PORT HOUSTON
Maritime Facilities Inspection and Condition Assessment Course Binder

Modules 1-7 and Capstones 1 and 2

Issued by:
Port of Houston Authority
111 East Loop North
Houston, Texas
77029-4326

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Facility Inspection & Condition Assessment Program (FICAP)

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MODULE 1.1

Course Overview

Introductions

WJE ENGINEERS ARCHITECTS MATERIALS SCIENTISTS
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Page 3

Getting to Know You

- Inspection experience?
- Maritime structure inspection experience?
- What do you hope to get out of the course?

Instructor Outcomes

- Prepare you to be efficient and effective PHA inspectors/engineers
- Have some fun and get to know you better

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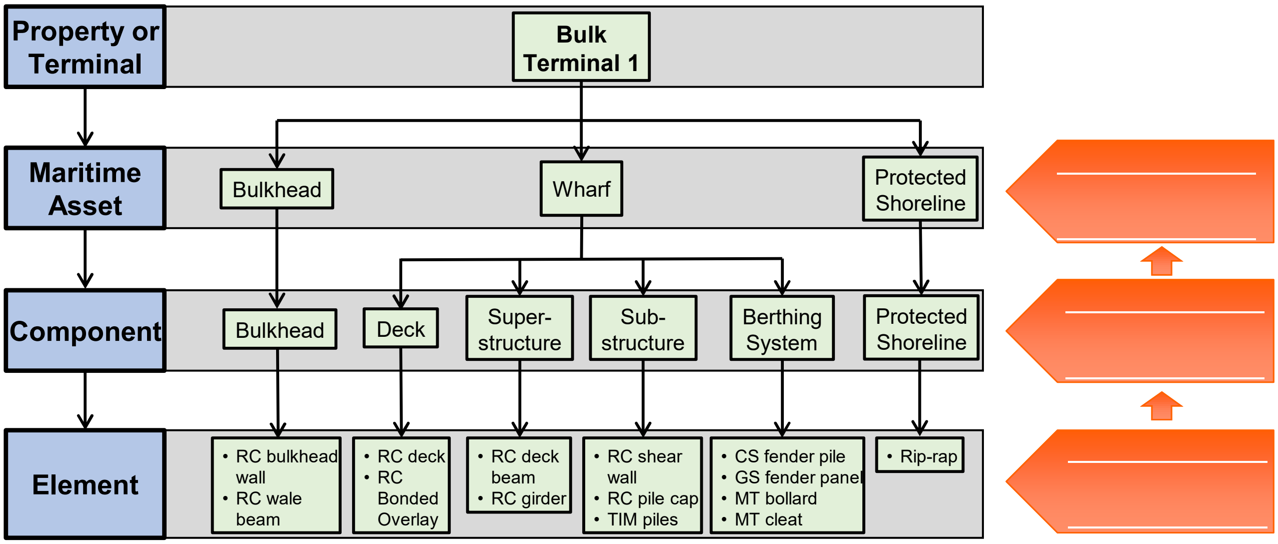
The "Big" Picture (Fill in the blanks)



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GLOBAL LEARNING OUTCOMES

- Describe the element-based inspection approach for maritime assets
- Describe the hierarchy used to define PHA maritime facilities, and identify the structural and non-structural components and elements included within the inspection scope
- Describe the typical element condition states in terms of types of defects, damage, and deterioration that may be observed during an inspection
- Conduct inspections in accordance with PHA standards, utilizing, where available, job aids such as checklists and forms
- Recommend and prioritize follow-up actions
- Assign component condition and overall maritime asset ratings

Schedule – Day 1

Lesson	Title	Duration (min.)	Start	Finish
Module 1: Course Overview and Introduction to PHA FICAP				
1.1	Introductions and Course Overview	15	1:00 PM	1:15 PM
1.2	Introduction to PHA and FICAP	15	1:15 PM	1:30 PM
1.3	Introduction to Element-Based Inspection	30	1:30 PM	2:00 PM
Module 2: Maritime Asset, Component and Element Types				
2.1	PHA Asset Types	30	2:00 PM	2:30 PM
2.2	Component Groups	40	2:30 PM	3:10 PM
Break		15	3:10 PM	3:25 PM
2.3	Elements	90	3:25 PM	4:55 PM
	Total Instructional Time Day 1:	**220**	**minutes**	

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Schedule – Day 2

Lesson	Title	Duration (min.)	Start	Finish
Module 3: Inspection Types and Reports				
3.1	Inspection Types and Reports	90	8:00 AM	9:30 AM
Break		10	9:30 AM	9:40 AM
3.1	Inspection Types and Reports (continued)	60	9:40 AM	10:40 AM
Module 4: Element Conditions and Condition States				
4.1	Element Damage and Deterioration Conditions	80	10:40 AM	12:00 PM
Lunch		60	12:00 PM	1:00 PM
4.1	Element Damage and Deterioration Conditions (continued)	60	1:00 PM	2:00 PM
4.2	Element Condition States	90	2:00 PM	3:30 PM
Break		10	3:30 PM	3:40 PM
4.3	Documenting Element Condition States	90	3:40 PM	5:10 PM
	Total Instructional Time Day 2:	**470**	**minutes**	

Schedule – Day 3

Lesson	Title	Duration (min.)	Start	Finish
Module 5: Recommended Follow-up Actions				
5.1	Recommended Follow-up Actions	30	8:00 AM	8:30 AM
Break		10	8:30 AM	8:40 AM
Capstone Project Part 1: Element Inspection				
CP 1.1	Element Identification, Classification, and Documentation	60	8:40 AM	9:40 AM
CP 1.2	Rapid Element Condition State Recognition	30	9:40 AM	10:10 AM
Module 6: Component Condition Assessment				
6.1	FICAP Condition Assessment and Rating Approach	20	10:10 AM	10:30 AM
6.2	Component Ratings	100	10:30 AM	12:10 PM
Lunch		60	12:10 PM	1:10 PM
6.3	Overall Asset Condition Rating	60	1:10 PM	2:10 PM
6.4	Condition Rating for Post-Event Inspections	15	2:10 PM	2:25 PM
Module 7: Overall Documentation and Reporting Requirements				
7.1	Overall Documentation and Reporting Requirements	30	2:25 PM	2:55 PM
Capstone Project Part 2: Component and Asset Condition Assessment				
CP 2.1	Component Condition Assessment	60	2:55 PM	3:55 PM
Break		10	3:55 PM	4:05 PM
CP 2.2	Asset Condition Assessment and Reporting	60	4:05 PM	5:05 PM
	Total Instructional Time Day 3:	**465**	**minutes**	

Course Structure

GOAL: Provide or strengthen the core competencies of PHA maritime asset inspection team members so as to improve the quality, consistency, and documentation for inspections and condition assessments of PHA maritime assets.

INTERACTIVE PROCESS

EVALUATION

Wrap-up

Module 1.1 Learning Outcomes

- List previous maritime structure inspection experience.
- Summarize the course structure and global learning outcomes.
- Describe the course agenda.
- Recognize that performance-based evaluations and an end-of-course exam will be administered.

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END OF MODULE

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MODULE 1.2

Introduction to PHA and FICAP

Module Objectives

- State the purpose of an inspection and condition assessment program.
- Relate this purpose to the needs of PHA.
- Describe generally how inspection and condition assessment findings will be collected and utilized by PHA.
- Describe the scope of the PHA FICAP Manual.

Module Resources

- Chapter 1: Introduction
  - 1.1 General
  - 1.2 Manual Scope

Introduction to PHA

PHA by the numbers:

- **8** public terminals managed
- **25** miles of complex
- **150+** private and public industrial terminals
- **8,000** vessels
- **200,000** barges
- **200 million** tons of cargo

Image: J. Kurth

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Introduction to PHA

Variety of assets managed:

- Cargo wharves
- T-Docks
- Boat and barge docks
- Bulkheads (not associated with wharves)
- Protected and unprotected shoreline
- Rail loading platforms
- Bridges

Image: J. Kurth

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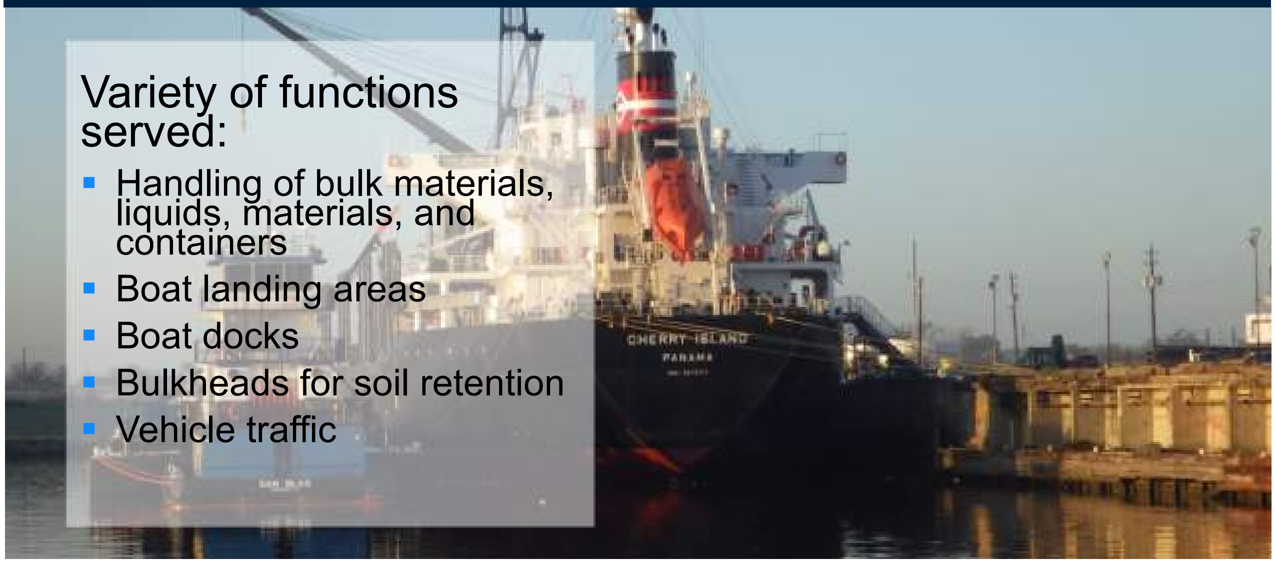
Introduction to PHA



Variety of functions served:

- Handling of bulk materials, liquids, materials, and containers
- Boat landing areas
- Boat docks
- Bulkheads for soil retention
- Vehicle traffic

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Introduction to PHA FICAP

Maritime assets managed by PHA are inspected and assessed through the FICAP:

Facilities

Inspection and

Condition

Assessment

Program

Introduction to PHA FICAP

Facilities

Inspection and

Condition

Assessment

Program

Process by which a qualified team leader carries out or supervises the **observation**, **classification**, and **documentation** of the physical condition of a maritime asset.

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Introduction to PHA FICAP

Facilities

Inspection and

Condition

Assessment

Program

Evaluation based on **engineering judgment**, which considers qualitative and quantitative inspection findings and may be supplemented by engineering calculations.

Introduction to PHA FICAP

Facilities

Inspection and

Condition

Assessment

Program

Fill in your slide!

Why perform a facility inspection and condition assessment?

- ☐
- ☐
- ☐
- ☐
- ☐
- ☐

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Introduction to PHA FICAP

Facilities

Inspection and

Condition

Assessment

Program

FICAP Objectives:

- Provide uniform **guidance for inspection teams** to carry out baseline and routine (structural) visual inspections and conditions assessments of maritime assets owned by PHA
- Provide inspection and assessment information necessary for PHA management to determine timing of some **preventative and remedial actions** required to maintain desired level of service

Scope of PHA FICAP Manual

The FICAP Manual defines processes, procedures, and requirements for completing inspections and condition assessments in a consistent manner and level of detail to meet the needs of the PHA.

Scope of PHA FICAP Manual

Included in Scope:

- Cargo wharves
- T-docks
- Boat and barge docks
- Bulkheads
- Protected and unprotected shoreline
- Rail loading platforms
- Bridges owned and maintained by PHA

Not Included in Scope:

- Cathodic protection systems
- Mechanical, electrical, and plumbing systems
- Buildings and sheds
- Mechanical operations of crane and train rails
- Wharf cranes and other mechanized equipment
- Security components

Organization of FICAP Manual

1. Introduction
2. Inspection Types
3. Elements and Element Conditions
4. Component Types
5. Maritime Asset Types
6. Assessment and Rating Approach
7. Recommended Follow-Up Action Guidelines

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Organization of FICAP Manual

8. Documentation and Reporting
9. Administrative Requirements
10. References

Appendices:
A. PHA Maritime Asset List
B. Glossary
C. Element Descriptions
D. Condition States (Alphabetical)
E. Condition States (by Material)
F. Template Documents and Forms
G. Standard Inspection Drawings

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Wrap-up

Module 1.2 Learning Outcomes

- State the purpose of an inspection and condition assessment program.
- Relate this purpose to the needs of PHA.
- Describe generally how inspection and condition assessment findings will be collected and utilized by PHA.
- Describe the scope of the PHA FICAP Manual.

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END OF MODULE

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MODULE 1.3

Introduction to Element-Based Inspections

Module Objectives

- Explain the hierarchy of facility terms.
- Describe the application of an element-based approach to inspection and assessment programs.

Module Resources

- Chapter 1: Introduction
  - 1.3 Inspection and Condition Assessment Approach

Hierarchy of Terms: Property/Terminal

- **Property/Terminal:**
  - Collection of **maritime assets**
  - Highest order in the PHA FICAP
  - Defined by distinct property boundaries

Property or Terminal

Bulk Terminal 1

A "terminal" is a collection of cargo wharves.

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Hierarchy of Terms: Property/Terminal

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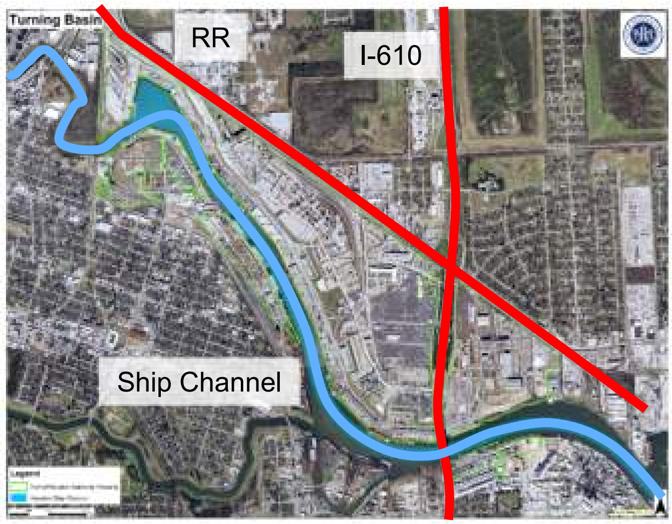

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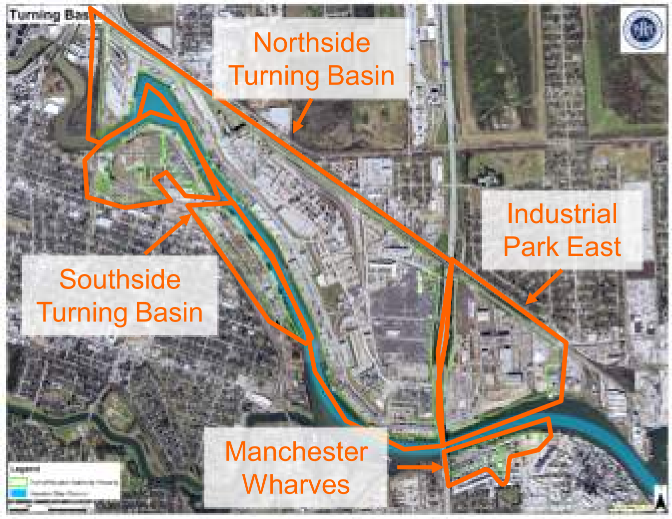

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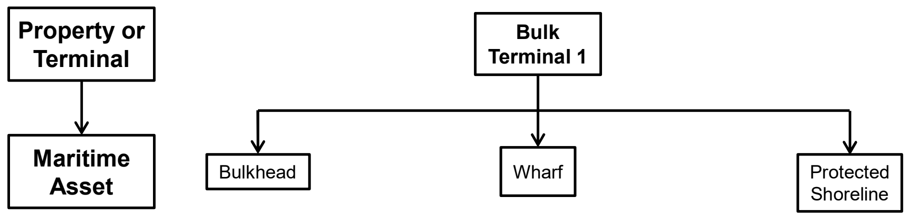
Hierarchy of Terms: Maritime Asset

- **Maritime Asset:**
  - Part of a **property** or **terminal** that serves a particular functional purpose
  - Boundaries determined by asset type



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Hierarchy of Terms: Maritime Asset

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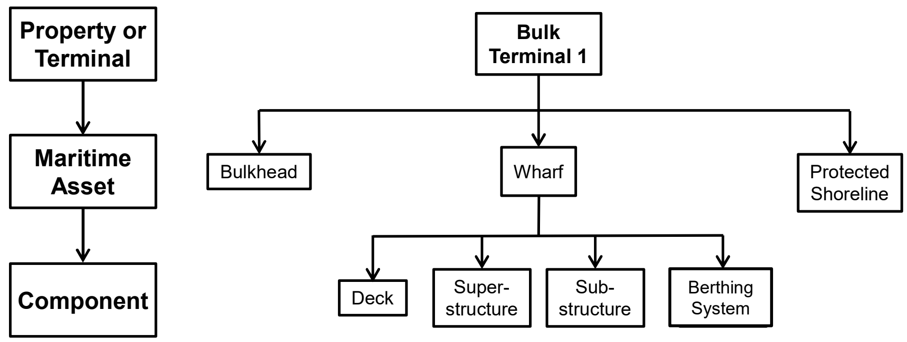
Hierarchy of Terms: Component

- **Component:**
  - Structural or non-structural system of **elements** that makes up an **asset**
  - Boundaries defined by structural or functional purpose



Hierarchy of Terms: Component

- **Component:**
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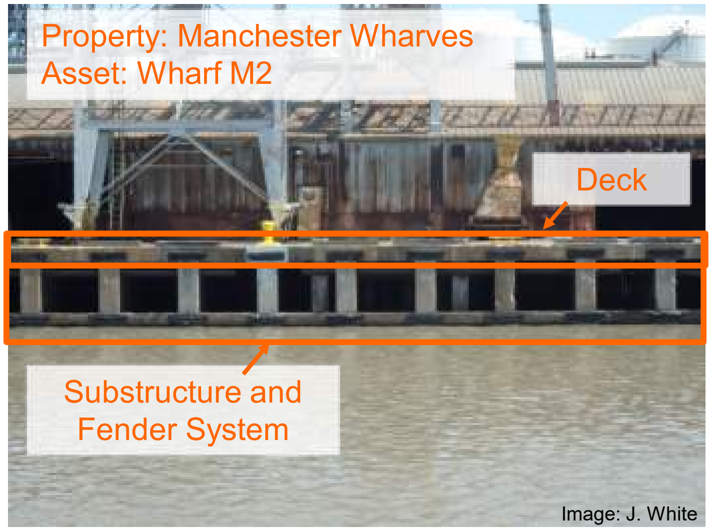

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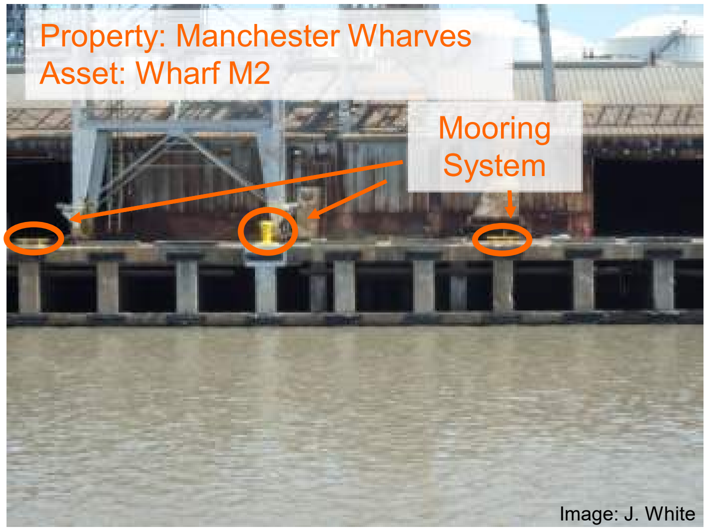

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Hierarchy of Terms: Component

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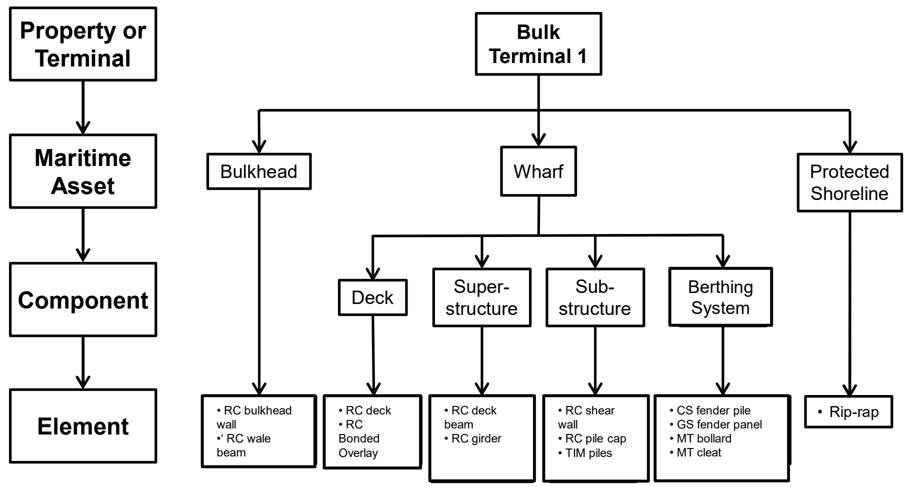
Hierarchy of Terms: Element

- **Element:**
  - Individual structural or non-structural member
  - Boundaries defined by associated component, purpose, geometry, and material



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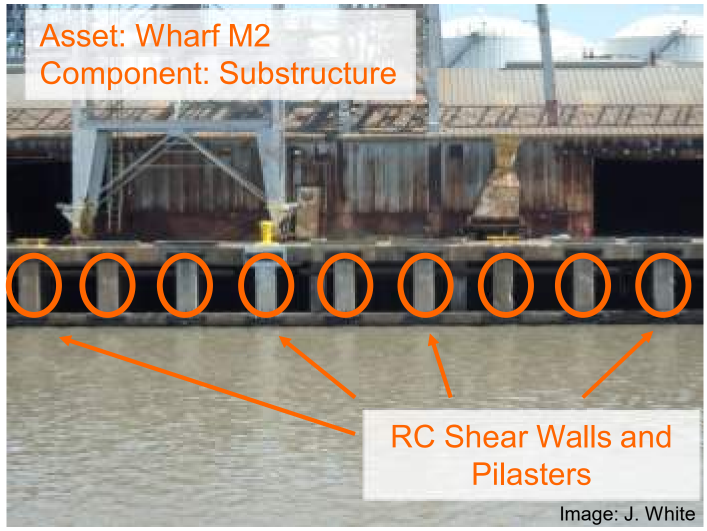

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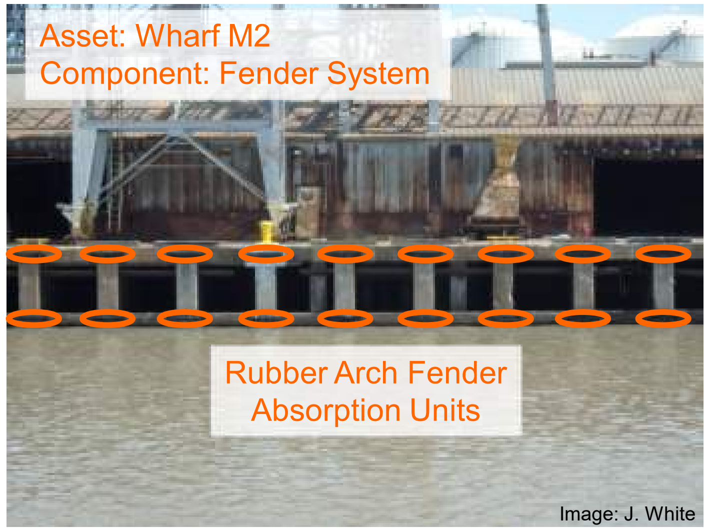

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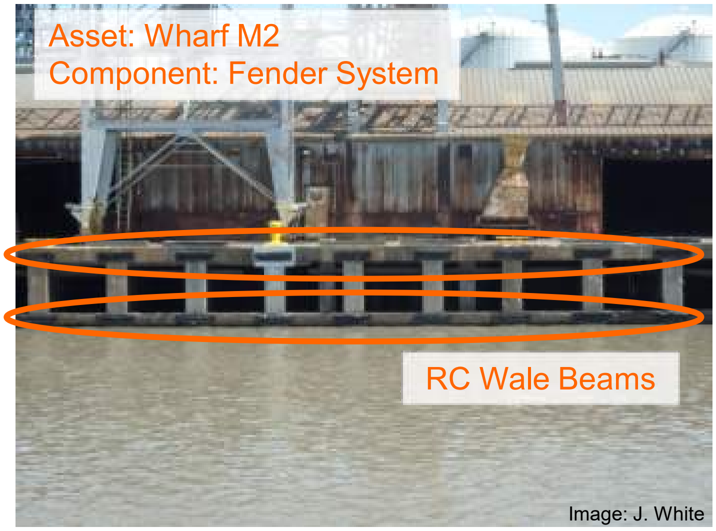

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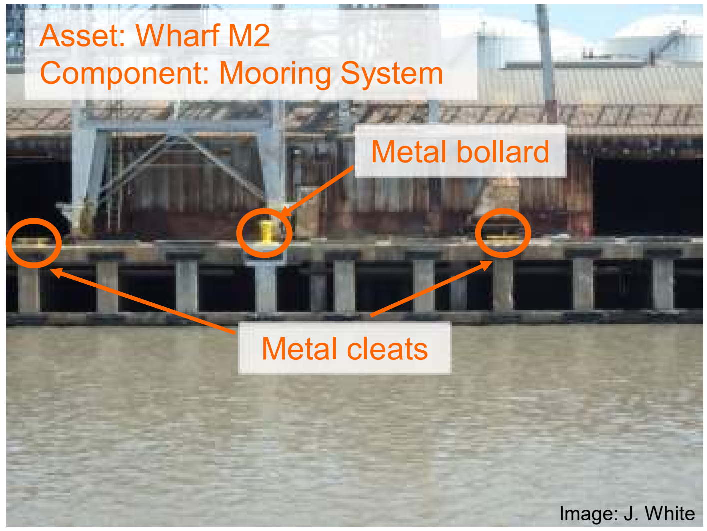


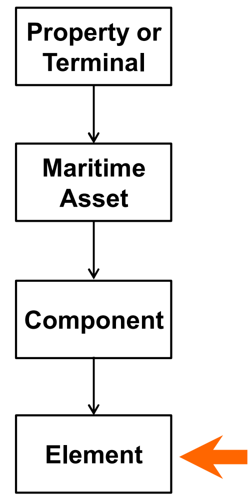
You’re the inspector…

- How do you conduct an inspection in a way that provides a credible assessment of an asset’s condition?
- How do you determine which follow-up actions to take?

Image: J. Kurth

Element-based Inspection Approach

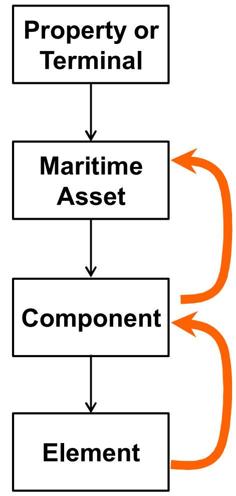
- Inspections are conducted at the **element level**
  - Damage/deterioration characterized by element and material type
  - Provides level of detail necessary for credible condition assessment



Element-based Inspection Approach

- Element conditions used to determine **component ratings**
  - Engineering interpretation of element condition states and corresponding impact on component condition
  - Guides **Follow-up Actions**

- Component ratings used to determine overall **asset condition assessment**

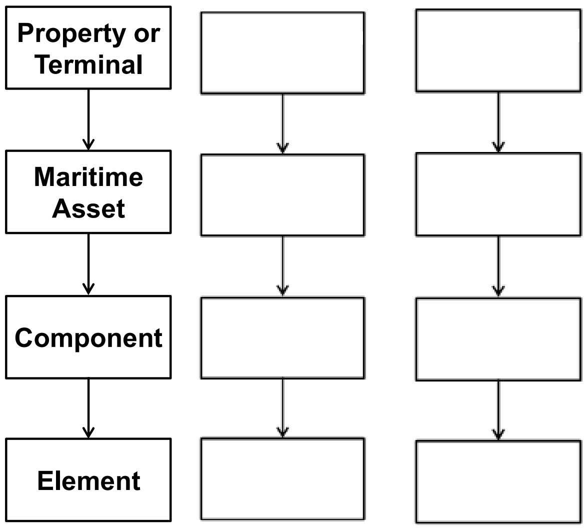


Discussion

- What element characteristics should be recorded to facilitate a credible condition assessment?
  - ☑
  - ☑
  - ☑
  - ☑

Fill in your slide!

Module 1.3 Practical Exercise



- Develop a parallel hierarchy of terms using
  - The building we are in
  - Family relationships
- Fill in the boxes accordingly
- Start from bottom up

Wrap-up

Module 1.3 Learning Outcomes

- Explain the hierarchy of facility terms.
- Describe the application of an element-based approach to inspection and assessment programs.

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END OF MODULE

MODULE 2.1

PHA Maritime Assets

Module Objectives

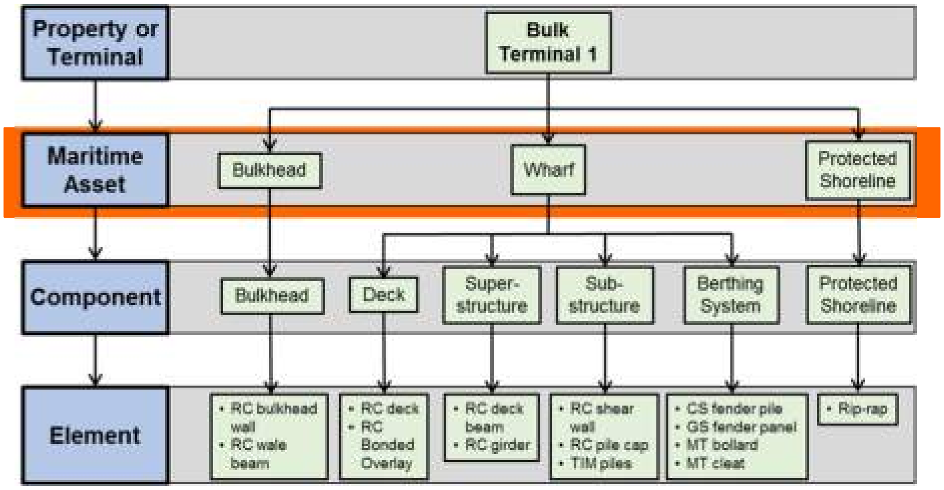
- Identify maritime assets within the PHA inventory.
- Describe the functional purpose of each maritime asset type.

Module Resources

- Chapter 5: Maritime Asset Types
- Appendix A: PHA Maritime Asset List
- Appendix B: Glossary

Maritime Asset

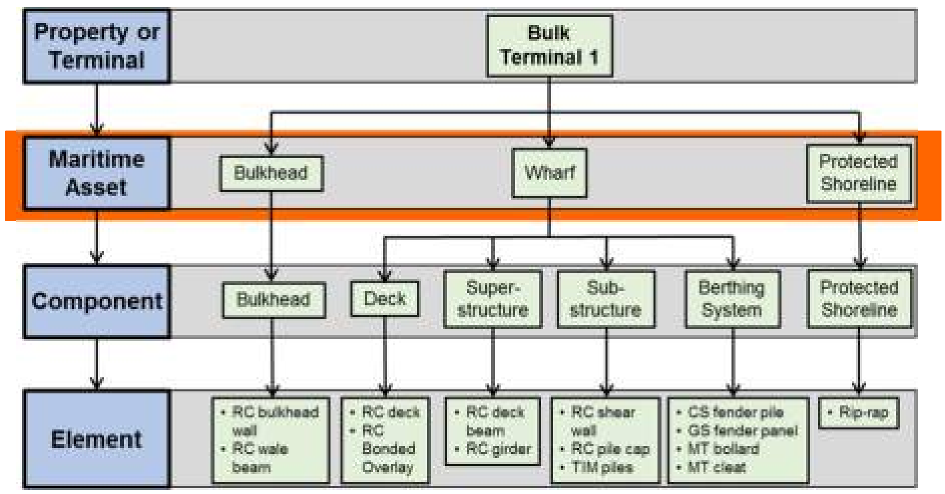
Maritime Asset: A unit of a property or terminal that has a defined boundary and serves a functional purpose



Maritime Asset

Four main types of asset:

1. Wharf
2. Boat Dock
3. Bulkhead
4. Shoreline



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Wharf

- Structure oriented parallel to shore for mooring ships
- Functional purpose?

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Wharf

- Structure oriented parallel to shore for mooring ships
- Purpose: loading and unloading cargo or personnel from large vessels

Wharf

- Structure oriented parallel to shore for mooring ships
- Purpose: loading and unloading cargo or personnel from large vessels

- Consists of one or more structural systems:
  - Open platform with open structure
  - Open platform with solid structure
  - Solid bulkhead
  - Solid bulkhead with relieving platform

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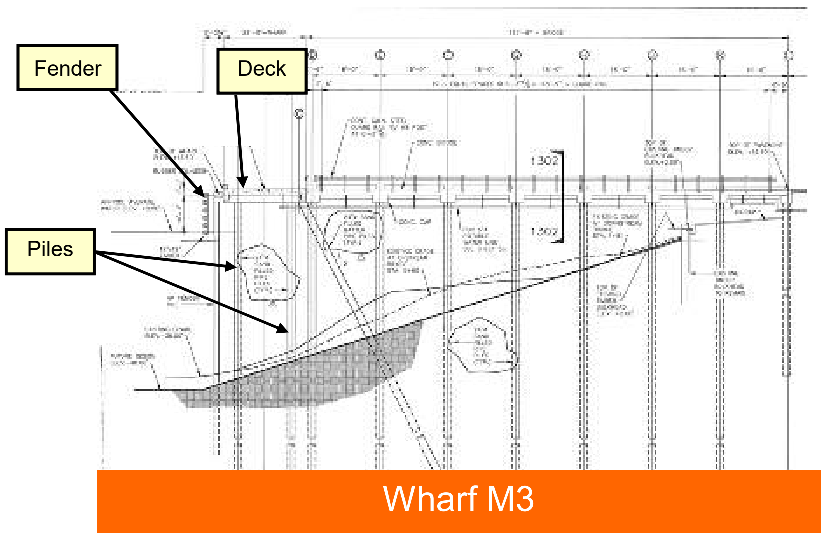
Wharf: Open platform, open structure

- **Open platform**: Water free to move underneath
- **Open structure**: Structure supported over water by piles or drilled shafts

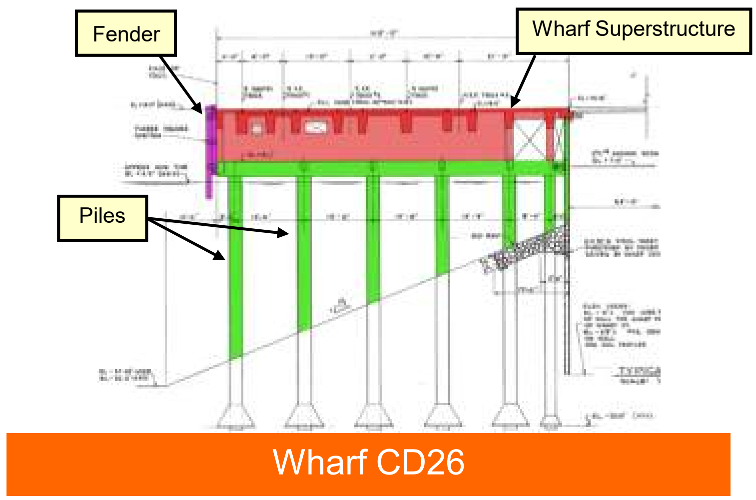
Wharf: Open platform, open structure

- **Open platform**: Water free to move underneath
- **Open structure**: Structure supported over water by piles or drilled shafts



Wharf: Open platform, open structure

- **Open platform**: Water free to move underneath
- **Open structure**: Structure supported over water by piles or drilled shafts

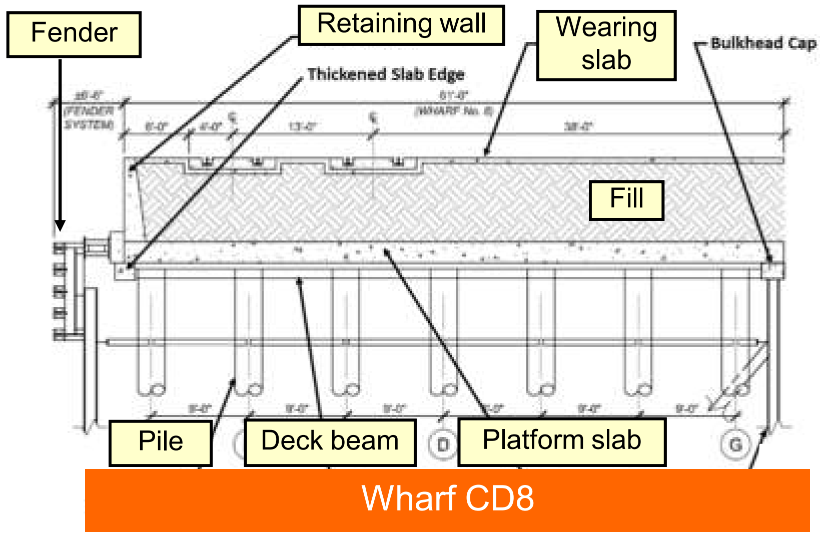


Wharf: Open platform, solid structure

- **Open platform**: Water free to move underneath
- **Solid structure**: Deck supported on fill, supported on structural platform slab

Wharf: Open platform, solid structure

- **Open platform**: Water free to move underneath
- **Solid structure**: Deck supported on fill, supported on structural platform slab



Wharf: Solid bulkhead

- **Solid bulkhead**: Wharf structure supported on fill retained by wall or sheet piles

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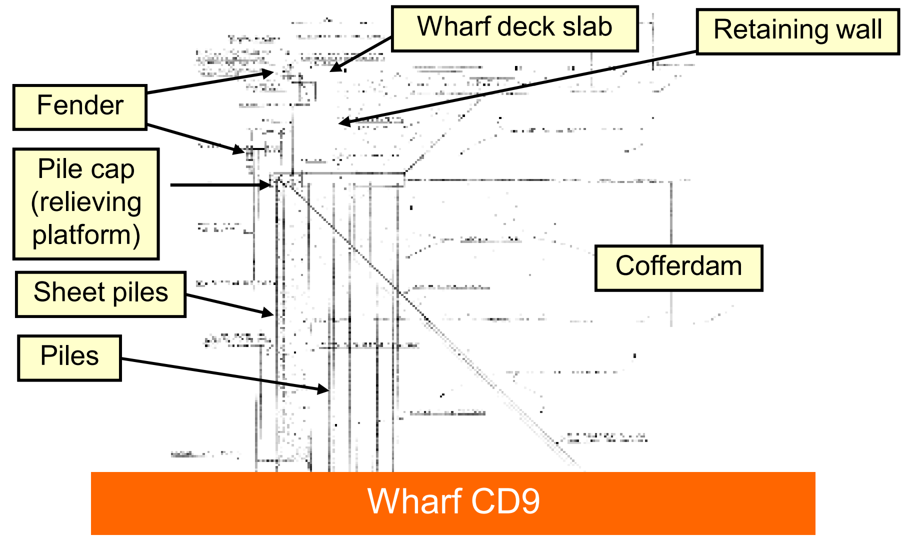
Wharf: Solid bulkhead, relieving platform

- **Solid bulkhead**: Wharf structure supported on fill retained by wall or sheet pile
- **Relieving platform**: Buried support structure

Wharf: Solid bulkhead, relieving platform

- **Solid bulkhead**: Wharf structure supported on fill retained by wall or sheet pile
- **Relieving platform**: Buried support structure



Boat Dock

- Similar to wharves, but self-supporting
- **Functional purpose**: loading and unloading cargo or personnel from vessels

Boat Dock

- Similar to wharves, but self-supporting
- **Functional purpose**: loading and unloading cargo or personnel from vessels

- Three general categories:
  - Open platform with open structure
  - Solid bulkhead
  - Floating platform

Bulkhead

- Vertical step in elevation
- **Functional purpose**: separate shoreline from water

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Shoreline

- Intersection between land and water
- May be protected or unprotected

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Four Types of Maritime Assets

- Wharf
- Boat dock
- Bulkhead
- Shoreline

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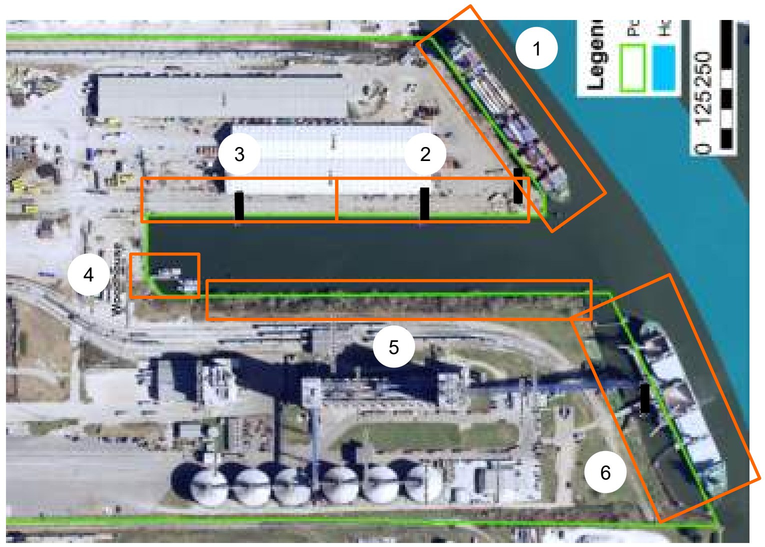
Which maritime assets can you identify?

- Woodhouse Terminal

Recall "terminal" = collection of wharves

  - Wharves?
  - Boat docks?
  - Bulkheads?
  - Shorelines?



Wrap-up

Module 2.1 Learning Outcomes

1. Identify maritime assets within the PHA inventory.
2. Describe the functional purpose of each maritime asset type:
   a. Wharf
   b. Boat dock
   c. Bulkhead
   d. Shoreline

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MODULE 2.2

Component Groups

Module Objectives

- Identify component types within the PHA inventory.
- Differentiate between a component and an asset.
- Describe the functional purpose of each component type.

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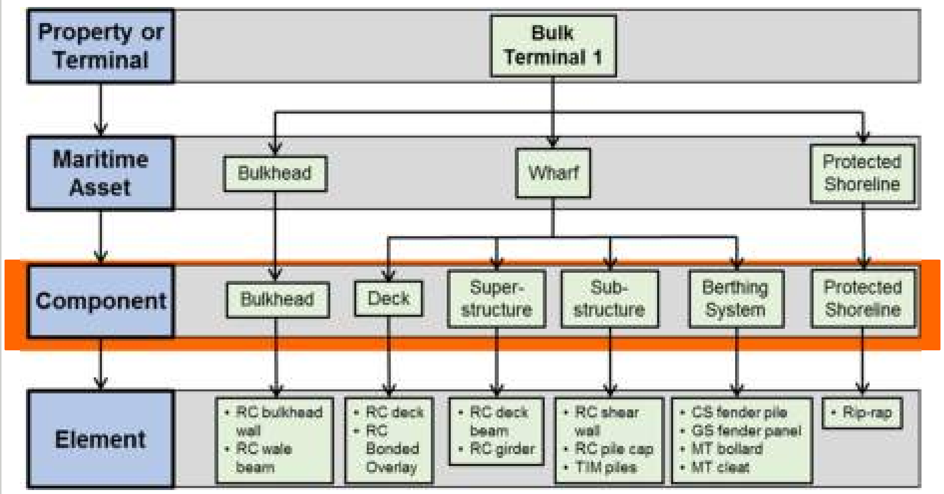
Module Resources

- Chapter 4: Component Types
- Appendix B: Glossary

Components

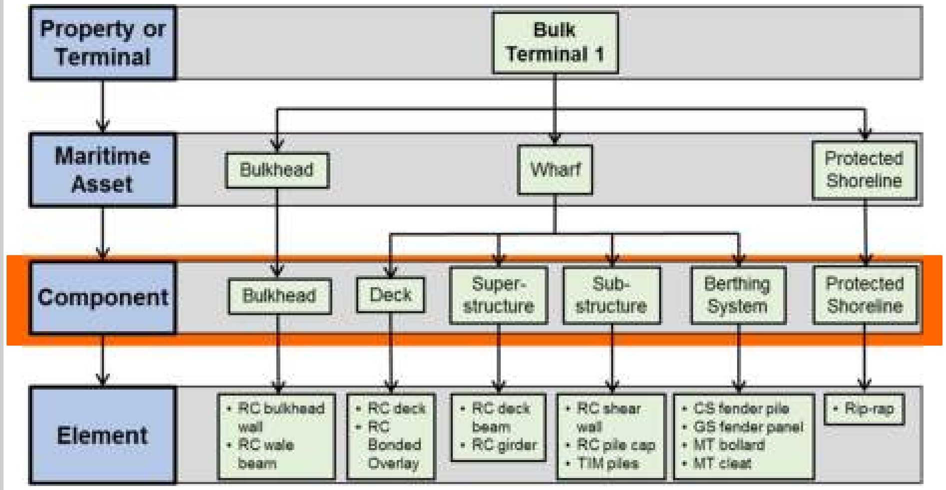
- **Component**: group of elements forming a structural or non-structural system
- Boundaries dictated by structural or functional purpose, or by changes in structural system, framing, or material



Components

Four component groups:

1. Structural
2. Berthing
3. Shoreline
4. Ancillary



Component Groups and Definitions

Structural Component: Group of elements that comprises a structural system (e.g., deck, superstructure, bulkhead)

Berthing Component: Group of elements that serves a functional purpose related to the berthing of vessels (e.g., mooring system or fender system)

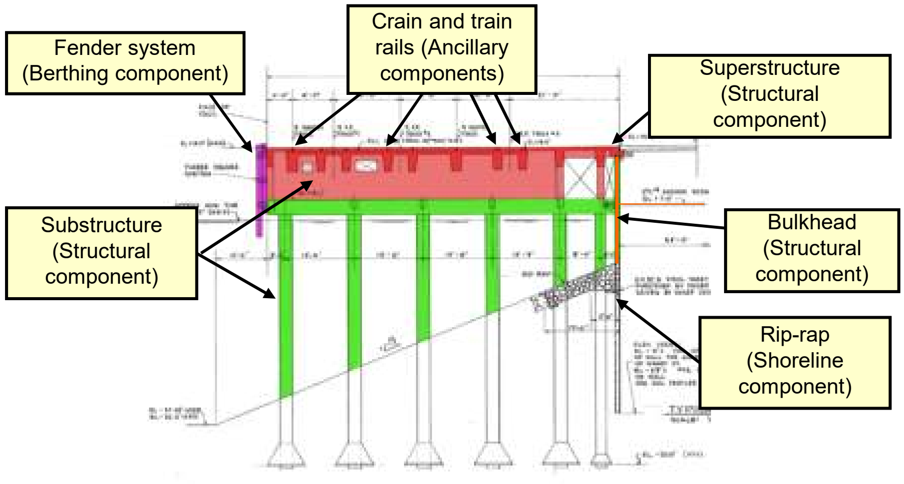
Shoreline Components: Group of elements (or single element) that defines the channel shoreline (e.g., unprotected shoreline, rip-rap)

Ancillary Components: Group of elements that serves a purpose other than categorized as above (e.g., utility systems, paint and markings, personnel access systems)

Example: Wharf Asset

Four component groups:

1. Structural
2. Berthing
3. Shoreline
4. Ancillary



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Structural Components

Four component groups:

1. **Structural**
2. Berthing
3. Shoreline
4. Ancillary

Group of elements that comprises a structural system. Structural Component Types:

- Deck
- Slabs and Wearing Surfaces
- Superstructure
- Substructure
- Bearings
- Joints
- Bulkhead

Structural Components

Structural Component Types:

1. **Deck**
2. **Slab**
3. Superstructure
4. Substructure
5. Bearings
6. Joints
7. Bulkhead

1. Deck

- Functional purpose: provides a flat and safe working surface for users of wharves or boat docks
- Structural purpose: transfers loads to superstructure or substructure

2. Slab and Wearing Surfaces

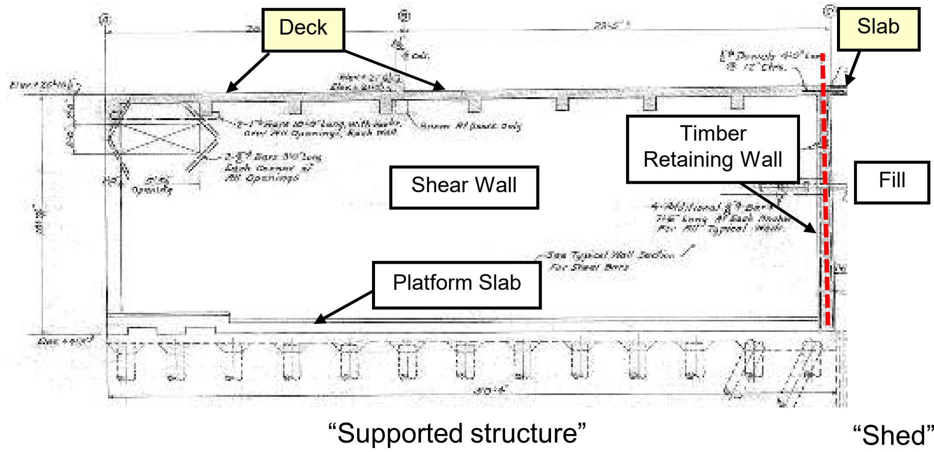
- Functional purpose: provides a flat and safe working surface for users of wharves or boat docks
- Structural purpose: transfers loads to soil or subgrade

Structural Components

Structural Component Types:

1. **Deck**
2. **Slab**
3. Superstructure
4. Substructure
5. Bearings
6. Joints
7. Bulkhead

Wharf M2

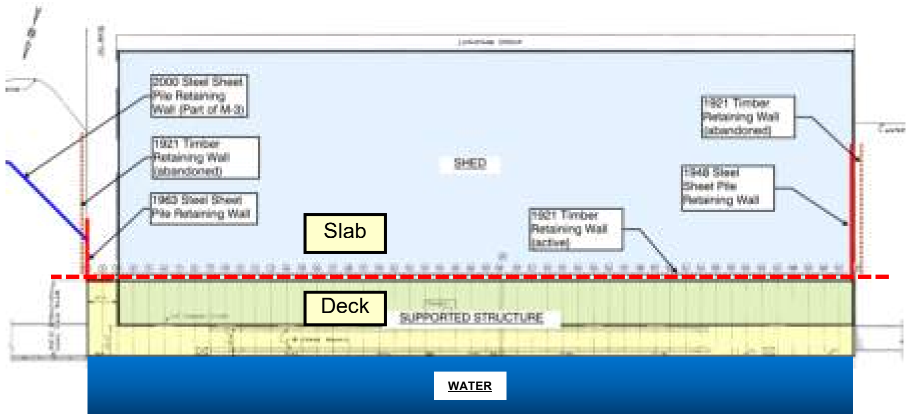


Structural Components

Structural Component Types:

1. **Deck**
2. **Slab**
3. Superstructure
4. Substructure
5. Bearings
6. Joints
7. Bulkhead

Wharf M2



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Structural Components

Structural Component Types:

1. **Deck**
2. **Slab**
3. Superstructure
4. Substructure
5. Bearings
6. Joints
7. Bulkhead

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Structural Components

Structural Component Types:

1. Deck
2. Slab
3. **Superstructure**
4. **Substructure**
5. Bearings
6. Joints
7. Bulkhead

3. Superstructure

- Functional purpose: supports the deck
- Structural purpose: transmits loads from deck to substructure

4. Substructure

- Functional purpose: supports the superstructure or deck
- Structural purpose: transmit load effects from superstructure or deck to the foundation soil or rock

Structural Components

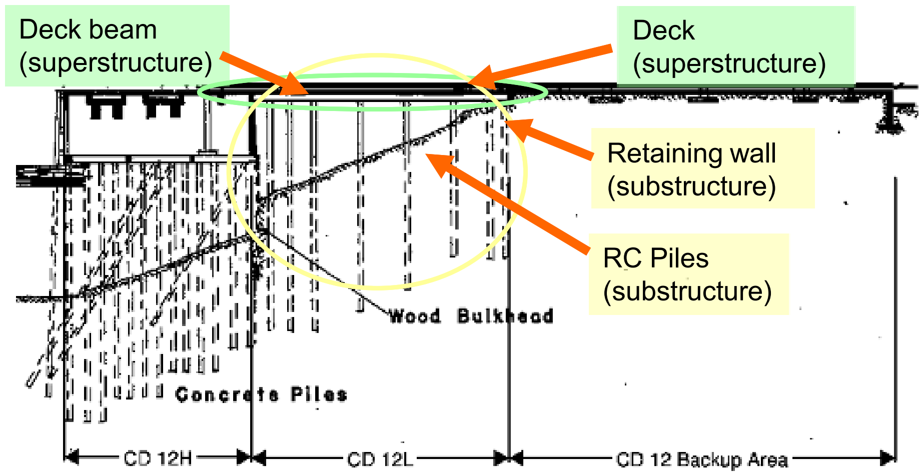
Structural Component Types:

1. Deck
2. Slab
3. **Superstructure**
4. **Substructure**
5. Bearings
6. Joints
7. Bulkhead

Structural Components

Structural Component Types:

1. Deck
2. Slab
3. **Superstructure**
4. **Substructure**
5. Bearings
6. Joints
7. Bulkhead



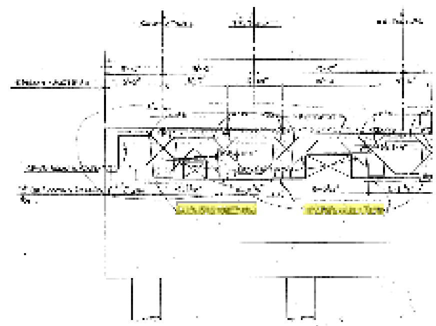
Structural Components

Structural Component Types:

1. Deck
2. Slab
3. Superstructure
4. Substructure
5. **Bearings**
6. **Joints**
7. Bulkhead

5. Bearings

- Functional purpose: provide interface between superstructure and substructure
- Structural purpose: transmit load effects from superstructure to substructure



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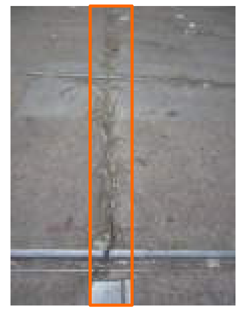
Page 41

Structural Components

Structural Component Types:
1. Deck
2. Slab
3. Superstructure
4. Substructure
5. **Bearings**
6. **Joints**
7. Bulkhead

6. Joints

- Structural purpose: accommodate relative movement between the deck and superstructure or between different regions of the deck



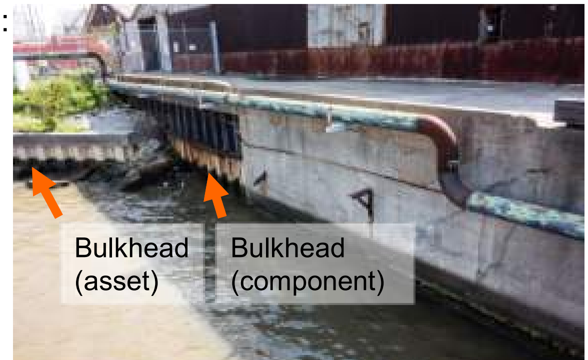
Structural Components

Structural Component Types:

1. Deck
2. Slab
3. Superstructure
4. Substructure
5. Bearings
6. Joints
7. **Bulkhead**

7. Bulkhead

- Functional purpose: separate land from water
- Structural purpose: retain earth fill



Note: A bulkhead is considered a component when it is part of an overall maritime asset (e.g., wharf).

