Visual comfort with side-lit at restaurants under sunny climate

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2018 International Radiance Workshop: 3-5 September Loughborough University, UK

Introduction

Glare simulation: DGP

CBDM simulation: DA

Case study: restaurant

Conclusions

COMPLEX SCENES to achive heterogeneity and dynamism:

· Light **perception and** light **level**

· **Type of planes** and **transition** planes

· **Regulating attention** increasing the efficiency

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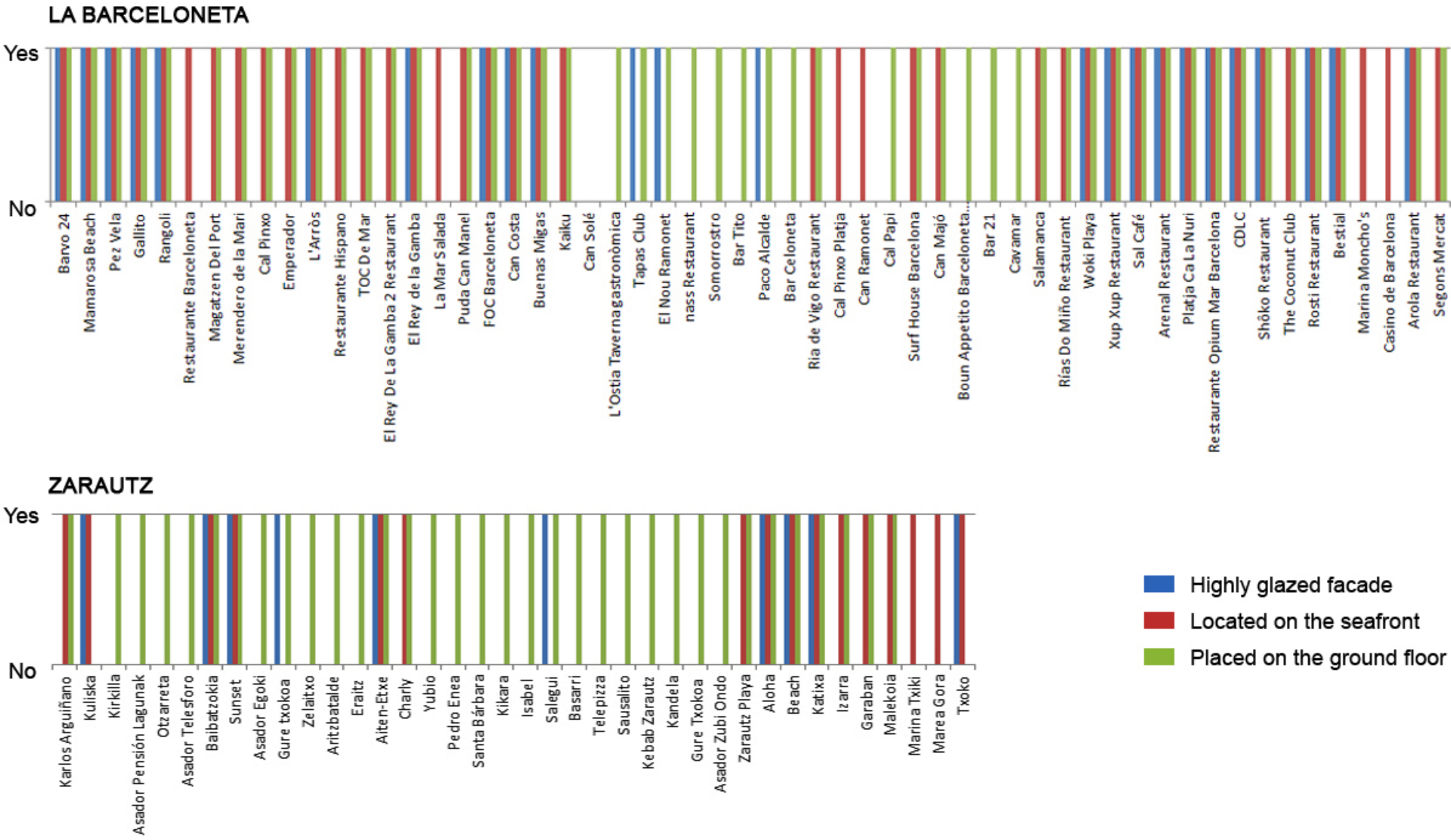
· There are some problems to control properly daylight

· Especially an activity with needs a considerable time.


EL REY DE LA GAMBA


LA BARCELONETA
Yes
No
Barvo 24
Mamarosa Beach
Pez Vela
Gallito
Rangoli
Restaurante Barceloneta
Magatzen Del Port
Merendero de la Mari
Cal Pinxo
Emperador
L'Arròs
Restaurante Hispano
TOC De Mar
El Rey De La Gamba 2 Restaurant
El Rey de la Gamba
La Mar Salada
Puda Can Manel
FOC Barceloneta
Can Costa
Buenas Migas
Kaiku
Can Solé
L'Ostia Tavernagastronòmica
Tapas Club
El Nou Ramonet
nass Restaurant
Somorrostro
Bar Tito
Paco Alcalde
Bar Celoneta
Ria de Vigo Restaurant
Cal Pinxo Platja
Can Ramonet
Cal Papi
Surf House Barcelona
Can Majó
Boun Appetito Barceloneta...
Bar 21
Cavamar
Salamanca
Rías Do Miño Restaurant
Woki Playa
Xup Xup Restaurant
Sal Café
Arenal Restaurant
Platja Ca La Nuri
Restaurante Opium Mar Barcelona
CDLC
Shôko Restaurant
The Coconut Club
Rosti Restaurant
Bestial
Marina Moncho's
Casino de Barcelona
Arola Restaurant
Segons Mercat
ZARAUTZ
Yes
No
Karlos Arguiñano
Kuliska
Kirkilla
Asador Pensión Lagunak
Otzarreta
Asador Telesforo
Baibatzokia
Sunset
Asador Egoki
Gure txokoa
Zelaitxo
Aritzbatalde
Eraitz
Aiten-Etxe
Charly
Yubio
Pedro Enea
Santa Bárbara
Kikara
Isabel
Salegui
Basarri
Telepizza
Sausalito
Kebab Zarautz
Kandela
Gure Txokoa
Asador Zubi Ondo
Zarautz Playa
Aloha
Beach
Katixa
Izarra
Garaban
Malekoia
Marina Txiki
Marea Gora
Txoko
Highly glazed facade
Located on the seafront
Placed on the ground floor

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Therefore, according the assessment of restaurants at **Barcelona:**

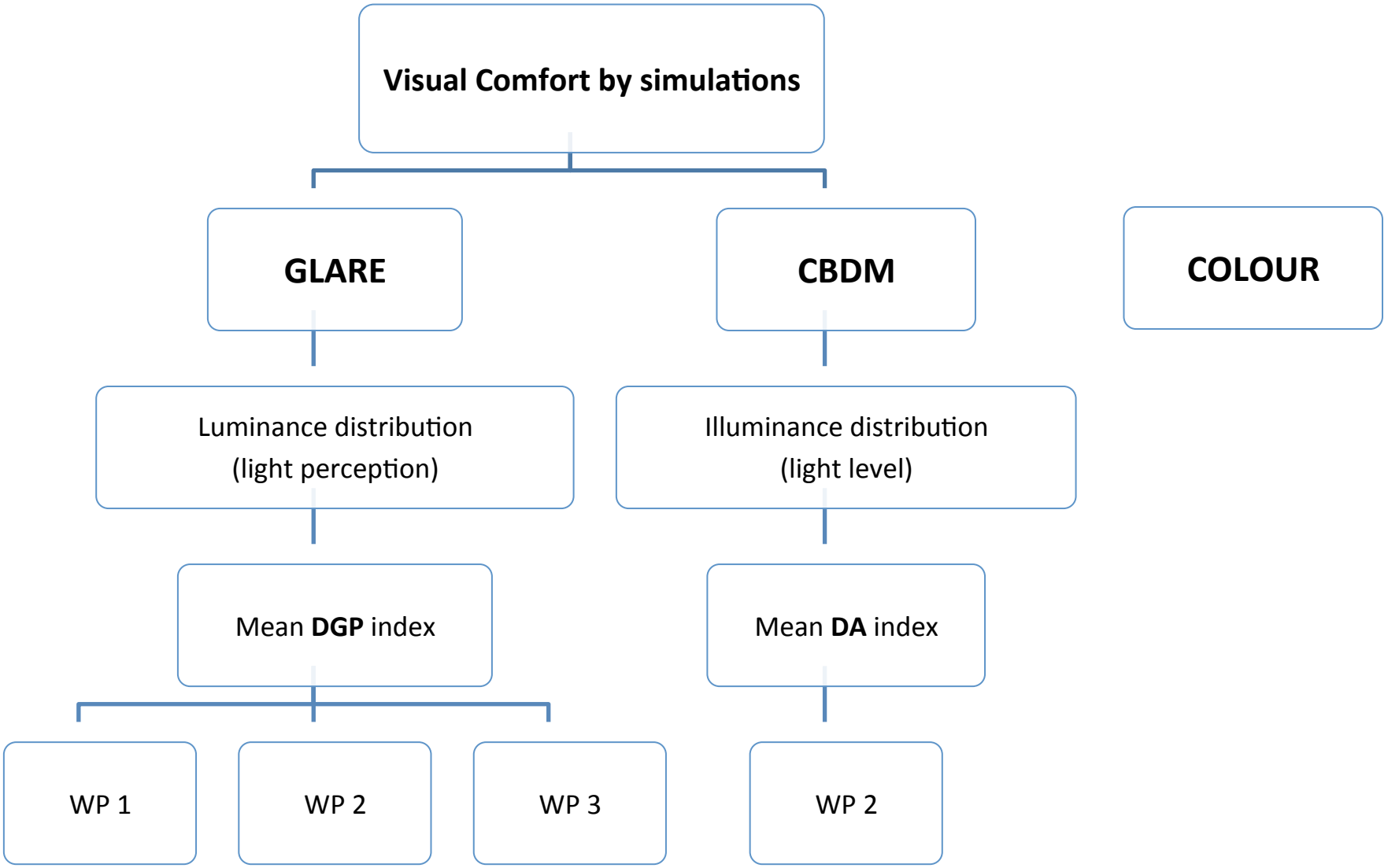
· **56 restaurants** were studied in Barcelona (Spain)

