Table 2: Proprieties used in the thermal-energy model

Walls	thickness (cm)	Rugosity	Thermal conductivity (W/mK)	Density (Kg/m³)	Specific heat (J/Kg.K)
Solid brick	10,0	Rough	0,9	2900	920
Plaster	2,5 (x2)	Rough	1,15	2500	1000
Walls	U-Value (W/m²K)		Thermal mass (kJ/m²K)		
Brick + Plaster	2,28		168		

The adopted internal shading devices were roller shades, curtains and Venetian blinds. The blinds considered two slat angles (50° and 0°). Each shading device was considered in two proprieties sets, following different transmittance values (τ = 0.1 and 0.50) and reflectance values (ρ = 0.1 and 0.5), as shown in Figure 2. The user behaviours attributed to the shading devices control were two static positions (50% and 100% closed) and four dynamic controls.

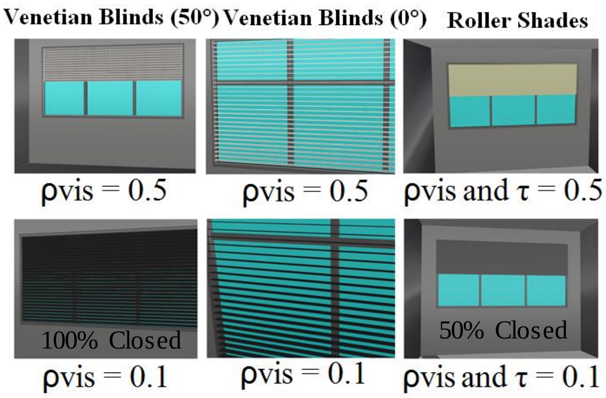

Figure 2: Indoor shading devices and visual proprieties.

The trigger conditions were based on the intolerable daylight glare condition (DGP>45%), as proposed by Wienold and Christoffersen (2006) and the excess direct sunlight incidence (Rad_{direct}>50 W/m²), as proposed by Reinhart (2004) and Bavaresco and Ghisi (2018). The device was lowered considering the automated and daily activation, as Reinhart (2004) proposed in the "*Light-Switch Model*". The daily control retracts the shading device at the beginning of the next occupancy if the condition allows. The automated algorithm retracts the devices since the hourly condition allows.

Building simulation processing

The data acquisition process was established using the modelling on the *Rhinoceros*-3D 5.0 connected to the *Grasshopper* v0.9 plug-in, which allowed to perform the simulation engines used in *DIVA v4* (*Annual Daylight, Radiation Map and Point-in-time Glare*) and *EnergyPlus 8.8* (*Heat balance*).

The horizontal plane with 0.80 m height from the floor and 0.50 m spacing was used in the "*Annual Daylight*" and "*Radiation Map*" functions. They registered the hourly horizontal illuminances (E_h) and when the work plane was hit by direct solar radiation. The "*Point-in-time-Glare*" function was used to perform the annual DGP simulation through a proposed script shown in Figure 3. A vertical plane with 0.5 m diameter was used at the occupant face height to record the vertical illuminance (E_v). In addition, this variable was used to get the DGPs data. The "Ambient bounces" (-ab) was the only *RADIANCE* parameter changed from the default values. That was changed from 2 to 5 to better represent the indoor reflections.

