

Summary Report

George Hearn, July 6, 2009

Overview

Scan 07-05 is a domestic scan focusing on practices among US transportation departments for identification, prioritization and execution of programs for maintenance of highway bridges. The scan includes review of DOT manuals, guidelines, and policy statements, collection of responses to amplifying questions from DOTs, and travel to seven sites for meetings with DOT staff. The most detailed information is collected from thirteen DOTs that participated in meetings with the scan team. Document review includes input from eleven other DOTs; overall, the desk scan includes sixty-eight documents collected from twenty-one US transportation agencies. All sources are state or local government agencies of the United States (Table 1).

Materials collected from participating agencies during scan travel include PowerPoint presentations, maintenance manuals, technical memoranda, coding guides, policy memos, and spreadsheets used in prioritizing and executing bridge maintenance work.

This scan collects policies and procedures only. Visits to bridge sites or other field sites are not part of the scan.

Table 1- Agencies in the Scan

| Agency | Office / Branch | Doc Review | Amplify Ques | Visit |
|---|--|------------|--------------|----------------|
| Alabama Dept. of Transportation | | Y | | |
| California Dept. of Transportation | Structures Maintenance and Investigations | Y | | Y |
| Colorado Dept. of Transportation | | Y | | |
| Delaware Dept. of Transportation | Maintenance & Operations Division, Maintenance of Bridges and Roads | Y | | Y |
| El Dorado County Public Works, California | County Dept. of Transportation | | Y | Y ¹ |
| Florida Dept. of Transportation | Office of Maintenance | Y | Y | Y |
| Florida Turnpike Enterprise | Turnpike Roadway Maintenance | | Y | Y ² |
| Idaho Dept. of Transportation | | Y | | |
| Illinois Dept. of Transportation | | Y | | |

¹ Participated in meetings at CalTrans' offices in Sacramento

² Participated by video link in meetings at FDOT offices in Tallahassee

| | | | | |
|--|--|---|---|----------------|
| Louisiana Dept. of Transportation | Bridge Design (scan team member) | Y | | |
| Michigan Dept. of Transportation | Bridge Operations | Y | Y | Y |
| Minnesota Dept. of Transportation | | Y | | |
| Montana Dept. of Transportation | | Y | | |
| New Mexico Dept. of Transportation | | Y | | |
| New York State Dept. of Transportation | Bridge Maintenance (scan team member) | Y | Y | |
| North Carolina Dept. of Transportation | | Y | | |
| Ohio Dept of Transportation | Bridge Operations and Maintenance | Y | Y | Y |
| Oregon Dept. of Transportation | Bridge Engineering (scan team member) | Y | Y | |
| Pennsylvania Dept. of Transportation | | Y | | |
| Placer County Public Works, California | County Bridge Engineer | | Y | Y ¹ |
| Texas Dept. of Transportation | | Y | | |
| Virginia Dept. of Transportation | Structure and Bridge Division | Y | | Y |
| Washington Dept. Transportation | Bridge Preservation | Y | Y | Y |
| Wisconsin Dept. of Transportation | Bureau of Structures (scan team member) | Y | | |

Recommendations

The scan team recommends that certain practices in bridge maintenance, observed in current practices at DOTs, be identified as useful and effective. Full explanations of these practices should be prepared, and should be disseminated through documents, websites, webinars, presentations to AASHTO committees and TRB committees, and content in National Highway Institute courses for bridge maintenance bridge management. The effective practices are outlined below. A draft implementation plan begins on page 4. Information on practices at individual DOTs appears in *Findings*.

Preventive Maintenance

A significant portion of bridge resources (funds, personnel, and effort) can be directed to preventive maintenance (PM). Preventive maintenance can succeed in maintaining good bridge conditions.

Preventive maintenance actions must be applied before bridge conditions become poor. DOTs must be able to recognize current needs for PM actions, anticipate near-term needs, and follow work programming procedures that deliver PM actions promptly.

To recognize and program preventive maintenance, DOTs require trained staff, adequate funding, flexible allocation of funds, and clear plans of action for bridge components. These last two aspects, allocations and plans, are key. Funding must be directed to preventive maintenance for bridges before bridges become deficient. DOT staff must recognize maintenance needs related to time in service, and not only to the defects extant.

Bridge Management Process

Bridge management is a process that combines information on needs at bridges, significance of bridge conditions and risks, appropriate remedies and actions, available means of execution, and efficient programming and coordination of maintenance work. Bridge management, as a process, responds to limitations in available resources, and yields appropriate work programs for specified planning periods.

The bridge management process makes several demands on DOT practices:

1. Maintenance Needs

The identification of maintenance needs at bridges must be uniform, specific and repeatable. Needs should be identified at the bridge element level. Needs must be stated as standard work actions, so that procedures, expected costs, and requirements in permitting and scheduling are identified. The work needs at bridges must be stored in a corporate database accessible to program managers.

2. Maintenance Performance Measures

Performance measures must be matched to objectives in bridge maintenance. Performance measures focused on deficient bridges deliver programs for deficiencies. Performance measures focused on PM needs deliver programs for preventive maintenance. Performance measures must both: 1) Identify work to advance maintenance objectives, and; 2) Provide simple indications of status of bridge networks.

3. Prioritization

Prioritization of maintenance projects must integrate agency objectives for deficient bridges, for preventive maintenance of good bridges, for network performance, and for risk. The process for prioritization must recognize the effect that deferred maintenance will have on individual bridges and on the network of bridges.

For automated evaluation of priorities, multi-object approaches are needed to combine the benefits of least cost, risk reduction, and preventive maintenance. Inputs to automated evaluations must include bridge conditions, bridge vulnerabilities, indicators for PM needs such as paint health index, and attributes of bridge inventory.

Procedures for prioritization must engage both central and regional DOT offices, and must advance from network-level rankings of candidates to bridge-by-bridge selection of projects.

4. Verification

The bridge management process must incorporate reports of completed maintenance work and verification, at completion, that bridge conditions are improved, that risk is reduced, or that PM needs are satisfied. Verification can require integration of DOT data systems so that bridge management applications can collect relevant information from crew- and contract-management applications.

Agency Support

DOT formal organization must support the bridge management process at all levels. DOT bridge inspection teams, by training and experience, must be able to identify work needs and to recommend actions.

Bridge owners need to leverage their bridge site inspections for both the identification of needed work, and the verification of completed work (from previous recommendations). Maintenance crews must take initiative in the execution of maintenance work and be guided, but not controlled, by lists of needs from bridge inspections. District maintenance engineers must collect information from inspectors and from crews, evaluate the continuing needs and trends in their bridges, and make appropriate applications to DOT central office for funds and for projects. The central DOT office must operate with quantitative performance measures that are compatible with district operations, and must recognize the first-hand knowledge that resides in the districts. DOT executives and government executives generally must accept that maintenance is not an episodic response to deficient bridges, but rather a continuing program of support for good bridges.

