
Proceedings of the 2011

National Bridge Management, Inspection and Preservation Conference: Beyond the Short Term



U.S. Department of Transportation
Federal Highway Administration

December 2011

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1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.	
4. Proceedings of the National Bridge Management, Inspection and Preservation Conference of Nov 1-Nov. 2, 2011 in St. Louis, Mo.		5. Report Date	
		6. Performing Organization Code	
7. Author(s) (Gordon D. Proctor, Shobna Varma, John M. Hooks		8. Performing Organization Report No.	
9. Performing Organizations Name and Address Gordon Proctor & Associates, Inc. 7825 Wiltshire Drive Dublin, Ohio 43016 National Center for Pavement Preservation 2857 Jolly Road Okemos, MI 48864 StarIsis Corp. 3737 Woodstone Drive Lewis Center, Ohio 43035		10. Work Unit No.	
		11. Contract or Grant No. DTFH61-07-D-00031-T-09001	
12. Sponsoring Agency Name and Address FHWA Office of Asset Management, Pavements and Construction		13. Type of Report and Period Covered Draft Report 9/29/09-12/23/2011	
		14. Sponsoring Agency Code	
15. Supplementary Notes			
16. Abstract This report summarizes the proceedings of the National Bridge Management, Inspection and Preservation Conference held November 1 and 2, 2011, in St. Louis, Missouri. The conference included tracks on bridge management, inspection and preservation with an emphasis upon how all three interrelated disciplines can collaborate to improve the long-term performance of the nation's highway bridges with the conference theme being beyond the short term.			
17. Key Words Bridge Preservation Asset Management Bridge Inspection Sustainable Infrastructure Bridge Management		18. Distribution Statement	
19. Security Classification (of this report)Unclassified	20. Security Classification (of this page) Unclassified	21. No. of Pages 54	22. Price None

National Bridge Management, Inspection and Preservation Conference Proceedings: Beyond the Short Term

Message from the Director,

More than 350 bridge professionals gathered in St. Louis, Mo., to promote the preservation of one of our nation's most important assets - its bridges. Bridges link communities, promote commerce, and span our nation's physical obstacles. They are so common that many members of the public take them for granted. However, the bridge professionals who gathered in St. Louis understand that these important national resources require diligent, on-going and determined effort to maintain.

"Beyond the Short Term" was the theme of the conference but more importantly it represents the mindset of the FHWA and its partners in the state and local highway agencies. Those of us in the transportation community are increasingly aware of the need to maintain the transportation system not just for today's generation, but for those who come after us. Creating a sustainable transportation system that provides benefits for the next generation, as well as the current one, is an overriding concern of us all.

To that end, those who manage, inspect and preserve our bridges gathered to share best practices, learn from one another and to promote the growing attitude that we need to preserve our scarce transportation resources in the best condition possible. We do not have the luxury of building new bridges whenever our old ones age or fall into states of disrepair. We must be pro-active and anticipate the factors that will degrade our bridges and address them before they occur. Sound bridge preservation is the key to sustaining our nation's bridges.

Sustaining our bridges requires the close collaboration between those who design, build, manage, inspect and preserve them. We must break down walls between our traditional agency silos and collaborate through the complete lifecycle of our bridges. Such collaboration was apparent in St. Louis. It is clear that our nation's bridge community is becoming increasingly aware of the need to work across disciplines and to use sound asset management principles to preserve our nation's highway structures.

I want to thank those who came to St. Louis, not only for their participation in this important conference but for their continuing efforts to preserve our nation's bridges. We hope these proceedings and the related materials will help others join the growing movement of bridge preservation.



Butch Wlaschin
Office of Asset Management, Pavements and Construction

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Introduction

The second National Bridge Management, Inspection and Preservation Conference was held in St. Louis, Mo., Nov. 1 and 2, 2011.

The theme of the event was “Beyond the Short Term”, a concept that emphasizes a sustainable, long-term approach to preserving the nation's highway bridges. During the two days of joint plenary and breakout sessions, the attendees focused upon the collaboration necessary by all three groups, those who manage, those who inspect and those who preserve the nation's bridges.

The following people served on the conference planning committee.

Sheila Masters (co-chair)	FHWA
Shyan Yung Pan (co-chair)	FHWA
Paul Sharp	FHWA
Dennis O’Shea	FHWA
Gary Moss	FHWA
Wade Casey	FHWA
Anwar Ahmad	FHWA
Sonny Jadun	FHWA
Larry O’Donnell	FHWA
Dave Juntunen	Michigan DOT
Michael Johnson	Caltrans
Jeremy Shaffer	InspectTech
Ted Hopwood	University of Kentucky
Steve Varnedoe	National Center for Pavement Preservation (NCPP)
John Hooks	NCPP
Patte Hahn	NCPP
Lacy Love	AASHTO

Conference Summary

The National Bridge Management, Inspection and Preservation Conference held November 1 and 2, 2011, in St. Louis documented a growing interest in comprehensive management, inspection and preservation of the nation's bridges.

The increased interest was evident in the large attendance that nearly doubled from the first conference held in 2007. Beyond the numbers, however, the presentations illustrated a growing array of strategies to ensure the safety and performance of the nation's highway bridges. The State, Federal, and private-sector presenters illustrated a growing number of innovations that will extend the life of bridges, ensure their safety, reduce their costs and display to the public that the nation's bridge inventory is being responsibly managed.

Speakers emphasized that the bridge community is leading the nation to a new understanding that bridge preservation is the most economical and sustainable strategy to ensure the nation's highway bridges are safe and can support a robust economy. They reiterated the need to create a national awareness that preserving good bridges in good condition for as long as possible should be a priority for all State and local transportation agencies. Adopting a mindset of being "owners and operators" who inspect and preserve bridges so they last for 100 years was promoted as a major conference theme, and as a national priority.

The presentations also documented the evolving advancements in bridge management that are promoted by the FHWA and its State partners. The Pontis bridge management system is being updated under the auspices of a national oversight team. The updated management system will accommodate the "element level" inspection processes that bring additional data, granularity and analytical capability to the inspection and evaluation of the nation's bridges. State and Federal bridge participants discussed the challenges that migrating to the new management system and the new inspection process will bring. They also discussed the new insights and sophistication that both will contribute to the inspection and management of the nation's aging bridge inventory.

Speakers described how the FHWA is responding to calls for greater oversight and accountability of the national bridge program. Congress and the Government Accountability Office called on the FHWA to increase its oversight and the agency is doing so in partnership with the state highway agencies.

Emerging innovations in technology that can improve the inspection, management and preservation of bridges were shared among the participants. The technological innovations were numerous and ranged from improved rope access that allows inspectors to reach high-level or difficult structures to advanced sonar that allows them to peer beneath rivers to inspect bridge foundations. In terms of management, presenters shared sophisticated new computerized management system reports and advanced bridge-treatment optimization routines that aid in decision-making. In terms of new materials, presenters discussed improved sealers and membranes to preserve bridge decks, corrosion-resistant components and coatings to preserve steel and concrete.

The practitioners within the areas of management, inspection and preservation also discussed ways to work across silos and use the strategies of one discipline to assist the practice of the others. Inspection data are serving several uses including the identification of maintenance needs or the improvement of management system data. The improved understanding of preservation strategies can help refine the deterioration curves of the management systems so they can better predict the performance of bridges. Sound management systems can better identify which bridges require more frequent and robust inspections, and which ones will require preservation treatments. The presentations described how the bridge community is finding efficient, multiple uses for its tools that can help in all three areas of management,

inspection and preservation.

The growing movement to increase performance reporting was evident throughout the conference. Emerging ways to use performance data to manage entire bridge inventories, to select treatment projects and to report to policy makers were reported by several states. Presenters discussed how they are using performance metrics to move away from the practice of addressing only bridges in poor condition but to also use preservation strategies to keep good bridges in good condition.

Highway agencies are struggling to stay abreast of promising opportunities created by changes in technology, policy, materials and practices. As agencies cope with constrained resources they express strong interest in learning of proven strategies to reduce their costs and improve their management of structures. The conference attendees gave the event high marks and called for another conference in at least two years. In the meantime, they asked for continued promotion of bridge preservation, increased research into effective preservation strategies and they called for increased sharing of best practices among the states.

Participants were asked what additional actions and research should occur, as well as what lessons they learned from the conference (see Appendix 3 for more details).

In terms of what actions should occur to advance bridge management, inspection and preservation, the participants most frequently urged the dissemination of best practices. Conference attendees said in their evaluation of the event that learning of the innovations that were successful elsewhere was a major benefit of the conference. They urged the continued development of resources that document best practices in management, inspection and preservation.

In terms of needed research, participants recommended research that further documents the beneficial effects of preservation strategies including cost savings. Although many strategies are known to be effective, the degree to which they preserve bridges and the amount of additional performance and extended service life they provide could be better defined.

As to lessons learned, the most commonly cited lesson is that bridge preservation should be pursued as a priority for all highway agencies. The concept that bridges should be actively managed so that they remain in sound condition for as long as possible was cited as the most important lesson learned by the participants.

Session 1 Welcome and Introductions

Mr. Butch Wlashin, FHWA Director of Asset Management, Pavements and Construction welcomed the attendees and introduced the first speaker, Kevin Keith, director of the Missouri Department of Transportation. Mr. Keith reiterated Mr. Wlashin's comments regarding the importance of preserving the nation's bridges and said that preserving the existing system is the highest priority for the Missouri DOT and for most transportation agencies in this current era.

"We have to take care of what we have for as long as we can, period," he told the audience. He noted that 25 percent of Missouri's structures are deficient, creating major challenges for the department. The DOT also faces the need to preserve 50 major bridges. Based on the age and condition of the major bridges, the DOT should be replacing two a year but only can afford to replace one annually.

Because of the challenges of aging structures and diminishing revenues, the transportation agencies need to innovate, as has Missouri with its major program to replace 809 deficient bridges through a statewide financial plan and campaign. They have focused upon not only replacing deficient structures but learning to replace them quickly to minimize the effects upon the public. Many bridges are replaced in 21 days, and recently one was completed in 2.5 days.

Mr. Ed Cordero, the assistant division administrator for the FHWA Missouri division office, added his praise to the participants for their efforts to preserve the nation's aging, and traffic-burdened bridges. He said the FHWA is providing tools to transportation agencies, such as the conference, a National Highway Institute course on bridge management and is producing a bridge preservation "toolbox." The FHWA also long has been a proponent of an asset management approach, which provides an overarching framework that incorporates bridge preservation. He commended the participants for their efforts and urged them to continue a partnership with the FHWA to preserve the nation's bridge inventory.

Mr. Wlashin noted while introducing keynote speaker Kirk Stuedle that the FHWA has been urged by Congressional analysts to develop a more comprehensive approach to managing the nation's bridges. He said the FHWA has been systematic but is taking steps to even more comprehensively manage bridges. He said in dialogue with Congressional staff, it appears they want the FHWA and the State and local transportation agencies to have a plan for preserving bridges, to ensure the nation does not lose any more bridges and they want the nation to have a long-term approach to bridge management and preservation.

Mr. Stuedle titled his presentation, "Managing the Nation's Bridges Better, Faster, Cheaper, Safer and Smarter." He is the director of the Michigan Department of Transportation (MDOT) and president of the American Association of State Highway and Transportation Officials (AASHTO.)

Director Stuedle laid out a national bridge agenda that included all the elements incorporated in the title of his speech. In terms of better bridges, highway agencies should embrace research findings that produce new materials such as carbon fibers to extend bridge life and performance. Faster bridge construction is possible through the results of the Strategic Highway Research Program 2, (SHRP2), the Every Day Counts (EDC) initiative and the Highways for Life program. Accelerated bridge construction has dramatically reduced maintenance of traffic impacts which is a key public consideration. When he asked the audience how many of them had used accelerated bridge strategies such as pre-fabricated components, only about one-fourth of the audience members raised their hands. He said accelerated bridge construction holds significant promise and should be embraced. The higher initial costs of accelerated construction can be offset by lower maintenance of traffic costs.

He noted the AASHTO Board of Directors approved the definition of bridge preservation, which is,

"Bridge preservation is defined as actions or strategies that prevent, delay, or reduce deterioration of bridges, or bridge elements, restore the function of existing bridges, keep bridges in good condition and extend their life. Preservation actions may be preventive or condition-driven."

No one would build a house, neglect its upkeep for 50 years and then build a new house, he said as an analogy for bridge management. However, to some degree highway agencies failed to adequately preserve their bridges throughout their first 50 years necessitating the need for replacement. Bridge preservation can be made smarter through the embrace of innovations, research findings, monitoring of bridge health, asset management and performance management, data-driven decisions and partnerships. The bridge community also needs performance measures that are technically sound and understandable to the public. Bridge engineers and public relation specialists need to collaborate on terminology that satisfies both technical and public educational objectives.

Section 2 Putting It All Together

During this session the discussions focused on what is happening nationally at the FHWA, trends involving decommissioned bridges, how to use inspection data in management systems to preserve infrastructure and lastly inspection and management technological forecast.

FHWA National Bridge Management, Inspection and Preservation Initiatives by Mr. Anwar Ahmed, P.E.

The session speaker, Mr. Anwar Ahmad, gave a brief update on Bridge Safety, Management and Preservation Developments at the FHWA. Mr. Ahmad provided a brief overview of the kinds of activities and initiatives that the FHWA has been engaged in both now and in the future.

Mr. Ahmad, the FHWA bridge preservation engineer, said the FHWA is preparing to orient the national bridge program in conformance with two areas of emphasis. First, the re-authorized federal transportation program may include a performance management element. Second, the federal Department of Transportation inspector general recommended that the FHWA seek more oversight and consistency in the bridge program nationally. Toward both ends, the FHWA will promote the more consistent and comprehensive management of the nation's bridges within a performance-management framework. Other significant activities include:

- Earlier this year the FHWA implemented a new oversight of the National Bridge Inspection Program This included the implementation of the 23 Metrics to ensure consistency in the oversight process in accordance with the CFR. A team was formed earlier this year consisting of members from the FHWA and the AASHTO who are reviewing the new oversight process and are looking for improvement opportunities. The team will provide a report on their efforts during the AASHTO SCOBS meeting next July in Austin, TX.
- The FHWA conducted a load rating reviews of the State DOTs in the past couple of years and have begun a series of webinars in assisting bridge owners with their load rating efforts.
- The FHWA issued a memo to provide additional guidance regarding assigned load ratings in accordance with the national bridge inspection standards.
- As a result of the inspection findings on the I-64 Sherman Minton Bridge linking Louisville, KY and New Albany, Indiana, on September 12, 2011, the FHWA issued a TA regarding the inspection of FCM fabricated from AASHTO M270 Grade 100 steel

- The FHWA has updated several National Highway Institute bridge courses;
- The FHWA conducted a review of the state of the practice of bridge inspection critical findings practices. Visited 12 states as part of the national assessment. A report is due early next year;
- The FHWA is developing the National Bridge Inventory of the future that will include updating the NBI coding guide as part of the transition from general condition rating to element-level condition rating;
- The FHWA may start requiring element-level inspection for structures on the National Highway System;
- Turner-Fairbanks is researching non-destructive testing of steel bridges;
- Another research project is examining gusset plates, both single and additional;
- Other research is examining corrosion in pre-stressed concrete beams. The research is examining mitigation strategies and developing a manual for owners;
- Research is under way on underwater acoustic imaging;
- Bridge preservation efforts are being promoted by the Bridge Preservation Expert Task Group;
- The TSP2 bridge program has a website of activities and resources;
- The FHWA is developing a one-day bridge preservation course for supervisors and decision makers;
- The FHWA sponsored six regional bridge management peer exchanges;
- The bridge management team is developing performance-based bridge management training, a Bridge Management Implementation Guide and the publishing of case studies in the use of BMS.

Structural and Functional Characteristics of Decommissioned Bridges by Mr. John M. Hooks, P.E.

The second Session 2 presenter, Mr. John M. Hooks, provided the results of an ongoing study he has done entitled *Structural and Functional Characteristics of Decommissioned Bridges*. The study seeks to understand the life cycle of highway bridges and what factors influence their service life.

Mr. John Hooks reported the findings of a study on a population of 20,645 bridges that were taken out of service between 1992 and 2009. Bridges are taken out of service for many reasons including bridge failure due to flood, earthquake or superstructure failure, damage from vehicle collisions, structural deficiency, or the road is being widened or reconstructed. Although records as to why bridges were decommissioned are ambiguous, it is possible to identify a significant number of bridges and the last year that the NBI contained a record on them. From a review of those characteristics, it is possible to infer one or more reasons that the bridge was taken out of service and replaced. Some key findings that were delivered include:

- 86% of the decommissioned bridges were on rural highways and 14% on urban highways;
- 62% of the decommissioned bridges carried traffic volumes of less than 500 vehicles per day and another 25% carried between 500 and 1000 vehicles per day;
- The full sample displayed a normal distribution of median ages when replaced;
- Median age of replacement varied significantly by type and material;
- 85% of the replaced bridges were either structurally deficient or functionally obsolete;
- The most common reason for a rating of structurally deficient was “structural evaluation”;
- The most common reason for a rating of functionally obsolete was deck geometry.

Determining Preservation Needs Using Inspection and Bridge Management System Data by Mr. Paul Jensen, P.E.

The third Session 2 speaker, Mr. Paul Jensen, outlined how to determine Preservation Needs Using Inspection and Bridge Management System Data. The presentation defined the process and how to develop and retain inspection data.

Mr. Jensen, formerly of the Montana Department of Transportation, is currently working with the long-term bridge performance program. He described the OODA Loop, or a systematic process of Observe, Orient, Decide and Act as a rational process for decision making. Basing preservation needs upon sound data is a logical and preferable way to pursue bridge preservation but the reality is that much of the older NBI data is problematic. The quality control processes for data may not have been as adequate as previously assumed. Also, the granularity of the data is very important, but is sometimes lacking when NBI data is used as a source for preservation needs decisions.

The history of past maintenance activities also is often missing in bridge databases. The timing and cost of the maintenance, therefore, is not fully known. Improvements over time in the capturing of maintenance treatments and their costs can improve future decision making regarding the benefits of maintenance activities and how they contribute to long-term bridge performance. Metrics for bridge condition, and preservation, are improving. A rate of return for an activity, action, or treatment is among the better metrics. The Bridge Health Index from the mid-1980s remains a useful metric. It is important to track over time the benefits of preservation to document that preservation provides benefits that may not be apparent only in the short term. An objective may be to adopt strategies for a "steady state" of good bridge conditions that are sustained through systematic preservation of the bridge inventory.

The Future of Bridge Technology and Management by Dr. Jeremy Shaffer

Dr. Jeremy Shaffer wrapped-up Session 2 as he provided a glimpse of the Future of Technology and Bridge Inspection and Management over the next 10 to 20 years. Advances in technology will continue to exert profound effects upon how agencies design, preserve and inspect bridges. The bridge and highway industry traditionally is slow to evolve because of the conservative nature of the industry, and its rule-and-regulation-driven environment. However, the rapid availability of new technologies increasingly will influence practices in the bridge community.

By 2031, the power of computing will be beyond what most users imagine today. Inspectors in the field will have access to virtually unlimited computing power, speed and memory. Computers may be so small and powerful that could resemble a badge or other inconspicuous item. It may be common for input devices to accommodate voice or handwriting recognition. They are likely to include instant access to past inspection data, have "wizards" for guiding inspections and have quality-assurance components built into them. Bridge management software will blossom. It is likely to include full access to past plans and bridge data. Although adoption of new technology can be difficult, the blossoming of both software and hardware relevant to the preservation and inspection of bridges will be common and will bring new profound changes to the way the nation's bridges are managed.

Moving from Fighting Fires to Preventing Them by Mr. King Gee, FHWA

FHWA Associate Administrator King Gee used an analogy to describe the changing national approach to bridge management. Bridge program managers are evolving from being firefighters to being fire wardens. Instead of reacting to problem bridges as they arise, they are systematically putting in place practices to prevent bridges from deteriorating rapidly or unpredictably. "We've been very good, in fact we are excellent, at being firefighters. We've not been so good at being fire wardens."

The future of bridge management is to manage beyond the short term. The first shift is to actively manage bridges, not just to build or repair them. The shift to an owner/operator approach requires a change from identifying problems with bridges to anticipating and forecasting when problems will occur and taking steps to forestall them to the extent possible. The long-term approach requires considering individual bridges, as well as entire inventories, from a lifecycle cost perspective. The emerging bridge program manager of the future will have a well-balanced approach that incorporates appropriate treatments and strategies for each phase of a bridge's life to ensure the lowest-cost treatment to prolong the bridge's useful life.

Legislative Outlook, Ms. Alison Klein, ARTBA

Allison Klein of the American Road and Transportation Builders Association (ARTBA) briefed the luncheon participants on the uncertainties facing the nation's transportation programs. The House and Senate both have competing programs for re-authorizing the federal transportation program, which differ from the White House proposal. There is considerable uncertainty as to when and how a consensus transportation program re-authorization will be developed and at what funding level. Funding levels between the various proposals differ significantly.

Despite the uncertainty of when the legislation will be enacted, there does appear to be a consensus to have a performance-based federal program. The various reauthorization versions all include an emphasis upon accountability in the federal programs. The versions also include consolidation of programs.

Panel and Roundtable Discussions, Sessions 3, 4,

The afternoon of the first day of the conference and the morning of the second were devoted to panel discussions and round table discussions intended to present a broad-cross section of best practices from across the country and to identify common issues that need to be addressed. Sessions also encouraged audience questions and comments. The session topics are listed here with the summaries of each session included in the appendices.

The sessions operated in three parallel tracks: Bridge Management, Bridge Inspection and Bridge Preservation.

Section 3 Management, Inspection and Preservation Tracks

During the afternoon of the first day and the morning of the second, separate breakout sessions occurred in three tracks, one each for Bridge Management, Bridge Inspection and Bridge Preservation. The sessions allowed the sharing of best practices, and emerging issues among the participants.

Session 3A Bridge Management Track

During this session, the speakers discussed several important areas of bridge management including bridge element migration, moving toward a performance-based Federal aid program, and Virginia DOT's experience with comprehensive bridge management.

Bridge Element Migration by Mr. Allen Marshall

The first Session 3A speaker, Mr. Allen Marshall of Allen Marshall Consulting, presented on efforts to migrate the commonly recognized (CoRe) element level data to the new AASHTO element-level inspection data using an automated tool.

Mr. Marshall was tasked with developing an automated tool that would help the agencies migrate from the old CoRe element standards to the new AASHTO element standards. Among the issues that the migration faces is that states now manage a huge array of element data and they do not have the individual resources to migrate them to the new Pontis or AASHTO specification. An automated tool is needed to support the conversion and strengthen adoption nationwide. The migration tool must address the fact that each agency has collected data to its own standards. Any data migration needs to be flexible to accommodate individual agency practice. Another key element is that migration must allow for engineering judgment and not be a black box, closed application. The new tool opened up the "black-box" and allowed agencies to understand the logic used in the conversion. It is configurable and allows the agencies to make changes to the migration logic to incorporate feedback from the testing process. The users can review the rules, add to existing rules or make changes to meet specific agency needs.

He described a series of parameters for a migration solution that will help users with an automated migration of old CoRe data to element-level data suitable for Pontis. In addition to describing how the automation tool will work, he discussed next steps that include integrating the National Bridge Element rollup logic, integrating automated defect flags and protective system generation, finalizing rules and distributing them to the user community.

Moving Toward a Performance-based Federal-aid Highway Program by Mr. Butch Wlaschin, FHWA

The second Session 3A speaker, Mr. Butch Wlaschin described the movement toward a performance-based federal-aid highway program. He said the FHWA has provided the following definition. "Performance Management at the Federal Highway Program is a systematic approach to making investment and strategic decisions using information about the condition and performance of the system and developing an approach to achieve a desired set of national goals."

Significant national momentum underlies the move to performance management with support coming from various organizations and associations. The FHWA has proposed a performance-based federal aid program that consolidates 55 funding programs into five core programs. They focus investment on safety, state of good repair, and livability. The programs also put renewed emphasis upon the National Highway System. As proposed in the 2012 budget, the performance-based program would work in the following way:

- The Secretary, with input, will establish quantifiable performance measures and national perfor-

mance goals;

- The states will work in partnership with the FHWA to set targets;
- The planning process will be envisioned as the vehicle to implement performance management;
- States will be called upon to report annually on progress toward meeting the targets;
- Additional flexibility will be provided when targets are met;
- Performance improvement plans will be required when targets are not met.

Performance goals will be set in few areas. They probably will be set for safety, pavement and bridge conditions, reliability, freight/economic competitiveness, environmental/climate change and livability. A process to monitor, evaluate and report on progress will be a major emphasis. The monitoring of performance is expected to be routine with data analyzed at both the state and national level. The identification of best practices also will be common with them disseminated nationally. The reporting of findings and outcomes will be common, and states will be reporting progress on a regular basis. Accountability will be based on performance.

Comprehensive Bridge Management - The Virginia Experience by Mr. Jeff Milton, VDOT

The third Session 3A speaker was Virginia DOT bridge preservation specialist Jeff Milton who presented a case study of Virginia's comprehensive bridge management system and processes. He described a comprehensive, integrated process that relies on asset management principles to sustain Virginia's bridges at an acceptable condition for the lowest lifecycle cost. The elements of Virginia's successful processes include:

- A complete and up-to-date structure inventory database;
- A quality structure inspection program;
- Computer software that provides a tool to develop network level optimization models that minimize the long-term maintenance funding needs while keeping bridge elements out of risk of failure;
- A work candidate and project-selection process that includes the use of bridge management software, analysis of element-level inspection data, analysis of general condition data;
- Performance targets based on the number of structurally deficient structures;
- A preservation approach to managing the structure inventory that includes work actions on preservation, rehabilitation and replacement;
- Design and construction policies that will reduce future maintenance needs of structures constructed today;
- A project-delivery program that includes both in-house and contract activities;
- A system for tracking work accomplishments;
- A letter agreement with the FHWA allowing preventive maintenance and system-preservation activities using federal bridge funds.

VDOT's global performance measure is to maintain 92 percent of the structures as non-structurally deficient. Other performance measures are considered in the overall management of the program and include functional obsolescence, general condition ratings greater or equal to 5, and the Health Index. It has a public dashboard that tracks and reports conditions in real time.

VDOT's relies on a comprehensive set of treatment strategies to achieve its lowest-lifecycle approach. These include preventive maintenance, painting, restorative maintenance, rehabilitation and replacement.

Session 3B Bridge Inspection Track

During this session, the speakers looked at several important inspection issues, including Minnesota's new bridge management system, identifying preservation needs using inspection data, the FHWA national bridge inventory of the future, and the use of rope access to address inspection-access challenges.

Mr. Claude Napier of the Virginia DOT moderator of the inspection track, noted that he always advises inspectors during their training that bridge inspection is the beginning of bridge management. From the inspection process flows the information that supports all other decision making regarding bridges. Therefore, sound inspection processes are fundamental to sound bridge management. After those remarks, he introduced the speakers for the inspection sections.

Section 3A Bridge Inspection Track

MnDOT's Web-Based Inspection and Maintenance Reporting Process, Mrs. Jennifer Zink MNDOT

Mrs. Jennifer Zink of the Minnesota DOT bridge inspection unit described how MnDOT replaced a legacy, paper-based bridge inspection system with a web-based system that connects both inspection and maintenance data. Among the functions of the new system are that it will produce reports of bridges that need to be inspected, it has a dashboard of results, it also has version control that tracks when files are updated and by whom. It also fills a gap in which the inspection findings were not regularly shared with maintenance crews to address needed repairs or maintenance. The need for that linkage was emphasized by an audit of the department's bridge processes following the collapse of the I-35 bridge in Minneapolis. The system also links to Google Maps so that a user can view aerial and street-level views of each bridge and its surroundings. The department estimated that the increased efficiencies in data entry will result in a return on investment of 2.4 years.

Identifying Preservation Needs Using Inspection Data by Mr. Lee Floyd, SCDOT

Mr. Lee Floyd of the South Carolina DOT described the agency's process of ranking bridges for repair, rehabilitation and improvement using sound inventory and condition data, combined with engineering judgment and social and economic factors. The department has been able to adopt a new system that relies upon factors from Pontis for 75 percent of the selection weight with engineering judgment comprising the other 25 percent weight. The new selection system recognizes that some bridges take many years to develop considering the environmental, design and right of way process. The selection process allows for those types of structures to begin development long before they become critically deficient. A simple-condition-based selection process did not anticipate the need for such long development schedules.

FHWA National Bridge Inventory of the Future by Mr. Wade Casey, FHWA

The FHWA bridge management engineer Mr. Wade F. Casey discussed the FHWA plans to modernize the National Bridge Inventory. The vision for the project is, "A NBI that accurately reflects the condition and performance of our nation's highway bridges." Goals of the project include:

- Advance the NBI through, quality data;
- Incorporate data that provides for:
 - support of the data-driven, risk-based NBIP oversight process;
 - development and use of effective performance measures;

- support for National level analysis;
- Improved timeliness.

The project will take several years. Currently a team has been formed to pick up this task that was begun by a previous team. Among the first tasks is to review the 2,007 comments received earlier in the project. A key objective is to transition bridge condition reporting requirements from the current general component condition rating system to the element-level condition state rating system. It is assumed that, initially, the FHWA will require only element data for the National Highway System bridges.

The AASHTO Guide Manual for Bridge Element Inspection classifies bridge elements under the following three element types:

- National Bridge Elements (NBEs);
- Bridge Management Elements (BMEs), and;
- Agency Developed Elements.

Mr. Casey said the team is finding that it wants more than NBEs such as the Bridge Management Elements. The desired data will be more granular than now exists. It will improve national uniformity in the element inspections, should be easier for the public to understand and should support a performance-based approach.

There are many reasons for the increased granularity in element data including:

- More quantitative condition assessment;
- Enhance and facilitate needs assessments, and performance measurement;
- Simplify the general condition rating scale from nine to four condition state (CS) ratings;
- It is superior to the NBI;
- Easily understood rating measurements by the public (Good/Fair/Poor/Severe);
- Field collected data preferred by National Bridge Investment Analysis (NBIAS) which goes into the Condition and Performance report to Congress that identifies national needs which translates into funding;
- Office of Inspector General recommendations: a) Greater use of BMS (Bridge Management Systems); b) Update CoRe elements and require data be submitted to the FHWA;
- GAO recommendations: a) Identify best tools and practices for bridge management systems; b) Review and evaluate HBP funding mechanism to align with performance;
- Congressional interest;
- It doesn't take much more time to collect.

Inspection Challenges Addressed with Rope Access by Mr. Tom Howell, HDR

Mr. Tom Howell of HDR discussed how rope access can be used in new ways to achieve "arm's length" inspection of modern high-level or high traffic structures. The advancement of rope inspection allows inspectors to use very little equipment yet still access all components of unique or challenging structures. Not only can rope access be used to access high structures, but it also can be used to access load-posted structures that cannot accommodate trucks, or high-traffic structures that do not easily accommodate lane closures. It even has been used in isolated areas of Alaska where it would be expensive to transport other inspection equipment.

Although technologically simple, the modern rope-access tools can lower the cost of inspection, reduce the need for inspection vehicles and reduce traffic impacts. In addition to cable and pulley systems, other low-cost but practical tools to assist the rope access inspectors include:

- Waterproof notebooks and pens;
- Waterproof and shockproof cameras;
- Cordless magnetic particle testing equipment;
- Headlamps to illuminate connection regions;
- Magnetic rulers;
- Compact ultrasonic measuring units;
- Bridge-specific booklets for note-taking.

Session 3C Bridge Preservation Track

During this session, the presenters looked at important aspects of bridge preservation including maintaining bridges in a state of good repair using low-cost strategies, data collection to support bridge preservation, and associating the right bridge treatment at the right time.

Bridge Preservation - Maintaining State of Good Repair Using Low Cost Investment Strategies by Mr. Anwar Ahmad, FHWA

Mr. Anwar Ahmad of the FHWA presented a framework upon which to build a consistent view of bridge preservation programs and augmented this with a discussion of bridge preservation related terminology, systematic preventive maintenance and examples of bridge preservation actions. He presented the AASHTO approved definition of bridge preservation and explained that preventive maintenance – either condition driven or planned cyclical actions – as well as rehabilitation actions were considered preservation. Bridge replacement is not considered preservation.

