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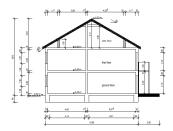
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# Energy performance requirements for new buildings in 11 countries from Central Europe – Exemplary Comparison of three buildings

performed on behalf of the
German Federal Office
for Building and Regional Planning
(Bundesamt für Bauwesen
und Raumordnung, Bonn)



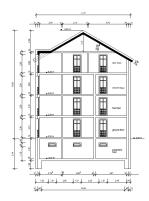


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Darmstadt/Germany, 5<sup>th</sup> December 2008

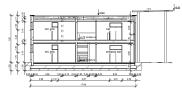
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# Energy performance requirements for new buildings in 11 countries from Central Europe – Exemplary Comparison of three buildings

performed on behalf of the German Federal Office for Building and Regional Planning (Bundesamt für Bauwesen und Raumordnung, Bonn) /

German project title: "Energiesparrecht im mitteleuropäischen Vergleich – energetische Anforderungen an Neubauten" (Vertrag Z 6 – 10.08.17.7-07.16)

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# 1 Summary

The objective of the present comparison study is to show which energy efficiency requirements have to be complied in different European countries when a new building is going to be constructed. For this purpose three Model Buildings were defined: a single-family house, a multi-family house and a school building. For each involved country (or region) the energy quality of the thermal envelope was determined which is necessary in order to just comply with the building code. Due to requirements on the overall energy performance the requested envelope quality usually depends also on the type of heat supply system or energy carrier. Therefore the systems were varied in a parameter study. The main result for each of the three Model Buildings is a comparison table which shows the heat transfer coefficient by transmission (a sort of mean U-value) for the different countries differentiated by supply system types. In a final step the primary energy demand according to the German regulation (EnEV 2007) was calculated for every envelope/system combination of the different countries. This allows a comparison of buildings with different supply systems. The study was performed by experts from 11 European member states: Germany, Austria, Czech Republic, Poland, Sweden, Denmark, UK, The Netherlands, Belgium, Luxembourg and France.



# 2 About the project

In Germany the transposition of the Energy Performance of Buildings Directive (EPBD) was performed by an amendment of the German Energy Saving Ordinance (Energieeinsparverordnung EnEV) in the year 2007. During this process formal and methodological changes were applied whereas the requirements remained the same. In year 2007 the German government announced to undertake a new revision which mainly will introduce a higher energy performance mandatory for new and refurbished buildings. In the discussion about tightening the requirements in Germany the question often arises which energy efficiency standards are applied in other European countries with comparable climatic conditions. The present study aims at giving some more transparency in this field.

The concrete objective of the project is to compare the energy performance requirements for new buildings in Germany with those of several other European countries with similar climate conditions. Due to the very different methods and traditions it is clear that an exact comparison between the countries will not be possible. Therefore this study is based on example buildings and certain assumptions that have been chosen by IWU and which certainly reflect a specific (German) perspective. Certainly it would be possible to select other methodical approaches and maybe the results could be (slightly) different.

The question to be answered by each partner is: Which U-values have to be chosen for roof, walls, windows and floor if a given building is supposed to just comply with the requirements for new buildings in the respective country. Since generally the level of insulation indirectly depends on the building geometry and of the supply system type these parameters are varied. In the framework of the project three example buildings are analysed: a single family house (which is the subject of this report), a multi family house and a school building. Furthermore the installation of several different supply systems is assumed.

The analysis focuses on the comparison of the tangible quality of the building envelope defined by the national regulations. Neither the different certification methodologies nor the aspects of practical implementation of these standards are a topic of the study.

The analysis is performed on behalf of the German Federal Office for Building and Regional Planning (BBR) by IWU (Institut Wohnen und Umwelt / Institute for Housing and environment) with the assistance of the following partners:



N°		Country	Institution
1	de	Germany	IWU (Institute for Housing and Environment)
2	at	Austria	e7 - Energie-Markt-Analyse
3	CZ	Czech Republic	Stu-k
4	pl	Poland	NAPE (National Energy Conservation Agency S.A.)
5	se	Sweden	Mälardalen Universität, Västerås/Eskilstuna
6	dk	Denmark	SBi (Danish Building Research Institute)
7	uk	UK	BRE (Building Research Establishment)
8	nl	The Netherlands	BuildDesk (former EBM-Consult)
9	be	Belgium (Flanders)	BBRI (Belgian Building Research Institute)
10	lu	Luxembourg	Goblet Lavandier & Associés S.A.
11	fr	France	ADEME - Agence de l'Environnement et de la Maîtrise de

# 3 Methodical approach

# 3.1 Proceeding

The analysis consisted of the following steps:

#### Step 1: Definition of the thermal envelope of the building (IWU)

The following documents were elaborated by IWU and distributed to the partners:

- a set of plans (scale 1:100, see Appendix),
- a table with the envelope element areas, determined according to the German regulations (basis: external dimensions, see chapter 4.1, 5.1 and 6.1 for the three buildings)
- an Excel sheet with the detailed envelope area calculation, which was the basis of the above mentioned table (see Appendix)



#### Step 2: Definition of the supply system variants (IWU)

IWU defined a set of supply systems for each Model Building (see chapter 4.2, 5.2 and 6.2). The partners received a table defining the different variants on two levels (see Appendix):

- a determination of the type of the components, which was often sufficient for the calculation;
- detailed information about the components (for example thermal power of the heat generator, electric power of pumps, length and heat loss of heating pipes), which were to be used only in case that national standard values are not available.

#### Step 3: Determination of the U-values (all partners)

Each partner was requested to determine the U-values which have to be chosen for this building in order to comply with the building code – under assumption of the different supply system variants.

The principles of this procedure were:

- In those countries in which the thermal envelope is not defined by the external dimensions the envelope area table delivered by IWU could not be used. The concerned partners were supposed to determine the envelope areas on their own by use of the building plans.
- For simplification purpose it was assumed that the thicknesses of the building envelope elements do not depend on the U-value (the U-value variation can therefore be seen as a variation of the thermal conductivity).
- The U-value for each construction element was supposed to be the "pure" thermal transmittance not including supplements or reductions caused by transmission losses at the border of the elements. (In case of the opaque elements the study may be see as a comparison of insulation thicknesses.)
- If there are different methods in a country the most common should be used (typically the most simple method).
- If for a country the requirements are different for certain regions a region had to be selected where the climate conditions are as close as possible to the German ones.
- If deviations from the building or system definitions were necessary these had to be documented.

The results of this analysis was documented by each partner in a uniform sheet (see Appendix: "Country Sheets")



# Step 4: Calculation of a simplified heat transfer coefficient by transmission and cross-country comparison (IWU)

For purpose of comparison a weighted average of the U-values of the different construction elements were calculated by IWU. For this weighting the external area was used. The result is a sort of simplified heat transfer coefficient by transmission.<sup>1</sup> The calculation of these values can be found in the country sheets (Appendix), the results of the cross-country comparison are shown in chapter 4.3, 5.3 and 6.3.

# Step 5: Calculation of the primary energy demand according to the German official method and cross-country comparison (IWU)

In order to compare the total energy performance of the building variants from the different countries the primary energy demand was calculated according to the rules of the German regulations (Energy Saving Ordinance / Energieeinsparverordnung EnEV 2007). The resulting values are shown in the chapters 4.4, 0 and 6.4.

#### 3.2 Limits of evidence

The chosen method is capable to depict the level of national energy efficiency requirements in a concrete and exemplary way. Of course, the exactness and evidence of this comparison is limited since the results depend on factors which were not considered in this study:

- <u>Number of Model Buildings:</u> The example buildings considered in this study represent only a small fraction of possible building geometries. The dependence of the requirements from the surface to volume relation and from the building size is different for each country. In consequence the relation of the requirements between the different countries could possibly change if different buildings were considered.
- <u>Definition of the thermal envelope</u>: The definition of the thermal envelope in a unique way is not always possible, since the rules sometimes allow different solutions (cellar rooms, stair wells, garages, winter gardens, ...). In order to avoid such uncertainties rather simple building geometries were selected for this investigation (which may have effects on the requirement level, see above). A special problem is the energy balance calculation for an apartment building. In some countries the thermal envelope is considered to be the surface of the whole building, in others only the thermal envelope of the apartments are considered, in some countries there is

In case of a well designed building with minimized constructive thermal bridges this simplified heat transfer coefficient by transmission is very close to the real value including thermal bridging (to the experience of the authors). A precondition is that the envelope area determination is based on external dimensions.



