



**NATIONAL INSTITUTE FOR CERTIFICATION IN ENGINEERING TECHNOLOGIES®**  
sponsored by the National Society of Professional Engineers

Transportation Engineering Technology  
**BRIDGE SAFETY INSPECTION**

**PROGRAM DETAIL MANUAL**

Please check NICET's web site ([www.nicet.org](http://www.nicet.org)) to make sure you have the most recent edition of this document.

Effective upon issuing a new edition of any program detail manual, all previous editions of that program detail manual become obsolete.

This manual may be freely copied in its entirety.

## CAUTION

The Institute occasionally makes changes in its certification programs which will significantly affect the currency of individual program detail manuals. These changes could include any or all of the following:

- o deletion, modification, or addition of work elements
- o modification to the Examination Requirements Chart
- o modifications to crossover work element credit
- o changes to the work experience requirement
- o changes to the verification requirement

**KEEP YOUR  
MANUALS  
CURRENT**

Since these changes could affect the requirements for certification, it is highly recommended that you contact the Institute before applying for an examination if this manual is more than a year old. The date of publication of this manual is June 1995.

It is the responsibility of all applicants to make sure they are using a current manual.

**CHANGES  
TO THIS  
MANUAL**

This Fourth Edition of the Bridge Safety Inspection does not have any changes from the Third Edition (5/93) except for an expansion of the explanation on crossover work element credit.

Once certified, each certificant will be mailed an annual renewal bill. If the yearly payment is not made for three consecutive calendar years, the certification "expires" (all certification records as well as all previous testing records will be deleted) and active certification can be regained only by reapplying as a new applicant and meeting the current criteria.

**PAYMENT OF  
ANNUAL  
RENEWAL BILL**

Payment of an exam fee does not substitute for payment of the annual renewal fee.

**FIELD OF TRANSPORTATION ENGINEERING TECHNOLOGY**

**SUBFIELD OF BRIDGE SAFETY INSPECTION**

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## **GENERAL INFORMATION**

This Program Detail Manual contains the information needed to apply for the NICET certification examination in the Bridge Safety Inspection subfield of Transportation Engineering Technology.

This manual does **not** contain all of the rules and procedures for obtaining certification. For this, you must refer to our website ([www.nicet.org](http://www.nicet.org)).

National Institute for Certification in Engineering Technologies (NICET)  
1420 King Street, Alexandria, Virginia 22314-2794  
703-684-2835 (9:00 am to 4:00 pm)  
1-800-787-0034 (24-hrs, messages only)

This certification program is for technicians engaged in the safety inspection of **existing** bridges in order to determine their physical condition, maintenance needs, and potential hazards. (This program is **not** designed for technicians engaged in the construction and inspection of new bridges.) The program tests knowledge of the physical sciences, the materials and structural elements of common and special bridges, and the analysis, rating, and reporting of bridge inspection results.

This program became operational in 1985. Development of the program was initiated in 1983, with technical guidance from the U.S. Department of Transportation, various state departments of transportation, and various local agencies and entities actively engaged in the bridge inspection process.

## **WORK ELEMENT DESCRIPTIONS**

The typical job duties and associated responsibilities of bridge safety inspection technicians have been broken down into discrete work elements which form the basis for an evaluation of the candidate's knowledge. Each work element is written in sufficient detail to permit candidates who have the appropriate work experience to make reasonable assumptions about the types of questions likely to be asked.

In addition, the supervisor verifying the experience of the candidate should be able to interpret the scope of the activities associated with each work element.

## **FIELD CODE AND WORK ELEMENT IDENTIFICATION NUMBERS**

In order for us to prepare individualized examinations for each applicant, identification numbers have been assigned to each technical field and to each work element. Each technical field is represented by a 3-digit number. The technical field code number for Transportation Engineering Technology is 001.

The identification number assigned to each work element is 5 digits long. The **first digit** identifies the technical subfield within the field of Transportation Engineering Technology:

### (7) Bridge Safety Inspection

- |                                |                         |
|--------------------------------|-------------------------|
| (1) Highway Construction       | (2) Highway Design      |
| (4) Highway Traffic Operations | (5) Highway Surveys     |
| (8) Highway Materials          | (9) Highway Maintenance |

The second digit identifies the level (Levels I through IV) and the work element type (General or Special):

**GENERAL WORK ELEMENTS**

- (1) Level I General
- (3) Level II General
- (5) Level III General
- (7) Level IV General

**SPECIAL WORK ELEMENTS**

- (2) Level I Special
- (4) Level II Special
- (6) Level III Special
- (8) Level IV Special

The third, fourth and fifth digits identify the individual work element within each category.

A sample of this numbering system is illustrated below for work element number 001/75005:

Technical Field Code:	001	(Transportation Engineering Technology)
Subfield:	7	(Bridge Safety Inspection)
Level/Type:	5	(Level III General)
Work Element Number:	005	

This eight-digit identification number is needed when using the application form to request an examination or provide work element verification.

**REQUIREMENTS FOR CERTIFICATION AT LEVELS I THROUGH IV**

Level I is designed for entry-level technicians with very limited relevant work experience in this technical subfield. We recommend that persons with eighteen or more months of relevant work experience set their initial certification goal at Level II. Certification at a particular level does NOT require prior certification at a lower level. The Examination Requirements Chart on the next page lists the actual examination requirements for certification at Levels I, II, III, and IV in the subfield of Bridge Safety Inspection.

