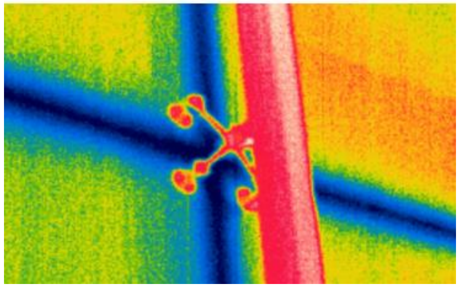
Innovative glass point fixing façades an approach to a better thermal performance



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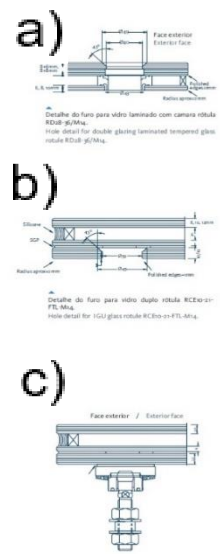
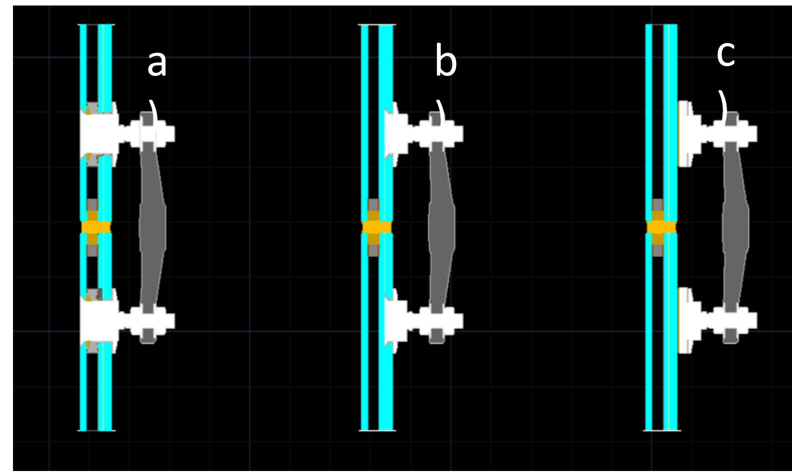
Glass Performance Days 2018
March 07-09, 2018, Istanbul, Turkey

1. Types of point fixings systems for IGU

Point fixing glazing systems for architecture using drilled bolted fittings to support glasses are the most common, but in alternative new innovative systems are used such as embedded and adhesive fittings.





Details for 3 different types of point fixing system for IGU glass:

FITECHNIC® Glass Fitting System

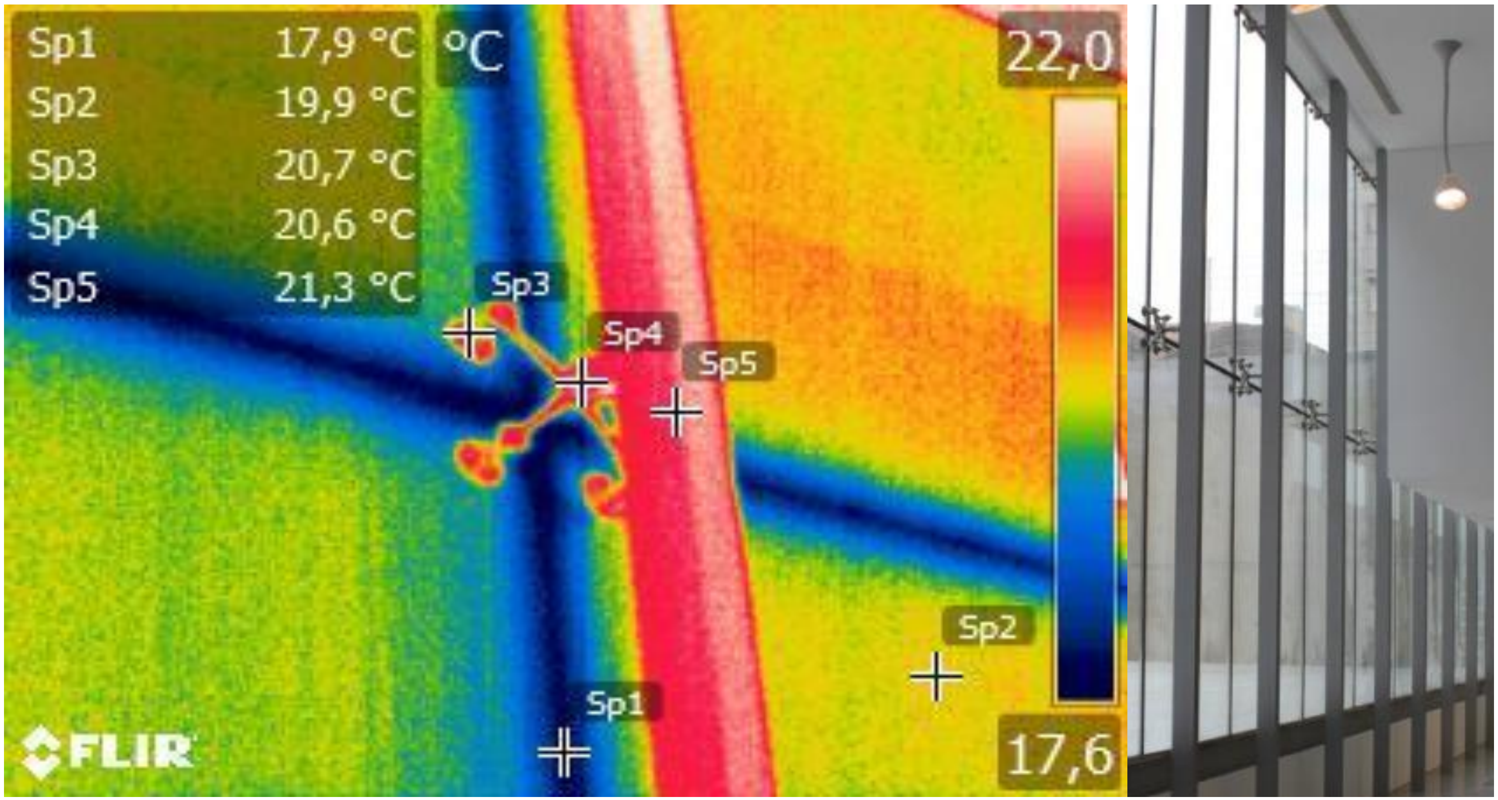
a) Totally perforated system (nylon ring inside IGU gap) - FITECHNIC® RD

