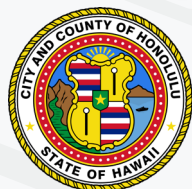


ALA WAI ALTERNATIVES ANALYSIS

APPENDIX E: CONCEPTUAL BRIDGE DESIGNS



BRIDGE TYPE: CONCRETE ARCH (BIFURCATED)

A bifurcated arch bridge balances a sense of openness and connection to the surrounding environment, while maintaining a clear span across the canal with reduced impact to view corridors.

PROS

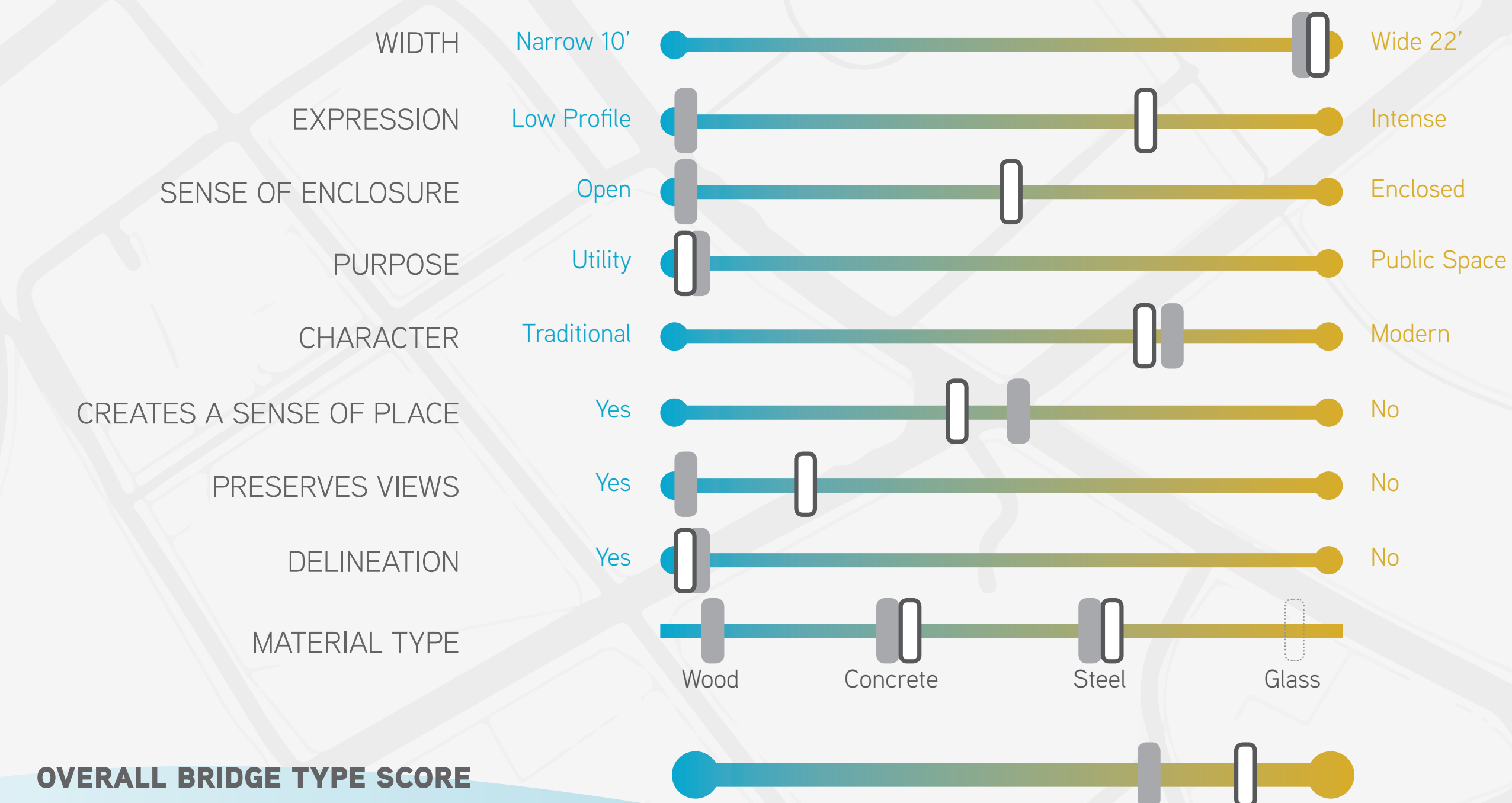
- Maintains sense of openness
- Structural delineation separates people bicycling and walking
- Least amount of impact to view corridors while maintaining a clear span across canal (no piers in the water)
- Concrete is easy to maintain

CONS

- Potential impact on view corridors
- Potential temporary trestle needed across canal during construction

RANGE OF POSSIBLE BRIDGE EXPERIENCES

How does this bridge concept score compared to expressed community feedback?



Concept Score Community Feedback* on Preferred Bridge Experience

*Source: Community Kickoff Meetings, September 2018



How well does this bridge type achieve your desired bridge experience?

Vote: Place your sticker here

Comments?

BRIDGE TYPE: CONCRETE CABLE-STAYED

A concrete cable-stayed bridge maintains a sense of openness while creating a visible landmark.

PROS

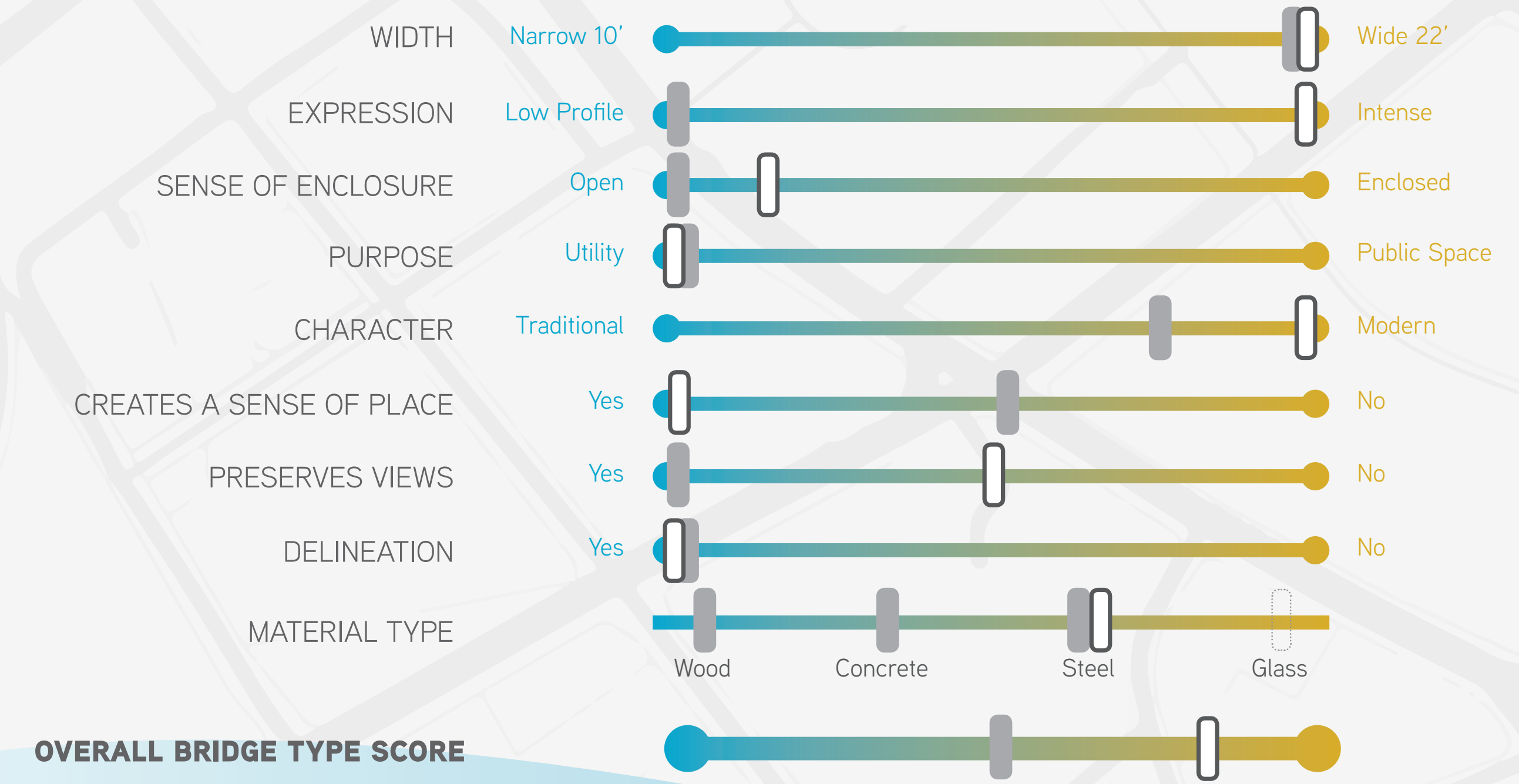
- Creates a sense of place and destination-quality landmark
- Structural delineation separates people bicycling and walking
- Sense of openness
- Maintains a clear span over canal (no piers in the water)

CONS

- Impacts views toward Diamond Head
- Geotechnical and structural considerations with cantilevered tower

RANGE OF POSSIBLE BRIDGE EXPERIENCES

How does this bridge concept score compared to expressed community feedback?



