Austria

The Passive House

National Publication

What is a Passive House?

*In this age of **increased energy prices** and **emission excesses**, efficient energy use is becoming more and more important. This is no longer solely an environmental consideration, but increasingly also a financial one. Some **40% of our annual energy consumption** is used in buildings. The Passive House concept primarily focuses on residential buildings, though these principles are applicable in other building types as well. As the numbers show, **energy-wise**, there is **much to be gained in buildings**. For this reason, more and more building professionals have recognized the Passive House approach as the sensible way forward.*

The Passive House is a residence that has been optimally designed to retain energy. Much attention is paid to performance of the materials and components with respect to **indoor climate**. The advantage being that temperatures inside the residence have very few fluctuations, resulting in **notably higher indoor comfort.**

The **Passive House concept** applies **established techniques** and **solid design principles** to realize a residence that utilizes it's energy optimally.

By **reducing heat losses** to a minimum through optimal insulation and heat recovery techniques and **maximizing passive heat gains**, the Passive House is so efficient that it no longer requires a conventional heating system.

This means that the **cost savings** for the heating system can, in part, compensate for the higher cost of high performance building components.

Moreover, by using less energy over its lifetime, a Passive House not only generates a **smaller environmental impact**, it also incurs **lower energy costs** during use. In addition, a Passive House decreases the financial impact on occupants that rising energy prises may bring.

Introduction

What is PEP?

PEP, which stands for **'Promotion of European Passive Houses'** is a consortium of European partners, supported by the **European Commission**, Directorate General for Energy and Transport.

Why Promotion of European Passive Houses?

It is generally recognized that, within the housing sector in Europe, **many building activities** can be expected over the coming decades. The old building stock will need to be refurbished or, in many cases, even demolished and new buildings erected. The existing housing stock is responsible for a **large share of our total energy consumption**, and therefore many **energy savings** can be accomplished in these upcoming reconstruction activities. As previous demonstration projects (such as CEPHEUS) have demonstrated, the **reduction of non-renewable energy demand** by a **factor 4** (compared to contemporary national standards) is not only **possible** but also **realistic**. The Passive House concept is a **sound** and relatively **low-cost method** to achieve these energy savings. To spread this knowledge throughout the professional building community, beyond the select group of specialists, PEP has set out to spread the experience gained throughout Europe on the Passive House concept.

What does PEP do?

Goal of P.E.P. is to promote regional economic activities, especially for SMEs (which perform a significant part of the work in the housing industry) in order to induce a substitution of expenses for energy use during the lifetime of houses with investment in the building envelope.

To achieve this goal, the consortium intends to:

- communicate the passive house concept and specific solutions in different European regions and climates

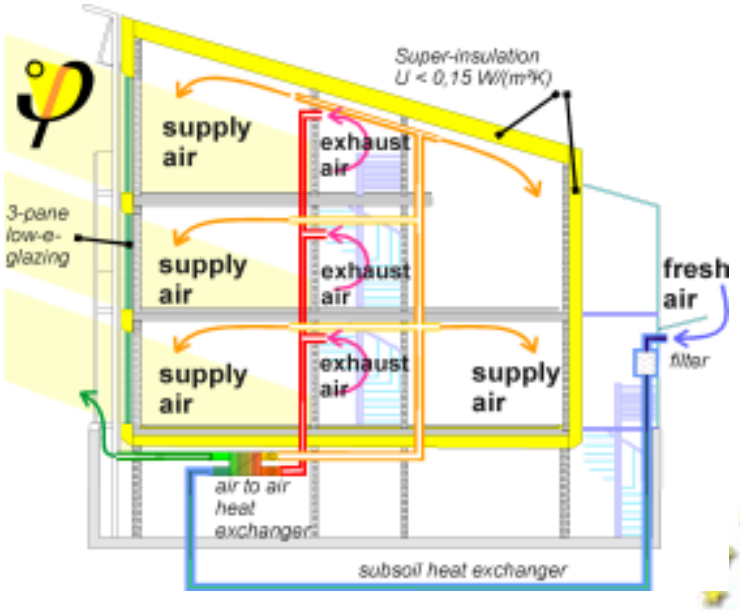
Introduction

- adapt the existing Passive House design tool (PHPP, Passive House Planning Package) to meet the demand of architects and planners in different countries
- develop practical information packages, such as building product documentation, design guides, research results, calculation methods and quality assurance activities to assist building professionals throughout Europe in the development of Passive Houses
- set up a certification programme for Passive House buildings and technologies and a link to the national Energy Performance Certification system according to the EU building directive
- organize national workshops and the annual international Passive House Conference
- Create national Passive House websites for continuous up-to-date information provision

How can I find out more?

