Room-side Low-e Coating: As Good As It Sounds?

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Senior Building Scientist | Associate
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Designer

BuildingEnergy NYC
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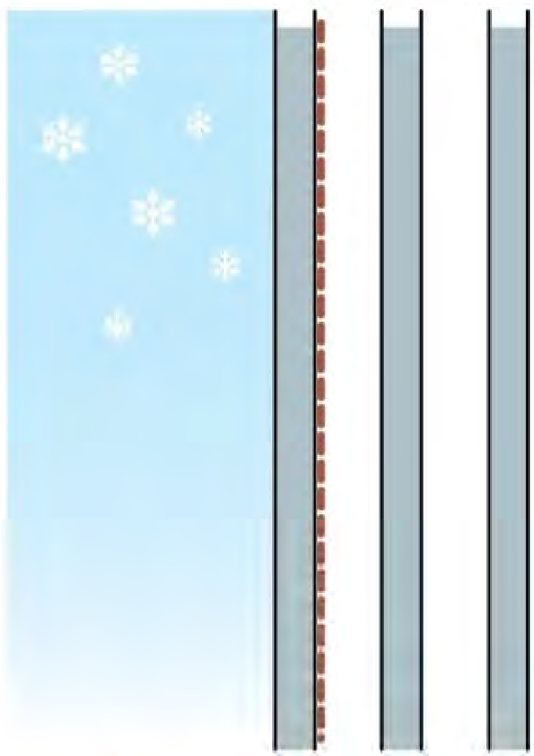
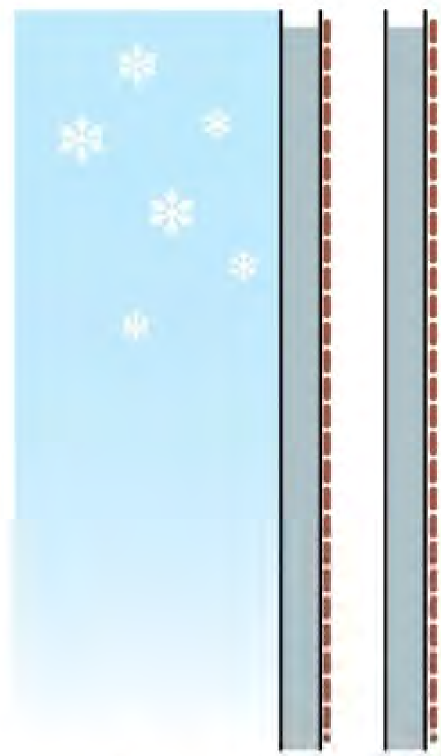
PAYETTE

ROOM-SIDE LOW-E

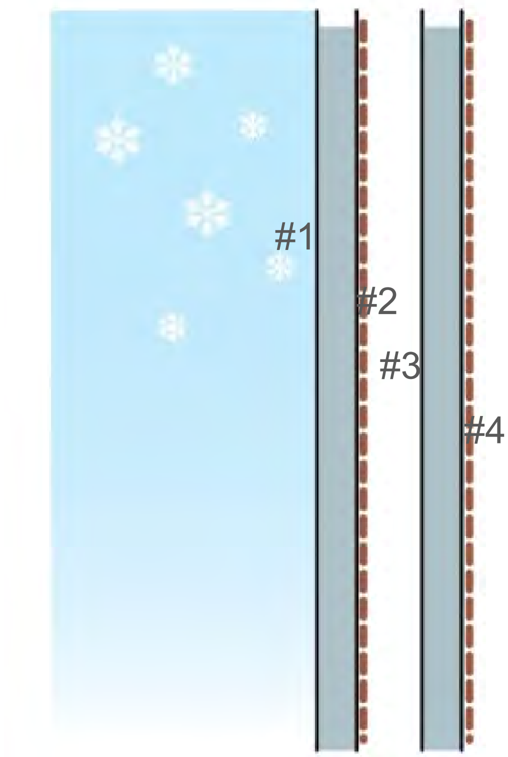


Triple-Glazed IGU



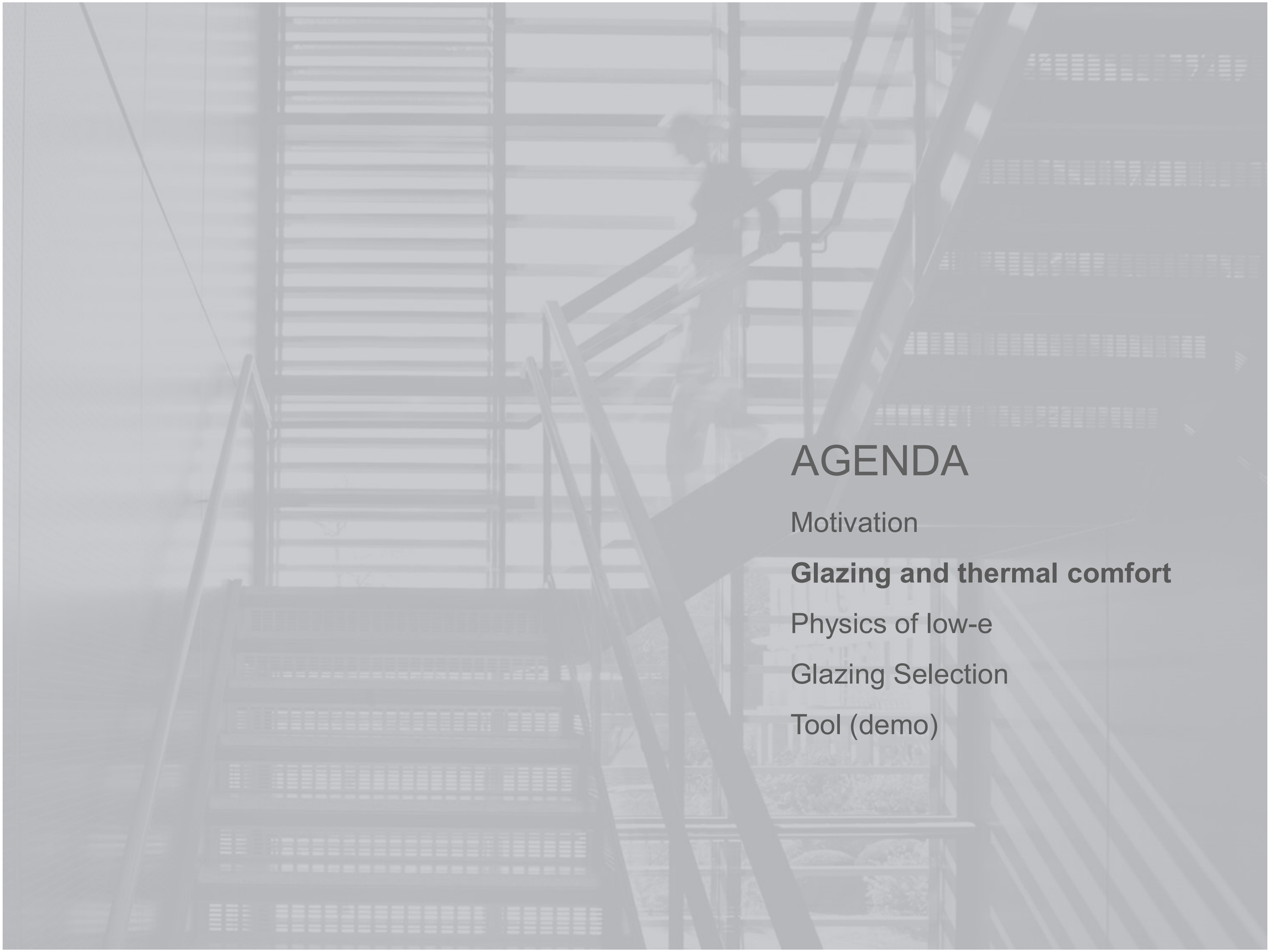
Double-Glazed IGU
with Room-side low-e

ROOM-SIDE LOW-E



- *Room-side*, *4th surface*, *Indoor surface* low-e
- ε ~ 0.2 (compared to ε ~ 0.05 of cavity coatings)
- Scratch-resistant clear coating
- Lighter, cheaper
- Improved radiant occupant comfort

ROOM-SIDE LOW-E: AS GOOD AS IT SOUNDS?



AGENDA

Motivation

Glazing and thermal comfort

Physics of low-e

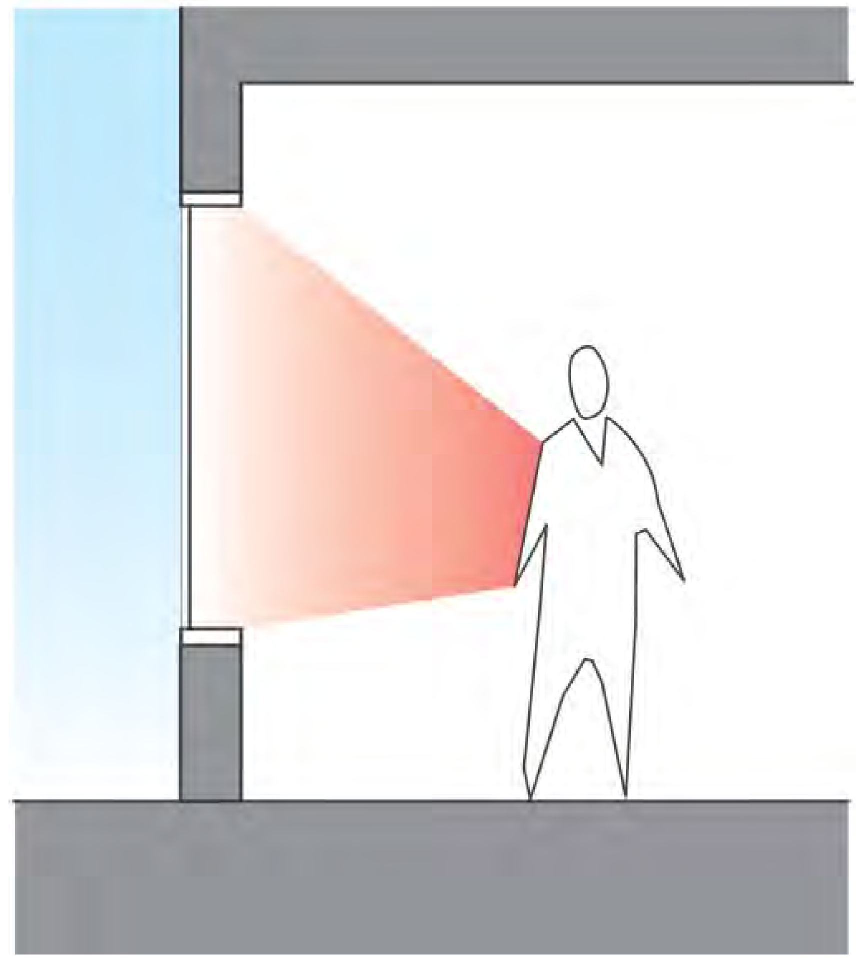
Glazing Selection

Tool (demo)

THERMAL COMFORT | Glazing

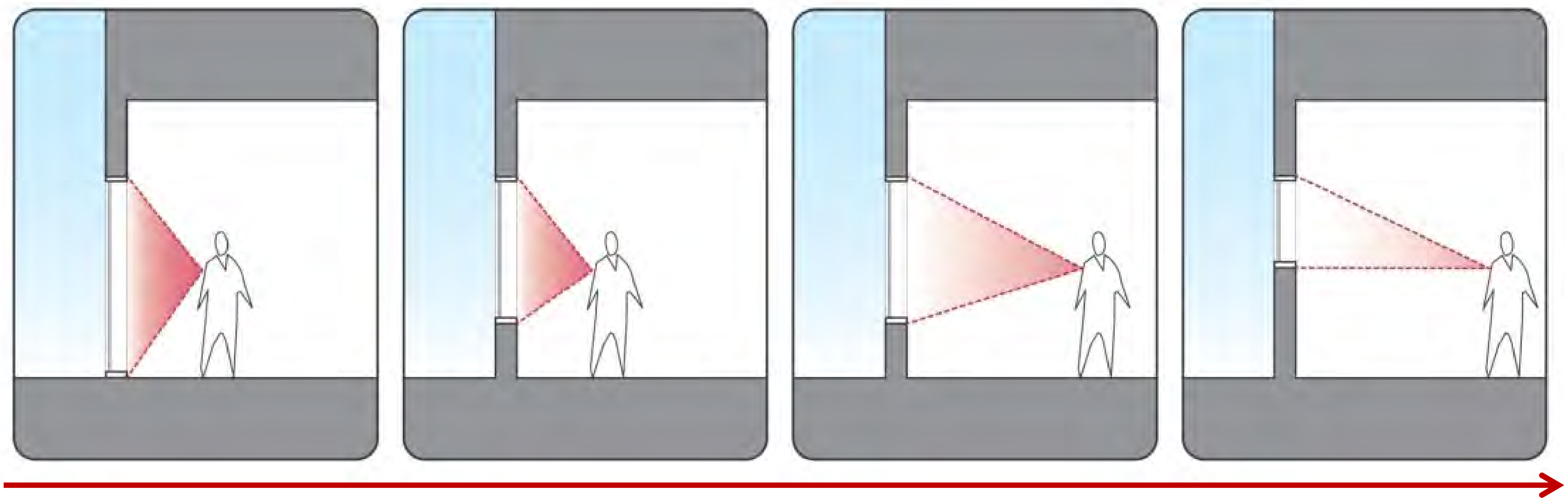
Exterior glazing makes us feel cold through:

- Radiant discomfort
- Downdraft discomfort



THERMAL COMFORT | Radiant Discomfort

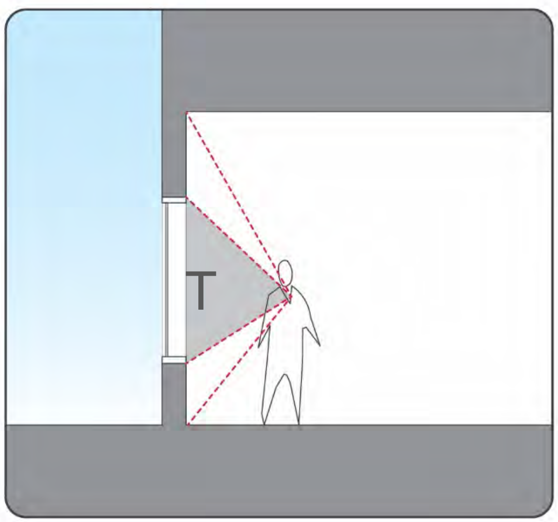
- Radiant discomfort depends on:
  - How much “we see” of each cold surface (view factor)



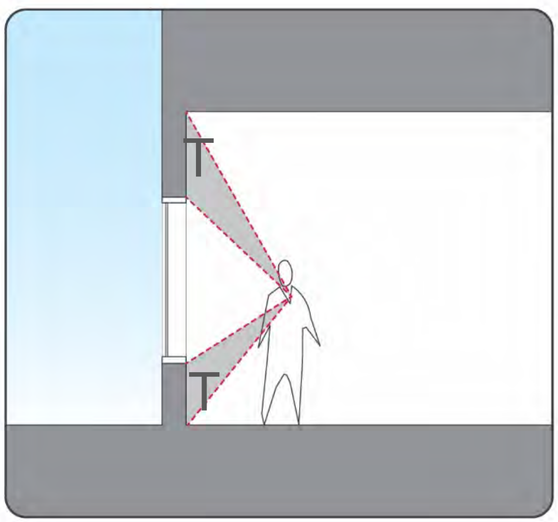
THERMAL COMFORT | Radiant Discomfort

- Radiant discomfort depends on:
  - How much “we see” of each cold surface (view factor)
  - How cold each surface is (T)
  - The emissivity (ε) of each surface

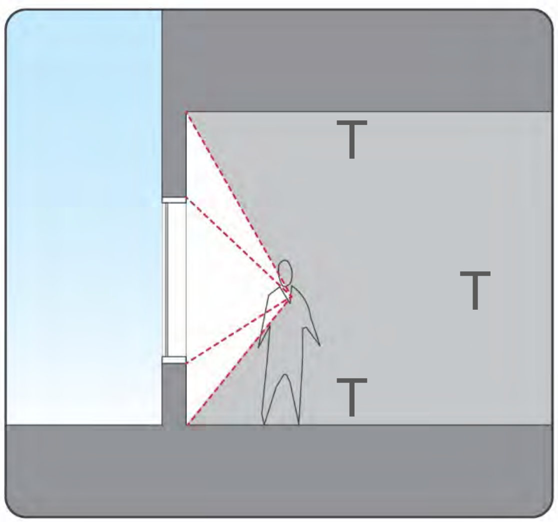
Glazing



Solid wall



Interior surroundings



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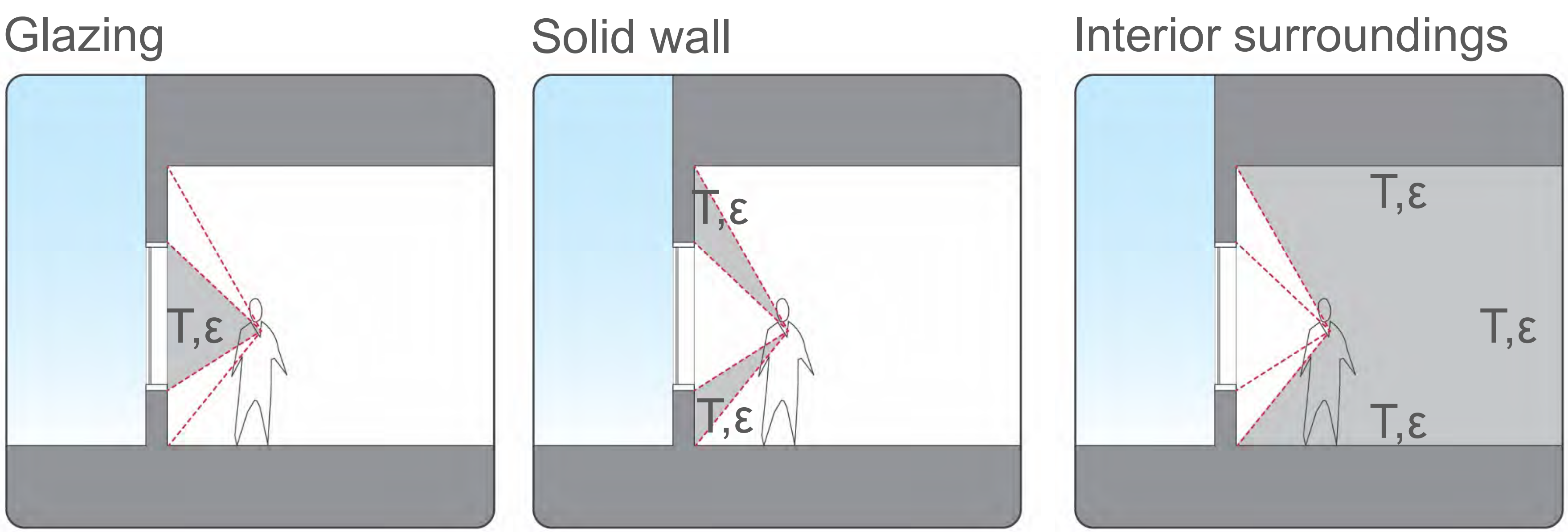
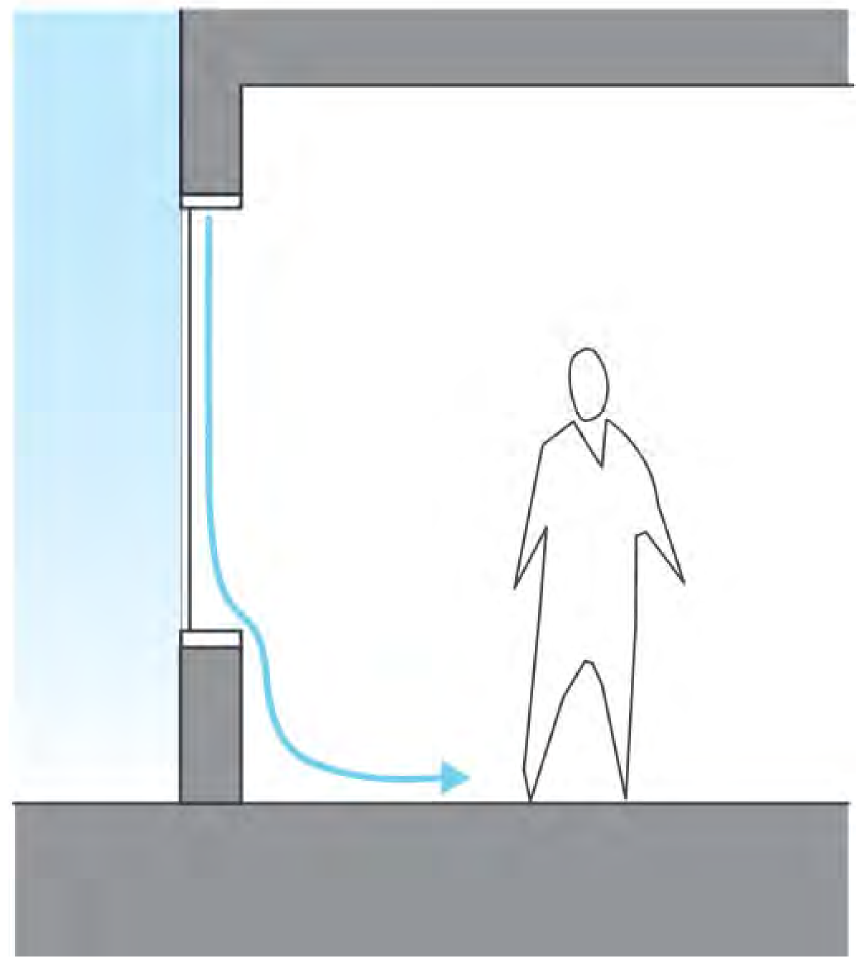


THERMAL COMFORT | Glazing

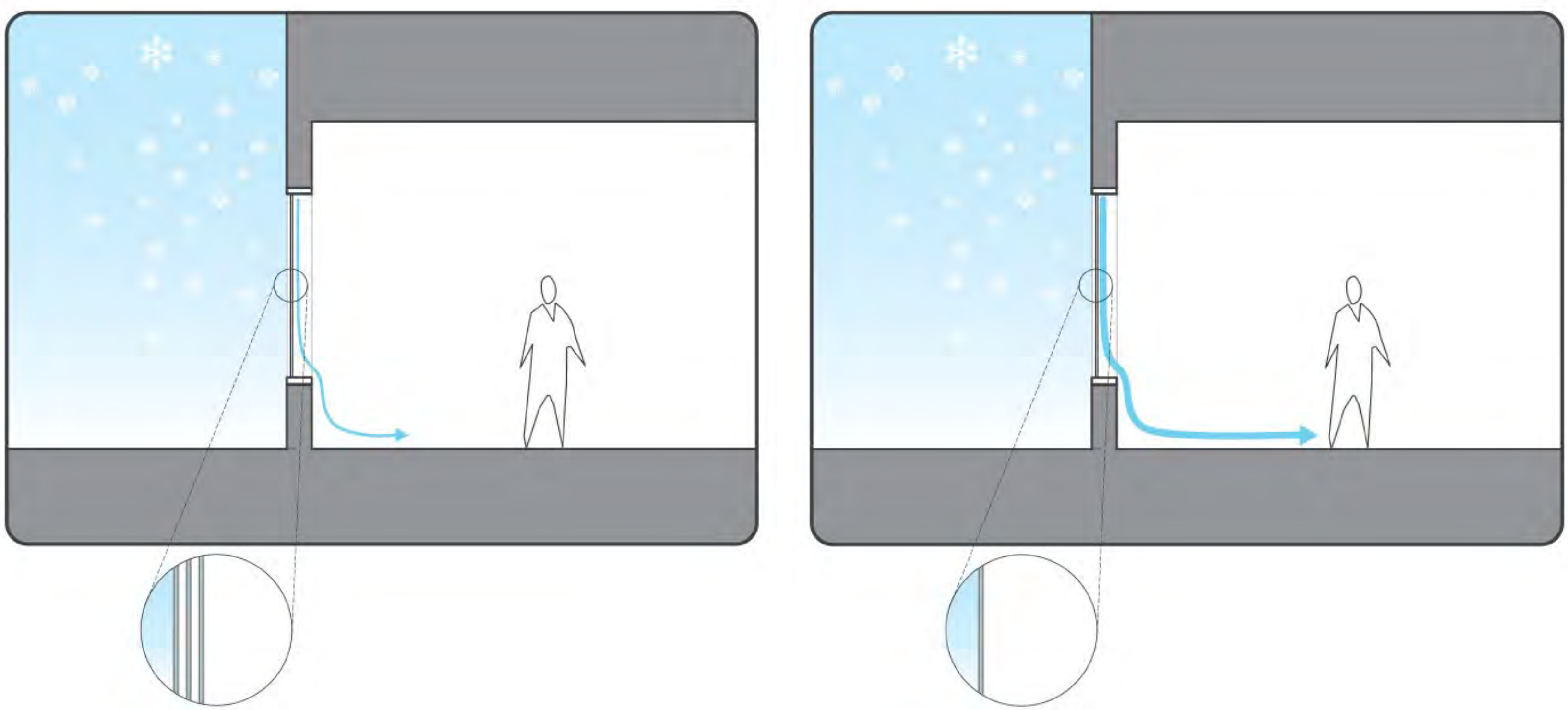
Exterior glazing makes us feel cold through:

- Radiant discomfort
- Downdraft discomfort



THERMAL COMFORT | Draft Discomfort

- Draft discomfort depends on:
  - How cold the surface is
  - How tall the surface is
  - How close the occupant is to the surface



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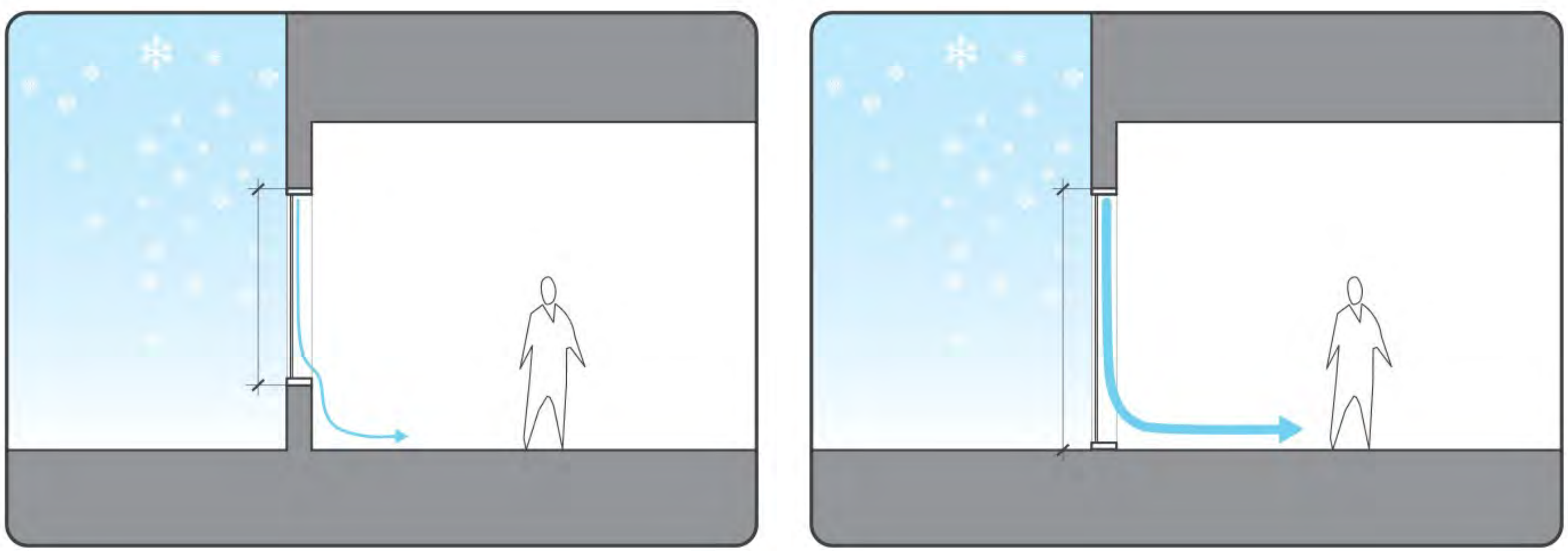

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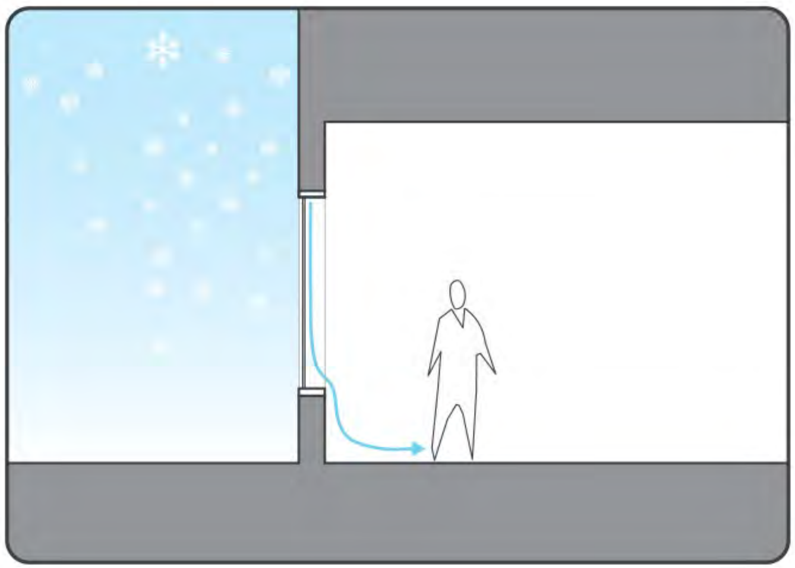
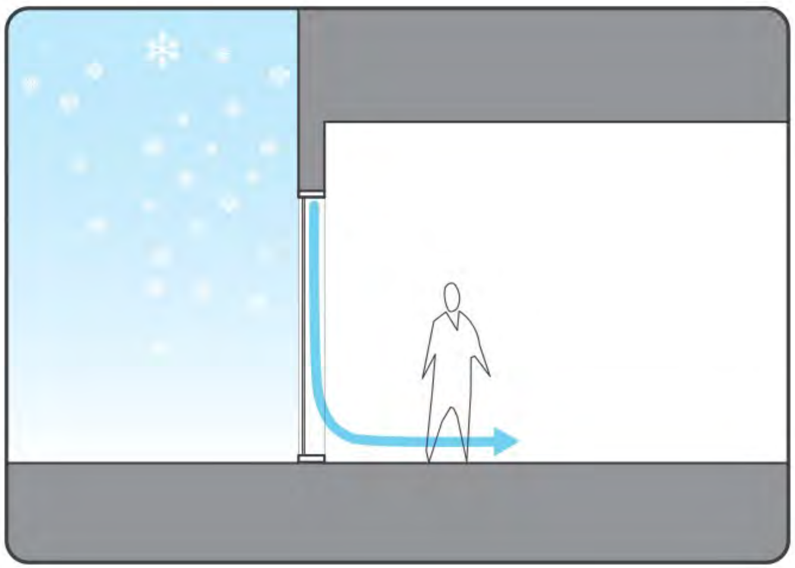
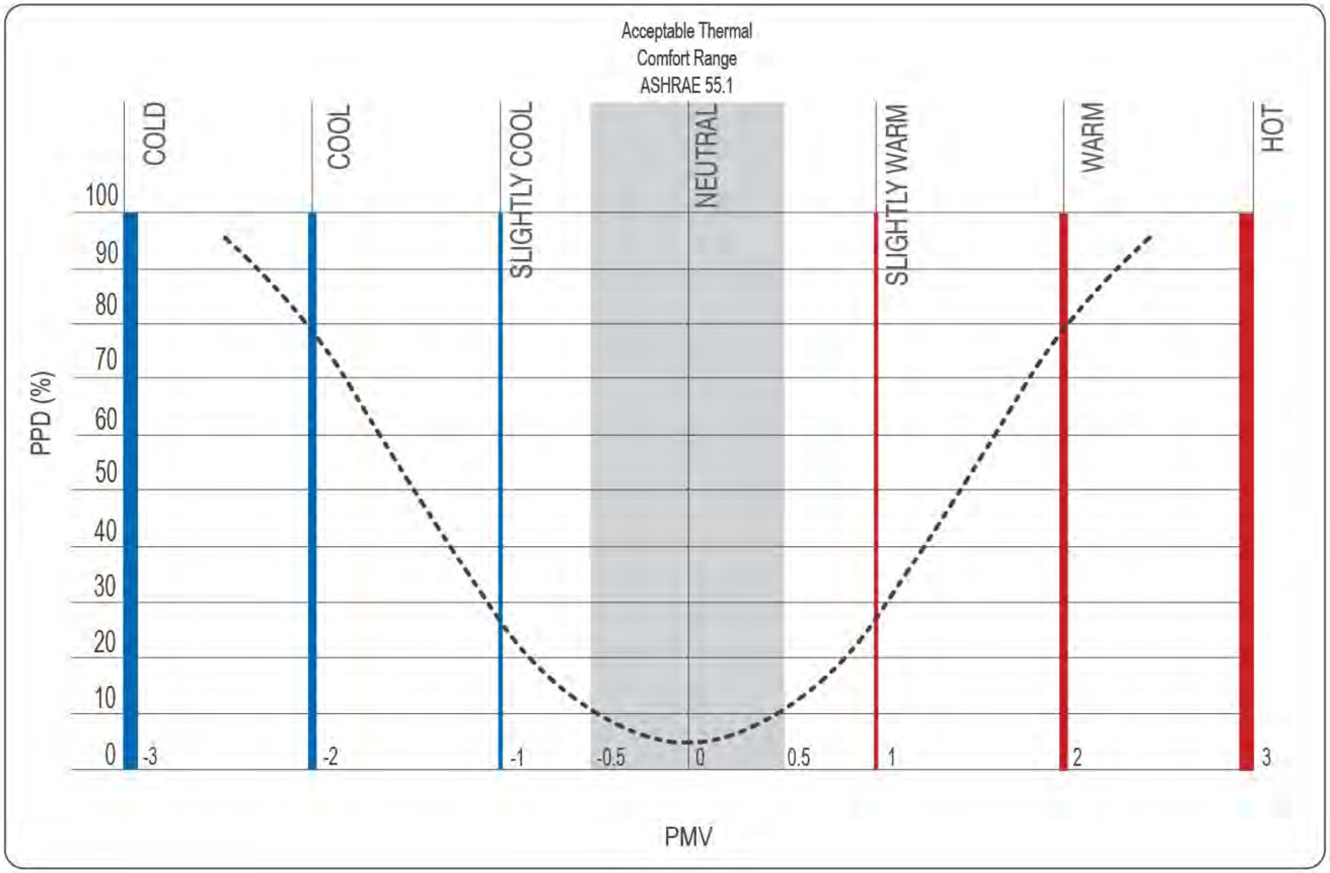




THERMAL COMFORT | Predicted Percentage Dissatisfied



- Predicted Percentage Dissatisfied (PPD) less than 10%
- Predicted Mean Vote (PMV) Range -0.5 to +0.5

Thermal Comfort. P. O. Fanger (1970), Copenhagen: Danish Technical Press.

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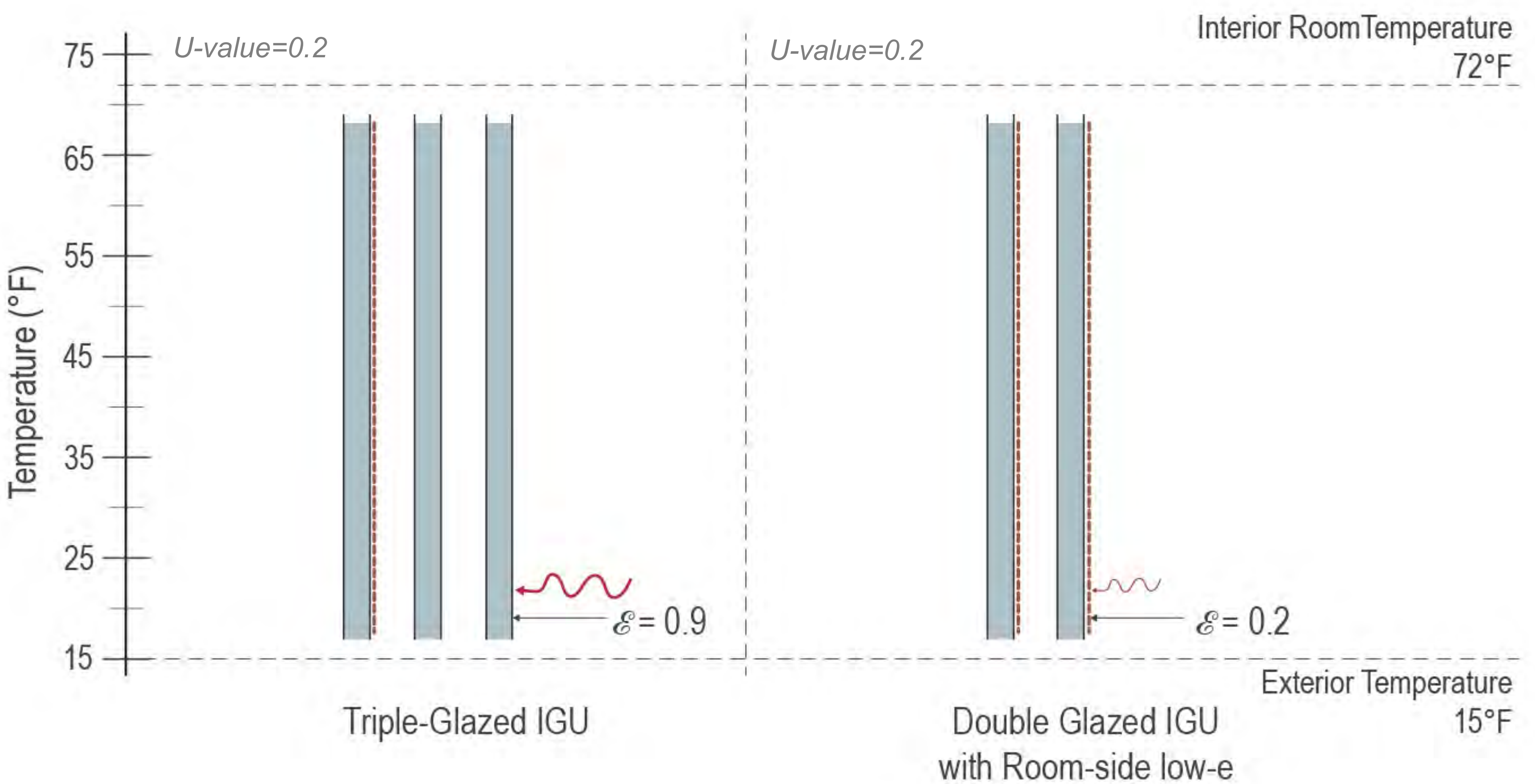
ROOM-SIDE LOW-E | Interior Surface Temperature