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Berthing Components

Four component groups:

1. Structural
2. **Berthing**
3. Shoreline
4. Ancillary

Group of elements that serves a functional purpose related to the berthing of vessels.
Berthing Component Types:

- Fender System
- Mooring System

Berthing Components

Berthing Component Types:

1. Fender System
2. Mooring System

1. Fender system

- Functional purpose: protect both asset and vessel from impact
- Structural purpose: absorb energy during impact

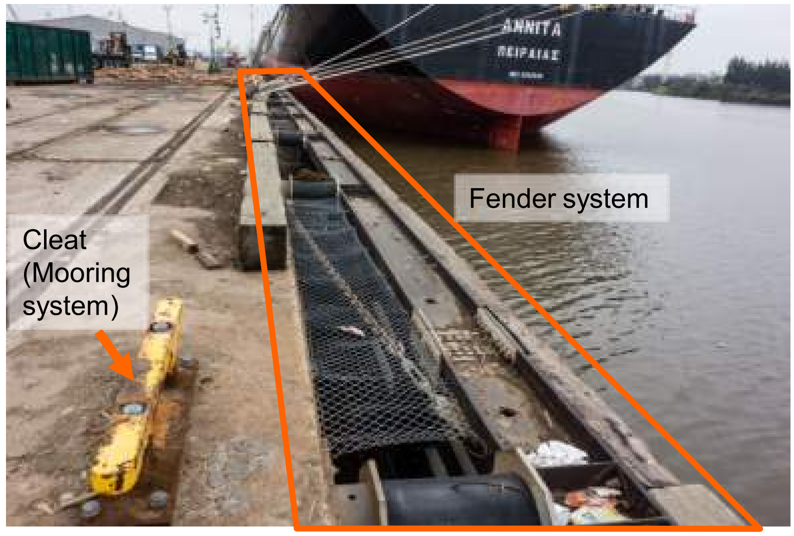
2. Mooring system

- Functional purpose: fixed point for securing vessel mooring lines
- Structural purpose: transmit mooring forces to superstructure, substructure, or foundation soil

Berthing Components

Berthing Component Types:

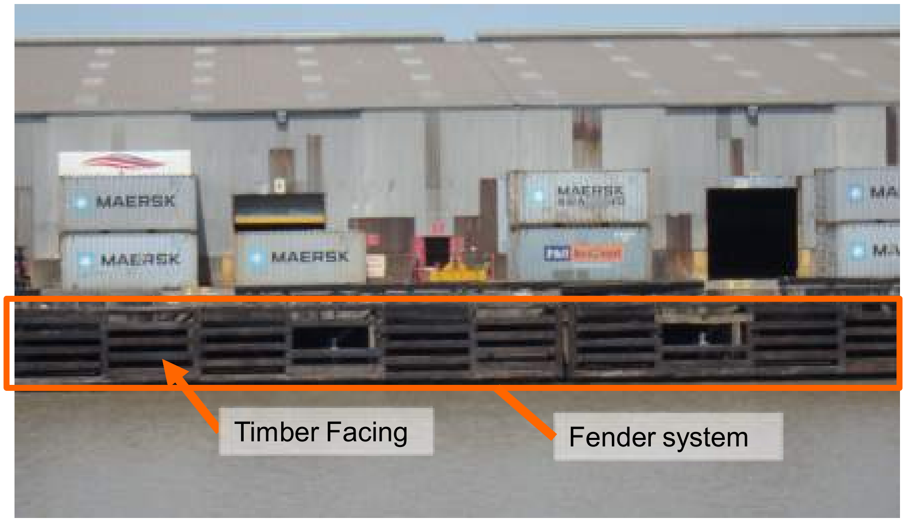
1. Fender System
2. Mooring System



Berthing Components

Berthing Component Types:

1. **Fender System**
2. Mooring System



Berthing Components

Berthing Component Types:

1. Fender System
2. **Mooring System**

Shoreline Components

Four component groups:

1. Structural
2. Berthing
3. **Shoreline**
4. Ancillary

Group of elements (or single element) that defines the channel shoreline. Shoreline Component Types:

- Protected Shoreline
- Unprotected Shoreline

Note: A shoreline component is not associated with a particular asset (e.g., wharf or boat dock).

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Shoreline Components

Shoreline Component Types:

1. Protected Shoreline
2. Unprotected Shoreline

1. Protected Shoreline

- Structural purpose: fill retention
- Functional purpose: shoreline definition and erosion control

2. Unprotected Shoreline

- Unprotected or undeveloped shoreline within the boundaries of a terminal or property

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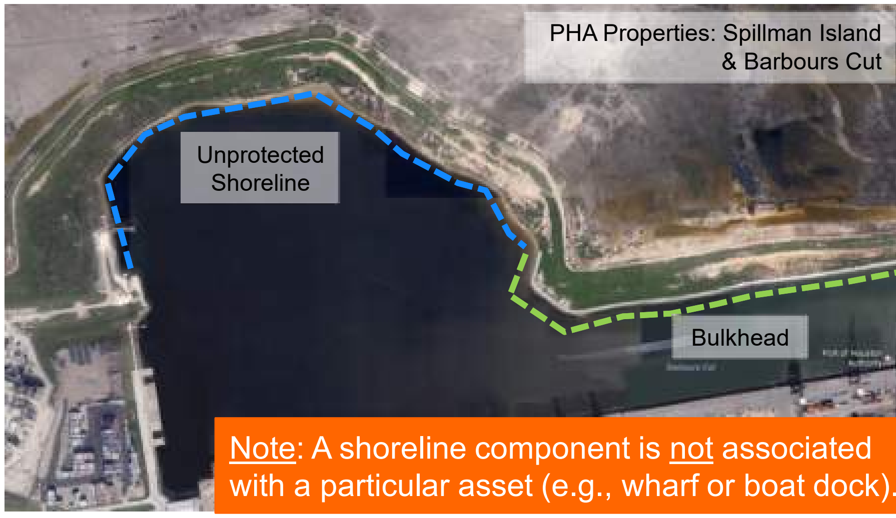
Shoreline Components

Shoreline Component Types:

1. Protected Shoreline
2. Unprotected Shoreline



Note: A shoreline component is not associated with a particular asset (e.g., wharf or boat dock).

Ancillary Components

Four component groups:

1. Structural
2. Berthing
3. Shoreline
4. **Ancillary**

Group of elements that serves a purpose other than as categorized by the other three component groups. Ancillary Component Types:

- Crane and Train Rails
- Guards
- Paint and Markings
- Personnel Access Systems
- Utilities

Note: Assessment of ancillary components only considers the general condition of elements and connections to or support by other components.

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Ancillary Components

Ancillary Component Types:

1. **Crane and Train Rails**
2. **Guards**
3. **Paint and Markings**
4. Personnel Access Systems
5. Utility Systems

1. Crane and Train Rails

Track and rail elements, crane tie downs, and crane stops attached to the deck

2. Guards

Vehicle and pedestrian edge protection on channel side of a wharf

3. Paint and Markings

Paint, signs, striping or other markings used for regulatory or informational purposes (not for corrosion protection)

Ancillary Components

Ancillary Component Types:

1. Crane and Train Rails
2. Guards
3. Paint and Markings
4. **Personnel Access Systems**
5. **Utility Systems**

4. Personnel Access Systems

Group of elements related to personnel access to areas of the maritime asset (e.g., catwalk, ladder, fall protection)

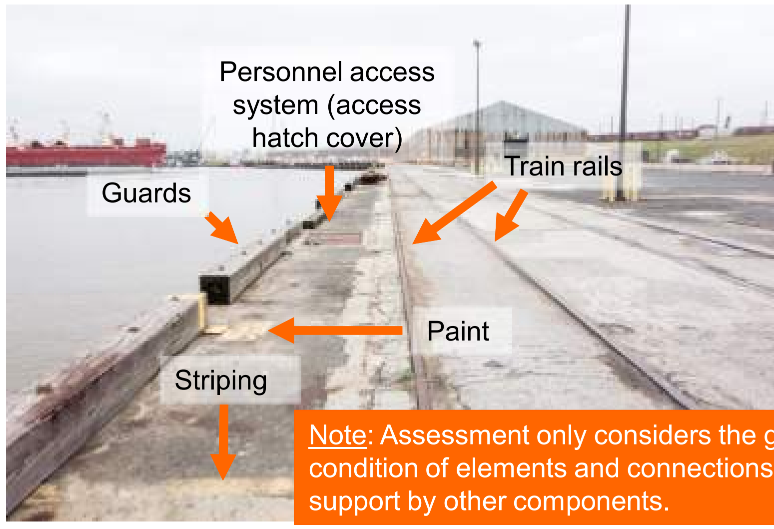
5. Utility Systems

Elements such as risers, hangers, brackets and other accessories attached to structural or non-structural components in the maritime asset

Ancillary Components

Ancillary component Types:

1. **Crane and Train Rails**
2. **Guards**
3. **Paint and Markings**
4. **Personnel Access Systems**
5. Utility Systems



Note: Assessment only considers the general condition of elements and connections to or support by other components.

Ancillary Components

Ancillary Component Types:

1. Crane and Train Rails
2. Guards
3. Paint and Markings
4. Personnel Access Systems
5. **Utility Systems**

Note: Utility Systems are the support for utilities – not the utilities themselves

Practical Exercise

Multiple Choice #1

What component group(s) are being inspected in this photo?

a. Structural
b. Berthing
c. Shoreline
d. Ancillary

1
2
3

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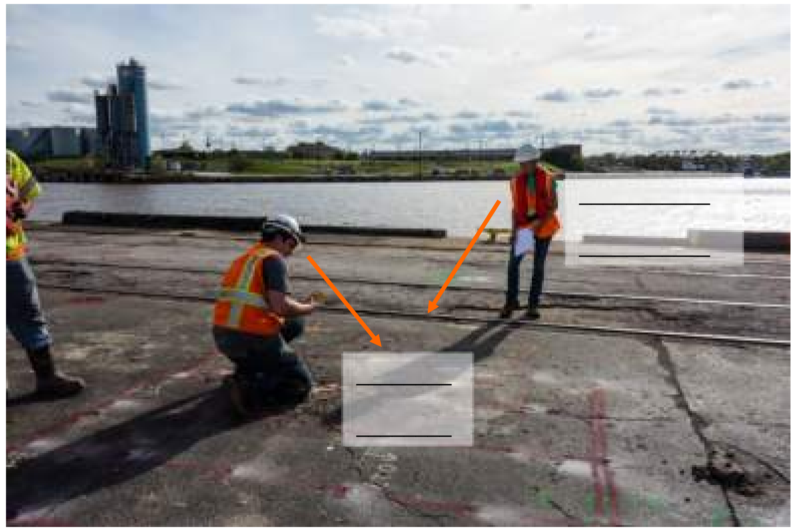
Multiple Choice #2

What component group(s) are being inspected in this photo?

a. Structural
b. Berthing
c. Shoreline
d. Ancillary



Partner activity

What type(s) of components can you identify in this photo?

a. **Structural**
b. Berthing
c. Shoreline
d. Ancillary

Partner activity

What component types can you identify in this photo?

a. Structural
b. **Berthing**
c. Shoreline
d. Ancillary

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Partner activity

What component types can you identify in this photo?

a. Structural
b. Berthing
c. **Shoreline**
d. Ancillary

Partner activity

What component types can you identify in this photo?

a. Structural
b. Berthing
c. Shoreline
d. **Ancillary**

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End of Exercise

Wrap-up

Module 2.2 Learning Outcomes

1. Identify component types within the PHA inventory.
2. Differentiate between a component and an asset.
3. Describe the functional purpose of each component type:
   a. Structural components
   b. Berthing components
   c. Shoreline components
   d. Ancillary components

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END OF MODULE

MODULE 2.3

Elements

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Module Objectives

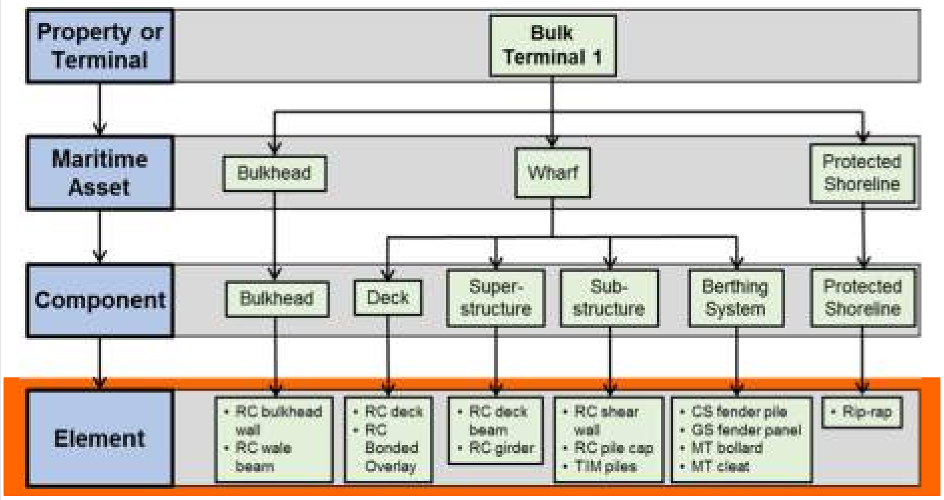
- Identify element types within the PHA inventory.
- Describe the hierarchical relationship between an element, a component, and an asset.
- Differentiate between structural and non-structural elements.
- Describe the system used to identify and categorize elements and components.
- Complete element codes, IDs, and descriptions for inventory reporting.

Module Resources

- Chapter 3, Elements and Element Conditions
- Appendix B, Glossary
- Appendix C, Element Descriptions

Elements

- Components of an asset are made up of individual **elements**
- Defined by structural or functional purpose and material type
  - Structural or non-structural



Elements: Example

- Components of an asset are made up of individual **elements**
- Defined by structural or functional purpose and material type
  - Structural or non-structural

Element Type Descriptors

Appendix C

- Elements in PHA inventory are defined in terms of:
  - **Associated component**
  - Element code
  - Element descriptor
  - Element identification
  - Measured units

Table C-1. Structural Component Elements

Element Code(s)	Element Descriptor	Element Identification	Units[1]
Deck Elements (DK)			
DT-RC DT-PCC DT-CS DT-TIM DT-OTH	RC Deck Topside PCC Deck Topside CS Deck, Open Grid TIM Deck Topside OTH Deck Topside	A horizontal, planar structural element that carries and distributes loads to superstructure or substructure elements. Observations specific to topside of element.	SF
DU-RC DU-PCC DU-TIM DU-GS DU-OTH	RC Deck Underside PCC Deck Underside TIM Deck Underside GS Deck (stay-in-place form) OTH Deck Underside	A horizontal, planar structural element that carries and distributes loads to superstructure or substructure elements. Observations specific to underside *or* full-depth of element.	SF
DR-RC	RC Deck Drop Panel	A thickened portion of a deck over a columnar structural element below.	EA
BO-RC BO-UC	RC Bonded Overlay UC Bonded Overlay	Concrete material cast on top of and bonded to a deck surface.	SF
TF-PCC TF-PSC	PCC Top Flange PSC Top Flange	Top flanges of girders or beams where live loads are applied directly on the structural element.	SF

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Element Type Descriptors

- Elements in PHA inventory are defined in terms of:
  - **Associated component**
  - Element code
  - Element descriptor
  - Element identification
  - Measured units

Component group

Element Code(s)	Element Descriptor	Element Identification	Units[1]
	Table C-1. Structural Component Elements		
	Deck Elements (DK)		
DT-RC DT-PCC DT-CS DT-TIM DT-OTH	RC Deck Topside PCC Deck Topside CS Deck, Open Grid TIM Deck Topside OTH Deck Topside	A horizontal, planar structural element that carries and distributes loads to superstructure or substructure elements. Observations specific to topside of element.	SF
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Component type

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Element Type Descriptors

- Elements in PHA inventory are defined in terms of:
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Table C-1. Structural Component Elements

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DR-RC	RC Deck Drop Panel	A str	
BO-RC BO-UC	RC Bonded Overlay UC Bonded Overlay	Co to	
TF-PCC TF-PSC	PCC Top Flange PSC Top Flange	To loa element.	SF

Element code:

DT-RC

Element type	Element material
DT: Deck Topside	RC: Reinforced Concrete
BO: Bonded Overlay	PCC: Precast concrete
SL: Slab	TIM: Timber

Element Type Descriptors

- Elements in PHA inventory are defined in terms of:
  - Associated component
  - **Element code**
  - **Element descriptor**
  - Element identification
  - Measured units

Table 3.1. Basic Material Types for Structural Elements

Material		Abbreviation	Description
Concrete	Reinforced Concrete	RC	Conventional, reinforced, cast-in-place concrete
	Precast Concrete	PCC	Conventionally reinforced concrete that is cast off-site and then installed on the structure.
	Prestressed Concrete	PSC	Reinforced concrete with bonded or unbonded prestressing tendons. Elements may be precast or cast-in-place, and pre- or post-tensioned.
	Unreinforced (Plain) Concrete	UC	Concrete without reinforcement.
	Bituminous	BM	Bituminous (asphalt) paving or patching material, typically used as wearing surfaces.
Metals	Steel	CS	Carbon steel materials. Typically coated or painted for corrosion protection.
	Stainless Steel	SS	Stainless steel materials. Stainless steels have a minimum of 10.5 percent chromium.
	Galvanized Steel	GS	Carbon steel that has been hot-dip galvanized with zinc.
	Metals (all other)	MT	Metals that do not fall into any of the other categorized. Includes aluminum, cast iron, ductile iron, etc.
Other	Timber	TIM	Rough, sawn, or engineered wood
	Rubber	RB	Rubber or elastomeric materials.
	Other materials	OTH	All other materials that do not fit in any of the predefined categories.

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Element Type Descriptors

- Elements in PHA inventory are defined in terms of:
  - Associated component
  - Element code
  - Element descriptor
  - **Element identification**
  - Measured units

Table C-1. Structural Component Elements

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Element Type Descriptors

- Elements in PHA inventory are defined in terms of:
  - Associated component
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  - Element descriptor
  - Element identification
  - **Measured units**

Table C-1. Structural Component Elements

Element Code(s)	Element Descriptor	Element Identification	Units[1]
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DU-RC DU-PCC DU-TIM DU-GS DU-OTH		l element that o superstructure servations lepth of element.	SF
DR-RC		k over a columnar	EA
BO-RC BO-UC		of and bonded	SF
TF-PCC TF-PSC		ms where live the structural element.	SF

SF: square foot
Elements whose primary function depends on area (e.g., deck, slab, protective coating)

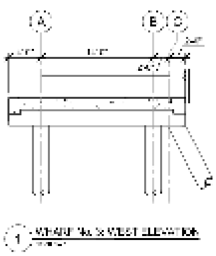
LF: linear foot
Elements whose primary function depends on length (e.g., beam, bulkhead, wharf log, shoreline protection)

EA: each
Elements that function as a unit (e.g., cleat, cofferdam, column, pile)

Examples: Wharf M3

Example 1: Wharf M3

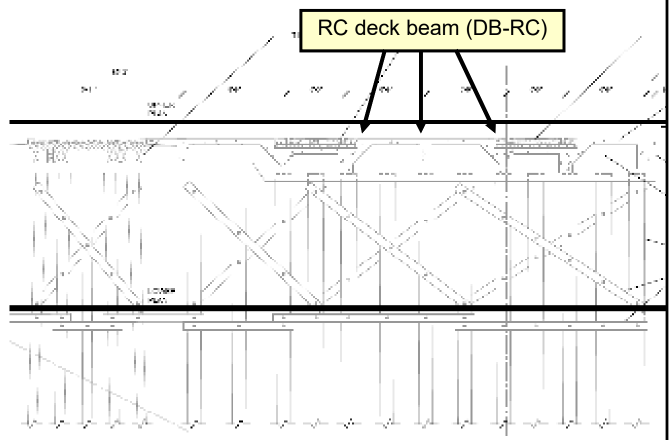
Example 2: Wharf M3



Group: Structural Components
Types: Deck & Substructure

Element IDs

- A single component may contain several elements having the same element code (e.g., DB-RC)
- Elements are differentiated for inspection by assigning unique element IDs (e.g., DB1-1, DB2-1, DB3-12)

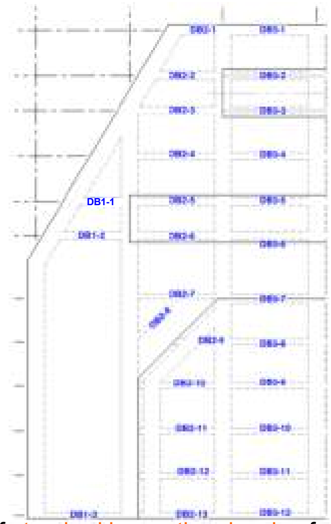


Excerpt of standard inspection drawing for Wharf 41

Element IDs

- A single component may contain several elements having the same element code (e.g., DB-RC)

- Elements are differentiated for inspection by assigning unique element IDs (e.g., DB1-1, DB2-1, DB3-12)



Excerpt of standard inspection drawing for Wharf 41

Element IDs

DB3-12

Element Code
DB, PI, WL, FF, etc.

First two letters of element code (material type not included)

Bay Number
1, 2A, 7, 10C, etc.

Numbered sequentially, upstream to downstream

Letters for different structural systems

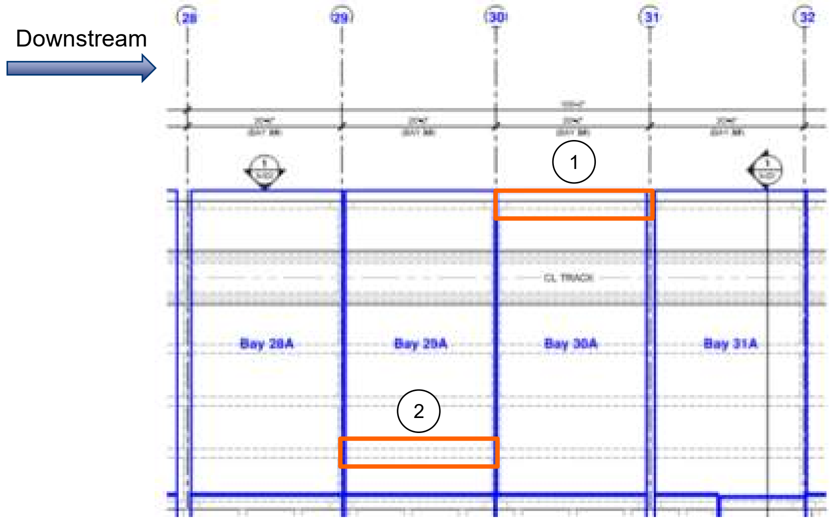
Element Number
1, 2, 3, etc.

Numbered sequentially upstream to downstream, water to land, top to bottom

More about bay and element numbering in Module 3.

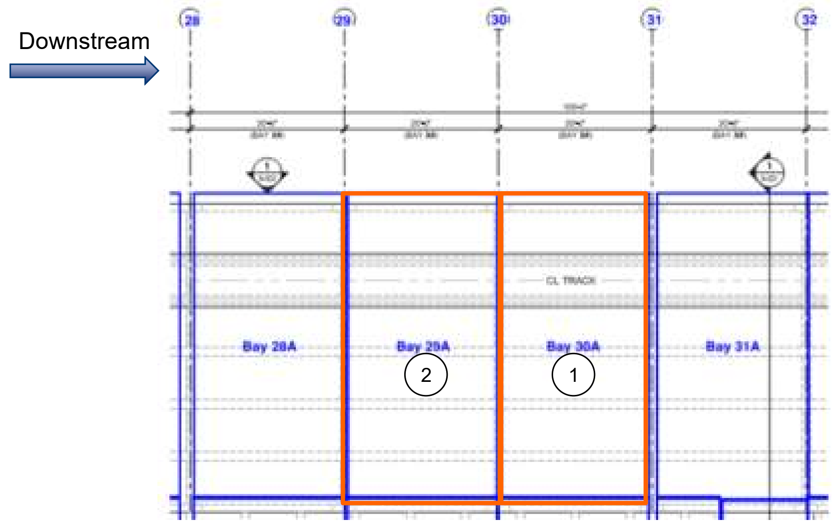
Example: Element IDs

- Element code for deck beams:
  - Reinforced concrete?
  - Steel?
- Element IDs for deck beam at:
  - Location 1?
  - Location 2?



Example: Element IDs

- Element code for RC deck:
  - Topside?
  - Underside?
- Element IDs for topside deck at:
  - Location 1?
  - Location 2?

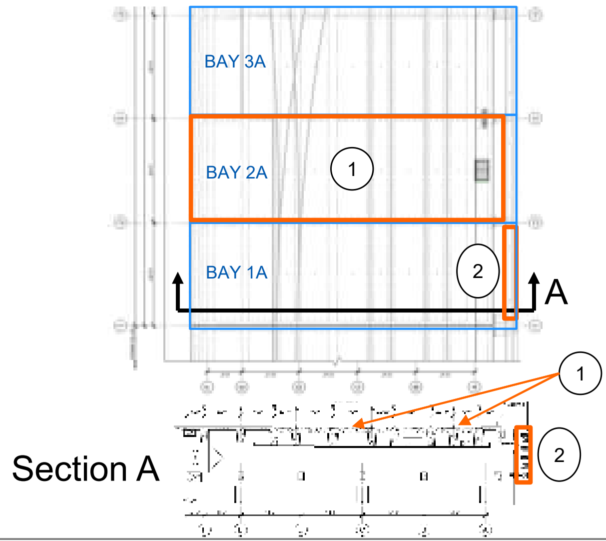


Practical Exercise

Element IDs

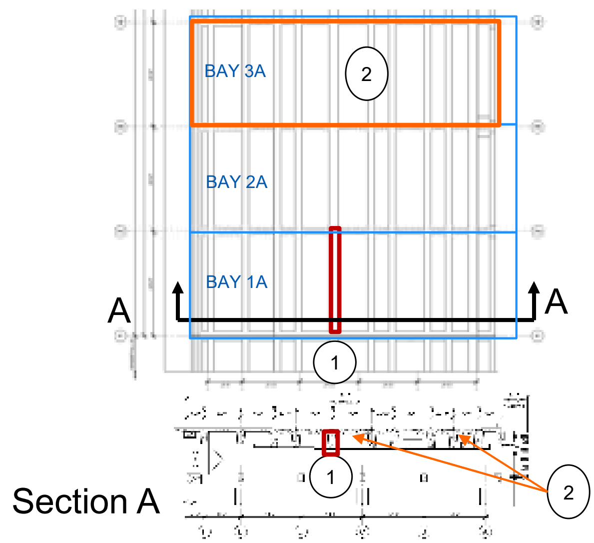
PE: CD26 Reinforced Concrete Deck Plan

- Determine Element IDs for locations
  - 1
  - 2



PE: CD26 Reflected Deck Plan

- Determine Element IDs for locations
  - 1
  - 2



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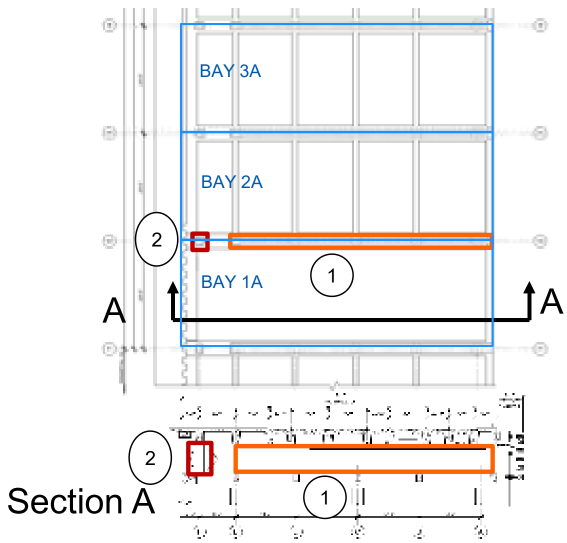
PE: CD26 Lower Beam Plan

- Determine Element IDs for locations
  - 1
  - 2



Wrap-up

Module 2.3 Learning Outcomes

1. Identify element types within the PHA inventory.
2. Describe the hierarchical relationship between an element, a component, and an asset.
3. Differentiate between structural and non-structural elements.
4. Describe the system used to identify and categorize elements and components.
5. Complete element codes, IDs, and descriptions for inventory reporting.

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END OF MODULE

Facility Inspection & Condition Assessment Program (FICAP)

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Inspection Types and Reports

Module 3

Module Objectives

- List the three inspection types and their objectives, intervals, level of effort, and scope.
- Describe the relationships between inspection types
- Identify readily accessible elements
- Describe the documentation required for the inspection and condition assessment program
- Identify errors in a completed Inventory Record, Inspection Summary, and Inspection History
- Describe standard inspection drawings
- Prepare a set of inspection drawings

Module References

- FICAP Manual Chapter 2: Inspection Types
- FICAP Manual Chapter 8: Documentation and Reporting
  - 8.2 Inventory Record
  - 8.3 Standard Inspection Drawings
  - 8.4 Inspection Summary
  - 8.5 Inspection History
  - 8.6 Element Inspection Forms
  - 8.7 Follow-up Action Form

Agenda

- Inspection System & Conditions
- Inspection Types and Objectives
  - Baseline
  - Routine
  - Special
    - Post-Event
    - Due Diligence
    - In-Depth
- Inspection Documentation
  - Inventory Record
  - Inspection Drawings
  - Inspection Summary
  - Inspection History
  - Element Inspection Forms
  - Follow-up Inspection Forms
- Inspection Relationships

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Inspection System

- Inspection Types
- Inspection Sub-types
- Inspection Conditions

Inspections and reporting documents build asset file

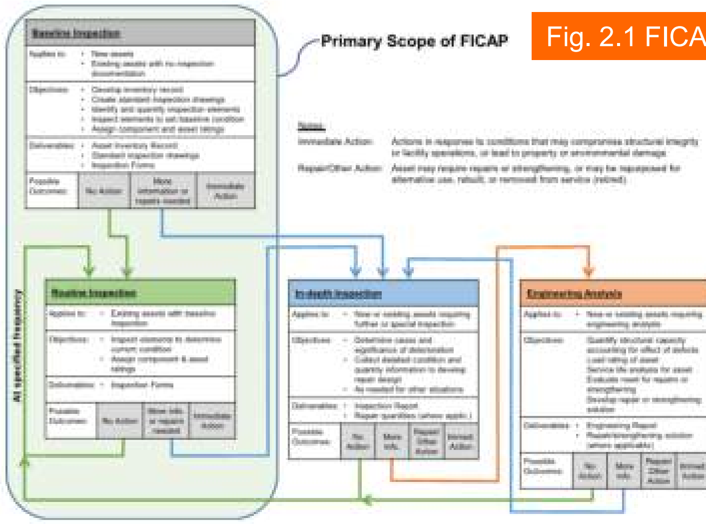
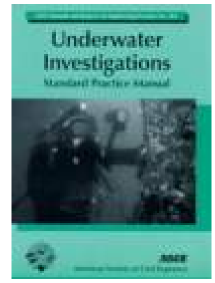


Fig. 2.1 FICAP Manual

Inspection Sub-types



- Above Water
  - Light debris removal/sweeping
  - Visual inspection **within 25 feet**
- Below Water - ASCE 101
  - Level I – visual or tactile with no marine grown removal
  - Level II – partial marine growth removal
  - Level III – non-destructive or partially-destructive testing
  - Sonar Imaging may be used instead of divers

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Inspection Sub-types

- For the Special Inspection Type
  - Post-event
  - In-Depth
  - Due Diligence

Could we have a Special In-Depth Below Water Inspection?

Inspection Conditions

- Inaccessible elements
  - Elements obscured by cargo, debris, etc
  - May be skipped for one inspection cycle if
    - – Does not exceed 10% of any component
    - – No significant distress is suspected
  - Permanently inaccessible elements must have special inspections

PORT HOUSTON

Inspection Conditions

- Accessible elements are
  - Exposed to either open water or open atmosphere
  - Do not require removal of overburden or other elements
  - Are not confined spaces

Inspection Conditions

- Confined Spaces
  - – Are large enough for an employee to enter
  - – Have limited means of entry or exit
  - – Are not designated for continuous occupancy
  - – May require permitted entry
  - – Any entry coordinated with PHA project manager

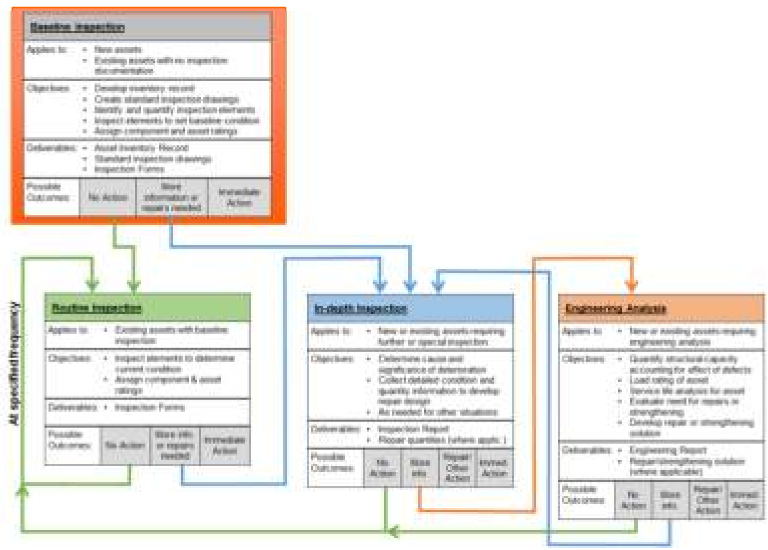
https://www.osha.gov/confinedspaces/index.html

PORT HOUSTON

Inspection Types – Baseline Inspection

- New or refurbished asset
- No previous inspection record
- After a change in ownership

"the first Routine Inspection"



PORT HOUSTON

Inspection Types – Baseline Inspection

- Purposes
  - Identify all components and elements belonging to asset
  - Identify inaccessible or special access elements
  - Inspect readily-accessible elements
  - Develop component ratings and asset condition assessment

Inspection Types – Baseline Inspection

- Inspection Interval and Effort
  - Above water - Comprehensive visual inspection of all readily accessible elements for the entire asset
  - Below water
    - – Level 1
    - – Sonar for substructure if diving access is restricted

Inspection Types – Baseline Inspection

- Deliverables
  - Common across inspection types
  - Some difference

FICAP TBL 8.2

Deliverable	Type of Inspection			
	Baseline	Routine	Post-Event	Due Diligence
Inventory Record	Yes. Includes initial generation of document.	Revise only if change identified	No	Revise only if change identified
Standard Inspection Drawing Set	Yes. Includes initial generation of document.	No	Marked-up Standard Drawing identifying extent of damage.	Revise only if change identified
Element Inspection Forms	Yes. Includes initial generation of document.	Yes. Relies on inspection forms generated by Baseline.	No	Yes. Relies on inspection forms generated by Baseline.
Inspection History	Yes. Includes initial generation of document.	Update	Update	Update
Inspection Summary	Yes	Yes	Yes[1]	Yes
Follow-Up Action Form	Yes	Yes	Yes	Yes
Submission into PHA database	Yes	Yes	Yes	Yes

PORT HOUSTON

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Inspection Types – Baseline Inspection

- Deliverables
  - Inventory Record
    - Identification and background
    - Overall dimensions
    - Load rating
    - History

FICAP PG F.1

PORT HOUSTON

Page 16

Identification – Identification of the asset by the appropriate property/terminal and asset ID. These identifiers are coordinated with the Port of Houston Authority's GIS implementation.

Asset Classification and Type – Categorization of the asset based on the asset type (e.g., wharf, boat dock, bulkhead, etc.). For wharves or boat docks, this also includes the generic type of construction (e.g. open or closed) and usage (e.g. break bulk, liquids, containers, etc.). Note that usage information is coordinated with the PHA.

Original Date of Construction – The year when the asset was originally constructed.

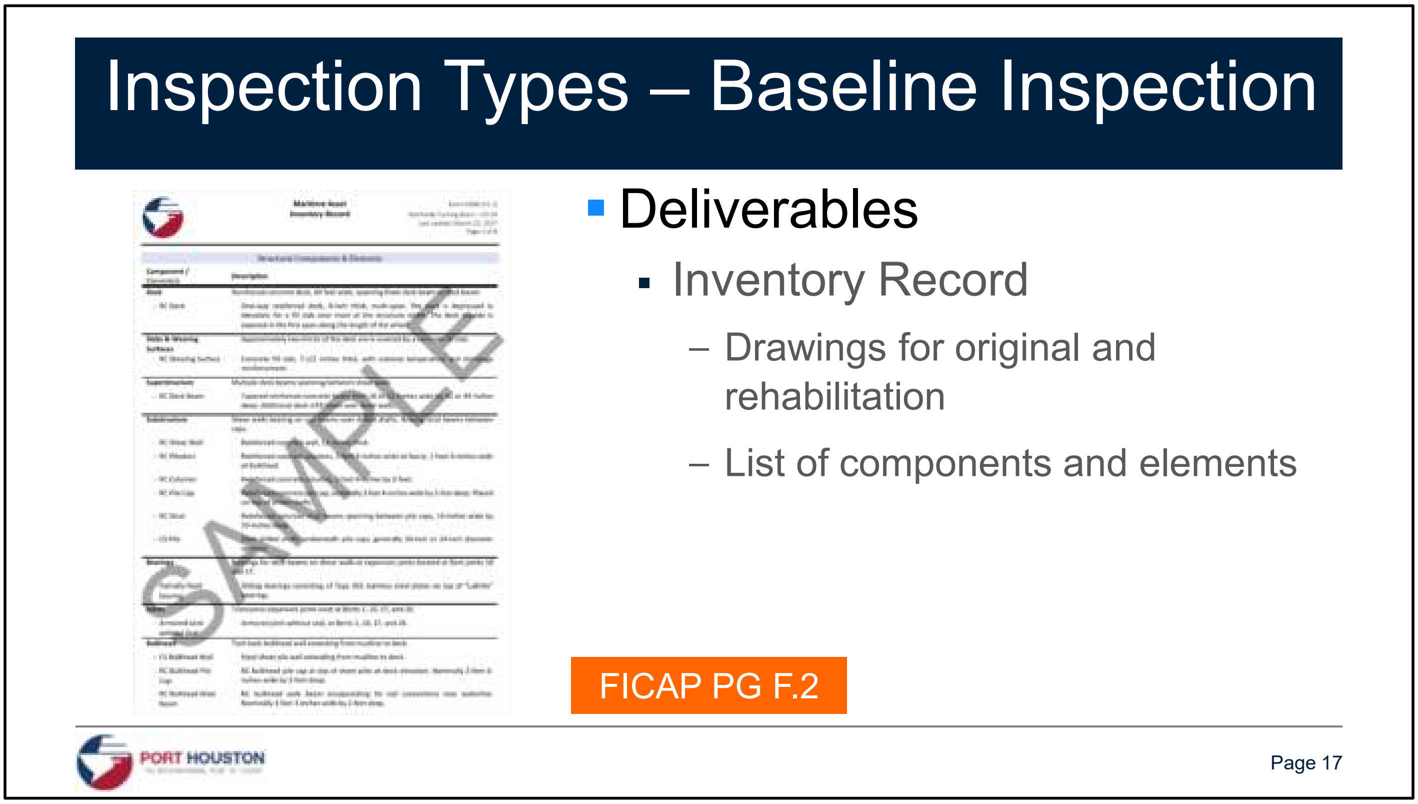
Date(s) of Rehabilitation or Modification –Year(s) of significant rehabilitation or modifications. Significant modifications are defined as work that alters the asset's footprint or changes structural components; this definition applies regardless of the percentage of asset being modified.

Inspection Frequency – The designated frequency for Routine Inspections.

Geometric Data – Pertinent structural dimensions, including plan dimensions, deck elevation, and channel depth.

Load Rating – The capacity of the structure relative to live loads. Live loads considered and defined by the PHA Engineering Design Guide include uniform loads, shore cranes, railroad, and truck loads. If available, the designed maximum vessel size for the fender and mooring systems should be listed.

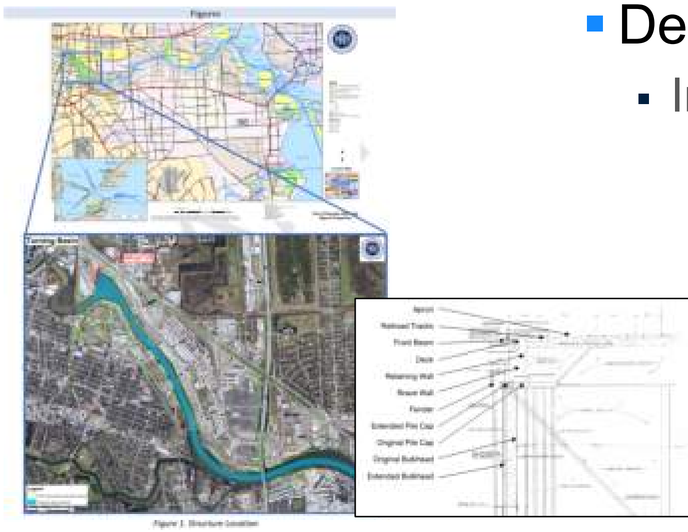
Structure History – A narrative describing the history of the wharf construction, repairs, and modifications. If known, the reason for structural modifications or repairs should be noted.



Reference Drawing List– A list of existing drawings, titles, dates, and general scopes of work. At a minimum, drawings sets for original construction and any rehabilitation or should be listed, if available.

Components and Elements – A list of components and elements comprising the asset. Components groups are categorized as structural, berthing, protection, shoreline, and other. For each component, applicable element types must be listed and briefly described. Component descriptions should include the location and extent of component on the asset. Descriptions of elements should include the material and typical geometric features, such as size, thickness, and span. If a standard component is not present on the asset, it shall be listed with “none” as the description.

Inspection Types – Baseline Inspection



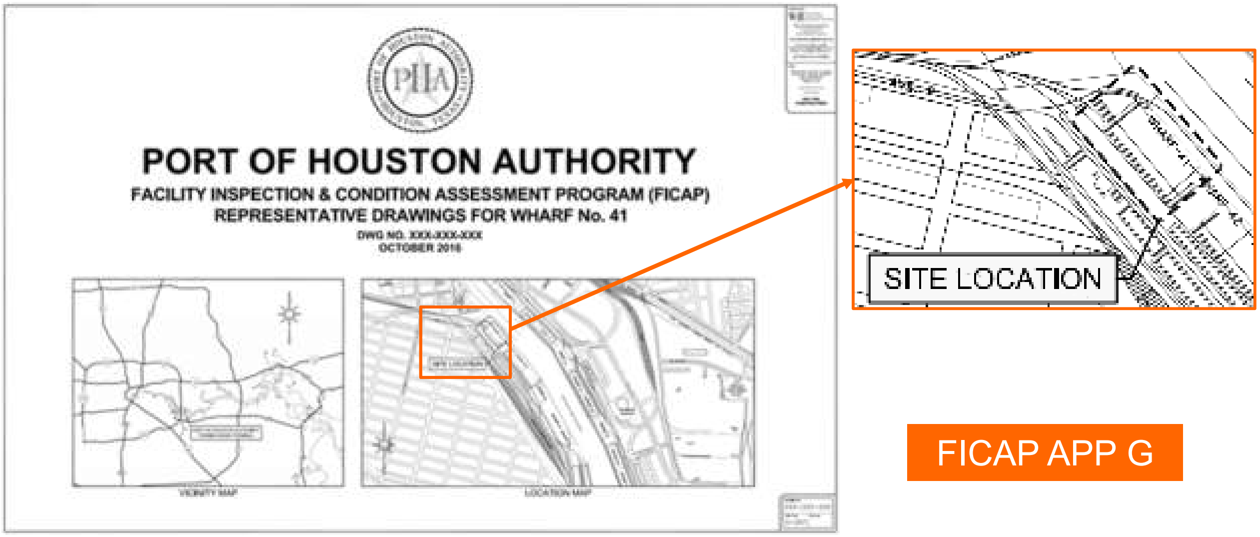
- Deliverables
  - Inventory Record
    - Figures
      - Maps
      - Photos
      - Drawings

PORT HOUSTON

Inspection Types – Baseline Inspection

- Deliverables
  - Standard Inspection Drawing Set
    - Purpose
      - Schematic cumulative as-built of current configuration
      - Define consistent naming scheme
    - Uses current Port CAD standards
    - Sheet list shown in TBL 8.1
    - Includes Plan, Section, and Elevation Views

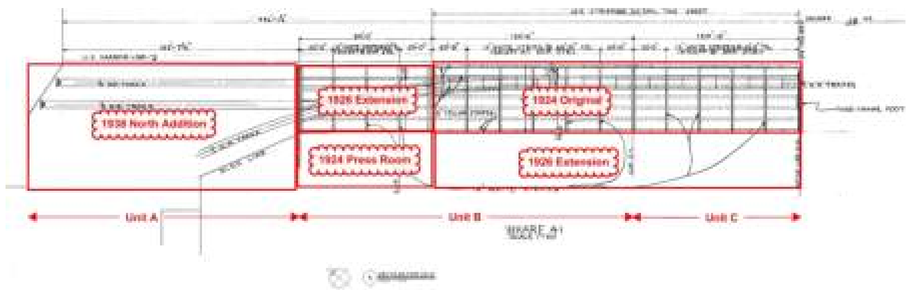
Baseline Deliverable – Inspection Drawings



FICAP APP G

Baseline Deliverable – Inspection Drawings

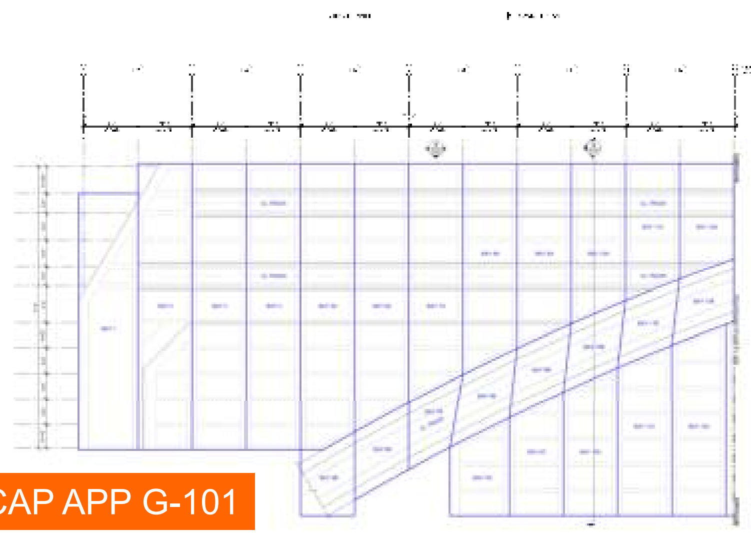
- Key Plan
- Channel at page top
- Cumulative history of construction



FICAP APP G-002

Baseline Deliverable – Inspection Drawings

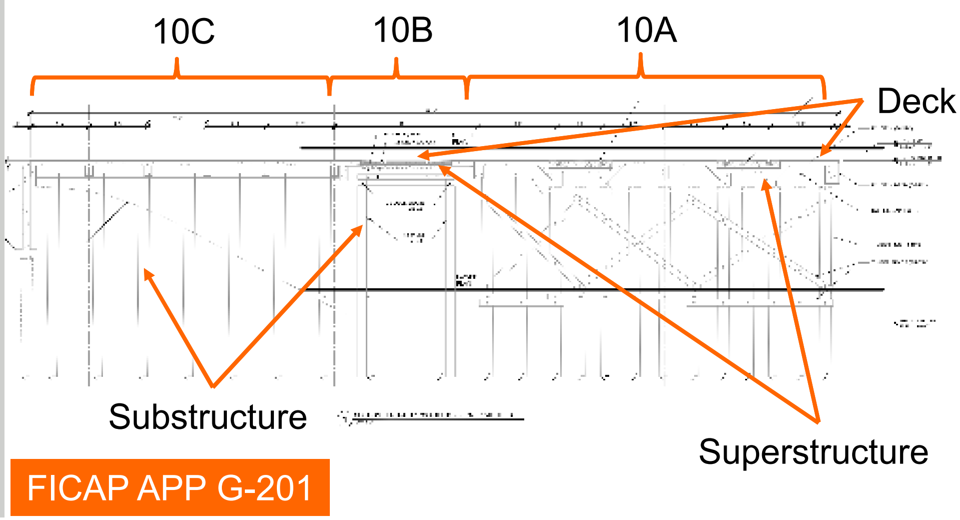
- Bay Plan View
- Bay Numbering
  - Water to land
  - Upstream to downstream
  - Letters for differing structural systems



FICAP APP G-101

Baseline Deliverable – Inspection Drawings

- Typical Section View
- Deck
  - 10A&C Concrete
  - 10B Timber
- Superstructure
  - 10A&C RC Deck Beams
  - 10B Timber Stingers
- Substructure
  - 10A&B Timber Piles
  - 10C Precast Concrete Piles
- Element IDs labelled (not shown here)



PORT HOUSTON

Need to think in FICAP terms. Which structural components differ here, Deck, Superstructure, Substructure? Differences are described via Element Descriptors. Good time to review structural components and elements

Other questions to ask

What would the Element code be for the deck elements in Bay 10B? (DT-TIM see TABLE C1)

Baseline Deliverable – Inspection Drawings

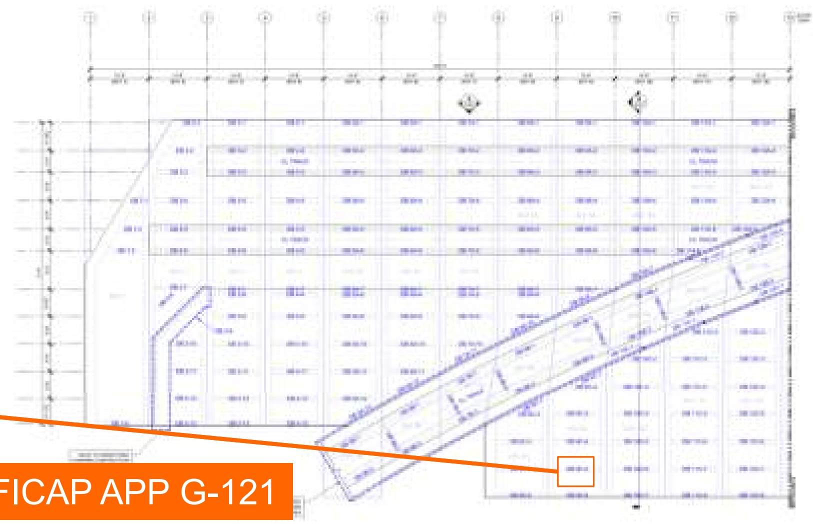
- Plan View
- Superstructure
- Element ID labelled
  - Water to land
  - Upstream to downstream

DB9C-5

Element Code
DT, PI, WL, etc.

