Project Documentation
Gebäude-Dokumentation

Abstract | Zusammenfassung

2 Residentian Passive House Towers in Tianjin Eco-City ID: 6119

Data of building | Gebäudedaten

Year of construction Baujahr	2019	**Space heating Heizwärmebedarf**	**14 kWh/(m²a)**
U-value external wall U-Wert Außenwand	0,138 W/(m²K)		
U-value basement U-Wert Kellerdecke	0,135 W/(m²K)	Primary Energy Renewable (PER) Erneuerbare Primärenergie (PER)	62 kWh/(m²a)
U-value roof U-Wert Dach	0,144 W/(m²K)	Generation of renewable Energy Erzeugung erneuerb. Energie	34 kWh/(m²a)
U-value window U-Wert Fenster	0,81 W/(m²K)	Non-renewable Primary Energy (PE) Nicht erneuerbare Primärenergie (PE)	104 kWh/(m²a)
Heat recovery Wärmerückgewinnung	85 %	Pressurization test n_{50} Drucktest n_{50}	0,24 h^{-1}
Special features Besonderheiten	Split air-cooled heat pump as cold and heat source; Air-cooled heat pump with re-circulation air for each dwelling; Solar hot water 80%.		

Project Documentation
Gebäude-Dokumentation

Abstract | Zusammenfassung

2 Residentian Passive House Towers in Tianjin Eco-City ID: 6121

Data of building | Gebäudedaten

Year of construction Baujahr	2019	**Space heating** **Heizwärmebedarf**	**12** **kWh/(m²a)**
U-value external wall U-Wert Außenwand	0,138 W/(m²K)		
U-value basement U-Wert Kellerdecke	0,135 W/(m²K)	Primary Energy Renewable (PER) Erneuerbare Primärenergie (PER)	62 kWh/(m²a)
U-value roof U-Wert Dach	0,144 W/(m²K)	Generation of renewable Energy Erzeugung erneuerb. Energie	43 kWh/(m²a)
U-value window U-Wert Fenster	0,81 W/(m²K)	Non-renewable Primary Energy (PE) Nicht erneuerbare Primärenergie (PE)	104 kWh/(m²a)
Heat recovery Wärmerückgewinnung	85 %	Pressurization test n_{50} Drucktest n_{50}	0,24 h^{-1}
Special features Besonderheiten	Split air-cooled heat pump as cold and heat source; Air-cooled heat pump with re-circulation air for each dwelling; Solar hot water 80%.		

Brief Description

Passive House Darmstadt Kranichstein

Two residential high-rise buildings of 18 floors within a larger master plan development in Tianjin's Sino-Singapore Eco-City. The project is initiated by the local government of Tianjin Eco-City with the support of SoftGrid (Shanghai) and the Passive House Institute (PHI), Darmstadt. The treated Floor Area according to PHPP is 4227 m2 for project ID: 6119 and 5021 m2 for project ID: 6121.
The idea behind the project is to integrate the passive house standard into a pilot project of a standard residential building and thus to develop the base for a local passive house standard to be mass replicated in future in the region of Tianjin.
The process consisted of optimizing the architectural layout, changing all construction details so that they can comply with the requirements of the PH standard, rethinking the building services and all technical equipment.
The used construction products are predominantly local, imported solutions were only used where there was no local alternative on the market.
The construction costs are estimated at 1020 €/m^2 Treated Floor Area (Costs of group 200-700)

Kurzbeschreibung

Passivhaus Darmstadt Kranichstein

Zwei 18-stöckige Wohnhochhäuser in einem größeren Masterplan in Tianjins Öko-Stadt Sino-Singapur. Das Projekt wird von der lokalen Regierung von Tianjin Eco-City mit Unterstützung von SoftGrid (Shanghai) und dem Passivhaus-Institut (PHI) in Darmstadt initiiert.
Die nach PHPP behandelte Grundfläche beträgt 4227 m2 für Projekt-ID: 6119 und 5021 m2 für Projekt-ID: 6121.
Die Grundidee hinter dem Projekt ist es, den Passivhausstandard in ein Pilotprojekt eines Standardwohngebäudes zu integrieren und damit die Basis für einen lokalen Passivhausstandard zu entwickeln, der in Zukunft in der Region Tianjin massenrepliziert werden kann. Während der Planung wurde das architektonische Layout optimiert, alle Konstruktionsdetails wurden geändert und verbessert, damit sie den Anforderungen des PH-Standards entsprechen, die Gebäudetechnik und die gesamte technische Ausstattung wurden auch angepasst. Die verwendeten Bauprodukte sind überwiegend lokal, importierte Lösungen wurden nur dort eingesetzt, wo es keine lokale Alternative auf dem Markt gab.
Die Baukosten wurden auf 1020 € / m2 geschätzt (Kostengruppe 200-700).

Responsible project participants
Verantwortliche Projektbeteiligte

Architect Entwurfsverfasser	Tianjin Architectural Design Institute (LDI)
Implementation planning Ausführungsplanung	Tianjin Architectural Design Institute (LDI)
Building systems Haustechnik	Tianjin Architectural Design Institute (LDI)
Structural engineering Baustatik	Tianjin Architectural Design Institute (LDI)
Building physics Bauphysik	Tianjin Architectural Design Institute (LDI)
Passive House project planning Passivhaus-Projektierung	SoftGrid (Shanghai) and Energy Design Shanghai, www.soft-grid.com, www.energydesign-asia.com
Construction management Bauleitung	China Construction Third Engineering Bureau Co., Ltd.

Certifying body
Zertifizierungsstelle

Passivhaus Institut Darmstadt
www.passiv.de

Certification ID
Zertifizierungs ID

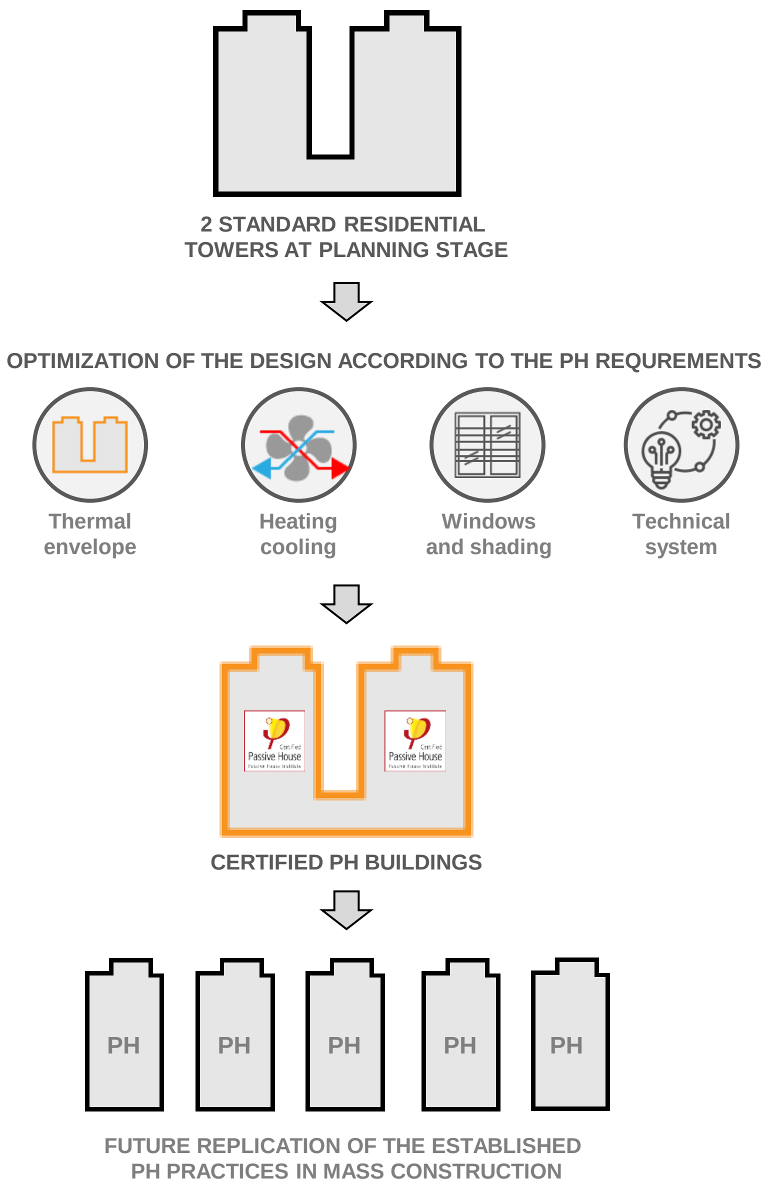
6119 **6121**	Project-ID (www.passivehouse-database.org) Projekt-ID (www.passivhausprojekte.de)

Author of project documentation
Verfasser der Gebäude-Dokumentation

Passivhaus Institut Darmstadt
www.passiv.de

Date Datum	Signature Unterschrift
30.12.2020	

Project background and purpose



The idea behind the project was to integrate the PH standard into a pilot project of a standard residential building and thus to develop the base for a local PH standard to be mass replicated in future in the region of Tianjin.

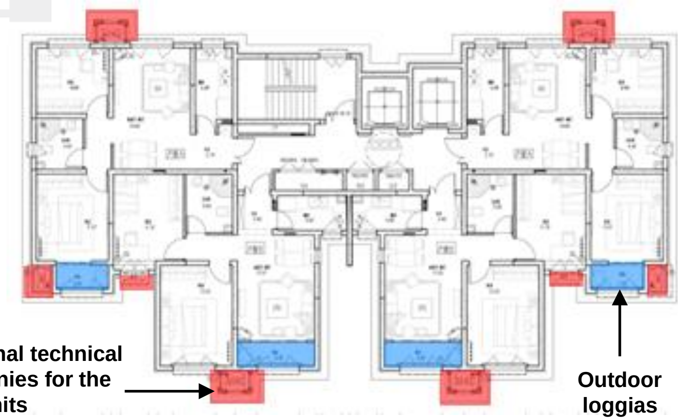
The process consisted of optimizing the architectural layout, changing all construction details to comply with the requirements of the PH standard, rethinking the building services and all technical equipment.

The used construction products are predominantly local, imported solutions were only used where there was no local alternative on the market.

Thermal envelope: Layout optimization

4

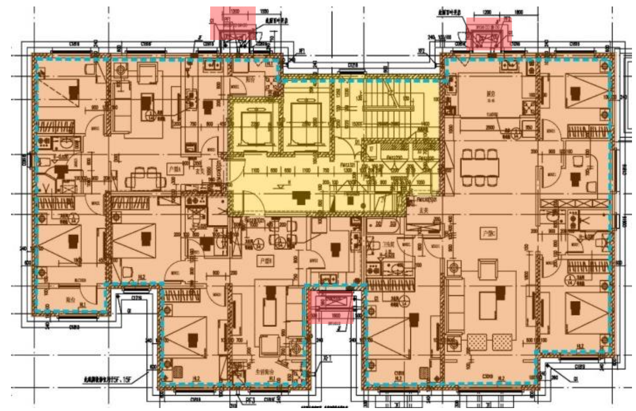
INITIAL LAYOUT



External technical balconies for the AC units

Outdoor loggias

OPTIMIZED LAYOUT



The outlines of the thermal volume are simplified in order to improve the S/V ratio.

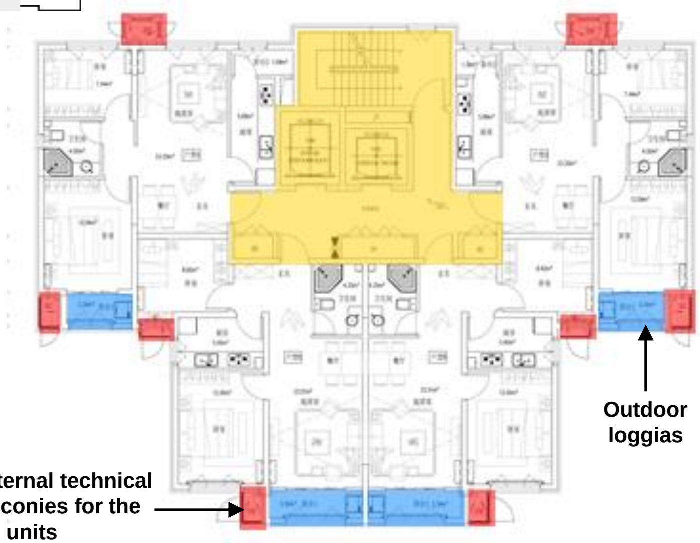
The outdoor loggias are integrated into the thermal envelope.

The number of technical balconies is reduced

- conditioned, in thermal envelope
- unconditioned, in thermal envelope
- airtight layer

5

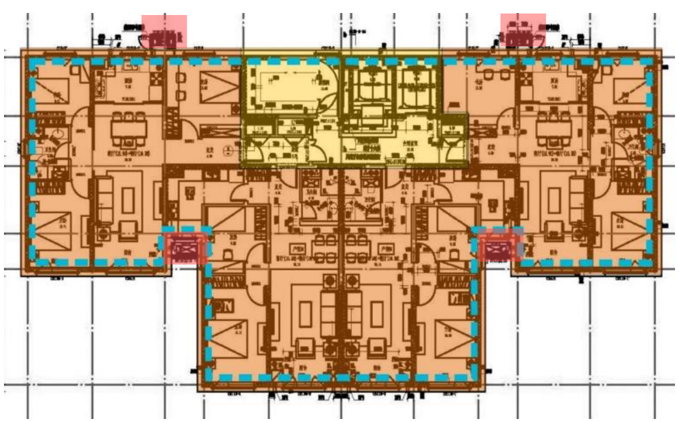
INITIAL LAYOUT



Outdoor loggias

External technical balconies for the AC units

OPTIMIZED LAYOUT



The outlines of the thermal volume are simplified in order to improve the S/V ratio.

The shape and the size of the core is optimized

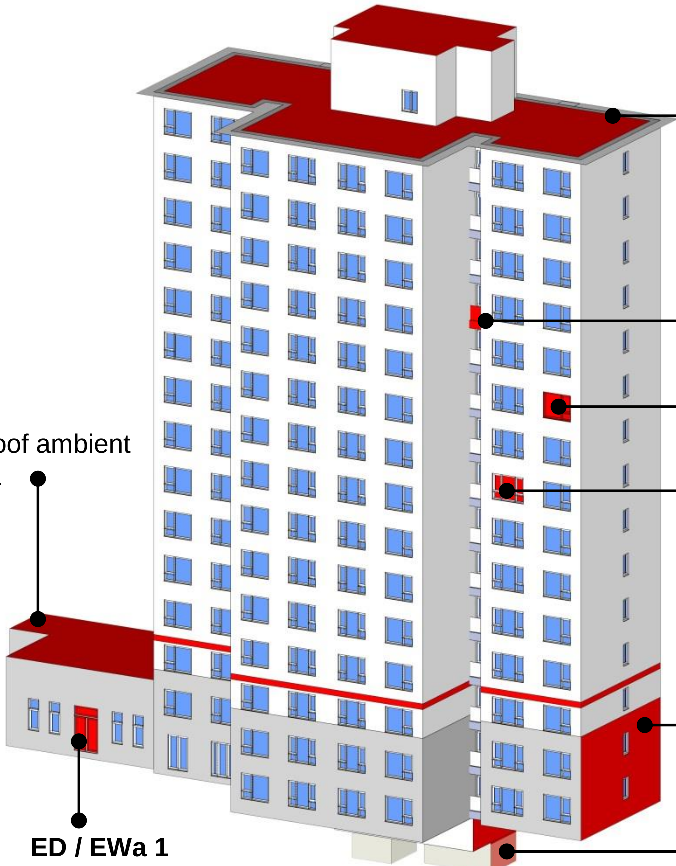
The outdoor loggias are integrated into the thermal envelope.