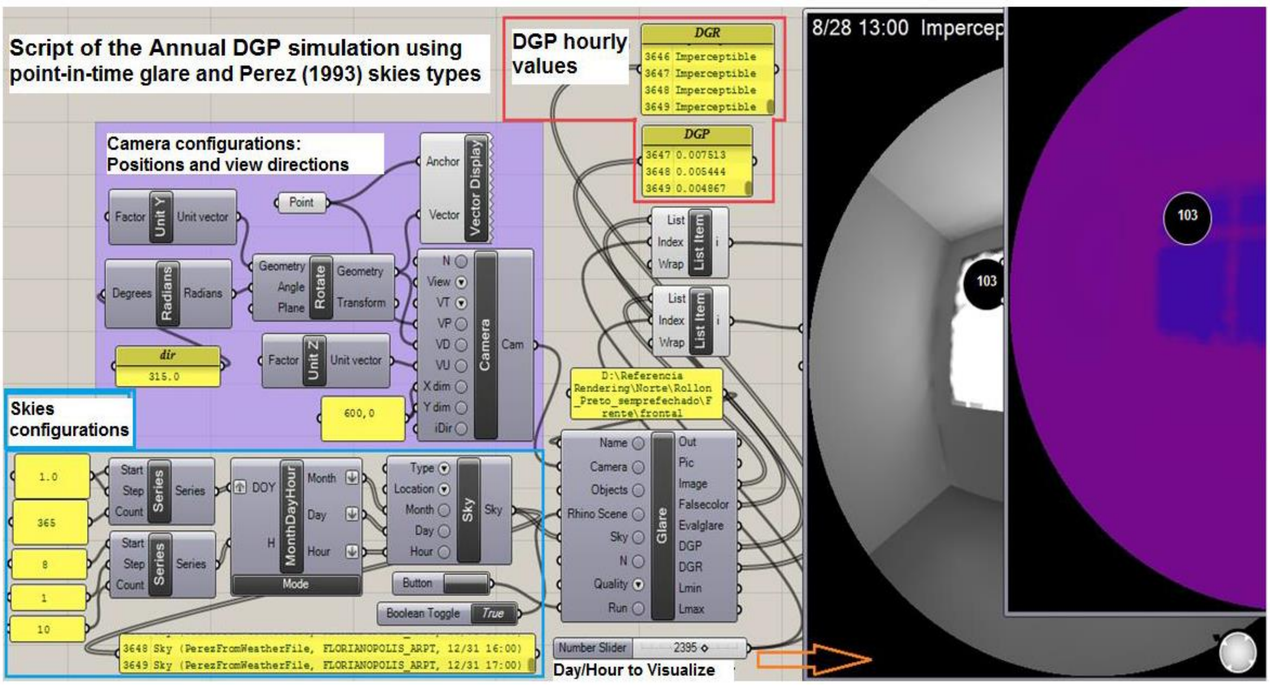

Figure 3: Script generated on Grasshopper v0.9 for Rhinoceros-3D v5.0.

The simulations to obtain the hourly window's solar heat gain (WSHG) and energy cooling demand were performed using the *EnergyPlus 8.8*, proposed by the Department of Energy of the United States (DOE, 2020). The Input Data Files were generated using the ArchSim contained on DIVA package and accessed through the *Grasshopper* plug-in. The details that could not be set on the plug-in were managed on the *EnergyPlus* interface. The energy simulations used the Zone Network Heat balance. To highlight the fenestration influence, floor, ceiling and internal walls were considered adiabatic. The mechanical ventilation of 27 m^3/h and the infiltration rate of 0.5 ach were considered in the thermal zone. A person using a computer involved an internal load rate of 147 W. The artificial lighting of 10.76 W/m^2 was considered when the daylighting was lower than 300 lx. The conditioning system applied the cooling set-point of 26 °C and the heating set-point of 18 °C. The shading devices properties and controls were entered through the "*Window Shade Materials*" and "*Window Shade Control*" objects in the *Input Data Files* (IDF) on the *EnergyPlus* 8.8 interface.

Data analysis

The obtained hourly data through the simulations were transformed into the ratio between controlled (n) and uncontrolled condition (b). These ratios (n/b) were then subjected to linear correlations, as announced in Table 3. Table 3 highlight through the colours the correlations between variables of the same aspects or between different aspects.

Table 3: Performed correlations

DGP(n/b) x Eh(n/b)	DGP(n/b) x WSHG(n/b)
DGP(n/b) x Ev(n/b)	DGP(n/b) x Cooling(n/b)
DGP(n/b) x DGPs(n/b)	DGP(n/b) x Cooling(n/b)
DGPs(n/b) x Eh(n/b)	Cooling(n/b) x Ev(n/b)
Ev(n/b) x Eh(n/b)	WSHG(n/b) x Eh(n/b)
Cooling(n/b) x WSHG(n/b)	Cooling(n/b) x Eh(n/b)
	DGPs(n/b) x WSHG(n/b)

The identified trends and the coefficients of correlation (r) and determination (r^2) were compared and discussed. The r-value represented the strength of the relationship between the two correlated variables. The correlation coefficients were classified according to the strength degree ranges: weak<0.50, 0.50<moderate<0.70, 0.70<strong<0.90 and 0.90<very strong. The r^2 value indicated the quality of the calculation models that generated the analysed data. This determination coefficient showed the percentage of the total variability that was shared between the two correlated variables. The diagram shown in Figure 4 indicates the followed method procedures.

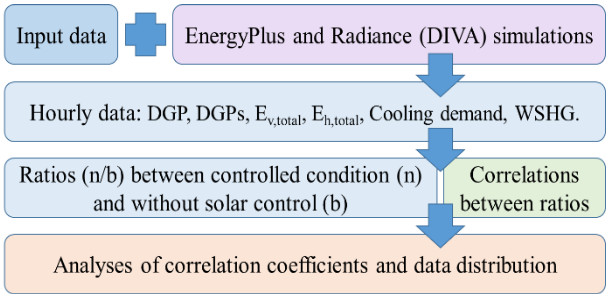

Figure 4: Diagram flow of the research method.

