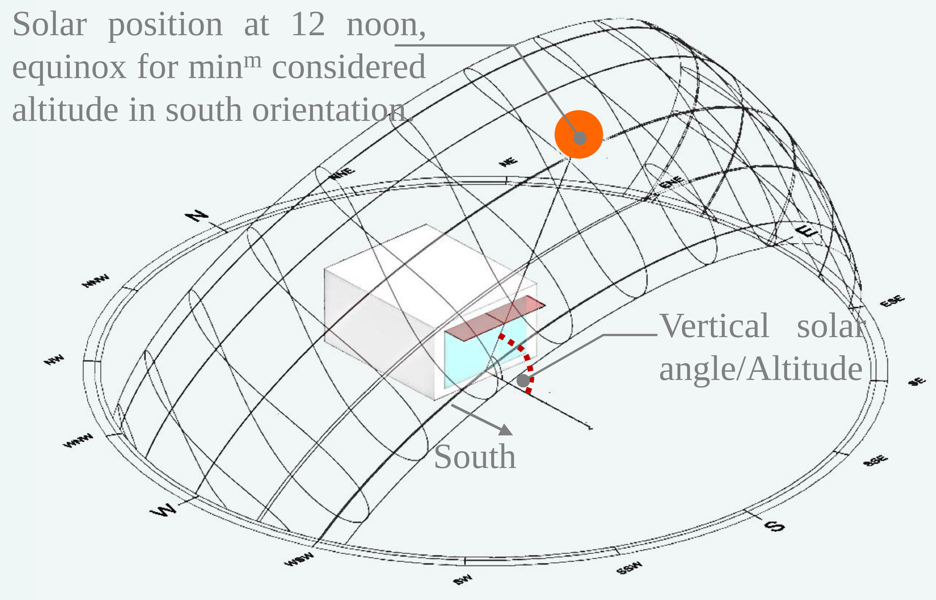
Addressing visual comfort, daylight access and solar shading with fixed external shading devices: A simplified approach

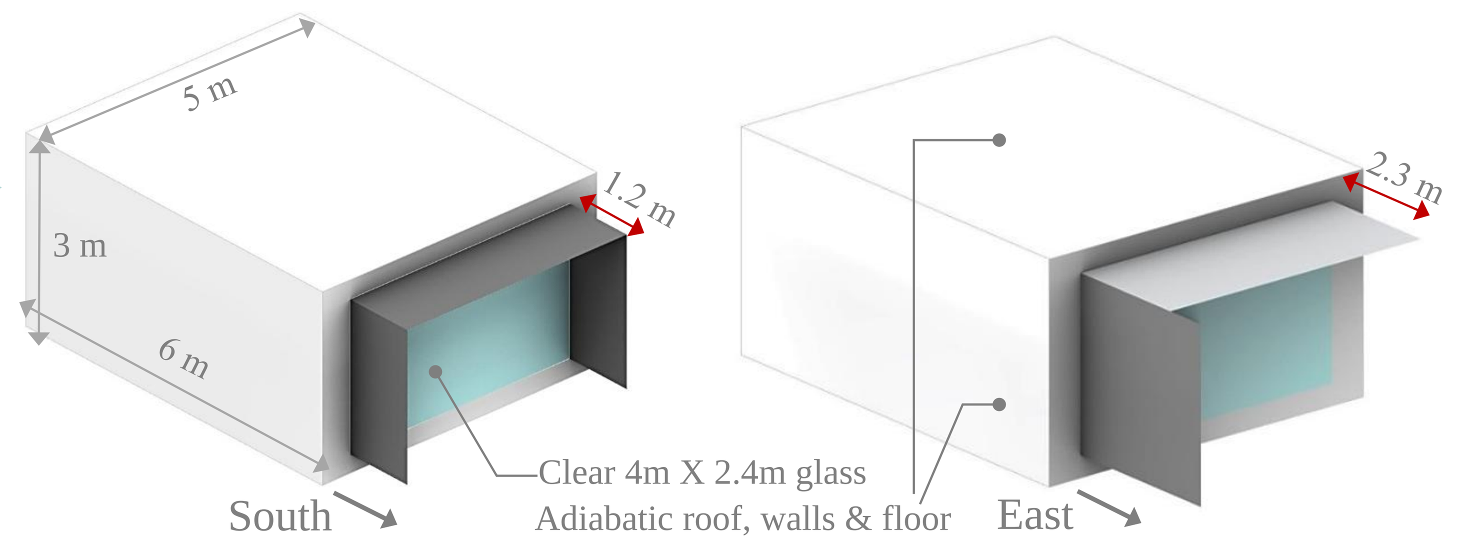
Focus areas: Geometric approach-Early design stage-Daylight access(Sky view factor)-Visual comfort(Guth position index)-Radiation mitigation(SHGC)-Resultant Energy Use Intensity