· Almost all cases (**93%**) have a window with **outside views**

· Almost half cases (**43%**) have **highly glazed façade**

· Almost all **new or retrofit cases** (**94%**) have **highly glazed façade**

I would continue to test if daylight simulations will be interesting tool for hotel industry and tourism as restaurants to help light designing aspects and to achieve some performance results to prevision the effects of the proposed design


Visual Comfort by simulations
GLARE
CBDM
COLOUR
Luminance distribution
(light perception)
Illuminance distribution
(light level)
Mean DGP index
Mean DA index
WP 1
WP 2
WP 3
WP 2

Glare simulation: DGP

· DGP index are calculated by **Evalglare**, tool for performing a glare analysis of a Radiance-based HDR scene.

· This tool needs **HDR picture** with **fisheye projection** and **incoming illuminance** data of the picture.

· DGP works mostly with **indoors**, especially when; a specific **rating of luminance** and there is **contrast between glare source and background**; **incoming illuminance is higher than 380 lx**; and the **sun luminance is calibrated**. The used formula for DGP:

· Where:

Ev, vertical eye illuminance (lux)
Ls, luminance of source (cd/m2)
ws, solid angle of source (-)
P, position index (-)
c1= 5.87·10^-5; c2= 9.18·10^-2; c3= 0.16; a1=1.87

· Possible scaling

Imperceptible,	DGP ≤ 0.35 (35%)
Perceptible,	0.35 (35%) < DGP ≤ 0.40 (40%)
Disturbing,	0.40 (40%) < DGP ≤ 0.45 (45%)
Intolerable,	DGP > 0.45 (45%)

Source: Wienold J.

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Glare simulation: DGP

· **Doubts** to assess **highly glazed façade** and glaring **outdoor plane contribution**. However, it is considered that outdoor view is relevant as transition plane especially for **attention quality, as rest and break away**.

· We would like to attempt to describe the complex light scene next to highly glazed façade; **when you view toward to outdoor what happen with overall scene**.

· So, we have detected **different workplanes** . Usually three relevant workplanes:

· Toward to task "SOURCE" visual field = **Work Plane** (table)

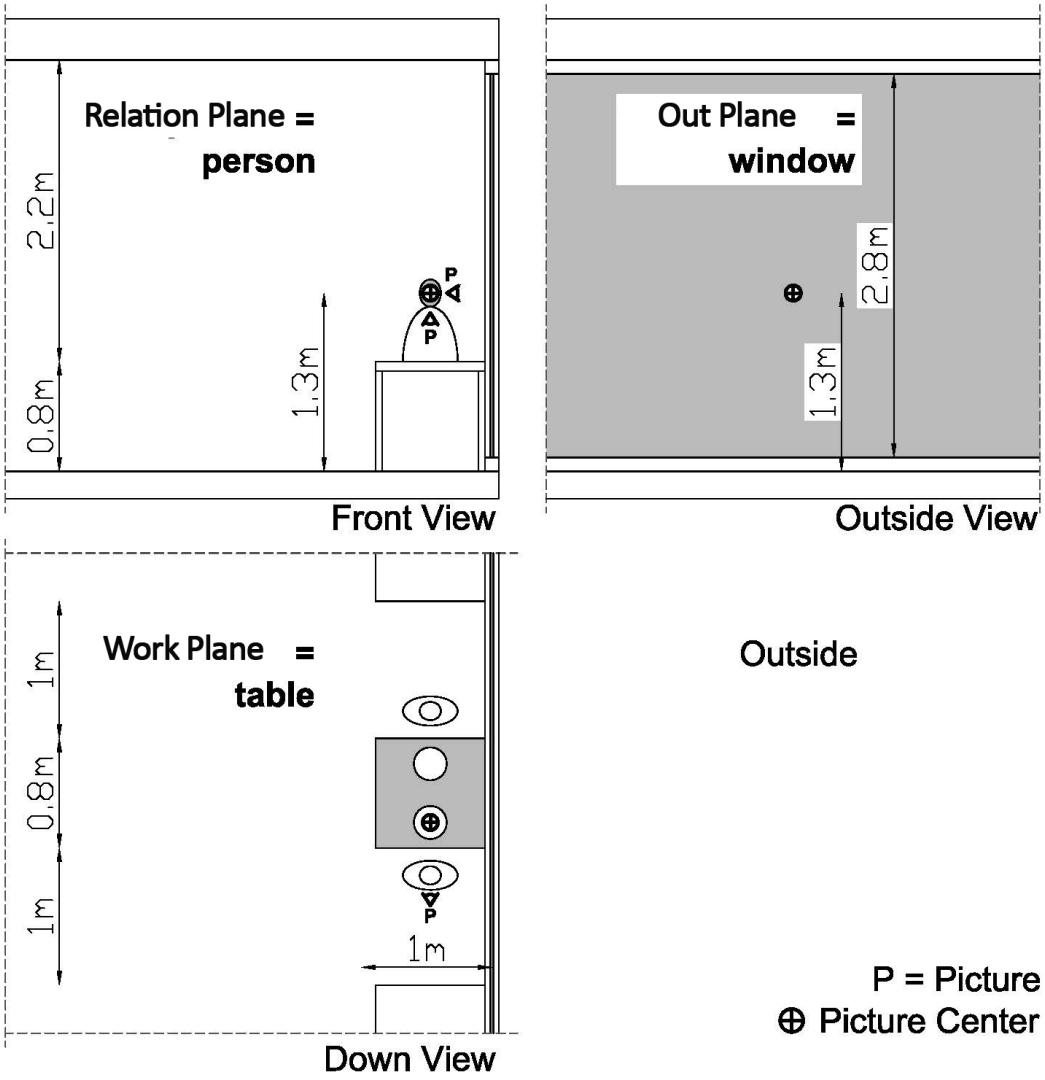
· Toward to around "BACKGROUND" visual field = **Relation Plane** (person)

· Toward to far "OUT" visual field = **Out Plane** (window)

· Mean DGP is calculated by the mean between the DGP of WP 1, WP 2 and WP 3:

$$Mean\ DGP = (\ [\![DGP]\!]\_WP1 + [\![DGP]\!]\_WP2 + [\![DGP]\!]\_WP3)/3$$

Glare simulation: DGP



Depending the **time** and **accuracy of attention** the plane could be different.