Preventive maintenance is a planned strategy of cost-effective treatments to an existing roadway system and its appurtenances that preserves the system, retards future deterioration, and maintains or improves the functional condition of the system (without substantially increasing structural capacity). Rehabilitation involves major work required to restore the structural integrity of a bridge as well as work necessary to correct major safety defects. *Source: 23 CFR 650.403(c).*

The FHWA has published a *Bridge Preservation Guide* that describes the benefits of preventive maintenance and provides guidance on Systematic Preventive Maintenance (SPM) and eligibility criteria for use of federal aid funds for SPM. Systematic preventive maintenance programs should be an iterative process starting with goals and measures and following through with inventory and condition assessment, needs assessment, budgeting and alternative evaluation, a work plan, implementation of the plan and finally the evaluation of the results.

Mr. Ahmad described several examples of actions that are typically considered preventive maintenance and presented the following conclusions:

- Bridge preservation is a fundamental component of bridge management;
- A balanced program addresses preservation, replacement, and improvement needs;
- Systematic preventive maintenance is eligible for federal aid funding;
- Preservation activities are effective when applied at the appropriate time to the appropriate bridge;
- Preservation activities are aimed at extending the life of bridges;
- Preservation activities cost much less than reconstruction and replacement.

Data Collection and Analysis to Support Bridge Preservation by Mr. Dave Juntunen of MDOT

Mr. Dave Juntunen from Michigan DOT described the approach that MDOT takes with regards to collection, analysis and management of data that is necessary to support programs for bridge preservation. The process of bridge inspection and data collection is seen as the foundation for all other bridge program activities including bridge management, project selection, design and construction. MDOT collects NBI rating data, element level inspection data (consistent with the AASHTO Guide), inspector recommendations and other Structure Inventory and Appraisal (SI&A) data. They consider an NBI rating of 5 as the break point between fair and poor condition and at the extremes of the scale; ratings below 4 indicate poor condition and ratings above 6 are considered good. As one primary performance measure, MDOT tracks the numbers of bridges that drop to poor condition year by year. Performance of bridge preservation activities are measured by the yearly cycle of bridges degrading to fair, then poor balanced against the bridges that are brought up from poor to fair to good condition by preservation activities.

MDOT keys on indicators - data collected during the routine or detailed bridge inspection that identifies a specific work type activity. One example is whether expansion joints leak which can identify repair or replacement actions. Other indicators include poor condition of steel coatings and top and bottom surface condition of bridge decks. In some cases, the routine visual bridge inspection may not be enough to determine actual bridge project needs and additional methods such as chain drag are used to better define the condition. MDOT has done extensive work tracking the deterioration of concrete decks with black rebar and those with epoxy-coated rebar. They have developed detailed guidance on types of projects to be deployed based on the condition of those two different types of decks. They have also developed detailed guidance on the preservation actions that takes into consideration the type of the existing paint, need for containment and contractor qualification.

The Right Bridge - The Right Time - The Right Fix - The Right Funding by Mr. Chris Keegan WSDOT

Mr. Chris Keegan, Olympic Region Operations Engineer for Washington DOT, stressed the need for an asset management plan that will work effectively if it features close coordination and cooperation between the bridge designers, inspectors, constructors, program managers and maintenance personnel. He highlighted the main goals of a bridge asset management plan and presented preventive maintenance objectives in terms of a carefully designed program that delivers preventive maintenance actions, reviews effectiveness and continually improves.

He presented a detailed matrix of repair, preventive maintenance and preservation actions that are funded and also presented a table that showed bridge asset backlogs for certain bridge elements and features. Ongoing preservation initiatives include a bridge washing pilot where bridges are flushed annually without first hand cleaning. The preliminary results show little change to local water quality.

Section 4 Management, Inspection and Preservation Tracks

Section 4A Bridge Management Track

During this session, the panelists looked at bridge management issues including analysis of transition probabilities in bridge modeling, prioritization using multi-objective optimization, and the results of a questionnaire regarding bridge management practices.

Bridge Modeling - Introduction to Transition Probabilities by Mr. Paul Thompson

Mr. Paul Thompson discussed theories and practice of bridge deterioration models using research conducted with the Virginia and Florida DOTs. Mr. Thompson explained the main assumptions used in the Markovian deterioration models incorporated in Pontis. Comparing the Markov deterioration model with other models showed that Markov assumed that even in the first year there would be bridge element deterioration, while other models assumed that bridge elements remained in the “new” state for the first year before degrading. The result of testing both models with Florida and Virginia data showed that the Markov model was too conservative, and in reality, it takes between three and four years before deterioration starts taking place.

In conclusion, the Virginia study confirmed the Florida conclusions that the one-step method of estimating transition probabilities produces results statistically comparable to the Pontis regression-based approach, using smaller sets of data. In both studies, transition times and life expectancy were found to be twice as long as the results determined earlier from expert judgment. This serves to emphasize the importance of developing models based on actual inspection data as soon as possible in the implementation of a bridge management system.

Prioritization Using Multi-Objective Utility Functions by Mr. Mike Johnson

Mr. Mike Johnson of Caltran discussed multi-objective utility functions and how they can improve project-selection and decision-making. Bridge investment decisions are traditionally done using condition-based deterioration models and often using lowest cost. This approach does not often take into consideration multiple objectives that an agency needs to consider in prioritizing bridges for investments. Traditionally, bridge management software looks at the minimum cost of maintaining bridges in a theoretical “non-failure” state. This may mean looking at least-cost and may result in doing no rehabilitation until the bridge elements reach a certain state of degradation. A more pragmatic approach is to do rehabilitation and maintenance work to prevent the bridge from reaching such a degraded state.

The Multi-Objective Utility Function looks at multiple functions such as risk, condition, load capacity and functional needs and assigns values and weights to each. The total utility of a project is the sum of each function. The utility function is flexible and allows an agency to increase or decrease the weight to a function to reflect the agency’s policy. The Multi-Objective Utility Function allows decision makers to include multiple criteria in the prioritization and selection of projects for investment.

Bridge Management Questionnaire Report by Mr. F. Casey, FHWA

Mr. Wade F. Casey, FHWA's bridge management engineer, presented the results of a national FHWA survey which examined state agencies' use of bridge management systems. The enquiry was prompted by the Office of Inspector General's audit of the national Bridge Inspection Program (NBIP.) The OIG report recommended that the FHWA initiate a program to collect data on the state's use of bridge management systems (BMS), evaluate the data states need to effectively manage bridges, and to provide resources and technical assistance to the states.

The FHWA division offices reported that 46 percent of states use Pontis to capture and store bridge condition data, while 33 percent use state-developed software, and 21 percent use Pontis and another program. In short, the survey indicates that states are using a variety of different software to capture and store bridge inspection data.

In terms of predicting future deterioration of bridge elements, 44 percent use Pontis, 37 percent of states don't appear to use any software for predicting deterioration, while 17 percent of states use an in-house system. Two percent use both Pontis and another system for predicting deterioration.

When asked about the uses of their bridge management systems, the majority of states use their BMS to store bridge information. Only about 10 percent said they use their BMS to track performance and about 25 percent use it to predict future conditions. About 15 percent use it for allocating funds. The result of this finding causes the FHWA to conclude it will assist states to use their BMS beyond simply storing bridge information.

The barriers to expanded use of the full capability of BMS for decision support were listed in order as: 1) lack of staff; 2) lack of dedicated funding; 3) lack of training; and 4) lack of upper management support. However, the lack of staff was clearly the overriding issue. The FHWA has identified as focus areas assisting states who lack upper management support, assisting with dedicated funding, appropriate staffing through discussions with management on the benefits of a viable bridge management program.

The survey indicated the FHWA divisions saw numerous changes necessary to ingrain bridge management into state practices. They include possible staff reorganizations, promotion of BMS success stories, management and politicians need to set priorities based on management systems rather than political will, and in another state there needs to be a commitment to provide funding to projects recommended by the BMS. The FHWA will promote assistance with changes that are needed to ingrain bridge management into the state's business practices.

The most common performance measures were structurally deficient bridges, followed by NBI condition rating, functionally obsolete bridges, vulnerability, health index and lifecycle benefit. The information needed for decision support that is not currently supplied is a lack of forecasting or modeling; additional data, risk vulnerability and cost-related data. A majority of states, 60 percent, are not incorporating lifecycle costs into their decision making. Thirteen states were reported to not optimize their bridge program with respect to prioritizing bridge preservation, rehabilitation and improvement. The FHWA will be promoting optimized budgets with respect to prioritizing bridge preservation, rehabilitation and improvement and replacement among states not already doing so.

The survey results indicate that 58 percent of states do not have a bridge preservation policy while 42 percent do. Another 67 percent of the states do not use the BMS to prioritize or select and track bridge functional improvements. The survey also indicated that most agencies use the bulk of their funds for bridge replacements, generally between 25 percent to 95 percent. Systematic preservation ranged from zero to 30 percent. Little over half, 54 percent, were reported to have linkages between the bridge management processes and the state's planning processes.

As a result of the findings, the FHWA is adopting a Bridge Management Technical Assistance Plan. It includes the conduct of bridge management case studies, peer exchanges, bridge management process improvement reviews, the St. Louis conference and a bridge management business plan and roadmap to address needed changes in the bridge management arena. In general, the technical assistance program will be achieved through regional peer exchanges, targeted bridge management process improvement reviews, and conferences such as these.

Session 4B Bridge Inspection Track

During this session, the panelists and audience discussed important aspects of bridge inspection including innovative use of inspection technology, quality assurance of inspection data, the use of Pontis 5.1.2 for inspectors, and performing deck inspections using non-destructive technology,

GDOT's Use of New Inspection Technology, by Mr. Andy Doyle, GDOT

Mr. Andy Doyle, state bridge inspection engineer for the George Department of Transportation, discussed the innovative, and generally low cost, tools his department uses to inspect structures. These have saved the department time and equipment costs, and have lessened maintenance of traffic impacts. Some of the tools include:

- A \$7,700 pole-mounted camera that includes a video display so the user can see the camera's view. The unit can take still pictures or video and is augmented with light to illuminate enclosed spaces;
- A "snake camera" allows a lighted camera on the end of a flexible cable to be inserted into enclosed spaces;
- An improved compressor allows for the air tanks of the underwater inspectors to be filled two at a time with considerable cost and time savings for the department;
- Rugged laptops with wireless broadband access saved each inspector six hours weekly because they can access electronic files and email without having to travel to the office;
- A Structure Analysis Management System (SAMS) is a web-based system for managing load ratings.

QA/QC of Bridge Inspection, Mr. Bert Hartman, ODOT

Mr. Bert Hartman of the Oregon Department of Transportation discussed the department's Quality Assurance/Quality Control (QA/QC) practices. He noted that the Oregon DOT participated in a 2007 NCHRP 20-07 project that found substantial variability in inspections, That research influenced efforts by Oregon to ensure consistency in its inspections.

The Oregon DOT uses four steps to reduce variability and improve inspection quality. They are:

- bridge inspection;
- qualification and certification;
- bridge inspection manuals;
- training and continuing education.

Each state bridge inspector has the responsibility to inspect the bridges in his or her region. By having the inspectors look at the same population of bridges for many years, they develop a sense of ownership and are also aware of the deterioration that is happening from one inspection cycle to the next. For data entry, ODOT uses "pick lists" where possible to eliminate data entry errors. ODOT shares the results of its QA program with all inspectors, so that each will know the issues that were discussed and the chosen path forward. The inspector who had an inspection that was subject to a Quality Assurance Review gets specific feedback and sometimes will need to amend the inspection. In addition to the federal requirements, bridge inspectors in Oregon must pass the "ODOT Bridge Inspector Proficiency Exam" before they are issued a certification card that has an assigned identification number.

Pontis Version 5.1.2 for Inspectors by Dr. Jeremy Shaffer, InspectTech

Dr. Jeremy Shaffer of InspectTech discussed the upcoming release of Pontis 5.1.2 bridge management system with an emphasis on how it facilitates improved inspections. A fundamental aspect of the new Pontis version is that it will support the new element-level inspection process. The Pontis version 5.1.2 is built off of the existing Pontis architecture but will include many enhancements with a major goal of allowing for the National Bridge Elements (NBE) and Bridge Management Elements (MBE) to be accommodated. The newly adopted bridge element standard will replace the older CoRe elements for element-level inspections. The old CoRe elements will be visible in Pontis but all new inspections will be done in the NBE/MBE process.

The new version of Pontis also has improved interfaces, provides additional import and export options, and will be faster. Pontis 5.1.2 will have the user-friendly "Graphical User Interface" (GUI) screens for easier data entry. Other significant changes are that:

- CoRE elements will be read only;
- Sybase, the old data base that is no longer supported, will be replaced by Oracle and Microsoft SQL options;
- There will be the XML option for importing and exporting;
- There will be support for the Migrator data functions;
- It will be unable to use the NBI translator;
- A single action type is adopted for all work candidates.

Deck Inspection Using Non-Destructive Testing by Mr. Jody Bywater, WSDOT

Mr. Jody Bywater of the Washington Department of Transportation presented on WSDOT's use of video technology used traditionally for automated pavement inspection for inspecting bridge decks. The Pathway van used to photograph and video record pavement distresses has been used for surface inspection of decks. The department uses the technology specifically on low-risk desks such as ones rated as an NBI of 6 or better. The use of the video technology saves time and money by allowing low-risk decks to be inspected more conveniently which allows the department's resources to be directed to inspection of other bridges with higher risks.

The department uses the technique sparingly and if a potential deck distress is observed through the video inspection, an inspector is dispatched to the bridge for a traditional visual inspection. However, the use of the technology has freed the department from devoting resources to inspecting decks that are known to be sound and to have low risk.

Session 4C Bridge Preservation Track

During this session, issues of bridge preservation were discussed by the panelists and audience including the NYSDOT approach to bridge deck preservation, guidelines for the use of overlays and sealers, rapid overlays for deck preservation, and cathodic protection practices.

New York State DOT Approach for Deck Preservation by Mr. Pete Weykamp, NYSDOT

Mr. Pete Weykamp presented information on the various aspects of NYSDOT's current approaches to preserving structural decks wherein the goals are to maintain structural deck ratings at a satisfactory level, extend the service life of existing decks, minimize deck replacement projects and maintain mobility. Approximately 29% of the state-owned bridge decks (25% of the deck area) are rated 4. Options for deck preservation include deck patching, crack sealing, waterproof membranes and two other options described below. The pros and cons of each of these methods were discussed and some specifications for materials and applications were provided. Waterproof membranes are used but their performance is not always certain. If they work (that is they don't leak) they prevent salts from reaching reinforcing bars and minimize problems related to rebar corrosion; however, if they leak, and this situation may not always be apparent, they result in salts being trapped near the reinforcing bars and exacerbate the problems related to corrosion. A detailed chart describing the various options available for decks in different states of condition was presented and the anticipated effective life of the treatment was estimated.

The use of polymers in bridge preservation based on the results of SHRP task force 34 was described and examples of application of the polymer material in aggregate were shown. The polymer/aggregate treatment has many advantages, however, they can be costly, labor-intensive and the resulting bond between the treatment and the deck is critical.

Guidelines for Selection of Bridge Deck Overlays, Sealers and Treatments by Mr. Paul Krause, WJE

Mr. Paul Krause of Wiss, Janney, Elstner Associates described the results of a study (NCHRP Project 20-07, Task 234) aimed at developing guidelines for selection of bridge deck overlays, sealers and treatments. The study was based on survey of the states (46 responded) and an extensive literature search. Repair methods covered by the survey included several types of overlays, deck replacement (including partial deck replacement), sealers and crack repair.

The most common currently used practices were: asphalt concrete overlay with a membrane (30 users); epoxy injection crack repair (22); high performance concrete overlays (17); polymer concrete overlays (16); high molecular weight methacrylate crack repair (15); and silane sealers (15). The survey elicited the following estimated service life for different treatments:

Rigid overlays	15 to 30 years
AC overlays	10 to 15 years
Polymer overlays	10 to 20 years
Crack repair	20 to 30 years
Sealers	5 to 10 years
Deck replacement	30 years +/-

Rapid Overlays for Deck Preservation by Mr. Michael Sprinkel, VCTIR

Mr. Michael M. Sprinkel, P.E., Associate Director, Virginia Center for Transportation Innovation & Research, reported that overlays have been used since the 1960's to repair, protect and preserve bridge decks. In recent years, traffic congestion, inability to close lanes for extended periods, and the need for nighttime operations have increased the interest in rapid overlays. Mr. Sprinkel's presentation covered Virginia DOTs experience with three types of rapid overlays.

- Epoxy: 2 layers of epoxy and broad casted aggregate used by VDOT since 1986;

- LMC-VE: Latex-modified concrete prepared with a very early hardening cement used by VDOT since 1997;
- Rosphalt: Polymer-modified asphalt that has negligible permeability first used by VDOT in 2009.

His presentation discussed the performance and cost of each based on the Virginia experience.

Florida DOT Cathodic Protection Practices for Bridge Preservation by Mr. Ivan Lasa, FDOT

Mr. Ivan R. Lasa, State Corrosion Mitigation Technologist for FDOT, described how the Florida DOT is employing cathodic protection systems to prevent corrosion damage to substructure units where some conventional practices have not been successful. Encapsulation and discrete concrete patches have not been effective. Removal of standard jackets showed that conventional encapsulations allow continued corrosion. Good patches promote accelerated corrosion in the concrete surrounding the patch and new spalls develop within a few years.

In the mid 1980's FDOT established that the approach to preserve these corrosion-affected bridges would be based on the concept of corrosion control using cathodic protection and concrete rehabilitation. Mr. Lasa provided the following conclusions from their experience with cathodic protection systems for substructure elements in a corrosive environment:

- The FDOT cathodic protection program has been successful in extending the service life of bridges in marine environments;
- The cathodic protection program has proven to be a cost effective means for the long term preservation of corrosion-affected structures;
- A work group solely dedicated to corrosion and cathodic protection maintains the program. Continuity in monitoring and maintenance is provided for all cathodic protection systems.

Sessions 5 and 6

Sessions 5 and 6 consisted of panel discussions and other participatory break-out sessions. Because of their length, they are included in Appendix 1. The summaries provide a cross section of current practices among the states regarding bridge management, inspection and preservation. The Power Point presentations from each session will be included on the conference website <http://www.tsp2.org/bridge2011media>. Sessions also were recorded and the video recordings also will be posted.

Session 7 Putting It All Together Part 2

Session 7 resumed the plenary format with three presentations that discussed key, emerging areas facing the bridge community - the AASHTO Bridge Element Inspection Manual, the effective use of performance measures, and implementing a successful bridge management process.

Implementation of the AASHTO Bridge Element Inspection Manual by Mr. Mike Johnson, Caltrans

Mr. Mike Johnson of Caltrans explained the benefits and challenges facing the bridge community as a result of the new *AASHTO Guide Manual for Bridge Element Inspection*. The new elements will provide improved inspection results that produce more detail, more national consistency and which will support the advancements that will be included in the new Pontis 5.1.2 bridge management system. These new aspects will improve condition assessments and will improve management decision-support activities. However, the transition to the element-level inspection will require effort to train inspectors and to update their practices to implement the new manual.

A significant issue for agencies will be the conversion of inspection data. They have two choices: to manually create the elements using the new manual; or migrating legacy elements using the AASHTO Element Migrator software. Another migration issue will be inspector training. Among the issues that inspectors will have to learn are the new measurement conventions, how to categorize elements in the four condition states, the separation of new elements compared to the old CoRe elements, the application of defect flags and the use of the new elements. Another migration issue will be the need to update customized agency software to support the new elements. There will be need to be database changes, inspector-interface changes and changes to custom reports and queries. Migrator compatibility issues need to be addressed while preserving the national consistency in the National Bridge Elements.

In summary, the new elements will provide improved inspection results but the conversion will take time, effort and planning. The new migrator tool can help with the conversion and Pontis 5.1.2 also will support the new direction. Inspector training should be fairly straight forward but will require time and effort. Although some existing performance measures may be affected, the overall result of the new approach should be to improve decision-support efforts.

Florida DOT Efficient Use of Bridge Performance Measures and Getting Positive Results by Mr. Richard Kerr, FDOT

Mr. Richard Kerr, the bridge management inspection engineer for the Florida Department of Transportation, presented on the department's efficient use of performance measures to achieve positive results. The department's statutory mission states that the prevailing principles include preserving the existing infrastructure. A statutory definition of preservation is protecting the state's infrastructure investment with a specific target of ensuring that 90 percent of the department-maintained bridges meet department standards. The department's first long-range objective is to "maintain all elements of the transportation system to protect the public's investment for the future."

The department uses three tiers of metrics that focus upon bridge conditions, weight restrictions and quality-assurance metrics. The summary conclusions are that :

- Performance measures need to support the overall mission of the department;
- They help to track and manage the budget;
- They assist with identifying needed budget levels;
- A periodic review is needed to ensure conformance with the goals and mission;
- Performance measures that are thoughtfully crafted and properly used will yield good results;
- To meet performance measures takes time and effort.

Instituting a Successful Bridge Management Approach in Michigan by Mr. David Juntunen

Mr. David Juntunen of the Michigan DOT presented on the department's successful development of a comprehensive bridge-management system. The Michigan DOT substantially improved the bridge inventory condition and created a long-term focus on sustaining bridge conditions at an acceptable level. In 1998, the Michigan DOT had among the lowest bridge conditions in the country with more than 20 percent of the bridges in poor or worse condition. In 1998, the department adopted a strategic plan to improve its bridge conditions. Targets were set to immediately address 100 percent of structures of critical concern, to get 95 percent of freeway bridges in good or fair condition by 2008 and to get 85 percent of non-freeway bridges in good or fair condition by 2008. Since then, bridge conditions steadily have increased to the point that by 2010 90.4 percent of all bridges were good or fair.

The Michigan DOT has a Bridge Condition Forecast System (BCFS) that allows the department to run scenarios of future bridge conditions based upon different program expenditure levels. The BCFS evaluates different mixes of fixes by considering preventive maintenance, rehabilitation and replacement treatments. The BCFS is populated at the region level with a program of preventive maintenance, rehabilitation and replacement projects. Michigan has a complementary mix of treatments with 20 percent of its funds allocated for preventive maintenance, 30 percent for rehabilitation and 50 percent for replacement.

Preservation is a very important component of the Michigan overall bridge management system. The department tracks as a key measure the degree to which projects and activities raise the condition level of poor bridges and sustain the condition levels of good bridges. The department looks systematically at its overall inventory and views each project not as an isolated treatment but as part of a larger strategy to intentionally improve or sustain the inventory at the desired target. Rehabilitation projects are targeted at projects rated between a 4 and a 5 and they are expected to raise the bridge to at least a 7. Replacements are expected to raise structures from a 4 to an 8 or a 9.

Session 8 Putting It All Together

The closing session concluded the conference with presentations about metrics for long-term asset management, the new FHWA approach to bridge inspection, the perspective from the AASHTO and concluding, summary remarks.

Other Industry Approaches to Asset Management by Mr. Gordon Proctor

Gordon Proctor, an independent consultant, discussed international and private-sector examples of the use of asset management to promote the long-term preservation of infrastructure, including bridges. The concept of sustainability increasingly is becoming a framework for international practices in infrastructure management. The Australian states of Queensland, New South Wales and Victoria have enacted statutes intended to ensure that local governments manage their infrastructure sustainably for the long term. The local governments are tasked with developing a credible asset management plan that uses a comprehensive mix of treatments to sustain their infrastructure for the lowest cost over its lifecycle. Metrics such as an Asset Sustainability Index, an Asset Consumption Ratio and an Asset Renewal Funding Ratio are being pursued to provide insight into whether agencies are able to preserve their infrastructure in good condition over the long term and to preserve "equity" for future users.

Accompanying the concept of long-term infrastructure sustainability is an increased emphasis upon asset valuation. By assigning financial value to the infrastructure, it communicates to the public and to the agency that the infrastructure has a high intrinsic value that deserves to be protected.

National Bridge Inspection Program Metrics by Mr. Jon Nekritz, FHWA

Mr. John Nekritz of the FHWA discussed the development of the National Bridge Inspection Program (NBIP.) As part of the (NBIP), the FHWA has established 23 individual performance metrics upon which to conduct risk-based, data-driven oversight of bridge inspection programs nationwide. The reason for establishing these metrics included the high-risk nature of the NBIP, concerns by states that level of oversight is not consistent across the nation, the I-35W bridge collapse and recent audits by the U.S. DOT Office of Inspector General (OIG) and the Government Accounting Office (GAO).

The OIG recommended that the FHWA develop and implement minimum requirements for data-driven, risk based bridge oversight during annual NBIS compliance reviews with detailed criteria to determine compliance with greater consistency plus a policy defining procedures for the FHWA Division Offices to follow. The FHWA also should develop a comprehensive plan to identify nationwide bridge safety risks and to prioritize identified risks. The FHWA Division offices would work with states to remediate higher priority nationwide bridge safety risks. The oversight plan contains 23 individual metrics – each linked to a specific NBIS requirement. Three levels of assessment can be conducted and each level has specific criteria to be reviewed. The intermediate level which uses random sampling of inspection records or files, analysis of NBI data, visits to bridges, interviews of inspectors, and documentation of qualifications is the most commonly applied level. Four levels of compliance are established, each with specific thresholds to be met for compliance. The levels are **Compliance**: Adhering to requirements of the NBIS; **Substantial Compliance**: requiring deficiencies to be corrected in 12 months; **Non-Compliance**: where identified deficiencies may adversely affect overall effectiveness of the program; and **Conditional Compliance**:

corrective steps are being taken.

Under the new NBIP oversight process, compliance is determined based upon statistical sampling and compliance status is continuously being assessed and updated. The “Final Summary of Metric Compliance Report” is reported annually as of December 31.

The 23 metrics cover all aspects of the DOT’s inspection program including organization (policies and procedures), personnel qualifications, inspection frequency, inspection procedures and the inventory. The effect of the new process has been an overhaul of how compliance with the NBIS is monitored and assessed by the FHWA including:

- Clear expectations for each State;
- Consistent criteria to judge each metric annually;
- Compliance based upon criteria listed for each metric rather than unstructured policy;
- Clear, consistent guidance provided to the FHWA Divisions for taking non-compliance action.

Calendar year 2011 is the year for establishing baseline results for all DOTs and as of the end of the 3rd Quarter of the year, most FHWA Divisions were well under way and many metric assessments had been made. Many metrics are in compliance or substantial compliance. Where non-compliance was assessed, Divisions are working with their state to develop approved plans of corrective action. An the FHWA/AASHTO Joint National Bridge Inspection Task Force has been established to discuss the 2011 baseline review process and results and discuss ideas the AASHTO and the FHWA Divisions offer for modifications and improvements.

AASHTO Update on Managing the Nation’s Bridges - Beyond The Short Term by Mr. Mal Kerley, VDOT

Mr. Mal Kerley, Chief Engineer of Virginia DOT, provided a view of the major factors that will affect the role of bridge preservation in the future. He began by describing the structure of AASHTO stepping down through the executive level to the standing committee level, one of which is devoted to highways. The Subcommittee on Bridges and Structures (SCOBS) is part of the Standing Committee on Highways and has several responsibilities including developing and maintaining major engineering and geometric standards; developing standards for rating and evaluating highway and pedestrian bridges; making recommendations for testing and investigating existing and new materials of construction and determining needs and areas for research and study. SCOBS has 20 Technical Committees of which T-9, Bridge Preservation and T-18, Bridge Management, are of most relevance to the focus of the conference. Mr. Kerley mentioned numerous interests of these two committees that related to bridge management, inspection and preservation including:

- Communicating the benefits of bridge management to upper management, the general public, and legislators;
- Developing formal process other than inspection reports;
- Applying the appropriate treatments and strategies at the right time.

Five programs that would have a major impact on implementation were identified

- Long Term Bridge Performance (LTBP) Program State Coordinators where early and continuous involvement by the LTBP state coordinators was urged;

- SHRP II where the Renewal area is developing technologies and institutional solutions to support systematic rehabilitation of highway infrastructure in a way that is rapid, presents minimal disruption to users, and results in long-lasting facilities;
- QA/QC programs where the AASHTO is working with the Federal Highway Administration to develop and implement a bridge design quality assurance/quality control program to be used by the States and other bridge owners, that includes procedures to detect and correct bridge design errors before the design plans are made final;
- Bridge Inspection – 23 Metrics where the FHWA/AASHTO Joint National Bridge Inspection Task Force will attempt to identify short-term changes to NBIP assessment process (for 2012 implementation) and long-term changes to NBIP assessment process (for implementation in 2013 and beyond);
- Tunnel Inspection Program where the three big questions are Inspection frequency? How much flexibility will be allowed? And where will the resources come from?

Finally, Mr. Kerley stressed that the issue of future funding was paramount in driving the future of bridge programs. Key questions are: When will transportation reauthorization happen, how many years will funding be authorized and at what leveling will the funding be? Current debate revolves around the Senate or the House Bill? A two-year or a six-year bill? Maintaining the current level of funding or reducing by 30 percent? When the funding level is established, does the Bridge Program get its “Fair Share”? With its “Fair Share”, will the funding be spent appropriately?

Conference Closeout and Summary by Mr. Butch Wlaschin, FHWA

Mr. Wlaschin closed out the conference by thanking the organizers and participants, and by summarizing the key points and observations. He noted that the 2007 conference initiated several efforts that have borne fruit since then. They included developing a definition of bridge preservation, creating a bridge preservation strategic plan and road map, bridge preservation research roadmap and creating partnerships such as the TSP2 group and the bridge preservation expert task group.

It will be important for the bridge preservation practitioners to consider what they learned at the 2011 conference and to continue promoting new advances between now and 2015, the likely date for the next conference. Participants should ask themselves what should be the new best management practices and what new tools should be added to the bridge preservation toolbox.

Some aspects of the bridge industry are changing rapidly, such as the development of signature bridges, the use of accelerated bridge construction and the lessons learned from bridge tragedies such as the I-35 collapse. Yet, the bridge community also needs to learn to communicate effectively. Despite legitimate concerns over bridges, the fact remains that over 98 percent of bridges on the Interstate Highway System are in good condition and more than 90 percent of the bridges on the National Highway System are in good condition.

In addition to learning new ways to communicate the realities of the bridge inventory and its major issues, the bridge community needs to communicate to decision makers that bridge management, bridge inspection and bridge preservation are essential to maintaining the quality of life, the nation's mobility and to the nation's economic growth. These three elements should not be an afterthought but should be a part of senior management's dialog.

A network of bridges in a state of good repair is a "must have" for society. The preservation and promotion of bridge preservation is a partnership between the states, the FHWA, the AASHTO, industry and

academia. Collectively, those stakeholders can work jointly to promote the concept of “Beyond the Short Term” - that society should invest wisely and adequately to preserve the nation's bridges in a state of good repair.

Appendix 1

Sessions 5 and 6 Breakout Discussions

During conference sessions 5 and 6, three concurrent breakout tracks were held, one each on Bridge Management, Bridge Inspection and Bridge Preservation. The Bridge Management and Inspection tracks were held twice, each time with different speakers grouped by regions. The Bridge Preservation track took a different format. It took a workshop-like format that allowed participants to identify key issues in bridge preservation and then to identify key strategies that should be promoted or pursued nationally. The Bridge Preservation breakout session covered both the Session 5C and 6C conference slots with the 5C session identifying issues and the 6C session discussing how those issues could be addressed.

The breakout sessions on Bridge Management and Bridge Inspection produced a cross-section of bridge management and inspection practices nationally. The participants responded to the same questions providing a wide range of examples as to how states address major issues of bridge management and inspection.

For the Bridge Inspection and Bridge Management sessions, the Session 5 and 6 responses are combined. The combining allows all the similar questions and answers to be grouped together.

Session 5A and 6A Bridge Management Panel Discussion

During session 5A and 6A, the participants focused on bridge management practices in states representing all regions of the country. This grouping of the states in the sessions was based in part on the recently completed cycle of bridge management peer exchanges that the FHWA sponsored beginning back in 2008 and ending in 2011.

On the panel in session 5A were Mr. Greg Robey of the Maryland State Highway Administration (SHA); Mr. Mike Johnson of the Caltrans, Mr. Todd Thompson of the South Dakota DOT, Mr. Eric Christie of the Alabama DOT; Mr Dave Juntunen of the Michigan DOT and Mr. James Foster of the Maine DOT.

