


HISTORIC BRIDGE MANAGEMENT PLANNING TOOLS FOR OFF-SYSTEM BRIDGES

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Management Planning Without Jurisdiction

- TxDOT's initiative for locally owned bridges
- Case Study: CR 402 at the Navasota River
- Challenges

TxDOT's Initiative for Locally Owned Bridges

Why is TxDOT doing this?

TxDOT's Desired Outcome

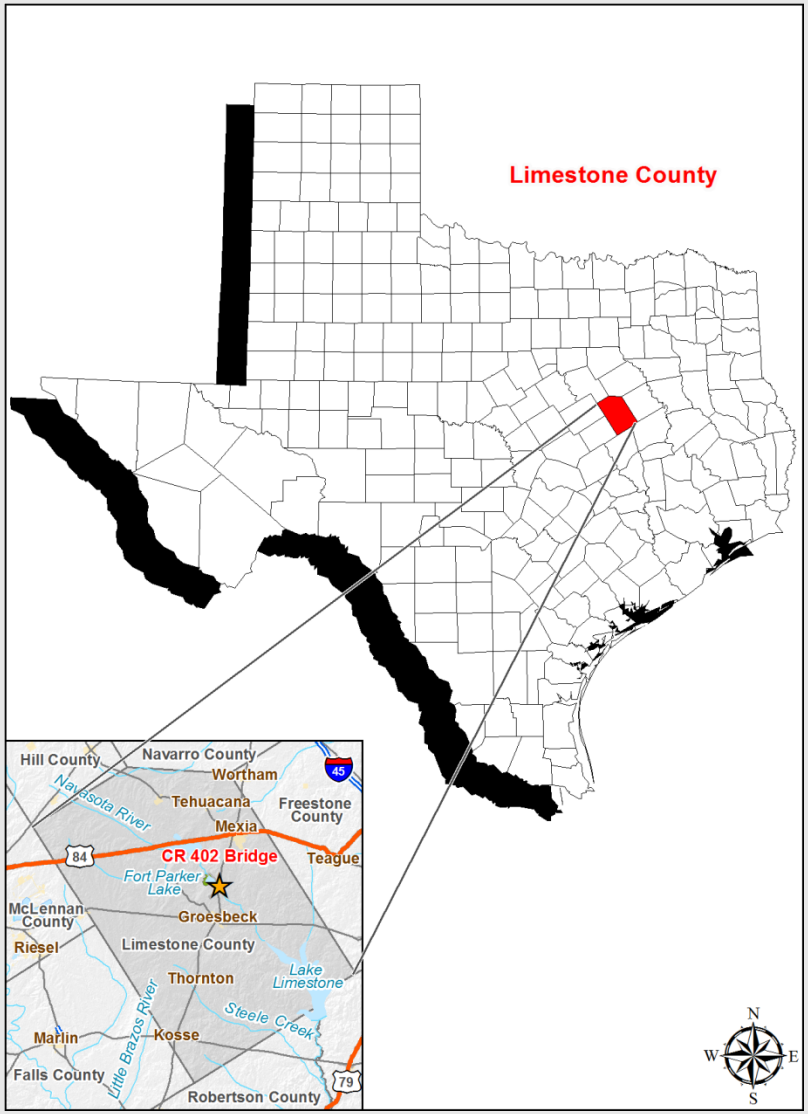
- Provide tools for long-term management
- Promote proactive planning

Photo credit: Michael Amador (TxDOT)

