13^{th} International Radiance Workshop

London

September 1-3, 2014

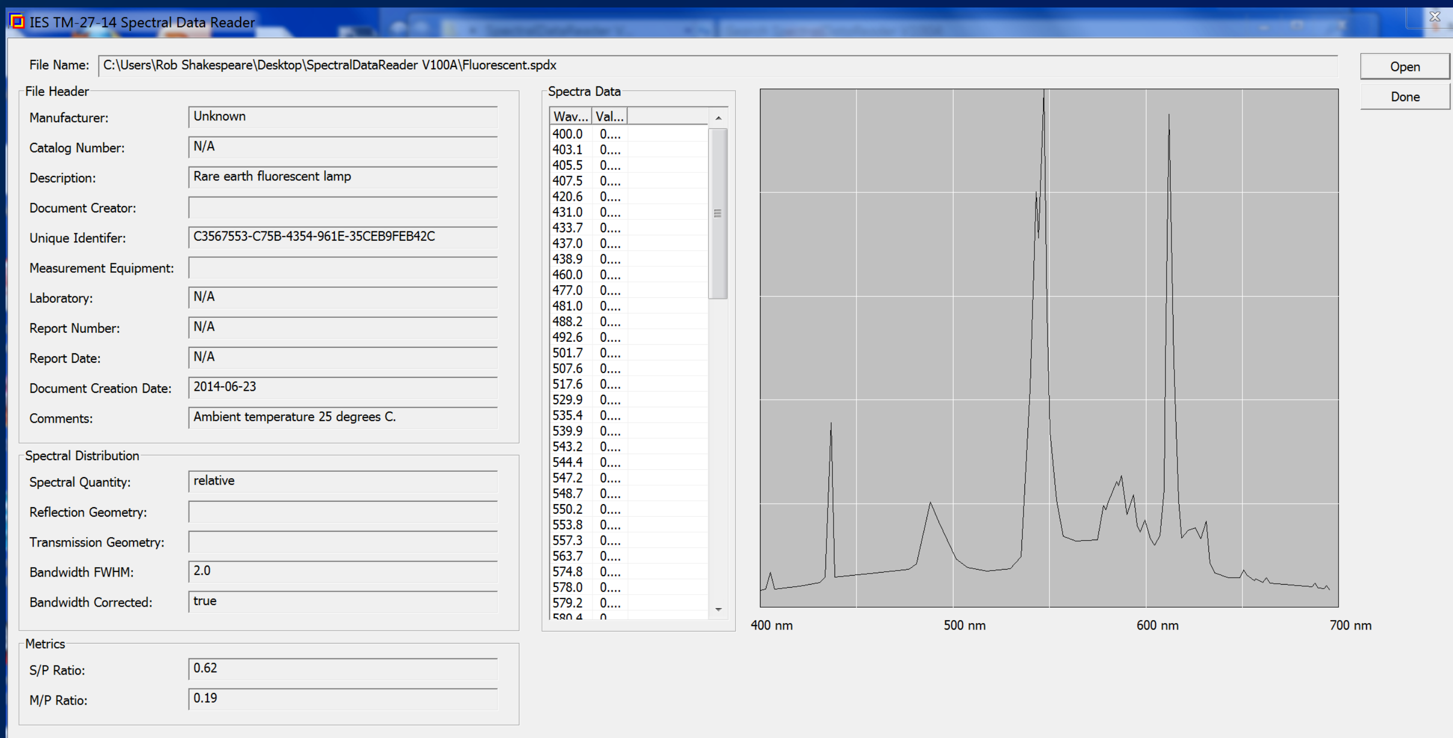
Light to look at+

by

Rob Shakespeare

IES TM-27-14

IES Standard Format for the Electronic Transfer of Spectral Data



scotopic-photopic ratio
melanopic-photopic ratio

Spectral Data Reader by Ian Ashdown

Single spectral sample format

IES TM-27-14

IES Standard Format for the Electronic Transfer of Spectral Data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		<SpectralData wavelength="405.5">0.069</SpectralData>
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		<SpectralData wavelength="420.6">0.042</SpectralData>
		<SpectralData wavelength="431.0">0.049</SpectralData>
		.
		.
```


Spectral Data sample file

“Radiometric power as a function of wavelength, typically represented as a table of wavelength and corresponding radiometric power.”

IES TM-27-14

IES Standard Format for the Electronic Transfer of Spectral Data

How do we visually model photometry which represents varying spectra?

IES TM-27-14

IES Standard Format for the Electronic Transfer of Spectral Data

NEED an updated LM-63 Standard File Format for the Electronic Transfer of Photometric Data with associated spectrum/color depiction per sample

IES TM-27-14

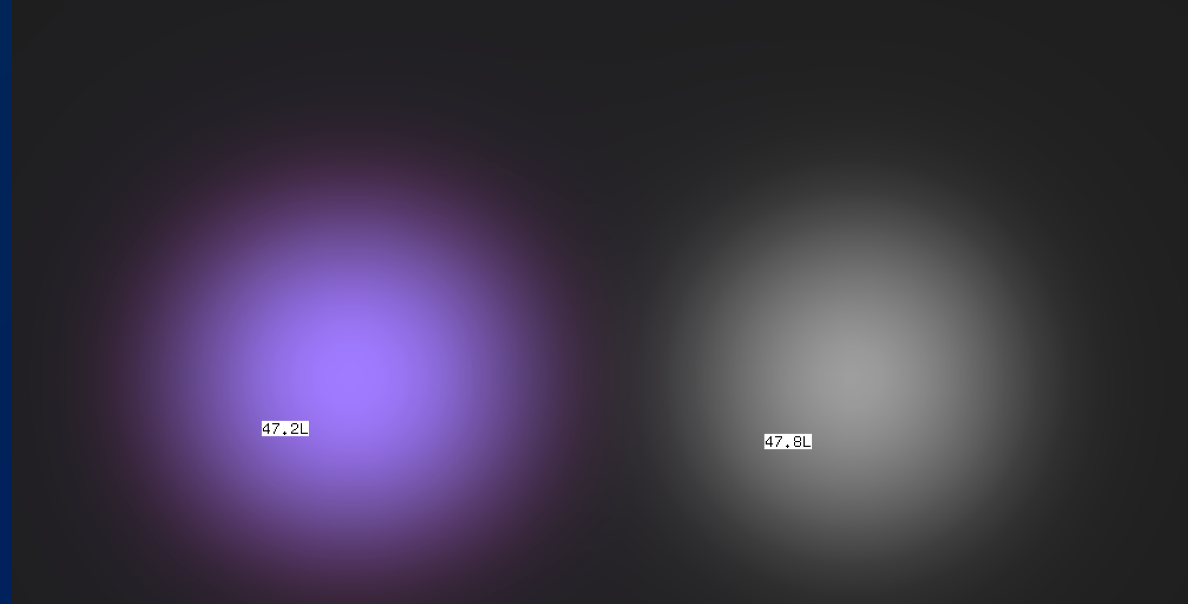
IES Standard Format for the Electronic Transfer of Spectral Data

"Generally, the document will contain a single spectral power distribution. Future formats that contain multiple spectra, including spectra as a function of angle are planned, with this document being a stepping stone in that direction, while also creating a format that still has widespread usability across industries."

… Thank you IES… AT LAST!

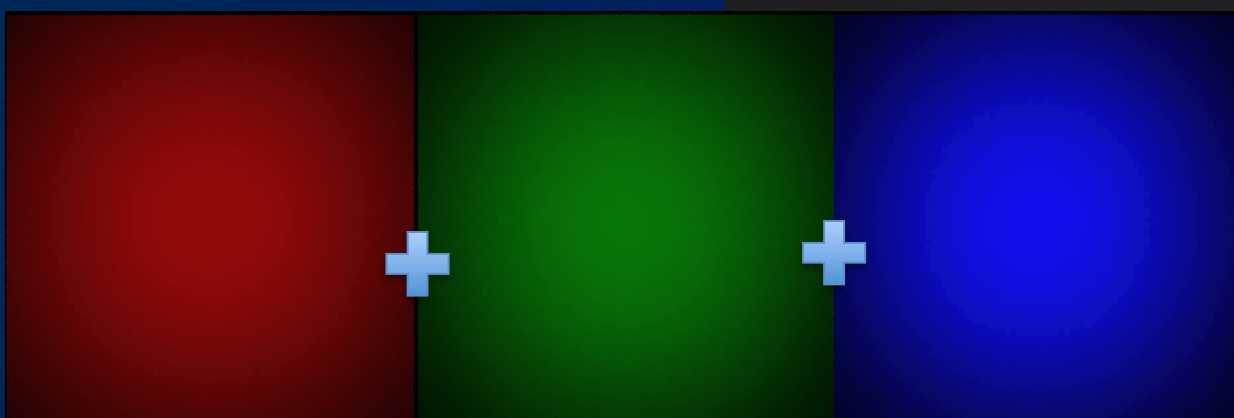
Fortunately for some of my current projects, where evaluating the appearance of the luminance patterns from LED RGB luminaires is essential, there are some solutions (Color Kinetics, Martin, LumenPulse,…)

COMPARE:



Combined R&G&B LED file 100%
More similar to obeserved

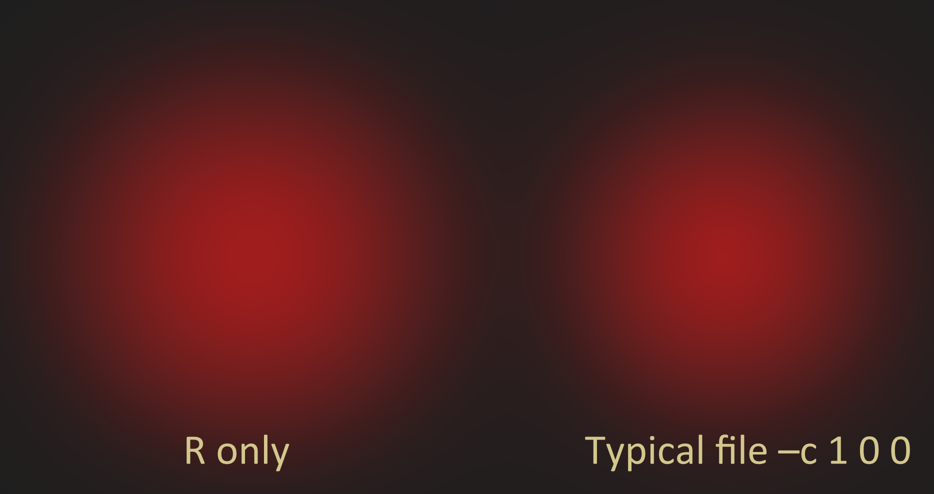
TYPICAL
Single scan RGB LED file 100%



Combining color component .ies photometric files

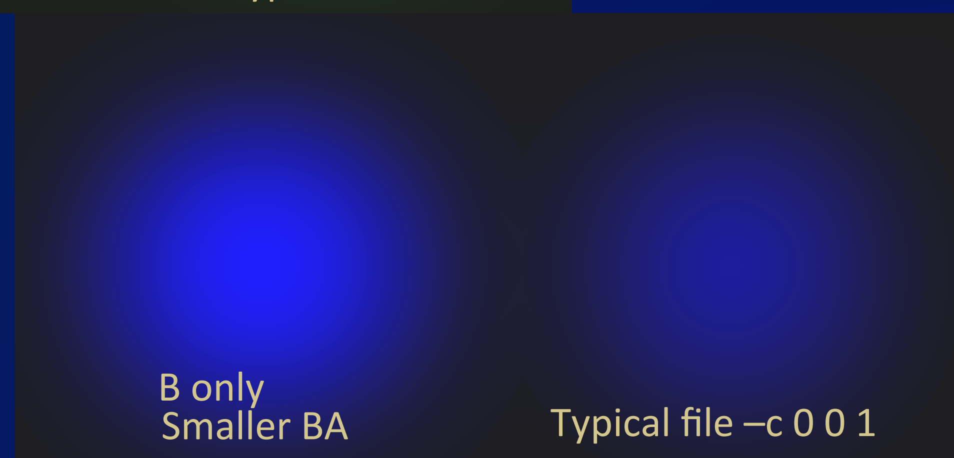
NOT PERFECT but a better representation

Different color LEDs can have different distributions



Wider FA
(more similar to observed)

Individual R&G&B photometric files left
Typical single scan photometric files right



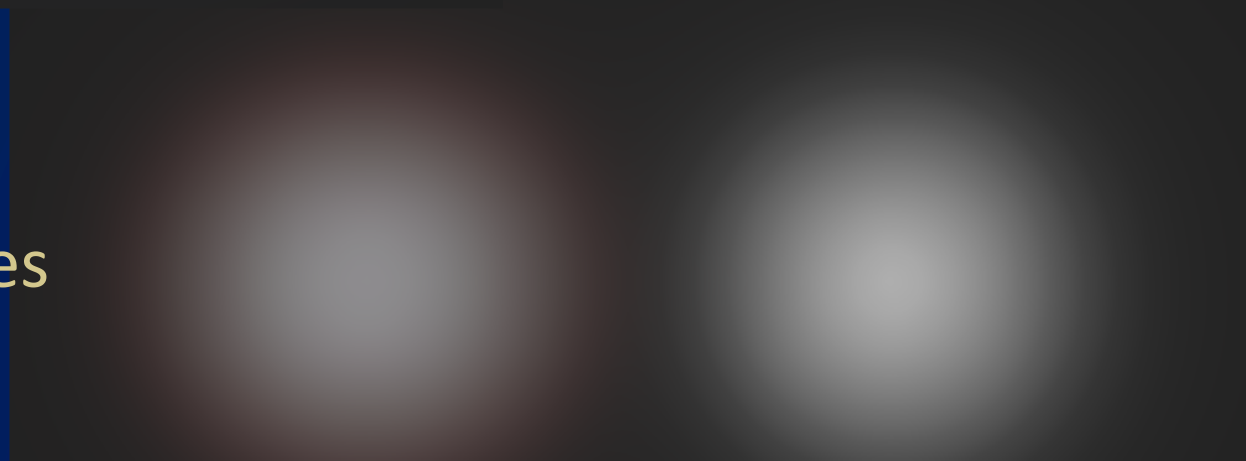
R+G+B 1 1 1

More similar to observed

XENON –c 1 1 1

Significant mix changes to achieve white in simulation

(& in the field!)

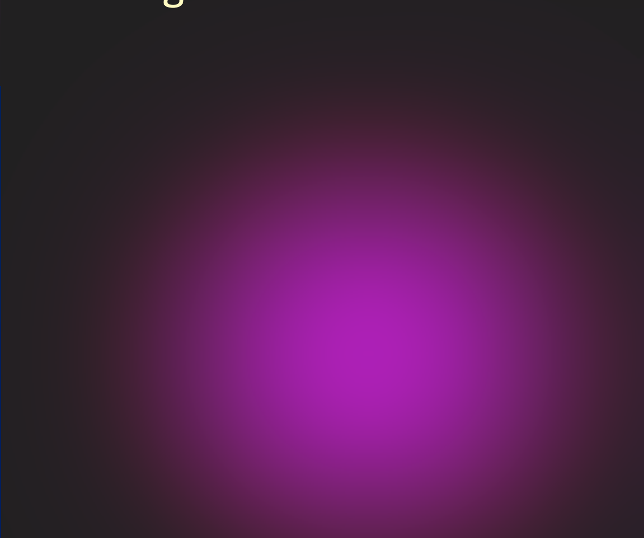


R+G+B .6 1 .2

XENON –c 1 1 1

Magenta –c 1 .01 1

Magenta –c 1 .01 1



Magenta –c 1 .01 .45

Magenta –c 1 .01 1

Amber –c 1 1 .01

Amber –c 1 1 .01

Amber –c 1 1 .01

Amber –c 1 .55 .01

Process:

Generate individual .dat files:

