Harbourfront Centre
Water's Edge Revitalization Project
Value Engineering Study

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Marshall Macklin Monaghan Limited

VE Study was carried out by the Toronto Waterfront Joint Venture for the Toronto Waterfront Revitalization Corporation

It involved work planned for York Quay, the first phase of reconstruction of the Toronto Waterfront

Value Engineering Process

- Involves the review of a project in the context of the stated functions achieved
- VE Team is independent of the initial design work
- Opportunity to review the design decisions and constraints from a different perspective
- It is not a criticism of the design under review, but a fresh look at the problem from a different point of view

Purpose of VE Study

- Find better value solutions to achieve the functional objectives of the project, without jeopardizing the project schedule or existing approvals.
- Recommend viable VE alternatives for the design to improve constructability, minimize risk, and/or improve schedule.
- Identify potential safety, cost and other impacts associated with the proposed changes.

VE Team

- Owner’s Representatives
- Marine Works Specialist
- Marine Engineer
- Landscape Architect
- Architect
- Structural Engineer
- Contractor

Value Engineering Process

Although a hybrid study was undertaken due to time constraints, the normal VE Study process was followed

5 Phases

1 - Review Existing Information
2 - Carry Out Function Analysis
3 - Identify Ideas during Creative Phase
4 - Develop Ideas and Evaluate
5 - Present Findings

Information Phase

- Important that the VE Team understands the complete project and all issues
- Review existing drawings, design criteria, costs, regulations, assumptions
- Review costs and develop cost model
- Review performance criteria categories
- Advantage / Disadvantage evaluation method was used for this study

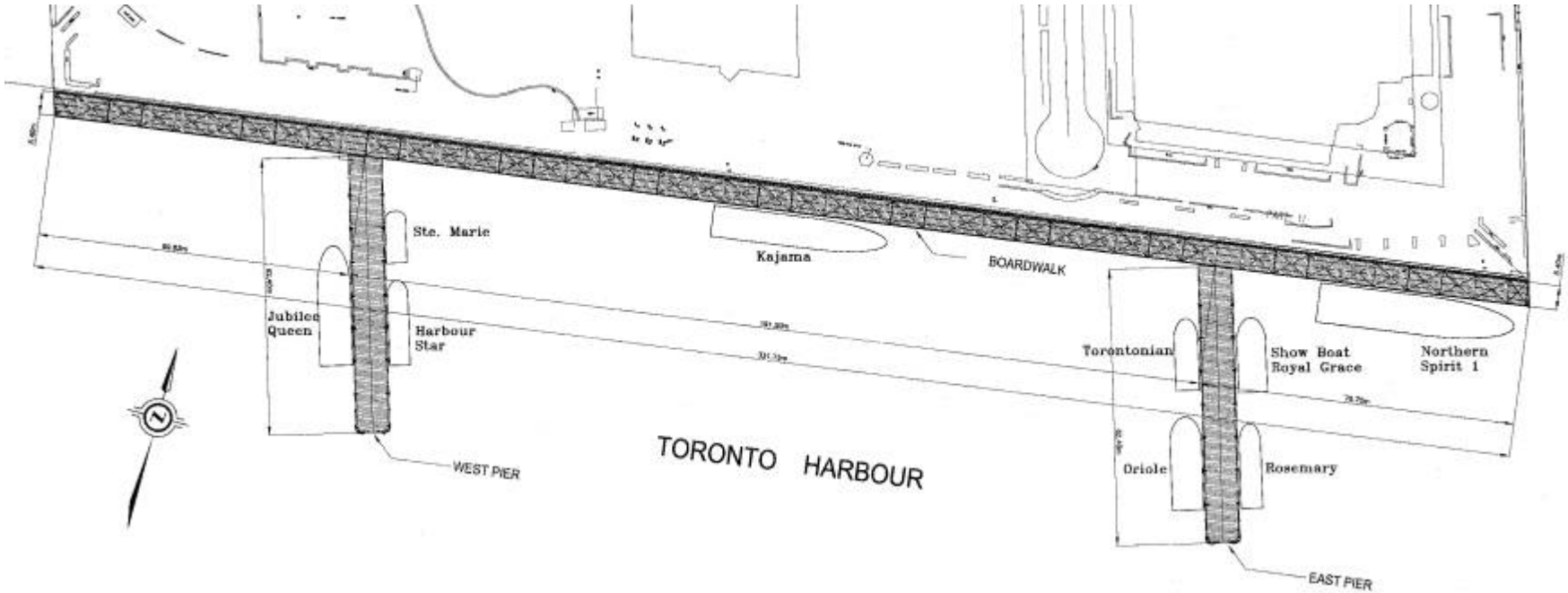
Study

- Study reviewed the design and constraints of the Harbourfront Centre Water's Edge Revitalization recognizing its potential application to other areas of future waterfront development in the City of Toronto

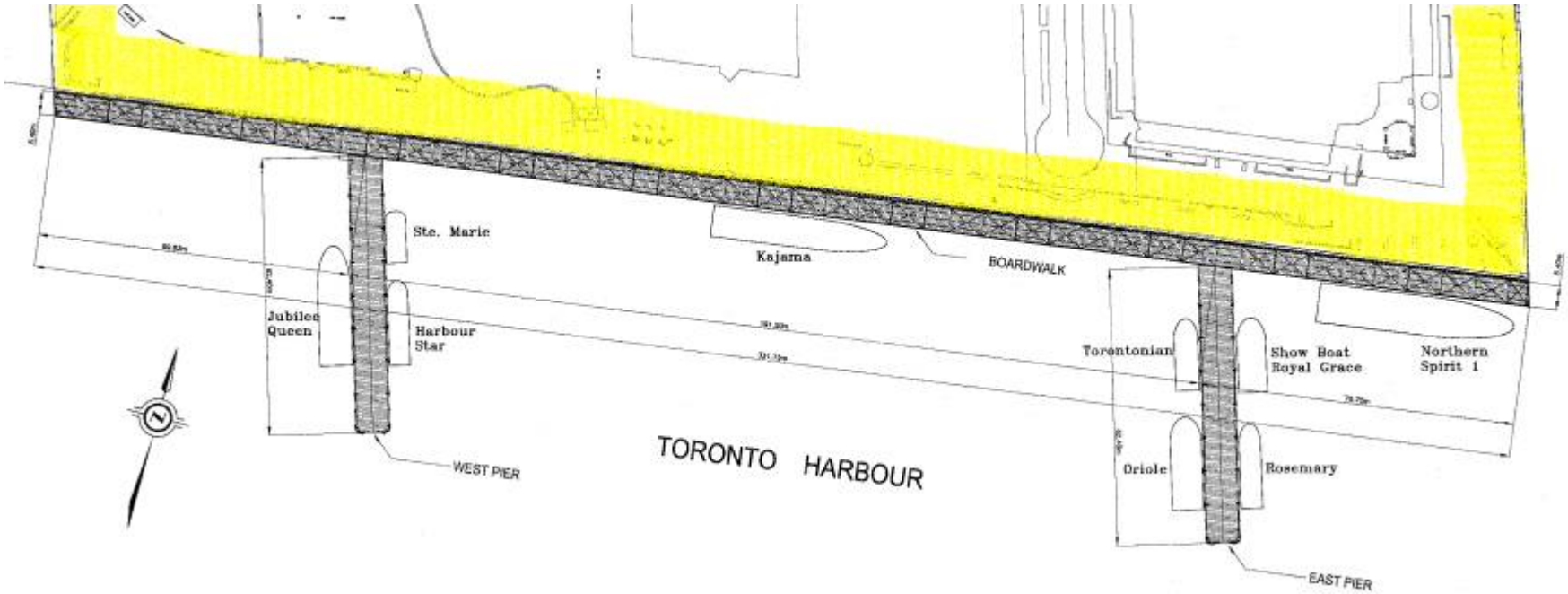
Project

- Concrete promenade supported on existing crib wall
- Boardwalk deck structure supported independent of the existing crib wall
- Two independent finger piers, constructed perpendicular to the boardwalk