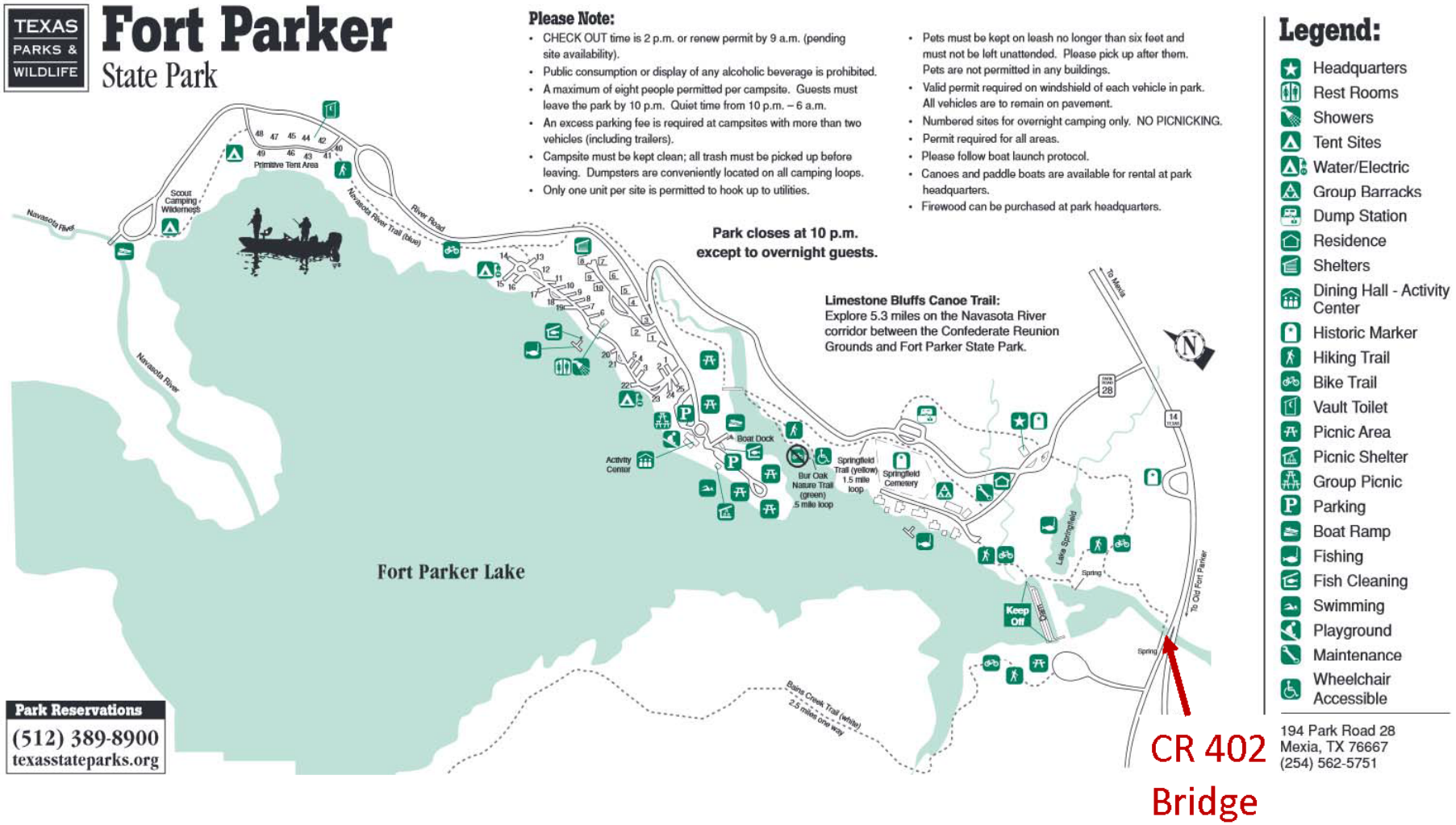
TxDOT's Challenges

- Experience level of maintenance crews
- Varied interest of bridge owners
- Creating a usable document

Case Study: CR 402 at the Navasota River



Case Study: CR 402 at the Navasota River



Case Study: CR 402 at the Navasota River

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Writing the Historic Bridge Management Plan

- Initial Meetings
- Field Visit
- Preliminary Draft Report

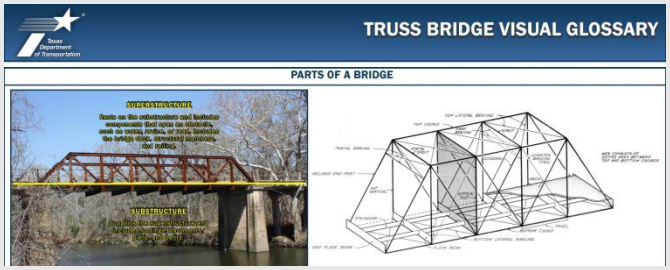
Case Study: CR 402 at the Navasota River

