Applying DeVAS Tools:
Low Vision Face Recognition

EVA New Research Initiative Extending DeVAS

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Designing Visually Accessibility Spaces
original mission:

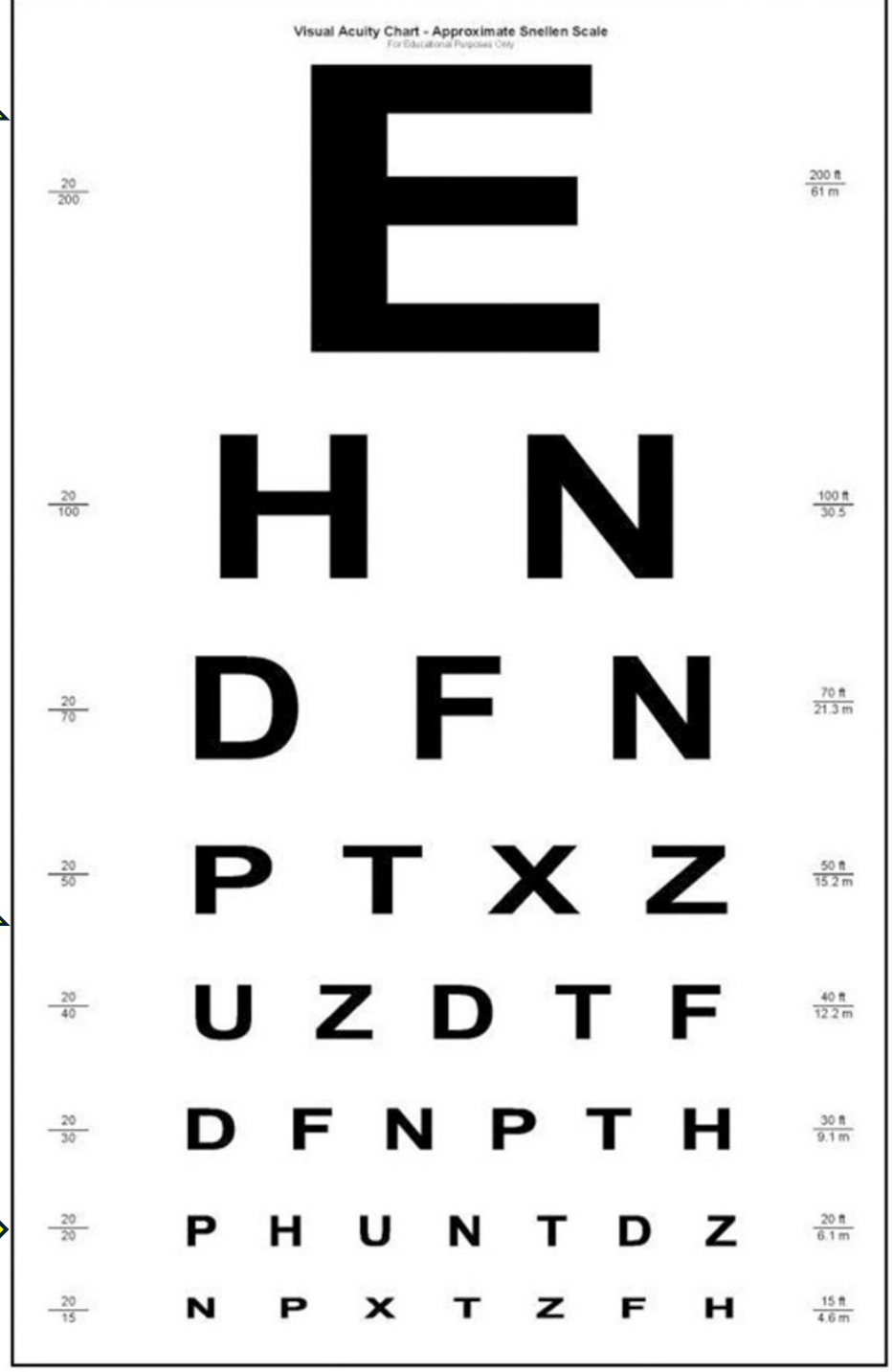
To enable the designer to analyze and improve the visibility of hazards to aid in the creation of architectural spaces that are accessible to those with vision impairment, who make use of vision for mobility.

Today I will share how these tools can aid in optimizing face recognition and a few other unexpected applications.

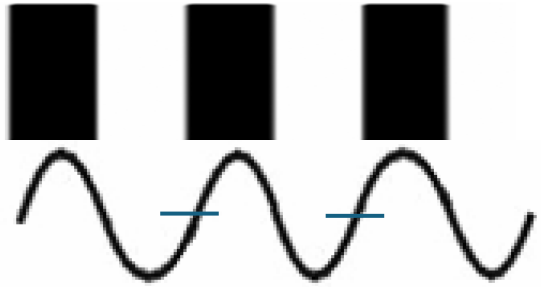
Legally Blind

Cannot Drive

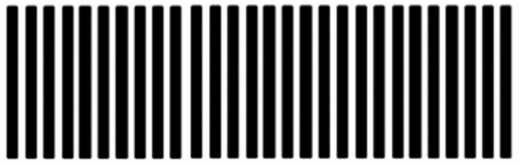
Normal Vision



20/200 ~3 CPD



20/20 ~30 CPD

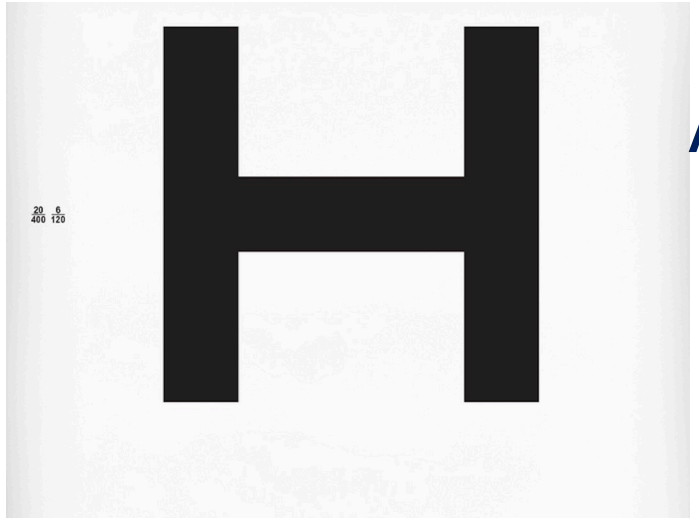


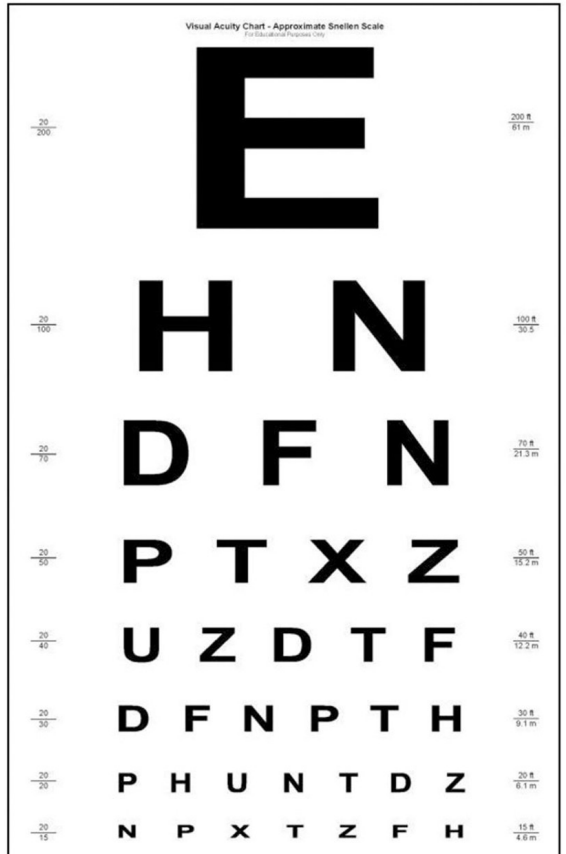
Severe Low Vision

Legally Blind

Cannot Drive

Normal Vision





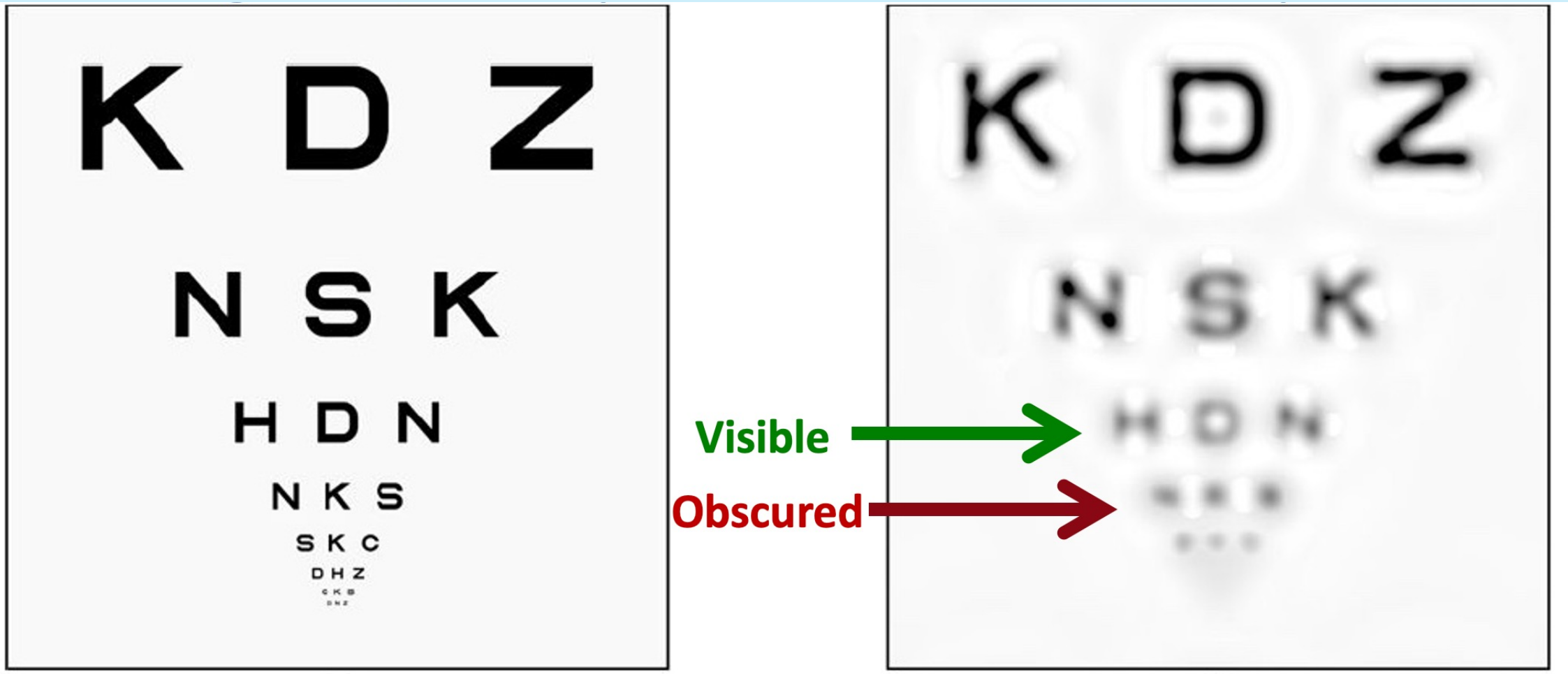
Acuity Used In Studies

20/400 ~1.5 CPD

At a specified acuity,

DeVAS removes image details predicted NOT to be visible,

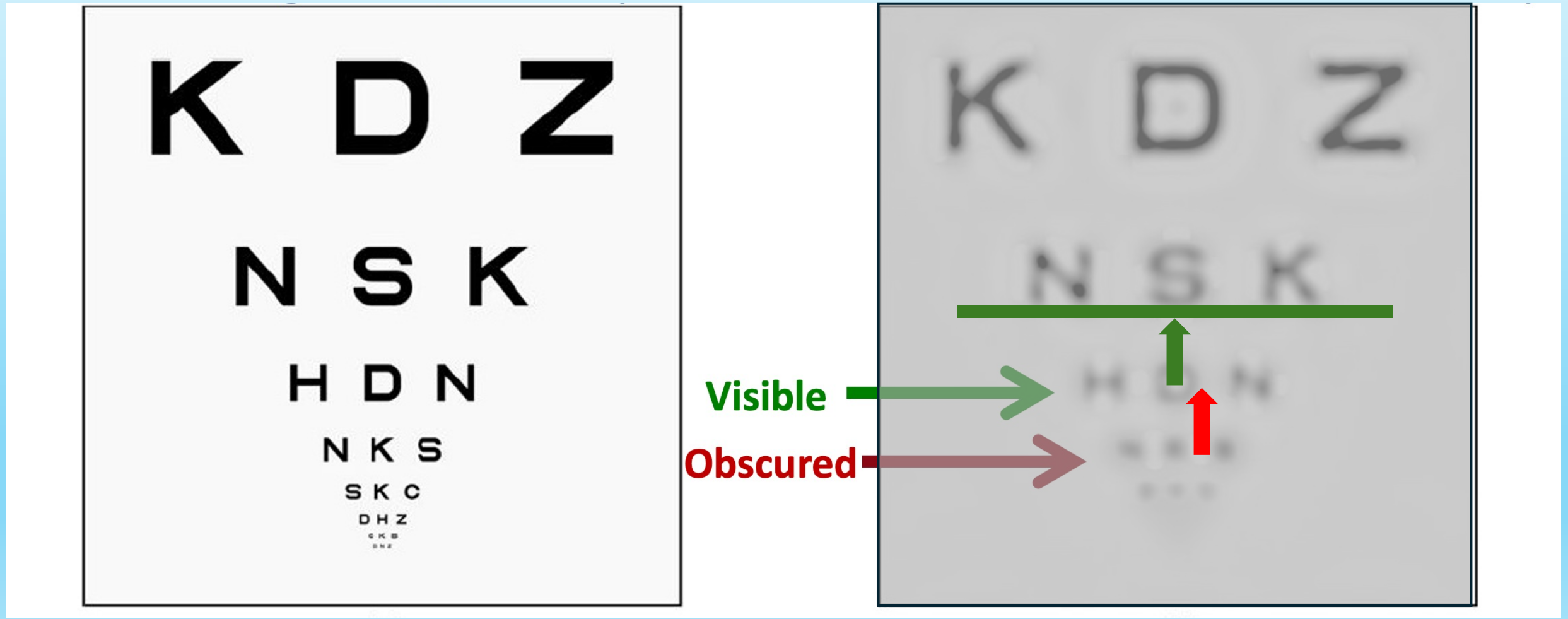
while leaving intact, details predicted to be visible



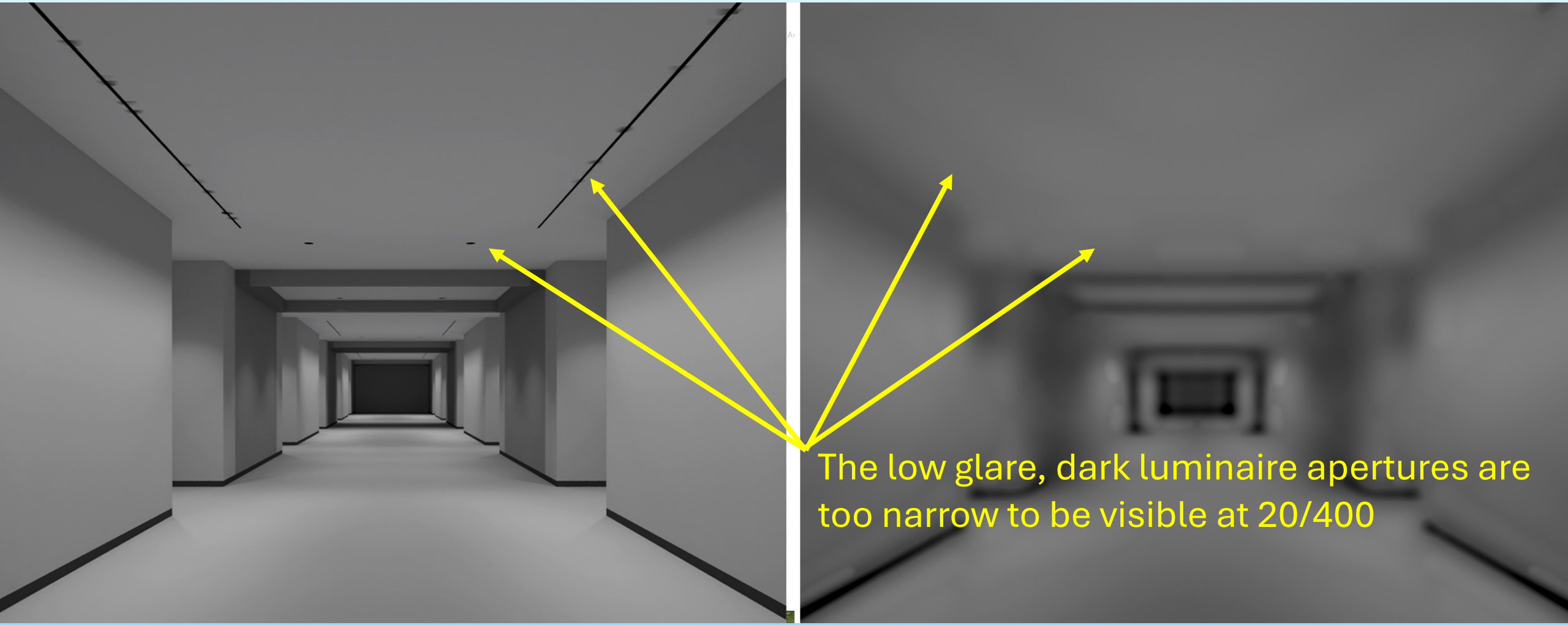
DeVAS processed at a specific acuity

DeVAS removes image details predicted to be not visible

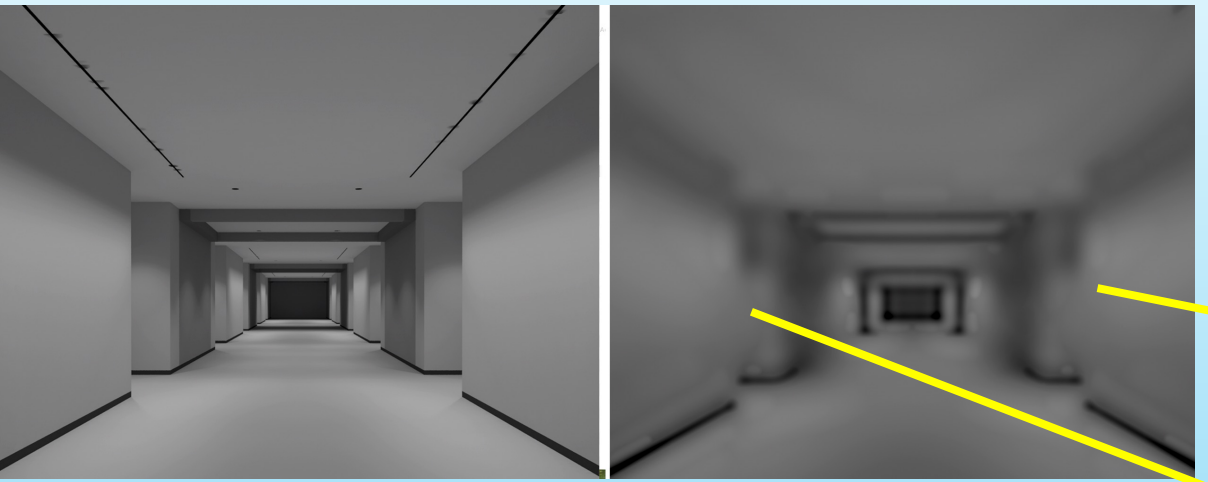
As Contrast Decreases, Acuity Lowers… details are harder to see

