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US Army Corps of Engineers
Waterways Experiment Station

Computer Aided Structural Engineering Project

User's Guide: Computer Aided Inspection Forms for Hydraulic Steel Structures (CAIF-HSS), Windows Version

by Guillermo A. Riveros

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Final report

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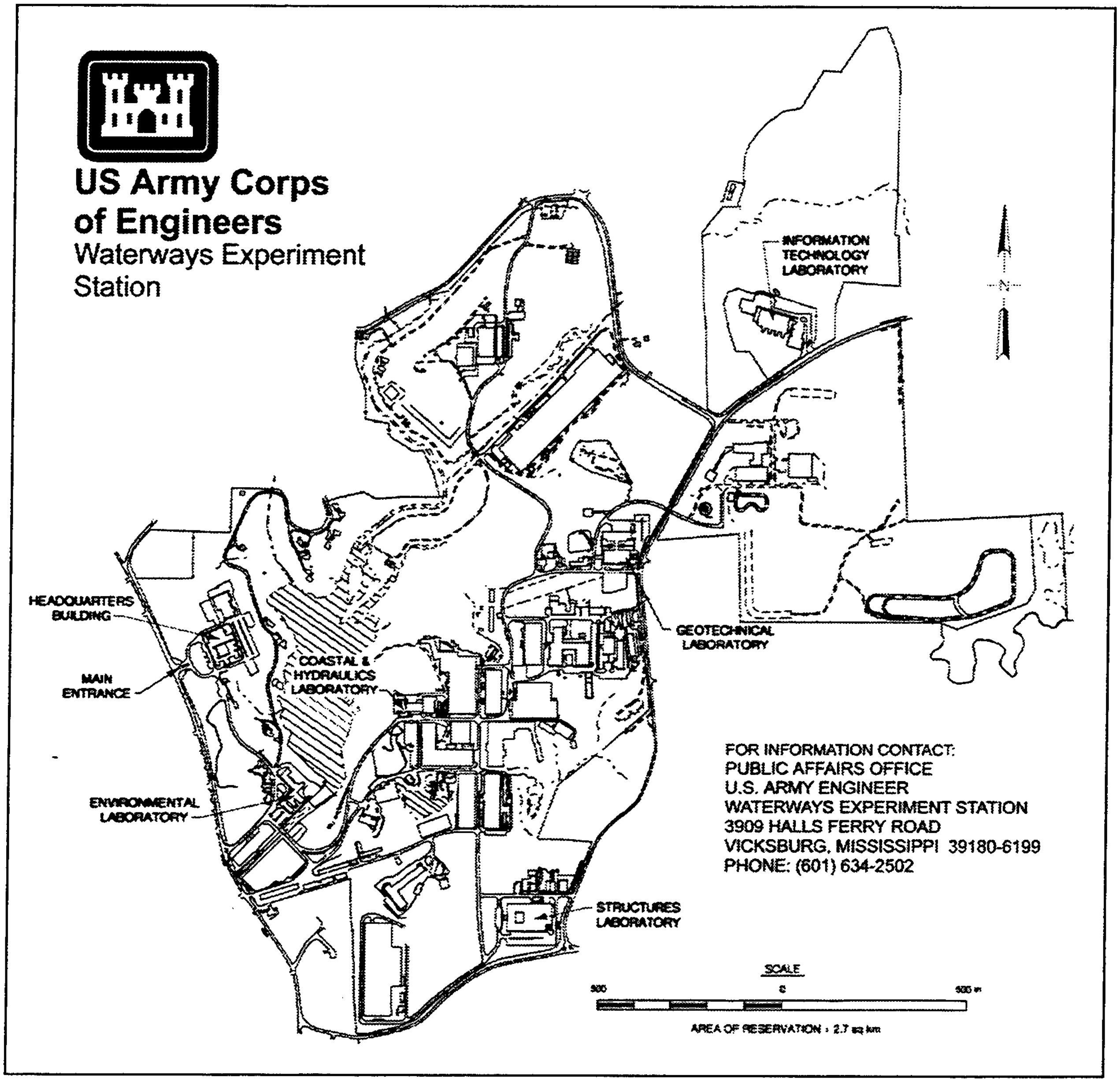

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Preface

This report presents the user's manual for the Computer Aided Inspection Forms for Hydraulic Steel Structures (CAIF-HSS). CAIF-HSS is a Windows-based computer program to store the information obtained during the inspection of miter, tainter, lift, and sector gates. Funding for the development of the program and preparation of this report was provided to the Scientific and Engineering Applications Center (S&EAC), Computer Aided Engineering Division (CAED), Information Technology Laboratory (ITL), U.S. Army Engineer Waterways Experiment Station (WES), by Headquarters, U.S. Army Corps of Engineers (HQUSACE), under the Computer Aided Structural Engineering (CASE) Project.

Specifications for the computer program were prepared by the members of the Steel CASE task group. Members of the task group during development of the program included:

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Ray Dewey, Portland District

Joe Hartman, HQUSACE

Nathan Kathir, St. Paul District

Tom Ruf, St. Louis District

Henry Stewart, North Central Division

William Wigner, Jacksonville District

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Inspection forms were prepared by Mr. Ardine (miter gates), Mr. Stewart (tainter gates), Mr. Wigner (sector gates), and Mr. Riveros (lift gates). The computer program was written by Mr. Riveros, WES, and Mr. Mark Elliot (DynCorp); this report was prepared by Mr. Riveros, under the supervision of Mr. Barry Fehl, Chief, S&EAC; Mr. Wayne Jones, Chief, CAED; and Dr. N. Radhakrishnan, Director, ITL.

At the time of publication of this report, Director of WES was Dr. Robert W. Whalin.

1 Introduction

This report is the user's manual for the Computer Aided Inspection Forms for Hydraulic Steel Structures (CAIF-HSS) computer program, which should be used to store the information obtained during periodic or detailed inspections of miter, tainter, lift, and sector gates.

Scope

This chapter presents a brief explanation for periodic and detailed inspections and describes high-stress zones, stress concentration in detail, and the critical operational elements for miter, lift, sector, and tainter gates. It also defines the distress variables and rating numbers that are used in CAIF-HSS.

Periodic Inspections

Periodic inspections in hydraulic steel structures (HSS) are primarily visual. If a periodic inspection indicates that the HSS may be distressed, a more detailed inspection and evaluation may be required (Engineer Technical Letter (ETL) 1110-2-346).[1]

Inspection procedures

The periodic inspection procedure should include the following steps:

1. Review documentation on gate design, operational history, and maintenance records.

[1] Headquarters, U.S. Army Corps of Engineers. (1993). "Structural Inspection and Evaluation of Existing Welded Lock Gates," ETL 1110-2-346, Washington, DC.

2. Identify critical members and connections.

3. Develop plan for visual inspection.

4. Inspect for weld connections and surface discontinuities.

5. Inspect for corrosion conditions.

6. Observe gate operation (and cathodic protection, if applicable).

7. Document weld, discontinuities, corrosion, and any other distress conditions.

8. Conduct initial evaluation.

Critical members and connections

The periodic inspection should ensure that all critical members and connections are fit for service until the next scheduled inspection. Critical members and connections are those structural elements whose failure would render the gate inoperable. Fitness for service means that the material and fabrication quality are at an appropriate level considering risks and consequences of failure.

Critical gate members and connections shall be determined from structural analysis of the gate. This should include local stress concentrations and fatigue considerations. In addition, effects of existing corrosion and reduced weld quality or associated residual stresses should be considered. This analysis will require information pertaining to the existing mechanical properties of the structural material and weld (i.e., strength, toughness, ductility), and the location, type, size, and orientation of any known discontinuities. Critical structural members, connections, and critical operational elements for miter, tainter, lift, and sector gates are presented later in this chapter.

Visual inspection

The inspector should look closely at the members and connections and not just view them from the top of the lock wall. Visual inspections shall be performed with an emphasis on critical gate members and connections. Historically, distressed gate members and connections have been located in areas subject to high structural loads or stress ranges, geometric stress concentrations, corrosion promoting conditions, and thick plates.

Inspectors shall use various measuring scales and weld gauges for checking the dimensions of the weld bead. Boroscopes, flashlights, and mirrors may be necessary to inspect areas of limited accessibility. Handtools may be necessary for cleaning the surface for inspection.

Other inspection methods

Methods other than visual inspection may be used for the periodic inspection of HSS if necessary. These methods may include penetrant inspection, magnetic particle inspection, ultrasonic inspection, and eddy current inspection. These inspection methods are discussed in ETL 1110-2-346.

Detailed Inspections

If distressed HSS members or connections are identified in the periodic inspection, or if deterioration in structural performance is assessed from the initial evaluation, then the entire HSS should receive a more detailed inspection of the distressed members and connections should be evaluated as presented in ETLs 1110-2-346 and 1110-2-351.[1]

Critical Zones for HSS

The following information is provided to highlight areas and details that should receive special attention during the gate inspection. Typical areas and details of critical gate components are shown in the accompanying drawings.

Miter gates

High-stress zones (Figures 1 and 2).

a. Girders at midspan and end diaphragms.

b. Intercostal at center line.

c. End diaphragms and girder supporting gusset plate.

d. Quoin post and thrust diaphragm.

e. Struts shear plates.

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[1] Headquarters, U.S. Army Corps of Engineers. (1994). "Structural Inspection and Evaluation of Existing Spillway Gates," ETL 1110-2-351, Washington, DC.