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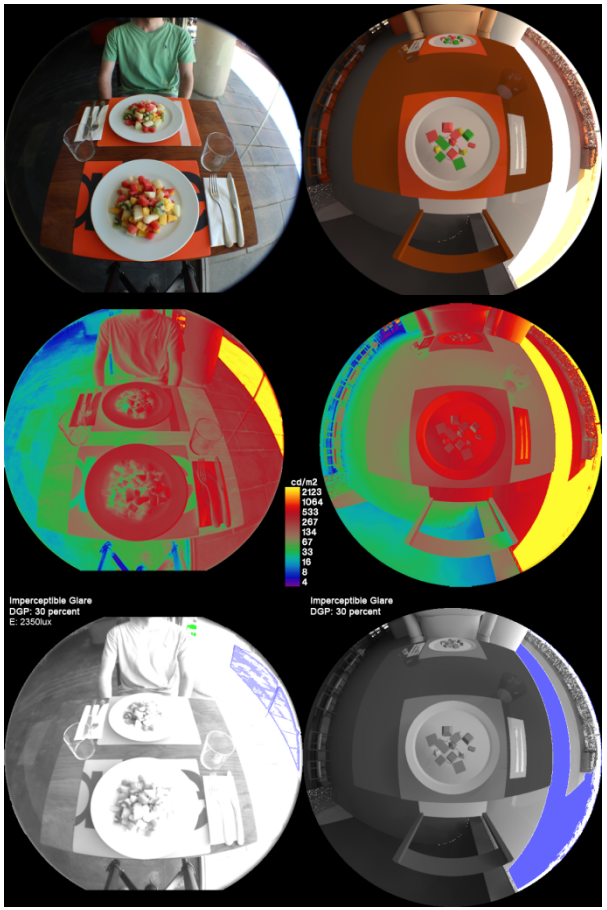
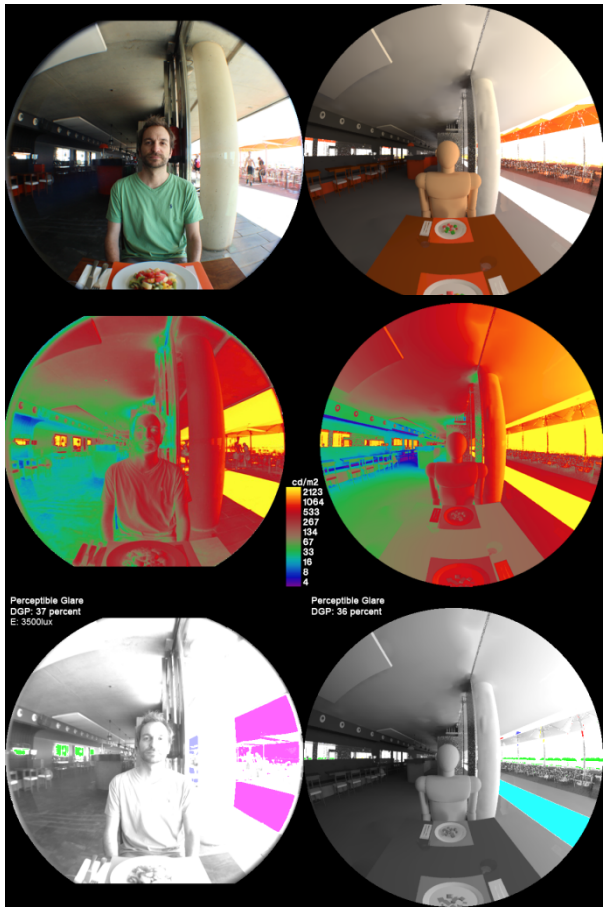
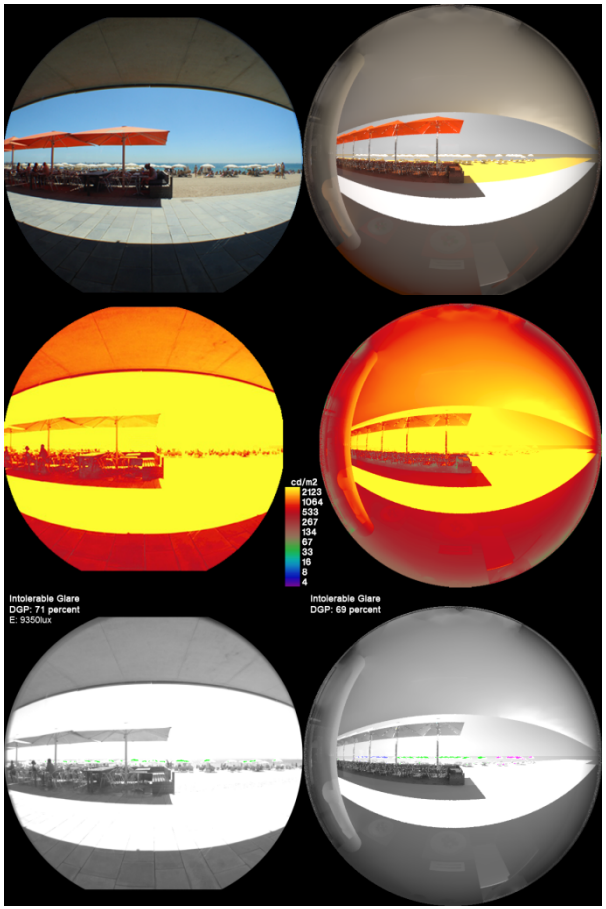
Glare simulation: DGP

Comparison of real photographs and visualisations owing to calibrate the simulation:







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Glare simulation: DGP

Scripts of Evalglare program by Linux Ubuntu 14.04:

To obtain DGP index:

```
$ evalglare –i 2350 *res1_wp1_nf.hdr > *res1_wp1_nf.glr
```

To obtain glare source image:

```
$ evalglare –c *res1_wp1_nf_gs.pic *res1_wp1_nf.hdr
```

```
$ ra_tiff *res1_wp1_nf_gs-pfilt.pic *res1_wp1_nf_gs-pfilt.tif
```

Glare simulation: DGP

Parameters and Scripts of Point-in-Time glare metric of DIVA for Virtual Restaurant Prototype:

- Medium Quality
- Clear Sky with Sun (CIE Clear Sky)
- 07 22 11
- 180 deg. Fisheye
- Radiance parameters:

```
-ps 4 -pt .10 -pj .9 -dj .5 -ds .25 -dt .25 -dc .5 -dr 1 -dp 256 -st .5 -ab 3 -
aa .2 -ar 256 -ad 2048 -as 1024 -lr 6 -lw .01
```

For Workplane 1, table => -vu 0.5 0.5 0

- 800 x 600 image size
- 100 geometry density

Glare simulation: DGP

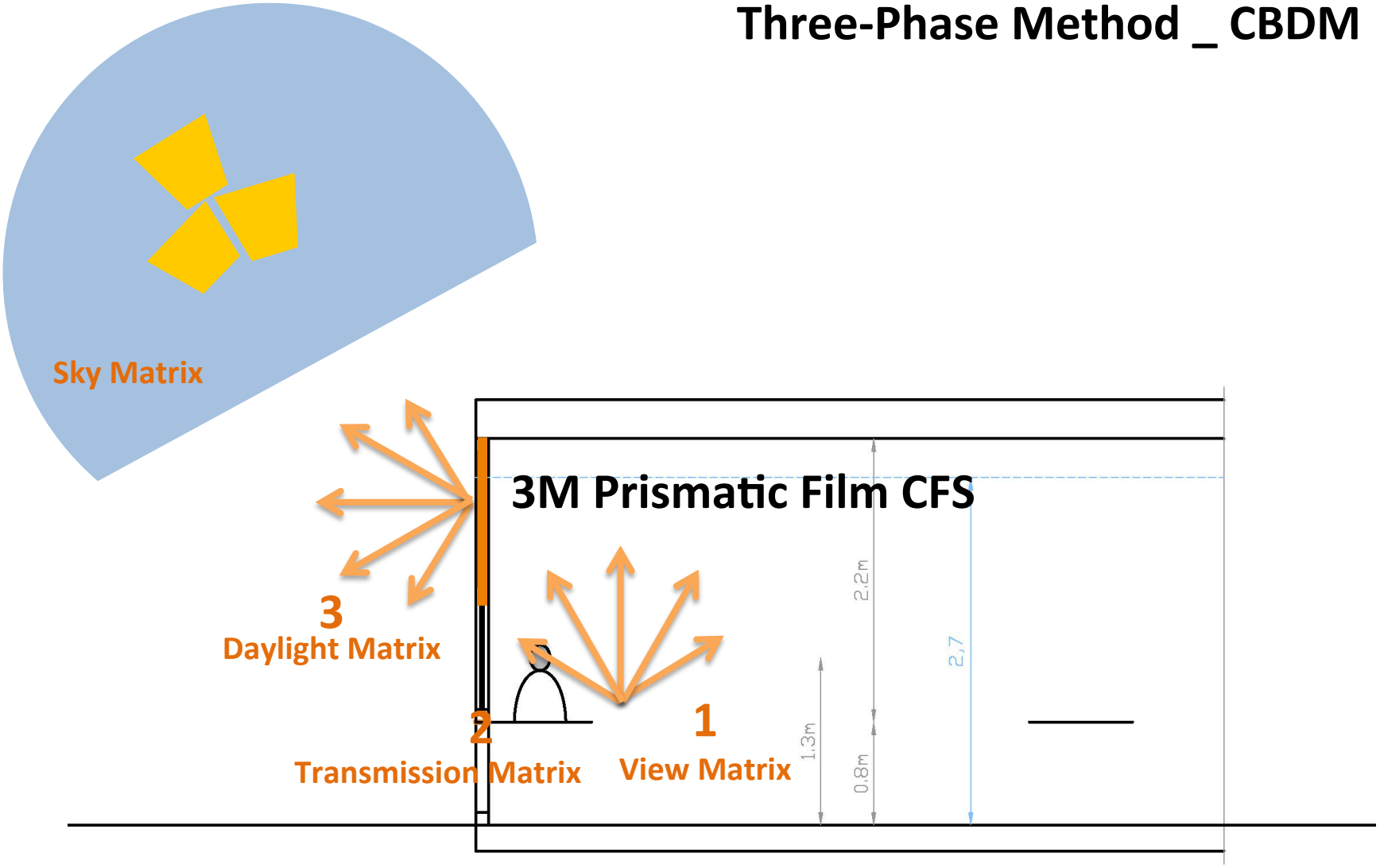
· With ***gensky*** program, some pictures' incoming illuminance data was different comparing with the measured illuminance.

· ***gendaylit*** program has –E parameter option for Global Horizontal Irradiance (GhI) data.

· The false colour image has been obtained by ***wxfalsecolor*** program. The parameters of the legend have been (The false colour image parameters of WebHDR for real pictures' have been the same):

- · 3000 cd/m2 the scale limit
- · 10 steps
- · log 3

Three-Phase Method _ CBDM



Source: Ward G., Mardaljevic J, McNeil A.

