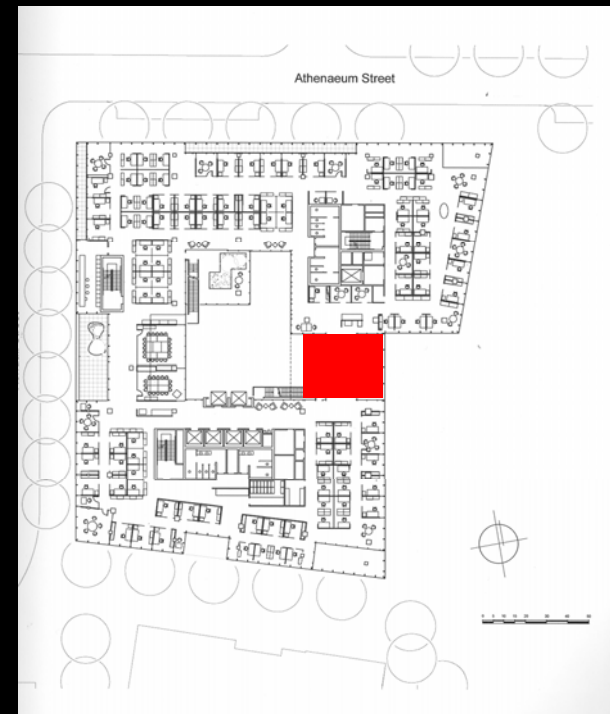




Study of Daylight in Genzyme

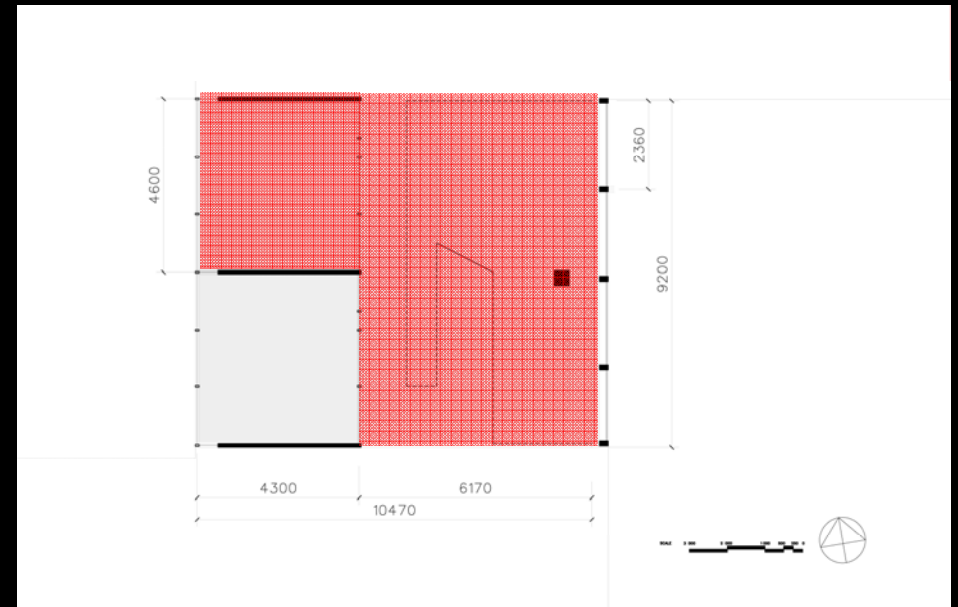
Courtney Browne
Siân Kleindienst
Ed Rice

How can we improve this space?



Summary of Presentation

- How can we improve this space?
- Objectives, Recommendations and Proposals
- Conference Room
 - Analysis
 - Proposal
- Circulation Space
 - Analysis
 - Control recommendations
- Solar Gains
 - Analysis
 - Recommendations
- Conclusion



Qualitative objectives for project

- Increase natural light in the conference room
- Develop dynamic and artistic lighting solution involving blind control
- Reduce the effect of solar gains in the circulation lobby

Quantitative objectives:

Conference Room

- Double the natural light in the conference room
- Avoid glare at seating level

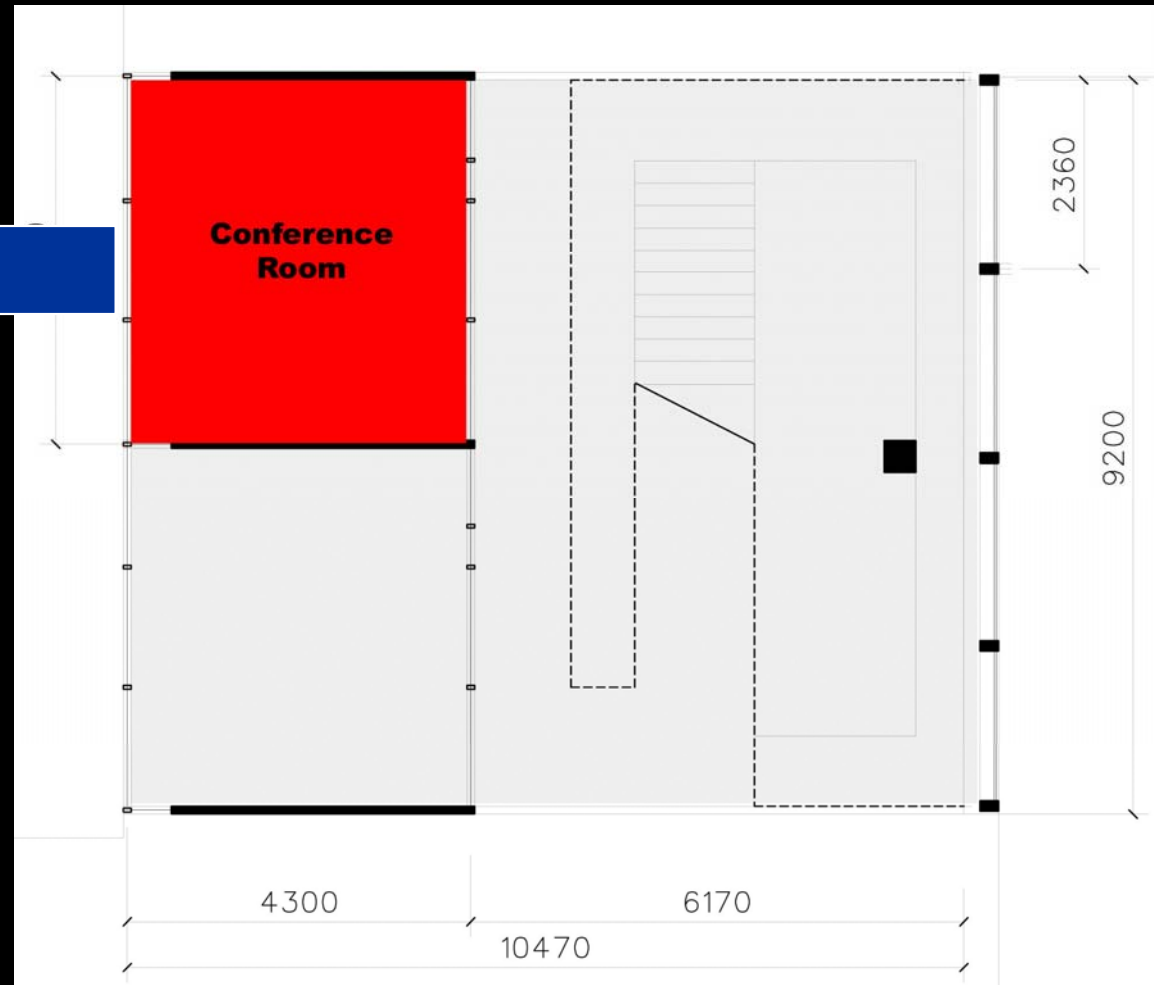
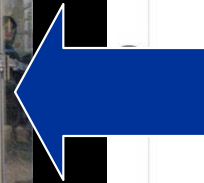
Control recommendation: *Circulation Lobby*

- Propose timing suggestions for when the blinds can and should be opened
- Take advantage of solar gains to lower the heating bill in the winter

Management proposal: *Solar Gains*

- Daylighting strategies will have solar gain ramifications
- Increase ventilation in the space for necessary times of year