Concept Score Community Feedback* on Preferred Bridge Experience

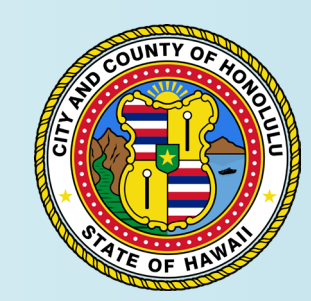
*Source: Community Kickoff Meetings, September 2018



How well does this bridge type achieve your desired bridge experience?

Vote: Place your sticker here

Comments?



BRIDGE TYPE: STEEL LENTICULAR

A steel lenticular truss bridge is visually interesting and implementable, although it has a greater sense of enclosure.

PROS

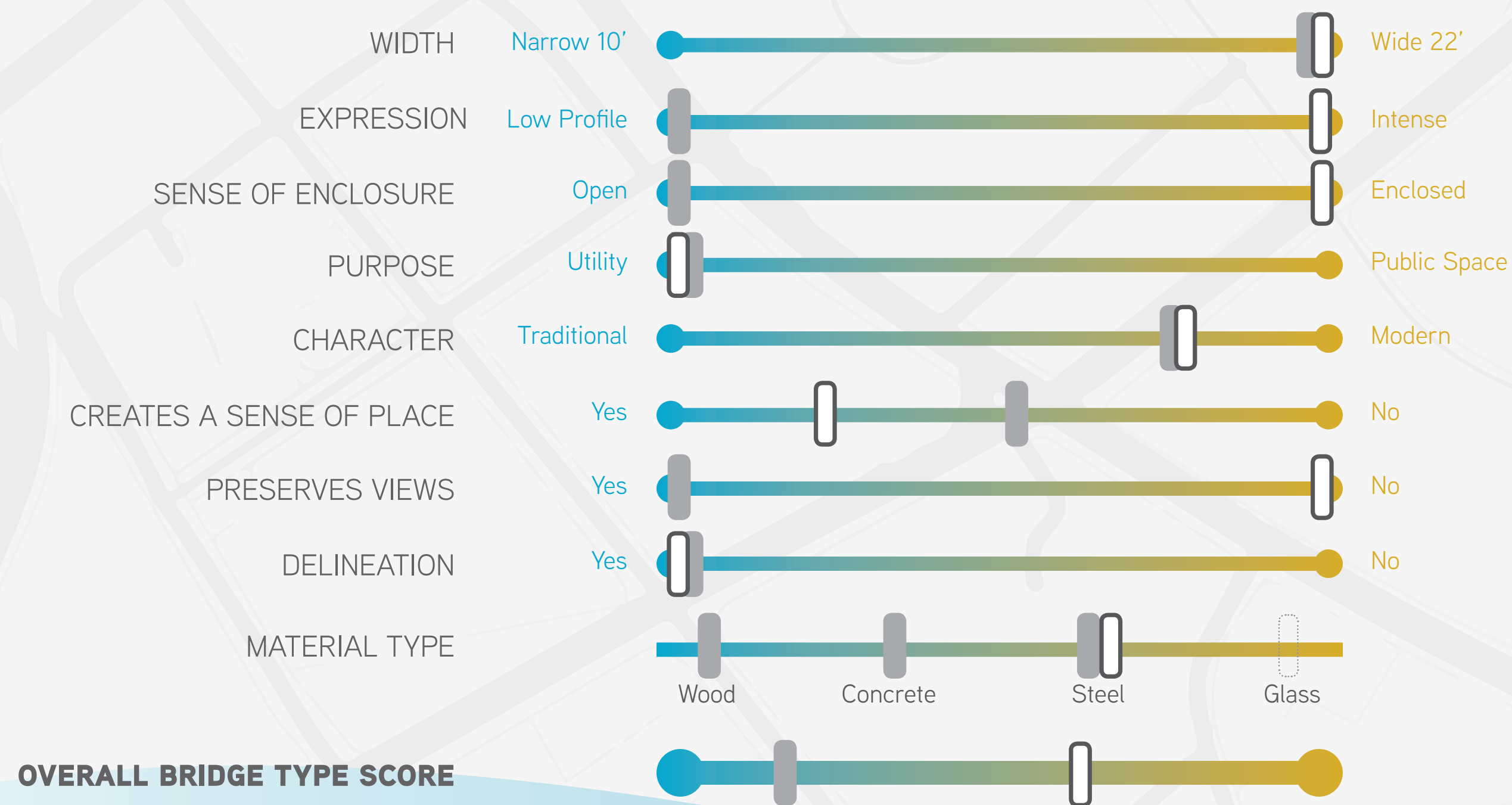
- Visually interesting overhead bridge structure
- Modern character
- Traditional bridge implementation
- Maintains a clear span over canal (no piers in the water)

CONS

- Impact on view corridors
- Sense of enclosure; disconnection from surrounding setting
- No structural separation for people
- Steel is difficult to maintain in the Hawaiian marine environment

RANGE OF POSSIBLE BRIDGE EXPERIENCES

How does this bridge concept score compared to expressed community feedback?



Concept Score Community Feedback* on Preferred Bridge Experience

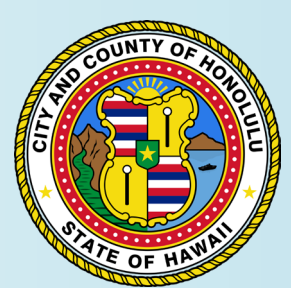
*Source: Community Kickoff Meetings, September 2018



How well does this bridge type achieve your desired bridge experience?

Vote: Place your sticker here

Comments?