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CBDM simulation: DA

Parameters and Scripts of DA metric of **Three-Phase Method** with Complex Fenestration Systems:

· View Matrix:

```
$ rcontrib -f klems_int.cal -b kbinS -bn Nkbins -m windowglow -I+ \
-ab 2 -ad 1000 -lw 2e-5 resProSF_PF_vmx.oct < resProSF_PF.pts > \
resProSF_PF.vmx
```

· Daylight Matrix:

```
$ rfluxmtx -v -n 2 -c 20000 -ff -ab 4 -lw 1e-4 -ad 1000 windowNF.rad \
dummysky.rad -w res1NF_material.rad res1NF_geometry.rad > res1NF.dmx
```

· Transmission Matrix by Chantal Basurto Dávila's PhD as Film3M_145x145_9142012_t.xml and occasionaly WINDOW 7 software:

· Sky Matrix:

```
$ gendaymtx Barcelona.wea > Barcelona.smx
```

· Final results with *dctimestep* program:

```
$ dctimestep res1NF.vmx SimpleGlass.xml res1NF.dmx Barcelona.smx | rmtxop \
-fa -c 47.4 119.9 11.6 - > res1NF.dat
```

CBDM simulation: DA

Parameters and Scripts of DA metric of DIVA without CFSs:

- Occupancy Schedule: hourly, from 11:00 to 17:00 in all year
- 300 lux target illuminance
- Radiance parameters:

```
-ab 2 -ad 1000 -as 20 -ar 300 -aa 0.1
```

- 100 geometry density
- The used settings of visualization map:
  - Min. Percentage: 0
  - Max. Percentage: 100

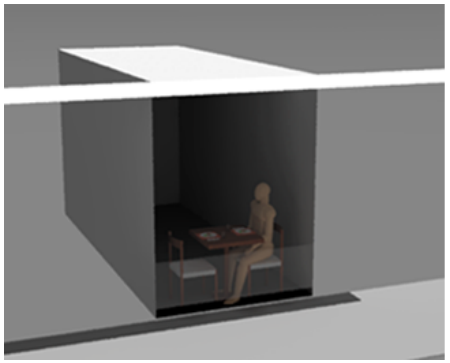
Parameters and Scripts of Point-in-Time illuminance metric of DIVA:

- Clear Sky with Sun (CIE Clear Sky)
- 07 22 11 Standard Time
- The same as DA's unit, Radiance parameters, geometry density and visualization map settings


For Calibrations 2 real restaurants:

Restaurant 1 (R1), Sal Café


Restaurant 2 (R2), Azurmendi




Virtual Restaurant Prototype (VRP)

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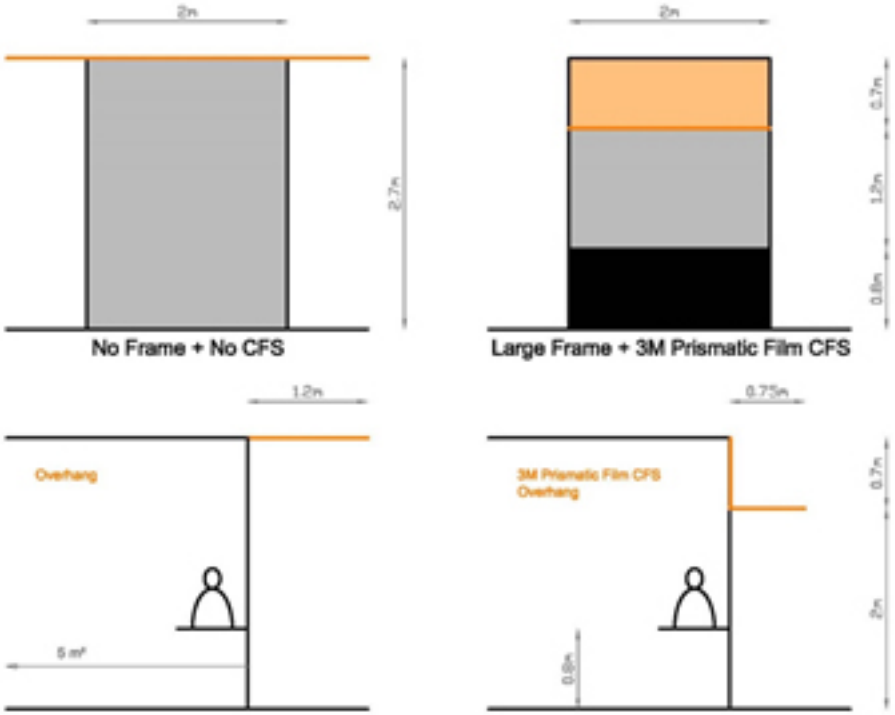
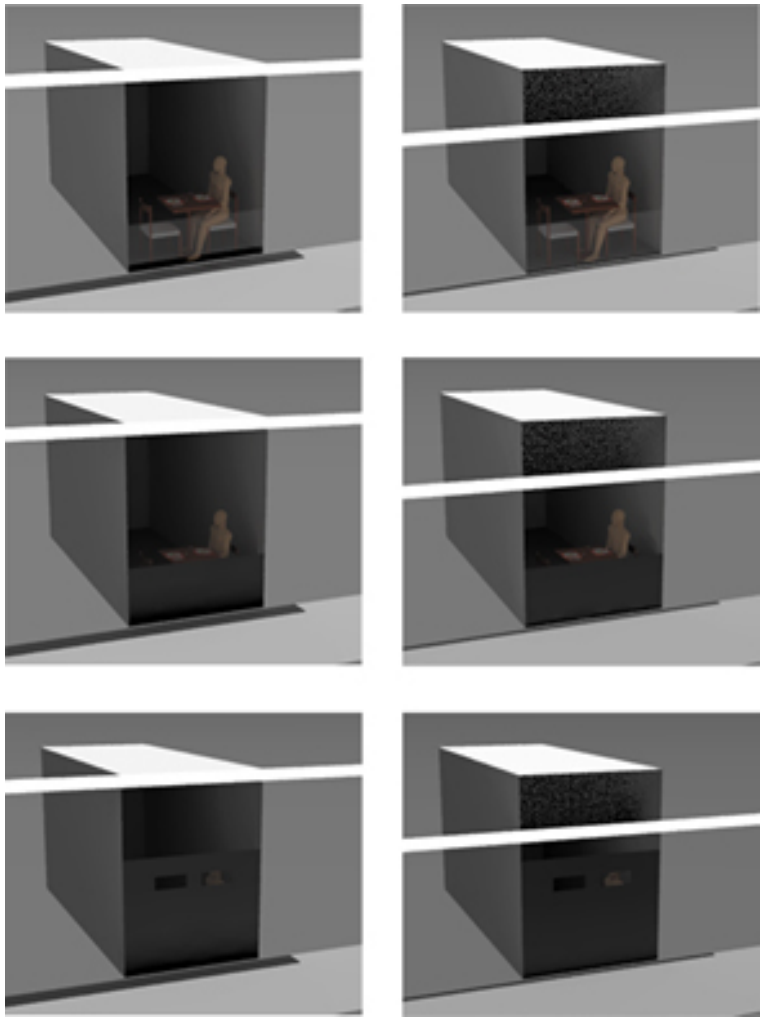


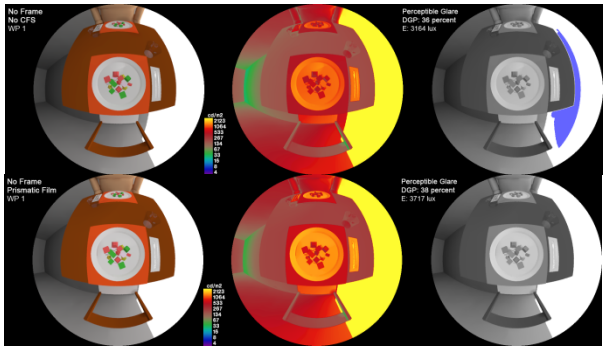


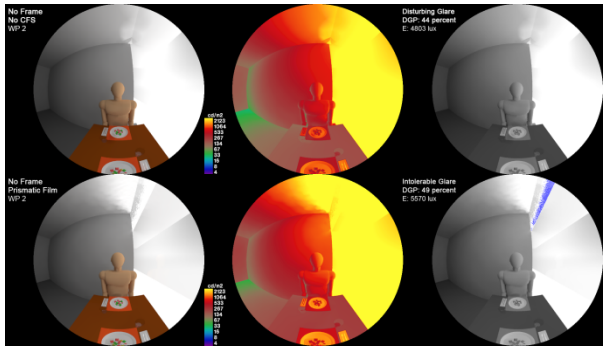
Nine window systems are proposed:
· No Frame and No Frame with Prismatic Film CFS
· Large Frame and Large Frame with Prismatic Film CFS
· Small Frame and Small Frame with Prismatic Film CFS

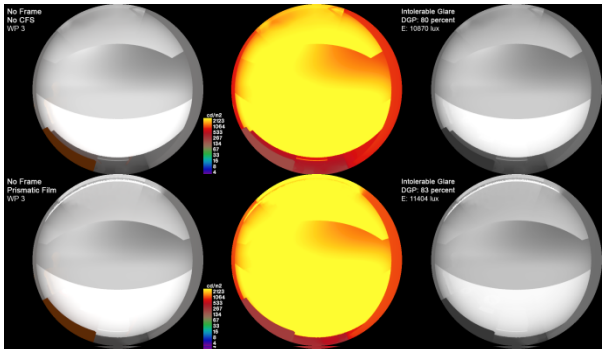
The studied façade is orientated to the south.
The virtual module has 2.7m height, 2m large and 5m deep.
There is a table with 0.7m x 0.7m and two chairs of 0.5m x 0.4m.
There is some food on the table and a sit person. Inside there are white high reflecting ceiling, medium reflecting plane grey walls and low reflecting plane grey floor.