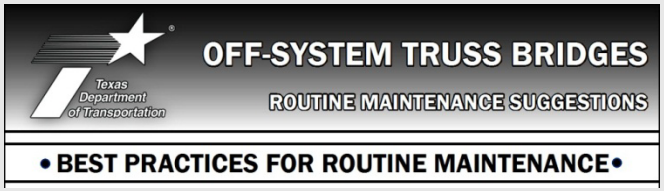
- Rework the document
  - Shorten
  - Improve reader-friendliness
  - Use non-technical terms when possible
- Create toolkits in the appendices
  - Stand-alone reference guides to help maintenance crews and county engineers
  - Can be applied and used by other truss bridge owners

Case Study: CR 402 at the Navasota River

- Meet with Limestone County Engineer and TxDOT
- Meet with Texas Historical Commission and Historic Bridge Foundation
- Revise the toolkits based on these meetings

Case Study: CR 402 at the Navasota River





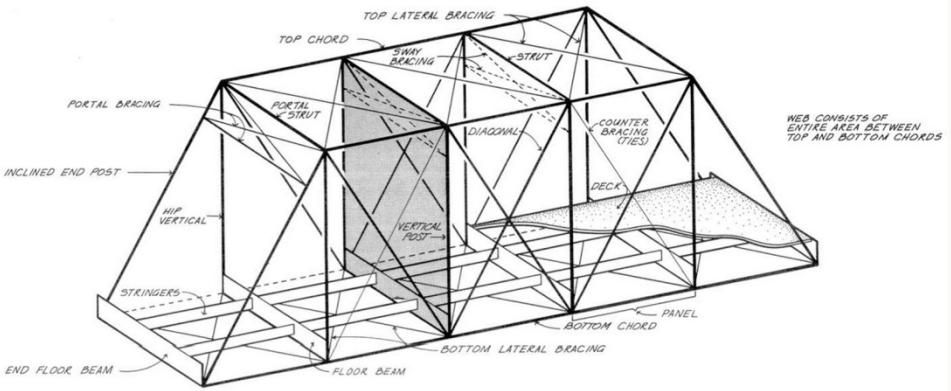
- Visual Glossary
- Chart of typical problems and suggestions
  - Recommended actions after incidents
  - Repairs following bridge inspection
- Ongoing maintenance recommendations

Historic Bridge Toolkits: Visual Glossary

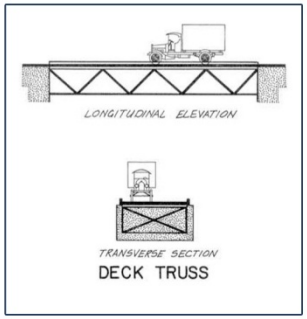
Texas Department of Transportation

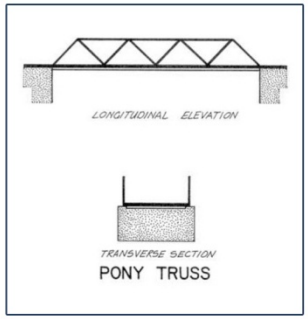
TRUSS BRIDGE VISUAL GLOSSARY

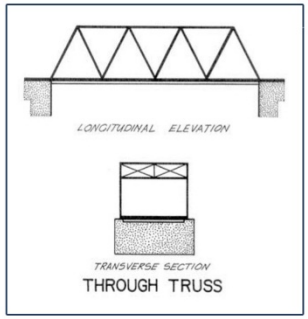
PARTS OF A BRIDGE



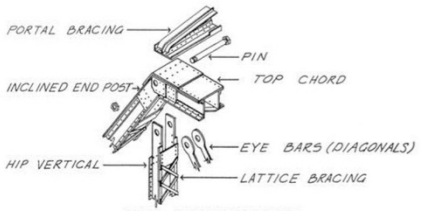
TYPES OF TRUSS BRIDGES

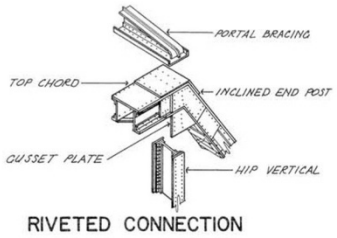






TYPES OF CONNECTIONS





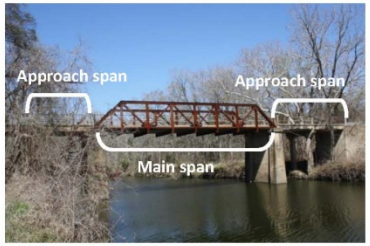
Drawings courtesy of Historic American Engineering Record, U.S. National Park Service.