For more information, please contact:

AEE – Institute for Sustainable Technologies (AEE INTEC)
Feldgasse 19, A-8200 Gleisdorf
Tel: +43 (0) 3112-5886-0
Fax: +43 (0) 3112-5886-18
office@aee.at, www.aee-intec.at



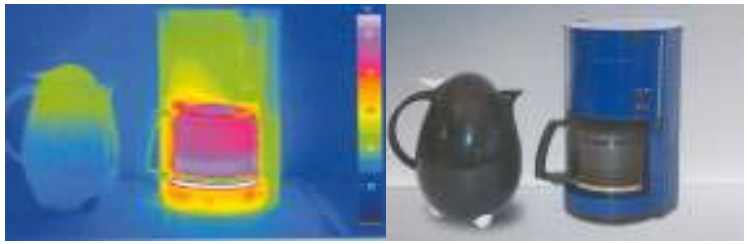
Passive House a definition

The term **Passive House** refers to a specific construction standard for residential buildings with good interior comfort conditions during winter and summer, without traditional heating systems and without active cooling. Typically this includes very good insulation levels, very good air- tightness of the building, whilst a good indoor air quality is guaranteed by a mechanical ventilation system with highly efficient heat recovery.

Thereby the design heat load is limited to the load that can be transported by the minimum required ventilation air. However space heating does not have to be carried through the ventilation system. For 40° - 60° Northern latitudes, under conditions specified in the PHPP calculation model[1]:

- the total energy demand for **space heating and cooling** is limited to **15 kWh/m² treated floor area**[2];
- the total **primary energy use** for all appliances, domestic hot water and space heating and cooling is limited to **120 kWh/m² treated floor area**

A passive house has a **high level of insulation** with **minimal thermal bridges**, **low infiltration**, and utilizes **passive solar gains** and **heat recovery** to accomplish these characteristics. Consequently **renewable energy** sources can be used to meet the resulting energy demand.



The Passive House Concept ïllustrated: Passive (thermos) versus Active (stove)
Source:Informations-Gemeinschaft Passivhaus Deutschland

1 *Passive House Planning Package, Passiv Haus Institut*

Passive House measures

Measure/ solution	*Passive House standard*
1. Super Insulation	
Insulation walls	U ≤ 0,15 W/(m²K)
Insulation roof	U ≤ 0,15 W/(m²K)
Insulation floor	U ≤ 0,15 W/(m²K)
Window casing, doors	U ≤ 0,8 W/(m²K)
Window glazing	U ≤ 0,8 W/(m²K)
Thermal bridges	linear heat coeff ψ ≤ 0,01W/(mK)
Air tightness	n50 ≤ 0,6 h-1
Minimal Shape Factor (Area TFA/ Volume TV)	
2. Heat Recovery/ IAQ	
Ventilation counter flow air to air heat exchanger	heat recovery ηHR ≥ 75 %
Ventilation air sub-soil heat exchanger	air outlet after sub-soil heat exchanger above frost temperature
Ventilation ducts insulated	
Other heat recovery (e.g. ventilation & DHW return pipes)	
DHW heat recovery	
DHW pipes insulated	
Minimal space heating	postheater ventilation air/ low temperature heating
Efficient small capacity heating syst.	biomass, heat pump, gas, co-generation (e.g. district heating), etc.
Air Quality through ventilation rate	min. 0,4 ach^{-1} or 30 m^3/pers/h or national regulation if higher
3. Passive (Solar) Gain	
Window glazing	solar energy transmittance g ≥ 50 %
DHW (solar) heater	
Thermal mass within envelope	
Solar orientation	
Night-time shutters	
Shading factor [%] (East & West)	

Measure/ solution	*Passive House standard*
4. Electric Efficiency	
Energy labeled household appliances [Labeling A - G]	Energy reduction 50% of common practice
Hot water connections washing machines/ dishwashers	
Compact Fluorescent lighting	
Regular maintenance ventilation filters	
Direct Current motor ventilation	
Efficient fans: SFP (Specific Fan Power)	≤ 0,45 W/(m3/h) (transported air)
5. On-site Renewables	
Wind turbine	
Photo Voltaics	
Solar thermal energy	
Biomass system	
Other	
	=basic measure/ solution
	=often applied optional measure/solution
	=other optional measure/ solution

Passive House publications

Barriers to build passive houses

Good components are already available, but:

- Energy concepts are not always thought through
- Training of planers, builders, installers has to be extended and improved
- General conditions of the buildings has to be improved (especially air tightness)
- Maintenance / quality assurance of the ventilation systems has to be improved
- Alternatives to the heat pump (compact unit) should be developed
- There is still a lack of information within the different target groups (housing associations, producer of prefabricated houses, end user, ..)

