Buildings Guide

Upgrade to ultra-low-energy buildings

E3 Berlin
Europe´s first wooden high-rise

Detailed Good Practice Building

Author
Christopher Moore

08/2016

Building Name and ID

Building Name:	E3
Building ID:	-
Real:	-
Published:	-
Date entered:	24.08.2016

Picture

General Information

Building Name:	E3
Climate Zone:	Temperate
Project State:	Finished
Building Sector:	Residential
Building Type:	Multi-Family
Mode:	Closed
Energy Efficiency Level:	ULEB

Year built:	8/2007 – 5/2008
Location:	Esmarchstraße 3, Berlin-Prenzlauer Berg
Municipality:	Berlin
State:	Berlin
Country:	Germany
Geo. Latitude:	52,53 °N
Geo. Longitude:	13,43 °N
TFA:	-
Treated Building Volume:	-
Number of Dwellings:	7
Cost/m^2:	2400 €/m2

Summary

Description

E3 is the first seven story wooden building in Europe. Built in the Esmarsch Strasse, Prenzlauer Berg, Berlin the building is nestled between two concrete high-rises in an inner-city context. The aim of the project was a energy efficient building with a maximum on a healthy living environment. Placed between an accurately refurbished wilhelminian building on the right and a newly constructed apartment building in wilhelminian proportions to the left the e3 project with its aesthetic display of its constructive characteristics bestows upon the Esmarchstraße a completely new accent, the e3 project with its open building structure breaks with the traditional façade structure and at the same time enters into a constructive dialog with it. The building gap existed since World War 2. Surrounded by the typical Berlin buildings of 5 to 6 stories.

E3 was developed with a client collective because issues like individual decision making, sustainability and special urban design features could only be called for by a critical client as opposed to a developer whose primary interest are the expected financial return.

The building is made up of 7 Apartments of sizes ranging from 120 m^2 – 160 m^2. The apartments are connected to this stair well via "bridges" from the free-standing fireproof concrete staircase. This structure also contains the lifts which make the building barrier free with wheelchair access on all floors. A positive advantage of this was that a third façade received day lighting even though the building has been integrated into the block development. . A high flexibility of the floor plan is achieved through the absence of interior load bearing walls. The only exception being two concrete piping and ductwork shafts. This allows residents to choose the layout of their apartments. An Architecture Practice is located in the ground floor with (7) apartments in the floors above.
Three of the floors have common spaces as shared terraces with access to the staircase , the attic has a private roof terrace. for all apartments have various sized balconies towards the garden side. A

terrace in front of the apartments opens towards the street. Shading is through shades which can be controlled individually. The floor area of the building is approximately 950 m^2. Floor heights between storeys are 2.78 m. All inner walls are lightweight construction.. As there is no cellar appropriate storage possibilities for the apartments are found on the ground floor at the rear of the complex. There is also a room for bicycles and children prams etc.

Before changes to the German building regulations in 2002, timber constructions were restricted to only three storeys. Even the new building regulations of Berlin restrict timber constructions to only five floors. The building also belongs to the category 5 building class with the height of the finished surface of the topmost floor over 22m in height above street level. In such buildings the greater part of the building needs to be made of incombustible materials. Therefore a seven-storey timber construction is a novelty. The building allowance only came through a close cooperation, based on exceptional grounds, with the relevant building authorities. A strategy was developed with which the safety requirements of a residential building were accounted for. A special release from local fire and safety paragraphs was thus needed. This resulted for example in the separate stair well of concrete separate to the building itself. Due to the high levels of quality required for the fire safety all details were newly developed for this project. It was thus proved that with an intelligent combination of constructive and technical measures the safety levels of a traditional masonry building could be reached. Due to the necessary examination of the fire protection aspects the e3 project has gained a Europe wide model character.

The quick building time was achieved through a high degree of industrial prefabrication of the walls and floor slabs. The speedy building process was aided through the building owner association as this allowed a good participation and close cooperation within the planning process. The building façade was constructed, regardless of weather conditions, in air-conditioned hall. This allowed a completion of the pre-fabricated elements in only ten weeks.

Building costs were reduced as there was no property developer involved. Total costs of the building lay at 1628000 €. The cost of buying an apartment was at 2400 €/m^2. Even in terms of energy consumption during the construction phase a large saving of 30% compared to a conventional cement or masonary building was calculated.

At the time of building the primary energy consumption of the building lay at just 30% of a conventional massive building. Energy costs lie at around 2 €/m^2a. The building was designed using DGNB and received a Gold Rating (new Platinum rating)

The building received the German Holzpreis wood award in 2009. The building was also supported by DBU Deutsche Bundesstiftung Umwelt.