Historic Bridge Toolkits: Visual Glossary

BRIDGE TERMS

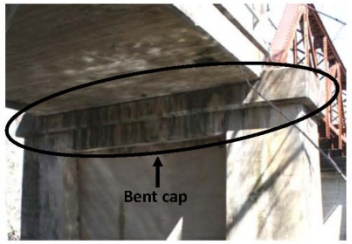
Abutment/Wingwall
Location on Bridge: Substructure
Definition:
Abutment: A retaining wall that supports the ends of the superstructure. Abutments can be constructed of concrete, stone, or timber planks.
Wingwall: An angled wall made of timber, masonry, concrete, or steel that is attached to the abutment.

Approach Span
Location on Bridge: Superstructure
Definition: The span(s) that connect the abutment with the main span(s) of the bridge.



Bent
Location on Bridge: Substructure
Definition: A support structure under the bridge. It generally includes vertical members (i.e. columns) and a horizontal bent cap. The foundation of the bent (usually concrete footings or drilled shafts) is below grade. A pier (defined below) is similar to a bent but it is one solid piece with integrated columns instead of stand alone columns.

Bent Cap
Location on Bridge: Substructure
Definition: A horizontal bridge member that rests on top of the vertical members of a bent or pier. The bent cap can be integrated into the vertical members as one solid piece or it can be a separate member.



Bolt/Rivet
Location on Bridge: Superstructure
Definition:
Bolt: A metal fastener that historically included a square nut and bolt thread used to connect members of a bridge together. Newer bolts have hexagonal nuts or button heads.
Rivet: A metal fastener most often with rounded heads used to connect members of the bridge together.

Bottom Chord/Top Chord
Location on Bridge: Superstructure
Definition:
Bottom Chord: The bottom and outermost members that are generally parallel to the deck.
Top Chord: The uppermost members that are frequently parallel to the deck.

Bracing
Location on Bridge: Superstructure
Definition: Bridge members which help to stiffen the truss bridge. Several types of bracing are defined below.

Portal bracing: Connects the top of the end posts. Only found on through truss bridges.
Sway bracing: Connects the top chords to each other. Only found on through truss bridges.

Top (overhead) lateral bracing: Typically cylindrical bars in a crisscross configuration connecting the top chords to each other. Only found on through truss bridges.
Bottom lateral bracing: Typically cylindrical bars in a crisscross configuration under the deck connecting the floorbeams to each other.

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Historic Bridge Toolkits: Visual Glossary

Deck
Location on Bridge: Superstructure
Definition: The roadway portion or riding surface of the bridge, including the shoulders. Bridges can be timber, concrete, or steel grid decks.

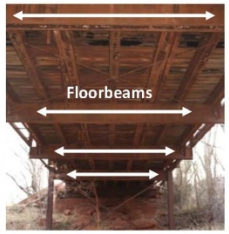
Diagonal
Location on Bridge: Superstructure
Definition: The sloping members of a bridge or bracing system that connect the top and bottom chords.

Embankment
Location on Bridge: N/A
Definition: Raised area of fill used in constructing roadway approaches. Embankments are sometimes supported or held in place by retaining walls.

Image courtesy of GoogleEarth

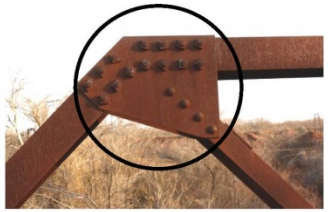
End Post
Location on Bridge: Superstructure
Definition: The outermost vertical or diagonal member of a bridge.

Floorbeam
Location on Bridge: Superstructure
Definition: Steel beams under the deck. They are perpendicular to the deck and connect the two sides of the truss.

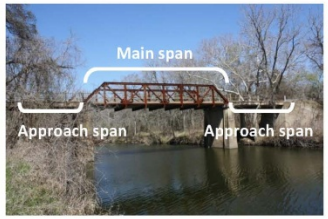


Footing
Location on Bridge: Substructure
Definition: The part of the bent that rests directly on the soil, bedrock, or pile. It is usually below grade and not visible except in instances of erosion and scour.

Gusset Plate
Location on Bridge: Superstructure
Definition: A metal plate used to connect multiple structural members.



Main Span
Location on Bridge: Superstructure
Definition: The longest span(s) in a multiple-span bridge, located between the bridge's main bents or piers.



