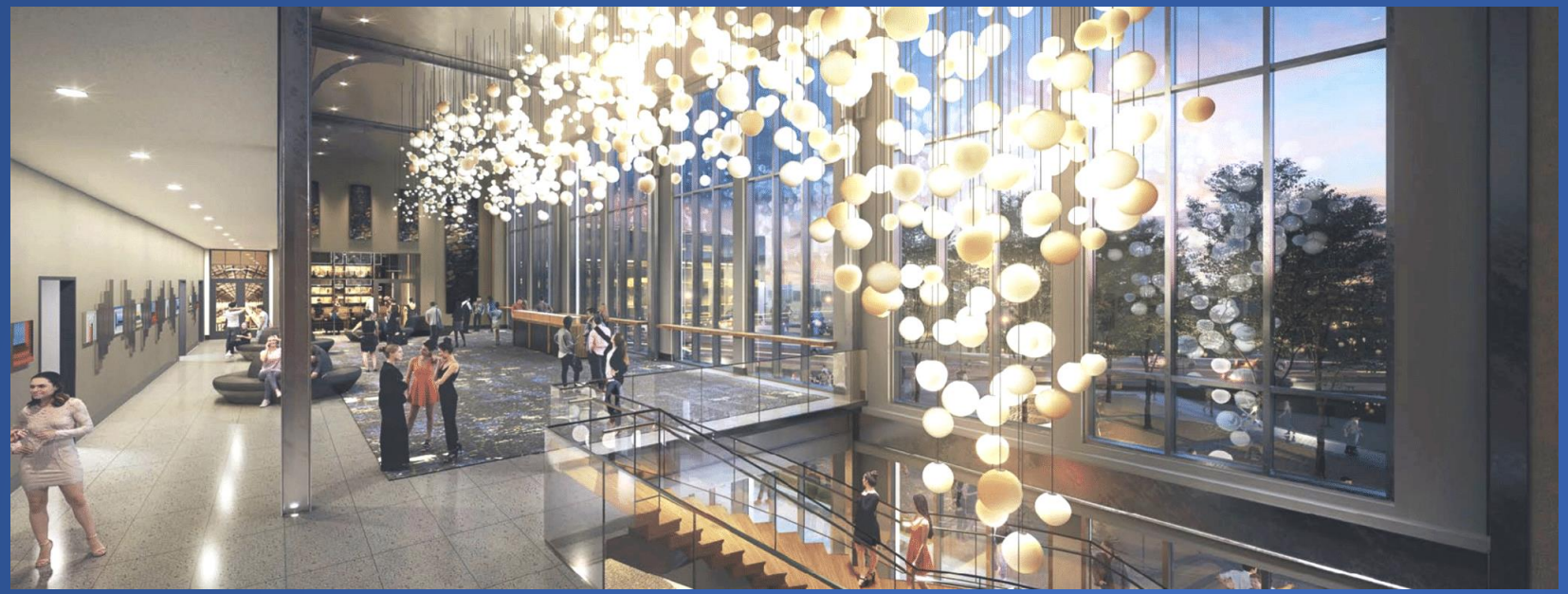
21st International Radiance Workshop
Innsbruck, Austria

by

Rob Shakespeare

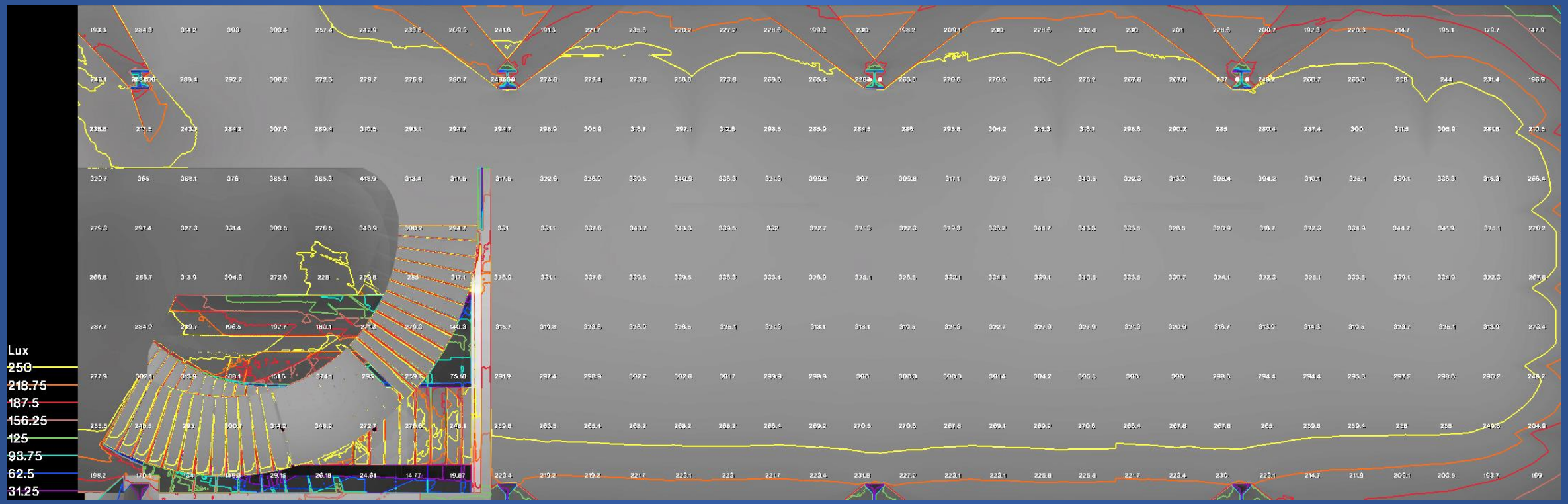
Shakespeare Lighting Design LLC

Wednesday, August 30th

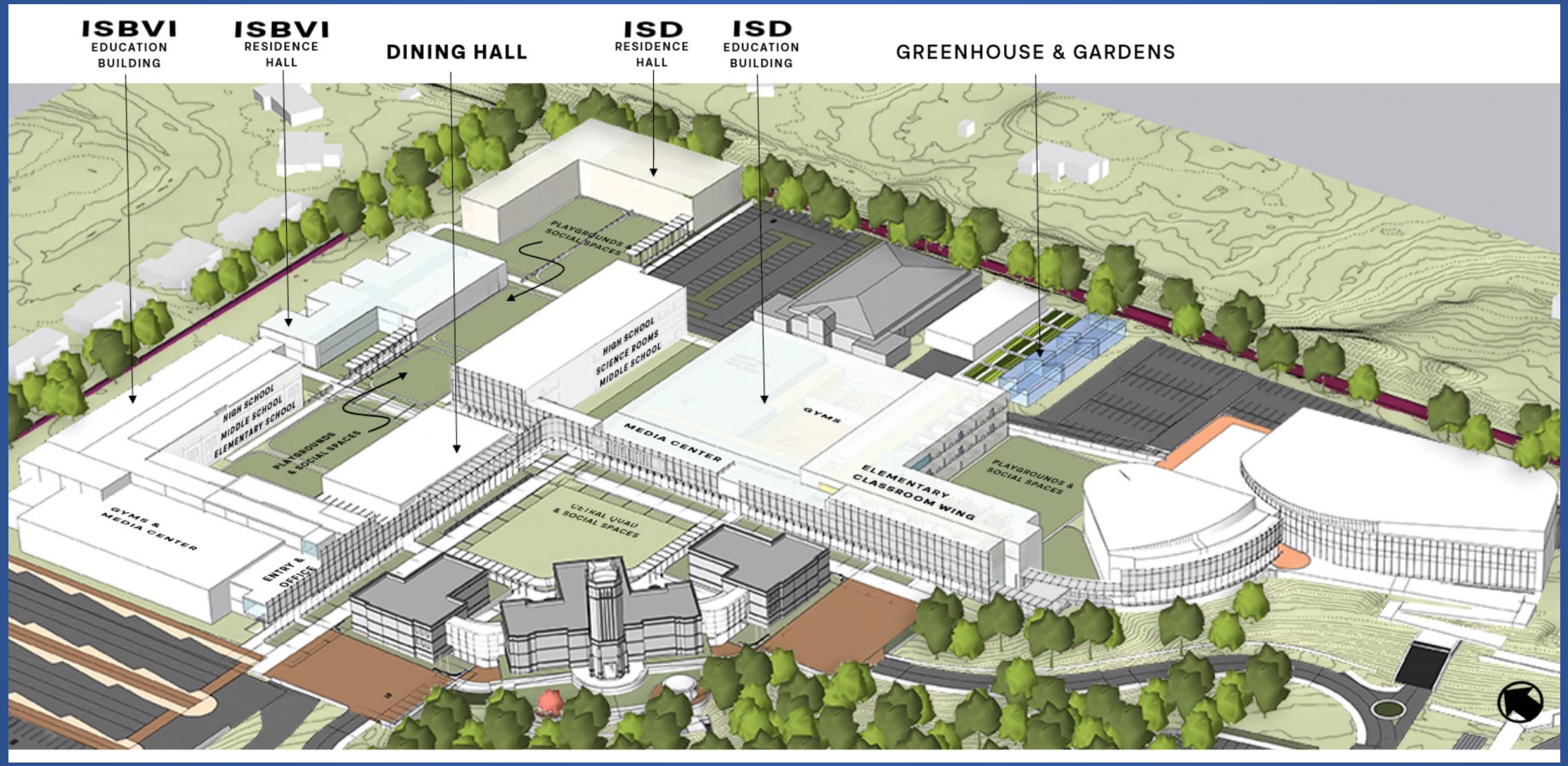


Illumination Grid (falsecolor option) helpful for approvals!

THANKS GREG!

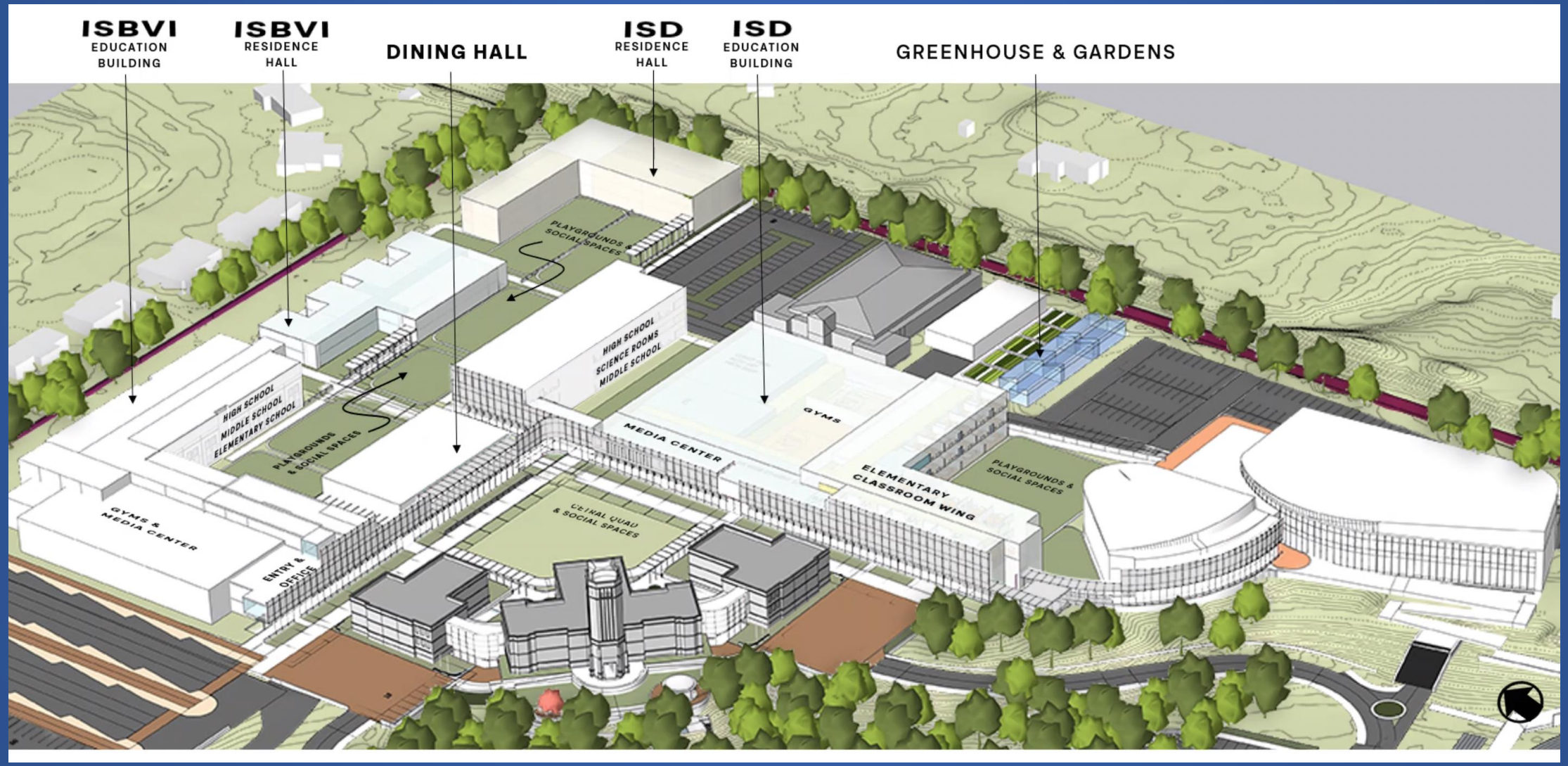


Indiana School for the Blind and Visually Impaired and School for the Deaf Campus