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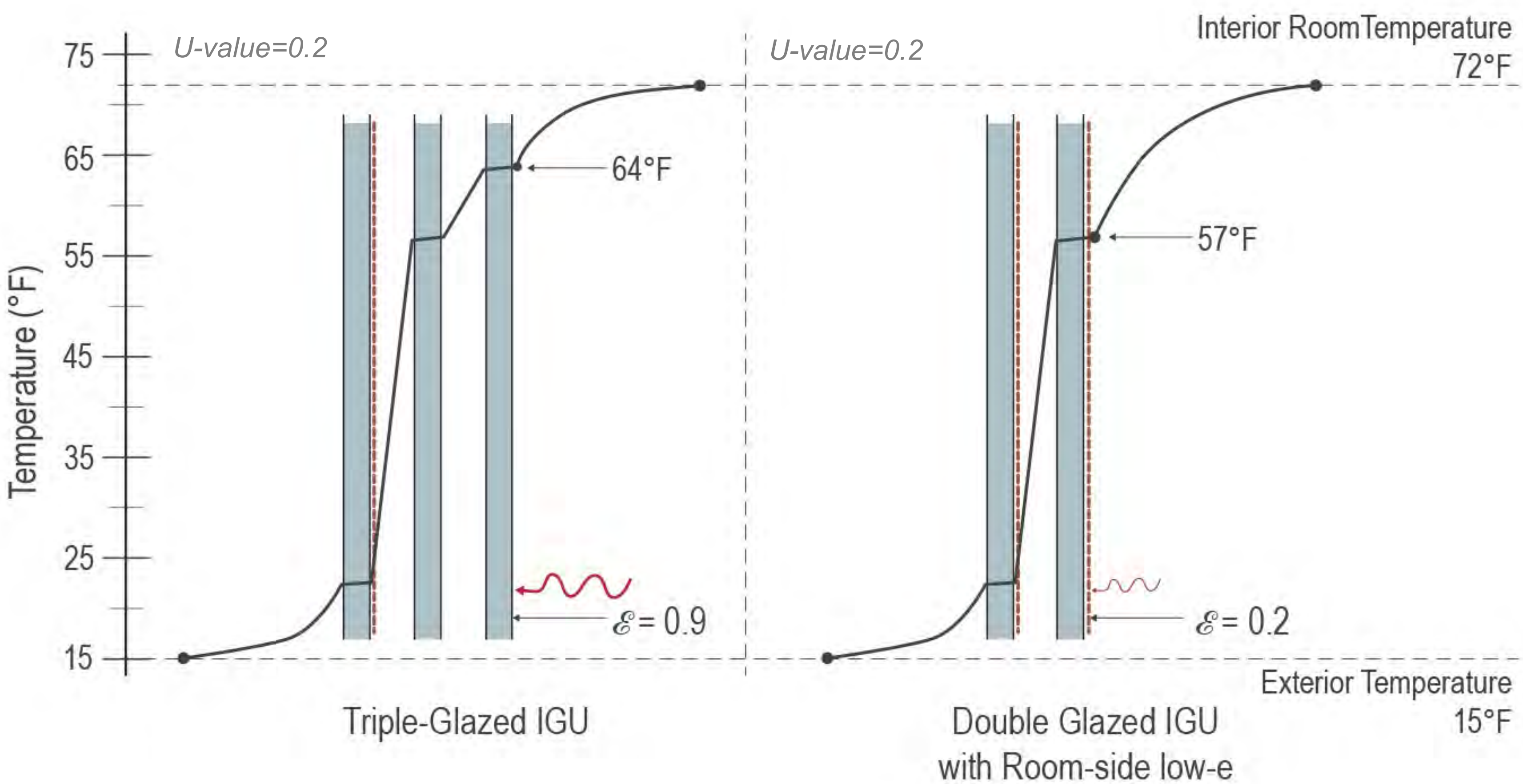
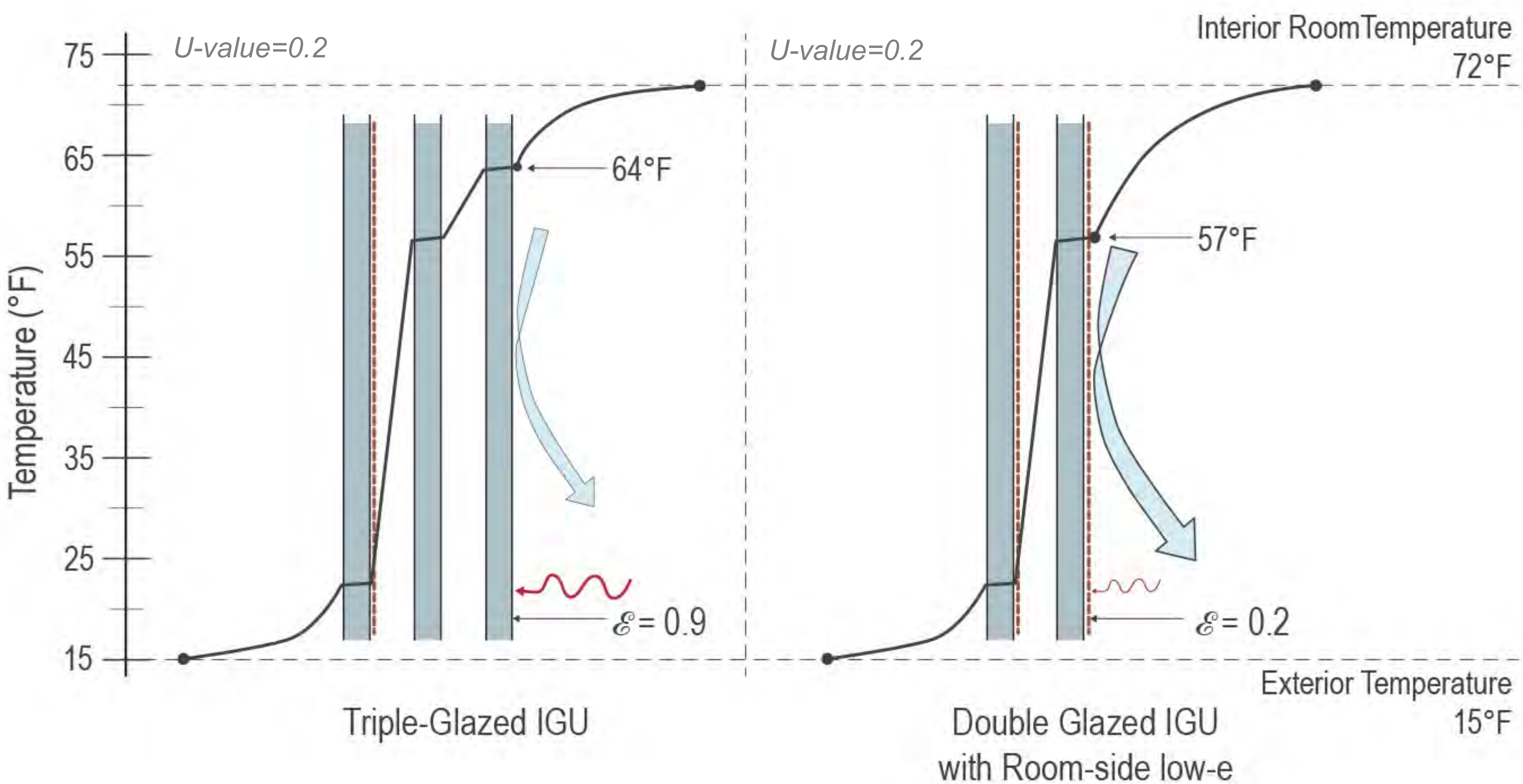
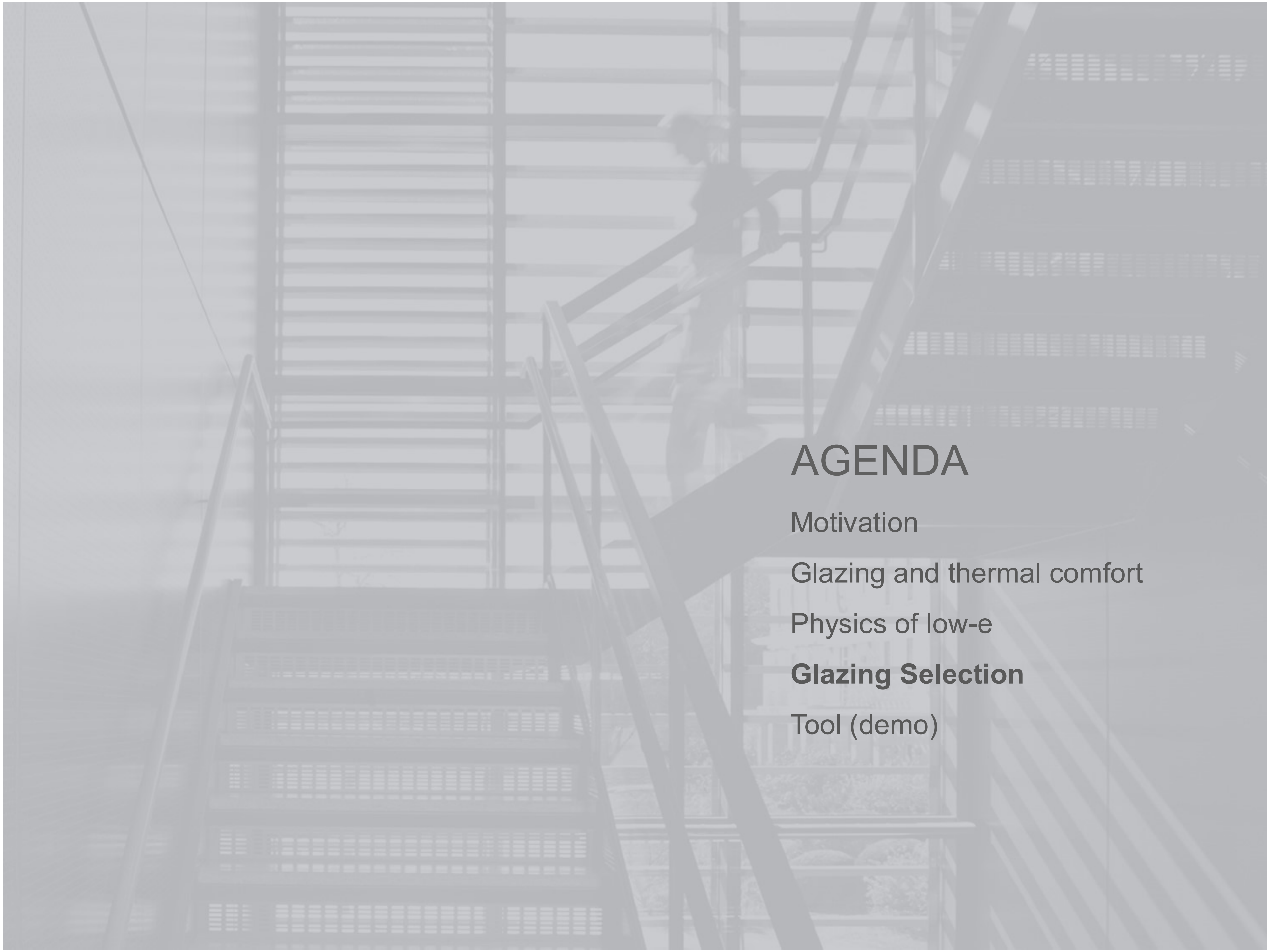


ROOM-SIDE LOW-E | Interior Surface Temperature



- Colder, stronger downdraft
- Potential for condensation
- Improved radiant occupant comfort