Historic Bridge Toolkits: Visual Glossary

Pier
Location on Bridge: Substructure
Definition: A support structure under the bridge. It is generally one solid piece with integrated vertical members (i.e. columns) and a bent cap. A bent (defined above) is similar to a pier but it has standalone columns instead of integrated columns.

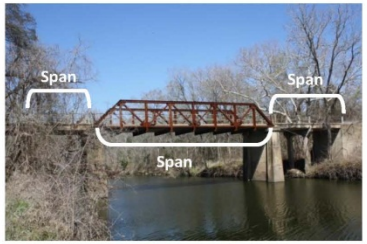
Pile
Location on Bridge: Substructure
Definition: A long column (often timber or steel) driven deep into the ground to form part of a foundation or substructure.

Pin Connection
Location on Bridge: Superstructure
Definition: Intersection of several structural members that are held together with a steel or wrought iron pin.

Runners
Location on Bridge: Superstructure
Definition: Timber planks or metal runners that serve as the driving surface on bridges with timber decks.

Scour
Location on Bridge: N/A
Definition: Erosion of a stream bank or channel causing removal of sediment (i.e. soil, sand, and rocks) from around bridge abutments, bents, or piers.

Span
Location on Bridge: Superstructure
Definition: The horizontal space between two vertical support members (i.e., bents or piers).



Stringer
Location on Bridge: Superstructure
Definition: Steel or timber beams under the deck. They run parallel to and support the deck.

Vertical
Location on Bridge: Superstructure
Definition: The member that is perpendicular to the deck and connected to the top and bottom chords.

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Historic Bridge Toolkits: Maintenance Tables

OFF-SYSTEM TRUSS BRIDGES

Texas Department of Transportation

REPAIR SUGGESTIONS FOR LONG-TERM PRESERVATION

AFTER IMPACT DAMAGE

PROBLEM	SUGGESTIONS		EXAMPLE IMAGES
	DO:	DO NOT:	
Dented or bent truss members.	• Notify TxDOT Area Engineer, TxDOT District Bridge Engineer, or structural engineer consultant.	• Heat-straighten members because it can result in subsequent fracturing of members, particularly when members were previously heat-straightened. • Weld steel members to the truss members in an attempt to fix damage or strengthen members, which can add undue stress to other members and worsen damage.	 DENTED TRUSS MEMBER
Cracked truss members.	• Notify TxDOT Area Engineer, TxDOT District Bridge Engineer, or structural engineer consultant.	• Weld steel members to the truss members in an attempt to strengthen members, as this can add undue stress to other members and worsen damage.	 CRACKED TOP CHORD
Missing or severely damaged steel railing.	• Notify TxDOT Area Engineer, TxDOT District Bridge Engineer, or structural engineer consultant when replacement cannot be conducted with compatible members. • Replace steel members with compatible members (when possible), and connect to the truss using the same bolt holes as previous railing.	• Weld new steel members to the truss, as this can add undue stress to other members and worsen damage. • Drill new bolt holes or enlarge existing holes, as this can compromise the structural integrity of the bridge and worsen damage.	 MISSING STEEL RAILING, ONLY THE BRACKETS REMAIN

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OFF-SYSTEM TRUSS BRIDGES

Texas Department of Transportation

REPAIR SUGGESTIONS FOR LONG-TERM PRESERVATION

AFTER IMPACT DAMAGE

PROBLEM	SUGGESTIONS		EXAMPLE IMAGES
	DO:	DO NOT:	
Scraped or damaged paint.	• Create an adhesive surface by lightly scoring and sanding the area by hand; spot treat paint corroded area.	• Delay repairs as this can lead to corrosion at areas of impact.	 SCRAPED PAINT ON VERTICAL AND RAILING

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OFF-SYSTEM TRUSS BRIDGES

REPAIR SUGGESTIONS FOR LONG-TERM PRESERVATION

AFTER IMPACT DAMAGE

PROBLEM	SUGGESTIONS		EXAMPLE IMAGES
	DO:	DO NOT:	
Dented or bent truss members.	• Notify TxDOT Area Engineer, TxDOT District Bridge Engineer, or structural engineer consultant.	• Heat-straighten members because it can result in subsequent fracturing of members, particularly when members were previously heat-straightened. • Weld steel members to the truss members in an attempt to fix damage or strengthen members, which can add undue stress to other members and worsen damage.	 DENTED TRUSS MEMBER

