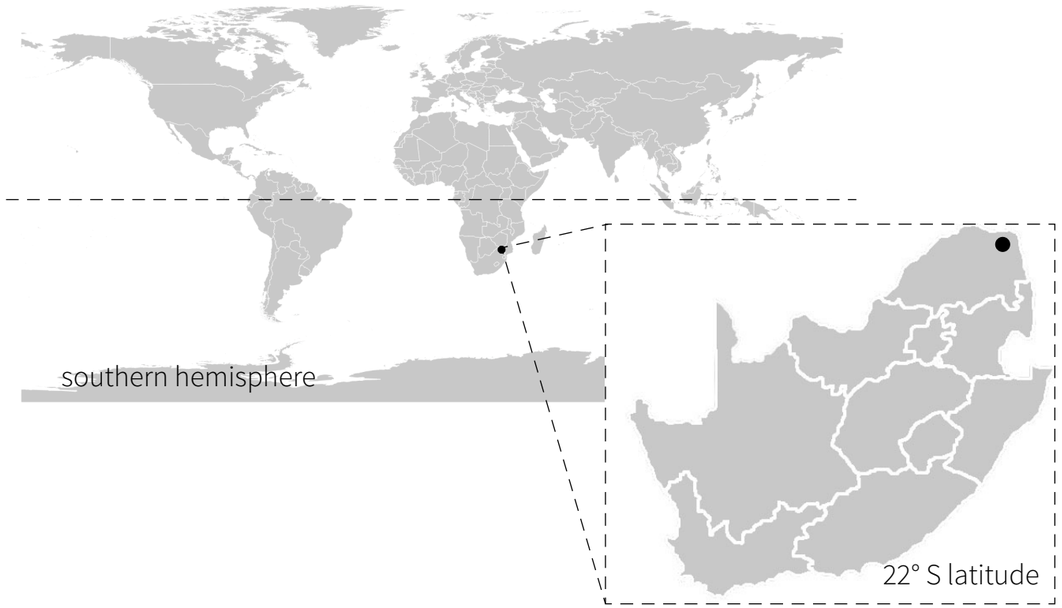
MAKULEKE COMMUNITY LIBRARY

MARIANA BALLINA

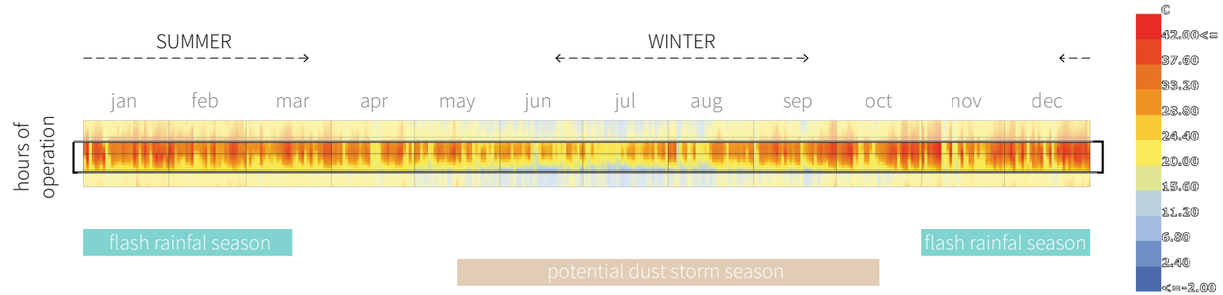
GENERAL

CLIMATE INFORMED ORIENTATION

LOCATION

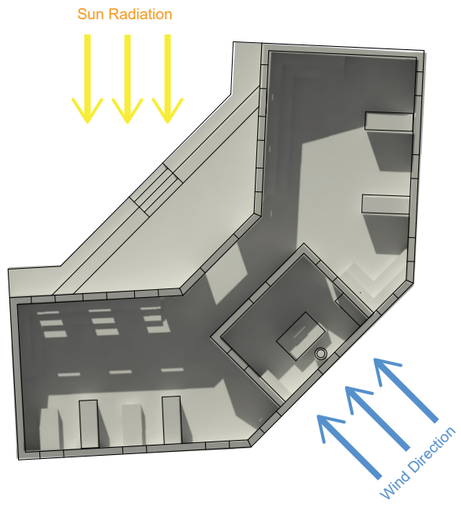


THE SEASONS



ORIENTATION

building primarily oriented to shield visitors from south-eastern winds due to heavy dust storms (winter)



WIND

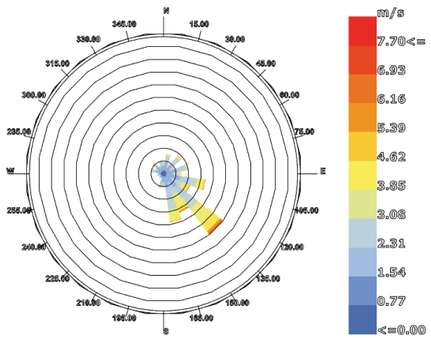
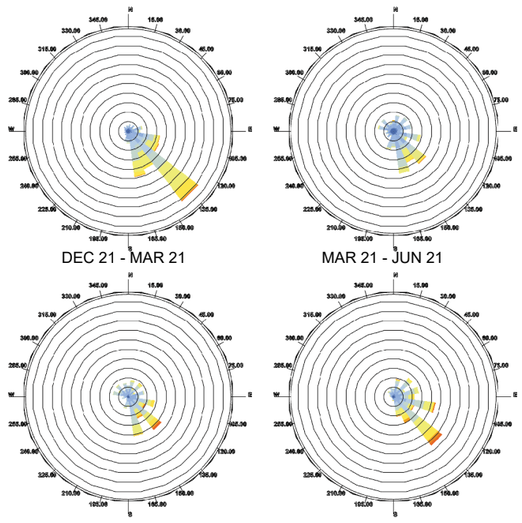
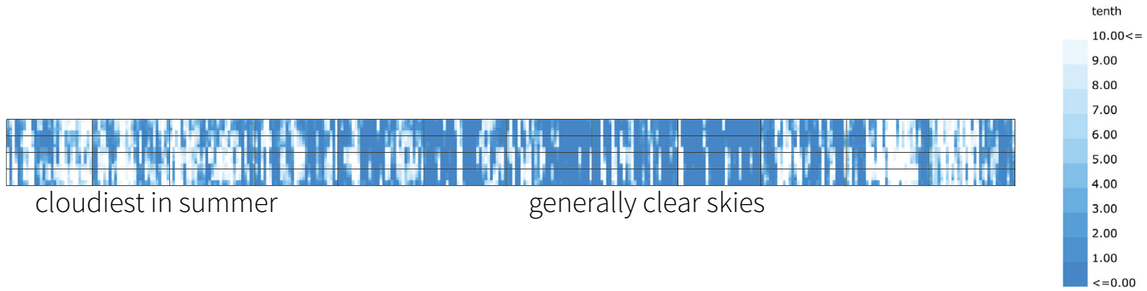


FIG 15. YEAR WIND ANALYSIS



SOLAR ENVIRONMENT

SKY COVERAGE

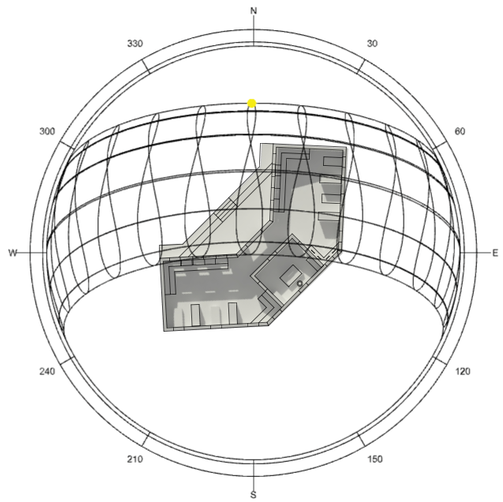


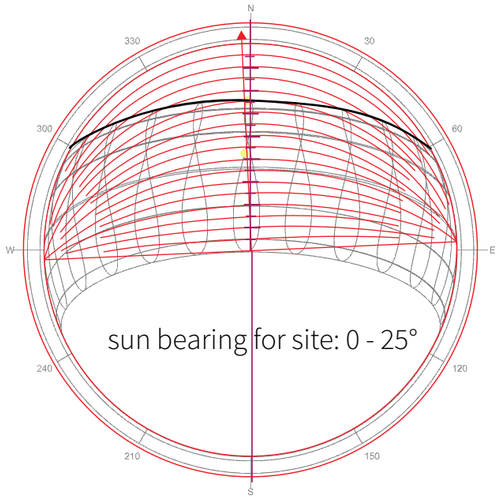
NOTES ON SOLAR GAIN

- Daylight problematic at all solar positions due to heat
- Minimize direct sun entering building at all costs