On the panel in session 6A were Mr. Jeff Milton of the Virginia DOT, Mr. Walt Peters of the Oklahoma DOT, Mr. Bert Hartman of the Oregon DOT, Mr. Richard Kerr of the Florida DOT, Mr. Scot Becker of the Wisconsin DOT and Mr. David Powelson of the New Hampshire DOT.

The following states were not on the formal panel, but participated from the audience and provided post conference responses to the questions: Illinois, Indiana, Minnesota, Montana and New York State DOT. Their responses are shown in a table located after the comments from the formal panel.

1. Identification of Bridge Needs

How does your State identify highway bridge needs (i.e. replacement, rehabilitation, preventive and ordinary maintenance)? a) How do competing bridge needs get prioritized against competing bridge needs?

Maryland SHA

Representatives from the inspection and repair office and the major rehabilitation office perform a yearly bridge tour of all the bridges with the potential need for replacement, rehabilitation, or an overlay. These bridges include those that are structurally deficient, recommended by the engineer or maintenance person responsible for the bridge, or may be a good candidate for an overlay based on the number of years the deck has a certain rating. Preventative and ordinary maintenance is recommended by the engineer in charge of the bridge.

Maryland is a small state with a centralized bridge office. All bridge needs are evaluated by the one office and prioritization determined. We have baseline budgets for inspection, repair/maintenance, and major rehabilitation/replacements. These budgets are adjusted if the need arises.

Caltrans

Bridge needs are identified through bridge inspections and analysis of vulnerabilities, load capacity and safety. Minor needs are assigned to Caltrans crews for immediate repair. Preventative maintenance contract work is planned as needs become known. Minor repairs are given a time frame for completion based on the inspector's assessment. Major rehabilitation or replacement projects compete against each other in a multi-objective prioritization approach.

South Dakota DOT

We identify bridge needs in three different ways. The first is by our best practices that we've established over time and experience. The second way is by our bridge inspectors' recommendations for work. The third way is by evaluating Pontis recommended work. We try to prioritize by urgency, when necessary, and try to gather like work geographically to make efficient contracts. If there is a surfacing project, we will try to address any bridge needs at the same time within the project limits.

Alabama DOT

Bridge needs for state-owned replacements are prioritized based on a Deficiency Ranking, which is based on width, vertical clearance, condition, and load restriction. The rankings are reviewed by each Division for input to the Bridge Replacement Prioritization Committee. Preventive and ordinary maintenance needs are identified by the bridge inspectors, and then prioritized by the Division Maintenance Engineers.

Michigan DOT

Michigan identifies highway bridge needs by reviewing inspection data (NBI, Michigan specific NBI type data, Pontis, and inspector recommendations.) Bridges are categorized as preventive maintenance, rehabilitation, and replacement candidates. Through our five year call, analysis is

done to identify the ideal strategy for each region in accordance with Department goals. Money is allocated for preventive maintenance, rehabilitation, and replacement in accordance to condition needs, and instructions are provided to each region. Projects are picked by regions and reviewed by a bridge team. Projects are prioritized by the regions.

Maine DOT

Identification of Bridge Needs. Maine DOT is responsible for 2212 bridges and 751 minor spans. Bridge needs are first identified by querying our bridge data, which captures bridges and minor spans with deficiencies in the superstructure, deck, substructure, culvert in poor, or worse, condition (NBI ≤ 4); decks in fair condition if over traffic, scour critical bridges, fracture critical bridges, bridges with wearing surfaces with average condition states (CS) worse than 2.5 with a deck in satisfactory condition or better, bridges with paint with average (CS) worse than 2.5 with superstructures in satisfactory condition or better, bridges with defective joints with bridge decks in satisfactory or better condition, etc. Additionally, this database will include any potential bridge needs that were identified by other sources, inspection reviews, public inquiries, etc.

Additionally, Maine DOT maintains a Bridge Maintenance Division with regionalized work crews. Major work activities include structural repairs, rail and curb, bridge joints, wearing surfaces (concrete), painting, and cleaning. Work activities are generated by the Bridge Maintenance Division in part utilizing Pontis work actions identified by the bridge inspectors.

An ACCESS database tracks these needs as projects are developed for the capital work plan, and as work actions are assigned to bridge maintenance forces. Bridge lists generated from this database are screened in-house by the Bridge Review Team, comprised of members from the Bridge Committee. During these in-house reviews, the team considers all available bridge information in order to determine which bridges will require on-site reviews. During these field reviews, the following information is documented: scope of work, an alternative scope of work when applicable, a priority for the work (expressed as program year e.g. 2014/15, not 1-150), an estimated cost breakdown, how traffic will be maintained, consideration of historic and environmental issues, etc.

Final office reviews are conducted by the Review Team to finalize the Work Plan when funding levels are better known. Highway Corridor Priorities (HCPs 1-6) are used to assist with prioritizing competing bridge needs. HCP 1 = interstate and key principal arterials. HCP 1 represents 7 percent of the miles, but carries 40 percent of vehicle miles traveled. HCP 6 = local roads and streets. HCPs are classified using factors such as Federal Functional Classification, regional economic significance, heavy haul truck utilizations, and relative regional traffic volumes.

Virginia DOT

The Virginia Bridge Program consists of the following work actions:

- Preventive Maintenance
- Painting
- Restorative Maintenance
- Rehabilitation
- Replacement

Virginia considers Preventative maintenance, painting, and restorative maintenance to be the components of the Bridge Preservation Program.

Virginia's goal is to use a balanced, asset management approach to the structure program where preservation, rehabilitation, and replacement activities are performed in an effective way to improve the overall health of the inventory.

The primary selection criteria for structure replacement or major rehabilitation is structural deficiency. Virginia's global performance measure is based on the number of non-structurally deficient (SD) structures in the inventory. The goal is to maintain a 92 percent non-structurally deficient performance level statewide.

The primary selection criteria for restorative maintenance are those structures that are at risk of becoming structurally deficient.

The primary selection criteria for preventive maintenance are structures that are in good condition. Virginia has developed a planned preventive maintenance program for bridges, and we have requested dedicated funding to support this program.

Viewed from a high level, rehabilitation and replacement candidates would be structures having a low General Condition Rating of 4 or less, restorative maintenance candidates would be structures having a low General Condition Rating equal to 5, and preventive maintenance candidates would be structures having a low General Condition Rating of 6 or greater.

Virginia uses the Bridge Management Modules of the AASHTO Pontis software as a tool in developing network level (statewide) needs for the bridge program, and in developing the maintenance budget allocations for each district.

In addition to scenarios generated by the Pontis Bridge Management application, Virginia uses element level inspection data and General Condition Rating (GCR) data as tools in selecting specific bridge preservation and rehabilitation candidates

Oklahoma DOT

We use PONTIS to identify and prioritize our bridge needs. The selection of projects is primarily done by our Field Divisions. Our Bridge Management Engineer provides each field division with a list of bridge preventative maintenance candidates, re-deck and rehabilitation candidates identified by PONTIS as well as a list of replacement candidates based on condition, functionality (narrow width, low clearance), scour critical or fracture critical. These candidates are provided on an annual basis. The Field Division Engineers can use these lists to balance their part of the 8-year program each year.

Oregon DOT

Oregon considers bridge needs in three classes: ordinary maintenance; major maintenance; and rehabilitation or replacement. The predominant factor in determining the appropriate class is the magnitude of the resources needed to complete the project. The needs themselves are identified primarily on the basis of local knowledge (in the case of ordinary maintenance); element level inspection data and maintenance recommendations in the case of major maintenance and a combination of these factors along with department policy and priorities in the case of rehabilitation and replacement.

Since having to replace a major coastal bridge in the early 1990's due to deterioration, Oregon has focused on preserving major structures. Our shift from replacement to preservation is substantial; only one state highway bridge is programmed for replacement in 2014-2015. In addition to prioritizing based on structure size, route is also an important factor.

Florida DOT

Bridge needs are identified at the District level. Mostly these are identified through the routine inspection process. A review committee in the District determines what the needs are based on the inspection report and the inspector's recommendations. a) How do competing bridge needs get prioritized against competing bridge needs? Routine Maintenance, Bridge Repairs and Bridge replacements each have separate funds.

Wisconsin DOT

Bridge needs are identified with many processes and systems, captured by our improvement program, our bridge inspection, and bridge management program. WisDOT applies deck condition to a deck program as part of the rehabilitation program. Each of the programs works with overarching policies that determine which projects are interjected into the letting program.

New Hampshire DOT

We start with our inspection data, primarily the Red List (Bridges that require additional inspections due to condition or load posting.) We also look at the Near Red List, bridges that could be a single inspection on the Red List. We carry a priority list of all Red List Bridges, their status in the program, the severity of the condition, and try to balance that with the time necessary to prepare a project to address them. Bridges are generally:

- In the Program (the Ten Year Plan);
- To be addressed by Bridge Maintenance Forces (outside of the ten year plan);
- Monitor and Keep in Service (Covered Bridges or others where we never intend to remove the bridge), or;
- Need to be Added to the Program.

The committee is top level Bridge Inspection, Bridge Maintenance, and Inspection personnel. We agree on a priority and a year to do the work, considering how much work is in each of our categories and how severe the need is. This sometimes involves moving bridge projects forward or backward in the ten year plan. We will also look into Corridor Projects to see if it makes sense to shift bridge work into a year with other work sharing the same corridor and hopefully funding. The Red List is available at :

<http://www.nh.gov/dot/org/projectdevelopment/bridgedesign/documents.htm>. The Ten Year Plan and the Update Process are available at:

<http://www.nh.gov/dot/org/projectdevelopment/planning/typ/index.htm>. An overview of the Ten Year Plan is the GACIT Hearing Presentation at the above link.

2. Prioritization of Bridge Needs.

How does your State prioritize the highway bridge needs in relation to other assets, such as pavement, roadside, etc.? In other words how do you juggle a high number of needs with limited

funding? How do we move away from a worst first approach? Does your state use vulnerability or risk based approach to prioritizing bridge projects? If yes, please briefly describe how it is used and for what type of bridges.

Maryland SHA

Each year the different Offices (bridge, pavement, traffic, maintenance, etc.) present a budget request to the Administrator. For the Office of Structures, we prepare a report called, "State of the State of Maryland Bridges." This report includes all the information related to the state's bridge program and includes a budget request with back up information. Again, typical yearly budgets exist but adjustments are made based on needs and availability. How do we move away from a worst first approach? Make it even easier to use federal funds for bridge repair and preventative maintenance? Bridge painting and scour remediation is already allowed without any programmatic agreement. Why not include other work without any requirements?

Does your state use vulnerability or risk based approach to prioritizing bridge projects? We do consider risk or vulnerability in our prioritization. We also have a Structural Adequacy, Functionality, and Exposure (SAFE) rating that we consider in our prioritization. It is used on all bridges and is just one more tool in the development of our prioritization.

Caltrans

- A) The available funds are divided up among the assets based on relative need, priority and recent past performance. Once the funds are split among the assets, the assets do not compete directly.
- B) Caltrans has been successful in making a case for bridge preventive maintenance expenditures. As a result, we are currently allocating approximately 20% of all available bridge funding to preservation activities.
- C) Caltrans has been utilizing a multi-objective prioritization frame work for major rehabilitation and replacement projects. This framework takes into consideration bridge condition, use, seismic and scour vulnerabilities, barrier rail safety, traffic impediment and detour lengths.

South Dakota DOT

We have not had an extremely high number of needs when compared to our funding and we have not really needed to compete against other needs, yet. We moved away from worst first over 30 years ago. In the late 1970's we started emphasizing bridge preservation by protecting our decks, water proofing our joints and on new bridges eliminating joints by using Integral Abutments. We have not used vulnerability or risk based approaches.

Alabama DOT

At the present time, bridge needs are not prioritized against other needs. We have developed a new Maintenance Management System and will be moving to Pontis as our Bridge Management System. Bridge needs will be incorporated into our Maintenance Management System to help optimize our budget. We are optimistic that the future Pontis modeling capabilities will help move away from a worst first approach.

Michigan DOT

Progress is monitored for all department goals and money is allocated by the planning division with approval of executive staff and transportation commission to balance progress for each. Michigan moved away from a worst-first strategy 10 years ago by adopting asset management strategies and allocating money to preventive maintenance. Michigan does use a risk based approach for prioritizing bridge projects on rivers for scour vulnerability. This is done in accordance to A Guide to Highway Vulnerability Assessment for Critical Asset Identification and Protection. National Cooperative Highway Research Program Project 20-07/Task 151B.

Maine DOT

Maine has a lot of miles of roads and relatively few people spread out over a large area. For example, New Hampshire has less than half the state roads located in less than one-third of the area, yet it has about the same population and state transportation funding. This means that the New Hampshire DOT has about twice the funding per mile that Maine does. Therefore, our State needs to prioritize very aggressively to target projects that achieve the most value to Maine's businesses and travelers.

To deal with this, we are using two tools for prioritizing project candidates. 1) Highway Priority (priority 1 thru 6), and 2) Customer Service Levels (CSLs) A, B, C, D and F (Grade based on safety, condition and service of the road or asset e.g. bridge). A-Excellent, B – Good, C-Fair, D-Poor, and F-

Unacceptable. Safety, condition, and service grades provide the common denominator for highways, pavement, and bridges. For bridges, Safety is based on reliability, scour critical/condition; Condition = lowest condition of deck, superstructure, substructure, culvert condition; and Service = based on posting.

MaineDOT expects to continue to develop asset priorities and condition state levels (CLS) for other hard assets such as airports, rail, and passenger transportation. When you combine priority with customer service levels, project candidates can be better evaluated. Obviously, a high priority road with a D rating needs work, and addressing it will yield high value.

Most people understand that there is insufficient funding to address all of the needs, but this understanding wanes when the bridge in question is in their town, or on their street. The HCP – CSL methodology will assist us in answering the question: why must our town's bridge remain closed? This HCP – CSL methodology is not intended to replace our current processes (i.e. engineering site visits and Pontis optimization). It only tells us the priority of a deficiency relative to the system as a whole. The HCP – CSL methodology does not consider preservation needs.

Virginia DOT

The Code of Virginia mandates the funding of maintenance needs ahead of construction needs. The state wide bridge maintenance funding available is based on a needs assessment of all highway assets and total funding for the overall maintenance program. VDOT's main focus has been towards major assets such as pavement and bridges. Both assets are funded equitably based on needs and desired level of service. Virginia's goal is to use a balanced, asset management approach to the structure program where preservation, rehabilitation, and replacement activities are performed in an effective way to improve the overall health of the inventory.

Structures that have a low General Condition Rating equal to 5 are at risk of becoming structurally deficient – these structures are candidates for restorative actions when the maintenance budgets are developed.

Virginia developed a ranking criterion that is used to aid in prioritizing the funding and programming of eligible bridge replacement projects. The factors used for ranking are shown in the following table. The vulnerability of a structure to fracture critical member failure or scour failure is considered in these factors. Each factor has a maximum total weight of one point.

<u>ADT</u> 0 – 200 = 0.25 201 – 1000 = 0.5 1001 – 6500 = 0.75 >6500 = 1.0	<u>Truck ADT</u> 0% - 5% = 0.25 6% - 10% = 0.5 11% – 15% = 0.75 >15% = 1.0	<u>Weight Restricted</u> B = 0.25 D = 0.5 P = 0.75 K = 1.0	<u>Detour Length</u> 0 – 5 miles = 0.25 6 – 10 miles = 0.5 11 – 15 miles = 0.75 >15 miles = 1.0
<u>Fracture Critical</u> 1.0	<u>Scour Critical</u> 1.0	<u>Structurally Deficient</u> 1.0	<u>Substandard Width</u> 1.0
<u>Sufficiency Rating</u> <50% – 40% = 0.25 39% - 30% = 0.5 29% - 20% = 0.75 <20% = 1.0	<u>Lowest GCR</u> 7- 9 = 0.25 6 – 5 = 0.5 4 = 0.75 <4 = 1.0	<u>Age</u> Built 1970 – 1980 = 0.25 1971 – 1960 = 0.5 1959 – 1950 = 0.75 <1950 = 1.0	

Oklahoma DOT

In recent years, ODOT has put a strong emphasis on bridge needs by replacing all the load posted bridges and by dramatically reducing the number of trusses and structurally deficient bridges. These programs have been primarily done with special state funds from our legislature and not at the expense of pavement improvements or safety enhancements like adding cable barriers in the roadway medians. We are very committed to reducing the number of deficient bridges, after 50 years of neglect.

Oregon DOT

The Oregon Transportation Commission sets the funding for the bridge and other major programs on the basis of total funding available, historic funding levels and needs. This is primarily an exercise in judgment. For the State Bridge Program, the first move away from “worst first” was to focus bridge improvement projects on high priority freight routes. Today, the meaning of moving away from worst first has broadened to incorporate freight route priority in addition to the protection of high value structures and preventive maintenance of “cusp” bridges (Bridges with NBI ratings of 5 for Deck, Superstructure or Substructure). Public safety requires that attention always be paid to the “worst”, but less expensive solutions have to be found for low priority bridges.

Florida DOT

Each group is given a budget for its needs and has performance measures to determine if it is meeting the needs. If we fall short on our performance measures the Executive Board may choose to provide greater budget. In other words how do you juggle a high number of needs with limited funding? How do we move away from a worst first approach? I believe this is the wrong question. The proper question should be in addition to addressing the worst situations (critical deficiencies) how do we maintain and preserve our assets to prevent or minimize our critical deficiencies. As one District Director in Florida stated it is cheaper to maintain 12 lanes of roadway

than build two new ones. This is an educational process for the DOT managers. Does your state use vulnerability or risk based approach to prioritizing bridge projects? Currently only on a very limited basis, sort of a tie breaker. We are currently doing research in this area.

Wisconsin DOT

Bridges are always given a highest priority when competing with other infrastructure assets. The risk associated with structures is a leading factor for this policy. Also, individual projects are prioritized on a risk-based approach when applicable. The BMS system has reports that are brought into the scoping process that allows the risks to be taken into account. Risks such as load posting, condition deficiencies fracture critical and scour are taken into account.

New Hampshire DOT

Through the Ten Year Plan Update Process, a two year process that starts with the NHDOT, goes to the Regional Planning Commissions for their review and prioritization, comes back to NHDOT, goes to the Governor's Advisory Commission on Intermodal Transportation (GACIT). GACIT holds another series of regional meetings, the responses are collected and return to NHDOT, compiled and the proposed Ten Year Plan is updated and sent to the Governor, who forwards it to the Legislature. The legislature can revise things as well and enacts it into law. The stated priorities for this cycle are: Preservation and Maintenance; Red List Bridges; I-93 Reconstruction Priority Improvements; and Capacity Improvements, which are unfunded for the 2012 to 2022 Ten Year Plan.

3. Funding/Budget.

How are your bridge activities funded? i.e. do you have a dedicated fund for the program, or funded on as needed basis? Has your funding been cut because of fiscal constraints? Does your agency optimize its budget with respect to prioritizing bridge preservation, rehabilitation and replacement projects to improve the overall network performance measures within your agency ?

Maryland SHA

We have a dedicated fund for the program. Although the MDSHA has received budget cuts, the Administration has left the bridge budget basically intact. The cuts were felt mostly in other areas. The bridge office manages the entire program as far as balancing the work. There are specific budgets set up to address some preservation work along with repair and rehabilitation. So, we do balance the work over these areas.

Caltrans

Caltrans collects sales tax on gasoline and petroleum products in addition to the federal excise tax. These state funds are required to be used for transportation activities. With these funds, Caltrans manages a fund geared to preservation and maintenance of bridges and multiple funds geared toward addressing scour, seismic, rehabilitation and similar bridge needs.

Caltrans produces a Five Year Maintenance Plan for Bridges and a Ten year Financially Constrained Rehabilitation and Replacement Plan for all assets. Each of these reports has perfor-

mance measures that are tracked over time to evaluate the program effectiveness.

Funding in both programs has leveled out over the past few years.

South Dakota DOT

Primarily our bridge work is funded with Highway Bridge Program (HBP) funding along with other federal funds. We have a very small amount of state funding. It has remained steady or increased over the last several years. We handle replacements as needed but the majority of the effort is dedicated to bridge preservation work.

Alabama DOT

Bridge Replacement and Rehabilitation is funded by HBP funds. Up to 5% of HBP funds can be used for Bridge Painting. Approximately \$11 million was budgeted for state bridge maintenance and “preservation” activities. Funds were reduced due to fiscal constraints, but they have since returned to previous funding levels.

Michigan DOT

Bridge preservation projects are funded by a dedicated template which uses a combination of Federal Aid to highway program funds and Michigan funds. No, funding has not been cut, yet. Yes, our agency optimizes budget with respect to prioritizing bridge preservation, rehabilitation and replacement projects to improve the overall network performance measures. An in-house program, called Bridge Condition Forecast System (BCFS) is used to determine the ideal mix of fixes (preventive maintenance, rehabilitation, replacement) and show the result of different strategies on future bridge condition.

Maine DOT

Maine DOT has a Biennial Capital Work Plan of \$764.6 M (57 % fed, 40 % State, 3% local), that includes \$184 M for bridge work: \$121 M for 34 replacements, \$ 63 M for 53 rehabilitations/ preservation, plus an additional \$10 M for engineering of bridges that will receive construction funding in the next work plan. This work plan was based on the assumption of flat federal transportation funding. In addition to traditional state highway fund sources, planned funding also includes a \$20 million General Fund appropriation, and TransCAP Bridge Bonding, although this Work Plan excludes any new authorized borrowing.

The current Work Plan predictably reduces bridge funding by about 22 percent as the extraordinary bridge funding program authorized by law winds down. It targets its funding such that bridge preservation investment is projected to increase 61.5%. Bridge maintenance is funded between \$10 million and \$15 million per year, which is all state funded.

The distribution of funding in future Work Plans will be influenced by Corridor Priorities and uniform Customer Service Levels (CSL's) to focus investments on projects that have the most traveler and economic benefits. The Bridge Committee/ Bridge Review Team will continue to scope and prioritize bridges for the Capital Work Plan as it has in the past, except now it will be influenced by Corridor Priorities and system Customer Service Levels. The Bridge Committee will continue to enhance bridge preservation actions to increase average bridge service life.

Virginia DOT

Preventive maintenance, painting, restorative maintenance, and rehabilitation activities are typically funded through the maintenance program.

Replacement activities are typically funded by construction funds. Virginia has developed a Dedicated Bridge Fund as a part of the construction program – federal bridge replacement funds are allocated to this program with the majority of the bridge replacement projects funded by this program.

The bridge maintenance program funding has remained relatively stable in recent years.

Virginia utilizes a preservation approach to managing the structure inventory that includes performing preventive, painting, and restorative work actions that address structures while they are still in good or fair condition and before the onset of serious deterioration.

This balanced approach to structure management provides for preservation, rehabilitation, and replacement actions, and we believe that this is the most efficient and effective way to improve the health of the structure inventory.

The suggested distribution for structure maintenance allocations is as follows:

- Preventive Maintenance ⇒ 15%
- Painting ⇒ 10%
- Restoration ⇒ 25%
- Rehabilitation ⇒ 50%

The distribution of maintenance allocations for a specific geographic area will depend on the condition and needs of the structures in that area.

Oklahoma DOT

In recent years due partly due to a tragic event on I-40 and largely due to the efforts of our Director calling attention to bridge needs, we have been blessed with both dedicated funds and special project funds on an as needed basis. In May 2002 when the I-40 bridge over the Arkansas River was knocked down by a barge and traffic was placed on a long detour route, Oklahomans publicly became painfully aware of the deplorable condition of our highway system bridges. The Department desperately tried to maintain these detour bridges while carrying I-40 traffic. Through the Director's efforts, the Oklahoma Legislators have provided funds for Oklahoma bridges, but not at the exclusion of roadway or traffic needs. In 2006, SB 1288 designated a one-time appropriation of \$100 million to be used specifically to reconstruct or rehabilitate on-system load posted bridges plus an additional \$25 million for county bridges. Annually, our field divisions get \$20 million in state funds to be used for bridge preservation needs such as paint, joint, decks, and a few bridge overlay projects. The Bridge Division gets an additional dedicated \$5M for bridge preservation annually to do preventative maintenance projects primarily paint and joint projects identified through PONTIS. With the on-going replacement of our I-40 crosstown bridge in Oklahoma City, the Director has made a firm commitment to give approximately 1,800 beams to the County Governments for bridge replacement. Oklahoma obtained a \$63.3 million TIGR grant to replace the I-244 bridge over the Arkansas River with provision for rail traffic on the lower level.

Oregon DOT

Ordinary maintenance is funded with state funds. Oregon's major maintenance program is also state funded. Rehabilitation and replacement is Highway Bridge Program (HBP) funded. Bonds were used to pay for OTIA III, a major rehabilitation and replacement program for bridges, but repayment of the bond funds has reduced the amount of funding available annually for the bridge program. The size of the bridge program has also been reduced by current and anticipated reductions in the amount of federal funding available. There is no formal optimization process of overall network performance measures at this time.

Florida DOT

We have dedicated funds for repairs and routine maintenance. Structural repairs are generally on an as-needed basis. Has your funding been cut because of fiscal constraints? Not yet, however unused funds that were not appropriated to a specific project were swept at the end of the last fiscal year. Does your agency optimize its budget with respect to prioritizing bridge preservation, rehabilitation and replacement projects to improve the overall network performance measures within your agency. No.

Wisconsin DOT

WisDOT includes federal bridge funds whenever possible and exhausts all federal funds. In addition the state provides more money to achieve a desired goal to keep the bridges operating under good and fair condition (See #4) WisDOT does not have enough funds to fund all bridge needs.

New Hampshire DOT

We have a mix of dedicated and as needed funds for the various programs including Bridges. Currently we have our Ten Year Plan divided up into 30% Preservation /Maintenance, 7% bridges, 17% Red List Bridges, 5% I-93, 12% Interstate Maintenance. The remaining 29 or so percent is not likely to be spent on Bridge Work. Our total Federal Program is estimated to be \$100,000,000.00 per year projected funding, down from \$150,000,000.00.

4. Performance Measures/Goals.

Has your State established performance goals for your bridge program? If so, a) What are your Agency's performance goal(s) and measure(s)? b) How did you go about establishing these goals and measures?

Maryland SHA

We track the number of posted bridges on the NHS with a goal not to have any (we have no posted bridges on the NHS). We also track the number of structurally deficient bridges with a goal to decrease them. There is a non-stated goal of being less than country average and less than adjacent states. We currently have 106 structurally deficient bridges or 4% of inventory. There are many other measurements in our yearly report but these are the two biggest. How did we establish goals and measures? We periodically go through an assessment of all our performance measures. These have not changed since first developed.

Caltrans

- a) Caltrans has performance goals for both maintenance and rehabilitation/ replacement programs.
- b) For crew maintenance and preventive maintenance (preservation), Caltrans tracks the time frame for completion of an item of work. Work that is not completed by the specified time frame is considered “backlogged maintenance” and the number of bridges with backlogged maintenance are regularly tracked and reported. For major rehabilitation and replacement work programs, we track the number of “distressed bridges”. A distressed bridge is a bridge with a major rehabilitation, replacement, scour or seismic need identified.

The performance goals for backlogged bridges and distressed bridges were set by evaluating historical trends, inventory characteristics, user surveys and experience.

South Dakota DOT

We have two performance measures: number of structurally deficient bridges on the state system and network (State System) Health Index. The goal is to decrease the number of structurally deficient bridges and increase the network health index. [Currently 3.9% of state bridges are structurally deficient and the network health index is 90.0] But we have not set any target numbers or values at this time.

Alabama DOT

Our goals are to reduce the number of bridges that are structurally deficient or posted.

Michigan DOT

Yes, Michigan has established performance goals for our bridge program, and this is one of the best things we have ever done, as it has kept us focused on improving our bridges over the past ten years. Our performance measures are:

- As a priority on the network, immediately address the needs of 100% of the structures of critical concern.
- To improve the overall condition of the freeway bridge network so that 95% of the structures on that network are rated good or fair.
- To improve the overall condition of the non-freeway bridge network so that 85% of the structures on that network are rated good or fair.

A review of other state conditions was done to establish goals.

Maine DOT

Various performance measures have been studied over the years from age, condition, structurally deficient/functional obsolete, Health Index, and now customer service Levels. Better Roads has reported a steady decrease in structurally deficient/functionally obsolete bridges since 2004, from 32% in 2004 to 26% in 2011.

Goals have varied over the years. They have been based on condition, posted bridges, leveling

bridge needs to achieve uniform funding needs, etc. The new goals will combine highway and bridge goals based on Corridor Priorities and Customer Service Levels (CSL), and are currently proposed as follows:

- By 2022, improve all Priority One and Priority Two corridors so that their overall CSL = C or better (Safety, Condition and Service CSLs);
- By 2027, improve all Priority Three corridors so that their overall CSL = C or better (Safety, Condition and Service CSLs);
- By 2017, implement a pavement program for all Priority Four Corridors that maintains their Ride Quality CSL at “C” or better;
- Continue the Light Capital Paving program on a seven year cycle for Priority Five Corridors outside State Urban Compact Areas;
- By 2015, develop and implement a similar asset priority and CSL system of measurement for all major freight and passenger transportation assets owned or supported by the department, including capital goals.

Virginia DOT

Virginia’s current global performance measure is based on the number of non-structurally deficient structures in the inventory. The goal is to maintain 92 percent of bridges non-structurally deficient statewide.

Other performance measures that are considered in the overall management of the bridge program are functional obsolescence, General Condition Ratings greater than or equal to 5, load posting, and Health Index.

Virginia (VDOT) has established a public, web based Structure Condition Dashboard application that provides real time structure condition data and trends in structure conditions over time. The structurally deficient measure was established by VDOT’s executive management. The reason for selecting this measure is due to its common use by the States and the FHWA. Performance can be easily compared to other states.

Oklahoma DOT

Our goal is to have no load posted or truss bridges on our state system. We also want to reduce the number of deficient bridges. ODOT established this goal when Oklahoma was identified as having the largest number of deficient bridges in the US several years ago. The number of on-system posted bridges has dropped from 137 in January 2006 to 30 bridges as of October 2011. The number of trusses dropped from 142 in 2006 to 92 in 2011. The number of on-system structurally deficient bridges has decreased from 1,168 in 2005 to 706 in 2011. Recently, our Governor has made a commitment to eliminate all of Oklahoma’s 706 structurally deficient bridges by 2019 by replacement or rehabilitation.

Oregon DOT

Oregon has a performance measure for state bridges (percent of bridges not distressed), but no performance goal. The measure was established after discovering that an SD/FO based measure

was not responsive to Oregon's investment in bridges. The distressed bridge measure is based on the Bridge Management System (BMS). It consists of four major components: freight mobility needs (load capacity, vertical clearance and other geometric clearances, based on Oregon standards); deterioration needs (bridges that are structurally deficient according to federal definition, paint and timber substructure needs); bridge safety (scour and rail deficiencies); and serviceability needs (cathodic protection, movable bridges and bridges with low service life).

Florida DOT

Yes. If so, a) What are your Agency's performance goal(s) and measure(s)? See my presentation earlier in the program. b) How did you go about establishing these goals and measures? The overall performance measures were established at a high level. The lower level ones were developed to address specific program shortcomings.

Wisconsin

Wisconsin has recently established a performance measure of good and fair bridges expressed as a percentage of deck area. The good and fair comes from the NBI values for the bridge. While a target has not been set, the number will be monitored for trends to ensure bridge condition is staying or trending at a favorable direction.