Communities of Interests for Passive Houses- Austria:

- Community of interest for Passive houses Austria, www.igpassivhaus.at
- Community of Interest for Passive houses East, www.ig-passivhaus.at
- Community of Interest for Passive houses Styria - Burgenland, www.ig-passivhaus-stmk.at
- Community of Interest for Passive houses Tyrol, www.igpassivhaus.at
- Community of Interest for Passive houses Vorarlberg, www.igpassivhaus.at
- Community of Interest for Passive houses Carinthia, www.igpassivhaus.at
- Community of Interest for Passive houses Upper Austria, www.igpassivhaus.at

Links to national publications

- Living space ventilation, www.fh-kufstein.ac.at/wohnraumlueftung
- Passive house brochure for endusers, www.gdi.at
- Documentation of passive houses "1000 passive houses in Austria", www.hausderzukunft.at
- Reports on the national CEPHEUS project, www.cepheus.at

Passive House publications

National / german-language publications (extract):

Title (German/English)	Authors / editors	Year	Detailed Information
Wohnraumlüftung / Living space ventilation	Greml, Blümel, Leitzinger, Kapferer	2004	www.fh-kufstein.ac.at/wohnraumlueftung
Passivhaus – Details für Anwender / Passive House – Details for experts	Gemeinschaft Dämmstoff Industrie	2004	www.gdi.at
Passivhaus Datenbank: 1000 Passivhäuser in Österreich / Passive House Database: 1000 Passive Houses in Austria	Lang	2004	http://www.hausderzukunft.at/results.html?id=2757
Konzept zur Durchsetzung großvolumiger Passivhauswohnanlagen in der gemeinnützigen Wohnbauwirtschaft Österreichs - im besonderen am Beispiel Wettbewerb Passivhausmodellwohnbauvorhaben Samer Mösl, Salzburg / Concept for the implementation of large-volume passive house residential buildings in the nonprofit housing economy of Austria	Sturm	2004	http://bokudok.boku.ac.at/bokudok/en_search_publication.unit_supervisor?unit_id_in=H875
„Das Passivhaus“ –Planungs -, Bau- und Kalkulationsgrundlagen / „The passive house“ –planning-, building- and calculation basics.	Lang, Lang	2004	http://www.passivehouse.at/buch.htm
Grosse Passivhäuser / Large passive houses	Oehler	2004	http://aleph.ub.tuwien.ac.at http://www.sozialprojekte.de/info/aevuevovec www.kohlhammer.de
Passivhauskindergarten mit heilpädagogischer Integrationsgruppe / Passive house Kindergarten with an integrated therapeutical group	Kislinger, Zelger, Obermayer	2003	http://www.energytech.at/(de)/architektur/results/id2088.html
Passivhaus in Ziegelbauweise mit Schwerpunkt Zweischalenmauerwerk/ Passive house built of bricks and mortar	Krapfenbauer	2003	http://bokudok.boku.ac.at/bokudok/en_search_publication.unit_supervisor?unit_id_in=H875
Passivhaus / Passive house	Metikos	2003	http://meteor.bibvb.ac.at
Anwendung der Passivhaustechnologie im sozialen Wohnbau / Appliance of the passive house technology in social housing	Schöberl	2003	http://nachhaltigwirtschaften.at/results.html/id3508
Altbausanierung mit Passivhauspraxis / Existing building reconstruction and implementation of passive house components	Guschlbauer-Hronek	2003	http://nachhaltigwirtschaften.at/results.html/id2748