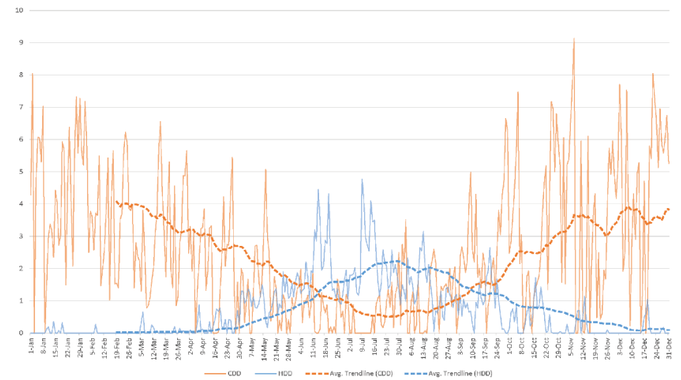
GENERAL

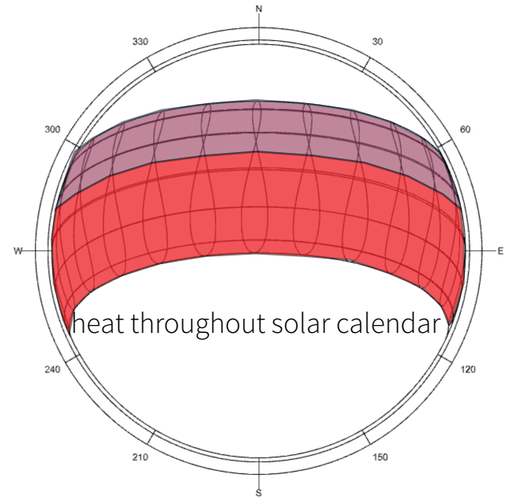
GENERAL SUN DIRECTION





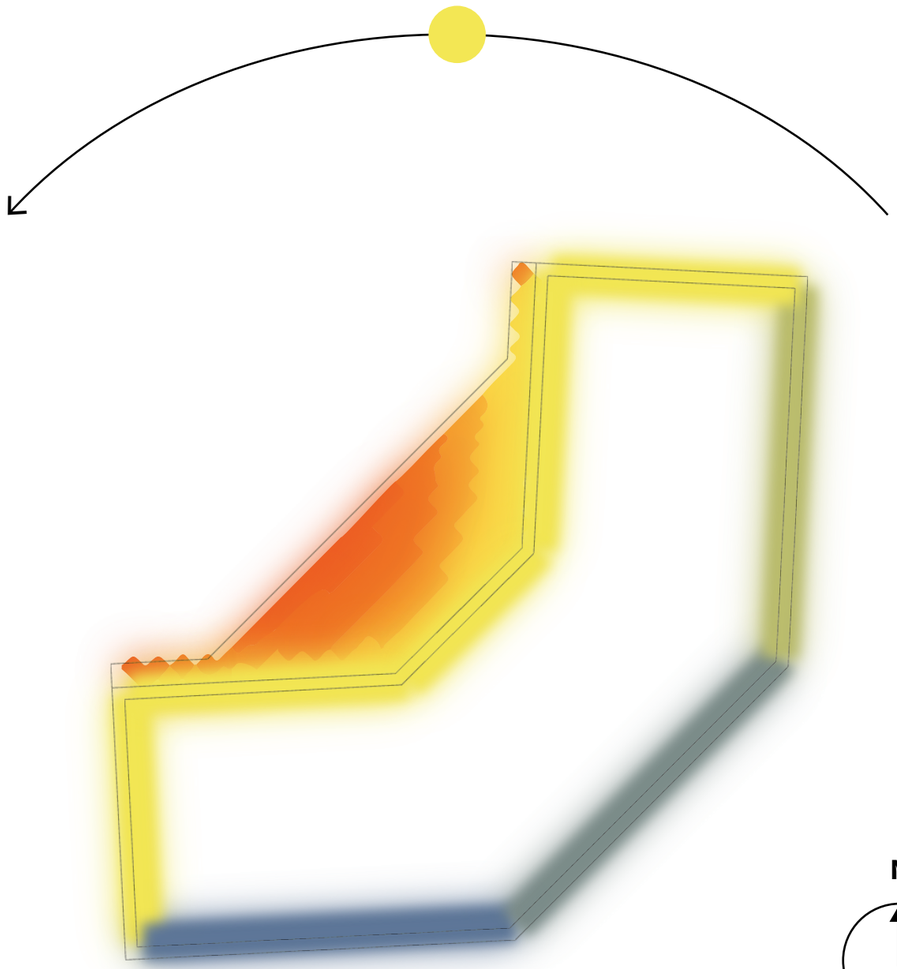
HEATING/COOLING DEGREE DAYS

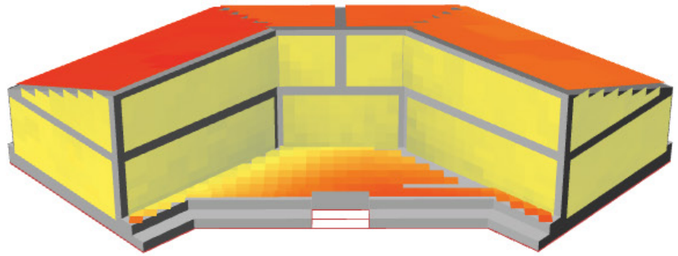




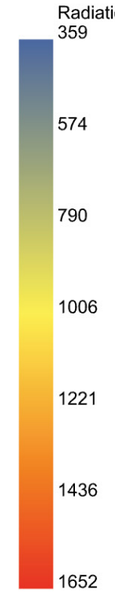
GENERAL

RADIATION ANALYSIS



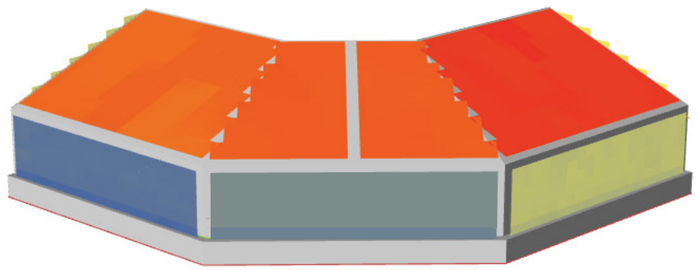


ENTRANCE FACADE - NORTH-WEST FACING



N

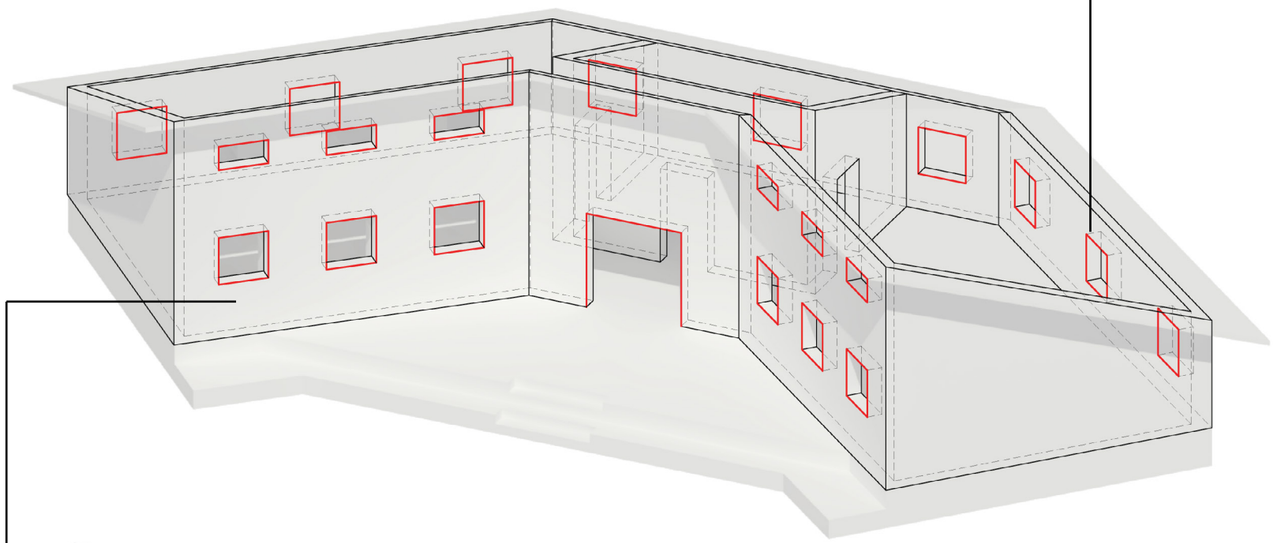
BACK FACADE - SOUTH-EAST FACING



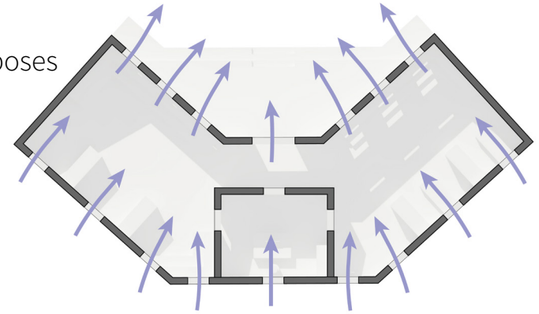
BASE CONDITIONS

PHYSICAL OVERVIEW

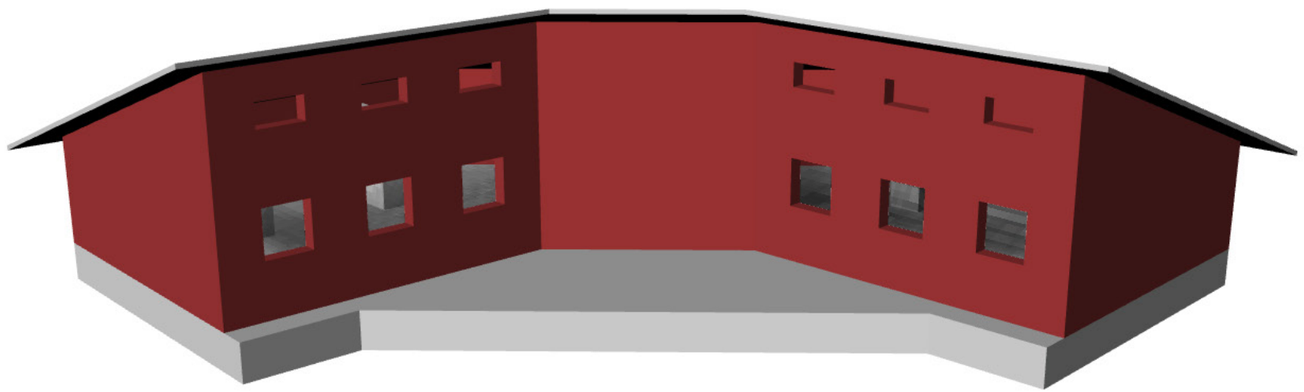
BASE DESIGN



BACK FACADE
kept the same, for ventilation purposes
primarily designed for ventilation



FRONT FACADE
focus of this studv



OBJECTIVES

The Makuleke Community Library is a proposed community space for a small village and surrounding villages in South Africa. As such, the building must affordably built and affordably maintained while providing a useable space in which students and adults can read, write, build and interact with technology. Climactically, the library is in an inland region subject to great quantities of annual solar radiation and high average temperatures of 90 degrees during the hottest months. Taking into account climactic comfort, affordability, and the use of the library for daily activities, the community space must both shield occupants from heat and solar radiation and make use of daylight to reduce operational costs and provide adequate lighting for performance.