b) Partially perforated system (embedded in interior laminate) - FITECHNIC® RCE-FTL

c) Non perforated system (adhesive) - FITECHNIC® RCE-GL

2. Thermographic IR Analysis of internal surface

Point fixing glazing systems are composed by various components other than fittings and glasses such as metallic structure, silicon joints, which influence the thermal performance of the façade. Thermographic IR analysis shows different temperatures and Linear thermal transmittance.

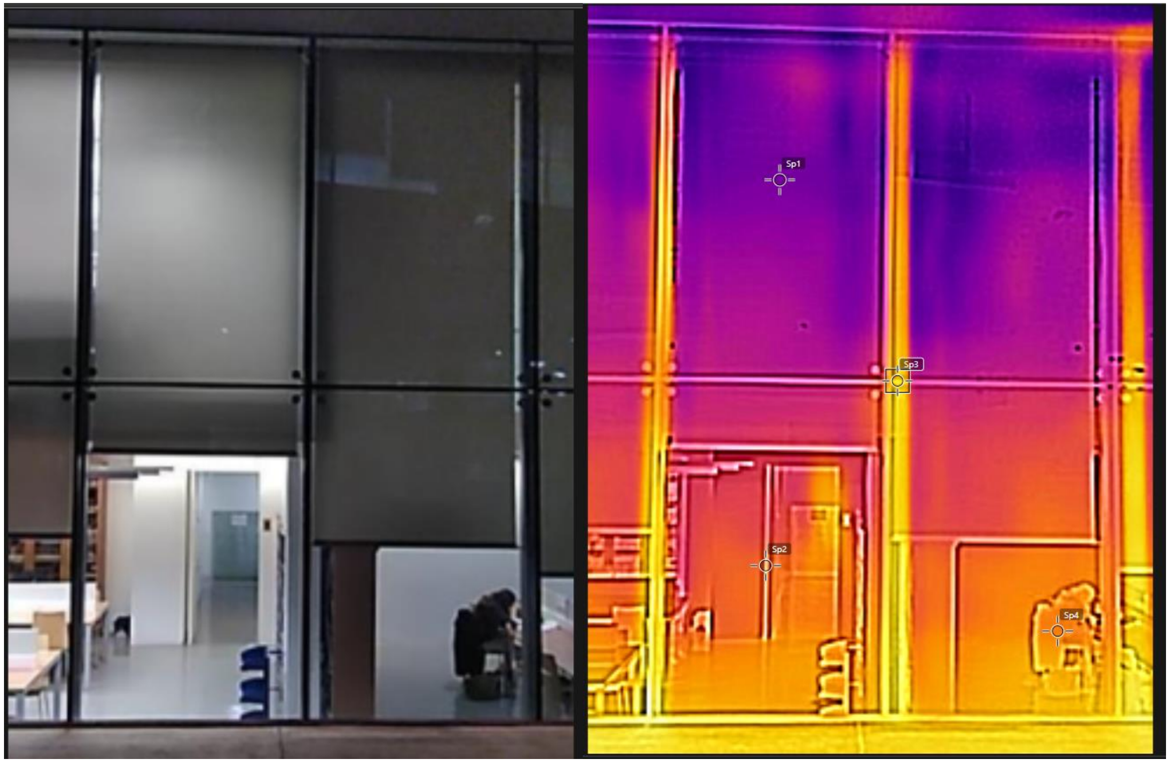


FiTECHNIC® Glass Fitting System

Thermographic analysis in the interior of a Glass Façade, Lisbon, Portugal at 22:50 - 23/03/17