Attached is the five year trend graph and our description of this measure:

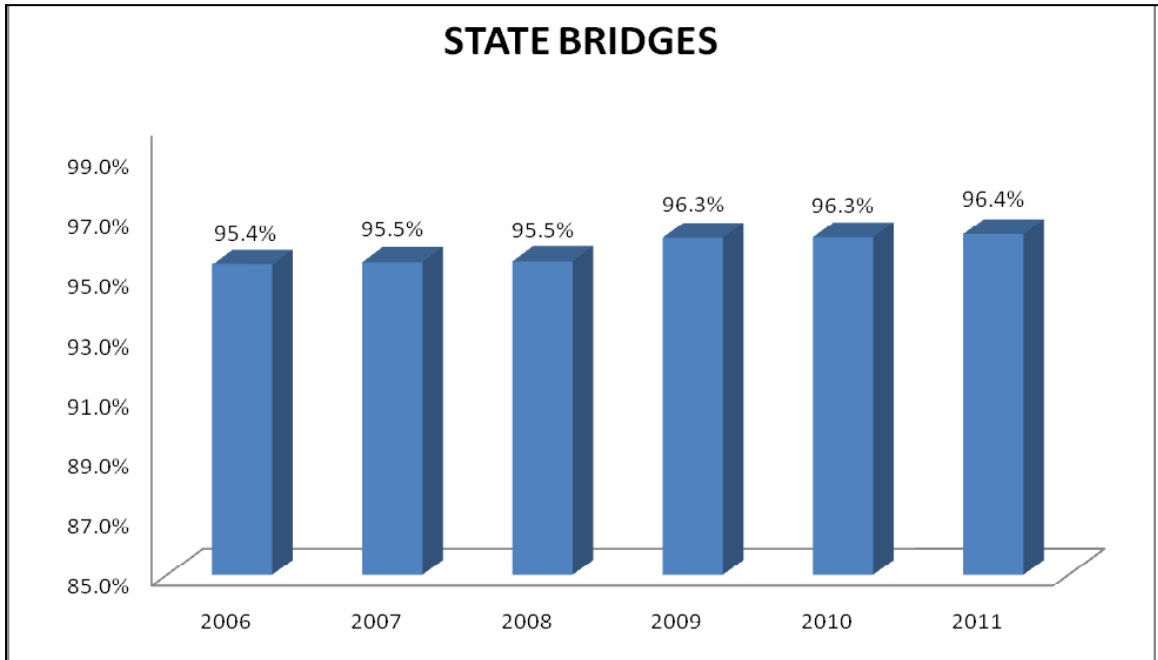


Figure 1 Wisconsin DOT bridge-condition trends

Why is this important?

Wisconsin bridges are an important infrastructure asset for the vitality of the highway transportation network. Ensuring safety for the traveling public is a top priority for the department. Inspecting and evaluating bridges is a key component to meeting this objective. Bridges with a condition rating of poor are considered deficient and may need corrective action to ensure current and fu-

ture operation of the transportation system. An accurate understanding of the condition of the inventory of bridges allows for planning and prioritization of limited resources to address operational needs.

How we are doing?

The above trend line shows that Wisconsin has been increasing its good and fair bridges over the past five years. The numbers of these bridges has been improving since 2006 in Wisconsin and the nation as a whole. Wisconsin has 91.8% good and fair bridges (for local and state owned) whereas the nation's average is 88.5%.

What factors affect results?

Wisconsin puts a high emphasis on maintaining and improving its bridges through its rehabilitation and replacement improvement programming. Bridges receive the highest priority in the project selection process. Wisconsin spends additional state money above the federal dollars it receives from the bridge program to maintain its bridges. In addition, the department has a highly successful bridge inspection and bridge management program that ensures safe and efficient bridges for its users.

New Hampshire DOT

We are still in the midst of developing a Balanced Scorecard approach to bridge conditions, looking at the Red List as a measure.

5. Program Effectiveness and Effectiveness of Bridge Management Tool(s).

How is your Agency assuring themselves that their preventative actions work (in other words how do you measure the effectiveness of a program)? How do they know that in fact they are doing the right things? For those managing large investments what gives them confidence that they are doing the right thing?

Maryland SHA

For the overall program, we look at the trends over many years such as decreasing the number of structurally deficient bridges. We also look at trends on how many are rated 5, how many structurally deficient bridges come on a system each year, etc.

California DOT

a) By tracking our performance measures and general system condition over time using the Bridge Health Index, we can assess the overall bridge network condition. Success for preventive actions is measured by the reduction in new "distressed bridges" being identified annually.

b) The performance measures noted provide clear indicators. We also monitor the value of outstanding work in all categories as well. Caltrans evaluates many options for larger value projects and uses Life Cycle Cost Analysis to ensure ourselves we are making good investment decisions.

South Dakota DOT

We have not done any in depth studies or evaluations. We have a difficult time finding bridges that need to be replaced, so we feel the 30+ years of bridge preservation work proves the effectiveness of those actions. We only have 3.9% of our state bridges that are structurally deficient and only 0.7% are eligible for replacement.

Alabama DOT

We do not have a formal procedure to determine the effectiveness of our preventative actions. We are hopeful of using Pontis and our new Maintenance Management System to better manage our funding and measure the effectiveness in the future.

Michigan DOT

We are assured that preservation actions work by monitoring overall bridge conditions over time, by monitoring bridge deterioration rate (example number of bridges becoming poor reach year, and bridge cycle of life)

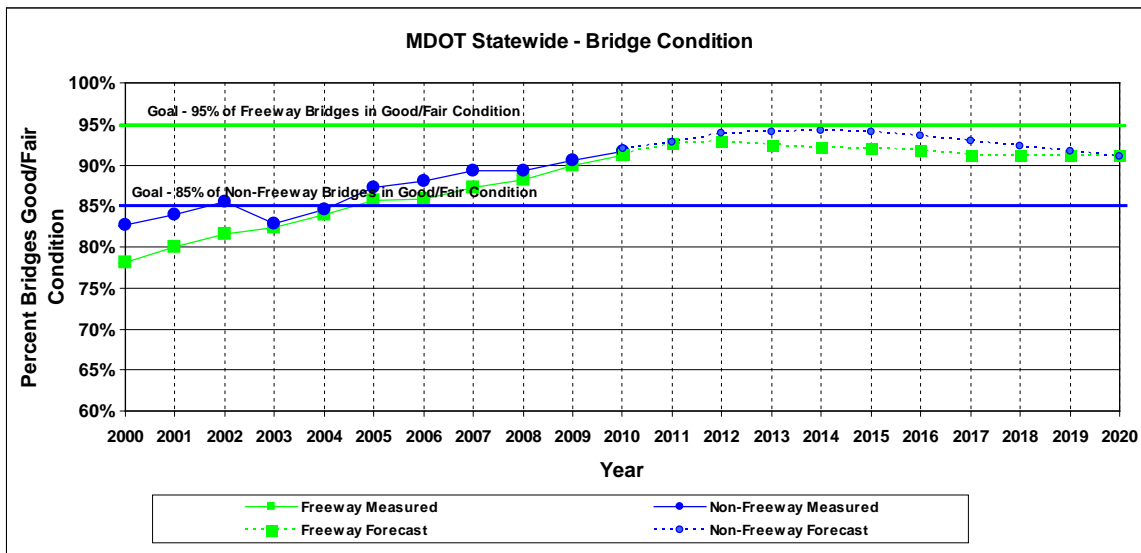


Figure 2 Michigan DOT bridge conditions and targets

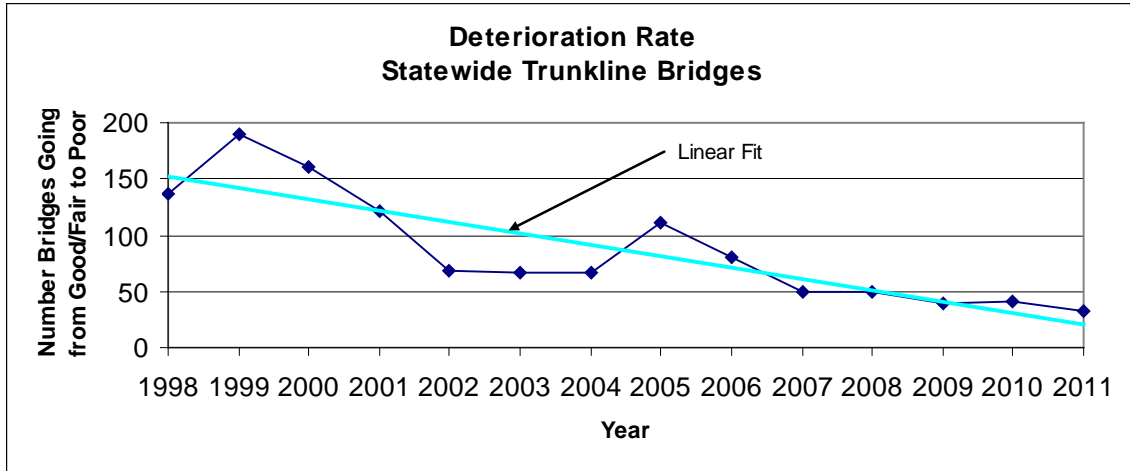


Figure 3 Deterioration rate for Michigan DOT bridges

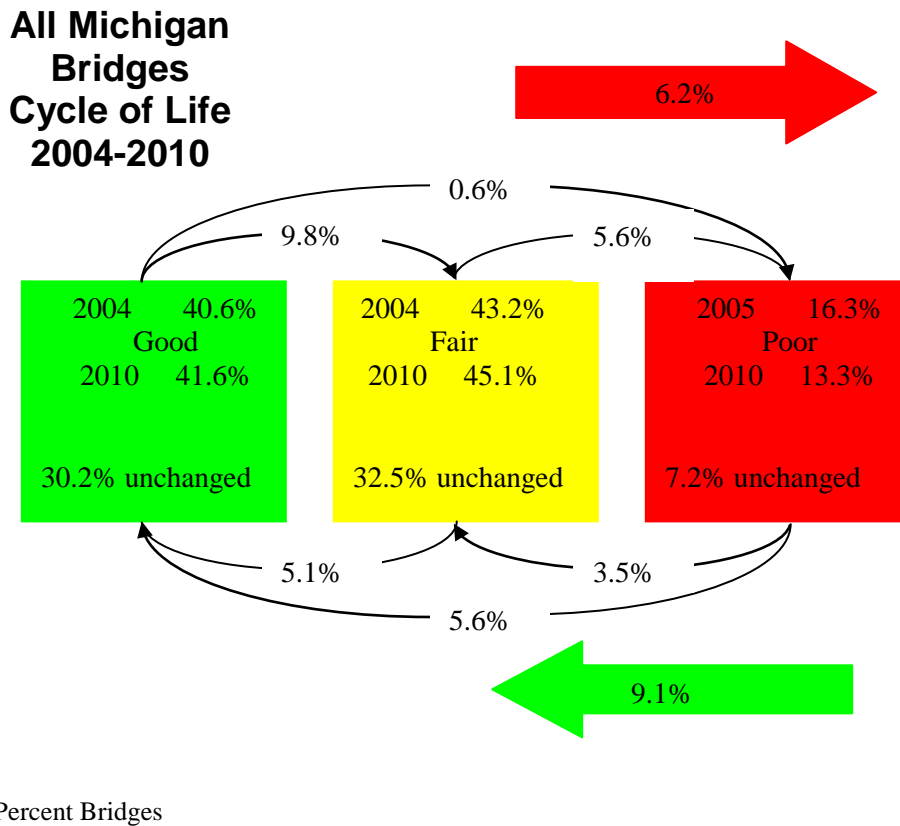


Figure 4 Michigan DOT tracks change in bridge conditions

Maine DOT

Having a relatively small number of bridges allows the Review Team to evaluate all bridge project candidates on site to scope and prioritize for the best use of available funding. Final office reviews are conducted by the Review Team to finalize the Work Plan when funding levels are better known. The bridge scopes are later re-evaluated quantitatively during the preliminary en-

gineering phase (PCE) of the project.

In current practice, prioritization and program development is predominantly founded on the ‘on site’ and office reviews. Additionally, Pontis analysis has been used as a backup check for proposed work plans, and also for the purpose of running what-if funding scenarios. Our interest in Pontis optimization will be renewed with the implementation of national elements and the release of version 5.2.

We are currently using dTIMS for pavement management. We are currently investigating having dTIMS (and perhaps MD) be the common tool for everyone in our Asset Services Division, utilizing dTIMS analysis to benchmark current conditions, set customer service level (CSL) Goals, and quantify funding to achieve them. Ref: North Dakota and Utah

Virginia DOT

The effectiveness of the Virginia bridge program is evaluated using data concerning the change in structure conditions over time (number of structurally deficient structures, number of structures at risk of becoming structurally deficient, etc.) and the change in the network level needs over time.

Oklahoma DOT

We along with the maintenance division’s new maintenance management program will be able to track maintenance actions over time. ODOT has only been doing systematic preventative maintenance with dedicated funding for about seven years. We know from that short amount of time that painting bridge beams is far more effective if they get attention before *ANY* section loss has occurred, and that keeping expansion joints in good condition is very effective. In recent years, ODOT has replaced a large number of bridge decks which effectively seals the roof and greatly slows down the deterioration process.

Oregon DOT

Currently, the program remains largely reactive. With the prospect of reduced funding levels, it will be increasingly difficult to get out of a reactive mode. However, we are making efforts to develop better linkages between inspection data and preventive maintenance actions. A focus on preservation, a greater emphasis on planned maintenance actions and an increased evaluation of action effectiveness may help increase confidence in program efficiency.

Florida DOT

The only way we know is on the global scale. There is insufficient data to establish if a specific preservation activity is effective.

Wisconsin DOT

WisDOT evaluates the policy and decision making strategies periodically. It has peer meetings that ask questions regarding the overarching policies. Tools such as data analysis, research, and workshops help to determine the effectiveness. Bureau of Structures staff are dedicated to answer and challenge these strategies.

New Hampshire DOT

I do not know of anyone who has tried spending on Maintenance for a control group of bridges and replacing another control group to track wisdom of these actions.

6. Noteworthy Policies, Procedures

What is the state's most noteworthy policy or procedure(s) that enhances quality and improves effectiveness in performing bridge management?

Maryland SHA

Being a small centralized state allows us a good overall view on how our system is working and where we need improvements. Also, contributing is our bridge tour where representatives from the different aspects of bridge management look at all the critical bridges each year.

Caltrans

Caltrans provides a means for the Program Manager to shift funds between preventive maintenance programs and major capital programs. This flexibility provides the opportunity to monitor the network and make the best investments possible.

South Dakota DOT

We feel our most noteworthy procedure is the efforts to protect our bridge decks and waterproof our joints.

Alabama DOT

Our current bridge management system tracks bridge maintenance needs as well as bridge maintenance performed. We are starting element level inspections and moving to Pontis to help refine our bridge needs. Our Bridge Replacement Prioritization process has improved the effectiveness of our bridge management.

Michigan DOT

Developing preservation goals and adopting a mix of fixes with money specifically allocated to preventive maintenance.

Maine DOT

Maine DOT is no longer able to select the best low-cost, lifecycle solution for all of its bridges. HCPs and CSLs provide a transparent means to support our decision making - which bridges get the funding, and which do not.

Virginia DOT

The Virginia Bridge Management Program includes the following noteworthy components:

- A complete and up-to-date structure inventory database;
- A quality structure inspection program;

- Computer software that provides a tool for staff to develop network level optimization models which minimize the long term maintenance funding requirements while keeping bridge elements and components out of risk of failure;
- A work candidate and project selection process that includes the use of bridge management software, analysis of element level inspection data, analysis of general condition data, and analysis of other data by bridge managers at both the Central Office and the District level;
- Performance Targets based on the number of structurally deficient structures;
- A preservation approach to managing the structure inventory that includes work actions for preservation, rehabilitation, and replacement;
- Design and construction policies that will reduce the future maintenance needs of structures constructed today;
- A project delivery program that includes both state force activities and contract activities;
- A system for tracking work accomplishments;
- A letter agreement with the FHWA Division office for performing preventive maintenance and system preservation activities utilizing Federal Highway Bridge Program funds.

The Virginia Bridge Management Program is executed by a staff of bridge engineers, bridge managers, bridge specialists, bridge safety inspectors, and bridge maintenance crew members who are dedicated to protecting the safety of the traveling public and protecting and preserving the public's investment in the highway infrastructure.

Oklahoma DOT

ODOT's QC/QA program for bridge inspectors has been very successful. The quality of the inspection data has improved a great deal in the last 10 years. In the odd number years, ODOT requires all the Program Managers and Team Leaders to inspect the same three bridges. This process helps to promote consistency and helps to identify wording in the Oklahoma PONTIS Manual that needs improvement. In even number years, ODOT requires the Program Managers to participate in a bridge rating exercise using software like BAR7.

Oregon DOT

Recently, Oregon has adopted seven strategies for the bridge program which include:

- Protecting high value coastal, historic, major river crossings and border structures;
- Using Practical Design and funding only basic bridge rehabilitation projects and rare replacements;
- Giving priority to maintaining the highest priority freight corridors;
- Developing a bridge preventive maintenance program;
- Continuing to raise awareness of the lack of seismic preparation;
- Addressing significant structural problems (only) on low-volume bridges to protect public safety, and;
- Health monitoring of bridges.

Florida DOT

Support from upper management for system preservation. System preservation is funded first. In addition, the Department with the assistance of our Materials Office has pursued specification changes that have led to longer lasting bridge components.

Wisconsin DOT

In-house system developed has some great features including notifications for safety concern, QA for data and tracking, reports allowing the combination of condition/risk, to be compared simultaneously to make decisions on a micro and macro level. Inspection manual and inspection program is very well defined. The program is administered and is considered to be a national leader.

New Hampshire DOT

We are a small state. We in a small bridge committee can know the conditions of our bridges.

7. Needed Research to Support Bridge Management

What types of activities as well as kinds of research should the FHWA pursue to support bridge management needs within the State?

Maryland DOT

First, determine how to measure the overall efficiency of a bridge program. Then, look at those owners that have an efficient system and see what the best practices are that make it efficient. There are assumptions of what a BMS should be, but has anybody determined if these really result in an efficient BMS?

Caltrans

Performance measures are critical for bridge managers to be able to convey the needs of the system. Currently there are only three nationally used bridge performance measures (Structurally Deficient, Functionally Obsolete and the Bridge Health Index). Research is needed to develop new consistent national bridge performance measures. The FHWA relies on Structurally Deficient and Functionally Obsolete measures to allocate funds. These two measures could be improved significantly. It is hard to move to a well managed system approach when the FHWA, academics, industry groups and the media want to compare states based on Structurally Deficient and Functionally Obsolete.

South Dakota DOT

Reliable and repeatable automated (or semi-automated) data collection for deck/slab conditions.

Alabama DOT

Better guidance on effectiveness of bridge maintenance and preservation activities would support our bridge management efforts.

Michigan DOT

Develop a national method for monitoring bridge deterioration. Markov chain transition probabilities work very well with NBI bridge data.

Maine DOT

Maybe look at expanding National Elements e.g. roadway retaining walls, high mast structures, railroad bridges, ferry transfer bridges, tunnels, movable bridges.

Virginia DOT

Federal policy to recognize and reward State's successes in bridge preservation would support current practices and prompt state DOT's to increase preservation efforts. Develop an updated NBI translator.

Oklahoma DOT

FHWA should support the BRIDGEWARE task force in developing the PONTIS software beyond the inspection module. Many states don't use PONTIS for much more than collecting and storing inspection data. The programming module needs further development.

Oregon DOT

It would be helpful to have practical methods and tools for collecting, storing and evaluating data for bridge life cycle analysis. Also beneficial would be practical methods and tools for collecting, storing and evaluating data for treatment or repair effectiveness and expected life. In addition, the development of cost effective means for evaluating remaining service life of structure is needed.

One activity that FHWA could help with is improving our rail prioritization program. Instead of using a portion of our funding to address the rails of most concern in the state (we still have some worthless aluminum rails on the interstate system), we have to include rails with every rehabilitation project. Due to mobility concerns with trucks, and stakeholder concerns from bicyclists in urban areas, upgrading the rail may have to include widening. The result is that some bridges that should have rehabilitation projects programmed, including scour, cannot be programmed due to the requirement to upgrade rails.

Being able to use HBP funding for preventive maintenance would also support the bridge management effort. While HBP funds can technically be used for preventive maintenance, the standard for approval is such that the bridge management system must be fully developed before qualifying.

Florida DOT

It would be helpful to develop consistent definitions for bridge management type terms. For example, there is no real definition for service life, or useful service life. What criteria should be used to establish that a structure has reached the end of its service life? This definition needs to apply to single bridges and bridge systems as a whole.

Wisconsin DOT

Please provide understanding of how programs are delivered to meet the State DOT needs including safety, economics, and risks. (As well as other factors) Bridge management is a process – not a system. Decision makers need to have the correct information and meaningful information. Try to understand the needs of decision makers on every level of the organization. Bridge management means something different to each of them.

FHWA obsolete items: The sufficiency number needs to be re-evaluated as it is outdated. Deficiency is a bad term to use for the media and laymen's understanding. NBI ratings. Try to explain that when closing a bridge.

Provide consistent national definitions of preventive maintenance. Define activities that actually have shown to be good for bridges. Allow a national set of items that every state can use. (Currently, FHWA has done a less than desirable job with this consistency)

8. Future BMS Plans

What are your future plans for expanding your BMS? What new features/capabilities do you most need?

Maryland SHA

We are nearing completion of a deck overlay program document/system which will be submitted to FHWA for the use of federal funds. It includes a Deck Priority Rating (DPR) and some cost benefit analysis. This will help to formalize our program where we try to protect a deck before it gets too bad for an overlay and requires replacement.

Caltrans

Caltrans has been focusing its efforts on the project level decision making and multi-objective optimization at the program level. At the project level, we continue to do more life-cycle cost analysis as well as evaluating project delivery risks. At the program level we are looking to evaluate projects that include risk reduction, condition improvement, and operational improvements of the system.

South Dakota DOT

We are looking forward to incorporating the multi-objective approach that will be in Pontis 5.2, along with incorporating the new AASHTO Guide manual for Bridge Element Inspections.

Alabama DOT

We are in the process of starting element level inspections and transitioning to Pontis. The ability to model deterioration and perform network level analysis is needed.

Michigan DOT

Expand use of risk based assessments. Use Pontis to provide project-level decisions and information regarding bridge needs and estimates of cost within the three major categories of preventive maintenance, rehabilitation, and replacement.

Maine DOT

- MaineDOT Dashboard, new external dashboard similar to North Carolina's.
- Implement Deighton dTIMS for bridges, drawing bridge data from Pontis.
- Take CSLs to the Commission to assist with resource allocation.
- Departmental shift from "bridges" to "structures."

Virginia DOT

Virginia has plans to develop a Standard Operating Procedures manual for Bridge Management. Virginia continues to develop procedures and processes to enable the bridge management software to become a more effective project level tool.

Oklahoma DOT

See above.

Oregon DOT

We are currently developing a business process for preventive maintenance and preservation. Currently the maintenance, inspection and management aspects of our program do not work together as effectively as we would like. Without a "to be" process in mind, it is not practical to determine BMS software requirements. At this point, system flexibility would have to be what is most needed.

Florida DOT

In the near future (next 5 years) most of our resources will be spent working on changing to the new elements and if FHWA releases a new coding guide adapting to those changes. The major enhancement we are trying to make is creating a process to provide an electronic signature of the bridge inspection report and having this electronic version automatically stored in our document-management system.

Wisconsin DOT

WisDOT intends to implement 5.2 modeling on multi-objective optimization and project and bridge level prioritization. In addition, WisDOT will be implementing the new core elements in the next couple of years.

New Hampshire DOT

With available time, we will be upgrading to the NBE and MBE bridge elements for inspection. We are currently using the CoRe Elements.

NBMIPC
Session 5a and 6 a.
Roundtable Questions and Responses
from states that were not on the panel but in the audience

<p>1. Identification of Bridge Needs. How does your State identify highway bridge needs (i.e. replacement, rehab, preventive and ordinary maintenance)? a) How do competing bridge needs get prioritized against competing bridge needs?</p>	
IL	<p>Replacement and Rehabilitation type bridge projects (excepting those driven by a roadway widening or reconstruction which is independent of bridge condition) are determined using a Bridge Analysis and Monitoring System (BAMS) which assigns Table numbers to structures that meet certain criteria. The criteria is based on NBIS ratings and other inventory information – the tables consist of structurally deficient and functionally obsolete bridges and group them into critical backlog, other backlog, short-term accruing, and long term accruing needs. Attached is a copy of the criteria showing the various tables. Personnel from the Programming Department together with the District Bridge Personnel then prioritize and otherwise work to include the bridges into the Multi-Year Program as necessary.</p> <p>Ordinary and preventative maintenance needs are identified by each District Bridge Engineer. Each District has a small ‘Bridge Crew’ for doing certain small or urgent jobs. For other larger needs, the District Bridge Engineer works with the Programming section in order to fund this type of work out of the regular District Appropriation – basically the bridge needs have to be weighed against the roadway and roadside needs. There is some funding set aside each year for Bridge Painting, and Bridge Deck Sealing, but otherwise there is no set amount of money or other method of funding available for the preventative or ordinary maintenance.</p>
IN	<p>At the Indiana Department of Transportation (INDOT), Bridge needs are identified by both Bridge Management System (BMS) “Deighton Transportation Infrastructure Management System (dTIMS) and by districts personnel using inspection records and notes. District personnel will consider the BMS output/recommendations to select and submit their list of proposed projects with required information i.e., proposed Work Type, Year Needed, Project Cost...etc. The proposed projects will be prioritized by the Bridge Asset Management Team (BAMT) which consists of nine senior professional engineers representing INDOT’s districts and central office divisions lead by the Bridge Asset Manager from the division of Asset Management. BAMT has developed the “Project Scoring Guidelines and Business Rules for Bridge and Large Culvert Asset Programs” to consider all bridge needs from Maintenance to Rehabilitation and Replacement otherwise; allowing Paint, Scour, Deck Overlay to compete against Deck, Super and Bridge Replacement projects. Bridge Team will use the guidelines to score and prioritize projects based on their respective scores.</p>
MN	<p>Preservation needs (bridge maintenance) are identified during safety inspections. District Bridge Maintenance staff prioritize and plan this work. Bridge Improvement needs (extensive rehabilitations and replacements) are prioritized by a condition-based and risk-based analysis of the bridge system. The central Bridge Office produces a candidate program, which includes a prioritized bridge list, work type, and timeframe to address. Each District reviews and modifies the priority list according to their direct knowledge and experience with the bridges.</p>

<p>1. Identification of Bridge Needs. How does your State identify highway bridge needs (i.e. replacement, rehab, preventive and ordinary maintenance)? a) How do competing bridge needs get prioritized against competing bridge needs?</p>	
<p>MT</p>	<p>We use the Bridge Management System (BMS) to identify potential bridge preservation, rehabilitation and replacement projects. We screen the bridge database to develop lists of bridges that are structurally and functionally deficient along with separate lists identifying bridges with substandard deck health ratings. We also solicit input from the district maintenance personnel and division administrators for what they consider problem bridges, whether for maintenance, traffic congestion, and safety issues (accident trends). For safety reasons, structural concerns generally take precedent over functional capacity concerns. Risk, based on ADT, type of structure (i.e. fracture critical), type of traffic carried, detour length, and scour and seismic issues are also considered in the decision-making process. Political pressure, as always, weighs in as well.</p> <p>Replacement and rehabilitation decisions are based on structural and functional evaluations. If HBP funding is used, the structure needs to meet those eligibility requirements. When other sources of funding are used, HBP funding condition requirements are evaluated, but the structure may be replaced based on future or current route capacity needs. The cost benefit of replacement or widening of the structure is then considered.</p> <p>Bridge deck preservation rehabilitation projects include deck crack sealing and overlays. Bridges selected for these projects are generally within a section of a corridor to take advantage of consolidated traffic control.</p>
<p>NY</p>	<p>Primarily based on element and structure condition derived from inspection ratings and vulnerability assessments. a) How do competing bridge needs get prioritized against competing bridge needs? Assessment of a team of professional engineers responsible for a geographic region of the State.</p>

<p>2. Prioritization of Bridge Needs. How does your State prioritize the highway bridge needs in relation to other assets, such as pavement, roadside, etc.? In other words how do you juggle a high number of needs with limited funding? How do we move away from a worst first approach? Does your state use vulnerability or risk based approach to prioritizing bridge projects? If yes, please briefly describe how it is used and for what type of bridges.</p>	
<p>IL</p>	<p>Illinois – our Bridge Condition Goal is one of the highest goals we have. The state has put forth the concept that maintaining the existing system using our normal funding, before any widening / congestion mitigation projects.</p> <p>As for prioritizing the bridge projects – some of that is done by our BAMS process wherein the higher the Table, the higher priority is given to that bridge to be included in the MYP. Otherwise, a more detailed priority listing is somewhat left to the District Bridge Engineers. We do use various factors when setting priorities, including ADT & ADTT, Posting Levels, frequency of needed maintenance activities etc, to set the priority. Of course that’s balanced against the available budget and the time to get a project ready to be let as well.</p>
<p>IN</p>	<p>At INDOT, Bridge & Large Culvert projects will be scored primarily based on the following factors; Condition (40% Max), Cost Effectiveness (40% max), System Priority (10% max) and Other Impacts (scour, fracture critical, paint....10% max). Maximum score is 100 points. Other asset teams (Roadway “Pavement”, Safety and Mobility) have developed their respective team’s scoring system based on 0-100 score points as well. Bridge & Large Culvert projects will compete against other asset teams through Amalgamation process (determining and adjusting median scores for all assets are done by another team</p>

	<p>2. Prioritization of Bridge Needs. How does your State prioritize the highway bridge needs in relation to other assets, such as pavement, roadside, etc.? In other words how do you juggle a high number of needs with limited funding? How do we move away from a worst first approach? Does your state use vulnerability or risk based approach to prioritizing bridge projects? If yes, please briefly describe how it is used and for what type of bridges.</p>
	<p>of senior engineers/managers (Oversight Committee). The Oversight Committee reports to the Executive Team which consists of senior level managers that handles the funding distributions based on asset need (number of high score projects.....etc).</p>
MN	<p>Assessment, Preservation and Improvement programs are generally managed by the District Bridge Engineer with guidance from the central Bridge Office. Bridge Assessment and Preservation are mostly funded with the Operating budget and Improvement is funded with the Capital budget. Currently there isn't a formal analysis of competing bridge needs. Decisions are made based on experience and engineering judgment.</p> <p>How do we move away from a worst first approach?</p> <p>We need detailed information about the costs and effects of Preservation activities. If we can demonstrate the benefit (in terms of slowed deterioration), investment decisions in both Preservation and Improvement can be optimized to meet target bridge network conditions.</p> <p>Does your state use vulnerability or risk based approach to prioritizing bridge projects? If yes, please briefly describe how it is used and for what type of bridges.</p> <p>All rehabilitation and replacement projects are prioritized with a risk-based probabilistic approach. The risk of service interruptions on a bridge (frequent inspections, repairs, load restrictions, etc.) is assessed, along with the consequence of such service interruptions. Risk factors include such things as; condition of main components, presence of fatigue-prone details, scour susceptibility, load restrictions, substandard clearances, fracture criticality, etc.</p> <p>The automated system was developed by MnDOT. Inventory and inspection data is pulled from our Pontis database and the decision-making logic was created by expert elicitation.</p>
MT	<p>We use a Performance Programming Process (P3) to identify system wide transportation needs. This process gathers data from the pavement, maintenance and bridge management systems to develop funding scenarios based on future health predictions and rehabilitation actions. This process tries to optimize finite funding to at a minimum, sustain current health. There are legislative rules that set minimum percentages of funding for bridge projects. Montana has historically set aside more than this minimum for bridge projects. Off the top of total available funding, Montana sets aside \$5.5 million for bridge preventative maintenance and preservation projects. The limited funding for HBP generally goes to bridges that are structurally deficient and eligible for replacement. The route impacts play a big role in determining which projects are funded first.</p> <p>Money not specifically set aside for bridge projects is made available on other projects where a bridge is within the project limits. For example, if a section of a route is nominated for a widening project, replacement or widening of the bridges within the project limits are considered. FO bridges that are not eligible for HBP funding are replaced with other funding sources in order to meet the capacity needs of the route the bridge is on. This in part takes us away from a worst-first approach because bridges are replaced as</p>

<p>2. Prioritization of Bridge Needs. How does your State prioritize the highway bridge needs in relation to other assets, such as pavement, roadside, etc.? In other words how do you juggle a high number of needs with limited funding? How do we move away from a worst first approach? Does your state use vulnerability or risk based approach to prioritizing bridge projects? If yes, please briefly describe how it is used and for what type of bridges.</p>	
	<p>needed for capacity, and not because of structural concerns.</p> <p>Future growth is considered in rehabilitation versus replacement decisions (usually involves widening and cost-effectiveness). The cost benefit is evaluated in making rehabilitate versus replace decisions.</p> <p>Seismic, scour, and fracture critical vulnerabilities are part of a risk-based assessment of bridge funding needs.</p>
NY	<p>Performance measure are set for each asset class and associated with an associated funding/budget level. How do we move away from a worst first approach? By setting an acceptable performance level for an asset class and emphasizing the focus of a program to slow down the rate of deterioration.</p> <p>Does your state use vulnerability or risk based approach to prioritizing bridge projects? Yes, vulnerability assessments are used in the identification and prioritization of bridge needs.</p> <p>If yes, please briefly describe how it is used and for what type of bridges. Primarily, scour vulnerability is used. (Other vulnerabilities are also assessed, including seismic.) Bridges with scour vulnerabilities are identified as critical need bridges requiring expeditious response and treatment.</p>