1 Introduction to problem statement

- Balancing energy demand , daylight access & visual comfort
- Simplified geometric approach suitable to early design
- Sample space: Office building in Delhi, India (Composite Climate, 28.7° N, 77.1° E)
- Energy conservation Building Code (ECBC) used for base geometry. (Fig. 1)



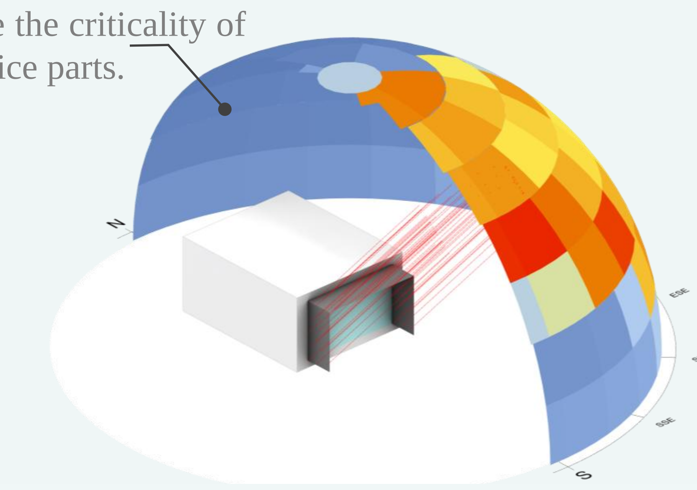
Code compliant (ECBC) case



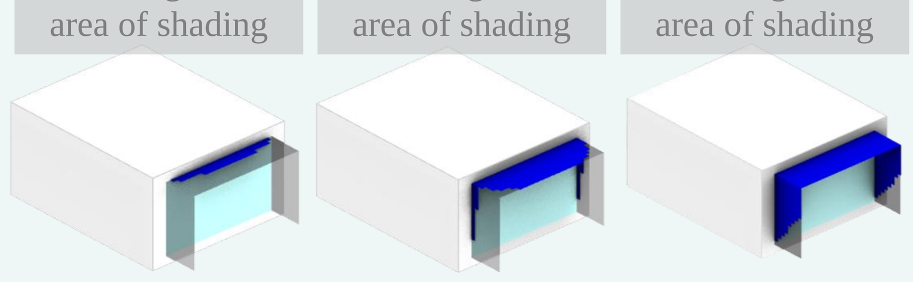
2 SHADERADE: Balance between Solar gains & Daylight access

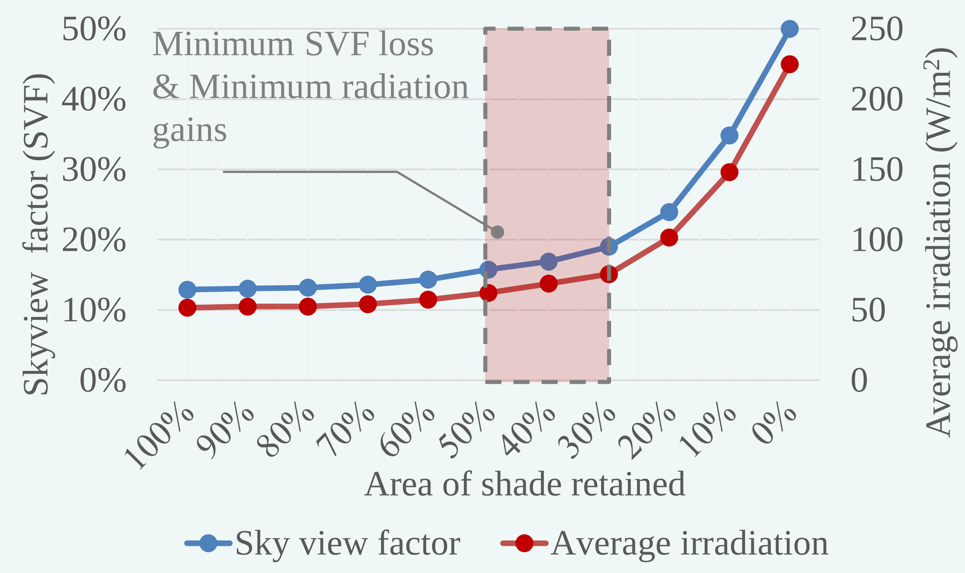
- Intersection of ray with shading device & glass to check protection from radiation.
- Assigning weightage geometric grid of shading device based on its ability to protect from solar radiation.
- Most critical 40% geometry is kept intact as it optimises Sky view factor (SVF) & Radiation gains.
- Glare mitigation not addressed yet