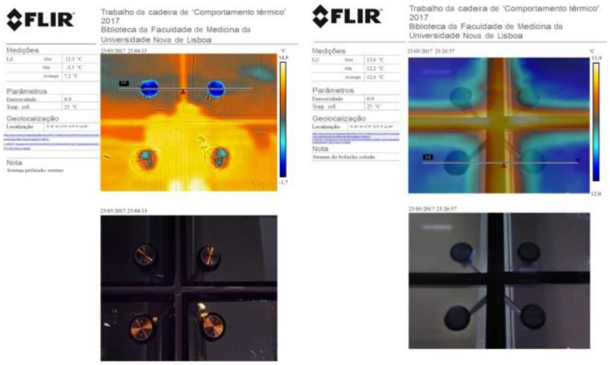
2. Thermographic IR Analysis of exterior surface

Influence in a thermographic IR analysis might come also from other elements not related to point fixing glazing systems.



Thermographic IR analysis in a Glass Façade, Lisbon, Portugal at 23:00 - 23/03/17
Exterior/Interior temperature: 7ºC / 21ºC - Wind: ,6 km/h - Humidity: 87%

- The upper glasses presents in average a higher superficial temperature (+1~2ºC)
- People, shades influence results
- Periphery U glass channel is responsible for linear thermal transmittance
- Metallic columns act as a heat radiator conducing heat thru spiders and bolts

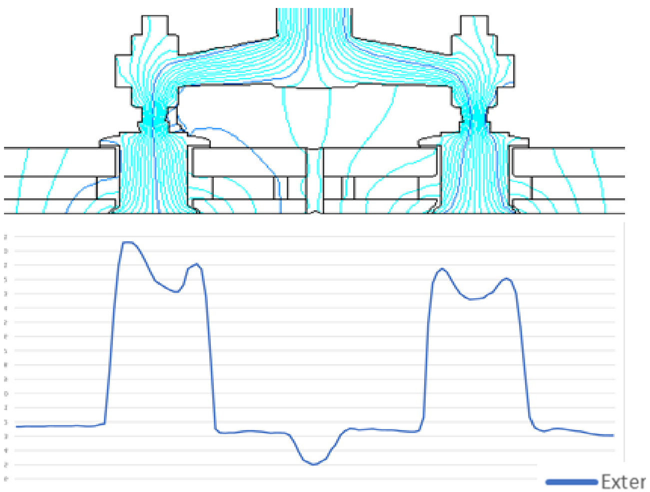


Thermographic IR analysis in a perforated and non perforated system

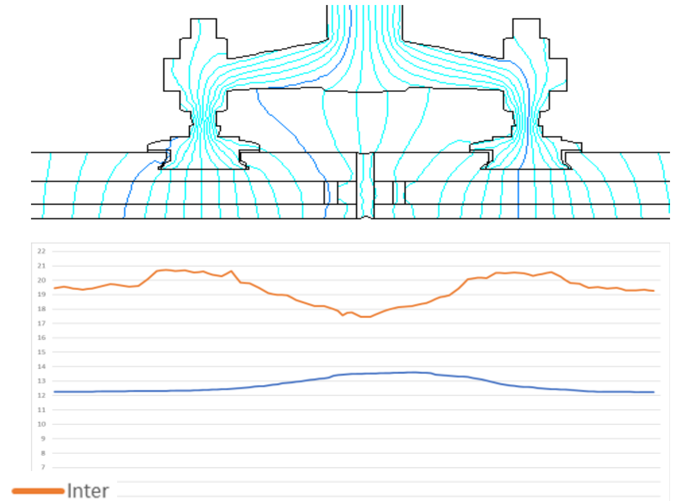
3 Thermal performance diferent fitting systems

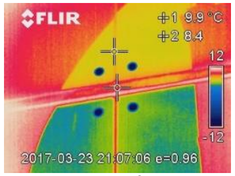
Numerical analysis (Pysibel-BISCO) presents distinctive Isotherms, heat fluxes, temperatures and thermal transmittances in different point fixing glazing systems show great influence on performance.

a) FITECHNIC® RE-D



b) FITECHNIC® RCE-FTL





a) FITECHNIC® RE-D

b) FITECHNIC® RCE-FTL

FITECHNIC® Glass Fitting System

Comparing heat flux and temperatures for 2 different types of glass fittings:

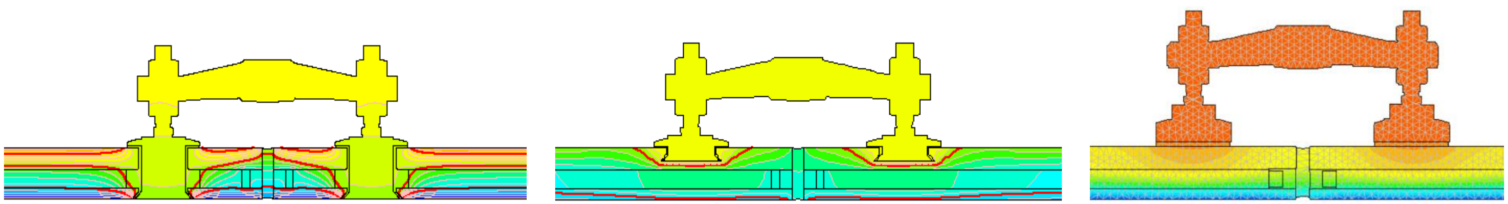
a) Totally perforated system (nylon ring inside IGU gap) - FITECHNIC® RD

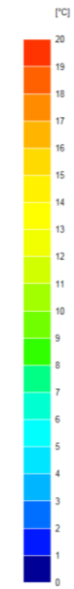
b) Partially perforated system (embedded fixing interior laminated) - FITECHNIC® RCE-FTL

3 Thermal performance in diferent fitting systems

Numerical analysis to calculate thermal transmittance accordingly to EN ISO 10077-2 (Pysibel-BISCO software) in different systems show great influence on performance of the Uf (frame) value.

a) FITECHNIC® R-D: Uf = 29,6 W/(m².K)   b) FITECHNIC® R-FTL: Uf = 8,0 W/(m².K)   c) FITECHNIC® R-GL: Uf = 5,3 W/(m².K)



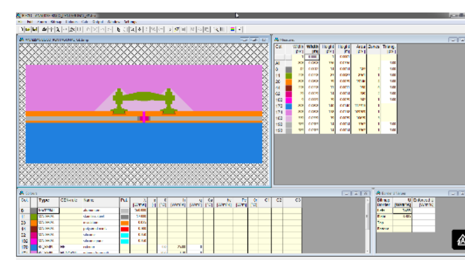


Comparing 3 different types of point fixing system for IGU glass:

a) Totally perforated system (nylon ring inside IGU gap) - FITECHNIC® RD

b) Partially perforated system (embedded fixing interior laminated) - FITECHNIC® RCE-FTL

c) Non perforated system (adhesive) - FITECHNIC® RCE-GL

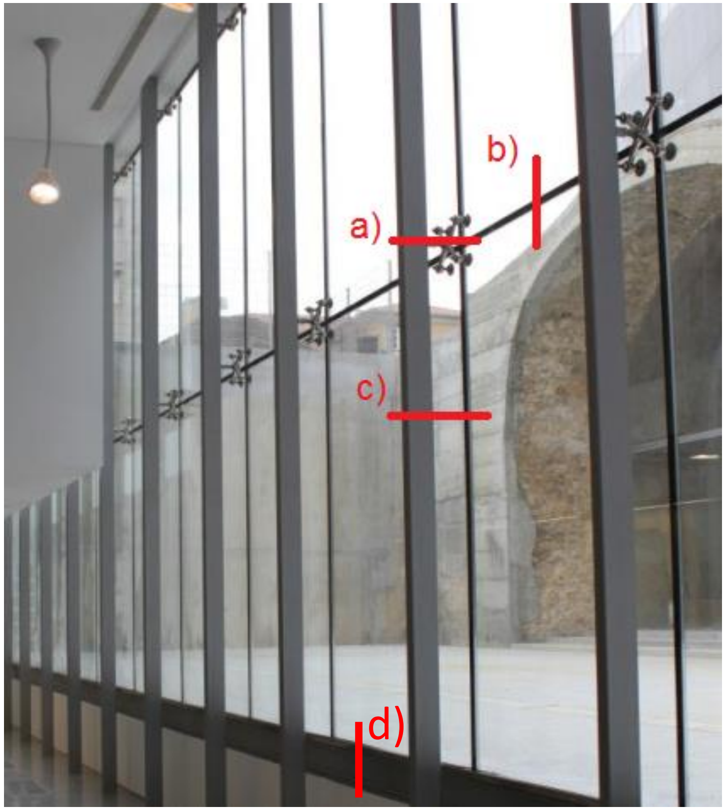


FITECHNIC® Glass Fitting System

EN ISO 10077-2:2012

4. Calculation Ucw Point Fixing Glass Façade

Calculate thermal transmittance value *Ucw* (curtain wall) of an example building glass façade in Lisbon assuming various areas of elements, components and boundary conditions.



a) Area glass - fixing system- column
b) Area glass – silicon horizontal joint
c) Area column – glass – silicon vertical joint
d) Area glass – periferical U channel.