The number of technical balconies is reduced

Thermal envelope: Elements coding

Passive House Institute

Example of elements coding:

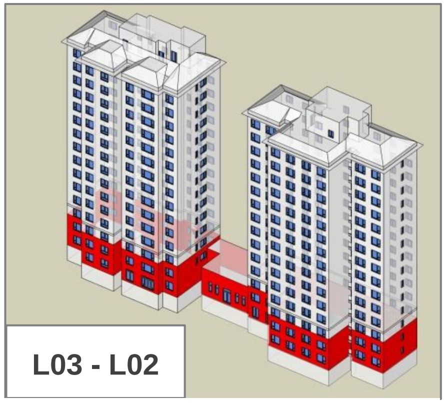


Elements coding:

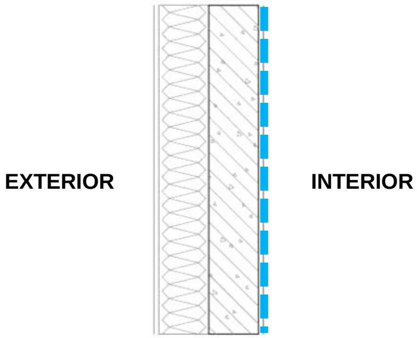
For the purpose of understanding the project better and sharing the project documentation among all parties involved in the project planning, an element coding was developed.
Individual codes, corresponding to each relevant element of the building was implemented into the Design books, designPH model, PHPP calculations.

Assigning names to the elements helped tremendously the communication process, making it easier to avoid potential mistakes.

Thermal envelope: Walls



Because of fire safety regulation, the lower levels are insulated by mineral wool

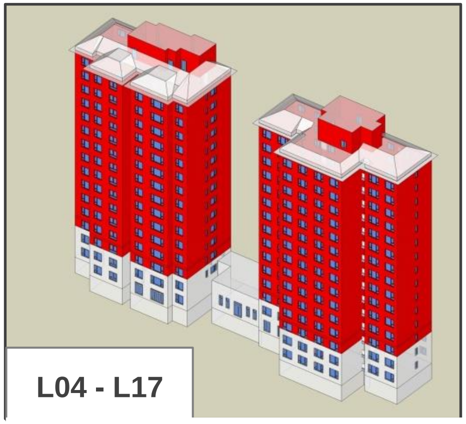


EXTERIOR WALLS

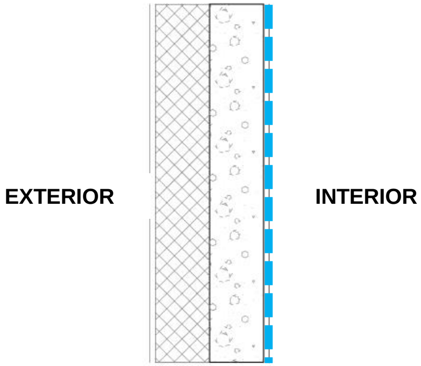
For fire safety reasons, there are 2 types of exterior walls insulation in this project Mineral wool for the lower levels and EPS for the upper floors

EWa1 - External Wall Ambient 1

internal plaster - 0.930 W/(m2K) – 20 mm
concrete - 1.740 W/(m2K) – 200 mm
mineral wool - 0.04 W/(m2K) – 240 mm
external plaster - 0.930 W/(m2K) – 20 mm



The rest of the building is insulated with EPS, whereas each level has fire safety rings from Mineral wool

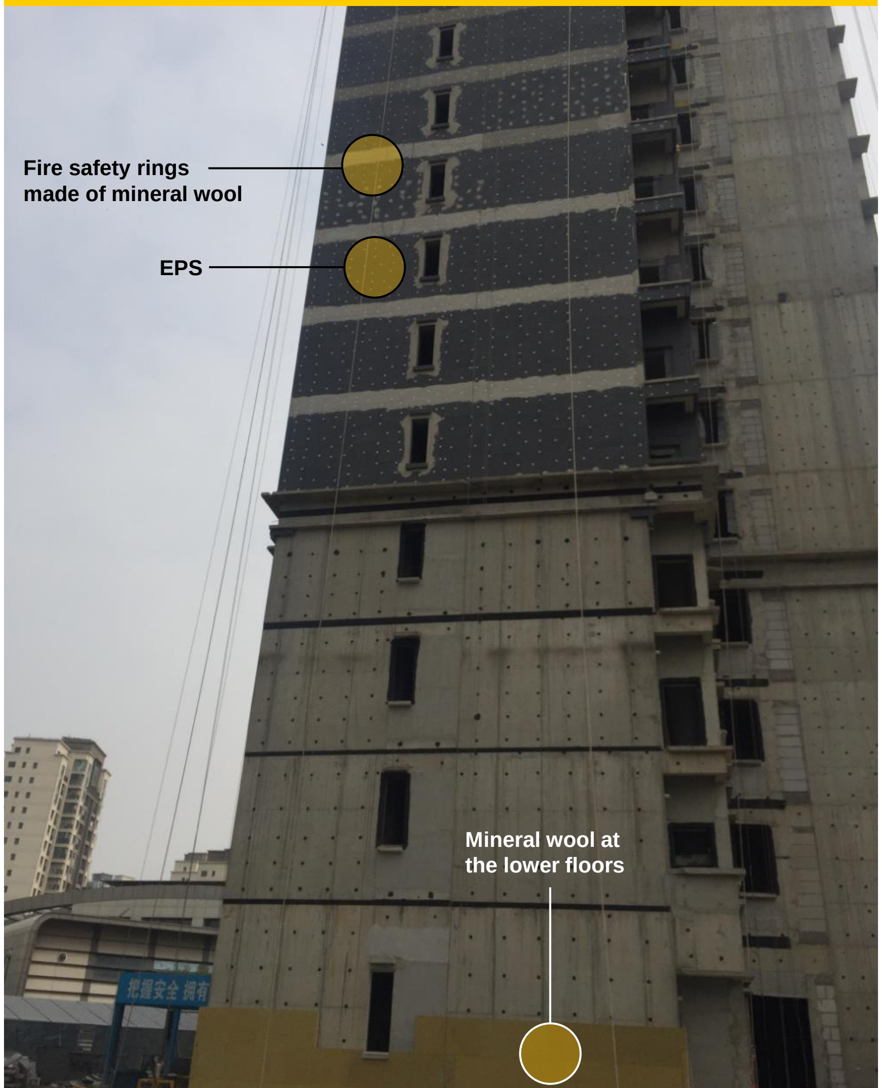


EWa2 - External Wall Ambient 2

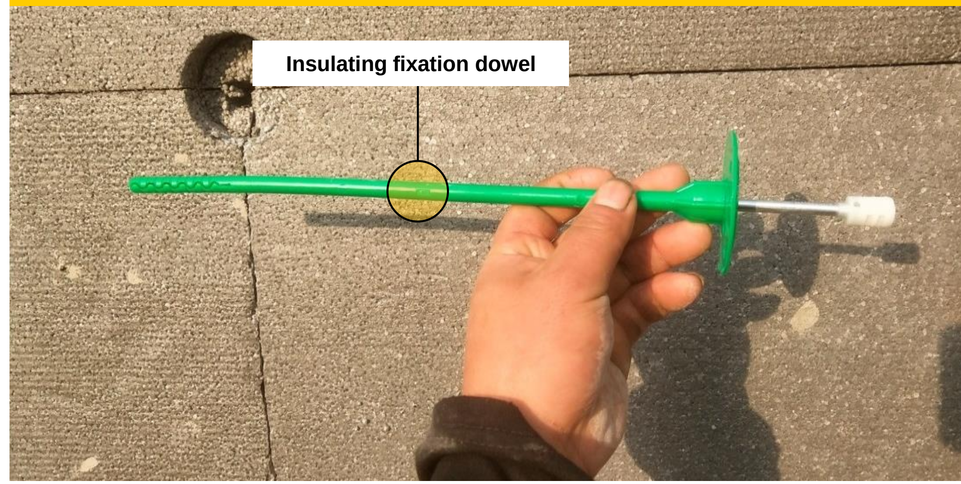
internal plaster - 0.930 W/(m2K) – 20 (mm)
concrete 1.740 W/(m2K) – 200 mm
EPS - 0.033 W/(m2K) – 240 mm
external plaster - 0.930 W/(m2K) – 20 mm

Thermal envelope: Walls – site images

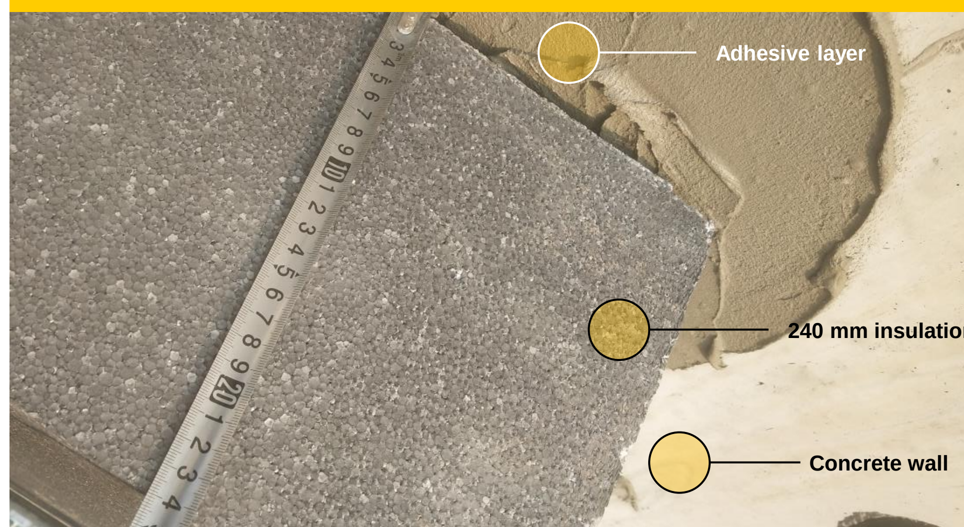
Installation of the thermal insulation



Installation of the thermal insulation



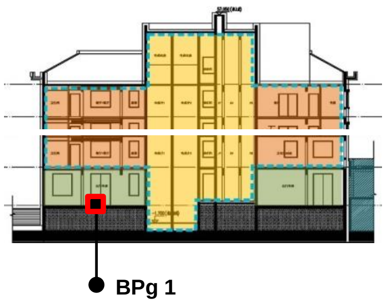
Installation of the thermal insulation

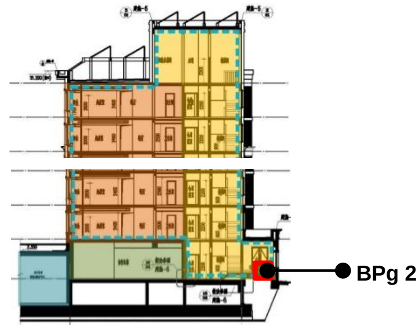


Images owned by Softgrid (Shanghai)

Thermal envelope: Basement / Floor slabs

Passive House Institute





- conditioned, in the thermal envelope
- unconditioned, in the thermal envelope
- unconditioned, out of the thermal envelope
- unconditioned, in the thermal envelope
- airtight layer

BPg 1 – Implemented solution

“Baseplate ground” under unconditioned ground floor, outside the thermal envelope

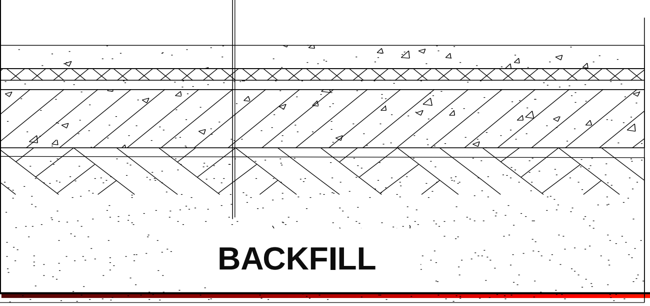
40mm C20 fine aggregate concrete

40mm C15 fine aggregate concrete

20mm XPS

150mm concrete

BACKFILL



BPg 2 – Implemented solution

“Baseplate ground” under conditioned spaces, whithin the thermal envelope

10mm flooring

20mm screed

50mm C15 fine aggregate concrete

20mm screed

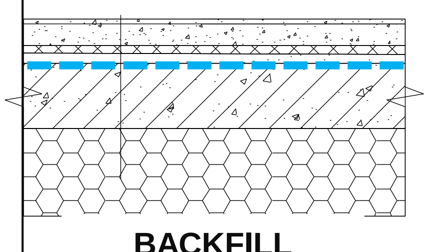
1.5mm high polymer waterproof paint

120mm concrete

200mm XPS

Cement plaster

BACKFILL



Description of the detail solution

According to the planning, the ground floor had to remain unconditioned and only the core remained entirely in the thermal envelope. This resulted in different detail solutions for the Baseplate at GF level.
The unconditioned spaces require no insulation under the baseplate and the spaces within the thermal envelope have 200 mm of XPS under the baseplate.

Thermal envelope: Floor slabs – site images

Passive House Institute

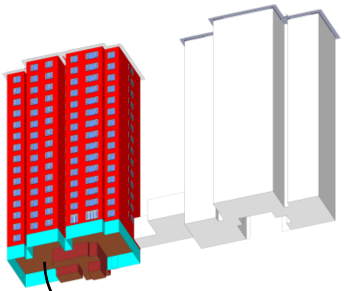
Insulation of base plate under conditioned spaces – site images

Insulation of base plate under conditioned spaces – site images

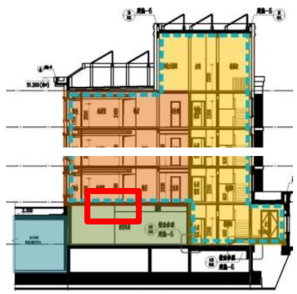
Insulation of base plate under conditioned spaces – site images

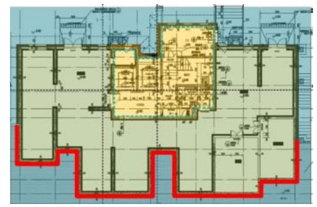
Images owned by Softgrid (Shanghai)

Thermal envelope – Unconditioned ground floor



GF is unconditioned and also adjacent to the underground parking

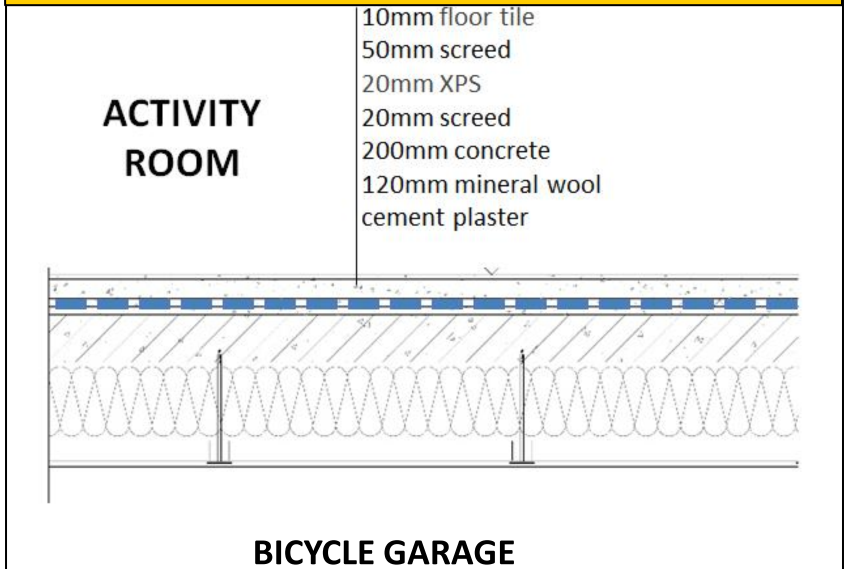




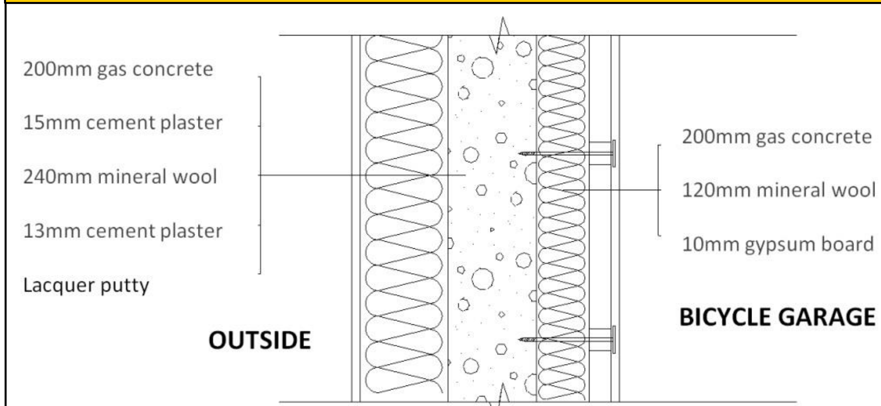
Description of the detail solution

According to the planning, the ground floor (GF) had to remain unconditioned and only the core remained entirely in the thermal envelope.
This required insulation of the GF ceiling using 200 mm mineral wool. As well of the internal walls and the columns.
Even though the GF was separated from the thermal envelope, in order to avoid thermal bridges and to keep the integrity of the wall system, the GF walls were also insulated on the outside.
The used products for windows and the doors of the unconditioned GF are the same as for the rest of the building.