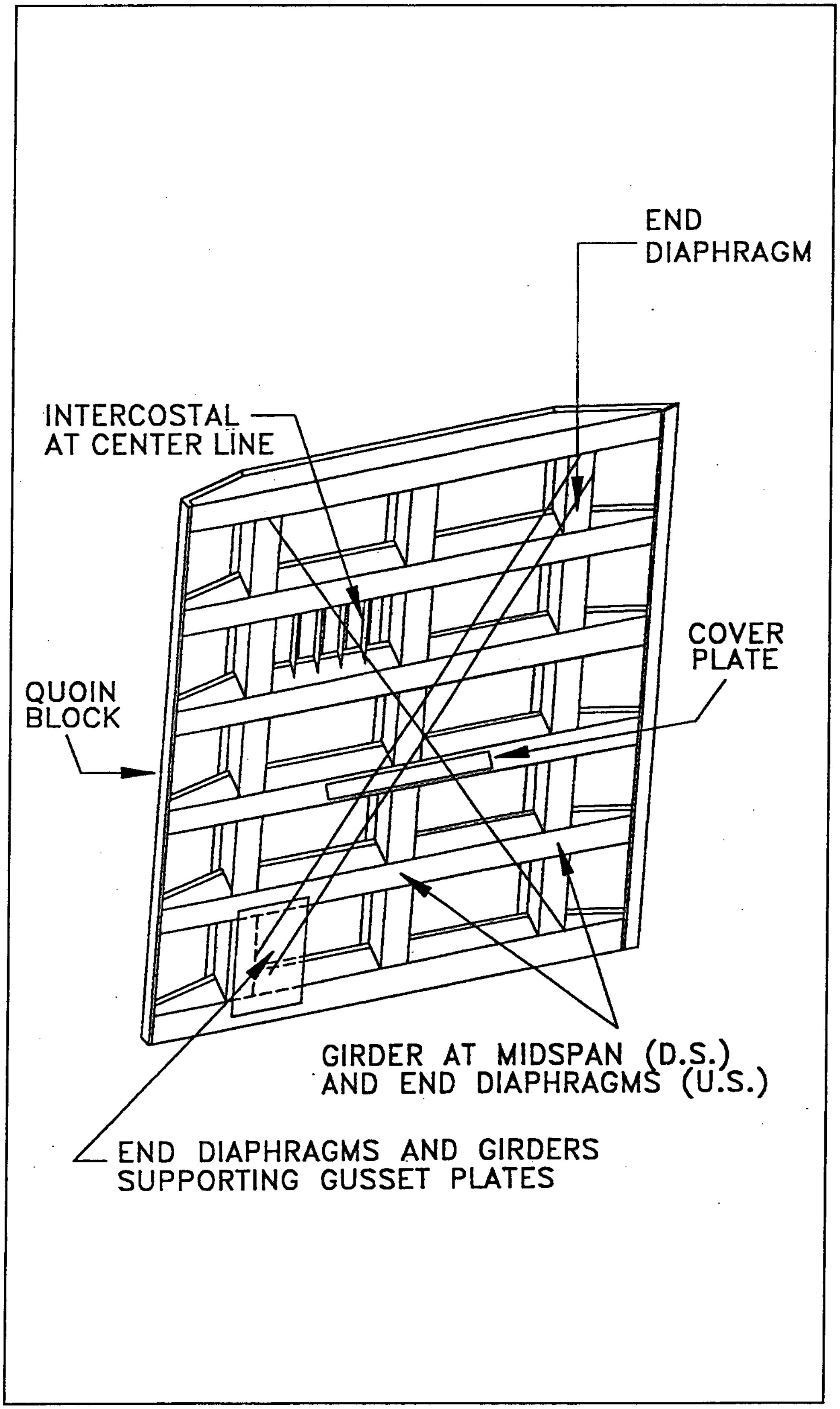

Figure 1. Critical zones on a horizontally framed miter gate

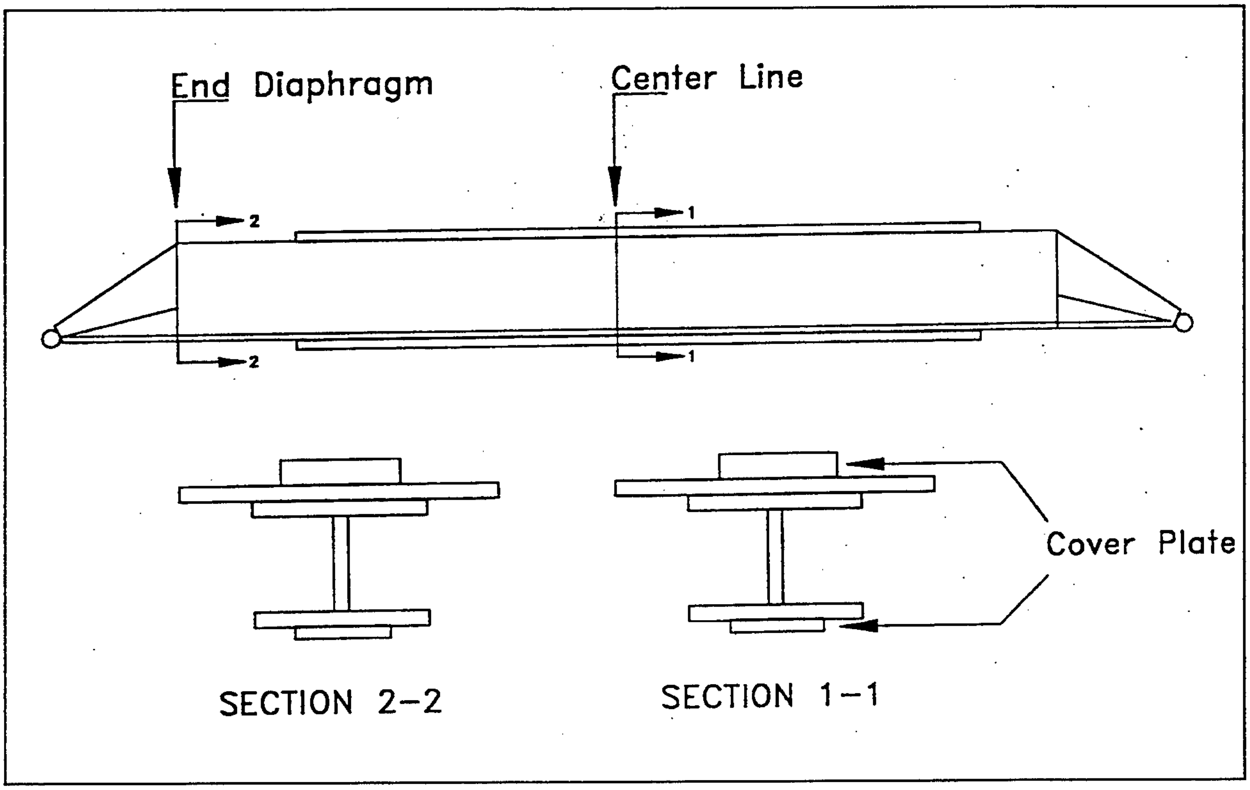

Figure 2. Critical zones on horizontal girders

Stress concentration in details. (See Figure 3 for stress-concentration regions in welds.)

a. Girder web, flange, and intercostal (Figure 4).

b. Girder web, flange, and diaphragm.

c. Cover plate ends (Figure 2).

d. Gusset plate and diagonal connection (Figure 5).

Critical operation elements.

a. Diagonals.

b. Pintle and linkage assembly (Figure 6).

c. Strut connections.

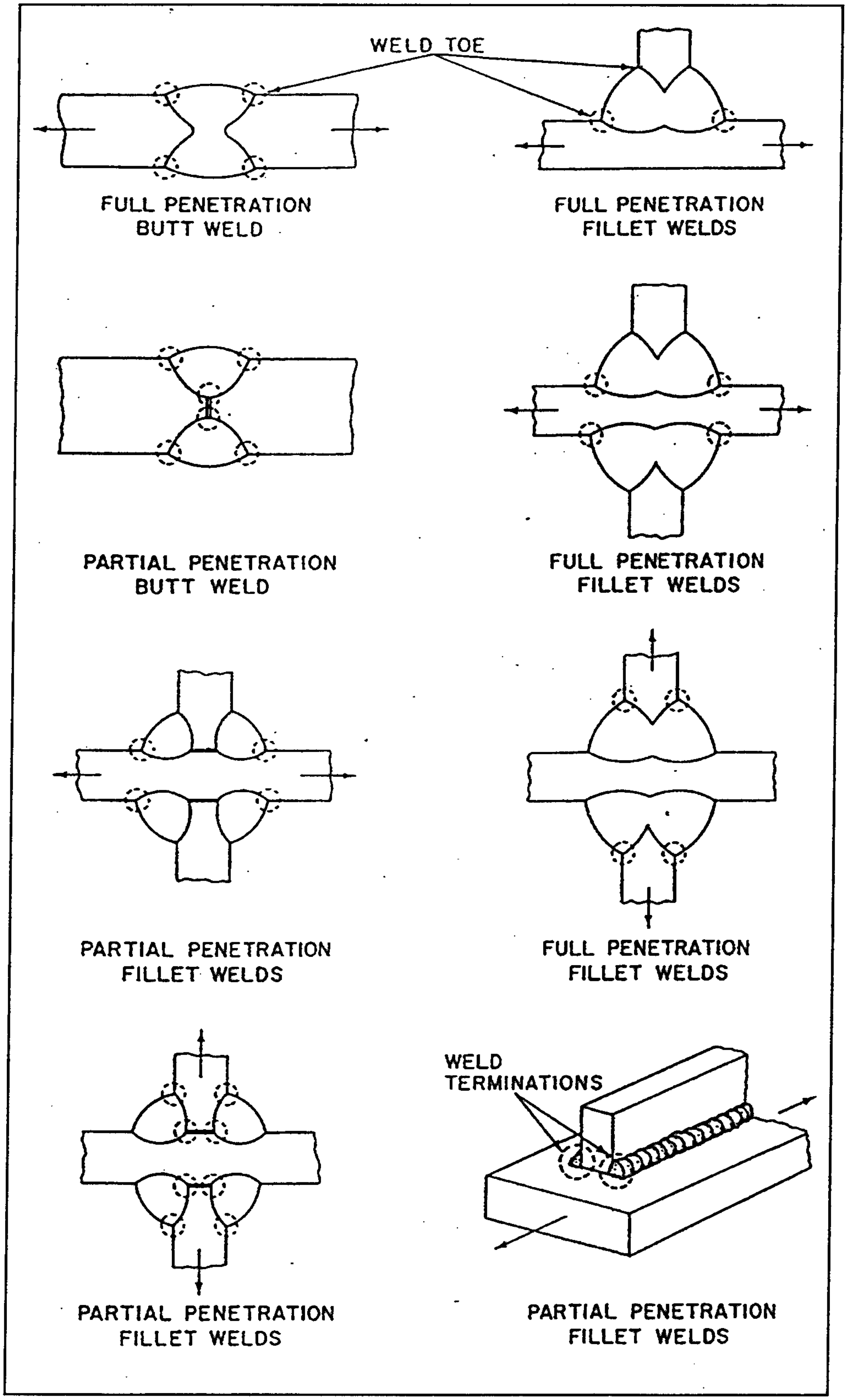

Figure 3. Stress-concentration regions (indicated by dashed circles) for weldments

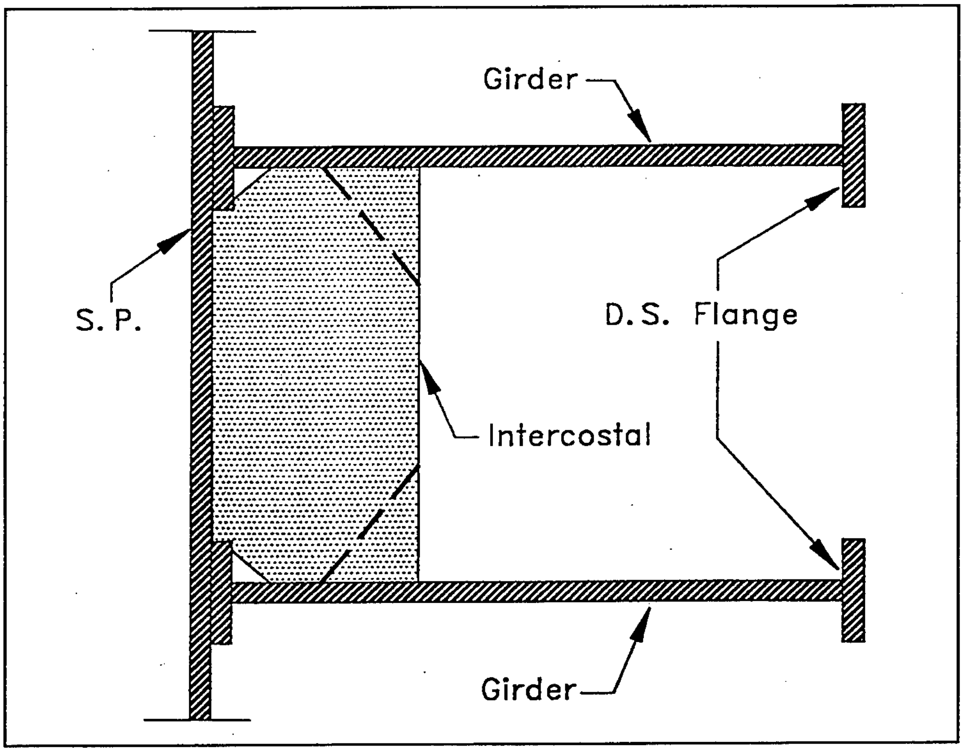

Figure 4. Intracostals, skin plate (S. P.), and girder connections

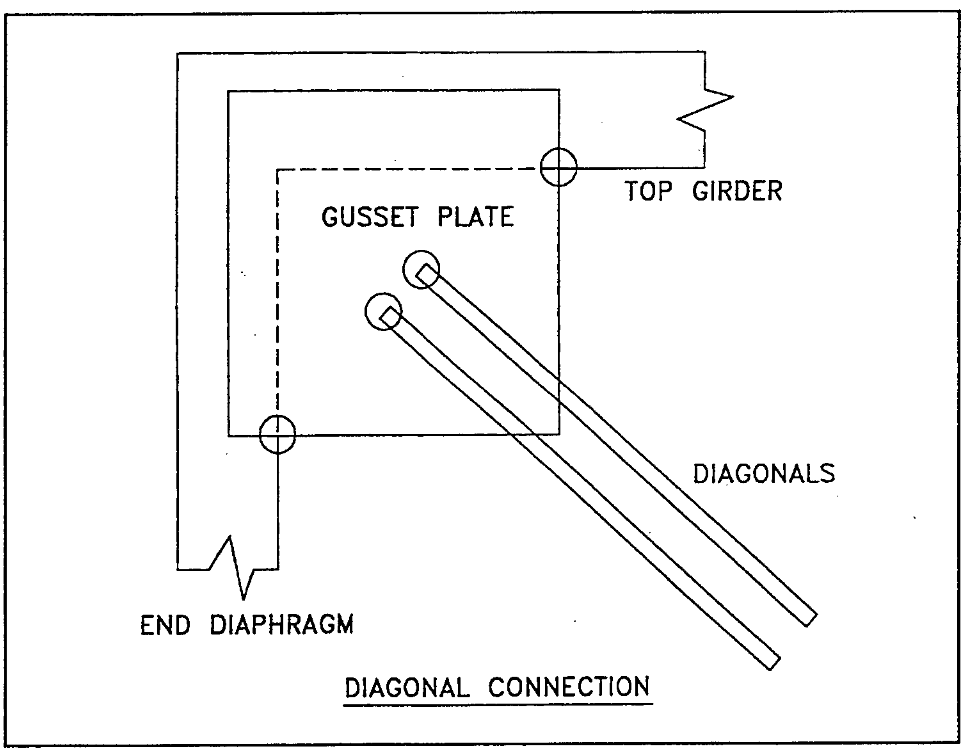

Figure 5. Gusset plate and diagonal connection

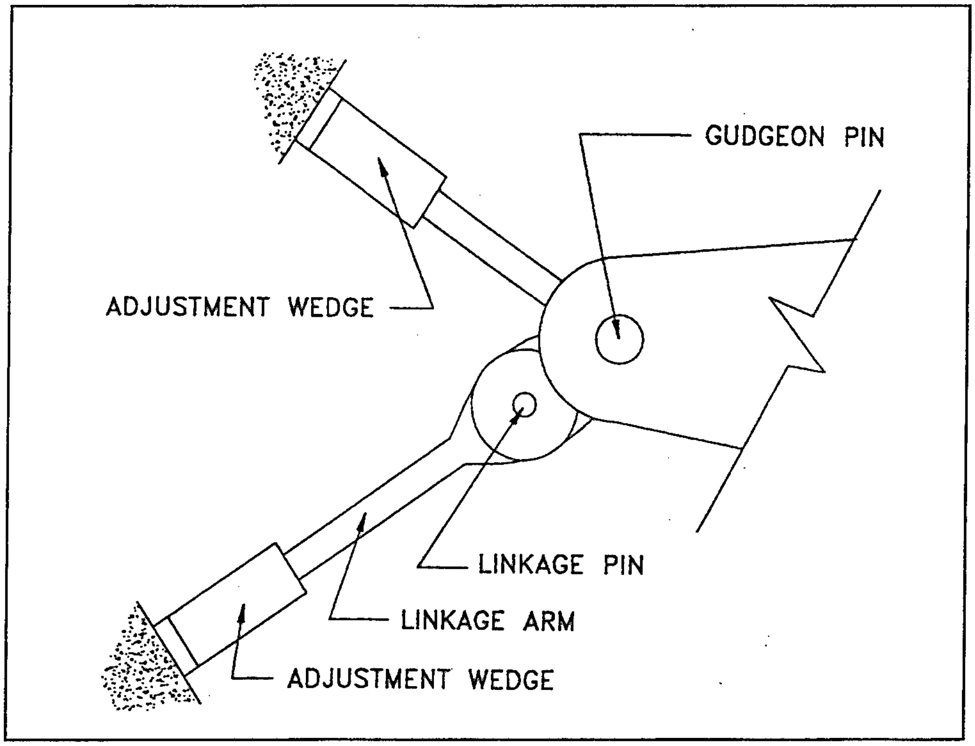

Figure 6. Linkage pin assembly

Vertical lift gates

High-stress zones (Figure 7).

a. Horizontal girders lift gate.

