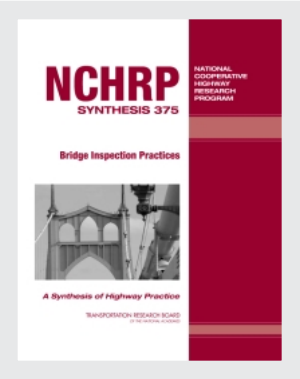

Bridge Inspection Practices

DETAILS

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NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

NCHRP SYNTHESIS 375

Bridge Inspection Practices

A Synthesis of Highway Practice

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SUBJECT AREAS
Bridges, Other Structures, Hydraulics and Hydrology, and Maintenance

Research Sponsored by the American Association of State Highway and Transportation Officials
in Cooperation with the Federal Highway Administration

TRANSPORTATION RESEARCH BOARD

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FOREWORD

By Staff
Transportation
Research Board

Highway administrators, engineers, and researchers often face problems for which information already exists, either in documented form or as undocumented experience and practice. This information may be fragmented, scattered, and unevaluated. As a consequence, full knowledge of what has been learned about a problem may not be brought to bear on its solution. Costly research findings may go unused, valuable experience may be overlooked, and due consideration may not be given to recommended practices for solving or alleviating the problem.

There is information on nearly every subject of concern to highway administrators and engineers. Much of it derives from research or from the work of practitioners faced with problems in their day-to-day work. To provide a systematic means for assembling and evaluating such useful information and to make it available to the entire highway community, the American Association of State Highway and Transportation Officials—through the mechanism of the National Cooperative Highway Research Program—authorized the Transportation Research Board to undertake a continuing study. This study, NCHRP Project 20-5, "Synthesis of Information Related to Highway Problems," searches out and synthesizes useful knowledge from all available sources and prepares concise, documented reports on specific topics. Reports from this endeavor constitute an NCHRP report series, *Synthesis of Highway Practice.*

This synthesis series reports on current knowledge and practice, in a compact format, without the detailed directions usually found in handbooks or design manuals. Each report in the series provides a compendium of the best knowledge available on those measures found to be the most successful in resolving specific problems.

PREFACE

This synthesis reports on bridge inspection practices in the United States and selected foreign countries. Specifically, it is a collection of information on formal inspection practices of departments of transportation (DOTs). For U.S. inspection practices, information is presented on inspection personnel (staff titles and functions, qualifications, training and certification, inspection teams, and the assignment of teams to bridges), inspection types (focus, methods, and frequency), and inspection quality control and quality assurance by the DOT inspection programs. Foreign practices are also presented according to inspection personnel, types, and quality programs. Also examined are uses agencies make of information gathered from bridge inspections, what triggers repairs, and plans for future development of inspection programs. Information from Canadian sources can be found in Appendix C.

Information for the study was collected through a DOT survey and reviewed bridge inspection manuals. Information was also obtained from 7 European transportation agencies and the South African transportation agency.

George Hearn, Department of Civil, Environmental, and Architectural Engineering, University of Colorado, Boulder, collected and synthesized the information and wrote the report. The members of the topic panel are acknowledged on the preceding page. This synthesis is an immediately useful document that records the practices that were acceptable within the limitations of the knowledge available at the time of its preparation. As progress in research and practice continues, new knowledge will be added to that now at hand.

CONTENTS

BRIDGE INSPECTION PRACTICES

SUMMARY

This synthesis reports bridge inspection practices in the United States and selected foreign countries. The synthesis is a collection of information on formal inspection practices of departments of transportation (DOTs). These are primarily visual inspections and they provide data to bridge registries and databases. For U.S. inspection practices, this synthesis reports on inspection personnel, inspection types, and inspection quality control and quality assurance. Staff titles and functions in inspection programs are reported, together with qualifications and training of personnel, formation of inspection teams, and assignment of teams to bridges. Inspection types are described in terms of their scope, methods, and intervals. Quality control and quality assurance programs are reviewed in terms of the procedures employed, staff involved, quality measurements obtained, and the use of quality findings in DOT inspection programs. Foreign practices are presented in the same organization of inspection personnel, types, and quality programs. Comparisons of U.S. and foreign inspection practices are included.

Information was obtained from a questionnaire sent to U.S. state transportation departments, similar questionnaires modified individually for transportation agencies in selected foreign countries, and formal documents used by transportation departments and agencies. These documents primarily included bridge inspection manuals, inspection training manuals, and technical memoranda, but also included blank forms for inspections, DOTs' job descriptions for inspectors, and descriptions of inspection training courses. Overall, this synthesis includes information from forty U.S. state transportation departments and from roads agencies in eight foreign nations (Denmark, France, Finland, Germany, Norway, South Africa, Sweden, and the United Kingdom). The synthesis also includes, in an appendix, information from a few provincial and municipal transport agencies in Canada.

Information collected in this synthesis supports findings in two broad areas: inspection practice at U.S. state DOTs in relation to U.S. federal regulations and the scope and kind of bridge inspection programs in foreign counties.

U.S. federal regulations, called the National Bridge Inventory Standards (NBIS), establish rules on the structures to inspect, the intervals of inspection, and the qualifications of personnel. U.S. state DOTs implement the NBIS and also expand on the standards. State programs inspect more structures, perform some inspections more frequently, and place additional requirements on qualifications of personnel.

NBIS require periodic inspection of bridges and culverts on public roads having a span greater than 20 ft. Many U.S. states inspect bridges and culverts having shorter spans, and inspect other structures such as sign structures, high-mast lights, retaining walls, and ferry terminals.

NBIS set basic intervals for three types of bridge inspection: routine inspection (24 months), fracture-critical member inspection (24 months), and underwater inspection (60 months). Many states set intervals for interim inspections, for in-depth inspections, and for hands-on inspections, as well as for some types of testing and measurements at bridges. Usually states estab-

lish the use and interval for inspections based on structure type, structure condition, roadway class, and traffic volume.

Many U.S. state DOTs require that inspection program managers be licensed professional engineers (PEs). NBIS do not require PEs. U.S. state DOTs require PEs to have experience in bridge inspection before acting as inspection team leaders. NBIS does not require experience for PEs who are team leaders.

NBIS require that states have procedures for quality assurance and quality control for their inspection programs. Quality programs at state DOTs include reviews of inspection reports, verification of inspections at some bridges, field visits by supervisors to inspection teams at work, periodic on-site reviews of regional and local bridge inspection programs, and continuing training of inspection personnel

In foreign countries, road agencies in national governments are responsible for bridges and other structures on national roads. Bridges on provincial and local roads are not regulated by national road agencies.

Bridge inspection programs in foreign agencies include frequent, sometimes daily, visits to structures by maintenance contractors, annual checks on bridges by maintenance contractors or by national agencies, inspection of known defects at 3-year intervals usually by national agencies, and thorough inspection of bridges at 6-year intervals, again usually by national agencies.

Inspection programs, overall, combine long-interval inspections by PEs, medium-interval inspections by certified inspectors, and short-interval checks and visits by maintenance contractors.

U.S. and foreign practices for bridge inspection differ in the jurisdiction of national transport agencies, the use of maintenance contractors within bridge inspection programs, the qualifications of bridge inspectors, and the focus and intervals of bridge inspections.

In the United States, federal regulations affect all bridges on public roads. As a result, there is near uniformity in the basic features of inspections programs at U.S. state DOTs. In foreign countries, national transport agencies regulate the national roads only. Transport agencies of provincial and local governments often follow the inspection practices of their national agencies, but this is not required.

Foreign countries use contractors to maintain roads and bridges, often as long-term concessions. The maintenance contract undertakes daily visits, annual checks, and, in general, all shot-interval inspections. The transport agency performs longer-interval inspections. In the United States, state DOT personnel perform most inspections at all intervals. Inspection consultants are employed, but for inspection services alone, and not as one of the services within a larger maintenance agreement.

In foreign countries, qualifications for inspectors range from road foremen to licensed PEs. The higher qualifications are required for the longer-interval inspections. The U.S. NBIS establish a single level of qualification and require this for all inspections.

In foreign practice, short-interval inspections are limited intensity or limited scope. That is, frequent visits to bridges are quick checks for new defects or quick checks on the status of known defects. In the United States, underwater inspections and inspection of fracture-critical members are both limited-scope inspections. U.S. state DOTs' use of interim inspections is often directed at known defects. Frequent cursory inspections are not typical of U.S. inspection programs.

CHAPTER ONE

INTRODUCTION

TRANSPORTATION AGENCIES AND INFORMATION SOURCES

This synthesis on bridge inspection practices is based on information collected from department of transportation (DOT) source documents including inspection manuals, blank inspection forms, technical memoranda, job announcements, and training course descriptions; from a standard questionnaire distributed to DOTs in the United States and Canada; and from individualized questionnaires sent to countries that participated in the 2003 FHWA/AASHTO scan trip on bridge preservation (Denmark, Finland, France, Germany, Norway, Sweden, South Africa, and the United Kingdom).

Responses to the standard questionnaire were obtained from 28 U.S. state transportation agencies and six Canadian transportation agencies. U.S. respondents were Alaska, Arizona, Arkansas, California, Delaware, Idaho, Iowa, Kentucky, Maine, Maryland, Michigan, Missouri, Nevada, New Mexico, New York, North Carolina, North Dakota, Ohio, Oregon, Pennsylvania, Rhode Island, South Dakota, Texas, Utah, Vermont, Virginia, Washington, and West Virginia. Canadian respondents were the provinces of Alberta, New Brunswick, Ontario, and Quebec and the cities of Edmonton and Ottawa.

Bridge inspection manuals or other documentation were obtained from U.S.DOT Eastern Federal Lands and the following 26 U.S. state transportation agencies: Alabama, California, Colorado, Connecticut, Florida, Georgia, Idaho, Illinois, Iowa, Kentucky, Massachusetts, Michigan, Minnesota, Missouri, Montana, New Jersey, New York, Ohio, Oklahoma, Oregon, Pennsylvania, Tennessee, Texas, Virginia, Washington, and Wisconsin. Bridge inspection manuals were obtained from the Canadian provinces of Alberta and Ontario.

The synthesis also presents information obtained from the following foreign transportation agencies: Danish National Roads Directorate, Finnish National Roads Administration, French National Roads Directorate, German Federal Highways Research Institute, Norwegian National Roads, Swedish Roads Administration, South African National Roads Limited, and the United Kingdom Highways Agency.

Because this synthesis lacks information from the majority of Canadian provinces and territories, the main body of the text does not include Canadian information. However, it does include an appendix (Appendix C) that presents the set of Canadian information that was obtained. Where the synthesis offers findings on "foreign practices," these findings do not include Canada.

Standard manuals and guides used in U.S. bridge inspection are included in Table 1. Table 2 lists inspection manuals from foreign sources.

OVERVIEW OF INSPECTION PRACTICES

Road Agencies

Most nations included in this synthesis have road agencies at three administrative levels: national, state, and local (see Table 3). National agencies perform relatively few bridge inspections. Instead, inspections are delegated to state DOTs in U.S. practice, to inspection consultants in many foreign nations, and to federal states or departments, respectively, in Germany and France.

Inspection Personnel

Most U.S. state DOTs have a central office inspection program manager, district program managers, and inspection team leaders based in districts. Some DOTs have central teams for statewide work on underwater inspections, emergency inspections, or quality assurance inspections.

U.S. federal regulations do not require a professional engineering (PE) license for inspection program managers or inspection team leaders. Instead, a PE license obviates federal requirements for bridge inspection experience both for program managers and for team leaders. Many U.S. state DOTs require a PE license for inspection program managers and some state DOTs require a PE license for inspection team leaders. Many state DOTs require bridge inspection experience for all inspection team leaders, and do not accept a PE license as a substitute.

U.S. federal regulations establish qualifications for inspection team leaders and for divers, but not for other inspection team members. Foreign practice recognizes two or three levels of qualification of inspectors, and relates qualification to inspection type (see Table 4).

TABLE 1
STANDARD MANUALS AND GUIDES USED IN U.S. BRIDGE INSPECTION

Publisher	Document
AASHTO	*Commonly Recognized* (*CoRe*) *Structural Elements* (2001).
	Manual for Condition Evaluation of Bridges, 2nd ed. (2000).
	Movable Bridge Inspection, Evaluation, and Maintenance Manual (1998), 608 pp.
	Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals, 4th ed. (2001), 272 pp.
FHWA	*Bridge Inspector's Reference Manual*, FHWA NHI 03-001(2002), 1,762 pp.
	Bridge Scour and Stream Instability Countermeasures Experience, Selection, and Design Guidance, 2nd ed., NHI-01-003 (2001).
	Culvert Inspection Manual, FHWA-IP-86-2 (1986).
	Highway and Rail Transit Tunnel Inspection Manual, FHWA-IF-05-002 (2005), 112 pp.
	Inspection of Fracture Critical Bridge Members, FHWA-IP-86-26 (1986), 232 pp.
	Recording and Coding Guide for the Structural Inventory and Appraisal of the Nation's Bridges, FHWA-PD-96-001 (1995), 124 pp.
	Underwater Inspection of Bridges, FHWA-DP-80-1 (1989).
USDA	*Timber Bridges Design, Construction, Inspection, and Maintenance* (1992), Forest Service.

TABLE 2
INSPECTION MANUALS—FOREIGN SOURCES

Nation	Document
Denmark	*Inspection of Bridges* (1994), Danish National Road Directorate, 175 pp.
Finland	*Guidelines and Policy for Bridge MR&R Operation*
	Guidelines for Bridge Inspection
	Bridge Inspection Manual
	Bridge Repair Manual (SILKO–Guidelines)
Germany	*Highway Structures Testing and Inspection*, DIN 1076 (1999), Deutsche Norm, 10 pp.
	Preservation and Maintenance (n.d.), Construction and Housing, German Federal Department of Transportation, 23 pp.
	Guideline for the Structural Design and Equipment of Bridges for Monitoring, Inspection and Maintenance (1997), German Federal Department of Transportation, 6 pp.
	Recording and Assessment of Damages, Guideline RI-EBW-PRÜF, 1998.
	ASB Structure Inventory, (coding manual for *SIB–Bauwerke*) (1998).
Norway	*Handbook for Bridge Inspections* (2001), Norwegian Public Roads Administration, 339 pp.
United Kingdom	*Requirements for Inspection and Management of Bridges*, BD 62/94 and BD 63/94.
Canada, Alberta	*BIM Inspection Manual*, Version 3 (2005), Alberta Infrastructure and Transportation.
	BIM Inspection Manual—Level 2, Version 1 (2004), Alberta Transportation, 153 pp.
Canada, Ontario	*Ontario Structure Inspection Manual* (2000), Ontario Ministry of Transportation, 380 pp.

TABLE 3
ROAD AGENCIES, ADMINISTRATIVE LEVELS

Nation	National Agency	State/Province[a]	Local
United States	FHWA	State DOTs	County, municipal
Denmark	National Roads Directorate	Regional road agencies	Municipal agencies
Finland	Road Administration		Municipal agencies
France	National Road Directorate	Inter-departmental[b] road agencies (11)	Conseil Général
Germany	Federal Ministry of Transport, Building and Urban Affairs	State road agencies (16)	County, municipal, and rural
Norway	Public Roads Administration (PRA)	PRA regions (5)	Local road agencies
South Africa	National Roads Agency Limited	Provincial departments of transport (9)	Municipal transport agencies
Sweden	Roads Administration	Regional road agencies (7)	Municipal road agencies
United Kingdom	Highways Agency	Highways Agency maintenance areas (14)	Local road agencies

[a]Number of agencies in parentheses.
[b]A French *department* is similar to a U.S. *state*.

TABLE 4
BRIDGE INSPECTORS

Nation	Inspector	Inspections
United States	Team leader	All
Denmark	Bridge inspectors	Principal inspections—6 years
	Road foreman	Annual inspection
	Roadman	Daily inspection
Finland	Engineer—Certified bridge inspector	Basic inspection—5 years
	Certified bridge inspector	General inspection—5 years
	Road foreman	Annual inspection
France	Certified inspector	Detailed inspection—6 years
	Inspection agent	IQOA—3 years
	Road maintenance agent	Annual inspection
Germany	Bridge inspector	Major test—6 years
	Road maintenance crew	Superficial inspection—3 months
South Africa	Senior bridge inspector	Verification inspections—QA
	Bridge inspector	Principal inspection—5 years
	Maintenance personnel	Annual inspection
Sweden	Bridge inspector	Major inspection—6 years
	Maintenance contractor	Annual inspection
United Kingdom	Supervising engineer	Principal inspection—6 years
	Bridge inspector	General inspection—3 years

IQOA = Image de la Qualité des Ouvrages d'Art (Image of the Quality of Bridges, Walls, and Tunnels).

Bridge Inspections

U.S. federal regulations define eight types of bridge inspection. Three are periodic: routine inspection, fracture-critical member inspection, and underwater inspection. U.S. state DOTs establish more detailed guidelines providing for periodic use of hands-on inspection, close-up access, and collection of quantitative data. State DOTs establish guidelines for short-interval, interim inspections in response to bridge defects, conditions, or load posting. State DOTs also establish guidelines for long-interval, in-depth inspections for selected bridge types and bridge elements. Foreign road agencies define between four and eight types of inspection. Each foreign agency defines two or three routine inspections at different intensities and at different intervals.

Ninety-five percent of U.S. routine inspections are performed at intervals of 24 months or less. Foreign road agencies perform detailed inspections at 5- or 6-year intervals in combination with less detailed check inspections at intervals of 1 to 3 years.

Most U.S. state DOTs use two-person teams for bridge inspections. At a few DOTs, routine inspections are made by individual inspectors. Equal numbers of state DOTs either rotate inspection teams to new bridges periodically or prefer that inspection teams inspect the same set of bridges each cycle.

Most U.S. state-owned bridges are inspected by state DOT personnel. Inspection consultants perform underwater inspections, inspections of some large bridges, and inspections of local agency bridges. Foreign road agencies delegate many inspections to consultants or to maintenance contractors.

Quality Control and Quality Assurance

At most U.S. state DOTs, the inspection program manager guides quality control (QC) and quality assurance (QA) policies and execution. U.S. state DOTs make QC reviews of inspection reports. QC verifies that inspection reports are accurate and complete; that there are sufficient notes, sketches, and photographs of conditions; and that recommendations for maintenance are appropriate.

Most U.S. DOTs use peer team leaders to review inspection reports. At some DOTs, the district inspection manager or other staff performs additional QC review of a sample of inspection reports. Some DOTs make specific QC reviews for inspections of bridges that have poor conditions, significant defects, or posting for load.

For a sample of bridges, QC/QA programs often include field activities such as:

- Independent inspection by a peer inspection team.
- Verification by a peer team of the current inspection report.
- Joint audit of the current inspection report by a peer team and the inspector of record.
- Site visit by an inspection supervisor to an inspection team at work.
- Inspection of control bridges as part of periodic workshops or training.

QA activities usually focus on a DOT region or on a local bridge owner. QC activities usually focus on a team leader or inspection team. Focus determines how samples of bridges are selected and where findings on quality are directed. QA

review collects a sample of bridges in a region and discusses findings in a close-out meeting with region staff. QC collects a sample of bridges for a team, and discusses findings with the team and their immediate supervisors.

QA activities verify that inspection personnel are qualified, that staff and equipment are adequate for the workload, that bridge files and bridge lists are maintained, and that there is appropriate follow-up on significant findings. Intervals for QA review range from 12 months to 48 months.

Refresher training for bridge inspectors is a part of QA at most U.S. state DOTs.

Foreign practice delegates most QC responsibilities to consultants performing inspections. Road agencies require and review consultants' QC plans as part of contract administration.

Foreign QA activities center on periodic advanced training that usually includes inspection of control bridges and discussions among inspectors at the training.

CHAPTER TWO

TRANSPORTATION AGENCIES

U.S. INSPECTION INVENTORY

U.S. federal regulations require the periodic inspection of bridges on public roads with a span of greater than 20 ft (*1*). State DOTs may inspect other highway structures such as sign bridges, high mast lights, tunnels, and retaining walls, as well as minor bridges with span of 20 ft or less. Structures such as pedestrian bridges and railroad bridges that cross public roads are also inspected, either directly by the DOT or bridge owners.

The counts of National Bridge Inventory (NBI)-eligible structures among U.S. states range from fewer than 800 in Rhode Island to more than 49,000 in Texas (Table 5). These include bridges owned by the state government, local governments, tollway authorities, and others. Although the responsibility for compliance with federal regulations at all bridges is imposed on the state government and by extension the state DOT, inspection of bridges may be done by bridge owners, subject to review and approval by the state DOT.

The set of NBI-eligible structures includes approximately 471,000 bridges and 125,000 culverts. Of these, 499,000 are water crossings, 38,000 require underwater inspection, 22,000 are fracture-critical, and 84,000 are posted for load capacity (see Table 5).

ADMINISTRATIVE LEVELS

U.S. road agencies exist at national, state, and local levels. At the national level, the FHWA is concerned with the infrastructure of public roads throughout the nation. The FHWA executes the bridge inspection programs for many federally owned bridges on public roads and regulates the inspection of public roads bridges owned by others. U.S. state transportation departments execute bridge inspection programs for state-owned bridges and variously execute, regulate, or review inspection programs for bridges owned by others within the state. Local governments are among these other owners. Inspection of local governments bridges are performed by local agency staff, by consultants hired by local road agencies, or by state DOT staff.

Federal regulations address bridge inspection population, inspection intervals, inspection methods, inspection personnel, and inspection reporting. Federal requirements are presented primarily in the *Code of Federal Regulations* (*1*) and, by reference, in FHWA guides and manuals (*3,4*), AASHTO manuals (5–7), and National Highway Institute (NHI) courses. State DOTs, acting within the limits of federal regulation, develop additional requirements and provide more detailed statements of inspection program requirements.

ROAD AGENCIES IN OTHER NATIONS

Denmark—Danish Road Directorate

The Danish Road Directorate administers 4000 km of roadways; approximately 5% of the total public road network in Denmark (see Table 6). The Directorate's responsibilities include bridges, tunnels, retaining walls, noise barriers, sign structures, and ferry berths.

In 2006, Denmark had national roads, regional roads, and local roads, and a corresponding three levels of road agencies. A reorganization that became effective in 2007 eliminated county agencies and reduced the number of municipal agencies (see Table 7). Some roads and major bridges are conceded, and some crossings, including the Great Belt and the Oresund, are private roads.

The Road Directorate is responsible for planning, creation of standards for road design and construction, and for inspections of structures. The Directorate prepares a guide to inspection of bridges (*8*), which is followed by the Directorate and by local agencies. Local agencies frequently hire consultants for bridge inspection, and inspection data for local bridges are usually reported to the Directorate, although this is not mandatory. Local agency bridges are designed, inspected, and rated in conformance with Directorate standards.

Finland—Finnish Road Administration

The Finnish Road Administration (Finnra) manages 78 000 km of roads, 11,191 bridges, and 2,935 culverts. Finnra oversees contract work, with design, construction, maintenance, and most inspections performed by contractors.

Finnra sets national standards for bridges, offers expert guidance to regional and local road agencies, and addresses all issues that must be coordinated at the national level. Finnra's guides and handbooks are followed by local road agencies, by other Finnish agencies such as the forestry

TABLE 5
U.S. NATIONAL BRIDGE INVENTORY STRUCTURES

	Structures		Owner			Special Inspection			Load Postings		Water Crossings	
DOT	Bridges	Culverts	State	Local	Other	Fracture Critical	Under-water	Other Special	Bridges	Culverts	Bridges	Culverts
Alabama	9,921	5,784	5,602	9,925	178	260	945	380	2,982	47	8,342	5,783
Alaska	1,125	53	756	123	299	103	175	12	273	2	1,042	49
Arizona	3,361	3,849	4,469	2,268	473	65	12	43	201	26	2,242	3,844
Arkansas	9,690	2,792	7,084	5,239	159	347	7,536	707	1,836	13	8,822	2,791
California	20,757	3,274	11,900	11,342	789	1,007	638	80	803	25	12,699	3,164
Colorado	6,617	1,661	3,442	4,534	302	207	75	61	672	31	5,383	1,621
Connecticut	3,569	599	2,775	1,235	158	169	309	289	106	8	1,779	595
DC	244	2	211	0	35	13	13	2	29	1	91	2
Delaware	649	203	812	7	33	29	77	21	7	2	407	203
Florida	9,352	2,189	5,295	5,477	769	339	3,950	578	988	31	6,302	2,176
Georgia	9,081	5,444	6,499	7,767	259	82	2,170	94	2,050	15	6,843	5,430
Hawaii	948	158	704	370	32	10	102	19	146	4	762	157
Idaho	3,962	110	1,269	1,620	1,183	173	306	71	593	4	3,485	109
Illinois	21,664	4,142	7,513	17,613	680	550	1,293	271	1,128	8	18,068	4,131
Indiana	16,832	1,442	5,132	12,664	478	523	710	905	1,923	114	14,706	1,428
Iowa	21,270	3,583	3,972	20,665	216	1,660	144	939	5,298	20	19,722	3,582
Kansas	17,834	7,682	4,829	20,090	597	1,109	201	572	9,803	2,861	16,102	7,628
Kentucky	10,672	2,851	8,784	4,624	115	349	2,147	84	1,346	51	9,284	2,781
Louisiana	10,995	2,356	7,794	5,241	316	142	1,198	7	2,124	11	10,909	2,355
Maine	2,034	336	1,936	208	226	45	371	14	99	1	1,557	331
Maryland	3,914	1,170	2,504	2,174	406	285	421	135	356	26	2,346	1,161
Massachusetts	4,624	298	2,816	1,536	570	329	756	448	433	9	2,194	289
Michigan	9,488	1,399	4,408	6,368	111	105	353	187	1,253	51	6,485	1,391
Minnesota	7,261	5,773	3,571	9,245	218	248	338	187	350	76	5,400	5,593
Mississippi	13,647	3,258	5,537	10,879	489	244	304	1,715	3,828	151	12,269	3,252
Missouri	19,239	4,645	10,134	13,637	113	1,589	174	318	5,656	86	16,652	4,633
Montana	4,725	204	2,449	1,938	542	310	499	24	648	8	3,930	197
Nebraska	12,510	2,947	3,471	11,795	191	1,289	95	50	5,246	0	11,849	2,944
Nevada	952	682	956	613	65	34	122	25	25	2	365	668
New Hampshire	2,127	244	1,289	861	221	144	137	53	222	8	1,556	233
New Jersey	6,035	410	2,370	2,532	1,543	652	708	391	291	6	3,235	405
New Mexico	2,164	1,672	2,933	699	204	53	7	32	180	4	1,560	1,628
New York	15,665	1,677	7,424	8,512	1,406	1,777	804	4	1,145	19	10,425	1,651
North Carolina	12,725	4,788	16,531	712	270	140	2,142	27	4,427	9	9,802	4,780
North Dakota	3,641	837	1,111	3,298	69	239	38	37	1,040	4	3,273	829
Ohio	26,296	1,770	8,855	18,448	763	1,099	290	29	2,434	17	21,240	1,739
Oklahoma	16,722	6,665	6,759	15,767	861	754	71	1,129	5,818	144	14,748	6,633
Oregon	6,937	314	2,661	3,918	672	347	676	42	796	30	5,840	313
Pennsylvania	20,613	1,694	14,812	6,004	1,491	1,896	3,881	1,981	2,618	48	15,595	1,653
Puerto Rico	1,816	327	1,812	322	9	22	30	40	198	13	1,322	322
Rhode Island	721	28	588	138	23	35	89	97	70	1	321	28
South Carolina	8,120	1,084	8,326	818	60	65	241	322	601	26	6,845	1,075
South Dakota	4,811	1,150	1,811	4,021	129	228	112	26	1,333	54	4,313	1,144
Tennessee	11,388	8,381	8,038	11,330	401	271	543	46	1,258	32	8,775	8,376
Texas	31,408	17,818	32,086	16,467	673	624	796	108	3,602	86	23,501	17,815
Utah	2,302	526	1,706	967	155	62	78	46	211	8	1,387	503
Vermont	2,530	173	1,077	1,597	29	161	53	41	125	1	2,178	124
Virginia	10,275	2,974	11,696	1,086	467	344	697	134	1,269	18	7,341	2,969
Washington	7,395	250	3,080	3,869	696	364	315	170	802	17	5,574	238
West Virginia	6,417	504	6,628	108	185	563	256	337	314	3	5,755	474
Wisconsin	11,765	1,926	4,869	8,682	140	116	276	12	378	6	9,088	1,918
Wyoming	2,609	424	1,938	839	256	97	61	13	448	27	1,758	422

Source: *National Bridge Inventory Data* (2).

TABLE 6
ROADS AND BRIDGES IN DENMARK

	National Directorate	Local Agencies
Roads (route miles)	4000 km	70 000 km
Bridges*	3,500	7,000

*Approximate number.

TABLE 7
ROAD AGENCIES IN DENMARK

	Prior to 2006	Current (2007)
County Road Agencies	14	0
Municipal Road Agencies	273	99

administration, and by private bridge owners. Local road agencies (primarily municipal governments) can store their bridge information in Finnra's registry if the local user is certified for the registry.

Documents prepared by Finnra include guidelines and policy for bridge maintenance, rehabilitation, and repair operation; guidelines for bridge inspection; a bridge inspection manual; and a bridge repair manual [SILKO Guidelines, **Sil**tojen **Ko**rjausohjeet (*Bridge Repair Guidelines*)].

France—French National Road Directorate

French road authorities exist at three levels: national, departmental (similar to U.S. states), and local (cities, towns, and villages). The French National Road Directorate, an agency within the French Ministry of Equipment (Ministère de l'Équipement, des Transports, de l'Aménagement du territoire, du Tourisme et de la Mer (Ministry for Infrastructure, Transport, Spatial Planning, Tourism, and the Sea), provides funding to national road agencies acting in the departments (states) and establishes national policies for road transport. The Directorate develops and operates the bridge management system. Departmental agencies [Direction Départementale de l'Equipement (DDE), an agency of the Ministry of Equipment] do repairs of bridges and conduct specialized studies and investigations as needed. Local agencies, called subdivisions, each guided by its departmental agency, do routine bridge inspection and maintenance.

In France, the *Instruction Technique pour la Surveillance et l'Entretien des Ouvrages d'Art* (*ITSEOA*) (*9*) establishes procedures for inspection of most roadway infrastructure including bridges, tunnels, culverts, retaining walls, and embankments. The first part of the *ITSEOA* addresses administrative issues. The second part consists of 30 documents addressing methods and techniques for particular materials and structures. Condition assessment is further guided by the *Image de la Qualité des Ouvrages d'Art* (*IQOA*) (*10*), which presents standard classifications for each kind of deterioration and damage encountered on some 25 types of structures.

Two substantial reorganizations of French road agencies have occurred since the 1980s. Before 1982, the Ministry of Equipment controlled 105,000 bridges. Between 1982 and 2006, the ministry had direct control of 23,000 bridges and controlled the activities of six private companies that managed conceded motorways. There are 7,000 bridges along these motorways. In 2006, further decentralization reduced the Directorate's inventory to fewer than 15,000 bridges. Roadway concessionaires have consolidated, and there are now three large corporations managing most conceded roads. Overall, maintenance responsibilities at most bridges are delegated to private companies.

There are 11 interdepartmental road agencies that have direct control of inspections, maintenance, repairs, and replacements of bridges. Funds for these activities come from the national government, and decisions on repairs and replacements are subject to review and approval by the national road directorate.

National funds for bridge repairs are allocated to interdepartmental road agencies through five general supervisors. The supervisors belong to the General Bridge Inspection Service and each supervisor is charged with a geographic region in France. General supervisors control DDE activities that affect bridges.

Local road agencies include approximately 100 Conseil Général, and more than 38,000 towns and villages. Local road agencies are assisted by the Assistance Technique fournie par l'etat pour des raisons de Solidarité et de l'Aménagement du Territoire (ATESAT), a program of the Ministry of Equipment, to ensure the safety of roadways.

Technical organizations involved in bridge engineering and road operations include:

SETRA (Service d'Etudes Techniques des Routes et Autoroutes)—reviews proposed repair projects and operates LAGORA, the French bridge management system.

CETE (Centre d'Etudes Techniques de l'Equipement)—a group of eight regional centers providing technical advice to local road agencies and assisting in bridge investigations and planning for repair projects.

LCPC (Laboratoire Central des Ponts et Chaussées)—the central (national) laboratory performing bridge research and providing expert technical advice on bridges.

LRPC (Laboratoire Régional des Ponts et Chaussées)—a group of 17 regional laboratories engaged in detailed inspection, testing, instrumentation, and diagnosis for bridges and structures.

CETU (Centre d'Etudes des Tunnels)—performs detailed inspection, testing, and studies of tunnels.

Road concessionaries are required to adhere to the guides and standards of the French National Road Directorate; local government road agencies are not. In practice, most local agencies do follow national standards, and it is the policy of Interior Ministry (Ministère de l'Intérieur, responsible for departments, towns, and cities) to advise local governments on their bridge inspections.

Germany—German Federal Roads

German federal roads are administered by the Bundesministerium für Verkehr, Bau und Stadtentwicklung (BMVBS) (Federal Ministry of Transport, Building, and Urban Affairs). The ministry provides advice and technical support

to German states and to other federal agencies. States administer inspections, control data in the bridge management system, and develop five-year plans for maintenance programs. There are approximately 120,000 bridges on all roads; of these, 37,000 are on federal highways and trunk roads, and 83,000 are on state, county, municipal, and rural routes. [A note on wording: Germany distinguishes federal roads from national roads. Two German states, Bavaria and Saxony, refer to their state roads as national roads.]

German guides and standards for inspection of structures and for standardized reporting of condition include:

- *Inspection and Testing of Engineering Structures in Connection With Roads*, DIN 1076, 1999 (*11*).
- *Recording and Assessment of Damages*, Guideline RI-EBW-PRÜF, 2004 (*12*).
- *Structure Inventory*, ASB, 2004 (*13*).

These publications are revised and updated by working groups that have representatives from BMVBS, from Bundesanstalt für Strassenwesen (Bundesanstalt für Strassenwesen is the Federal Highway Research Institute of BMVBS), and from some federal states. Deutsches Institut für Normung (DIN), the German Institute for Standardization, provides standards for a wide range of engineering and manufacturing activities.

German federal standards for bridge inspection apply to states for inspection of bridges on federal roads. Inspections of bridges on state roads and bridges on county and municipal roads are not required to meet federal standards; however, local agencies are strongly encouraged to do so.

Norway—Norwegian Public Roads Administration

The Norwegian Public Roads Administration (Statens vegvesen) has a central office, 5 regions, and 30 districts. All construction and maintenance are done by contract. In each region there is one engineer responsible for bridges. This engineer is involved in all activities including bridge management, inspection, maintenance, repair, strengthening, and construction.

South Africa—South African National Roads Agency

The South African National Department of Transport develops policy, strategy, and high-level regulation for all modes of transport. The Department of Transport directs the operating agencies. The operating agency for roads is the South African National Roads Agency Limited (SANRAL), which administers the national road system. SANRAL's assets in roads, structures, and equipment are valued at 30 billion Rand (US$3.8 billion). In addition to SANRAL, there are nine provincial departments of transport and numerous municipal transport agencies.

SANRAL is decentralized. Four regional branches administer roads. SANRAL has a total staff complement of approximately 140 individuals. SANRAL outsources most road design and construction work to private firms.

Inspections are also out-sourced. Firms hired by SANRAL to provide inspection services are assigned a section of road and a set of bridges. On conceded roads, concessionaires arrange all inspections, using their own personnel or hiring consulting engineers. Based on inspection reports, repair needs are identified and prioritized. Design consultants, independent of inspection consultants, are hired to make detailed evaluations of bridges and to prepare plans and specifications for repair projects.

Through training consultants, SANRAL offers certification courses for bridge inspectors. The agency reviews inspection reports; however, it does not verify inspection findings directly, although the overlapping work of inspection consultants and project development consultants yields such verification for some bridges.

SANRAL produces a manual for bridge inspection and reporting and maintains standards for design and construction. These standards apply to the national roads whether maintained by SANRAL or by concessionaires. The agency does not formulate national regulations. It does not direct inspection practices of provincial governments or local governments, nor does it receive inspection data or otherwise monitor the condition of bridges other than bridges on national roads.

Road agencies in each of South Africa's nine provinces are autonomous and perform all inspection and maintenance of bridges on provincial roads. Provincial agencies often follow SANRAL standards for bridge design, inspection, and maintenance, although this is not required. The provinces do not participate in the inspection or maintenance of national roads within their boundaries.

Swedish Road Administration

Vagverket, the Swedish Road Administration (SRA), has approximately 6,500 employees in 16 groups that include the head office; 2 support and development divisions; 7 regional offices; and groups for vehicle registrations, driver licensing, ferry operations, engineering consulting, construction and maintenance, and road sector training.

Three groups are profit centers: construction and maintenance, consulting services, and ferry operations. Profit centers operate as subsidiary companies of SRA and compete with

private contractors and engineering consultants for work in bridge design, construction, and maintenance. SRA's construction and maintenance group holds 62% of SRA routine maintenance contracts. Work performed by SRA includes strategic management, planning of projects, specifications for bridge works, procurement of bridge works, and supervision of contract work. SRA performs about half of all bridge inspections, with other inspections done by consultants. Work by consultants and SRA profit centers include bridge design, maintenance and repair projects, bridge construction, and bridge inspections.

SRA maintains guides and manuals for bridge design, construction, and inspection. These are mandatory only for SRA bridges. Sweden does not have national regulations for bridge inspection, but these may be developed in the near future.

There are seven regional road agencies in Sweden. The agencies maintain bridges on regional roads and on national roads. SRA provides funding and sets standards for the inspection and maintenance for SRA bridges, although the work is executed through the regional road agencies.

Municipal road agencies are autonomous, operate without SRA oversight, but usually adhere to SRA standards in bridge design, construction, and inspection.

United Kingdom of Great Britain and Northern Ireland—United Kingdom Highways Agency

The United Kingdom Highways Agency has a network of 9400 km of trunk roads that link population centers, ports, and key cross-border routes. The network has approximately 10,000 bridges and 6,000 other structures (tunnels, retaining walls, and sign structures). There are approximately 100,000 other bridges and structures that are the responsibility of local authorities. In total, the United Kingdom has approximately 155,000 bridges on roadways, waterways, and rails.

The Highways Agency has a staff of 1,700 people involved in development of guides and specifications, and in contract administration. It develops policies for the entire life cycle of bridges including construction, inspection, maintenance, and improvement. The direct tasks of construction, maintenance, inspection, etc., are done by contractors under Highways Agency oversight.

All Highways Agency bridge inspections are performed under contract. Increasingly, the agency relies on long-term contracts for the operation and maintenance of roads. It has assigned 14 areas to Maintenance Area Contracts (MACs). MACs are usually let for 7 years. The 14 maintenance areas are regional in extent, with exact boundaries adjusted to achieve viable work programs. MACs operate in accordance with Highways Agency standards.

TABLE 8
STRUCTURES INSPECTED—FOREIGN AGENCIES

Nation	Structures Inspected
Denmark	Bridges
	Culverts
	Decks on piles
	Sign bridges
	Retaining walls
	Cable ducts
	Pipe ducts
	Sluices
	All structures of importance to the traffic network
Finland	Inspectors are mostly employees of consulting firms that inspect all varieties of civil structures and highway assets.
Germany	Bridges
	Culverts
	Sign structures
	Signal structures
	Tunnels
	Noise barriers
	Retaining walls
	High mast lights
Sweden	Bridges
	Culverts
	Retaining walls

The *Design Manual for Roads and Bridges* (*14*) was created and is maintained by the Highways Agency. The manual's provisions are mandatory for work on highways controlled by the Highways Agency.

The Highways Agency works in association with trunk road authorities in Scotland, Wales, and Northern Ireland to produce requirements for the inspection and management of structures. Requirements are published as BD 62/94 and BD 63/94. These are not statutory instruments; instead, they are enforceable as contract provisions. Interim Advice Note IAN 45 modifies the requirements in BD 62/94 and BD 63/94. The revised BD62/BD63 will be supplemented by advice in a bridge inspection manual, which will have a scope similar to the FHWA/NHI training manual for inspectors.

Highways Agency standards apply only to Highways Agency bridges; however, many regional and local road agencies also follow agency standards. These agencies may include Highways Agency standards as contract clauses to

TABLE 9
MINIMUM SIZE FOR INSPECTION—FOREIGN AGENCIES

Nation	Structure Type	Min. Inspection Size
Denmark	Highway bridge	2 m span
Finland		2 m
France		2 m
Germany		2 m
Norway		2.5 m
South Africa		6 m
Sweden (pre-1989)		3 m
Sweden (today)		2 m
United Kingdom		1.8 m
Germany	Noise barrier	2 m height
Germany	Tunnel	80 m length
Finland	Pipe bridge	2 m span

their consultants. All road agencies have a statutory Duty of Care. The use of Highways Agency standards is one method of demonstrating sufficient care.

The management of the secondary and tertiary road network is complex. Responsibilities are shared among a variety of counties, boroughs, and cities. These local entities are autonomous and can set their own rules, but most adopt some or all of the standards produced by the Highways Agency.

BRIDGE INSPECTION INVENTORY—FOREIGN AGENCIES

Tables 8 and 9 list the structures and minimum sizes of structures inspected by foreign road agencies. These include bridges, culverts, and retaining walls in all countries, and tunnels, pipe bridges, sign bridges, and noise barriers in most countries. Finland inspects all structural assets of importance to the highway network, including decks on piles, retaining walls, cable ducts, pipe ducts, culverts, and sluices.

CHAPTER THREE

INSPECTION PROGRAM PERSONNEL

This chapter reviews staff titles, responsibilities, and the qualifications of personnel in bridge inspection programs. The size, formation, and assignments of inspection teams are discussed. The chapter begins with U.S. information and continues with information collected from foreign nations.

U.S. INSPECTION STAFF TITLES

U.S. federal regulations identify four staff positions for bridge inspection programs:

- Program manager: The individual in charge of bridge inspection, reporting, and inventory.
- Team leader: The individual in charge of an inspection team and responsible for planning, performing, and reporting field inspections.
- Load rater: The individual with the overall responsibility for bridge load rating.
- Underwater bridge inspection diver: Individual(s) performing inspections, by diving, of submerged components of bridges.

U.S. state DOTs implement federal requirements and expand both program management structure and program technical expertise to suit the bridge population of each state. Staff titles were collected from 34 state DOTs plus the U.S.DOT Eastern Federal Lands Highway Division (Eastern Federal Lands). More detailed responses can be found in the tables in Appendix E.

Inspection Program Manager

All state DOTs identified at least one and sometimes two central office personnel that manage the bridge inspection program. Where two staff members are named, responsibilities may be divided between inspection field work and bridge data management, or between state-owned bridges and local-agency bridges (see Table E1).

Additional Inspection Program Managers

Eight of 34 DOTs identified additional central office personnel that manage contracts for inspection consultants, coordinate inspections for local agencies, manage bridge data, supervise underwater inspections, supervise special inspections, or manage inspections of movable bridges. Twenty-two DOTs employ district-level managers for inspection programs, often assigning this duty to the district engineer. Districts (or regions at some DOTs) may have further levels of staff working under the district engineer to supervise inspection teams and inspection equipment. Additional central- and district-level management staff is listed in Table E2.

Bridge Load Rater

Ten DOTs have staff identified as a bridge load rating engineer or similar title. Two DOTs assign bridge load rating to the inspection program manager, 3 DOTs assign load rating to staff in charge of load permits, 13 DOTs assign load rating to the state bridge engineer or other central office staff, and 17 DOTs delegate some load rating duties to districts or to engineering consultants. DOT staff titles for central and district-level load raters are shown in Table E3.

Inspection Team Leaders, Inspectors, Inspection Assistants

U.S. state DOTs all have staff designated as leaders of bridge inspection teams. Titles include Team Leader, Lead Inspector, Bridge Inspector, Safety Inspector, Supervising Inspector, and District Inspector. Twenty of 34 DOTs have a separate title or grade for inspection team members subordinate to a team leader. Twelve DOTs do not identify inspection team members by specific job title. Other DOTs variously use one-person teams for most routine inspections or have all field staff qualified as team leaders; one person serves as the inspector of record for a particular inspection and other equally qualified staff serves as team members. Ten DOTs identified staff as inspection assistants, inspection helpers, or inspection trainees. DOT staff titles for team leaders, bridge inspectors, and inspection assistants are shown in Table E4. Many DOTs employ consulting firms for inspection services and do not track numbers of staff employed by consultants.

Underwater Inspection Leaders and Inspectors

Ten of 34 DOTs identified agency staff as underwater leaders or inspectors. Fourteen DOTs do not designate staff in these job titles, and 11 DOTs employ consultants to furnish leaders for underwater inspections. These same counts and categories

apply to divers performing underwater inspections. Staff titles for underwater inspections can be found in Table E5.

For inspections of channels, DOTs in New York and Oregon identified specific personnel for fathometer and sounding inspections near bridges.

Inspection Specialists

Nine of 34 DOTs identified personnel who focus on the inspection of fracture-critical or fatigue-prone members. Six DOTs identified personnel who focus on scour inspection and evaluation, 12 DOTs identified personnel for movable bridges and equipment, and 5 DOTs have other specialized personnel. Staff specialist titles are shown in Table E6.

Other Inspection Staff Titles

Other staff titles in bridge inspection programs include bridge management engineers; database engineers; bridge appraisal engineers; and equipment operators for snoopers, cranes, and under bridge inspection vehicles or trucks (see Table E7).

RESPONSIBILITIES OF INSPECTION PROGRAM STAFF

Program Manager

Responsibilities for inspection program managers are collected under several headings:

- Administration, including annual reports, annual budgets, and personnel hiring;
- Inspection policies, including updates to bridge inspection manuals and standards;
- Inspector training and qualifications;
- Inspection work, including scheduling, assignments, team formation, and use of inspection consultants; and
- Inspection findings and critical inspections.

Information was collected from 34 DOTs.

Administrative tasks assigned to the inspection program manager include preparation of annual reports for the inspection program (14 DOTs), annual budgets for the inspection program (16 DOTs), recommendations on size and composition of program workforce (19 DOTs), and recommendations for inventory and types of equipment needed for inspections (23 DOTs). Hiring of agency personnel (17 DOTs), inspection consultants (24 DOTs), and agency load raters (10 DOTs) can also be the responsibilities of the inspection program manager (see Table E8).

At most DOTs, the program manager maintains a bridge inspection manual or prepares technical memoranda on inspection procedures (26 DOTs), establishes methods of inspection (22 DOTs), creates or controls standard inspection reporting forms (19 DOTs), and sets the format of the bridge database (16 DOTs). The manager directs these same program aspects for inspection of non-state-owned bridges at 10 DOTs (see Table E9).

The program manager determines inspection intervals (20 DOTs); identifies complex bridges (18 DOTs), fracture-critical bridges (18 DOTs), and scour-critical bridges (11 DOTs); forms DOT inspection teams (15 DOTs), assigns bridges to agency teams (15 DOTs), directs the use of access methods or equipment (10 DOTs), and assigns bridges to inspection consultants (15 DOTs) (see Table E10).

The program manager orders the execution of damage inspections (21 DOTs), special inspections (15 DOTs), in-depth inspections (17 DOTs), hands-on inspections (14 DOTs), bridge monitoring (15 DOTs), field testing (11 DOTs), and the application of nondestructive testing (14 DOTs). At 18 DOTs, the program manager identifies critical findings for bridges (see Table E11 for more details).

The program manager directs training of inspection staff (21 DOTs), certifies (19 DOTs) and decertifies (10 DOTs) DOT leaders and inspectors, and certifies inspection staff employed by consultants at 13 DOTs (see Table E12).

The program manager establishes QA and QC procedures (standards and oversight) at 26 of 31 DOTs, and executes QA/QC activities at 27 DOTs. The program manager also executes quality programs for inspection consultants at 15 DOTs (see Table E13).

The program manager can be involved in bridge emergency repairs (11 DOTs), bridge maintenance repairs (11 DOTs), and bridge rehabilitation (4 DOTs). The manager's role can range from recommending work, to monitoring progress, to execution of repair work, or preparation of rehabilitation plans (see Table E14 for a breakdown of responses).

The program manager is frequently involved in bridge load rating (21 DOTs), but less frequently involved in load posting (8 DOTs) and load permitting (6 DOTs). The manager's role can range from selection of load rating methods, to execution of analyses, to collection and storage of rating and posting data (see Table E15).

Bridge Load Rater

The bridge load rater, in addition to performing analysis of bridges, can have a role in bridge inspection (25 of 29 DOTs), bridge inventory data (26 DOTs), or load permitting (9 DOTs). The rater's role in bridge inspection can include requests for inspections, for measurements, or for monitoring. Sometimes the load rater participates in the inspections themselves (see Table E16 for details).

Bridge Inspection Team Leader

Inspection team leaders are responsible for the administration of inspection work both in the office and at the bridge site. Leaders plan for field inspections, set schedules for inspections (28 of 29 DOTs), and assign personnel to inspection teams (2 DOTs). Leaders request (24 DOTs), coordinate (3 DOTs), or supervise (3 DOTs) traffic control and lane restrictions during inspections. Leaders request (23 DOTs), coordinate (4 DOTs), and sometimes operate (3 DOTs) UBITs/UBIVs and other access equipment. Leaders recommend critical findings for review by supervisors (23 DOTs) or identify critical findings directly (5 DOTs). At three DOTs, leaders inspect minor bridges, tunnels, light masts, sign bridges, and other structures in addition to the bridges and culverts covered by U.S. federal regulations (see Table E17).

During field inspections the team leader may specify the inspection methods to be used by the team (12 DOTs), may act as the primary inspector assisted by a team member (9 DOTs), or may supervise the team's choice and use of inspection methods (4 DOTs). Leaders will recommend additional inspections or bridge monitoring (14 DOTs). Leaders will perform or will direct team members to perform hands-on inspection of components (23 DOTs) (see Table E18). The team leader either performs or verifies entry of inspection data to the bridge database (27 of 29 DOTs) (see Table E19 for the complete team leader and inspection data responses). At 25 of 29 DOTs, team leaders perform QC for inspection reports (Table E20 provides the details for the team leader and QC responses).

With the addition of supervision of diving operations, responsibilities of team leaders for underwater inspections are similar to responsibilities of other team leaders.

QUALIFICATIONS OF INSPECTION STAFF

Training

U.S. federal regulations (*1*) require training for program managers and inspection team leaders in an FHWA-approved comprehensive course in bridge inspection. (Available NHI training courses and in-house state DOT courses are noted in Table E21 in Appendix E).

Refresher Training

Twenty-six of 28 DOTs reported refresher training for inspectors through NHI courses, in-house courses, in-house workshops, or program-wide meetings. Eight DOTs use an NHI course. Eight DOTs use in-house courses, workshops, or other methods for refresher training. Intervals for refresher training are five years (11 DOTs), two years (5 DOTs), annually (1 DOT), or other period (9 DOTs) (see Table E22).

Inspection Program Manager

U.S. federal regulations require that the inspection program manager complete comprehensive bridge inspection training and have either registration as a professional engineer (PE) or at least 10 years of bridge inspection experience. Requirements for inspection program managers were collected from 30 U.S. state DOTs. Of these, 26 require a PE license. In addition, 20 DOTs require professional licensure plus minimum bridge inspection experience ranging from 2 years to 10 years, 23 DOTs require an engineering degree, and 1 DOT specifically requires a civil engineering degree. Five DOTs require a PE license, but do not require engineering degrees; 24 DOTs require inspection training, usually in NHI courses; and 5 DOTs require other training. Requirements for inspection program managers are shown in Table E23.

Bridge Load Rater

U.S. federal regulations require that the person in charge of bridge load rating be a registered PE. Additional requirements at state DOTs for load raters include bridge inspection training (17 of 30 DOTs) and bridge inspection experience (9 DOTs). At seven DOTs, bridge load rating is the responsibility of the central or district-level inspection program manager (see Table E24).

Inspection Team Leader

U.S. federal regulations provide six means for qualification as a team leader for bridge inspections. These include four means specifically for team leader plus acceptance of qualification as an inspection program manager, itself having two means of qualification. U.S. federal regulations require comprehensive bridge inspection training plus specific combinations of professional certification and bridge inspection experience. There is no federal requirement for bridge inspection experience for individuals who are registered PEs or who are certified by the National Institute for Certification of Engineering Technologies (NICET). Bridge inspection experience of two years is required for engineering graduates who have passed the fundamentals of engineering exam and four years for individuals with an associate's degrees in engineering technology. Five years of bridge inspection experience is required for an individual without other certification or formal education.

Qualifications for inspection team leaders were collected from 34 state DOTs. Of these, seven accept federal requirements without change, and 14 DOTs add a required period of bridge inspection experience for registered PEs. Periods range from two to six years. Twelve DOTs require a high school diploma or equivalent, 4 DOTs require regular participation in DOT-developed workshops or courses for continuing certification as team leader, and 5 DOTs require registration as a PE for inspection team leaders (see Table E25 for details).

For the current workforce of agency team leaders, 3 DOTs (of 28) reported that all team leaders are registered PEs. Ten DOTs reported no PEs among inspection team leaders, 2 DOTs reported that all team leaders hold NICET certification, and 8 DOTs reported no NICET-certified team leaders. Bridge inspection experience among team leaders is 10 years or greater at 17 of the 23 DOTs that reported experience levels (see Table E26).

For the current workforce of team leaders employed by inspection consultants, 9 DOTs (of 28) reported that all consultant-employed team leaders are registered PEs, and 2 other DOTs reported that 90% or more of the consultant team leaders are PEs. Four DOTs reported some NICET-certified team leaders. For one DOT, 60% of team leaders are NICET-certified. Bridge inspection experience is 10 years or greater for 11 DOTs among the 13 DOTs reporting values for experience of consultant staff (see Table E27).

Inspection Team Members

U.S. federal regulations do not establish qualifications for inspection team members working under the direction of an inspection team leader. Twenty of 32 state DOTs identified inspection team members either as regular staff positions or as one among the regular duties attached to a staff position. Fifteen DOTs require bridge inspection training for inspection team members (see Table E28).

Underwater Bridge Inspection Team Leader, Underwater Bridge Inspector

U.S. federal regulations require that divers for underwater inspections complete an FHWA-approved course in bridge inspection or underwater bridge inspection. Divers are not required to meet team leader requirements and there is no separate federal designation of team leaders for underwater inspections. Nine state DOTs (of 33) have qualified team leaders for underwater inspections, usually adding requirements for dive training and certification to other inspection team leader qualifications. Fifteen DOTs use consultants for underwater inspections (see Table E29).

Inspector Requirements for Fitness, Vision, and Color Perception

Nineteen of 28 DOTs require general good health for bridge inspectors. Fourteen DOTs require some moderate agility or strength (see Table E30 for details on fitness requirements). Five DOTs require good vision for bridge inspectors, two DOTs require adequate color perception, three DOTs require good hearing, and one DOT accepts a valid driver's license as proof of basic sensory fitness. No DOT reported that there are periodic checks of inspectors' vision, color perception, or hearing (see Table E31).

Divers for underwater inspections must complete an annual physical examination to maintain dive certification. DOTs require certified divers, often as a staff of inspection consultants. DOTs are not involved in diver certification (see Table E32).

INSPECTION TEAMS

Twenty of 28 DOTs usually use two-person inspection teams. Four DOTs use single-person teams. Among the DOTs with two-person teams, 11 have teams that work together for the long-term and 10 form teams as needed. Four DOTs enforce rotation among team members (see Table E33).

Eighteen of 28 DOTs identified specific inspectors or teams for fracture-critical inspections (11 DOTs), inspections having difficult access (6 DOTs), and inspection of complex or large bridges (9 DOTs) (see Table E34).

Thirteen of 31 DOTs prefer or enforce rotation of different inspection teams to bridges usually after one or two inspection cycles. Thirteen DOTs prefer that teams inspect the same bridges through many cycles so that teams are thoroughly familiar with the status and progress of bridge conditions. Five DOTs have no preference or have little control on repeat assignments because inspections are done by consultants (see Table E35).

Twenty-nine DOTs reported on the basis for assignment of bridges to inspection consultants. Eight DOTs assign bridges based on bridge owner (usually local bridges), bridge route, or DOT region; each essentially a geographic criterion. Six DOTs assign some inspection types, such as underwater inspections, to consultants. Six DOTs assign to consultants individual bridges that are large, complex, or demand significant effort for maintenance of traffic. Consultant contracts may provide for a single inspection or for many inspections over periods of as long as six years. At 11 DOTs, inspection consultant firms usually inspect the same bridges over many cycles (see Table E36).