**WORK ELEMENT SELECTION FOR AN INITIAL EXAM**

1. Refer to the Examination Requirements Chart on the following page.
2. Select the appropriate box for the level of certification desired.
3. Note the number of work elements required for certification, by category, as shown in the selected box.
4. Turn to the Work Element Listing section and carefully select work elements from the required categories, paying attention at each level to whether they are classified as General or Special work elements. The General work elements are further divided into Core work elements and Non-Core work elements. Core work elements are those whose successful completion is MANDATORY for certification at Levels II, III and IV. When selecting work elements for testing, it is recommended that Core work elements be given preference; then selection should be based on those remaining work elements most likely to be passed.
5. When possible, select a few extra in each category so that failing one or more work elements leaves enough passed work elements to satisfy the examination requirements.
6. If the requirement for the desired level is more than 34, it is advisable to examine first all lower level work elements needed to achieve certification. Save the upper level work elements for a subsequent examination.
7. It is highly recommended that the maximum number of work elements (34) be selected for each examination taken. Selection of 34 work elements provides the greatest opportunity for successful completion of the examination requirements with the smallest number of subsequent examinations. Recognize, however, that all elements selected on an exam application WILL BE SCORED, even if no attempt is made to answer the question. That is, a score of

"0" will be assigned to the work element if the questions are not answered and the work element will have one failure marked against it.

8. It is strongly recommended that all applicants keep a copy of their completed application. This will assist in resolving questions over the telephone.

# EXAMINATION REQUIREMENTS CHART

## (Subfield: Bridge Safety Inspection)

You must pass the number of work elements shown in each category to achieve certification at that level.

You must pass this many work elements to achieve certification at Level I

Level I - General - 6 Level I - Special - 4  TOTAL 10
--

You must pass this many work elements to achieve certification at Level II

Level I - General - 8c Level I - Special - 6 Level II - General - 7c Level II - Special - 4  TOTAL 25
--

You must pass this many work elements to achieve certification at Level III  
Note (a)

Level I - General - 8c Level I - Special - 6 Level II - General - 7c Level II - Special - 8 Level III - General - 13 Level III - Special - 4  TOTAL 46
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You must pass this many work elements to achieve certification at Level IV  
Notes (a) and (b)

Level I - General - 8c Level I - Special - 6 Level II - General - 7c Level II - Special - 8 Level III - General - 13 Level III - Special - 6 Level IV - General - 6 Level IV - Special - 5  TOTAL 59
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**NOTES:**

- (a) Time restrictions dictate that no more than 34 work elements can be scheduled for any single examination sitting. Therefore, at least two examination sittings will be needed in order to complete this requirement.
- (b) Read very carefully the two sections applicable to Level IV certification in this manual before seeking Level IV certification.
- (c) All 6 work elements in this category which are listed as CORE must be passed to complete the exam requirement at this level.

**GENERAL NOTES:**

- (1) Work elements passed which are in excess of the requirement at a particular level and which can be used to meet the requirement at the next higher level are automatically applied to that higher level requirement.
- (2) Use the Personal Tally Worksheet on page 16 of this manual to keep track of the number of work elements you

have successfully passed.

### **WORK ELEMENT SELECTION FOR ALL SUBSEQUENT EXAMS**

All the items listed on page 2 for the selection of work elements apply to subsequent exams. In addition, the following should be understood:

1. It is not necessary to retest work elements which were failed on an earlier examination if there are other work elements in the appropriate categories which can be selected instead. If you do retest a failed work element, you will be blocked from testing it a fourth time if it has been previously failed three times. For further details, read the information on repeating failed work elements in Section IV and read Policy #20 on the website (www.nicet.org).
2. If an adequate number of work elements has been selected to meet the certification requirement (with a few extra selected to provide a cushion), and there is room on the exam application to add more elements, it is appropriate to include work elements that will satisfy the examination requirement of the next level of certification or to include work elements from another subfield or another field.

### **CROSSOVER WORK ELEMENTS**

"Crossover" work elements are those which we have identified as being identical or nearly identical in topic coverage and test questions to work elements in selected other fields/subfields. In addition, almost all of the certification programs have "generic" crossover work elements covering communication skills, mathematics, physical science and other basic areas of knowledge which should be known by all engineering technicians. Once a crossover work element is passed on an examination, it does not normally have to be taken again on any other examinations. Crossover credit for the passed elements will be assigned to an examinee's record according to items 1-8 below.