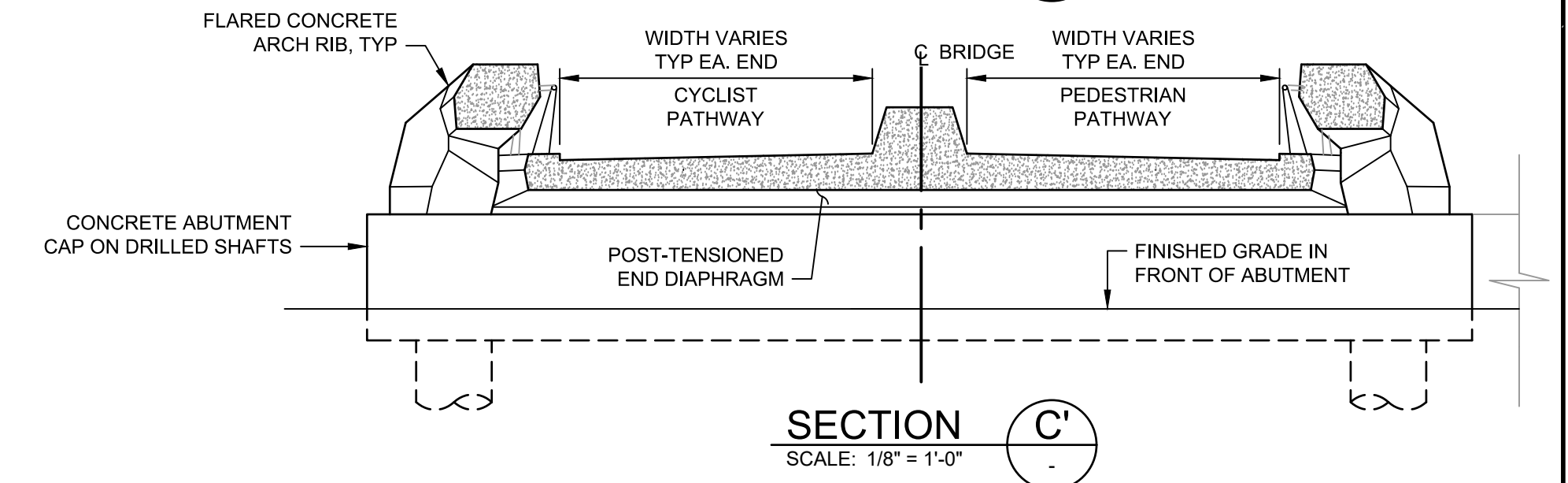
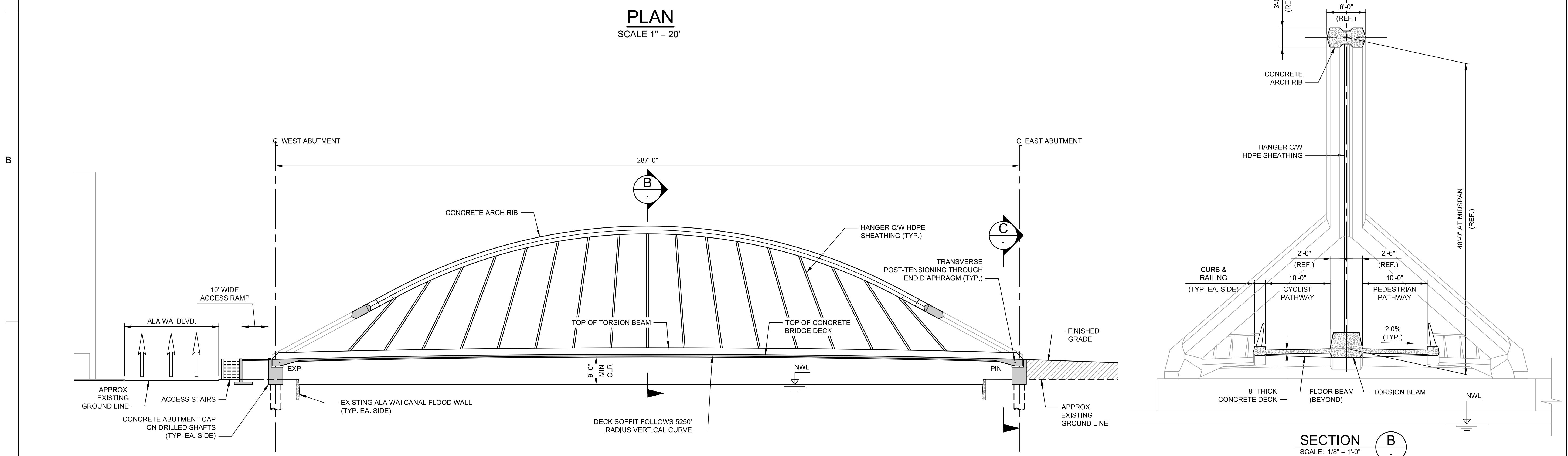
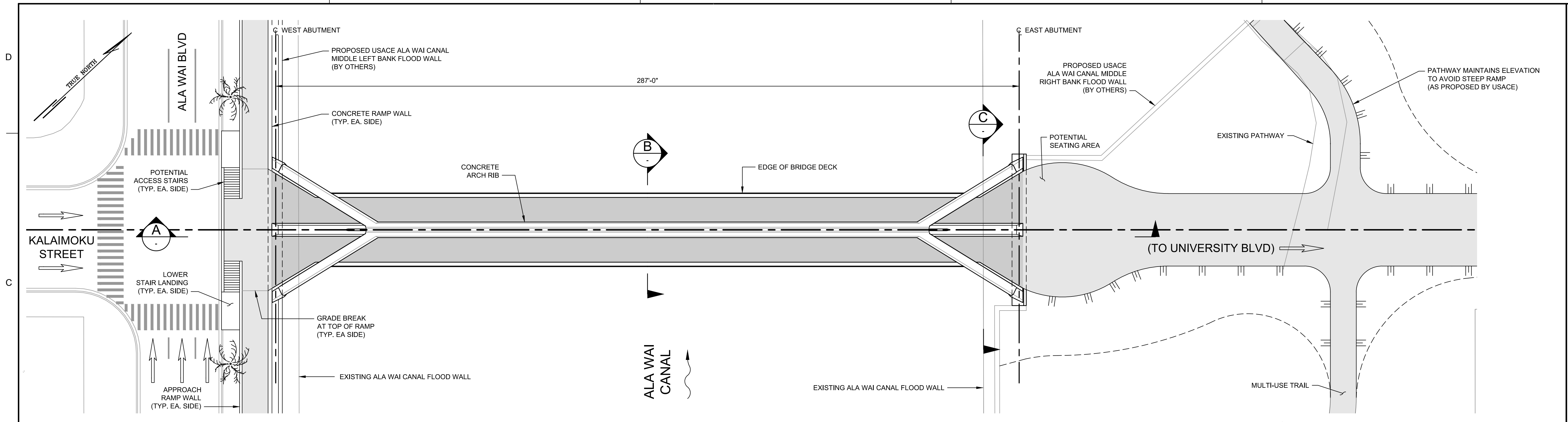
1

2

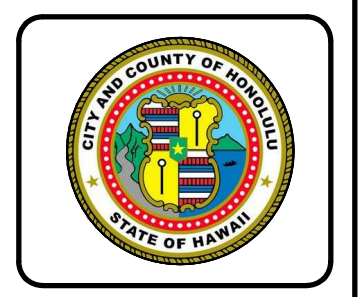
3

4

5



PRELIMINARY - NOT FOR CONSTRUCTION



REVISION	DATE	DESCRIPTION

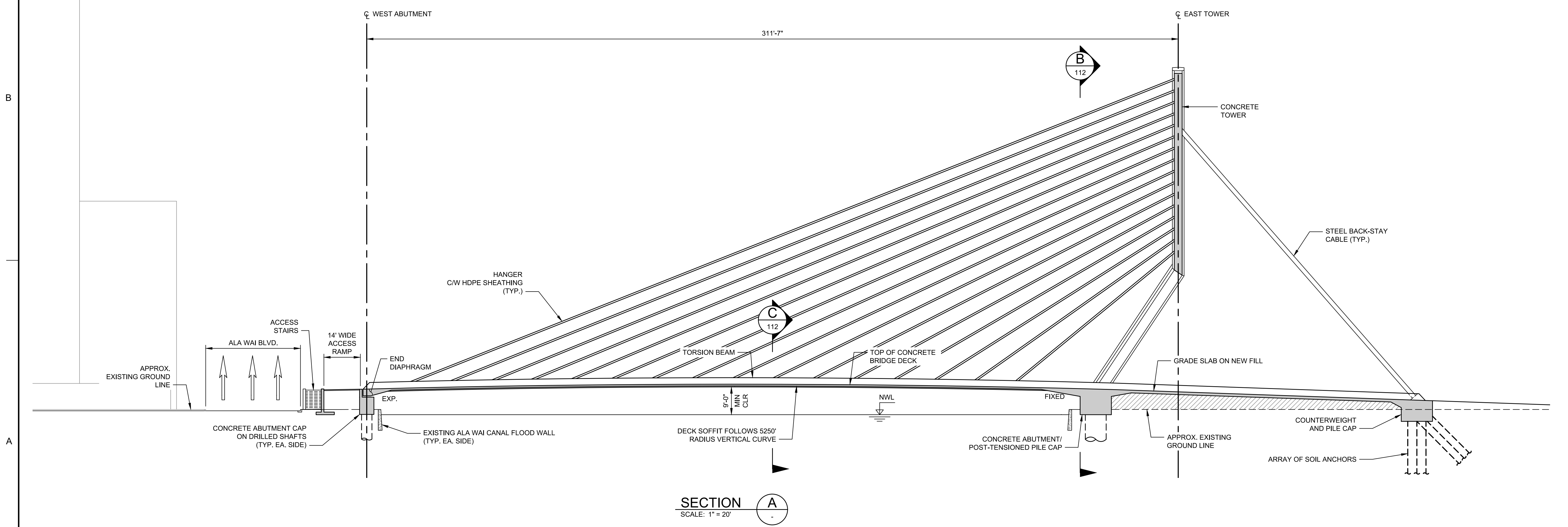
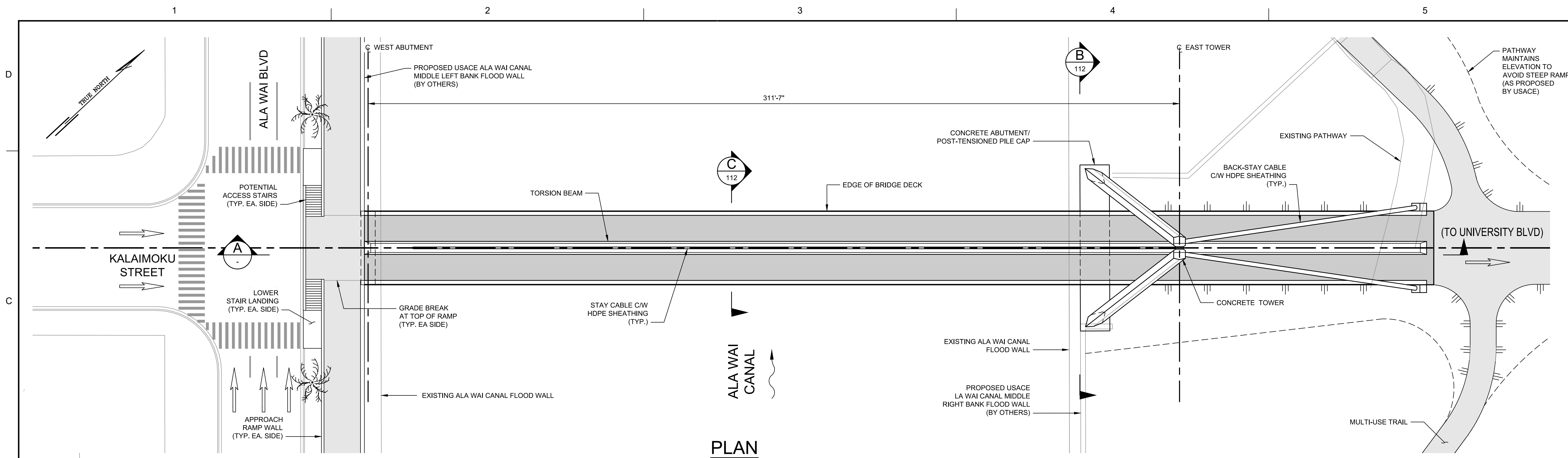
DESIGNED BY:	DATE:	REVISION:
DRAWN BY:	CHECKED BY:	SOLICIT/CONTRACT NO.:
SUBMITTED BY:	LOCATION CODE:	
PLOT SCALE:	FILE NAME:	
AS SHOWN	DRAWING NUMBER:	
FILE NAME:		
ANSI D		