Discussion and result analysis

Table 4 shows the operation time achieved for each dynamic control. From 13 relationships investigated, 05 showed a very strong correlation occurrence (r>0.90) and a very strong determination percentage (r^2>0.90). As shown in Figure 5. These five relationships occurred between the effects on the visual performance criteria: DGP(n/b) x Eh(n/b), DGP(n/b) x Ev(n/b), DGP(n/b) x DGPs(n/b), DGPs(n/b) x Eh(n/b) and Ev(n/b) x Eh(n/b). These correlations indicated that between the visual comfort and daylighting availability criteria the proportions between the controlled conditions and the uncontrolled case were similar and varied proportionally. The high coefficient of determination (r^2>0.90) indicated that the effects' magnitude of the shading devices use on one of these criteria explains the effects' magnitude observed in the other.

Occurrences of very strong and strong relationships predominated through the dynamic controls. (Automated and Daily: $DGP_{intolerable}$ and Rad_{direct}). This indicates that the effects of the shading devices controls according to two different criteria tended to demonstrate proportionality between each other. The static controls (50% and 100%) showed lower values of r and r^2 because, besides contributing less with occurrences of n/b=1 than the dynamic models, there was a wider amplitude of n/b under no excessive conditions. Note that the two automatic controls and the daily Rad_{direct} operated for a shorter time. This indicates that the increase in r and r^2 values in these controls is related to the increase in ratios equal to one (n/b=1).

Dynamic controls outlined occurrences of moderate and strong relationships between the effects of shading devices use on window's solar heat gain (WSHG(n/b)) related to effects on visual performance criteria (DGP(n/b), DGPs(n/b), Eh(n/b), Ev(n/b)). In these relationships, the clearer shading devices (τ=0.5 and ρ=0.5) showed higher values of r and r^2 than the darker ones (τ=0.10 and ρ=0.10). These results showed the integrated behaviour within the luminous and the radiant aspect of daylight and the high heat admission showing visual discomfort conditions.

In general, the blinds 0° reached r and r^2 lower than those achieved by the other shading devices. It indicated that the relationship between the effects of internal shading devices use on visual and thermal energy performance criteria is weaker when the shading device is active but, does not promote window obstruction most of the time.

Table 4: Occupied time with obstructed window considering the dynamic controls

Control	Daily $DGP_{intolerable}$	Automated $DGP_{intolerable}$	Daily Rad_{direct}	Automated Rad_{direct}
North	83%	65%	32%	19%
South	49%	30%	0%	0%
East	96%	54%	69%	11%
West	62%	59%	23%	16%