1. **First Time Testing in New Subfield:** As soon as you test work elements from a new subfield (at least one element), any crossover credit from previously-tested subfields will automatically be assigned to the new subfield. At the same time, any crossover credit from the new subfield will automatically be assigned back to previously-tested subfields. This assignment of crossover credit will occur every time a new subfield is tested.
2. **Additional Testing in Previously-Tested Subfield:** When you test new work elements or retest failed work elements from a previously-tested subfield, any crossover credit from the newly-passed work elements will automatically be assigned to all previously-tested subfields.
3. No crossover credit will be assigned to your testing record for a subfield until you test at least one work element from that new subfield.
4. We will print and mail, for a nominal fee, an **"Official Personal Transcript"** which will list all work elements presently credited to your testing record (including those passed on an exam and those achieved through crossover) for a designated subfield. See the website (www.nicet.org) for ordering information.
5. We will print and mail, for a nominal fee, a **"Personal Crossover Evaluation"** which will list your "potential" crossover credit to a designated UNTESTED subfield. This will enable you to see how close (or how far) you are from passing an exam requirement. See the website (www.nicet.org) for ordering information. People who obtain this "Personal Crossover Evaluation" need to read and understand the cautionary statement printed on the next page.
6. We will print and mail, free of charge, a **"Crossover Listing"** between any two subfields designated. This list is different from #5 above in that it is not printed for a specific examinee, but rather shows all current crossovers between the two specified subfields available to any examinee. See the website (www.nicet.org) for ordering information. The cautionary statement below needs to be understood.
7. Crossover credit will not be assigned to or from work elements if the certification is in Delinquent or Expired Status.

8. The same 120-day waiting period policy which applies to failed work elements (see item #1 at the top of page 4) also applies to all work elements which have crossover credit to that work element (read Policy #20 on our website (www.nicet.org)).

The work elements in the Bridge Safety Inspection program which provide crossover credit to other programs are identified in the Work Element Listing in this manual by an asterisk (\*) after the work element number. The "generic" crossover work elements are identified by a circumflex (^) after the work element number.

#### CAUTION

Crossover credit shown on the "Personal Crossover Evaluation" (item #5 above) and on any Crossover Listing (item #6 above) cannot be assumed to be permanent since revisions to certification programs can occasionally eliminate previous crossovers relationships or create new ones. For this reason, crossover credit is permanently assigned only when new testing takes place. Only those crossover relationships in existence at that point in time are credited.

If you receive a "Personal Crossover Evaluation", you must understand that the crossovers listed have not been posted to your record; therefore, it is a "potential" list. Only when a new subfield is tested and the crossover credit is posted to your record does it become permanent. Only the "Official Personal Transcript (item #4 above) shows the crossover credit actually awarded.

#### **VERIFICATION OF WORK ELEMENTS**

Verification should be provided by the applicant's immediate supervisor. The verifier, by signing his or her initials, is signifying that the applicant has actually performed at least the operations indicated in the work element description and that the verifier is confident that the applicant has performed the specific job tasks **repeatedly and satisfactorily**. Exposure to a job task through demonstrations by others or through partial involvement by the applicant should not be a basis for a supervisor to verify that the task can be performed correctly by the candidate under a variety of conditions.

#### WARNING

**NICET takes very seriously the role of the verifier. All certification candidates and their verifiers must understand that verification is an important component of the certification process.**

NICET's Policy #2, "Handling of Certification Process Irregularities" says, in part, that if NICET determines that any verification was obtained from a non-qualified verifier or was given for tasks not actually performed, the NICET action against the candidate can be to permanently deny the certification sought or revoke the certification(s) held. The NICET action against the verifier can be to terminate the privilege of serving as a verifier. If the verifier is NICET-certified, the certification(s) could be revoked.

Lack of verification on any (or all) work elements does not prevent an applicant from testing those work elements. Certification, however, will not be awarded until all work elements counted toward certification are verified.

#### **WORK EXPERIENCE REQUIREMENT**

A preponderance of the work experience must be acquired while residing in the United States and its territories, employing U.S. standards and practices.

NICET certification is only conferred upon persons performing engineering technician level work. NICET will not certify persons performing higher level work (such as engineering) or lower level work (such as craft).

## **LEVEL IV WORK EXPERIENCE REQUIREMENT**

In addition to the normal work experience information requested on the technician application form, all candidates for certification at Level IV, Senior Engineering Technician, in Bridge Safety Inspection must establish, in writing, that they have occupied a senior position of responsibility on several major bridge inspection projects. It must be remembered that ten years or more of employment in the technical area, by itself, is not sufficient for the granting of a Level IV certification.

The writeup sent to NICET must provide detailed, concise descriptions of several bridge inspection projects which show the candidate's involvement in a majority of the various aspects of the process. The pertinent work experience must be described in depth by the candidate personally -- official job descriptions or testimonials from others will not be evaluated.

The writeup on each of the projects should include such information as:

1. bridge type (concrete, steel, timber, beam, truss, arch, moveable, etc.);
2. bridge size (overall length, span, traffic load);
3. your supervisory responsibilities on each project; and
4. the range of your experiences on each project as related to organizing, conducting, and reporting inspections.

### **IF YOU HAVE BEEN ASSIGNED TO PROJECTS WHICH RESULT IN NARROWLY-FOCUSED EXPERIENCES, YOU SHOULD DESCRIBE SEVERAL ASSIGNMENTS WHICH CAN BE USED COLLECTIVELY TO MEET THE EXPERIENCE REQUIREMENT.**

Your writeup must address the Level IV requirement that your level of responsibility demonstrates independent engineering technician work, including delegated responsibilities and duties for which engineering precedent exists.

In order to avoid lengthy delays in processing your Level IV certification, this documentation should be sent with the Level IV examination application.