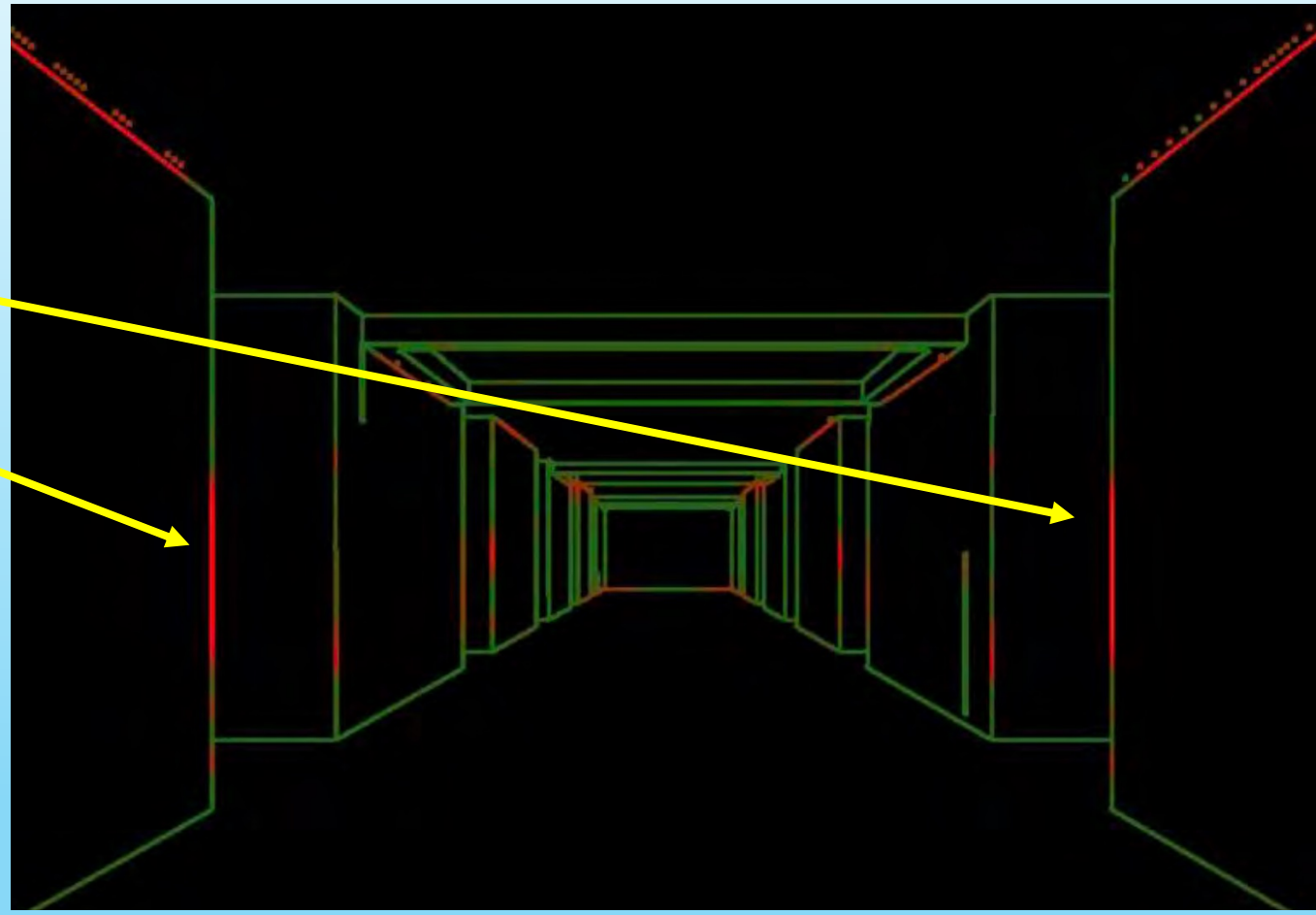


DeVAS removes image details predicted to be not visible



DeVAS can objectively determine the Visibility of Edges for a specified acuity

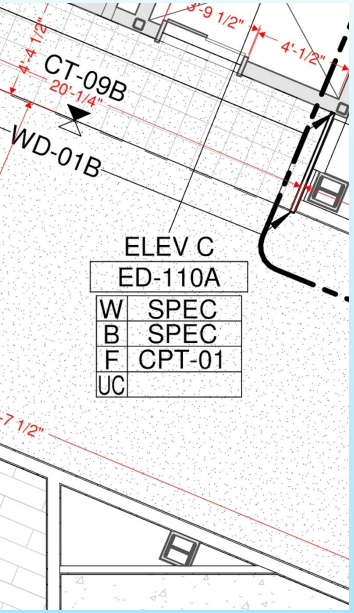


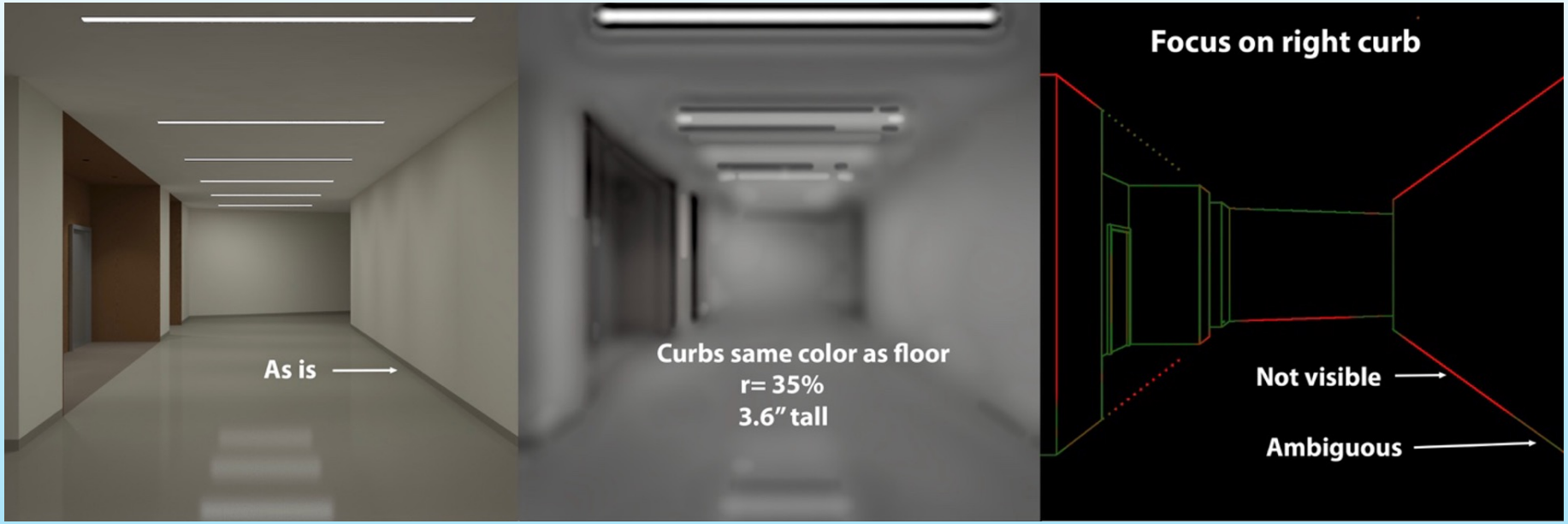


Green edges predicted visible

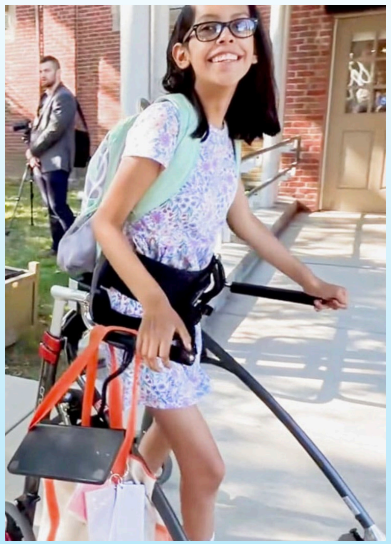
Red edges predicted not visible

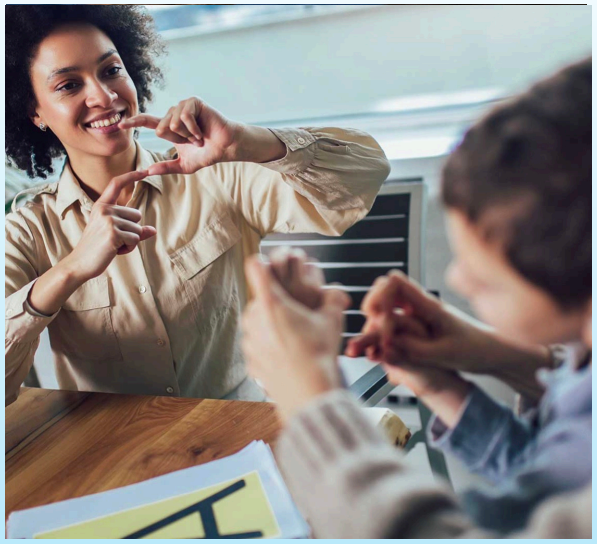
DeVAS can be used iteratively to optimize the visibility of edges





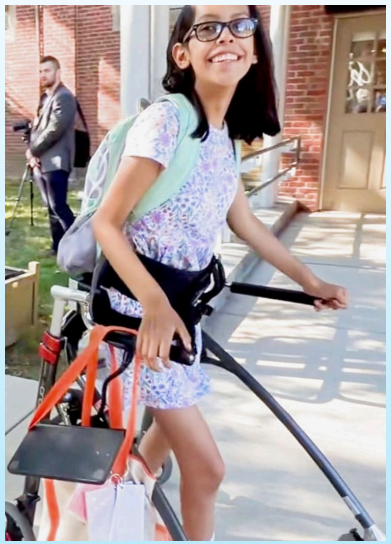
Study to optimize Terrazzo curb height and reflectivity for increased visibility

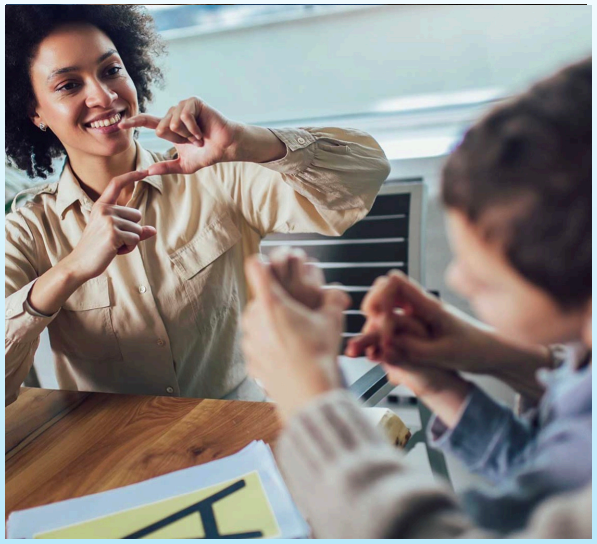




Face Recognition: observations from low some vision articles, 1992 through 2024:

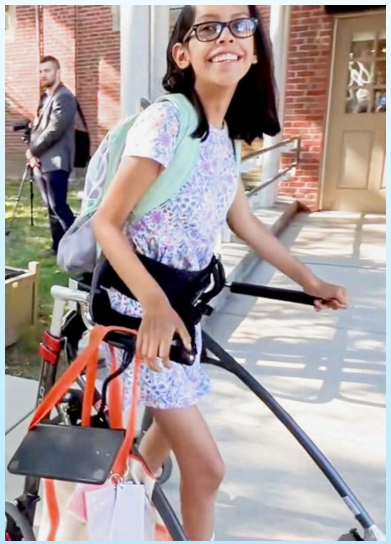
The inability to recognize known individuals, setting aside audio or haptic cues, severely limits the visually impaired in their social interactions, which can lead to social disengagement, and can put them at risk from a security perspective.

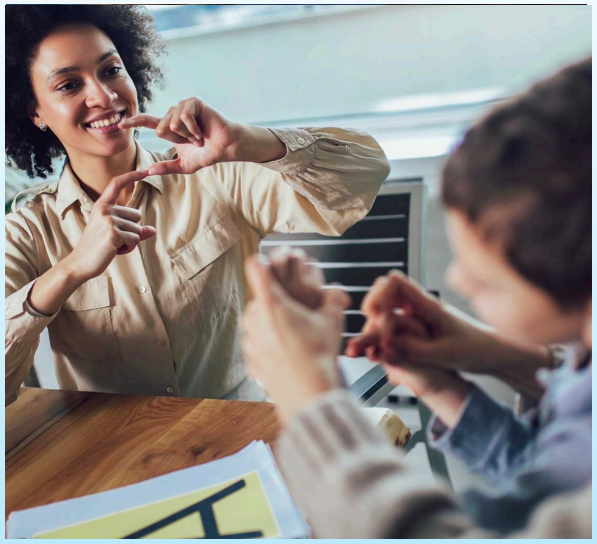


Face Recognition: observations from low some vision articles, 1992 through 2024:

Reduced contrast sensitivity in low vision may be an important factor in limiting performance in everyday tasks such as face recognition. **Face recognition is illumination-dependent, indicating that face-recognition processes are sensitive to either the direction of lighting or the resultant pattern of shading.** ***This can be enhanced by compensating for the viewer's reduced contrast sensitivity…*** **increasing the contrast of the face with lighting, while avoiding shadows that mask or distort features.**



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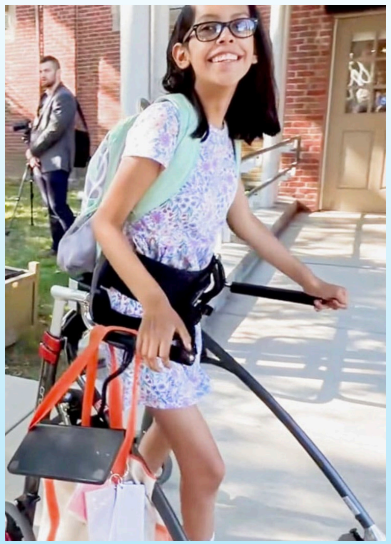


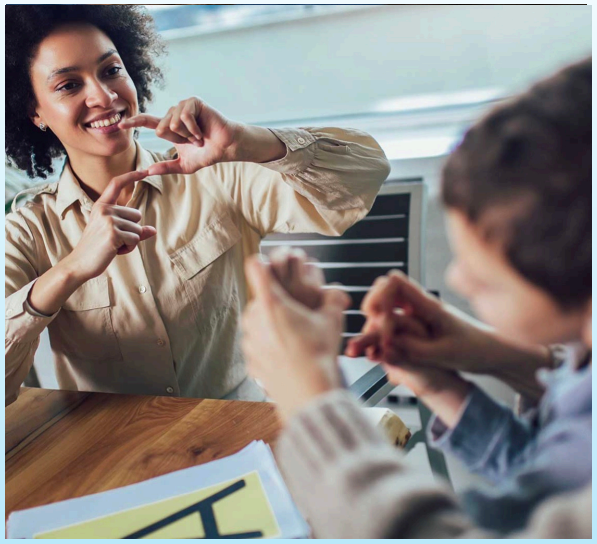

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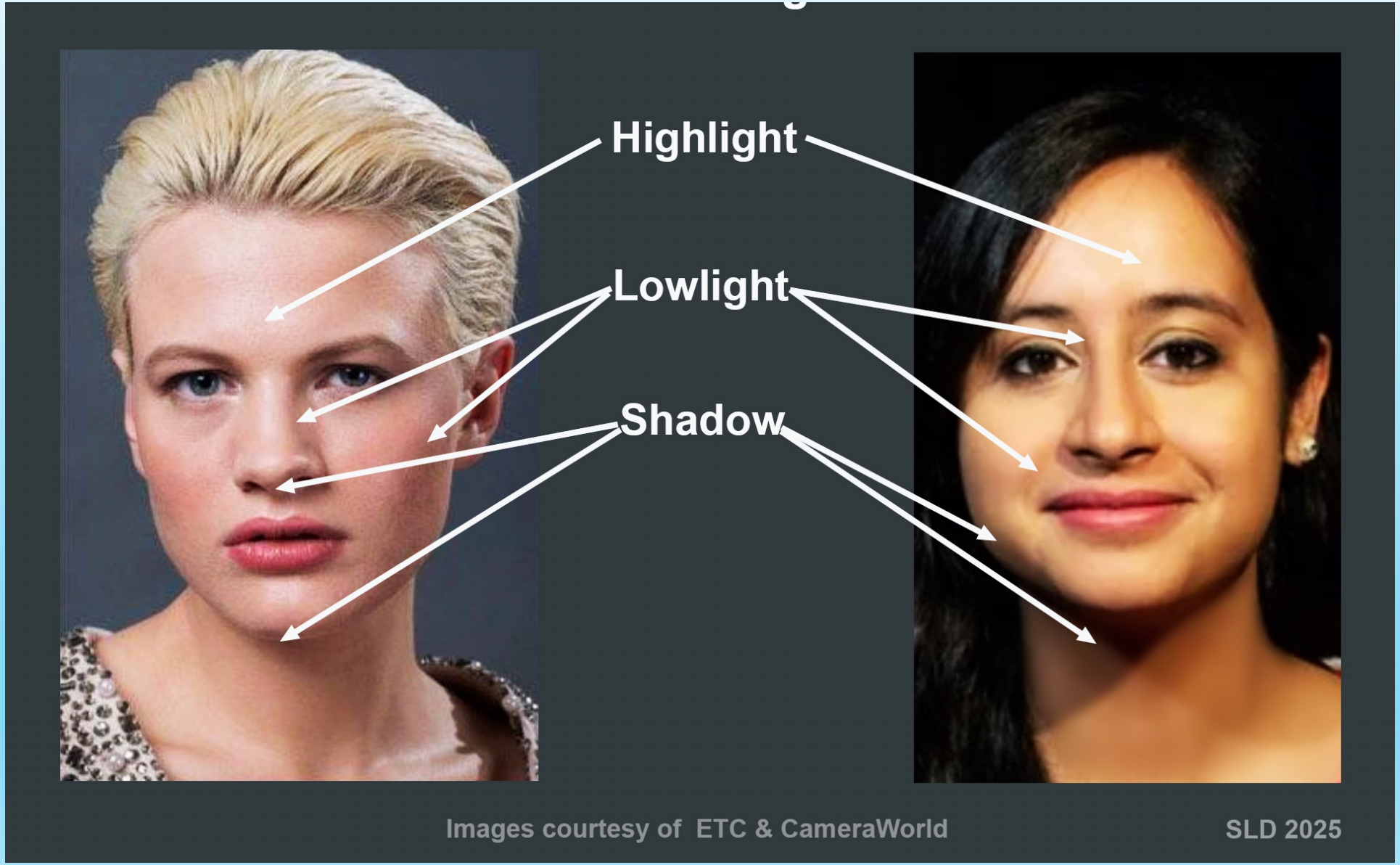
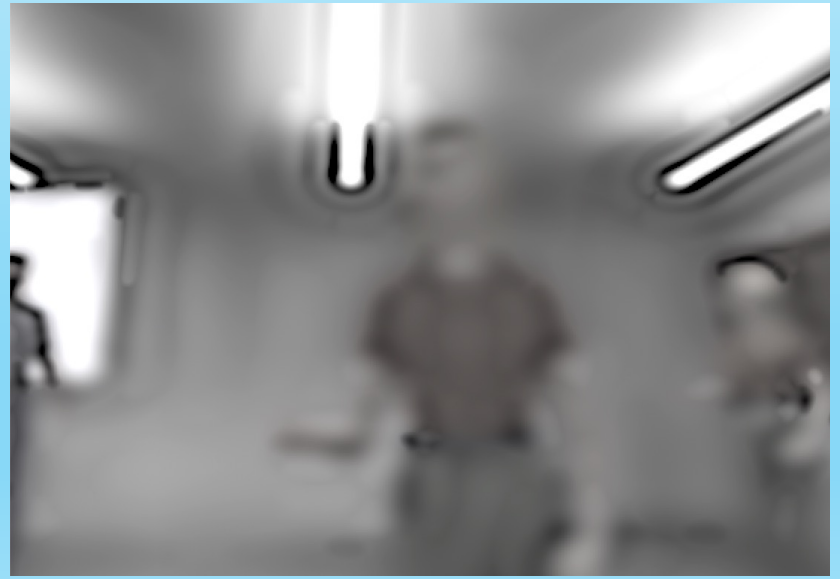
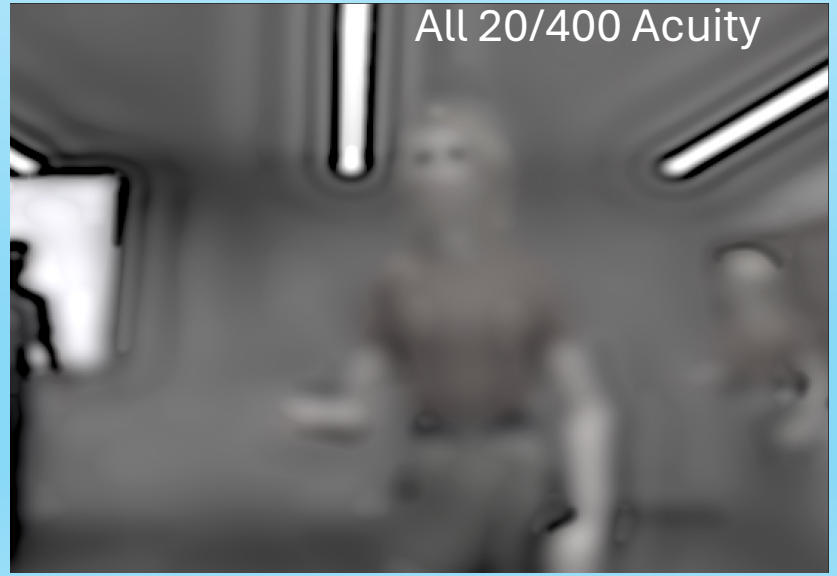
Face Visibility is optimized with illumination from multiple overlapping directions and contrast to reveal facial contours and expressions



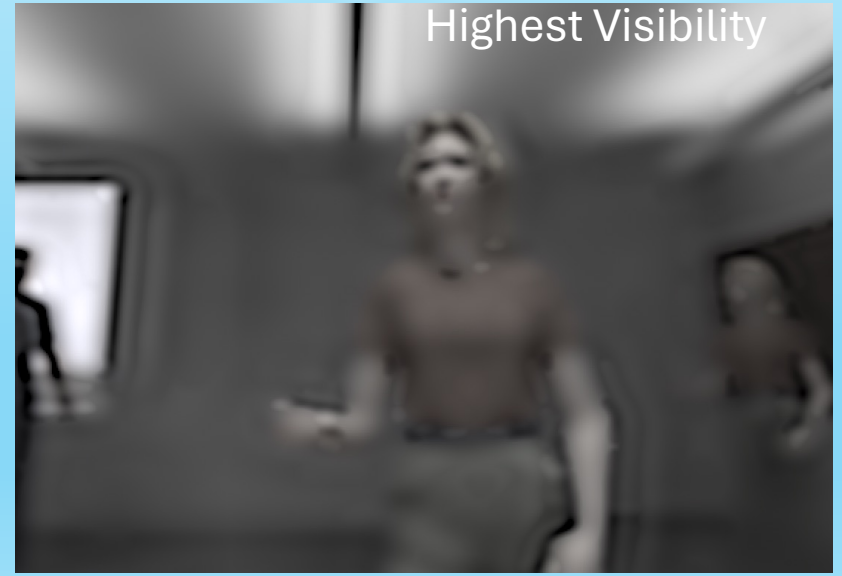
DeVAS can be used to subjectively explore the visibility of faces…



