








**House of the Future**

# Office Overview



-  **Overall planning old/new build**
-  Architecture + Technical planning
-  Building measurement+ expert advice
-  **PH-Consulting + Certification**
-  **Training + Development**

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# We need new recipes !

## Special attributes in heated non-residential buildings

### Standard Non-Res

**High heating demand** in spite of high internal heat gains,  
(facilities, light, people,..)

**High cooling demand** caused by internal gains, missing  
systems for passive cooling (shading, ventilation, brine  
energy,..) and normally high requirements to summer comfort  
in working areas.

**This causes higher costs for cooling than for heating**



# We need new recipes !

## Special attributes in heated non-residential buildings

### Passive Non-Res

**Minimal heating demand** by consequent avoiding of losses and using the high internal heat gains, (facilities, light, people)

**Minimal cooling demand** by integrated shading concepts and using passive cooling (ventilation over night and brine energy) to meet the high requirements to summer comfort in working areas.

**This causes low costs for cooling and heating**



# Passive Art Museum Ravensburg 2012

1st PH-Museum worldwide with PHI Certification



Recycled  
brick  
facade !



Passive House Consulting



# Building envelope: Thermal bridges

Thermal bridge influence:

$$U_{TB, total} = 0,05 \text{ W/(m}^2\text{K)} !!$$

Influence of thermal bridge pile foundation

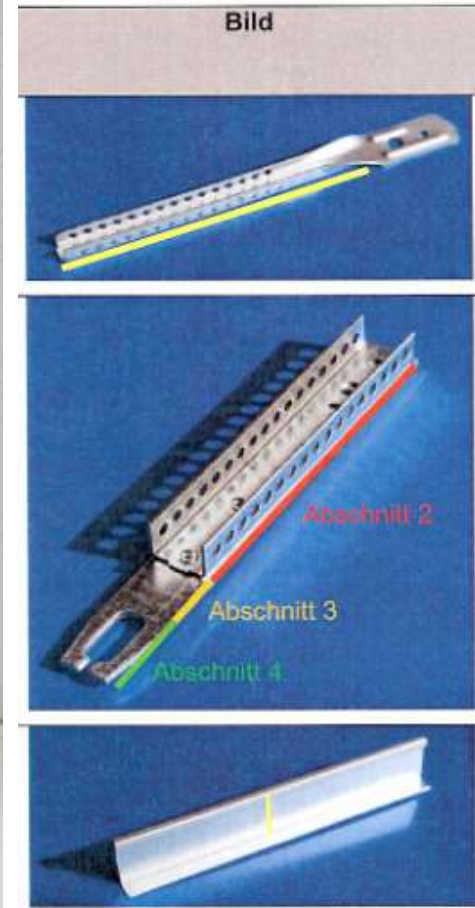
$$U_{TB, piles} = 0,04 \text{ W/(m}^2\text{K)}$$



# Building envelope: Garage ceiling



Garage ceiling  
26 cm Insulation  
Thermal Conductivity: 035  
 $U = 0,136 \text{ W}/(\text{m}^2\text{K})$  incl.  
Bracket (System Abakus)



