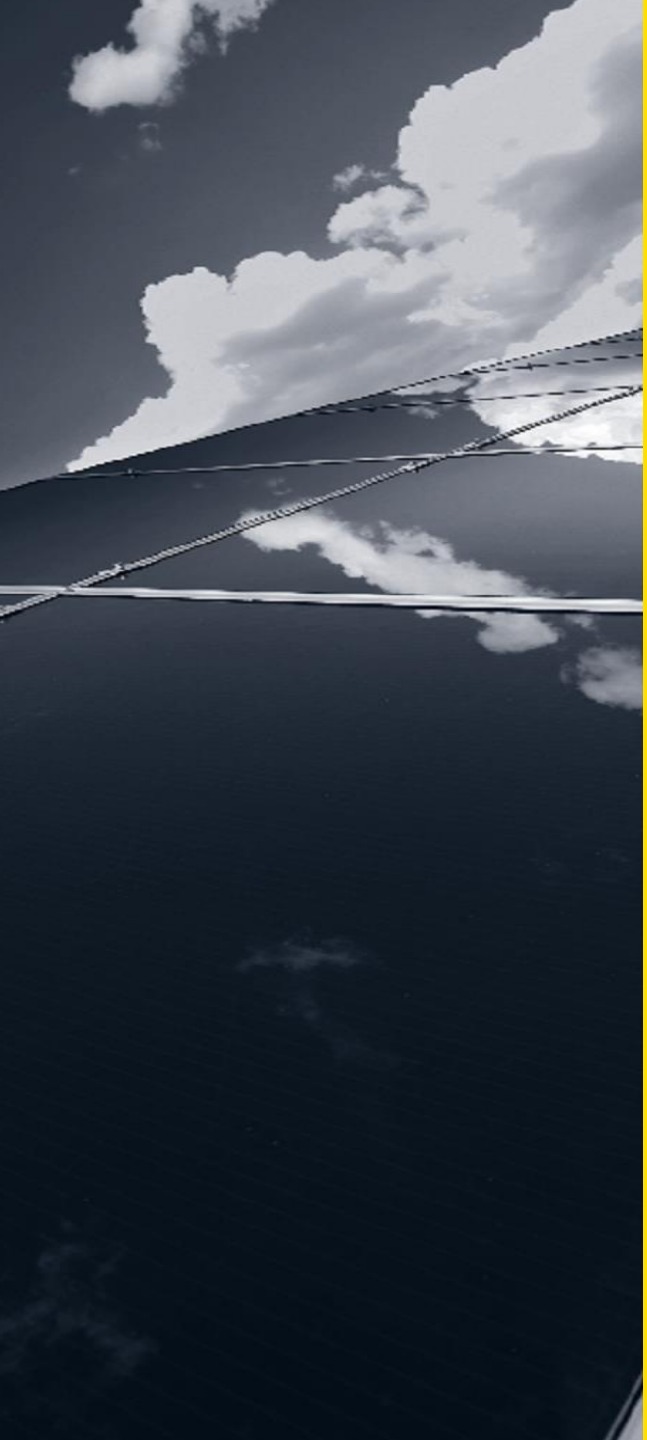

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ces CLEAN ENERGY SOLUTIONS

iC consulenten

EE measures and Implementation - Trainings Program for Construction Companies and Supervisors

10/11/2016

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Measures to achieve the objective energy-plus standard

Increase of energy efficiency In buildings:

- Reduction of heat losses of the building envelope
- Use of passive solar energy
- Reduction of ventilation losses
- Heat recovery
- Mass storage / PCM
- Sun protection
- Passive cooling
- Effective use of daylight
- Efficient lighting
- Efficient appliances
- Efficient office equipment

Heat and electricity from „Renewables“:

- Photovoltaics on the roof
- Photovoltaics integrated in the facade
- Solar thermal energy for space heating
- Biomass heating
- Combined heat and power
- Heat pump
- Small wind power
- Small hydropower

