Buildings Guide

Upgrade to ultra-low-energy buildings

Boyenstrasse
Zero-Emission Building Berlin

Detailed Good Practice Building

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Building Name and ID

Building Name:	Boyenstrasse
Building ID:	-
Real:	Real
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Picture

Photos: Andrea Kroth

General Information

Building Name:	Boyenstrasse
Climate Zone:	Temperate
Project State:	New Build
Building Sector:	Residential
Building Type:	Multi-Family
Mode:	Closed
Energy Efficiency Level:	ULEB

Year Built:	2013
Location:	Boyenstrasse
Municipality:	Berlin
State:	Berlin
Country:	Germany
Geo. Latitude:	52,53 °N
Geo. Longitude:	13,37 °E
TFA:	2535 m^2
Treated Building Volume:	m^2
Number of Dwellings:	21
Cost/m^2:	2480 €/m^2

Summary

Description

The Boyenstrasse Building is a 7 storey Passive House residential building in mixed construction with a massive core and a wooden panel façade. Located at the edge of the federal district of Berlin along the old East-West Border the building is owned by the LUU Gbr Boyenstrasse Cooperative. Completed in 2013. Built as a zero emissions building the design approach concentrates on super-insulation of the building envelope and innovative building systems. The aim of the cooperative was to build a cost-effective affordable energy efficient ecological building.

It has a planning constraint of a maximum height of 21 m and is to be built in a block perimeter city design.

As a core design feature, the building was constructed as a multigenerational building with barrier free access and an apartment concept that allows for a flexible multi-generational building. Flexible planning provides for good quality of the interior spaces – the mixed generation living is related with the adoptability of plans to the needs of the inhabitants. Duplex apartments can be split to two individual apartments and where necessary switchable rooms can be added or taken away from the apartments. This was achieved also through the clever use of a well-planned ventilation system. Even the bell and post systems can split according to apartment set up. As the building has been built as a

multi-generational flexible building they are two stairwells to ensure access to all apartments. Larger apartments are prepared to be split into smaller units. Apartments vary in size of about 60 – 160m^2. Common areas on the ground floor the roof terrace and the garden, being integral parts of the overall project idea, were designed in close collaboration with the inhabitants. The green roof is also a plus for the microclimate of the site. The cooperative made a justified decision against an underground parking and for a covered bicycle parking spot in the garden. The excellent access to public transport supports this decision.

The impressive architecture is characterized by an appealing façade and carefully treated details of balconies and shading devices. The building was built in a mixed construction of cement and timber panel façade. A bracing core and ferro-cement walls supports the building. The façade is of timber panels hung in front of the building shell. Insulation is through cellulose insulation and is covered either by fibre cement panels or soft fibre wood panels. The street façade is varied with window bays that jump back and forth within the façade. This reflects the Grunderzeit building style of traditional Berlin buildings. The garden façade has steel balconies which are thermally separated from the main building and in addition are covered with sliding and folding shutters which as a complete system with the balconies provides shade in summer. The balconies also serve as extra living space in summer. To reduce thermal bridges these were uncoupled from the building. The interior design is carefully considered – with clear spaces, beautiful details and generous day lighting. The bathrooms and toilets have no windows and must thus be constantly ventilated

Boyenstrasse is a zero emission building through the use of an excellent energy efficiency planning the use of combined heat and power unit, a semi-central ventilation system with heat exchange and PV electricity. The photovoltaic system has a 10kW Peak. Extra heating could be disclaimed, only the bathrooms have towel radiators for comfort. A green roof and grey water recycling are also part of the overall concept. Through the use of all of these measures an ecological sustainable building was achieved.

The building has been presented in many publications as well as the general public as a good practice building for the future and was the winner of the Berlin KlimaSchutzPartner Berlin 2012 (Climate Partner of the Year 2012 Berlin) prize in the category „Erfolgreiche und innovative Planung“,(Sucessful and innovative planning) as well as the Passivhouse Award 2014 in the category Multi-Family Building

Overall Performance

The building was built as a Passive House building.

Cost and cost effectiveness

To keep costs low the building was constructed in wood panel façade within a concrete compartment framework. Total costs of the building were 5,9 million Euros or around 2480 €/m^2. The building proves to be cost effective over Its lifecycle, thus proving the applicability of the Passive House Standard even in this type of collectively used buildings.