# Building envelope: Brick facade

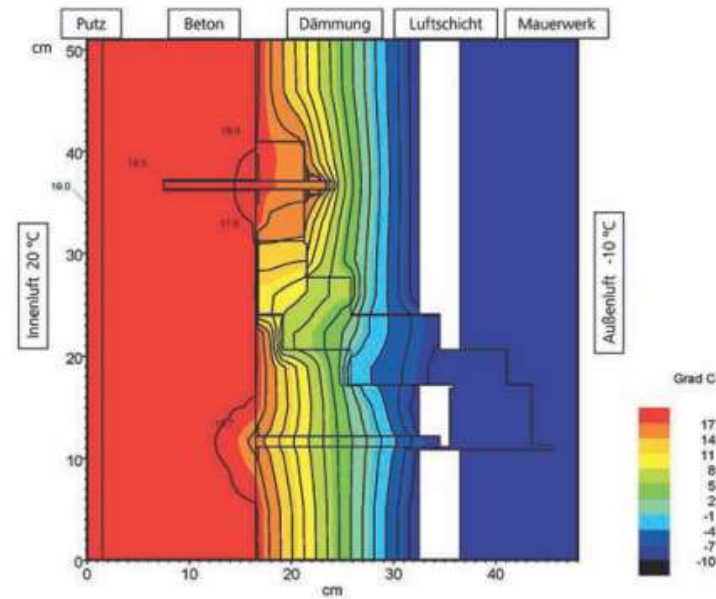
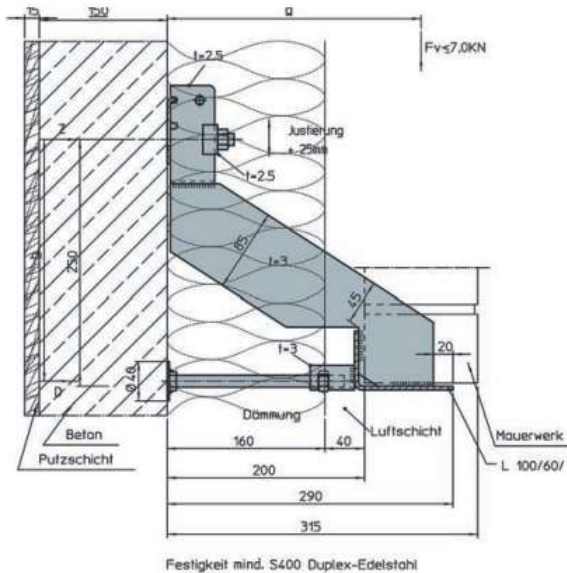


Bild 18. WK-D-290-7,0- Lean Duplex Rostfrei D4  
Fig. 18. WK-D-290-7,0 lean duplex stainless steel D4

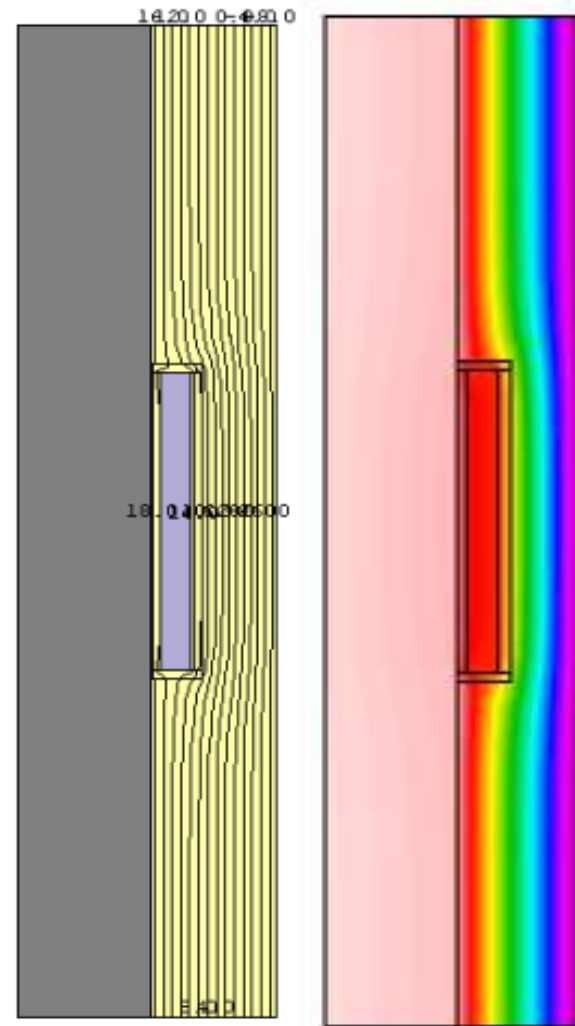
Brick facade 24 cm  
Insulation  
Thermal conductivity: 032  
 $U = 0,137 \text{ W}/(\text{m}^2\text{K})$  incl.  
Brackets and wind anchor





# Building envelope: Conduit ventilation

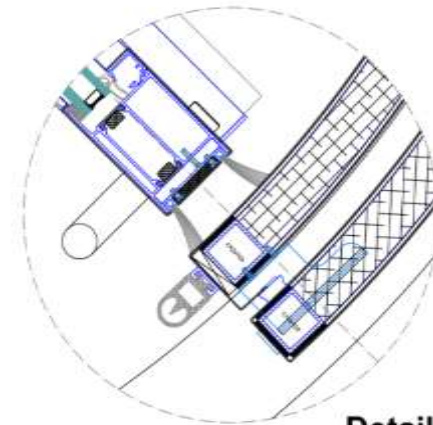
**Passive house facade enables  
conduit to run through the facade**