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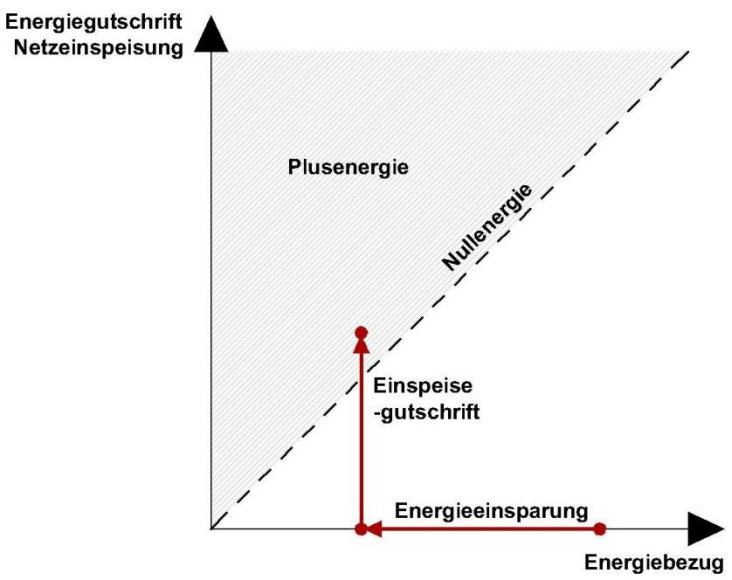
The Importance of Photovoltaics and Solar Thermal



- Photovoltaics and solar thermal currently almost inevitable for a positive energy balance
- PV and solar thermal systems have a strong influence on building design
- Reduction of energy demand →

  → smaller footprint of PV and solar thermal

  → more architectural freedom

see also detailed study

„Post-oil Life“!

Structure optimization measures

Optimization objectives:

- Reduction of heat loss through the building envelope
- Optimization of passive solar gains
- Optimized use of daylight
- Optimization of returns from PV and solar thermal
- Optimization of summer temperature behavior

Relations

Parameter:

- Compactness
- Portion of the south facade glazing
- Integration of PV and solar thermal components in south-facing exterior of the building envelope

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Parametric studies to find out how to optimize best

Relevant qestions:

- What architectural changes result from the advancement of the energy-plus house / passive house?
- How and where can the required space/room for renewable energy sources be provided?
- Which opposing interests do occur in the planning process?

Development of universal design recommendations:

➔ by representative model buildings

➔ based on model buildings according to building regulations and funding guidelines

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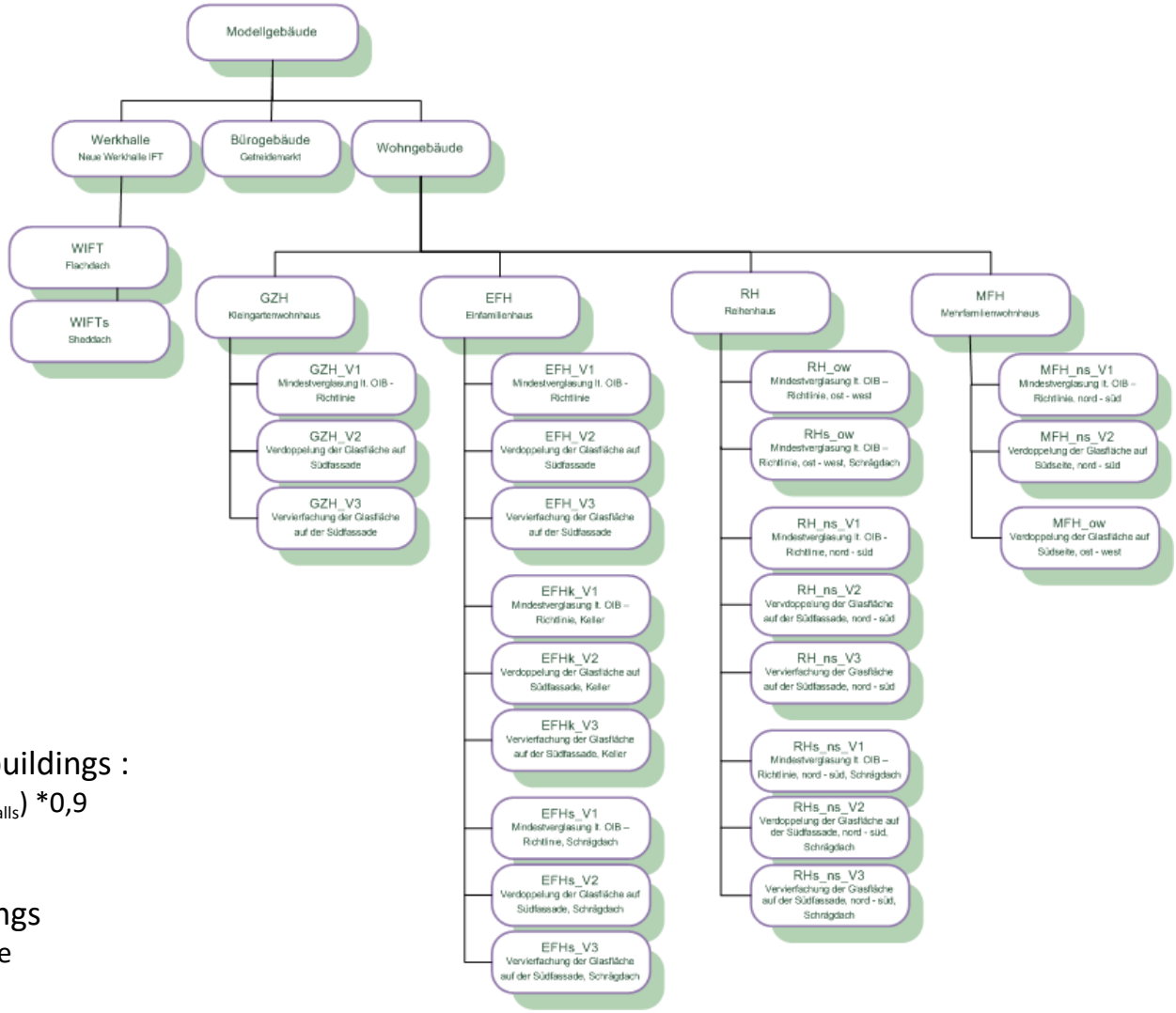
Overview of model buildings