```
!ies2rad -dm -t default   -o r        COLORREACHGEN2_RED.IES
!ies2rad -dm -t default   -o g        COLORREACHGEN2_GREEN.IES
!ies2rad -dm -t default   -o b        COLORREACHGEN2_BLUE.IES
```

Process:

Generate individual .dat files:

```
!ies2rad -dm -t default   -o r        COLORREACHGEN2_RED.IES
!ies2rad -dm -t default   -o g        COLORREACHGEN2_GREEN.IES
!ies2rad -dm -t default   -o b        COLORREACHGEN2_BLUE.IES
```

Construct a .rad proxy file to combine r.dat g.dat & b.dat

Typical ies2rad generates a .rad file containing:

void brightdata w_dist ....

Process:

Generate individual .dat files:

```
!ies2rad -dm -t default   -o r        COLORREACHGEN2_RED.IES
!ies2rad -dm -t default   -o g        COLORREACHGEN2_GREEN.IES
!ies2rad -dm -t default   -o b        COLORREACHGEN2_BLUE.IES
```

Construct a .rad proxy file to combine r.dat g.dat & b.dat

Typical ies2rad generates a .rad file containing:

```
void brightdata w_dist ....
```

Change to:

```
void colordata rgb_dist
9 flatcorr flatcorr flatcorr  r.dat  g.dat  b.dat   source.cal src_phi4 src_theta
0
1 4.46064
```

Process:

Now scale *light* lumen values 1 1 1 to R G B:

```
void colordata rgb_dist
9 flatcorr flatcorr flatcorr  r.dat  g.dat  b.dat   source.cal src_phi4 src_theta
0
1 4.46064

rgb_dist light rgb_light
0
0
3   3.772   1.492   15.435     # 100% output
```

Process:

Now scale *light* lumen values 1 1 1 to R G B:

```
void colordata rgb_dist
9 flatcorr flatcorr flatcorr  r.dat  g.dat  b.dat   source.cal src_phi4 src_theta
0
1 4.46064

rgb_dist light rgb_light
0
0
3   3.772   1.492   15.435     # 100% output
```

Generate output color by varying the R G B light values

```
3.773     .01      15.435    # = 100% Magenta
1.867     .01       7.718      # = 50% Magenta
```

Process:

Awkward :	3.773	.01	15.435	# = 100% Magenta
	1.867	.01	7.718	# = 50% Magenta

Process:

Awkward : 3.773 .01 15.435 # = 100% Magenta

1.867 .01 7.718 # = 50% Magenta

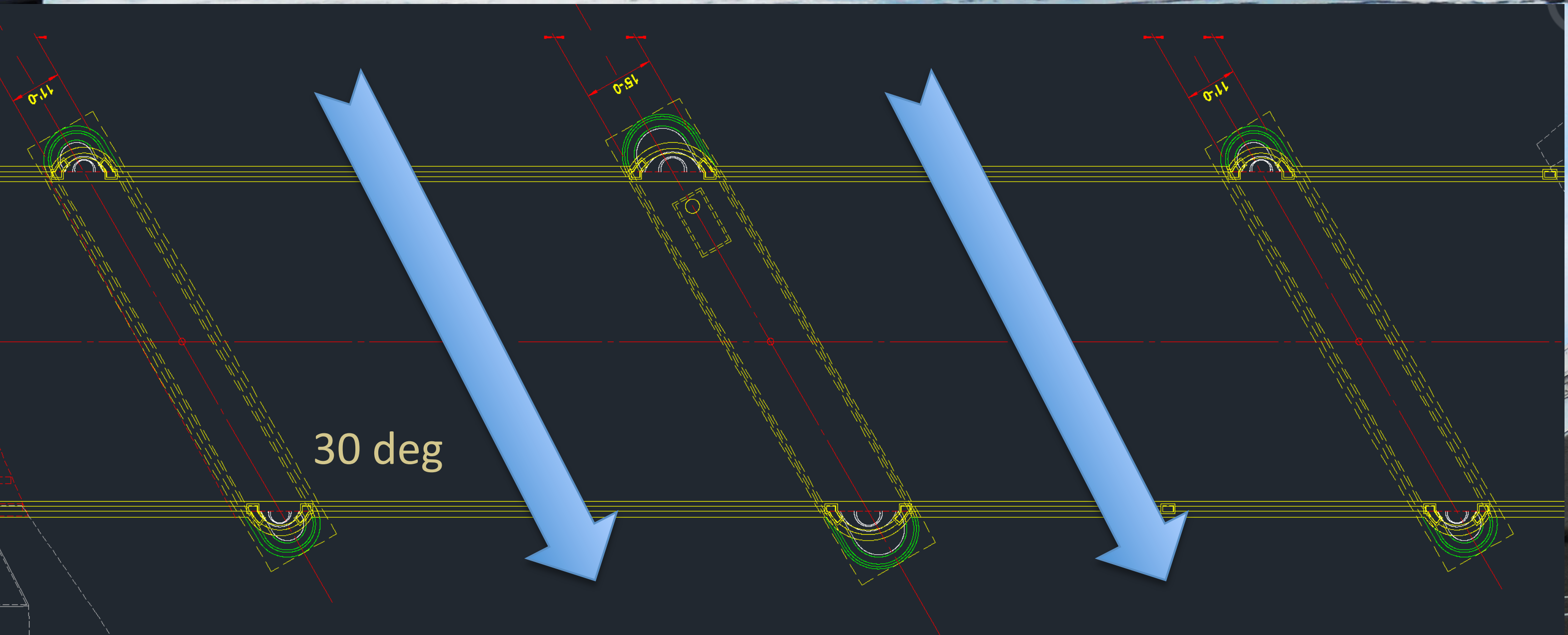
Insert a function to scale between 0 >1 . Much easier to use!

```
void colorfunc rgb_mult
4   .5   .01   .5   .
0
0

rgb_mult  colordata rgb_dist
9 flatcorr flatcorr flatcorr  r.dat  g.dat  b.dat   source.cal src_phi4 src_theta
0
1 4.46064
```

Now to an application

South Bend Indiana: Installation Study

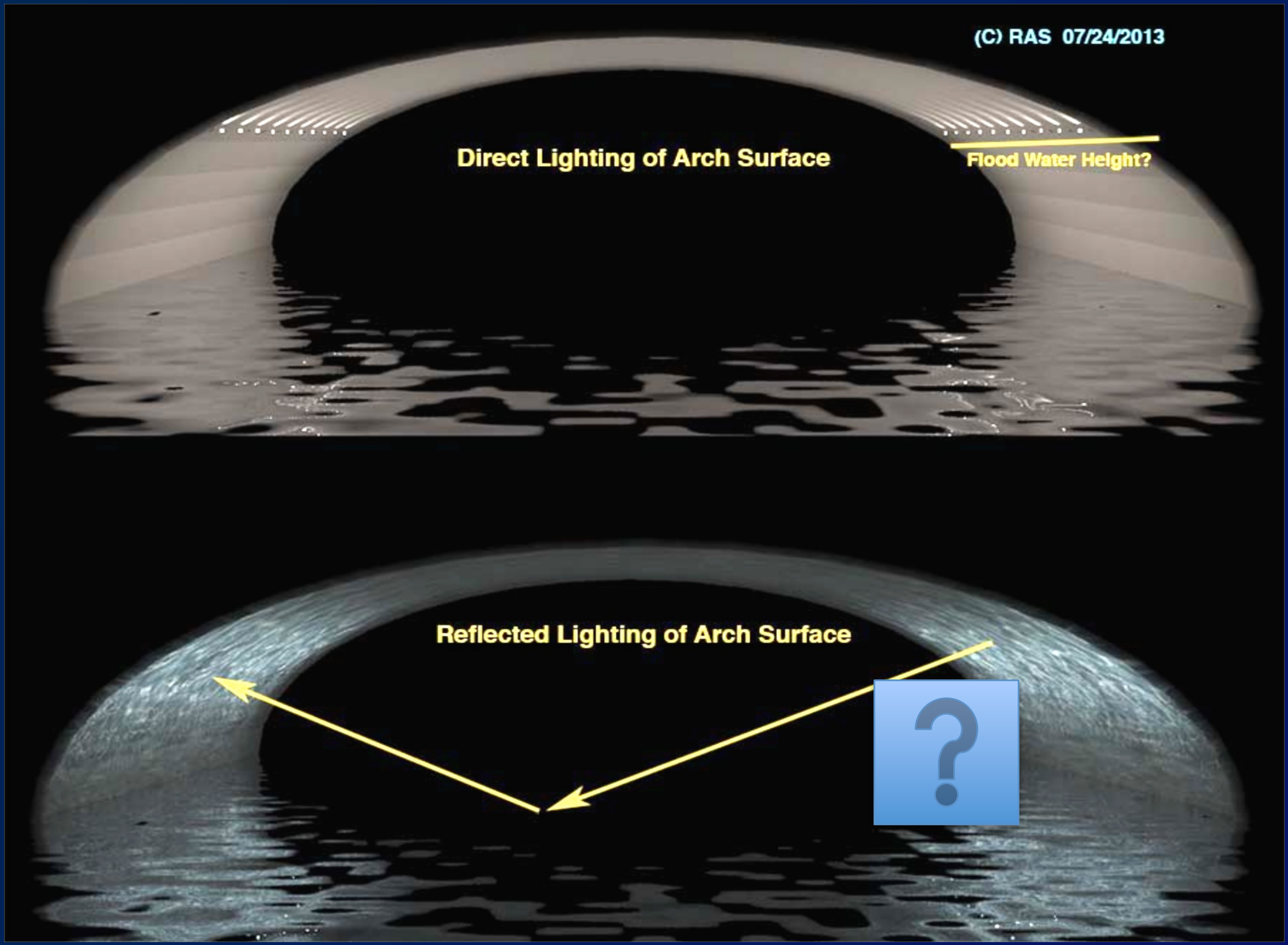


Create an elliptical bridge surface for concept study:

```
!gensurf grey span2-3 "95.26/2*sin(PI*(t-.5))" '150*s'  "28.5/2*cos(PI*(t-.5))" 1 50 | xform -rz 30
```

Create an elliptical bridge surface for concept study:

!gensurf grey span2-3 "95.26/2*sin(PI*(t-.5))" '150*s' "28.5/2*cos(PI*(t-.5))" 1 50 | xform -rz 30

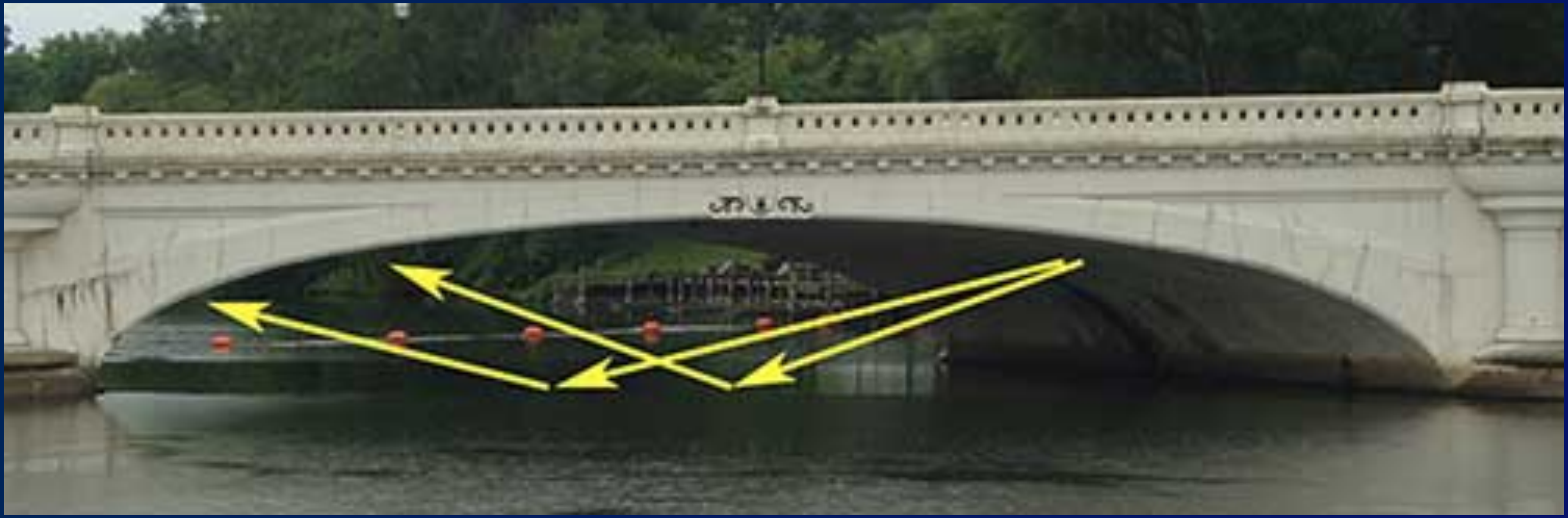


Reflected water pattern mockup:

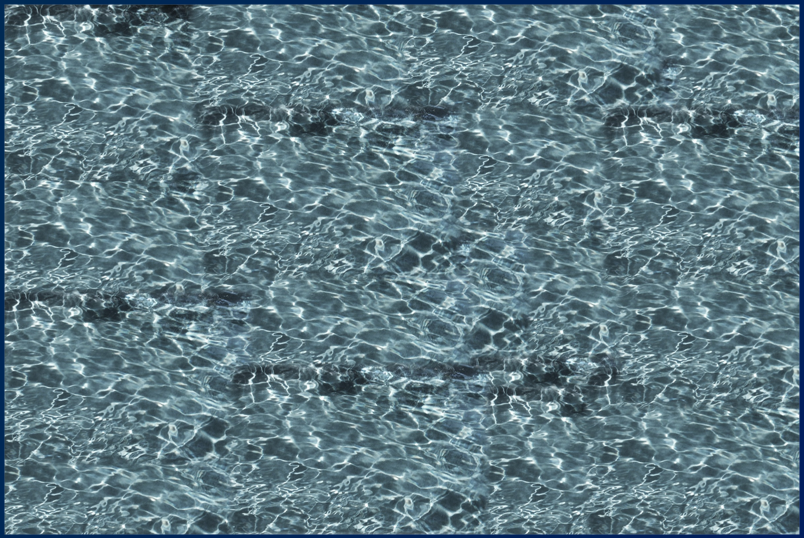
Fresnel calculation

75 degree incident angle
Refractive Index 1.333

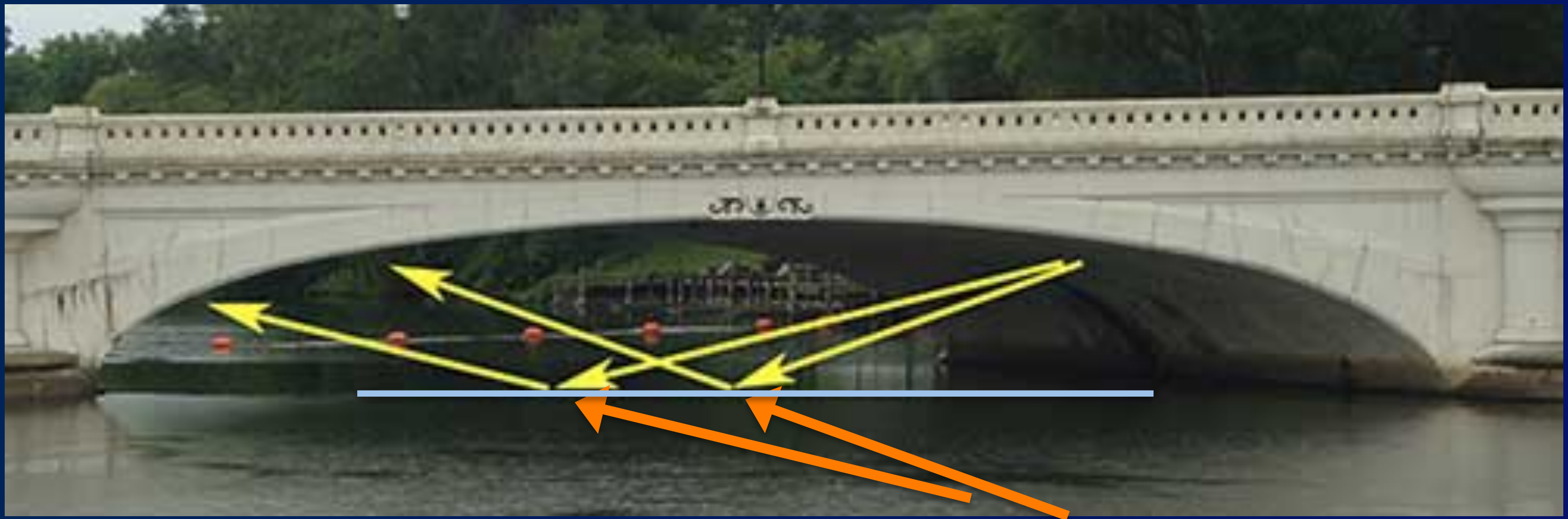
Reflectance ~ 20%



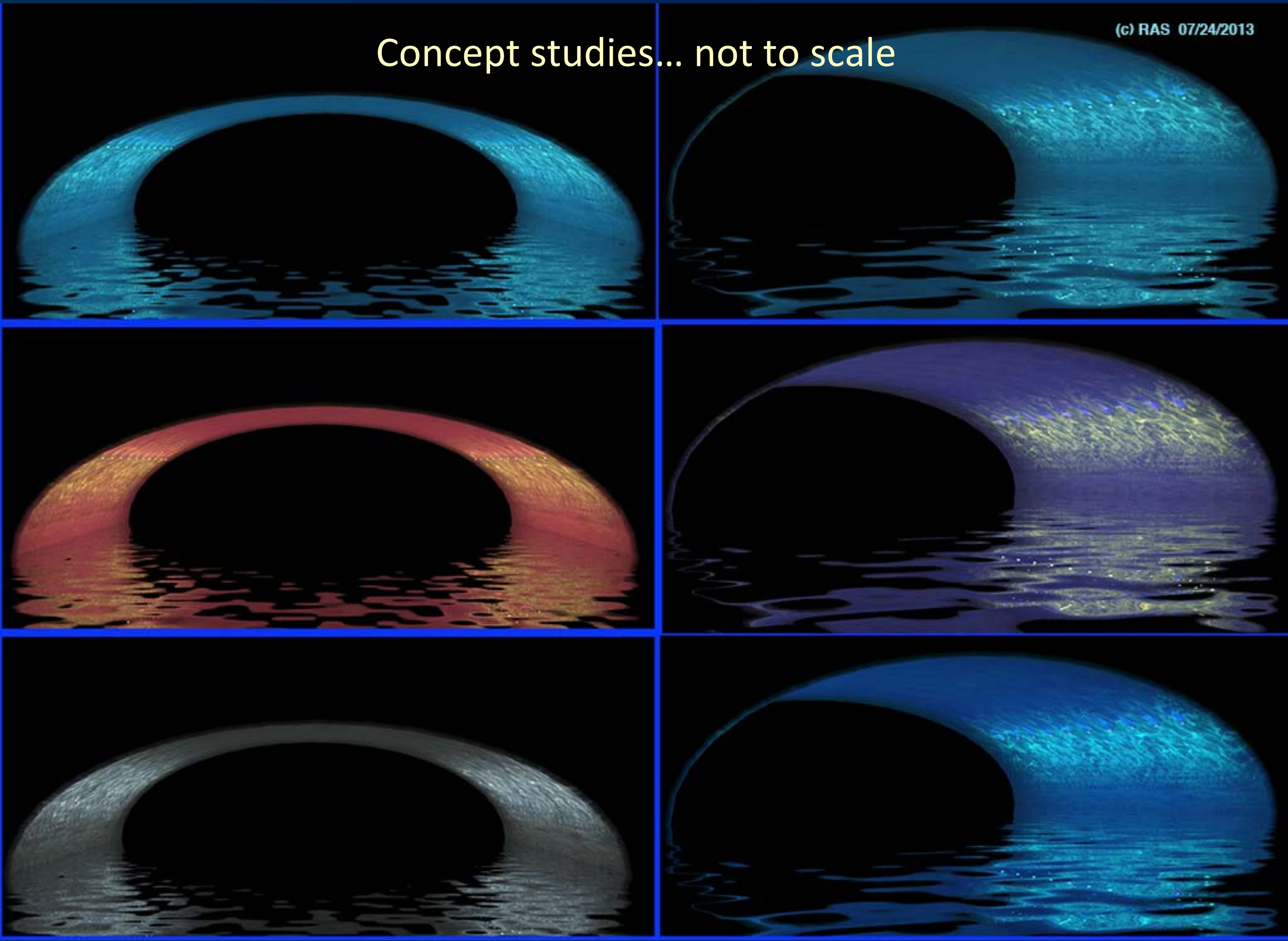
Reflected water pattern mockup:



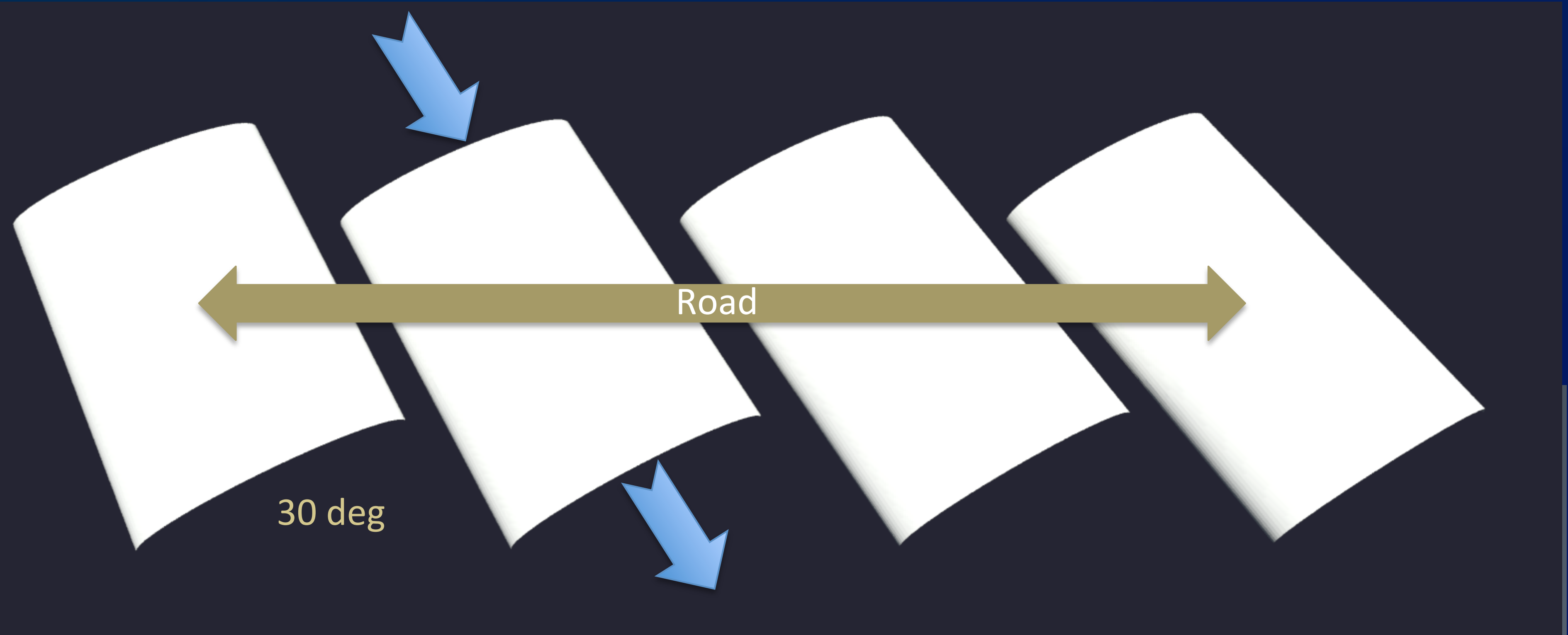
Luminaires located underwater
Trial and error to approximate
20% intensity of reflected caustics on bridge surface

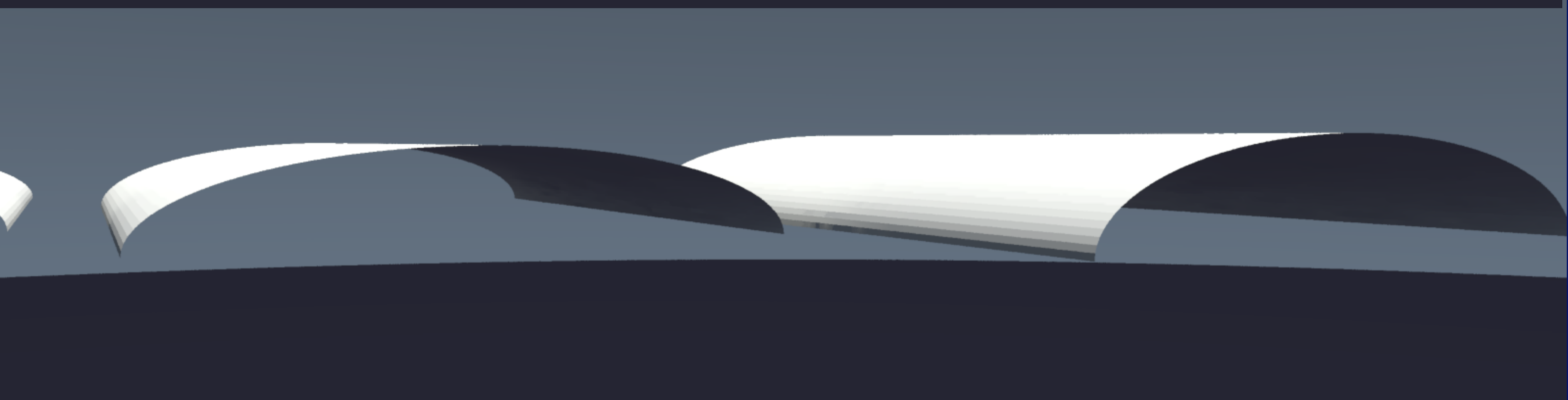


Concept studies… not to scale

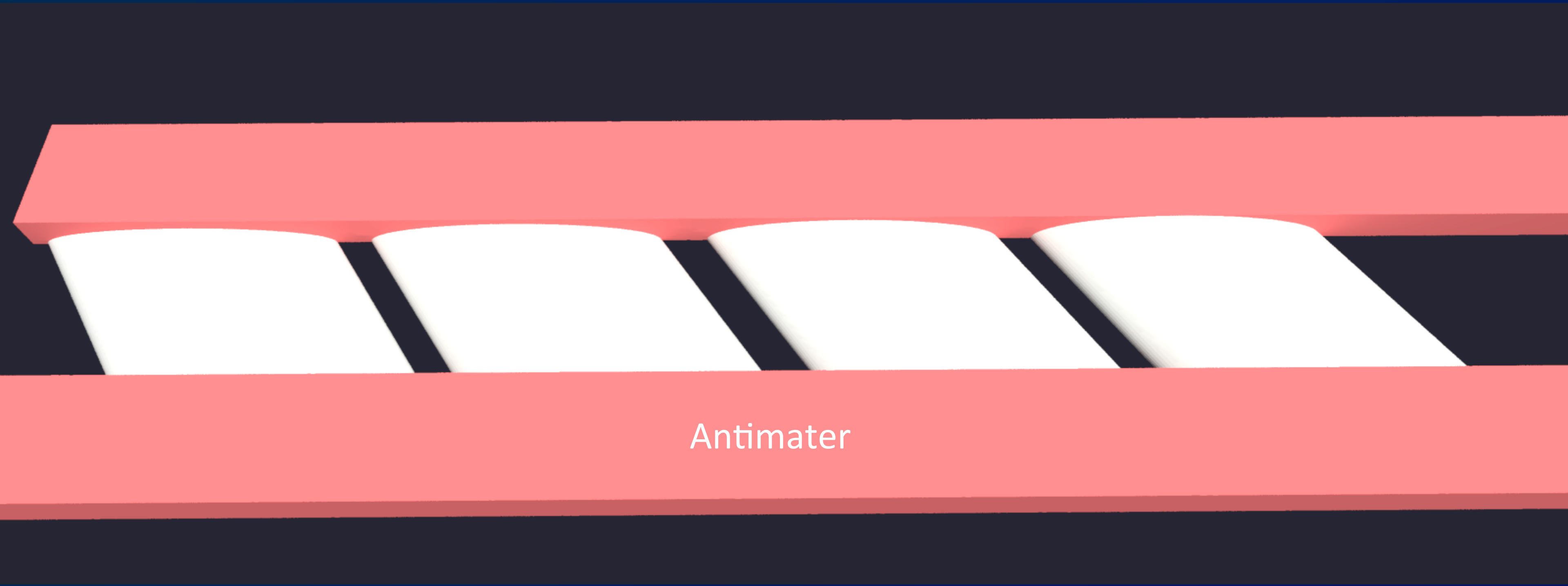


Modeling the bridge… Radiance only



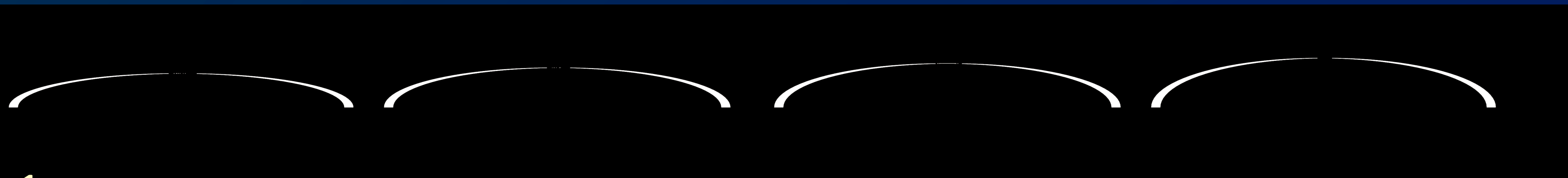


Modeling the bridge… arches

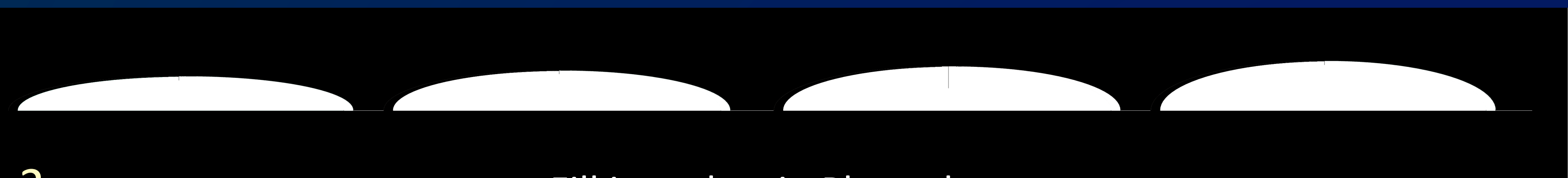


Modeling the bridge… arches

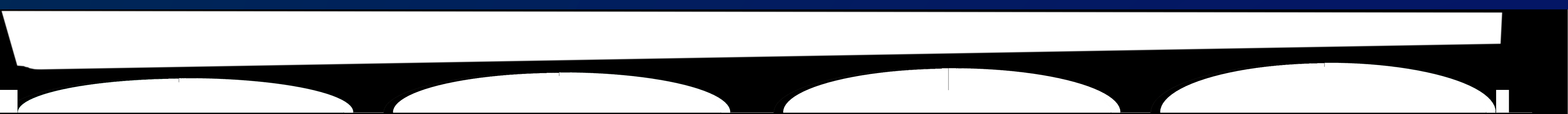
Modeling the bridge... facade



1 Parallel view with narrow clipping planes



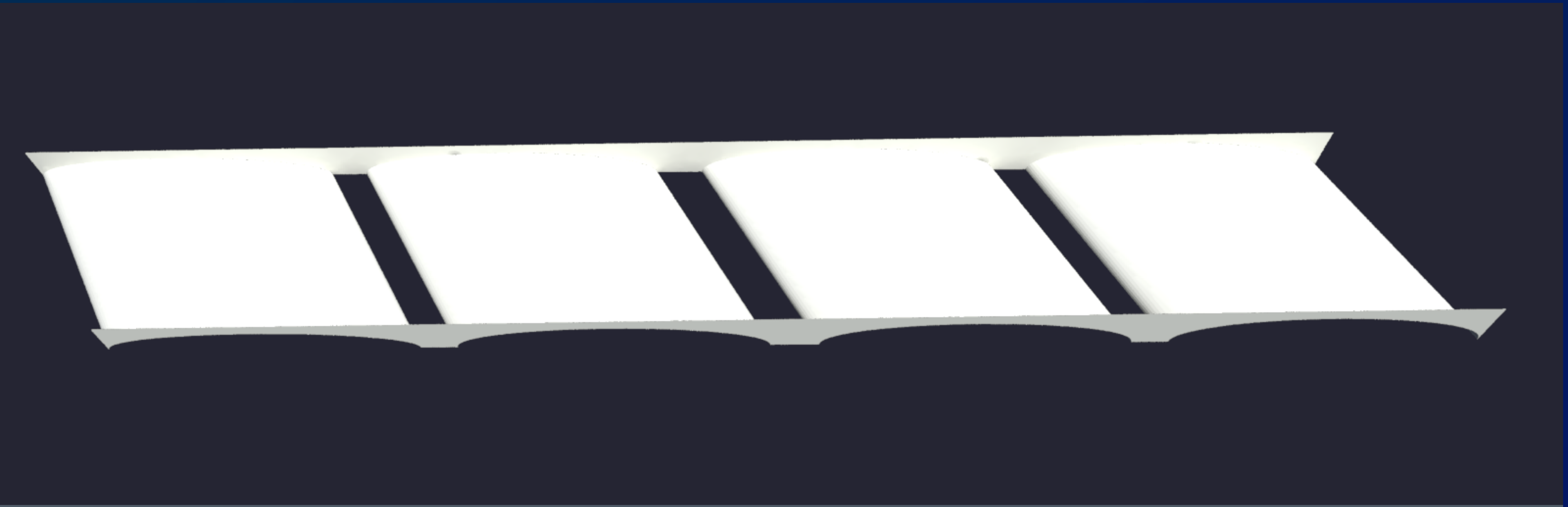
2 Fill in arches in Photoshop

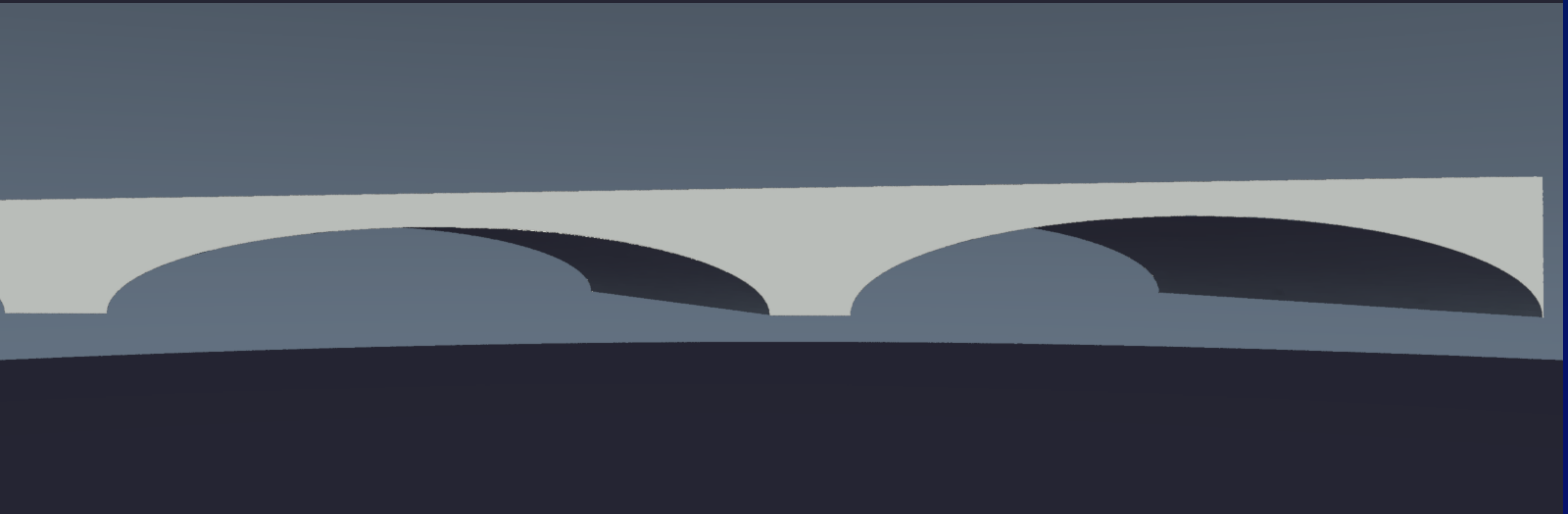


3 Add road slope in Photoshop

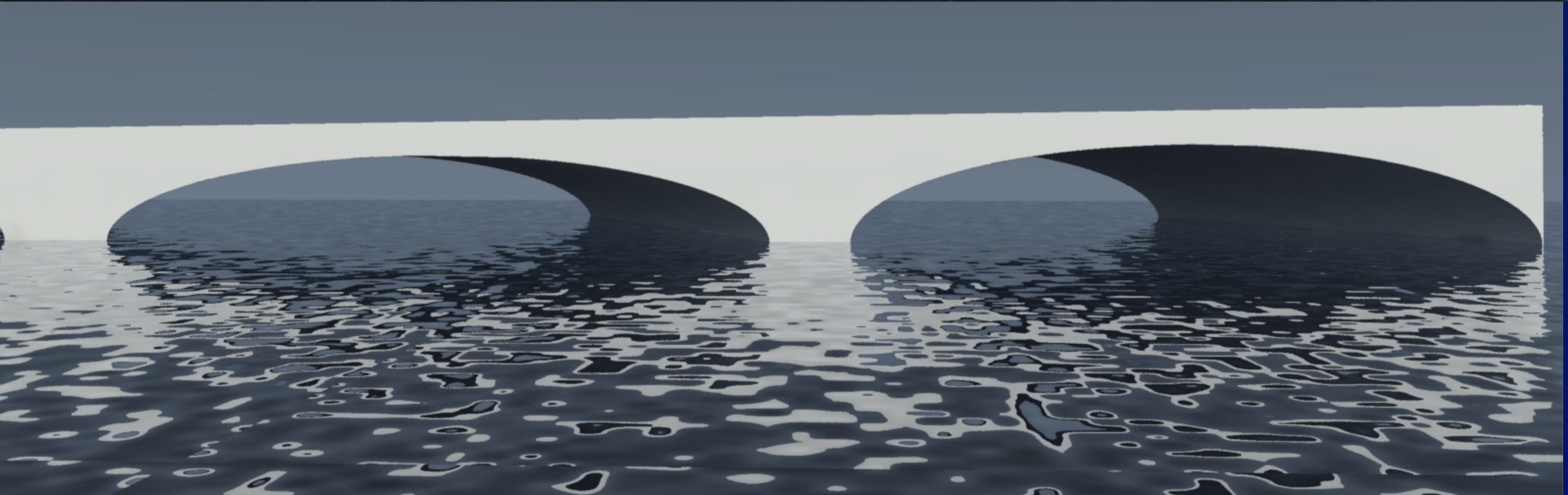