- a mix of both approaches. In order to compare the U-values one of these approach has to be chosen. (In the present study the surface of the whole building was used.)
- <u>Variety of methods in some countries:</u> In some countries different proofs of conformity are permitted. Applying different methods will typically produce different results for the same building. (The rule for the present study was to use the most common method, which is typically one with a lesser effort.)
- Frequentness of supply system types in each country: The comparison of the results for the
  primary energy (calculated according the German EnEV) shows that the maximum allowable
  demand of non-renewable energy can be very different, depending on the system or energy
  carrier. For a comprehensive comparison of the countries information about the frequentness
  of the installed supply system types is necessary.
- Implementation in practice: The practical realisation of equally designed buildings may be different from country to country. On the one hand the implementation of the building code certainly depends on the control mechanisms applied by state. It may also depend on traditions of planning and quality assurance.

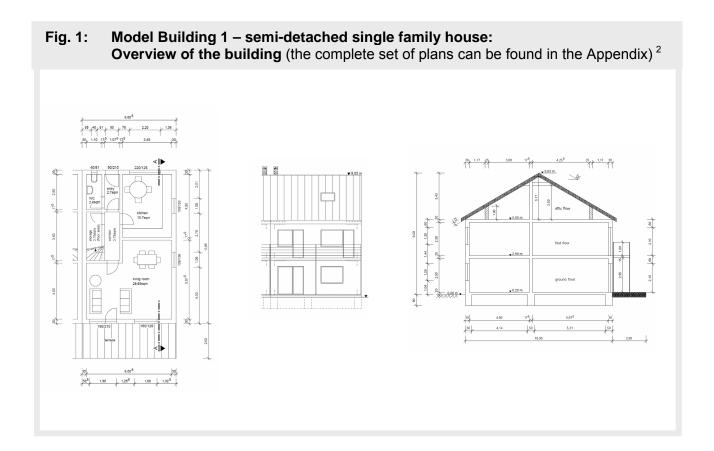


# 4 Model Building 1: semi-detached single family house

# 4.1 Thermal envelope

Model Building 1 is a semi-detached single family house with 140 m² living area. A building with a simple geometry has been chosen in order to keep the envelope area evaluation transparent. Two storeys and the attic is located inside the thermal envelope.

Fig. 1 displays the geometry, Tab. 2 the thermal envelope areas. A complete set (floor plans of all storeys, vertical section, façade plans) and a table specifying the envelope area calculation can be found in the Appendix.



Source for the plans of this building: Kadir Durmaz: Modellrechnungen zur kommenden Energieeinsparverordnung. Vertieferarbeit an der TU Darmstadt. Supervisors: Susanne Schwickert (TUD) / Tobias Loga (IWU); TU Darmstadt August 2000 revised by Christina Kappich A-HP/Energie&Haus on behalf of IWU



Model building N° 1			
Single family house (semi-deta	ched / end-	terrace)	
General building data			
gross floor area of all storeys	ext. dim.	(inside therm. env.)	217,0 m <sup>2</sup>
useful floor area	int. dim.	(inside therm. env.)	151,3 m <sup>2</sup>
lving area	int. dim.	(inside therm. env.)	140,2 m <sup>2</sup>
building volume	ext. dim.	(inside therm. env.)	538,5 m <sup>3</sup>
relation envelope surface area	to building vo	lume	0,588 m <sup>2</sup> /m <sup>3</sup>
Envelope surface area (ext. dir	n.)		
roof			82,5 m <sup>2</sup>
walls			133,4 m <sup>2</sup>
floor above soil			72,3 m <sup>2</sup>
door			1,9 m²
windows	North	vertical	6,8 m <sup>2</sup>
	North	skylight	1,5 m <sup>2</sup>
	East	vertical	4,1 m <sup>2</sup>
	South	vertical	12,8 m <sup>2</sup>
	South	skylight	1,3 m <sup>2</sup>
sum envelope surface area			316,6 m <sup>2</sup>
ext. dim. = external dimensions	_		<u> </u>

#### 4.2 Types of supply systems

#### Reference case: variant "basis"

As a base case for the parameter variation a system with the following components has been defined:

- low temperature boiler (non-condensing) for heating and domestic hot water (dhw), installed in the central heating room (attic)
- hot water storage, installed in the central heating room (attic)
- distribution system for space heating completely inside of the thermal envelope
- distribution system for DHW completely inside the thermal envelope, no circulation ducts
- no ventilation system

The details of the system can be found in the Appendix.

#### Variation of parameters

Starting from the base case a variation of heat generators (hg-\*), of the domestic hot water system (dhw-\*) and of the ventilation system (vent-\*) was performed. Furthermore two variants were considered where more than one component was changed (sys-\*). The complete definition of these systems is documented in the Appendix.



Label	Туре	Varied component
basis	basis variant	low temperature boiler for heating and dhw, no vent. system
hg-cond	variation heat generator	condensing boiler
hg-pellet	variation heat generator	wood pellet boiler
hg-hp	variation heat generator	electric heat pump
dhw-el	variation hot water system	decentral electric
dhw-sol	variation hot water system	thermal solar system
sys-el	variation heating & hot water system	electric resistance system
vent-exh	variation ventilation	exhaust ventilation system
vent-rec	variation ventilation	ventilation system with heat recovery
sys-cond/sol/rec	variation heating, hot water and ventilation system	condensing boiler + solar dhw system + ventilation system with heat recovery

## 4.3 Results for the thermal quality of the envelope

# Compliance with national requirements for new buildings

#### - maximum respectively adapted U-values

For the above described building the level of thermal insulation was identified which is determined by the building regulations of each participating country. As a result each partner provided a table with U-values of floor, roof, walls and windows which have to be selected for this building in order to comply with the national / regional requirements. If the thermal insulation requirements depend on the supply system efficiency the U-values were determined for different system types.

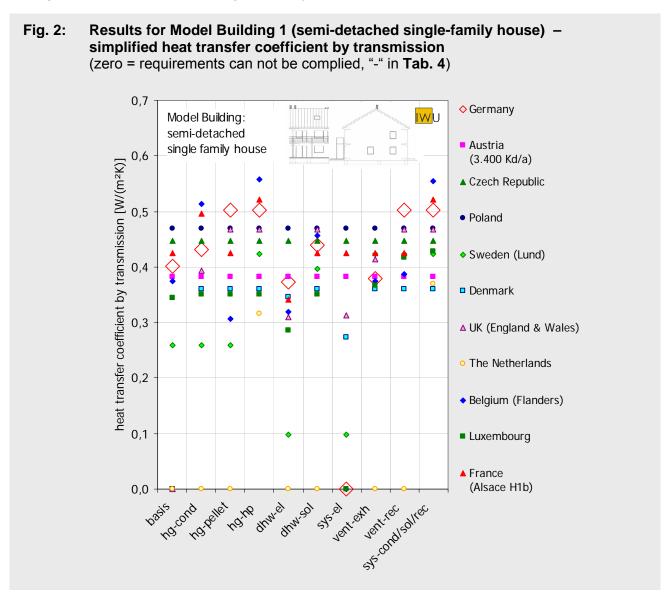
The U-values determined by each partner can be found in the Appendix ("Country Sheets").



#### Simplified heat transfer coefficient by transmission

For each of the variants the U-values of the different construction elements were weighted by their areas (external dimensions, considering reduction factors for losses to soil, if applicable). The result is a simplified heat transfer coefficient (without losses caused by thermal bridging), which is sort of a mean U-value of undisturbed elements. The resulting values for the different countries are displayed in Tab. 4 and Fig. 2.

After collecting the results from the partners it turned out that the pre-defined basis variant could not be realised in 5 countries, partly because non-condensing gas boilers are not allowed any more for new buildings (Denmark, UK), partly because the installation of ventilation systems is obligatory (Sweden, Belgium) and in one case because the overall requirements are so severe (the Netherlands). Also some of the other variants were changed by the respective partners (see footnotes at the table) in order to achieve a compliance. In these cases the heat transfer coefficient can not directly be compared with the others. In consequence the definition of the variants was changed when the second building was analysed (see chapter 5.3)





