

SR 99 AURORA AVENUE BRIDGE FENCE

Design Committee

Work Book



Revised 2 2009
POKunderman

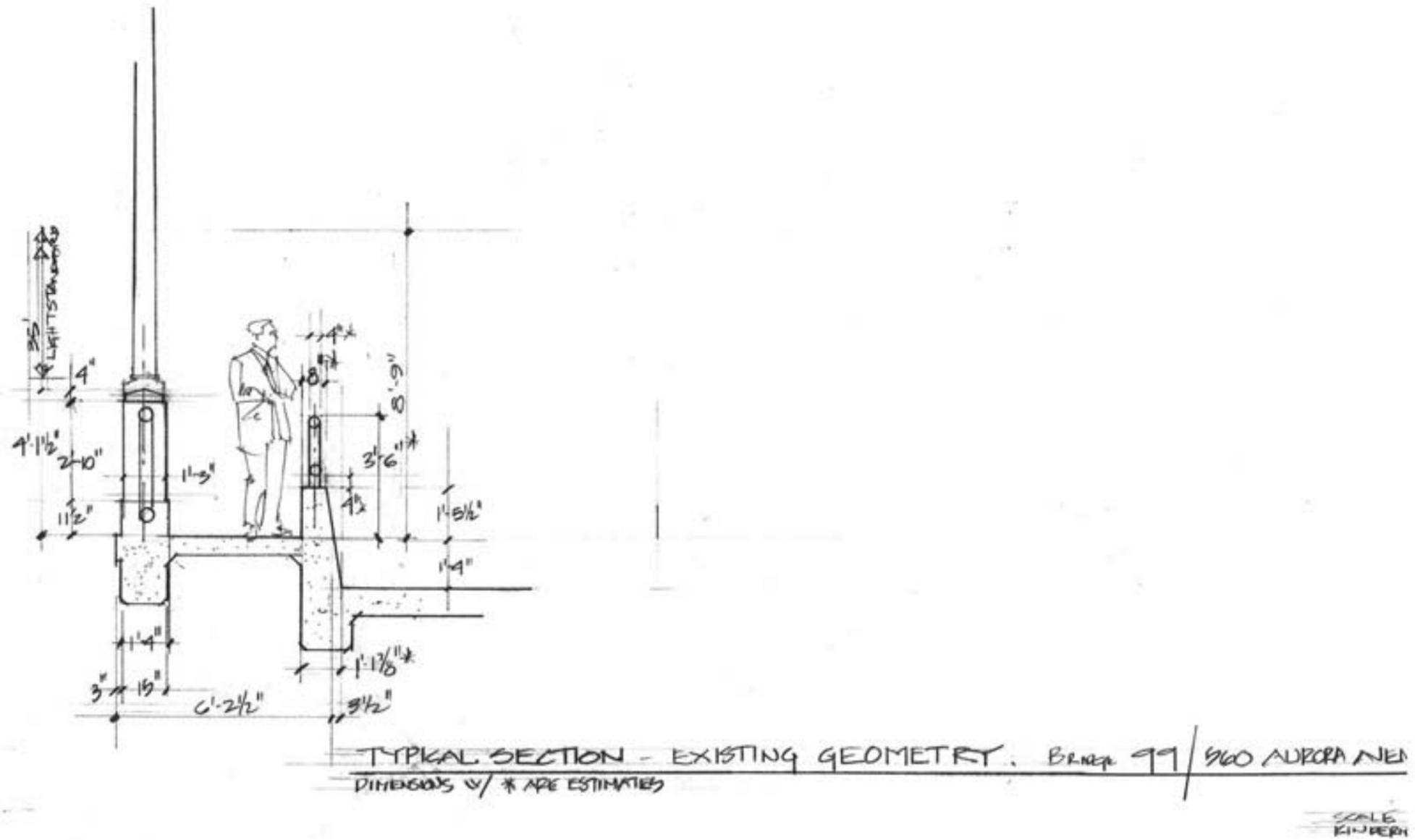
Index

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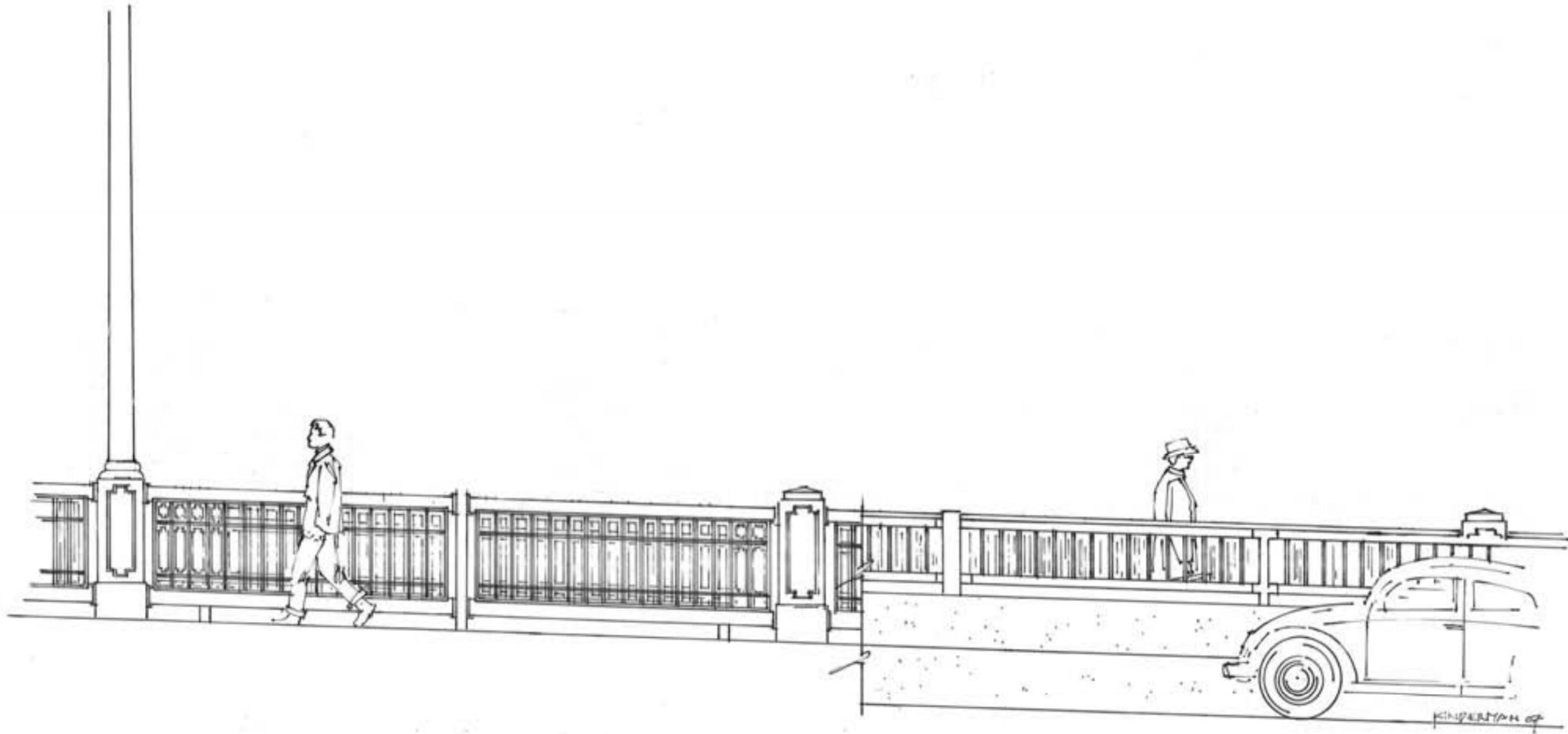
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Existing Geometry

- Typical Section of sidewalk
- Elevation View from the Roadway



Existing Typical Section

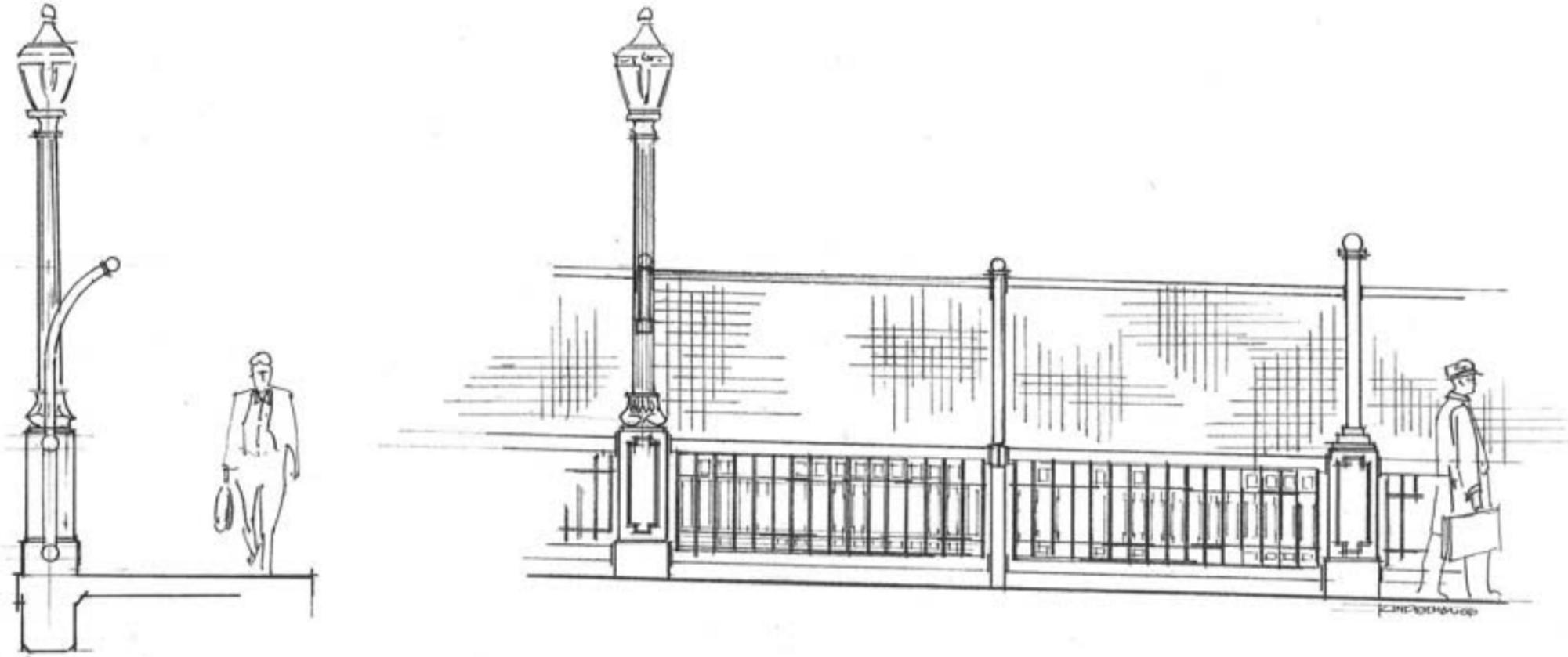


Existing Elevation

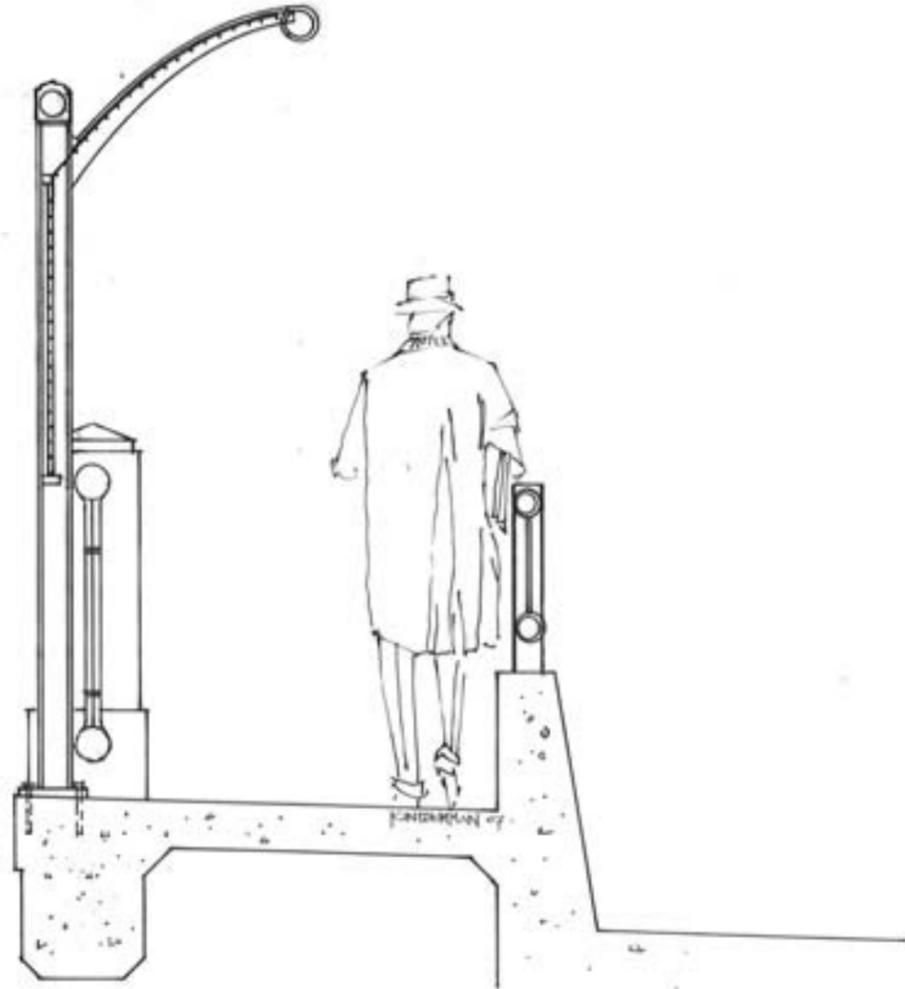
Preliminary Design Concepts

Provided during the early project funding phases

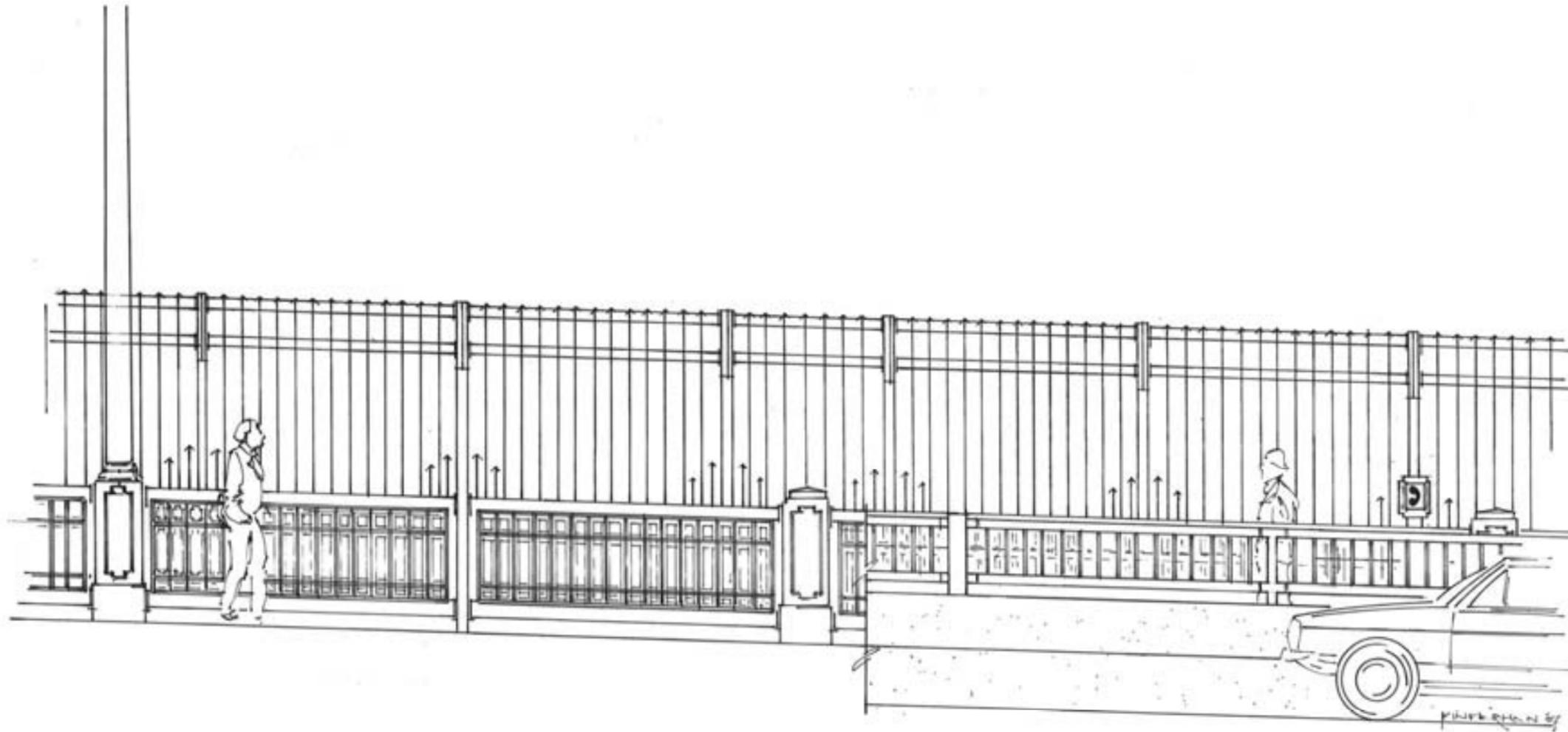
- Design for the Secretary of Transportation
- Design for the Washington State Legislature



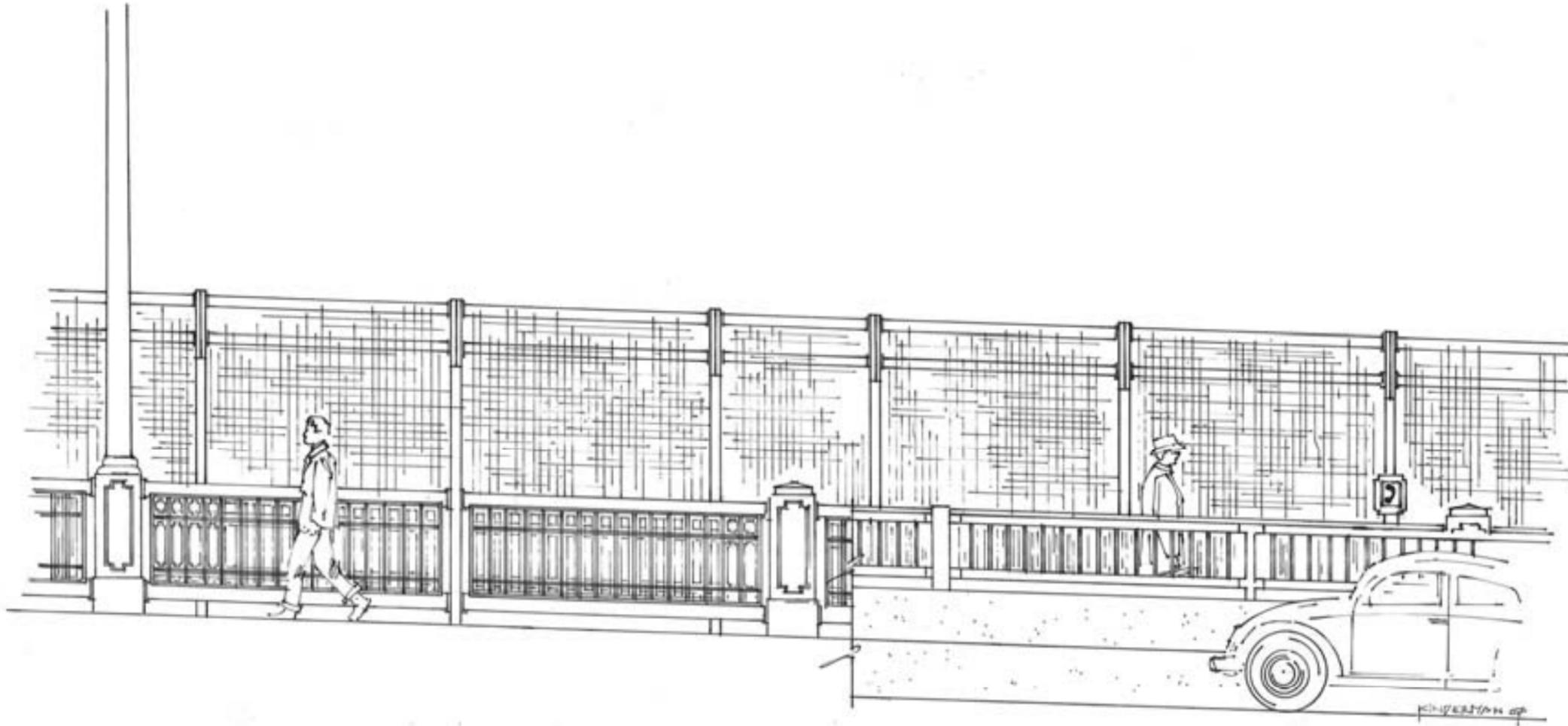
Design for the Secretary of Transportation



Design for the State Legislature



Design with Bars for the State Legislature

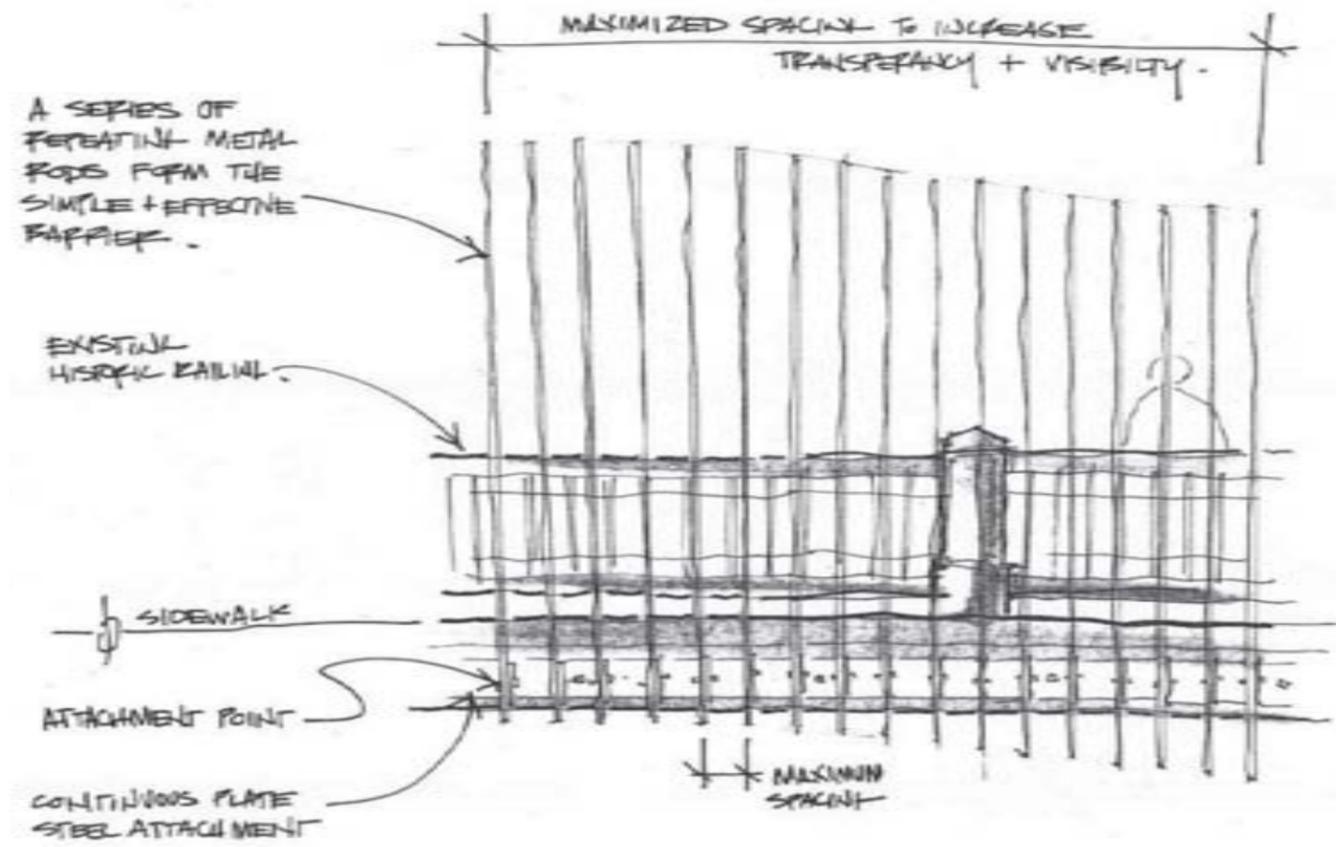
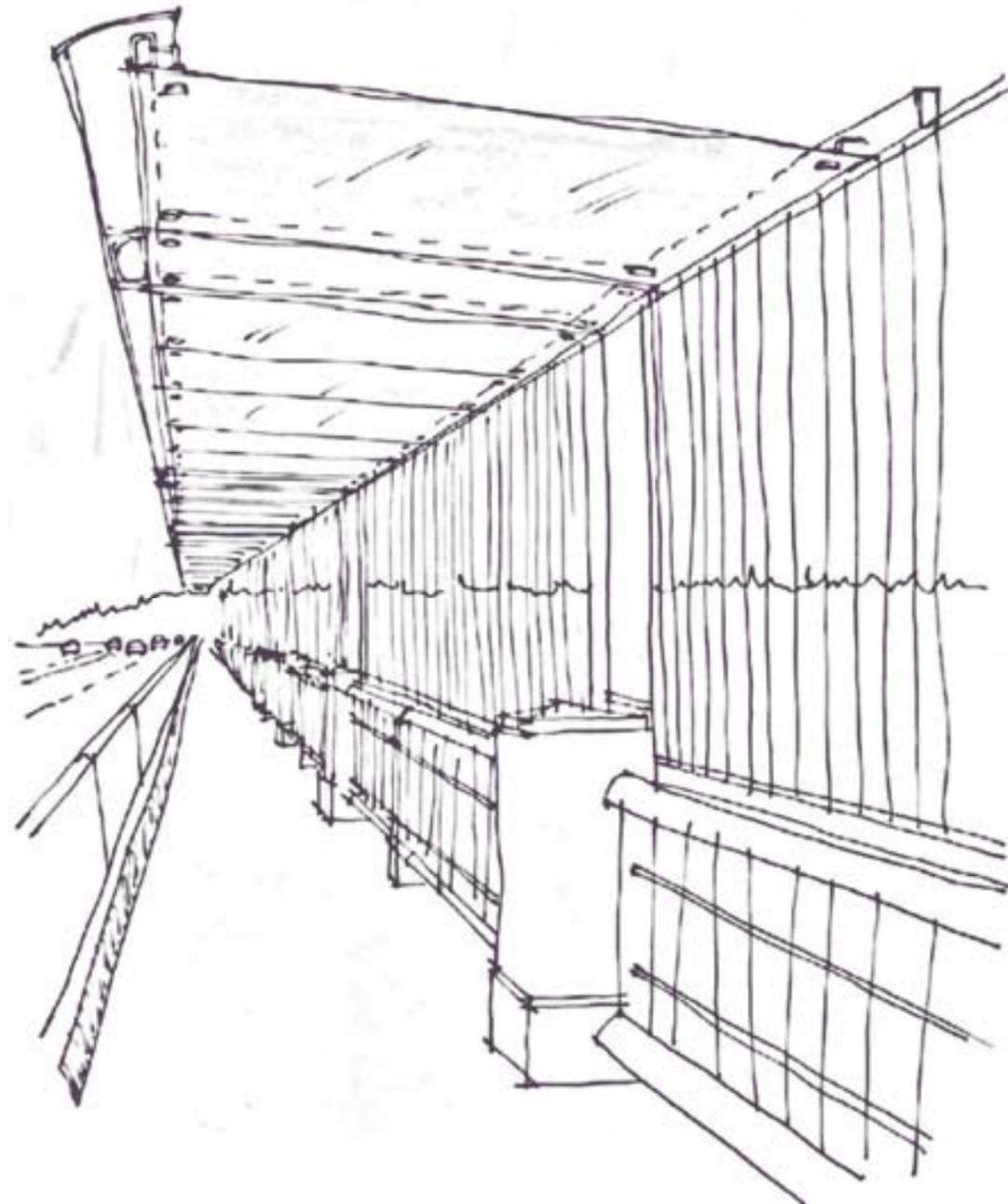