The project e_3 is to be understood as a prototype for an innovative approach to urban design and construction techniques. The interaction between architectural attractiveness, a maximum of envi-

ronmental protection, and sustainability by increasing the urban density in the central city districts are used to achieve an optimal result. The interdisciplinary application of innovative state of the art construction techniques are used to create a new residential archetype for the urban context.

Overall Performance

The building achieved the KfW Standard 40

Cost and cost effectiveness

Total costs of the building lay at 1628000 €. The cost of buying an apartment was at 2400 €/m^2

Project Description

General Information

Year of construction:	2008
Year of refurbishment:	-
Status :	Closed
Treated Floor Area:	-
(Gross floor area):	950 m^2
(Gross volume):	-
Number of floors:	7
Areas:	-
Number of units:	7
Number of occupants:	-
Elevation:	45,43 m
Orientation:	-
Average Summer Temperature	18,6 °C
Average Summer Humidity	64%
Average Winter Temperature	0 °C

Architectural Description:

(Stakeholders)

Owner :	e3 Bau GbR
Investor:	e3 Bau GbR
Developer:	
Architect:	Kaden Klingbeil Architekten
Construction Firms:	Projekt Holzbau Merkle
Contracting Method:	
Structural Engineer:	Bois Consult Natterer BCN Julius Natterer, Tobias Linse
Fire Consulting:	Dehne, Kruse and Partner

(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 was built to the German KfW40 Standard

Special Features

Additional Sustainable features

References:

Berlini, S. 2010. PUU 02/2010.

DBU. 2013. Bauen und Wohnen, E3

E3, http://www.architectureindevelopment.org/project.php?id=318

E3, http://www.kadenundlager.de/projekte/e3/

E3, https://divisare.com/projects/239891-kaden-klingbeil-architekten-bernd-borchardt-e3

Huschke, R.2008. Höhepunkt im Holzbau. http://www.heise.de/tp/artikel/26/26922/1.html

Klingbeil, K. 2008. Bauwelt 15/2008, Esmarschstrasse 3, Germany

Kaden + Klingbeil Architects. 2008. Siebengeschossiges Wohngebäude e3 in Berlin. Berlin

Kaden + Klingbeil Architects. 2008. Ibk1 – holz urban, Blockrandbebauung in der Esmarchstrasse, Berlin. Berlin

Kaden + Klingbeil Architects. 2008. http://www.nextroom.at/building.php?id=31008

Mehrfamilienhaus E3 in Berlin, http://www.baunetzwissen.de/objektartikel/Brandschutz-Mehrfamilienhaus-in-Berlin_3187771.html
Nurmi, T. 2/2010. Puu-lehti / Wood Magazine. Finnland
Zuschnitt 03/2009. page 6ff

Envelope

Summary Construction:

The 7-story apartment building consists of a timber column and beam construction method. The buildings loads are carried through the façade as well as the two building cores. The timber shell and core of the apartments is characterised by its load-bearing skeleton, consisting of columns and beams. The load bearing structure is comprised of glulam components combined with timber-concrete composite slabs. The design of the timber - concrete composite slabs supported on a central reinforced concrete flat beam and spans from the fire gable over the two service shafts to the third façade is a novelty. These two concrete shafts are the only fixed elements of the building plan. Ground floor is also of concrete.

The construction method generates transparency and variability as well as a completely free scope for the layout design. The building uses 320 x 360 mm glue laminated column and beam frame. Intermediate floors have a cross-laminated timber-concrete slab. The facades are in cross-laminated timber. The bracing of the building is integrated into the solid timber panels of the façade. This helped to save construction height and minimize the cross section of the beam. Only 0,40 m^3 timber was used per square meter floor space. To facilitate the execution completely new detail solutions had to be developed for example the steel connections of the columns and beams as well as the supports for the timber-concrete slabs. Three steel joints were specially developed for the timber frame.

The wooden façade is used to cross brace the building. The design is so that the wooden nature of the façade is not directly transparent. The façade is plastered. This was done to ensure that the building design would comply with building authority approval and did not starkly differ from the surrounding buildings. However, the rendered façade does have a relationship to the structural system: the different textures in the rendering trace the timber frame and the infill.

Short building schedules and high quality due to industrial prefabrication of the timber elements:
The exterior walls including the windows and HBV-slab elements were prefabricated in the air-conditioned carpentry under monitored conditions. There is only one joint between wall elements and the slabs meaning that the substructure was completed within 8 weeks. Prefabricated components enabled a schedule of one week per storey.