In its external aspects, agency-wide support for bridge management is seen in staff training, peer-exchange conferences, policies on preventive maintenance practices, web-accessible guides and manuals and, in general, access of staff to technical knowledge and policy guidance for bridge maintenance.

Draft Implementation Plan

BMS Scan – Implementation Plan

DRAFT

June 6, 2009

1. Investigate and recommend an FHWA Demo Project of Best Practices in Bridge Management Technologies and Computer Applications.
2. Repository of home grown repair techniques for skills training (TSP2 or TCC web page?).
3. FHWA HQ issue national approval guidelines for acceptable systematic process for bridge preventive maintenance activities.
4. Present recommendations to the Pontis Task Force for changes to the software:
 - a. Option to include all needs in any project identified for a specific bridge
 - b. Link recommended actions to corresponding core elements when applicable
 - c. Include inspector recommended actions in prioritized needs
5. Recommend an NCHRP Synthesis Study on methods of cost-effective maintenance contracting.
6. Recommend changes to the NHI Bridge Maintenance and Bridge Rehabilitation courses to include findings from the scan. Encourage cross training of maintenance and inspection technicians.
7. Recommend changes to the NHI 2-week Bridge Inspection Course on making repair recommendations.
8. Prepare draft PPT on summary and findings from the Scan. Present PPT at July SCOBS and SCOM general meetings.
9. Publish applications / spreadsheets / programs for identification, prioritization, and monitoring maintenance recommendations.
10. Include links to recommended applications in final report for scan.

11. Publish a paper that describes examples of determining optimum level of maintenance and to justify adequate expenditures and publish successful state Federal-aid Preventive Maintenance Programs in preventative maintenance based on improved overall system performance.
12. Recommend an NCHRP Synthesis on Optimal Performance Measures for Bridge Preventive Maintenance, including use of simple Red-Yellow-Green indicators.
13. Prepare Public Roads (Road and Bridges, Bridge Design and Engineering, New York Bridge Maintenance Newsletter) article on a summary and findings of the Scan.
14. Submit to various bridge conferences to present a summary and findings on the Scan; IBC, NBC, NWBMC, IABSE and TRB.
15. Recommend an NCHRP Synthesis on best practices for identification, prioritization, and monitoring of bridge management techniques, decision making, and actions.
16. Prepare a communication plan (web sites, FHWA, webinars, articles, TRB, AASHTO committees and task forces) to increase exchange of information on identification, prioritization, and monitoring of bridge management techniques, decisions and actions, including support for exchanging information between TSP2 Regional Groups.
17. Recommend FHWA increase emphasis or requirements for maintenance of Federal-aid projects, including preventive maintenance to achieve planned service life.
18. Encourage dissemination and use of the new NCHRP Report on Deck Overlays and Preservation Methods.
19. Recommend FHWA Office of Asset Management host a webinar to describe the summary and findings of the Scan and have 3 states highlight their best practices.
20. Recommend a special set-aside of NCHRP funding dedicated to bridge maintenance and preservation issues, based on the TSP Roadmap and TSP2 Strategic Plan.

Findings

Bridge Maintenance

Maintenance work includes bridge cleaning and minor repairs that can be performed by DOT crews; major repairs, component treatments and component replacements that may be performed by DOT crews or by contract; and rehabilitations of components or bridges, usually performed by contract. Maintenance actions, and the associated maintenance categories identified by DOTs are shown in Table 2. Some DOTs have separate maintenance programs for large bridges (Table 3).

DOT Organization

DOT organization for bridge maintenance includes a central office that provides funding, policies, and priorities to DOT districts; district offices that identify candidates for work programs in minor repairs, major repairs and rehabilitations; and field inspectors, supervisors and crews that identify maintenance needs, form detailed work plans, execute maintenance actions, and verify completed work.

DOT Inventory

DOT maintenance programs are responsible for most state-owned structural assets that carry or cross highways. These include NBI bridges and culverts³, short spans⁴, tunnels, earth retaining structures, non-bridge assets such as high mast lights and sign structures, and facilities such as ferry terminals, rest areas, and welcome centers (Table 4).

DOT Maintenance Crews

DOT maintenance crews are organized for bridge and culvert work, for structural work including assets other than bridges and culverts, or for general maintenance with some assignments to bridge work (Table 5). Many DOTs have special or dedicated maintenance crews for movable bridges, special bridges or painting.

DOT crews have basic construction skills, and some crew members may be qualified as welders, as equipment operators or as journeymen in a construction trade. Many DOTs require that crew members hold a commercial driver's license. Most training for crews is by experience on the job. Ohio has a formal, multilevel training program that is tied to advancement of personnel through five titles in the highway technician series (Table 6).

Identification of Maintenance Needs

Maintenance needs are identified at the element-level by bridge inspectors and maintenance crews (Table 7). Many DOTs have standardized lists of maintenance actions that are used by inspectors; lists of standard actions are available as drop-down lists on electronic forms for inspection reporting. Standard actions reported from inspections are available to districts to aid in formation of work plans and report-

³ Bridges and culverts meeting the definition of the National Bridge Inventory (NBI).

⁴ Bridges and culverts with span of 20 ft and less, and not meeting the NBI definition.

ing of completed work. Inspectors identify maintenance needs, quantities and priorities. Inspectors at some DOTs report whether maintenance work should be completed by DOT crew or by contractor.

DOT districts receive maintenance needs in annual summaries prepared by DOT central office. Not all recommendations are acted on. High priority needs are addressed. Needs that are suitable for maintenance crews are addressed. Other needs are sent to contract. Large needs, such as bridge replacement, enter administrative procedures for prioritizing and programming.

Priorities of Maintenance Needs

Inspectors identify the priorities of maintenance needs during safety inspections (Table 8). Maintenance crews, too, will report priorities for needs. DOTs have standard identification and response to needs that affect safety or performance of bridges.

Priorities for maintenance needs are reviewed by regional or central DOT staff. In review, needs are directed to crew work, district-level contracts, or programming through the central DOT office.

Priorities persist. A need for significant work that remains unmet can enter a higher priority. In one DOT, bridges are placed on a distressed bridge list if there are significant needs that go unmet for more than one inspection cycle.

Performance Measures and Priority Indicators

DOTs employ both performance measures and priority indicators. Performance measures are network-level values that show the fitness of bridge networks and, over time, the achievements of bridge programs (Table 9). Priority indicators are values for individual bridges, and are used to determine the category of maintenance that is appropriate for a bridge, and to rank competing candidates for work programming. Often, a single kind of measure, such as NBI condition rating, is a basis both for performance and priority. In a performance measure, the percentage of bridges at or beyond a stated NBI condition rating is tracked. In a priority indicator, NBI condition ratings contribute to ranking of work candidates.

Performance measures include percentages of bridges that are structurally deficient, functionally obsolete, or present a risk such as seismic or scour vulnerability. Performance measures also include program success in timely response to maintenance needs, especially for high priority needs. Washington DOT's maintenance accountability process (MAP) is an example (Table 10). Ohio DOT uses Organization Performance Indicators (OPI) that identify deficiencies in bridge paint, wearing surface, floor condition and general appraisal.