Glare results

Visualizations, False Colour Images and Glare Source Images with DGP index of **No Frame** (**highly glazed façade) WS**; without CFS and with Prismatic Film CFS; WP 1, table down view; WP 2, person front view; WP 3, window out view:

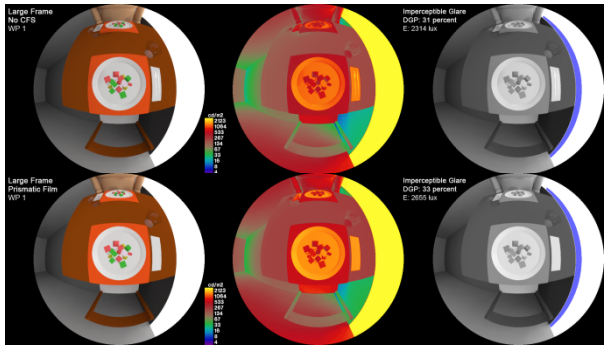


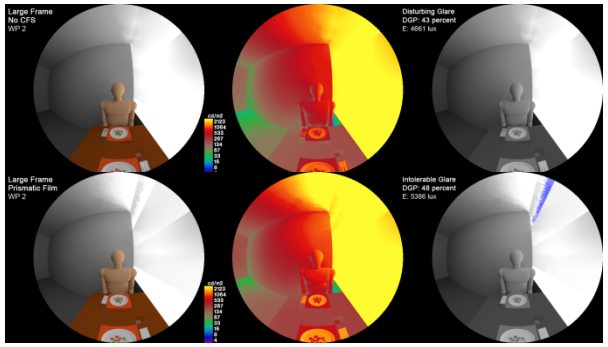


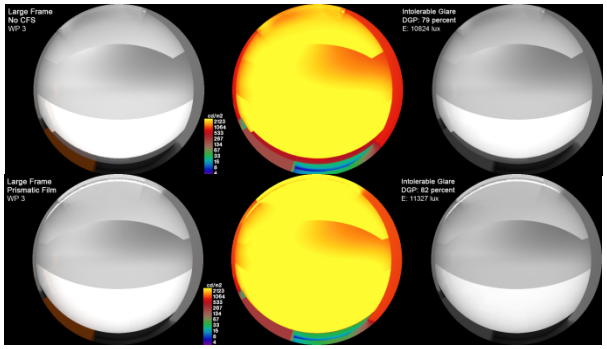


Glare results

Visualizations, False Colour Images and Glare Source Images with DGP index of **Large Frame WS**; without CFS and with Prismatic Film CFS; WP 1, table down view; WP 2, person front view; WP 3, window out view:

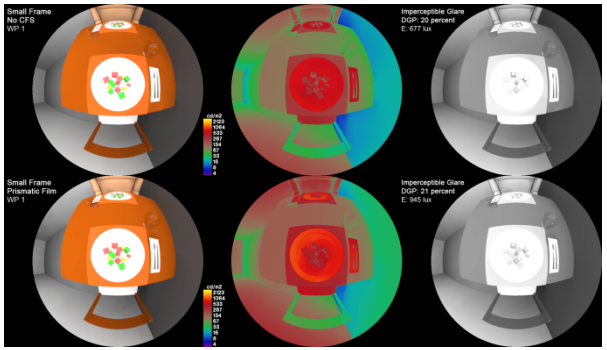


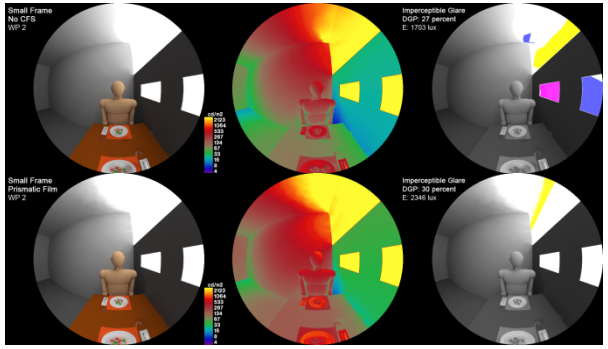


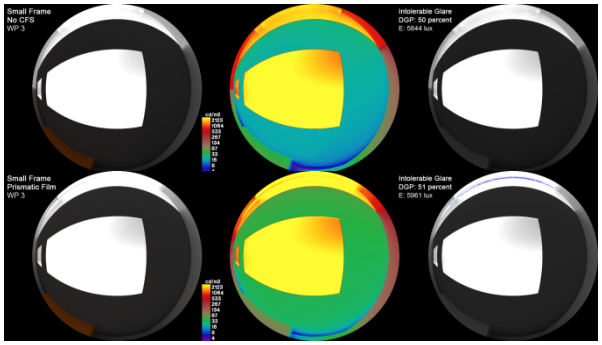


Glare results

Visualizations, False Colour Images and Glare Source Images with DGP index of **Small Frame WS**; without CFS and with Prismatic Film CFS; WP 1, table down view; WP 2, person front view; WP 3, window out view:







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Summary Glare results

Façade Systems	DGP				
	Work Plane WP 1	Relation Plane WP 2	Out Plane WP 3	Arithmetic Mean	Geometric Mean
No Frame (highly glazed)	**36**	44	80*	53*	50.2*
Large Frame	31	43	79*	51*	47.2*
Small Frame + 3M CFS	21	**30**	51	**34**	31.8

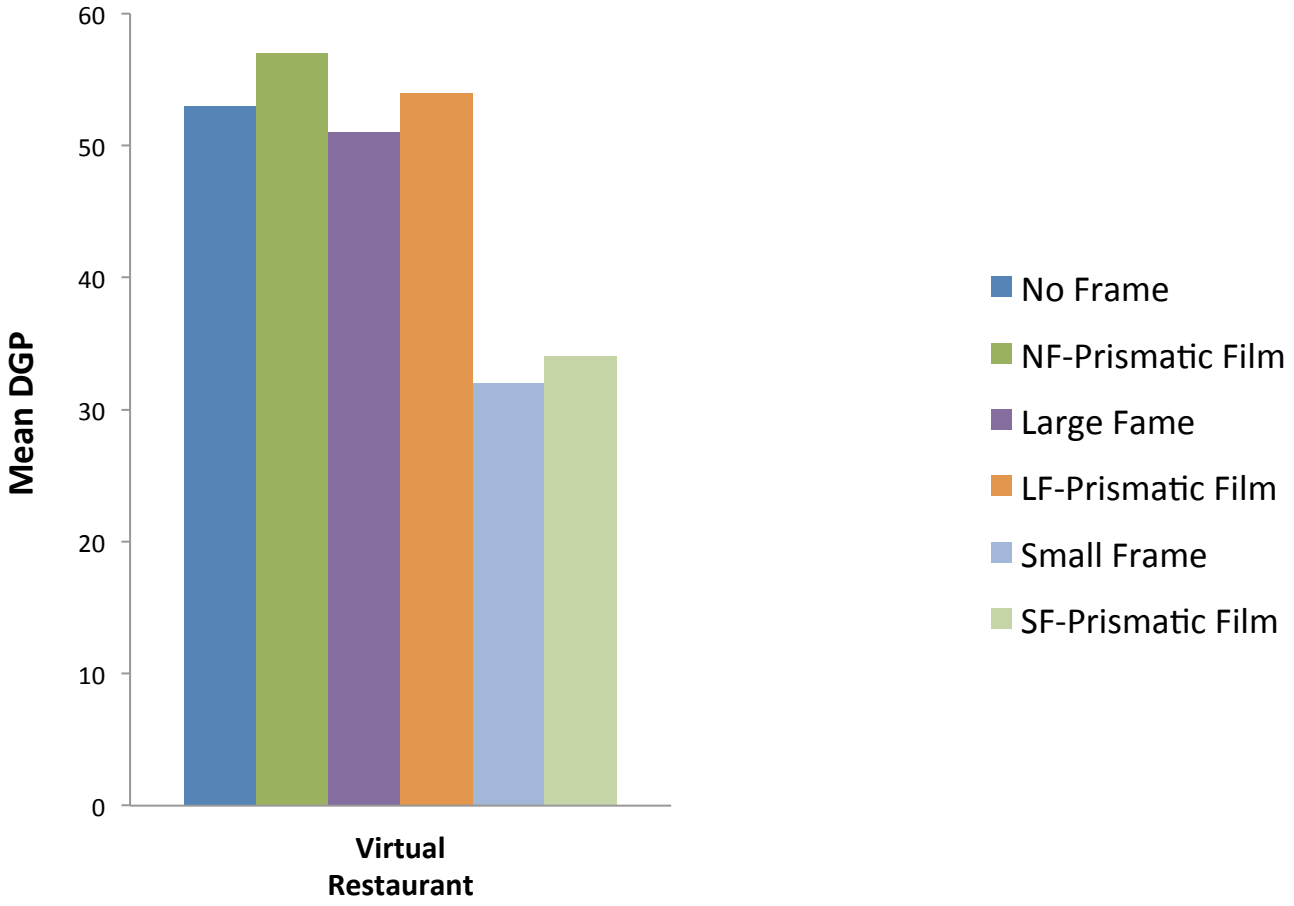
* No reliable data

· The results of Out Plane DGP are high, because the DGP ratings are not calibrate for outdoors. To calculate better the mean of complex scene, it could be interesting to know the real out plane contribution because the tolerance is different.