Assumptions for residential buildings :

living area = (gross area – $A_{exterior\ walls}$) *0,9

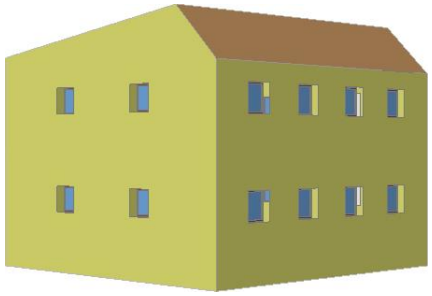
$A_{living\ rooms}$ = WNFL*0,75

~ 43 m² living area/Pers.

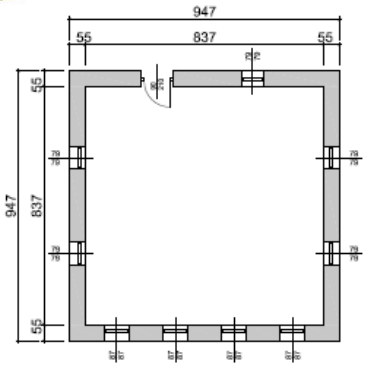
Assumptions for office buildings

25 m² net floor area/working place

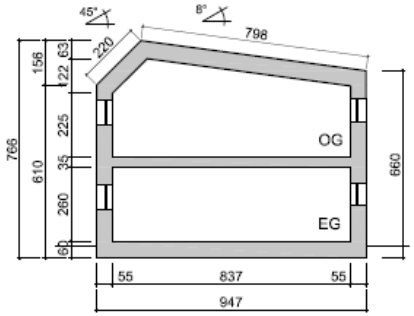
Example, residential buildings: House with sloped roof



EG



schematic section



Type of building:	Single family house
Abbreviation:	EFHs
Description:	"average" house in passive house standard (maximum grant size according to Austrian funding laws for housing 130 m² - 150 m² NFL, NFL average for apartments by homeowners in 2008, according microcensus Statistics Austria 134.1 m²) with rampant gable roof
Building:	Compact building (square), 2 floors (rh = 2.6 m), without basement, rampant gable roof
Gross floor area:	179,36 m²
Net living area:	126,11 m²
Volume:	635,55 m³
Envelope:	440,62 m²
Ratio of envelope to volume:	0,69
Use:	Standard for residential use according to Austrian Standard B 8110-5
Occupancy:	statistical: 2,96 persons calculated: 3 persons