# Building envelope: Revolving door

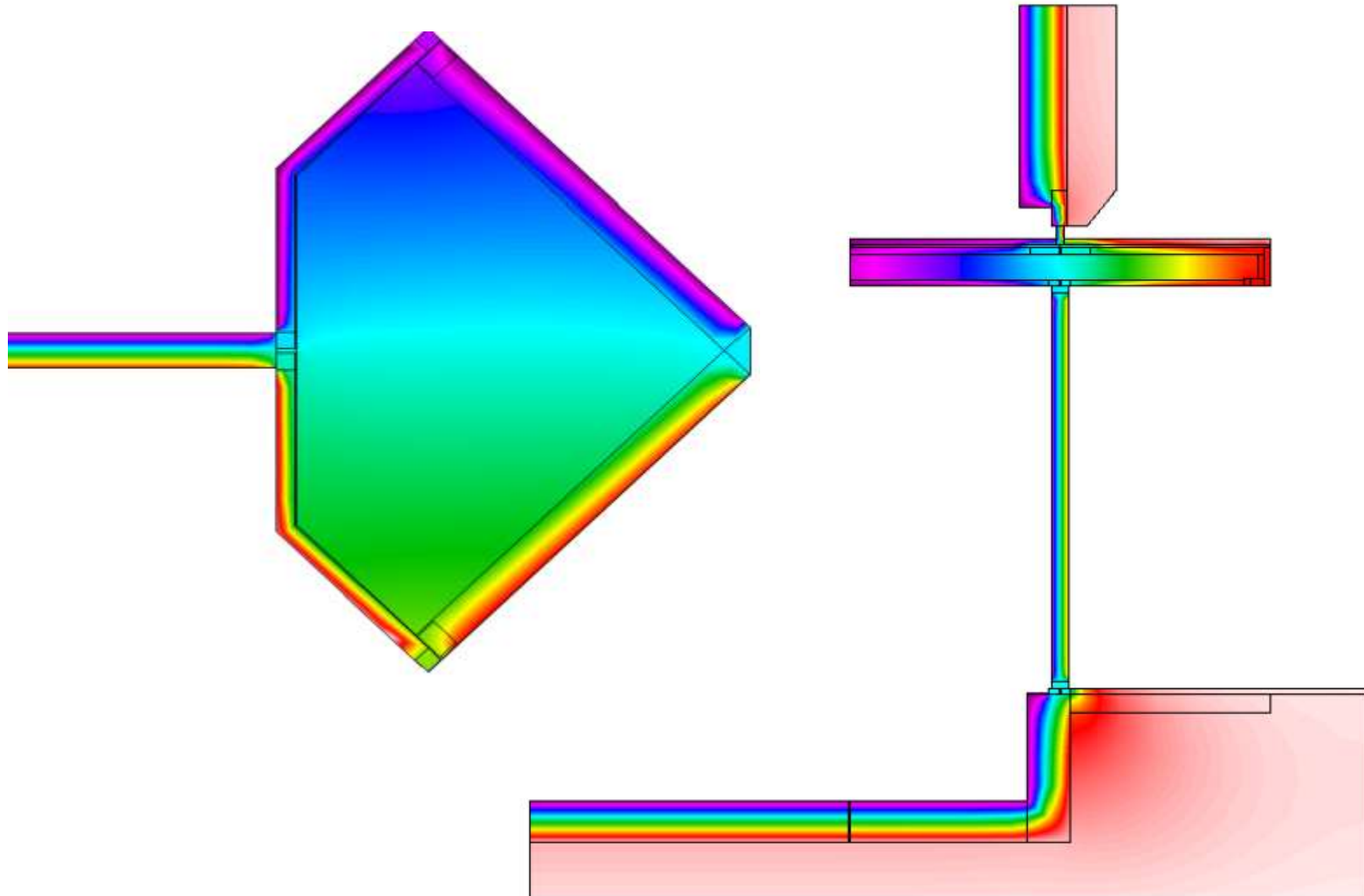
## Improvements for use in a Passive House