· If we knew calculating the Out Plane light comfort conditions in this case the mean glare result would not have to rise much.

· Therefore, perhaps the mean of; highly glazed and large window façade will be close to Disturbing glare; and small window façade will be close to Imperceptible glare.

Summary Glare results



Glare concerns

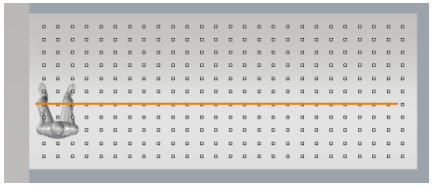
Possible factors to introduce to **type of plane or activity**:

· Glare **ratings**

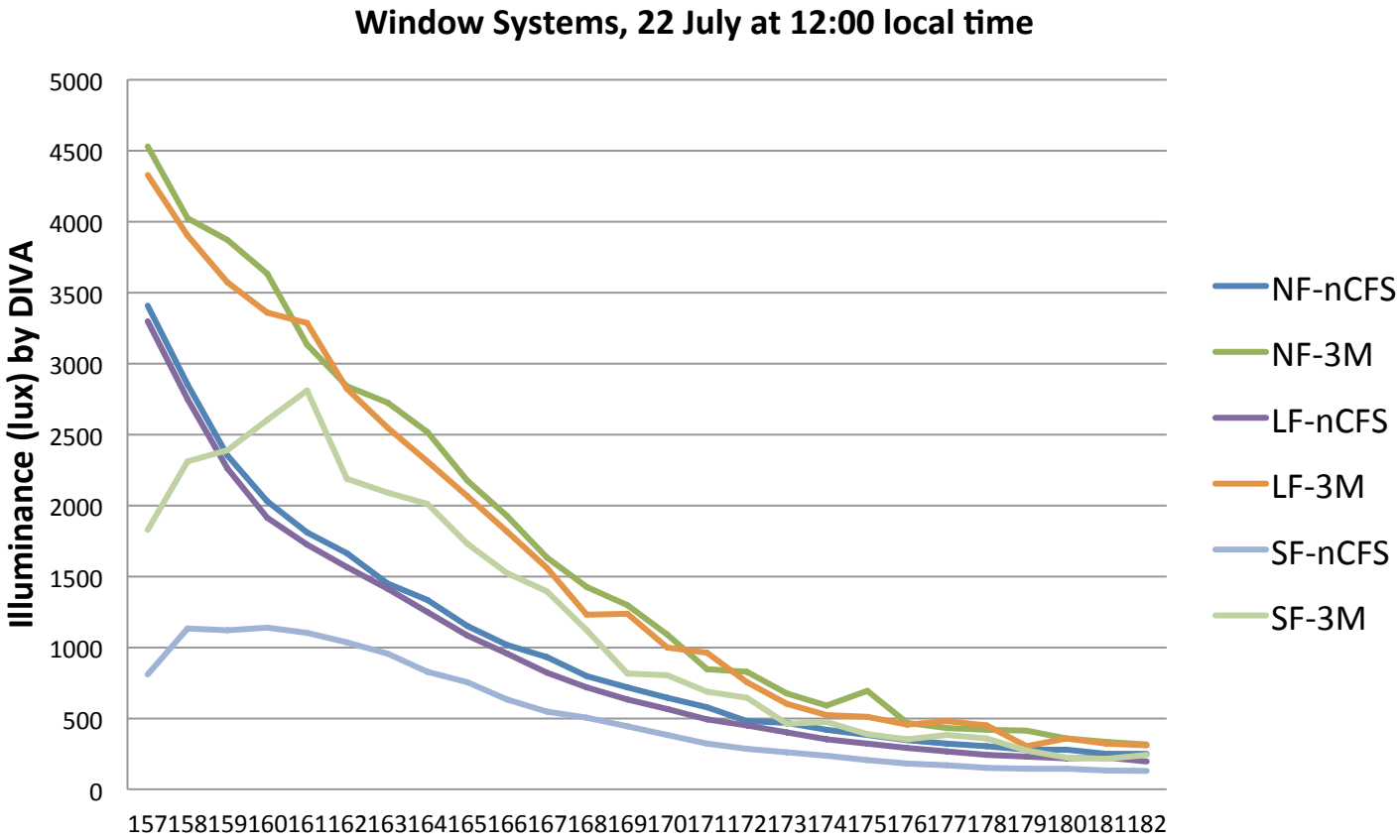
· **Time** of attention

· **Accuracy** of attention

· Spatial contrast as **information content**

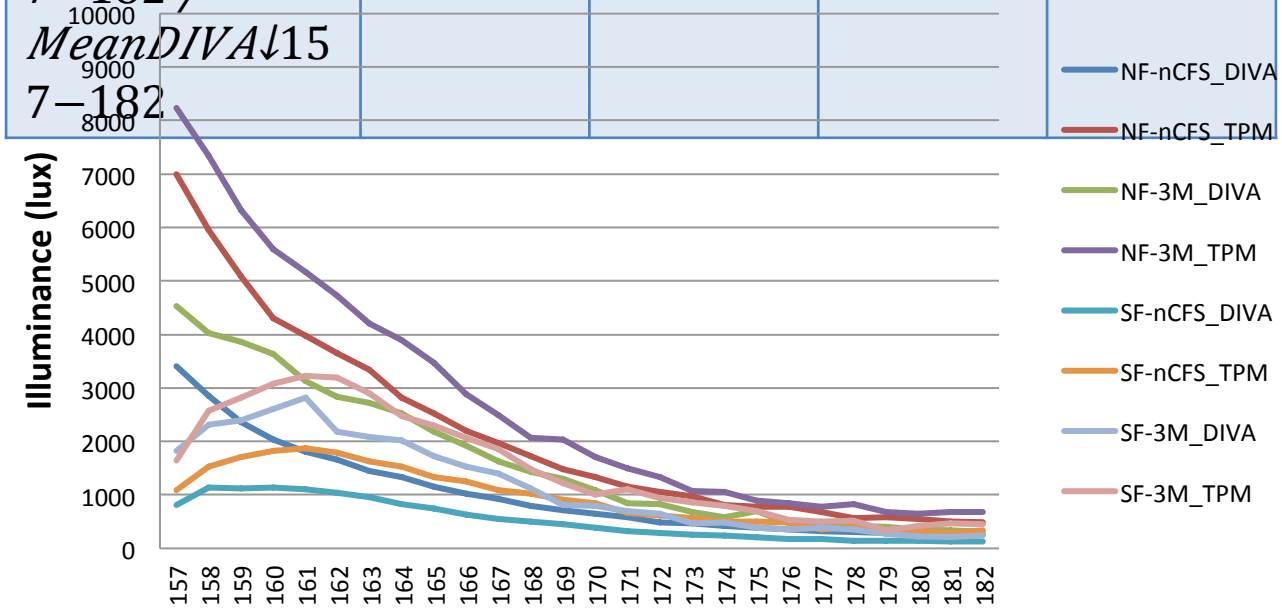


Point-in-Time Illuminance results



Point-in-Time Illuminance results

	Point-in-Time Illuminance (lux) by TPM, 22 July at 12:00 local time			
	No Frame		Small Frame	
	No CFSnf	Prismatic Film	No CFSsf	Prismatic Film
$MeanTPM\downarrow 15_{7-182}$ / $MeanDIVA\downarrow 15_{7-182}$	2.12	1.65	1.80	1.30