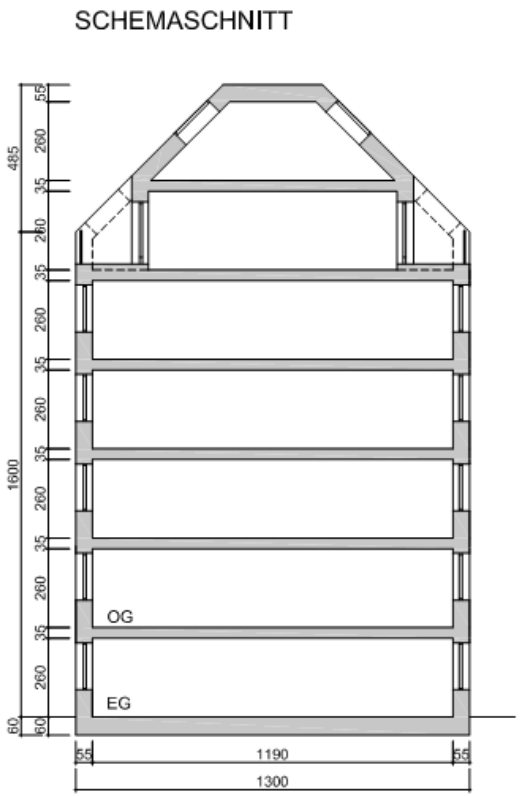
Variants: 33 variants by increasing the glazing area in the south facade

EFHs_V1: Min. required illumination surface acc. to OIB RL 3 (of which 10% north, 25% each to the east and west, 50% south)

EFHs_V2: glass area in the south façade doubled

EFHs_V3: 4-fold glass area in the south facade

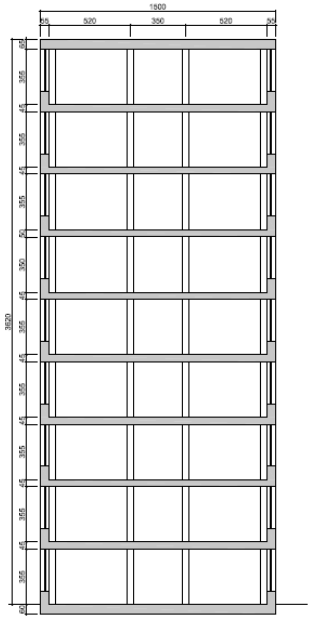
Example, residential buildings: multistorey housing

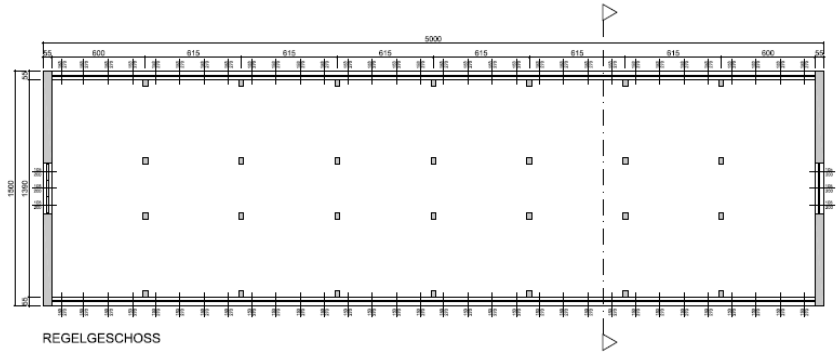


Typ:	Mehrfamilienhaus
Kürzel:	MFH_ns / MFH_ow
Beschreibung:	Nord-Süd-orientiertes Mehrfamilienhaus in „typischer“ Wiener Gründerzeitbaulücke, Bauklasse III, geschlossene Bauweise
Baukörper:	länglicher Baukörper (20 m breit, 13 m Trakttiefe, 16 m Gebäudehöhe), beidseitig angebaut, 45° Dachneigung, abgeflachter First mit Nord-Süd-Verlauf/ mit Ost-West-Verlauf, 5 Vollgeschosse und 2 Dachgeschosse (Raumhöhe = 2,6 m), Dachgeschosse teilweise terrassiert, 17 Wohneinheiten (im Schnitt 72,3 m²), Keller außerhalb der Passivhaushülle
BGF:	1637,82 m²
WNFL:	1229,05 m²
Volumen:	5025,58 m³
Hüllfläche:	1302,89 m²*
AV-Verhältnis:	0,26*
Nutzung:	Normnutzung für Mehrfamilienhäuser lt. ÖNORM B 8110-5
Personenbelegung:	statistisch: 28,9 Personen berücksichtigt: 29 Personen
Varianten:	3 Varianten durch Vergrößerung der Glasfläche in der Südfassade
MFH_ns_V1:	mindesterforderliche Belichtungsfläche nach OIB RL 3 (50% nach Norden, 50% nach Süden)
MFH_ns_V2:	doppelte Glasfläche in der Südfassade
MFH_ow:	mindesterforderliche Belichtungsfläche nach OIB RL 3 (50% nach Osten, 50% nach Westen)