Design with screen for the State Legislature

Design Concepts

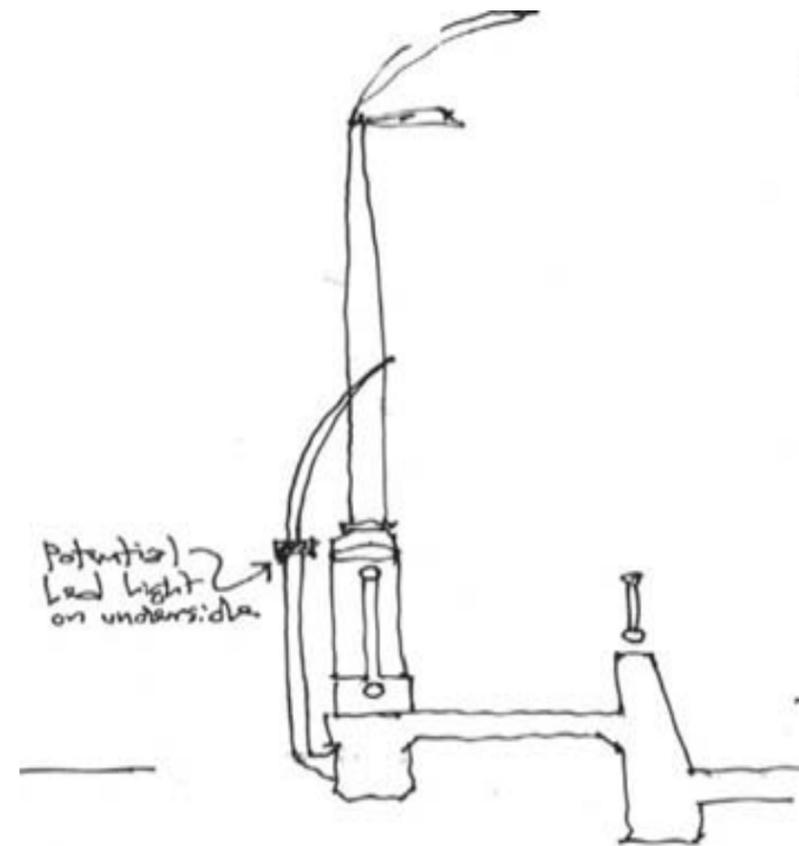
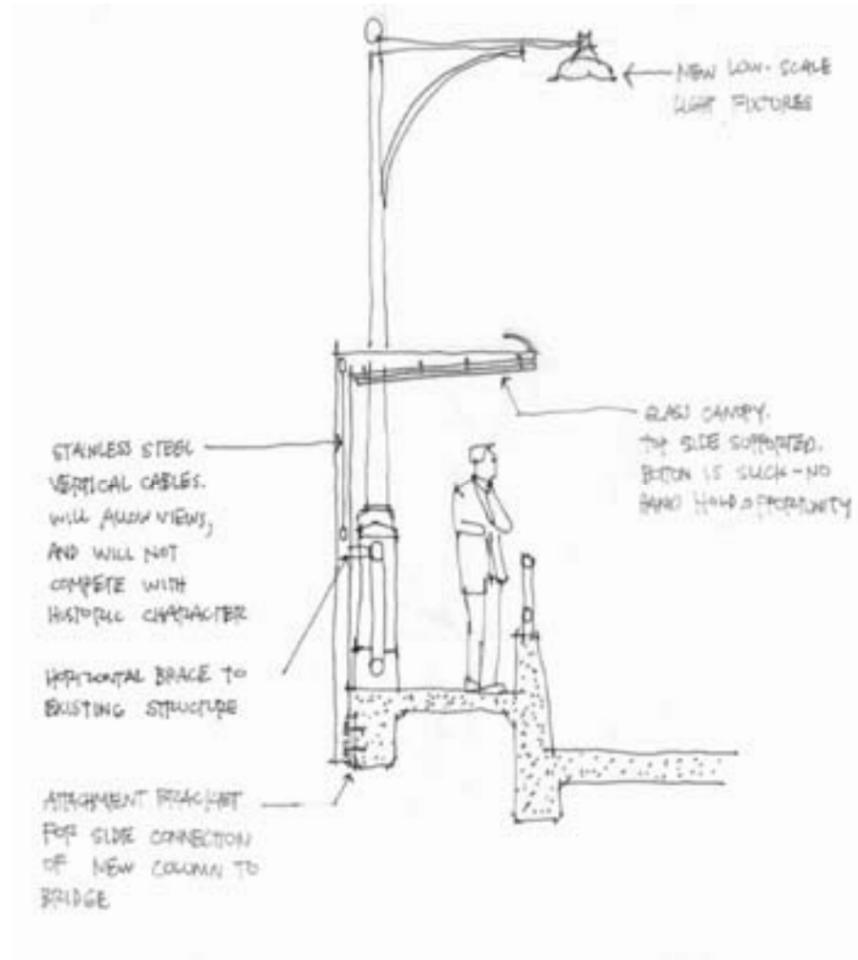
- Designs concepts from the *Community Conceptual Design Report 2007* to be integrated into the final design

Vertical Elements

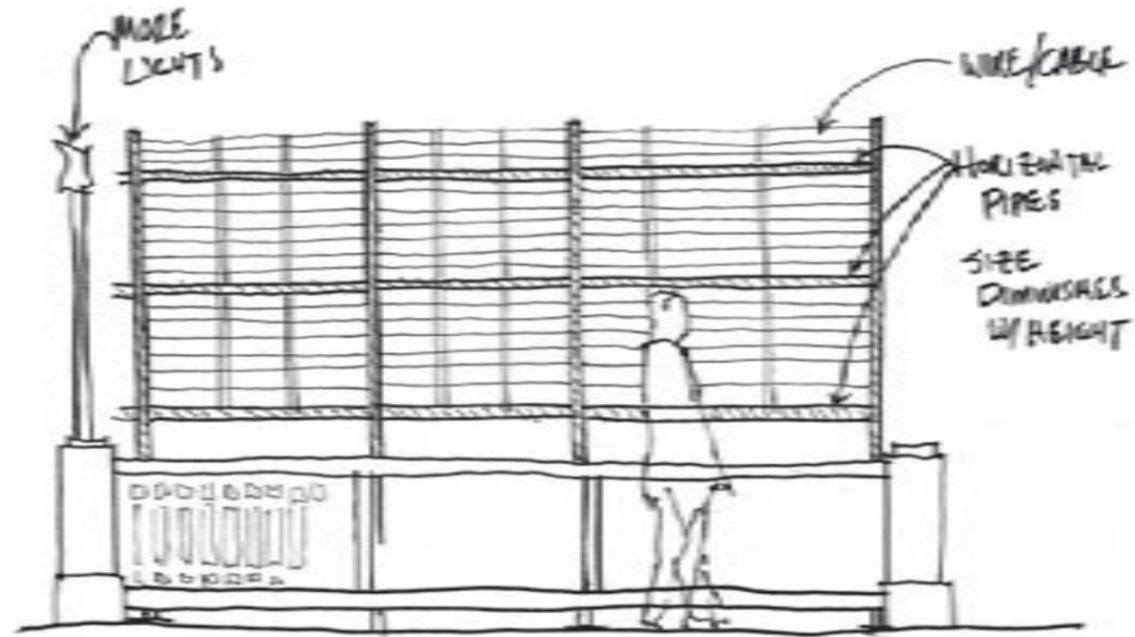




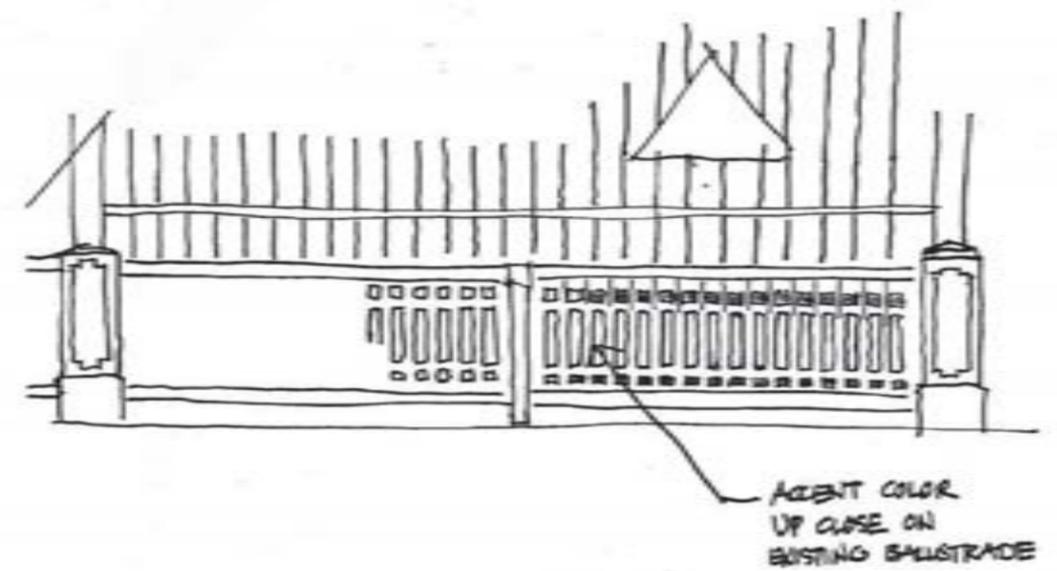
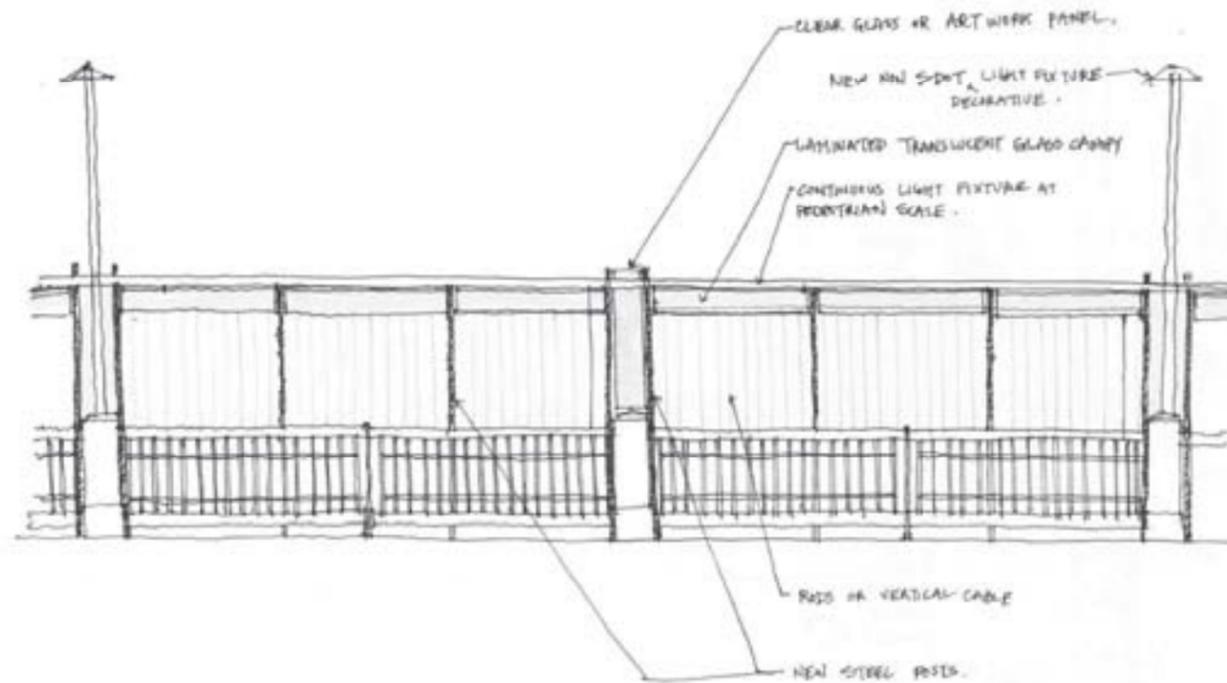
Pedestrian Lighting



Historic Character



Pedestrian Scale



City of Seattle Lighting Standards

- Standard lights from the City's Right of Way Manual



Z11



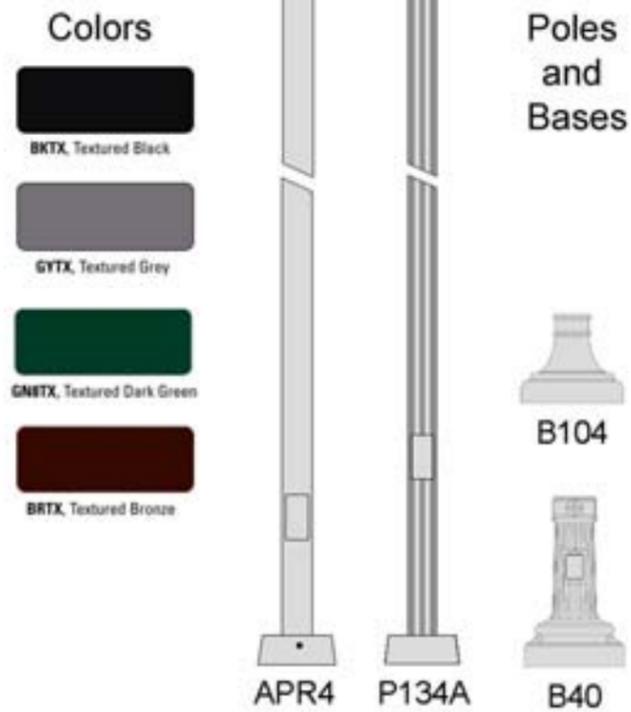
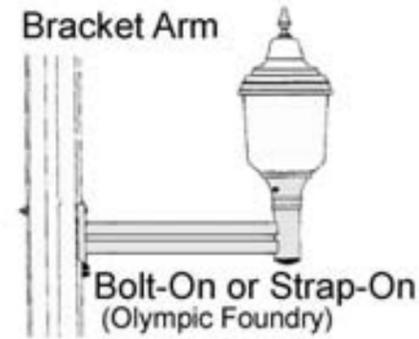
Z15



Z40



Z47A



Preapproved Manufacturer - Lumec

City of Seattle Pedestrian Lighting Design Standards

- City of Seattle Right of Way Manual figure 4-21

Anthropometric Data

- Human Dimensions

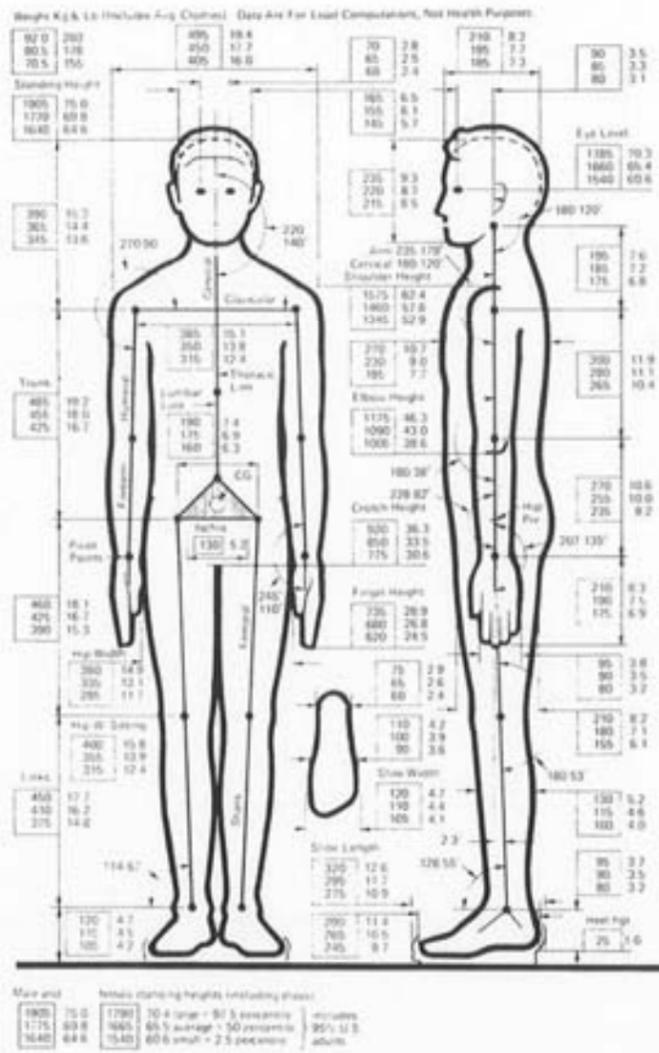
INTRODUCTION TO ANTHROPOMETRIC DATA

The following anthropometric drawings show three values for each measurement: the top figure is for the large person or 97.5 percentile, the middle figure, the average person or 50 percentile; and the lower figure, the small person or 2.5 percentile. The chosen extreme percentiles thus include 95%. The remaining 5% include some who learn to adapt and others, not adequately represented, who are excluded to keep designs for the majority from becoming too complex and expensive. Space and access charts are designed to accept the 97.5 percentile large man and will cover all adults except a few giants. Therefore, use the 97.5 percentile to determine space envelopes, the 2.5 percentile to establish control and display heights. To accommodate both men and women, it is useful at times to add a dimension of the large man to the corresponding dimension of the small woman and divide by 2 to obtain data for the average adult. This is the way height standards evolve. Youth data are for combined sex. Although girls and boys do not grow at the same

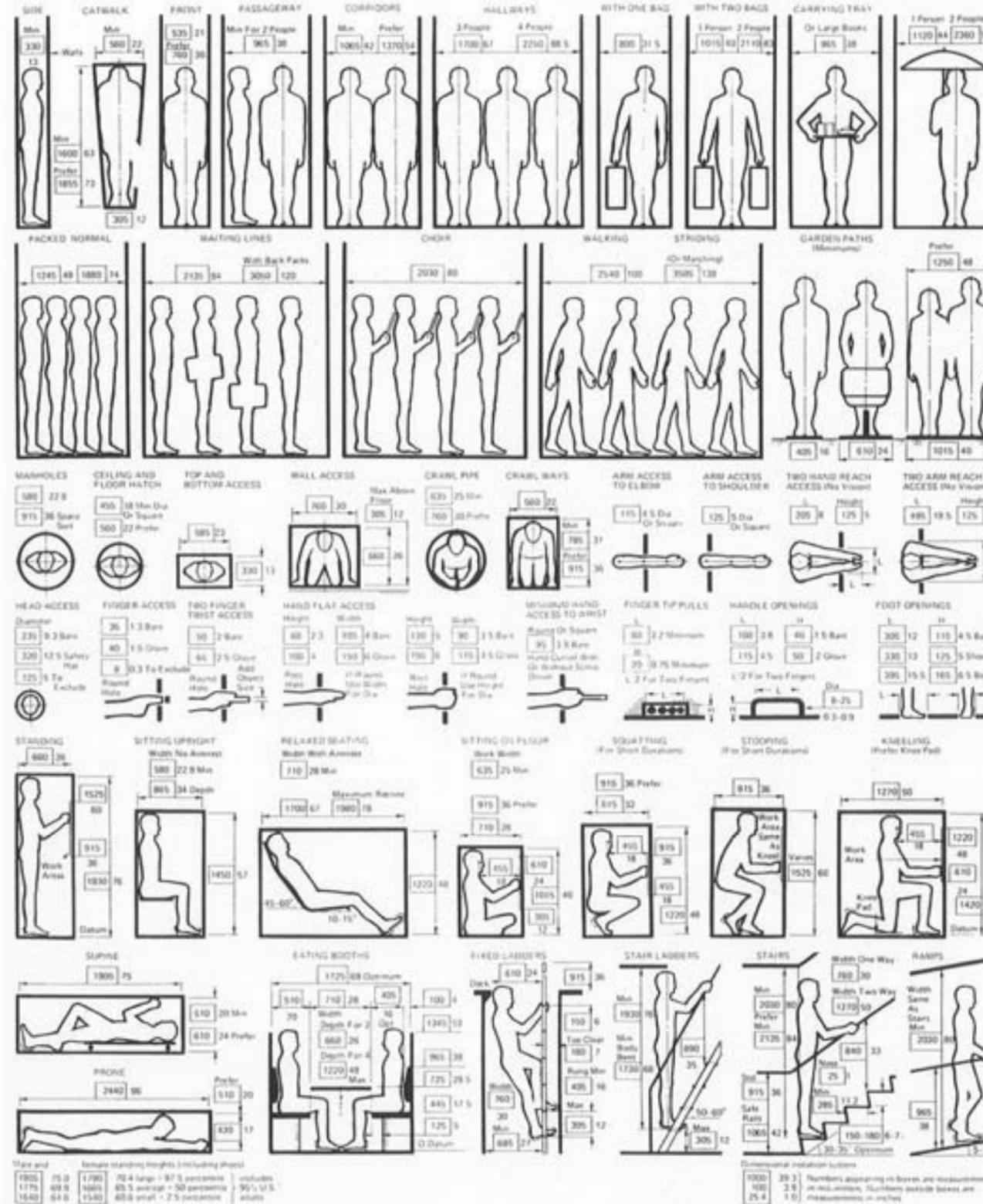
rate, differences are small when compared with size variations.

Pivot point and link systems make it easy to construct articulating templates and manikins. Links are simplified bones. The spine is shown as a single link; since it can flex, pivot points may be added. All human joints are not simple pivots, though it is convenient to assume so. Some move in complicated patterns like the rowing shoulder. Reaches shown are easy and comfortable; additional reach is possible by bending and rotating the trunk and by extending the shoulder. Stooping to reach low is better than stretching to reach high. The dynamic body may need 10% more space than the static posture allows. Shoes have been included in all measurements; allowance may need to be made for heavy clothing. Sight lines and angles of vision given in one place or another apply to all persons.