- Double glazing  $U_g = 1,1 \text{ W}/(\text{m}^2\text{K})$
- Insulated curved panels
- Thermal break profiles in the vertical, floor and ceiling ring
- Double brush seal
- Standard position to  $360^\circ$ , warm side returns to the inside after rotation



Detail E  
A0 - M 1:2

# Building envelope: Revolving door



# Building envelope: Air tightness ( $n_{50} < 0,40$ 1/h)

## Prüfbericht

### über die Luftdichtheitsmessung

#### Das Gebäude/Objekt

Kunstmuseum Ravensburg

Burgstraße 9  
88212 Ravensburg

hat am 04.12.12

bei der Messung der Luftdichtheit nach DIN EN 13829, Verfahren A  
folgenden Wert für die Luftwechselrate bei 50 Pascal erzielt:

$$n_{50} = 0,30 \text{ 1/h}$$

Die Anforderungen an die Luftdichtheit nach Passivhausinstitut betragen  
bei Gebäuden mit raumluftechnischen Anlagen:

$$n_{50} \leq 0,6 \text{ 1/h}$$

Die Anforderungen der Vorschrift werden erfüllt.

21.12.2012



Schermer

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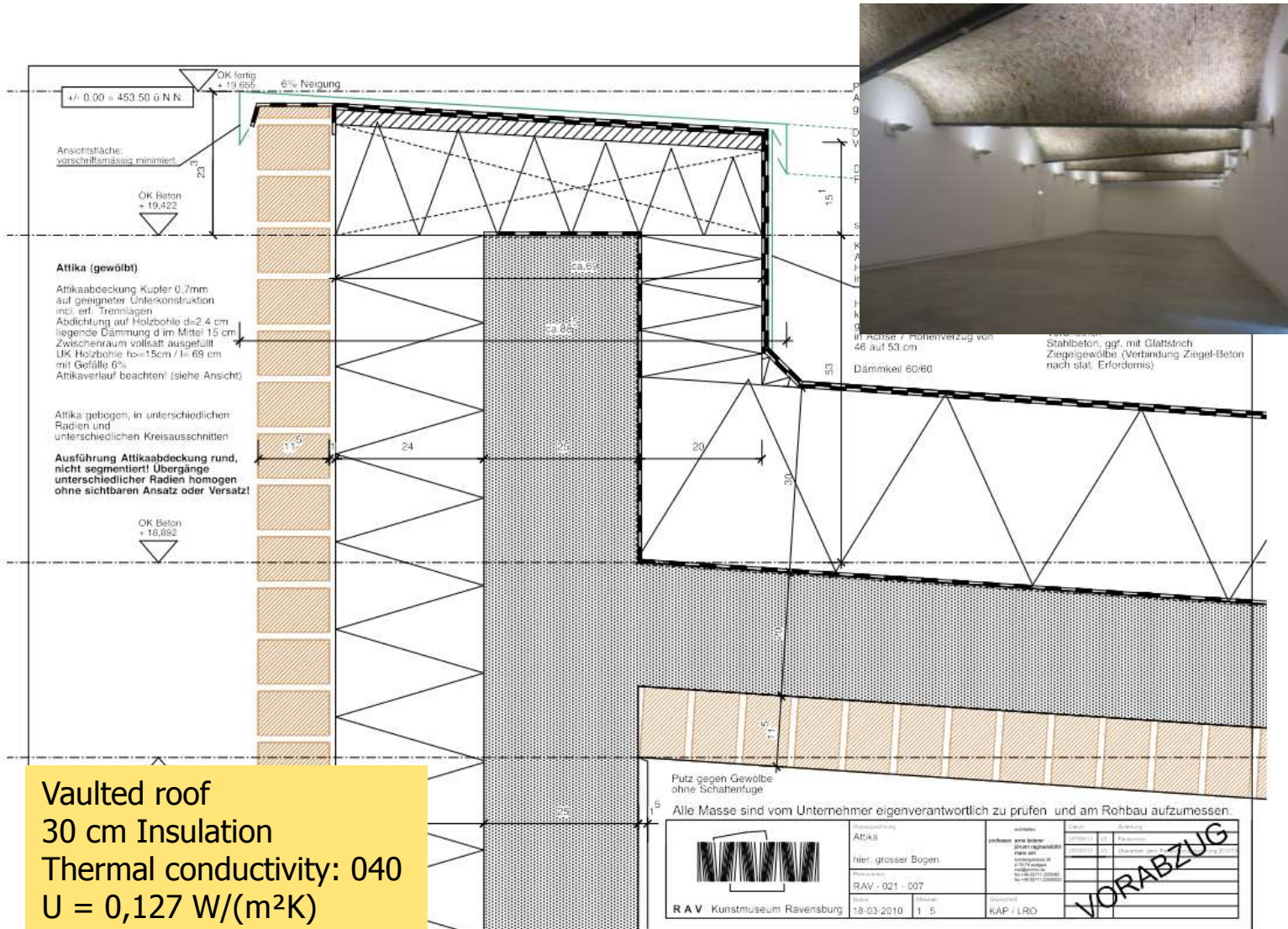
#### Air tightness results:

$$n_{50} = 0,30 \text{ [1/h]}$$

$$q_{50} = 0,71 \text{ m}^3/(\text{m}^2\text{h})$$



# Building envelope: Vaulted roof



Vaulted roof  
30 cm Insulation  
Thermal conductivity: 040  
 $U = 0,127 \text{ W}/(\text{m}^2\text{K})$



## Requirements for the indoor environment for the protection of works of art

Room air temperature	20-24 °C
Relative humidity	50 % +/- 5 %

## Heating and cooling

- Gas absorption heat pump 40kW, COP 1.6 with borehole heat exchangers 15kW and buffer tank
- Concrete core temperature control for heating and cooling of ceilings (base load)
- Flow temperature max. 35/28°C for CCTC (concrete core temperature control) and post heating ventilation max. 35/28°C
- Domestic hot water via decentralized mounted boilers



## Ventilation

- Large unit with heat and moisture recovery (Menerga)
- VOC/CO<sub>2</sub>- sensors and motion detectors control the ventilation / air flow
- Fresh air rate minimized by air recirculation mode (90%)
- Supply air temperature 20-24 °C in the standard case  
at higher heating load (peak) with 30-35 °C
- Conditioning  
(humidification and dehumidification)
- Brine heat exchanger for preheating  
of fresh air to about 5-7 °C, also for cooling

## Lighting

- Occupancy sensor and ambient light sensor
- Fluorescent lights, single spotlights and LEDs



# Passive Courthouse/Prison Korneuburg 2012

1st jail and courthouse PHI certified in Austria and worldwide



68.000 m<sup>3</sup> enclosed space (RC+Hybrid)

27.000 m<sup>2</sup> Heated area

Construction Cost 65 Mil. Euro





# Office building Airoptima = energy<sup>+</sup>

Shell: baseplate 20cm, EIFS 20cm, roof 45cm

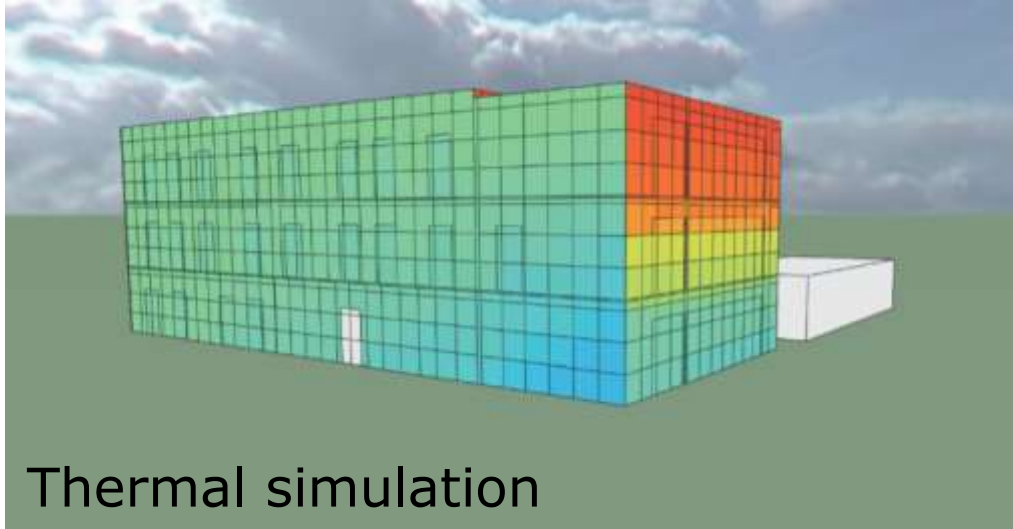
Technology: brine heat pump, 8\*decentral ventilation systems