## **EARLY TESTING OF LEVEL IV WORK ELEMENTS**

Although NICET does permit testing of Level IV work elements prior to satisfying the work experience requirement, the Institute reserves the right to question the validity of Level IV work elements passed by, and verified for, persons with little work experience. If, for example, a technician with only three years experience passes Level IV work elements, NICET may require documentation of how this higher level knowledge was obtained without accumulating the requisite work experience.

If documentation is inadequate, NICET may require specific work elements to be tested and passed again, at the candidate's expense, at the time of the Level IV certification decision.

In addition, NICET reserves the right to require reverification of work elements designated for meeting the Level IV examination requirement if the verifications were signed three years prior to the time of the Level IV certification decision.

## **PREPARATION FOR TESTING**

As the NICET written examinations are designed for the individual who has already performed, on a routine basis, the work elements associated with the program, it is anticipated that preparation for this examination should be minimal.

## **SUPPORT MATERIALS FOR TESTING**

The NICET exams are "open-book"; therefore bringing standards, references, or textbooks to the exam session is permitted (and encouraged). When appropriate, the work element description is rather specific in mentioning applicable standards or procedures.

When work elements are keyed directly to specific industry-wide standards, they will be identified by a normally-used notation at the end of the work element description. For testing purposes, the current version of standards shall be the most recent edition, provided the edition was published at least one year prior to the date of testing.

Additionally, when a specific publication is used as an authoritative source in writing the work element questions, the title will be listed at the end of the work element. Refer to the "Selected General References" in this manual for publisher information.

## **TRAINING COURSES**

NICET does not endorse, certify, or accredit training programs and any claims to that effect should be viewed with caution. NICET does, however, provide information on the certification procedures and objectives so that training courses can be developed specifically to help persons planning to take a NICET certification exam.

## Work Element Listing

### BRIDGE SAFETY INSPECTION

#### **LEVEL I - GENERAL WORK ELEMENTS**

(Work at Level I Is Performed Under Direct Supervision)

#### **CORE WORK ELEMENTS (See Note 1)**

##### **ID #**      **Work Element Title and Description**

- 71001\* SIMPLE BRIDGE PLANS & SPECS  
Use simple plans and specifications to determine basic dimensions, types and descriptions of component materials, and component locations.
- 71004 BASIC BRIDGE TYPES  
Know the basic bridge types, such as arch, beam, cantilever, girder, movable, suspension, truss, etc.
- 71005 BASIC BRIDGE COMPONENTS  
Recognize basic bridge components and structural members such as decks, parapets, wing walls, abutments, stringers, girders, diaphragms, bearings, etc.
- 71006 FIELD SKETCHING  
Draw free-hand sketches describing bridge component configurations and illustrating condition of components.
- 71007 BASIC FIELD MEASUREMENTS  
Assist in making measurements of basic dimensions such as span lengths, overall length, roadway width, abutment widths, truss depth, etc.
- 71008^ BASIC METRIC UNITS AND CONVERSIONS  
Perform conversions to and from basic metric (SI) units. (ASTM E-380)

#### **NON-CORE WORK ELEMENTS**

- 71002^ BASIC MATHEMATICS  
Solve mathematical problems requiring simple addition, subtraction, multiplication, and division. Round to the correct number of significant figures, calculate percentages, read graphs, and use simple geometric definitions and formulas. (See general mathematics textbooks.)
- 71003^ BASIC COMMUNICATION SKILLS  
Use proper punctuation, vocabulary, spelling, and sentence structure. Follow written instructions. (See basic grammar references.)
- 71009\* TOPOGRAPHIC MAPS & SITE PLANS  
Use topographic maps and site plan drawings to determine elevations, stationing, grid coordinates, and general drainage features.

**NOTE 1: All Level I and Level II General Work Elements are classified as either Core or Non-Core. All Level I and II Core Work Elements must be passed in order to achieve a Level II certification -- this is a mandatory requirement.**

\*Crossover credit exists in other fields/subfields for this work element. Read information on crossover work elements on pages 4 and 5.

^Generic crossover credit exists in other fields/subfields for this work element. Read information on crossover work elements on pages 4 and 5.

- 71010^ BASIC PHYSICAL SCIENCE  
Apply terms, definitions, and concepts from mechanics, electricity, heat, and chemistry. (Solutions may involve simple formulas found in basic physics textbooks, but will not involve algebraic manipulation or trigonometry.)

### **LEVEL I - SPECIAL WORK ELEMENTS**

- 72001 INSPECTION AT HEIGHTS  
Obtain access to remote inspection areas and perform required tasks safely at heights necessary in bridge inspection. Use appropriate safety devices such as hard hats, safety belts, safety lines, harnesses.
- 72002\* TEMPORARY TRAFFIC CONTROL  
Understand basic arrangements for protecting inspection crews from traffic and for maintaining flow of traffic. (MUTCD - Part VI, FHWA)
- 72003^ FIRST AID PROCEDURES  
Understand the basic rules and procedures of first aid. (See general handbooks on first aid.)
- 72004^ BASIC DRAFTING  
Recognize and describe standard manual drafting techniques. Describe the characteristics and proper usage of standard drafting equipment. (See basic technical drawing textbooks.)
- 72005 INSPECTION EQUIPMENT  
Know the name, function and care of basic bridge inspection equipment.
- 72006^ BASIC INDIVIDUAL SAFETY  
Follow standard safety practices in performing job tasks. Recognize and call attention to improper safety practices at the work site. (Construction Industry Standards - OSHA 2202)
- 72007 PHOTOGRAPHY  
Have sufficient rudimentary knowledge of photography to obtain usable photographs. Know the appropriate equipment necessary, and understand appropriate picture-taking techniques.
- 72008 STRUCTURAL STEEL SHAPES  
Identify common structural steel shapes.

