

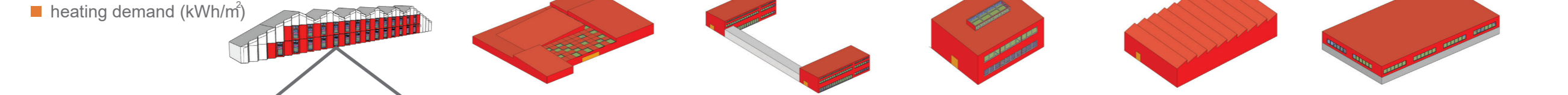
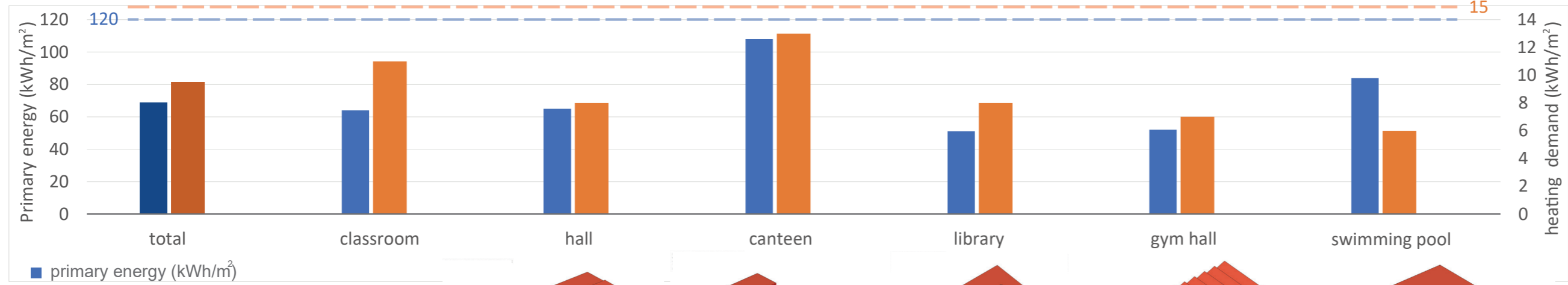
Total annual primary energy consumption: 68.8 kWh/m<sup>2</sup> Total heating demand: 9.5 kWh/m<sup>2</sup>



in partnership with

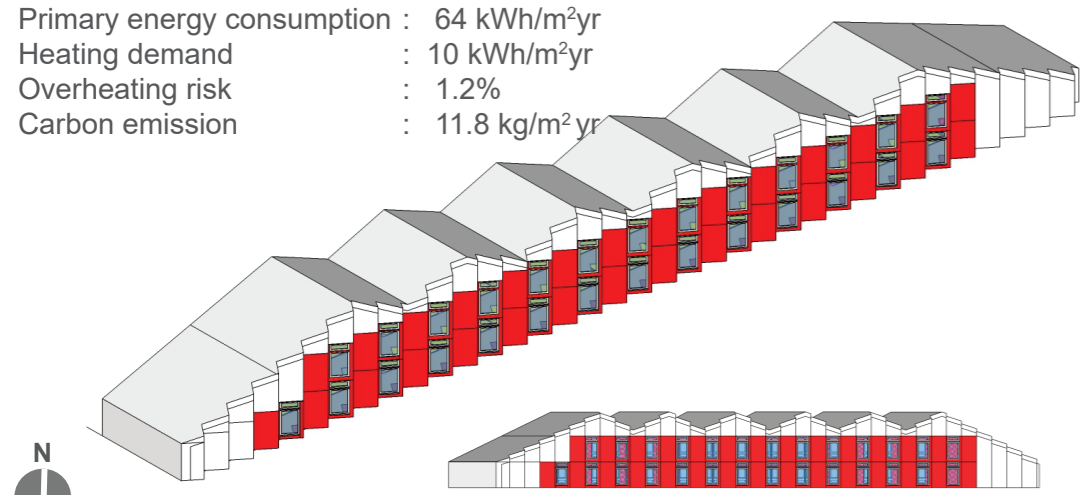


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CLASSROOM BUILDING

Primary energy consumption : 64 kWh/m<sup>2</sup>yr  
Heating demand : 10 kWh/m<sup>2</sup>yr  
Overheating risk : 1.2%  
Carbon emission : 11.8 kg/m<sup>2</sup>yr