University Nova Lisboa Medical School Library – Portugal

$$Ucw = \frac{\sum AgUg + \sum ApUp + \sum AtUt + \sum AmUm + \sum lg,p\,\psi p,g}{\sum Ag + Ap + At + Am}$$

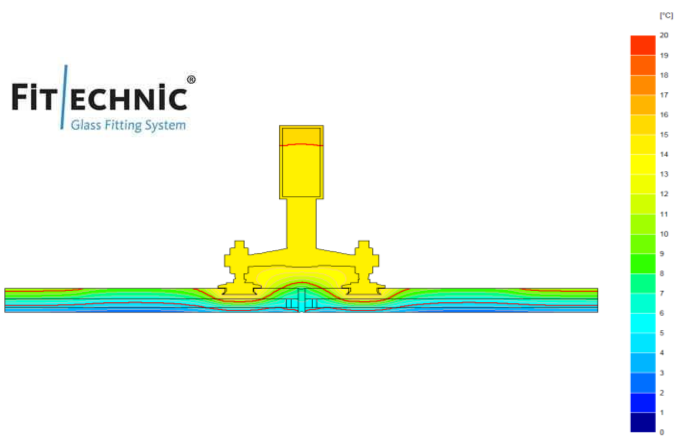
[EN 13947:2006]

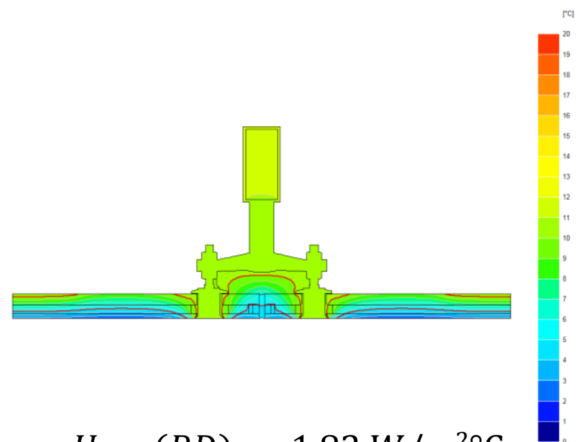
4. Results Ucw Point Fixing Glass

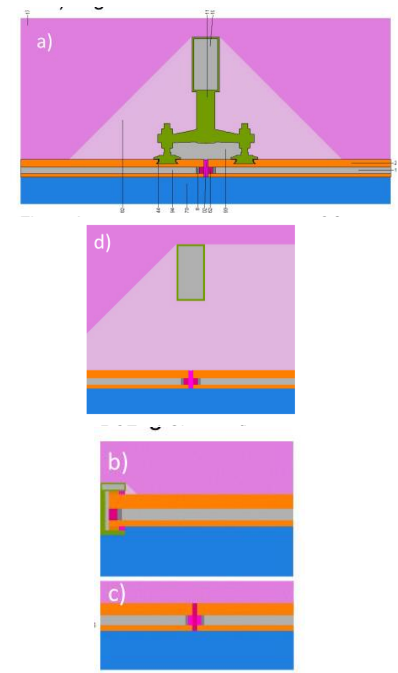
Numerical analysis to calculate thermal transmittance Uf (frame) value for the building elements and determining the Ucw (curtain wall) for the façade with partially and total perforated system. Non-perforated systems demonstrates some improvement in thermal performance.

Glass				Fitting RCE		U channel		Horizontal joint		Vertical joint	
[m²]	[W/m²C]	[m]	[W/m2C]	[m²]	[W/m²C]	[m²]	[W/m²C]	[m²]	[W/m²C]	[m²]	[W/m²C]
14.97	1.40	19.10	0.15	0.0068	8.00	0.186	13.31	0.062	5.13	0.196	3.80

thermal transmittance Uf (frame) for various elements







$$Ucw(RCE.FTL) = 1{,}76\, W/m^2{}^{\circ}C$$

25% higher than the U value of glass

$$Ucw\ (RD) = 1{,}82\, W/m^2{}^{\circ}C$$

30% higher than the U value of glass

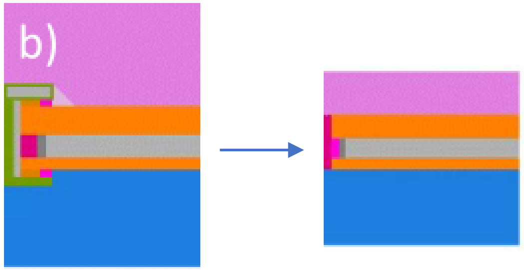
$$Ug\ (glass) = 1{,}40 W/m^2{}^{\circ}C$$

5. Discussing other elements and solutions

Some of the building elements have problems with conductivity, for example the glass U channel used in perimeter with no thermal breakage.
Calculations of the Ucw with a simple joint of silicon without the metallic U channel would improve thermal performance of the façade.