Passive House publications

Title (German/English)	Authors / editors	Year	Detailed Information
SIP- Siedlungsmodelle in Passivhausqualität / SIP settlement models in passive house quality	Prehal	2003	http://nachhaltigwirtschaften.at/results.html/id1754
Neue Passivhäuser / New passive houses	Graf	2003	www.callwey.de
Arbeiten und Wohnen im Passivhaus / Working and Living in the passive house	Oberhöller	2003	http://aleph.ub.tuwien.ac.at
Bauen mit Stroh / Building with straw	Gruber, Gruber	2003	http://www.baubiologie.at/asbn/literatur.html
Berichte zu öster. CEPHEUS Projekten / Reports on the Austrian CEPHEUS projects	Energieinstitut Vorarlberg, AEE INTEC	2002	http://www.hausderzukunft.at/results.html?id=2757
CEPHEUS - Austria Zusammenfassender Bericht / CEPHEUS-Austria summary report	Energieinstitut Vorarlberg	2002	http://www.energieinstitut.at/?sID=285
CEPHEUS Horn Niederösterreich/ CEPHEUS Horn Lower Austria	Energieinstitut Vorarlberg	2002	http://www.energieinstitut.at/?sID=285
CEPHEUS cost efficient passive houses as european standards	Energieinstitut Vorarlberg	2002	www.energieinstitut.at
Das Passivhaus in Niederösterreich/ The passive house in Lower Austria	AEE Niederösterreich, Amt der Niederösterreichischen Landesregierung	2002	www.noel.gv.at/service/wst/wst6/energie/Publikationen.htm
Planen und Bauen für die Zukunft - Das S-House/ Designing and building for the future - The S-House	Gruppe Angepasste Technologie, Techn. Universität Wien	2002	www.grat.at/publikationen.htm www.s-house.at
Das Passivhaus in der Praxis/ The passive house in practice	Grabler-Bauer	2002	http://www.hausderzukunft.at/results.html?id=1727
Passivhäuser planen und bauen / Designing and building passive houses	Grobe	2002	www.callwey.de
Grundlagen und Bau eines Passivhauses / Basics to build a passive house	Pregizer	2002	www.buch.de/
Bauen im Gleichgewicht / Building in balance	Schmid	2002	www.jupiter-uranus.com
Energieeffiziente Wohngebäude / Energy efficient residential buildings	Schulze	2002	www.tuev-verlag.de
Das Passivhaus: Bauen für die Zukunft / The passive house Building for future	Endhardt	2002	http://aleph.ub.tuwien.ac.at www.amazon.de

Passive House publications

Title (German/English)	Authors / editors	Year	Detailed Information
Ökolgische Passivhäuser/ Ecological passive houses	Schuster, Lipp	2001	http://www.hausderzukunft.at/results.html?id=1741
CEPHEUS Wohnkomfort ohne Heizung / CEPHEUS Livingcomfort without heating	Drössler, Krapmeier	2001	http://buecher.compricer.de/3211837213
Das ökologische Passivhaus / The ecological passive house	IBO, Donau Universität Krems	2001	www.ibo.at
Das EnergieEinsparHaus -Die neue Generation des Bauens / The energy saving house -The new generation of building	Meyer	2001	http://www.amadeusbuch.at
Das intelligente Haus / The intelligent building	Tränkler, Schneider	2001	http://e2ie2i.at/var1.php?newsID=2805
Das kostengünstige mehrgeschossige Passivhaus in verdichteter Bauweise / The costefficient mulitstorey passive house in a compact architecture	Blume	2000	http://aleph.ub.tuwien.ac.at
Das Passivhaus-Wohnen ohne Heizung / The passive house-Living without heating	Graf	2000	www.callwey.de
Das Passivhaus / The passive house	Feist	1999	http://www.etn.wsr.ac.at/(de)/rxml/results.html?id=1518
Heizlastauslegung im Niedrigenergie- und Passivhaus / Dimensioning of the heat load in the low energy- and passive house	Bisanz	1999	http://aleph.ub.tuwien.ac.at www.passiv.de/04_pub/BestellF/OnlineB.htm
Niedrigenergie und Passivhäuser / Low – energy and passive houses	Mumm	1998	www.oekobuch.de
Solare Warmwasserbereitung in Passivhäusern / Solar hot water in passive houses	Bartelsen	1997	http://aleph.ub.tuwien.ac.at http://www.passiv.de/04_pub/BestellF/OnlineB.htm
Grundlagen der Gestaltung von Passivhäusern/ Basics of designing passive houses	Feist	1996	www.verlag-das-beispiel.de
Architektur mit der Sonne / Architecture with the sun	Kiraly	1996	http://www.kiraly.at/wir_ueber_uns.htm
Der Sonnenkollektor im Passivhaus / The solar collector in passive houses	Loga	1995	http://meteor.bibvb.ac.at