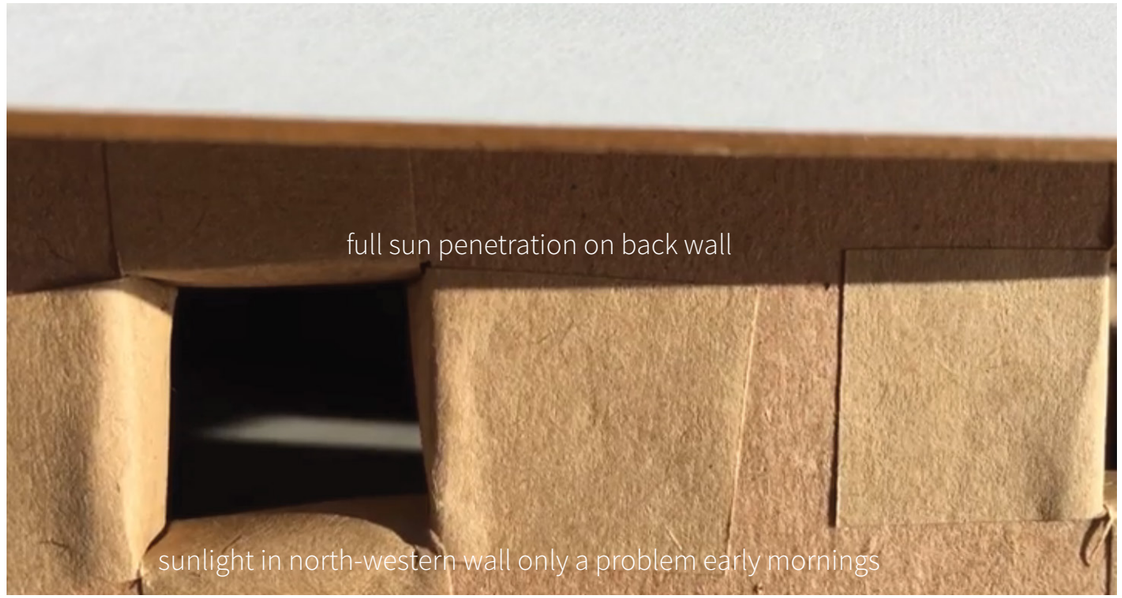
As part of its initial environmental design, 98% of the Makuleke Community Library floor space successfully achieved daylight autonomy (measured at 400 lux of light with the door open). However, despite the abundance of light within the space during operating hours, the initial library design did not take into account problems which arise from heavy contrast, direct sunlight radiation in the space, or glare, nor was natural daylight taken into account as part of the overall design, mood or effect on occupants outside of technically providing “enough light”.

My objective is to go beyond the efforts of the initial basic design to provide enough light for occupants. The goals are to 1) use **diffused or indirect daylight** to light the space (as opposed to direct light which I believe is providing much light during the winter months) 2) make the manner in which diffused light is being provided a **design feature** (as opposed to the basic use of blinds currently implemented), 3) **avoid glare** in the space from harsh outdoor sunlight and 4) provide **ambient electrical lighting** that also goes beyond “providing enough light”.