### **LEVEL II - GENERAL WORK ELEMENTS**

(Work at Level II Is Performed under General Supervision)

#### **CORE WORK ELEMENTS (See Note 2)**

- 73001 BRIDGE PLANS AND SPECS  
Understand and use standard plans (shop and as-built) and specifications to determine dimensions, types of materials, and member make-up, shape, and size.
- 73002 WRITTEN DOCUMENTATION  
Prepare accurate, comprehensive written reports of the conditions observed when participating in the inspection of bridges.

**NOTE 2: All Level I and Level II General Work Elements are classified as either Core or Non-Core Work Elements. All Level I and II Core Work Elements must be passed in order to achieve a Level II certification -- this is a mandatory requirement.**

**GENERAL NOTE: See "Selected General References" page in this manual for information on listed standards and publications.**

- 73003 MEASURING DEVICES  
Use measuring devices and instruments such as calipers, micrometers, feeler gauges, crack gauges, etc.
- 73004 BRIDGE NOMENCLATURE  
Extension of 71004 and 71005. Know the bridge types and their variations and know their superstructure and substructure components.
- 73005 MATERIAL DETERIORATION  
Recognize basic indications of sound and unsound materials, such as rust, scale, etc. Know the range of non-destructive testing techniques for checking physical condition of in situ materials.
- 73006 MATERIAL PROPERTIES  
Know the elementary physical and mechanical properties of concrete, steel, timber, and other bridge materials.

**NON-CORE WORK ELEMENTS**

- 73007 JOB SAFETY  
Exercise good safety practices during inspection of bridges from standpoint of type of bridge, access to parts of structure, influence of weather conditions, presence of electrical installations, etc.
- 73008 AREA, VOLUME, AND WEIGHT CALCULATIONS  
Calculate areas, volumes, and weights, including those of standard structural member shapes.
- 73009^ INTERMEDIATE PHYSICAL SCIENCE  
Solve problems in mechanics, electricity, heat, and inorganic chemistry. (Solutions may involve algebra and trigonometry.)

**LEVEL II - SPECIAL WORK ELEMENTS**

- 74001 WATER SAFETY  
Have a general knowledge of U.S. Coast Guard requirements for use of boats, including familiarity with "Rules of the Road" and proper on-board safety practices. (Navigation Rules, U.S. Coast Guard)
- 74002\* ELEMENTARY PLANE SURVEYING  
Use engineer's transit and level to conduct simple surveying operations such as measuring horizontal angles and distances; determining the elevation of objects or points; and making appropriate notes in the field notebook.
- 74003 UNDERWATER INSPECTION  
Be familiar with basic underwater inspection equipment used by professional divers. Know the general limitations and safety considerations of the equipment.
- 74004\* TRAFFIC CONTROL DEVICES  
Be familiar with appropriate uses of signs, markings, and signals given in the MUTCD to effectively assist in control of traffic. (MUTCD - Part VI, FHWA)
- 74005 CONCRETE STRUCTURE INSPECTION  
Have a basic knowledge of the behavior of plain, reinforced, and prestressed concrete, particularly in relation to sound and deteriorated concrete, rebars, and prestressing tendons. Note the extent and severity of damage or deterioration in the overall structure.
- 74006 STEEL STRUCTURE INSPECTION  
Have a basic knowledge of the behavior of steel, particularly in relation to sound and unsound common structural steel and steel wire and cable. Note the extent and severity of damage or deterioration in the overall structure,

including load repetitions (fatigue) and fire/heat.

- 74007 TIMBER STRUCTURE INSPECTION  
Have a basic knowledge of the behavior of timber, particularly in relation to sound and deteriorated wood. Note the extent and severity of damage or deterioration in the overall structure, including decay and insect damage.
- 74008\* EXPANSION AND CONTRACTION  
Have a general knowledge of methods and devices that accommodate expansion and contraction of entire bridges and bridge components such as rollers and rockers, elastomeric pads, sliding plates, roadway joints and joint fillers.
- 74009 NAVIGATIONAL LIGHTING  
Be familiar with exterior bridge lighting requirements needed to satisfy U.S. Coast Guard & Federal Aviation Agency navigational requirements. ("Bridge Inspector's Manual for Movable Bridges", FHWA)
- 74010^ INTERMEDIATE MATHEMATICS  
Perform mathematical calculations utilizing basic algebra (fundamental laws, algebraic expressions), geometry, and the trigonometric functions of right triangles. (See basic textbooks on algebra and trigonometry.)
- 74011 WATERWAYS  
Observe and report waterway influences such as scour, debris build-up, and alignment.
- 74012 REPORT INFORMATION  
Organize field notes and document photographs. Using good drafting technique, develop drawings from existing plans and field sketches for reports.