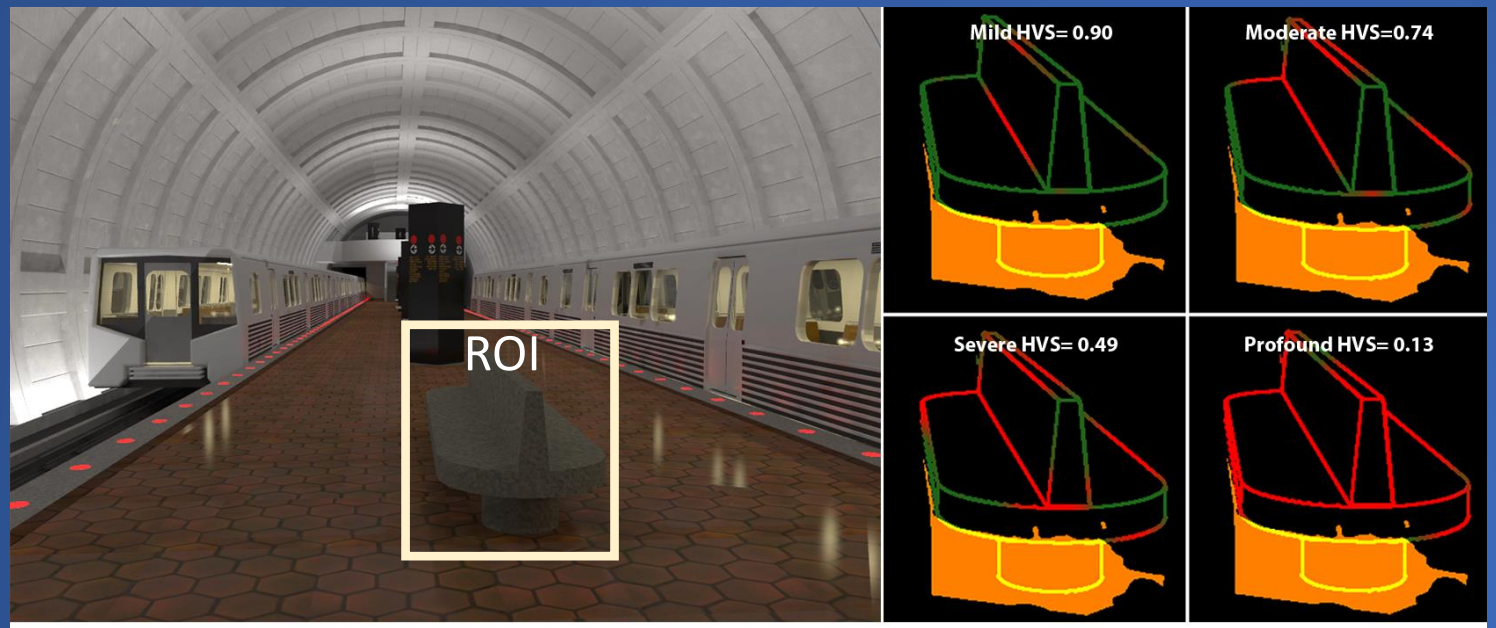


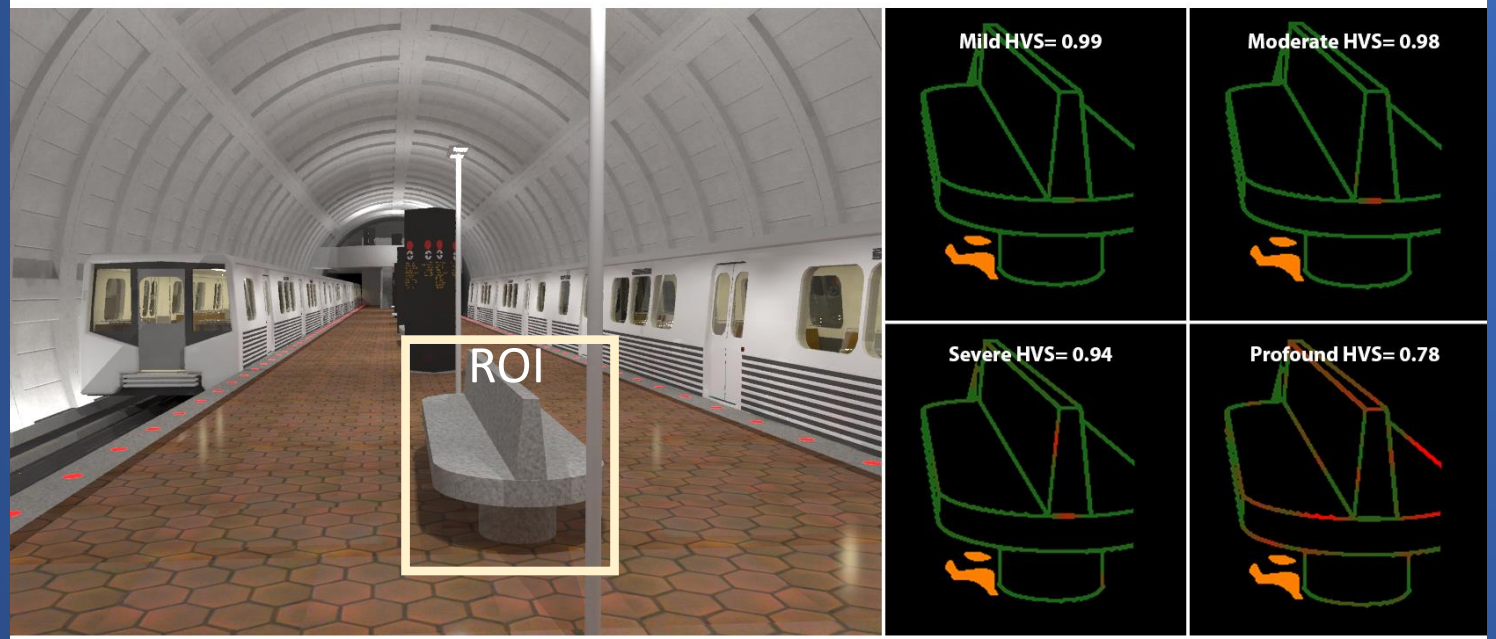
Indiana School for the Blind and Visually Impaired and School for the Deaf Campus

Thanks to Designing Visually Accessible Spaces (DeVAS), SLD is Lighting Designer for ISBVI and Low Vision Consultant for the Whole Project



What is DeVAS? A set of tools that predict visibility during the end of the model stage





Studies for Mild to Profound Low Vision:

RED = Not Visible

Green = Predicted Visible

Amber = Below Photopic

ROI Hazard Visibility Score (HVS)

1.0 = Very Visible

0.9 = Predicted Visible

~0.7 = Possibly Visible

0.0 = Not Visible

Based on Human Studies

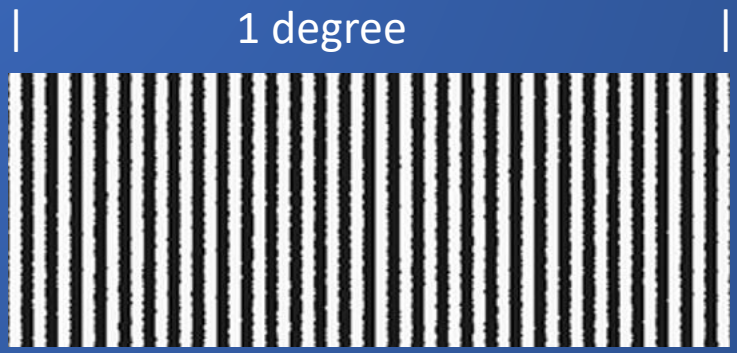
For New Workshop Friends:

A VISION PRIMER

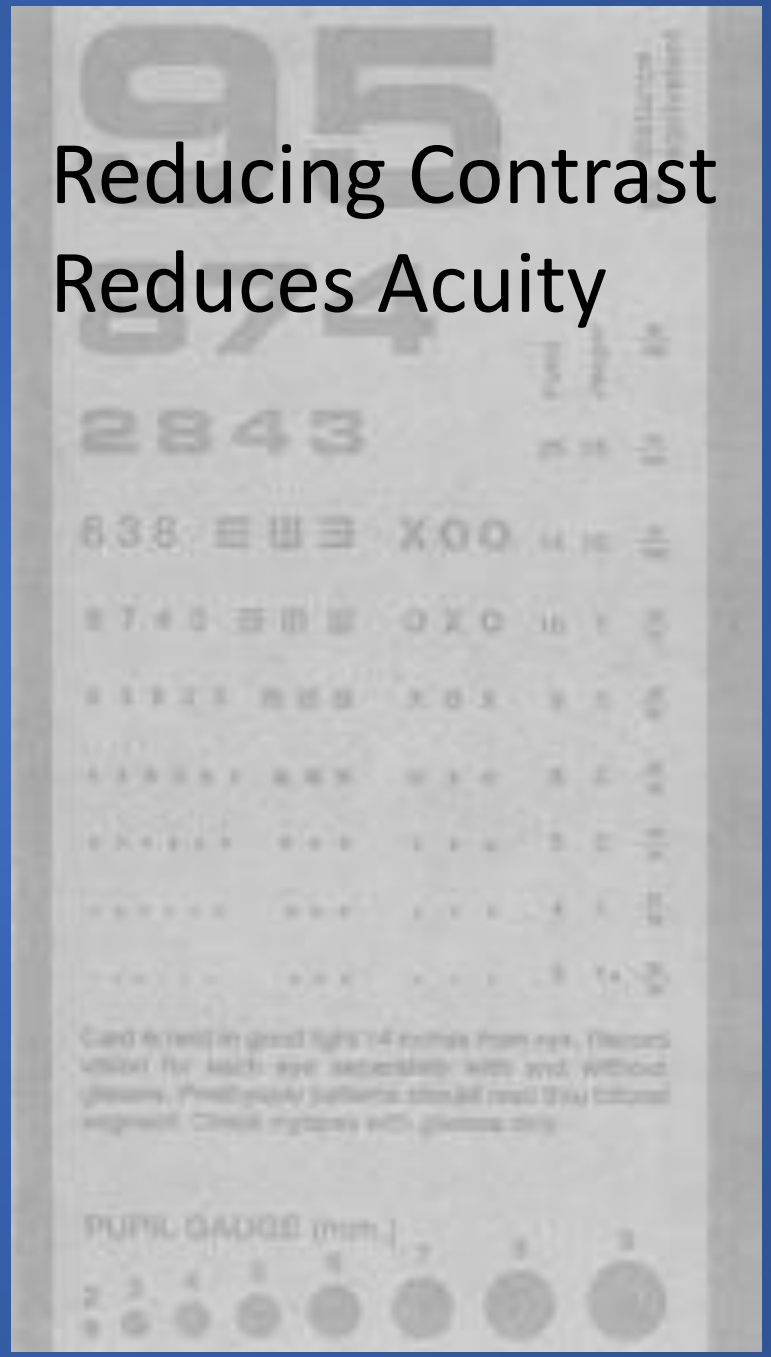
Acuity is the measure of the smallest detail which you can see from a given distance

Acuity is measured in CYCLES PER DEGREE (CPD)

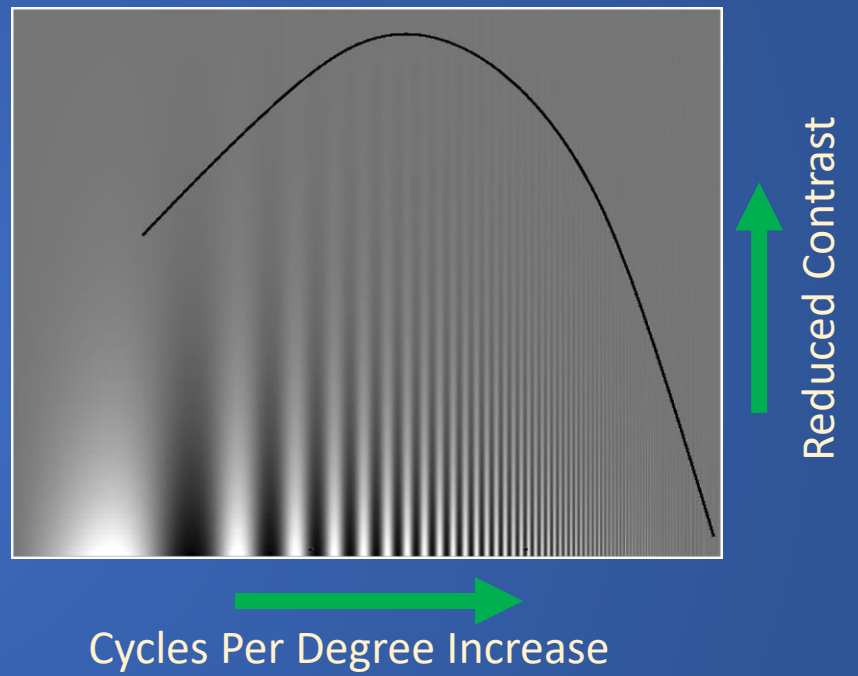
Normal Vision is 20/20 Acuity
Ability to discern 30 CPD



Reducing Contrast Reduces Acuity

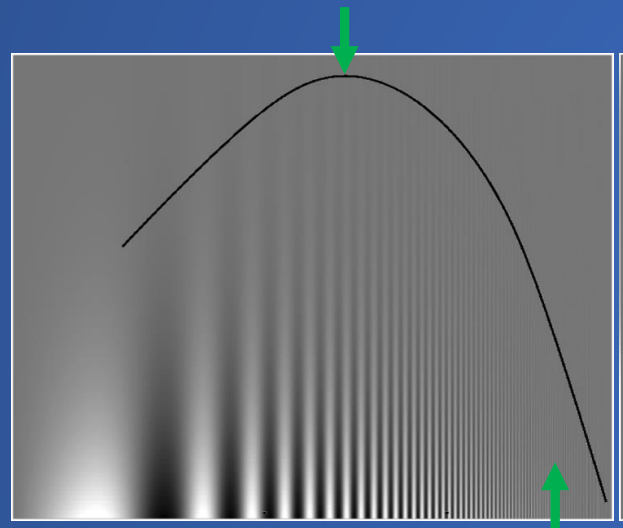


Acuity + Contrast = Contrast Sensitivity Function



Low Vision has Reduced Acuity and Contrast Sensitivity…. smaller CPD details become blurred