* Flächen die an benachbarte Gebäude grenzen sind hier nicht berücksichtigt

Bürogebäude: in Anlehnung an Chemiehochhaus TU-Wien





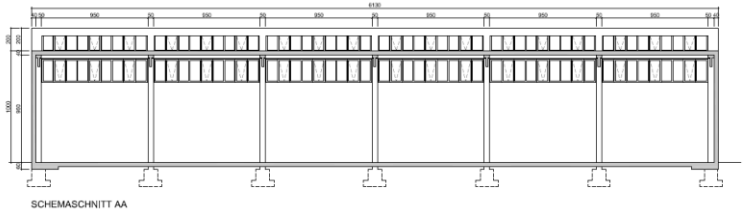
Type:	Office building
Abbreviation:	BÜRO
Description:	nine-storey detached office building, according to the VUT-chemical to Getreidemarkt (about 230 m² net floor area at 30 APL / APL, 9 storeys of floor 2 to floor 10), flat roof
Building:	elongated, high building with flat roof
Gross floor area:	6750,00 m²
Net living area:	5737,50 m²
Volume:	27600,00 m³
Envelope:	6284,00 m²
Ratio of envelope to volume:	0,23
Use:	Office use
Occupancy:	app. 230 working places (at 25m² net floor area/working place)

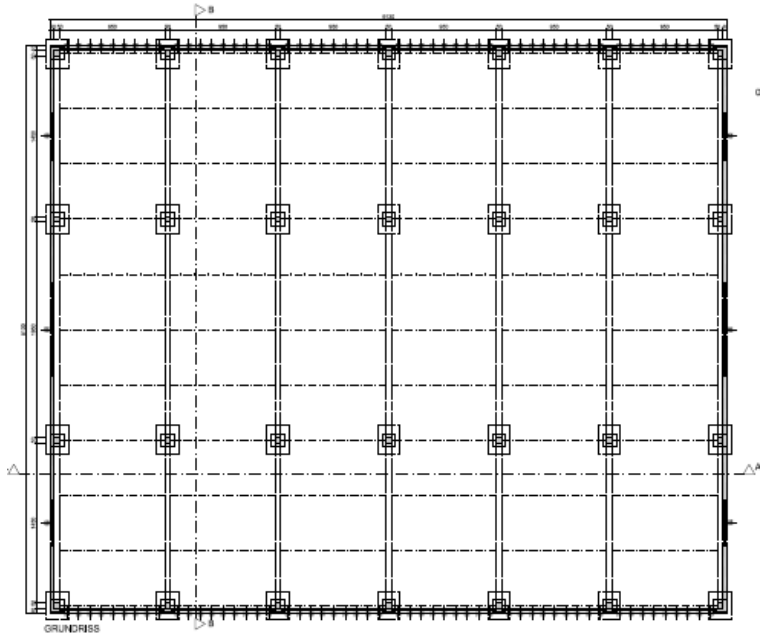
Varianten: Variants possible with all-glass facade and double facade, structure variations (changes in the compactness) possible

BÜRO_ow: East-West orientation (long axis runs north to south)

BÜRO_ns: North-south orientation (long axis runs from east to west)

Factory: based on the floor plan of the IFT





Type:	Factory building IFT
Abbreviation:	WIFT
Beschreibung:	nave, detached hall (without installed office, administrative offices), in line with the new factory of the IFT (net floor area of approximately 3000 m² without office space), flat or shed roof, overconfidence nave for lateral exposure of the central hall
Building:	compact structure with a flat or shed roof and higher nave
Gross floor area:	3144,69 m²
Net floor area:	3048,25 m²
Volume:	35945,09 m³
Envelope:	9006,90 m²
Ratio of envelope to volume:	0,25
Use:	acc. to roombook IFT
Occupancy:	acc. to roombook IFT
Glazed area:	10% of net floor area (acc. to roombook)
Variants:	Variants with larger glazed areas / modified orientation possible

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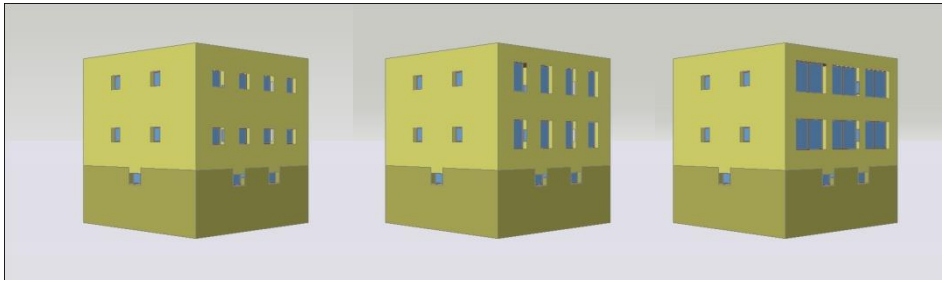
Example: surface preparation of the external components