Implemented solution - Ceiling



Implemented solution – External wall



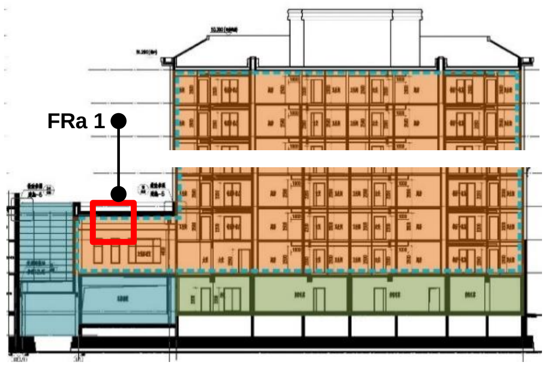
Thermal envelope:Unconditioned GF – site images

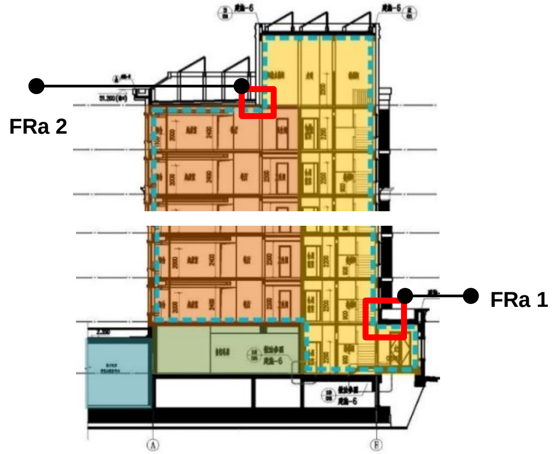
Passive House Institute

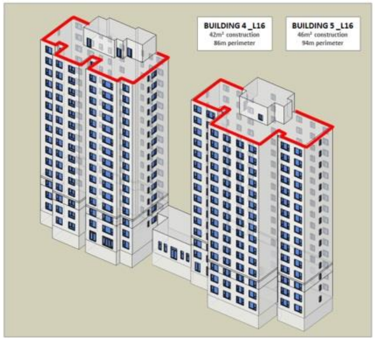
Insulation of GF ceiling – site image

Insulation of GF wall – site image

Thermal envelope: Roofs

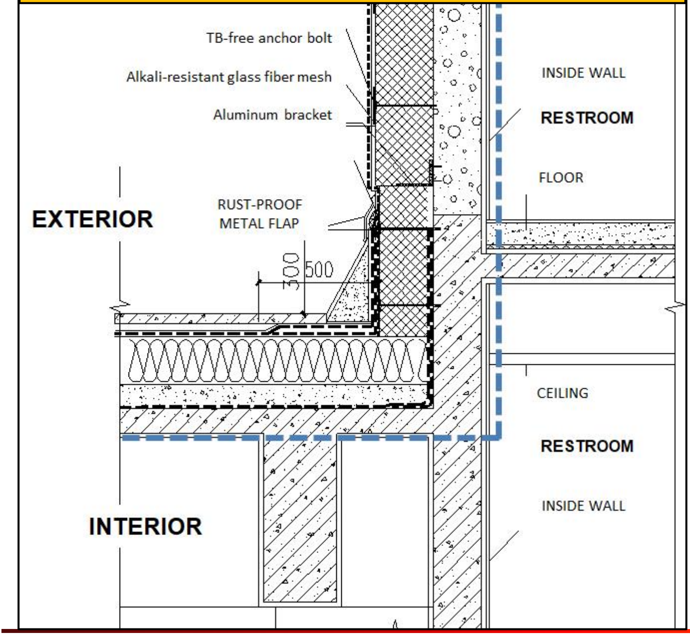




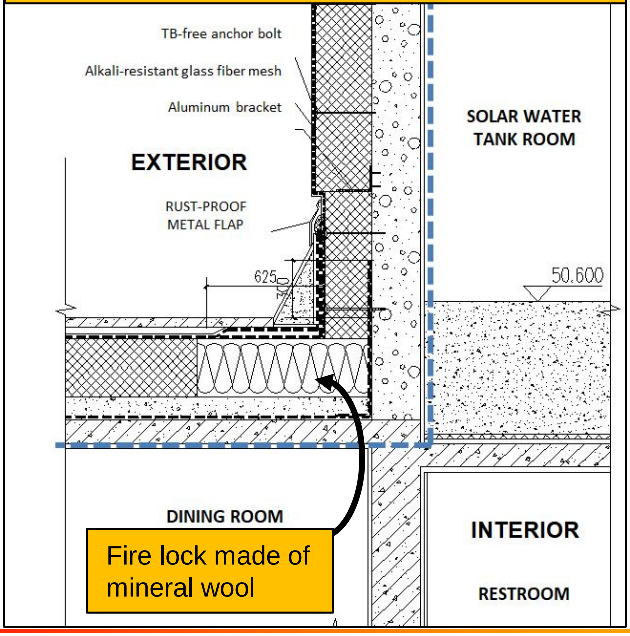


Fire locks – for fire safety reasons, there is a fire lock made of mineral wool at the perimeter of the roofs.

Implemented solution – lower levels
Flat roofs at the lower levels are insulated with mineral wool for fire safety reasons



Implemented solution – upper levels
Flat roofs at the top levels are insulated with XPS with a fire ring of mineral wool on the perimeter



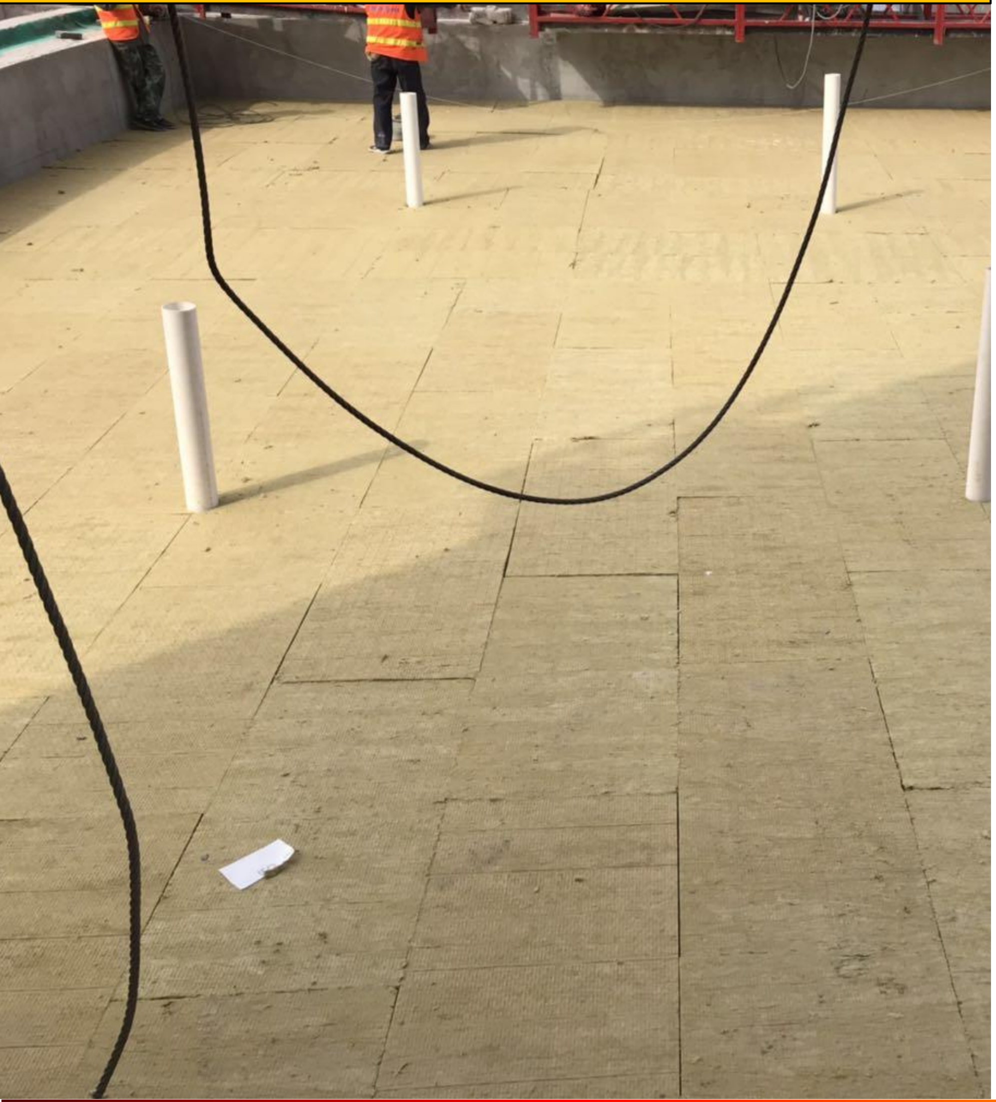
Description of the detail solution

There are special fire safety requirements In China regarding high rise buildings. In order to avoid rapid spread of fire fueled by the organic components in the XPS, roofs at lower levels shall be insulated by mineral wool.

Similar preventive measure is implemented at the top levels, where a fire safety lock made of mineral wool is applied at the outer perimeter of the roofs.

Thermal envelope: Roofs – site images

Site image - Flat roofs at the lower levels are insulated with mineral wool for fire safety reasons



Mockup room image - Flat roofs at the top levels are insulated with XPS with a fire safety ring of mineral wool on the outer perimeter

Images owned by Softgrid (Shanghai)

Thermal envelope: Doors

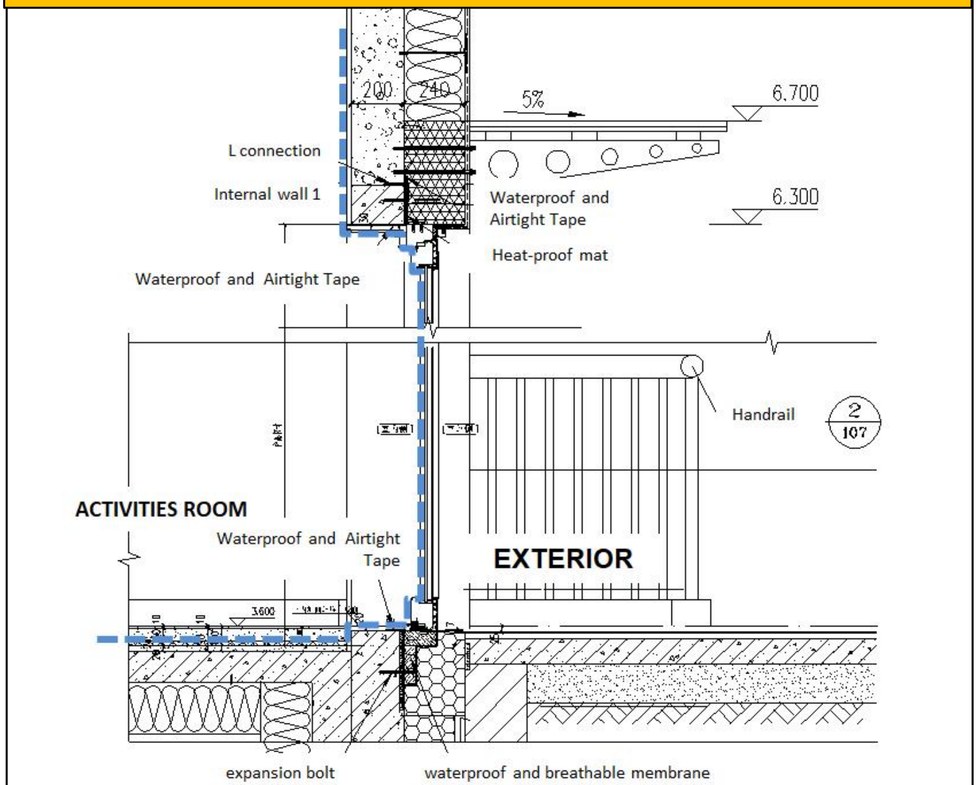
Passive House Institute

Description of the detail solution

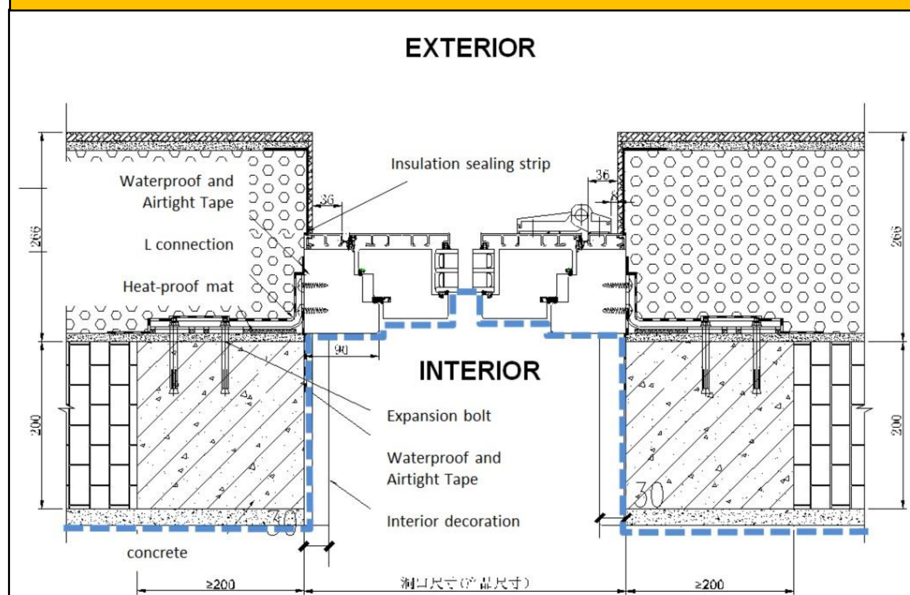
Doors, bordering the thermal envelope: the doors are installed in the thermal layer, following the principles of the passive house standard.
The entrance platforms are separated by thermal insulation from the walls in which the doors are installed.

The exterior doors are also locally supplied and are manufactured by Sayyas - same producer as the windows.