Dir-Ind with No DL

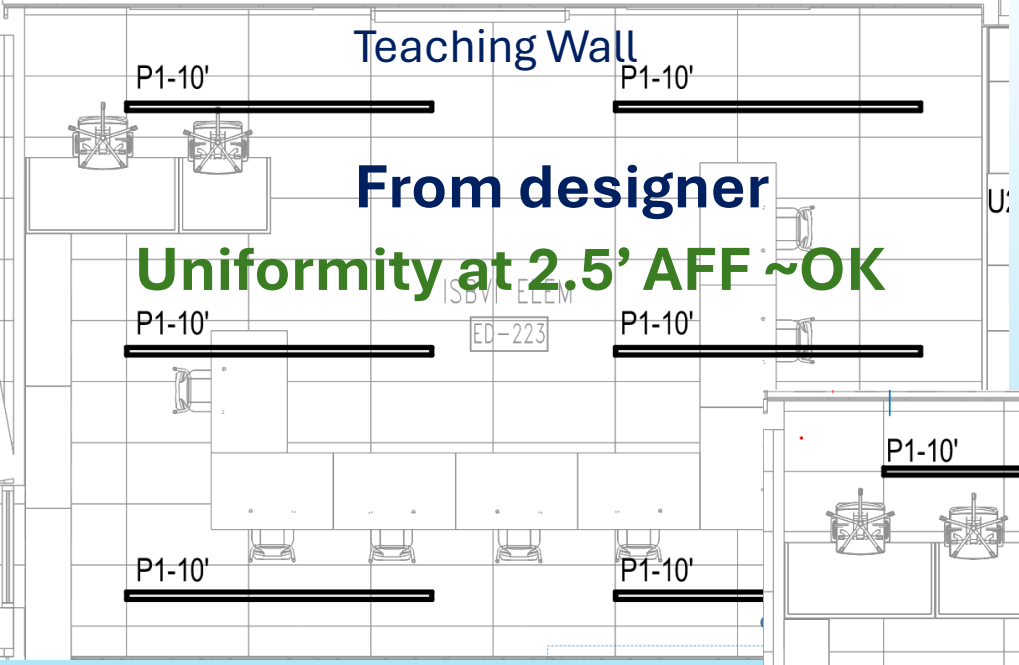


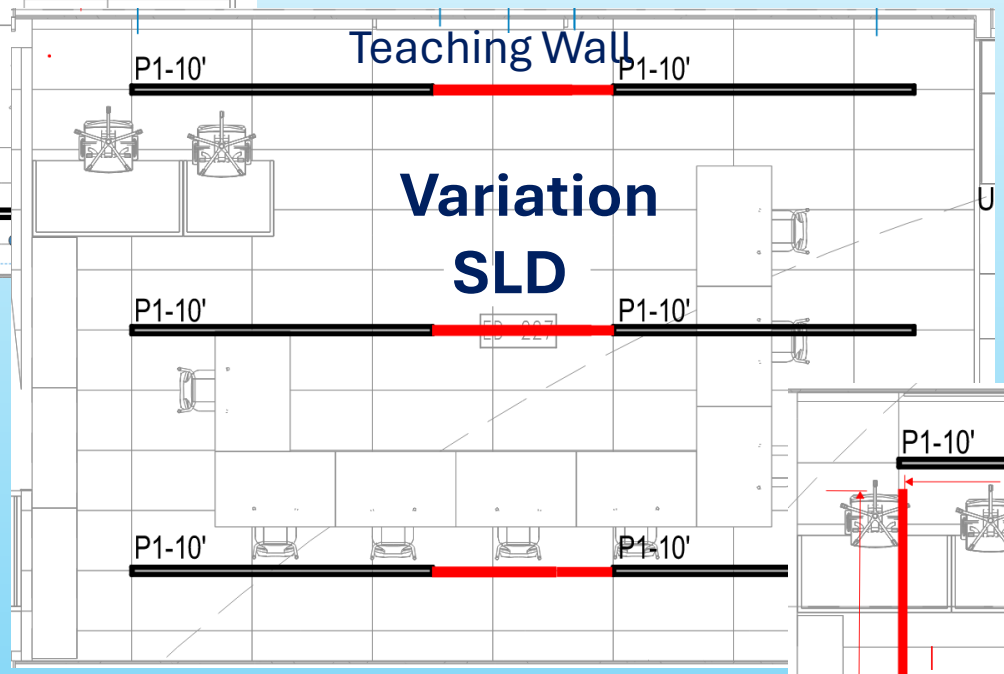
Dir with DL

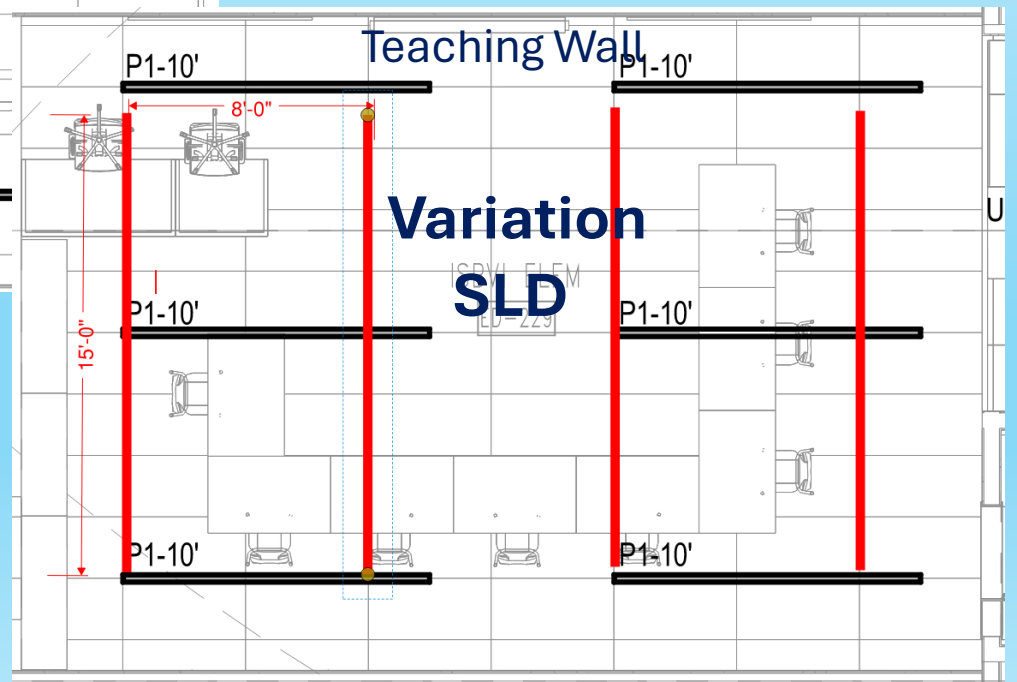


Ind with DL

Classroom Lighting for Visually Impaired Students

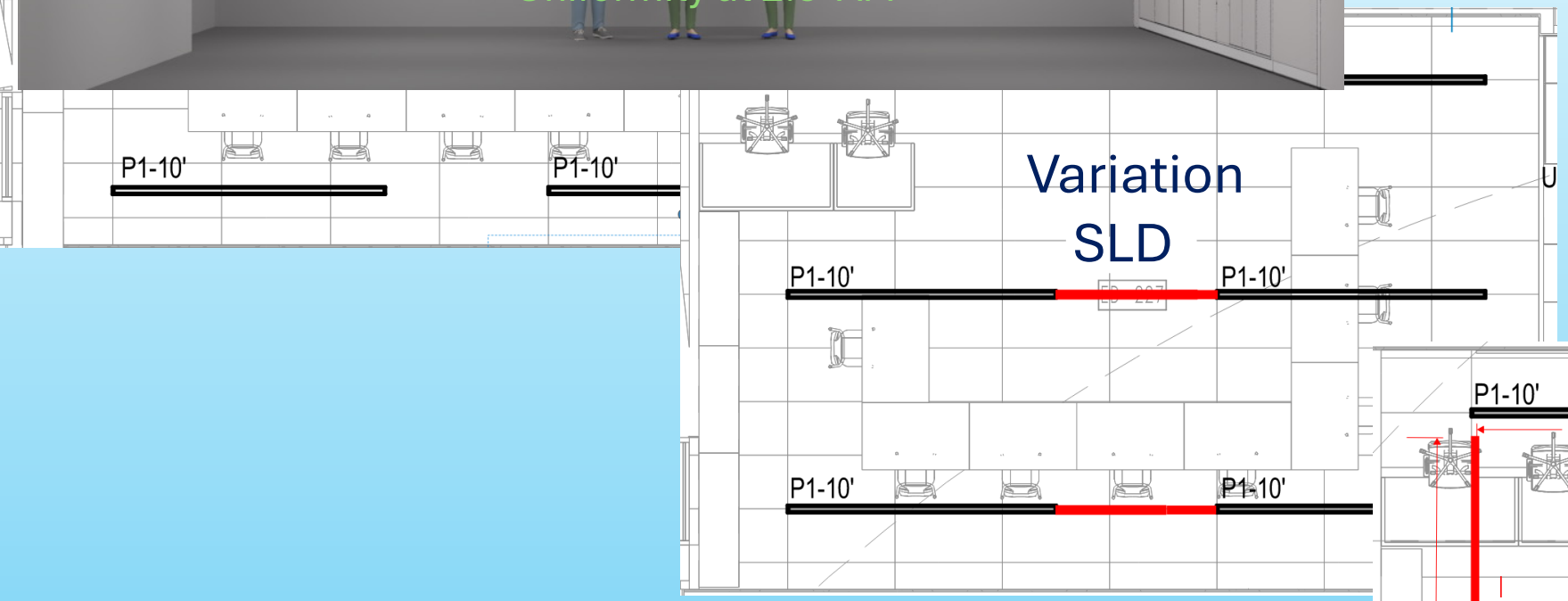


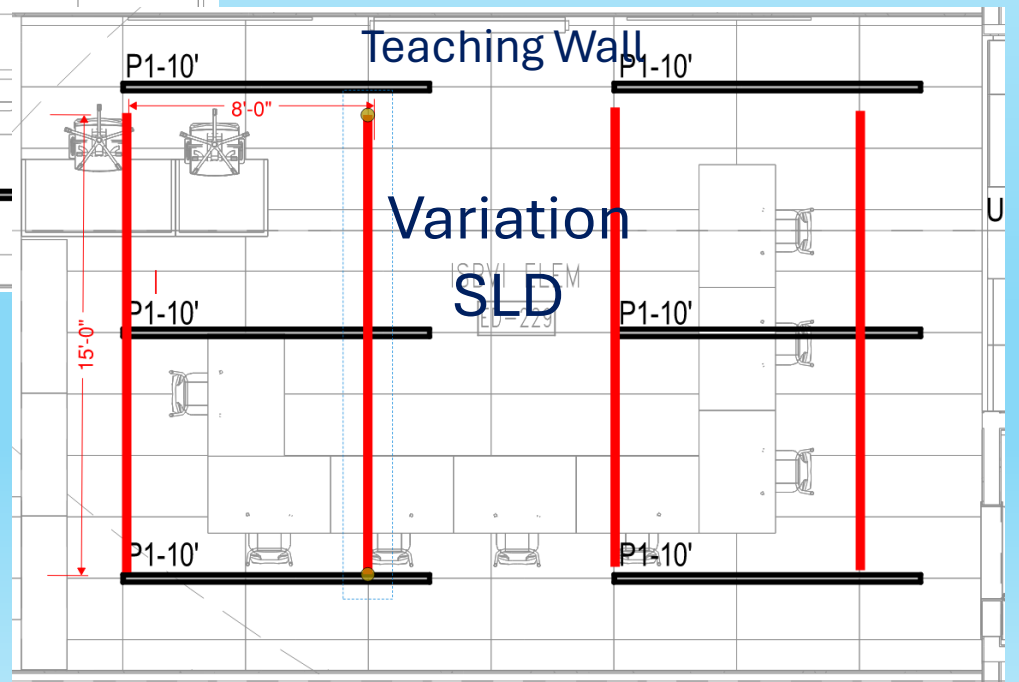


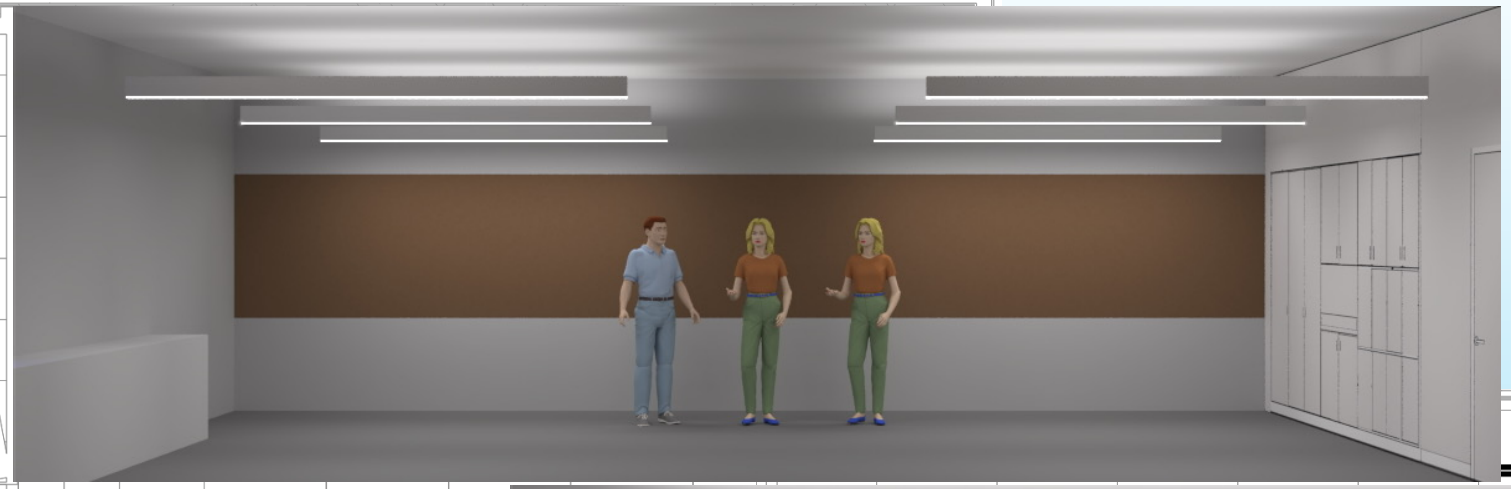


Face Recognition Study for
20/400 acuity (logMAR 1.3)
~4' AFF eye height sitting
+5' AFF eye height standing


Face Visibility?
Uniformity at 2.5’ AFF

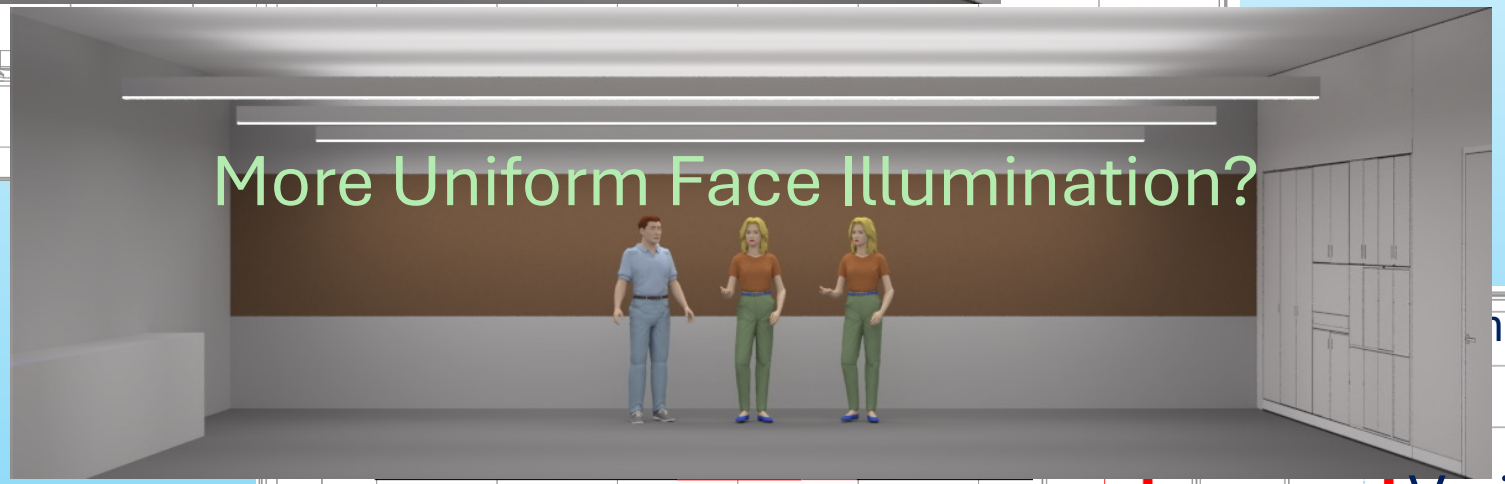

P1-10'
P1-10'
Variation
SLD
P1-10'
P1-10'
P1-10'
P1-10'


Teaching Wall
P1-10'
P1-10'
8'-0"
Variation
SLD
P1-10'
P1-10'
15'-0"
P1-10'
P1-10'



P1-10'

More Uniform Face Illumination?



ning Wall

P1-10'

Variation

SLD

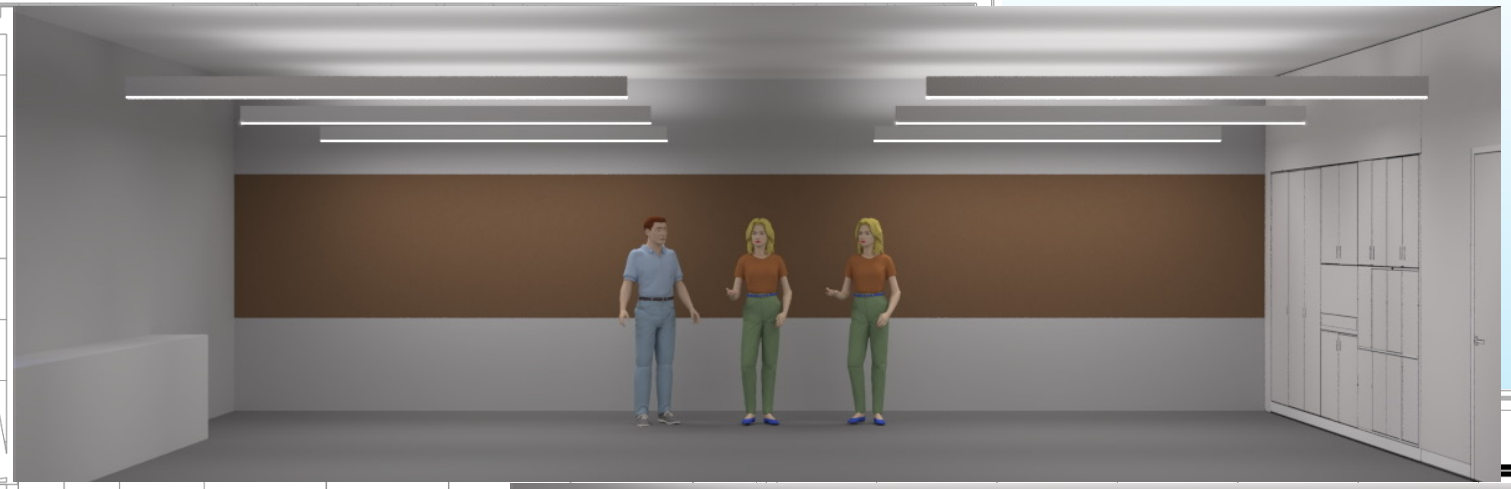
P1-10'

P1-10'

15'-0"

P1-10'

P1-10'



P1-10'

ning Wall

P1-10'