Tab. 4: Results for Model Building 1 (semi-detached single-family house) – simplified heat transfer coefficient by transmission

variant name	basis	hg-cond	hg-pellet	hg-hp	dhw-el	dhw-sol	sys-el	vent-exh	vent-rec	sys- cond/sol /rec
variant type	basis	variation heat generator	variation heat generator	variation heat generator	variation hot water system	variation hot water system	variation heating & hot water system	variation ventilation	variation ventilation	variation heating, hot water and ventilation system
short description	low temperature boiler for heating and dhw, no vent. system	condensing boiler	wood pellet boiler	electric heat pump	decentral electric	thermal solar system	electric resistance system	exhaust ventilation system	ventilation system with heat recovery	condensing boiler + solar dhw system - ventilation system with heat recovery
			ı	Heat trans		ent by tra n <sup>2</sup> K)]	nsmission <sup>3</sup>	*		
Germany	0,40	0,43	0,50	0,50	0,37	0,44	-	0,38	0,50	0,50
Austria (3.400 Kd/a)	0,38	0,38	0,38	0,38	0,38	0,38	0,38	0,38	0,38	0,38
Czech Republic	0,45	0,45	0,45	0,45	0,45	0,45	0,45	0,45	0,45	0,45
Poland	0,47	0,47	0,47	0,47	0,47	0,47	0,47	0,47	0,47	0,47
Sweden (Lund)	0,26 2)	0,26	0,26	0,42 2)	0,10	0,40 2)	<b>0</b> ,10 <sup>2)</sup>	0,42 3)	0,42	0,42
Denmark	-	0,36	0,36	0,36	<b>0</b> ,35 <sup>1)</sup>	<b>0</b> ,36 <sup>1)</sup>	0,27	<b>0,36</b> <sup>1)</sup>	0,36	0,36
UK (England & Wales)	-	0,39	0,47	0,47	0,31	0,47	0,31	0,41	0,47	0,47
The Netherlands	-	-	-	0,32	-	-	-	-	-	0,37
Belgium (Flanders)	0,37 2)	<b>0,51</b> <sup>2)</sup>	<b>0,31</b> <sup>2)</sup>	<b>0,56</b> <sup>2)</sup>	<b>0,32</b> <sup>2)</sup>	0,46 2)	-	0,37	0,39	0,55
Luxembourg	0,34	0,35	0,35	0,35	0,29	0,35	-	0,37	0,42	0,43
France (Alsace H1b)	0,43	0,50	0,43	0,52	0,34	0,43	0,43	0,43	0,43	0,52
				relation	to variant	"basis" of	Germany			
Germany	100%	108%	125%	125%	93%	110%	-	95%	125%	125%
Austria (3.400 Kd/a)	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%
Czech Republic	112%	112%	112%	112%	112%	112%	112%	112%	112%	112%
Poland	117%	117%	117%	117%	117%	117%	117%	117%	117%	117%
Sweden (Lund)	65% 2)	65%	65%	106% 2)	24%	99% 2)	24% 2)	106% 3)	106%	106%
Denmark	-	90%	90%	90%	86% <sup>1)</sup>	90% 1)	68%	90% 1)	90% 1)	90%
UK (England & Wales)	-	98%	116%	116%	77% 1)			103%	1) 116%	116%
The Netherlands	-	-	-	79%	-	-	-	-	-	92%
Belgium (Flanders)	93% 2)	128% 2)	76% <sup>2)</sup>	139% 2)	80% 2)	114% 2)	-	93%	97%	138%
Luxembourg	86%	87%	87%	87%	71%	87%	-	92%	104%	107%
France (Alsace H1b)	106%	124%	106%	130%	85%	106%	106%	106%	106%	130%

#### Remarks

#### Deviations from the variant definition

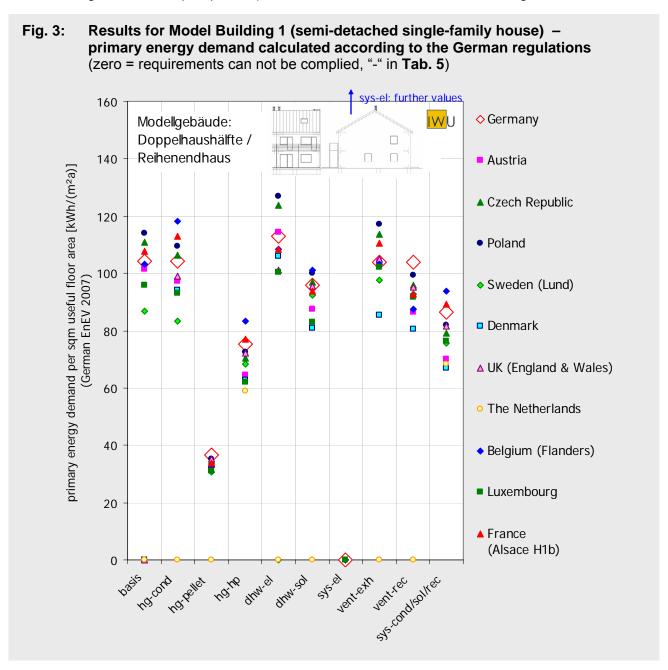
- 1) condensing boiler (mandatory) in place of low temperature boiler
- 2) with exhaust ventilation system (mandatory)
- 3) with an additional dhw heatpump

<sup>\*)</sup> considering transmission losses through thermal envelope areas determined by external dimensions, not explicitly considering possibly supplements or reductions by thermal bridging



#### 4.4 Primary energy demand (according to German regulations)

Based on the U-values and the type of supply system the primary energy demand was calculated according to the German Energy Saving Ordinance (EnEV 2007) for each variant from each country. The simplified procedure based on seasonal energy balance for the building and table values for the system calculation was applied.<sup>3</sup> Supply system variants which differ from the prescribed definitions were calculated accordingly, therefore these values can be compared with the others (of course using the German perspective). The results are shown in Tab. 5 and Fig. 3.



<sup>&</sup>quot;vereinfachtes Verfahren" nach EnEV 2007 Anlage 1, Nr. 3 / e<sub>P</sub> nach DIN V 4701-10 Anhang C



Tab. 5: Results for Model Building 1 (semi-detached single-family house) primary energy demand calculated according to the German regulations

variant name	basis	hg-cond	hg-pellet	hg-hp	dhw-el	dhw-sol	sys-el	vent-exh	vent-rec	sys- cond/so /rec
variant type	basis	variation heat generator	variation heat generator	variation heat generator	variation hot water system	variation hot water system	variation heating & hot water system	variation ventilation	variation ventilation	variation heating, ho water and ventilation system
short description	low temperature boiler for heating and dhw, no vent. system	condensing boiler	wood pellet boiler	electric heat pump	decentral electric	thermal solar system	electric resistance system	exhaust ventilation system	ventilation system with heat recovery	condensing boiler + sola dhw system ventilation system with heat recover
			Prin	nary energ		per sqm re	eference a	rea*		
Germany	104	104	37	75	113	(m²a)] <b>96</b>	-	104	104	87
Austria	101	97	32	65	114	87	216	104	87	70
Czech Republic	111	106	35	70	124	97	238	114	96	79
Poland	114	109	35	72	127	100	245	117	99	82
Sweden (Lund)	<b>87</b> 2)	83	31	<b>68</b> <sup>2)</sup>	-	<b>92</b> 2)	- 2)	<b>98</b> 3)	93	76
Denmark	-	94	31	63	<b>106</b> 1)	<b>81</b> 1)	209	<b>85</b> 1)	<b>80</b> 1)	67
UK (England & Wales)	-	99	35	72	<b>101</b> 1)	<b>95</b> 1)	194	<b>105</b> 1)	<b>95</b> 1)	82
The Netherlands	-	-	-	59	-	-	-	-	-	68
Belgium (Flanders)	<b>103</b> <sup>2)</sup>	118 <sup>2)</sup>	<b>32</b> 2)	<b>83</b> 2)	108 2)	<b>101</b> 2)	-	103	87	94
Luxembourg	96	93	31	62	100	83	-	102	92	76
France (Alsace H1b)	108	113	34	77	108	94	231	111	93	89
				relation	to variant	"basis" of	Germany			
Germany	100%	100%	35%	72%	109%	92%	-	100%	100%	83%
Austria	97%	93%	31%	62%	110%	84%	208%	100%	83%	67%
Czech Republic	106%	102%	33%	68%	119%	93%	229%	109%	92%	76%
Poland	110%	105%	34%	70%	122%	96%	236%	112%	95%	79%
Sweden (Lund)	83% 2)	80%	30%	66% 2)	_	89% 2)		9470		73%
Denmark	-	91%	30%	60%	102% <sup>1)</sup>	78% <sup>1)</sup>		82% <sup>1)</sup>		
UK (England & Wales)	-	95%	34%	69%	97% <sup>1)</sup>	92% 1)	186%	101%	91% <sup>1)</sup>	78%
The Netherlands	-	-	-	57%	-	-	-	-	-	66%
Belgium (Flanders)	99% 2)	114% <sup>2)</sup>	31% <sup>2)</sup>	80% 2)	104% 2)	97% <sup>2)</sup>	-	99%	84%	90%
Luxembourg	92%	89%	30%	59%	97%	80%	-	98%	88%	73%
France	103%	109%	32%	74%	104%	90%	221%	106%	89%	86%

#### Remarks

#### Deviations from the variant definition

- condensing boiler (mandatory) in place of low temperature boiler
   with exhaust ventilation system (mandatory)
- 3) with an additional dhw heatpump

