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41.1 Introduction

The Federal Highway Administration (FHWA) Moving Ahead for Progress in the 21st Century (MAP-21) legislation contains the following definition for asset management:

Asset management is a strategic and systematic process of operating, maintaining, and improving physical assets, with a focus on both engineering and economic analysis based upon quality information, to identify a structured sequence of maintenance, preservation, repair, rehabilitation, and replacement actions that will achieve and sustain a desired state of good repair over the life-cycle of the assets at minimum practicable cost.

The Wisconsin Department of Transportation (WisDOT) has developed and is implementing a structures asset management program that meets FHWA’s definition. At a basic level, WisDOT structures asset management is practiced as shown in Figure 41.1-1.

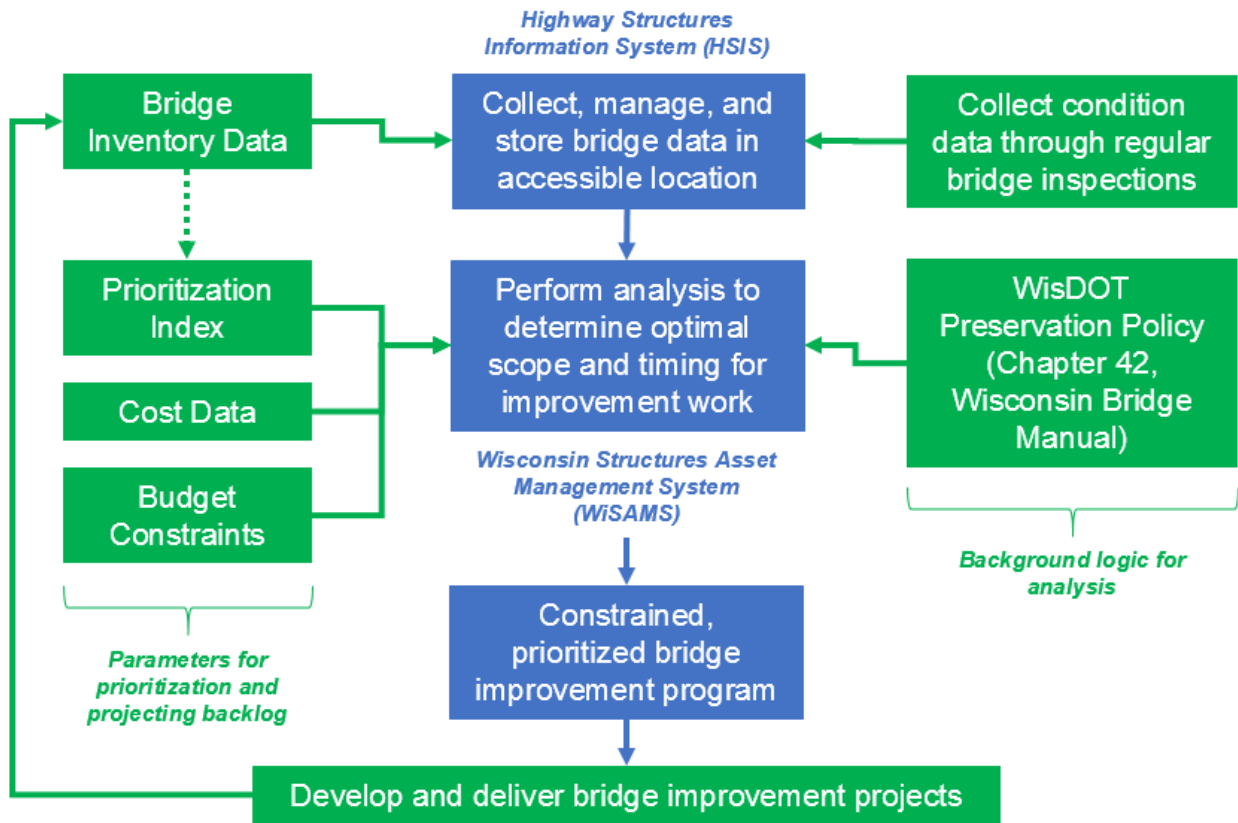


Figure 41.1-1
WisDOT Structures Asset Management



This chapter provides an outline of the WisDOT structures asset management process, including roles and responsibilities and policy items to be considered during the selection of structures improvement projects.