GENERAL

r

Correlations		100% ■	100% □	50% ■	50% □	Daily DGP ■	Daily DGP □	Auto DGP ■	Auto DGP □	Daily Rad ■	Daily Rad □	Auto Rad ■	Auto Rad □
DGP(n/b) x Eh(n/b)	RS	0.16	0.26	0.02	0.14	1.00	0.94	1.00	0.96	1.00	0.95	1.00	0.95
	B50°	0.47	0.01	0.00	0.59	0.92	0.91	0.97	0.96	0.96	0.95	0.99	0.98
	B0°	0.04	0.26	0.15	0.27	0.68	0.67	0.80	0.75	0.76	0.72	0.78	0.68
DGP(n/b) x Ev(n/b)	RS	0.36	0.43	0.60	0.52	1.00	0.95	1.00	0.97	1.00	0.96	1.00	0.94
	B50°	0.16	0.01	0.60	0.59	0.91	0.91	0.96	0.96	0.95	0.95	0.98	0.98
	B0°	0.34	0.26	0.39	0.27	0.72	0.67	0.79	0.75	0.78	0.72	0.71	0.68
DGP(n/b) x DGPs(n/b)	RS	0.50	0.26	0.69	0.59	0.86	0.85	0.96	0.92	0.92	0.90	0.99	0.92
	B50°	0.08	0.20	0.68	0.67	0.81	0.88	0.96	0.96	0.91	0.94	0.98	0.98
	B0°	0.42	0.35	0.44	0.34	0.67	0.61	0.73	0.68	0.72	0.66	0.71	0.65
DGPs(n/b) x Eh(n/b)	RS	0.06	0.31	0.14	0.06	0.89	0.86	0.97	0.94	0.94	0.91	0.99	0.92
	B50°	0.11	0.14	0.19	0.89	0.88	0.88	0.97	0.97	0.93	0.94	0.99	0.99
	B0°	0.08	0.94	0.04	0.94	0.57	0.94	0.70	0.98	0.64	0.97	0.69	1.00
Ev(n/b) x Eh(n/b)	RS	0.30	0.25	0.20	0.09	1.00	0.94	1.00	0.96	1.00	0.95	1.00	0.94
	B50°	0.36	1.00	0.18	1.00	0.99	1.00	0.99	1.00	0.99	1.00	1.00	1.00
	B0°	0.00	1.00	0.01	1.00	0.74	1.00	0.81	1.00	0.77	1.00	0.73	1.00
Cooling(n/b) x WSHG(n/b)	RS	0.08	0.01	0.05	0.05	0.05	0.16	0.08	0.01	0.25	0.29	0.28	0.07
	B50°	0.01	0.01	0.03	0.05	0.04	0.07	0.03	0.14	0.20	0.17	0.28	0.22
	B0°	0.00	0.01	0.04	0.05	0.05	0.05	0.09	0.09	0.31	0.22	0.34	0.38
WSHG(n/b) x Ev(n/b)	RS	0.09	0.02	0.01	0.01	0.46	0.78	0.68	0.84	0.62	0.82	0.52	0.71
	B50°	0.05	0.12	0.00	0.09	0.32	0.58	0.23	0.73	0.73	0.45	0.37	0.64
	B0°	0.33	0.06	0.02	0.03	0.42	0.67	0.59	0.74	0.56	0.72	0.46	0.64
Cooling(n/b) x Ev(n/b)	RS	0.12	0.03	0.10	0.13	0.07	0.19	0.11	0.05	0.39	0.31	0.59	0.01
	B50°	0.01	0.02	0.06	0.14	0.07	0.08	0.07	0.18	0.43	0.22	0.65	0.48
	B0°	0.02	0.01	0.03	0.03	0.08	0.05	0.11	0.08	0.46	0.27	0.52	0.36
DGP(n/b) x WSHG(n/b)	RS	0.04	0.07	0.07	0.15	0.46	0.77	0.68	0.84	0.62	0.82	0.52	0.71
	B50°	0.20	0.29	0.09	0.12	0.33	0.64	0.46	0.73	0.46	0.73	0.36	0.63
	B0°	0.10	0.30	0.08	0.21	0.38	0.59	0.59	0.74	0.54	0.70	0.48	0.68
DGP(n/b) x Cooling(n/b)	RS	0.03	0.13	0.12	0.11	0.06	0.14	0.11	0.04	0.36	0.27	0.58	0.01
	B50°	0.01	0.01	0.16	0.15	0.06	0.02	0.13	0.19	0.43	0.29	0.64	0.48
	B0°	0.03	0.02	0.07	0.03	0.08	0.06	0.10	0.08	0.51	0.32	0.57	0.39
WSHG(n/b) x Eh(n/b)	RS	0.01	0.03	0.01	0.03	0.46	0.79	0.68	0.85	0.62	0.83	0.52	0.74
	B50°	0.11	0.12	0.00	0.08	0.33	0.65	0.47	0.73	0.46	0.73	0.37	0.64
	B0°	0.01	0.06	0.01	0.02	0.50	0.67	0.65	0.74	0.62	0.72	0.45	0.64
Cooling(n/b) x Eh(n/b)	RS	0.00	0.08	0.00	0.01	0.07	0.19	0.11	0.06	0.39	0.30	0.59	0.05
	B50°	0.01	0.02	0.00	0.14	0.08	0.08	0.12	0.18	0.45	0.22	0.65	0.48
	B0°	0.00	0.01	0.01	0.03	0.07	0.05	0.11	0.08	0.38	0.27	0.51	0.36
DGPs(n/b) x WSHG(n/b)	RS	0.05	0.12	0.05	0.09	0.40	0.68	0.65	0.80	0.58	0.76	0.51	0.69
	B50°	0.13	0.20	0.06	0.06	0.25	0.54	0.44	0.71	0.42	0.69	0.36	0.63
	B0°	0.09	0.21	0.06	0.13	0.31	0.49	0.52	0.64	0.47	0.59	0.44	0.61