### **LEVEL III - GENERAL WORK ELEMENTS**

- 75001 PLANS AND SPECS  
Understand and use complex plans and specifications to determine the dimensions and locations of bridge components, component function, and material specifications.
- 75002^ BUSINESS COMMUNICATIONS  
Use the rules of syntax and style to write clear sentences and paragraphs in preparing routine correspondence and reports. Follow standard business communications procedures.
- 75003 INSPECTION ARRANGEMENTS  
Assist in the review of bridge plans, past inspection reports, and other pertinent information for bridges to be inspected. Arrange for necessary equipment for inspection and for traffic control including, when needed, special access equipment.
- 75004 LOADINGS AND FORCES ON BRIDGES  
Have an elementary working knowledge of internal and external primary and secondary forces acting upon and within a bridge and how they affect the bridge and its components. Understand dead loads, live loads, impact loads, ice loads, wind pressure, water pressure, earth pressure, and thermal stresses.
- 75005 BRIDGE INVENTORY TERMINOLOGY  
Be familiar with all definitions, terms, and explanations required for completion of the SI&A sheet.
- 75006\* BRIDGE INSPECTION BASICS  
Be familiar with the definitions, explanations, and procedures in the current AASHTO "Manual for Maintenance Inspection of Bridges".
- 75007 BASIC SEQUENCE FOR INSPECTION  
Know the proper sequence of steps for a comprehensive and systematic inspection for the type of bridge being inspected and the type of inspection to be performed.

- 75008 TRAFFIC SAFETY FEATURES  
Have a working knowledge of function and present design criteria for vehicular and pedestrian safety features such as bridge railings, transitions, approach guardrails, and approach guardrail ends.
- 75009 STATICS  
Have an elementary working knowledge of forces, force components, resultants, moments, free-body diagrams, principles of equilibrium, two-force members. Analyze reactions of free bodies as they relate to bridges. See applied mechanics (statics) textbooks.
- 75010 CONDITION OF TRUSS BRIDGES  
Identify deterioration and damage to truss bridges and document same in inspection reports. Estimate the significance of damage or deterioration in relation to the overall structure.
- 75011 CONDITION OF SIMPLE SPAN BRIDGES  
Identify deterioration and damage to simple span bridges and document same in inspection reports. Estimate the significance of damage or deterioration in relation to the overall structure.
- 75012 CONDITION OF CONTINUOUS SPAN BRIDGES  
Identify deterioration and damage to continuous span bridges and document same in inspection reports. Estimate the significance of damage or deterioration in relation to the overall structure.
- 75013 CONDITION OF ARCH BRIDGES  
Identify deterioration and damage to arch bridges and document same in inspection reports. Estimate the significance of damage or deterioration in relation to the overall structure.
- 75014 CONDITION OF CULVERTS  
Identify deterioration and damage to culverts and document same in inspection reports. Estimate the significance of damage or deterioration in relation to the overall structure.
- 75015 CONDITION OF SUBSTRUCTURES  
Identify deterioration and damage to substructures and document same in inspection reports. Estimate the significance of damage or deterioration in relation to the overall structure.
- 75016 CONDITION OF DECKS  
Identify deterioration and damage to decks and document same in inspection reports. Estimate the significance of damage or deterioration in relation to the overall structure.

### **LEVEL III - SPECIAL WORK ELEMENTS**

- 76001 UNDERWATER INVESTIGATIONS  
Be familiar with how underwater investigations are conducted by professional divers using scuba equipment and other types of underwater inspection equipment. Understand diving safety and basic underwater physics.
- 76002 WATERWAY CONDITIONS  
Recognize and understand the significance of waterway conditions such as channel stability (pools, shoals, siltation, scour), current velocity, discharge rate, icepacks, ice dam, floods; and protective measures such as embankment protection (dikes, revetments), substructure protection (fenders, dolphins).
- 76003 MECHANICS OF MATERIALS  
Solve problems involving normal and shear stress and strain, Hooke's law, Poisson's ratio, shear and moment diagrams, the flexure formula, and torsional stress and strain involving circular members. Locate simple centroids. (See general textbooks on strength of materials.)

- 76004 MOVABLE BRIDGES  
Be familiar with the types of movable bridges and how they function, including electrical and mechanical components. ("Bridge Inspector's Manual for Movable Bridges", FHWA)
- 76005 COLLISION DAMAGE  
Have a general knowledge of significance of collision damage to various components of truss and stringer-type bridges. Understand when traffic restrictions may be needed.
- 76006 COASTAL BRIDGES  
Have a general knowledge of the special environmental problems associated with bridges located in salt water areas. Detect and assess superstructure and substructure damage and deterioration.
- 76007 PROPERTY CONTROL  
Assure proper control of equipment use and storage to prevent loss or misuse of instruments, supplies, and equipment. Investigate loss or damage of equipment and complete the necessary forms and reports to establish responsibility. Take corrective action if appropriate.
- 76008 ELEMENTARY STRUCTURAL ANALYSIS  
Solve elementary problems required in the analysis of simple beams and tension members.
- 76009 PROTECTIVE COATINGS  
Be familiar with protective coatings on bridge structures, including paints, concrete sealants, and preservatives. Recognize types of coating failures.
- 76010 BOLTS & FASTENERS  
Recognize and document deficiencies found in riveted and bolted connections.
- 76011 PRESTRESS FUNDAMENTALS  
Be familiar with the principles of prestressed concrete.
- 76012 RAILROAD BRIDGES  
Be familiar with the loading conditions of railroad and rail rapid transit bridges.
- 76013 WORK ELEMENT DELETED  
Credit retained by those who have previously passed it.