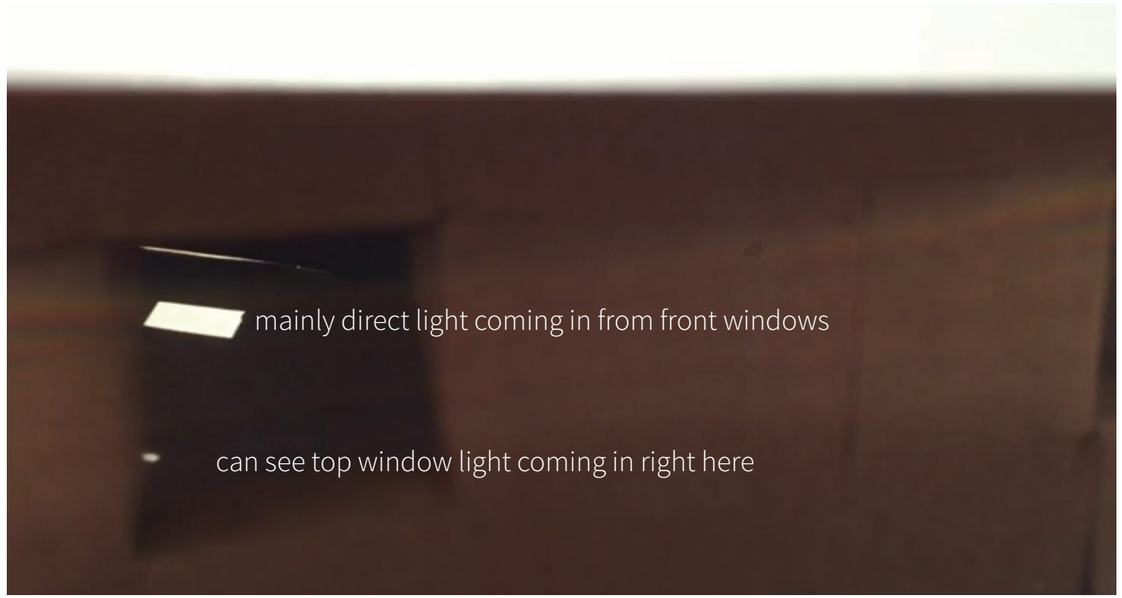
BASE CONDITIONS

PHYSICAL MODEL TESTS

BACK WALL VIEW



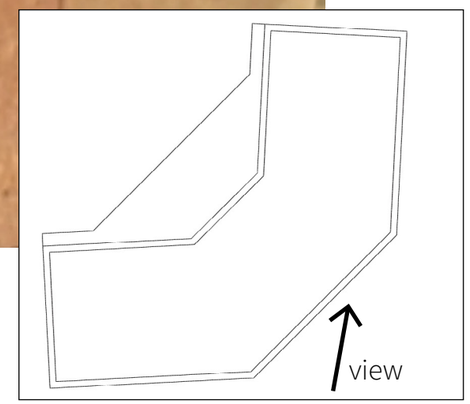
WINTER SOLSTICE - 7 am



WINTER SOLSTICE - 9 am

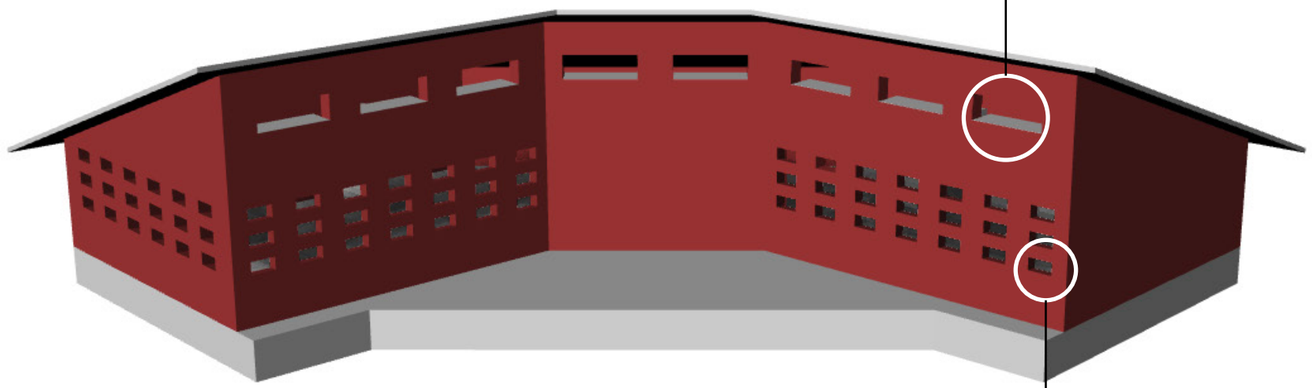
WINTER SOLSTICE - 12 pm

WINTER SOLSTICE - 5 pm

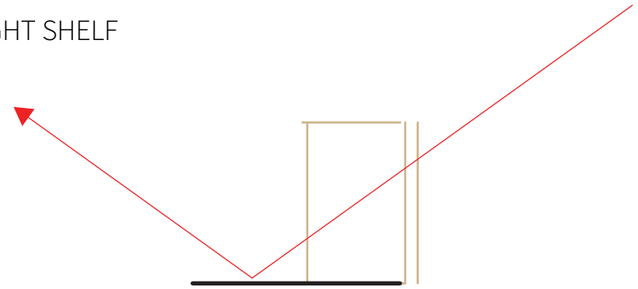


VERSION 2

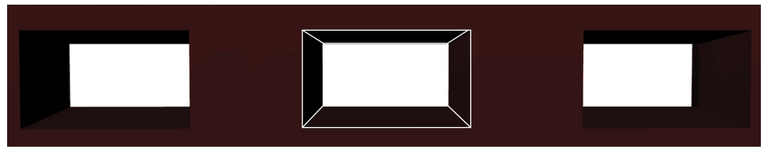
STRATEGIES



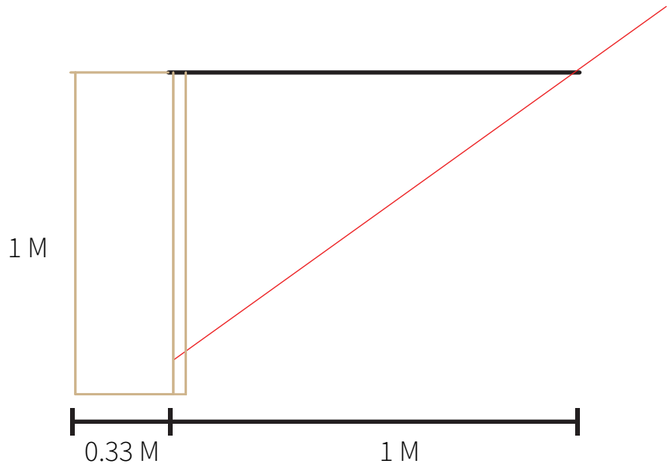
INDOOR LIGHT SHELF



TAPERED WINDOWS

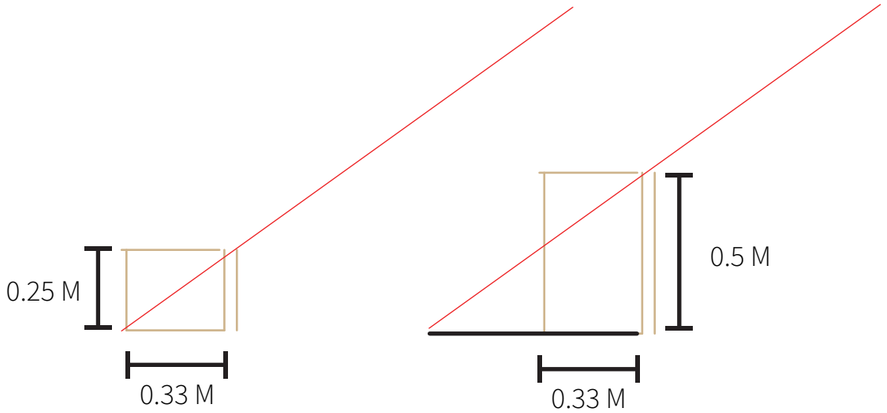


SHADING STRATEGY: WINTER SOLSTICE



LOWER WINDOWS

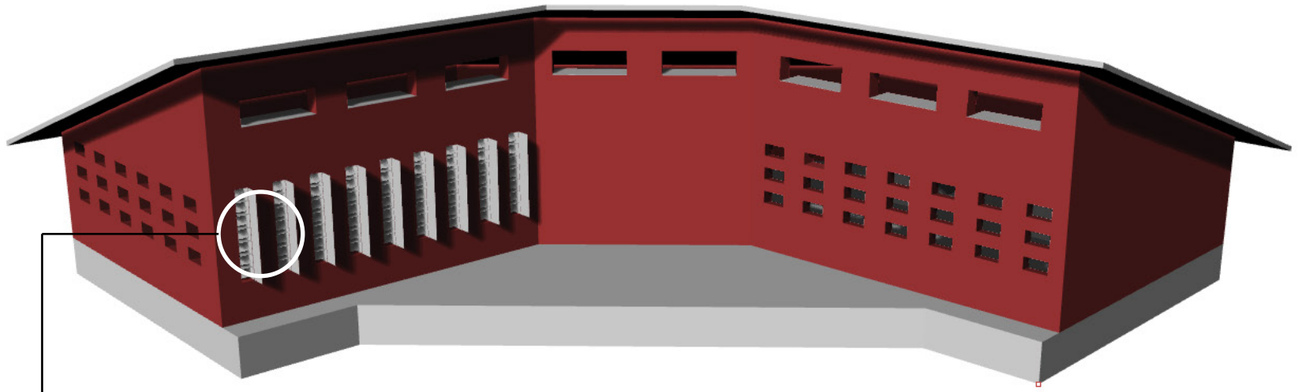
UPPER WINDOWS + SHELVE



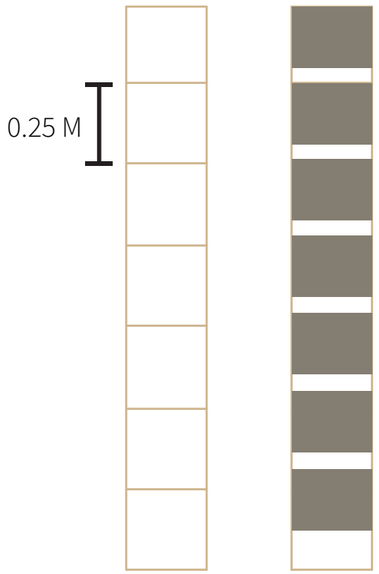
small windows, minimize direct light

VERSION 3

STRATEGIES

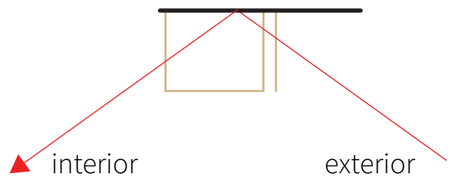