Major Study Areas

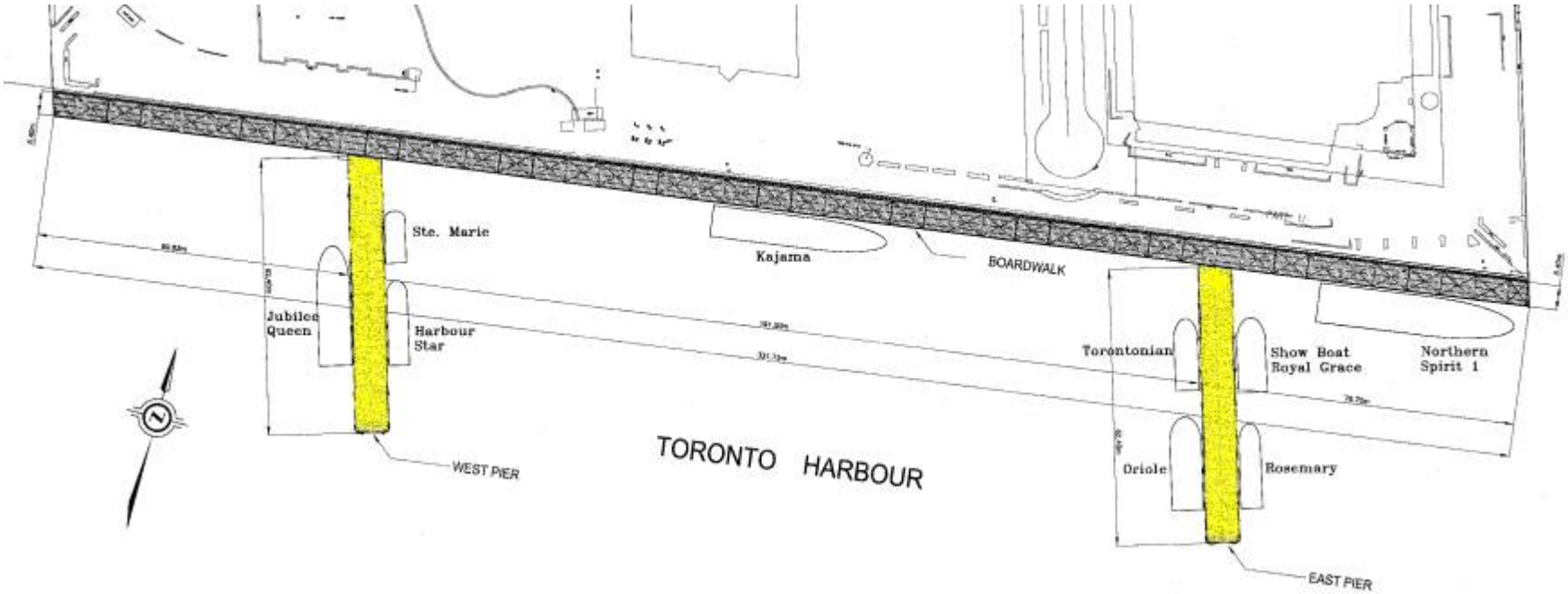


Major Study Areas



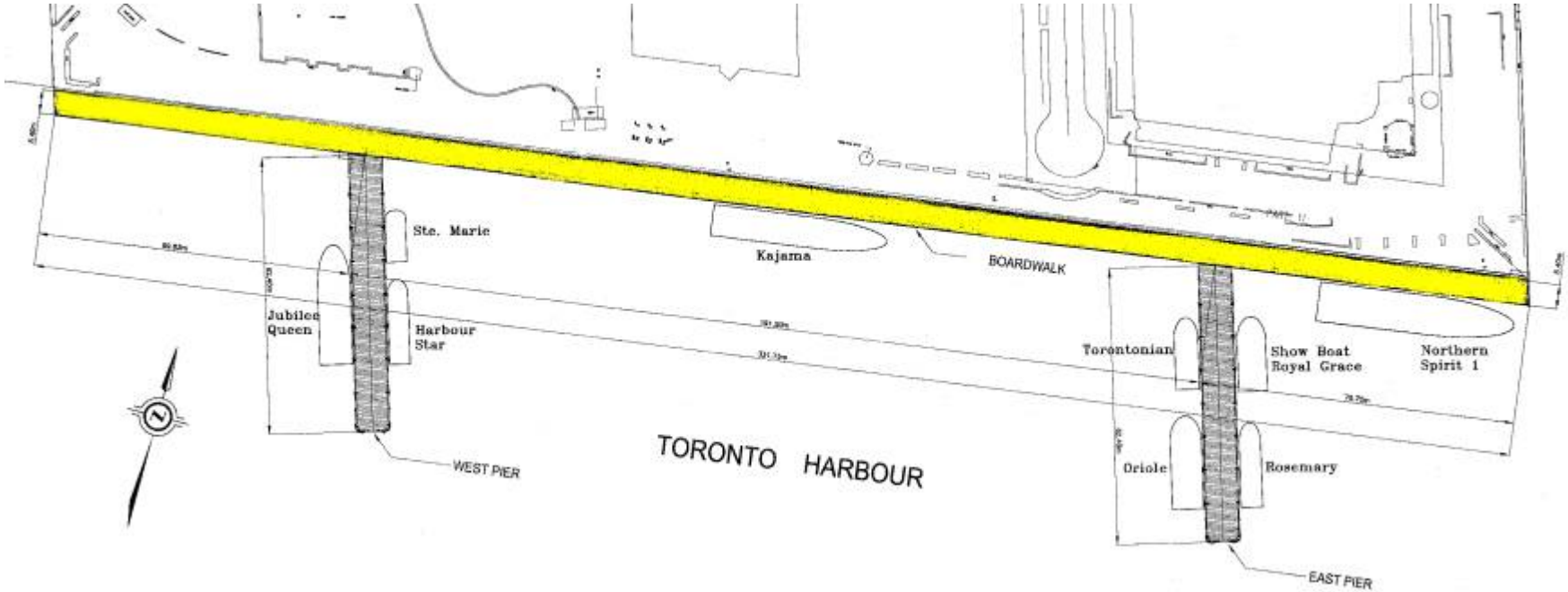
Landscaping / Promenade

Major Study Areas



Finger Piers

Major Study Areas



Boardwalk

Scope and Focus of Study

- Client looking for value within the existing concept, while improving safety, staging and constructability

