LEDucation
Trade Show and Conference

Designers Lighting Forum

Luminous Connections:
Exploring Innovative Bridge Lighting Design

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ARCHITECTURAL LIGHTING DESIGN

March 19, 2025

LEDucation.org

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Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.

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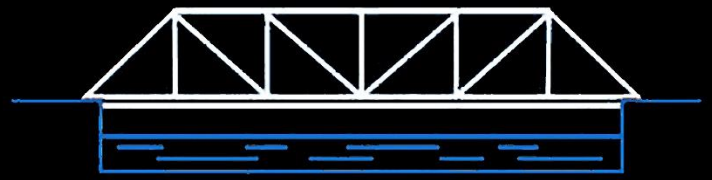
Learning Objectives

At the end of this course, participants will be able to:

1. Learn how to determine a basis of design for bridge lighting
2. Gain insights on how concepts for bridge lighting are developed
3. Discover how to document design intent
4. See the importance of mockup, aiming and adjusting during construction

Bridge Typologies

Cantilever



Truss

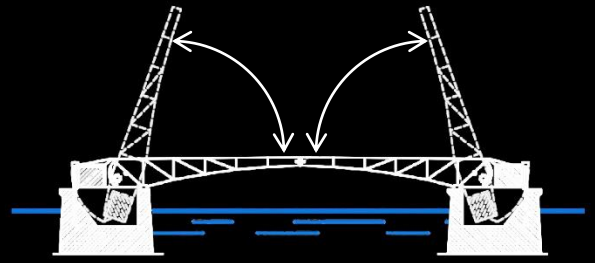
Arch

Beam

Tied Arch

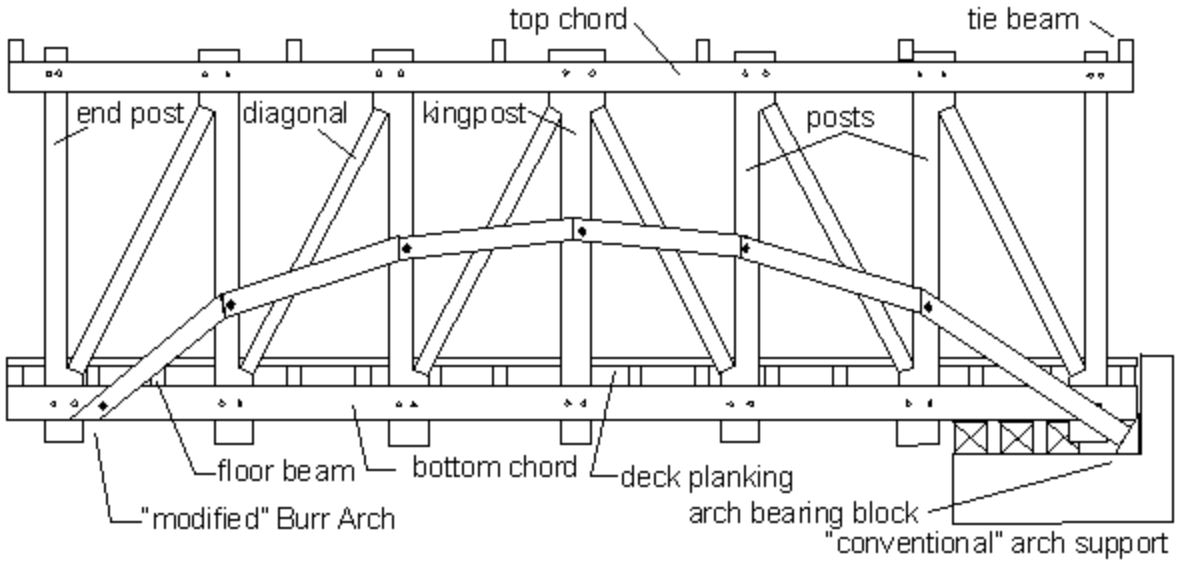
Suspension

Movable

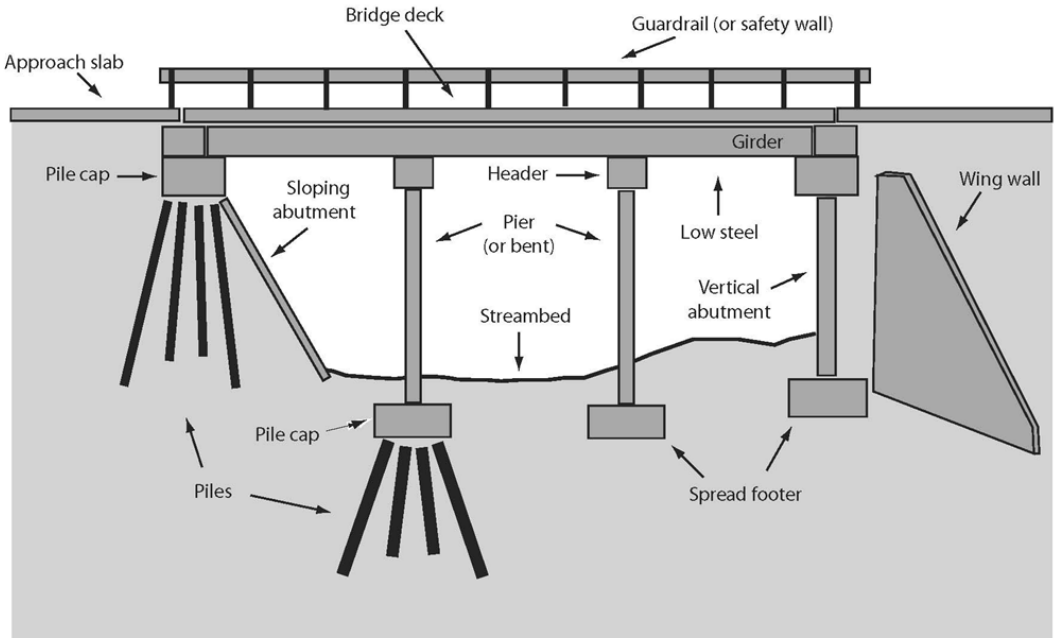


Cable-Stayed

Bridge Terminology



FHWA-HRT-04-098-Chapter 4: Types of Longitudinal Trusses



CivilArc.com

Bridge Use

Pedestrian

Vehicular

Vehicular &
Pedestrian

Bridge Crossing

Water

Land

Basis of Design

Codes/
Regulations

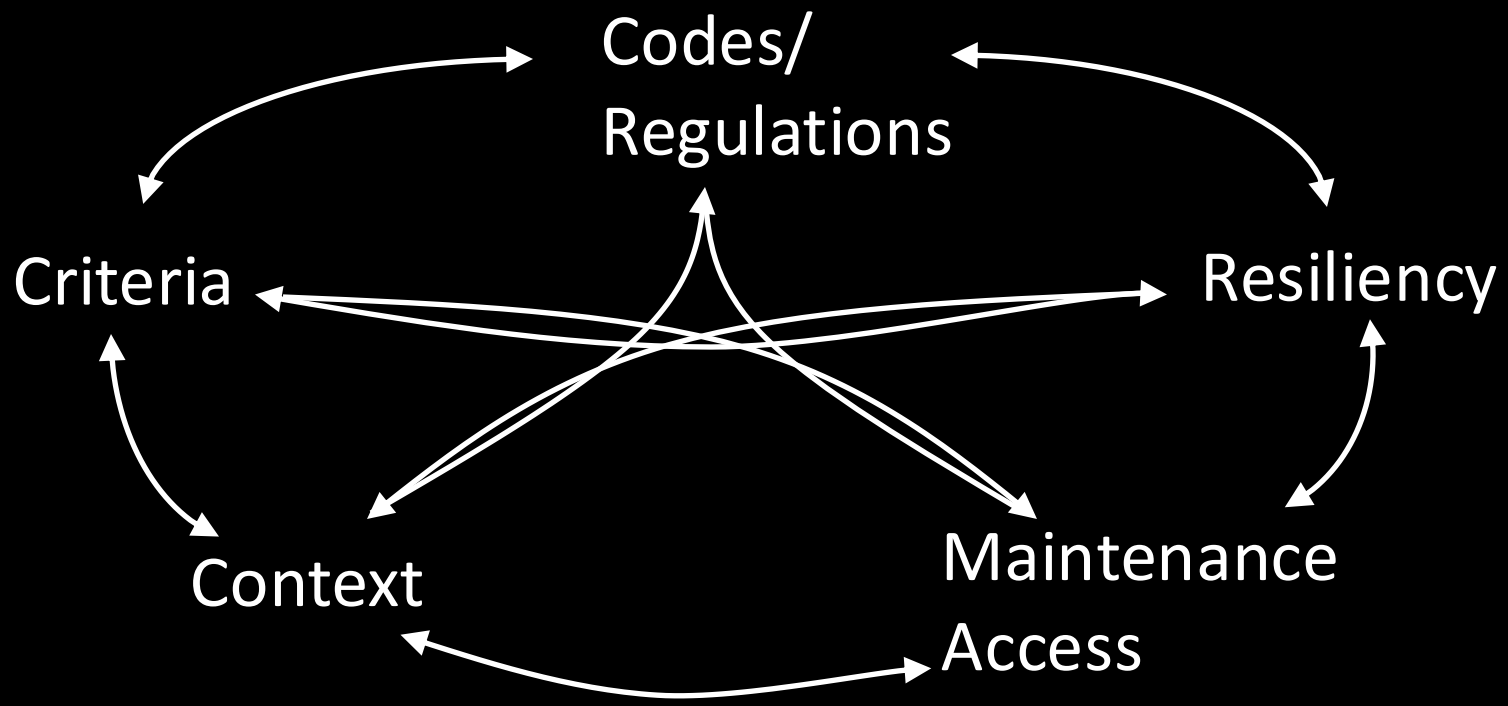
Criteria

Resiliency

Context

Maintenance
Access

Basis of Design



Codes/ Regulations

- Federal, State or Local Laws and Ordinances
- Authority Having Jurisdiction’s Standards & Guidelines
- Owner’s Project Requirements