15’
4.5m

Different Order…

1

2

3

20/400
1.3 logMAR

14’
4.3m

1

2

3

13’
4.0m

1

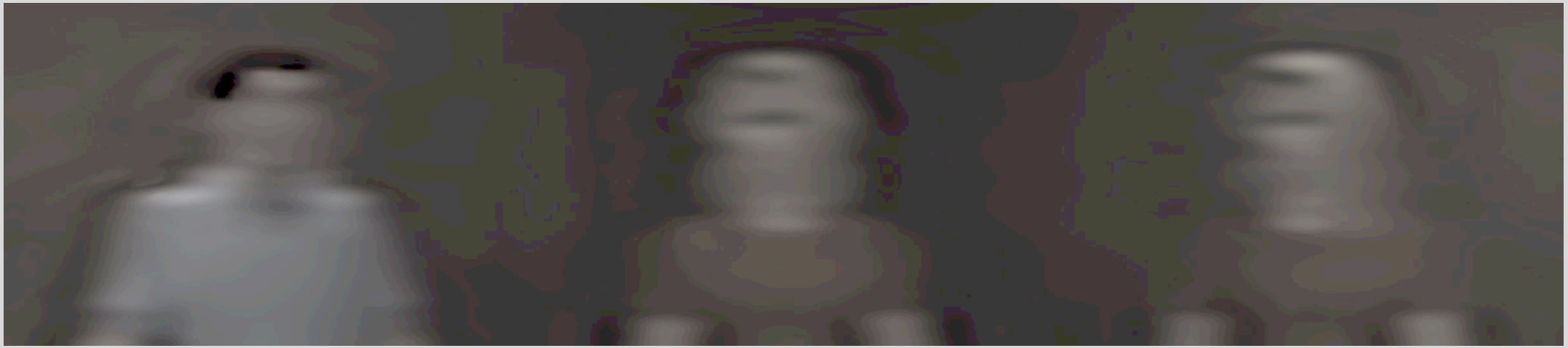
2

3

12’
3.6m

1

2



3

11’
3.3m

1

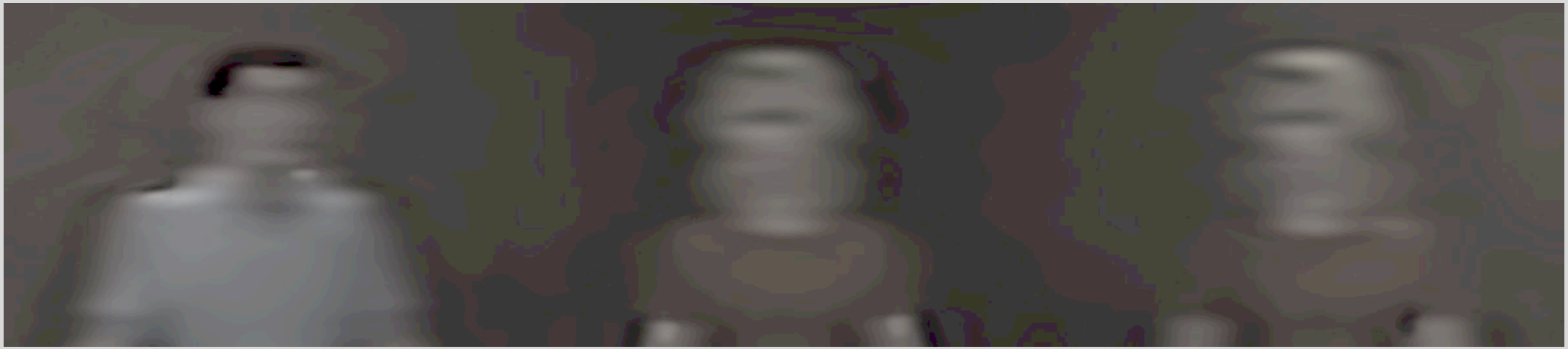
2

3

10’
3.0m

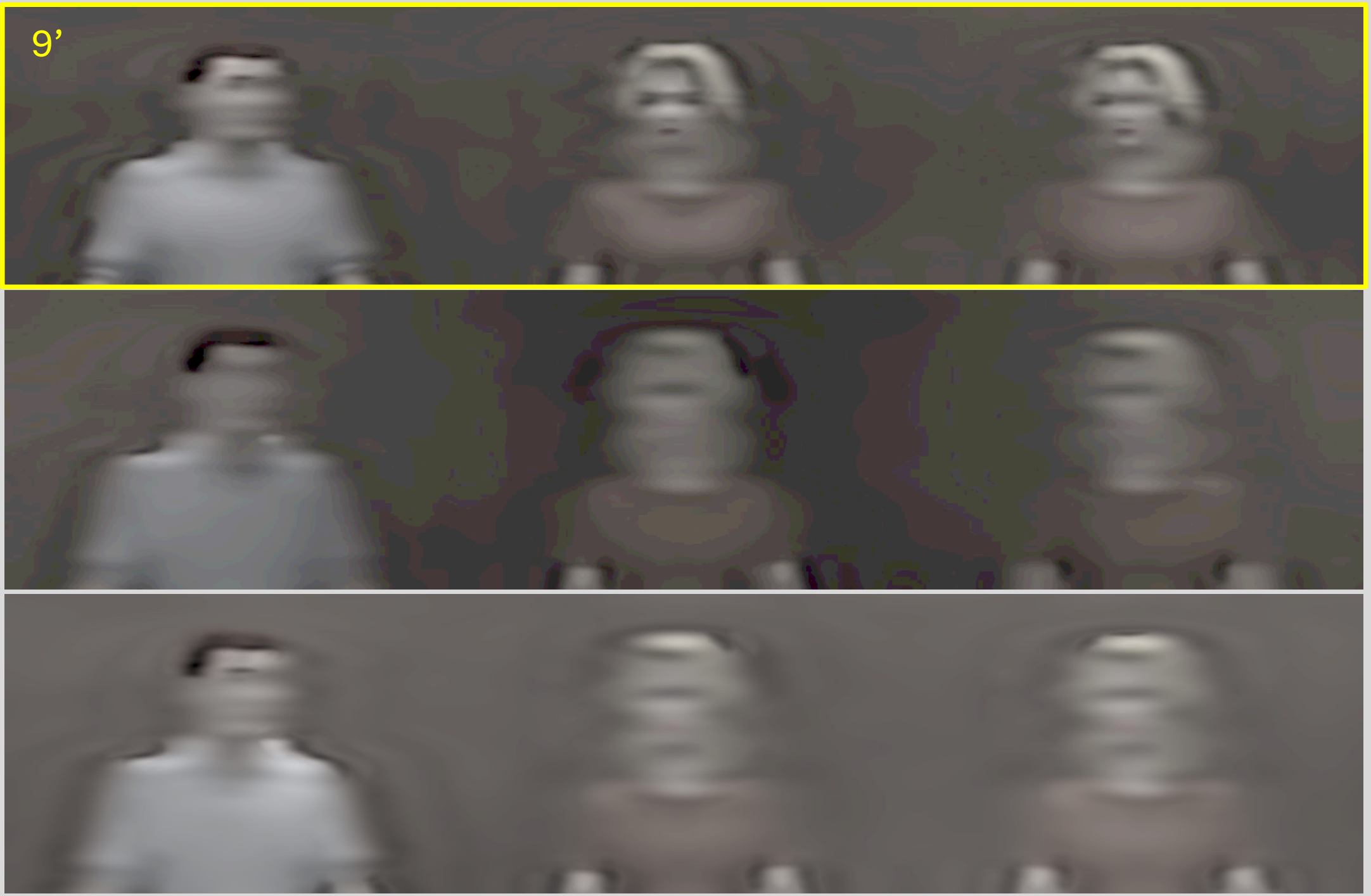
1

2



3

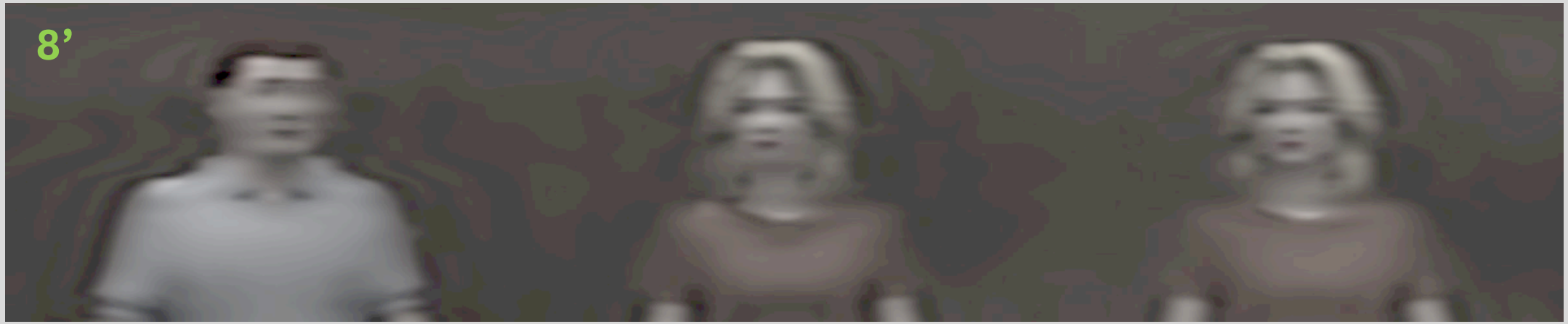
9’
2.7m



8’
2.4m

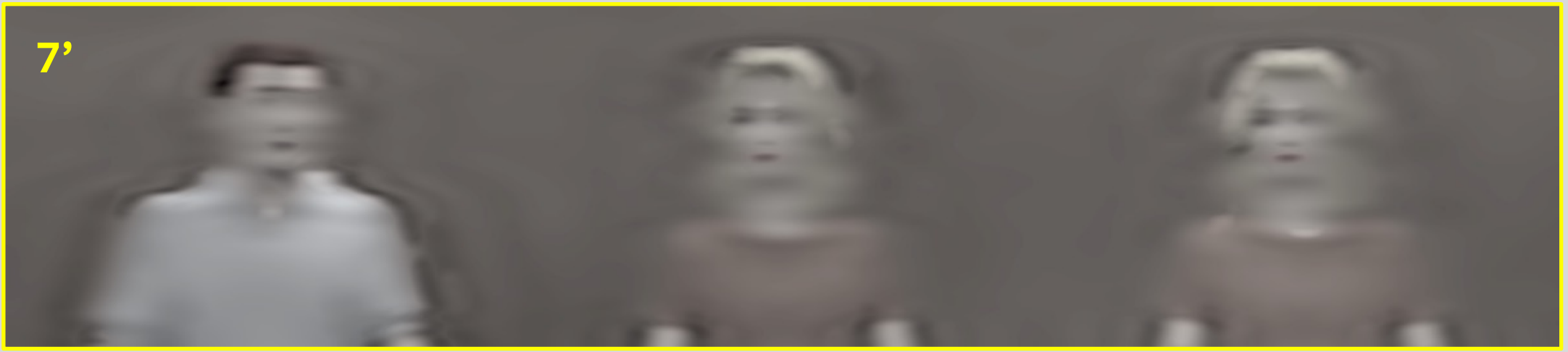
7’
2.1m

1



2

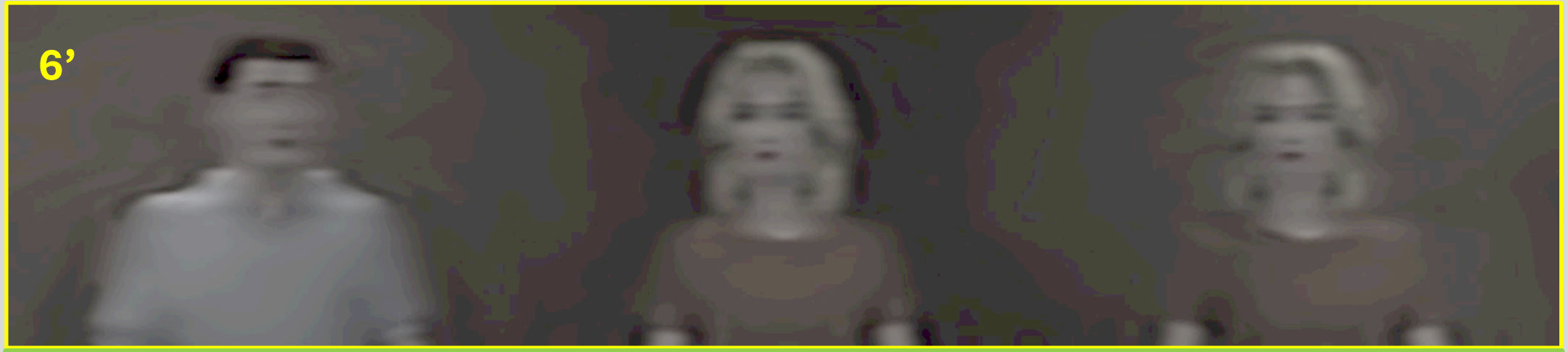
3



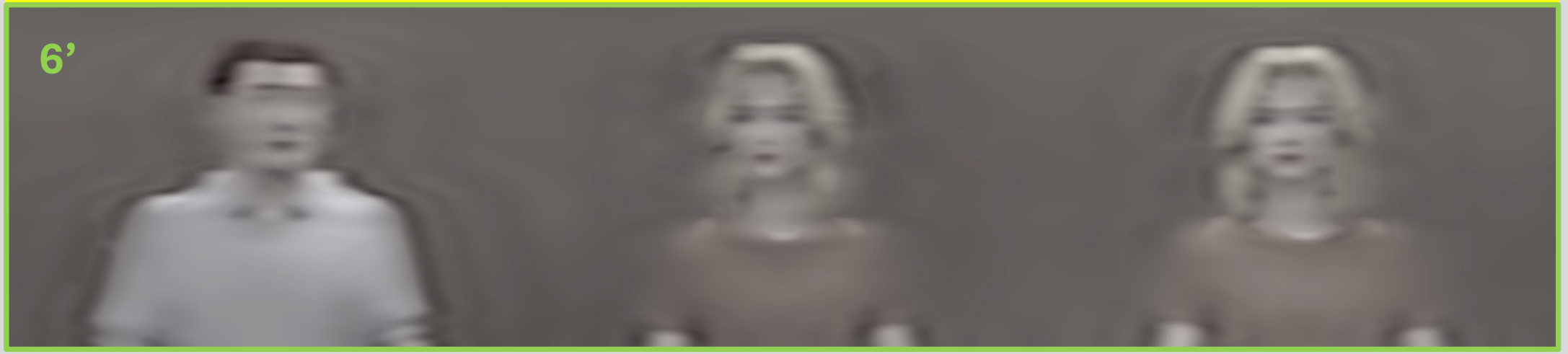
6’
1.8m

1

2



3



5’
1.5m

1

2

3

4’
1.2m

1

2

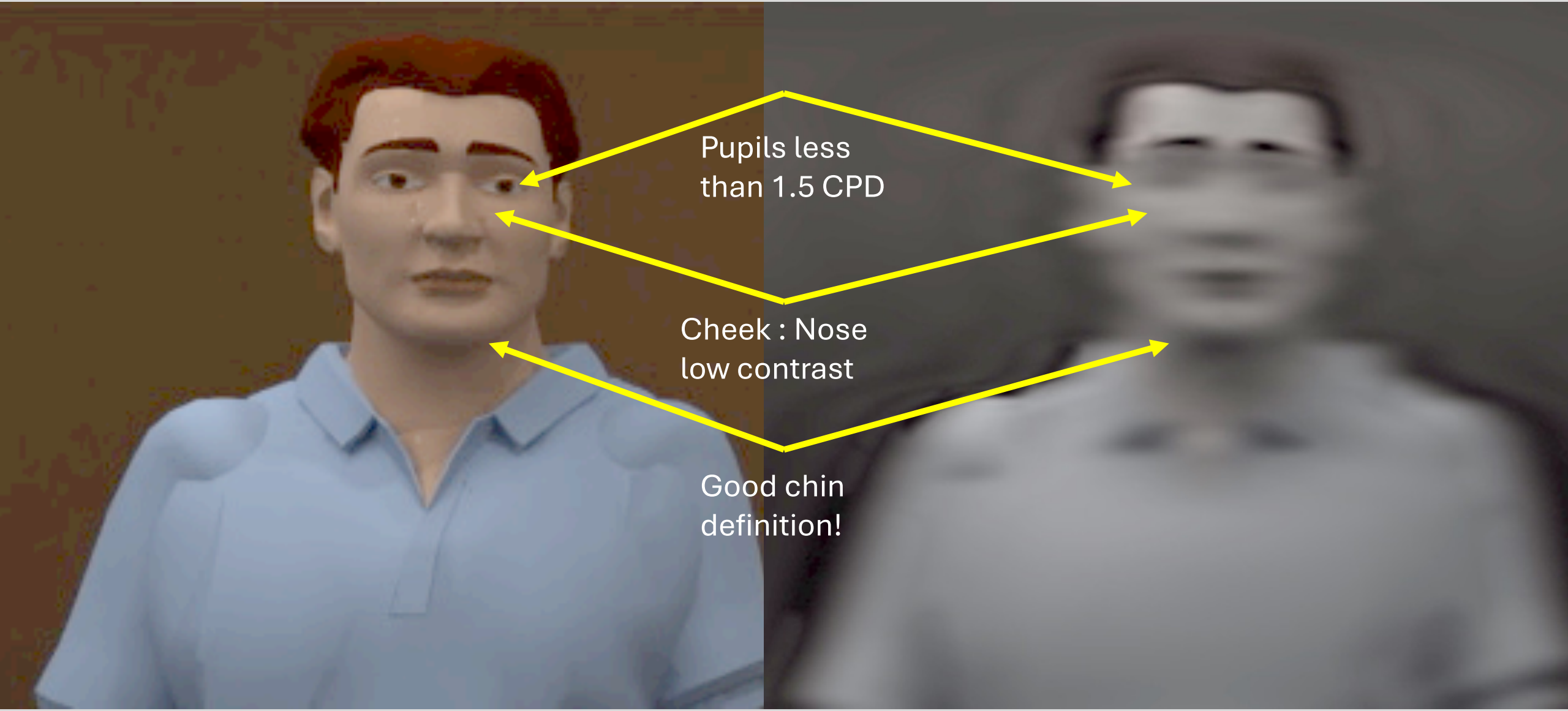
3

Final Recommendation

8’

~4’

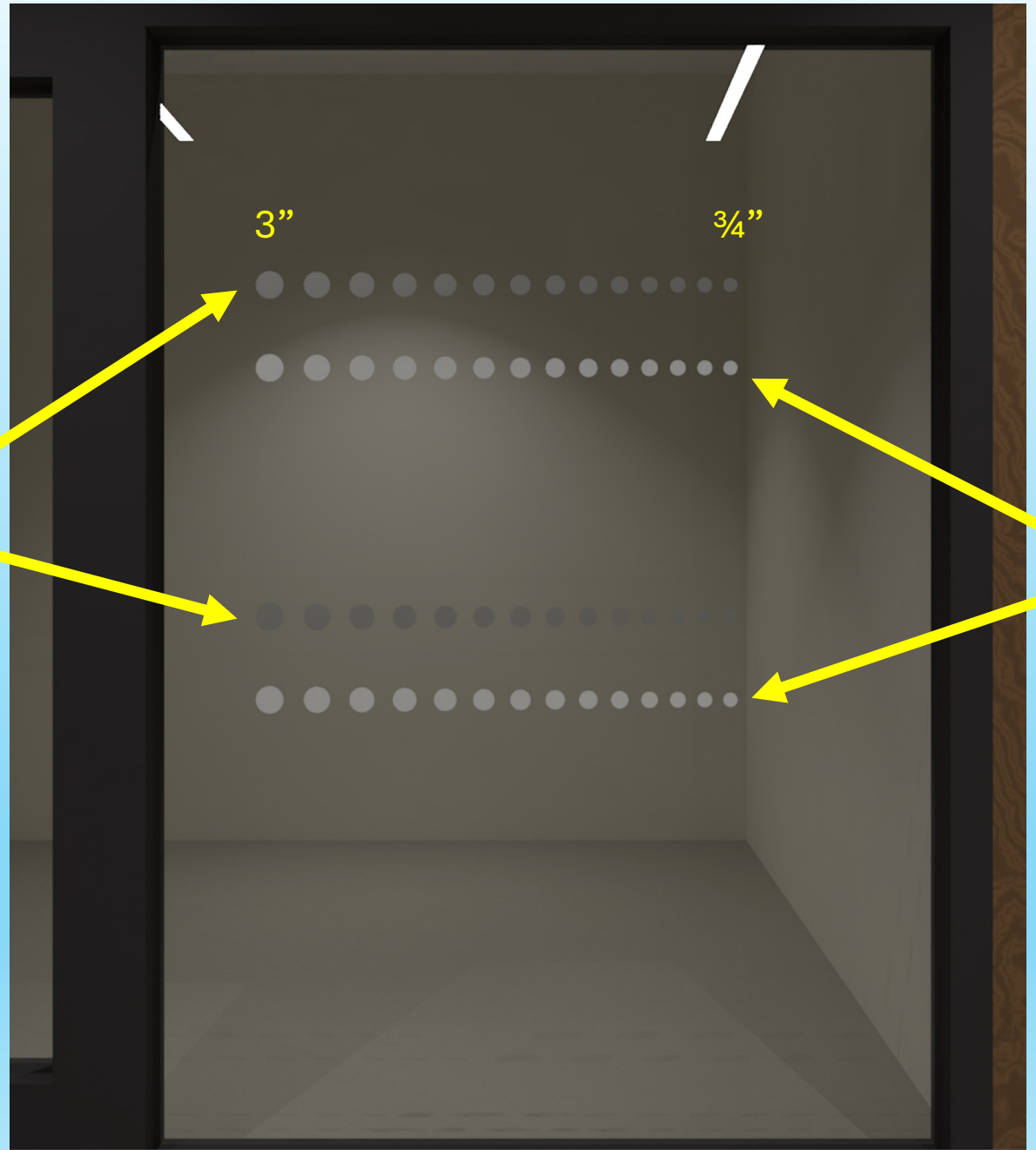
6’


Pupils less
than 1.5 CPD
Cheek : Nose
low contrast
Good chin
definition!

98 Classrooms adopted this optimized approach

Classroom Hallways adopted this low glare approach

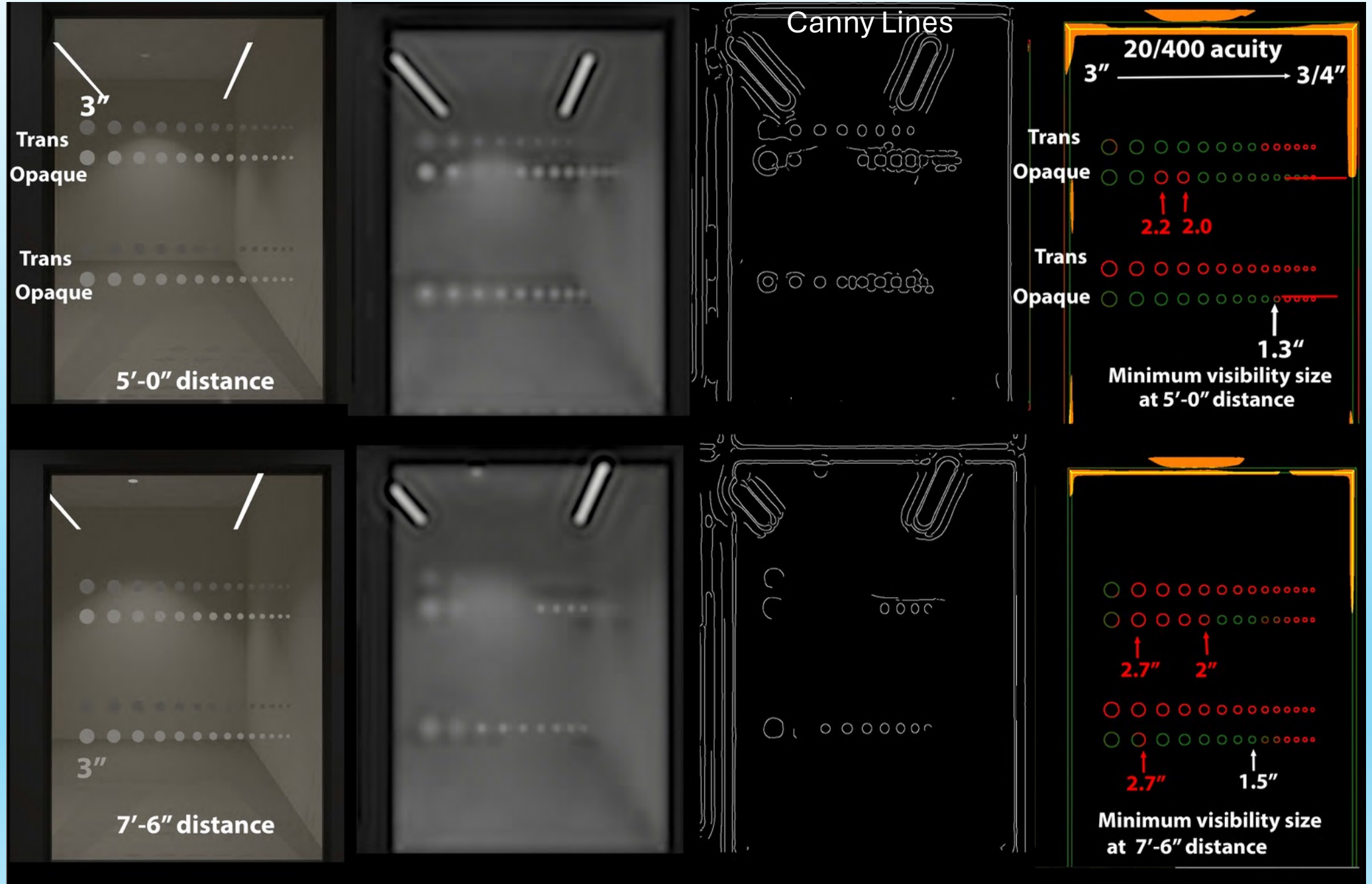
FRIT Visibility Study: Visually Impaired Residence Hall Glass Partitions