41.1.1 Definitions

Primary structure work concept: The primary work being performed on a given structure.***
Primary structure work concepts are currently defined as any of the following:

- New structure (new alignment, etc.)
- Structure replacement
- Superstructure replacement
- Deck replacement
- Structure widening
- Overlay (any type)
- Painting (full)

***Note that a given bridge may not have a primary structure work concept, but only a secondary structure work concept. One example of this would be a bridge requiring a joint replacement and concrete surface repairs to the substructure elements, with no “major rehabilitation” (deck replacement, overlay, etc.) required.

Secondary structure work concept: Work performed on a given structure that is not designated as primary. Examples include, but are not limited to:

- Joint replacement or rehabilitation
- Bearing replacement or rehabilitation
- Parapet or railing repairs

Structures improvement project: An improvement project funded through WisDOT’s let program that includes primary or secondary work to one or more structures. Other work, such as pavement or safety, may or may not be included.



41.1.2 WisDOT Asset Management Themes

The WisDOT Bureau of Structures (BOS) work in asset management is enveloped by the broader asset management philosophies of the Department. Current emphasis areas include:

- Ensuring that all in-service structures are safe for the travelling public. This is the top priority.
- Making decisions that are supported by data and policy and applied consistently across the state.
- Seeking to extend the usable life of a structure (versus replacement) when feasible, practical, and cost-effective by using identified preservation techniques.
- Considering the whole-life-cycle costs when selecting treatments.
- When structure replacement is unavoidable, replacing the existing structure following the current Department replace-in-kind policy and design standards.



41.2 Identifying Theme-Compliant Structure Work

Themes for structures asset management are noted in 41.1.2 and represented in the policy documented in Chapter 42 – Bridge Preservation. This section details how BOS arrives at recommended bridge improvement work actions that comply with Department asset management principles.

41.2.1 Wisconsin Structures Asset Management System (WiSAMS)

To accurately and consistently apply structures asset management strategies, BOS developed a software application; the Wisconsin Structures Asset Management System, or WiSAMS. WiSAMS was developed and is maintained within BOS. Its core function is to produce recommendations for structures improvement work using a consistent, objective, data-driven, logic-based process.

The success of WiSAMS is heavily dependent on the quality of the data it uses. The primary data consists of the following:

- Inventory data: Information that defines the bridge type, location, use, and history. This includes items such as number of spans, superstructure type, construction history, Average Daily Traffic (ADT).
- Condition data: Collected and recorded during bridge inspections, condition data reflects the current state of deterioration of the bridge. WiSAMS currently uses both NBI and AASHTO element condition data.

The background logic for WiSAMS consists of a series of “if-then” statements and a corresponding structure improvement work action. These if-then statements are referred to as “rules”. The WiSAMS rules are based on the asset management and bridge preservation policy documented in Chapter 42 – Bridge Preservation. WiSAMS evaluates each rule in sequence. When a rule evaluates as “true”, the corresponding work action for that rule is logged as the recommended structure improvement work. If no rules evaluate as “true”, then the WiSAMS recommendation is “no action.” For illustration purposes, a very simple WiSAMS rule is shown below.

- If all the following criteria are met...
 - The current NBI rating for substructure is less than or equal to 3, and
 - The structure is scour critical;
- ...then the recommended work action is “REPLACE STRUCTURE.”

WiSAMS performs the analysis described above for the current year based on the most recent condition data (inspection report). To project future needs, WiSAMS uses deterioration curves to model the future condition of the structure. For each future year, WiSAMS again performs the rule analysis using the projected future condition data and provides recommendations for structure work concepts in these future years.



41.2.2 Eligibility

WiSAMS is the primary asset management tool for BOS. It is a tool that aims to meet WisDOT's need for data-driven, consistent, cost-effective structures work recommendations. The general accuracy of WiSAMS recommendations is heavily dependent on the available condition data and the ability to accurately project future deterioration. Final recommendations on structures improvement actions are subject to a manual review by BOS asset management engineers, as necessary. This combination of WiSAMS output and BOS review results in a recommendation for improvement work scope and timing.

A proposed structures work concept that matches this BOS recommended scope and is within an acceptable range for timing is considered an eligible structures work concept. Effort should be made to program structures improvement work to match the BOS-recommended work concept and optimal year to the extent possible.

WisDOT policy item:

BOS currently considers +/- 3 years as acceptable deviation from the BOS-recommended year for programming structures work concepts.