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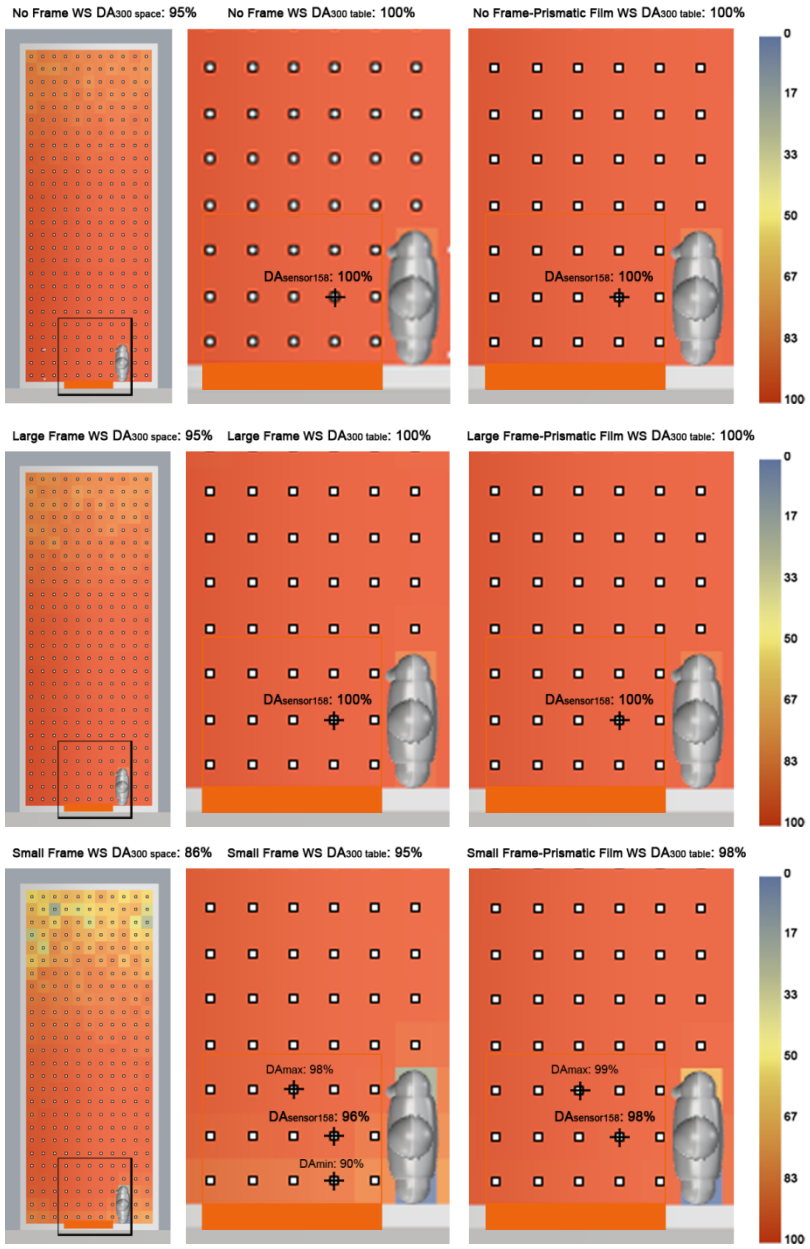

DA results

DA of No Frame WS without CFS and with Prismatic Film CFS

DA of Large Frame WS without CFS and with Prismatic Film CFS

DA of Small Frame WS without CFS and with Prismatic Film CFS

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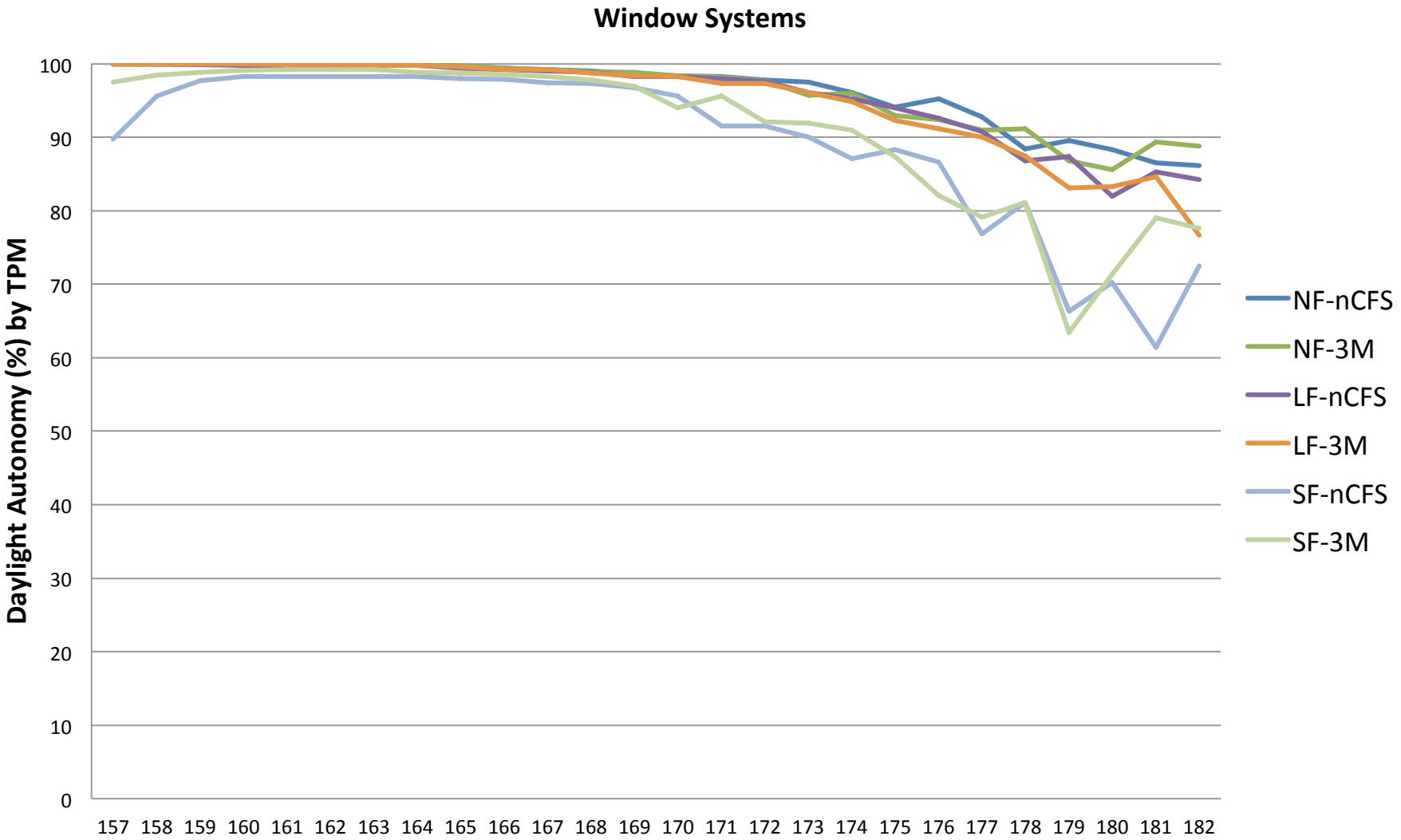
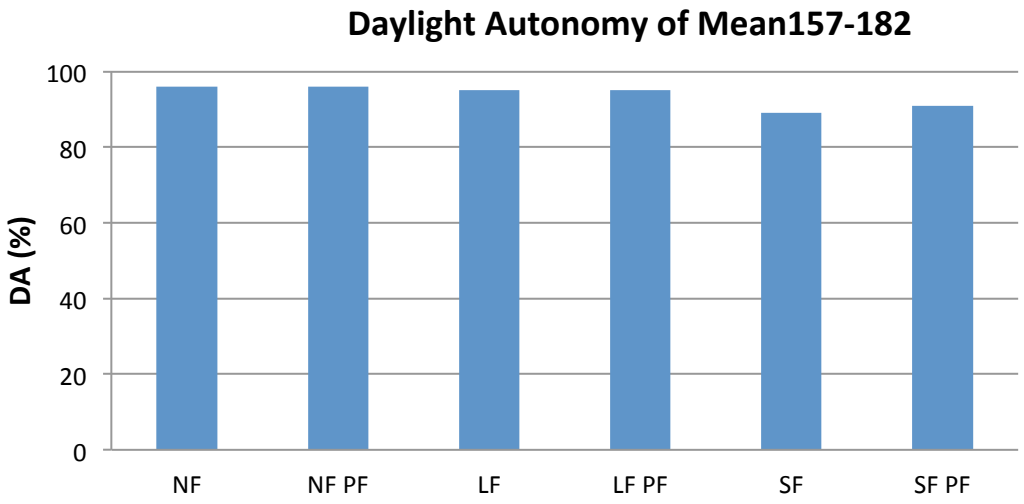
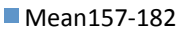
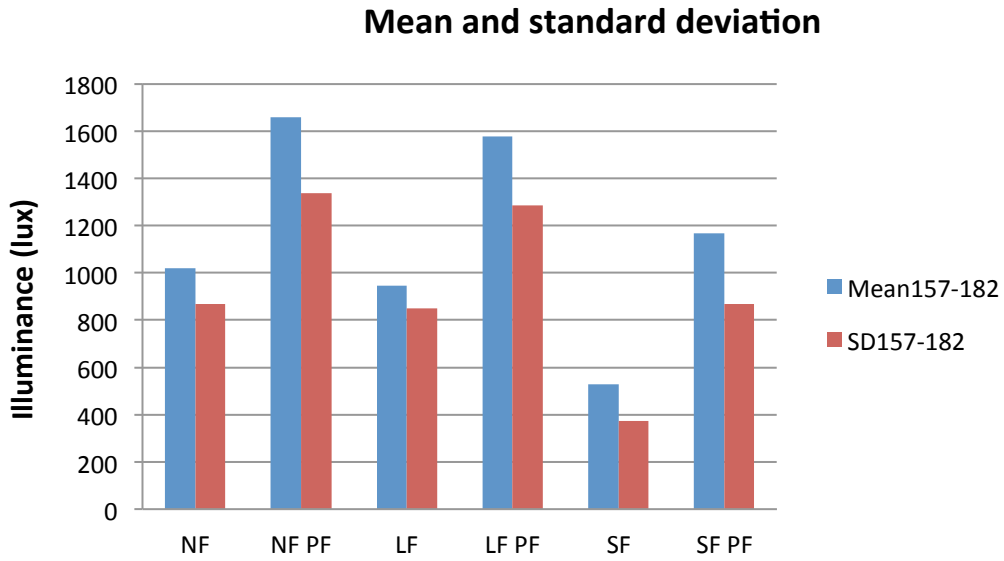
DA results