Background: *Conference Room*



Background: *Conference Room*

Anidolic Daylighting Systems

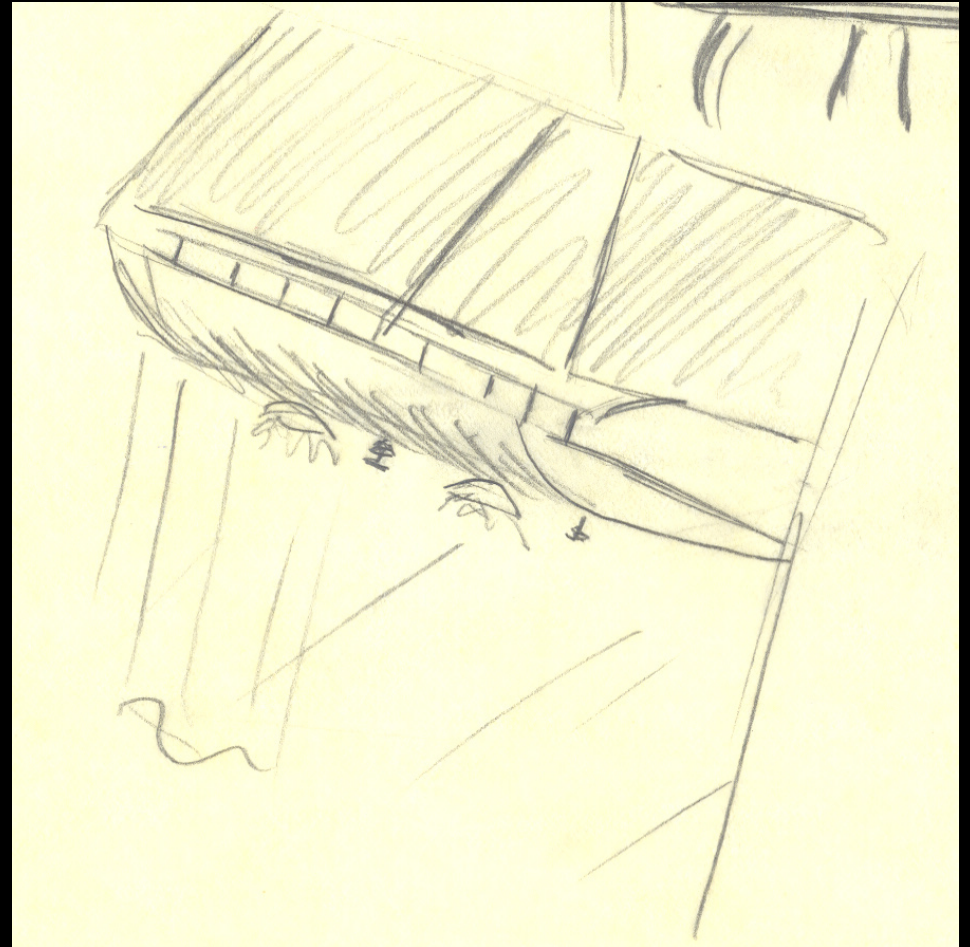
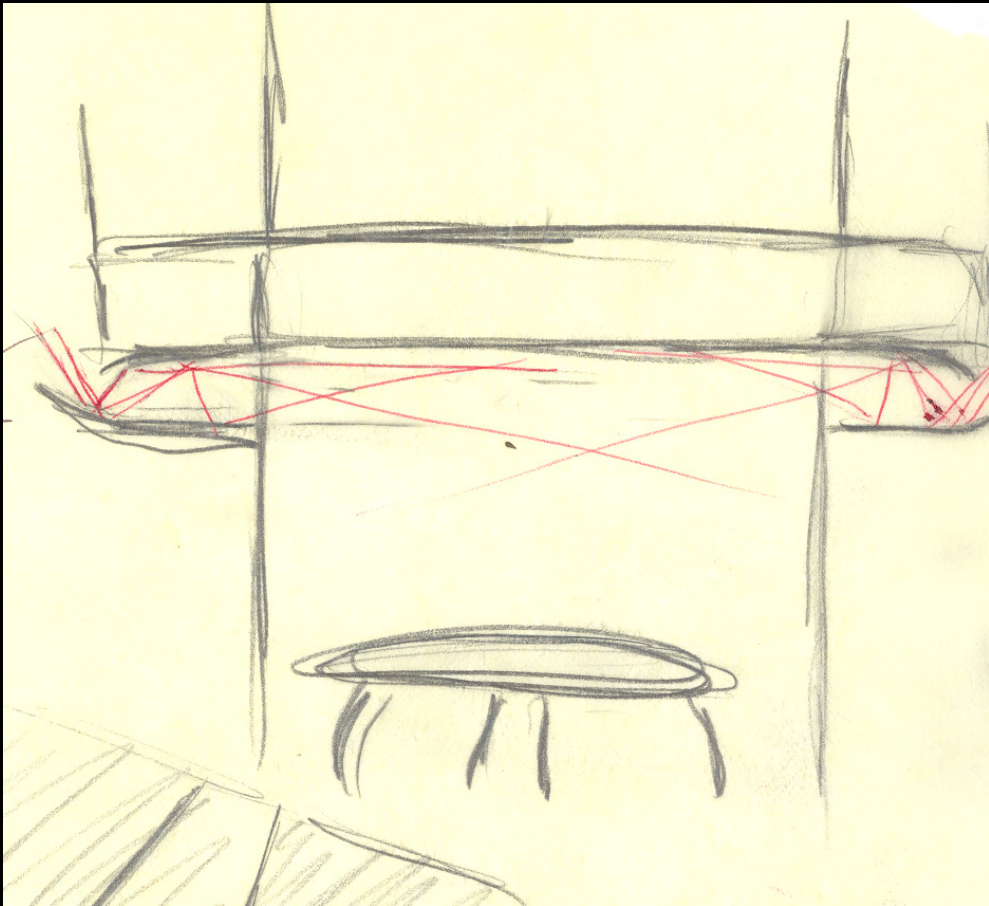
- From Ancient Greek:
an = “without”
+ *eidolon* = “image”
→ *nonimaging*

Background: *Conference Room*

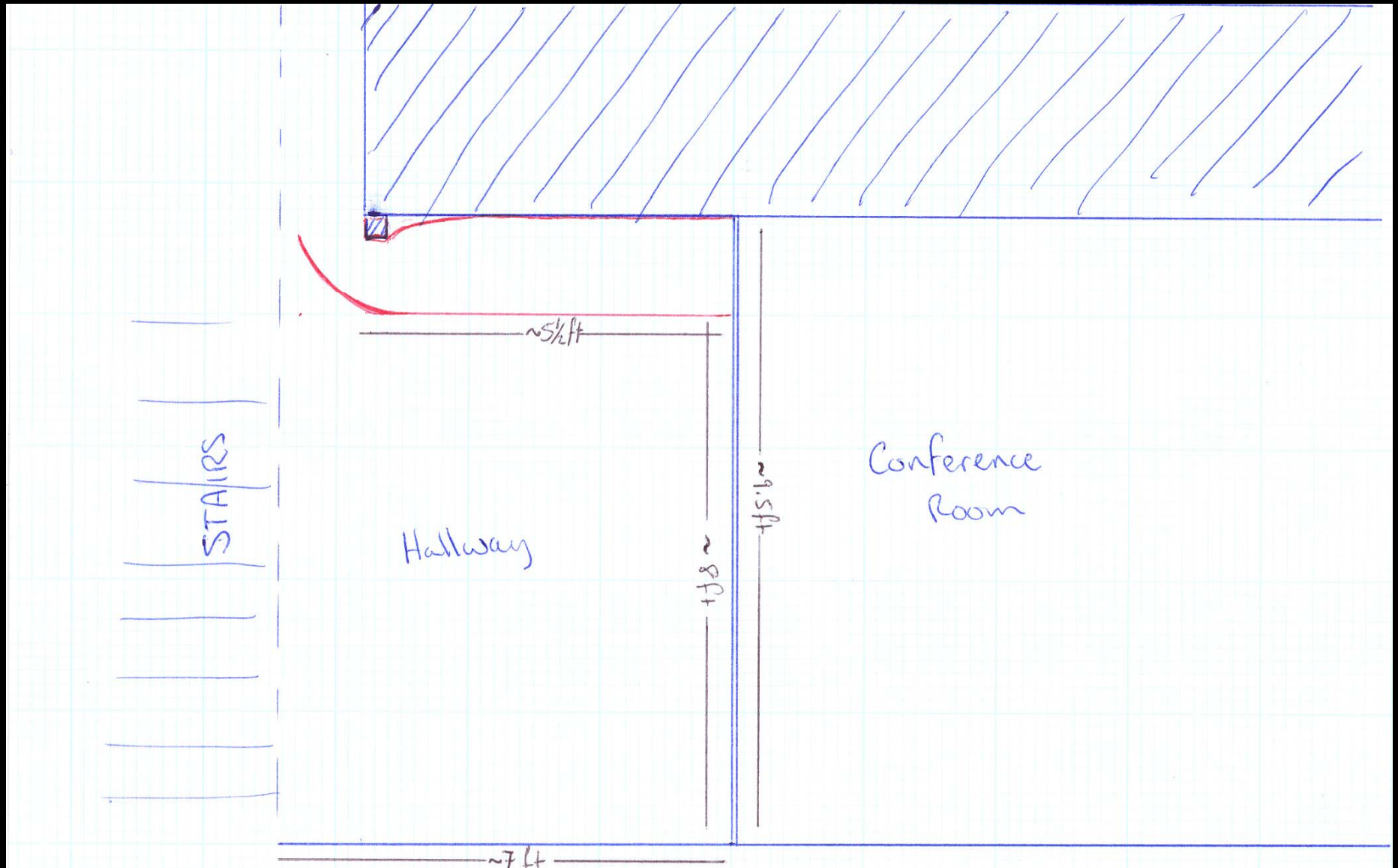
- Anidolic Systems as light duct...