The metric system of measurement has been included, since it is used in scientific work everywhere and is the most practical system of measurement ever devised. Millimeters have been chosen to avoid use of decimals. Rounding to 5 mm aids mental retention while being within the tolerance of most human measurements.



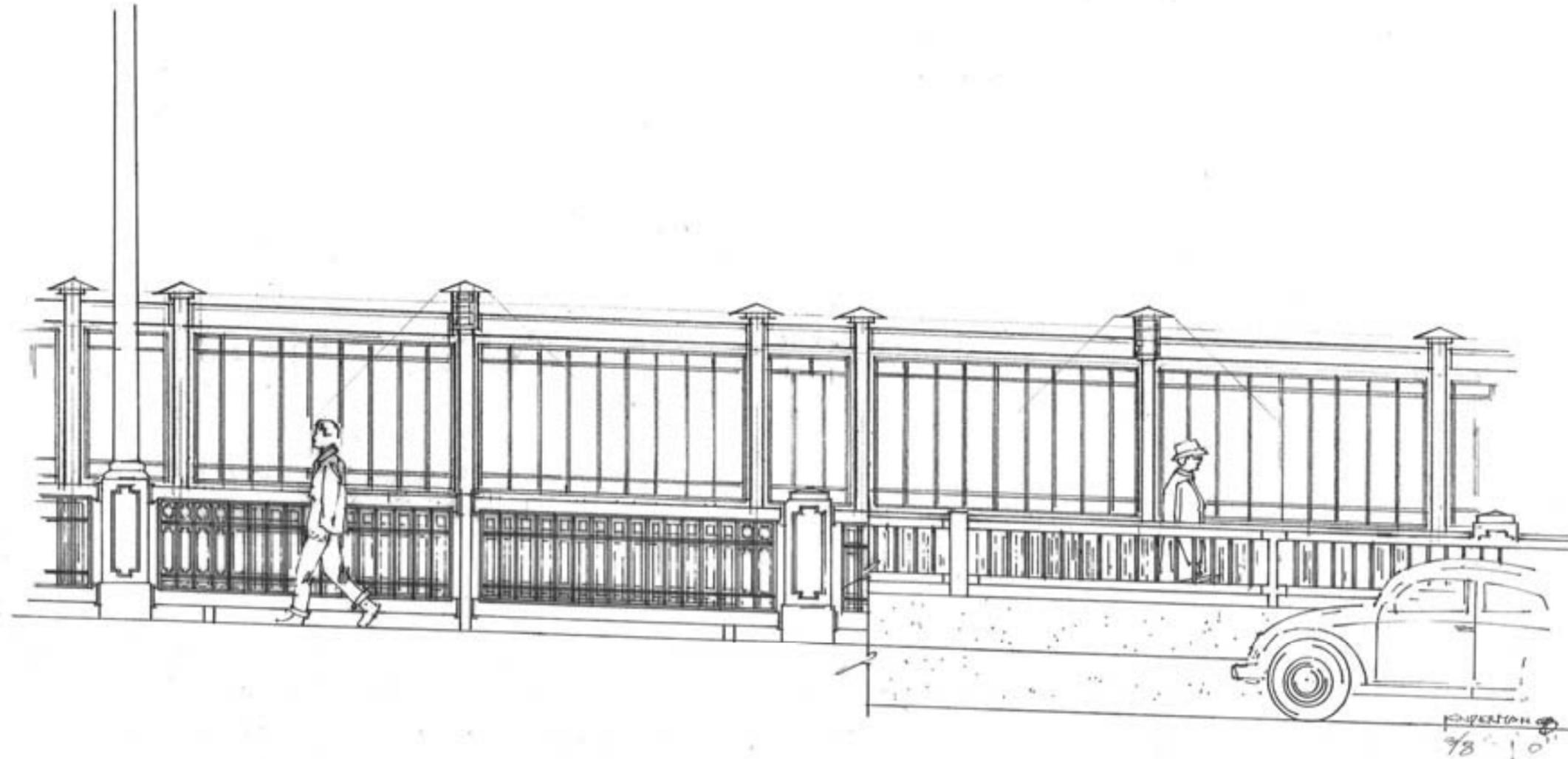
Anthropometric Data



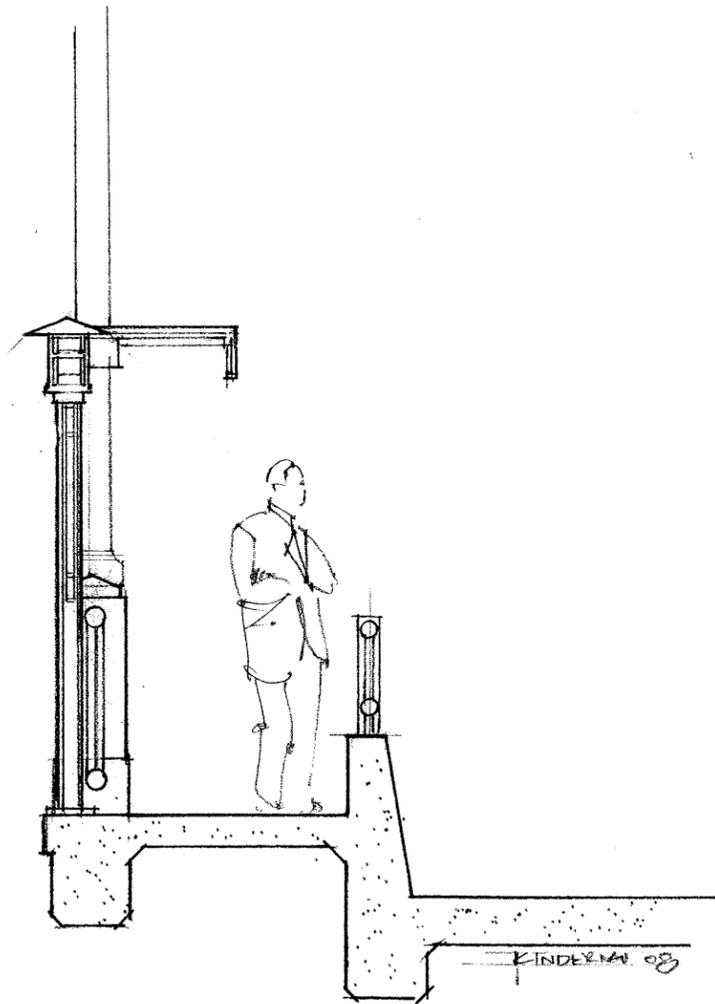
Info Diffrient, Alvin R. Tilley, Henry Dreyfuss Associates, New York, New York

Design Concepts

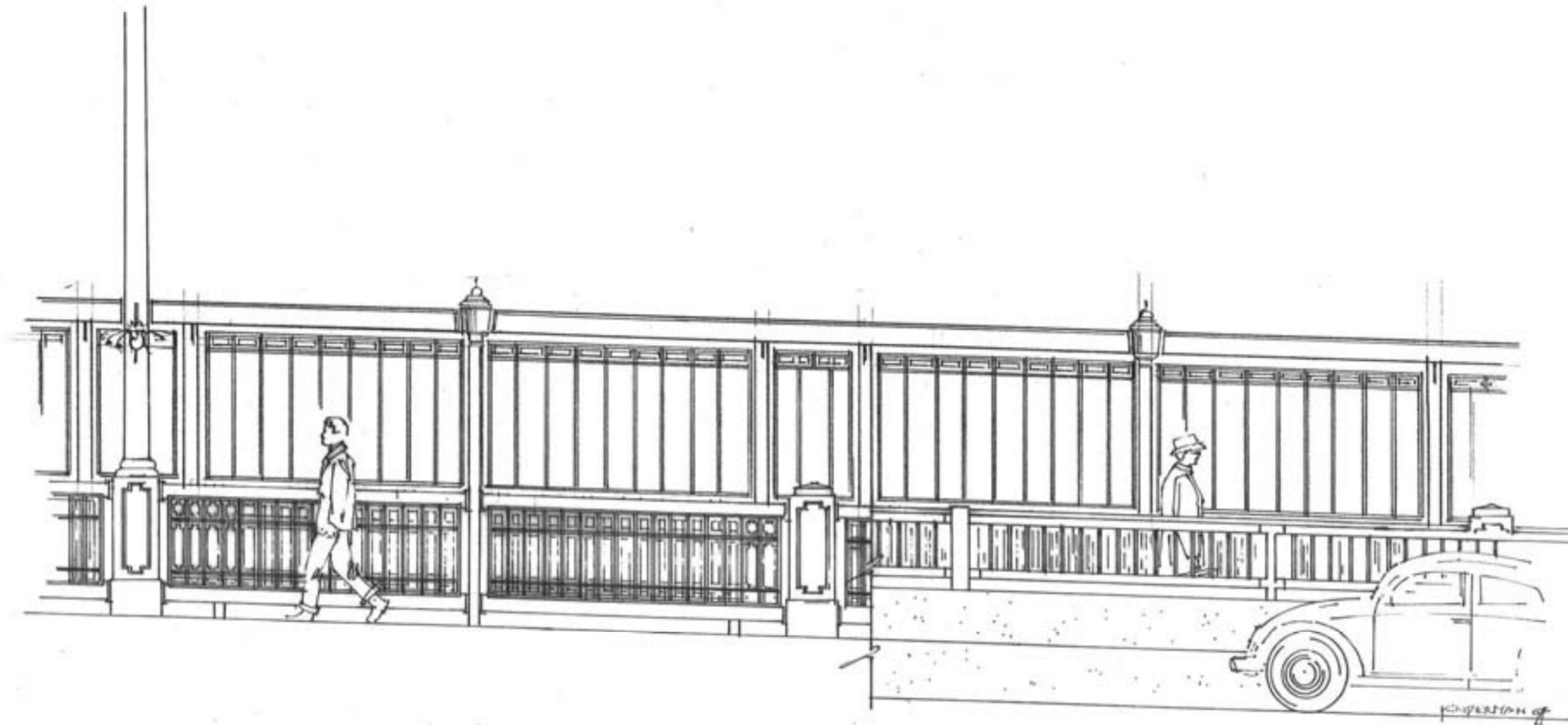
- First designs following the *Community Conceptual Design Report 2007*



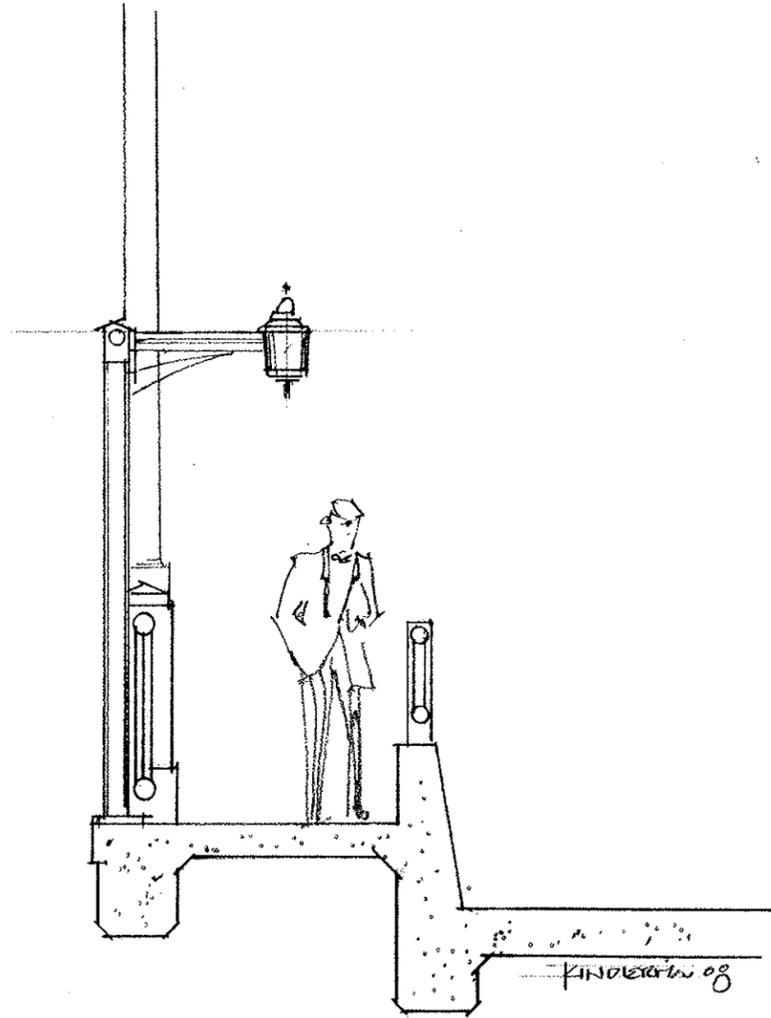
Concept A
Classic Fence with Pedestrian Lights
Niland Aspen Series light standard similar



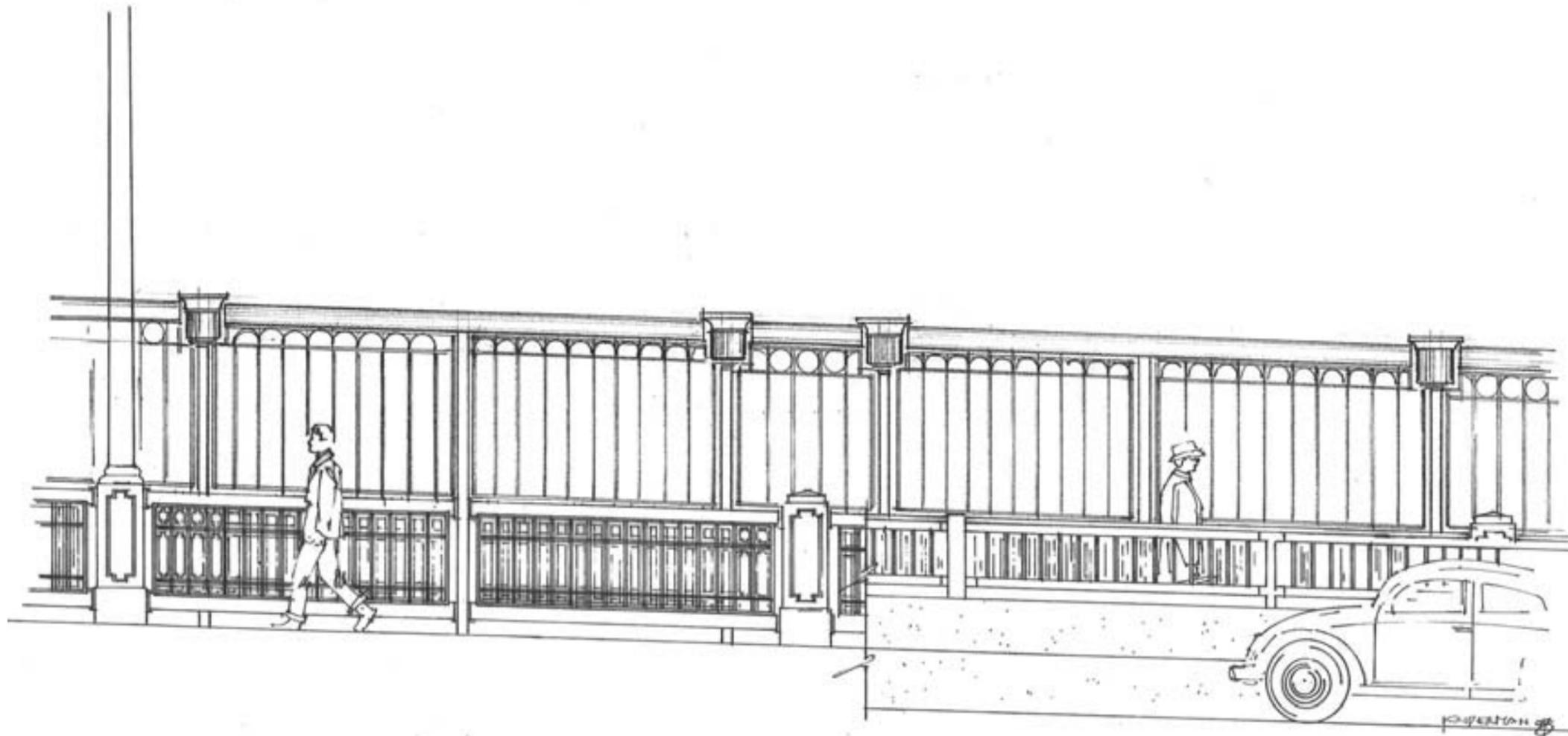
Concept A Typical Section
Classic Fence with Pedestrian Lights
Niland Aspen Series light standard similar



Concept B
Classic Fence with Pedestrian Lights
Lumec Z47A light standard similar



**Concept B Typical Section
Classic Fence with Pedestrian Lights
Lumec Z47A light standard similar**



Concept C
Classic Fence with Pedestrian Lights
Lumec Z11 light standard similar



**Concept C Typical Section
Classic Fence with Pedestrian Lights
Lumec Z11 light standard similar**

Post Advisory Committee Meetings 1 & 2

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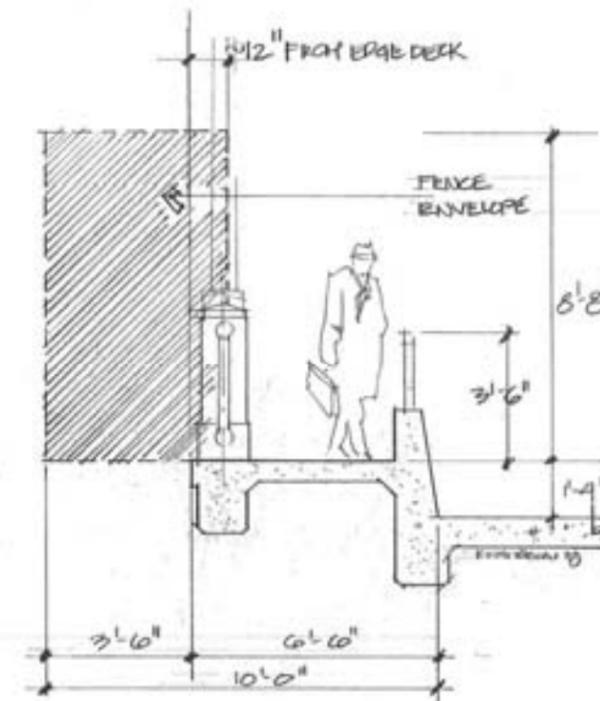
Design Considerations

Qualitative

- Use vertical elements as the main fence safety feature.
- Do not use mesh or wire fabric.
- The elements should be stainless steel wire rope or rods. Small diameters contribute to visibility from the bridge.
- The fence may extend only slightly 'outward' toward the water to provide a more 'open' experience for pedestrians. However, not required beyond that of a reasonable structural installation.
- The fence should have an overhang to discourage climbing. Recognize the 'face validity' of such an assembly. Although climbable by some, the overhang may be perceived as difficult to climb.
- The climb ability of the existing rail should be taken into account. Designs should discourage access to the fence top from the top rail or posts.
- Pedestrian lighting, if used, should be low wattage and essentially decorative.

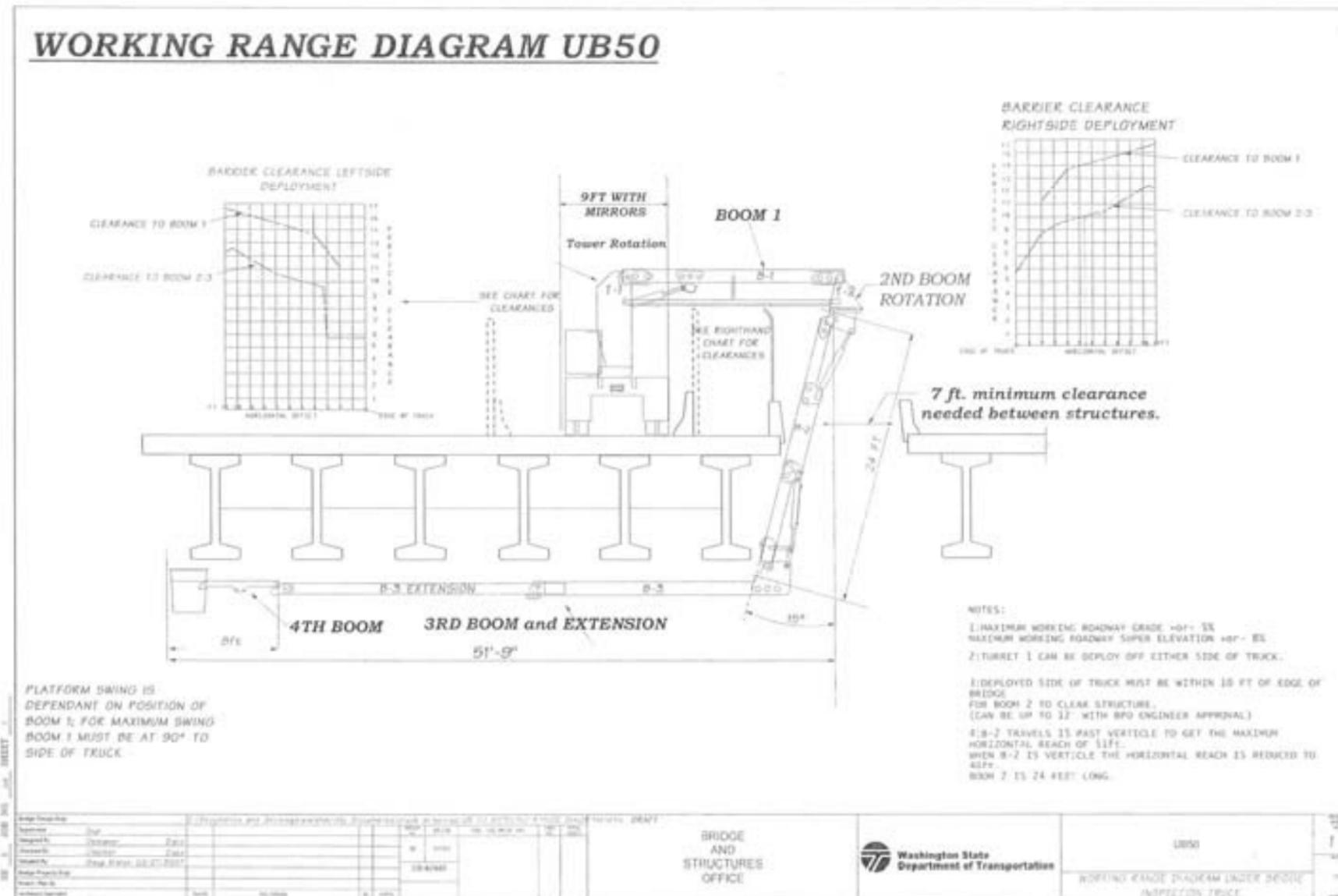
Quantitative

- The elements should be spaced no greater than 6" apart.
- The overhang is limited by inspection truck requirements. The Bridge Office is studying inspection traffic control requirements which may affect the dimension.

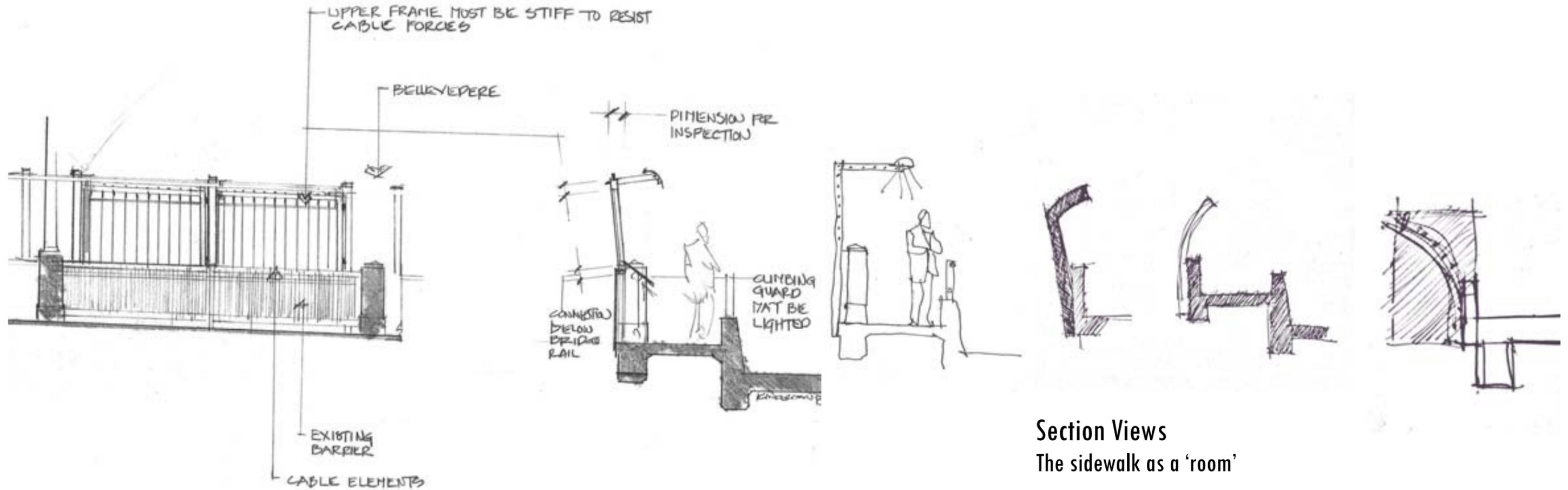


Fence Envelope

The fence must be contained within this space.