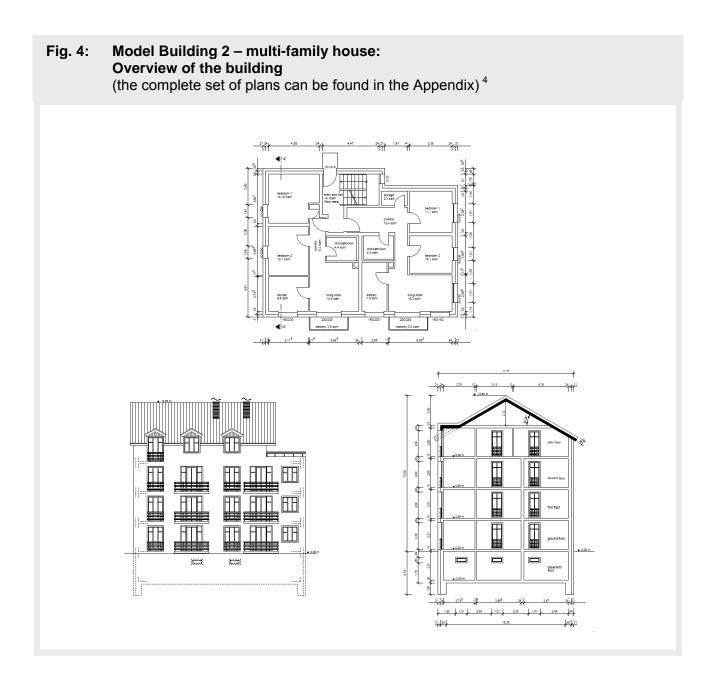
<sup>\*)</sup> calculated according to the rules of the German Energy Saving Ordinance (Energieeinsparverordnung EnEV 2007)



# 5 Model Building 2: multi-family house

## 5.1 Thermal Envelope

Model Building 2 is a multi-family house with 3 storeys plus conditioned attic storey. The cellar is not heated. The living area of the 7 apartments is 461 m² in total.



Source for the plans of this building: Kadir Durmaz: Modellrechnungen zur kommenden Energieeinsparverordnung. Vertieferarbeit an der TU Darmstadt. Supervisors: Susanne Schwickert (TUD) / Tobias Loga (IWU); TU Darmstadt August 2000 revised by Christina Kappich A-HP/Energie&Haus on behalf of IWU

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Tab. 6: General building data / thermal envelope areas

Model building N° 2			according to	for comparison
Apartment house		Gern	nan regulations	(simplified)
General building da	ta			
floor area	ext. dim.	(inside therm. env.)	657,5 m <sup>2</sup>	657,5 m <sup>2</sup>
useful floor area	int. dim.	(inside therm. env.)	520,3 m <sup>2</sup>	520,3 m <sup>2</sup>
lving area	int. dim.	(inside therm. env.)	461,2 m <sup>2</sup>	461,2 m <sup>2</sup>
building volume	ext. dim.	(inside therm. env.)	1936,7 m <sup>3</sup>	1936,7 m <sup>3</sup>
relation envelope s	surface area t	o building volume	0,517 m <sup>2</sup> /m <sup>3</sup>	0,517 m <sup>2</sup> /m <sup>3</sup>
Envelope surface ar	ea (ext. dim	ı.)		
tilted roof			150,4 m <sup>2</sup>	150,4 m <sup>2</sup>
flat roof (terrace fl	oor)		36,7 m <sup>2</sup>	36,7 m <sup>2</sup>
dormer roof			7,5 m <sup>2</sup>	7,5 m <sup>2</sup>
walls			454,4 m <sup>2</sup>	454,4 m <sup>2</sup>
dormer walls			4,4 m <sup>2</sup>	4,4 m <sup>2</sup>
cellar ceiling			158,2 m <sup>2</sup>	173,5 m <sup>2</sup>
floor to soil			15,3 m <sup>2</sup>	0,0 m <sup>2</sup>
walls to soil			18,0 m <sup>2</sup>	0,0 m <sup>2</sup>
walls to cellar			24,9 m <sup>2</sup>	0,0 m <sup>2</sup>
door to cellar			2,0 m <sup>2</sup>	0,0 m <sup>2</sup>
outside door			2,1 m <sup>2</sup>	2,1 m <sup>2</sup>
windows	East	vertical	45,7 m <sup>2</sup>	45,7 m <sup>2</sup>
	South	vertical	63,1 m <sup>2</sup>	63,1 m <sup>2</sup>
	West	vertical	18,6 m <sup>2</sup>	18,6 m <sup>2</sup>
sum envelope surfa	ace area		1001,3 m <sup>2</sup>	956,4 m <sup>2</sup>

ext. dim. = external dimensions

int. dim. = internal dimensions

According to the German regulations the stairwell is included in the thermal envelope. Since there is no door to the stair running down to the cellar the stairwell part of the cellar storey is considered to be heated as well. Therefore the thermal envelope in this area consists of the cellar floor of the stairwell, the walls bordering on soil as well as the walls and the door bordering on the cellar rooms. Since in some countries this is not considered in the same way a simplified envelope was defined for the determination of the simplified heat transfer coefficient used for comparison (see Tab. 6).



# 5.2 Types of supply systems

In order to avoid the problem which had occurred concerning the definition of the basis variant of the single family house (see 4.3) it was decided to change the variants definition for Model Building 2 in the following way:

- The new basis variant is a system with a condensing boiler for heating and hot water and an exhaust ventilation system.
- The variant "hg-cond" (condensing boiler) is replaced by "hg-bnc" (non-condensing boiler). This variant will not be calculated for countries in which non-condensing boilers are not allowed.
- The variant "vent-exh" (exhaust ventilation system) is replaced by "vent-nomec" (no mechanical ventilation). This variant will not be calculated for countries in which ventilation systems are mandatory.

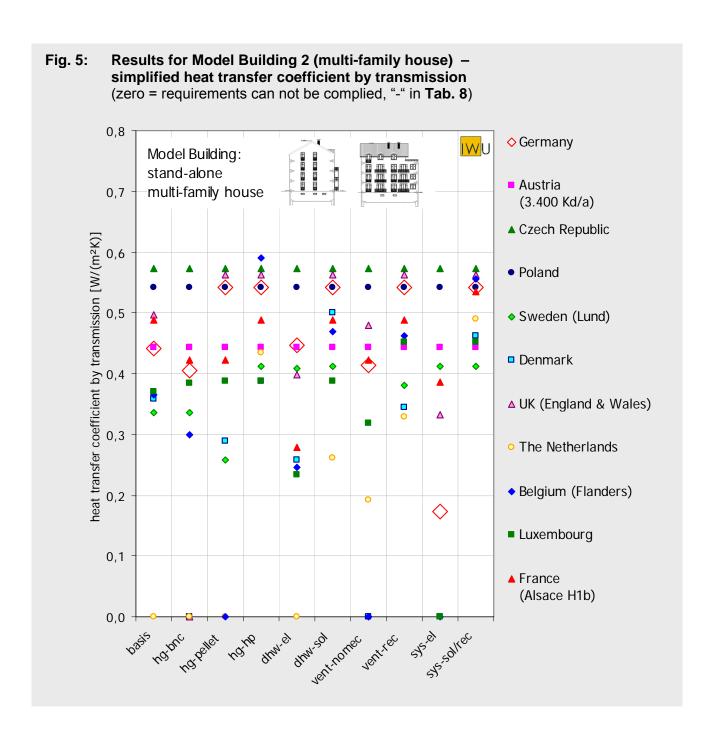
In consequence the following supply systems were defined:

Label	Туре	Varied component
basis	basis variant	central system with condensing boilder for heating and hot water, exhaust ventilation system
hg-bnc	variation heat generator	low temperatur boiler, non-condensing
hg-pellet	variation heat generator	wood pellet boiler
hg-hp	variation heat generator	electric heat pump
dhw-el	variation hot water system	decentral electric
dhw-sol	variation hot water system	thermal solar system
vent-nomec	variation ventilation	no mechanical ventilation system
vent-rec	variation ventilation	ventilation system with heat recovery
sys-el	variation heating, hot water and ventilation system	electric resistance system
sys-cond/sol/rec	variation heating, hot water and ventilation system	condensing boiler + solar dhw system + ventilation system with heat recovery



## 5.3 Results for the thermal quality of the envelope

The calculations of the thermal standard which just complies with the national requirements for new buildings was performed in the same way as for Model Building 1. The results are shown in Tab. 8 and in Fig. 5.