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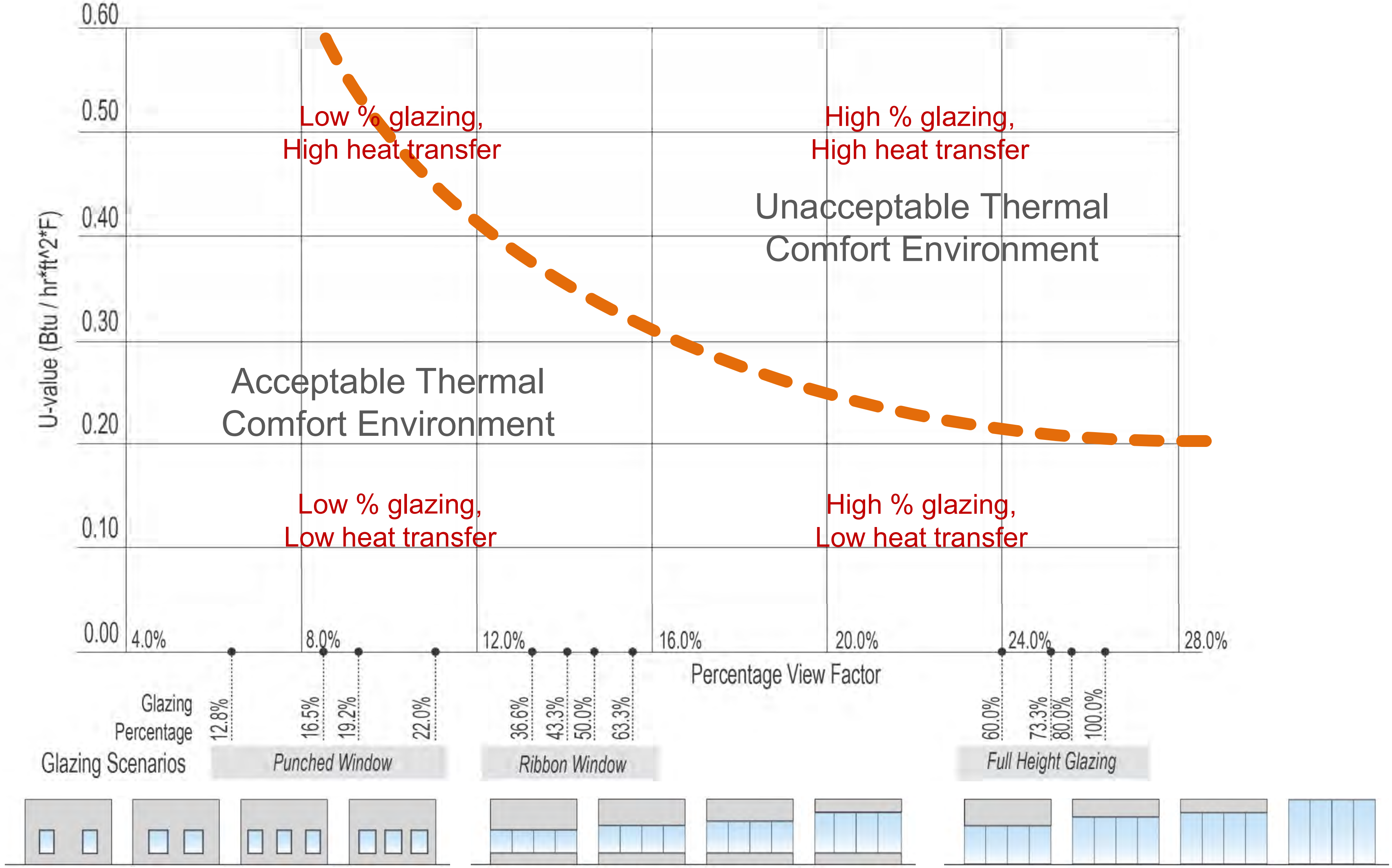
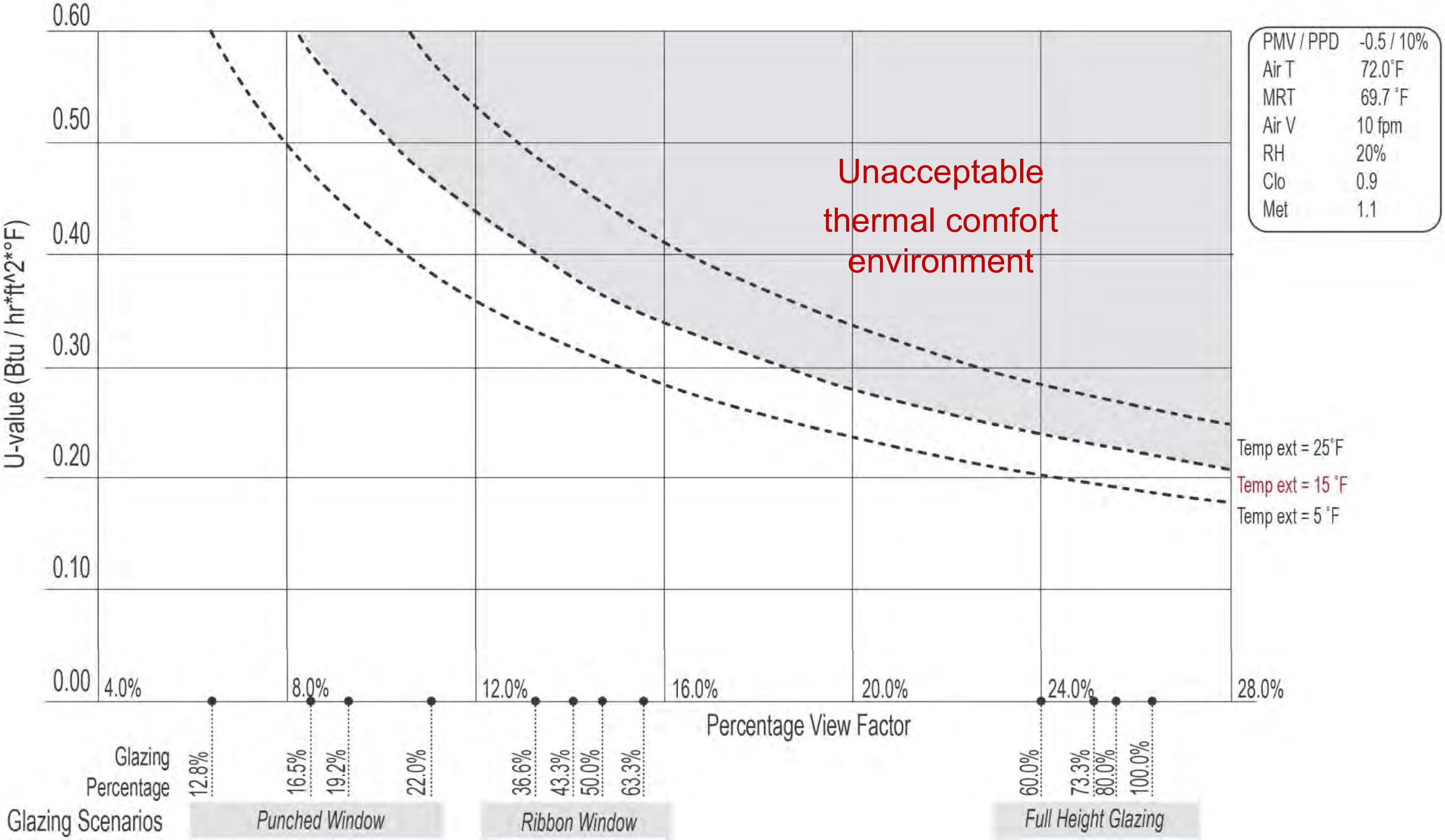
GLAZING DESIGN SCENARIOS

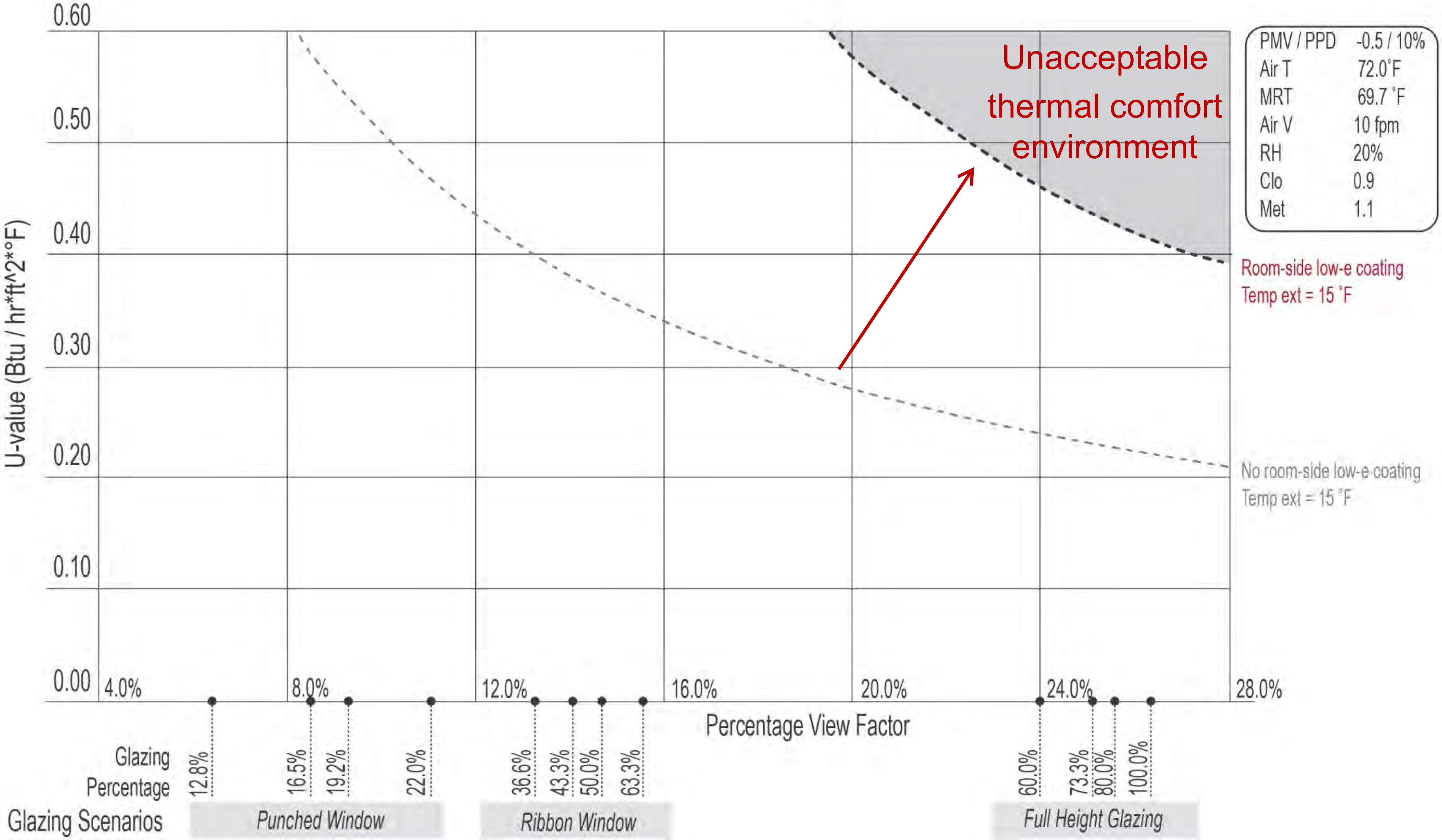
RADIANT DISCOMFORT | U-Value vs. View Factor