ALAI WAI CANAL PROJECT

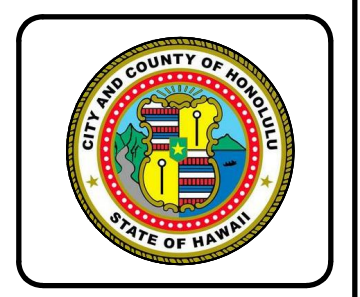
ALAI WAI CANAL BRIDGE CROSSING CONCRETE ARCH OPTION GENERAL ARRANGEMENT

SHEET IDENTIFICATION **S-101**

SHEET OF



PRELIMINARY - NOT FOR CONSTRUCTION



REVISION	DATE	DESCRIPTION

DESIGNED BY:	CHECKED BY:	DATE:	REVISION:
DRAWN BY:	SUBMITTED BY:	SOLICIT/CONTRACT NO.:	
		LOCATION CODE:	
		PLOT SCALE:	DRAWING NUMBER:
		AS SHOWN:	
		FILE NAME:	

STRUCTURAL DESIGN

ALA WAI CANAL PROJECT
 ALA WAI CANAL BRIDGE CROSSING
 CABLE-STAY BRIDGE OPTION
 GENERAL ARRANGEMENT - SHEET 1

SHEET IDENTIFICATION
S-111
 SHEET OF

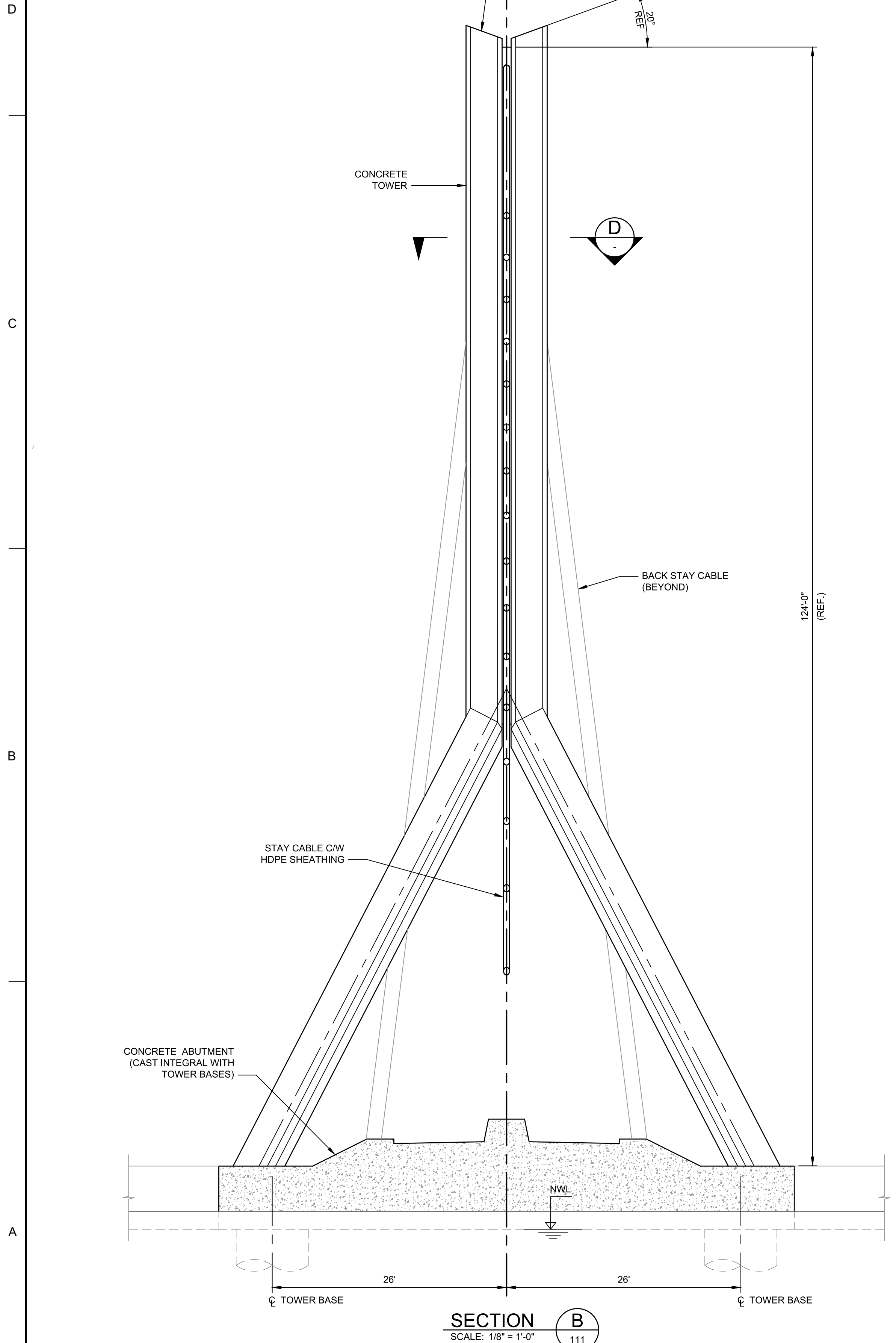
1

2

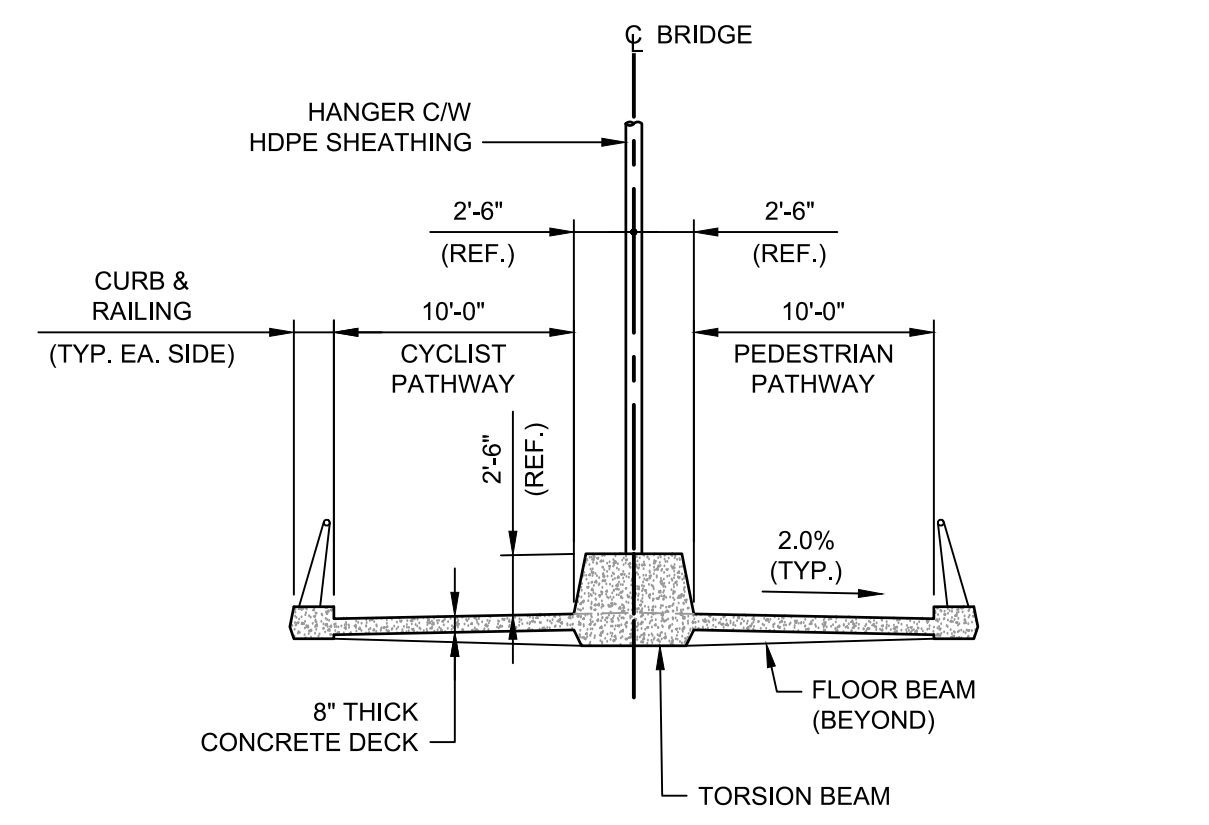
3

4

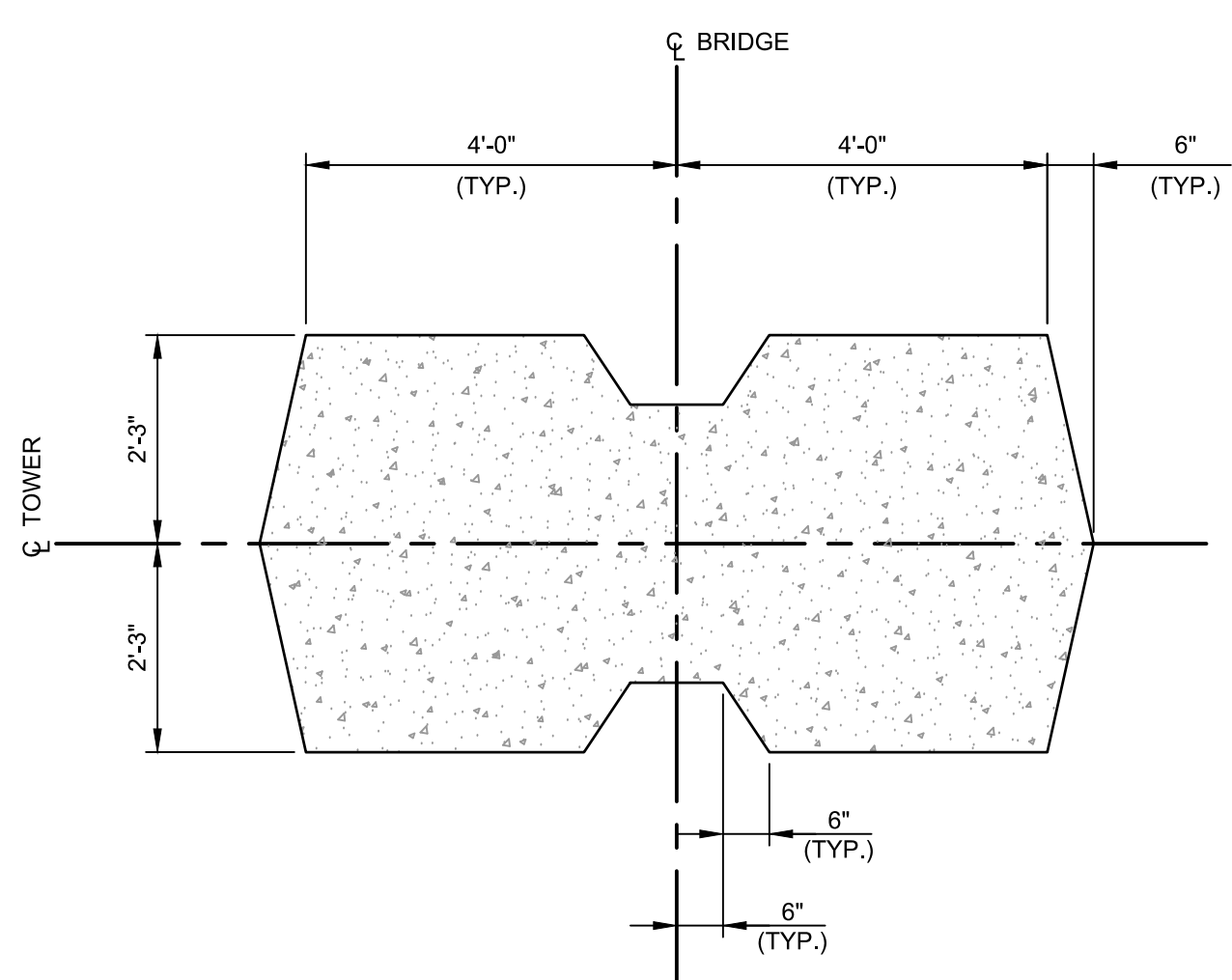
5



SECTION B
SCALE: 1/8" = 1'-0"
111



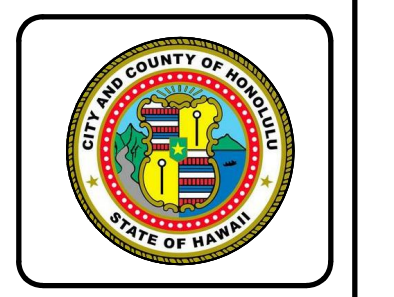
SECTION C
SCALE: 1/8" = 1'-0"



(DIMENSIONS OF TOWER PROVIDED FOR REFERENCE ONLY)

SECTION D
SCALE: 1/2" = 1'-0"