- Girders at center line (D.S. flange).

- Girders at end diaphragm (U.S. flange).

- End of diaphragm flanges attached to downstream girder flanges.

- Connections to downstream flange at midspan.

b. Horizontal trusses lift gate.

- Center line of upstream cord.

- Elements carrying tension forces.

c. Arc lift gate.

- Tension girders (end connection).

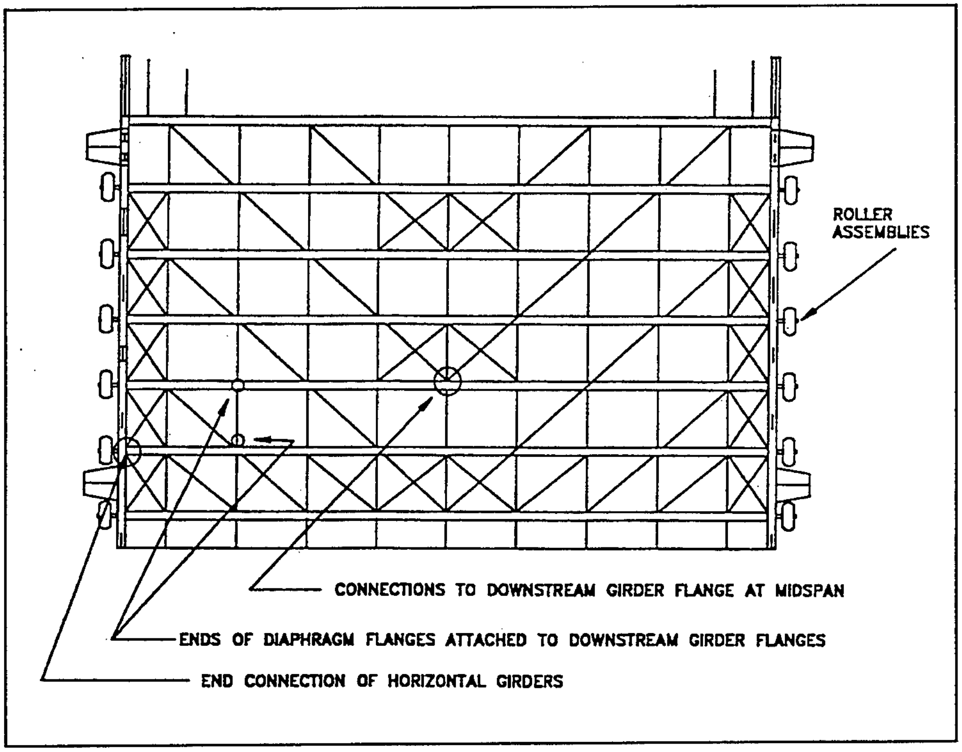

Figure 7. Critical areas for lift gates

Stress concentration in details. (See Figure 3 for stress concentration regions in welds.)

a. Girder web, flanges, and intercostals.

b. Girder web, flanges, diaphragms, and diagonal members.

c. Cover plate ends, if any.

d. Gusset plate connections.

e. Any weld connection where more than two elements are connected (ETL 1110-2-351).

f. Diaphragm connections.

Critical operational elements.

a. Lifting assemblies and cables.

b. Roller assemblies.

Sector gates

High-stress zones (Figures 8 and 9).

a. Truss members carrying axial tensile forces.

b. Tensile zones of beam members.

c. Gate hinge and anchorage.

Stress concentration in details. (See Figure 3 for stress concentration regions in welds.)

a. Gusset plate connections.

b. Full penetration welds in tension members normal to the direction of tensile stress, if any.

c. Any connection involving the intersection of more than two welds.

d. Cover plate ends, if any.

e. Any weld located in the tension zone of a member that is oriented in the direction normal to the stress.

Critical operational elements.

a. Cable or rack and pinion gear.

Tainter gates

High-stress zones (Figures 10 and 11).

a. Girder to strut.

b. Strut arms and bracings.

c. Girder-rib-skinplate connections at end frames.

Critical operational elements.

a. Lifting connections.

b. Lifting cables.

c. Trunnion assembly.