Ray projection checking the intersection with fenestration to determine the criticality of shading device parts.

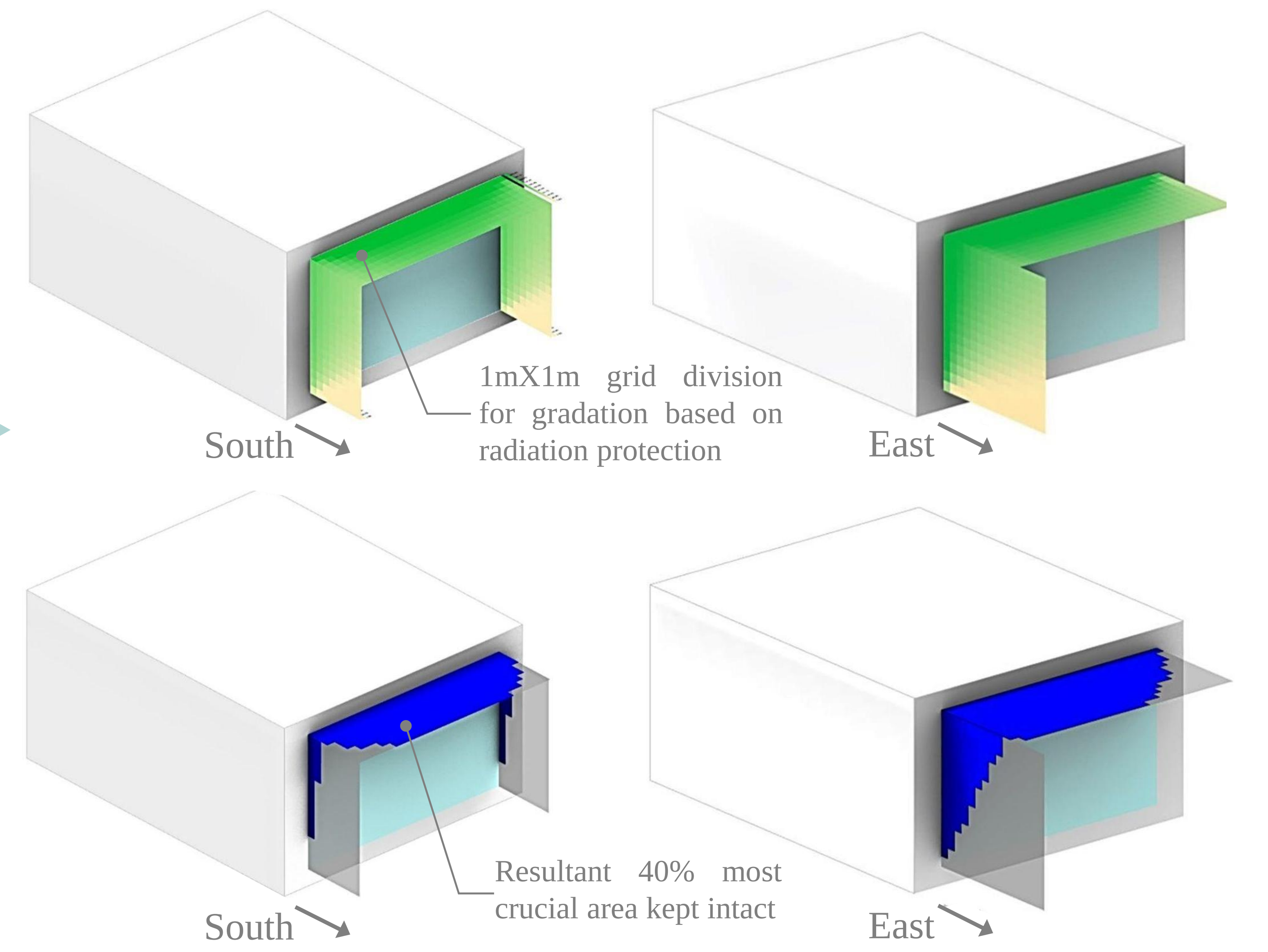


Result of retaining **10%** area of shading	Result of retaining **40%** area of shading	Result of retaining **90%** area of shading



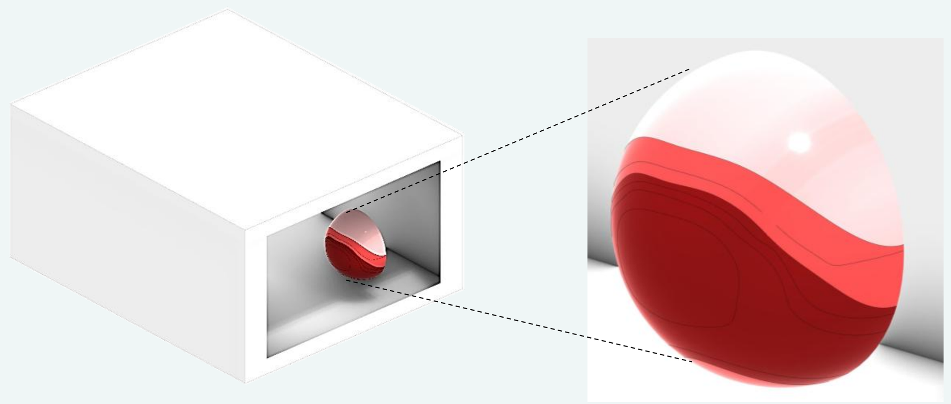


SHADERADE case



