Daylight, Glare and View-out

Analysis and Evaluation

Introduction

Daylight as source of illumination is strongly favoured by occupants and should be a significant source of illumination for all spaces with daylight openings. However, in order to reduce visual discomfort such as glare, shading devices may be provided. Daylight, glare and view-out has been simulated for Room 062 in Building 210 at DTU, Lyngby Campus to examine whether the conditions comply with the standard EN 17037:2018.

Figure 1 | View-out from room 062 in building 210.

Room | Room 062 is analysed as a part of a larger parametric analysis where different shading types and reflectances are applied to the room. In this case, the room is assigned variation 6 which includes the shading type T2 which is a vertical shading system. The view-out from the room without shading can be seen in Figure 1 where the outside distance of the view is more than 50 m.

Requirements

EN 17037:2018

Daylight | Minimum 300 lx on 50% of the relevant floor area for 50% of the daylit hours.

Glare | The daylight glare probability must not exceed the maximum value of 0.45 for more than 5% of the usage time of the space.

View | The view-out must meet the minimum level of recommendation according to Table 1.

Table 1 | Different levels of threshold for glare protection and view-out given in the standard EN 17037:20218.

Visual Comfort	Boundary values for glare Protection	View-out		
Level of recommendation	$DGP_{e<5\%}$	Horizontal sight angle	Outside distance of the view	Number of layers seen from at least 75% of utilized area
Minimum	0.45	≥ 14°	≥ 6 m	At least landscape layer
Medium	0.40	≥ 28°	≥ 20 m	Landscape layer and sky or ground layer
High	0.35	≥ 54°	≥ 50 m	All layers included

Methodology

To simulate the daylight distribution in the room, the software Rhino grasshopper was used while climate studio was used to simulate the glare and view-out for the room. All simulations are based on the same 3D model of the building.

Further, all surfaces (walls, floor, ceiling, window frame, window sill, shading slats, beam, and façade plate) was assigned a reflectance (see Table 2), and the window was assigned a glazing light transmittance of 0.77.

Table 2 | Design input values for the reflectance.

Surface	Reflectance
Floor	30 %
Terrain	20 %
Wall	80 %
Ceiling	90 %
Window Frame	2.5 %
Window Sill	2.5 %
Shading Slat	2.5 %
Beam and Façade Plate*	90 %

* Values assumed.

An analysis plane 0.85 m above the floor was created to evaluate the daylight distribution in the room. Additionally, an annual temporal map was simulated for glare, and five analysis points in different locations in the room were analysed for the view-out as well as glare. This was done for the room both with and without shading.

Results

Daylight Autonomy | The distribution of the daylight in the room on the work plane with shading can be seen in Figure 3. This accounts for 300 lx on 50% of the floor for 58% of the time. Without shading, the daylight autonomy is 90%.

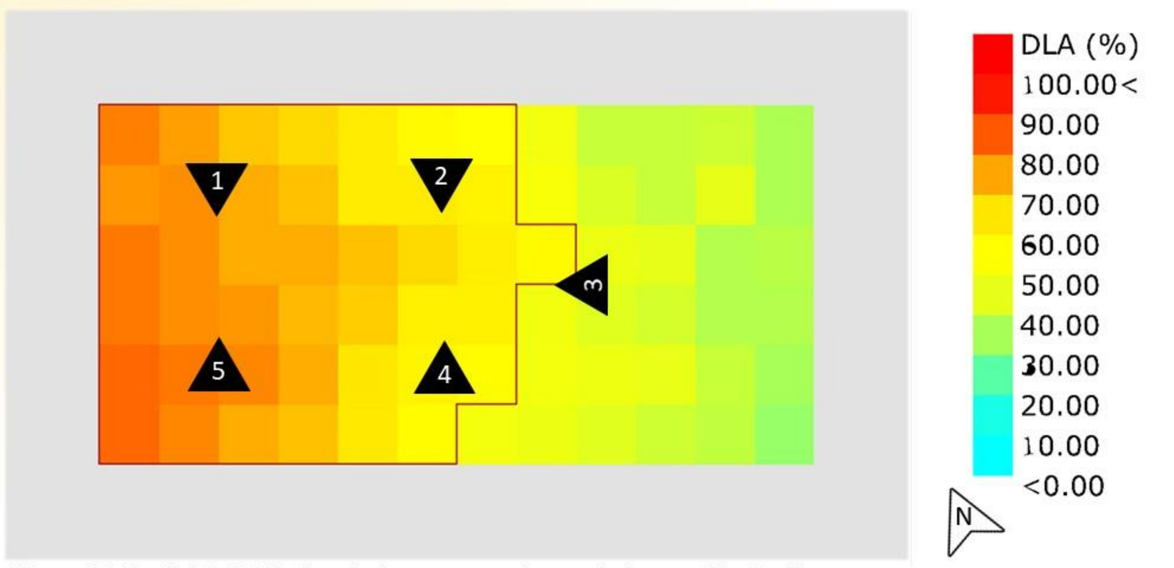

Figure 2 | Daylight distribution in the room on the workplane, with shading.