#### **LEVEL IV - GENERAL WORK ELEMENTS**

**NOTE: Certification at Level IV requires that the candidate must have occupied a senior position of responsibility throughout the duration of one or more major bridge safety inspection projects. There are no exceptions to this requirement and documentation must be present in the work history listed on the application form.**

- 77001 INSPECTION REPORT REVIEW  
Review completed inspection reports, forms, and sketches for content, format, accuracy, and clarity. Suggest appropriate corrections.
- 77002 PREINSPECTION DATA  
Review previous inspection reports and, when necessary, available bridge plans and specifications. Note any special items for inspection.
- 77003 INSPECTION ORGANIZATION  
Establish bridge inspection equipment requirements. Define responsibilities, qualifications, and relationships of all concerned parties.

- 77004 INSPECTION EXPERTISE  
Evaluate performance of others participating in inspections by periodically accompanying teams. Provide expertise and leadership on inspection of major structures or in situations of an unusual nature. Assist Bridge Inspection Engineer or assistant in administering the overall bridge inspection program.
- 77005 AS-BUILT DRAWINGS  
Verify that plans, specifications, and shop drawings reflect actual field conditions. Recognize deficiencies and implement corrections.
- 77006 SPECIAL TRAINING  
Prepare, conduct, and evaluate training efforts.
- 77007 BRIDGE SUFFICIENCY RATING  
Understand and calculate bridge sufficiency ratings by the sufficiency rating formula given in FHWA's "Recording and Coding Guide for the Structure, Inventory and Appraisal of the Nation's Bridges".
- 77008 BRIDGE LOAD CAPACITY  
Assist in determining the safe live load capacity of existing simple bridges. ("Manual for Maintenance Inspection of Bridges", AASHTO)
- 77009 NONDESTRUCTIVE TESTING  
Be familiar with fundamental principles of, uses of, and limitations of nondestructive testing methods such as ultrasonic, radiographic, magnetic particle, penetrants, and Swiss hammer. ("Guide for Nondestructive Inspection of Welds," AWS, and "Nondestructive Methods of Fatigue Crack Detection in Steel Bridge Members," TRB")

#### **LEVEL IV - SPECIAL WORK ELEMENTS**

- 78001 SPECIAL BRIDGES  
Know the peculiar features and inspection considerations for special bridges, including suspension, segmental, and box girder bridges.
- 78002 NON-REDUNDANT ELEMENTS  
Identify non-redundant elements and fracture-critical members.
- 78003 ANALYSIS OF COMPRESSION MEMBERS  
Solve problems involving stress in the analysis of compression members such as in trusses and piers. (See general textbooks on structural analysis and applied strength of materials.)
- 78004 ANALYSIS OF TRUSSES  
Solve problems required in the analysis of simple trusses. (See standard textbooks on structural analysis.)
- 78005 FATIGUE-PRONE DETAILS  
Recognize and identify fatigue-prone details. (Fisher, 1977, 1981)
- 78006 WELDS  
Identify deficiencies in weldments, including rust, cracks and poor welding technique. ("Structural Welding Code for Steel," AWS).
- 78007 STRUCTURAL PLATE PIPES & PIPE ARCHES  
Recognize problems with soil-metal interaction systems such as deformations, joint slippage, settlements, and absence of connectors.

- 78008 DECK CONDITION SURVEYS  
Be familiar with tests required for concrete deck condition surveys, including chloride test and half-cell meter readings. Also know the type and use of instruments for determining deck lamination, locating rebars, and applicable nondestructive testing.
- 78009 MAINTENANCE-PRONE DETAILS  
Identify bridge details which accelerate maintenance needs.
- 78010 REQUIRED REPAIRS  
Be familiar with conventional repairs required to correct deficiencies found during inspections.
- 78011 CATASTROPHIC COLLISIONS & FIRE DAMAGE  
Recognize serious and hazardous effects of collision or fire damage.
- 78012 ADVANCED REPORT PREPARATION  
Review and organize inspection reports, drawings and exhibits. Review repair details and develop cost estimates.

## PERSONAL TALLY SHEET

### Passed Work Elements in Bridge Safety Inspection

- o Put a checkmark next to the appropriate work element number when you receive a passing score on your Examination Score Report.
- o Put a "C" next to the appropriate work element number if you have crossover credit from another subfield. Read pages 4 and 5 in this manual concerning crossover credit.
- o Refer to the chart on page 3 to determine whether you have passed an exam requirement.