Analysis: *Conference Room*

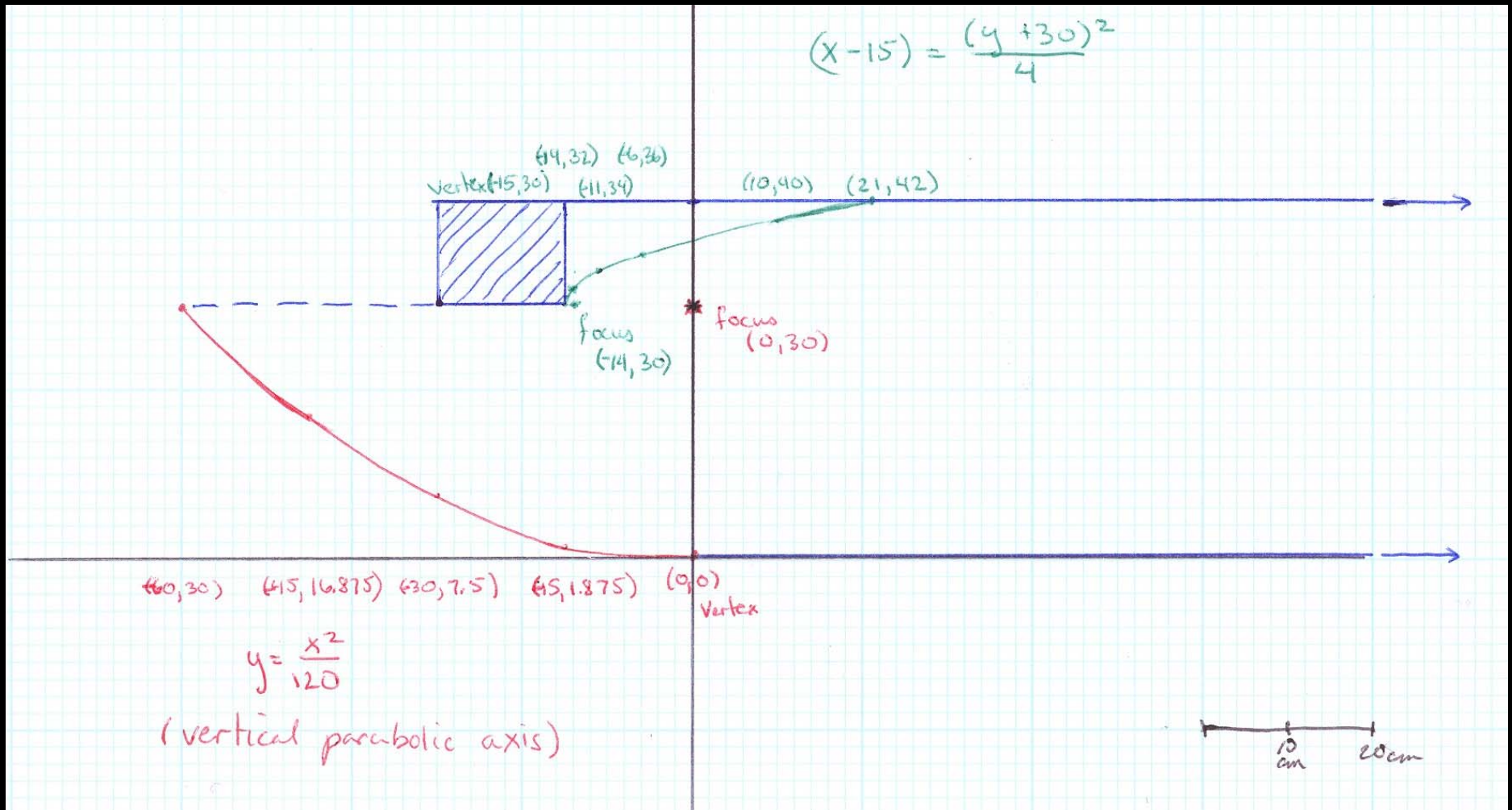
Hall-length half Anidolic
Duct



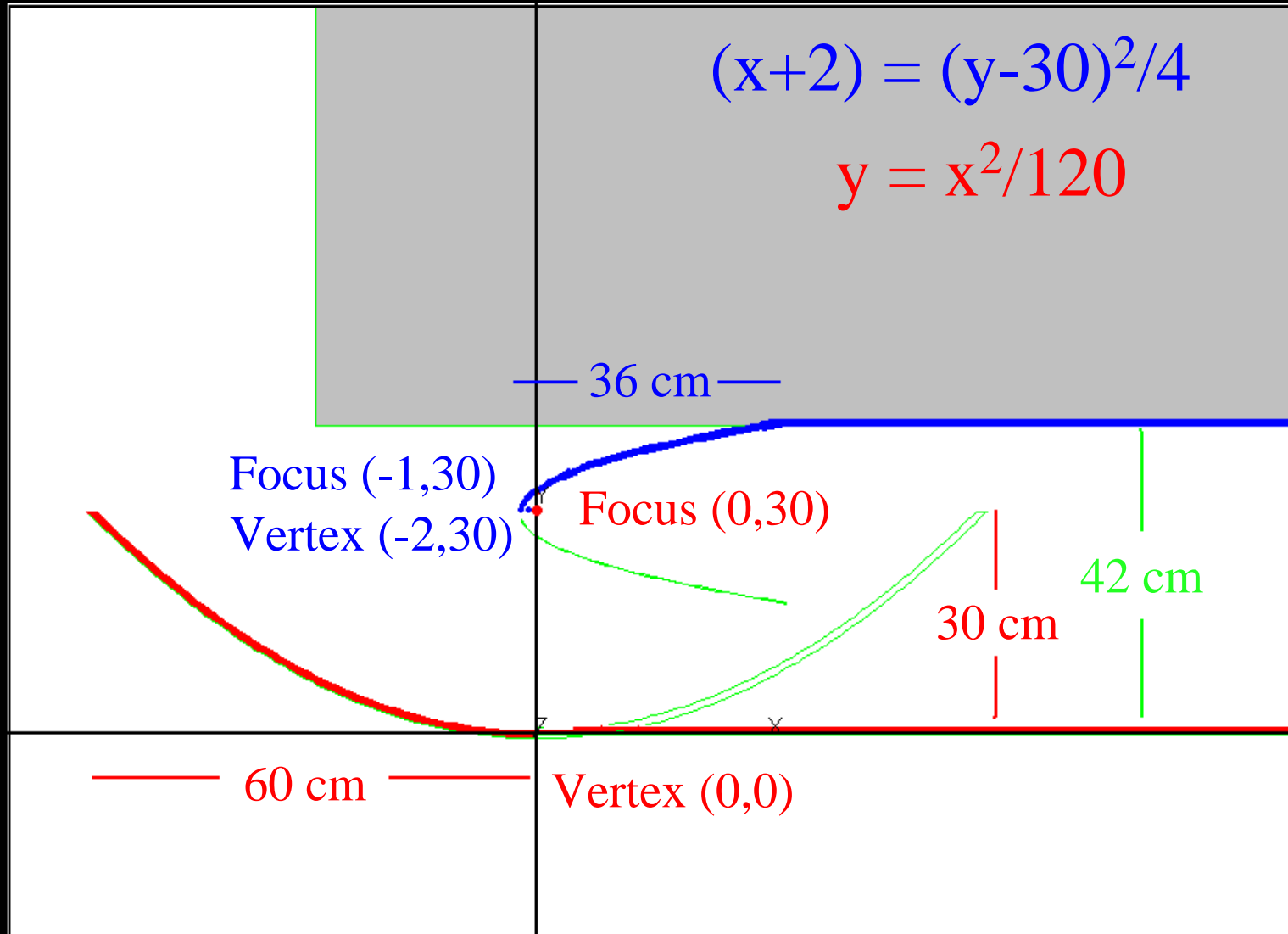
Analysis: *Conference Room*



Analysis: Conference Room

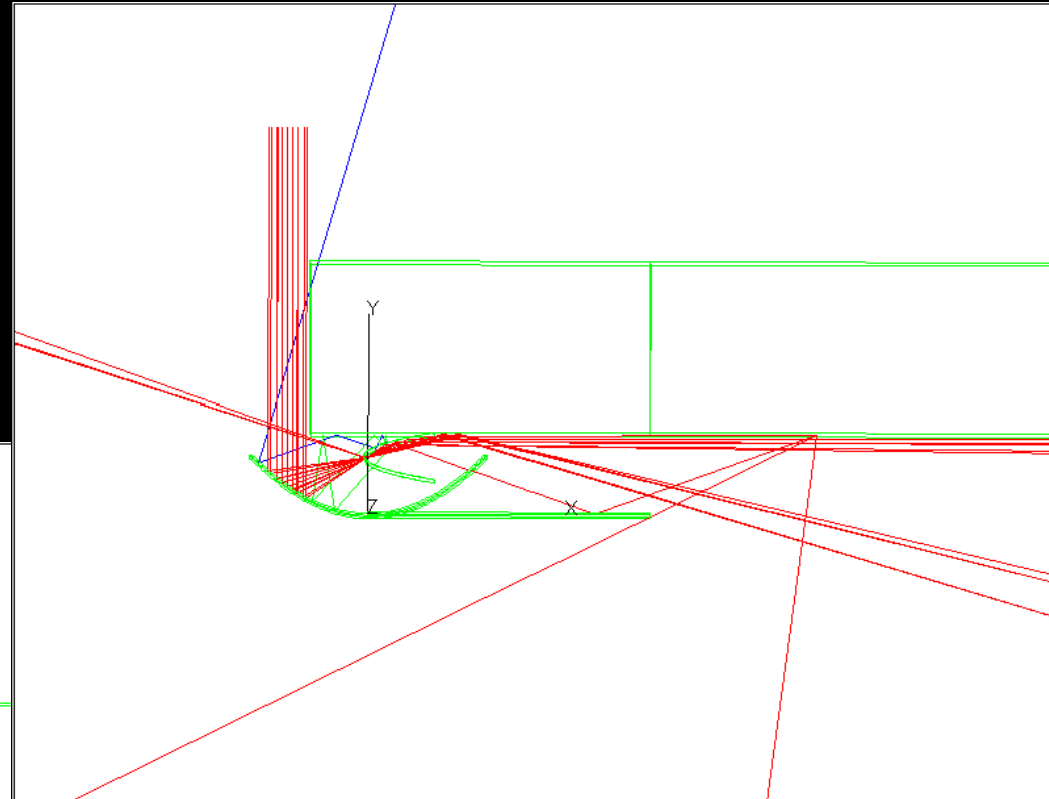
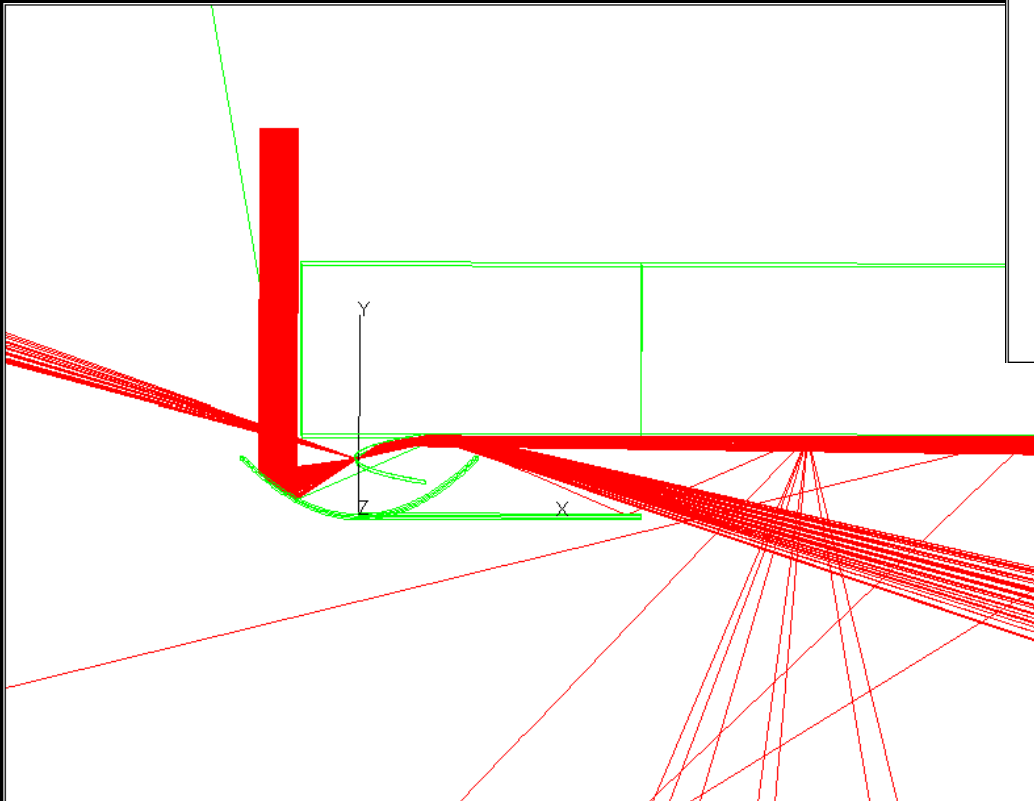