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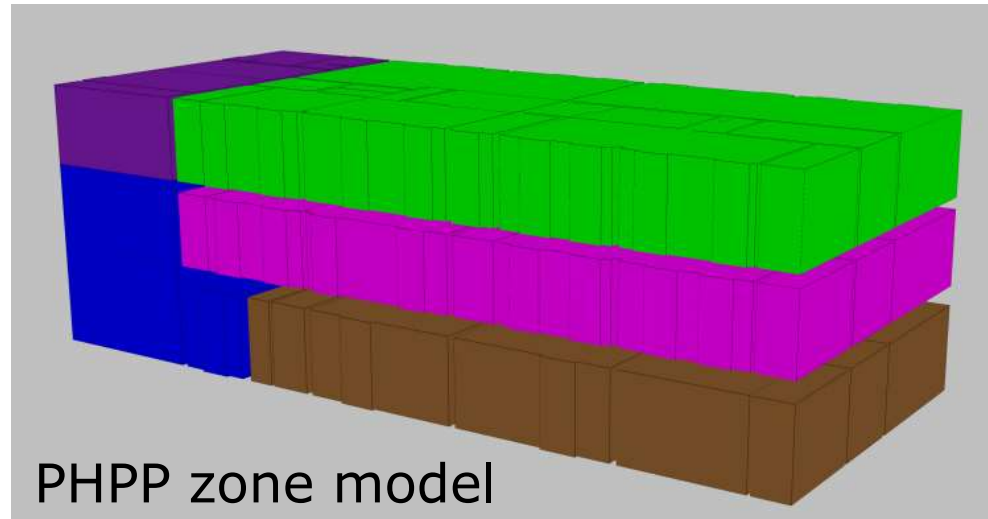
Treated floor area	=	910 m <sup>2</sup>
Space heat demand	=	4,9 kWh/(m <sup>2</sup> a)
End energy consumption	=	29.800 kWh
Photovoltaics	=	- 56.000 kWh