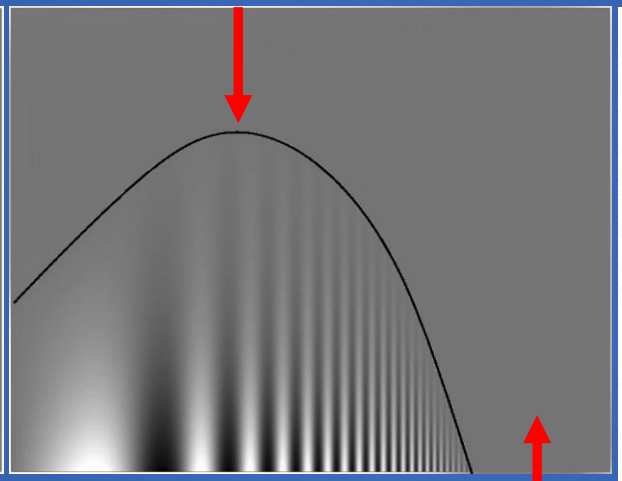
Normal vision



Fine detail visible

Large detail less affected by contrast reduction

Low Vision



Fine detail invisible

Large detail more affected by contrast reduction

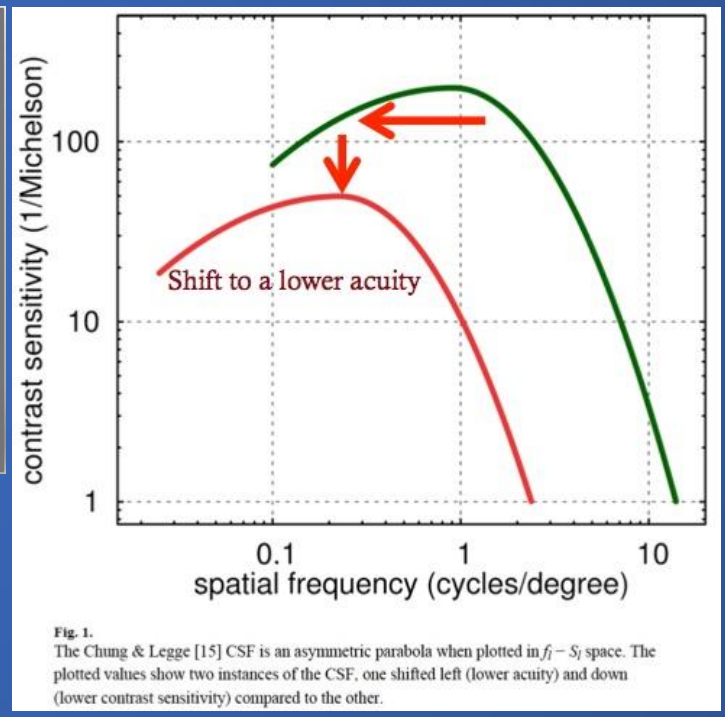
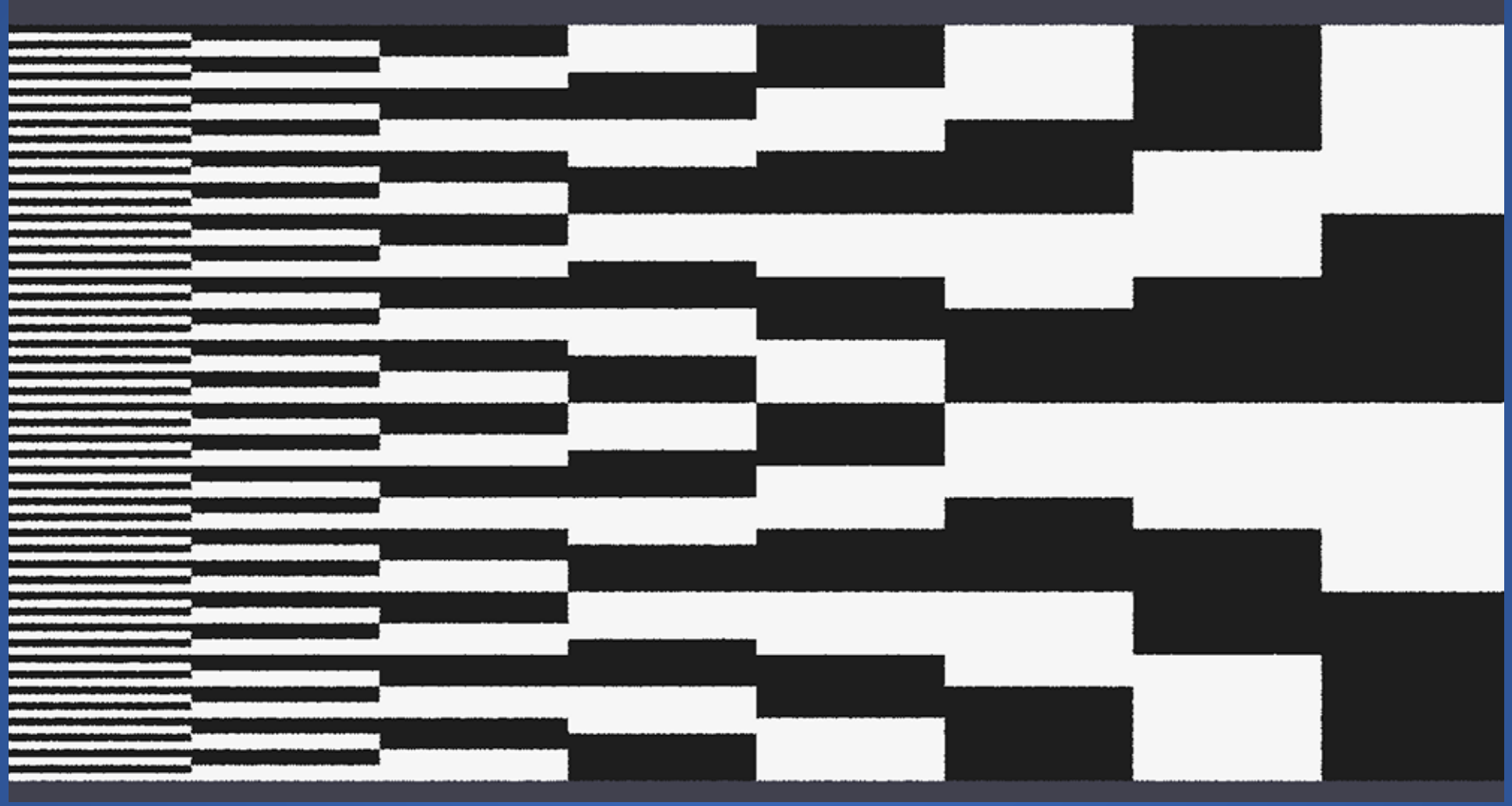


Fig. 1.
The Chung & Legge [15] CSF is an asymmetric parabola when plotted in $f_l - S_l$ space. The plotted values show two instances of the CSF, one shifted left (lower acuity) and down (lower contrast sensitivity) compared to the other.

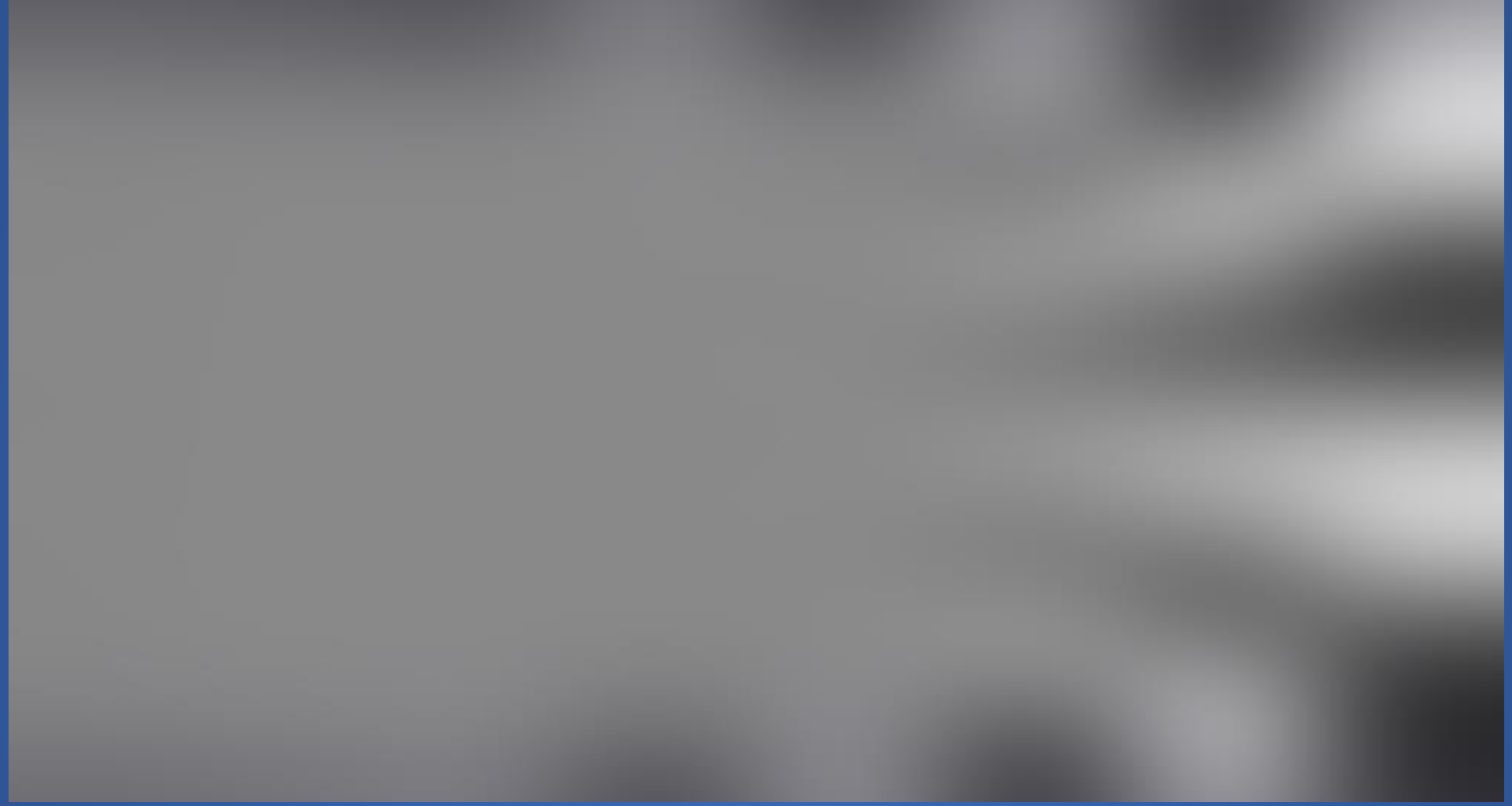


20/20 (20/80)

30 cpd (7.5 cpd)

20/20 20/40 20/80

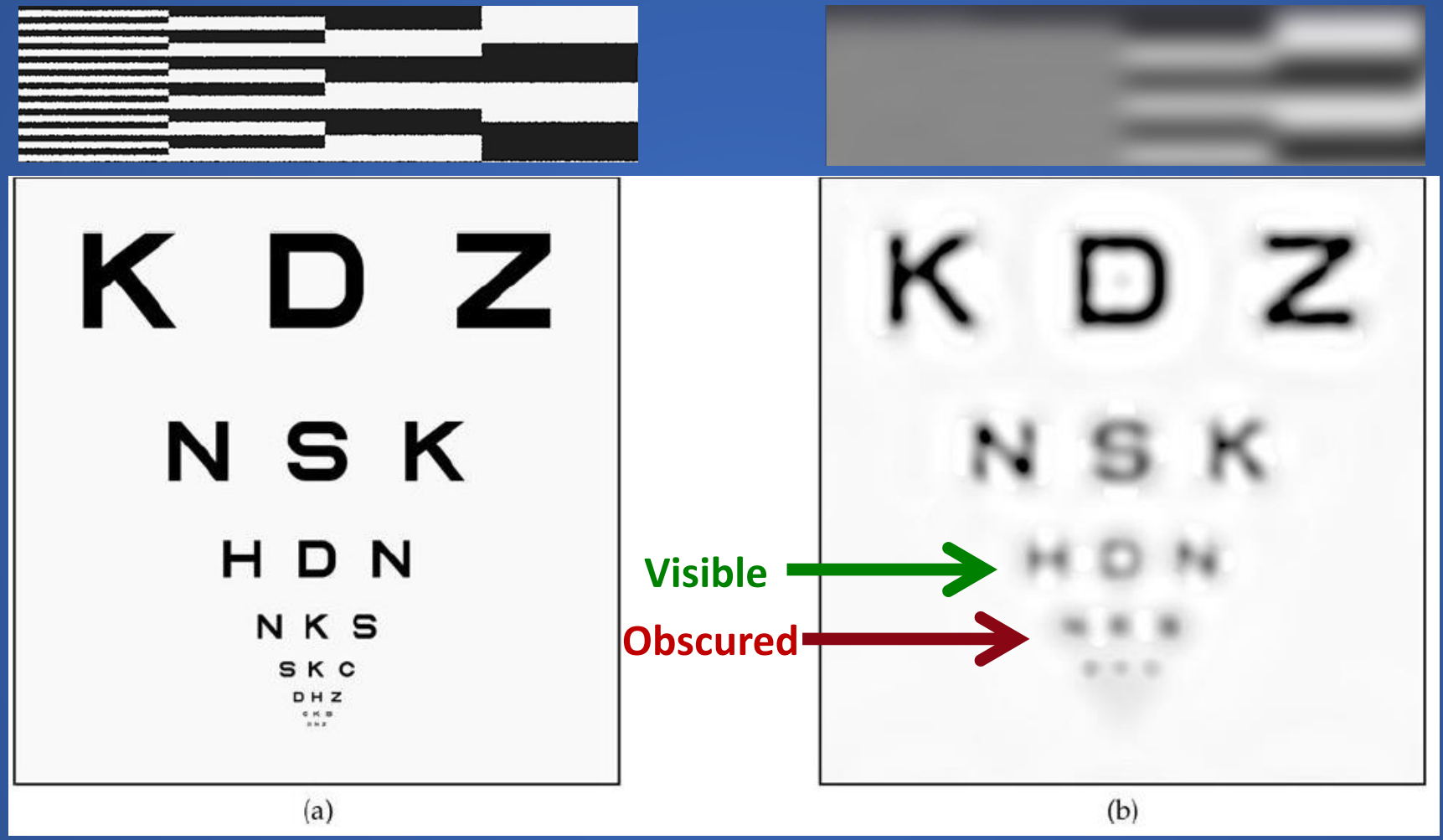
30 cpd 7.5 cpd



20/240

2.5 cpd

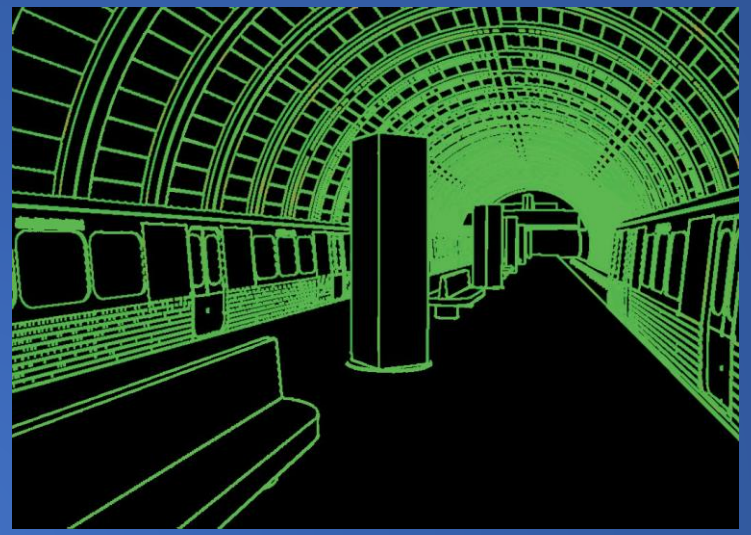
DeVAS Removes image details predicted to be not visible, while leaving intact, details predicted to BE visible.