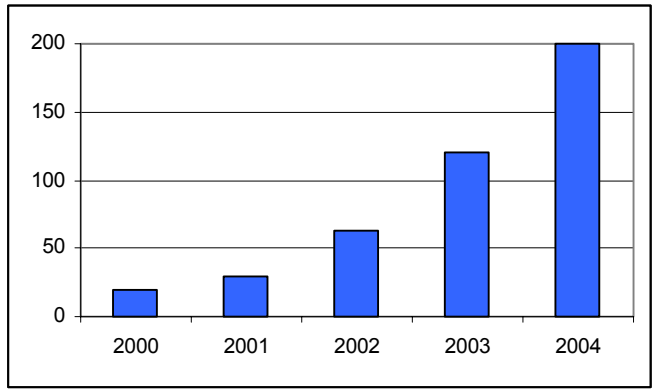
Austria building stock

The existing number of buildings in Austria is about 2,046,000 with a total of around 3,863,000 dwellings.
76% of the buildings are detached and semi-detached houses, 10% are multi family residential buildings and 14% are other types of buildings (warehouses, office and industrial buildings).
47% of the dwellings consists of detached and semi-detached houses, 50% are multi family residential buildings and 3% are buildings with other utilisation.
About 23,000 buildings are yearly erected in Austria (average value from the building count from 1991 to 2001). From these are in the last years about 25% light building (wooden construction), with an increasing tendency. Among the heavy constructions is bricks construction of majority with 80% and the rest is concrete.

Source: www.statistik.at

Type of house	Existing building stock
Single family, row house	Not explicit mentioned in the national statistics
Semi detached/ Detached	76%
Apartment/flat	10%
Other	14%

The following graph shows the number of passive houses for the peroid from the year 2000 to 2004, surveyed within the national research program "buildings of tomorrow". The predicted number of passive houses is about 400 for the year of 2005.

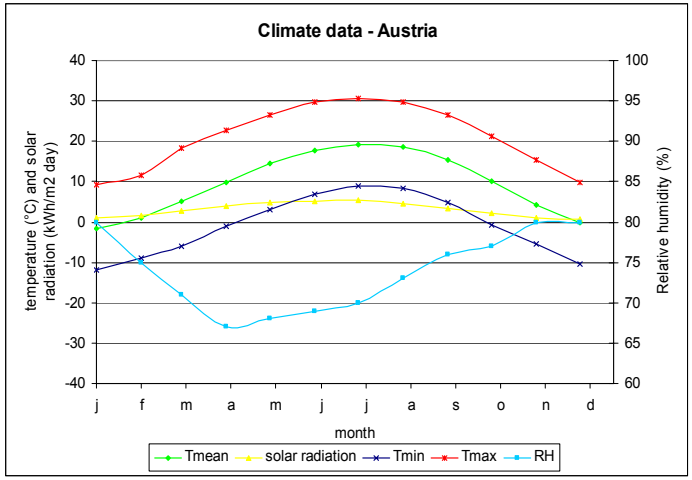


Source: www.hausderzukunft.at

Austria climate

Austria is in the temperate climate zone. The climate of Austria changes from the temperate west, affected by the Atlantic sea, to the continental east. The rainfall shows a west east decline. The biodiversity is effected by the variety of the terrain and the climate of Austria. Austria is one of the best wooded countries in Europe (46% of the total area).
The highest temperatures in occur July and August, with an average daily maximum of 32°C. The lowest temperatures of the year are in January with an average daily temperature of –13°C.
The minimum/maximum design temperature is therefore –13°C for winter and 32°C for summer. The temperature, humidity and solar radiation (location: Graz, Styria) are given per month in the graph.

source: ZAMG, Central Institute for Meteorology and Geodynamics



Climate data of Graz, Austria; monthly mean temperatures for the period from 1960 to 1990

Austria Egg Passive House example

Type of dwelling: Multiple family dwelling in Egg, Vorarlberg, Austria with 2 storeys and 4 apartments.

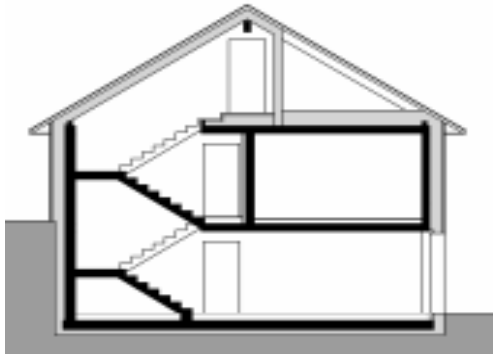
Occupancy: Building Occupancy = 10 persons for this dwelling type.

Overall Measurements

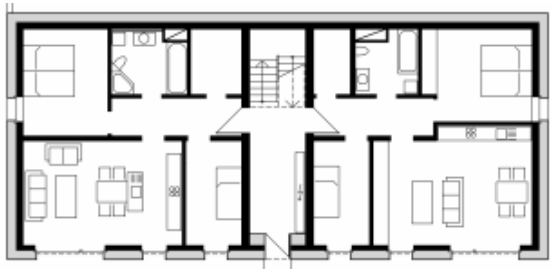
Treated floor area	309.69 m^2
Average ceiling height	2.35 m

Foto: Helmut Krappmeier, EIV

Section



Ground floor



First floor

source: cepheus – final report

Austria Egg Passive House example

Thermal mass: This Austrian ***passive house*** is designated "high" thermal mass. Exterior walls: on the ground floor concrete, on the first floor bricks - high thermal mass Interior (separation) walls: bricks– medium thermal mass Floors: prefabricated concrete – high thermal mass.