Primary Issues Addressed

- Find better value solutions without jeopardizing project schedule, existing approvals, or previously tendered items
- Recommend viable alternatives to improve constructability, minimize risk, and/or improve the schedule of the project
- Identify potential safety, cost, and other impacts associated with the proposed changes

Cost Models

In order to better understand the distribution of cost, 2 cost models were developed

1) by area
2) by component

Cost Model
(by Area)

Area	Cost	Percent
Promenade	$ 5.01 Million	55 %
Boardwalk	$ 2.80 Million	31 %
Finger Piers	$ 1.34 Million	15%
Total	$ 9.15 Million	100%

Cost Model
(by Component)

Area	Cost	Percent
Landscaping	$ 2.1 Million	23%
Piling	$ 2.1 Million	23%
Struct. Steel Frame	$ 1.4 Million	15%
Concrete Slabs	$ 1.3 Million	14%
Electrical	$ 0.8 Million	9%
Paving Stones	$ 0.8 Million	8%
Wood Deck	$ 0.5 Million	5%

Evaluation / Performance Measures

- Public Safety
- Cost (Capital, Life Cycle)
- Maintenance (Material, Long Term, Ease)
- Constructability (Stages, Complexity)
- Schedule
- Aesthetics
- Conformance with Existing Approvals
- Repeatability for Other Areas

Project Analysis

- List of project issues, including performance measures, helped the VE Team to focus on the most important issues and risks of the project
- Function-cost analysis provided by the Cumulative Cost FAST Diagram led to a clearer understanding of the project
- Agreed by the team that none of the functions of the project could be eliminated without affecting the basic function
- Since LANDSCAPING and STRUCTURAL elements of the project accounted for approximately 78% of total costs these areas were selected as Value Target Areas

Functions

- Basic Function
  - Revitalize Waterfront
- Higher Order Functions
  - Create Image
  - Create Signature Space
- Key Secondary Function
  - Improve Sightlines
  - Increase Dock Space

Value Target Areas

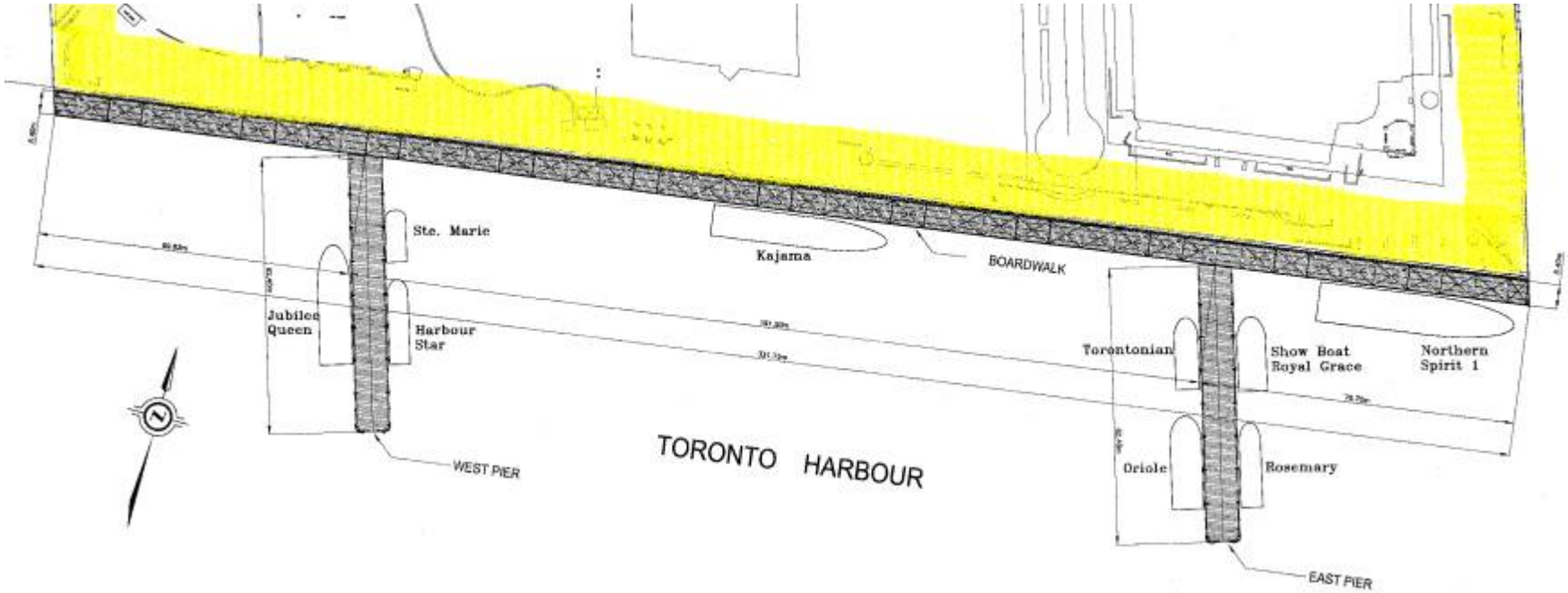
As a result of the analyses the VE Team selected the following Value Target Areas

- Landscaping $ 2.5 M
- Piling $ 2.1 M
- Structural Steel Framing $ 1.4 M
- Concrete Promenade Slab $ 1.3 M

Creative Phase

- VE Team brainstormed as many ways as possible to provide the necessary functions within the project’s value target areas
- 29 creative ideas were generated

Landscaping / Promenade



Landscaping Alternatives

- Review Light Density
- Reduce Number of In-ground Lights
- Use Regular Lights Instead of LEDs
- Use Thinner Pavers
- Eliminate Pavers and Use Exposed concrete Pavement
- Use Smaller Caliper Trees
- Reduce Number of Area Drains at John St. Quay

