Channel Cross Sections.

Section 753.4.3: Critical Inspection Findings

The National Bridge Inspection Standards defines the term “critical finding” as a structural or safety related deficiency that requires immediate follow-up inspection or action. For the purposes of the bridge and culvert inspection program, MoDOT will use the term Critical Inspection Finding (hereinafter CIF) and will define it as any structural or safety related issue on a structure that requires closure of the structure, a severe load restriction on the structure, or some type of immediate (within 30 days) repair work to address deterioration problems on primary load carrying members or correct a serious safety issue on a structure. This section of the BIRM provides MoDOT’s policies and procedures for CIF’s, and this section will apply to any structure that is reported on the National Bridge Inventory (NBI). CIF’s may also be used for non-NBI length structures that are open to traffic and on MoDOT Right of Way, to report condition or safety concerns that need immediate attention.

Section 753.4.3.1: Situations Requiring a CIF

The following guidance is provided to assist the inspector in determining the need for a CIF on a structure. This guidance is not meant to be all encompassing, so there may be situations that require a CIF that are not listed below. The inspector should be familiar with this guidance prior to commencing inspection activities in the field each inspection cycle. The inspector should also be familiar with EPG 753.4.4, which deals with issues that require some type of follow-up action, but don’t rise to the level of a CIF.

Section 753.4.3.1.1: Structural Condition Concerns

The table shown below shows the various condition rated items and the rating levels that require closure of a structure and the issuance of a CIF. More specific information pertaining to the conditions that might warrant lowering a rating value to these levels can be found for each rated item in EPG 753.3. The table provides the item number references for the old NBI Coding Guide format as well as the new SNBI Coding Guide format.

Condition Item	Criteria	NBI Reference	SNBI Reference
Deck	≤ 2	Item 58	(SNBI B.C.01)
Superstructure	≤ 2	Item 59	(SNBI B.C.02)
Substructure	≤ 2	Item 60	(SNBI B.C.03)
Culvert	≤ 2	Item 62	(SNBI B.C.04)
Channel	≤ 2	Item 61	(SNBI B.C.09)
Channel Protection	≤ 2		(SNBI B.C.10)
Scour Condition	≤ 2	Item 113	(SNBI B.C.11)

The inspector should also be aware that there may be some cases where a CIF is warranted for structures categorized as being in serious condition (“3” rated). This will

typically be for a serious problem that needs to have immediate attention, but does not require closure of the structure.

Section 753.4.3.1.2: Load Capacity Concerns

The inspector will periodically find condition concerns that are not at the level that would require closure of the structure but may be serious enough that there are immediate concerns about the safe load capacity for the structure, resulting in the need for an immediate reduction in the field posting for the structure. These situations will typically be found on structures that have one of the rated items coded as being in serious condition (Condition 3). These situations may be addressed with a substantial reduction in the approved load posting for the structure. The reduced load posting would either be permanent or it would remain in place until the condition concerns on the structure are addressed thru repairs. In these types of situations, a CIF should be issued by the inspector recommending the change in the load posting and identifying repairs that need to be implemented to return to the previous approved load posting level.

When a CIF is issued in these situations for a nonstate structure, the inspector should consult with the District Bridge Engineer (DBE) to determine an appropriate load posting recommendation to include on the CIF form. The Bridge Management Engineer (BME), Supervising Bridge Inspection Engineer (SBIE), Structural Project Management Engineer (SPME), and the Bridge Rating and Inventory Engineer (BRIE) are available to provide guidance on an appropriate load posting for these situations. In some situations, a quick load rating may be done on a structure to determine an appropriate load posting recommendation.

When a serious load capacity concern exists on a state system structure, the DBE shall be notified and the BME, SBIE, SPME, or BRIE shall be consulted to determine the appropriate load posting for the structure.

The following examples are some situations where a CIF with a load posting reduction may be warranted. These examples are not meant to be the only situations where this might be warranted, but are provided as guidance to the inspector when making a determination of the best course of action to address the concerns they have on a structure. For situations where the inspector does not feel that an immediate change in load posting is needed, the load posting may still need to be reviewed based on MoDOT's guidance for when the conditions found in the field should trigger a load rating review.

1. Serious section loss on a fracture critical member where the structure does not already have a low load posting and the conditions found don't warrant immediate closure of the structure.
2. Structures with serious deterioration of piling where closure of the structure is not deemed necessary, but a reduction in the load posting for the structure is needed until repairs can be completed.

3. Scour or undermining issue that is not serious enough for closure of the bridge but is serious enough that there are concerns about the ability of the structure to safely carry heavier live loads.

Section 753.4.3.1.3: Safety Concerns

The inspector will occasionally encounter safety issues on a structure that are unrelated to load capacity concerns or the structural condition of a structure. A safety concern would be something that would present an imminent danger to the traveling public and require that some type of action be taken to address this concern. The action taken could include anything from restricting traffic on a structure all the way up to closure of a structure.

The following examples are some situations that might warrant a CIF on a structure because of a safety concern.

1. Severe damage or deterioration to a safety barrier curb or railing on higher ADT structures where there is a high risk that traffic may impact the curb or railing.
2. Debris falling from a structure into traffic lanes.
3. Items hanging from a structure that could potentially impact traffic.
4. Large holes in the approach roadway or bridge deck resulting in a serious safety concern for the traffic crossing the bridge.

Section 753.4.3.2: Responsibility for Issuing CIF's

The following sections define who is primarily responsible for the issuance of CIF's on bridges and culverts across the state.

Section 753.4.3.2.1: District

The DBE shall be responsible for ensuring that CIF procedures are followed for all bridge and culvert inspections that are being done by personnel in their district. The DBE may delegate all or some of these responsibilities to the inspectors that are performing inspections within the district.

The Team Leader on a given inspection will be responsible for identifying the need for a CIF to be issued. Once this need has been identified, they should contact the DBE to discuss the issues on the structure and determine the appropriate course of action needed.

Section 753.4.3.2.2: Bridge Division

The Bridge Division shall be responsible for issuing CIF's for structures that are being inspected by the UBI crews or the Dive Team. The Team Leader on the inspection will be responsible for identifying the need for a CIF to be issued and should discuss the issues found with the SBIE (state system), BME (nonstate system), or the DBE to determine the appropriate course of action.

Section 753.4.3.2.3: Consultants

Consultant engineers shall be responsible for issuing CIF's for structures that they are inspecting under contract with MoDOT or a local agency. When the need for a CIF has been determined, the DBE or BME shall be contacted to discuss the appropriate course of action for the structure.

For structures owned by local agencies, the consultant will be responsible for the initial contact with the local agency to communicate the CIF and the immediate actions needed to address the problems found on the structure. If the local agency does not take action on the consultant's recommendation within one week, the consultant shall contact the DBE so that the DBE can pursue further actions with the local agency.

Section 753.4.3.2.4: Local Agencies

For situations where a local agency is performing the inspections on bridges and culverts, the Team Leader on the inspection shall be responsible for issuing a CIF. Once this need has been identified, they should contact the DBE or the BME to discuss the issues on the structure and determine the appropriate course of action needed.

Section 753.4.3.3: Resolution of CIF's

Whenever a CIF has been issued recommending closure or a permanent load posting change on a structure, the CIF will be considered resolved once the structure has been closed or the load posting change has been implemented. If the CIF involves a recommendation for immediate (within 30 days) repairs to address a deficiency on a structure, the CIF will be considered resolved once the repairs are completed. If a safety issue has resulted in a CIF, then it will be considered resolved when corrective action has been taken to mitigate the safety concern.

Section 753.4.3.3.1: State System Timeline

When conditions found during an inspection warrant closure of a state structure, the closure shall be implemented immediately by starting the process to mobilize the necessary resources to achieve closure of the structure. For conditions that warrant a reduction in the load posting on a structure, the load posting change shall be implemented as soon as possible after agreement has been reached on the appropriate load posting for the situation. When immediate repairs are recommended on a structure, they should be completed within one week. When safety concerns are involved, the safety concerns shall be addressed within one week. If repairs or actions to resolve a safety concern can't be completed within one week, the Team Leader shall consult the DBE, SBIE, or BME for guidance on the best course of action.

Section 753.4.3.3.2: Nonstate System Timeline

When conditions found during an inspection warrant closure of a nonstate structure, the owner shall be contacted immediately to inform them that the structure needs to be closed. The owner is then expected to quickly take action to ensure that the structure is closed. Load posting recommendations should be implemented as soon as possible, preferably within one week and no more than 30 days from the issuance of the CIF. Safety concerns should preferably be addressed within a couple of weeks, but may need a quicker timeline for a more serious issue. The inspector should be following up with the owner to ensure that the CIF is resolved.

The maximum time for resolution of a CIF on the local system for any issue is 30 days from the date of issuance. If the owner has not taken action to resolve the CIF within 30 days, then federal funds available to the owner will be suspended until the CIF is resolved. Compliance with NBIS requirements in federal law as well as MoDOT policies and procedures enacted to ensure compliance with NBIS requirements is required as a condition of the local agency receiving federal funds.

For most nonstate structures, the owner will typically be a county, but may also be a city or a special road district. Occasionally, there are situations where a structure is not owned by a public entity (railroad, for example), but the roadway leading up to the structure is controlled by a public entity. In these situations, the local agency with jurisdiction over the roadway is expected to implement the closure or load posting change on the structure by barricading the roadway leading up to the structure or by the placement of load posting signs on the approaches to the structure.

Section 753.4.3.4: Bridge Division Reporting of CIF's

The DBE will be responsible for ensuring that CIF's are submitted to Bridge Division in a timely manner. CIF's shall be submitted to Bridge Division electronically by sending the information to the email address BRCIF@modot.mo.gov within a week of the issuance of the CIF. The submittals should include the appropriate CIF form along with photos, the updated inspection report documenting the findings, and information on any discussions with the local agency when it involves a nonstate structure.

Bridge Division will be responsible for reviewing the submitted CIF to verify that it complies with the policies in this section and for logging the CIF in the yearly tracking spreadsheet. The BME will review nonstate system CIF's and ensure closeout of the CIF within designated timelines. The BME and/or SBIE will review state system CIF's and ensure closeout of the CIF within designated timelines.

FHWA will be informed as soon as possible for CIF's issued for state system structures. For nonstate structures, information on CIF's will be sent to FHWA as requested. Bridge

Division will provide FHWA a copy of the CIF tracking spreadsheet at the beginning of each quarter during the year.

Section 753.4.3.5: CIF Procedures—State System Structures

The following procedures should be followed whenever an inspector finds a situation requiring a CIF on a state system structure. The inspector should use the form that has been developed for reporting CIF's on state system structures.

Immediate Notification—The inspector shall immediately notify the DBE of the concerns found on the structure and the recommended course of action. The DBE should contact the SBIE or the BME to discuss the issues found and mutually determine a course of action. Once the course of action has been determined, the DBE will be responsible for implementing the actions necessary to close or restrict the structure.

Submittal of CIF—The DBE or the inspector will be responsible for completing the CIF form and providing the appropriate documentation needed to properly convey the problems found on the structure and the actions already taken and any future actions that will be needed to address the problems on the structure. Once the form is completed, it should be submitted electronically along with other supporting information to Bridge Division through the email address BRCIF@modot.mo.gov with the DBE, District Engineer, and any other appropriate district personnel copied. This information shall be submitted within seven days of the inspection.

Review of CIF—The SBIE or BME will review all CIF information that is submitted for state system structures and make any minor adjustments needed to the CIF form or supporting documentation to ensure that it complies with policies and procedures. If significant issues are found, the form may be returned to the DBE for correction and resubmittal.

CIF's for Permanent Closure or Load Restrictions—When a CIF is issued for closure or a load posting restriction on a structure and no repairs will be made to the structure, the CIF will be considered resolved when the closure or load posting restrictions have been implemented in the field. The DBE should submit an email to BRCIF@modot.mo.gov indicating that the appropriate barriers or signing has been installed and include photographs documenting the implementation of the restrictions.

CIF's Requiring Repairs—When a CIF requires immediate repairs on a structure, the CIF will be considered resolved whenever the repairs have been completed. In situations where temporary closure or load posting restrictions on a structure are recommended until repairs can be completed, the CIF can be considered resolved whenever the restrictions have been implemented on the structure. When repairs are needed to address an issue on a structure, the repairs should be identified as part of the action needed on a structure. Once these repairs have been completed, the DBE

should submit an email to BRCIF@modot.mo.gov indicating that the necessary repairs have been completed on the structure and any temporary restrictions that were placed on the structure have been removed. The submittal should include photographs documenting the completed repairs, as appropriate. The DBE should also review the appropriate condition ratings on the structure and make any necessary changes. This action should be taken as soon as the repairs have been completed.

Final Documentation of CIF's—After a CIF issue has been fully resolved on a structure, Bridge Division will review the TMS Media for a structure to ensure that proper documentation is present for the CIF on the structure and the actions taken to resolve it. Bridge Division will be responsible for making the final determination that a CIF has been fully addressed on a structure.

Section 753.4.3.6: CIF Procedures—Nonstate System Structures

The following procedures should be followed whenever an inspector finds a situation requiring a CIF on locally owned structures. The inspector should use the form that has been developed for reporting CIF's on nonstate structures.

Immediate Discussion with DBE—The inspector shall immediately notify the DBE of the concerns found on the structure to determine the recommended course of action. The typical course of action will be either closure or some type of load posting restriction. When the DBE is not available, the BME or SBIE may be contacted to discuss the concerns that the inspector has on a structure. Once the recommended course of action has been determined, the inspector or the DBE will be responsible for making the initial contact with the owner either by phone or in person. The date that this initial contact was made will need to be documented on the CIF form. If the owner takes immediate action to either close or load restrict the structure, then the CIF is considered to be resolved. If no immediate action is taken, then the CIF is considered to be unresolved. When immediate action is taken, the inspector should verify that the actions have been taken. Verification may be done by revisiting the structure to check on implementation of the recommendation and collect photos to document the actions taken by the owner. It is acceptable for the owner to also provide photo documentation showing implementation of the recommendations from the CIF. On the CIF form, the inspector should document the date (actual or approximate) that the recommendation was implemented and the date that they verified the implementation.

CIF's Recommending Repairs—A CIF recommending immediate repair can be made for a local structure, but should be done with caution. This should only happen whenever the inspector has confidence that the local agency is capable of implementing a repair and that it can be completed within 30 days of the issuance of a CIF. Any CIF issued recommending repairs shall clearly state that the repairs must be completed within 30 days. If repairs can't be implemented within 30 days, then

the structure shall be closed and/or load restricted with the CIF until repairs can be completed.

Follow-Up with Owner—After the initial contact with the owner, the inspector should follow up with written correspondence to the owner. This correspondence should discuss the problems found on the structure and either the actions taken to resolve the problem or the actions needed to resolve the problem. This written correspondence may be done through a letter to the owner or by an email and should be done within seven days of the initial contact of the owner, with the date documented on the CIF form. If the CIF has not been resolved within the first week, this correspondence should include the 30 day timeline necessary for compliance with the recommendation and that non-compliance with this recommendation may result in suspension of federal funds to the local agency. Copies of the CIF form, photos of the problem areas, and any other appropriate documentation should be provided to the owner at this time.