VERTICAL WINDOWS

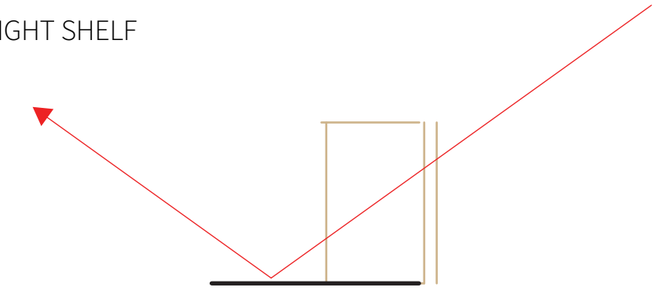


OPERABLE SHADING

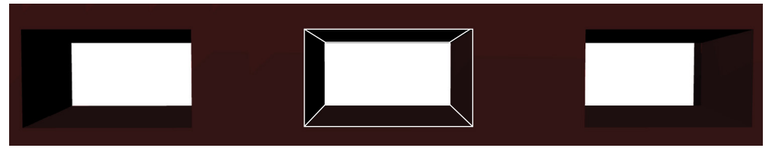
VERTICAL REFLECTIVE WINGS



INDOOR LIGHT SHELF

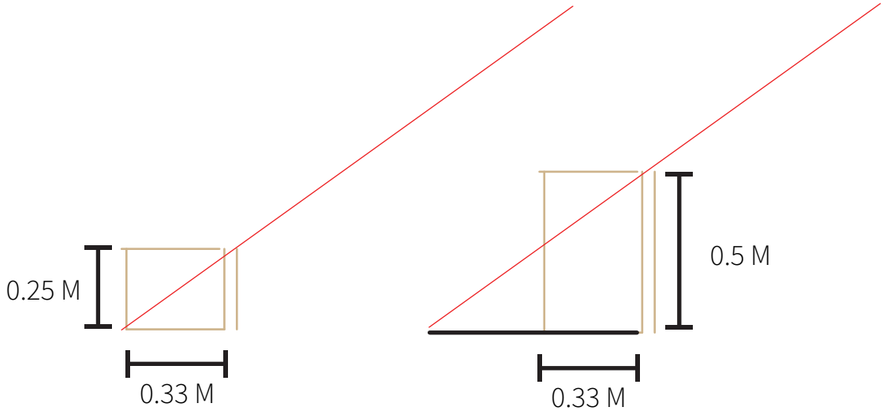


TAPERED WINDOWS



LOWER WINDOWS

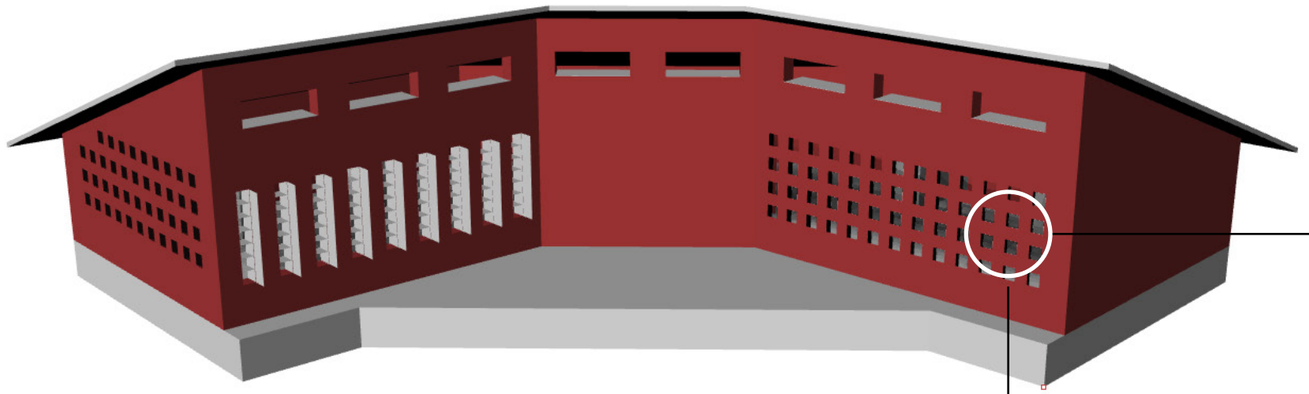
UPPER WINDOWS + SHELVE



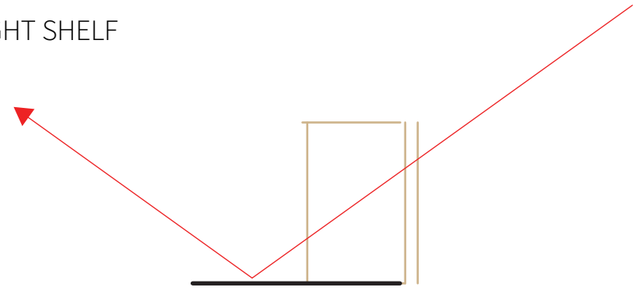
small windows, minimize direct light

VERSION 4

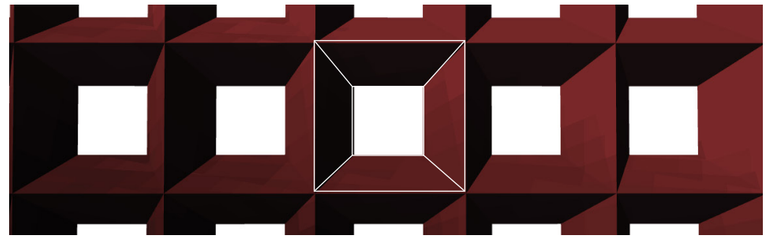
STRATEGIES



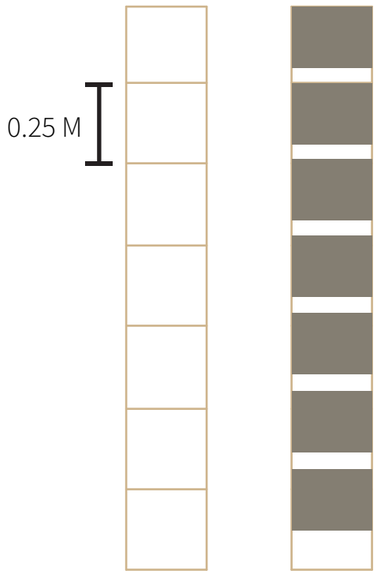
INDOOR LIGHT SHELF



TAPERED WINDOWS

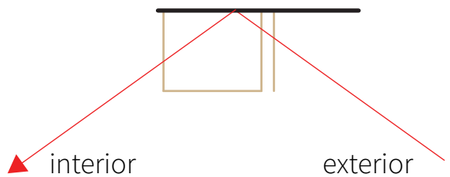


VERTICAL WINDOWS

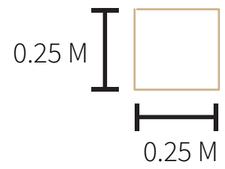


OPERABLE SHADING

VERTICAL REFLECTIVE WINGS

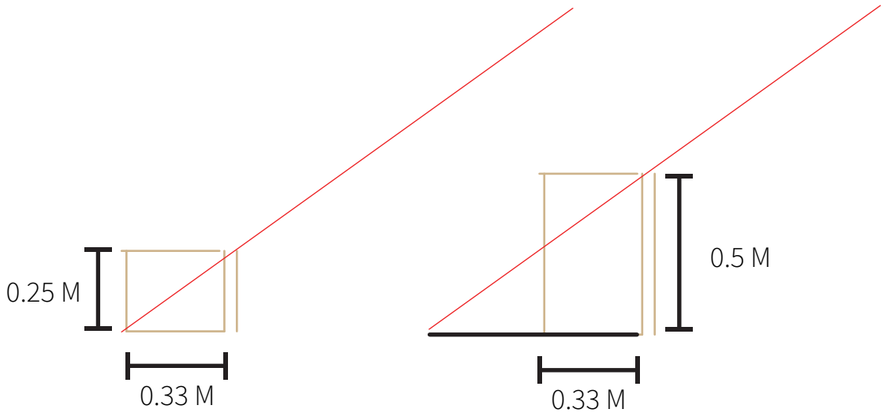


SMALLER WINDOWS



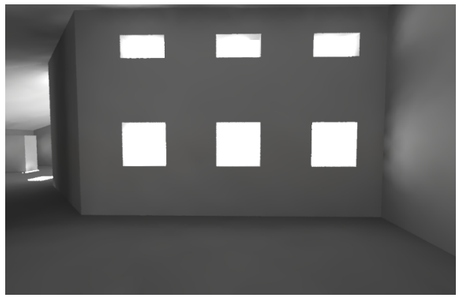