Twenty-eight DOTs reported on the extent of the use of inspection consultants (see Table E37 for details on the use of consultants for inspectors). Twenty-one DOTs employ consultants for less than 25% of their bridge inspections, whereas three employ consultants for more than 75% of inspections.

INSPECTION PROGRAM STAFF—FOREIGN AGENCIES

Denmark

Danish bridge inspections are executed by a single unit in the Road Directorate consisting of a manager and six district inspectors. Underwater inspections and bridge load ratings are done by consultants. The bridge database is maintained by a Directorate manager with three staff, and assisted by

consultants. Staff titles for bridge inspection personnel are shown in Table E38 in Appendix E.

Directorate bridge inspectors perform "Principal" inspections and serve as contract managers for "Routine" and "Special" inspections performed by consultants.

Finland

Finland has a headquarters unit for bridge inspection policy, QA, and inspector certifications. Here, the Finnra Program Manager and staff members establish policies and procedures for bridge inspections, and maintain the bridge inspection manual, reporting forms, and other documentation. Bridge load ratings and the bridge database are responsibilities of headquarters staff. Certified bridge inspectors at Finnra headquarters are leaders of consultant inspection teams for inspection of reference bridges. These inspections contribute to formation of deterioration models in Finland's bridge management system.

Each Finnra district has a bridge engineer who directs inspection work by consultants. Most certified inspectors work for consulting firms. Underwater inspections are done by consultants. Staff titles for the Finnra bridge inspection program are listed in Table E39.

There are 20 to 25 individuals in the bridge inspection and data management program at Finnra. Five of these are in Finnra's central office. Road foremen are not included among these program personnel. Finnra employs nine Certified Bridge Inspectors (three in the central office, six in the districts). Seven other personnel are trained but not currently certified for bridge inspection. Certification requires annual participation in Finnra's Advanced Training Day.

Among consultants' workforce the number of inspectors varies. There are currently 61 inspectors with valid certification in Finland as of summer 2006. Inspection consultants must name a Bridge Inspection Quality Manager in charge of their work (see Table E40).

France

The French national government has five general inspectors who each manage the execution of inspections for various regions of the country, one director at LCPC who manages inspector training and inspection quality programs, and one manager for bridge management who also allocates funding for inspections to regions in France. French departments have managers for bridge inspection who schedule inspections and assign work to agency crews and to consultants. Inspection teams include team leaders, bridge inspectors, and inspection agents. Team leaders, inspectors, and agents are employed by French Departments, by regional laboratories (LRPC), and by consultants. In addition, Rapid Bridge Evaluators determine IQOA classifications for bridges. Bridge data specialists operate the BMS. Divers for underwater inspections are employed by the national government and assigned to regional laboratories (LRPC). Job titles for bridge inspection personnel in France are cited in Table E41. Numbers of personnel are cited in Table 10.

Consultants for bridge inspections employ team leaders, bridge inspectors, and underwater inspectors. Staff titles are shown in Table 11 and numbers of personnel in Table 12.

Germany

German states administer inspection of bridges on federal and state roads, and on some county roads. Some states maintain bridge inspection staff in their road agency; other states employ consultants to do inspections. The federal road agency, BMVBS, does not inspect bridges and does not maintain a bridge inspection staff.

Staff organizations differ among German states; however, in general, each state has an inspection program manager (see Table E42). Among states that employ inspectors, there are leaders and inspectors that work in teams, usually with one leader assisted by one inspector. Most inspection program managers and team leaders are civil engineers. Inspectors are technicians. Underwater inspectors may be civil engineers qualified as divers, but more often a nonengineer diver works under the direction of an on-site civil engineer. Submerged elements are viewed with video equipment.

South Africa

SANRAL has a single individual, the manager of the bridge network, to select and monitor consultants for inspections services. Among consultants, there are approximately 30 individuals certified to inspect bridges or culverts (see Table E43).

Sweden

The SRA employs two inspection managers who together set inspection policies, maintain the inspection manual,

TABLE 10
FRANCE: NUMBER OF BRIDGE INSPECTION PERSONNEL
(Government agencies)

Title	No. of staff
General Inspectors for Bridges	5
LCPC—Technical Director for Bridges	1
State Bridge Inspection Program Manager	1
District Managers CDOA Chief	100 (in 2006)
Inspection Team Leaders	50 (LRPC) + 10 (DDE)
Bridge Inspectors	100 (LRPC) + 20 (DDE)
Underwater Inspectors	4
Inspection Agents	20
Rapid Bridge Evaluators	100
Bridge Data Specialist or Software Specialist	5

CDOA = Cellule Départementale des Ouvrages dArt; DDE = Direction Départementale de l'Equipement.

TABLE 11
FRANCE: JOB TITLES AMONG INSPECTION CONSULTANTS

Title	Function
Inspection Team Leaders	Leader of a team (or crew) for bridge inspection Reports to the district manager (CDOA of the DDE) Guides all field inspection activities and works as a part of the inspection team Completes all necessary preparations for field work including travel, equipment, and reporting forms
Bridge Inspectors	Personnel performing inspection tasks, taking observations, assigning condition ratings, etc. Reports to team leaders during field work
Underwater Inspectors	Personnel trained in both diving and bridge inspection; performs underwater inspection tasks, takes observations, assigns condition ratings, etc. Reports to team leaders during field work

CDOA = Cellule Départementale des Ouvrages d'Art; DDE = Direction Départementale de l'Equipement.

and direct inspection quality programs. The SRA has 20 inspection team leaders, who perform inspections, hire consultants for inspections, and perform QC (see Tables 13 and E44).

United Kingdom

The U.K. Highways Agency is a managing agency that sets policies and standards, hires contractors, and monitors contractor work. The Highways Agency has 20 area structures managers, each assigned a portion of the agency's network. Contractors employ team leaders, inspectors, divers, and inspection specialists. Contractor personnel include approximately 30 inspection team leaders, 120 bridge inspectors, and 10 underwater inspectors (see Table E45).

QUALIFICATIONS OF INSPECTION STAFF—FOREIGN AGENCIES

Denmark

Apart from underwater inspectors, all Danish inspection personnel are engineers (Table 14). Danish inspectors perform Principal inspections at six-year intervals. Annual inspections are performed by maintenance personnel. Danish policy on inspections, inspectors, and inspectors' skills are listed in Table 15. The Danish Road Directorate does not certify inspectors.

Denmark conducts annual refresher training for all bridge inspectors. There are no other training requirements. For staff titles, such as underwater inspector and bridge load rater, individuals must bring appropriate experience to their positions (Table 16).

The Danish National Road Directorate has goals rather than formal requirements for experience of inspection personnel. In this area of qualification, the scarcity of experienced personnel is a constraint (Table 17).

Danish bridge inspectors and underwater inspectors must be in good physical condition with good eyesight and good color perception. There are no fitness or vision requirements for other staff titles among bridge inspection staff.

Finland

Among Finnra staff, the inspection program manager and certified inspectors for basic inspections (inspections of reference bridges) are engineers. Inspectors for basic inspections must also have a certificate in concrete structures. Other inspectors need not be engineers; however, they must be certified as inspectors. Finnra's inspector certification requires four days of theoretical training and two days of field work followed by both written and field examinations (Table 18). Continued certification requires annual advanced training. A separate two-day course in the use of Finnra's Bridge Register is required for inspectors permitted to enter registry data.

Finnra's bridge inspection course is required for bridge inspectors and program administrators. The more experienced personnel are selected for basic inspections of reference bridges and for leadership positions in the inspection program. Newly certified inspectors often work with more experienced personnel for their first year. Training courses in Finland are listed in Table 19. Training and mentoring requirements are listed in Table 20.

Finnra's policy on inspections and inspectors is shown in Table 21.

TABLE 12
FRANCE: NUMBER OF CONSULTANT INSPECTION PERSONNEL

Title	No. of Staff (approximately)
Inspection Team Leaders	50
Bridge Inspectors	100
Underwater Inspectors	20

TABLE 13
SWEDEN: NUMBERS OF INSPECTION STAFF

Job Title	SRA Staff	Consultant Staff
Inspection Program Manager	2	—
Team Leaders and Bridge Inspectors	20	30
Equipment Inspectors	—	6
Regular Inspectors (road foremen)	—	50

TABLE 14
DENMARK: BRIDGE INSPECTOR QUALIFICATIONS

Title	Education
Bridge Department Manager	Engineering B.Sc
Bridge Inspectors	Engineering B.Sc
Underwater Inspectors	Experienced personnel
Bridge Load Rater	Engineer B.Sc, Senior engineer with experience in bridge rating calculation
Bridge Data Specialist or Software Specialist	Engineering B.Sc

B.Sc = Bachelor of Science.

TABLE 15
DENMARK: INSPECTIONS AND INSPECTORS

Inspection Type	Inspector	Inspector Skills
Normal Routine Inspection	Roadmen	Can evaluate matters affecting traffic safety Can distinguish between significant and insignificant damage Can take prompt action in the event of sudden damage Can evaluate repairs to drainage systems, winter conditions, surfacing, etc. Can make reports
Extended Routine Inspection	Road foreman	Have a good knowledge of bridge maintenance Be able to describe damage Be able to propose improvements Can evaluate the need for preventive maintenance
Principal Inspection	Bridge inspector	The inspector will normally be an engineer Good observation abilities Knowledge of damage concepts Knowledge of damage causes The ability to distinguish significant damage from insignificant damage The ability to evaluate the consequences of damage The ability to evaluate cleaning and maintenance conditions A fair knowledge of materials technology and the mode of action of major structures Knowledge of repair methods and cost estimates Experience in the technical supervision of bridge work
Economic Special Inspection	Bridge inspector	Good knowledge of the causes and development of damage Good knowledge of repair methods Good overview of the influence of repair works on other structural components Experience in bridge design and construction Good knowledge of construction methods and materials technology Good knowledge of cost estimates for repair works Able to make a general evaluation of various repair strategies Able to judge when specialist help is needed for traffic aspects and calculation of road-user costs, evaluation of available condition registrations, and evaluation of load-carrying capacity
Technical Special Inspection	Bridge inspector	Good knowledge of the causes and development of damage Good knowledge of investigation methods Able to decide on the necessary extent of the investigation Experience in work planning Good knowledge of construction methods and materials technology Able to judge when specialist help is needed for special registrations (measurement specialists), materials technology, special investigations, evaluation of the results of investigations, and carrying out structural calculations

TABLE 16
DENMARK: TRAINING AND MENTORING REQUIREMENTS

Title	Training
Bridge Department Manager	No obligatory training programs
Bridge Inspectors	Two days of refresher training every year, with inspection in field and calibrating of condition marks and repair cost estimates
Underwater Inspectors	Review of resumes of team members
Bridge Load Rater	Review of staff resumes. Internal QC in the consulting company
Bridge Data Specialist or Software Specialist	No obligatory training programs. Thorough knowledge of Danbro use for data specialist Thorough knowledge of Danbro programs for software specialist

Danbro = Bridge management systems used by Danish Road Directorate.

TABLE 17
DENMARK: JOB TITLES AND DESIRED EXPERIENCE

Title	Bridge Inspection (years)	Bridge Maintenance (years)	Bridge Design (years)
Bridge Department Manager	2	2	2
Bridge Inspectors	2	2	1
Underwater Inspectors	—	—	—
Bridge Load Rater	1	1	5
Bridge Data Specialist or Software Specialist	5	5	2

TABLE 18
FINLAND: REQUIREMENTS FOR EDUCATION AND CERTIFICATION

Title	Education (minimum)	Certification (minimum)
Bridge Inspection Program Manager	Higher exam at a technical university	Bridge inspector certification
Inspection Staff Member	Exam at a technical high school	
District Bridge Engineer	Exam at a technical high school	
Certified Bridge Inspector	Exam at a technical high school	Bridge inspector certification
Certified Bridge Inspector (for basic inspections)	Higher exam at a technical university	Bridge inspector certification + FISE certificate in concrete design
Certified Bridge Inspector (for special inspections)	Higher exam at a technical university	Bridge inspector certification + FISE certificate in concrete design
Underwater Inspector	Exam at a technical high school	Bridge inspector certification, diving license
Road Foreman (for annual inspections)	Exam at a technical school	
Bridge Load Rater	Higher exam at a technical university	
Bridge Data Specialist	Higher exam at a technical university	
Main User of Bridge Register	Exam at a technical school	

Note: FISE is a Finnish organization that trains and certifies personnel in a variety of technical areas, including bridge design and inspection.

TABLE 19
BRIDGE INSPECTION TRAINING: FINLAND

Training	Description
Theoretical Training, 4-Day	Lessons on bridge structure, structural parts, and measures; static behavior, load capacity; construction materials; damage, defects, and deterioration; repair, inspection system, and handbooks; bridge register and reports Participant gets the handbooks (2) and all the materials of the lessons Field work and examination take place about one month later
Field Work, 2-Day	Guided (instructional) inspection of two bridges, followed by testing of individual inspectors
Advanced Training, One Day per Year (refresher)	Individual inspection of two bridges. The correct results are given and discussed in the afternoon session. After the day, the data are stored in the bridge register and quality points are calculated. Every inspector gets feedback.
Bridge Register, 2-Day	Use of bridge register system; successful completion certifies the individual for adding and editing data in the bridge database system.

France

In France, inspection personnel are certified at three levels: Team Leader, Inspector, and Inspector Agent (Table 22). The central laboratory, LCPC, directs a certification board for inspection personnel. Board members are personnel from regional laboratories. To become certified, team leaders and inspectors must complete the training required for the job title and be examined by the certifying board. Inspection agents are certified by the director of the regional laboratory.

Certification at each level has requirements for formal education, for training, and for experience with bridges. Inspection team leaders are engineers, inspectors are college-educated, and inspection agents have a high school education or better. These requirements are listed in Table 23. Training courses, called "modules," are managed by the Ecole Nationale des

TABLE 20
FINLAND: TRAINING AND MENTORING REQUIREMENTS

Title	Training	Mentoring
Bridge Inspection Program Manager	Bridge inspection course Basic course in Bridge Register	Many years experience
Inspection Staff Member (instructors for the inspection course)	Bridge inspection course	Depends on the person's responsibility and examination, many years experience
District Bridge Engineer	Bridge inspection course Basic course in Bridge Register and BMS use	
Certified Bridge Inspector	Bridge inspection course Basic course in Bridge Register use	
Certified Bridge Inspector (for basic inspections)	Bridge inspection course Basic course in Bridge Register use	Two years experience
Underwater Inspector	Bridge inspection course Basic course in Bridge Register use Diving course	
Road Foreman (for annual inspections)	None	
Bridge Load Rater	Bridge inspection course Basic course in Bridge Register use	Many years experience
Bridge Data Specialist (teacher of users and developer of Bridge Register and BMS)	None	Many years experience
Main User of Bridge Register	Basic course in Bridge Register use	

BMS = bridge management system.

TABLE 21
FINLAND: INSPECTORS AND INSPECTIONS

Inspection Type	Inspector
Acceptance, Annual, General	Road foremen
Basic, Special	Engineers having BS or MS degrees who are certified bridge inspectors
Underwater	Certified bridge inspectors who are also certified as divers
Intensified Monitoring	Road foreman or engineer depending on need

TABLE 22
FRANCE: EDUCATION AND CERTIFICATION REQUIREMENTS FOR INSPECTION PERSONNEL

Title	Education	U.S. Equivalent Education	Certification
Inspection Team Leader or Project Manager (Chargé d'études)	Civil engineering degree (Baccalauréat + 5 years or Bac + 2 years)	BS Civil Engineering	By Certifying Board
Inspector	Baccalauréat + 2 years or Bac	Basic university degree	By Certifying Board
Inspection Agent	BEP or Baccalauréat	High school diploma	By the laboratory director

BEP = Brevet d' Enseignement Professionel.

TABLE 23
FRANCE: INSPECTION CERTIFICATIONS

Certification/ Awarding Organization	Certification	Description
LCPC (DTOA)	Chargé d'études en inspection d'ouvrages d'art	Team leader
LCPC (DTOA)	Inspecteur	Inspector
LRPC (Directeur)	Agent d'inspection	Inspector agent

DTOA = Direction technique Ouvrages d'art (Technical Direction on Engineering Structures).

TABLE 24
FRANCE: TRAINING MODULES

Training	Description
Module 1	General structures including common forms of bridges in reinforced concrete, prestressed concrete, steel, and masonry; culverts; common retaining walls
Module 2	Prestressed concrete bridges having long spans and/or unusual forms
Module 3	Uncommon retaining walls and trenches
Module 4	Great steel bridges, cable bridges, gantries
Module 5	Tunnels
Module 6	Special course for project manager (team leader): Special behavior of bridges, diagnosis, investigations, repair, case studies

Ponts et Chaussées (Tables 24 and 25). Certifications for Team Leaders, Inspectors, and Inspection Agents follow a common sequence of training. At a minimum, a bridge inspector must be qualified in Module 1. A project manager must be qualified in at least Modules 1 and 6. Having these modules, the individual then completes a field test in bridge inspection and an oral examination by the certifying board. Requirements for experience are listed in Table 26. New team leaders and new inspectors are mentored by senior personnel during the first year of their certification.

Regarding fitness and vision requirements for inspectors, France makes a distinction between personnel qualifications and assignments. Qualifications are the formal requirements for education, training, and certification. Among qualified personnel, particular assignments, and the duties that come with these, depend on factors such as good vision, ability to work at height, and the general ability to work well with other staff and with clients.

Germany

In Germany, bridge inspectors must have formal education as civil engineers and complete a federal training course lasting one week that covers all aspects of inspection (Table 27). Inspection program managers in each state will also routinely have this course on their resume, although there is no federal requirement for it. Additional courses, often dealing with special structures or tasks, are offered at the state level. Continuing training occurs at annual federal conferences for bridge inspections. There is no formal certification of bridge inspectors.

German bridge inspectors and inspection team leaders must have five years experience in bridge design, construction, or maintenance. Usually, state inspection program managers also have sufficient bridge-related experience. There is no formal requirement for experience for program managers.

There are physical fitness requirements. Inspectors must be capable of the walking, climbing, or other activities required by an inspection. Inspectors may not be colorblind and must have no hearing impairment.

South Africa

For SANRAL, Principal inspections are led by licensed PEs who are certified bridge inspectors and who have experience in bridge design (Tables 28 and 29). All inspectors must attend a two-day inspection workshop run by SANRAL in which the Structures Management System is outlined, full inspections at bridge sites are performed, and all participants must provide condition ratings for a bridge. This course is taught by the Bridge Network Manager with some input from the developer of BMS software. The condition rating system is then discussed by participants as a group.

SANRAL accreditation for inspectors requires attendance at an inspection workshop and submission of a resume detailing experience and qualifications. The following educational qualifications and experience are needed:

- Major culvert inspectors—Civil engineering degree with a minimum of 5 years experience in the design of bridges and culverts.
- Bridge inspectors—Civil engineering degree, professional registration, and a minimum of 5 years of full-time experience in bridge design and documentation.
- Senior bridge inspectors—A university degree, professional registration, and 17 years bridge design experience that must specifically include design of continuous prestressed decks.

TABLE 25
FRANCE: TRAINING REQUIREMENTS

Title	Training (course name)	Duration
Team Leader/Project Manager	Modules 1 and Module 6	Module 1: 6 days Module 6: 3 days
Inspector	Module 1 Optional: Modules 2, 3, 4, and 5	Module 2: 1 day Module 3: 3 days Module 4: 2 days Module 5:
Inspection Agent	Module 1	Module 1: 6 days

TABLE 26
FRANCE: INSPECTION STAFF QUALIFICATIONS

Title	Qualifications
Team Leader	Current requirements: Training Modules 1 and 6 with a good notation + One year of mentoring + Test inspection on site + Approval by certifying board Alternative requirements: 3 years experience as a team leader + Approval by certifying board
Inspector	Current requirements: Training Module 1 with a good notation + One year of mentoring + Test of inspection on site + Approval by certifying board Alternative requirements: 5 years of functioning like an inspector + discussion with certifying board
Inspection Agent	Test on site or demonstration of technical know-how

TABLE 27
GERMANY: EDUCATION AND CERTIFICATION REQUIREMENTS

Title	Education
Inspection Program Manager	Civil engineering degree
Inspection Team Leader	Civil engineering degree
Bridge Inspector	Civil engineering degree
Underwater Inspector	Engineering college diploma

There are no formal requirements for physical fitness or vision, except the general requirement that inspectors must be able to do the work.

Sweden

In Sweden, individuals performing General or Major inspections must hold an engineering degree, have experience with bridge design and construction, and must complete a one-week training course offered by the SRA (Tables 30 and 31). Inspectors must have knowledge of bridge types, bridge design specifications, defect types, and the likely rates of growth of defects.

Additional certification is needed for underwater inspection, and for inspection of mechanical and electrical equipment. QA in bridge inspections is achieved by adequate training of inspectors and by the use, where possible, of quantitative measures of damage.

Sweden does not have numerical requirements for inspection experience, but inspectors must have good knowledge of bridges, structural behavior, materials, and deterioration mechanics, as well as the Swedish bridge code.

United Kingdom

The Highways Agency does not impose formal requirements for education for any staff title, and requires certification as a chartered engineer (equivalent to U.S. PE) only for the supervising engineer for an inspection team (Table 32). The supervising engineer hires inspection team members. The agency requires that the supervising engineer ensure that all personnel performing bridge inspections be fit and qualified for their tasks.

Divers are certified by the U.K. Health and Safety Executive. Some nondestructive testing (NDT) specialists are certified by the British Institute for Non-Destructive Testing. This is similar to certification by the American Society for Nondestructive Testing in the United States.

The contractor is responsible for providing qualified personnel and for executing competent inspection work. Poor, perhaps incompetent, work by a contractor is evidence that personnel are not qualified or not properly directed. The qualifications that may be applied to individuals regarding their education, licensure, work experience, physical fitness, etc., are all matters for contractor management and oversight.

Overall, requirements are met by the contractor; that is, the performance of the contract is judged on the basis of the

TABLE 28
SOUTH AFRICA: EDUCATION AND CERTIFICATION REQUIREMENTS

Title	Education	Certification*
Inspection Program Manager	Professional bridge engineer Engineering degree	
Inspection Team Leader	Civil engineering degree	PE license
Bridge Inspector	Civil engineering degree	
Senior Bridge Inspector	Civil engineering degree	PE license
Underwater Inspector	—	Certification as diver
Inspection Specialists	Civil engineering degree	
Major Culvert Inspector	Technical civil diploma or degree	

*All titles except underwater inspector require certification by SANRAL.

TABLE 29
SOUTH AFRICA: INSPECTION PERSONNEL EXPERIENCE REQUIREMENTS

Title	Experience (years)
Inspection Program Manager	17
Senior Bridge Inspector	17
Bridge Inspector	5
Major Culvert Inspector	5
Inspection Specialists	17

quality of the inspection work. The achievements of a firm are considered in the contract award process, rather than the experience of individual personnel.

INSPECTION TEAMS—FOREIGN AGENCIES

Little information has been collected on questions concerning the size of inspection teams and the assignment of teams to bridges. Two-person teams are used in Denmark, France, and Germany. An inspectors' abilities or experience may sometimes determine their assignments to particular bridges. In Denmark, team members work together for many years. In other countries teams are formed as needed, with frequent changes of individual personnel. No nation in this group reported a policy on repeat assignments of the same teams to the same bridges.

In Sweden, bridge inspectors usually work alone unless inspection lifts are needed, with larger bridges requiring two or more inspectors. Dive inspections necessarily have at least two-person teams.

Swedish inspectors work on all kinds of bridges. In regions that use consultants for inspections, the same individual rarely inspects the same bridge in consecutive cycles. Where SRA personnel perform inspections, it may

TABLE 30
SWEDEN: EDUCATION AND CERTIFICATION REQUIREMENTS FOR INSPECTION STAFF

Title	Education	Certification
Inspection Program Manager	Engineering degree	
Inspection Team Leader	Engineering degree	Certified completion of bridge inspection course
Bridge Inspector	Engineering degree	Certified completion of bridge inspection course
Underwater Inspector	Engineering degree	Certification for diving
Inspection Specialists	Engineering degree	
Mechanical, Electrical Equipment Inspector	Engineering degree	Equipment inspection certification
Regular Inspector	High school diploma	

TABLE 31
SWEDEN: INFORMATION ON CERTIFICATIONS

Certification/Awarding Organization	Description of Certification
Certified Completion of Bridge Inspection Course/SRA	Five-day course including three days of theory and two days of field practice (not compulsory); examination
Equipment Inspection Certification/ Electrical Installations Ordinance	Electrical competence in accordance with the Electrical Installations Ordinance
Certification for Work Under Water/ Labor Inspectorate in Sweden	Divers license

TABLE 32
UNITED KINGDOM: REQUIREMENTS IN EDUCATION AND CERTIFICATION

Title	Education	Certification
Area Structures Manager	No specified requirement, but Highways Agency employs a body of technical specialists that can be called on for advice	None
Inspection Team Leader (supervising engineer)	The supervising engineer should be a Chartered Civil or Structural Engineer with a background in design, construction, or maintenance of highway structures.	None
Bridge Inspector	All maintenance inspections must be undertaken by personnel that are judged by the supervising engineer to satisfy the minimum requirements for health, experience, and, where appropriate, requirements for the particular inspection type.	None
Underwater Inspector	U.K. Health and Safety Executive (HSE) control the competency requirements for commercial divers and diving regulations.	Yes
Inspection Specialists	British Institute of NDT provides certification and training of operatives for nondestructive testing. HSE controls safety requirements for some specific operations; e.g., radiography. Otherwise, dependent on the resume of the operator for more innovative methods that are not yet codified; e.g., acoustic emission.	Where available

happen that the same inspectors are repeatedly assigned to the same bridge. There is no policy to discourage such an occurrence.

Much of the bridge inspection work for these countries is done by consultants. In Denmark, Principal inspections are performed by Directorate personnel, Finland has a set of reference bridges that are inspected by Finnra personnel, and in France large bridges are inspected by personnel of departmental agencies or by regional laboratories. Other bridges and other types of inspections are the work of consultants (Table 33).

TABLE 33
INSPECTIONS BY CONSULTANTS OR AGENCY—FOREIGN AGENCIES

Nation	Inspections	Agency	Consultants
Denmark	Routine		~100%
	Principal*	~100%	
	Special		~100%
Finland	All except Basic	5%	95%
	Basic (125 bridges)	100%	
France	Bridges		100%
	Great bridges	100%	
South Africa	All		100%
Sweden	All	50%	50%
United Kingdom	All		100%

*Principal inspections of a few major bridges are performed by consultants.

CHAPTER FOUR

INSPECTION TYPES AND INTERVALS

U.S. INSPECTIONS

U.S. federal regulations define eight types of bridge inspections (Table 34). Three of these, fracture-critical member inspection, routine inspection, and underwater inspection occur at intervals set by regulation.

For routine inspection and underwater inspection, U.S. federal regulations cite three intervals: A standard interval; a longer interval applied to specific bridges and with the approval of the FHWA; and any interval, shorter than standard, that may be needed at a bridge. For fracture-critical member inspections, a standard interval and shorter interval, if needed, are stated in regulation (Table 35).

NBI data from 2005 (*2*) show that state DOTs use standard intervals for 85% of routine inspections, 34% of underwater inspections, and 67% of fracture-critical member inspections (Table 36). Inspection intervals from NBI data are listed for routine inspections (see Tables 37 and F1), underwater inspections (see Tables 38 and F2), and fracture-critical inspections (see Tables 39 and F3). Throughout this chapter more detailed responses to the questions on inspection types and intervals can be found in the tables in Appendix F.

Routine Inspection—U.S. Federal Regulations

U.S. federal regulations define four aspects of routine inspection of bridges:

- Structures—regulations define the bridges and structures that must be inspected.
- Frequency—regulations set maximum intervals for inspections.
- Inspectors—regulations set minimum qualifications for inspection program managers and inspection team leaders.
- Procedures—regulations include, by reference, the *Bridge Inspector's Reference Manual* (*4*) and the AASHTO *Manual for Condition Evaluation of Bridges* (*5*).

Aspects of routine inspection that are determined by state DOTs, other bridge owners, and their inspection staff include:

- Short-interval inspections of some structures. Interim inspections of structures or critical components of structures.
- Access for inspections and policy for close-up and hands-on inspection.
- Application of methods of testing and/or measurement including NDT methods.
- Personnel requirements for complex structures, complex inspection methods, and/or complex access.

This section presents practices at U.S. state DOTs related to routine inspections. Information was collected from 34 DOTs. Not all DOTs have information on every topic related to routine inspection.

Routine Inspection—U.S. State Department of Transportation Practice

Full routine inspection of bridges occurs at 24-month intervals at most state DOTs and for the majority of bridges. Two states, Minnesota and Ohio, require routine inspection at 12-month intervals. Minnesota allows a 24-month inspection interval for specific bridges with the approval of the DOT. As a result, routine inspection intervals are 24 months for approximately 63% and 12 months for 28% of bridges in Minnesota. In Ohio, more than 99% of all bridges have routine inspections at 12-month intervals.

Specific Tasks in Routine Inspections

Seven DOTs reported policies on specific inspection methods or measurements that must be collected at set intervals (see Table F4). Tasks include measurement of vertical clearances, measurement of channel cross section, fathometer surveys at substructures, mandatory wading at substructures, and mandatory boring of timber members. For bridges in good condition, intervals for tasks range from 60 to 144 months. Intervals become progressively shorter as bridge condition becomes poorer, as scour hazard is more severe, or as vertical clearances are more limited.

Access Policies for Routine inspections

Ten DOTs and Eastern Federal Lands reported policies regarding access to bridge components for routine inspection (see Table F5). Access can include climbing, rigging, UBIVs, and entry of confined spaces. Idaho, Iowa, Oregon, and Eastern Federal Lands set maximum intervals for close-up inspection, ranging from 48 to 120 months. The Oregon DOT requires entry of box girders during every routine

TABLE 34
U.S. FEDERAL INSPECTION TYPES

Inspection	Description
Damage Inspection	An unscheduled inspection to assess structural damage resulting from environmental factors or human actions.
Fracture-Critical Member Inspection	A hands-on inspection of a fracture-critical member or member components that may include visual and other nondestructive evaluation.
Hands-On Inspection	Inspection within arms length of the component. Inspection uses visual techniques that may be supplemented by NDT.
In-Depth Inspection	A close-up inspection of one or more members above or below the water level to identify any deficiencies not readily detectable using routine inspection procedures; hands-on inspection may be necessary at some locations.
Initial Inspection	First inspection of a bridge as it becomes a part of the bridge inventory to provide all Structure Inventory and Appraisal data and other relevant data and to determine baseline structural conditions.
Routine Inspection	Regularly scheduled inspection 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.
Special Inspection	An inspection scheduled at the discretion of the bridge owner, used to monitor a particular known or suspected deficiency.
Underwater Inspection	Inspection of the underwater portion of a bridge substructure and the surrounding channel that cannot be inspected visually at low water by wading or probing, generally requiring diving or other appropriate techniques.

Source: *Code of Federal Regulations* (*1*).

inspection if deterioration is known to exist. DOTs in other states track the need for access equipment at some bridges as a part of planning and scheduling for inspections.

Routine Inspections for Specific Structures or Details

Nineteen DOTs set intervals for inspection of specific bridge types and detail types (see Table F6). Intervals are set for inspection of pin and hanger details and fatigue-prone details on redundant bridges, for pontoons of floating bridges, for cables in cable-supported spans, and for segmental superstructures.

Hands-On Inspection

Thirty DOTs and Eastern Federal Lands reported policies for hands-on inspection during routine inspections. Policies range from general advice to making hands-on inspections as needed, to requirements for hands-on inspection at specific details or in response to specific defects (see Table F7). The Pennsylvania DOT sets a maximum 72-month interval for hands-on inspection of each component of a bridge.

In-Depth Inspection

Eight DOTs set maximum intervals for in-depth inspection of bridges (see Table F8). For bridges in good condition, intervals range from 10 to 15 years. DOT policy may require specific measurements, specific reports, and the use of specific personnel for in-depth inspection. Long-interval in-depth inspections are thorough, detailed inspections of entire bridges. Short-interval in-depth inspections are applied to specific components such as nonredundant members or connections, and equipment for movable bridges.

Underwater Inspection

NBI data (*2*) indicate that although 84% of NBI-length bridges and culverts are water crossings, only 6% require in-

TABLE 35
INSPECTION INTERVALS: U.S. FEDERAL REGULATIONS

Inspection	Standard Interval	Maximum Interval
Fracture-Critical Member	24 months	—
Routine	24 months	48 months
Underwater	60 months	72 months

TABLE 36
U.S. INSPECTION INTERVALS IN PRACTICE

Inspection	Short Interval	Standard Interval	Long Interval
Fracture-Critical Member	26%	67%	7%
Routine	11%	84%	5%
Underwater	66%	34%	<1%

Source: 2005 NBI data (*2*).

TABLE 37
INSPECTION INTERVALS—ROUTINE INSPECTION—SUMMARY

Bridges and Culverts Routine Inspection Interval, Months					
<12	12	24	36	48	Total
1,629	60,363	504,413	19	28,275	595,149
(0.3%)	(10.1%)	(84.8%)	(0.003%)	(4.8%)	(100%)

Source: 2005 NBI data (*2*).
Note: Not all inspection intervals are shown.

TABLE 38
INSPECTION INTERVALS—UNDERWATER INSPECTION—SUMMARY

Bridges and Culverts								
Underwater Inspections (total)	Inspection Interval, Months							
	<12	12	24	36	48	60	72	>72
37,735 (100.00%)	2,209 (5.9%)	1,114 (3.0%)	11,092 (29.4%)	636 (1.7%)	9,835 (26.1%)	12,796 (34.0%)	4 (0.01%)	0 (0.0%)

Source: 2005 NBI data (*2*).
Note: Not all inspection intervals are shown.

spection by diving. Thirty-eight percent of dive inspections are performed at intervals of 24 months or less, 26% are done at 48-month intervals, and 34% are done at 60-month intervals. Less than 1% of dive inspections are performed at the maximum 72-month interval currently permitted by U.S. federal regulations.

Dive inspections are applied when inspection by wading and probing is not adequate (see Table F9). Seven DOTs reported a maximum depth of water for inspections by wading or from boats. Maximum depths range from 30 in. to 6 ft. In deeper water, inspection must be by diving. Eight DOTs reported policies for short-interval underwater inspection. Inspection intervals are shorter for bridges with poor scour ratings and where scour protection is absent or inadequate. Five DOTs identified two or three intensity levels for dive inspections that differ in the extent of cleaning of submerged components. Channel cross sections may be measured during dive inspections.

Fracture-Critical Inspection

Inspection of fracture-critical members is required every 24 months by federal regulation. Three DOTs reported annual inspections of fracture-critical members, and four DOTs perform increased intensity inspections of fracture-critical members using intervals that range from 48 to 120 months. The shorter intervals are applied to older bridges, bridges with a greater volume of truck traffic, and bridges having specific design details. Longer intervals for increased intensity inspections are applied to newer bridges in good condition with (relatively) robust design details (see Table F10). The Oregon DOT, for example, employs a Level 1 fracture-critical inspection that is done with every routine inspection, and a more intense Level 2 fracture-critical inspection at a longer interval. Level 2 inspections can include use of NDT methods.

TABLE 39
INSPECTION INTERVALS—FRACTURE-CRITICAL INSPECTION—SUMMARY

Bridges and Culverts						
Fracture Critical (total)	Inspection Interval, Months					
	<12	12	24	36	48	>48
21,668 (100.0%)	384 (1.8%)	5,292 (24.5%)	14,616 (67.6%)	16 (0.1%)	288 (1.3%)	1,023 (4.7%)

Source: 2005 NBI data (*2*).
Note: Not all inspection intervals are shown.

Complex Bridges

U.S. federal regulations identify movable bridges and cable-supported bridges as examples of complex bridges. Inspection of complex bridges may require special procedures or specially trained inspectors.

Twenty-four DOTs identified some structures and inspection types as complex or as needing special methods (Table 40). These are in addition to fracture-critical inspection and underwater inspections. Twenty-two DOTs require specific training or experience in personnel for these inspections. The Connecticut DOT identifies bridge complexity in three levels and specifies inspection team size and technical grades of team members for each level of complexity. The Ohio DOT identifies major bridges by structural type and span length. Bridge types and inspection types that require specific training of personnel are listed in Table F11.

Movable Bridges

At movable bridges, additional inspections are made of motion equipment, motion operation, and signals and gates (see Table F12). Cursory inspections and trial operation of movable spans are made once each year at four DOTs. One DOT performs trial operations once each month. In-depth inspections of motion equipment are done at 72-month interval at two DOTs.

Routine Interim Inspection

Short-interval inspections, usually called interim inspections, are performed in response to poor conditions, posting for load, scour vulnerability, fracture vulnerability, and for

TABLE 40
U.S. COMPLEX BRIDGES

Complex Bridge	No. of DOTs
Suspension	19 (59%)
Cable-Stayed	17 (53%)
Movable Bridge	14 (44%)
Tied-Arch	13 (41%)
Eyebar Bridge	8 (25%)
Box Girder with External Post-Tensioning	8 (25%)
Single Concrete Box Girder	7 (22%)
Two-Girder	6 (19%)
Single Steel Box Girder	6 (19%)
Bridges with Pins and Hangers	6 (19%)

Note: Percentage refers to how many of the 32 agencies that responded to the question mentioned inspecting this type of complex bridge.

specific defects such as damage resulting from high-load hits, loss of bearing, the presence of temporary supports, and incipient buckling of members (see Table F13). DOT policy guidelines to interim inspections recognize:

- Bridges posted for load (five DOTs);
- Bridges with low NBI condition ratings (seven DOTs)—This usually means condition ratings for deck, superstructure, substructure, and culvert; however, some DOTs include ratings for channel and approach roadway as well;
- High-load hits, unrepaired critical findings, severe section loss, or other known significant defects (seven DOTs); and
- Temporary bridges and bridges with temporary supports or temporary repairs (three DOTs).

Interim inspections focus on the specific defect, specific poor condition, or specific cause of load posting.

Intervals for interim inspections range from 6 to 24 months, with shorter intervals for more severe deficiencies. Note that interim inspections at 24 months alternate with routine inspections also at 24 months. In this way, defects are inspected every 12 months.

Forty-Eight-Month Routine Inspection

DOTs in Arizona, Illinois, and New Mexico apply a 48-month interval for routine inspection at more than one-third of their bridges (*2*) (Table 41). Five other DOTs, Colorado, Kentucky, Montana, North Dakota, and West Virginia use a 48-month interval for at least 10% of their bridges. Thirty-six DOTs use a 48-month interval for less than 1% of their bridges.

Forty-eight-month inspection intervals are applied only to bridges in good condition. Some DOTs set bounds on bridge length, bridge age, load capacity, or vertical clearance to qualify for a 48-month inspection interval (see Table F14).

TABLE 41
PREVALENCE OF 48-MONTH INSPECTION INTERVAL

DOT	Percentage of Routine Inspections at 48-Month Interval
Arizona	44
Illinois	42
New Mexico	35
West Virginia	24
Kentucky	17
Montana	16
Colorado	14
North Dakota	10
Texas	9
South Dakota	7
Connecticut	6
Washington	6
Arkansas	5
Virginia	5
Mississippi	1
Oklahoma	1

Special Inspections

Eleven DOTs identified as "special" a variety of inspections directed at particular types of structures, addressing specific defects or performing specific tasks. Table F15 lists inspections that collect specific quantitative data, but might not be periodic. These inspections include measurement of joint opening, crack extent, substructure settlement, vertical clearance after overlays are placed, and inspection of substructures and channels after storms or other high-flow events.

Minor Bridges and Non-Bridges

Information on routine inspection of minor bridges, non-highway bridges, and non-bridges was collected from 13 state DOTs (see Table F16). Tennessee and Washington State DOTs inspect roadway bridge spans as short as 4 ft. The Virginia DOT inspects all structures with openings of 36 square feet or greater. DOTs inspect or require the inspection of pedestrian bridges, railroad bridges, utility bridges, and private bridges that cross public roads. Inspection may be limited to the highway environs, and may focus on potential hazards to road traffic. DOTs also inspect sign structures, high-mast lights, retaining walls, noise barriers, tunnels, and ferry slips. Intervals for routine inspection generally range from 24 to 72 months. At ferry terminals, vehicle transfer spans and equipment for hoists may be inspected annually.

Informal Inspections

U.S. DOTs responding to the questionnaire all indicated that external reports of problems at bridges are investigated by bridge inspectors (see Table F17). Thirteen DOTs preserve external reports as hardcopy in bridge files. Twelve DOTs routinely receive problem reports from state maintenance crews. In North Carolina, findings from annual highway reviews (ride-bys) performed by maintenance crews are shared with bridge inspectors. In Vermont, annual reports of the DOT's Operation Division are shared. In Iowa, there is frequent, informal contact among inspectors and maintenance crews, and frequent exchange of information.

Monitoring of Bridges

Table F18 presents bridge monitoring methods for 31 U.S. DOTs and Eastern Federal Lands. Methods of monitoring are identified as visual monitoring, measurement, and instrumentation. Visual monitoring (15 DOTs) is often not periodic, is directed at one or very few defects, might be performed by maintenance crews or others, and is not recorded as an individual inspection. Measurement (22 DOTs) is the collection, usually by hand methods, of quantitative values during routine inspections. Instrumentation (10 DOTs) is the application of acoustic detectors, strain gages, or other devices for precise and/or remote collection of quantitative data.

INSPECTION TYPES—FOREIGN ROAD AGENCIES

Denmark

The Danish Road Directorate identifies eight types of bridge inspections (Table 42).

- *Inventory* inspections are made for new bridges, after major projects on bridges, and in general after each significant construction or repair event in the service life of a bridge.
- *Daily* inspections are made by road maintenance crews. Each day, the highway road patrol performs a drive-by inspection of all national roads, noting distress in bridges, pavements, and all other road facilities. Crews observe each bridge in all weather conditions and develop a thorough familiarity with each structure and its basic systems. Daily inspections note:
  - Failure of load-bearing components;
  - Impact damage;
  - Washing away of slopes, shoulders, etc.;
  - Vandalism on slope facings, railings, traffic signals, lights, etc.;
  - Detached objects; for example, fragments of concrete, railing segments, and goods that have fallen off lorries;
  - Function of drainage systems;
  - Conditions of road surface; and
  - Winter conditions; accumulation of ice and snow.

Daily inspections are not recorded in the bridge database.

- *Routine* inspections are done once a year by the maintenance foreman or the bridge engineer for the road management authority. The inspector must stop and view the bridge from the deck and from below. The inspector verifies that recommended cleaning and routine maintenance have been done and makes further recommendations for cleaning and maintenance for the next year. Maintenance work that is not complicated and of modest cost (around $20,000 U.S. maximum) is programmed through Danbro, the Danish bridge management system, and done by maintenance contractors. Maintenance contractors are supervised by the Directorate's regional bridge inspector. Routine inspection notes:
  - Stoppage of drainage systems;

TABLE 42
TYPES OF BRIDGE INSPECTIONS—DENMARK

Inspection Type	Description	Interval	Inspector
Inventory	Collect bridge data and baseline conditions	At new construction, and after every major repair project	Bridge inspector
Daily[a]	Cursory examination noting failure, damage, debris, etc.	Daily	Road maintenance crew[b]
Routine—Extended	Planning and checking routine cleaning and maintenance Inspectors stop and view the structure from the top and bottom Damage, if any, is noted.	Annually	Consultant bridge inspector
Reports from Users	Reports of: impact damage vandalism debris on bridge or road erosion damage	In response to user report	
Principal	Thorough and systematic visual inspection of all the components of the bridge	6 years or less[c]	Directorate bridge inspector
Special	Collection of more detailed information for decisions on maintenance actions	In response to recommendation from routine inspection	Consultant bridge inspector
Economic Special Inspection	Preparation for major repair project for a bridge Development and comparison of remedial strategies	In advance of project selection and development	Consultant bridge inspector
Technical Special Inspection	Damage investigations Special investigations Load-carrying capacity evaluations	In response to extreme event, or suspect capacity	Consultant bridge inspector

[a]Not a formal part of the Directorate bridge inspection program.
[b]Specially trained personnel. Currently provided by contractors, but Directorate personnel were scheduled to take over this work in 2007.
[c]Approximately 5% of Directorate bridges have Principal inspections at intervals of less than 6 years.

  - Grit and dirt, especially along edge-beams, gutters, low points, expansion joints, etc.;
  - Unwanted vegetation;
  - Erosion on slopes, washing away of foundations, hindrances, and deposits in watercourses;
  - Settlements at abutments and around manholes; and
  - A need for preventive maintenance (e.g., surface protection of concrete).
- *Reports* from highway users can require special visits to bridges. Often these reports deal with impact damage, vandalism, debris on the road, and erosion damage.
- *Principal* inspections are thorough visual inspections of all components. The inspector assigns condition ratings to all components. Principal inspections are usually performed at 6-year intervals, but may be undertaken at shorter intervals. The inspector notes damage, reports the apparent causes of damage, and evaluates the risk to users. The inspectors recommend the interval to the next Principal inspection and may recommend additional special inspections. The interval to the next inspection depends on the bridge age, average daily traffic, location, existing conditions, and special features. Recommendations for maintenance and repair are made, with the inspector estimating the cost for each recommendation and indicating when the recommendation should be completed (within 1 year, 2 years, or as many as 11 years into the future).
- *Special* inspections collect more detailed information about specific conditions at bridges.
- *Economic special* inspections provide information needed for selection of repair strategy and development of plans.
- *Technical special* inspections are detailed investigations of damage seeking causes of damage and evaluating the effect of damage on load capacity.

Finland

Finland defines seven types of routine bridge inspection (see Table 43).

- *Acceptance* inspections are done to add or modify bridge inventory data (the Finnish term is "registry data"). Acceptance inspections occur for newly constructed bridges and after major repair or modification projects.
- *Annual* inspections are performed by road maintenance foremen, or consultants hired by road foremen, and seek conditions that are a threat to safety.
- *General* inspections are thorough visual inspections performed every 5 years for most bridges, and every 8 years for large bridges. All bridge components are assigned condition ratings, and inspection data are entered in the bridge registry. General inspections are done by certified bridge inspectors.
- *Basic* inspections are similar to General inspections, but are performed on a select population of 125 bridges called reference bridges. Data from basic inspections and the accompanying materials tests are the basis of the formation and updating of bridge deterioration models. Basic inspections are performed by degreed engineers who are certified bridge inspectors.
- *Special* inspections collect complete, detailed information in preparation for repair projects. Special inspections are usually done by certified inspectors who are degreed engineers and have experience with the testing methods that may be needed at particular structures.
- *Underwater* (dive) inspections are done by certified inspectors with special training. Bridge components are inspected both visually and by touch.
- *Intensified monitoring*, a kind of interim inspection, is performed on selected components and may be done by bridge inspectors, engineers, or road foremen depending on the nature of the monitoring program.

For long-span bridges in good condition, general inspections are performed at 8-year intervals. The inspection of a long-span bridge is a complex effort that requires lane closures and lift equipment. Long-span bridges usually have high traffic volume. Inspections are intentionally more intense at large bridges, with the increased scrutiny permitting the longer inspection interval.

For most bridges, inspection intervals are determined by two factors. One is the bridge; inspection intervals are consistent with the condition of each bridge. The other is logistics; bridges in remote areas are inspected when personnel are on hand; therefore, inspection intervals may be somewhat longer or shorter than intended.

France

France has four types of routine inspections: routine visit, annual inspection, IQOA (Image de la qualité des Ouvrages d'Art: Image of the Quality of Bridges, Walls, and Tunnels) evaluation, and detailed inspection (Table 44). Routine visits are made by road agents during their patrols. Annual inspections are cursory examinations intended to discover new, significant defects in structures, and to program routine maintenance. IQOA evaluations occur every three years and are more complete visual examinations of structures to establish the condition of bridges in IQOA classes. Detailed inspections occur at intervals ranging from 3 to 9 years, depending on bridge condition, and are thorough visual examinations of bridges noting all defects. The detailed inspection is a "blank slate" examination. The annual inspection, in contrast, is a check of defects known to exist at the structure.

Annual inspections and IQOA inspections often require about one-half day of work for the inspection team. Detailed inspections require additional time and usually require access using lane closures, lift equipment, etc. The detailed inspection is a hands-on inspection. This is mandatory; the inspector must be able to touch each component.

TABLE 43
TYPES OF BRIDGE INSPECTIONS—FINLAND

Inspection Type	Description	Interval	Inspector
Acceptance	Collect data for bridge registry	After construction or repair work	District bridge engineer
	Inspection of all components at arms length		Bridge engineer and designer
	First general inspection of a large bridge		
Annual	Cursory inspection for safety	1 year	Road foreman or maintenance consultant
General	Inspection of all components at arms-length	4 to 8 years (usually 5 years)	Certified bridge inspector
	Results are stored in the Bridge Registry by the inspectors themselves.		
	Inspection of all components at arms-length	Large waterway bridges 8 years	Certified inspector with engineering degree
	NDT methods are used when necessary		
	Results are stored in the Bridge Registry by the inspectors themselves.		
Basic	For reference bridge group	5 years	Certified inspector with engineering degree
	Inspection of all components		
	Includes material sampling and testing to improve deterioration models		
Special	Methods vary with needs of project	For planning and development of repair projects	Certified inspector with engineering degree
	Machinery of movable bridges; includes annual maintenance	1 year	Specialist
	Suspension cables, stay cables	15 years	Certified bridge inspection, specialist in cables
Underwater	Inspection by diving; visual and touch inspection of components	5 years	Certified inspectors with special training
Intensified Monitoring	More frequent inspection	Due to poor or weakened condition	

Germany

Germany performs bridge inspections at two levels called Major Test and Minor Test (*15*) (Table 45). Major tests are arms-length (DIN wording is "touching-distance") inspections of all elements with access to all parts. This entails opening access doors and covers, using lift equipment, performing underwater inspection, and inspecting the riverbed. Lane closures are used, if necessary, but use is limited by the large traffic volume on most federal roads. Major tests are performed at acceptance of construction, near the end of the guarantee period, and every six years during service life.

Minor tests are done three years after each major test. Minor tests use findings of the previous major test and focus on known damage and defects. Access equipment is not used in a Minor test, but the level of effort is expanded as necessary for the conditions that are observed. Tests of electrical and mechanical equipment, such as ventilation systems, are required by statute.

All highway structures are visited twice a year for safety. Viewing is from the ground level as well as the traffic level. Germany performs ad hoc inspections after significant events such as storms or floods.

TABLE 44
TYPES OF BRIDGE INSPECTIONS—FRANCE

Inspection Type	Interval	Performed by	Description
Routine Visit	Frequent	Road maintenance agents employed by DDE	Drive-by inspection
Annual	1 year	Road maintenance agents employed by DDE	Cursory examination during visit to bridge
IQOA	3 years	Inspection agent sometimes with certified inspector	Visual verification of conditions focusing on known defects
Detailed	9 years	Certified inspector	Robust bridges. Arms-length visual examination of all components and noting all defects
	6 years	Certified inspector	Normal bridges. Arms-length visual examination of all components and noting all defects
	3 years	Certified inspector	Ill bridges. Arms-length visual examination of all components and noting all defects
	1 year	Certified inspector	Very ill bridges. Arms-length visual examination of all components and noting all defects
Underwater	6 years	Certified inspector	Diver making arms-length touch and visual inspection

DDE = Direction Départementale de lEq uipment.

The names of inspection types are used a bit differently in the German preservation and maintenance guide (*15*) (Table 46).

German structural design practice requires explicit consideration of access for inspection. Germany's guide to design for monitoring, inspection, and maintenance (*16*) directs designers to consider:

- Visibility of parts;
- Internal clearances in boxes;
- Interior ventilation;
- Installation of fixed ladders;
- Lighting, both exterior and interior; and
- Room for jacking points at abutments.

Norway

The Norwegian Public Roads Administration (*17*) identifies three classes and seven types of inspection (Table 47).

- *Acceptance* inspections are performed for new construction and after major repair projects.

TABLE 45
TYPES OF BRIDGE INSPECTIONS—GERMANY

Inspection Type	Description	Interval	Performed by
Major Test	Arms-length inspection of all components; uses access equipment and includes underwater inspection	6 years	Bridge inspector
Acceptance	Major test	After new construction or major rehabilitation	
Guarantee	Major test	Near the end of the guarantee period	
Minor Test	Verification of current state of known damage and defects	3 years after Major test	Bridge inspector
Superficial	Cursory inspection for safety	3 months	Road maintenance crew
Ad Hoc	After significant events, such as storms, floods, etc.; also for known, severe damage.	N/A	Depends on situation
Systems	Inspection of electrical or mechanical systems	As required by regulation	

N/A = not applicable.

TABLE 46
INSPECTION DESIGNATIONS—GERMANY

Designation	Description
H1	Main inspection before acceptance
H2	Main inspection before the expiration of the claims deadline for defects
H	Main inspection
E	Simple inspection
S1–S9	Special inspections (inspection owing to particular reasons)

  - *Warranty* inspections are performed near the end of the warranty period for construction or repairs.
- *Routine*
  - *General* inspections every 1 or 2 years, and
  - *Major* inspections every 5 to 10 years. Structural cables are inspected every 5 years.
- *Additional Special* inspections for known damage or after extreme events are performed as needed.

Norway specifies the field measurements and materials tests that are part of each type of inspection (Table 48). General inspections require few measurements and no materials testing. Major inspections require many measurements and tests.

South Africa

South African practice includes three types of routine inspections: *Monitoring*, *Principal,* and *Verification* (Table 49). *Monitoring* inspections are performed by maintenance personnel and occur at frequent but irregular intervals. Maintenance personnel report problems, if any, but do not otherwise report that specific bridges have been visited. Monitoring inspections are part of routine maintenance surveys for road sections and also part of quick surveys conducted after accidents, floods, cyclones, or other extreme events.

Principal inspections are conducted every 5 to 6 years by inspectors who are experienced in bridge design, maintenance, or rehabilitation. Principal inspections are thorough examinations of bridges that record all defects. A principal inspection produces a full inspection report with photographs. The 5-year interval for principal inspections matches SANRAL's 5-year programming cycle for bridge repairs.

Verification inspections are part of SANRAL's QA program. Each year some bridges are selected and their conditions are verified by a senior bridge inspector.

Two event-related inspections pertain to repair projects. (1) The project-level inspection is a directed examination of a bridge to collect data needed for the preparation of contract documents for a repair project; and (2) an acceptance inspection is made after repairs are complete.

Condition data from principal inspections are stored in the bridge database. Monitoring inspections do not produce condition ratings.