3 Glare mitigation through Guth position index

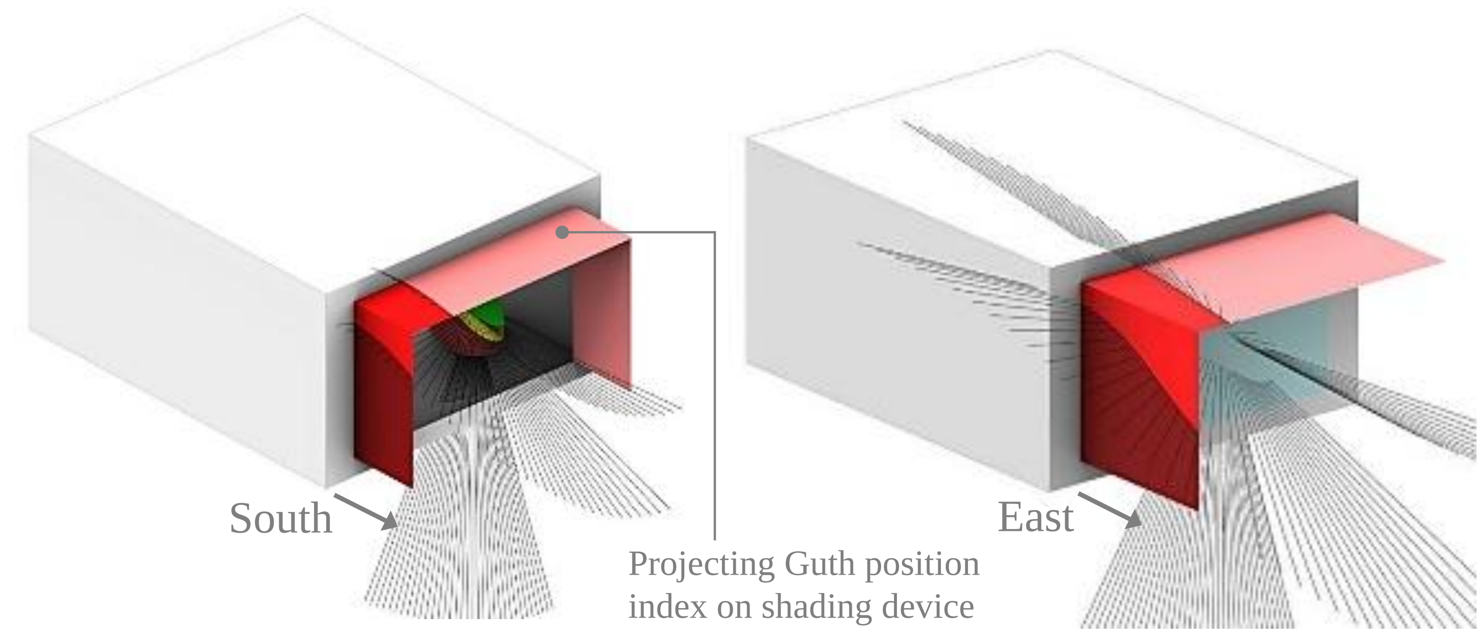
- Guth position index allocates scores to view angles with respect to user direction and perception of glare
- Index diagram is projected on the shading device, creating a division in the parts of shading device as per the criticality gradation