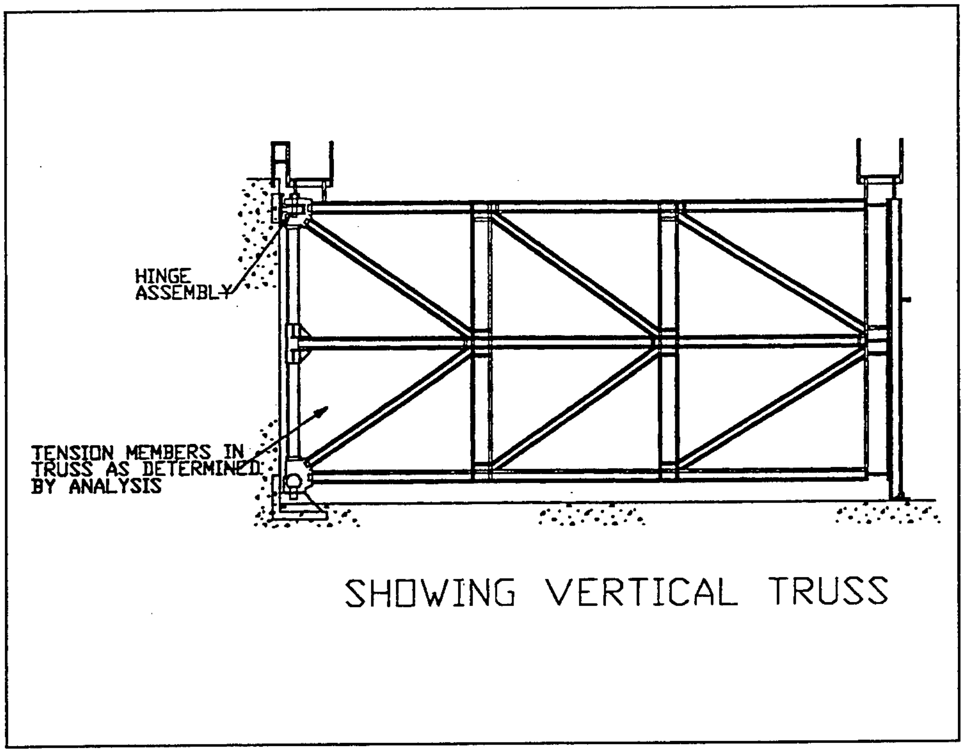

Figure 8. Critical areas for sector gates, plan view

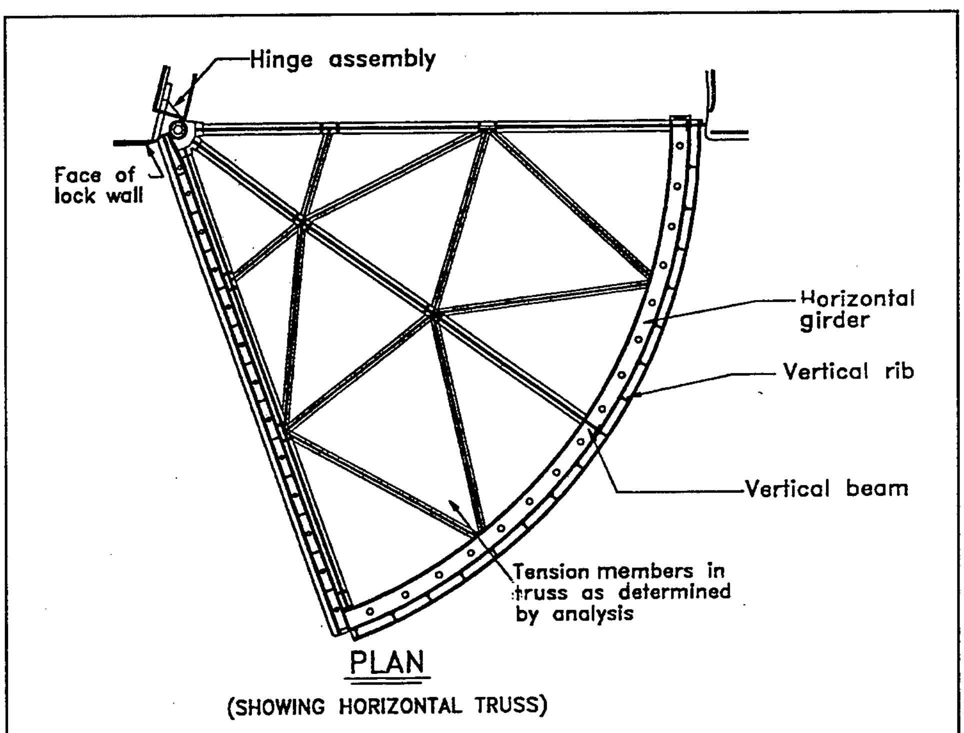

Figure 9. Critical areas for sector gates, front view

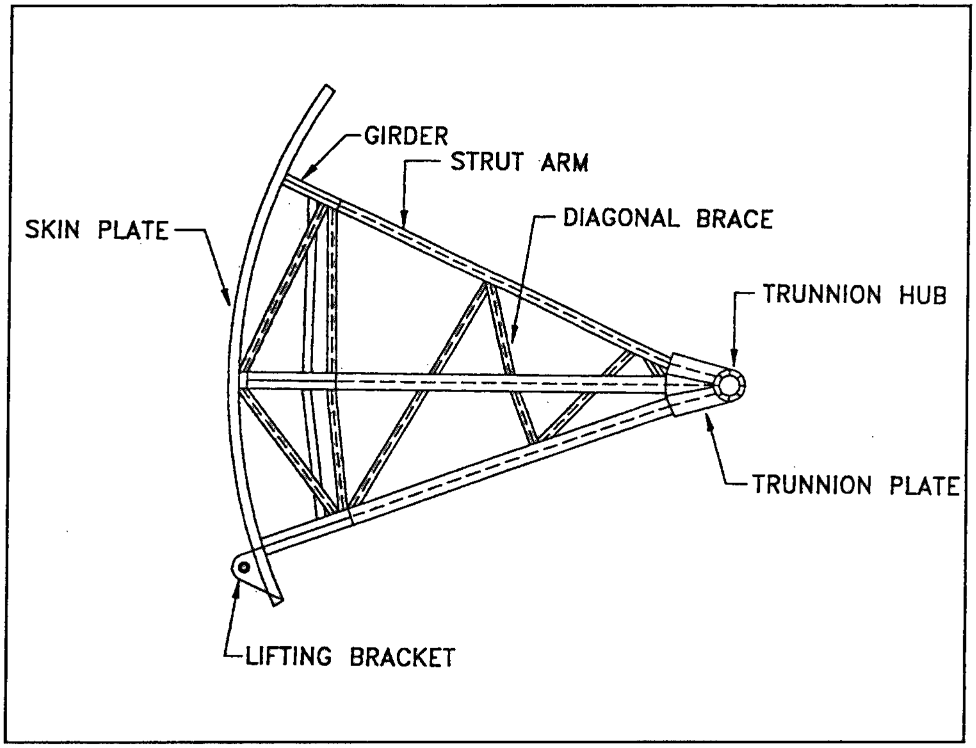

Figure 10. Critical areas for tainter gates

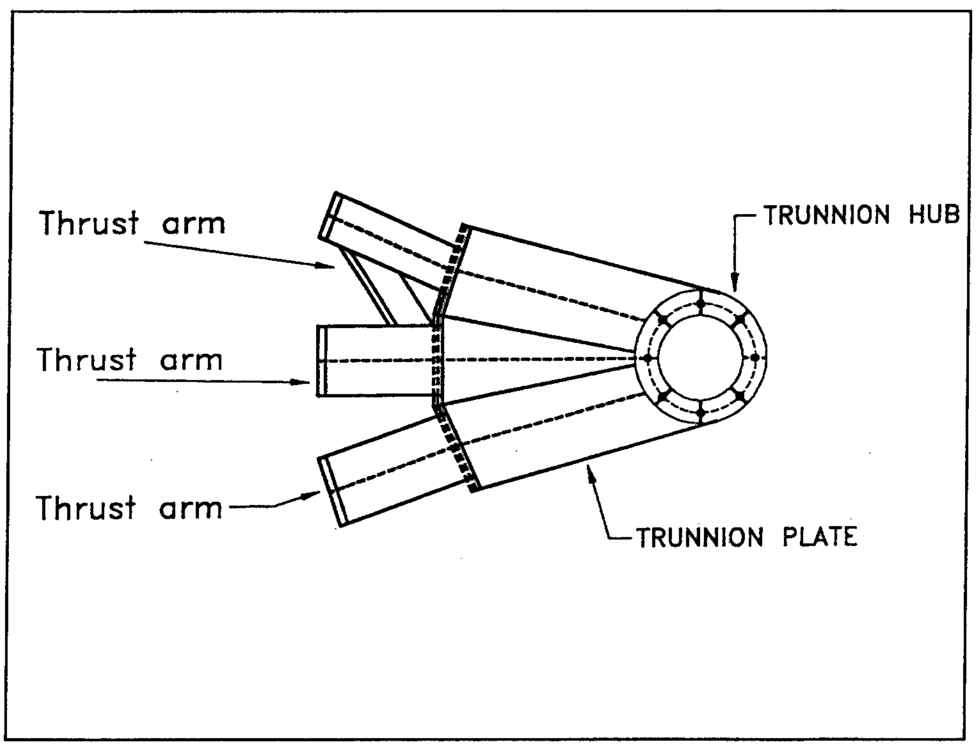

Figure 11. Trunnion hub and flange assembly, tainter gates

Computer Aided Inspection Forms for HSS—Description

As explained above, two types of inspections are performed as part of the evaluation and maintenance of HSS. The Computer Aided Inspection Forms for HSS (CAIF-HSS) computer program can be used to store the information collected during either the periodic or detailed inspections. Inspection forms are divided into operational elements and structural elements, which facilitates the inspection procedures.

Distress variables

Distress variables that are included in the computer program are listed below:

N - No faults noted

A - Alignment out of tolerance

B - Bent element

C - Cracked element

Cr - Corrosion or excessive rust

D - Dented item

G - Gap between elements

M - Movement out of tolerance

W - Wear members

* - Other (e.g., boils, binding, noise)

Rating number for HSS

Rating numbers for HSS (defined below) are used to classify the condition of each element in the structure. Rating numbers are based on the Federal Highway Administration's "Recording and Coding Guide" (FHWA).[1] Good engineering judgment is required to assign values to any element.

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[1] U.S. Department of Transportation, Federal Highway Administration. (1988). "Recording and Coding Guide for the Structure Inventory and Appraisal of Nation's Bridges," FHWA-ED-89-044, Washington, DC.

0 - **FAILED CONDITION** - out of service - beyond corrective action.

1 - **IMMINENT FAILURE CONDITION** - distresses show an imminent element failure.

2 - **CRITICAL CONDITION** - presence of advanced distress conditions.

3 - **SERIOUS CONDITION** - combination of distresses has seriously affected the element.

4 - **POOR CONDITION** - combination of distresses has affected the element.

5- **FAIR CONDITION** - various distress combinations are present.

6 - **SATISFACTORY CONDITION** - some distress combinations are present.

7 - **GOOD CONDITION** - some minor problems.

8 - **VERY GOOD CONDITION** - no problem noted.

9 - **EXCELLENT CONDITION**

2 Installation of CAIF-HSS

Minimum Program Requirements

Minimum requirements to run the CAIF-HSS Windows version are as follows:

a. An IBM (386) or a compatible computer with MS DOS 3.1 and Microsoft Windows 3.1.

b. 1.0 MB of memory (RAM) to run Windows 3.1 in standard mode and 2.0 MB of memory to run Windows 3.x in the 386 enhanced mode.

c. 1.2 MB or 1.4 MB floppy disk drive.

d. A mouse compatible with Microsoft Windows.

e. A monitor (color or monochrome) with a display adapter supported by Windows.

f. A printer supported by windows.

Installation Procedure

The following sequence should be used to install the CAIF-HSS program:

a. Insert setup disk in a floppy disk drive.

b. In File Manager or Program Manager, click File and then Run.

c. Type the drive letter, followed by a colon (:) and a backslash (\), and the word setup. For example:

a:\setup

d. Follow the instructions on your screen.

3 Program Execution

Main Window Options

CAIF-HSS can be run using a mouse, the keyboard, or both. When the program is executed, the main window (shown below, Figure 12) is displayed:

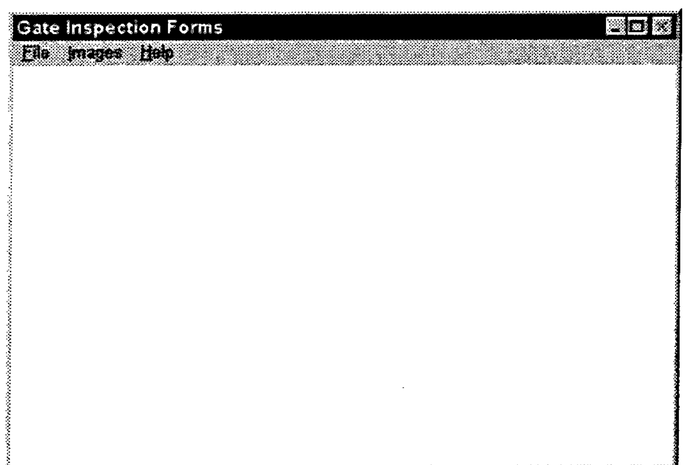

Figure 12. Gate inspection forms, main window

The main window includes the following options:

- *File option* - allows the user to generate a new inspection form, open or edit an existing form, print either a blank or a filled form, open or edit an image log file, and exit the program.

- *Images option* - can be used to display and describe any image stored in the computer.

- *Help option* - provides help on execution of the program.

Program File Options

New inspection

The following paragraphs describe the required sequence to develop a new inspection form:

1. Select **New Inspection** from **File** option (Figure 13).

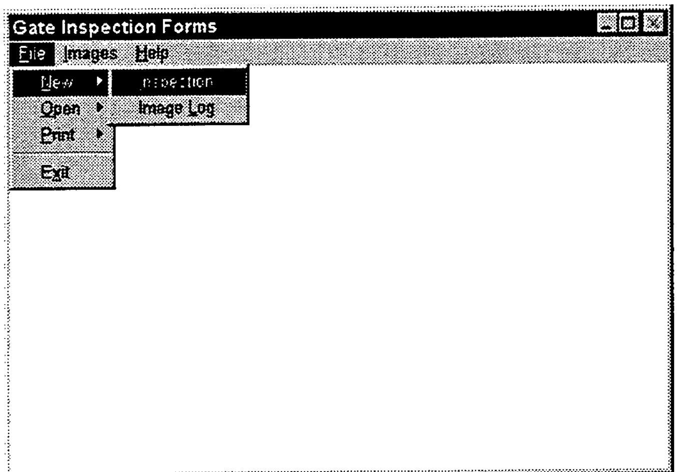

Figure 13. Gate inspection forms, new inspection option

2. Enter the file name where the information will be stored (Output File) (Figure 14).

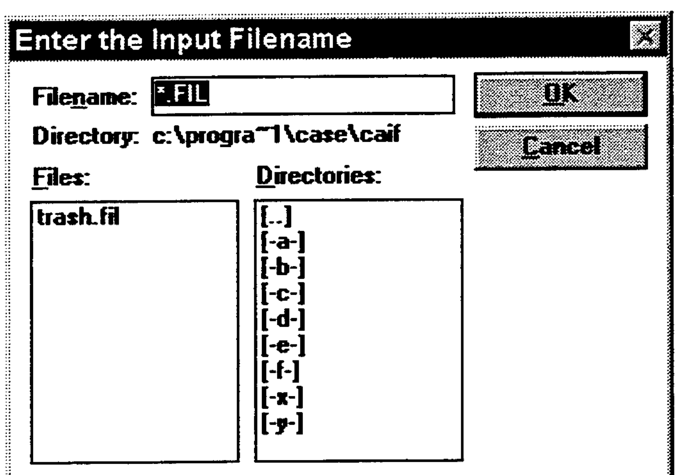

Figure 14. Output file name, input window

3. Select the type of gate that will be inspected (Figure 15).

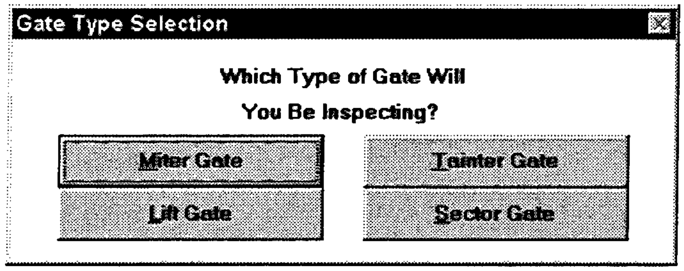

Figure 15. Gate type selection, input window

4. Complete the corresponding forms.

New image log file

The program allows the user to write a description of each image. To do this, the user has to create an image log file, as follows.

1. Select **New Image Log** from **File** Option (Figure 16).

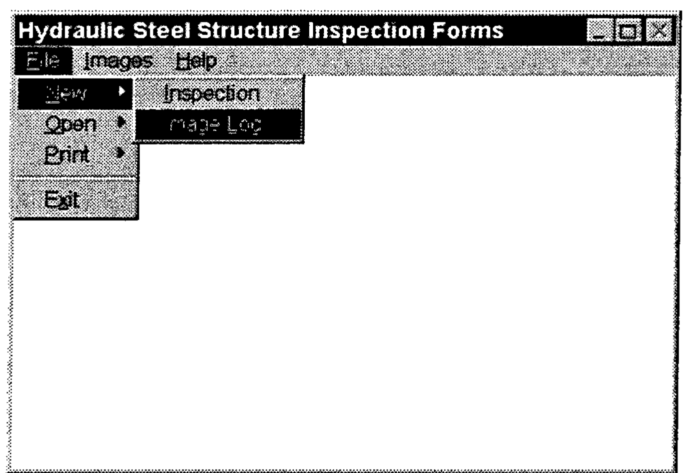

Figure 16. New image log, input window

2. Enter a log file name (Figure 17). The program will suggest the same name as on the inspection forms if the file does not exist. However, if a log file exists with the same name as on the inspection forms file, the program will not suggest a name.

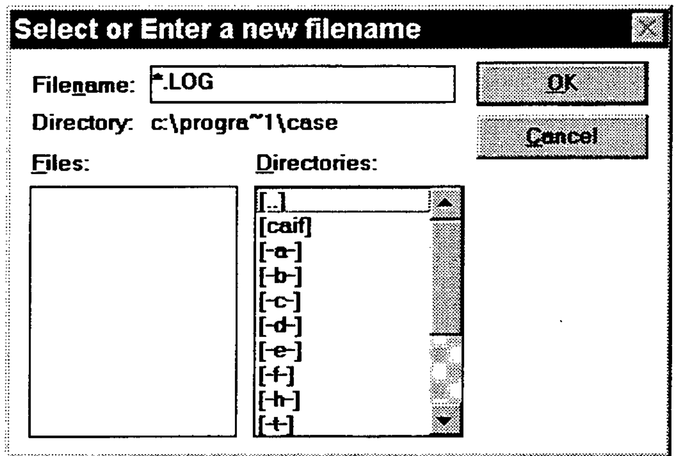

Figure 17. Log file name, input window

3. Select the image file name to be added (Figure 18).

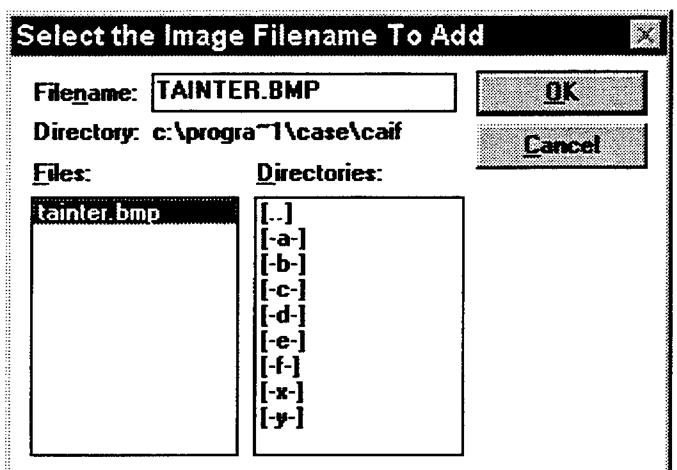

Figure 18. Image file name, input window

4. Add image description.

Open an existing inspection form

The required sequence to edit an existing inspection form (illustrated in Figure 19) is as follows:

1. Select **Open Inspection** from **File** option.

2. Enter the file name of the form that will be edited.

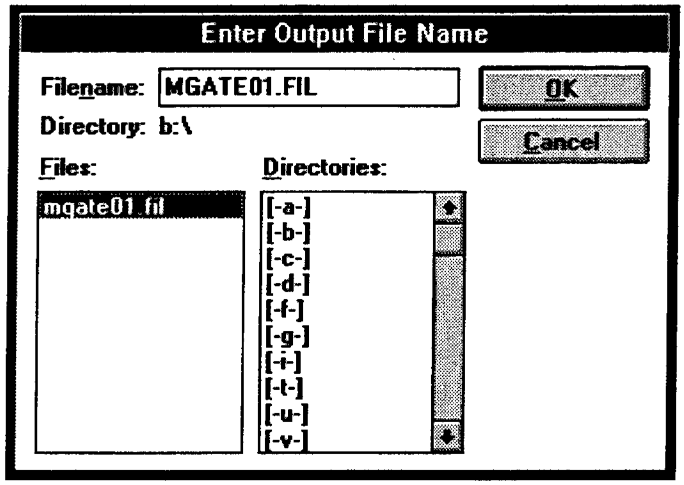

Figure 19. Input file name

3. Edit the corresponding form.

Open image log

The required sequence to edit an existing image log file is as follows:

1. Select **Open Image Log** from **File** option.

2. Select image log file to be edited.

3. Edit file.

Print option

The CAIF-HSS program allows the user to print the form that is being created or a blank inspection form for the desired gate type (Figures 20 and 21). Appendix A shows the blank inspection forms for a horizontally framed miter gate. Forms for other types of gate are similar in appearance and can be obtained using this option.