r^2

Correlations		100% ■	100% □	50% ■	50% □	Daily DGP ■	Daily DGP □	Auto DGP ■	Auto DGP □	Daily Rad ■	Daily Rad □	Auto Rad ■	Auto Rad □
DGP(n/b) x Eh(n/b)	RS	0.02	0.07	0.00	0.02	0.99	0.88	0.99	0.92	0.99	0.91	1.00	0.90
	B50°	0.23	0.00	0.00	0.35	0.85	0.83	0.94	0.93	0.93	0.90	0.97	0.97
	B0°	0.00	0.07	0.02	0.07	0.46	0.44	0.64	0.56	0.58	0.52	0.61	0.47
DGP(n/b) x Ev(n/b)	RS	0.13	0.18	0.36	0.27	0.99	0.90	1.00	0.94	1.00	0.93	1.00	0.88
	B50°	0.03	0.00	0.36	0.35	0.82	0.83	0.92	0.93	0.91	0.90	0.97	0.97
	B0°	0.11	0.07	0.15	0.07	0.52	0.44	0.63	0.56	0.60	0.52	0.50	0.47
DGP(n/b) x DGPs(n/b)	RS	0.25	0.07	0.47	0.34	0.75	0.73	0.92	0.84	0.85	0.80	0.98	0.84
	B50°	0.01	0.04	0.47	0.45	0.65	0.78	0.92	0.92	0.82	0.88	0.97	0.96
	B0°	0.18	0.12	0.20	0.12	0.45	0.38	0.54	0.46	0.52	0.44	0.51	0.42
DGPs(n/b) x Eh(n/b)	RS	0.00	0.09	0.02	0.00	0.79	0.74	0.94	0.88	0.88	0.82	0.98	0.84
	B50°	0.01	0.02	0.04	0.79	0.78	0.78	0.93	0.94	0.87	0.88	0.98	0.99
	B0°	0.01	0.87	0.00	0.88	0.32	0.88	0.49	0.95	0.41	0.94	0.48	0.99
Ev(n/b) x Eh(n/b)	RS	0.09	0.06	0.04	0.01	1.00	0.89	1.00	0.92	1.00	0.91	1.00	0.89
	B50°	0.13	1.00	0.03	1.00	0.98	1.00	0.99	1.00	0.99	1.00	0.99	1.00
	B0°	0.00	1.00	0.00	1.00	0.55	1.00	0.65	1.00	0.59	1.00	0.53	1.00
Cooling(n/b) x WSHG(n/b)	RS	0.01	0.00	0.00	0.00	0.00	0.03	0.01	0.00	0.06	0.09	0.08	0.00
	B50°	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.02	0.04	0.03	0.08	0.05
	B0°	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.10	0.05	0.12	0.15
WSHG(n/b) x Ev(n/b)	RS	0.01	0.00	0.00	0.00	0.21	0.61	0.46	0.70	0.39	0.68	0.27	0.50
	B50°	0.00	0.01	0.00	0.01	0.10	0.33	0.05	0.53	0.53	0.21	0.14	0.41
	B0°	0.11	0.00	0.00	0.00	0.18	0.45	0.35	0.55	0.31	0.51	0.21	0.41
Cooling(n/b) x Ev(n/b)	RS	0.01	0.00	0.01	0.02	0.00	0.04	0.01	0.00	0.15	0.09	0.35	0.00
	B50°	0.00	0.00	0.00	0.02	0.01	0.01	0.00	0.03	0.19	0.05	0.42	0.23
	B0°	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.01	0.21	0.07	0.27	0.13
DGP(n/b) x WSHG(n/b)	RS	0.00	0.01	0.00	0.02	0.21	0.59	0.46	0.70	0.39	0.67	0.27	0.51
	B50°	0.04	0.09	0.01	0.02	0.11	0.41	0.21	0.54	0.21	0.53	0.13	0.40
	B0°	0.01	0.09	0.01	0.04	0.14	0.35	0.35	0.55	0.30	0.49	0.23	0.46
DGP(n/b) x Cooling(n/b)	RS	0.00	0.02	0.01	0.01	0.00	0.02	0.01	0.00	0.13	0.07	0.33	0.00
	B50°	0.00	0.00	0.03	0.02	0.00	0.00	0.02	0.04	0.19	0.08	0.41	0.23
	B0°	0.00	0.00	0.01	0.00	0.01	0.00	0.01	0.01	0.26	0.10	0.33	0.15
WSHG(n/b) x Eh(n/b)	RS	0.00	0.00	0.00	0.00	0.21	0.62	0.46	0.71	0.39	0.69	0.27	0.55
	B50°	0.01	0.01	0.00	0.01	0.11	0.42	0.22	0.53	0.21	0.53	0.14	0.41
	B0°	0.00	0.00	0.00	0.00	0.25	0.45	0.43	0.55	0.39	0.51	0.20	0.41
Cooling(n/b) x Eh(n/b)	RS	0.00	0.01	0.00	0.00	0.00	0.04	0.01	0.00	0.15	0.09	0.35	0.00
	B50°	0.00	0.00	0.00	0.02	0.01	0.01	0.02	0.03	0.20	0.05	0.43	0.23
	B0°	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.14	0.07	0.26	0.13
DGPs(n/b) x WSHG(n/b)	RS	0.00	0.01	0.00	0.01	0.16	0.47	0.42	0.64	0.34	0.58	0.27	0.47
	B50°	0.02	0.04	0.00	0.00	0.06	0.30	0.19	0.50	0.18	0.47	0.13	0.39
	B0°	0.01	0.05	0.00	0.02	0.10	0.24	0.27	0.41	0.22	0.35	0.19	0.37

Note: 0.00 = <0.01 / 1 = >0.99 | Weak degree | Moderate degree | Strong degree | Very strong degree | RS: Roller Shades / B: Blinds

Figure 5: Coefficients of correlation (r) and determination (r^2) classified by the relationship strength.