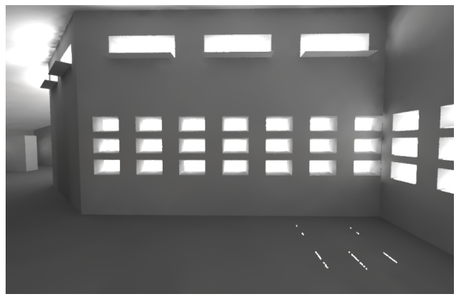
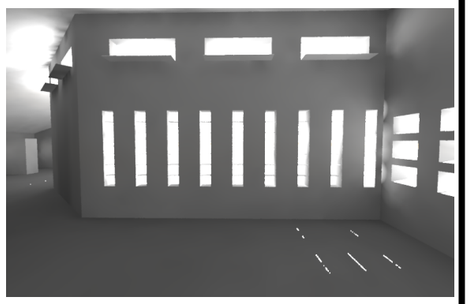
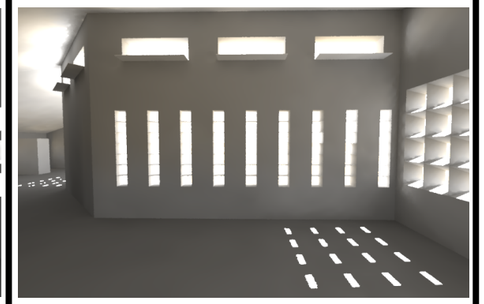
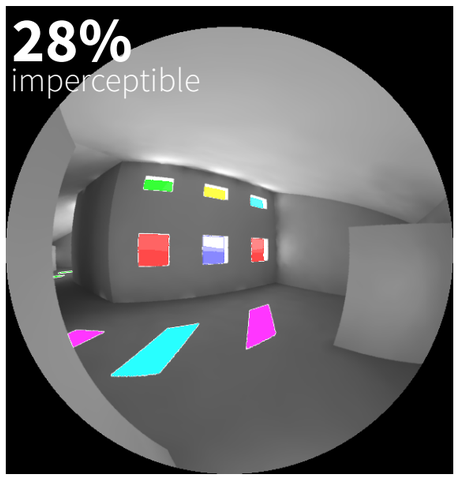
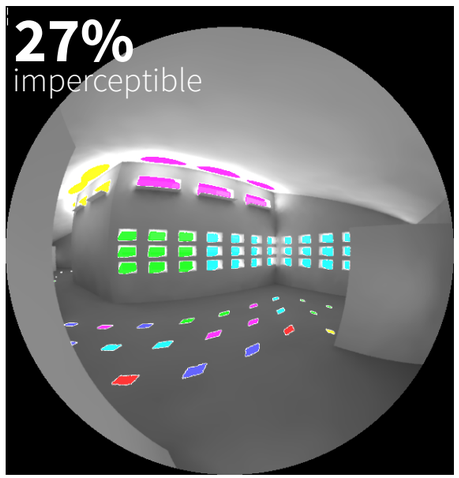
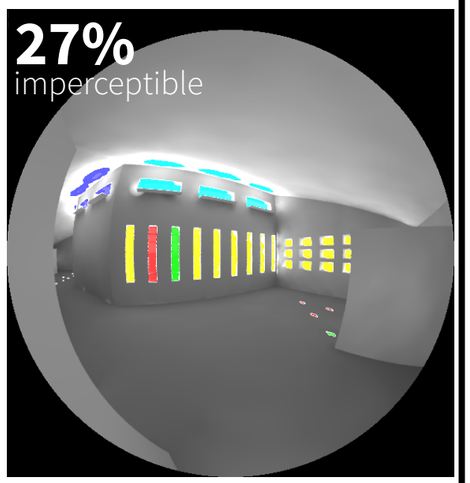
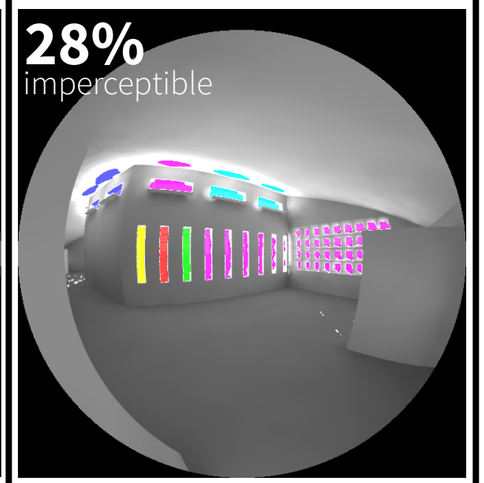
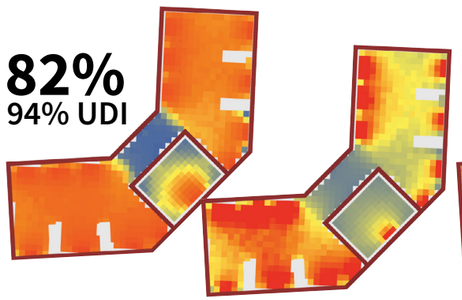
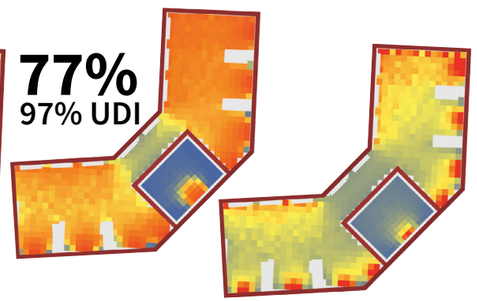
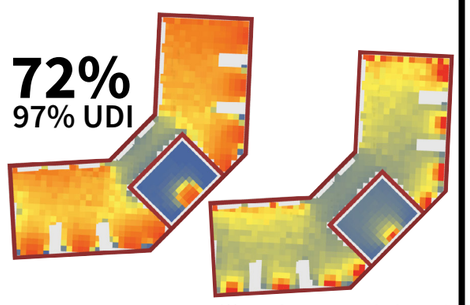
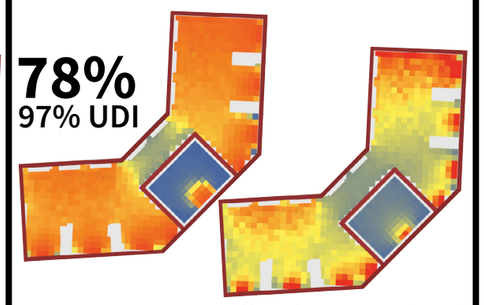
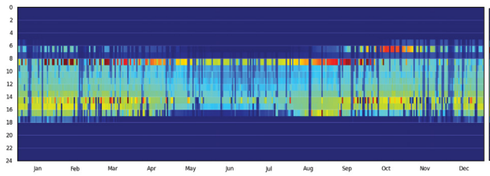
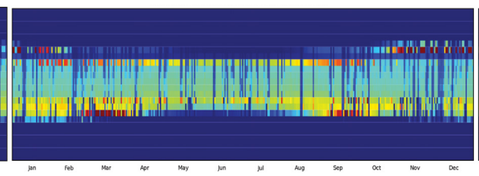
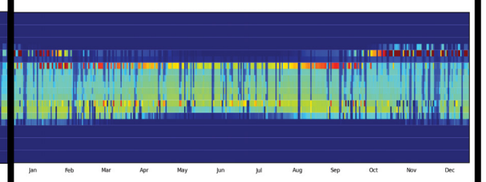
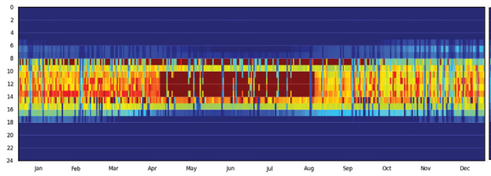
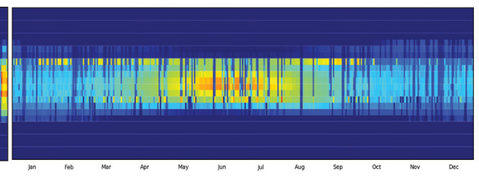
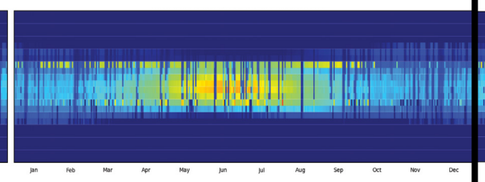
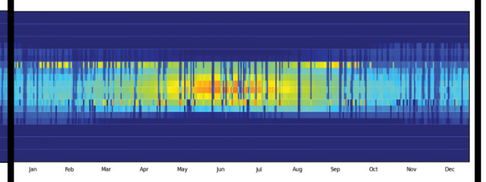
LOWER WINDOWS