Codes/ Regulations

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Resiliency

Impact 

 Corrosives

Weather 

 Wind

Particulate 

 Vibration

Resiliency

Impact 

Weather 

Particulate 

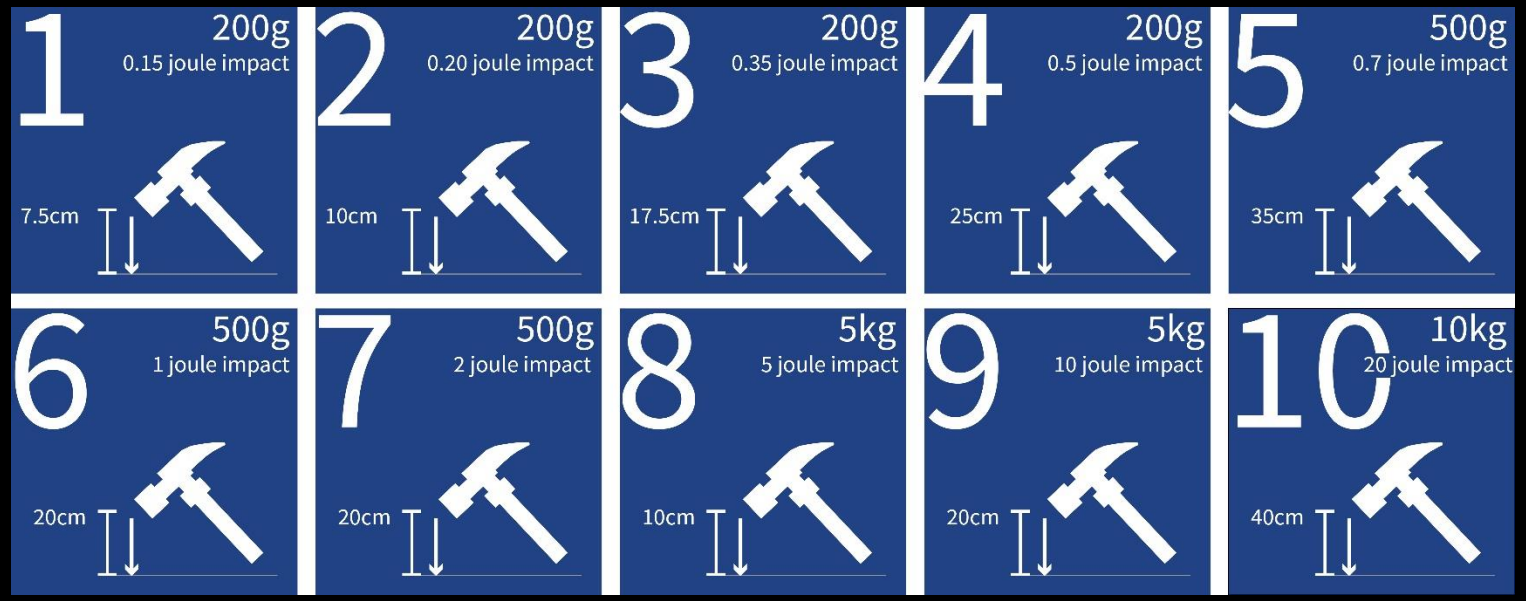
 Corrosives

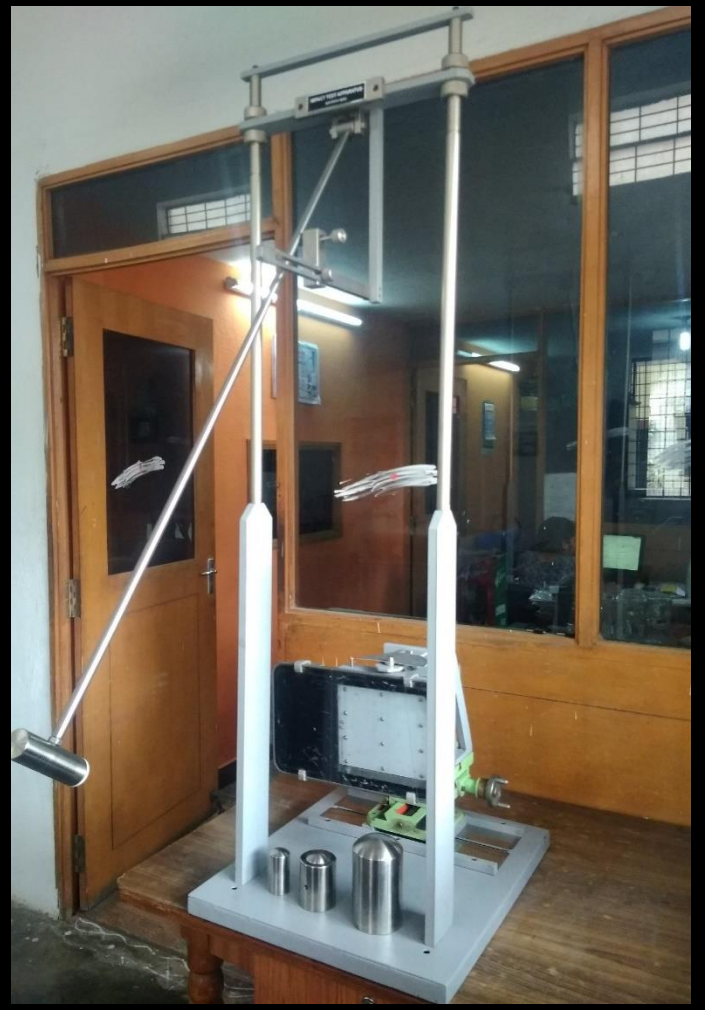
 Wind

 Vibration

Impact

IEC 62262 - Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code)





Sharadatronic Instruments

Weather

- Rain
- Lightning
- Flooding
- Snow, Sleet, Ice, Hail
- Sandstorm
- Fog
- Humidity
- Hot and/or freezing temperatures

Weather and Lightning

IEC 61643-01 - Low-voltage surge protective devices - Part 01: General Requirements and test methods

C62.62 IEEE Standard Test Specifications for Surge-Protective Devices (SPDs) for Use on the Load Side of the Service Equipment in Low-Voltage (1000 V and Less) AC Power Circuits

Don’t forget about the lighting controls!

Weather and Particulates

IEC 60529 - Degrees of protection provided by enclosures (IP Code)

Wet Location Listed

EMC Technologies

Weather and Particulates

SOLIDS

3	PROTECTED AGAINST A SOLID OBJECT GREATER THAN 2.5MM
4	PROTECTED AGAINST A SOLID OBJECT GREATER THAN 1MM
5	PROTECTED AGAINST DUST LIMITED IN-GRESS BUT NOT HARMFUL
6	DUST TIGHT - NO INGRESS OF DUST - TWO TO EIGHT HOURS

IP 65

DUST WATER

2	RESISTS SPLASHES
3	RESISTS LIGHT RAIN
4	RESISTS HEAVY RAIN
5	RESISTS LOW PRESSURE JETS OF WATER
6	RESISTS VERY SHORT PERIODS IN WATER
7	RESISTS IMMERSION IN WATER FOR 30 MINUTES AT 1 METER
8	RESISTS PERIODS OF IMMERSION UNDER WATER
9	PROTECTED AGAINST HIGH TEM-PERATURE, HIGH PRESSURE WATER AND STEAM