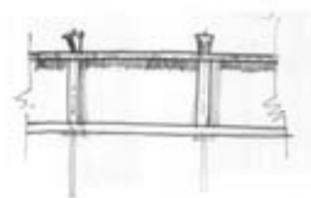


Under Bridge Inspection Truck (UBIT)

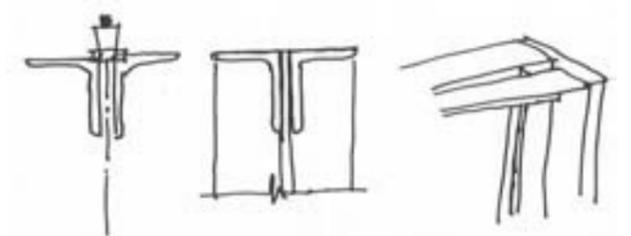


Section Views
The sidewalk as a 'room'

Elevation View
Vertical cables concept.



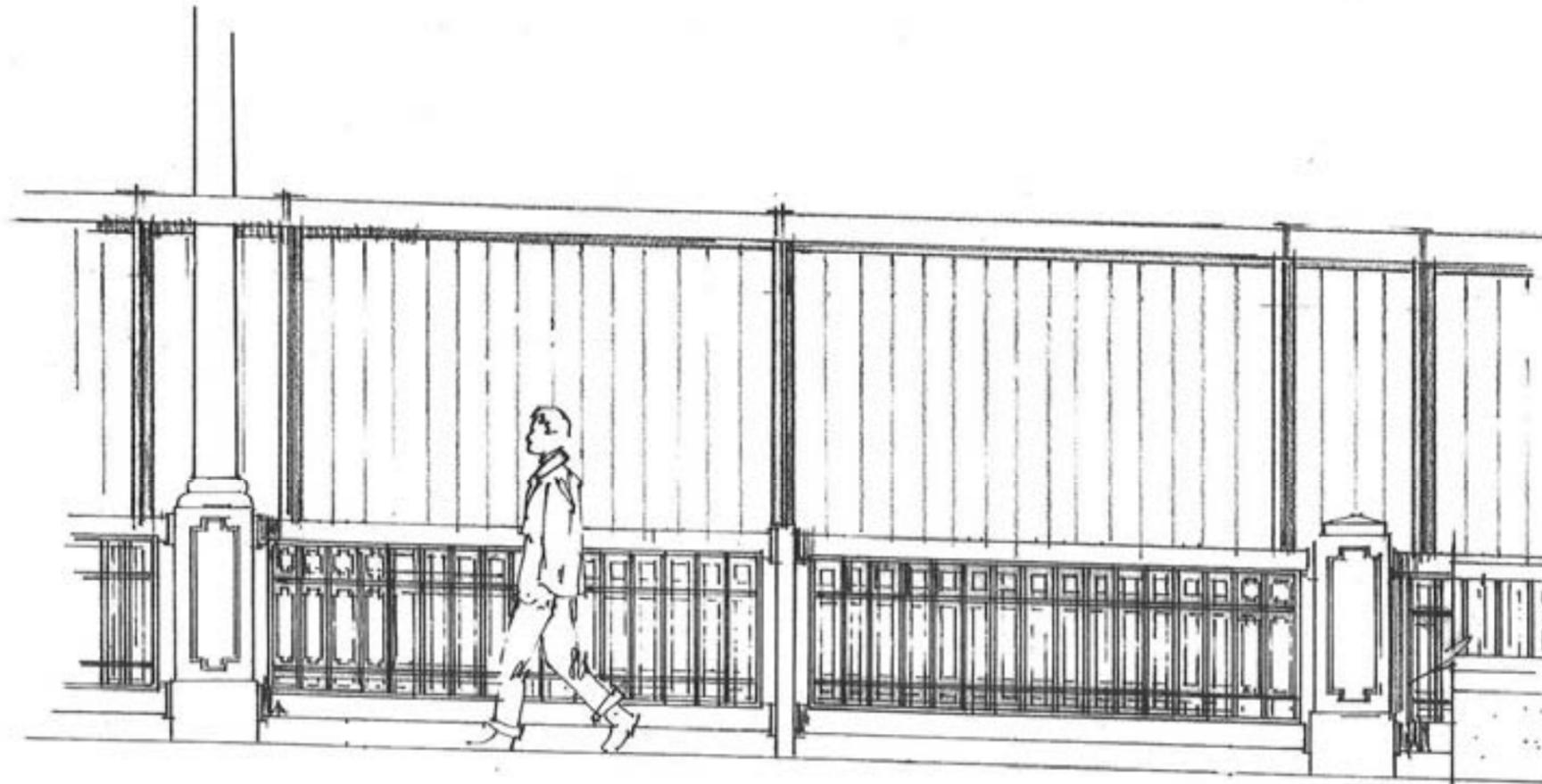
Upper frame style ideas.



Frame section shapes should be light in weight and appearance.

Design Committee: Sketch Diary

Conversations with citizen architects David Clinkston AIA and Marc Pevoto AIA



Elevation
Viewed from the traveled way

CURRENT DESIGN DISCUSSION

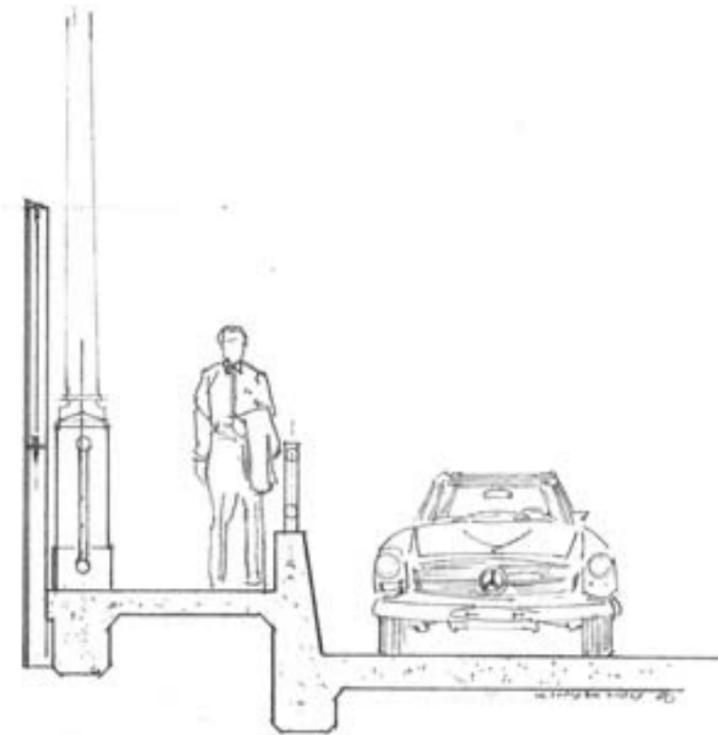
Provide a demountable double T frame system to house 3/16" stainless steel cables. Tension cables to prohibit spreading.

Design an overhang to discourage climbing.

Frame detailing will be visually light to facilitate views.

The fence weight is critical to structural bridge preservation issues.

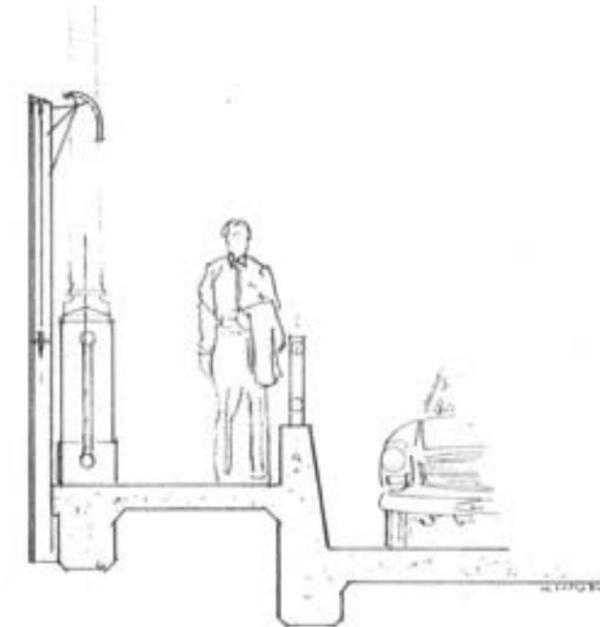
Vertical Cable Design



Straight Fence



Sloping Cap



Curved Cap

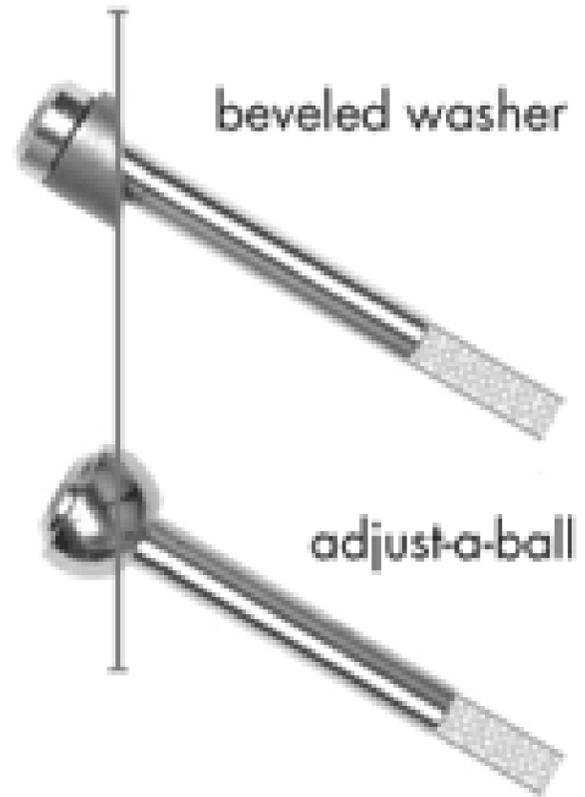
Discussion

The fence should have an overhang. The style will visually dominate the fence.

The designs shown are intended to be schematic in nature. The final design style will be developed as the project goes forward.

Typical Section Scenarios Study

Vertical Cable Design



Cable system hardware for vertical elements.

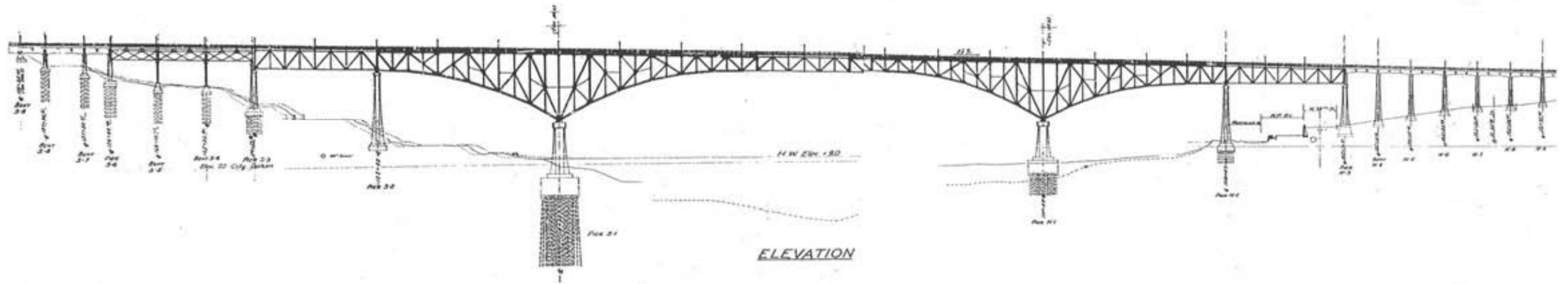


The top of the overhang for the straight cap option.

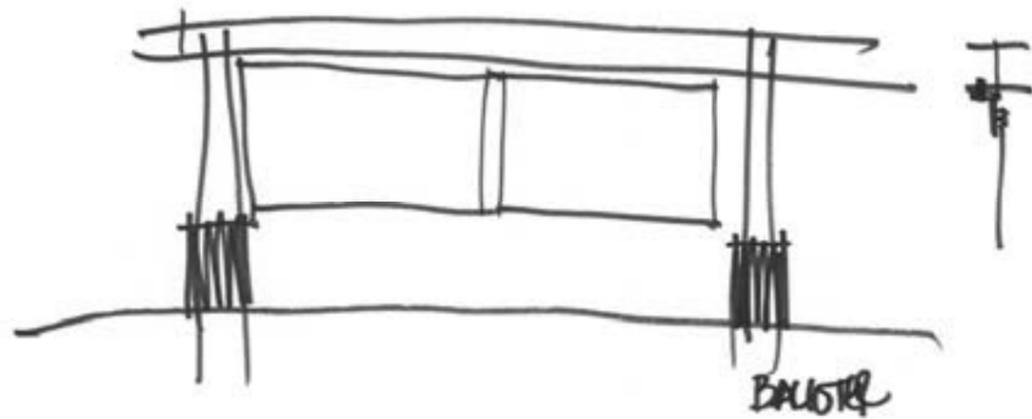
Materials

Currently under consideration.

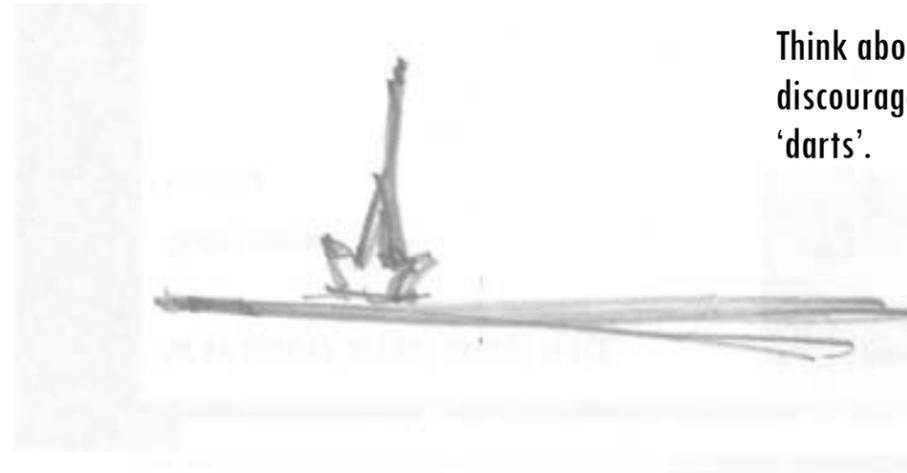
Post Advisory Committee Meetings 3



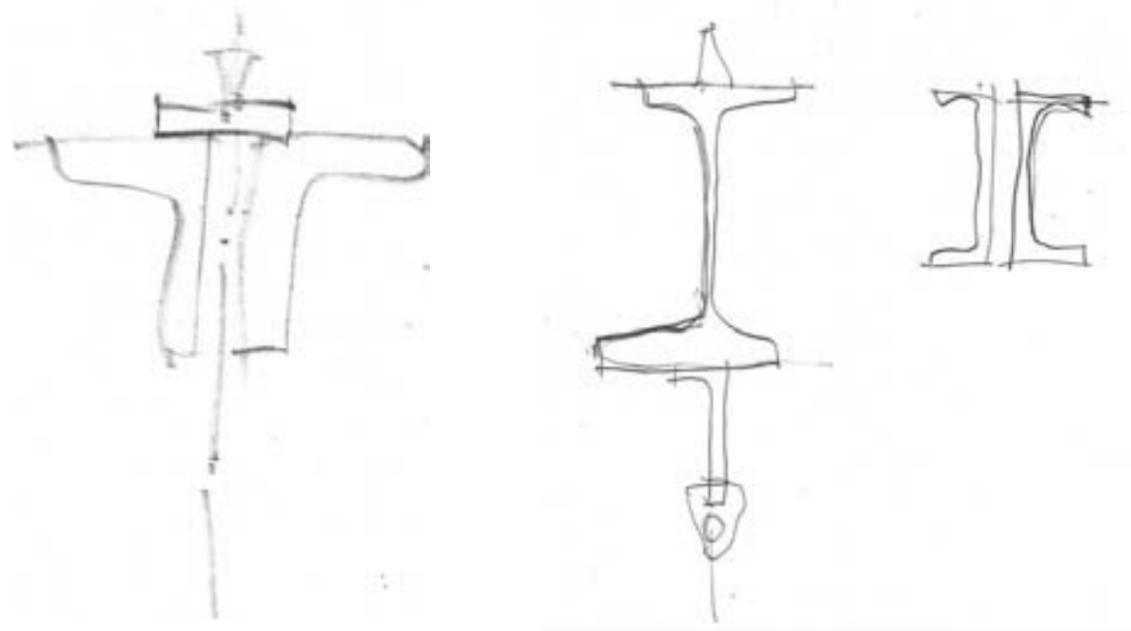
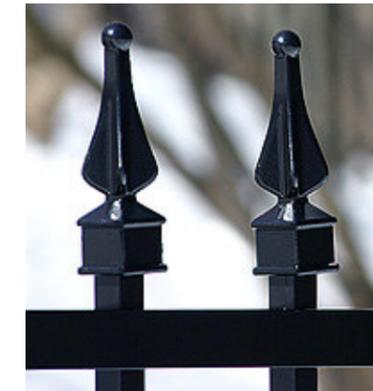
Elevation
Original 1930 Contract Plans



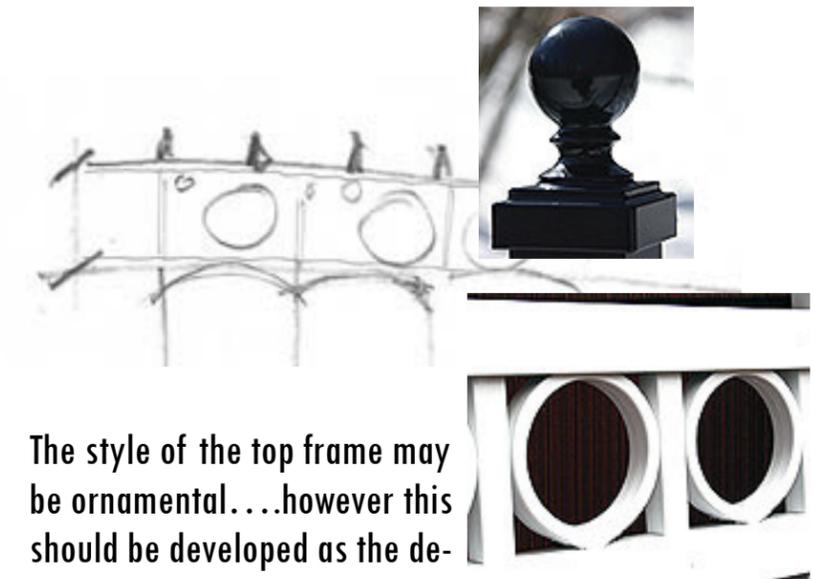
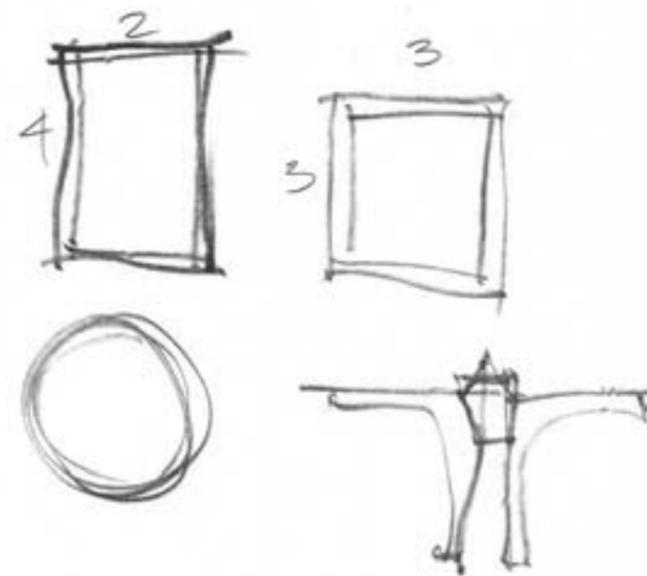
The top frame may span between main rail posts and the cable frame hang from the span.



Think about traditional methods to discourage climbing such as fence 'darts'.



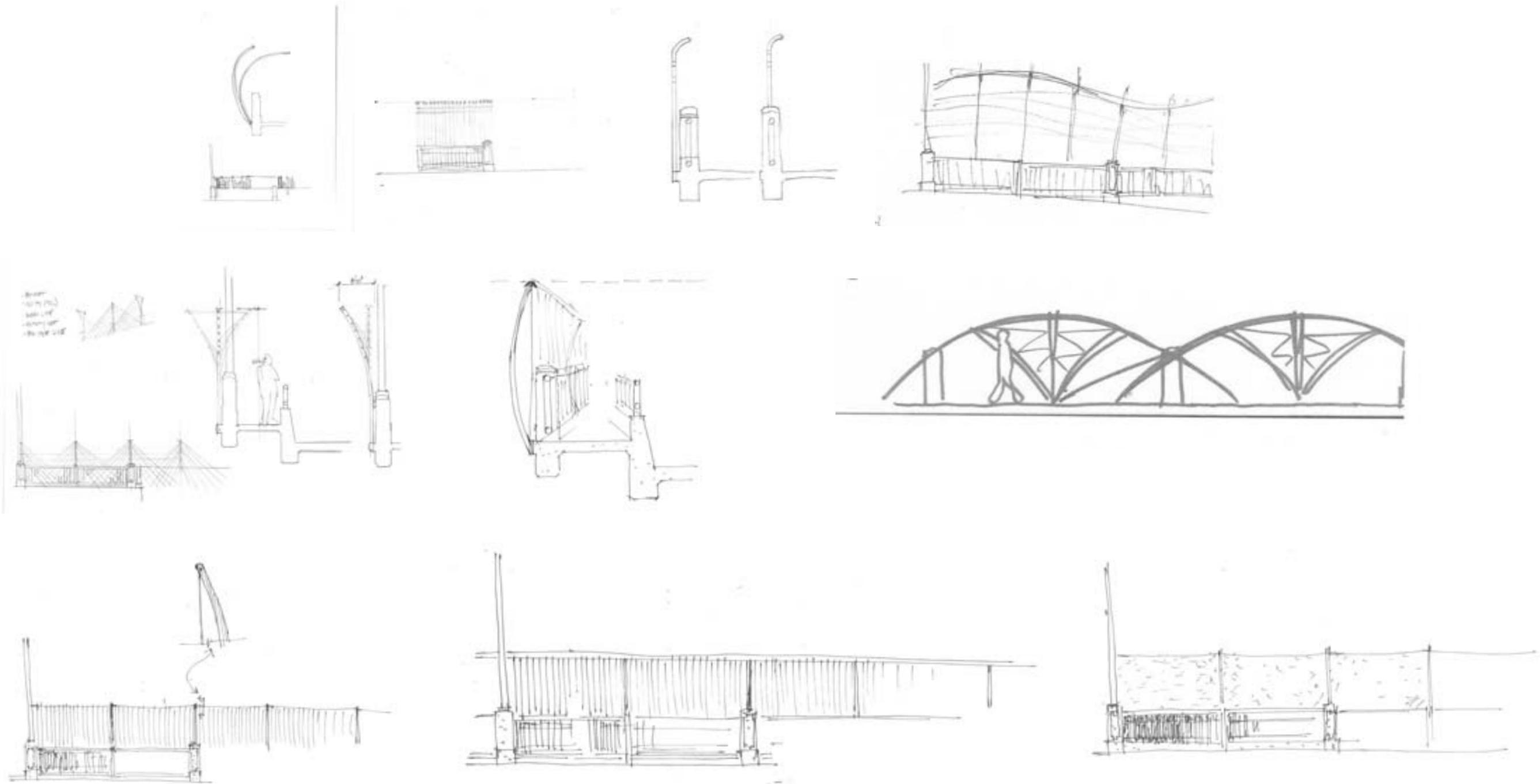
Sections under consideration for the frame. Look for sections that are visually light and produce interesting shadow lines.