Project Description

General Information

Year of construction:	2013
Year of refurbishment:	-
Status :	Closed
Treated Floor Area:	2535
(Gross floor area):	3040
(Gross volume):	-
Number of floors:	7
Areas:	-
Number of units:	21
Number of occupants:	Will be filled out by bigEE from excel file
Elevation:	Will be filled out by bigEE from excel file
Orientation:	
Average Summer Temperature	18,6 °C
Average Summer Humidity	64 %
Average Winter Temperature	0° C

Architectural Description:

(Stakeholders)

Owner :	LUU GbR Boyenstraße
Investor:	LUU GbR Boyenstraße
Developer:	LUU GbR Boyenstraße
Architect:	Deimel Oelschläger Architekten Partnerschaft
Construction Firms:	-
Contracting Method:	-
Building Services:	AEH Ingenieure
Statics:	Jockwer + Partner, Ingenieurbüro für Statik u. Baukonstruktion
Craftsperson	Statik Holzfassade Bauplanungsbüro Bauer Dipl. Ing. Jochen Bauer
Building Physics	ACBM Acoustic Consulting Bernhard Marx
Project controlling	L-S-H Bauprojekte für Mensch und Umwelt GmbH
Quality control	Passive House Institute

(Urban Environment)

Description:

Land plot area:	- m^2
Built up area:	- m^2
Green space:	- m^2

Certificates and Compliance

MEPS (Minimum Energy Performance Standard)

Description or list of Minimum Energy Performance Standard which building must comply to

Needs to comply with green buildings laws:	No
Needs to comply with energy efficient buildings laws:	Yes

Certificates

The building is Passive House certified

Special Features

-

Additional Sustainable features

Green roof and grey water use.

References:

Bachmann. U. 2014. Mikado 3.2016, Ökologishce Vorzeigeprojekt. Heiligengrabe

Diemel Oelschäger Architects. 2010. Praxisbeispiele für nachhaltiges Planen und Bauen. Architektenkammer. Berlin

Passive House Institute. 2016. Passive House Database. www.passivhausprojekte.de

Energie Spezial - Ausgabe 07/2014. 2014. Null CO2 und wenig Kosten. http://www.dbz.de/artikel/dbz_Null_CO2_und_wenig_Kosten_Nullemissionshaus_Boyenstrasse_Berlin_2030938.html

Schäfer W. 2014. Bauen mit Holz, Die mischungs Machts. 1.2014.

Meyer. U. 2013. Greenbuilding, Nullemissionshaus Boyenstrasse in Berlin. 09/13.

Energie Spezial, Architektur. 2014. Null CO2 und wenig Kosten, Nullemissionshaus Boyenstrasse Berlin.

Passive House Institute. 2014. Passive House Award. Passive House Institute. Darmstadt

Envelope

Summary Construction:

The construction of the building is that of a mixed construction with timber panel façade with cellulose insulation and with a (to some part pre-fabricated) cement core. The cement core also serves as a fire and safety measure ensuring that all relevant fire regulations are met. Through these measures a building class of 5 was reached with the highest fire and safety level. The cement core also offers good sound insulation characteristics.

The highly insulated timber frame panels in the facade were core to the concept of this Passive House. The pre-fabricated elements also allowed for a quick building time. All panels were designed with a two centimetre gap to the next panel. This allowed for easier and faster construction on site. The gaps were then filled on site. In addition it helped any tolerances, for example in the construction of the cement core or the bowing under load of the cement slabs were easily taken care of due to this measure. The timber panels have a 24 cm thick wooden frame. Towards the interior these are sealed with OSB and towards the outside with MDF Board , which is open to natural diffusion. The panels have a 6 centimetre insulation layer on the interior which also serves as an installation layer. The panels are insulated at the core with mineral wool. The timber panels are protected against the weather, on the north face, with a sand coloured fibre-cement panel. These panels are rear ventilated. On the north face through the use of mineral wool , which covers the wooden completely covers the wooden elements no extra fire protection or firewall was needed. The building´s south façade is also protected by fibre-cement panels, these were however plaster coated. The steel balcony as well as folding and sliding shutters provide shade on the south façade in summer. This construction design also reduced thermal bridging. The choice of mineral wool was also made on ecological grounds as this is the better system when compared to insulation on a polystrol basis.

Through the use of a pre-fabricated façade as well as many pre-fabricated cement elements this allowed a quick and easy build which was cheaper than both a purely wooden or cement construction. This also aided in a simplification of details as the best of both systems was combined. An interesting idea is that through the use of the pre-fabricated building systems an easy, simple and quick refurbishment can take place if ever needed.

As regards airtightness, a certified blower door test was done on the building. The results were 0,27 resulting n50-value, demonstrating an impressive air tightness.