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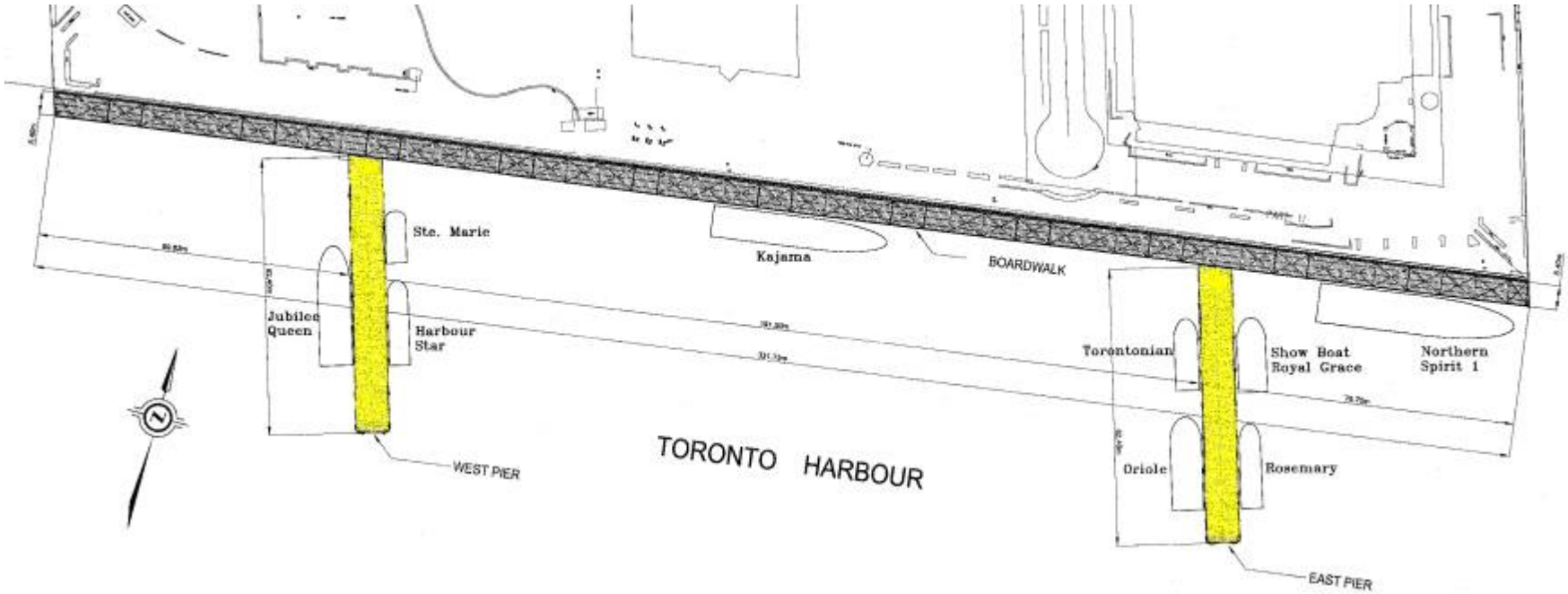
- Reduce Number of Area Drains at John St. Quay

Not Acceptable Due to Aesthetics

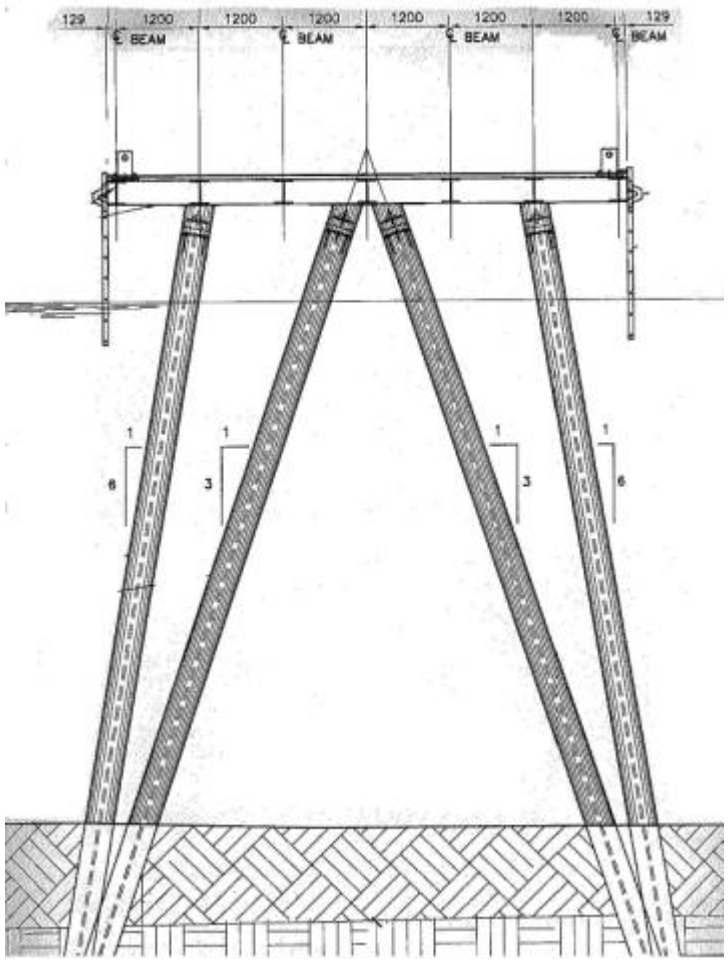
Landscaping Alternatives

• Reduce Number of In-ground Lights	$ 135,000
• Use Thinner Pavers	$ 40,000
• Use Smaller Caliper Trees	$ 42,000
• Reduce Number of Area Drains at John St. Quay	$ 4,000
TOTAL SAVINGS	$ 221,000

Finger Piers



Finger Piers – Base Case



- Piles driven open-ended, cut to exact height, material removed from interior of piles
- Tension anchor installed into bedrock through end of pile, grouted and pile filled with concrete
- Steel framework welded to bents constructed of 3 or 4 tension/compression piles
- Wood deck fastened to structural steel framework

Finger Piers - Alternatives

- Floating Finger Piers with Precast and Steel Tube Floats
- Precast Concrete Deck Structure on Reduced Pile Arrangement
- Steel Deck Structure on Reduced Pile Arrangement

Finger Piers - Alternatives

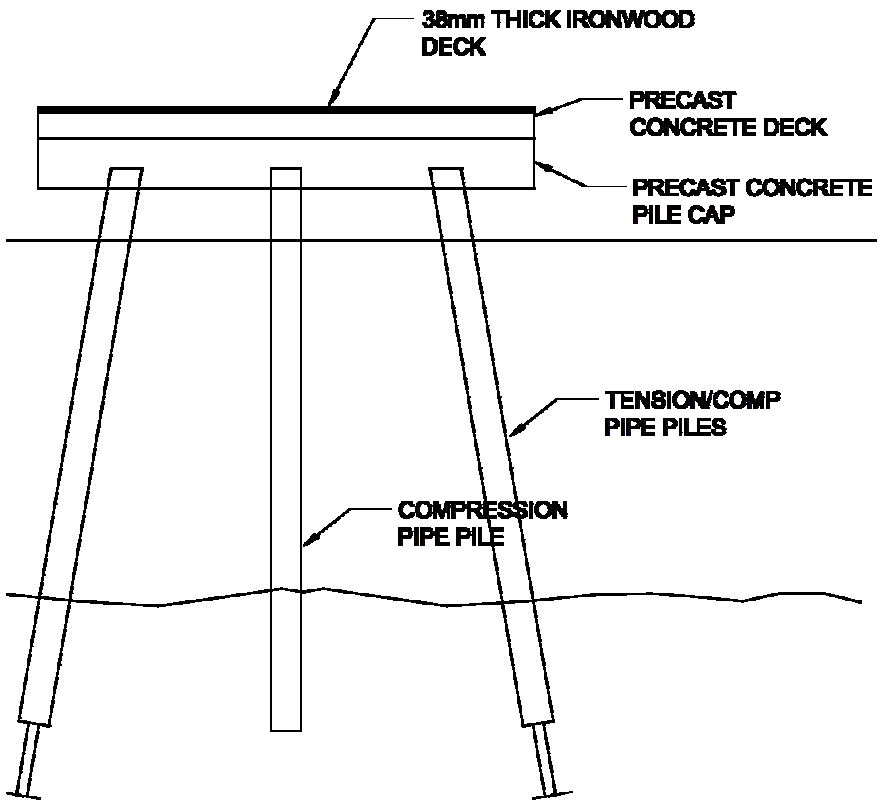
- Floating Finger Piers with Precast and Steel Tube Floats — $ 380,000
- Precast Concrete Deck Structure on Reduced Pile Arrangement — $ 584,000
- Steel Deck Structure on Reduced Pile Arrangement — $ 338,000