4 Invert image and clip out black in Radiance

Modeling the bridge… facade

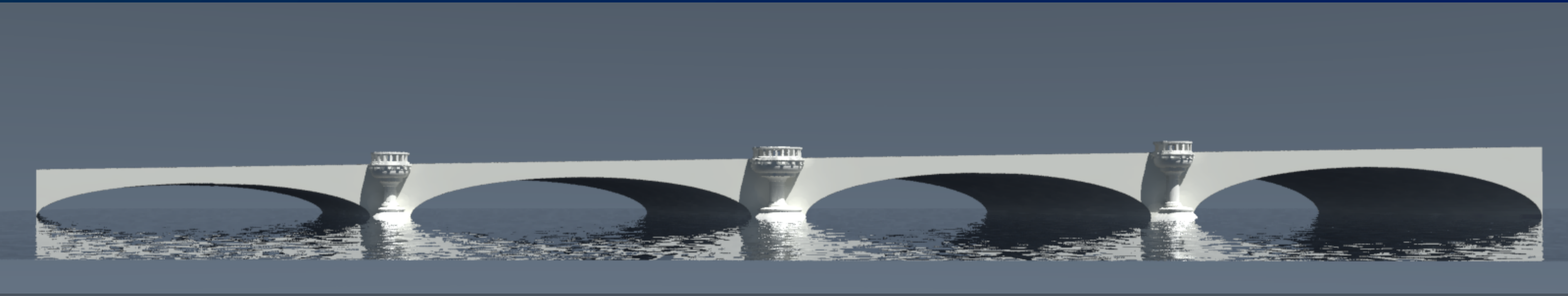


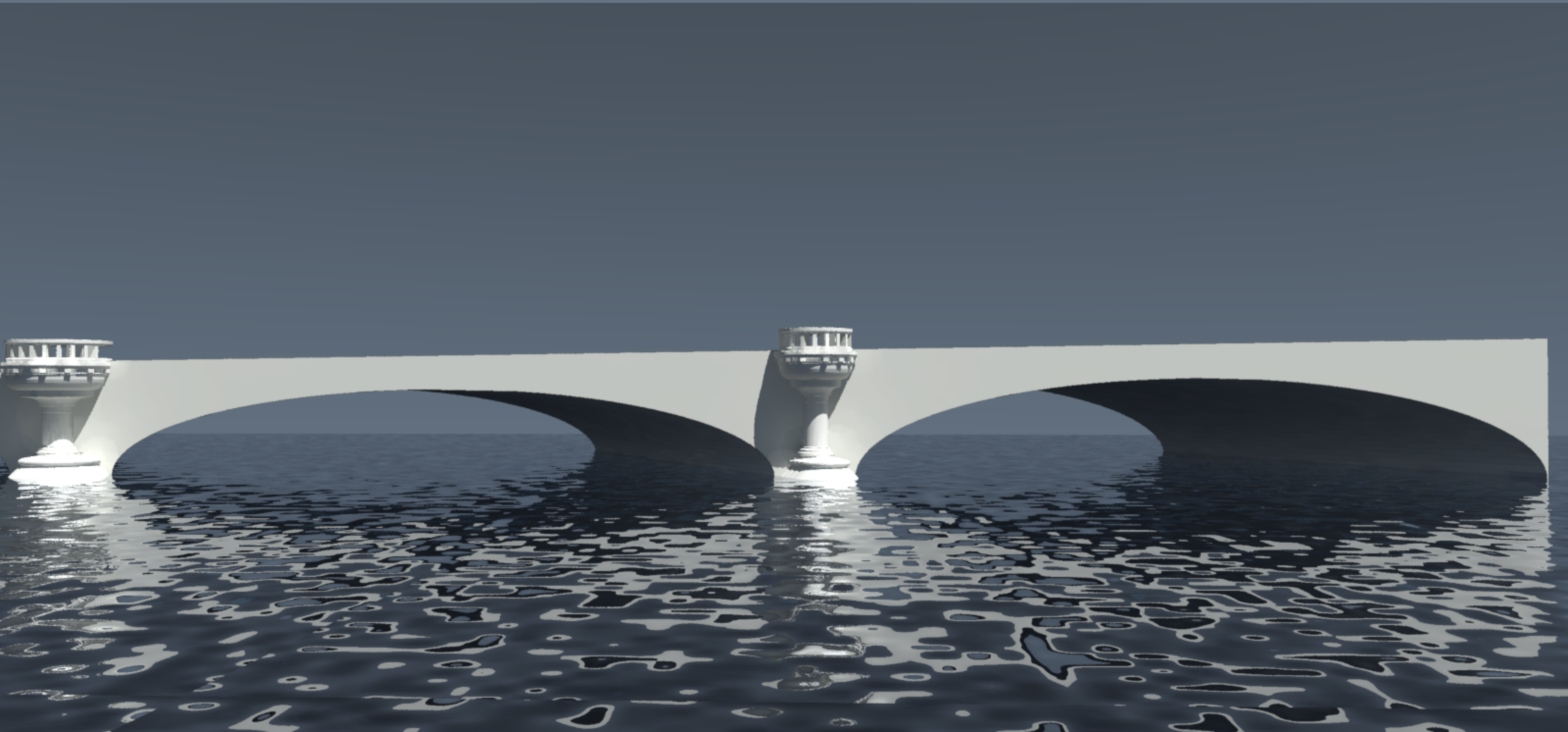


Modeling the bridge… water

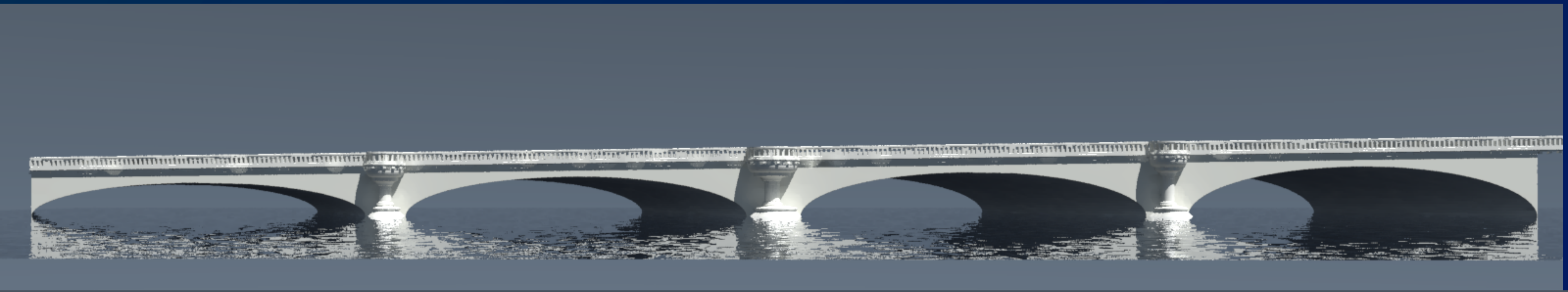


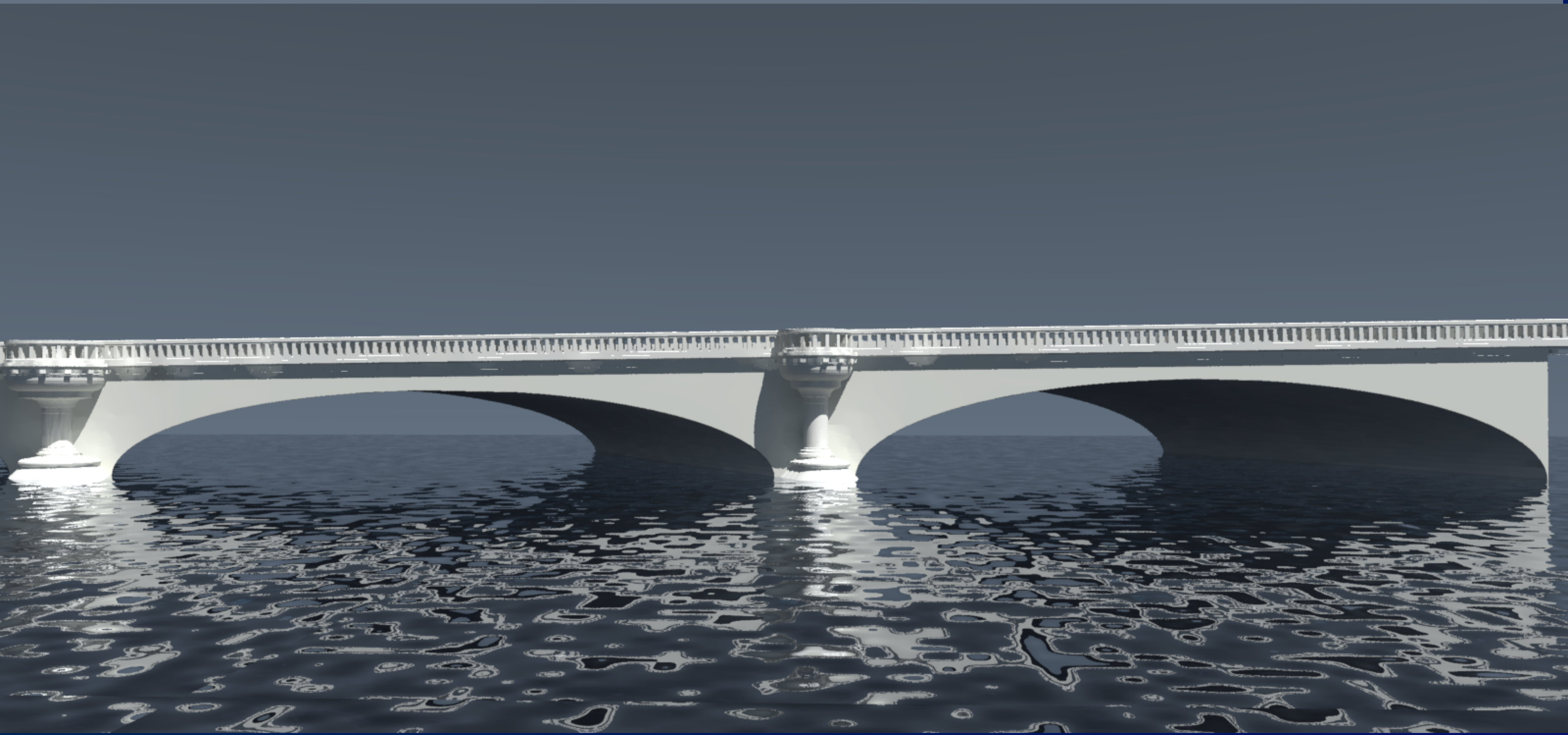
Modeling the bridge… piers and chalices



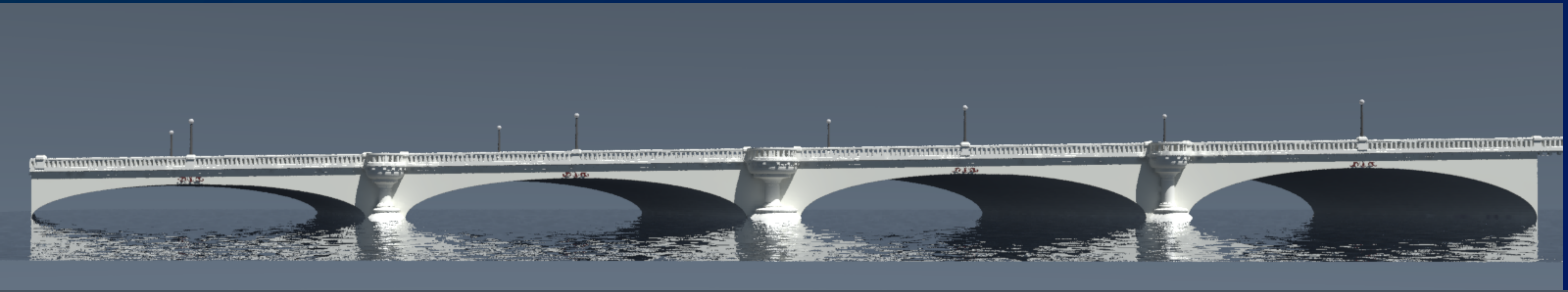


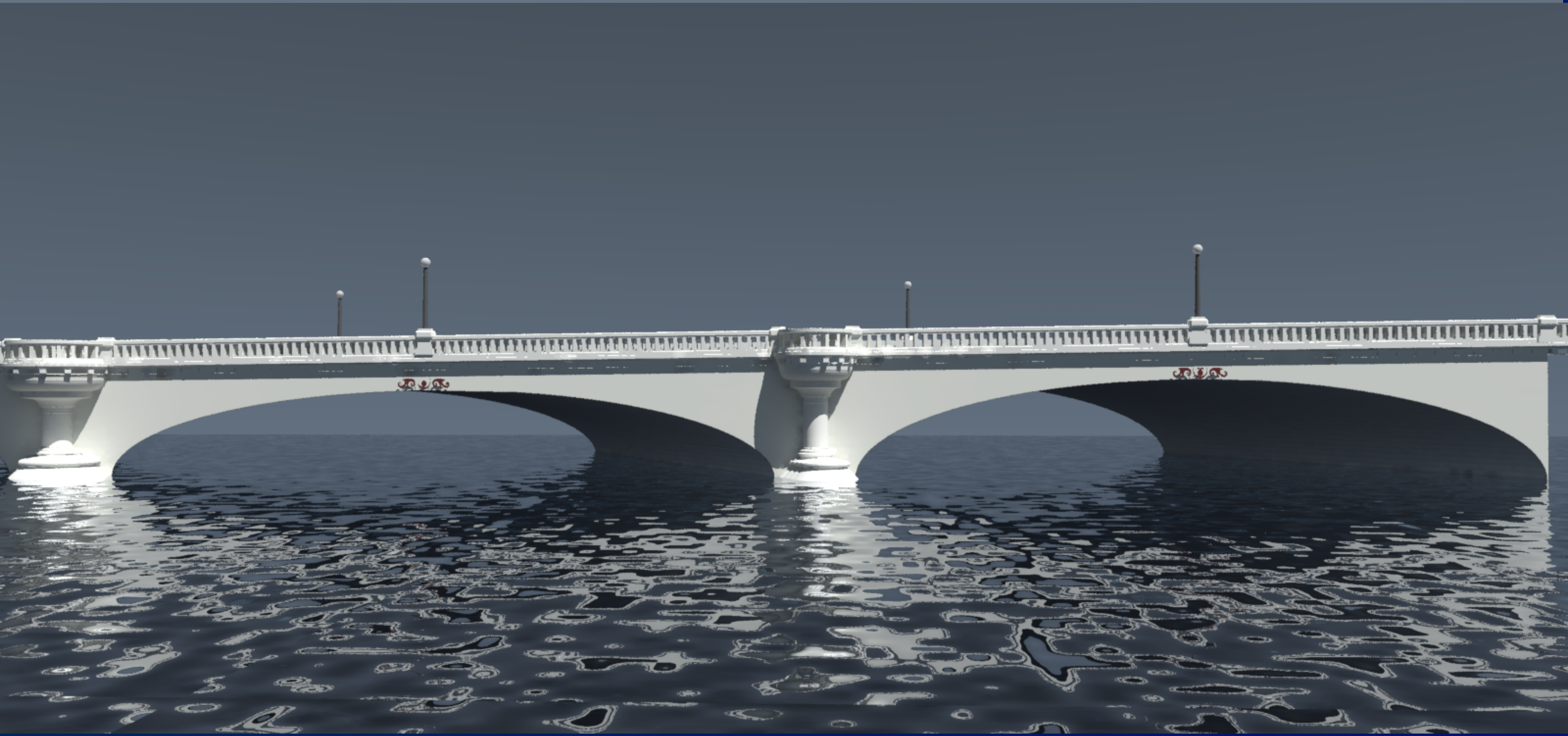
Modeling the bridge… railings



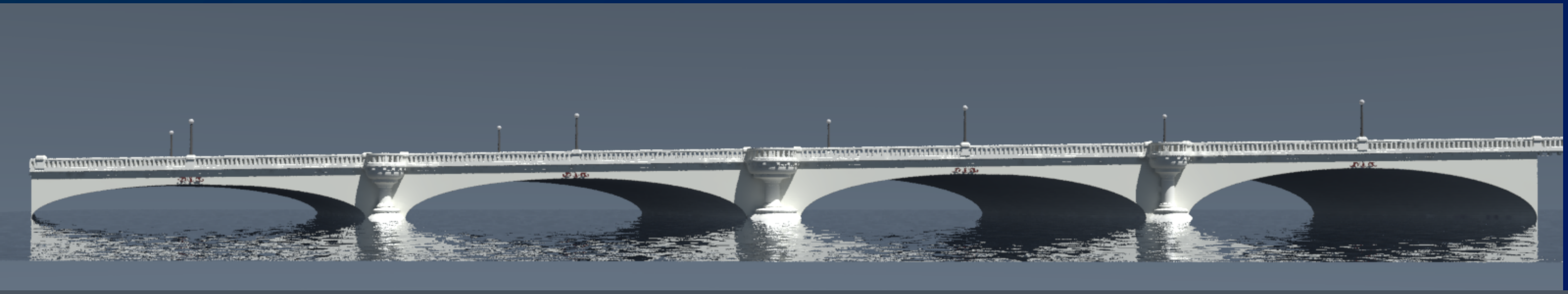


Modeling the bridge… final details

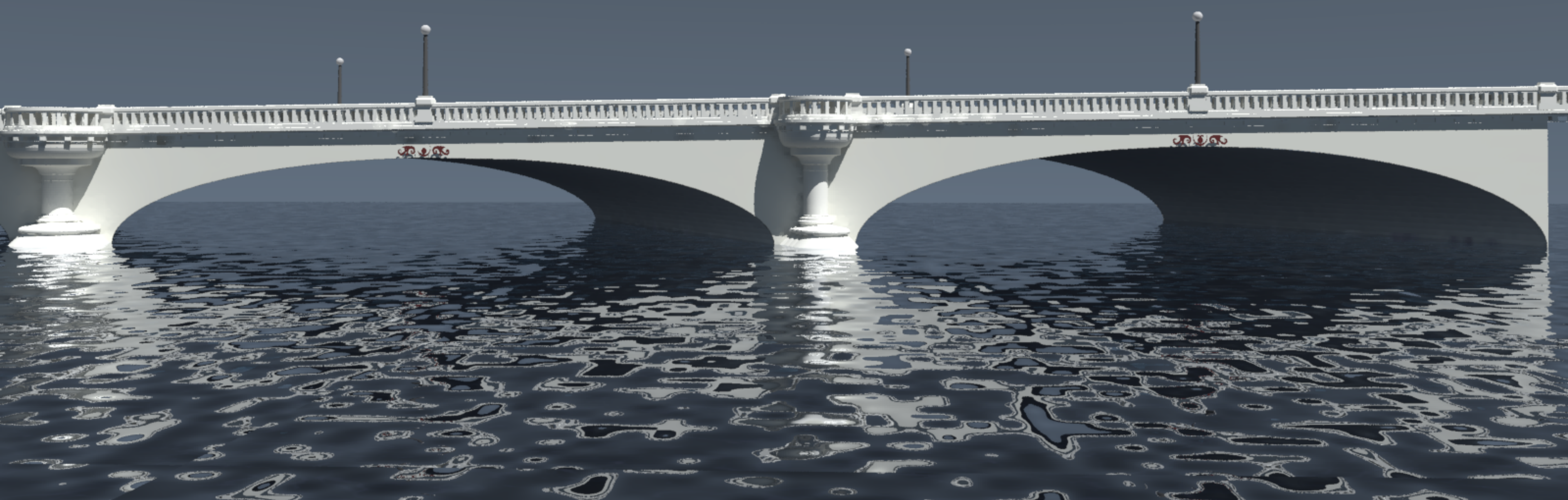


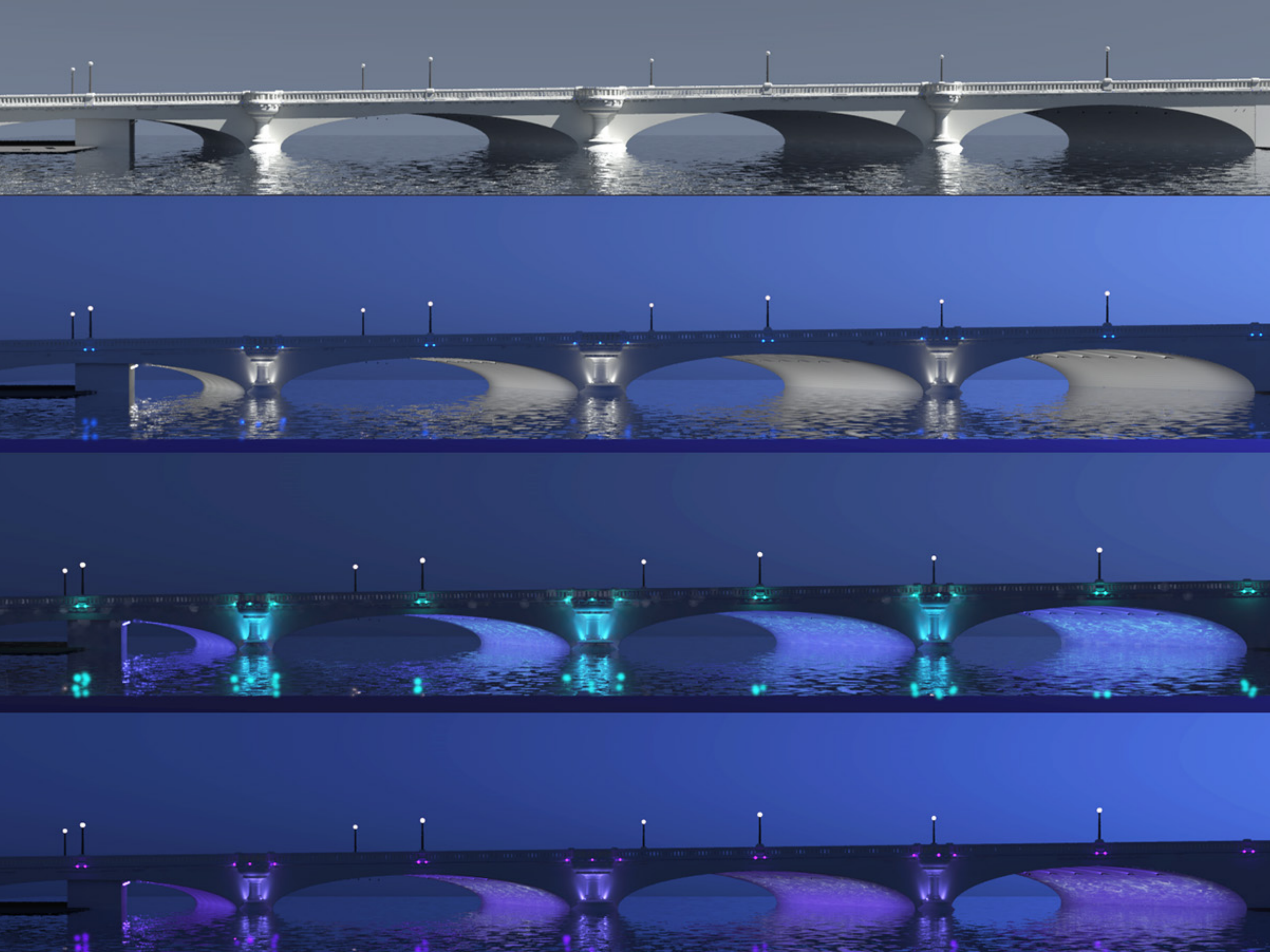


Modeling the bridge… final details

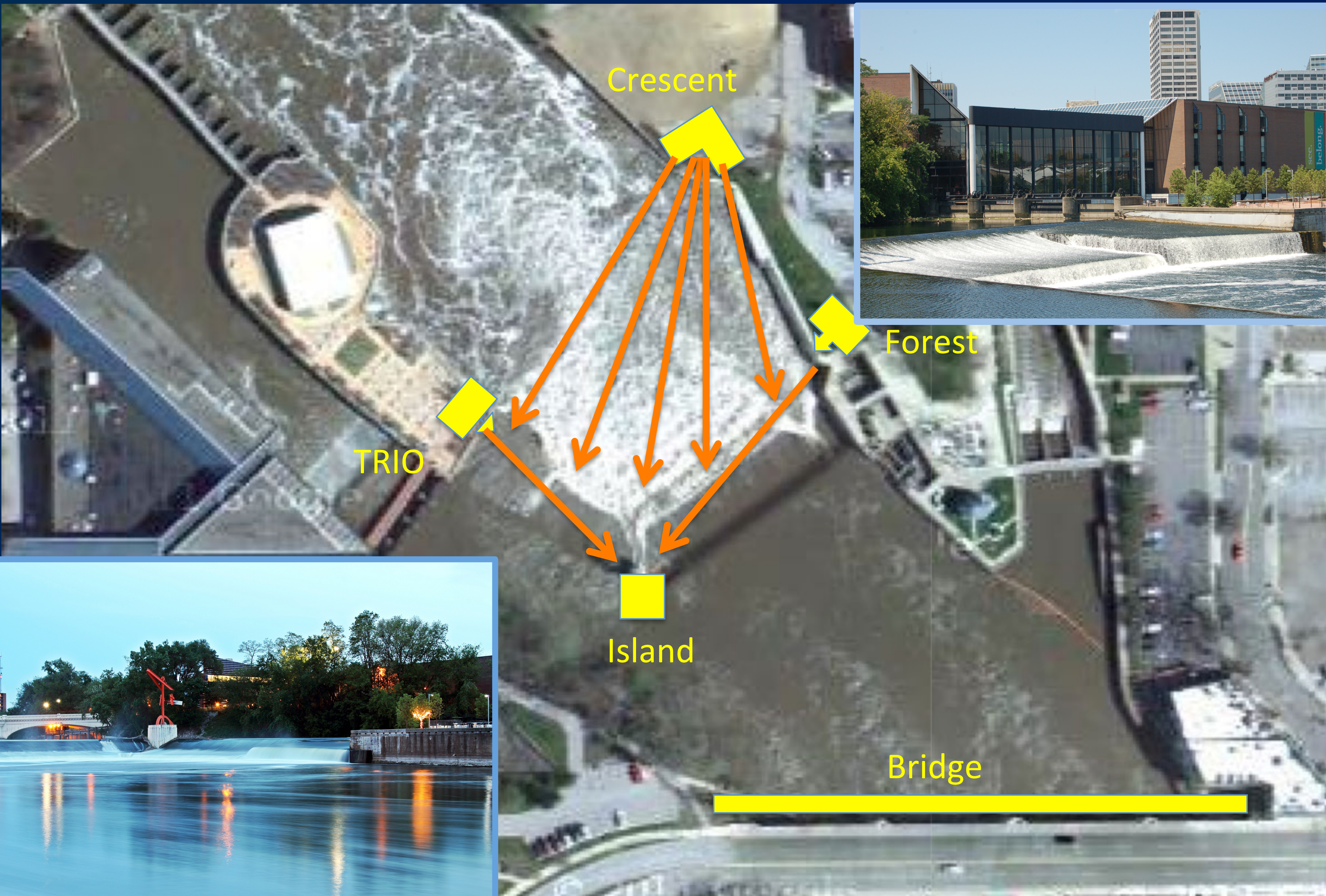


READY TO LIGHT… back to LED’s

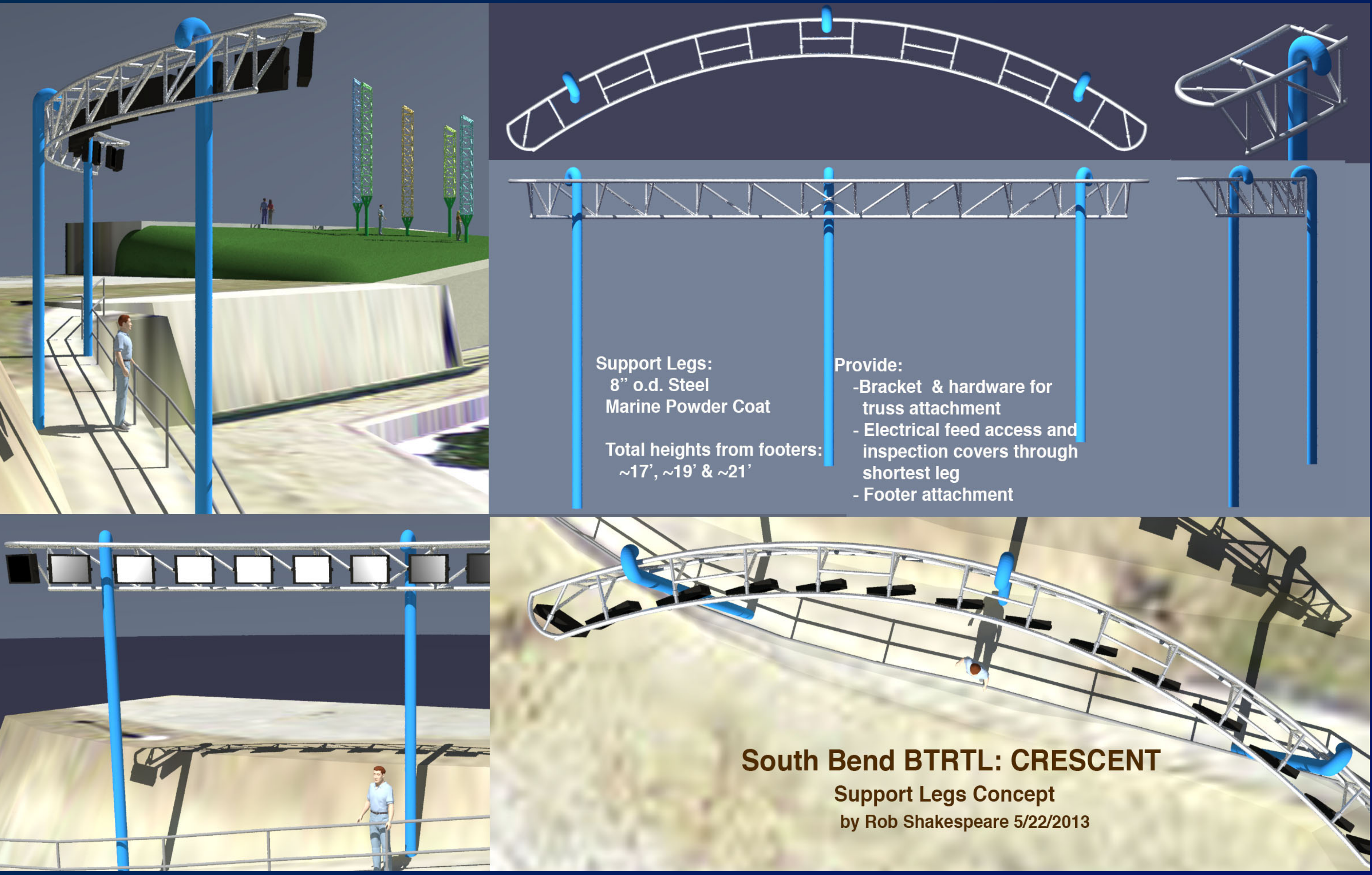




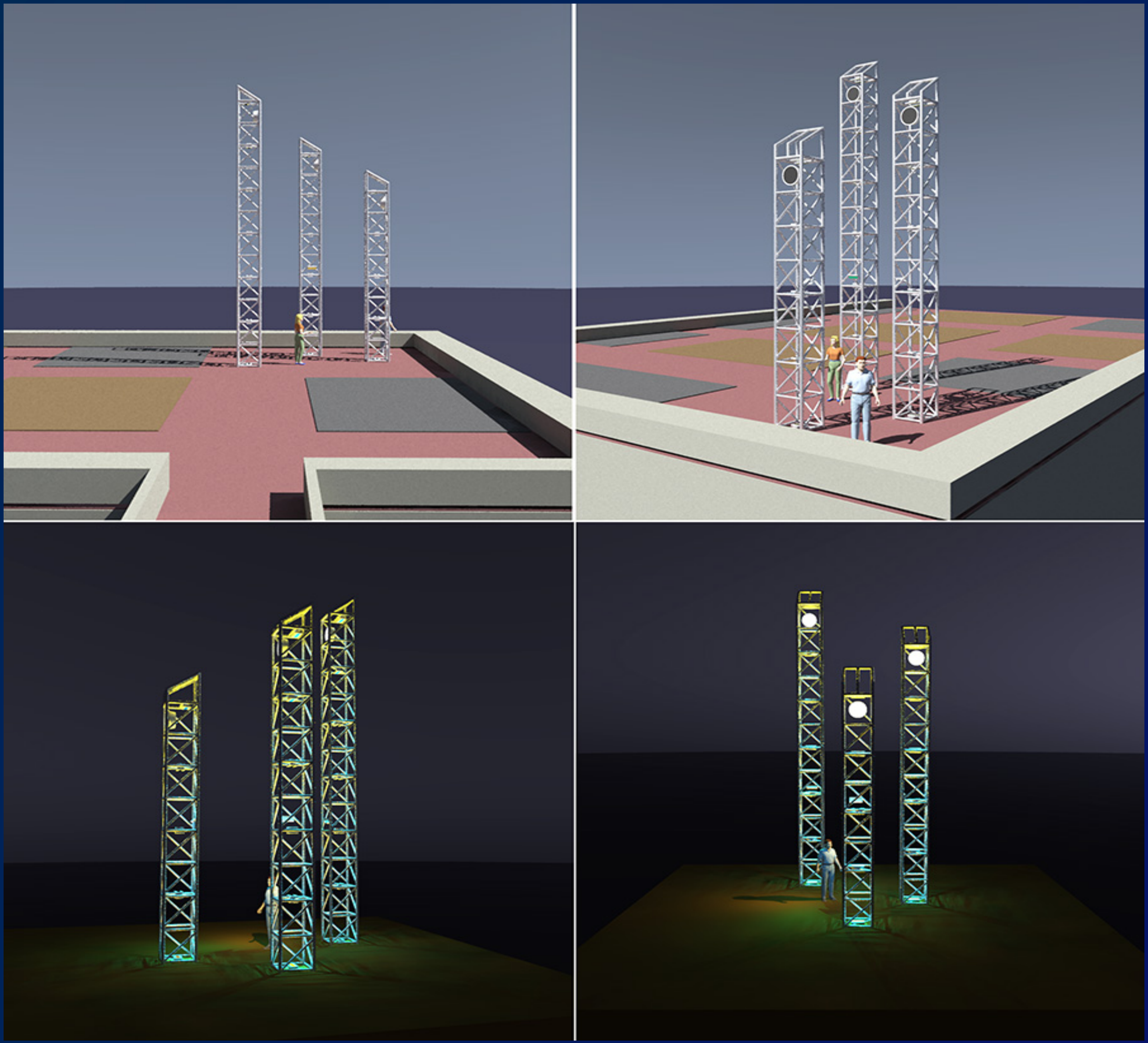
The whole installation…



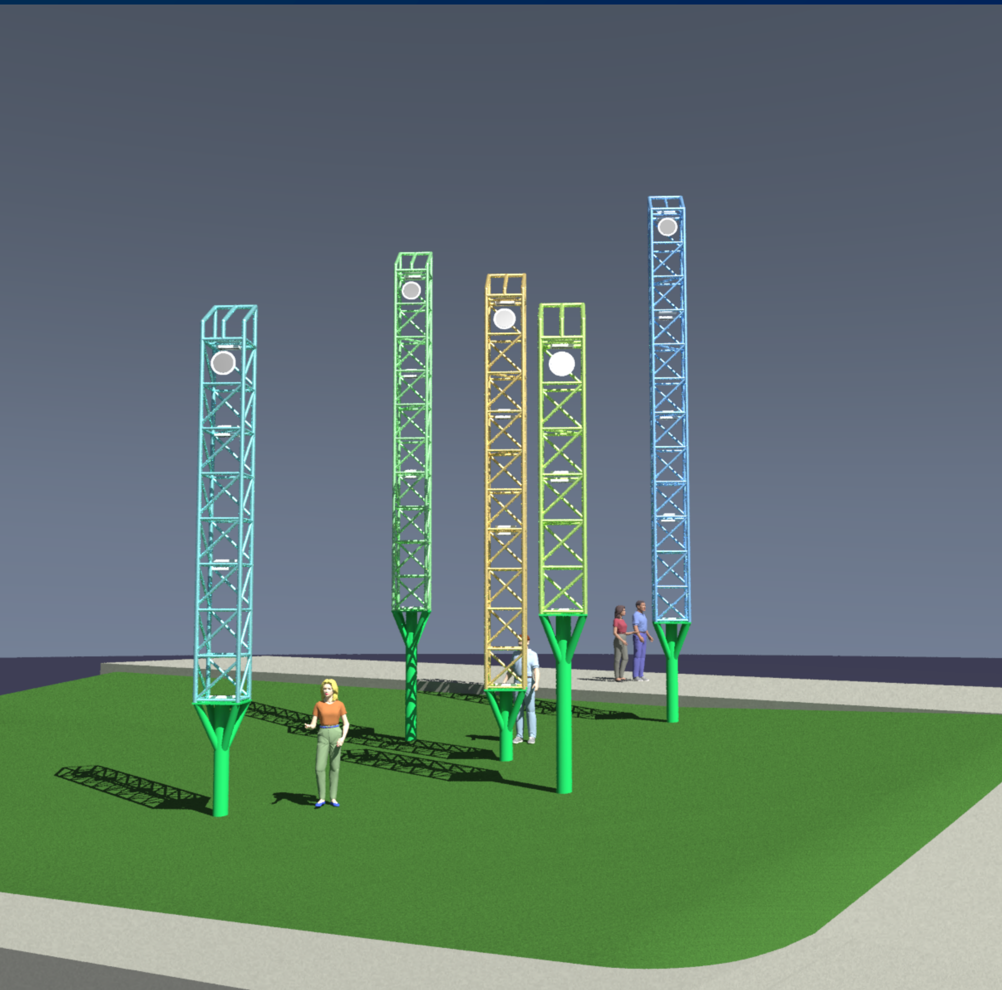
CRESCENT lights the cascades

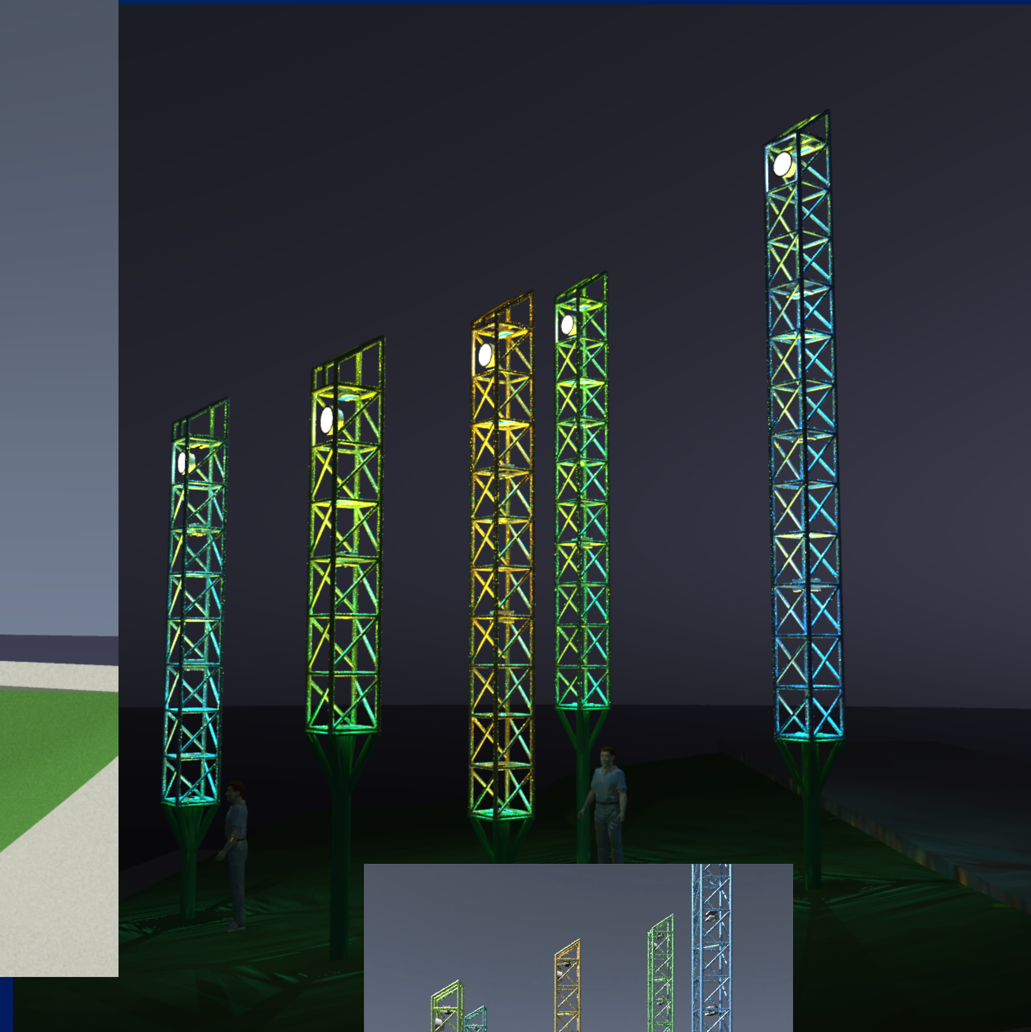


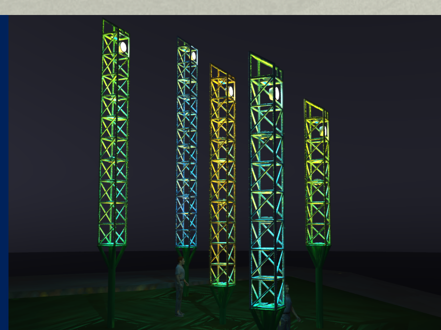
TRIO interactive and lights island

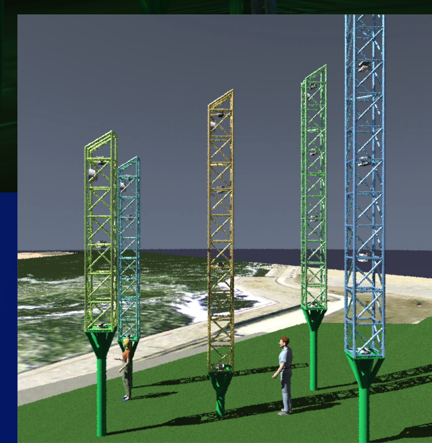


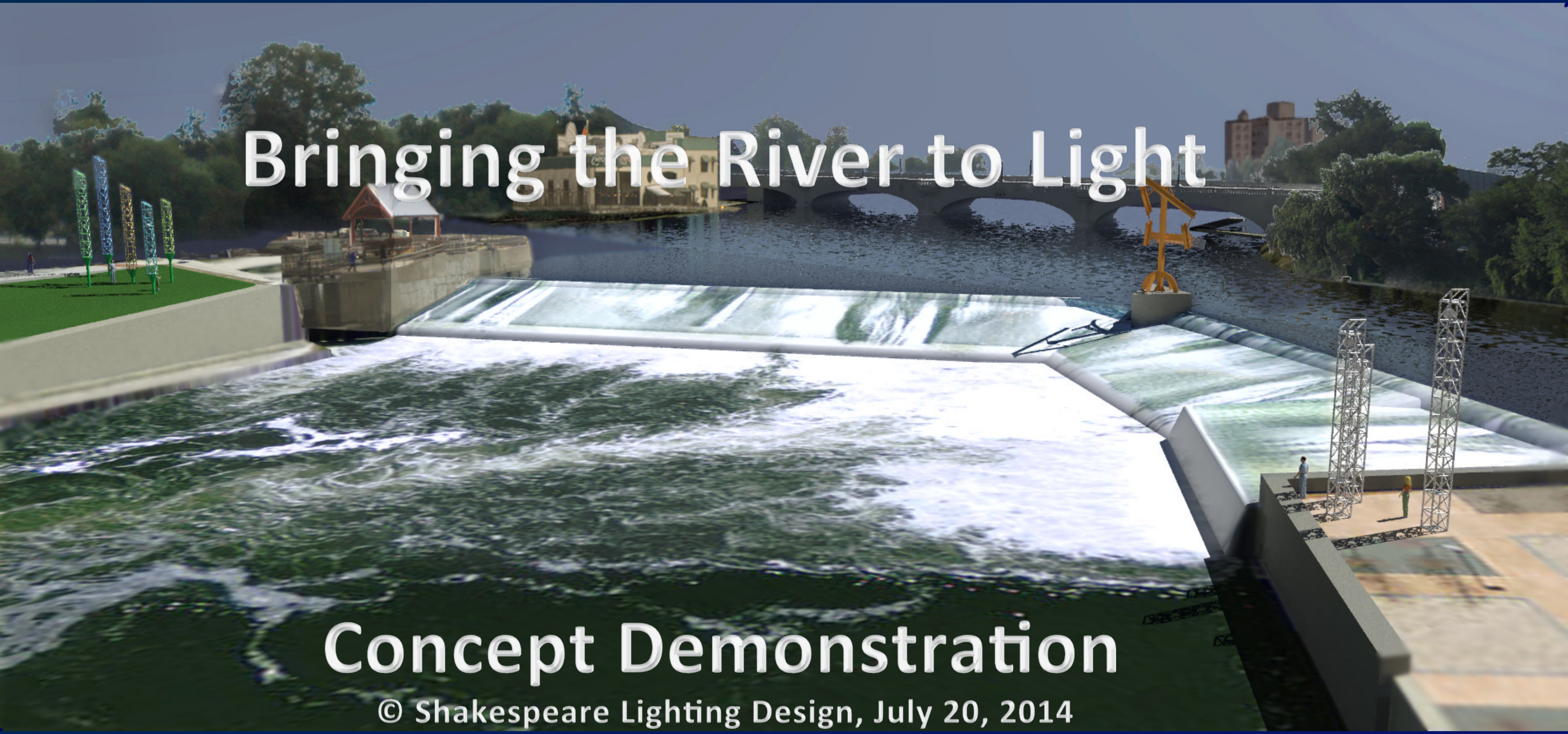
FOREST interactive and lights island

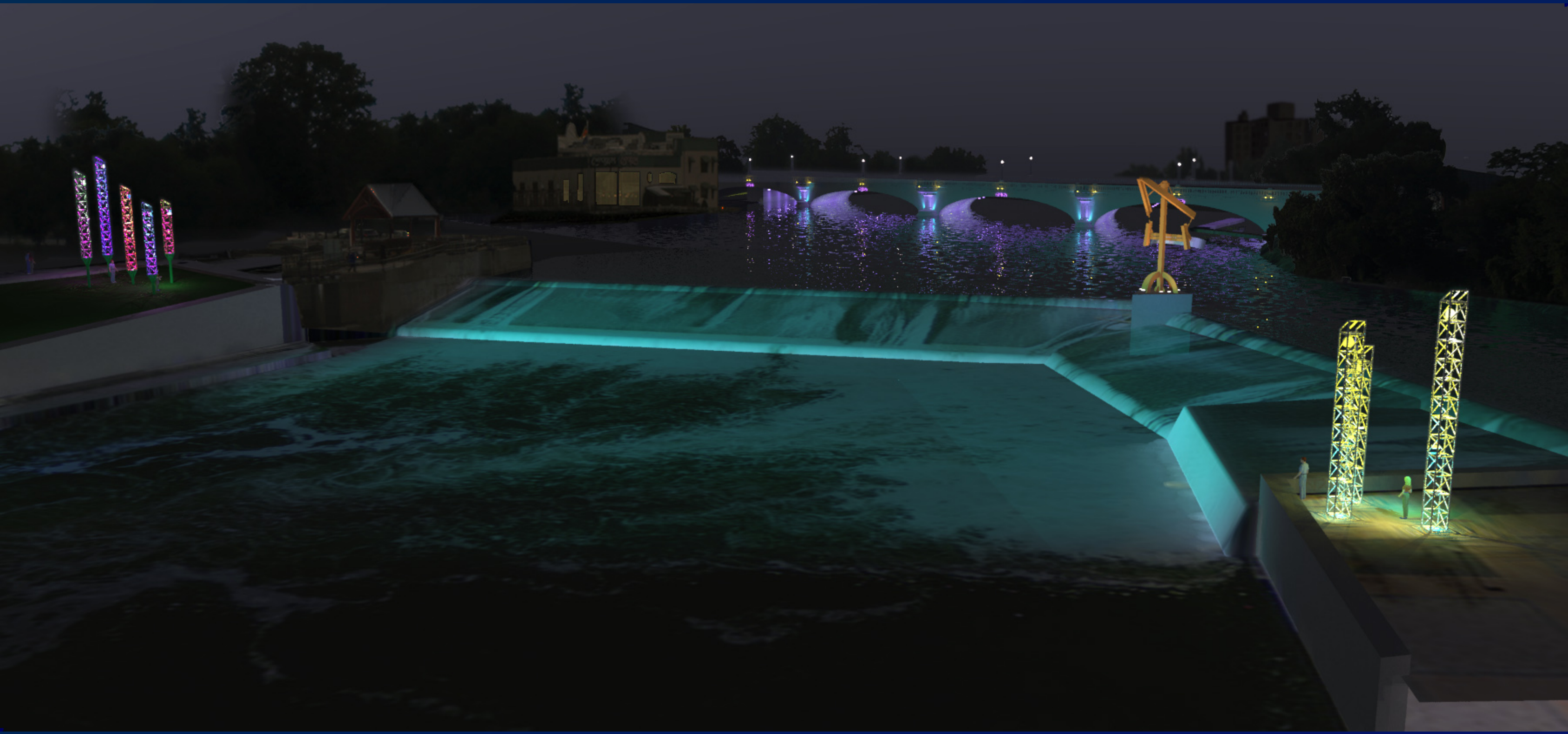









Bringing the River to Light
Concept Demonstration
© Shakespeare Lighting Design, July 20, 2014




Concept Demonstration
© Shakespeare Lighting Design, July 20, 2014

Light to look at+