Design:	-
A/V Ratio:	-
U-Value Building:	-
Thermal bridging:	-

Air tightness:	-
Air tightness:	0,27 /h
Shading:	-
Solar reflectance roof:	-

External Wall Build Up Strasse

The external wall is a wood panel façade system

(Note Table must be added to as needed, it will be variable.)

Material	Thickness, cm	Thermal Conductivity λ
Ventilated façade panel		-
Mineral wool insulation 035	6	-
OSB Panel	3,5	-
Cellulose Insulation (Isoflock 040)	24	-
OSB Panel	3,5	-
Mineral wool insulation 035	5	-
Epoxy fiberglass laminate. outer shell	1,25	-
Epoxy fiberglass laminate. outer shell	1,25	-

Total Thickness	-
U-Value (Thermal transmission coefficient)	0,113 W/m^2K
Total Area	-

External Wall Build Up Garten

The external wall is a wood panel façade system

(Note Table must be added to as needed, it will be variable.)

Material	Thickness, cm	Thermal Conductivity λ
Plaster		-
Wood soft fibre panel 045	6	-
Wood fibre panel		-
OSB Panel	3	-
Cellulose Insulation (Isoflock 040)	24	-
OSB Panel	3	-

Mineral wool insulation 035	6	-
Gipson board	2,5	-

Total Thickness	-	
U-Value (Thermal transmission coefficient)	0,118	W/m²K
Total Area	-	

Ground Floor Build up (Will be filled out by bigEE from excel file)

Material	Thickness, cm	Thermal Conductivity **λ**
-	-	-
-	-	-

(Note Table must be added to as needed, it will be variable.)

Total Thickness	-	
U-Value (Thermal transmission coefficient)	0,117	W/m²K
Total Area	-	

Basement Floor Build up (Will be filled out by bigEE from excel file)

Material	**Thickness, cm**	**Thermal Conductivity λ**
Screed	6	-
Insulation 035	10	-
Concrete slab	14	-
Perimeter insulation 037	18	-

(Note Table must be added to as needed, it will be variable.)

Total Thickness	-	
U-Value (Thermal transmission coefficient)	0,12	W/m²K
Total Area	-	

Basement Wall Build up

Material	**Thickness, cm**	**Thermal Conductivity λ**
-	-	-

Total Thickness	-	
U-Value (Thermal transmission coefficient)	0.141	W/m²K

Total Area	-

Roof Build Up

Material	Thickness, cm	Thermal Conductivity λ
Gravel filling	Float	-
Bituminous seaing / membrane		-
Polystrol Insulation 035	35	-
Membrane		
Reinforced concrete	23	-

Total Thickness	-	
U-Value (Thermal transmission coefficient)	0,11	W/m²K
Total Area	-	

Window

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The windows are a timber-aluminium, thermally insulated wooden frame with aluminium cover strip, combination. The window glass triple glass with an Argonn N Solar filling.

Glass Infill:	-	
Coatings/Tint :	-	
Solar Heat Gain Coefficient:	61 %	
U-Value Glass:	0,64	W/m²K
U-Value Window Frame:	-	
U-Value Window	0,74	W/m²K)
Total Area:	-	

Door

The doors are aluminium, SchüCal + Basic, passive house insulated doors.

U-Value Door	1,1	W/m²K)
Total Area:	-	

Passive Strategies

The building uses passive heat strategies such as solar gains and internal heat sources as well ground coupling for the ventilation for heating. In summer the building also uses passives strategies for cooling this time with shading as well as the ventilation ground coupling.

Additional Information

-

Systems

Intro:

The house features an innovative system, Mephisto G16+, combined heat and power unit. Ventilation is provided via mechanical ventilation with heat recovery system with 85% heat recovery ratio. Waste heat from the showers is also recovered. Renewable energy supplied through the PV help to make the building in the sum a Zero-Emissions Building.

Design temperature Summer:	19 °C
Design temperature Winter:	19 °C

Heating System

The heating system is a combined heat and power (onsite, natural gas), unit providing heat as well as electricity. Heating is via the ventilation system. All surplus electricity is supplied to the net. The CHP-Unit is controlled by heat demand and has an efficiency of 90% . Only in the bathroom does the building have (comfort) heating radiators.

Type of System:	-
Central/decentral:	Central
Storage Tank (heating):	-
Controls:	-
Heating Capacity:	-
Thermal Efficiency:	-
Energy Source:	Gas
Annual Final Energy Demand:	-

Cooling System

No cooling system was needed as planning had shown that there would be no overheating in summer. The ground coupled loop heat exchanger in the ventilation system helps to cool the air the summer.