UPPER WINDOWS + SHELVE

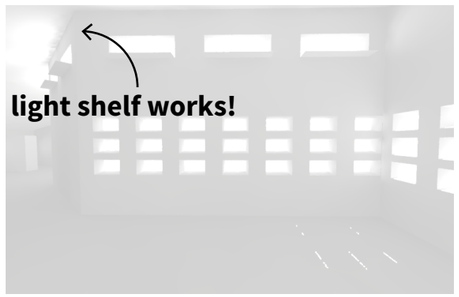
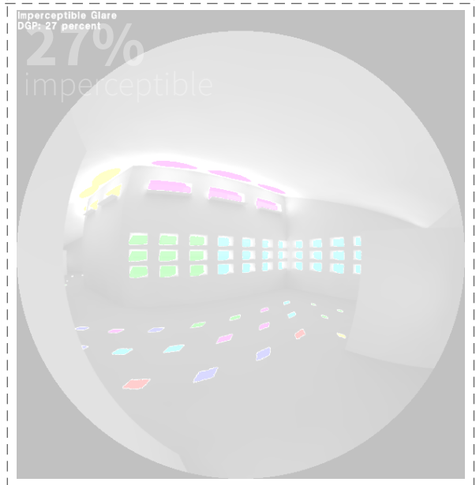
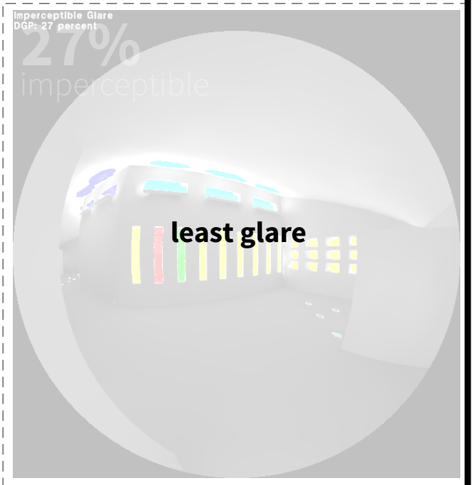
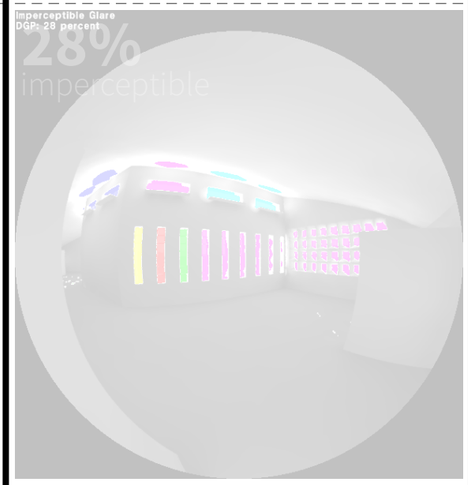
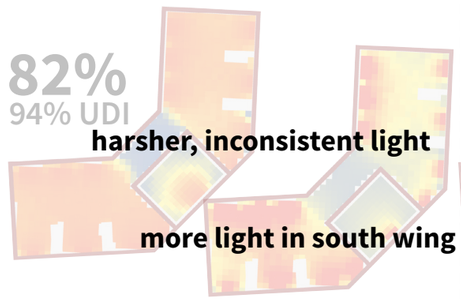
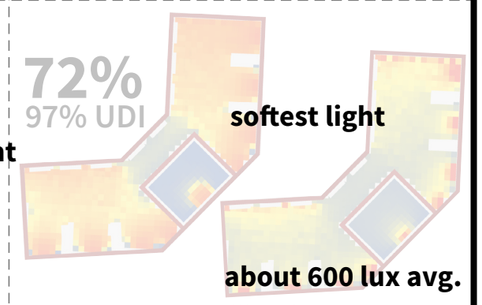
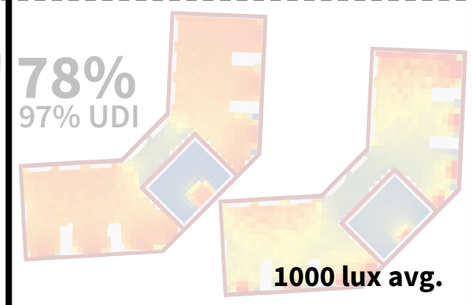
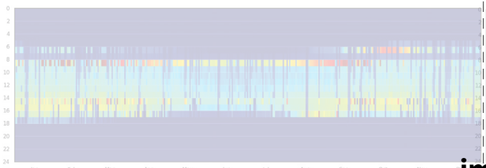
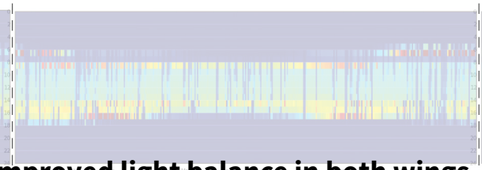
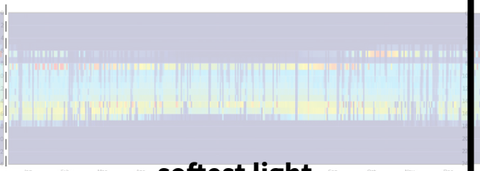
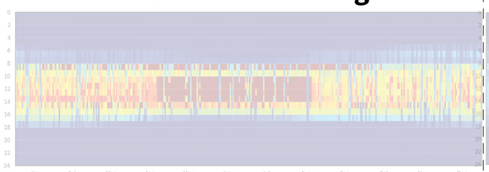
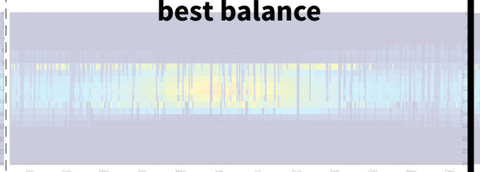
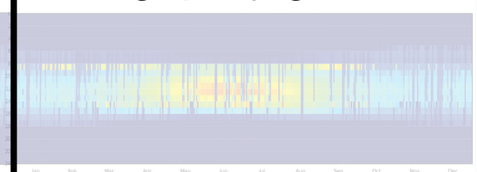