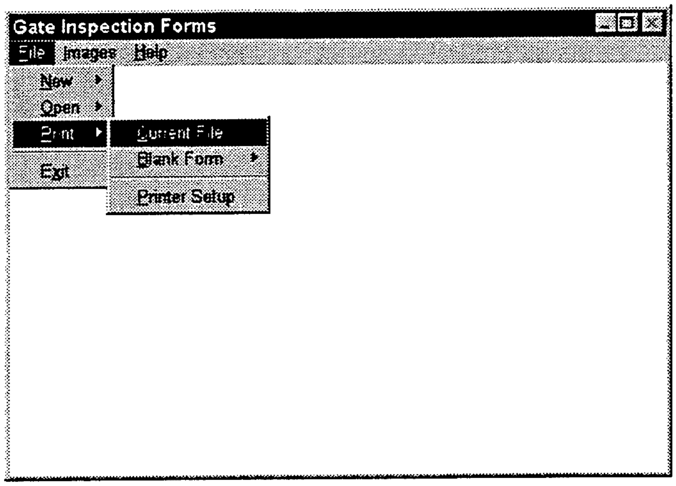

Figure 20. Gate inspection forms, print option

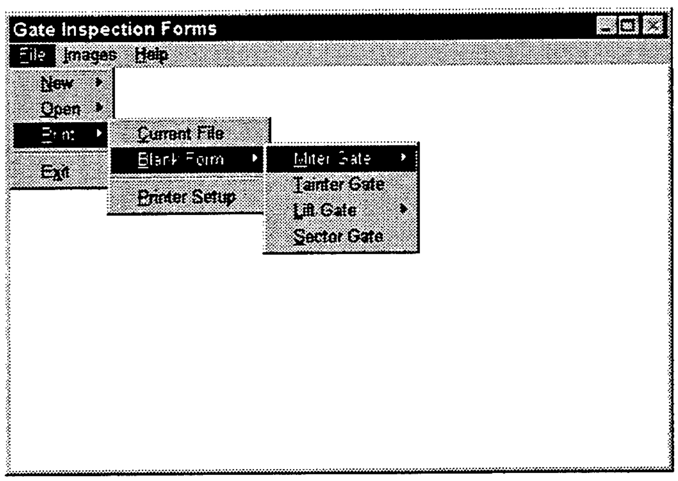

Figure 21. Gate inspection forms, print blank form option

Program Images Option

Displaying images

The Images option allows the user to display and write a description of any image related to the inspection that has been previously stored in the computer. The image will be displayed using Paintbrush (by default), but the user has the option to specify any graphics package desired. The following section (.INI File Setup) provides details on this option.

INI file setup

The setup program automatically sets Paintbrush as the default graphics software to display images. However, if the user wants to use other graphics editor, these procedures must be followed:

1. Select **.INI File Setup** from **Images** option (Figure 22).

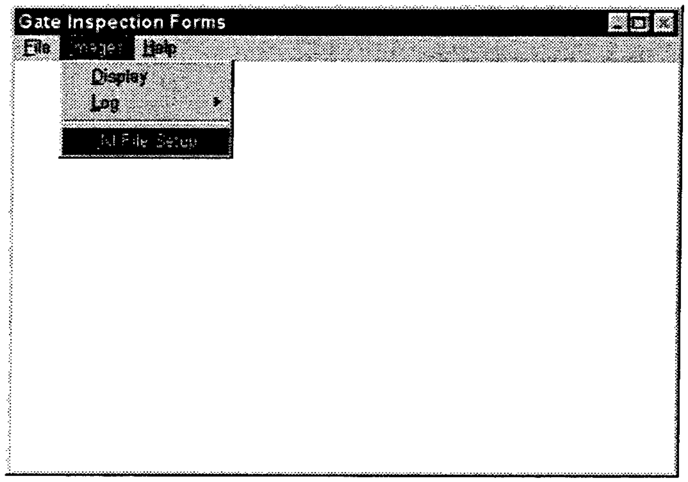

Figure 22. Graphics editor setup option

2. Select the image editor (Figure 23). Here the user has to select the executable file that corresponds to the desired image editor.

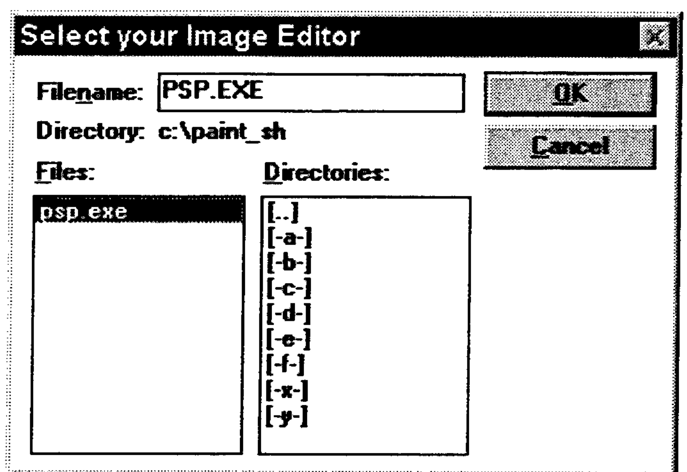

Figure 23. Image editor input window

3. Select the default graphics format (bmp, pcx, tif, dxf, gif, jpg, tga, etc.) (Figure 24).

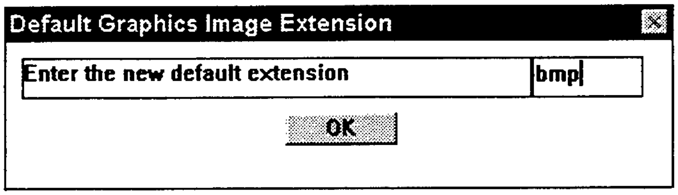

Figure 24. Default graphics extension, input window

Display option

1. To display an image, the user must select **Display** from the **Images** option (Figure 25).

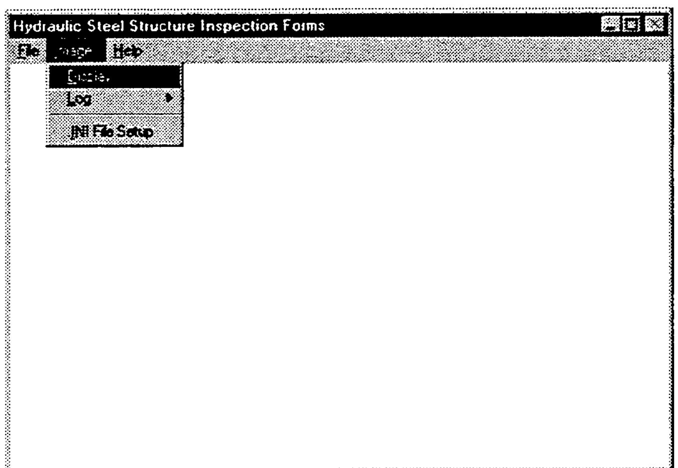

Figure 25. Display option window

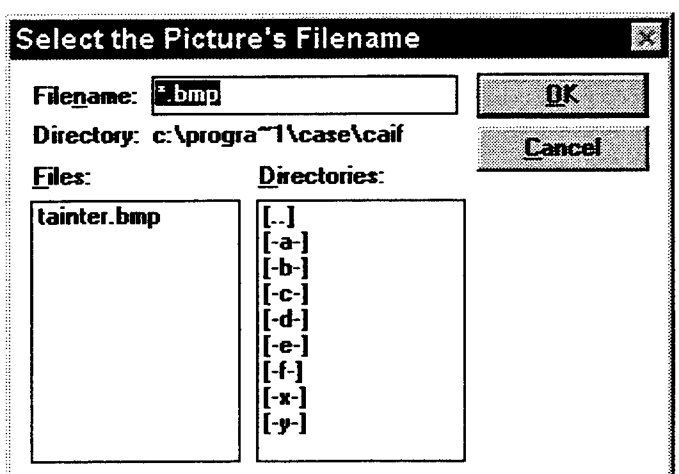

Figure 26. Image file name, input window

3. The graphics editor (Figure 27) will start showing the image selected in the previous step (Figure 24).

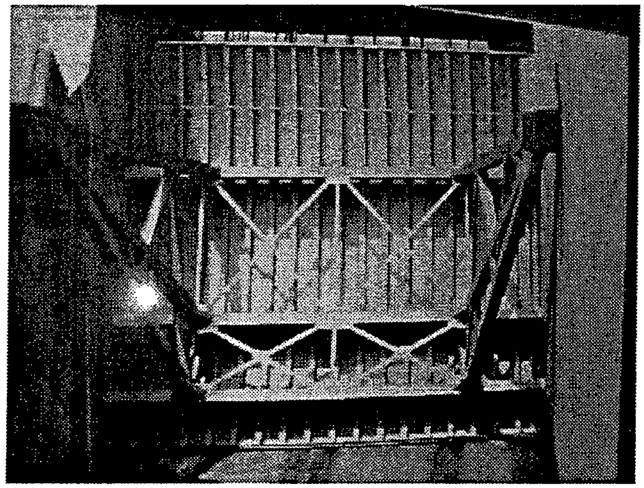

Figure 27. Graphics editor window

Images log file

The required sequence to write a brief description of each image is described below.

1. Select **Log Add Item** from **Images** menu (Figure 28).

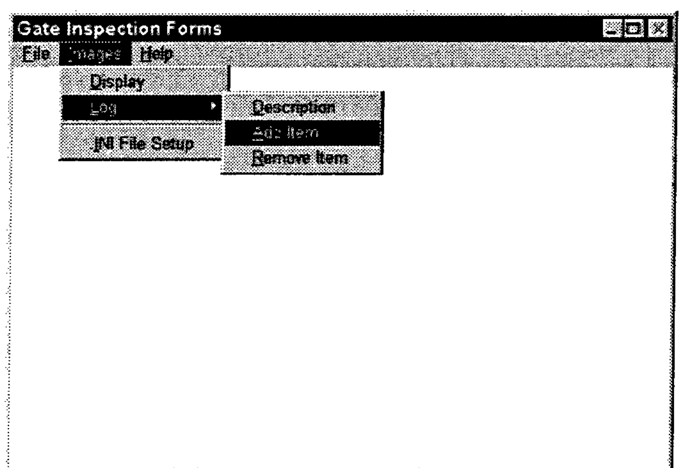

Figure 28. Log/add item option window

2. Select image file name that will be added and press **OK** (Figure 29).

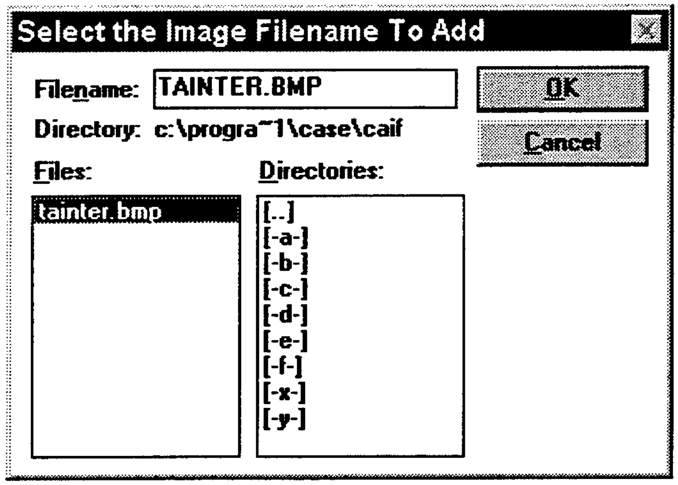

Figure 29. Image selection, input window

3. Write brief description of selected image (Figure 30) and press **Add**.

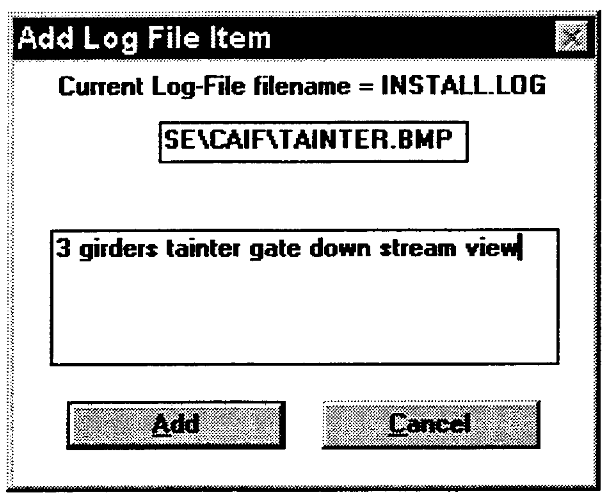

Figure 30. Add log file item, input window

4. To read the description, select **Log Description** from **Images** option.

5. To remove any item from the log file, select **Log Remove Item** from **Images** option.

Using On-line Help

The user can access help from almost anywhere in the program by clicking on an item (or tabbing to it) and pressing the F1 key. Another way to get help is to press the SHIFT-F1 key combination, and then click the mouse cursor on the item for which the user desires help. When the "Question mark - Arrow" cursor appears, the user is in "Help Mode," and the next item the user clicks on will bring up Windows Help.