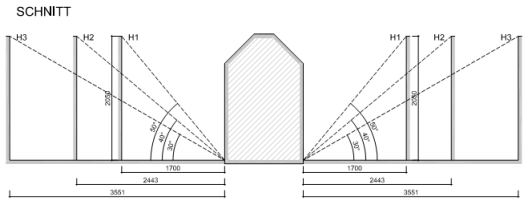
Building comp.	Abb.	Area	Transparency	U-Value	Orientation	O2	O3	O4	W2	W3	W4	Inclination	g-Value	z-Value	Horizon
Exterior wall	AW1	58,83 m²	0	0,12	0	345	330	315	15	30	45	0			
Exterior wall	AW2	64,62 m²	0	0,12	90	75	60	45	105	120	135	0			
Exterior wall	AW3	51,71 m²	0	0,12	180	165	150	135	195	210	225	0			
Exterior wall	AW4	64,62 m²	0	0,12	270	255	240	225	285	300	315	0			
Sloped roof	D5	75,61 m²	0	0,1	0	345	330	315	15	30	45	8			
Sloped roof	D6	20,83 m²	0	0,1	180	165	150	135	195	210	225	45			
Floor slab	BTK1	17,94 m²	0	0,15	TK1	TK1	TK1	TK1	TK1	TK1	TK1	-90			
Floor slab	BTK2	15,94 m²	0	0,15	TK2	TK2	TK2	TK2	TK2	TK2	TK2	-90			
Floor slab	BTK3	43,76 m²	0	0,15	TK3	TK3	TK3	TK3	TK3	TK3	TK3	-90			
Floor slab	BTK4	12,04 m²	0	0,15	TK4	TK4	TK4	TK4	TK4	TK4	TK4	-90			
Entrance door	T1	2,42 m²	0	0,75	0	345	330	315	15	30	45	0			
Window frame	FR1	0,30 m²	0	0,7	0	345	330	315	15	30	45	0			
Window frame	FR2	0,59 m²	0	0,7	90	75	60	45	105	120	135	0			
Window frame	FR3	1,31 m²	0	0,7	180	165	150	135	195	210	225	0			
Window frame	FR4	0,59 m²	0	0,7	270	255	240	225	285	300	315	0			
Glazing	G1	0,47 m²	1	0,7	0	345	330	315	15	30	45	0	0,55	0,27	EG
Glazing	G1	0,47 m²	1	0,7	0	345	330	315	15	30	45	0	0,55	0,27	OG1
Glazing	G2	0,95 m²	1	0,7	90	75	60	45	105	120	135	0	0,55	0,27	EG
Glazing	G2	0,95 m²	1	0,7	90	75	60	45	105	120	135	0	0,55	0,27	OG1
Glazing	G3	2,36 m²	1	0,7	180	165	150	135	195	210	225	0	0,55	0,27	EG
Glazing	G3	2,36 m²	1	0,7	180	165	150	135	195	210	225	0	0,55	0,27	OG1
Glazing	G4	0,95 m²	1	0,7	270	255	240	225	285	300	315	0	0,55	0,27	EG
Glazing	G4	0,95 m²	1	0,7	270	255	240	225	285	300	315	0	0,55	0,27	OG1
Sum		**440,57 m²**													

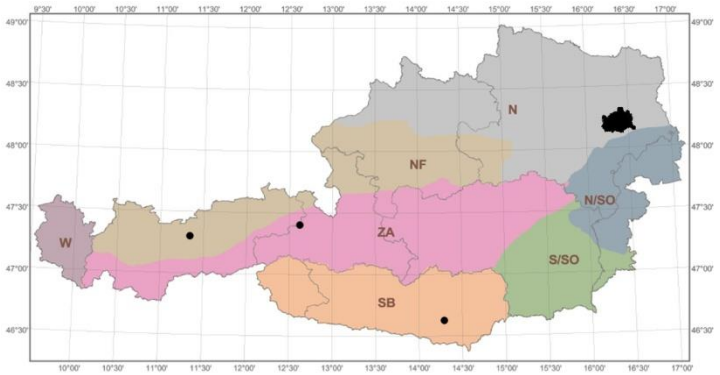
Thermal bridge	Kürzel	Länge	ψ-Wert
Glass edge seal	GLV1	5,52 m	0,034
Glass edge seal	GLV2	11,04 m	0,034
Glass edge seal	GLV3	24,64 m	0,034
Glass edge seal	GLV4	11,04 m	0,034
Sum		**52,24 m**	