Glare | The annual temporal glare for the room can be seen in Figure 4, where the day with potentially the most glare is marked. The glare of the room from the five different analysis points can be seen in Figure 5, and their respective DGP can be found in Table 3. The $DGP_{e<5\%}$ for the room with shading is calculated to be 0.36 and 0.53 without shading, presented in figure 7.

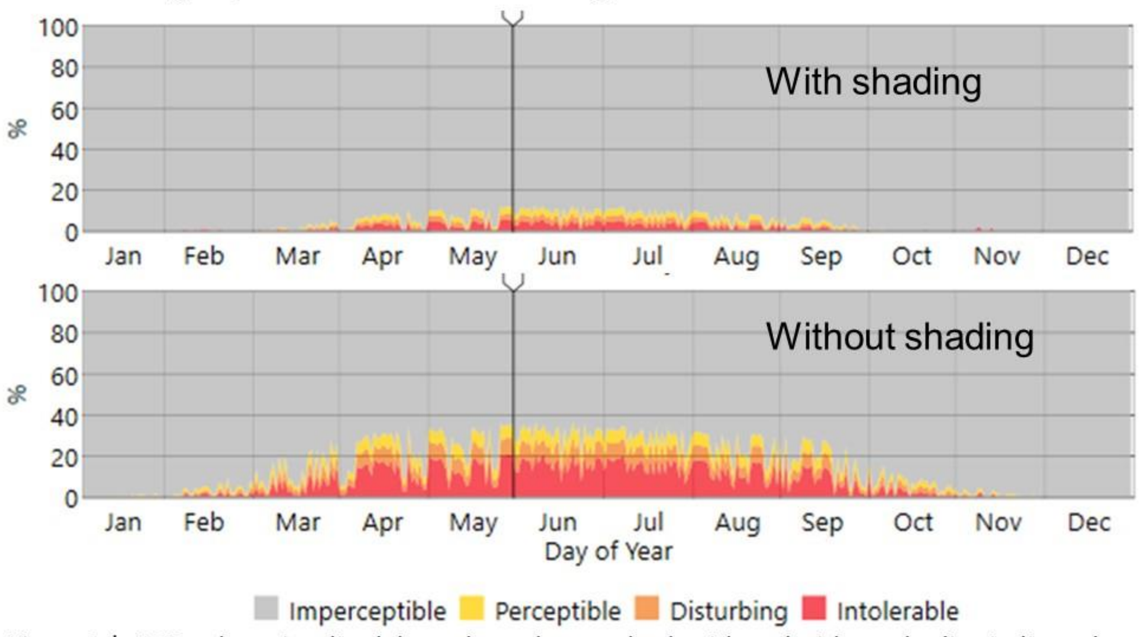

Figure 3 | DGP values visualized throughout the year both with and without shading indicated within four categories (imperceptible, perceptible, disturbing, intolerable).