Tab. 8: Results for Model Building 2 (multi-family house) – simplified heat transfer coefficient by transmission

variant name	basis	hg-bnc	hg-pellet	hg-hp	dhw-el	dhw-sol	vent- nomec	vent-rec	sys-el	sys- sol/rec
variant type	basis	variation heat generator	variation heat generator	variation heat generator	variation hot water system	variation hot water system	variation ventilation	variation ventilation	variation heating and hot water system	variation ho water and ventilation system
short description	condensing boiler for heating and hot water + exhaust ventilation system	low temperature boiler (non- condensing)	wood pellet boiler	electric heat pump	decentral electric	system	no mechanical ventilation system	system with heat recovery	electric resistance system	solar dhw system + ventilation system with heat recover
			ı	Heat trans		i <mark>ent by tra</mark> m²K)]	nsmission	*		
Germany	0,44	0,41	0,54	0,54	0,45	0,54	0,41	0,54	0,17	0,54
Austria (3.400 Kd/a)	0,44	0,44	0,44	0,44	0,44	0,44	0,44	0,44	0,44	0,44
Czech Republic	0,57	0,57	0,57	0,57	0,57	0,57	0,57	0,57	0,57	0,57
Poland	0,54	0,54	0,54	0,54	0,54	0,54	0,54	0,54	0,54	0,54
Sweden (Lund)	0,34	0,34	0,26	0,41	0,41	0,41	-	0,38	0,41	0,41
Denmark	0,36	-	0,29	0,39	0,26	0,50	-	0,34	-	0,46
UK (England & Wales)	0,50	-	0,56	0,56	0,40	0,56	0,48	0,56	0,33	0,56
The Netherlands	-	-	-	0,43	-	0,26	0,19	0,33	-	0,49
Belgium (Flanders)	0,37	0,30	-	0,59	0,25	0,47	-	0,46	-	0,56
Luxembourg	0,37	0,38	0,39	0,39	0,23	0,39	0,32	0,45	-	0,45
France (Alsace H1b)	0,49	0,42	0,42	0,49	0,28	0,49	0,42	0,49	0,39	0,54
				relation	to variant	"basis" of	Germany			
Germany	100%	92%	123%	123%	101%	123%	94%	123%	39%	123%
Austria (3.400 Kd/a)	101%	101%	101%	101%	101%	101%	101%	101%	101%	101%
Czech Republic	130%	130%	130%	130%	130%	130%	130%	130%	130%	130%
Poland	123%	123%	123%	123%	123%	123%	123%	123%	123%	123%
Sweden (Lund)	76%	76%	59%	93%	93%	93%	-	86%	93%	93%
Denmark	81%	-	66%	88%	58%	113%	-	78%	-	105%
UK (England & Wales)	112%	-	127%	127%	90%	127%	109%	127%	75%	127%
The Netherlands	-	-	-	98%	-	59%	44%	75%	-	111%
Belgium (Flanders)	83%	68%	-	134%	56%	106%	-	105%	-	126%
Luxembourg	84%	87%	88%	88%	53%	88%	72%	102%	-	102%
France (Alsace H1b)	111%	96%	96%	111%	63%	111%	96%	111%	87%	121%

Remarks

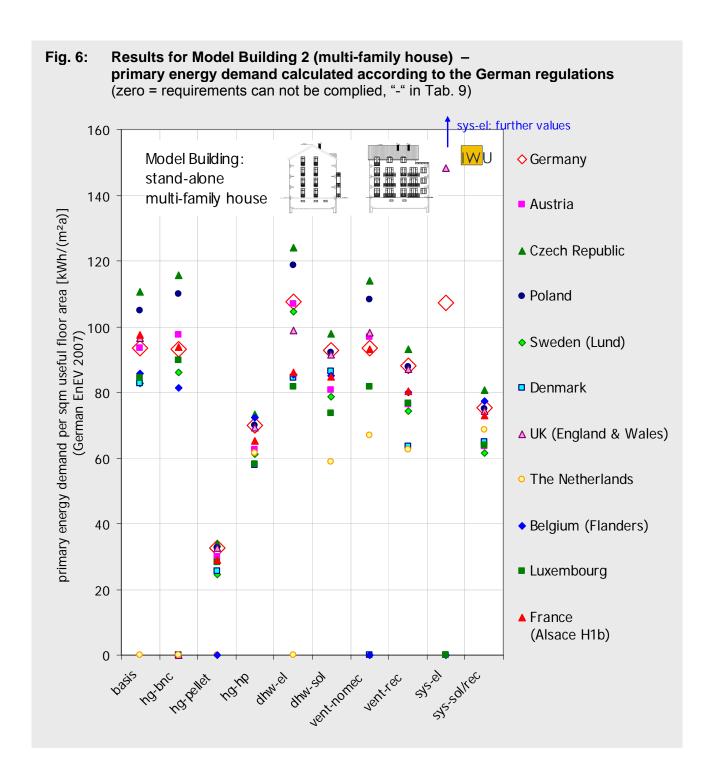


<sup>\*)</sup> considering transmission losses through thermal envelope areas determined by external dimensions, not explicitly considering possibly supplements or reductions by thermal bridging



#### 5.4 Primary energy demand (according to German regulations)

Starting from the U-values for each variant from each country the primary energy demand was calculated according to the German Energy Saving Ordinance (EnEV 2007). The proceeding was the same as for Model Building 1 (see chapter 4.4). The results are shown in Tab. 9 and Fig. 6.





Tab. 9: Results for Model Building 2 (multi-family house) – primary energy demand calculated according to the German regulations

variant name	basis	hg-bnc	hg-pellet	hg-hp	dhw-el	dhw-sol	vent- nomec	vent-rec	sys-el	sys- sol/rec
variant type	basis	variation heat generator	variation heat generator	variation heat generator	variation hot water system	variation hot water system	variation ventilation	variation ventilation	variation heating and hot water	variation ho water and ventilation system
short description	condensing boiler for heating and hot water + exhaust ventilation system	low temperature boiler (non- condensing)	wood pellet boiler	electric heat pump	decentral electric	thermal solar system	no mechanical ventilation system	ventilation system with heat recovery	electric resistance system	system solar dhw system + ventilation system with heat recover
			Prin	nary energ		per sqm re (m²a)]	eference a	rea*		
Germany	93	93	33	70	108	93	93	88	107	75
Austria	93	98	30	62	107	81	97	76	185	63
Czech Republic	110	116	34	73	124	98	114	93	225	81
Poland	105	110	33	70	119	92	108	88	212	75
Sweden (Lund)	83	86	25	61	105	79	-	74	181	61
Denmark	83	-	25	58	84	86	-	64	-	65
UK (England & Wales)	96	-	32	69	99	91	98	87	148	74
The Netherlands	-	-	-	62	-	59	67	62	-	68
Belgium (Flanders)	86	81	-	72	85	85	-	80	-	77
Luxembourg	84	90	28	58	82	74	82	77	-	64
France (Alsace H1b)	97	94	29	65	86	85	93	80	167	73
				relation	to variant	"basis" of	Germany			
Germany	100%	100%	35%	75%	115%	99%	100%	95%	115%	81%
Austria	100%	105%	32%	67%	115%	86%	104%	82%	199%	68%
Czech Republic	118%	124%	36%	78%	133%	105%	122%	100%	241%	86%
Poland	112%	118%	35%	75%	127%	99%	116%	94%	228%	80%
Sweden (Lund)	89%	92%	26%	66%	112%	84%	-	80%	194%	66%
Denmark	88%	-	27%	62%	90%	93%	-	68%	-	69%
UK (England & Wales)	103%	-	35%	74%	106%	98%	105%	93%	159%	80%
The Netherlands	-	-	-	66%	-	63%	72%	67%	-	73%
Belgium (Flanders)	92%	87%	-	77%	92%	91%	-	86%	-	83%
Luxembourg	90%	96%	30%	62%	88%	79%	88%	82%	-	69%
France (Alsace H1b)	104%	100%	31%	70%	92%	91%	100%	86%	179%	78%

Remarks



<sup>\*)</sup> calculated according to the rules of the German Energy Saving Ordinance (Energieeinsparverordnung EnEV 2007)



# 6 Model Building 3: School

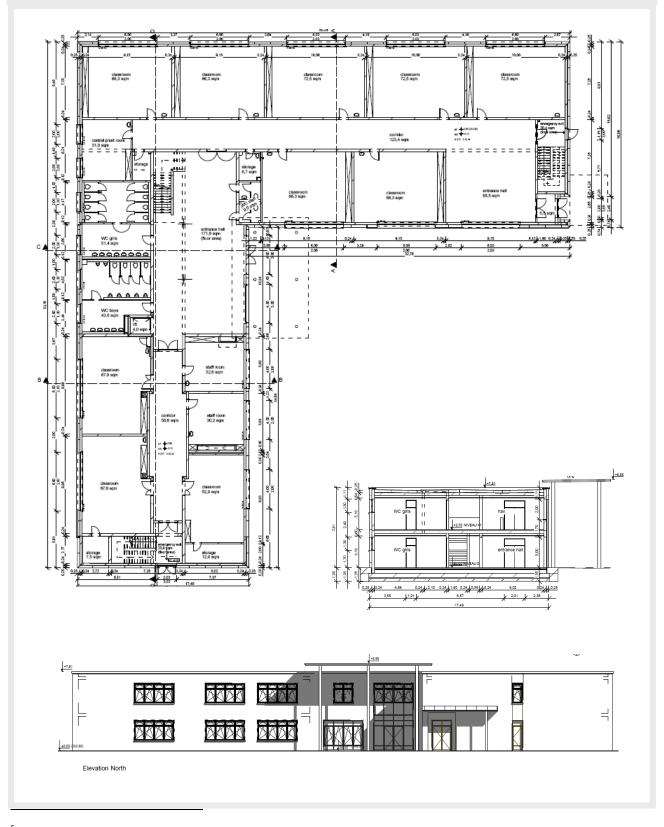
## 6.1 Thermal envelope

Model Building 3 is a two storey school building with about 2700 m² net floor area. It has a flat roof, a cellar is not existent. An overview of the building geometry is given by Fig. 7. In Tab. 10 the surface areas of the thermal envelope elements determined by use of external dimensions are listed. The complete set of plans and the details of the envelope area calculation can be found in the Appendix.