<p>3. Funding/Budget. How are your bridge activities funded? i.e. do you have a dedicated fund for the program, or funded on as needed basis? Has your funding been cut because of fiscal constraints? Does your agency optimize its budget with respect to prioritizing bridge preservation, rehabilitation and replacement projects to improve the overall network performance measures within your agency?</p>	
IL	<p>Illinois – no prioritization between preservation rehabilitation/replacement is done. Most of our funding is directed to rehabilitation / replacement with preservation / maintenance taking a distant 3rd place. The only successes that the Preservation end has seen recently is the creation of a deck sealing program with an annual appropriation that is set aside from the regular program; an even more recent program is to allocate an annual amount toward the maintenance of ‘1,000 ft long’ bridges – this an attempt to make sure we are addressing those maintenance needs which are obviously beyond our in-house capability; also the recent Federal Stimulus Program has allowed additional bridge maintenance projects to be brought forward in the program (basically they were shovel ready, while many other replacement/rehabilitation projects could not be brought forward quickly enough.</p> <p>When a bridge is proposed for rehabilitation a Bridge Condition Report is prepared that evaluates rehabilitation versus replacement for all the bridge components on a bridge-by-bridge basis.</p> <p>Regarding a cut in funding, only as a process of growth – the cost inflation of</p>

	<p>3. Funding/Budget. How are your bridge activities funded? i.e. do you have a dedicated fund for the program, or funded on as needed basis? Has your funding been cut because of fiscal constraints? Does your agency optimize its budget with respect to prioritizing bridge preservation, rehabilitation and replacement projects to improve the overall network performance measures within your agency?</p>
	<p>materials and labor over the last decade hasn't been matched by an increase in our budget. That is the budget hasn't declined, but the costs have grown.</p>
IN	<p>At INDOT, Bridge Projects are programmed as needed, there is no dedicated (state) funds for bridge program. BAMT is giving a high priority (automatic 100 score points) to those maintenance projects (deck patching, joint replacement, culvert lining....etc) that meets the Bridge and Culvert Preservation Initiative (BCPI) criteria (using federal STP funds for culverts and HBP funds for bridges).</p>
MN	<p>Minnesota has a constitutionally established Highway Fund that dedicates a portion of state revenue (motor vehicle sales tax, fuel tax, vehicle registration fees) to transportation. This revenue is paired with federal dollars and used to fund the operation and maintenance of Minnesota's highway network.</p> <p>Occasionally, the state legislature provides targeted funding for specific transportation needs. For example, MnDOT is currently administering a 10 year (2008-2018) legislatively-mandated bridge improvement program. This program provides \$2.1 billion for the replacement or rehabilitation of fracture-critical and structurally deficient bridges.</p> <p>Has your funding been cut because of fiscal constraints?</p> <p>No. As stated above, we are currently involved in a focused bridge improvement effort.</p> <p>Does your agency optimize its' budget with respect to prioritizing bridge preservation, rehabilitation and replacement projects to improve the overall network performance measures within your agency.</p> <p>Not yet. Our investment decisions for Preservation (maintenance) are generally made separately from our investment decisions on rehabilitation and replacement. We are currently working on the decision-support systems that will allow us to optimize all bridge investments to maintain our bridge network performance targets.</p>
MT	<p>HBP funding is used for bridges meeting the criteria. We use a P3 process to identify long-term needs based on funding levels. Scenarios based off of deterioration models are utilized to help determine where to use available funding to provide overall improvement of the system. The P3 process is only a start. Verification of actual conditions and needs by the fund managers ultimately determines what gets programmed.</p> <p>As stated earlier, bridge preventative maintenance and preservation programs have specific funding set asides. For bridge decks, we are trying to target those preservation activities at the right time to extend the health of the bridge.</p>
NY	<p>Capital and maintenance activities are systematically funded with HBP and non-dedicated programs.</p> <p>Has your funding been cut because of fiscal constraints?</p> <p>Yes.</p>

<p>3. Funding/Budget. How are your bridge activities funded? i.e. do you have a dedicated fund for the program, or funded on as needed basis? Has your funding been cut because of fiscal constraints? Does your agency optimize its budget with respect to prioritizing bridge preservation, rehabilitation and replacement projects to improve the overall network performance measures within your agency?</p>	
	<p>Does your agency optimizes its' budget with respect to prioritizing bridge preservation, rehabilitation and replacement projects to improve the overall network performance measures within your agency.</p> <p>No.</p>

<p>4. Performance Measures/Goals. Has your State established performance goals for your bridge program? If so, a) What are your Agency's performance goal(s) and measure(s)? b) How did you go about establishing these goals and measures?</p>	
IL	<p>Illinois – for state owned Bridges, our published goal is to remain at or above 93% acceptable condition for state bridges. This goal was derived based to some extent on available funding levels, but also with the realization that it would be poor management to keep everything in good or better condition; things have to get old before you replace them – otherwise you are replacing bridges that still have time to serve.</p>
IN	<p>At INDOT, in the past we have used a combination of bridge element condition ratings (Wearing Surface, Paint, Deck, Superstructure, Substructure, Structural Evaluation, Sufficiency Ratings) to monitor and report the bridge condition on annual basis since 2005. This annual report was for the agency internal use. But, we are in the process of developing the Bridge Quality Index (BQI) which is the average of the Wearing Surface, Deck, Superstructure, Substructure, Geometry, and Inventory Load Capacity ratings. The BQI is based on 0-100 scoring points. It still is in the testing process. Once approved, INDOT intends to use it for both internal and external reporting system to monitor the bridge network condition.</p>
MN	<p>We have several performance measures for bridge condition, inspection and maintenance accomplishments. The measures and targets were established by expert elicitation. See attached sheet for a summary of MnDOT's bridge performance measures.</p>
MT	<p>The P3 process is used to help determine funding levels that improve the system. The only real current measureable is the change in percentage of structures that are SD or FO. The measure of these criteria is fairly straight forward. A goal is to reduce the number of structures that are SD or FO along with extending the service life of existing bridges.</p>
NY	<p>Yes.</p> <p>If so, a) What are your Agency's performance goal(s) and measure(s)?</p> <p>Performance measures are based on the "Condition Rating" – a NY State specific weighted measure of 13 significant bridge elements' inspection ratings. Minimum acceptable condition rating goals are set for bridges aggregated by functional classifications.</p> <p>b) How did you go about establishing these goals and measures?</p> <p>Agency expert consensus based on historical data, state of good repair, and expert elicitation of budget and condition trends.</p>

5. Program Effectiveness and Effectiveness of Bridge Management Tool(s). How is your Agency assuring themselves that their preventative actions work (in other words how do you measure the effectiveness of a program)? How do they know that, in fact, they are doing the right things? For those managing large investments what gives them confidence that they are doing the right thing?	
IL	Illinois – there really isn't a long term evaluation of preventative actions being done – though on the other hand Illinois isn't doing very many truly preventative maintenance actions. We have recently started a deck sealing program, which is based on a 5 year study of various sealing methods that has shown a benefit in the sealants being able to decrease or prevent chloride intrusion into bare concrete decks. Now how will that come into play when considering the lifespan of our bridge decks – only the next 20-30 years will tell.

September 2010

CRITERIA FOR DETERMINATION OF ILLINOIS BRIDGE NEEDS					
Bridge Analysis and Monitoring			State-Maintained Structures		
(Planning or Original Logic)					
SD* or FO	TABLE #	WHEN: ITEM NUMBER	DESCRIPTION	RATES: RATING	THEN: NEEDS CATEGORY
SD	1	59, 60 OR 62	Super, Sub or Culvert	0 - 3	CRITICAL
SD	2	58	Deck	0 - 3	
SD	3	67	Structural Evaluation	0 - 2	
SD	4	70 A2, B2, C2, D2	Posted Load Limit	D2 > 0 or A2, B2, C2 Not Spaces	
SD	5	59, 60 OR 62	Super, Sub or Culvert	4	OTHER
SD	6	64 A & B	Operating Rating	0 - 26 Tons	
FO	7	68	Deck Geometry	0 - 3	
		29/ON	AADT/ON	≥ 1000	
FO	8	69	Underclearance	0 - 3	
		42B	Type of Service Under	1, 2, 4, 6-9	
FO	9	72	Approach Alignment	0 - 3	SHORT TERM
		29/ON	AADT	≥ 1000 ON	
SD	10	58	Deck Condition	4	
SD	11	67	Structural Evaluation	3	
SD	12	59, 60 OR 62	Super, Sub or Culvert	5	
SD	13	64 A & B	Operating Rating	27-35 Tons	
FO	14	130	Sufficiency Rating	0.0-49.9	
FO	15	29/ON	AADT ON	≥ 1000 ON	
		51	Bridge Roadway Width	1.0-23.9	
			-OR-		
		29/ON	AADT ON	1-999 ON	LONG TERM
		68	Deck Geometry	0 - 3	
FO	16	130	Sufficiency Rating	50.0-80.0	

* SD: Structurally Deficient FO: Functionally Obsolete

17-3

IN At INDOT, it seems there is some level of trust and confidence by the senior level managers and executive in our BMS system, because we have been receiving constant request from our senior manager to run our BMS with different budget scenarios. As far as impact on the bridge network concerns, our bridge programs utilizes combination of BMS, preservation activities and having involvement from district level to top level management. Our process is based on Asset Management Principles! We have started this process in 2010 and it is early to measure the results.

MN We are mostly relying on "institutional wisdom" to assure ourselves that our Preservation

	<p>activities are effective. We have some very experienced practitioners who can attest to the importance of preventive bridge maintenance.</p> <p>We are in the process of developing analysis tools and additional performance measures that will help us quantify the cost and benefit of Preservation activities. This will help us gauge the effectiveness of our program and communicate the benefits to department leadership.</p> <p>The effectiveness of our large capital bridge investments is generally gauged by monitoring bridge condition performance targets. Ultimately, we hope to have decision-support tools to help us optimize our bridge investments in both Preservation and Improvement.</p>
MT	<p>We use deterioration modeling to track the overall condition of our bridge inventory. We track preservation treatments on decks and their effectiveness. We are just beginning to look at using our construction management system in tandem with the BMS to track preventative maintenance activities, types of designs, and products that are used, and how they perform. Integrating our bridge management system with our construction management system will help us track the long-term performance of specific products, preventative maintenance activities, and even types of bridge designs, given the environment the item in question is subjected to.</p>
NY	<p>The effectiveness of a program will be realized (or not) at some future point in time. However, regardless of the program's time horizon, periodic assessment of actual bridge condition during a program cycle (including projections beyond the end of the program cycle) and comparison to theoretical model simulations of bridge conditions is an essential part of an effective assessment.</p> <p>How do they know that in fact they are doing the right things? Given the dramatic and significant reductions in available funding, the best anticipated short-term outcome is to maintain current conditions. However, this probable outcome is likely achievable at the cost of reduced long-term conditions and an unacceptable backlog of bridge replacements in the future.</p> <p>For those managing large investments what gives them confidence that they are doing the right thing? Combining a systematic BMS approach (developed and in use since the 1980s), analytical modeling tools available to NY State, and application of regional teams' expert professional engineering judgment yields a comprehensive solution based on the best available information and funding levels.</p>

6. What is the state's most noteworthy policy or procedure(s) that enhances quality and improves effectiveness in performing bridge management?	
IN	Asset Management Process, Bridge and Culvert Preservation Initiative (BCPI) policy.
MN	<u>Employing and supporting a team of dedicated bridge inspection and maintenance staff.</u> The foundation of a successful program is people who have the appropriate resources (knowledge, skills, equipment, etc.) to adequately care for our public bridges. By supporting this staff, we ensure that our bridge team has a strong feeling of ownership in their bridges and a sense of purpose in their work.
MT	The implementation of the NCHRP Report 590 on utility functions.

6. What is the state's most noteworthy policy or procedure(s) that enhances quality and improves effectiveness in performing bridge management?	
NY	Reliance on a BMS approach (developed and in use since the 1980s), and regional professional engineering teams that are intimately aware of a geographic region's bridges needs and associated constraints on multiple fronts (functional, structural, sustainability, local significance among other factors.)

7. What types of activities as well as kinds of research should the FHWA pursue to support bridge management needs within the State?	
IN	Promote and reward the states which use the BMS in the bridge project planning, selection and prioritization process. Research and develop deterioration model, cost model and any feature that could be included in the BMS.
MN	Continue to facilitate interaction among DOTs (conferences, working groups, etc.) so that we can collectively advance our preservation programs. Provide an on-line resource area for access to bridge preservation information, such as research, DOT manuals and policies, guidance documents, and contact information. This information is currently scattered among many locations (FHWA, TSP2, DOT websites, TRB), and many DOT resources are not available on-line. It would be convenient to have a categorized resource area for the exchange of this type of information.
MT	<i>No Response to this question</i>
NY	<i>No Response to this question</i>

8. What are your future plans for expanding your BMS? What new features/capabilities do you most need?	
IN	Short term plan; to include our BQI into our BMS and revise the deterioration models to predict and reflect more realistic future bridge element condition.
MN	We intend to continue developing our BMS so that it contains the tools necessary to support investment decisions across all aspects of our bridge management program (Assessment, Preservation and Improvement). Our bridge management decisions are segmented and we need to move toward an integrated system that helps us manage all life-cycle investments into our bridges. The features that we most need are; <ul style="list-style-type: none"> • Ability to quantify the effects of preservation activities, so that we can establish accurate cost/benefit information. This will help us move from experience-based decision making toward a data-based, analytical method. • Accurate predictive models that can forecast future bridge conditions based on investment scenarios.
MT	We are looking into other data sources that will enhance our ability to query data to track the effective use of preservation and maintenance activities. We are hoping to use our construction management system to help with this. We are also starting to better track our maintenance activities in our bridge management system.

8. What are your future plans for expanding your BMS? What new features/capabilities do you most need?	
	We need the ability to track construction activities for each bridge. The Construction Management System we use is vendor provided (SiteManager). Collaboration from other States that use this software to promote enhancements to track work done on specific bridges by their bridge identification number would be helpful.
NY	Awaiting Pontis 5.2 as we continue to enhance and update our State developed modeling tools. What new features/capabilities do you most need? Incorporation of economic and risk optimization in modeling.

Sessions 5B and 6B Bridge Inspection Panel Discussions

In Sessions 5B and 6B, the same panel format was followed as in 5A only the 5B focus was upon bridge inspection. Presenting were Mr. Carl Puzey of the Illinois DOT, Mr. Jerry Leatherman of the Tennessee DOT, Mr. Michael Johnson of Caltrans, Mr. Jody Bywater of Washington State DOT, Mr. Don Whistler of the Kansas DOT, Mr. Don Kellogg of the Oklahoma DOT, Mr. Rick Smith of the Idaho Transportation Department and Mr. Bert Hartmann of the Oregon DOT.

1. Critical Inspection Findings and Follow Up Procedures

Please describe your state's process for dealing with critical inspection findings and the follow-up procedures to them.

Illinois DOT

Illinois' definition for Critical Finding: A structural or safety related deficiency that requires immediate follow-up or action.

For the purpose of identifying inspection findings as critical, Illinois uses the following guidelines:

- Lowering the condition rating for Deck, Superstructure, Substructure or Culvert (ISIS Items 58, 59, 60 and 62 respectively) to a "2" (critical condition) or less.
- Lowering the condition rating for Channel & Channel Protection Condition (ISIS Item 61) to a "3" (serious condition) or less.
- Lowering the code for Scour Critical Evaluation (ISIS Item 113) to a "3" or less.

Critical Findings must be immediately provided to the District/Agency Program Manager. Typically, Critical Findings require the establishment of monitoring procedures or the use of Special Feature Inspections, along with the development of maintenance/repair projects to address the finding. District/Agency Program Managers must report Critical Findings to the Bureau of Bridges and Structures to initiate an evaluation of the structure's load-carrying capacity. IDOT does not have a standard form for critical finding documentation at this time, but does have standard documentation for the load rating results.

Critical Findings can also arise from inspections that are not directly related to the NBIS. Bridges that sustain damage from vehicle impacts or severe flooding may also present conditions that require the reporting of a Critical Finding to the District/Agency Program Manager, and subsequently to appropriate personnel for evaluating load-carrying capacity.

The Department provides the FHWA, on a semi-annual basis, a summary of bridges that have condition ratings or codings that indicate a Critical Finding occurred. In addition, IDOT notifies the Bridge Engineer of the FHWA Illinois Division Office of any Critical Findings related to vehicle accidents or environmental circumstances affecting the National Highway System or marked routes under the jurisdiction of the Department.

Tennessee DOT

The Tennessee Dept. of Transportation (TDOT) has a written procedure for this topic in its

Bridge Inspection Manual. Each critical finding is documented in a Bridge Evaluation Report (BER). The BER is distributed to Regional Personnel and (as necessary) to local bridge owners. If the BER involves a bridge closure, a copy also goes to the TN Division FHWA Office. If the BER involves implementation of a bridge weight posting or closure, the Inspection Manual also sets time periods for follow-up on the BER. In the case of a bridge closure, for example, a follow-up inspection is performed no later than two weeks after the bridge owner is notified. The owner has this long to either properly close the bridge or to make repairs.

Caltrans

Caltrans has a formal communication and documentation procedure for findings. Critical findings are immediately communicated to the bridge owner and then up the management chain in Caltrans. Formal documentation is required within 24 hours of the finding. The documentation requires tracking of the finding through resolution.

Washington DOT

For Washington DOT, a critical finding is any finding of a significant structural problem requiring an emergency load restriction, lane closure, bridge closure, or if a bridge has failed.

Follow-up procedure involves a Critical Damage Bridge Repair Report. This is a form used by both the Lead inspector in the field and any follow-up within the office to document and record damage done to a bridge, recommended repairs and the repairs that are ultimately completed.

This report is submitted to the FHWA Washington Field Office for each and every bridge incident that meets the critical finding definition above.

Kansas DOT

Kansas DOT considers any finding that needs immediate attention in order to maintain safe passage for the traveling public as a Critical Finding. A Critical Finding is one that requires immediate action that must be started within a week and the repairs have to be completed or the roadway closed within one month to ensure safety. This action includes developing repair details and proceeding with the repair by contract or maintenance crews. These types of findings are recorded in Pontis and e-mails are automatically sent out to remind everyone that the action is still pending. The inspector that finds the problem is held responsible to track its completion until it is field verified. The department also has a bulletin board that lists all current problems posted within the working group.

Oklahoma DOT

Critical (CX) findings are those that could result in the immediate failure of the structure or could cause harm to the traveling public. Off-system bridge owners with critical findings are notified immediately, the structure is placed on a 6 month inspection schedule and the structure must be repaired or closed within 90 days. Repairs of on-system bridges with critical findings (CX) are initiated immediately upon notification by the inspector.

Idaho Transportation Department

Structural items rated a 2 or less on the NBI trigger a critical inspection. Likewise, culverts and channel protection that are a 3 or less. The follow-up is immediate. Consultants use an Agency

Communication Form to transit the findings. State Inspectors contact the District directly. A copy of the inspection report and local agency communication form is sent to FHWA.

Virginia DOT

When the condition of a structure is identified as posing a threat to public safety, the Residency Administrator and/or the responsible manager shall be notified of the situation and shall be informed of a proposed method of correction. Conditions requiring the issuance of a critical recommendation include, but are not limited to:

1. Critical repairs to fracture critical members;
2. Correction of critical scour and/or hydraulic induced problems;
3. Condition rating of 3 or less for deck, superstructure, substructure or culvert;
4. Immediate work to prevent substantial reduction in safe load capacity.

When the corrective work has been completed, the Residency Administrator and/or the responsible manager shall complete their portion of the critical recommendation form and return it to the District Structure and Bridge Engineer.

Oregon DOT

Bridges on the Critical Follow-up list have the deck, superstructure, substructure, or channel and channel protection NBI rating of 3 or less. Or the NBI 113 has a rating of 2 or less. Or, NBI 70 shows the bridge should be posted and it is not posted. The status of each state bridge is followed by the Senior Bridge Inspector, the status of each local agency bridge is followed up by the Local Agency Coordinator. The Critical Follow-up list of bridges, and the results of the follow-up are provided to FHWA in April and October as part of the submittal.

2. Scour Inspections During Routine Storm Events

Please describe your state's processes for handling scour inspections during routine and storm events.

Illinois DOT

Methods for identifying scour during routine and underwater inspections would typically include wading and probing for smaller structures and sonar for larger structures and deeper water. Side scan sonar is now being used on a limited basis. Our underwater inspection consultants commonly use Mesotech side scan sonar imaging on our major river bridges. Illinois has a standard Underwater Inspection form that must be completed for each Underwater Inspection.

Illinois has approximately 80 scour critical state maintained bridges and a similar number of local agency bridges. Inspection methods during a flood event are admittedly challenging and we feel there is room for improvement in this area and look forward to information from the other states regarding their practices. Some methods used during flood events have included small depth finders on extendable poles and more crude methods such as a weight on a rope. Illinois has a trial installation of a "pop-up device" that is buried in the streambed and sends a signal if it becomes exposed and "pops-up". Illinois does not have a standard form specifically for documentation of monitoring data during a flood event.

Illinois is in the process of implementing a software package that will send alerts to bridge inspection personnel when water levels are expected to be at a pre-determined level at a given scour

critical bridge and will therefore assist in proper timing of implementation of Scour Plans of Action. This is or is expected to be similar to the BridgeWatch program being used in some other states, and is expected to help greatly in focusing inspection resources in the right locations during flood events.

Tennessee DOT

TDOT licenses the BridgeWatch System from US Engineering solutions. All of the Tennessee bridges which are either Scour Critical or have Unknown Foundations are loaded into the software. Scour Plans-of-Action (POA's) are also loaded for all these structures. In addition, draining area information is loaded for each bridge along with contact information for responders. The BridgeWater program continuously monitors rainfall events. Events with the potential to exceed "trigger" levels will generate an alert. The responder will then investigate the situation and may close the bridge as necessary for safety. A written response to the alert is then loaded into BridgeWatch.

Caltrans

Caltrans provides lists of scour critical or other scour watch bridges out to local maintenance forces in advance of larger storm events. Local maintenance staff are given instruction related to the signs of potential hydraulic concerns. Sites of concern are often actively monitored using float outs or similar remote sensors. In one recent event Caltrans was able to use sector scanning sonar to capture active scour at its peak and subsequent backfilling of the scour hole.

Washington DOT

Scour is a consideration by our inspectors for any bridge over water. Each bridge over water will have been assessed for calculated scour and will be evaluated with ongoing observations for scour during field inspections. Field inspections will include channel profile measurements every 24 months or less for those bridges calculated or observed as being scour critical. The Scour Engineer may also ask field inspectors for channel profile measurements of any bridges not considered scour critical but usually on a less frequent basis.

A scour smart flag element is included in every report for those bridges considered to be over water. This is similar to PONTIS. An inspector rates each pier considered to be vulnerable to scour in one of four condition states. These condition states range from "No scour exists" to "Significant scour exists that has reduced foundation structural capacity."

The bridge office has a Scour Engineer that manages the activities and records of all state bridges considered to be over water. Any bridge deemed scour critical will have been assessed by this person. A plan of action will have been created for each individual bridge that is monitored and updated on a regular basis by the Scour Engineer.

In the event of a flood, the inspection procedures are broken up into 5 steps.

- 1) During Event Inspection (general observations)
- 2) Follow-up Inspection (Specific impacts to bridge or surrounding channel)
- 3) Reporting (Identification of damage and repair needs)
- 4) Updating of Inventory Record (Changes in condition of bridge)
- 5) Updating of Bridge File (Reports, photos, soundings)

Kansas DOT

During any major flood event, a list of scour critical bridges is sent out to each Area Office affected by the flooding. It is their responsibility to monitor these structures during the event or follow the Plan of Action (POA) established for these structures. In the past, all the department could do is try and take soundings from the deck and monitor the visual lines of the structure for any scour effects during the event. Once the waters had recessed, inspectors could then go out and actually dive or wade as needed.

The department is currently in the process of purchasing a side scanning sonar system that will allow actually looking at what is actually going on underwater during the flood event.

Oklahoma DOT

Most span structures have had scour evaluations completed and plans of action (POA) developed where deemed necessary. NBI Item 113 for on-system structures has been "locked" so that a change in Item 113 requires a special inspection by the hydraulics engineer. Proposed changes are made by the field service engineer and documented in the bridge file. Scour inspections are made as per the scour POA for off-system structures and on-system structures are re-inspected as per notification from Scour Cast.

Idaho Transportation Department

During routine and underwater inspections inspectors check for scour. There are 235 scour critical bridges in Idaho. They are all in Bridge watch with their own plan of action (POA). Thresholds have been set where alerts are generated, such as a 25 year event or greater. Results are documented in Pontis with a scour smart flag.

Virginia DOT

A bridge's vulnerability to scour (coded in Federal Item 113) shall be initially determined through analysis by a hydraulic/foundation engineer and the design engineer of record. Once a structure has been placed into service, the lead inspector shall review Item 113 as a part of each inspection to determine if field conditions warrant a change.

Each scour critical bridge has a Plan of Action (POA). Until a scour critical bridge is retrofitted with a scour countermeasure, it is monitoring after each major event and during regular inspections.

Oregon DOT

ODOT uses a standard "Cross Channel" profile form that has an ongoing historical record of changes to the channel profile. The department also monitors the criticality by overlaying the cross channel profile with a plot of the bridge substructure in order to determine how close the streambed is to the bridge footings. Inspectors also assess the rate of change in the channel migration. They have evaluated each bridge over a waterway for scour potential, and have made a plan of action for each bridge that is scour critical. Bridges that have piling or piers in the water too deep to permit a wading inspection with a probe (water more than 2 ft deep or velocity greater than 2 ft/sec) are inspected by the ODOT underwater dive team at least every five years.

3. In-Depth and Fracture Critical Inspections

Please describe your state's processes for addressing in-depth and fracture-critical inspections

Illinois DOT

IDOT's use of the term In-Depth Inspection is typically used for inspection of major river bridges. Major river bridges are for the most part those that cross the Mississippi, Ohio, Wabash and Illinois Rivers. These in-depth inspections include more thorough documentation of deficiencies, such as steel section loss for example, with more detailed measurements, sketches, photographs and descriptions. The reports for these inspections often provide information useful in preliminary programming, load rating and repair plan preparation without the need for return trips to the site that would result in costly traffic control and public inconvenience. These inspections are performed at intervals not to exceed 24 months, but may be more frequent if required by IDOT policy, which may require a 12 month interval.

Illinois' current definition for a Fracture Critical Member is : A steel member in tension, or with a tension element, whose failure would probably cause a portion of or the entire bridge to collapse. Fracture Critical members are identified by the Central Bureau of Bridges and Structures through plan review. Fracture Critical inspections consist of a minimum of a visual inspection of all surfaces of each Fracture Critical member within arm's reach. Magnetic particle and dye penetrant testing are used as needed in suspect locations. Fracture Critical Inspection interval is a maximum of 24 months. A 12 month interval is required for bridges with a Fracture Critical Appraisal Rating of "4" or less or a history of fatigue crack formation. IDOT has a standard form for documentation of Fracture Critical Inspection information, methods and condition ratings. The forms are required to be reviewed and signed by the appropriate Program Manager, allowing for appropriate follow-up actions.

Tennessee DOT

During the 2003-04 inspection cycle, TDOT moved to a computerized reporting system for bridge records. Prior to this change, all bridge records were paper-based. With the electronic format, an In-depth inspection was standardized for all regular inspection. Therefore, the line between "routine inspections" and "In-depth inspections" does not really apply anymore. Fracture critical inspection plans have been prepared for all applicable bridges and are followed during the inspection process. In general, fracture critical inspections and regular inspection are performed at the same time. Occasionally, a separate FC inspection using non-destructive testing equipment will be performed by consulting engineering firms working for TDOT.

Caltrans

Caltrans has specially trained fracture critical inspectors who focus entirely on steel bridge inspections and non-destructive testing and remote monitoring. The Fracture Critical Team members utilize a variety of lift equipment, climbing and floating access equipment to get hands on with the key members. Caltrans also develops site-specific fracture critical inspection plans that identify all the relevant members and limits to be inspected. The plans also define any scheduled non-destructive testing requirements on the bridge.

Washington DOT

In-depth Inspections

Over the years, in-depth inspections have been conducted on bridges by inspectors. They do not have a standard form that is used for these findings to encapsulate these types of inspections into its own category identified as “In-Depth“. The need for an in-depth inspection generally arises as a result of a finding during a routine inspection. This would typically be rolled into the routine inspection report. If the inspection is going to take a considerable amount of time or be completed by another inspector an interim report would likely be created. If an inspection finding were to be found during a damage, flood or interim inspection it would typically be rolled into either a damage or interim report.

Fracture Critical Inspections:

Complete access is a key to completing an inspection in particular of any bridge considered to be fracture critical as defined in the CFR. A fracture critical inspection can be explained as inspection of fracture critical members conducted within an arm's reach. This type of inspection is to be conducted at least every 24 months. The bridge office uses several different types of equipment and procedures in order to attain arms reach to each and every fracture critical member on a given bridge. However, this is not limited to only fracture critical bridges but for any bridge deemed necessary for up-close inspection. Any bridge inspection could include the use of a UBIT, bucket truck, lift truck and/or climbing techniques for access to a bridge member.

Inspection procedures and report is another key to completing an inspection of any fracture critical bridge. The typical fracture critical bridge inspection frequency is set at 24 months. Each fracture critical bridge has a packet that includes a plan drawing of the structure with FCM's identified (typically in a PowerPoint document), unique inspection methods for different types of FCM's and a report broken down by individual FC member from the most recent FC inspection.

Training and education is another key to completing an inspection of any fracture critical bridge. The Washington State Department of Transportation has chosen to set a high standard for Team leaders within its staff of inspectors. A PE license is required by all team leaders. In addition, the office has required that the NHI Fracture Critical Inspection Techniques course be taken within a certain timeframe as well.

Kansas DOT

The department currently uses the term In-depth Inspection as the initial (new construction) or the inspection after a major repair has been completed.

The In-depth inspection is what Kansas calls a Routine Snooper Inspection. This type of inspection is very similar to a Fracture Critical Inspection. They take a hands-on approach to the details that they are concerned with. Both of these types of inspection require that a detailed report be completed listing all of the types of details or fracture critical members that were found on the structure. The report lists all findings and provides a list of the required actions. These reports are submitted to the Area and District Staff at the Area Review Meeting conducted once an entire Area is inspected. At the time, the details are worked out on who and what will be done to complete the repairs. Critical Findings are handled separately and timely.

All inspection frequencies for Fractural Critical Inspections are set at no more than two years. Any reduction in that frequency would be determined during the Office Review. All Fracture Critical structures are looked at routinely (not hands-on) annually. All inspection frequencies for

Routine Snooper Inspections are based on the actual findings and the frequency set during the Office Review. These can range from 8 years to 1 month pending on the severity. All Routine Snooper structures are looked at routinely (not hands-on) bi-annually as a minimum.

Oklahoma DOT

Some relevant language from Oklahoma includes:

Routine Inspection – Regularly scheduled inspections consisting of observations and/or measurements needed to determine the physical and functional condition of the bridge, to identify any changes from initial or previously recorded conditions, and to ensure that the structure continues to satisfy present service requirements. Routine and Fracture Critical Member inspections are to coincide on the same date. They are to be scheduled at 24 or 12 month frequencies.

Fracture Critical Member Inspection – A hands on inspection of a fracture critical member or member components that may include visual and other non-destructive evaluation. Routine and Fracture Critical Member inspections are to coincide on the same date. They are to be scheduled at 24 or 12 month frequencies.

“Other” Special Inspection – An inspection scheduled at the discretion of the bridge owner, used to monitor a particular known or suspected deficiency. “Other” Special Inspections are not to coincide with the Routine or Fracture Critical Member Inspections. “Other” Special Inspections are to be scheduled at 24 or 12 month frequencies.