Implemented solution
Vertical section detail of an entrance door bordering the thermal envelope



Implemented solution
Horizontal section of an entrance door bordering the thermal envelope



Thermal envelope: Doors – site images

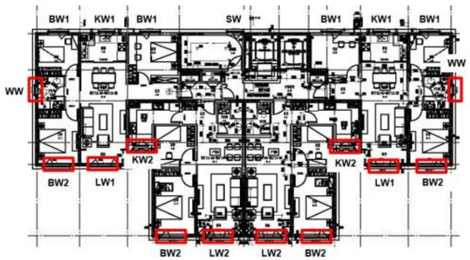
Passive House Institute

Exterior doors at the building entrances

Images owned by Softgrid (Shanghai)

Thermal envelope: Windows with shading

Passive House Institute

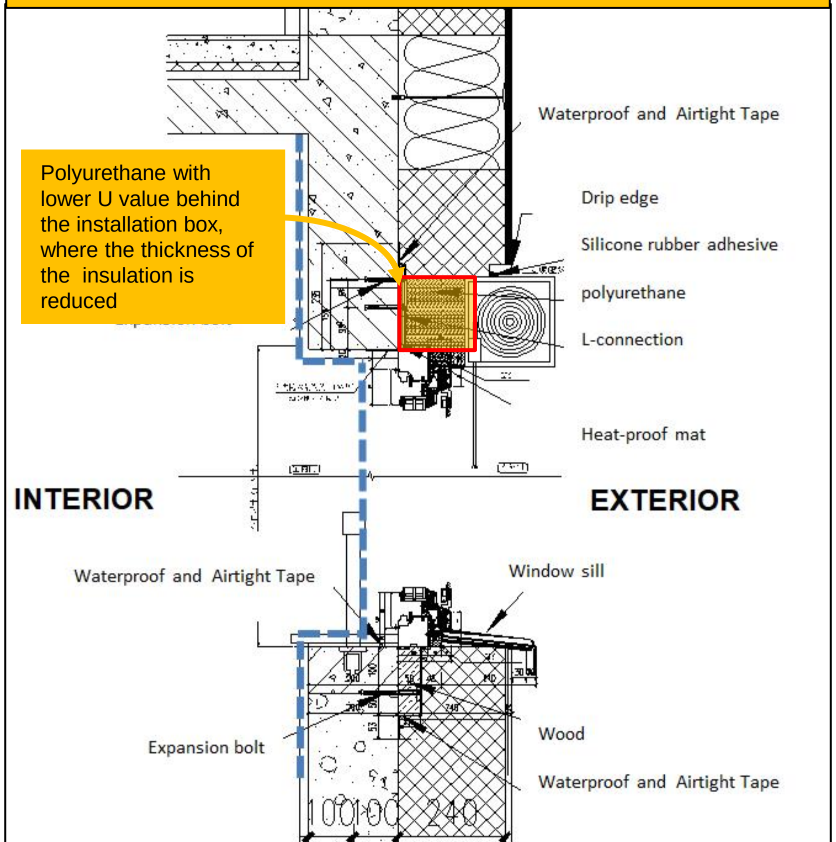


Description of the detail:

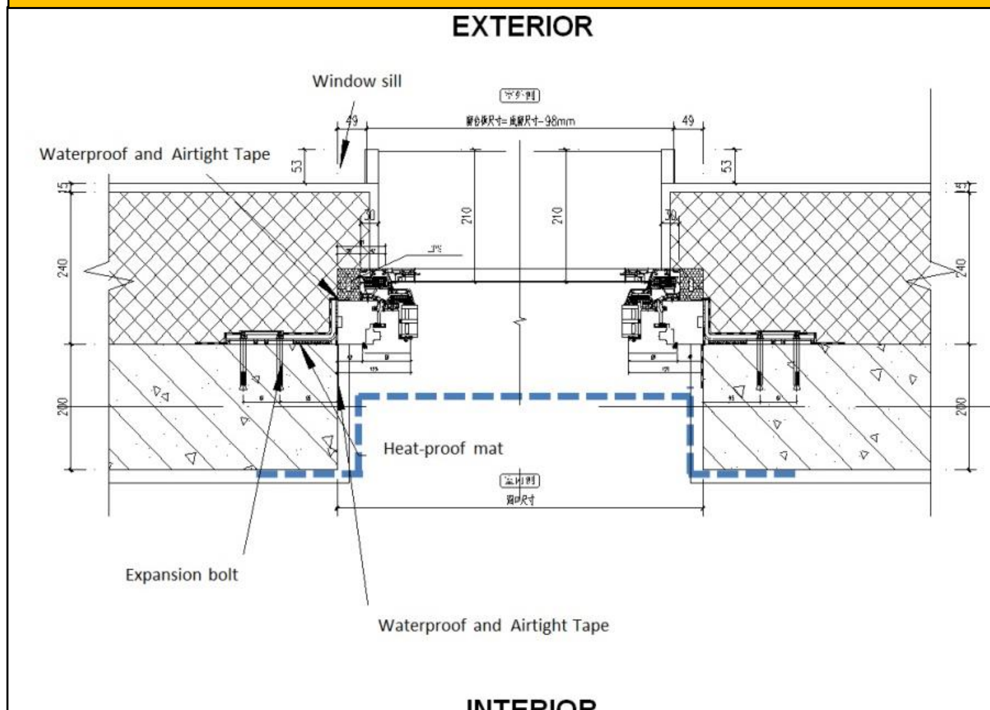
The windows are PH certified and locally supplied by Sayyas.
All windows on the South, West and East façade are equipped with operable, wind resistant shading.

Comfort U = 0.80 0.80 W/(m2 K)
U;installed 0.85 W/(m2 K)
with Ug = 0.70 W/(m2 K)
Hygiene fRsi=0.25 0.70

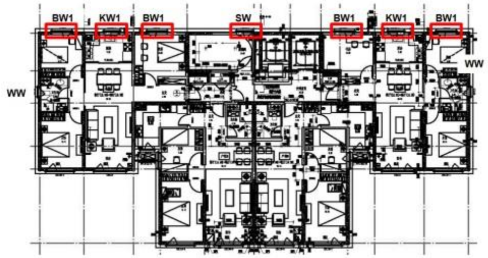
Implemented solution
Vertical section detail of a window with shading



Implemented solution
Horizontal section detail of a window with shading



Thermal envelope: Windows without shading

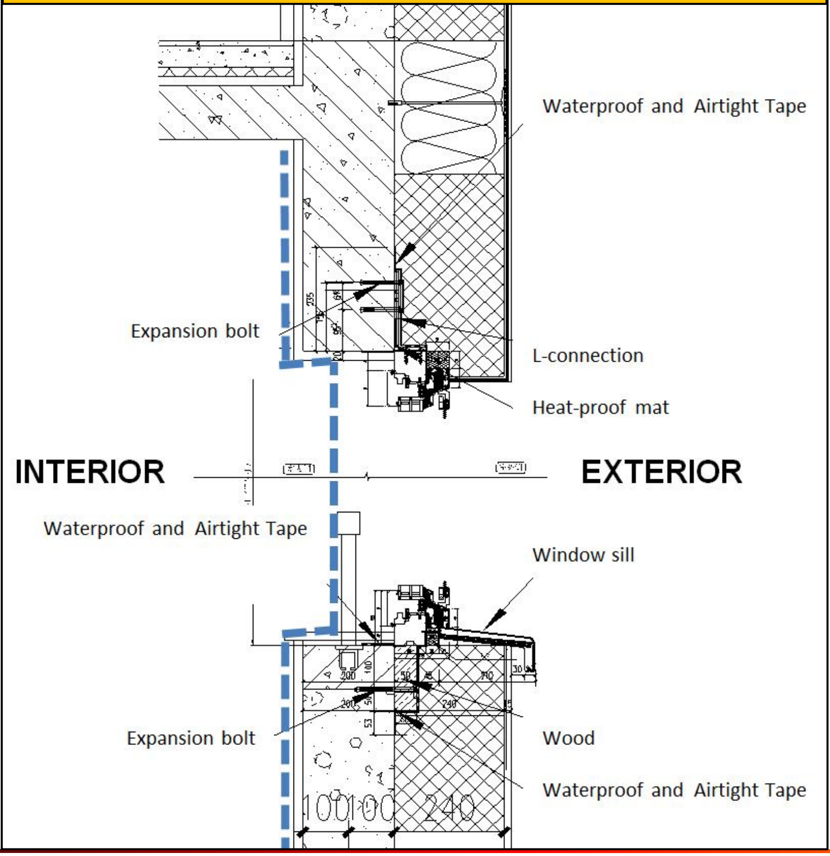


Description of the detail:

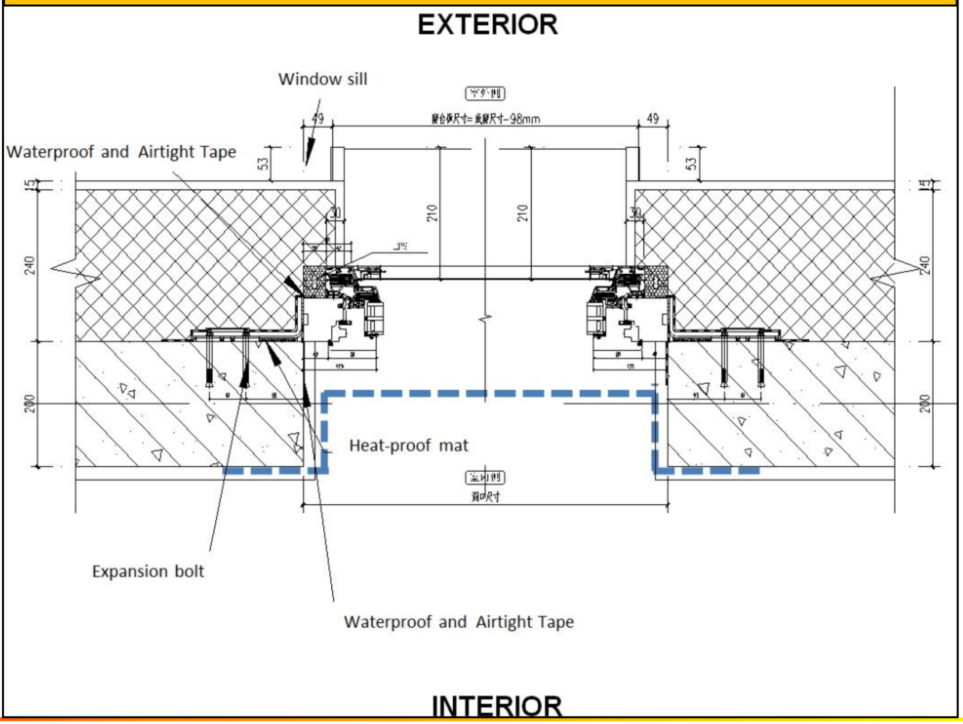
According to the calculation and the climate location of the building, the windows on the North façade do not need shading.

Comfort U = 0.80 0.80 W/(m2 K)
U;installed 0.85 W/(m2 K)
with Ug = 0.70 W/(m2 K)
Hygiene fRsi=0.25 0.70

Implemented solution
Vertical section detail of a window with shading

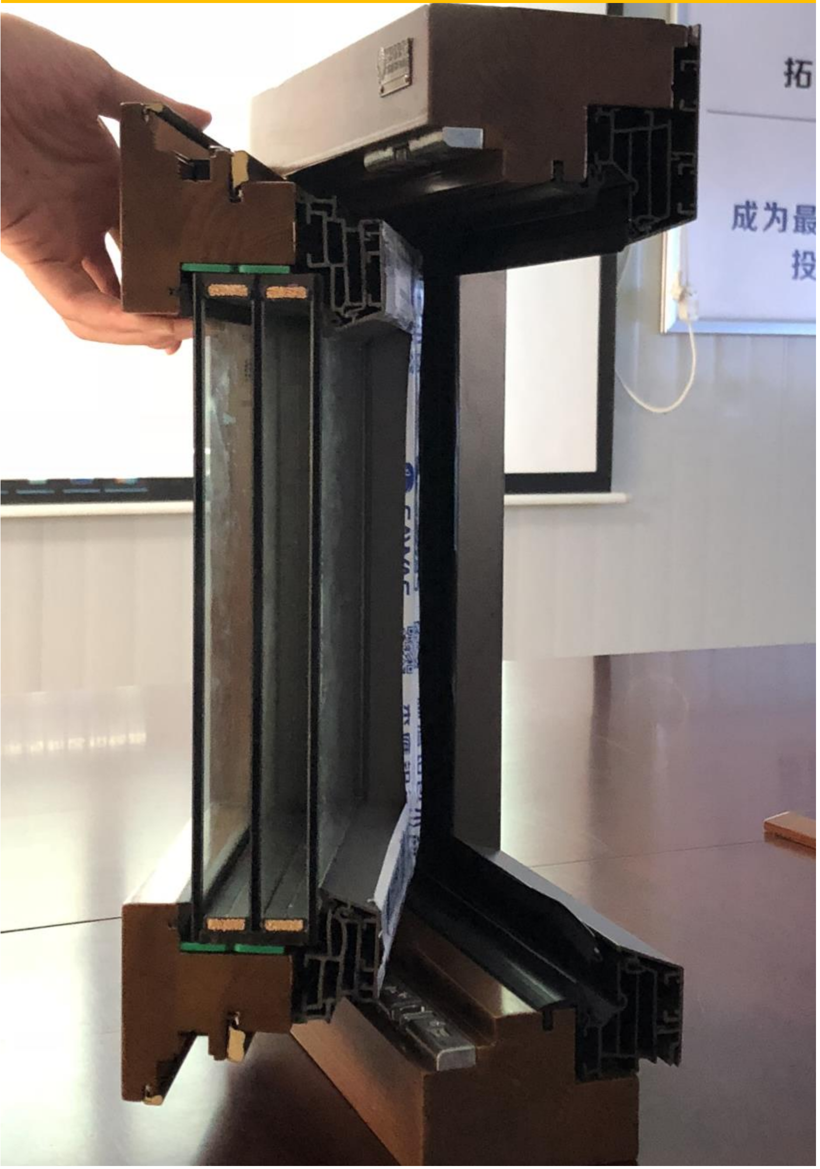


Implemented solution
Horiyontal section detail of a window with shading



Thermal envelope: Windows – mock up room

PH Window product - Sayyas



Wall section with installed window

Images owned by Softgrid (Shanghai)

Thermal envelope: Windows - site images

Installation of windows – site photos

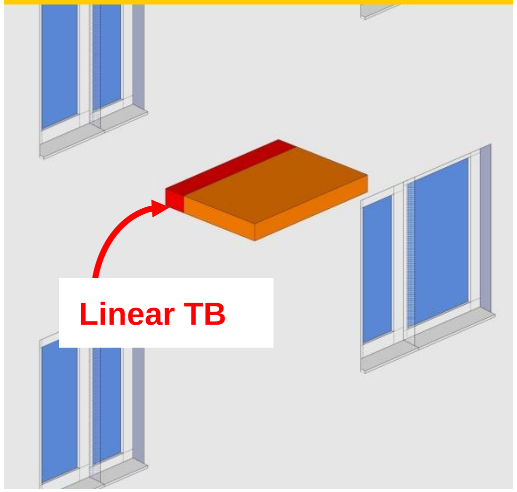
Window after airtight sealing

Images owned by Softgrid (Shanghai)

Thermal envelope: Technical balconies

The technical balconies are located at each level on the North and South façades of the buildings and are used to support the external conditioning units.

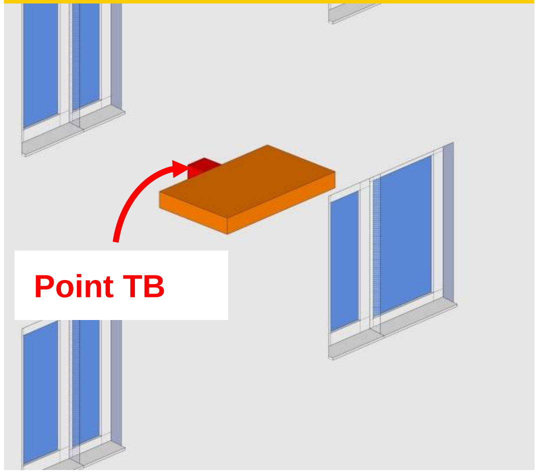
Initial solution



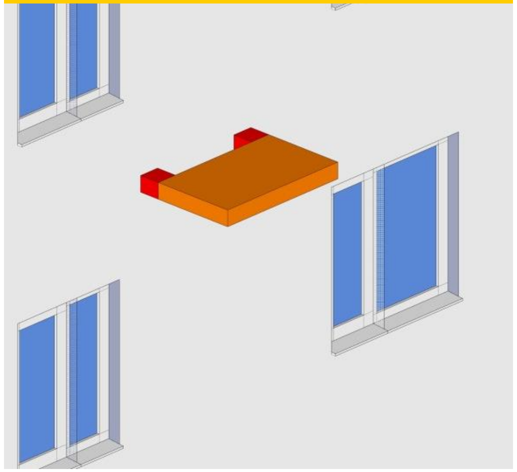
Description of the detail solution

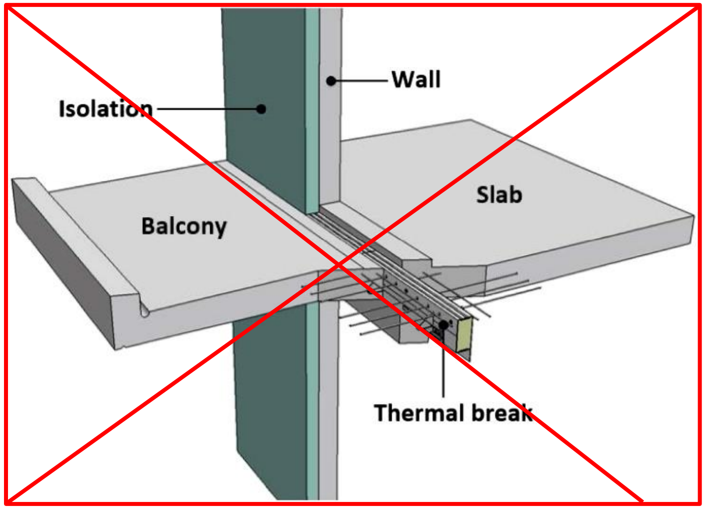
In China, thermal breaks are not available on the market and forbidden to use in highrise buildings. As an imported product, this would also have added high extra cost to the project budget.
At the same time, the initial detail would have caused big thermal losses, so a special solution was developed to answer the requirements of the high rise static and to minimize the thermal bridges at those locations.