Bay Number
1, 2A, 2B, etc.

Element Number
1, 2, 3, etc.



FICAP APP G-121

PORT HOUSTON

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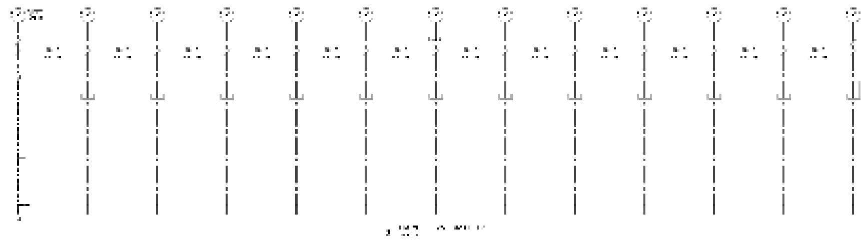
Good time to review Element ID Names

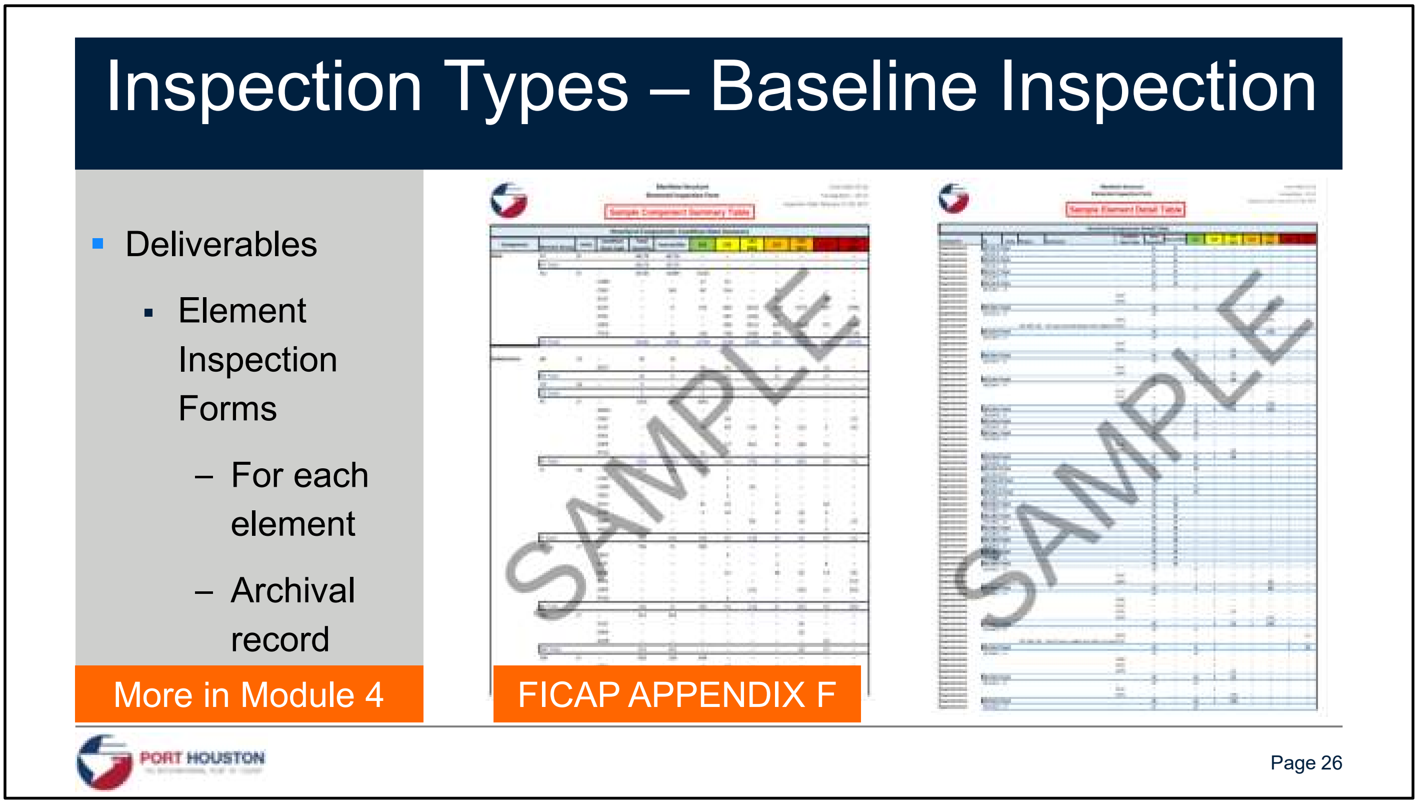
Baseline Deliverable – Inspection Drawings

- Typical Elevation
  - Drawn from water side
  - Show berthing and fender systems
  - Element ID labelled (not shown here)



FICAP APP G-301

PORT HOUSTON



Form shows another good example between Components and Elements

Inspection Types – Baseline Inspection

- Deliverables
  - Inspection History
    - Log of all inspections
    - Includes ratings summaries

FICAP APPENDIX F

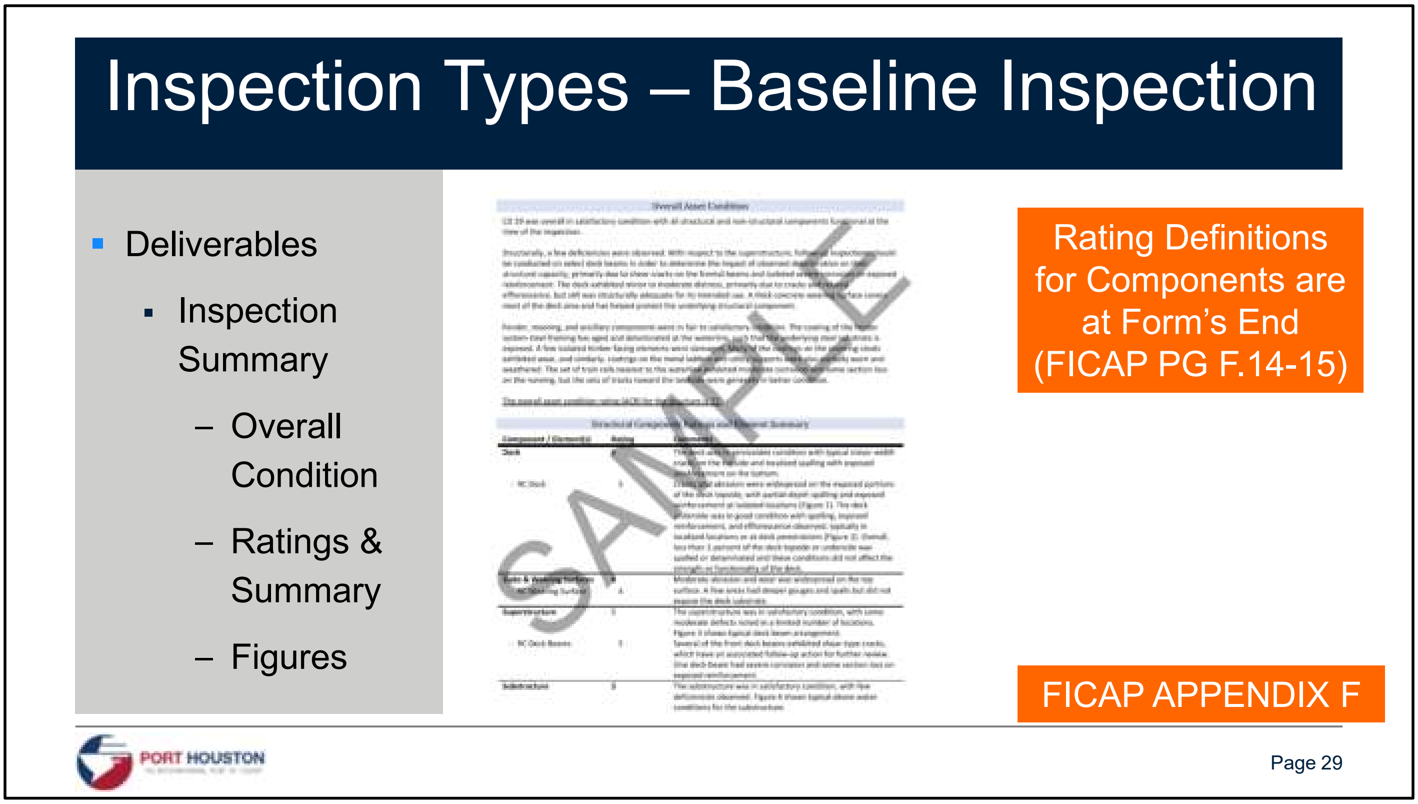
Inspection Types – Baseline Inspection

- Deliverables
  - Inspection Summary
    - Information
    - Procedure
    - Certification

FICAP APPENDIX F

PORT HOUSTON

Page 28



Note the Figures page (F.12) nor is Rating Definition is not shown here.

Inspection Types – Baseline Inspection

- Deliverables
  - Follow-up Action Form
    - FICAP CHP 7 categories
    - Justification
    - Prioritization

FICAP APPENDIX F

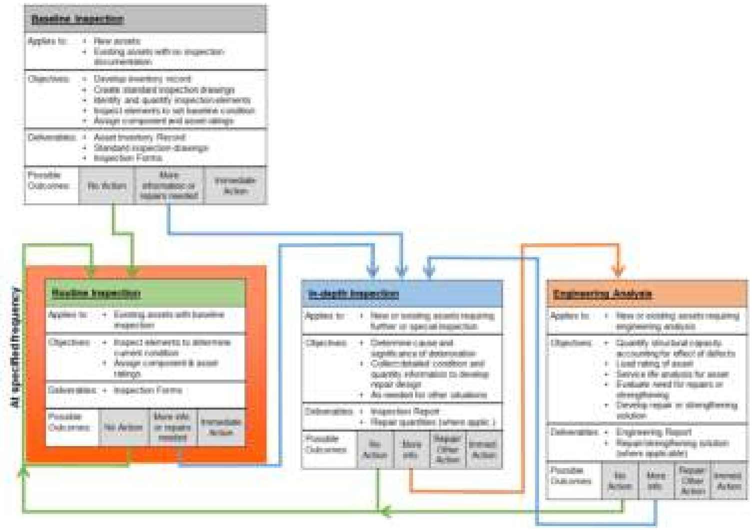
Inspection Types – Baseline Inspection

- The Baseline Bottom Line

Provide a complete asset file for database purposes

Inspection Types – Routine Inspection

- At predefined intervals
- Following Baseline or last Routine Inspection



Most Commonly Performed

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Inspection Types – Routine Inspection

- Purposes
  - Inspect readily-accessible elements
  - Document change in asset's inventory record
  - Update component ratings and asset condition assessment

Useful in Providing Trends for Management

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Inspection Types – Routine Inspection

- Inspection Interval and Effort
  - Above water
    - – At least once every 3 years (FICAP Default)
    - – Comprehensive visual inspection of all readily accessible elements for the entire asset

Inspection Types – Routine Inspection

- Inspection Interval and Standard
  - Below water
    - – At least once every 6 years (FICAP Default)
    - – Level 1 – Same scope as Baseline
    - – Sonar may be used if recommended in Baseline

Inspection Types – Routine Inspection

- Deliverables
  - Updated Inventory Record Form
  - Recommended Follow Up Actions may include
    - Change inspection frequency
    - Change in inspection effort
    - Required special inspection

Transition to special inspection using last bullet.

Inspection Types – Routine Inspection

- Deliverables
  - Update Baseline forms
  - Separate summary & Follow-Up

FICAP TBL 8.2

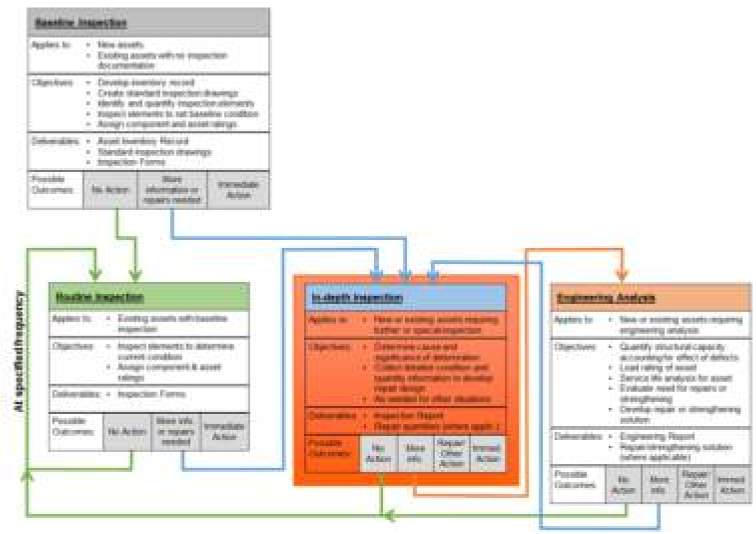
Deliverable	Type of Inspection			
	Baseline	Routine	Post-Event	Due Diligence
Inventory Record	Yes. Includes initial generation of document.	Revise only if change identified	No	Revise only if change identified
Standard Inspection Drawing Set	Yes. Includes initial generation of document.	No	Marked-up Standard Drawing identifying extent of damage.	Revise only if change identified
Element Inspection Forms	Yes. Includes initial generation of document.	Yes. Relies on inspection forms generated by Baseline.	No	Yes. Relies on inspection forms generated by Baseline.
Inspection History	Yes. Includes initial generation of document.	Update	Update	Update
Inspection Summary	Yes	Yes	Yes[1]	Yes
Follow-Up Action Form	Yes	Yes	Yes	Yes
Submission into PHA database	Yes	Yes	Yes	Yes

PORT HOUSTON

Inspection Types – Special Inspections

- **In-Depth**
- Post Event
- Due Diligence

Others Possible

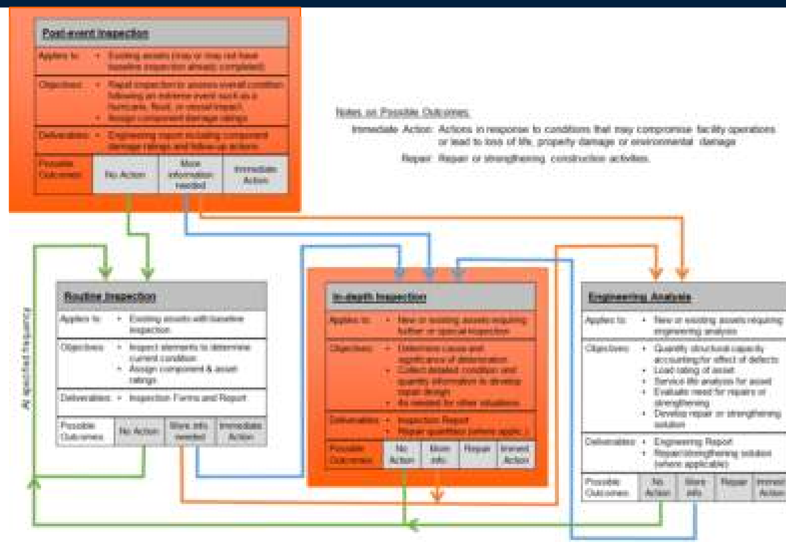


PORT HOUSTON

Inspection Types – Special Inspections

- In-Depth
- **Post-Event**
- Due Diligence

Others Possible



Inspection Types – Special Inspections

- Post-Event
  - Performed in response to an event – immediate & rapid
  - Coordinated with standing PHA Post-Event Procedures
  - Conducted at discretion of PHA Director of Project & Construction Management

Inspection Types – Special Inspections

- Post-Event
  - Purposes
    - Immediate survey
    - Inspect readily-accessible elements
    - Assess event's impact on structural integrity and functionality
    - Locate and quantify damage severity
    - Provide recommended actions (shoring, repairs, further eval)
    - Provide post-event component and overall asset rating

Inspection Types – Special Inspections

- Post-Event
  - Not comprehensive – targeted
  - Component rating criteria differ from Routine and Baseline Inspections (more in Module 5)
  - Level of effort is defined by need
  - Previous inspection records used to determine if damage pre-existing or event caused

“Bird’s Eye” View to Determine Event Caused Significant Damage

Inspection Types – Special Inspections

- Post-Event Deliverables
  - Drawings
  - Summary
  - History
  - Follow-up actions

FICAP TBL 8.2

Deliverable	Type of Inspection			
	Baseline	Routine	Post-Event	Due Diligence
Inventory Record	Yes. Includes initial generation of document.	Revise only if change identified	No	Revise only if change identified
Standard Inspection Drawing Set	Yes. Includes initial generation of document.	No	Marked-up Standard Drawing identifying extent of damage.	Revise only if change identified
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Inspection History	Yes. Includes initial generation of document.	Update	Update	Update
Inspection Summary	Yes	Yes	Yes[1]	Yes
Follow-Up Action Form	Yes	Yes	Yes	Yes
Submission into PHA database	Yes	Yes	Yes	Yes

Inspection Types – Special Inspections

- Due Diligence
  - Limited inspection to provide information for
    - Change of ownership (prior to transaction)
    - Tenants
    - Leases
    - Insurance
    - Other legalities

Inspection Types – Special Inspections

- Due Diligence
  - Purposes
    - – Provide engineering opinion of probable cost
    - – Estimate order-of-magnitude maintenance or replacement costs
    - – Condition assessment for real property transactions
    - – Evaluate maintenance effectiveness

Inspection Types – Special Inspections

- Due Diligence Deliverables
  - Update forms
  - Separate Summary & Follow-Up Action

FICAP TBL 8.2

Deliverable	Type of Inspection			
	Baseline	Routine	Post-Event	Due Diligence
Inventory Record	Yes. Includes initial generation of document.	Revise only if change identified	No	Revise only if change identified
Standard Inspection Drawing Set	Yes. Includes initial generation of document.	No	Marked-up Standard Drawing identifying extent of damage.	Revise only if change identified
Element Inspection Forms	Yes. Includes initial generation of document.	Yes. Relies on inspection forms generated by Baseline.	No	Yes. Relies on inspection forms generated by Baseline.
Inspection History	Yes. Includes initial generation of document.	Update	Update	Update
Inspection Summary	Yes	Yes	Yes[1]	Yes
Follow-Up Action Form	Yes	Yes	Yes	Yes
Submission into PHA database	Yes	Yes	Yes	Yes

PORT HOUSTON

Inspection Types – Special Inspections

- In-Depth
  - Performed in response to previous inspection recommendation to provide detailed information for
    - Change of use
    - Rehabilitation
    - Repair

Inspection Types – Special Inspections

- In-Depth
  - Purposes – to collect detailed condition assessments to:
    - – Understand the cause and extent of deterioration
    - – Predict the remaining service life
    - – Evaluate structural capacity or load rating
    - – Characterize conditions for construction documents

Inspection Types – Special Inspections

- In-Depth
  - May involve
    - Material sampling and testing
    - Non-destructive evaluation
    - Structural analysis
    - Load rating

Inaccessible Elements May Be Included

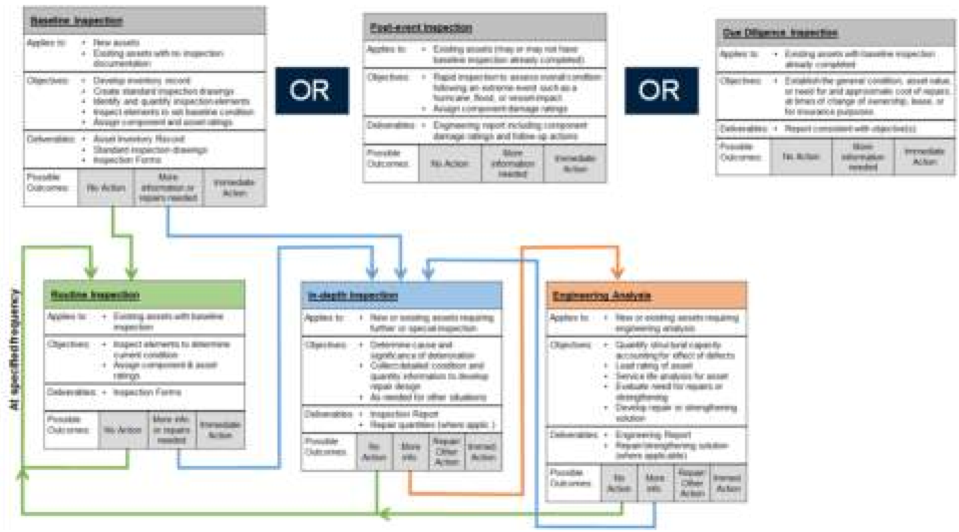
Inspection Types – Special Inspections

- In-Depth Deliverables
  - Unique from other inspections
  - No pre-defined format
  - Should be consistent with element-based approach
    - Element nomenclature
    - Element condition states

More in Module 4

Inspection Relationships

- Baseline
- Routine
- Special
  - Post-Event
  - Due Diligence
  - In-Depth



Module 3 Practical Exercise

PORT HOUSTON
THE INTERNATIONAL PORT OF TEXAS

Situation: CD 23 has just had its first inspection under FICAP. You are now completing the required inspection reports for Unit B of the wharf and are reviewing the following two documents.

- CD 23 Inventory Record
- CD 23 Unit B Inspection Summary

Review these two documents (attached) and answer the following questions.

1. Which type of an inspection best describes the one your team completed for Unit B (circle the best answer)
    a. Baseline
    b. Routine
    c. Special
    d. Field

2. List the other documents that are the minimum required to complete the Wharf 23 Asset File.

3. You notice that some of the elements on the representative section (Figure 4) in the inventory record are not labelled with their appropriate element descriptors. Correct the existing element descriptors so they match Appendix C of the FICAP manual. Do not add additional labels.

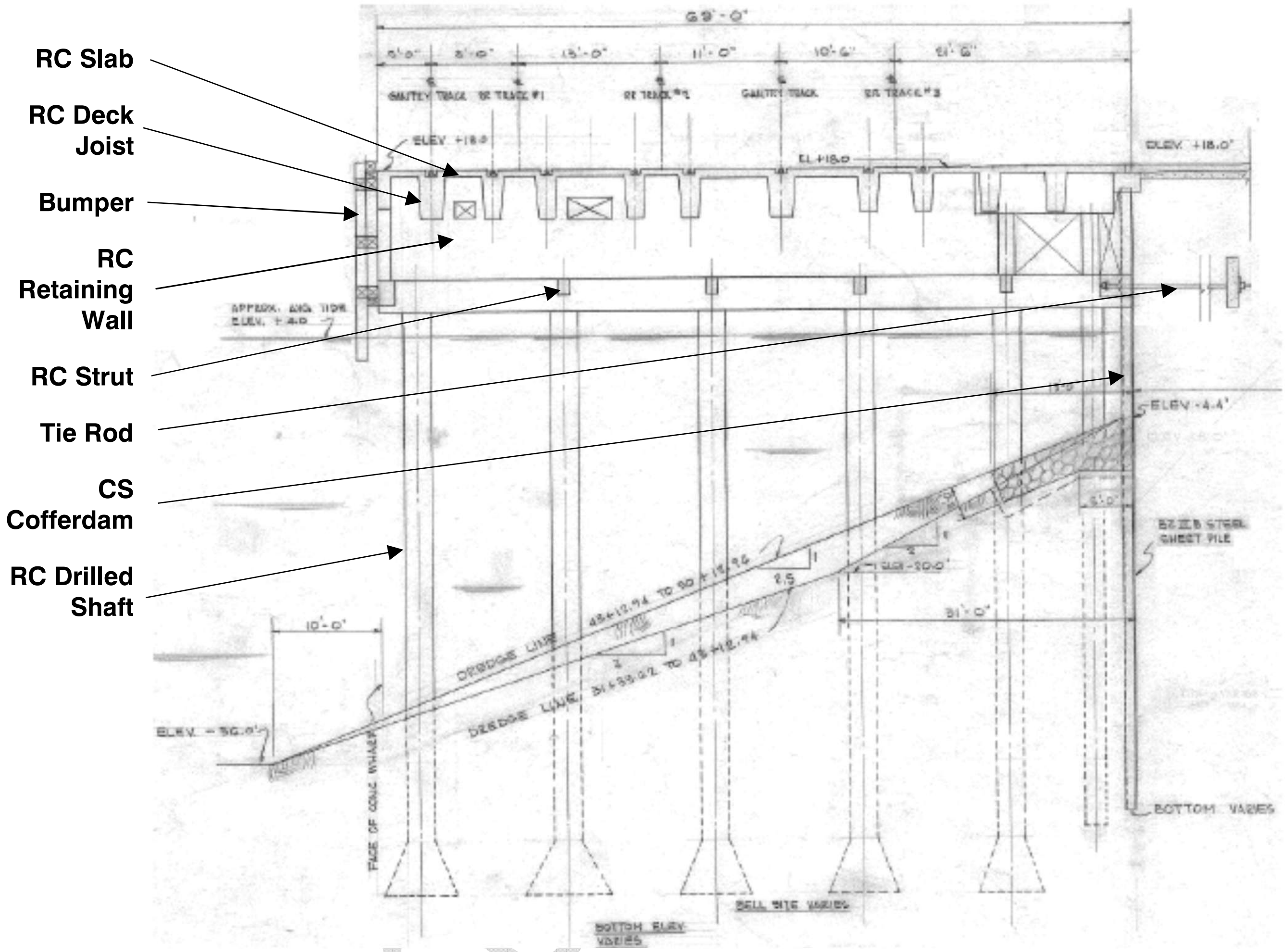
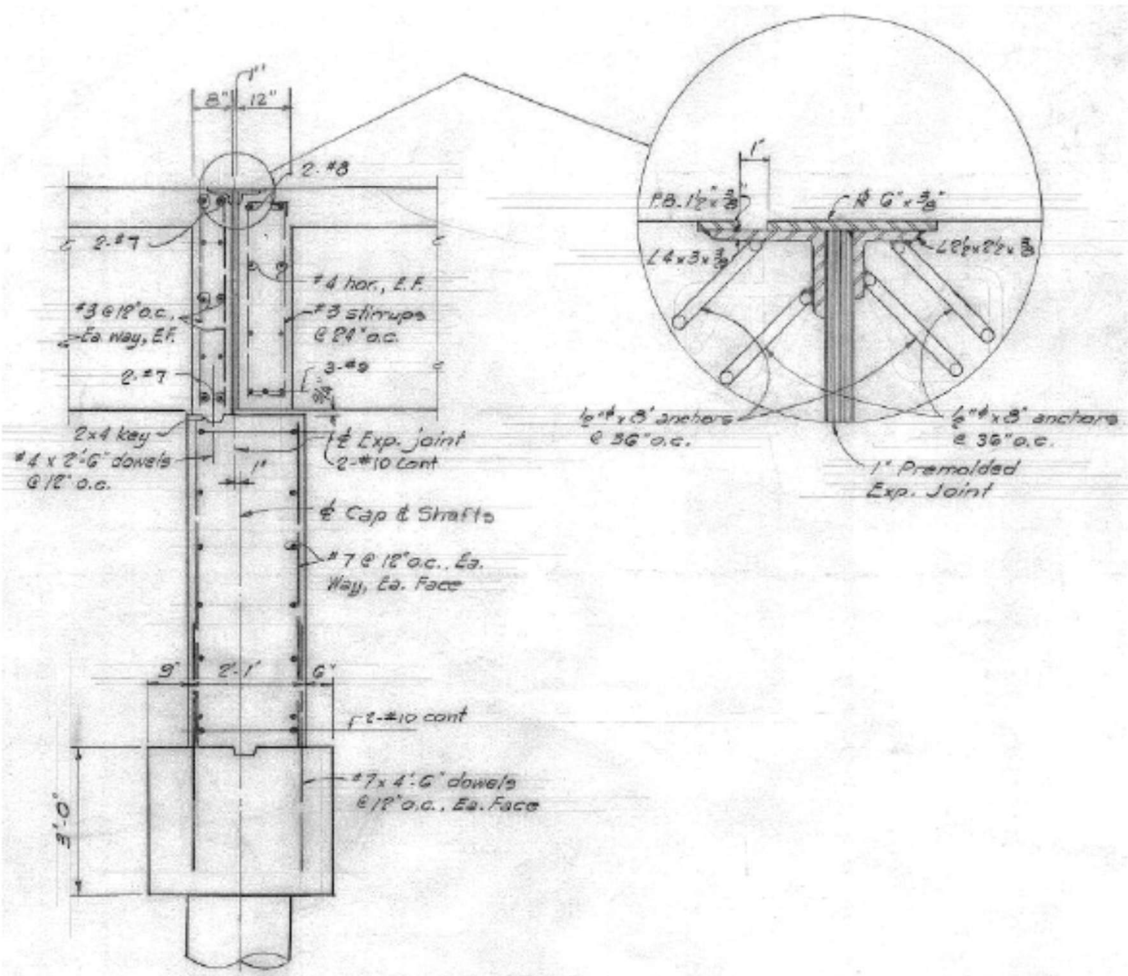


Figure 4. Typical Section through Structure.

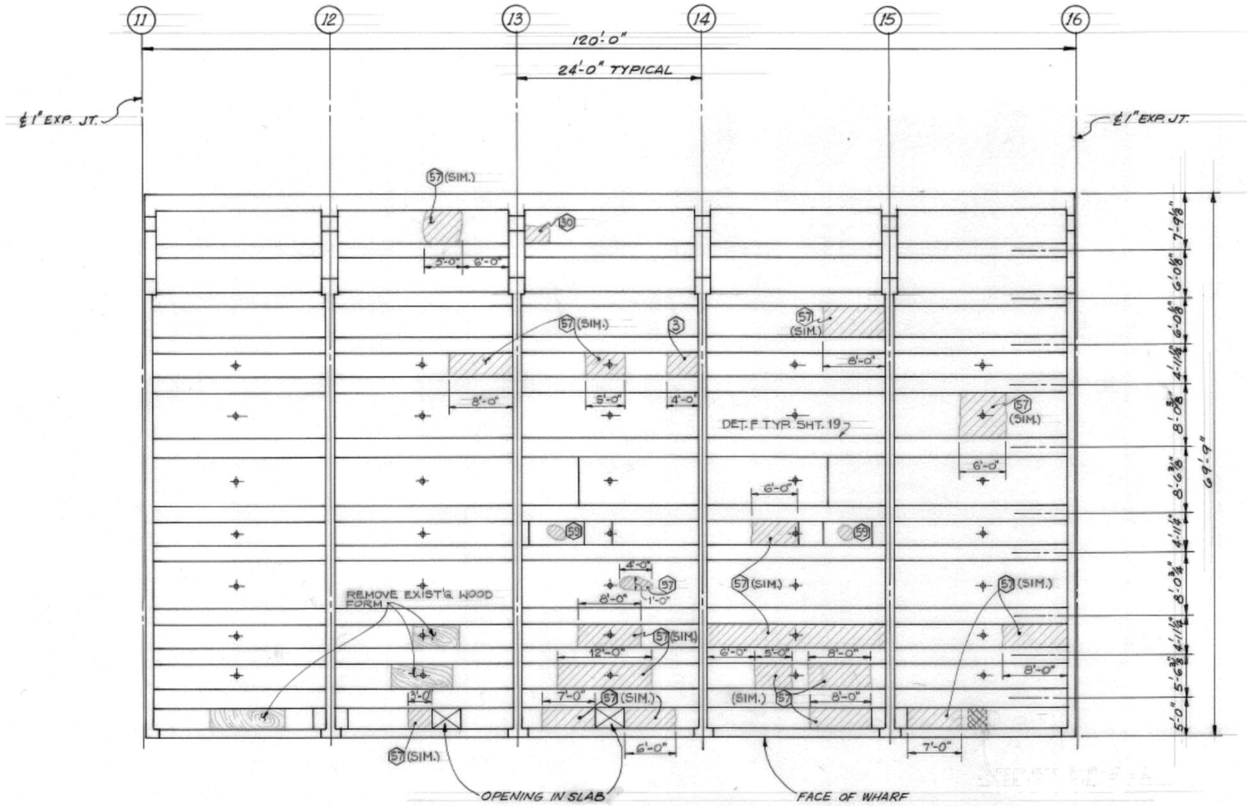
4. Upon reviewing the original plans for the wharf, you come across the following detail call out at columns lines 11 and 16.



Properly annotate this element for unit B in the appropriate blanks extracted from the inventory record form below.

Component / Element(s)	**Description**
Joints (JN)	None
	–

5. Now, looking closely at the inventory record form, you notice that the deck was repaired, and the fender system was replaced in 1990. Looking through the 1990 repair documents, you find the following details for Unit B.

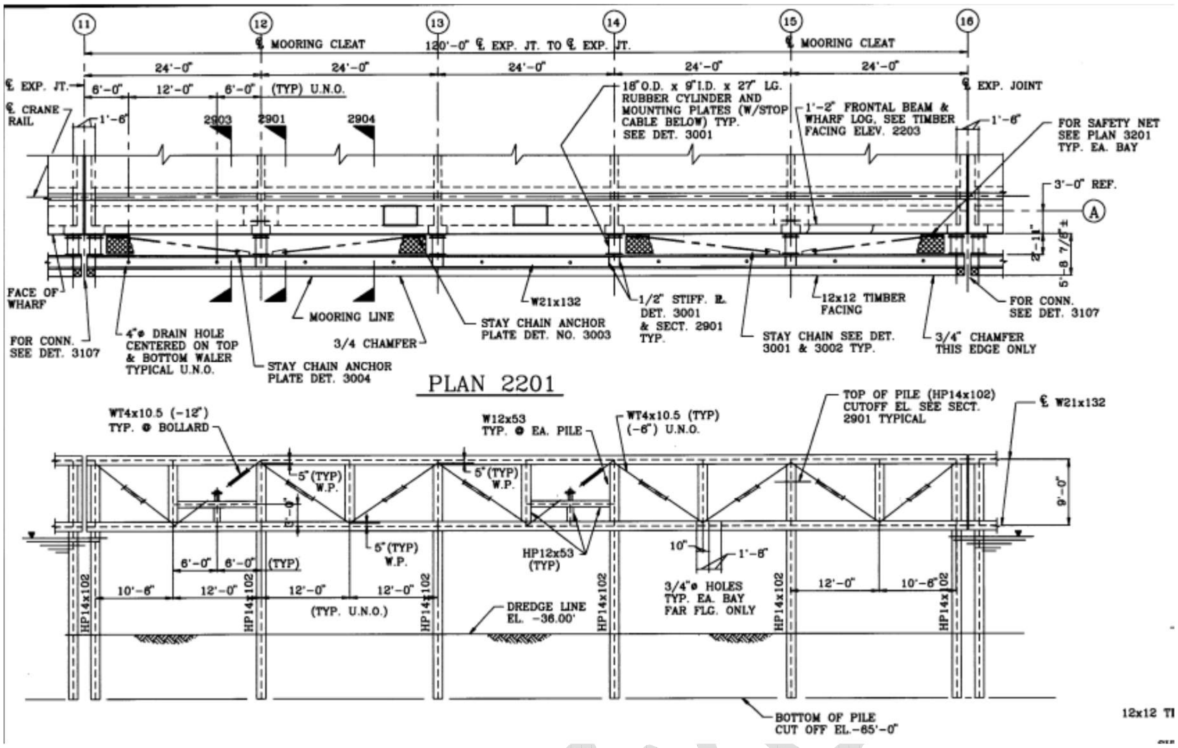


3. 3FT. X 4FT. SPALL AT BOTTOM OF DECK W/EXPOSED BOTTOM REBAR, CHIP OUT TO SOUND CONCRETE AND REPAIR WITH SHOTCRETE.

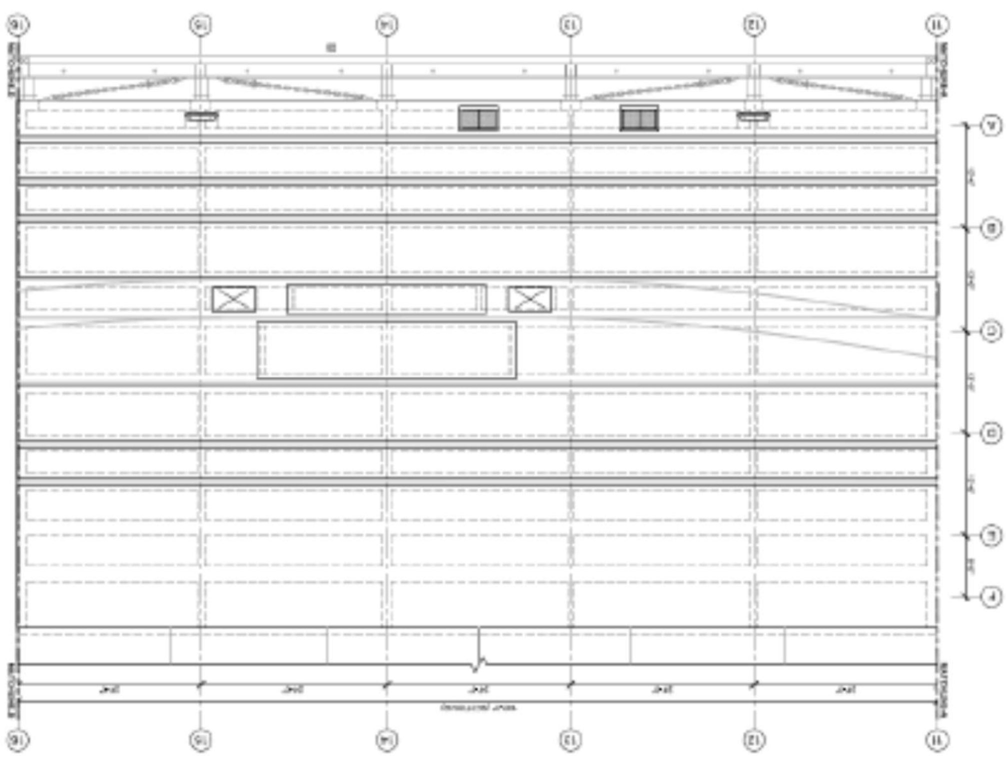
30. 3 FT X 2 FT SPALL. CHIP OUT, CLEAN REBAR AND REPAIR WITH SHOTCRETE.

57. DECK SLAB SPALLED ABOUT 2 FT WIDE BETWEEN LONGITUDINAL BEAMS. CHIP OUT TO SOUND CONCRETE, CLEAN REBAR AND REPAIR WITH SHOTCRETE.

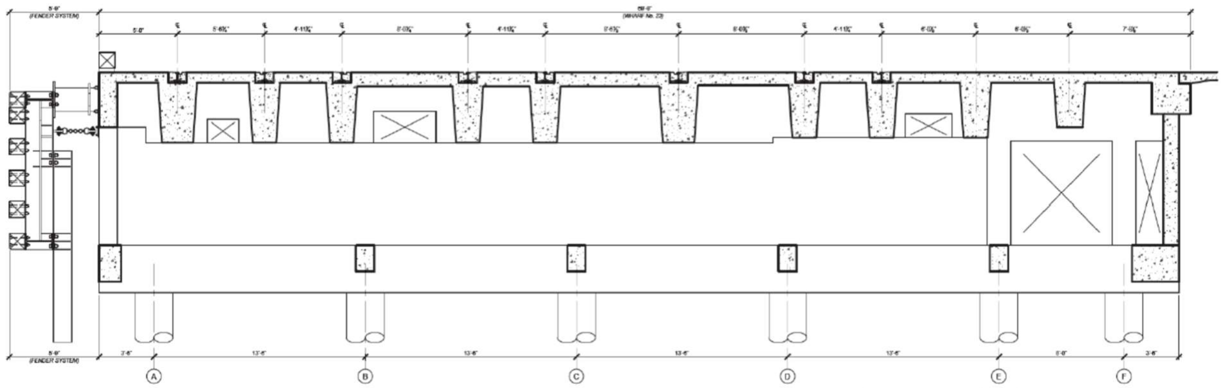
59. DECK SLAB SPALLED ABOUT 1 FT-6 INCHES BY 2 FT. CHIP OUT TO SOUND CONCRETE, CLEAN REBAR AND REPAIR WITH SHOTCRETE.



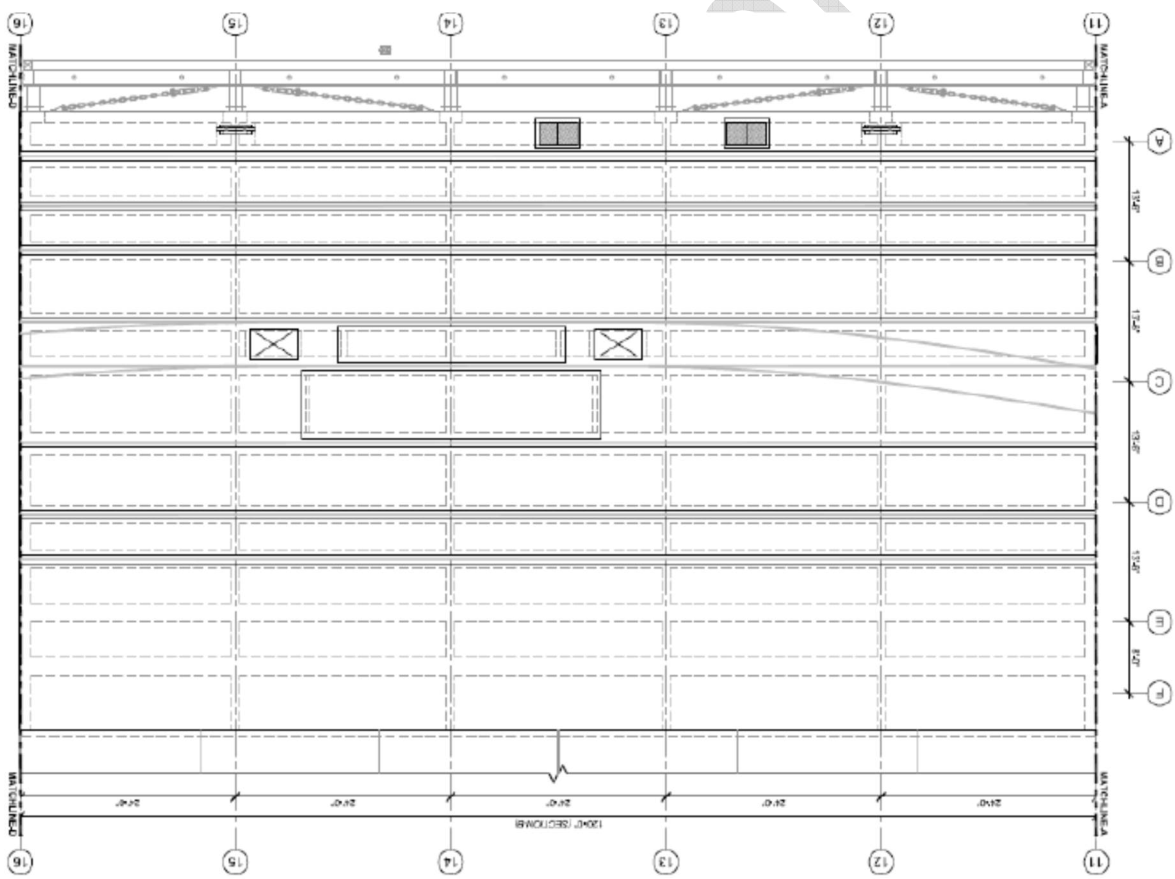
To help your overworked CAD technicians, you decide to redline the inspection drawings to show these actions. On the view below, make the appropriate annotations on the Inspection Drawing Key Plan.



6. You decide to continue to develop the inspection drawings by giving the CAD technicians a representative sample of the bay numbering scheme. To do so, examine the representative cross section below and answer the following questions.



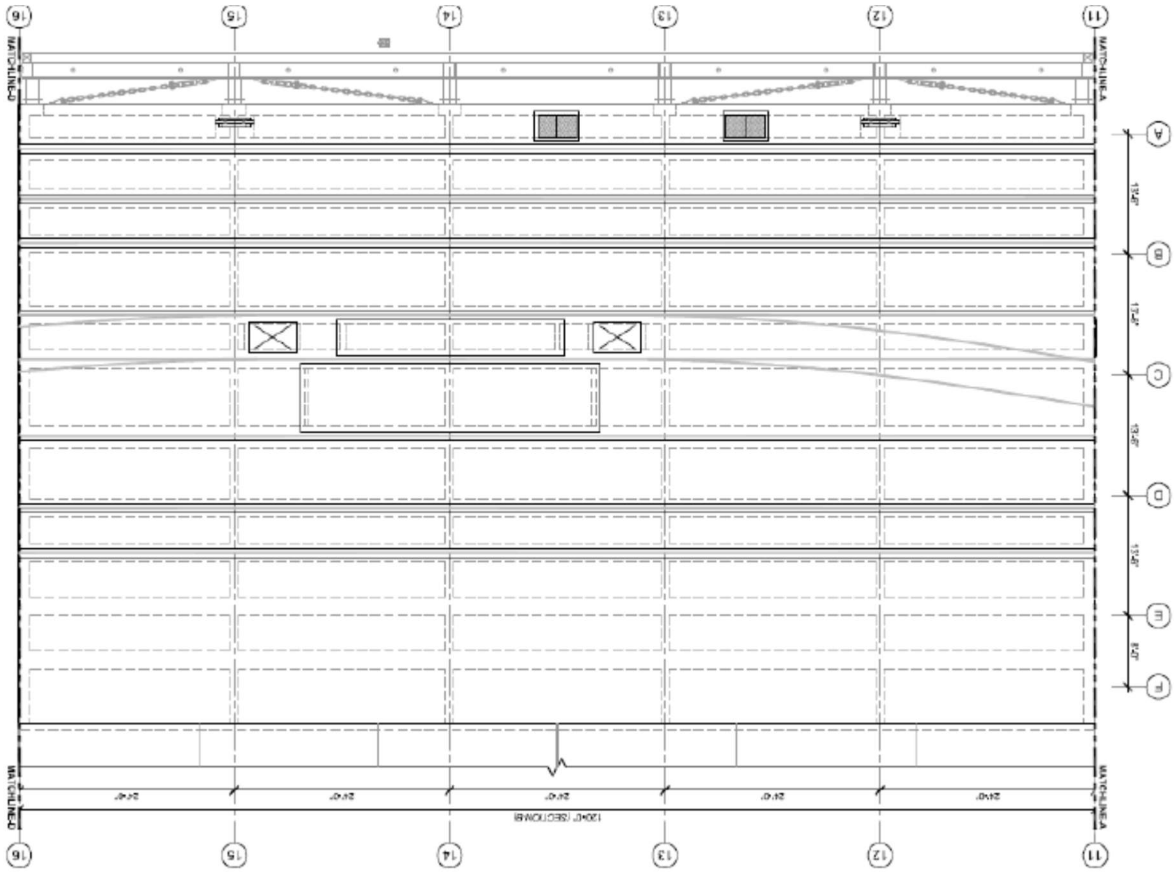
   a. Assuming that the cross section does not change for the length of unit B, label the view below with the appropriate bay numbering.



   b. On the blank below, list the other information that will need to be added to the sheet to complete the bay plan.

____

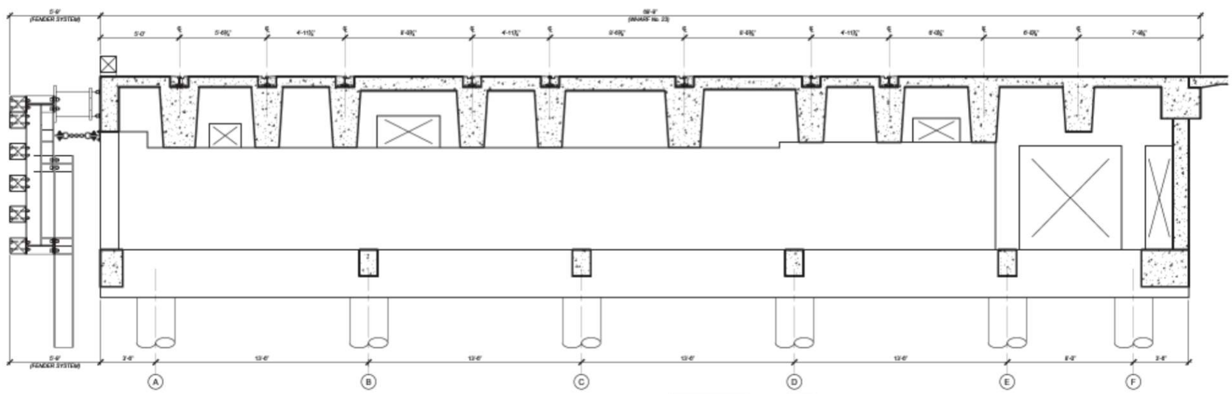
7. You then decide to show the CAD technicians how to label the deck and superstructure elements for the deck element and superstructure element plans. Label the following deck elements on the plan view below: DT11-1, DU14-1, DB13-5, DB 15-8



8. How would the view in question 7 need to be changed for it to become the background for the substructure element plan?

9. You then look at the Inspection Summary form and notice that the deck elements are not listed properly. How would you correct the Inspection Summary form? (write answer below).

10. You then begin work on a typical section for the Standard Inspection Drawing. For this view you decide to use the section below along column line 13. Label the following elements DS13-2, SW13-1, FF13-1, FA13-1, ST13-4, BW13-1



11. Other than additional element labels, what other information is required to be included on the Standard Inspection Drawing (answer in the blank below)?

____

12. On which form can you find the information for question 11?

____

13. To complete the Standard Inspection Drawing Set, your CAD Technician asks you what the typical elevation for unit B should include. List the requirements for the typical elevation in the space below.

Property:	Turning Basin North	**Asset ID:**	CD 23
Asset Type:	Wharf	**Year of Original Construction:**	1963
Asset Description:	Open Air Wharf	**Year(s) of Significant Modifications or Repairs[1]:**	1989, 1990, 1998
Wharf Usage:	Break bulk, open	**Date of Last Inventory Record Update:**	
Inspection Frequency:	Above water: 3 yr Underwater: 6 yr		

Asset Geometric Data

Area (sf):	Wharf Deck: 41,538 Apron: 137,712 Total: 179,250	**Deck Elevation above MLT:**	14 ft. 9 in.
Structure Length:	602 ft.	**Channel Depth at Fender:**	36 ft. 0 in.
Structure Width:	Deck: 69 ft. Apron: 228 ft.	**Channel Depth at Bulkhead:**	4 ft. 5 in.

Structure Load Rating

Uniform Load	750 psf	**Railroad:**	3 active lines, Cooper E-80
Shore Crane:	300T	**Truck Rating:**	HS20-44
Fender Design (Max. Vessel):	37 kips (cleats)		

Asset History

The wharves along the Turning Basin and Manchester Terminals were constructed at various time periods ranging from the 1910s to 1980s. The wharf known as CD 23 is located toward the center of the Turning Basin Terminal on the northeast side of the Houston Ship Channel. The original drawings for CD 23 are dated 1961, and the wharf was reportedly constructed in 1963. In 1990, the original fender system consisted of timber framing was replaced with a steel-framed fender system and significant[1] concrete repairs were made. The concrete repairs included shotcrete repairs to approximately 1,400 square feet (sq. ft.) of deck underside and approximately thirty wall and column locations. In addition, eighteen of the harbor line strut beams were demolished and replaced with new 18-inch by 18-inch beams cast on top of the pile cap beams. The front pilasters typically were repaired at the ends of the new strut beams, and seven concrete piles were repaired.

Additional minor repairs to small portions of the wharf deck were made in 1996, 1997, 1998, 2000, 2002, and 2003.

[1] Significant modifications: Work that altered the structure's footprint or changes structural components. Significant repairs: Repair work in excess of 10 percent of the area or length of a structural component.

Reference Drawing List

Drawing Set	Title	Date	Description
C123-34	Wharves 23, 24 & 25 Prop. 1	30 Jun 1961	Original Construction Drawings
C123-8	Repair of Wharf and Fender System at Wharves 23, 24, & 25	21 Mar 1990	Deck/Beam Repair and Fender Replacement

Structural Components & Elements

Component / Element(s)	**Description**
Deck (DK)	Reinforced concrete deck, 6 feet wide, spanning across reinforced concrete beams
RC Deck	One-way reinforced slab, 8-inch thick, continuous span
Slab (SL)	Slab extending 228 feet landward from deck
RC Slab	Reinforced concrete slab on grade, 6 inches thick
Superstructure (SP)	Deck beams spanning between shear walls.
RC Deck Beam	46 inches deep overall and vary in width from 18 inches at the bottom to 24 inches at the top. The beams are aligned parallel to the harbor line and are generally located beneath the rails for the railroad tracks and the gantry crane; as a result, the center-to-center spacing of these beams varies from 4 feet, 11-1/4 inches at the railroad tracks to as much as 9 feet, 1-1/2 inches in between
Substructure (SB)	Reinforced concrete bents generally consist of a shear wall and column supported on a reinforced concrete pile cap beam, tying together the tops of six belled drilled piers. Except at the bays south of the expansion joints, adjacent bents are tied together by strut beams located at the top of the pile cap beams.
RC Columns/Pilasters	18-inch by 18-inch reinforced concrete column
RC Shear Wall	Reinforced concrete wall, 12-inch thick
RC Pile Cap	Reinforced concrete pile cap, 3-foot, 4-inch wide by 3-foot deep.
RC Drilled Shaft	29- or 30-inch diameter shafts, with bell diameters varying from between 58 and 90 inches, depending on footing location.
RC Strut	Reinforced concrete beams 14 inches wide by 20 inches deep along Grid Lines B through E, and 18 inches wide by 27 inches along Grid Line A at the harbor line. Strut beams were also provided along Grid Line A at the bays south of the expansion joints, although these beams are jointed at their south end to accommodate the movement of the expansion joint.
Bearings (BR)	None
Joints (JN)	None
Bulkhead (BH)	Steel sheet pile wall except for a length of approximately 75 feet from Bent 1 to beyond Bent 4 where the bulkhead wall is constructed of concrete.
CS Bulkhead Wall	BZ IIIB sheet piling
RC Bulkhead Wall	one foot thick

Component / Element(s)	**Description**
RC Bulkhead Pile Cap	2-foot, 6-inch wide by 1-foot, 4-inch-deep reinforced concrete beam cast monolithically with the wharf deck
CS Bulkhead Wale Beam	Concrete-encased, double-channel steel whaler
CS Bulkhead Tie Rod	3-inch diameter anchor rods typically spaced at approximately 10 feet on center

Berthing Components & Elements

Component / Element(s)	**Description**
Fender System	Steel fender pile system with timber facing
CS Fender Pile	Steel H-piles
CS Support Framing	Additional steel framing (horizontal and diagonal) bolted onto the harbor side face of the piles connected with pins at bents 1, 11, 16, and 26.
TIM Facing	Six rows of 12x12 timbers installed alternatingly across the face of the fender system
OTH Cylindrical Rubber Fender Absorption Unit	18-inch diameter, 27-inch long rubber bearing
Mooring System	Description of Mooring System
– MT Cleat	8 forged cleats along located approximately 22 inches to 24 inches from the harbor line, and each was connected to the slab by a group of six anchor rods. The anchor rods typically extended through a thickened section of the deck slab and were secured to the wharf by plate washers and nuts. The anchor rod diameters ranged from 1 to 1-1/4 inches.