Filtered by DeVAS to a specified Acuity

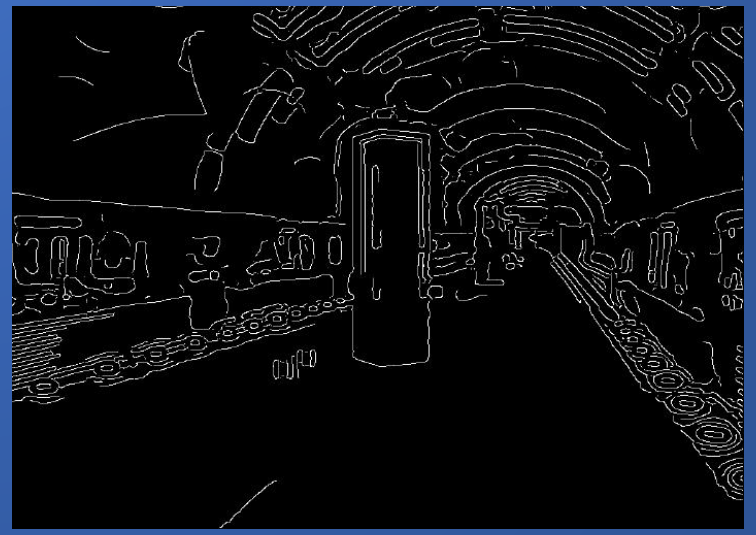
DeVAS-Visibility: Automated Visibility Prediction Application

Radiance Rendering + Geometric Data



Ground Truth Edges

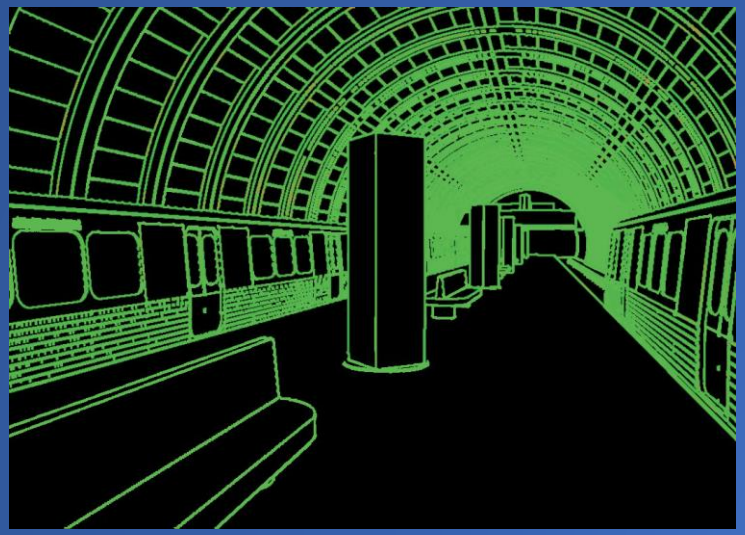
DeVAS-Filter *Severe Low Vision*



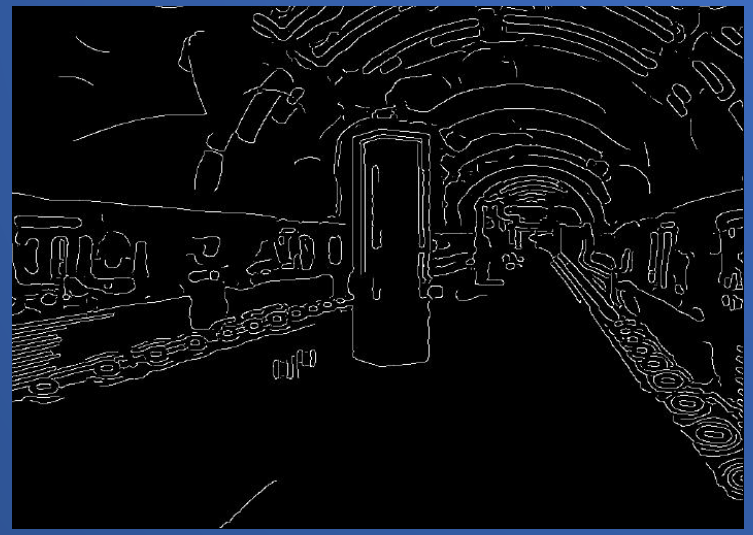
Luminance Boundaries: Canny Edges

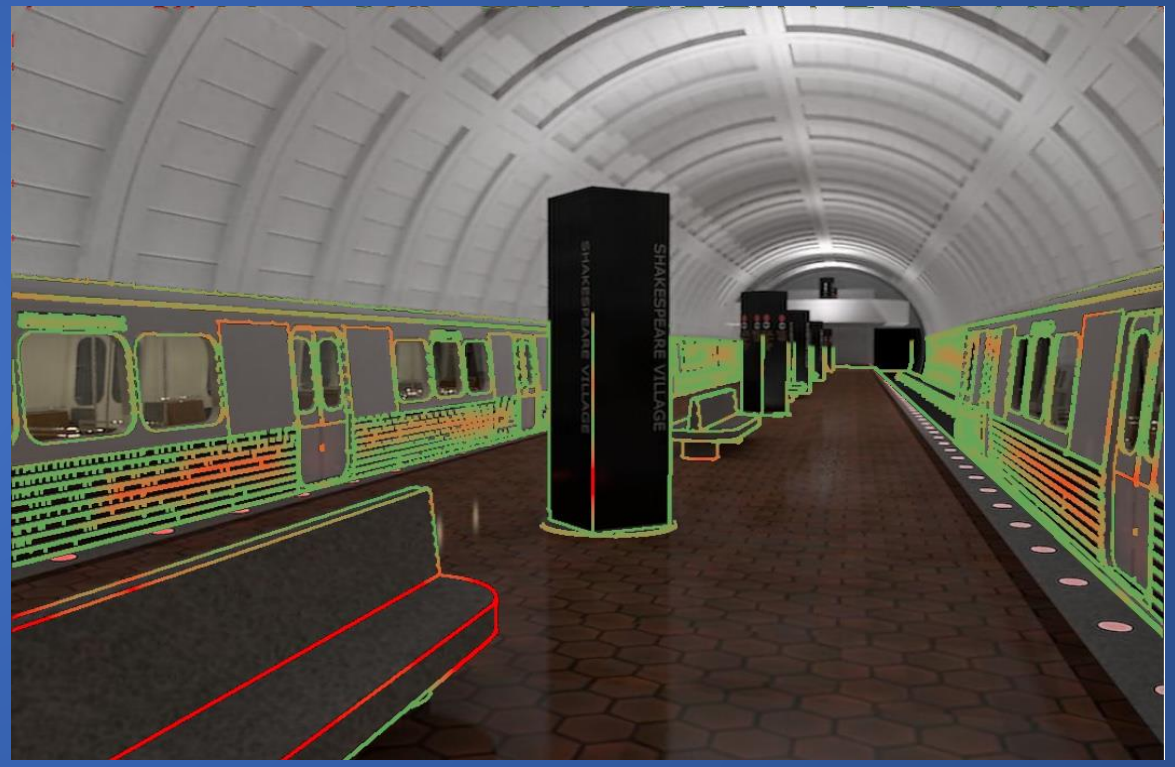
DeVAS-Visibility: Automated Visibility Prediction Application

Ground Truth Edges



Luminance Boundaries: Canny Edges

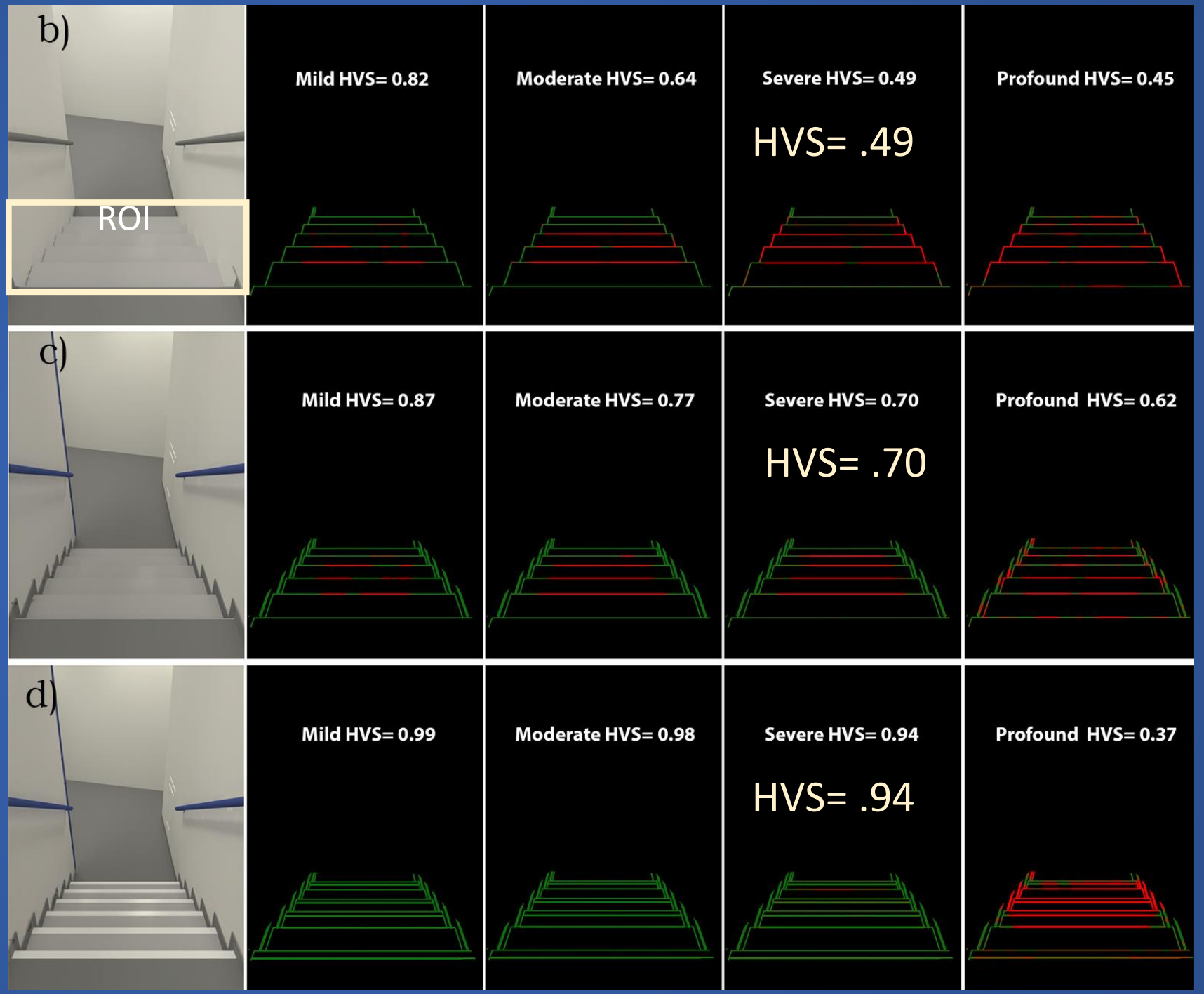




RED edges predicted **NOT** to be **visible**
Green edges predicted **visible** for Severe LV

Lighthouse, Miami

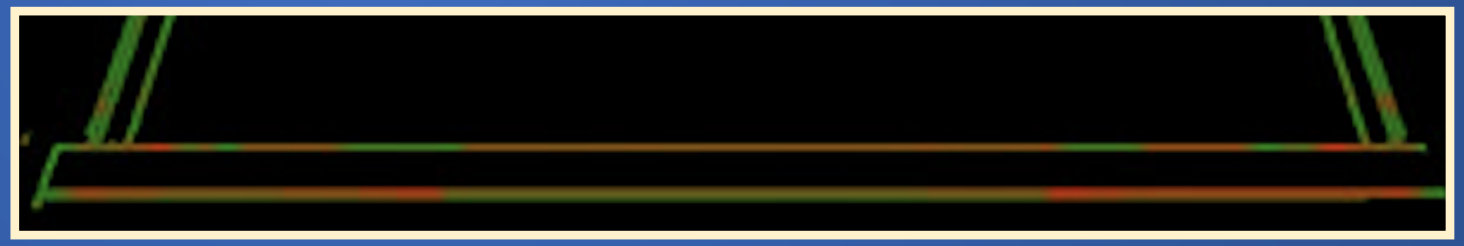
Iterative study to improve visibility using ROI & HVS.



Visible leading edge

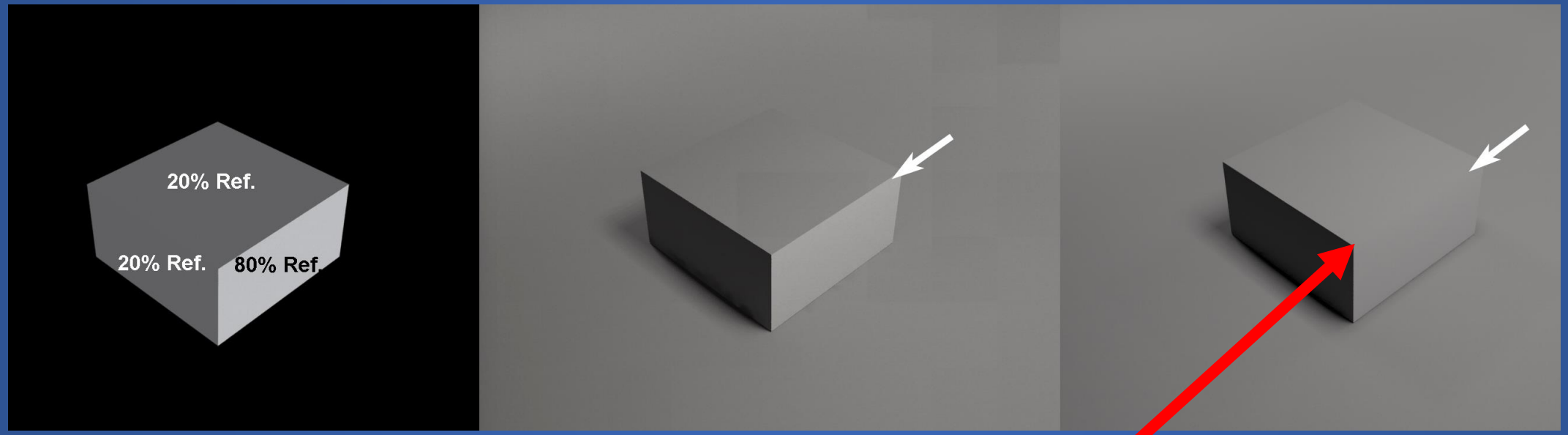
Is this leading edge visible?

Mild HVS = 0.991
Moderate HVS = 0.979
LB HVS = 0.977
Severe HVS = 0.947
Profound HVS = 0.741
Possibly visible



Refining the Region Of Interest.

DeVAS tools use Luminance to Predict Visibility.
… to assist in designing what we need to see



Designing by surface contrasts and illumination misses this visual hazard
Interior Designer and Lighting Designer both followed recommended practices
To avoid the hazard on the right we need to implement tools like DeVAS

DeVAS WORKS!