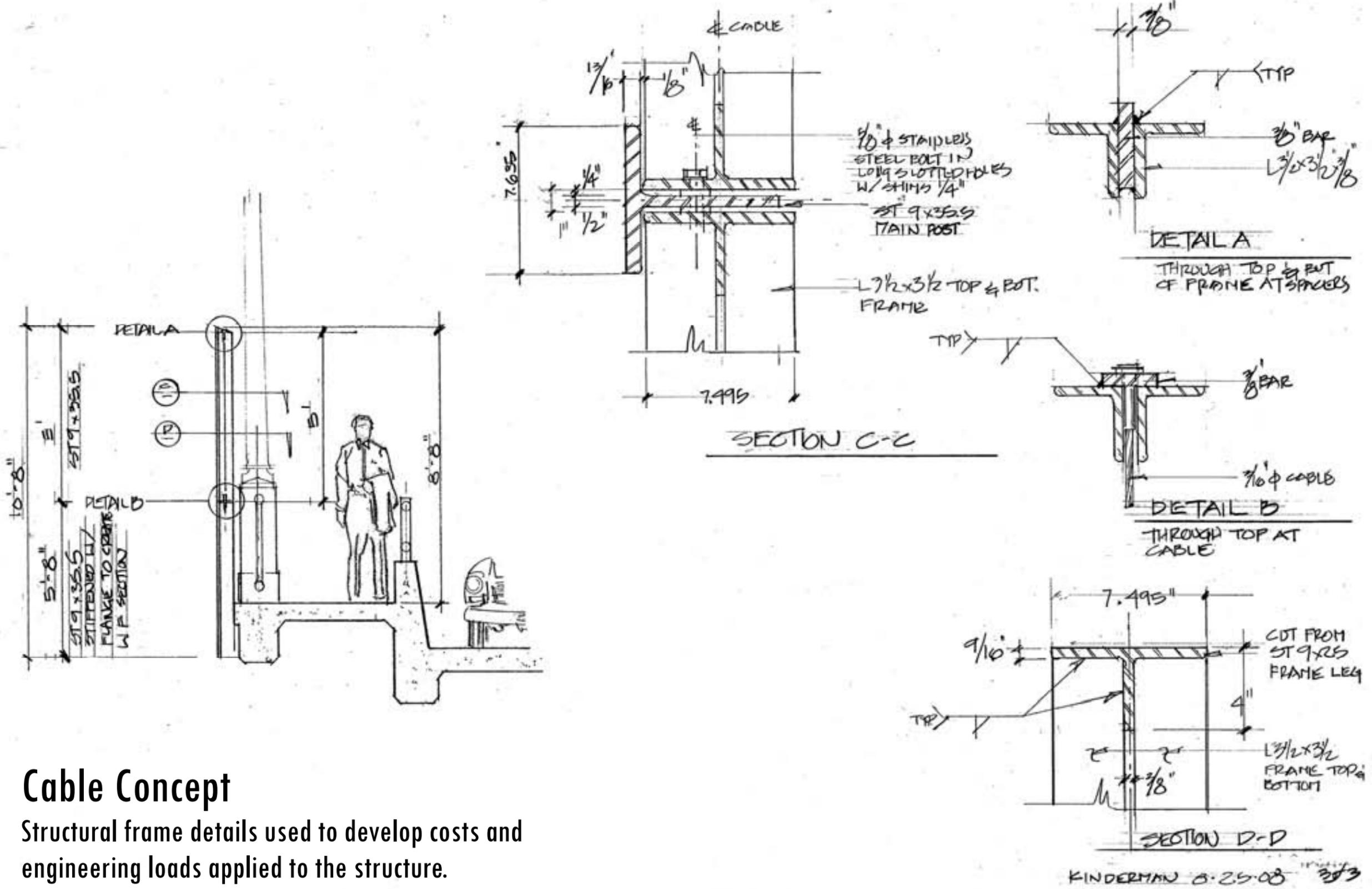
The style of the top frame may be ornamental...however this should be developed as the design progresses.

Design Committee: Sketch Diary

Conversations with citizen architects David Clinkston AIA and Marc Pevoto AIA

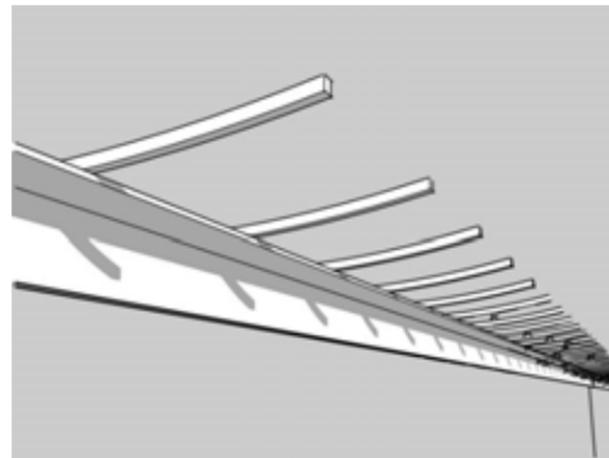
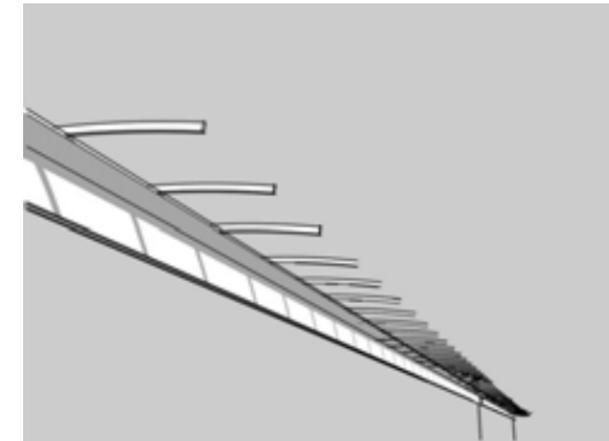
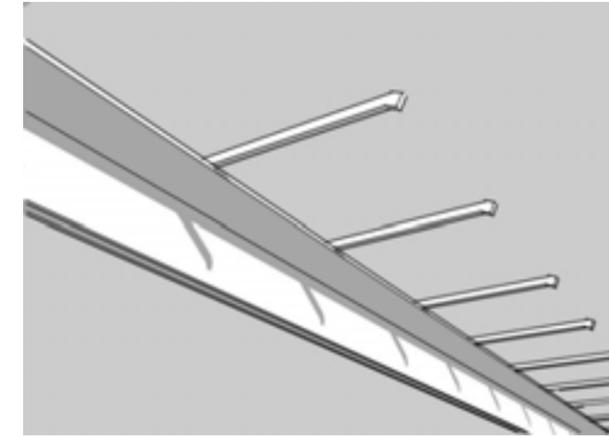
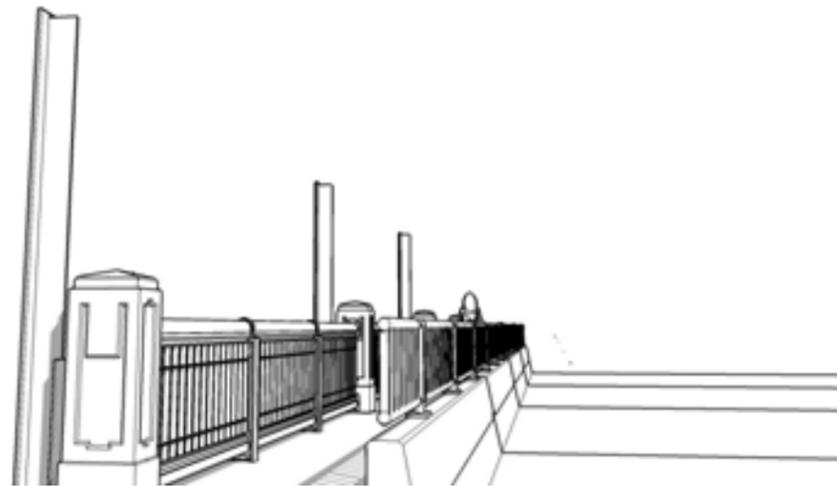


Sketches from Bassetti Architects
Provided following an afternoon in house charrette at the Bassetti office.



Cable Concept

Structural frame details used to develop costs and engineering loads applied to the structure.



Cable Concept

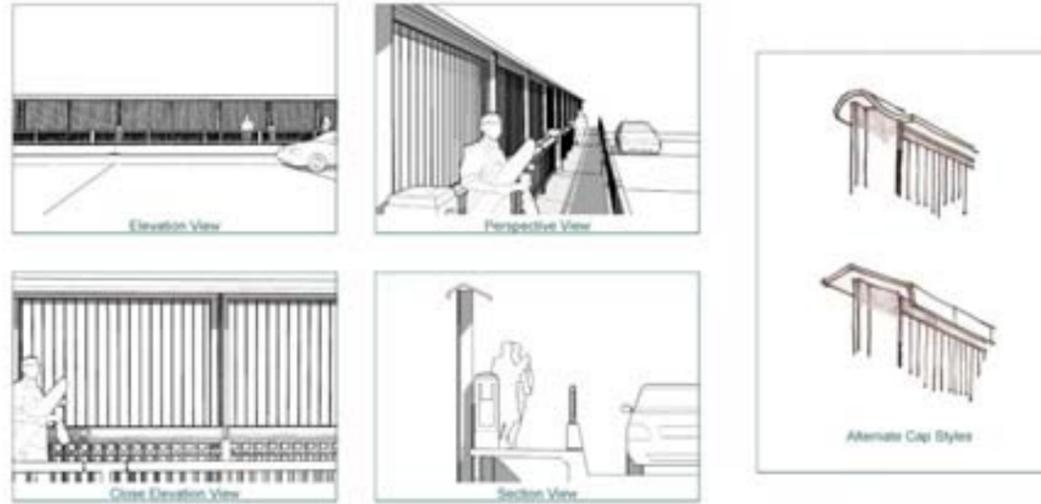
Three dimensional computer models.
WSDOT is beginning modeling.

Tine designs

Post Advisory Committee Meetings 4

SR 99 Aurora Avenue Bridge Fence

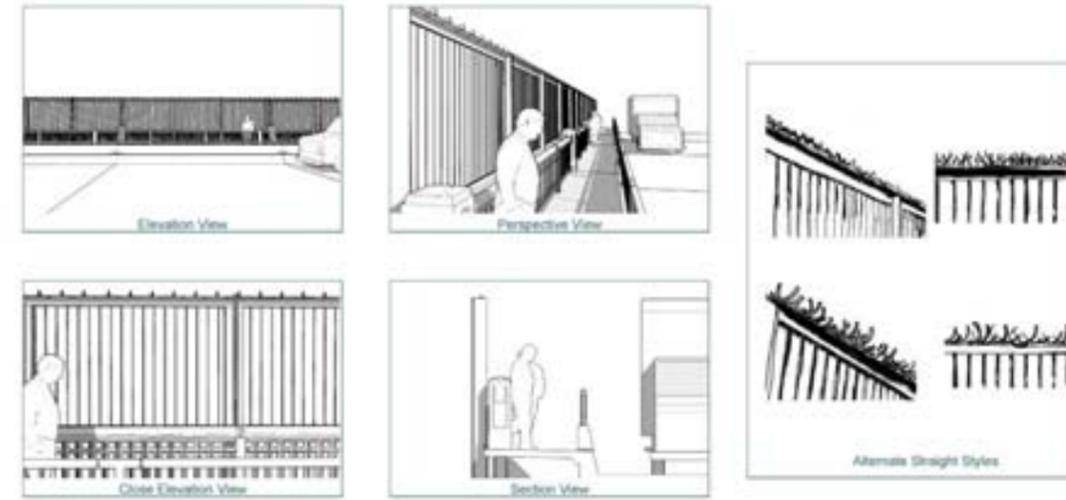
"Cap"



Draft Design Concepts

SR 99 Aurora Avenue Bridge Fence

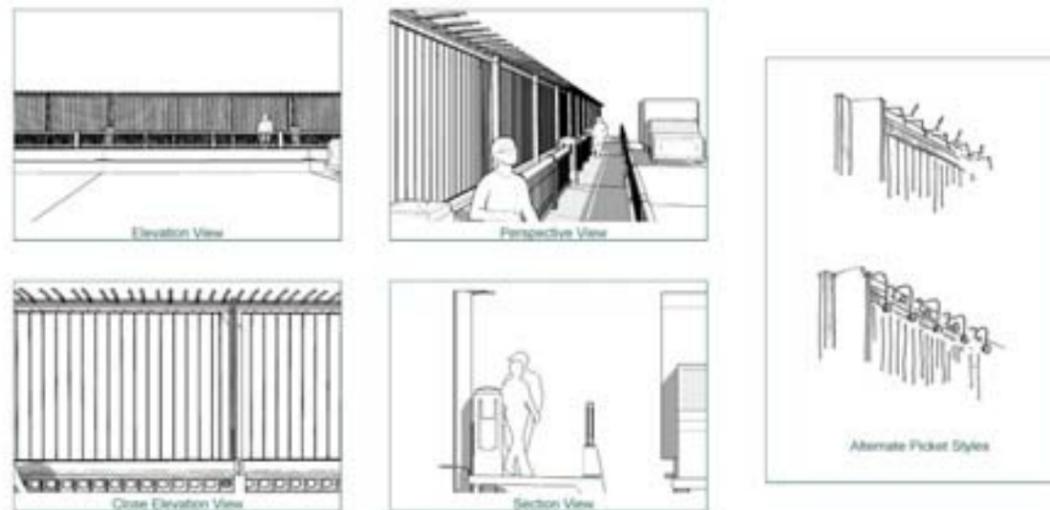
"Straight"



Draft Design Concepts

SR 99 Aurora Avenue Bridge Fence

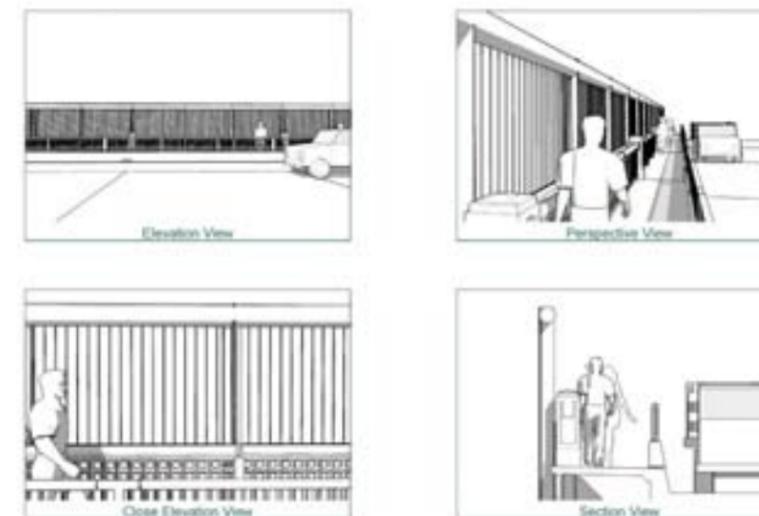
"Pickets"



Draft Design Concepts

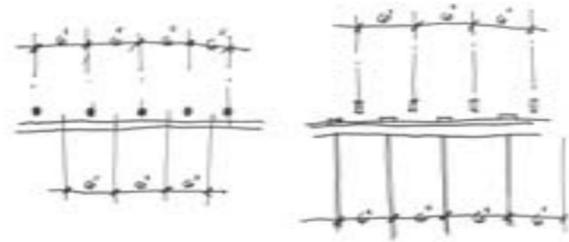
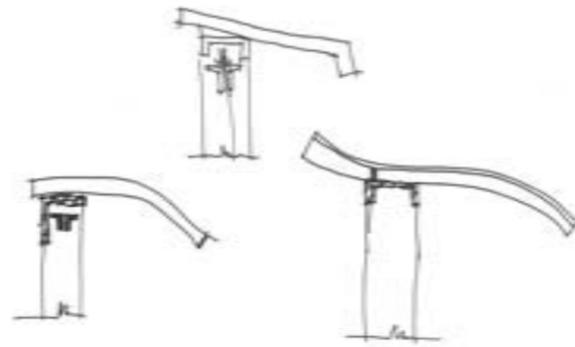
SR 99 Aurora Avenue Bridge Fence

"Tube"

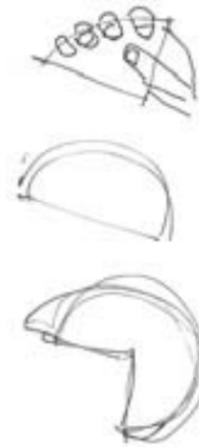


Draft Design Concepts

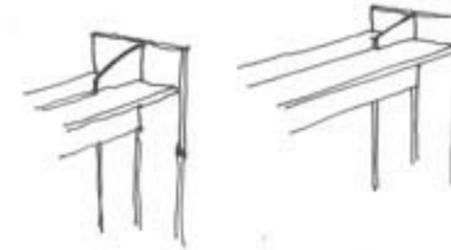
Concepts: The four families of top treatments



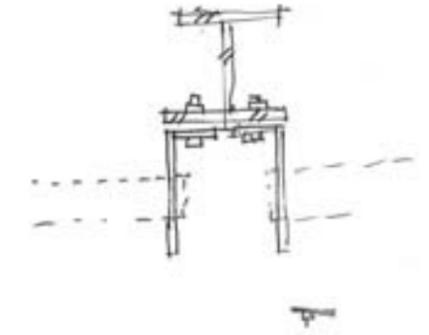
Spacing of top elements.



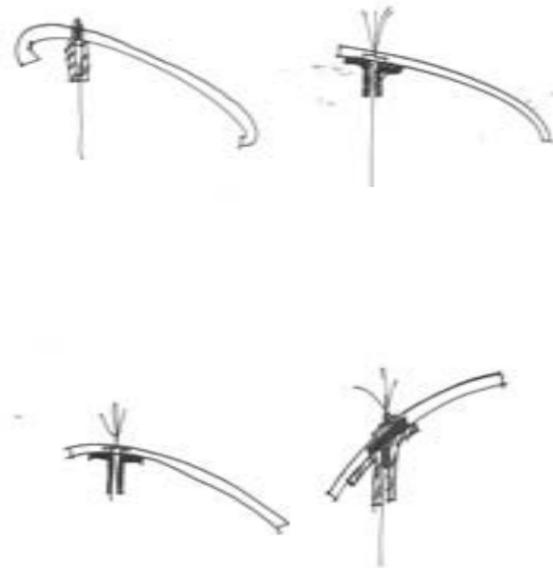
Straight top treatments to discourage climbing.



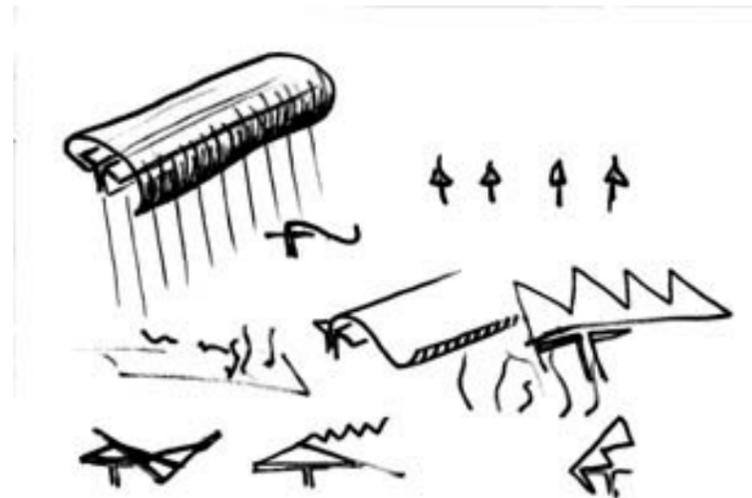
Sculpting the frame by 'coping'.



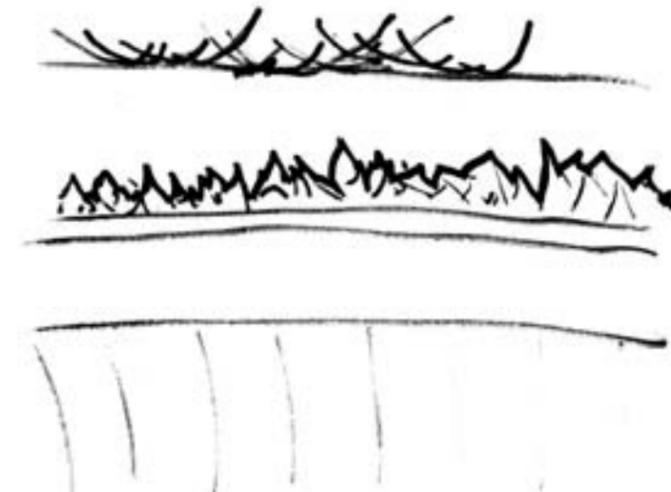
Connection Ideas.



Picket Ideas



Cap Ideas

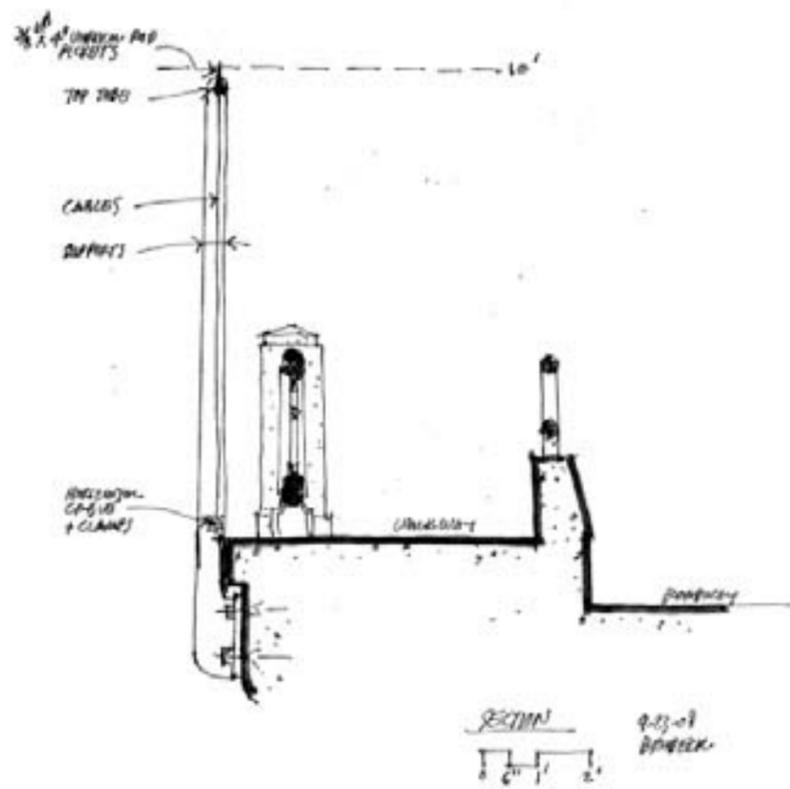


'Organic' straight top concept.

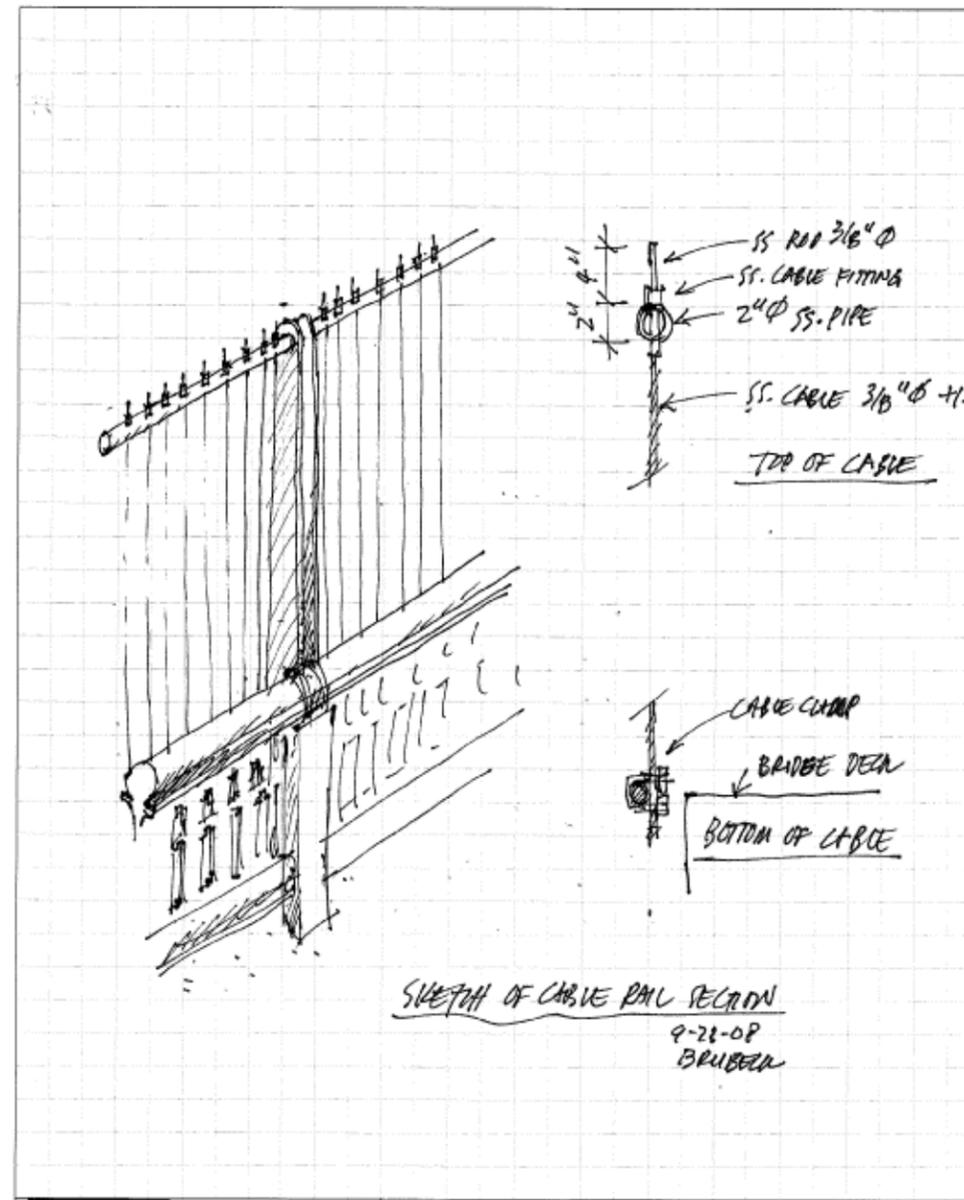
Design Committee: Sketch Diary

Conversations with citizen architects David Clinkston AIA and Marc Pevoto AIA

Brainstorming on various ideas within each of the four top treatment families..