Single beam optimization



Double beam optimization





This solution is not permitted for highrise buildings in China

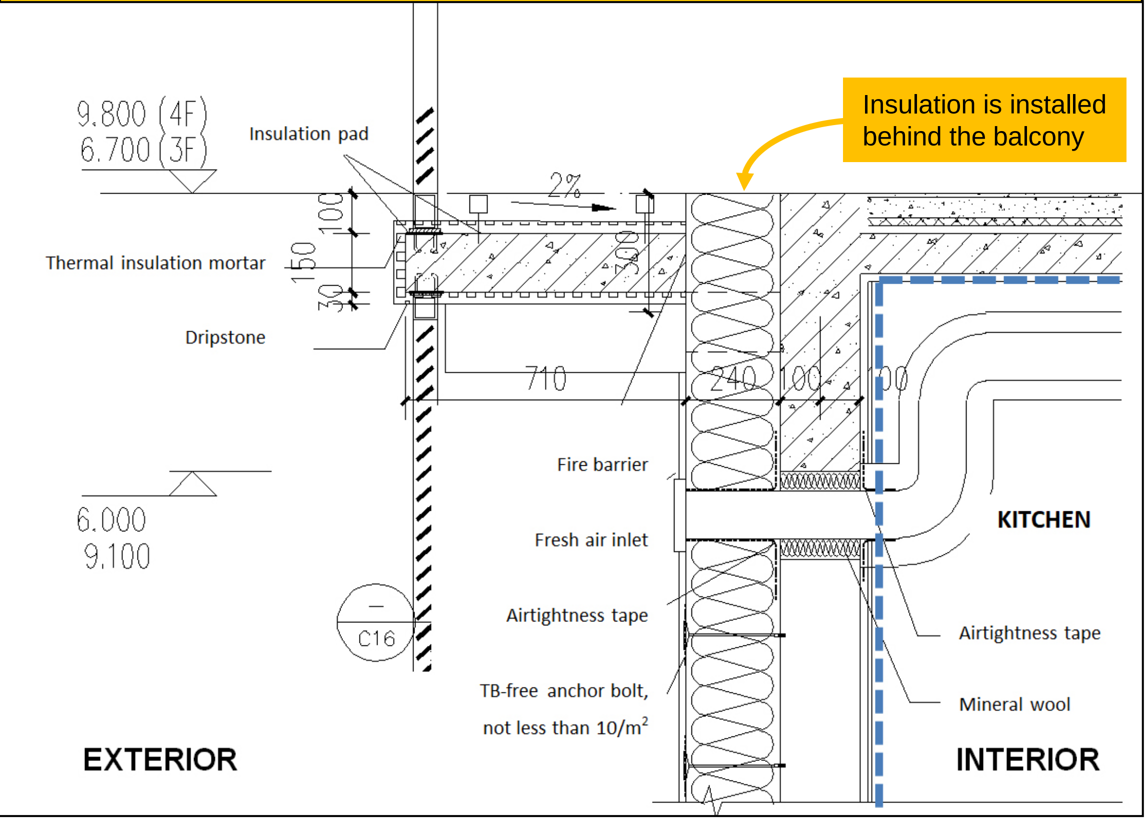
Thermal envelope – Technical balconies

Passive House Institute

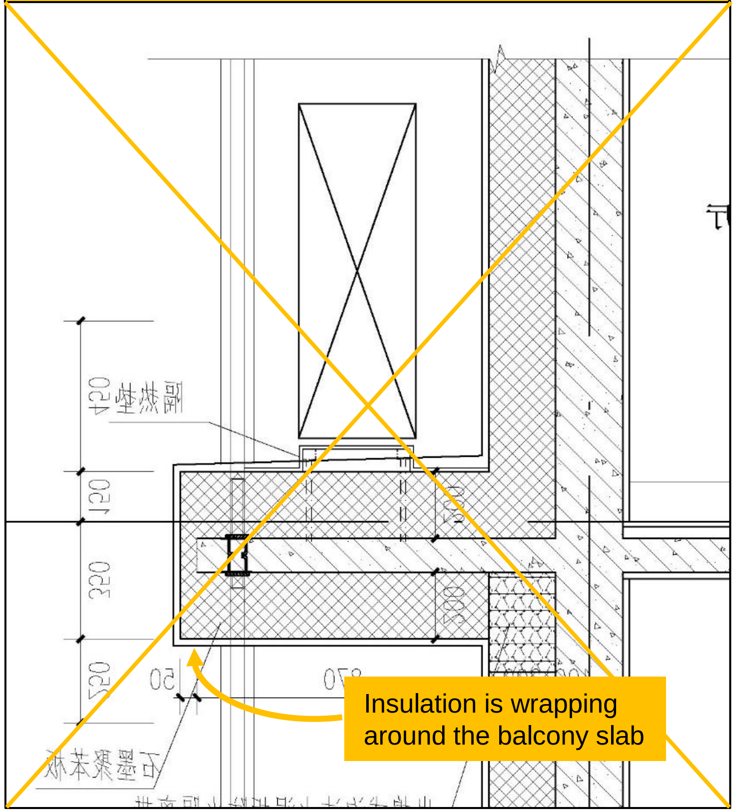
Description of the detail solution

During the planning there was also a solution where the slab of the technical balcony was completely wrapped in insulation. This solution however, had the potential risk of maintenance complications, water leakage and damage by the strong winds at high-rises and was rejected at a later stage of the planning process.

Implemented construction detail

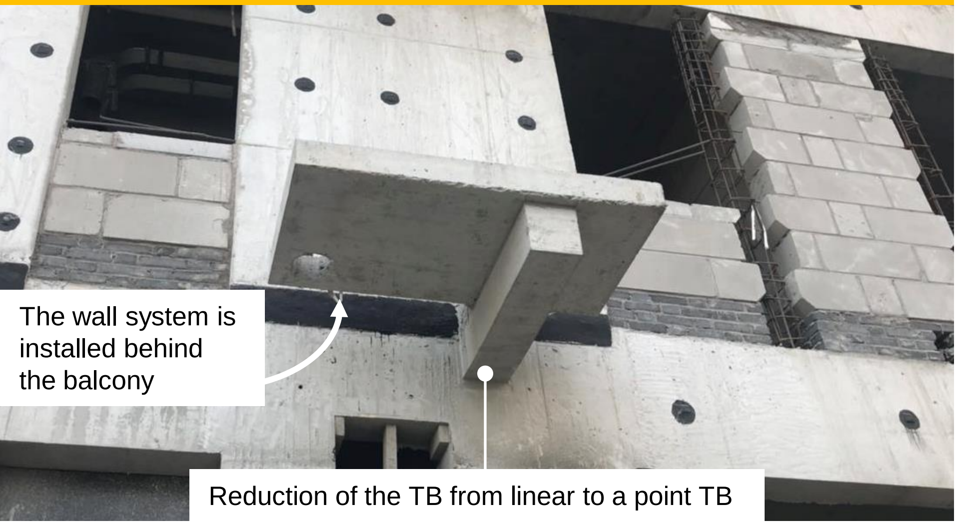


Rejected detail

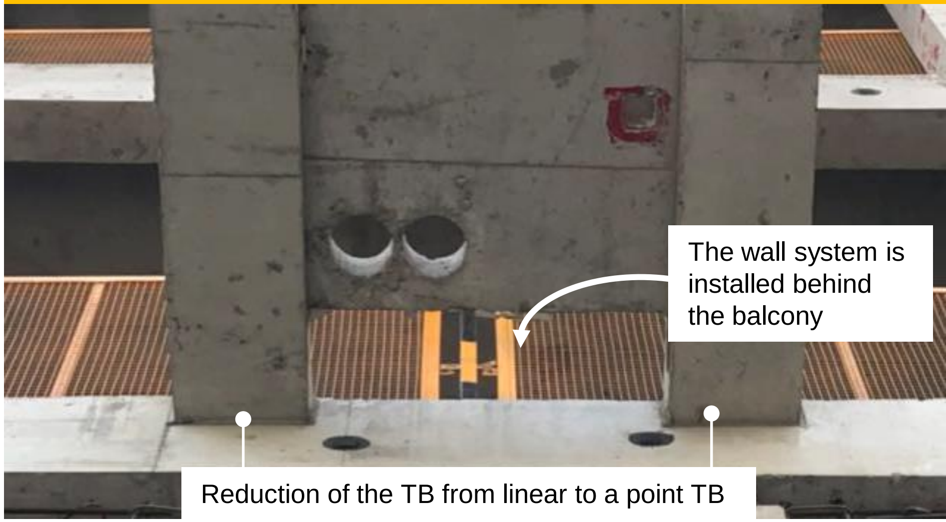


Thermal envelope: Technical balconies – site images

Thermal bridge (TB) optimizaton of the technical balcony – single beam



Thermal bridge(TB) optimizaton of the technical balcony –double beam

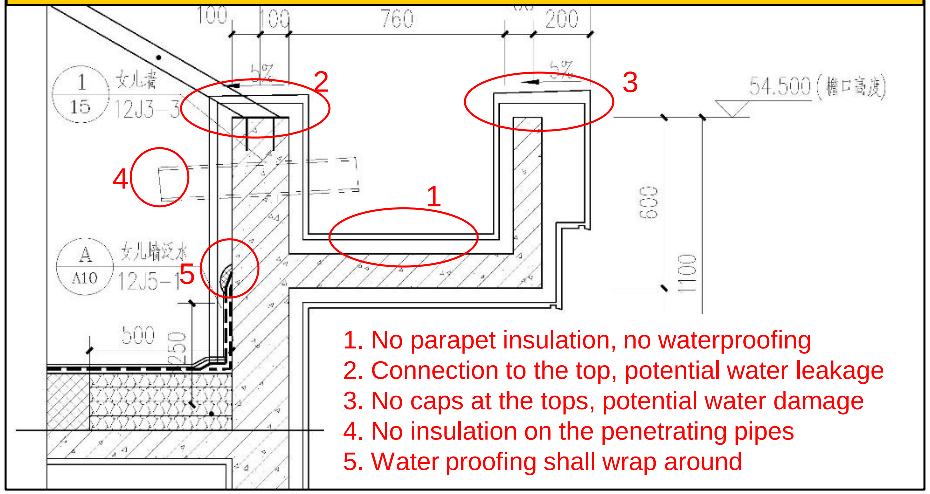


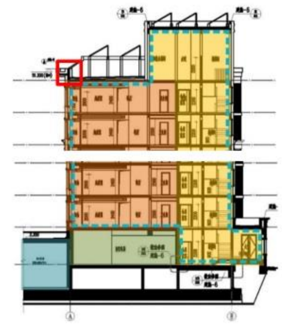
Single beam technical balcony after installing the wall system

Double beam technical balcony after installing the wall system

Thermal envelope – Roof Parapet

Initial detail – critical points

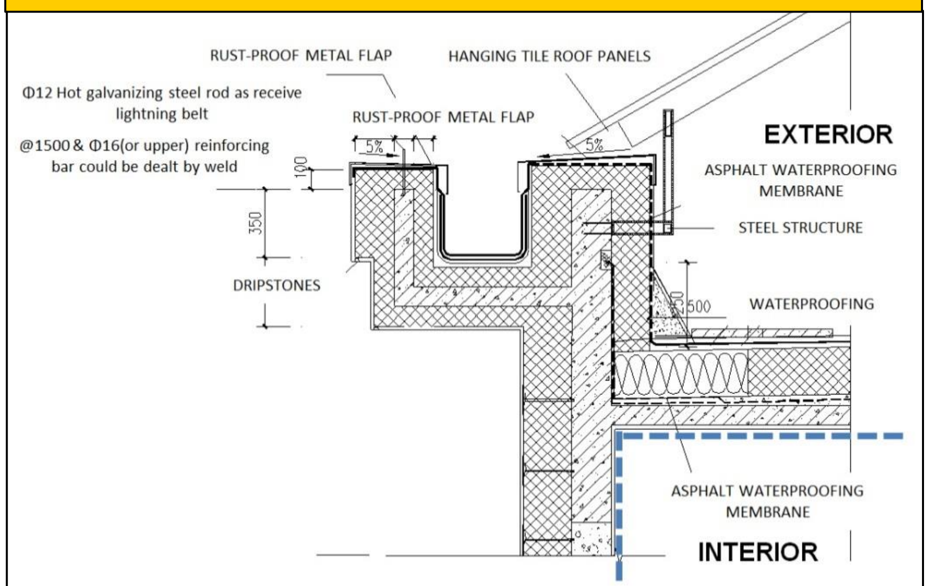




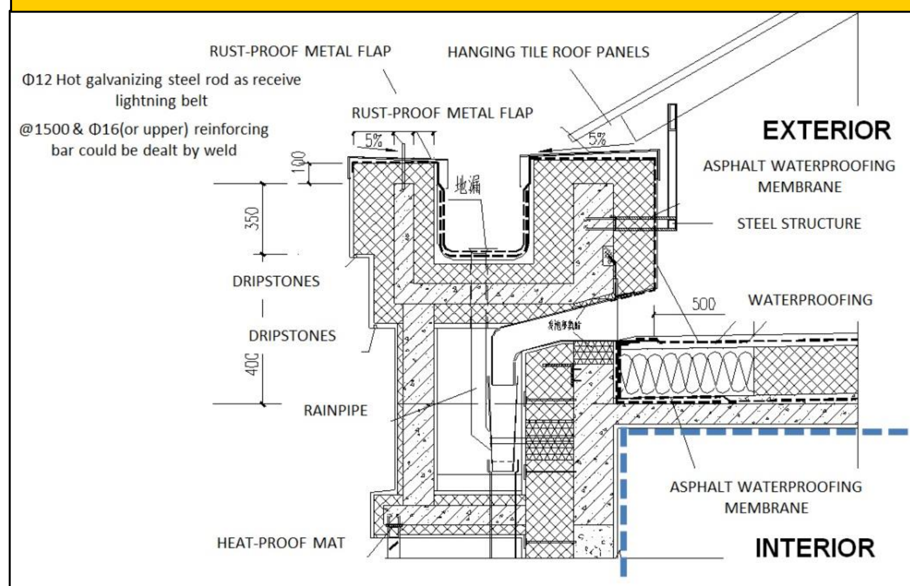
Description of the detail solution

The initial planning did not foresee insulation at the parapet locations and around the protruding pipes. The implemented solutions are wrapped in insulation in order to reduce the TB.