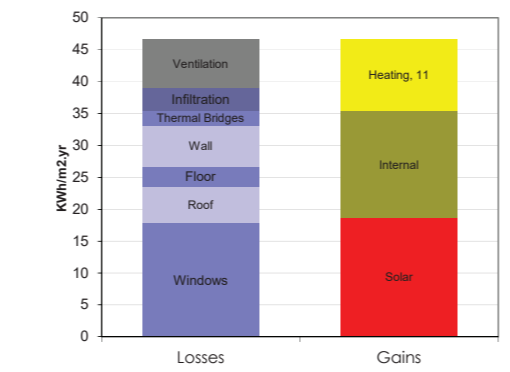
South facade

North facade

East facade

Orientation	Glazing area m <sup>2</sup>
North	226.44
East	2.34
South	113.96
West	0.00
Horizontal	0.00

ANNUAL HEAT BALANCE



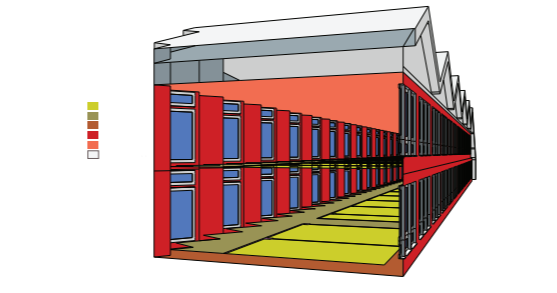
PROJECT OVERVIEW

Specific building demands with reference to the treated floor area		Treated floor area	Requirements	Fulfilled?*
Space heating	Heating demand	1080.9 m <sup>2</sup>	15 kWh/(m <sup>2</sup> a)	yes
	Heating load	10 kWh/(m <sup>2</sup> a)	10 W/m <sup>2</sup>	-
Space cooling	Overall specif. space cooling demand	-	-	-
	Cooling load	-	-	-
	Frequency of overheating (> 25 °C)	1.2 %	-	-
Primary energy	Heating, cooling, dehumidification, DHW, auxiliary electricity, lighting, electrical appliances	64 kWh/(m <sup>2</sup> a)	120 kWh/(m <sup>2</sup> a)	yes
	DHW, space heating and auxiliary electricity	46 kWh/(m <sup>2</sup> a)	-	-
	Specific primary energy reduction through solar electricity	11 kWh/(m <sup>2</sup> a)	-	-
Airtightness	Pressurization test result n <sub>50</sub>	0.6 1/h	0.6 1/h	yes

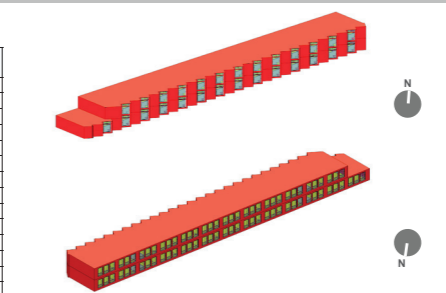
\* empty field: data missing; -: no requirement

AREA DETERMINATION

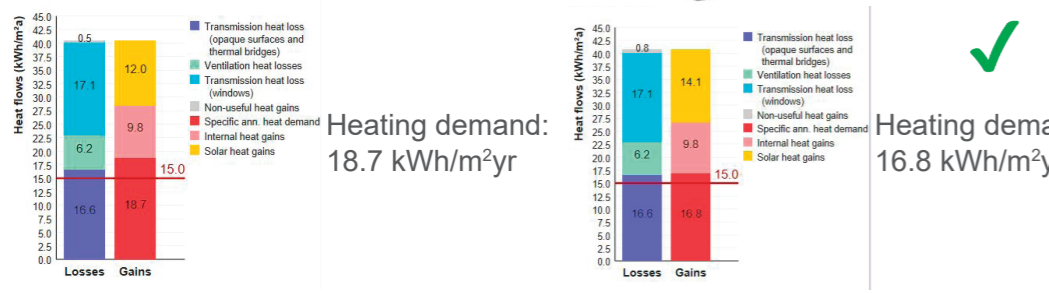
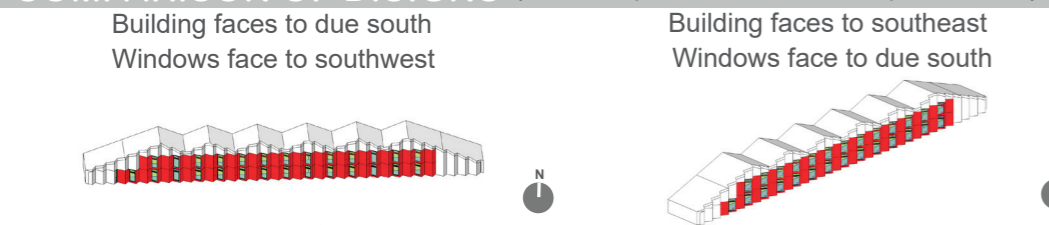
- Treated floor area 100%
- Treated floor area 60% basement ceiling
- External wall
- Roof/ Ceiling
- Shading