Priority indicators include single measures such as NBI condition ratings or status of a bridge as structurally deficient, and combined measures such as Delaware's *Bridge Deficiency Formula*, that use multiple factors in bridge condition and inventory (Table 11).

Maintenance Budget

Funding for maintenance work typically has three components (Table 12): funding allocated to districts for work by maintenance crews, funding for small contracts that are administered in districts, and funding for larger contracts allocated to specific bridge projects through a process of candidate identification and ranking. Identification and ranking involves cooperative work by DOT central and regional offices.

Funding is obtained from state governments and from the federal government. Federal participation is available to projects that remedy bridges that are deficient, in poor condition or present a specific risk. Federal participation in bridge preventive maintenance is available to DOTs that have secured prior approval from the US Federal Highway Administration (FHWA).

Budgets are determined using historical funding shares, or using cost estimates for known maintenance needs, or using proportions based on performance measures, bridge conditions and bridge inventories in DOT districts.

Allocations to DOT districts are under district control. That is, the district makes decisions on the application of funds to specific tasks in maintenance. The use of funds within a district can differ from the basis for allocation used by the DOT central office. Some DOTs allow (even encourage) districts to ‘bank’ funds. Districts can accumulate funds over several years for large projects, and can borrow funds from other districts.

Maintenance Planning and Programming

Work planning and project programming follow processes that depend on the means of work execution (Table 13). Work plans for DOT crews are developed in districts. Districts use lists of maintenance needs compiled from inspection reports, together with districts’ first-hand knowledge of their bridges to form work plans for crews that suit both crew capabilities and available funding. DOTs may set targets for work distribution to crews and to contracts. Florida DOT’s goals are 20% DOT crews, 40% site contracts and 40% asset maintenance contracts. Districts also plan for cyclic maintenance activities, such as bridge washing and deck sealing.

Districts in most DOTs are able to develop, award and manage small contracts for maintenance work. These may be site contracts, contracts to provide specific service in support of crew work, or specific items under open-ended contracts.

Larger projects are programmed jointly by a central DOT office and by district offices. The central office identifies and ranks bridges that are eligible for work under preventive maintenance, rehabilitation and replacement categories. Central office establishes the budget available to each district for these work categories. Districts respond with their selections among eligible bridges, and prepare project scope and cost estimates. Joint review by central office and district offices yields an agreed work program. Districts prepare their proposed programs within constraints of eligible bridges, available funding, and the priorities and initiatives of their DOT.

Programs are assembled as multi-year plans (Table 14). Major projects enter the program at a five- or six-year horizon, and detailed project development begins two years before the planned date for award. DOTs allocate funding for project development as projects enter the two-year window.

Contracting Mechanisms

Contracts for bridge maintenance work include *site* contracts that deliver a fixed schedule of repairs at a fixed set of bridges, *open-ended* contracts that provide specified maintenance actions, and *asset management* contracts that provide a level of service along a route (Table 15). Site contracts are construction contracts that deliver a set of repairs or treatments at bridges. Open-ended contracts offer a schedule of maintenance actions that district managers can direct to bridges. The contractor provides, in effect, additional maintenance crews. Asset management (AM) contracts place responsibility for both the identification of maintenance needs and the execution of work with the contractor. In AM contracts, DOTs make periodic inspections of assets to verify that level of service is adequate.

In the bid processes, site contracts entail bidding on a fixed schedule of items and fixed quantities. Open-ended contracts entail bidding on a fixed schedule of actions and estimated quantities; quantities are estimated for the first years' work in the contract based on known maintenance needs. AM contracts entail bidding on a schedule of actions and estimated quantities intended to deliver a specified level of service.

Preventive Maintenance

DOTs apply preventive maintenance actions to preserve bridges in good condition (Table 16). Preventive maintenance actions range from routine cleaning, to repairs of joints, to deck treatments, to deck and superstructure replacements. Some improvements are included, such as retrofits with cathodic protection systems. Virginia DOT includes a set of cyclic actions in preventive maintenance (Table 17).

One Florida district performs preventive maintenance tasks such as clearing drains and repairs of spalls at adaptable intervals. With each visit to bridges, crews perform the intended maintenance, and report the extent of work needed. The interval to the next work visit is adjusted, based on the work quantities just completed, to limit the accumulation of new defects.

DOTs report that preventive maintenance work is improving network conditions. Michigan reports that interstate routes now have 88% of bridges in good condition, up from 76% at the start of their strategic plan. Among MiDOT's state bridges, 89% are in good condition, up from 79% previously. More importantly, some MiDOT regions have already met the goals of 95% (interstate) and 85% (state-owned) bridges in good condition.

Federal Funds for Preventive Maintenance

Among DOTs included in the scan, Delaware, Michigan, New York and Virginia have agreements with FHWA to use federal HBP funds for specific preventive maintenance activities. Other DOTs have not ap-

plied for the use of federal HBP funds for preventive maintenance, or have applied but have not received approval.

Maintenance Tracking and Accomplishments

The maintenance needs noted by bridge inspectors, and entered into data systems, are tracked using those same data systems (Table 18). Districts perform and report work in response to the lists of maintenance needs compiled by central DOT offices. At some DOTs, work reports are verified by safety inspectors in the following inspection cycle.

Maintenance needs accumulate for some bridges until these needs are resolved in projects for bridge rehabilitation or replacement.

Effectiveness of Maintenance

For DOT central office, effectiveness of maintenance is expressed in performance measures. The success of maintenance is seen as improvement in performance measures, and in the persistence of good performance once it is achieved. For DOT districts, effectiveness is the timely and reliable execution of appropriate maintenance actions. Effectiveness is a part of selection, scheduling and completion of maintenance work, and of application of the appropriate maintenance methods and products (Table 19).

Effectiveness is improved by communication among maintenance personnel. Several DOTs have regular meetings or conferences that bring together different regions or different states to share information and experiences of their bridge maintenance programs.

Data Systems

DOTs use data systems for reporting inspections, for compiling maintenance needs, for tracking the completion of work, for assessing network conditions, for prioritizing bridge work candidates, and for cost evaluation and analysis (Table 20). Often, there is a separate software application for each use. Links between software applications are developed as data shells or web portals that present a single data view by drawing on multiple systems. DOTs deploy different portals for different users. Bridge inspectors see a portal adapted to detailed reporting of conditions. Maintenance supervisors see a portal adapted to lists of bridges and work needs. Project programmers see a portal adapted to bridge candidates, priorities and costs. DOT managers see a portal adapted to network performance measures and budgets in various work categories.

DOT practices differ in the application of standard entries for data items. DOTs in this scan require bridge inspectors to identify needed maintenance work. Some DOTs restrict these recommendations to selections from a list of standard actions. This makes a direct link to crew work planning, to project development and to reports of work completion.