Optical Society: CPD Blur approach

Research Article Vol. 34, No. 4 / April 2017 / Journal of the Optical Society of America A 583

Journal of the Optical Society of America A

OPTICS, IMAGE SCIENCE, AND VISION

Simulating visibility under reduced acuity and contrast sensitivity

WILLIAM B. THOMPSON,[1,*] GORDON E. LEGGE,[2] DANIEL J. KERSTEN,[2] ROBERT A. SHAKESPEARE,[3] AND QUAN LEI[2]

Illumination Engineering: Visibility Prediction Application

LEUKOS
2022, VOL. 18, NO. 2, 154–172
https://doi.org/10.1080/15502724.2021.1890115

Illuminating Engineering Society

Taylor & Francis
Taylor & Francis Group

(first published online: April 2021)

Check for updates

Evaluating the Visibility of Architectural Features for People with Low Vision – A Quantitative Approach

William B. Thompson[a], Robert A. Shakespeare[b], Siyun Liu[c], Sarah H. Creem-Regehr[d], Daniel J. Kersten[c], and Gordon E. Legge[c]

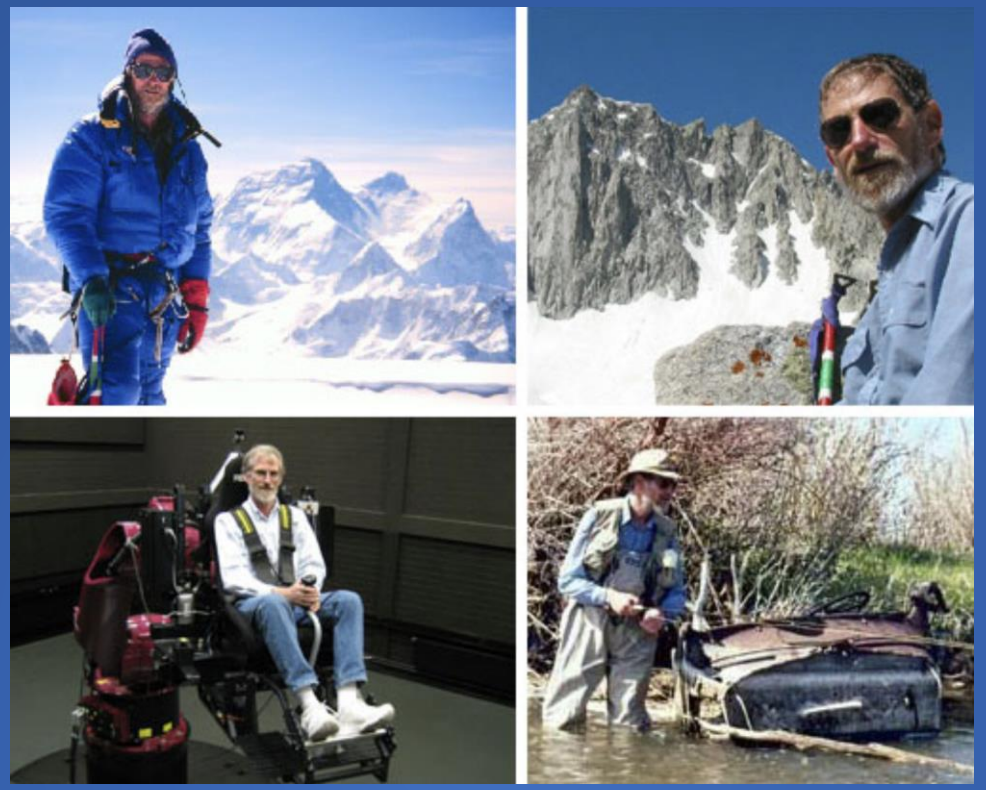
[a]School of Computing, University of Utah, Salt Lake City, Utah, USA; [b]Department of Theatre, Drama, and Contemporary Dance, Lighting Design, Indiana University, Bloomington, Indiana, USA; [c]Department of Psychology, University of Minnesota, Minneapolis, Minnesota, USA; [d]Department of Psychology, University of Utah, Utah, USA

Additional Extended Validation Confirmation

Validating a model of architectural hazard visibility with low-vision observers

Siyun Liu, Yichen Liu, Daniel J. Kersten, Robert A. Shakespeare, William B. Thompson, Gordon E. Legge

Published: November 22, 2021 • https://doi.org/10.1371/journal.pone.0260267



Bill Thompson, Professor, School of Computing, U of Utah

A core DeVA member, wrote the code for DeVAS Tools

In 2019 Bill worked with Greg to streamline Radiance-DeVAS

Greg developed a layered image to simplify data handling

The work was unable to be implemented

Bill died spring of this year

https://github.com/visual-accessibility/DeVAS-filter

Workflow can be simplified… seeks a developer

Further research : Add impact of Glare on Visibility Prediction

: Extend into Mesopic and Scotopic Regions

: Calibrate HVS for visibility benchmarks

Members of the research team are available for inquiries

DEVA-VISIBILITY(1) General Commands Manual DEVA-VISIBILITY(1)

NAME

deva-visibility – estimate locations of potential low-vision hazards

SYNOPSIS

deva-visibility *preset-option* [*options*] {*input.hdr* | –}
coordinates xyz.txt dist.txt nor.txt simulated-view.hdr hazards.png

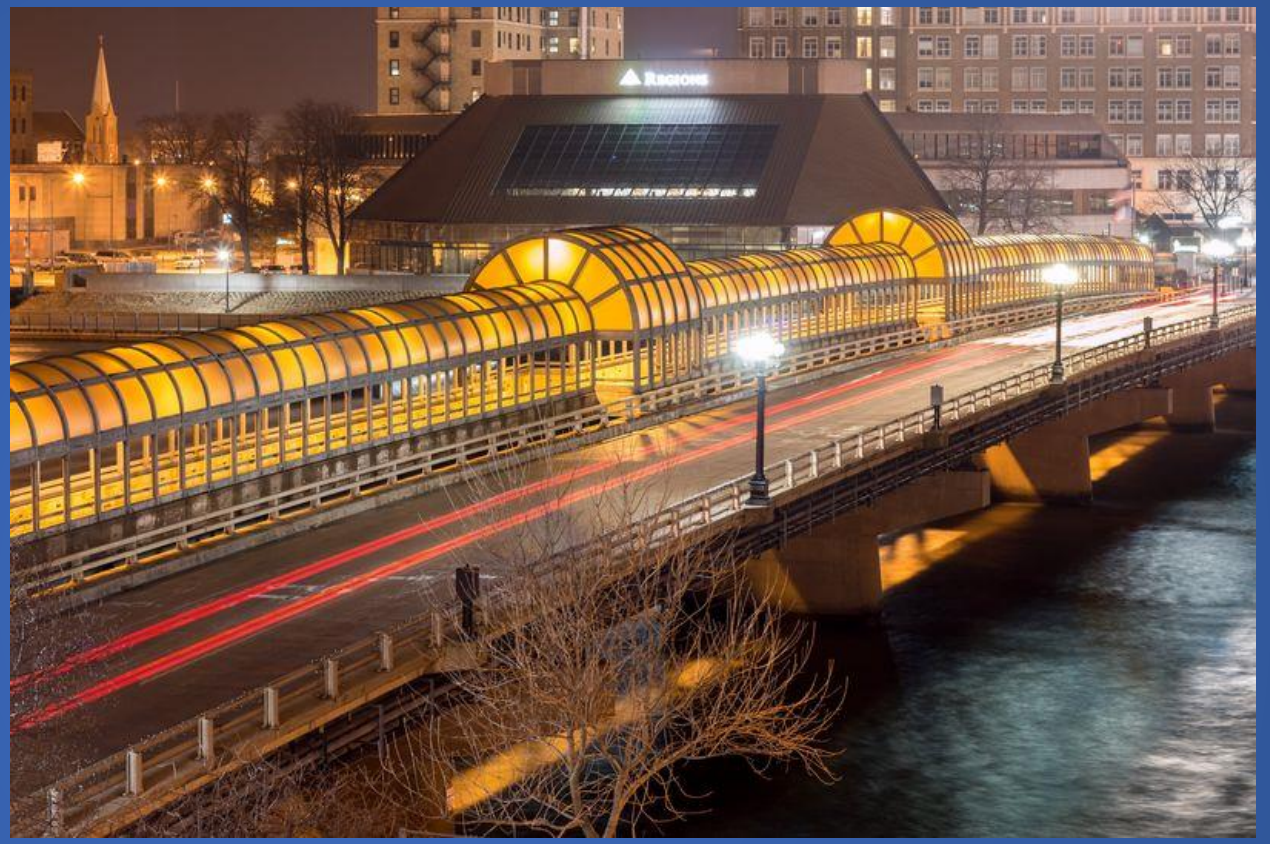
or

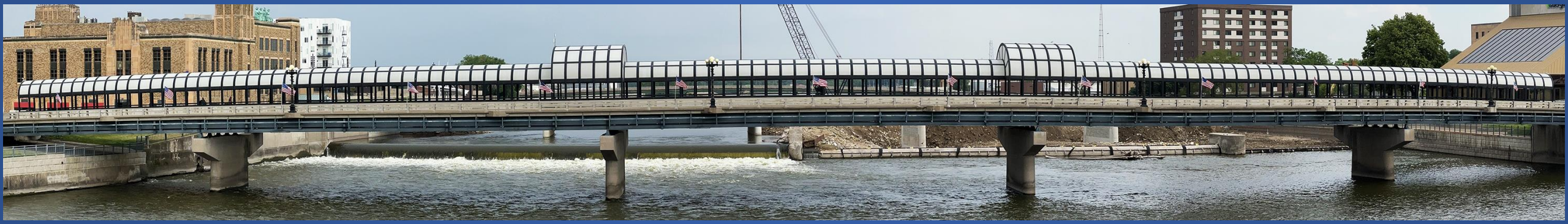
deva-visibility [*options*] *acuity contrast* {*input.hdr* | –} *coordinates*
xyz.txt dist.txt nor.txt simulated-view.hdr hazards.png

DESCRIPTION

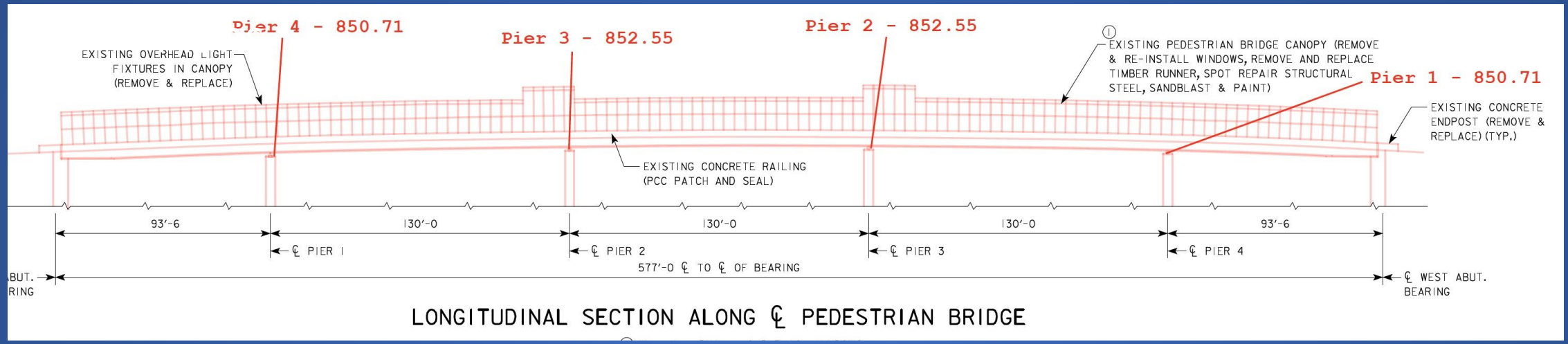
Extends functionality of **deva-filter** to provide estimates of likely low-vision hazards, defined as geometric