Shoreline Components & Elements

Component / Element(s)	**Description**
Protected Shoreline	Riprap
Unprotected Shoreline	None observed.

Ancillary Components & Elements

Component / Element(s)	**Description**
Utility Systems	See original drawings.
Paint and Markings	None observed
Guards	None observed
Crane and train rails	See original drawings
Personnel access systems	See original drawings

Figures

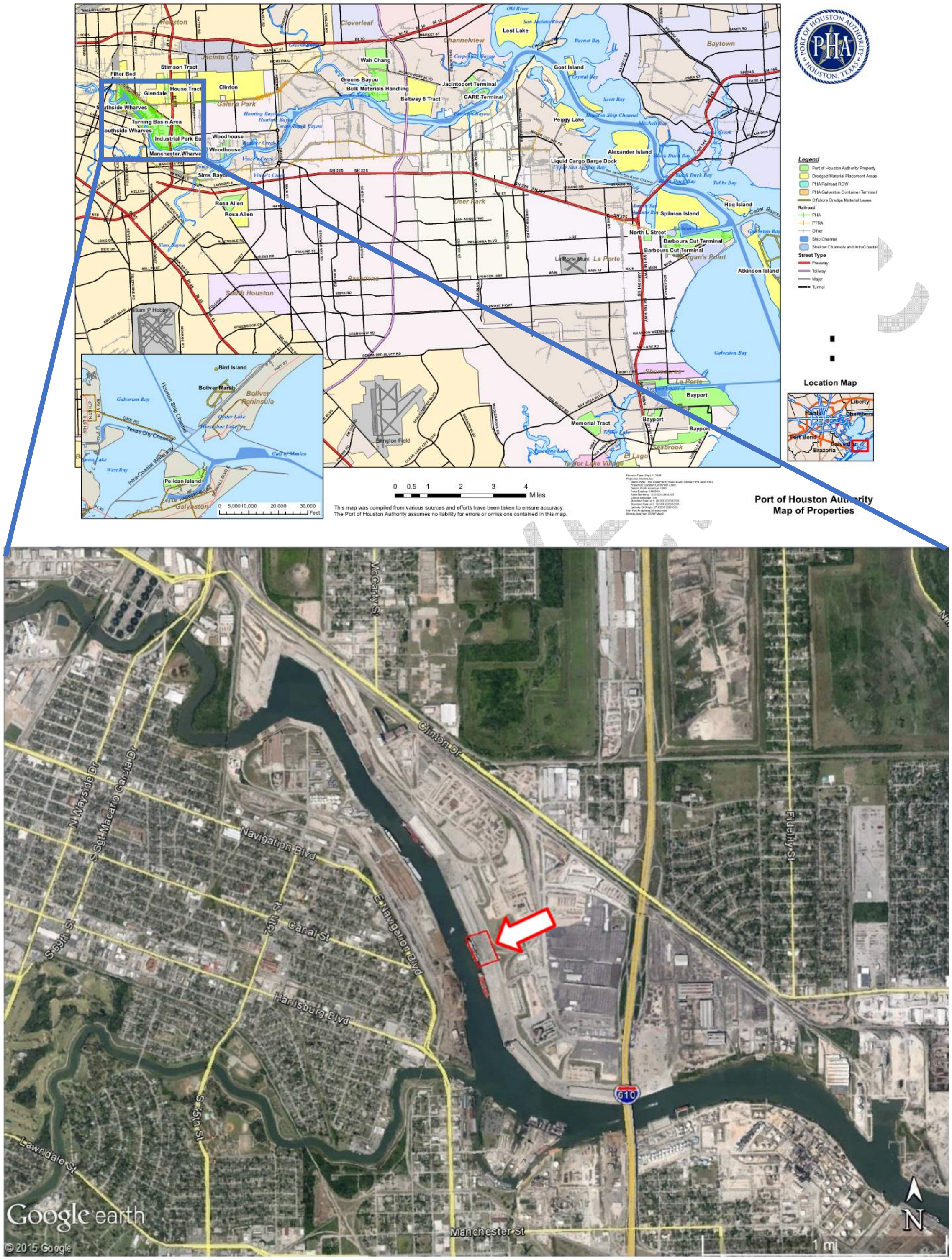


Figure 1. Asset Location

Figure 2. Aerial view of structure and immediate vicinity.

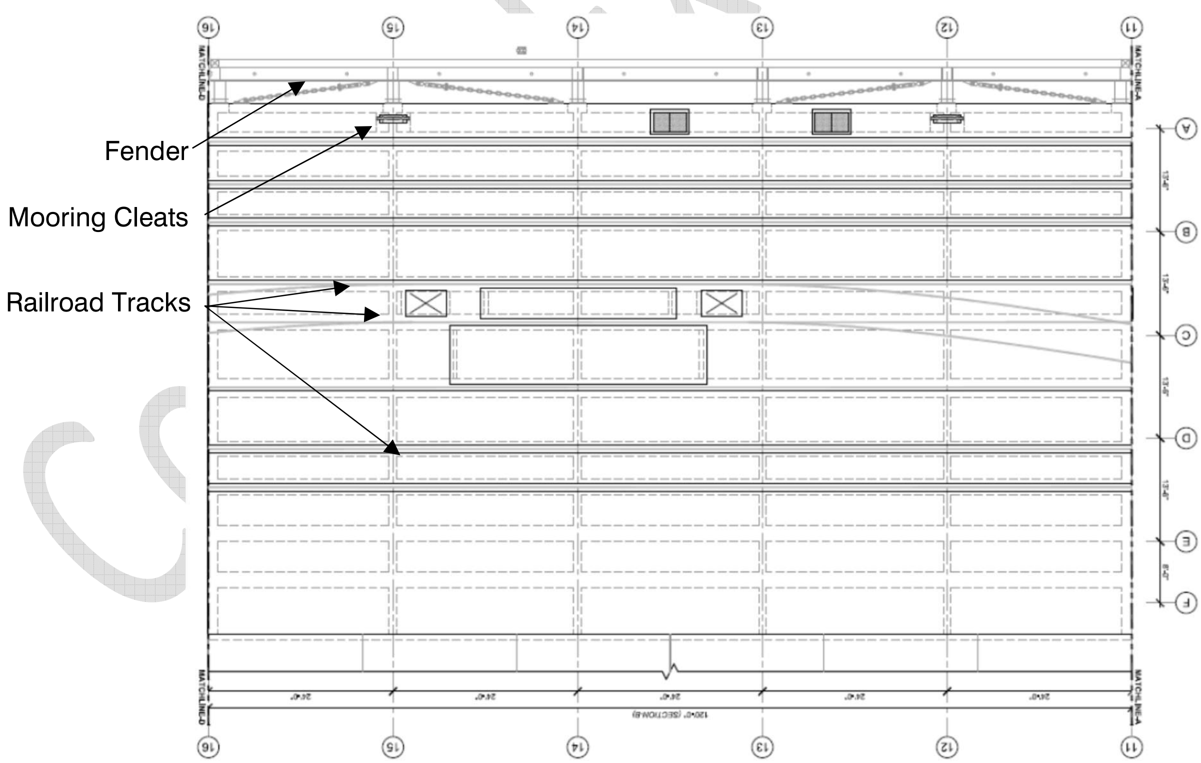


Figure 3. Typical Partial Plan of Structure.

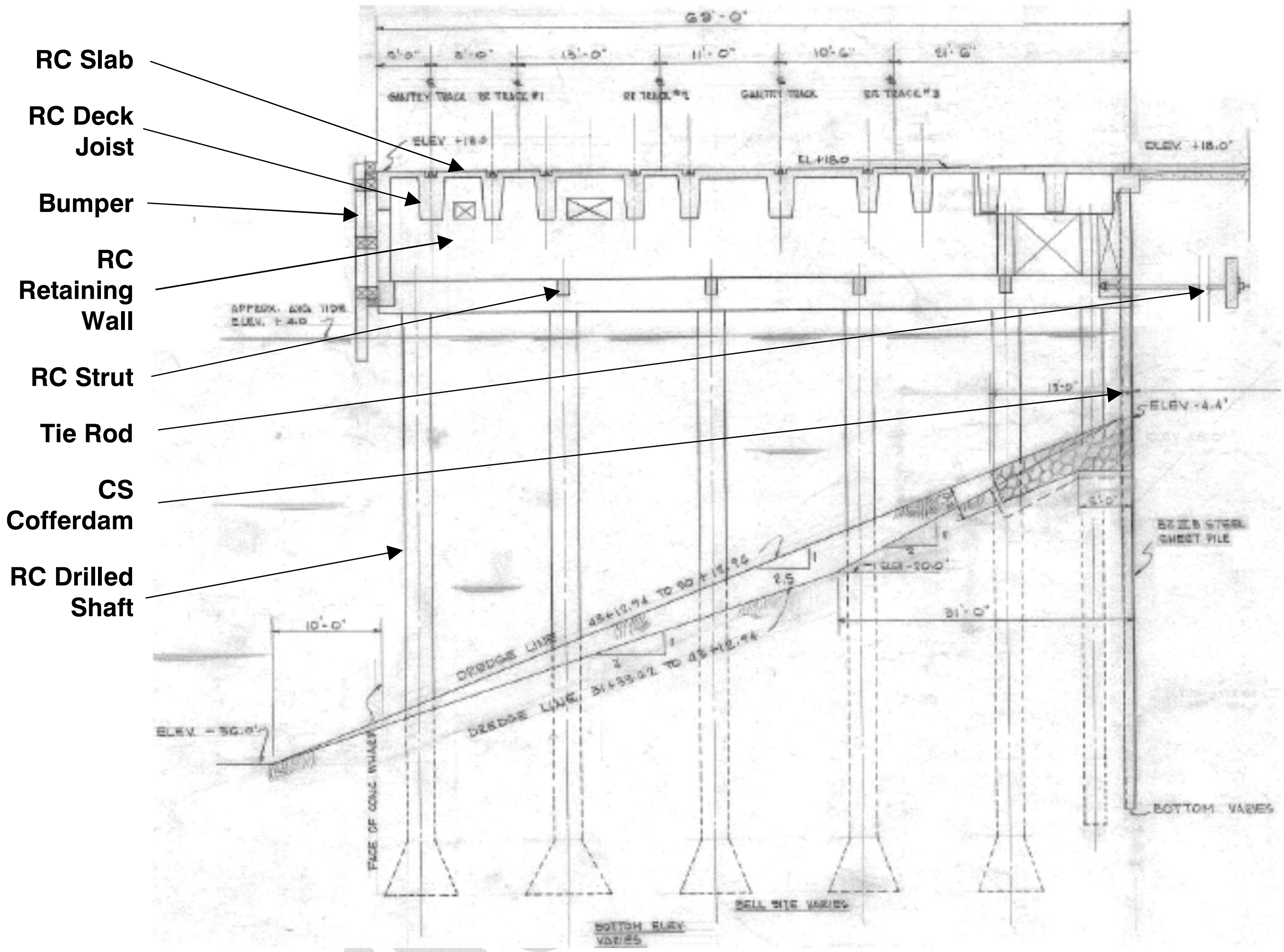


Figure 4. Typical Section through Structure.

Revision History

Rev. No.	Reported by:	Date	Verified by	Date	Comments

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Property:	Turning Basin North	**Asset ID:**	CD 23
Inspection Type	☐ Baseline ☐ Routine ☐ Special	**Inspection Date(s):**	
Scope of Inspection	Unit B; Bays 11 - 15		
Inspection Firm(s):	**Prime**: Inspections R Us		
	Underwater: Sponge Bob Square Pants Inspectors		
	Other (role): N/A		
Reported By:		**Report Date:**	[Publish Date]
FICAP Manual Version/Date:	February 2017	**Variances from FICAP Procedure:**	None

Seal of Responsible Engineer

I hereby certify this inspection was performed under my direct supervision and control and to the best of my professional knowledge complies with the FICAP Manual and applicable codes.

Signed:________________________________

Name:________________________________

Texas License No.:________________________

Date:______________ Expires: ______________

Seal

Inspection Team Members

Project Manager:
Inspection Team Leader(s):
Inspection Team Members: Larry, Daryl, and Daryl

Underwater Team Leader: Joe Smith
Underwater Team Member: Jim Adams

Overall Asset Condition

The baseline inspection of Unit B utilized visual and sounding surveys, non-destructive testing techniques, and sampling and laboratory testing to establish the existing condition of the wharf. This study found significant distress to the topside of the wharf deck slab, including apparent corrosion and impact damage, widespread cracking and high corrosion potentials on the strut beams, and generally localized corrosion-related damage elsewhere in the structure. Other items of concern noted included leakage at construction and expansion joints and around drains, and shear cracking in some deck beams.

Corrosion-related damage was found to be related to chloride intrusion at the portions of the walls, columns, pilasters, and pile cap beams directly exposed to the channel water, particularly in the splash zone, and at the deck topside. Otherwise, corrosion-related deterioration is related to carbonation. Structural analyses performed for load rating the wharf found that the current load rating is accurate but that upgrading the wharf to a uniform load rating of 1,200 psf as desired by PHA would only require strengthening selected deck beams, particularly at the two lines of beams not located at the crane or train rails. Service life analyses found that the structural elements of the wharf generally have at least 50 more years of service life, except at the deck slab, strut beams, and vertical faces of the deck beams where the concrete cover is reduced.

The steel elements of CD 23 are also in generally good condition. The steel sheet piling for the bulkhead wall exhibits localized surface corrosion along the top and bottom edges of its exposed section. Corrosion of the steel fender elements was localized but severe in some instances, and a few bent or damaged members were identified. The timber lagging exhibits damage and deterioration in a number of locations. Overall, the fender system is in good condition.

Structural Component Ratings and Element Summary

Component / Element(s)	Rating	Comments
Deck		*Add Narrative:*
RC Deck		Overall, approximately 30% of the deck topside was identified as delaminated or spalled. The topside of the concrete deck was scarred and gouged from mechanical impact at numerous locations, with gouges up to 1 inch deep. The deck underside was in good condition.
Slab		
RC Slab		Not inspected
Superstructure		*Add Narrative:*
RC Deck Beam		Approximately 25% of the beams were in good condition, and about 75% of the deck beams were rated as fair condition. The distress in these beams mainly consisted of random small spalls and delaminations on the vertical or bottom faces of the beam (Figure 5). Most beams exhibited a horizontal crack along the top of the beam near the beam-to-deck transition (Figure 6), and some exhibited shear cracking (Figure 7).

Structural Component Ratings and Element Summary (continued)

Component / Element(s)	Rating	Comments
Substructure		*Add Narrative:*
RC Columns/Pilasters		Approx. 75% of columns and pilasters had some concrete delamination or spalls (fair to poor). Column F11 was noted to exhibit more than 50% section loss (severe) of the longitudinal corner reinforcement exposed by spalling (Figure 8). Pilaster A16 and Columns F11 and F16 were observed to have cracking and spalling at the bearing area where the deck girders and beams are supported (Figure 9) resulting in severe loss of bearing.
RC Shear Walls		Spalling and delamination were frequently observed at the bottom of the walls above the pile cap (Figure 10). Spalling and delamination (fair to poor condition) was observed on approximately 80% of the shear walls. Delaminations have exposed reinforcement (fair to poor) over approximately 60% of wall length.
RC Pile Caps		Pile caps exhibited top surface delamination (fair) over approximately 25% of length (Figure 11).
RC Drilled Shaft		Generally, the piers and collars were in good condition. No scour was reported.
RC Strut		In 55 percent of the strut beams, longitudinal cracking (fair to poor) was observed to extend for at least half of the strut beam length.
Bearings		None
Joints		Add Narrative:
Armored Open Expansion Joint		The armor was gouged along column line 16 but otherwise adhered and aligned (good cond). Joint was undamaged along column line 11 (good).

Structural Component Ratings and Element Summary (continued)

Component / Element(s)	Rating	Comments
Bulkhead		*Add Narrative:*
CS Bulkhead Wall		Evidence of previous moderate to severe pitting of the sheet piling was generally visible in the bottom 12 inches of the exposed portion of sheet piles above wale beam (Figure 12). Section loss is generally minor to moderate (fair condition).
RC Bulkhead Wall		Not inspected
RC Bulkhead Pile Cap		Not inspected
CS Bulkhead Wale Beam		The concrete encasement for the tieback whaler along the bulkhead wall exhibited minor surface spalls and delamination along the top edge at some locations, as shown in Figure 13. Fair condition along entire length.
CS Bulkhead Tie Rod		Not inspected

Berthing Component Ratings and Element Summary

Component / Element(s)	Rating	Comments
Fender System		*Add Narrative:*
CS Fender Pile		Isolated moderate to severe corrosion of fender piles within the splash zone in all bays.
CS Support Framing		Isolated moderate to severe corrosion of fender support elements within splash zone for all bays (from bottom element to 36 in. above). Buckled or distorted fender elements noted in 4 locations. Fractured bottom connection of diagonal brace (severe corrosion) in Bay 6-7. Severe corrosion and failed connections at pinned connections at Bent 11 and 16 (Figure 14).
TIM Facing		Moderate to severe wood decay/splitting of timber lagging elements in 4 bays. Severe impact damage fractured lagging observed at 4 locations. Lagging missing at 10 locations (primarily bottom 2 rows). Moderate to severe corrosion of anchor bolts/nuts in splash zone.
OTH Cylindrical Rubber Fender Absorption Unit		Tears or severe cracking in rubber dampers at Bents 18, and 19, moderate cracks in dampers at Bents 9 and 20.
Mooring System		*Add Narrative:*
MT Cleat		Minor surface corrosion and coating failure were observed at all cleats. Moderate corrosion of plate washers for cleat anchor rods noted at all cleats.

Figures

Figure 5. Beam bottom spall and delamination

Figure 6. Crack at beam to deck transition

Figure 7. Deck beam shear crack

Figure 8. Column F11 spall

Figure 9.Cracking and spalling column F11

Figure 10. Spalling at RC Shear Wall

Figure 11. Pile cap beam delamination

Figure 12. Pitted Sheet Pile Wall

Figure 13. Delamination on tieback whaler

Figure 14. Bent 11 secondary framing pinned connection

Figure 15. Typical wharf log distress

Rating Abbreviations

N/A: Component not applicable to structure.
NI: Not inspected

Rating Definitions

Ratings for Structural and Berthing Components

Rating	Description
6 Good	Minor or no problems noted. Also applies to newly constructed or rehabilitated components.
5 Satisfactory	Minor defects, damage or deterioration - not extensive.
4 Fair	Extensive minor or limited moderate defects, damage or deterioration. Structural capacity of primary structural components and functional use of fender or mooring systems are not affected.
3 Poor	Moderate or extensive defects, damage or deterioration that affects structural capacity of primary structural components or functional use of fender or mooring system components.
2 Serious	Defects, damage or deterioration significantly reduces structural capacity of primary structural components or reduces functional use of fender or mooring systems.
1 Critical	Advanced defects, damage or deterioration with localized failure(s) of components imminent or observed. Immediate load or use restrictions, including closing of the asset should be considered.
Applicable Component Types: Deck, superstructure, substructure, bearings, bulkheads, mooring and fender systems.	

Ratings for Shoreline Components

Rating	Description
6 Good	Minor or no problems noted. Also applies to newly constructed or rehabilitated shoreline components.
5 Satisfactory	Minor defects, damage or deterioration - not extensive.
4 Fair	Protected shoreline: Extensive minor or limited moderate defects, damage or deterioration observed but does not affect shoreline protection. Unprotected shoreline: Extensive minor or limited moderate indications of shoreline beginning to slump. May be minor movement of shoreline.
3 Poor	Protected shoreline: Moderate or extensive deterioration or displacement that affects shoreline protection. Unprotected shoreline: Moderate or extensive indications of shoreline slumping or movement.
2 Serious	Protected shoreline: Deterioration, displacement, or breakage significantly affects the shoreline protection and local failures are possible. Unprotected shoreline: Shoreline is being eroded. Local slump or embankment failures are present. Use restrictions may be necessary for roadways, railways and working areas near shoreline.

1 Critical	Protected shoreline: Very advanced deterioration, displacement, or breakage with localized failure(s) of primary shoreline protection imminent or observed. Shoreline is being eroded and/or shoreline movement has occurred. Unprotected shoreline: Widespread erosion and/or slump or embankment failures have occurred. More widespread failures are possible or likely to occur. Immediate actions, such as emergency shoreline protection measures, use restrictions, or barricading of roadways, railways and working areas near the shoreline should be considered.
Applicable Component Types: Protected shoreline, unprotected shoreline.	

Functional Ratings for Ancillary Components

Rating	Description
6 Good	Minor or no problems noted. Also applies to newly constructed or rehabilitated protective components.
5 Satisfactory	Minor defects, damage or deterioration - not extensive.
4 Fair	Extensive minor or limited moderate defects, damage or deterioration. All primary elements and their attachment to the asset are sound and functional purpose/use of the component is not affected. Minor repairs or maintenance may be required.
3 Poor	Moderate or extensive defects, damage or deterioration that affects functional purpose/use of the component or compromises attachment of the component to the asset.
2 Serious	Defects, damage or deterioration significantly affects functional purpose/use of the component and/or local failures of the attachment to the asset are present.
1 Critical	Advanced damage or deterioration has resulted in frequent imminent or observed failure(s) of the attachment of the component to the asset. The component may no longer serve its functional purpose/use and/or conditions are present that may lead to property damage or environmental damage. Immediate repairs or other protective measures should be considered, and/or immediate use restrictions should be considered for components affected.
Applicable Component Types: Utility systems, paint and markings, crane and train rails, personnel access systems.	

Facility Inspection & Condition Assessment Program (FICAP)

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Element Conditions and Condition States

Module 4

Module Objectives

- Identify damage and deterioration found in PHA elements
- Describe the basis for the four element condition states
- Characterize maritime elements using the four predefined condition states
- Quantify damage and deterioration conditions found in PHA elements
- Document an element's condition state using an Element Inspection Form

Module References

- FICAP Manual Chapter 3: Elements and Element Conditions
- FICAP Manual Appendices
  - C Element Descriptions
  - D, E Condition States Description

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Agenda

- Module 4.1 Element Condition Codes
- Module 4.2 Element Condition States
- Module 4.3 Documenting Element Condition States

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Module 4.1

Element Damage and Deterioration Conditions

Element Condition Codes

- Four letter code
- Describes type of
  - Damage
  - Deterioration
  - Defect
- Individual element

By Component

Berthing & Mooring System Components*

Fender Systems

Code	Condition Name
BULG	Bulging/ splitting/ tearing
DBIM	Debris impaction
DIST	Distortion
FNFA	Condition of fender facing
FNPN	Condition of fender panel
FNSC	Condition of fender stay chain
MISS	Missing
SCOR	Scour
STTL	Settlement

By Material

Structural Components

Concrete Materials

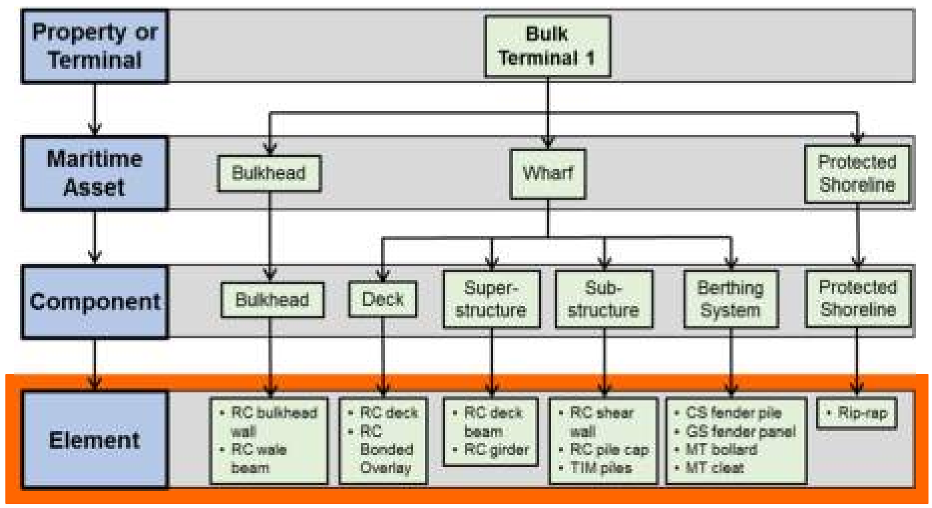
Code	Condition Name
ABWC	Abrasion/ wear
CRKC	Cracking
DIST	Distortion
DLSP	Delamination/ spall (partial-depth)
DLSF	Delamination/ spall (full-depth)
EFRS	Efflorescence/ rust staining
EXPR	Exposed reinforcement
EXPS	Exposed prestressing
LSBR	Loss of bearing area
MISS	Missing
PTCH	Patched area
SCOR	Scour
STTL	Settlement
VOID	Voids or Honeycombing

FICAP PG E.1

Maritime Elements

- Defined by
  - Component
  - Code
  - Descriptor
  - Identification
  - Units

Structural or Non-Structural



Element IDs Review

DB3-12

Element Code
DB, PI, WL, FF, etc.

First two letters of element code (material type not included)

Bay Number
1, 2A, 7, 10C, etc.

Numbered sequentially, upstream to downstream

Letters for different structural systems

Element Number
1, 2, 3, etc.

Numbered sequentially upstream to downstream, water to land, top to bottom

Recall Module 2.3.

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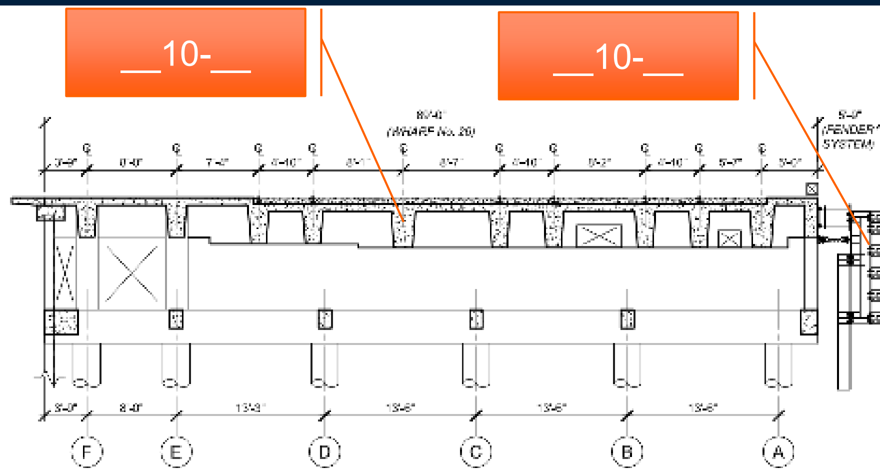
Element IDs - Review

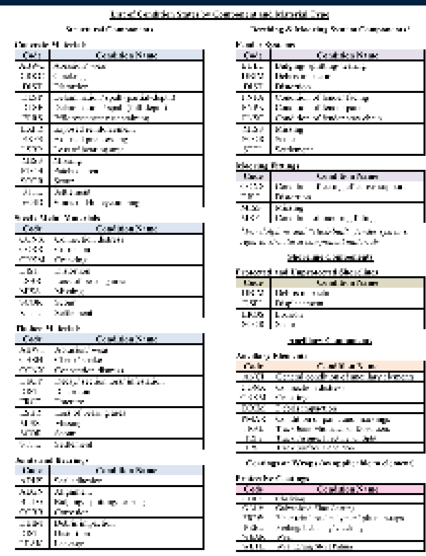
- Element Number Order
  - Upstream
  - Water front
  - Top



Fill in the blanks

Element Condition Codes

- Systemic approach
  - Component
  - Material
  - Element
- Multiple if required



Single Page Summary
FICAP PG E.1

Element Condition Codes

- Systemic approach
  - Component
  - Material
  - Element
- Multiple if required

Type	Code	Condition Name	Condition Definition	Condition States CS1 (Good)	CS2 (Fair)	CS3 (Poor)	CS4 (Severe)
Concrete	ABWC	Abrasion/ wear	Abrasion or wear in concrete elements	No abrasion or wear.	Coarse aggregate is exposed but remains secure in concrete matrix.	Coarse aggregate has been exposed and is loosened from concrete matrix due to wear.	N/A
	CRKC	Cracking [See Table 2.6.4-1]	Cracking in concrete elements (including wearing surfaces)	Insignificant cracks or moderate-width cracks that have been sealed.	Unsealed moderate-width cracks or unsealed moderate map cracking.	Wide cracks or heavy map cracking. For structural elements, this excludes cracks associated with reduction of structural capacity (e.g., bond splitting cracks, shear, bending, or torsional stress cracks).	Wide cracks associated with reduction of structural capacity or functionality (e.g., loss of bond, shear, bending, or torsional stress cracks).
	DIST	Distortion	Distortion from original location for any element	No distortion.	Elements have minor distortion, but translation or rotation is within the acceptable limits for the element.	Elements have moderate distortion, but translation or rotation is within the acceptable limits for the element OR a structural review has determined the element's functionality or capacity is not compromised.	Elements have distortion such that element's immediate functionality or capacity is affected. Element may also be missing.
	DLSP	Delamination/ spall (partial-depth)	Spalls or delamination in concrete elements or wearing surfaces. Distress does not extend through full thickness of element	No delaminated or spalled areas.	Delaminated. Spall is less than 1 inch in depth or less than 6 inches in diameter. Patched area is sound. Partial-depth pothole in wearing surface.	Spall greater than 1 inch in depth or greater than 6 inches in diameter.	Significant spalls or distress to patched areas is significant enough to affect element's immediate functionality or capacity

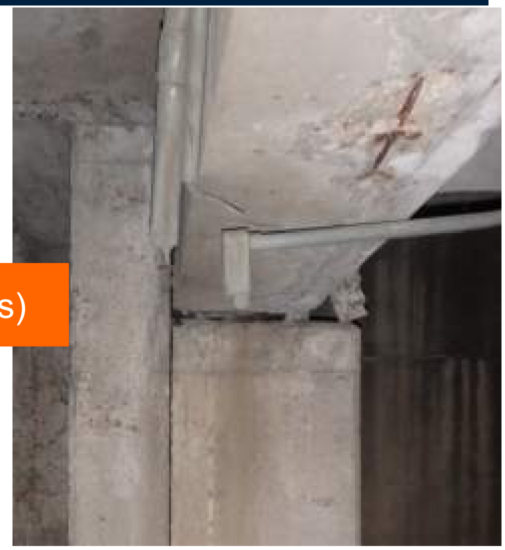
Detailed Descriptions FICAP PG E.2-20

Element Condition Code Examples

Concrete Materials

Code	Condition Name
ABWC	Abrasion wear
CRKC	Cracking
DIST	Distortion
DLSP	Delamination/ spall (partial depth)
DLSF	Delamination / spall (full depth)
EFRS	Efflorescence/ rust staining
EXPR	Exposed reinforcement
EXPS	Exposed prestressing
LSBR	Loss of bearing area
MISS	Missing
PTCH	Patched area
SCOR	Scour
STTL	Settlement
VOID	Voids or Honeycombing

List the Condition Code(s)



Element Condition Code Examples

Concrete Materials

Code	Condition Name
ABWC	Abrasion/ wear
CRKC	Cracking
DIST	Distortion
DLSP	Delamination/ spall (partial-depth)
DLSF	Delamination / spall (full-depth)
EFRS	Efflorescence/ rust staining
EXPR	Exposed reinforcement
EXPS	Exposed prestressing
LSBR	Loss of bearing area
MISS	Missing
PTCH	Patched area
SCOR	Scour
STTL	Settlement
VOID	Voids or Honeycombing

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Element Condition Code Examples

Steel / Metal Materials

Code	Condition Name
CONX	Connection distress
CORR	Corrosion
CRKM	Cracking
DIST	Distortion
LSBR	Loss of bearing area
MISS	Missing
SCOR	Scour
STTL	Settlement

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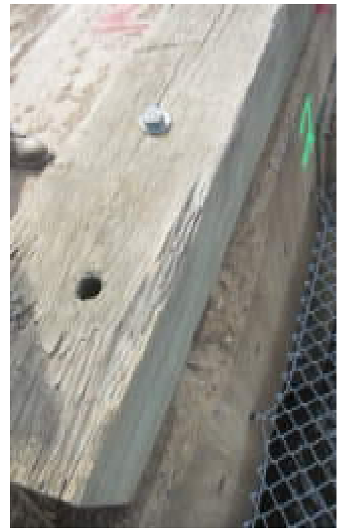
Element Condition Code Examples

Timber Materials

Code	Condition Name
ABWT	Abrasion/wear
CHSH	Check/shake
CONN	Connection damage
DECY	Decay/section loss/infestation
DIST	Distortion
FRCT	Fracture
LSBR	Loss of bearing area
MISS	Missing
SCOR	Scour
SETL	Settlement



Element Condition Code Examples

Fender Systems

Code	Condition Name
BULG	Bulging/ splitting/ tearing
DBIM	Debris impaction
DIST	Distortion
FNFA	Condition of fender facing
FNPN	Condition of fender panel
FNSC	Condition of fender stay chain
MISS	Missing
SCOR	Scour
STTL	Settlement

Module 4.1 Practical Exercise

- Using Appendix D, list the element condition code in the condition code column (there may be more than one)

PE 4.1

Picture	Notes	Element Code	Condition Code	Condition State
		DB-RC		

PE 4.1

Picture	Notes	Element Code	Condition Code	Condition State
		BW-CS		

PE 4.1

Picture	Notes	Element Code	Condition Code	Condition State
		FA-RB		

PE 4.1

Picture	Notes	Element Code	Condition Code	Condition State
		FF-TIM		

PE 4.1

Picture	Notes	Element Code	Condition Code	Condition State
		CL-MT		

PE 4.1

Picture	Notes	Element Code	Condition Code	Condition State
		DU-RC		

PE 4.1

Picture	Notes	Element Code	Condition Code	Condition State
		DU-RC		

PE 4.1

Picture	Notes	Element Code	Condition Code	Condition State
		DB-RC		

PE 4.1

Picture	Notes	Element Code	Condition Code	Condition State
		SF-CS		

PE 4.1

Picture	Notes	Element Code	Condition Code	Condition State
		BD-MT		

PE 4.1

Picture	Notes	Element Code	Condition Code	Condition State
		SF-CS		

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Module 4.2

Element Condition States

Module Objectives

- ✓ Identify damage and deterioration found in PHA elements
- Describe the basis for the four element condition states
- Characterize maritime elements using the four predefined condition states
- Quantify damage and deterioration conditions found in PHA elements
- Document an element's condition state using an Element Inspection Form

Module References

- FICAP Manual Chapter 3: Elements and Element Conditions
- FICAP Manual Appendices
  - C Element Descriptions
  - D, E Condition States Description

Element Condition States

- Four predefined Condition States
  - CS1 (Good)
  - CS2 (Fair)
  - CS3 (Poor)
  - CS4 (Severe)

Element Condition States

- Categorized by
  - Measurable quantity – ABWT CS2: <10% member thickness
  - Functionality – FRCT CS4: "enough to affect functionality"
  - Visual appearance – CORR CS2: "freckled rust"
- "Soft words"
  - Minor, moderate, severe
  - Document condition (picture) and describe general use

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Element Condition States

- Damage or Deterioration
  - Type
  - Severity
  - Scope

Damage Type is described by Condition Code

Code	Condition	Definition	Example Reinforced Concrete Condition States CS1 (Good)	CS2 (Fair)	CS3 (Poor)	CS4 (Severe)
ABWC	Abrasion / Wear (Concrete)	Abrasion or wear in concrete elements (RC, PC, PS, or UC)	No observable abrasion or wear	Coarse aggregate is exposed but remains secure in concrete matrix	Coarse aggregate has been exposed and is loosened from concrete matrix due to wear	N/A
CRKC	Crack (Concrete)	Cracking in concrete elements (RC, PC, PS, or UC)	Insignificant cracks or moderate-width cracks that have been sealed.	Unsealed moderate-width cracks or moderate map cracking.	Wide cracks (excluding shear-type cracks) or severe map cracking.	Wide shear cracks or other cracks that could impact capacity of the element
DLSP	Delamination / Spall	Spalls or delaminations in concrete elements (RC, PC, PS, or UC)	No delaminations or spalled areas	Distressed area less than 1 foot in length or width, and depth not in excess of first layer of reinforcement	Distressed areas less than 5 feet in length or width and not in excess of first layer of reinforcement	Distressed areas exceed 5 feet in length of width or deeper than first layer of reinforcement
EXPR	Exposed Reinforcement	Exposed conventional reinforcement in concrete elements (RC, PC, PS, or UC). Excludes pre-stress strands.	No exposed reinforcement	Present without measurable section loss.	Present with measurable section loss.	Present with measurable section loss that could impact capacity of element.

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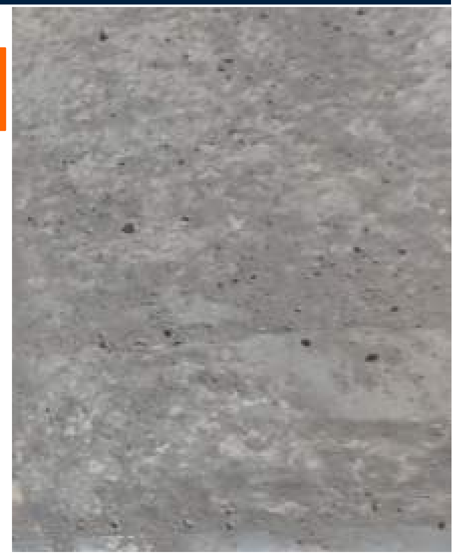
Element Condition State Examples

List the Condition State
ABWC

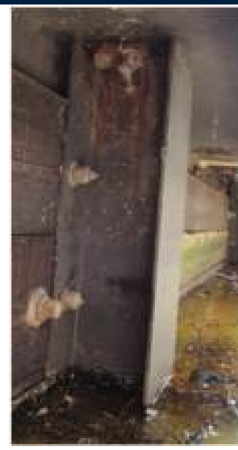


Element Condition State Examples



List the Condition State
BULG

Element Condition State Examples



List the Condition State
CORR

Element Condition State Examples




List the Condition State
CRCK

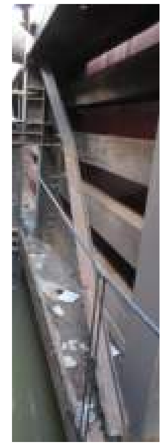
Element Condition State Examples

List the Condition State
CRKC

Element Condition State Examples

List the Condition State
CONX

Element Condition State Examples



List the Condition State
DIST

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Element Condition State Examples

List the Condition State
DECY

Element Condition State Examples

List the Condition State
DLSP

Element Condition State Examples

List the Condition State
EFRS

Element Condition State Examples

List the Condition State EXPR

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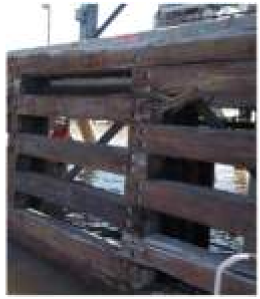
Element Condition State Examples



List the Condition State
FNFA

Element Condition State Examples

List the Condition State
MRFT

Module 4.2 Practical Exercise

- Using Appendix D, list the element condition state in the condition state column (there may be more than one condition state).

PE 4.2

Picture	Notes	Element Code	Condition Code	Condition State
		DB-RC	DLSP EXPR PTCH	

PE 4.2

Picture	Notes	Element Code	Condition Code	Condition State
		BW-CS	CORR	

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PE 4.2

Picture	Notes	Element Code	Condition Code	Condition State
		FA-RB	BULG	

PE 4.2

Picture	Notes	Element Code	Condition Code	Condition State
		FF-TIM	FNFA	

PE 4.2

Picture	Notes	Element Code	Condition Code	Condition State
		CL-MT	MRFT	

PE 4.2

Picture	Notes	Element Code	Condition Code	Condition State
		DU-RC	DLSP EXPR	

PE 4.2

Picture	Notes	Element Code	Condition Code	Condition State
		DU-RC	DLSP EXPR	

PE 4.2

Picture	Notes	Element Code	Condition Code	Condition State
		DB-RC	CRKC	

PE 4.2

Picture	Notes	Element Code	Condition Code	Condition State
		SF-CS	CORR	

PE 4.2

Picture	Notes	Element Code	Condition Code	Condition State
		BD-MT	MRFT	

PE 4.2

Picture	Notes	Element Code	Condition Code	Condition State
		SF-CS	DIST	

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Module 4.3

Documenting Element Condition States

Module Objectives

- ✓Identify damage and deterioration found in PHA elements
- ✓Describe the basis for the four element condition states
- ✓Characterize maritime elements using the four predefined condition states
- ✓Quantify damage and deterioration conditions found in PHA elements
- Document an element's condition state using an Element Inspection Form

Module References

- FICAP Manual Chapter 3: Elements and Element Conditions
- FICAP Manual Chapter 8 Section 6: Element Inspection Forms
- FICAP Manual Appendices
  - C Element Descriptions
  - D, E Condition States Description

Documenting Element Condition States

- Element Inspection Forms
  - For each element instance in a component
  - Archival Record
  - Two Parts
    - – Component Summary Table
    - – Element Detail Table

Documenting Element Condition States

- Element Inspection Forms
  - Component Summary Tables
    - Structural
    - Berthing
    - Ancillary

Structural Components: Condition State Summary

Component	Element Group	Units	Condition State Code	Total Quantity	Inaccessible	CS1	CS2	CS2 [NC]	CS3	CS3 [NC]	CS4	CS4 [NC]
Deck	DT	SF	–	48178	48178	–	–	–	–	–	–	–
	DT Total			48178	48178	–	–	–	–	–	–	–
	DU	SF	–	33183	10389	15161	–	–	–	–	–	–
			CORR	–	–	17	15	–	–	–	–	–
			CRKC	–	261	40	254	–	30	–	–	–
			DLSF	–	–	–	–	–	15	–	58	–
			DLSP	–	6	432	693	[432]	[illegible]	[972]	[illegible]	[596]
			EFRS	–	–	–	247	[149]	17	–	–	–
			EXPR	–	–	–	385	[631]	862	[illegible]	722	[illegible]
			PTCH	–	83	140	736	[138]	401	[illegible]	–	[129]
	DU Total			33183	10739	15790	2330	[1350]	2653	[illegible]	[illegible]	[1474]

Documenting Element Condition States

- Element Inspection Forms
  - Element-by-Element Observations

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Documenting Element Condition States

- Photos
  - Representative samples of conditions
  - Submit to database
    - – JPEG
    - – 2048 pixels
    - – Name: AssetID_InspectorFirstInitialLastName-YYYMMDD_seqNo.jpg

Element Condition – Example

- What is the damage
  - Type
  - Severity
  - Quantity

How do we quantify multiple conditions?


Photo Courtesy Joshua White

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Element Conditions

- Multiple Condition States in same location
- Example – Concrete Deck (DK001)
  - 20 sf spall (DSLP) – CS3
  - 20 sf exposed rebar (EXRB) – CS2
    - Recorded but not in CS total

Element Location ID	Element / Condition Code	Units	Total Quantity	In-accessible	Condition States (quantity [counted with other CS])			
					CS1	CS2	CS3	CS4
DT12-1	DK001	SF	400	0	380	0	20	0
	– DLSP	*SF*	*20*				20	*0*
	– EXRB	*SF*	*20*			*0[20]*		
Deck Subtotal	**DK001**	**SF**	**400**	**0**	**380**	**0**	**20**	**0**

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Element Condition – Example

- Photographs
  - JPEG
  - 2048 pixels on longest edge
  - Naming scheme

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Documenting Element Condition States

- Protective Layers – Coatings and Jackets
  - CS4 assumed prior to degradation of underlying element
  - Condition associated with underlying element
  - Never are controlling condition states
  - Always marked with brackets

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Module 4.3 Practical Exercise

- Elemental Inspection Form
- See attached handout

Module 4.3 Practical Exercise

- Deck Element Record done
- Start with Individual Element Records (at end of form)
- Fill out tables based on photos from field sheets

Element Records

Table 1. Structural Component - Deck Element Observations

Element ID			Element / Condition Code	Unit	Total	Inacc	Condition State [NC]				Photos	Comments
Type	Bay	No.					CS1	CS2	CS3	CS4		
DT	11	1	CRKC	SF	1488				4		747-001	12”x4’ crack
DU	12	1	DLSP	SF	1488				4		747-002	
DU	12	1	EXPR	SF	1488			[4]			747-002	
DU	15	1	EXPR	SF	1488			[6]			747-004	
DU	15	1	DLSP	SF	1488				6		747-004	
DT	13	1	ABWC	SF	1488			324			747-005	
DT	14	1	ABWC	SF	1488			324			747-005	

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PE 4.3 Ex. – DU Element Records

Field Sheet Extracts

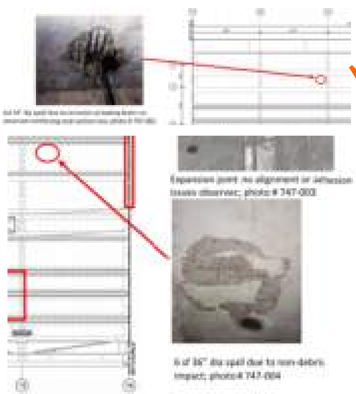

Table 1. Structural Component - Deck Element Observations

Element ID			Element / Condition Code	Unit	Total	Inacc	Condition State [NC]				Photos	Comments
Type	Bay	No.					CS1	CS2	CS3	CS4		
DT	11	1	CRKC	SF	1488				4		747-001	12"x4' crack
DU	12	1	DLSP	SF	1488				4			
DU	12	1	EXPR	SF	1488			[4]				
DU	15	1	EXPR	SF	1488			[6]				
DU	15	1	DLSP	SF	1488				6			
DT	13	1	ABWC	SF	1488			324			747-005	
DT	14	1	ABWC	SF	1488			324			747-005	

These need to be summarized in Element Condition Summary by Component

Module 4.3 Practical Exercise

- After Element Record Complete
- Complete Summary Tables (at front of form)
- Element Records are totaled by condition and condition state

Element Condition Summary by Component

STRUCTURAL COMPONENT - DECK ELEMENTS

Element Location ID	Element Descriptor	Condition	CS1	CS2	CS3	CS4	Condition Quantity	Unit
DT-RC	Reinforced Concrete Deck Topside (SF)		Complete this part					
		Total						
DU-RC	Reinforced Concrete Deck Underside (SF)	NONE	7430				7430	SF
		DLSP			10		10	SF
		EXPR		[10]			0	SF
		Total	7430		10		7440	SF

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PE4.3 Situation. Continuing your completion of the CD 23 Unit B inspection forms from Module 3, you note that the Element Inspection forms for the Unit B, Deck, Superstucture, Substructure, Joint, Bulkhead, Fender, and Mooring Component Elements are missing, and you must complete them using the field data sheets used during the inspection.

Task. Complete the attached element inspection form for CD 23 Unit B, Deck, Superstucture, Substructure, Joint, Bulkhead, Fender, and Mooring Component Elements using what you know from the following documents in your possession.

- The CD23 Inventory Record (Corrected from Module 3 and attached)
- The CD23 Unit B Inspection Summary (Corrected from Module 3 and attached)
- The CD23 Unit B field inspection sheets (attached)

Note: since you are completing the forms based on a review of the field data sheets, list only elements that you have pictures for and do not complete the column labelled inaccessible since you are not yet sure which areas are inaccessible. The DU-RC and CL-MT have been completed for you as examples (you still need to complete the DT-RC element Condition Summary by Component).

Maritime Asset
Element Inspection Form

Property:	Turning Basin North	**Asset ID:**	CD 23 Unit B
Inspection Type:	☒ Baseline ☐ Routine ☐ Due Diligence	**Inspection Date(s):**	FEB 29, 2017
Inspection Team:	Inspections R Us, Sponge Bob Square Pants Inspectors		
Structural Component(s):	☒ Deck ☐ Slab ☒ Superstructure ☒ Substructure ☐ Bearings ☒ Joints ☒ Bulkhead		
Berthing Component(s):	☒ Fender Systems ☒ Mooring Systems		
Shoreline Component(s):	☐ Protected Shoreline ☐ Unprotected Shoreline		
Ancillary Component(s):	☐ Crane and Train Rails ☐ Guards ☐ Paint and Markings ☐ Personnel Access Systems ☐ Utility Systems		

Contents

Summary Table 1. Structural Components Condition States

Element Location ID	Element Descriptor	Condition	Condition State CS1	CS2	CS3	CS4	Condition Quantity	Unit
DT-RC	Reinforced Concrete Deck Topside (SF)							
		Total						
DU-RC	Reinforced Concrete Deck Underside (SF)	NONE	7430				7430	SF
		DLSP			10		10	SF
		EXPR		[10]			0	SF
		Total	7430		10		7440	SF

STRUCTURAL COMPONENT - SUPERSTRUCTURE ELEMENTS

Element Type	Description	Condition	Condition State CS1	CS2	CS3	CS4	Condition Quantity	Unit
DB-RC	Reinforced Concrete Deck Beam (LF)							
		Total						

STRUCTURAL COMPONENT - SUBSTRUCTURE ELEMENTS

Element Type	Description	Condition	Condition State CS1	CS2	CS3	CS4	Condition Quantity	Unit
CO-RC PS-RC	Reinforced Concrete Columns/Pilasters (LF)							
SW-RC	Reinforced Concrete Shear Wall							
		Total						
PC-RC	Reinforced Concrete Pile Cap							
		Total						
DS-RC	Reinforced Concrete Drilled Shaft							
		Total						
ST-RC	Reinforced Concrete Strut							
		Total						

STRUCTURAL COMPONENT - JOINT ELEMENTS

Element Type	Description	Condition	Condition State CS1	CS2	CS3	CS4	Condition Quantity	Unit
JN-AU	Armored Open Expansion Joint (LF)							
		Total						

STRUCTURAL COMPONENT - BULKHEAD ELEMENTS

Element Type	Description	Condition	Condition State				Condition Quantity	Unit
			CS1	CS2	CS3	CS4		
BW-CS	Carbon Steel Bulkhead Wall							
		Total						
BW-RC	Reinforced Concrete Bulkhead Wall							
		Total						
PC-RC	RC Bulkhead Pile Cap							
		Total						
BB-CS	Carbon Steel Bulkhead Wale Beam							
		Total						
BT-CS	Carbon Steel Bulkhead Tie Rod							
		Total						

BERTHING COMPONENT - FENDER ELEMENTS

Element Type	Description	Condition	Condition State				Condition Quantity	Unit
			CS1	CS2	CS3	CS4		
FP-CS	Carbon Steel Fender Pile							
		Total						
FF-TIM	Timber Facing (EA)							
		Total						
SF-CS	Carbon Steel Secondary Framing							
		Total	0			1		LF
FA-01	OTH Cylindrical Rubber Fender Absorption Unit (EA)							
		Total						

BERTHING COMPONENT - MOORING ELEMENTS

Element Type	Description	Condition	CS1	CS2	CS3	CS4	Condition Quantity	Unit
CL-MT	Metal Cleat (EA)	NONE	1				1	EA
		MRFT		1			1	EA
		Total	1	1			2	EA

SHORELINE COMPONENT ELEMENTS

Element Type	Description	Condition	CS1	CS2	CS3	CS4	Condition Quantity	Unit
		Total						

ANCILLARY ELEMENTS

Element Type	Description	Condition	CS1	CS2	CS3	CS4	Condition Quantity	Unit
		Total						

PROTECTIVE ELEMENTS

Element Type	Description	Condition	CS1	CS2	CS3	CS4	Condition Quantity	Unit
		Total						

Element Records

Table 1. Structural Component - Deck Element Observations

Element ID			Element / Condition Code	Unit	Total	Inacc	Condition State [NC]				Photos	Comments
Type	Bay	No.					CS1	CS2	CS3	CS4		
DT	11	1	CRKC	SF	1488				4		747-001	12”x4’ crack
DU	12	1	DLSP	SF	1488				4		747-002	
DU	12	1	EXPR	SF	1488			[4]			747-002	
DU	15	1	EXPR	SF	1488			[6]			747-004	
DU	15	1	DLSP	SF	1488				6		747-004	
DT	13	1	ABWC	SF	1488			324			747-005	
DT	14	1	ABWC	SF	1488			324			747-005	

Table 4. Structural Component - Superstructure Elements

Element ID			Element / Condition Code	Unit	Total	Inacc	Condition State [NC]				Photos	Comments
Type	Bay	No.					CS1	CS2	CS3	CS4		

Table 5. Structural Component - Substructure Elements

Element ID			Element / Condition Code	Unit	Total	Inacc	Condition State [NC]				Photos	Comments
Type	Bay	No.					CS1	CS2	CS3	CS4		

Table 6. Structural Component - Bearing Elements

Element ID			Element / Condition Code	Unit	Total	Inacc	Condition State [NC]				Photos	Comments
Type	Bay	No.					CS1	CS2	CS3	CS4		

Table 7. Structural Component - Joint Elements

Element ID			Element / Condition Code	Unit	Total	Inacc	Condition State [NC]				Photos	Comments
Type	Bay	No.					CS1	CS2	CS3	CS4		

Table 8. Structural Component - Bulkhead Elements

Element ID			Element / Condition Code	Unit	Total	Inacc	Condition State [NC]				Photos	Comments
Type	Bay	No.					CS1	CS2	CS3	CS4		

Table 9. Berthing Component - Fender Elements

Element ID			Element / Condition Code	Unit	Total	Inacc	Condition State [NC]				Photos	Comments
Type	Bay	No.					CS1	CS2	CS3	CS4		

Table 10. Berthing Component - Mooring Elements

Element ID			Element / Condition Code	Unit	Total	Inacc	Condition State [NC]				Photos	Comments
Type	Bay	No.					CS1	CS2	CS3	CS4		
CL	12	1	MRFT	EA	1			1			747-017	

Table 11. Shoreline Component Elements

Element ID			Element / Condition Code	Unit	Total	Inacc	Condition State [NC]				Photos	Comments
Type	Bay	No.					CS1	CS2	CS3	CS4		

Table 12. Ancillary Component Elements

Element ID			Element / Condition Code	Unit	Total	Inacc	Condition State [NC]				Photos	Comments
Type	Bay	No.					CS1	CS2	CS3	CS4		

Table 13. Protective Component Elements

Element ID			Element / Condition Code	Unit	Total	Inacc	Condition State [NC]				Photos	Comments
Type	Bay	No.					CS1	CS2	CS3	CS4		

Property:	Turning Basin North	**Asset ID:**	CD 23 Unit B
Asset Type:	Wharf	**Year of Original Construction:**	1963
Asset Description:	Open Air Wharf	**Year(s) of Significant Modifications or Repairs[1]:**	1989, 1990, 1998
Wharf Usage:	Break bulk, open	**Date of Last Inventory Record Update:**	
Inspection Frequency:	Above water: 3 yr Underwater: 6 yr		

Asset Geometric Data

Area (sf):	Wharf Deck: 41,538 Apron: 137,712 Total: 179,250	**Deck Elevation above MLT:**	14 ft. 9 in.
Structure Length:	602 ft.	**Channel Depth at Fender:**	36 ft. 0 in.
Structure Width:	Deck: 69 ft. Apron: 228 ft.	**Channel Depth at Bulkhead:**	4 ft. 5 in.