Texas Department of Transportation

OFF-SYSTEM TRUSS BRIDGES

REPAIR SUGGESTIONS FOR LONG-TERM PRESERVATION

AFTER IMPACT DAMAGE

Cracked truss members.	• Notify TxDOT Area Engineer, TxDOT District Bridge Engineer, or structural engineer consultant.	• Weld steel members to the truss members in an attempt to strengthen members, as this can add undue stress to other members and worsen damage.	 CRACKED TOP CHORD

Historic Bridge Toolkits: Maintenance Tables

OFF-SYSTEM TRUSS BRIDGES

Texas Department of Transportation

REPAIR SUGGESTIONS FOR LONG-TERM PRESERVATION

• AFTER FLOODING •

PROBLEM	SUGGESTIONS		EXAMPLE IMAGES
	DO:	DO NOT:	
Severe erosion around the substructure elements.	•Add riprap to embankment for stabilization and erosion correction. •Notify TxDOT Area Engineer, TxDOT District Bridge Engineer, or structural engineer consultant for erosion that has extended below the existing at-grade line.	•Build berms on the upstream side of the bridge as it traps debris and in the event of future flooding it may erode or may further damage the bridge. •Backfill to compensate for erosion that has extended below the existing at-grade line. Backfill is susceptible to collapse and further erosion when saturated.	 EROSION AT BRIDGE ABUTMENT
Instability of substructure members due to scour/ erosion.	•Notify TxDOT Area Engineer, TxDOT District Bridge Engineer, or structural engineer consultant to determine if the bridge should be closed.	•Backfill to compensate for erosion that has extended below the existing at-grade line. Backfill is susceptible to collapse and further erosion when saturated. •Bolt or weld any members to the substructure. This can further compromise the bridge's stability.	 SEVERE EROSION AT BRIDGE BENT
Debris caught on the substructure and lower truss members.	•Remove debris to prevent scour around substructure. •Clean lower truss members, connections, and bearings with high pressure water spray.	•Attempt to straighten or repair impacted members as it can result in subsequent fracturing of members, particularly when members were previously heat-straightened. •Allow debris to remain as it can cause corrosion and weakening of members.	 DEBRIS CAUGHT ON TRUSS MEMBERS AND BETWEEN THE STRINGERS

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OFF-SYSTEM TRUSS BRIDGES

Texas Department of Transportation

REPAIR SUGGESTIONS FOR LONG-TERM PRESERVATION

• AFTER FLOODING •

PROBLEM	SUGGESTIONS		EXAMPLE IMAGES
	DO:	DO NOT:	
Debris on the upstream side of the bridge.	•Remove debris, if possible.	•Do not allow debris to remain as it increases the velocity of water on substructure members and can increase scour at the base of the substructure supports.	 DEBRIS ON THE UPSTREAM SIDE OF THE BRIDGE

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OFF-SYSTEM TRUSS BRIDGES

REPAIR SUGGESTIONS FOR LONG-TERM PRESERVATION

• AFTER FLOODING •

PROBLEM	SUGGESTIONS		EXAMPLE IMAGES
	DO:	DO NOT:	
Severe erosion around the substructure elements.	• Add riprap to embankment for stabilization and erosion correction. • Notify TxDOT Area Engineer, TxDOT District Bridge Engineer, or structural engineer consultant for erosion that has extended below the existing at-grade line.	• Build berms on the upstream side of the bridge as it traps debris and in the event of future flooding it may erode or may further damage the bridge. • Backfill to compensate for erosion that has extended below the existing at-grade line. Backfill is susceptible to collapse and further erosion when saturated.	 EROSION AT BRIDGE ABUTMENT

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OFF-SYSTEM TRUSS BRIDGES

REPAIR SUGGESTIONS FOR LONG-TERM PRESERVATION

• AFTER FLOODING •

Instability of substructure members due to scour/ erosion.	• Notify TxDOT Area Engineer, TxDOT District Bridge Engineer, or structural engineer consultant to determine if the bridge should be closed.	• Backfill to compensate for erosion that has extended below the existing at-grade line. Backfill is susceptible to collapse and further erosion when saturated. • Bolt or weld any members to the substructure. This can further compromise the bridge's stability.	 SEVERE EROSION AT BRIDGE BENT