Towards Automated Visibility Metrics

Hazard demo

11th Radiance Workshop

Designing Visually Accessible Spaces
NIH Grant 1 R01 EY017835-01

Rob Shakespeare
Indiana University PI
Rob@ShakespeareLighting.com

Other research team members from:
University of Minnesota, Low Vision Lab & Computational Vision
University of Utah, Computer Science & Visual Perception & Spatial Cognition

Industry is speaking…

IESNA is slowly moving from illumination based to luminance (vision) based metrics.

ANSI/IESNA RP-28-07 targets the elderly and low vision community.

American Disability Act is now working with IESNA, National Institute of Building Sciences and others, exploring building code to address the needs of low vision.

In response, a leading Illumination Engineer, software developer, and industry partner states " the DEVA project is absolutely critical to visibility building code standards development"

Industry is speaking…

The potential impact of this work is summarized by a prominent architectural firm and industry partner : ”While architecture as a profession stands at the forefront of handeling issues of universal access, we have not encountered a means of early detection in the design development stage that can adequately address the requirements of the visually impaired. The DEVA modelling platform is of great value, allowing an iterative process that incorporates visibility analysis into an evolving design”

DEVA’s tools aim to assist:

- Fully sighted acuity: 20/20
- Low vision (US definition) 20/40
- **Legal Blindness Threshold (US): 20/200**
- **Visual access for persons up to 20/600**

Low Vision persons have visual ability

BUT we do not meaningfully include their visual needs in our environments.

vision and visibility

An art museum atrium: 20/400 acuity visitor (mockup)

Let's take a walk.. (a step through)

OUCH!!!!

ARGHhhhhhh

ARGHhhhhhh

What happened.. Ohhhh no!

ARGHhhhhhhh

What happened.. Ohhhh no!

call an AMBULANCE!

What happened?…

Why didn't the designers anticipate this accident and fix the problem?

What happened?…

Why didn’t the designers anticipate this accident and fix the problem?

There are only recommended practices..
Illumination does not predict illuminance

There are no tools yet available to the design process which accurately predict visibility

Take a closer look… at 20/200

No obviously visible hazard… it’s noon

View a few hours later...

Hmmm.. something is emerging

View a few hours later... at 20/20 acuity

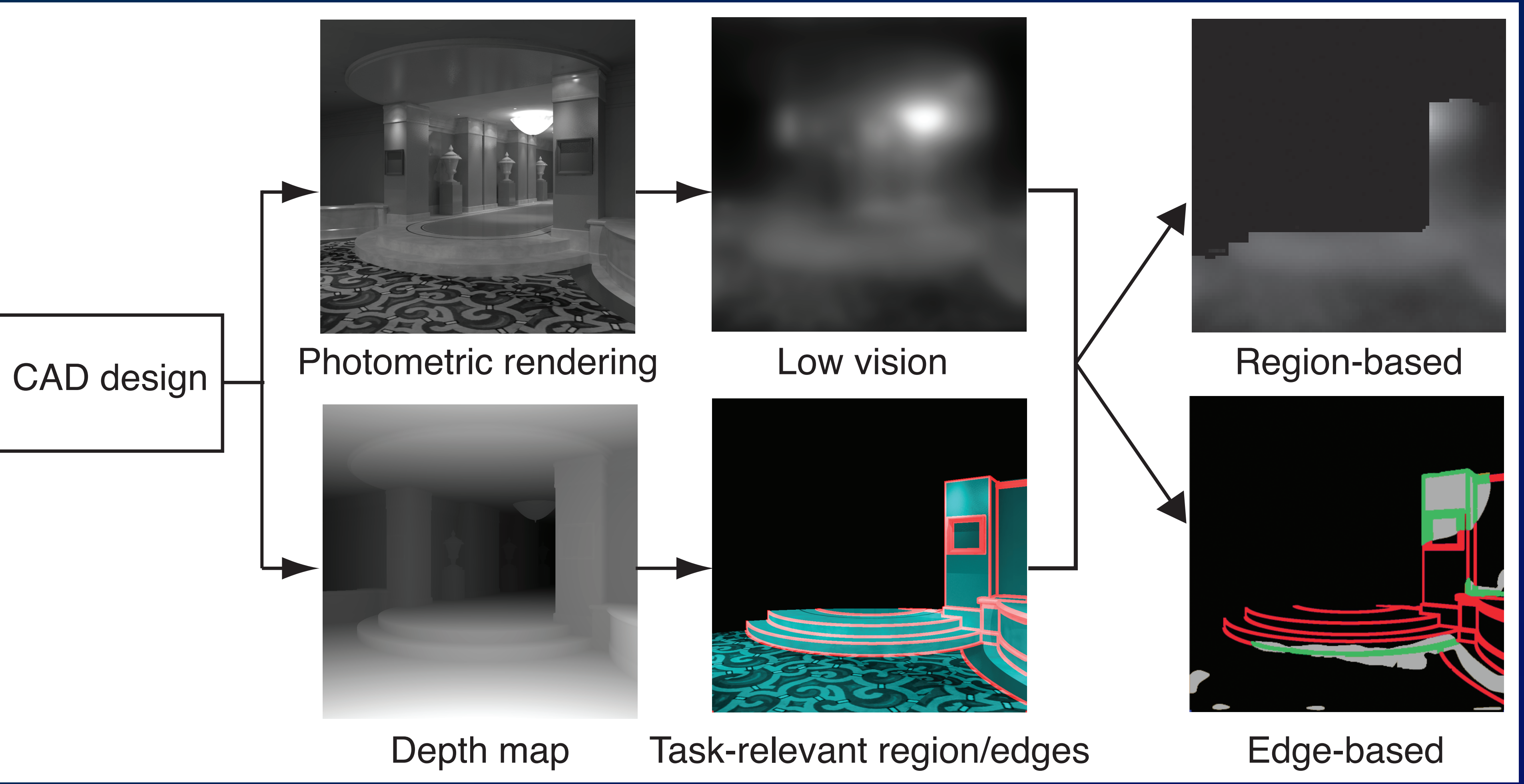
Is this a lighting problem? NO

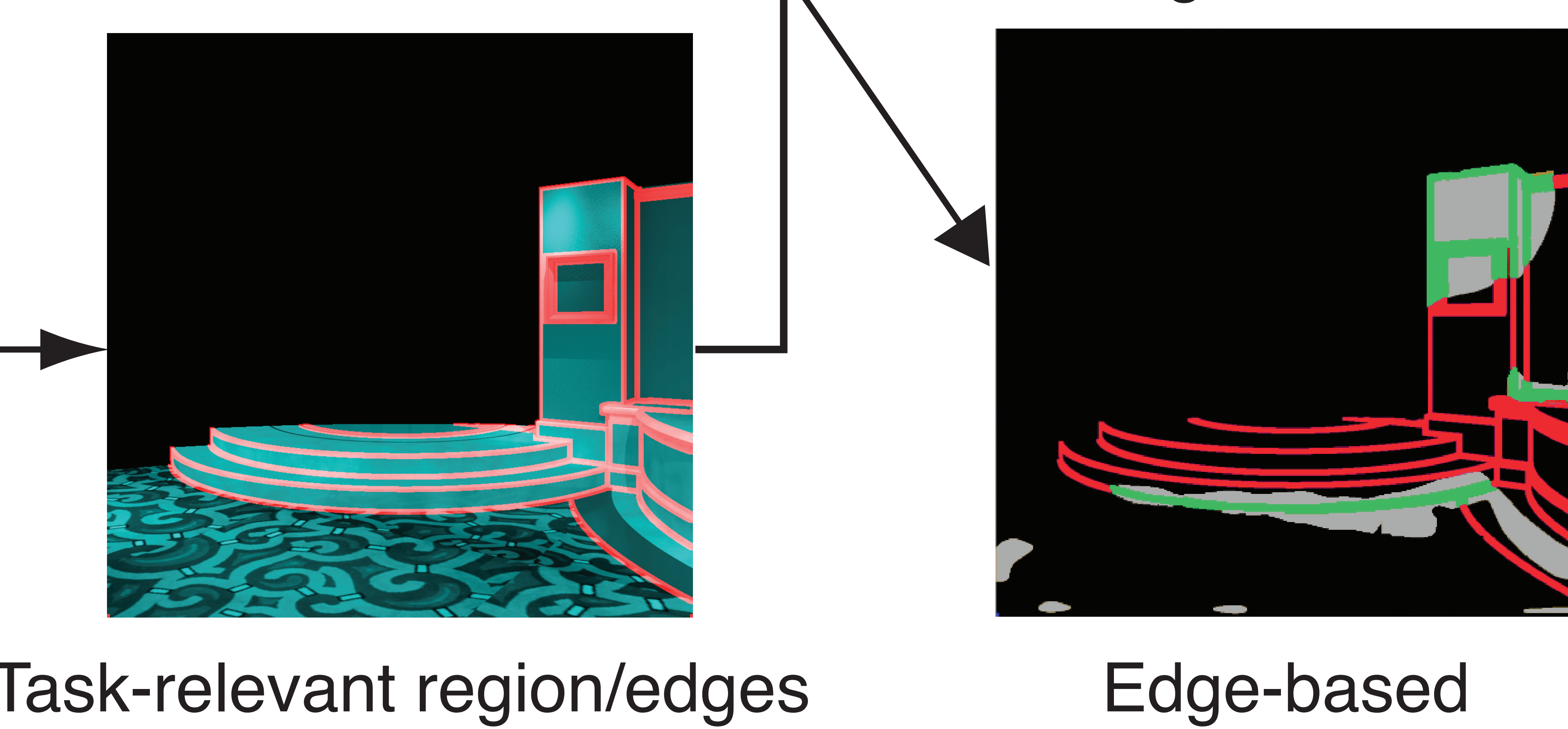
This view could have been avoided by..

20/20 acuity

by adding a darker stain!

Current automated pipeline