TABLE 47
TYPES OF BRIDGE INSPECTIONS—NORWAY

Class	Type	Description
First	Acceptance inspection	Performed for new construction and after major repair projects Note deficiencies and damage Identify sources of deterioration that may be significant to maintenance
	Warranty inspection	Performed near the end of the warranty period Verify that repairs required by acceptance inspection are complete Note additional deficiencies and damage Identify additional sources of deterioration that may be of significance to maintenance
Routine	General inspection	Check for any serious damage affecting the load capacity, traffic safety, future maintenance, or environment/aesthetics
	Major inspection	Inspection of all components Determine needs for maintenance or repair Estimate costs of maintenance or repair Measurements and material sampling as needed
	Major inspection—Cables	Inspection of cables, hangers, clamps and anchorage points Verify adequacy and function of cable systems Determine maintenance needs and costs
	Major inspection—Underwater	Dive inspection Inspect submerged components Inspect the river bed Determine maintenance needs and costs
Additional	Special inspection	Diverse purposes: • investigation of known damage • development of repair/rehabilitation projects • checking after extreme events • checking after problems at bridges of similar type

TABLE 48
REQUIREMENTS FOR TESTS—NORWAY

	Acceptance Inspection	Warranty Inspection	General Inspection	Major Inspection	Major Inspection Cable	Major Inspection Underwater	Special Inspection
Measurements							
Bearing elevations	X	X		X			X
Horizontal distances/displacement	X	X		X	X		X
Thickness of wearing surfaces	X	X		X			X
Track wear		X	X	X			X
Evenness	X						
Sag	X	X			X		X
Recording bridge details	X			X			X
Headroom	X			X			X
Materials Investigations—Concrete							
Rebar location and cover	X			X			X
Depth of carbonization				X			X
Chloride content	X	X		X			X
Corrosion investigation (ECP)							X
Structural analysis							X
Inspection of bracing cables							X
Cutting open the concrete to assess corrosion level							X
Materials Investigations—Steel							
Check bolt torque							X
Check rivets							X
Check welds							X
X-ray check							X
Ultrasound check							X
Magnetic powder check							X
Fiber optics							X
Ultrasound measurement of material thickness							X
Materials Investigations—Stone and Wood							
Humidity check (wood)							X
Fungus and rot check (wood)							X
Compressive strength							X
Checking Surface Coating							
Thickness of surface coating (concrete)	X						X
Adhesive bonding between surface coating and concrete	X						X
Thickness of surface coating (steel)	X						X
Adhesive bonding between surface coating and steel	X						X
Condition of surface coating (wood)	X						X

TABLE 49
TYPES OF BRIDGE INSPECTIONS—SOUTH AFRICA

Inspection Type	Interval	Performed by	Description
Monitoring	At least once each year, usually more frequently	Maintenance personnel	Quick look for new defects and status of known defects
Principal	5 years	Inspectors experienced in bridge design or maintenance	Full report with photographs of defects
Verification	~60 bridges per year	Senior bridge inspector	QA effort to verify accuracy of inspection data
Project-level	Before repair project	Experienced bridge engineer employed by consulting engineering firm	Inspection to collect information for contract documents
Acceptance	After repair project	Experienced bridge engineer employed by consulting engineering firm	Inspection of work during and after contract

TABLE 50
TYPES OF BRIDGE INSPECTIONS—SWEDEN

Inspection Type	Interval	Performed by	Description
Regular	Frequent	Maintenance contractor	Quick visit to detect significant new conditions
Superficial	12 months	Maintenance contractor	To verify that maintenance requirements are met
General	3 years	SRA staff or consultants	Follow-up on damages detected at the last major inspection Visual inspection of components
Major	6 years	SRA staff or consultants	Arms-length, visual inspection of all components. Includes underwater inspection Basis for recommendations for continuing maintenance
Special	As needed	Consultants	Further investigation of defect or deterioration mechanisms May involve testing methods

Sweden

Sweden has four levels of routine inspections: *Regular*, *Superficial*, *General*, and *Major* (Table 50). *Regular* inspections are frequent, quick visits to bridges to detect significant new conditions. Such inspections are done by maintenance contractors, and may occur once a day or once a month. *Superficial* inspections are made once a year to verify that contract maintenance requirements are being met. Superficial inspections are done by maintenance contractors. *General* inspections are made every three years by trained inspectors from SRA staff or SRA consultants. General inspections check on defects discovered in a previous Major inspection. General inspections also examine electrical, hydraulic, or other bridge equipment. *Major* inspections are made every six years by trained inspectors from SRA staff or SRA consultants. Major inspections are complete examinations reporting all conditions and noting all defects in bridges, and include underwater inspection. Major inspections are the basis for specification of requirements for continuing maintenance.

In addition, SRA performs *Special* inspections of known defects, suspected defects, and deterioration mechanisms, as needed. Special inspections will often involve testing methods such as ultrasound, radiography, etc.

United Kingdom

The U.K. Highways Agency identified five types of bridge inspection: *Acceptance*, *Superficial*, *General*, *Principal*, and *Special* (Table 51). *Acceptance* inspections are performed for new bridges, newly repaired bridges, and newly assigned responsibility; that is, at the start of a new maintenance contract. *Superficial* inspections are frequent visits to bridges made by the road maintenance contractor. Superficial inspections do not yield condition ratings. *General* inspections are visual inspection of all parts of bridges. General inspections are made every two years. No access equipment or lane closures are used. *Principal* inspections occur every six years and are thorough visual examinations of all parts of bridges, reporting all conditions and noting all defects.

TABLE 51
TYPES OF BRIDGE INSPECTIONS—UNITED KINGDOM

Inspection Type	Interval	Performed by	Description
Acceptance	N/A		When responsibility for the structure changes hands; i.e., on completion of construction, when contracts for maintenance change
Superficial	Frequent	Contractor	The contractor staff is encouraged to be vigilant at all times and report anything needing urgent attention, such as impact damage to superstructure, bridge supports, flood damage, expansion joints, etc.
General	2 years	Contractor	A visual inspection of all parts of the structure that can be inspected without special access equipment
Principal	6 years	Contractor	Touching-distance visual inspection using any necessary access equipment
Special	As necessary	Contractor	To investigate some identified defect

N/A = not applicable.

Special inspections, often involving material sampling or NDT applications, occur as needed.

Inspections of the Highways Agency's 10,000 bridges are done by consulting engineers. Inspections for approximately 100,000 bridges controlled by local road agencies are either done by local agency staff or by consultants.

UNDERWATER INSPECTION—FOREIGN AGENCIES

Intervals for underwater inspections are listed in (Table 52).

Denmark

The Road Directorate sets no fixed interval for inspection by divers. The regional bridge inspector selects the bridges and intervals for dive inspections. Inspections are done by consultants. Inspection by wading and probing, if appropriate, is performed during principal inspections. The underwater inspection affects the condition rating for the "underpassing" feature.

Finland

Underwater inspections by divers are done at 5-year intervals for Finnra. Scheduling is determined by the district bridge engineer. Seasons with high water or ice in streams are avoided. Finnra guidelines provide detailed lists of the components to inspect and the observations to make. Condition ratings of substructure components are affected by observations from underwater inspections.

France

In France, dive inspections are sight and touch inspections of submerged components with probing at foundations for scour holes. Dive inspections are performed at 6-year intervals. Underwater inspections are separate from IQOA and detailed inspections. France defines both underwater inspections and underwater investigations. Investigations are thorough, arms-length examinations, and include measurements, sampling, or testing as needed.

Germany

In Germany, underwater inspections are done every 6 years as part of each Major test. If there is known damage, underwater inspections are performed during Minor tests as well. Dive inspections usually involve a diver with a video camera directed by a civil engineer at the surface. Inspections are by sight and by touch.

South Africa

Few South African bridges require underwater inspection by divers. There is no policy on interval or intensity of dive inspections. No SANRAL bridges cross navigable waterways and there is no hazard resulting from vessel collision, other than small craft.

Sweden

In Sweden, underwater inspections employ divers at submerged foundations of bridges. Divers use sight and touch to inspect structural components and probe at foundations for scour holes. Video cameras are sometimes used. The channel profile may be measured at the discretion of the inspection team. Underwater inspections usually occur at 6-year intervals.

United Kingdom

For the Highways Agency, underwater inspections are usually performed at 6-year intervals; however, area structures managers can set different intervals. The Highways Agency requires that all surfaces of a structure be inspected. This may be accomplished by divers or by other means. Area structure managers review and approve inspection plans submitted by maintenance contractors.

TABLE 52
UNDERWATER INSPECTION INTERVALS—FOREIGN AGENCIES

Country	Type	Interval	Notes
Denmark	Dive	None	When ordered by regional bridge inspector
	Wade	6 years	Performed during Principal inspection
Finland	Dive	5 years	Schedule set by district bridge engineer
France	Dive, Intensity 1	6 years	Arms-length inspection Performed separately from other inspections
	Dive, Intensity 2	None	Includes measurements and material sampling Performed as needed
Germany	Dive	6 years	Performed during Major test
South Africa	Dive	None	Few bridges require inspection by divers
Sweden	Dive	6 years	
	Channel profile	None	At discretion of inspection team
United Kingdom	Dive or wading	6 years	Highways Agency Area Structures Manager reviews/approves contractor's proposed method(s) for underwater inspections

TABLE 53
COMPONENT RATING SCALE—DENMARK

Rating	Description
0	Insignificant deterioration; little or no damage Component condition corresponds to that of a new component
1	Minor deterioration; damage with a very slow rate of development No repairs needed, as the condition more or less corresponds to that of a new component
2	Damage is at an early stage of development or there are a few fully developed defects Repairs should be carried out at any convenient time, as several years may elapse before the component no longer fulfils its function.
3	Damage has developed to such a degree and/or extent that it is likely that within a short time the component will no longer fulfill its function. Repair necessary within a year or two
4	The component is severely deteriorated, so that its capacity to fulfill its function has or will soon disappear. Repair necessary in the near future
5	The component has completely deteriorated and can no longer fulfill its function Immediate repair is necessary

BRIDGE CONDITION DATA—FOREIGN AGENCIES

Denmark

The Road Directorate collects condition ratings for the following 13 bridge components:

1. Entire structure
2. Wing walls
3. Slopes
4. Abutments
5. Intermediate supports
6. Bearings
7. Load-carrying superstructure
8. Waterproofing
9. Edge beams
10. Safety barrier/railings
11. Surfacing/permanent way
12. Expansion joints
13. Other components.

Condition ratings (Table 53) are built up (literally summed) from three contributors: damage (3 pts), function (1 pt), and consequence (1 pt). The overall rating scale is 0 to 5, with "0" meaning no damage and "5" that the component can no longer function.

The bridge file contains a record of each inventory inspection, general inspection, and special inspection of the bridge. Routine inspections are not recorded in themselves, but a special inspection is always recorded, and these may be in response to a report from a routine inspection.

Bridge components are identified in a hierarchical numbering system (Table 54) that allows inspectors to assign conditions and record observations about general regions of the bridge such as deck, superstructure, and substructure, and to make specific element-level repair recommendations.

Finland

Finnra practice assigns ratings to bridge defects in each of four categories: Weight (importance in the load path), condition of the structural element (apart from this defect), urgency of the repair (rate of growth of defect), and damage class (severity of the defect) (Tables 55–57).

TABLE 54
HIERARCHICAL IDENTIFICATION OF BRIDGE COMPONENTS—DENMARK

Level 1	Level 2	Level 3	Level 4
1000 Structure	2000 Substructure	2100 Foundation and supports	2101 Pile 2102 End foundation 2103 Intermediate foundation
		2200 Bearing structure	2201 Bearing
		2300 Adjacent structure	2301 Slope
		2400 …….	2401 …….
	3000 Superstructure	3100 Load-bearing superstructure	3101 Deck slab 3102 Main beam …… ……
		3200 Road/railway	3201 Waterproofing 3202 Bridge surfacing ….. ……
		3300 Safety-barrier and railings	3301 Safety-barrier …. ……
		3400 …….	3401 …….

TABLE 55
FINNISH ELEMENT CONDITION, *C*

Condition Rating	Condition Points, C
0—New or like new	1
1—Good	2
2—Satisfactory	4
3—Poor	7
4—Very poor	11

TABLE 56
FINNISH REPAIR URGENCY, *U*

Repair Class	Repair Urgency Points, U
11—Repair during the next two years	10
12—Repair during the next four years	5
13—Repair in the future	1

TABLE 57
FINNISH DAMAGE CLASS, *D*

Damage Class	Damage Severity Points, D
1—Mild	1
2—Moderate	2
3—Serious	4
4—Very serious	7

France

French practice reports condition ratings on a 1 to 3 scale. Ratings 2 and 3 are subdivided according to the urgency of maintenance. A special mention *S* is added to defects that may affect the safety of road users (Table 58).

Germany

In Germany, condition rating scales run from 0 (good) to 4 (very poor). Each bridge component is assigned three ratings; one each for structural damage, traffic safety, and bridge durability (Tables 59–62). These ratings are combined automatically by SIB Bauwerke, the bridge management system, and a single rating for each bridge component is determined (*15*).

Norway

Norwegian practice reports condition ratings for bridge elements and identifies specific types of damage that are observed. Condition ratings are reported on a 1 to 4 scale, with 1 indicating good condition (Table 63). Condition ratings are provided for each of four consequences of element condition: strength (carrying capacity), traffic safety, maintenance costs, and aesthetics (Tables 64–67).

The Norwegian inspection manual (*17*) lists approximately 150 types of deterioration and damage in bridge components. Each type is identified by a three-digit code for use in inspection reports. For example, types of damage to concrete elements are shown in Table 68. Similar lists, each specific to a construction material or to a type of bridge component, are provided in Norway's manual. List headings are shown in Table 69. Sketches for location and extent of damage must employ a common set of symbols (Figure 1).

TABLE 58
CONDITION RATINGS—FRANCE

Condition	Definition	Urgency
1	Good condition	
2	Good condition or minor defects; maintenance required	Not urgent
2E	Minor defect requires prompt maintenance	Urgent
3	Damaged structure; repair needed	Not urgent
3U	Damage requires prompt repair	Urgent
NE	Not evaluated	
Mention *S*	Condition endangering the safety of users	Urgent

TABLE 59
CONDITION RATINGS FOR STRUCTURAL DAMAGE—GERMANY

Assessment	Description
0	Defect/damage has no effect on the strength of the element or structure.
1	Defect/damage affects the strength of the structural element, but does not affect the strength of the structure. Element and structure have adequate strength. Repairs can be carried out within the scope of regular maintenance.
2	Defect/damage affects the strength of the structural element and has little effect on the strength of the structure. Structure has adequate strength. Repairs are needed.
3	Defect/damage affects the strength of the structural element and the structure. Structure does not have adequate strength. Load posting is needed, but not currently in place. Required restrictions on the use are not in place or are ineffective. Repairs are needed. Load posting is needed.
4	Structural strength of the structural element is lost. Structure does not have adequate strength. Immediate restrictions on use are needed. Repair or rehabilitation is needed.

TABLE 60
CONDITION RATINGS FOR TRAFFIC SAFETY—GERMANY

Assessment	Description
0	Defect/damage has no effect on traffic safety.
1	Defect/damage has slight effect on traffic safety. Traffic safety is adequate. Repairs can be carried out within the scope of regular maintenance.
2	Defect/damage has slight effect on traffic safety. Traffic safety is adequate. Repairs must be carried out or warning signs must be put up.
3	Defect/damage affects traffic safety. Repairs must be carried out or warning sign must be put up at once.
4	Traffic safety is not adequate. Immediate restrictions on use are needed. Repair or rehabilitation is needed.

TABLE 61
CONDITION RATINGS FOR DURABILITY—GERMANY

Assessment	Description
0	Defect/damage has no effect on the durability of the structural element or structure.
1	Defect/damage affects the durability of the structural element, but does not affect the durability of the structure. Affect on durability or damage of other elements is not expected. Repairs can be carried out within the scope of regular maintenance.
2	Defect/damage affects the durability of the structural element and may affect the durability of the structure. Affect on durability or damage of other elements may follow. Repairs are needed.
3	Defect/damage affects the durability of the structural element and the durability of the structure. Affect on durability or damage of other elements is expected. Repairs are needed.
4	Element and the structure are no longer durable. Durability of other elements is affected. Immediate repair or rehabilitation is needed

TABLE 62
GERMANY: COMPUTED CONDITION RATINGS FOR COMPONENTS

Grade	Description
1.0–1.4	Very good structural condition Continue normal maintenance
1.5–1.9	Good structural condition, but may have less long-term durability Continue normal maintenance
2.0–2.4	Satisfactory structural condition, but may have less long-term durability Continue normal maintenance and consider a plan for repair
2.5–2.9	Unsatisfactory structural condition Traffic safety may be affected Structure is not sufficiently durable Continue normal maintenance and plan for repair Restrictions on traffic use or load may be needed
3.0–3.4	Critical structural condition Traffic safety is affected Structure is not durable Immediate repair is needed Restrictions on traffic use or load are needed
3.5–4.0	Inadequate structural condition Traffic safety is not adequate Structure is not durable Immediate repair or rehabilitation is needed Restrictions on traffic use or load are needed

TABLE 63
NORWAY: CONDITION RATINGS

Rating	Description
1	Minor damage or defects that might not require any remedial action within the next 10 years
2	Average or slight damage or defects that require remedial action within 4 to 10 years
3	Serious damage or defects that require remedial action within 1 to 3 years
4	Critical damage or defects that require remedial action within 0 to 1/2 year
9	Not inspected

TABLE 64
NORWAY: CONDITION RATINGS FOR STRENGTH

Rating	Description
1C	Minor damage/defect that might reduce strength if not repaired within the next 10 years.
2C	Average damage/defect that may reduce strength if not repaired within the next 3 to 10 years.
3C	Serious damage/defect that will reduce strength if not repaired within 1 to 3 years.
4C	Critical damage that reduces strength and requires immediate repair or repair within 6 months. Report this damage to the Bridge Engineer immediately.

TABLE 65
NORWAY: CONDITION RATINGS FOR TRAFFIC SAFETY

Rating	Description
1T	Minor damage/defect that might reduce traffic safety if not repaired within the next 10 years
2T	Average damage/defect that may reduce traffic safety if not repaired within the next 3 to 10 years
3T	Serious damage/defect that will reduce traffic safety if not repaired within 1 to 3 years
4T	Critical damage that reduces traffic safety and requires immediate repair or repair within 6 months Report this damage to the Bridge Engineer immediately

TABLE 66
NORWAY: CONDITION RATINGS FOR MAINTENANCE COSTS

Rating	Description
1M	Minor damage/defect that might increase maintenance costs if not repaired within the next 10 years.
2M	Average damage/defect that may increase maintenance cost or complexity if not repaired in the next 3 to 10 years.
3M	Serious damage/defect that may increase maintenance cost or complexity if not repaired in the next 1 to 3 years.
4M	Critical damage that will increase maintenance cost or complexity if not repaired immediately or within the next 6 months.

TABLE 67
NORWAY: CONDITION RATINGS FOR AESTHETICS

Rating	Description
1E	Minor damage/defect that might affect the environment/aesthetics if not repaired within the next 10 years
2E	Average damage/defect that might affect environment/aesthetics if not repaired within 3 to 10 years
3E	Serious damage/defect that might affect environment/aesthetics if not repaired within 1 to 3 years
4E	Critical damage that affects environment/aesthetics; needs immediate repair or repair within 6 months

TABLE 68
NORWAY: CODES FOR DAMAGE TO CONCRETE ELEMENTS

Damage Code	Description
201	Settlement of concrete element
202	Movement of concrete element
203	Deformation of concrete element
204	Cracks in concrete element
205	Rupture of concrete element
206	Damage to concrete surface treatment
207	Leakage/dampness of concrete element
208	Discoloration of concrete elements
209	Insufficient/damaged cover of concrete element
210	Weathering of concrete element
211	Honeycombing of concrete element
212	Delamination of concrete element
213	Spalling of concrete element
214	Corrosion of reinforcement
215	Wash out of concrete element
216	Inadequate cleaning of concrete element
217	Inadequate clearing-up/removal
218	Poor concrete quality
219	Scoring/undermining of concrete element
220	Missing part(s) of concrete element
290	Other damage to concrete element

TABLE 69
NORWAY: SERIES FOR DAMAGE TYPES

Damage Code	Description
100	Elements in ground
200	Concrete elements
300	Steel, aluminum, and iron elements
400	Stone/masonry elements
500	Timber elements
600	Deck surfacing
700	Bearings and joints
800	Drainage, approaches, and accessories

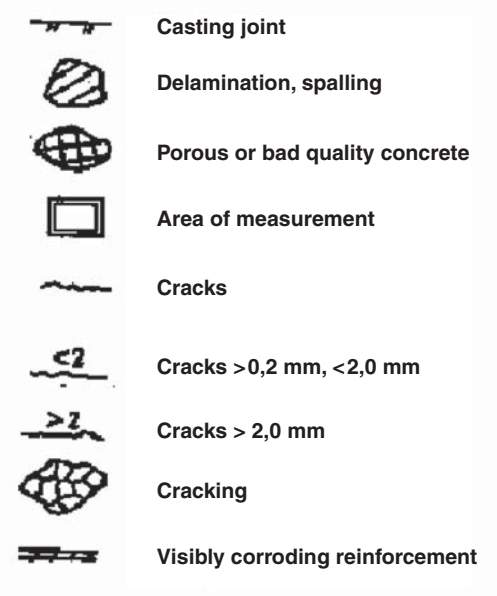

FIGURE 1 Norwegian graphic symbols for damage.

South Africa

SANRAL records defects in bridge components with ratings for Degree, Extent, Relevancy, and Urgency. This system employs integer ratings in all four categories (Table 70). Ratings range from 0 (no defect) to 4 (critical defect) (Table 71).

Sweden

The SRA collects ratings and other data on conditions of bridge components during General, Major, and Special inspections. A Regular inspection may yield a report of damage that is followed up by a Special inspection. The condition data, strictly, are from the Special inspection. Superficial inspections may record condition data as indicators of adequacy of work by the maintenance contractor.

Defects in bridges are reported in terms of physical, functional, and economic conditions. Physical condition is reported as a measurement of an appropriate physical quantity. The quantity and the method of its measurement are fitted to the type of damage, structural element, material, and other considerations (e.g., mode of action of element). Functional condition is reported on a 0 to 3 rating scale, with 3 being the worst condition (Table 72). Functional condition is related to the time until the defect is expected to impair the service of the bridge.

Economic condition is expressed as cost. Economic condition is computed as defect quantity times average unit cost for repair. This is not an estimate of actual project costs, because project scope may differ from defect quantity. However, greater values of economic condition correctly indicate more severe and more extensive defects.

United Kingdom

During Principal inspections, defect severity is reported on a 1 to 5 scale, and defect extent on an "A" to "E" scale. These condition ratings are used in Structures Management Information System to generate the performance indicator for visual condition.

ACCESS FOR INSPECTIONS—FOREIGN AGENCIES

Foreign road agencies reported on the use of traffic lane closures, lifts or climbing for acceptance inspections, principal inspections, and special inspections; that is, at longer inspection intervals. These access methods are not used during routine inspections at shorter intervals (Tables 73–75).

TABLE 70
SOUTH AFRICA: DEFECT CATEGORIES

Category	Description
D—Degree of defect	Severity of defect
E—Extent of defect	Prevalence of defect within the bridge element
R—Relevancy of defect	Impact of the defect on structural integrity and/or user safety
U—Urgency of defect	Recommended time for repair

TABLE 71
SOUTH AFRICA: DEFECT RATING VALUES

Rating	Degree	Extent	Relevancy	Urgency
0	None			Monitor only
1	Minor	Local	Minimum	Routine
2	Fair	>Local	Moderate	<5 year
3	Poor	<General	Major	<2 year
4	Severe	General	Critical	ASAP

TABLE 72
SWEDEN: CONDITION RATINGS

Rating	Physical Condition	Functional Condition
3	Repair needed now	Service impaired now
2	Repair within 3 years	Service impaired within 3 years
1	Repair within 10 years	Service impaired within 10 years
0	Repair beyond 10 years	Service greater than 10 years

TABLE 73
USE OF LANE CLOSURES FOR INSPECTIONS—FOREIGN AGENCIES

Country	Inspection Type	Lane Closures
Denmark	Routine, Principal	Very rare
	Special	Nearly always
Finland	General	Rarely, except if inspection lift is used
	Basic, Special	Often
France	Routine, Annual, IQOA	No
	Detailed	Yes
Germany	Superficial, Minor,	No
	Major	Yes, if needed
Norway	General	No
	All other types	Inspectors must be at arms length to component
South Africa	Principal	Yes, if needed
	Acceptance	Yes, to test water tightness of joints
	Other types	Seldom used
Sweden	General, Major, Special	If needed
	Routine, Superficial	No
United Kingdom	Acceptance, Special	Yes, but structure may not be open at time of acceptance inspection. For special inspection, closure may be used during installation of instruments for monitoring.
	All others	No

TABLE 74
USE OF LIFTS AND OTHER EQUIPMENT FOR INSPECTION ACCESS—FOREIGN AGENCIES

Country	Inspection Type	Lifts, Other Equipment
Denmark	Special	Nearly always uses lifts
	Principal, Special	Might use boats
Finland	General	Rarely
	General, Large bridge	Often
	Basic, Special	Often
France	Routine, Annual, IQOA	No
	Detailed	Yes, France has a special snooper for great arches and piers.
Germany	Superficial, Minor,	No
	Major	Yes
Norway	General	No
	All other types	Inspectors must be at arms length to component
South Africa	Principal	If needed
	Other types	Seldom used
Sweden	General, Major, Special	If needed
	Routine, Superficial	No
United Kingdom	Acceptance, Principal, Special	Yes
	General	No

TABLE 75
USE OF CLIMBING, LADDERS, AND OTHER METHODS FOR BRIDGE INSPECTION—FOREIGN AGENCIES

Country	Inspection Type	Climbing
Denmark	Special	Large structures and by special personnel only
Finland	All	Climbing is not used. Access is by lifts, if necessary.
Germany	Superficial, minor	No
	Major	Yes, if needed
Norway	General	No
	All other types	Inspectors must be at arms length to component
South Africa	Principal	If needed
	Other types	Seldom used
Sweden	General, major, special	If needed, and performed by trained personnel
	Routine, superficial	No
United Kingdom	Special	Yes, abseilers (rappelling)

CHAPTER FIVE

QUALITY PROGRAMS

U.S. federal regulations make QC and QA the responsibilities of each state's bridge inspection program. Quality program activities may include office reviews of inspection programs, field review of inspection teams, refresher training for inspection staff, and independent reviews of inspection reports and computations.

The FHWA provides recommendations for QC/QA programs at state DOTs (*18*). Recommended procedures for QC include:

- Documentation of QC responsibilities of inspection program staff,
- Documentation of required qualifications for staff titles in the inspection program,
- A process for tracking the qualifications of current staff,
- Procedures for review and validation of inspection reports and data, and
- Procedures for identification and resolution of errors in inspection reports.

Recommended procedures for QA include:

- Documentation of QA responsibilities of inspection program staff,
- Procedures for office review and field review of inspection programs,
- Procedures for disqualification and requalification of inspection team leaders and inspection consulting firms, and
- Procedures for validation of QA programs.

QA reviews should verify bridge lists for underwater, fracture-critical, and other specific inspections, and follow up on critical findings. QA should verify a sample of inspections and reports. QA reviews should document their outcomes and recommend improvements to inspection programs.

QUALITY PROGRAMS OF U.S. STATE DEPARTMENTS OF TRANSPORTATION

Information on QC/QA programs of U.S. state DOTs is presented in the order of FHWA's framework. Detailed responses can be found in the tables in Appendix G.

Quality Control Documentation

Thirty of 37 DOTs have or are preparing documentation of their QC/QA programs. Documentation appears as part of DOT bridge inspection manuals, as bulletins and directives, or as standard forms that are used in the course of QC/QA activities (see Table G1).

Program Staff Role in Quality Control and Quality Assurance

Thirty-five of 37 state DOTs and Eastern Federal Lands identified staff responsible for QC or QA activities (see Table G2). For nearly all of these personnel, QC/QA is one area in a larger set of job responsibilities. At 11 DOTs, the inspection program manager, or equally qualified staff, is directly involved in QC/QA. Most DOTs use peer team leaders for QC review of inspection reports and periodic QA reviews of districts. Two DOTs have central inspection teams that perform QC/QA activities.

Quality Control of Inspector Qualifications

Eight of 37 DOTs track an identified population of qualified team leaders, often by use of unique Certified Bridge Inspector numbers assigned to leaders. The team leader enters the Certified Bridge Inspector number on inspection reports. Twenty-four DOTs rely on personnel records or a personnel database having records of training and experience for team leaders. During QA review, personnel records provide verification that inspection leaders meet National Bridge Inspection Standard requirements (see Table G3).

Quality Control Review of Inspection Reports

Thirty-two of 38 state DOTs and Eastern Federal Lands perform QC review of all inspection reports. Reviewers may be peer team leaders, regional DOT staff, central DOT staff, or software applications performing checks for valid data entries. Nine DOTs review all reports plus a sample of reports. The sample is reviewed by the district program manager or other higher-level staff. Four DOTs do special QC review for bridges with fracture-critical members, load posted bridges, or bridges in poor condition (see Table G4). Twelve DOTs track the progress of field inspections, reports, and report reviews as a QC activity (see Table G5).

Quality Control Field Reviews

Fifteen of 36 DOTs make QC field visits to inspection teams at work or field verifications of inspection reports. QC may be

as frequent as twice-per-month verifications of one or a few bridge inspection reports or as infrequent as one or two field reviews of teams per inspection cycle. Six DOTs make QC site visits or field verifications targeted at every inspection team. Field visits are logged, and the results of field QC are recorded and discussed with the inspection team (see Table G6).

Quality Control of Inspections by Consultants

Thirteen of 35 DOTs delegate QC review to inspection consultants as a part of their contract work. Twelve DOTs perform their own QC reviews of consultants' inspection reports (see Table G7).

Quality Control Program Validation

Sixteen of 36 DOTs reported methods for validation of QC programs in addition to the use of QA review. State DOTs approve QC plans of local government inspection programs and of inspection consultants. A state DOT may use annual review by the FHWA as a measure of validation of the DOT's QC program. Four DOTs rely on check inspections of a sample of bridges to validate QC programs. Two DOTs view annual training of staff as a way to maintain effectiveness of QC programs (see Table G8).

QUALITY ASSURANCE

Activities in Quality Assurance Reviews of Inspection Programs

QA reviews are verifications of the organization and execution of bridge inspection programs. QA reviews determine whether inspection programs have qualified staff and adequate equipment. QA verifies that appropriate progress, records, identifications, and follow-up are achieved. Thirty of 39 DOTs make QA reviews that are directed at districts and local government inspection programs (16), at inspection leaders and teams (15), or at samples of bridge inspection reports (6). Sampling of inspections reports may be within a district or statewide. Other DOTs (six) are developing their QA policies or extending QC review to address QA needs (see Table G9).

Fifteen DOTs make QA reviews of inspection office procedures and records. QA reviews verify:

- Staff qualifications and training, including refresher training.
- Bridge lists, especially lists of bridges having fracture-critical members, scour-critical bridges, posted bridges, bridges needing dive inspections, bridges needing access equipment, and bridges needing interim inspections.
- Records of critical findings, repair recommendations, and staff follow-up.
- Planning, scheduling, and progress of inspection work including report review and acceptance.

Office review may include the review of a sample of inspection reports (nine DOTs), usually through comparison of condition ratings and maintenance recommendations with photographs and inspectors' notes.

As a part of QA, field review can have several forms:

- Independent inspections by QA teams with subsequent comparison with current inspection reports (seven DOTs).
- Field verification of inspection reports by QA review teams generating lists of differences in condition ratings and other findings (seven DOTs).
- Field review of current inspection reports performed jointly by QA review teams and inspectors of record.
- Site visits of QA review teams to inspection teams at work (three DOTs).

Selection of bridges for QA review may be random (14 DOTs), based on bridge condition or special features (15 DOTs), or targeted at specific inspection leaders or teams (7 DOTs). QA review may include as few as two bridges or as many as 50% of inspections for the current cycle (see Table G10).

QA reviews produce reports of the review and its findings, often with a set of recommendations for continuing improvement of inspection work. Eleven of 30 DOTs employ standard forms, checklists, or questionnaires in QA review and these become part of QA reports.

Intervals for Quality Assurance Review

Nineteen of 37 DOTs reported on intervals for QA review of inspection leaders and/or inspection teams. Intervals range from 1 to 36 months. Nineteen DOTs reported on intervals for QA review of district and/or local government inspection programs. Intervals range from 12 months to 48 months (see Table G11).

Aspects of Quality Assurance Review of Bridge Inspections

Thirty DOTs reported items in QA review of bridge inspections. Most DOTs identify five items:

- Discovery of deterioration (21 DOTs).
- Recognition of critical conditions (24 DOTs).
- Accuracy of condition ratings (26 DOTs).
- Thoroughness of inspection reports (24 DOTs).
- Appropriate methods of inspection (17 DOTs).

Tolerances Used in Quality Assurance Review

Twenty-five of 32 DOTs reported tolerances used in QA reviews. Twenty-one DOTs reported a tolerance of ±1 for NBI condition ratings. Nine DOTs reported a tolerance on bridge load rating, with 10% being a common limit on differences. Twelve DOTs reported tolerance on element-level

condition ratings, with ±1 condition state being a common value (see Table G12).

Benchmarks in Quality Assurance Reviews

DOTs that perform QA reviews of samples of bridge inspection reports can track accuracy of condition ratings as a benchmark of program quality. Various aspects of program compliance, such as timely completion of inspection reports, completion by staff of refresher training, and up-to-date bridge lists each might serve as a measure of program quality. Most DOTs include these aspects in QA reviews. Few DOTs reported the use of any of these as benchmarks (see Table G13).

Disqualification of Inspection Program Staff

Fifteen of 32 DOTs reported on grounds for disqualification of inspection program personnel. Common concerns included timely completion of work (4 DOTs), accuracy and consistency of inspection findings (10 DOTs), and inadequate response to QA advice for improvement to performance (3 DOTs) (see Table G14).

Six DOTs allow requalification of team leaders after retraining. Remedies for poor performance, short of disqualification, include additional training, counseling or coaching, and further quality review (18 DOTs). Poor performance can affect career advancement of DOT personnel and selection of inspection consultants (11 DOTs) (see Table G15).

QUALITY PROGRAMS—FOREIGN PRACTICE

Denmark

QC activities in Denmark include:

- Review of all Principal inspection field reports by a peer bridge inspector.
- Review of data entry by experienced data personnel and verification by the bridge inspector.
- Comparison of field measurements over several inspection cycles.
- Automated checks within the bridge database system.
- Automated alerts for missing data as reports are generated.

Finland

Finnra uses automated checks in its bridge database for QC of inspection data. There are no other checks. Instead, Finnra emphasizes QA by inspector certification and training.

Consultants to Finnra must propose and implement inspection quality programs. These plans differ among consultants.

France

France implements ISO 9000 to direct its QC program. ISO 9000 is a set of standards for quality management published by the International Organization for Standardization.

Germany

In Germany, QC is a matter for the individual states. The federal ministry has no direct involvement. Bridge data and the use of the bridge management system are monitored by BASt. When errors in data are apparent, the federal ministry is notified and the state is asked to resolve the errors.

South Africa

In South Africa, QC is performed by inspection consultants. Typically, the degree-extent-relevancy component ratings and inspectors' notes are compared with supporting photographs. Inspection data are entered into SANRAL's bridge management system by consultants. Printouts of these data must be reviewed and signed by inspectors. In addition, the bridge management system performs automated checks of inspection data.

Sweden

Sweden uses standard inspection forms and the existing bridge record to guide inspectors and to ensure that all needed inspection tasks are completed. There is no independent review of inspection reports.

United Kingdom

Contract provisions for inspection services address some aspects of QC. Supervising engineers must sign inspection reports. Maintenance agents are required to have third-party review of inspection reports. Timely completion of reports, accuracy and completeness of bridge data, and provision of adequate equipment to inspectors are all aspects that may be tracked as measures of contract performance.

In addition, the administrator for the Structure Management Information System, the Highway Agency's bridge management system, makes spot checks on bridge data. Inspection reports that have errors are returned to the maintenance agent and ultimately the supervising engineer for the inspection. Serious or persistent errors are recognized as poor service by the contractor, and these could influence future contract awards.

Quality Assurance

Among the nations included in this synthesis, QA usually entails training and workshops. Denmark, Finland, and Germany all conduct annual workshops for bridge inspectors, and all of these workshops include field inspections. Denmark and Germany use field work to recalibrate inspectors. Finland collects quantitative measures of accuracy of condition ratings and evaluates the performance of individual inspectors. In South Africa, SANRAL's QA is a program of independent reinspection of 2% of bridge inspections per year. Sweden has no periodic QA program, but instead relies on contract supervision to ensure consistent work among

consultants. In the United Kingdom, the detailed inspections that are made in preparation for repair projects are viewed as verification of previous inspection reports. These offer a measure of inspection quality.

Denmark

In Denmark, each bridge inspector is required to complete a QA review every year. Over a two-day period, teams inspect a number of selected bridges. Results are compared team by team, and the differences are discussed. Each year, different bridges are selected for this exercise. The outcomes of the reviews can include further training for inspectors, improvements to inspection procedures, or improvements to Danbro software. The Directorate views each Special inspection as a verification of conditions and previous inspection reports. Special inspections are done as needed. There is no sampling of bridges for QA review at a regular interval.

Finland

Finnra holds an Advanced Training Day each year at which certified inspectors participate in general inspections of two bridges. These two bridges are also inspected by a select group of Finnra personnel. Inspection data from individual inspectors are compared with Finnra results. Deviations are computed and quantitative measures of the accuracy of the inspectors' work are obtained. Finnra sets limits on permissible deviations, allowing larger deviations for evaluation of individual defects and smaller deviations in the overall evaluation of a bridge. Finnra central administration tracks the quality of the inspection program with the quantitative measures.

Inspection results are discussed with inspectors. The control inspections are used, in part, as refresher training for inspectors. The quality of work at advanced training days affects awards of inspection contracts. Repeated, large deviations by an inspector can result in the loss of certification.

Similar control inspections are made within Finnra regions as well. The number of control inspections for a region depends on the number of bridges inspected in the past year (Table 76).

TABLE 76
NUMBER OF FINNISH QC INSPECTIONS IN 2005

No. of Inspected Bridges	No. of Control Inspections
1–100	2
101–300	3
>300	4

Germany

In Germany, continuing training for bridge inspectors occurs at annual federal conferences conducted by BMVBS and lasting 2 or 3 days. Discussions at each conference focus on interesting bridges, as well as problems and new developments in bridge inspection. One day is spent in field observations of structures. The conference is held in a different state each year. Some states require attendance at the conference by their inspectors, whereas other states either do not require attendance, or require attendance in only some years.

Other QA procedures, such as sampling of bridges and independent verification of inspection findings, are not performed.

South Africa

South Africa performs two activities for QA. First, when a consultant starts a contract for inspection services, SANRAL conducts an inspection workshop to calibrate all inspectors. The workshop and a briefing on inspection methods are mandatory for all inspectors who will participate in the contract.

Second, verification inspections are done for 2% of Principal inspections each year by senior bridge inspectors. If many and/or large discrepancies are found, a new Principal inspection may be ordered.

A third, though informal, type of QC is a product of the contract award process. As groups of bridges pass from one inspection firm to another, inspections by the new firm offer a verification of previous work. QA can affect the tender process. Evidence of negligence in consultant work is grounds for disqualification for further work.

QA efforts do not evaluate or track individual inspectors. This too is a product of the tender process: there is no permanent inspection staff.

Sweden

In Sweden there is informal QA for inspection consultants. SRA staff acquires knowledge of consultants' competence during the course of inspection contract work. Firms that do not meet SRA expectations do not obtain further contracts for inspection services.

United Kingdom

In the United Kingdom, specific programs for QA are the responsibility of the maintenance contractor. The Highways Agency views the detailed inspections in preparation for repair projects as a verification of conditions at bridges.

Bridge data records stored as part of SIMS, the bridge management system, have been collected for about 5 years. The Highways Agency will engage a contractor to undertake a records health check for existing data.

Bridge data quality is considered in continuing development of SIMS. Here, the Highways Agency works cooperatively as one member of a users group made up of agencies using the bridge management system.

CHAPTER SIX

CONCLUSIONS

Bridge inspections are performed for at least three reasons: (1) to ensure the safety of bridges, (2) to discover needs in maintenance and repair, and (3) to prepare for bridge rehabilitation. These three reasons produce three levels of inspection: (1) short-interval checks of safety, (2) medium-interval reviews of maintenance needs, and (3) long-interval assessments of needs for major work.

U.S. federal regulations provide at least two levels of inspections; interim inspections that are short-interval and detail-specific, and routine inspections that are medium-interval and full-extent. Routine inspection at 48-month intervals is applied to a few robust bridges in good condition. The policies of U.S. state departments of transportation (DOTs) often provide three levels of inspection: (1) short-interval interim inspections; (2) medium-interval routine inspections; and (3) longer-interval, in-depth, close-access, or increased-intensity inspections for at least some bridges or details.

In foreign practice, frequent, less-detailed inspections are used together with a long-interval Principal or Major inspections. Of the countries studied, three employ short-, medium-, and long-interval periodic inspections for bridges, and nearly all identified noninterval special or project-level inspections for repair projects (Table 77).

Inspection types in U.S. and in foreign practices can be compared in terms of inspector qualifications, inspection intensity, repair recommendations, and inspection program control. Table 78 cites the qualifications of inspectors required for each type of inspection. In foreign practice, inspections at 12-month or shorter intervals are done by maintenance foremen or other capable, noncertified personnel. Inspections at medium intervals require certified bridge inspectors. Long-interval inspections demand degreed engineers who are also certified bridge inspectors. U.S. federal regulations establish a single personnel level, a team leader, and require this level for all inspections. U.S. team leaders need not be engineers.

Inspection intensity varies with inspection interval (Table 79). In foreign practice, short-interval inspections might be as cursory as drive-by inspections. Medium-interval inspections often require that inspectors be able to view all bridge components, whereas long-interval inspections require hands-on access. U.S. federal regulations require hands-on inspection of fracture-critical members, but otherwise allow inspectors to determine which bridges or portions of bridges need hands-on inspection. Some U.S. state DOTs have policies that require hands-on inspection at specific details, for specific conditions, or within specific maximum intervals.

In foreign practice, depending on interval, inspections may collect few condition ratings, all condition ratings or all condition ratings plus field measurements, results of materials tests, or other quantitative data (Table 80). U.S. federal regulations require updates to National Bridge Inventory (NBI) data at each routine inspection. For most U.S. bridges, this entails a complete set of NBI condition ratings plus any changes to appraisal ratings and inventory data at 24-month intervals.

In foreign practice, recommendations for work at bridges range from superficial maintenance needs noted for the most frequent inspections, to complete identification of repair needs during inspections at medium intervals, to detailed recommendations of actions, quantities, and costs at long intervals (Table 81). In U.S. practice, maintenance recommendations are updated every 24 months for most bridges.

In foreign practice, authority for inspections is usually shared between two branches of a road agency, or between a road agency and its maintenance contractors. The most frequent inspections are done by maintenance crews and reported to agencies' bridge inspection programs (Table 82). Inspections that require certified inspectors and occur at longer intervals are directly administered by agencies' inspection programs. U.S. federal regulations require team leaders for all inspections, with the result that administration of all inspection work remains within a DOT's inspection program using either DOT staff or inspection consultants.

TABLE 77
BRIDGE INSPECTIONS

Inspection Interval	U.S.	Denmark	Finland	France	Germany	Norway	South Africa	Sweden	United Kingdom
3 months					Superficial				Superficial
1 year		Routine	Annual	Annual		General	Monitoring	Superficial	
2 year	Routine								General
3 year				IQOA	Minor			General	
4 year	Routine 48-month								
5 year			General 5-year			Major	Principal		
6 year		Principal		Detailed	Major			Major	Principal
7 year									
8 year			General 8-year						
10 year	In-depth 120-month								
For Project	Special	Economic Special	Special		Special	Special	Project-level	Special	Special

IQOA = Image de la Qualité des Ouvrages dArt.

TABLE 78
INSPECTORS AND INSPECTIONS

Personnel	U.S.	Denmark	Finland	France	Germany	Norway	South Africa	Sweden	United Kingdom
Non-Certified Inspector		Routine	Annual	Annual	Superficial	General	Monitoring	Superficial	Superficial
Agency Certified	Routine		General 5-year	IQOA	Minor				General
Inspector	Routine 48-month		General 8-year	Detailed					
	In-depth 120-month								
Engineer		Principal Economic Special	Basic Special		Major	Major	Principal	General	Principal

IQOA = Image de la Qualité des Ouvrages d'Art.

TABLE 79
INSPECTIONS AND INTENSITY

Inspection Access	U.S.	Denmark	Finland	France	Germany	Norway	South Africa	Sweden	United Kingdom
Drive-By		Daily		Routine				Routine	
Visible	Routine	Routine		Annual	Minor	General	Monitoring	Superficial	Superficial
	Routine	Principal		IQOA				General	General
	48-month								
Arms Length	In-depth		General	Detailed	Major	Major	Principal	Major	Principal*
	120-month		5-year*						

*Said to be "arms-length," but traffic lane closures are rarely provided.
IQOA = Image de la Qualité des Ouvrages d'Art.

TABLE 80
INSPECTIONS AND CONDITION DATA

Condition Data	U.S.	Denmark	Finland	France	Germany	Norway	South Africa	Sweden	United Kingdom
None or Few		Routine	Annual		Minor	General	Monitoring	Superficial	Superficial
All Condition	Routine	Principal	General	IQOA	Major		Principal	General	General
Ratings			5-year	Detailed				Major	Principal
Tests and	Special		General		Special	Major	Project-	Special	Special
Measurements			8-year				level		

IQOA = Image de la Qualité des Ouvrages d'Art.

TABLE 81
INSPECTIONS AND MAINTENANCE AND REPAIR RECOMMENDATIONS

Actions	U.S.	Denmark	Finland	France	Germany	Norway	South Africa	Sweden	United Kingdom
Cleaning		Routine	Annual	Annual	Minor	General	Monitoring	Superficial	Superficial
All Actions	Routine	Principal	General 5-year	IQOA Detailed	Major	Major	Principal	General Major	General Principal
			General 8-year						
Costs and Quantities	Special	Economic Special	Special		Special	Special	Project-level	Special	

IQOA = Image de la Qualité des Ouvrages d'Art.

TABLE 82
INSPECTIONS AND SUPERVISION BY INSPECTION PROGRAM

Inspection Program	U.S.	Denmark	Finland	France	Germany	Norway	South Africa	Sweden	United Kingdom
Partial or No Control		Daily Routine	Annual	Routine Annual	Superficial		Monitoring	Superficial	Superficial
Primary Control	Routine	Principal	General 5-year	IQOA	Minor	General	Principal	General	General
	Routine 48-month		General 8-year	Detailed	Major	Major		Major	Principal
	In-depth 120-month	Economic Special	Special			Special	Project-level	Special	Special

IQOA = Image de la Qualité des Ouvrages d'Art.

REFERENCES

1. *Code of Federal Regulations*, Title 23: Highways, Part 650—Bridges, Structures, and Hydraulics, U.S. Government Printing Office, Washington, D.C., 2005.
2. *National Bridge Inventory Data*, Office of Bridge Technology, Federal Highway Administration, Washington, D.C., CD-ROM, 2005.
3. *Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation's Bridges*, Report FHWA-PD-96-001, Federal Highway Administration, Washington, D.C., 1996, 125 pp.
4. *Bridge Inspector's Reference Manual*, FHWA Report NHI 03-001, Federal Highway Administration, Washington, D.C., 2002, 1,762 pp.
5. *Manual for Condition Evaluation of Bridges*, 2nd ed., American Association of State Highway and Transportation Officials, Washington, D.C., 1994, as amended by 1995, 1996, 1998, and 2000 interim revisions.
6. *2001 Interim Revision to the Manual for Condition Evaluation of Bridges*, American Association of State Highway and Transportation Officials, Washington, D.C., 2001.
7. *2003 Interim Revision to the Manual for Condition Evaluation of Bridges*, American Association of State Highway and Transportation Officials, Washington, D.C., 2003.
8. *Inspection of Bridges*, Danish National Road Directorate, Copenhagen, Denmark, 1994, 175 pp.
9. *Instruction Technique pour la Surveillance et 1'Entretien des Ouvrages d'Art* (*ITSEOA*). Direction Départementale de l'Equipement (DDE), Ministere des Transport, Paris, France, Oct. 1979.
10. *Image de la Qualité des Ouvrages d'Art*, Classification des Ouvrages, Marcq en Baroeul, France, 1996.
11. *Inspection and Testing of Engineering Structures in Connection With Roads*, DIN 1076, Deutsches Institut für Normung (DIN), Berlin, 1999.
12. *Recording and Assessment of Damages, Preservation and Maintenance,* Guideline RI-EBW-PRÜF, Abteilung Strassenbau, Strassenverkehr, Dortmund, Germany, 2004, 23 pp.
13. *Structure Inventory*, Abteilung Strassenbau, Strassenverkehr, Dortmund, Germany, 2004.
14. *Design Manual for Roads and Bridges*, Highways Agency, London, United Kingdom [Online]. Available: http://www.standardsforhighways.co.uk/dmrb/index.htm.
15. *Preservation and Maintenance*, German Federal Department of Transportation, Construction, and Housing, Berlin, n.d., 23 pp.
16. *Guideline for the Structural Design and Equipment of Bridges for Monitoring, Inspection and Maintenance*, German Federal Department of Transportation, Construction, and Housing, Berlin, 1997, 6 pp.
17. *Handbook for Bridge Inspections*, Norwegian Public Roads Administration, Oslo, 2001, 339 pp.
18. *Recommended Framework for a Bridge Inspection QC/QA Program*, Federal Highway Administration, Washington, D.C., 2005, 5 pp. [Online]. Available: http://www.fhwa.dot.gov/bridge/nbis/nbisframework.cfm.

APPENDIX A

U.S. State Transportation Departments' Input on Federal Regulations

Departments of transportation (DOTs) were asked to comment on changes or improvements to inspection practice and U.S. federal regulations for inspection programs. The most frequent responses were no input or the comment that existing regulations are adequate. Other responses are listed here.

Bridge Routine Inspection Interval

Four comments by DOTs:

- The interval for routine inspection should be approximately two years, and might be better stated as inspection of a bridge in every second calendar year. This would make inspection scheduling easier.
- The interval for routine inspection of a bridge should be 24 months only. Culverts might be inspected at longer intervals.
- Inspectors should have the authority to set the interval to the next inspection of each bridge, but only to a maximum interval of 24 months.
- The combination of bridge complexity and inspector qualifications should determine a matrix of inspection intervals.

Fracture-Critical Inspection Interval

Two comments, both proposing longer intervals for some fracture-critical inspections:

- Specific bridges: A longer interval is appropriate for bridges on low-volume roads, bridges with a low volume of truck traffic, and bridges that have low stresses.
- Specific inspections: Routine intensity inspections at 24 months can supplement hands-on inspections at longer intervals.

Certification of Inspectors

Three comments:

- There should be no certification of inspectors.
- Certification of inspectors should include testing of applicants.
- Certification should include an entry-level grade for inspectors assigned to simple bridges only.

Quality Control and Quality Assurance Procedures

Two points:

- Procedures should be determined by state DOTs.
- Formal requirements should be developed at the federal level.

Additional Comment on Regulations for Bridge Inspection

- DOTs indicate a need for a central source of information and discussion of federal regulations and its interpretation.

APPENDIX B

Questionnaire

NCHRP TOPIC 37-05

BRIDGE INSPECTION PRACTICES

Background and Purpose

NCHRP synthesis topic 37-05 examines U.S. practices regarding certification and training of inspectors, and quality control/quality assurance (QC/QA) in bridge inspection programs. U.S. practices will be compared with foreign practices. The information will serve as guidance to FHWA and transportation agencies in potential enhancements to bridge inspection practices in the United States.

This questionnaire is a primary source of information on U.S. practices. We greatly appreciate, and emphatically need, your assistance. On many points, questions address policies of your transportation agency. Your response may take several forms:

- Response in the text field provided.
- Reference to your Agency's manuals, guides, or technical memoranda on the topic. For such responses, please provide a copy, electronic or print, of the reference documents.
- Link to a public website of your agency. For such responses, please provide complete links to the exact pages or documents.

Note: Throughout this questionnaire the term "Agency," when it is capitalized, refers to your transportation agency or department.

Respondent(s) Information

☐ **State Bridge Inspection Program Manager**

Name:					
Title:					
Agency:					
Address:					
City:		State:		Zip:	
Phone:		Fax:		e-mail:	

☐ **Other Respondent**

Name:					
Title:					
Agency:					
Address:					
City:		State:		Zip:	
Phone:		Fax:		e-mail:	

Please return the completed questionnaire by April 21, 2006 to:

George Hearn Civil Engineering University of Colorado Boulder, Colorado 80309-0428	 e-mail: George.Hearn@colorado.edu Phone: 303.492.6381 Fax: 303.492.7317

After completing the survey, if there are issues pertaining to bridge inspection practices that you believe are important but which are not addressed adequately by this questionnaire, please feel free to contact George Hearn directly.

BRIDGE INSPECTION PROGRAM

Bridge Inventory

How many bridges[1] does your agency inspect?
Bridge count:

How many of these bridges are inspected by agency forces and how many by consultants? (Report counts or percentages.)

Agency inspections:	Consultant inspections:

For bridges over water, how many are inspected by wading and probing, and how many require underwater inspection by divers? (Report counts or percentages.)

Wading, probing:	By divers:

Complex[2] Bridges

Does your agency require special training, experience, equipment, or methods for inspection of complex bridges?
Complex bridge inspection:

Which types of bridges does your agency consider to be complex?
(Check all that apply. List additional types at bottom of table.)

☐ Suspension bridges	☐ Cable-stayed bridges
☐ Two-girder bridge	☐ Orthotropic decks
☐ Cantilever arm bridges	☐ Tied arch bridges
☐ Single box bridges—steel	☐ Single box bridges—concrete
☐ Boxes with external post-tensioning	☐ Fatigue-vulnerable bridges

[1] *Bridge*—A structure including supports erected over a depression or an obstruction, such as water, highway, or railway, and having a track or passageway for carrying traffic or other moving loads, and having an opening measured along the center of the roadway of more than 20 ft between undercopings of abutments or spring lines of arches, or extreme ends of openings for multiple boxes; it may also include multiple pipes, where the clear distance between openings is less than half of the smaller contiguous opening.

[2] *Complex bridges*—Bridges with unusual characteristics.

☐ Main span >? ft	☐ Bridge length >? ft
☐ Bascule bridges	☐ Vertical lift bridges
☐ Floating bridges	☐ Swing bridges
☐ Covered bridges	☐ Post-tensioned timber decks
☐ Eyebar bridges	☐ Patent truss bridges
☐ Bridge age >? years	☐ Historic American Engineering Record bridges
☐ Flatcar bridges	☐ Jack arch bridges
☐ Bridges with obsolete reinforcing steel	☐ Concrete bridges without shear reinforcement
☐ Bridges lacking design documents	

Additional complex bridges:

BRIDGE INSPECTION TYPES

Bridge Inspection Manual

What documentation, manual, or guidance does your agency maintain for bridge inspection?
Inspection documentation:

Is a copy of the documentation available for use in this Synthesis? How can a copy be obtained?
Documentation copy:

Who maintains or modifies agency documentation for inspections (i.e., Bridge Inspection Program Manager, State Bridge Engineer, etc.)?
Documentation officer:

Use of Damage, Hands-On, In-Depth, and Special Inspections

Damage inspection, hands-on inspection, in-depth inspection, and special inspection are defined in Federal regulations[3]. What is your agency's policy for use of these inspections? That is, why and when do you perform these inspections?
(Check all that apply. List additional factors below the table.)

☐ Bridge condition	☐ Bridge age
☐ Known defect(s)	☐ Discovery of new defect(s)
☐ Storm, flood, other natural event	☐ Collision, other man-made event
☐ Interval since last damage, hands-on, in-depth or special inspection	☐ Critical finding

Additional use factors:

When a damage, hands-on, in-depth, or special inspection is performed, does this apply to:

☐ An entire bridge	☐ Specified element(s) or location(s)

Use extent:

[3] *Damage inspection*—An unscheduled inspection to assess structural damage resulting from environmental factors or human actions. *Hands-on*—Inspection within arms length of the component. Inspection uses visual techniques that may be supplemented by nondestructive testing. *In-depth inspection*—A close-up inspection of one or more members above or below the water level to identify any deficiencies not readily detectable using routine inspection procedures; hands-on inspection may be necessary at some locations. *Special inspection*—An inspection scheduled at the discretion of the bridge owner, used to monitor a particular known or suspected deficiency.

Does the inspection report indicate that a damage, hands-on, in-depth, or special inspection has been performed?
Use report:

Does the report identify the specific element(s) or location(s) that received a damage, hands-on, in-depth, or special inspection? Are these specific elements recorded in your electronic database?
Use location:

Does your agency recognize other types of inspections, not defined in Federal regulation? If yes, please identify and describe these other inspections.
Additional inspection types:

Informal Inspections
Does your agency collect information on bridge conditions from road maintenance crews, state police patrols, or other sources outside of the bridge inspection program?
Informal sources:

Does your agency record and store information collected from informal sources? Are these data part of your inspection database?
Informal record:

Monitoring of Bridges
What is your agency's definition of monitoring of bridges (e.g., monitoring may be visual inspection at intervals less than 24 months, or instrumentation plus data logging, etc.)?
Monitoring definition:

When does your agency use monitoring? What factors affect this decision (e.g., poor condition, known deterioration, potential critical deterioration, etc.)?
Monitoring use:

What methods are used for monitoring (i.e., visual inspection, hands-on inspection, measurement of a movement, crack-opening or deflection, or instrumentation such as strain gages or acoustic detectors, etc.)?
Monitoring methods:

How long does monitoring usually continue?
Monitoring duration:

Is your Agency monitoring some bridges at present? Please describe the monitoring intervals and methods presently in use.
Current monitoring:

BRIDGE INSPECTION STAFF—ORGANIZATION

Generic titles are provided below for managers, leaders, and technical personnel engaged in bridge inspection. These include both Agency personnel and consultant personnel. For each title please:
Confirm the generic title, or provide the alternate title used by your Agency.
Check box(es) indicating whether Agency personnel or consultant personnel or both hold this title.
Report the number of persons holding this position, both among Agency personnel and consultant personnel.