Model building N° 3			
school building			
General building da	ta		
gross floor area	ext. dim.	(inside therm. env.)	3121,7 m <sup>2</sup>
net floor area	int. dim.	(inside therm. env.)	2724,9 m <sup>2</sup>
useful floor area	int. dim.	(inside therm. env.)	1876,2 m²
building volume	ext. dim.	(inside therm. env.)	13891,1 m <sup>3</sup>
relation envelope s	surface area t	o building volume	0,358 m <sup>2</sup> /m <sup>3</sup>
Envelope surface ar	ea (ext. dim	ı.)	
roof			1560,9 m <sup>2</sup>
wall N			324,1 m <sup>2</sup>
wall E			310,4 m <sup>2</sup>
wall S			335,1 m <sup>2</sup>
wall W			272,4 m <sup>2</sup>
wall to soil N			58,6 m <sup>2</sup>
wall to soil E			54,8 m <sup>2</sup>
wall to soil S			58,6 m <sup>2</sup>
wall to soil W			54,8 m <sup>2</sup>
window N			84,0 m <sup>2</sup>
window E			76,0 m <sup>2</sup>
window S			84,8 m²
window W			120,0 m <sup>2</sup>
door N			11,8 m²
door E			6,0 m <sup>2</sup>
floor			1560,9 m <sup>2</sup>
sum envelope surf	ace area		4973,2 m <sup>2</sup>



Fig. 7: Model Building 3 – school:
Overview of the building
(the complete set of plans can be found in the Appendix) 5



Source for the plans of this building: Atelier d'Architecture Arlette Feierstein, Luxembourg revised by Christina Kappich A-HP/Energie&Haus on behalf of IWU



#### 6.2 Types of supply systems

A central heating system with a condensing gas boiler is defined as the basis variant. The heat generator is installed in a central heating room. The heating room and all heat ducts are located inside of the thermal envelope. The two lavatories are very close to the central heating room and are supplied with hot water by circulation pipes. In the class rooms conventional radiators are installed for heat emission. In order to make sure that the basis variant can be realised in all countries a ventilation system with heat recovery is considered.

Starting from this basis system variations are defined: Instead of the condensing boiler a low temperature gas boiler (non-condensing), an electric heat pump and a wood pellet boiler are used for heat generation. In a further variant the ventilation system is omitted.

The details of the supply system variants (system temperatures, duct lengths, thermal and electric power, ...) are documented in the Appendix.

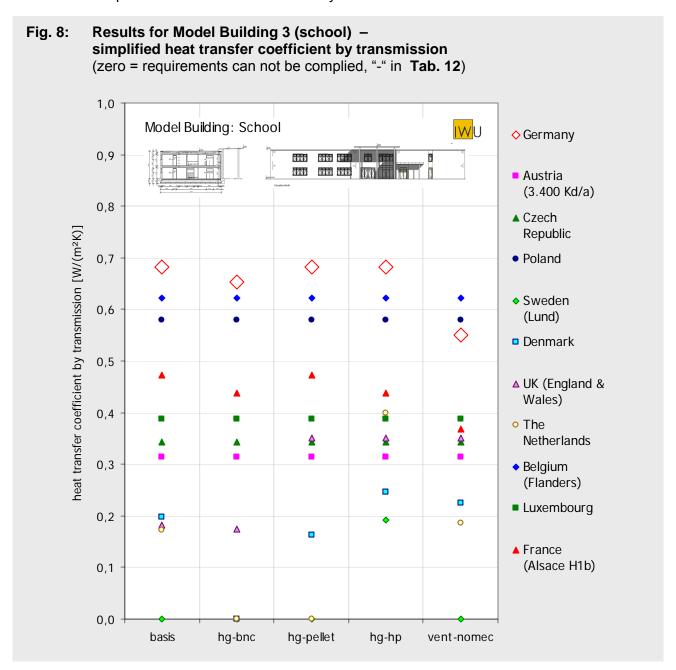
Label	Туре	Varied component	
basis	basis variant	condensing boiler for heating and hot water + exhaust ventilation system	
hg-bnc	variation heat generator	low temperature boiler (non-condensing)	
hg-pellet	variation heat generator	wood pellet boiler	
hg-hp	variation heat generator	electric heat pump (soil)	
vent-nomec	variation ventilation	no mechanical ventilation system	



#### 6.3 Results for the thermal quality of the envelope

The calculations of the thermal standard which just complies with the national requirements for new buildings was performed in the same way as for Model Building 1 and 2. The results are shown in Tab. 12 and in Fig. 8. Information about the calculation methods which were used in the different countries can be found in the "Country Sheets" (Appendix).

The lowest values can be found for the countries Sweden, UK, Denmark and the Netherlands. Similar to the previous example buildings the missing values (indicated by "-" in the table) are caused by the fact that the U-values have to be reduced below a level which can be realised in practice (U-value of opaque elements <  $0.08~W/(m^2K)$  / of windows <  $0.8~W/(m^2K)$ ). In case of Sweden the requirements are so severe that only one of the five variants could be built.





Tab. 12: Results for Model Building 3 (school) – simplified heat transfer coefficient by transmission

variant name	basis	hg-bnc	hg-pellet	hg-hp	vent-nomec	
variant type	basis	variation heat generator	variation heat generator	variation heat generator	variation ventilation	
short description	condensing boiler for heating and hot water + exhaust ventilation system	low temperature boiler (non-condensing)	wood pellet boiler	electric heat pump	no mechanical ventilation system	
	Heat transfer coefficient by transmission* [W/(m²K)]					
Germany	0,68	0,65	0,68	0,68	0,55	
Austria (3.400 Kd/a)	0,31	0,31	0,31	0,31	0,31	
Czech Republic	0,34	0,34	0,34	0,34	0,34	
Poland	0,58	0,58	0,58	0,58	0,58	
Sweden (Lund)	-	-	-	0,19	-	
Denmark	0,20	-	0,16	0,25	0,23	
UK (England & Wales)	0,18	0,17	0,35	0,35	0,35	
The Netherlands	0,17	-	-	0,40	0,19	
Belgium (Flanders)	0,62	0,62	0,62	0,62	0,62	
Luxembourg	0,39	0,39	0,39	0,39	0,39	
France (Alsace H1b)	0,47	0,44	0,47	0,44	0,37	
	relation to variant "basis" of Germany					
Germany	100%	96%	100%	100%	81%	
Austria (3.400 Kd/a)	46%	46%	46%	46%	46%	
Czech Republic	50%	50%	50%	50%	50%	
Poland	85%	85%	85%	85%	85%	
Sweden (Lund)	-	-	-	28%	-	
Denmark	29%	-	24%	36%	33%	
UK (England & Wales)	27%	26%	52%	52%	52%	
The Netherlands	25%	-	-	58%	27%	
Belgium (Flanders)	91%	91%	91%	91%	91%	
Luxembourg	57%	57%	57%	57%	57%	
France (Alsace H1b)	69%	64%	69%	64%	54%	

#### Remarks



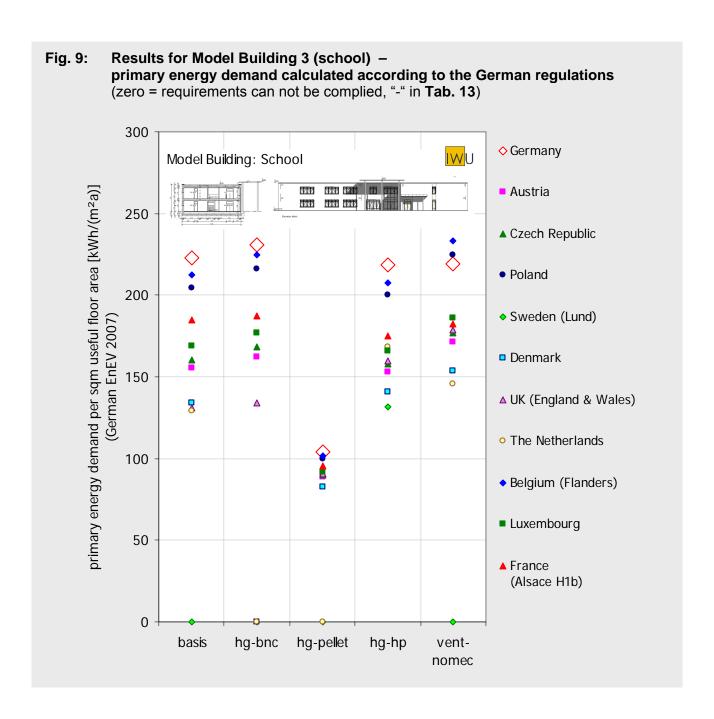
<sup>\*)</sup> considering transmission losses through thermal envelope areas determined by external dimensions, not explicitly considering possibly supplements or reductions by thermal bridging



#### 6.4 Primary energy demand (according to German regulations)

Starting from the U-values for each variant from each country the primary energy demand was calculated according to the German Energy Saving Ordinance (EnEV 2007, calculation procedure DIN V 18599, 1 zone building). The results are shown in Tab. 13 and Fig. 9.