Implemented solution

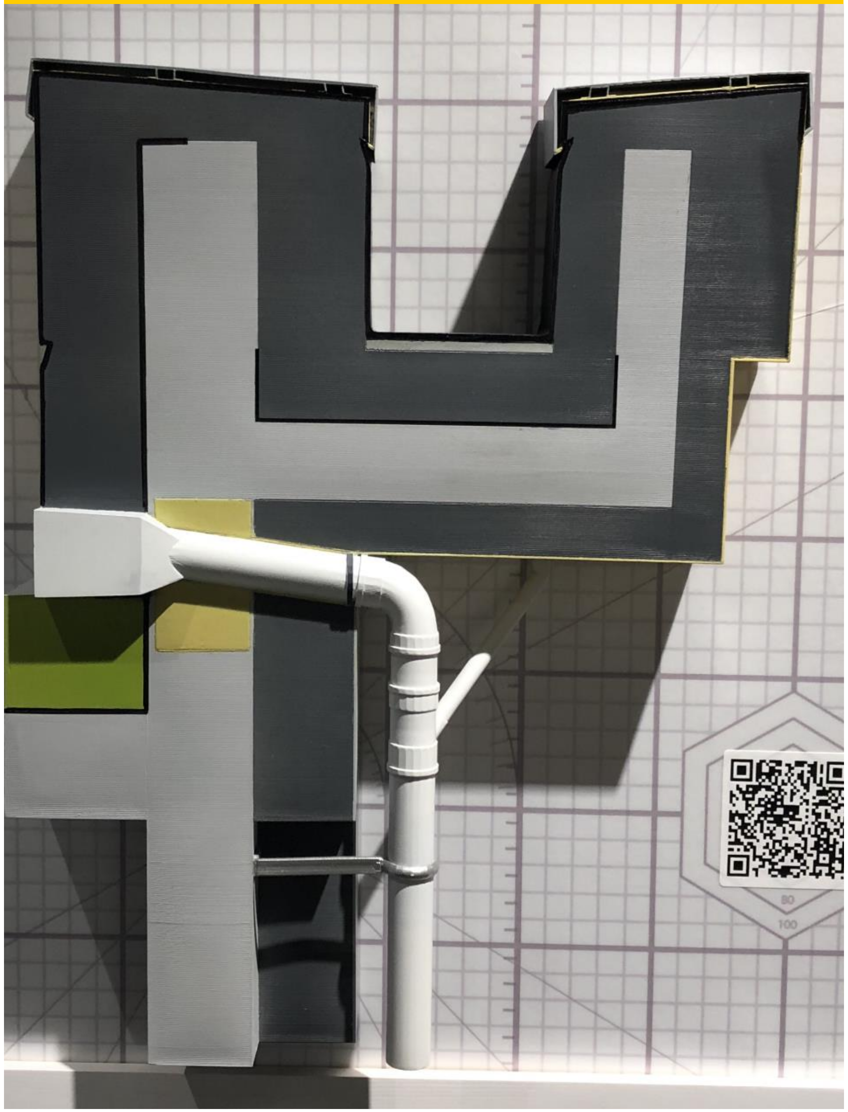


Implemented solution



Thermal envelope – Roof Parapet

Parapet detail – exhibition room

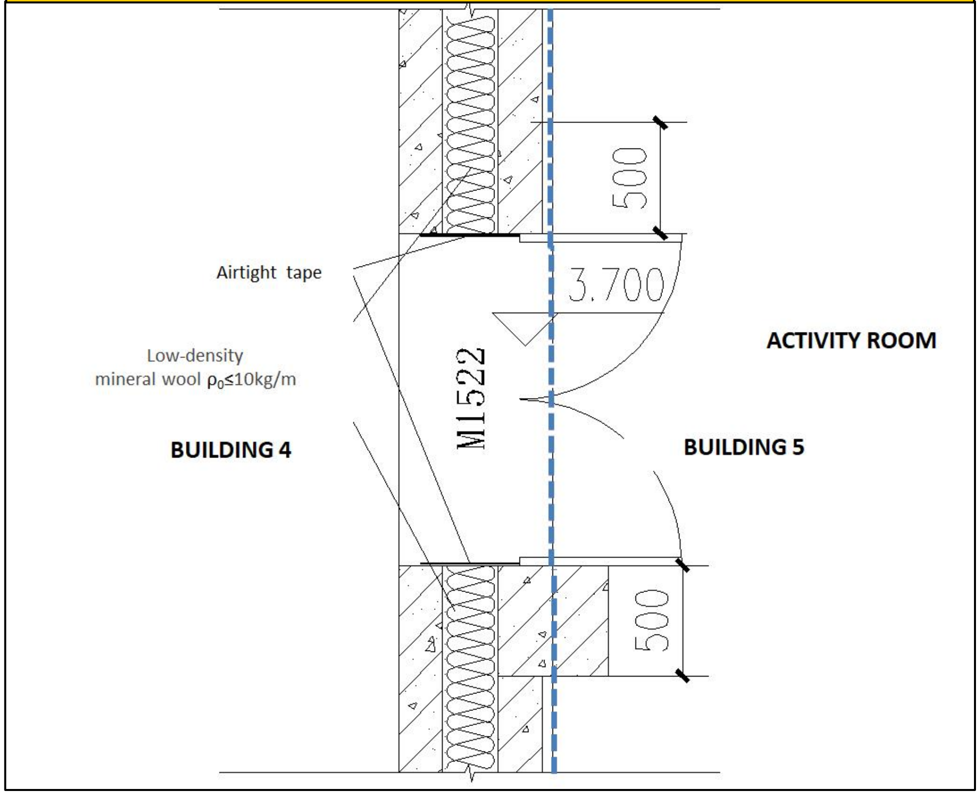


Parapet detail – mock up room

Images owned by Softgrid (Shanghai)

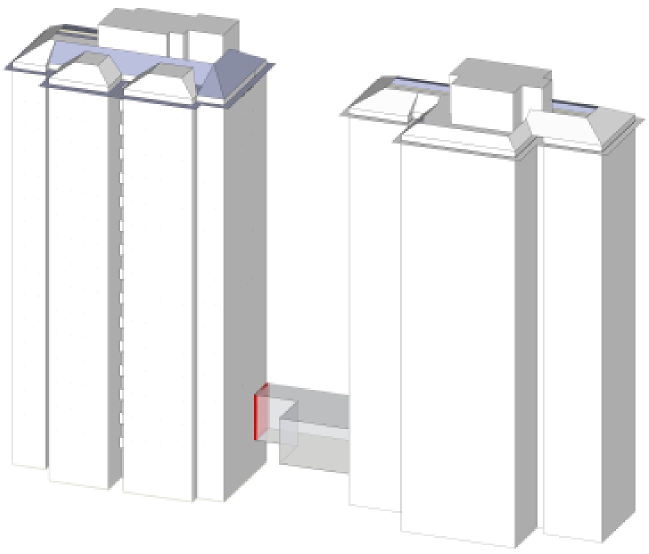
Thermal envelope – Expansion joint

Implemented solution



Description of the detail solution

Both buildings are connected via a door, located at the expansion joint between them. The space between both buildings is insulated using mineral wool and the location of the connection is sealed with airtight sealing tapes.



Thermal envelope: Expansion joint

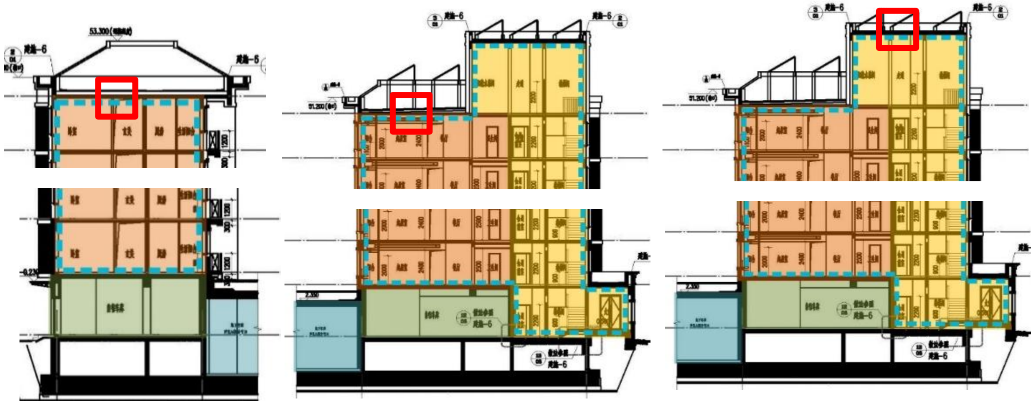
Expansion joint – site images

Expansion joint – site images

Images owned by Softgrid (Shanghai)

Thermal envelope: Roof fixations

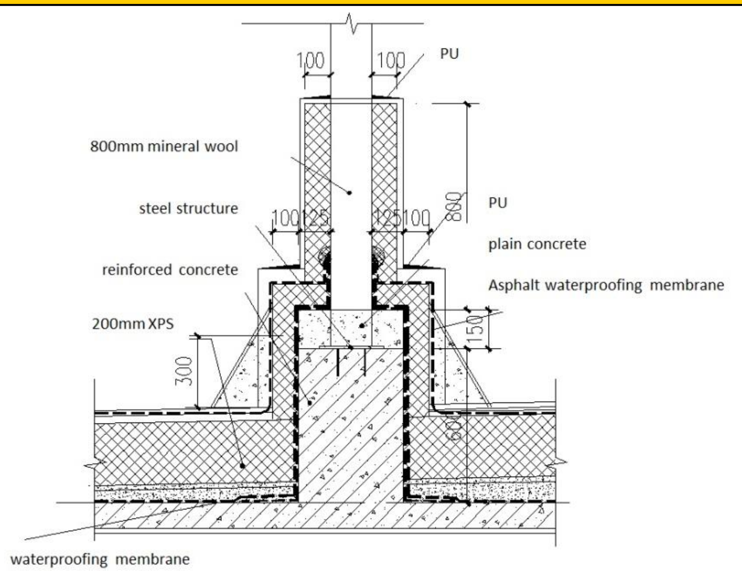
Passive House Institute



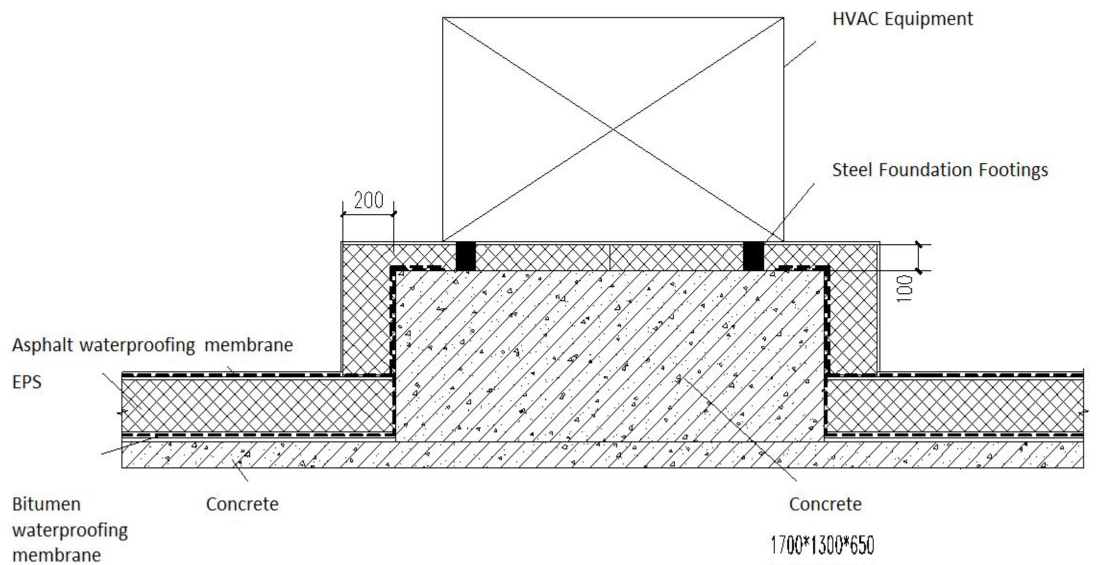
Description of the detail solution

All fixations on the roof are thermally insulated and waterproof.

Implemented solution – PV structure



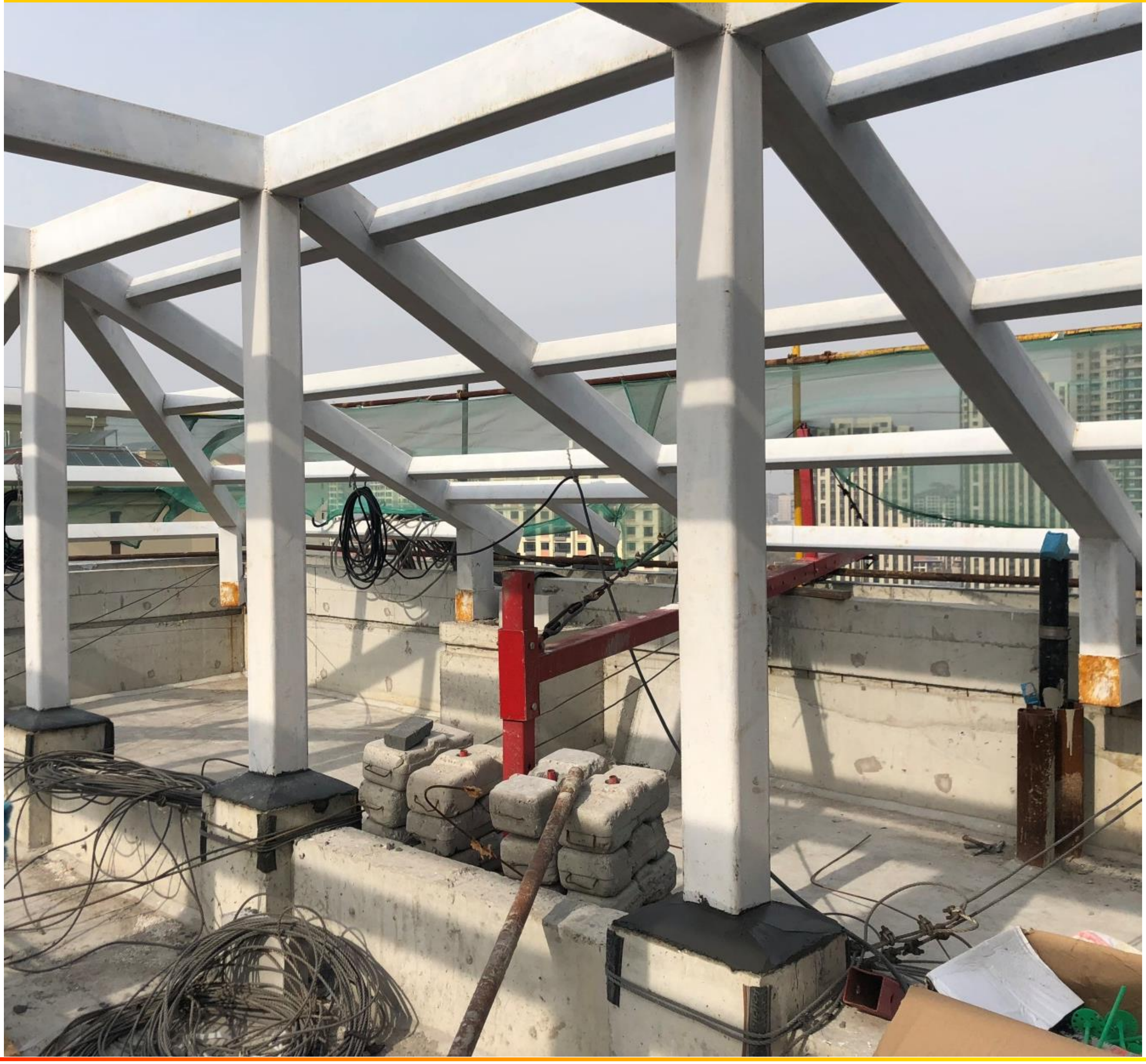
Implemented solution – HVAC structure



Thermal envelope: Roof fixations – site images

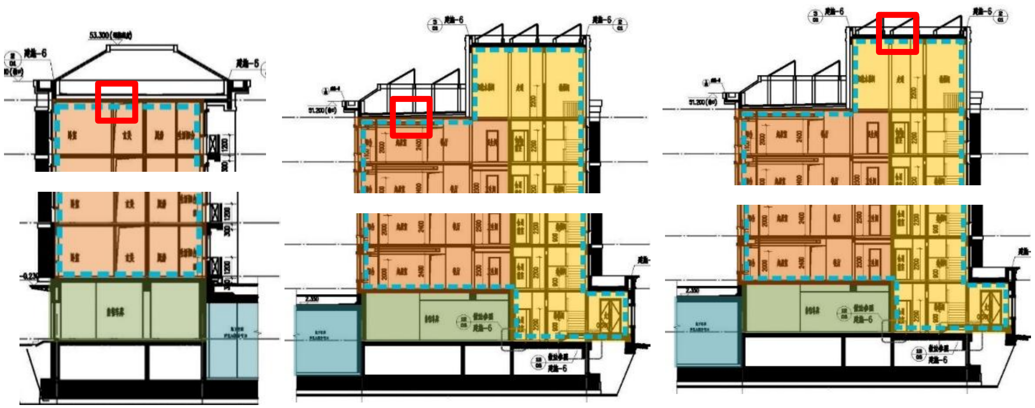
Solar panels structure fixation – mock up room

Solar panels structure fixation – site image, before adding insulation and waterproofing



Images owned by Softgrid (Shanghai)