PRELIMINARY - NOT FOR CONSTRUCTION



REVISION	DATE	DESIGNED BY	CHECKED BY	DESIGNATION	DATE	APPR. / MARK	DATE	APPR. / MARK	DESCRIPTION

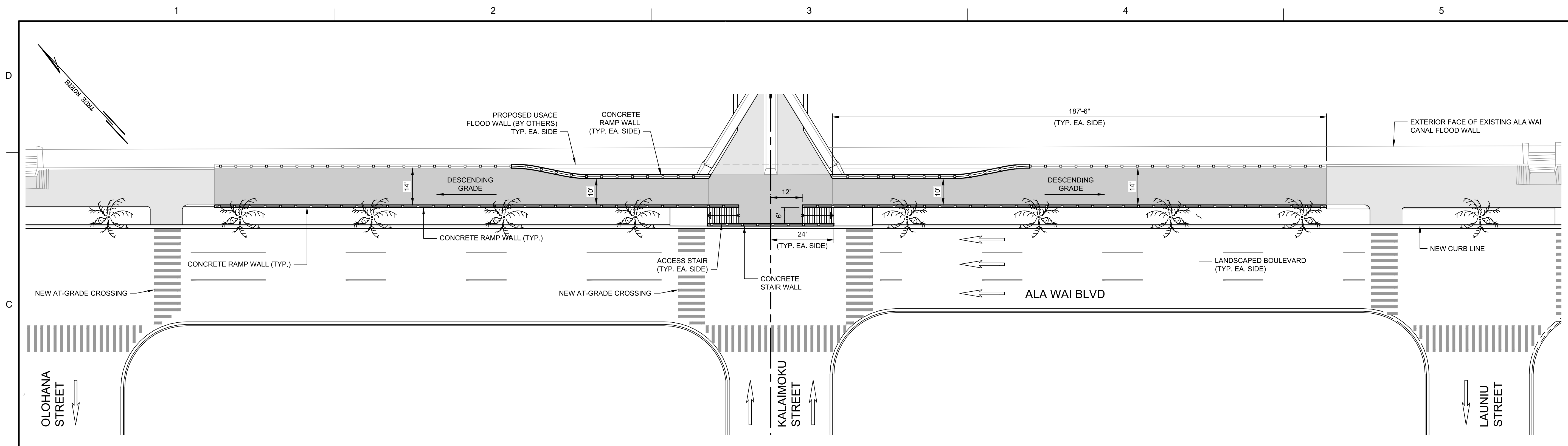
DESIGNED BY:	REVISION:	DATE:	DATE:
DRAWN BY:	CHECKED BY:	SOLICIT/CONTRACT NO.:	CHECKED BY:
SUBMITTED BY:	PLOT DATE:	LOCATION CODE:	LOCATION CODE:
AS SHOWN:	FILE NAME:	DRAWING NUMBER:	DRAWING NUMBER:
ANSI D	SIZE:		

STRUCTURAL DESIGN

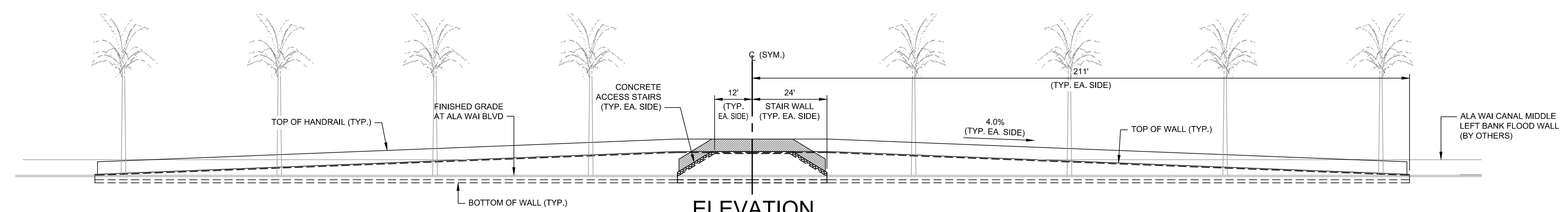
ALA WAI CANAL PROJECT

ALA WAI CANAL BRIDGE CROSSING
 CABLE-STAY BRIDGE OPTION
 GENERAL ARRANGEMENT - SHEET 2

SHEET IDENTIFICATION
S-112
 SHEET OF

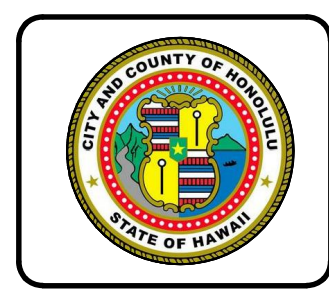


PLAN
SCALE 1" = 20'



ELEVATION
SCALE 1" = 20'

PRELIMINARY - NOT FOR CONSTRUCTION



REVISION	DATE	DESCRIPTION	DATE	APPR.	MARK

DESIGNED BY:	CHECKED BY:	REVISION:
DRAWN BY:	SUBMITTED BY:	DATE:
PROJECT NO.:	LOCATION CODE:	SOLICIT/CONTRACT NO.:
PLOT SCALE:	FILE NAME:	DRAWING NUMBER:
AS SHOWN:	ANSI D	

STRUCTURAL DESIGN

ALA WAI CANAL PROJECT

ALA WAI CANAL BRIDGE CROSSING
MAKAI ACCESS RAMP
GENERAL ARRANGEMENT

SHEET IDENTIFICATION
S-102
SHEET OF



Ala Wai Canal Crossing Planning Study Cost Estimate - Summary

Disclaimer

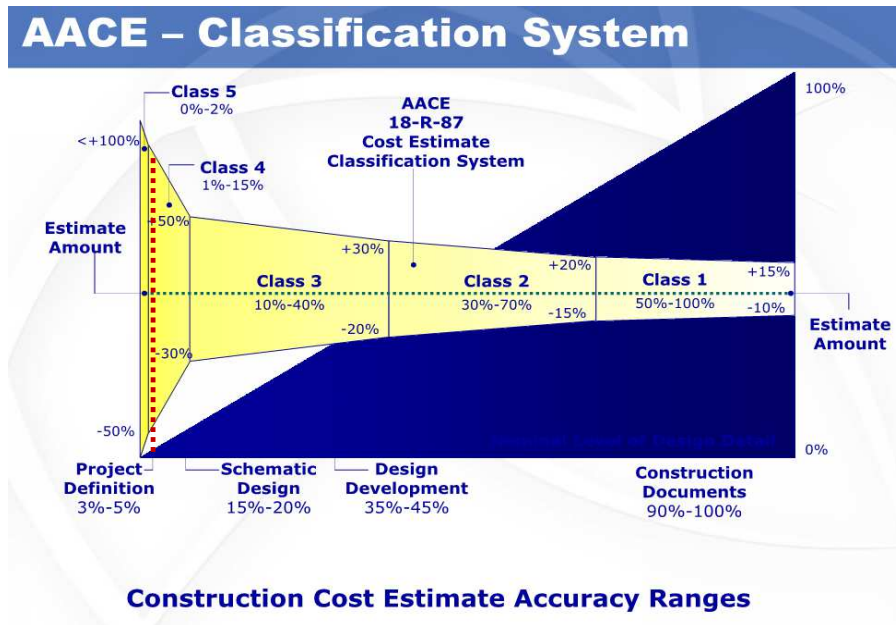
This document has been prepared for the titled project. V+M accepts no responsibility or liability for the consequence of this document being used for a purpose other than the purposes for which it was commissioned.

To the extent that this report is based on information supplied by other parties, V+M accepts no liability for any loss or damage suffered by the client, whether through stemming from any conclusions based on data supplied by parties other than V+M and used by V+M in preparing this document.

Basis of Estimate

This is a feasibility Rough Order of Magnitude cost estimate to provide a high level cost for the Ala Wai Canal Crossing concepts for the Owner's planning purposes. This cost estimate is developed based on a bridge structure that spans across the canal and associated approaches. The estimate includes costs to complete Final Design, Construction Management, Owner staff costs, Construction, and 25% Contingency.

The cost estimate is for a conceptual 5% design corresponding to the project definition level of the AACE classification system. The estimate retains ambiguity on structural details, and precedes survey or geotechnical information. As such, it is an estimate built up using basic unit costs applied to major elements. Unit prices are based on published costs and previous experience with costs for relevant completed pedestrian bridge structures and retaining walls.



For bridge unit costs, Caltrans' comparative bridge costs for 2018 were used as a reference to develop order of magnitude values. A cost premium of 50% was assumed to account for location and local construction markets.

Source: http://www.dot.ca.gov/hq/esc/estimates/Construction Stats 2018.pdf



Assumptions for Estimate

The estimates are based on a preliminary linear alignment with built up approach ramps on the makai side and an earthen berm on the mauka side. Ramps are all less than 5% grade.

Foundations are assumed to be moderate in size using conventional construction with no ground improvements. A pair of drilled shaft foundations is assumed for supporting each end of the arch and truss bridge options. For the cable-stayed option, the back stays will require additional vertical resistance achieved by a combination of a dead weight, soil anchors and potentially deep foundation. It is again noted that there has been no review of the underground conditions at the site.

The estimate excludes excessive lighting, extravagant railings, extensive street furniture, or artwork.

No contaminated material removal and disposal is included.

No property acquisition is anticipated and therefore is not included.

It is assumed that permanent impacts on the canal are minor (using a clear span) and temporary construction impacts are acceptable.

The estimate assumes basic landscaping costs.

Costs for roadway modifications and new signalized intersections are to be provided by others.