State-wide manager(s) for bridge inspection program:

Title:	☐ State Bridge Inspection Program Manager ☐ Other title:		☐ Title not used
Held by	☐ Agency personnel	☐ Consultants	☐ Both
Number[4]	Agency:	Consultant:	

Region or district manager(s) for bridge inspection program:

Title:	☐ Regional Inspection Program Manager ☐ Other title:		☐ Title not used
Held by	☐ Agency personnel	☐ Consultants	☐ Both
Number	Agency:	Consultant:	

Other inspection manager (managers of sub-regions such as counties):

Title:			☐ Title not used
Held by	☐ Agency personnel	☐ Consultants	☐ Both
Number	Agency:	Consultant:	

State-wide bridge load rater or manager of load rating staff:

Title:	☐ State Bridge Load Rater ☐ Other title:		☐ Title not used
Held by	☐ Agency personnel	☐ Consultants	☐ Both
Number	Agency:	Consultant:	

Region or district bridge load rater(s) or manager(s) of load rating staff:

Title:	☐ Regional Bridge Load Rater ☐ Other title:		☐ Title not used
Held by	☐ Agency personnel	☐ Consultants	☐ Both
Number	Agency:	Consultant:	

Other bridge load rater or manager of load rating staff:

Title:			☐ Title not used
Held by	☐ Agency personnel	☐ Consultants	☐ Both
Number	Agency:	Consultant:	

Bridge inspection team leader:

Title:	☐ Team Leader ☐ Other title:		☐ Title not used
Held by	☐ Agency personnel	☐ Consultants	☐ Both
Number	Agency:	Consultant:	

[4]Number of personnel holding this title.

Underwater inspection team leader:

Title:	☐ Underwater Team Leader ☐ Other title:		☐ Title not used
Held by	☐ Agency personnel	☐ Consultants	☐ Both
Number	Agency:	Consultant:	

Other inspection team leader:

Title:			☐ Title not used
Held by	☐ Agency personnel	☐ Consultants	☐ Both
Number	Agency:	Consultant:	

Bridge inspector:

Title:	☐ Bridge Inspector ☐ Other title:		☐ Title not used
Held by	☐ Agency personnel	☐ Consultants	☐ Both
Number	Agency:	Consultant:	

Underwater bridge inspector:

Title:	☐ Underwater Bridge Inspector ☐ Other title:		☐ Title not used
Held by	☐ Agency personnel	☐ Consultants	☐ Both
Number	Agency:	Consultant:	

Other inspector:

Title:			☐ Title not used
Held by	☐ Agency personnel	☐ Consultants	☐ Both
Number	Agency:	Consultant:	

Bridge inspector assistant/trainee:

Title:	☐ Inspector Assistant ☐ Other title:		☐ Title not used
Held by	☐ Agency personnel	☐ Consultants	☐ Both
Number	Agency:	Consultant:	

Electrical equipment inspector (for movable bridges):

Title:	☐ Electrical Equipment Inspector ☐ Other title:		☐ Title not used
Held by	☐ Agency personnel	☐ Consultants	☐ Both
Number	Agency:	Consultant:	

Mechanical equipment inspector:

Title:	☐ Mechanical Equipment Inspector ☐ Other title:		☐ Title not used
Held by	☐ Agency personnel	☐ Consultants	☐ Both
Number	Agency:	Consultant:	

Other equipment inspector:

Title:			☐ Title not used
Held by	☐ Agency personnel	☐ Consultants	☐ Both
Number	Agency:	Consultant:	

Specialist—Fracture-critical inspector:

Title:	☐ Fracture-Critical Inspector ☐ Other title:		☐ Title not used
Held by	☐ Agency personnel	☐ Consultants	☐ Both
Number	Agency:	Consultant:	

Specialist—Scour-critical inspector:

Title:	☐ Scour-Critical Inspector ☐ Other title:		☐ Title not used
Held by	☐ Agency personnel	☐ Consultants	☐ Both
Number	Agency:	Consultant:	

Other titles:

Title 1			
Held by	☐ Agency personnel	☐ Consultants	☐ Both
Number	Agency:	Consultant:	

Title 2			
Held by	☐ Agency personnel	☐ Consultants	☐ Both
Number	Agency:	Consultant:	

Title 3			
Held by	☐ Agency personnel	☐ Consultants	☐ Both
Number	Agency:	Consultant:	

BRIDGE INSPECTION PROGRAM MANAGER

What is the job description for your agency's bridge inspection program manager?
Manager job description:

Who does the Bridge Inspection Program Manager report to (i.e., Agency Director, Agency Chief Engineer, State Bridge Engineer, etc.)?
Manager reports:

Please indicate the responsibilities of the Bridge Inspection Program Manager (Check all that apply. Comment below as needed).

- ☐ Hires inspectors and leaders
- ☐ Certifies inspectors and leaders
- ☐ Hires consultants for bridge inspection
- ☐ Sets QA/QC standards
- ☐ Administers QA/QC for consultants
- ☐ Sets load rating methods
- ☐ Sets standards for inspection methods
- ☐ Sets inspection database format
- ☐ Maintains bridge inspection data
- ☐ Sets inspection intervals
- ☐ Identifies fracture-critical bridges
- ☐ Forms inspection teams
- ☐ Selects access methods/equipment
- ☐ Orders damage inspection
- ☐ Orders in-depth inspection
- ☐ Orders bridge monitoring
- ☐ Orders non-destructive testing methods
- ☐ Prepares annual report for inspection
- ☐ Prepares annual budget for inspection
- ☐ Trains inspectors and leaders
- ☐ De-certifies inspectors and leaders
- ☐ Certifies consultants for bridge inspection
- ☐ Administers QA/QC procedures
- ☐ Hires bridge load raters
- ☐ Selects load rating software
- ☐ Develops inspection reporting forms
- ☐ Maintains bridge inventory data
- ☐ Maintains bridge load rating data
- ☐ Identifies complex bridges
- ☐ Identifies scour-critical bridges
- ☐ Assigns bridges to teams
- ☐ Assigns bridges to consultants
- ☐ Orders special inspection
- ☐ Orders hands-on inspection
- ☐ Orders field tests for inspection
- ☐ Identifies critical findings
- ☐ Prepares/submits National Bridge Inspection Standard data
- ☐ Proposes changes to inspection workforce (full-time equivalent)
- ☐ Proposes acquisition of inspection equipment

Additional manager responsibilities:

Load Raters

What is the job description for your agency's bridge load rater?
Load rater job description:

Who does the bridge load rater directly report to (i.e., Inspection Program Manager, State Bridge Engineer, Agency Chief Engineer, etc.)?
Load rater reports:

Please indicate the responsibilities of the Bridge Load Rater related to bridge inspection activities. (Check all that apply. Comment below as needed).

- ☐ Requests in-depth inspections
- ☐ Maintains load rating data for bridges
- ☐ Requests measurements of deteriorated members
- ☐ Requests damage inspections
- ☐ Requests monitoring of bridges

Additional load rater responsibilities:

Inspection Team Leaders

What is the job description for Agency inspection team leaders?
Team leader job description:

Please indicate the responsibilities of team leaders. (Check all that apply. Comment as needed).

- ☐ Plans inspections
- ☐ Requests access equipment
- ☐ Requests in-depth, damage, special inspections, or bridge monitoring
- ☐ Requests traffic lane closures
- ☐ Directs inspectors' actions and methods
- ☐ Directs hands-on inspection of selected components

☐ Recommends critical findings
☐ Performs data entry of inspection report
☐ Performs QC for inspection reports
☐ Verifies data entry of inspection report

Additional team leader responsibilities:

Team Leaders—Underwater Inspections

Does your agency have a separate job description for leaders of underwater inspections?
Underwater team leader job description:

What different or additional responsibilities does the underwater team leader have?
Underwater team leader responsibilities:

Bridge Inspectors

What is the job description for agency bridge inspectors?
Bridge inspector job description:

Please indicate the responsibilities of bridge inspectors. (Check all that apply. Comment below as needed).

☐ Recommends hands-on inspection
☐ Requests traffic lane closures
☐ Recommends damage, special inspections, or bridge monitoring
☐ Performs data entry of inspection report
☐ Performs QC for inspection report
☐ Recommends in-depth inspection
☐ Requests access equipment
☐ Recommends critical findings
☐ Verifies data entry

Additional bridge inspector responsibilities:

Underwater Bridge Inspectors

What is the job description for agency underwater bridge inspectors?
Underwater bridge inspector job description:

Please indicate the responsibilities of underwater bridge inspectors. (Check all that apply. Comment below as needed).

☐ Recommends hands-on inspection
☐ Requests access equipment
☐ Recommends Level II, III cleaning
☐ Recommends critical findings
☐ Performs data entry of inspection report
☐ Recommends in-depth inspection
☐ Requests closure to river traffic
☐ Recommends damage, special inspections, or bridge monitoring
☐ Performs QC for inspection reports
☐ Verifies data entry

Additional underwater bridge inspector responsibilities:

Inspection Specialists

For specialists among your inspection staff, please provide information on job description and job responsibilities. Specific entries are requested for the categories listed below. If your Agency does not recognize specialization in a category, please indicate that.

Fracture-critical inspectors:

Description/ Responsibilities		
Number	Agency:	Consultant:

Scour-critical inspectors:

Description/ Responsibilities		
Number	Agency:	Consultant:

In-depth inspectors:

Description/ Responsibilities		
Number	Agency:	Consultant:

Damage inspectors:

Description/ Responsibilities		
Number	Agency:	Consultant:

Complex bridge inspectors:

Description/ Responsibilities		
Number	Agency:	Consultant:

Other inspector titles:

Description/ Responsibilities		
Number	Agency:	Consultant:

Inspection Teams

What is the typical size and composition of your inspection teams (i.e., one leader plus two inspectors, etc.)?
Team size:

How are inspection teams formed? Are leaders and inspectors assigned to teams that consistently work together or are teams formed as needed?
Team formation:

Are there special teams for fracture-critical inspections, scour-critical inspections, or other inspections requiring particular training or experience? Or are there specialist inspectors or leaders who join other teams as needed for these inspections?
Fracture-critical/scour-critical teams:

Are there special teams for in-depth inspection, damage inspection, inspections of "48-month" bridges, inspections of complex bridges, or other inspections requiring particular experience? How many types of special teams does your Agency have?
Special teams:

Do inspection teams specialize in certain types of bridges? For example, are there teams for prestressed concrete bridges, teams for timber bridges, teams for masonry bridges, etc.?
Bridge-type teams:

Bridge Portfolio

Does a team leader and/or an inspection team usually inspect the same bridges each cycle? Or is there a random assignment of leaders and teams to bridges? Is it Agency policy to encourage or to avoid repeated cycles of the same team inspecting the same bridges?
Method of team assignments:

What types of bridge inspections are performed by consultants?

☐ Inventory inspection ☐ Routine inspection ☐ Damage inspection
☐ In-depth inspection ☐ Special inspection ☐ Hands-on inspection
☐ Underwater inspection ☐ Fracture-critical inspection ☐ Scour-critical inspection
Consultant inspection types:

How are bridges assigned to consultants? Are assignments by region, by route, by roadway class, by bridge type, etc.?
Consultant bridge assignments:

Do these assignments persist over many inspection cycles? Does the same consultant inspect the same bridges routinely?
Assignment persistence:

Inspection by Other Branches

Are some types of inspection performed by agency groups outside of the bridge inspection program? For example, do maintenance crews conduct damage inspections or inspections after emergencies? For each type of inspection below please indicate whether other branches perform the inspection. Please identify the other branch, where appropriate.

Inspection type	Performed by others?	Other branch
Routine inspection	Never	
Damage inspection	Never	
Special inspection	Never	
Scour-critical inspection	Never	
Fracture-critical inspection	Never	
Complex bridge inspection	Never	
Specific bridges or inspection types (identify)	Never	

BRIDGE INSPECTION STAFF—TRAINING, QUALIFICATIONS, CERTIFICATIONS

Please provide your agency's requirements in certification, education, experience, and training for personnel in your bridge inspection program. Please indicate requirements for job titles in the table below:

Job Title	Certification	Education	Bridge Inspection Experience	Bridge Inspection Training
State Bridge Inspection Program Manager	?	?	?	?
Regional Inspection Program Manager	?	?	?	?
Load Rater	?	?	?	?
Team Leader (preferred criteria)	?	?	?	?

Job Title	Certification	Education	Bridge Inspection Experience	Bridge Inspection Training
Team Leader (other criteria)		?		
Underwater Team Leader	?	?	?	? + ?
Bridge Inspector	?	?	?	?
Underwater Bridge Inspector	?	?	?	? + ?
Electrical Equipment Inspector	?	?	?	?
Mechanical Equipment Inspector	?	?	?	?

Additional information on requirements:

Are there any additional or different requirements for consultant personnel performing the job functions for the titles listed above?
Consultant requirements:

Training Program
Please state your agency's method of training for inspection personnel. Training may include one or more National Highway Institute (NHI) courses, in-house (agency) courses, courses by training consultants, on-the-job training, etc.
Training:

Does your agency use the following NHI courses for training of bridge inspection personnel? (Check all that apply. Provide additional comments below table.)

☐ FHWA-NHI-130054 Engineering Concepts for Bridge Inspectors
☐ FHWA-NHI-130055 Safety Inspection of In-Service Bridges
☐ FHWA-NHI-130078 Fracture Critical Inspection Techniques for Steel Bridges
☐ FHWA-NHI-130079 Bridge Coatings Inspection
NHI courses:

Special Training
Does your agency require additional or special training for
(Check all that apply. Comment below as needed):

☐ Inventory inspection ☐ Damage inspection ☐ Special inspection
☐ In-depth inspection ☐ Hands-on inspection ☐ Underwater inspection
☐ Complex bridges ☐ Fracture-critical inspection ☐ Scour-critical inspection
☐ Electrical equipment ☐ Mechanical equipment
Other special training:

Refresher Training
Does your Agency use the NHI course FHWA-NHI-130053 Bridge Inspection Refresher Training or some other course or method for refresher training (if other, please describe)?
Refresher:

What is the preferred interval for refresher training? *Refresher interval*:

Are there different requirements for refresher training for Team Leaders and for Bridge Inspectors? *Refresher training*:

Current Workforce

Among your current bridge inspection workforce what percentages of team leaders, bridge inspectors, underwater inspectors, and equipment inspectors hold Professional Engineer (PE) license, or National Institute for Certification in Engineering Technologies (NICET), or American Society for Nondestructive Testing (ASNT) certification? What is the average number of years of bridge inspection experience?

Among Agency personnel:

	PE (%)	NICET III or IV (%)	ASNT (%)	Bridge Inspection Experience, years
Team Leaders				
Bridge Inspectors				
Underwater Inspectors				
Equipment Inspectors				

Additional comments on Agency workforce:

Among consultant personnel:

	PE (%)	NICET III or IV (%)	ASNT (%)	Bridge Inspection Experience, years
Team Leaders				
Bridge Inspectors				
Underwater Inspectors				
Equipment Inspectors				

Additional comments on consultant workforce:

Other Certifications

Does your Agency recognize certification "Other" than PE license, NICET, or ASNT? If yes, please identify.

Other certification:

Fitness/Vision/Color Perception Requirements

What are your agency's requirements for vision, for color perception, and for general physical fitness of bridge inspectors and team leaders?

Vision, color perception, physical fitness:

Are there specific requirements that are met by some, but not all, inspectors? These may include ability to climb, ability to work at height, ability to work in confined spaces, etc.?

Specific physical requirements:

What are your agency's physical fitness requirements for underwater bridge inspectors?

Underwater physical requirements:

Does your agency conduct periodic review of fitness/vision/color perception of bridge inspectors? Does this include periodic vision testing?

Periodic fitness review:

Quality Assurance/Quality Control
What documentation does your agency maintain for bridge inspection QC/QA procedures? Is a copy of this documentation available for use in this Synthesis?
QC/QA documentation:

Quality Control Personnel
Who (what job titles) perform QC procedures at your agency? Are there permanent QC staff?
QC personnel:

What training does QC staff complete?
QC training:

Quality Control Procedures
What are your agency's procedures for tracking qualifications (qualifications include years and type of experience, training completed, and certifications/registrations) of inspection personnel?
QC tracking:

What are your agency's procedures for review and validation of inspection reports and data?
QC procedure:

Who performs QC for inspections by consultants?
Consultant QC perform:

What are your agency's procedures for identification and resolution of data errors, omissions, and/or changes?
QC actions:

What errors, discovered in a QC procedure, would warrant re-inspection of a bridge?
QC re-inspection:

What are your agency's procedures for review and validation of QC procedures?
QC validation:

Quality Assurance Personnel
Who [what job title(s)] perform bridge inspection QA at your agency? What are the roles and responsibilities of QA staff? Are there permanent QA staff?
QA staff:

What training does QA staff complete?
QA training:

Quality Assurance Procedures
What are your agency's bridge inspection QA procedures?
QA procedure:

What aspects of inspection field practice are evaluated in QA review?

☐ Appropriate methods of observation
☐ Recognition of critical conditions
☐ Complete and accurate inspection reports
☐ Discovery of deterioration
☐ Accuracy of condition ratings
QA field review:

How often are QA reviews performed:

	12 months	24 months	Other?
For individual bridge inspectors?	☐	☐	
For individual team leaders?	☐	☐	
For individual bridges?	☐	☐	
For a region or district within the agency?	☐	☐	
For other unit or division within the agency?	☐	☐	

What special or additional QA procedures are used for:

Underwater inspectors?
Fracture-critical inspectors?
Scour-critical inspectors?
Complex bridge inspectors?
Electrical equipment inspectors?
Mechanical equipment inspectors?

Quality Assurance Outcomes
What differences are considered to be "out-of-tolerance" for:

NBI condition ratings?
Element condition reports?
Bridge load ratings?

How does your agency define poor performance for:

Bridge inspectors?
Team leaders?
Bridge load raters?
Inspection consultants?

What records are kept of QA results (e.g., a database of personnel, their QA dates, QA results, recommendations for remedial actions, date of completion of remedies, etc.)?
QA record:

Are inspection personnel informed of their QA outcomes?
QA inform:

What remedies are used for inspectors having poor results in your QA process?
QA remedies:

What are your agency's procedures for disqualification of inspection personnel or consultants?
Disqualification:

What are your agency's procedures for re-qualification of inspection personnel or consultants?
Re-qualification:

Do QA outcomes affect promotion of personnel within the Bridge Inspection Program? Do outcomes affect selection of consultants for inspection services?
QA promotion:

Quality Assurance Bridge Review
On average how many bridges per year, or what percentage of bridges per year, receive QA review?
QA bridges:

How are bridges selected for QA review? What aspects of bridge type, condition, age, average daily traffic, load rating, etc., are important?
QA selection:

What items are verified during QA review of a bridge (Check all that apply)?

- ☐ Current inspection report
- ☐ Load rating
- ☐ Qualification of team leader
- ☐ Other:
- ☐ Bridge file
- ☐ Qualification of inspectors
- ☐ Qualification of load rater

Does every bridge undergo a QA procedure (at least once, or every 10 years, or other interval, etc.)?
QA bridge interval:

Quality Assurance/Quality Control Benchmarks
What program-wide benchmarks are used to track overall QA/QC achievement for your agency?
QA/QC benchmarks:

Does your agency compile an annual, or other periodic, report of QA/QC procedures, applications, outcomes, and benchmarks? Please describe the content of this report.
QA/QC periodic report:

Does your agency track QA/QC benchmarks for consultants?
QA/QC tracking:

BRIDGE INSPECTION REGULATIONS

This part seeks your agency's input on Federal regulations for bridge inspection. Kindly indicate changes, if any, that your agency recommends in each of the following areas. Please include your reason for each recommendation, the potential benefits of each change, and the potential impacts on inspection personnel, methods, training, certification, etc., as appropriate.

Bridge inspection intervals:

Underwater inspection intervals:

Fracture-critical inspection intervals:

Scour-critical inspection intervals:

Requirements for training of personnel:

Requirements for certification of personnel:

Requirements for QA/QC procedures:

Additional input on bridge inspection regulations:

Who are the stakeholders in regulations for bridge inspection? What groups or functions among state governments, local governments, toll authorities, industry groups, and citizen groups would you include in review or approval of new regulations?
Stakeholders:

Additional comments:
Please use this space for additional comments related to bridge inspection.
Additional comments:

APPENDIX C

Bridge Inspection Practices of Canadian Transport Agencies

TRANSPORTATION AGENCIES AND INFORMATION SOURCES

The questionnaire on inspection practices that was prepared for U.S. state departments of transportation (DOTs) was also distributed to Canadian transportation agencies. Six agencies responded: provincial agencies of Alberta, New Brunswick, Ontario, and Quebec, and municipal agencies of Edmonton and Ottawa. Two provinces, Alberta and Ontario, provided copies of their bridge inspection manuals (see Table 2).

Inspection information from the six Canadian agencies is presented in this appendix. The information is useful itself, but is not a full report on Canadian practices. Most Canadian provinces and territories are not represented.

Canada has road agencies at three administrative levels: federal (national, Ministry for Transport, Infrastructure, and Communities), provincial/state [provincial and territorial agencies (13; see Table C1)], and municipal (local). The Ministry for Transport, Infrastructure, and Communities has a broad portfolio that includes roads, ports, recreational resources, cultural resources, and the postal service. Transport Canada, a part of the federal ministry, administers roads, marine ports, and airports. Infrastructure Canada (http://www.infrastructure.gc.ca/index_e.shtml), a program within the federal ministry, addresses renewal of infrastructure. The Canadian Transport Agency (http://www.cta-otc.gc.ca/about-nous/role_and_structure_e.html), a seven-member tribunal within the federal ministry, decides economic matters arising from air, rail, and marine transport. Canada's National Highway System includes interprovincial and international roads. There are about 27,000 km of national highways.

INSPECTION PROGRAM

Inspection Inventory

Alberta Infrastructure and Transportation is responsible for approximately 5,600 bridges. The province has direct oversight of inspections of 2,000 bridges and delegates inspection of the remaining 3,600 bridges to local road authorities. In addition, 8,200 bridge-size culverts are inspected by the provincial ministry or by local road authorities. Alberta's inspection program includes bridges, culverts, ferry structures, and sign structures (Table C2).

- The city of Edmonton inspects 270 bridges.
- The New Brunswick DOT inspects 2,823 bridges.
- The Ontario Ministry of Transportation inspects 2,700 bridges.
- The city of Ottawa inspects 667 bridges having an aggregate deck area of 294,604 m^2.
- Transports Quebec inspects 8,600 bridges. Quebec also inspects sign structures.

Documents

Alberta has a two-volume manual for bridge inspection and maintenance (BIM) (*C1,C2*). The two volumes correspond to two levels of inspection; Level 1 is routine visual inspection and Level 2 is in-depth inspection and can involve material sampling and testing. BIM manuals are maintained by Alberta's Bridge Preservation Specialist. BIM is the inspection component of Alberta's Transportation Infrastructure Management System (TIMS). TIMS, deployed in 2005, absorbed Alberta's older Bridge Information System (BIS) and Culvert Information System (CIS).

Edmonton, a city in Alberta, also uses the BIM manuals. The Edmonton Bridge Engineer has general responsibility for documentation of inspection methods.

Ontario province publishes the *Ontario Structure Inspection Manual* (*OSIM*) (*C3*). The manual is maintained by Ontario's Bridge Inspection Program Manager. The province of New Brunswick and the city of Ottawa also use Ontario's inspection manual.

Quebec has a two-volume bridge inspection manual maintained by the structural head office.

INSPECTION PROGRAM PERSONNEL

Inspection Program Manager

Inspection program manager titles for each responding agency in Canada are listed in Table C3.

Three provinces, Alberta, Ontario, and Quebec, have regional or district managers in addition to a central manager. New Brunswick reports that three technical assistants manage the inspection program. Edmonton and Ottawa report only a head for inspection programs.

Bridge Load Rater

All four provinces reported a person in charge of bridge load rating. Provinces also have engineers in regional offices that perform ratings as a part of their duties. Ottawa uses consultants for load rating (see Table C4).

TABLE C1
CANADIAN PROVINCIAL TRANSPORT AGENCIES

Province or City	Agency	Portfolio
Alberta	Alberta Infrastructure and Transportation	Roads, water, and wastewater
British Columbia	Ministry of Transportation	Roads, ports, commercial transportation
Manitoba	Manitoba Infrastructure and Transportation	Roads and water stewardship
New Brunswick	Department of Transportation	Roads
Newfoundland and Labrador	Transportation and Works	Roads, ports, and marine transport
Northwest Territories	Department of Transportation	Roads, ports, community airports, and ice crossings
Nova Scotia	Transportation and Public Works	Roads, government buildings, environmental projects
Nunavut	Pivalliayuliqiyikkut Ingilrayuliqiyitkullu, (Department of Economic Development and Transportation)	Roads, mining, fishing, tourism, cultural industries
Ontario	Ministry of Transportation	Roads and Rails
Prince Edward Island	Transportation and Public Works	Roads
Quebec	Transports Quebec	Roads; public transportation; air, rail, and marine transportation
Saskatchewan	Highways and Transportation	Roads, ferries, and airports
Yukon Territory	Highways and Public Works	Roads, government buildings, government property

TABLE C2
CANADIAN INSPECTION INVENTORY

	Structures	
DOT	Bridges	Culverts
Alberta	5,600	8,200
Edmonton	270	
New Brunswick	2,823	
Ontario	2,700	
Ottawa	667	
Quebec	8,600	

Inspection Team Leaders, Inspectors, and Inspection Assistants

Alberta certifies two classes of bridge inspector. Class A inspectors are qualified for all structures including major bridges and complex bridges. Class B inspectors are qualified for standard bridges and culverts. Quebec identifies Class A and Class B bridge engineers who are qualified for complex bridges and for simple bridges, respectively. Quebec also has Class B inspectors and Class B2 assistants. Both work with Class A bridge engineers.

Ontario identifies both inspection team leaders employed by the agency and inspection senior structural engineers employed by the agency or by inspection consultants. Ottawa reports that it has inspection technologists as team leaders assisted by structure inspectors. Edmonton and New Brunswick reported inspection team leaders only (Table C5).

Underwater Inspection Leaders and Inspectors

Quebec employs two staff members as leaders for underwater inspections. Ottawa employs consultants for dive inspections. Alberta's BIM manual requires that underwater inspectors be

TABLE C3
CANADIAN DOT EXECUTIVES AND INSPECTION PROGRAM MANAGERS

Agency	Executives	Inspection Program Managers	Regional Inspection Managers
Alberta	Director, Bridge Engineering	Bridge Preservation Specialist (1)	Regional Bridge Manager (4)
Edmonton		Bridge Engineer	
New Brunswick	Assistant Director—Bridge and Ferry Maintenance	Senior Technical Advisor (3)	
Ontario	Manager Bridge Office	Head Inspection and Evaluation Engineer (1)	Head Regional Structural Engineer (5)
Ottawa	Program Manager, Infrastructure Assessment and Program Development Unit	Needs and Programming Engineer—Structures (1)	
Quebec	Head of structural department	State Bridge Inspection Program Manager (1)	Ingénieur régional en structures (1 per district)

Note: Shown in parentheses is the number of DOT staff holding each title.

TABLE C4
CANADIAN BRIDGE LOAD RATERS

DOT	State Load Rater	Regional/Other Load Rater
Alberta	Bridge Rating Engineer (1)	Varies—Numerous consulting firms are used
Edmonton		
New Brunswick	Senior Bridge Design Engineer (2)	
Ontario	Inspection and Evaluation Engineer (3)	Regional Structural Engineer (responsible for all aspects of structures—No individual responsible for only inspection) (30)
Ottawa		Structural Engineering Consultant—Structure/seismic evaluation (15 firms to call on)
Quebec	State Bridge Load Rater (1)	Ingénieurs en évaluation de la capacité portante (7)

experienced bridge inspectors or work under the direct supervision of bridge inspectors.

Inspection Specialists

Quebec province has specialists for equipment inspections, fracture-critical inspections, scour inspections, in-depth inspections, and sign structures. Other Canadian agencies employ consultants for special inspections (Table C6).

Alberta uses consultants for most specialized inspections except damage inspections. Alberta's Senior Bridge Maintenance Technologist is responsible for initial damage inspections, with further inspections done by consultants as needed.

RESPONSIBILITIES OF INSPECTION STAFF

Program Manager

Responsibilities for inspection program managers at Canadian transportation agencies are collected under several headings.

Administration

At most Canadian agencies, the inspection program manager is involved in hiring inspection consultants. Edmonton's inspection program manager oversees program budget and workforce, and hires agency personnel and inspection consultants (Table C7).

TABLE C5
CANADIAN TEAM LEADERS, INSPECTORS, AND ASSISTANTS

DOT	Team Leader	Inspector	Assistant
Alberta	BIM project manager (consultant 3) Class A inspector (major bridges) Class B inspector (standard bridges and culverts)	Various titles (agency 20, consultant 75)	
Edmonton	Bridge technologist		
New Brunswick	Bridge maintenance technician (agency 2)		
Ontario	Team leader (agency 15) Senior structural engineer (50% agency, 50% consultant)	Senior structural engineer (50 total, 50% agency, and 50% consultant)	Structural technician or engineering trainee (5 to 10)
Ottawa	Structure inspection technologist (3)	Structure inspector (3)	
Quebec	Class A bridge engineer (complex bridges) (agency 25, consultant 30) Class B bridge engineer (simple bridges) (agency 30)	Class B inspectors (technicians) (agency 40, consultant 50)	Class B2 inspectors (agency 40)

TABLE C6
CANADIAN INSPECTION SPECIALISTS

DOT	Inspection	Staff Title
Alberta	Fracture-critical	Consultants
	Scour	Consultants
	In-depth	Consultants
	Damage	Senior bridge maintenance technologist (1)
Edmonton	Fracture-critical	Consultants
	Scour	Consultants
	In-depth	Consultants
	Damage	Consultants
New Brunswick	Electrical equipment	Consultants
	Mechanical equipment	Consultants
	Fracture-critical	Consultants
	Scour	Consultants
Ontario	None	
Ottawa	Electrical equipment	Consulting firms (13)
	Mechanical equipment	Consulting firms (13)
	Fracture-critical	Consulting firms (13)
	Scour	Consulting firms (2)
	Damage	Structure inspection team
Quebec	Electrical equipment	Electrical equipment inspector (10)
	Other equipment	Signage structure (5)
	Fracture-critical	Fracture-critical inspector (2)
	Scour	Scour-critical inspector (4)
	In-depth	In-depth inspector (4)
	Damage	Damage inspector (3)

Inspection Policies

At all six reporting agencies, program managers develop inspection reporting forms. At most agencies, managers set inspection methods, inspection intervals, and formats for bridge databases (Tables C8 and C9). At most agencies, managers direct the use of bridge monitoring, and may direct the application of special, damage, and in-depth inspections (Table C10).

Inspector Training and Qualifications

At three agencies, program managers direct the training of inspection staff. In Alberta and Quebec, program managers certify bridge inspectors (Table C11).

Quality Programs

Four Canadian agencies reported that program managers set policies and procedures for the quality control and quality assurance of bridge inspections (Table C12).

Bridge Load Rating

Two of the six agencies (Edmonton and Ottawa) reported that inspection program managers keep bridge load rating data. In Quebec, the program manager sets load rating methods.

Bridge Maintenance

In New Brunswick, the inspection program manager allocates repair funding. In Ottawa, the manager prepares scoping documents for bridge design and construction.

Bridge Load Rater

Bridge load raters at the Canadian agencies request inspections, if needed, for re-rating. Alberta's load rater initiates reviews of ratings, Edmonton uses consultants to provide assessment reports that include load ratings, New Brunswick's load rater reviews requests for load permits, Ontario's load rater responds to requests for review from inspection team leaders, Quebec's load rater performs inspections as needed for re-rating (Table C13).

TABLE C7
ADMINISTRATIVE RESPONSIBILITIES OF CANADIAN PROGRAM MANAGERS

DOT	Inspection Annual Report	Inspection Annual Budget	Inspection Workforce	Inspection Equipment	Hires Agency Leaders and Inspectors	Hires Inspection Consultants	Hires Agency Load Raters
Alberta						Yes	
Edmonton	Yes	Yes	Yes		Yes	Yes	Yes
New Brunswick	Yes			Yes		Yes	
Ontario							
Ottawa				Yes	Yes	Yes	Yes
Quebec	Yes						Yes

TABLE C8
CANADIAN PROGRAM MANAGERS AND PROGRAM PROCEDURES

DOT	Bridge Manual	Inspection Methods	Reporting Forms	Bridge Database Format	Local Bridges
Alberta		Yes	Yes	Yes	
Edmonton		Yes	Yes	Yes	
New Brunswick		Yes	Yes		
Ontario		Yes	Yes	Yes	
Ottawa			Yes		
Quebec		Yes	Yes	Yes	

TABLE C9
CANADIAN PROGRAM MANAGERS AND INSPECTION DETAILS

DOT	Sets Inspection Intervals	Identifies Complex Bridges	Identifies Fracture-Critical Bridges	Identifies Scour-Critical Bridges	Forms Agency Inspection Teams	Assigns Bridges to Agency Teams	Selects Access Methods or Equipment	Assigns Bridges to Consultants
Alberta								
Edmonton	Yes	Yes	Yes					
New Brunswick	Yes	Yes	Yes	Yes				Yes
Ontario	Yes		Yes					
Ottawa	Yes			Yes	Yes		Yes	Yes
Quebec	Yes	Yes		Yes				

TABLE C10
CANADIAN PROGRAM MANAGERS AND INCREASED INTENSITY INSPECTIONS

DOT	Orders Damage Inspection	Orders Special Inspection	Orders In-Depth Inspection	Orders Hands-On Inspection	Orders Bridge Monitoring	Orders Field Tests for Inspection	Orders NDT Methods	Identifies Critical Findings
Alberta								
Edmonton	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
New Brunswick	Yes	Yes	Yes		Yes		Yes	Yes
Ontario								
Ottawa	Yes	Yes	Yes		Yes		Yes	
Quebec					Yes			

NDT = non-destructive testing.

TABLE C11
CANADIAN PROGRAM MANAGERS AND TRAINING

DOT	Trains Leaders and Inspectors	Certifies Leaders and Inspectors	Decertifies Leaders and Inspectors	Certifies Inspection Consultants
Alberta		Yes	Yes	Yes
Edmonton				
New Brunswick				
Ontario	Yes			
Ottawa	Yes			
Quebec	Yes	Yes		

TABLE C12
CANADIAN PROGRAM MANAGERS AND QUALITY CONTROL AND QUALITY ASSURANCE ACTIVITIES

DOT	QA/QC Standards and Oversight	Agency QA/QC Execution	Consultant QC/QA Execution
Alberta	Yes	Yes	Yes
Edmonton	Yes		
New Brunswick			
Ontario	Yes		
Ottawa		Yes	
Quebec	Yes		

TABLE C13
CANADIAN BRIDGE LOAD RATER RESPONSIBILITIES

DOT	Inspection Role	Inventory Data	Load Permit Review	Reports to
Alberta	Requests inspection	Load ratings		Director, bridge engineering
Edmonton	Requests inspection Requests monitoring			Bridge engineer
New Brunswick	Requests inspection Requests monitoring Requests measurement		Yes	Assistant director—Structures
Ontario	Requests inspection Requests monitoring Requests measurement			Head evaluation and inspection engineer
Ottawa				
Quebec	Requests inspection Requests monitoring Requests measurement			State bridge engineer

TABLE C14
CANADIAN INSPECTION TEAM LEADER RESPONSIBILITIES

DOT	Inspection Planning	Traffic Control	Access Equipment	Critical Findings	Load Posting
Alberta	Plans			Recommends	
Edmonton	Plans	Requests	Requests		
New Brunswick					
Ontario	Plans	Requests	Requests	Recommends	
Ottawa	Plans	Requests			
Quebec	Plans	Requests	Requests	Recommends	

Bridge Inspection Team Leader

Inspection team leaders have responsibilities for inspection planning, field operations, and data entry reporting (Tables C14 and C15). At three agencies (Alberta, Ontario, and Quebec), the team leader performs QC for inspection reports (Table C16).

Inspection team members, where used, perform similar activities as leaders but with less independence (Table C17).

QUALIFICATIONS OF INSPECTION STAFF

Training

In Alberta, inspection personnel complete a combination of in-house training and field training. There are separate training courses for Class A and Class B inspector certification. Quebec has in-house training courses for inspectors. Other Canadian agencies use on-the-job training or employ consultants for training (Table C18).

Refresher Training

Alberta provides additional training when there are changes to inspection practice. Ontario provides a 3-day course that all bridge inspectors must complete every 2 years. Quebec will require refresher training in the future (Table C19).

Special Training

Quebec provides special training courses for hands-on and fracture-critical inspections. Other agencies do not provide training, but do consider experience in special inspections when hiring inspection consultants.

Inspection Program Manager

Four Canadian agencies require a Professional Engineering (PE) license for inspection program managers (Table C20). All six agencies require an engineering degree. Four agencies require 5 years or more experience in bridge inspection. Requirements for regional inspection managers are similar (Table C21).

TABLE C15
CANADIAN TEAM LEADER FIELD RESPONSIBILITIES

DOT	Inspection Methods	Special Inspections, Monitoring	Directs Hands-On Inspection	Note
Alberta	Directs		Yes	
Edmonton	Directs		Yes	
New Brunswick				
Ontario	Directs	Recommends	Yes	
Ottawa	Directs		Yes	
Quebec	Directs			

TABLE C16
CANADIAN INSPECTION TEAM LEADERS AND INSPECTION DATA

DOT	Inspection Report	Performs Data Entry	Verifies Data Entry
Alberta		Yes	Yes
Edmonton		Yes	Yes
New Brunswick			
Ontario		Yes	Yes
Ottawa		Yes	Yes
Quebec		Yes	Yes

Bridge Load Rater

Four agencies reported on the qualifications for bridge load raters; all four require engineering degrees. Three agencies require PE licenses (Table C22).

Inspection Team Leader

In Alberta, Class A inspectors must have a civil engineering degree or certification as a civil engineering technologist (certified by the Association of Certified Engineering Technicians and Technologists). Class B inspectors must have a high school diploma. Training and examinations differ for Class A inspectors (all bridges) and Class B inspectors (standard bridges). Inspectors' certifications are reviewed every 3 years. Individuals must demonstrate adequate continuing practice in bridge inspection. For team leaders, Ontario requires either a PE license or certification as a civil engineering technologist. Edmonton, Ottawa, and Quebec require a college education for team leaders. Most agencies require bridge inspection experience (Table C23). Quebec measures individual experience as aggregate deck area, in square meters, inspected.

In the current workforce, many Canadian inspection team leaders (agency and consultant) are licensed engineers and have many years experience (Tables C24 and C25).

Qualifications for inspection team members, other than leaders, are listed in Table C26.

Underwater Bridge Inspection Team Leader, Underwater Bridge Inspector

Qualifications for leaders of underwater inspections were reported by three agencies. Edmonton requires an engineering degree for leaders, whereas Ontario and Quebec require PE licenses (Table C27).

Other Certifications

Alberta, New Brunswick, Ontario, and Ottawa all recognize certification as a civil engineering technologist as one measure of inspector preparation. Quebec issues certificates to inspectors completing the agency's in-house training courses.

TABLE C17
CANADIAN BRIDGE INSPECTOR RESPONSIBILITIES

DOT	Hands-On Inspection	In-Depth Inspection	Traffic Lane Closures	Access Equipment	Bridge Monitoring	Critical Findings	Data Entry	Report QC
Alberta	Recommends	Recommends	Requests		Recommends	Recommends	Verifies	Performs
Edmonton		Recommends	Requests	Requests	Recommends		Performed and verifyies	
New Brunswick		Recommends	Requests	Requests	Recommends	Recommends		
Ontario		Recommends	Requests	Requests	Recommends		Performs and verifies	Performs
Ottawa		Recommends					Performs and verifies	Performs
Quebec						Recommends	Performs	

TABLE C18
CANADIAN BRIDGE INSPECTION TRAINING

DOT	Training
Alberta	In-house and field training programs for inspectors, leading to two levels of certification: Class A is all bridges; Class B is standard bridges and culverts only.
Edmonton	
New Brunswick	On-the-job training
Ontario	In-house training
Ottawa	College education, on-the-job training, training consultants
Quebec	In-house; two courses of 4 days each

TABLE C19
CANADIAN REFRESHER TRAINING

DOT	Course	Interval
Alberta	In-house	As needed for changes to inspection practice
Edmonton	No requirement	
New Brunswick	No requirement	
Ontario	3-day inspection course	2 years
Ottawa	No requirement	
Quebec	No present requirement; may in future	

TABLE C20
CANADIAN QUALIFICATIONS FOR INSPECTION PROGRAM MANAGERS

DOT	Certification	Education	Bridge Inspection Experience	Bridge Inspection Training
Alberta	PE	Engineering degree	10 years	Yes
Edmonton		Engineering degree	5 years	
New Brunswick		Engineering degree		
Ontario	PE	Engineering degree	5 years	Yes
Ottawa	PE	Engineering degree	10 years	
Quebec	PE	Engineering degree	5 years	Yes

TABLE C21
CANADIAN QUALIFICATIONS FOR REGIONAL INSPECTION PROGRAM MANAGERS

DOT	Certification	Education	Bridge Inspection Experience	Bridge Inspection Training
Alberta	PE	Engineering degree	10 years	Yes
Edmonton				
New Brunswick				
Ontario	PE	Engineering degree	5 years	Yes
Ottawa				
Quebec	PE	Engineering degree	5 years	Yes

Inspector Requirements for Fitness, Vision, and Color Perception

Edmonton, New Brunswick, and Quebec require that inspectors be adequately fit to perform their work. Quebec requires that divers meet commercial qualifications. No agency reported that there was a periodic review of physical fitness (Table C28). No formal requirements or periodic review are reported for vision, color perception, or hearing.

INSPECTION TEAMS

Ontario and Ottawa use two-person inspection teams in summer and three-person teams in winter. Edmonton and Quebec use two-person teams, and New Brunswick uses one-person teams year round. Team size varies in Alberta (Table C29).

All six agencies reported the use of specific teams for fracture-critical inspections and for special inspections. At five agencies, these are consultant teams and can be agency teams in Quebec (Table C30).

In Ontario and Ottawa inspection teams work together consistently. Alberta, Edmonton, and Ontario prefer to assign the same bridges to the same teams (Table C31).

Quebec reported that maintenance crews may perform routine inspections. Other Canadian agencies reported no inspections outside of agency inspection staff and consultants.

Alberta uses consultants for 95% of its bridge inspections, whereas Ontario and Quebec use consultants for 50% or less of their bridges. Edmonton, New Brunswick, and Ottawa reported that all inspections are by agency staff (Table C32). Bridges are assigned to consultants as needed for individual bridges, or by region and route when many bridges are included in a contract (Table C33).

INSPECTION TYPES AND INTERVALS

Alberta defines two levels of inspection. Level 1 inspections are routine visual inspections. Reporting forms are tailored to the type of main structure. There are 25 dedicated forms for inspection reporting (Table C34). Level 1 inspections report only the worst condition rating among similar elements at a bridge.

TABLE C22
CANADIAN QUALIFICATIONS FOR BRIDGE LOAD RATERS

DOT	Certification	Education	Bridge Inspection Experience	Bridge Inspection Training
Alberta	PE	Engineering degree	10 years	Other training
Edmonton		Engineering degree		
New Brunswick				
Ontario	PE	Engineering degree	5 years	
Ottawa				
Quebec	PE	Engineering degree	2 years	Yes

TABLE C23
CANADIAN INSPECTION TEAM LEADER QUALIFICATIONS

DOT	Title	PE[a]	Cert.	BS[b]	AD[c]	HS[d]	Bridge Inspection Experience	Bridge Inspection Training
Alberta	Team leader			Yes			10 years	Yes
	Class A			Yes			2 years	Class A training and exam
	Class A						3 years	Class A training and exam
	Class B					Yes	2 years	Class B training and exam
Edmonton	Team leader			Yes				
New Brunswick								
Ontario	Team leader	PE		Engineering college			5 years	Yes
		Structural technician					5 years	Yes
Ottawa	Team leader			Yes				Yes
Quebec	Team leader			Yes			5 years	Yes

[a]Registered Professional Engineer.
[b]College bachelors de gree; usually Bachelor of Science in engineering.
[c]Associate's degree in engineering technology, usually civil engineering technology.
[d]High school diploma or equivalent.

Level 2 inspections are in-depth inspections of specific components using special tools, techniques, or equipment. Level 2 inspections usually are element-level inspections that report condition ratings for individual elements. Level 2 inspections include:

- Concrete deck
- Copper sulfate electrode testing
- Chloride testing
- Ultrasonic truss
- Culvert barrel measurements (barrel shape)
- Vertical clearance measurements
- Paint
- Concrete girder (crack measurement and mapping)
- Scour monitoring
- Timber coring
- Special structure monitor
- Underwater
- Linear polarization testing of concrete
- Bond testing
- Steel culvert corrosion testing
- Pin and hanger connection
- Steel girder cover plate.

Some Level 2 inspections are periodic. Alberta conducts periodic half-cell testing on approximately 500 bridge decks. The program began in 1977. Electrical potential measurements are taken at all points in a 1.2 m x 1.2 m grid and along all curb lines. The data are used to make predictions of the progress of deterioration.

TABLE C24
CANADIAN AGENCY TEAM LEADERS—CURRENT WORKFORCE

DOT	PE	Bridge Inspection Experience	Note
Alberta			
Edmonton	100%		Team leaders (other categories blank)
New Brunswick	100%	28 years	Team leaders
	100%	10 years	Bridge inspectors
Ontario	100%	10 years	Agency team leaders
	90%	8 years	Agency bridge inspectors
Ottawa	0	19 years	Team leaders
	0	6 years	Bridge inspectors
Quebec	100%	5 years	Team leaders
	50%	2 years	Bridge inspectors
	2%	10 years	Underwater inspectors

TABLE C25
CANADIAN CONSULTANT TEAM LEADERS—CURRENT WORKFORCE

DOT	PE	Bridge Inspection Experience	Note
Alberta			
Edmonton			
New Brunswick			
Ontario	100%	10 years	Team leaders
	75%	8 years	Bridge inspectors
Ottawa	100%	15 years	Underwater inspectors
	100%	15 years	Equipment inspectors
Quebec	100%		Team leaders
	50%	2 years	Bridge inspectors

Alberta also makes periodic ultrasonic inspections of approximately 75 truss bridges built in the 1920s and earlier.

Ontario's inspection types include routine inspection, emergency inspection, and the following set of specialized inspections:

- Detailed deck condition survey
- Non-destructive delamination survey of asphalt covered decks
- Substructure condition survey
- Detailed coating condition survey
- Underwater investigation
- Fatigue investigation
- Seismic investigation
- Structure evaluation.

INSPECTION INTERVALS

Alberta sets inspection intervals at 21 months for bridges along primary highways, 39 months along secondary highways, and 57 months along local roads. Ultrasonic inspections of fatigue-prone bridges are performed at 5- to 7-year intervals.

Ontario uses 24- and 48-month inspection intervals. The longer interval is for culverts in good condition. Quebec has intervals ranging from 24 to 60 months for routine inspections (Table C35).

Hands-On Inspection

All six agencies reported the use of hands-on inspections in response to floods, accidents, critical findings, or other singular

TABLE C26
CANADIAN INSPECTION TEAM MEMBERS

DOT	Inspector	Certification	Education	Experience	Bridge Inspection Training
Alberta	Inspector	Yes	High school	2 years	Yes
Edmonton	Inspector	Yes	College degree		
New Brunswick			College degree		
Ontario					
Ottawa					
Quebec	Inspector	PE	Engineering degree	2 years	Yes
	Electrical equipment	Yes	College degree	5 years	Yes

TABLE C27
CANADIAN UNDERWATER INSPECTION TEAM LEADER AND UNDERWATER BRIDGE INSPECTOR

DOT	Leader	Inspector/Diver	Certifications	Experience	Training	Education
Alberta						
Edmonton	Team leader					Engineering degree
		Inspector				College degree
New Brunswick						
Ontario	Team leader		PE	5 years	Bridge inspection	Engineering degree
		Inspector		5 years		
Ottawa						
Quebec	Team leader		PE	2 years	Bridge inspection, diving	Engineering degree
		Inspector	NICET III	2 years	Bridge inspection, diving	Engineering degree

NICET = National Institute for Certification in Engineering Technologies.

TABLE C28
CANADIAN FITNESS REQUIREMENTS

DOT	Good Health	Agility	Strength	Equipment	Note
Alberta					No specific requirements or review
Edmonton					General physical suitability No periodic review
New Brunswick		Ability to climb			Work in confined space No periodic review
Ontario					Must be able to get around at bridge site No periodic review
Ottawa					No specific requirements or review
Quebec	Good health	Ability to climb Able to work at height			Commercial qualification for divers Other, no periodic review

TABLE C29
CANADIAN INSPECTION TEAM SIZE

DOT	Team Size	Make Up	Team Formation/Stability	Note
Alberta	Varies			Based on assignment and consultant's experience
Edmonton	2	Leader + inspector		
New Brunswick	1	Inspector		
Ontario	2	Leader + inspector	Long-term	
	3	Leader + two inspectors	Long-term	Near ice or fast water
Ottawa	2	Leader + inspector	Long-term	Some rotation to accommodate annual leave
	3	Leader + two inspectors	Long-term	In winter
Quebec	2		As needed	

TABLE C30
CANADIAN INSPECTION TEAMS AND INSPECTION TYPES

DOT	Fracture-Critical Members	Special Inspections	Increased Intensity	Access	Bridge Type	Movable Bridges	Notes
Alberta	Yes	Yes			Yes		Consultants with recognized experience engaged
Edmonton	Yes	Yes			No		Consultants
New Brunswick	Yes	Yes	Yes		Yes		Consultants
Ontario	Yes	Yes			No		Consultants selected among list of qualified firms
Ottawa	Yes	Yes			No		Consultants
Quebec	Yes	Class A inspector			No		Fracture or scour specialists join inspection team as needed Special inspections performed by Class A inspectors.

TABLE C31
CANADIAN ROTATION OF INSPECTION TEAMS

DOT	Teams Repeat	Teams Rotate	Neutral	Notes
Alberta	Yes			Team inspects same bridges to the extent possible
Edmonton	Yes			
New Brunswick			Yes	
Ontario	Yes			Same bridges; encourages familiarity
Ottawa			Yes	Random assignments
Quebec				

TABLE C32
CANADIAN USE OF INSPECTION CONSULTANTS

DOT	DOT Inspections, %	Consultant Inspections, %
Alberta	5	95
Edmonton	100	0
New Brunswick	100	0
Ontario	50	50
Ottawa	100	0
Quebec	40	60

TABLE C33
CANADIAN INSPECTION CONSULTANT TEAM ASSIGNMENTS

DOT	Inspections	Assignment Basis	Assignment Term	Assignment Repeat
Alberta	All types of inspection	By region	3 years	No policy
Edmonton	Damage Fracture-critical In-depth Scour-critical special Underwater	As needed		
New Brunswick	Damage Fracture-critical In-depth Scour-critical underwater			
Ontario	All types of inspections	By region		No
Ottawa	Most types of inspections	Pre-qualified firms		No
Quebec	In-depth Damage Hands-on	By region		No

TABLE C34
ALBERTA INSPECTION FORMS

Reporting Form	Bridge Type
TH	Through trusses
PT	Pony truss
SG	Rolled beams
	Riveted plate girders
	Welded girders
	Steel rigid frames
SS	Other trusses and arches
DT	Deck trusses
TT	All timber bridges
PCS	Standard precast bridges
PSR	Regular prestress bridges
CON	All cast-in-place concrete bridges
	Concrete tee girder bridges
	Concrete flat slab bridges
CUL1	Single culverts
CULM	Multiple culverts
CULE	Culverts extended with different material and/or size
SIGN	Sign structures
THTT	Through trusses with timber approaches
THPCS	Through trusses with standard precast approaches
THPSR	Through trusses with regular prestress approaches
THSG	Through trusses with steel girder approaches
THPT	Through trusses with pony truss approaches
PTTT	Pony trusses with timber approaches
PTPCS	Pony trusses with standard precast approaches
SGTT	Steel beams with timber approaches
SGPCS	Steel beams with standard precast approaches
PSRPCS	Regular prestress with standard precast approaches
SSSG	Special steel with steel girder approaches
DTSG	Deck truss with steel girder approaches

TABLE C35
CANADIAN INSPECTION INTERVALS

Agency	Inspection	Standard Interval
Alberta	Bridges and culverts on primary highways	21 months
	Bridges and culverts on secondary highways	39 months
	Bridges and culverts on local roads	57 months
	Pedestrian bridges in parks	57 months
	New bridges, bridge after major repairs	Immediate on completion
Ontario	Bridges and culverts with spans more than 3 m All retaining walls All movable bridges	24 months
	Culverts in good condition with spans up to 6 m Retaining walls in good condition	48 months
	Structures with extensive poor condition Posted structures Structures with restricted clearance Single-load-path structures Structures with fatigue-prone details Structures with fracture-critical components Pins and hangers in arch structures Pins in suspended spans and pinned arches	<24 months
	Underwater	60–120 months
Ottawa	Routine	24 months
	Underwater	120 months
Quebec	Routine	24–60 months
	Underwater	120 months
	Fracture-critical	As needed

events. Four of the six agencies set maximum intervals between hands-on inspections. Two agencies consider bridge age in the application of hands-on inspection (Table C36).

Underwater Inspection

Alberta reported that approximately 15% of its bridges require wading for inspection of some components. Dive inspections are not routinely performed. Edmonton reported that no bridges require either wading or diving for inspections. New Brunswick reported that approximately 1% of bridges that cross water require dive inspections. Ontario reported that approximately 10% of bridge inspections include wading, and only 30 to 40 bridges require dive inspections. Ontario uses dive inspections in water depths of greater than 1 m. Ontario's interval for dive inspections ranges from 5 to 10 years. Ottawa reported that 257 bridges require wading during inspections and 113 bridges require dive inspections. Quebec performs wading inspections for all components in water and dive inspections for approximately 10% of water crossings. Ottawa and Quebec reported 10-year intervals for dive inspections.

Fracture-Critical Inspection

As noted earlier, Alberta performs periodic Level 2 ultrasonic inspections of approximately 75 truss bridges built in the 1920s and earlier.

TABLE C36
CANADIAN ROUTINE, HANDS-ON INSPECTION

DOT	Name	Location on Component	Notes
Alberta	Hands-on	Locations identified in report	Specific elements; extent of hands-on varies as needed
Edmonton	Hands-on	Locations identified in report	Can include entire bridge or specific elements
New Brunswick	Hands-on	Locations identified in report and in database	Can include entire bridge or specific elements
Ontario	Hands-on	Locations identified in report and in database	Specific elements; extent of hands-on varies as needed
Ottawa	Routine, hands-on	Locations identified in stand-alone report via detailed element maps. Database indicates occurrence and date of hands-on inspection	By consultants; use and extent based on findings of regular inspection
Quebec	Hands-on	Locations identified in report	Entire bridge, often; specific element(s) in response to accident or flood

Complex Bridges

Cable-stayed bridges, suspension bridges, tied arches, and orthotropic decks are identified as complex by four of six agencies. No agencies identified complex bridges based on bridge length, span, or age. Complex bridge types are listed in Table C37. Ontario reported that no bridge types are identified as complex.

Complex bridge inspections are most often assigned to Class A inspectors (Alberta) or Class A bridge engineers (Quebec). Edmonton, New Brunswick, and Ontario reported no special methods, training, or experience for inspections of complex bridges. Ottawa noted that requirements for special access equipment or traffic management are complex inspections.

TABLE C37
CANADIAN COMPLEX BRIDGE TYPES

Bridge Types	Complex Type or Inspection
Cable-stayed	4 Agencies
Orthotropic decks	
Suspension	
Tied-arch	
Fatigue-vulnerable	3 Agencies
Swing	
Vertical-lift	
Bascule	2 Agencies
Box beams with external post-tensioning	
Cantilever arm	
Eyebar	
Floating	
Jack-arch	
Patent-truss	
Bridges lacking design documents	1 Agency
Bridges with obsolete reinforcing steel	
Flatcar	
Historic	
Post-tensioned timber decks	
Single box—concrete	
Single box—steel	
Two-girder	
Bridge age	0 Agencies
Concrete without shear reinforcement	
Covered	
Length of bridge	
Length of main span	

Informal Inspections

All six Canadian agencies respond to damage reports submitted by maintenance crews, state police, or the public. Alberta keeps initial reports as part of paper bridge files (Table C38).