Structure Load Rating

Uniform Load	750 psf	**Railroad:**	3 active lines, Cooper E-80
Shore Crane:	300T	**Truck Rating:**	HS20-44
Fender Design (Max. Vessel):	37 kips (cleats)		

Structure History

The wharves along the Turning Basin and Manchester Terminals were constructed at various time periods ranging from the 1910s to 1980s. The wharf known as CD 23 is located toward the center of the Turning Basin Terminal on the northeast side of the Houston Ship Channel. The original drawings for CD 23 are dated 1961, and the wharf was reportedly constructed in 1963. In 1990, the original fender system consisted of timber framing was replaced with a steel-framed fender system and significant[1] concrete repairs were made. The concrete repairs included shotcrete repairs to approximately 1,400 square feet (sq. ft.) of deck underside and approximately thirty wall and column locations. In addition, eighteen of the harbor line strut beams were demolished and replaced with new 18-inch by 18-inch beams cast on top of the pile cap beams. The front pilasters typically were repaired at the ends of the new strut beams, and seven concrete piles were repaired.

Additional minor repairs to small portions of the wharf deck were made in 1996, 1997, 1998, 2000, 2002, and 2003.

[1] Significant modifications: Work that altered the structure's footprint or changes structural components.
Significant repairs: Repair work in excess of 10 percent of the area or length of a structural component.

Reference Drawing List

Drawing Set	Title	Date	Description
C123-34	Wharves 23, 24 & 25 Prop. 1	30 Jun 1961	Original Construction Drawings
C123-8	Repair of Wharf and Fender System at Wharves 23, 24, & 25	21 Mar 1990	Deck/Beam Repair and Fender Replacement

Structural Components & Elements

Component / Element(s)	**Description**
Deck (DK)	Reinforced concrete deck, 6 feet wide, spanning across reinforced concrete beams
RC Deck	One-way reinforced slab, 8-inch thick, continuous span
Slab (SL)	Slab extending 228 feet landward from deck
RC Slab	Reinforced concrete slab on grade, 6 inches thick
Superstructure (SP)	Deck beams spanning between shear walls.
RC Deck Beam	46 inches deep overall and vary in width from 18 inches at the bottom to 24 inches at the top. The beams are aligned parallel to the harbor line and are generally located beneath the rails for the railroad tracks and the gantry crane; as a result, the center-to-center spacing of these beams varies from 4 feet, 11-1/4 inches at the railroad tracks to as much as 9 feet, 1-1/2 inches in between
Substructure (SB)	Reinforced concrete bents generally consist of a shear wall and column supported on a reinforced concrete pile cap beam, tying together the tops of six belled drilled piers. Except at the bays south of the expansion joints, adjacent bents are tied together by strut beams located at the top of the pile cap beams.
RC Columns/Pilasters	18-inch by 18-inch reinforced concrete column
RC Shear Wall	Reinforced concrete wall, 12-inch thick
RC Pile Cap	Reinforced concrete pile cap, 3-foot, 4-inch wide by 3-foot deep.
RC Drilled Shaft	29- or 30-inch diameter shafts, with bell diameters varying from between 58 and 90 inches, depending on footing location.
RC Strut	Reinforced concrete beams 14 inches wide by 20 inches deep along Grid Lines B through E, and 18 inches wide by 27 inches along Grid Line A at the harbor line. Strut beams were also provided along Grid Line A at the bays south of the expansion joints, although these beams are jointed at their south end to accommodate the movement of the expansion joint.
Bearings (BR)	None

Component / Element(s)	**Description**
Joints (JN)	Two at column lines 11 and 16
Open Expansion Joint	1-inch wide; armored with 2-1/2 x 2-1/2/x 3/8 steel angles
Bulkhead (BH)	Steel sheet pile wall except for a length of approximately 75 feet from Bent 1 to beyond Bent 4 where the bulkhead wall is constructed of concrete.
CS Bulkhead Wall	BZ IIIB sheet piling
RC Bulkhead Wall	one foot thick
RC Bulkhead Pile Cap	2-foot, 6-inch wide by 1-foot, 4-inch deep reinforced concrete beam cast monolithically with the wharf deck
CS Bulkhead Wale Beam	Concrete-encased, double-channel steel whaler
CS Bulkhead Tie Rod	3-inch diameter anchor rods typically spaced at approximately 10 feet on center

Berthing Components & Elements

Component / Element(s)	**Description**
Fender (FN)	Steel fender pile system with timber facing
CS Fender Pile	Steel H-piles
CS Support Framing	Additional steel framing (horizontal and diagonal) bolted onto the harbor side face of the piles connected with pins at bents 1, 11, 16, and 26.
TIM Facing	Six rows of 12x12 timbers installed alternatingly across the face of the fender system
OTH Cylindrical Rubber Fender Absorption Unit	18-inch diameter, 27-inch long rubber bearing
Mooring (MR)	Description of Mooring System
– MT Cleat	8 forged cleats along located approximately 22 inches to 24 inches from the harbor line, and each was connected to the slab by a group of six anchor rods. The anchor rods typically extended through a thickened section of the deck slab and were secured to the wharf by plate washers and nuts. The anchor rod diameters ranged from 1 to 1-1/4 inches.

Shoreline Components & Elements

Component / Element(s)	**Description**
Protected Shoreline	Riprap
Unprotected Shoreline	None observed.

Ancillary Components & Elements

Component / Element(s)	**Description**
Utility Systems	See original drawings.
Paint and Markings	None observed
Guards	None observed
Crane and train rails	See original drawings
Personnel access systems	See original drawings

Figures

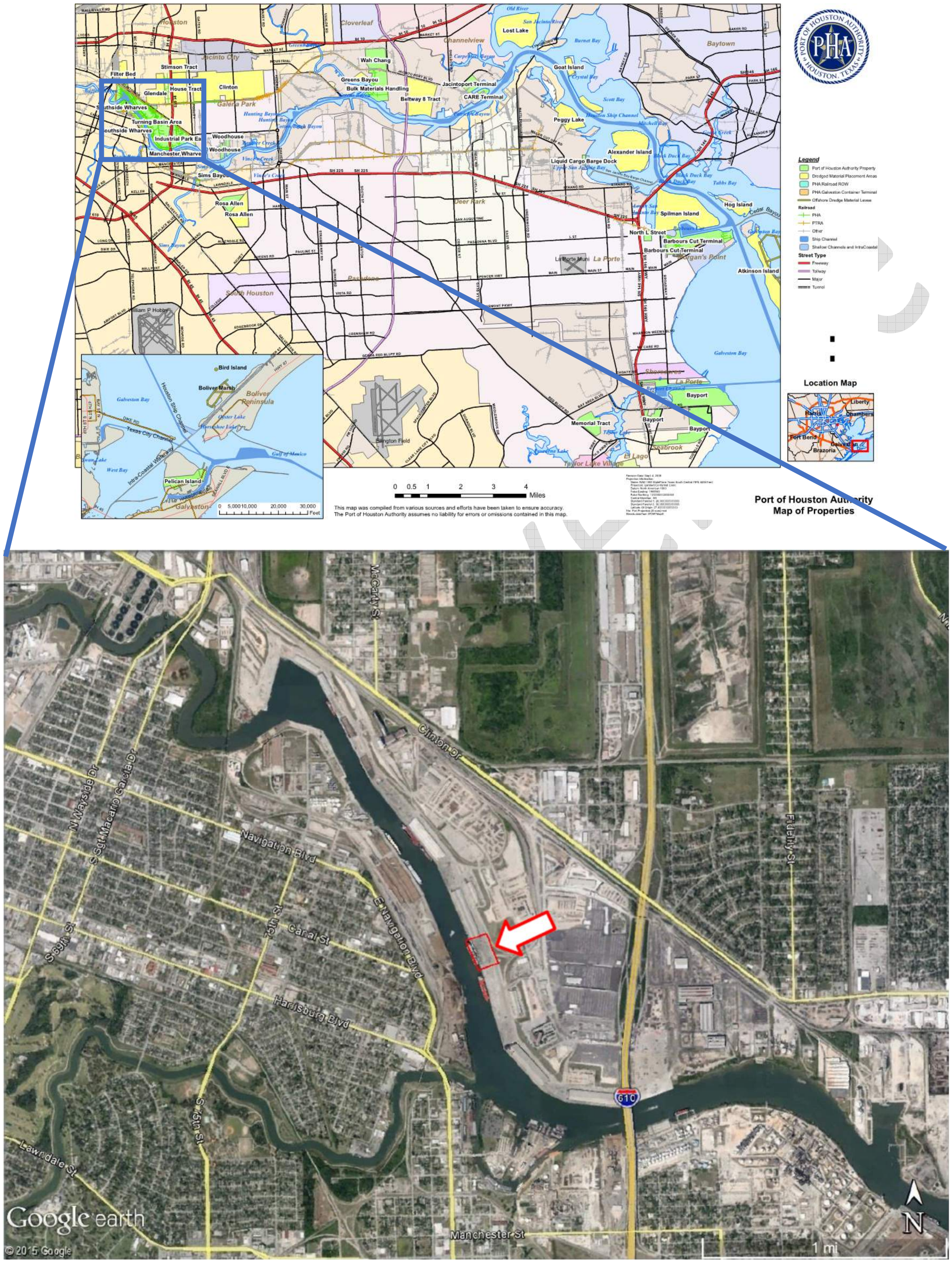

Figure 1. Structure Location

Figure 2. Aerial view of structure and immediate vicinity.

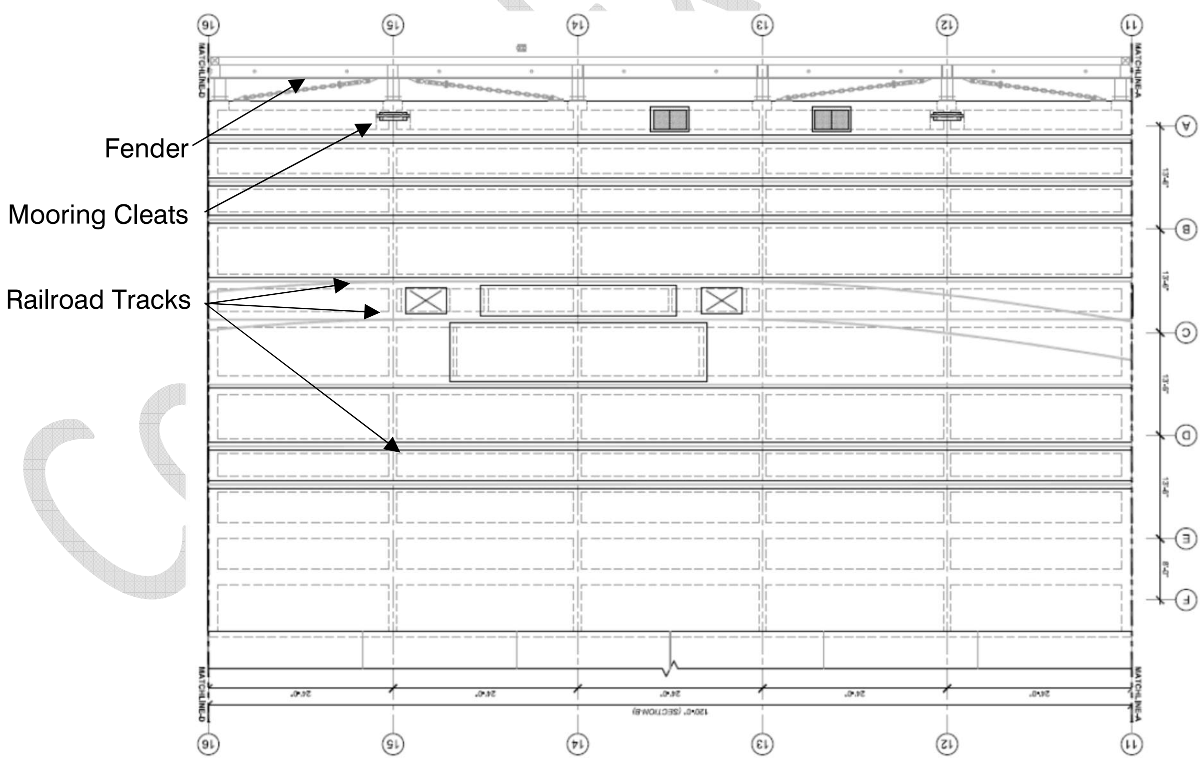

Figure 3. Typical Partial Plan of Structure.

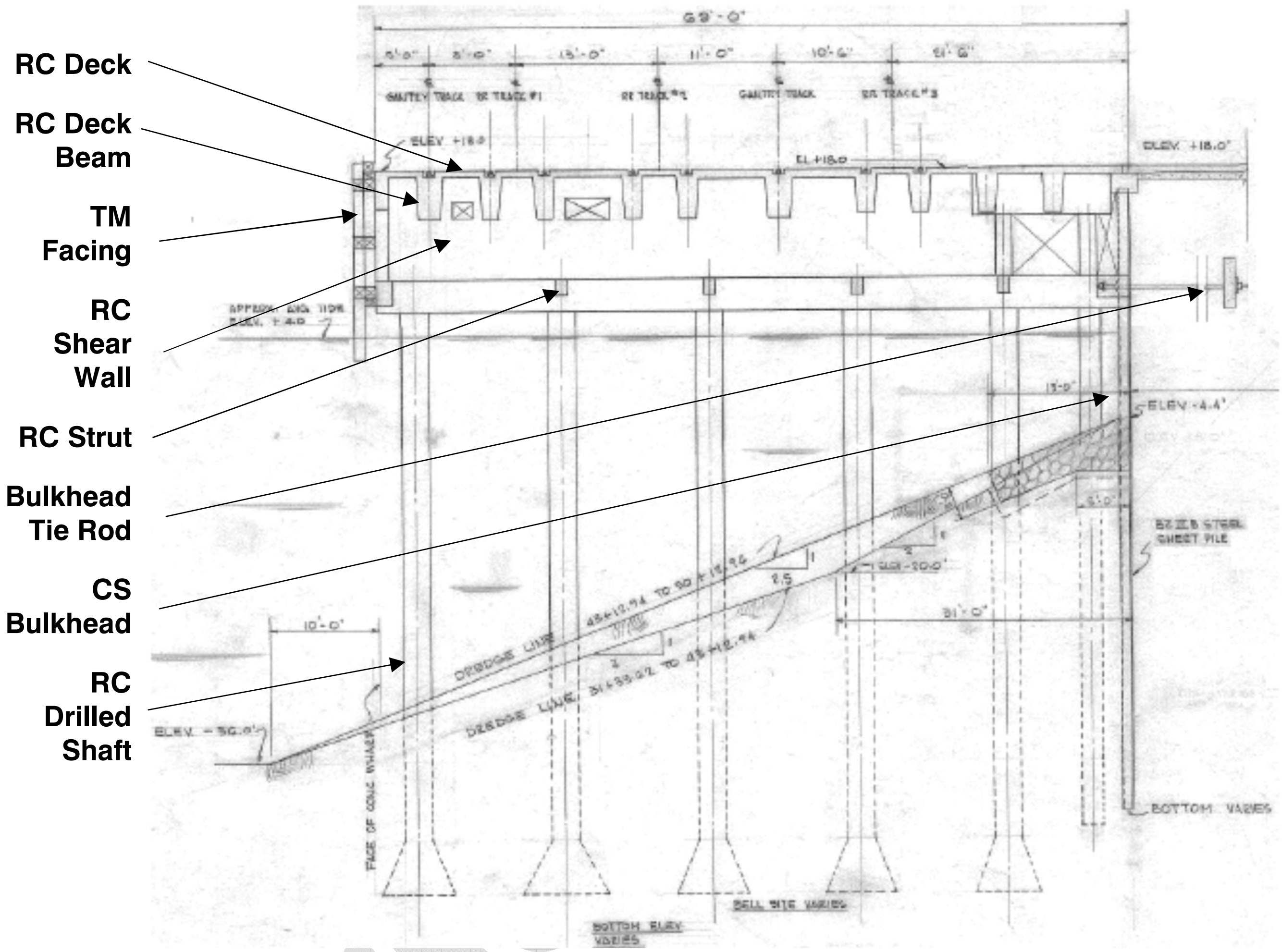

Figure 4. Typical Section through Structure.

Revision History

Rev. No.	Reported by:	Date	Verified by	Date	Comments

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Property:	Turning Basin North	**Asset ID:**	CD 23 Unit B
Inspection Type	☐ Baseline ☐ Routine ☐ Special	**Inspection Date(s):**	
Scope of Inspection	Unit B; Bays 11 - 15		
Inspection Firm(s):	**Prime**: Inspections R Us		
	Underwater: Sponge Bob Square Pants Inspectors		
	Other (role): N/A		
Reported By:		**Report Date:**	[Publish Date]
FICAP Manual Version/Date:	February 2017	**Variances from FICAP Procedure:**	None

Seal of Responsible Engineer

I hereby certify this inspection was performed under my direct supervision and control and to the best of my professional knowledge complies with the FICAP Manual and applicable codes.

Signed:______________________________

Name:______________________________

Texas License No.:______________________________

Date:______________ Expires: ______________

Seal

Inspection Team Members

Project Manager:
Inspection Team Leader(s):
Inspection Team Members: Larry, Daryl, and Daryl

Underwater Team Leader: Joe Smith
Underwater Team Member: Jim Adams

Overall Asset Condition

The baseline inspection of Unit B utilized visual and sounding surveys, non-destructive testing techniques, and sampling and laboratory testing to establish the existing condition of the wharf. This study found significant distress to the topside of the wharf deck slab, including apparent corrosion and impact damage, widespread cracking and high corrosion potentials on the strut beams, and generally localized corrosion-related damage elsewhere in the structure. Other items of concern noted included leakage at construction and expansion joints and around drains, and shear cracking in some deck beams.

Corrosion-related damage was found to be related to chloride intrusion at the portions of the walls, columns, pilasters, and pile cap beams directly exposed to the channel water, particularly in the splash zone, and at the deck topside. Otherwise, corrosion-related deterioration is related to carbonation. Structural analyses performed for load rating the wharf found that the current load rating is accurate but that upgrading the wharf to a uniform load rating of 1,200 psf as desired by PHA would only require strengthening selected deck beams, particularly at the two lines of beams not located at the crane or train rails. Service life analyses found that the structural elements of the wharf generally have at least 50 more years of service life, except at the deck slab, strut beams, and vertical faces of the deck beams where the concrete cover is reduced.

The steel elements of CD 23 are also in generally good condition. The steel sheet piling for the bulkhead wall exhibits localized surface corrosion along the top and bottom edges of its exposed section. Corrosion of the steel fender elements was localized but severe in some instances, and a few bent or damaged members were identified. The timber lagging exhibits damage and deterioration in a number of locations. Overall, the fender system is in good condition.

Structural Component Ratings and Element Summary

Component / Element(s)	Rating	Comments
Deck		*Add Narrative:*
RC Deck Topside		Overall, approximately 30 percent of the deck topside was identified as delaminated or spalled. The topside of the concrete deck was generally scarred and gouged from mechanical impact, with gouges up to 1 inch deep.
RC Deck Underside		All -five exhibited concrete delamination or spalls. Some of these delaminations were observed to occur randomly within the field of the deck, but most delaminations and spalls were concentrated along deck construction joints, cracks, and penetrations. On average, approximately 7 percent of the deck underside exhibited spalls or delaminations.
Slab		
RC Slab		Not inspected
Superstructure		*Add Narrative:*
RC Deck Beam		Approximately 25% of the beams were in good condition, and about 75% of the deck beams were rated as fair condition. The distress in these beams mainly consisted of random small spalls and delaminations on the vertical or bottom faces of the beam (Figure 5). Most beams exhibited a horizontal crack along the top of the beam near the beam-to-deck transition (Figure 6), and some exhibited shear cracking (Figure 7).

Structural Component Ratings and Element Summary (continued)

Component / Element(s)	Rating	Comments
Substructure		*Add Narrative:*

RC Columns/Pilasters	Approx. 75% of columns and pilasters had some concrete delamination or spalls (fair to poor). Column F11 was noted to exhibit more than 50% section loss (severe) of the longitudinal corner reinforcement exposed by spalling (Figure 8). Pilaster A16 and Columns F11 and F16 were observed to have cracking and spalling at the bearing area where the deck girders and beams are supported (Figure 9) resulting in severe loss of bearing.
RC Shear Walls	Spalling and delamination were frequently observed at the bottom of the walls above the pile cap (Figure 10). Spalling and delamination (fair to poor condition) was observed on approximately 80% of the shear walls. Delaminations have exposed reinforcement (fair to poor) over approximately 60% of wall length.
RC Pile Caps	Pile caps exhibited top surface delamination (fair) over approximately 25% of length (Figure 11).
RC Drilled Shaft	Generally, the piers and collars were in good condition. No scour was reported.
RC Strut	In 55 percent of the strut beams, longitudinal cracking (fair to poor) was observed to extend for at least half of the strut beam length.
Bearings	None
Joints	*Add Narrative:*
Armored Open Expansion Joint	The armor was gouged along column line 16 but otherwise adhered and aligned (good cond). Joint was undamaged along column line 11 (good).

Structural Component Ratings and Element Summary (continued)

Component / Element(s)	Rating	Comments
Bulkhead		*Add Narrative:*
CS Bulkhead Wall		Evidence of previous moderate to severe pitting of the sheet piling was generally visible in the bottom 12 inches of the exposed portion of sheet piles above wale beam (Figure 12). Section loss is generally minor to moderate (fair condition).
RC Bulkhead Wall		Not inspected
RC Bulkhead Pile Cap		Not inspected
CS Bulkhead Wale Beam		The concrete encasement for the tieback whaler along the bulkhead wall exhibited minor surface spalls and delamination along the top edge at some locations, as shown in Figure 13. Fair condition along entire length.
CS Bulkhead Tie Rod		Not inspected

Berthing Component Ratings and Element Summary

Component / Element(s)	Rating	Comments
Fender System		*Add Narrative:*
CS Fender Pile		Isolated moderate to severe corrosion of fender piles within the splash zone in all bays.
CS Support Framing		Isolated moderate to severe corrosion of fender support elements within splash zone for all bays (from bottom element to 36 in. above). Buckled or distorted fender elements noted in 4 locations. Fractured bottom connection of diagonal brace (severe corrosion) in Bay 6-7. Severe corrosion and failed connections at pinned connections at Bent 11 and 16 (Figure 14)
TIM Facing		Moderate to severe wood decay/splitting of timber lagging elements in 4 bays. Severe impact damage fractured lagging observed at 4 locations. Lagging missing at 10 locations (primarily bottom 2 rows). Moderate to severe corrosion of anchor bolts/nuts in splash zone.
OTH Cylindrical Rubber Fender Absorption Unit		Tears or severe cracking in rubber dampers at Bents 18, and 19, moderate cracks in dampers at Bents 9 and 20.
Mooring System		*Add Narrative:*
MT Cleat		Minor surface corrosion and coating failure were observed at all cleats. Moderate corrosion of plate washers for cleat anchor rods noted at all cleats.

Figures

Figure 5. Beam bottom spall and delamination

Figure 6. Crack at beam to deck transition

Figure 7. Deck beam shear crack

Figure 8. Column F11 spall

Figure 9.Cracking and spalling column F11

Figure 10. Spalling at RC Shear Wall

Figure 11. Pile cap beam delamination

Figure 12. Pitted Sheet Pile Wall

Figure 13. Delamination on tieback whaler

Figure 14. Bent 11 secondary framing pinned connection

Figure 15. Typical wharf log distress

Rating Abbreviations

N/A: Component not applicable to structure.
NI: Not inspected

Rating Definitions

Ratings for Structural and Berthing Components

Rating	Description
6 Good	Minor or no problems noted. Also applies to newly constructed or rehabilitated components.
5 Satisfactory	Minor defects, damage or deterioration - not extensive.
4 Fair	Extensive minor or limited moderate defects, damage or deterioration. Structural capacity of primary structural components and functional use of fender or mooring systems are not affected.
3 Poor	Moderate or extensive defects, damage or deterioration that affects structural capacity of primary structural components or functional use of fender or mooring system components.
2 Serious	Defects, damage or deterioration significantly reduces structural capacity of primary structural components or reduces functional use of fender or mooring systems.
1 Critical	Advanced defects, damage or deterioration with localized failure(s) of components imminent or observed. Immediate load or use restrictions, including closing of the asset should be considered.
Applicable Component Types: Deck, superstructure, substructure, bearings, bulkheads, mooring and fender systems.	

Ratings for Shoreline Components

Rating	Description
6 Good	Minor or no problems noted. Also applies to newly constructed or rehabilitated shoreline components.
5 Satisfactory	Minor defects, damage or deterioration - not extensive.
4 Fair	Protected shoreline: Extensive minor or limited moderate defects, damage or deterioration observed but does not affect shoreline protection. Unprotected shoreline: Extensive minor or limited moderate indications of shoreline beginning to slump. May be minor movement of shoreline.
3 Poor	Protected shoreline: Moderate or extensive deterioration or displacement that affects shoreline protection. Unprotected shoreline: Moderate or extensive indications of shoreline slumping or movement.
2 Serious	Protected shoreline: Deterioration, displacement, or breakage significantly affects the shoreline protection and local failures are possible. Unprotected shoreline: Shoreline is being eroded. Local slump or embankment failures are present. Use restrictions may be necessary for roadways, railways and working areas near shoreline.

1 Critical	Protected shoreline: Very advanced deterioration, displacement, or breakage with localized failure(s) of primary shoreline protection imminent or observed. Shoreline is being eroded and/or shoreline movement has occurred. Unprotected shoreline: Widespread erosion and/or slump or embankment failures have occurred. More widespread failures are possible or likely to occur. Immediate actions, such as emergency shoreline protection measures, use restrictions, or barricading of roadways, railways and working areas near the shoreline should be considered.
Applicable Component Types: Protected shoreline, unprotected shoreline.	

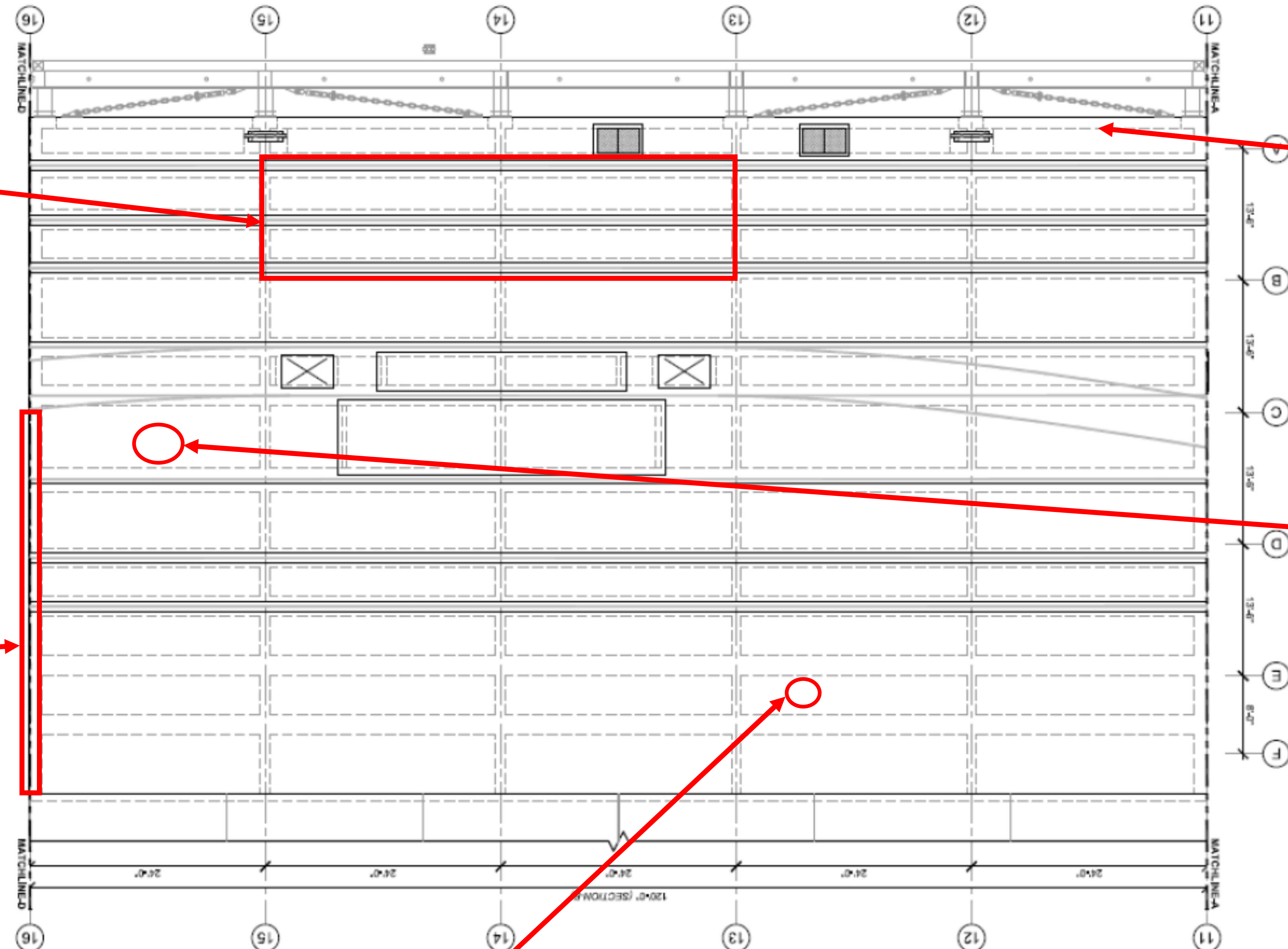
Functional Ratings for Ancillary Components

Rating	Description
6 Good	Minor or no problems noted. Also applies to newly constructed or rehabilitated protective components.
5 Satisfactory	Minor defects, damage or deterioration - not extensive.
4 Fair	Extensive minor or limited moderate defects, damage or deterioration. All primary elements and their attachment to the asset are sound and functional purpose/use of the component is not affected. Minor repairs or maintenance may be required.
3 Poor	Moderate or extensive defects, damage or deterioration that affects functional purpose/use of the component or compromises attachment of the component to the asset.
2 Serious	Defects, damage or deterioration significantly affects functional purpose/use of the component and/or local failures of the attachment to the asset are present.
1 Critical	Advanced damage or deterioration has resulted in frequent imminent or observed failure(s) of the attachment of the component to the asset. The component may no longer serve its functional purpose/use and/or conditions are present that may lead to property damage or environmental damage. Immediate repairs or other protective measures should be considered, and/or immediate use restrictions should be considered for components affected.
Applicable Component Types: Utility systems, paint and markings, crane and train rails, personnel access systems.	

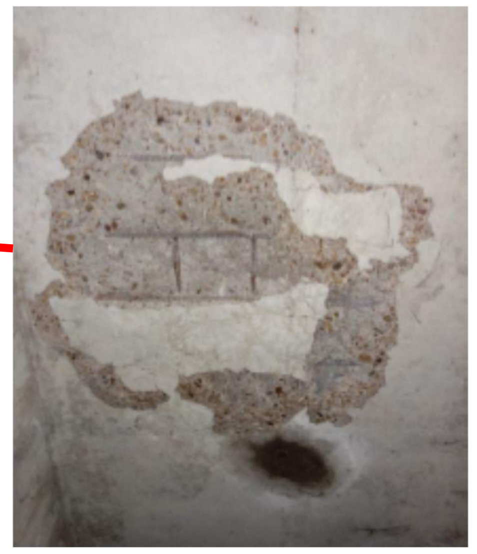
Structural Component - Deck/Joint Element Field Sheet (Unit B)

Raveled deck surface; course aggregate still secure; photo # 747-005

Expansion joint; no alignment or adhesion issues observed; photo # 747-003



4' long > 20 mil crack photo # 747-001



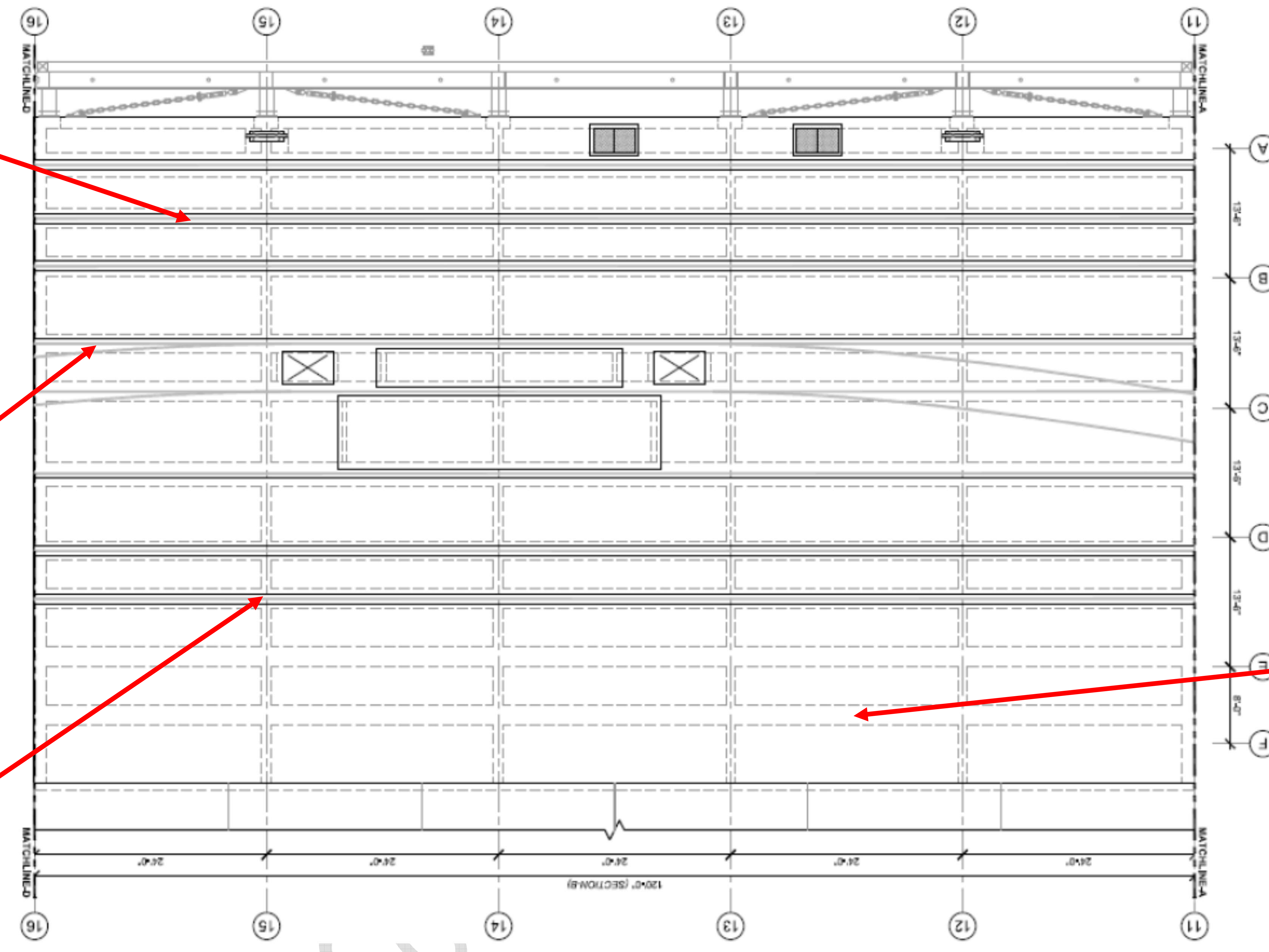
6 sf 36" dia spall with no observed steel section loss; photo # 747-004

4sf 24" dia spall due to corrosion at leaking drain; no observed reinforcing steel section loss; photo # 747-002

Structural Component - Superstructure Element Field Sheet (Unit B)

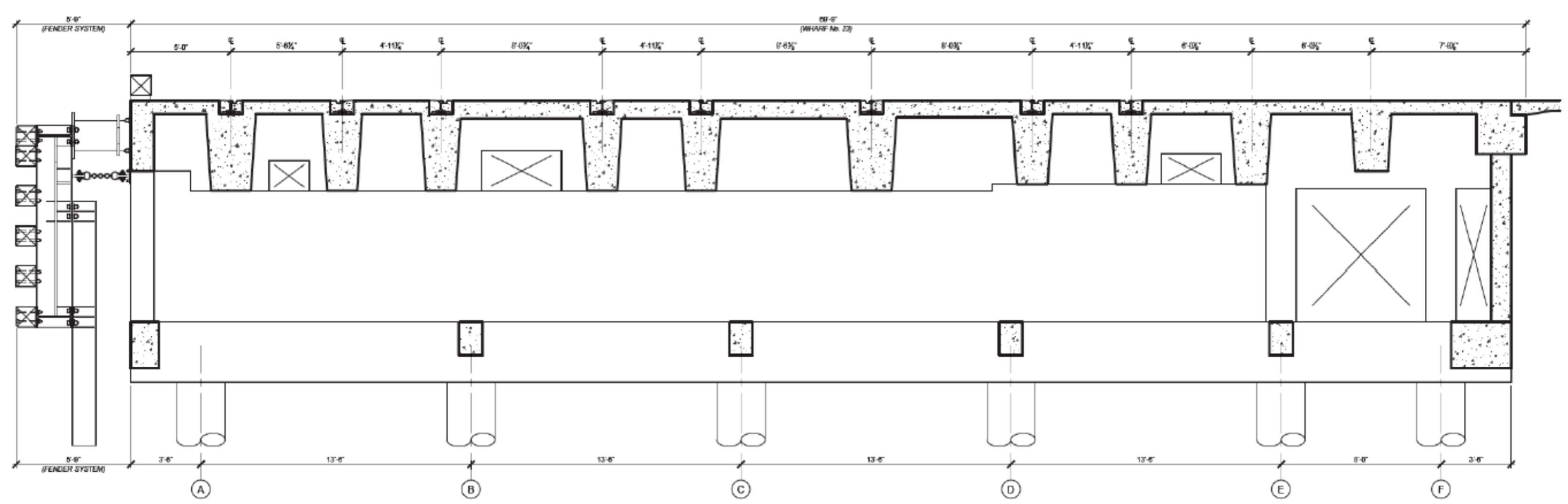
6 LF crack causing no reduction in capacity; photo # 747-011

4 LF causing reduction in flexural capacity; photo # 747-010



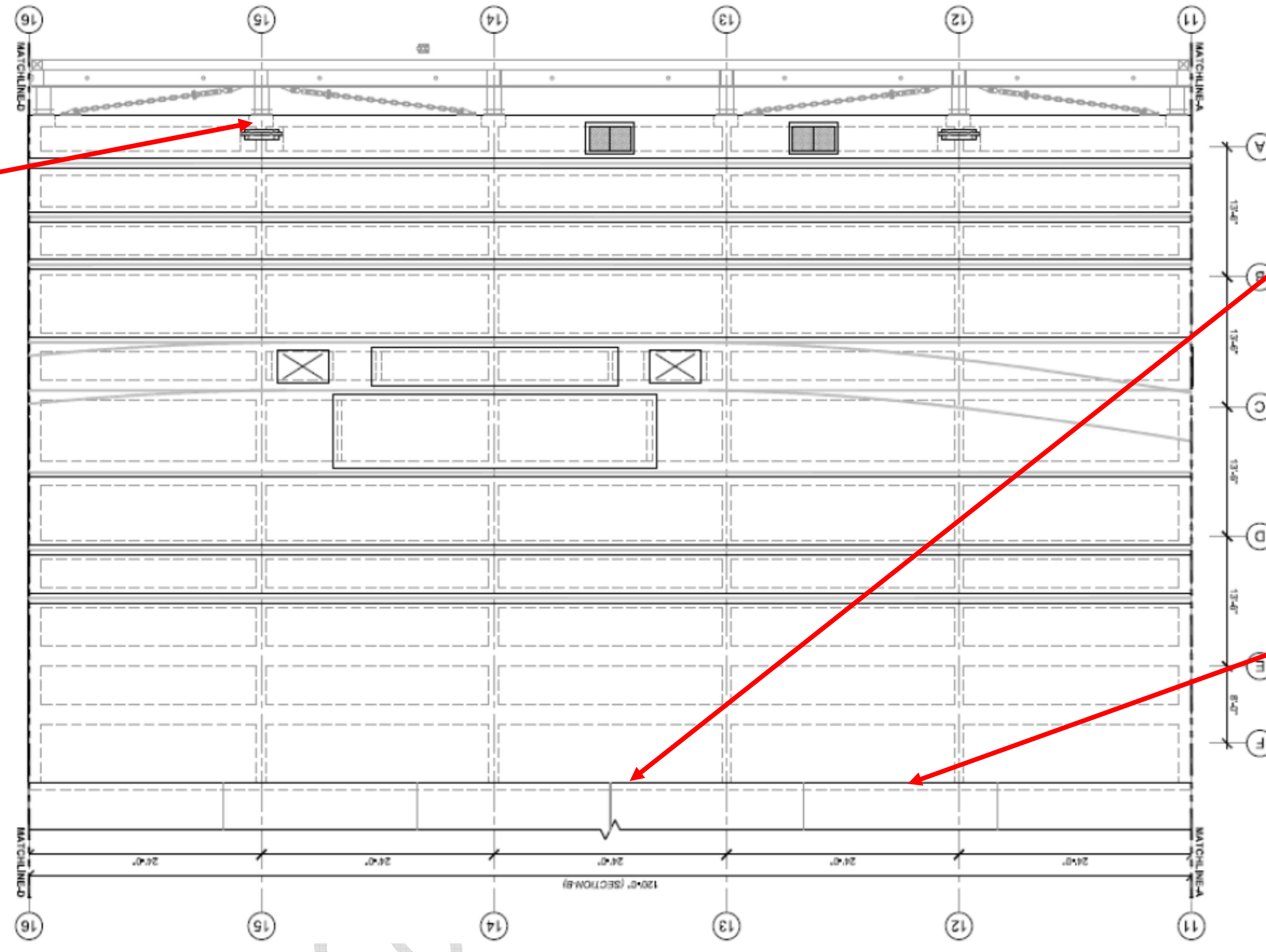
36” x 8” spall due to corrosion; no observed reinforcing steel section loss photo # 747-009

2 LF Spall due to corrosion; measurable reinforcing steel section loss with w/further review required due to rebar section loss; photo # 747-006



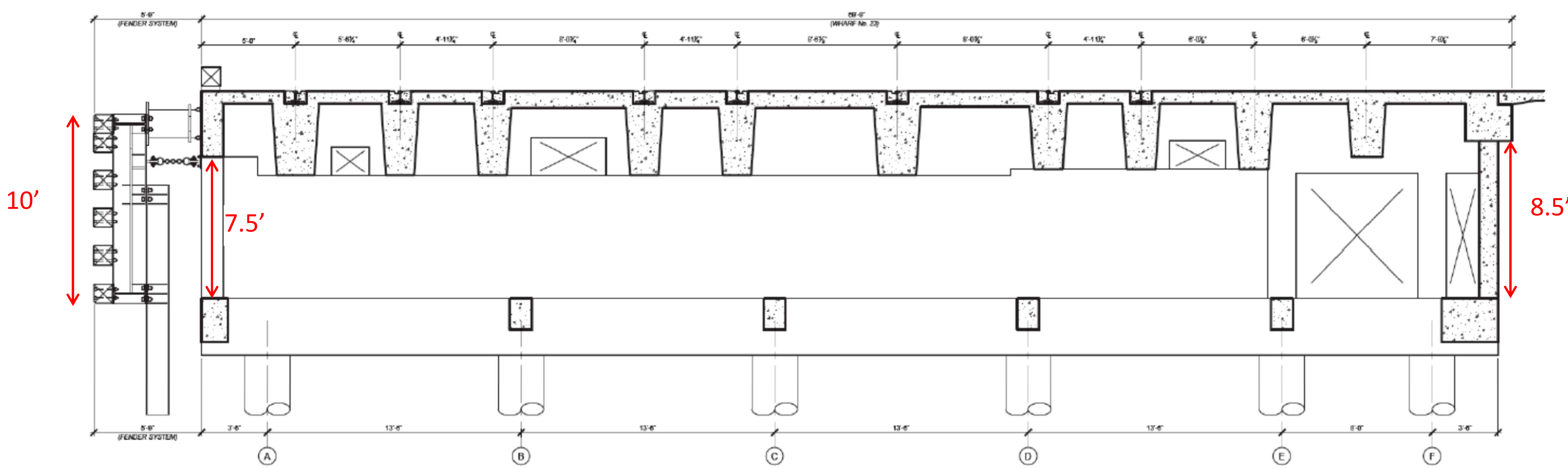
Structural Component - Substructure/Bulkhead Element Field Sheet

4’ x 2’ Spall due to corrosion; photo # 747-014



1 SF steel bulkhead wall corrosion; photo# 747-013

3’ long x 2’ tall area steel bulkhead wall corrosion; photo # 747-012



Berthing Component - Fender and Mooring Element Field Sheet

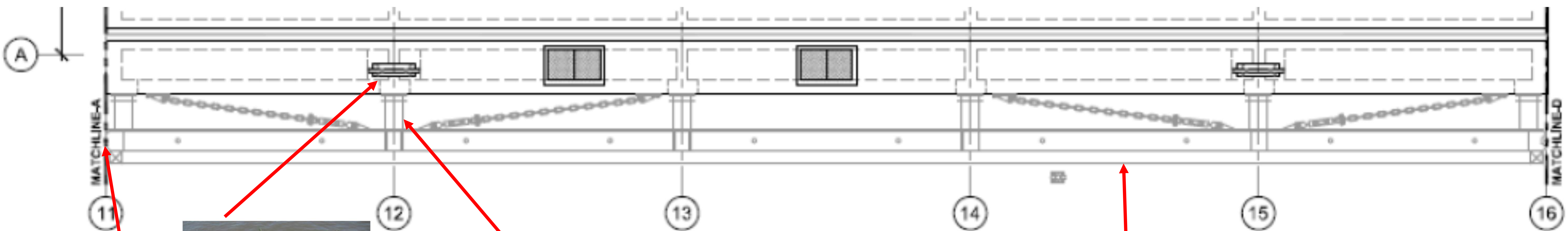



photo # 747-017


photo # 747-018


photo # 747-020


photo # 747-019

Module Wrap-Up

- Identify damage and deterioration found in PHA elements
- Describe the basis for the four element condition states
- Characterize maritime elements using the four predefined condition states
- Quantify damage and deterioration conditions found in PHA elements
- Document an element's condition state using an Element Inspection Form

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Recommended Follow-up Actions

Module 5

Module Objectives

- Describe the categories of recommended follow-up actions.
- Formulate follow-up action recommendations.
- Distinguish between immediate, priority, and routine follow-up actions.
- Document follow-up actions using appropriate forms.

Module References

- FICAP Manual Chapter 7: Recommended Follow-Up Action Guidelines
- FICAP Manual Inspection Form
  - Follow-Up Action Form (FICAP Manual Section 8.7 and Appendix F)

Recommended Follow-Up Actions

- Recommended ***follow-up actions*** are an important outcome of an inspection and condition assessment
  - Helps to guide what should happen next for asset
    - – Assists PHA with planning and management decisions
  - Provides Engineer with the opportunity to make suggestions or express concerns

Recommended Follow-Up Actions

- Recommended follow-up actions may include suggestions for:
  - Maintenance or repairs
  - Further investigation or analysis required
  - Immediate actions to remedy or avoid conditions that may:
    - Compromise structural integrity
    - Compromise facility operations
    - Lead to property or environmental damage

Recommended Follow-Up Actions

- Recommended follow-up actions are described in FICAP using five categories:
  1) No action required (i.e., “do nothing”)
  2) Investigation Recommendations (maintenance, repair, etc.)
  3) In-depth Investigation required
  4) Engineering Analysis required
  5) Immediate (i.e., emergency) actions

Depends on type, severity and implications of conditions observed

Recommended Follow-Up Actions

- Important Points:
  - More than one recommended action may arise from the condition assessment of a given asset
  - All actions should be prioritized in a consistent manner across all assets
  - A brief justification (written explanation) should be provided for any recommended actions
  - Documented on **Follow-Up Actions Form**

Follow-Up Actions Form

(See Section 8.7 and Appendix F)

Maritime Asset
Follow-up Actions

Property:
Asset ID:
Inspection Type:
Inspection Date:
Scope of Inspection:
Inspection Firm(s):
Prime:
Underwater:
Other:
Reported By:
Report Date:

Follow-up Actions

Item No.:
Priority:
Component:
Element Type:
Element ID(s):
Condition Identified:
Reason for action:
Recommended Action:

Representative Photos

Follow-Up Actions Form

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Maritime Asset
Follow-up Actions

Form MSFA (V1.1)
Property – Asset ID
MMMM DD, YYYY
Page 2 of 8

Follow-up Actions Log

Item No.	Priority	Action	Assigned To	Assigned By	Date
1	Priority	Schedule follow-up investigation	P. Manager	D. Engineer	MM-DD-YYYY

(See Section 8.7 and Appendix F)

No Action Required (Section 7.2)

- Every Baseline and Routine Inspection requires completion of the "Follow-Up Actions Form"
  - If inspection and condition assessment does not reveal conditions requiring action, recommendation is ***"No action required"***
  - Engineer should recommend timing for next Routine Inspection:
    – Based on standard interval (Section 2.1, Table 2.2)
    – Increased or reduced interval*   (* Final selection by PHA)

Example: No Action Required

Using Follow-Up Action Form
(See Section 8.7 and Appendix F)

Item No.:	1	Priority:	☐Priority ☐Routine
Component:	n/a		
Element Type:	n/a	Element ID(s):	n/a
Condition Identified:	No action required		
Reason for action:	Asset condition does not warrant further action at this time.		
Recommended Action:	Schedule next Routine Inspection at standard interval (3 yrs above water, 6 yrs below water)		

N/A	N/A
Figure 1. Overall view of location	*Figure 2. Close-up view of condition*

Investigation Recommendations (Section 7.3)

- Applies to conditions that require follow-up action, but do not represent an immediate or emergency situation, such as:
  - Conditions requiring maintenance (e.g., clean drains, repaint bollard, replace joint material)
  - Conditions requiring minor repairs (e.g., minor crack or spall repair)
  - Conditions requiring replacement of one or more non-structural elements (e.g., replace wharf log)
  - Elements assigned condition state of CS4 (Severe)

Investigation Recommendations (Section 7.3)

- Note on Elements assigned CS4 (Severe) Condition State:
  - CS4 represents the most severe case of condition type in question
  - May correspond to reduction in structural capacity of a structural element, or reduction in functional performance of non-structural element
  - Warrants further review as a recommended follow-up action

Investigation Recommendations
Documentation Required on Follow-Up Action Form

- Classify the recommendation as "priority" or "routine:"
  - Priority: Action should take precedence over scheduled maintenance (but does not represent immediate structural or functional concern)
  - Routine: Action can be scheduled in future without affecting integrity or functionality and without significantly increasing future cost of maintenance or repair

- Provide a brief written justification of need for action and associated priority

Example: Investigation Recommend-ations

Priority

Using Follow-Up Action Form
(See Section 8.7 and Appendix F)

Item No.:	1	**Priority:**	☒Priority ☐Routine
Component:	Berthing - Fender System		
Element Type:	TIM Facing	**Element ID(s):**	FF 2-1, FF 3-1, FF 6-1
Condition Identified:	Horizontal fender facing elements exhibit ship impact damage. Some facing elements are missing.		
Reason for action:	Facing elements should be replaced on a priority schedule to reduce possible future damage to ship hulls or other fender elements due to ship contact/impact.		
Recommended Action:	Replace missing and damaged TIM Facing elements		

Figure 5. Example of fractured TIM Facing due to impact damage – Bay 2

Figure 6. Examples of missing TIM Facing – Bay 6

Example: Investigation Recommend-ations

Routine

Using Follow-Up Action Form
(See Section 8.7 and Appendix F)

Item No.:	2	**Priority:**	☐Priority ☒Routine
Component:	Berthing – Mooring System		
Element Type:	MT Cleat	**Element ID(s):**	CL 2-1, CL 5-1A, CL 6-2A, CL 8-1, CL 11-1A
Condition Identified:	Metal cleats - coating (paint) missing, exposed metal surfaces with light to moderate corrosion.		
Reason for action:	Restoration of coating system (paint) will extend cleat service life and provide an opportunity to evaluate section loss.		
Recommended Action:	Implement routine cleaning and recoating of cleat surfaces every 5 to 10 years as part of maintenance program.		