Implementation of Recommendations by Owner—For unresolved CIF's, once the owner has been sent official written notice of the CIF, the inspector should be following up with the owner to verify that the recommendation has been implemented for the structure. Verification may be done by a field visit to check on implementation of the recommendation or by the owner submitting pictures showing implementation of the recommendation. The inspector should be checking back weekly with the owner until the recommendation has been implemented. On the CIF form, the inspector should document the date (actual or approximate) that the recommendation was implemented and the date that they verified the implementation. As the end of the 30-day period approaches, the inspector should be discussing the unresolved CIF with the DBE or the BME to determine how to proceed once the 30-day period has expired.

Submittal of CIF—The DBE or the inspector will be responsible for completing the CIF form and providing the appropriate documentation needed to properly convey the problems found on the structure and the actions that are needed to resolve the issue. A summary of the owner's response to the CIF should be included on the form. Once the form is completed, it should be submitted electronically along with other supporting information to Bridge Division through the email address BRCIF@modot.mo.gov with the DBE copied. This information should be submitted as soon as possible, preferably within seven days of the decision to issue a CIF.

Review of CIF—The BME will review all CIF information that is submitted for nonstate system structures to ensure that it complies with policies and procedures. When significant issues are found, the form may be returned to the DBE for correction and resubmittal. Once a structure has been closed or the load posting changed, the CIF will be considered resolved. If the issues that resulted in the CIF can be addressed by some type of immediate repairs by the owner, then the CIF can be considered resolved when the repairs have been completed.

Repaired CIF Structures—After the CIF has been initially resolved by closing or load restricting a structure, the owner may later decide to make repairs to either reopen the structure or remove the load restriction that was placed on it. Once these repairs are made, the owner should contact the DBE to let them know that the problems on the structure have been fixed. The DBE should then make a field visit to the structure to review the repairs and make any adjustments needed to the inventory information on the bridge. After this field visit, updated information should be submitted to the Bridge Division indicating that the repairs have been made and the owner desires to reopen the structure or revise the load posting on the structure to the previous level. This information should be submitted in an email to BRCIF@modot.mo.gov requesting that the status on the structure be updated. The BME will provide an updated posting recommendation for the structure after reviewing the submitted information.

Documentation of CIF's—Bridge Division will be responsible for making sure that all appropriate documentation on a CIF has been provided and is loaded in the TMS Media file for a structure.

Section 753.4.3.6.1: Inspection Review of Closed Structures

As part of a bridge inspection cycles, the inspector should be aware of all structures that have been previously closed by the local agency, especially closures that resulted from a CIF. The inspector should review the closure for the common issues listed below.

- a. Are the closure barricades still in place and fully functioning to keep traffic from crossing the structure.
- b. Is there any evidence that barricades are being moved so vehicles can cross a structure and then put back in place.
- c. If dirt piles or rock piles have been used to restrict traffic from a structure, are the dirt piles still fully in place and completely blocking traffic from accessing the structure by going around the piles.
- d. When dirt piles or rock piles are present, is there any evidence the vehicles have been driving over these piles to access the structure.

If any of the issues listed above are observed, the inspector shall contact the local agency and make them aware of the issue and that they need to get it corrected to ensure public safety. The inspector should follow up within 30 days to ensure that the local agency has implemented the corrective actions.

Section 753.4.3.7: Guidance for CIF Forms

The following guidance is provided to assist the inspector in completing the various sections of the CIF forms and to promote consistency in the documentation on the forms.

Section 753.4.3.7.1: General Information

This section of the form provides general identification information that is needed for the structure. Most of this information should be available from the inspection report for the structure. Information not found on the inspection report can be found in TMS.

Section 753.4.3.7.2: Reasons for Issuing the CIF

This section should identify all of the deficiencies that resulted in the issuance of the CIF. The deficiencies should be described using a short narrative as provided in the examples shown below. Photographs of the problem areas should be taken and submitted as part of the documentation.

Example 1: The South abutment consists of a timber beam cap that is supported by five timber piles. During the inspection, a close examination of the piling found the three interior piles to be severely deteriorated. This condition has severely compromised the ability of the bent to support the superstructure resulting in the need for closure.

Example 2: The structure consists of three spans of steel wide flange girders. At the North abutment (span 1), the exterior girders have severe deterioration of the web at the bearing. The girders are showing signs of buckling. The remaining four girders at this abutment are in fair condition.

Example 3: Spans two and three of this structure consist of a girder/floorbeam system with stringers supporting the slab. At the floorbeam connections at Bents 2 and 4, there are cracks in the webs of various stringers, requiring immediate repair.

Section 753.4.3.7.3: Recommendations for Resolving the CIF

In this section, the inspector should provide a narrative describing the actions that they believe are necessary to resolve the CIF. Typical actions may be closure of the structure, lowering the load posting, or immediate repair (within 30 days) of the members that the inspector had concerns about. Once the structure is closed, the load posting change implemented, or the repair work is completed, the CIF is considered to be resolved. For structures where repairs could address the problems found, the inspector should specifically identify all the repairs that are needed for the CIF to be resolved and clearly state the 30-day timeline for completion of the repairs.

Example 1: Because of the conditions found on the South abutment, immediate closure of the structure is recommended. This closure should remain in place until the county replaces or repairs the deteriorated piles. After repairs are completed, the county should contact the district for a review of the repairs prior to reopening the structure.

Example 2: The county should implement a load posting of 10 tons on this structure. This posting should remain in place until the exterior girders in span 1 can be repaired or

replaced. After repairs are completed, the county should contact the district for a review of the repairs prior to removing the load posting.

Example 3: Traffic needs to be moved to the Southbound lane and a temporary 20 ton posting implemented. This posting needs to remain in place until shoring can be placed or permanent repairs made.

Section 753.4.3.7.4: Summary of Response or Actions Taken (Nonstate)

For nonstate structures, the inspector should provide a narrative describing the actions that have been taken by the owner to resolve the CIF. Additionally, if the local agency is planning on repairing the structure to reopen it or remove the load posting, the inspector should provide this information in the narrative.

Example 1: The county has responded to the CIF by closing the structure. The county plans on pursuing repairs to the piles on the South abutment so that the structure can be reopened to traffic.

Example 2: The county has responded to the CIF by implementing the 10 ton posting. At this time, the county has not determined if they will try to repair the deficiencies found during the inspection.

Section 753.4.3.7.5: Action Plan for MoDOT Structures

For state owned structures, the SBIE or BME and the DBE will discuss the problems on a structure and determine an action plan for the structure. This plan of action should be documented on the CIF form and include who will be responsible for the various parts of the action plan.

Example 1: The District will mobilize portable signals to the bridge site restricting traffic to the Southbound lane and implement a temporary 20 ton load restriction until the problems can be addressed. Bridge Division will notify Motor Carrier services of the temporary restrictions on the structure. UBI crews from Bridge Division will assist the district repairs crews, as needed, with installation of shoring and/or repairs of the structure.

Section 753.4.3.7.6: Documenting Follow-Up Actions on MoDOT Structures

For state owned structures, the SBIE or BME will document that the follow-up actions have been completed on a structure. The DBE should notify the SBIE or BME once all repairs are completed and should provide a finalized CIF document outlining the completed repairs.

Example 1: The UBI crew assisted the district repair crew with the installation of permanent shoring supporting the stringers from the pier cap at piers 2 and 4. Temporary posting and lane restrictions were removed once the shoring was in place.

Section 753.4.3.8: Local Structures Found Closed During Inspection

It is common for inspectors to find structures that have been closed by a local agency since the last inspection cycle and the local agency didn't make MoDOT aware of the closure. In the past, we issued Informational CIF's for these structures to document the closure and the local agencies plans for the structure. Informational CIF's are no longer required for structures found closed during an inspection.

For structures found closed during an inspection, the inspector should document in the TMS system the information shown below on the structure. In addition to this documentation, the inspector should highlight this structure and reasons for closure in the cover letter submitted to Bridge Division once the inspections are completed.

- a. Reasons for closure of the structure.
- b. The approximate date when the structure was closed.
- c. Local agencies long-term plans for the closed structure.

EPG 753.4.4: Follow-Up Action Required (FAR)

Inspectors on occasion will encounter conditions on structures that may not warrant a Critical Inspection Finding (CIF), but still require some type of remedial action in an accelerated time frame to ensure that the structure remains safe for use by the public. In order to document these conditions and track the actions, the Follow-up Action Required (FAR) process is used. This process will typically be reserved for use on MoDOT owned structures since we will be the ones instigating the repairs. At the option of the inspector, this process may be used on the nonstate system to highlight more important repair needs on structures owned by local agencies.

EPG 753.4.4.1: Situations Requiring a FAR

It is important to only use the FAR process in order to document the more urgent (“high priority”) repairs, evaluation needs, or other actions, and not as a means for issuing “work orders.” Other lower priority work needs should be set up in TMS as recommended work items. The following guidance is provided for the inspector to determine when it is appropriate to issue a FAR. Generally, the recommended timeline for repairs recommended thru a FAR is more than 1 month, but less than 6 months. Any repairs needing urgent attention to address within one month or less should be documented as a CIF, which is covered in EPG 753.4.3.

EPG 753.4.4.1.1: Structural Condition Concerns

A FAR would be appropriate where fairly quick action is needed to perform a structural repair. The following are examples of work that might warrant a FAR, based on the inspector’s findings. These examples are not meant to be the only situations where a FAR might be warranted, but are provided as guidance for the inspector in determining the best course of action on a structure.

1. A bearing seat spall that is exposing 50% of the bearing, and requires blocking or shoring to support until such time as a permanent repair can be made.
2. Several cracks noted in plug welds of pin plate connections on various girders.
3. Active fatigue cracking that is documented to be working into the web of the girder and needs to be arrested.
4. Timber bent observed to have more than 50% of the timber piling that are rotten and requiring replacement.

EPG 753.4.4.1.2: Load Capacity Concerns

The inspector will periodically find condition concerns that are not at the level that would require a CIF, but may be to the extent that the safe load capacity for the structure may be reduced warranting a structural analysis/review of the structure. These situations will typically be found on structures that have been classified as being in poor (Condition 4) or serious (Condition 3) condition on the deck, superstructure, substructure, culvert or

scour ratings. When these concerns are found, a FAR should be issued by the inspector recommending the reevaluation of the load capacity. It is important that specific details of the deterioration and photographs are included with the FAR to assist with the evaluation process. Inspectors should refer to the “Process for Evaluating Load Capacity for Bridges” and the “Minimum Conditions when the Load Rating should be Reevaluated” documents for guidance.

EPG 753.4.4.1.3: Safety Concerns

The inspector will occasionally encounter safety issues on a structure that are unrelated to load capacity concerns or the structural condition of a structure. There could be other repair needs that are more of a safety concern, and not necessarily driven by a specific condition rating. A safety concern FAR would be for something that could very shortly present an imminent danger to the traveling public if not corrected, requiring that some type of action be taken to address this concern.

The following examples are some situations that might warrant a FAR on a structure because of a safety concern.

1. Failing expansion devices that have loose sections or anchorage issues that could result in the device coming loose, especially on higher ADT routes.
2. Large spalls in bridge deck or impending full-depth type repair needs.
3. Delaminated concrete hanging from the underside of the bridge that could potentially fall onto traffic lanes.
4. Low or settled approach roadways at bridge ends that are causing an extreme impact for motorists crossing the bridge, and could lead to damage to vehicles or the bridge.

EPG 753.4.4.1.4: Structures with Missing or Incorrect Load Posting Signs

Missing or incorrect load posting signs **should not** result in a FAR being issued. The inspection should enter a work item in the TMS System indicating the need to address the problems with the load posting signs. The inspector shall also issue a Posting Issue Notification in accordance with the process outlined in EPG 753.4.5 and utilizing the PIN form in that section.

1. Load limit sign is missing at bridge site.
2. Posting limit on sign is higher than the approved posting.
3. Incorrect sign at bridge.

EPG 753.4.4.2: Responsibility for Issuing FAR's

The following sections define who is primarily responsible for the issuance of FAR's on bridges and culverts across the state.

EPG 753.4.4.2.1: District

The District Bridge Engineer (DBE) will be responsible for ensuring that FAR procedures are followed for all bridge and culvert inspections that are being done by personnel in their district. The DBE may delegate all or some of these responsibilities to the inspectors that are performing inspections within the district.

The Team Leader on a given inspection will be responsible for identifying the need for a FAR to be issued. Once this need has been identified, they should contact the DBE to discuss the issues on the structure and determine the appropriate course of action needed.

EPG 753.4.4.2.2: Bridge Division

The Bridge Division will be responsible for issuing FAR's for structures that are being inspected by the UBI crews, the Dive Team, or other Bridge Division inspection staff. The Team Leader on the inspection will be responsible for identifying the need for a FAR to be issued and should discuss the issues found with the Bridge Inspection Engineer, (BIE) or Supervising Bridge Inspection (SBIE) to develop the FAR. The DBE should also be consulted to determine the appropriate course of action, where district repair processes or reaction will be required.

Consultant contracts for performing bridge inspections are administered by Bridge Division. If the consultant finds issues during inspection that may require a FAR, they should contact the BIE or the SBIE who will then take the lead in developing the FAR document.

EPG 753.4.4.2.3: Local Agencies

The use of the FAR process is optional for the nonstate system. The Bridge Management Engineer (BME) may be contacted for questions that the local agency or a consultant performing inspections for a local agency may have about this process.

EPG 753.4.4.3: Resolution of FAR's

When a FAR has been issued it will be considered resolved when the action plan has been completed. Good judgment needs to be made on the part of the inspector and the DBE to develop the appropriate plan of action, and to determine a reasonable period of time for scheduling and completing the repairs.

EPG 753.4.4.4: Bridge Division Reporting of FAR's

The DBE will be responsible for ensuring that FAR's are submitted to Bridge Division in a timely manner. FAR's should be submitted to Bridge Division electronically by sending the information to the email address BRFAR@modot.mo.gov within a week of identifying the FAR in the field. The submittals should include the appropriate FAR

form along with photos, and any repair plans, drawings, or other applicable details that they have already developed. Condition rating items that are affected should also be updated within TMS.

Bridge Division will be responsible for reviewing all FAR submittals and logging the FAR into the yearly tracking spreadsheet. The SBIE will review state system FAR's that are submitted, and the BME will review any nonstate system FAR's that are submitted.

EPG 753.4.4.5: Guidance for FAR Forms

The following guidance is provided to assist the inspector in completing the various sections of the FAR form and to promote consistency in the documentation on the forms.

EPG 753.4.4.5.1: General Information

This section of the form provides general identification information regarding the structure and inspection. This information will be available from the inspection report or TMS.