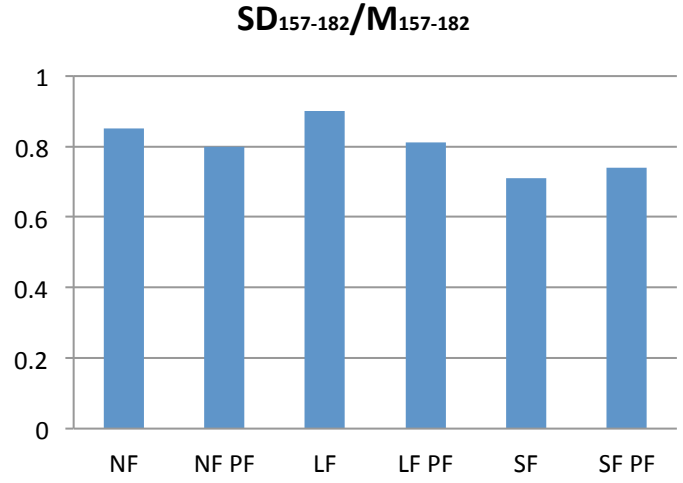

Window Systems
Daylight Autonomy (%) by TPM
100
90
80
70
60
50
40
30
20
10
0
157 158 159 160 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175 176 177 178 179 180 181 182
NF-nCFS
NF-3M
LF-nCFS
LF-3M
SF-nCFS
SF-3M



Summary DA results







· Although the calculation get more complicate and for same cases will be not necessary, different workplanes contribution as a third plane, **out or side plane**, could **smooth light perception** increasing and decreasing Work Plane perception, **keeping better attention**.

· **Each activity or work plane**, relation plane and out plane should have **different visual comfort conditions and possible glare condition scaling**. According to the required **time and the accuracy of attention** the comfort parameter could be different.

· The Three-Phase Method results of DA are a little higher than DIVA's DA results.

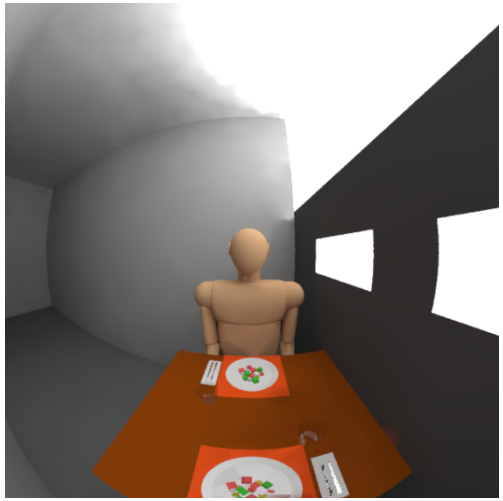
· Side-lit by small **window combined by Prismatic Film CFS** tends to provide **less probability of daylight glare** (less glare source surface) and it tends to provide slightly less **light amount** but it is **enough**. It can provide indoor side-lit, with an **intimate and comfortable atmosphere**; less is more.

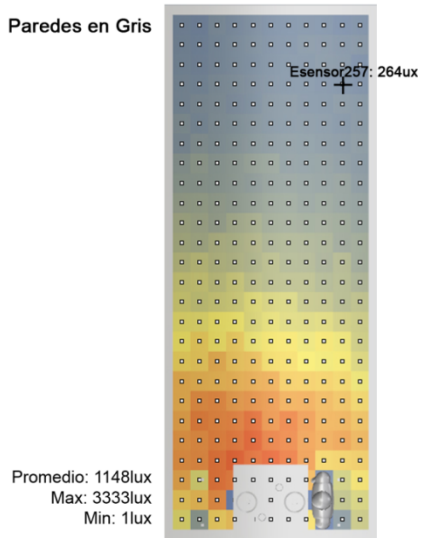
· **Level and perception a**re **different requirements and could work separately.** Combining different types of light and planes as; **out plane, redirected light, indirect light and direct light** could provide more heterogeneous and dynamic atmospheres.

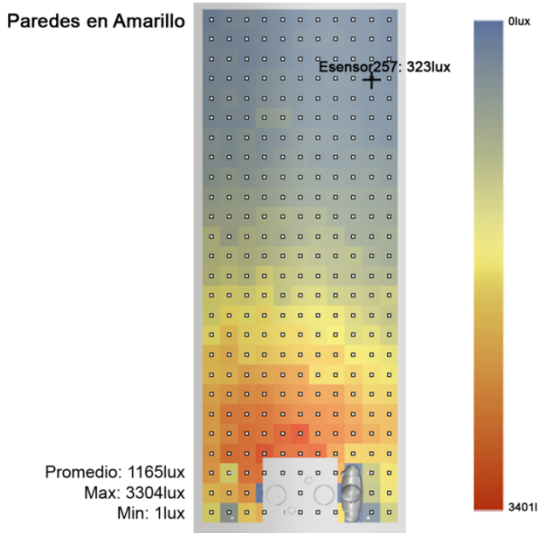
FUTURE WORKS

Colour

Window combined by CFS façade has a probability to provide a gloomy atmosphere (Kruithof). Adding some warm colour to the atmosphere could create more pleasant atmosphere.







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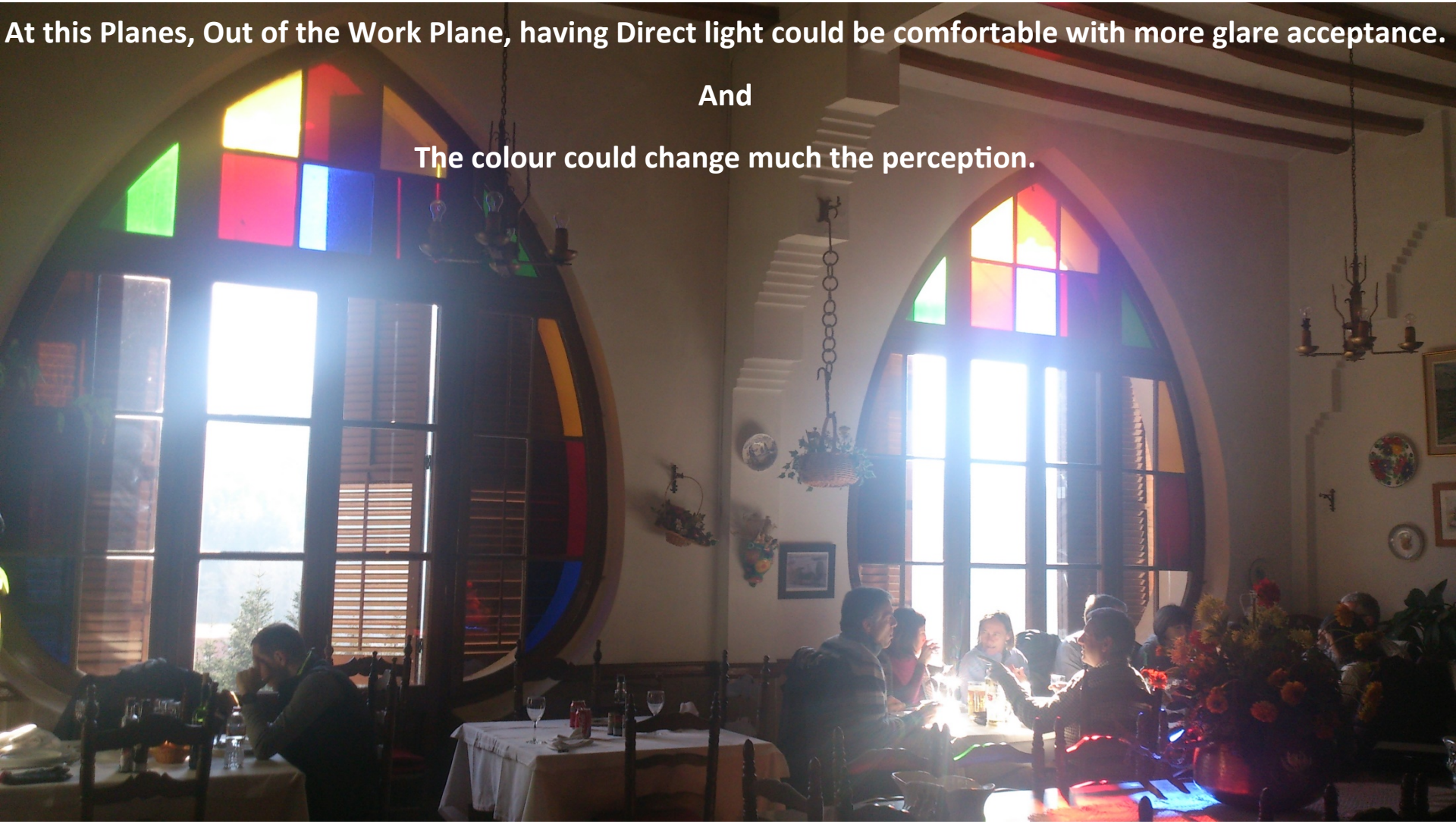
FUTURE WORKS



THANK YOU

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