Group Nr.	Area group	Temp.-zone	Area	Unit
1	Treated floor area	A	1080.91	m <sup>2</sup>
2	North windows	A	281.25	m <sup>2</sup>
3	East windows	A	2.93	m <sup>2</sup>
4	South windows	A	137.01	m <sup>2</sup>
5	West windows	A	0.00	m <sup>2</sup>
6	Horizontal windows	A	0.00	m <sup>2</sup>
7	Exterior door	A	0.00	m <sup>2</sup>
8	Exterior wall - Ambient	A	996.02	m <sup>2</sup>
9	Exterior wall - Ground	B	0.00	m <sup>2</sup>
10	Roof/Ceiling - Ambient	A	805.30	m <sup>2</sup>
11	Floor slab / Basement ceiling	B	822.13	m <sup>2</sup>
12			0.00	m <sup>2</sup>
13			0.00	m <sup>2</sup>
14		X	0.00	m <sup>2</sup>



COMPARISON OF DISIGNS (before improvement in PPHP spread sheet)



U-VALUE

Hemp-lime wall

Area section	U (W/(m <sup>2</sup> K))	Area section 2 (optional)	U (W/(m <sup>2</sup> K))	Area section 3 (optional)	U (W/(m <sup>2</sup> K))	Thickness (mm)
1 Concrete board	0.210	0.130	0.000	0.000	30	
2 Stone wool	0.033	0.130	0.000	0.000	150	
3 Hemp lime	0.240	0.130	0.000	0.000	300	
4 Air	0.180	0.130	0.000	0.000	25	
5 Air cavity	0.160	0.130	0.000	0.000	30	
6 Cladding	0.350	0.130	0.000	0.000	100	
7	0.000	0.000	0.000	0.000	0	
8	0.000	0.000	0.000	0.000	0	

U-value supplement: 0.00 W/(m<sup>2</sup>K) U-Value: 0.108 W/(m<sup>2</sup>K) Total: 63.5

Polystyrene floor and roof

Area section	U (W/(m <sup>2</sup> K))	Area section 2 (optional)	U (W/(m <sup>2</sup> K))	Area section 3 (optional)	U (W/(m <sup>2</sup> K))	Thickness (mm)
1 Concrete board	0.180	0.000	0.000	0.000	0	
2 Polystyrene	0.020	0.000	0.000	0.000	300	
3	0.000	0.000	0.000	0.000	0	
4	0.000	0.000	0.000	0.000	0	
5	0.000	0.000	0.000	0.000	0	
6	0.000	0.000	0.000	0.000	0	
7	0.000	0.000	0.000	0.000	0	
8	0.000	0.000	0.000	0.000	0	

U-value supplement: 0.00 W/(m<sup>2</sup>K) U-Value: 0.118 W/(m<sup>2</sup>K) Total: 39.0

SHADING FATORS

Surrounding buildings

Orientation	Reduction factor winter r <sub>sw</sub>	Reduction factor summer r <sub>ss</sub>
North	77%	83%
East	36%	65%
South	85%	81%
West	100%	100%
Horizontal	100%	100%

**Design & development**  
Aiming to increase the façade area for BIPVT and windows installation, the south facade of the building is designed as a saw-tooth shape. Many iterations have been analysed in the designPH. Two key scenarios, which have different orientations, are shown in this report. The facade of basic one faces to due south and the window faces to the southwest, which shows 18.7 kWh/m<sup>2</sup>yr of heating demand. To decrease the heating demand, another scenario changes the orientation of the building that windowss face to due south and building face to the southeast. The result shows that the heating demand has been reduced to 16.8 kWh/m<sup>2</sup>yr because of the solar gain increment. After modified the developed scenario by improving the window frames thermal insulation and adding MVHR system, the class building unit gets 68 kWh/m<sup>2</sup>yr primary energy consumption with 10 kWh/m<sup>2</sup>yr.