Typical Section

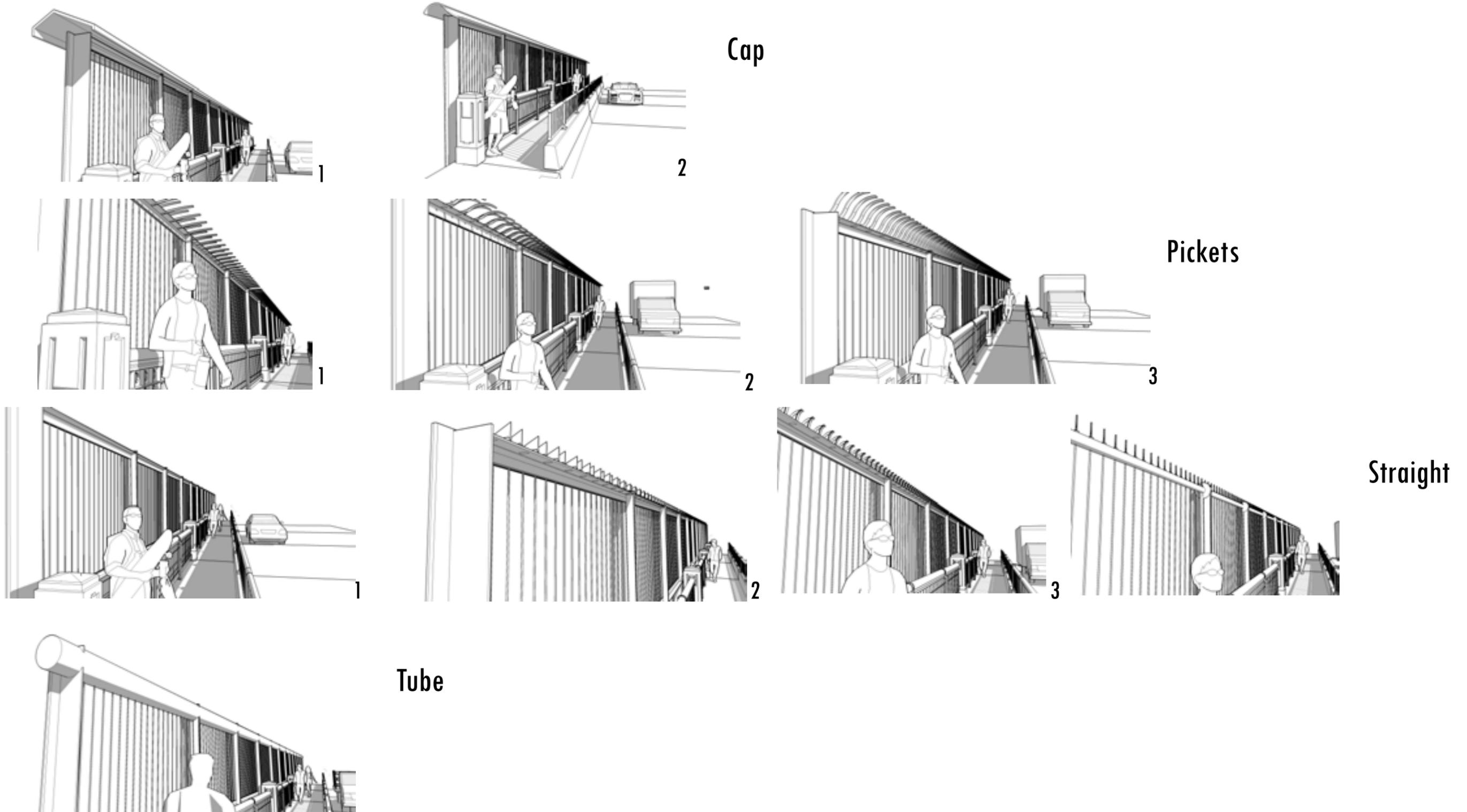


Isometric View showing smaller top tube and integral small pickets at top.



Manufacturer's photo's showing the range of possibilities for cable systems.

Citizen Concept Sketch: Smaller top tube and extended cable length

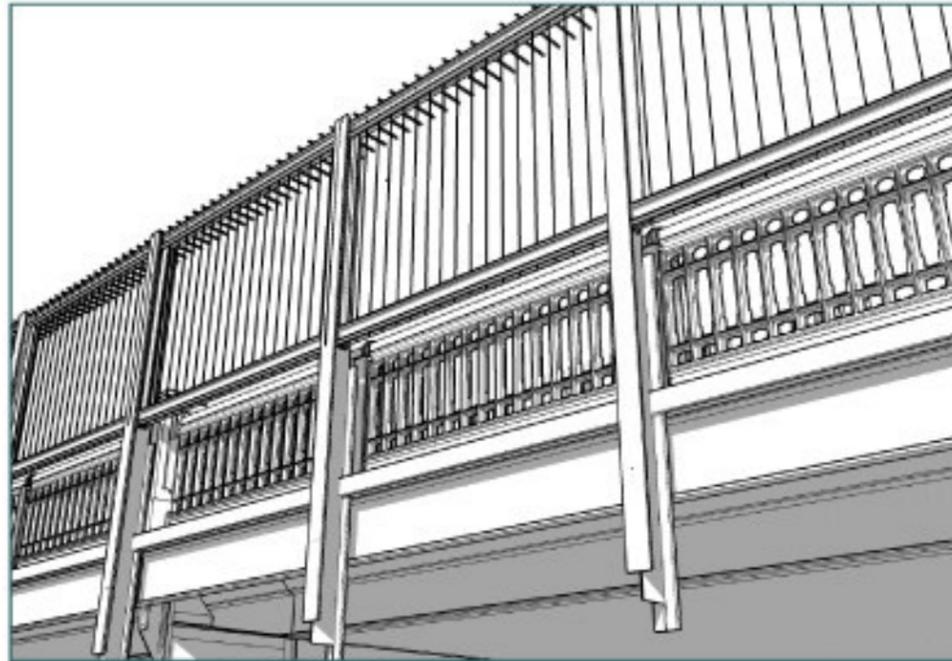


3D Computer Models: Exploring possibilities within the four families of top treatments

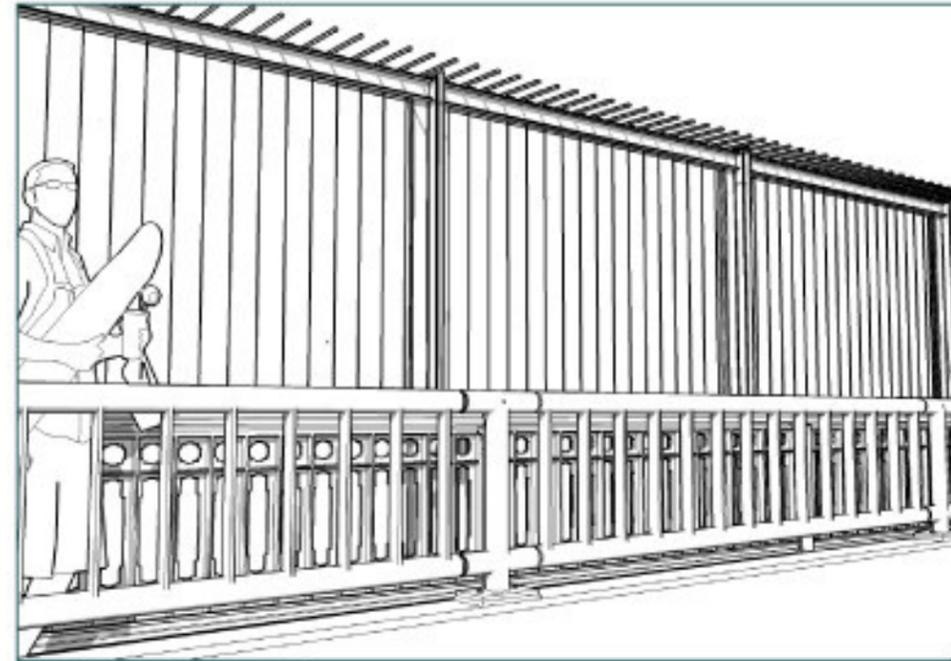
Post Advisory Committee Meetings 5

SR 99 Aurora Avenue Bridge Fence

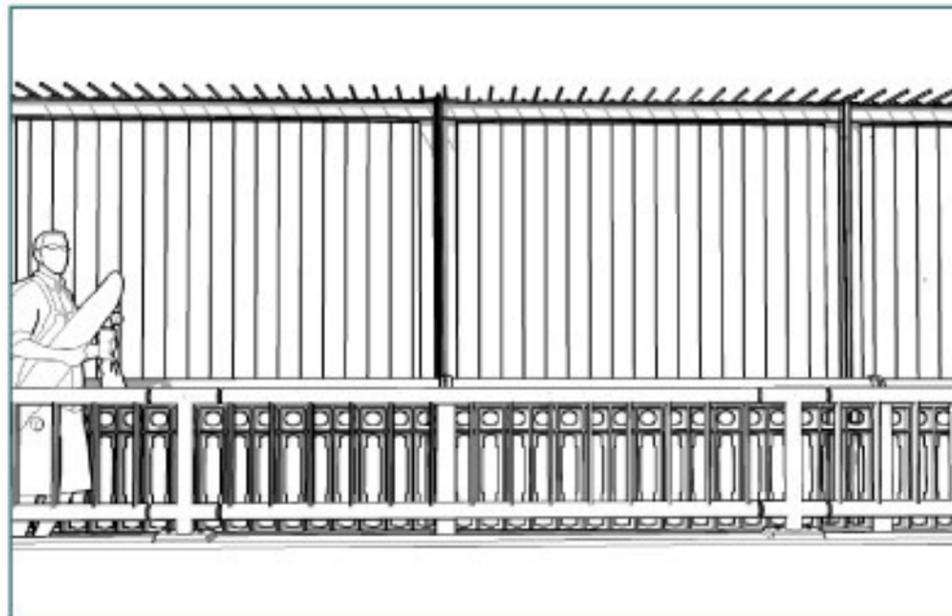
Channel Frame with Horizontal Picket Top