Historic Bridge Toolkits: Maintenance Tables

Texas Department of Transportation

OFF-SYSTEM TRUSS BRIDGES

REPAIR SUGGESTIONS FOR LONG-TERM PRESERVATION

AFTER VANDALISM

PROBLEM	SUGGESTIONS		EXAMPLE IMAGES
	DO:	DO NOT:	
Fire damage to bridge deck.	•Notify TxDOT Area Engineer or District Bridge Engineer to determine if the bridge should be closed.	•Attempt to replace damaged deck elements, floor beams, or stringers as these actions may not address the safety issue of continued use of the bridge.	 FIRE DAMAGE ON BRIDGE DECK
Spray painted graffiti on truss members.	•Spot paint over graffiti in a color that matches the bridge.	•Attempt to scrape paint or remove paint with chemical treatments which may damage the integrity of the steel.	 ATTEMPT TO REMOVE SPRAY PAINT WHICH DAMAGED THE STEEL
Graffiti obscuring the load posting signs.	•Contact TxDOT Area Engineer to get replacement load posting signage.	•Delay replacement as overweight vehicles may use the bridge.	 GRAFFITI ON LOAD POSTING SIGN

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OFF-SYSTEM TRUSS BRIDGES

REPAIR SUGGESTIONS FOR LONG-TERM PRESERVATION

AFTER VANDALISM

PROBLEM	SUGGESTIONS		EXAMPLE IMAGES
	DO:	DO NOT:	
Fire damage to bridge deck.	• Notify TxDOT Area Engineer or District Bridge Engineer to determine if the bridge should be closed.	• Attempt to replace damaged deck elements, floor beams, or stringers as these actions may not address the safety issue of continued use of the bridge.	 FIRE DAMAGE ON BRIDGE DECK

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OFF-SYSTEM TRUSS BRIDGES

REPAIR SUGGESTIONS FOR LONG-TERM PRESERVATION

AFTER VANDALISM

Graffiti obscuring the load posting signs.	• Contact TxDOT Area Engineer to get replacement load posting signage.	• Delay replacement as overweight vehicles may use the bridge.	 GRAFFITI ON LOAD POSTING SIGN

Historic Bridge Toolkits: Maintenance Tables

Texas Department of Transportation

OFF-SYSTEM TRUSS BRIDGES

REPAIR SUGGESTIONS FOR LONG-TERM PRESERVATION

• AFTER BRIDGE INSPECTIONS •

PROBLEM	SUGGESTIONS		EXAMPLE IMAGES
	DO:	DO NOT:	
Cracked and fatigued truss members.	•Discuss with TxDOT Area Engineer, TxDOT District Bridge Engineer, or structural engineer consultant about repair options.	•Attempt to weld or replace truss members as this can add undue stress to other members and worsen damage.	 CRACKED TOP CHORD
Large cracks in masonry abutments or wingwalls.	•Discuss with TxDOT Area Engineer, TxDOT District Bridge Engineer, or structural engineer consultant about repair options.	•Apply concrete to the crack or any part of the abutment and wingwalls. Application of concrete may further damage the masonry and negatively affect the historic character of the abutments and wingwalls.	 LARGE CRACK IN MASONRY ABUTMENT
Pack rust on truss members, connections, and joints.	•Consult with a structural engineer regarding the degree of pack rust.	•Sandblast connections and bearings as this may result in weakening and further deterioration of bridge members.	 PACK RUST ON UNDERSIDE OF STRINGER
Corrosion.	•Consult with a structural engineer regarding the degree of corrosion. •Create an adhesive surface by lightly scoring and sanding the area by hand; spot treat paint corroded area.	•Attempt to treat large areas of corrosion without consulting with a structural engineer. Treating corrosion prior to consultation may result in incompatible repairs that further deterioration of bridge members.	 CORROSION OF BATTEN PLATE

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OFF-SYSTEM TRUSS BRIDGES

REPAIR SUGGESTIONS FOR LONG-TERM PRESERVATION

• AFTER BRIDGE INSPECTIONS •

PROBLEM	SUGGESTIONS		EXAMPLE IMAGES
	DO:	DO NOT:	
Missing bolts.	•Consult with a structural engineer regarding the appropriate strength, diameter, and grade.	•Attempt to replace missing bolts without first consulting with a structural engineer. Use of the wrong type of bolts may further damage the bridge.	 MISSING TWO BOLTS
Fatigued or deteriorated turnbuckles.	•Discuss with TxDOT Area Engineer, TxDOT District Bridge Engineer, or structural engineer consultant about repair options.	•Replace turnbuckles as this can weaken truss members.	 REPLACEMENT TURNBUCKLE
Deck joints filled with debris.	•Clean debris from deck joints.	•Allow debris to accumulate as this prevents the deck from expanding and contracting with temperature fluctuations.	 DEBRIS AND RUBBLE IN DECK JOINT