EPG 753.4.4.5.2: FAR Type

The inspector should identify the FAR type that best describes the condition: Structural, Load Rating Evaluation, Safety, or Signing.

EPG 753.4.4.5.3: Reasons for Issuing FAR

This section should identify all of the deficiencies that resulted in the issuance of the FAR. The deficiencies should be described using a short narrative. Photographs, where applicable, should be taken and submitted as part of the documentation of the problems.

Example 1: There is a large spall at the bearing seat on Girder 1 at Bent 5. The spall has resulted in the exposure of 60% of the bearing. The structure is on a low volume route and there are four girders on the structure.

Example 2: Significant section loss is present on the lower chord of the truss in Span 1. The load capacity of the structure needs to be reevaluated based on the section loss that is present.

EPG 753.4.4.5.4: Inspector's Recommendations

The inspector should provide a narrative describing all the actions that they believe are necessary to resolve the FAR. This should include the suggested timeline that the work should be completed in (generally 1 to 6 months) and any intermediate actions that are needed prior to the repair being completed.

Example 1: Temporary blocking should be installed under the diaphragm near Girder 1 on Bent 5. Within 3 months, the concrete bearing area should be repaired by a structural repair crew.

Example 2: Significant section loss was found on the lower chord of the truss in Span 1. Someone needs to return to the bridge site within 30 days to more accurately document the amount and locations of the section loss. Once collected, section loss information should be submitted to the BRIE for a structural evaluation.

EPG 753.4.4.5.5: Plan of Action

The DBE will be responsible for determining the plan of action when a FAR is issued for a structure in their district. This will include documenting the date that the work was assigned and the individuals that will be responsible for completing the repairs. When inspectors from Bridge Division identify an issue that requires a FAR for a structure, the DBE should consult with the BIE, SBIE, Structure Resource Manager, Structural Liasson Engineer, and other resources when determining the plan of action for a structure.

Where load capacity evaluation is required, the initial plan of action will require submittal of information to the Bridge Rating and Inventory Engineer (BRIE) for a rating analysis on the structure. The BRIE will be responsible for completing the rating analysis and communicating the results of this analysis to the DBE. The DBE will be responsible for the implementation of any posting changes that are needed.

Example 1: The structural repair crew will install blocking under the diaphragm on Girder 1 at Bent 5 on Friday May 24. The crew will come back the week of July 8 to make the necessary repairs to the deteriorated bearing area. The repair crew supervisor will notify the DBE once the repairs are complete so that the FAR can be closed out.

Example 2: Significant section loss was noted on the lower chords of the truss in Span 1 during the inspection on May 20th. The inspector will return to the site on June 10th and collect detailed section loss information for submittal to the BRIE for a structural evaluation. Once the structural evaluation is completed, the BRIE will communicate any load posting changes to the DBE for implementation.

EPG 753.4.4.5.6: Follow-Up Actions

For state owned structures, the SBIE will document that the items outlined in the plan of action for the structure have been completed. The DBE should notify the SBIE once all repairs have been completed. The SBIE will finalize the FAR document and distribute it to the appropriate individuals.

Section 4.5: Load Posting Compliance

The National Bridge Inspection Standards requires bridge owners to perform a load rating analysis on all structures that are part of the National Bridge Inventory. The purpose of the load rating analysis is to determine the structural capacity of a bridge for the different vehicular configurations that are legal to travel on the public roadways within a state without an overweight permit. Specific requirements for load rating analysis on structures within Missouri can be found in EPG 753.15. This section provides guidance on load posting practices in Missouri and the process for managing issues related to load postings.

Section 4.5.1: Posting Required

Whenever a structure does not have the capacity to safely carry the normal state legal loads without some type of restriction, a load posting is required for that structure. Load postings may involve speed restrictions, lane restrictions, gross weight restrictions, or some combination of these restrictions. Load posting requirements are implemented in the field thru gross weight signage, speed restriction signage, and lane restriction signage or striping.

For NBI purposes, MoDOT maintains two types of postings on structures within the state. The approved posting on a structure represents the most current legal load restrictions that have been recommended for a structure. The field posting on a structure represents the restrictions that are found in the field during an inspection of the structure. Bridge Division is responsible for developing, approving, and issuing recommendations for the approved posting on structures and maintaining the approved posting information in our TMS data system. Bridge inspection team leaders are responsible for reviewing the field posting during a bridge inspection to ensure that it is consistent with the approved posting for the structure and updating the TMS data system to accurately reflect the field posting conditions, including documentation of any posting problems that are found. To facilitate review of load postings during inspections, the bridge inspection report lists the approved posting and the field posting for each structure.

Section 4.5.2: Tracking Load Posting Issues

The Specification for the National Bridge (SNBI) inventory was released in 2022. The SNBI contains the latest standards for reporting bridge inventory data to FHWA for inclusion on the National Bridge Inventory. The TMS data system has been updated to reflect the SNBI reporting requirements for load posting issues

The SNBI requires states to maintain a load posting status for all structures reported on the National Bridge Inventory. SNBI B.PS.01 is the item used for reporting a load posting status on the SNBI. For each load posting status that is reported, a posting status date (SNBI B.PS.02) also must be reported. Essentially, this item requires states to

maintain a historical record of the changes in posting status over the lifetime of a structure.

The reporting criteria for SNBI B.PS.01 are summarized in a table in the SNBI guide. This table contains a lot of information that is very challenging to clearly understand and develop a data entry format to ensure accurate reporting on the SNBI.

As part of the simplification of data input on posting issues, all load postings on a structure will include a Structure Category. The coding options for this item are Permanent, Temporary, and Shored. Temporary would only be used for temporary structures that are in place and Shored would only be used for situations in which shoring has been placed to support a structure and keep it open to traffic. A functioning structure that is in place without any shoring will be categorized as Permanent, which will be the value coded for most structures. The use of Shored and Temporary should be rare.

Structures will also be assigned a Bridge Status in relation to restrictions that may or may not be in place. In the TMS System, the Bridge Status will be a single data entry field that will have multiple options that can be selected. The tables shown below are provided to guide a data entry person on the proper coding of Bridge Status when updating field or approved postings on a structure. Structures can be broadly categorized as being New, Open, Restricted, Restricted and Under Construction, and Closed or Needs Closure. The tables below show the applicable Bridge Status options for each of the five broad categories. When data entry is being completed, the broad category should be used to determine which table to use and then the Bridge Status option that best represents the field/approved posting condition should be selected.

Coding Options for Bridge Status--New Structures	
TMS Drop Down Menu	Description
NEW-CONSTR PENDING-STARTED	NEW-CONSTRUCTION PENDING OR STARTED
NEW-NOT OPEN TO TRAFFIC	NEW BRIDGE-COMPLETED BUT NOT OPEN TO TRAFFIC

Coding Options for Bridge Status--Open-Unrestricted	
TMS Drop Down Menu	Description
OPEN - NEEDS POSTING	STRUCTURE IS OPEN AND NEEDS POSTING
OPEN - NO RESTRICTIONS	STRUCTURE IS OPEN WITH NO RESTRICTIONS
OPEN - UNDER CONSTRUCTION	STRUCTURE IS OPEN AND UNDER CONSTRUCTION

Coding Options for Bridge Status--Restricted	
TMS Drop Down Menu	Description
POSTED W	STRUCTURE IS POSTED WEIGHT
POSTED LN	STRUCTURE IS POSTED LANE
POSTED SP	STRUCTURE IS POSTED SPEED
POSTED WL	STRUCTURE IS POSTED WEIGHT-LANE
POSTED WS	STRUCTURE IS POSTED WEIGHT-SPEED
POSTED WLS	STRUCTURE IS POSTED WEIGHT-LANE-SPEED
POSTED-NEEDS REDUCTION	POSTED-NEEDS REDUCTION
POSTED-SIGN PROBLEMS	POSTED-SIGN PROBLEMS

Coding Options for Bridge Status--Restricted-Under Construction	
TMS Drop Down Menu	Description
POSTED W-UNDRCNST	STRUCTURE IS POSTED WEIGHT UNDER CONSTRUCTION
POSTED LN-UNDRCNST	STRUCTURE IS POSTED LANE UNDER CONSTRUCTION
POSTED SP-UNDRCNST	STRUCTURE IS POSTED SPEED UNDER CONSTRUCTION
POSTED WL-UNDRCNST	STRUCTURE IS POSTED WEIGHT-LANE UNDER CONSTRUCTION
POSTED WS-UNDRCNST	STRUCTURE IS POSTED WEIGHT-SPEED UNDER CONSTRUCTION
POSTED WLS-UNDRCNST	STRUCTURE IS POSTED WEIGHT-LANE-SPEED UNDER CONSTRUCTION

Coding Options for Bridge Status--Closed or Needs Closure	
TMS Drop Down Menu	Description
STRUCTURE CLOSED	STRUCTURE IS CLOSED
STRUCTURE CLOSED UNDRCNST	STRUCTURE IS CLOSED UNDER CONSTRUCTION
STRUCTURE CLOSED-CIF	STRUCTURE IS CLOSED BECAUSE OF CIF
STRUCTURE NEEDS CLOSURE	STRUCTURE NEEDS TO BE CLOSED

The reporting of the load posting status will be automated in the TMS data system thru utilization of the Structure Category field and the Bridge Status field. These two items will be coded/updated as part of the Approved Posting and the Field Posting. As changes occur either in the Approved Posting or the Field Posting information, posting status history records will be automatically generated for reporting of SNBI B.PS.01 and SNBI B.PS.02. Bridge Division will update information related to changes to the Approved Posting and inspectors will update information related to changes to the Field Posting.

Section 4.5.3: Posting Problems

As part of routine inspections of structures, the inspector should review the approved and field postings for a structure. To be compliant with NBIS regulations, the field posting should either match the approved posting for the structure or be more restrictive than the approved posting. Structures that have field postings violating this requirement shall have a posting problem coded in the TMS system that best represents the field condition.

Structures that have a load rating analysis completed will have a load posting letter issued by Bridge Division. The load posting letter for a structure will provide the approved posting for the structure that resulted from the load rating analysis. If the posting letter requires a change in the field posting on a structure, a posting problem will be entered on the field posting by Bridge Division to represent the changes needed in the field.

The table shown below provides the coding options available for posting problems. As part of coding a posting problem, a sign direction should also be assigned. Posting problems in the TMS system will always be tied to the field posting since that is where the action is needed to get a structure in compliance with NBIS requirements.

Coding Options for Posting Sign Problems	
TMS Drop Down Menu	Description
ADD LOAD POSTING	ADD LOAD POSTING TO BRIDGE
LOWER POSTING	LOWER POSTING ON SIGN
ILLEGIBLE SIGN	ILLEGIBLE SIGN
SIGN MISSING	SIGN MISSING
STRUCTURE NOT CLOSED	STRUCTURE NOT CLOSED

Section 4.5.4: Timeline for Resolution of Posting Problems

Posting problems will either be generated when a letter with an updated approved load posting is issued by Bridge Division, or when a problem with the field posting is found during inspection. NBIS regulations require that issues with load posting signs on structures be resolved within 30 days. The 30-day timeline will start on the inspection date whenever it is related to a problem found in the field. When a load rating analysis results in an updated load posting letter issued by Bridge Division, the 30-day timeline will start on the date the district is notified of the load posting change by the letter emailed to the District Bridge Engineer.

In general, to comply with the 30-day requirement for resolution of identified load posting deficiencies, it is critical that clear and prompt communication is provided to the appropriate staff that will be addressing the posting issue. The District Bridge Engineers will primarily be responsible for ensuring that this happens within their respective district.

Section 4.5.5: Posting Issue Notifications

The SNBI requires reporting of all issues related to the load postings present on structures. This includes tracking deficiencies whenever they are identified as well as tracking whenever a deficiency has been addressed by the bridge owner. This will be used by FHWA during yearly reviews of the bridge inspection programs in states to determine if a state is compliant with the posting requirements in the NBIS.

To ensure that we are compliant with NBIS regulations, all posting issues will have to be reported on a structure as soon as they are found. These will be reported by completing a Posting Issues Notification (PIN) form and submitting it to the BRINV@modot.mo.gov email address. The submittal of “a PIN” form will be tracked/monitored in the same manner as done for Critical Inspection Findings (CIF). Requirements specific to the state system or the nonstate system are detailed below.

Section 4.5.5.1: State System Structure Requirements

Bridge Division will email letters with load posting updates to the District Bridge Engineer within a district. When a letter is emailed to the district, the approved/field postings in TMS will be updated by Bridge Division to reflect the posting change. Additionally, the Bridge Status will be updated to reflect the current status of the

structure as of the date of the letter. If the letter requires updates to the current posting in the field, the submittal of the load posting letter email and subsequent update of the Bridge Status will trigger the start of the 30-day timeline and the structure will be added to the PIN tracking list. A PIN form should be sent along with the letter.

Once the letter is received, the District Bridge Engineer will be responsible for implementing the load posting change in the field. The load posting change should be communicated immediately to the appropriate staff within the district to ensure that it is resolved within thirty days of the letter date. Once the District Bridge Engineer is notified of the posting change being implemented in the field, a PIN form should be completed and emailed to the BRINV email group. As part of the resolution of the posting issue, photographs of the updated posting signs in place should be added to the TMS Media for the impacted structure.

The other situation in which posting issues on structures may be identified will be during inspections. The inspections issues will involve problems found with the posting signage that is in the field. When these issues are discovered on state structures, the inspector should immediately notify the District Bridge Engineer of the posting problem. The field posting in TMS should be updated to reflect the issues with the most appropriate Bridge Status from EPG 753.4.5.2. Additionally, a Posting Sign Problem from EPG 753.4.5.3 should be entered in the TMS System. The District Bridge Engineer or the Team Leader for the bridge inspection will be responsible for filling out the PIN form to document the posting deficiency and submitting the form to the BRINV email group.

For issues found during inspection, the District Bridge Engineer will be responsible for notifying the appropriate staff within the district of the actions needed on an identified structure and ensuring that the staff are aware that the issue must be resolved within the 30-day period. Once the issue is resolved, the District Bridge Engineer or the Team Leader should submit a completed PIN form documenting that the previous posting deficiency has been addressed. Once the PIN form is submitted, Bridge Division will be responsible for making the final updates in TMS to reflect resolution of the posting deficiency.

Section 4.5.5.2: Nonstate System Structure Requirements

The nonstate system consists of structures that are owned by a local agency such as a city, county, township, or road district. Since the structures are not owned by MoDOT, the local agency is responsible for ensuring compliance with the federal regulation requirements specified in the NBIS, including load posting requirements. Load posting issues will result from either a change in the approved load posting for a structure or a posting issue that is identified during the inspection process.

Section 4.5.5.2.1: Approved Posting Changes

As part of the inspection program, MoDOT maintains an Approved Posting for all local structures. The Approved Posting may result from load rating reviews completed by

MoDOT or from load rating calculations/updates provided by the local agency that owns a structure. Load rating calculations completed by a local agency will be reviewed by MoDOT and a letter with an updated Approved Posting will be issued by Bridge Division.