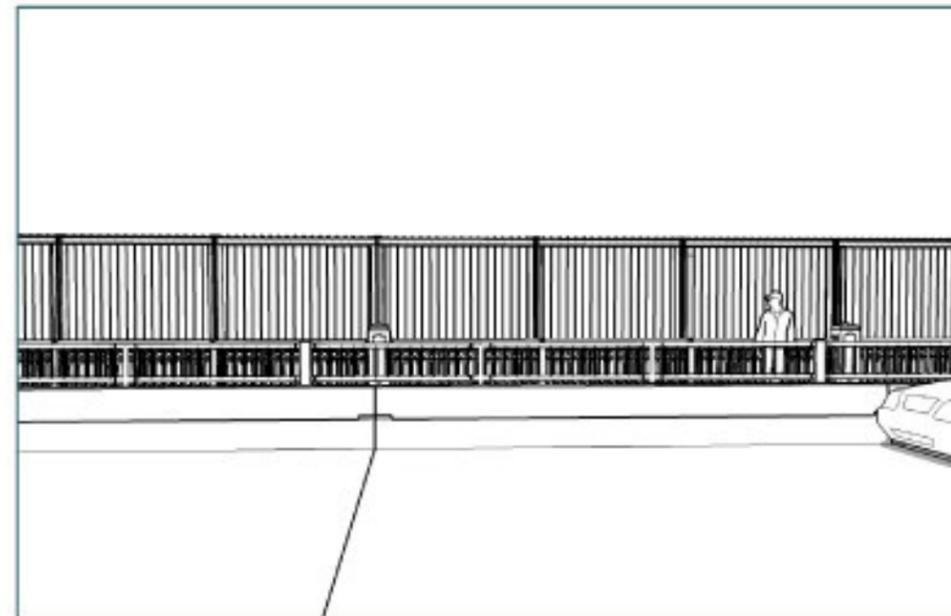
Perspective View—Below the Bridge



Perspective View—On the Bridge



Elevation View—Near



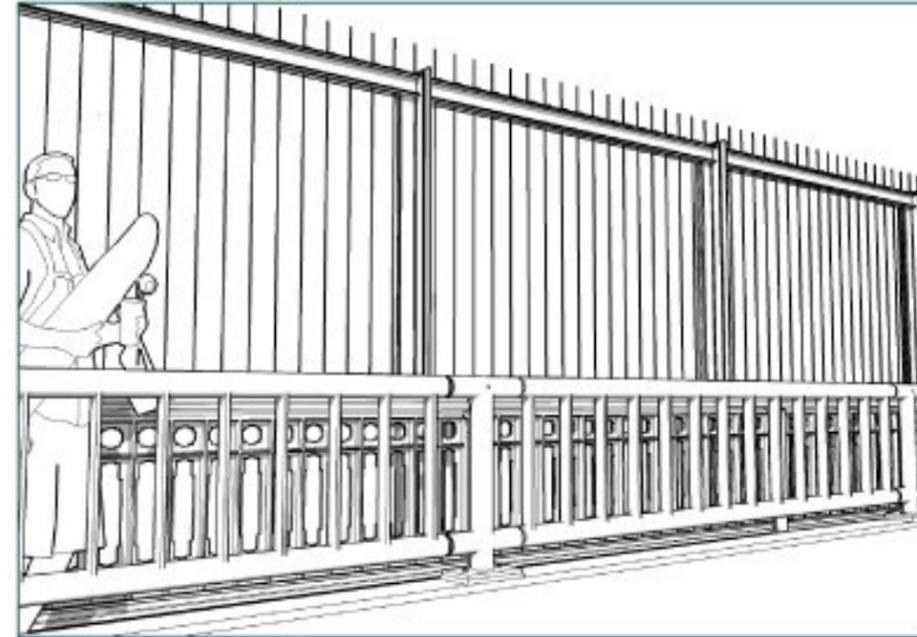
Elevation View—Far

SR 99 Aurora Avenue Bridge Fence

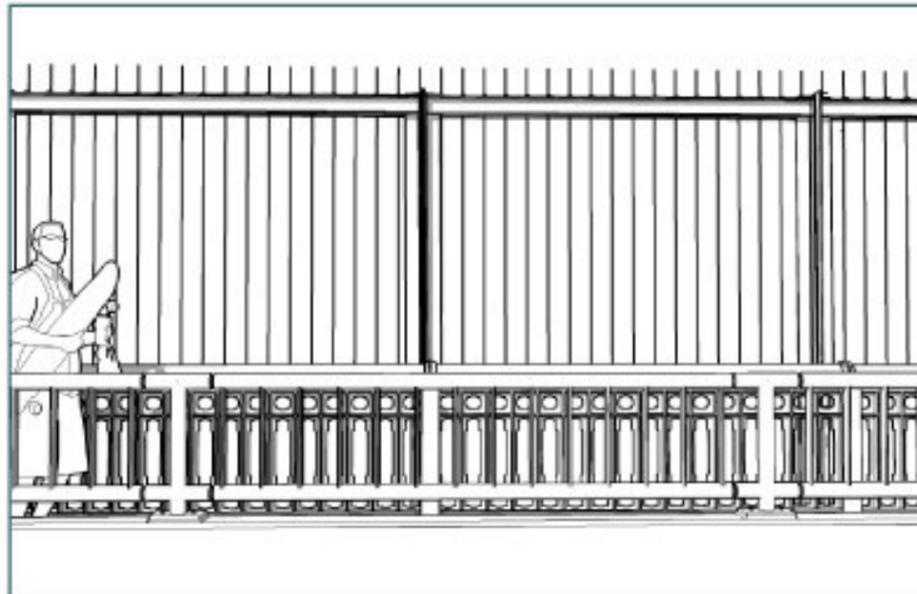
Channel Frame with Vertical Picket Top



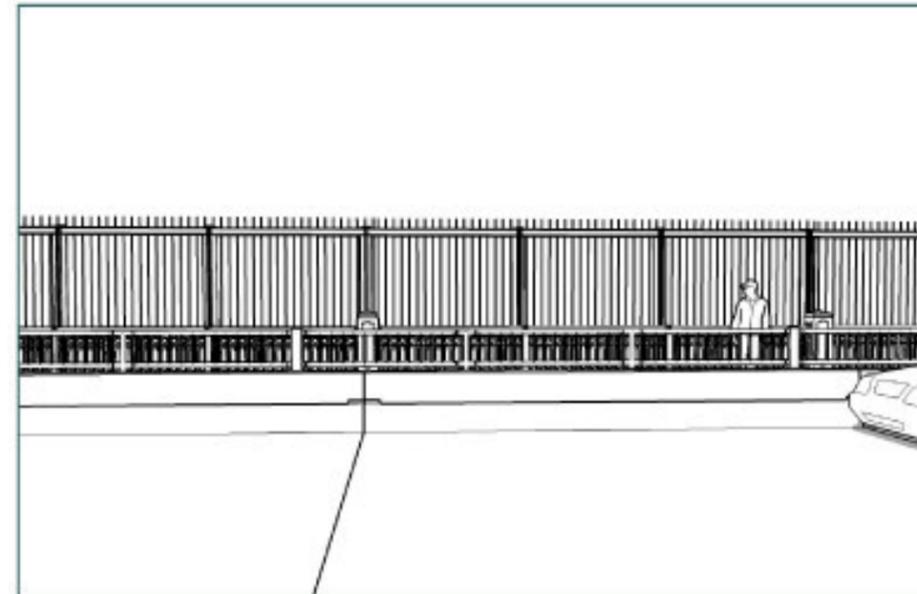
Perspective View—Below the Bridge



Perspective View—On the Bridge



Elevation View—Near



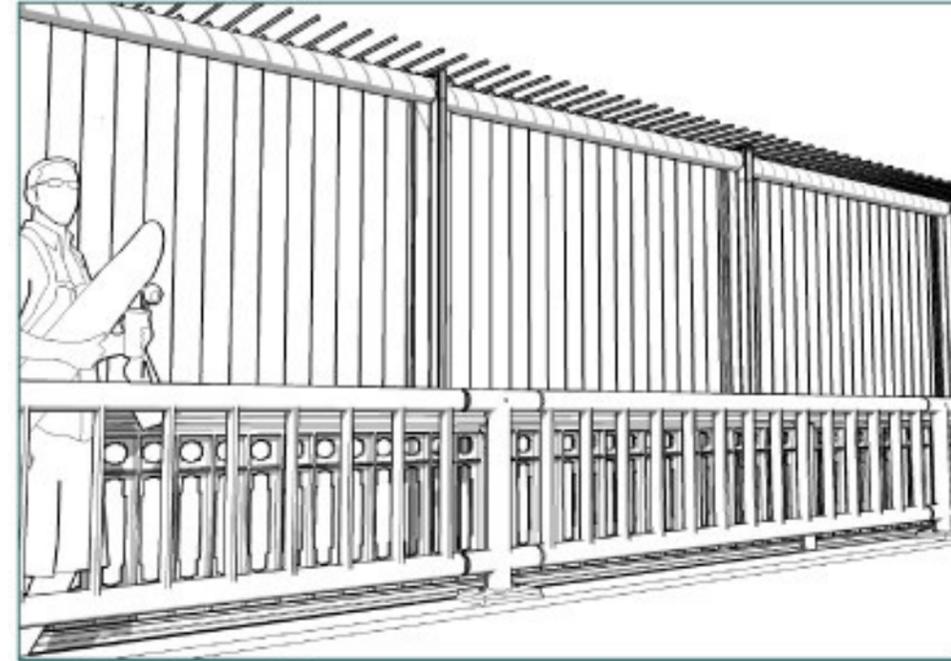
Elevation View—Far

SR 99 Aurora Avenue Bridge Fence

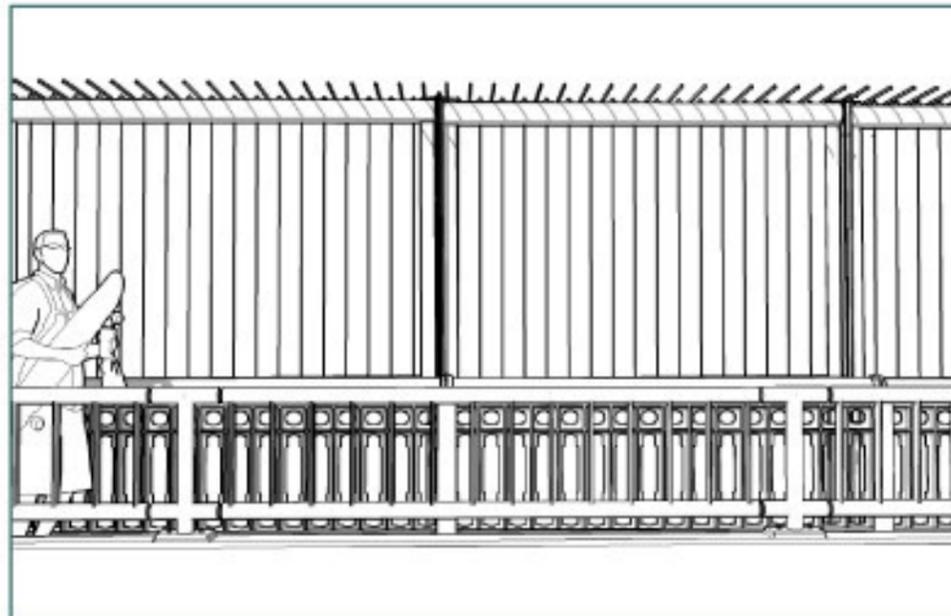
Tube Frame with Horizontal Picket Top



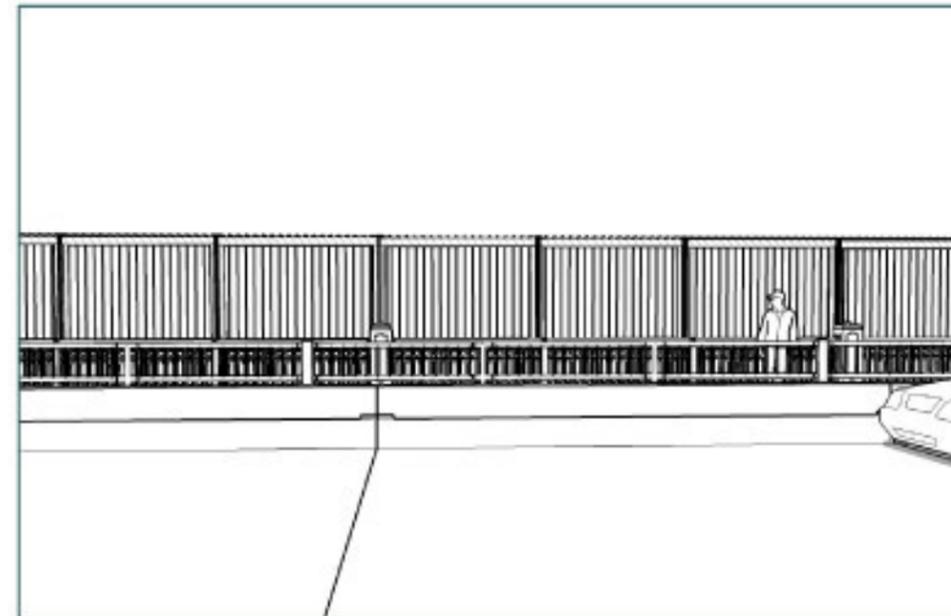
Perspective View—Below the Bridge



Perspective View—On the Bridge



Elevation View—Near



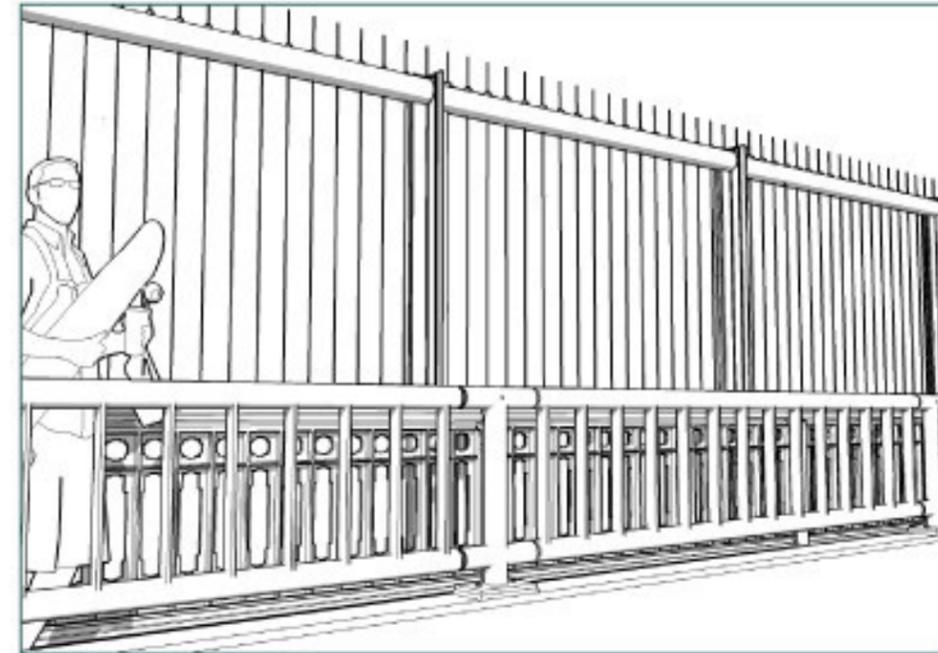
Elevation View—Far

SR 99 Aurora Avenue Bridge Fence

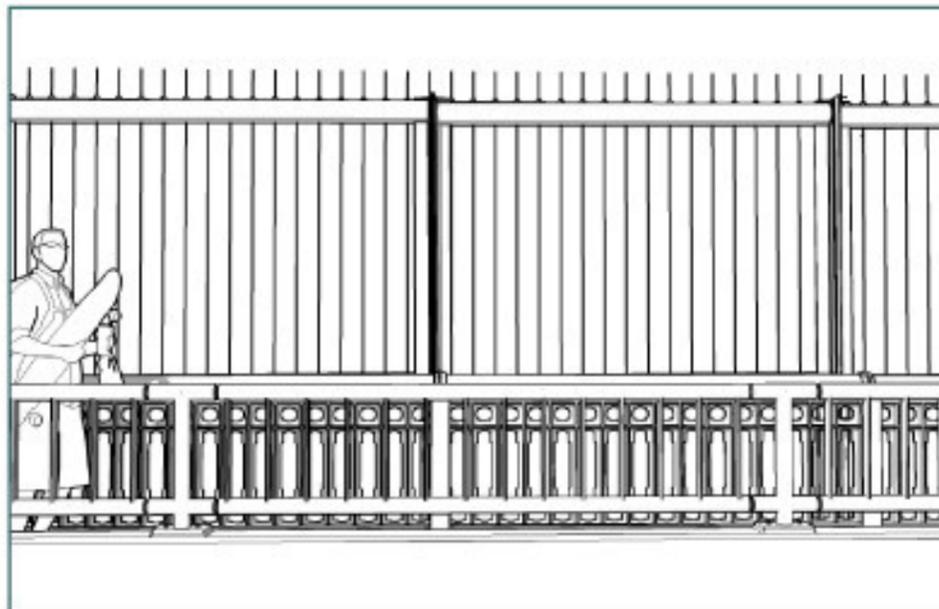
Tube Frame with Vertical Picket Top



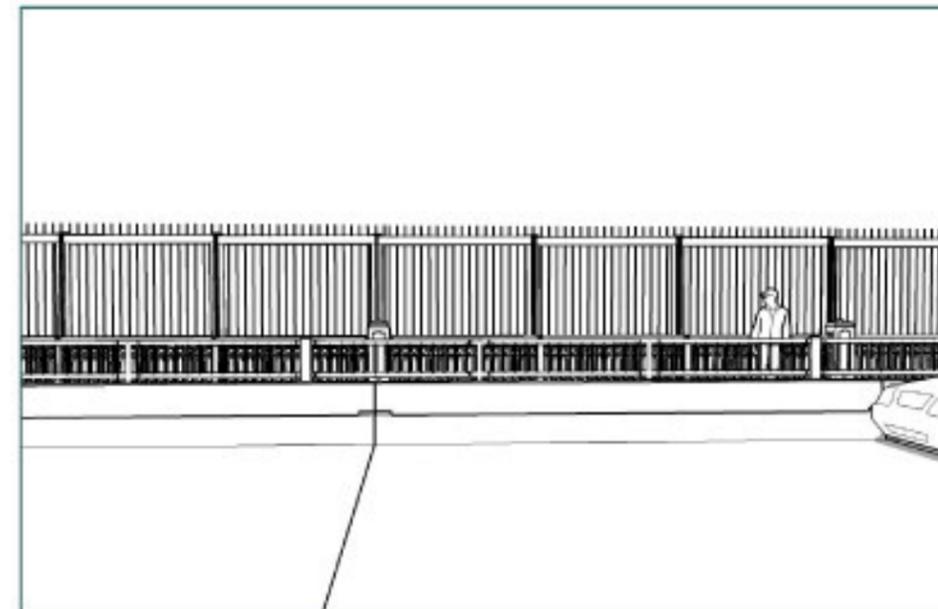
Perspective View—Below the Bridge



Perspective View—On the Bridge



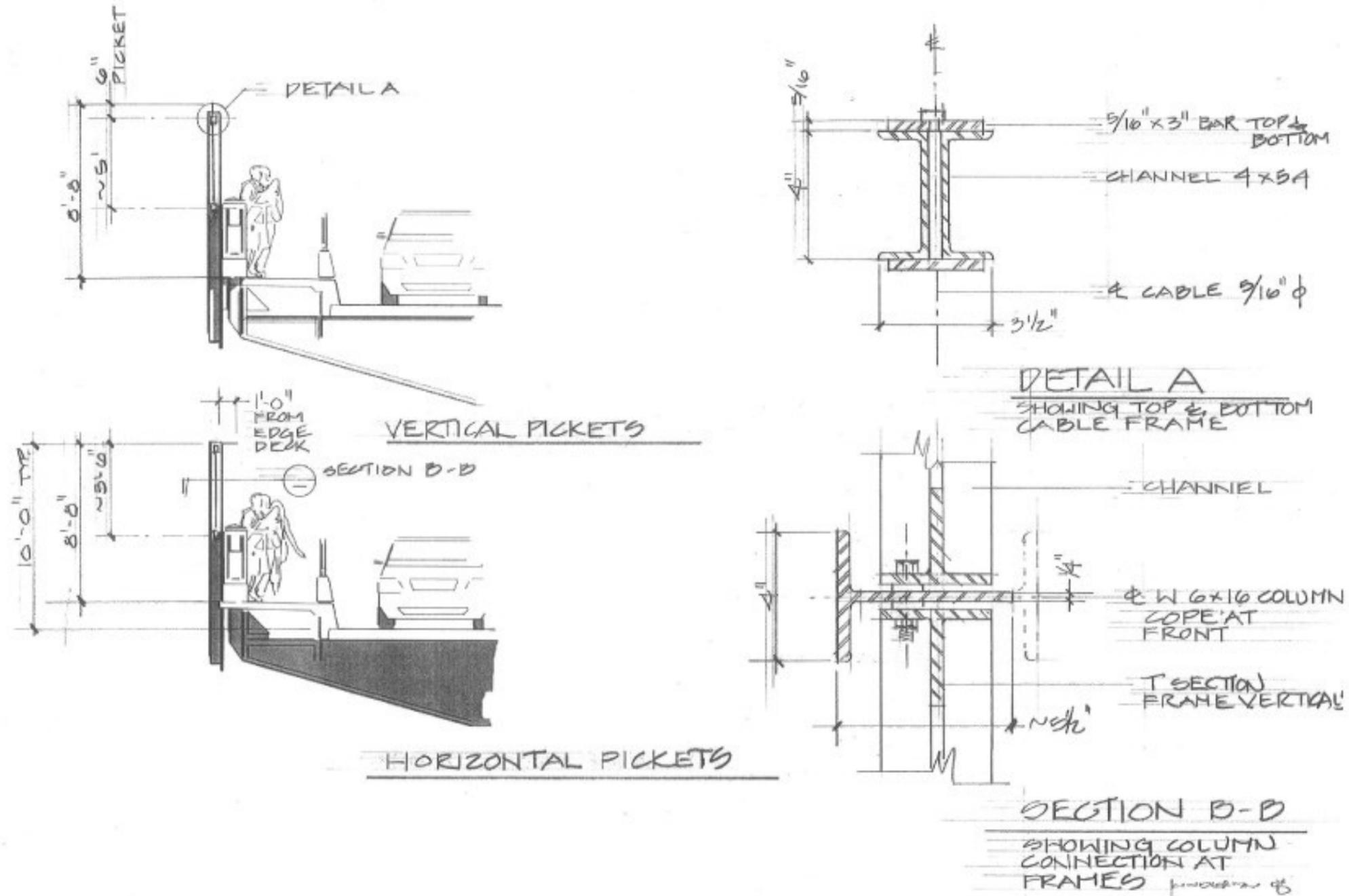
Elevation View—Near



Elevation View—Far

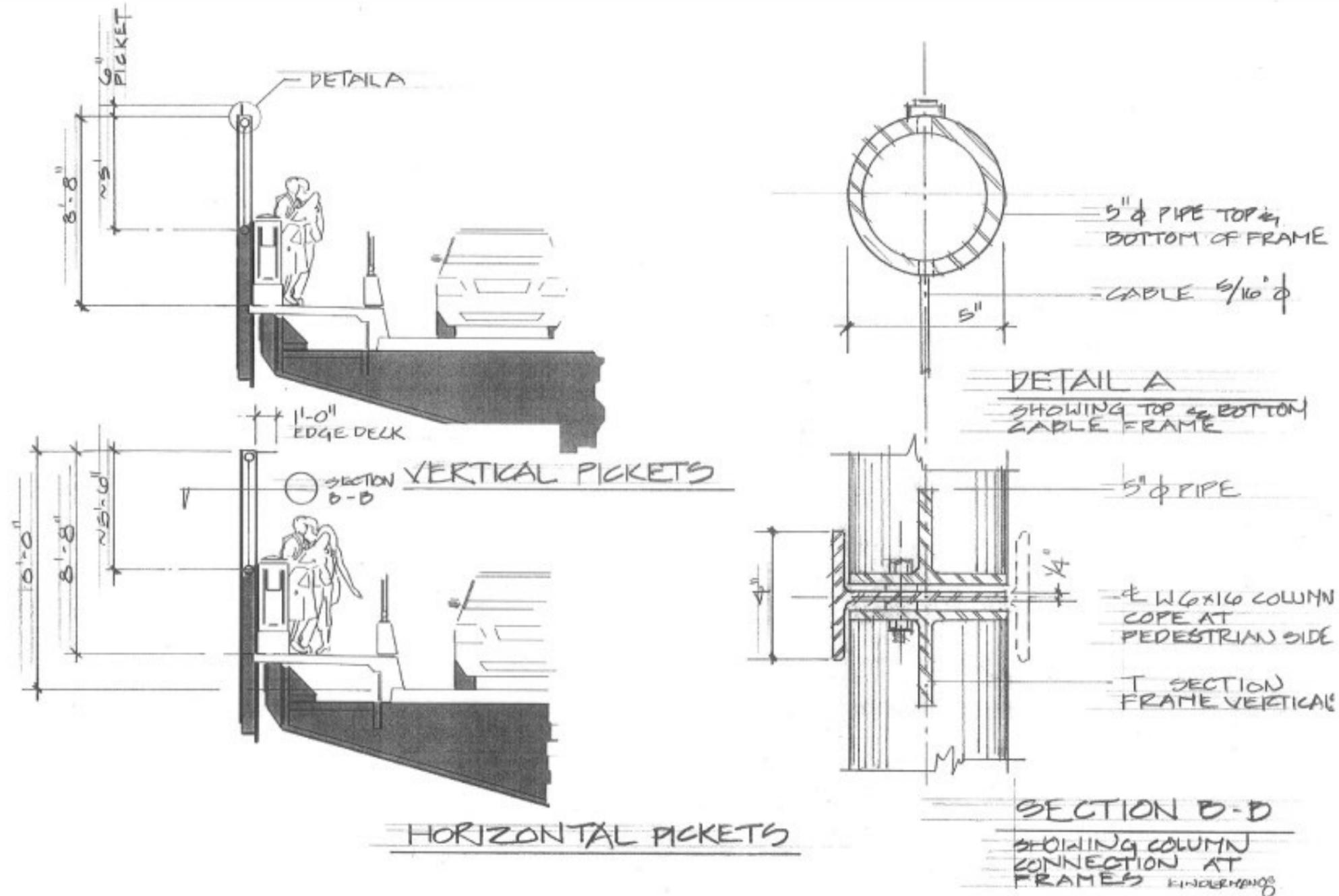
SR 99 Aurora Avenue Bridge Fence

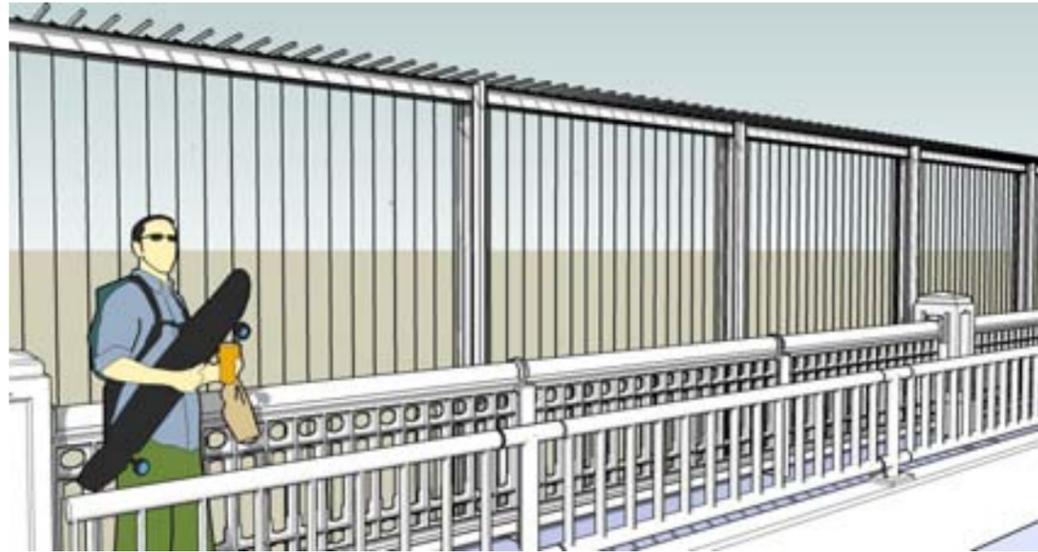
Channel Frame Details



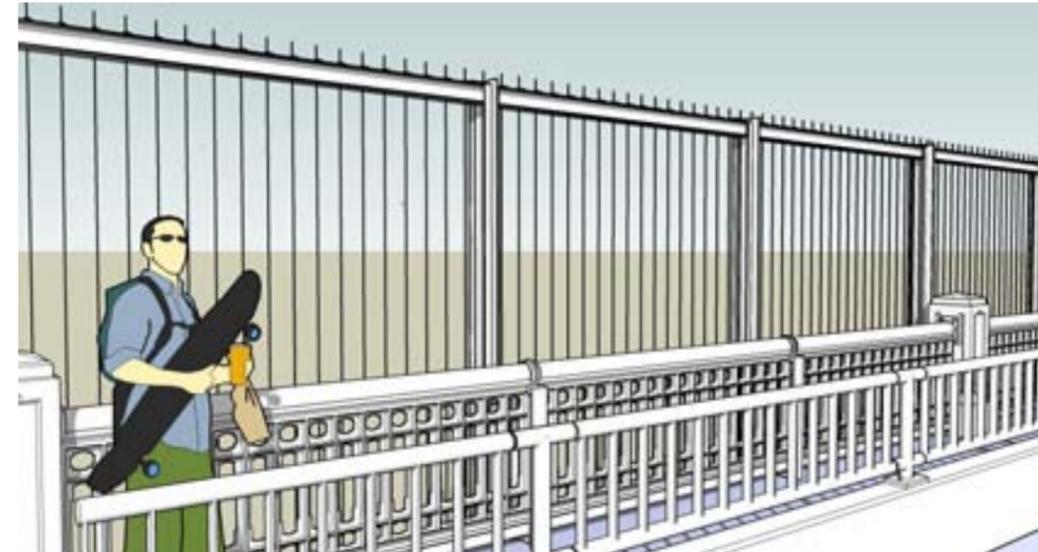
SR 99 Aurora Avenue Bridge Fence

Tube Frame Details

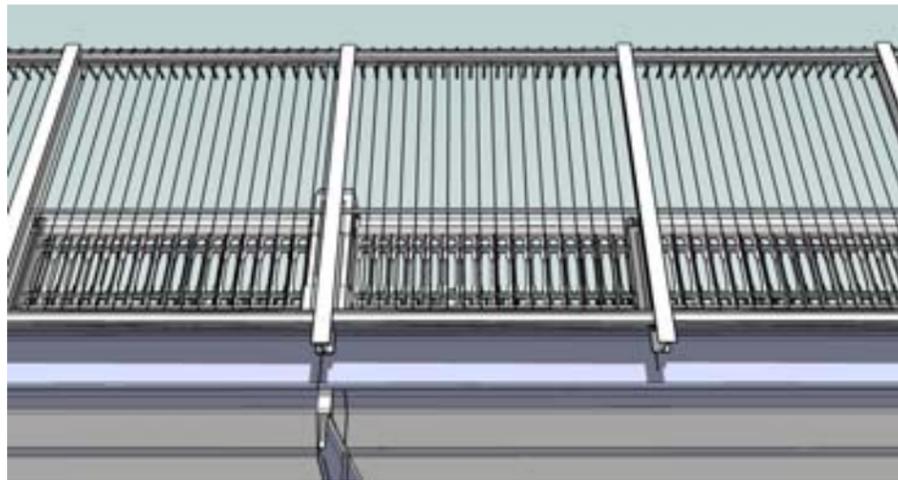




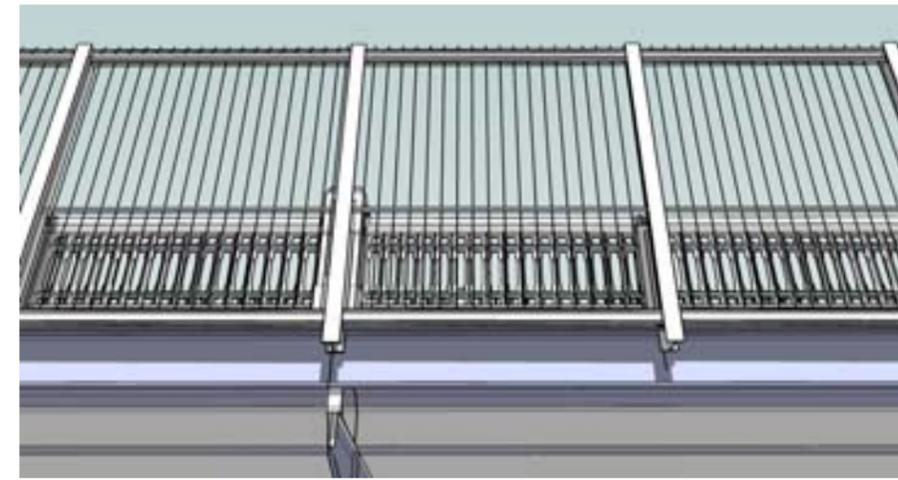
Horizontal
Top Pickets.



Vertical
Top Pickets



Extend stainless steel
cable vertical elements to
bottom of existing railing.

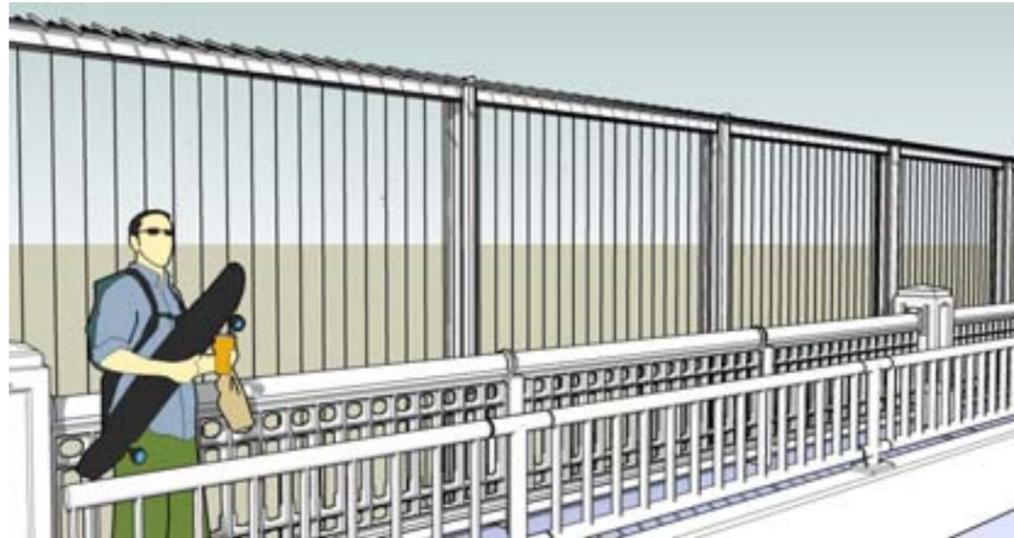


'Channel' sections
at the frame top in lieu of
'tubes'.
Decrease the size of vertical
structural elements to the extent
possible.

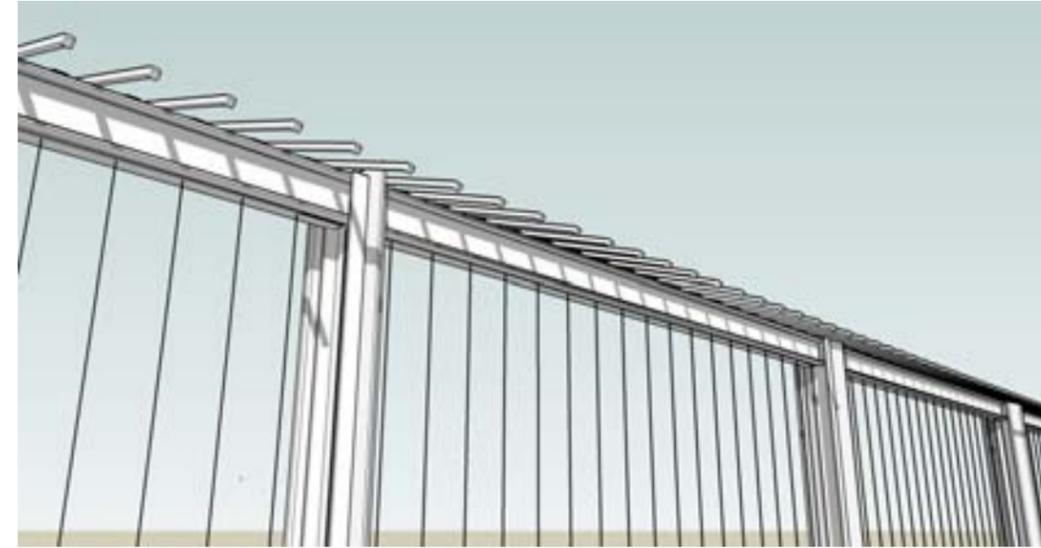


Design Concepts:

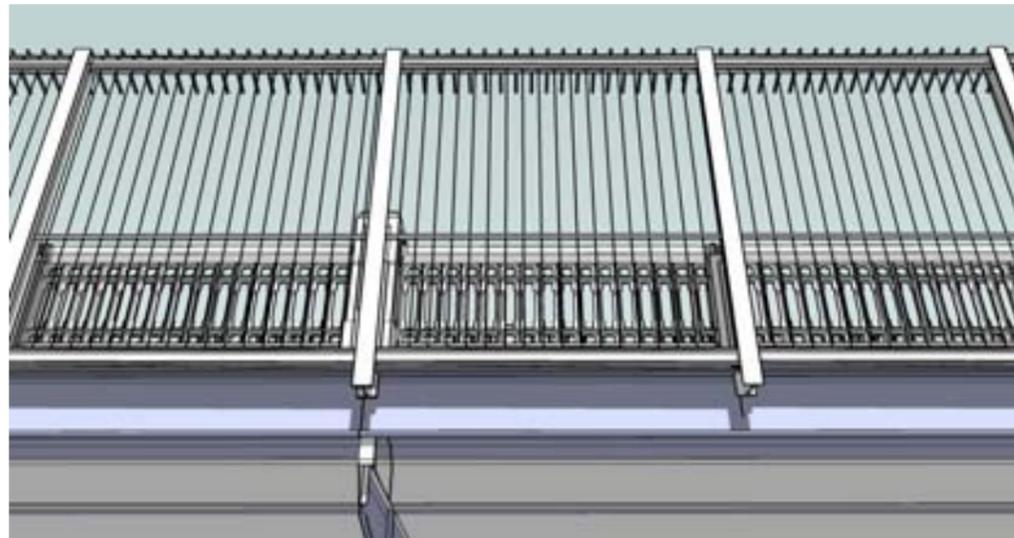
Created after the second meeting with the Architect's Review Committee.
Presented at the third committee meeting.



Channel' sections
at the frame top.