Idaho Transportation Department

In-depth inspections that require the Under Bridge Inspection Truck (UBIT) or other equipment to get a closer look at bridge components. ITD has identified all F.C. bridges and their members. It has a special F.C. inspection reports and inspection procedures for each F.C. bridge. Frequency is no more than 24 months, but sometimes less. Findings and follow-up actions are documented in the inspection report with photos. These items are tracked in Pontis.

Virginia DOT

Fracture Critical Members

A fracture critical member is a metal member or element that is subjected to tension forces and whose failure would probably cause a portion of or the entire bridge to collapse. Bridges that contain fracture critical members are referred to as fracture critical bridges.

Fatigue and Fatigue Prone Details

Fatigue is the tendency of a member to fail at a stress level below its yield stress when subject to cyclical loading. Fatigue prone details are details meeting the AASHTO fatigue strength categories of C through F on bridges carrying interstate routes or other routes carrying 500 or more trucks per day.

Pin and Hanger Assemblies

During each scheduled inspection of the bridge, each pin and hanger assembly shall receive a hands-on inspection and each pin shall receive an ultrasonic inspection.

Fatigue Prone Details

Fatigue prone details shall receive a hands-on inspection of fatigue prone categories D, E, E' and F details during the initial and each subsequent regular inspection. Category C or C' details shall receive a close-up inspection during the initial and each subsequent regular inspection. Inspection folders are to include sketches showing the location of fatigue prone details and any specific details that are to be inspected. A statement about the condition of each fatigue prone detail or group of details shall be entered in the inspection report regardless of their condition.

Fracture Critical Members / Bridges

Fracture critical members are to receive a hands-on inspection during each inspection. Inspection folders are to include sketches showing the location of fracture critical members and any specific details that are to be inspected. A statement about the condition of each fracture critical member shall be entered in the inspection report regardless of their condition.

Oregon DOT

The CFR's define what a fracture critical member is, state that the inspection must be "Hands on" and give examples of systems that have fracture critical members . Oregon used the visual FC Level 1 inspections at least every 24 months, and FC Level 2 inspections at an extended frequency based on the details (welding vs bolted), loading, ADTT, condition (Pack Rust, Section Loss, Fatigue Smart Flags). Now that the 24 month frequency has been established for both, it may revisit how it conducts fracture critical inspections, although they will be "hands on". All of the bridges with fracture critical members have been identified, and a standard report format is used. The FC members are identified in red. The form lists the span, member, type of member, inspection method, surface prep, and inspector notes. The bridge specific FC and Underwater inspection report form will soon include specific procedures as to how the inspection is going to be accomplished.

4. How Risk Management is Incorporated into Inspections

How is risk management incorporated into your state's inspection processes?

Illinois DOT

The most notable method of risk management in inspection practices within Illinois is our extensive use of a FHWA approved policy allowing a 48 month inspection interval for bridges meeting certain criteria. The criteria includes items such as structure type, deck, superstructure and substructure condition rating, load capacity rating, vertical clearance, maximum span length, ADT, age, load path redundancy, Scour Critical Evaluation Rating and type of route carried. Although the criteria are extensive, Illinois has a large number of bridges that qualify and are inspected using the 48 month interval. This allows more resource availability for structures that are in less than good condition or do not otherwise meet the criteria.

Tennessee DOT

Risks may be managed in several ways. First, bridges that are prone to certain types of problems (fatigue cracking, scour, etc.) may be identified and closely monitored. Secondly, non-destructive technologies such as ultrasonic inspection, dye penetrant, side scan sonar, etc. may be used to supplement visual and tactile inspection methods. Thirdly, a regular program of bridge maintenance and bridge replacement can address problems before safety is compromised. Also, training of personnel must be kept up-to-date. Such a multi-pronged approach can produce an overall re-

duction of risk to the motoring public.

Caltrans

The CFR is fairly prescriptive with regard to the available latitude an agency can explore. Caltrans does utilize a four year inspection cycle on benign bridges that meet and established criteria. This criteria is reevaluated annually. It would like to see greater latitude afforded agencies so that they could take environmental, design type and use characteristics into consideration when setting frequencies. More latitude is also needed in setting the underwater inspection frequency.

Washington DOT

The Bridge Preservation office has incorporated the following practices in the area of risk management:

- Bridge pins considered either redundant or non-redundant will receive a UT inspection every 72 months based on a condition state 1(good) rating. All pins shall receive a visual inspection within arm's reach every 24 months. Any pin in condition state 2 or worse shall receive both a visual and a UT inspection at least every 24 months, more frequent as determined;
- The Bridge Preservation Office has FHWA approved criteria for inspecting bridges that qualify on a 48 month frequency. This criteria is based on condition ratings, scour criticality, load ratings, vertical clearances, ADT, and design type.
- The program manager for the state of Washington has established the frequency for inspection refresher training by all team leaders to be every 3 years.
- All team leaders within WSDOT shall meet the requirements of a program manager by being a licensed Professional Engineer in the state of Washington and have taken an approved comprehensive bridge inspection training course. The local agencies are allowed to follow one of the five options listed in CFR 650.309 under team leader.
- Short Span inspection Program – Short spans include the following provided the depth of fill (if present) is less than half the span opening and:
 - Timber with spans between 4 and 20 feet;
 - Concrete or steel with spans between 6 and 20 feet;
 - Steel corrugated pipes with an opening greater than 8 feet;
 - Multiple pipes with out-to-out dimension from 10 feet to 20 feet.

Kansas DOT

It doesn't have a systematic method for this. During all Office Reviews, the amount of risk does play a big factor in its decisions to determine what actions will be taken and when. It also plays a major role in the inspection frequencies we set.

Oklahoma DOT

It is currently revising its approach to assigning bridge inspection frequencies to a similar approach proposed by Parr, Connor, and Bowman in "Proposed Method for Determining the Interval for Hands-on Inspection of Steel Bridges with Fracture Critical Members". This revision, if adopted, will hopefully help ODOT focus its inspection efforts more on our at-risk population of structures rather than evenly across the spectrum of structures.

Idaho Transportation Department

ITD has used a risk based approach in handling bridges over water with unknown foundations. Bridges with poor waterway adequacy and channel protection, long detour lengths and high ADTs are considered high risk and are put into its Bridge Watch system with their POAs. Bridges with good waterway adequacy and channel protection or low ADTs and shorter detour lengths are low to medium risk and are monitored with routine inspections.

Virginia DOT

Risk management is incorporated in the policy and procedures by addressing the frequency of inspections (12 months or less for certain type of inspections and general condition rating of 4 or less) as noted under frequency of inspections), level of inspections and special category inspections (pin and hanger assemblies, fatigue prone details, fracture critical members/bridges, and underwater), critical recommendations, scour critical structures (plan of actions for each scour critical bridge), and posting requirements.

Oregon DOT

Our Senior Mechanical Engineer works closely with our bridge inspectors so that they are thoroughly trained on the details that are of concern and the deterioration that is associated with those details. The department has attempted to have an inspection frequency that matches the risk, but have not had success in gaining any flexibility from the national standards. By looking at the details, truck volumes, the minimum size of defect that is visible, and the possibility that the defect is not noted on an inspection; there are bridges that could have in-depth inspections on greater intervals. This would allow it to use its inspection resources where they are most needed.

5. Execution of Inspection Frequencies in the Agency

Please describe your agency's inspection frequencies.

Illinois

Illinois has a policy with criteria requiring a 12 month inspection interval for bridges with:

- Superstructure, Substructure or Culvert condition rating of 4 or less;
- Appraisal rating for Structural Evaluation is 3 or less;
- A posted weight limit or restriction to legal loads only.

The 12 month interval is only required for state maintained bridges, but may be used by a local agency program manager as well. However, IDOT may require a 12 month interval for a local agency bridge if determined necessary from an inspection to determine safe load carrying capacity.

Criteria for inspection intervals greater than 24 months are as described in the previous question.

Inspection interval and automated checks of data for determining appropriate inspection interval are tracked and handled by the Illinois Structure Information System database.

Tennessee DOT

While the layman may suppose that simply producing a schedule of inspections and following it will keep an agency on-schedule, the reality is far different. Such an approach is hampered by

numerous factors (weather, equipment breakdowns, man-power shortages, etc.) that are often outside of human control. Therefore, to stay on schedule requires constant monitoring of the schedule. TDOT produces monthly reports that are distributed statewide. These reports not only show any bridge that falls behind schedule but also shows bridges that are coming due for inspection. The report both monitors the schedule and serves a planning function.

Caltrans

Chasing inspection dates is an ongoing part of the bridge inspection business. Staffing, access, additional demands, traffic, working with the railroads etc. can all challenge our ability to complete 100% inspection on time.

Washington DOT

The office has recently made some adjustments to address and ensure full compliance with metric number 6, 7, 8, 9, 10 and 11. Three positions of differing duties triangulate and converge on a list of structures due in a given year. These positions consist of a Database Specialist, Regional Bridge Inspection Supervisor and a Lead Inspector/Scheduler. Once a list is established, efforts are made to coordinate and schedule those specific bridges requiring specialized equipment using a computer program that has been developed in-house. The program is connected with the inventory database allowing access to information helpful for scheduling purposes. The typical "Routine inspection" that doesn't require specialized equipment is left to the Regional Bridge Inspection Supervisor and subordinate team leaders to identify and coordinate inspection trips with the Scheduler. Each month a report is generated for review by management that shows the overall inspection status for the office. This report has evolved over the years to the level that it is accessible for all staff to see the current "live" status of the overall inspection program. The report is divided into sections that show routine inspections and UBIT inspections status separately. For each month in one table the report displays the total number of bridge inspections due in a given month, the total number of bridge inspections scheduled, total number of bridge inspections not yet started, the total in process and the total completed.

Kansas DOT

The field inspectors (always a two man team) begin the process by making a request for a finding to receive a comprehensive Office Review. All inspections are reviewed in the Office; the Area Reviewer can also make the same formal review request for any finding during the review process.

The formal Office Review consists of a team that looks at the problem and determines what actions are needed and sets frequencies and develops a Plan of Action (POA.) Sometimes during the Area Review Meeting with District Staff, problems that should have received a formal Office Review are found and decisions are made at that time. All frequency changes are updated in the database. Reports are completed after every Area's Inspection data is entered. These reports check that all required inspections have been completed for that particular area. At the end of each year, we again run several different reports that verify that all inspections were completed and data updated.

Oklahoma DOT

Currently inspection frequencies are established by engineering judgment, fatigue analysis, policy, or a combination of the three for inspection frequencies ≤ 24 months. For routine inspection frequencies >24 months, documentation supporting a frequency greater than 24 months must be

submitted and approved through ODOT and FHWA. Currently only off-system bridges are eligible for decreased frequencies routine inspections.

Idaho Transportation Department

If structural items are rated a 4 or less, if operating rating is less than 28 tons, if the bridge is posted or should be posted, then inspections don't go past 24 months.

Virginia DOT

Twelve months or less for both NBI and non-NBI if :

- Redundant pin and hanger bridges with evidence of problems such as frozen hanger bars or other questionable conditions;
- Non-redundant pin and hanger bridges;
- Structures that have a restricted weight limit;
- Structures having a general condition rating of 4 or less on one or more of the following: Deck; Superstructure; Substructure;
- Concrete structures where the reinforcing details are unknown;
- Bridges with fracture critical members.

Oregon DOT

We do not have any bridges on a routine inspection schedule that exceeds 24 months. The criteria for a bridge to be on a 12 month inspection cycle are: NBI 3 or less for NBI items 58 thru 62, NBI 2 or less for NBI Item 113; a primary structural element in the lowest condition state that is affecting load capacity, temporary repairs in poor condition, or a rating factor less than .8 for a legal truck configuration. We have used frequencies of less than 12 months to monitor specific structural deficiencies such as settlement which contributed to excessive concrete cracking. We have the inspection frequency in Pontis and track it like any other routine inspection.

6. How to Implement a Uniform and Comprehensive Bridge Inspection Policy

How do you implement a uniform and comprehensive bridge inspection policy?

Illinois DOT

IDOT's inspection policies are contained in the Inspection section of the Structural Services Manual. This includes policy on inspection types and methods, intervals, inspector qualifications, QC/QA etc. Specific requirements for Program Manager and Team Leader qualifications, certifications, training, experience and refresher training are included. Criteria for assigning and recording bridge condition ratings and recording bridge inventory information are contained in IDOT's Structure Information and Procedure Manual, which is Illinois' expanded version of the Coding Guide.

IDOT policy requires refresher training for Program Managers and Team Leaders every 60 months. Refresher training is provided through the 3-day NHI Bridge Inspection Refresher Training class and an IDOT specific 2-day "Calibration Class". The Calibration Class was developed for more efficient refresher training aimed at achieving consistent assignment of condition ratings to bridge components using IDOT's Structure Information and Procedure Manual.

Program Managers are responsible for the bridge inventory data for the bridges that are their responsibility. They are responsible for QC of the data and QC of Team Leader procedures and results for those Team Leaders performing inspections under their direction. Maintaining highly accurate bridge inventory information is certainly a challenge and an area with some room for improvement nationwide. QA is performed by IDOT on bridge data and District and local agency inspection programs, but benefit could certainly be realized with expanded QA resources.

Tennessee DOT

There are two aspects to this question: National policy and Agency policy. On the National level, the regulations and guidelines promulgated by the Federal Highway Administration help provide a uniform and comprehensive policy. However, these National guidelines are, of necessity, too broad to cover the "nuts and bolts" details of doing the job. Therefore, each agency needs to develop a written Bridge Inspection Procedures Manual that starts with the National (NBI) policies but expands to cover the implementation details for the agency. TDOT does have such a manual which is distributed to all inspection teams and which is updated as necessary. In addition, TDOT has an inspection "WorkFlow" procedure which allows inspection information to be saved to a document management system and then be channel through an independent review process.

Caltrans

This is a constant challenge for an agency the size of Caltrans doing inspections out of multiple inspection offices. We try to provide consistent training, manual and procedures. Communication among the inspection staff is one key aspect that make an inspection organization consistent. We foster this communication through monthly meetings with inspectors and annual inspection training of all inspectors together. Quality reviews up the management chain as well as our formal QA unit help to identify practices or activities that are not consistent with established inspection policy. We try to have our supervisors go out in the field with our staff regularly to make sure things are being done appropriately.

Washington DOT

The state of Washington has a bridge inspection manual (WSBIM) that is managed and updated by a Bridge Inspection Committee (BIC) made up of State and Local Agency representatives. The manual includes the requirements, procedures and practices that are to be followed by an inspection staff working within the state of Washington.

The opening chapter of the WSBIM addresses the organization of the inspection program. The final chapter addresses bridge inspection program personnel qualifications and certifications for program manager, team leader, load rater, and divers and the training, experience and continuing education requirements for these positions. This final chapter also defines the roles and procedures of a Quality Control (QC) and Quality Assurance (QA) program.

The state of Washington has chosen to develop its own FHWA approved two-week inspection as an option for state and local agency inspectors alike to attend. In addition, updates classes are held separately for both local agencies and the Bridge Preservation Office. Other various NHI courses are offered to inspectors based on frequency of need that is established in the continuing education requirement section of the manual. An example is that the Inspection Refresher Training course (FHWA-NHI-130053) is required for Team Leaders and Program Managers every 3 years.

QC/QA procedures include the review of staff qualifications, bridge files, load ratings, inspection status reports and procedures. These are employed to ensure data quality and integrity.

For the Bridge Preservation Office within the WSDOT, an annual quality assurance report is prepared for the state program manager that summarizes the findings and recommendations of the work completed by the Bridge Preservation Office. A presentation is delivered to the inspection staff that illustrates these findings and recommendations.

For the Local Agencies, any particular agency will be reviewed once every three years. The results are discussed with each agency followed up with a formal letter summarizing the review.

Kansas DOT

Kansas DOT has compiled a Bridge Inspection Manual and a Bridge Management Policy and Procedure Manual that defines the requirements for the bridge inspection program and provides QC/QA procedures on how to properly maintain it.

Local Bridge Inspections are handled by the Bureau of Local Projects. They too have compiled a Bridge Inspection Manual and a Bridge Management Policy and Procedure Manual that defines the requirements for the bridge inspection program and provides QC/QA procedures on how to properly maintain it. They also have teams of inspectors that complete Quality Assurance checks on these inspections.

Oklahoma DOT

The bridge inspection program is implemented via the Pontis Bridge Inspection Manual and in contract. All requirements are documented in these two locations. This information is revised every two years to incorporate changes and streamline the inspection process. QC/QA is also a contractual part of the inspection process. All inspectors, program managers, and load raters must participate in and attend the annual ODOT QC/QA program. Inspectors must participate in field inspection exercises and load raters must participate in load rating exercises.

Idaho Transportation Department

ITD formalized a written QA/QC policy. It is in compliance with NBIS as far as all bridge inspection personnel. It does continuing education at least once every four years. It doesn't specifically provide training to other bridge owners. The department does field reviews and office reviews of all inspectors.

Virginia DOT

Policy Instructional and Informational Memorandums (IIM): IIM-S&B-27 (Bridge Safety Inspections), IIM-S&B-86 (Load Rating and Posting of Structures (Bridges and Culverts)), IIM-S&B-78 (Establishing Quality Control and Quality Assurance Procedures to Maintain a High Degree of Accuracy and Consistency in the Inspection Program), and IIM-S&B-35 (Restricted Structures Atlas).

Oregon DOT

Oregon has a detailed Bridge Inspection Coding Guide. The way to increase the quality of the bridge inspection program is to reduce variation. Visual inspection can be subjective, and the definitions in the NBI and Element Coding Guide are not specific enough in themselves to reduce variation to an acceptable level. ODOT elected to keep all condition state and NBI rating criteria wording as presented, but have provided supplemental information that is detailed and not subjective. The Bridge Inspection Coding Guide is very specific on how to code deterioration for both the NBI and element level portions of the inspection report. It also has a control group of bridges that are used to test the inspectors' knowledge of the Bridge Inspection Coding Guide. If a certified bridge inspector does not know the Bridge Inspection Coding Guide, the chances of passing the control group of bridges is very small. For training, it holds the Pacific NW Bridge Inspection Conference, and NHI classes.

The department conducts a yearly QA review on each bridge inspector in the five regions, and the seven areas where consultants inspect local agency bridges. The NBI ratings need to be within 1, the element list needs to be exact, and the element condition states need to be within 1. If there is an average of 4 or more errors per bridge, then additional training is needed or recertification is in order. The program managers and bridge inspectors all meet the requirements that are outlined in the CFR's.

7. Inspection Access Challenges and Equipment to Provide Access

What significant inspection access challenges do you face and how do you address them?

Illinois DOT

The major accessibility issues concerning bridge inspections are access over railroads; access above, below and along side of power lines; access between deep girders with wind bracing; access where a manlift over 90 ft is required because of lane width constraints and structural inspections where underwater diving is required.

Currently the department has seven inspection cranes with under bridge reaches of 30 to 60 feet; a 60 foot lift; several bucket trucks; one boat for sonar scans on the major rivers and several small flat boats.

The department is limited in staffing and they are only trained to operate the above equipment. The department utilizes consultants / contractors trained in climbing and repelling techniques and underwater diving to help access these difficult areas.

Tennessee DOT

Tennessee is fairly well equipped to provide bridge access. The department has a total of seven under-bridge trucks with reach lengths of 30, 50 and 62 feet. Each region is also equipped with boats, ladders, and other equipment to conduct inspections. Often, the most difficult part of the process is to arrange for traffic control and lane closures so that the under-bridge trucks can be effectively used. Maintenance of the trucks and training for the operators are also challenges that must be continually met.

Caltrans

Caltrans is challenged with inspection access on fracture critical bridge on a regular basis. Common challenges are: high cross slope or grades limiting our Under Bridge Inspection Truck (UBIT) use, access over water requiring lifts from the water level, floor beams on truss structures that we cannot thread our UBIT through and inspection access on low load rated bridges that we cannot access from on the bridge or below the bridge.

Washington DOT

The WSDOT Bridge Preservation office itself owns four UBIT's (one UB30, two UB50's & one UB60), two bucket trucks, and a vertical lift truck. There are many more bucket trucks available to it across the state when coordinated. When necessary the office will rent a platform lift (genie lift) to reach heights inaccessible by available bucket trucks. There is one deck truss in our system that cannot be reached full depth with a UBIT that we employ our climbing team to complete.

Kansas DOT

The department generally doesn't have these types of problems. Its structures can usually be inspected by the use of a lift truck or snooper. It has two snoopers, a UB60 Aspen Aerial and a Mark II Snooper. It has only two structures that require special needs for, one which is climbed and the other accessed through a rented special lift truck.

Oklahoma DOT

Inspection access is gained via ground, snooper, snooper platform, or rope access. All forms of access are available in-house.

Idaho Transportation Department

Inspection and traffic control involving railroad companies. Access openings in closed web box girder bridges with confined space. Steep embankments. ITD uses a UBIT. It also uses bucket trucks, man lift trucks, platform trucks and ladders. It hires consultants for climbing.

Virginia DOT

The department typically uses ladders, bucket vans, bridge platform trailers, bridge snoopers or bridge masters. Underwater diving equipment is used as required for depth of water.

Oregon DOT

It recently had a local agency bridge built that has some special challenges. Provisions were made to inspect the tied arch, but the approach spans have confined spaces that the department would rather not have. Of most concern is that the cables in the tied arch are in a configuration where inspectors can't inspect the fracture critical floor beams, and it is expensive to use barges and lifts to accomplish the inspections. The department contracts the climbing inspections on major bridges. Freight mobility challenges are pushing some inspections to the night work. Performing inspections of railroads is always a challenge.

The department currently has three UBIT vehicles, the smallest of which is from the early 1980's. It is pursuing an intergovernmental agreement with a local agency so that it can use their agency's

light weight UBIT on bridges that are narrow or are weight restricted.

8. The Effective Use of Monitoring Systems in Bridge Inspection

Please describe your agency's use of bridge monitoring systems.

Illinois DOT

Examples of monitoring systems used by IDOT include:

- A bridge experiencing relatively rapid settlement and movement due to mine subsidence was equipped with tilt meters and vibrating wire sensors used to detect pier and abutment movement and tilt, beam movement and rotation and change in beam to substructure cap distances indicating loss of bearing. A data logger, solar panel, backup battery system and cell phone modem were part of the system used for analyzing data and sending automatic notifications when thresholds were exceeded.
- A bridge with a steel box tension member with a longitudinally cracked corner weld was equipped with sensors at the crack tips to monitor for crack propagation. The sensors were activated by loss of vacuum within the sensor. A data logger, solar panel, backup battery system and cell phone modem were also used with this system.

It should be noted that both of these systems required a significant amount of attention when false alarms were received from the systems for various reasons.

A cable stayed bridge has one-fourth of the cables equipped with an acoustic monitoring system for detection of wire breaks within the cables. A data logger transmits data via cell phone to an offsite facility that filters and sorts the data into various categories including wire break, possible wire break, test impacts and other events/noise. Based on signal strength from sensors at various locations, the system can also provide approximate location along the cable of a wire break or other event. This system includes a service contract, but has not been overly problematic or required excessive amounts of attention.

Commonly used types of non-destructive evaluation and testing used by IDOT include dye penetrant and magnetic particle testing, which are fairly reliable. Infrared imaging and ground penetrating radar (GPR) are sometimes used on bridge decks and have produced mixed results. Less commonly used NDT methods include: Brinell hardness testing of steel, impact echo, rebound hammer (concrete hardness), half-cell potential, chloride sampling and corrosion rate measurement in reinforcement. IDOT recently purchased an infrared camera for easy, rapid detection of concrete delaminations, but it does not appear to be giving good results. The department anticipates side by side testing with a FHWA camera to see if the problem is with our specific type of camera.

Tennessee DOT

The only real-time monitoring system regularly used by Tennessee is that provided by Bridge-Watch for Scour Critical / Unknown Foundation bridges. Tennessee has experimented with stress / strain measuring systems and scour detection systems but they are not used on a routine basis. Given the current cost of these systems, they may not be cost-effective for routine monitoring of bridges but they could prove useful for large, important structures that constitute vital links in high traffic zones. This is an area of future interest for TDOT.

Caltrans

Caltrans has been using more and more monitoring systems. It has been using acoustic testing for crack monitoring and sound triangulation, displacement monitoring to evaluate repair effectiveness, it has a significant number of accelerometers to monitor seismic activity and of course strain in load or fatigue situations. In the hydraulic area, it uses stream gauges, tilt meters and scour float outs to actively monitor bridges of concern.

Caltrans is currently installing a significant "sentry" system to monitor for potential steel cracks on a large bridge in California. The department sees this area of business growing substantially moving forward as the technology is better understood and appropriately selected and used.

Washington DOT

BridgeWatch collects and processes real-time data at regular intervals from weather and hydrologic sources, meters and gauges, and other sensing devices. Data comparisons are then performed with internal client bridge databases to alert, when appropriate, critical personnel via any electronic medium (cell phones, pagers, email, fax, etc.) when bridges are experiencing a dangerous or critical event. <http://www.usengineeringsolutions.com/solutions/bridgewatch/> The system has been in place for a year now and shows promise, however, the effectiveness of this system has yet to be established due to the length of time required to dial in key criteria at each bridge site so that the alerts received are correct and meaningful.

Bridge Pin ultrasonic testing - Bridge pins are tested ultrasonically every 72 months. This applies to those pins considered to be in a good state of condition (CS1). Any other condition state and those pins will be ultrasonically tested at a frequency of 24 months or less.

Dye-penetrant – Steel members are tested on an as needed basis. It is effective, however, influenced by environmental and human factors.

Magnetic Particle testing: Used on steel members on an as-needed basis. Pretty effective but limited by geometry and location of flaws in tight corners.

Crack Monitors – cheap and effective for monitoring crack growth in critical areas over time.

Survey – traditional surveying of points on a bridge that establish whether settlement is occurring. This has been effective in monitoring vertical movement on the Alaskan Way Viaduct in Seattle.

Scratch plate “tattle tales” for monitoring movement. We’ve had occasional problems keeping them in place.

Slope inclinometers - used on small number of bridges over the years.

Tilt meters (Simpson) - used on small number of bridges over the years.

3-D Terrestrial Laser Scanning – WSDOT GeoMetrix Office uses 3-D Terrestrial Laser Scanning technology to produce very accurate, very dense 3-dimensional digital data sets (called "point clouds") used for CAD mapping. This technology is a fast, safe, and efficient way to model and measure many areas where it can provide advantages over traditional survey or photogrammetric

methods. The WSDOT GeoMetrix Office Photogrammetry & Remote Sensing Branch and Geodetic Survey Branch are highly skilled and experienced in this advanced technology. The Geodetic Survey crew scans the project while the Photogrammetry staff processes the data to the final 3D CAD deliverables. This is an expensive option but has a use when necessary.

<http://www.wsdot.wa.gov/Mapsdata/Photogrammetry/3DTL.htm>

Video Deck Program – Use of video cameras mounted to a van to perform bridge deck inspections. The video cameras are contained in a specially designed vehicle that takes digital images of the bridge deck, with each image covering an area roughly the width of a lane, 3.8 m wide (12.5 ft) by 8.04 m long (26.4 ft). Hairline cracks are the smallest crack size that can be detected in the final processed digital images. After reviewing the video images, signs of distress such as open cracks and spalling in the deck surface or superstructure are triggers for conducting a more in-depth inspection of the deck. The benefits of the technology include savings on manpower and equipment, improved quality of inspections with less impact from weather conditions, and reduced impact to the traveling public. The video technology also limits the exposure of bridge inspectors to hazardous traffic conditions.

Kansas DOT

We have only used strain gauges at this time. They work well.

Oklahoma DOT

Currently the only monitoring system employed by ODOT is Scour Cast (Scour Cast is currently operational, but development is ongoing). Various methods of non-destructive testing (NDT) are employed during inspections (GPR, Mag Particle, D-Meters, etc.), but only "impact sounding" is routinely employed.

Idaho DOT

ITD uses Bridge Watch, a web-based application to monitor our scour critical bridges. Bridge Watch uses real-time weather data i.e. national weather service, USGS stream gage data, and Snotel. Alerts are issued to responders at user-determined thresholds via email, fax and cell phone. Plans of actions for each bridge are stored in the system.

Virginia DOT

Ultrasonic inspection of pins (Pin and Hanger Assemblies) at each scheduled inspection. Magnetic particle for accessing cracking of steel structures as needed. Dye penetrant as needed to assess cracking of steel structures. Looking at health monitoring of several major structures.

Oregon DOT

Oregon has developed software that helps identify bridges of concern for scour due to rainfall events. It uses bridge inventory information and input from flow gauges, rainfall stations, and NEXRAD to determine if there is a 10-year flow event. The system automatically sends email and text messages to selected recipients. Those recipients can then use email to get the Scour Plan of Action, a status on the rain flow data inputs, and lists of scour critical bridges. There is a back-up system, and if the back-up system fails then those who developed the system are notified and they can manually provide the information. The department has shared this system with

Alaska and they are developing a similar system. The Senior Hydraulics Engineer is John Woodroof.

Oregon has nine bridges with Structural Health Monitoring Systems. They have monitored piers of a Bascule Span bridge for movement for the last 10 years, It also has used SHM on cracked concrete bridges to see how crack widths vary with temperature and loading, and also to measure strain in the reinforcement. One was a two girder bridge with significant shear cracks that was restricted for load and programmed for replacement. SHM has been used in a vertical lift span to measure tilt changes and drive performance, and a swing span to measure bearing and drive performance and need for lubrication.

Session 6C – Group Reports from Session 5C

Sessions 5C and 6C were focused upon discussing various priority issues for bridge preservation. The following combines summaries of the key findings from each of the four pairs of breakout groups (two groups for decks, two for superstructures, etc.)

Program Management Strategies for Bridge Preservation

Discussion Highlights

- Wide variation in approaches between states when considering “worst first” vs. preservation
- Environmental issues often control decisions
- Need upper management buy-in, better understanding of the future benefits of preservation and a steady stream of funding

Notable Practices

- Preventive treatments used: washing, joint maintenance, thin overlays, sealers
- Rehabilitation actions used: LMC overlays, microsilica, polyester concrete

Action Items

- Proposed research: quantify performance measures; minimize variables
- Need outreach to cities and counties
- Educate the public to benefits and costs of preservation
- Need to promote dedicated funding for preservation

Deck Preservation

Discussion Highlights

- Some states use state funds only for deck preservation to avoid federal regulations
- Cleaning (washing) of decks is a good idea but environmental regulations sometimes make it problematic
- Common deck preservation actions include
 - Sealers are effective if concrete is in good condition; several states have systematic sealing programs:
 - Illinois seals decks every five years
 - Montana and North Dakota use HMWM to fill cracks
 - Missouri uses asphalt based crack sealer with good results
 - Epoxy overlays are also an effective solution on decks if applied before significant problems develop
 - Decks with delaminations should have surface removed and replaced with latex modified or silica fume concrete
- Deck joints
 - Most joints fail due to incorrect installation
 - Elimination of joints using integral abutments is best
 - Experiences with types of joints
 - Montana has success with silicone (self-leveling) seals
 - Missouri and Illinois have had less success with silicone seals; prefers strip seals
 - Joint systems with bolt down elements exhibit problems with anchorages

Notable Practices

- Methods to determine deck conditions
 - Montana investigates whole corridors
 - Screen by deck rating first and then test for chloride, etc.
- North Carolina uses mechanical removal and then hydro removal for ¼” profile
- Montana uses mechanical removal instead of hydro removal due to cost reasons
- Minnesota and Wisconsin have ongoing studies on sealers
- WJE guidance on selection of bridge deck overlays (NCHRP Project 20-07, Task 234)

Action Items

- Develop and follow a maintenance plan for each bridge
- Investigate loosening of environmental restrictions that impede washing of decks
- Investigate short term (~ 2years) warranties for deck joints
- Proposed research:
 - Additional deck thickness for extended life
 - Effectiveness of deck curing practices versus sealers

Superstructure Preservation

Discussion Highlights

- Bridge cleaning methodologies (pressure washing, flushing, vacuuming, do-nothing) and environmental issues
- Coatings and surface preparation needs to be designed for each structure (one size does not fit all)
- Use of cathodic protection worked but due to lost expertise and maintenance intensity is not commonly used
- Leaking joints causing deterioration of beam ends – all types of beams
- Graffiti eradication
- Beam damage from over-height loads

Notable Practices

- Regular bridge cleaning - work with environmental agency prior and use of local fire departments to wash decks
- Use of epoxy coated reinforcing steel
- Increased depth of cover for reinforcing steel
- Product/Process Champion must train and develop successors (Succession Planning) or change your standards/accepted practices
- Pre-painting steel repair and cleaning work/contract
- Bearings – NYSDOT replaces short rockers with elastomeric bearings
- Beam ends
 - NYSDOT supplements web section with steel box section as a post
 - Iowa DOT repairs/patches/rehabs pre-stress concrete beam ends
 - NYSDOT has a steel beam end painting program
- Fatigues issues – Nevada and Iowa DOTs have in-house programs for rehabilitation projects
- Washing – Iowa DOT does washing; Nevada faces environmental regulation issues

Action Items

- Develop bridge cleaning guidelines and environmental best practices
- Field testing for steel surface preparation cleanliness (free from chlorides)
- Develop a dependable joint system that does not leak
- Polyurea (pickup truck bed liner material) or other materials for beam ends, pier caps, and bridge seats
- Design bridges coating system at joints and over lanes as “marine environment”
- Investigate interagency coordination to minimize problems with environmental restrictions on washing and painting - document costs of failure to act
- Research needed – better communication of best practices; quicker process of getting a product on approved product lists
- Publicize best practices on beam end preservation and rehab

Substructure Preservation

Discussion Highlights

- Timber piles exposed by scour and then rotted out by shipworms
- Concrete encased piles where loss of concrete exposes steel to corrosion
- Riprap size for scour protection
- Restrictions on use of creosote for timber pile repair

Notable Practices

- Using high performance concrete
- Carbon fiber wrap for pile repairs; thermographic imaging for quality control
- Use of hockey puck anodes for control of corrosion around repairs
- Galvanizing or metallizing for corrosion control
- Silica fume concrete, low permeability concrete, 3 to 4 inches of cover over reinforcing steel

Action Items

- Succession planning to avoid loss of agency knowledge and skills
- Repair effectiveness depends greatly on quality of workmanship
- Research on direct determination of material loss
- Develop nondestructive testing technology for checking condition of concrete behind carbon wraps

Peer Exchange Sessions – Format and Process

The following was the format and process used to plan the Preservation peer exchange that was held in sessions 5C and 6C.