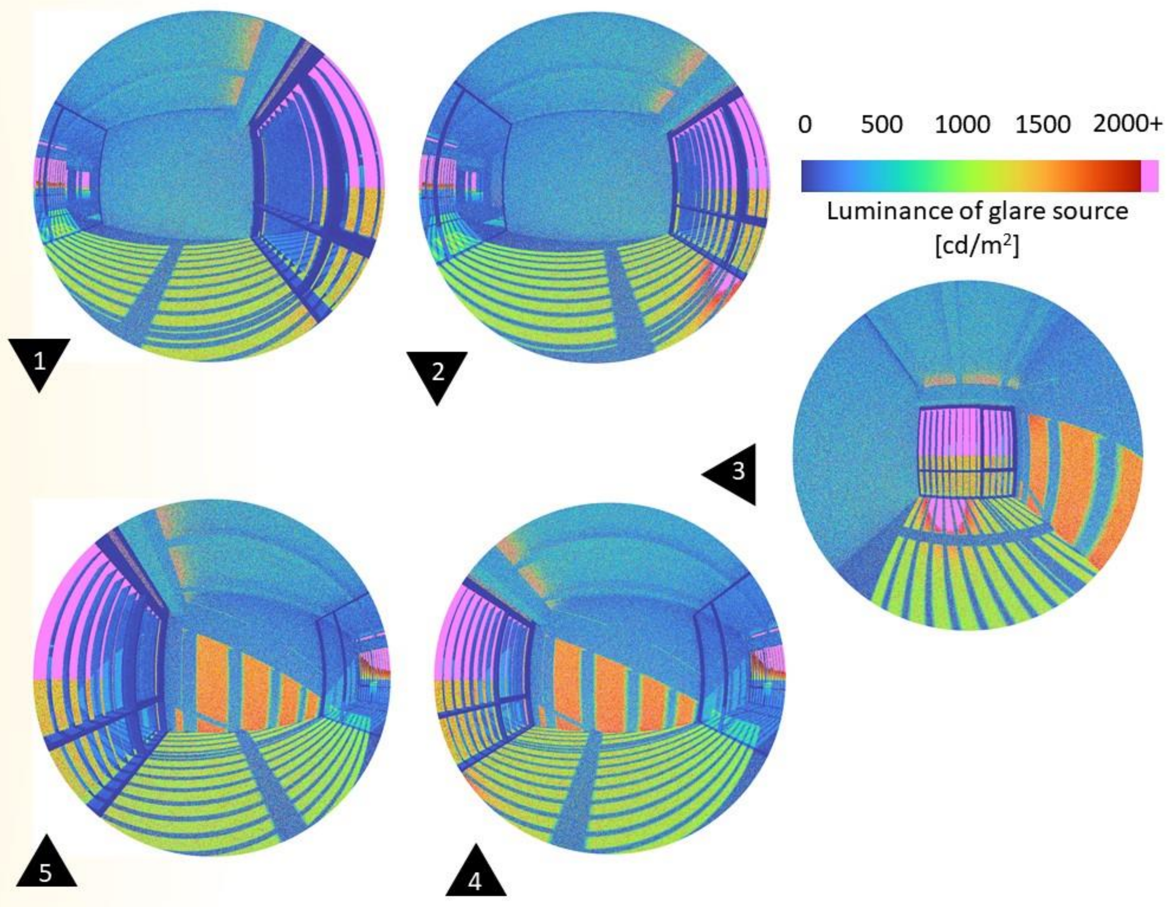

Figure 4 | Fish-eye glare view of 180 degrees from viewpoint 1-5 with shading on 30th of May 17.30. The colours represent the luminance from 0 to 2000 [cd/ m²] and the pink colour is above 2000.

View-out | The horizontal sight angle from the five different analysis points have been analysed by overlaying a Schmidt net onto a 180° fish-eye render of each view in accordance with EN 17037 and can be seen in Table 3. All five view points can see the landscape layer, presented in Table 1, by assessment of Figure 1, and an outside distance of at least 50 m, meeting the required minimum level of recommendation for visual comfort. The shading device only has an effect on the horizontal sight angle due to its vertical appearance.

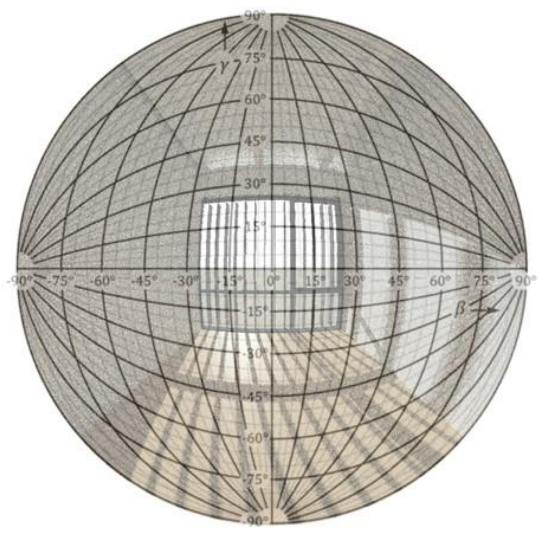

Figure 5 | 180 ° fish-eye render for analysis point 3 with equidistant spherical projection.