Foto: Helmut Krappmeier, EIV

Compared to typical construction:
*Until the last 10-15 years the **typical Austrian houses** were designated with high thermal mass (brick or concrete construction). During the last 10-15 years houses were designed more and more with low to medium thermal mass (25% of all new buildings). Austrian "standard" house can be designated "low" thermal mass, only the basement is "high" thermal mass.*

Air tightness Egg Passive House	n_{50} = 0.51 h^{-1}
Air tightness typical Austria	*n_{50} = 1 h^{-1}*

Thermal insulation

	Egg Passive House	*Typical House Austria*
Envelope component	**U-value [W/m²K]**	
Facade	0,12	*0,18*
Roof	0,10	*0,18*
Floor	0,13	*0,4*
Doors	1,1	*1,3*
Window frame	1,25	*1,3*
Windows	0,7 /Triple Pane	*1,3 /Dual Pane*

Overall measurements

	Area (m²)
Facade	309.8
Roof	202.3
Floor	203.,4
Doors	2.4
Window frame	27.3
Glazing, triple pane	81.9

Austria Egg Passive House example

Envelope components, materials

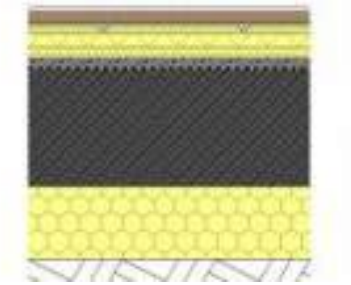
Facade, exterior wall – ground floor

Materials (out → in)	*Thickness [cm]*
Polyethylene sheeting	0.05
Extruded polystyrene	24
Ferroconcrete	25
Plaster	1.5

Facade, exterior wall – first floor

Materials (out → in)	*Thickness [cm]*
Wainscot	2.4
Battens, rear ventilated	2.4
Expanded polystyrene	30
Vertically perforated brick	18
Plaster	1.5

Floor, base plate



Materials (out →in)	*Thickness [cm]*
Extruded polystyrene	16
Ferroconcrete	25
Vapour barrier	0.05
Sand escape	1.6
Expanded polystyrene	3
Impact sound insulation	2.5
Floor heating	2.4
Particle board	2.5
Floor covering	1

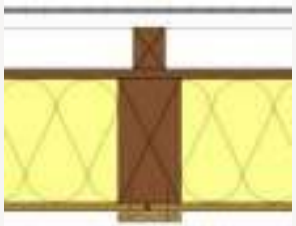
Austria Egg Passive House example

Envelope components, materials

Ceiling to unheated spaces (roof)Ceiling to unheated spaces (roof)

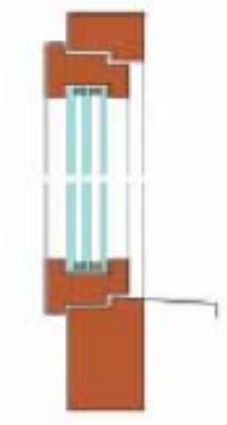
Materials (out → in)	*Thickness [cm]*
Particle board	1
Expanded polystyrene	40
Ferroconcrete	20
Plaster	1.5

Roof



Materials (out → in)	*Thickness [cm]*
Tiles	2
Battens	3
Counter battens, rear ventilated	8
Medium density fibreboard	1.8
Rafter / rockwool	24
OSB - board	1.5

Glazing, frames



Triple pane window	U_{window}=0.86 W/m²K
Material	Wood
U_{frame}=1,25 W/m²K	U_{glas}=0.7 W/m²K
Glass pane	argon

Austria Egg Passive House example

Equipment/ installations

This passive house is not heated on the ventilation system although the specific heat demand is only 15.7 kWh/m²a and the specific heat load only10.6 W/m². There is a small, low temperature floor heating installed which is provided by a heat pump and solar thermal collectors.
The supply with fresh air for the rooms is ensured by a decentralised ventilation system with a heat recovery and a system for preheating the fresh air with an earth to air heat exchanger. The domestic hot water generation is also carried out by the heat pump and the solar thermal system.