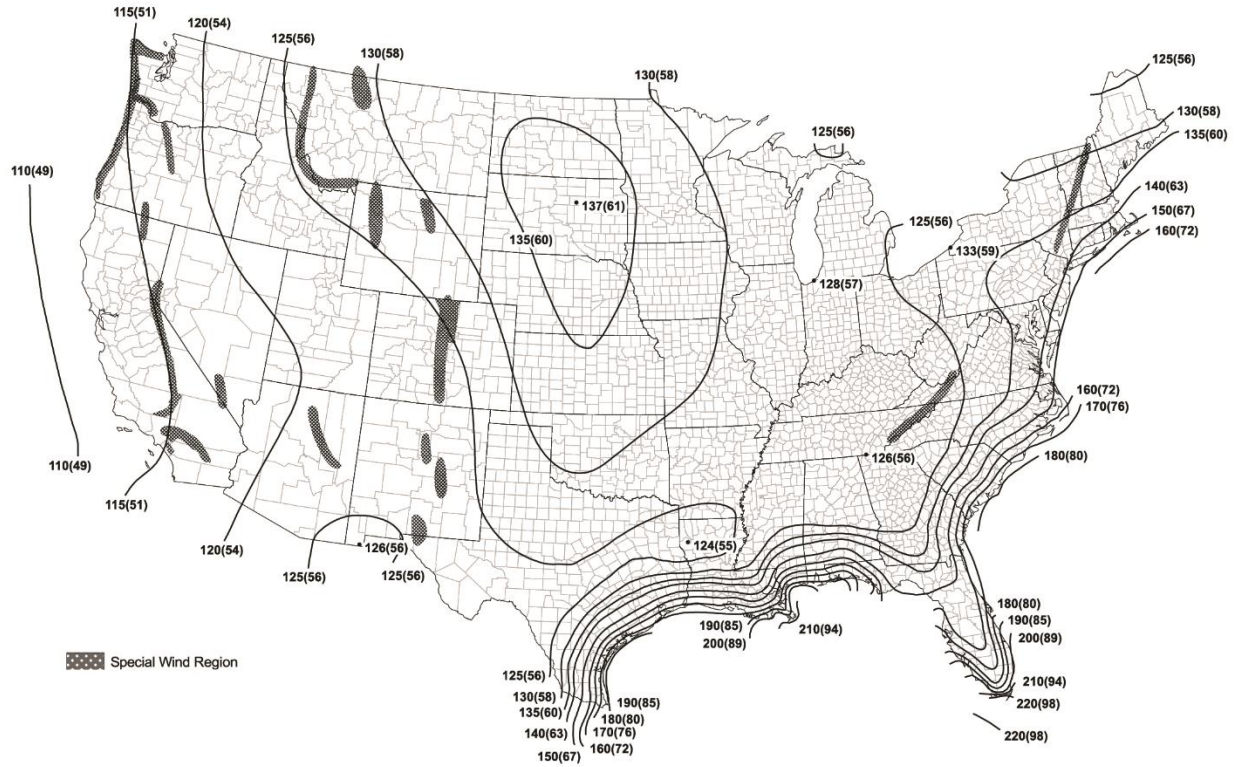
Corrosives

MIL-STD-810G Method 509.5 Salt Fog Testing?

Wind

AASHTO LTS-6 – Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals

Make sure to factor in added accessories like snoots and visors!



Notes:

1. Values are 3 s gust wind speeds in mi/h (m/s) at 33 ft (10 m) above ground for Exposure Category C.
2. Linear interpolation is permitted between contours. Point values are provided to aid with interpolation.
3. Islands, coastal areas, and land boundaries outside the last contour shall use the last wind speed contour.
4. Location-specific basic wind speeds shall be permitted to be determined using the ASCE Wind Design Geodatabase.
5. Mountainous terrain, gorges, ocean promontories, and special wind regions shall be examined for unusual wind conditions.
6. Wind speeds correspond to approximately a 0.5% probability of exceedance in 50 years (Annual Exceedance Probability = 0.0001, MRI = 10,000 years).
7. The ASCE Wind Design Geodatabase is available at the ASCE 7 Hazard Tool (https://asce7hazardtool.online), or approved equivalent.

ASCE 7-22 Appendix F – Wind Hazard Maps for Long Return Periods

Vibration

ANSI 136.31 - Roadway and Area Lighting Equipment - Luminaire Vibration

- Elevated vs. at grade roadways
- Luminaire and mounting bracket materials
- 3G, 5G, or more?

ALI Testing Equipment Co

Maintenance Access

Ladder

Lifts

Scaffolding

Snooper Truck

Context

- Historic, contemporary, modern style?
- Geographic area?

Urban

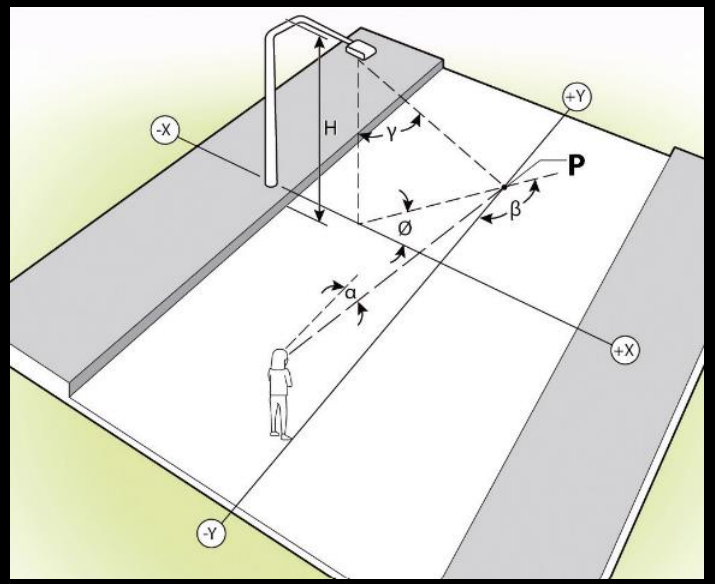
Suburban

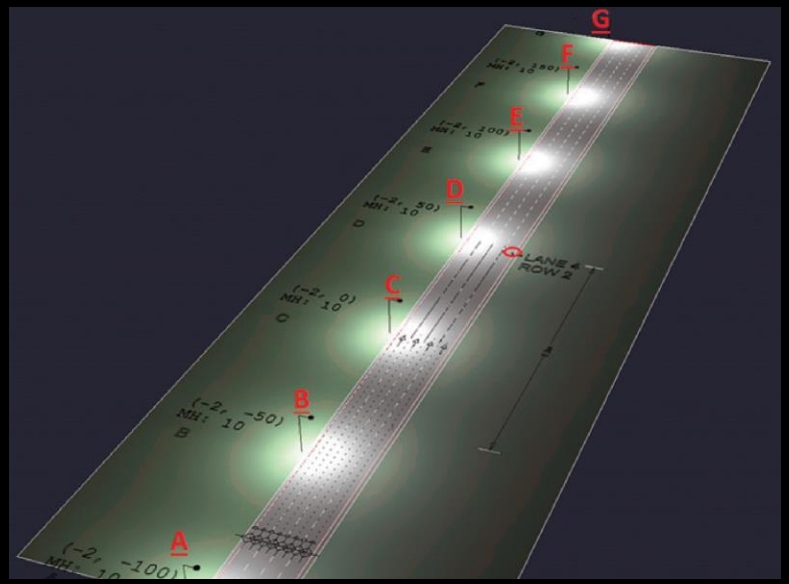
Rural/Natural

Context

- Wildlife sensitivity?
- Light pollution

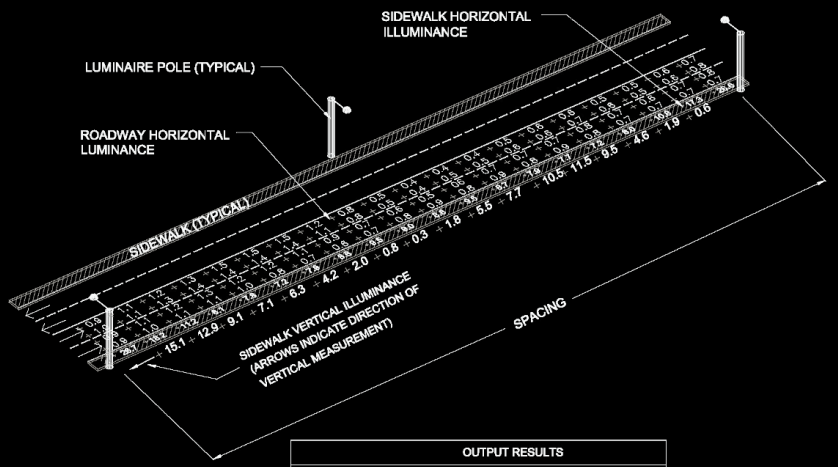
Criteria



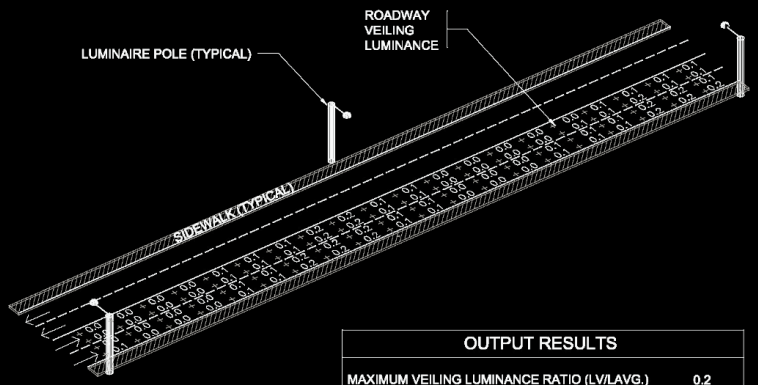


Roadway and Walkway Lighting

From IES RP-8-22



OUTPUT RESULTS			
GRID	MAINTAINED AVERAGE	UNIFORMITY RATIO (AVG./MIN.)	UNIFORMITY RATIO (MAX./MIN.)
ROADWAY HORIZONTAL LUMINANCE	cd/m.sq	2.4	4.2
SIDEWALK HORIZONTAL ILLUMINANCE	lux	1.8	N/A
SIDEWALK VERTICAL ILLUMINANCE	lux	N/A	N/A



OUTPUT RESULTS	
MAXIMUM VEILING LUMINANCE RATIO (LV/LAVG.)	0.2

Figure 11-5. Sample roadway calculation: street and sidewalk.