The effects of shading devices use on the window's solar heat gain (WSHG(n/b)) was not significantly related to the effects observed on the cooling energy demand (Cooling(n/b)). Both from *EnergyPlus* thermal-energy simulations showed that the magnitude of changes in WSHG did not follow the amplitude effects on the cooling energy demand.

Under direct solar radiation control, some correlations between the shading devices effects on the energy cooling demand and the visual performance criteria indicated moderate strength.

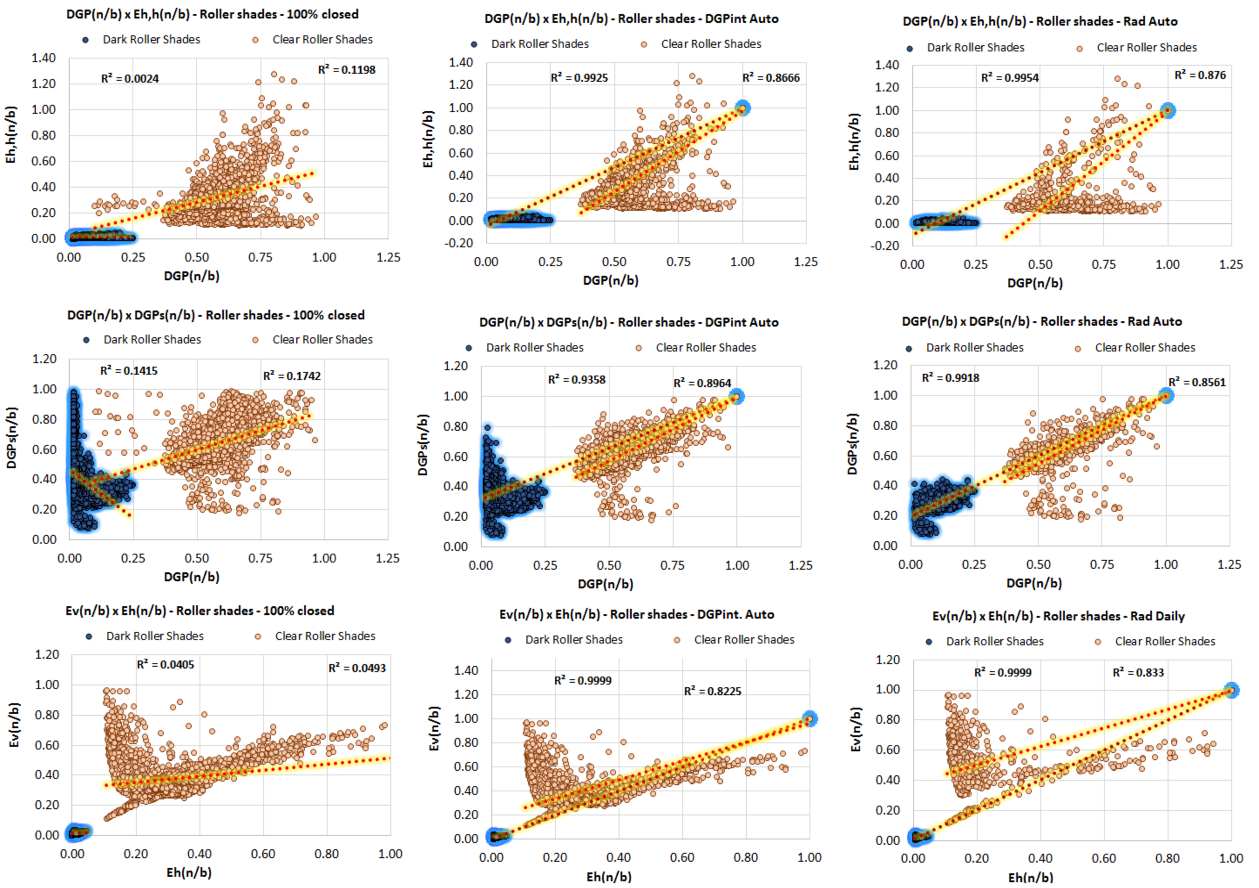

Figure 6: Data distribution on the correlations between visual performance variables, considering roller shades.