Major utility impacts/relocations are not anticipated as part of this project. We have not reviewed in detail the apparent conflict with the existing culvert infrastructure on the mauka side of the canal, but have included a \$400,000 allowance for its relocation. We have the understanding that existing proposed power cable crossing beneath the canal will be moved to a revised location to avoid conflict with the bridge. And the USACE flood wall concept is being revised to relocate the pump station and associated power equipment to avoid conflict with the bridge.

Additional items for further consideration during PE1:

- 1) Maintenance of the steel truss option will be most expensive of the three options.
- 2) DFM review during PE1 is needed prior to making a final selection of the bridge option, as they will be maintaining the bridge.
- 3) Discussions with the USACE are needed during PE1 to discuss the potential of permitting a bridge that has piers in the water.



Comparative Cost Summary

Option	Total Deck Width (ft)**	Construction Cost (Subtotal 1 Range*)	Soft Costs (Subtotal 2)	Total Cost Range
A - Arch	28	\$8.4M to \$27.9M	\$5.2M	\$13.6M to \$33.1M
B - Truss	28	\$8.7M to \$29.1M	\$5.4M	\$14.1M to \$34.5M
C - Cable Stayed	28	\$8.3M to \$27.6M	\$5.1M	\$13.4M to \$32.7M

* Accuracy of estimate for a 3%-5% project definition phase is -40% and +100%.

** Operational clear width of the bridge deck is 20-ft.





Feasibility Cost Estimate

Deck Width 28 ft

Description	Unit	\$/Unit	Quantity	Item Cost
Approaches and Ramps				
CIP Wall - boulevard	SF	\$ 90	2696	\$ 242,640
CIP Wall - canal	SF	\$ 90	760	\$ 68,400
CIP Wall - flood (optional)	SF	\$ 90	440	\$ 39,600
Asphalt pavement - blvd	SF	\$ 2.75	4236	\$ 11,649
Asphalt pavement - canal	SF	\$ 2.75	15901	\$ 43,728
Berm	CF	\$ 25	570	\$ 14,259
Railing - approaches	LF	\$ 150	712	\$ 106,800
Approach/Ramp Lighting	LS	\$ 100,000	1	\$ 100,000
This is a feasibility Rough Order of	SF	\$ 100	515	\$ 51,450
Stairs - CIP wall (optional)	SF	\$ 90	296	\$ 26,676
Railing - stairs (optional)	LF	\$ 150	52	\$ 7,860
Subtotal approaches and ramps				\$ 713,062
Main Bridge				
Bridge	SF	\$ 1,000	8460	\$ 8,460,000
Railing - main span	LF	\$ 300	592	\$ 177,600
Bridge Functional Lighting	LF	\$ 300	580	\$ 174,000
Bridge Aesthetic Lighting	LS	\$ 250,000	1	\$ 250,000
Subtotal main bridge				\$ 9,061,600
Miscellaneous				
Landscaping	LS	\$ 250,000	1	\$ 250,000
Hardscaping/seating	LS	\$ 150,000	1	\$ 150,000
Utility conflicts	LS	\$ 400,000	1	\$ 400,000
Roadway/Intersection improvements	LS	\$ 400,000	1	\$ 400,000
Maintenance of Traffic	LS	\$ 200,000	1	\$ 200,000
Contingency	Each	25.0%	1	\$ 2,793,666
Subtotal miscellaneous				\$ 4,193,666

along Ala Wai Blvd, +2' below grade
trapezoidal wall on canal side, +2' be
between Ala Wai Blvd and canal, +2'
2" asphalt, Blvd side
2" asphalt, canal side
at north end
Blvd side only
at Blvd side (plan area)
along curb

arch main span
accounts for flared ends

<-- by others
<-- by others
<-- by others

Subtotal 1 (lower range) = \$ 8,380,997 -40%*
Subtotal 1 (nominal) = \$ 13,968,328
Subtotal 1 (upper range) = \$ 27,936,655 +100%*

* The expected variation for a 5% design is -40% and +100%

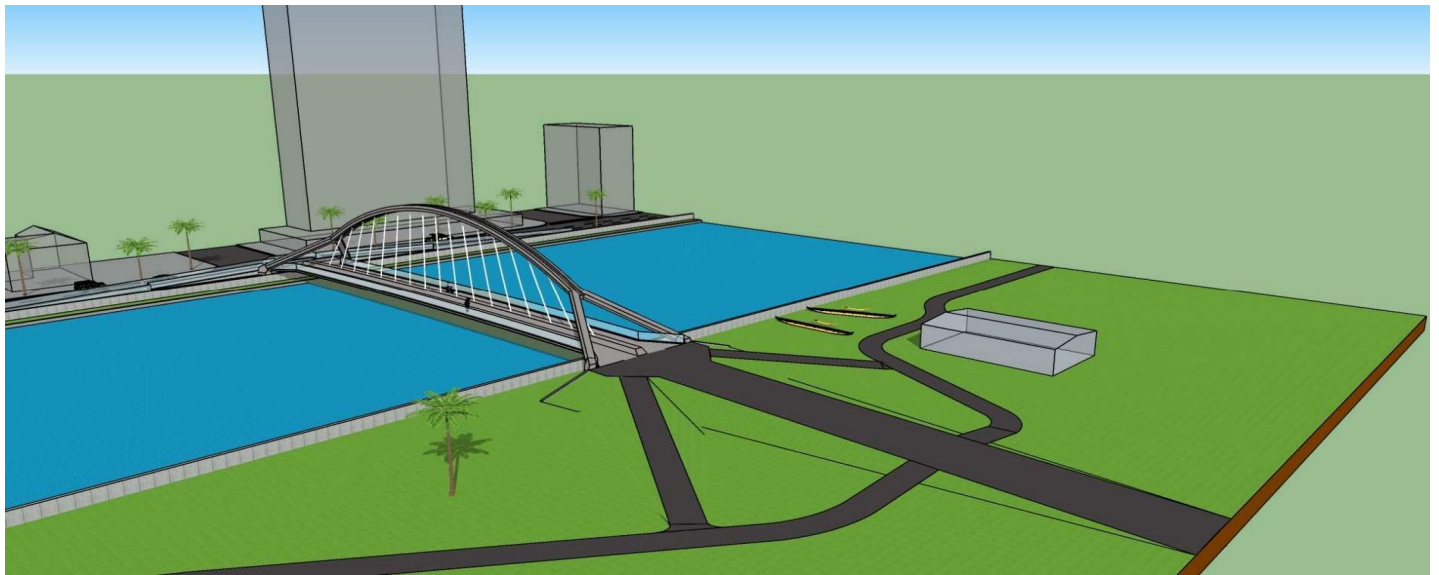
Description	Unit	Value	Quantity	Item Cost
Taxes	Each		1	\$ -
Engineering	Each	17.5%	1	\$ 2,444,457
Construction Management	Each	12.0%	1	\$ 1,676,199
Permits	LS		1	\$ -
Agency Cost	Each	7.5%	1	\$ 1,047,625
Subtotal 2 =				\$ 5,168,281

<-- by others
<-- by others

Total (lower range) = \$ 13,550,000 -40%*
Total (nominal) = \$ 19,140,000
Total (upper range) = \$ 33,100,000 +100%*

Note:

For the assumptions associated with this Feasibility Cost Estimate, please refer to the "Summary" worksheet of this workbook.
Bridge unit cost based on Caltrans comparative bridge cost, with mark-up of 25% to account for higher local construction costs.