Translucent: Etched

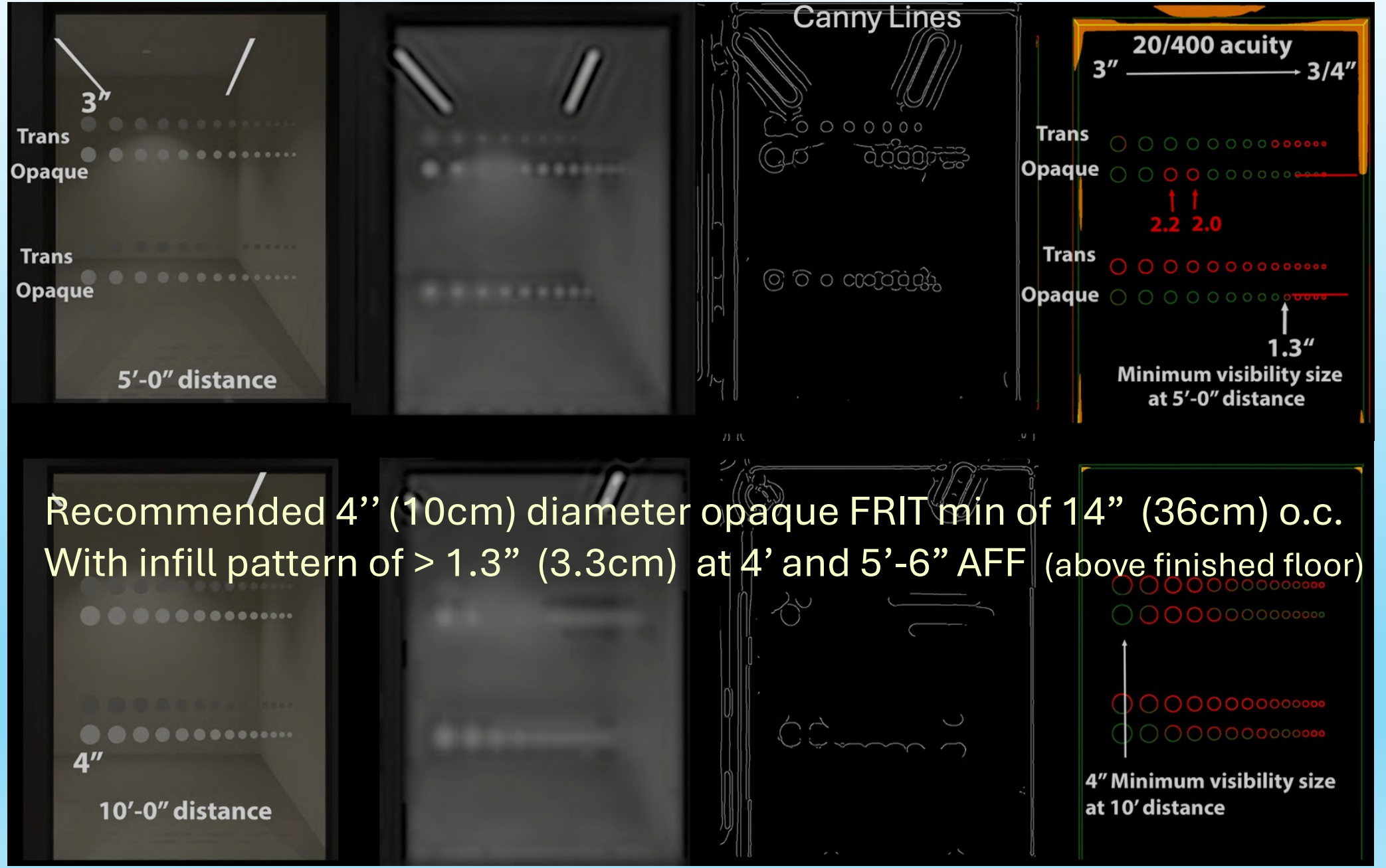
Opaque White

FRIT Visibility Study:



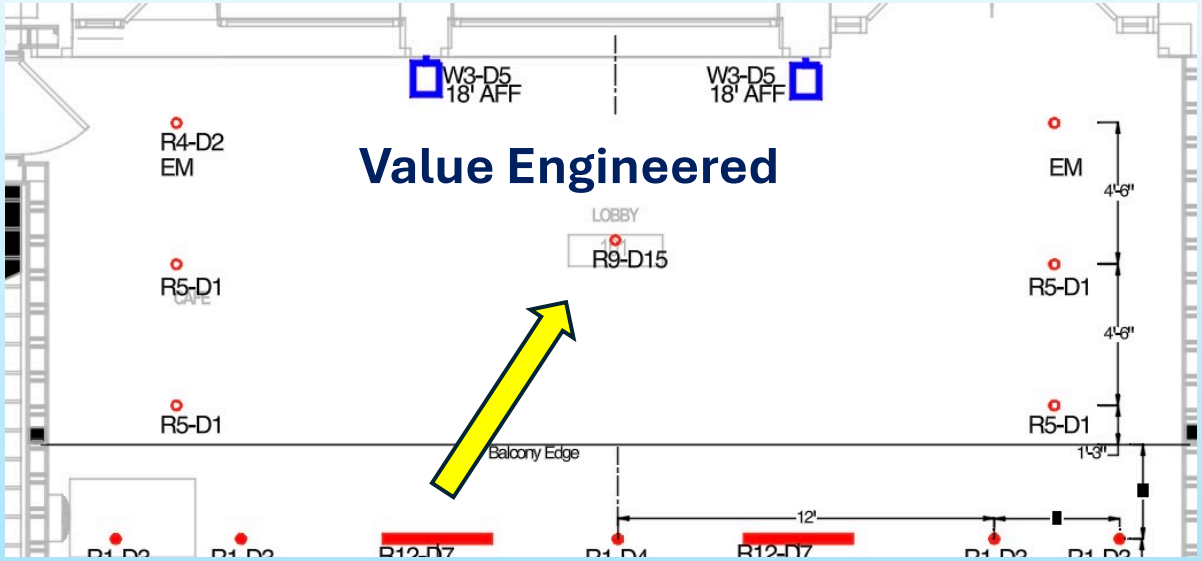
FRIT Visibility Study:

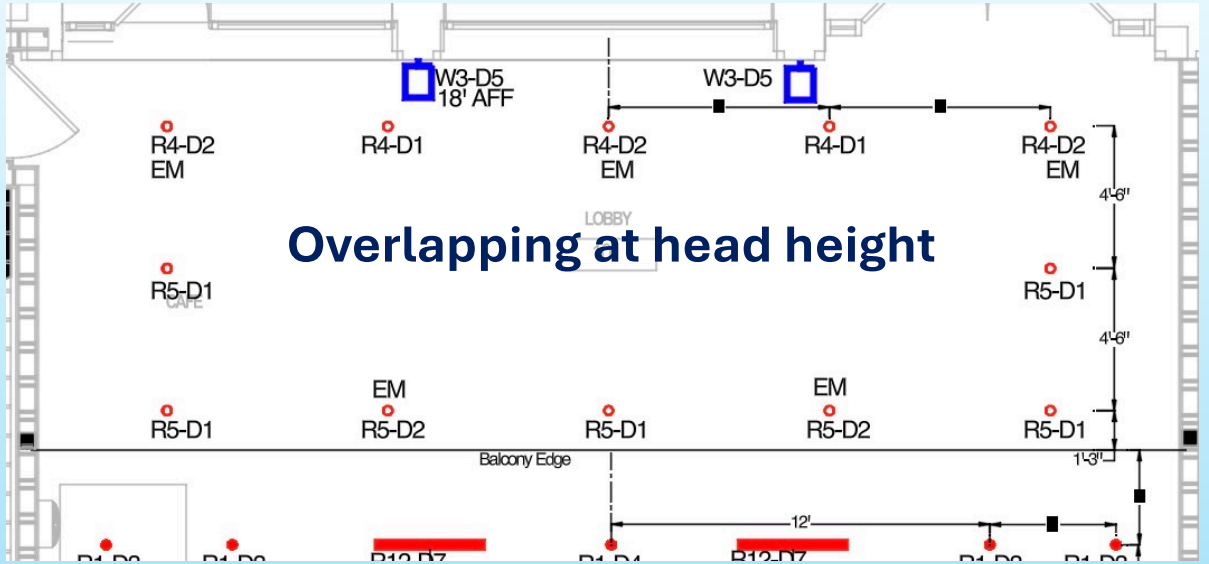
FRIT Visibility Study Recommendation

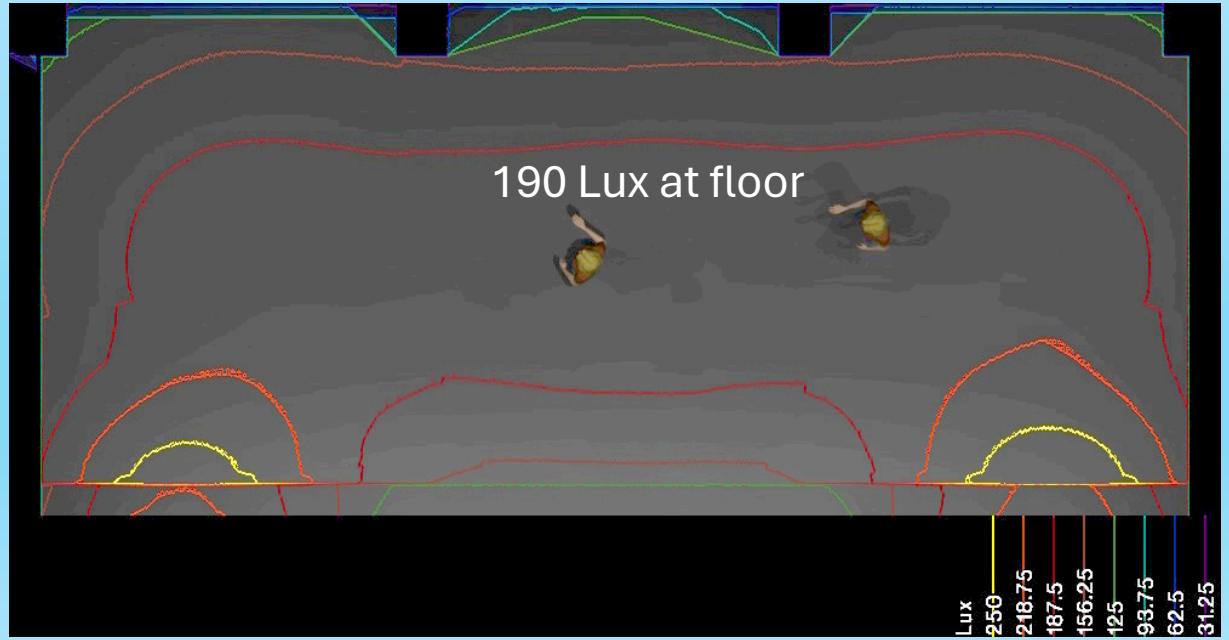


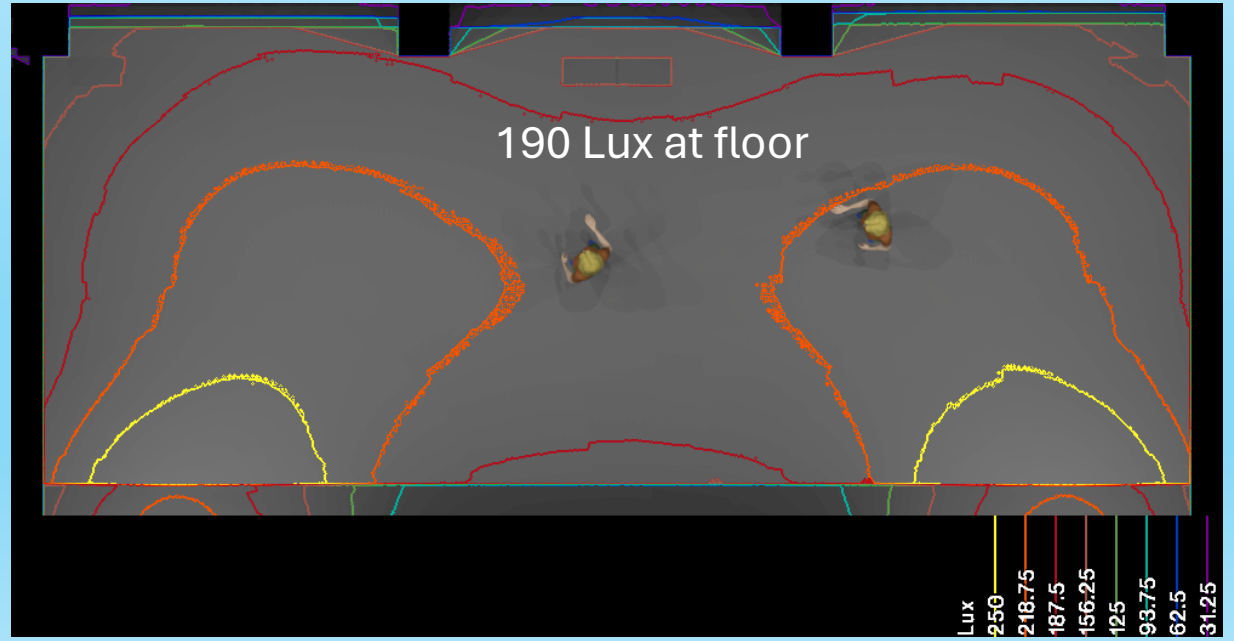
Recommended 4’’ (10cm) diameter opaque FRIT min of 14” (36cm) o.c.
With infill pattern of > 1.3” (3.3cm) at 4’ and 5’-6” AFF (above finished floor)