Table A-3. Recommended Illuminance Criteria for People in Outdoor Environments

APPLICATION TASK/AREA[8]	Task or Area	High Med Low	Lighting for Human Vision, Visibility, and Reassurance: Recommended Average Maintained Illuminance Targets[9] — Illuminances are at height of Task Surface (TS) above finished grade (AFG) — Horizontal Illuminance: Target E_h @ Height AFG: Lux @ m	(Fc @ Ft)	Uniformity: Ratio (Avg:Min)	Ratio Basis	Vertical Illuminance: Target E_v @ Height AFG: Lux @ m	(Fc @ Ft)	Uniformity: Ratio (Avg:Min)	Ratio Basis	Lighting for Responsible Design: Optic Control: Glare, Uplight Ratings: Max Glare Rating (G)	Max Uplight Rating (U)	Controls: Vacancy, Seasonal, & Time of day: Light Output During Controls Reduction	Spectrum: Acceptable Short Wavelength Content[7]: (VL), (L), (M), (H), (VH)[12]
CONTEXT, ORIENTATION, WAYFINDING, REASSURANCE														
Façades														
Façades (low reflectance materials, <0.3)[10]														
LZ4														
Lower limit (avg.)							8 @ TS	(0.8 @ TS)						
Upper limit (avg.)							40 @ TS	(4 @ TS)					0% to 50%	VL, L, M, H
LZ3														
Lower limit (avg.)							4 @ TS	(0.4 @ TS)						
Upper limit (avg.)							30 @ TS	(3 @ TS)					0% to 50%	VL, L, M
LZ2														
Lower limit (avg.)							2 @ TS	(0.2 @ TS)						
Upper limit (avg.)							20 @ TS	(2 @ TS)					0% to 50%	VL, L, M
LZ1														
Lower limit (avg.)							1 @ TS	(0.1 @ TS)						
Upper limit (avg.)							10 @ TS	(1 @ TS)					50%	VL, L
LZ0														
Lower limit (avg.)														
Upper limit (avg.)														

Table A-3. Recommended Illuminance Criteria for People in Outdoor Environments

APPLICATION TASK/AREA[8]	Task or Area	High Med Low	Lighting for Human Vision, Visibility, and Reassurance: Recommended Average Maintained Illuminance Targets[9] — Illuminances are at height of Task Surface (TS) above finished grade (AFG) — Horizontal Illuminance: Target E_h @ Height AFG: Lux @ m	(Fc @ Ft)	Uniformity: Ratio (Avg:Min)	Ratio Basis	Vertical Illuminance: Target E_v @ Height AFG: Lux @ m	(Fc @ Ft)	Uniformity: Ratio (Avg:Min)	Ratio Basis	Lighting for Responsible Design: Optic Control: Glare, Uplight Ratings: Max Glare Rating (G)	Max Uplight Rating (U)	Controls: Vacancy, Seasonal, & Time of day: Light Output During Controls Reduction	Spectrum: Acceptable Short Wavelength Content[7]: (VL), (L), (M), (H), (VH)[12]
Façades (high reflectance materials, >0.6)[10]														
LZ4														
Lower limit (avg.)							2 @ TS	(0.2 @ TS)						
Upper limit (avg.)							20 @ TS	(2 @ TS)					0% to 20%	VL, L, M, H
LZ3														
Lower limit (avg.)							1 @ TS	(0.1 @ TS)						
Upper limit (avg.)							10 @ TS	(1 @ TS)					0% to 20%	VL, L, M
LZ2														
Lower limit (avg.)							0.5 @ TS	(0.05 @ TS)						
Upper limit (avg.)							5 @ TS	(0.5 @ TS)					0% to 20%	VL, L, M
LZ1														
Lower limit (avg.)							0.2 @ TS	(0.02 @ TS)						
Upper limit (avg.)							2 @ TS	(0.2 @ TS)					0% to 20%	VL, L
LZ0														
Lower limit (avg.)														
Upper limit (avg.)														

From IES RP-43-22

Criteria: Accent Lighting

Table A-3. Accent Illuminance Ratios Table

Attraction	Role	Focal-Point Reflectance	Illuminance Ratio[a]	Application Notes[b, c, d]	Example Applications
Strong	**Dominant**	≥50%	~ 20:1, focal point to task	Use very sparingly for short duration on no more than a few relatively small focal points, for a momentous occasion or experience. Focal point lit to these ratios may be a fraction of the total focal area.	• House of worship: reverent focal element during dark-house ceremony • Retail: highly exclusive indoor small displays, such as an extraordinary piece of jewelry
		<50%	~ 40:1, focal point to task		
	Dramatic	≥50%	~ 10:1, focal point to task	Use sparingly on as many as several focal areas for significant effect. Focal point lit to these ratios may be a fraction of the total focal area.	• Corporate and hospitality lobbies: exclusive wall materials such as granite • Retail: exclusive indoor display, such as vignette at department or store entry
		<50%	~ 20:1, focal point to task		
Moderate	**Feature**	≥50%	~ 5:1, focal point to task	Use on focal points for visual attention. Focal point lit to these ratios may be a fraction of the total focal area.	• Hospitality: destination features, such as concierge, front desk, wall-material features • Retail: dazzle and highlight of feature displays
		<50%	~ 10:1, focal point to task		
Soft	**Visual edge**	≥50%	~ 2:1, focal point to task	Use on focal points or features for visual interest.	• Conference rooms: artwork, wall-material features • Contemporary residences: artwork • Reception: artwork, wall-material features
		<50%	~ 5:1, focal point to task		
Subtle	**Visual relief**	≥50%	~ 1:1, focal point to task	Use liberally on focal points for visual relief.	• Office: artwork, wall-material features • Traditional residences: artwork
		<50%	~ 1:1, focal point to task		

Table notes:

a. Ratio of E_v (average on focal point typically of vertical orientation) to E_h (average illuminance on primary task plane typically of horizontal orientation).

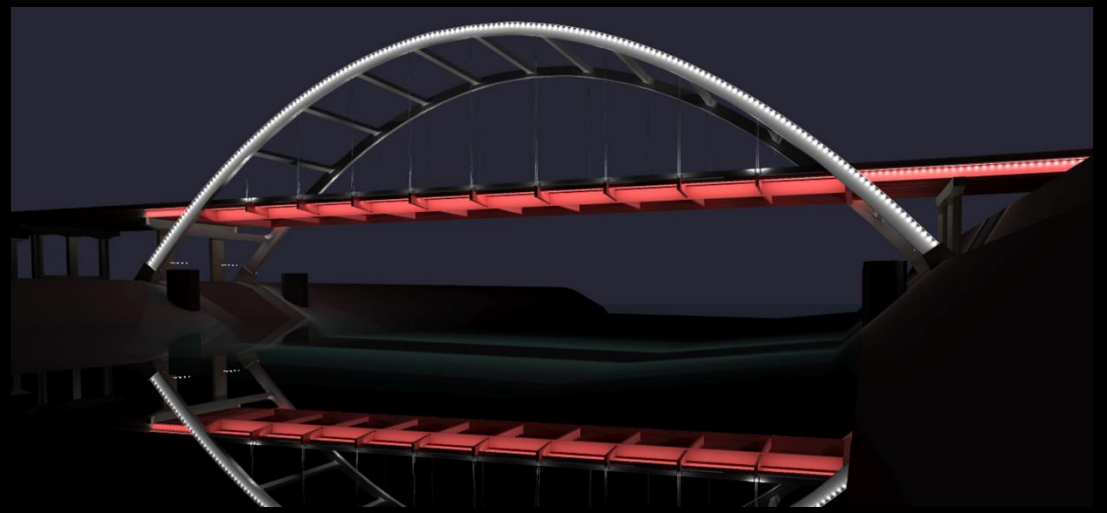
b. Refer to *ANSI/IES RP-30-20, Recommended Practice: Lighting Museums.*[9]

c. Long-term exposure may cause fading or degradation.

d. Focal plane may be different from task plane.

