

Building envelope

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1. CONDITIONS OF THE THERMAL ENVELOPE

1.1. Transmitancia de la envolvente térmica

Transmission heat transfer coefficient (EN ISO 13789:2017)

$$H_{tr} = 492.68 \text{ W/K}$$

where:

H_{tr} : Transmission heat transfer coefficient (EN ISO 13789:2017), W/K.

$$U_{mn} = H_{tr} / \sum A_i = 0.61 \text{ W/(m}^2 \cdot \text{K)}$$

where:

U_{mn} : Mean thermal transmittance of building fabric (EN ISO 13789:2017), W/(m²·K).

H_{tr} : Transmission heat transfer coefficient not including heat transfer to adjacent buildings, W/K.

A_i : Área del elemento i de la envolvente térmica excluyendo el área en contacto con edificios adyacentes, m².

	S (m ²)	L (m)	H _i (W/K)	% H _{tr}
Total exchange area of the thermal envelope = 805.914 m ²				
Façades	384.78	--	108.72	22.07
Interior partitions	102.93	--	13.33	2.70
Slab-on-ground floors	127.37	--	37.48	7.61
Floors with their lower surface exposed to the environment	6.55	--	3.19	0.65
Roofs	111.20	--	26.95	5.47
Fenestration	73.09	--	146.18	29.67
Thermal bridge	--	366.941	156.84	31.83

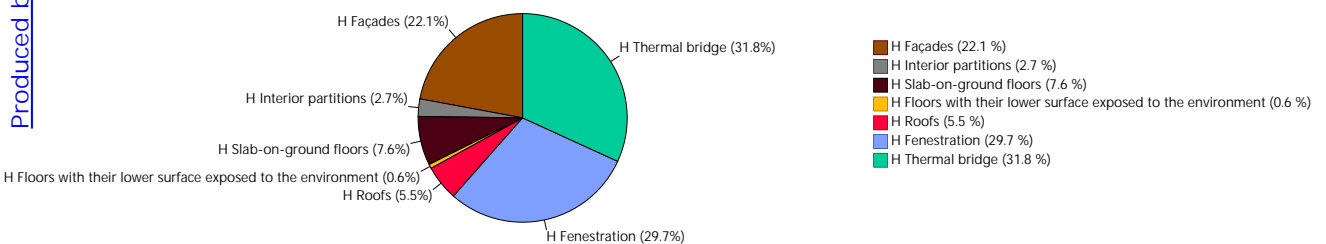
where:

S: Surface, m².

L: Length, m.

H_i: Coeficiente parcial de transferencia de calor por transmisión, W/K.

%H_{tr}: Porcentaje del coeficiente de transferencia de calor por transmisión, %.



1.2. Aire permeability of the thermal envelope

$$n_{50} = 0.629 \cdot (C_o \cdot A_o + C_h \cdot A_h) / V = 3.560 \text{ h}^{-1} \leq n_{50,lim} = 5.000 \text{ h}^{-1}$$

where:

n_{50} : Calculated value of the air change rate with a differential pressure of 50 Pa, h⁻¹.

$n_{50,lim}$: Limit value of the air change rate with a differential pressure of 50 Pa, h⁻¹.

C_o : Coeficiente de caudal de aire de la parte opaca de la envolvente térmica, expresado a 100 Pa, m³/(h·m²).

A_o : Superficie de la parte opaca de la envolvente térmica, m².

C_h : Permeabilidad de los huecos de la envolvente térmica, expresada a 100 Pa, m³/(h·m²).

A_h : Superficie de los huecos de la envolvente térmica, m².

V: Volumen interno de la envolvente térmica, m³.

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2. GEOMETRIC AND CONSTRUCTIVE DESCRIPTION OF THE CALCULATION MODEL

2.1. Space groups.

The characterisation of the thermal envelope of the building is shown below, as well as that of each of the zones that have been included in it:

	S (m ²)	V (m ³)	V _{inf} (m ³)	n ₅₀ (h ⁻¹)	V/A (m ³ /m ²)
Offices - South	189.33	681.34	643.14	3.993	-
Offices - North	143.72	519.94	485.51	4.366	-
Cafeteria	50.51	173.80	171.90	2.915	-
Unconditioned	57.53	267.81	246.23	1.291	-
Thermal envelope	441.10	1642.89	1546.78	3.6	2.0

where:

S: Net internal floor area, m².

V: Internal volume, m³.

V_{inf}: Internal volume to calculate infiltrations, m³.




















n₅₀: Air change rate with a differential pressure of 50 Pa, h⁻¹.

V/A: Compactness (ratio between the enclosed volume and the exchange surface with the outside), m³/m².