Letters with updates to the Approved Posting for locally owned structures will be emailed to the District Bridge Engineer within a district. When the letter is emailed to the district, the approved/field postings in TMS will be updated by Bridge Division to reflect the posting change. Additionally, the Bridge Status will be updated to reflect the current status of the structure as of the date of the letter. If the letter requires updates to the current posting in the field, the submittal of the load posting letter email and subsequent update of the Bridge Status will trigger the start of the 30-day timeline and the structure will be added to the PIN tracking list. A PIN form shall also be sent with the letter.

Once the District Bridge Engineer receives the letter with the updated Approved Posting, the District Bridge Engineer will be responsible for ensuring that the load posting change is implemented in the field. Since the local agency is ultimately responsible for implementing the load posting change, the District Bridge Engineer should immediately communicate the updates needed for an Approved Posting change as soon as the load posting letter is received. As part of the communication process with the local agency, the District Bridge Engineer should make sure the local agency is aware of the 30-day timeline required in federal regulations for resolution of the load posting issue and that they must notify the district once the changes have been made in the field. Once the District Bridge Engineer is notified of the posting change being implemented in the field, a PIN form should be completed and emailed to the BRINV email group. As part of the resolution of the posting issue, photographs of the updated posting signs in place should be added to the TMS Media for the impacted structure.

Section 4.5.5.2.2: Field Postings Issues

About 95% of the locally owned structures in Missouri are inspected by MoDOT staff. The remaining 5% of locally owned structures are inspected either directly by the local agency or by a consultant that is working with the local agency. The responsibilities for reporting and addressing load posting issues found during inspections will vary depending upon whether MoDOT or the local agency completed the inspection.

For local agency inspections, the inspector is required to compile a summary letter of the various issues noted during the inspection cycle. As part of this summary letter, a list of structures that had PIN forms submitted during the inspection cycle should be provided.

Structures Inspected by MoDOT

When a MoDOT inspector discovers deficiencies with the load posting during an inspection, the inspector should immediately notify the District Bridge Engineer of the posting problem found and get direction on how to proceed. The District Bridge Engineer will be responsible for determining who fills out and submits the PIN form that

is required for documenting posting deficiencies found during inspection. Part of that discussion will include designating who will update the field posting in TMS, including updating of the Bridge Status to the most appropriate value from EPG 753.4.5.2, and the TMS entry of a Posting Sign Problem from EPG 753.4.5.3.

Since the local agency is ultimately responsible for addressing load posting deficiencies, the District Bridge Engineer should contact the local agency about the posting deficiency and the updates needed in the field to resolve the posting issue. A copy of the PIN form should be provided to the local agency and the local agency should be made aware of the 30-day timeline required in federal regulations for resolution of the load posting issue. The local agency should be instructed to notify the District Bridge Engineer once the changes have been made in the field. Once the District Bridge Engineer is notified of the posting change being implemented in the field, the PIN form should be completed and emailed to the BRINV email group. As part of the resolution of the posting issue, photographs of the updated posting signs in place should be added to the TMS Media for the impacted structure.

Structures Inspected by Local Agency or their Consultant

When a local agency inspector discovers deficiencies with the load posting during an inspection, the inspector should immediately notify the appropriate authorities at the local agency which would be responsible for correcting the posting deficiency. The inspector should also make the MoDOT District Bridge Engineer aware of the posting problem found and what is being done to resolve the issue so that the District Bridge Engineer can provide any additional warranted direction including determining who will fill out the PIN form and the 30-day timeline for resolution of the posting deficiency. The completed PIN form should be provided to the District Bridge Engineer who will review it and submit it to the BRINV email group. The District Bridge Engineer will ensure that the field posting in TMS is updated to reflect the deficiency found during inspection, including updating the Bridge Status to the most appropriate value from EPG 753.4.5.2. The District Bridge Engineer will also complete the TMS entry of any appropriate Posting Sign Problems from EPG 753.4.5.3.

Once the local agency has addressed the posting deficiency, the inspector should revisit the structure to confirm resolution of the posting issues and document the resolution of the issues with photographs. Once the resolution of the posting deficiency is confirmed, a new PIN form should be completed to document that the issue has been resolved. The completed PIN form should be provided to the District Bridge Engineer who will review it and submit it to the BRINV email group. The District Bridge Engineer will ensure that the field posting in TMS is updated to reflect that the deficiency has been addressed, including an update of the Bridge Status to the most appropriate value from EPG 753.4.5.2 and removal of any previously coded sign problems.

EPG 753.4.6: Underwater Inspection

Coding of an underwater inspection in TMS will be required for all structures that cross waterways. This section defines the different categories of underwater inspections and provides guidance on the processes and procedures that shall be followed for underwater inspections and for the collection of channel cross sections on structures over waterways. Section 4.1 should be referenced for the definition of the following terms that are used in this section: Team Leader, Inspector Diver, and Safety Diver.

EPG 753.4.6.1: Inspection Categories

An underwater inspection is generally defined as a detailed inspection performed on the substructure elements of a bridge or culvert that are either directly in the waterway or are adjacent to the waterway, such that normal stream flow activity has a direct impact on that element of the structure. An underwater inspection should also include a review and assessment of the channel and channel protection surrounding the structure. For tracking purposes, an underwater inspection will be coded in TMS for all structures that cross waterways.

Underwater inspections will be performed using some combination of visual techniques, wading/probing techniques, diving techniques, depth soundings, and other acceptable methods. Other acceptable methods would include bathymetric surveys which can provide very detailed information related to the scour that may be going on at a structure and acoustic imaging (sometimes referred to as side scan sonar) which can provide information on the scour that may be present at a bridge pier as well as provide an acoustic image of the elements of the substructure unit that are below the waterline.

There are four categories of underwater inspections: Dry, Shallow Wade, Deep Wade, and Dive. All structures over waterways will be required to have an underwater inspection coded in TMS using one of these categories. For National Bridge Inventory (NBI) reporting purposes, only the Deep Wade and Dive categories will be reported as underwater inspections since they typically involve more advanced inspection techniques and/or require equipment that is typically not present during a normal routine inspection.

The category for an underwater inspection shall be assigned based on the most common situation present during inspections. Once a category is determined for a structure, it should not be changed on future inspections without approval of the Bridge Management Engineer. As an example, an underwater inspection coded as a Dive or Deep Wade should never have the category switched to a Dry or Shallow Wade during an abnormal dry period.

EPG 753.4.6.1.1: Dry

Many structures that cross waterways will not have any substructure units that are directly located within the waterway. In other situations, there may be substructure units

that are either located directly in the waterway or are close enough to the waterway that they are directly impacted by stream flow, but during the routine inspection the areas around the substructure units are found to be dry. In these situations, the underwater inspection will be categorized as “Dry” and the inspection should be completed as part of the routine inspection.

“Dry” underwater inspections should be performed using visual inspection techniques along with normal routine inspection tools to assess and record the condition of the substructure elements that are directly impacted by the waterway. All “Dry” underwater inspections should be coded with an inspection frequency of 60 months, unless a reduced frequency of inspection is needed based on the criteria discussed in Sections 4.2.6.2 and 4.2.10. Although the inspection frequency is being coded as 60 months, it is expected that an underwater inspection will be performed and coded along with each routine inspection, provided the units can still be observed in a “Dry” state.

During the routine inspection, the elements of the substructure that are near or in the waterway should be reviewed as part of that inspection. Once the routine inspection is completed, the inspector should code and update the normal routine inspection information and then update the date, inspector, and other pertinent information for the underwater inspection that is coded in TMS for the structure. If the typical conditions found at the site have changed such that the underwater inspection would no longer be classified as a “Dry”, then the structure may be considered for a higher level of underwater inspection. The Team Leader for the inspection should notify the District Bridge Engineer of the recommended change in the underwater inspection category. The District Bridge Engineer should review the recommended category change, and if in agreement, forward the information to the Bridge Management Engineer for review and concurrence. Updates to the category for underwater inspections will be made by Bridge Division personnel under the direction of the Bridge Management Engineer.

EPG 753.4.6.1.2: Shallow Wade

During a routine inspection, it is common to find substructure units located within areas of the waterway that have shallow water present and require some combination of visual, wading, and probing techniques to assess the condition of the substructure elements located in the waterway. When these situations are found, the underwater inspection will be categorized as a “Shallow Wade.” To be categorized as a “Shallow Wade” underwater inspection, at least one of the substructure units has to be partially or fully in the water with water depths typically not exceeding three feet. Water depths of three feet or less should easily be inspected using water proof boots or hip waders, which are typically available for the inspectors doing the routine inspection.

During the underwater inspection, substructure units that are directly impacted by the waterway but are found in a dry condition should be inspected using visual inspection techniques along with normal routine inspection tools to assess and record the condition of the substructure unit. For the substructure units that are found in a wet condition,

visual techniques and normal inspection tools would be appropriate for conducting the inspection whenever the water depth and visibility are such that everything can be visually assessed. When the water is deeper or has low visibility, wading and probing techniques will be required to properly assess the physical condition of the substructure elements that are below the waterline and to determine and document any undermining that may be present. Probing techniques should include checking for the presence of scour as well as feeling with the probing rod along the substructure elements for signs of defects such as spalling and section loss.

All “Shallow Wade” underwater inspections should be coded with an inspection frequency of 60 months, unless a reduced frequency of inspection is needed based on the criteria discussed in Sections 4.2.6.2 and 4.2.10. Although the inspection frequency is being coded as 60 months, it is expected that an underwater inspection will be performed and coded along with each routine inspection unless conditions exist that would prohibit a “Shallow Wade” underwater inspection from being completed. The inspector may elect to return to the site at a later date to perform the underwater inspection whenever conditions are more conducive for performing this inspection provided that the inspection frequency will not be exceeded.

During the routine inspection, the elements of the substructure that are near or in the waterway should be reviewed as part of that inspection. Once the routine inspection is completed, the inspector should code and update the normal routine inspection information and then update the date, inspector, and other pertinent information for the underwater inspection that is coded in TMS for the structure. If the typical conditions found at the site have changed such that the underwater inspection would no longer be classified as a “Shallow Wade” underwater inspection, then the structure may be considered for a higher level of underwater inspection. The Team Leader for the inspection should notify the District Bridge Engineer of the recommended change in the underwater inspection category. The District Bridge Engineer should review the recommended category change, and if in agreement, forward the information to the Bridge Management Engineer for review and concurrence. Updates to the category for underwater inspections will be made by Bridge Division personnel under the direction of the Bridge Management Engineer.

EPG 753.4.6.1.3: Deep Wade

Occasionally, structures will be found that have substructure units that are located in deeper water where wading/probing techniques are still appropriate for assessing the condition of the substructure elements in the waterway, but normal inspection equipment may not be sufficient for doing the inspection. These inspections may require the use of specialized equipment, such as a boat, to access the substructure units that are in the waterway. When these situations are found, the underwater inspection will be categorized as a “Deep Wade.” To be categorized as a “Deep Wade” underwater inspection, at least one of the substructure units has to be located in the water with water depths typically exceeding three feet around the substructure unit. “Deep Wade”

inspections should generally be limited to no more than 10 feet in maximum depth, where a combination of wading and probing of the unit(s) is appropriate for verifying conditions. It will be the responsibility of the Team Leader on the inspection to confirm that wading and probing techniques are appropriate and that a “Dive” inspection is not needed. Situations where a substructure unit may not be in deeper water, but deeper water has to be crossed using specialized equipment to access the substructure unit, should be coded as a “Deep Wade” and noted on the inspection report.

During the underwater inspection, substructure units that are directly impacted by the waterway but are found in a dry condition should be inspected using visual inspection techniques along with normal routine inspection tools to assess and record the condition of the substructure unit. For the substructure units located in the water, visual techniques and normal inspection tools would be appropriate for conducting the inspection whenever the water depth and visibility are such that everything can be visually assessed. When the water is deeper or has low visibility, wading and probing techniques will be required to properly assess the physical condition of the substructure elements that are below the waterline and to determine and document any undermining that may be present. Probing techniques should include checking for the presence of scour as well as feeling with the probing rod along the substructure elements for signs of defects such as spalling and section loss.

All “Deep Wade” underwater inspections should be coded with an inspection frequency of 60 months, unless a reduced frequency of inspection is needed based on the criteria discussed in Sections 4.2.6.2 and 4.2.10. Substructure elements that can be accessed using normal routine inspection equipment should be inspected as part of the routine inspection at the intervals that have been established for that inspection. The portions of the substructure that are located in deeper water and require some type of special equipment to inspect the unit should have a “Deep Wade” inspection coded with an inspection frequency of 60 months or less. Whenever the underwater inspection has been completed, the date, inspector, and other pertinent information should be coded in TMS for the structure.

If the typical conditions at the structure site have changed such that a Deep Wade inspection is no longer required, the Bridge Management Engineer or the Supervising Bridge Inspection Engineer should be provided with information on the structure for review and final determination of a category switch. If an update is needed, the TMS coding will be changed by Bridge Division as directed by the Bridge Management Engineer.

EPG 753.4.6.1.4: Dive

Whenever substructure units are located in water where the water depth exceeds three feet and wading/probing techniques have been eliminated as an inspection option, the inspection will be categorized as a “Dive.” For these inspections, a boat and/or SCUBA equipment are used to access and assess the underwater condition of the substructure

units. These inspections are typically a “hands-on” and tactical type of inspection and should include determination of the limits of any scour that is present and provide recommendations for repairs, as needed.

All underwater inspections categorized as a “Dive” should be coded with an inspection frequency of 60 months, unless a reduced frequency of inspection is needed based on the criteria discussed in Sections 4.2.6.2 and 4.2.10. Whenever the underwater inspection has been completed, the date, inspector, and other pertinent information should be coded in TMS for the structure.

If the typical conditions at the structure site have changed such that a Dive inspection is no longer required, the Bridge Management Engineer or the Supervising Bridge Inspection Engineer should be provided with information on the structure for review and final determination of a category switch. If an update is needed, the TMS coding will be changed by Bridge Division as directed by the Bridge Management Engineer.

EPG 753.4.6.1.4.1: Acoustic Imaging

Acoustic imaging technology has advanced to where it can basically provide a three dimensional type image of the substructure units that are in the water. When done properly, these images can provide a better and more thorough assessment of the condition of the underwater elements of a pier than what a diver may provide. Acoustic scanning is basically done by shooting sonar waves sideways onto a pier to develop an image of the surface of the pier from the waves reflected back. Because of the way this scanning is done, some individuals refer to this technique as side scan sonar.

The use of acoustic imaging in conjunction with diving operations may be acceptable for situations where it is difficult to inspect the underwater elements of a bridge. When this method is being employed, it would be expected that the entire perimeter of the substructure unit be scanned using this technology. The scanned images should be reviewed “real time” for irregularities. These areas noted should be reviewed by the Team Leader to determine if a diver needs to be sent into the water to physically review and better define these potential areas of concern. Also, any known deficiencies in the substructure or foundation should be reviewed by divers, as directed by the Team Leader.