Lobby with 28’ ceiling: both approaches meet the goal of +150 Lux floor

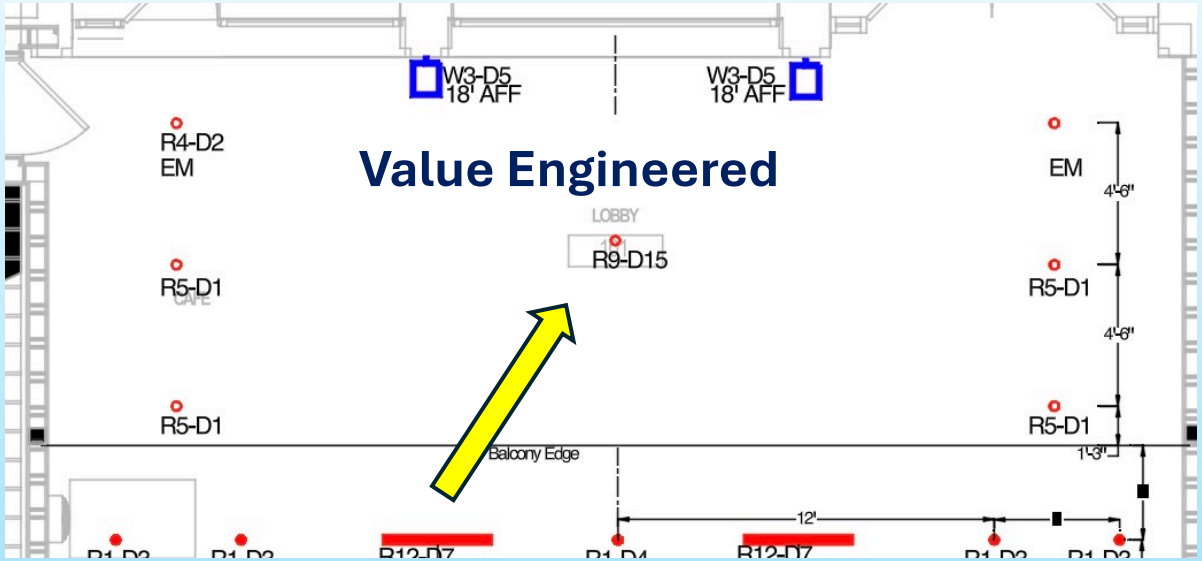


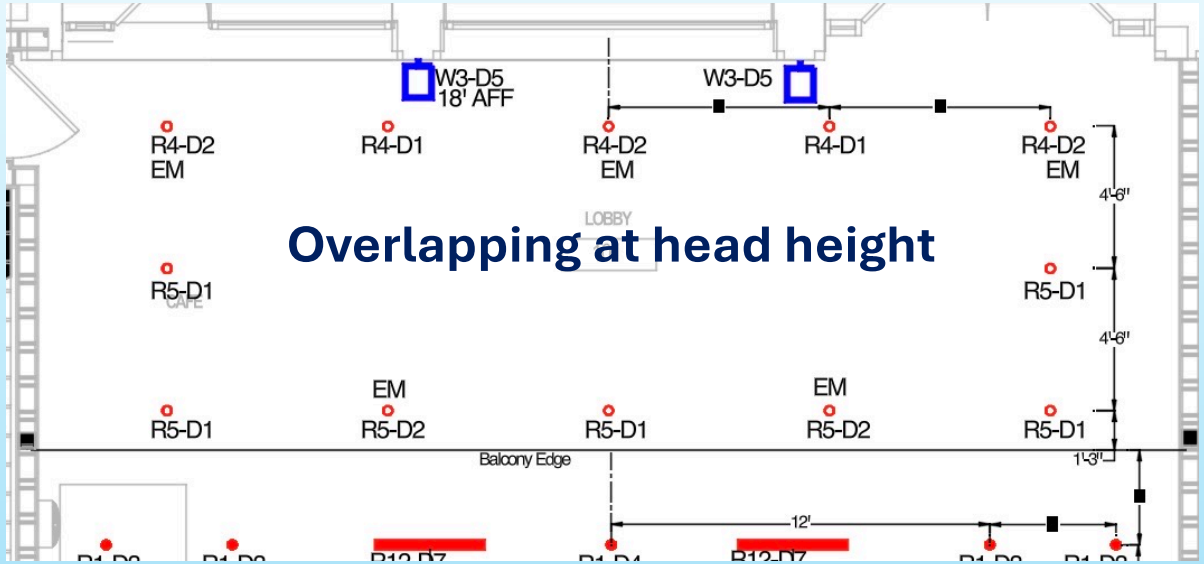


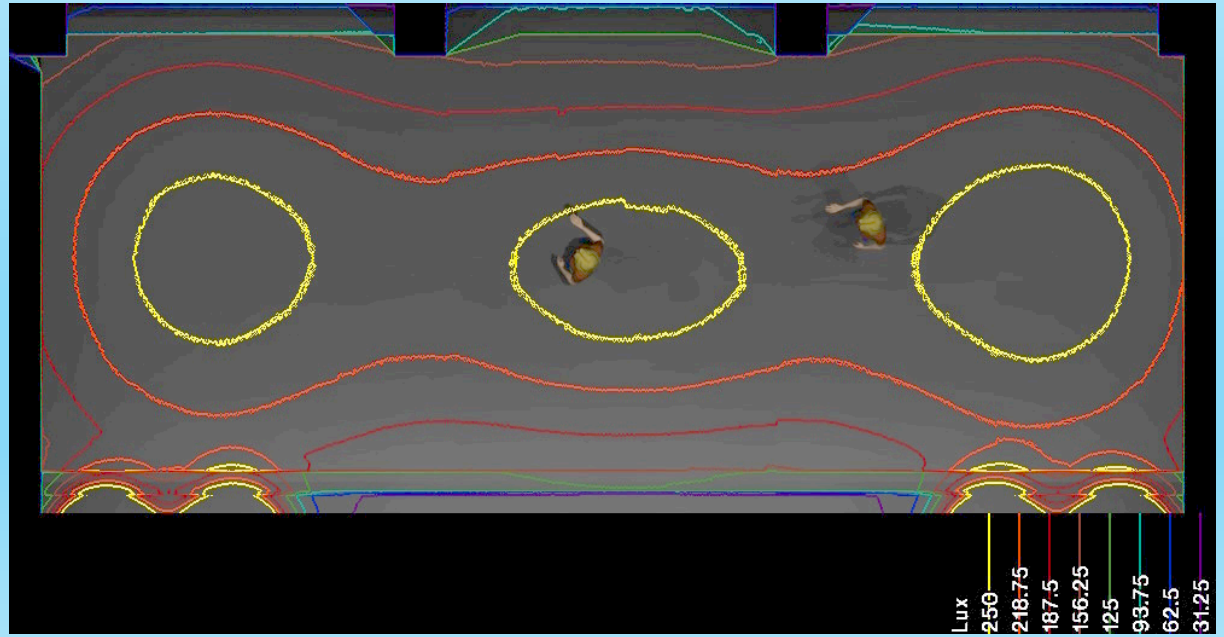


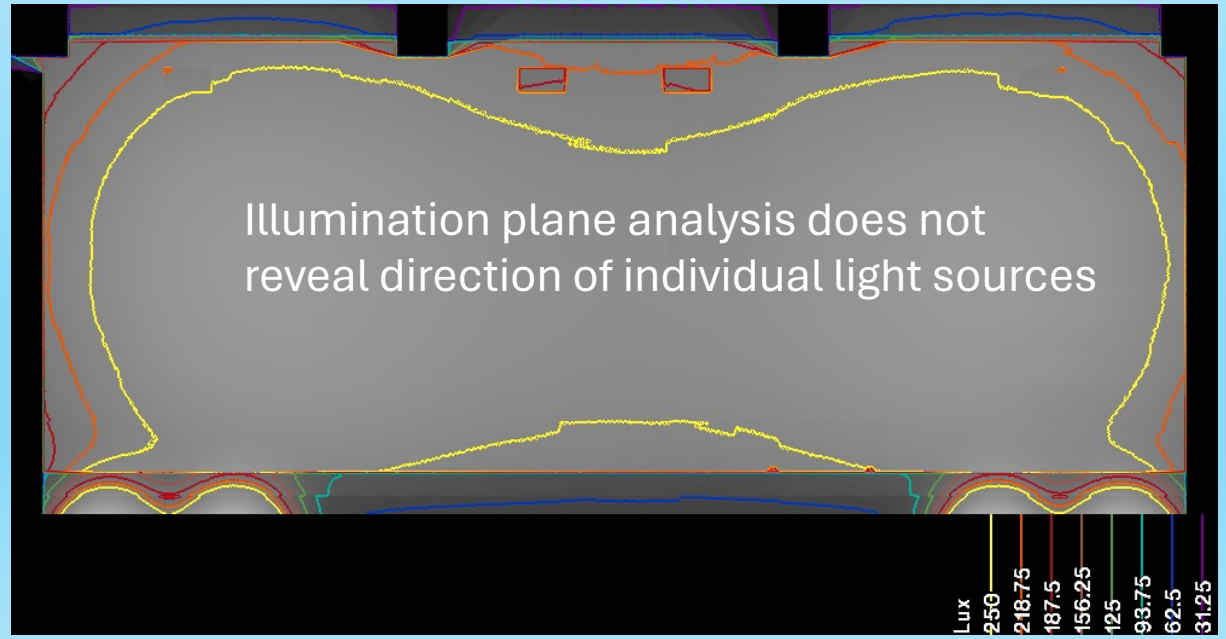


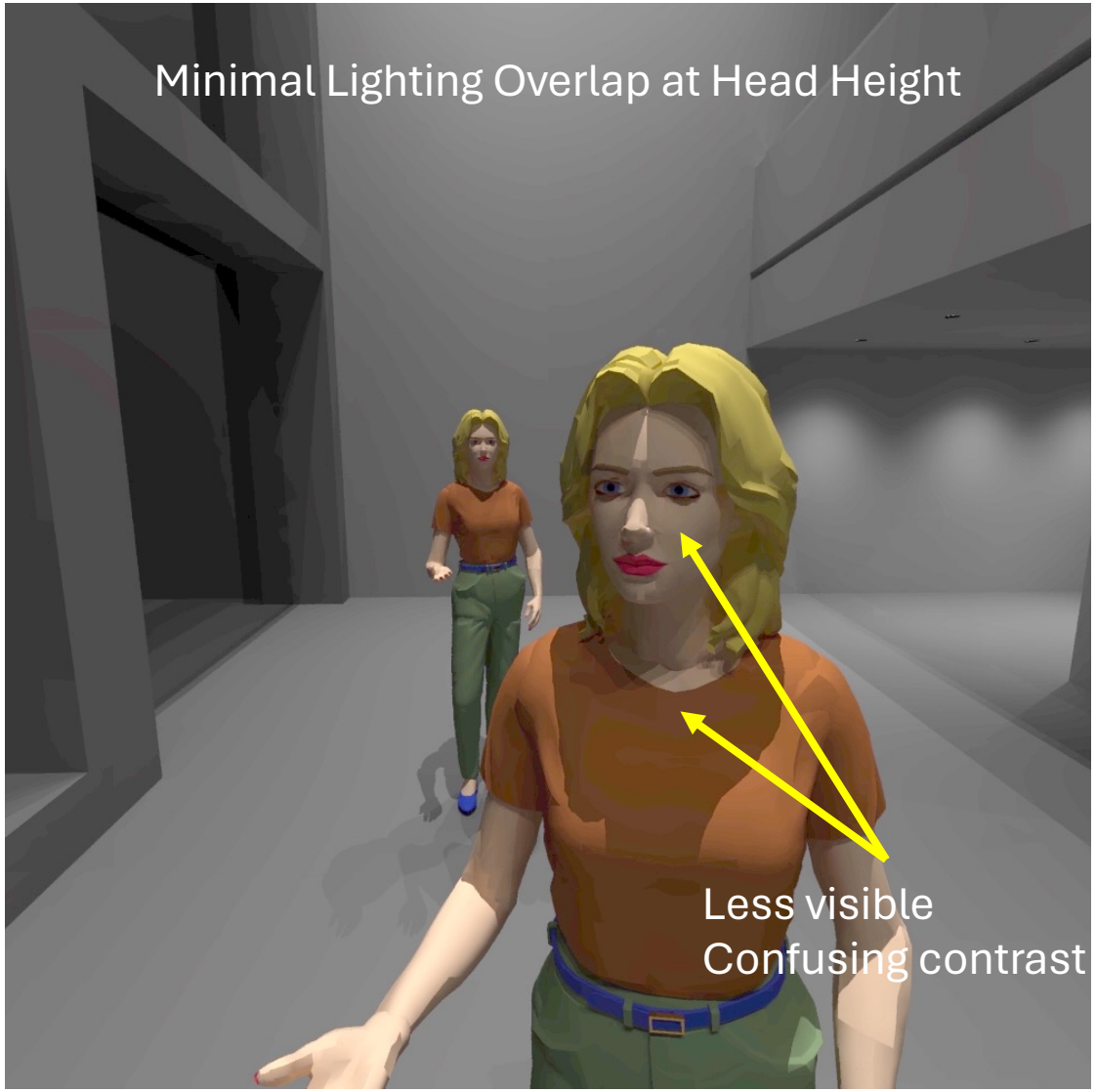
Compare Illumination at 5’ AFF for LV Face Visibility and Sign Language