2.2. Characterisation of the elements that make up the thermal envelope

2.2.1. Opaque façades

Los cerramientos opacos suponen el 38.50% del coeficiente de transferencia de calor por transmisión (H_{tr})

	Type	S (m ²)	U (W/(m ² ·K))	a	O. (°)	S·U (W/K)
Offices - South						
Facade		105.66	0.28	0.60	Sur(180)	29.85
Facade		85.31	0.28	0.60	Este(90)	24.10
Facade		3.12	0.28	0.60	Oeste(270)	0.88
Party wall		66.35	0.66	0.60	Oeste(270)	43.85
Roof		43.19	0.24	0.60	-	10.47
Creed		71.52	0.29	-	-	21.04
Proposed floor slab		6.55	0.49	0.60	-	3.19
Vertical internal partition		5.09	0.09 (b = 0.22)	-	-	1.99
Vertical internal partition		10.34	0.1 (b = 0.26)	-	-	4.03
Vertical internal partition		5.27	0.1 (b = 0.26)	-	-	2.06
Vertical internal partition		5.07	0.09 (b = 0.22)	-	-	1.98
Vertical internal partition		5.09	0.06 (b = 0.15)	-	-	1.98
Vertical internal partition		16.51	0.08 (b = 0.20)	-	-	6.43
Vertical internal partition		5.07	0.06 (b = 0.15)	-	-	1.98
Vertical internal partition		5.04	0.06 (b = 0.15)	-	-	1.96
Vertical internal partition		4.98	0.06 (b = 0.15)	-	-	1.94
Vertical internal partition		5.17	0.12 (b = 0.32)	-	-	2.01
Vertical internal partition		2.93	0.29 (b = 0.74)	-	-	1.14
Horizontal internal partition		5.50	0.42 (b = 0.92)	0.60	-	2.53
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Type	S (m ²)	U (W/(m ² .K))	a	O. (°)	S-U (W/K)
Offices - North					
Façade	85.32	0.28	0.60	Norte(0)	24.11
Façade	43.00	0.28	0.60	Este(90)	12.15
Party wall	37.23	0.66	0.60	Oeste(270)	24.61
Roof	59.13	0.24	0.60	-	14.33
					75.19

Type	S (m ²)	U (W/(m ² .K))	a	O. (°)	S-U (W/K)
Cafeteria					
Façade	28.50	0.28	0.60	Norte(0)	8.05
Façade	15.43	0.28	0.60	Este(90)	4.36
Party wall	12.96	0.66	0.60	Oeste(270)	8.57
Screed	50.51	0.29	-	-	14.86
					35.84

Type	S (m ²)	U (W/(m ² .K))	a	O. (°)	S-U (W/K)
Unconditioned					
Façade	13.19	0.28	0.60	Sur(180)	3.73
Façade	5.25	0.28	0.60	Este(90)	1.48
Party wall	42.58	0.66	0.60	Oeste(270)	28.14
Roof	8.88	0.24	0.60	-	2.15
Screed	5.34	0.29	-	-	1.57
Vertical internal partition	10.55	0.08 (b = 0.20)	-	-	4.11
Vertical internal partition	3.16	0.08 (b = 0.20)	-	-	1.23
Vertical internal partition	1.28	0.12 (b = 0.32)	-	-	0.50
Vertical internal partition	5.18	0.12 (b = 0.32)	-	-	2.02
Horizontal internal partition	6.68	0.41 (b = 0.89)	0.60	-	3.08
					48.02

where:

- S: Surface, m².
- U: Thermal transmittance, W/(m².K).
- U_{lim}: Applied limit thermal transmittance, W/(m².K).
- b: Temperature reduction coefficient.
- a: Solar absorption coefficient (absorptivity) of the opaque surface.
- O.: Surface orientation (azimuth with respect to the north), °.

2.2.2. Fenestration

Los huecos suponen el 29.67% del coeficiente de transferencia de calor por transmisión (H_{tr}).

	S (m ²)	O. (°)	F _F (%)	U (W/(m ² .K))	S-U (W/K)	g _{gl,n}
Offices - South						
External door	3.36	Sur(180)	-	2.00	6.72	0.70
Window 1	1.04	Sur(180)	-	2.00	2.08	0.70
Window 1	1.04	Este(90)	-	2.00	2.08	0.70
Window 2	3.08	Sur(180)	-	2.00	6.16	0.70
Window 2	3.08	Sur(180)	-	2.00	6.16	0.70
Window 2	3.08	Este(90)	-	2.00	6.16	0.70
Window 2	3.08	Sur(180)	-	2.00	6.16	0.70
Window 2	3.08	Sur(180)	-	2.00	6.16	0.70
Window 2	3.08	Este(90)	-	2.00	6.16	0.70
Window 1	1.04	Oeste(270)	-	2.00	2.08	0.70