Materials and Methods

DOTs that have maintenance crews are able to field trial new materials and techniques. Maintenance crews, working with the DOT Materials Engineer, assist in approving products to the Qualified Materials List. (Table 21)

Table 2 – Maintenance Categories

| DOT | Category | Note |
|------------|-------------------------------|--|
| California | Maintenance | Minor repairs |
| | Preservation | Joint repair & replacement, deck treatments and overlays |
| | SHOPPs | State Highway Operation & Protection Program - rehabilitations & replacements |
| Delaware | Crews | Clear vegetation and debris, repair erosion and erosion control measures, repair deck, slab, and approach slab spalls. repair ac overlay, clean scuppers and drains, clean/clear weepholes, clean/flush bearings/bearing seats, apply protective coating (for concrete), seal joints in slope paving and at abutment or wingwall |
| | Contract Maintenance | Larger repairs, items on open-ended maintenance contracts |
| | STIP | Rehabilitations and replacements |
| Florida | Periodic | Movable rebuild, deck major repair, superstructure or substructure major repair, paint system replacement, deck joint replacement, deck/slab overlay, scour countermeasures, fender repair replacement |
| | Routine | Deck joint maintenance and repair, deck maintenance and repair, railing maintenance and repair, superstructure maintenance and repair, channel maintenance and repair, electrical maintenance and repair, mechanical maintenance and repair, movable structural maintenance and repair |
| Michigan | Routine | Minor repairs by MiDOT crews following recommendations from inspections |
| | Capital scheduled maintenance | Superstructure washing, vegetation control, drainage system cleaning / repair, spot painting, joint repair / replacement, concrete sealing, minor concrete patching and repair, concrete crack sealing, approach pavement relief joints, slope paving repair |
| | Capital preventive maintain | Joint replacement, pin & hanger replacement, complete painting, zone painting, epoxy overlays, deck patching, scour countermeasures, hma overlay with waterproofing membrane, hma cap (no membrane) |
| | Rehabilitation | Concrete overlay, shallow concrete overlay, superstructure repairs, extensive substructure repair, substructure replacement |
| | Replacement | Deck replacement, superstructure replacement, structure replacement |

| DOT | Category | Note |
|------------|---|--|
| New York | Cyclical Maintenance: | Washing, lubricating bearings, and sealing concrete surfaces |
| | Minor Repairs: | Spall repair, minor joint repair, bolt tightening |
| | Corrective Maintenance, Major Repairs: | Cap beam/pier column repair, wing wall replacement, structural concrete repairs, steel beam repairs, etc. |
| | Major Bridge Rehabilitation, Replacement and Construction | Complete design review process |
| Ohio | Maintenance | Repairs of all bridge elements including abutments, wingwalls, and headwalls but excluding approach fill and approach slab |
| | Major maintenance | Painting, repairs and emergency patching of bridge decks to restore the structural integrity of a bridge. |
| | Routine maintenance | Clearing debris, sweeping, snow and ice removal, minor wearing surface patching, cleaning bridge drainage systems, marking decks for traffic control, minor and emergency repairs to railing and appurtenances, emergency patching of deck, maintenance of traffic signal and lighting systems |
| | Cyclic maintenance | Bridge cleaning |
| | Preventive maintenance | Sealing concrete surfaces |
| | Scheduled maintenance | Expansion Joint replacement, deck replacements & overlays , painting Structural Steel, Paving flowlines and replacing headwalls on culverts |
| | Reactive maintenance | Deck patching, Corrective repair from accidents, weather, etc. |
| Oregon | Maintain | Maintain: Brush, Drift removal, Concrete Caps & Sills, Concrete superstructure members, Steel superstructure members, Concrete deck, Curbs, Rail, Felloe guards, Concrete piling or posts, Steel piling or posts, Approach roadway, Deck joints, Bearings and seats, Catch basins, Fish restoration, Bridge protective screening |
| | Repair/Replace | Repair/Replace: Timber caps/sills, Steel caps/sills, Concrete caps/sills, Concrete superstructure members, Steel superstructure members, Timber superstructure members, Concrete deck, Wood deck, Curbs, Rails, Felloe guards, Timber pilings/posts, Concrete piling/posts, Steel piling/posts, Bracing, Metal decking, Deck joint, Bearings & seats, Rivets, Catch basins, Rip rap or Bioremediation, Slope paving, Drainage, Fender systems, Approach roadway work, Diving, Sounding, Fish restoration, Structure painting, Transient camp cleanup, Graffiti removal |
| | Major Maintenance | Replacing deteriorated timber elements, repairing/replacing joints, jacking end panels, deck overlays, deck sealing, strengthening, washing steel bridges, heat straightening bent steel, spot painting, cleaning bearings. Projects are usually less than \$250,000 |

| DOT | Category | Note |
|------------|------------------------|---|
| Virginia | Preventive Maintenance | Cleaning, Deck sealing, Joint repairs, Thin deck overlay |
| | Restoration | Rigid deck overlay, Superstructure repair, Substructure repair, Fatigue retrofit, Scour repair |
| | Rehabilitation | Superstructure replacement, Deck replacement, Culvert rehabilitation |
| Washington | Preservation | Bridge replacement, repairs to pier columns, movable bridge machinery, steel painting, deck overlays, deck replacement, seismic strengthening, and scour protection |
| | Maintenance | Similar to preservation, but with lesser scope, cost or complexity. Repairs to bridge rails, repairs to rail transitions, and repairs to fatigue cracks in steel stringers |
| | Other | Anchor cables for floating bridges. Ferry slips: Pile replacement, pile repair, pile cap repair or replacement |

Table 3 - Maintenance of Large Bridges

| DOT | Program | Note |
|----------|----------------------|---|
| Michigan | Big bridge program | Deck area 100,000 SF or greater Post-tensioned segmental concrete Movable bridges |
| Ohio | Major bridge program | More than 1000 feet in length Single bridge with deck area 81,000 SF or greater Twin bridges with deck area 135,000 SF or greater Spans the Ohio River Movable bridge Continuous/cantilever truss bridge Suspension bridge Cantilever truss span > 300 feet Arch, deck & through truss span > 250 feet Concrete deck arch span > 130 feet Continuous steel girder span > 150 feet Cable Stay span > 300 feet |

Table 4 – Assets to Maintain

| DOT | Assets |
|------------|---|
| California | Bridges, small structures, tunnels, earth retaining structures, pedestrian bridges, railroad bridges, overhead signs, local bridges |
| Delaware | Bridges, small bridges, pipes, sign structures, |
| Florida | Bridges, small bridges, sign structures, high mast lights |
| Michigan | Bridges, small bridges, pedestrian bridges, railroad bridges |
| New York | Bridges, small bridges, overhead sign structures, high mast lights |
| Ohio | Bridges, small bridges, railroad bridges, overhead structures |
| Oregon | Bridges, small bridges, overhead sign structures, tunnels |
| Virginia | Bridges, small bridges, tunnels, ferry slips, rest areas, welcome centers, commuter parking lots |
| Washington | Ferry terminals, transfer spas, hoists, walls, and dolphins |