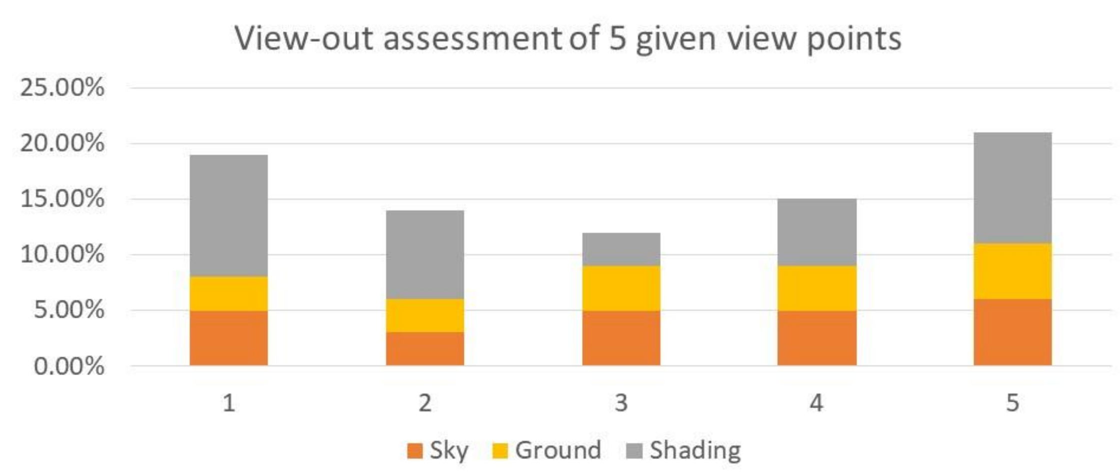

Figure 6 | View-out analysis assessed in the five given analysis points. The view content has been categorized in three categories (sky, ground and shading).

Table 3 | DGP and horizontal sight angle for the different analysis points with and without shading.

Point	DGP		Horizontal sight angle	
	With shading	Without shading	With shading	Without shading
1	0.25	0.34	15	49
2	0.66	0.86	22	40
3	1	1	27	42
4	0.24	0.31	23	43
5	0.24	0.33	22	53

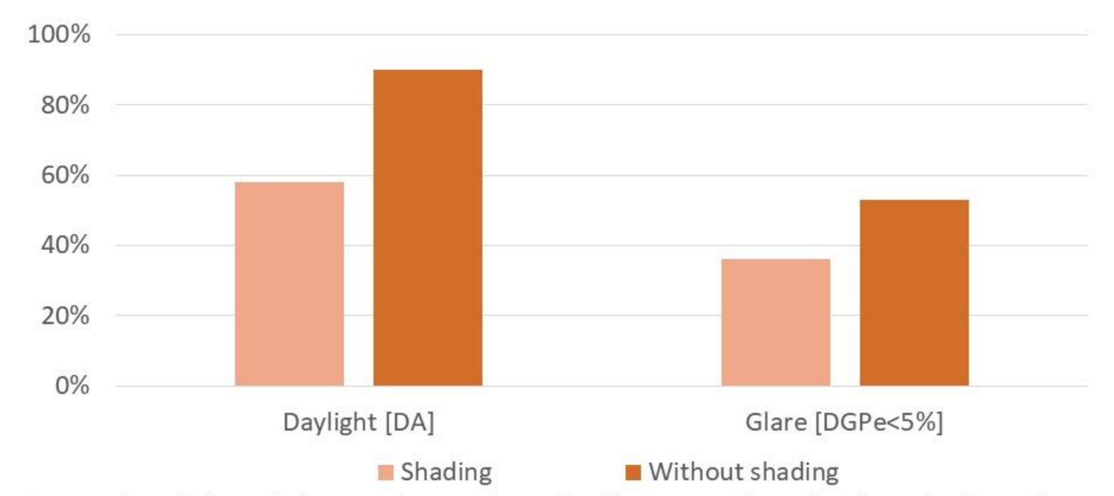

Figure 7 | Daylight and glare results are shown for the room with and without shading. The parameters are not comparable as they represent different measures.

Discussion and Conclusion

The vertical shading system reduces the daylight autonomy with 32% but the room still obtains a sufficient amount of daylight with 300 lx on 50% of the floor area for 58% of the time. However, the daylight glare probability is also reduced in all of the five analysis points except point 3 as the view direction is parallel to the shading.

The view-out assessment shows a decrease of percentage view to the sky and ground with shading, as the shading constitute a large percentage of the view-out. The view-out assessment shows a decrease of percentage view to the sky and ground with shading, as the shading constitute a large percentage of the view-out. It also shows a decrease of horizontal sight angle from each analysis point. This decrease follows that the comfort level for view-out drops from the high end of "medium" to "minimum".

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