From IES RP-10-20

Criteria



Accent Lighting Calculations

Concept Development



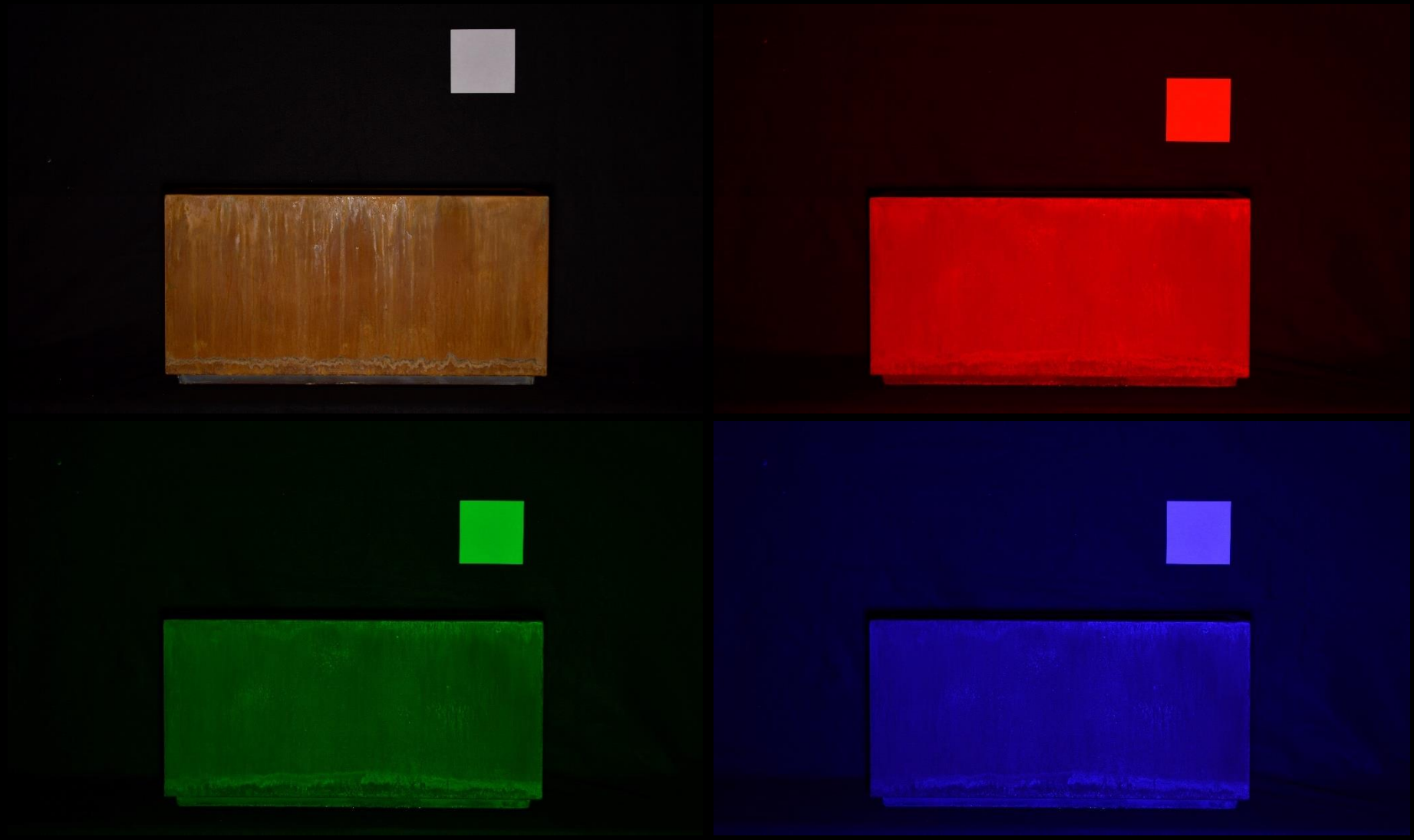



Existing conditions

Concept Development

Materiality and color temperature

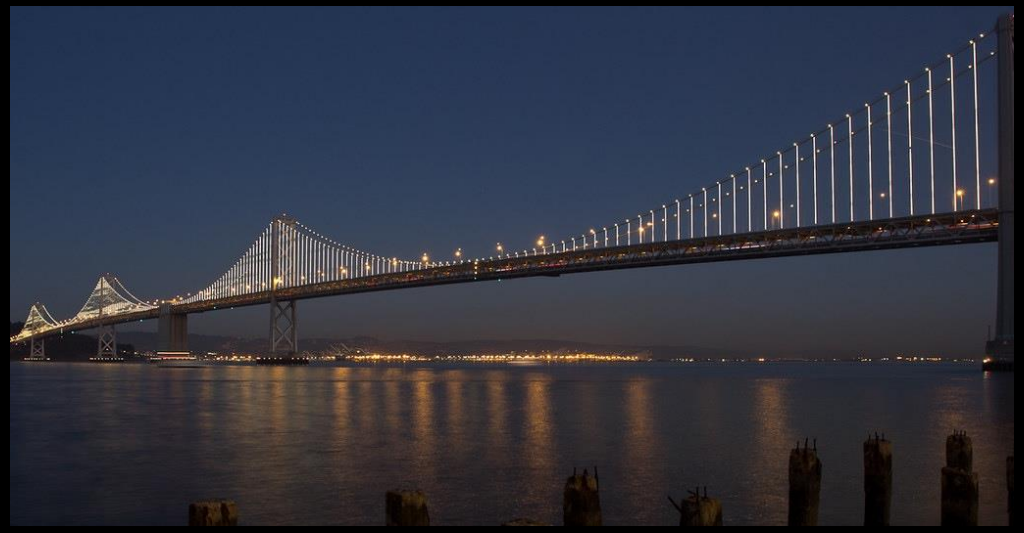
Concept Development



Saturated/monochromatic color

Concept Development

Necklace



Cables

Arch and/or Spandrel

Piers

Concept Development

Internal Structure

External Structure

Light on Objects

Light as the Object

Concept Development

Base

Concept Development

Layering

Concept Development

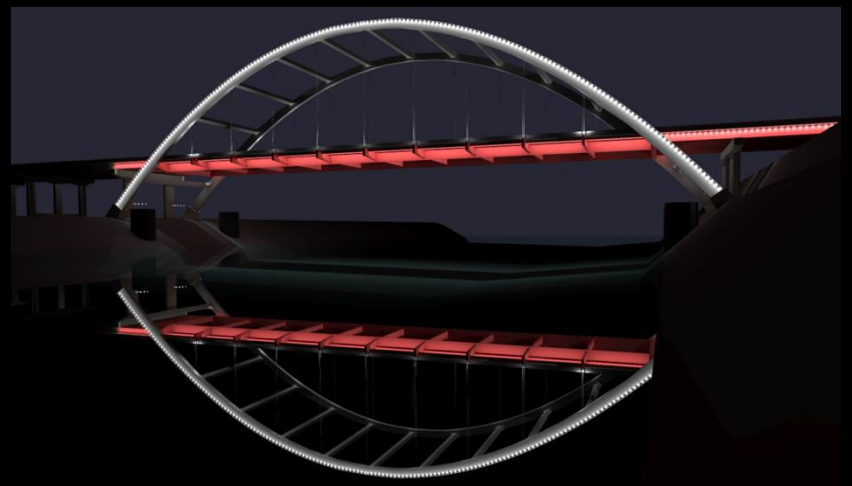
Layering

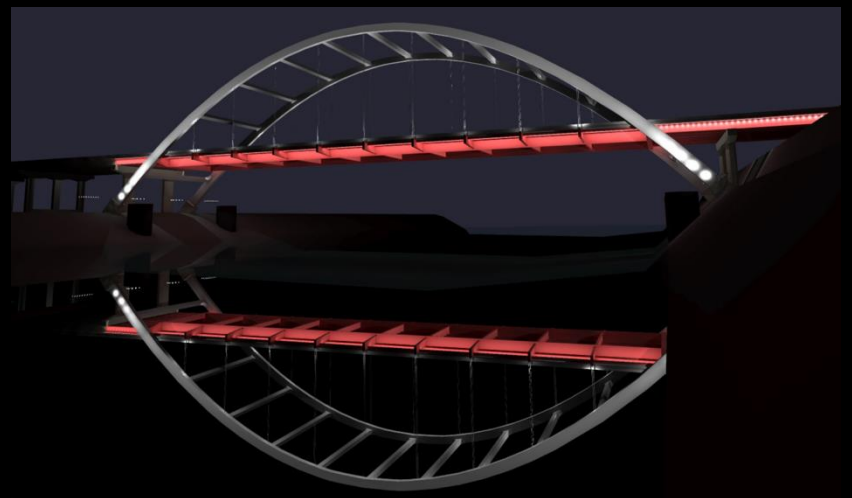
Concept Development

Top it off

Concept Development

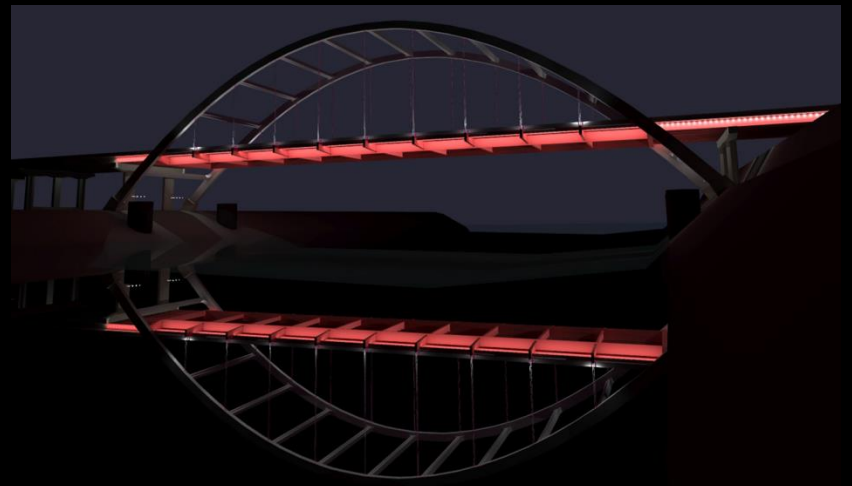
Options 1

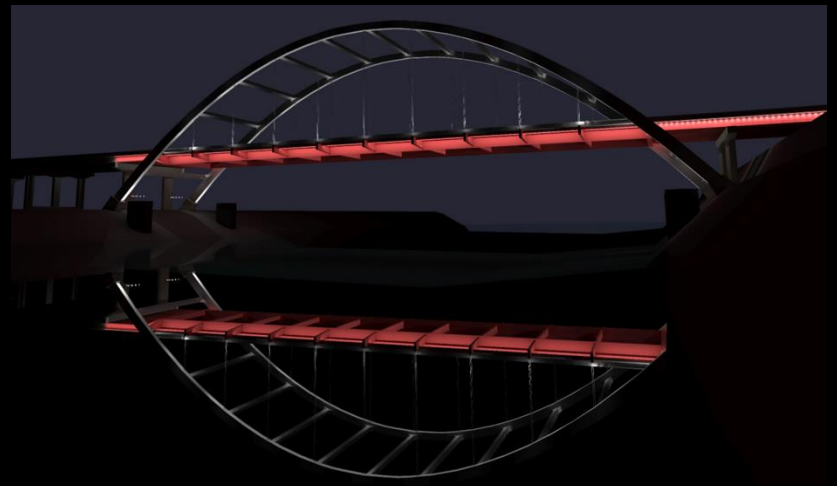




Options 2

Options 3





Options 4

Calculations - What’s the difference between option 3 and 4?