Because of the high water velocities and difficult diving conditions, underwater inspection of Missouri River and Mississippi River bridges should involve the use of acoustic imaging in conjunction with diving operations. All piers located in the river should have an acoustic scan done of the entire pier to assess the general condition of the pier and to determine any scour that may be present. If irregularities are identified during the scanning process, then divers should be sent down to review these areas, as determined by the Team Leader in charge of the inspection. Likewise, known deficiencies should be reviewed by divers as directed by the Team Leader.

EPG 753.4.6.1.4.2: Bathymetric Surveys

A bathymetric survey is another type of acoustic imaging. It differs from side scan sonar in that the sonar waves used for the scan are projected downward to the streambed to develop a three dimensional image of the bottom of the stream. This type of imaging provides a good assessment of the scour conditions that exist at a structure, but typically won't provide any detail on the physical condition of a pier. MoDOT has utilized this technology through USGS to study the Missouri River and Mississippi River structures to better assess scour conditions at individual bridges. This type of scan would not be considered acceptable as an underwater inspection by itself since it does not provide information on the condition of the piers. However, this type of scan can be utilized in conjunction with other techniques to perform underwater inspections on structures.

EPG 753.4.6.2: Channel Cross Sections

Stream channel cross sections must be collected for each bridge that spans a waterway. The purpose of collecting channel cross section data is to document long-term changes in the waterway opening at the bridge, stream bed degradation, or any lateral shift in the stream, that may affect the structure.

The methods and procedures used to collect this data will vary depending on the type of underwater inspection that was coded for the bridge. Collection of channel cross sections does not constitute an underwater inspection and does not have to be performed by a Team Leader. Channel Cross Sections will be coded as a Data Collection inspection in TMS.

EPG 753.4.6.2.1: Dry or Shallow Wade

For structures that have underwater inspections categorized as a "Dry" or "Shallow Wade", the collection of channel cross section measurements should be done at intervals not to exceed 10 years. The collection of this data should be completed during the routine inspection for the structure. New structures should have cross section data taken as part of the inventory data collection effort for the structure, but should be done no later than the first routine inspection for the structure after it is initially inventoried.

More frequent collection of cross section measurements will be required for structures that meet the criteria shown in the table below. When the Channel Rating or Channel Protection Rating is different than the Scour Rating, the lower of the three ratings should be used to determine the required interval for collecting cross section measurements. Data collection for structures meeting these criteria should be done during the routine inspection for the structure. Data collection at more frequent intervals than what is shown in this table can be done at the discretion of the inspector.

Channel or Channel Protection Rating	Scour Rating	Required Interval
5	5	72 months
4	4	48 months
≤ 3	≤ 3	24 months

The collection of channel cross section measurements will not be required for structures that are classified as culverts in TMS. For culverts, it is recommended that upstream and downstream photographs be taken on ten year intervals as a means for documenting what is happening with the channel around the culvert. In situations where the culvert has a bottom slab and the toe wall is significantly exposed from scour, it is recommended that the inspector measure and document the extent of the scour at the toe wall so that it can be used for reference during future inspections or for planning corrective maintenance activities at the structure.

For non-culvert structures that have a paved channel running under the structure, collection of channel cross section measurements is not required. For these situations, it is recommended that the inspector put a general comment in the TMS system to document the presence of a paved channel bottom resulting in no need for channel cross section measurements.

EPG 753.4.6.2.1.1: Collection Procedure

The Team Leader in charge of the inspection on a structure will be responsible for determining the appropriate procedure to use for the collection of channel cross section information on a structure. The following guidance is provided to ensure that the data is collected in a consistent manner and is appropriately recorded.

Horizontal Reference Point on a Structure—A fixed horizontal reference point should be used as a datum for taking channel depth measurements on a structure. It is recommended for most situations that this reference point be the top of the deck.

The horizontal reference point that is used should be recorded as part of the documentation of the measurements taken on a structure. If different reference points are used for different spans on a structure, then the documentation should clearly define which reference point was used for each span. From this fixed reference point, drop lines, rods, or other appropriate measuring equipment can be used to collect the data.

Longitudinal Locations along Structure—It is recommended that the vertical measurements from the horizontal reference point to the ground line be taken at the front face of each abutment, at each intermediate bent location, and at the break points in the slope or channel along the length of the structure. As an alternative on some shorter structures, the inspector may take measurements at the quarter or third points or at other fixed reference points along the structure such as the panel points on trusses or at the rail

posts. The horizontal distances from the beginning of the structure to the various measuring locations may need to be recorded as part of the data collection effort.

As the minimum requirement, measurements will have to be taken along one side of the structure. Most structures are inventoried in the direction of the stationing, when plans are available, or in the case of most nonstate structures, from North to South or West to East. Based on the direction of increasing stationing or the inventoried direction of the structure, measurements should generally be taken on the right side of the structure unless some obstacle prevents this from being possible. Measurements along the other side of the structure may be taken, at the discretion of the inspector. Measurements should be recorded to the nearest one tenth of a foot. Where obvious channel movement is observed, additional data may need to be collected further upstream or downstream, at the discretion of the inspector.

For larger bridges where there may be many spans located outside the main channel of the waterway, it is not necessary to take measurements for all of these spans. For these situations, the spans located within the channel should have measurements taken and the inspector on site should determine which adjacent spans on each side of the main channel need to have measurements taken. Whenever serious channel migration issues are developing on a structure, additional spans outside of the required spans should have measurements taken for future reference in monitoring the channel migration issues.

Drift and Localized Scour—Over the course of time, the inspector will encounter drift piles or localized scour around substructure units. When localized scour is present, the inspector may need to take additional measurements to better define the extent of the scour that is present. When drift piles are encountered at locations where a measurement needs to be taken, the inspector should take measurements on each side of the drift pile in lieu of the original measurement location, and make note of the condition on the data form

Datasheet—Cross section measurements should be recorded in a consistent manner so that the information can be reproduced and utilized in future inspections for the purpose of tracking changes in the channel cross section. The recommended method of recording this data is in a tabular format where the longitudinal location of the measurement and the corresponding vertical measurement are recorded in rows or columns for each year that the measurements are taken. When plan sheets are available, measurements may be plotted on these plan sheets, if it better depicts the history of the channel section under the bridge. When bottom of footing elevations are known, it is recommended to document this information on the data form for reference during inspections.

At subsequent data collection times, the previous data sheet should be updated with the new data so that it can be compared to the previous data, to determine the change in the channel cross section. Standard datasheets for collecting this data in a tabular format have been developed and are available from the Bridge Inventory Analysts. Other data forms may be developed as long as the measurements can be adequately collected and

added to the form to depict the channel cross section, and can be recreated on future inspections.

Photos—As part of the documentation, when channel measurements are made, photographs of the channel condition should also be taken. At a minimum, one upstream and one downstream photograph should be taken from the deck of the structure. These photographs should be taken at the approximate center of the channel and along the skew line of the structure for the substructure units located in or near the channel. Where significant channel issues exist, additional photographs should be taken to better document the channel conditions and alignment.

Recording in TMS—Once the data for a structure has been recorded on the datasheet, it should be loaded into TMS. The datasheet should include the date that the data was collected and the frequency on which the data needs to be collected. A Data Collection inspection should be entered or updated in the TMS system to document that the channel cross section dimensions were collected.

EPG 753.4.6.2.2: Deep Wade or Dive

For structures that have underwater inspections categorized as a “Deep Wade” or “Dive”, the collection of channel cross section information should be done at the same time the underwater inspections are completed. The appropriate method for collecting this information should be determined by the Team Leader in charge of the underwater inspection.

EPG 753.4.6.2.2.1: Collection Procedure

The locations for taking measurements should be determined by the Team Leader in charge of the inspection based on the conditions found in the field as well as past inspection reports. The following are the minimum requirements for the collection of this data. Additional data may be collected at the discretion of the Team Leader.

1. Upstream Fascia—Take measurements along the outside edge of the structure at each substructure unit and, at a minimum, quarter points between the substructure units. For very large structures, tenth points are suggested or whenever the structure is a truss, at the panel points.
2. Downstream Fascia—Take measurements along the outside edge of the structure at each substructure unit and, at a minimum, quarter points between the substructure units. For very large structures, tenth points are suggested or whenever the structure is a truss, at the panel points.
3. Upstream—Generally, measurements should be taken in line with the measurements taken along the upstream fascia. Additional points parallel to the structure may be needed to completely define the channel of the stream whenever the extents of the channel are beyond the bridge length. A minimum of one set of

measurements is required with the measurement line being at least 20 feet away from the face of the structure. Additional lines of measurement may be taken, at the discretion of the inspector.

4. Downstream—Generally, measurements should be taken in line with the measurements taken along the downstream fascia. Additional points parallel to the structure may be needed to completely define the channel of the stream whenever the extents of the channel are beyond the bridge length. A minimum of one set of measurements is required with the measurement line being at least 20 feet away from the face of the structure. Additional lines of measurement may be taken, at the discretion of the inspector.
5. Substructure Units—When information is known about the depth and size of the footings for the substructure units in the water, measurements should be taken at the approximate edge of the footing on all four sides at each footing location.

Channel cross section measurements taken during a deep wade or dive inspection should be documented using a graphical representation. At a minimum, a plan view of the structure should be provided indicating the locations of the measurements taken along with the value of the measurements. It is also recommended that elevation views of the upstream and downstream fascia be provided as well to give a better presentation of what is going on underwater in relation to the substructure units. Any graphical representations that are developed should be included as part of the inspection report on the structure.

EPG 753.4.6.3: Inspection Responsibilities

The individuals responsible for performing the underwater inspection will vary depending on the owner of the bridge and on the category of inspection that is needed. The following sections provide guidance on the person that will be responsible for performing an underwater inspection on a structure.

EPG 753.4.6.3.1: State

MoDOT owned structures that have site conditions that meet the criteria to be categorized as either a “Dry” or a “Shallow Wade” underwater inspection will be the responsibility of the inspector that performs the routine inspection on the structure, if conditions exist that permit the underwater inspection to be performed. The inspector may elect to return to the site at a later date to perform the underwater inspection whenever conditions are more conducive for performing this inspection provided that the inspection frequency will not be exceeded.

The underwater inspection may be performed and the appropriate information updated in TMS as part of the routine inspection process. These inspections will typically be performed by district personnel, but may be performed by Bridge Division personnel for

the situations where the routine inspection is being performed by one of the inspection crews from Bridge Division.

MoDOT owned structures that have site conditions that meet the criteria to be categorized as a “Deep Wade” or “Dive” underwater inspection will be the responsibility of the dive team located in Bridge Division. In some situations, the dive team may request assistance from district personnel when performing these inspections.

Consultants or other outside agencies occasionally may be contracted to perform underwater inspections or acoustic scans on structures. This will primarily happen on Missouri River and Mississippi River bridges or on deep lake bridges, but may happen on other structures as well. All contracts for underwater inspections by outside entities will be administered by Bridge Division.

EPG 753.4.6.3.2: Nonstate

Locally owned structures that have site conditions that meet the criteria to be categorized as either a “Dry” or a “Shallow Wade” underwater inspection will be the responsibility of the inspector that performs the routine inspection on the structure. The underwater inspection should be performed and the appropriate information updated in TMS as part of the routine inspection process. These inspections will typically be performed by district personnel, but may be performed by local agency personnel and consultant personnel that are performing routine inspections on structures.

Locally owned structures that have site conditions that meet the criteria to be categorized as a “Deep Wade” or “Dive” underwater inspection will be done in a variety of ways. Some of them will be contracted out to consultants specializing in underwater inspection services. In some situations, the district may have the training and appropriate equipment to perform a Deep Wade inspection. For Dive and most Deep Wade inspections, members of the dive team from Bridge Division may perform the inspection. Consultant contracts for underwater inspection of locally owned structures will be administered by Bridge Division.

EPG 753.4.6.4: Inspection Team Makeup

The requirements defined in this section will apply to all underwater inspections that are categorized as “Deep Wade” or “Dive”. Underwater inspections that are categorized as “Dry” or “Shallow Wade” should have an inspection team makeup in accordance with the requirements in Section 4.1.8 and Section 4.1.9.

EPG 753.4.6.4.1: State and Nonstate

A minimum of three personnel will be required to be on site during all underwater “Deep Wade” inspections performed by MoDOT personnel. When the inspection involves diving operations, a minimum of four people will be required. MoDOT’s *Manual of Safe*

Diving Procedures should be consulted for more detailed requirements about the makeup of the inspection team.

EPG 753.4.6.4.2: Consultant

The inspection team makeup for consultant inspections shall be in accordance with the requirements in the contract.

EPG 753.4.6.4.3: Team Leader Requirement

Federal law requires a Team Leader certified person to be on site during underwater inspections on structures. The basic requirements for becoming Team Leader qualified are defined in Section 4.1. Section 4.1.7.4 includes additional requirements for the individual acting as the Team Leader on underwater inspections.

EPG 753.4.6.4.4: Diver Qualifications

Section 4.1 defines the terms Inspector Diver and Safety Diver. An Inspector Diver qualified person is required to perform the “in the water” portions of all underwater inspections categorized as a “Deep Wade” or “Dive”. The requirements to qualify as an Inspector Diver and Safety Diver are defined in Section 4.1.5 and Section 4.1.6, respectively.

EPG 753.4.6.5: Inspection Process/Procedures

All underwater inspections should be conducted in a manner such that the underwater elements of the structure can be properly assessed using appropriate methods.

When visual methods are being used, all elements of the substructure unit that are under water should be reviewed as part of the inspection. Notable defects that are present should be recorded on the inspection report through comments or by coding the actual conditions found in TMS. When possible, pictures of the defects should be taken. The presence of scour and debris in the channel should be noted as well.

When wading/probing methods are used, all elements of the substructure unit that are under water should be reviewed as part of the inspection. When diving, a “hands on” inspection should be done on the substructure elements that are under water. When probing, the elements should be checked for defects and undermining that is present. Notable defects that are found should be recorded on the inspection report. Undermining that is found should be documented in accordance with Section 4.6.7.2. Photographs should be taken, when possible.

If the diving operation identifies a need for a more advanced type of inspection, it should be noted on the inspection report, and the Bridge Management Engineer (nonstate system) or Supervising Bridge Inspection Engineer (state system) should be notified. In

these situations, the inspections will be contracted out to consulting engineering firms that specialize in dive inspections.

EPG 753.4.6.6: Inspection Frequencies

For underwater inspections that can be categorized as “Dry” or “Shallow Wade”, it is expected that these inspections will be performed in conjunction with the routine inspection, and documented in TMS, even though the frequency has been set at 60 months. In the event that a “Dry” or “Shallow Wade” inspection cannot be performed at the time of the routine inspection, it may be deferred to the next inspection, or a later date when conditions are more favorable to access, provided that the established frequency is not exceeded.