1977 Pedestrian Bridge, Waterloo, Iowa. As Was 2020.



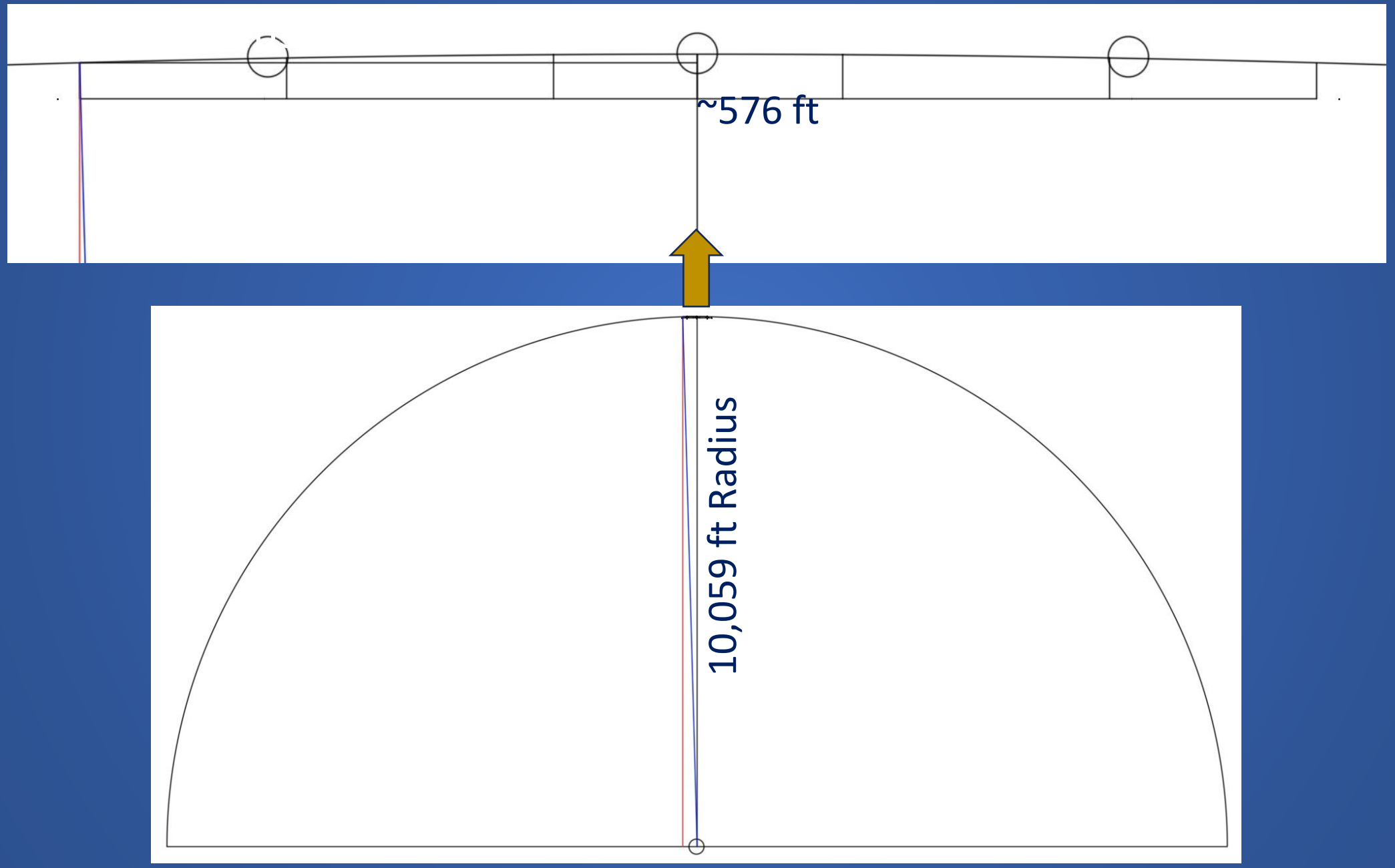


1977 Pedestrian Bridge, Waterloo, Iowa. : Hand Drafted

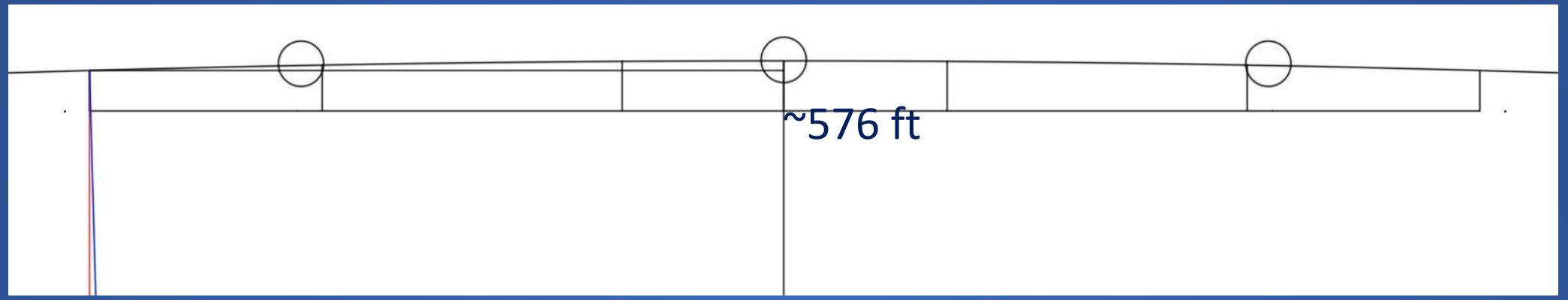


576’ - 176m Long, 12’ -3.7m wide with 2 Viewing Nodes

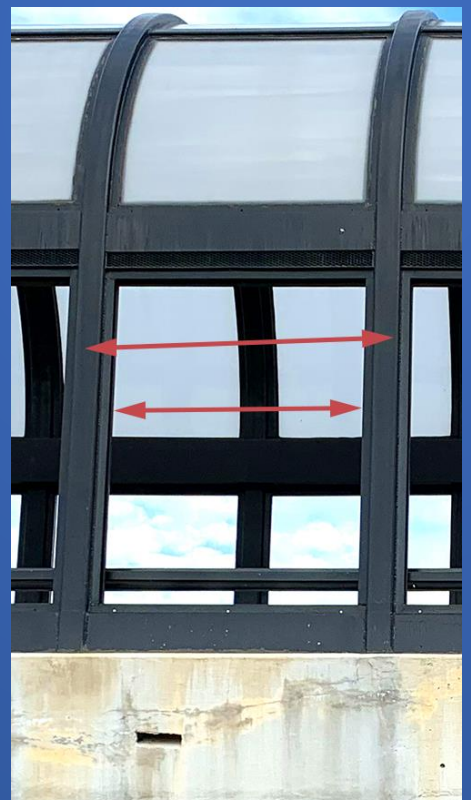
From Elevations determined the arc had a 10,059 ft



Mullions are 4.7’ o.c. Total of 122 sections across the arc

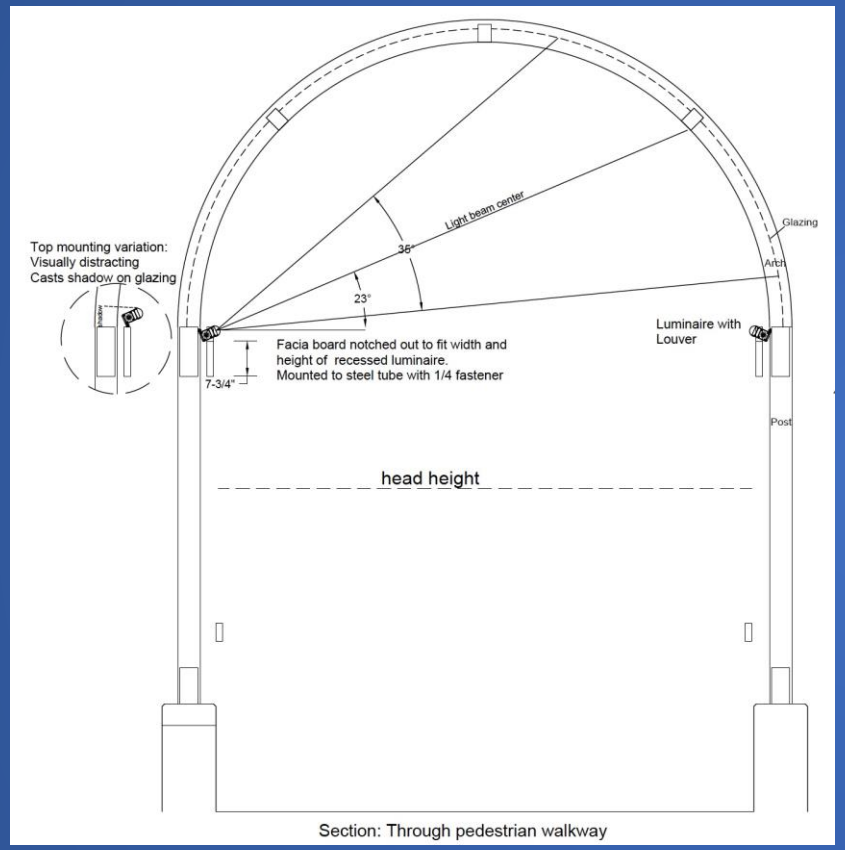


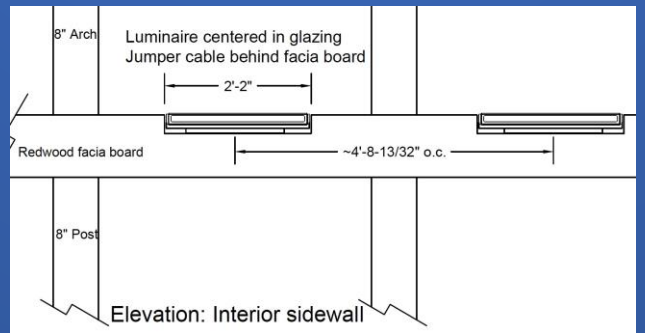
Each section is .026799 degrees of the arc



Modelled 2 sections, with Translucent top panels

And began preliminary lighting studies and tuning the TRANS canopy





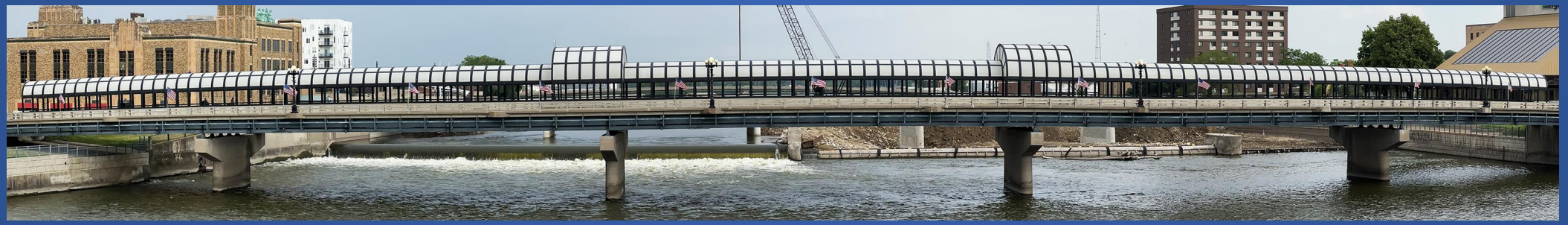
It was straight forward to array and locate the bridge single sections copying the single intensity from the ies2rad output

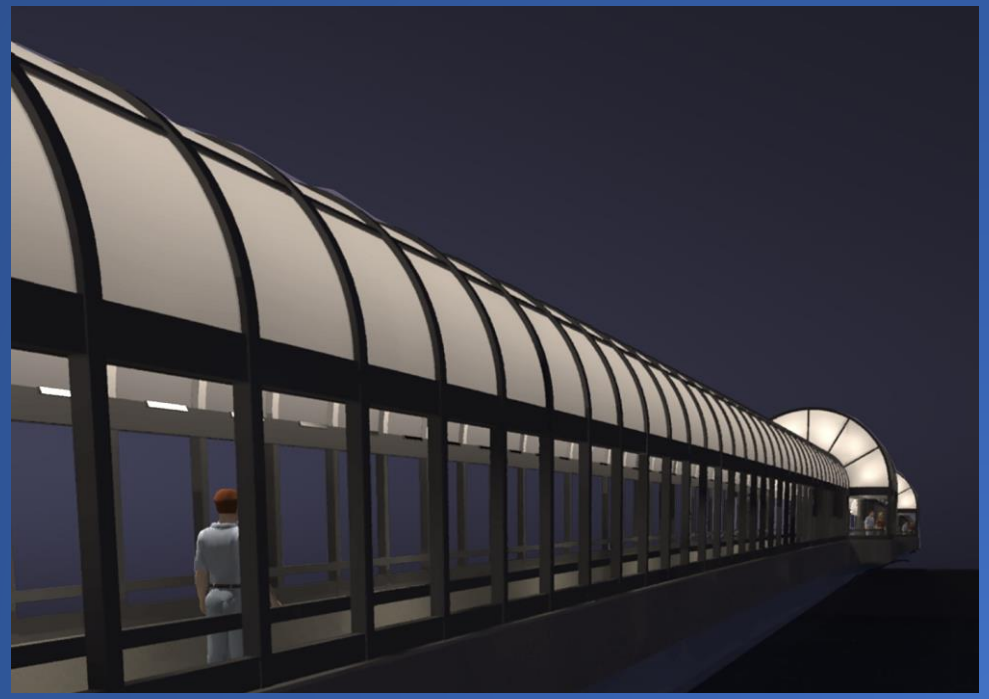
!ies2rad… –m .9… -o whitelight xxx.ies

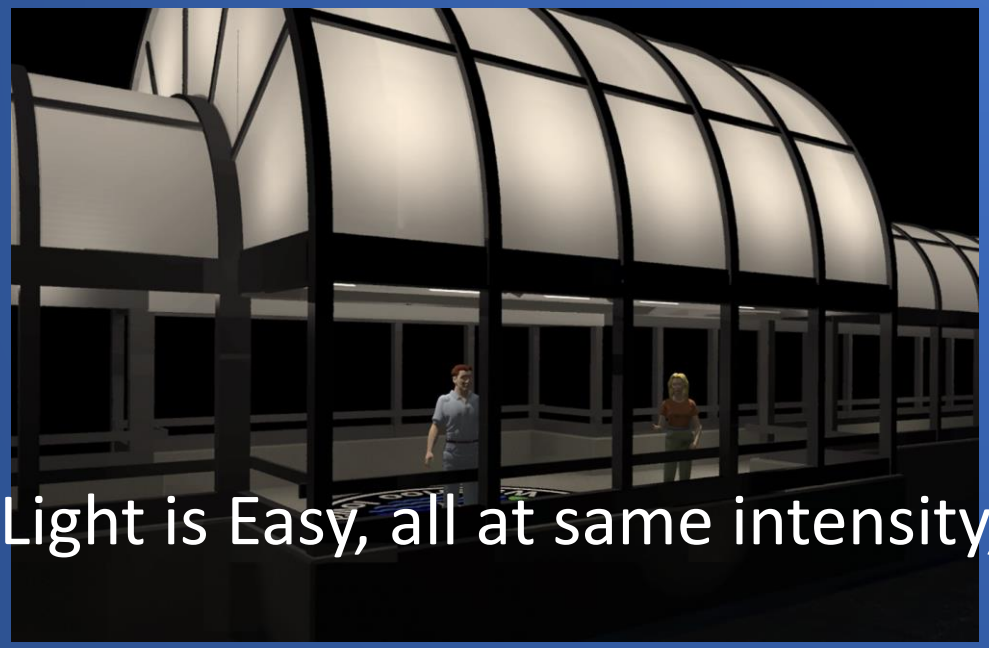
!xform… locate on arc end… -a 122 –rx .026799 whitelight.rad

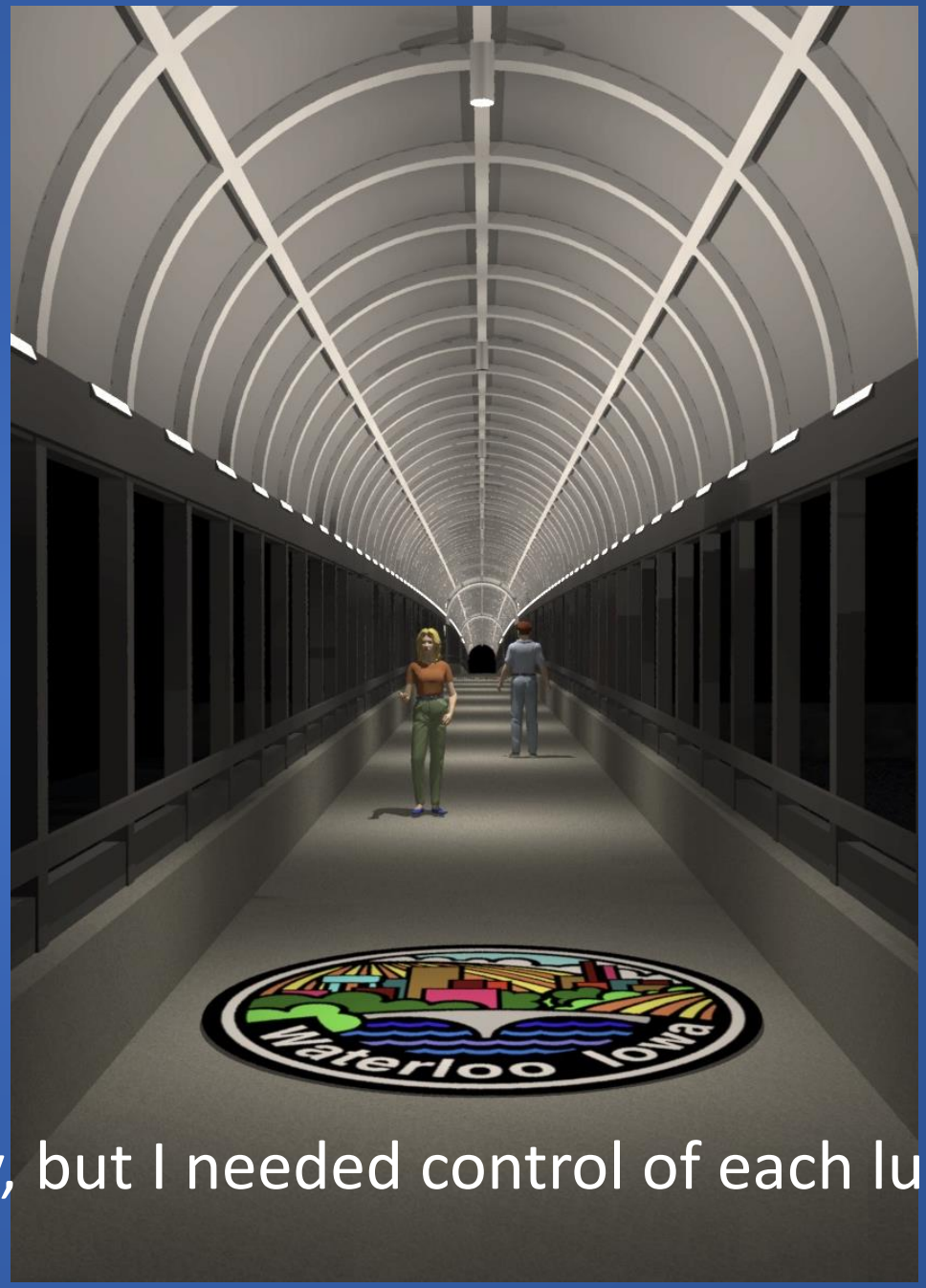
-a 122 *number of instances*

–rx .026799 *degrees on arc between sections*









White Light is Easy, all at same intensity, but I needed control of each luminaire

But how do I place individual instances with unique intensities?