Monitoring of Bridges

Five agencies equate bridge monitoring with interim inspection and employ visual inspection as the most common form of bridge monitoring (Table C39).

Alberta uses monitoring when a problem or potential problem of a critical nature is found (e.g., a fracture-critical member in a two-girder bridge has evidence of cracks) or there is major deterioration in condition from one inspection to the next (e.g., sudden shifting of an abutment). Methods vary: Visual monitoring is common and instrumentation is used where needed. Monitoring continues until the deterioration halts or rehabilitation or repairs are made.

Edmonton reported only visual monitoring of bridges and New Brunswick uses only visual monitoring at short or interim intervals. Inspections can be as frequent as monthly. Monitoring continues until repair or replacement.

Ontario applies measurements of crack opening, movements, or deflections in response to observed problems such as tilting or settlement. These measurements become part of routine 24-month inspections of bridges. Measurements may

TABLE C38
CANADIAN INFORMAL INSPECTIONS

DOT	Maintenance Source	State Police Source	Public Source	Store in Bridge File (paper)	Stored in BMS/Database
Alberta	Yes	Yes	Yes	Yes	Inspection in response to high-load strike or other event. Initial report is in bridge file, but not part of database.
Edmonton	Yes				No
New Brunswick	Yes				No
Ontario	Yes				No
Ottawa	Yes	Yes	Yes	No	Note for significant information; may be added to database.
Quebec	Yes			No	Reports are very seldom

BMS = bridge management system.

TABLE C39
CANADIAN BRIDGE MONITORING

DOT	Method	Notes
Alberta	Visual monitor	Interim inspection
	Instrumentation	Annual ultrasonic inspection of two-girder bridges
		Sonic radar inspection of footings at 15 river bridges after significant flood event
Edmonton	Visual monitor	1-, 2-, and 5-year cycles; for poor condition; indefinite duration
New Brunswick	Visual monitor	Interim inspections as frequent as monthly
Ontario	Measurement	Crack opening, movement, or deflection, often at 2 years
Ottawa	Measurement	Relative movement using slide gauges and survey points
	Instrumentation	Acoustic monitoring of a large post-tensioned bridge
Quebec	Visual monitor	Hands-on inspection at 6 or 12 months
	Instrumentation	Usually with data logging

occur more often if needed, and continue until repairs are made or until movement becomes stable.

Ottawa monitors bridges in response to known problems or deterioration. The monitoring often is by measurement of movements. Intervals range from 3 to 12 months and continue until repairs are made. At one large post-tensioned bridge, acoustic emission sensors were installed during construction and are still monitored.

Quebec employs instrumentation and data logging to monitor known problems at bridges. In most cases, data transmission and office review occurs weekly. Instrumentation is deployed until defects are repaired, usually in 24 months or less.

CONDITION DATA

Alberta

Alberta uses a 1 (poor) to 9 (good) scale for condition ratings. In Level 1 inspections, the rating is set to the worst condition among each common group of elements. The rating "N" means not visible for inspection or inadequate access for inspection. Rating "X" means an element is not present at the bridge (Table C40). There are also general ratings; one each for superstructure and for substructure. Inspection reports require that inspectors estimate the year of future repairs or replacement of bridges.

Level 2 inspections report condition ratings for all elements, not just the worst one in a group. Level 2 inspections also report quantitative data collected from testing or sampling.

Ontario

Ontario reported deterioration severity and extent for bridge elements. There are four deterioration states: Light, Medium, Severe, and Very Severe. The extent is reported as a percentage of element quantity. Ontario reported on performance deficiencies. These are similar to U.S. smart flags and include:

- Load carrying capacity
- Excessive deformations

TABLE C40
ALBERTA CONDITION RATINGS

Rating		Commentary	Maintenance Priority
9	Very good	New condition	No repairs in foreseeable future
8		Almost new condition	No repairs in foreseeable future
7	Good	Could be upgraded to new condition with very little effort	No repairs necessary at this time
6		Generally good condition Functioning as designed with no signs of distress or deterioration	No repairs necessary at this time
5	Adequate	Acceptable condition and functioning as intended	No repairs necessary at this time
4		Below minimum acceptable condition	Low priority for repairs
3	Poor	Presence of distress or deterioration or not functioning as intended	Medium priority for replacement, repair, and/or signing
2		Hazardous condition or severe distress or deterioration	High priority for replacement, repair, and/or signing
1	Immediate action	Danger of collapse and/or danger to users	Bridge closure, replacement, repair, and/or signing required as soon as possible
N	Not accessible	Element cannot be visually inspected	
X	Not applicable	Element not applicable to this bridge	

- Continuing settlement
- Continuing movements
- Seized bearings
- Bearing not uniformly loaded, unstable
- Jammed expansion joint
- Pedestrian/vehicular hazard
- Rough riding surface
- Deck drainage
- Slippery surfaces
- Flooding/channel blockage
- Undermining of foundation
- Unstable embankments.

Ontario inspectors indicate maintenance needs, mostly using selections from a standard list of actions (Table C41).

QUALITY PROGRAMS

Quality Program Documentation

A chapter in Alberta's BIM manual addresses quality programs for bridge inspections. Ontario reviews inspection reports, but does not have formal documents for quality programs. Quebec requires that all regional offices be certified to ISO 9001-2000 (*C4*) (Table C42).

Program Staff in Quality Control and Quality Assurance

Quality programs are executed by Class A inspectors in Alberta, by the Head Inspection and Evaluation Engineer in Ontario, and by special staff for ISO 9001 procedures in Quebec (Table C43).

TABLE C41
ONTARIO STANDARD ACTIONS FOR MAINTENANCE

Action	Maintenance	Description
1	Lift and swing bridge maintenance	The operation, maintenance, and repair activities that are unique to lift and swing bridge structures, including all mechanical equipment and electrical devices such as signals, flashers, lighting, navigation lights, etc., but not including work defined by other structural maintenance operations.
2	Bridge cleaning	The cleaning of bridge components including: 1) Washing of bearings, bearing seats, truss members, etc. 2) Sweeping of bridge decks, curbs, and gutters. 3) Removal of debris from expansion joints. 4) Debris pick-up or minor removal of aggregate. 5) Cleaning of catch-basins, manholes, and deck drains.
3	Bridge handrail maintenance	The painting, repair, and/or replacement of metal handrails and posts, as well as touch-up painting activities.
4	Painting steel bridge structures	The preparation (sandblasting, etc.) and painting of structural steel. Includes handrails when performed as part of an overall bridge painting operation.
5	Bridge deck joint repair	The repair and/or replacement of expansion and/or fixed-deck joints and end dams.
6	Bridge bearing maintenance	The adjustment, repair, and/or replacement of bridge bearings. Includes all work directly associated with bridge bearings.
7	Repair to structural steel	The repair of all structural steel, including repair or replacement of steel components, bolts, and fasteners.
8	Repair of bridge concrete	The repair of all concrete components of the structure, such as decks, curbs, pedestrian walks, concrete handrail posts, parapet walls, abutments, and piers, except when the repair is more directly associated with one of the other defined bridge maintenance operations.
9	Repair of bridge timber	The repair of all bridge timber, including the repair of timber decks on steel bridges.
10	Bailey bridges—Installation, maintenance, and removal	The installation, removal, repair, and maintenance work that is unique to Bailey Bridges, but not including work defined by other structural maintenance operations.
11	Animal/pest control	The installation and maintenance of animal/pest control devices under bridge structures such as pigeon proofing.
12	Bridge surface repair	The repair of bridge surfaces such as pothole patching.
13	Erosion control at bridges	Operations performed to prevent or repair damage due to erosion, such as scour at abutments and around piers, and washouts on slopes. Includes removal of obstructions to water flow, clearing of vegetation growth, etc.
14	Concrete sealing	The sealing or treatment of bridge concrete surfaces with approved materials, as well as the preparation of surfaces prior to treatment.
15	Rout and seal — Concrete and asphalt pavement on bridge decks	The routing of joints and/or cracks in concrete and asphalt pavement and the filling of same with joint fillers or rubberized asphaltic sealing compounds.
16	Bridge deck drainage	The repair, maintenance, and replacement/extension of deck drains. Includes steaming and calcium application to unthaw.

TABLE C42
CANADIAN QUALITY CONTROL DOCUMENTS

DOT	Documents
Alberta	Chapter 2 of the BIM *Inspection Manual* provides a general outline for QC/QA requirements. Detailed QC/QA is further defined in the contracts signed with the consultants performing our BIM inspections.
Edmonton	No formal procedure
New Brunswick	N/A
Ontario	Informal review of reports; no documentation is produced
Ottawa	No documentation
Quebec	Every regional office has to be certified ISO 9001-2000.

N/A = not applicable.

TABLE C43
CANADIAN PERSONNEL FOR QUALITY CONTROL AND QUALITY ASSURANCE

DOT	Personnel	Qualification
Alberta	Bridge preservation specialist	Class A Inspector
	Regional bridge managers	Class A Inspector
	BIM inspection reviewer (consultant)	Class A Inspector
Edmonton	No response	
New Brunswick	N/A	
Ontario	Head inspection and evaluation engineer	
Ottawa	Structure inspection technologists	
	Structure inspectors	
Quebec	Specific staff	Special ISO 9001 training courses

N/A = not applicable.

Quality Control of Inspector Qualifications

For QC of bridge inspectors, Alberta tracks the individuals' certification as Class A or Class B inspector. Ontario reviews resumes of personnel at the time of their assignment to bridge inspection work and Quebec has its inspectors registered with an external QC firm (Table C44).

Quality Control Review of Inspection Reports

In Alberta, all inspection reports are reviewed by Class A inspectors. Each report is placed in one or four "Lots" depending on the significance of repair needs (Table C45). Alberta's inspection reporting forms show both current and prior condition ratings for every element. Inspectors must provide adequate notes on all changes to condition ratings.

Ontario makes spot checks of some inspection reports. Ottawa and Quebec review all inspection reports (Table C46).

Quality Control of Inspections by Consultants

Transportation agencies in Alberta, Ontario, and Ottawa review inspection reports submitted by inspection consultants (Table C47). Ontario keeps records of errors in reports and these records can affect future awards to the contractor.

Quality Control Program Validation

Alberta relies on routine QC review of inspection reports as means of validation of the quality program. Ontario has its program manager and regional heads conduct peer reviews of QC.

TABLE C44
CANADIAN QUALITY CONTROL OF INSPECTION LEADERS

DOT	Certification	Agency	Consultants
Alberta	Certified as Class A or Class B inspector	Database with certification (A or B), courses completed, date of certification, expiration date of certification	Same
Edmonton			
New Brunswick			
Ontario			Resumes of inspectors, submitted at time of assignment
Ottawa	No formal procedure		
Quebec		Registration with external QC firm	

TABLE C45
ALBERTA INSPECTION REPORT LOTS

Inspection Report	Description
Lot 1	Reports for structures requiring major repairs, a Level 2 inspection, reduced inspection cycle, or an engineering assessment
Lot 2	Reports for structures requiring minor or routine repairs
Lot 3	Reports for municipal structures requiring minor repairs not funded by the department
Lot 4	Reports for structures requiring no action or monitoring

TABLE C46
CANADIAN QUALITY CONTROL OF INSPECTION REPORTS

DOT	Review Set	Review by	Action
Alberta	All inspection reports	Class A inspector; prior to database entry	Return for errors or omission
	Reports with large change in condition	Class A inspector	Possible re-inspection
	Reports having ratings that do not match photos		
Edmonton			
New Brunswick			
Ontario	Spot check for data integrity		
	Random QA re-inspection		
	Reports having gross errors		Possible re-inspection
Ottawa	All inspection reports	Needs and programming engineer	Review prior to acceptance of report
Quebec	All inspection reports		Verification of report
	Reports inconsistent with recent maintenance		Possible re-inspection

QUALITY ASSURANCE

In Ontario, QA programs are performed by regional structural engineers. Quebec uses bridge inspectors who are trained in ISO 9000 procedures to perform QA activities.

Both Alberta and Ontario use annual meetings and close-out meetings with inspection consultants to discuss their performance. Alberta conducts quality audits of inspection consultants. In Quebec, QA is part of the ISO audit report (Table C48).

Alberta verifies inspection reports at 15 bridges each year. Ontario verifies 50 bridge inspections per year. Quebec verifies approximately 5% of all bridge inspections each year (Table C49).

Intervals for Quality Assurance Review

Alberta makes QA reviews of team leaders and regions every 4 years. Ontario makes annual reviews of regions and biennial reviews of team leaders. Quebec performs QA audits every 3 years (Table C50).

Tolerances Used in Quality Assurance Review

Alberta requires that condition ratings by inspectors be within ±1 of ratings obtained in verification inspections. Ontario requires that element condition reports of inspectors vary by less than 10% from verification inspections. Quebec uses overall field verification to assess the quality of inspection work (Table C51).

TABLE C47
CANADIAN QUALITY CONTROL FOR INSPECTIONS BY CONSULTANTS

DOT	Consultant Review	QC	QA
Alberta	Review all inspection reports by Class A inspector	C, A	
	Agency does periodic audits/spot checks of consultant inspections		
Edmonton			
New Brunswick			
Ontario	Regional structural engineer and head evaluation and inspection engineer	A	
Ottawa	Design and construction project manager assigned to the project	A	
Quebec	Agency staff using ISO 9000 procedures		

Notes: A = agency or DOT; C = consultant.

TABLE C48
CANADIAN BASIC ELEMENTS OF QUALITY ASSURANCE REVIEW

DOT	Target	Office Review	Field Review	Reviewer	Report
Alberta	All inspection reports, reviewed for maintenance recommendations			Senior Bridge Technologist, Class A inspectors	A hard copy of the QA results is maintained on file.
	Inspection report		Verification	Senior Bridge Technologist, Class A inspectors	In annual meetings with the BIM consultant, the consultant is informed of any outcome of a QA audit.
Edmonton					
New Brunswick					
Ontario				Regional structural engineers, head inspection and evaluation engineer	Agency staff: Personnel performance reviews are filed. Consultants: Corporate performance rating at end of assignment. Rating considered for next award.
Ottawa					
Quebec				Bridge inspectors with ISO 9000 training	ISO audit report

TABLE C49
CANADIAN QUALITY ASSURANCE REVIEW OF BRIDGE INSPECTIONS

DOT	Bridge Review Unit	Unit Bridge Reviews	Review Activity	Basis for Bridge Selection	Review Current Inspection Report	Review Bridge File	Review Load Rating
Alberta	Report	100%		100%			
	Bridge	15 per year		Poor condition Specific bridge types	Yes	Yes	
Edmonton	Bridge	100 per year		Type, age, and use	Yes	Yes	
New Brunswick							
Ontario	Report	100%		100%			
	Re-inspection			Isolated, for verification			
	Bridge	50 per year (2%)		Various bridge types and locations	Yes	Yes	
Ottawa							
Quebec	Bridge	5%		5% per year Random	Yes	Yes	

TABLE C50
CANADIAN QUALITY ASSURANCE INTERVALS

DOT	Team/Team Leader Interval	Region/District Interval	Note
Alberta	4 years	4 years	
Edmonton			
New Brunswick			
Ontario	24 months	12 months	
Ottawa	As required	As required	
Quebec		3 years	Full verification

TABLE C51
CANADIAN TOLERANCES FOR QUALITY ASSURANCE REVIEW

DOT	Object	Tolerance
Alberta Edmonton New Brunswick	Condition rating (1 to 9)	±1
Ontario Ottawa	Element condition reports	>10%
Quebec	Element condition reports	Site verification

Benchmarks in Quality Assurance Reviews

Alberta files reports on field verifications that include the overall ranking of inspection work. Quebec prepares ISO audit reports (Table C52).

Disqualification of Inspection Program Staff

Only Quebec reports a basis for disqualification of individual inspectors and that is related to a lack of current experience. Alberta and Ontario consider quality in their selection of inspection consultants Tables C53 and C54. Additional training can restore firms and individuals who have been disqualified.

REFERENCES

C1. *BIM Inspection Manual*, version 3, Alberta Infrastructure and Transportation, Edmonton, AB, Canada, 2005.

C2. *BIM Inspection Manual*—Level 2, version 1, Alberta Infrastructure and Transportation, Edmonton, AB, Canada, 2004, 153 pp.

C3. *Ontario Structure Inspection Manual* (*OSIM*), Ontario Ministry of Transportation, Toronto, ON, Canada, 2000, 380 pp.

C4. Chung, H.W., *Understanding Quality Assurance in Construction—A Practical Guide to ISO 9000*, E&FN Spon, London, United Kingdom, 1999, 251 pp.

TABLE C52
CANADIAN QUALITY ASSURANCE BENCHMARKS

DOT	Benchmark	QA Report	Consultant Benchmark
Alberta	No formal benchmark	A report of the number of structures audited, variations in ratings, and overall ranking of the inspections (not acceptable, marginally unacceptable, acceptable, very good)	A report of the number of structures audited, variations in ratings, and overall ranking of the inspections (not acceptable, marginally unacceptable, acceptable, very good)
Edmonton New Brunswick			
Ontario Ottawa	No formal benchmark		
Quebec	ISO audit report		

TABLE C53
CANADIAN BASIS FOR DISQUALIFICATION OF INSPECTION PROGRAM STAFF

DOT	Team Leaders	Load Raters	Inspection Consultants
Alberta			No set policy; corporate rating affects award process
Edmonton New Brunswick			
Ontario			No set policy; corporate rating affects award process
Ottawa			
Quebec	5 years without bridge inspection work		

TABLE C54
CANADIAN INSPECTOR REMEDIES, DISQUALIFICATION, AND ADVANCEMENT

DOT	Inspector QA Remedies	Personnel Re-Qualify	Promotion/Award
Alberta	Training		No for agency staff, yes for consultants
Edmonton New Brunswick			
Ontario	Training		Yes for consultants
Ottawa			
Quebec	Training	New training + exam	Yes

APPENDIX D

Information Resources and Respondents

TABLE D1
U.S. INFORMATION SOURCES

DOT	Questionnaire Response	Publications Used in This Synthesis
Alabama		*Maintenance Manual* (1995), Alabama DOT, 217 pp. *Bridge Inspection Manual* (2002), Alabama DOT, 390 pp. *Bridge Inspection Program Compliance Review Questionnaire* (2002), Alabama DOT, 15 pp.
Alaska	Yes	
Arizona	Yes	
Arkansas	Yes	
California	Yes	*Element Level Inspection Manual* (2000), California DOT, 93 pp.
Colorado		*Pontis Bridge Inspection Coding Guide* (1998), Staff Bridge Branch, Colorado DOT, 184 pp.
Connecticut		*Bridge Inspection Manual* (2005), Version 2.1, Connecticut DOT, 624 pp.
Delaware	Yes	
U.S. Dept. of Defense		*Bridge Inspection, Maintenance, and Repair*, Army TM 5-600, Air Force AFJPAM 32-1088 (1994), Dept. of Defense, 186 pp.
District of Columbia		
U.S.DOT Eastern Federal Lands		*BIP Policy and Guidance Manual* (2006), U.S.DOT Eastern Federal Lands Highway Division, 58 pp.
Florida		*Manual for Bridge and Other Structures Inspection and Reporting Procedures*, 850-010-030-f, (2006), Florida DOT, 193 pp.
Georgia		*Policy and Procedure Statement Governing the Qualifications of Professional Consultants to Perform Work for the State of Georgia Department of Transportation* (2000), Georgia DOT, 47 pp.
Hawaii		
Idaho	Yes	*Idaho Bridge Inspection Coding Guide* (2004), Idaho DOT, 171 pp.
Illinois		*Bridge Condition Report Procedures & Practices* (2004), Illinois DOT, 50 pp.
Indiana		
Iowa	Yes	*Bridge Inspection*, Policies and Procedures Manual, 610.04 (2005), Iowa DOT, 8 pp.
Kansas		
Kentucky	Yes	*Quality Control/Quality Assurance Review for Kentucky NBIS Inspection Program* (2006), Kentucky Transp. Cabinet, 3 pp.
Louisiana		
Maine	Yes	
Maryland	Yes	
Massachusetts		*Quality Control and Quality Assurance*, Dir 2.1.1 (1998), Massachusetts Highway Department, 6 pp. *Inspection Team Field Evaluation*, Dir 2.1.2 (1998), Massachusetts Highway Department, 1 p. *Inspection Team Report Evaluation*, Dir 2.1.3 (1998), Massachusetts Highway Department, 1 p.
Michigan	Yes	*Guidelines For Bridge Inspection Frequencies* (2002), Michigan DOT, 1 p.
Minnesota		*Bridge Inspection Manual*, draft version 1.3 (2006), Minnesota DOT, 108 pp. *Certification of Bridge Safety Inspection to the Commissioner of Transportation* (2005), Minnesota DOT, 2 pp. Stehr, R.A., *Guidelines for Bridge Inspection Frequency* (2004), Minnesota DOT, 3 pp. *Quality Assurance Review of Bridge Owners* (n.d.), Minnesota DOT, 9 pp.
Mississippi		
Missouri	Yes	Harms, M., *Memorandum: Non-State Bridge Inspection Program*, Oct. 6, 2004, Missouri DOT, 16 pp. *Critical Inspection Findings* (2000), Missouri DOT, 54 pp. *Bridge Redundancy and Fracture Critical Members* (1991), Missouri DOT 27 pp. *Policy For Non-State System Bridge Inspection Program* (2000), Missouri DOT, 71 pp.
Montana		*Bridge Inspection Manual* (1996) Montana DOT, web document: http://www3.mdt.mt.gov:7783/db-pub/pontis40_site.htm.
Nebraska		

(*continued*)

TABLE D1 (*Continued*)
U.S. INFORMATION SOURCES

DOT	Questionnaire Response	Publications Used in This Synthesis
Nevada	Yes	
New Hampshire		
New Jersey		*Forum—Bridge Inspection Clarifications* (2006), New Jersey DOT, 26 pp. *Pontis Coding Guide* (2003), New Jersey DOT, 246 pp. *How to Review Pontis Data* (n.d.), New Jersey DOT, 7 pp. *Recording and Coding Guide for Structure Inventory and Appraisal of New Jersey Bridges* (2003), New Jersey DOT, 347 pp. *First-Cycle Report for Consultant* (2006), New Jersey DOT, 47 pp. *How to Review SI&A Data* (n.d.), New Jersey DOT, 9 pp. *Underwater Inspection and Evaluation of New Jersey Bridges Guidelines Manual* (1997), New Jersey DOT, 105 pp. *Structural Evaluation Explanation Of NBIS Scope of Work Consultant Contracts* (2006), New Jersey DOT, 20 pp. *Special Inspection—Pin/Hanger Assemblies Scope of Work* (n.d.), New Jersey DOT, 5 pp. *Scope of Work for Consultant Inspections Type I* (n.d.), New Jersey DOT, 14 pp. *Scope of Work for Consultant Inspections Type II* (2002), New Jersey DOT, 12 pp. *Scope of Work for Consultant Inspections Type III* (2001), New Jersey DOT, 1 pp.
New Mexico	Yes	
New York	Yes	*Bridge Inspection Manual* (1997), New York State DOT, 518 pp. *Bridge Inventory Manual* (2004), New York State DOT, 240 pp. *Overhead Sign Structure Inventory And Inspection Manual* (1999), New York State DOT, 42 pp.
North Carolina	Yes	
North Dakota	Yes	
Ohio	Yes	*Manual of Bridge Inspection* (2006), Ohio DOT, 179 pp.
Oklahoma		*Pontis Bridge Inspection Manual for Oklahoma Bridges* (2004), Bridge Division, Oklahoma DOT, 183 pp. *Quality Control and Quality Assurance Plan for State and Local Jurisdiction Bridge Safety Inspections* (n.d.), Oklahoma DOT, 4 pp.
Oregon	Yes	*Bridge Inspection Pocket Coding Guide* (2006), Oregon DOT, 119 pp. *Local Agency Guidelines* (2006), Oregon DOT: http://www.oregon.gov/ODOT/HWY/LGS/lagmanual.shtml. *ODOT Bridge Inspection Program QA Review* (n.d.), Oregon DOT, 3 pp.
Pennsylvania	Yes	*Bridge Safety Inspection Manual*, Pub. 238, (2002), Pennsylvania DOT, 316 pp.
Puerto Rico		
Rhode Island	Yes	
South Carolina		
South Dakota	Yes	
Tennessee		*Bridge Inspection Program Procedures Manual* (2006), Structures Division, Tennessee DOT, 210 pp.
Texas	Yes	*Bridge Inspection Manual* (2002), Texas DOT, 147 pp. *Elements—Field Inspection and Coding Manual* (2001) Texas DOT, 74 pp.
Utah	Yes	
Vermont	Yes	
Virginia	Yes	*Bridge Safety Inspections*, instructional and informational memo, S&B 27.5 (2005), Virginia DOT, 32 pp.
Washington	Yes	*Washington State Bridge Inspection Manual*, M36-64 (2002), Washington State DOT, 412 pp. *Transportation Structures Preservation Manual* (1998), Washington State DOT, 29 pp.
West Virginia	Yes	
Wisconsin		*Level I—Review Record*, DT2002 (2003), Wisconsin DOT, 8 pp. *Level II—Review Record*, DT2003 (2007), Wisconsin DOT, 3 pp. *SI&A Field Review*, DT2006 (2003), Wisconsin DOT, 1 p.
Wyoming		

TABLE D2
RESPONDENTS FOR U.S. AGENCIES

State	DOT	Respondent
Alaska	Alaska Department of Transportation and Public Facilities	Drew Sielbach, Bridge Management Engineer
Arizona	Arizona Department of Transportation	Shafi Hasan, Assistant State Bridge Engineer Sunil Athalye, P.E., Bridge Management Leader
Arkansas	Arkansas Highway and Transportation Department	Garland Land, Heavy Bridge Maintenance Engineer David Ball, Staff Structures Engineer
California	California Department of Transportation	Barton Newton, State Bridge Maintenance Engineer Pete J. Whitfield, Office Chief—Investigations North
Delaware	Delaware Department of Transportation	Jason Arndt, Bridge Inspection Engineer/Program Manager
Idaho	Idaho Transportation Department	Kathleen Slinger, Bridge Inspection Engineer
Iowa	Iowa Department of Transportation	Bruce L. Brakke, P.E., Bridge Maintenance Engineer
Kentucky	Kentucky Transportation Cabinet	Jeffrey T. Sams, Chief Bridge Inspector
Maine	Maine Department of Transportation	John E. Buxton, P.E., Assistant Bridge Maintenance Engineer
Maryland	Maryland State Highway Administration	Joseph R. Miller, Chief, Bridge Inspection and Remedial Engineering Division Ryan M. Hughes, Assistant Division Chief, Bridge Inspection and Remedial Engineering Division
Michigan	Michigan Department of Transportation	Richard M. Smith, Bridge Inspection Program Manager
Missouri	Missouri Department of Transportation	Ken Foster, Supervising Bridge Inspection Engineer Mike Harms, Structural Services Engineer
Nevada	Nevada Department of Transportation	Dave Severns, Manager I, Registered Professional Engineer Marc S Grunert, Administrator I, Registered Professional Engineer
New Mexico	New Mexico Department of Transportation	Jeff V. Vigil, Bridge Management Engineer Jimmy Camp, State Bridge Engineer
New York	New York State Department of Transportation	Peter McCowan, Civil Engineer III (Structures)—Bridge Inspection Unit Supervisor
North Carolina	North Carolina Department of Transportation, Bridge Maintenance Unit	Henry A. Black, Jr., Assistant State Bridge Maintenance Engineer/Inspection
North Dakota	North Dakota Department of Transportation	Gary L. Doerr, P.E., Bridge Management Section Leader
Ohio	Ohio Department of Transportation	Mike Loeffer, Bridge Inspection and Maintenance Engineer
Oregon	Oregon Department of Transportation	Gary L. Bowling, Bridge Operations Engineer Jeff Swanstrom, Senior Bridge Inspector
Pennsylvania	Pennsylvania Department of Transportation	Harold C. Rogers, P.E., Assistant Chief Bridge Engineer for Bridge Inspection & Management Nevin L. Myers, P.E., Bridge Inspection Quality Assurance Manager
Rhode Island	Rhode Island Department of Transportation	Richard Snow, P.E., Chief Civil Engineer—Bridge Design Patrick Vu, P.E., Senior Civil Engineer
South Dakota	South Dakota Department of Transportation	Tom Gilsrud, Bridge Maintenance Engineer Todd Thompson, Special Assignments Engineer
Texas	Texas Department of Transportation	Alan Kowalik, Inspection Engineering Supervisor
Utah	Federal Highway Administration, Salt Lake City	Russell Robertson, ITS/Bridge Engineer
Vermont	Vermont Agency of Transportation—Structures Section	Pamela Maza Thurber, Bridge Management and Inspection Engineer
Virginia	Virginia Department of Transportation	John Coleman, Engineer II
Washington	Washington State Department of Transportation	Harvey L. Coffman, P.E., S.E., Bridge Preservation Engineer Grant D. Griffin, Local Agency Bridge Inspector, Local Agency Program Manager
West Virginia	West Virginia Department of Highways	Frank C. Liss, Bridge Evaluation Engineer

TABLE D3
FOREIGN RESPONDENTS

Nation	Agency	Respondent
Denmark	Danish National Roads Directorate	Arne Henriksen, Project Manager
Finland	Finnish Road Administration	Marja-Kaarina Söderqvist, Bridge Management Systems Engineer
France	Laboratoire Central des Ponts et Chaussées	Bruno Godart, Head of Division "Behavior and Durability of Bridges"
Germany	Federal Highways Research Institute (BASt)	Ralph Holst, Maintenance of Engineering Structures
South Africa	South African National Roads Agency Limited	Edwin Kruger, Bridge Network Manager
Sweden	Swedish Roads Administration	Susanne Troive, Bosse Eriksson
United Kingdom	Highways Agency	Brian Hill, Senior Technical Adviser Awtar Jandu, Team Leader Bridge Management
Alberta	Alberta Infrastructure and Transportation	Lloyd Atkin, Bridge Preservation Specialist
Edmonton	City of Edmonton	Shiraz Kanji, Bridge Engineer
New Brunswick	New Brunswick Department of Transportation	Ron Joyce, Bridge Maintenance Technician Ralph Campbell, Research Engineer
Ontario	Ministry of Transportation of Ontario	Dino Bagnariol, Head Evaluation and Inspection Engineer
Ottawa	City of Ottawa	Wim Jellema, Needs and Programming Engineer—Structures
Quebec	Ministère des Transports du Québec	Guy Richard, Directeur des structures

APPENDIX E

Details for Program Inspection Personnel

TABLE E1
U.S. STATE DOT EXECUTIVES AND INSPECTION PROGRAM MANAGER

DOT	DOT Executives (no. of staff)	DOT Inspection Program Manager (no. of staff)
Alabama	Transportation Director (1) Chief Engineer (1) Maintenance Engineer (1)	Assistant Maintenance Engineer for Bridges (1)
Alaska	Chief Engineer	Bridge Management Engineer/Bridge Inspection Manager (1)
Arizona	State Bridge Engineer	Assistant State Bridge Engineer—Operations (1)
Arkansas	Maintenance Engineer	Heavy Bridge Maintenance Engineer (1)
California	Chief, Division of Maintenance	State Bridge Management Engineer (1)
Connecticut	Chief Engineer (1)	Manager of Bridge Safety and Evaluation (1)
Delaware	Bridge Management Engineer	State Bridge Inspection Program Manager (1)
Eastern Federal Lands	Bridge Engineer	Bridge Inspection Program Coordinator
Florida	Engineer of Structures Maintenance (1)	Bridge Inspection and Evaluation Engineer (1) Bridge Management Inspection Engineer
Idaho	State Bridge Engineer	Bridge Inspection Engineer (1)
Iowa	State Bridge Engineer/Director, Office of Bridges and Structures (1)	Bridge Maintenance Engineer (1)
Kentucky	Branch Manager for Bridge Preservation	Chief Bridge Inspector (1)
Maine	Bridge Maintenance Engineer	Assistant Bridge Maintenance Engineer (1)
Maryland	Director, Office of Bridge Development	Chief, Bridge Inspection and Remedial Engineering Division (1)
Michigan	Bridge Operations Engineer	State Bridge Inspection Program Manager (1)
Missouri	State Bridge Maintenance Engineer Assistant Bridge Division Engineer	Supervising Bridge Inspection Engineer (1) (state bridges) Structural Services Engineer (1) (non-state bridges)
Montana	Bridge Engineer	Bridge Management Engineer
Nevada	Assistant Chief Bridge Engineer—Inventory/Inspection	Manager I, Registered Professional Engineer (1)
New Mexico	State Bridge Engineer	State Bridge Management Engineer
New York	Bridge Program and Evaluation Services Bureau Director	Bridge Inspection Unit Supervisor (1)
North Carolina		Assistant State Bridge Maintenance Engineer for Inspection (1)
North Dakota	State Bridge Engineer	State Bridge Inspection Program Manager (1)
Ohio	State Bridge Engineer	Bridge Inspection Engineer (1)
Oregon	Bridge Program Manager	Bridge Operations Engineer (1) Senior Bridge Inspector (1)
Pennsylvania	Chief Bridge Engineer	Assistant Chief Bridge Engineer (1)
Rhode Island		Program Manager (1)
South Dakota	State Bridge Engineer	Bridge Maintenance Engineer (1)
Tennessee		Manager of Bridge Inspection and Repairs, Headquarters
Texas	Director of the Bridge Division (1)	Inspection Engineer Supervisor (1)
Utah	State Bridge Engineer	Deputy Bridge Engineer—Operations
Vermont	Structures Program Manager	Bridge Management and Inspection Engineer (1)
Virginia	Chief Engineer	Engineer II—State Structure and Bridge Engineer (1)
Washington	Bridge and Structures Engineer	Bridge Preservation Engineer (1) Local Agency Bridge Program Manager (1)
West Virginia	Director of Maintenance Division	State Bridge Evaluation Engineer (1)

Note: Shown in parentheses is the number of DOT staff in each position.

TABLE E2
U.S. STATE DOT REGIONAL MANAGERS AND OTHER MANAGERS

DOT	Other DOT Central Managers (no. of staff)	Regional DOT Managers (no. of staff)
Alabama	County Transportation Engineer	Division Engineer (9) Division Chief Bridge Inspector (9)
Alaska		
Arizona		
Arkansas		District Construction Engineer (10)
California		Office Chief (5)
Connecticut		Transportation Supervising Engineer Transportation Engineer III (Senior Engineer) Transportation Engineer II Transportation Engineer I
Delaware	Consultant Manager for Interstate Bridges	
Eastern Federal Lands		Lead Structural Engineer
Florida		District Structures and Facilities Engineer District Bridge Inspection Supervisor Area Maintenance Engineer (bridges under 20 ft long) Professional Engineer, Engineering Section Leader Bridge Inspection Supervisor Section Leader Project Manager—Consultant Contract
Idaho		
Iowa		
Kentucky		District Bridge Engineer (12)
Maine		
Maryland		
Michigan		Region Bridge Engineer (7)
Missouri		District Bridge Engineer
Montana		District Inspection Coordinator
Nevada		
New Jersey	Manager, Movable Bridge Engineering DOT Project Manager for Consultant Contracts	
New Mexico		
New York	Main Office Liaison Engineer (6)	Bridge Management Engineer (11)
North Carolina	State-wide Bridge Inspection Superintendent (1) Bridge Underwater Inspection Supervisor (1) Bridge Special Inspections Supervisor (1)	Area Bridge Inspection Supervisors (3)
North Dakota		District Inspection Manager (8)
Ohio		District Bridge Engineer (12)
Oregon	Bridge Preservation Engineer (1) Bridge Inventory Coordinator Local Agency Bridge Inspection Coordinator (1)	District Manager
Pennsylvania		BMS Manager Bridge Inspection Agreement Manager District Bridge Engineer (11) District Inspection Manager (11) Assistant District Bridge Engineer for Inspection (11)
Rhode Island		Supervising Civil Engineer (2)
South Dakota	Bridge Operations Engineer (1) Local Transportation Program Bridge Engineer (1)	Region Bridge Maintenance Specialist (4)
Tennessee	SI&A Manager Assistant SI&A Manager	Regional Bridge Engineer
Texas		District Bridge Engineer Bridge Inspection Coordinator Project Manager (consultant)
Utah		
Vermont		
Virginia		Engineer I—District Structure and Bridge Engineer (9) District Bridge Safety Engineer
Washington		Regional Inspection Engineer (2)
West Virginia		District Bridge Engineer (10) District Evaluation Engineer (10)

Notes: Where reported, the number of staff in each position is noted in parentheses.
BMS = bridge management system; SI&A = structure inventory and appraisal.

TABLE E3
BRIDGE LOAD RATERS

DOT	State Load Rater (no. of staff)	Regional/Other Load Rater (no. of staff)
Alabama	Assistant Maintenance Engineer for Permits and Operations	Bridge Rating Engineer
Alaska	State Load Rater (1)	Other rater (2)
Arizona	Assistant State Bridge Engineer—Operations	Bridge Technical Leader (1)
Arkansas	Bridge Engineer (1)	Staff Structures Engineer (1)
California	State Load Rater (1)	
Connecticut	Supervising Engineer (TSE)	
Delaware		
Eastern Federal Lands		Structural Engineer
Florida	State Permits Engineer	Engineering Section Leader
Idaho	Load Rating Engineer	Consultant Load Rater
Iowa	Bridge Rating Engineer	Assistant Rating Engineer
Kentucky	Chief Load Rating Engineer (1)	None
Maine	Assistant Bridge Maintenance Engineer (1)	
Maryland	Assistant Division Chief (1)	Project Team Leader in Bridge Inspection and Remedial Engineering Division (5)
Michigan	None	
Missouri	Bridge Inventory and Rating Engineer—Supervisor	
Montana		
Nevada	Staff III, Registered Professional Engineer (1)	Consultant Engineers
New Mexico	Assistant State Bridge Management Engineer	
New York		Load Raters (consultant 16)
	State Bridge Load Rating Engineer (2)	Regional Load Rating Engineer (11) Load Raters (6)
North Carolina	Analysis and Permits Supervisor (1)	Bridge Analysis Supervisor (2) Bridge Analysis Engineer I and Bridge Analysis Engineer II (9)
North Dakota	State Bridge Load Rater (1)	
Ohio	Bridge Engineer (3)	
Oregon	Senior Load Rating Engineer (1)	Local Load Rating Engineer (1) Load Rating Engineer (2)
Pennsylvania	None	District Inspection Manager Heavy Hauling Permit Bridge Review Engineer (11) In-house design engineers
Rhode Island	State Load Rater (1)	
South Dakota	Special Assignments Engineer (1)	
Tennessee	Manager of Bridge Inspection and Evaluation	Bridge Evaluator
Texas	None	
Utah	Deputy Bridge Engineer—Design (1)	
Vermont	BMIE directing Civil Engineer I, II, III, or IV (2)	
Virginia	Must be PE	
Washington	Load Rating Engineer (1)	
West Virginia	Evaluation Section Analysis Engineer (1)	District Evaluation Engineer (10)

TSE = transportation supervising engineer; BMIE = Bridge Maintenance and Inspection Engineer.

TABLE E4
TEAM LEADERS, INSPECTORS, ASSISTANTS

DOT	Team Leader (no. of staff)	Inspector (no. of staff)	Assistant (no. of staff)
Alabama	Team Leader	DOT-certified bridge inspector (state) Local Government Bridge Inspector (local)	
Alaska	Team Leader (10) Consultant Team Leader (varies)		Inspection Assistant (2)
Arizona	Team Leader (4)	None	Bridge Inspection Technician (4)
Arkansas	District Bridge Inspector (21)		Bridge Inspection Helper (21)
California	Area Bridge Maintenance Engineer (60)	Area Bridge Maintenance Engineer (60 leaders + 30 others)	
Connecticut	Lead Inspector	Bridge Safety Inspector	
Delaware	Team Leader (3 + 2 temporary)	Bridge Inspector (9 in season, temporary assignment)	
Eastern Federal Lands	Field Team Leader		
Florida	Bridge Inspection Team Leader	Certified Bridge Safety Inspector	
Idaho	Bridge Inspector (agency 4, consultant 9)		Bridge Inspector Trainee (agency 1)
Iowa	Senior Team Leader (6) Team Leader (6)	Bridge Inspector (6)	Not used
Kentucky	Team Leader (agency 29, consultant varies)	Bridge Inspector (5)	Not used
Maine	One person teams (3 + 2 part time)	Not used	
Maryland	Inspection Team Leader (7)	Bridge Inspector (agency 11, consultants multiple)	Not used
Michigan	Bridge Inspector (agency 23, consultant 30 to 50)	Not used	Inspection Assistant (agency ~15, consultant 30–50)
Missouri	Bridge Inspection Engineer (all qualify as leader)		
Montana	Lead Inspector	Assistant Inspector	
Nevada	Team Leader (agency 2, consultant varies)	Bridge Inspector (consultant varies)	Staff I, Associate Engineer (2)
New Jersey	Team Leader		
New Mexico	District Bridge Engineer or District Bridge Inspector	Bridge Inspector (agency and New Mexico State University)	
New York	Team Leader (agency 27, consultant 54)	Assistant Team Leader (agency 27, consultant 54)	Trainee (consultant 17)
North Carolina	Bridge Inspection Team Leader (18)	Bridge Inspector (21)	Not used
North Dakota	Team Leader (28)	Bridge Inspector (70) Bridge Inspector (consultant varies)	
Ohio	Bridge Specialist 2 (30)	Bridge Specialist 1 (1)	
Oregon	Certified Bridge Inspection Team Leader (agency 5, consultant 15)	Certified Bridge Inspector	Inspection Assistant (agency 2, consultant 15)
Pennsylvania	Team Leader (agency 25, consultant not tracked)	Certified Bridge Inspection Engineer (24)	Not used
Rhode Island	Supervising Bridge Safety Inspector (agency 1, consultants 5 firms)	Bridge Safety Inspector (agency 3, consultants 5 firms)	Not used
South Dakota	Project Engineer, Engineer or Technician (6)		
Tennessee	Team Leader		
Texas	Team Leader (agency, consultant 28 firms)	Bridge Inspector (agency) Bridge Inspector (consultant 28 firms)	

(*continued*)

TABLE E4 (*Continued*)
TEAM LEADERS, INSPECTORS, ASSISTANTS

DOT	Team Leader (no. of staff)	Inspector (no. of staff)	Assistant (no. of staff)
Utah	Team Leader (4)	Bridge Inspector (4)	Inspector Assistant (1)
Vermont	AOT Tech IV or V—Bridge Inspection Team Leader (4)	Not used	AOT Tech I, II, or III—Assistant Bridge Inspector (4)
Virginia	Team Leader—Bridge Safety Inspector (33) Bridge Inspector Senior (17)	Bridge Inspector (26) Engineer I (2)	
Washington	Lead Inspector and Senior Lead Inspector (9)	Inspector—Assistant Inspector (12)	
West Virginia	District Team Leader (23)	District Team Member (30)	

Notes: Where reported, the number of staff in each position is noted in parentheses. AOT = Agency of Transportation.

TABLE E5
UNDERWATER (DIVE) INSPECTION LEADERS AND INSPECTORS

DOT	Leader (no. of staff)	Inspector (no. of staff)
Alabama	Chief Underwater Bridge Inspector	Underwater Bridge Inspector—Certified Bridge Inspector
Alaska	Consultant	
Arizona	Not used	
Arkansas	Underwater Team Leader (consultant 1)	
California	Program Manager (1) Dive Supervisor (3)	Diver (6)
Connecticut		Certified Diver
Delaware	Underwater Team Leader (consultant 1)	Underwater Bridge Inspector (consultant 2)
Eastern Federal Lands		
Florida	Underwater Team Inspection Leader	
Idaho	Not used	Dive Team Member (8)
Iowa	Underwater Team Leader (consultant varies)	Underwater Bridge Inspector (consultant, varies)
Kentucky	Underwater Team Leader (consultant)	
Maine	Dive Manager (1)	Underwater Bridge Inspector (14 part-time)
Maryland	Not used	Consultants
Michigan	Underwater Team Leader (consultant, 3 to 5 firms)	Underwater Bridge Inspector (consultant, 3 to 5 firms)
Missouri		
Montana		
Nevada	Underwater Team Leader (consultant, 1 firm)	Underwater Bridge Inspector (consultant ~2)
New Jersey	Team Leader to Supervise (consultant)	ACDE-certified commercial diver (consultant)
New Mexico		
New York	Underwater Team Leader (consultant 5) Fathometer Survey Team Leader (consultant 5)	Dive Tender (consultant 10) Diver (consultant 10) Fathometer Surveyor (consultant 5)
North Carolina	Bridge Underwater Inspection Team Leader (4) Underwater Inspection Supervisor (1)	Bridge Underwater Inspector (8)
North Dakota	Underwater Team Leader (consultant)	
Ohio	Underwater Team Leader (consultants, 5 firms prequalified)	
Oregon	Underwater Inspection Leader (1) Underwater Dive Team Manager Underwater Sounding Coordinator (1)	
Pennsylvania	Not used	Divers are certified bridge inspectors (consultant)
Rhode Island	Not used	
South Dakota		
Tennessee	Diver with comprehensive inspection training	Divers
Texas	Underwater Team Leader	Underwater Bridge Inspector
Utah	Consultant (1)	Consultant (1)
Vermont	Not used	Not used
Virginia	Team Leader (1)	Bridge Inspector (2)
Washington	Lead Underwater Inspector (1) Senior Lead Underwater Inspector (1)	Underwater Bridge Inspector (2)
West Virginia	Title not used. Agency has five staff qualified	Not used

ACDE = Association of Commercial Diving Educators.

TABLE E6
INSPECTION SPECIALISTS

DOT	Inspection (no. of staff)	Staff Title (no. of staff)
Alabama	Scour	Bridge Scour Engineer
Alaska	Fracture-critical	Consultants
	Scour	Inspector (agency 2, consultant varies)
Arizona		None
Arkansas		
California	Electrical equipment	Electrical Engineer (10)
	Fracture-critical	Structural Steel Inspectors (8)
	Mechanical equipment	Mechanical Engineer (10)
	Scour	Hydraulics Engineer (10)
Connecticut		None
Delaware	Fracture-critical	All agency inspectors
	Movable bridges	Consultant (1)
	Scour	Scour Engineer
Eastern Federal Lands		None
Florida	Fracture-critical	Participation by District Bridge Inspection Supervisor, District Bridge Structural Engineer, or the District Structures and Facilities Engineer
	Movable bridges	Level III NDT Inspector
Idaho	Equipment	Bridge Inspection Equipment Specialist (1)
Iowa	Special inspections	Special Projects Engineer (1) inspects major bridges on Mississippi and Missouri rivers
Kentucky		None
Maine	Electrical equipment	Bridge Manager (1)
	Mechanical equipment	Bridge Manager (1)
Maryland	Electrical equipment	Consultants
	Mechanical equipment	Consultants
Michigan	Electrical equipment	Master Electrician (agency 1, consultant 3 to 5)
	Fatigue	Fatigue-Prone Detail Engineer (1)
	Fracture-critical	Fracture-Critical and Movable Bridge Engineer (1)
	Mechanical equipment	Mechanical Equipment Inspector (consultant 3 to 5)
Missouri		None
Montana	NDT Inspections	NDT Inspector Level I
		NDT Inspector Level II
		NDT Inspector Level III
Nevada		None
New Jersey	Fracture-critical	AWS-certified inspector for welds
New Mexico	Fracture-critical	Consultant
New York	Electrical equipment	Consultant as needed
	Mechanical equipment	Consultant as needed
North Carolina	Special inspections	Special Inspection Supervisor (1)
		Bridge Special Inspections Team Leader (3)
		Bridge Inspector for Special Inspections (3)
North Dakota		None
Ohio		None
Oregon	Electrical equipment	Cathodic Protection Engineer (2)
	Fracture-critical	Fracture Control Engineer (1)
	Geotechnical	Senior Geotechnical Engineer (1)
	Mechanical equipment	Drawbridge Engineer (2)
	Scour	Bridge Hydraulics Engineer (1)
Pennsylvania*		None
Rhode Island		None
South Dakota		None
Tennessee		None
Texas	Fracture-critical	Fracture Critical Inspector
	Mechanical equipment	Consultant
Utah		None
Vermont	QA/QC Bridge Inspector (1)	Also performs load ratings and permit reviews
Virginia	Electrical equipment	Engineer I (1)
	Mechanical equipment	Engineer I (1)
Washington	Mechanical equipment	Senior Lead Mechanical Inspector (2)
	Other equipment	Inspector, Equipment (1)
	Scour	Scour Engineer (1)
	Sign bridges	Senior Sign Bridge Lead Inspector (1)
West Virginia		None

*Pennsylvania DOT reports no maintenance responsibility for movable bridges. NDT = non-destructive testing; AWS = American Welding Society.

TABLE E7
OTHER STAFF TITLES

DOT	Title (no. of staff)
Arizona	Bridge Management Leader (1)
	Bridge Office Engineers (2)
	Bridge Office Technicians (2)
Delaware	Bridge Maintenance/Pontis Engineer (1)
Florida	Bridge Management Quality Control Engineer
	Local Government Bridge Inspection Program Manager
Idaho	Bridge Inspection Database Manager (1)
Iowa	Field Engineer (1)
New Jersey	Certifying Engineer (consultant)
Ohio	Snooper Operator and Bridge Specialist 2 (4)
Pennsylvania	Manager for Crane Operation
South Dakota	Bridge Appraisal Engineer (1)
Virginia	UBIT Operators (4)
Washington	Coding and Appraisal Engineer (1)
	Bridge Resource Engineer (1)

Notes: Where reported, the number of staff in each position is noted in parentheses.
UBIT = under bridge inspection trucks.