4 Example Problem

This chapter describes an inspection example for a horizontally framed miter gate in order to help the user understand the procedures required for completing the inspection forms.

1. To start the example, choose **New Inspection** from the file menu, name it as Miter01.fil and select the left leaf of a horizontally framed miter gate (Figures 31-34).

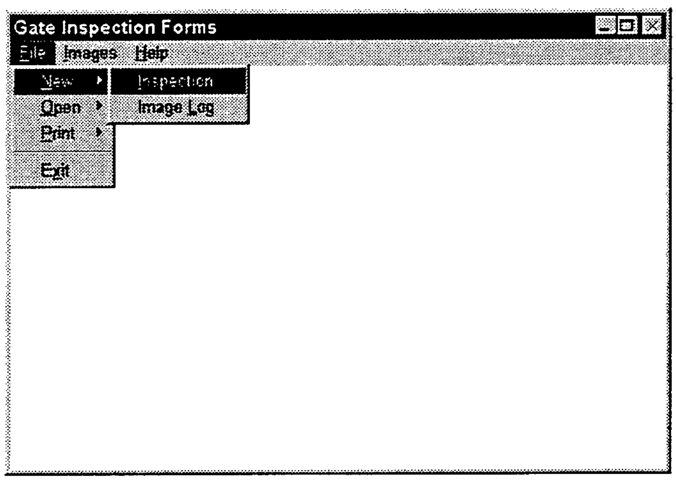

Figure 31. Beginning of miter gate inspection example

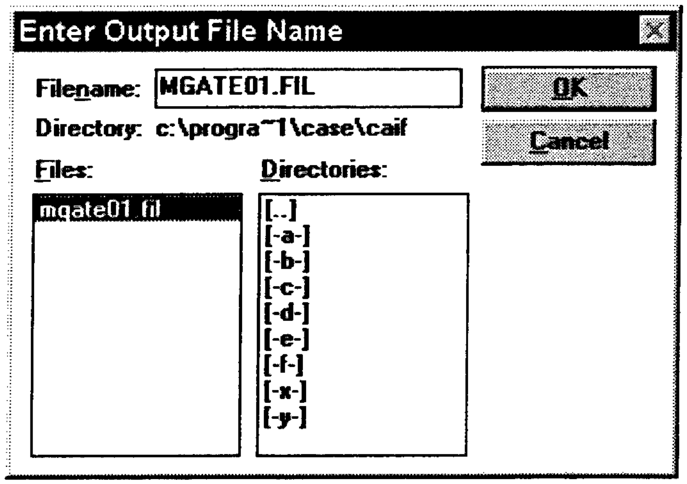

Figure 32. Output file name, input window

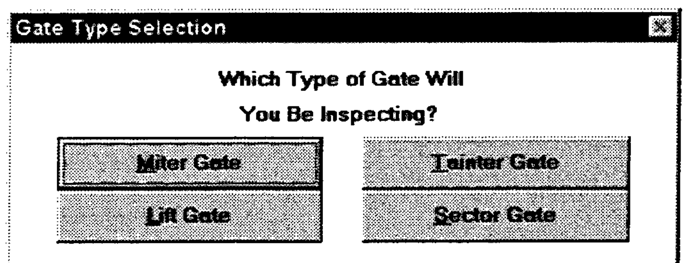

Figure 33. Gate type selection, input window

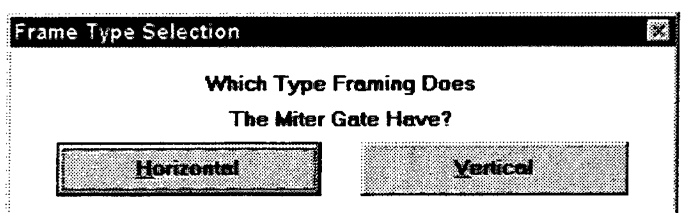

Figure 34. Framing type, input window, horizontal

2. Project information is then required (Figure 35), followed by leaf selection (Figure 36).

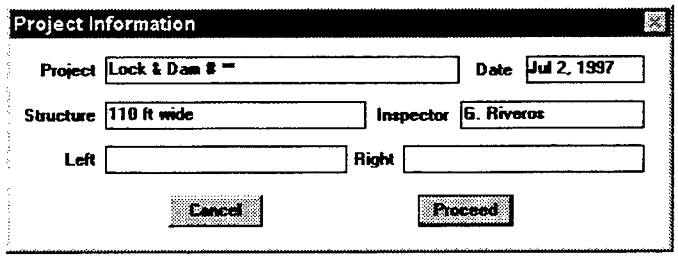

Figure 35. Project information, input window

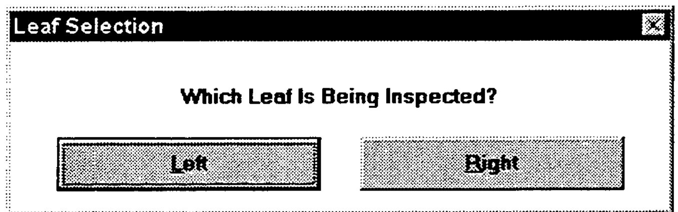

Figure 36. Leaf selection window

3. The user should mark the Appraisal Data, Distress Record, and assign a Rating Number (Chapter 1) to each element in the structure. Five lines of text are also available for any additional comment that the inspector might have. Figure 37 shows the definitions of the appraisal data and distress record terms. These can be accessed by selecting **Terms** in any one of the input windows.

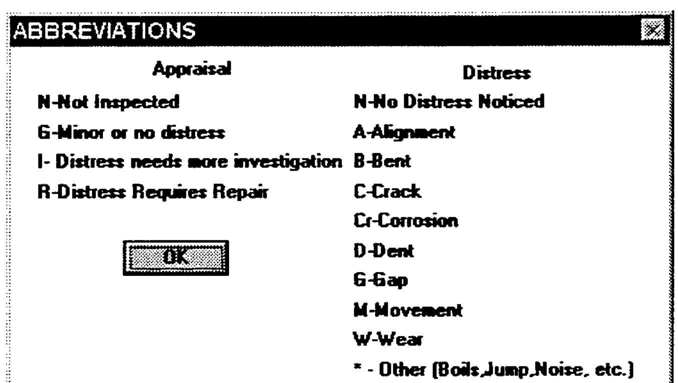

Figure 37. Terms definition window

4. A series of windows then prompt the user for input on linkage assembly, strut connection, quion and miter, pintle assembly, girders, diagonals, skin plate, diaphragms, and intercostals (Figures 38-48).