NON-CRITICAL (Safe) Position index more than 12

CRITICAL (Not safe) Position index between 4 & 1

INTERMEDIATE Position index between 12 & 4

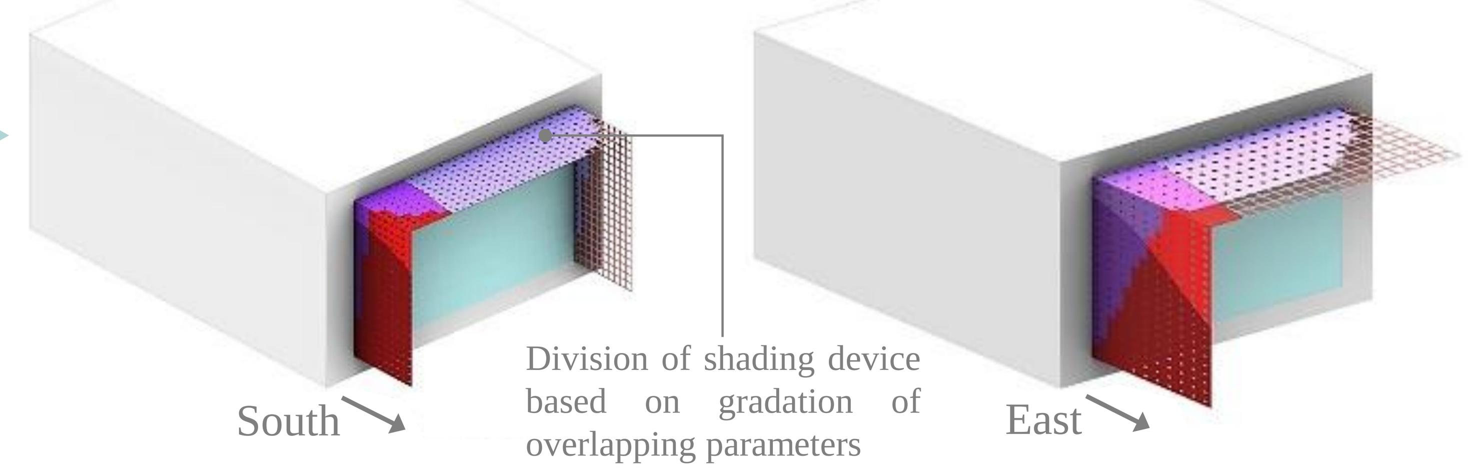


4 Resultant LITERADE case: Overlapping of parameter

- Result includes overlap of Solar radiation logic & Guth position index gradation.
- Perforation sizes used as one of the methods to control light transmission as per criticality.
- Resultant Literade case balances daylight access, radiation control and glare mitigation.