Table 5 – DOT Maintenance Crews

| DOT | Crew | Note |
|------------|-----------------|--|
| California | General Maint. | District-based |
| | Painting | Twelve Crews: Six crews regional, six crews statewide. |
| Delaware | Structures crew | Actions: Bridge repair and maintenance, building maintenance, movable bridge maintenance, pipe (culvert) replacement, sign structure maintenance, concrete sealing, parapet painting, graffiti cleaning. |
| Florida | Bridge crew | Some, but not all, districts have bridge crews |
| Michigan | Bridge crew | All seven districts have bridge crews |
| New York | | Staff of 550 for bridge maintenance crews |
| Oregon | General Maint. | Fourteen crews for fifteen maintenance districts. Crews perform patching, deck sealing, joint replacement, epoxy injection, pile replacement, spot painting, and welding |
| | Dedicated crews | Four crews for DOT’s movable bridges |
| Virginia | Small bridge | For bridges with length less than 60 feet, bridge replacement, superstructure replacement, box culvert construction, timber deck replacement, bridge, widening, railing replacement, and other work |
| | General Maint. | Crews in each of nine DOT districts and each of forty-two construction residencies. |
| Washington | Dedicated crews | Crews for movable bridges. Crews for floating bridges |

Table 6 - Ohio Crew Titles

| Grade | Title | Note |
|--------------|----------------------|----------------------------------|
| HT 1 | Highway Technician 1 | General highway maintenance |
| HT 2 | Highway Technician 2 | Basic construction inspection |
| HT 3 | Highway Technician 3 | Lead worker |
| HT 4 | Highway Technician 4 | Construction contract inspection |
| HT 5 | Highway Technician 5 | Monitor field operations |

Table 7 - Identification of Maintenance Needs

| DOT | Staff | Note |
|------------|--------------------------------------|---|
| California | Bridge inspectors | From standard action matrix |
| Delaware | Bridge inspectors | From standard action list of work suitable for crews |
| Florida | Bridge inspectors | Inspectors' recommendations are reviewed by DOT committee |
| Michigan | Bridge inspectors | From standard action list |
| | Maint. Crews | Needs identified during normal work at bridges |
| New York | Regional Bridge Maintenance Engineer | From review of bridge inspection reports, bridge inventory, bridge history, and input from crew foremen |
| Ohio | Bridge inspectors | From standard action list |
| | County supervisors | Bi-weekly inspection |
| | Bridge Operations and Maintenance | Lists of maintenance needs compiled annually. Crew work goes to county supervisors. Contract work goes to OhDOT programming |
| Oregon | Maint. Crews | Annual inspections |
| | Regional Bridge Inspectors | Needs are sent to district maintenance supervisors by telephone, email or in-person |
| | Bridge Preservation Team | Lists of maintenance needs compiled annually by bridge engineering section. List is sent to district maintenance supervisors. Smaller needs are sent to district maintenance supervisor. Larger needs are sent to OrDOT's bridge program team |
| Virginia | Bridge inspectors | Recommend standard actions. Federal-eligible actions are identified in coding |
| Washington | Bridge inspectors | Needs identified in plain language, not standard list |
| | Bridge Preservation Office | Compiles list of maintenance needs collected from inspectors, crews, and other input |

Table 8 - Priorities of Work Needs

| DOT | Priority | Note |
|------------|---|--|
| California | Time to Repair | Recommendations range from 6 months to 10 years. Drop-down list. |
| Florida | Feasible Action Review Committee (FARC) | Committee in district reviews and prioritizes needs reported by bridge inspectors. 1 - Emergency, repair in 60 days 2 - Urgent, 180 days 3 - Routine, 365 days 4 - Informational, Monitor. |
| Michigan | Priority | <i>High, Medium or Low.</i> |
| New York | Red Structural Flag | Imminent failure of critical primary structural component. Resolve with 42 days |
| | Yellow Structural Flag | Potentially hazardous condition. Resolve within two years |
| | Safety Flag | Clear and present danger to vehicle or pedestrian traffic, but not structural failure |
| | Prompt Interim Action | Red or safety-flag condition needs immediate attention. Resolve within 24 hours |
| Ohio | Priority | 1 - Immediate 2 - Schedule 3 - Preventive |
| Oregon | Priority | Critical (NBI 3) Urgent (NBI 4) Routine (program this work) Monitor (do not program at this time). |
| Virginia | Priority | Order of recommendations on inspector's report indicates priority. Critical repairs, priority repairs, repairs. |
| Washington | Priority | Urgent – respond as soon as possible 1 – respond within 1 year 2 – regular work schedule 3 – no limit M – monitor |

Table 9 – Performance Measures

| DOT | Measure | Note |
|------------|----------------|---|
| California | Measure: | Percentage of elements in condition states 1 or 2 |
| | Goal: | 85% or greater |
| | Measure: | Percentage of bridges needing major maintenance |
| | Goal: | < 10% |
| | Measure: | Distressed bridges (bridges at risk or needing replacement) |
| | Goal: | < 5% |
| | Measure: | Count of SD and FO bridges |
| | Measure: | Count of bridges with Health Index < 80 |

| DOT | Measure | Note |
|------------|----------------------|--|
| Delaware | Measure: | Percentage of structurally deficient bridges |
| Florida | Measure: | NBI Structural Evaluation |
| | Goal: | 90% of the bridges rated 6 or higher |
| | Measure: | Timely completion of maintenance work orders |
| | Goal: | 90% for all work. 100% for priority 1 and priority 2 work |
| | Measure: | Programming for structurally deficient or weight-restricted bridges |
| | Goal: | Program within 6 years of identification |
| Michigan | Measure: | NBI Structural Evaluation |
| | Goal: | 95% of bridges on interstate roads in good condition (NBI 7 or higher) 85% of other bridges in good condition |
| New York | Measure: | NYS Condition Rating - Weighted average of 13 structural bridge component inspection ratings |
| | Investment Strategy: | Number of interstate bridges rated < 4.5 Number of NHS bridges rated < 4.0 |
| Ohio | Measure: | Network average values of Operational Performance Indices (OPI) see Ohio Priority Indicators |
| Oregon | Measure: | Number of on-system bridges that are structurally deficient. |
| Virginia | Measure: | Percentage of structurally deficient bridges |
| | Goal: | Less than 8 % structurally deficient bridges |
| Washington | Measure: | M A P – Maintenance Accountability Process; Level-of-service grades |
| | Measure: | NBI Structural Evaluation |
| | Goal: | Less than 8 % structurally deficient bridges |