Analysis: *Conference Room*



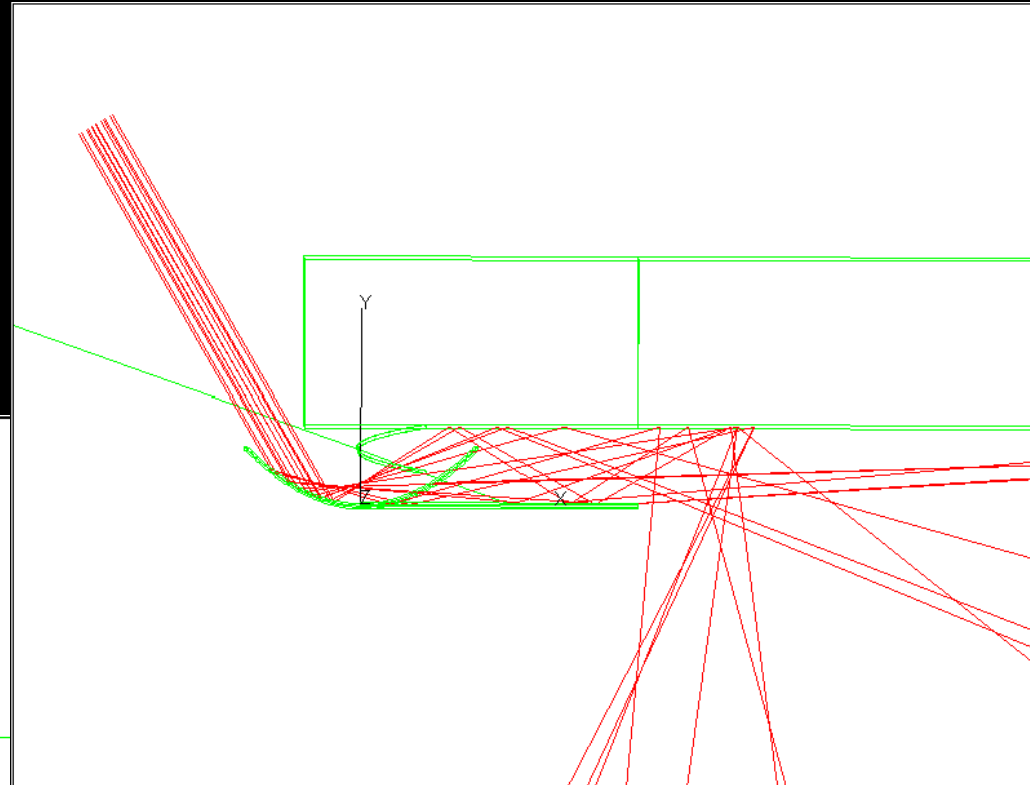
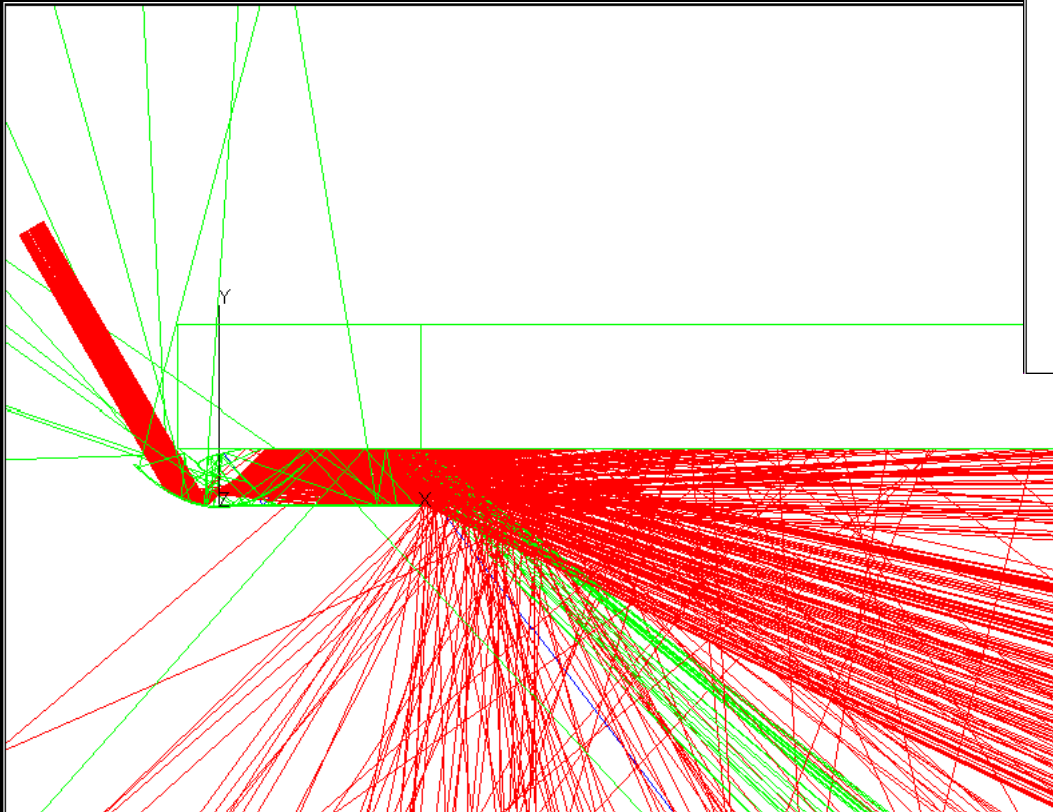
Analysis: *Conference Room*

90° source



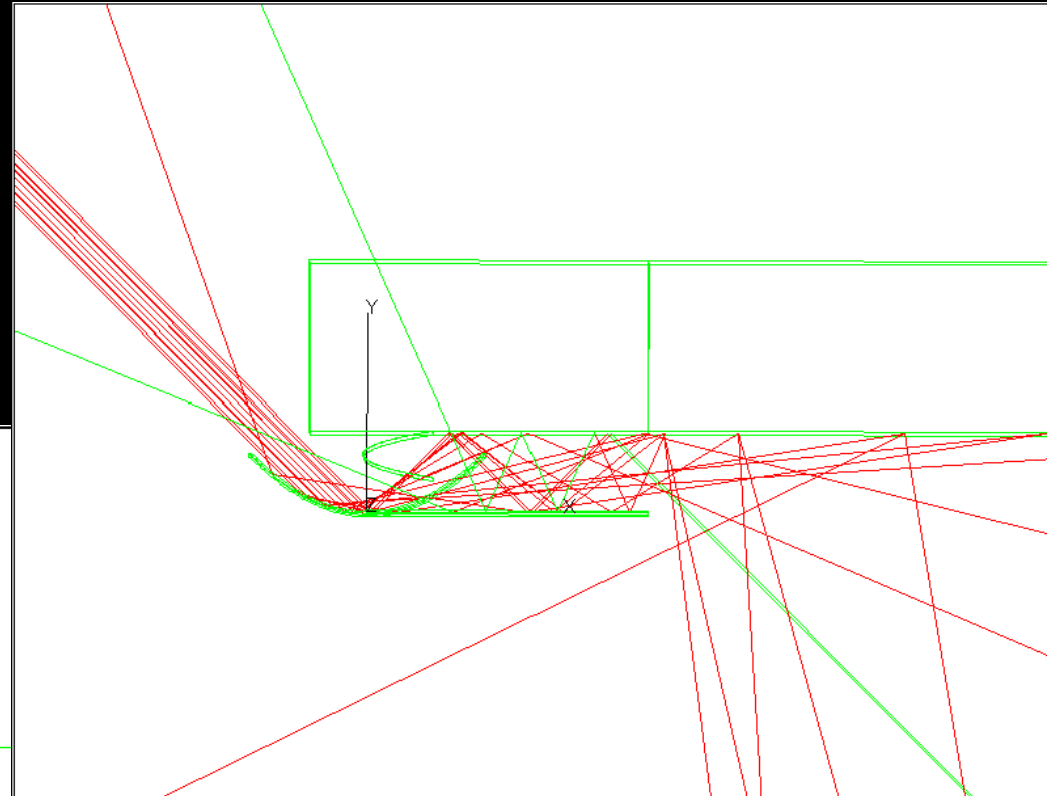
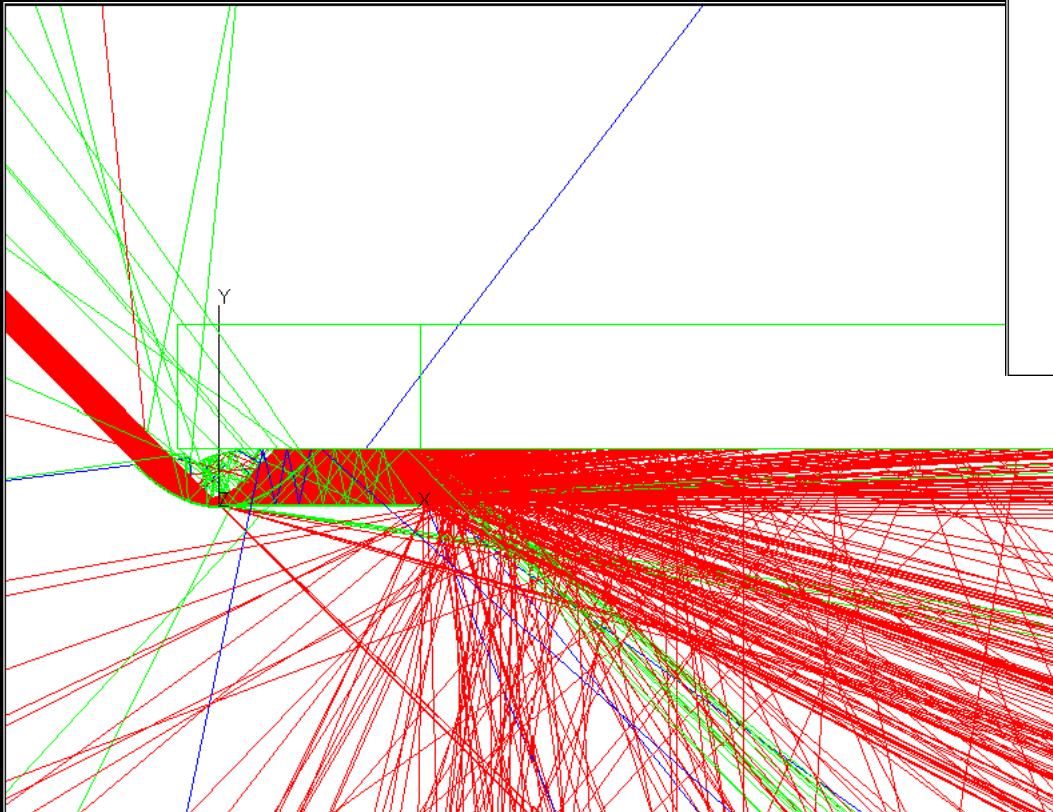
Analysis: *Conference Room*