TABLE E8
PROGRAM MANAGER ADMINISTRATIVE RESPONSIBILITIES

DOT	Inspection Annual Report	Inspection Annual Budget	Inspection Workforce	Inspection Equipment	Hires Agency Leaders and Inspectors	Hires Inspection Consultants	Hires Agency Load Raters
Alabama							
Alaska		Yes		Yes		Yes	
Arizona	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Arkansas							
California	Yes	Yes	Yes	Yes	Yes		Yes
Connecticut	Yes	Yes	Yes	Yes			
Delaware	Yes			Yes	Yes	Yes	
Idaho	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Iowa		Yes	Yes	Yes	Yes	Yes	Yes
Kentucky			Yes	Yes			
Maine	Yes	Yes	Yes	Yes	Yes	Yes	
Maryland	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Michigan	Yes	Yes	Yes	Yes	Yes	Yes	
Missouri					Yes	Yes	
Nebraska			Yes	Yes			
Nevada					Yes	Yes	
New Jersey	Yes		Yes	Yes			
New Mexico	Yes	Yes		Yes		Yes	Yes
New York	Yes		Yes	Yes		Yes	
North Carolina					Yes	Yes	
North Dakota	Yes	Yes	Yes	Yes		Yes	
Ohio					Yes		
Oklahoma			Yes	Yes			
Oregon		Yes	Yes	Yes	Yes	Yes	
Pennsylvania						Yes	
Rhode Island				Yes		Yes	
South Dakota						Yes	Yes
Tennessee	Yes	Yes	Yes	Yes			
Texas		Yes	Yes		Yes	Yes	Yes
Utah	Yes	Yes		Yes	Yes	Yes	
Vermont				Yes	Yes	Yes	Yes
Virginia		Yes	Yes	Yes		Yes	
Washington			Yes		Yes	Yes	Yes
West Virginia						Yes	
Total	14	16	19	23	17	24	10

TABLE E9
PROGRAM MANAGER AND PROGRAM PROCEDURES

DOT	Bridge Manual	Inspection Methods	Reporting Forms	Bridge Database Format	Local Bridges
Alabama					Yes, through district
Alaska	Yes	Yes			
Arizona	Yes	Yes	Yes	Yes	
Arkansas	Yes	Chairs committee on inspection policies and procedures			
California		Yes	Yes	Yes	Yes, through district
Connecticut	Yes	Yes	Yes	Yes	
Delaware	Yes	Yes	Yes	Yes	
Idaho	Yes	Yes	Yes		
Iowa	Yes	Yes	Yes	Yes	
Kentucky	Yes	Yes			
Maine	Yes	Yes			
Maryland	Yes	Yes	Yes	Yes	
Michigan	Yes	Yes	Yes	Yes	Yes
Missouri	Yes				Yes
Nevada	Yes				
New Mexico	Yes	Yes	Yes	Yes	
New York	Yes	Yes	Yes	Yes	
North Carolina	Yes				Yes
North Dakota	Yes	Yes	Yes	Yes	
Ohio			Yes		
Oregon	Yes	Yes	Yes		Yes
Pennsylvania		Yes	Yes	Yes	Yes
Rhode Island	Yes	Yes			
South Dakota	Yes				
Texas	Yes	Yes	Yes	Yes	Yes
Utah	Yes				Yes
Vermont	Yes		Yes	Yes	
Virginia	Yes	Yes	Yes	Yes	
Washington	Yes, by committee	Yes		Yes	
West Virginia	Yes	Yes	Yes		
Total	26	22	19	16	10

TABLE E10
PROGRAM MANAGER AND INSPECTION DETAILS

DOT	Sets Inspection Intervals	Identifies Complex Bridges	Identifies Fracture-Critical Bridges	Identifies Scour-Critical Bridges	Forms Agency Inspection Teams	Assigns Bridges to Agency Teams	Selects Access Methods or Equipment	Assigns Bridges to Consultants
Alabama								
Alaska	Yes	Yes	Yes					Yes
Arizona	Yes	Yes	Yes	Yes	Yes	Yes		Yes
Arkansas								
California	Yes		Yes	Yes	Yes	Yes	Yes	
Connecticut	Yes				Yes	Yes	Yes	Yes
Delaware	Yes	Yes	Yes		Yes	Yes		Yes
Idaho	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Iowa	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Kentucky			Yes	Yes	Yes	Yes	Yes	
Maine	Yes	Yes	Yes	Yes	Yes			
Maryland	Yes	Yes	Yes	Yes	Yes	Yes		Yes
Michigan	Yes	Yes	Yes		Yes	Yes	Yes	Yes
Missouri					Yes	Yes		
Nevada	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
New Mexico	Yes	Yes	Yes	Yes				Yes
New York	Yes	Yes	Yes					
North Carolina		Yes						Yes
North Dakota	Yes	Yes	Yes					
Ohio	Yes		Yes	Yes		Yes	Yes	Yes
Oregon	Yes	Yes	Yes		Yes	Yes		Yes
Pennsylvania	Yes							
Rhode Island	Yes							
South Dakota								
Texas	Yes	Yes	Yes		Yes	Yes	Yes	Yes
Utah		Yes						
Vermont				Yes	Yes	Yes		
Virginia								
Washington		Yes	Yes				Yes	
West Virginia	Yes	Yes						Yes
Total	20	18	18	11	15	15	10	15

TABLE E11
PROGRAM MANAGER AND INCREASED INTENSITY INSPECTIONS

DOT	Orders Damage Inspection	Orders Special Inspection	Orders In-Depth Inspection	Orders Hands-On Inspection	Orders Bridge Monitoring	Orders Field Tests for Inspection	Orders NDT Methods	Identifies Critical Findings
Alabama								
Alaska	Yes		Yes	Yes	Yes	Yes	Yes	Yes
Arizona	Yes	Yes	Yes	Yes	Yes			
Arkansas								
California	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Connecticut	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Delaware	Yes		Yes		Yes		Yes	Yes
Idaho	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Iowa	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Kentucky								Yes
Maine	Yes	Yes	Yes	Yes	Yes		Yes	Yes
Maryland	Yes							
Michigan	Yes	Yes	Yes	Yes		Yes		Yes
Missouri								
Nevada	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
New Mexico	Yes		Yes		Yes		Yes	Yes
New York								Yes
North Carolina	Yes							Yes
North Dakota	Yes	Yes	Yes	Yes			Yes	
Ohio	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Oregon	Yes	Yes		Yes	Yes	Yes		
Pennsylvania								
Rhode Island	Yes	Yes	Yes				Yes	
South Dakota								
Texas	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Utah	Yes	Yes	Yes		Yes			Yes
Vermont	Yes							Yes
Virginia								
Washington	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
West Virginia								
Total	21	15	17	14	15	11	14	18

TABLE E12
PROGRAM MANAGER AND TRAINING

DOT	Trains Leaders and Inspectors	Certifies Leaders and Inspectors	De-Certifies Leaders and Inspectors	Certifies Inspection Consultants
Alabama	Yes	Yes		Yes
Alaska		Yes		
Arizona	Yes			
Arkansas				
California	Yes	Yes		
Connecticut	Yes	Yes	Yes	
Delaware	Yes			
Idaho	Yes			
Iowa	Yes	Yes	Yes	Yes
Kentucky	Yes	Yes	Yes	
Maine		Yes		
Maryland				
Michigan	Yes			Yes
Missouri	Yes			
Nevada	Yes	Yes	Yes	Yes
New Mexico	Yes	Yes		Yes
New York	Yes	Yes		Yes
North Carolina				Yes
North Dakota	Yes	Yes		Yes
Ohio	Yes	Yes	Yes	
Oregon	Yes	Yes	Yes	Yes
Pennsylvania	Yes	Yes	Yes	Yes
Rhode Island				Yes
South Dakota		Yes	Yes	
Texas	Yes	Yes	Yes	Yes
Utah				
Vermont		Yes		
Virginia	Yes			
Washington	Yes	Yes	Yes	Yes
West Virginia	Yes	Yes		
Total	21	19	10	13

TABLE E13
PROGRAM MANAGER AND QC/QA ACTIVITIES

DOT	QA/QC Standards and Oversight	Agency QA/QC Execution	Consultant QC/QA Execution	QA/QC Notes
Alabama		Yes		DOT emergency inspection team (central office) reviews districts and local agencies
Alaska	Yes	Yes		
Arizona	Yes		Yes	
Arkansas				
California	Yes	Yes		
Connecticut	Yes	Yes		
Delaware	Yes	Yes		
Florida		Yes		Each district maintains an internal QC plan; QA reviews are done by central maintenance office
Idaho	Yes	Yes	Yes	
Iowa	Yes	Yes		
Kentucky	Yes	Yes		
Maine	Yes	Yes		
Maryland	Yes	Yes		
Michigan	Yes	Yes	Yes	
Missouri	Yes	Yes		
Nevada	Yes	Yes	Yes	
New Mexico	Yes	Yes	Yes	
New York	Yes	Yes	Yes	
North Carolina	Yes	Yes	Yes	
North Dakota	Yes	Yes	Yes	
Ohio	Yes	Yes		
Oregon	Yes	Yes	Yes	
Pennsylvania	Yes	Yes	Yes	By Bridge Quality Assurance Division
Rhode Island				
South Dakota	Yes			
Texas	Yes	Yes	Yes	
Utah	Yes	Yes	Yes	
Vermont		Yes		
Virginia	Yes	Yes	Yes	
Washington	Yes	Yes	Yes	
West Virginia	Yes	Yes	Yes	
Total	26	27	15	

TABLE E14
PROGRAM MANAGER AND BRIDGE MAINTENANCE

DOT	Emergency Repair	Maintenance Repair	Bridge Rehabilitation	Notes
Alabama				
Alaska			Yes	Planning project development
Arizona		Executes		
Arkansas				
California	Executes	Executes		
Connecticut	Recommends	Recommends	Recommends	Manager is technical consultant for bridge maintenance, repair, rehabilitation, and replacement
Delaware	Recommends			
Florida	Executes	Executes		
Idaho				
Iowa				
Kentucky				
Maine		Executes		
Maryland	Yes	Executes	Recommends	Bridge selection for construction/rehabilitation
Michigan				
Missouri				Maintenance training for inspection staff
Nevada				
New Mexico				
New York				
North Carolina	Monitor	Monitor		
North Dakota				
Ohio	Executes	Executes		
Oregon	Recommends	Recommends		
Pennsylvania	Plans			
Rhode Island				
South Dakota	Executes	Executes		
Texas				
Utah	Executes	Executes		
Vermont			Yes	Prepares budget for bridge projects
Virginia				
Washington				
West Virginia				

TABLE E15
PROGRAM MANAGER AND LOAD RATING, POSTING, AND PERMITTING

DOT	Load Rating	Load Posting	Load Permits	Notes
Alaska	Methods			
Arizona	Yes			
Arkansas				
California	Yes	Yes	Yes	
Connecticut	Yes			
Delaware				
Florida				Ratings are done by Engineering, not Inspection Section in district office
Idaho	Yes			
Iowa	Yes	Yes	Yes	
Kentucky				
Maine	Methods and data			
Maryland	Yes	Yes	Yes	
Michigan				
Missouri	Yes	Yes		
Nevada				
New Mexico	Yes		Yes	
New York				
North Carolina	Yes	Yes	Yes	
North Dakota	Yes			
Ohio				
Oregon	Yes	Recommends		
Pennsylvania	Methods and data	Yes		
Rhode Island				
South Dakota	Yes			
Texas	Yes			
Utah	Yes			
Vermont	Yes	Yes	Yes	
Virginia	Yes			
Washington	Methods			
West Virginia	Methods			
Total	21	8	6	

TABLE E16
BRIDGE LOAD RATER RESPONSIBILITIES

DOT	Inspection Role	Inventory Data	Load Permit Review
Alaska	Requests inspection	Load ratings	
Arizona	Requests inspection	Load ratings	
Arkansas	Requests inspection	Load ratings	
	Requests monitoring		
	Requests measurement		
California	Requests inspection	Load ratings	Supervises
Delaware	Requests inspection	Load ratings	Executes
	Requests monitoring		
	Requests measurement		
Idaho	Requests inspection	Load ratings	Executes
	Requests measurement		
Iowa	Requests inspection	Load ratings	Supervises
	Requests monitoring		
	Requests measurement		
Kentucky	Requests inspection	Load ratings	
	Requests monitoring		
	Requests measurement		
Maine	Requests inspection	Load ratings	
	Requests monitoring		
	Requests measurement		
Maryland	Requests inspection	Load ratings	
	Requests monitoring		
	Requests measurement		
Michigan	Requests inspection	Load ratings	
	Requests measurement		
Missouri	Requests inspection	All inventory data	
	Requests monitoring		
	Requests measurement		
Nevada		Load ratings	
New Mexico	Requests inspection	Load ratings	
	Requests monitoring		
New York	Requests inspection	Load ratings	
	Requests measurement		
North Carolina	Requests inspection		Executes
	Requests measurement		
North Dakota	Requests inspection	Load ratings	
	Requests monitoring		
	Requests measurement		
Ohio			
Oregon	Requests inspection	Load ratings	Supervises
	Requests monitoring		
	Requests measurement		
Pennsylvania	Requests inspection	Load ratings	Supervises
	Requests monitoring		
	Requests measurement		
Rhode Island		Load ratings	
South Dakota	Requests inspection	Load ratings	Executes
	Requests measurement		
Tennessee	Requests measurement		
Texas	Requests inspection	Load ratings	
Utah	Requests inspection	Load ratings	
	Requests monitoring		
	Requests measurement		
Vermont		Load ratings	
Virginia	Requests inspection	Load ratings	Executes
	Requests monitoring		
	Requests measurement		
Washington	Performs inspection	Load ratings	
	Requests monitoring		
	Requests measurement		
West Virginia	Requests inspection	Load ratings	
	Requests monitoring		
	Requests measurement		
Total	25	26	9

TABLE E17
INSPECTION TEAM LEADER RESPONSIBILITIES

DOT	Inspection Planning	Traffic Control	Access Equipment	Critical Findings	Load Posting	Notes
Alaska				Recommends		
Arizona	Plans	Requests		Identifies		
Arkansas	Plans	Requests	Requests	Recommends		
California	Plans	Requests	Requests	Recommends		
Connecticut	Schedules, Assigns team members	Requests Supervises	Requests Operates	Identifies		
Delaware	Plans	Requests	Requests	Recommends		Set of bridges is assigned to leader at start of inspection season Teams are central, not regional
Idaho	Plans	Requests	Requests	Recommends		Teams are regional
Iowa	Plans	Requests	Requests	Recommends		
Kentucky	Plans	Requests	Requests	Recommends		
Maine	Plans	Coordinates	Coordinates	Identifies		Element-level field data
Maryland	Plans	Requests	Requests			
Michigan	Plans	Requests	Requests	Recommends		
Missouri	Plans	Requests	Requests	Recommends		All inspectors qualify as team leaders
Nevada	Plans	Requests	Requests	Recommends		
New Mexico	Plans	Requests	Requests	Recommends		Teams are regional
New York	Plans	Requests	Requests	Recommends		Leader performs hands-on inspections
North Carolina	Planning, Personnel assignments, Progress reports	Requests Supervises in field	Requests Recommends maintenance and upgrade of equipment	Recommends		Team inspects bridges, culverts, movable bridge equipment, high mast lights, pipes, walkways, signs, tunnels Leader performs NDT Leader performs all sampling and testing Leader hires subordinate to form two-person team Leader attends/conducts safety meetings
North Dakota	Plans	Requests, Supervises	Requests, Supervises	Recommends		
Ohio	Plans	Coordinates	Coordinates	Recommends		Responsible for safety of work site
Oregon	Plans, Schedules	Requests	Coordinates UBIT	Identifies	Recommends	Team inspections bridges, culverts, minor bridges, sign structures, tunnels All, routine, fracture-critical, scour-critical, special surveys, clearances, channels soundings Teams are regional.
Pennsylvania	Plans, Schedules	Coordinates Assists	Coordinates Operates	Recommends		Two teams in each of eleven regions
Rhode Island	Plans, Schedules	Requests	Requests	Recommends		
South Dakota	Plans	Requests	Requests	Recommends		One-person teams
Texas	Plans, Coordinate	Requests	Requests	Recommends		
Utah	Plans, Schedules	Requests	Requests	Recommends		Provide NBI data to inventory.

(*continued*)

TABLE E17 (*Continued*)
INSPECTION TEAM LEADER RESPONSIBILITIES

DOT	Inspection Planning	Traffic Control	Access Equipment	Critical Findings	Load Posting	Notes
Vermont	Plans		Requests	Identifies		Makes special report for critical findings
Virginia	Plans	Requests	Requests	Recommends		Team performs acceptance inspections. Team inspects minor and ancillary structures.
Washington	Plans	Requests	Requests, Schedules, Operates, Maintains	Recommends		
West Virginia	Plans	Requests	Requests	Recommends		Two- or three-person teams
Total	28 (Plans) 5 (Sets schedules) 2 (Assigns team members)	24 (Requests) 3 (Supervises) 3 (Coordinates)	23 (Requests) 4 (Coordinates) 3 (Operates)	23 (Recommends) 5 (Identifies)	1 (Recommends)	

NDT = non-destructive testing; UBIT = under bridge inspection truck; NBI = National Bridge Inventory.

TABLE E18
TEAM LEADER FIELD RESPONSIBILITIES

DOT	Inspection Methods	Special Inspections, Monitoring	Directs Hands-On Inspection	Note
Alaska	Specify		Yes	
Arizona				
Arkansas	Specify	Recommends		
California	Specify	Recommends	Yes	
Connecticut				
Delaware				
Idaho	Perform	Recommends		
Iowa	Specify		Yes	
Kentucky	Perform	Recommends	Yes	
Maine	Perform		Yes	
Maryland	Specify		Yes	
Michigan	Perform	Recommends	Yes	
Missouri		Recommends	Yes	All inspectors qualify as team leaders
Nevada	Perform	Recommends	Yes	
New Mexico	Specify	Recommends	Yes	
New York	Perform Supervise		Yes	Performs hands-on inspection
North Carolina	Specify			
North Dakota	Specify		Yes	
Ohio	Perform	Recommends	Yes	
Oregon	Specify		Yes	Supervise dive team; perform dive inspection
Pennsylvania	Lead, not supervise	Recommends	Yes	
Rhode Island	Specify		Yes	
South Dakota	Specify	Recommends	Yes	
Texas	Supervise		Yes	
Utah	Perform		Yes	
Vermont	Perform		Yes	
Virginia	Supervise	Recommends	Yes	
Washington	Specify	Recommends	Yes	
West Virginia	Supervise	Recommends	Yes	
Total	12 (specify) 9 (perform) 4 (supervise)	14	23	

TABLE E19
INSPECTION TEAM LEADER AND INSPECTION DATA

DOT	Inspection Report	Performs Data Entry	Verifies Data Entry
Alaska		Yes	Yes
Arizona	Prepares	Yes	Yes
Arkansas		Yes	Yes
California		Yes	Yes
Connecticut	Prepares, Reviews dive report		
Delaware		Yes	Yes
Idaho		Yes	
Iowa		Yes	Yes
Kentucky		Yes	Yes
Maine	Prepares	Yes	Yes
Maryland		Yes	Yes
Michigan		Yes	Yes
Missouri			Yes
Nevada		Yes	Yes
New Mexico	Signs	Yes	Yes
New York	Supervises preparation		Yes
North Carolina	Prepares		
North Dakota			Yes
Ohio	Reviews, Signs	Yes	
Oregon	Prepares, Signs	Yes + inventory data New clearances	Yes
Pennsylvania	Prepares	Yes + new clearances	Yes
Rhode Island		Yes	Yes
South Dakota		Yes	Yes
Texas		Yes	Yes
Utah		Yes + inventory data	
Vermont	Prepares	Yes	Yes
Virginia		Yes + inventory data	Yes
Washington		Yes	Yes
West Virginia	Prepares	Yes + SI&A data	Yes
Total		24	24

SI&A = Structure Inventory and Appraisal.

TABLE E20
TEAM LEADER AND QUALITY CONTROL

DOT	QC for Inspection Reports	Note
Alaska		
Arizona	Yes	
Arkansas		
California	Yes	
Connecticut	Yes and reviews underwater dive reports	Personnel performance evaluations of team members
Delaware		
Idaho	Yes	
Iowa	Yes	
Kentucky	Yes	
Maine	Yes	
Maryland	Yes	
Michigan	Yes	
Missouri	Yes	Responsible for quality of all work during inspection
Nevada	Yes	
New Mexico	Yes, signs report	
New York	Other team leader	Other team leader signs report
North Carolina	Yes, reviews and signs report	Reviews work of subordinates
North Dakota	Yes	
Ohio	Review and sign	
Oregon	Reviews with inspection team, Signs report, Reviews underwater dive report	Leader is part of QA team for review of local owners
Pennsylvania	Yes	
Rhode Island	Yes	
South Dakota	Yes	
Texas	Yes	
Utah		
Vermont	Yes	
Virginia	Yes	Leader reviews/evaluates team members
Washington	Yes	
West Virginia	Yes; writes report	

TABLE E21
BRIDGE INSPECTION TRAINING COURSES

DOT	Course	Description
NHI Courses	FHWA-NHI-130054	Engineering Concepts for Bridge Inspectors
	FHWA-NHI-130055	Safety Inspection of In-Service Bridges
	FHWA-NHI-130078	Fracture Critical Inspection Techniques for Steel Bridges
	FHWA-NHI-130079	Bridge Coatings Inspection
	FHWA-NHI-130091	Underwater Bridge Inspection
	FHWA-NHI-130053	Bridge Inspection Refresher Training
	FHWA-NHI-134029	Bridge Maintenance Training
	FHWA-NHI-135047	Stream Stability and Scour at Highway Bridges
	FHWA-NHI-134056	Pontis (BMS) Training
Alabama	Annual training	Annual bridge inspection training school, one day to one week in length State and local government inspectors are expected to attend in preparation for inspection of bridge structures.
Florida	General bridge inspection course	Three-week course Inspection of fixed bridges
	Movable bridge inspection course	One-week course Movable bridge inspection Inspection of mechanical and electrical components
	Complex bridge inspection course	One-week course Inspection of segmentally constructed, post-tensioned, concrete box girder bridges
	Culvert inspection course	Pipe and box culverts
	Inspection of Fracture Critical Bridge Members	Recognize and inspect fracture-critical bridge members and teach the student how to inspect these members
	Non-Destructive Testing (NDT) Methods for Steel Bridges	Use of NDT on fracture-critical steel bridges
New Jersey	NHI refresher	Once per year
	Railroad bridges	For bridges over active railroad lines (NJ Transit, Conrail, Amtrak, CSX, Norfolk Southern, Shared Assets, etc.) the consultant must have his team leader and other field inspection engineers complete annual training provided by the concerned company.
New York	NYSDOT Bridge Inspection Workshop	Five-day course required for all inspectors and QC personnel
Ohio	Comprehensive	Six-day course that meets federal requirements for comprehensive bridge inspection training
	Major bridge	Special training and experience are required for major bridges
Oregon	Confined Space Awareness	Personnel inspecting interiors of box girders must complete the Confined Space Awareness training course
Pennsylvania	Basic bridge inspection training course	7.5 work days; instructors are PEs Certificate of completion for attendance Certified Bridge Safety Inspector card after testing/evaluation
	Bridge inspection refresher training course	Three work days; instructors are PEs
	Fracture Critical Inspection Techniques for Steel Bridges	
	Bridge Scour Evaluation	
Washington	Bridge Condition Inspection Fundamentals	Three-day course Preparatory for Bridge Condition Inspection Training
	Bridge Condition Inspection Training	10-day course Training includes 20 h in the field For new inspectors or those who desire a complete refresher Class is equivalent to the NHI-130055A (6 CEUs) Satisfactory completion of this course will fulfill the training requirements

BMS = bridge management system; PE = professional engineer; CEUs = continuing education units.

TABLE E22
REFRESHER TRAINING

DOT	Course	Interval
Alaska	NHI course[a]	~5 years
Arizona	NHI course	3 or 4 years
Arkansas		2 years
California	2-day training, topics by QC/QA program	1 year
Delaware	Yes	3 years
Idaho	NHI course + other training	2 years
Iowa	Other	5 years
Kentucky	NHI course	Varies
Maine	Other	5 years
Maryland	Other	As needed for changes to inspection regulations or methods
Michigan	NHI course, 1-day Michigan DOT workshop	5 years 3 workshops in 5 years
Missouri	Yes	As needed
Nevada	NHI course	As needed
New Mexico	Yes	5 years
New York	2-day NYSDOT bridge inspector's meeting with presentations Annual course offering	2 years interval to attend
North Carolina	NHI course[b]	5 to 6 years
North Dakota	Yes	5 years
Ohio	Yes	As needed
Oregon	Yes	5 years
Pennsylvania	Agency course	2 years
Rhode Island	Pontis course[c]	As needed
South Dakota	NHI course	5 years
Texas	Agency course	2 years
Utah	Yes	5 years
Vermont	Not at this time	
Virginia	Yes	3 years
Washington	Agency courses	5 years
West Virginia	Continuing training courses	As needed

[a]FHWA-NHI-130053, Bridge Inspection Refresher Training.

[b]FHWA-NHI-130055, Safety Inspection of In-Service Bridges.

[c]FHWA-NHI-134056, Pontis Training.

TABLE E23
QUALIFICATIONS FOR INSPECTION PROGRAM MANAGERS

DOT	Certification	Education	Bridge Inspection Experience	Bridge Inspection Training
U.S. Federal Regulation	PE		10 years	Comprehensive, FHWA-approved Comprehensive, FHWA-approved
Alaska	PE	Engineering degree	10 years	NHI 2-week course[a]
Arizona	PE	Engineering degree	Other	Other course
Arkansas	PE	Engineering degree	10 years	NHI 2-week course
California	PE	Engineering degree	2 years	NHI 2-week course
Connecticut	PE		2 years	Comprehensive, FHWA-approved
Delaware	PE	Engineering degree	5 years	NHI 2-week course
Idaho	PE	Engineering degree	None	NHI 2-week course
Iowa	None	Engineering degree		NHI 2-week course
Kentucky			(Federal regulation)	
Maine	PE	Engineering degree	10 years	Other training method
Maryland	PE	Engineering degree	10 years	NHI 2-week course
Michigan	PE	Engineering degree	5 years	NHI 2-week course
Missouri—Non-State	PE	Civil engineering degree	9 years	
Missouri—State	PE	Civil engineering degree	9 years	
Montana	PE			Comprehensive, FHWA-approved
Nevada	PE	Engineering degree	10 years	NHI 2-week course
New Mexico	PE	Engineering degree	None	NHI 2-week course
New York	PE	Engineering degree	5 years	Other course
North Carolina	PE	Engineering degree	10 year	NHI 2 week course
North Dakota	Other		None	NHI 2-week course
Ohio	PE	Engineering degree	10 years	Other course
Oregon	PE	None	10 years	NHI 2-week course
Pennsylvania	PE	Engineering degree	10 years	NHI 3-week course[b]
Rhode Island	PE	Engineering degree	None	NHI 3-week course
South Dakota	PE	Engineering degree	None	NHI 2-week course
Tennessee			(Federal regulation)	
Texas	PE	Engineering degree	10 years	NHI 2-week course
Utah	PE	Engineering degree	None	NHI 2-week course
Vermont	PE	Engineering degree	10 years	NHI 2-week course
Virginia	PE	None	None	NHI 2-week course
Washington	SE	Engineering degree	5 years	Other course
West Virginia	PE	Engineering degree	10 years	NHI 2-week course

[a] FHWA-NHI-130055, an FHWA-approved comprehensive training course for bridge inspection.
[b] FHWA-NHI-130054, plus FHWA-NHI-130055 for 3-weeks of training.

TABLE E24
QUALIFICATIONS FOR BRIDGE LOAD RATERS

DOT	Certification	Education	Bridge Inspection Experience	Bridge Inspection Training
Federal Regulation	PE			
Alaska		Engineering degree		
Arizona	PE[a]			Other course
Arkansas	PE	Engineering degree	5 years	NHI 2-week course
California	PE	Engineering degree	2 years	NHI 2-week course
Connecticut	PE[a]		5 years	
Delaware	PE	Engineering degree	2 years	NHI 2-week course
Idaho	PE	Engineering degree		Other training method
Iowa		Engineering degree		NHI 2-week course
Kentucky				
Maine	PE[a]	Engineering degree		Other course
Maryland	PE[a]	Engineering degree	5 years	NHI 2-week course
Michigan	PE	Engineering degree		
Missouri	PE	Civil engineering degree	6 years	
Nevada	PE	Engineering degree		Other training method
New Mexico	PE[b]	Engineering degree		NHI 2-week course
New York	PE	Engineering degree		
North Carolina	PE	Engineering degree	5 years	
North Dakota	PE	Engineering degree		
Ohio	PE	Engineering degree		Other course
Oregon	PE	Engineering degree		
Pennsylvania	PE[b]			
Rhode Island	PE	Engineering degree	5 years	NHI 3-week course
South Dakota	PE	Engineering degree		NHI 2-week course
Tennessee	PE			
Texas	PE	Engineering degree		
Utah	PE	Engineering degree		NHI 2-week course
Vermont	PE[a]	Engineering degree		Other training method
Virginia	PE	None		
Washington	PE	Engineering degree		Other course
West Virginia	PE	Engineering degree	5 years	NHI 2-week course

[a]Inspection program manager.
[b]District or deputy program manager.

TABLE E25
QUALIFICATIONS FOR INSPECTION TEAM LEADER

DOT	Title	PE[a]	FE[b]	NICET[c]	DOT Cert.[d]	BS[e]	AD[f]	HS[g]	Bridge Inspection Experience	Bridge Inspection Training
Federal Regulation	Team leader	Yes								FHWA-approved comprehensive (program manager)
									10 years	FHWA-approved comprehensive (program manager)
				III, IV						FHWA-approved comprehensive
			Yes			Yes			2 years	FHWA-approved comprehensive
							Yes		4 years	FHWA-approved comprehensive
									5 years	FHWA-approved comprehensive
Alabama	Team leader				Yes					NHI 2-week + Alabama DOT annual workshop (program manager)
		Yes			Yes					NHI 2-week + Alabama DOT annual workshop
				III, IV	Yes					NHI 2-week + Alabama DOT annual workshop
					Yes				5 years	NHI 2-week + Alabama DOT annual workshop
Alaska	Team leader	Yes Federal regulation				Yes			5 years	NHI 2-week
Arizona	Team leader	Federal regulation								
Arkansas	District bridge inspector				Yes			Yes	5 years	NHI 2-week
California	Area bridge maintenance engineer	Yes							2 years	NHI 2-week
Connecticut	Lead inspector					Yes			1 year	FHWA-approved comprehensive
							Yes		2 years	FHWA-approved comprehensive
									5 years	FHWA-approved comprehensive
Delaware	Team leader	Yes				Yes			2 years	NHI 2-week
					Yes			Yes	5 years	NHI 2-week
Florida	Team leader				Yes					Federal regulation
Idaho	Bridge inspector				Yes			Yes	5 years	NHI 2-week
Iowa	Team leader	Federal regulation								
Kentucky	Team leader	Federal regulation								
Maine					Yes			Yes	5 years	NHI 2-week

(*continued*)

TABLE E25 (*Continued*)
QUALIFICATIONS FOR INSPECTION TEAM LEADER

DOT	Title	PE[a]	FE[b]	NICET[c]	DOT Cert.[d]	BS[e]	AD[f]	HS[g]	Bridge Inspection Experience	Bridge Inspection Training
Maryland	Team leader							Yes	5 years	NHI 2-week
Michigan	Bridge inspector				Yes	Yes			2 years	NHI 2-week
					Yes			Yes	5 years	NHI 3-week
Missouri	Bridge inspection engineer, state bridges	Yes			Yes	Yes			6 years	NHI 2-week
	Bridge inspection engineer, non-state bridges	Yes							4 years	NHI 2-week
			Yes			Yes			4 years	NHI 2-week
				III, IV					5 years	NHI 2-week
									5 years	NHI 2-week
Montana	Team leader	Yes							1 year	FHWA-approved comprehensive
				III, IV					1 year	FHWA-approved comprehensive
									5 years	FHWA-approved comprehensive
Nevada	Team leader	Yes				Yes			5 years	NHI 2-week
New Jersey	Team leader, consultant	Yes							3 years	NHI 2-week
						Yes			5 years	NHI 2-week
New Mexico	District bridge inspector	Yes Federal regulation				Yes			5 years	NHI 2-week
New York	Team leader	Yes				Yes			3 years	NYS bridge inspection workshop
North Carolina	Team leader							Yes	5 years	NHI 2-week
North Dakota	Team leader	Federal regulation								
					Yes				5 years	NHI 2-week
Ohio	Bridge specialist 2			III, IV						FHWA-approved comprehensive
			Yes			Yes			2 years	FHWA-approved comprehensive
							Yes		4 years	FHWA-approved comprehensive
									5 years	FHWA-approved comprehensive
					Yes			Yes	5 years	Other course
Oregon	Team leader	Yes			Yes				5 years	NHI 2-week + retraining every 5 years for certification
					Yes				5 years	NHI 2-week
Pennsylvania	Team leader									Federal regulation + refresher biennially
Rhode Island	Team leader				Yes			Yes	5 years	NHI 3-week
South Dakota	Engineer	Yes				Yes			2 years	NHI 2-week
Tennessee	Team leader	Federal regulation								
Texas	Team leader	Yes				Yes			5 years	NHI 2-week
								Yes	7 years	NHI 2-week
Utah	Team leader							Yes	5 years	NHI 2-week

(*continued*)

TABLE E25 (*Continued*)
QUALIFICATIONS FOR INSPECTION TEAM LEADER

DOT	Title	PE[a]	FE[b]	NICET[c]	DOT Cert.[d]	BS[e]	AD[f]	HS[g]	Bridge Inspection Experience	Bridge Inspection Training
Vermont	Team leader	Yes				Yes			5 years	NHI 2-week
				III, IV					5 years	NHI 2-week
					Yes				5 years	NHI 2-week
Virginia	Bridge safety inspector			III, IV					5 years	NHI 2-week
Washington	Lead inspector	Yes				Yes			5 years	FHWA-approved comprehensive
	Team leader			III					5 years	
				IV					10 years	
West Virginia	Team leader				Yes			Yes	10 years	NHI 2-week

[a]Registered Professional Engineer.
[b]Fundamentals of Engineering Examination.
[c]National Institute for Certification of Engineering Technologies.
[d]Certification by DOT as inspection team leader.
[e]College bachelor's degree, usually Bachelor of Science in engineering.
[f]Associate's degree in engineering technology, usually civil engineering technology.
[g]High school diploma or equivalent.

TABLE E26
AGENCY TEAM LEADERS—CURRENT WORKFORCE

DOT	PE	NICET III or IV	Bridge Inspection Experience	Note
Alaska	75%		10 years	
Arizona	100%		5 years	
Arkansas	0	0	10 years	
California	75%		9 years	
Delaware	16.7%		9 years	One PE team leader doubles as inspector for other team leader Also get PEs from Bridge Inspection Manager, Load Rater, and Bridge Maintenance Engineer
Idaho	0	0	15 years	
Iowa	0	0	22 years	
Kentucky	32%		15 years	
Maine	0	0	5 years	
Maryland	0		17 years	
Michigan	15 to 20%	0	6 to 8 years	Most team leaders are technicians Engineers are team leaders for complex structures and load analysis Local agencies use consulting engineers
Missouri				
Nevada				Had two team leaders, who left; now trying to replace
New Mexico	67%		10 years	
New York	100%			
North Carolina	0	0	20 years	
North Dakota	25%		75 years	
Ohio		10%		
Oregon	71%	0	10 years	
Pennsylvania	4%		10+ years	
Rhode Island	0		20 years	Rhode Island DOT uses consultants to carry out inspections Rhode Island DOT only has a small group of veteran bridge inspectors, who mainly do QA/QC of submitted inspection reports
South Dakota	30%		Unknown	
Texas	75%		10 years	
Utah	0	100%	10 years	
Vermont		1%	3 years	
Virginia	0	20%	16.2 years	
Washington	100%	0	10+ years	
West Virginia	0	100%	20 years	

0 = no PEs among inspection team leaders.

TABLE E27
CONSULTANT TEAM LEADERS—CURRENT WORKFORCE

DOT	PE	NICET III or IV	Bridge Inspection Experience	Note
Alaska	100%		Varies	
Arizona	100%		Unknown	
Arkansas	100%	0	5 years	
California				
Delaware	100%			
Idaho	89%		15 years	
Iowa				
Kentucky				
Maine	100%		10 years	
Maryland				
Michigan	100%		3 to 5 years	
Missouri				
Nevada	20%	60%	10+ years	Values vary among consultants ASNT certification is 60% among team leaders
New Mexico	67%		20+ years	
New York	100%		>15 years	
North Carolina	60%	2%	15 years	
North Dakota				Qualified people hired as needed No consultant on retainer
Ohio				Data not known
Oregon	60%	0	10 years	
Pennsylvania				Certified through Pennsylvania training program Other data not tracked
Rhode Island	100%		10 years	
South Dakota				
Texas	90%	25%	10 years	
Utah				
Vermont				
Virginia	99%	10%	10 years	
Washington				
West Virginia	100%		15 years	

ASNT = American Society for Nondestructive Testing.

TABLE E28
INSPECTION TEAM MEMBERS

DOT	Inspector	Certification	Education	Experience	Bridge Inspection Training	Note
Federal Regulation						
Alabama	DOT-certified bridge inspector (state) Local government bridge inspector (local)					
Alaska			None	None		Design engineer used for inspections; no separate job description
Arizona						Job similar to team leader, but with less responsibility
Arkansas						Same as inspection team leader
California	Area Bridge Maintenance Engineer					Same as inspection team leader
Connecticut	Bridge Safety Inspector			4 years	Comprehensive training course based on the BITM 90	Construction inspection
	Bridge Safety Inspector		Associate Degree	2 years	Comprehensive training course based on the BITM 90	Construction inspection
Delaware	Bridge Inspector	Other	HS	None	Other training method	Engineer who has other full-time function
Florida	Certified Bridge Safety Inspector					
Idaho						
Iowa	Bridge Inspector	None	None	None	NHI 2-week course	
Kentucky	Bridge Inspector					Assists team leader during inspection
Maine	Title not used					
Maryland	Bridge Inspector		High school	None	NHI 2-week course	
Michigan	Title not used					All inspectors are team leaders. Assistant for safety, as needed
Missouri			High school	6 years	NHI 3-week course	Usually inspect bridges for cities and counties
Montana	Assistant Inspector					
Nevada	Bridge Inspector	NICET III	High school	2 years	NHI 3-week course	
New Mexico	Bridge Inspector	Other	High school	None	NHI 2-week course	Team members taken from construction division. Personnel familiar with bridges
New York	Assistant Team Leader					All inspectors are team leaders
North Carolina	Bridge Inspector	None	High school	None	NHI 2-week course	
North Dakota	Bridge Inspector				NHI 2-week course	NBIS definition
Ohio	Bridge Specialist 1		High school		Other course	
Oregon	Certified Bridge Inspector	Other	None	None	Other training method	Same as Inspection Team Leader; more work with non-NBI (minor) structures
Pennsylvania	Certified Bridge Inspection Engineer (24)	PennDOT certification and training program	Engineering	None	NHI 3-week course	Little distinction between leader and member; they share work
Rhode Island	Bridge Safety Inspector		High school	5 years		

(*continued*)

TABLE E28 (*Continued*)
INSPECTION TEAM MEMBERS

DOT	Inspector	Certification	Education	Experience	Bridge Inspection Training	Note
South Dakota						One person teams
Texas	Bridge Inspector	Other	High school	None	NHI 2-week course	
Utah	Bridge Inspector	None	High school	5 years	NHI 2-week course	Similar to team leader
Vermont	Not used	None				
Virginia	Bridge Inspector, Engineer I		None	None	NHI 2-week course	
Washington	Inspector—Assistant Inspector	EIT	Engineering	None	Other course	Operates vehicles and equipment; assists with maintenance
West Virginia	District Team Member	Other	HS	5 years	NHI 2-week course	Works under direction of district team leader

BITM = bridge inspection team manager; EIT = engineer in training.

TABLE E29
UNDERWATER INSPECTION TEAM LEADER, UNDERWATER BRIDGE INSPECTOR

DOT	Leader	Inspector/ Diver	Duties	Certifications	Experience	Training	Education
Federal Regulation		Diver				FHWA-approved course	
Alabama	Underwater bridge inspector Certified bridge inspector Chief underwater bridge inspector			NBIS leader Commercial diver + CPR + first aid		Bridge inspection course	
Alaska	Consultant			Certified diver	5 years	NHI 2-week course	None
Arizona	Title not used						
Arkansas	Consultant						
California	Dive supervisor		Lead and organize field work; USCG notification Prepare report of dive inspection	PE Certified diver	2 years	NHI 2-week course	Engineering
		Diver					
Connecticut		Certified diver		NBIS leader			
Delaware	Consultant						
Florida	Senior underwater inspector			DOT certified diver PE		Underwater bridge inspection course	
				DOT certified diver DOT-certified bridge inspector		Underwater bridge inspection course	
		Lead underwater inspector		DOT-certified diver PE DOT-certified diver DOT-certified bridge inspector			
Idaho	Title not used			Certified diver	None	NHI 2-week course	High school
Iowa	Consultant			NBIS team leader			
Kentucky	Consultant		No special duties				
Maine	Dive manager		Equipment and personnel management; manages safety and training for dive				
		Underwater bridge inspector					
Maryland	Consultant						
		Consultant		Other	5 years	NHI 2-week course	High school
Michigan	Consultant						
		Consultant		Other	2 years	Underwater bridge inspection course	High school

(*continued*)

TABLE E29 (*Continued*)
UNDERWATER INSPECTION TEAM LEADER, UNDERWATER BRIDGE INSPECTOR

DOT	Leader	Inspector/ Diver	Duties	Certifications	Experience	Training	Education
Missouri							
Nevada	Consultant		Leads and organizes field work Prepares report of dive inspection	Commercial diver	5 years	NHI 2-week course	College
		NICET III-certified diver			2 years	NHI 3-week course	High school
New Jersey	Consultant		Team leader supervises divers	ACDE-certified commercial diver (consultant)			
New Mexico				Qualified diver			
New York	Consultant		Some team leaders are divers Leader responsible for safety of dive	PE		Other	Engineering
		NICET III-certified diver	Other	Other course	Other		
North Carolina	Underwater Inspection Supervisor		Fathometer runs Assist with underwater repairs; cofferdam inspections at new bridges			NHI 2-week course	High school
		Bridge underwater inspector					
North Dakota	Consultant					Underwater inspection course	
Ohio	Consultant			Firm must be pre-qualified		FHWA-approved course	
Oregon	Underwater dive team manager		Maintain underwater manual Diver reports findings to top side; works in inspection, maintenance, and construction programs Prepares report of dive inspection Coordinate training of divers				
	Underwater inspection leader						
		Certified diver		None		Other training method	None

(*continued*)

TABLE E29 (*Continued*)
UNDERWATER INSPECTION TEAM LEADER, UNDERWATER BRIDGE INSPECTOR

DOT	Leader	Inspector/ Diver	Duties	Certifications	Experience	Training	Education
Pennsylvania	Consultant			PE NBIS team leader			
		Diver		None		NHI 3-week course	None
Rhode Island	Title not used						
South Dakota	Consultant			NBIS team leader	10 years	NHI 2-week course + underwater bridge inspection course	Other
Tennessee		Diver				Comprehensive inspection training	
Texas	Underwater team leader		Plans and coordinates inspection				
		Underwater bridge inspector		Other	None	NHI 2-week course + diving instruction	High school
Utah	Consultant		No separate job description	Diver certification			
		Diver		Certified diver	5 years	None + diving instruction	High school
Vermont	Title not used						
Virginia	Team leader		Plan and schedule inspection Supervise and operate dive equipment Knowledge of underwater inspection, maintenance, and repair methods	Dive school + CPR + first aid + drivers license	5 years bridge inspection	NHI 2-week	High school
				PE + dive school + Scuba + CPR + first aid + drivers license			High school
				NICET III, IV + dive school + CPR + first aid + drivers license			High school
		Diver		None		NHI 2-week course + diving instruction	None

(*continued*)

TABLE E29 (*Continued*)
UNDERWATER INSPECTION TEAM LEADER, UNDERWATER BRIDGE INSPECTOR

DOT	Leader	Inspector/ Diver	Duties	Certifications	Experience	Training	Education
Washington	Senior lead underwater inspector			Washington State DOT-certified inspector		Bridge inspection course	
	Lead underwater inspector			Washington State DOT-certified inspector		Bridge inspection course	
		Underwater bridge inspector		EIT	None	Other course + diving instruction	Engineering
West Virginia	No separate title		Agency has five qualified staff Divers are volunteers from DOT divisions No specific job description				

USCG = United States Coast Guard; ACDE = Association of Commercial Diving Educators; EIT Engineer in Training.

TABLE E30
FITNESS REQUIREMENTS FOR BRIDGE INSPECTORS

DOT	Good Health	Agility	Strength	Equipment	Note
Alaska					
Arizona	Yes				
Arkansas		Able to climb			
California		Fine control, dexterity, typing	Open heavy doors	Use computer keyboard	Shallow (3 ft) water wading
		Overhead reach	Handle heavy tools	Ride and operate UBIT	Make unsupervised safety decisions
		Climb fences/or guardrails			Handle adverse weather
		Walk/climb up/down a steep incline/slope		Boat operation	Make long auto trips
		Use ladders at height		Respirator fit test	First aid use
Delaware					
Idaho					
Iowa		Work at height	Lift and carry 50 lb		Work near heavy traffic Work over water
Kentucky		Special climb team			
Maine	Yes	Traverse steep slopes Use ladders			
Maryland	Yes				Must be able to perform field work
Michigan	Yes	Work outdoors on uneven terrain Big climbs done by consultants			Valid drivers license
Missouri					
Nevada	Yes	Able to climb Work at height			ADA-type requirements Work in confined space
New Mexico					
New York	Yes				Ability to perform job Able to comply with safety standards
North Carolina		Traverse slopes Work at height	Carry equipment, ladders, jon boats		Work in confined space
North Dakota	Yes				Ability to do job
Ohio	Yes	Able to climb			Ability tested at time of hire

(*continued*)

TABLE E30 (*Continued*)
FITNESS REQUIREMENTS FOR BRIDGE INSPECTORS

DOT	Good Health	Agility	Strength	Equipment	Note
Oregon		Able to climb Work at height			Work in confined space
Pennsylvania		Walk on adverse terrain Use ladders to 30 ft Limited free climbing			
Rhode Island	Yes				General fitness
South Dakota					
Texas		Fracture-critical inspectors must climb, work at height			Fracture-critical inspectors must work in confined spaces
Utah	Yes	Able to climb			Ability to perform inspection
Vermont					
Virginia					
Washington		Able to climb Work at height			Work in confined spaces
West Virginia					

TABLE E31
VISION, COLOR PERCEPTION, AND HEARING OF BRIDGE INSPECTORS

DOT	Good Vision	Color Perception	Good Hearing	Note
Alaska				
Arizona				
Arkansas	Yes			
California	Corrected vision OK		Corrected hearing OK	
Delaware				
Idaho				
Iowa	Yes			Able to detect defects
Kentucky				
Maine				
Maryland				
Michigan	Yes	Yes	Yes	Drivers license
Missouri				
Nevada	Yes	Yes	Yes	Poor perception would trigger review
New Mexico				
New York				
North Carolina				
North Dakota				
Ohio				
Oregon				
Pennsylvania				
Rhode Island				
South Dakota				
Texas				
Utah				
Vermont				
Virginia				
Washington				
West Virginia				
Total	5	2	3	

TABLE E32
FITNESS FOR DIVERS

DOT	Periodic exam
Alaska	Pass diver physical; consultant staff
Arizona	
Arkansas	
California	Hyperbaric physical Annual fitness swim test
Delaware	
Idaho	
Iowa	
Kentucky	
Maine	Annual
Maryland	
Michigan	Yes
Missouri	
Nevada	Commercial dive test
New Mexico	
New York	Compliance with safety standards
North Carolina	Yearly diver medical exam
North Dakota	
Ohio	
Oregon	Certification as a Dive Master requires physical test
Pennsylvania	
Rhode Island	Diving license Inspections conducted by consultants providing qualified personnel
South Dakota	
Texas	Underwater inspectors must pass a physical every two years that covers vision, color blindness, and physical fitness
Utah	
Vermont	
Virginia	
Washington	Dive certification with its implicit physical requirements is the primary additional requirement for our underwater inspectors
West Virginia	

TABLE E33
INSPECTION TEAM SIZE

DOT	Team Size	Make Up	Team Formation/ Stability	Note
Alaska	2		As-needed	Personnel indicate trip preference to Bridge Program Inspection Manager; manager makes teams
Arizona	2	Leader + inspector	Long-term	Teams formed by inspection program manager
Arkansas	2	Leader + helper	Long-term	Leader hires helper
California	2		As-needed	Teams formed by inspection program manager
Delaware	2	Leader + member	Rotation	Teams formed each month by inspection program manager
Idaho	1 or 2	Leader or leader + leader	As-needed	Teams formed by inspection program manager
Iowa	3	Senior leader + leader + inspector	Long-term	Teams with two leaders: one works with inspector and one works independently DOT has six teams, in total; teams formed by inspection program manager
Kentucky	2	Leader + inspector	As-needed	Varies by district and by type of inspection
Maine	1		As-needed	Teams formed by inspection program manager
Maryland	2 or 3	Leader + inspector(s)	Long-term	Teams formed by inspection program manager
Michigan	2	Leader + assistant	As-needed	Teams formed by inspection program manager
Missouri	2	Leader + other	Rotation	State bridges Leaders rotate among districts; teams formed by inspection program manager.
		DOT leader + owner rep.		Local bridges
Nevada	2	Leader + assistant	Rotation	Teams formed each week. Teams formed by inspection program manager Additional staff provided for traffic control
New Mexico	2	Leader + inspector	Long-term	District may be 2 or 3 people only
New York	2	Leader + assistant leader	Long-term	Team sometimes includes 1 trainee or 1 laborer
North Carolina	2	Leader + inspector	Long-term	
North Dakota	2	Leader + inspector		Team sometimes includes 1 leader + 2 inspectors District ofooce forms teams
Ohio	1 or 2		As-needed	
Oregon	2 1 2	Leader + inspector Leader Leader + inspector	Long-term	2-person: bridge with high ADT 1-person: bridge with low ADT Consultant inspection team
Pennsylvania	2	Leader + inspector	Long-term	Each district has two teams
Rhode Island	2	Leader + inspector	As-needed	DOT team Separate staff for traffic control; may include police detail
	3	Leader + 2 inspectors		Consultant team Traffic control and police detail personnel are also typically required

(*continued*)

TABLE E33 (*Continued*)
INSPECTION TEAM SIZE

DOT	Team Size	Make Up	Team Formation/ Stability	Note
South Dakota	1	Leader	As-needed	
Texas	2	Leader + inspector	Long-term	
Utah	2 or 3	Leader + 1 or 2 inspectors	As-needed	
Vermont	2	Leader + assistant bridge inspector	Long-term	Long-term by outcome, not policy
Virginia	2	Leader + inspector	Long-term	
Washington	2	Leader + inspector	As-needed	
West Virginia	3	Leader + 2 members	Rotation	Rotated within districts as necessary for work

ADT = average daily traffic.

TABLE E34
SPECIAL INSPECTION TEAMS AND SPECIAL INSPECTION TYPES

DOT	Fracture-Critical Members	Special Inspections	Increased Intensity	Access	Bridge Type	Movable Bridges	Notes
Alaska	Yes	Yes	No	Yes	No		Personnel in the Bridge Management Section do fracture-critical, special inspections, and inspections requiring access equipment
Arizona		No	Yes		No		In-depth inspections by on-call consultants
Arkansas		No	No		No		
California	Yes		No	Yes	No		Team for fracture-critical inspections that require lifts
Delaware		No	No	Yes	No		UBIT or boat inspection
Idaho		No	No		No		
Iowa		No	No		No		
Kentucky	Yes		Yes	Yes	No		Intra-district climbing team for fracture-critical inspections Fracture-critical team members are selected for experience and training in special access Fracture-critical team includes program manager Access/climbing crew for truss bridges and for all special inspections requiring access
Maine	Yes	Yes	No		Yes		Some inspectors specialize in fracture-critical or scour-critical inspections and will assist as needed
Maryland		Yes	Yes		Yes	Yes	Consultants for drawbridges, underwater and electrified railroads, all special/intensity inspections
Michigan	Yes (1 person)				Yes, complex bridge		DOT fracture-critical engineer All team leaders do scour inspections
Missouri	Yes Yes		No	Yes	No Yes		State bridges Local bridges; fracture-critical inspections by consultants
Nevada	No	No	No		No		
New Mexico	Yes		No		No		Consultant, New Mexico State University, performs fracture-critical inspections

(*continued*)

TABLE E34 (*Continued*)
SPECIAL INSPECTION TEAMS AND SPECIAL INSPECTION TYPES

DOT	Fracture-Critical Members	Special Inspections	Increased Intensity	Access	Bridge Type	Movable Bridges	Notes
New York			No		No		
North Carolina		No	Yes		Yes	Yes	Specialists for movable bridges, ultrasonic testing, sign supports, high mast lights, and deck evaluations Consultants used for 6 or 7 large bridges
North Dakota	Yes		No		Yes		Consultants for fracture-critical inspections on large bridges Fracture-critical inspections at small bridges are routine
Ohio			No		No		
Oregon		No			Yes		Geologist joins tunnel inspection team
Pennsylvania	Yes	Yes		Yes	No		Some districts form fracture-critical teams; some districts form, or hire, special teams for some inspections Inspection consultants perform dive inspections
Rhode Island		No	No		No		
South Dakota		No	No		No		
Texas	Yes		Yes		No		
Utah		No	Yes		No		May hire consultant for some specific inspections
Vermont		No	No		No		
Virginia	No	No	No	No	No	Yes	Movable bridges only
Washington		Yes			Yes		One scour-critical inspector There are a few assignments of an experienced inspector to a specific bridge
West Virginia		No	No		No		

UBIT = under bridge inspection trucks.

TABLE E35
ROTATION OF INSPECTION TEAMS

DOT	Teams Repeat	Teams Rotate	Neutral	Notes
Alaska		Yes		Rotated to new routes
Arizona	Yes			Teams remain in same regions and inspect same bridges
Arkansas		Yes		Districts rotate assignments
California	Yes			Same leader/same bridges including local bridges
Delaware			Random	Random assignments
Florida		Yes		Rotate teams for interest, alertness, objectivity
Idaho	Yes	Team leader request		No rotation unless leader requests it
Iowa			Yes	Teams often repeat at bridges, but there is no DOT policy to repeat or avoid.
Kentucky		Yes, if possible		Staffing shortages in most KTC districts prohibit consistent rotation of bridges to inspectors. Where possible the KTC encourages rotation of inspections.
Maine		Yes		Repeat two cycles only for state bridges; no policy for local bridges
Maryland	Yes			Teams repeatedly inspect the same bridges
Michigan	Yes			Same team/bridges for routine inspection Different team for interim inspections
Missouri		Yes		Central office rotates leaders; districts usually do not. Outcome differs by district
Montana	Yes	Yes		Leader has portfolio of bridges; 10% rotated annually to different leader
Nevada			Yes	Neutral, no policy either way
New Mexico	Yes			Same team/bridges each cycle
New York		Yes		Try to rotate, when possible
North Carolina	Yes			Yes, same teams/bridges each cycle
North Dakota		Yes		Usually rotate teams
Ohio				
Oregon	Yes			Same teams/bridges encouraged for familiarity
Pennsylvania		Yes		Teams are alternated
Rhode Island			Yes	100% of inspections are by consultants; consultant assignments last 2 years
South Dakota	Yes			Same leader/same bridges each cycle
Tennessee				
Texas			Yes	Most inspections by consultant; no control on repeats
Utah	Yes			Yes, by outcome. Assignments are random, but inspection staff is small
Vermont	Yes			Teams work within county and district lines
Virginia	Yes			Yes, since assignments are to region
Washington		Yes		Rotate leaders after two cycles for state bridges. Local agencies differ
West Virginia		Yes		Policy to rotate after each cycle, 2 years

KTC = Kentucky Transportation Cabinet.

TABLE E36
INSPECTION CONSULTANT TEAM ASSIGNMENTS

DOT	Inspections	Assignment Basis	Assignment Term	Assignment Repeat
Alaska		Competitive bid	3 years	May
Arizona		By region and route		Not usually
Arkansas	All dive inspections			No
California	Confined space Non-routine dives; contaminated water	Individual bridge		
Delaware	Inspections that require significant traffic control	Interstate highways	3 years	
Florida	Local bridges by consultants			
Idaho	Off-system routes		2 years	Yes, many cycles
Iowa	Suspension bridges, Other complex bridges	Individual bridges		Yes
Kentucky	Large, complex, river crossing	Individual bridges		Neutral
Maine	Suspension bridges, lift spans	Individual bridges		Yes, preferred
Maryland	Drawbridges, Electrified railroads	Firm assignment based on budget in standing contracts		No
Michigan	As needed to supplement DOT staff			Yes
Missouri	Consultants for local bridges	By region, by bridge type		Yes
Nevada		By inspection type, routine or in-depth	2 years	Neutral
New Mexico	Fracture-critical inspections			Yes
New York	All underwater and equipment inspections; other inspections; as needed 5,384 bridges in 2004	By region, and for individual major bridges	Two cycles	Not more than two cycles
North Carolina	Time-consuming bridges + 750 municipal bridges			No
North Dakota	By type of inspection	Competitive bid		Neutral
Ohio	By type of bridge	Competitive bid	3 years	Neutral
Oregon	Local bridges State bridges	By region By access and expertise		Yes, over many cycles
Pennsylvania	All dive inspections; other inspections as needed	Within district	Multi-year contract	Yes
Rhode Island		Location and along roadways, as along a stretch of Interstate highway	One cycle	No

(*continued*)

TABLE E36 (*Continued*)
INSPECTION CONSULTANT TEAM ASSIGNMENTS

DOT	Inspections	Assignment Basis	Assignment Term	Assignment Repeat
South Dakota	Inspection for bridge rehabilitation	Usually before a rehab project		No
Texas	94% of bridges	By region	One cycle	Neutral
Utah		Hired on statewide basis		No
Vermont	Special testing equipment, ultrasonic tests Non-routing dive inspections	Prior use and experience	Single inspection service	No
Virginia	Larger bridges	Bid process		Neutral
Washington	Selected equipment inspections	Assigned by local bridge owner		Yes
West Virginia	Major river bridges	Individual bridges	6 years	Yes

TABLE E37
USE OF CONSULTANTS FOR INSPECTIONS

DOT	Note	DOT Inspections (%)	Consultant Inspections (%)
Alaska	Routine inspections	100	0
	Fracture-critical inspections	60	40
	Underwater inspections	0	100
Arizona		97	3
Arkansas		95	5
California		100	0
Delaware		90	10
Idaho		43	57
Iowa		99.9	0.1
Kentucky		98	2
Maine		99.9	0.1
Maryland		99.9	0.1
Michigan		46	54
Missouri	Local bridges	99	1
	State bridges	100	0
Nevada		20	80
New Mexico		78	22
New York		45	55
North Carolina		96	4
North Dakota		100	0
Ohio		99.5	0.5
Oregon	Non-NBI structures	100	0
	Overall (11,000 structures)	64	36
	NBI structures	62	38
Pennsylvania		85	15
Rhode Island		0	100
South Dakota		99.9	0.1
Texas		7	93
Utah		100	0
Vermont		100	0
Virginia		85	15
Washington	Consultants do a small set of underwater and movable bridge inspections.	99	1
West Virginia		99	21

TABLE E38
DANISH BRIDGE INSPECTION PERSONNEL

Job Title	Description	Workforce
Bridge Department Manager (DPM)	Head of bridge division, responsible for personnel, technique, and economy (methods and budgets)	1 manager
Bridge Inspectors (BI)	One engineer responsible for each district Executes principal inspection (condition and economy needs), orders special inspection and routine inspections (by consultants) Responsible for tender and execution of repair contracts. Reports to DPM	6 inspectors
Underwater Inspectors	Consultants/contractors hired for selected jobs; few Danish bridges require inspection by divers.	2 or 3 firms
Bridge Load Rater	Consultants hired for bridge capacity rating; reports to BI	1 rater
Bridge Data Specialist,	Bridge management project manager	1 manager
Software Specialist	Collects information/needs on software updates Coordinates with Danbro software consultants Responsible for external and internal user meetings, updating of manuals, and delivery of data to external users of bridge data	3 staff, 2 consultants

TABLE E39
FINNISH BRIDGE INSPECTION PERSONNEL

Job Title	Description	Workforce
Bridge Inspection Program Manager	Head of the bridge inspection staff at Finnra HQ Reports to the Finnra Bridge Section Responsible for creating and updating the bridge inspection manual, bridge inspection reporting forms, and annual reports together with the team Selects and schedules QA events for inspectors and establishes QC procedures on country level Oversees the hiring of consultants for inspection services	1 manager
Inspection Staff Member	District Bridge Engineers, Certified Bridge Inspectors, and bridge experts at the Finnra HQ Responsible for developing bridge inspection activities together with the Bridge Inspection Program Manager	4 or 5 inspectors
District Bridge Engineer	Head of the bridge inspection program within a district of Finnra Reports to the Finnra HQ's Bridge Inspection Program Manager Responsible for scheduling bridge inspections and assigning inspection crews to bridges Selects and schedules QA events for inspectors and establishes QC procedures at district level Makes recommendations on funding, personnel, and equipment needs for the inspection program Responsible for hiring of consultants for bridge inspection services	9 engineers
Certified Bridge Inspector	Performs bridge inspection and data entry	Consultant
Certified Bridge Inspector (basic inspections)	Responsible for scheduling inspections of BMS reference bridges Decides inspection tasks, observations, methods, and analyses of inspection results, etc Leader of a special inspection team of one specified consultant company Reports to District Bridge Engineer and Finnra Bridge Section Reports for BMS model work and other purposes Responsible for updating inspection data and photos in the Bridge Register	1 inspector
Underwater Inspector	Performs dive inspections	Consultant
Road Foreman	Responsible for maintenance contracts including washing of bridges, small repairs, and annual inspections	Consultant
Bridge Load Rater	Person at HQ using analysis methods to determine the safe load capacity of bridges Responds to requests for new load ratings as needed for unusual (permit) loads, newly discovered deterioration, or for changes to standard design loads Hires consultants if needed Reports to the Finnra Bridge Section	1 rater
Bridge Data Specialist	Person responsible for BMS Upkeep of the Bridge Registry Reports to the HQ's Bridge Inspection Program Manager, makes recommendations for software changes and updates, leads the development projects, and coordinates with software consultants or vendors for upkeep of data systems	1 specialist
Main User of Bridge Register	Responsible of Bridge Register and BMS use Main user and contact person in the district Minimum requirement Bridge Register training course for two days	9 users

BMS = bridge management system.