Table 10 - Washington Maintenance Accountability Process (MAP)

| MAP Measure | Basis |
|---|--|
| 4A1 Bridge Deck Repair | Percentage area that is spalled. |
| 4A2 Structural Bridge Repair | Inspection interval, debris removal, bridge rail, traffic gates, navigation lights, etc |
| 4A3 Bridge Cleaning | Cleaning of the structure and bridge drains, and painting |
| 4B1 Movable and Floating Bridge Operation | Inspection interval, preventive maintenance and emergent maintenance) of mechanical, electrical and hydraulic components |
| 4B3 Urban Tunnel Systems | Preventive maintenance and emergent maintenance of electrical, air and fire suppression systems |

Table 11 - Priority Indicators

| DOT | Priority Indicator |
|------------|---|
| California | Painting: Paint index is a form of health index. Painting is programmed for Paint Index less than 65 (of 100) |
| | Multi-Objective Optimization: Combined application of Pontis analysis and utility functions, described in NCHRP project 12-67 |

| DOT | Priority Indicator | | |
|------------|---|------------------------|----------------|
| Delaware | Bridge Deficiency Formula, includes: Health index, Benefit cost ratio, Structural deficiency, Scour critical, Load capacity, Functional class, Detour length, AADT, AADTT, Functional obsolescence, Fracture critical status, Historical significance | | |
| New York | Component Indices | | |
| | NYS Condition Rating: A weighted average for 13 structural bridge component condition | | |
| Ohio | Organizational Performance Indices for Structure General Appraisals (GA), Wearing Surface (WS), Floor Condition (FC), and Paint Condition (PC) | | |
| Florida | NBI condition ratings. Structural deficiency | | |
| Michigan | NBI condition ratings | Replace | NBI 4 or lower |
| | | Rehabilitation | NBI 4 and 5 |
| | | Preventive maintenance | NBI 5 and 6 |
| | | | |
| Oregon | State-owned bridges: NBI condition ratings | Critical | NBI 3 or lower |
| | | Urgent | NBI 4 |
| | | | |
| | | | |
| | Local-owned bridges: Technical ranking formula that includes bridge sufficiency rating, load deficiency, detour length, use by emergency vehicles, functional class, and construction material | | |
| Virginia | Ranking by factors that include sufficiency rating, ADT, detour length, NBI structural evaluation, and load posting | | |
| Washington | NBI condition ratings. Structural deficiency | | |

Table 12 - Maintenance Budget Categories

| DOT | Category | Note |
|------------|-----------------------------|--|
| California | Contract maintenance | \$94MM current FY |
| | Crew maintenance | \$9MM current FY |
| | Bridge Preservation | \$94MM current FY |
| | SHOPP | \$300MM current FY |
| Delaware | Contract maintenance | \$1.5MM per year |
| Florida | Routine | Annual allocation to districts. State funds only. |
| | Periodic and rehabilitation | Allocation to districts by bridge condition and inventory. <i>Repairs</i> are state funds only. <i>Rehabilitations</i> include federal participation |
| Michigan | Preventive maintenance | 22% |
| | Bridge rehabilitation | 30% |
| | Bridge replacement | 48% |
| | Big Bridge Program | Separate allocation that equals about 10% of MR&R funding |

| DOT | Category | Note | |
|------------------------|--------------------------------|--|--|
| New York (FY 07-08) | Bridge improvements | <i>New bridges, replacements, rehabilitations</i> By contact: \$450MM for 296 bridges | |
| | Preventive maintenance | By crews & contract: \$142MM for 5812 bridges | |
| | Local bridges | \$257MM for 53 bridges | |
| | Crews | \$6MM for crew tools and materials | |
| Ohio | Maintenance | Allocation to districts based on current inventory in square feet of bridges that are deficient in General Appraisal, Floor Condition, Wearing Surface or Paint Condition. | |
| Oregon | Major bridge maintenance (MBM) | MBM funds are part of OrDOT's Statewide Transportation Improvement Program. MBM funds are \$15MM in 2012-2013; this is 16% of STIP funding | |
| | Crews | \$7.8MM in 2009-2011. | |
| Virginia | Maintenance | \$160MM statewide for all bridge work short of bridge replacement | |
| | Preventive maintenance | 15% | Funding allocations used in Pontis analysis, and in Project Optimizer for 11-year plan |
| | Painting | 10% | |
| | Restoration | 25% | |
| | Rehabilitation | 50% | |
| Washington | Crews | \$25.5MM current biennial funding | |
| | Bridge Preservation | \$250MM current biennial funding. | |

Table 13 - Coordination of Bridge Programming

| DOT | Category | Office | Note |
|------------|-----------------------|----------|--|
| California | Work recommendations | Central | Peer-review meeting to select maintenance actions |
| | Preservation & SHOPPS | Central | Structures Maintenance & Investigations |
| | | District | District maintenance staff |
| Delaware | Contract maintenance | Central | Bridge maintenance & operations |
| | | District | Supervisor for maintenance. Staff to manage contracts |
| Florida | Major repairs | District | District Structures Maintenance Engineer |
| | | Central | Bridge Operations, DOT Financial Management |
| | Routine maintenance | District | District Structures Maintenance Engineer directs work to crews or to standing contract |

| DOT | Category | Office | Note |
|-----------------|--------------------------|--|---|
| Michigan | Crew work | Regional | Bridge Manager |
| | | Sub-Regional | Transportation Service Center |
| | Maintenance projects | District | Region Bridge Staff |
| | | Central | Structure Maintenance Section |
| | Capital maintenance | Regional | Region Bridge Staff |
| Central | | Bridge Operations Office. Advertises call for projects to DOT regions. | |
| Long-range plan | Central | Asset Management Council, membership selected by Michigan governor | |
| New York | Maintenance projects | Regional | Regional Bridge Maintenance Engineer |
| | | Central | Bridge Maintenance Program Engineer |
| | Large projects | Regional | Regional Program and Planning Engineer Regional Structures Management Team |
| | | Central | Capital Maintenance |
| Ohio | Maintenance work plan | County | County supervisor, develops county work plan |
| | | Regional | Region manager reviews, and combines into region plan |
| | | Central | OhDOT's Program Management Committee. Reviews and combines into statewide plan |
| Oregon | Maintenance projects | District | District supervisors |
| | | Regional | Set district allocations. Assists in scheduling and permits. |
| | Major bridge maintenance | Central | Bridge Program Team |
| Virginia | Bridge replacement | District | District Bridge Engineer |
| | | Central | Structure and Bridge Division |
| Washington | Crew work | Regional | Regional crew supervisor. Work plan developed from BEISt repair list. |
| | Bridge preservation | Central | Bridge Preservation Office. May be altered by state legislature. |
| | | Regional | Region maintenance engineer |

Table 14 – Planning

| DOT | Note |
|------------|--|
| California | 5-year plan, updated every 2 years |
| Michigan | 4-year bridge replacement plan |
| Ohio | Multi-year work plan at district level |