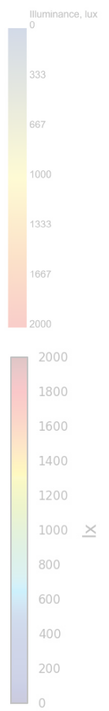
small windows, minimize direct light

COMPARISON STUDY

	BASE CONDITION	V2	V3	V4
VIEW OUTSIDE				
GLARE				
DAYLIGHT AUTONOMY (400 lux) + POINT-IN-TIME ILLUMINANCE	 Illuminance 9.21.12	 Illuminance 9.21.12	 Illuminance 9.21.12	 Illuminance 9.21.12
POINT ILLUMINANCE NORTH WING				
POINT ILLUMINANCE SOUTH WING				

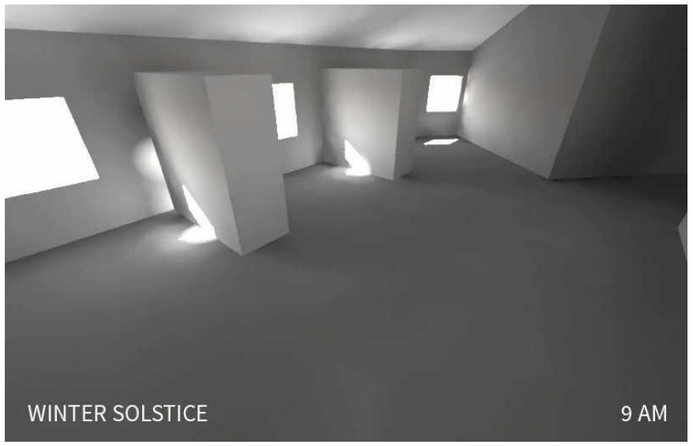
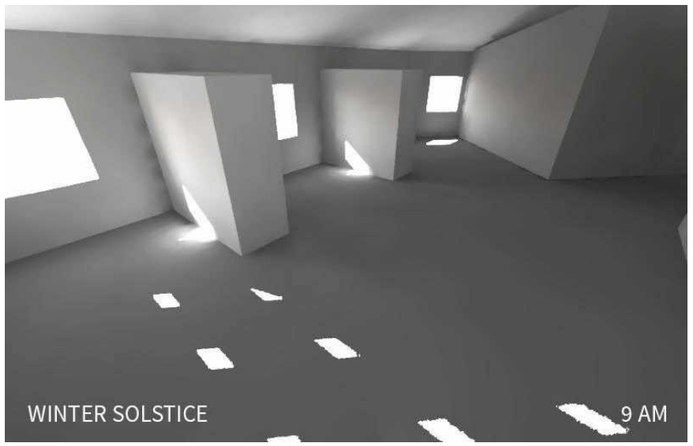
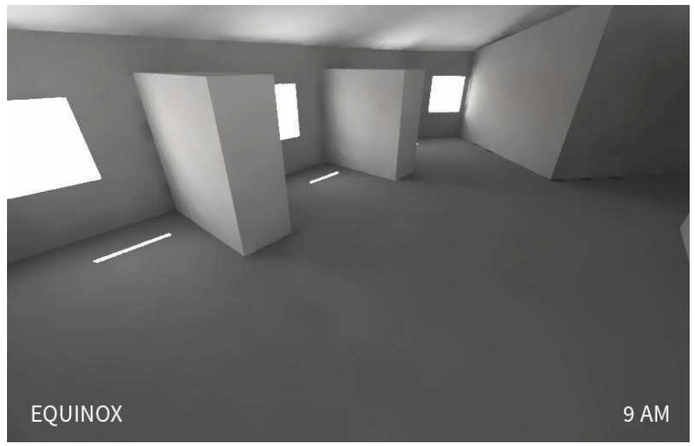
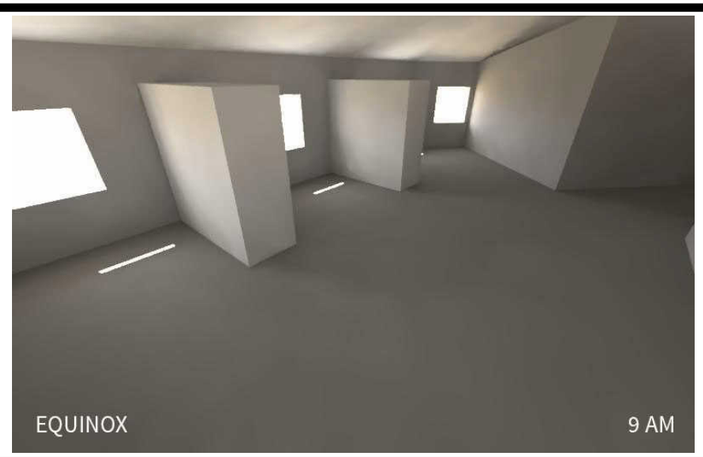
COMPARISON STUDY

	BASE CONDITION	V2	V3	V4
VIEW OUTSIDE	 greatest view potential	 light shelf works!		 tapered windows look good, brings in outdoor light
GLARE	 greatest glare potential		 least glare	
DAYLIGHT AUTONOMY (400 lux) + POINT-IN-TIME ILLUMINANCE	 82% 94% UDI harsher, inconsistent light more light in south wing Illuminance 9.21.12	 77% 97% UDI better light quality, softer, more consistent about 800 lux avg. Illuminance 9.21.12	 72% 97% UDI softest light about 600 lux avg. Illuminance 9.21.12	 78% 97% UDI 1000 lux avg. Illuminance 9.21.12
POINT ILLUMINANCE NORTH WING	 overlit south wing	 improved light balance in both wings more consistency over time	 softest light, best balance	 still high quality light balance
POINT ILLUMINANCE SOUTH WING				



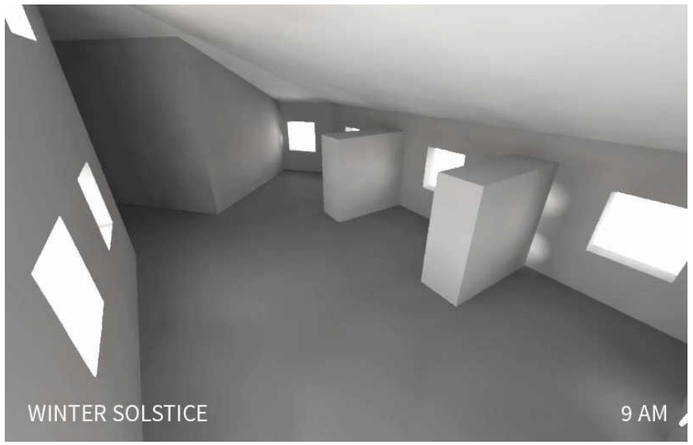
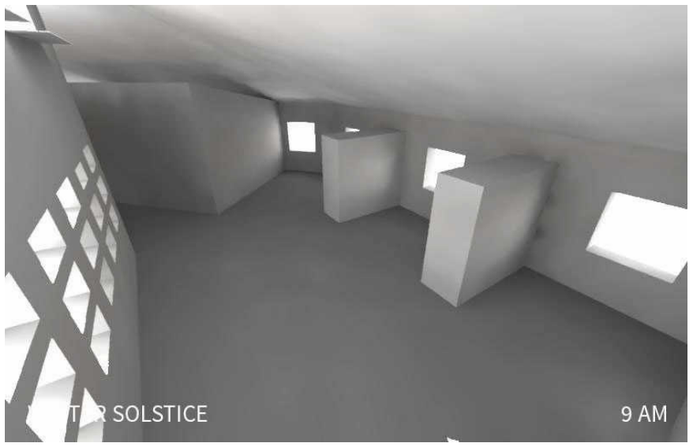
COMPARISON STUDY

NORTH WING

	WINTER	EQUINOX	SUMMER
ORIGINAL			
VERSION 3			
VERSION 4			

COMPARISON STUDY

SOUTH WING

	WINTER	EQUINOX	SUMMER
ORIGINAL			
VERSION 3			
VERSION 4