Heating	Heat generator Heating fluid Heating system	Heat pump + solar thermal collectors Geological heat + solar energy Central / floor heating
Domestic hot water	Heating Energy source	Heat pump + solar thermal collectors Geological heat + solar energy
Ventilation	System Heat recovery Supply- and exhaust air flow per apartment	Mechanical, decentralised ventilation system (supply and exhaust) preheating the fresh air with an earth to air heat exchanger Yes, ~75% 125 m³/h

Compared to typical construction:
The most applied system for the ‚standard building" are radiators and floor heating systems. The most common fuel sources are oil, gas, fire wood, pellets and ground heat pumps. The supply with fresh air for the rooms is ensured by a centralised ventilation system with a heat recovery.

Heating	Heat generator Heating fluid Temp. control Heating system	Wood pellets fired boiler + solar thermal collectors Solar + biomass Room thermostat central, low temperature wall- and floor heating
Domestic hot water	Heating Energy source	The same like heating
Ventilation	System Heat recovery Ventilation Rate	Mechanical yes 1

Austria Egg Passive House example

Energy Use

Specific heat demand 15,7 kWh/m²a (calc. PHPP)
Specific heat load 10,6 W/m²
Final energy consumption 45,7 kWh/m²a (Heating, domestic hot water and household, measured in the 1st year)
Specific value for primary energy (heating, domestic hot water and electricity) **113,9 kWh/m²a**

Compared to typical new build construction:
Energy use for heating *is 68 kWh/m²*
Energy use for domestic hot water (DHW) *is 16 kWh/m²*
Total electricity use *for a single family house is 21 kWh/m².*
The electricity use for household appliances *is 11 kWh/m².*

Austria Horn Passive House example

Type of dwelling: Single family house in Horn, Lower Austria, Austria with a basement and two storeys.

Occupancy: Building Occupancy = 4 persons for this dwelling type.

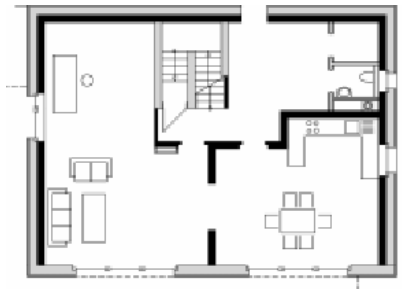
Overall Measurements

Treated floor area	172.76 m^2
Average ceiling height	2.5 m

Foto: Helmut Krappmeier, EIV

Section

Ground floor



First floor

source: cepheus – final report

Austria Horn Passive House example

Thermal mass: This ***passive house*** is designated "medium" thermal mass. All the walls inside are loam rendered. Exterior walls: recycled ecological bricks – high thermal mass and for the south wall prefabricated timber frame constructions with cellulose insulation – low thermal mass. Interior (separation) walls: ecological recycled bricks – high thermal mass. Floors: prefabricated concrete – high thermal mass.

Compared to typical construction:
Until the last 10-15 years the ***typical Austrian houses*** *were designated with high thermal mass (brick or concrete construction). During the last 10-15 years houses were designed more and more with low to medium thermal mass (25% of all new buildings). Austrian "standard" house can be designated "low" thermal mass, only the basement is "high" thermal mass.*

Air tightness Horn Passive House	n_{50} = 0.61 h^{-1}
Air tightness typical	*n_{50} = 1 h^{-1}*

Thermal insulation

	Horn Passive House	*Typical House Austria*
Envelope component	**U-value [W/m²K]**	
Facade		*0,18*
High thermal mass	0,097	
Low thermal mass	0,093	
Roof	0,085	*0,18*
Floor	0,13	*0,4*
Doors	1,9	*1,3*
Window frame	1,1	*1,3*
Windows	0,8 /Dual Pane	*1,3 /Dual Pane*

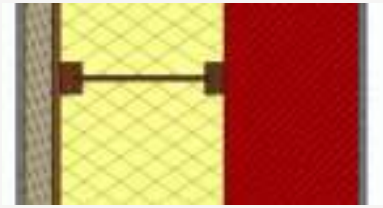
Overall measurements

	Area (m²)
Facade – high thermal mass	205.2
Facade – low thermal mass	48.8
Roof	135.2
Floor to the unheated cellar	119.1
Doors	2.2
Window frame	15.4
Glazing, dual pane	51.5

Austria Horn Passive House example

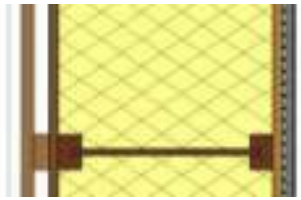
Envelope components, materials

Façade - high thermal mass



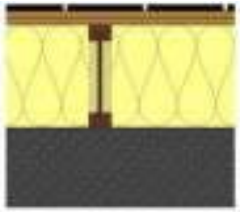
Materials (out → in)	*Thickness [cm]*
Plaster	1.5
Wood wool light weight building board	5
Medium density fibreboard	1.6
Cellulose	30.2
Recycled ecological bricks	25
Plaster	1.5