Finger Piers - Alternatives

• Floating Finger Piers with Precast and Steel Tube Floats	$ 380,000
• Precast Concrete Deck Structure on Reduced Pile Arrangement	$ 584,000
• Steel Deck Structure on Reduced Pile Arrangement	$ 338,000
TOTAL SAVINGS	$ 584,000

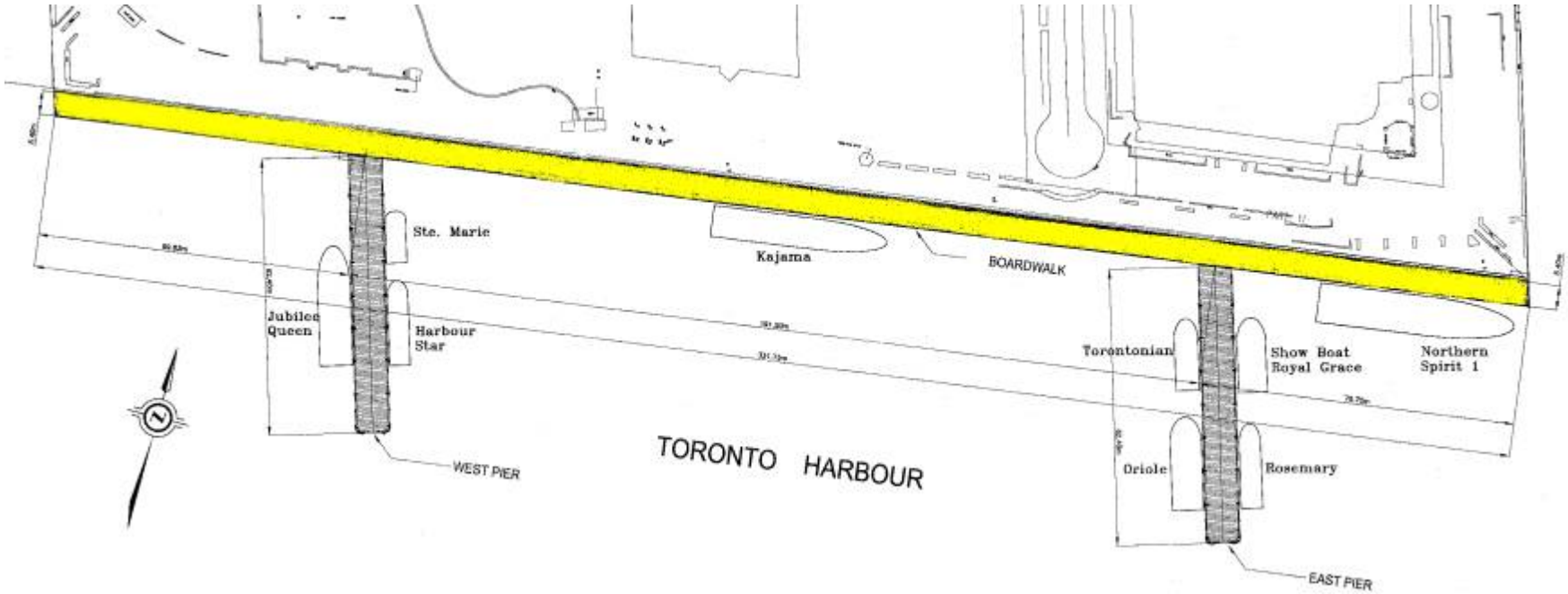
Maximize Saving

Selected Finger Piers Alternative



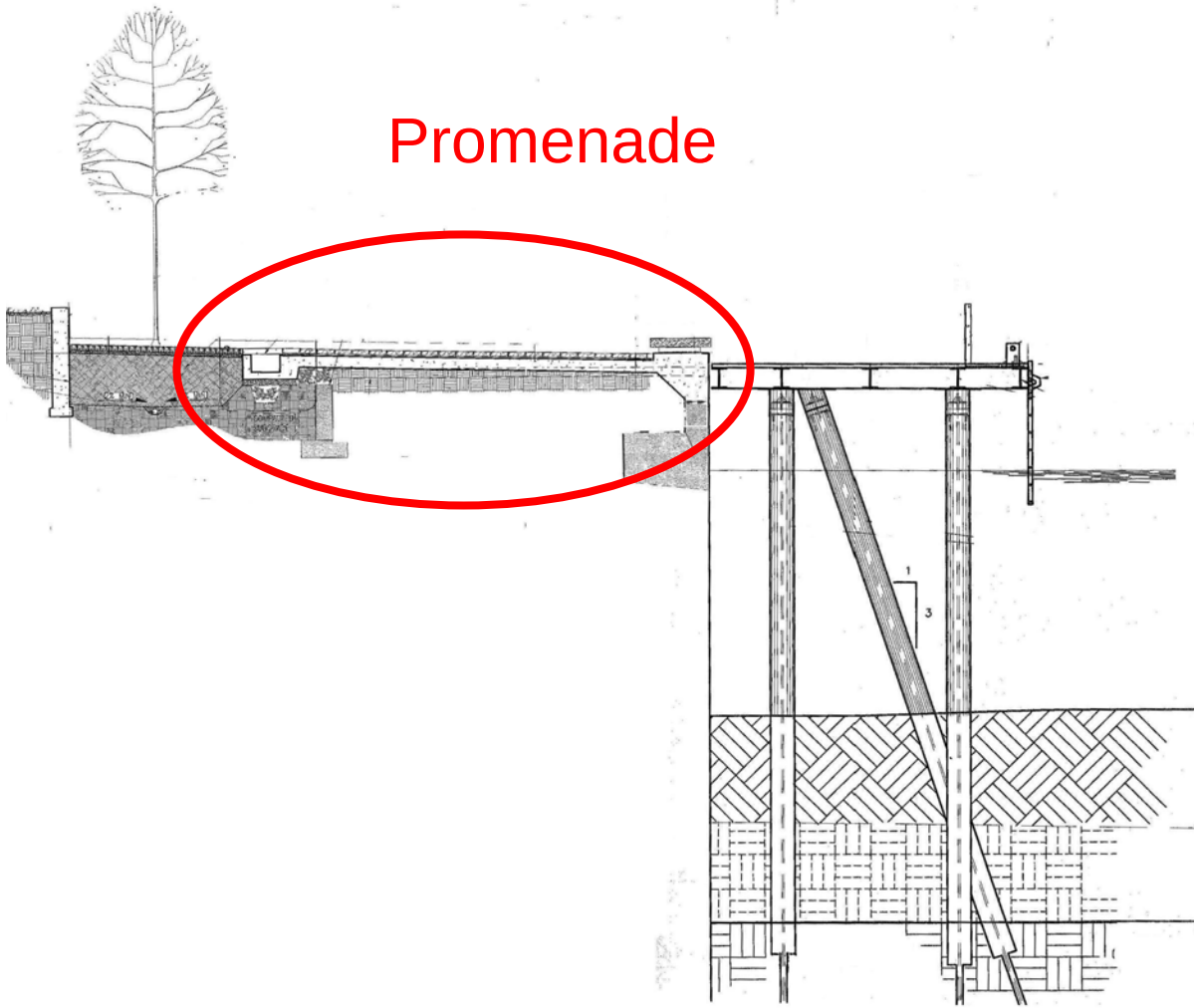
- Piles driven closed-ended
- 2 tension/compression pipe piles and one compression pile per bent
- Tension anchor installed into bedrock through end of pile, grouted and pile filled with concrete
- Wood deck fastened to non-bio-degradable nailing strips, embedded in precast concrete deck structure