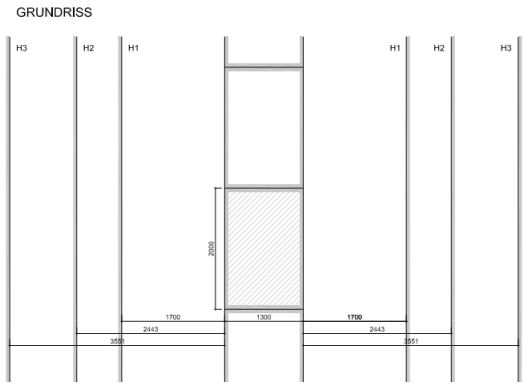
Parameters of simulations

- location
- orientation
- construction
- building
- proportion of glazing of south façade
- shading by surrounding buildings









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➔ Guidelines for the Design of Energy-efficient buildings

- Basic requirements for goal achievement plus energy
- Urban and spatial planning aspects
- Architectural framework
- Building integrated renewable energy sources
- Planning recommendations for optimizing structures
- Design and layout options (materials, colors, use)
- Rules of thumb for planning and design (orientation, dimensions, ...)
- Renewable energy sources in the refurbishment of existing buildings
- Examples of best-practice examples

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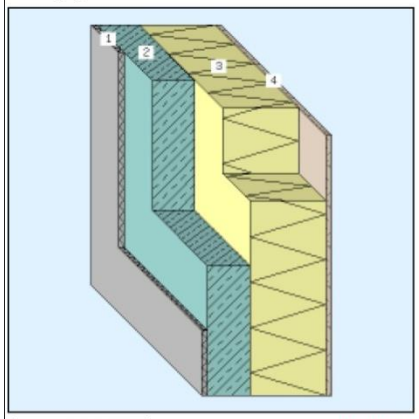
Conventional Building Components for Passive Houses

AWm 01 a Stahlbeton-Außenwand, WDVS

Wand: gegen Außenluft - nicht hinterlüftet



0,121 W/m²K — U-Wert [1]

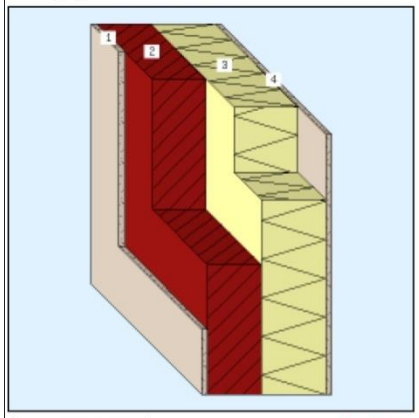
A++ RL6

Nr.	Typ	Schicht (von innen nach aussen)	d cm	λ W/mK	R m²K/W	ΔOI3 Pkt/m²
1		Spachtel - Gipsspachtel (alt)	0,300	0,800	0,004	1
2		Stahlbeton	18,000	2,500	0,072	58
3		Polystyrol (EPS f. Wärmedämmverbundsysteme WDVS	32,000	0,040	8,000	40
4		Silikatputz armiert	0,190	0,800	0,002	2
		R_{si} / R_{se} =			0,130 / 0,0	
		R' / R'' (max. relativer Fehler: 0,0%) =			8,248 / 8,248	
		Bauteil	**50,490**		**8,248**	

Masse	**446,0 kg/m²**
$OI3_{KON}$	**64 Pkt/m²**
PEI n. e.	1.130,44 MJ/m²
GWP100	87,6190 kg CO_2/m²
AP	0,362941 kg SO_2/m²

AWm 05 a Hochlochziegel-Außenwand, WDVS

Wand: gegen Außenluft - nicht hinterlüftet



0,115 W/m²K — U-Wert [1]

A++ RL6

Nr.	Typ	Schicht (von innen nach aussen)	d cm	λ W/mK	R m²K/W	ΔOI3 Pkt/m²
1		Kalk-Zementputz	1,500	1,000	0,015	4
2		Ziegel - Hochlochziegel porosiert <=800kg/m³	25,000	0,250	1,000	37
3		Polystyrol (EPS f. Wärmedämmverbundsysteme WDVS	30,000	0,040	7,500	38
4		Silikatputz armiert	0,190	0,800	0,002	2
		R_{si} / R_{se} =			0,130 / 0,0	
		R' / R'' (max. relativer Fehler: 0,0%) =			8,687 / 8,687	
		Bauteil	**56,690**		**8,687**	