60° source



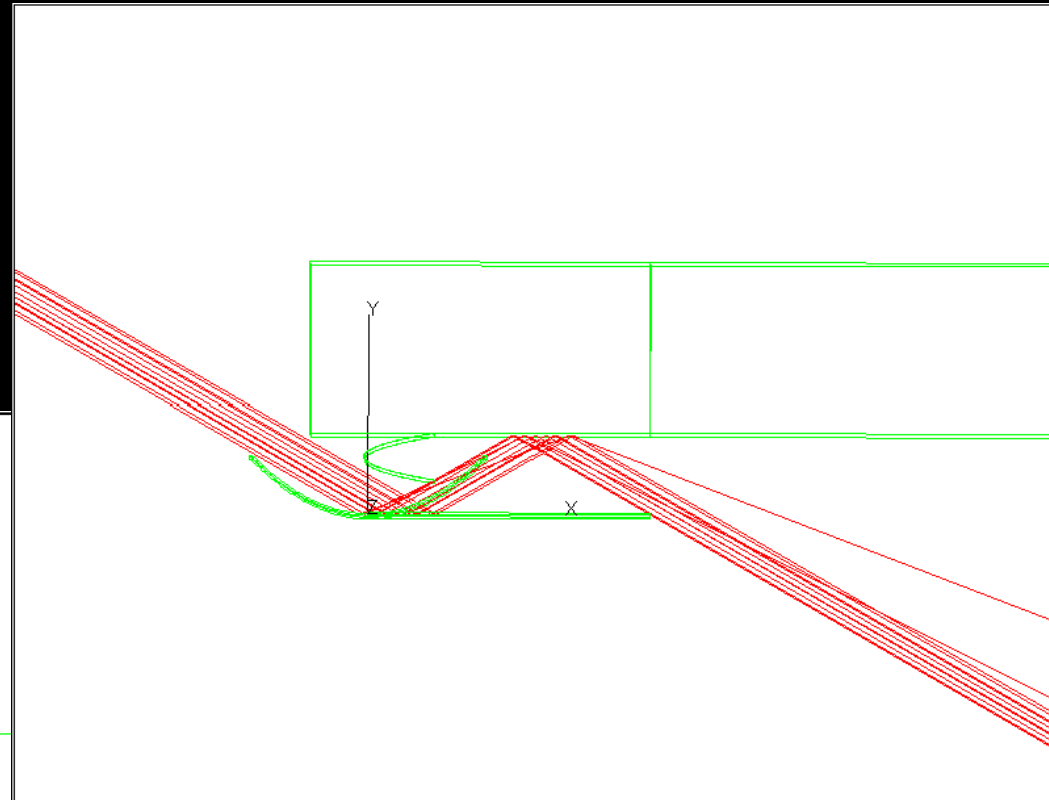
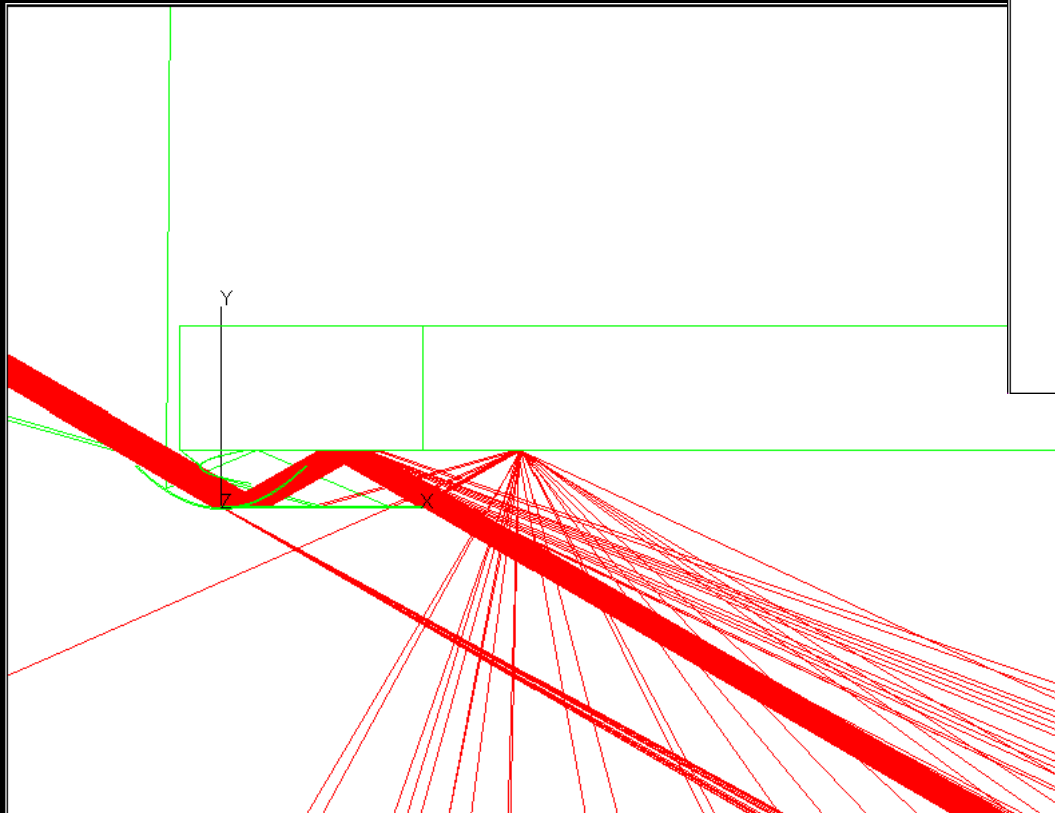
Analysis: *Conference Room*

45° source



Analysis: Conference Room

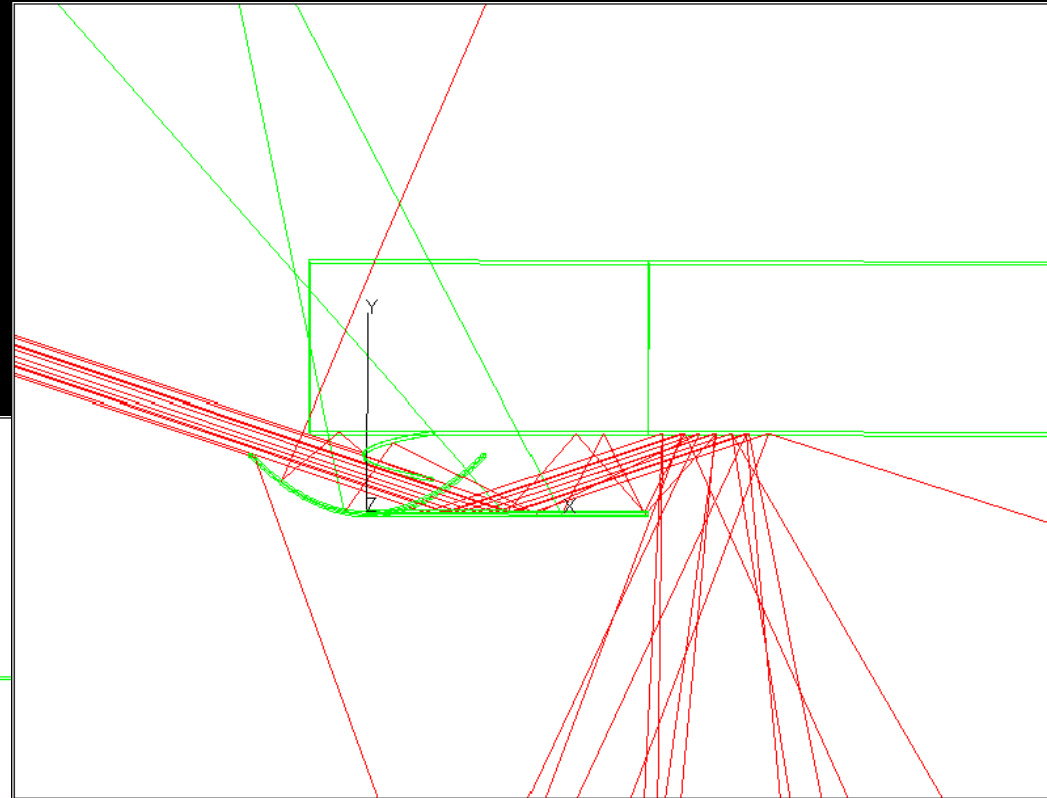
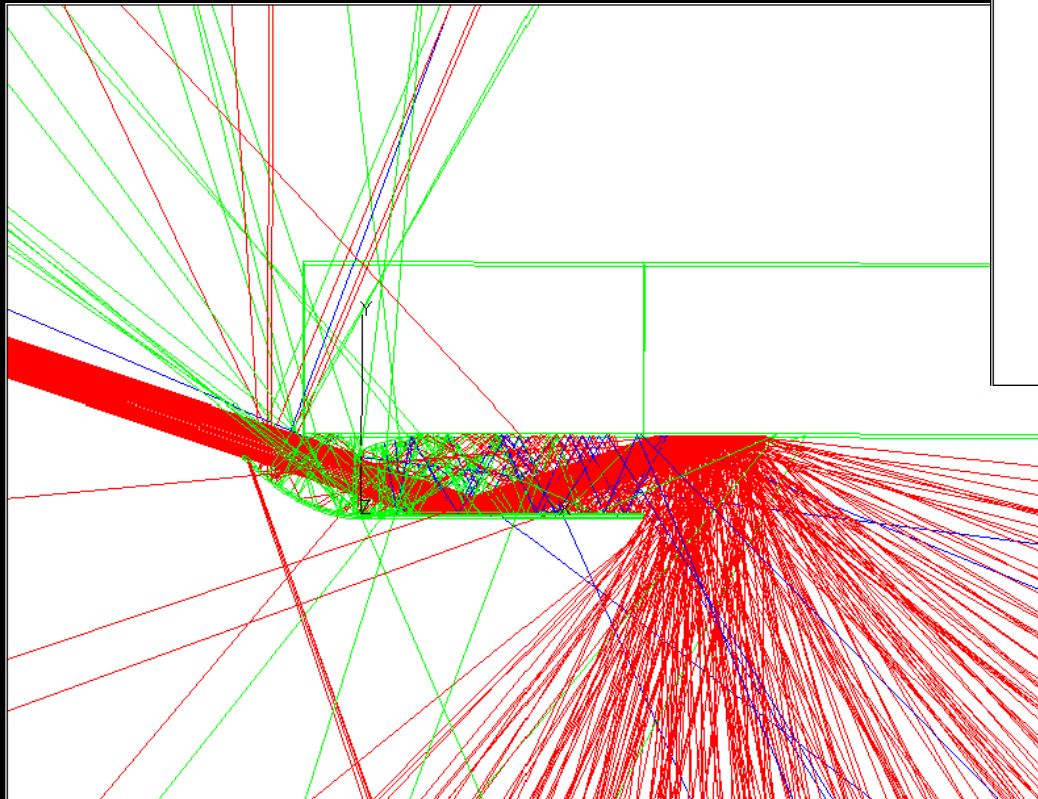
30° source



“light shelf” effect

Analysis: *Conference Room*

18° source



“light shelf” effect

Analysis: *Conference Room*

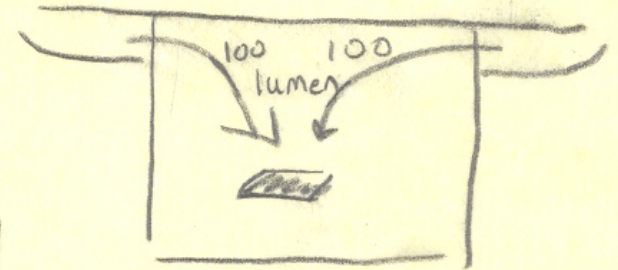
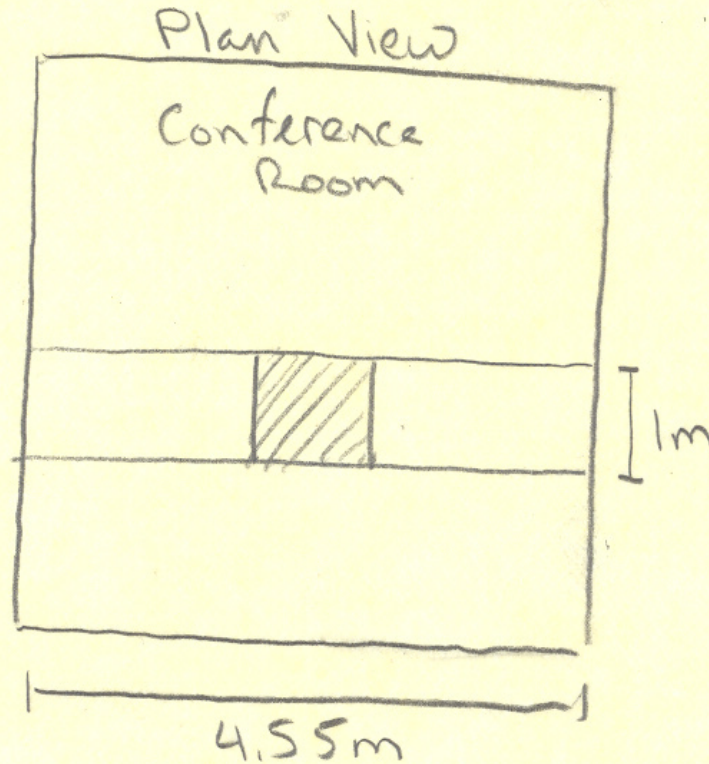
- Works best for the angle it was designed for (90°)
 - Should determine where most light coming from before design
 - Angling the outer parabola would probably get more light to the ceiling