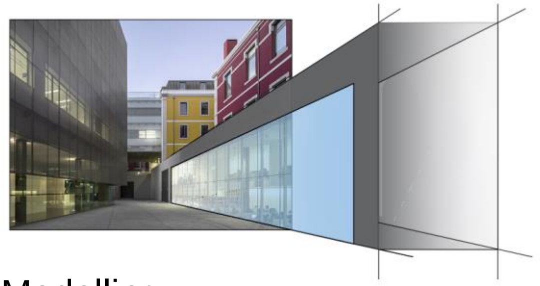
$$Ucw\ (RCE\ w/Uchannel) = 1{,}76 W/m^{2}{}^{\circ}C$$

$$\boldsymbol{Ucw\ (RCE\ w/silicon) = 1{,}68\ W/m^{2}{}^{\circ}C}$$



Improvement of 7%

6. Bulding Ocupation Modelling by Energy Plus



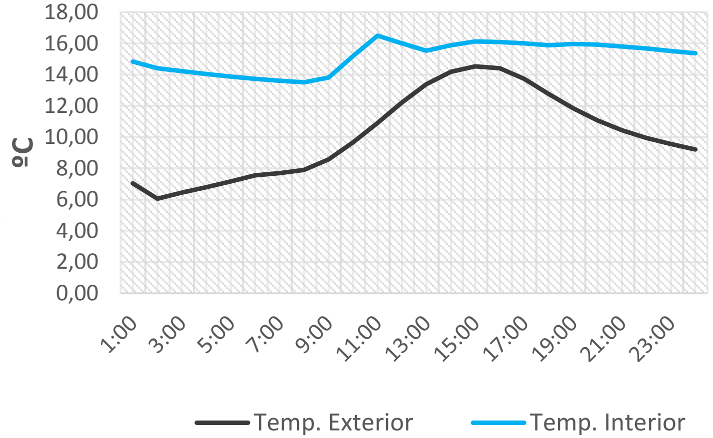
Modelling

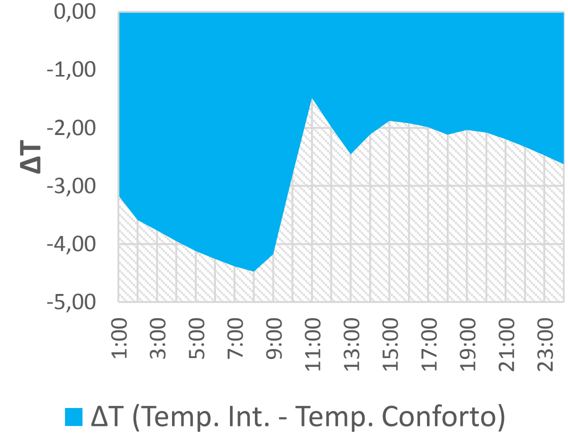
- Free Floating
- Different fitting systems
- 24h Winter and Summer/1 year

Field	Units	Obj1
Name		Fachada VEA
Optical Data Type		SpectralAverage
Window Glass Spectral Data Set Name		baixoemissivo
Thickness	m	0,038
Solar Transmittance at Normal Incidence		0,42
Front Side Solar Reflectance at Normal Incidence		0,18
Back Side Solar Reflectance at Normal Incidence		0,15
Visible Transmittance at Normal Incidence		0,67
Front Side Visible Reflectance at Normal Incidence		0,11
Back Side Visible Reflectance at Normal Incidence		0,11
Infrared Transmittance at Normal Incidence		0
Front Side Infrared Hemispherical Emissivity		0,84
Back Side Infrared Hemispherical Emissivity		0,147
Conductivity	W/m-K	0,068
Dirt Correction Factor for Solar and Visible Transmittanc		1
Solar Diffusing		No
Young's modulus	Pa	72000000000
Poisson's ratio		0,22

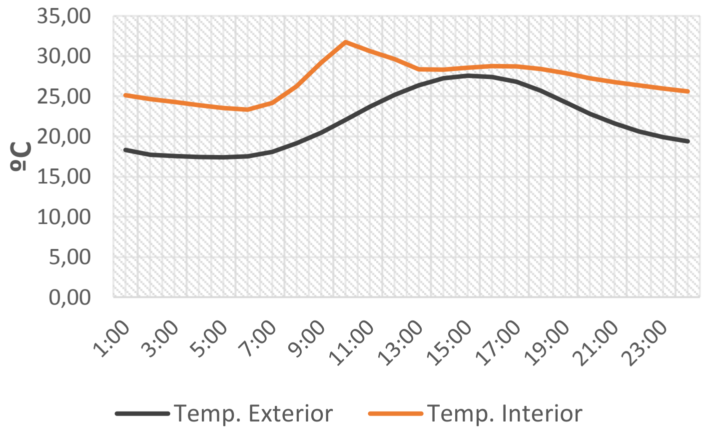
Field	Units	Obj1	Obj2	Obj3	Obj4	Obj5
Name		Parede Exterior	Pavimento	Envidraçado	Parede interior	Tecto
Outside Layer		Reboco (2cm)	Betão (20cm)	Fachada VEA	Reboco (2cm)	Betão (20cm)
Layer 2		Betão (20cm)	parquet (1cm)		Alvenaria (11cm)	Reboco (2cm)
Layer 3		Reboco (2cm)			Reboco (2cm)	
Layer 4						
Layer 5						
Layer 6						
Layer 7						