Masse	**235,8 kg/m²**
$OI3_{KON}$	**44 Pkt/m²**
PEI n. e.	1.112,33 MJ/m²
GWP100	59,0576 kg CO_2/m²
AP	0,252279 kg SO_2/m²

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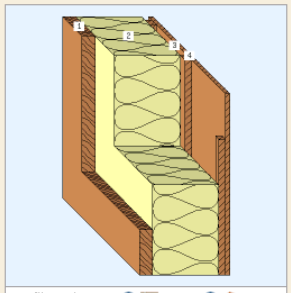
Ecologic Building Components for Passive Houses

S-HOUSE

Wand: gegen Außenluft - hinterlüftet



Grafik ändern: 2D 3D

0,090 W/m²K — U-Wert

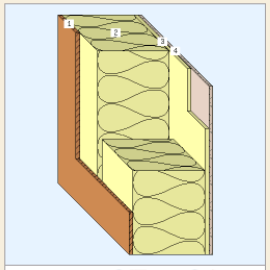
A++ RL6

Masse	**112,5 kg/m²**
OI3$_{KON}$	**-16 Pkt/m²**
PEI n. e.	446,48 MJ/m²
GWP100	-147,1531 kg CO_2/m²
AP	0,224028 kg SO_2/m²

Nr.	Typ	Schicht (von innen nach aussen)	d cm	λ W/mK	R m²K/W	ΔOI3 Pkt/m²
1		KLH Wand (Holz - Brettschichtholz)	10,000	0,120	0,833	23
2		Waldland Baustrohballen	50,000	0,050	10,000	-3
3		*Inhomogen (Elemente horizontal)*	5,000			
		54,5 cm (87%) Luftschicht stehend, Wärmefluss nach oben 46 < d <= 50 mm	5,000	1	1	0
		8 cm (13%) Holz - Schnittholz Nadel, gehobelt, technisch getrocknet	5,000	1	1	1
4		Holzfassade (Holz - Schnittholz Nadel, rauh, lufttrocken)	2,340	1	1	0
				R_{si} / R_{se} =		0,130 / 0,130	
				R' / R'' (max. relativer Fehler: 0,0%) =		11,093 / 11,093	
		Bauteil	**67,340**		**11,093**	

Stegträger Strohwand

Wand: gegen Außenluft - nicht hinterlüftet



Grafik ändern: 2D 3D

0,122 W/m²K — U-Wert

A++ RL6

Masse	**70,8 kg/m²**
OI3$_{KON}$	**-14 Pkt/m²**
PEI n. e.	350,26 MJ/m²
GWP100	-79,1282 kg CO_2/m²
AP	0,181209 kg SO_2/m²

Nr.	Typ	Schicht (von innen nach aussen)	d cm	λ W/mK	R m²K/W	ΔOI3 Pkt/m²
1		OSB-Platte (OSB-Platte)	2,000	0,130	0,154	11
2		*Inhomogen (Elemente horizontal)*	40,000			
		56,5 cm (90%) Waldland Baustrohballen	40,000	0,050	8,000	-2
		6 cm (10%) STEICOjoist SJ60, B60xH240, gedämmt m. Steico Flex	40,000	0,086	4,651	3
3		AGEPAN UDP	2,200	0,060	0,367	8
4		Silikonharzputz	0,200	0,700	0,003	3
				R_{si} / R_{se} =		0,130 / 0,040	
				R' / R'' (max. relativer Fehler: 0,1%) =		8,200 / 8,176	
		Bauteil	**44,400**		**8,188**	

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To compare

Type	PEI [MJ/m²]	GWP [kg CO2/m²	AP [kg SO2/m³]	OI3	U-Value [W/m²K]	Wall thickness [cm]
Steel&concrete, exterior wall insulation system	1.130,44	87,61	0,36	64	0,116	50,49
Vert. Perfor. Brick exterior wall insulation system	1.112,33	59,05	0,25	44	0,115	56,69
Timber frame exterior wall ventilated	701,75	-29,29	0,26	17	0,116	50,30
S-HOUSE construction	446,48	-147,15	0,22	-16	0,090	67,34
Joists straw wall	350,26	-79,12	0,18	-14	0,122	49,40

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We are looking forward
to the future.
Wherever!
Whenever!
With you.

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