- Session 5C (8:00 am – 9:45 am) to conduct the peer exchanges.
- Session 6C (10:15 – 12:00 noon) for the report out by the group facilitators.
 - Each facilitator will be allowed up to 10 minutes to report on their group’s discussion. Q and A are done at the end of each report.
- The following four broad topics will be covered during the peer exchanges:
 1. Deck Preservation Techniques & Strategies
 2. Superstructure Preservation Techniques & Strategies
 3. Substructure Preservation Techniques & Strategies
 4. Bridge Preservation Program Management
- The session participants will be divided into eight groups. Each group will cover one of the topics shown in the following table:

Group 1: Deck Preservation Techniques & Strategies	Group 2: Superstructure Preservation Techniques & Strategies	Group 3: Substructure Preservation Techniques & Strategies	Group 4: Bridge Preservation Techniques & Strategies
Group 5: Deck Preservation Techniques & Strategies	Group 6: Superstructure Preservation Techniques & Strategies	Group 7: Substructure Preservation Techniques & Strategies	Group 8: Bridge Preservation Techniques & Strategies

- Each group will consist of 8 – 10 participants per table depending on the size of the audience
- Each group will have a facilitator to lead and facilitate the discussion.
- Each group will have a scribe to document key discussion points and action items.
- Each group will have a flip chart and markers.
- Suggested discussion items and leading questions are provided in appendix 1 for each of the four topics.
- A report template is provided in appendix 2 for use by the Scribes and facilitators.

Group Facilitator Duties

1. Lead the group in discussion.
2. Ensure that the discussion stays within the current topic.
3. Each Facilitator will provide a summary of their respective group's discussion during the report out session (session 6C). Following are suggested format of the information to be provided during the report out:
 - a. Introduce self and the group participants
 - b. Introduce the topic discussed (Deck, or Superstructure, or Substructure, or Preservation Techniques & Strategies)
 - c. Provide an overview of the main items discussed
 - d. Provide information on the notable and best practices being used
 - e. Provide information on the action items generated by the group (i.e., need for research topics, synthesis, clarifications, technical assistance, etc)

Group Scribe Duties

1. Record bulleted items of the main points of the discussions
2. Record best practices
3. Record action items generated by the group

Session Questions and Topics

Topic 1 - Deck Preservation Techniques & Strategies

Suggested discussion items:

1. Deck Joints
2. Deck Seals and Overlays
3. Cathodic Protection
4. Design details & Specifications
5. Cleaning and drainage
6. Deck Evaluation & Scoping

Suggested leading questions:

Specific maintenance/preservation actions – what works and what doesn't for:

1. Deck Joints
2. Deck Seals and Overlays
3. Concrete Surface Repairs for Decks
4. Crack Sealing
5. Bridge Washing
6. Methods being used to scope deck preservation work for contract.
7. What products are being used
8. What specifications are being used
9. What design details, materials, specifications are working well that support extending service life of bridges, i.e. joint elimination, high performance materials, policies, etc
10. What manuals, guides, policies, are being used or needed by maintenance crews. Are these documents available to share with other practitioners, if so where can they be found?
11. What suggestions do you have to preserve or improve the condition of the bridge inventory?
12. What specific Research Needs Statement would you like to suggest for this topic?
13. What action register items do you want to include for this topic?

Topic 2 - Superstructure Preservation Techniques & Strategies

Suggested discussion items:

1. Painting (Spot, Partial, Complete)
2. Retrofit, Repairs, Rehab of damaged elements
3. Bearings
4. Cathodic Protection
5. Design details & Specifications
6. Cleaning
7. Superstructure Evaluation & Scoping

Suggested leading questions:

Specific maintenance/preservation actions – what works and what doesn't

1. What routine or preventive maintenance, or repairs that are working well for you and why? Conversely, what does not work well?
2. What criteria, strategies, materials is being used for:
 - a. partial painting (beam ends)
 - b. maintenance or spot painting
 - c. complete painting
3. What is the state of the practice on retrofitting of fatigue prone details and fracture critical members?
4. What is the state of the practice on retrofitting of damaged concrete, steel, timber elements?
5. Methods being used to scope superstructure preservation work for contract.
6. How bridge underclearance issues are being resolved by your state?
7. What guidance, manuals, policies, etc, are being used? Are these documents available to share with other practitioners, if so where can they be found?
8. What is the state of the practice on maintaining bearings?
9. What is the state of the practice on cleaning superstructure elements?
10. What suggestions do you have to preserve or improve the condition of the bridge inventory?
11. What specific Research Needs Statement would you like to suggest for this topic?
12. What action register items do you want to include for this topic?

Topic 3 - Substructure Preservation Techniques & Strategies

Suggested discussion items:

1. Retrofit, Repairs, Rehab of damaged elements
2. Scour Protections and mitigations
3. Design details & Specifications
4. Substructure Evaluation & Scoping

Suggested leading questions:

Specific maintenance/preservation actions – what works and what doesn't

1. Methods being used to scope substructure preservation work for contract.
2. What routine or preventive maintenance, or repairs that are working well for you and why? Conversely, what does not work well?
3. What specific scour related issues are you faced with and what are some of the mitigation techniques/strategies have you implemented?
4. What are some of the underwater repair techniques that you have had success?
5. Concrete repairs
6. What design details, materials, specifications are working well that support extending service life of bridges, i.e. use cathodic protection/prevention techniques?
7. What are some of the techniques you have used for stabilizing/correcting settlement?
8. What suggestions do you have to preserve or improve the condition of the bridge inventory?
9. What specific Research Needs Statement would you like to suggest for this topic?
10. What action register items do you want to include for this topic?

Topic 4 - Bridge Preservation Program Management

Suggested discussion items:

1. Data collection and management
2. Funding
3. Performance Measures
4. Contracts management

Suggested leading questions:

1. How do you transition from doing "worst first" to a planned Preventive Maintenance strategy?
2. How do you get out of the mindset of "doing the same thing and expecting different results?"
3. When do you "let a bridge go?" Should PM be done on a bridge that is slated for replacement?
4. How can you gain upper management support in making this transition?
5. How do you get your "rank-and-file" maintenance employees on board with this strategy?
6. What kind of data should be used to support this transition?
7. What bridge preservation related performance measures are being used and what potential bridge preservation related performance measures should be implemented?
8. How are you tracking your bridge preservation performance?
9. Where should decisions for activities be made (locally or centrally or both?)
10. What tools are used to make decisions?
11. Should training be part of the program and if so, what kind of training?
12. What tools are needed to facilitate achieving preservation program goals and objectives?
13. How do you balance the preventive maintenance, rehabilitation, and replacement needs? How funding is established under each category?
14. What preservation activities provide the largest return (extending service bridge life)?
15. What suggestions do you have to preserve or improve the condition of the bridge inventory?
16. What specific Research Needs Statement would you like to suggest for this topic?
17. What action register items do you want to include for this topic?

Report Template

Peer Exchange Discussion – Report Template

Group number:	Discussion topic:
Discussion Highlights (<i>note main discussion items</i>) <ul style="list-style-type: none">•	
Notable Practices (<i>Note practices, strategies, policies, products, etc that are working well</i>) <ul style="list-style-type: none">•	
Action Items (<i>Note recommendations for research, leadership, communication, facilitation, technical assistance, etc</i>) <ul style="list-style-type: none">•	

Appendix 2 Agenda

2011 National Bridge Management, Inspection and Preservation Conference								
Theme: Managing the Nation's Bridges, Beyond the Short Term								
Session 1 Welcome and Introductions								
Tuesday Nov. 1 8:00 to 9:45 a.m.								
Welcome and Introduction			Butch Wlaschin			FHWA		
Welcome and Opening Remarks			Kevin Keith			Missouri DOT		
Managing the Nation's Bridges - Better, Faster, Cheaper, Safer, Smarter			Kirk Steudle			Michigan DOT		
Session 2 Putting It All Together								
Bridge Safety Management and Preservation Developments			Anwar Ahmad			FHWA		
Structural and Functional Characteristics of Decommissioned Bridges			John Hooks			TSP.2		
Determining Preservation Need Using Inspection and Bridge Management System Data			Paul Jensen			Jensen Engineering and Consulting		
The Future of Technology and Bridge Inspection and Management Over the Next 10 to 20 Years			Jeremy Shaffer			InspectTech		
Tuesday Nov. 1 1:00 to 2:45 p.m.								
Sessions 3								
3A Bridge Management Track			3B Bridge Inspection Track			3C Bridge Preservation Track		
Establishing a State DOT Management Core Group	Jeff Milton	VDOT	MnDOT's Bridge Inspection Data Collection	Jennifer Zink	MnDOT	Introduction of FHWA Bridge Preservation Guide	Anwar Ahmad	FHWA
Moving Toward a Performance-Based Federal-aid Highway Program	Butch Wlaschin	FHWA	Identify Preservation Needs Using Inspection Data	Lee Floyd	SCDOT	WSDOT-The Right Bridge, at the Right time, with the Right Fix, and the Right Amount of Funding	Chris Keegan	WSDOT
Element Migration	Allen Marshall	Allen Marshall LLC	FHWA National Bridge Inventory of the Future	Wade Casey	FHWA	Data Collection and Analysis to Support Bridge Preservation	Dave Juntunen	MDOT
			Inspection Challenges (Rope Access)	Tom Howell	HDR			

Tuesday Nov. 1 3:15 to 5:00 p.m.								
Session 4								
4A Bridge Management Track			Bridge Inspection Track			Bridge Preservation Track		
Bridge Modeling - Intro to Transition Probabilities	Paul Thompson	Paul D. Thompson	GDOT's Use of New Technology for Bridge Inspection QC/QA of Bridge Inspection Including Oversight of Multiple Agencies	Andy Doyle	GDOT	NYSDOT Approach for Deck Preservation Guidelines for Selection of Bridge Deck Overlays, Sealers and Treatments	Paul Weykamp	NYSDOT
Prioritization Using Multi-Objective Utility Functions	Mike Johnson	CalTrans	Pontis Vs 5.1.2 for Inspectors	Jeremy Shaffer	InspectTech	Rapid Overlays for Deck Preservation	Michael Sprinkel	VDOT
Bridge Management Questionnaire Report	Wade Casey	FHWA	Deck Inspections Using NDT Techniques	Jody Bywater	WSDOT	Cathodic Protection Practices in Florida	Ivan Lasa	FDOT

Wednesday Nov. 2, 2011 8:00 to 9:45		
Session 5		
5A Bridge Management Track	5B Bridge Inspection Track	5C Bridge Preservation Track
Discussion Topic	Discussion Topic	Discussion Topic
1. Identification of bridge needs	1. Critical Inspection Finding and Follow-Up Procedures	Group 1 - Deck Preservation Techniques and Strategies
2. Prioritization of bridge needs	2. Scour Inspections During Routine and Storm Events	Group 2 - Superstructure Preservation Techniques and Strategies
3. Funding/budget	3. In-Depth and Fracture Critical Inspection	Group 3 - Substructure Preservation Techniques and Strategies
4. Performance measures/goals	4. How Do You Incorporate Risk Management Into Your Inspection Practices?	Group 4 - Bridge Preservation Program Management
5. Program effectiveness and effectiveness of bridge management tools	5. Execution of Inspection Frequencies Within Your Agency.	Group 5 - Deck Preservation Techniques and Strategies
	6. How To Implement a Uniform and Comprehensive Bridge Inspection Policy.	Group 6 - Superstructure Preservation Techniques and Strategies
	7. Inspection Access Challenges and Equipment to Provide Access.	Group 7 - Substructure Preservation Techniques and Strategies
	8. NBIS Compliance Oversight Program Metrics	Group 8 - Bridge Preservation Program Management

Wednesday Nov. 2 10:15 to Noon		
Session 6 Putting It All Together		
6A Bridge Management Track	6B Bridge Inspection Track	6C Bridge Preservation Track
Discussion Topic	Discussion Topic	Discussion Topic
1. Identification of bridge needs	1. Critical Inspection Finding and Follow-Up Procedures	Group 1 Report - Pete Weykamp
2. Prioritization of bridge needs	2. Scour Inspections During Routine and Storm Events	Group 2 Report - Dick Dunn
3. Funding/budget	3. In-Depth and Fracture Critical Inspection	Group 3 Report - Siva Venugopalan
4. Performance measures/goals	4. How Do You Incorporate Risk Management Into Your Inspection Practices?	Group 4 Report - Bruce Johnson
5. Program effectiveness and effectiveness of bridge management tools	5. Execution of Inspection Frequencies Within Your Agency.	Group 5 Report - Deck Preservation Techniques and Strategies
	6. How To Implement a Uniform and Comprehensive Bridge Inspection Policy.	Group 6 Report - Dave Sevems
	7. Inspection Access Challenges and Equipment to Provide Access.	Group 7 Report - Chris Keegan
	8. NBIS Compliance Oversight Program Metrics	Group 8 Report - Jim Edgerton

Wednesday 1:00 to 2:45 p.m.		
Session 7 Putting It All Together		
AASHTO Guide Manual for Bridge Element Inspection - Driver for Change in How We Make Our Decisions	Mike Johnson	Caltrans
FDOT Efficient Use of Bridge Performance Measures and Getting Positive Results	Richard Kerr	FDOT
Institution a Successful Approach to Bridge Management in Michigan	Dave Jutunen	MDOT

Wednesday 3:15 to 5:00		
Session 8 Putting It All Together		
Managing Bridges Beyond the Short Term	Gordon Proctor	Gordon Proctor & Associates
NBIP Metrics Introduction	Jon Nekritz	FHWA
AASHTO Update	Mal Kerley	VDOT
Wrap-up, feedback, questionnaire, action register, research register, planning next NBMIPC	Butch Wlaschin	FHWA

Appendix 3 Conference Evaluations

Analysis of Comments

In these tables, the conference participants' comments to a questionnaire are grouped. Three sets of comments are shown, one set for lessons learned, one for what actions should be pursued and one for what research should be pursued. The comments are grouped by common themes, and the frequency of those themes is counted. Some comments are listed more than once if the comment included more than one theme. Each theme listed in a comment with multiple themes is counted as an individual comment.

Comments as to 'Lessons Learned' from the Conference		
Frequency	Category of Comment	Actual Comment
16	Promote Preservation	Need to get preservation in our department's mission/goals.
	Promote Preservation	Need to fund bridge preservation.
	Promote Preservation	Having a performance based system is coming fast. We need to be able to show the effect of an investment in bridge preservation. We need to work with the inspectors, so the new coding guide will allow for inspectors to raise ratings when work is done. At this time, we get zero credit for sealing a deck. We need numbers, not good feelings.
	Promote Preservation	Systematic preservation plan for all bridges in the state.
	Promote preservation	That we need to understand that bridge cannot be left alone after being built. That is the important time to have a plan to begin it would last for 100 years.
	Promote preservation	Bridge preservation is a hot topic nationwide. FHWA supports preventive maintenance and bridge preservation.
	Promote Preservation	How to market bridge preservation program appropriate performance measures and benefits to all our partners
	Promote Preservation	A clear definition of preservation for everybody to understand. A clear understanding of the "Bridge Preservation Guide".
	Promote Preservation	Improving our bridge preservation program.
	Promote Preservation	We need to increase the amount of bridge preservation work in our state.
	Promote Preservation	Good information on creating a policy for getting approval to use bridge funds for bridge preservation
	Promote Preservation	General message that there is no money therefore we need to preserve our bridges forever.
	Promote Preservation	Bridge preservation plan
	Promote Preservation	The need for dedicated funding for bridge preservation and the need to get away from a replacement oriented bridge program
	Promote Preservation	Move away from worse first to maintaining good/fair
	5	NBI elements
Future changes to NBI and changes to elements.		

Comments as to 'Lessons Learned' from the Conference		
Frequency	Category of Comment	Actual Comment
	NBI elements	Illinois is in the mix or a little ahead in following NBIS requirements for metrics.
	NBI elements	The NBIS is moving toward element level inspiration.
	NBI elements	Implementation of AASHTO element-level bridge inspections currently using NBI ratings.
	NBI elements	Set a timeline for the near AASHTO element migration. Be proactive on this and set up a task force with a definitive timeline. Share practices with other states and solicit best practices especially in regards to technological advances.
4	Inspection frequencies	Inspection practices, frequencies – better streamline our program and help in updating our standard operating procedures
	Inspections/treatments	Techniques and timing of deck seals and overlays. Performance measures and reporting. Where to look for info. Have inspectors recommend treatments and priority.
	Inspections/treatments	The need to be able to process data. Inspection is changing from visual to digital and more information must be gathered and processed.
	Inspections/treatments	Implementation of new technology and tools for bridge inspection, best practices for QC/QA programs for bridge inspection
4	State innovations	The presentation ideas an actions other states are doing or trying to implement.
	State innovations	Experiences and processes from other states. Products that may help us preserve our bridges.
	State innovations	Information and contacts from others states and how we can incorporate/learn from their processes.
	State innovations	The interaction that occurs during breaks is invaluable to open discussion that occur that are generated by session topics. The group breakouts used in the bridge preservation track on Wednesday worked very well and allowed good discussion.
4	Performance based	Evaluate data. Set program direction. Document progress- performance measures. Obtain buy-in from staff (understand the mission).
	Performance based	Techniques and timing of deck seals and overlays. Performance measures and reporting. Where to look for info. Have inspectors recommend treatments and priority.
	Performance based	Emphasize the use of data and other asset management techniques in decision making
	Performance based	Develop a decision matrix like Michigan. Very impressive
3	Rope access	Rope access technologies.
	Rope access	Rope climbing and training.
	Rope access	Adding rope techniques to an in-house abilities
2	Pontis	The implementation and new items for Pontis 5.1.2.
	Pontis changes	New PONTIS core elements- 4 condition states separate paint from steel, separate overlays from deck.
2	Update with technology	Bridge inspection from NDE technologies. New technologies for bridge inspection. National bridge inventory for the future.
	Update with technology	Continue to be updated with new technology.
1	Fund preservation	Scope of bridge inspection. Future eligible preventive maintenance activities.

Comments as to 'Lessons Learned' from the Conference		
Frequency	Category of Comment	Actual Comment
1	Change thinking	We need to change our status quo thinking.
1	Continual improvement	Progress, however slow, can be made in development of meaningful Bridge management systems. We should not let the problems that arise stop us from continuing to pursue process improvements. Made new helpful contacts that may help our agency move forward in bridge preservation.
1	Deck preservation	Techniques and timing of deck seals and overlays. Performance measures and reporting. Where to look for info. Have inspectors recommend treatments and priority.
1	Forecast with elements	Importance of asset management and the importance the new elements will play into accurate forecasting and programming of bridge programs/projects.
1	Future of preservation	The future of Bridge Inspection and Preservation.
1	Prioritization	Multi objective optimization- (MOO) takes a good look at this technology.
1	Products for preservation	Experiences and processes from other states. Products that may help us preserve our bridges.
1	Promote Asset Management	Importance of asset management and the importance the new elements will play into accurate forecasting and programming of bridge programs/projects.
1	NDT	Bridge inspection from NDE technologies. New technologies for bridge inspection. National bridge inventory for the future.
1	New bridge inventory	Bridge inspection from NDE technologies. New technologies for bridge inspection. National bridge inventory for the future.
1	BMS	Talk to our people about "sims" the BMS that MN and NV recently started using.

Comments as to What Should be on the 'Action Register'		
Frequency	Category of Comment	Actual Comments
13	Best practices	Sharing technology
	Best practices	Develop the tool box, use TSP2 site forum and promote its use.
	Best practices	Communication. Continuing to have better ways for states, FHWA, consultants, suppliers, etc. to exchange information for innovation.
	Best practices	What if any, preservation work is being done in each state?
	Best practices	Suggest FHWA create a website for bridge preservation best practices. Suggest FHWA communicate to the states the importance of bridge preservation.
	Best practices	Management to move toward preventative maintenance.
	Best practices	Need one stop shop for getting information regarding what other states are doing, research available, manuals, etc.
	Best practices	Develop bridge cleaning guide with environmental best practices.
	Best practices	The development of preservation best practices for bridge preservation
	Best practices	Develop a bridge management strategic plan, develop a bridge inspection strategic plan, develop bridge management tool box, develop a bridge inspection toolbox.
Best practices	Matrix of best practice	

Comments as to What Should be on the 'Action Register'		
Frequency	Category of Comment	Actual Comments
	Best practices	Overall bridge preservation benefits and best practices toolbox published, marketing thru ARTBA. Promote all the good things the bridge industry is doing for the entire network.
	Best practices	The graph Paul Jensen had with the first time to consider work, and the last time to consider preventive maintenance was good. Can we have an example how to use the data we collect and actually make a chart for a specific element or deck/super/sub?
4	Metrics	23 metrics- what are other states doing for these!
	Metrics	How does the FHWA choose metrics and do states have a say in their new rules and regulations?
	Metrics	How many states are actually on board with Pontis – the metrics – etc.? FHWA losing touch with states and what happened to partnering? The number of licenses doesn't answer this. How do we pay for these changes? How many states actually use new core element now?
	Metrics	Monitoring of bridge structures, NBI metrics
3	Inspection frequency	Bridge inspection training between states- i.e. states have different requirements in order to perform inspections in there state. FHWA should look into coordinating and establishing single, national requirements.
	Inspection frequency	Summary of fracture critical inspection reasons. Summary of justifications or greater than 24 months inspection criteria.
	Inspection frequency	Risk management / inspection frequency à dealing with limited funds
3	Pontis	Who is using the newest versions of Pontis, state specific?
	Pontis	How many states are actually on board with Pontis – the metrics – etc.? FHWA losing touch with states and what happened to partnering? The number of licenses doesn't answer this. How do we pay for these changes? How many states actually use new core element now?
	Pontis	Need better timeline of when new AASHTO element-level/Pontis bridge inspections will be fully implemented.
2	Local agencies	Inclusion of local agencies.
	Local agencies	Have local bridge groups speak on behalf of the local bridge community on their needs and if we can help.
1	Funding	Risk management / inspection frequency à dealing with limited funds
1	Joint performance	Coordinate between state representatives and joint manufacturers on what performance/characteristics we the state are looking for in joint systems so they can manufacture and research what we need.
1	Research	Continued research
1	Risk management	Risk management / inspection frequency à dealing with limited funds
1	Service life definition	Define useful service life needed on a bridge level and system level.
1		Set mandates by FHWA and actual answers, national bridge elements for example.

comments as to 'What Bridge Preservation Research Topics Should be Pursued?'		
Frequency	Category of Comment	Actual Comments
12	Preservation Effectiveness	I think we need a study on the bridge performance which they were built before these and the bridges built after the 80's which was last time the federal government (FHWA) initiated program like this.
	Preservation Effectiveness	Deterioration curves including condition and maintenance data, joints, preservation matrices survey of practitioners, practices when applied, what is cost, what is benefit.
	Preservation Effectiveness	Performance measures for bridge preservation activities.

		comments as to 'What Bridge Preservation Research Topics Should be Pursued?'
Frequency	Category of Comment	Actual Comments
	Preservation Effectiveness	Analysis of preservation activities with respect to performance.
	Preservation Effectiveness	Implementation practices of different state agencies for bridge preventive maintenance programs.
	Preservation Effectiveness	ROI for preservation – metrics to sell concept to decision makers
	Preservation Effectiveness	Bridge preservation strategies for elements and cycle times
	Preservation Effectiveness	Best practices for bridge preservation
	Preservation Effectiveness	What and when, bridge preservation actions should be done that be the most cost effective.
	Preservation Effectiveness	Sealers – effectiveness, longevity, costs wearing surfaces – timing, construction of, advantages, disadvantages
	Preservation Effectiveness	Treatment, when, why- cost benefit.
	Preservation Effectiveness	Treatments/ duration/ benefits- costs.
2	Chloride	Better field chloride test for worked and cleaned steel beams prior to painting. Polyurea or other tough coating for beam ends, end diaphragms, pier caps and bridge seats.
	Chloride	Field testing of cleaned steel surfaces for chlorides
1	100 year bridges	Developing a long range transportation plan that relate to 100 yrs life of bridges.
1	Advanced technology	Infrared technology for deck delaminations, voice recognition software for inspection data collection.
1	Corrosion	Would like to see research on sacrificial anodes and corrosion inhibitors.
1	Decks	Decks- this is where we will be starting with when it comes to a program. I want as much information from others as possible.
1	Design, repair	Cost effectiveness of different design and repair methods for comparison.
1	Deterioration forecasting	Bridge deterioration forecasting replacement – preservation – rehab forecasting.
1	Forum	Need a better forum for sharing ideas and best practices in an ongoing manner not just at conferences and regional meetings
1	Galvanizing	Galvanizing structure is painting which is cheaper over the life of a bridge. All cost considered building, maintenance, future repairs, cost of public.
1	Log	Log of info from other states.
1	Monitoring	Smart sponsor monitoring and data collection approaches
1	State practices	What are other states doing and who in that state should be a contact about such a topic.
1	Technology	More innovative technologies for inspection, repair, preventative maintenance. Out of the box, yet safe innovation.
1	Washing	Bridge washing/cleaning and the cost savings by using this program. Environmental impacts to bridge preservation and are there positive environmental long-term impacts.

National Bridge Management, Inspection and Preservation Conference
 St. Louis, MO
 October 31, 2011 – November 2, 2011

GENERAL SESSION (Wednesday)

LUNCH KEYNOTE: VP Member Services, American Road & Transportation Builder Association	5=15 4=32 3=17 2=3 1=1 N/A=5 21% 44% 23% 4% 1% 7%
Comments:	
AASHTO Guide Manual for Bridge Element Inspection: Driver for Change in How We Make Our Decisions	5=29 4=27 3=9 2=1 1 N/A=6 40% 37% 12% 1% 8%
Comments:	
FDOT Efficient Use of Bridge Performance Measures & Getting Positive Results	5=17 4=35 3=13 2=2 1 N/A=6 23% 48% 18% 3% 8%
Comments:	
Instituting a Successful Approach to Bridge Management in Michigan	5=28 4=34 3=6 2 1 N/A=5 38% 47% 8% 7%
Comments:	
Other Industry Approaches to Asset Management	5=14 4=36 3=14 2 1 N/A=9 19% 49% 19% 12%
Comments:	
NBIP Metric Introduction	5=14 4=28 3=13 2=6 1 N/A=12 19% 38% 18% 8% 16%
Comments:	
Closing Remarks	5=29 4=28 3=7 2 1 N/A=19 40% 38% 10% 26%
Comments:	

OVERALL

Agenda, Speakers, and Content	5=22 4=40 3=7 2 1 N/A=3 30% 55% 40% 4%
Comments:	
Technical Tracks	5=20 4=46 3=30 2=1 1 N/A=3 27% 63% 41% 1% 4%
Comments:	
Balance of Government and Industry Participation	5=20 4=35 3=14 2=1 1 N/A=3 27% 48% 19% 1% 4%
Comments:	
Hotel Accommodations, Accessibility and Location	5=13 4=21 3=3 2 1 N/A=4 18% 29% 4% 5%
Comments:	
Meeting Rooms & Accommodations	5=27 4=36 3=7 2 1 N/A=3 37% 49% 10% 4%
Comments:	
Travel Coordination (Invitational Attendees)	5=22 4=30 3=3 2 1 N/A=18 30% 41% 4% 25%
Comments:	

National Bridge Management, Inspection and Preservation Conference
St. Louis, MO
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Bridge Management, Inspection and Preservation Tracks

BRIDGE MANAGEMENT TRACK						
Moving Beyond Data Collection	5=7	4=19	3=2	2	1	N/A=65
Comments:	10%	26%	3%			89%
Application of Bridge Management and Preservation Programs in the NYDOT	5=11	4=12	3	2	1	N/A=50
Comments:	15%	16%				68%
Element Migration	5=6	4=13	3=5	2=1	1	N/A=46
Comments:	8%	18%	7%	1%		63%
Bridge Modeling – Introduction to Transition Probability	5=9	4=13	3=3	2	1	N/A=48
Comments:	12%	18%	4%			66%
Communicating the Benefits of Bridge Management to Upper Management, General Public and Legislators	5=11	4=12	3=1	2	1	N/A=49
Comments:	15%	16%	1%			67%
Project Selection and Prioritization	5=10	4=13	3	2	1	N/A=50
Comments:	14%	18%				68%
Overall: Bridge Management Track	5=8	4=17	3	2=2	1	N/A=45
Comments:	11%	23%	3%			62%
BRIDGE INSPECTION TRACK						
FHWA National Bridge Inventory of the Future	5=14	4=24	3=12	2	1	N/A=24
Comments:	19%	33%	16%			33%
Inspection Challenges	5=17	4=20	3=6	2	1	N/A=30
Comments:	23%	27%	8%			41%
Formal Process Other Than Inspection Reports	5=14	4=21	3=8	2	1	N/A=30
Comments:	19%	29%	11%			41%
Identify Preservation Needs Using Inspection Data	5=10	4=27	3=10	2=2	1	N/A=24
Comments:	14%	37%	14%	3%		33%
Inspections Using New AASHTO Bridge Element Inspection Manual	5=10	4=33	3=4	2=2	1	N/A=24
Comments:	14%	45%	5%	3%		33%
Innovation Inspection Techniques	5=23	4=15	3=7	2	1	N/A=28
Comments:	32%	21%	10%			38%
QC/QA of Bridge Inspection Data	5=13	4=18	3=15	2	1	N/A=27
Comments:	18%	25%	21%			37%
Inspection Program as the Keystone to Bridge	5=15	4=18	3=10	2	1	N/A=30
Comments:	21%	25%	14%			41%
Overall: Bridge Inspection Track	5=10	4=25	3=10	2	1	N/A=28
Comments:	14%	34%	14%			38%

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Bridge Management, Inspection and Preservation Tracks

BRIDGE PRESERVATION TRACK						
Introduction of FHWA Bridge Preservation Guide	5=1	4=13	3=5	2	1	N/A=54
Comments:	1%	18%	7%			74%
Laying Out the Framework for a Successful Bridge Preservation Program	5=3	4=11	3=4	2	1	N/A=54
Comments:	4%	15%	5%			74%
Applying the Appropriate Treatments and Strategies at the Right Time	5=6	4=9	3=7	2	1	N/A=51
Comments:	8%	12%	10%			70%
Data Collection and Analysis to Support Bridge Preservation	5=9	4=9	3=5	2	1	N/A=50
Comments:	12%	12%	7%			68%
NYS DOT Approach to Deck Preservation	5=7	4=13	3=4	2	1	N/A=49
Comments:	10%	18%	5%			67%
Guidelines for Selection of Bridge Deck	5=8	4=10	3=6	2	1	N/A=49
Comments:	11%	14%	8%			67%
Long Lasting LMC Bridge Deck Overlays	5=11	4=8	3=5	2=1	1	N/A=48
Comments:	15%	11%	7%	1%		66%
Cathodic Protection Practices in Florida	5=8	4=4	3=7	2=3	1	N/A=51
Comments:	11%	5%	10%	4%		70%
Overall: Bridge Management Track	5=4	4=15	3=4	2	1	N/A=49
Comments:	5%	21%	5%			67%

The following are the open-ended comments from the conference evaluations.