Even the visual performance variables achieving strong relationship, as shown in Figure 6, the data distribution of the clear shading devices presented higher dispersion. The dark roller shades reduced the DGP to a quarter or less, of the uncontrolled condition, but the clear roller shades still allowed visual discomfort condition near the uncontrolled condition.

Figure 6 shows the lower coefficients of correlation reached by the always 100% closed mode. In addition, it showed the higher coefficients when using the $DGP_{intolerable}$ and Rad_{direct} controls, due to the occurrences of n/b=1. Considering the window always fully obstructed by a shading device with high transmittance indicated that the effects between the visual criteria achieved low correspondence.

Figure 7 shows that there is no clear trend in the correlation between DGP(n/b) and WSHG(n/b), even achieving moderate and strong r^2 values. It was showed a large range of DGP reduction.

The WSHG kept reducing around 40% using the clear roller shades and less using the dark roller shades. Considering the direct sunlight control operating the dark roller shades, controlled conditions indicated higher WSHG than the no solar control condition. However, the dark roller shades also demonstrated occurrences of WSHG reduction to zero when blocking the direct sunlight.

Figure 8 shows the low correspondence between the shading devices effects observed on the cooling demand and the WSHG correlation, regardless of the applied device. However, using the roller shades were indicated two different tendency line. Even though, a large range of cooling demand variation was linked to a short range of WSHG variation. The dark shading devices increased the cooling demand up to the double than the clear ones. The clear shading devices showed higher WSHG and cooling demand reduction, showing that their proprieties worked better against the overheating and energy consumption.

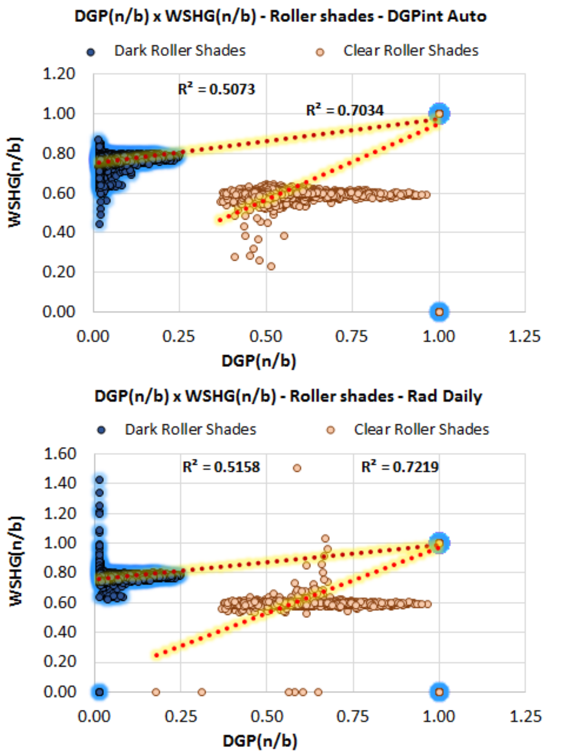

Figure 7: Roller shades effects on DGP and WSHG operated by automated $DGP_{intolerable}$ and daily Rad_{direct}.

The only one tested location was an imporant study limitation. Future simulations should compare the difference obtained from several latitudes. The type and proprieties considered to the internal shading devices also limited the research and the parametric guidelines. More view directions should be considered in further simulations to build guidelines giving more options for indoor design. The parallel to the window (90°) and the diagonal to the window (45°) are suggestions that will be strongly important in technical standards.

Conclusion

The paper focused on the understanding of relationships between metrics applied in the visual and thermal-energy performance prediction considering office buildings with internal shading devices operated by different occupant behaviours. This study showed correspondences between the effects of shading devices controls on the daylight glare probability, daylighting availability, window's solar heat gain and energy cooling demand. It was performed annual simulations and the hourly variables were transformed into ratios (n/b) of controlled (n) and uncontrolled conditions (b). The correlations between these ratios aimed to show the significance strength between the variables and the trend that they follow.

From the thirteen analysed relationships, the correlations between the visual performance criteria (05) presented occurrences of "very strong" correlation level (r>0.90) and "very strong" coefficient of determination (r^2>0.90). The correlations between visual performance criteria and WSHG presented occurrences of moderate (>0.50) and strong (>0.70) coefficients (r and r^2).