# Thermal simulation and PHPP-calculation



Thermal simulation

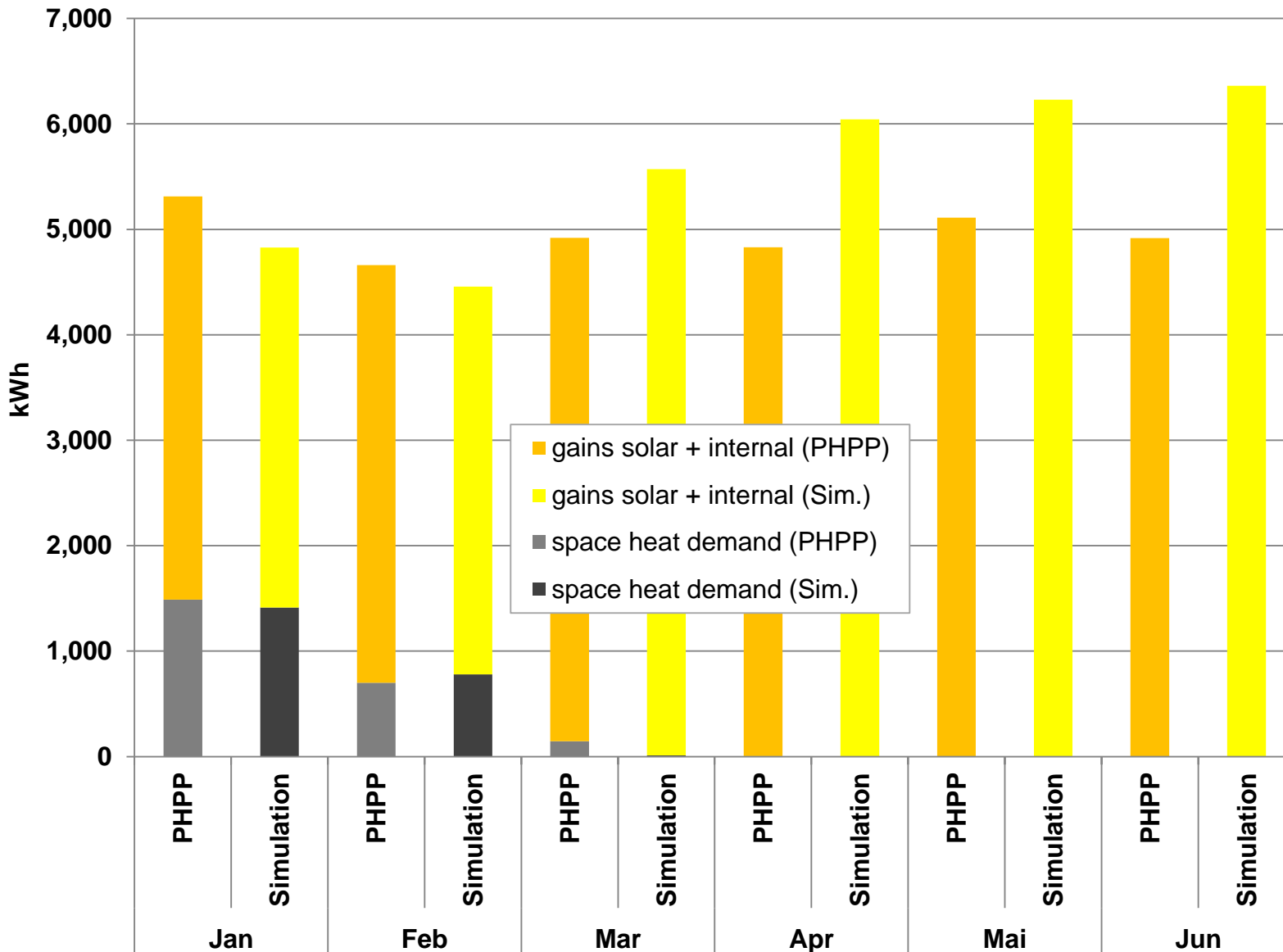


PHPP zone model



# PHPP and Simulation in comparison

## space heat demand and gains solar+internal



# Passive School Buchloe/Bavaria 2013



## New build – Secondary school in Passive House standard:

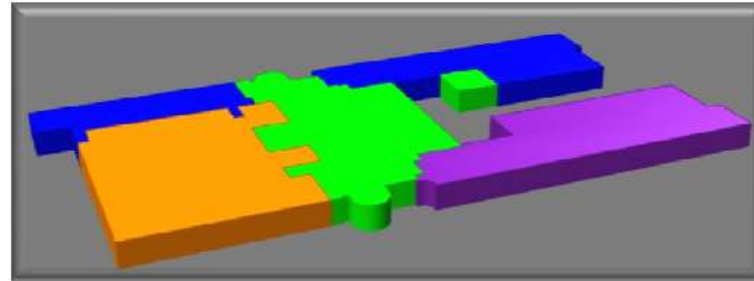
- Concrete construction with ventilated façade and EIFS(PS)
- 8200 m<sup>2</sup> Treated floor area
- Passive House Standard: Energy requirement for heating <15kWh/(m<sup>2</sup>a)
- Heating and warm water through ground water heat pump
- Central Ventilation: 84% Heat recovery



# Passive School Buchloe/Bavaria 2013



## PHPP-calculation 7 zones model



- zone 1: classroom
- zone 2: auxiliary rooms
- zone 3: gymnasium
- zone 4: break hall
- zone 5: library
- zone 6: administration
- zone 7: technic

# Explorer Hotel Fischen / Bavaria 2010

1st Passive Hotel worldwide with PHI certification



- 76 rooms
- TFA 2.522 m<sup>2</sup>
- Economy Class
- 3-Stars
- High comfort
- Low energy costs



Zero carbon building



# Explorer-Hotel Montafon / Austria 2011

1st Passive Hotel in Austria with PHI certification



- 100 rooms
- TFA 3.568 m<sup>2</sup>



# Explorer-Hotel Neuschwanstein / Bavaria 2013

- 100 rooms
- TFA 3.481 m<sup>2</sup>





# Passive House Centre of Excellence

Kempten / Bavaria 2012



Source: Sozialbau Kempten, Architekt Huber

# District Court Günzburg / Bavaria



1st Passive-Courthouse in Germany

Neubau Amtsgericht Günzburg



Passive House is the current building standard for Bavarian government buildings since 2011