Analysis: *Conference Room*

- Works best for the angle it was designed for (90°)
 - Should determine where most light coming from before design
 - Angling the outer parabola would probably get more light to the ceiling
- Light exits duct after 1 to 3 bounces
 - 2 or 2.5 bounces is a good average
 - Reflection coefficient of the duct is 0.9...
 - ... so 70 – 80% of the light should make it through the duct

Analysis: Conference Room

Now: 200 lux
We want:
400 lux



Assuming even Distribution across width...
We want ~450lm on this 1m slice

Analysis: Conference Room

Ceiling: Diffuse white

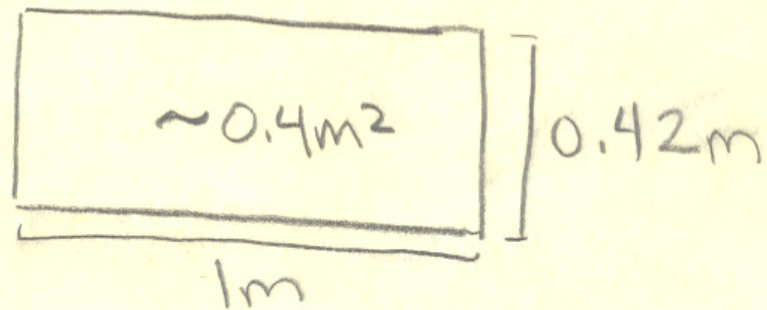
Assume ~ 80% reflect.

Assume all light reflect off

Ceiling: $4150 / 0.8 \approx 5600$

Analysis: Conference Room

Opening \Rightarrow



$$\frac{560 \text{ lm}}{0.4 \text{ m}^2} = 1400 \text{ lx}$$

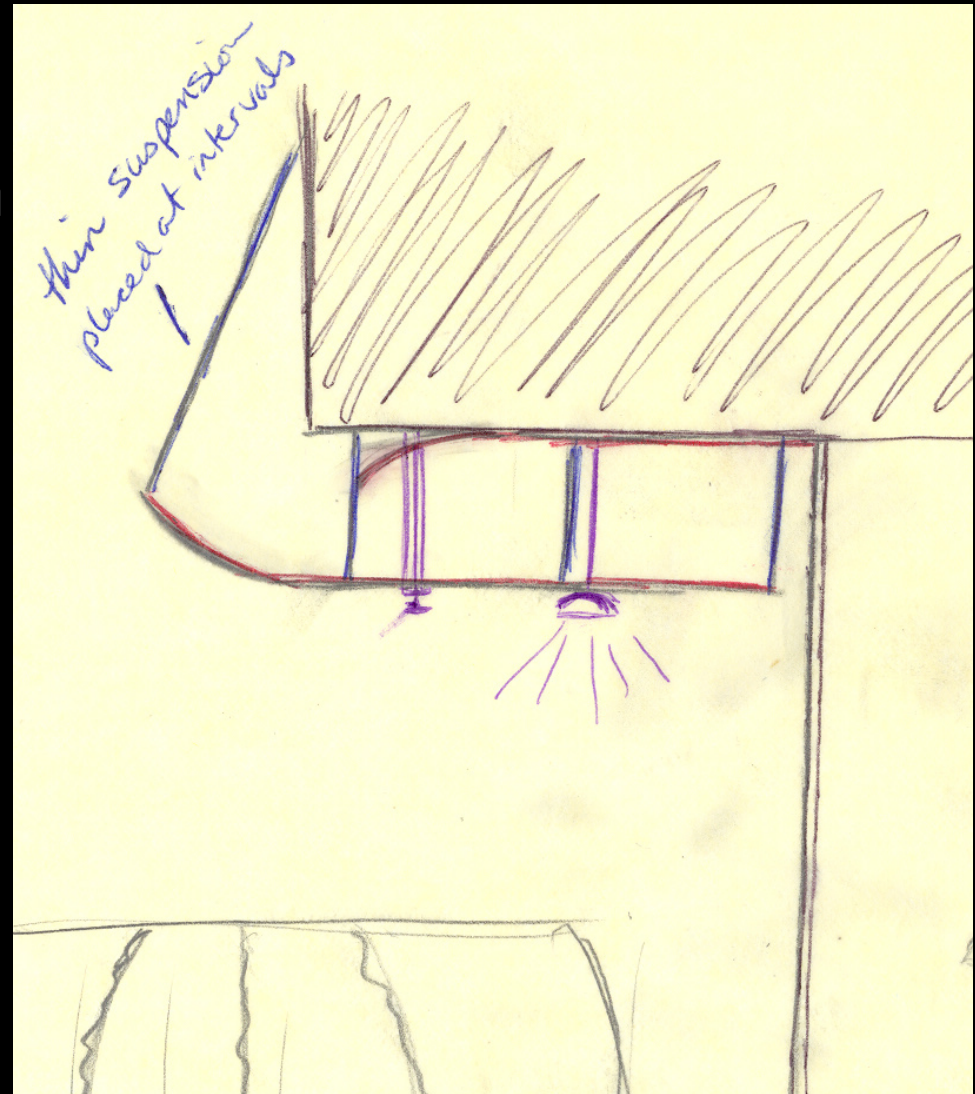
Assume 2 bounces inside duct
at 90° reflection each bounce

$\sim 80\%$ reflect.

$$\frac{1400 \text{ lx}}{0.8} = 1750 \text{ lx}$$

Proposal: *Conference Room*

- Ceiling Fixture
 - Suspending tie system
 - Allows for lights and sprinkler heads



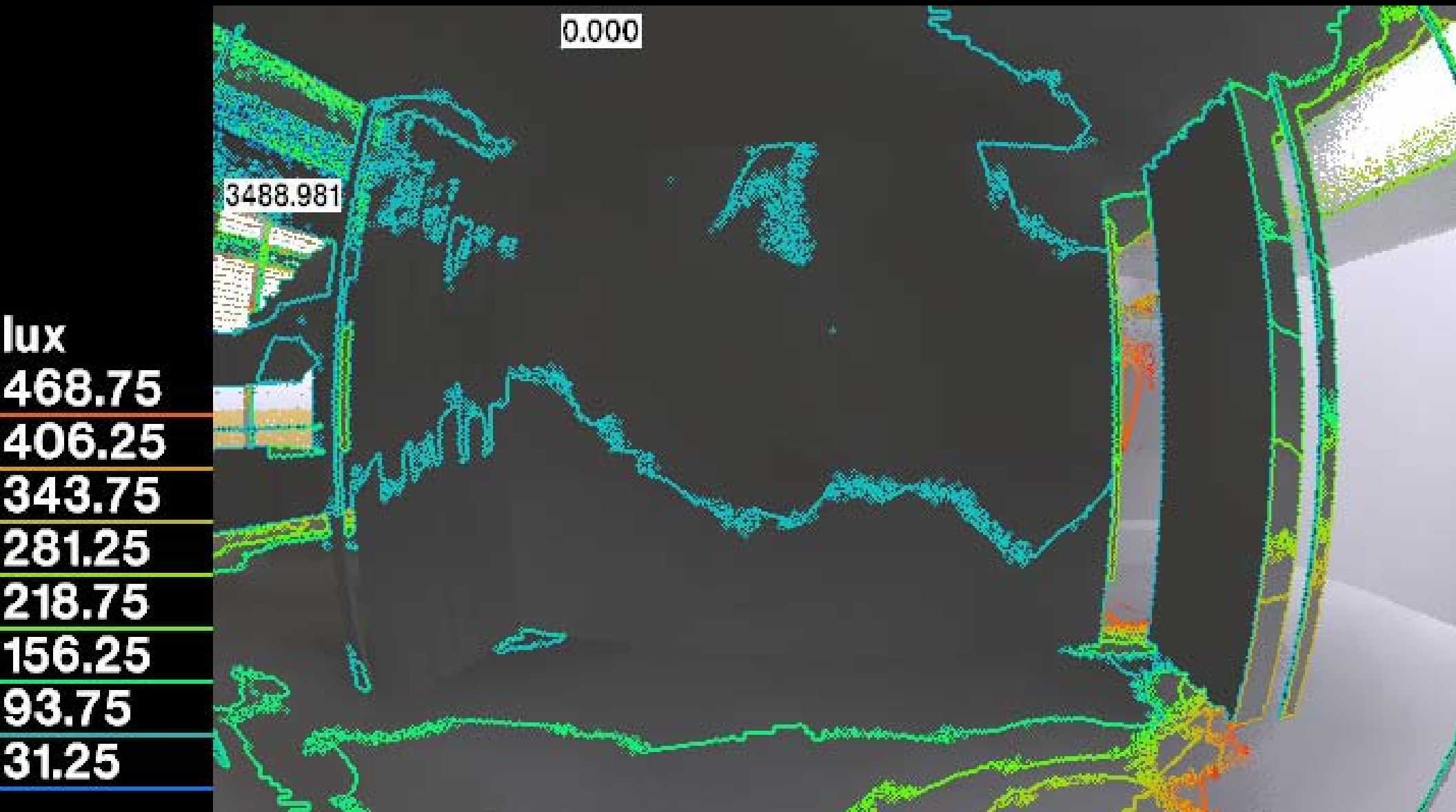
Proposal: *Conference Room*

- Ceiling Fixture
 - Suspending tie system
 - Allows for lights and sprinkler heads
- Simple, attractive materials
 - Aluminum sheet
 - Nuts and bolts hidden
 - Ties attach fixture to ceiling