Concept Development

Options 1

Options 2

Options 3

Options 4

Use different visual tools to convey the concept

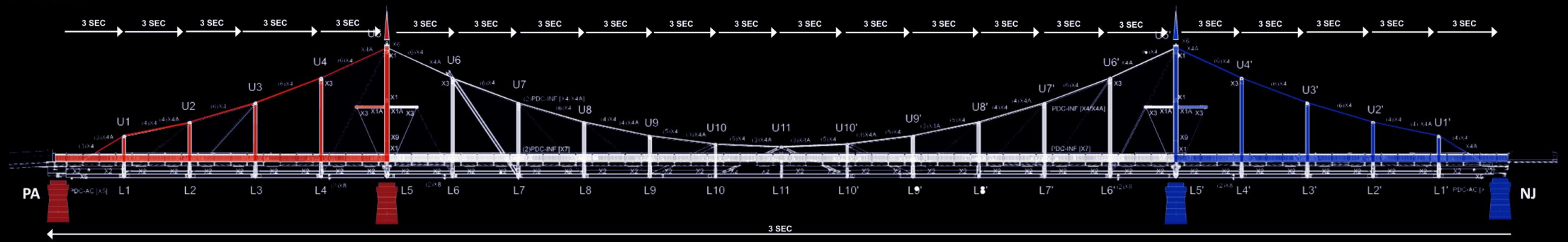
Concept Development






Color Control Scenes

Concept Development

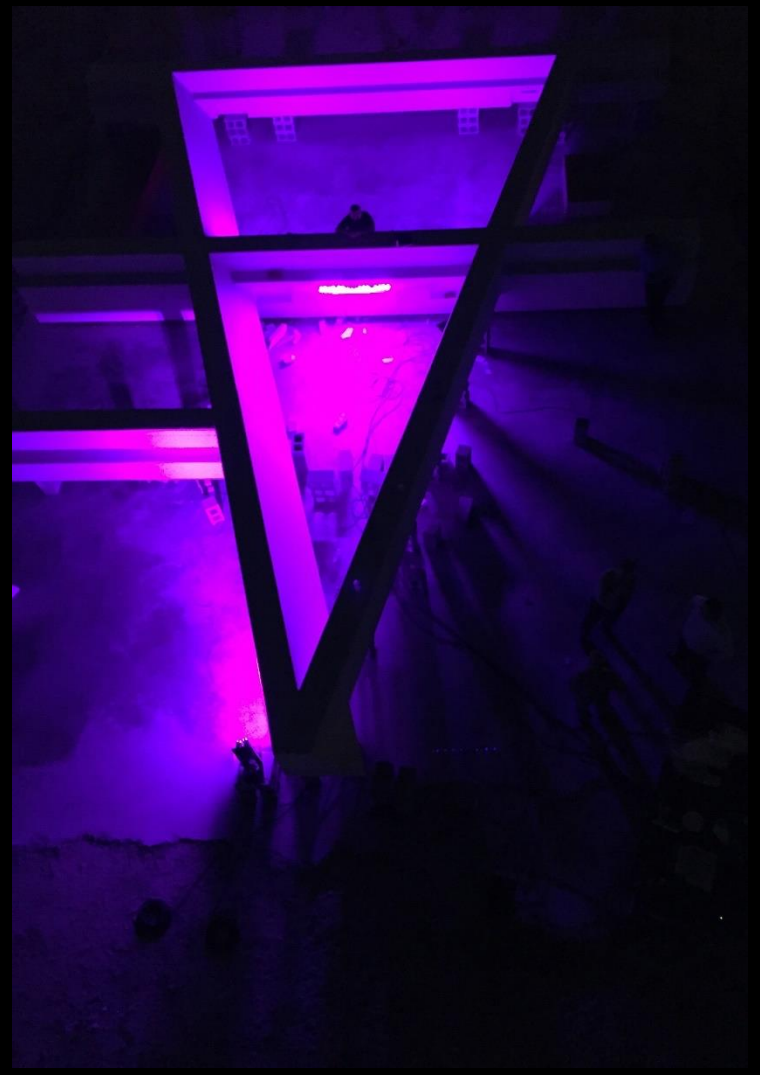


Slow

Fast

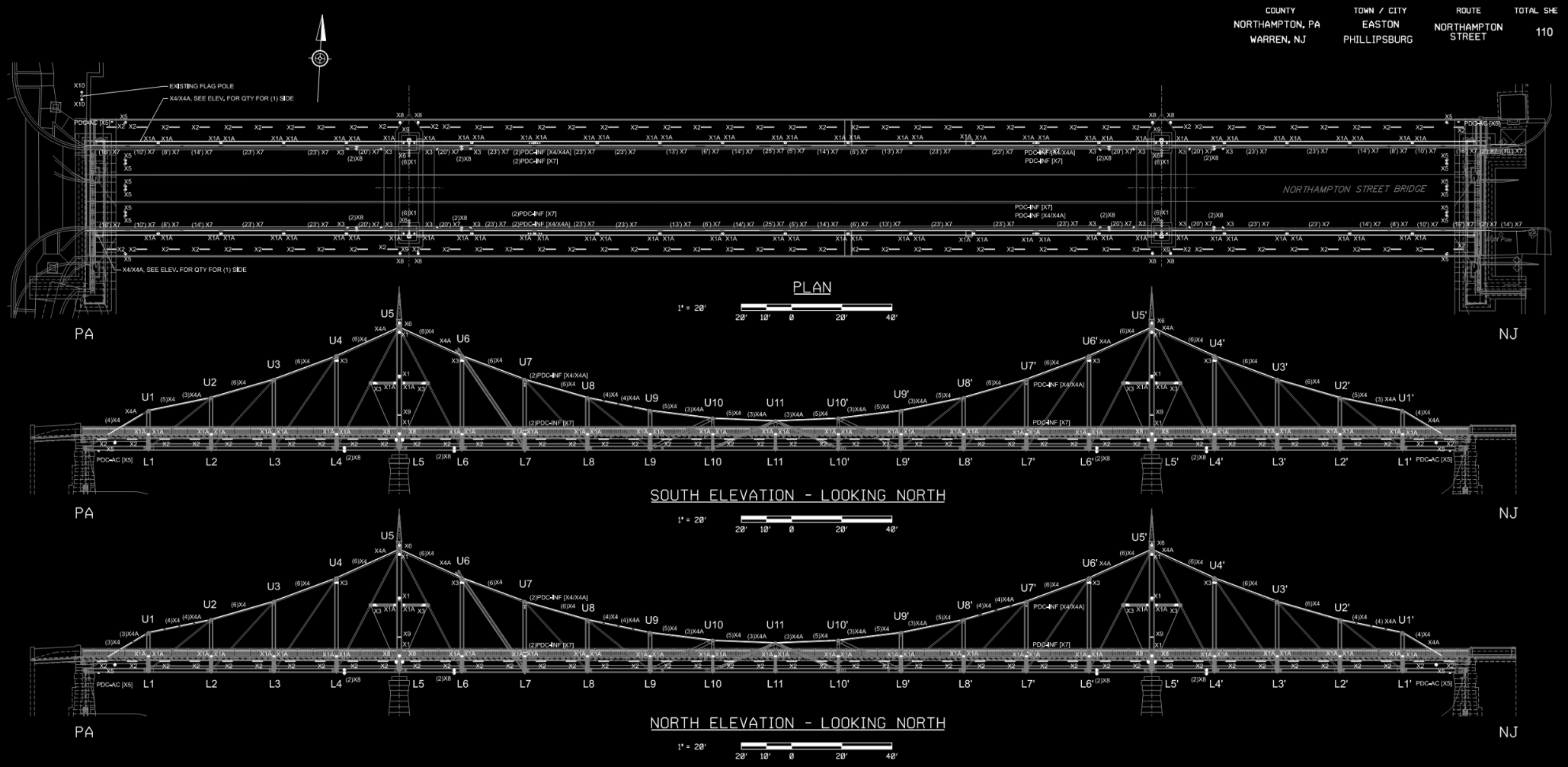
Movement

Concept Development



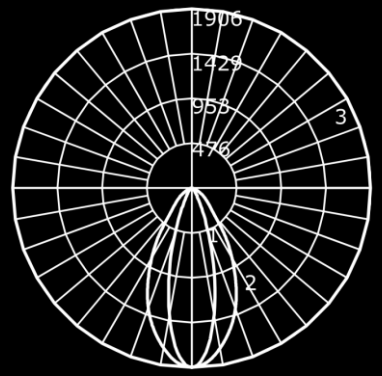
Preliminary Mockups