Figure 7. Typical coating (paint) failure and surface corrosion on cleat

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In-Depth Investigation (Section 7.4)

- Not part of regular FICAP scope of Baseline/Routine Investigations
- May be recommended following a Baseline or Routine Inspection to:
  - Investigate non-typical conditions that require further information to assess
  - Determine cause or significance of deterioration
  - Collect information needed to develop repair design and quantities
  - Confirm as-built conditions (geometry, material properties, etc.) to facilitate repair design, load rating, asset inventory, etc.

In-Depth Investigation (Section 7.4)

- May involve:
  - Material sampling and analysis
  - Non-destructive evaluation techniques
  - Non-standard equipment and inspection techniques

- Specialized testing and engineering knowledge and experience may be required to develop the inspection plan and to conduct the In-Depth Inspection

In-Depth Investigation
Documentation Required on Follow-Up Action Form

- Recommendation for In-Depth Investigation should include:
  - Description of the non-typical conditions
  - Brief written justification of need for further investigation and associated priority
  - Objective of the In-Depth Investigation

Note:

- In-Depth Investigations are conducted at the discretion of the PHA
- Scope and objective will be defined by PHA

Example:
In-Depth Investigation

Item No.:	1	**Priority:**	☒Priority ☐Routine
Component:	Substructure		
Element Type:	RC Pile Cap	**Element ID(s):**	PC 35-1 / PC 35-2
Condition Identified:	Unusual separation between pile cap elements.		
Reason for action:	No apparent cause for separation; condition may reflect underlying deficiency in structure.		
Recommended Action:	Follow-up investigation (In-depth Inspection)		

Figure 1. Overall view of location

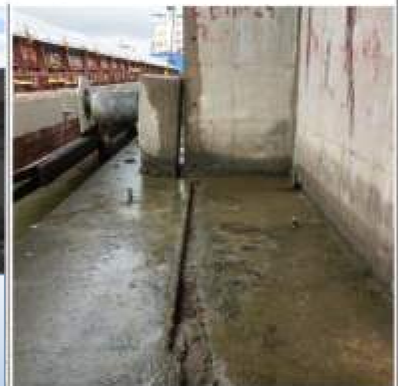

Figure 2. Close-up view of condition

Using Follow-Up Action Form
(See Section 8.7 and Appendix F)

Triggered if cause and/or effect of condition unknown after routine inspection results review.

Engineering Analysis (Section 7.5)

- In-Depth Investigation may identify significant damage, defects, atypical conditions, or potential structural or functional concerns
  - In-Depth Investigation may recommend an Engineering Analysis to provide further information as a Follow-Up Action
- PHA may request Engineering Analysis depending on Asset Management needs

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Engineering Analysis (Section 7.5)

- Possible objectives for Engineering Analysis:
  - Structural evaluation to quantify structural capacity accounting for observed defects or damage (i.e., determine if structural integrity of asset is at risk)
  - Assign a load rating or load capacity for the asset
  - Conduct service life analysis for the asset
  - Evaluate need for repairs or strengthening
  - Develop appropriate repair or strengthening solution

Engineering Analysis
Documentation Required on Follow-Up Action Form

- Recommendation for Engineering Analysis should include:
  - Brief written justification of need for analysis and associated priority
  - Objective of the Engineering Analysis

Note:

- Engineering Analysis is not in scope of Baseline/Routine Inspection
- Engineering Analysis is conducted at the discretion of the PHA
- Scope and objective will be defined by PHA

Example: Engineering Analysis

Using Follow-Up Action Form
(See Section 8.7 and Appendix F)

Item No.:	1	**Priority:**	☒Priority ☐Routine
Component:	Superstructure		
Element Type:	RC Deck Beams	**Element ID(s):**	DB 3-8, DB 3-9
Condition Identified:	Shear cracking was observed near the ends of two beams. In-Depth Investigation has assessed crack patterns and widths and concludes cracking is due to overloading.		
Reason for action:	The shear cracking is indicative of structural overloading in the past. Shear strength of beams may have been compromised, possibly affected structural capacity of Bay 3.		
Recommended Action:	Engineering Analysis to determine potential reduction of shear capacity based on cracking and shear crack widths. Load rating of Bay 3. Develop structural repair solution.		

Figure 1. Typical shear crack at end of beam

Figure 2. Close-up of shear crack; approx. 1/8 inch wide, with faulting along bottom of beam.

Immediate Actions (Section 7.6)

- Required when any inspection and/or condition assessment identifies severe conditions that have occurred, or appear likely to occur:
  - Potential for property or environmental damage
  - May affect structural integrity or facility operations
- Intended to be a response to extreme conditions or emergency situations
  - Not intended to apply to routine maintenance or repairs

Immediate Actions
Notification and Documentation Required

- Inspection Team Leader or Engineer must immediately notify PHA Project Contact by phone with follow-up notification in writing within 24 hours
- Follow-up Action Form:
  - Provide justification for immediate action and brief description and photographs of the condition(s) of concern
  - Recommend whether an In-Depth Inspection or Engineering Analysis is needed to further ascertain the extent and implications of the observed conditions

Discussion
Hypothetical Situations Requiring Immediate Action

- Potential for property damage
- Potential for environmental damage
- Condition may affect structural integrity
- Condition may affect facility operations

Module 5 Wrap-up
Module Objectives

- Describe the categories of recommended follow-up actions.
- Formulate follow-up action recommendations.
- Distinguish between immediate, priority, and routine follow-up actions.
- Document follow-up actions using appropriate forms.

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END OF MODULE

Situation: You have discovered that some of the distressed areas of CD26 were overlooked when the Elemental Inspection Form was developed during the baseline inspection. You have gathered the photos, notes, and background drawings from the baseline inspection files and will use them to update the Element Record Tables and Structural Component Summary Tables and annotate the locations of the photos on the field sheets.

Tasks:

- Annotate the field sheets in the appropriate location with the element IDs given with each picture below
- Complete an entry in the appropriate Element Record Table for each of the elements shown.
- Update the summary tables given below by adding the appropriate quantities to them.

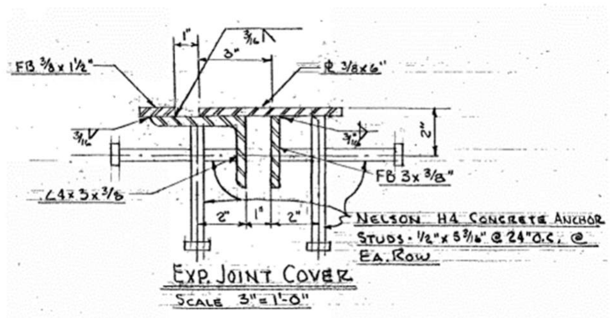
Element ID	Photo #	Notes
DU24-1	0050	Reinforcement - no section loss

Element ID	Photo #	Notes
DB19-1	4080102	Wide crack not reducing structural capacity

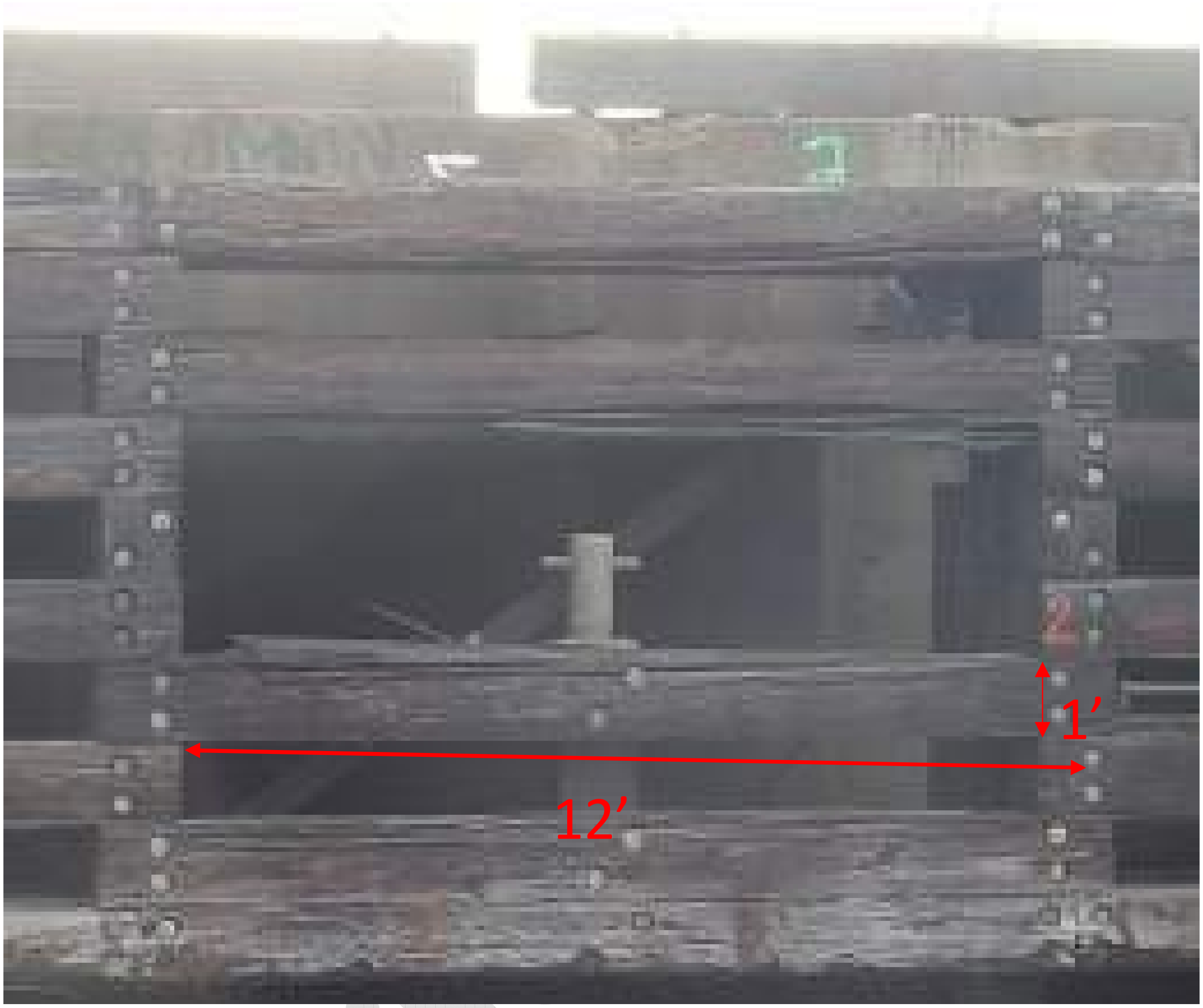
Element ID	Photo #	Notes
DB19-5	0236	Wide crack not reducing capacity and heavy leachate buildup

Element ID	Photo #	Notes
SW13-1	3722	Moderate width crack - 8 x more in element with similar leaching

Element ID	Photo #	Notes
ST19-5	0085	Wide crack not impacting capacity



Element ID	Photo #	Notes
JN17-1	0047	Concrete slabs impinging on each other for full joint length



Element ID	Photo #	Notes
FF5-1	0038	Partial depth splitting on full length of two timbers

Element ID	Photo #	Notes
SF 26-1	0267	No longer functional

Summary Table 1. Structural Components Condition States

Elem Local	Element Desc	In-Access	CS1	CS2	CS2 [NC]	CS3	CS3 [NC]	CS4	CS4 [NC]	Total
Deck										
DT-RC	**RC Deck Tops**	**1338**	**24101**	**11522**	**[168]**	**4173**	**[139]**	**–**	**–**	**41134**
	--	1030	4257	2	–	–	–	–	–	5289
	CRKC	308	19153	11281	[168]	4052	[139]	–	–	34794
	DLSP	–	–	239	–	121	–	–	–	360
	PTCH	–	691	–	–	–	–	–	–	691
DT-RC Total		**1338**	**24101**	**11522**	**[168]**	**4173**	**[139]**	**–**	**–**	**41134**
DU-RC	**RC Deck Unde**	**–**	**27073**	**11601**	**[14375]**	**2447**	**[630]**	**–**	**–**	**41121**
	--	–	11108	–	–	–	–	–	–	11108
	CRKC	–	15874	10979	[56]	1628	–	–	–	28481
	DLSP	–	–	19	–	45	–	–	–	64
	PTCH	–	91	29	[1]	–	–	–	–	120
	EFRS	–	–	572	[12789]	774	[630]	–	–	1346
	EXPR	–	–	2	[1529]	–	–	–	–	2
DU-RC Total		**–**	**27073**	**11601**	**[14375]**	**2447**	**[630]**	**–**	**–**	**41121**
Deck Total		**1338**	**51174**	**23123**	**[14543]**	**6620**	**[769]**	**–**	**–**	**82255**
Substructure										
SW-RC	**RC Shear Wall**	**0**	**1114**	**311**	**[190]**	**85**	**[6]**	**6.5**	**–**	**1516**
	--	–	1114	–	–	–	–	–	–	1114
	CRKC	0	–	224	–	–	–	6.5	–	230.5
	DLSP	–	–	24	–	81	[4]	–	–	105
	PTCH	–	–	43	–	–	–	–	–	43
	EFRS	–	–	20	[190]	–	–	–	–	20
	EXPR	–	–	–	–	4	[2]	–	–	4
SW-RC Total		**0**	**1114**	**311**	**[190]**	**85**	**[6]**	**6.5**	**–**	**1516**
ST-RC	**RC Strut (LF)**	**96**	**1280**	**168**	**[72]**	**1200**	**[192]**	**–**	**–**	**2744**
	--	96	1232	–	–	–	–	–	–	1328
	CRKC	–	24	24	[24]	984	–	–	–	1032
	DLSP	–	–	48	–	216	[96]	–	–	264
	PTCH	–	–	–	[24]	–	–	–	–	0
	EFRS	–	24	96	[24]	–	[96]	–	–	120
ST-RC Total		**96**	**1280**	**168**	**[72]**	**1200**	**[192]**	**–**	**–**	**2744**
CO-RC	**RC Column (E**	**–**	**19**	**4**	**–**	**2**	**[1]**	**–**	**–**	**25**
	--	–	19	–	–	–	–	–	–	19
	DLSP	–	–	4	–	1	[1]	–	–	5
	EXPR	–	–	–	–	1	–	–	–	1
CO-RC Total		**–**	**19**	**4**	**–**	**2**	**[1]**	**–**	**–**	**25**
PI-CS	**CS Pile (EA)**	**156**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**156**
	--	156	–	–	–	–	–	–	–	156
PI-CS Total		**156**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**156**
PC-CS	**CS Pile Cap (L**	**–**	**2379**	**–**	**–**	**–**	**–**	**–**	**–**	**2379**
	--	–	2379	–	–	–	–	–	–	2379
PC-CS Total		**–**	**2379**	**–**	**–**	**–**	**–**	**–**	**–**	**2379**
CF-CS	**CS Cofferdam**	**–**	**–**	**7**	**–**	**–**	**–**	**–**	**–**	**7**
	CORR	–	–	7	–	–	–	–	–	7
CF-CS Total		**–**	**–**	**7**	**–**	**–**	**–**	**–**	**–**	**7**
Substructure Total		**252**	**4792**	**490**	**[262]**	**1287**	**[199]**	**6.5**	**–**	**6827**

Summary Table 1. Structural Components Condition States										
Element Location I	**Element Descriptor**	**In-Accessible**	**CS1**	**CS2**	**CS2 [NC]**	**CS3**	**CS3 [NC]**	**CS4**	**CS4 [NC]**	**Total**
Superstructure										
DB-RC	**RC Deck Beam (LF)**	**60.75**	**5793**	**202**	**[179]**	**40**	**[6]**	**–**	**–**	**6096**
	--	60.75	5793	–	[1]	2	–	–	–	5856
	CRKC	–	–	146	[25]	4	–	–	–	150
	DLSP	–	–	47	[7]	–	[6]	–	–	47
	PTCH	–	–	–	[4]	–	–	–	–	0
	EFRS	–	–	4	[138]	22	–	–	–	26
	EXPR	–	–	5	[4]	12	–	–	–	17
DB-RC Total		60.75	5793	202	[179]	40	[6]	–	–	6096
Superstructure Total		**60.75**	**5793**	**202**	**[179]**	**40**	**[6]**	**–**	**–**	**6096**
Bulkhead										
BW-CS	**CS Bulkhead Wall (LI**	**–**	**206**	**377**	**–**	**–**	**–**	**–**	**–**	**583**
	--	–	206	377	–	–	–	–	–	583
BW-CS Total		–	206	377	–	–	–	–	–	583
Bulkhead Total		**–**	**206**	**377**	**–**	**–**	**–**	**–**	**–**	**583**
Joint										
JN-AU	**Armored Joint withc**	**–**	**69**	**–**	**–**	**–**	**–**	**210**	**–**	**279**
	ALGN	–	69	–	–	–	–	210	–	279
JN-AU Total		–	69	–	–	–	–	210	–	279
Joint Total		**–**	**69**	**–**	**–**	**–**	**–**	**210**	**–**	**279**

Summary Table 2. Berthing Components Condition States										
Element Location	Element Descriptor	In-Accessible	CS1	CS2	CS2 [NC]	CS3	CS3 [NC]	CS4	CS4 [NC]	Total
Fender System										
FF-TIM	**TIM Facing (EA)**	–	**248**	**2**	–	–	–	–	–	**250**
	--	–	220	–	–	–	–	–	–	220
	FNFA	–	28	2	–	–	–	–	–	30
FF-TIM Total		–	248	2	–	–	–	–	–	250
CH-GS	**GS Stay Chains (EA)**	–	**17**	–	–	–	–	**7**	–	**24**
	--	–	17	–	–	–	–	–	–	17
	FNSC	–	–	–	–	–	–	7	–	7
CH-GS Total		–	17	–	–	–	–	7	–	24
SF-CS	**CS Secondary Framir**	**621**	**645**	**462**	–	**70**	–	**1**	–	**1799**
	--	600	600	–	–	–	–	–	–	1200
	CORR	21	45	462	–	70	–	1	–	599
SF-CS Total		621	645	462	–	70	–	1	–	1799
FP-CS	**CS Fender Pile (EA)**	**26**	–	–	–	–	–	–	–	**26**
	--	26	–	–	–	–	–	–	–	26
FP-CS Total		26	–	–	–	–	–	–	–	26
FA-RB	**OTH Cylindrical Rubl**	–	**14**	–	–	**6**	–	**6**	–	**26**
	--	–	14	–	–	–	–	–	–	14
	BULG	–	–	–	–	6	–	6	–	12
FA-RB Total		–	14	–	–	6	–	6	–	26
Fender System Total		**647**	**924**	**464**	–	**76**	–	**14**	–	**2125**
Mooring										
CL-MT	**MT Cleat (EA)**	–	**8**	–	–	–	–	–	–	**8**
	--	–	8	–	–	–	–	–	–	8
CL-MT Total		–	8	–	–	–	–	–	–	8
Mooring Total		–	**8**	–	–	–	–	–	–	**8**

Summary Table 3. Ancillary Components Condition States										
Element Location	Element Descriptor	In-Accessible	CS1	CS2	CS2 [NC]	CS3	CS3 [NC]	CS4	CS4 [NC]	Total
Guards										
WL-TIM	**TIM Wharf Log (LF)**	–	**15**	**4**	**[1]**	**7**	–	**7**	–	**33**
	--	–	15	–	–	–	–	–	–	15
	CONX	–	–	2	–	7	–	7	–	16
	DIST	–	–	2	[1]	–	–	–	–	2
WL-TIM Total		–	15	4	[1]	7	–	7	–	33
Guards Total		–	**15**	**4**	**[1]**	**7**	–	**7**	–	**33**
Crane and Train										
TR-MT	**Train Rails, Carne Ra**	–	**2280**	–	–	–	–	–	–	**2280**
	--	–	2280	–	–	–	–	–	–	2280
TR-MT Total		–	2280	–	–	–	–	–	–	2280
Crane and Train Total		–	**2280**	–	–	–	–	–	–	**2280**

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Element Records

Table 1. Structural Component - Concrete Deck Element Observations

Element ID			Element / Condition Code	Unit	Total	Inacc	Condition State [NC]				Photos	Comments
Type	Bay	No.					CS1	CS2	CS3	CS4		

Table 2. Structural Component - Concrete Superstructure Element Observations

Element ID			Element / Condition Code	Unit	Total	Inacc	Condition State [NC]				Photos	Comments
Type	Bay	No.					CS1	CS2	CS3	CS4		

Table 3. Structural Component - Concrete and Steel Substructure Elements

Element ID			Element / Condition Code	Unit	Total	Inacc	Condition State [NC]				Photos	Comments
Type	Bay	No.					CS1	CS2	CS3	CS4		

Table 4. Structural Component - Concrete and Steel Joint Elements

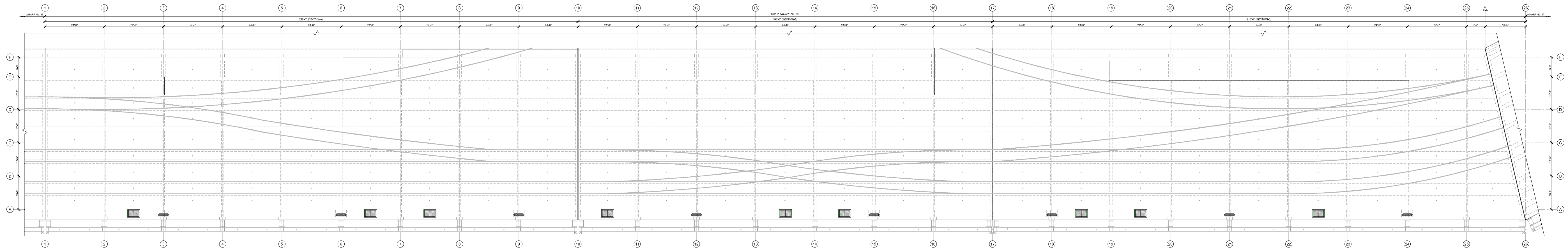
Element ID			Element / Condition Code	Unit	Total	Inacc	Condition State [NC]				Photos	Comments
Type	Bay	No.					CS1	CS2	CS3	CS4		

Table 5. Structural Component - Concrete and Steel Bulkhead Elements

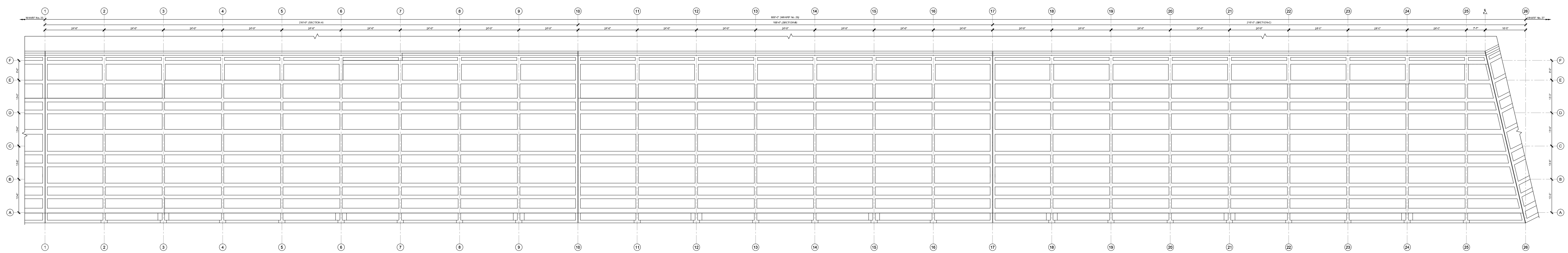
Element ID			Element / Condition Code	Unit	Total	Inacc	Condition State [NC]				Photos	Comments
Type	Bay	No.					CS1	CS2	CS3	CS4		

Table 6. Berthing Component - Timber Fender Elements

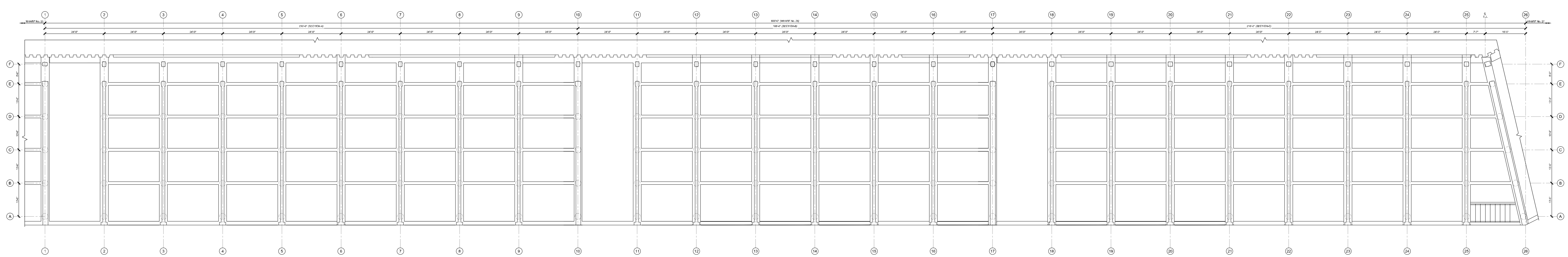
Element ID			Element / Condition Code	Unit	Total	Inacc	Condition State [NC]				Photos	Comments
Type	Bay	No.					CS1	CS2	CS3	CS4		



1 WHARF No. 26: TOP SURFACE PLAN
3/32" = 1'-0"



2 WHARF No. 26: REFLECTED DECK PLAN
3/32" = 1'-0"



3 WHARF No. 26: LOWER BEAM PLAN
3/32" = 1'-0"

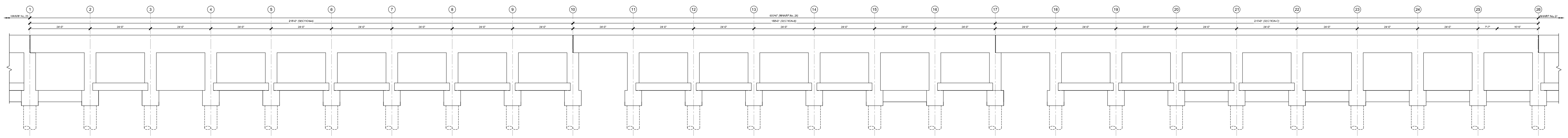
TRUE NORTH PLAN NORTH

WJE ENGINEERS ARCHITECTS MATERIAL SCIENTISTS
Wiss, Janney, Elstner Associates, Inc.

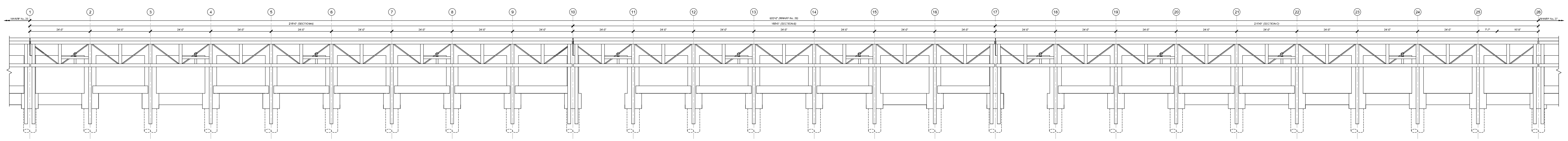
PORT OF HOUSTON AUTHORITY: Wharf No. 26 at Turning Basin Terminal
HOUSTON, TEXAS
WJE No. 2014.3252.R

TOP SURFACE PLAN & ASSESSMENT ELEVATION

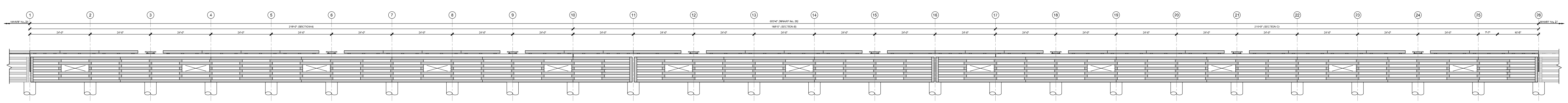
WHARF No.
CD-26



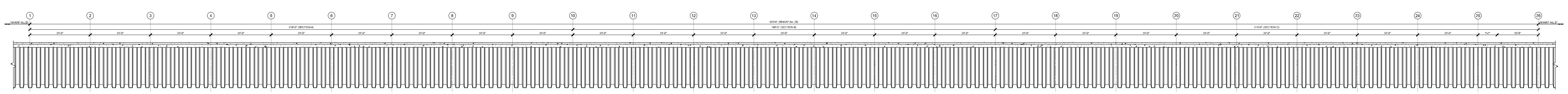
4 WHARF No. 26: WEST ELEVATION



5 WHARF No. 26: WEST ELEVATION STEEL FRAMING



6 WHARF No. 26: WEST ELEVATION WOOD FENDER



7 WHARF No. 26: EAST ELEVATION METAL SHEET PILE

TRUE NORTH PLAN NORTH

WJE ENGINEERS ARCHITECTS MATERIAL SCIENTISTS
Wiss, Janney, Elstner Associates, Inc.

PORT OF HOUSTON AUTHORITY: Wharf No. 26 at Turning Basin Terminal
HOUSTON, TEXAS
WJE No. 2014.3252.R

TOP SURFACE PLAN & ASSESSMENT ELEVATION

WHARF No.
CD-26

Facility Inspection & Condition Assessment Program (FICAP)

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Condition Assessment of Components and Maritime Assets

Module 6

Page 2

Module Objectives

- Summarize FICAP approach to condition assessment of components and assets
- Assign component ratings for structural and berthing, shoreline, and ancillary components
- Use component ratings to determine the overall asset condition rating
- Summarize FICAP damage rating system for post-event inspections
- Use of FICAP Inspection Summary Form to record condition assessment information

Module References

- FICAP Manual Chapter 6: Assessment and Rating Approach
- FICAP Manual Inspection Form
  - Inspection Summary Form (FICAP Manual Section 8.4)

Agenda

- Module 6.1 FICAP Condition Assessment and Rating Approach
- Module 6.2 Component Ratings
- Module 6.3 Overall Asset Condition Rating
- Module 6.4 Condition Rating for Post-Event Inspections

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Module 6.1

FICAP Condition Assessment and Rating Approach

Page 6

Module 6.1 Objectives
FICAP Condition Assessment and Rating Approach

- Summarize FICAP approach to condition assessment of components and assets

FICAP Inspection and Condition Assessment Approach

- FICAP Objectives:
  - Provide a uniform guideline to perform Baseline and Routine inspections and condition assessments of the maritime assets owned by Port of Houston Authority (PHA).
  - Provide maritime asset condition information
    - Used by Asset Management, Project and Construction Management, and Maintenance Departments at PHA
    - Determine need and timing of preventative or remedial actions to maintain the desired level of service

Maritime Asset Condition Information

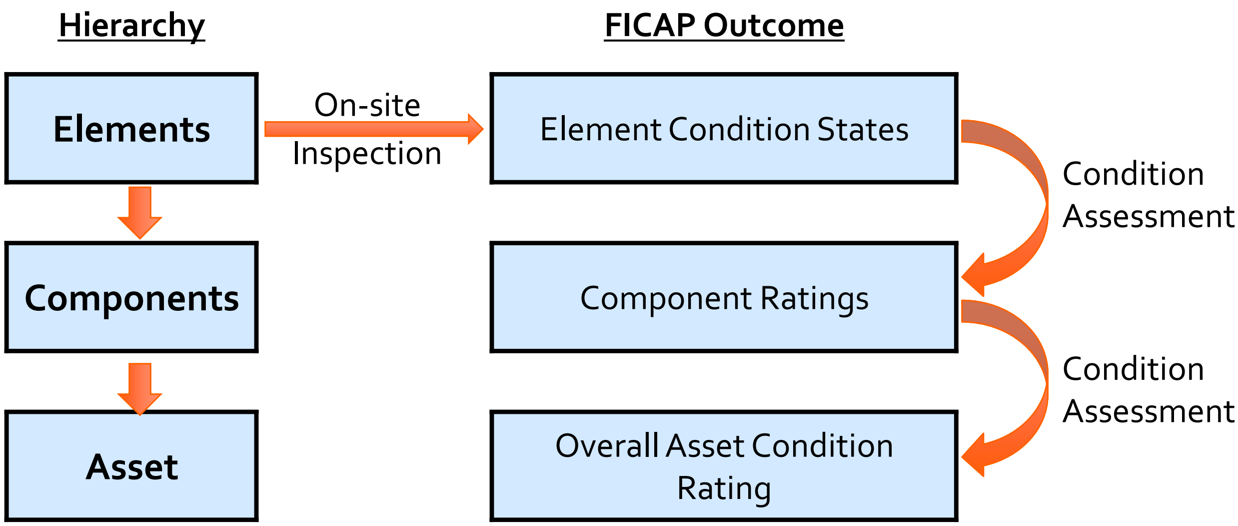
- Baseline, Routine and Due Diligence Inspections
  - Desirable to have comprehensive, detailed information
    - – Element condition
    - – Component condition
    - – Overall asset condition

Primary emphasis

- Post-Event Inspections
  - Need rapid, overall assessment of component and asset condition

FICAP Inspection and Condition Assessment Approach

Baseline
Routine
Due Diligence



Definition of Terms

Baseline
Routine
Due Diligence

- **Component Rating**
  - Numerical rating to indicate component structural and/or functional condition
  - Based on engineering interpretation of element condition
    - **knowledge**
    - **experience**
    - **judgement**

    → **Condition Assessment**
  - **Component Ratings are used for Condition Assessment of asset**

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Definition of Terms

Baseline
Routine
Due Diligence

- **Overall Asset Condition Rating**
  - Qualitative description of overall asset condition
    - Based on engineering interpretation of component condition

Condition Assessment

  - Supplemented by numerical rating for asset overall condition
    - Based on component ratings
  - Qualitative description and numerical rating used by PHA to guide asset management decisions

Documentation and Reporting

Baseline
Routine
Due Diligence

- Element Condition States are documented on **“Elemental Inspection Form”**
  - Discussed and used previously in Module 4 and Capstone Project 1
- Component Ratings and Overall Asset Condition are documented on **“Inspection Summary Form”**

Maritime Asset
Inspection Summary

Form MSS (V1.0)
Property – Asset ID
MMMM DD, YYYY
Page 1 of ?

Property:	Property	**Asset ID:**	Asset ID
Inspection Type	☐ Baseline ☐ Routine ☐ Special	**Inspection Date(s):**	MMMM DD, YYYY
Scope of Inspection	[Entire Asset] / [Limited; Bays ## to ##]		
Inspection Firm(s):	**Prime:** [Firm Name]		
	Underwater: [Firm Name]		
	Other (role): [Firm Name]		
Reported By:	[L. Inspector]	**Report Date:**	MMMM DD, YYYY
FICAP Manual Version/Date:	Version #.#, dated MMMM DD, YYYY	**Variances from FICAP Procedure:**	None

Seal of Responsible Engineer

I hereby certify this inspection was performed under my direct supervision and control and to the best of my professional knowledge complies with the FICAP Manual and applicable codes.

Signed: ____________________

Name: ____________________

Texas License No.: ____________________

Date: __________ Expires: __________

Seal

Inspection Team Members

Project Manager:
Inspection Team Leader(s): Underwater Team Leader:
Inspection Team Members: Underwater Team Member:

SAMPLE

Maritime Asset Inspection Summary "DRAFT" February 2017

Maritime Asset
Inspection Summary

Form MSS (V1.0)
Property – Asset ID
MMMM DD, YYYY
Page 2 of ?

Overall Asset Condition

Provide narrative of asset's overall condition. Note significant areas of distress and reference action items for these as warranted. For routine inspection, note changes in condition from previous inspections.

Structural Component Ratings and Element Summary

Component / Element(s)	Rating	Comments
Deck	#	Brief narrative describing reason for rating.
– RC Deck		Comment regarding condition; reference figures.
Slab on Grade	#	Narrative.
– RC Slab		Comments.
Superstructure	#	Narrative.
– RC Deck Beams		Comments.
Substructure	#	Narrative.
– RC Shear Walls		Comments.
– RC Pile Caps		Comments.
– TIM Piles		Comments.
Bearings	N/A	–
Joints	N/A	–
Bulkhead	#	Narrative.
– TIM Sheet Pile Wall		Comments.

…similar format for other components…

Berthing Component Ratings and Element Summary

Component / Element(s)	Rating	Comments
Fender System	#	Comments.
Mooring System	#	Comments.

SAMPLE

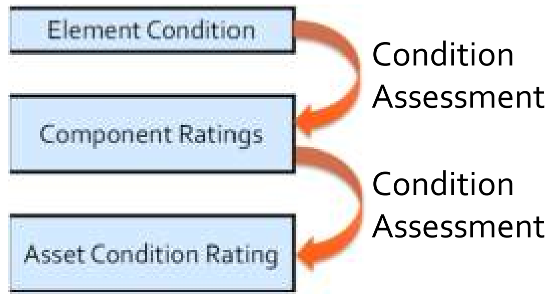
Maritime Asset Inspection Summary "DRAFT" February 2017

FICAP Post-Event Inspections

- Purpose and scope different from other inspection types
  - Immediate, rapid overall assessment of maritime asset after an extreme event
  - Determine whether event caused significant damage that requires repairs, restricted use, or closing of the asset
  - May be conducted by PHA staff or on-call engineering firm
  - In conjunction with current PHA ship-caused and system wide damage (hurricane) protocol
  - **Outcome:** *damage rating* for major components of asset and prioritized follow-up actions

Module 6.1 Summary

- Baseline, Routine and Due Diligence Inspections:



- Post-Event Inspection:
  - Rapid, overall assessment to establish "damage ratings"
  - Determine need for follow-up actions in response to event

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Module 6.2

Component Ratings

Module 6.2 Objectives

Component Ratings

- Summarize FICAP ratings for structural and berthing, shoreline, and ancillary components
- Discuss implication of element condition states (type, severity, and extent) on component condition
- Employ engineering judgement to assign component ratings
- Describe use of FICAP Inspection Summary Form to record component rating information

FICAP Component Ratings

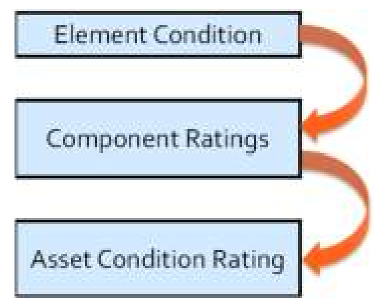
- Applicable to Baseline, Routine and Due Diligence Inspections
  - May be applied to In-Depth Inspections
- Component Ratings are:
  - Assigned relative to assumed **as-built condition** of component
  - Intended to reflect physical conditions including the effects of deterioration or damage
  - **Not** intended to rate the component in regards to current or future **use or loading** requirements (which may be different from time of original construction)

FICAP Component Ratings

- Component ratings are based on an evaluation of element inspection results considering significance of observed conditions

➔ **Condition Assessment**

- Based on engineering judgment, knowledge & experience
- Considers qualitative and quantitative inspection findings
- May be supplemented by calculations



Element Conditions and Component Ratings Relationship

- Components in maritime assets may consist of
  - numerous elements
  - different types of elements
  - different structural or functional systems

    ➔ structural and functional relationship between elements and component may be complicated

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Element Conditions and Component Ratings Relationship

- In spite of quantitative element condition information, the relationship between **element condition** and **component rating** is **not** quantitative
  - influence of element conditions on component condition depends on many complex factors
    → no formula!

Component condition must be determined through an ***engineering interpretation*** of the effect of the element condition on the component condition

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Component Condition Assessment

(Engineering Interpretation of Inspection Findings)

- Assess implication of observed conditions on **element performance**
- Assess implication of **element conditions and performance** on integrity, serviceability and functionality of **component**

Inputs

Engineering Knowledge Base

(Education and Experience)

- Deterioration mechanisms
- Structural behavior (element and systems)
- Structural analysis and design principles
- Structural integrity/safety, serviceability and functional requirements for maritime components

Inputs

Element Condition

(from inspection)

- Type of damage
- Severity of damage
- Extent of damage

Inputs

Component Details

(from asset record)

- Structural system(s)
- Layout & dimensions
- Element details
- Redundancy

Outcome

Component Condition

- Extent and severity of damage
- Effect on structural or functional performance
- Need for maintenance or repair

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Component Condition Considerations

- Component should be rated for overall condition
  - May not necessarily reflect localized or element-level conditions
  - Consider:
    - Severity <u>and</u> extent of conditions
    - Structural or functional implications of conditions
    - Impact of localized severe conditions in one or more elements on the overall performance of component

Assigning Component Rating

- Once the *condition assessment* has established the *component condition*, a **Component Rating** is assigned
  - Defined for Baseline, Routine and Due Diligence Inspections
  - Scale of 1 to 6 (Critical to Good)
  - Different rating scales for:
    - Structural and Berthing components
    - Shoreline components
    - Ancillary components
  - Consider both structural and functional performance

FICAP Manual
6.2.1 – 6.2.3

Structural and Berthing Components Ratings (Section 6.2.1)

- Rating descriptions include language to address:
  - Structural performance of primary structural components
  - Possible impact of observed conditions on structural capacity
  - Both structural and functional aspects of berthing components

- Structural Capacity: strength of component as designed at the time of original construction
- Load rating: (or Load Capacity) adequacy to carry specified loads *(which may be higher or lower than at time of original construction)*

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Page 26

Structural Capacity and Load Rating

- Component rating should be assigned relative to ***structural capacity***; load rating or load capacity should not influence component rating
  - For example, a component with negligible damage/deterioration is rated as **"good"** since structural capacity is comparable to original design strength
  - Component rating of "good" is applied even if unable to carry the current specified loads (i.e., rating is not decreased because loading was increased or intended use was changed)

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Ratings for Structural and Berthing Components
(Section 6.2.1, Table 6.1)

Rating	Description
6 Good	Minor or no problems noted. Also applies to newly constructed or rehabilitated components.
5 Satisfactory	Minor defects, damage or deterioration - not extensive.
4 Fair	Extensive minor or limited moderate defects, damage or deterioration. Structural capacity of primary structural components and functional use of fender or mooring systems are not affected.
3 Poor	Moderate or extensive defects, damage or deterioration that affects structural capacity of primary structural components or functional use of fender or mooring system components.
2 Serious	Defects, damage or deterioration significantly reduces structural capacity of primary structural components or reduces functional use of fender or mooring systems.
1 Critical	Advanced defects, damage or deterioration with localized failure(s) of components imminent or observed. Immediate load or use restrictions, including closing of the asset should be considered.
Applicable Component Types: Deck, superstructure, substructure, bearings, bulkheads, mooring and fender systems.	

Structural capacity or functional use not affected

Structural capacity or functional use is negatively affected

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Ratings for Structural and Berthing Components
(Section 6.2.1, Table 6.1)

Rating	Description
6 Good	Minor or no problems noted. Also applies to newly constructed or rehabilitated components.
5 Satisfactory	Minor defects, damage or deterioration - not extensive.
4 Fair	Extensive minor or limited moderate defects, damage or deterioration. Structural capacity of primary structural components and functional use of fender or mooring systems are not affected.
3 Poor	Moderate or extensive defects, damage or deterioration that affects structural capacity of primary structural components or functional use of fender or mooring system components.
2 Serious	Defects, damage or deterioration significantly reduces structural capacity of primary structural components or reduces functional use of fender or mooring systems.
1 Critical	Advanced defects, damage or deterioration with localized failure(s) of components imminent or observed. Immediate load or use restrictions, including closing of the asset should be considered.
Applicable Component Types: Deck, superstructure, substructure, bearings, bulkheads, mooring and fender systems.	

Repairs not likely required (6 Good, 5 Satisfactory)

Minor repairs likely required (4 Fair)

Structural repairs (possibly significant) required (3 Poor, 2 Serious)

Major intervention may be required (1 Critical)

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Shoreline Components Ratings (Section 6.2.2)

- Rating descriptions include language to address:
  - Both protected and unprotected shoreline components
  - Structural performance (e.g., fill retention)
  - Functional performance (e.g., shoreline definition, erosion control)

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Rating	Description
6 Good	Minor or no problems noted. Also applies to newly constructed or rehabilitated shoreline components.
5 Satisfactory	Minor defects, damage or deterioration - not extensive.
4 Fair	Protected shoreline: Extensive minor or limited moderate defects, damage or deterioration observed but does not affect shoreline protection. Unprotected shoreline: Extensive minor or limited moderate indications of shoreline beginning to slump. May be minor movement of shoreline.
3 Poor	Protected shoreline: Moderate or extensive deterioration or displacement that affects shoreline protection. Unprotected shoreline: Moderate or extensive indications of shoreline slumping or movement.
2 Serious	Protected shoreline: Deterioration, displacement, or breakage significantly affects the shoreline protection and local failures are possible. Unprotected shoreline: Shoreline is being eroded. Local slump or embankment failures are present. Use restrictions may be necessary for roadways, railways and working areas near shoreline.
1 Critical	Protected shoreline: Very advanced deterioration, displacement, or breakage with localized failure(s) of primary shoreline protection imminent or observed. Shoreline is being eroded and/or shoreline movement has occurred. Unprotected shoreline: Widespread erosion and/or slump or embankment failures have occurred. More widespread failures are possible or likely to occur. Immediate actions, such as emergency shoreline protection measures, use restrictions, or barricading of roadways, railways and working areas near the shoreline should be considered.
Applicable Component Types: Protected shoreline, unprotected shoreline.	

Ratings for Shoreline Components

(Section 6.2.2, Table 6.2)

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Ratings for Ancillary Components
(Section 6.2.3)

- Includes utility systems, paint and markings, crane and train rails, joints, and personnel access systems
  - May carry loads (e.g., utility supports) but do not serve a primary structural purpose
  - Primarily serve functional or regulatory purpose
- Rating descriptions are largely functional-based
  - Is component able to function as intended?
  - Rating should also consider adequacy of “attachment” of component to asset

Ratings for Ancillary Components
(Section 6.2.3, Table 6.3)

Rating	Description
6 Good	Minor or no problems noted. Also applies to newly constructed or rehabilitated protective components.
5 Satisfactory	Minor defects, damage or deterioration - not extensive.
4 Fair	Extensive minor or limited moderate defects, damage or deterioration. All primary elements and their attachment to the asset are sound and functional purpose/use of the component is not affected. Minor repairs or maintenance may be required.
3 Poor	Moderate or extensive defects, damage or deterioration that affects functional purpose/use of the component or compromises attachment of the component to the asset.
2 Serious	Defects, damage or deterioration significantly affects functional purpose/use of the component and/or local failures of the attachment to the asset are present.
1 Critical	Advanced damage or deterioration has resulted in frequent imminent or observed failure(s) of the attachment of the component to the asset. The component may no longer serve its functional purpose/use and/or conditions are present that may lead to property damage or environmental damage. Immediate repairs or other protective measures should be considered, and/or immediate use restrictions should be considered for components affected.
Applicable Component Types: Utility systems, paint and markings, crane and train rails, personnel access systems.	

Consider:
- general or overall condition of ancillary component compared to as-built
- attachment to asset
- potential risk to personnel, property or environment

Not intended to be an in-depth or detailed inspection

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Recording Component Condition Assessment and Ratings

- Use Inspection Summary Form

Page 1

Maritime Asset Inspection Summary

Virtual Inspection
Example Terminal – Wharf XY
November 30, 2016
Page 1 of 13

Property:	Example Terminal	**Asset ID:**	Wharf XY
Inspection Type	Baseline	**Inspection Date(s):**	November 14-26, 2016
Scope of Inspection	Entire Asset above MLT		
Inspection Firm(s):	**Prime:** ABC **Sub:** N/A		
Reported By:	L. Inspector	**Report Date:**	November 30, 2016
FICAP Manual Version/Date:	Revised Draft Dated September 27, 2016	**Variances from FICAP Procedure:**	None

Seal of Responsible Engineer

I hereby certify this inspection was performed under my direct supervision and control and to the best of my professional knowledge complies with the FICAP Manual and applicable codes.

Signed: ______________________

Name: ______________________

Texas License No.: ______________________

Date: ____________ Expires: ____________

Seal

Inspection Team Members

Project Manager: N/A
Inspection Team Leader(s): N/A
Inspection Team Members: N/A
Underwater Team Leader: N/A
Underwater Team Member: N/A

Overall Asset Condition

Overall Asset Condition Rating, ACR = 73 (out of 100)

City Dock (CD) 26 is in generally good condition with the majority of conditions related to localized impact or corrosion-related damage in the various elements throughout the structure. The deck (both topside and underside) and the strut beams that have undergone widespread corrosion-related damage, with most conditions noted as minor. Other items of concern noted for follow-up action include severe damage to and leaking of all four expansion joints, a shear crack at a shear wall opening (SW 21-1 at Column Line E-21), and a failed pin connection at two wale beams (WB 1-1 and WB 25-1).

The generally good condition of the deck, deck beams, and shear walls can be in part attributable to the construction method of having a continuous fill slab across the topside of the deck. This method of construction thickens the slab, provides additional cover to the structural reinforcing, provides a wear surface, and limits the number of joints in the deck that may be prone to water intrusion.

Recording Component Condition Assessment and Ratings

- Inspection Summary Form *(continued)*

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Maritime Asset Inspection Summary

Virtual Inspection
Example Terminal – Wharf XY
November 30, 2010
Page 2 of 13

Structural Component Ratings and Element Summary

Component / Element(s)	Rating	Comments
Deck	**4**	*Provide brief commentary to explain reasoning behind rating assigned and highlight any conditions of particular concern.*
– Deck Topside	3	*A Rating (1 – 6 using the component-specific rating scale) should also be provided for each of the main element types in the component. These ratings help to justify the Component Rating and clarify which elements may be primarily contributing to the overall component rating.* *Photos to illustrate the conditions of concern should be included in the Inspection Summary Form and cited here.* *These ratings are not (directly) used to determine the Overall Asset Condition Rating (ACR). (See Module 5.3).*
– Deck Underside	5	
Superstructure	**5**	Deck beam conditions are minor and not extensive.
– Deck Beams	5	
Substructure	**5**	Substructure elements generally have minor distress or deterioration conditions that are not extensive.
– Shear Walls	4	Several shear wall locations show minor cracking (CS2). One location (SW 11-2 at Column Line D-15) has a severe rating due to a wide shear crack that warrants additional investigation. See Figure 1 and Figure 2.
– Piles	5	Pile conditions are minor and not extensive.
– Pile Caps	5	Pile cap conditions are minor and not extensive

Component

Element types for component

Component Ratings
- *Primary information of interest*
- *Used to determine ACR*

Ratings for Element Types *(for information only)*

Structural Component Ratings and Element Summary

Component / Element(s)	Rating	Comments
Deck	4	*Provide brief commentary to explain reasoning behind rating assigned and highlight any conditions of particular concern.*
– Deck Topside	3	*A Rating (1 – 6 using the component-specific rating scale) should also be provided for each of the main element types in the component. These ratings help to justify the Component Rating and clarify which elements may be primarily contributing to the overall component rating.* *Photos to illustrate the conditions of concern should be included in the Inspection Summary Form and cited here.* *These ratings are not (directly) used to determine the Overall Asset Condition Rating (ACR) (See Module 5.3)*
– Deck Underside	5	
Superstructure	5	Deck beam conditions are minor and not extensive.
– Deck Beams	5	
Substructure	5	Substructure elements generally have minor distress or deterioration conditions that are not extensive.
– Shear Walls	4	Several shear wall locations show minor cracking (CS2). One location (SW 11-2 at Column Line D-15) has a severe rating due to a wide shear crack that warrants additional investigation. See Figure 1 and Figure 2.
– Piles	5	Pile conditions are minor and not extensive.
– Pile Caps	5	Pile cap conditions are minor and not extensive

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Discussion

- Why can't the Component Rating be determined using a formula?