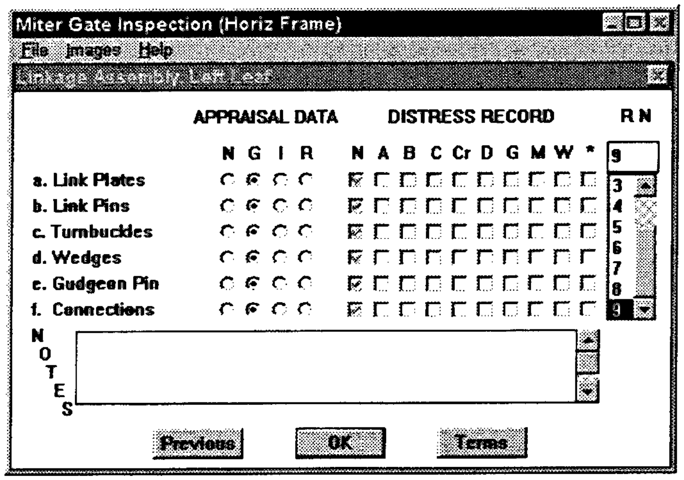

Figure 38. Linkage assembly input window

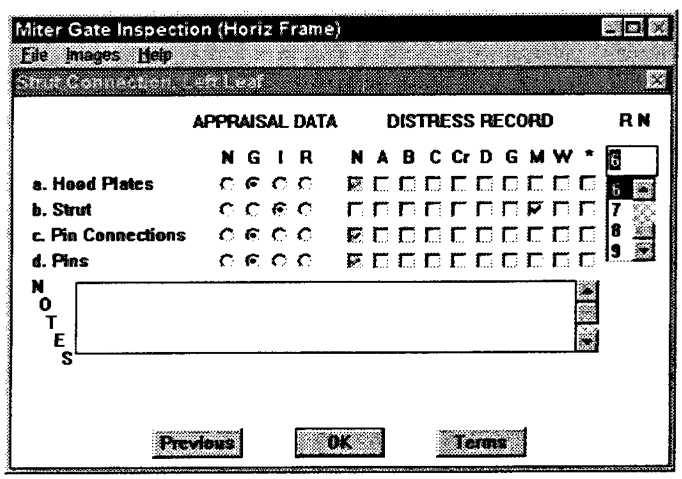

Figure 39. Strut connection input window

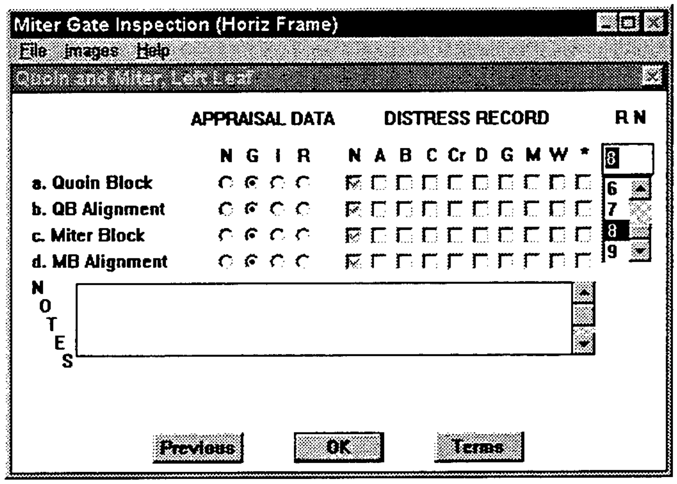

Figure 40. Quoin and miter input window

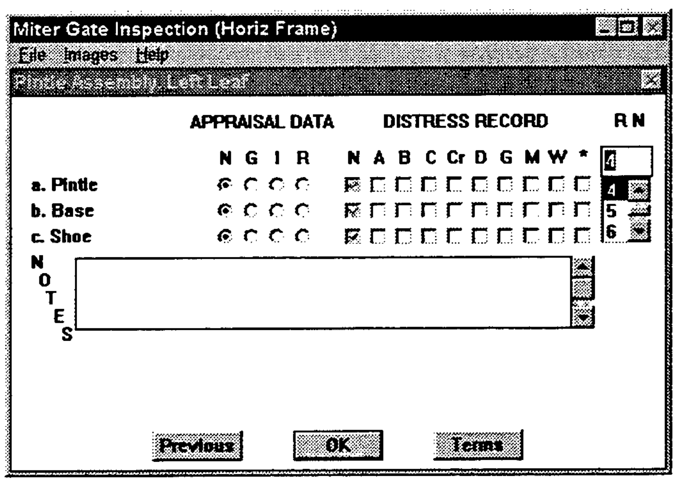

Figure 41. Pintle assembly input window

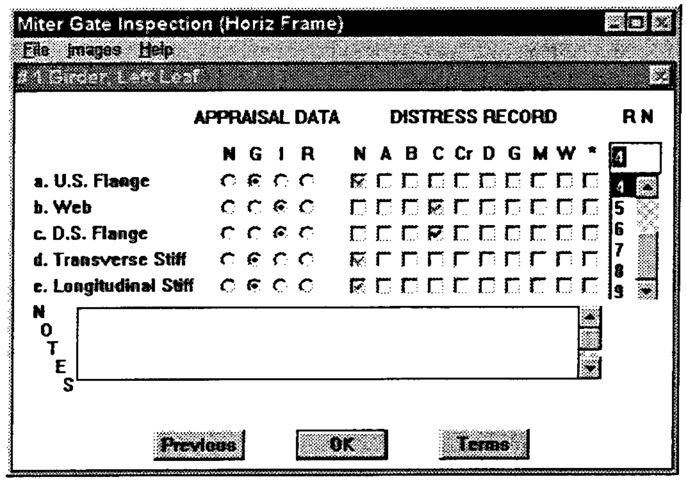

Figure 42. Girder input window

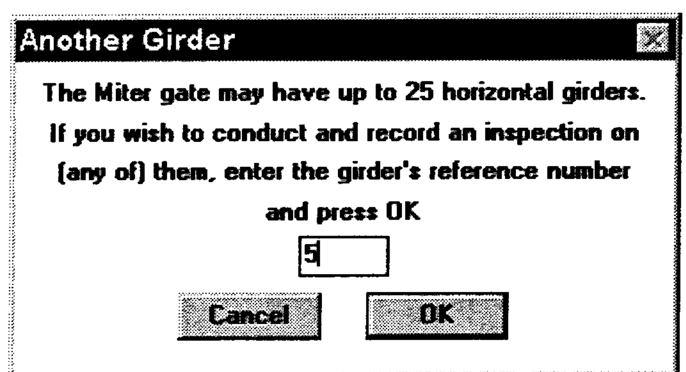

Figure 43. Girder number input window

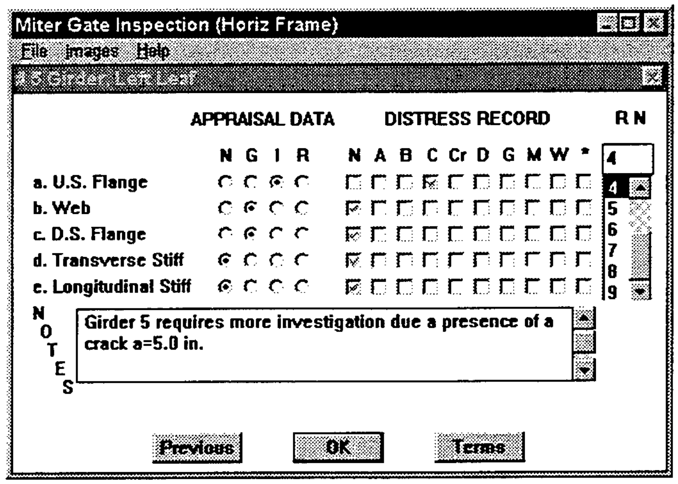

Figure 44. Girder 5, input window

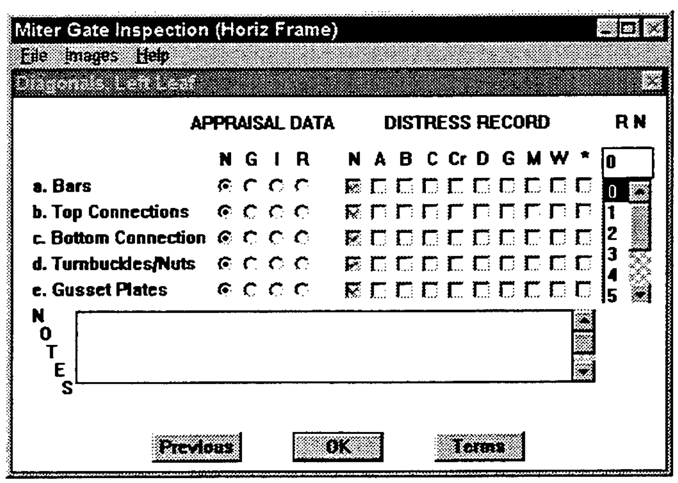

Figure 45. Diagonals input window

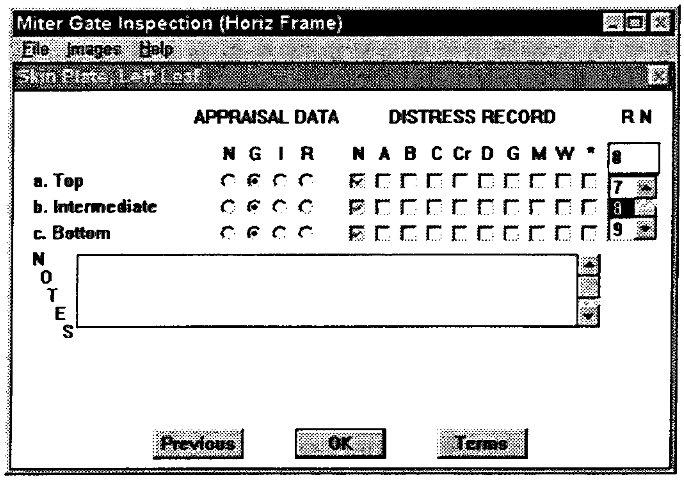

Figure 46. Skin plate input window

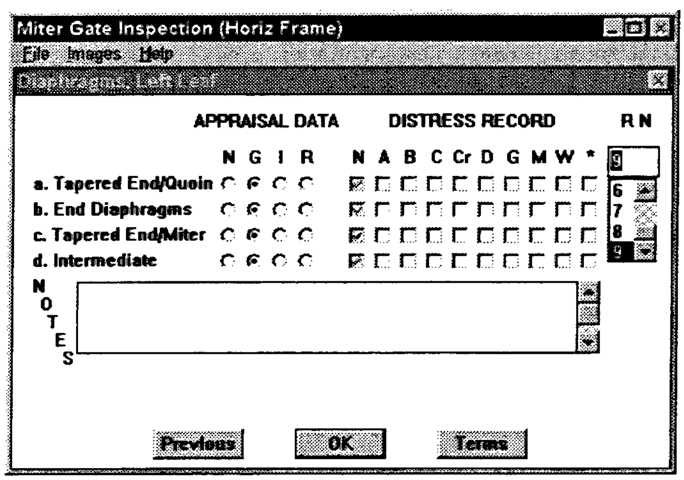

Figure 47. Diaphragms input window

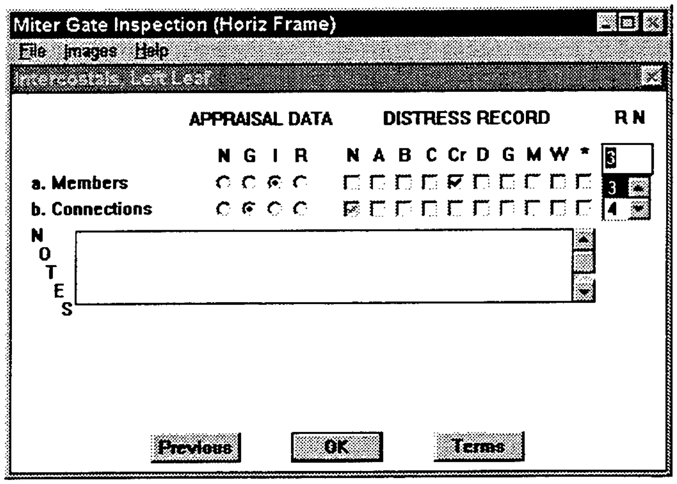

Figure 48. Intercostals input window

5. The Condition Matrix option provides a review of the inspection for both leafs (where "R" means right leaf and "L" means left leaf) (Figure 49).

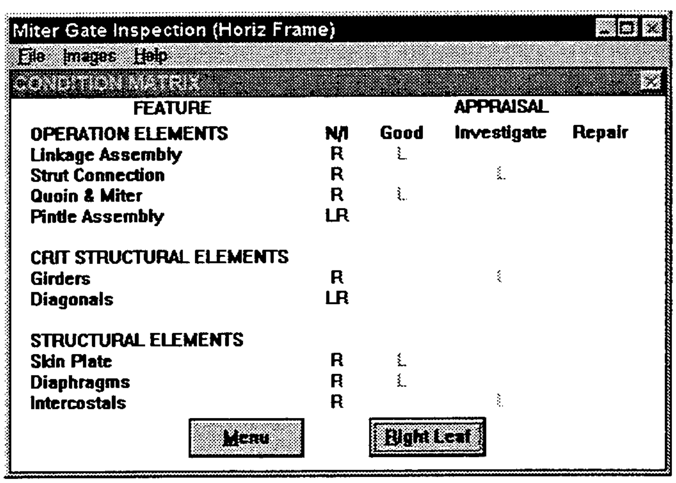

Figure 49. Condition matrix window

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Appendix A: Miter Gate Inspection Forms

Miter Gate Inspection,
Horizontal Type Framing, Right Leaf

PROJECT:

DATE:

STRUCTURE:

INSPECTOR:

REMARKS:

	APPRAISAL				DISTRESS RECORD										
	N	G	I	R	N	A	B	C	Cr	D	G	M	W	*	RN
LINKAGE ASSEMBLY															0
Link Plates	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Link Pins	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Turnbuckles	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Wedges	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Gudgeon Pin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Connections	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
STRUT CONNECTION															0
Hood Plates	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Strut	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Pin Connections	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Pins	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
QUOIN & MITER															0
Quoin Block	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
QB Alignment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Miter Block	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
MB Alignment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
PINTLE ASSEMBLY															0
Pintle	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Base	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Shoe	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

	APPRAISAL				DISTRESS RECORD										
	N	G	I	R	N	A	B	C	Cr	D	G	M	W	*	RN
GIRDER # 1															0
US Flange	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Web	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
DS Flange	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Transverse Stiffeners	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Longitudinal Stiffeners	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
GIRDER # 2															0
US Flange	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Web	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
DS Flange	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Transverse Stiffeners	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Longitudinal Stiffeners	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
GIRDER # 3															0
US Flange	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Web	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
DS Flange	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Transverse Stiffeners	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Longitudinal Stiffeners	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
GIRDER # 4															0
US Flange	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Web	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
DS Flange	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Transverse Stiffeners	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Longitudinal Stiffeners	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

	APPRAISAL				DISTRESS RECORD										
	N	G	I	R	N	A	B	C	Cr	D	G	M	W	*	RN
GIRDER # 5															0
US Flange	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Web	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
DS Flange	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Transverse Stiffeners	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Longitudinal Stiffeners	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
GIRDER # 6															0
US Flange	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Web	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
DS Flange	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Transverse Stiffeners	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Longitudinal Stiffeners	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
GIRDER # 7															0
US Flange	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Web	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
DS Flange	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Transverse Stiffeners	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Longitudinal Stiffeners	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
GIRDER # 8															0
US Flange	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Web	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
DS Flange	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Transverse Stiffeners	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Longitudinal Stiffeners	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
GIRDER # 9															0
US Flange	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Web	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
DS Flange	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Transverse Stiffeners	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Longitudinal Stiffeners	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

	APPRAISAL				DISTRESS RECORD										
	N	G	I	R	N	A	B	C	Cr	D	G	M	W	*	RN
GIRDER # 10															0
US Flange	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Web	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
DS Flange	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Transverse Stiffeners	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Longitudinal Stiffeners	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
GIRDER # 11															0
US Flange	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Web	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
DS Flange	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Transverse Stiffeners	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Longitudinal Stiffeners	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
GIRDER # 12															0
US Flange	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Web	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
DS Flange	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Transverse Stiffeners	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Longitudinal Stiffeners	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
GIRDER # 13															0
US Flange	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Web	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
DS Flange	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Transverse Stiffeners	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Longitudinal Stiffeners	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
GIRDER # 14															0
US Flange	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Web	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
DS Flange	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Transverse Stiffeners	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Longitudinal Stiffeners	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

	APPRAISAL				DISTRESS RECORD										
	N	G	I	R	N	A	B	C	Cr	D	G	M	W	*	RN
GIRDER # 15															0
US Flange	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Web	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
DS Flange	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Transverse Stiffeners	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Longitudinal Stiffeners	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
GIRDER # 16															0
US Flange	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Web	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
DS Flange	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Transverse Stiffeners	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Longitudinal Stiffeners	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
GIRDER # 17															0
US Flange	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Web	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
DS Flange	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Transverse Stiffeners	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Longitudinal Stiffeners	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
GIRDER # 18															0
US Flange	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Web	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
DS Flange	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Transverse Stiffeners	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Longitudinal Stiffeners	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
GIRDER # 19															0
US Flange	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Web	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
DS Flange	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Transverse Stiffeners	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Longitudinal Stiffeners	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

	APPRAISAL				DISTRESS RECORD										
	N	G	I	R	N	A	B	C	Cr	D	G	M	W	*	RN
GIRDER # 20															0
US Flange	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Web	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
DS Flange	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Transverse Stiffeners	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Longitudinal Stiffeners	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
GIRDER # 21															0
US Flange	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Web	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
DS Flange	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Transverse Stiffeners	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Longitudinal Stiffeners	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
GIRDER # 22															0
US Flange	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Web	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
DS Flange	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Transverse Stiffeners	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Longitudinal Stiffeners	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
GIRDER # 23															0
US Flange	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Web	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
DS Flange	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Transverse Stiffeners	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Longitudinal Stiffeners	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
GIRDER # 24															0
US Flange	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Web	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
DS Flange	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Transverse Stiffeners	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Longitudinal Stiffeners	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

	APPRAISAL				DISTRESS RECORD										
	N	G	I	R	N	A	B	C	Cr	D	G	M	W	*	RN
GIRDER # 25															0
US Flange	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Web	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
DS Flange	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Transverse Stiffeners	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Longitudinal Stiffeners	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
DIAGONALS															0
Bars	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Top Connections	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Bottom Connections	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Turnbuckles	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Gusset Plates	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
SKIN PLATE															0
Top	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Intermediate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Bottom	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
DIAPHRAGMS															0
Tapered End/Quoin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
End Diaphragms	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Tapered End/Miter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Intermediate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
INTERCOSTALS															0
Members	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Connections	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