Façade - low thermal mass



Materials (out → in)	*Thickness [cm]*
Wainscot	2
Battens, rear ventilated	2.5
Medium density fibreboard	1.6
Cellulose	35
OSB board	1.5
Gypsum plasterboard	1.25
Plaster	0.5

Floor to the unheated cellar

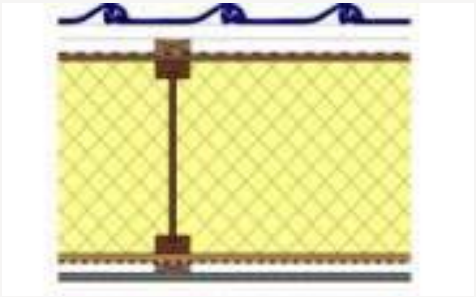


Materials (out → in)	*Thickness [cm]*
Floor covering	1.5
OSB board	2 x 1.8
Flax insulation	25.4
Ferroconcrete	20

Austria Horn Passive House example

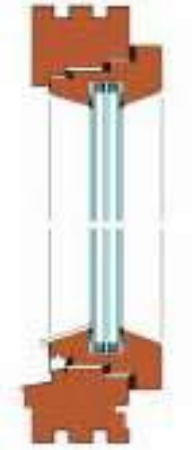
Envelope components, materials

Roof



Materials (out → in)	*Thickness [cm]*
Tiles	1.5
Battens	3
Counter Battens	3
Medium density fibreboard	1.6
Cellulose	40.6
OSB board	1.5
Battens	3
Gypsum plasterboard	1.5
Plaster	0.5

Glazing frames



Triple pane window	U_{window}=0.91 W/m²K
Material	Wood
U_{frame}=1.1 W/m²K	U_{glas}=0.8 W/m²K
Glass pane	argon

Austria Horn Passive House example

Equipment/ installations

This passive house is not only heated on the ventilation system although the specific heat demand is only 162 kWh/m²a and the specific heat load only 123 W/m². There is a low temperature wall heating sytem installed which is provided by a small wood pellets fired boiler and solar thermal collectors.
The supply with fresh air for the rooms is ensured by a centralised ventilation system with a heat recovery and a system for preheating the fresh air with an earth to air heat exchanger.
The domestic hot water generation is also carried out by the wood pellets fired boiler and the solar thermal system.

Heating	Heat generator Heating system	Wood pellets fired boiler + solar thermal collectors Central wall heating
Domestic hot water	Heating Energy source	Wood pellets fired boiler + solar thermal collectors Wood pellets + solar energy
Ventilation	System Heat recovery Ventilation Rate	Central ventilation system, preheating the fresh air with an earth to air heat exchanger yes, ~80% Supply- and exhaust air flow 95-220 m³/h

Compared to typical construction:
The most applied system for the ‚standard building" are radiators and floor heating systems. The most common fuel sources are oil, gas, fire wood, pellets and ground heat pumps. The supply with fresh air for the rooms is ensured by a centralised ventilation system with a heat recovery.

Heating	Heat generator Heating fluid Temp. control Heating system	Wood pellets fired boiler + solar thermal collectors Solar + biomass Room thermostat central, low temperature wall- and floor heating
Domestic hot water	Heating Energy source	The same like heating
Ventilation	System Heat recovery Ventilation Rate	Mechanical yes 1

Austria Horn Passive House example

Energy Use

Specific heat demand 16,2 kWh/m²a (calc. PHPP)
Specific heat load 12,3 W/m²
Final energy consumption 13,6 kWh/m²a (Heating, domestic hot water and household, measured in the 1st year)
Specific value for primary energy (heating, domestic hot water and electricity) **65,1 kWh/m²a**

Compared to typical construction:
Energy use for heating *is 68 kWh/m²*
Energy use for domestic hot water (DHW) *is 16 kWh/m²*
Total electricity use *for a single family house is 21 kWh/m².*
The electricity use for household appliances *is 11 kWh/m².*

This publication has be
created by DHV
www.dhv.com, as part
the European PEP proj

Austria
The Passive House

Intelligent Energy Europe

The PEP-project is partially supported by the European Commission under the IEE Programme. EIE/04/030/S07.39

For more information, please contact:

AEE - Institute for Sustainable Technologies (AEE INTEC)
Feldgasse 19, A-8200 Gleisdorf
Tel: +43 (0) 3112-5886-0
Fax: +43 (0) 3112-5886-18
office@aee.at, www.aee-intec.at