Feasibility Cost Estimate

Deck Width 28 ft

Description	Unit	\$/Unit	Quantity	Item Cost
Approaches and Ramps				
CIP Wall - boulevard	SF	\$ 90	2696	\$ 242,640
CIP Wall - canal	SF	\$ 90	760	\$ 68,400
CIP Wall - flood (optional)	SF	\$ 90	440	\$ 39,600
Asphalt pavement - blvd	SF	\$ 2.75	4236	\$ 11,649
Asphalt pavement - canal	SF	\$ 2.75	15901	\$ 43,728
Berm	CF	\$ 25	570	\$ 14,259
Railing - approaches	LF	\$ 150	712	\$ 106,800
Approach/Ramp Lighting	LS	\$ 100,000	1	\$ 100,000
This is a feasibility Rough Order of	SF	\$ 100	515	\$ 51,450
Stairs - CIP wall (optional)	SF	\$ 90	296	\$ 26,676
Railing - stairs (optional)	LF	\$ 150	52	\$ 7,860
Subtotal approaches and ramps				\$ 713,062
Main Bridge				
Bridge	SF	\$ 1,100	8120	\$ 8,932,000
Railing - main span	LF	\$ 300	580	\$ 174,000
Bridge Functional Lighting	LF	\$ 300	580	\$ 174,000
Bridge Aesthetic Lighting	LS	\$ 250,000	1	\$ 250,000
Subtotal main bridge				\$ 9,530,000
Miscellaneous				
Landscaping	LS	\$ 250,000	1	\$ 250,000
Hardscaping/seating	LS	\$ 150,000	1	\$ 150,000
Utility conflicts	LS	\$ 400,000	1	\$ 400,000
Intersection improvements	LS	\$ 400,000	1	\$ 400,000
Maintenance of Traffic	LS	\$ 200,000	1	\$ 200,000
Contingency	Each	25.0%	1	\$ 2,910,766
Subtotal miscellaneous				\$ 4,310,766

along Ala Wai Blvd, +2' below grade trapezoidal wall on canal side, +2' between Ala Wai Blvd and canal, +2' 2" asphalt, Blvd side
2" asphalt, canal side
at north end
Blvd side only
at Blvd side (plan area)
along curb

steel truss main span

<-- by others
<-- by others
<-- by others

Subtotal 1 (lower range) = \$ 8,732,297 -40%*
Subtotal 1 (nominal) = \$ 14,553,828
Subtotal 1 (upper range) = \$ 29,107,655 +100%*

* The expected variation for a 5% design is -40% and +100%

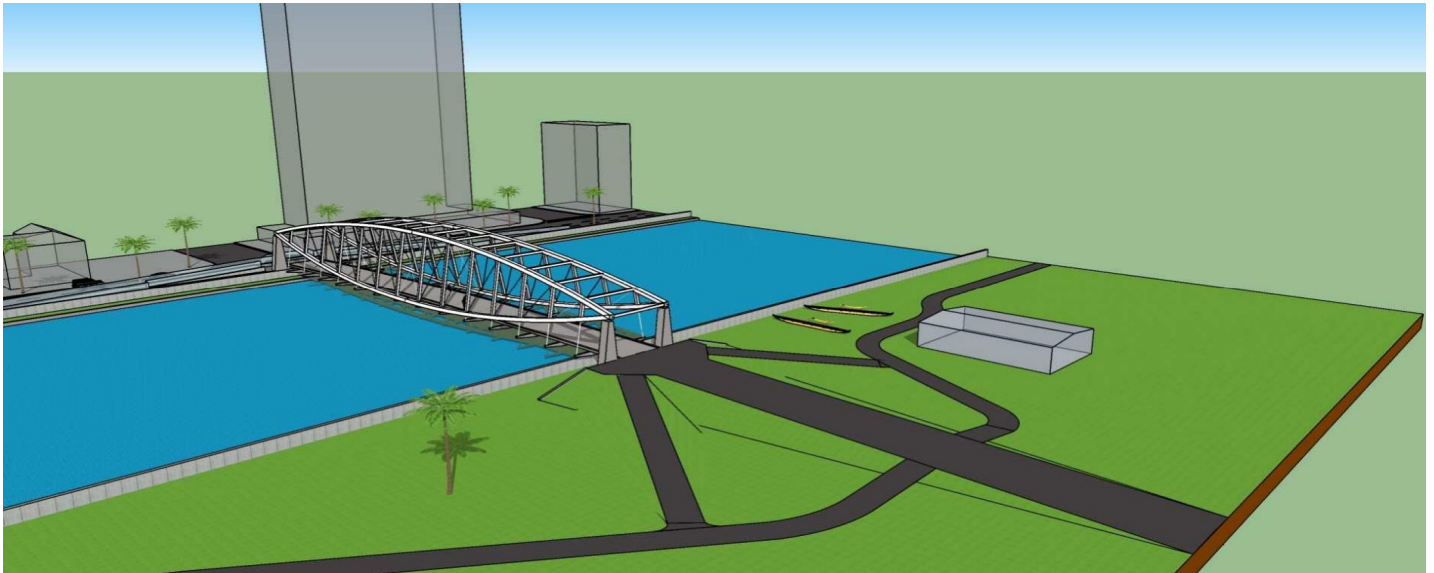
Description	Unit	Value	Quantity	Item Cost
Taxes	Each	0.0%	1	\$ -
Engineering	Each	17.5%	1	\$ 2,546,920
Construction Management	Each	12.0%	1	\$ 1,746,459
Permits	LS	\$ -	1	\$ -
Agency Cost	Each	7.5%	1	\$ 1,091,537
Subtotal 2 =				\$ 5,384,916

<-- by others
<-- by others

Total (lower range) = \$ 14,120,000 -40%*
Total (nominal) = \$ 19,940,000
Total (upper range) = \$ 34,490,000 +100%*

Note:

For the assumptions associated with this Feasibility Cost Estimate, please refer to the "Summary" worksheet of this workbook.
Bridge unit cost based on Caltrans comparative bridge cost, with mark-up of 25% to account for higher local construction costs.
Higher material cost of steel reflected in bridge unit price for this option.





Feasibility Cost Estimate

Deck Width 28 ft

Description	Unit	\$/Unit	Quantity	Item Cost
Approaches and Ramps				
CIP Wall - boulevard	SF	\$ 90	2696	\$ 242,640
CIP Wall - canal	SF	\$ 90	760	\$ 68,400
CIP Wall - flood (optional)	SF	\$ 90	440	\$ 39,600
Asphalt pavement - blvd	SF	\$ 2.75	4236	\$ 11,649
Asphalt pavement - canal	SF	\$ 2.75	8992	\$ 24,728
Berm	CF	\$ 25	570	\$ 14,259
Railing - approaches	LF	\$ 150	712	\$ 106,800
Approach/Ramp Lighting	LS	\$ 100,000	1	\$ 100,000
This is a feasibility Rough Order of	SF	\$ 100	515	\$ 51,450
Stairs - CIP wall (optional)	SF	\$ 90	296	\$ 26,676
Railing - stairs (optional)	LF	\$ 150	52	\$ 7,860
Subtotal approaches and ramps				\$ 694,062
Main Bridge				
Bridge - main span	SF	\$ 1,000	8120	\$ 8,120,000
Bridge - back span	SF	\$ 60	3724	\$ 223,440
Railing - main bridge	LF	\$ 300	580	\$ 174,000
Bridge Functional Lighting	LF	\$ 300	580	\$ 174,000
Bridge Aesthetic Lighting	LS	\$ 250,000	1	\$ 250,000
Subtotal main bridge				\$ 8,941,440
Miscellaneous				
Landscaping	LS	\$ 250,000	1	\$ 250,000
Hardscaping/seating	LS	\$ 150,000	1	\$ 150,000
Utility conflicts	LS	\$ 400,000	1	\$ 400,000
Intersection improvements	LS	\$ 400,000	1	\$ 400,000
Maintenance of Traffic	LS	\$ 200,000	1	\$ 200,000
Contingency	Each	25.0%	1	\$ 2,758,876
Subtotal miscellaneous				\$ 4,158,876

along Ala Wai Blvd, +2' below grade
trapezoidal wall on canal side, +2' be
between Ala Wai Blvd and canal, +2'
2" asphalt, Blvd side
2" asphalt, canal side
at north end
Blvd side only
at Blvd side (plan area)
along curb

main span
back span

<-- by others
<-- by others
<-- by others

Subtotal 1 (lower range) = \$ 8,276,627 -40%*
Subtotal 1 (nominal) = \$ 13,794,378
Subtotal 1 (upper range) = \$ 27,588,756 +100%*

* The expected variation for a 5% design is -40% and +100%

Description	Unit	Value	Quantity	Item Cost
Taxes	Each	0.0%	1	\$ -
Engineering	Each	17.5%	1	\$ 2,414,016
Construction Management	Each	12.0%	1	\$ 1,655,325
Permits	LS	\$ -	1	\$ -
Agency Cost	Each	7.5%	1	\$ 1,034,578
Subtotal 2 =				\$ 5,103,920

<-- by others
<-- by others

Total (lower range) = \$ 13,380,000 -40%*
Total (nominal) = \$ 18,900,000
Total (upper range) = \$ 32,690,000 +100%*

Note:

For the assumptions associated with this Feasibility Cost Estimate, please refer to the "Summary" worksheet of this workbook.
Bridge unit cost based on Caltrans comparative bridge cost, with mark-up of 25% to account for higher local construction costs.