Boardwalk


Ste. Marie
Kajama
BOARDWALK
Jubilee
Queen
Harbour
Star
Torontonian
Show Boat
Royal Grace
Northern
Spirit 1
WEST PIER
TORONTO HARBOUR
Oriole
Rosemary
EAST PIER

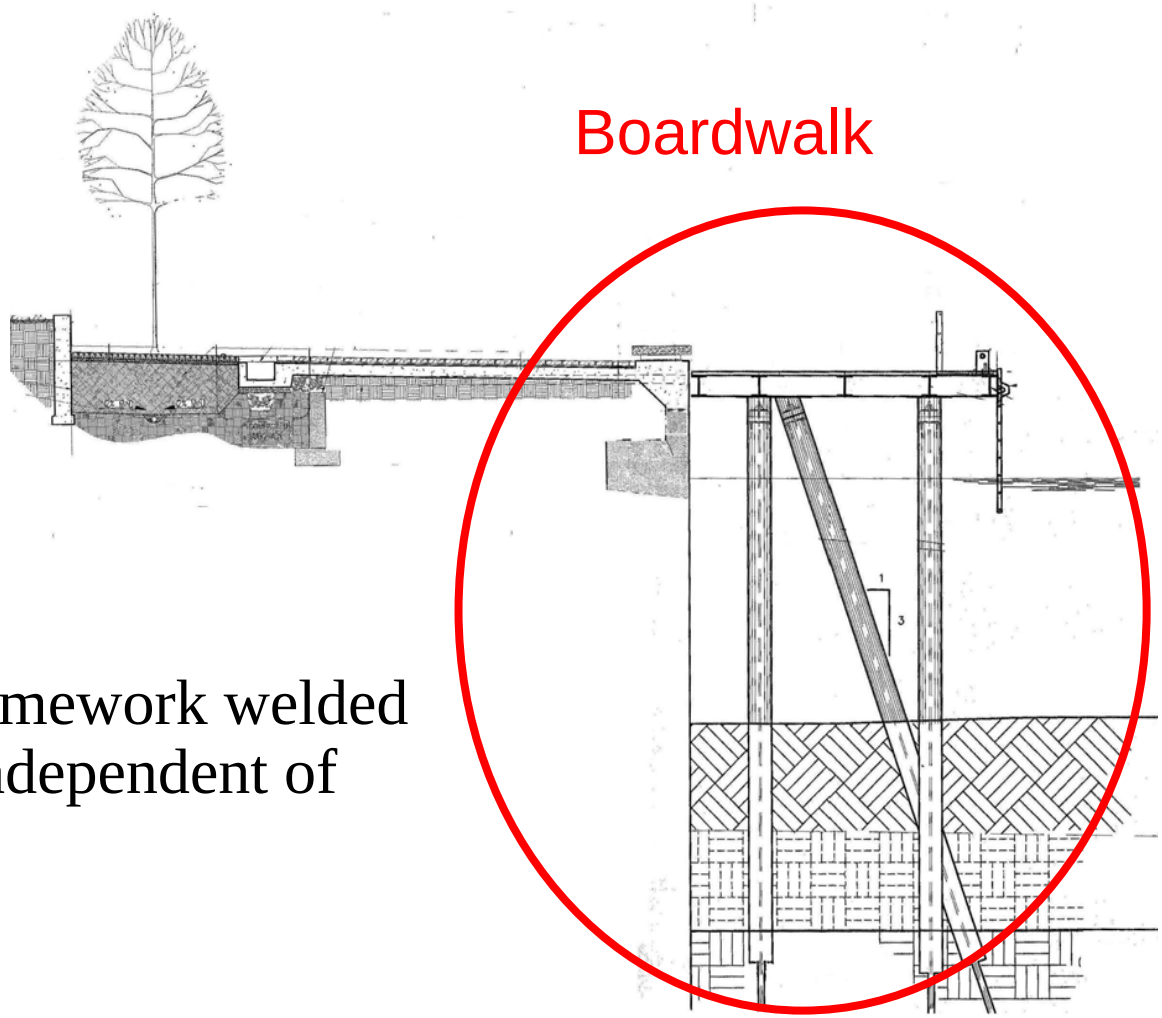
Boardwalk – Base Case

- Constructed on grade with lakeshore edge supported on existing crib wall
- Designed to bridge over any localized loss of material/ support due to failure of crib wall



Boardwalk – Base Case

- 3 tension/ compression piles driven open-ended and cut to exact height, material removed, tension anchor installed into bedrock, grouted and filled with concrete
- Structural steel framework welded directly to piles, independent of existing wall
- Wood deck



Boardwalk Concerns

- Any movement of the front part of the crib wall impacts the structural integrity of the promenade slab resulting in movement or rotation of the complete slab.
- During repair of crib wall heavy equipment will not be able to work supported on the promenade slab.
- New 50 year lifespan structure will be supported on structure with 20 year remaining life (some movement will most likely occur prior to 20 years)

Boardwalk - Alternatives

- Support Landside Edge of Boardwalk on Crib Wall
- Reduce Pile Arrangement
- Use Floating Structure
- Use Precast Concrete Deck Structure
- Reduce Thickness of Wood Deck
- Support Promenade on H-Piles and Thicken Slab
- Cantilever Boardwalk off Promenade
- Support on Coping and Cantilevered over Pile

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Eliminate due to Poor Condition of Crib Wall