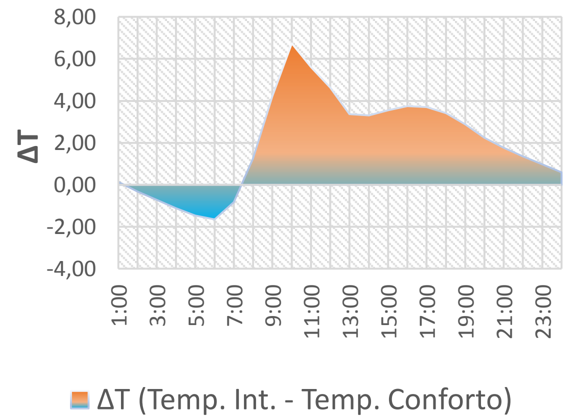
Winter season - Exterior and interior air temperature





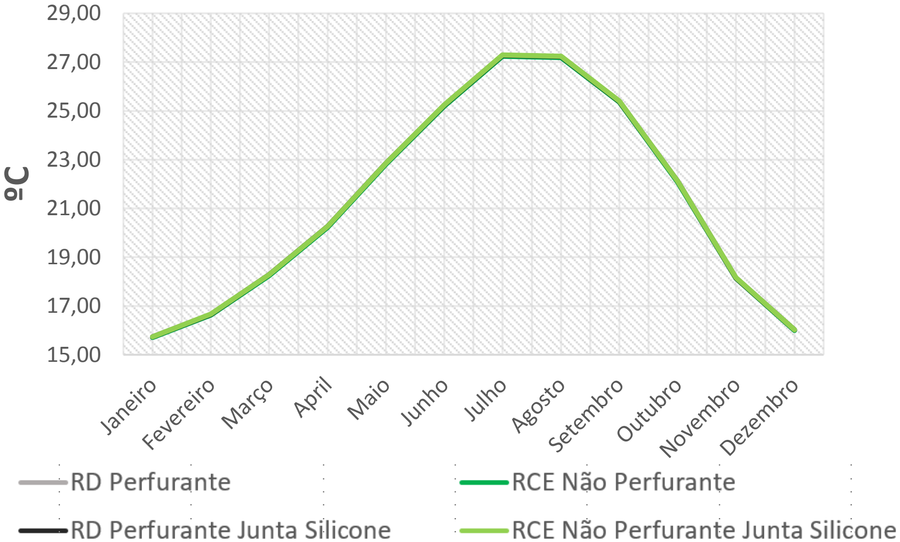
Summer season - Exterior and interior air temperature

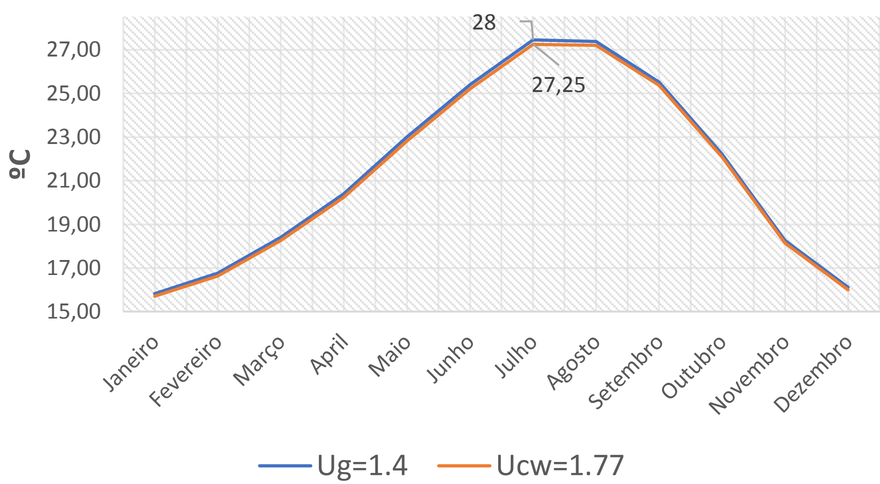




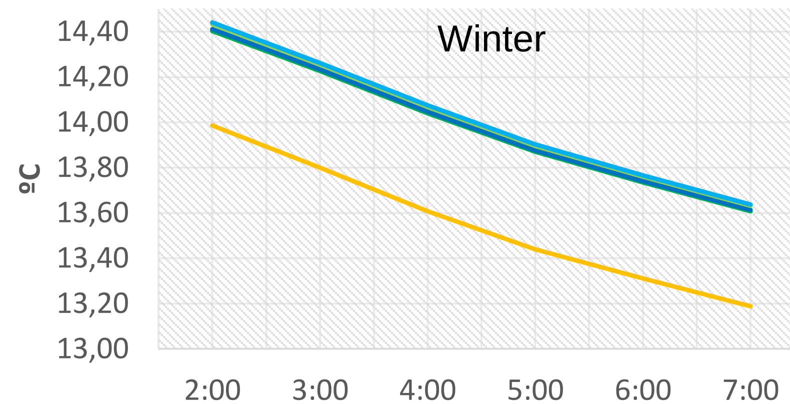
6. Occupation Building Analysis by Energy Plus