41.3 Structures Programming Process (State-System)

The process for developing projects with structures improvement work is shown in [Figure 41.3-1](#) below. The process is primarily a collaboration between BOS and Regional personnel. The Division of Transportation Investment Management (DTIM) has a role in funding, which varies based on the funding source. Roles and responsibilities are discussed further in [41.5](#).

It is important to note that structures work concepts can be included in a let improvement project via several different methods. They include:

- Stand-alone structures improvement project: A let improvement project developed based on structure needs and including only structures improvement work.
- Combined improvement project: A let improvement project developed based in part on structure needs, but also including other improvement needs, such as pavement, safety, etc.
- Improvement project with only secondary structures improvement work: A let improvement project developed based on “other” needs (pavement, safety, etc.), but includes structures within the project limits. Structures within the project limits should always be evaluated for secondary work concepts.

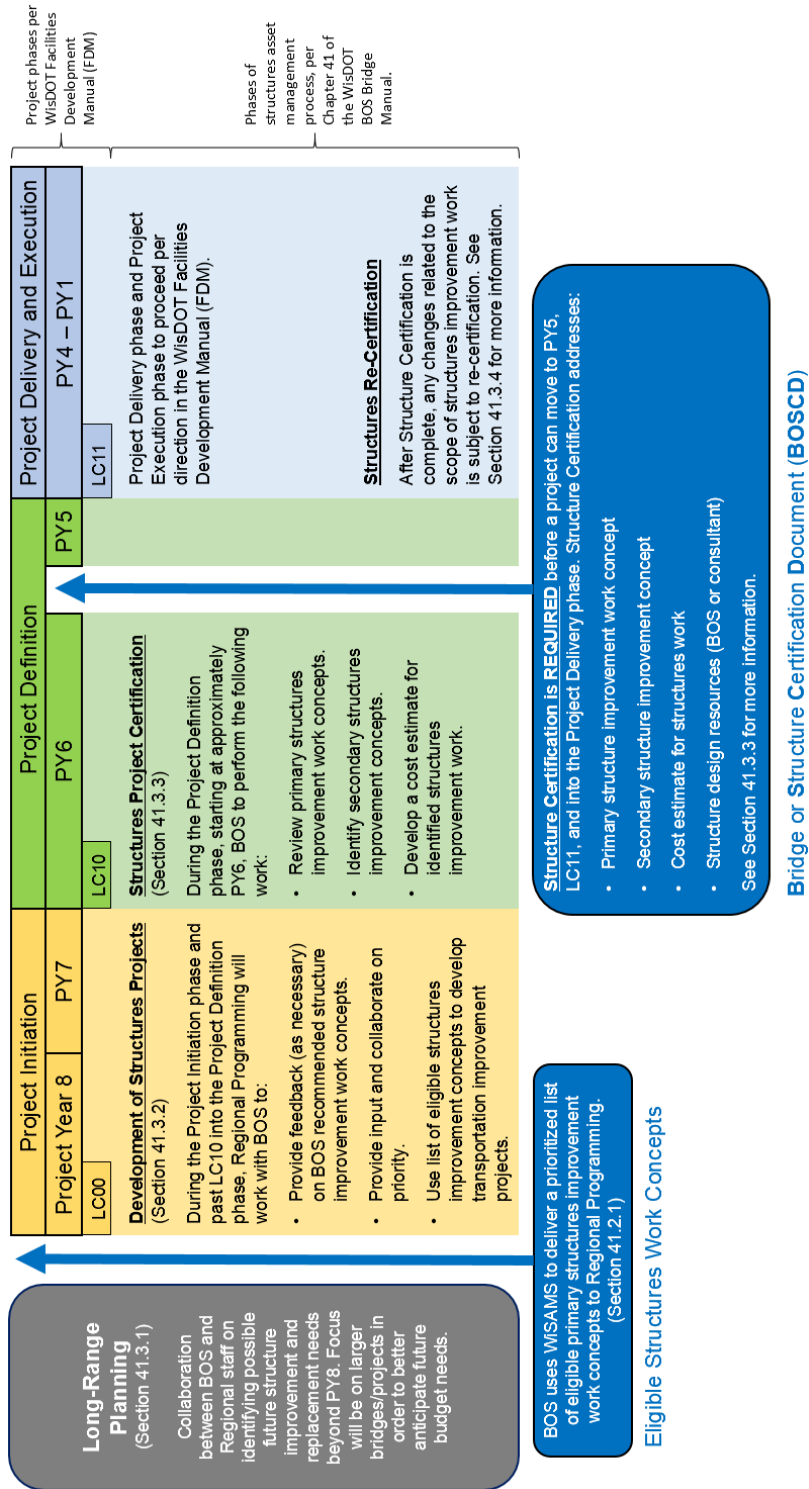


Figure 41.3-1

WisDOT Structures Asset Management – Structures Project Development



41.3.1 Long-Range Planning

Long-range planning refers to planning work done for projects with a target year beyond Program Year 8. Long-range planning serves several purposes, including examples such as:

- Coordinates improvement projects that are close in proximity to each other to minimize inconvenience for the travelling public.
- Project future improvement needs to large and/or complex bridges. Work of this nature may have a large impact in terms of budget and required design time.
- Provide information on future structure needs to coordinate with the long-term Division and Department vision for targeted corridors or areas.
- Provide a network-wide projection of future needs to be used when considering future transportation funding levels.

Projection of long-range structure improvement needs are based on WiSAMS output. BOS and Region collaboration on long-range planning occurs on an as-needed basis.

41.3.2 Development of Projects with Structures Work (PY8-PY7, Life Cycle 00-10)

The process of developing structure projects initiates with the BOS. Using WiSAMS (described above in 41.2.1) and review by BOS asset management engineers, BOS develops a list of eligible structures work concepts for the target year – Program Year 8 (PY8). The work is based on established BOS and Department policies for structures asset management, as described in this chapter and Chapter 42 – Bridge Preservation. The list of eligible structures work concepts is also prioritized. BOS will deliver these concepts to the Regions twice annually; in February and August.

41.3.2.1 Work Concept Review

At this stage in the process, Regional personnel has the opportunity to review the draft structures improvement program. The focus of this review is the primary work concepts, though some secondary work concepts may also be identified at this stage. BOS recommendations for structures work concepts are based on WiSAMS, supplemented as necessary by BOS asset management engineers.

Regional review should be focused on identifying perceived gross mismatches in scope and/or timing, and highlighting structure work concepts not identified by WiSAMS or BOS. Final decisions on scope and timing must be based on data and/or documentation. A majority of the time, this will be WiSAMS, but it can also be supplemented by other information, such as construction history, supplemental inspection data, IR data, or any other information pertinent to the programming decision. BOS will collaborate with Regional personnel to review and discuss any additional information that is brought forth. Final scope and timing decisions for structures work will be made by BOS, with strong consideration of Regional input.



41.3.2.2 Priority Review

BOS provides a prioritized list of eligible structures work. Priority is determined using a priority index (PI); an algorithm developed by BOS. The algorithm considers data such as ADT, functional class, etc. This is intended to assist the regions as they program projects.

The Region may see fit to adjust the prioritized list based on regional system and operational factors.

41.3.2.3 Creating Improvement Projects with Structures Work Concepts

The next step in the programming process is for Regional Programming to develop structures improvement projects based on the list of individual structures work concepts. Projects may combine structures work as appropriate, but also consider pavement needs, safety needs, operational needs, etc.

There may be non-structural rationale for deviations from BOS-recommended scope and/or timing. Common reasons include, but are not limited to:

- Coordination with other improvement work (pavements, safety, operations, etc.)
- Traffic control costs
- User delay

If reasons such as those noted above are used to justify deviations from BOS-recommended scope and/or timing, a cost-benefit analysis should be performed to support the decision. More information on cost-benefit analysis and structures programming policy can be found in [41.6.6](#).

During this phase as projects are developed and up until the Structures Project Certification Phase (See [41.3.3](#)), BOS asset management engineers will evaluate proposed projects on a regular basis to ensure that programmed structures work is eligible in terms of both scope and timing. Projects that contain only eligible structures work concepts or have appropriate justification for any deviations are considered *pre-certified*.

Only eligible projects or projects with appropriate justification will be considered for funding.

41.3.3 Structures Project Certification Phase (PY6-PY5, Life Cycle 10/11)

Structures project certification refers to the work required to produce the Bridge or Structure Certification Document (BOSCD). The components of the BOSCD are outlined in [41.3.3.6](#) below.

WisDOT policy item:

Any improvement project with structures work (primary or secondary work concepts) requires certification.



41.3.3.1 BOS Structures Certification Liaison

BOS will designate a certification liaison for every structures improvement project, regardless of whether the project is designed by BOS or a consultant. The certification liaison will perform all of the work necessary for structures certification. A certification liaison will remain with each structures project (BOS-designed or consultant-designed) through the letting of that project, though the actual person assigned to a project may change over the lifecycle of that project.