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

Air tightness:	-
Shading:	-
Solar reflectance roof:	-

External Wall Build Up

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

Material	**Thickness, cm**	**Thermal Conductivity λ**
Plaster	0,8	-
Mineral wool	10	-
Fermacell	12,5	-
(Wood Pillar)		-
Laminated timber,	16	-
Fermacell	1,8	-
Fermacell	1,8	-

Total Thickness	-
U-Value (Thermal transmission coefficient)	-
Total Area	-

Ground Floor Build up

Material	Thickness, cm	Thermal Conductivity λ
Parquet Floor	1,8	-
Cement Screed	4,5	-
Heating element plate	3,0	-
Sound Insulation	5,0	-
(Holzbeton-Verbunddecke)		-
Concrete	10	-
Laminated timber slab	16	-
Fire retardant coating		-

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

Total Thickness	-
U-Value (Thermal transmission coefficient)	-
Total Area	-

Basement Floor Build up

The building has no cellar but is rather built on a foundation build- up of ferrocement (30 cm) and is supported by 57 cement pillars. This special construction was required due to a pre-existing ruin as well as the poor load-bearing capacity of the ground.

Material	**Thickness, cm**	**Thermal Conductivity λ**
Ferrocement	30	-

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

Total Thickness	Float cm
U-Value (Thermal transmission coefficient)	Float W/m²K
Total Area	Integer m²

Upper Ceiling Build Up

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

Total Thickness	-
U-Value (Thermal transmission coefficient)	-
Total Area	-

Basement Wall Build up

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

Total Thickness	-
U-Value (Thermal transmission coefficient)	-
Total Area	-

Roof Build Up

Material	**Thickness, cm**	**Thermal Conductivity λ**
Extensive Green	-	-
Substrat	2	-
Ausgleichshicht	7	-
Drainage- und Wasser-	3	-

speicher-		
Trenn-/Schutzmatte	-	-
Polymerbitumbahn	-	-
Wurzelschutzbahn	-	-
Glasgewebe-Bitumenbahn	-	-
Wärmedämmung Mineralwol-le	-	-
Trennlage	-	-
Holzbetonverbunddecke	-	-
Stahlbeton	10	-
Laminated Timber	16	-
Fire retardant coating	-	-

Total Thickness	-
U-Value (Thermal transmission coefficient)	-
Total Area	-

Upper Ceiling Build Up

Material	Thickness, cm	Thermal Conductivity λ
-	-	-

Total Thickness:	-
U-Value (Thermal transmission coefficient)	-
Total Area:	-

Window

Glass Infill:	-
Coatings/Tint :	-
Solar Heat Gain Coefficient:	-
U-Value Glass:	-
U-Value Window Frame:	-
U-Value Window Frame:	1,2 W/m^{2}K
Total Area:	-

Passive Strategies

Description of passive heating and cooling strategies:

Additional Information

Any other additional Information:

Systems

Intro:

-

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

Heating System

Heating is via district heating

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

Cooling System

Cooling System: -

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

Hot Water Systems

Hot Water system: -

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: -

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

Ventilation System

The ventilation system is through a central Heat Recovery System. Ventilation can be controlled separately for each room.

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

Power Generation

Power generation system: -

Electric power :	-
Total electricity production:	-

Renewable Energy System

Renewable systems: -

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

Auxiliary Systems

Auxiliary Energy: -

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

Smart building systems: -

Energy Efficient Lighting and Appliances: -

Energy Consumption

Intro:

The excellent thermal properties of timber together with the external thermal insulation guarantee an energy requirement of less then 40 kWh/m², around that of a Passive House. The primary energy input for the building shell of the e3 project is only 30% of a traditional heavyweight building structure. Wood's high thermal performance, in synergy with the exterior insulation and the passive solar gains through the large glazed surfaces, results in a calculated energy requirement of 27kWh/m². Additionally, it is CO2 neutral.

Primary energy used:	-
Primary energy reference building:	-
Specific primary energy demand:	27 kWh/m^2
(Calculation method: e.g. EnEV):	-
Final energy:	-
Breakdown final energy consumption:	-
Heating System:	-
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

--

Envelope costs :	-
Systems costs :	-
(Renewable energy system cost):	-
Total investment Costs:	1628000 €
Cost/m²:	€/m²
Annual total costs:	-
Annual total costs/m²:	-
Yearly energy costs:	-
Early energy savings against reference building:	-
Internal Rate of Return:	-
Static payback time:	-
Dynamic Payback time:	-

Cost and cost effectiveness

Assumptions

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

bigEE

Your guide to energy e ciency in buildings.

bigee.net

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.

Co-ordinated by

Wuppertal Institute for Climate, Environment and Energy

Partners to date

中城深科 CSUSIBR

sonedi

cscp

Financial support

Federal Ministry for the Environment, Nature Conservation and Nuclear Safety

Dr. Stefan Thomas • bigee@wupperinst.org

Wuppertal Institute for Climate, Environment and Energy • Doeppersberg 19 • 42103 Wuppertal • Germany • Phone: +49 (0)202 2492-129