Lessons Learned. The most important message I can take back to my office and discuss with staff and/or associates for possible implementation or use is:

- Need to get preservation in our department's mission/goals.
- New PONTIS core elements- 4 condition states separate paint from steel, separate overlays from deck.
- Multi objective optimization- (MOO) takes a good look at this technology.
- Need to fund bridge preservation.
- Having a performance based system is coming fast. We need to be able to show the effect of an investment in bridge preservation. We need to work with the inspectors, so the new coding guide will allow for inspectors to raise ratings when work is done. At this time, we get zero credit for sealing a deck. We need numbers, not good feelings.
- Systematic preservation plan for all bridges in the state.
- We need to change our status quo thinking.
- Rope access technologies.
- Future changes to NBI and changes to elements.
- Scope of bridge inspection. Future eligible preventive maintenance activities.
- Illinois is in the mix or a little ahead in following NBIS requirements for metrics.
- Evaluate data. Set program direction. Document progress- performance measures. Obtain buy-in from staff (understand the mission).
- Importance of asset management and the importance the new elements will play into accurate forecasting and programming of bridge programs/projects.
- That we need to understand that bridge cannot be left alone after being built. That is the important time to have a plan to begin it would last for 100 years.
- Continue to be updated with new technology.
- Bridge preservation is a hot topic nationwide. FHWA supports preventive maintenance and bridge preservation.
- The NBIS is moving toward element level inspiration.
- The implementation and new items for Pontis 5.1.2.
- The presentation ideas an actions other states are doing or trying to implement.
- The future of Bridge Inspection and Preservation.
- Bridge inspection from NDE technologies. New technologies for bridge inspection. National bridge inventory for the future.
- How to market bridge preservation program appropriate performance measures and benefits to all our partners
- A clear definition of preservation for everybody to understand. A clear understanding of the "Bridge Preservation Guide".
- Rope climbing and training.
- Progress, however slow, can be made in development of meaningful Bridge management systems. We should not let the problems that arise stop us from continuing to pursue process improvements. Made new helpful contacts that may help our agency move forward in bridge preservation.
- Improving our bridge preservation program.
- Experiences and processes from other states. Products that may help us preserve our bridges.
- We need to increase the amount of bridge preservation work in our state.
- Techniques and timing of deck seals and overlays. Performance measures and reporting. Where to look for info. Have inspectors recommend treatments and priority.
- Talk to our people about "sims" the BMS that MN and NV recently started using.

- The need to be able to process data. Inspection is changing from visual to digital and more information must be gathered and processed.
- Good information on creating a policy for getting approval to use bridge funds for bridge preservation
- Implementation of AASHTO element-level bridge inspections currently using NBI ratings.
- Information and contacts from others states and how we can incorporate/learn from their processes.
- General message that there is no money therefore we need to preserve our bridges forever.
- Bridge Management, preservation and inspection
- Bridge preservation plan
- Inspection practices, frequencies – better streamline our program and help in updating our standard operating procedures
- Emphasize the use of data and other asset management techniques in decision making
- The need for dedicated funding for bridge preservation and the need to get away from a replacement oriented bridge program
- The interaction that occurs during breaks is invaluable to open discussion that occur that are generated by session topics. The group breakouts used in the bridge preservation track on Wednesday worked very well and allowed good discussion.
- Move away from worse first to maintaining good/fair
- Adding rope techniques to an in-house abilities
- Implementation of new technology and tools for bridge inspection, best practices for QC/QA programs for bridge inspection
- Develop a decision matrix like Michigan. Very impressive
- Set a timeline for the near AASHTO element migration. Be proactive on this and set up a task force with a definitive timeline. Share practices with other states and solicit best practices especially in regards to technological advances.
- The national focus and priorities on Asset Management: Discuss pushing preservation practices beyond capitol rehab/replace

Conference Action Register. What actions should be identified in an action register that need to be pursued beyond this conference? Please describe and list accordingly.

- Sharing technology
- Develop the tool box, use TSP2 site forum and promote its use.
- The graph Paul Jensen had with the first time to consider work, and the last time to consider preventive maintenance was good. Can we have an example how to use the data we collect and actually make a chart for a specific element or deck/super/sub?
- Inclusion of local agencies.
- Bridge inspection training between states- i.e. states have different requirements in order to perform inspections in there state. FHWA should look into coordinating and establishing single, national requirements.
- 23 metrics- what are other states doing for these!
- Communication. Continuing to have better ways for states, FHWA, consultants, suppliers, etc. to exchange information for innovation.
- Who is using the newest versions of Pontis, state specific?
- What if any, preservation work is being done in each state?
- How does the FHWA choose metrics and do states have a say in their new rules and regulations?
- Summary of fracture critical inspection reasons. Summary of justifications or greater than 24 months inspection criteria.

- Overall bridge preservation benefits and best practices toolbox published, marketing thru ART-BA. Promote all the good things the bridge industry is doing for the entire network.
- Coordinate between state representatives and joint manufacturers on what performance/characteristics we the state are looking for in joint systems so they can manufacture and research what we need.
- Define useful service life needed on a bridge level and system level.
- Suggest FHWA create a website for bridge preservation best practices. Suggest FHWA communicate to the states the importance of bridge preservation.
- Management to move toward preventative maintenance.
- How many states are actually on board with Pontis – the metrics – etc.? FHWA losing touch with states and what happened to partnering? The number of licenses doesn't answer this. How do we pay for these changes? How many states actually use new core element now?
- Need better timeline of when new AASHTO element-level/Pontis bridge inspections will be fully implemented.
- Need one stop shop for getting information regarding what other states are doing, research available, manuals, etc.
- Develop bridge cleaning guide with environmental best practices.
- The development of preservation best practices for bridge preservation
- Risk management / inspection frequency → dealing with limited funds
- Monitoring of bridge structures, NBI metrics
- Have local bridge groups speak on behalf of the local bridge community on their needs and if we can help.
- Develop a bridge management strategic plan, develop a bridge inspection strategic plan, develop bridge management tool box, develop a bridge inspection toolbox.
- Set mandates by FHWA and actual answers, national bridge elements for example.
- Matrix of best practice
- Continued research

Bridge Preservation Research Topics. What bridge preservation research topics should be pursued? Please describe and list accordingly.

- Performance measures for bridge preservation activities.
- Would like to see research on sacrificial anodes and corrosion inhibitors.
- Decks- this is where we will be starting with when it comes to a program. I want as much information from others as possible.
- Analysis of preservation activities with respect to performance.
- Implementation practices of different state agencies for bridge preventative maintenance programs.
- Galvanizing structure is painting which is cheaper over the life of a bridge. All cost considered building, maintenance, future repairs, cost of public.
- Treatment, when, why- cost benefit.
- Treatments/ duration/ benefits- costs.
- Log of info from other states.
- More innovative technologies for inspection, repair, preventative maintenance. Out of the box, yet safe innovation.
- What and when, bridge preservation actions should be done that be the most cost effective.
- Bridge washing/cleaning and the cost savings by using this program. Environmental impacts to bridge preservation and are there positive environmental long-term impacts.
- Smart sponsor monitoring and data collection approaches
- Best practices for bridge preservation
- Cost effectiveness of different design and repair methods for comparison.

- Bridge deterioration forecasting replacement – preservation – rehab forecasting.
- Need a better forum for sharing ideas and best practices in an ongoing manner not just at conferences and regional meetings
- Deterioration curves including condition and maintenance data, joints, preservation matrices survey of practitioners, practices when applied, what is cost, what is benefit.
- Better field chloride test for worked and cleaned steel beams prior to painting. Polyurea or other tough coating for beam ends, end diaphragms, pier caps and bridge seats.
- Sealers – effectiveness, longevity, costs wearing surfaces – timing, construction of, advantages, disadvantages
- ROI for preservation – metrics to sell concept to decision makers
- Field testing of cleaned steel surfaces for chlorides
- What are other states doing and who in that state should be a contact about such a topic.
- Developing a long range transportation plan that relate to 100 yrs life of bridges.
- Infrared technology for deck delaminations, voice recognition software for inspection data collection.
- I think we need a study on the bridge performance which they were built before these and the bridges built after the 80's which was last time the federal government (FHWA) initiated program like this.
- Bridge preservation strategies for elements and cycle times

TSP-2 Bridge Preservation Partnerships/Midwest Bridge Working Group. How can the regional partnerships and groups become more involved in national bridge management, inspection and preservation discussions? Please describe and list accordingly.

- By developing guide manuals for bridge preservation.
- Scheduling meetings in specific states or region (>3 states) to discuss management inspection and preservation. Online webinars for states to discuss management, inspection, and preservation on a periodic basis.
- Promote regional conference for partnership states
- The WPPP seems to be struggling to become organized, find role. Perhaps there is not sufficient program development to share. Also, the participants vary substantially in range of interests – like this conference.
- Attend international bridge conference in Pittsburgh and hold a workshop.
- Continue meeting and spreading the word.
- By helping to disseminate information, share BMPs toolboxes
- Make sure TSP2 regional/national representatives to get the various AASHTO and TRB meetings
- More meetings like this throughout the US
- Get the word out about your forum. I believe a lot of good can come from this, if people know about it and use it.
- Through conferences such as this more often or on a set frequency and through national webinars solicited by these groups
- I actually think they should get more involved at a local level – on a state level, or even municipal level to communicate the resources that are available.

Other Comments. What other comments do you have regarding the 2011 National Bridge Management, Inspection and Preservation Conference?

- Great conference
- Very good meeting- excellent organization
- There was a good mix of general sessions, round table, and technical presentations.

- Don't have the same topics for the panel sessions. Have 1 set for the 1st session-another for the 2nd.
- Given the percentage of national bridges that are locally owned, increase focus on local bridges and make local government reps feel more welcome.
- It would be good to be able to attend other parts of the conference. Maybe some sessions could be presented twice!
- More time needed for inspection track. All states need to be present at same time. Don't split.
- Overall great conference. Very informative topics.
- Panel discussion should have different topics second round!
- The hotel rooms had no heat until the temperature dropped to 58 degrees. The front desk told me to just add a couple of blankets to the bed.
- What happened to subject 8 on the new NBIS metrics?! (Inspection roundtable). I was looking forward to that topic! Also- please don't schedule the next conference during a holiday. I missed my daughters first Halloween!
- The NBMIP conference is informative and ideas are shared maybe include all regions and partners in future conferences. Possibly future NBMIP conferences can be climate.
- More time needs to be built into the program for questions. For example, no opportunity (at all) was offered for questions during session 8. This lack of feedback creates the impression of "preaching doctrine" down to attendees. More time for questions and feedback is definitely needed!
- You should have an ability to evaluate the roundtable/panel sessions
- You should have an ability to suggest discussion topics for future conference
- Great conference that I would like to attend again. Would recommend to others
- Great conference. Good to hear about progress being made on a variety of fronts.
- Nicely done conference.
- Overall the conference was good. Excellent opportunity to find out how the other states do things. Finding out about products was helpful too. Enjoyed having speakers during lunch – both were informative and motivational!
- Good to break out tracks. Should consider funding 3 individuals from each state to cover all tracks.
- This was a really good idea grouping management, inspection and preservation into one conference. It was great to hear from all corners of the country, and hear about and discuss our problems and solutions.
- Excellent transfer of information. Well done!
- Great job! Great location and food – service – conference rooms
- Great way to allow states to discuss what everyone else is doing. Especially liked ability for everyone to get input in regarding various topics in small groups and report back to entire group.
- Very, very good conference; congratulations to the organizers.
- Very good presenters. Keep up the good work.
- Need to talk about other data collection software, methods other than Pontis
- The event was well organized and the presenters were prepared and credible
- One of the better conferences that I have attended in the last 3-4 years. Fills a need that is underserved.
- Fantastic event!
- Very good
- Have the peer exchange track early in the conference to allow more interaction between attendees. Vary the subjects and allow the attendees to select the subject that they have questions about.

- Need to get more states to attend (all states). Hold conference later in the year (April). Do not combine with bridge preservation partnership meetings. Need audience microphone for general session. Need a bell or going to call attendees to general sessions.
- The roundtable discussion for inspection was a panel, not a roundtable – it would be better as an organized roundtable discussion to brainstorm ideas on these topics so every state could be heard. I think a lot was missed by having a panel.
- We need to make a better effort of reaching locally owned bridges such as the counties and cities.
- Great program

Next Conference. Would you like to see another National Bridge Management, Inspection and Preservation Conference scheduled? Yes / No

If so, when? 2013, 2014, 2015, 2016, Other: _____

Yes, 2015

Yes, 2014

Yes, 2015

Yes, 2014

Yes, 2015

Yes, 2013

Yes, after reauthorization

Yes, 2015

Yes, 2015

Yes, 2013

Yes, 2013

Yes, 2014

Yes, 2013

Yes, 2015

Yes, 2014

Yes, 2013

Yes, 2015

Yes, 2015, 4 yr interval

Yes, 2014

Yes, 2014 or 2015

Yes, 2014

Yes

Yes, 2013

Yes, 2015

Yes, 2014

Yes, 2015

Yes, 2015

Yes, 2014

Yes, 2014

Yes, 2014 or 2015

Yes, 2014

Yes, 2014

Yes, 2013

Yes, EVERY YEAR

Yes, 2014

Yes, 2015 This allows enough time for conditions/situations to change.

Yes, 2015

Yes, 2013 Once every 2 years would be perfect
Yes, 2015
Yes, 2015

Appendix 4 Survey Responses



In Preparation for
National Bridge Management, Inspection and Pre-
servation Conference

Survey Results-V1

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Introduction

A National Bridge Management, Inspection, and Preservation Conference (NBMIPC) is scheduled to be held in November 2011 in St. Louis, MO. The purpose of the conference is to provide a forum where bridge practitioners can learn and share strategies for more effective management of bridge inventories with a focus on extending service life through preservation. On January 31, 2011, a survey was deployed to obtain feedback to assist in the development of an agenda for the NBMIPC. The survey was closed on February 28, 2011. This report provides an initial analysis of the feedback received from sixty four responses. It also provides the comments and suggestions provided by the respondents to various questions.

Roles

Figure 1 shows the survey responses to the question, “Which of the following categories most applies to you?”

- Inspection
- Preservation
- Management
- Other



Figure 5- Role of Survey Respondents

In addition to the three roles listed in the survey, participants identified the following as roles also performed, but not listed in the survey:

1. State Bridge Engineer - all of the above is within my responsibility
2. Repair of bridges in conjunction with inspection guidance.
3. Manage bridge rehabilitation and replacement projects during design phase and during the construction phase review changes.

4. I work on preservation and maintenance indirectly when I recommend actions after bridges are inspected. Also, at maintenance trainings I promote preservation and preventive maintenance.
5. I oversee the Bridge Inspection Program and I'm the Fund Manager for the Bridge Set-Aside Program which funds the majority of the bridge repairs (Bridge Preservation) for the State System.
6. Emergency/Maintenance as well
7. Comprehensive Bridge Program Management
8. Bridge Repair
9. Bridge rating, mostly, as it applies to management.
10. Bridge Painting, Bridge Design, Context-Sensitive Maintenance and Construction, Bridge Construction, Bridge Materials, Corrosion
11. Bridge maintenance and bridge emergencies
12. Bridge Maintenance & Repairs
13. Bridge Maintenance
14. Bridge Load Rating
15. Bridge design, bridge construction, materials, etc
16. Bridge Design and Rating
17. Bridge Design and Bridge Maintenance
18. Bridge Design
19. Bridge Data Management
20. Assistant State bridge engineer

Bridge Management Topics

The survey requested participants to rate the following potential bridge management topics on a scale of 1 (little interest) to 5 (very high interest). The feedback is to be used by the Steering Committee to develop an agenda addressing bridge management topics that would be of interest to the conference attendees.

- Application of Bridge Management and Preservation Programs in the DOT
- Bridge Management 101- How do we get started? Moving Beyond Data Collection. Effective Management, Preservation, Inspection Policies
- Risk Based Management Approaches
- Performance Measures for bridges
- Communicating the Importance of Bridge Management to Upper Management, General Public, and Legislators
- Bridge Management Round Table Discussion- Challenges/Success Stories
- Life Cycle Cost Application and Tools
- Decision making - How Projects are Selected and Prioritized

- Deterioration Modeling Development
- Cost Modeling Strategies

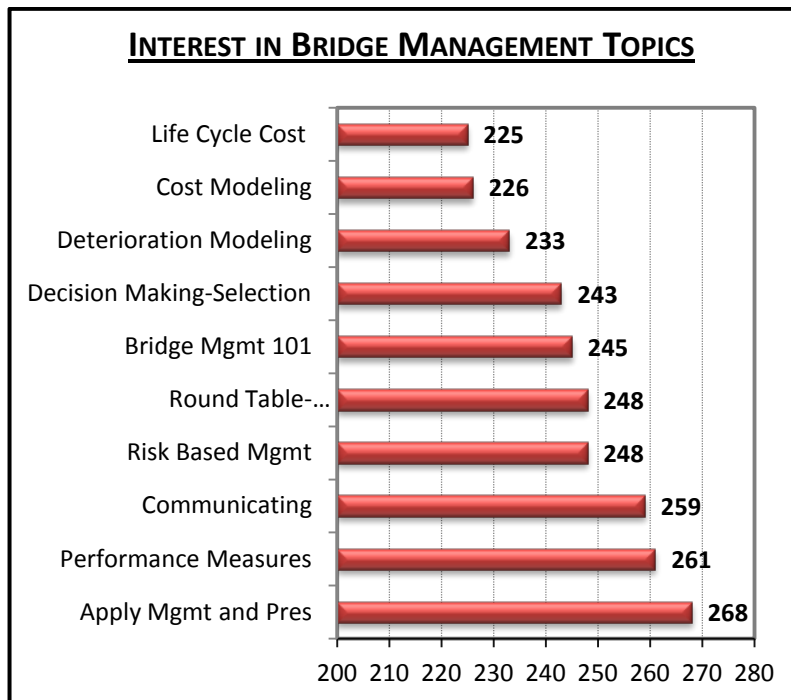


Figure 6- Scoring of Interest in Bridge Management Topics

Additional feedback received on topics for Bridge Management

1. For Bridge Management Round Table Discussion-**I rate this “5”, if this is done in small group round table sessions mentioned earlier. I would rate it 2 if done on the larger scale.
2. The placement of the Bridge Management System in the organization so that they are most effective and they serve the right user.
3. Practical application of developing a system to collect life cycle costs for bridges.
4. Long term performance prediction.
5. Performance measures are something that we will all be faced with in the near future as a condition of funding. We should take some time to learn from each other rather than everyone working on their own.
6. More discussion on defining and measuring to know it is successful
7. Integrating preventive maintenance actions in bridge management
8. Performance measures and expected outcomes.

9. I like all the Bridge Management Topics listed
10. Elemental deterioration rates are a key element to being able to forecast bridge needs. This information must be gathered before anyone can objectively communicate these needs with upper management.

Bridge Inspection Topics

The survey requested participants to rate the following potential bridge inspection topics on a scale of 1 (little interest) to 5 (very high interest). The feedback is to be used by the Steering Committee to develop an agenda addressing bridge inspection topics that would be of interest to the conference attendees:

- Identify Preservation Needs Using Inspection Data
- QC/QA of Bridge Inspection Data
- Deck Inspections Using NDT Techniques
- Use of NDE to Supplement Visual Inspection
- Inspection Round Table-Challenges/Success Stories
- NBIS Compliance Oversight Program Metrics
- Inspections Using New AASHTO Bridge Element Inspection Manual
- Element Level Inspection
- Inspection Program as the Keystone to Bridge Management and Preservation
- Inspection of Bridge Decks with Stay in Place Forms
- NHI Underwater Bridge Inspection Training

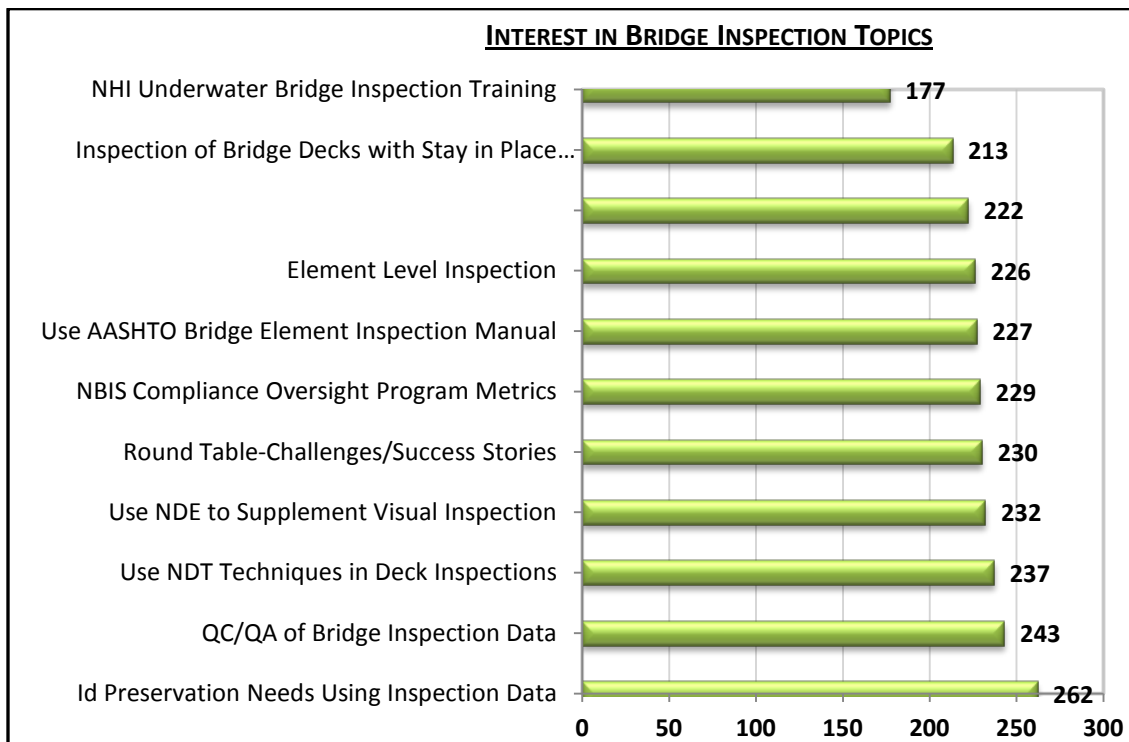


Figure 7-Survey Scoring of Bridge Inspection Topics

Additional feedback on Topics for Bridge Inspection

1. What are states doing to collect vertical clearances on high ADT roadways?
2. Extending inspection cycle on new, very low risk bridges - have any states been able to do this and what criteria did they use?
3. Uniformity in Bridge Inspection and QC/QA in Bridge Inspection specially when dealing with several Districts/entities performing the inspection for the same organization.
4. Since we will all be using the new Bridge Element Inspection Manual, it would be good to know the thought processes and considerations for how it came about.
5. Presentation by FHWA on the new NBIS Oversight Program.
6. NBIS Compliance Metrics - specifically Inspection Frequency compliance. Discuss potential clarification(s) to the definition of "inspection frequency" compliance to permit efficient management of an inspection program.
7. Currently, the due date for the next routine inspection is the most recently defined frequency added to the precise last inspection date. To remain in compliance each bridge must be inspected "on or before" the due date. When inspected "before" as most will inevitably be if staying in compliance, the next inspection due date is then ratcheted forward (earlier). For some structures, due dates eventually become moved forward far enough to be out of desirable/permisible inspection windows and associated scheduling problems begin to escalate. A secondary consequence of the forward ratcheting is that over a period of time more inspections will be performed than were envisioned. Of course that is not a bad thing, but is it really necessary and is it a wise use of scarce resources?
8. Insufficiency in granularity of bridge inspection data to prioritize bridge preservation needs.
9. Inspection access challenges and equipment to provide access. For example, how are fracture critical bridges on steep grades and cross slopes being inspected? How are floor beams on lightly designed thru trusses being inspected?
10. How to use free climb to access and inspect truss floor beams that are not accessible by snooper or ladder?
11. For Bridge Inspection Round Table Discussion-****Again-small group round table =5, large =2.**
12. Discuss the potential for "Reliability Based Inspection"
13. How do you incorporate risk management into our inspection practices?

Bridge Preservation Topics Included In the Survey

The survey requested the participants to rate their interest in including the following as conference topics:

- Bridge Preservation Round Table Discussion- Challenges/Success Stories
- What does an ideal bridge preservation program look like? Laying out the framework for a successful bridge preservation program
- Applying the appropriate treatments and strategies at the right time. How to get out of the “doing the same things and expecting different results” mode? □
- Deck Preservation, Treatment and Strategies
- Superstructure Preservation, Treatment and Strategies
- Substructure Preservation, Treatment and Strategies
- Underwater Bridge Repair Technologies
- Bridge Preservation Investment Strategies
- Data collection and analysis to support Bridge Preservation

Figure 4 shows the interest shown by the respondents in the above Bridge Preservation topics.

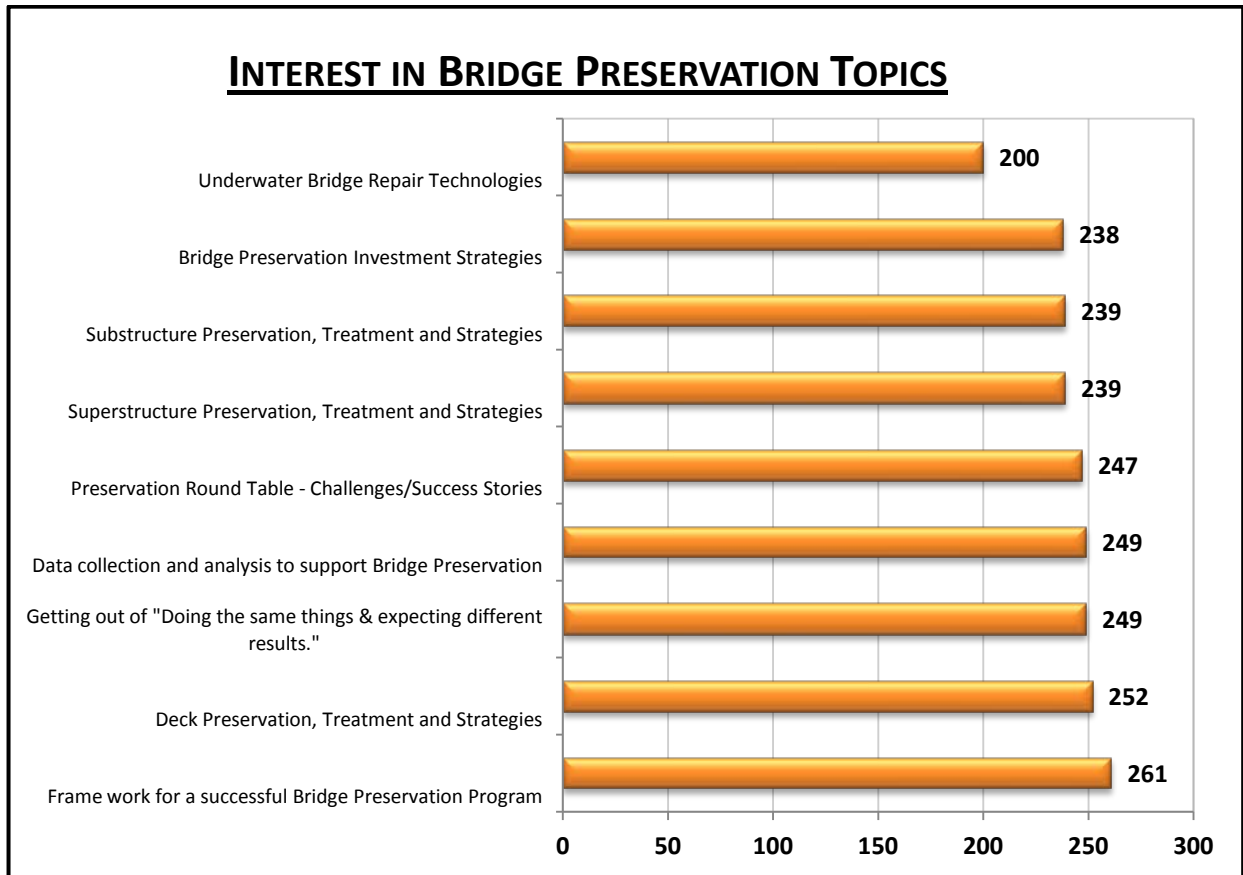


Figure 8 Scoring of interest in Bridge Preservation Topics

Feedback received on Additional Bridge Preservation Topics for Consideration

1. What does FHWA consider "preservation"?
2. Understanding by most of the stakeholders, the definition of Bridge Preservation and measuring the affect of actions.
3. Moisture in the embankment is the cause of several abutment, bearing and pile defects. It is hard to keep the existing embankments dry.
4. Many states use deck treatments early in the life of the bridge, either Silanes or HMWM. Because of problems with thin overlays about 20 years ago there is a reluctance to use these in our preventive maintenance program. It would be helpful to have something definitive that shows that these are cost effective measures to extend bridge deck life.
5. Lack of clear linkages between bridge elements and identified preservation project work items. Justifying work items that do not result in improved element level or NBI condition ratings.
6. I would like to see successful performance measures that have been used around the country.
7. From pavements, we know that it is more cost effective to maintain pavement at a high condition, but we don't have the data for bridges since they are so varied and have a longer service life. Being able to make the case for preservation using actual facts instead of feelings is important to be able to sell the concept.
8. Do we have a standard definition of "Bridge Preservation"?
9. Bridge Preservation Round Table Discussion-******Again-small group round table =5, large =2.
10. Bridge Preservation definition, trade off, and benchmarks
11. Bridge cleaning process, environmental regulations as needed for preservation and inspection

Survey Final Thoughts

Additional suggestions requested and provided by survey participants are listed below:

- Having round table discussions will enhance the conference.
- What software for Bridge Management, Bridge Inspection, and Bridge Preservation do DOTs use? Written "in-house" or by consultants? What other software is available?
- The use of Non-NBI data for bridge management purposes is helpful. NBI limitations are documented and known, but useful for General Public, Legislature and small bridge inventories. The use of non-NBI data is required to effectively manage larger bridge inventories.
- Provide topics and let each state respond.

- Please contact us if any additional information concerning the Virginia bridge program is needed. We look forward to participating in the conference.
- Please allow the option to select from 30 minutes or 15 minutes presentations. Some topics require a good 20 to 25 minutes for delivery and some may require only 10 minutes. By asking the presenters which session they prefer to have, we all will benefit. Also, please do not break into groups and sessions unless you could provide the video of all presentations on web.
- More breakout sessions to engage interaction and increased participation
- International Practices! And how other countries (specifically Canada and Europe) maintain their bridges and handle bridge management issues such as funding, maintenance and repair?
- If a highway bill passes that give the DOT's one bucket of money to distribute between pavement preservation and bridge preservation, do both preservation programs have the same metrics? if so, what are they?
- How to use PONTIS as a tool for Bridge Management based on NBI inspection (not elemental inspection)?
- Have some discussions on what did not work. Sharing this with other states may prevent other states from making the same mistakes.
- From what I understand FHWA will fund travel for one participant from Washington State, and AASHTO TSP2 will fund the travel for two as members of the Western Bridge Preservation Partnership.
- Each of these three topics could be a conference by itself. May be too much to put into one conference and have participants attend all the sessions they'd like to attend.
- NCDOT is under travel restrictions so only 2 will be able to attend.
- Any workshop-style forum would be more useful than lecture style for some topics