Source: Lehmann Architekten



# Postquartier Ravensburg

## Office building



6.600 m<sup>2</sup> treated floor area



# Helmholzzentrum Competition Munich 2013



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in Sustainable Building



Passive House Consulting



Source: Sauerbruch & Hutton Berlin

# Museum of Bavarian history

Regensburg 2013-2018



Passive House Consulting



Source: woernerund partner/frankfurt



# Baaderstraße 7, Munich

## EnerPHit Pilot project - Certification 2013

### Zertifikat

Zertifikats-ID: 5800\_PHI\_EP\_20130313\_STh

Passivhaus Institut  
Dr. Wolfgang Feist  
Rheinstraße 44/46  
D-64283 Darmstadt



Das Passivhaus Institut verleiht dem Gebäude

**BV Baaderstraße, Baaderstr. 7, D-80469 München**

das Zertifikat



Bauherrschaft:	Baaderstraße GmbH & Co. KG Auerspitzstr. 7a, D-81549 München
Architektur:	Peter Fink Architekten GmbH Mitterer str. 3, D-80336 München
Haustechnik:	Feulner TGA-Planung Holzstr. 27, D-80469 München

Die Planung des Gebäudes erfüllt die vom Passivhaus Institut vorgegebenen Kriterien für die Modernisierung mit Passivhaus-Komponenten.

Bei sachgemäßer Bauausführung hat das Gebäude die folgenden Eigenschaften:

Gebäudekennwerte:	Kennwert	Grenzwert	
Jährlicher spezifischer Heizwärmebedarf	24 kWh/(m²a)	≤ 25 kWh/(m²a)	✓
Jährlicher spezifischer Primärenergiebedarf <sup>2</sup> <small>für Heizung, Warmwasser, Lüftung, Licht und elektr. Geräte bei Standardnutzung</small>	117 kWh/(m²a)	≤ 127 kWh/(m²a)	✓
Luftdichtheit der Gebäudehülle $n_{50}$ -Wert laut Drucktest	0,86 h <sup>-1</sup>	≤ 1,0 h <sup>-1</sup>	✓
<b>Mittlerer Wärmeschutzstandard der Einzelbauteile:</b>			
Außendämmung zu Außenluft <small>Wärmedurchgangskoeffizient</small>	0,13 W/(m²K)	≤ 0,15 W/(m²K)	-1
Außendämmung zu Erdreich <sup>2</sup> <small>Wärmedurchgangskoeffizient</small>	0,25 W/(m²K)	-	-1
Innendämmung zu Erdreich <sup>2</sup> <small>Wärmedurchgangskoeffizient</small>	0,32 W/(m²K)	-	-1
Wärmebrücken $\Delta_{i}$ Gebäudehülle (ohne Fenstereinfbau-Wärmebrücke)	0,17 W/(m²K)	kein Grenzwert	
Fenster <small>Wärmedurchgangskoeffizient <math>U_{w, fenster}</math></small>	0,85 W/(m²K)	≤ 0,85 W/(m²K)	-1
Außentüren <small>Wärmedurchgangskoeffizient <math>U_{w, außentür}</math></small>	1,10 W/(m²K)	≤ 0,80 W/(m²K)	-1
Lüftungsanlage <small>effektiver Wärmebereitstellungsgrad</small>	78 %	≥ 75 %	-1
<small><sup>1</sup>Grenzwert hier nicht relevant. <sup>2</sup>Grenzwert gebäudeabhängig unterschiedlich hoch. <sup>3</sup>Grenzwert nicht erreichbar (Ausnahmeregelung)</small>			
Zertifizierungskriterien erfüllt?	nach Heizwärmebedarf	✓	
Auswahl des Bewertungsverfahrens:	nach Bauteilqualität		

ausgestellt  
Darmstadt, den 13.03.2013

*Wolfgang Feist*  
Dr. Wolfgang Feist



# House of the Future = Zero Carbon Building Basic : Passive House PHI



PH-Consulting: Ensure energy efficiency in design, construction and use

# Passive House

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# Energy Costs

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