Boardwalk - Alternatives

-
- Reduce Pile Arrangement
- Use Floating Structure
- Use Precast Concrete Deck Structure
- Reduce Thickness of Wood Deck
- Support Promenade on H-Piles and Thicken Slab
-
-

Not Client Preference

Boardwalk - Alternatives

- Reduce Pile Arrangement
- Use Precast Concrete Deck Structure
- Reduce Thickness of Wood Deck
- Support Promenade on H-Piles and Thicken Slab

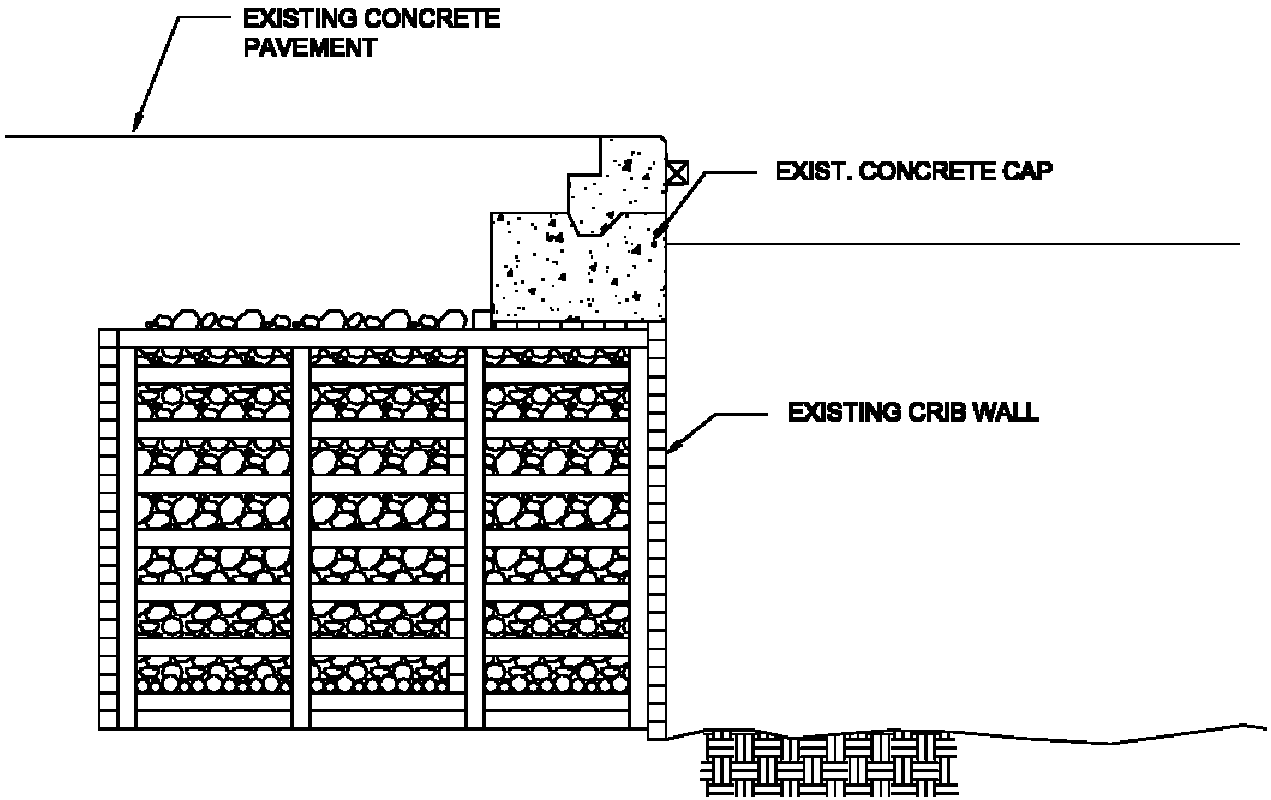
Combine Above Features

Boardwalk - Alternatives

- Use Precast Concrete Deck Structure
- Reduce Pile Arrangement
- Reduce Thickness of Wood Deck
- Thicken Promenade Slab and Span to H-Piles

