Pre-design sheet for an exergy optimised building design

IEA ECBCS Annex 37

Steady state calculations for heating case

Version 2.3

Object: *The ZUB Office Building, IEA Annex 37 Demoproject*

1. Project data, boundary conditions

Volume (inside) [m³]	V =	*6882,35*		
Net floor area [m²]	A_N =	*2202,35*		
Indoor air temperature [°C]	θ_i =	*21*		
Exterior air temperature [°C]	θ_e =	*0*	= θ_{ref}	Reference temperature

2. Heat losses

2.1 Transmission losses Φ_T[W]

Building part	Symbols	Area A_i [m²]	Thermal transmittance U_i [W/(m²K)]	$U_i * A_i$ [W/K]	Temperature-correction-factor F_{xi} [-]	$U_i * A_i * F_{xi}$ [W/K]
Exterior wall	EW 1	*430,36*	*0,13*	*55,95*	1	*55,95*
	EW 2	*4,02*	*0,85*	*3,42*	1	*3,42*
	EW 3	*277,71*	*0,27*	*74,98*	0,5	*37,49*
	EW 4	*5,55*	*0,17*	*0,94*	1	*0,94*
Window	W 1	*482,35*	*0,80*	*385,88*	1	*385,88*
	W 2	*64,10*	*0,80*	*51,28*	1	*51,28*
	W 3	*104,62*	*0,90*	*94,16*	1	*94,16*
	W 4	*12,78*	*1,20*	*15,34*	1	*15,34*
Door	D 1	*8,09*	*0,80*	*6,47*	1	*6,47*
Roof	R 1	*368,56*	*0,16*	*58,97*	1	*58,97*
	R 2	*81,83*	*0,17*	*13,91*	1	*13,91*
	R 3				1	
Upper story floor	R 4				0,8	
	R 5				0,8	
Wall to roof rooms	RW 1				0,8	
	RW 2				0,8	
Walls and floors to unheated rooms	uhW 1				0,5	
	uhW 2				0,5	
Floors to ground. Areas of unheated cellar to ground	G 1	*396,07*	*0,26*	*102,98*	0,6	*61,79*
	G 2	*86,09*	*0,20*	*17,22*	0,6	*10,33*
	G 3	*12,06*	*0,20*	*2,41*	0,6	*1,45*
	G 4				0,6	
	G 5				0,6	
$\Sigma A_i = A$ =		*2334,19*	**Specific transmission heat loss $\Sigma U_i * A_i * F_{xi}$ =**			*797,37*

Transmission heat losses [W]

$\Phi_T = \Sigma (U_i * A_i * F_{xi}) * (\theta_i - \theta_e)$

Φ_T = *797,37* * *21,00* **Φ_T =** *16.744,77*

2.2 Ventilation heat losses Φ_V [W]

Air exchange rate [ach/h]	n_d =	*0,6*
Heat exchanger efficiency [-]	η_V =	*0,8*

Ventilation heat losses [W]

$\Phi_V = (cp * \rho * V * n_d * (1-\eta_V)) * (\theta_i - \theta_e)$

Φ_V = *276,67* * *21,00* **Φ_V =** *5.810,08*

3. Heat gains

3.1 Solar heat gains Φ_s [W]

Window frame fraction [-] F_f = *0,3*

Orientation	Solar radiation $I_{s,j}$ [W/m²]	Window area $A_{W,j}$ [m²]	Total transmittance g_j [-]	$I_{s,j} * (1-F_f) * 0.9 * 0.9 * A_{W,j} * g_j$ [1)] [W]
south-east to south-west	20	*435,03*	*0,42*	*2.071,96*
		12,78	*0,58*	*84,06*
north-west to north-east	20	*31,26*	*0,42*	*148,89*
other directions	50	*81,90*	*0,42*	*975,18*
Dormer window with slope < 30°	5			

Solar heat gains: $\Phi_s = \Sigma (I_{s,j} * (1-F_f) * A_{W,j} * g_j)$ **Φ_s =** *3.280,09*

3.2 Internal Heat Gains Φ_i [W]

Number of occupants [-]: no_o = *12,50*

Internal gains of occupants [W]: $\Phi_{i,o} = no_o * \Phi''_{i,o}$

$\Phi_{i,o}$ = *12,50* * *80,00* **$\Phi_{i,o}$ =** *1.000,00*

Spec. internal gains of equipmen $\Phi''_{i,e}$ = *1,36*

Internal gains of equipment [W]: $\Phi_{i,e} = \Phi''_{i,e} * A_N$

$\Phi_{i,e}$ = *1,36* * *2.202,35* **$\Phi_{i,e}$ =** *3.000,00*

4. Other uses

Spec. lighting power [W/m²]: p_l = *2*

Lighting power [W]: $P_l = p_l * A_N = \Phi_{i,l}$

P_l = *2,00* * *2.202,35* **P_l =** *4.404,70*

Spec. ventilation power [Wh/m³]: p_v = *0,54*

Ventilation power [W]: $P_v = pv * V * n_d$

P_v = *0,54* * *6.882,35* * *0,60* **P_v =** *2.229,88*

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