TABLE E40
STAFF TITLES FOR INSPECTION CONSULTANTS: FINLAND

Title	Responsibilities
Bridge Inspection Quality Manager	Head of bridge inspection activities (must be named by firm) Responsible for the quality of inspection data Reports to the District Bridge Engineer Guides inspector QA Recommends QC procedures to the District Bridge Engineer Reports QA/QC outcomes to District Bridge Engineer
Certified Bridge Inspector	Performs inspection Reports to Bridge Inspection Quality Manager during field work Reports to District Bridge Engineer for urgent needs at bridges Updates inspection data and photos in the Bridge Register
Underwater Inspector	Personnel trained in both diving and bridge inspection Perform underwater inspections Reports to Bridge Inspection Quality Manager during field work Reports to District Bridge Engineer for urgent needs at bridges
Main User of Bridge Register	Responsible for Bridge Register use Main user and contact person Minimum requirement Bridge Register training course for two days

TABLE E41
FRENCH BRIDGE INSPECTION PERSONNEL

Title	Function	Scope
General Inspectors for Bridges (IGOA)	There are five IGOA, each one responsible for one-fifth of the country. They are linked to the Service in charge of the General Inspection of the Services of the Ministry of Equipment. Responsible for creating and updating the bridge inspection instructions	National
LCPC Technical Director for bridges (central laboratory)	Directs the LRPC (regional laboratories) network Selects and schedules training programs for new inspectors of LRPC Selects and schedules QA events for inspectors of LRPC Establishes QC procedures for LRPC	National
State Bridge Inspection Program Manager	Head of the bridge inspection program Head of the bridge management program Reports to the Road and Bridge Engineer of the transportation agency (Road Directorate of the Ministry of Equipment) Distributes money to CDOA to organize inspections	National
District Managers CDOA Chief (Cellule Départemental des Ouvrages d'Art)	Head of the bridge inspection program within a district (DDE) of the transportation agency (Ministry of Equipment, Road Directorate) Reports to the State Bridge Inspection Program Manager Responsible for scheduling bridge inspections, and selecting inspection by LRPC, private companies, or own crews. Participates in hiring of consultants for bridge inspection services. Responsible for receiving bridge inspection reporting forms and annual reports.	Departmental
Inspection Team Leaders	Leader of a team (or crew) for bridge inspection Reports to the District Manager (CDOA in the DDE) Guides all field inspection activities and works as a part of the inspection team Completes all necessary preparations for field work including travel, equipment, and reporting forms Buys or hires inspection equipment They are located mainly in the LRPC; however, some team leaders are also located in the CDOA of the DDE	Regional (LRPC) and departmental (DDE)
Bridge Inspectors	Personnel performing detailed inspection tasks, taking observations, assigning condition ratings, etc. Report to team leaders (Chargé d'études) during field work They are located mainly in the LRPC; however, some inspectors are also located in the DDE	Regional (LRPC) and departmental (DDE)
Inspection Agent	Helps the inspector in field; does the drawings and photographs	Regional (LRPC) and departmental (DDE)
Underwater Inspectors	Personnel trained in both diving and bridge inspection. These personnel perform underwater inspection tasks, take observations, assign condition ratings, etc. This team is located in the Laboratoire Régional de Melun (a Laboratoire Régional de l'Est Parisien LREP) near Paris. The chief of the team reports to the CDOA. Reports to the team leader (at LREP) during field work	National
Rapid Bridge Evaluator	Person using the IQOA method to classify the conditions of bridges This person is in the Subdivision or in the CDOA Report IQOA ratings to the Road Directorate	Departmental and local
Bridge Data Specialist or Software Specialist	Person responsible for use and upkeep of the data system or management system that stores bridge inspection data Reports to the State Bridge Inspection Program Manager Makes recommendations for software changes and updates This job is done by SETRA with its own software, LAGORA	

CDOA = Cellule Départementale des Ouvrages d'Art; DDE = Direction Départementale de l'Equipement; SETRA = Services d'Etudes Techniques des Routes et Autoroutes

TABLE E42
BRIDGE INSPECTION STAFF: GERMANY

Title	Function	Employed by
Inspection Program Manager	Head of state-level inspection program; inspects all bridges on federal and state roads	Federal state
Inspection Team Leader	Team leader for bridge inspections	Federal state
Bridge Inspector	Nonengineer assisting team leader	Federal state
Underwater Inspector or Team	In some cases, civil engineer and diver is one person. More often a team is made up of a "standard" diver in the water and a civil engineer outside the water with video equipment.	Federal state/private company
Inspection Specialists		Federal state/private company

TABLE E43
INSPECTION JOB TITLES: SOUTH AFRICA

Job Title	Function	Employed by:
Bridge Network Manager	Coordinates all BMS activities, including appointments of consultants	SANRAL
Consultant Inspection Team Leader	Coordinates activities and all administrative duties of consulting engineer firm	Consultant
Certified Bridge Inspector	This is a professional graduate bridge engineer who has attended a bridge and culvert inspection course run by SANRAL. Certificates are issued based on experience in bridges and course attendance.	Consultant
Certified Culvert Inspector	A technician or graduate engineer who has attended a bridge and culvert inspection course run by SANRAL. Certificates are issued based on experience and course attendance.	Consultant
Underwater Inspector	Very limited in South Africa and done on ad hoc basis	Consultant
Senior Bridge Inspector	Verification inspections are done by these individuals. Senior bridge inspectors also inspect the large strategic structures.	Consultant
Inspection Specialists	Only on an ad hoc basis	Consultant

BMS = bridge management system.

TABLE E44
JOB TITLES/GRADES—SWEDISH BRIDGE INSPECTION PROGRAM

Job Title	Function	Employed by:
Inspection Program Manager	Works at the support and development unit. Responsible for creating and updating the bridge inspection manual, bridge inspection reporting forms, and annual reports. Selects and schedules training programs for new inspectors. Selects and schedules QA events for inspectors. Establishes QC procedures.	SRA
Inspection Team Leader	Makes recommendations on funding, personnel, and equipment needs for the inspection program. Responsible for scheduling bridge inspections. Performs bridge inspections or hires consultants. Responsible for QA of data reported by the bridge inspectors.	SRA
Bridge Inspector	Performs general (major) inspections. Completes all necessary preparations for field work. Performs inspection tasks, assigning physical, functional, and economical condition ratings, etc. Reports directly into the bridge management system. QC is performed by the inspection team leaders.	SRA/contractor
Underwater Inspector	Specially trained personnel. Performs underwater inspection tasks.	Contractor
Inspection Specialists	Specially trained personnel. Performs special inspection tasks, investigates in greater detail detected or presumed defects.	Contractor
Mechanical, Electrical Equipment Inspector	Specially trained personnel. Performs inspection tasks on mechanical and electrical equipment.	Contractor
Regular Inspector	Performs inspections to detect acute damage and inspections to verify the requirements in the maintenance contracts.	Maintenance contractor

TABLE E45
INSPECTION STAFF: UNITED KINGDOM

Job Title	Function	Employed by:
Area Structures Manager (ASM)	Manages the inspection program and reviews inspection reports, and approves maintenance priorities within budgets.	Highways Agency
Inspection Team Leader	Takes responsibility for programming inspections within a maintenance area and reviewing and certifying the inspection reports before issuing to Highways Agency	Contractor
Bridge Inspector	Hands-on inspection	Contractor
Underwater Inspector	To carry out periodic inspection of river bridge foundations, condition after high river flows if scour is suspected, or underwater impact damage	Contractor
Inspection Specialists	To undertake specialist inspection that would be beyond what would be expected of a normal bridge inspector; e.g., abseilers, thermography, and other nondestructive testing These personnel work on special inspections, outside the normal scope of inspection contracts, and only after instruction by the ASM.	Contractor

APPENDIX F

Details for Inspection Types and Intervals

TABLE F1
INSPECTION INTERVALS—ROUTINE INSPECTION

	Bridges and Culverts				
	Routine Inspection Interval, Months				
DOT	<12	12	24	36	48
Alabama	242	2,532	12,913	0	16
Alaska	0	1	1,177	0	0
Arizona	0	37	3,963	0	3,206
Arkansas	6	1,942	9,928	0	606
California	47	52	23,907	0	17
Colorado	10	71	7,012	0	1,185
Connecticut	16	19	3,897	0	236
Delaware	2	15	834	1	0
Dist. of Columbia	0	0	244	0	0
Florida	60	383	11,091	0	0
Georgia	7	20	14,492	0	1
Hawaii	1	15	1,090	0	0
Idaho	0	614	3,448	0	10
Illinois	2	529	14,392	0	10,883
Indiana	2	3	18,269	0	0
Iowa	16	1,251	23,586	0	0
Kansas	25	2,105	23,183	0	3
Kentucky	49	1,374	9,808	0	2,291
Louisiana	62	1,129	12,160	0	0
Maine	0	43	2,322	0	5
Maryland	10	376	4,685	0	12
Massachusetts	139	377	4,402	0	0
Michigan	145	240	10,233	0	1
Minnesota	4	3,721	9,294	15	0
Mississippi	56	1,822	14,933	0	93
Missouri	0	1,409	22,468	0	2
Montana	2	7	4,074	0	846
Nebraska	0	173	15,281	0	0
Nevada	5	30	1,598	0	1
New Hampshire	148	222	2,001	0	0
New Jersey	1	3	6,437	0	3
New Mexico	4	217	2,276	0	1,322
New York	3	1,361	15,978	0	0
North Carolina	2	3	17,497	0	0
North Dakota	2	44	3,980	0	452
Ohio	41	28,019	5	0	0
Oklahoma	33	1,085	21,934	0	335
Oregon	14	300	6,924	0	13
Pennsylvania	190	1,652	20,361	0	4
Puerto Rico	8	42	1,978	0	0
Rhode Island	2	118	629	0	0
South Carolina	2	2,793	6,408	0	0
South Dakota	2	44	5,473	0	441
Tennessee	0	5	19,724	0	31
Texas	98	225	44,297	0	4,598
Utah	1	5	2,822	0	0
Vermont	0	52	2,651	0	0
Virginia	37	2,169	11,032	0	8
Washington	14	506	6,706	2	414
West Virginia	70	951	4,205	0	1,688
Wisconsin	48	54	13,589	0	0
Wyoming	1	203	2,822	1	2
Total	1,629	60,363	504,413	19	28,275

Source: 2005 NBI data (2).
Note: Not all inspection intervals are shown.

TABLE F2
INSPECTION INTERVALS—UNDERWATER INSPECTION

	Bridges and Culverts								
	Total Underwater	Inspection Interval, Months							
DOT	Inspections	<12	12	24	36	48	60	72	>72
Alabama	945	0	19	613	0	297	16	0	0
Alaska	175	0	0	9	0	0	166	0	0
Arizona	12	1	4	1	0	0	3	3	0
Arkansas	7,536	3	260	1,064	28	5,227	954	0	0
California	638	0	1	6	1	26	603	0	0
Colorado	75	5	1	6	1	0	62	0	0
Connecticut	309	4	5	294	0	6	0	0	0
Delaware	77	0	1	1	0	4	71	0	0
Dist. of Columbia	13	1	0	6	0	0	6	0	0
Florida	3,950	37	165	3,735	0	1	1	0	0
Georgia	2,170	0	0	2	0	38	2,130	0	0
Hawaii	102	3	0	2	0	0	97	0	0
Idaho	306	0	5	1	0	1	299	0	0
Illinois	1,293	0	340	401	5	46	501	0	0
Indiana	710	1	9	36	14	180	470	0	0
Iowa	144	19	3	18	0	5	97	0	0
Kansas	201	1	2	14	1	41	142	0	0
Kentucky	2,147	2,015	1	2	0	21	107	0	0
Louisiana	1,198	27	54	260	0	0	856	0	0
Maine	371	0	4	28	0	1	338	0	0
Maryland	421	0	1	2	0	357	61	0	0
Massachusetts	756	0	46	40	556	56	44	0	0
Michigan	353	43	2	79	1	17	208	0	0
Minnesota	338	0	0	0	0	1	337	0	0
Mississippi	304	0	0	2	0	0	302	0	0
Missouri	174	0	0	9	2	4	159	0	0
Montana	499	4	0	1	0	364	130	0	0
Nebraska	95	0	0	0	0	0	95	0	0
Nevada	122	0	0	54	0	67	1	0	0
New Hampshire	137	2	1	5	0	2	120	0	0
New Jersey	708	0	1	150	0	516	41	0	0
New Mexico	7	0	0	0	0	0	7	0	0
New York	804	0	0	1	0	0	803	0	0
North Carolina	2,142	0	4	351	0	1,784	3	0	0
North Dakota	38	0	0	0	0	0	37	1	0
Ohio	290	8	5	8	9	1	257	0	2
Oklahoma	71	0	0	1	0	0	70	0	0
Oregon	676	16	72	128	0	392	68	0	0
Pennsylvania	3,881	9	81	3,697	5	79	8	0	0
Puerto Rico	30	1	4	14	5	6	0	0	0
Rhode Island	89	0	0	0	0	2	87	0	0
South Carolina	241	0	0	1	0	218	22	0	0
South Dakota	112	0	0	0	0	0	112	0	0
Tennessee	543	0	0	1	0	17	525	0	0
Texas	796	4	11	24	2	2	753	0	0
Utah	78	0	0	3	0	0	75	0	0
Vermont	53	0	1	4	2	44	2	0	0
Virginia	697	0	2	5	0	4	686	0	0
Washington	315	5	3	12	4	6	280	0	0
West Virginia	256	0	6	1	0	1	248	0	0
Wisconsin	276	0	0	0	0	1	275	0	0
Wyoming	61	0	0	0	0	0	61	0	0
Total	37,735	2,209	1,114	11,092	636	9,835	12,796	4	0

Source: 2005 NBI data (*2*).
Note: Not all inspection intervals are shown.

TABLE F3
INSPECTION INTERVALS—FRACTURE-CRITICAL INSPECTION

	Bridges and Culverts						
	Total Fracture	Inspection Interval, Months					
DOT	Critical	<12	12	24	36	48	>48
Alabama	260	21	94	145	0	0	0
Alaska	103	9	2	53	0	39	0
Arizona	65	10	12	28	0	2	13
Arkansas	347	4	320	23	0	0	0
California	1,007	6	15	978	0	0	8
Colorado	207	32	8	166	0	0	1
Connecticut	169	0	5	164	0	0	0
Delaware	29	1	4	24	0	0	0
Dist. of Columbia	13	1	0	11	0	0	0
Florida	339	2	119	217	0	1	0
Georgia	82	0	81	1	0	0	0
Hawaii	10	2	0	8	0	0	0
Idaho	173	3	91	77	0	1	1
Illinois	550	0	17	453	0	9	71
Indiana	523	12	45	464	0	0	2
Iowa	1,660	16	502	1,140	0	0	2
Kansas	1,109	6	586	383	2	48	78
Kentucky	349	60	3	280	0	0	6
Louisiana	142	3	53	86	0	0	0
Maine	45	0	3	42	0	0	0
Maryland	285	3	52	196	0	0	34
Massachusetts	329	6	2	320	0	0	0
Michigan	105	22	11	31	12	0	0
Minnesota	248	0	0	1	0	84	163
Mississippi	244	0	111	133	0	0	0
Missouri	1,589	0	12	1,576	0	0	0
Montana	310	0	1	309	0	0	0
Nebraska	1,289	1	130	1,158	0	0	0
Nevada	34	7	7	20	0	0	0
New Hampshire	144	25	43	74	0	0	2
New Jersey	652	2	5	639	0	4	1
New Mexico	53	3	47	3	0	0	0
New York	1,777	0	436	1,341	0	0	0
North Carolina	140	0	1	139	0	0	0
North Dakota	239	0	0	5	0	9	225
Ohio	1,099	23	1,026	32	2	0	16
Oklahoma	754	21	348	385	0	0	0
Oregon	347	4	9	322	0	0	12
Pennsylvania	1,896	44	455	1,375	0	12	7
Puerto Rico	22	1	12	6	0	0	0
Rhode Island	35	1	34	0	0	0	0
South Carolina	65	0	37	28	0	0	0
South Dakota	228	0	29	199	0	0	0
Tennessee	271	0	5	263	0	0	0
Texas	624	2	21	232	0	0	369
Utah	62	0	0	62	0	0	0
Vermont	161	0	8	153	0	0	0
Virginia	344	11	287	37	0	6	2
Washington	364	11	4	342	0	0	7
West Virginia	563	6	186	368	0	0	3
Wisconsin	116	1	1	114	0	0	0
Wyoming	97	2	12	10	0	73	0
Total	21,668	384	5,292	14,616	16	288	1,023

Source: 2005 NBI data (*2*).
Note: Not all inspection intervals are shown.

TABLE F4
PERIODIC TASKS IN ROUTINE INSPECTION

DOT	Inspection	Scope	Interval	Notes
Eastern Federal Lands	Cross-channel profile	Component	24 months	Along substructures
	Vertical clearance	Component	24 months	Clearance <16 ft
	Vertical clearance	Component	72 months	Clearance >16 ft
	Vertical clearance	Component	72 months	Clearance <16 ft, agricultural crossing
Missouri	Wading	Component	24–60 months	During routine inspection
New Jersey	Underwater Type 1		24 months	Channel cross section and scour evaluation; no diver
New York	Fathometer readings along fascias + profiles along substructures	Component	24 months	Scour documentation for bridges over water
Oregon	Cross-channel profile	Component	As work load permits	Bridge is not scour critical
	Cross-channel profile	Component	At next regular inspection	Scour critical
	Cross-channel profile	Component	24 months	Channel condition (61) 5 or less
	Cross-channel profile	Component	24 months	Scour SmartFlag in state 2 or 3
	Cross-channel profile	Component	48 months	Scour code (113) is 3 or U
	Cross-channel profile	Component	48 months	Channel condition (61) > 6
	Cross-channel profile	Component	48 months	Scour SmartFlag in state 1
	Cross-channel profile	Component	120 months	Scour code (113) is 4 or greater
	Cross-channel profile	Component	120 months	Channel condition (61) > 7
	Cross-channel profile	Component	120 months	Scour SmartFlag not on
	Timber member boring report	Component	Immediate	Hollow sound, borer or beetle activity, bulging, splits, cracks noted during routine inspection
	Timber member boring report	Component	96 months	Structure located west of the Coast Range and in service longer than 20 years
	Timber member boring report	Component	120 months	Structure located in western Oregon and in service longer than 25 years
	Timber member boring report	Component	144 months	Structure located east of the Cascades and in service longer than 30 years
Pennsylvania	Routine, close-up, hands-on	Component	72 months	Areas without hands-on in other routine inspections, as noted in inspection report
Tennessee	Cursory—substructure	Component	24 months	Substructure in shallow water

TABLE F5
ACCESS FOR ROUTINE INSPECTION

DOT	Inspection	Scope	Interval	Notes
Connecticut	Box beams—Bridges with three or more box beams	Component		Interior inspection full length for every cycle
Eastern Federal Lands	Interior of box girders	Component		Enter every inspection
	UBIV	Component	120 months	High bridge (>40 ft)
	UBIV—Bearings	Component	120 months	Bearings not fully visible
Idaho	Confined space inspection	Component		
	Reach-all inspection	Component	48 months	
Iowa	Limited—Not close up	Entire	24 months	Bridges in good condition and not fracture critical Can replace 1 or 2 cycles of routine inspection; by NBIS team leader
	Regular—Close-up as needed	Entire	48 months	For bridges getting limited inspections, but subject to scour
	Regular—Close-up as needed	Entire	72 months	For bridges getting limited inspections
Maryland	Confined spaces inspection	Component		
New Jersey	UBIV	Component		Snooper inspections
New York	Access equipment	Component		Bridge files show need for special equipment during inspection
Ohio	Access equipment	Component		Require riggers, divers, or other personnel with special skills
Oklahoma	Long and tall bridges	Component		Snooper inspection of “Long and Tall” bridges that are not fracture critical
Oregon	Interior of box girders	Component	Every cycle	Elements visible only from inside
	Interior of box girders	Component	Every cycle	If signs of active corrosion
	Interior of box girders	Component	Every cycle	If fatigue cracking is noted
	Interior of box girders	Component	48 months	Areas where water is known to puddle
	Interior of box girders	Component	72 months	Curve girders subject to out-of-plane distortion
	Interior of box girders	Component	120 months	All box girder sections
	Major bridge inspection	Entire		Requires climbing or special skills
	UBIV			Tall bridge requiring UBIV
Pennsylvania	Access equipment only—A	Component		Areas needing special access by cranes, lifts, rigging, etc.

UBIV = under bridge inspection vehicle; NBIS = National Bridge Inspection Standards.

TABLE F6
ROUTINE INSPECTION OF STRUCTURE TYPES AND DETAILS

DOT	Inspection	Scope	Interval	Note
Alabama	Special A—Segmental concrete Special B—Cable stayed Special C—Suspension and movable bridges Special J—Long-span metal culverts and structural plate culverts			
Alaska	Cathodic protection system inspections	Component		
California	Special feature—Close up	Component		Fatigue-prone details that are not fracture critical
Florida	Cantilever superstructure	Component		Inspect pin and hanger
Illinois	Fatigue prone Pin and hanger	Component Component		Fatigue-prone details Pins and hangers in the main load-carrying elements
Iowa	Intermediate fatigue, close-up Pin, hanger Fatigue, close-up	Component Component Component	12, 24, or 36 months 60 months 72 months	Mid-interval inspection for fatigue-vulnerable bridge Using NDT Fatigue-vulnerable bridges; not fracture critical; no cracks
Michigan	Segmental, post-tensioned Hydraulic engineering			Segmental post-tensioned bridges Inspections related to hydraulic engineering
Montana	Pin and hanger	Component	48 months	Pin and hangar for redundant structure
New Jersey	Pin and hanger	Component		Pin and hanger assemblies
North Dakota	Segmental box bridges			Segmental box bridges
Ohio	Accessories			Lighting, fencing, glare screen, splash guard, catwalks, other
Oklahoma	Electronic distance meter	Component		Monitor pier movement
Oregon	Major bridge inspection Major bridge inspection Suspension span Cable-stayed span			Unusual or complex features Inordinate amount of time required Suspension bridge Cable-stayed bridge
Pennsylvania	Critical elements Prestressed concrete segmental	Component		Critical elements of complex structures may be inspected separately using special equipment or personnel Prestressed concrete segmental bridges
Rhode Island	Concrete segmental bridge Tied-arch bridge			Concrete segmental bridge Tied-arch bridge
Tennessee	Suspension bridge Cable-stayed bridge			Suspension bridge Cable-stayed bridge
Texas	External post-tensioned tendons			External post-tensioned tendons

(*continued*)

TABLE F6 (*Continued*)
ROUTINE INSPECTION OF STRUCTURE TYPES AND DETAILS

DOT	Inspection	Scope	Interval	Note
Virginia	Routine		12 months	Concrete structure with unknown reinforcing details
	Pin and hanger	Component		Pin and hangers
	Pin and hanger—UT	Component	During scheduled inspection	Redundant structures with new or newly replaced pins
	Fatigue prone	Component		Fatigue-prone details
Washington	Special feature—High-strength steel			High-strength steel
	Special feature—Pins/hangers, redundant structures			Pins/hangers; redundant structure
	Special feature—Floating bridge		12 months	Floating bridge; inspect for water tightness of pontoons
	Special feature—Segmental bridge		12 months	Segmental bridge
	Special feature—Suspension bridge		12 months	Suspension bridge
	Special feature—Cable-stayed bridge		12 months	Cable-stayed bridge
	Floating bridge—Equipment	Component	24 months	Electrical and mechanical systems

UT = ultrasonic testing.

TABLE F7
ROUTINE, HANDS-ON INSPECTION

DOT	Name	Location on Component	Notes
Alabama	Routine		Most routine inspections are hands-on
	Special D—Pin and hanger details		Close-up inspection of pin and hanger
Alaska	Routine		Extent of hands-on varies as needed
Arizona	Hands-on	Locations identified in report	Extent of hands-on varies as needed
Arkansas	Hands-on	Locations identified in report and in database	Extent of hands-on varies as needed
California	Hands-on	Electronic notes; not searchable	Extent of hands-on varies as needed
Connecticut	Hands-on	Locations identified in report; excluded areas also noted	Extent of hands-on varies as needed
	100% hands-on		Box beams—Curved
	100% hands-on		Box beams—Bridges with one or two box beams
	100% hands-on		Tension members of trusses
	100% hands-on		Welded connections for lateral bracing
	100% hands-on		All nonredundant members
	100% hands-on		Rusted areas of members
	100% hands-on		All bearings
	100% hands-on		Metal deck connections
	100% hands-on		Welds in tension
	100% hands-on		Repaired welds
	100% hands-on		Fatigue-prone welds
Delaware	Hands-on	Locations identified in report	Extent of hands-on varies as needed
Eastern Federal Lands	Hands-on		Some post-tensioned structures; every cycle
	Hands-on		Bearings, if accessible
	Post-tensioned box girders		Every square foot must be viewed; use UBIV as required.
	Hands-on		At least some sounding of concrete
	Hands-on		At least some probing of timber
	Hands-on		Clean and inspect representative area of bearings
Florida		Locations identified in report	Extent of hands-on varies as needed
Idaho	Hands-on	Locations identified in report and in database	Extent of hands-on varies as needed
Iowa	Hands-on	Locations identified in report and in database	Extent of hands-on varies as needed
Kentucky	Hands-on	Locations identified in report and in database	Extent of hands-on varies as needed
Maine	Hands-on	Locations identified in electronic report, not database	Extent of hands-on varies as needed
Maryland	Hands-on	Locations identified in report and in database	Extent of hands-on varies as needed
Michigan	Hands-on	Locations identified in web-based report	Extent of hands-on varies as needed
Missouri	Hands-on	Locations identified in report and in database	Extent of hands-on varies as needed

(*continued*)

TABLE F7 (*Continued*)
ROUTINE, HANDS-ON INSPECTION

DOT	Name	Location on Component	Notes
Nevada	Hands-on	Locations identified in report and in database	Extent of hands-on varies as needed
New Jersey	Hands-on		Tension areas of steel boxes Steel pier caps Steel two-girder bridges
New York	Special emphasis hands-on, 0.5 m	Locations identified in report	Nonredundant metal superstructure
	Special emphasis hands-on, 0.5 m	Locations identified in report	Fracture-critical metal superstructure
	Special emphasis hands-on, 0.5 m	Locations identified in report	Stringers within 1 m of connection to floorbeam
	Special emphasis hands-on, 0.5 m	Locations identified in report	Pin/hanger + main member within 1 m
	Special emphasis hands-on, 0.5 m	Locations identified in report	Fatigue-vulnerable elements
	Special emphasis hands-on, 0.5 m	Locations identified in report	Welded backup bars
	Special emphasis hands-on, 0.5 m	Locations identified in report	Welded tension areas and stress reversal areas
	Special emphasis hands-on, 0.5 m	Locations identified in report	Welded repairs to main members
	Special emphasis hands-on, 0.5 m	Locations identified in report	Bearing stools fabricated from welded shapes
	Special emphasis hands-on, 0.5 m	Locations identified in report	Splices in multispan through girders
	Special emphasis hands-on, 0.5 m	Locations identified in report	Details subject to out-of-plane distortion
	Special emphasis hands-on, 0.5 m	Locations identified in report	Concrete deck haunches
	Special emphasis hands-on, 0.5 m	Locations identified in report	Steel staggered diaphragms
North Carolina	Hands-on	Locations identified in report	Extent of hands-on varies as needed
North Dakota	Hands-on	Locations identified in electronic report	Extent of hands-on varies as needed
Ohio	Hands-on	Locations identified in report and in database	Extent of hands-on varies as needed
Oregon	Hands-on	Locations identified in report and electronic notes	Extent of hands-on varies as needed
Pennsylvania	Hands-on	Locations identified in report and in database	Vulnerable areas, poor condition areas
	Hands-on	Locations identified in report and in database	Any component without hands-on inspection in 72 months
	Hands-on	Locations identified in report and in database	Load-carrying members in poor condition
	Hands-on	Locations identified in report and in database	Fracture-critical member with less than 10 years remaining life
	Hands-on	Locations identified in report and in database	Fracture-critical member where displacement-induced fatigue is critical
	Hands-on	Locations identified in report and in database	Redundancy retrofit systems (e.g., catcher beams) for fracture-critical details (pin and hangers, etc.)
	Hands-on	Locations identified in report and in database	Critical sections of controlling members on posted bridges
	Hands-on	Locations identified in report and in database	Scour-critical substructure units
	Hands-on	Locations identified in report and in database	End regions of steel girders or beams under deck joint
	Hands-on	Locations identified in report and in database	Cantilever portions of concrete piers or bents in fair or lesser condition

(*continued*)

TABLE F7 (*Continued*)
ROUTINE, HANDS-ON INSPECTION

DOT	Name	Location on Component	Notes
	Hands-on	Locations identified in report and in database	Ends of prestressed concrete beams at continuity diaphragms
	Hands-on	Locations identified in report and in database	Precast concrete bridge parapets
Rhode Island	Hands-on		All routine inspections are hands-on
Tennessee	Hands-on		Routine inspections are hands-on
Texas	Hands-on	Locations identified in report	Extent of hands-on varies as needed
Vermont	Hands-on	Locations identified in report	Extent of hands-on varies as needed
Virginia	Hands-on	Locations identified in report	Extent of hands-on varies as needed
	Fatigue prone		AASHTO fatigue categories D or worse and ADTT 500 or more AASHTO fatigue categories D or worse and Interstate route
Washington	Hands-on	Locations identified in report and in electronic notes	Most routine inspection is hands-on; extent of hands-on varies as needed
West Virginia	Hands-on	Locations identified in report and in electronic notes	Extent of hands-on varies as needed

UBIV = under bridge inspection vehicle; ADTT = average daily truck traffic.

TABLE F8
IN-DEPTH INSPECTIONS

DOT	Name	Scope	Interval	Notes
Connecticut	Class I in-depth	Entire	120 months max.	Team is Lead Inspector and Bridge Inspector; hands-on entire deck soffit In place of hands-on inspection that cycle Senior engineer must be present. Includes stream cross sections; new clearance diagram
	Class II in-depth	Entire	120 months max.	Team is Lead Inspector and Bridge Inspector with 25% time of Engineer III for critical parts. Hands-on entire deck soffit In place of hands-on inspection that cycle Senior engineer must be present. Includes stream cross sections; new clearance diagram
	Class II in-depth	Entire	120 months max.	Team is Lead Inspector and Bridge Inspector with Engineer III leading the inspection. Hands-on entire deck soffit In place of hands-on inspection that cycle Senior engineer must be present. Includes stream cross sections; new clearance diagram
	In-depth (all bridge classes)	Entire		Deck survey. Half-cell potentials for exposed concrete surface. Hammer tapping of all cracked areas. Chain drag all surfaces Hands-on access to entire superstructures; maps of damage/loss. Ultrasonic testing of all nonredundant pins and hangers. 3 ft distance is OK. Ultrasonic testing on welds in fracture-critical members. 10 ft x 10 ft sounding grid for channel Measure all expansion bearings. Tap all anchor bolts. Probing of 50% of timber members. Arch profile against springline Plumb bob check for all substructure units
	In-depth (all culvert classes)	Entire		Culverts measure water velocity upstream, downstream, and hydraulic opening
Florida	In-depth pin/hanger	Component	24 months	Ultrasonic inspection of pins and hangers for suspended spans
	Storm event—Level 3			In-depth inspection based on findings of Level 1 or 2 inspection
Michigan	25-year-old bridge	Entire		Do “Detail” inspection
	Fatigue-prone details	Component	36 months	Redundant bridges having fatigue-prone details
New Jersey	Fracture critical	Entire	48 months	Alternate inspection cycles

(*continued*)

TABLE F8 (*Continued*)
IN-DEPTH INSPECTIONS

DOT	Name	Scope	Interval	Notes
Oregon	In-depth—Cable-suspended span	Component	120 months	Cable-suspended spans Inspection of cables. Measure/record broken wires and amount/extent of corrosion
	In-depth—Concrete in corrosive environment	Entire	120 months	Large concrete structures located in a highly corrosive environment. Collect electrical potentials, chloride contents, amount of section loss in steel reinforcement
	In-depth—Concrete segmental bridge	Component	120 months	Concrete segmental bridge Inspection for corrosion of post-tensioning system and for longitudinal cracking
	In-depth—Electroslag welds	Component	120 months	Bridge has electroslag welds Nondestructive testing for fatigue cracks in the welds
	In-depth—Other special details	Component	120 months	Other details that warrant special inspection
	In-depth—Pin and hanger	Component	120 months	Redundant pin and hanger assemblies
	In-depth—stringer/floorbeam connections	Component	120 months	Stringer/floorbeam connections
	Movable bridge	Component	72 months	In-depth inspection of operational mechanism
Pennsylvania	In-depth—Fracture critical	Entire	120 months	Fracture-critical member in fair or lesser condition Span ≥150 ft
	In-depth—Fracture critical		180 months	Fracture-critical member in good condition
	In-depth—Redundant, not fracture critical		180 months	Span >500 ft
	In-depth—Redundant, not fracture critical		120 months	Redundant, non-fracture-critical bridges Span >500 ft and superstructure in poor or lesser condition
Washington	Ferry—Vehicle transfer spans	Component	24 months	
	Ferry terminal—Other structures/areas	Component	24 months	
	Movable bridge equipment	Component	72 months	In-depth for electrical and mechanical equipment
	Underwater—In-depth	Component (specific)	As needed	Detailed inspection of specific portions; may include nondestructive testing
Wisconsin	In-depth	Entire	72 months	

TABLE F9
UNDERWATER INSPECTIONS

DOT	Name	Interval	Notes
Alabama	Underwater inspection	24 months	State-owned bridges
		48 months	Locally owned bridges
Connecticut	Interim underwater	<24 months	Submerged components/areas of known or suspected problems
	Dive inspections	24 months	Water >30 in. deep and having poor visibility, swift current, soft bottom, low headroom, debris, or other conditions that make wading/raft impractical
		48 months max.	Water >30 in. deep and having poor visibility, swift current, soft bottom, low headroom, debris, or other conditions that make wading/raft impractical
	Special underwater		Submerged components/areas. To monitor known or suspected deficiency
Eastern Federal Lands	Channel profile	24 months	Along substructures
Florida	Underwater		Water depth >1 m
Iowa	Underwater investigation	60 months	Dive inspection by consultants for water >6 ft deep
	Underwater investigation	72 months	Dive inspection by consultants for water >6 ft deep FHWA approval of 72-month interval
Missouri	Dive	60 months	
Montana	Underwater—Category I	48 months	Components not visible during regular inspections. Inspection by wading, probing or from boats
	Underwater—Category II	60 months	Dive inspection by consultants
New Jersey	Underwater Type 1	24 months	Hands-on inspection. No diver. Channel cross section and scour evaluation
	Underwater Type 2		Dive inspection where wading/probing not possible and water at least 4 ft deep Cleaning: 100% Level I, 10% Level II
	Underwater Type 3		Dive inspection, in-depth for prior evidence of distress or scour Cleaning: 100% Level I, >10% Level II
	Underwater Type 4		Dive inspection to prepare for replacement, rehabilitation, or priority repairs Cleaning: Level II
New York	Dive		Water depth >0.9 m, water current >0.6 m/s, and chest waders not adequate
	Fathometer survey	60 months	Scour rating 4 or higher. Channel cross section
		12 months	Scour rating 1 or 2. Active structural flag for scour. Channel cross section
		24 months	Scour rating 3. Channel cross section
	Scour documentation	24 months	Fathometer readings along fascias and profiles along substructures
	Underwater	60 months	General recommendation is 4 or greater
		12 months	Active flag due to structural condition General recommendation 1 or 2
		24 months	General recommendation is 3
North Carolina			
Oklahoma	Underwater		Dive inspections for water > 5 ft

(*continued*)

TABLE F9 (*Continued*)
UNDERWATER INSPECTIONS

DOT	Name	Interval	Notes
Oregon	Underwater w/cross-channel profile	12 months	NBI Scour Code = 2 Scour SmartFlag in condition state 2 or 3 NBI Substructure Condition < 5 NBI Channel and Channel Protection < 5 Element 223 Submerged Seal Footing is exposed Combination of age, environment, history, importance, etc.
		24 months	NBI Scour Code ≤ 3 or "U" Scour SmartFlag in condition state 1 NBI Substructure Condition = 5 or 6 NBI Channel and Channel Protection = 6 Element 223 Submerged Seal Footing is exposed
		48 months	NBI Scour Code = 4 Scour Smartflag is not turned on NBI Substructure Condition = 6 or 7 NBI Channel and Channel Protection = 7
		60 months	NBI Scour Code ≥ 5 Scour SmartFlag is not turned on NBI Substructure Condition > 8 NBI Channel and Channel Protection > 8
Pennsylvania	Underwater	12 months	Scour critical; bridge closed
		12 months	Scour critical; substructure unit is unstable
		24 months	Substructure may be unstable
		24 months	Protection needed; substructure is stable
		24 months	Scour critical; substructure is stable
		24 months	Substructure integrity not known
		60 months	Previous scour problem; countermeasures in place
		60 months	No scour problems
	Underwater only—U		Inspection of underwater components only
Tennessee	Dive—Level I		Swim-by, minimal cleaning
	Dive—Level II		Cleaning and detailed inspection of critical areas
	Dive—Level III		Highly detailed inspection seeking hidden/internal deterioration
	Underwater, dive	60 months	Water > 3.5 ft deep
	Underwater, camera	60 months	Can use dive or camera in alternate cycles
Texas	Underwater	60 months	"Wet" year round and water depth > 4 ft
Washington	Underwater, in-depth	As needed	Detailed inspection of specific portions; may include nondestructive testing
	Underwater—Hands-on	60 months	Swim-by. Clean 10% of submerged surface. Probe around submerged components. May identify portions and recommend in-depth inspection
Wisconsin	UW probe/visual	24 months	Inspection from surface of water
	UW survey	24 months	Streambed profile in vicinity of bridge
	UW dive	60 months	Dive inspection

TABLE F10
FRACTURE-CRITICAL INSPECTIONS

DOT	Name	Scope	Interval	Notes
Alabama	Fracture-critical details	Component	24 months	
Connecticut	Fracture critical—secondary roads			Rotating 25% of details receive hands-on Bridges *not* on Interstate or other limited-access highway
Eastern Federal Lands	Fracture critical	Component	24 months	Fracture-susceptible bridges
	Fracture critical w/NDE	Component	120 months	Includes use of nondestructive testing
	UBIV fracture critical	Component		
Iowa	Fatigue	Component	24 months	Fracture-critical bridges, bridges with arrested cracks
Minnesota	Fracture critical		12 months	
Missouri	Comprehensive fracture-critical inspection			
	Most fracture-critical member			
Montana	Fracture critical	Component	24 months	
New Jersey	Fracture critical	Component	24 months	Hands-on for vulnerable areas and details
	Fracture critical—In-depth	Entire	48 month	In-depth for alternate inspection cycles
North Carolina	Fracture critical			
Rhode Island	Fracture critical		12 months	
Oregon	Level 2—Fracture-critical inspection	Component	12 months	Base metal is ASTM A7, A8, A94, A242, A440, A514, or A517 steel
	Level 2—Fracture-critical inspection	Component	24 months	Age of structure > 30 years ADTT > 1000
	Level 2—Fracture-critical inspection	Component	48 months	Age of structure < 30 years ADTT < 1000
	Level 2—Fracture-critical inspection	Component		Base metal has low values of toughness in field situations; similar to A514 or A517
	Level 2—Fracture-critical inspection	Component		Nonredundant riveted or bolted members in tension
	Level 2—Fracture-critical inspection	Component		Bending with no welding present
	Level 2—Fracture-critical inspection	Component		Detail vulnerable to fatigue or collision damage
	Level 2—Fracture-critical inspection	Component		Nonredundant riveted or bolted members with tack welding present
	Level 2—Fracture-critical inspection	Component		Nonredundant welded members in bending
	Level 2—Fracture-critical inspection	Component		Nonredundant welded members in direct tension
	Level 2—Fracture-critical inspection	Component		Pin and hanger assembly—Perform an initial UT of the pin and hangers and follow-up at least every 4 years
	Level 2—Fracture-critical inspection	Component		E or E' detail—Perform an initial UT of the detail and follow up at least every 4 years
	Level 2—Fracture-critical inspection	Component	72 months	Age of structure > 30 years Rolled members with no welds present

(*continued*)

TABLE F10 (*Continued*)
FRACTURE-CRITICAL INSPECTIONS

DOT	Name	Scope	Interval	Notes
	Level 2—Fracture-critical inspection	Component		ADTT > 1,000 Rolled members with no welds present
	Level 2—Fracture-critical inspection	Component	120 months	Age of structure < 30 years Rolled members with no welds present ADTT < 1,000 Rolled members with no welds present
Pennsylvania	In-depth—Fracture critical	Entire	120 months	Fracture-critical member in fair or lesser condition Span ≥ 150 ft
			180 months	Fracture-critical member in good condition
Virginia	Fracture critical	Component	12 months	
Washington	Fracture critical	Component	24 months	
Wisconsin	Fracture critical	Component	≤72 months	

UBIV = under bridge inspection vehicle; UT = ultrasonic testing ; NDE = nondestructive evaluation; ADTT = average daily truck traffic.

TABLE F11
COMPLEX BRIDGES, INSPECTIONS, AND TEAMS

DOT	Complex Staff/Training	Complex Inspections and Structures
Alabama		Master list of structures with unique or special features
Alaska	Yes	Yes
Arizona		
Arkansas		
California	Experience, but not training	No formal designations of structures or methods, but engineering oversight and judgment within districts Engineers investigate inspection practices for the "complex" bridges in their inventories and apply them to their inspections.
Connecticut	Yes	Formal definition of three levels of structural complexity with defined team size and technical grade
Delaware	Yes	Dye-Penetrant Test Training UBIV/Snooper Training for driving and operation
Florida	Yes	Managers/supervisors provide technical guidance to inspection team training: Complex Bridge Inspection Course Movable Bridge Inspection Course Inspection Procedures for Trunnion Shafts of Vertical Lift Bridges Hanger and Pin Assemblies of Cantilever Superstructure Systems
Iowa	Yes	
Kentucky	Yes	Specific training or experience for some inspections
Maine	Yes	
Maryland	Yes	Drawbridge inspections require electrical and mechanical engineers for equipment
Michigan	Yes	Segmental post-tensioned bridges Some inspections related to hydraulic engineering
Montana	Yes	Master list of bridges with special features. These must receive special inspections Inspection team will include specialists, as needed
Nevada		
New Jersey	Yes	Open-deck railroad bridges—Special attention to condition of ties Ultrasonic inspections Movable bridges
New Mexico		
New York	No	Require all inspectors to handle any bridge Inventory indicates need for special equipment during inspection
North Carolina	No	Require all inspectors to handle any bridge
North Dakota	Yes	Training for segmental box bridges
Ohio	Yes	Major bridges identified by span length and structure type Inspectors must demonstrate adequate experience In-depth inspection may require riggers, divers, or other personnel with special skills
Oklahoma	Yes	Snooper inspection of "Long and Tall" bridges that are not fracture critical Monitoring pier movement with an electronic distance measuring device
Oregon	Yes	Special expertise or equipment may be needed for: Movable bridge Suspension or cable-stayed bridge Tall bridge

(*continued*)

TABLE F11 (*Continued*)
COMPLEX BRIDGES, INSPECTIONS, AND TEAMS

DOT	Complex Staff/Training	Complex Inspections and Structures
Pennsylvania	Yes	Prestressed concrete segmental bridges More experienced team leaders are used for more complex inspections Critical elements of complex structures may be inspected separately for use of special equipment or personnel Consultants hired for complex inspection by central office
Rhode Island	Yes	One concrete segmental bridge One tied-arch bridge
South Dakota	No	No complex bridges identified
Tennessee	No	Movable, suspension, or cable-stayed bridges Other bridges with unusual characteristics No special qualifications for personnel
Texas	Yes	Unusual features such as external post-tensioned tendons For complex bridge inspections, consultants must have as project manager a PE with 7 years bridge inspection experience and BIRM training. At least one year of experience must be with complex bridges. The team leader for complex inspections must have 6 years bridge inspection experience and BIRM training.
Utah	Yes	Yes
Vermont		
Virginia	Yes	Movable bridge team is an electrical engineer, a bridge safety engineer, and a mechanical engineer.
Washington	Yes	DOT keeps master list of bridges with special features or needing special equipment. Bridge Preservation Office has Special Structures Unit for complex types including: Movable bridges Floating bridges Suspension bridges Cable-stayed bridges Precast segmental bridges Ferry terminals
West Virginia	No	No

UBIV = under bridge inspection vehicles; BIRM = *Bridge Inspector's Reference Manual*.

TABLE F12
ROUTINE INSPECTIONS OF MOVABLE BRIDGES

DOT	Name	Scope	Interval	Note
Alabama	Special C—Suspension and movable bridges	Entire		
Florida	Movable bridge		12 months	Poor condition
	Movable portion	Operation	12 months	
Maryland	Drawbridge	Equipment		Team has electrical engineer and mechanical engineer
Michigan	Movable equipment, routine	Equipment	72 months	Movable bridge equipment
New Jersey	Movable Bridge—Type I	Equipment		In-depth electrical, mechanical equipment inspection
	Movable Bridge—Type II	Equipment		Medium-depth electrical, mechanical equipment inspection
	Movable Bridge—Type III	Equipment		Visually monitor operation of electrical, mechanical equipment
North Carolina	Movable span inspections			
Oregon	Movable bridge	Entire	12 months	Cursory inspection for operation
Virginia	Movable bridge			Special team having an electrical engineer, a bridge safety engineer, and a mechanical engineer
Washington	Movable bridge operation	Operation	1 month	Trial opening of span
	Special feature—Movable		12 months	Inspector has special training or experience
	Movable bridge equipment	Equipment	72 months	In-depth for electrical and mechanical equipment
Wisconsin	Movable bridge		12 months	

TABLE F13
ROUTINE INTERIM INSPECTION

DOT	Inspection	Scope	Interval	Notes
Alabama	Special K—Interim inspection			Posted bridge
	Special L—Interim inspection			Bridges with condition codes of 4 or less
Connecticut	Interim—Load posted	Component		Posted bridge
	Interim—Pin and hanger	Component		Monitor pin and hanger
Eastern Federal Lands	Interim—Structurally deficient			Priority A—zero remaining life Priority B—2 to 5 years remaining life
Florida	Interim	Component		Condition rating <5
	Regular	Entire	6 months	Condition rating ≤3, for deck, superstructure, substructure, channel, culvert, or approach roadway
	Regular	Entire	12 months	Condition rating = 4, for deck, superstructure, substructure, channel, culvert, or approach roadway
Maryland	Out-of-cycle inspection	Component		
Michigan	Bridge deck	Component	9 to 15 months	Deck condition rating = 3
	Concrete substructure	Component	9 months max.	Substructure condition rating = 3
			15 months max.	Substructure condition rating = 4
	Concrete tee beam	Component	9 months max.	High-load hit—Rebar exposed
			15 months max.	Main rebar exposed
	Posted—Deterioration		9 months max.	Weakened by deterioration
	Posted—Design		9 to 15 months	Designed to lower standard
	Prestressed box beam	Component	15 months max.	Shear cracks Beam exhibits lateral movement
	Prestressed I beam	Component	9 months max.	Loss of bearing at two adjacent beams
			15 months max.	Loss of bearing/spall
	Scour critical		15 months max.	On scour critical list
	Steel superstructure	Component	<6 months	Steel section loss 25% Fatigue cracks
			9 months max.	High-load hit Temporary supports for beams
New Jersey	Interim inspection	Component	12 months	Load posted for operating rating Superstructure condition rating 3 or less Substructure condition rating 3 or less
New York	Fathometer survey, channel cross section	Component	12 months	Scour rating 1 or 2. Active structural flag for scour
			24 months	Scour rating 3
	Interim (Type 2)	Entire	12 months	General recommendation ≤3, assigned by inspector
	Interim (Type 2)	Entire		Condition rating weighted average ≤3, computed by NYSDOT data system
	Interim (Type 2)	Entire		Inactive red flag or active yellow flag
	Interim (Type 2)	Entire		Posted bridge
	Interim (Type 2)	Entire		Poor condition

(*continued*)

TABLE F13 (*Continued*)
ROUTINE INTERIM INSPECTION

DOT	Inspection	Scope	Interval	Notes
	Interim (Type 2)	Entire		Unrepaired critical findings
	Interim (Type 2)	Entire		Posted bridge
Ohio	Interim		<12 months	General appraisal 2 or less (9 to 0 scale, "2" is critical) Drastic load reductions (~75%)
Oregon	Interim		<12 months	Load capacity issue Local failures possible Concrete shear cracks continue to grow Serious traffic hazard
			12 months	Primary structural element condition rating < 3 Primary structural element deteriorated and affecting load capacity of bridge General condition of bridge is poor Temporary repair of primary structural element is in poor condition Operating rating factor <1 for any of three permit truck configurations
	Routine—Culvert	Entire	6 months	Signs of culvert failure exists; bottom buckling in CMP, etc.
			12 months	Culvert (62) condition 3 or 4. Any culvert element quantity in state 4
Pennsylvania	Interim (special)—I	Component	24 months	Between routine inspections, to provide reduced interval for component
	Routine	Entire	6 months	Condition rating 3 or less for fracture-critical superstructure
	Routine	Entire	12 months	Condition rating 3 or less for superstructure, substructure, or culvert; not fracture-critical Condition rating 4 or less for fracture-critical superstructure
	Routine	Entire	6 months	Temporary bridge Bridge with temporary support
			12 months	Posted bridges
	Special	Component	<24 months	Examine known or expected deficiencies
Virginia	Pin and hanger—Ultrasonic testing	Component	6 months	Frozen pins/hangers, non-redundant structures
			12 months	Frozen pins/hangers, redundant structures Non-redundant structures. New or newly replaced pins
	Routine		12 months	Restricted weight limit
		Component	12 months	General condition rating <4
Wisconsin	Interim	Component	12 months	Suspect details. Unscheduled inspection

TABLE F14
FORTY-EIGHT-MONTH INTERVAL FOR ROUTINE INSPECTION

DOT	Inspection	Interval	Notes
Connecticut	Routine—Bridges	48 months	In service four years Had in-depth inspection Condition ratings 6 or better HS 30 inventory Single span <100 ft span Less than 75 years old 14 ft vertical clearance ADT < 125,000 ADTT < 10%
Eastern Federal Lands	Bridges	48 months	Main elements condition rating >5
Montana	NBI/element level inspection	48 months	Prestressed structures MDT design standards Length < 100 ft Known good condition
Oregon	Routine—Culvert	48 months	Culvert (62) condition 6 or better Element state 100% 1 or 2

ADT = average daily traffic; ADTT = average daily truck traffic; MDT = Montana Department of Transportation.

TABLE F15
SPECIAL INSPECTIONS

DOT	Name	Notes
Connecticut	Deck surveys	Damage mapping for deck. Visual inspection, hammer tapping, additional testing as necessary
	Joint measurements	Measurement for monitoring
	Settlement	Measurement for monitoring
	Interim A	Pin and hanger or hinge measurements
	Interim B	Shiplap measurements
	Interim C	Tipping/settlement of substructure
	Interim D	Lateral movement of beams and bearings
	Interim E	Temporary bents and supports
	Interim F	Crack growth
	Interim G	Check for scour or undermining
Delaware	Storm inspection	Live, remote monitoring of scour vulnerable bridges during high flow periods Live, remote monitoring of flow in selected waterways
Eastern Federal Lands	Concrete deck studies	Component investigation
	Vertical clearance	After new overlay or rehabilitation
Florida	Storm event—Level 1	Site visit to verify that approaches are intact with no obvious problem
	Storm event—Level 2	Measure channel profile
	Storm event—Level 3	In-depth inspection based on findings of Level 1 or 2 inspection
Iowa	Local surveillance	To monitor specific elements; NBIS team leader preferred but not required
Maryland	Ultrasonic inspection of pins	
Michigan	Scoping	Selection for bridge program. Development of repair project. More precise evaluations such as deck sounding and beam thickness measurements after cleaning. Information is given to the previous bridge inspector to adjust their ratings.
New York	Special—Type 5	Address maintenance or inspection concerns unique to bridge. Results not entered in database.
North Carolina	Ultrasonic inspections	
Oregon	Concrete corrosion survey	
Pennsylvania	Interim (special)	Limited to critical areas
	Special (problem area)—P	Special areas as directed by management
Tennessee	Repair	Verify repairs done to bridge

NBIS = National Bridge Inspection Standards.

TABLE F16
ROUTINE INSPECTION OF MINOR BRIDGES AND NON-BRIDGES

DOT	Inspection	Interval	Note
Connecticut	Sign structure	48 months	Overhead sign support
Florida	Ferry slip		Ferry slip
	Sign structure	24 months	Overhead sign
	Tunnel		Tunnel
Iowa	Pedestrian bridge	48 months	Pedestrian bridge—Inspect for hazards to highway below. Inspect for high load hits. Inspection by NBIS team leader. Owner notified of conditions needing attention.
	Railroad bridge	48 months	Railroad bridge—Inspect for hazards to highway below. Inspect for high-load hits. Inspection by NBIS team leader. Owner notified of conditions needing attention.
Maryland	Electrified railroad bridge		Electrified railroad bridges
Michigan	Minor bridge		State DOT inspects spans down to 10 ft. Local agencies are only required to inspect structures 20 ft and above.
	Pedestrian bridge		Pedestrian bridges. NBI procedures, but not reported to FHWA
	Railroad bridge		Railroad bridge over public road. NBI procedures, but not reported to FHWA
Montana	Minor bridge		Spans down to 8 ft on national and state highway systems, or on transporter erector routes
New Jersey	Minor culverts		Inspected as funds allow
	Noise wall		Noise reduction walls
	Railroad bridge		Open deck railroad bridges. Inspect condition of ties as hazard to road below
New York	Sign structure		Overhead sign structure; rating scale similar to bridges
Oregon	Adjacent structure		All structures, over or adjacent to public roads, that in failure would cause immediate danger to traveling public
	Minor bridge		Minor structures; spans down to 6 ft
	Tunnel		Tunnels
Pennsylvania	Conveyor belt		Conveyor belts
	High-mast light		High-mast lighting
	Highway environs—H	24 months	Non-bridge over highway. Inspection limited to highway environs
	Minor bridge—R	24 months	Bridge spans 8 to 20 ft
	Minor bridge—W	24 months	Routine and underwater inspection. Bridge spans 8 ft to 20 ft
	Miscellaneous—M	24 months	Other miscellaneous structure; NBIS style
	Noise walls—M	24 months	Noise walls; NBIS style
	Overhead structure—O	24 months	Overhead, non-highway bridge. Inspection usually performed by owner.
	Pipe truss		Pipe trusses
	Retaining Wall—M	24 months	Retaining walls; NBIS style
	Sign structure—S	24 months	Sign structure; NBIS-like inspection
	Utility structures		
Tennessee	Minor bridge		Minor structures with spans of 4 ft or more and fill/cover less than 16 ft
Virginia	Minor culvert	48 months	Any minor structure not identified as culvert
	Minor culvert	48 months	Minor culvert with opening greater than 36 square feet
	Overhead structure	24 months	Overhead structures. Vertical and lateral clearances

(*continued*)

TABLE F16 (*Continued*)
ROUTINE INSPECTION OF MINOR BRIDGES AND NON-BRIDGES

DOT	Inspection	Interval	Note
Washington	Ferry terminal	12 months	Ferry terminal—Vehicle transfer spans
			Ferry terminal—Other structures/areas
		24 months	Ferry terminal—Vehicle transfer spans. In-depth inspection
			Ferry terminal—Other structures/areas. In-depth inspection
	Ferry terminal equipment	12 months	Ferry terminal equipment. Electrical systems, mechanical systems, hoists
	Ferry terminal soundings	12 months	Soundings at vehicle transfer spans of ferry terminals
	Highway lid	60 months	
	Minor bridge	72 months	Bridge span < 20 ft, on STRAHNET highway
			Bridge span < 20 ft, operating rating less than HS 10
			Bridge span < 20 ft, vertical clearance < 18 ft
			Single steel or concrete spans 6 ft to 20 ft
			Steel corrugated pipes, spans 8 ft to 20 ft
			Timber spans 4 ft to 20 ft
	Multiple pipe	72 months	Multiple pipes out to 10 ft to 20 ft
	Multiple span	72 months	Multiple spans 8 ft to 20 ft
	Overhead structures		Safety inspection of structures crossing state-owned facilities
	Pedestrian bridge	60 months	Pedestrian bridge
	Private bridge	60 months	Private bridges over public highways
	Sign structure		Sign bridges
	Tunnel	24 months	Tunnels

NBIS = National Bridge Inspection Standards; STRAHNET = Strategic Highway Network.