RED = geometric change
GREEN= Luminance pattern

RED = misses. Not visible geometric change
GREEN= True positive where contrast predicts geometric change. Visible.
GREY = False positive. Contrast predicts a geometric change where there is not one.

”we have not encountered a means of early detection in the design development stage that can adequately address the requirements of the visually impaired”

DEVA is building these tools

built upon human subject research in situational visual acuity, low vision navigation, and their computational representation.

Funding is renewed for 5 years

DEVA group publications:

Legge., G.E. (in press). Driving with central visual-field loss. *JAMA Ophthalmology*.

2013

Bochsler, T.M., Legge, G.E., Gage, R. & Kallie C.S. (2012). Recognition of ramps and steps by people with low vision. *Investigative Ophthalmology & Visual Science*, *54*(1), 288-294. [abstract]

2012

Bochsler, T.M., Legge, G.E., Gage, R., & Kallie, C.S. (2012). Does locomotion enhance the visibility of steps and ramps for people with low vision? Poster Presented at the 2012 annual meeting of The Association for Research in Vision and Opthalmology. Fort Lauderdale, FL.

Bochsler, T.M., Legge, G.E., Kallie, C.S. & Gage, R. (2012). Seeing steps and ramps with simulated low acuity: Impact of texture and locomotion. *Optometry & Vision Science*, 89(9):E1299-E1307. [on-line from publisher]