Design Documentation



Plans and Elevations

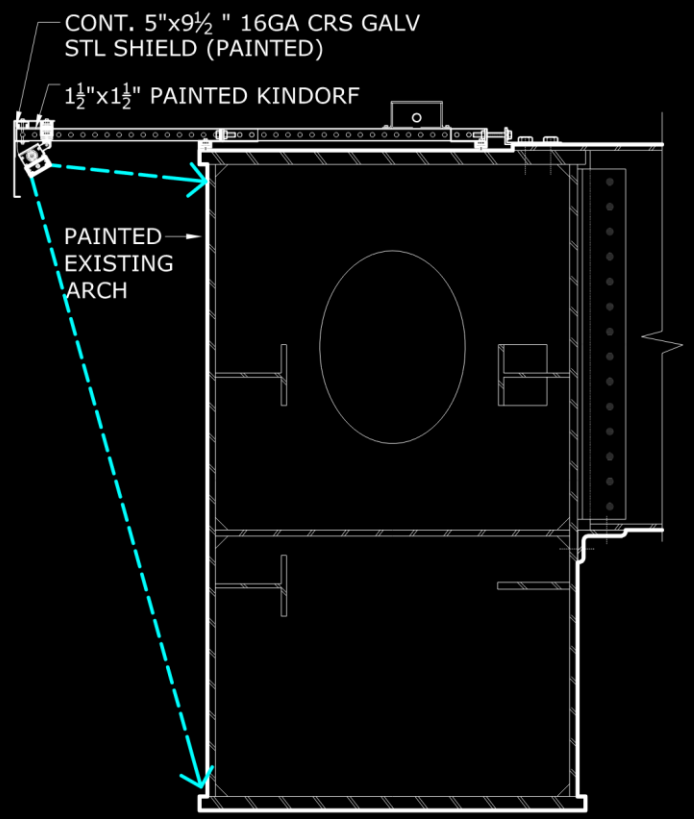
Design Documentation

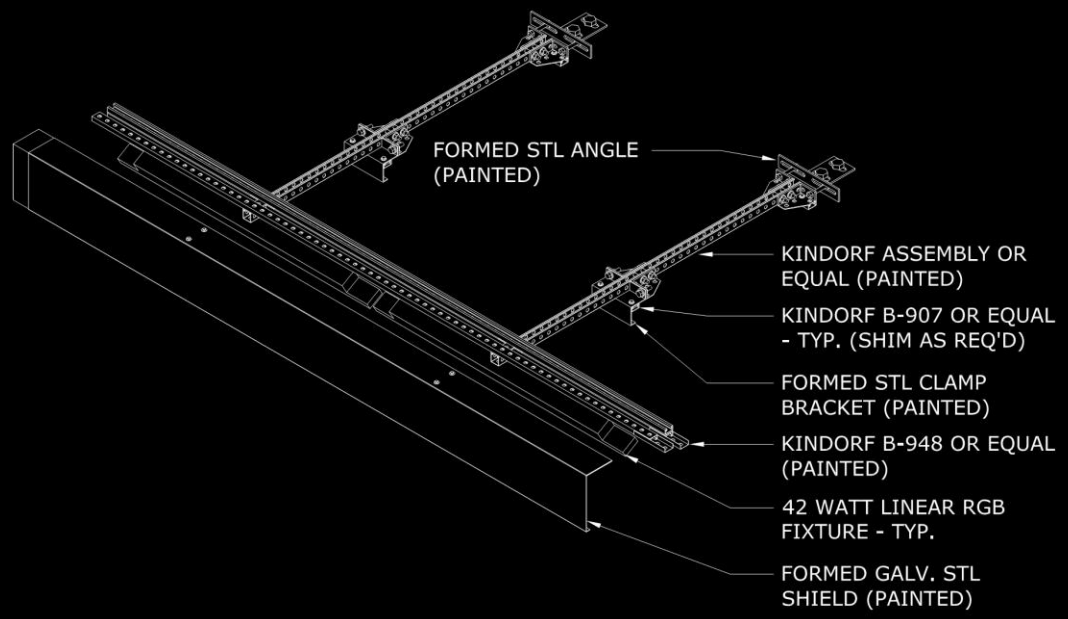


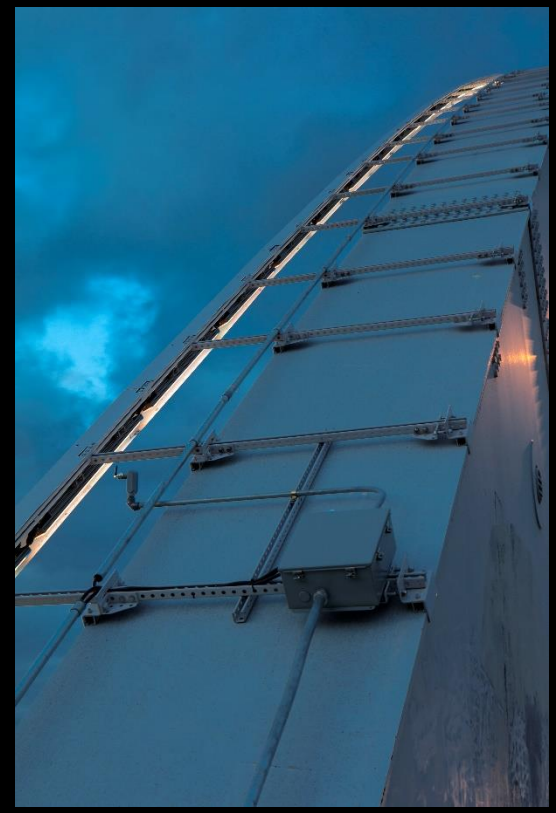
Fixture Schedule and Specifications

- Catalog numbers and 3-name specification
- Required listing and ratings
- Dimensional constraints
- Accessories
- Beam spread and light output
- Control protocol and intent