Type of System:	-
Central/decentral:	-
Controls:	-
Cooling Capacity:	-
COP:	-
Energy Source:	-
Annual Final Energy Demand:	-

Hot Water Systems

The warm water system is connected to the CHP unit, MEPHISTO G20+, and has circulation as well as single pipes. The waste water system has a grey water reuse as well as heat recovery system integrated.

Type of System:	-
Central/decentral:	-
Storage Tank (hot water):	-
Controls:	-
Heat Capacity :	-
Energy Source:	-
Annual Final Energy Demand:	-

Solar Hot Water System

Solar Hot Water system: Description of solar hot water system

Solar Thermal collector:	-
Aperture Size:	-
Orientation:	-
Inclination Angle:	-
Hot water covered by solar:	-
Heating covered by solar:	-

Ventilation System

The ventilation system is semi-centralised system with a heat recovery unit, LÜFTA MAXK-I2 4000 DC. Due to the semi-centralised system each apartment can be individually heated to the users needs. Frost protection for the system is through a ground coupled loop heat exchanger. This is located in the garden where the inlet and outlet air vents are located.

Type of System:	-
Central/decentral:	-
Controls:	-
Flow Rate:	-
Heat Recovery Ratio:	85%
Energy Source:	-
Annual Final Energy Demand:	-
Circulating Pumps:	-

Annual Final Energy Demand: -

Power Generation

Power generation system: Description of system

Electric power :	-
Total electricity production:	-

Renewable Energy System

Electricity is supplied as renewable energy via the 40 PV, Sunmodule plus SW 250 mono black, modules with a peak of 10 kWP. Yearly output of of 10246 kWh/a. All surplus electricity is supplied to the net.

Photovoltaic:	-
Aperture Size:	-
Orientation:	-
Inclination Angle:	-

Auxiliary Systems

Heating System:	-
Cooling System:	-
Hot Water:	-
Solar Hot Water:	-
Ventilation System:	-

Smart building systems: Description of system

Energy Efficient Lighting and Appliances: Description of system

Energy Consumption

Intro:

Energy consumption data were simulated with PHPP as well as calculated for EnEV. The building, as of 2015 is almost 60% more energy efficient than a conventional building built to standard. Simulation results were as follows:

Primary energy used:	-
Primary energy reference building:	-
Specific primary energy demand:	13 kWh/m^{2}a (72 kWh/m^{2}a including electricity @ PHPP)
(Calculation method: e.g. EnEV):	ENEV
Final energy:	29,7 kWh/m^{2}a
Breakdown final energy consumption:	-
Heating System:	8 kWh/m^{2}a (PHPP)
Cooling System:	-
Hot Water system:	-
Ventilation system:	-
Auxillary Energy:	-
Renewable systems:	-
Smart building systems:	-
Renewable energy production:	-

GHG emissions (hidden 2012)

Any information on Green House Gas savings

GHG Annual emissions:	-
GHG Building Lifetime emissions:	-

Costs

To keep costs low the building was constructed in wood panel façade within a concrete compartment framework. Total costs of the building were 5,9 million Euros or around 2480 €/m^2.

Envelope costs :	-
Systems costs :	-
(Renewable energy system cost):	-
Total investment Costs:	5900000 €
Cost/m^2:	2480 €/m^2
Annual total costs:	-
Annual total costs/m^2:	-
Yearly energy costs:	-
Early energy savings against reference building:	-
Internal Rate of Return:	-
Static payback time:	-
Dynamic Payback time:	-

Cost and cost effectiveness

At 2480 € the buildings cost are comparable to that of new conventional buildings in the surrounding districts, even though with all the amenities and sustainable features included. With the standard land value price deducted from the total costs the building construction costs lie at only 1800 €, a very favourable price for Berlin. The building received KFW 40 Efficient House Promotion

Assumptions

Real interest rate:	-
Local Currency:	-
Currency Rate (Date):	-
Energy Prices:	-
Electricity:	-
Gas:	-
Oil:	-
Wood:	-
Other:	-

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bigEE is an international initiative of research institutes for technical and policy advice and public agencies in the f eld of energy and climate, co-ordinated by the Wuppertal Institute (Germany). Its aim is to develop the international web-based knowledge platform bigee.net for energy ef ciency in buildings, building-related technologies, and appliances in the world's main climatic zones.

The bigee.net platform informs users about energy ef ciency options and savings potentials, net benef ts and how policy can support achieving those savings. Targeted information is paired with recommendations and examples of good practice.

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