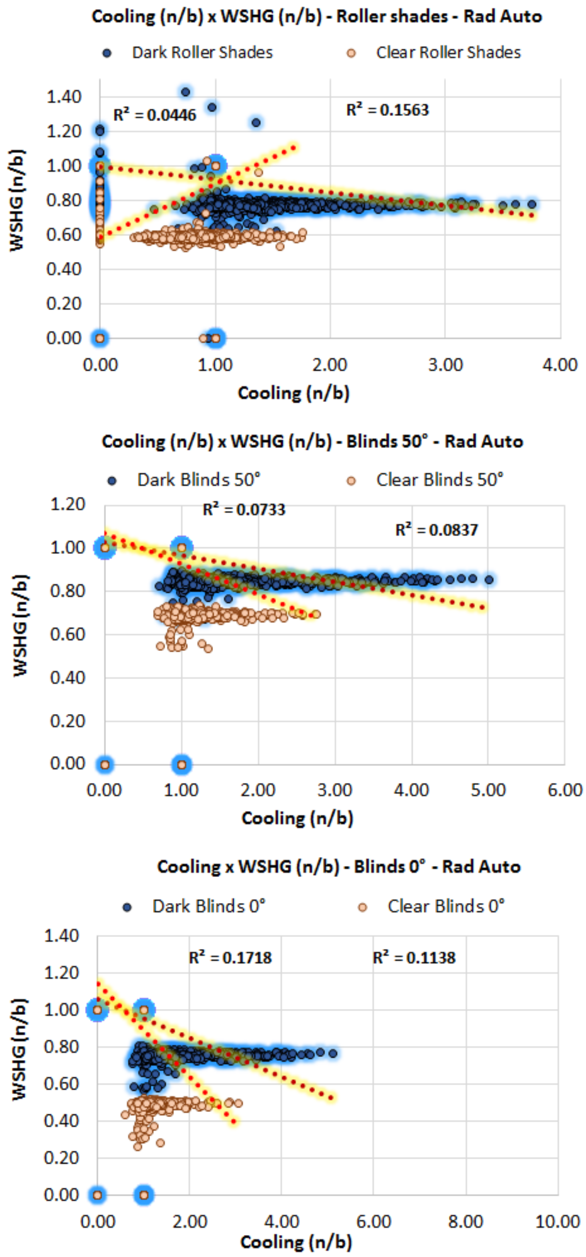

Figure 8: Correlations between the shading devices effects on the cooling energy demand and window's solar heat gain, using the Rad_{direct} automated control.

The variability obtained through the correlation between the cooling energy demand and the WSHG showed the lower correspondence level. The correspondence between thermal-energy performance metrics did not follow linear models due to the heat balance delay between the solar heat admission and the need to cool the indoor air. Therefore, future studies should use the metrics ratios following different correlation model.

Occurrences of "very strong" and "strong" (>0.70) relationships predominated through the automated and daily controls considering the $DGP_{intolerable}$ and the direct sunlight (>50W/m²). The roller shades and Venetian blinds considered in two proprieties sets indicated better correspondence to the higher transmittance and reflectance values (0.50).

The dark shading devices presented lower WSHG reduction and higher cooling demand raise. However, the clear roller shades and clear blinds 0º still allowed visual discomfort conditions when fully activated. Considering the tested proprieties, further researches should focus to find the balance between visual comfort protection and daylighting availability softly raising the transmittance.

The further researches should recommend the user behaviour related to the DGP higher than 45% and the incident solar radiation lower than 50 W/m^2 to balance these two triggers. In addition, the control model based on the direct solar incidence should be considered in the vertical plane at eye's level. The future application of parametric guidelines needs to involve several locations, more view directions and a wider range of shading devices proprieties.

References

Bavaresco, M. V.; Ghisi, E. (2018). Influence of user interaction with internal blinds on the energy efficiency of office buildings. *Energy and Buildings*, 166, p.538-549.

Department of Energy of United States, DOE (2020). EnergyPlus Weather Data. Available in: https://energyplus.net/weather . Access: 14 May 2020.

Perez, R.; Seals, R.; Michalsky, J. (1993). All-weather model for sky luminance distribution-Preliminary configuration and validation. *Solar Energy*, 50(3), p. 235–245.

Reinhart, C. F.; Jakubiec, J. A.; Ibarra, D. (2013). Definition of a reference office for standardized evaluations of dynamic façade and lighting technologies. *13th Conference of IBPSA*, p. 3645–3652.

Reinhart, C. F. (2004). Lightswitch-2002: A model for manual and automated control of electric lighting and blinds. *Solar Energy*, v. 77, n. 1, p. 15–28.

Wienold, J.; Christoffersen, J. Evaluation methods and development of a new glare prediction model for daylight environments with the use of CCD cameras. *Energy and Buildings*, 38(7), p. 743–757.

Van Den Wymelenberg, K. (2014) Visual Comfort, Discomfort Glare, and Occupant Fenestration Control: Developing a Research Agenda, LEUKOS: *The Journal of the Illuminating Engineering Society of North America*, 10(4), 207-221.

Van Den Wymelenberg, K. (2012). Patterns of occupant interaction with window blinds: A literature review. *Energy and Buildings*, 51, p. 165–176.