CONDITION ASSESSMENT MATRIX

	N/I	GOOD	INSPECT	REPAIR
LINKAGE ASSEMBLY				
STRUT CONNECTION				
QUOIN & MITER				
PINTLE ASSEMBLY				
GIRDERS				
DIAGONALS				
SKIN PLATE				
DIAPHRAGMS				
INTERCOSTALS				

ABBREVIATIONS

N - No faults noted
A - Alignment out of toleran
B - Bent item
C - Cracked item
Cr - Corrosion or excessive r
D - Dented item
G - Gap between elements
M - Movement out of toleranc
W - Worn members
* - Other ie. boils, binding

WATERWAYS EXPERIMENT STATION REPORTS PUBLISHED UNDER THE COMPUTER-AIDED STRUCTURAL ENGINEERING (CASE) PROJECT

	Title	Date
Technical Report K-78-1	List of Computer Programs for Computer-Aided Structural Engineering	Feb 1978
Instruction Report O-79-2	User's Guide: Computer Program with Interactive Graphics for Analysis of Plane Frame Structures (CFRAME)	Mar 1979
Technical Report K-80-1	Survey of Bridge-Oriented Design Software	Jan 1980
Technical Report K-80-2	Evaluation of Computer Programs for the Design/Analysis of Highway and Railway Bridges	Jan 1980
Instruction Report K-80-1	User's Guide: Computer Program for Design/Review of Curvilinear Conduits/Culverts (CURCON)	Feb 1980
Instruction Report K-80-3	A Three-Dimensional Finite Element Data Edit Program	Mar 1980
Instruction Report K-80-4	A Three-Dimensional Stability Analysis/Design Program (3DSAD)	
	Report 1: General Geometry Module	Jun 1980
	Report 3: General Analysis Module (CGAM)	Jun 1982
	Report 4: Special-Purpose Modules for Dams (CDAMS)	Aug 1983
Instruction Report K-80-6	Basic User's Guide: Computer Program for Design and Analysis of Inverted-T Retaining Walls and Floodwalls (TWDA)	Dec 1980
Instruction Report K-80-7	User's Reference Manual: Computer Program for Design and Analysis of Inverted-T Retaining Walls and Floodwalls (TWDA)	Dec 1980
Technical Report K-80-4	Documentation of Finite Element Analyses	
	Report 1: Longview Outlet Works Conduit	Dec 1980
	Report 2: Anchored Wall Monolith, Bay Springs Lock	Dec 1980
Technical Report K-80-5	Basic Pile Group Behavior	Dec 1980
Instruction Report K-81-2	User's Guide: Computer Program for Design and Analysis of Sheet Pile Walls by Classical Methods (CSHTWAL)	
	Report 1: Computational Processes	Feb 1981
	Report 2: Interactive Graphics Options	Mar 1981
Instruction Report K-81-3	Validation Report: Computer Program for Design and Analysis of Inverted-T Retaining Walls and Floodwalls (TWDA)	Feb 1981
Instruction Report K-81-4	User's Guide: Computer Program for Design and Analysis of Cast-in-Place Tunnel Linings (NEWTUN)	Mar 1981
Instruction Report K-81-6	User's Guide: Computer Program for Optimum Nonlinear Dynamic Design of Reinforced Concrete Slabs Under Blast Loading (CBARCS)	Mar 1981
Instruction Report K-81-7	User's Guide: Computer Program for Design or Investigation of Orthogonal Culverts (CORTCUL)	Mar 1981
Instruction Report K-81-9	User's Guide: Computer Program for Three-Dimensional Analysis of Building Systems (CTABS80)	Aug 1981
Technical Report K-81-2	Theoretical Basis for CTABS80: A Computer Program for Three-Dimensional Analysis of Building Systems	Sep 1981
Instruction Report K-82-6	User's Guide: Computer Program for Analysis of Beam-Column Structures with Nonlinear Supports (CBEAMC)	Jun 1982

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Instruction Report K-83-1	User's Guide: Computer Program with Interactive Graphics for Analysis of Plane Frame Structures (CFRAME)	Jan 1983
Instruction Report K-83-2	User's Guide: Computer Program for Generation of Engineering Geometry (SKETCH)	Jun 1983
Instruction Report K-83-5	User's Guide: Computer Program to Calculate Shear, Moment, and Thrust (CSMT) from Stress Results of a Two-Dimensional Finite Element Analysis	Jul 1983
Technical Report K-83-1	Basic Pile Group Behavior	Sep 1983
Technical Report K-83-3	Reference Manual: Computer Graphics Program for Generation of Engineering Geometry (SKETCH)	Sep 1983
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Technical Report ATC-86-5	Decision Logic Table Formulation of ACI 318-77, Building Code Requirements for Reinforced Concrete for Automated Constraint Processing, Volumes I and II	Jun 1986
Technical Report ITL-87-2	A Case Committee Study of Finite Element Analysis of Concrete Flat Slabs	Jan 1987
Instruction Report ITL-87-1	User's Guide: Computer Program for Two-Dimensional Analysis of U-Frame Structures (CUFRAM)	Apr 1987
Instruction Report ITL-87-2	User's Guide: For Concrete Strength Investigation and Design (CASTR) in Accordance with ACI 318-83	May 1987
Technical Report ITL-87-6	Finite-Element Method Package for Solving Steady-State Seepage Problems	May 1987
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	Title	Date
Instruction Report ITL-87-4	User's Guide: 2-D Frame Analysis Link Program (LINK2D)	Jun 1987
Technical Report ITL-87-4	Finite Element Studies of a Horizontally Framed Miter Gate Report 1: Initial and Refined Finite Element Models (Phases A, B, and C), Volumes I and II Report 2: Simplified Frame Model (Phase D) Report 3: Alternate Configuration Miter Gate Finite Element Studies–Open Section Report 4: Alternate Configuration Miter Gate Finite Element Studies–Closed Sections Report 5: Alternate Configuration Miter Gate Finite Element Studies–Additional Closed Sections Report 6: Elastic Buckling of Girders in Horizontally Framed Miter Gates Report 7: Application and Summary	Aug 1987
Instruction Report GL-87-1	User's Guide: UTEXAS2 Slope-Stability Package; Volume I, User's Manual	Aug 1987
Instruction Report ITL-87-5	Sliding Stability of Concrete Structures (CSLIDE)	Oct 1987
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Instruction Report ITL-88-2	User's Guide for Design and Investigation of Horizontally Framed Miter Gates (CMITER)	Jun 1988
Instruction Report ITL-88-4	User's Guide for Revised Computer Program to Calculate Shear, Moment, and Thrust (CSMT)	Sep 1988
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Technical Report ITL-89-3	User's Guide: Pile Group Analysis (CPGA) Computer Group	Jul 1989
Technical Report ITL-89-4	CBASIN–Structural Design of Saint Anthony Falls Stilling Basins According to Corps of Engineers Criteria for Hydraulic Structures; Computer Program X0098	Aug 1989

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Technical Report ITL-89-6	The Response-Spectrum Dynamic Analysis of Gravity Dams Using the Finite Element Method; Phase II	Aug 1989
Contract Report ITL-89-1	State of the Art on Expert Systems Applications in Design, Construction, and Maintenance of Structures	Sep 1989
Instruction Report ITL-90-1	User's Guide: Computer Program for Design and Analysis of Sheet Pile Walls by Classical Methods (CWALSHT)	Feb 1990
Technical Report ITL-90-3	Investigation and Design of U-Frame Structures Using Program CUFRBC Volume A: Program Criteria and Documentation Volume B: User's Guide for Basins Volume C: User's Guide for Channels	May 1990
Instruction Report ITL-90-6	User's Guide: Computer Program for Two-Dimensional Analysis of U-Frame or W-Frame Structures (CWFRAM)	Sep 1990
Instruction Report ITL-90-2	User's Guide: Pile Group–Concrete Pile Analysis Program (CPGC) Preprocessor to CPGA Program	Jun 1990
Technical Report ITL-91-3	Application of Finite Element, Grid Generation, and Scientific Visualization Techniques to 2-D and 3-D Seepage and Groundwater Modeling	Sep 1990
Instruction Report ITL-91-1	User's Guide: Computer Program for Design and Analysis of Sheet-Pile Walls by Classical Methods (CWALSHT) Including Rowe's Moment Reduction	Oct 1991
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Technical Report ITL-92-4	Introduction to the Computation of Response Spectrum for Earthquake Loading	Jun 1992
Instruction Report ITL-92-3	Concept Design Example, Computer-Aided Structural Modeling (CASM) Report 1: Scheme A Report 2: Scheme B Report 3: Scheme C	 Jun 1992 Jun 1992 Jun 1992
Instruction Report ITL-92-4	User's Guide: Computer-Aided Structural Modeling (CASM) -Version 3.00	Apr 1992
Instruction Report ITL-92-5	Tutorial Guide: Computer-Aided Structural Modeling (CASM) -Version 3.00	Apr 1992

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Contract Report ITL-92-2	Knowledge-Based Expert System for Selection and Design of Retaining Structures	Sep 1992
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Instruction Report GL-87-1	User's Guide: UTEXAS3 Slope-Stability Package; Volume IV, User's Manual	Nov 1992
Technical Report ITL-92-11	The Seismic Design of Waterfront Retaining Structures	Nov 1992
Technical Report ITL-92-12	Computer-Aided, Field-Verified Structural Evaluation	
	Report 1: Development of Computer Modeling Techniques for Miter Lock Gates	Nov 1992
	Report 2: Field Test and Analysis Correlation at John Hollis Bankhead Lock and Dam	Dec 1992
	Report 3: Field Test and Analysis Correlation of a Vertically Framed Miter Gate at Emsworth Lock and Dam	Dec 1993
Instruction Report GL-87-1	User's Guide: UTEXAS3 Slope-Stability Package; Volume III, Example Problems	Dec 1992
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Technical Report ITL-93-2	Steel Structures for Civil Works, General Considerations for Design and Rehabilitation	Aug 1993
Technical Report ITL-93-3	Soil-Structure Interaction Study of Red River Lock and Dam No. 1 Subjected to Sediment Loading	Sep 1993
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Instruction Report ITL-94-1	Tutorial Guide: Computer-Aided Structural Modeling (CASM); Version 5.00	Apr 1994
Instruction Report ITL-94-2	User's Guide: Computer-Aided Structural Modeling (CASM); Version 5.00	Apr 1994
Technical Report ITL-94-4	Dynamics of Intake Towers and Other MDOF Structures Under Earthquake Loads: A Computer-Aided Approach	Jul 1994
Technical Report ITL-94-5	Procedure for Static Analysis of Gravity Dams Including Foundation Effects Using the Finite Element Method – Phase 1B	Jul 1994

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	Title	Date
Instruction Report ITL-94-5	User's Guide: Computer Program for Winkler Soil-Structure Interaction Analysis of Sheet-Pile Walls (CWALSSI)	Nov 1994
Instruction Report ITL-94-6	User's Guide: Computer Program for Analysis of Beam-Column Structures with Nonlinear Supports (CBEAMC)	Nov 1994
Instruction Report ITL-94-7	User's Guide to CTWALL – A Microcomputer Program for the Analysis of Retaining and Flood Walls	Dec 1994
Contract Report ITL-95-1	Comparison of Barge Impact Experimental and Finite Element Results for the Lower Miter Gate of Lock and Dam 26	Jun 1995
Technical Report ITL-95-5	Soil-Structure Interaction Parameters for Structured/Cemented Silts	Aug 1995
Instruction Report ITL-95-1	User's Guide: Computer Program for the Design and Investigation of Horizontally Framed Miter Gates Using the Load and Resistance Factor Criteria (CMITER-LRFD)	Aug 1995
Technical Report ITL-95-8	Constitutive Modeling of Concrete for Massive Concrete Structures, A Simplified Overview	Sep 1995
Instruction Report ITL-96-1	User's Guide: Computer Program for Two-Dimensional Dynamic Analysis of U-Frame or W-Frame Structures (CDWFRM)	Jun 1996
Instruction Report ITL-96-2	Computer-Aided Structural Modeling (CASM), Version 6.00 Report 1: Tutorial Guide Report 2: User's Guide Report 3: Scheme A Report 4: Scheme B Report 5: Scheme C	Jun 1996
Technical Report ITL-96-8	Hyperbolic Stress-Strain Parameters for Structured/Cemented Silts	Aug 1996
Instruction Report ITL-96-3	User's Guide: Computer Program for the Design and Investigation of Horizontally Framed Miter Gates Using the Load and Resistance Factor Criteria (CMITERW-LRFD) Windows Version	Sep 1996
Instruction Report ITL-97-1	User's Guide: Computer Aided Inspection Forms for Hydraulic Steel Structures (CAIF-HSS), Windows Version	Sep 1997

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This report is the user's guide for the Computer Aided Inspection Forms for Hydraulic Steel Structures (CAIF-HSS) computer program, which is used to store information obtained during the inspections of miter, tainter, lift, and sector gates.

The CAIF-HSS runs under Windows environment and includes an interface that allows the user to generate the inspection forms by following a logical sequence of structural elements in the corresponding structure. The program also has the capability to display images.

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