Table 15 - Bridge Maintenance Contracting

| DOT | Contract | Note |
|------------|-----------------|---|
| Florida | AM | Along specific routes |
| Delaware | Open-end | 3-year duration, Standard maintenance actions and costs, Maximum contract amount |
| Michigan | Site | Capital scheduled maintenance, Capital preventive maintenance |
| New York | Site | Larger maintenance projects |
| | Job Order | An open-ended contract type using a construction task catalog of fixed prices. Suited to replacement-in-kind maintenance needs |
| | Hybrid | Contracts that provide bid items, quantities and engineering design plans for one among a set of similar projects. Schedule of bid prices are applied to additional, similar projects as quantities and engineering design become available |
| Florida | AM | Maintenance action executed when requested by DOT |
| | Site | Bridge rehabilitation, Bridge replacement |
| Oregon | Site | Small contracts are administered within districts. Larger projects go to OrDOT's central procurement. |
| Virginia | Open-end | District-wide contracts having 3-year duration and renewed each year. Contracts funded at \$2MM annually. Contracts have 95 bid items for both ordinary and preventive maintenance, and a mix of federal-eligible and non-eligible actions |
| | AM | Turnkey asset management (TAM) contracts are used for operations and minor repairs along interstate routes |
| | Design | Consultant design services are available to VaDOT districts through three, open-ended, regional contracts |
| Washington | Job Order | An open-ended contract type. Used for maintenance actions at ferry terminals |

Table 16 – Preventive Maintenance Actions

| DOT | Preventive Maintenance |
|------------|---|
| California | Crack sealing, deck overlays, replace joint seals, painting. Request for federal HBP funds is in review |
| Delaware | Deck Repairs, Treatments & Overlays, Painting, Cleaning, Pile jackets, Scour countermeasures, Bearing Replacement, Seismic retrofits. Uses federal HBP funds |
| Florida | Bridge deck cleaning, cathode protection systems. Movable bridges: lubrication, adjustment and general upkeep of mechanical and electrical systems. Does not use federal HBP funds |
| Michigan | Deck overlays, joint replacement, painting. Uses federal HBP funds |
| New York | Remove Brush, Maintain Stream Channels, Maintain Bank Protection & Walls, Clean Substructure, Seal Substructure, Lubricate Bearings, Repair Bearings, Clean Super & Deck, Repair Joints, Remove Wearing Surface, Place Wearing Surface, Place Membrane, Seal Deck, Seal Curb, Sidewalk, Fascia, Fill Cracks & Joints, Clean Drainage System, Spot Painting, Paint Bridges, Maintain Electrical & Mechanical Equipment. Uses federal HBP funds |

| DOT | Preventive Maintenance |
|------------|--|
| Ohio | Deck patching, Overhead loose material removal, Scour corrections, Resetting bearings Deck Repair and Replacement, Abutment Repair, Concrete Sealing, Replacement of Deck Edges, Box Culvert Installation, Approach Slab Repair and Replacement, Drainage Repair, including scupper extensions, Pile Encasements, Bridge and Deck Cleaning, Resetting / Repair Bearing Devices, Scour Protection / Channel Alignment. Does not use federal HBP funds |
| Oregon | Washing steel bridges, spot painting, and deck sealing. Does not use federal HBP funds |
| Virginia | Seal/replace leaking joints, Deck overlays, Painting spot and zone, Cathodic protection systems, Electrochemical chloride extraction (ECE), Scour countermeasures, Removal of large debris, Fatigue Retrofit, Concrete deck repairs during overlay, Substructure repairs during cathodic protection or ECE, Sealants for concrete by coating or membrane, Bridge cleaning or washing. Uses federal HBP funds |
| Washington | Bridge cleaning, drain clean/repair, painting. Federal HBP funds used for preservation, not preventive maintenance |

Table 17 - Virginia DOT PM intervals

| Action | Interval |
|--|-----------------|
| Wash bridge, Sweep bridge | 1 year |
| Wash bearing seats | 2 year |
| Timber bridges-Tighten bolts, Apply preservative | 2 year |
| Bearings – Clean and lubricate | 4 year |
| Culvert– Clean | 5 year |
| Joints-Replace pourable seal | 6 year |
| Joints-Replace compression seal | 10 year |
| Paint ends of steel beams | 10 year |
| Deck –Thin epoxy overlay | 15 year |

Table 18 - Maintenance Tracking

| DOT | Tracking |
|------------|---|
| California | Completion reports from state crews. Completion reports for contracts. |
| Delaware | Crews report completion to Maximo, a maintenance management system. Completion reports are later copied to Pontis' inspection comment field. |
| Florida | Crew report completion to online maintenance management system. Priority 1 & 2 repairs are verified by special inspection. Other repairs are verified at next regular inspection. |
| Michigan | Crew work completion is reported to Maintenance Activity Reporting System (MARS). Contract work completion is reported annually to district inspection team |
| New York | Crew work completion is reported to MAMIS, a maintenance management system. Annual reports sent from MAMIS to regional bridge maintenance engineer, and transferred to bridge inspection database. |
| Ohio | Completion reported to Transportation Management System (TMS) |
| Oregon | Crew supervisors report work completion to Pontis. Regional bridge inspectors verify work at next regular inspection. |
| Washington | Work completion reported to BEIS, and verified at next regular inspection. |

Table 19 - Maintenance Effectiveness

| DOT | Activity | Note |
|------------|-------------------|---|
| California | Meetings | Biennial Pacific Northwest Bridge Maintenance Conference; a multi-state conference for bridge maintenance personnel |
| Florida | Meetings | Five or six teleconferences annually among DOT central office and districts to exchange information on maintenance materials and methods |
| | Quality Assurance | Districts maintenance programs undergo annual review. A sample of work orders are reviewed for appropriate recommendation, for appropriate priority and timely completion |
| Michigan | Meetings | Annual 1-1/2 day Bridge Maintenance conference attended by DOT region crews, bridge inspectors/engineers, county personnel as well as material and equipment suppliers |
| | | Monthly meetings of Region Bridge Teams that include bridge inspectors, bridge programmers, maintenance supervisors and transportation service center representative |
| Oregon | Meetings | Biennial Pacific Northwest Bridge Maintenance Conference; a multi-state conference for bridge maintenance personnel |
| | | OrDOT statewide maintenance conference, held biennially to alternate with the Pacific Northwest Bridge Maintenance Conference |
| | Quality Assurance | OrDOT uses bridge design engineers as part of teams for quality assurance review of districts. This involvement helps inform design practice |

| DOT | Activity | Note |
|------------|--------------|---|
| New York | Meetings | Several meetings each year of the regional structures management team: the regional structures engineer, the regional bridge management engineer and the regional bridge maintenance engineer |
| | | Statewide quarterly meetings of regional bridge maintenance engineers and their staff along with liaisons for the Structures Division and the Technical Services Division |
| | Publications | Bi-monthly <i>Bridge Maintenance Newsletter</i> |
| Washington | Meetings | Biennial Pacific Northwest Bridge Maintenance Conference; a multi-state conference for bridge maintenance personnel |