41.3.3.2 Review of Primary Structures Work Concepts

Structures certification serves as the final review and approval for the scope and timing of the primary structures work concept. Regional planning engineers should only be selecting eligible structures work (scope and timing) for inclusion in transportation improvement projects. Additionally, BOS asset management engineers will evaluate projects on a regular basis (see [41.3.2](#)) to ensure eligibility. With this process in place, the certification liaison will collaborate with BOS asset management engineers and Regional programming engineers (as necessary) to confirm scope and timing for primary structures work concepts.

41.3.3.3 Development of Secondary Structures Work Concepts

A key portion of the BOSCD is the early identification of secondary structures improvement work. Some examples of secondary work include, but are not limited to:

- Bearing rehabilitation or replacement
- Parapet or railing repairs
- Backwall or wingwall repairs
- Identification of specific substructure repairs
- Scour mitigation

Some items such as those above may have already been identified during the scoping of the primary structures work concepts. The certification liaison will review the existing inspection reports on file and consult the appropriate Regional structures maintenance engineer(s) to identify any and all eligible secondary structures work concepts.

41.3.3.4 Development of the Structures Cost Estimate

A high-level cost estimate will have been developed as a part of the primary structures work concept. This estimate is for structures work only; costs for traffic control and mobilization are not included. The certification liaison will refine that estimate, taking into account the identified secondary structures improvement work. This estimate is not intended to be a final structures construction cost estimate, but is a refinement of the unit cost estimate previously developed.



41.3.3.5 Determination of Design Resourcing

BOS will determine design resourcing as a part of the structures certification process. If BOS chooses to decline structures design for a given project, the certification liaison will provide an estimated level of effort (in man-hours) for the structures work. The certification liaison and the BOS Consultant Review Supervisor will coordinate with Regional PDS staff to ensure selection of an appropriate consultant engineer for the project.

41.3.3.6 Bridge or Structure Certification Document (BOSCD)

The BOSCD is under development at the time of publishing this chapter. The certification document will include information on all the items noted above, in addition to other key information identified by Region personnel.

41.3.4 Project Delivery and Execution Phase (PY4-Construction, Life Cycle 12+)

41.3.4.1 Structures Re-Certification

Any and all changes related to structures improvement work affecting items approved as part of the structures project certification shall be reviewed and approved by the certification liaison. This includes, but is not limited to, any of the following items:

- Scope (primary or secondary)
- Structures construction cost estimate
- PS&E or let date
- Advanceable date
- Structures design resourcing

The certification liaison for the project should be notified of any changes as soon as reasonably possible to approve/re-certify the project in a timely manner and not delay project schedule.



41.4 Structures Programming Process (Local System)

Local structure improvement work is funded through a different mechanism than state structure improvement work. Based on Wisconsin State Statutes, local structure eligibility is largely based on the sufficiency rating, a measure detailed in the Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation's Bridges, published by FHWA. BOS provides a prioritized eligibility list of both primary and secondary work concepts for the Division of Transportation Investment Management (DTIM), which is then posted publicly for the local owners. Local owners use this eligibility list to select projects for submission to the local program, and DTIM programs structure work on a biannual basis. At this point, BOS has not pursued additional involvement in structures asset management for the local inventory.

More information about the Local Bridge Program can be found at the following link:

<https://wisconsin.gov/Pages/doing-business/local-government/astnce-pgms/highway/localbridge.aspx>



41.5 Structures Asset Management Roles and Responsibilities

41.5.1 Bureau of Structures (BOS)

BOS has three sections, each of which contribute to the structures asset management process, either directly or indirectly.

BOS Design Section

- Resource the design (including hydraulic considerations) of structures improvement projects or providing oversight for consultant-designed projects.
- Provide resources (certification liaison) for the structures project certification (See [41.3.3](#)).

BOS Maintenance Section

- Provide oversight for the WisDOT structures inspection program, working to ensure and improve the quality and accuracy of condition data.