<b>Level I</b>	<b>Level I</b>	<b>Level II</b>	<b>Level II</b>
<b>General</b>	<b>Special</b>	<b>General</b>	<b>Special</b>
__71001 (Core)	__72001	__73001 (Core)	__74001
__71002	__72002	__73002 (Core)	__74002
__71003	__72003	__73003 (Core)	__74003
__71004 (Core)	__72004	__73004 (Core)	__74004
__71005 (Core)	__72005	__73005 (Core)	__74005
__71006 (Core)	__72006	__73006 (Core)	__74006
__71007 (Core)	__72007	__73007	__74007
__71008 (Core)	__72008	__73008	__74008
__71009		__73009	__74009
__71010			__74010
			__74011
			__74012
<b>Level III</b>	<b>Level III</b>	<b>Level IV</b>	<b>Level IV</b>
<b>General</b>	<b>Special</b>	<b>General</b>	<b>Special</b>
__75001	__76001	__77001	__78001
__75002	__76002	__77002	__78002
__75003	__76003	__77003	__78003
__75004	__76004	__77004	__78004
__75005	__76005	__77005	__78005
__75006	__76006	__77006	__78006
__75007	__76007	__77007	__78007
__75008	__76008	__77008	__78008
__75009	__76009	__77009	__78009
__75010	__76010		__78010
__75011	__76011		__78011
__75012	__76012		__78012
__75013	__76013 (*deleted 8-90)		
__75014			
__75015			
__75016			

\*Those persons who passed work element number 76013 prior to its deletion in August 1990 will retain credit for it.

## SELECTED GENERAL REFERENCES\*

### Primary References

S.H. Park. Bridge Inspection and Structural Analysis. PO Box 7474, Trenton, NJ, 08628. 1980.

White, Kenneth R., et al. Bridge Maintenance Inspection and Evaluation. Marcel Dekker, Inc. New York, NY.

AASHTO Manual for Bridge Maintenance. American Association of State Highway and Transportation Officials. Washington, DC. 1976.

Bridge Inspector's Training Manual 70. Federal Highway Administration. Washington, D.C. Reprint 1979.

Construction Industry - OSHA Safety and Health Standards Digest (OSHA 2202). U.S. Department of Labor. Washington, D.C. (Available from U.S. Government Printing Office).

Manual for Maintenance Inspection of Bridges. American Association of State Highway and Transportation Officials. Washington, DC. 1983.

Manual of Steel Construction (8th edition). American Institute of Steel Construction. Chicago, IL. 1980.

Recording and Coding Guide for the Structure, Inventory and Appraisal of the Nation's Bridges. Federal Highway Administration. Washington, DC. December, 1988.

Standard Specifications for Highway Bridges (13th edition). American Association of State Highway and Transportation Officials. Washington, DC. 1983.

### Additional References

American Association of State Highway and Transportation Officials. Washington, DC.

- o Guide Specifications for Fracture Critical Non-Redundant Steel Bridge Members. 1978.

American Concrete Institute. Detroit, MI

- o ACI Manual of Concrete Practice. 1993
  - "Causes, Evaluation, and Repairs of Cracks in Concrete Structures" (ACI 224.1R-89).
  - "Guide for Making a Condition Survey of Concrete in Service" (ACI 201.1R-92).
  - "Guide for Repair of Concrete Bridge Superstructures" (ACI 546.1R-88).

American Institute of Steel Construction. Chicago, IL.

- o Iron and Steel Beams 1873 to 1952. 1981.

American Railway Engineering Association. Washington, DC.

- o Specification for Railway Bridges. latest edition.

American Red Cross. Washington, DC.

- o Standard First Aid and Personal Safety. latest edition.

American Society of Civil Engineers. New York, NY.

- o Wood Structures, Design Guide and Commentary. 1975.

American Welding Society. Miami, FL.

- o Guide for Nondestructive Inspection of Welds. 1977.
- o Structural Welding Code for Steel. latest edition.

Federal Highway Administration. Washington, DC.

- o Bridge Inspector's Manual for Movable Bridges. 1977.
- o Design and Construction of Welded Bridge Members and Connections. September, 1980.
- o Historic Bridges. June 9, 1982.
- o Inspection of Fracture Critical Bridge Members. 1986
- o Manual on Uniform Traffic Control Devices for Streets and Highways. 1978.

Also, the following topics are covered on a video tape:

- o "Introduction to Inspection of Bridges"
- o "Inspection of Steel Truss Bridges"
- o "Inspection of Timber Bridges"
- o "Prestressed Concrete Bridge Inspection"

Order Video Tape #58 from:

R&D Reports Center  
Federal Highway Administration  
6300 Georgetown Pike  
McLean VA 22101

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- o Movable and Long Span Steel Bridges (2nd edition). New York, NY: McGraw-Hill, 1943.

Transportation Research Board. Washington, DC.

- o "Nondestructive Methods of Fatigue Crack Detection in Steel Bridge Members," NCHRP Research Results Digest 66. 1975.

United States Coast Guard. Washington, DC.

- o Navigation Rules (GPO #050-012-00-205-3). 1983.

United States Department of Agriculture. Washington, DC.

- o "Wood Bridges - Decay Inspection and Control", Agriculture Handbook No. 557. 1979.

United States Department of Labor. Washington, DC.

- o Construction Industry Standards (29 CFR/1926, OSHA 2207). 1986.
- o OSHA Field Operations Manual and Industrial Hygiene Field Operations Manual (OSHA Inst. CPL 2.45 A). 1986.

Zisher, J.W.

- o Bridge Fatigue Guide, Design and Detail. Chicago, IL: American Institute of Steel Construction, 1977.
- o Fatigue and Fracture in Steel Bridges. New York, NY: John Wiley & Sons, 1984.
- o Inspecting Steel Bridges for Fatigue Damage. Fritz Engineering Laboratory Report No. 386-15(81). Lehigh University, PA, 1981.

(This listing is not intended to be complete or representative.)