Rand, K., Bakdash, J., Stefanucci, J. , Creem-Regehr, S., & Gustafson, W. (2012). Perceptual dependence of size and distance? A within subjects variability approach. Poster presented at the Vision Sciences Society annual conference, Naples FL.

Kallie, C.S. Evaluating Object Visibility with Simulated Low Vision Using Real and Rendered Scenes. Ph.D. Thesis, University of Minnesota, 2012.

Kallie, C.S., Legge, G.E. & Yu. D. (2012) Identification and detection of simple 3D objects with severely blurred vision. *Investigative Ophthalmology & Visual Science*, 53:7997-8005. [abstract]

Rand, K., Tarampi, M.R., Creem-Regehr, S.H, & Thompson, W.B. (2012). The influence of ground contact and visible horizon on perception of distance and size under severely degraded vision. *Seeing and Perceiving*, 25(5):425-447. [PubMed]

Shakespeare, R.A. (2012). Towards Automated Visibility Metrics. Presented at the 11th Annual International Radiance Workshop. Royal Danish Academy of Fine Arts, School of Architecture, Copenhagen.

2011

Beckmann, P., Legge, G., Kallie, C., & Thompson, W. (2011). Validation of Image Filters for Studies of Visual Accessibility. Poster presented at the Fall Vision Meeting of the Optical Society of America, Seattle, WA.

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Thank you

Rob Shakespeare