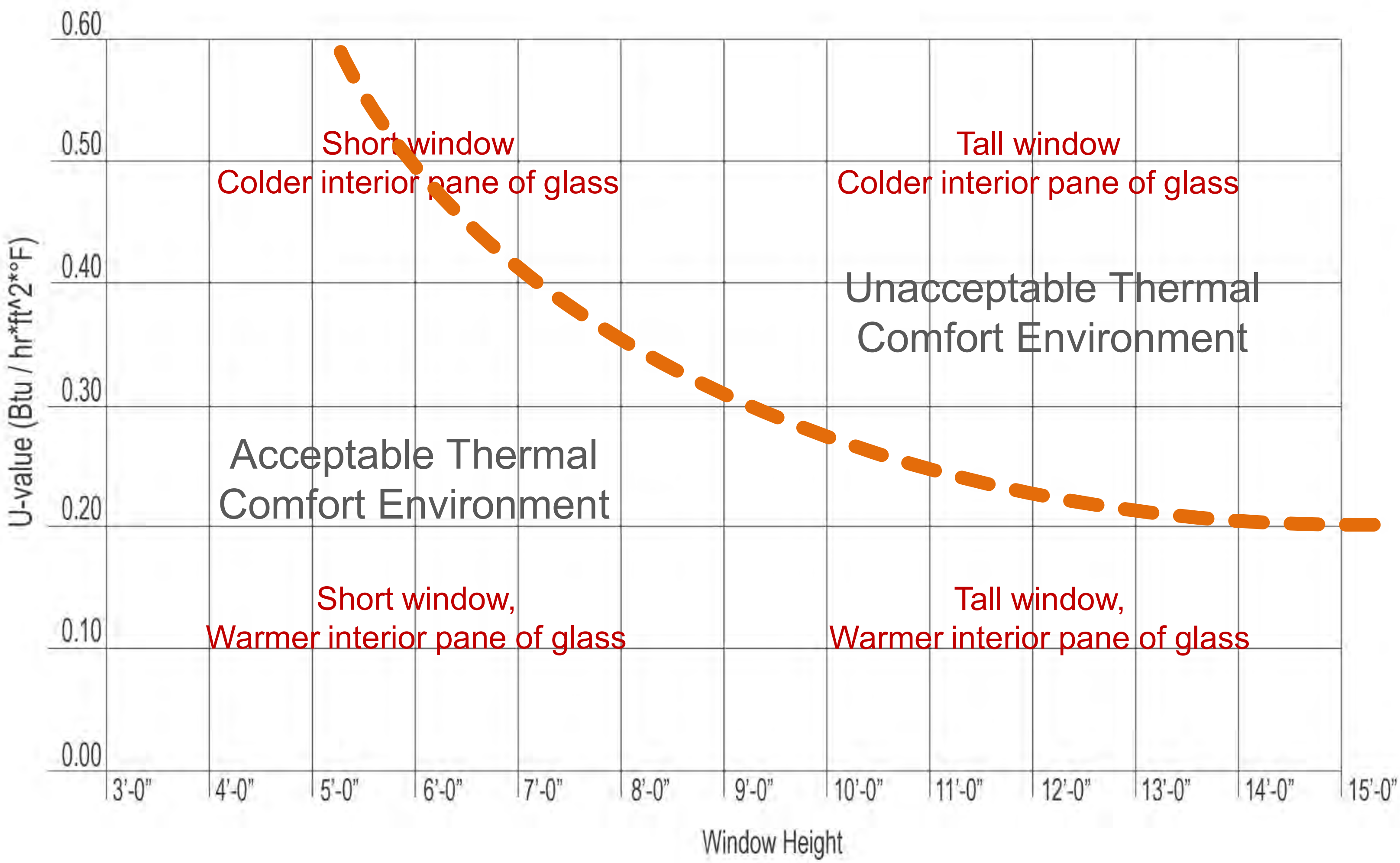
RADIANT DISCOMFORT | U-Value vs. View Factor



RADIANT DISCOMFORT | U-Value vs. View Factor



DOWNDRAFT DISCOMFORT | U-Value vs. Window Height



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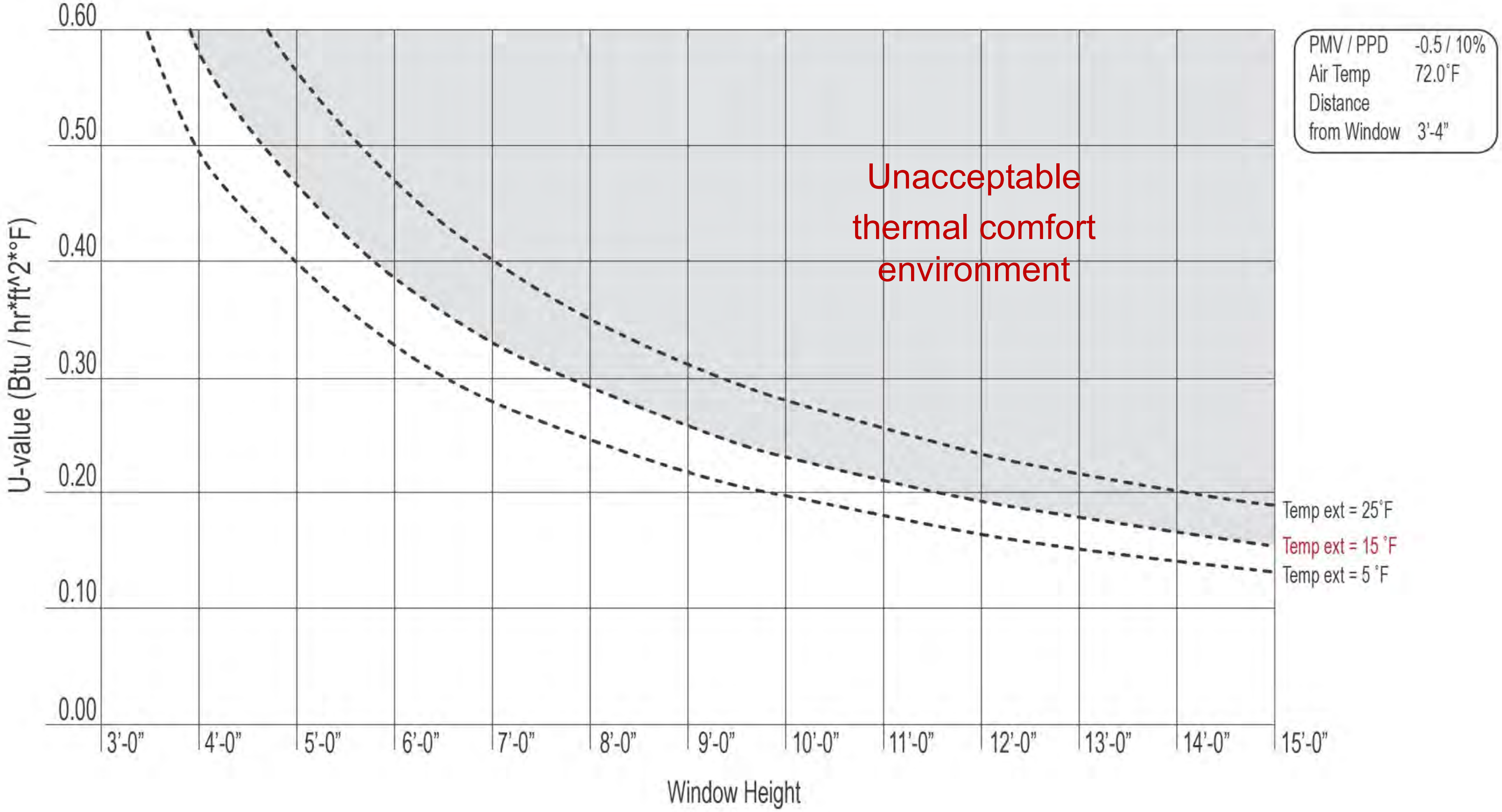
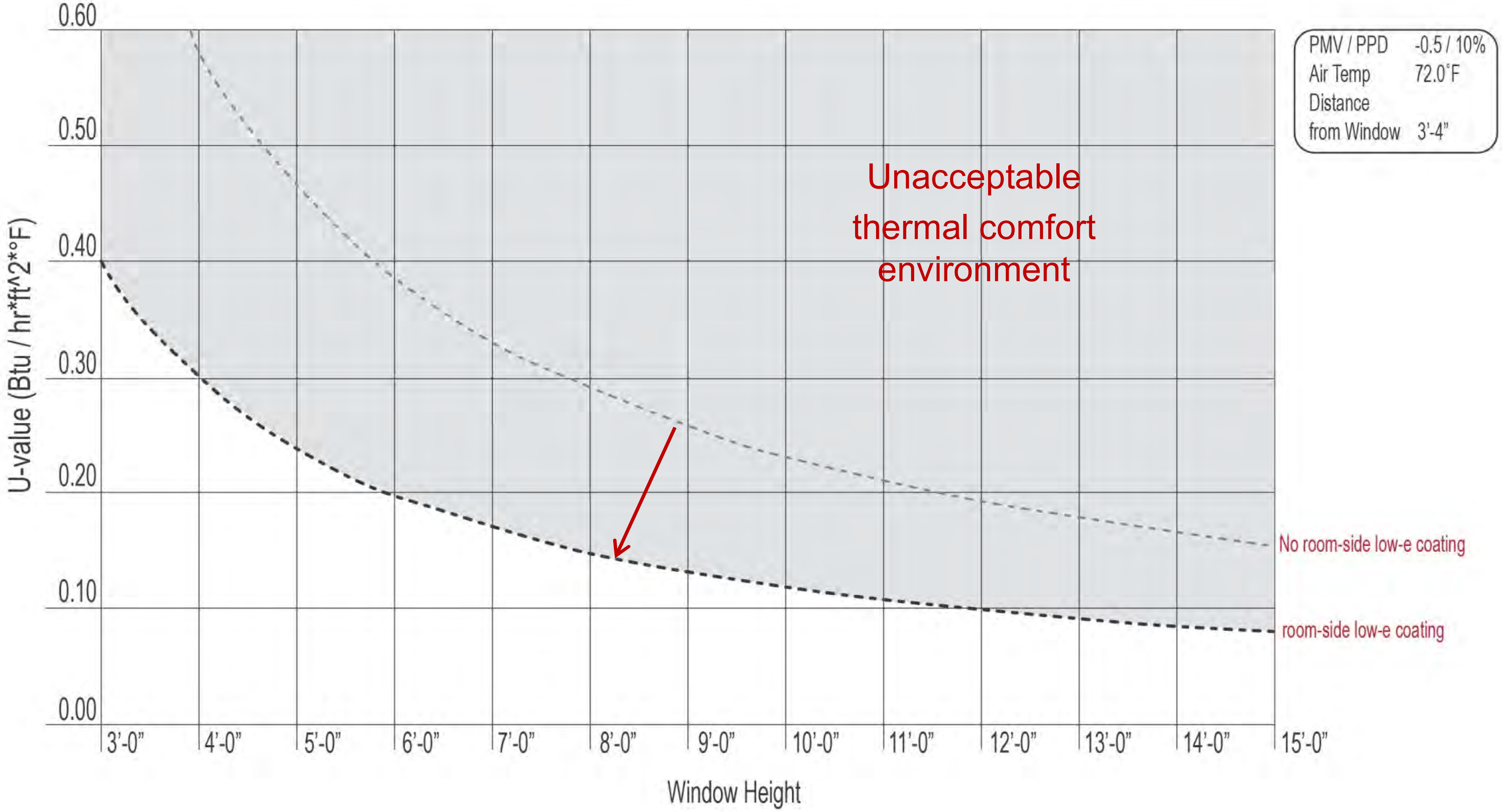


DOWNDRAFT DISCOMFORT | U-Value vs. Window Height



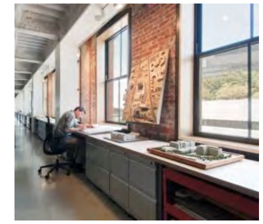
EXAMPLES | Punched Window

Window Dimensions:

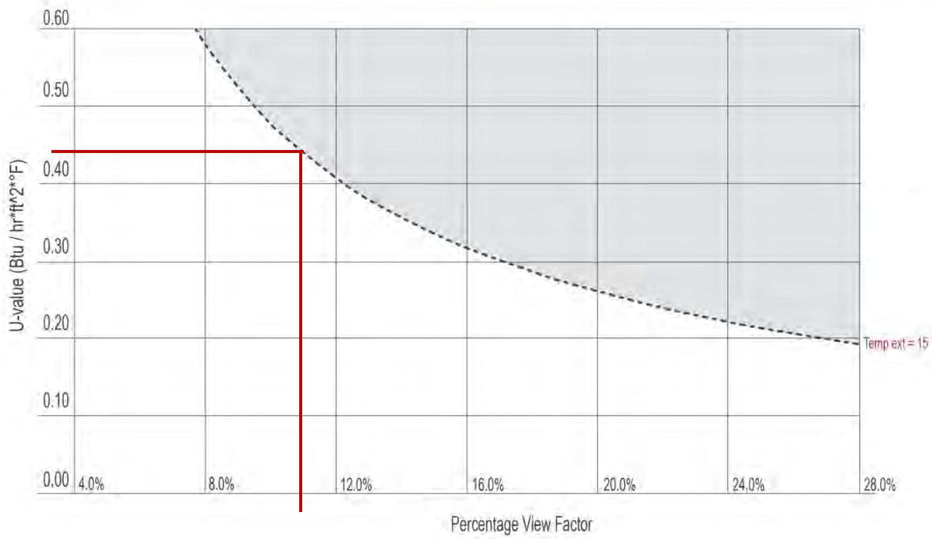
4’ (w) x 6’ (h) with sill

Percentage View Factor: 10.5%

EXAMPLES | Punched Window without Room-Side Low-e

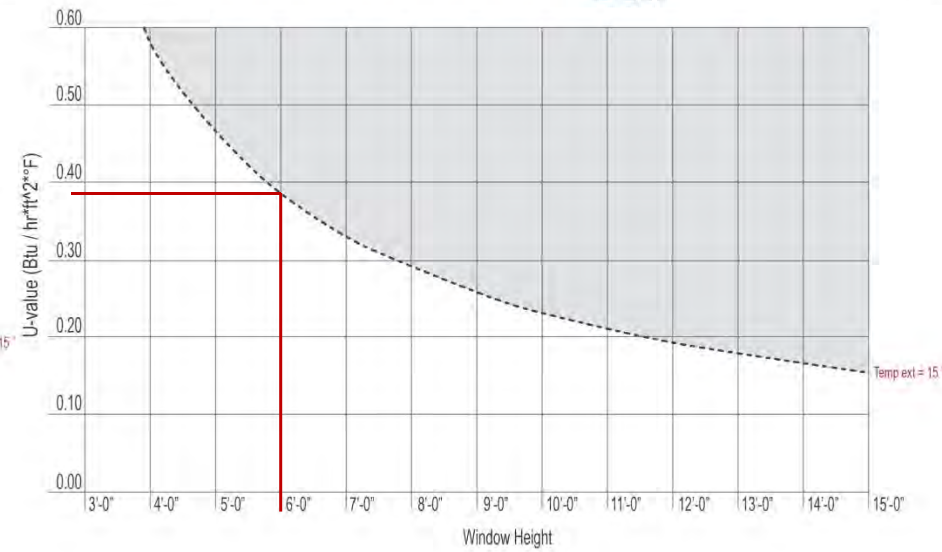


Radiant Discomfort



U-value – 0.44

Downdraft Discomfort



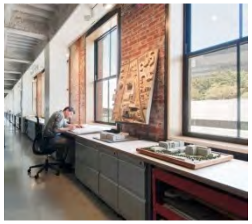
U-value – 0.38

View Factor Percentage: 10.5%

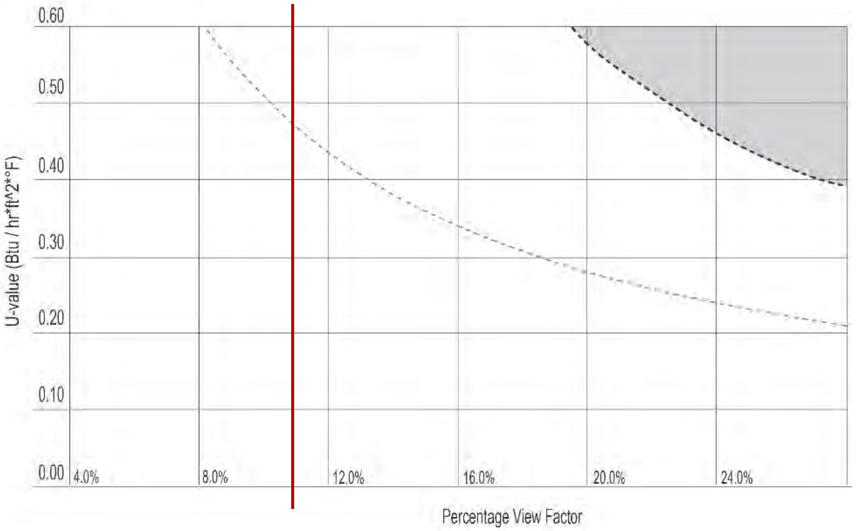
Window Height: 6’-0”

15°F exterior design temperature

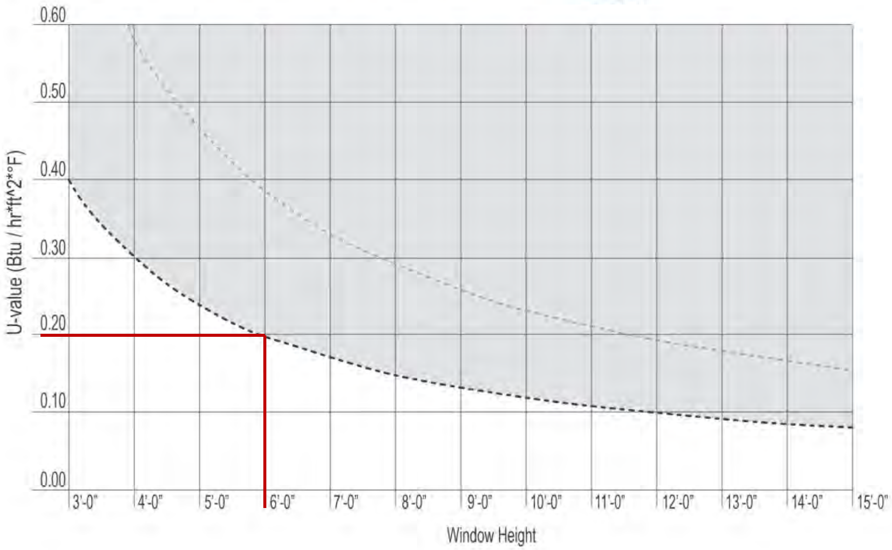
EXAMPLES | Punched Window with Room-Side Low-e



Radiant Discomfort



Downdraft Discomfort



U-value – 0.20

View Factor Percentage: 10.5%
Window Height: 6’-0”
15°F exterior design temperature

EXAMPLES | Full Height Glazing

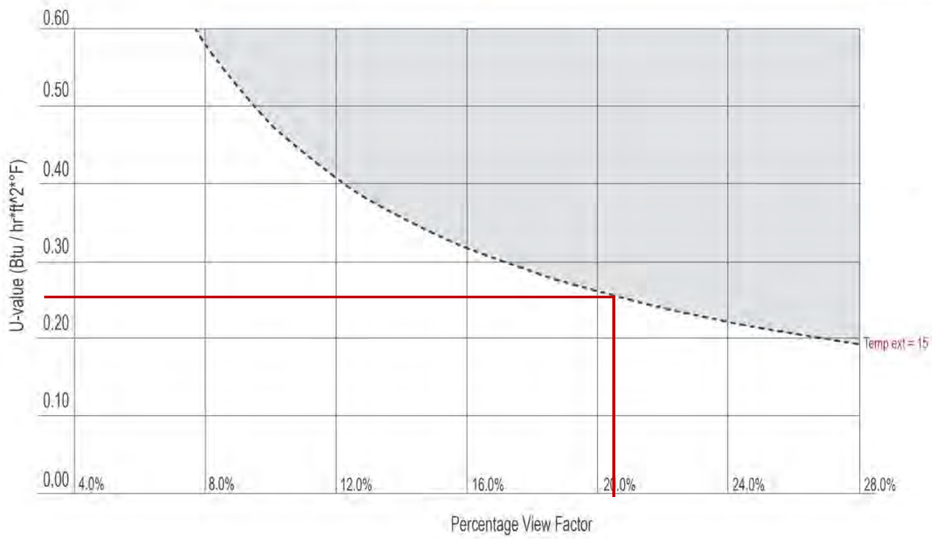
Window Dimensions:

10’ (h) x 11’ (w)

Percentage View Factor: 20.4%

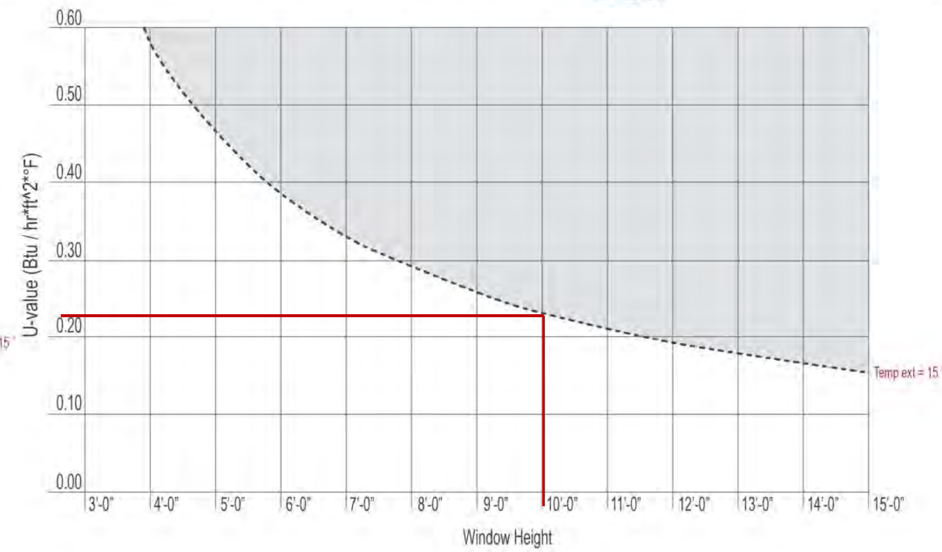
EXAMPLES | Full Height Glazing without Room-Side Low-e

Radiant Discomfort



U-value – 0.25

Downdraft Discomfort



U-value – 0.23

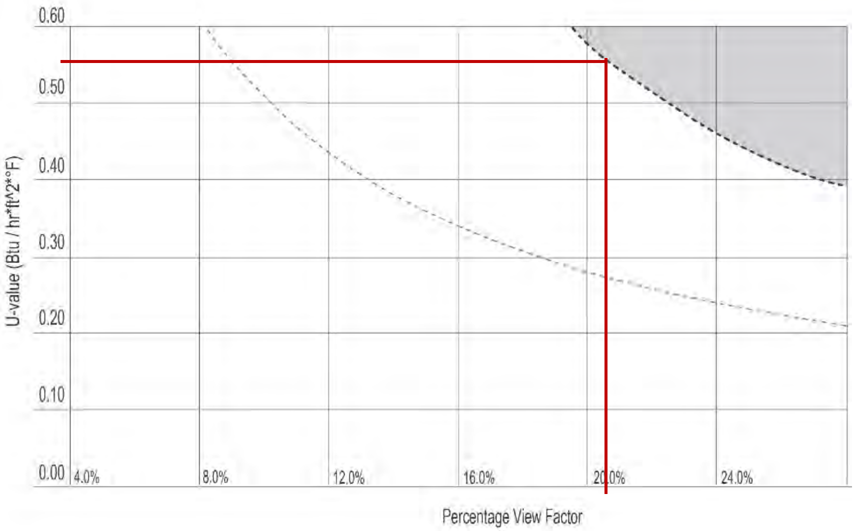
View Factor: 20.4%

Window Height: 10’-0”

15°F exterior design temperature

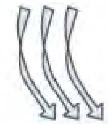
EXAMPLES | Full Height Glazing with Room-Side Low-e