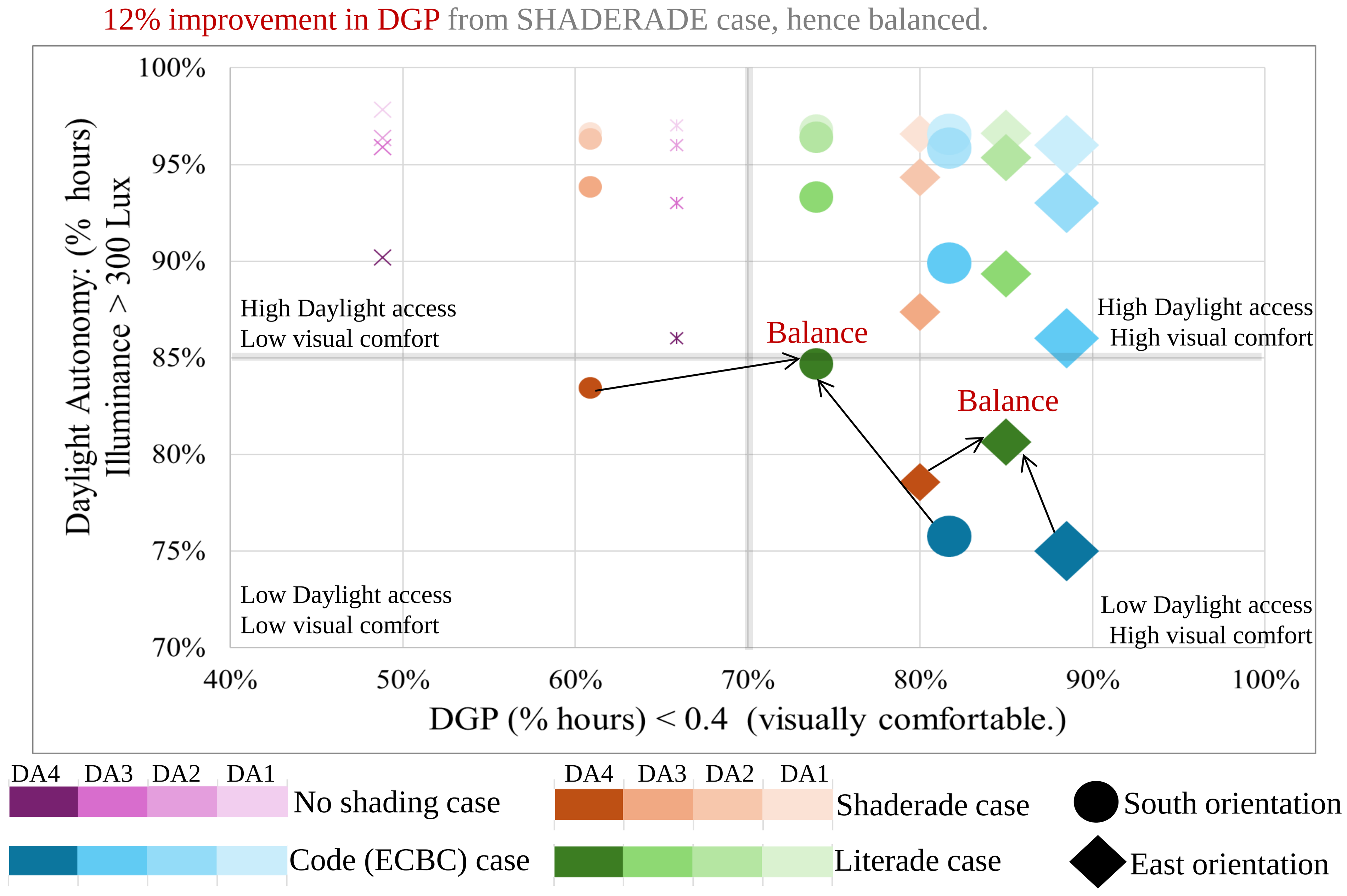
Colour code	Radiation protection (Shaderade)	Glare protection (Guth position)	Daylight access	Design decision
	Critical	Critical	Non-critical	Least light transmission (20% open)
	Critical	Intermediate	Non-critical	Least light transmission (20% open)
	Critical	Non-critical	Non-critical	Medium light transmission (40% open)
	Not critical	Critical	Non-critical	Least light transmission (20% open)
	Not critical	Intermediate	Non-critical	Medium light transmission (40% open)
	Not critical	Non-critical	Non-critical	Maximum light transmission (80% open)

LITERADE case (Proposed)