On some structures, a reduced interval inspection may be warranted because of issues that exist on the structure. More information on reduced inspection frequencies for underwater inspections can be found in Section 4.2.9.

EPG 753.4.6.7: Inspection Reporting/Coding

A formal underwater inspection report is only required for underwater inspections categorized as “Deep Wade” or “Dive”. This section provides guidance on the items that should be provided in an underwater inspection report for a structure. The inclusion of procedures for the underwater inspection is mandatory. Guidance is provided in the following sections on what would be classified as general inspection procedures and what would be classified as special inspection procedures.

For underwater inspections categorized as “Dry” or “Shallow Wade”, underwater conditions such as undermining or footing exposure should be documented in the comments area of TMS for the substructure, culvert, channel, channel protection, and/or scour ratings or by coding the actual conditions on the appropriate elements for the structure in TMS.

EPG 753.4.6.7.1: General Information

The following general information should be included on all inspection reports for Deep Wade and Dive underwater inspections. The sections that follow provide more detailed information for some of the items that are included in this list.

1. Date of inspection.
2. General procedures that would be used for a typical underwater inspection on the structure.
3. Specialized procedures that are unique to the inspection for a structure.
4. Team Leader, Divers, and other team members.
5. Identification of all substructure units to be inspected.
6. Weather conditions.

7. Water conditions and depth of water.
8. General condition of the waterway.
9. Inspection access to waterway and substructure units.
10. Risk factors associated with the inspection (i.e. stream velocity, water visibility, debris, underwater hazards, etc.).
11. Additional features inspected (i.e. scour countermeasures, dikes, etc.).
12. General inspection equipment used.
13. Historical or existing conditions at the site.
14. Stream bed composition.
15. Condition rating assessment of Substructure, Culvert, Channel, Channel Protection, Scour, and Underwater Member Condition, along with commentary on the findings.
16. Photographs of units in water and, if possible, deficiencies noted.
17. Recommendation for future inspection frequency.
18. Recommendations for any repairs or other actions needed on the structure.

EPG 753.4.6.7.1.1: General Procedures for Inspection

The inspection report should include a narrative that describes the general procedures used during the inspection. This would include identifying the substructure units and waterway features that were inspected as well as the general process used to inspect the items. This serves the purpose of documenting what generally needs to be done to conduct an underwater inspection at a structure.

When identifying the substructure units that were included as part of the underwater inspection, the labeling or numbering of the substructure units should be consistent with the bridge plans for the structure. When bridge plans are not available, the substructure units should be numbered in accordance with how the bridge is inventoried in TMS and the direction in which the substructure units are numbered (i.e. West to East) should be included in the report.

The following is an example of how the general inspection procedures might be documented with a short narrative in the inspection report.

Example Procedure: Perform an underwater inspection on Pier 2 and Pier 3, which are reinforced concrete hammerhead type piers with drilled shaft foundations. The inspection should be a visual and tactile inspection of the areas of the piers below the waterline with a more detailed examination of significant areas of deterioration that are identified. Channel cross sections should be taken upstream and downstream of the structure in accordance with current policy.

EPG 753.4.6.7.1.2: Specialized Inspection Procedures

Most underwater inspection will be conducted using procedures that are common for any type of diving operation. On some structures, there may be things present that put the structure at a higher risk for having underwater problems or there may be things present

that present a safety risk to the inspection personnel. These situations should be documented in the inspection record for the structure in a manner that allows future divers to easily determine that these special issues exist when reviewing past diving reports. The following are some common examples of things that should be documented in the inspection report.

- A. Environmental Hazards—Diving operations may be needed in water that is known to be contaminated or is highly likely to contain contaminants. The type of suspected contamination should be identified on inspection reports along with the appropriate countermeasures that may be needed to safely perform the dive.
- B. Physical Hazards—Physical hazards may be known to exist at certain bridge sites. A common example would be debris from a previously demolished structure. Another common example would be debris or drift piles that are significant enough to have an impact on the inspection. When these conditions are found and present a potential safety risk to divers, they should be documented on the inspection reports.
- C. Access Issues—Structures may have special access or scheduling issues that exist. This could include access points for the waterway. Another example may be a structure that is located within a secure area requiring coordination with security personnel to gain access to the site for the dive inspection. These issues should be documented on the inspection report and should include contact information when coordination with security personnel is needed.
- D. Resource Issues—More complicated dives may require additional personnel than what would be found on a typical dive inspection crew. This issue should be documented on the inspection report and should include the number of people needed to safely perform the dive.
- E. Equipment—Some dives may require equipment that is beyond what would normally be available on a routine diving operation. If this situation exists, the specialized equipment should be identified on the inspection report along with the reasons for this specialized equipment.
- F. Waterway Issues—Some structures may have waterway issues that the inspector should be aware of as the inspection is being planned. Common examples would be rapid stream flows, significant drift/debris issues, constricted waterway openings, unstable streambeds, and meandering channels. When these things are known to exist and have the potential to impact the inspection process in some manner, they should be identified on the inspection report.

The following is an example of documentation for a structure with special inspection procedures.

Example Special Procedures: Structure is located on a public road in the airport. Access to the structure has to be made through a secure area which requires coordination of the inspection with airport security personnel. The structure crosses a detention pond, which is suspected of being contaminated with chemical residue from deicing agents. The structure also acts similar to a dam with a large vertical drop off on the downstream side of the structure. Water typically does not flow under the structure unless there has been a significant rainfall event. During a significant rainfall event, the structure can't be safely inspected.

EPG 753.4.6.7.1.3: Team Members

The underwater inspection report shall identify the person that was acting as a Team Leader for the inspection. The report should also identify all individuals that were acting in the capacity of an Inspector Diver. Other members of the team may be identified on the report at the discretion of the Team Leader.

EPG 753.4.6.7.1.4: Condition Ratings

As part of an underwater inspection, the substructure rating or culvert rating, scour rating, and channel rating, and channel protection rating should be reviewed and updated accordingly. An overall underwater member condition should also be assessed. The recommended rating for these items based on the underwater conditions should be included on the inspection report. If collision damage, buckling, or other types of deterioration or damage are present on the submerged portions of a structure, then they should be appropriately documented on the inspection report. A short narrative should be provided on the report as a justification for the condition rating that was assigned. The substructure and culvert ratings assessed based on the underwater conditions will be compared to the ratings assessed for the conditions above the waterline and the lower value for each rating will be coded in TMS for the structure. When underwater conditions control the overall rating for a structure, a comment indicating this should be recorded in TMS.

EPG 753.4.6.7.1.5: Photographs

The underwater inspection report should include photographs to detail specific conditions that are found during the inspection. At a minimum, the report should include an upstream and downstream photograph of the channel along with some type of profile view of the substructure units that are in the water.

EPG 753.4.6.7.2: Documenting Undermining

Undermining is a common condition finding on underwater inspections. The level as well as the locations of undermining found on substructure units will vary over time as the conditions in the stream change. Undermining found in previous inspections may not be found in a subsequent inspection as the result of previous scour holes silting back in over a period of time. It is important to document undermining during an inspection so

that the inspectors on subsequent inspections can consider the history on a structure when determining the significance of findings on future inspections. The following guidance should be used for determining how to document undermining.

EPG 753.4.6.7.2.1: Minor or Visible Undermining

When undermining that covers less than 25% of the length or area of the footing on a substructure unit is present, it will be classified as minor. Undermining will be considered to be visible whenever the stream is in a dry condition or the water depth and clarity are such that any undermining present can be easily observed during an inspection.

Undermining that is present on a substructure unit and is visible and can be classified as minor may be documented using photographs. Photographs should be taken at each inspection on all substructure units that have the undermining present.

EPG 753.4.6.7.2.2: Major or Non-Visible Undermining

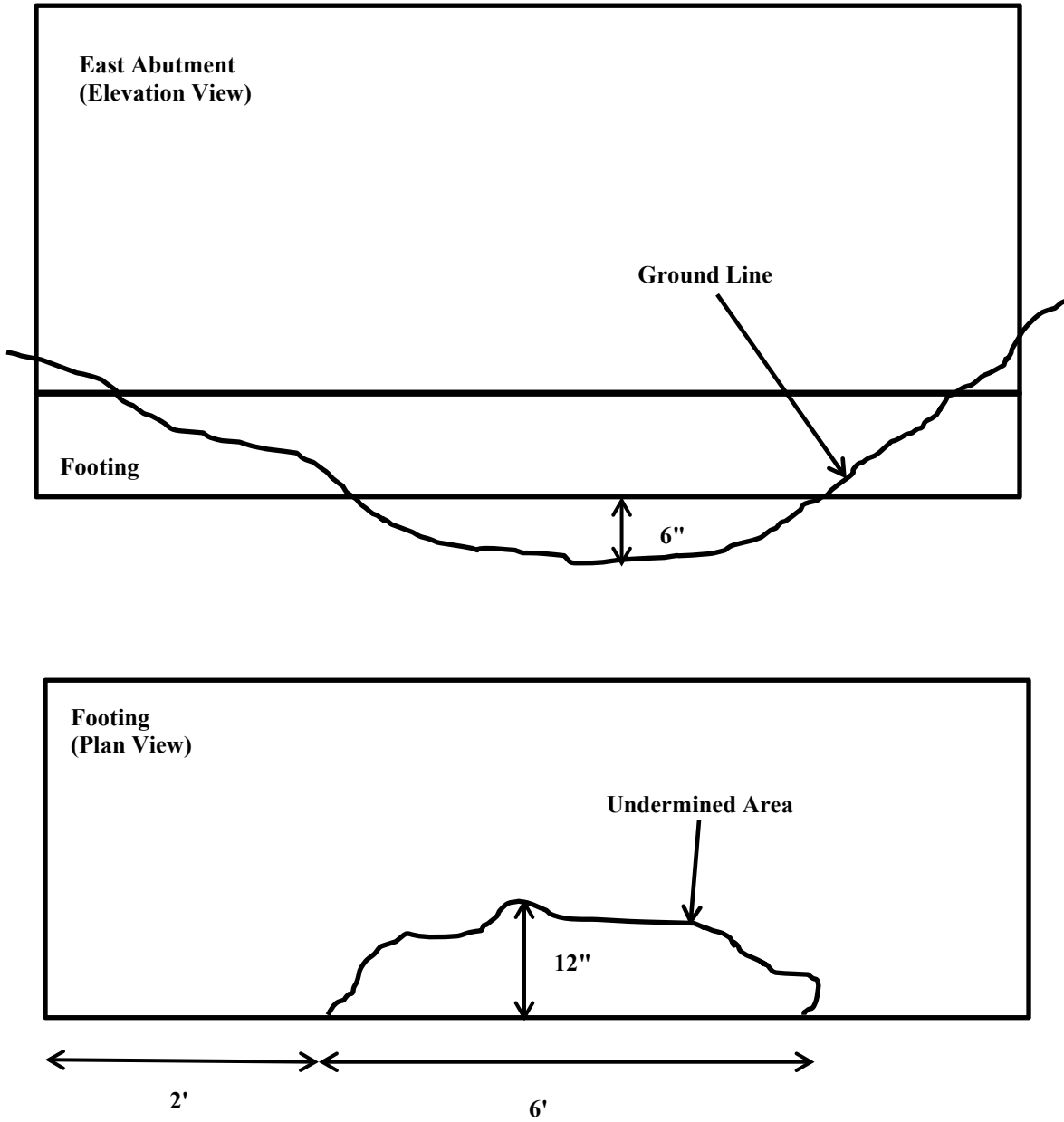
When undermining that covers more than 25% of the length or area of the footing on a substructure unit is present, it will be classified as major. When probing is required to assess the level of undermining present on a structure, it will be classified as non-visible.

Major undermining that is visible during an inspection, at a minimum, should be documented using photographs. Additional documentation should be provided as well. The additional documentation may include detailed comments on the inspection report or it may include some type of diagram that is developed that details the extent and location of the undermining that is present.

Non-visible undermining that is found on a structure during an inspection should be documented using some type of diagram to document the extent and locations of undermining. The diagram should include dimensions from a common reference point so that future inspectors can properly assess any changes that have taken place in relation to undermining that is present.

Documentation Example: An inspector has completed a routine inspection on a structure that has the underwater inspection type coded as “Dry”. During this inspection, major undermining of the footing on the East abutment was found. The structure is founded on weathered rock. Undermining was found to be 6 inches deep and extended back into the footing approximately 12 inches. The length of the undermined area is around 6 feet.

Since the undermining on this structure is considered to be major, the recommended way of documenting it is with a diagram as shown below.



Example of Sketch Documenting Undermining

EPG 753.4.7: Fracture Critical Inspections

A fracture critical inspection is required for all bridges that are determined to be fracture critical in accordance with NBIS regulations. With the 2022 NBIS regulation update, fracture critical members are now called non-redundant steel tension members (NSTM). This section provides guidance on the proper performance and reporting for fracture critical inspections.

MoDOT completes most fracture critical inspections on structures in Missouri. MoDOT also utilizes a statewide consultant contract to perform a small number of fracture critical inspections for local agency structures when it is more efficient to contract out the inspections. MoDOT will occasionally contract out a fracture critical inspection on a MoDOT owned structure as part of a planned rehabilitation project during the design or construction process.

EPG 753.4.7.1: Definitions

Fracture Critical Inspection—Detailed inspection performed on the members of a bridge that are determined to be fracture critical or in the terms of the NBIS 2022 update, non-redundant steel tension members (NSTM).

Fracture Critical Member (FCM)—A tension member, whose failure would result in the partial or total collapse of a bridge. The member has to be steel, non-load path redundant, and be in axial tension or have some element of the member that is in tension.

Hands-On—Inspection performed within arms-length of the fracture critical components of a fracture critical bridge. This inspection will use visual techniques and may be supplemented with nondestructive testing to provide additional information about defects found during the inspection.

EPG 753.4.7.2: Inspection Categories

MoDOT will assign a category to a fracture critical inspection. The category is used to define the predominate type of fracture critical spans that are present at the bridge site. The choices for inspection category are: Deck Truss, Pony Truss, Thru Truss, 2-Girder System, Cross Beam-Substructure, Tied Arch, Suspension Bridge, and Cable Stayed Bridge. In the past MoDOT used categories of Comprehensive and Most Fracture Critical to define fracture critical inspections. When inspectors encounter structures still using the legacy coding, they should be updated to one of the newer categories.

EPG 753.4.7.3: Identifying FCM's on Structures

Based on 2026 NBI data, there are around 540 fracture critical bridges inventoried in Missouri with around 22% of these structures being MoDOT owned and the remainder

being locally owned. The majority of fracture critical bridges in Missouri are either some type of a truss or a girder/floor beam system.