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Discussion

- What information, factors, etc., should be considered in the process of condition assessment for components? *(choose all that apply)*
  a) Element condition
  b) Intended use and design loads for asset
  c) Component structural system(s) and layout
  d) Forms of distress and deterioration and related mechanisms
  e) Value of the asset or component
  f) Strength and serviceability requirements for maritime structures

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Discussion

- Why are there different Component Rating criteria for Structural and Berthing, Shoreline and Ancillary Components?

Practical Exercise 6.2

- Complete the Inspection Summary Form from Module 4's Practical Exercise
  - Unit B CD 23
  - Use attached updated Element Inspection Form for element condition information
  - Fill in the Component Rating Column on the Inspection Summary Form from Module 4

PE6.2 Situation: Your inspection team completed the Element Inspection Form for CD 23 Unit B and the final Element Inspection Form is attached. Recall you partially filled out the Element Inspection Form in Module 4.3, but now all the element conditions have been incorporated into the form. You now have the following inspection documentation for CD 23 Unit B:

- **Element Inspection Form** for CD 23 Unit B: the "Element Condition Summary by Component" portion of the final Element Inspection Form is attached. This form presents the quantitative summary of the observed element condition states for each element type.
- **CD 23 Inspection Summary form:** You received this form in Module 4. It includes a partially completed "Structural Component Ratings and Element Summary" table; the descriptions and narratives of element and component condition are provided, but the component ratings have not been assigned. The form also includes photos showing representative damage conditions, along with drawings of the basic structural layout and elements.

Task: Using the information on the Element Inspection Form (Element Condition Summary) on the following pages and the Inspection Summary Form you received in Module 4, complete the component ratings on the CD 23 Inspection Summary Form you received in Module 4.

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Maritime Asset
Elemental Inspection Form

Property:	Turning Basin North	**Asset ID:**	CD 23
Inspection Type:	☒ Baseline ☐ Routine ☐ Due Diligence	**Inspection Date(s):**	FEB 29, 2017
Inspection Team:	Inspections R Us, Sponge Bob Square Pants Inspectors		
Structural Component(s):	☒ Deck ☐ Slab ☒ Superstructure ☒ Substructure ☐ Bearings ☒ Joints ☒ Bulkhead		
Berthing Component(s):	☒ Fender Systems ☒ Mooring Systems		
Shoreline Component(s):	☐ Protected Shoreline ☐ Unprotected Shoreline		
Ancillary Component(s):	☐ Crane and Train Rails ☐ Guards ☐ Paint and Markings ☐ Personnel Access Systems ☐ Utility Systems		

Element Condition Summary by Component

STRUCTURAL COMPONENT - DECK ELEMENTS

Element Type	Description	Condition	Condition State CS1	CS2	CS3	CS4	Condition Quantity	Unit
DT-RC	Reinforced	NONE	4588				4588	SF
	Concrete	ABWC		648			648	SF
	Deck Topside	CRCK			4		4	SF
	(SF)	DLSP			2200		2200	SF
		Total	4588	648	2204	0	7440	SF
DU-RC	Reinforced	NONE	7430				7430	SF
	Concrete	DLSP			10		10	SF
	Deck	EXPR		[10]			0	SF
	Underside							
	(SF)							
		Total	7430		10		7440	SF

STRUCTURAL COMPONENT - SUPERSTRUCTURE ELEMENTS

Element Type	Description	Condition	Condition State CS1	CS2	CS3	CS4	Condition Quantity	Unit
DB-RC	Reinforced	NONE	321				321	LF
	Concrete	CRKC		264	66	4	334	LF
	Deck Beam	DLSP		660	3[2]		663	LF
	(LF)	EXPR		[3]		2	2	LF
		Total	321	924	69	6	1320	LF

STRUCTURAL COMPONENT - SUBSTRUCTURE ELEMENTS

Element Type	Description	Condition	CS1	CS2	CS3	CS4	Condition Quantity	Unit
CO-RC PS-RC	Reinforced Concrete Columns/Pilasters (LF)	NONE	7				7	LF
		DLSP		22[12]	1[3]		23	LF
		EXPR			3	6	9	LF
		LSBR				6	6	LF
		Total	7	22	4	12	45	LF
SW-RC	Reinforced Concrete Shear Wall	None	50				50	LF
		DLSP		60[120]	20[60]		80	LF
		EXPR		120	60		180	LF
		Total	50	180	80		310	LF
PC-RC	Reinforced Concrete Pile Cap	None	245				245	LF
		DLSP		65			65	LF
		Total	245	65			310	LF
DS-RC	Reinforced Concrete Drilled Shaft	None	30					EA
		Total					30	EA
ST-RC	Reinforced Concrete Strut	None	595				595	LF
		CRCK		470	255		725	LF
		Total	595	470	255		1320	LF

STRUCTURAL COMPONENT - JOINT AND BEARING ELEMENTS

Element Type	Description	Condition	CS1	CS2	CS3	CS4	Condition Quantity	Unit
JN-AU	Armored Open Expansion Joint (LF)	NONE	124				124	LF
		Total	124				124	LF

STRUCTURAL COMPONENT - BULKHEAD ELEMENTS

Element Type	Description	Condition	Condition State CS1	CS2	CS3	CS4	Condition Quantity	Unit
BW-CS	CS Bulkhead Wall	NONE	0				0	LF
		CORR		48	72		120	LF
		Total	0	48	72		120	LF
PC-RC	CS Bulkhead Wale Beam	NONE	0					LF
		DLSP		120			120	LF
		Total		120			120	LF

BERTHING COMPONENT - FENDER ELEMENTS

Element Type	Description	Condition	Condition State CS1	CS2	CS3	CS4	Condition Quantity	Unit
FP-CS	CS Fender Pile (EA)	NONE						EA
		CORR			5	2	7	EA
		Total			5	2	7	EA
SF-CS	CS Support Framing (LF)	NONE	50				50	LF
		DIST			25		25	LF
		CORR		120	40		160	LF
		CONX		1		4	5	LF
		Total	50	121	65	4	240	LF
FF-TIM	Timber Facing (EA)	NONE	18				18	EA
		FNFA			7	8	15	EA
		DECY		9	7	3	19	EA
		MISS			10		10	EA
		CONX		6	4		10	EA
		Total	18	15	28	11	72	EA
FA-RB	OTH Cylindrical Rubber Fender Absorption Unit (EA)	NONE	2				2	EA
		BULG		2	2		4	EA
		Total	2	2	2		6	EA

BERTHING COMPONENT - MOORING ELEMENTS

Element Type	Description	Condition	Condition State CS1	CS2	CS3	CS4	Condition Quantity	Unit
CL-MT	Metal Cleat	NONE						EA
	(EA)	MRFT		3[1]			3	EA
		CONX		[3]	1		1	EA
		Total		3	1		4	EA

Element Records

Detailed element inspection results are not provided due to space limitations.

Practical Exercise 6.2 Solution

Structural Component Ratings and Element Summary

Component/Element(s)	Rating	Comments
Deck - RC Deck Topside		Overall, approximately 30% of the deck topside was identified as delaminated or spalled. The topside of the concrete deck was scarred and gouged from mechanical impact at numerous locations, with gouges up to 1 inch deep.
- RC Deck Underside		All -five exhibited concrete delamination or spalls. Some of these delaminations were observed to occur randomly within the field of the deck, but most delaminations and spalls were concentrated along deck construction joints, cracks, and penetrations. On average, approximately 7 percent of the deck underside exhibited spalls or delaminations.
Superstructure - RC Deck Beam		Approximately 25% of the beams were in good condition, and about 75% of the deck beams were rated as fair condition. The distress in these beams mainly consisted of random small spalls and delaminations on the vertical or bottom faces of the beam (Figure 5). Most beams exhibited a horizontal crack along the top of the beam near the beam-to-deck transition (Figure 6), and some exhibited shear cracking (Figure 7).

Table 6.1. Ratings for Structural and Berthing Components

Rating	Description
6 Good	Minor or no problems noted. Also applies to newly constructed or rehabilitated components.
5 Satisfactory	Minor defects, damage or deterioration - not extensive.
4 Fair	Extensive minor or limited moderate defects, damage or deterioration. Structural capacity of primary structural components and functional use of fender or mooring systems are not affected.
3 Poor	Moderate or extensive defects, damage or deterioration that affects structural capacity of primary structural components or functional use of fender or mooring system components.
2 Serious	Defects, damage or deterioration significantly reduces structural capacity of primary structural components or reduces functional use of fender or mooring systems.
1 Critical	Advanced defects, damage or deterioration with localized failure(s) of components imminent or observed. Immediate load or use restrictions, including closing of the asset should be considered.

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Structural Component Ratings and Element Summary

Component/Element(s)	Rating	Comments
Substructure		
- RC Columns/Pilasters		Approx. 75% of columns and pilasters had some concrete delamination or spalls (fair to poor). Column F11 was noted to exhibit more than 50% section loss (severe) of the longitudinal corner reinforcement exposed by spalling (Figure 8). Pilaster A16 and Columns F11 and F16 were observed to have cracking and spalling at the bearing area where the deck girders and beams are supported (Figure 9) resulting in severe loss of bearing.
- RC Shear Walls		Spalling and delamination were frequently observed at the bottom of the walls above the pile cap (Figure 10). Spalling and delamination (fair to poor condition) was observed on approximately 80% of the shear walls. Delaminations have exposed reinforcement (fair to poor) over approximately 60% of wall length.
- RC Pile Caps		Pile caps exhibited top surface delamination (fair) over approximately 25% of length (Figure 11).
- RC Drilled Shaft		Generally, the piers and collars were in good condition. No scour was reported.
- RC Strut		In 55% of the strut beams, longitudinal cracking (fair to poor) was observed to extend for at least half of the strut beam length.

Table 6.1. Ratings for Structural and Berthing Components

Rating	Description
6 Good	Minor or no problems noted. Also applies to newly constructed or rehabilitated components.
5 Satisfactory	Minor defects, damage or deterioration - not extensive.
4 Fair	Extensive minor or limited moderate defects, damage or deterioration. Structural capacity of primary structural components and functional use of fender or mooring systems are not affected.
3 Poor	Moderate or extensive defects, damage or deterioration that affects structural capacity of primary structural components or functional use of fender or mooring system components.
2 Serious	Defects, damage or deterioration significantly reduces structural capacity of primary structural components or reduces functional use of fender or mooring systems.
1 Critical	Advanced defects, damage or deterioration with localized failure(s) of components imminent or observed. Immediate load or use restrictions, including closing of the asset should be considered.

Structural Component Ratings and Element Summary

Component/Element(s)	Rating	Comments
Joints and Bearings		
- Armored Open Expansion Joint		The armor was gouged along column line 16 but otherwise adhered and aligned (good cond). Joint was undamaged along column line 11 (good).
Bulkhead		
- CS Bulkhead Wall		Evidence of previous moderate to severe pitting of the sheet piling was generally visible in the bottom 12 inches of the exposed portion of sheet piles above wale beam (Figure 12). Section loss is generally minor to moderate (fair condition).
- RC Bulkhead Wall	n/a	Not inspected
- RC Bulkhead Pile Cap	n/a	Not inspected
- CS Bulkhead Wale Beam		The concrete encasement for the tieback whaler along the bulkhead wall exhibited minor surface spalls and delamination along the top edge at some locations, as shown in Figure 13. Fair condition along entire length.
- CS Bulkhead Tie Rod	n/a	Not inspected

Table 6.1. Ratings for Structural and Berthing Components

Rating	Description
6 Good	Minor or no problems noted. Also applies to newly constructed or rehabilitated components.
5 Satisfactory	Minor defects, damage or deterioration - not extensive.
4 Fair	Extensive minor or limited moderate defects, damage or deterioration. Structural capacity of primary structural components and functional use of fender or mooring systems are not affected.
3 Poor	Moderate or extensive defects, damage or deterioration that affects structural capacity of primary structural components or functional use of fender or mooring system components.
2 Serious	Defects, damage or deterioration significantly reduces structural capacity of primary structural components or reduces functional use of fender or mooring systems.
1 Critical	Advanced defects, damage or deterioration with localized failure(s) of components imminent or observed. Immediate load or use restrictions, including closing of the asset should be considered.

Berthing Component Ratings and Element Summary

Component/Element(s)	Rating	Comments
Fender System		
- CS Fender Pile		Isolated moderate to severe corrosion of fender piles within the splash zone in all bays.
- CS Support Framing		Isolated moderate to severe corrosion of fender support elements within splash zone for all bays (from bottom element to 36 in. above). Buckled or distorted fender elements noted in 4 locations. Fractured bottom connection of diagonal brace (severe corrosion) in Bay 6-7. Severe corrosion and failed pinned connections at Bent 11 and 16 (Figure 14).
- Timber Facing		Moderate to severe wood decay/splitting of timber lagging elements in 4 bays. Severe impact damage fractured lagging observed at 4 locations. Lagging missing at 10 locations (primarily bottom 2 rows). Moderate to severe corrosion of anchor bolts/nuts in splash zone.
- OTH Cylindrical Rubber Fender Absorption Unit		Tears or severe cracking in rubber dampers at Bents 18, and 19, moderate cracks in dampers at Bents 9 and 20.
Mooring System		
- Metal Cleat		Minor surface corrosion and coating failure were observed at all cleats. Moderate corrosion of plate washers for cleat anchor rods noted at all cleats.

Table 6.1. Ratings for Structural and Berthing Components

Rating	Description
6 Good	Minor or no problems noted. Also applies to newly constructed or rehabilitated components.
5 Satisfactory	Minor defects, damage or deterioration - not extensive.
4 Fair	Extensive minor or limited moderate defects, damage or deterioration. Structural capacity of primary structural components and functional use of fender or mooring systems are not affected.
3 Poor	Moderate or extensive defects, damage or deterioration that affects structural capacity of primary structural components or functional use of fender or mooring system components.
2 Serious	Defects, damage or deterioration significantly reduces structural capacity of primary structural components or reduces functional use of fender or mooring systems.
1 Critical	Advanced defects, damage or deterioration with localized failure(s) of components imminent or observed. Immediate load or use restrictions, including closing of the asset should be considered.

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Module 6.3

Overall Asset Condition Rating

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Module 6.3 Objectives

Overall Asset Condition Rating

- Discuss the relationships between component ratings and overall asset condition rating
- Explain how component rating data are used to determine the overall asset condition rating
- Describe the use of FICAP Inspection Summary Form to record overall asset condition rating information

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FICAP Asset Condition Assessment

- Applicable to Baseline, Routine and Due Diligence Inspections
  - May be applied to In-Depth Inspections
- Two aspects:
  - Numerical “Asset Condition Rating” **(ACR)**
    – Based on component ratings
  - Qualitative description of overall asset condition
    – Based on engineering interpretation of component condition

FICAP Asset Condition Assessment

Key Aspects

- Asset condition determined based on component condition and ratings
- Determined relative to assumed as-built condition of asset
- Intended to reflect physical conditions including the effects of deterioration or damage
- **<u>Not</u>** intended to rate the asset in regards to current or future use or loading (may be different from time of original construction)

Overall Asset Condition Rating (ACR) (Section 6.4)

- Numerical rating (score out of 100) intended to reflect the overall condition of the asset
- Based on ***component ratings*** assigned to structural and non-structural components of asset
- Numerical score allows comparison of asset condition within PHA inventory
  - Intended to be supplemented with qualitative asset condition assessment (Section 6.4.4)
  - Interpretation and use of ACR done by PHA

Overall Asset Condition Rating (ACR) (Section 6.4)

$ACR = SR + FR \quad 0 \leq AR \leq 100$ for all assets except for shorelines

$ACR = 4 \times FR \quad 0 \leq AR \leq 100$ for shoreline assets

Where:

ACR = 100 corresponds to an asset in new or near new condition
0 corresponds to an asset in critical condition where structural integrity and functional use has been compromised

SR = Structural Component Combined Rating
= combined rating based on condition of structural components with a maximum score of 75. Includes deck, superstructure, substructure, and bulkhead components

FR = Functional Component Combined Rating
= combined rating based on condition of functional components with a maximum score of 25. Includes fender and mooring systems, joints, bearings, shoreline, and ancillary components

Overall Asset Condition Rating (ACR) (Section 6.4)

- Upper bounds on SR and FR reflect relative importance of the structural and non-structural components to structural and functional adequacy of the asset
  - SR ≤ 75
  - FR ≤ 25

Structural components have greater influence on Asset Condition Rating

- SR and FR are determined based on component ratings
  - Start from upper bound values and apply deductions based on component condition

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Structural Component Combined Rating (SR) (Section 6.4.1)

- For all assest except bulkhead and shoreline only assets

$$SR = \underset{\text{upper bound}}{75} - \underbrace{(SP + SB + DK + BH)}_{\text{deductions}} \geq 0$$

- SP = deduction based on superstructure component rating
- SB = deduction based on substructure component rating
- DK = deduction based on deck component rating
- BH = deduction based on bulkhead component rating

Structural Component Combined Rating (SR) (Section 6.4.1)

- For bulkhead assets

$$SR = \underbrace{75}_{\text{upper bound}} - \underbrace{(5/4 \times BH)}_{\text{deduction}} \geq 0$$

- BH = deduction based on bulkhead component rating

Structural Component Combined Rating (SR) (Section 6.4.1 – Table 6.5: SR Deduction Table)

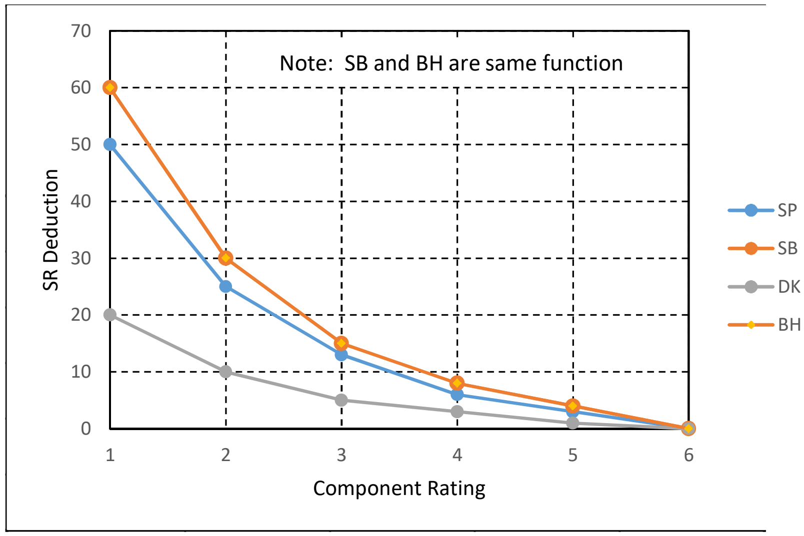
SR deductions are based on:

- Significance of component to the structural integrity of the asset
- Significance of component to the functional adequacy of the asset
- Ease of maintenance, repair, and/or replacement of component

Component Rating	SR Deductions by Component			
	Super-structure (SP)	Sub-structure (SB)	Deck (DK)	Bulkhead (BH)
1 (Critical)	50	60	20	60
2	25	30	10	30
3	13	15	5	15
4	6	8	3	8
5	3	4	1	4
6 (Good)	0	0	0	0

Structural Component Combined Rating (SR) (Section 6.4.1 – Table 6.5: SR Deduction Table)

- Max. deduction for a given component (for Rating of 1) chosen based on structural and functional significance and ease of repair
- Min. deduction is zero (for Rating of 6)
- Geometric series (scale factor of 2) used to determine deductions for Component Ratings of 2 through 5



Functional Component Combined Rating (FR) (Section 6.4.2)

$$FR = \underbrace{25}_{\text{upper bound}} - (\underbrace{[SL\_WS] + [JN\_BR] + FS + MR + SH + AC}_{\text{deductions}}) \geq 0$$

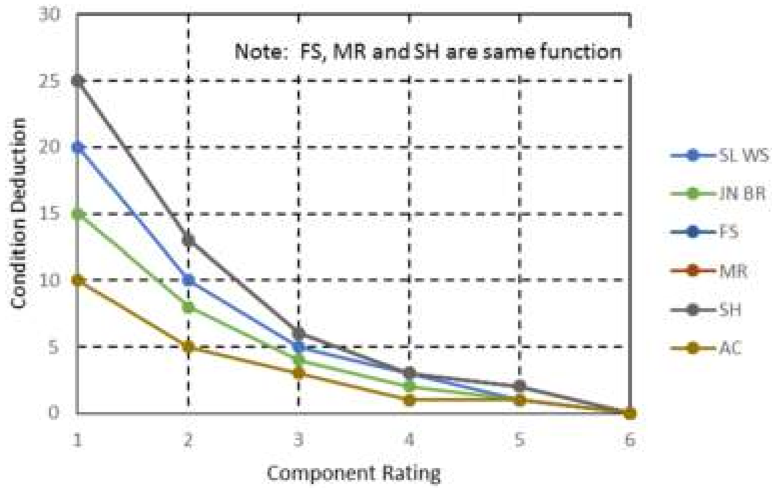
- SL_WS = deduction for slab & wear surface component rating
- JN_BR = deduction for joints & bearing component rating
- FS = deduction for fender system component rating
- MR = deduction for mooring system component rating
- SH = deduction for shoreline component rating
- AC = deduction for ancillary component rating

Functional Component Combined Rating (FR) (Section 6.4.2 – Table 6.6: FR Deduction Table)

Component Rating	FR Deductions by Component					
	Slabs & Wearing Surfaces	Joints & Bearings	Fender System	Mooring System	Shoreline	Ancillary Comp.
	SL_WS	JN_BR	FS	MR	SH	AC
1 (Critical)	20	15	25	25	25	10
2	10	8	13	13	13	5
3	5	4	6	6	6	3
4	3	2	3	3	3	1
5	1	1	2	2	2	1
6 (Good)	0	0	0	0	0	0

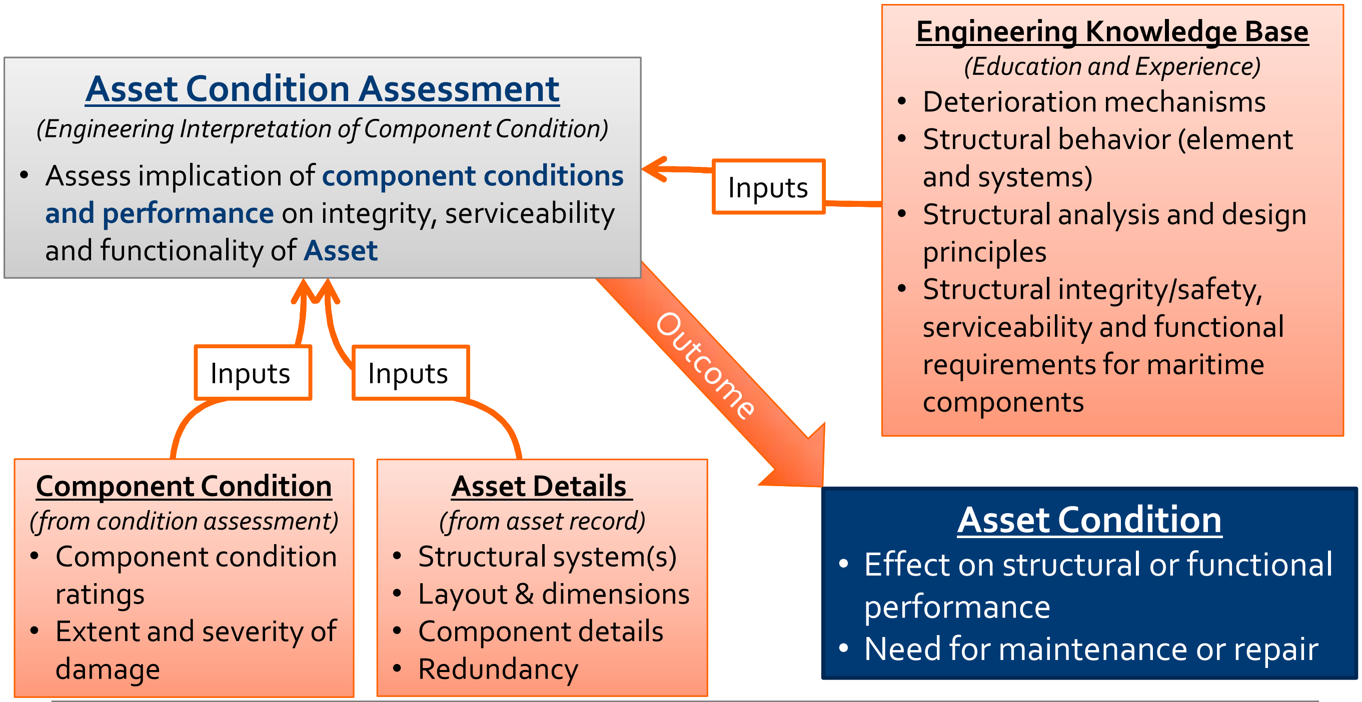
Functional Component Combined Rating (FR) (Section 6.4.2 – Table 6.6: FR Deduction Table)

- Max. deduction for a given component (for Rating of 1) chosen based on functional significance and ease of repair
- Min. deduction is zero (for Rating of 6)
- Geometric series (scale factor of 2) used to determine deductions for Component Ratings of 2 through 5



Description of Overall Asset Condition (Section 6.4.4)

- Single numerical rating (ACR) does not provide sufficient information to fully guide asset management decisions and follow-up actions
- Must be supplemented with a narrative condition assessment to provide a more complete evaluation of the overall structural performance and adequacy of the asset
  - Based on engineering interpretation of component condition
    - – Consideration of implication of component condition on asset condition



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Description of Overall Asset Condition
(Section 6.4.4)

- Narrative must include an overall qualitative description of the asset condition:
  - Brief discussion of the ratings for all components of the asset
  - Discuss implications of the reported component ratings on the overall asset condition rating and recommended actions
  - Discuss recommended follow-up actions
- Reported along with ACR on FICAP Inspection Summary Form

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Maritime Asset
Inspection Summary

Form MSIS (V1.0)
Property – Asset ID
MMMM DD, YYYY
Page 2 of 7

Overall Asset Condition

Provide narrative of asset's overall condition. Note significant areas of distress and reference action items for these as warranted. For routine inspection, note changes in condition from previous inspections.

Structural Component Ratings and Element Summary

Component / Element(s)	Rating	Comments
Deck	#	Brief narrative describing reason for rating.
– RC Deck		Comment regarding condition; reference figures.
Slab on Grade	#	Narrative.
– RC Slab		Comments.
Superstructure	#	Narrative.
– RC Deck Beams		Comments.
Substructure	#	Narrative.
– RC Shear Walls		Comments.
– RC Pile Caps		Comments.
– TIM Piles		Comments.
Bearings	N/A	–
Joints	N/A	–
Bulkhead	#	Narrative.
– TIM Sheet Pile Wall		Comments.

similar format for other components...

Berthing Component Ratings and Element Summary

Component / Element(s)	Rating	Comments
Fender System	#	Comments.
Mooring System	#	Comments.

Module 6.3 Practical Exercise

- Determine ACR for a hypothetical wharf asset
  - Provided with Component Ratings
  - Determine deductions for SR and FR
  - Calculate ACR
  - See FICAP Manual Section 6.4.3 for additional examples

Module 6.3 Practical Exercise: Calculation of ACR

- Component Ratings for hypothetical wharf asset:

Component	Rating	Comment
Superstructure	4	Extensive concrete cracking (CS2 to CS3). Negligible effect on structural capacity.
Substructure	4	Localized moderate (impact) damage (CS4) to shear wall and pile cap in Bay 9A. Localized reduction in structural capacity likely.
Deck	4	Widespread delaminations and spalling (CS2 to CS3). Negligible effect on structural capacity.
Bulkhead	5	Minor surface corrosion (CS2) in several areas.
Fender System	1	Fender system missing in all bays. Rubber tires suspended by ropes or chains to act as bumpers.
Mooring System	4	Widespread surface corrosion (CS2) on bollards. Negligible effect on structural capacity.
Ancillary Comp.	3	Wastewater utility line suspended from deck has numerous broken hangers.

Exercise: Calculation of ACR
Determine Structural Component Combined Rating (SR)

Component	Rating	Deduction	Comment
Superstructure	4	SP =	
Substructure	4	SB =	
Deck	4	DK =	
Bulkhead	5	BH =	

Calculate: *SR = 75 -*

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Exercise: Calculation of ACR
Determine Functional Component Combined Rating (FR)

Component	Rating	Deduction	Comment
Fender System	1	FS =	
Mooring System	4	MR =	
Ancillary Comp.	3	AC =	

Calculate: *FR = 25 -*

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Exercise: Calculation of ACR

Calculate: $ACR = SR + FR$

$=$

- Discussion:
  - What if component rating for substructure was decreased to 3?
    (assume significance of impact damage is deemed more severe)
  - What if component rating for ancillary components was decreased to 1?
    (assume impending hanger failures may lead to leakage of sewage into waterway)

Exercise: Calculation of ACR
Discussion of Reduced Substructure Rating

- Component rating for substructure decreased to 3
  (significance of impact damage is deemed more severe)
  - Revised SB =
  - Recalculate SR =
  - Recalculate ACR =

Exercise: Calculation of ACR
Discussion of Reduced Ancillary Component Rating

- Component rating for ancillary components decreased to 1 *(assume impending hanger failures may lead to leakage of sewage into waterway)*
  - Revised AC =
  - Recalculate FR =
  - Recalculate ACR =

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Module 6.4

Condition Rating for Post-Event Inspections

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Module 6.4 Objectives
Condition Rating for Post-Event Inspections

- Summarize FICAP damage rating system for post-event inspections
- Describe the application of the post-event rating system

FICAP Post-Event Inspections Purpose and Scope

- Immediate, rapid overall assessment of maritime asset after an extreme event (e.g., hurricane, flood, vessel impact)
- Determine whether event caused significant damage that requires repairs, restricted use, or closing of the asset
- May be conducted by PHA staff or on-call engineering firm
- Outcome:
  - Damage rating for major components of asset
  - Recommended follow-up actions with prioritization

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FICAP Post-Event Inspections
Factors to Consider

- Inspection typically limited to visual assessment of damaged above water portion of the asset
  - If asset type or nature of event suggests risk to underwater portion of asset, inspection scope should be expanded
- Detailed element-based inspection is not required
  - Comprehensive documentation of element condition states is not within the scope
  - Specific element conditions arising from the event should be noted in the inspection report

FICAP Post-Event Inspections
Factors to Consider

- Each major component of asset is assigned a damage rating
  - Based only on event-related conditions
  - Pre-existing damage, deterioration, or defects should not influence the post-event ratings
  - Conditions requiring immediate attention (e.g., compromised structural integrity or facility operations, potential for property or environmental damage) should be noted and addressed in the follow-up actions, regardless of cause.

Condition Rating for Post-Event Inspections
(Section 6.3)

- FICAP ratings based on ASCE 130 (2015)
- Four level rating scheme (Table 6.4)
  - Ranges from:
    A (no event-induced damage - no further action required) to D (major damage - urgent remedial measures required)
  - Use of Rating Scale with letters instead of numbers helps to distinguish inspection objectives and outcomes from other inspection types

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Condition Rating for Post-Event Inspections
(Section 6.3)

- Ratings are applied to major components of the asset
  - Should reflect overall condition (degree of damage) of the component resulting from the event
  - Severity and extent of the damage should be considered along with structural and functional implications
- Damage ratings should be accompanied by specification of follow-up actions (e.g., no action required, repairs, further inspection, emergency actions)
  - See Chp 7 (Module 5)

Condition Rating for Post-Event Inspections

(Section 6.3, Table 6.4)

Rating	Description
A	No significant event-induced damage observed; no further action is required.
B	Minor to moderate event-induced damage observed, but all primary structural elements are sound. Repairs may be required, but the priority of repairs is low.
C	Moderate to major event-induced damage observed that may have significantly affected the structural capacity of primary elements and components. Repairs are necessary on a priority basis. Loading or use restrictions may be necessary.
D	Major event-induced damage has resulted in localized or widespread failure of primary structural components. Additional failures are possible or likely to occur. Urgent remedial attention is necessary. Immediate load or use restrictions, including closing of the asset should be considered.
Applicable Component Types: All	

Consider:
- Overall damage to component based on rapid visual inspection
- Need for repairs
- Need for restriction of use

Not intended to include element-based inspection

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Discussion

- What are the primary differences between the condition assessment for a Post-Event Inspection and Baseline or Routine Inspection?
  - ☐
  - ☐
  - ☐
  - ☐

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Module 6 Wrap-up
Module Objectives

- Summarize FICAP approach to condition assessment of components and assets
- Assign component ratings for structural and berthing, shoreline, and ancillary components
- Use component ratings to determine the overall asset condition rating
- Summarize FICAP damage rating system for post-event inspections
- Use of FICAP Inspection Summary Form to record condition assessment information

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END OF MODULE
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Facility Inspection & Condition Assessment Program (FICAP)

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Documentation and Reporting Requirements

Module 7

Module Objectives

- Describe overall documentation and reporting requirements for each type of inspection.
- Describe the purpose of each type of documentation required by the FICAP.

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Module Resources

- FICAP Manual Chapter 8: Documentation and Reporting

- FICAP Manual Inspection Forms
  - FICAP Manual Appendix F

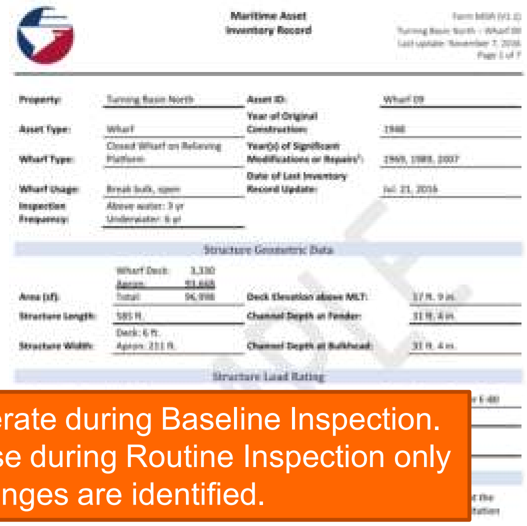
Documentation Overview

Basic asset documentation:	Maritime Asset Inventory Record		Standard Drawing Set	
Inspection forms:	Inspection Summary	Inspection History	Element Form	Follow-Up Action Form
Submission to PHA:	PHA Database			

Maritime Asset Inventory Record
(Section 8.2)

Record of as-built condition of asset.

<u>Includes:</u> *Asset Identification*
Asset Classification and Type
Original Date of Construction
Date(s) of Rehabilitation or Modification
Inspection Frequency
Geometric Data
Load Capacity
Asset History
Reference Drawing List
Components and Elements
Figures
Revision History



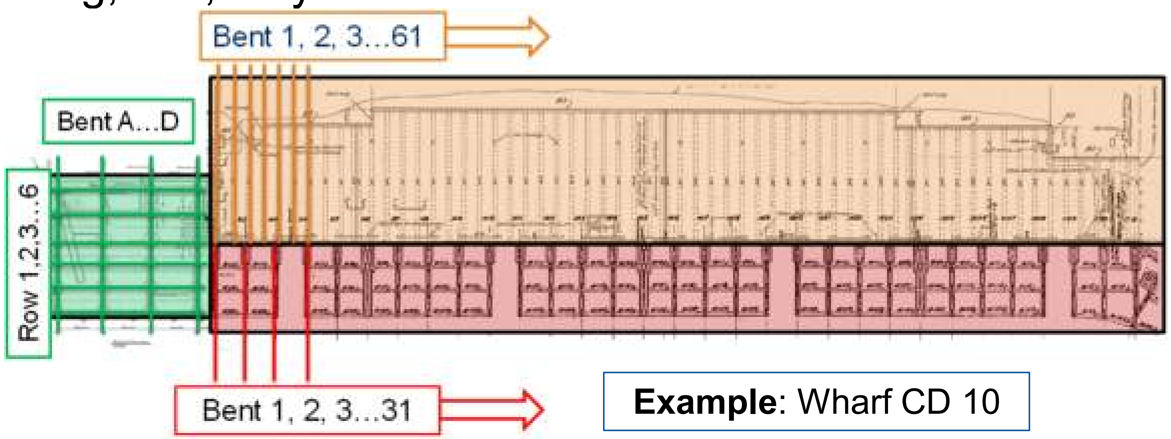
Generate during Baseline Inspection. Revise during Routine Inspection only if changes are identified.

Construction and Inspection Drawings

- PHA has extensive database of drawings for maritime assets
  - Approx. 40,000 records
  - Structural, Civil, MEP drawings
  - Searchable by Terminal, Dock
- Current configuration of a particular asset may be the result of multiple alterations performed years apart and recorded on different drawing sets
  - Cumulative as-builts do not exist for most PHA assets

Construction and Inspection Drawings

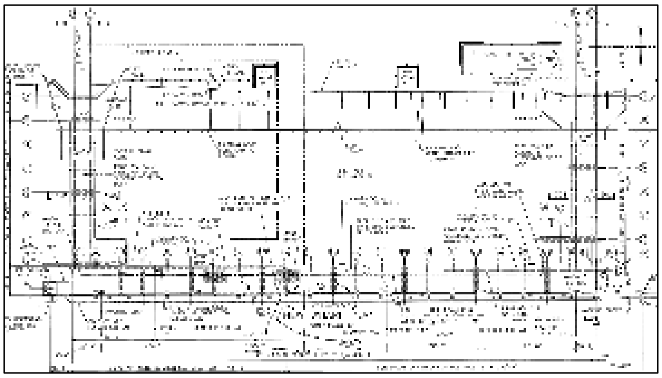
- Where alterations have been performed, grid lines, element naming, etc., may not be consistent

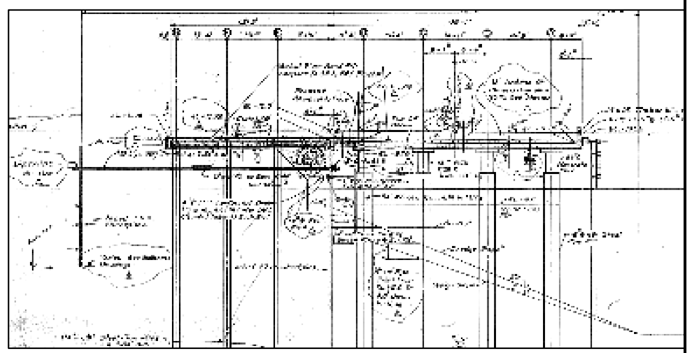


Example: Wharf CD 10

Construction and Inspection Drawings

- Original construction drawings may be too complicated or cluttered to use as inspection drawings





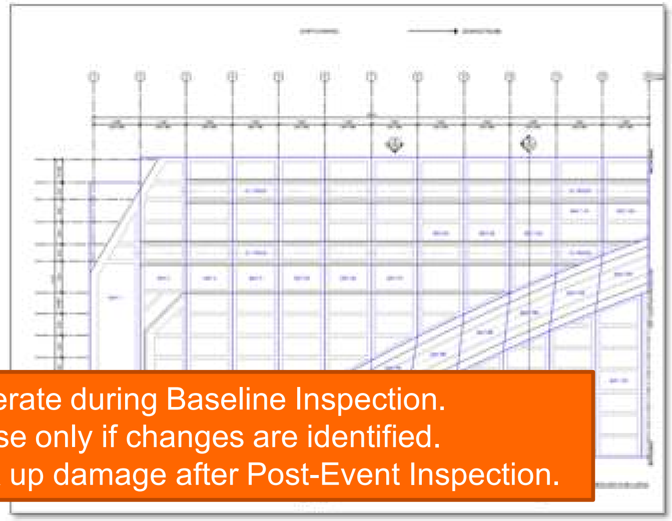
Standard Inspection Drawing Set (Section 8.3)

- FICAP Manual defines ***Standard Inspection Drawing Set*** to be created during Baseline Inspection:
  - Provides schematic, cumulative as-built of the asset
    - Verify as part of Baseline Inspection
  - Defines consistent grid lines and naming scheme for elements
    - Inspections, modifications, and repairs can quickly and accurately identify and locate each element for documentation and reporting purposes
  - Ten standard drawing types are defined (see Section 8.3, Table 8.1)

Standard Drawing Set (Section 8.3)

Ten standard drawing types:

- *Title Page*
- *Project Information*
- *Bay Plan(s)*
- *Deck Element Plan(s)*
- *Superstructure Element Plan(s)*
- *Substructure Element Plan(s)*
- *Pile and Bulkhead Element Plan(s)*
- *Ancillary and Mooring Element Plan(s)*
- *Typical Sections*
- *Typical Elevations*



Generate during Baseline Inspection.
Revise only if changes are identified.
Mark up damage after Post-Event Inspection.

See Appendix G for sample set

Inspection Summary
(Section 8.4)

Summarizes condition assessment findings for an asset and its components.

Includes: *Asset Identification*
Inspection Information
Inspection Procedures
Certification
Overall Asset Condition
Component Ratings and Element Summaries
Figures

Required for all inspection types.


Maritime Asset
Inspection Summary

Property: Property — Asset ID: Asset ID
Inspection Type: ☐ Baseline ☐ Routine ☐ Special — Inspection Date(s): MMMM DD, YYYY
Scope of Inspection: [Entire Asset] / [Limited: Bays ## to ##]
Inspection Firm(s): Prime: [Firm Name]
Underwater: [Firm Name]
Other (role): [Firm Name]
Reported By: [1. Inspector] — Report Date: MMMM DD, YYYY
FICAP Manual Version/Date: Version #.#, dated MMMM DD, YYYY — Variances from FICAP Procedure: None

Seal of Responsible Engineer

I hereby certify this inspection was performed under my direct supervision and control and to the best of my professional knowledge complies with the FICAP Manual and applicable codes.

Signed:
Name:
Texas License No.:
Date: Expires:

Inspection Team Members

Project Manager:
Inspection Team Leader(s): Underwater Team Leader:
Inspection Team Members: Underwater Team Member:

Inspection History
(Section 8.5)

Record of all inspections performed for the asset.

Includes: *Asset Identification*
Date of Inspection
Inspection Type
Inspection Prime Firm
Component Rating
Summaries and Overall
Asset Condition

Generate during baseline inspection.
Update after each subsequent inspection.


Maritime Asset
Inspection History

Property:	Property	Asset ID:	Asset ID
Asset Classification:	Wharf	Year of Original Construction:	YYYY
Inspection Frequency:	Above water: 3 yr Underwater: 6 yr	Year(s) of Significant Modifications or Repairs	YYYY, YYYY, YYYY

Dates of Inspections, Asset, and Component Ratings

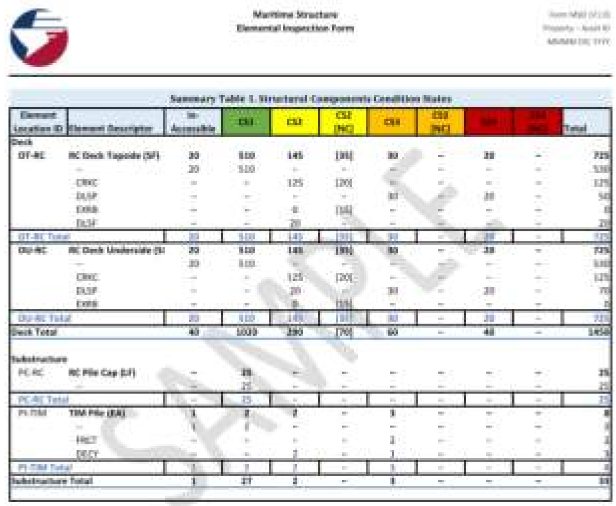
Date	YYYY-MM	YYYY-MM	YYYY-MM			
Inspection Type	Baseline	Routine (AW)	Post-Event (UW)			
Inspection Firm: Above Water	Prime	Prime	Prime			
Inspection Firm: Underwater	UW	-	UW			
Asset Condition Rating (ACR)	##	##	N/A			
Structural Components (SR)	##	##	N/A			
Deck	#	#	N/A			
Slab on Grade	#	#	N/A			
Superstructure	#	#	N/A			
Substructure	#	#	#			
Bearings	#	#	N/A			
Joints	#	#	N/A			
Bulkhead	#	#	N/A			
Berthing Components (FR)	##	##	N/A			
Fender System	#	#	#			
Mooring System	#	#	N/A			
Shoreline Components (RR)	##	##	N/A			

Element Inspection Form (Section 8.6)

Record of element-level observations for an asset.

Includes: *Component and Asset Identification*
Component Summary
element Record
Photographs

Generate during Baseline Inspection. Use for Routine and Due Diligence Inspections.



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Follow-Up Action Form (Section 8.7)

Summary of recommended follow-up actions.

Includes: *Asset Identification*
Inspection Information
Follow-Up Actions, Justification and Prioritization
Photographs

Required for all inspection types.

Deliverables: Baseline Inspection (Section 8.8)

Basic asset documentation:	Maritime Asset Inventory Record		Standard Drawing Set	
Inspection forms:	Inspection Summary	Inspection History	Element Form	Follow-Up Action Form
Submission to PHA:	PHA Database			

Deliverables: Routine Inspection (Section 8.8)

Basic asset documentation:	Maritime Asset Inventory Record (Revise if change identified)	Standard Drawing Set		
Inspection forms:	Inspection Summary	Inspection History	Element Form	Follow-Up Action Form
Submission to PHA:	PHA Database			

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Deliverables: Post-Event Inspection (Section 8.8)

Mark up extent of damage

Basic asset documentation: Maritime Asset Inventory Record | Standard Drawing Set

Inspection forms: Inspection Summary | Inspection History | Element Form | Follow-Up Action Form

Submission to PHA: PHA Database

Deliverables: Due-Diligence Inspection (Section 8.8)

Basic asset documentation:	Maritime Asset Inventory Record — **Revise if change identified**		Standard Drawing Set — **Revise if change identified**	
Inspection forms:	Inspection Summary	Inspection History	Element Form	Follow-Up Action Form
Submission to PHA:	PHA Database			

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Deliverables: In-Depth Inspection

Basic asset documentation:	Maritime Asset Inventory Record	Standard Drawing Set		
Inspection forms:	Inspection Summary	Inspection History	Element Form	Follow-Up Action Form
Submission to PHA:	PHA Database			

Deliverables: In-Depth Inspection (Section 8.8)

<u>Unique deliverables for In-Depth Inspections</u>:

- Objective and scope
- Methodology, including reference to procedures or standardized test methods, as appropriate
- Record of observations and data, including field or laboratory data
- Interpretation of observations and data
- Recommendations
- Summary
- Seal of responsible Design Professional

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Submission to PHA Database (Section 8.9)

All deliverables are submitted to Project Manager in electronic format (PDF/A-1) via PHA's Project Port System.

After approval, inspection findings are submitted into PHA Asset Database.

Database submission includes:
Inventory Record
Inspection Forms
All Referenced Photographs
Inspection Summary

Required for all inspection types.

Module 7 Wrap-up
Module Objectives

- Describe overall documentation and reporting requirements for each type of inspection.
- Describe the purpose of each type of documentation required by the FICAP.

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END OF MODULE

Facility Inspection & Condition Assessment Program (FICAP)

Capstone 2

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Capstone Project 2 Exercise

Name: ________________________

Situation: A Baseline Inspection of CD 26 was performed and has generated the following:

- **Drawings (Appendix A)**
  - Partial plan and elevation views (similar to Standard Inspection Drawings)
- **Element condition**
  - Detailed element-by-element condition states (available upon request)
  - Summary Tables of element condition for Structural and Berthing, Shoreline and Ancillary components (Included as Appendix B)

Additional figures (photos and drawings) of the asset are provided on the following pages to further present the structural system and details of CD 26.

Task: Using the findings of the Baseline Inspection (Capstone Project 1 and information in Appendices A and B herein), complete the condition assessment for CD 26. Document the condition assessment as follows:

- **Inspection Summary Form (Appendix C)**
  - Basic asset information has been input already
  - Some comments and photos illustrating conditions of concern have been added to assist condition assessment process.
  - Inspection Summary Form to be completed by recording the following:

Component Condition Assessment	▪ Perform component condition assessment considering element inspection findings ▪ Assign Component Ratings using FICAP Rating System (see Section 6.2) ▪ Record component ratings on **Inspection Summary Form** o Provide a component rating for each element group as well as the overall component rating. o Where applicable, add comments or discussion of element condition or other factors upon which component rating was based.
Overall Asset Condition Assessment	▪ Determine ACR using Component Ratings assigned based on condition assessment ▪ Prepare qualitative condition assessment (narrative) describing asset condition, sources of concern, etc. ▪ Record on Inspection Summary Form

- **Follow-up Action Form (Appendix D)**
  - Basic asset information has been input already
  - Form to be completed by assigning recommended follow-up actions as warranted.

Background Information

TURNING BASIN TERMINAL
WHARF CITY DOCK 26
Houston, Texas

1. WHARF DESCRIPTION

The wharves along the Turning Basin and Manchester Terminals were constructed at various time periods ranging from the 1910s to 1980s. The wharf known as CD 26 is located toward the south end of the Turning Basin Terminal on the northeast side of the Houston Ship Channel. CD 26 is an open air wharf composed of a reinforced concrete slab supported by reinforced concrete beams spanning between concrete bents spaced at 24 feet on center. Each bent is composed of a concrete shear wall and column on top of a pile cap beam that ties together six belled caissons. A sheet pile bulkhead is driven into the river bed at the landside edge of CD 26. The dock elevation is approximately 15 feet, 1 inch above mean low tide. The fender system, composed of H-piles, steel framing, and timber lagging, protrudes 5 feet, 8-7/8 inches into the harbor off the face of the wharf.

1.1. Description of Structure

The original drawings for CD 26 are dated 1965, and the wharf was reportedly constructed in 1968. These drawings indicate that the length of CD 26 is 600 feet along the harbor line, from where it abuts Wharf CD 25 at its north end to where it meets Wharf CD 27 at its south end[1]. Because the south end of CD 26 is angled, the wharf is only 583 feet, 7 inches long at the sheet pile bulkhead. CD 26 is 69 feet wide from the harbor line to the back of the sheet pile bulkhead. Three sets of railroad tracks and one set of gantry crane tracks run parallel to the harbor line; rails are typically centered over a deck beam, except at cross-overs and curved portions of track. A cross-section of CD 26 reproduced from PHA drawings showing the wharf, piles, and bulkhead is provided in Figure 1, and a plan view of the top surface of CD 26 is provided in Figure 2. On the landside of the sheet pile bulkhead, a 6-inch thick reinforced concrete slab-on-grade pavement extends 233 feet to a concrete access roadway. No portions of the wharf east of the sheet pile bulkhead were included in the assessment.

The wharf structure at CD 26 consists of a typically 8-inch thick reinforced concrete slab spanning across reinforced concrete beams. Where rails are embedded in the top surface (generally between Grid Lines A and E), the structural slab is depressed in elevation and topped by a 7-1/8-inch thick fill slab. Beams are typically 46 inches deep overall and vary in width from 18 inches at the bottom to 24 inches at the top. The beams are aligned parallel to the harbor line and are generally located beneath the rails for the railroad tracks and the gantry crane. As a result, the center-to-center spacing of these beams varies from 4 feet, 10 inches at the railroad tracks to 8 feet, 7 inches in between. The reinforced concrete bents generally consist of a 12-inch thick reinforced concrete shear wall and column supported on a 3-foot, 4- inch wide by 3-foot deep reinforced concrete pile cap beam, tying together the tops of six belled drilled piers. Typically, the shear walls extend 58 feet, 3 inches from the 2-foot, 4-inch thick by 1-foot, 2-inch wide pilaster at the harbor line to the 2-foot square pilaster at Grid Line E. On the landside of Grid Line E, a 2-foot wide by 3-foot deep girder extends to the bulkhead and is supported by a 24-inch by 16-inch reinforced concrete column at Grid Line F.

[1] For the purpose of the report: plan north is parallel to the long axis of the wharf in the direction of CD 25 (west is harbor side, east is land side).

The typical drilled piers at Grid Lines A through E have 29- or 30-inch diameter shafts, with bell diameters varying between 58 and 90 inches, depending on footing location. These piers extend to bottom elevations between 51 feet, 3 inches and 61 feet, 3 inches below mean low tide. The drilled piers at Grid Line F measure 20 inches in diameter and extend to bottom elevations between 43 feet, 3 inches and 48 feet, 3 inches below mean low tide. An elevation view of the typical shear wall and pile bent is provided in Figure 3, while a section cut through the typical shear wall and pile cap is provided in Figure 4.

In addition to the expansion joints at each end of the wharf, there are two 1-inch wide expansion joints in the interior of CD 26 located at Bents 10 and 17. At these locations, the concrete shear wall measures 2 feet, 1 inch wide up to a bearing ledge. Above the bearing ledge, the shear wall is only 8 inches wide and was cast monolithically with the wharf deck on the north side of the expansion joint. On the south side of the expansion joint, a 1-foot wide end beam is cast monolithically with the deck slab and beams, which is supported by and is free to slide on the bearing ledge below. A section through the expansion joint is provided in Figure 5.

Except at the bays south of the expansion joints, adjacent bents are tied together by strut beams located at the top of the pile cap beams. These strut beams measure 14 inches wide by 20 inches deep along Grid Lines B through E, and 18 inches wide by 27 inches along Grid Line A at the harbor line.