The results are in principle similar to the previous ones. The poorest requirements can be found in Germany, the severest in Sweden.





Tab. 13: Results for Model Building 3 (school) – primary energy demand calculated according to the German regulations

variant name	basis	hg-bnc	hg-pellet	hg-hp	vent-nomec	
variant type	basis	variation heat generator	variation heat generator	variation heat generator	variation ventilation	
short description	condensing boiler for heating and hot water + exhaust ventilation system	low temperature boiler (non-condensing)	wood pellet boiler	electric heat pump	no mechanical ventilation system	
	Primary energy demand per sqm reference area*  [kWh/(m²a)]					
Germany	223	231	104	218	219	
Austria	155	162	89	153	171	
Czech Republic	161	168	90	158	177	
Poland	204	216	100	200	225	
Sweden (Lund)	-	-	-	132	-	
Denmark	134	-	82	141	154	
UK (England & Wales)	131	134	90	160	179	
The Netherlands	129	-	-	168	146	
Belgium (Flanders)	212	225	102	208	233	
Luxembourg	169	177	92	166	186	
France (Alsace H1b)	185	187	96	175	182	
	relation to variant "basis" of Germany					
Germany	100%	104%	47%	98%	98%	
Austria	70%	73%	40%	69%	77%	
Czech Republic	72%	75%	40%	71%	79%	
Poland	92%	97%	45%	90%	101%	
Sweden (Lund)	-	-	-	59%	-	
Denmark	60%	-	37%	63%	69%	
UK (England & Wales)	59%	60%	41%	72%	80%	
The Netherlands	58%	-	-	75%	65%	
Belgium (Flanders)	95%	101%	46%	93%	105%	
Luxembourg	76%	79%	41%	74%	83%	
France (Alsace H1b)	83%	84%	43%	78%	82%	

Remarks

<sup>\*)</sup> calculated according to the rules of the German Energy Saving Ordinance (Energieeinsparverordnung EnEV 2007)





#### 7 Résumé

The here performed investigations give an impression of the energy performance requirements of new buildings in Germany and the 10 neighboured countries Austria, Czech Republic, Poland, Sweden, Denmark, UK, Netherlands, Belgium (Flanders), Luxembourg and France. The results which are to be considered as exemplary show certain tendencies: Regarding the two residential buildings the German requirements (EnEV 2007) are settled on a more or less average level. The best energy performance is achieved by the regulations in the Netherlands, Sweden, Denmark and Luxembourg. Especially the German requirements on the thermal transmittance of the envelope turned out to be comparably poor. It is the restricting limit in cases of supply systems with high efficiency or biomass. In case of the school building the German energy performance level is the poorest of all considered countries - for nearly all variants. The most ambitious requirements can be found in UK, Netherlands, Sweden and Denmark.

Facing the fact that an analytic comparison of the national methods was not a subject of this study the reasons for the dependencies of the different parameters can not be explained in detail. With regard to the objective of this study – the determination of the requirement level for a considerable number of countries – the applied method proved its worth. The documented building examples show how plans and tabled descriptions can be designed in order to make possible the application of national methods by experts from different countries. From this experience a two-step approach can be recommended for future investigations: In a first step the supply system of the basis variant should be selected in co-operation with the involved partners making sure that the respective building-system combination can be realised in all countries. Usually this will result in the selection of a more efficient supply system. Based on this reference case the parameter variations can be performed in a concerted way – omitting a variant in case that it cannot be built in a certain country.

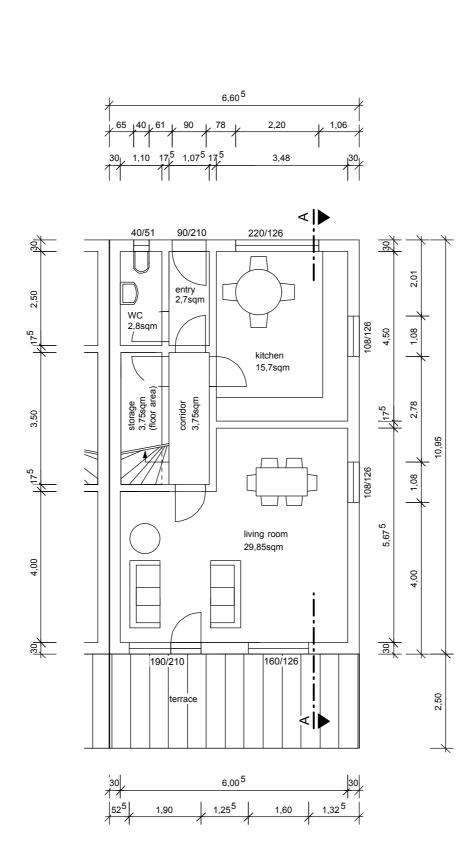
Since primary energy demand and carbon dioxide emissions are defined differently in the national regulations (especially regarding biomass) these quantities are not adequate for a comprehensive cross-country comparison of the overall energy performance. They can only be used in a single country for illuminating comparison results by applying the national definition framework. The primary energy values shown in this study can therefore be considered as translation to understand the results from the viewpoint of the German energy saving ordinance and are addressing especially German experts. On an international level the simplified transfer coefficient by transmission has proved to be a good comparison criterion which gives – being a sort of average U-value – an indication of the "insulation quality" for a given building geometry and its supply system. However, the application of this method is restricted to countries with similar climates and to building types with an energy consumption that considerably depends on the thermal transmittance of the envelope.



# **APPENDIX**

Appendix 1: Definition of Model Building 1 – semi-detached single family house

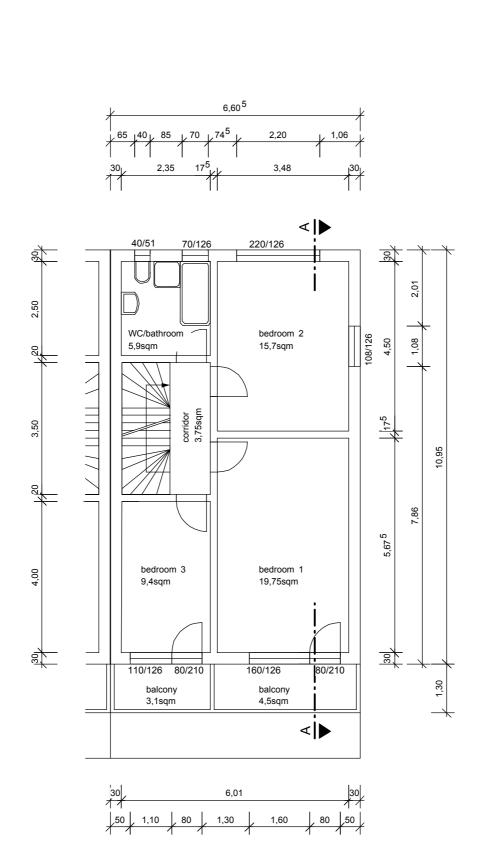
Appendix 1a: Plans



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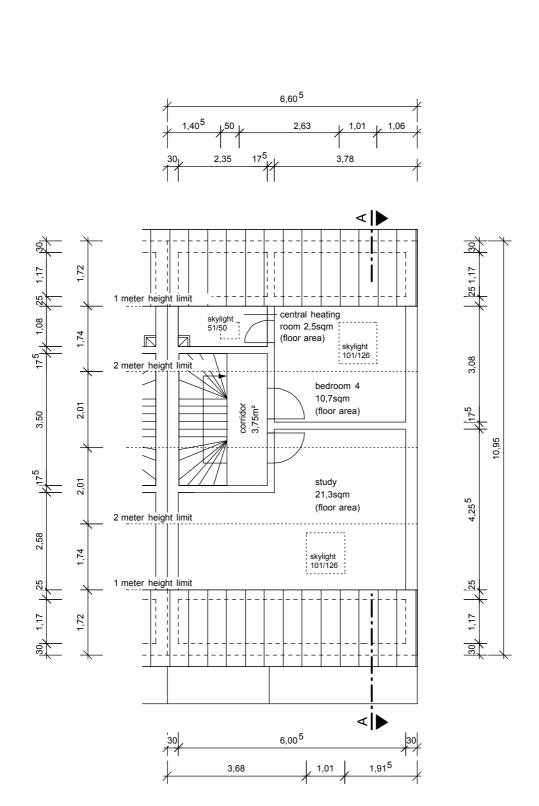
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Floor Plan	Ground Floor
Scale	1:100
Date	Jan 2008