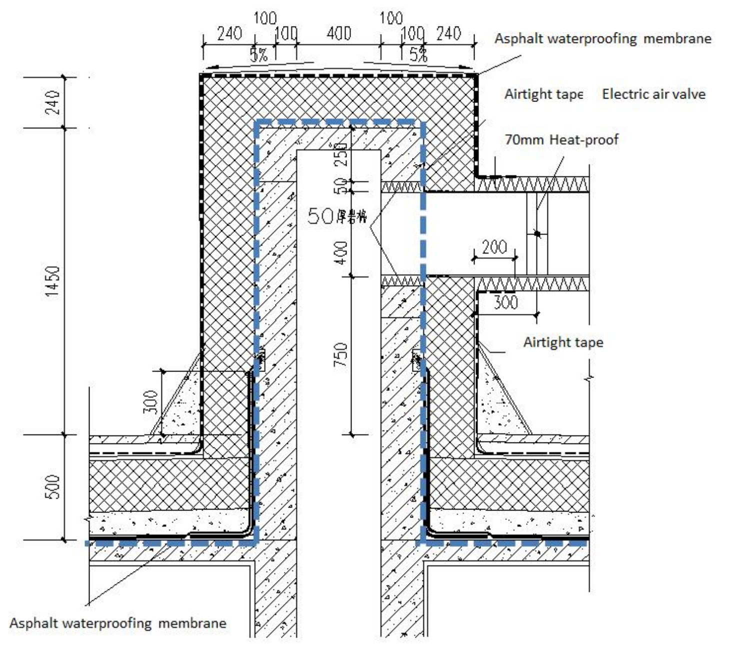
Thermal envelope – Roof penetrations



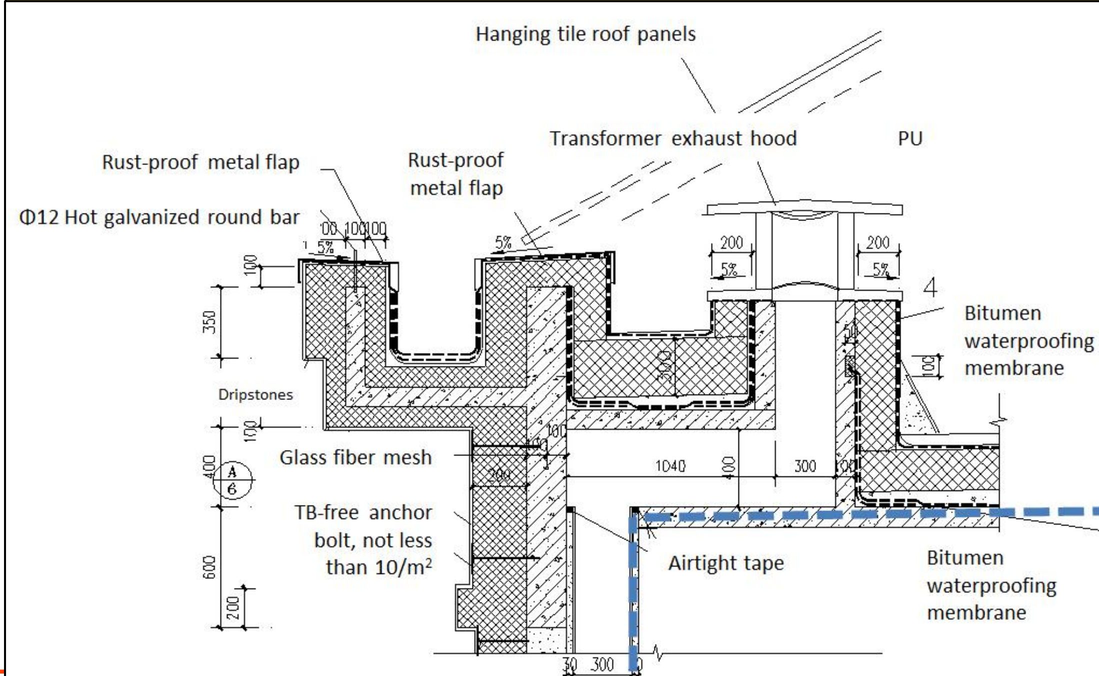
Description of the detail solution

All penetrations of the roof are thermally insulated, waterproof and have reverse valve in order to improve the airtightness where the technical solution allows it.

Implemented solution – smoke extractor



Implemented solution – kitchen exhaust



Thermal envelope – Roof penetrations

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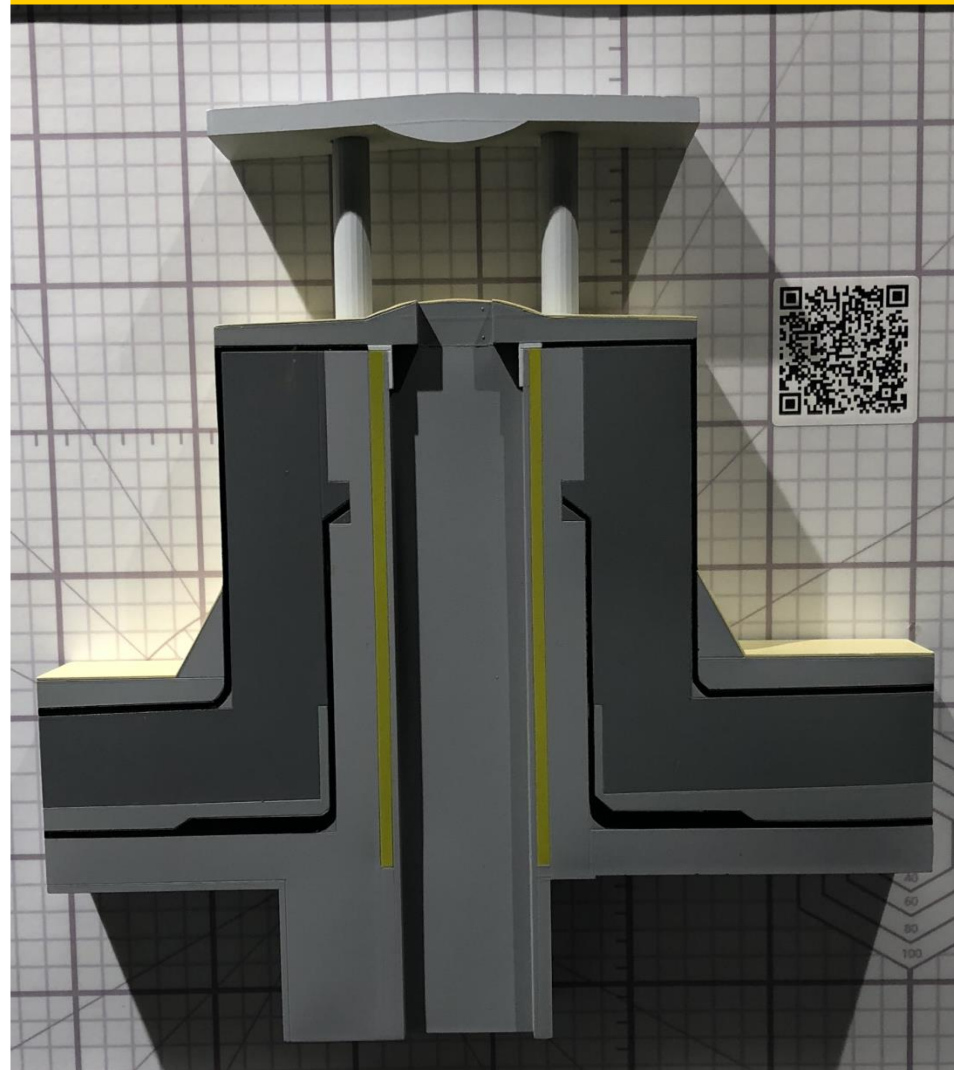
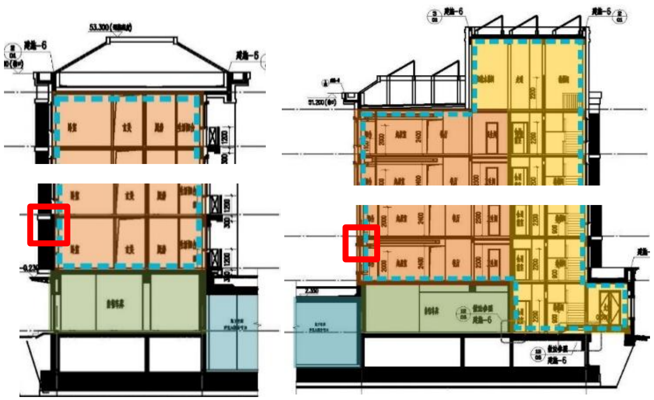
Roof penetration – details mock up room

Roof penetration – detail exhibition room



Images owned by Softgrid (Shanghai)

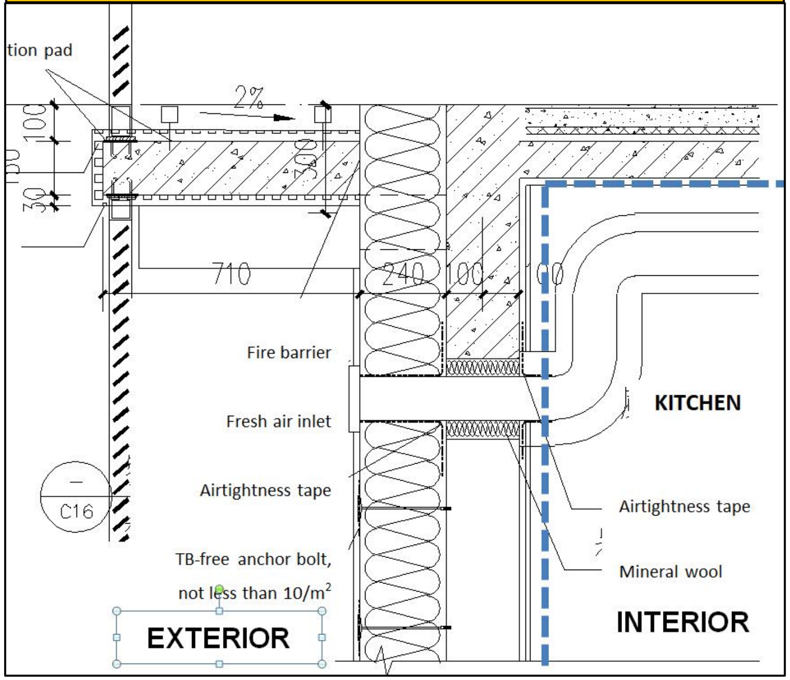
Thermal envelope – Wall penetrations



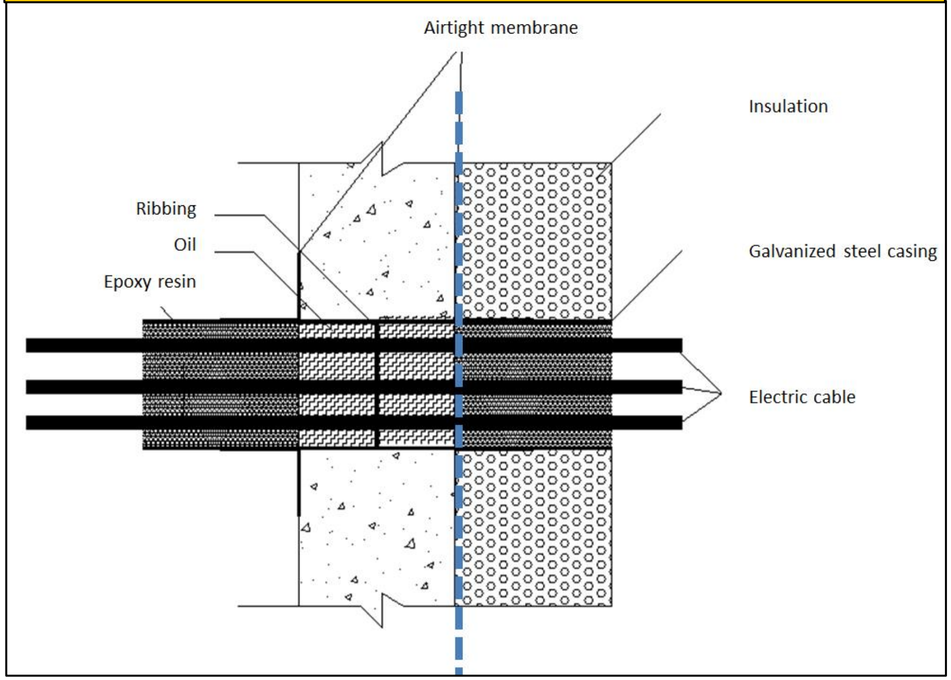
Description of the detail solution

All wall penetrations are sealed with airtight tapes and thermally insulated. Where needed, reverse claps are installed

Implemented solution – Air inlet



Implemented solution – Cables

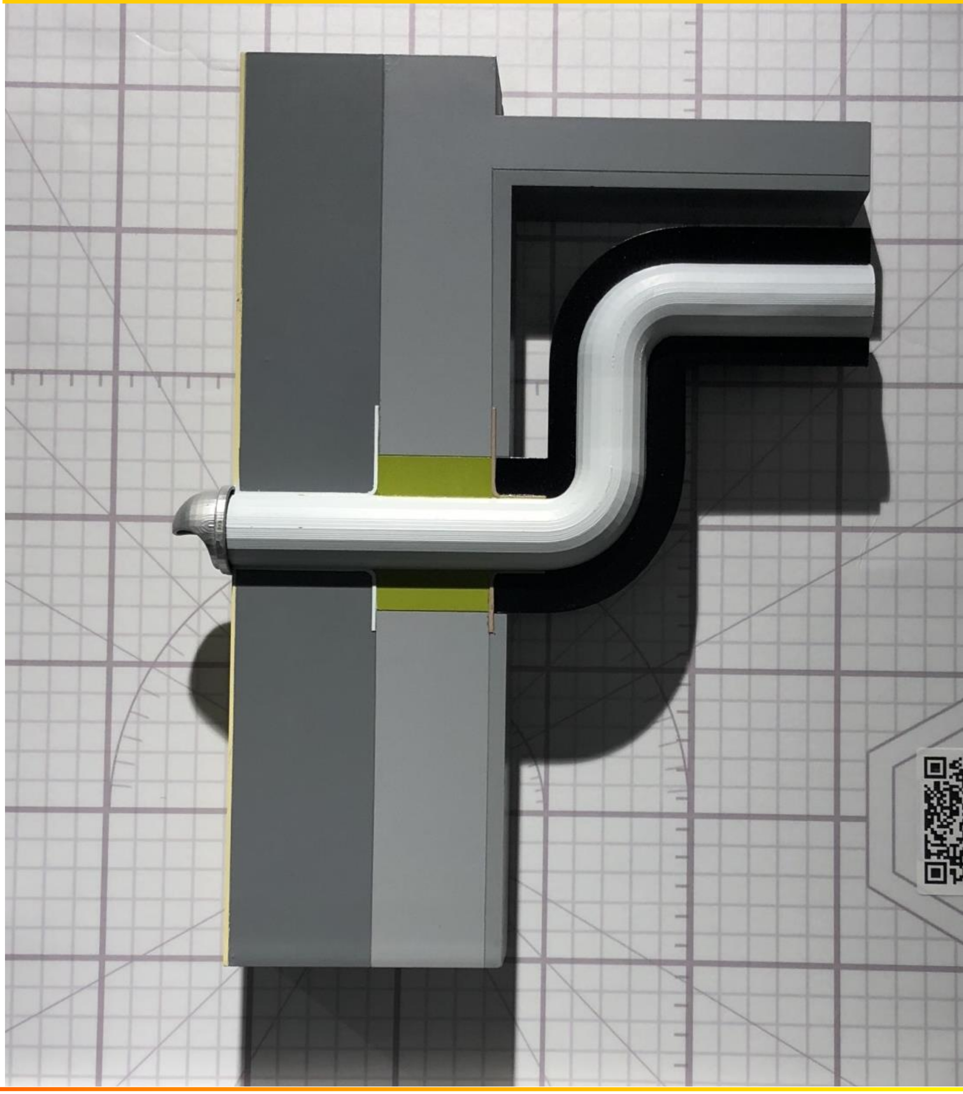


Thermal envelope – Wall penetrations

Passive House Institute

Wall penetration – detail mock up room

Wall penetration – detail exhibition room



Images owned by Softgrid (Shanghai)

Thermal envelope – Wall penetrations

Wall penetrations – site image

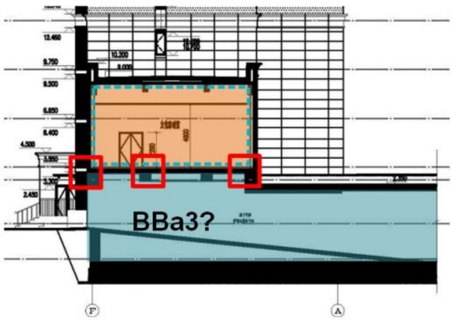
Wall penetration – site image

Images owned by Softgrid (Shanghai)