Table 20 –Data Systems

| DOT | System | Note |
|------------|-------------------------------|--|
| California | SMART | Structure Maintenance Automated Report Transmittal – inspection and work reporting |
| | BIRIS | Bridge Inspection Records Information System – presentation of reports and photos |
| | LP 2000 | Data for local government bridge programs |
| | Pontis | AASHTOWare bridge management system |
| | IMMS | Integrated Maintenance Management System – crew reporting |
| | TSN | Traffic information system – provides ADT and other roadway data |
| Delaware | MAXIMO | Maintenance management system |
| | Pontis | AASHTOWare bridge management system |
| Michigan | Oracle | Central database for bridges, roads and other transportation assets |
| | TMS | Transportation Management System – Suite of portals to Oracle database adapted to various DOT users |
| | MARS | Maintenance Activity Reporting System – System to report maintenance costs and track work completion |
| | MBIS | Michigan Bridge Inspection System – inspection reporting |
| | MBRS | Michigan Bridge Reporting System – general access to bridge data Used for bridge lists (SD, FO, etc.) Used in development of 5-year plans |
| | Possible Projects | Automated scoping and cost estimating for bridge projects. Forecasts network conditions resulting from projects |
| | BCFS | Bridge Condition Forecasting System – used in programming Markov chains applied to NBI condition ratings |
| New York | MAMIS | Work reporting system – crew reporting |
| | Bridge Program Worksheet | Microsoft Access – used in capital programming Includes risk for bridges |
| | Needs Assessment Tool | Microsoft Access – used in capital programming Provides forecasts for 5-, 12- and 2-year planning horizons |
| | Bridge Needs Assessment Model | Bridge condition curves calibrated to each bridge construction material and each DOT region. Curves respond to corrective and preventive maintenance programs. Used in capital programming |

| DOT | System | Note |
|------------|---------------|--|
| Ohio | BMS | Contains bridge inventory and appraisal data |
| | Ellis | Tracks project development |
| | TMS | Tracks bridge inspection & maintenance crew work |
| | BMRI | Bridge Management Remote Inspection – inspection reporting |
| Oregon | Pontis | Bridge inventory and condition data. Not used for programming work candidate section is used to identify and track maintenance needs |
| | MMS | Funding and tracking of work of maintenance crews |
| Virginia | Site Manager | Work accomplishment in district-wide maintenance contracts |
| | Pontis | For inventory and condition data |
| | CrossWalk | Relates Pontis actions to maintenance subprograms |
| | Optimizer | Post-processor for Pontis to generate 11-year maintenance work analysis |
| Washington | Bridgit | Bridge management developed in NCHRP project 12-28 |
| | TRAINS | Labor reporting system |
| | BEISt | Bridge Engineering Information System. Database of repair needs and completion reports |
| | SI | Application for bridge inspection reporting |
| | MPET | Maintenance Performance Enhancement Tool - Work order tracking. Automated generation of work orders for cyclic work |
| | BRL | Bridge Repair List |

Table 21 - Maintenance Materials

| DOT | Component | Note |
|------------|---------------------|---|
| California | Deck | High molecular weight methacrylate for crack sealing. Spread on surface and broadcast with sand for skid resistance |
| | Deck | Polyester concrete overlay. In use since 1985. Placed 9.1MM Sf in the past 10 years |
| | Painting | QuikDeck ⁵ and SafeSpan ⁶ used for painting platforms. Containment is watertight, allows for humidity control during painting |
| Florida | CFRP | Use of carbon fiber reinforced plastic repairs for 15 years |
| | Bridge | Controlled load testing to provide bridge load ratings, and to allow overloads |
| | Cathodic protection | Extensive use of both sacrificial and impressed cathodic protection for bridges and bridge components exposed to salt water |
| Michigan | Repair materials | Central construction testing lab uses maintenance crews to test and evaluate new materials |
| Virginia | Deck | Very early rapid set latex concrete carries traffic 3 hours after placement |
| | Deck | Trial decks with corrosion resistant reinforcing steels comparing stainless steel, stainless clad and MMFX reinforcing bars |
| Washington | Suspender ropes | Self contained paint removable by flexing steel ropes to shatter old, brittle paint |
| | Deck | Inspection by van-mounted video cameras for decks in good condition |

⁵ <http://www.safway.com/Products/QuikDeck.asp>

⁶ <http://www.safespan.com/>

Table 22 - Contacts at Agencies in the Scan

| | |
|-----------------------------|--|
| California DOT | Barton J. Newton, State Bridge Maintenance Engineer California Department of Transportation (CALTRANS) 1120 N Street Sacramento, California 95814 United States T: 916-227-8841, C: 916-997-8188, F: 916-227-8357 Barton_Newton@dot.ca.gov |
| El Dorado County DOT | Matt Smeltzer, Supervising Civil Engineer El Dorado County DOT, Bridge Unit Building C, 2nd Floor 2850 Fairlane Court Placerville, CA 95667 T: 530-621-5916, F:(530) 626-0387 msmeltzer@co.el-dorado.ca.us |
| Placer County DOT | Matt Randall, PE Senior Civil Engineer / County Bridge Engineer & Program Manager County of Placer Department of Public Works 530-741-3564, Fax: 530-745-3540 mrandalkplacer.ca.gov |
| Delaware DOT | Calvin W. Weber, Jr., Bridge Maintenance Engineer Bridge Management Central District Delaware DOT 930 Public Safety Blvd Dover, DE 19901 T: 302-760-2598, F: 302-739-3854 calvin.weber@state.de.us |
| Florida DOT | Richard I. Kerr, Bridge Management Inspection Engineer Rhyne Building 2740 Centerview Drive Tallahassee FL 32399-2100 Florida DOT T:(850) 410-5808, F:(850) 410-5511 richard.kerr@dot.state.fl.us |
| Florida Turnpike Enterprise | Aran Lessard, Florida Turnpike District Structure Maintenance Engineer FDOT Turnpike Operations Center MP 65 on Florida's Turnpike, Pompano Beach, Florida 33069 T:954-934-1234 aran.lessard@dot.state.fl.us |
| Michigan DOT | David A. Juntunen, Engineer of Bridge Operations Michigan DOT Construction & Technology Division 8885 Ricks Road Lansing MI 48909 Phone (517) 322-5688, Cell (517) 749-8034, Fax (517) 322-5664 JuntunenD@michigan.gov |

| | |
|----------------|---|
| Ohio DOT | Michael Loeffler, P.E. Bridge Inspection & Maintenance Office of Structure Engineering T: 614-466-4050, Cell: 614-395-9414 Mike.Loeffler@dot.state.oh.us |
| Washington DOT | DeWayne Wilson Bridge Management Engineer T: 360-705-7214 wilsond@wsdot.wa.gov |
| Virginia DOT | Anwar S. Ahmad, P.E., Assitant State Structure and Bridge Engineer Structure & Bridge Division 1401 E. Broad St. Richmond, VA 23219 T: 804-786-2853, C:(804) 263-1560, F: 804-786-7787 Anwar.Ahmad@vdot.virginia.gov |