The inventory/inspection information on a structure should include documentation of the fracture critical members on a structure. This documentation for state structures is typically done using elevation views of fracture critical spans and highlighting the fracture critical members. State system structures will also have a spreadsheet table of fracture critical members that is used to document conditions on the various members during an inspection. Nonstate structures will have an inspection spreadsheet that is used for documenting conditions on the structure, and this spreadsheet will have the fracture critical members identified.

Guidelines on how to document the fracture critical members for the common structure types in Missouri are shown below.

EPG 753.4.7.3.1: Trusses

The most common truss found in Missouri is a pony truss. There are also a significant number of thru trusses, which tend to be found on larger stream crossings. A small number of deck trusses still exist on the NBI in Missouri.

Most of the truss bridges in Missouri were constructed in the era when simple span construction was predominant. There are some continuous trusses in the state, but they are typically found on the major rivers and on the larger lakes throughout the state.

For simple span trusses, the fracture critical members will include all of the lower chords and the diagonal members of the truss that are in tension. Vertical members may be in tension or compression, and in some cases may vary back and forth as a vehicle moves across the structure. For simplicity purposes, vertical members should generally be assumed to have at least some tension on them and should be inspected as fracture critical members.

For continuous trusses, the loading scenarios are more complicated with lower chords and uppers chords being in tension or compression depending upon their location within the structure. Some continuous trusses may be cantilevered and have a suspended span, which is typically a simple span. The fracture critical members on a continuous truss should be identified in the inspection records for the bridge with the determination on which members are in tension typically based on a structural analysis or from information on the plans.

Floor beams span transversely between the trusses within a span and either directly support the deck on the bridge or provide support for stringers that the deck rests on. Floor beams are considered fracture critical members since the failure of one could result in the partial collapse of a structure. The floor beams will typically be simple spans between the trusses, so the tension elements on the floor beam members will be the

bottom flange and the lower portion of the web. On some deck trusses, floor beams may have a cantilever portion that extends out over the top of the deck trusses. In these situations, portions of the top flange and the upper portion of the web will be included as tension elements in the negative moment regions.

EPG 753.4.7.3.2: Girder/Floor Beam Systems

Girder/Floor Beam systems will typically consist of two main load carrying steel beams with floor beams spanning between the girders to help transfer the deck loads to the main girders. The floor beams may also cantilever either over the top of the main girders or through the main girders using bolted connections. The tension elements (fracture critical) of the girders and floor beams will be the bottom flange and lower portion of the web in positive moment areas and the top flange and upper portion of the web in negative moment areas.

EPG 753.4.7.3.3: 2-Girder Bridges

Uncommonly, an inspector may find steel bridges that have two girders without floor beams present. A 2-girder bridge is not load path redundant, so it will be classified as fracture critical. The tension elements (fracture critical) of the girders will be the bottom flange and lower portion of the web in positive moment areas and the top flange and upper portion of the web in negative moment areas.

EPG 753.4.7.3.4: Box Girder Bridges

The inspector may occasionally encounter steel box girder bridges. If the structure only has one or two girders on it, then it will be a fracture critical bridge because of the lack of load path redundancy. The tension elements will be the bottom flange and lower portion of the webs in positive moment areas and the top flanges and upper portion of the webs in negative moment areas.

EPG 753.4.7.3.5: Tied Arches

There are a small number of tied arch structures on Missouri's bridge inventory. They will typically consist of a simple span arch that has a member (arch tie) connecting the spring lines of the arch and a floor beam type system that transfers loads to the arch through some type of vertical member (hanger). The typical fracture critical elements of these structures will be the floor beams and the arch tie. In some situations, the hangers may be considered fracture critical if they are not load path redundant. Before classifying the hanger as fracture critical, the inspector should discuss the situation with the Bridge Management Engineer or the Supervising Bridge Inspection Engineer.

EPG 753.4.7.3.6: Cross Girders (Beam Caps)

Occasionally, the inspector will encounter a structure that has a single span steel beam cap that is supporting all of the stringers from the superstructure. These beam caps may also be referred to as a cross girder and may be a regular I-girder type shape or a box girder. Since these girders support the entire superstructure in that area of the bridge, they are not load path redundant and would be considered fracture critical. The tension elements of these members would be the bottom flange and lower portions of the web in positive moment areas.

The inspector may also encounter simple span cross girders that have cantilevers that extend across the column that supports the girder. In these situations, the cantilever portion of the girder will be in negative moment resulting in the tension elements being the top flange and the upper portions of the web.

Another common variation of a fracture critical beam cap is found on a single column hammer head pier that has a box girder beam cap. This beam cap will be cantilevered on both sides of the column, resulting in the tension elements being the top flange and upper portions of the web.

EPG 753.4.7.3.7: Cable Stayed Bridges

There are a small number of cable stayed bridges in Missouri. The structures will consist of one or more towers that have cables running down that attach to an edge girder (stay girder or stiffening girder) running along each side of the structure. Between the stay girders, there will be some type of floor system to transfer the deck loads over to the stay girders and cables. The fracture critical members of these structures will be the stay girders and the floor beams with the tension elements being the portions of the flanges and webs that are in tension.

EPG 753.4.7.3.8: Frame Bridges

Steel frame bridges are occasionally encountered in Missouri. Frame structures typically have a steel superstructure that curves down and continues into a steel column. These members will be made from plates that are welded together. The inspector should review the structure and count the number of frames present. If there are only two frames present, then the structure will not have load path redundancy and be considered fracture critical. Since the superstructure continues down into the frame legs, both the superstructure girders and frame legs would be considered fracture critical. The fracture critical elements of the members will be any portion of the flanges and web that would be in tension. On the frame legs, the stresses may reverse as vehicles move down a structure, so the entire member should be considered fracture critical unless a structural analysis has been completed to fully define the forces within the member.

EPG 753.4.7.4: Inspection Responsibilities

The individuals responsible for performing the fracture critical inspection will vary depending upon the owner of the bridge. The following sections provide guidance on the person that will be responsible for performing these inspections on a structure. All Team Leaders on fracture critical inspections shall meet the qualifications defined in EPG 753.4.1.

EPG 753.4.7.4.1: State System

Bridge Division will be responsible for performing fracture critical inspections on most MoDOT owned structures. These inspections will normally be completed by the UBI crews and may be done in conjunction with routine and in-depth inspections. District personnel may be asked to assist on these inspections whenever additional personnel are needed to safely complete an inspection

Occasionally, consultants may be used to perform fracture critical inspections on state structures. All contracts for fracture critical inspections by consultants will be administered by Bridge Division.

EPG 753.4.7.4.2: Nonstate System

The Districts will be responsible for completing fracture critical inspections on locally owned structures within their district. These inspections will typically be performed in conjunction with the routine inspection. In situations where a local agency inspects their own structures, the local agency will be responsible for the completion of the fracture critical inspection unless some type of specialized equipment or procedures are needed to inspect the structure resulting in the need to have a consultant perform the inspection.

Consultants may be used to perform fracture critical inspections on locally owned structures. Consultant inspections are typically reserved for more complicated structures, for structures that need more specialized equipment to access the fracture critical members, and for structures with severe deterioration where an outside opinion from a consultant may be warranted to assist in making decisions on the status of a structure. All contracts for fracture critical inspections by consultants on locally owned structures will be administered by the Bridge Management Engineer in Bridge Division.

EPG 753.4.7.5: Inspection Team Makeup

The requirements defined in this section will apply to all fracture critical inspections being performed. The members of the inspection team that are actively reviewing members and assigning conditions should at a minimum meet the requirements to be classified as an Inspector. Members of the inspection team that are present for safety

reasons or to provide assistance to the Team Leader and Inspectors do not have to meet the training requirements referenced in this section.

EPG 753.4.7.5.1: State and Nonstate

For safety reasons, at least two persons should be present when performing a fracture critical inspection on a structure. When more advanced access equipment is needed to perform the inspection, the number of people on the inspection team should be sufficient enough to allow the inspection to be safely performed.

EPG 753.4.7.5.2: Consultant

The inspection team makeup for consultant inspections shall be in accordance with the requirements in the contract.

EPG 753.4.7.5.3: Team Leader Requirement

Federal law requires a Team Leader qualified person to be on site during fracture critical inspections on structures. Team Leaders on fracture critical inspections shall meet the training, education, and experience requirements outlined in EPG 753.4.1.

EPG 753.4.7.5.4: Inspector Requirements

EPG 753.4.1 defines the terms Inspector as it relates to bridge inspections. Inspectors are generally someone that has taken some of the inspection classes but has not fulfilled the experience requirements to be certified as a Team Leader. It is recommended that inspectors take the same training required for a Team Leader to enhance their participation on a fracture critical inspection.

EPG 753.4.7.6: Inspection Process

As part of a fracture critical inspection, it is important that all of the fracture critical members are reviewed by the inspection team. To ensure that all members are properly inspected, the Team Leader should review past inspection reports for the structure to determine which members are fracture critical, requiring the “hands-on” inspection. Additionally, the Team Leader should review the types of access equipment that are needed to perform the inspection and any special processes/procedures that are needed in order to perform the inspection on the structure. The inspection team should also be aware of any past history of repairs and critical inspection findings related to the fracture critical members on a structure. For more complex structures, a pre-inspection meeting to discuss the upcoming inspection may be warranted.

During the inspection, the inspection team should follow a systematic process in the performance of the inspection. For all structures, this will involve following the diagram identifying fracture critical members that has been developed for a given structure and

systematically reviewing the members from the beginning to the end of the structure. When inspecting a fracture critical member, it is important that the entire length of the member is reviewed so that the condition of the member can be properly determined. The findings on an individual member should be noted as each member is reviewed and include photographs and measurements, when appropriate.

Some structures will have unique process/procedures that need to be followed during an inspection, resulting in a deviation from the normal inspection routines that are typically used on structures. The unique issues should already be identified on the structure and be included as part of the inspection documentation on the structure.

EPG 753.4.7.6.1: Pre-Inspection Cleaning

Some structures may be located in situations where frequent debris accumulation is common on the fracture critical members, with this being more prevalent on the nonstate system. This debris accumulation may come from the roadway or it may come from regular flooding that frequently submerges the members. If these conditions are known to exist at a site, the inspector should plan ahead for these situations and have the fracture critical members cleaned by the local agency (or other owner) prior to performing the inspection on the structure. A proper inspection can't be completed unless the inspector has visual "hands on" access to all areas of an individual fracture critical member.

EPG 753.4.7.7: Inspection Frequencies

Fracture critical inspections will be performed on a frequency of 24 months, unless a reduced interval inspection is warranted because of issues that exist on the structure. More information on reduced inspection frequencies for fracture critical inspections can be found in EPG 753.4.2. Fracture critical bridges are not eligible for extended frequency inspections.

EPG 753.4.7.8: Inspection Reporting/Coding

Some form of an inspection report/documentation is required for all fracture critical inspections that are completed. The Team Leader is responsible for ensuring that the inspection has been properly documented. Consultant inspections will generally include some type of written report that is submitted at the completion of the inspection. Inspections performed by MoDOT inspectors may be documented with a written report or they may be documented with standard inspection forms that have been developed and supplemented as needed with additional written documentation.

EPG 753.4.7.8.1: General Information

The inspection report should include some general bridge identification information that, as a minimum, includes things such as the bridge number, district, county, route carried, feature intersected, year built, posting information, and location. The layout direction

(i.e. North to South) of the structure should also be included so that member references are properly duplicated on future inspections. The inspection date and frequency are also required to be included on the report.

EPG 753.4.7.8.2: Team Members

The Team Leader for a fracture critical inspection must be identified on the inspection report. If only one inspector was present for the inspection, it will be assumed that this person was acting as the Team Leader. When multiple people are participating in the inspection the Team Leader should be specifically identified on the inspection report. A Team Leader must be present for the entire inspection. All other individuals that were significantly contributing to the inspection either as an Inspector or in another role should be identified on the inspection report. Someone that is just present during the inspection for safety reasons does not have to be identified on the inspection report.

EPG 753.4.7.8.3: Access Methods

An important part of the documentation for a fracture critical inspection is the access method. Many structures are configured such that the fracture critical members are easily accessible and viewable from the deck or from the ground below the bridge. For elements that are below the deck, a ladder is commonly needed to properly view the floor beams and girders. For structures that can't be accessed from the ground either directly or with a ladder, inspection vehicles or hanging scaffolding will be needed to properly inspect the structure. Cameras of differing types may also be used in certain situations to aid in the inspection process. The inspection report should identify all of the access methods that are needed to fully inspect a fracture critical structure. When different access methods are required for different elements of the structure, this distinction should be made on the inspection report as well.

Example 1: A fracture critical inspection is required for a thru truss. The access methods could be documented as follows. The upper chords and upper portions of diagonals and verticals were accessed using a 20' extension ladder. The lower chords and lower portions of the diagonals and verticals were accessed from the roadway. The floor beams were accessed from underneath the bridge using a ladder.

EPG 753.4.7.8.4: Special Inspection Issues/Procedures

As part of the documentation for a fracture critical inspection, the inspector should identify unique issues/procedures that may be present or needed when performing the inspection for a structure. These issues may be documented in the actual inspection report for a bridge, or they may be recorded as a separate document that is stored in the record for the structure and referenced as part of the preparation for future inspections. The identification of these issues/procedures will aid future inspectors in determining any special equipment or inspection procedures that may be needed to properly perform an inspection.

Most inspections can be performed using normal procedures or inspection techniques. Occasionally, there will be unique issues on a structure that need to be identified so that an inspector can properly prepare for the inspections. The following are some items that should be identified in the documentation for a fracture critical inspection so that an inspector can be properly prepared to perform an inspection.

A. Fatigue/Fracture Prone Details—Fatigue prone details are common on structures and inspectors will be familiar with the more routine types of details that may be encountered. Whenever there are non-typical types of details present on a structure, they should be identified in the documentation for the structure so that the inspector can be prepared to review those details. Examples could include the presence of intersecting vertical and horizontal welds (Hoan Bridge Detail), the presence of butt welds on primary tension members, and the presence of forged eyebars on a structure.

B. Poor Welding Details—The inspector may encounter fracture critical structures with members that are welded. These welds may be part of the original construction, or they may be from repairs that were done on a structure. Repairs that were done in the field may not follow proper welding techniques and result in poor quality welds. The presence of poor quality welds should be identified on the inspection report since they have a higher risk of developing fatigue type problems.

C. Out of Plane Distortions—The presence of out of plane distortions on members needs to be documented on inspection reports because these members may have a higher risk of failure.

D. Problematic Materials—Structures have been constructed with varying types of steel over the years. Experience has shown some of these materials to be problematic. If a problematic type of steel was used on a structure, it should be identified on the fracture critical report and include the locations on the structure where this material was used.