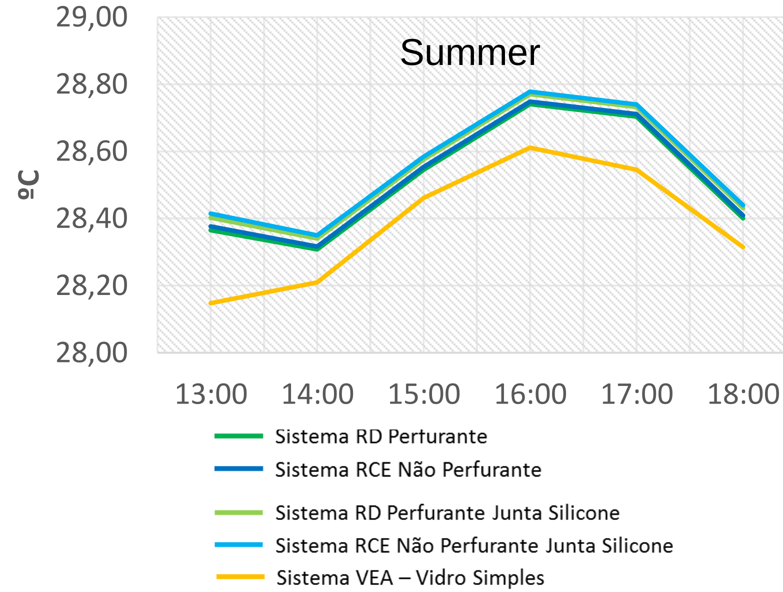
Interior air temperature variation, 1 year





Interior air temperature variation, critical hours





6. Conclusions

- Non-perforated and innovative systems are a suitable approach to a better thermal performance of the point fixing façades.

- Even though the *Uf* of perforated systems are 3,5x higher than other innovative non-perforated systems, the global impact in the *Ucw* is small if there are not many fittings per glass.

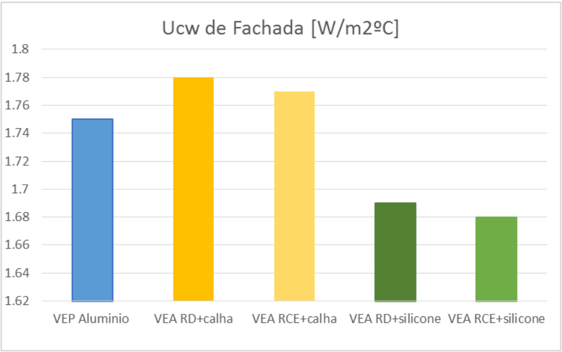
- Example of the glass façade with non perforated system with a Ucw=1,76W/m^{2}ºC is comparable to the other efficient aluminium thermal-breakage systems.

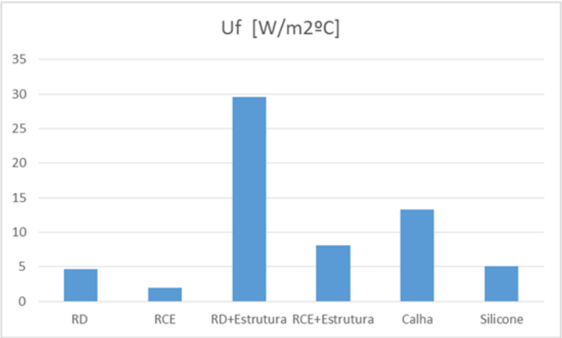
- Other elements in Point Fixing Glass façades might have great impact in the global solution (ex. Joints, U channels, silicon)

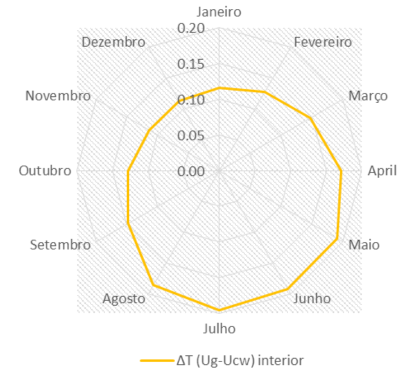
- Glass is the key element for a better thermal performance and no drilling innovative systems, allow the usage of more sensitive coatings creating glasses with better Ug values.

- Thermal transmittance value *Ug* of glass (1,40W/m^2 ºC) is 25% to 30% lower than the *Ucw* of the point fixing façade depending if it is the non or perforated system.

- Small changes of about 0,3W/m^{2}ºC in the Ucw value of the façade creates impact on comfort in the occupation of building (in example of south countries greater impact in the Summer)







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Obrigado!

Thank you!

Tesekkurler!