Part of a spreadsheet for luminaires on the Right side with rgb color mix

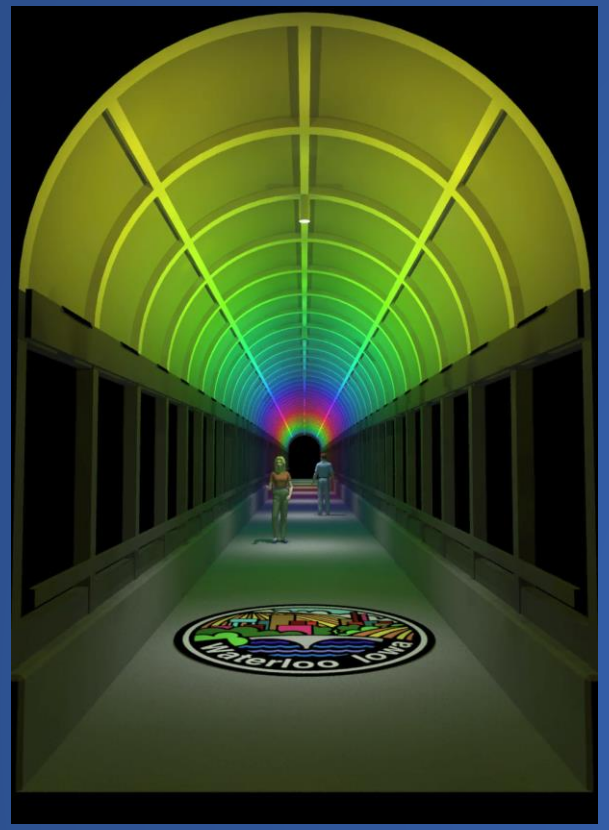
	A	B	C	D	E	F	G	H	I
1	!ies2rad -df -t default -m	0.9	-c	1.0	0.0	0.0	-o	xlights/R0	lights/LOG-100_277-24-RGB-35x35-DMX_RDM_LOGRD.ies
2	!ies2rad -df -t default -m	0.9	-c	0.5	0.5	0.5	-o	xlights/R1	lights/LOG-100_277-24-RGB-35x35-DMX_RDM_LOGRD.ies
3	!ies2rad -df -t default -m	0.9	-c	0.0	0.0	1.0	-o	xlights/R2	lights/LOG-100_277-24-RGB-35x35-DMX_RDM_LOGRD.ies
4	!ies2rad -df -t default -m	0.9	-c	0.0	0.0	1.0	-o	xlights/R3	lights/LOG-100_277-24-RGB-35x35-DMX_RDM_LOGRD.ies
5	!ies2rad -df -t default -m	0.9	-c	0.0	0.0	1.0	-o	xlights/R4	lights/LOG-100_277-24-RGB-35x35-DMX_RDM_LOGRD.ies
6	!ies2rad -df -t default -m	0.9	-c	0.0	0.0	1.0	-o	xlights/R5	lights/LOG-100_277-24-RGB-35x35-DMX_RDM_LOGRD.ies
7	!ies2rad -df -t default -m	0.9	-c	0.0	0.0	1.0	-o	xlights/R6	lights/LOG-100_277-24-RGB-35x35-DMX_RDM_LOGRD.ies
8	!ies2rad -df -t default -m	0.9	-c	1.0	0.0	0.0	-o	xlights/R7	lights/LOG-100_277-24-RGB-35x35-DMX_RDM_LOGRD.ies
9	!ies2rad -df -t default -m	0.9	-c	1.0	0.0	0.0	-o	xlights/R8	lights/LOG-100_277-24-RGB-35x35-DMX_RDM_LOGRD.ies
10	!ies2rad -df -t default -m	0.9	-c	1.0	0.0	0.0	-o	xlights/R9	lights/LOG-100_277-24-RGB-35x35-DMX_RDM_LOGRD.ies
11	!ies2rad -df -t default -m	0.9	-c	1.0	0.0	0.0	-o	xlights/R10	lights/LOG-100_277-24-RGB-35x35-DMX_RDM_LOGRD.ies
12	!ies2rad -df -t default -m	0.9	-c	1.0	0.0	0.0	-o	xlights/R11	lights/LOG-100_277-24-RGB-35x35-DMX_RDM_LOGRD.ies
13	!ies2rad -df -t default -m	0.9	-c	0.5	0.5	0.5	-o	xlights/R12	lights/LOG-100_277-24-RGB-35x35-DMX_RDM_LOGRD.ies
14	!ies2rad -df -t default -m	0.9	-c	0.5	0.5	0.5	-o	xlights/R13	lights/LOG-100_277-24-RGB-35x35-DMX_RDM_LOGRD.ies
15	!ies2rad -df -t default -m	0.9	-c	0.5	0.5	0.5	-o	xlights/R14	lights/LOG-100_277-24-RGB-35x35-DMX_RDM_LOGRD.ies
16	!ies2rad -df -t default -m	0.9	-c	0.5	0.5	0.5	-o	xlights/R15	lights/LOG-100_277-24-RGB-35x35-DMX_RDM_LOGRD.ies
17	!ies2rad -df -t default -m	0.9	-c	0.5	0.5	0.5	-o	xlights/R16	lights/LOG-100_277-24-RGB-35x35-DMX_RDM_LOGRD.ies
18	!ies2rad -df -t default -m	0.9	-c	0.0	0.0	1.0	-o	xlights/R17	lights/LOG-100_277-24-RGB-35x35-DMX_RDM_LOGRD.ies
19	!ies2rad -df -t default -m	0.9	-c	0.0	0.0	1.0	-o	xlights/R18	lights/LOG-100_277-24-RGB-35x35-DMX_RDM_LOGRD.ies
20	!ies2rad -df -t default -m	0.9	-c	0.0	0.0	1.0	-o	xlights/R19	lights/LOG-100_277-24-RGB-35x35-DMX_RDM_LOGRD.ies

xform –i to the rescue

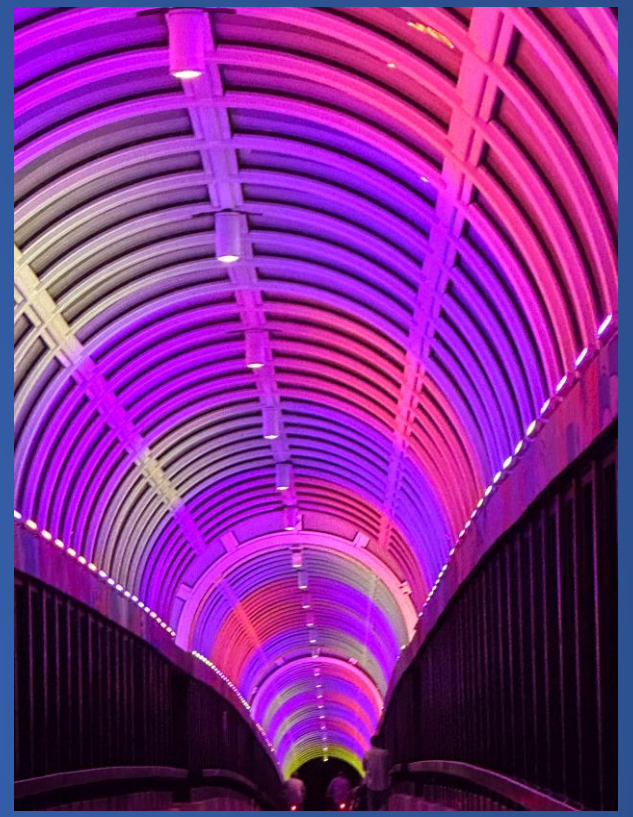
The luminaire was aimed then tilted and located in section 0 of the bridge arc

-i stepped through each 0.026799 degrees of arc locating each individually controlled luminaire. BRILLIANT! (no Math!)

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1	!xform	-ry	112	-t	5.0064	0	-.0517	-rx	1.63801896	-t	0	-286.8	10055.4890	-i	0	-rx	-0.026799	./xlights/R0.rad
2	!xform	-ry	112	-t	5.0064	0	-.0517	-rx	1.63801896	-t	0	-286.8	10055.4890	-i	1	-rx	-0.026799	./xlights/R1.rad
3	!xform	-ry	112	-t	5.0064	0	-.0517	-rx	1.63801896	-t	0	-286.8	10055.4890	-i	2	-rx	-0.026799	./xlights/R2.rad
4	!xform	-ry	112	-t	5.0064	0	-.0517	-rx	1.63801896	-t	0	-286.8	10055.4890	-i	3	-rx	-0.026799	./xlights/R3.rad
5	!xform	-ry	112	-t	5.0064	0	-.0517	-rx	1.63801896	-t	0	-286.8	10055.4890	-i	4	-rx	-0.026799	./xlights/R4.rad
6	!xform	-ry	112	-t	5.0064	0	-.0517	-rx	1.63801896	-t	0	-286.8	10055.4890	-i	5	-rx	-0.026799	./xlights/R5.rad
7	!xform	-ry	112	-t	5.0064	0	-.0517	-rx	1.63801896	-t	0	-286.8	10055.4890	-i	6	-rx	-0.026799	./xlights/R6.rad
8	!xform	-ry	112	-t	5.0064	0	-.0517	-rx	1.63801896	-t	0	-286.8	10055.4890	-i	7	-rx	-0.026799	./xlights/R7.rad
9	!xform	-ry	112	-t	5.0064	0	-.0517	-rx	1.63801896	-t	0	-286.8	10055.4890	-i	8	-rx	-0.026799	./xlights/R8.rad
10	!xform	-ry	112	-t	5.0064	0	-.0517	-rx	1.63801896	-t	0	-286.8	10055.4890	-i	9	-rx	-0.026799	./xlights/R9.rad
11	!xform	-ry	112	-t	5.0064	0	-.0517	-rx	1.63801896	-t	0	-286.8	10055.4890	-i	10	-rx	-0.026799	./xlights/R10.rad
12	!xform	-ry	112	-t	5.0064	0	-.0517	-rx	1.63801896	-t	0	-286.8	10055.4890	-i	11	-rx	-0.026799	./xlights/R11.rad
13	!xform	-ry	112	-t	5.0064	0	-.0517	-rx	1.63801896	-t	0	-286.8	10055.4890	-i	12	-rx	-0.026799	./xlights/R12.rad
14	!xform	-ry	112	-t	5.0064	0	-.0517	-rx	1.63801896	-t	0	-286.8	10055.4890	-i	13	-rx	-0.026799	./xlights/R13.rad
15	!xform	-ry	112	-t	5.0064	0	-.0517	-rx	1.63801896	-t	0	-286.8	10055.4890	-i	14	-rx	-0.026799	./xlights/R14.rad