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Historic Bridge Toolkits: Maintenance Tables

Texas Department of Transportation

OFF-SYSTEM TRUSS BRIDGES

REPAIR SUGGESTIONS FOR LONG-TERM PRESERVATION

• AFTER BRIDGE INSPECTIONS •

PROBLEM	SUGGESTIONS		EXAMPLE IMAGES
	DO:	DO NOT:	
Vegetation on substructure and truss members.	•Remove vegetation by cutting limbs and vines away from the truss. •Clean lower truss members, connections, and bearings with high pressure water spray.	•Allow overgrowth of vegetation on the bridge as this can weaken bridge members and lead to corrosion.	 VINES CLIMBING ON AN END POST
Missing load posting signage.	•Contact TxDOT Area Engineer to get replacement load posting signage so overweight vehicles do not use the bridge.	•Delay replacement as overweight vehicles may use the bridge.	N/A

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OFF-SYSTEM TRUSS BRIDGES

REPAIR SUGGESTIONS FOR LONG-TERM PRESERVATION

• AFTER BRIDGE INSPECTIONS •

Pack rust on truss members, connections, and joints.	•Consult with a structural engineer regarding the degree of pack rust.	•Sandblast connections and bearings as this may result in weakening and further deterioration of bridge members.	 PACK RUST ON UNDERSIDE OF STRINGER

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OFF-SYSTEM TRUSS BRIDGES

REPAIR SUGGESTIONS FOR LONG-TERM PRESERVATION

• AFTER BRIDGE INSPECTIONS •

Deck joints filled with debris.	•Clean debris from deck joints.	•Allow debris to accumulate as this prevents the deck from expanding and contracting with temperature fluctuations.	 DEBRIS AND RUBBLE IN DECK JOINT

Texas Department of Transportation

OFF-SYSTEM TRUSS BRIDGES

REPAIR SUGGESTIONS FOR LONG-TERM PRESERVATION

• AFTER BRIDGE INSPECTIONS •

PROBLEM	SUGGESTIONS		EXAMPLE IMAGES
	DO:	DO NOT:	
Vegetation on substructure and truss members.	• Remove vegetation by cutting limbs and vines away from the truss. • Clean lower truss members, connections, and bearings with high pressure water spray.	• Allow overgrowth of vegetation on the bridge as this can weaken bridge members and lead to corrosion.	 VINES CLIMBING ON AN END POST

Historic Bridge Toolkits: Maintenance Tables

Texas Department of Transportation

OFF-SYSTEM TRUSS BRIDGES

ROUTINE MAINTENANCE SUGGESTIONS

• BEST PRACTICES FOR ROUTINE MAINTENANCE •

SUGGESTIONS	SCHEDULE
DO:	
Use silane concrete sealer to protect concrete substructure elements of the bridge.	As needed.
Patch concrete decks; however, do not cover deck joints.	As needed.
Replace individual timber runner boards and timber decking material with wood boards.	As needed.
Clean connections and bearings with high pressure water spray to prevent rust.	Annually.
Clean debris from substructure to prevent scour.	Annually.
Remove climbing vegetation from abutment and wingwalls.	Annually.
Trim or remove vegetation from approach roadway.	Annually.
Remove vegetation from utility lines attached to the bridge.	Annually.
Use silane concrete sealer on concrete wearing surfaces.	Every 2 to 3 years.
Consult with a structural engineer to replace timber decks.	Every 10 years.
Consult with a structural engineer to clean and paint the bridge.	Every 10 years.
Remove existing overlay before adding a new overlay.	Every 10 years.
DO NOT:	
Use linseed oil on truss members, as this is a hazardous material.	N/A
Weld or bolt new members to the truss bridge.	N/A
Cover deck joints when applying a new overlay.	N/A
Replace turnbuckles.	N/A
Hang pipelines on a historic truss bridge as this adds weight to the bridge.	N/A
Repair mortar on masonry abutments and wingwalls with concrete.	N/A

Questions?

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Historic Bridge Toolkits