Design Documentation

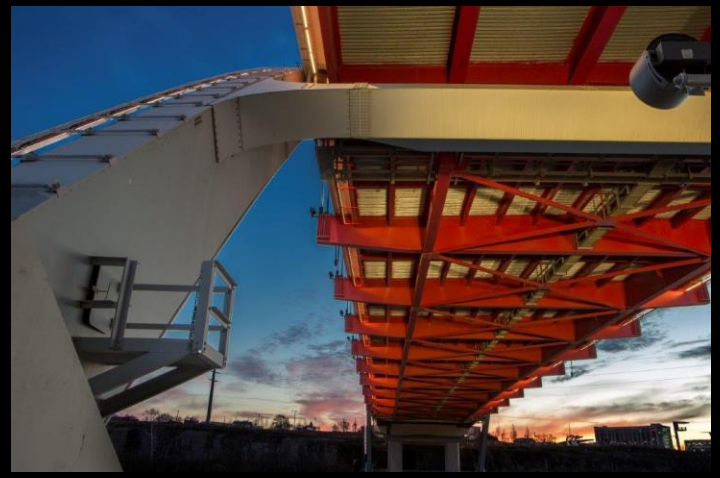


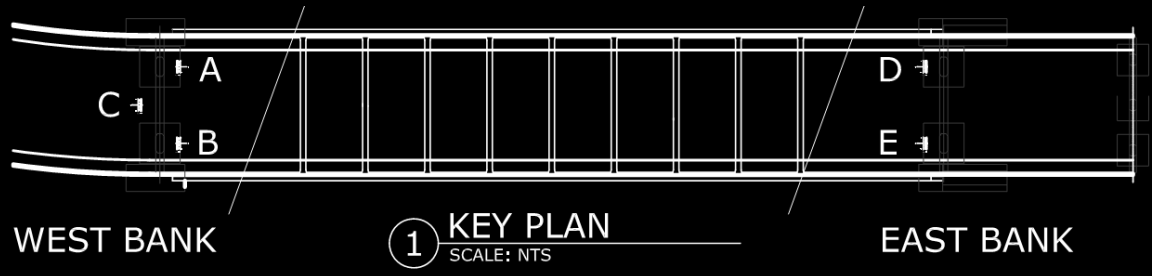




Mounting Details

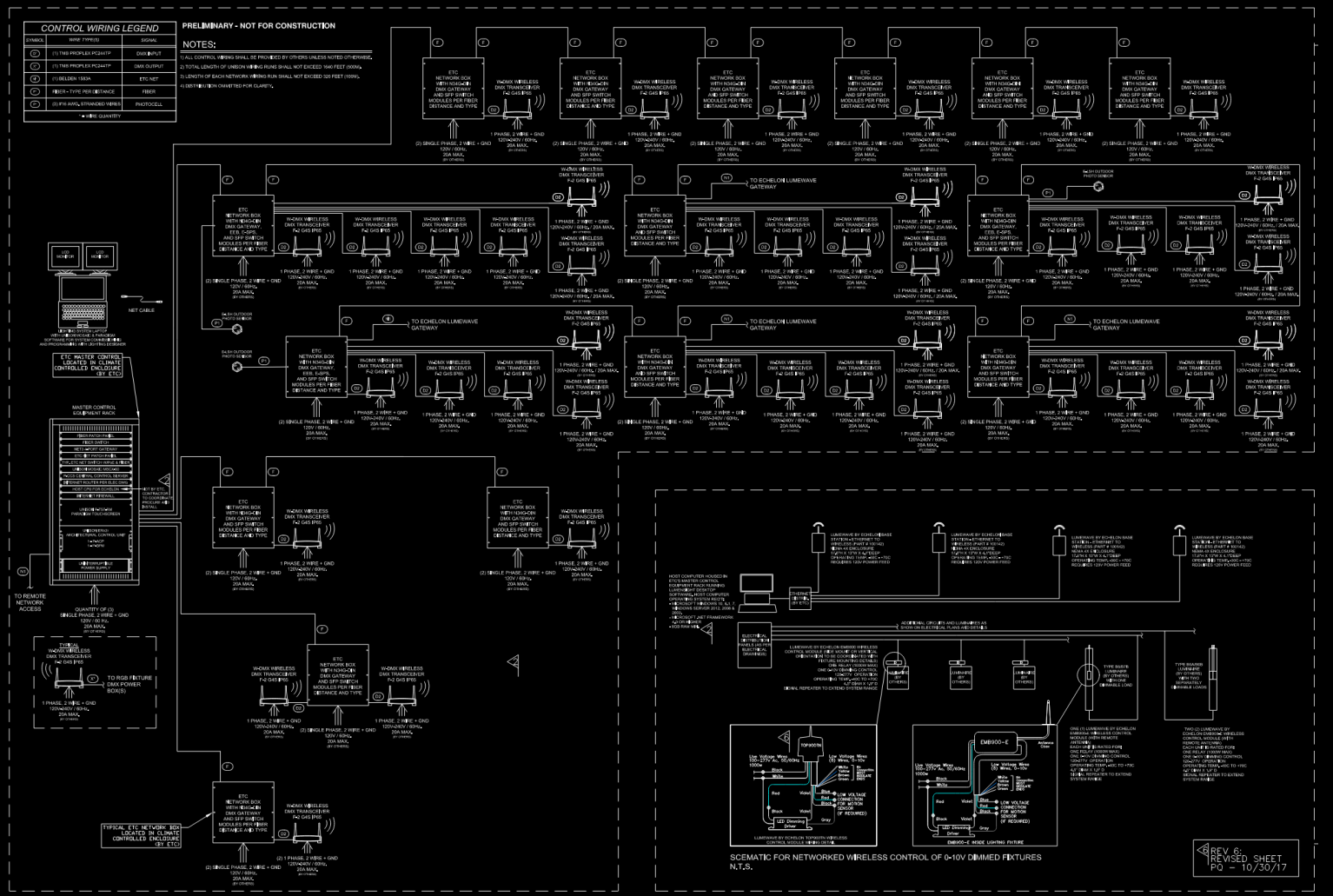
Design Documentation





Pre-Aiming Diagrams

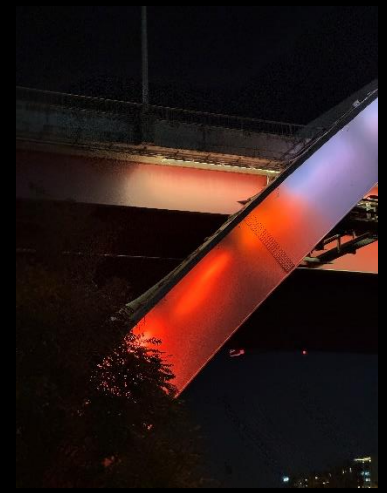
Design Documentation



Single-Line Diagram

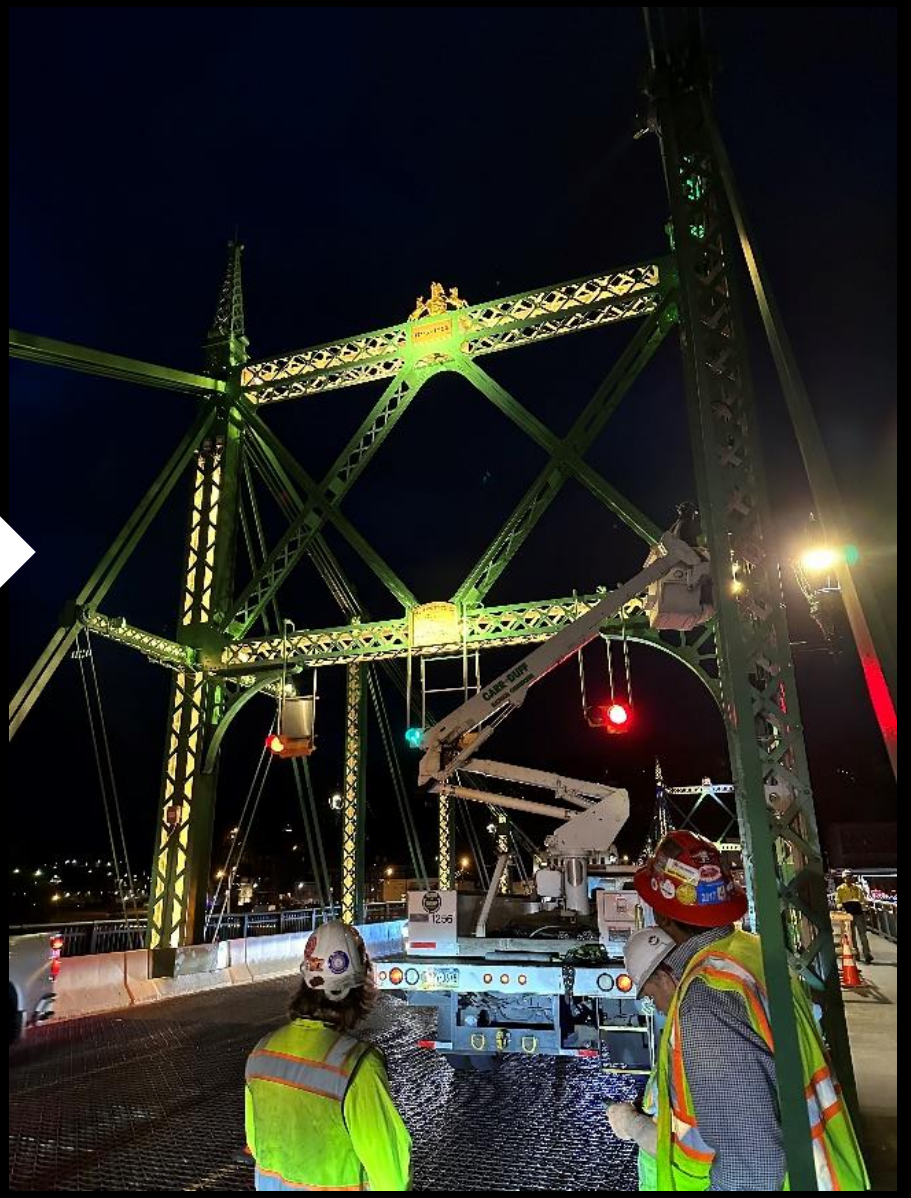
Construction Mockups

- Field conditions and tolerances
- Unforeseen circumstances
- Visual performance and verification
- Adjustments



Aiming/Adjusting

Before



After

Aiming/Adjusting

Before

After

Acknowledgements

- City of Tulsa
- Delaware River Joint Toll Bridge Commission
- George Kaiser Family Foundation
- Illuminating Engineering Society
- Nashville Department of Transportation
- New York State Thruway Authority

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ARCHITECTURAL LIGHTING DESIGN

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This concludes The American Institute of Architects Continuing Education Systems Course

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