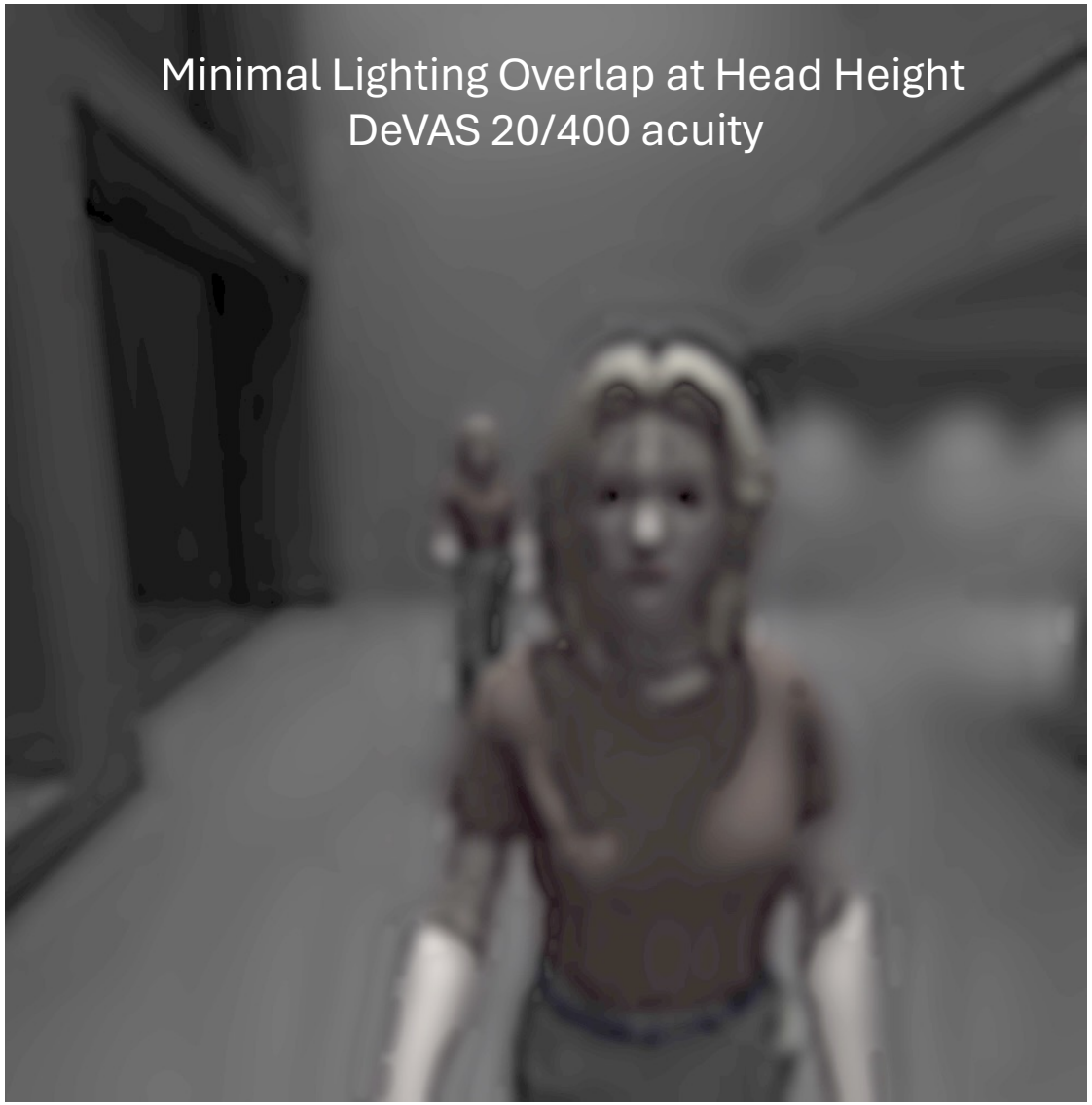


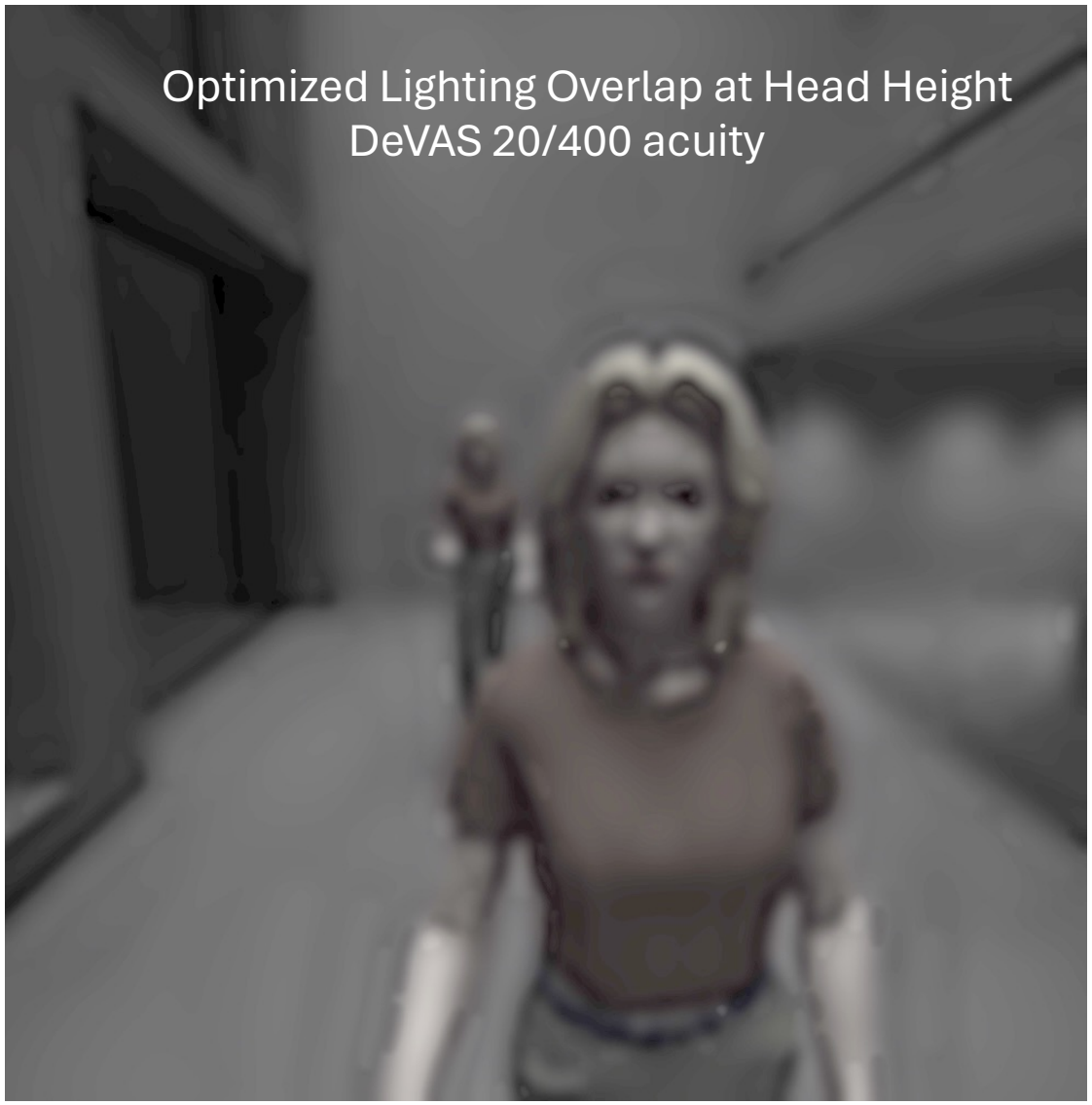


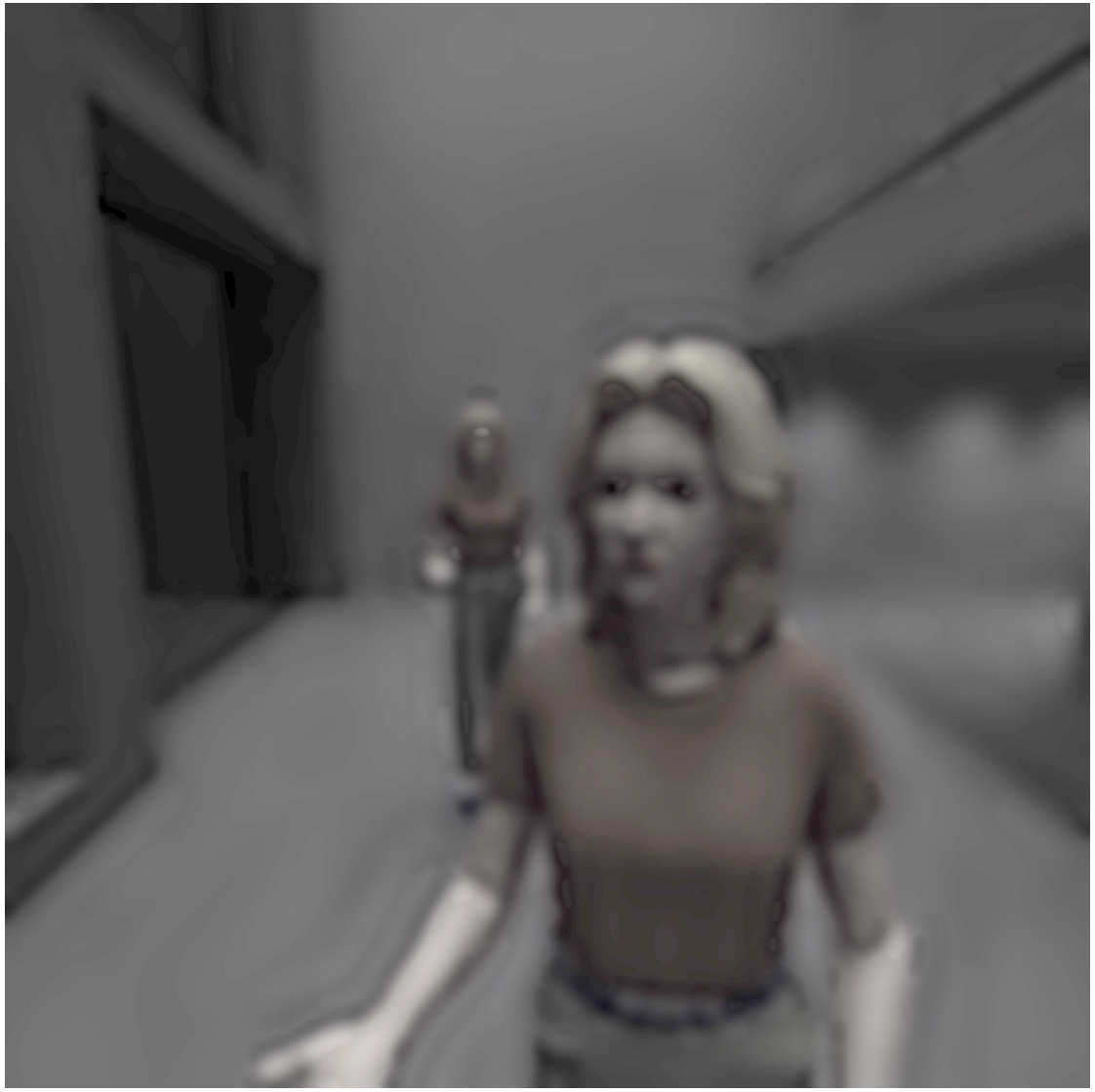


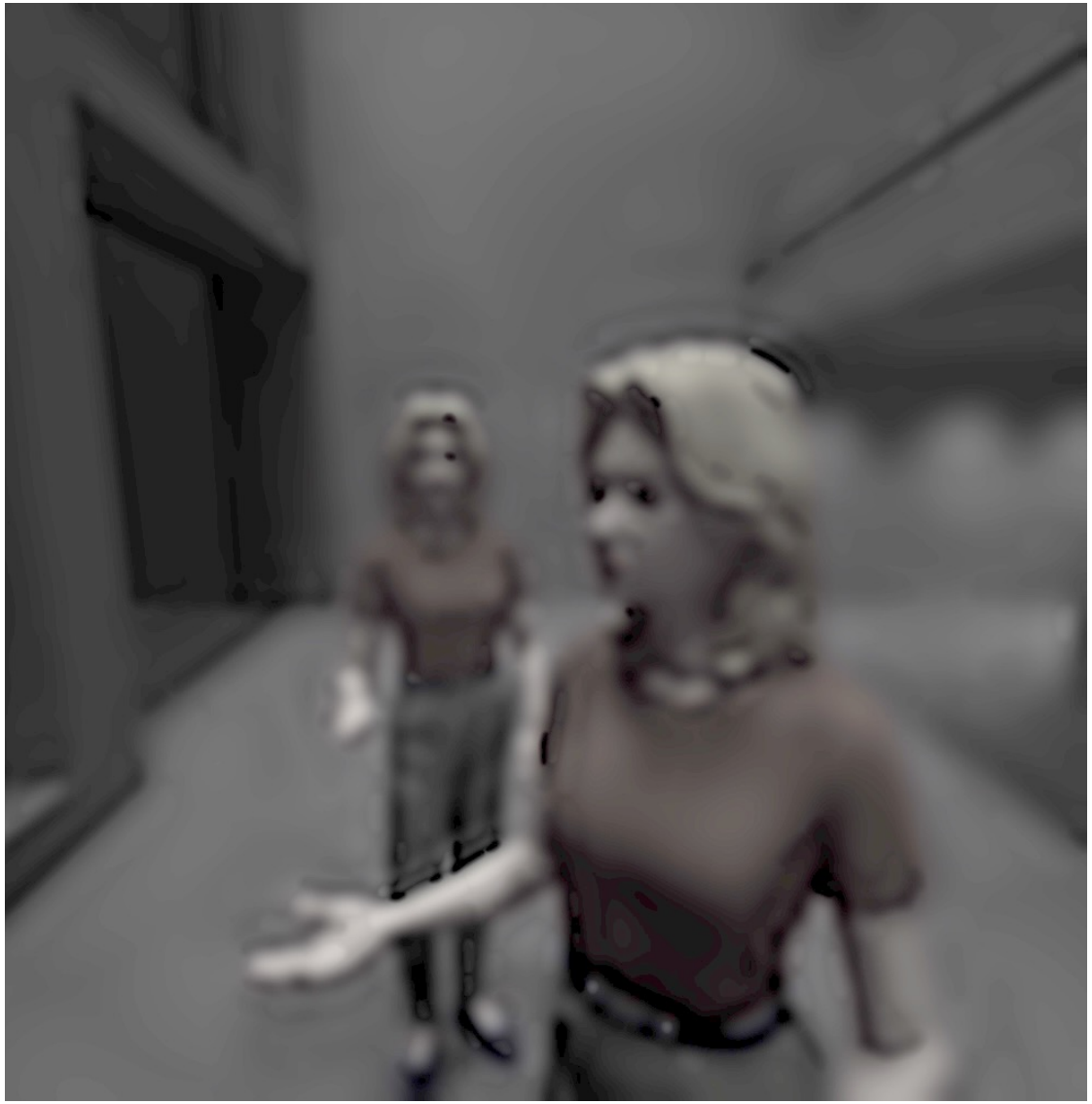

Minimal Lighting Overlap at Head Height
Less visible
Confusing contrast

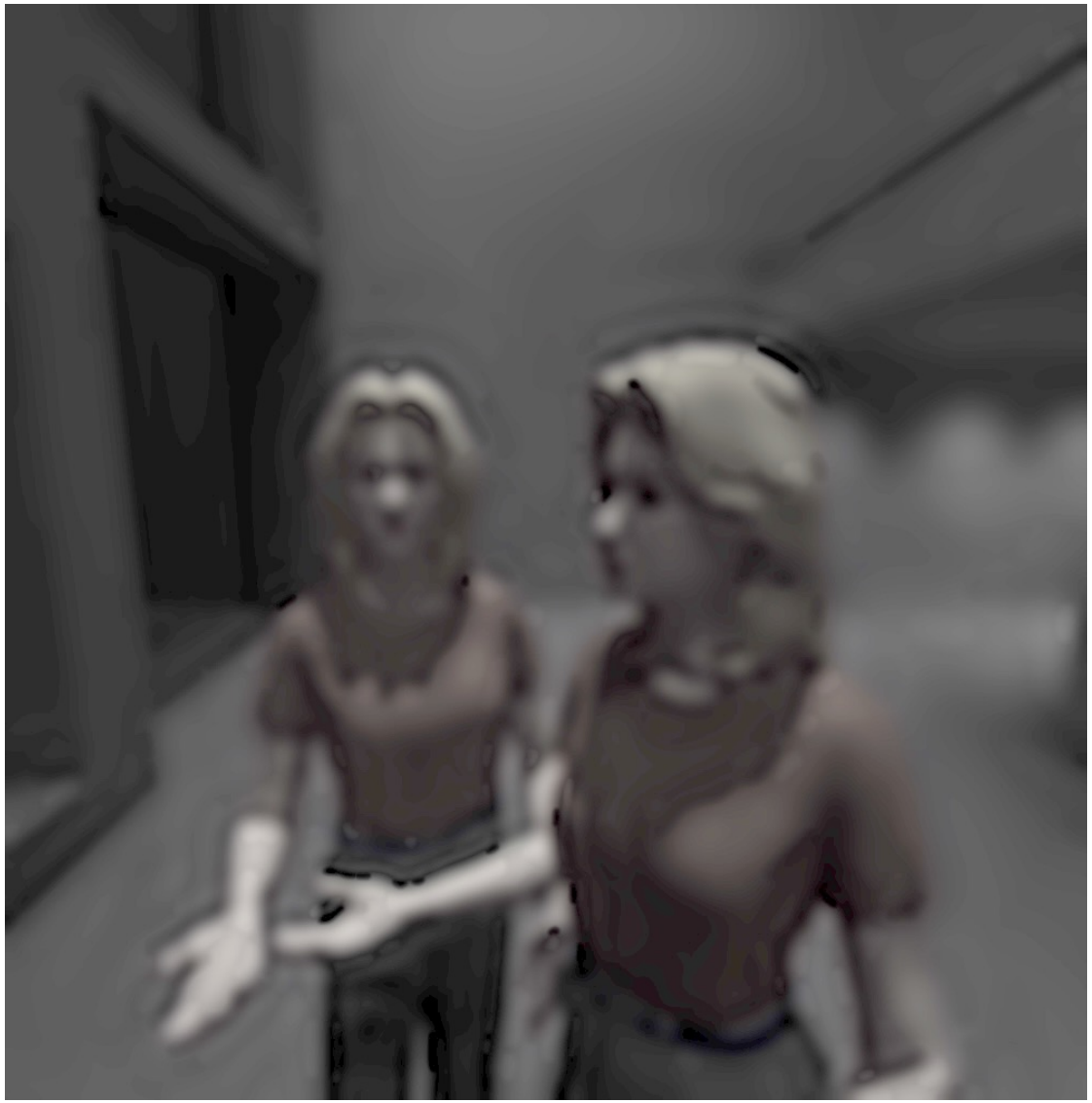

Optimized Lighting Overlap at Head Height
More visible
Useful contrast

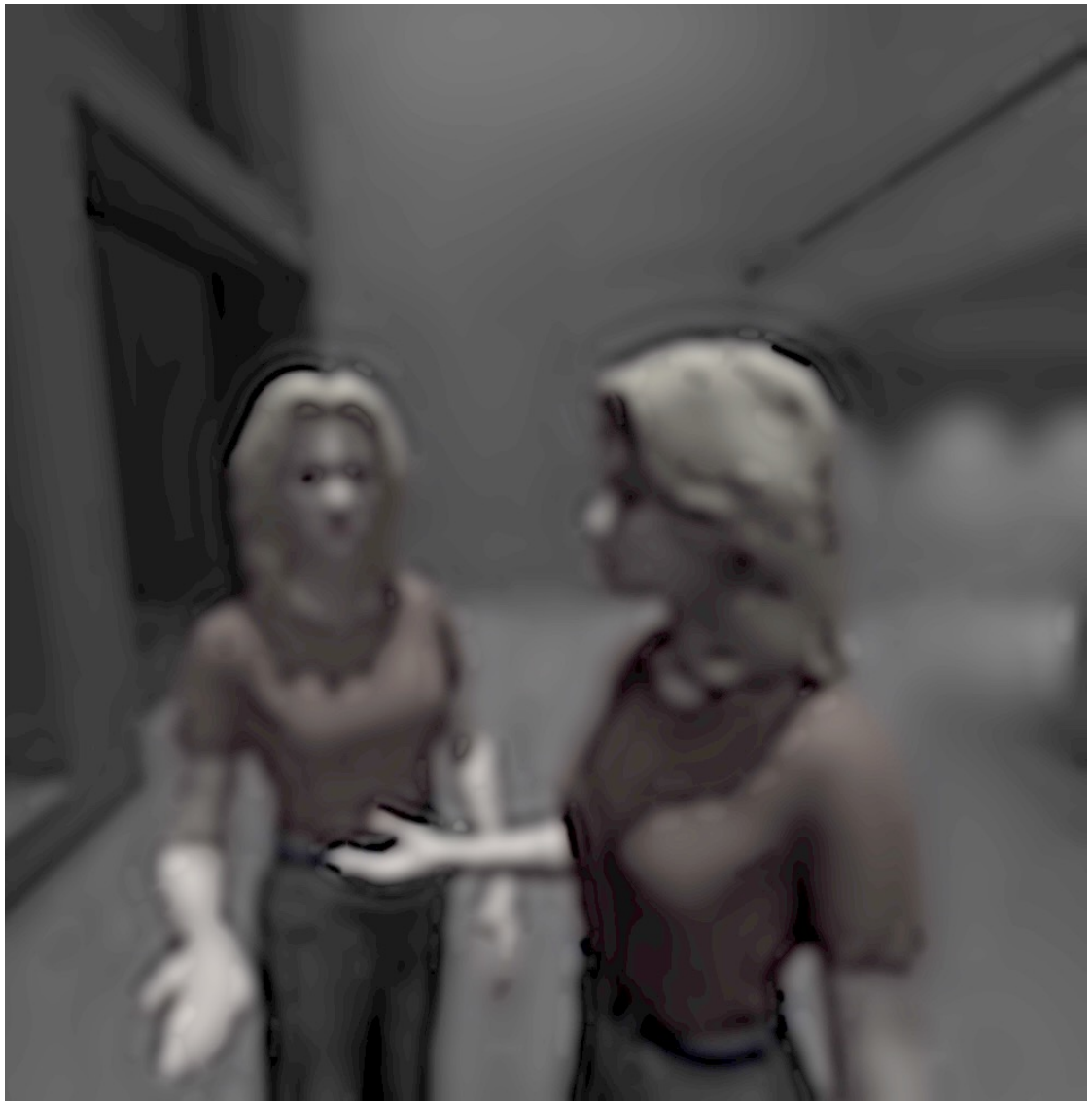

Minimal Lighting Overlap at Head Height
DeVAS 20/400 acuity

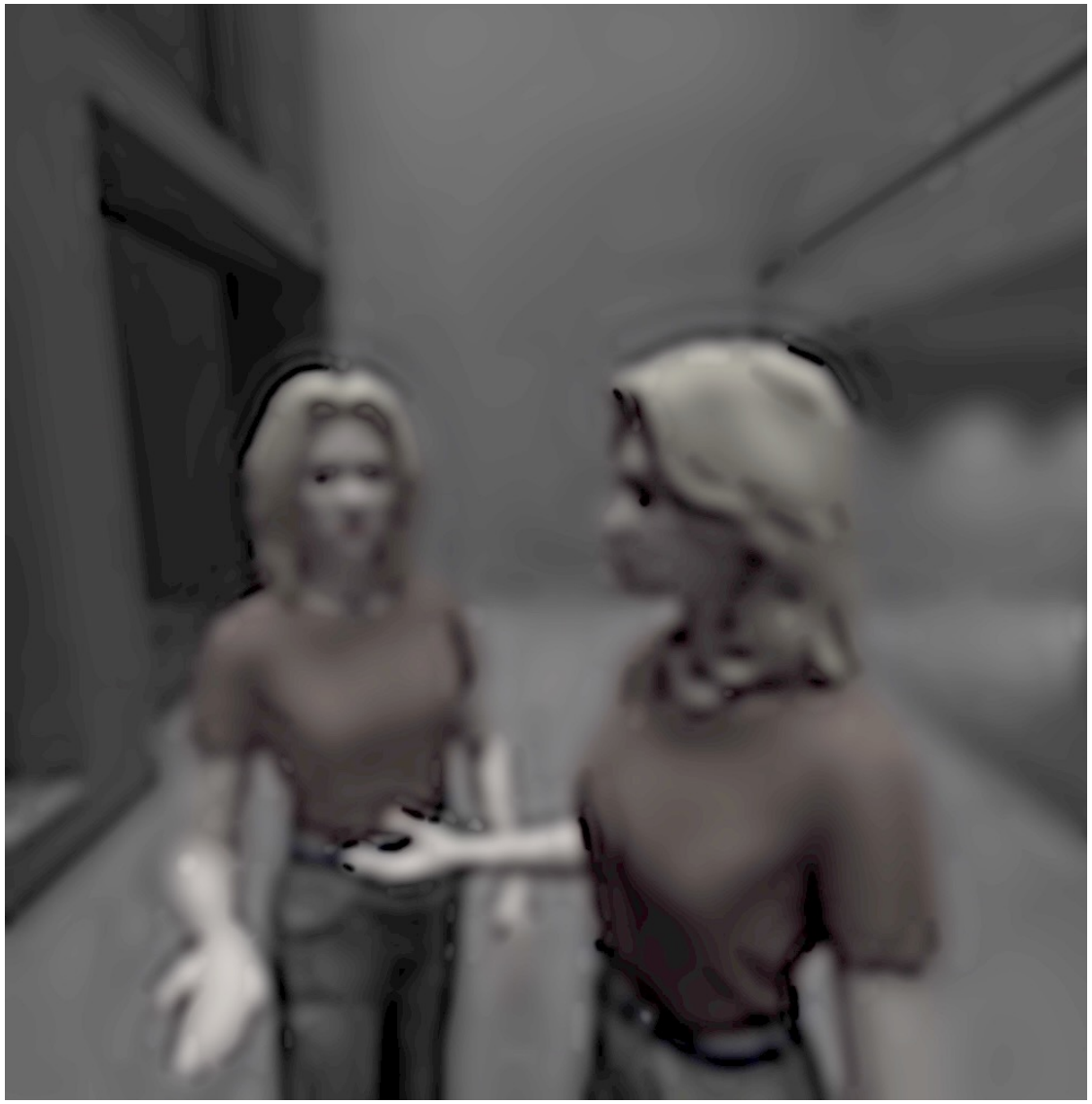

Optimized Lighting Overlap at Head Height
DeVAS 20/400 acuity







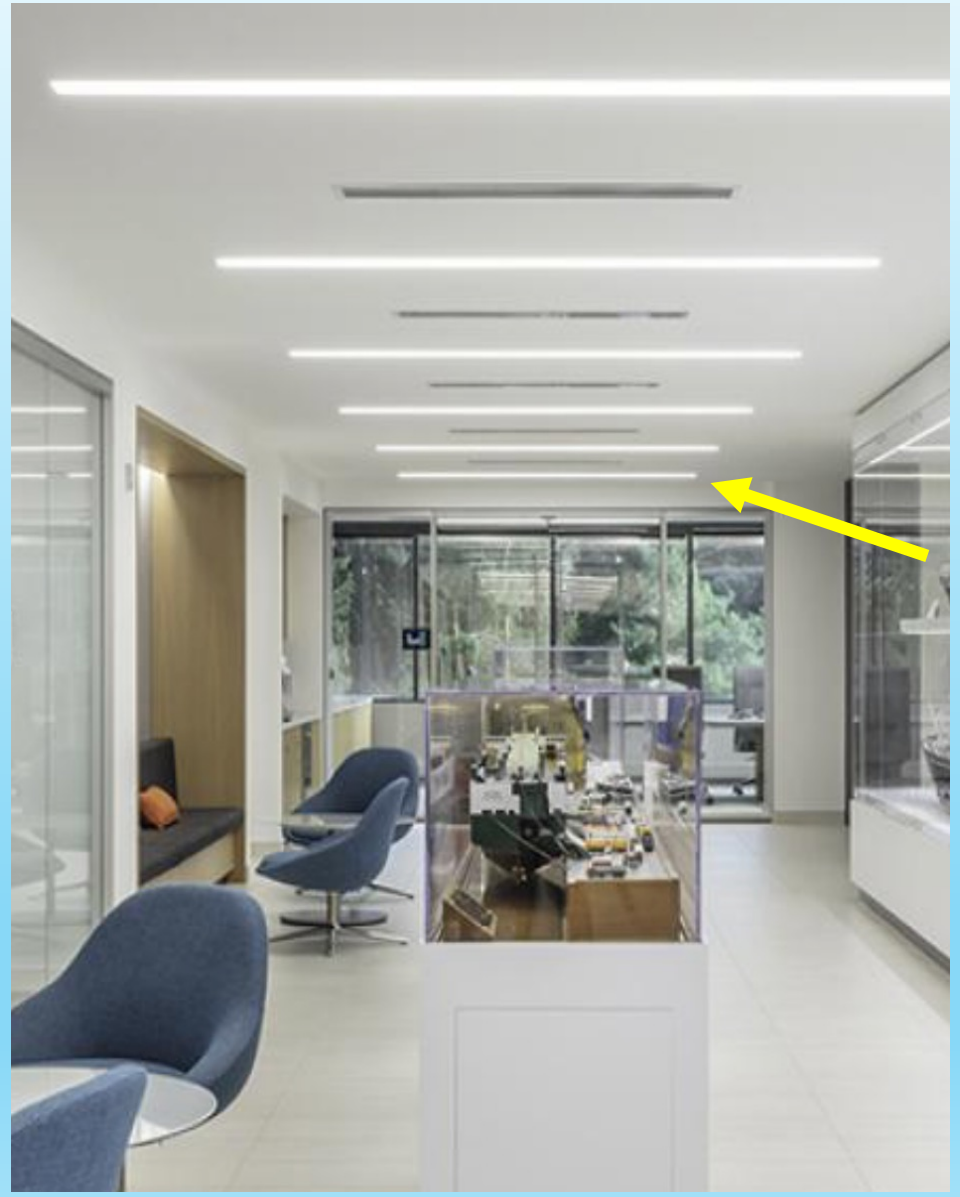




Evidence to argue for the additional cost of installing 5 more luminaires

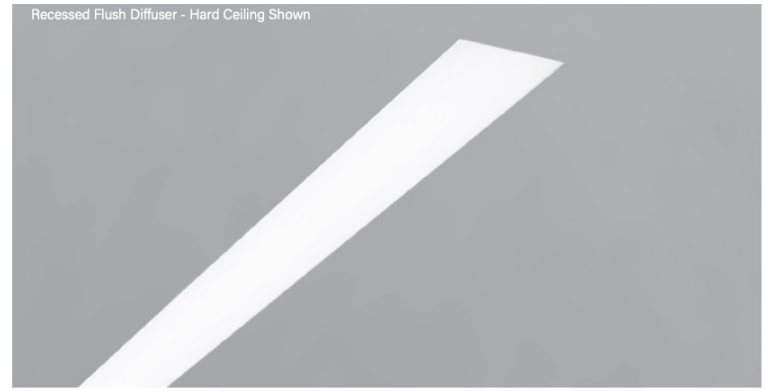
Faces Visible and upper body lit for enhanced LV and Sign Language communication

Searching for an Egress Wayfinding marker visible at ~25’

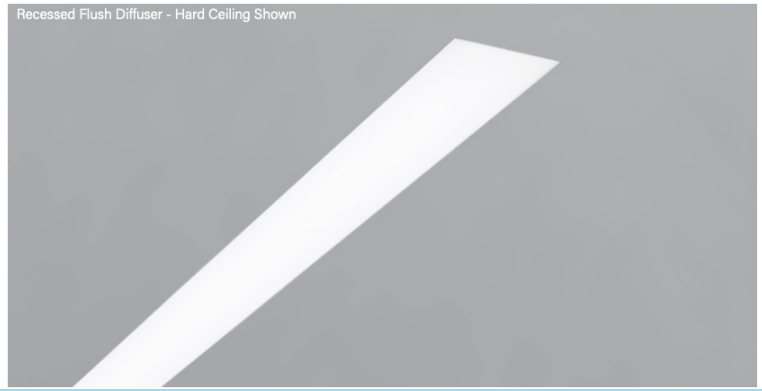


Is this line of light visible at 25’ with 20/400 acuity? (If other recessed lighting is UGR 0)

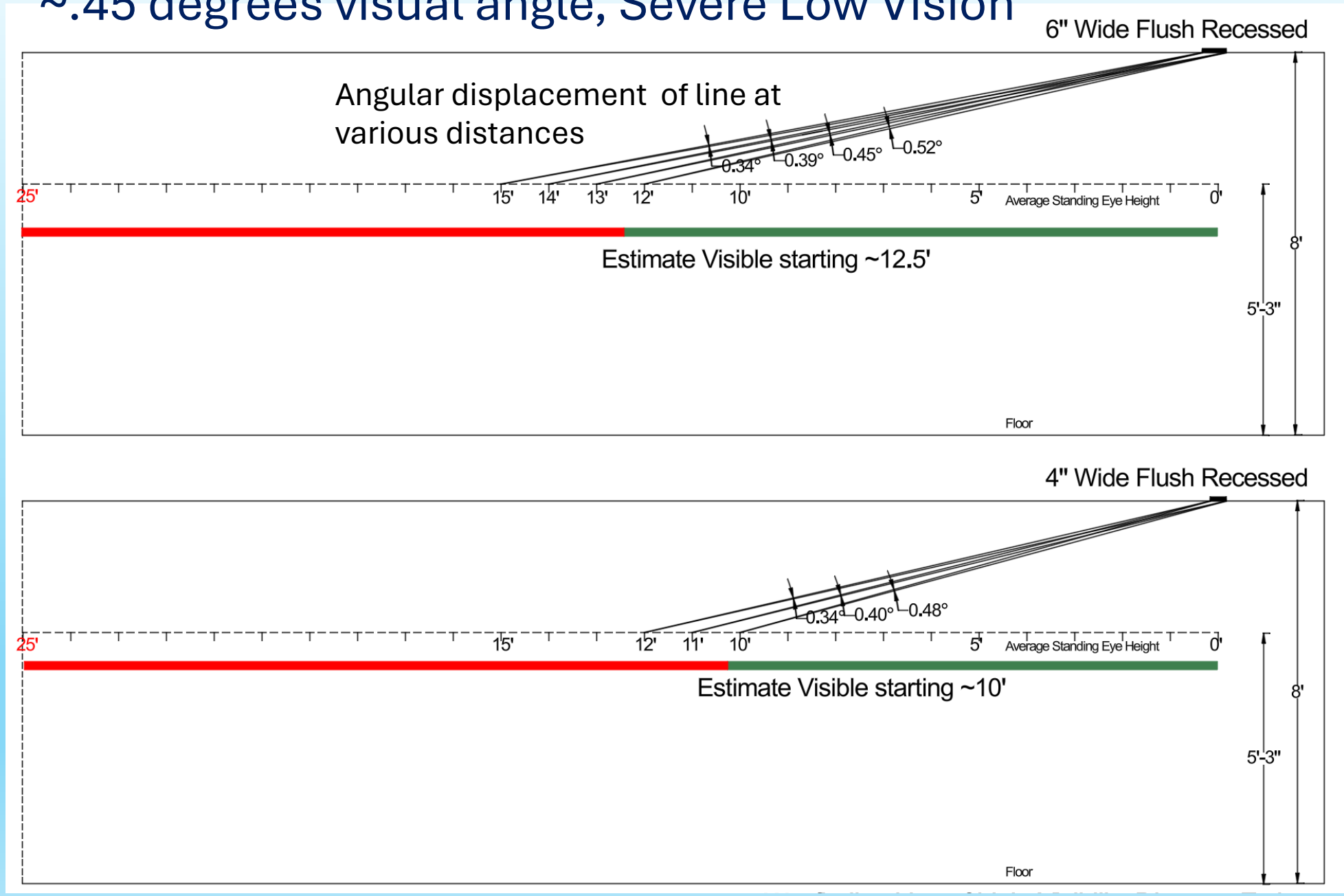
High Performance 4" Aperture (HP-4)



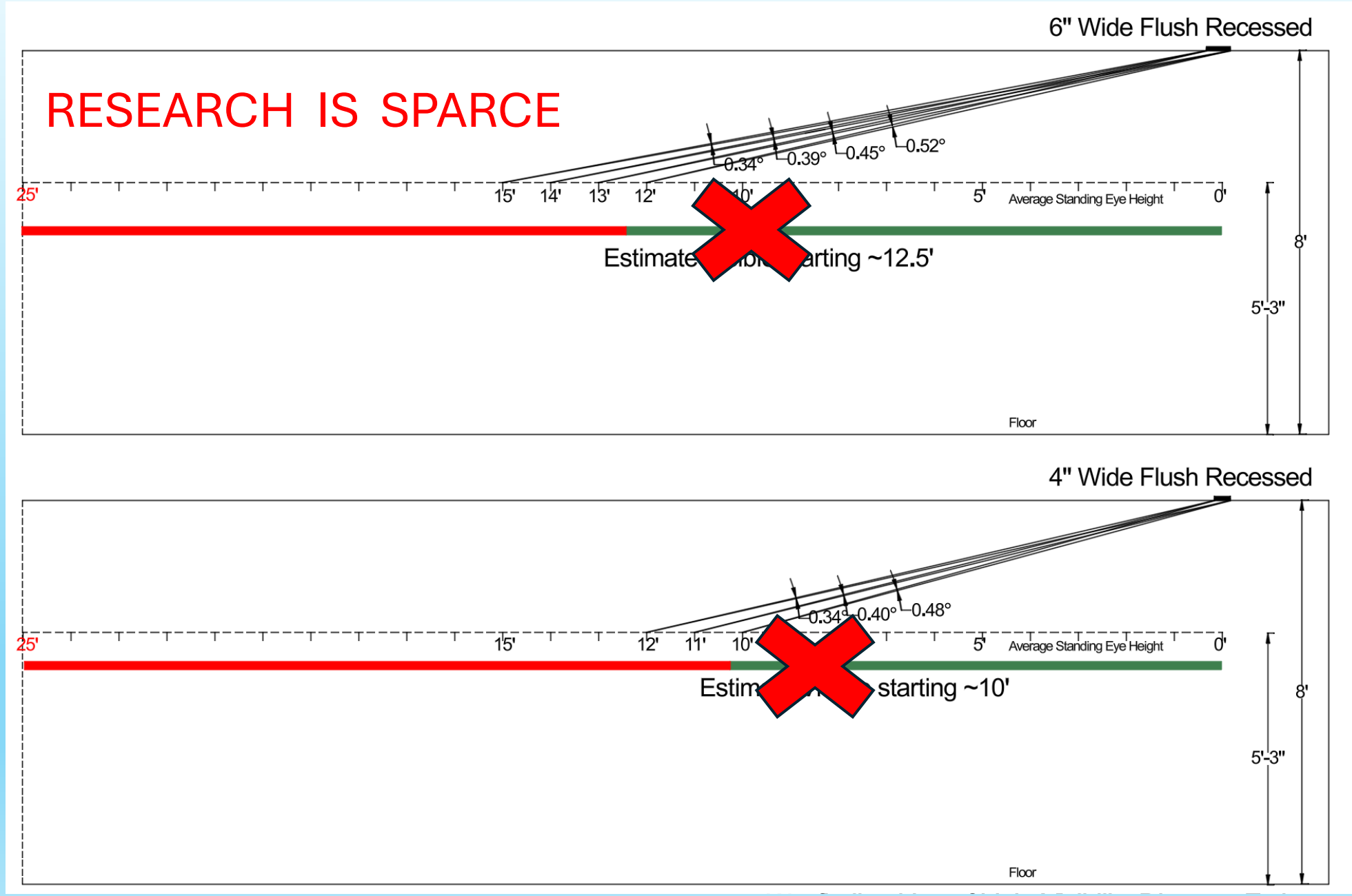
High Performance 6" Aperture (HP-6)