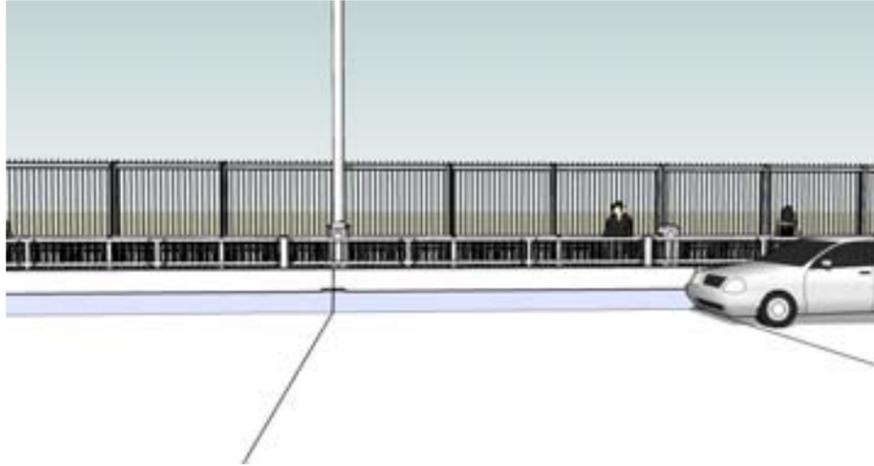
Sloped Top Pickets



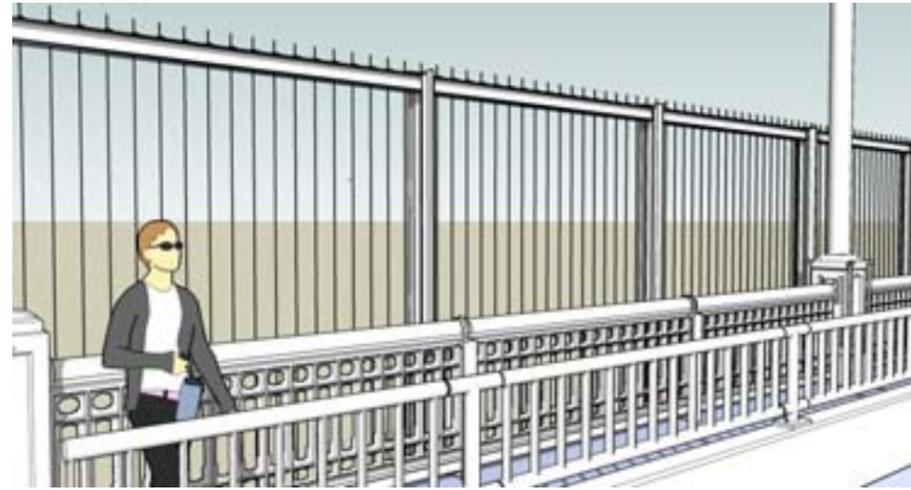
Extend stainless steel
cable vertical elements to bottom of
existing railing.

Design Concepts:

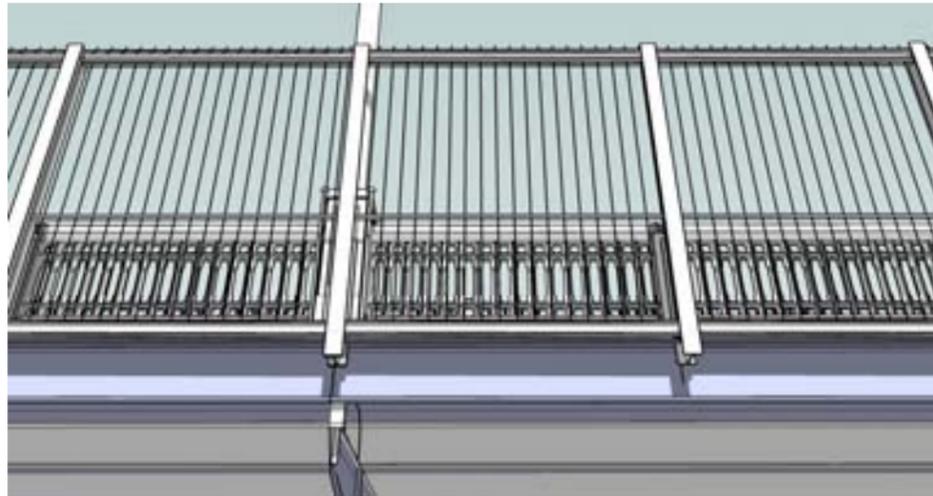
Additional design presented at the third Architect's Review Committee.
Presented at the third committee meeting.



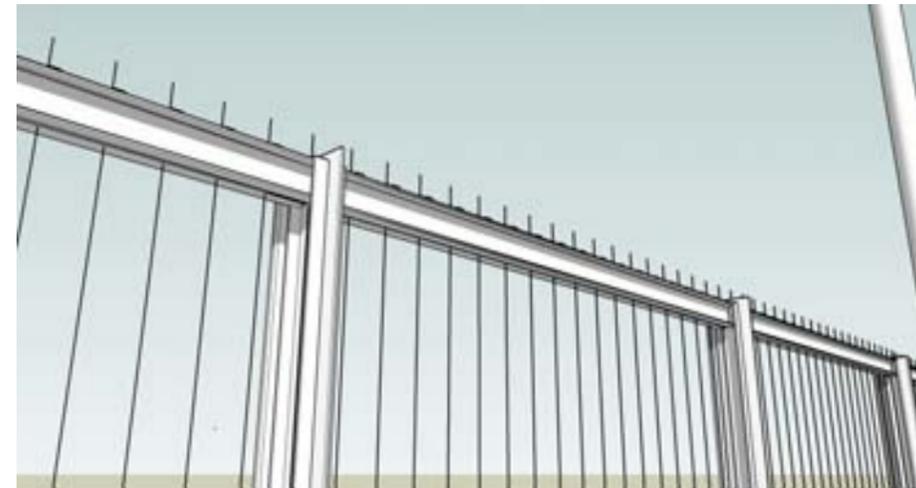
Elevation view from Aurora Avenue.



Perspective view showing sidewalk, existing railing and new fence.



Outside view showing vertical cables extending to the bottom of the existing railing.



Close-up of fence top showing the frame, cables and pickets.

Final Design Concept

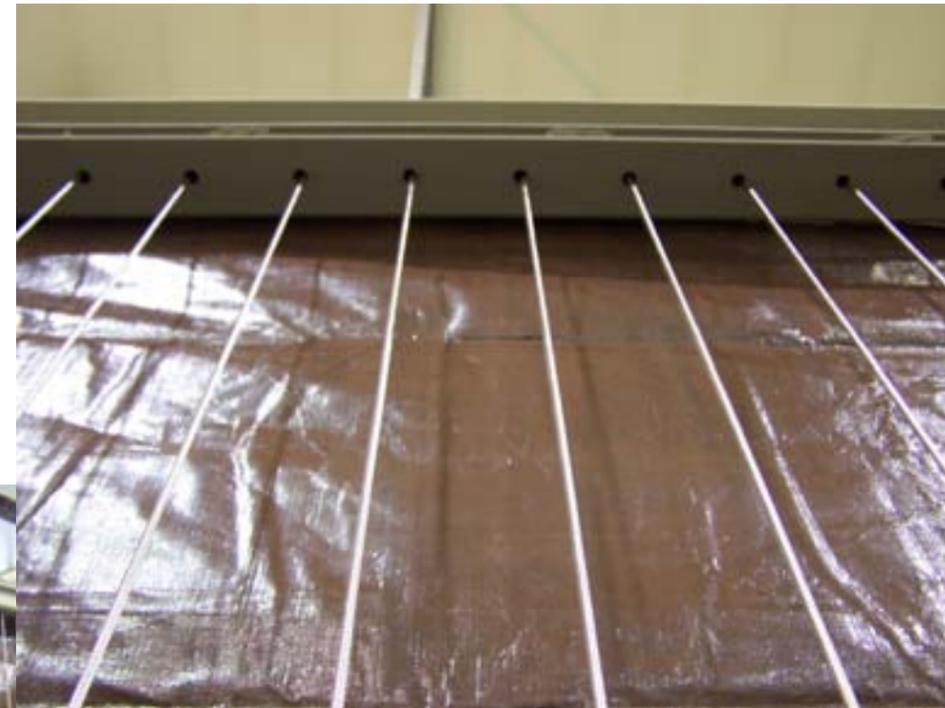
After the third meeting with the Architect's Review Committee.
Design to be presented to the City of Seattle Landmarks Preservation Board.

Stainless steel cables with vertical top pickets



Engineers placed brown plastic sheeting behind the model to make the vertical elements more visible for photographing.

1/4" stainless steel cables are shown in this mockup. The final fence will use 3/8" diameter bars.

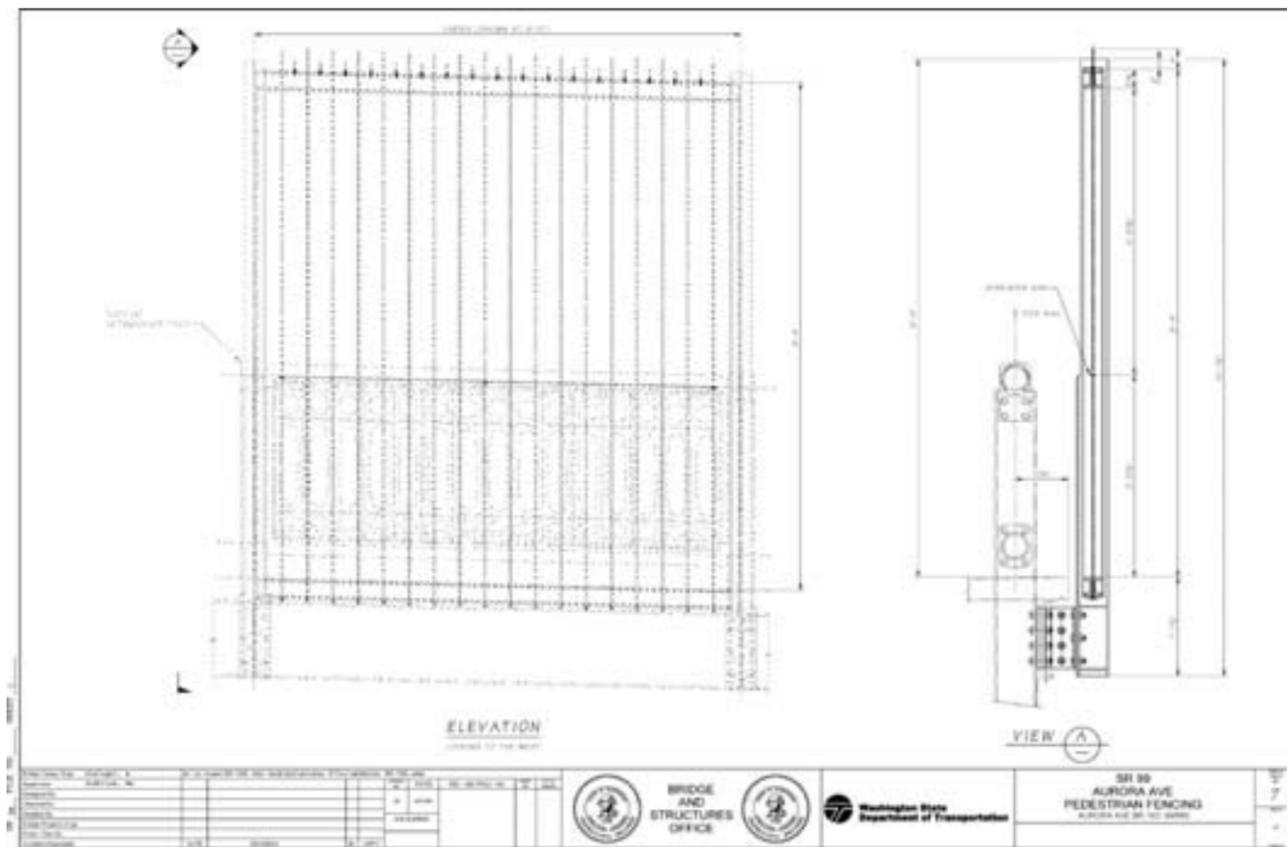


Final details will be somewhat different than those used in the mockup.

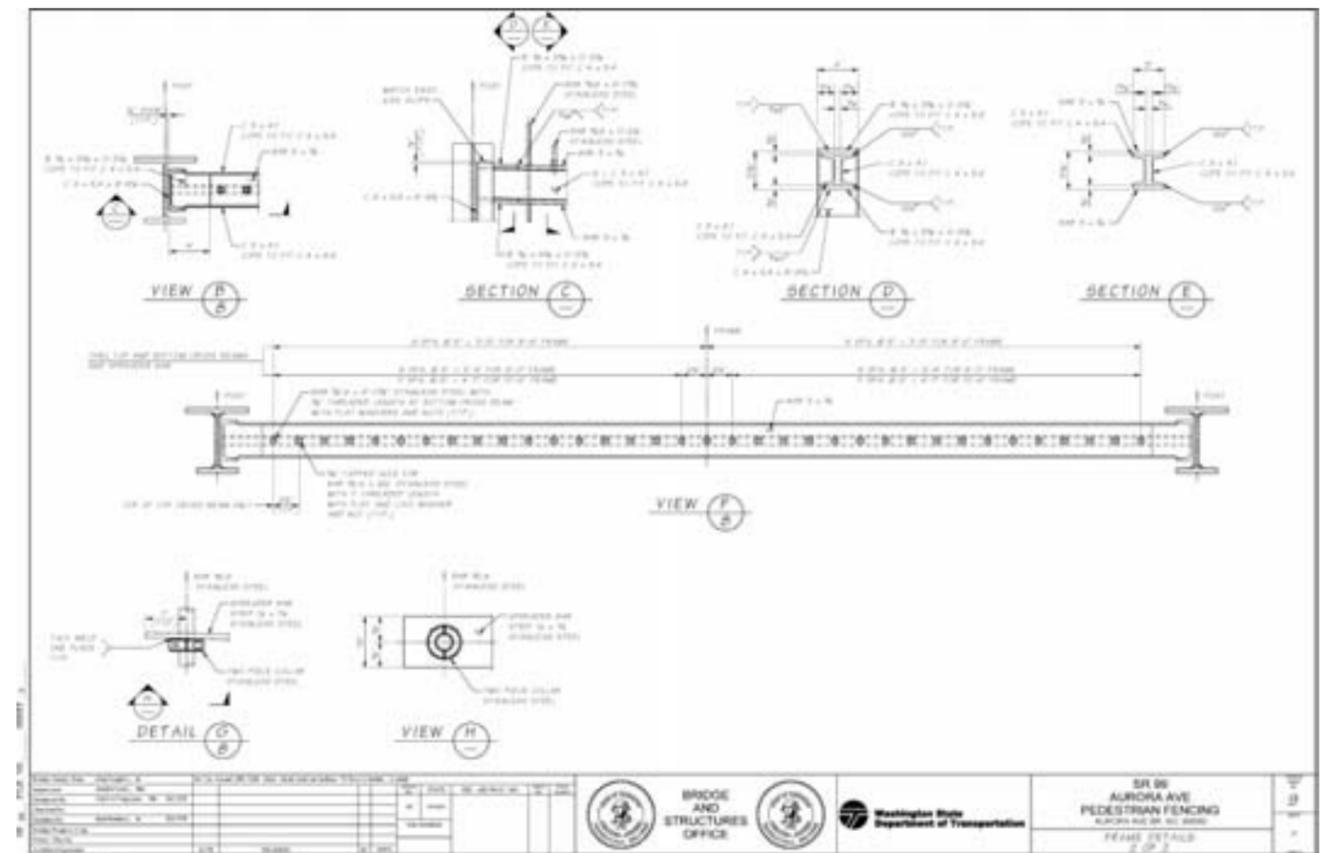
The welds connecting the plates will be 'continuous' in the final design. Those shown in the photo are 'stitch' welds.

Mockup of a Typical Fence 'Frame'

WSDOT engineers built a full scale mockup of the frame assembly.



Outside view showing vertical bars extending to the bottom of the existing railing.

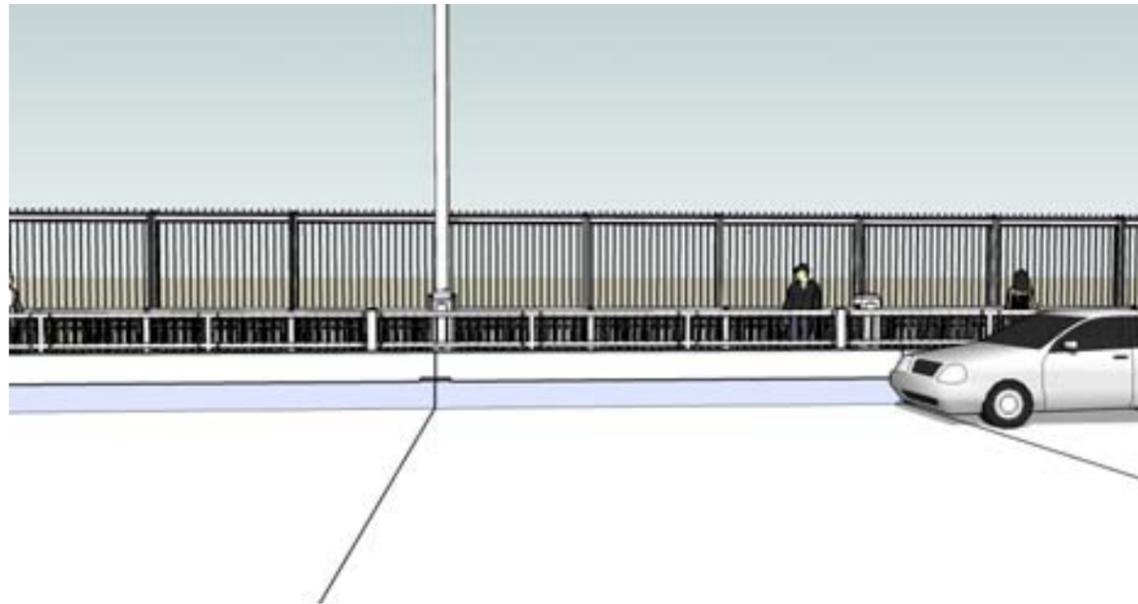


Engineer's preliminary construction drawing showing the top of the new fence and structural connections.

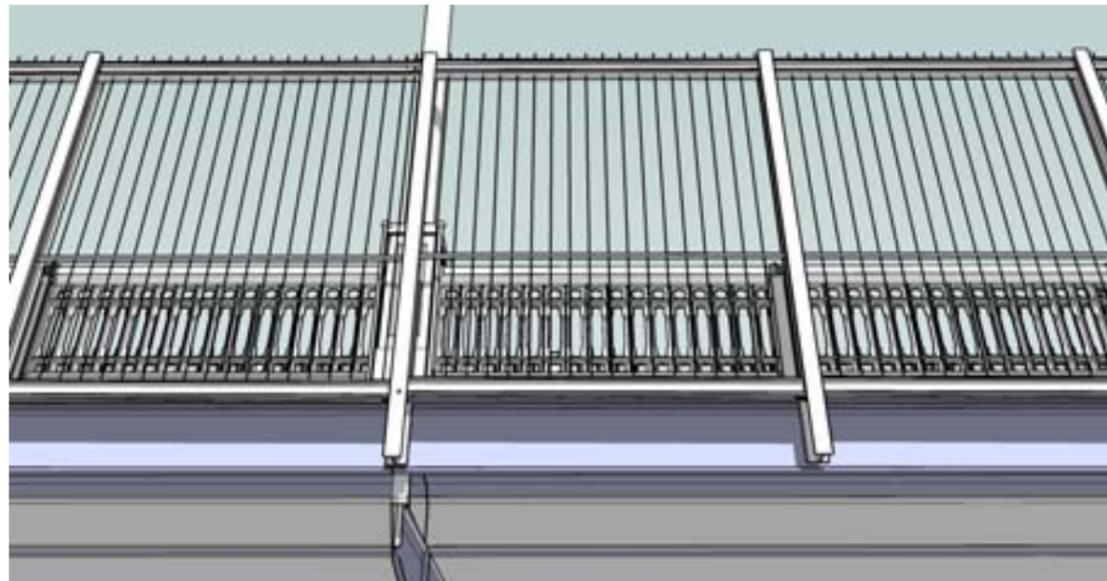
WSDOT engineers are in the process of assembling final contract drawings. These are two sheets amongst dozens to use by contractors to build the fence.

Bridge Engineer's Preliminary Construction Drawings

The drawings are preliminary and are not to be used for construction.



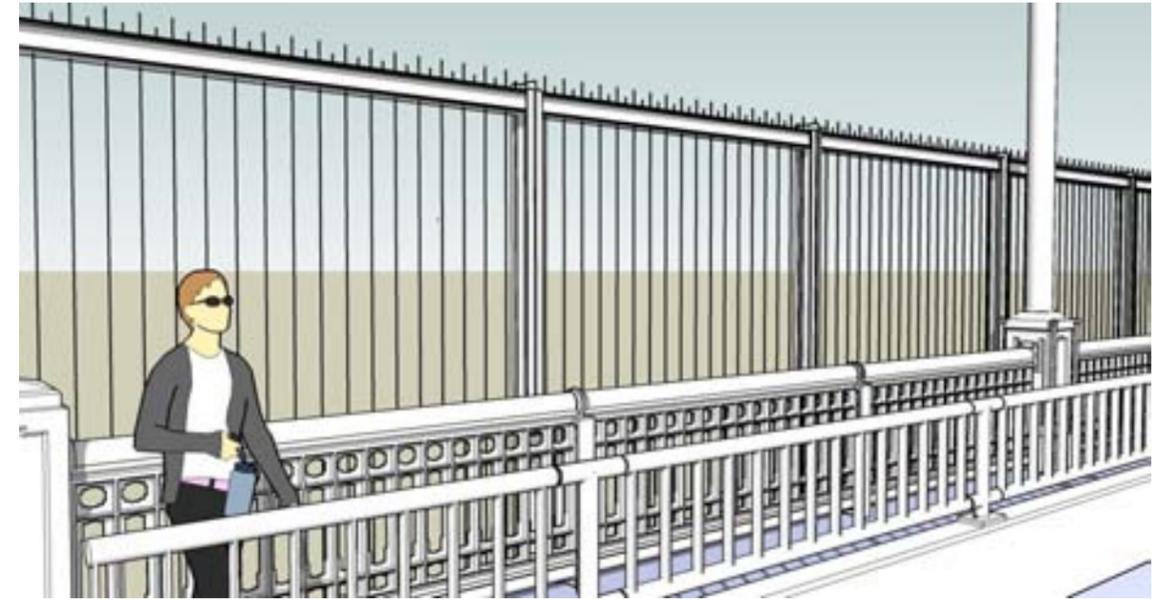
Elevation view from Aurora Avenue.



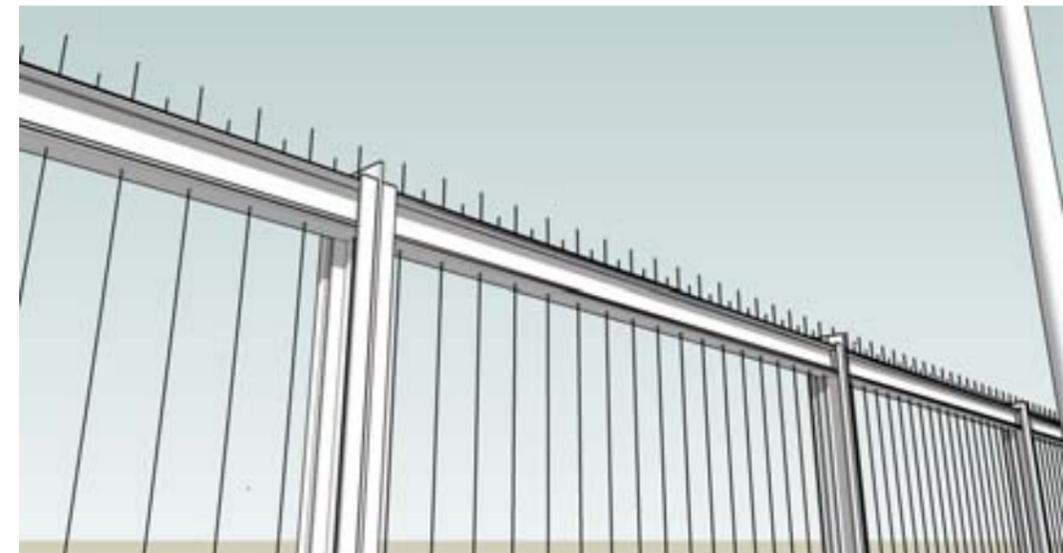
Outside view showing vertical bars extending to the bottom of the existing railing.

Final Design Concept Update

Before the fourth meeting with the Architect's Review Committee.
Final design refinements to be presented to the City of Seattle
Landmarks Preservation Board.



Perspective view showing sidewalk, existing railing and new fence.



Close-up of fence top showing the frame, bars and pickets.
Structural elements have been designed for smallest possible sizes.

Stainless steel 3/8" circular rods with 4" tall vertical top pickets
and 2" intermediate pickets.