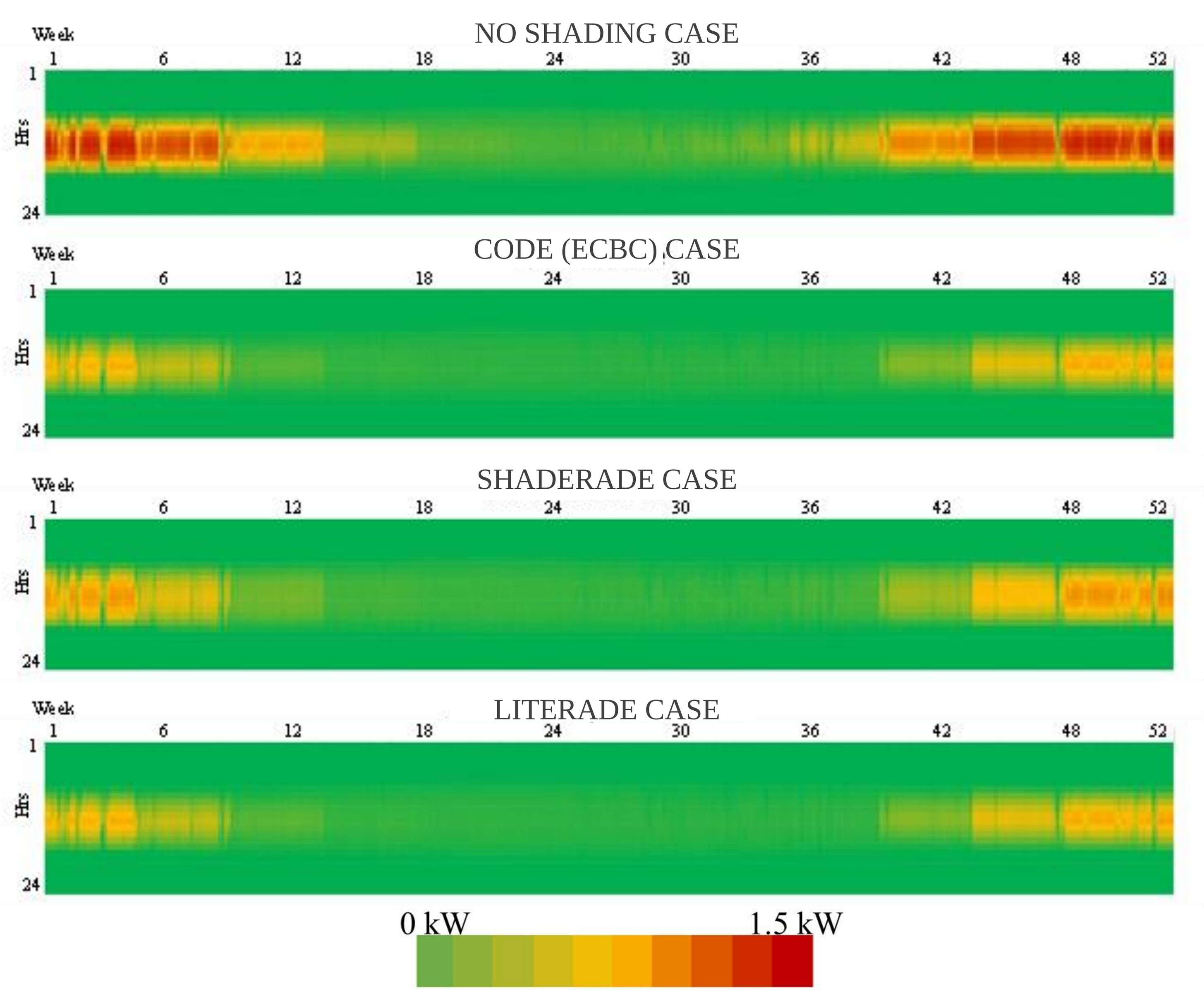


PERFORMANCE ANALYSIS

- For South oriented window,10% improvement in Daylight autonomy from ECBC case and 12% improvement in DGP from SHADERADE case, hence balanced.



- Graph represents Solar radiation transmission through window annually. 13% reduction in annual Energy Use Intensity (EUI) observed



Submitted by Mokshika Arora Guided by Prof. Minu Agarwal CEPT University, India

Representing ASHRAE