Analysis: *Conference Room*

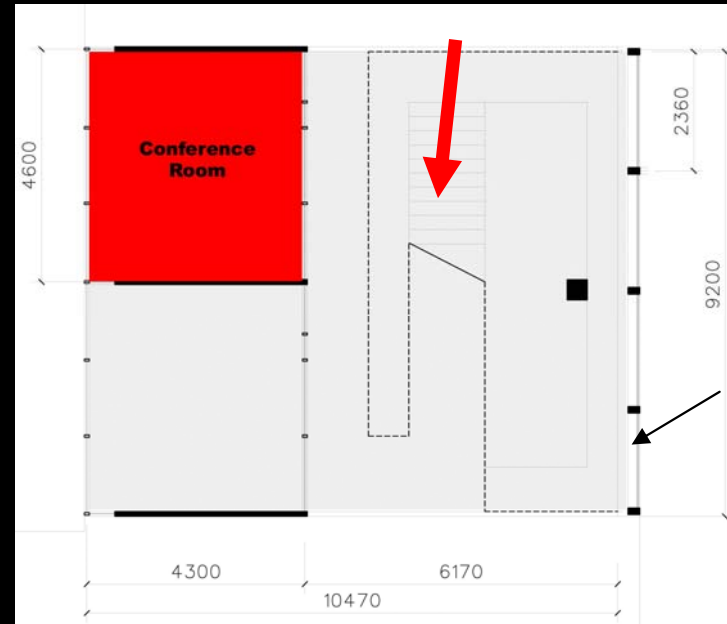


Analysis: *Conference Room*

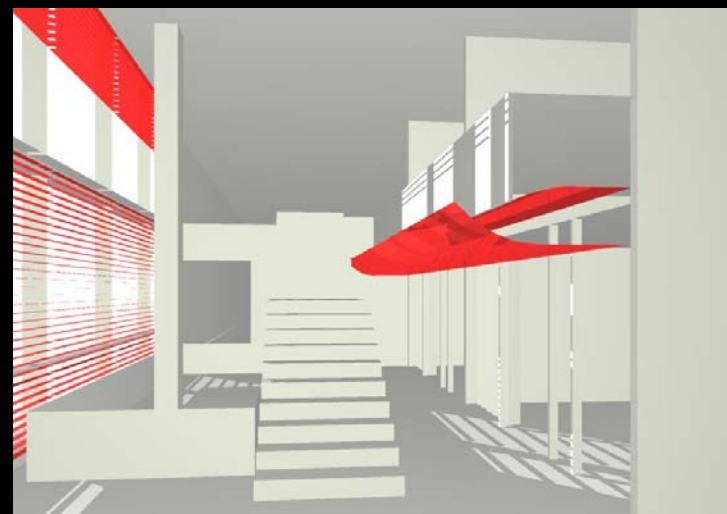


Background: *Circulation Lobby*

- Movement of light in space indicates the passage of time
- Light and dark patches give the impression of depth
- People seek direct sun exposure in the winter months to avoid depression



open
override
observed here



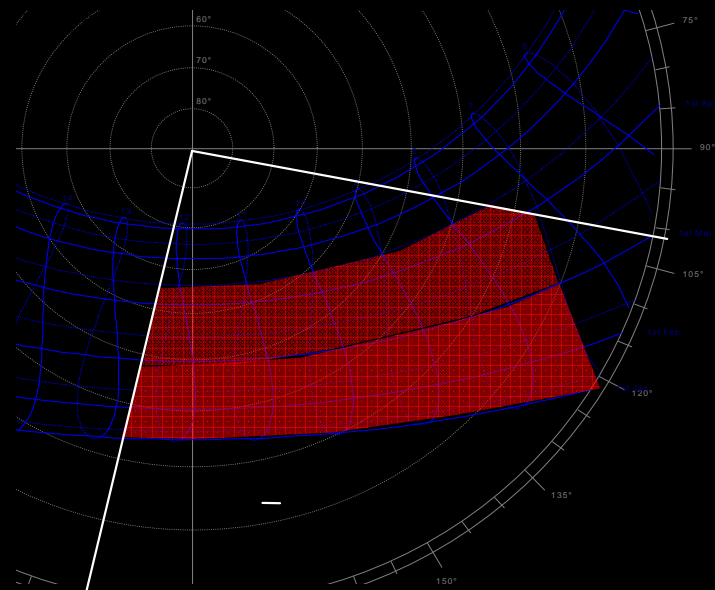
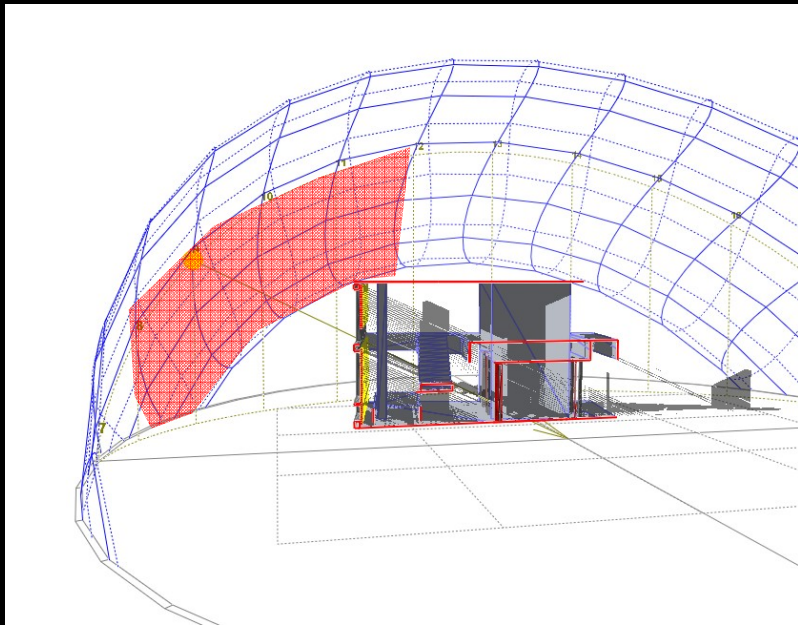
Guidelines: *Circulation Lobby*

- High contrast at conference room task plane should be avoided
- Try to balance sunlight across the circulation area
- Avoid sun patches over 2 m wide
- Avoid solar gains in cooling months



Method: *Circulation Lobby*

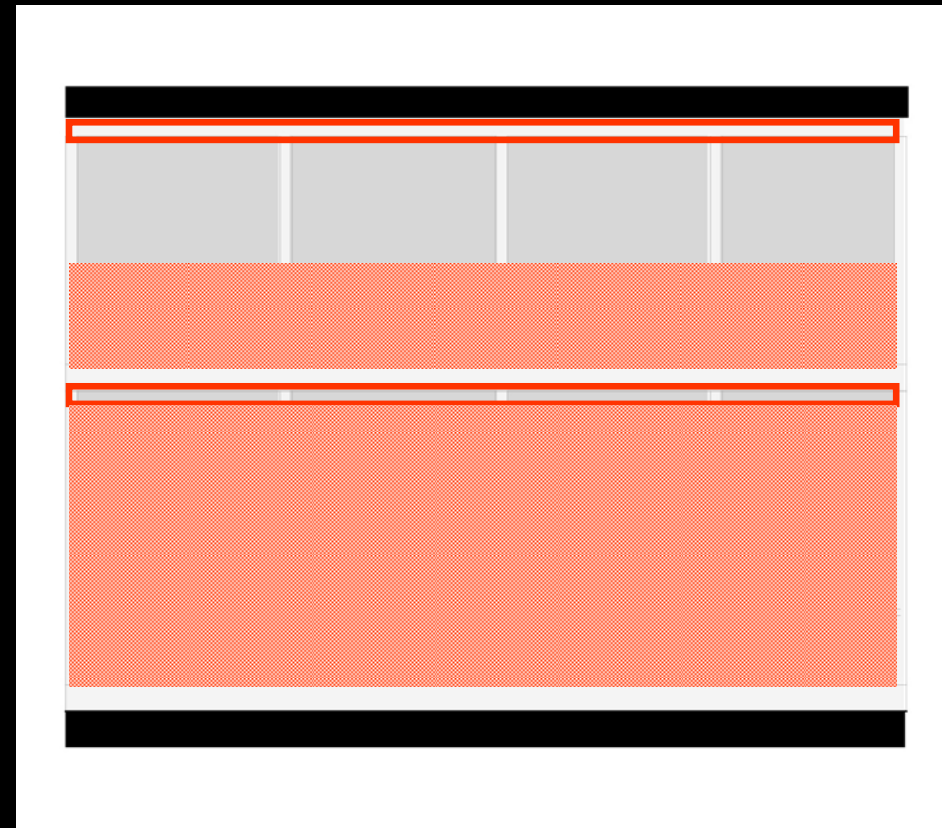
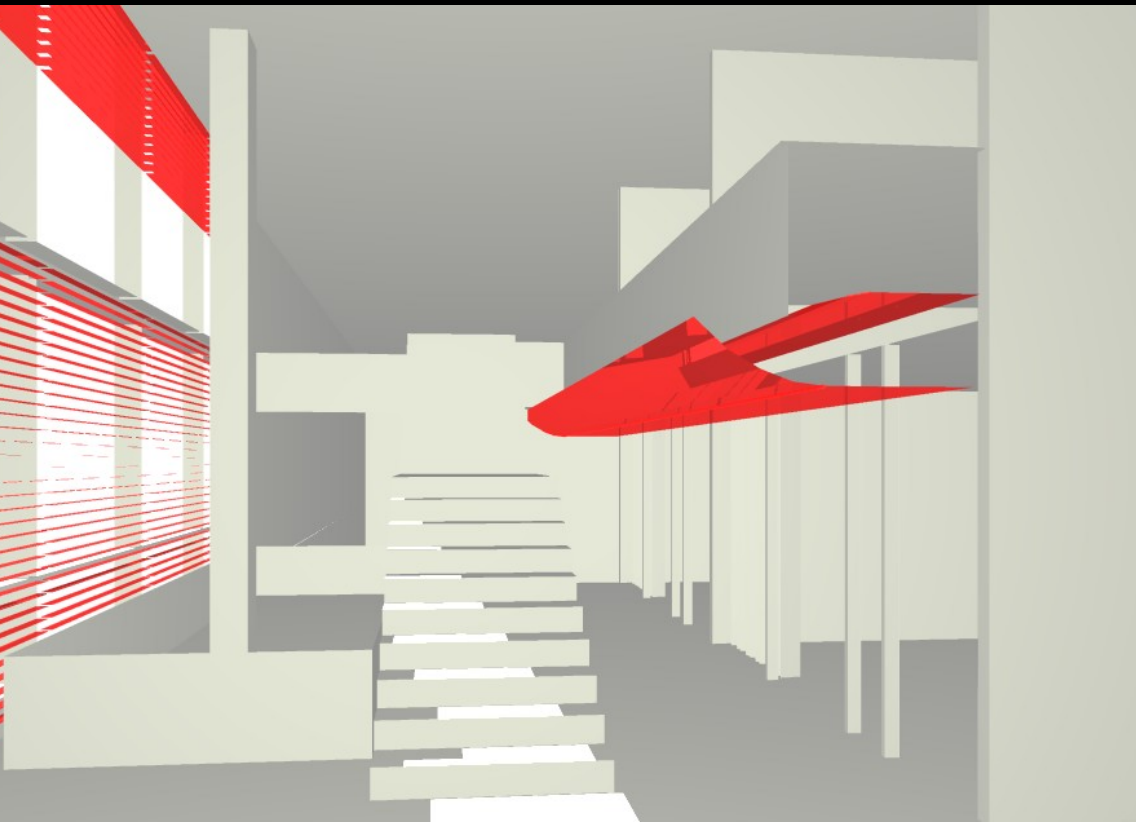
- Sunpath
- Raytrace