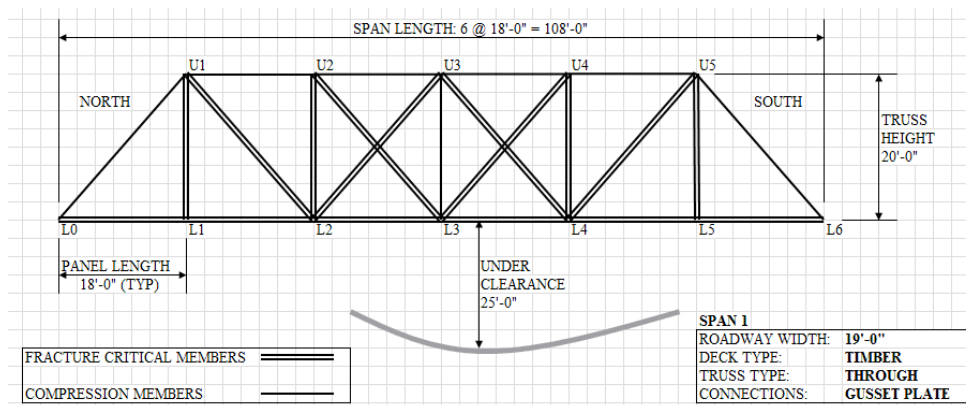
E. Previous Cracking/Repairs—If a structure has had repairs done to a fracture critical member, this should be identified on the inspection report. Additionally, if a structure has had problems with cracking on a fracture critical member, this should be identified in the report.

F. Accessibility Issues—Some structures may be located in areas that have limitations/restrictions on access to the structure. When these issues exist and they require some special process to gain the proper access to the structure, they should be documented on the inspection report.

EPG 753.4.7.8.5: Member Identification

All fracture critical inspection documentation should include some type of diagram that identifies all of the members that were inspected. The diagram should have the members labeled in some manner and include a directional orientation so that future inspections can be conducted in the same manner. Fracture critical member diagrams have been created and loaded into TMS for all state structures. Spreadsheets have been developed for nonstate structures and include a diagram that shows which members are fracture critical. For inspections completed by consultants, the inspection report will be available in TMS and will include a diagram of the structure.

An example diagram is shown below.



EPG 753.4.7.8.6: Condition Ratings

As part of a fracture critical inspection, the superstructure rating should be reviewed. Occasionally, there will be structures with a fracture critical element on the substructure resulting in the need to review the substructure rating for the bridge. If the conditions found during the inspection warrant changing these ratings, then they should be updated accordingly. Recommendations for these condition ratings should be included as part of the inspection report or other documentation of the inspection.

With the implementation of the Specifications for the National Bridge Inventory (SNBI), inspectors are now required to document an overall condition for the fracture critical members on a structure. All inspection reports should include an overall rating for the fracture critical members on a structure. This rating may be different than the substructure and superstructure ratings.

EPG 753.4.7.8.7: Photographs

The fracture critical inspection documentation should include photographs to represent specific problems found during the inspection as well as the general overall condition of

the structure. At a minimum, a general profile view of the fracture critical spans and a roadway view of the structure should be included in the inspection records for the structure and these should be updated every five years. Photos of the general condition of the fracture critical elements of the bridge as well as photos of specific condition problems found on the structure should be taken at each inspection.

EPG 753.4.7.8.8: Deterioration Documentation

Different levels of deterioration will be encountered during fracture critical inspections. At a minimum, this deterioration should be documented with written comments and photographs to represent typical situations found during the inspection. When more significant deterioration is observed, actual amounts of section loss should be recorded for individual members and include the location of the section loss. For structures where plans are not available, part of the documentation of the section loss amounts should include taking measurements of the truss members and floor system so that a load rating analysis can be performed, if needed.

EPG 753.4.7.9: Gusset Plate Inspections

The 2007 collapse of the IS 35 bridge in Minneapolis identified an additional area of focus that was needed for bridge inspections. The collapse of this structure was caused by the failure of an undersized vertical gusset plate, which buckled under a compressive load from one of the diagonals on the truss. Prior to this collapse, gusset plate connections were generally believed to have very conservative designs resulting in fracture critical inspection being mainly concerned about the condition of the actual truss members. Since this collapse, research has shown that although many of these connection plates are over designed, there are some out there that were not over designed and significant amounts of deterioration and/or distortion on these plates can severely impact the ability of these plates to adequately transfer forces between the various truss members. As a result, fracture critical bridge inspection programs have been enhanced to include a focus on these connection plates and identify problems and address them before they lead to some type of failure.

EPG 753.4.7.9.1: Loadings on Gusset Plates

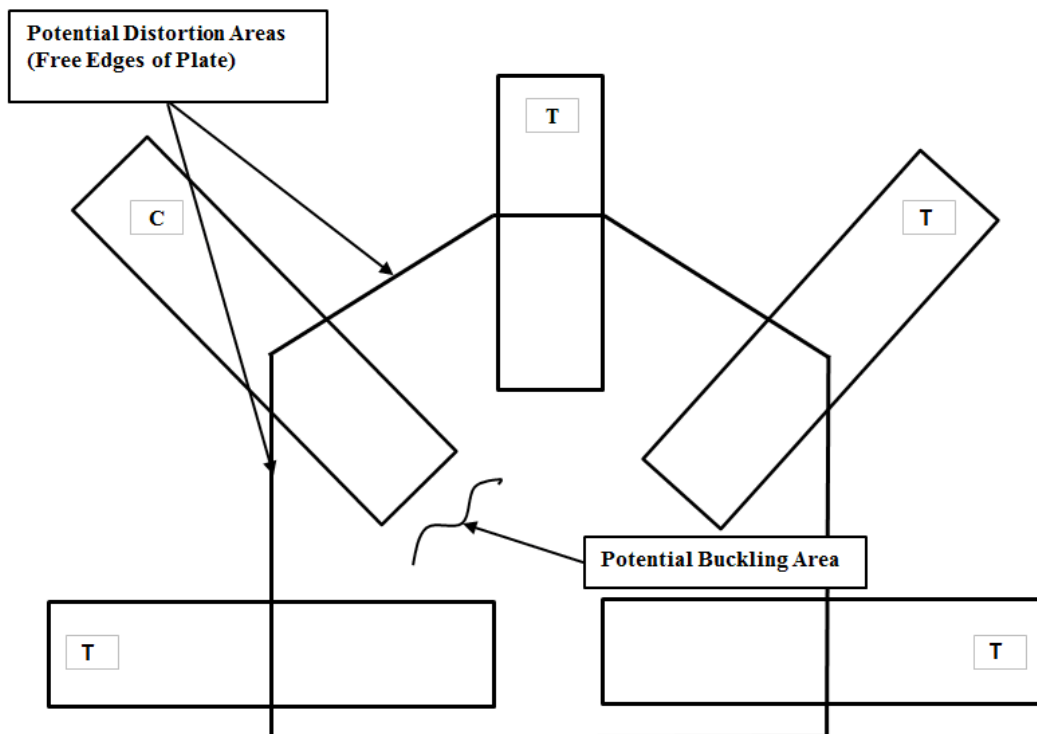
On visual observation, a gusset plate appears to be a straight forward type of connection with members typically attached to the plate using bolts and rivets. If the connections is studied in more detail and the forces from the various members connected to the plate are considered, an inspector should come to the realization that there is a very complex force transfer mechanism taking place. The plate (including the fasteners) has to be able to support differing combinations of axial tension, axial compression, and shearing forces.

This section provides a basic explanation of the different types of failures that can occur on gusset plates. Being familiar with some of the types of failures can aid the inspector in determining how to inspect and best document the findings on gusset plates.

EPG753.4.7.9.1.1 Compressive Forces

Compressive forces in the gusset plate will result from diagonal members and upper/lower chords members that are in compression. The primary concern for this type of force is the possibility of the gusset plate buckling in the area just beyond (see figure below) where the end of the truss member connects to the plate. This typically should not happen in a properly designed gusset plate. Gusset plates with section loss in this area may develop this type of problem.

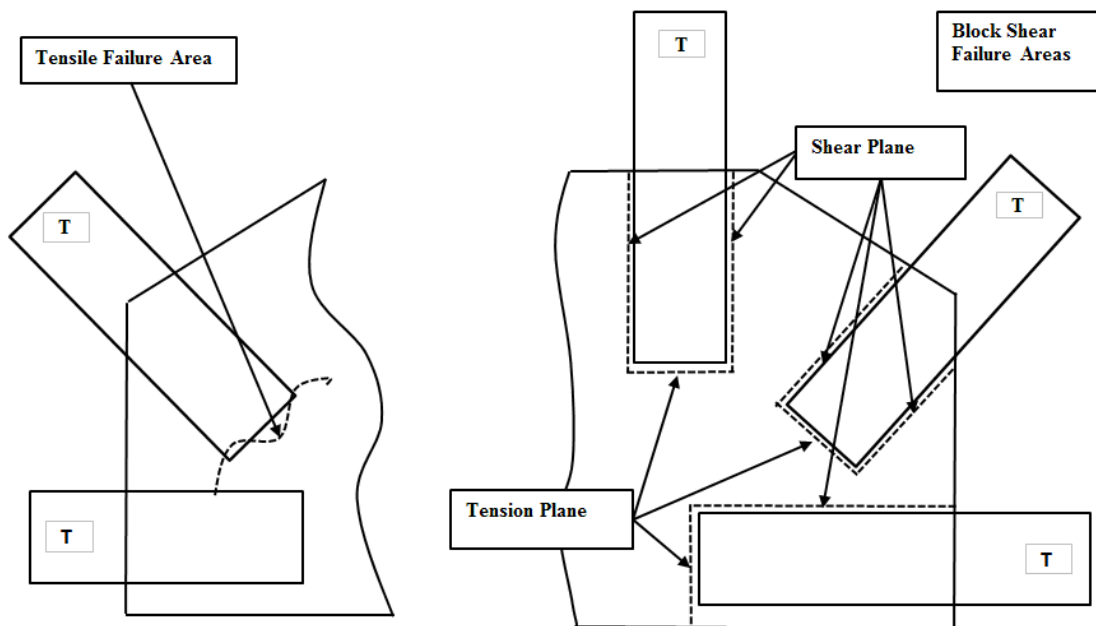
Another concern that exists with compressive forces is the possibility of the free edges of the gusset plate buckling or developing out of plane distortions near the area (see figure below) where the sides of the truss member first makes contact with the plate. Problems along the free edges of the gusset plate are more likely to develop in plates where the distance (along the gusset plate edge) from the compression member to the next member is fairly large resulting in a significant amount of the edge of the gusset plate being unsupported. This also may happen in gusset plates that have significant amounts of deterioration in this area.



EPG753.4.7.9.1.2 Tension Forces

Tension forces in the gusset plate will result from lower/upper chord members, diagonals, and vertical members that are in tension. These forces will tend to make the plate want to pull apart in the area where the end of the tension member connects to the gusset plate. Section loss in this area of the gusset plate can make them more susceptible to a tensile failure. The left side of the figure shown below highlights the gusset plate area at the end of tension member that is susceptible to this failure.

Block shear is another type of failure mode that is grouped as a tensile failure. It involves a combination of shearing type forces as well as a tensile force. This type of failure will basically happen around the perimeter of the gusset plate where it connects with the truss member. If this failure happens, the truss member will basically pull away the portion of the gusset plate that it is connected to. Section loss in the gusset plate around the perimeter of the truss member can make it more susceptible to this type of failure. The right side of the figure shown below depicts areas where a block shear failure would happen.



EPG753.4.7.9.1.3 Shearing Forces

Another mode of failure on a gusset plate is a complete fracture of the plate either thru a vertical plane or a horizontal plane on the plate. A vertical fracture will typically happen in the gross plate area adjacent to the vertical member or in the net plate area on a line that goes thru the bolts or rivets attaching the member to the plate. A horizontal fracture will happen either in the gross area of the plate along the upper or lower chord or in the

net plate area on a line that goes thru the bolts or rivets attaching the member to the plate. Section loss on the gusset plate in these areas can increase the risk for this type of failure.

EPG753.4.7.9.1.4 Rivets/Bolts

When a structural analysis of a gusset plate is performed, the capacity of the plate may be limited by the strength of the fasteners. The fasteners would include the bolts and the rivets. The fasteners may fail in tension or in bearing. Deteriorated, loose, or missing bolts and rivets need to be documented as part of a gusset plate inspection so that this can be considered during a structural analysis of the gusset plate.

EPG 753.4.7.9.2: Identification of Gusset Plates on a Structure

As part of the fracture critical inspection, the inspector should also be reviewing the gusset plates on a structure. If design plans are available, an inspection of the plates should include verification that the thickness of the plate matches what was designated on the design plans.

When design plans are available, gusset plates should be identified based on the layout of the structure as presented in the plans and include a span reference whenever multiple spans are involved. If plans are not available, then the plates should be identified in a manner that is consistent with how the rest of the fracture critical inspection was performed on the structure.

If the design plans contain an actual drawing of the gusset plate, then this drawing can be used as a basis for documenting the conditions during an inspection. If the plans don't contain drawings of the gusset plates, then a generic drawing of the gusset plate can be used to document the findings, or the inspector can create a detailed sketch of the plate for inspection purposes. Generic gusset plate inspection sheets have been developed for use and are available from the Bridge Division. Inspection sheets from previous gusset plate inspections are also available.

EPG 753.4.7.9.3: Guidance for Documenting Deficiencies

An important aspect of gusset plate inspections is to provide accurate information regarding the amount of deterioration or distortion that may be present in a gusset plate. Subsequent inspections should include a review of previous deficiencies found and documentation of continued deterioration as well as any additional deterioration that is present.

During a gusset plate inspection, it is imperative that the plate and surrounding areas are cleaned of any debris that would hinder the inspector from adequately viewing the entire plate and properly measuring any section loss that is found. Debris would include any layers of pack rust that may be present on the surface of the plate.

To aid in the uniform understanding of the deficiencies found during a gusset plate inspection, the following documentation methods have been developed. Inspectors should be using this standard nomenclature for their gusset plate inspections. Consultants are strongly encouraged to use this same documentation method, but may use another method as long as it properly conveys the problems found during inspection.

- Pack Rust—Use cross hatches
- Section Loss—Use a jagged line
- Distortion/Buckling—Use an oval
- Bold line—Use for cracks
- Missing Bolts/Rivets--Circle
- Locations of Thickness Measurements—Use an X.

When measuring section loss on gusset plates, it is important to record the thickness of the remaining section as well as the overall length and width of the section loss. Multiple measurements of the thickness should be taken within the extent of the section loss that is present with a minimum of three measurements taken. A maximum interval of three inches is a guide for determining how many thickness readings need to be taken along a member with section loss. The inspector should also be inspecting the truss members that are attached to the gusset plate and recording any section loss in these members at the point where they connect to the gusset plate.

Areas of deterioration should be photographed with close up shots of the deterioration along with a further out shot showing the general vicinity of the deterioration. Some sort of reference should be depicted in the photograph to help show a perspective on the size of the area of deterioration.

Distortion should be checked using a straight edge. The measured amount of distortion should be noted on the inspection sheet, including whether or not the distortion is believed to result from pack rust. Photographs of any distortion that is present should be taken.