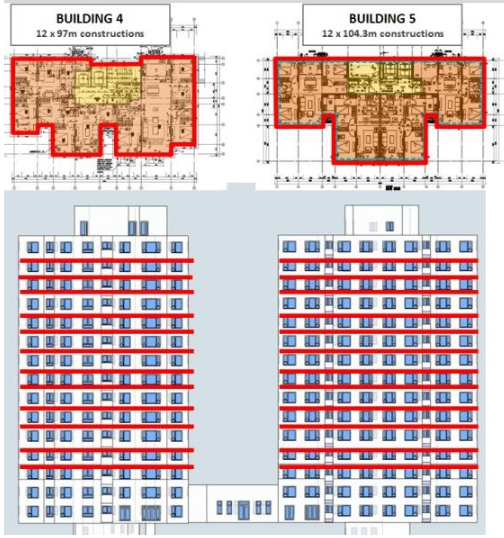
Thermal envelope: Thermal bridges (TB)

Passive House Institute

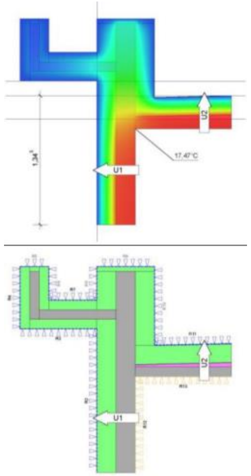
Step 1
Identifying and locating all TB



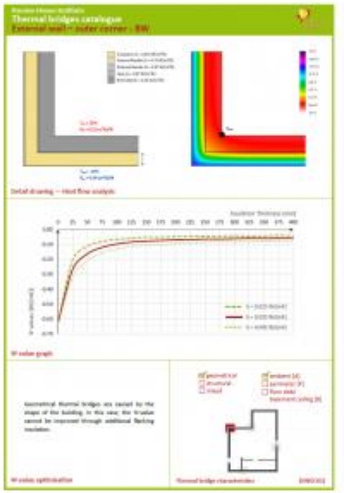
Step 2
Modelling, calculating all lengths/points



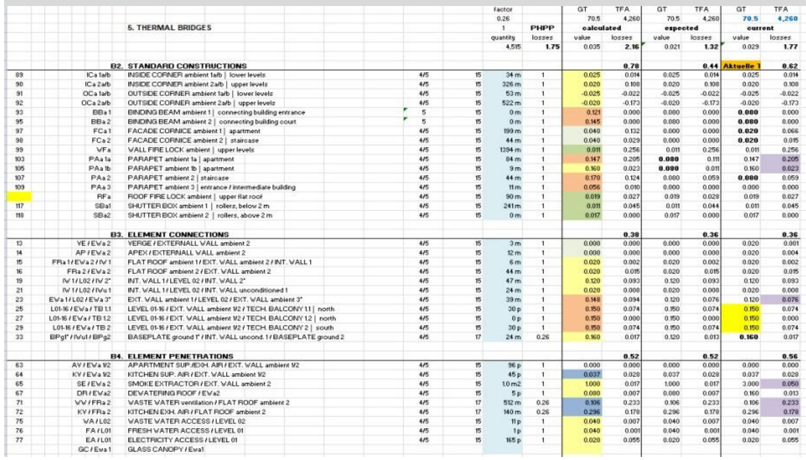
Step 3
ψ-value by TB calculation or using a TB catalogue



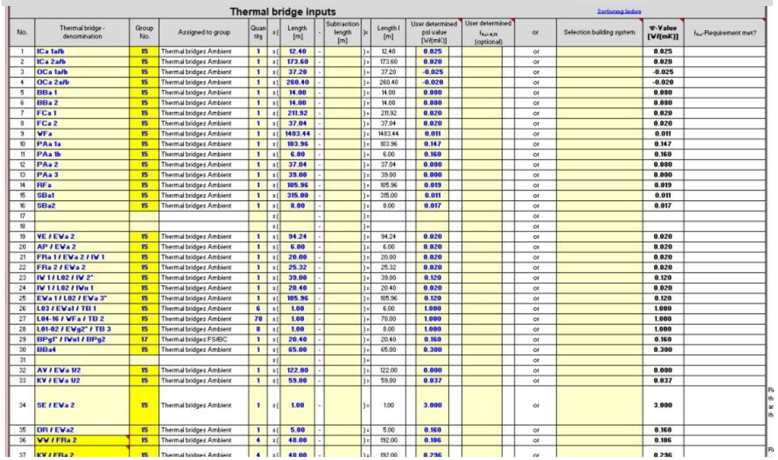
PSI = 0,147 W/(mK)



Step 4
Assigning the values and identifying possible optimizations



Step 5
Listing all TB into the PHPP calculation



Thermal envelope: Blower door test

BDT execution– site photo

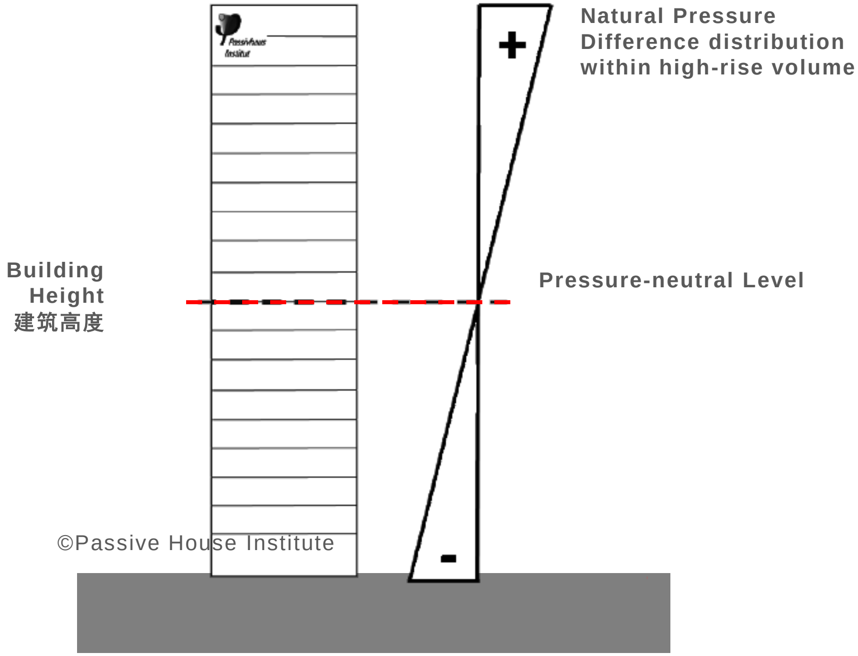
Blower door test was conducted for both towers with a very satisfactory outcome.

Final Air-Tightness Result

n_{50} = 0.24

n_{50} Positive Pressure 正压 = 0.24

n_{50} Negative Pressure 负压 = 0.23



Images owned by Softgrid (Shanghai)

Thermal envelope: Mockup room

Construction details – mock up room

Mockup room

During the planning, critical details were developed and constructed in a mock up room in order to identify potential critical points and to find the best solution. This approach was of great help for the general contractor in order to gain a better understanding of the PH requirements for the thermal envelope.

Construction details – mock up room

Images owned by Softgrid (Shanghai)

Thermal envelope – Exhibition room

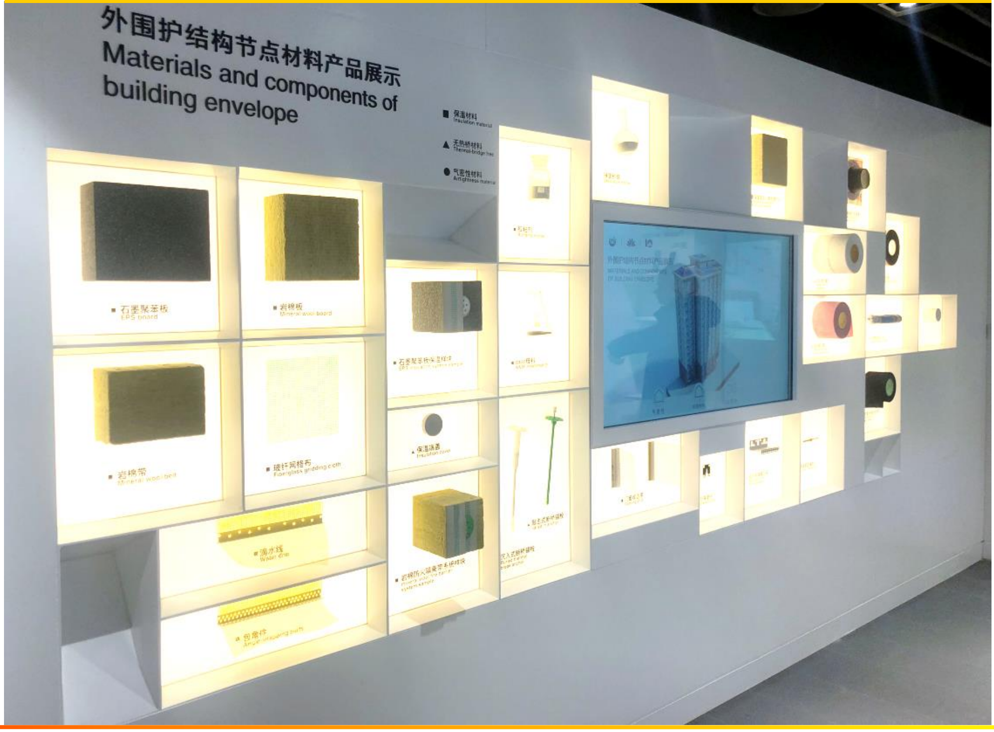
Passive House Institute

Construction details – exhibition room

Exhibition room

An exhibition room, showing all developed passive house details and technical solutions was curated after the completion of the project

Construction materials – exhibition room



Images owned by Softgrid (Shanghai)

Passive House Institute

Thermal envelope – PHPP calculation

PHPP results for project ID: 6119

Passive House Verification

Building:	Xinyuan No.4 Building		
Street:	Hechang Road, Zhongxin Eco-City		
Postcode/City:	300450		
Province/Country:	Tianjin	CN-China	
Building type:	Residential High-rise		
Climate data set:	CN0013a-Tianjin		
Climate zone:	3: Cool-temperate	Altitude of location:	5 m
Home owner / Client:	Tianjin Eco City Public Housing Construction Ltd.		
Street:	Hechang Road, Zhongxin Eco-City		
Postcode/City:	300450		
Province/Country:	Tianjin	CN-China	

Architecture:	Tianjin Architectural Design Institute (LDI)		Mechanical engineer:	Tianjin Architectural Design Institute (LDI)		
Street:	95 Qixiangtai Road, Hexi District		Street:	95 Qixiangtai Road, Hexi District		
Postcode/City:	300074	Tianjin	Postcode/City:	300074	Tianjin	
Province/Country:	Tianjin	CN-China	Province/Country:	Tianjin	CN-China	
Energy consultancy:	SoftGrid (Shanghai) Co., Ltd. + PHI - Germany		Certification:	Passivhaus Institut Dr. Wolfgang Feist		
Street:	200 Taikang Road, Building 1, Unit 401		Street:	Rheinstr. 44/46		
Postcode/City:	200025	Shanghai	Postcode/City:	64283	Darmstadt	
Province/Country:	Shanhgai	CN-China	Province/Country:	Hessen	DE-Germany	

Year of construction:	2019	Interior temperature winter [°C]:	20,0	Interior temp. summer [°C]:	25,0
No. of dwelling units:	44	Internal heat gains (IHG) heating case [W/m²]:	2,6	IHG cooling case [W/m²]:	2,6
No. of occupants:	102,0	Specific capacity [Wh/K per m² TFA]:	180	Mechanical cooling:	x

Specific building characteristics with reference to the treated floor area

					Criteria	Alternative criteria	Fulfilled?[2]
	Treated floor area	m²	4227				
Space heating	Heating demand	kWh/(m²a)	14	≤	15	-	yes
	Heating load	W/m²	10	≤	-	10	
Space cooling	Cooling & dehum. demand	kWh/(m²a)	18	≤	20	20	yes
	Cooling load	W/m²	8	≤	-	11	
	Frequency of overheating (> 25 °C)	%	-	≤	-		-
	Frequency of excessively high humidity (> 12 g/kg)	%	4	≤	10		yes
Airtightness	Pressurization test result n_{50}	1/h	0,24	≤	0,6		yes
Non-renewable Primary Energy (PE)	PE demand	kWh/(m²a)	104	≤	-		-
Primary Energy Renewable (PER)	PER demand	kWh/(m²a)	62	≤	60	62	yes
	Generation of renewable energy (in relation to projected building footprint area)	kWh/(m²a)	34	≥	-	21	

[2] Empty field: Data missing; '-': No requirement

I confirm that the values given herein have been determined following the PHPP methodology and based on the characteristic values of the building. The PHPP calculations are attached to this verification.

Passive House Classic? **yes**

Task:	First name:	Surname:	Signature:
2-Certifier	Maria Chiara	Failla	
	Certificate ID: 24422-24465_PHI_PH_20190927_MCF	Issued on: 27.09.19	City: Darmstadt

PHPP results for project ID: 6121

Passive House Verification

Building:	Xinyuan No.5 Building		
Street:	Hechang Road, Zhongxin Eco-City		
Postcode/City:	300450		
Province/Country:	Tianjin	CN-China	
Building type:	Residential High-rise		
Climate data set:	CN0013a-Tianjin		
Climate zone:	3: Cool-temperate	Altitude of location:	5 m
Home owner / Client:	Tianjin Eco City Public Housing Construction Ltd.		
Street:	Hechang Road, Zhongxin Eco-City		
Postcode/City:	300450		
Province/Country:	Tianjin	CN-China	

Architecture:	Tianjin Architectural Design Institute (LDI)		Mechanical engineer:	Tianjin Architectural Design Institute (LDI)		
Street:	95 Qixiangtai Road, Hexi District		Street:	95 Qixiangtai Road, Hexi District		
Postcode/City:	300074	Tianjin	Postcode/City:	300074	Tianjin	
Province/Country:	Tianjin	CN-China	Province/Country:	Tianjin	CN-China	
Energy consultancy:	SoftGrid (Shanghai) Co., Ltd. + PHI - Germany		Certification:	Passivhaus Institut Dr. Wolfgang Feist		
Street:	200 Taikang Road, Building 1, Unit 401		Street:	Rheinstr. 44/46		
Postcode/City:	200025	Shanghai	Postcode/City:	64283	Darmstadt	
Province/Country:	Shanghai	CN-China	Province/Country:	Hessen	DE-Germany	

Year of construction:	2019	Interior temperature winter [°C]:	20,0	Interior temp. summer [°C]:	25,0
No. of dwelling units:	59	Internal heat gains (IHG) heating case [W/m²]:	2,7	IHG cooling case [W/m²]:	2,7
No. of occupants:	125,4	Specific capacity [Wh/K per m² TFA]:	180	Mechanical cooling:	x

Specific building characteristics with reference to the treated floor area

					Criteria	Alternative criteria	Fulfilled?[2]
	Treated floor area	m²	5021				
Space heating	Heating demand	kWh/(m²a)	12	≤	15	-	yes
	Heating load	W/m²	9	≤	-	10	
Space cooling	Cooling & dehum. demand	kWh/(m²a)	18	≤	20	20	yes
	Cooling load	W/m²	8	≤	-	11	
	Frequency of overheating (> 25 °C)	%	-	≤	-		-
	Frequency of excessively high humidity (> 12 g/kg)	%	4	≤	10		yes
Airtightness	Pressurization test result n_{50}	1/h	0,2	≤	0,6		yes
Non-renewable Primary Energy (PE)	PE demand	kWh/(m²a)	104	≤	-		-
Primary Energy Renewable (PER)	PER demand	kWh/(m²a)	63	≤	60	63	yes
	Generation of renewable energy (in relation to projected building footprint area)	kWh/(m²a)	43	≥	-	35	

[2] Empty field: Data missing; '-': No requirement

I confirm that the values given herein have been determined following the PHPP methodology and based on the characteristic values of the building. The PHPP calculations are attached to this verification.

Passive House Classic ? **yes**

Task:	First name:	Surname:	Signature:
2-Certifier	Maria Chiara	Failla	
	Certificate ID: 24466-24524_PHI_PH_20190927_MCF	Issued on: 27.09.19	City: Darmstadt