BOS Development Section

- Manage and maintain the Highway Structures Information System (HSIS), an on-line database for collecting structures inventory and condition data.
- Develop, maintain, and refine Chapter 42 – Bridge Preservation. Policy documented in this chapter is the basis for WisDOT structures asset management.
- Develop and maintain WiSAMS, the software application that uses inspection and inventory data to produce recommendations for future structure improvement projects.
- Using WiSAMS (including priority and budget features), develop draft recommendations for the program-level scope of recommended structures work for the 8-year structures improvement program.
- Collaborate with Regional personnel to develop structures projects for the 8-year structures improvement program.
- Review and pre-certify structures projects that are introduced to the 8-year structures improvement program. See [41.3.2.3](#).
- Develop and maintain a program effectiveness measure to assess progress toward achieving program goals.

41.5.2 WisDOT Regions

WisDOT divides the state into five regions; Northwest, North Central, Northeast, Southeast, and Southwest. See Figure 2.1-3. Each Region has the responsibilities outlined below for the structures in their designated territory.

Regional Planning and Scoping Units

- Review structures work concepts provided by BOS and coordinate with other stakeholders (pavements, operations, safety, etc.) to recommend adjustments as deemed necessary.
- Collaborate with BOS to develop structures improvement projects that incorporate identified structure needs, coordinating as appropriate to address other need areas (pavement, safety, etc.).



- Collaborate with BOS in the structures certification process (See 41.3.3).

Regional Project Development Sections (PDS)

- Participate in the structures certification process, as necessary (See 41.3.3).
- Coordinate with BOS on structures project re-certification, as necessary. (See 41.3.4.1.)
- Guide structures improvement projects from project certification through construction, working to ensure that the project is constructed per plans and specifications.

Regional Structures Maintenance Units

- Provide detailed structures condition data (via inspection reports) that fully and accurately depict the current state of each individual structure.
- Collaborate with BOS certification liaison in the structures certification process, specifically in the scoping of primary and secondary structures work concepts (See 41.3.3.3).
- Perform or coordinate some preventative maintenance work; deck washing, deck sealing, crack sealing, etc. See Chapter 42 – Bridge Preservation for more information.

41.5.3 Division of Transportation Investment Management (DTIM)

DTIM is responsible for the financial component of structures asset management, determining the allocation of funds for structures improvement projects.

Bureau of State Highway Programs (BSHP)

- Collaborate with BOS to assess structures needs as they relate to the allocation of available funds to the various WisDOT funding programs.
- Determine the specific allocation of available funding for each of the WisDOT funding programs.
- Provide direct oversight and prioritization for the state-wide Backbone funding program.
- Provide financial analysis expertise and tools, such as Life Cycle Cost Analysis (LCCA) guidance.

Bureau of Transit, Local Roads, Railroads & Harbors (BTLRRH)

- Provide direct oversight and programming for the Local Bridge program, utilizing the list of eligible structure work concepts provided by BOS.



41.6 Programming Policy for Structures Improvement Projects

Structures improvement needs are identified by BOS as detailed 41.2 above. As Regional personnel work to develop projects to address these structures needs, other factors may contribute to the final project scope and timing. The policy items noted below provide direction on how some of these project factors shall be considered as they relate to the scope of structures improvement work.

41.6.1 Bridge Age

WisDOT policy item:

Bridge age shall not be a primary driver for the initiation of structures improvement work.

For a given bridge, there is correlation between the condition of the bridge and its age. However, condition (not age) shall be the primary driver for structures improvement work. The focus of evaluation should be on how the structure is currently performing, regardless of structure age.

41.6.2 Bridge Ratings

WisDOT policy item:

Unless specifically approved by BOS, inventory rating, operating rating, or the presence of a load posting shall not be the primary driver for the initiation of structures improvement work.

If a structures improvement project has been reviewed and approved by BOS (see 41.3.3), it may be appropriate to include work to improve load ratings or remove a load posting. It is strongly recommended to perform rating analysis early for a rehabilitation project to identify potential strengthening needs. Consult with the BOS Rating Unit before expanding structures scope to include strengthening.

41.6.3 Vertical Clearance

WisDOT policy item:

Vertical clearance shall not be the primary driver for the initiation of structures improvement work.

Various impact mitigation techniques shall be evaluated for bridges with a history of impacts before scoping an improvement project to include addressing substandard vertical clearance.

If deck replacement, superstructure replacement, or structure replacement are identified as the appropriate treatment and vertical clearance is substandard, the project team should investigate the additional cost of creating more vertical clearance.

Region and BOS concurrence is required to up-scope a project for vertical clearance issues.