Waterloo Iowa

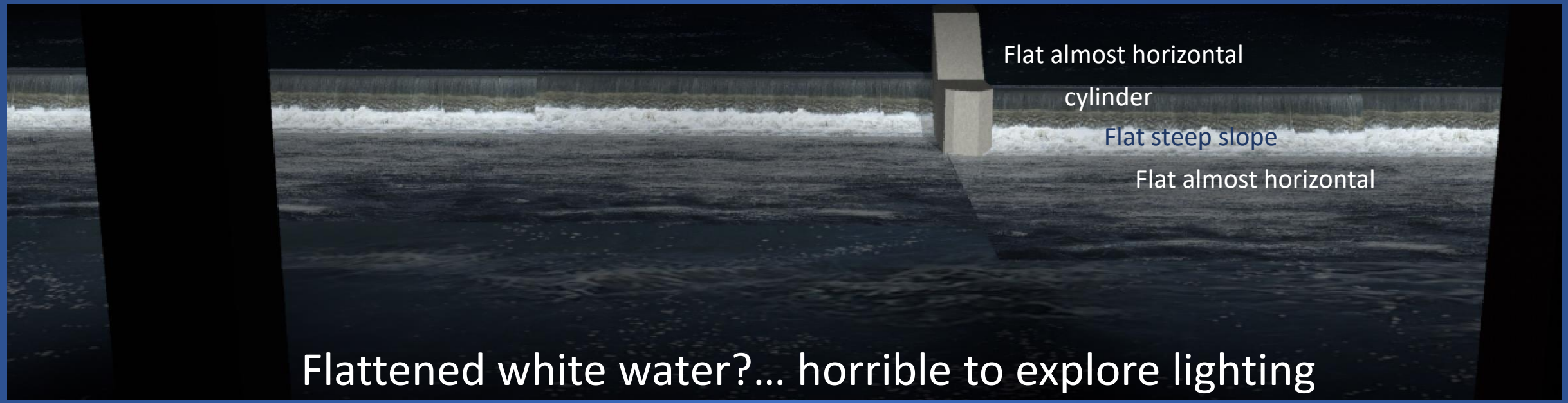

Waterloo Iowa




NO
FISHING
ON
BRIDGE

What about the white water? Needed to show the client some possibilities…

Radiance Model with mapped images



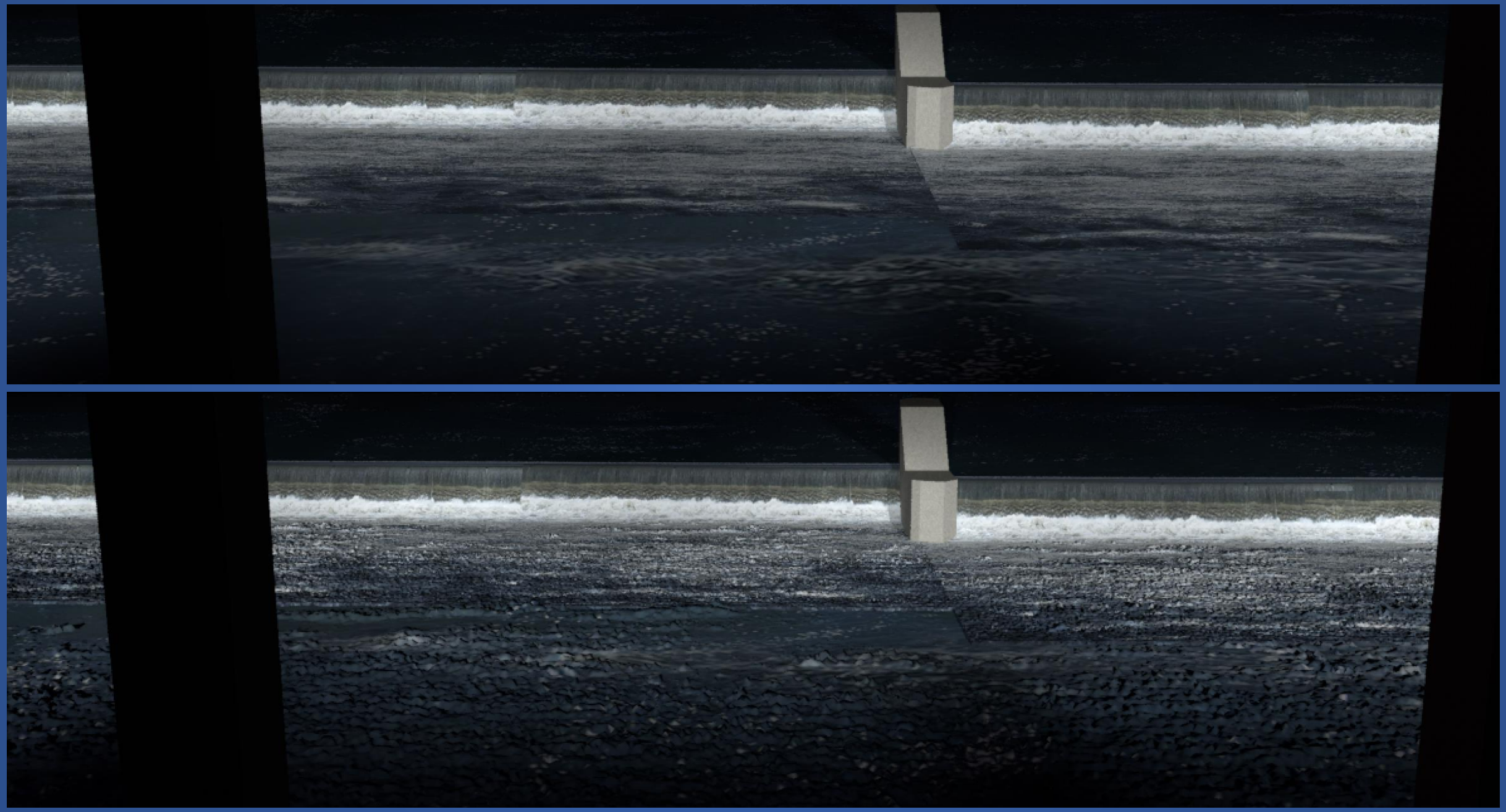
Radiance Model with mapped images

GREG MAGIC!

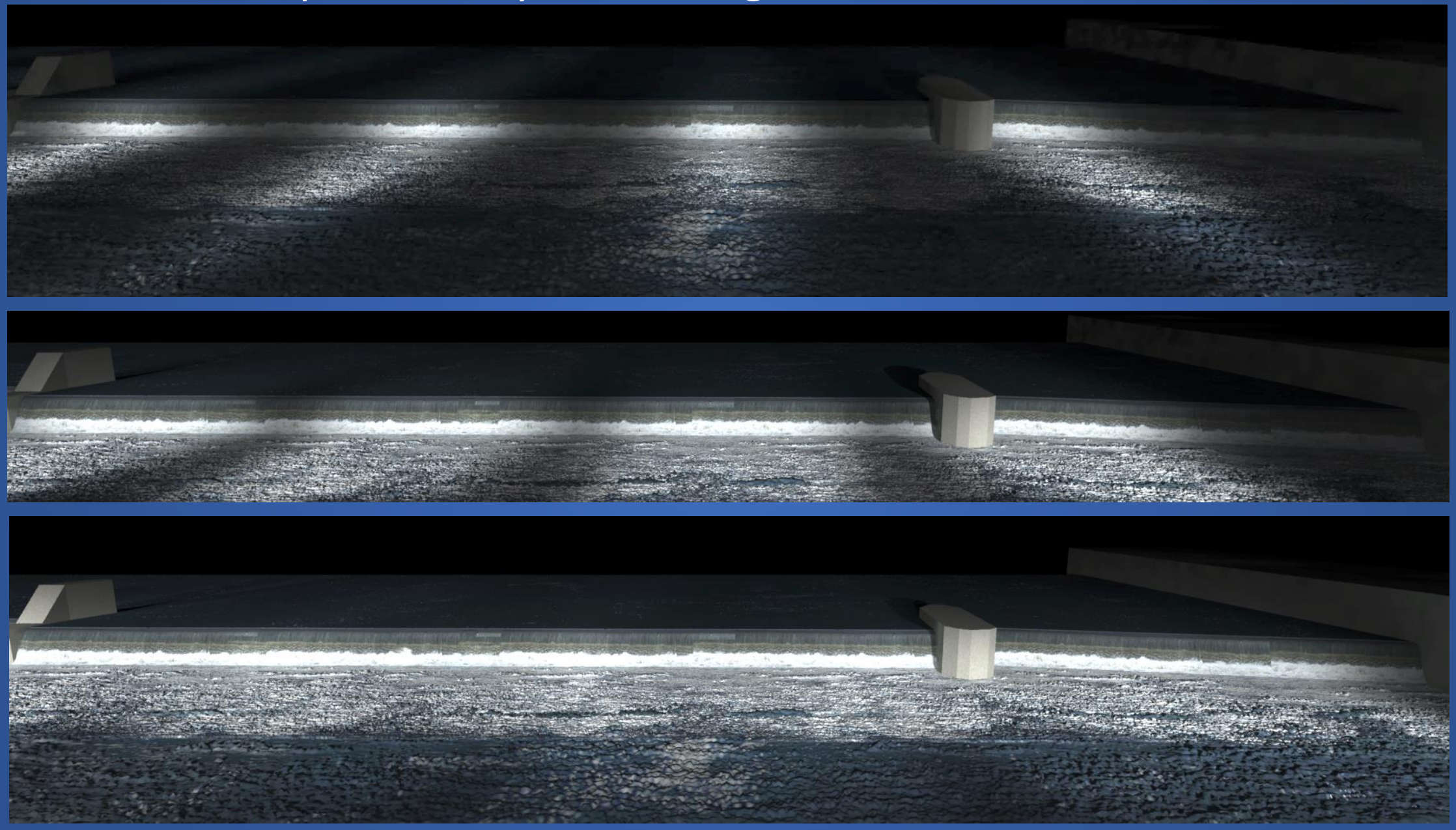
```
!ra_tiff -r sample-waterDS3.tif \
| pcomb -x 250 -y 200 -e 'lo=0.9*ri(1)' - \
| pvalue -h -H -b -d \
| gensurf water rapids 's*100' 't*80' - 249 199 -s -o \
| obj2mesh > rapids2.rtm
```

lo=0.9*ri(1) *0.9= height of mesh based on red value of pixel*

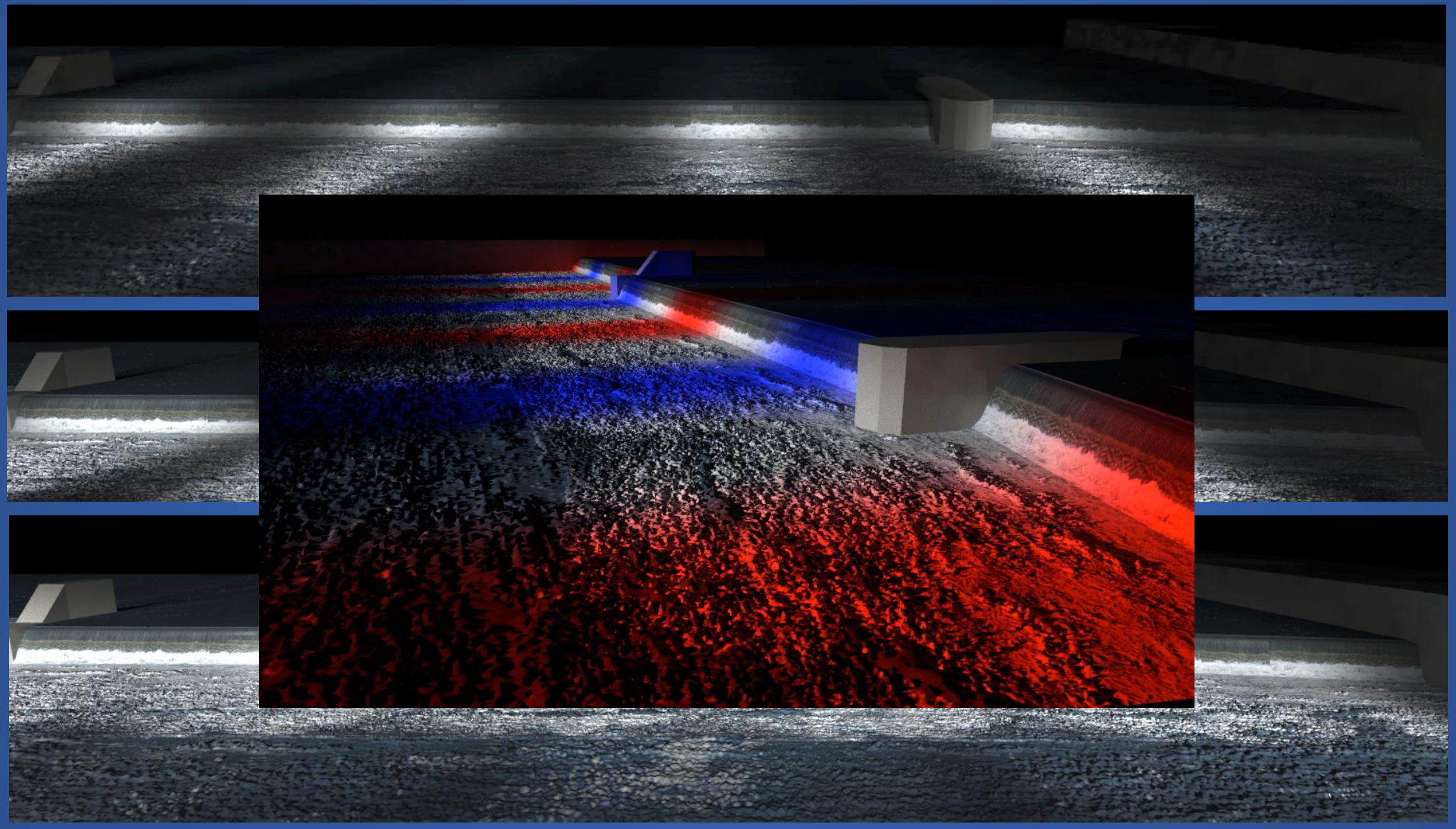
YES!!!



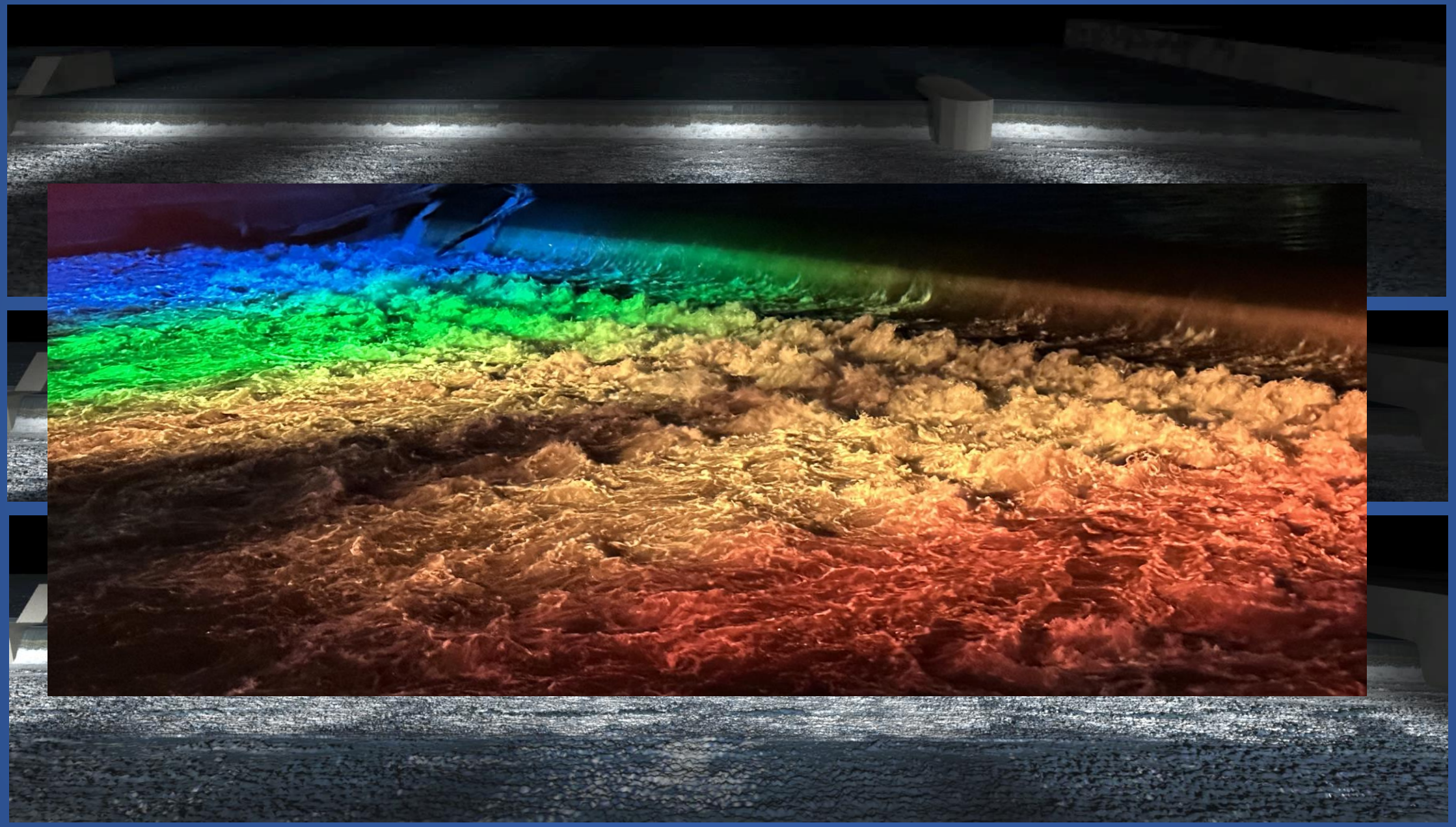
Tested various photometry and aiming



Tested color effects to share with clients…



The real deal……



21st International Radiance Workshop
Innsbruck, Austria

THANK YOU

Talk to me if interested in extending DeVAS

by

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