Analysis: *Circulation Lobby*

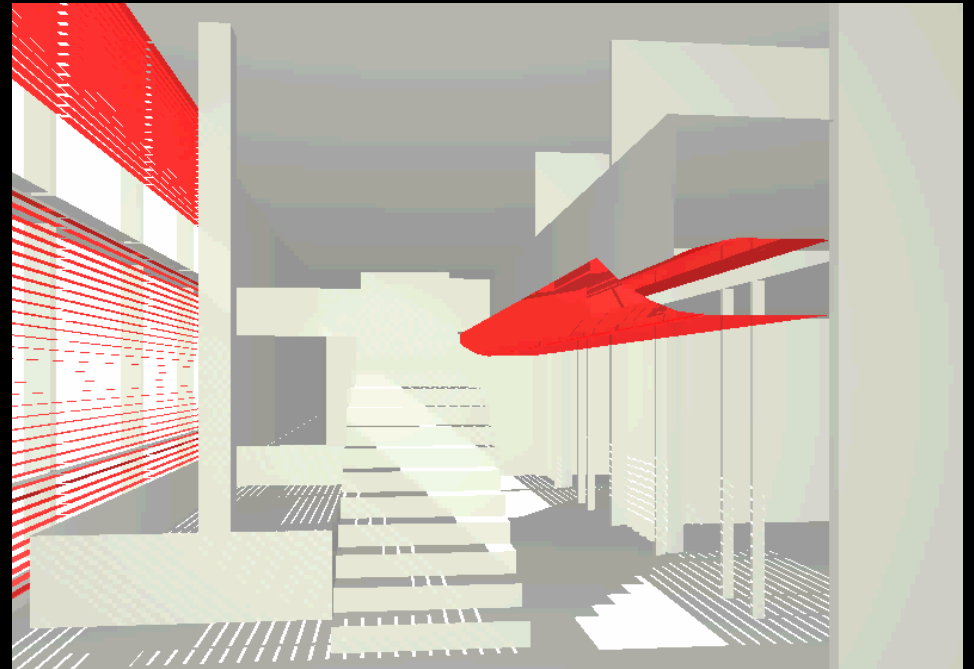
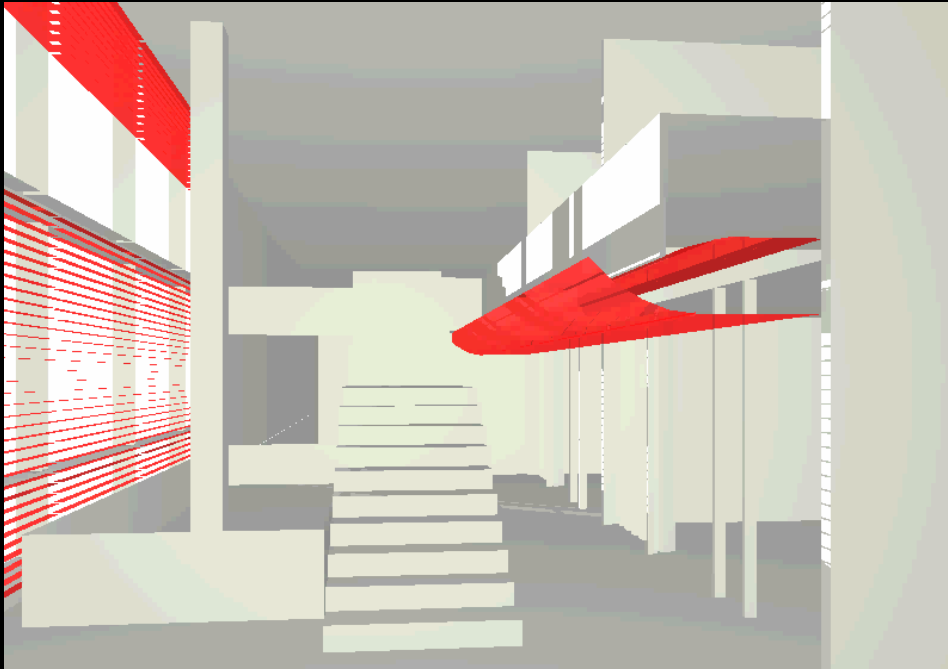
Open Upper blinds:

- 1 m (6AM-2PM) During December 15 to January 15.
- .5 m from from September 15 to May 15
- After 2PM only lower blinds may open



Elevation of blinds

Recommendations: *Circulation Lobby*



Background: *Solar Gains*

- Problem when it's too cold to use air conditioning and too hot to need the added heat

Background: *Solar Gains*

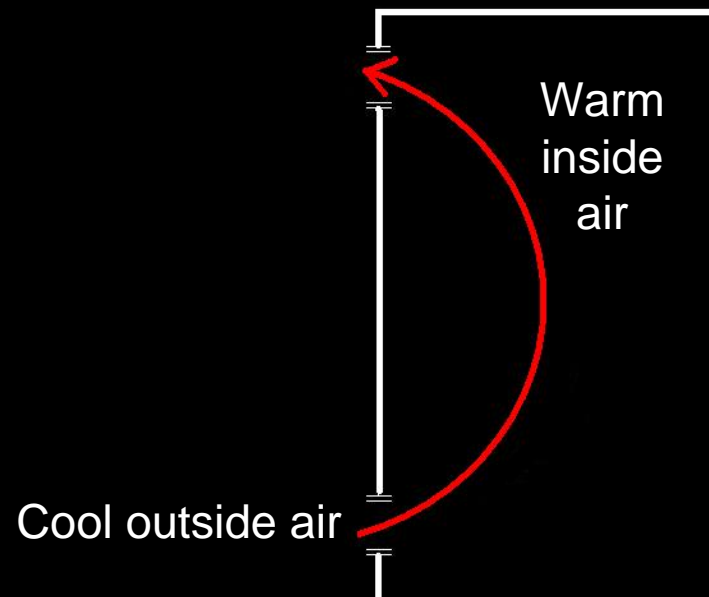
- Problem when it's too cold to use air conditioning and too hot to need the added heat
- “Stack effect”
 - Pressure is inversely proportional to height

Background: *Solar Gains*

- Problem when it's too cold to use air conditioning and too hot to need the added heat
- “Stack effect”
 - Pressure is inversely proportional to height
 - The gradient is greater for cool, outside air than for warm inside air

Background: *Solar Gains*

- Problem when it's too cold to use air-conditioning and too hot to need the added heat
- “Stack effect”
 - Pressure is inversely proportional to height
 - The gradient is greater for cool, outside air than for warm inside air
 - The warm, inside air wants to travel to the area of less pressure

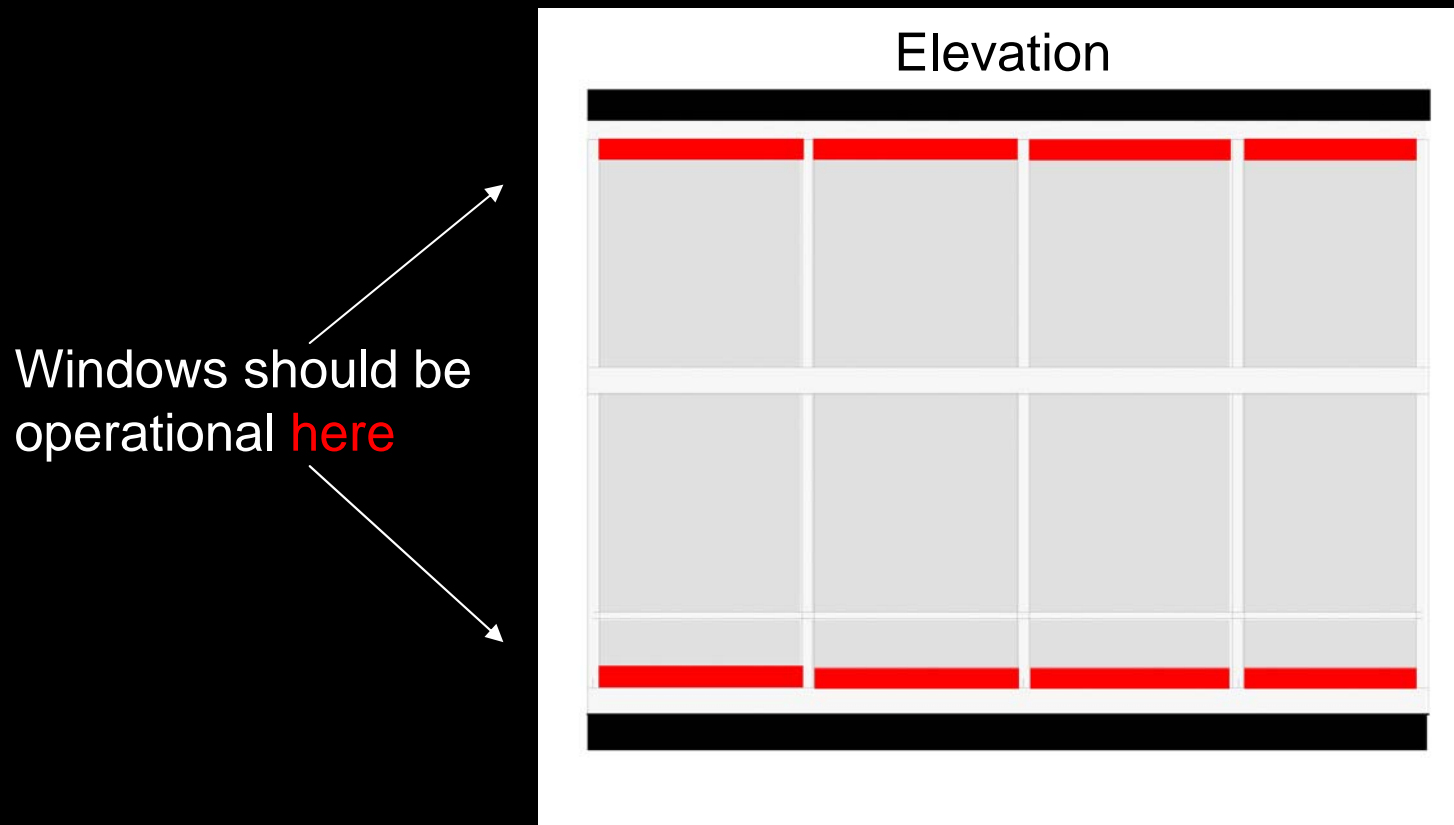


Analysis: *Solar Gains*

- Outside temperature must be less than the inside temperature (true for most of the year in Boston)
- If a bottom window and a top window are open:
 - Ventilation will occur
 - The space will cool
- When the outside temperature is hotter than the inside temperature, air conditioning will be used
- When ventilation is not necessary to cool the space (winter), the windows should be closed

Proposal: *Solar Gains*

- Windows should be functional at the very top and the very bottom



Proposal: *Solar Gains*

- Windows should be functional at the very top and the very bottom
- A rotating window allows for easy operation and is aesthetically pleasing

Conclusion

- Main areas to improve:
 - Natural lighting in conference area
 - Dramatic play of light in circulation lobby
 - Decrease solar gains in circulation lobby
- Proposals:
 - Anidolic light shelf
 - Timing system for blinds
 - Operable windows

Simulation topics: *Circulation Lobby*