41.6.4 Hydraulics

WisDOT policy item:

In the case of structures with flooding history or concerns, improvement work shall not be initiated unless mitigation (detours) are not possible. If mitigation is not possible, consult BOS Hydraulics Unit for direction.

In most cases, traffic can be adequately detoured around flooded structures until such time as waters recede.

41.6.5 Freight Considerations

WisDOT policy item:

Freight needs shall not drive the initiation of a structures improvement project.

As related to structures, freight needs are primarily capacity (load ratings and/or load postings) and clearance (vertical and horizontal).

41.6.6 Cost Benefit Analysis

When considering different options for structures improvement work, a cost-benefit analysis should be performed. The analysis should be performed by Regional programming staff using analysis tools approved by the DTSD Administrator’s Office. Direction on select input data to be used for cost-benefit analysis is detailed below.

41.6.6.1 Treatment Schedule

When performing cost-benefit analysis, the following shall be used as the idealized treatment schedule for a new bridge. **The treatment schedules below are only for use in cost-benefit analysis and are not intended to be used for programming purposes.**



Prestressed Girder Superstructure

Primary Work Concept	Secondary Work Concept	Structure Year
New Construction	---	Year 0
Reseal Deck	---	Year 4
Reseal Deck	---	Year 8
Thin Polymer Overlay	---	Year 12
Thin Polymer Overlay	---	Year 22
Concrete Overlay and New Joints	<ul style="list-style-type: none"> • Substructure repair • Superstructure repair 	Year 47
Deck Replacement	<ul style="list-style-type: none"> • Substructure repair • Superstructure repair 	Year 67
Reseal Deck	---	Year 71
Reseal Deck	---	Year 75
Thin Polymer Overlay	---	Year 79
Thin Polymer Overlay	<ul style="list-style-type: none"> • Substructure repair • Superstructure repair 	Year 89
Bridge Replacement	---	Year 100

Steel Girder Superstructure

Primary Work Concept	Secondary Work Concept	Structure Year
New Construction	---	Year 0
Reseal Deck	---	Year 4
Reseal Deck	---	Year 8
Thin Polymer Overlay	---	Year 12
Thin Polymer Overlay	---	Year 22
Concrete Overlay and New Joints	<ul style="list-style-type: none"> • Spot/zone painting • Substructure repair • Superstructure repair 	Year 47
Deck Replacement	<ul style="list-style-type: none"> • Complete painting • Substructure repair • Superstructure repair 	Year 67
Reseal Deck	---	Year 71
Reseal Deck	---	Year 75
Thin Polymer Overlay	---	Year 79
Thin Polymer Overlay	<ul style="list-style-type: none"> • Spot/zone painting • Substructure repair • Superstructure repair 	Year 89
Bridge Replacement	---	Year 100



Concrete Slab Superstructure

Primary Work Concept	Secondary Work Concept	Structure Year
New Construction	---	Year 0
Reseal Slab	---	Year 4
Reseal Slab	---	Year 8
Thin Polymer Overlay	---	Year 12
Thin Polymer Overlay	---	Year 22
Concrete Overlay and New Joints	<ul style="list-style-type: none"> • Substructure repair • Superstructure repair 	Year 47
Concrete Overlay and New Joints	<ul style="list-style-type: none"> • Substructure repair • Superstructure repair 	Year 67
Bridge Replacement	---	Year 87

For all other superstructure types or in-service structures, consult BOS Bridge Management Unit for direction.

41.6.6.2 Discount Rate

WisDOT policy item:
 A discount rate of 5% shall be used for cost-benefit analysis.

This value was determined based on analysis conducted by DTIM and is Department policy.

41.6.7 User Delay

WisDOT policy item:
 For the purposes of cost-benefit analysis, user delay shall be addressed per direction in the WisDOT Facilities Development Manual (FDM).

User delay can have a dramatic impact on the results of a cost-benefit analysis and must be considered based on Department policy.



41.7 References

1. *Specification for the National Bridge Inventory Bridge Elements Bridges* by Federal Highway Association, 2014
2. *Manual for Bridge Element Inspection, 2nd Edition* by American Association of State Highway Transportation Officials, 2019
3. *Structure Inspection Manual* by Wisconsin Department of Transportation, 2003.
4. *Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation's Bridges* by Federal Highway Association, 1995
5. *Facilities Development Manual (FDM)* by Wisconsin Department of Transportation, 2018
6. *Program Management Manual (PMM)* by Wisconsin Department of Transportation, Division of Transportation Investment Management, 2018



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