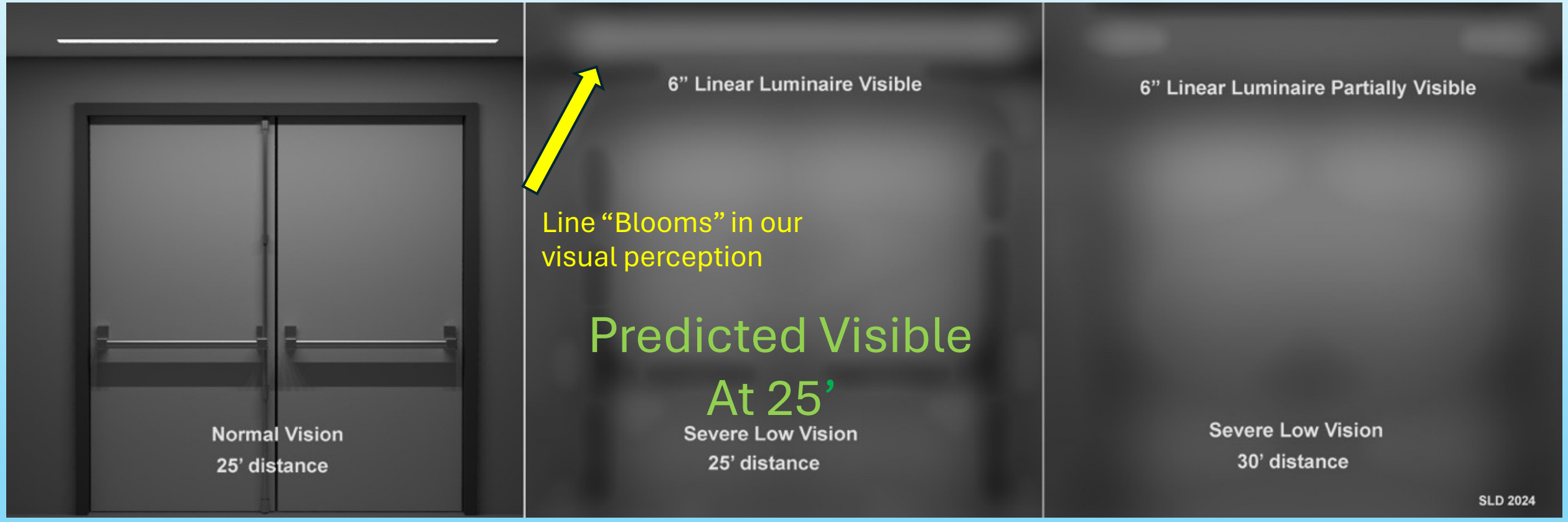
LV Non-Luminous Visibility of **4” & 6” wide linear black line** in 8’ ceiling ~.45 degrees visual angle, Severe Low Vision



But what about the Visibility of a flush **4” & 6” luminous luminaire** 8’ ceiling

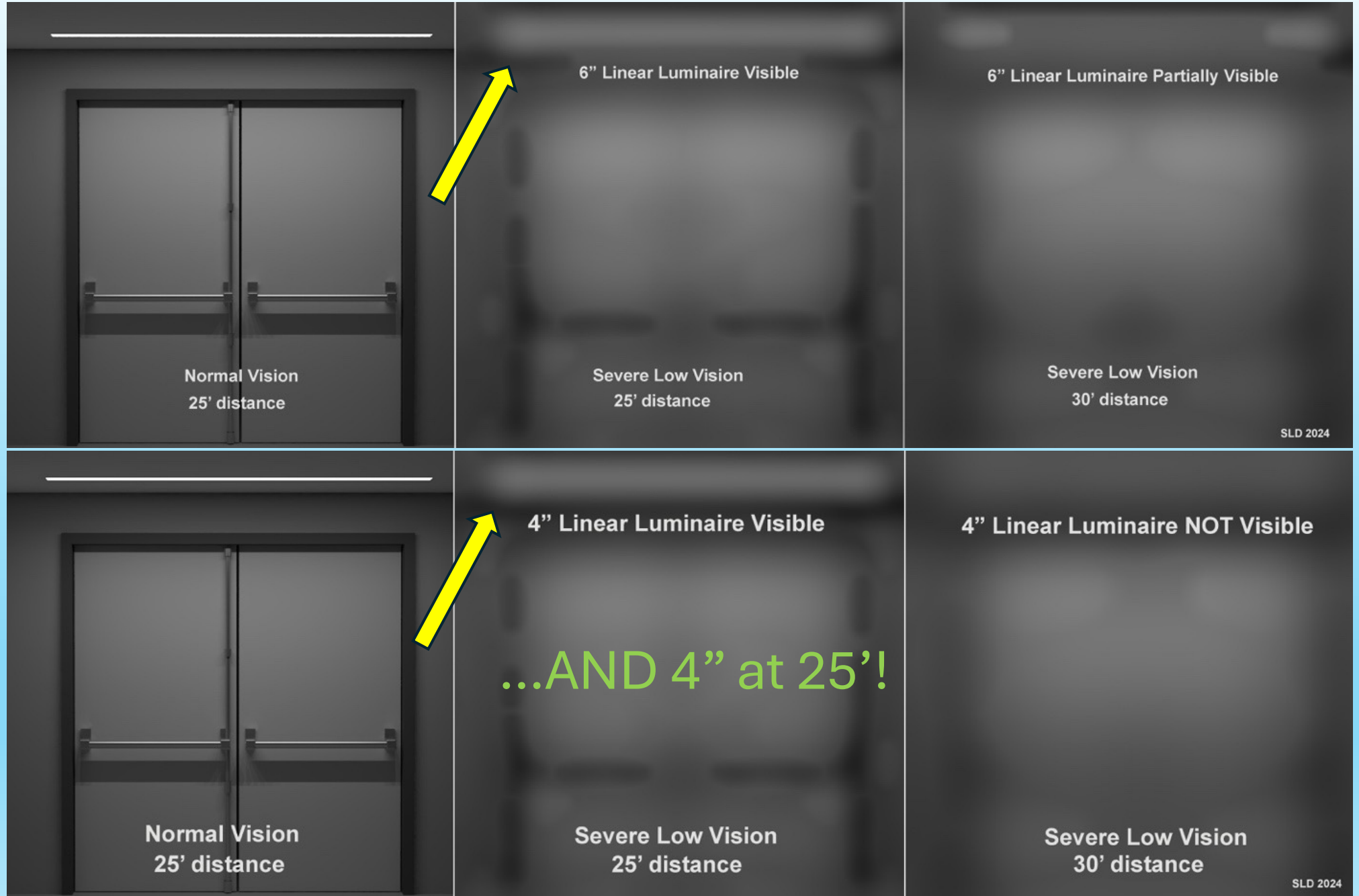


Applying DeVAS… 6” wide luminaire at 25’



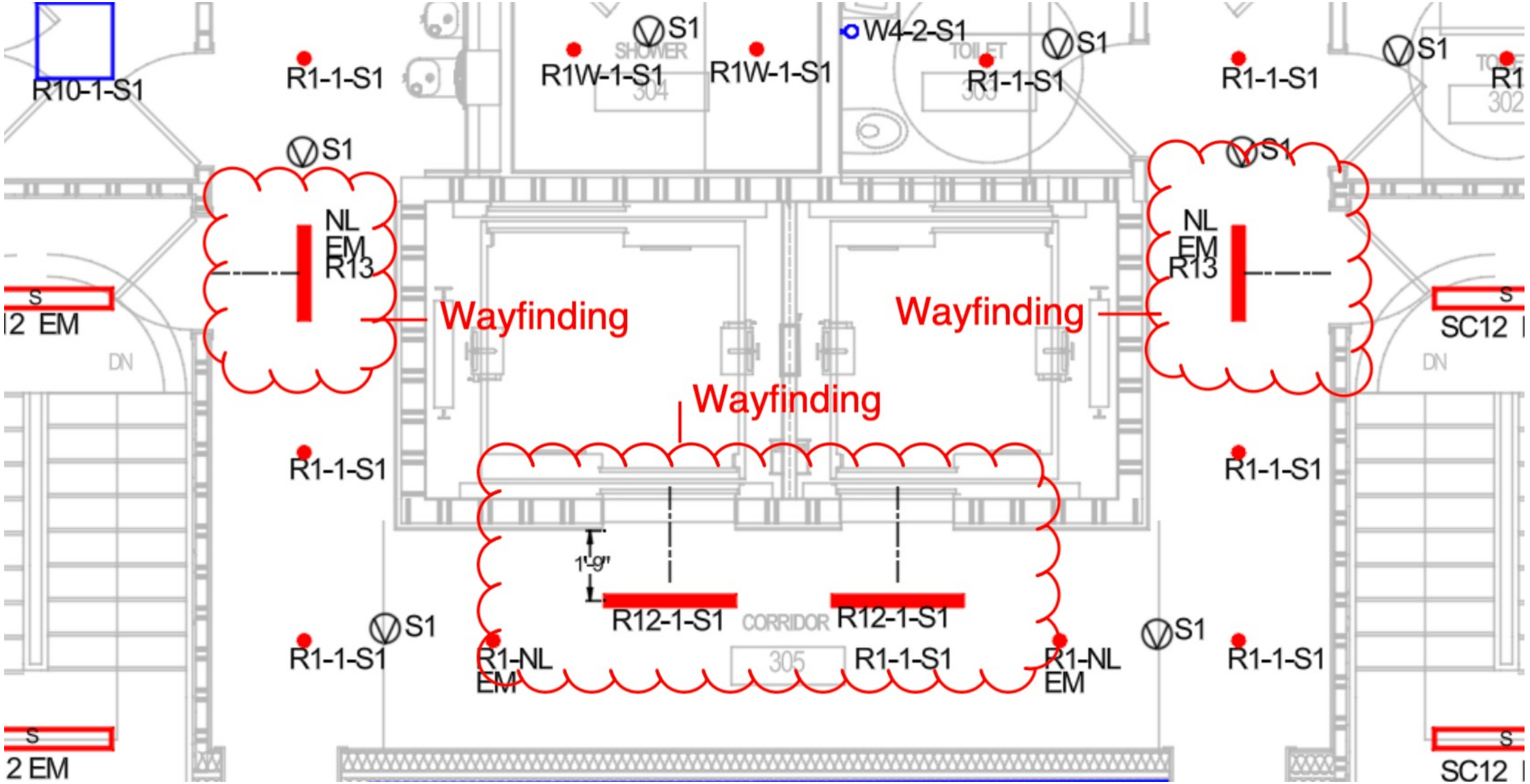
Indicates 6” luminaire predicted visible at 25’

Applying DeVAS… 6” AND 4” luminaire at 25’



Door Panic Hardware predicted visible from 5’ or closer

Informing the Design: Wayfinding using 4” wide flush linear at Egress Doors
All other luminaires UGR of 0



Deploying **GLARE** as an advantage

NEW Low Vision Visibility Analysis Research Project

EVA R01 1st Year Progress Report

Enhancing Visual Accessibility

2025.05.01

Johns Hopkins University, Department of Ophthalmology
in conjunction with Wilmer Eye Institute and Clinic

Project Goal

Develop an objective tool for evaluating the visual accessibility of indoor environments.

(for use by Field Clinicians when visiting patient residences)

Does not use Radiance, but this project extends the work of DeVAS, which is Radiance based… spawn of DeVAS!

Team Structure

Manager — Kyoko Fujiwara (JHU)

PI → Yingzi Xiong (JHU) — Qingying Gao, Bill Han, Clara Kim,

Researchers

- Gislin Dagnelie (JHU) — Jerry Rui, Roshnee Roberts, Sabrene Mechergui, Ava Jacqueline Flores
- Chris Bradley (JHU)
- Roberto Manduchi (UCSC) — Yunqian Chen
- Gordon Legge (UMN)
- Rama Challapa (JHU, honorary member)

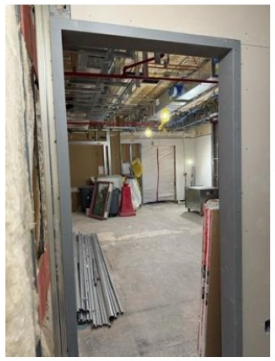
Clinician Scientists

- Judy Goldstein (JHU)
- Pradeep Ramulu (JHU) — Aleks Mihailovic
- Kristen Shifflett (JHU)

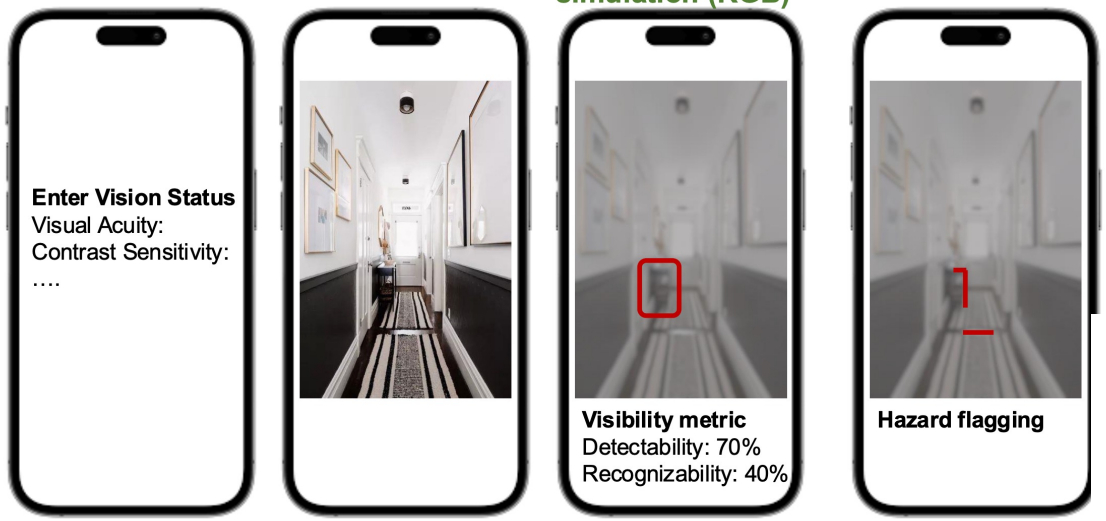
Consultants

- Rob Shakespeare (Shakespeare Lighting, LLC)
- Arathy Kartha (SUNY)

Lab construction – Expected Completion Mid-June



Project Goal – **Algorithm Development**



1. Low vision simulation (RGB)

2. Object-based analysis (RGB)

3. Edge-based analysis (RGB and depth)

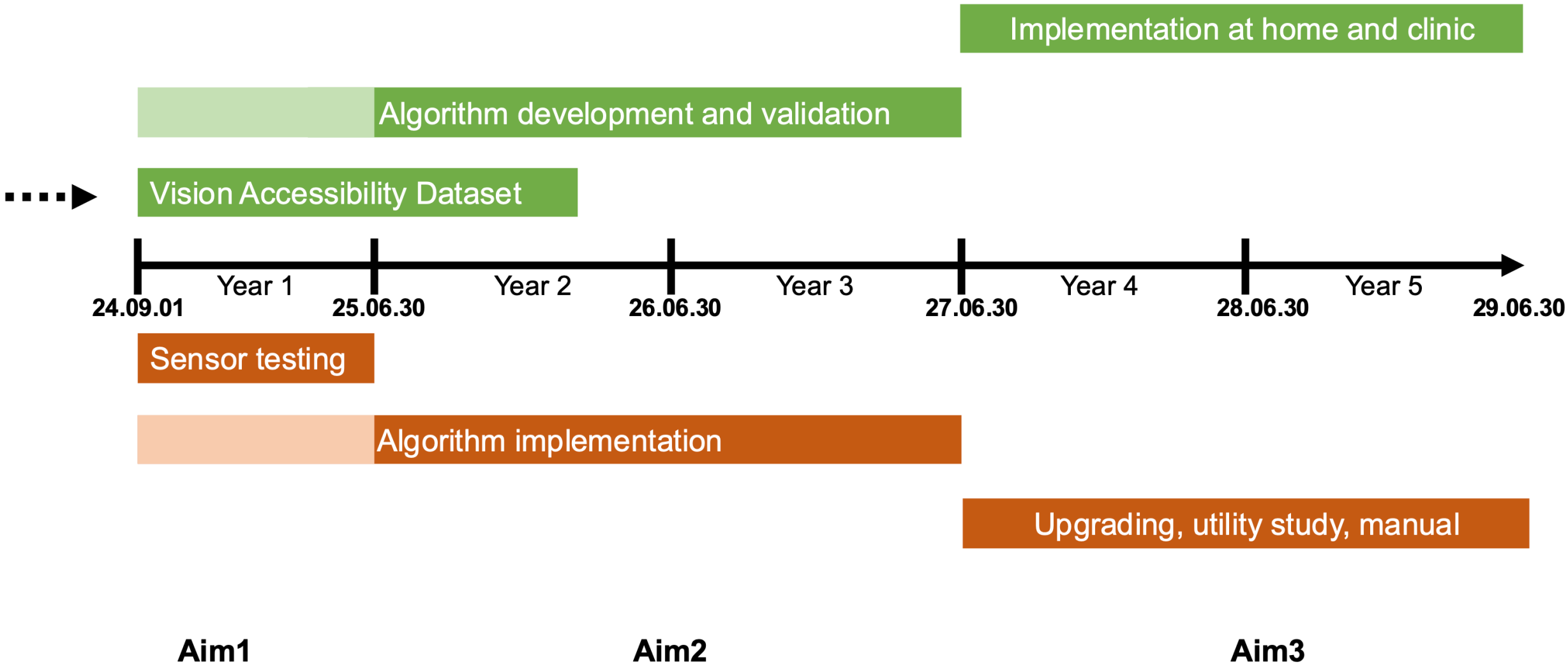
Project Goal – **Software Development**

1. Photometric fidelity (Camera)

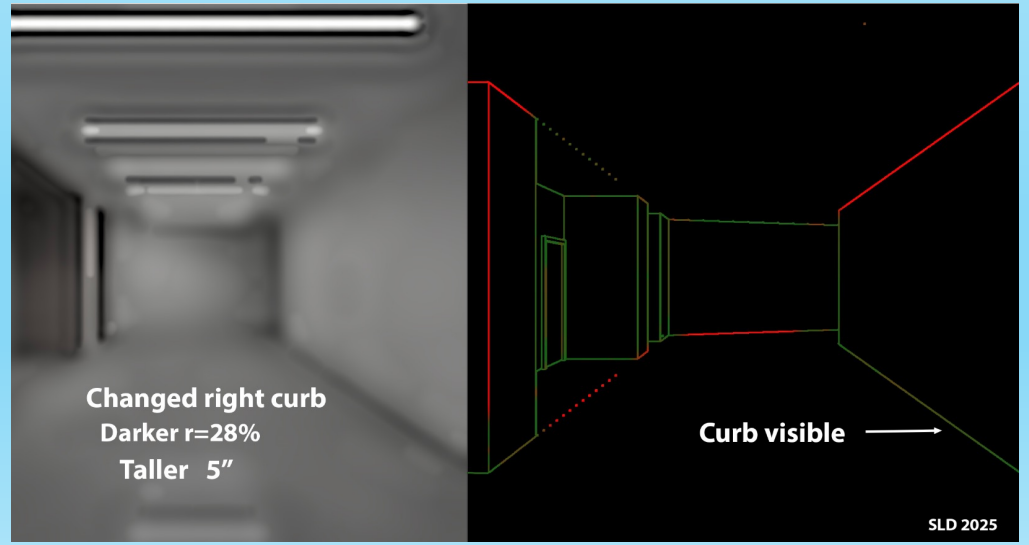
2. Depth accuracy (LiDAR)

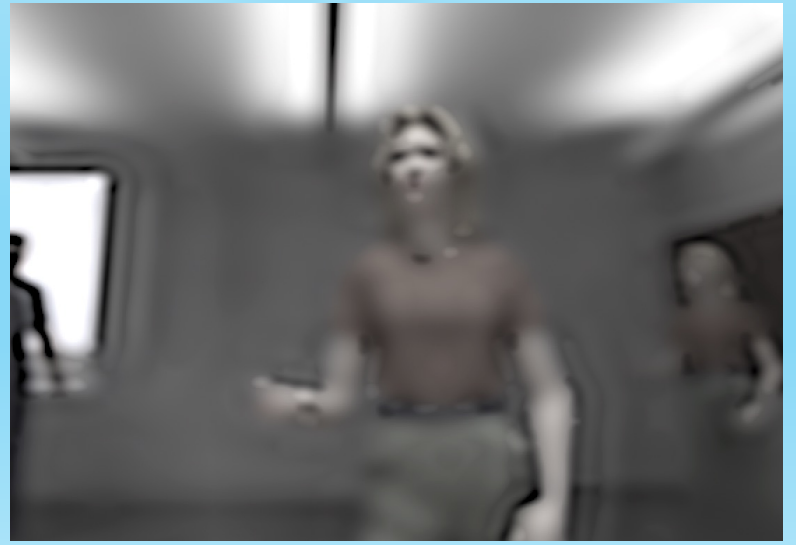
3. Algorithm implementation

5-year Project timeline



DeVAS is demonstrated effective for **Low Vision visibility analysis** and as a **visual hazard detection tool** in architectural projects

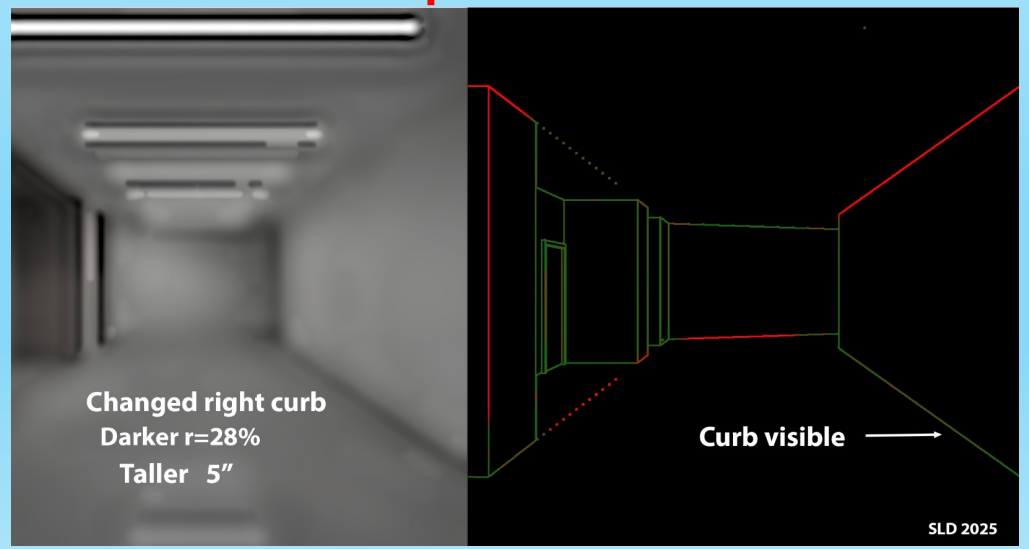




DeVAS can assist in improving the quality of life and safe passage for many

Please help in promoting these tools

Developers needed!!



Thank You!

Applying DeVAS Tools:
Low Vision Face Recognition

EVA New Research Initiative Extending DeVAS

Rob Shakespeare

Lighting Designer

Low Vision Design Consultant

Shakespeare Lighting Design LLC

Rob@ShakespeareLighting.com

Radiance International Workshop 2025

August 27-29

EPFL Lausanne Switzerland