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	S (m ²)	O. (°)	F _F (%)	U (W/(m ² ·K))	S·U (W/K)	g _{gl,n}
Window 1	1.04	Sur(180)	-	2.00	2.08	0.70
Window 1	1.04	Este(90)	-	2.00	2.08	0.70
54.09						

	S (m ²)	O. (°)	F _F (%)	U (W/(m ² ·K))	S·U (W/K)	g _{gl,n}
Offices - North						
Window 2	3.08	Norte(0)	-	2.00	6.16	0.70
Window 2	3.08	Norte(0)	-	2.00	6.16	0.70
Window 2	3.08	Norte(0)	-	2.00	6.16	0.70
Window 2	3.08	Este(90)	-	2.00	6.16	0.70
Window 2	3.08	Norte(0)	-	2.00	6.16	0.70
Window 2	3.08	Norte(0)	-	2.00	6.16	0.70
Window 2	3.08	Norte(0)	-	2.00	6.16	0.70
Window 2	3.08	Este(90)	-	2.00	6.16	0.70
External door	3.36	Norte(0)	-	2.00	6.72	0.70
External door	3.36	Norte(0)	-	2.00	6.72	0.70
Window 1	1.04	Este(90)	-	2.00	2.08	0.70
64.81						

	S (m ²)	O. (°)	F _F (%)	U (W/(m ² ·K))	S·U (W/K)	g _{gl,n}
Cafeteria						
Window 2	3.08	Norte(0)	-	2.00	6.16	0.70
Window 2	3.08	Norte(0)	-	2.00	6.16	0.70
Window 2	3.08	Norte(0)	-	2.00	6.16	0.70
Window 1	1.04	Este(90)	-	2.00	2.08	0.70
20.56						









	S (m ²)	O. (°)	F _F (%)	U (W/(m ² ·K))	S·U (W/K)	g _{gl,n}
Unconditioned						
External door	3.36	Sur(180)	-	2.00	6.72	0.70
6.72						

where:

- S: Surface, m².
- O.: Surface orientation (azimuth with respect to the north), °.
- F_F: Opaque part fraction, %.
- U: Thermal transmittance, W/(m²·K).
- U_{lim}: Applied limit thermal transmittance, W/(m²·K).
- g_{gl}: Solar heat gain coefficient.

2.2.3. Thermal bridge

Los puentes térmicos suponen el 31.83% del coeficiente de transferencia de calor por transmisión (H_{tr}).

	Type	L (m)	Y (W/(m·K))	L·Y (W/K)
Offices - South				
Encuentro de fachada con solera		8.020	0.600	4.8
Encuentro de fachada con solera		19.093	0.100	1.9
Esquina saliente de fachadas		10.151	0.500	5.1
Esquina saliente de fachadas		27.049	0.050	1.4
Encuentro de fachada con forjado		22.758	0.525	11.9
Encuentro de fachada con forjado		80.089	0.500	40.0
Encuentro de fachada con cubierta		22.394	0.500	11.2
Encuentro de fachada con voladizo		5.811	0.750	4.4

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Type	L (m)	Y (W/(m·K))	L·Y (W/K)
80.7			

Type	L (m)	Y (W/(m·K))	L·Y (W/K)
Offices - North			
Encuentro de fachada con forjado	16.164	0.525	8.5
Encuentro de fachada con forjado	56.614	0.500	28.3
Esquina saliente de fachadas	10.092	0.500	5.0
Esquina saliente de fachadas	6.748	0.050	0.3
Encuentro de fachada con cubierta	21.746	0.500	10.9
53.0			

Type	L (m)	Y (W/(m·K))	L·Y (W/K)
Cafeteria			
Encuentro de fachada con solera	3.808	0.600	2.3
Encuentro de fachada con solera	15.930	0.100	1.6
Esquina saliente de fachadas	3.403	0.500	1.7
Esquina saliente de fachadas	3.403	0.050	0.2
Encuentro de fachada con forjado	3.808	0.525	2.0
Encuentro de fachada con forjado	15.790	0.500	7.9
15.6			

Type	L (m)	Y (W/(m·K))	L·Y (W/K)
Unconditioned			
Encuentro de fachada con solera	1.821	0.600	1.1
Encuentro de fachada con forjado	9.107	0.525	4.8
Encuentro de fachada con forjado	1.571	0.500	0.8
Encuentro de fachada con cubierta	1.571	0.500	0.8
7.4			

where:

L: Length, m.

Y: Linear thermal transmittance, W/(m·K).

Produced by a version of internal use of VYPE