The bulkhead wall at the landside edge of CD 26 is composed of BZ IIIB sheet piling. The bulkhead wall is a continuation of the bulkhead wall installed during construction of CD 25, drawings for which are dated 1961. Based on those drawings, the bulkhead wall for CD 25 extends 75 feet, 6-3/8 inches into CD 26. Approximately 508 feet of additional bulkhead was installed for CD 26, which measures 47 feet, 4 inches tall and was driven to a depth of approximately 34 feet below mean low tide. Both sections of sheet pile are encased at the top by a 2-foot, 6-inch wide by 1-foot, 4-inch deep reinforced concrete beam cast monolithically with the wharf deck. Lateral support for the bulkhead between the deck and river bed is provided by a concrete-encased double-channel steel waler tied back to a 6-foot tall reinforced concrete anchor wall with 3-inch diameter anchor rods. The walers are located 11 feet below the wharf top deck and are encased in a concrete block measuring 3 feet, 3 inches wide by 2 feet tall. There are slight differences between the two sections of bulkhead wall regarding the size of the steel sections used as the walers (C15x33.9 versus C18x42.7), the location of the anchor wall (56 feet versus 53 feet, 6 inches from the bulkhead), and the spacing of the anchor rods (8 feet on center up to 12 feet, 8 inches). Figure 6 provides a section cut of the sheet pile bulkhead, waler, and anchor wall.

The original fender system consisted of timber framing anchored into the spandrel beams and shear walls. This system was replaced with a steel-framed fender system during a 1993 rehabilitation program as described further below.

The PHA document entitled "Public Wharf Characteristics," dated April 26, 2014, lists the load rating for the CD 26 wharf structure as 750 psf, with a 300-ton shore crane limit.

1.2. Repairs and Modifications

The available documents identified in PHA records indicate that various repairs and modifications have been performed on CD 26 over the life of the wharf. In 1986 and 1987, minor repairs to small portions of the wharf deck were made. Pipe hanger modifications were made in 1990. Major repairs were performed in 1993 and 1997. Additional minor repairs due to mechanical damage were made in 2001.

The 1993 work included significant repairs and modifications. Shotcrete repairs were performed on approximately 900 square feet of the deck underside and on twenty strut beams. Sixteen of the harbor line strut beams were demolished and replaced with new 18-inch by 18-inch beams cast on top of the pile cap beams. Additionally, the original timber fender system was removed and replaced with a new steel-framed fender system. This new system consists of steel framing supported by steel H-piles, with six rows of 12-inch by 12-inch timbers mounted on the face of the steel framing. The steel H-piles are spaced on 24 feet centers and were driven to a depth of approximately 68 feet below mean low tide, with a top elevation 5 feet below the wharf deck. The steel framing is installed on the harbor side face of the piles, and the top of this framing is aligned with the middle of the spandrel beams at an elevation of 1 foot, 9 inches below the wharf deck topside. An 18-inch diameter, 27-inch long rubber bearing is located between the top of the steel framing and the spandrel beam. The bottom of the steel framing is bolted to the H-piles at two locations. The outboard face of the fender system is located approximately 5 feet, 8-7/8 inches from the face of the concrete wharf structure. A section of the replacement fender system is provided in Figure 7.

The 1997 work, titled “Knuckle Repairs,” included strengthening of the structure where the curved gantry crane rails depart from the straight rail beams. It included the addition of W18 wide-flange steel beams transverse to deck beams underneath the rails and fiber-reinforced polymer (FRP) wrap of one line of concrete beams. Similar work was performed at CD 27 and CD 28. Additional 1997 work, performed under a separate contract, included maintenance painting of the splash zone of the sheet pile wall and minor modifications to the cathodic protection system.

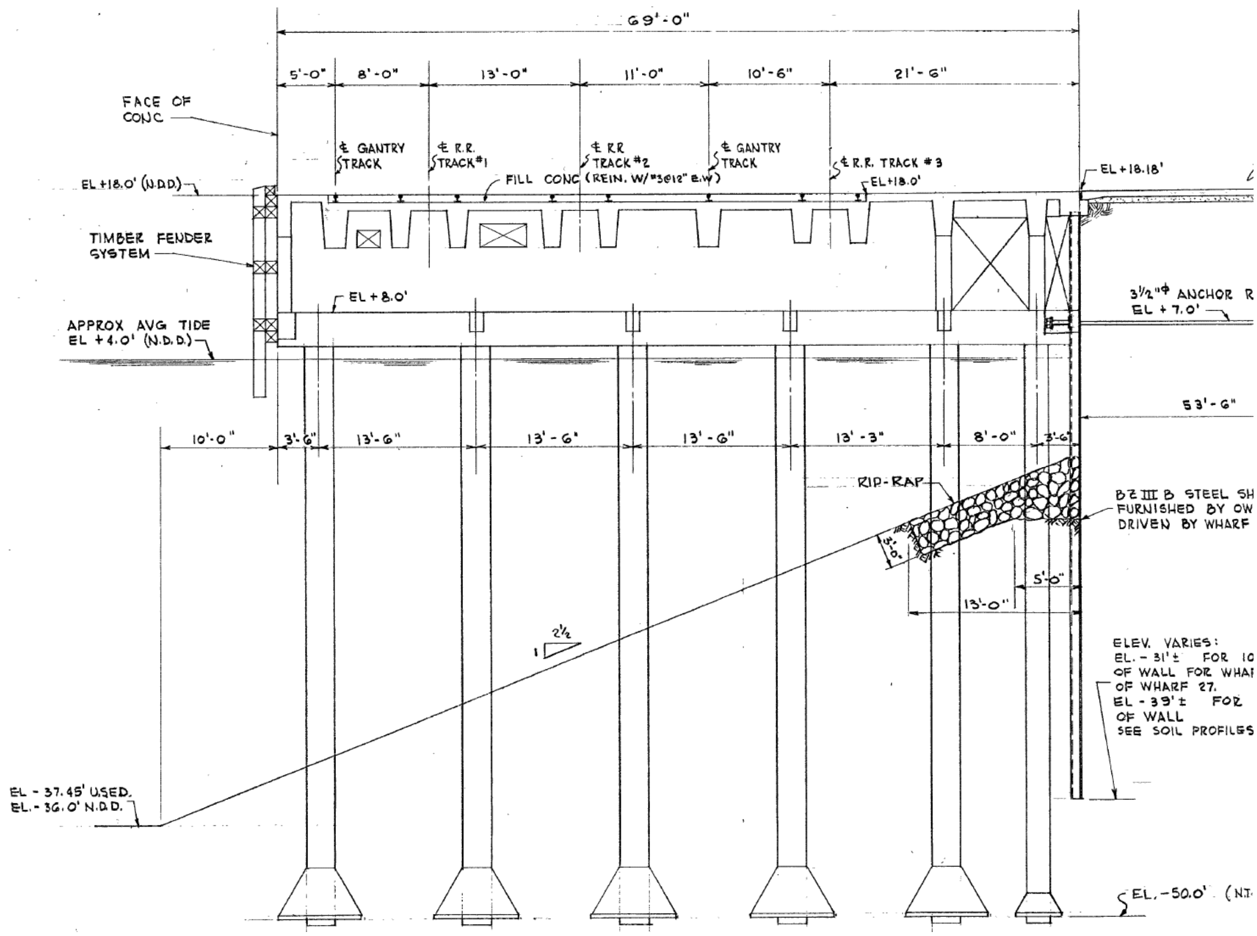


Figure 1. Typical cross-section through CD 26, reproduced from PHA drawings.

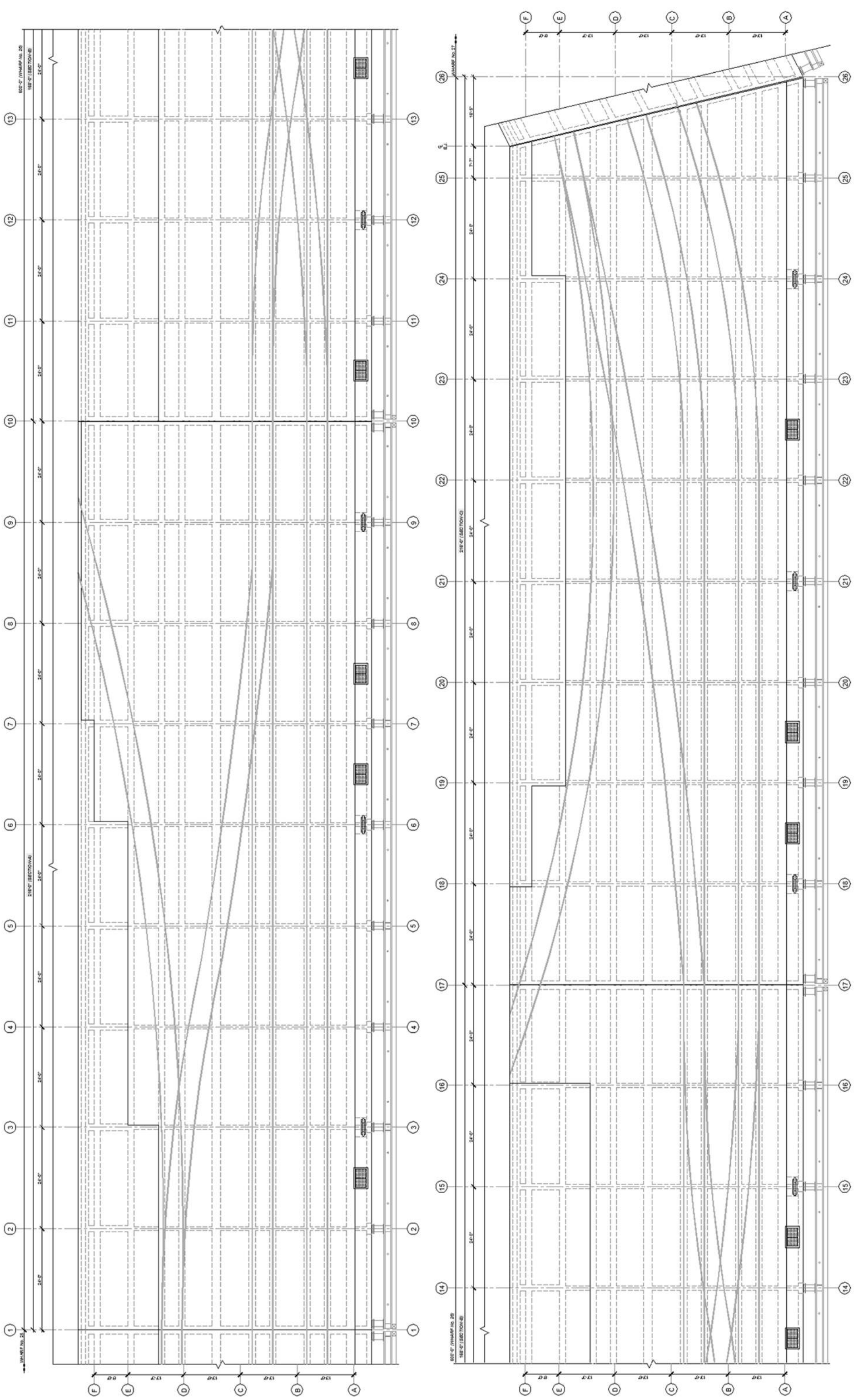


Figure 2. Top surface plan of CD 26.

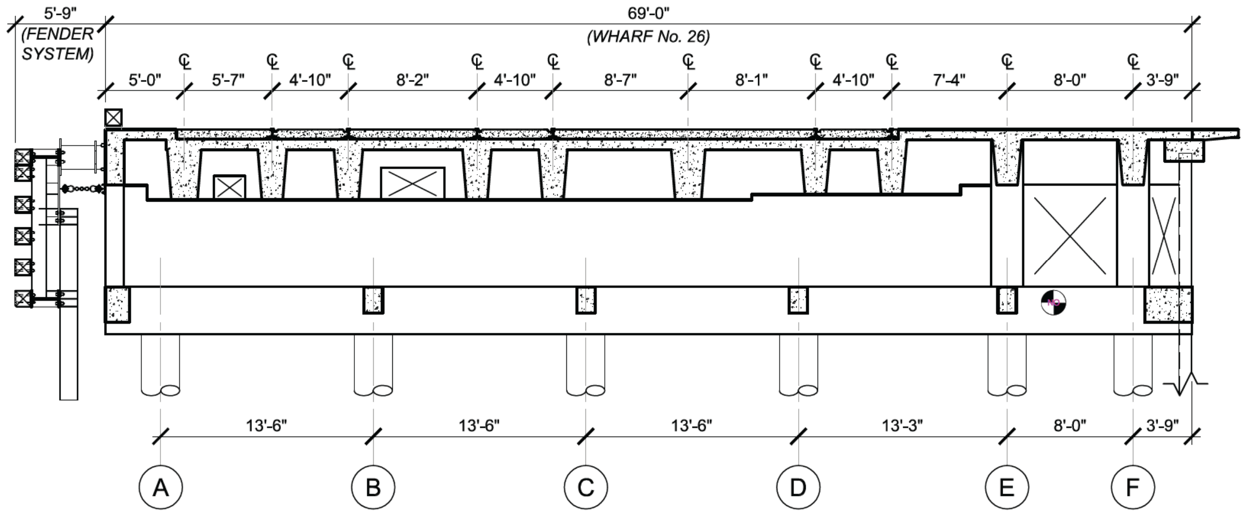


Figure 3. Elevation of typical bent and pile cap beam.

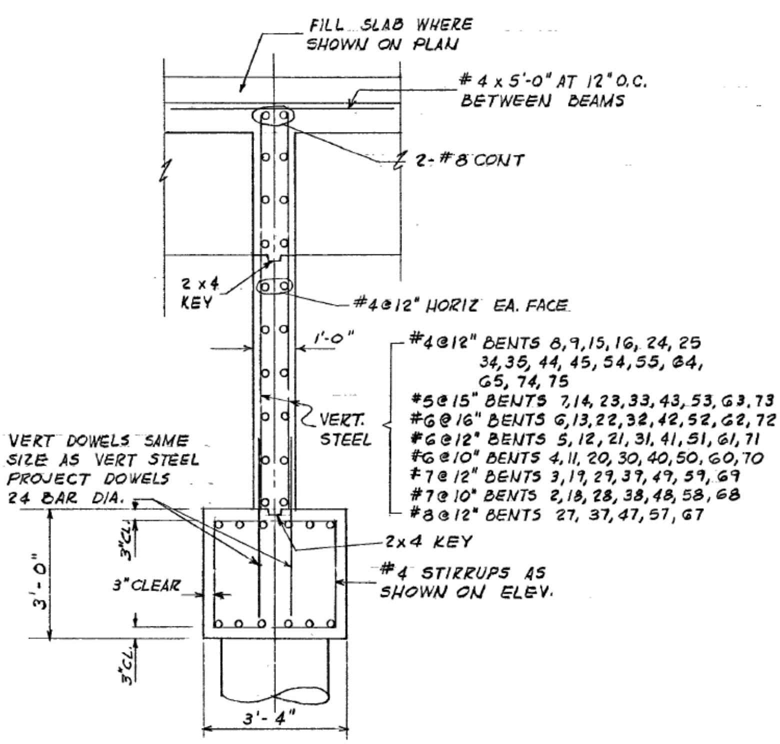


Figure 4. Section through typical shear wall and pile cap beam.

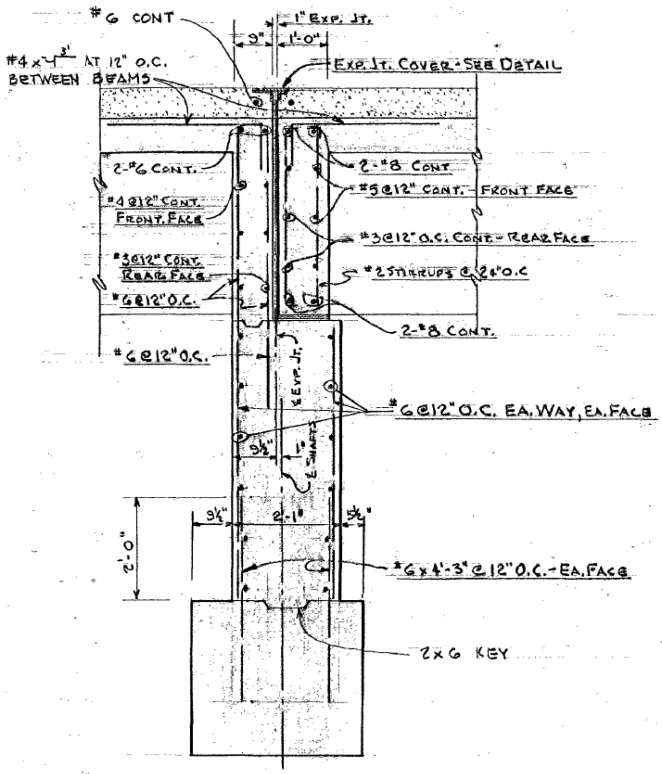


Figure 5. Cross-section through expansion joint at Bents 10 and 17, reproduced from PHA drawings.

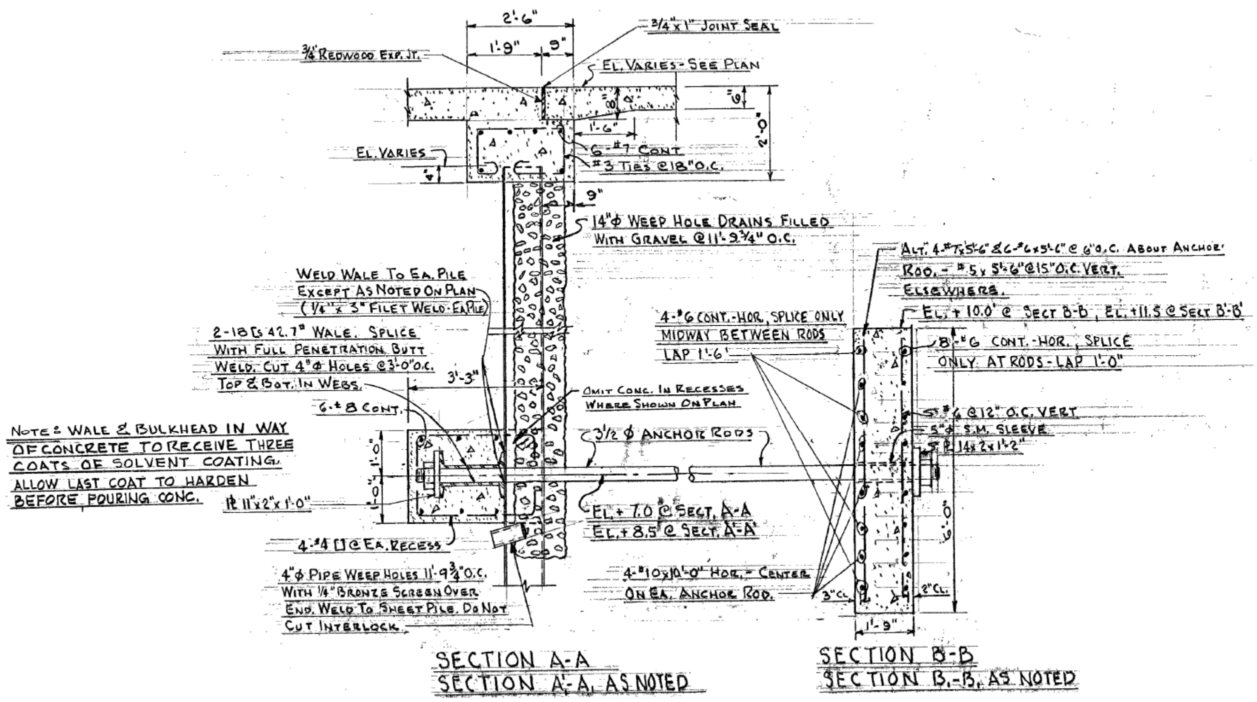


Figure 6. Cross-section of CD 26 through sheet piling bulkhead and anchor wall

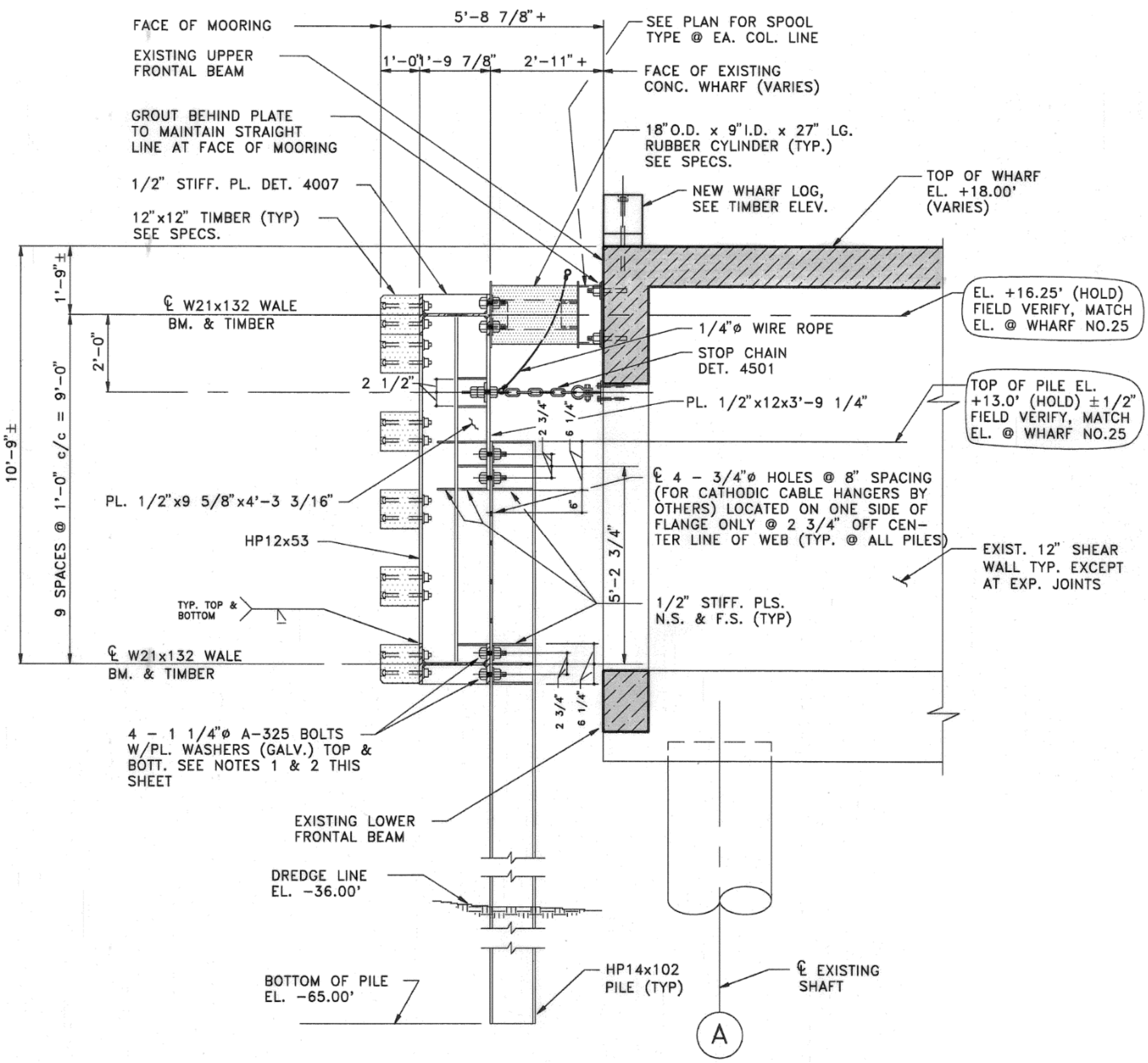
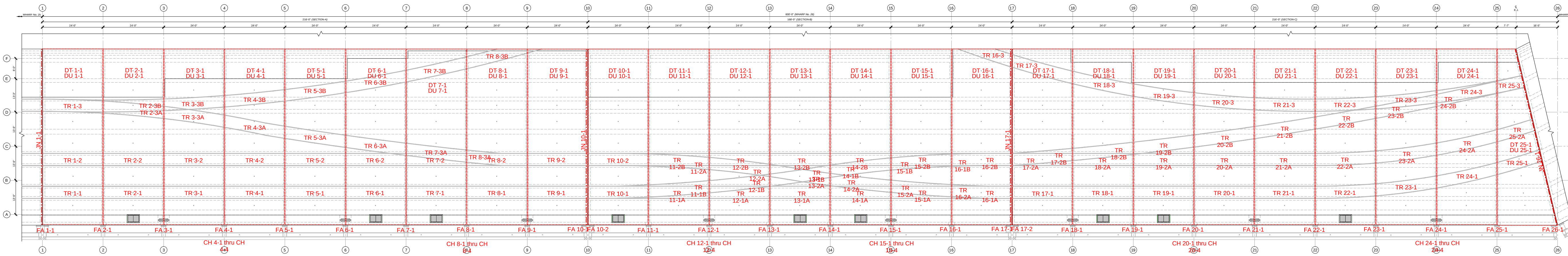
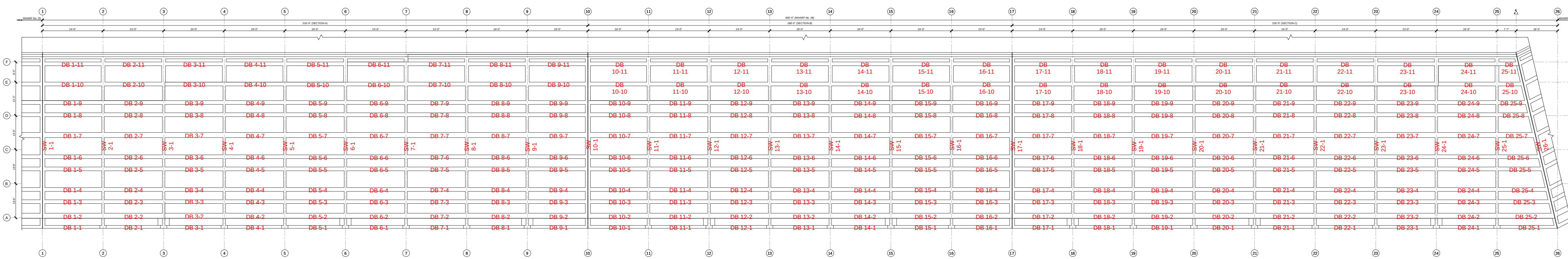


Figure 7. Cross-section of replacement fender system, reproduced from 1993 drawings.

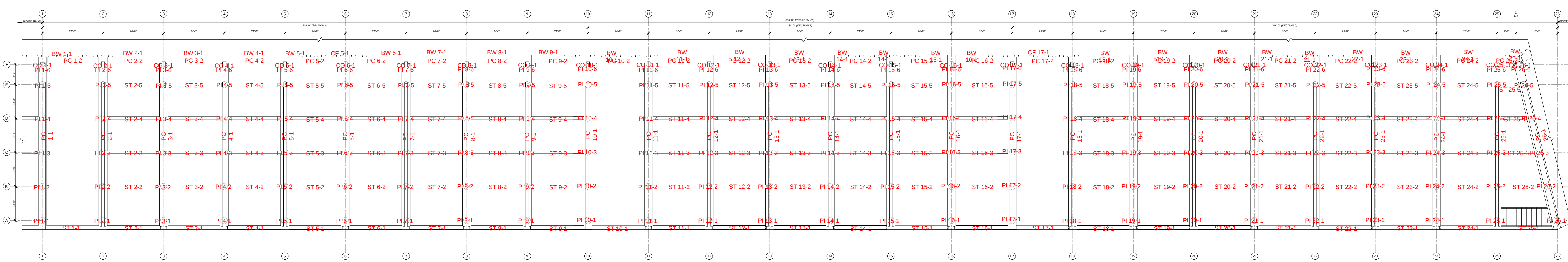
Appendix A – CD 26 Plan and Elevation



1 WHARF No. 26: TOP SURFACE PLAN



2 WHARF No. 26: REFLECTED DECK PLAN



3 WHARF No. 26: LOWER BEAM PLAN

TRUE NORTH PLAN NORTH

WJE ENGINEERS ARCHITECTS MATERIAL SCIENTISTS

Wiss, Janney, Elstner Associates, Inc.

PORT OF HOUSTON AUTHORITY: Wharf No. 26 at Turning Basin Terminal

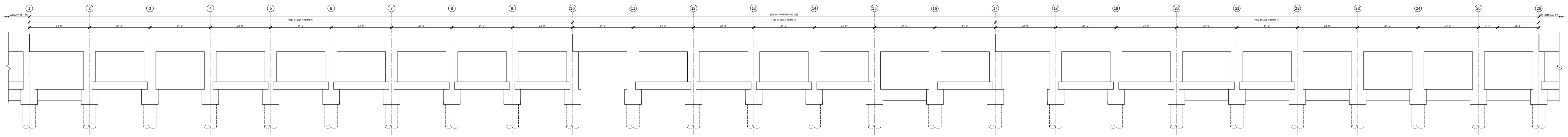
HOUSTON, TEXAS

WJE No. 2014.3252.R

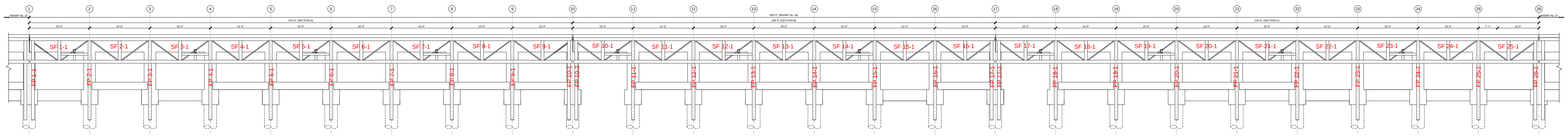
TOP SURFACE PLAN & ASSESSMENT ELEVATION

WHARF No.

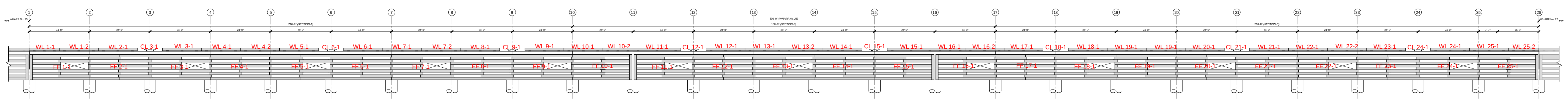
CD-26



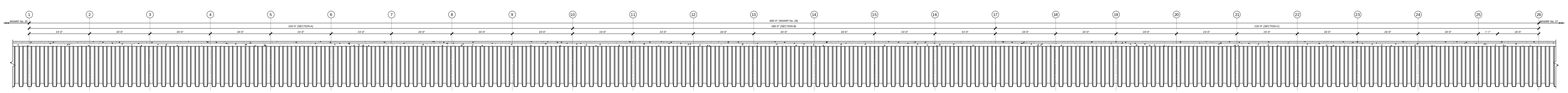
4 WHARF No. 26: WEST ELEVATION



5 WHARF No. 26: WEST ELEVATION STEEL FRAMING



6 WHARF No. 26: WEST ELEVATION WOOD FENDER



7 WHARF No. 26: EAST ELEVATION METAL SHEET PILE

TRUE NORTH PLAN NORTH

WJE ENGINEERS ARCHITECTS MATERIAL SCIENTISTS
Wiss, Janney, Elstner Associates, Inc.

PORT OF HOUSTON AUTHORITY: Wharf No. 26 at Turning Basin Terminal
HOUSTON, TEXAS
WJE No. 2014.3252.R

TOP SURFACE PLAN & ASSESSMENT ELEVATION

WHARF No.
CD-26

Appendix B – Element Inspection Form (summaries only)

Property:	Turning Basin Terminal	**Asset ID:**	City Dock 26
Inspection Type:	☒ Baseline ☐ Routine ☐ Due Diligence	**Inspection Date(s):**	November 14-16, 2016
Inspection Team:			
Structural Component(s):	☒ Deck ☐ Slab ☒ Superstructure ☒ Substructure ☐ Bearings ☒ Joints ☒ Bulkhead		
Berthing Component(s):	☒ Fender Systems ☒ Mooring Systems		
Shoreline Component(s):	☐ Protected Shoreline ☐ Unprotected Shoreline		
Ancillary Component(s):	☒ Crane and Train Rails ☒ Guards ☐ Paint and Markings ☐ Personnel Access Systems ☐ Utility Systems		

Summary Table 1. Structural Components Condition States

Element Location ID	Element Descriptor	In-Accessible	CS1	CS2	CS2 [NC]	CS3	CS3 [NC]	CS4	CS4 [NC]	Total
DT-RC	**RC Deck Topside (SF)**	**1338**	**24101**	**11522**	**[168]**	**4173**	**[139]**	**–**	**–**	**41134**
	--	1338	4257	2	–	–	–	–	–	5597
	CRKC	–	19153	11281	[168]	4052	[139]	–	–	34486
	DLSP	–	–	239	–	121	–	–	–	360
	PTCH	–	691	–	–	–	–	–	–	691
DT-RC Total		**1338**	**24101**	**11522**	**[168]**	**4173**	**[139]**	**–**	**–**	**41134**
DU-RC	**RC Deck Underside (S**	**–**	**27073**	**11601**	**[14375]**	**2447**	**[630]**	**–**	**–**	**41121**
	--	–	11108	–	–	–	–	–	–	11108
	CRKC	–	15874	10979	[56]	1628	–	–	–	28481
	DLSP	–	–	19	–	45	–	–	–	64
	PTCH	–	91	29	[1]	–	–	–	–	120
	EFRS	–	–	572	[12789]	774	[630]	–	–	1346
	EXPR	–	–	2	[1529]	–	–	–	–	2
DU-RC Total		**–**	**27073**	**11601**	**[14375]**	**2447**	**[630]**	**–**	**–**	**41121**
Deck Total		**1338**	**51174**	**23123**	**[14543]**	**6620**	**[769]**	**–**	**–**	**82255**
Substructure										
PC-RC	**RC Pile Cap (LF)**	**–**	**2379**	**–**	**–**	**–**	**–**	**–**	**–**	**2379**
	--	–	2379	–	–	–	–	–	–	2379
PC-RC Total		**–**	**2379**	**–**	**–**	**–**	**–**	**–**	**–**	**2379**
SW-RC	**RC Shear Wall (LF)**	**–**	**1114**	**311**	**[190]**	**85**	**[6]**	**6.5**	**–**	**1516**
	--	–	1114	–	–	–	–	–	–	1114
	CRKC	–	–	224	–	–	–	6.5	–	230.5
	DLSP	–	–	24	–	81	[4]	–	–	105
	PTCH	–	–	43	–	–	–	–	–	43
	EFRS	–	–	20	[190]	–	–	–	–	20
	EXPR	–	–	–	–	4	[2]	–	–	4
SW-RC Total		**–**	**1114**	**311**	**[190]**	**85**	**[6]**	**6.5**	**–**	**1516**
ST-RC	**RC Strut (EA)**	**4**	**54**	**7**	**[3]**	**50**	**[8]**	**–**	**–**	**115**
	--	4	53	–	–	–	–	–	–	57
	CRKC	–	–	1	[1]	41	–	–	–	42
	DLSP	–	–	2	–	9	[4]	–	–	11
	PTCH	–	–	–	[1]	–	–	–	–	0
	EFRS	–	1	4	[1]	–	[4]	–	–	5
ST-RC Total		**4**	**54**	**7**	**[3]**	**50**	**[8]**	**–**	**–**	**115**
CO-RC	**RC Column (EA)**	**–**	**19**	**4**	**–**	**2**	**[1]**	**–**	**–**	**25**
	--	–	19	–	–	–	–	–	–	19
	DLSP	–	–	4	–	1	[1]	–	–	5
	EXPR	–	–	–	–	1	–	–	–	1
CO-RC Total		**–**	**19**	**4**	**–**	**2**	**[1]**	**–**	**–**	**25**
DS-RC	**RC Drilled Shaft (EA)**	**156**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**156**
	--	156	–	–	–	–	–	–	–	156
DS-RC Total		**156**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**156**
Substructure Total		**160**	**3566**	**322**	**[193]**	**137**	**[15]**	**7**	**–**	**4191**

Summary Table 1. Structural Components Condition States

Element Location	Element Descriptor	In-Accessible	CS1	CS2	CS2 [NC]	CS3	CS3 [NC]	CS4	CS4 [NC]	Total
Superstructure										
DB-RC	**RC Deck Beam (LF)**	**61**	**5793**	**202**	**[179]**	**40**	**[6]**	–	–	**6096**
	--	61	5793	–	[1]	2	–	–	–	5856
	CRKC	–	–	146	[25]	4	–	–	–	150
	DLSP	–	–	47	[7]	–	[6]	–	–	47
	PTCH	–	–	–	[4]	–	–	–	–	0
	EFRS	–	–	4	[138]	22	–	–	–	26
	EXPR	–	–	5	[4]	12	–	–	–	17
DB-RC Total		61	5793	202	[179]	40	[6]	–	–	6096
Superstructure Total		**61**	**5793**	**202**	**[179]**	**40**	**[6]**	–	–	**6096**
Bulkhead										
BW-CS	**CS Bulkhead Wall (LI**	–	**206**	**377**	–	–	–	–	–	**583**
	CORR	–	206	377	–	–	–	–	–	583
BW-CS Total		–	206	377	–	–	–	–	–	583
Bulkhead Total		–	**206**	**377**	–	–	–	–	–	**583**
Joint										
JN-AU	**Armored Joint withc**	–	–	–	–	**69**	–	**210**	–	**279**
	DIST	–	–	–	–	69	–	209.5833	–	278.5833
JN-AU Total		–	–	–	–	69	–	210	–	279
Joint Total		–	–	–	–	**69**	–	**210**	–	**279**

Summary Table 2. Berthing Components Condition States

Element Location ID	Element Descriptor	In-Accessible	CS1	CS2	CS2 [NC]	CS3	CS3 [NC]	CS4	CS4 [NC]	Total
Fender System										
FF-TIM	**TIM Facing (EA)**	**–**	**211**	**46**	**–**	**43**	**–**	**–**	**–**	**300**
	--	–	48	–	–	–	–	–	–	48
	DECY	–	50	37	–	9	–	–	–	96
	CONX	–	58	–	–	26	–	–	–	84
	FNFA	–	27	9	–	–	–	–	–	36
	MISS	–	28	–	–	8	–	–	–	36
FF-TIM Total		–	211	46	–	43	–	–	–	300
CH-GS	**GS Stay Chains (EA)**	**–**	**17**	**–**	**–**	**–**	**–**	**7**	**–**	**24**
	--	–	17	–	–	–	–	–	–	17
	FNSC	–	–	–	–	–	–	7	–	7
CH-GS Total		–	17	–	–	–	–	7	–	24
SF-CS	**CS Secondary Framing**	**–**	**346**	**1605**	**–**	**245**	**–**	**8**	**–**	**2204**
	--	–	24	24	–	–	–	–	–	48
	CONX	–	–	–	–	–	–	4	–	4
	CORR	–	311	1455	–	227	–	4	–	1997
	DIST	–	11	126	–	18	–	–	–	155
SF-CS Total		–	346	1605	–	245	–	8	–	2204
FP-CS	**CS Fender Pile (EA)**	**26**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**26**
	--	26	–	–	–	–	–	–	–	26
FP-CS Total		26	–	–	–	–	–	–	–	26
FA-RB	**OTH Rubber Fender A**	**–**	**20**	**1**	**–**	**3**	**–**	**2**	**–**	**26**
	--	–	20	–	–	–	–	–	–	20
	DIST	–	–	–	–	–	–	1	–	1
	BULG	–	–	1	–	3	–	1	–	5
FA-RB Total		–	20	1	–	3	–	2	–	26
Fender System Total		**26**	**594**	**1652**	**–**	**291**	**–**	**17**	**–**	**2580**
Mooring										
CL-MT	**MT Cleat (EA)**	**–**	**–**	**8**	**[5]**	**–**	**–**	**–**	**–**	**8**
	CONX	–	–	5	–	–	–	–	–	5
	CORR	–	–	3	[5]	–	–	–	–	3
CL-MT Total		–	–	8	[5]	–	–	–	–	8
Mooring Total		**–**	**–**	**8**	**[5]**	**–**	**–**	**–**	**–**	**8**

Summary Table 3. Ancillary Components Condition States

Element Location ID	Element Descriptor	In-Accessible	CS1	CS2	CS2 [NC]	CS3	CS3 [NC]	CS4	CS4 [NC]	Total
Guards										
WL-TIM	**TIM Wharf Log (LF)**	**–**	**15**	**4**	**[1]**	**7**	**–**	**7**	**–**	**33**
	--	–	15	–	–	–	–	–	–	15
	CONX	–	–	2	–	7	–	7	–	16
	DIST	–	–	2	[1]	–	–	–	–	2
WL-TIM Total		**–**	**15**	**4**	**[1]**	**7**	**–**	**7**	**–**	**33**
Guards Total		**–**	**15**	**4**	**[1]**	**7**	**–**	**7**	**–**	**33**
Crane and Train										
CR-MT	**Train Rails, Crane Rail:**	**–**	**2280**	**–**	**–**	**–**	**–**	**–**	**–**	**2280**
	--	–	2280	–	–	–	–	–	–	2280
CR-MT Total		**–**	**2280**	**–**	**–**	**–**	**–**	**–**	**–**	**2280**
Crane and Train Total		**–**	**2280**	**–**	**–**	**–**	**–**	**–**	**–**	**2280**

Appendix C – Inspection Summary Form

Maritime Asset Inspection Summary

Property:	Turning Basin Terminal	**Asset ID:**	City Dock 26
Inspection Type	Baseline	**Inspection Date(s):**	November 14-26, 2016
Scope of Inspection	Entire Asset above MLT		
Inspection Firm(s):	**Prime**: WJE **Sub**: N/A		
Reported By:	L. Inspector	**Report Date:**	November 30, 2016
FICAP Manual Version/Date:	Revised Draft Dated September 27, 2016	**Variances from FICAP Procedure:**	None

Seal of Responsible Engineer

I hereby certify this inspection was performed under my direct supervision and control and to the best of my professional knowledge complies with the FICAP Manual and applicable codes.

Signed: ______________________________

Name: ______________________________

Texas License No.: ______________________________

Date: ______________ Expires: ______________

Seal

Inspection Team Members

Project Manager: N/A
Inspection Team Leader(s): N/A
Inspection Team Members: N/A
Underwater Team Leader: N/A
Underwater Team Member: N/A

Overall Asset Condition

Structural Component Ratings and Element Summary

Component / Element(s)	Rating	Comments
Deck		
– RC Deck Topside		
– RC Deck Underside		
Superstructure		
– RC Deck Beams		
Substructure		
– RC Shear Walls		One location at a shear wall (SW 21-1 at Column Line E-21) has a severe rating due to a wide shear crack that warrants additional investigation. Figure 1 and Figure 2.
– RC Struts		
– RC Columns		
– RC Drilled Shafts		
– RC Pile Caps		
Joint		
– Armored Joint without Seal		Nosing broken and missing, joint severely damaged and leaking. Figure 3.
Bulkhead		
– CS Bulkhead Wall		

Berthing Component Ratings and Element Summary

Component / Element(s)	Rating	Comments
Fender System		
– Rubber Fender Absorption Unit		Severely displaced or damaged FAUs (FA 1-1, FA 4-1, FA 10-1, FA 11-1, FA 16-1, and FA 17-1). Figure 4 and Figure 5.
– TIM Facing		
– CS Secondary Framing		Failed pin connections at joints in secondary framing at Bents 1, 10, 17 and 26. Figure 6 and Figure 7.
– GS Stay Chains		Missing or broken stay chains (CH 4-1, CH 8-1, CH 8-2, CH 12-1, CH 12-2, CH 15-1, and CH 15-2). Figure 8.
– CS Fender Piles		Not accessible
Mooring System		
– MT Cleat		

Ancillary Components Ratings and Element Summary

Component / Element(s)	Rating	Comments
Guards		
– TIM Wharf Logs		Missing wharf logs or damaged connections at WL 4-1, WL 7-2, WL 11-1, WL 12-1, WL 15-1, WL 17-1, and WL 19-2. Figure 9 - Figure 11
Crane and Train		
– MT Train Rails		

Figures

Figure 1. Elevation of damaged shear wall section above opening (red dashed line).

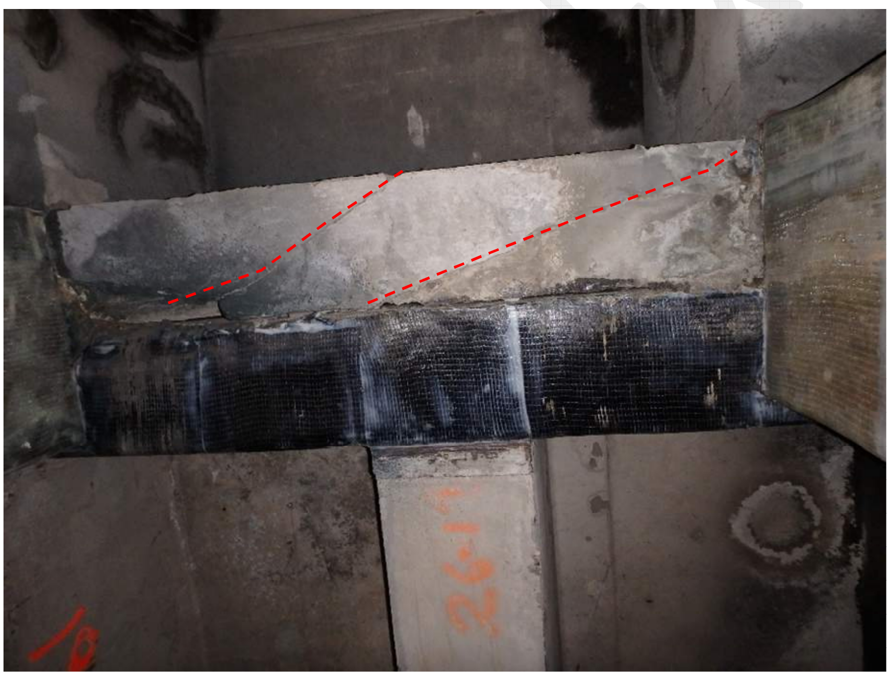


Figure 2. Soffit of opening through shear wall exhibiting shear cracks (red dashed line).

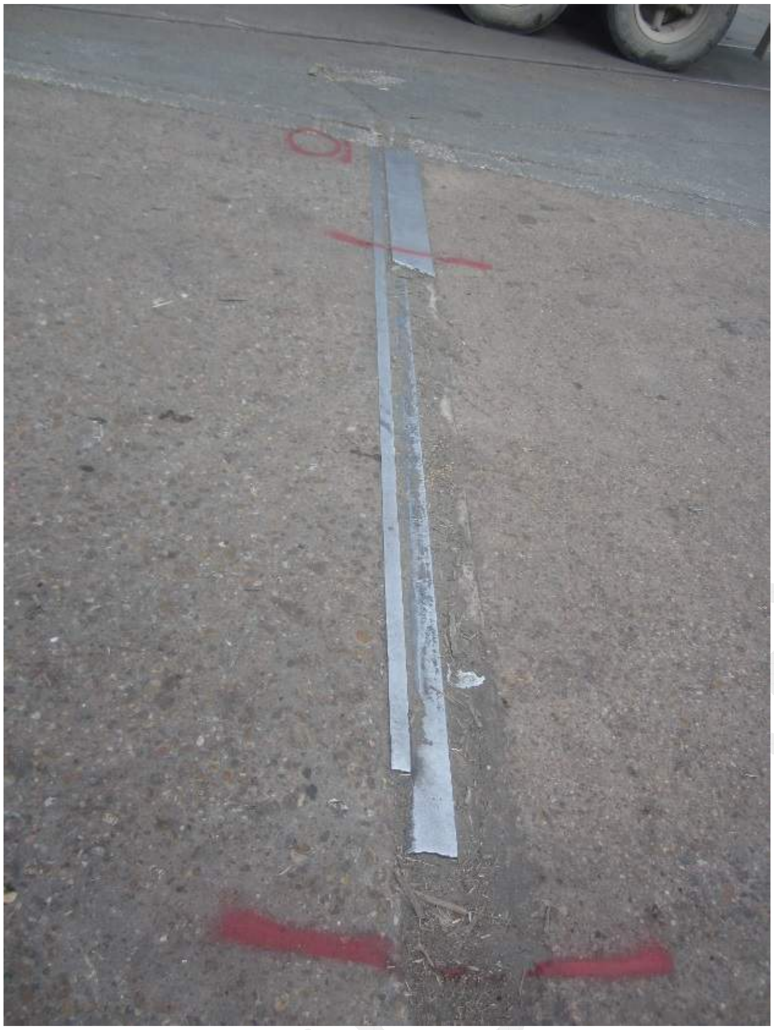


Figure 3. Expansion joint along Bent 10.

Figure 4.
Displaced damper at Bent 1.

Figure 5. Severely cracked damper at Bent 4 (arrow).

Figure 6.
Failed pin connection at joint in secondary framing at Bent 1.

Figure 7. Failed pin connection at joint in secondary framing at Bent 26.

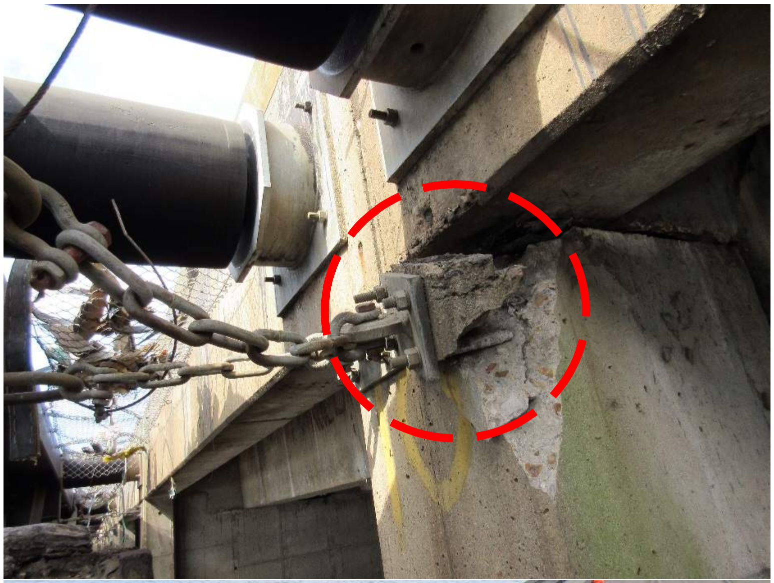


Figure 8. Failed stay chain anchorage at Bent 10 (red dashed circle).

Figure 9. Missing wharf log near Bent 18.

Figure 10. Missing wharf log near Bent 4.

Figure 11. Wharf log with missing anchors near Bent 26 (arrows).

Rating Abbreviations

N/A: Component not applicable to structure.
NI: Not inspected

Rating Definitions

Ratings for Structural and Berthing Components

Rating	Description
6 Good	Minor or no problems noted. Also applies to newly constructed or rehabilitated components.
5 Satisfactory	Minor defects, damage or deterioration - not extensive.
4 Fair	Extensive minor or limited moderate defects, damage or deterioration. Structural capacity of primary structural components and functional use of fender or mooring systems are not affected.
3 Poor	Moderate or extensive defects, damage or deterioration that affects structural capacity of primary structural components or functional use of fender or mooring system components.
2 Serious	Defects, damage or deterioration significantly reduces structural capacity of primary structural components or reduces functional use of fender or mooring systems.
1 Critical	Advanced defects, damage or deterioration with localized failure(s) of components imminent or observed. Immediate load or use restrictions, including closing of the asset should be considered.
Applicable Component Types: Deck, superstructure, substructure, bearings, bulkheads, mooring and fender systems.	

Functional Ratings for Ancillary Components

Rating	Description
6 Good	Minor or no problems noted. Also applies to newly constructed or rehabilitated protective components.
5 Satisfactory	Minor defects, damage or deterioration - not extensive.
4 Fair	Extensive minor or limited moderate defects, damage or deterioration. All primary elements and their attachment to the asset are sound and functional purpose/use of the component is not affected. Minor repairs or maintenance may be required.
3 Poor	Moderate or extensive defects, damage or deterioration that affects functional purpose/use of the component or compromises attachment of the component to the asset.
2 Serious	Defects, damage or deterioration significantly affects functional purpose/use of the component and/or local failures of the attachment to the asset are present.
1 Critical	Advanced damage or deterioration has resulted in frequent imminent or observed failure(s) of the attachment of the component to the asset. The component may no longer serve its functional purpose/use and/or conditions are present that may lead to property damage or environmental damage. Immediate repairs or other protective measures should be considered, and/or immediate use restrictions should be considered for components affected.
Applicable Component Types: Utility systems, paint and markings, crane and train rails, personnel access systems.	

Appendix D – Follow-up Action Form

Property:	Turning Basin Terminal	**Asset ID:**	City Dock 26
Inspection Type:	☒Baseline ☐Routine ☐ Special	**Inspection Date:**	November 26, 2016
Scope of Inspection	Entire Asset above MLT		
Inspection Firm(s):	**Prime**: WJE		
	Underwater: N/A		
	Other (role): N/A		
Reported By:	[L. Inspector]	**Report Date:**	November 26, 2016

Follow-up Actions

Item No.:	1	**Priority:**	☐Priority ☐Routine
Component:			
Element Type:		**Element ID(s):**	
Condition Identified:			
Reason for action:			
Recommended Action:			

Figure 1. Overall view of location	*Figure 2. Close-up view of condition*

Item No.:	2	**Priority:**	☐Priority ☐Routine
Component:			
Element Type:		**Element ID(s):**	
Condition Identified:			
Reason for action:			
Recommended Action:			

Figure 3. Overall view of location	*Figure 4. Close-up view of condition*

Item No.:	3	**Priority:**	☐Priority ☐Routine
Component:			
Element Type:		**Element ID(s):**	
Condition Identified:			
Reason for action:			
Recommended Action:			

Figure 5. Overall view of location	*Figure 6. Close-up view of condition*

Follow-up Actions Log

Item No.	Priority	Action	Assigned To	Assigned By	Date
1			P. Manager	D. Engineer	MM-DD-YYYY