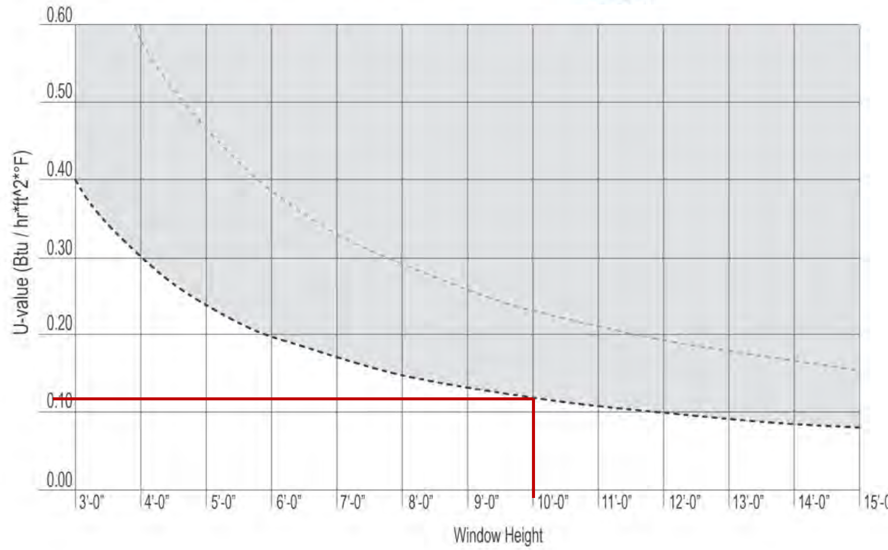
Radiant Discomfort



U-value – 0.55

Downdraft Discomfort



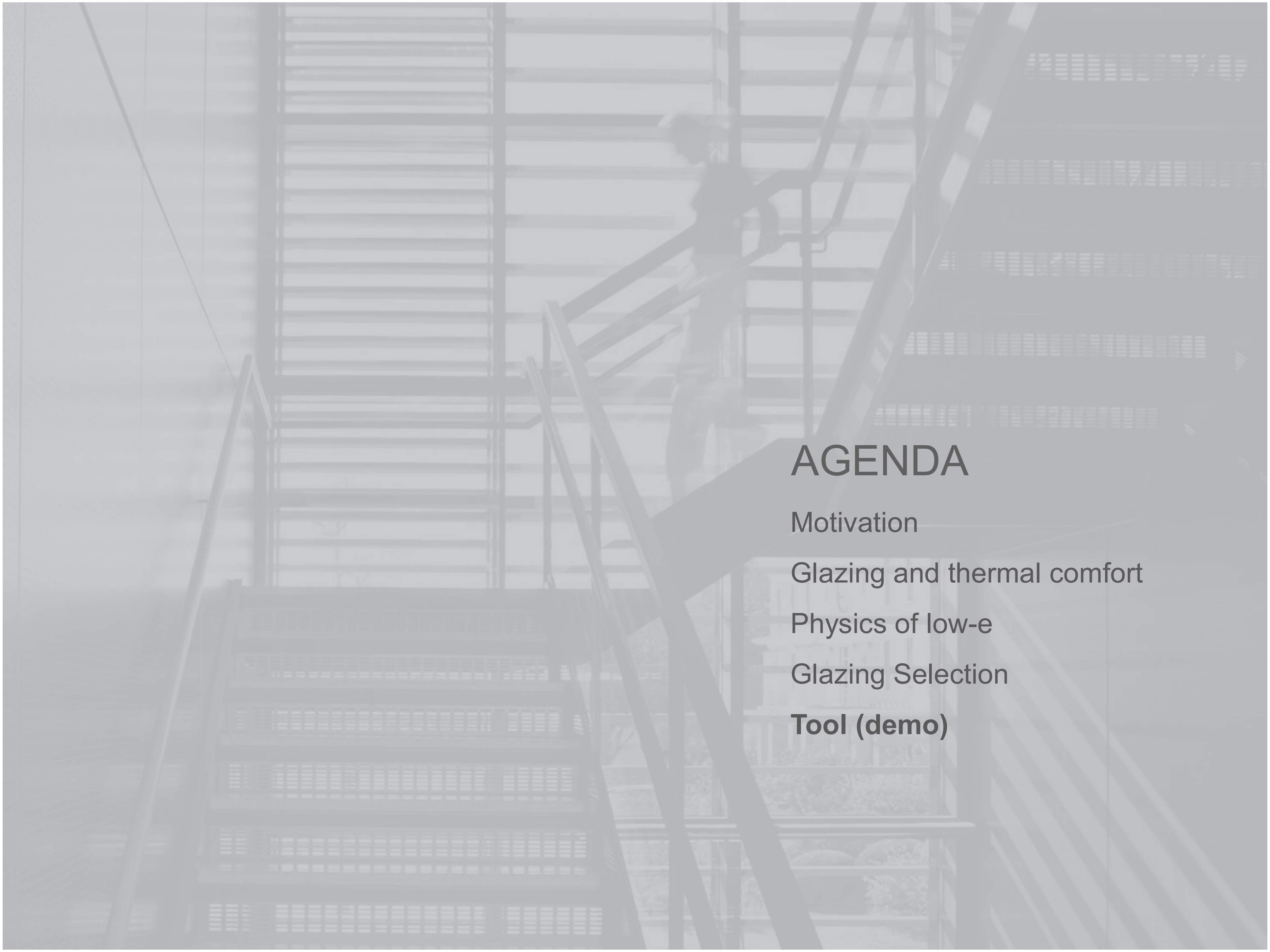


U-value – 0.12

View Factor: 20.4%

Window Height: 10’-0”

15°F exterior design temperature



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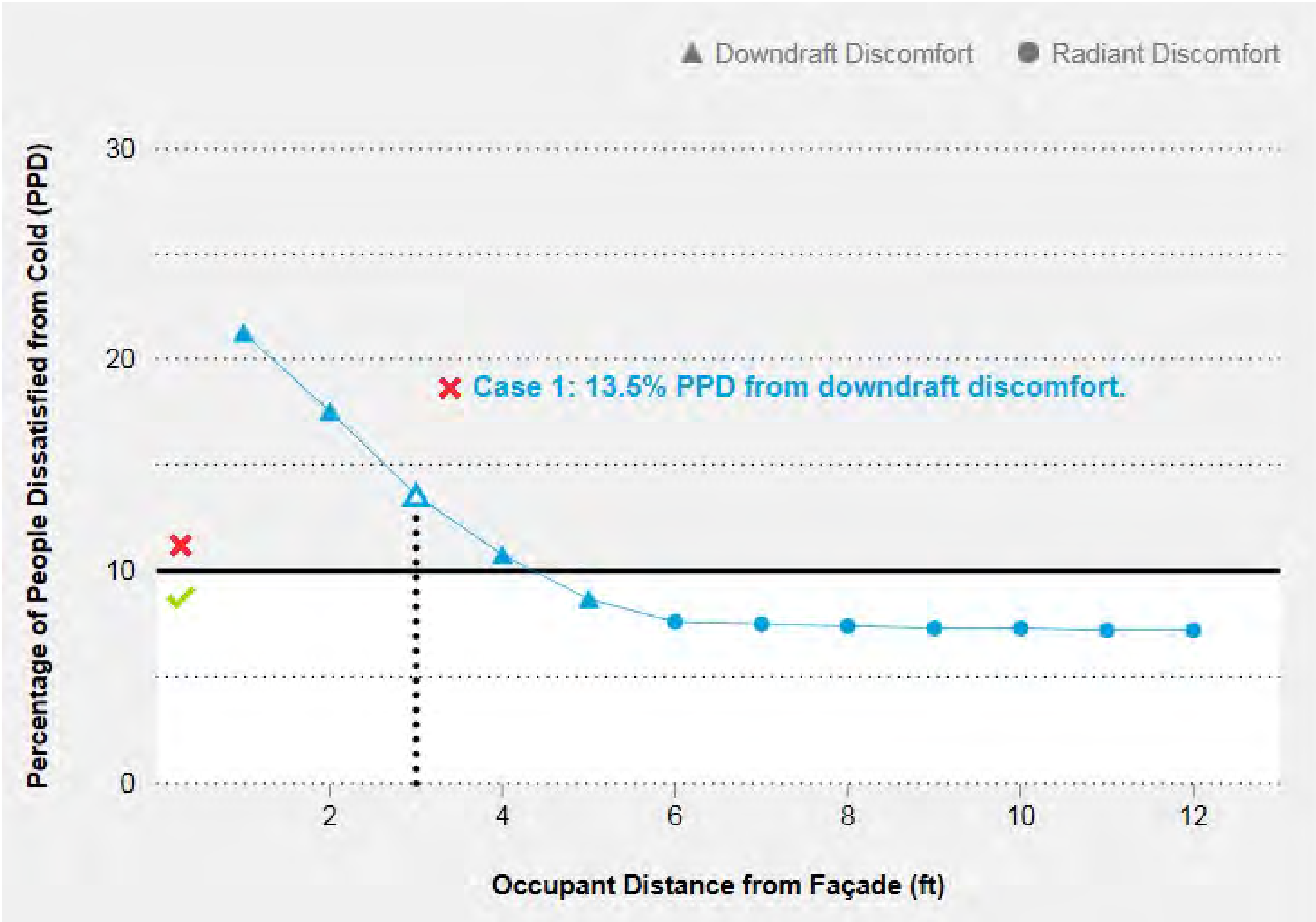
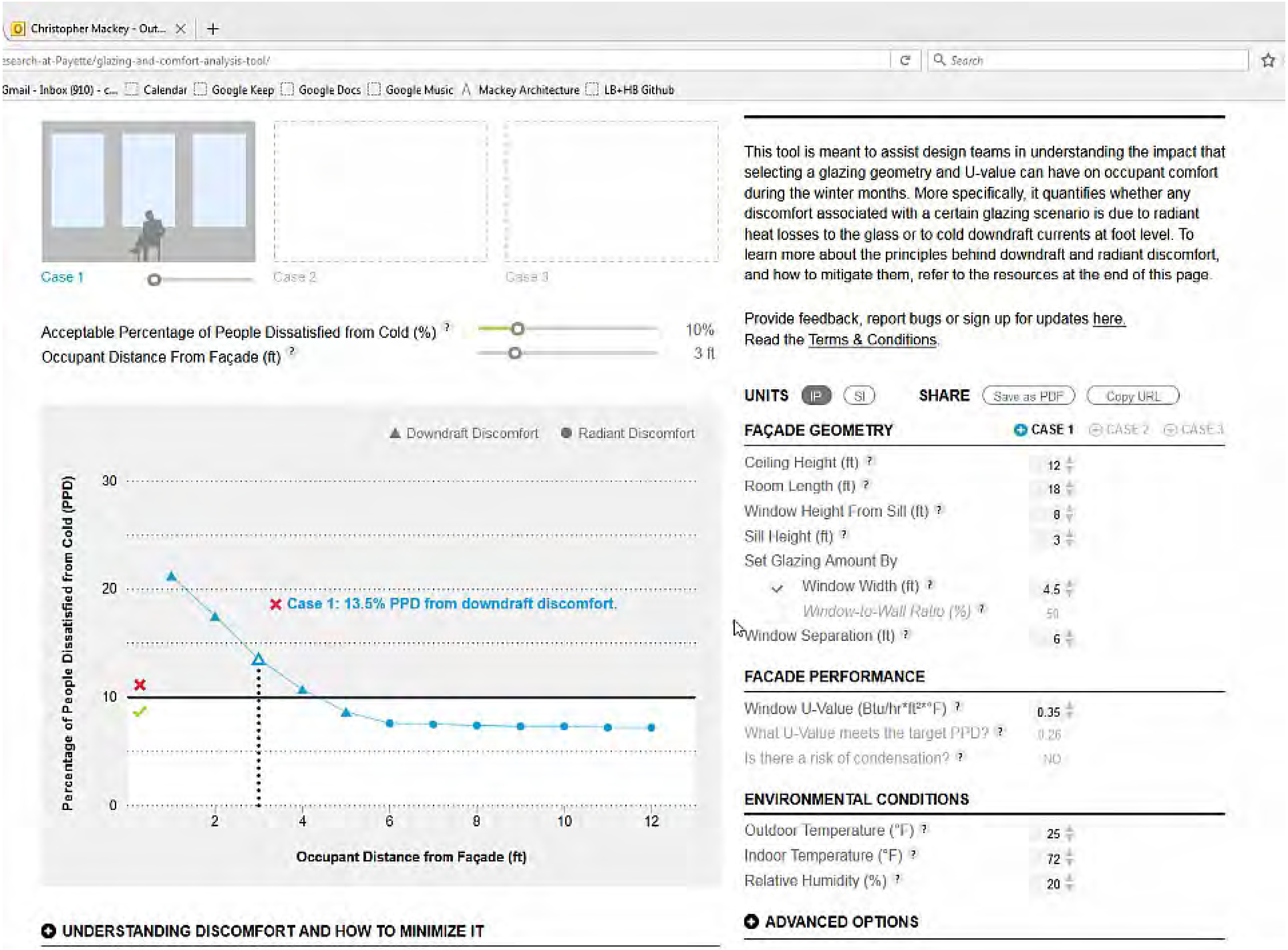
GLAZING TOOL





Christopher Mackey - Out...
esearch-at-Payette/glazing-and-comfort-analysis-tool/
Search
Gmail - Inbox (910) - c... Calendar Google Keep Google Docs Google Music Mackey Architecture LB+HB Github
Case 1
Case 2
Case 3
Acceptable Percentage of People Dissatisfied from Cold (%) ? 10%
Occupant Distance From Façade (ft) ? 3 ft
Downdraft Discomfort
Radiant Discomfort
Case 1: 13.5% PPD from downdraft discomfort.
Percentage of People Dissatisfied from Cold (PPD)
30
20
10
0
2
4
6
8
10
12
Occupant Distance from Façade (ft)
UNDERSTANDING DISCOMFORT AND HOW TO MINIMIZE IT
This tool is meant to assist design teams in understanding the impact that selecting a glazing geometry and U-value can have on occupant comfort during the winter months. More specifically, it quantifies whether any discomfort associated with a certain glazing scenario is due to radiant heat losses to the glass or to cold downdraft currents at foot level. To learn more about the principles behind downdraft and radiant discomfort, and how to mitigate them, refer to the resources at the end of this page.
Provide feedback, report bugs or sign up for updates here.
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SHARE Save as PDF Copy URL
FAÇADE GEOMETRY
CASE 1 CASE 2 CASE 3
Ceiling Height (ft) ? 12
Room Length (ft) ? 18
Window Height From Sill (ft) ? 8
Sill Height (ft) ? 3
Set Glazing Amount By
Window Width (ft) ? 4.5
Window-to-Wall Ratio (%) ? 50
Window Separation (ft) ? 6
FACADE PERFORMANCE
Window U-Value (Btu/hr*ft²*°F) ? 0.35
What U-Value meets the target PPD? ? 0.26
Is there a risk of condensation? ? NO
ENVIRONMENTAL CONDITIONS
Outdoor Temperature (°F) ? 25
Indoor Temperature (°F) ? 72
Relative Humidity (%) ? 20
ADVANCED OPTIONS

CONCLUSIONS | Room-side Low-e, As Good as it Sounds?

It depends!

Double pane IGU with room-side low-e:

- ✓ Great thermal performance
- ✓ Improved radiant thermal comfort
- ✓ Lighter, cheaper than triple pane
- ✗ Potential for downdraft discomfort with tall windows (~6’ tall for northeast climates)
- ✗ Potential for condensation

More on condensation:

Using 4th Surface Low-e Coating on Windows in a Cold Climate: Background, Observations and Practical Strategies. White paper by Wright, J.L. (2012), University of Waterloo.

TRY IT YOURSELF!