TABLE F17
U.S. INFORMAL INSPECTIONS

DOT	Maintenance Source	State Police Source	Public Source	Stored in Bridge File (paper)	Stored in BMS/Database
Alaska	Yes			Yes	If significant
Arizona				No	
Arkansas				No	
California	Yes			Yes	
Delaware		Yes		Yes	
Idaho				No	
Iowa	Yes			No	
Kentucky				Yes	
Maine				Yes	Inspection report
Maryland	Yes	Yes		Yes	
Michigan				Yes	
Missouri	Yes			No	
Nevada				Yes	
New Mexico				No	
New York				No	
North Carolina	Yes (Annual ride by)			No	
North Dakota				Yes	
Ohio		Yes		No	
Oregon	Yes			Yes	Inspection report
Pennsylvania				Yes	
Rhode Island	Yes			No	
South Dakota	Yes			No	
Texas	Yes			No	
Utah				No	
Vermont	Yes			No	
Virginia				No	
Washington	Yes			Yes	Inspection report
West Virginia				Yes	

TABLE F18
BRIDGE MONITORING

DOT	Method	Notes
Alabama	Visual monitor	Of known defect, by maintenance crew
Alaska	Measurement	Vertical or horizontal survey
Arizona	Visual monitor	Of known defect, by maintenance crew
	Measurement	Movement
Arkansas	Measurement	Deflection, differential movement
California	Visual monitor	Real-time monitor during high water
	Measurement	Crack gages, deck grades, EDM, Stringline
	Instrumentation	Remote scour monitoring for scour-critical bridges
Delaware	Measurement	Deflection, elevations, movement, settlement
Eastern Federal Lands	Visual monitor	
Idaho	Measurement	Crack length, crack progress
Iowa	Visual monitor	By district personnel; might not be team leader
	Measurement	Crack opening, movement
Kentucky	Visual monitor	For scour
	Measurement	Crack gage
Maine	Measurement	Crack growth, element rotation
	Instrumentation	Acoustic emission
Maryland	Measurement	Crack opening, deflection, movement
	Instrumentation	
Missouri	Visual monitor	For scour
	Measurement	Crack opening, deflection, movement
Montana	Visual monitor	
Nevada	Instrumentation	As appropriate until repaired
New Jersey	Visual monitor	Tracking defect without interim inspection
	Instrumentation	For scour displacement probes, sonar probes
New Mexico	Measurement	Crack opening, deflection
New York	Measurement	Crack growth
North Carolina	Visual monitor	
North Dakota	Visual monitor	For progress of defect
	Measurement	Crack growth, movement
Ohio	Measurement	Crack monitor
Oklahoma	Measurement	Movement
Oregon	Measurement	Crack growth
	Instrumentation	Acoustic emission, strain gages
Pennsylvania	Visual monitor	For scour, after high water by maintenance crew or county manager
	Measurement	Movement
	Instrumentation	Inclinometers, strain gages, other detectors
South Dakota	Visual monitor	For known defect
Tennessee	Visual monitor	For known defect
Texas	Instrumentation	Acoustic emission
	Measurement	Crack growth
Utah	Measurement	Crack opening
	Instrumentation	Ultrasound, electrochemical crack detection
Vermont	Visual monitor	For scour after high water, for crack growth, for movement
Virginia	Visual monitor	For known defect
Washington	Visual monitor	For known defect
	Measurement	Movement, settlement, streambed profile
West Virginia	Visual monitor	For known defect
	Measurement	Crack opening, deflection, movement
	Instrumentation	Acoustic emission, strain gages,

EDM = electronic distance meter.

APPENDIX G

Details for Quality Programs

TABLE G1
QUALITY CONTROL DOCUMENTS

DOT	Documents
Alabama	*Bridge Inspection Manual*
Alaska	
Arizona	
Arkansas	QA review form
California	Structure Maintenance and Investigations Quality Management Plan
	Structure Maintenance and Investigations *Area Bridge Maintenance Engineer Policy and Procedures Manual*
Connecticut	*Bridge Inspection Manual*
Delaware	Formal QA/QC report format (in preparation)
Florida	*Bridges and Other Structures Inspection and Report*, 850-010-030-f
	District QC plan
Idaho	QA/QC manual (in development)
Iowa	No written procedure
Kentucky	Kentucky QA/QC memorandum
Maine	
Maryland	No manual or policy statement
Massachusetts	Massachusetts Highway Department directives
Michigan	QA/QC manual for bridge inspection
Minnesota	Standard form: Quality Assurance Review of Bridge Owners
Missouri	DOT's *Bridge Inspection Rating Manual* (non-state bridges) (in preparation)
	(state bridges)
Montana	*Bridge Inspection Manual*
Nevada	DOT *Bridge Design and Procedures Guide* (being revised)
New Mexico	In preparation
New York	*Bridge Inspection Manual*; QA procedure in stand-alone document
North Carolina	DOT Bridge Inspection Unit; Bridge Inspection QC and QA procedures
North Dakota	
Ohio	*Manual of Bridge Inspection*
Oklahoma	District QC plan
Oregon	DOT *Bridge Inspection Manual*
Pennsylvania	*Bridge Safety Inspection Manual*—Pub. 238
Rhode Island	
South Dakota	In preparation
Tennessee	*Bridge Inspection Program Procedures Manual*
Texas	DOT's QC/QA program
Utah	DOT QC/QA procedures
Vermont	In-house bridge inspection manual
Virginia	Instructional and Informational Memorandum S&B 27.5
Washington	Washington State *Bridge Inspection Manual*
West Virginia	DOT bridge maintenance directives
Wisconsin	Standard forms.
	Level 1 Review Record—Structure Inspection Quality Assurance Program
	Level 2 Review Record—Structure Inspection Quality Assurance Program

TABLE G2
PERSONNEL FOR QUALITY CONTROL AND QUALITY ASSURANCE

DOT	Personnel	Qualification	Note
Alabama	Emergency Bridge Inspection Team + selected personnel	Team leader	QC/QA
Alaska	Bridge Management Engineer + selected team leaders	Team leader	QC/QA
Arizona	Bridge Management Leader	Team leader	QC/QA
	QA review engineer		
	Bridge report review office engineer	Team leader	QC
Arkansas	District Construction Engineer	Team leader	QC/QA
California	Quality Assurance Senior Specialist (senior bridge engineer specialist)		QC/QA
	Quality Control Administrator (Caltrans administrator)		QC/QA
	Quality Control Engineer (Transportation Engineer Range D)		QC/QA
	Quality Management Program Manager (supervising senior bridge engineer)		QC/QA
	Temporary QA inspectors		Volunteers from the inspection staff rotate in every 6 months
Connecticut	Manager Bridge Safety and Evaluation	Program manager	QA; sets policy
	Senior Engineer designated as QA Engineer	Team leader	QC/QA
	QA inspection team (selected team leaders)	Team leader	QA
	Supervising Engineer for each area (region)	Team leader	QC/QA
	Quality Control Engineer	Team leader	QC
Delaware	Bridge Inspection Manager/Engineer	Team leader	QC/QA
	Bridge Maintenance Engineer	Team leader	QC/QA
Eastern Federal Lands	Peer Team Leaders	Team leader	QC
Florida	Bridge Inspection and Evaluation Engineer	Team Leader w/PE	QC/QA
	Bridge Maintenance and Planning Engineer	PE	QA
	Bridge Management Systems Engineer	PE	QA
	Bridge Management Systems Quality Control Engineer	PE	QA
	Engineer of Structures Maintenance	PE	QA
Idaho	Program Manager	Team leader	QA
	Team leaders		
	Database Manager		
Iowa	Assistant Bridge Maintenance Engineer	Team leader w/PE	QA
	Staff Engineers in Bridge Maintenance and Inspection Unit, Office of Bridges and Structures	Team leader	QC
Kentucky	District Bridge Engineers		QC
	Program Manager	Team leader	QA

(*continued*)

TABLE G2 (*Continued*)
PERSONNEL FOR QUALITY CONTROL AND QUALITY ASSURANCE

DOT	Personnel	Qualification	Note
Maine	Assistant Bridge Maintenance Engineer	Team leader	QC/QA
	Human Resources		QA
	Bridge Management Engineer	Team leader	QC/QA
Maryland	Inspection team	Team leader	1st QC/QA review
	Senior Project Team Leader for Inspection	Team leader	2nd QC/QA review
Massachusetts	Area Bridge Inspection Engineer (QA engineer)	Team leader	QC/QA
	Bridge Inspection Engineer (QA supervisor)	Program manager	QA
	District Bridge Inspection Engineer	Team leader	QC/QA
Michigan	Bridge owner	Team leader	QC
	Program Manager selects consultants QA work done by contract	Team leader	QA
Minnesota			
Missouri	State Bridge Maintenance Engineer (state-owned bridges)		QC
	Supervising Bridge Inspection Engineer (state-owned bridges)		QC
	Structural Services Engineer (non-state bridges)		QC
Montana	District Bridge Inspection Coordinator		QC
	Bridge management, central office, Helena		QA
	QA inspection teams are peers from other districts	Team leader	QA
Nevada	Manager I, Registered PE (program manager)	Program manager	QC/QA
New Mexico	Team leaders for district-level peer reviews	PE or team leader	QC
	DOT Management Analyst + Consultant Management Analyst	Team leader	QA
	Design Engineer	PE	QC
New York	Civil Engineer II—QC Engineer	Team leader w/PE	QC/QA
North Carolina	State Inspection Superintendent, Inspection Program Manager	Program manager	QC/QA
	Inspection Area Supervisor	Team leader	QC/QA
North Dakota	Bridge Inspection Manager	Team leader	QC/QA
Ohio	Bridge Inspection Engineer	Program manager w/PE	QA
	Bridge Management Engineer		
	Consultants may perform quality assurance review for local agencies	PE + 10 years experience	QA
	District Bridge Engineer		QC
	Reviewer of Safety Inspections	Team leader w/PE	QC
Oklahoma	Reviewing Engineer—Peer Team Leader		QC
Oregon	Bridge Operations Engineer	Team leader	QC/QA
	Senior Bridge Inspector		
	Bridge Inspection Database Coordinator		
	Local Agency Bridge Inspection Coordinator		

(*continued*)

TABLE G2 (*Continued*)
PERSONNEL FOR QUALITY CONTROL AND QUALITY ASSURANCE

DOT	Personnel	Qualification	Note
Pennsylvania	Bridge Quality Assurance Division + Assistant Chief Bridge Engineer (head)	Team leader w/engineering degree	Permanent staff for QA statewide
	Bridge Inspection QA Manager	Team leader w/PE	QA
	District Bridge Inspection Manager (11 statewide)	Team leader + several years experience	District QC
	Internal (district) Review Engineer		QC
Rhode Island			
South Dakota	Bridge Operations Engineer	Team leader	QA
	Region Bridge Specialist		QC
	Bridge Appraisal Engineer		QC
Tennessee	Manager SI&A	PE	QA
	Manager, Headquarters Inspection and Repair Office		QC
	Regional Bridge Engineers		QC in region
	Bridge Evaluators		QC
Texas	Inspection Engineering Supervisor		QC
	Bridge Division	Team leader	QA review of districts
Utah	Program Manager	Program manager	QC/QA
	DOT District Staff	Team leader	QA review of consultants
Vermont	Civil Engineer IV—PE not required	Team leader	QC
		Team leader	QA
Virginia	Regional Inspection Manager	Team leader	QC
	State Bridge Inspection Program Manager	Program manager	QC/QA
Washington	Bridge Inspection Supervisors	Team leader + annual inspection training	QC
	State Bridge Inspection Program Manager (Engineer II)	Program manager	QA
	Consultant services, but future will be DOT QA staff	Team leader	QA for state bridges
	DOT Local Agency Bridge Engineer + FHWA Division Engineer.	Team leader	QA for local bridges
West Virginia	Selected district staff, such as Bridge Evaluation Engineer		QC
	State Bridge Evaluation Engineer	Program manager	QC/QA
Wisconsin	District Program Manager	Program manager	QA reviews of local government programs
	State Program Manager	Program manager	QA reviews of DOT districts

TABLE G3
QUALITY CONTROL OF INSPECTION LEADERS

DOT	Certification	Agency	Consultants
Alabama	CBI or PE number	Staffing list in division	Local government inspections by consultants Qualifications verified in QA review
Alaska	NBIS	Qualifications known within agency	Personnel named in contract
Arizona	NBIS	Annual review of qualifications	
Arkansas	NBIS	Personnel records	
California	Certification and registration	Personnel database has experience and training	
Connecticut	NBIS		
Delaware	NBIS	Personnel files	
Florida	CBI number	CBI files	Staff qualifications verified before notice to proceed
Idaho	NBIS	Human resources records have experience and training	Personnel named in proposal
Iowa	NBIS	Personnel files have experience and training	
Kentucky	NBIS	Personnel files have experience, training, and education	Same for all individuals engaged in NBIS
Maine	NBIS	Human resources records have training and experience	
Maryland	NBIS	Personnel files have training and experience	
Massachusetts	NBIS	QA review of personnel qualifications	
Michigan	Bridge owner responsible for their team leaders		
Minnesota	NBIS	QA review of personnel qualifications	
Missouri	Non-state bridges: Structural Service Engineer approves all team leaders	Personnel files have qualifications and resumes	
Montana	NBIS	QA review of personnel qualifications	
Nevada	Small group	Small group, staff qualifications are common knowledge	
New Mexico	NBIS	Qualifications checked during QA review (every 3 years)	
New York	NBIS	Approval of resumes prior to field work	QA approval of inspectors before field work
North Carolina	NBIS	Personnel files	

(*continued*)

TABLE G3 (*Continued*)
QUALITY CONTROL OF INSPECTION LEADERS

DOT	Certification	Agency	Consultants
North Dakota	NBIS	MS Access database of active bridge inspectors	
Ohio	Review/approval of regional bridge manager	Statement of training at hiring	
Oklahoma	NBIS	Record of refresher training at 24-month intervals	Record of refresher training at 24-month intervals
Oregon	Certification renewed every 5 years	Updated resume is reviewed at 5 years	
Pennsylvania	List of certification status	Personnel who attend PennDOT Basic Bridge Safety Inspection Training, and Refresher	List of trained consultants
Rhode Island	NBIS	Personnel files contain qualifications	Consultant qualifications on file
South Dakota	Bridge Operations Engineer certifies	Qualifications and training tracked by Bridge Operations Engineer	
Tennessee	NBIS	QA review of personnel qualifications	
Texas	NBIS	Human resources files using PeopleSoft	NBIS qualifications tracked by Contract Office, with consultant management database
Utah	NBIS	Personnel files have training and experience	
Vermont			
Virginia	Tracking by Central Office	Annual report to Central Office listing Team Leader qualifications	Annual report to Central Office listing Team Leader qualifications
Washington	IDs for team leaders	Personnel files list training and experience	
West Virginia	NBIS	Annual update of inspector personnel records	
Wisconsin	NBIS	QA review of personnel qualifications	

CBI = Certified Bridge Inspection; NBIS = National Bridge Inspection Standards.

TABLE G4
QUALITY CONTROL OF INSPECTION REPORTS

DOT	Review Set	Review by	Action
Alabama	Inspection reports		Reviewer signs and dates
Alaska	All inspection reports	Team leader peer	Review for content Return with comments to team leader
Arizona	All inspection reports	Bridge report review engineer Bridge management leader	Review and revise
Arkansas	All inspection reports	Pontis software validation Load rater's review	Coordinate with inspection team to correct errors
California		QC staff	
Connecticut	All inspection reports	Quality control engineer	Cross check condition ratings, photographs, notes, and maintenance recommendations Confer with leader, if necessary Review and sign
	All inspection reports for Class III bridges (complex)	Transportation Engineer III (Senior Engineer)	Cross check condition ratings, photographs, notes, and maintenance recommendations Confer with leader, if necessary Review and sign
	All load ratings	Quality control engineer	Confirm inputs to calculations; note age/condition context of load rating
	All load ratings for Class III bridges (complex)	Supervising engineer	Confirm inputs to calculations; note age/condition context of load rating
Delaware	All inspection reports	Inspection team	Revise/correct as needed prior to download to central office
	All inspection reports	Bridge inspection manager	Review after download to central office
Eastern Federal Lands	All inspection reports	Peer team leader	Signs
Florida	All inspection reports	District bridge inspection supervisor or peer team leader	Review is logged Discussion with inspection team, if needed Reviewer signs
	All inspection reports for state-owned bridges	Engineering section	PE signs final report
Idaho	All inspection reports	Database manager	Review, discuss with inspection team if needed
	Spot checks of inspection reports	Program manager	
Illinois	All inspection reports	Bureau of Bridges and Structures, unit supervisor	
Iowa	All inspection reports	Independent technical team member	Discuss/resolve with inspection team Bridge condition report is signed by PE, after review of inspection report
Kentucky	All inspection reports	District bridge engineer	Primary review in district Discuss/resolve with inspection team
	All inspection reports	DOT central office	Secondary review at DOT central office
Maine	All inspection reports	Assistant bridge maintenance engineer	Review for NBI rating errors Discuss/resolve with inspection team Sign completed review
	All inspection reports	Bridge manager and IT groups	Review for data errors Discuss/resolve with inspection team

(*continued*)

TABLE G4 (*Continued*)
QUALITY CONTROL OF INSPECTION REPORTS

DOT	Review Set	Review by	Action
Maryland	All inspection reports	Team leader	Return to team member for revision
	50% of inspection reports	Office review	
Massachusetts	All inspection reports	District bridge inspection engineer	Review for completeness, consistency
	All with NBI condition rating 4 or less	Area bridge inspection engineer	Review poor condition
	10% sample of reports	Area bridge inspection engineer	Review for completeness, consistency
Michigan			
Minnesota	All inspection reports		Reviewer signs and dates
	All load ratings		Rater signs with PE number
Missouri	All inspection reports	NBI edit program	Team responds to error codes
Montana	All inspection reports	Peer team leader	Review; discuss/resolve with inspection team
	5% sample of inspection reports	District bridge inspection coordinator	Check for completeness, consistency with previous report
Nevada	All inspection reports	QC reviewer	Discuss/resolve with inspection team leader
New Jersey	Element-level (Pontis) data	DOT	Cross check element-level data and related NJ–NBI fields. New Jersey uses additional NBI-style rating fields that identify defects much as SmartFlags do.
	20% of inspection reports	DOT	Thorough review; inspection by consultant
	80% of inspection reports	DOT	Review focused on certain aspects; inspection by consultant
	10% of inspection reports	DOT	Field verification
	All inspection reports for complex bridges	DOT	Thorough review
	All inspection reports for movable bridges	DOT	Thorough review
	10% of inspection reports by other agencies	DOT	Thorough review
	90% of inspection reports by other agencies	DOT	Review focused on certain aspects. Inspection by consultant.
	All diver's reports	Consultant	Review and attach to bridge inspection report
New Mexico	All inspection reports	Peer team leader	Discuss/resolve with inspection team Signs Report entered to Pontis
	All inspection reports	General office	Report entered to CHDB NBI items checked, especially if changed
	As needed	Design engineer	Reviews items noted by district
New York	All inspection reports	Quality control engineer	Review using standard checklist Discuss/resolve with team leader Sign and submit to DOT main office

(*continued*)

TABLE G4 (*Continued*)
QUALITY CONTROL OF INSPECTION REPORTS

DOT	Review Set	Review by	Action
North Carolina	All inspection reports	Analysis section	Statewide comparisons of reports
	5% of inspection reports	Bridge inspection superintendent	Office review
	10% of inspection reports	Area supervisor	Field review
North Dakota	Spot review		
Ohio	All inspection reports	Team leader	Team QC review before submission
	All inspection reports	PE in district	
	All load ratings	District structure rating engineer	Review and approve
Oklahoma	All inspection reports	Reviewing engineer	
Oregon	All inspection reports	Senior bridge inspection engineer	Review, notify inspector of record, submit revised report
		Local agency bridge inspection coordinator	
	All inspection reports	Bridge inspection database coordinator	Runs NBI edit/update program Resolve errors
Pennsylvania	All inspection reports, non-state bridges	Bridge owner	Owner affirms to DOT that QC review is performed
	All load ratings, non-state bridges	Bridge owner	Owner affirms to DOT that QC review is performed
	10% sample of routine inspection reports	Bridge Inspection Supervisor	
	10% sample of inspection reports for posted bridges	Bridge inspection supervisor	
	25% sample of inspection reports for fracture-critical members	Bridge inspection supervisor	
	Sample of routine inspection reports last quarter	Bridge engineer	
	Posted bridges	Bridge engineer	Review posting and maintenance recommendations
	Fracture-critical members	Bridge engineer	Review fracture-critical list and plans for repair or replacement
	All load postings, non-state bridges	DOT district	District reviews all posting by local agencies
	All new load postings	Assistant district engineer for design	Verify posting
	All large changes in condition	Assistant district engineer for design	Verify report
Rhode Island	All inspection reports	Consultant	PE stamp on report by consultant
	All inspection reports	DOT engineers DOT supervisors	Internal checks for consistency of data
South Dakota	All inspection reports	Region bridge specialist	Review reports at region before submission to bridge appraisal engineer
	All inspection reports	Bridge appraisal engineer	Discuss/resolve with inspector Perform appraisal ratings Send to file
Tennessee	All load ratings and postings	Supervisor of bridge evaluators	
	Sample of load ratings and postings	SI&A manager SI&A assistant manager	

(*continued*)

TABLE G4 (*Continued*)
QUALITY CONTROL OF INSPECTION REPORTS

DOT	Review Set	Review by	Action
	All inspection reports	Bridge evaluators	Compare condition ratings, photographs, notes, and maintenance recommendations
	Underwater inspection reports		Report stamped by PE
	Inspection reports for minor structures	Bridge evaluators	
Texas	All inspection reports	Central bridge division	Software check during database update; consultant corrects errors as needed
	All inspection reports	District personnel	Review of reports from inspection consultants
	10% sample of inspection reports	District personnel	Review of reports with field verification
	All inspection reports	Consultant	Consultant PE stamps report
Utah	All inspection reports	Agency staff	Software check on valid data entries
	Sample of inspections	Agency and FHWA staff	Periodic validation of inspection reports
Vermont	Sample of inspection reports	Civil Engineer IV	Field verification of inspection
Virginia	Bridge inventory sheet	Inspection team	Notify District Bridge Safety Engineer of errors
	All inspection reports	Other team member	Reviews for errors
	All inspection reports	District structure engineer District bridge engineer	Reviews, initials, dates
	All inspection reports for local-owned bridges	District structure Engineer District bridge engineer	
	All inspection reports for state-maintained bridges	Structure and Bridge Division, Central	
Washington	All inspection reports	Washington State Bridge Inventory System (WSBIS)	Software check for valid data Errors returned to team leader
	All inspection reports for local-owned bridges	Program manager for local agency	Review before submission WSDOT Bridge Inventory Engineer.
	All inspection reports for local-owned bridges	DOT Bridge Inventory Engineer	Final review before download to WSBIS
	All inspection reports	Database engineer	Proofread for data errors
	10% sample of inspection reports	Region inspection supervisor	Reviews Discuss/resolve errors with team leader Approve and submit to database engineer
	Inspection reports with deck, superstructure or substructure rating less than 6	Region inspection supervisor	Review for NBI condition ratings
	Inspection reports with repairs or conditions to be monitoring	Region inspection supervisor	Review for repair or condition
	Inspection reports for new bridges	Region inspection supervisor	
	Inspection reports for fracture-critical bridges	Region inspection supervisor	
	Inspection reports for local-agency bridges	Region inspection supervisor	
	Underwater inspection report	Diver	Report is prepared by team leader and reviewed by diver
West Virginia	Yes	District staff	Team leader receives comments by e-mail
Wisconsin	All inspection reports	District manager Local manager	

CBI = Certified Bridge Inspection; NBIS = National Bridge Inspection Standard; CHDB = Consolidated Highway Database System; SI&A = Structural Inventory and Appraisal.

TABLE G5
INSPECTION TRACKING: QUALITY CONTROL REPORTS—REPAIRS

DOT	Inspections and Reports	Data/Database	Repairs and Follow-Up
Alabama	Timely completion checked at QA review		Team submits standard form for maintenance needs Progress reported on standard form
Connecticut	Reports within 90 days of inspection; reviewed within 45 days of submission		Team notes repairs during routine inspection
Florida	Routing log used to schedule inspection, submit report, and complete review of report All reports must be complete within 45 days		Team notes repairs during routine inspection Emergency and critical repairs examined promptly after completion
Montana	Timely completion tracked in QC		
New Jersey	90 days to submit report. SI&A data must have QA/QC review		
North Carolina	Inspection schedules and monthly progress reports track work		
Ohio	Report within 90 days for state bridges; within 180 days for local-agency bridges		
Oklahoma	QC report is a collection of reviewed inspection reports, showing the errors/changes; QC report is stamped by the reviewing engineer		
Pennsylvania	The 11 PennDOT districts each keep a log of QC activities		
Texas	Monthly status report to track overdue inspections District tracks consultant progress	Monthly status report to track database errors	
Utah	Monthly progress meetings		
Washington	Inspections mapped in GIS and tracked to ensure completion within inspection year Database status: "In-work" for reports in preparation; most reports completed in one week. Large bridges take longer.	WSBIS keeps reports and status as in-work, completed, in-review, approved, or committed	Electronic repair list manager is published to Internet twice a year for tracking and reporting. Bridge Preservation Supervisor reviews completed repairs

SI&A = Structural Inventory and Appraisal; GIS = geographic information systems; WSBIS = Washington State Bridge Inventory System.

TABLE G6
QUALITY CONTROL FIELD REVIEW OF INSPECTIONS AND INSPECTION TEAMS

DOT	Field Review of Teams	Review by	Interval	Action
Alabama				
Alaska				
Arizona				
Arkansas				
California				
Connecticut	Field QC by team leader	Team leader self check	Every inspection	Leader's self check of team, equipment, methods
	Every team—Site visit	QC Engineer	Twice a year	Standard QC checklist Discuss results with team Copies to leader and to supervising engineer
Delaware				
Florida	Every team—Site visit	District Bridge Inspection Supervisor	Periodically	Observe team at work Log the visit Discuss with team
	Every team—Verify inspection	District Bridge Inspection Supervisor	3 months	Verify report in separate visit to site Log the event Discuss with team
	Consultant teams—Site visit	Agency bridge inspection office	3 months each team	Field observation of team at work
	Consultant teams—Verify inspection	Agency bridge inspection office	5% of inspections	Field verify inspection report
Idaho				
Iowa				
Kentucky	Field review for QC items	Leader and District Bridge Engineer	Case by case	Resolve items from QC review of reports
Maine				
Maryland				
Massachusetts	Every team—Site visit	District Bridge Inspection Engineering	Periodic	Observe team at work
	Every team—Field evaluation	Area Bridge Inspection Engineer District Bridge Inspection Engineer	Twice a year	Field review for timeliness, safety, access, preparation Discuss findings with team
Michigan				
Minnesota				
Missouri				
Nevada				
New Jersey	Bridge sample—Verify inspections	DOT	10% of state bridges	
New Mexico				
New York	Every team—Site visit	QC Engineer	6 months	Observe team at work

(*continued*)

TABLE G6 (*Continued*)
QUALITY CONTROL FIELD REVIEW OF INSPECTIONS AND INSPECTION TEAMS

DOT	Field Review of Teams	Review by	Interval	Action
North Carolina	Every team—Verify inspections	Bridge Inspection Superintendent	3 bridges per team per 2 years	Feedback to team
	Bridge sample—Verify inspection	Area supervisor	2 weeks	
	Bridge sample—Verify inspection	Bridge Inspection Superintendent	10% of inspections	
	Every team—Verify inspection	Bridge Inspection Superintendent	24 months	
North Dakota	Team sample—Site visit			
Ohio				
Oklahoma	Every team leader—Verify inspection	Reviewing engineer	5 bridges/2 years	Field verification of current inspection report
Oregon				
Pennsylvania	One team (rotating)—Verify inspection	Bridge Inspection Supervisor	4 bridges/month	Verify Log event Comments to team
	Four bridge sample—Verify inspection	Bridge Engineer	4 bridges/ 3 months	Verify Log event Comments to Bridge Inspection Supervisor
	Team sample—Site visit	District Engineer or Assistant District Engineer for Design	Twice a year	Observe team at work, discuss, log QC effort Unannounced visit
	Bridge sample—Verify inspection	District Engineer or Assistant District Engineer for Design	2 bridges, twice a year	Log event, feedback to Bridge Engineer and Bridge Inspection Supervisor
Rhode Island	Bridge sample—Verify inspection	DOT staff		
South Dakota				
Texas	Bridge sample—Verify inspection	District personnel	10% of inspections	Part of report QC
Utah				
Vermont	Bridge sample—Verify inspection			Compare with current inspection report
Virginia	Every team leader—Verify inspection	District Structure and Bridge Engineer	3 months	Log of QC field visits For bridges maintained by the state
Washington				
West Virginia	Bridge sample—Verify inspection	Maintenance Division District Staff		Random field visits
Wisconsin				

TABLE G7
QUALITY CONTROL FOR INSPECTIONS BY CONSULTANTS

DOT	Consultant Review	QC	QA
Alabama	Consultants are included in QA review of DOT division.		A
Alaska	QC by DOT team leader	A	
Arizona			
Arkansas			
California			
Connecticut	Consultant's project engineer	C	
Delaware	Consultant's project manager	C	
Florida	DOT project manager makes periodic review of consultant records and procedures. Consultant must have written QC plan.	C	A
Idaho	Agency team leader reviews consultant's reports.	A	
Iowa	QC by consultant	C	
Kentucky	DOT's manager for consultant contract	A	
Maine	Consultant + DOT Assistant Bridge Maintenance Engineer	C, A	
Maryland	QC by consultant	C	
Massachusetts			
Michigan	Bridge owner	A	
Minnesota			
Missouri	Supervising Bridge Inspection Engineer for state bridges Structural Services Engineer for non-state bridges	A A	
Nevada	Consultant's PE project manager	C	
New Jersey	Consultant staff reviews their reports. DOT contract manager reviews consultant submissions.	C	A
New Mexico	All reports signed and reviewed Database entry and review by DOT NBI changes reviewed by DOT	C, A	
New York	Consultant PE designated as QC engineer	C	
North Carolina	Consultants perform their own QC	C	
North Dakota	Consultant must have QC plan in place	C	
Ohio	Consultant reviews inspection reports	C	
Oregon	Local agency makes first review. DOT's Local Agency Bridge Inspection Coordinator reviews at entry to state database system.	A	
Pennsylvania	Consultant follows contract QC plan. District Bridge Inspection Manager approves consultant QC plan.	C	A
Rhode Island	Consultant's PE makes QC review. DOT verifies QC plan and execution.	C	A
South Dakota			
Texas	DOT reviews 10% of office work and 7% of field work. Consultant's performance information is documented using an evaluation process by the TxDOT.		A
Utah	DOT reviews qualifications of consultant staff.		A
Vermont			
Virginia	QC by consultant staff QA by DOT Engineer I	C, A	A
Washington	QC by hiring agency (may be local bridge owner) QA by DOT Regional Inspection Supervisor	A	A
Washington	Underwater and equipment inspections: inspections visited during site work	A	
West Virginia	DOT performs desk reviews and selected field reviews of inspection work.	A	A
Wisconsin			

Notes: A = agency or DOT; C = consultant.

TABLE G8
VALIDATION OF QUALITY CONTROL PROGRAMS

DOT	QC Program Validation
Alabama	
Alaska	
Arizona	
Arkansas	Random review of four bridges per year per district
California	Program manager validates with input from office chiefs and staff
Connecticut	Manager of Bridge Safety and Evaluation determines changes/improvements to QC
Delaware	
Idaho	FHWA approval
Iowa	Processing of biennial inspection data is randomly assigned to the technical team members and staff engineers.
Kentucky	
Maine	Annual in-house training General consistency review of data
Maryland	Monthly inspection status/summary report
Massachusetts	Oversight by Area Bridge Inspection Engineer
Michigan	QA review validates QC practices
Minnesota	
Missouri	
Montana	Annual district-level internal review of QC plan with report to state Bridge Management Engineer
Nevada	10% QA sample to validate QC
New Mexico	
New York	QA is check on QC
North Carolina	Annual review and discussion with FHWA
North Dakota	Central office reinspects 5%–10% of structures; comparison with inspector results
Ohio	
Oklahoma	
Oregon	
Pennsylvania	
Rhode Island	QC procedures are reviewed as needed
South Dakota	In development
Tennessee	
Texas	Bridge division does office and field reviews of districts; includes review of district QC procedures
Utah	Periodic refresher training for inspectors
Vermont	Informal; no written procedures exist at this time
Virginia	QA is validation of QC
Washington	Local agency QC procedures reviewed in QA by state
West Virginia	Independent review of inspections
Wisconsin	

TABLE G9
BASIC ELEMENTS OF QUALITY ASSURANCE REVIEW

DOT	Target	Office Review	Field Review	Reviewer	QA Report
Alabama	District	Yes		Central—Emergency bridge inspection team	Report using standard form To DOT Division, Central Office, and FHWA
Alaska					QC methods
Arizona	District		Yes Verify inspection reports	QA team	Recommendations for additional training
Arkansas	District		Yes Verify four inspection reports		QA report using standard form
California		Yes	Yes	QA team (supervisors)	Quarterly report Discussion with inspection teams
Connecticut		Yes	Yes Independent inspection	QA Manager QA inspection team	QA report to Manager of Bridge Safety and Evaluation Section
Delaware	Team		Yes Verify three inspections per team leader	Bridge Inspection Manager	QA report of field verification
Idaho					QA process in development
Iowa	Team	Yes Review two inspection reports	Yes Observe team at two sites	Area Bridge Maintenance Engineer	Report of review
Kentucky	District	Yes		Program Manager	Internal report of review Discussion with district staff
Maine		Yes			Training records Staff performance reviews
Maryland		Yes Audit of inspection			QA record of audit
Massachusetts	District	Yes		Bridge Inspection Engineer Area Bridge Inspection Engineer District Bridge Inspection Engineer	
	Team	Yes Inspection report	Yes Site visit to team	Area Bridge Inspection Engineer District Bridge Inspection Engineer	Standard form for QA field review of team Standard form for QA review of inspection Discuss with team
Michigan					QC methods

(*continued*)

TABLE G9 (*Continued*)
BASIC ELEMENTS OF QUALITY ASSURANCE REVIEW

DOT	Target	Office Review	Field Review	Reviewer	QA Report
Minnesota	District	Yes			
Missouri					QC methods
Montana	District	Yes Inspection reports	Yes Independent inspection	Bridge Management Section	QA report to state Bridge Engineer Discuss with district at staff meeting
	QA procedures	Yes Internal self-audit		Bridge Management Section	QA report to state Bridge Engineer Internal discussion in section
Nevada	Team	Yes Review inspection reports	Yes Independent audit inspections		QA record of audit
New Jersey	Inspection consultant	Yes Review of inspection reports			Report to Consultant Evaluation Rating System
New Mexico	Inspection report	Yes Review of significant condition		Design Engineer	Engineer's input on significant condition or finding
New York	District	Yes		Civil Engineer II, Main Office	Acceptance of inspection reports
	Inspection report	Yes		Inspection Liaison Engineer	Standard checklist for review of report
	Team		Yes	Structures Division	Standard form for field review of team
North Carolina	Inspection report		Yes Independent inspection	Bridge Inspection Supervisor + FHWA	In-depth inspection, followed by discussion at close-out meeting
North Dakota	Team		Yes	Peer team	Discussion among teams
Ohio	District	Yes		Statewide QA Review	QA report to Program Manager
	Inspection report	Yes		State Program Manager District Program Manager	Review of selected reports for routine inspections, special inspections, deficient bridges, load-posted bridges
	Team		Yes	Statewide QA Review	Discussion with inspector of record
Oklahoma	District		Yes Verify inspections		Report of field review
	State		Yes Control bridges		Annual training for team leaders
	Team		Yes Verify inspections	Reviewing engineer	Report of field review
Oregon	District	Yes	Yes	Peer teams from other districts	Report of review

(*continued*)

TABLE G9 (*Continued*)
BASIC ELEMENTS OF QUALITY ASSURANCE REVIEW

DOT	Target	Office Review	Field Review	Reviewer	QA Report
	Team		Yes Verify inspections	Peer team	Discussion among team and peer team Summary sheet of the review
Pennsylvania	District	Yes	Yes Independent inspection	Bridge Quality Assurance Division (central)	District summary report Discussion at close-out meeting Annual statewide summary
Rhode Island					QC methods
South Dakota					In development
Tennessee	District	Yes	Yes Verify inspection report	Manager SI&A	Report itemizing deficiencies
Texas	Team	Yes Inspection report			QA record of review
Utah	Inspection report	Yes Audit of report	Yes Independent inspection	PE or peer inspection team	Scorecard for QA review
Vermont	Inspection report		Yes Independent inspection	Civil Engineer IV	Notes of review to inspector of record
Virginia	District	Yes			Report including QA checklist
	Team		Yes Verify inspection report		Record of review Recommendations for improvement in next cycle
Washington	District	Yes			
	Inspection report		Yes Verify inspection report	Regional Bridge Inspection Engineer	Report on discrepancies
	Team leader		Yes Site visit during work		Employee Development and Performance Plan
	Underwater inspection		Yes Site visit during work		
West Virginia					QC methods
Wisconsin	District	Yes	Yes	DOT central office	Standard reporting forms

SI&A = Structural Inventory and Appraisal.

TABLE G10
QUALITY ASSURANCE REVIEW OF BRIDGE INSPECTIONS

DOT	Bridge Review Unit	Unit Bridge Reviews	Review Activity	Basis for Bridge Selection	Review Current Inspection Report	Review Bridge File	Review Load Rating
Alabama	Division						
Alaska			100% report review by peer leader				
Arizona	Region	10% of bridges		Bridges in region	Yes		
Arkansas		40 bridges		Random selection	Yes	Yes	
California		2% of bridges		Random, but represent fracture-critical, timber, and posted bridges	Yes	Yes	Yes
Connecticut	State/entire program	Representative sample	Independent inspection	Representative sample of bridges			
Delaware		24 full QA/QC reviews	Site visit by Bridge Inspection Manager and Bridge Management Engineer	Random selection			
Florida	Inspection team	Yes	Site visit by Bridge Inspection Supervisor	Random selection of team's bridges			
Idaho		Random number		Random selection	Yes	Yes	
Iowa	Inspection team	2 bridges; field visit with team 2 bridges; independent QA inspection		Bridges for inspection team			
Kentucky	District	5 bridges per district	Independent inspection	Random, but representative sample Selection not tied to teams	Yes	Yes	Yes
Maine		100 to 150 bridges	Review by Assistant Bridge Maintenance Engineer, Bridge Management Engineer, and the Bridge Design Engineer	Bridges in poor condition	Yes	Yes	Yes
Maryland		50% of bridges		Random selection	Yes		
Massachusetts	Inspection team	Yes	Formal comparison of condition ratings from inspection and from review				
Michigan	District or local agency	5% of bridges for each unit or program			Yes	Yes	Yes
Minnesota	District or local government	2 or 3 bridges	Verification of condition and inventory data				
Missouri							
Montana		5% of bridges	Independent inspection				
Nevada		10% of bridges		Random selection in district Include all bridge types Represent all inspectors	Yes	Yes	
New Mexico		40 bridges		Random Bridges with questionable sufficiency rating	Yes	Yes	

(*continued*)

TABLE G10 (*Continued*)
QUALITY ASSURANCE REVIEW OF BRIDGE INSPECTIONS

DOT	Bridge Review Unit	Unit Bridge Reviews	Review Activity	Basis for Bridge Selection	Review Current Inspection Report	Review Bridge File	Review Load Rating
New York		25% of bridges		Random—Bridges with condition rating 5 or lower. Bridges with critical findings (flags)	Yes		
North Carolina	Inspection team	10% of inspections		3 bridges per team per 2-year cycle No overlap with other field visits, field reinspections, etc. Bridges selected for inspection team	Yes	Yes	
	Statewide	2 or 3 bridges	Independent inspection				
North Dakota		5% to 10% of bridges		Random, selected in various districts	Yes	Yes	
Ohio	District or other inspection program	2 to 5 bridges per 24 months	Report and bridge file taken to field for verification; this is called QC Review performed with inspector of record	Deficient bridges Unique problems or features			
Oklahoma	Inspection team leader	5 bridges per 24 months	Field verification by reviewing engineer; team leader is present for verification	Bridges for team leader			
	Inspecting agency	5 bridges per 24 months					
Oregon	Region	5% of regional inventory		Worst bridges. Owner concern			
	Statewide	Goal: 300 (5%); actual: ~175 bridges		Poor condition; needing rehab New to inventory; load capacity issue; shoring in place	Yes	Yes	
Pennsylvania	Statewide	345 bridges per cycle		Type, length, sufficiency rating Inspected last 6 months	Yes	Yes	Yes
Rhode Island		5 per year		Bridge type Condition and age	Yes	Yes	Yes
South Dakota		Currently being developed		Currently being developed			
Tennessee	Each region, annually	Sampling, annually	Reinspection of bridges				
Texas	Districts	10% of bridges	100% database review	By districts; at random as check on consultant By division; poor condition, scour problems, posted, priority rehabilitation	Yes	Yes	Yes
Utah		1% of inspections		Recently inspected Poor condition ratings	Yes	Yes	Yes
Vermont		1% bridges per year		Random based on inspection area	Yes		
Virginia	District	150 bridges (1.5%)		Two bridges per team Last six months inspection Critical recommendations, fracture critical, fatigue prone, bridge type, ADT, load ratings	Yes	Yes	Yes
Washington	Regional/local	3 per team leader; ~100 bridges		Random Condition—posting, scour critical, material type, critical issues Selected for team leader	Yes	Yes	Yes

(*continued*)

TABLE G10 (*Continued*)
QUALITY ASSURANCE REVIEW OF BRIDGE INSPECTIONS

DOT	Bridge Review Unit	Unit Bridge Reviews	Review Activity	Basis for Bridge Selection	Review Current Inspection Report	Review Bridge File	Review Load Rating
	Statewide	Sampling	Verification of current report	UBIT access			
West Virginia		45% of bridges		Random selection	Yes		Yes
Wisconsin	District—Level 1 QA review	3 bridges		Bridges on replacement list Unusual features or problems			
	Local Government —Level 2 QA review	2 bridges		Bridges on replacement list Unusual features or problems			

ADT = average daily traffic; UBIT = under bridge inspection trucks.

TABLE G11
QUALITY ASSURANCE INTERVALS

DOT	Team/Team Leader Interval	Region/District Interval	Note
Alabama		24 months	Division review includes cities and counties
Alaska			
Arizona	24 months		
Arkansas		4 bridges per 12 months	
California	24 months	24 months	QA review of administrative area, not individuals
Connecticut	6 months		
Delaware			
Florida	3 months		Field visit to observe team at work
Idaho	12 months		
Iowa	36 months		
Kentucky	12 months	12 months	
Maine	12 months		
Maryland	12 months		
Massachusetts	6 months		
Michigan		12 months	
Minnesota		12 months	Certification by local agency inspection program
Missouri			
Montana		12 months 12 months 12 months	Central office review of submitted documents Field review of districts 5% bridges independent inspection
Nevada	4 months	12 months	
New Mexico	36 months	36 months	
New York	12 months	12 months	
North Carolina	Monthly	N/A	
North Dakota			
Ohio		48 months, state 48 months, county 48 months, city, town, village	
Oklahoma	24 months	24 months	
Oregon	12 months	12 months	
Pennsylvania		12 months 12 months 24 months, local agencies	Annual meeting Annual review of each district
Rhode Island	N/A		
South Dakota		Currently being developed	
Tennessee		12 months, all regions	

(*continued*)

TABLE G11 (*Continued*)
QUALITY ASSURANCE INTERVALS

DOT	Team/Team Leader Interval	Region/District Interval	Note
Texas	At the end of each work assignment	48 months	
Utah			
Vermont	Varies, no specific interval		
Virginia			
Washington	12 months	36 months for local agencies	
West Virginia		24 to 36 months	
Wisconsin		24 months, state program 48 months, local programs	

N/A = not applicable.

TABLE G12
ASPECTS OF QUALITY ASSURANCE REVIEW

DOT	Object	Tolerance
Alaska	NBI rating, change	Change of 2 or more in one cycle must be justified
Arizona	NBI rating	±1
Arkansas	NBI rating	±1
	Load rating	10%
California	Engineering calculations	Independent check of calculations
Delaware	NBI ratings 5 and up	±1
	NBI rating 4 or lower	0
	Element-level condition	No values set
Idaho	NBI condition rating	±1
	Element-level condition	No set values
	Inventory load rating	5%
Iowa	NBI condition rating	±1
Kentucky	NBI condition rating	±1
	Element-level condition	±1
Maine	NBI condition rating	±1
	Load rating	10%
Maryland	NBI condition rating	±1
Massachusetts		
Michigan		
Minnesota		
Missouri		
Nevada	NBI condition rating	±1
	Element-level condition	Significant deviation in quantities
New Mexico	NBI condition rating	±1
New York	NYS condition rating	±1
	NYS element rating	±1
North Carolina	NBI condition rating	±1
	Set of NBI ratings	±1
	Load rating	Unwarranted rating or posting
North Dakota	NBI condition rating	±1
	Element-level condition	±1
	Load rating	10%
Ohio	NBI condition rating	±1
	Element-level condition	±1
Oklahoma		
Oregon	NBI condition rating	±1
	NBI coding for sufficiency rating	Exact
	Element list	Must be exact
	Load rating	Reviewed by PE; might be prepared by EIT
	Load rating—Complex bridge or load Restriction	Prepared by PE; reviewed by PE
Pennsylvania	NBI condition rating	±1
	Load rating	±15%
	Posted bridge load rating	±2 tons
Rhode Island	NBI condition rating	±1
	Element-level condition	Depends on element
South Dakota		Currently being developed
Texas	NBI condition rating	±1
	Element-level condition	±1
	Load rating	Incorrect values or configuration
Utah	NBI condition rating	±1
Vermont	NBI condition rating	±1
	Element-level condition	±5%
	Load rating	All load ratings are “as new”
Virginia	NBI condition rating	±1
	Element-level condition	10%
	Load rating	10%
Washington	Element-level condition	15%
	Load rating	Ratings updated as needed
West Virginia	NBI condition rating	±1
	Element-level condition	N/A
	Load rating	Nothing definitive
Wisconsin		

NYS = New York State; EIT = engineer in training; N/A = not applicable.

TABLE G13
QUALITY ASSURANCE BENCHMARKS

DOT	Benchmark	QA Report	Consultant Benchmark
FHWA Framework	Bridge sampling and validation	Results of sampling and review	Included
Alabama	Recommended actions to correct deficiencies Formal aspects of QA review	Yes, by division to central, to division, and to FHWA	Included in field review, especially for cities and counties
Alaska			
Arizona	None established	No	No
Arkansas	No policy	No	No
California	Findings of QA inspections	We plan on a newsletter 3 to 4 times per year that would describe findings, program news, and training articles.	
Connecticut		QA reports for programs and for teams	
Delaware	Previous QA/QC results	Within our own section we keep records	No
Florida	Compliance with QC plans		Field observation of teams once per quarter Independent verification of inspections for 5% of bridges of initial phase of contract
Idaho	No	No	No
Iowa	No	No	No
Kentucky	FHWA review	No	No
Maine	Quality and reliability of data; adequacy of data for planning and programming network	No	No
Maryland	None	No	No
Massachusetts	Formal aspects of QA review	Yes	
Michigan			
Minnesota	Formal aspects of QA review	Yes	
Missouri		District QA review of local government inspection program	
Nevada	None	Audit reports at 4-month interval	None separate
New Mexico	None	No	No
New York	None	No	Not formally, but yes as part of their performance review
North Carolina	No benchmarks	No periodic report	No tracking
North Dakota	N/A	No	N/A
Ohio	Formal aspects of QA review	Yes	

(*continued*)

TABLE G13 (*Continued*)
QUALITY ASSURANCE BENCHMARKS

DOT	Benchmark	QA Report	Consultant Benchmark
Oklahoma	Control bridge inspections at annual training		
Oregon	ODOT Bridge Inspection QA Review Summary Sheet	No	Yes
Pennsylvania	95% accuracy of component condition and appraisal ratings New measures and benchmarks for accuracy of load ratings and inventory data are being considered	Annual statistical analyses of the 11 individual districts and the statewide results are produced, which includes findings, conclusions, and recommendations for improvements to inspection-related procedures and training.	Not for individual inspection firms
Rhode Island	Benchmark is to provide reliable, accurate, and consistent bridge ratings and information. Problems are continually identified and resolved.	No	No
South Dakota	Currently being developed	Currently being developed	
Tennessee	Formal aspects of QA review	Report on differences found in field verification of sample of bridge inspections	
Texas	No	No	No
Utah	Sufficiency rating Past due inspections Deficient deck area	Performance measures are presented online	No
Vermont	N/A	N/A	Consultants not used routinely
Virginia	No	No	No
Washington		Results of all QA reviews will be included in an annual report to FHWA. This report will summarize review findings with respect to NBIS requirements such as personnel qualifications, and bridge file completeness (scour evaluations, load ratings, and inspection).	Consultants are judged on the ability to provide the local agency bridge owner with correct, quality bridge program services. The agency will be responsible to contract with consultants that are qualified to do the work.
West Virginia	Under discussion	None at present	No
Wisconsin	Formal aspects of QA review	Program review form. Standard format/items for review and report	

N/A = not applicable.

TABLE G14
BASIS FOR DISQUALIFICATION OF INSPECTION PROGRAM STAFF

DOT	Team Leaders	Load Raters	Inspection Consultants
Alaska			
Arizona			
Arkansas	Critical findings missed or not in inspection report		Critical findings missed or not in inspection report
California	No written definition Poor performance in QA reviews will be discussed with inspector's supervisor and office chief.		
Delaware	Not meeting inspection schedule; tardiness, consistently coding/rating incorrectly, incomplete reports		Not meeting schedule; incomplete reports
Idaho	Failure of on-time reports, frequent inconsistent reports, frequent out-tolerance condition ratings		Failure of on-time reports, frequent inconsistent reports, frequent out-tolerance condition ratings
Iowa			
Kentucky	Lack of proper follow-up or recognition of critical needs Failure to correct findings from QC or QA reviews Recurring miscoded inventory or inspection items Recurring miscoded critical elemental items such as structural elements or SmartFlags Failure to attend continuing education classes as required		
Maine	Lack of thoroughness, accuracy, safety	Poor engineering judgment	
Maryland	Lack of consistency and use of existing criteria	Erroneous analysis	Lack of consistency and use of existing criteria
Michigan			
Minnesota			
Missouri			
Nevada	Not an occurrence, yet	Not an occurrence, yet	Failure to conform to NDOT standards
New Mexico			
New York	Consistently missed ratings, poor documentation, and missed critical findings	Inaccurate load ratings	Consistently missed ratings, poor documentation, and missed critical findings
North Carolina	Not performing accurate work in a timely manner; failure to follow instructions and guidelines	Not performing accurate work in a timely manner; failure to follow instructions and guidelines	Failure to follow guidelines and instructions and failure to be cooperate with and respond to NCDOT Bridge Maintenance

(*continued*)

TABLE G14 (*Continued*)
BASIS FOR DISQUALIFICATION OF INSPECTION PROGRAM STAFF

DOT	Team Leaders	Load Raters	Inspection Consultants
North Dakota			
Ohio			
Oklahoma	Repeated errors, refuse to train, no response to QC/QA input, no follow-up on critical finding or posting		
Oregon	More than four errors is poor	Errors such that load capacity is not accurate	More than four errors is poor
Pennsylvania	Not reviewed on individual basis	Not reviewed on individual basis	Not reviewed on individual basis
Rhode Island	N/A	N/A	Depends on nature of problem
South Dakota	Currently being developed	Currently being developed	Currently being developed
Tennessee			
Texas			Evaluation on accuracy, schedule management, level of oversight, responsiveness Districts complete evaluation form at end of work assignment, focusing on consultant firm and firm's project manager.
Utah	Case by case		Case by case
Vermont	Has never been a problem or issue		
Virginia	Not completing assignments by standards, not meeting timeline	Not completing assignments by standards, not meeting timeline	Not completing assignments by standards, not meeting timeline
Washington	Not meeting responsibilities of position		
West Virginia	Not defined		
Wisconsin			

N/A = not applicable.

TABLE G15
INSPECTOR REMEDIES, DISQUALIFICATION, AND ADVANCEMENT

DOT	Inspector QA Remedies	Personnel Requalify	Promotion/Award
Alabama	Inspector not reviewed		
Alaska			
Arizona	Training, coaching	No policy	Yes
Arkansas	Never had that problem	No policy	
California	Training	No policy	
Delaware	Refresher training, other training	No policy	No occurrence
Idaho	Have not had this occurrence	No occurrence	
Iowa	On-the-job training	No specific procedures	Significant problems could affect promotion or award
Kentucky	Additional training	Retraining	No
Maine	Training, recommendations on performance		Yes
Maryland	Never encountered this issue		
Michigan			
Missouri			
Nevada	Agency: no occurrence Consultant: dismiss inspector	Consultant instructed to remove employee Usually do not requalify	Agency: No Consultant: Yes
New Mexico	NHI course 130055 every 5 years	No occurrence	No
New York	Training, additional quality review, remedial discussion	Consultants respond to DOT instructions	No
North Carolina	Further coaching and training by supervisors	Consultants must demonstrate leadership changes and personnel changes	Yes, review results are taken into consideration for promotions and consultant selection.
North Dakota	Training or removal from team	Training and appeal to Bridge Engineer	Yes
Ohio		No policy	
Oregon	Training, additional quality review Inspector could lose certification		Agency: No Consultant: Yes, some influence on selection
Pennsylvania	Training; additional review; addressed by supervisor. QA does not formally evaluate individuals.	Retesting is allowed	No occurrence
Rhode Island	Depends on problem	Depends on problem	Potentially
South Dakota	Currently being developed		
Texas	Consultant: Training and actions recommended by project manager; discussion	Consultant: Must demonstrate actions to correct deficiencies	Agency: personnel review issue Consultant: QA affects firm rank in selection process
Utah	Case by case	Case by case	Yes, but situation has not occurred

(*continued*)

TABLE G15 (*Continued*)
INSPECTOR REMEDIES, DISQUALIFICATION, AND ADVANCEMENT

DOT	Inspector QA Remedies	Personnel Requalify	Promotion/Award
Vermont	Discussion to find out why the difference, perception, timing of the inspection (accelerating deterioration), etc.	Has never been done	
Virginia	Counseling, training	Training and reevaluation of personnel	Yes
Washington	Coaching, training, demonstrations, additional quality review	Training as new inspector	10% weight
West Virginia	Coaching, specific instruction on correction	No policy	No

Abbreviations used without definitions in TRB publications:

AAAE	American Association of Airport Executives
AASHO	American Association of State Highway Officials
AASHTO	American Association of State Highway and Transportation Officials
ACI–NA	Airports Council International–North America
ACRP	Airport Cooperative Research Program
ADA	Americans with Disabilities Act
APTA	American Public Transportation Association
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
ATA	Air Transport Association
ATA	American Trucking Associations
CTAA	Community Transportation Association of America
CTBSSP	Commercial Truck and Bus Safety Synthesis Program
DHS	Department of Homeland Security
DOE	Department of Energy
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
FHWA	Federal Highway Administration
FMCSA	Federal Motor Carrier Safety Administration
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
IEEE	Institute of Electrical and Electronics Engineers
ISTEA	Intermodal Surface Transportation Efficiency Act of 1991
ITE	Institute of Transportation Engineers
NASA	National Aeronautics and Space Administration
NASAO	National Association of State Aviation Officials
NCFRP	National Cooperative Freight Research Program
NCHRP	National Cooperative Highway Research Program
NHTSA	National Highway Traffic Safety Administration
NTSB	National Transportation Safety Board
SAE	Society of Automotive Engineers
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (2005)
TCRP	Transit Cooperative Research Program
TEA-21	Transportation Equity Act for the 21st Century (1998)
TRB	Transportation Research Board
TSA	Transportation Security Administration
U.S.DOT	United States Department of Transportation