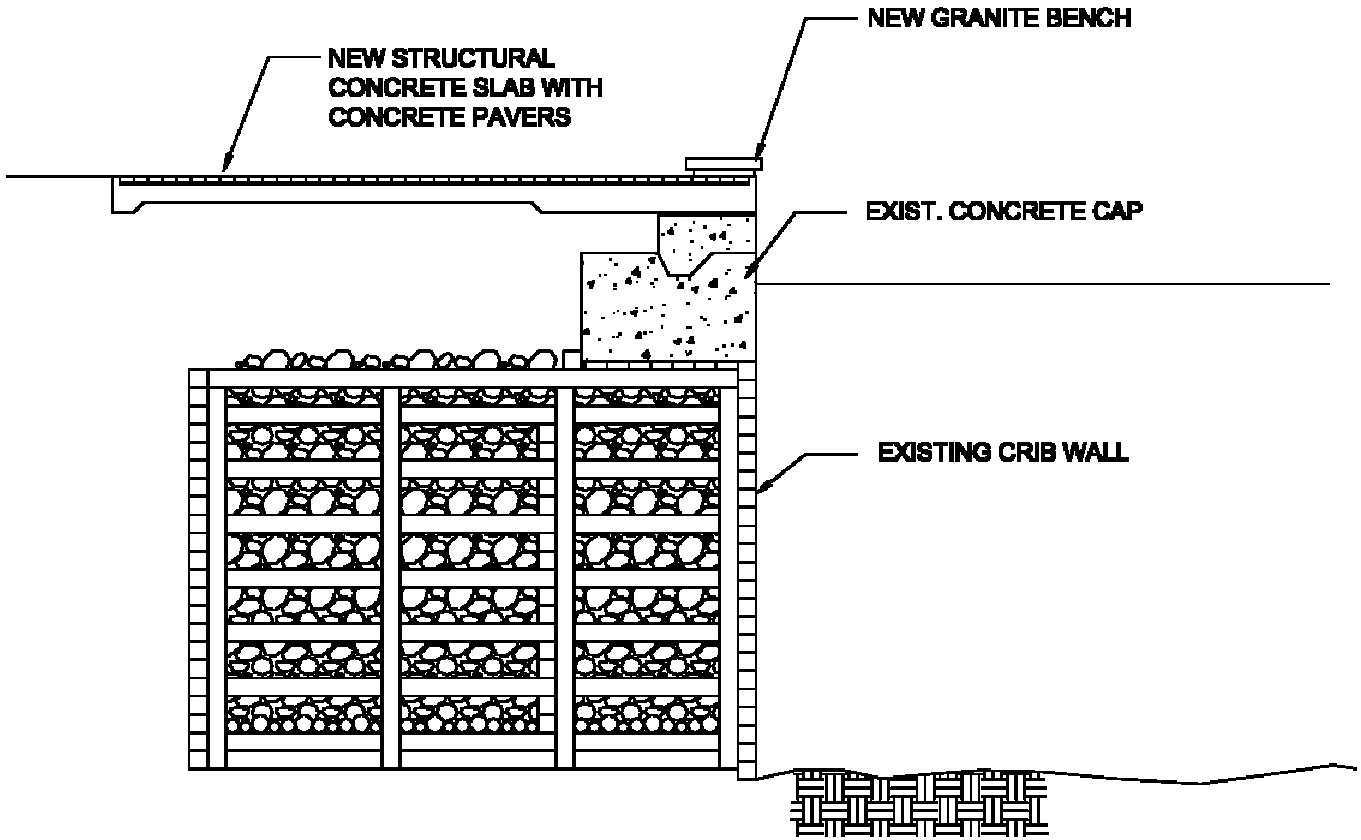
TOTAL SAVINGS $747,000

Selected Boardwalk Alternative



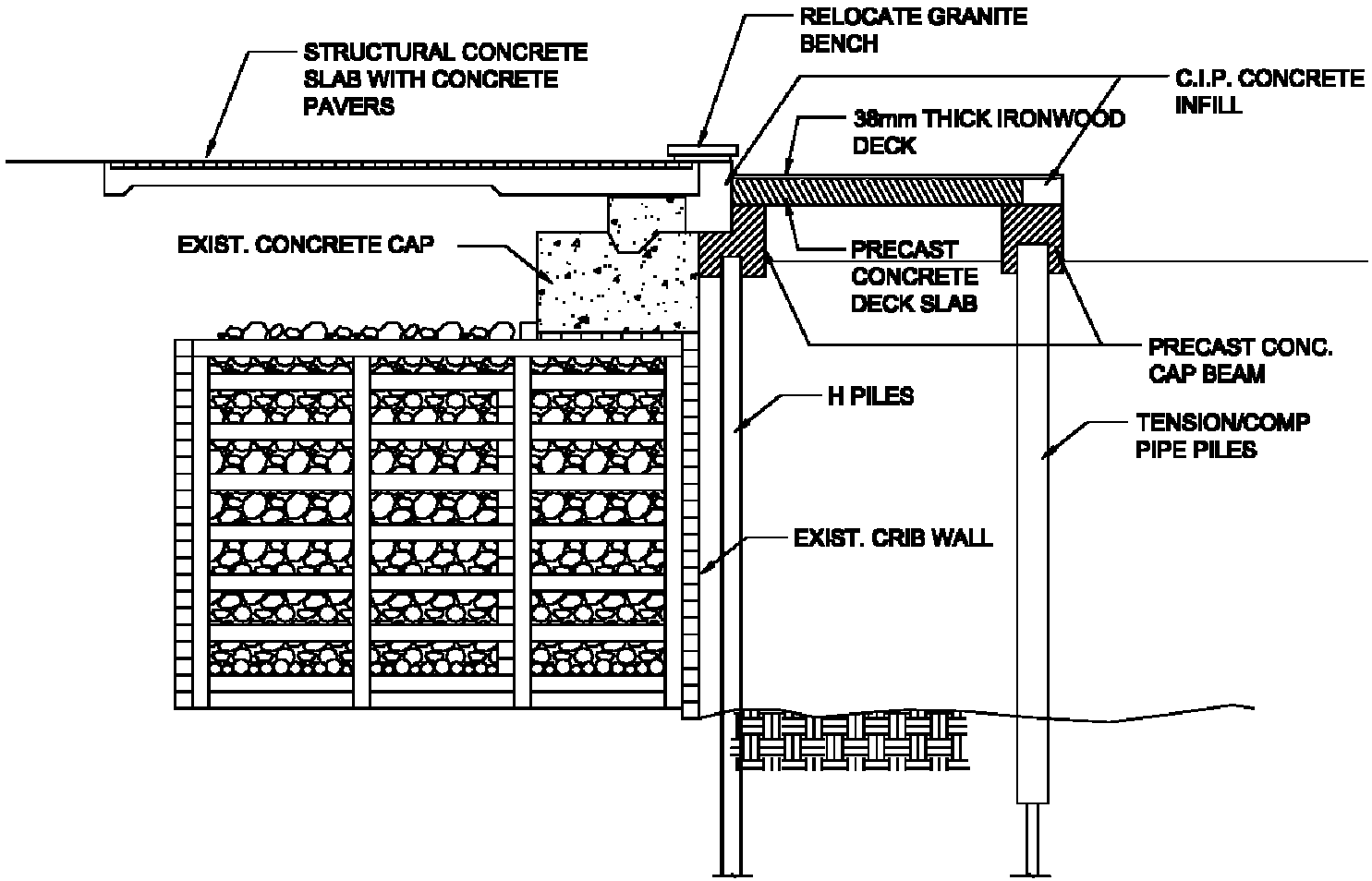
ORIGINAL CONFIGURATION

Selected Boardwalk Alternative



PROPOSED PROMENADE CONFIGURATION

Selected Boardwalk Alternative



PROPOSED BOARDWALK CONFIGURATION

Design Suggestions

- Pile Tip Modification
- Pile Top Modification
- Tension Anchor Attachment Detail
- Additional Modelling of Wave and Ice Action on Boardwalk and Finger Piers

Design Suggestions

Additional Modelling of Wave and Ice Action

- Potential for significant savings to be realized if the upward design forces can be reduced (reduction in size and number of piles and anchors)
- Savings due to size of ultimate waterfront development

Design Concerns / Comments

- Full ice load on Finger Piers should be distributed through deck structure to other pile bents.
- Review design loading on promenade slab to determine amount of support or loss of support assumed by undermining of slab. This will assist Owner to determine timing of repairs to crib walls or limits to loading/traffic on Promenade.

Recommended Scenario

- VE Team determined which VE proposals best fit together into the final VE scenario, are cohesive and present a complete design solution
- Removed cost savings overlaps between the proposals comprising the scenario
- Included engineering costs for redesign

Recommended Scenario

- Reduce Number of In-ground Lights
- Use Thinner Pavers
- Use Smaller Caliper Trees
- Reduce Number of Area Drains at John St. Quay
- Precast Concrete Deck Structure on Reduced Pile Arrangement for Finger Piers
- Precast Concrete Deck Structure on Reduced Pile Arrangement for Boardwalk
- Reduce Thickness of Wood Deck on both Finger Piers and Boardwalk
- Thicken Promenade Slab and Span to H-Piles

Potential Savings

• Landscaping	$ 221,000
• Finger Piers	$ 584,000
• Boardwalk	$ 747,000
TOTAL SAVINGS	**$ 1.55 Million**
	or 16.9%

Above savings include $150,000 for engineering redesign cost

Summary

- Base case engineering design avoided the use of the existing crib wall for support of the new boardwalk due to its poor condition. Failure of the crib wall would have caused partial failure of the new promenade and require maintenance.
- VE Study determined that some originally imposed constraints did not apply.
- VE Study demonstrated that there was no additional cost to design the promenade and boardwalk to avoid the effects of failure of the crib wall.

Summary

- Although normally a heavier structure results in a more expensive foundation, in this case a heavier structure reduced the number of expensive tension piles
- Cost savings did not include the cost savings due to the recent significant increase in price of steel

Questions?