IWU 2008



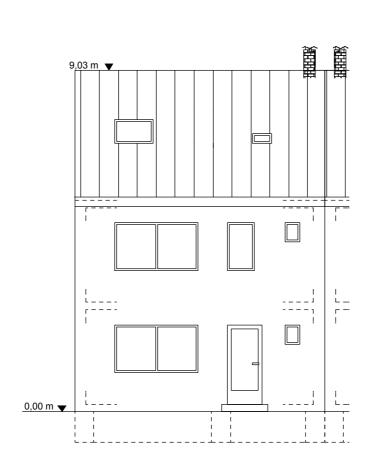
Building	END-TERRACE HOUSE
Floor Plan	First Floor
Scale	1:100
Date	Jan 2008



IWU 2008

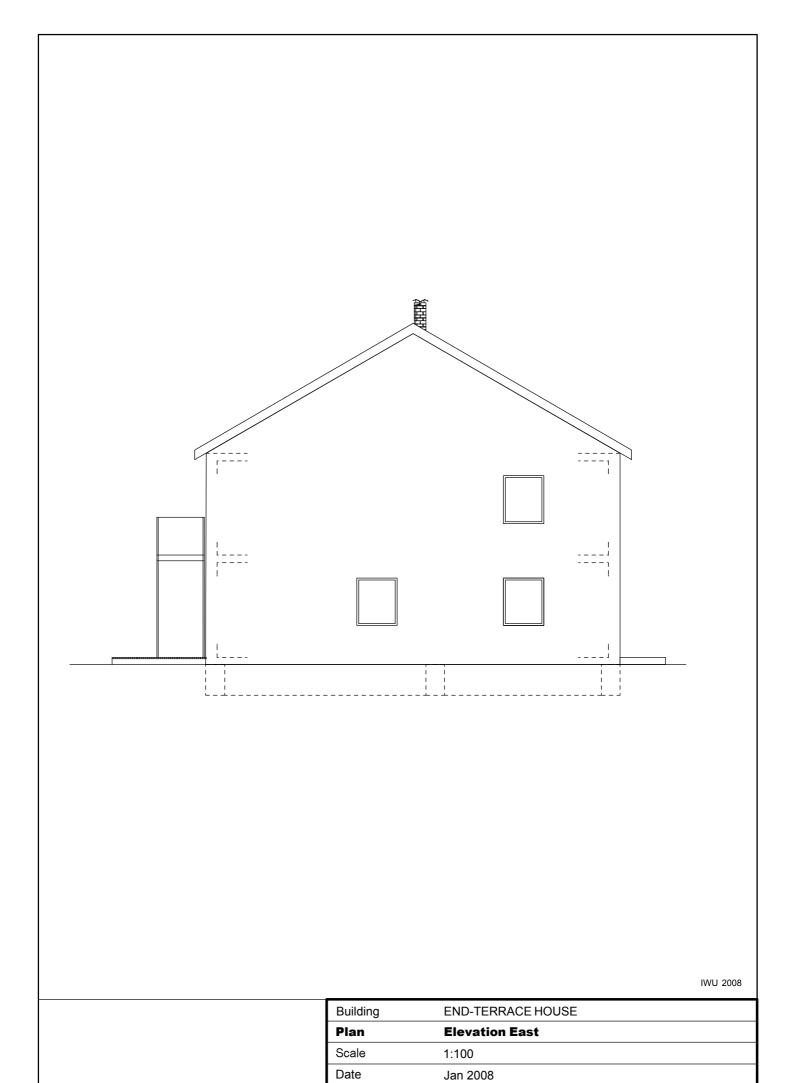


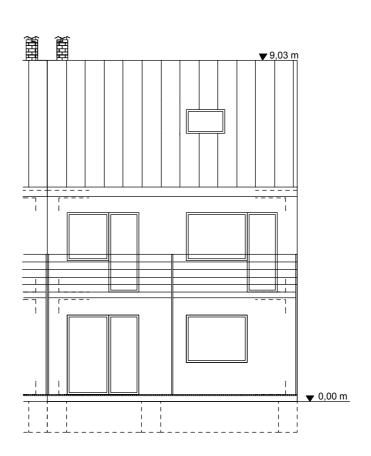
Building	END-TERRACE HOUSE
Floor Plan	Attic Floor
Scale	1:100
Date	Jan 2008



IWU 2008

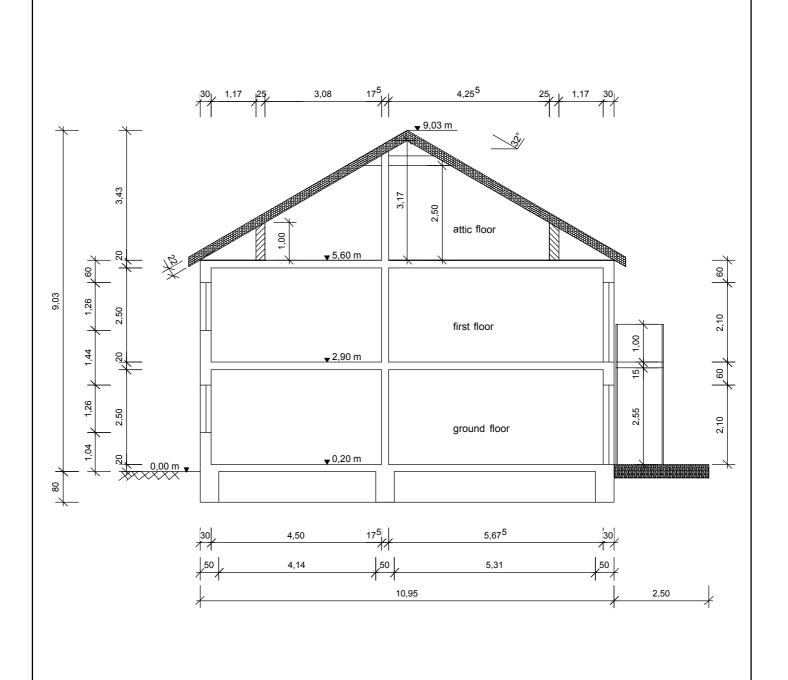
Building	END-TERRACE HOUSE
Plan	Elevation North
Scale	1:100
Date	Jan 2008





IWU 2008

Building	END-TERRACE HOUSE
Plan	Elevation South
Scale	1:100
Date	Jan 2008



IWU 2008

Building	END-TERRACE HOUSE
Plan	Section A - A
Scale	1:100
Date	Jan 2008



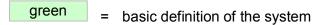
# Appendix 1b: Detailed envelope area calculation (external dimensions)

	name area element (free)	further specification /	location	envelope	dedicated orientation for windows	reductio n area: insert "R"	width	length	height	gross surface area	net surface area
							[m]	[m]	[m]	[m²]	[m²]
1.	floor above soil			floor			6,605	10,95			72,3
2.	wall N	front side		wall				6,605	5,86	38,7	30,0
3.	door N	front side		door		R	0,90		2,10		1,9
4.	window N 1	North / ground floor		window	N	R	2,20		1,26		2,8
5.	window N 2	North / ground floor		window	N	R	0,40		0,51		0,2
6.	window N 3	North / first floor		window	N	R	2,20		1,26		2,8
7.	window N 4	North / first floor		window	N	R	0,70		1,26		0,9
8.	window N 5	North / first floor		window	N	R	0,40		0,51		0,2
9.	wall S	South		wall				6,605	5,86	38,7	25,9
10.	window S 1	South / ground floor		window	S	R	1,90		2,10		4,0
11.	window S 2	South / ground floor		window	S	R	1,60		1,26		2,0
12.	window S 3	South / first floor		window	S	R	1,10		1,26		1,4
13.	window S 4	South / first floor		window	S	R	0,80		2,10		1,7
14.	window S 5	South / first floor		window	S	R	1,60		1,26		2,0
15.	window S 6	South / first floor		window	S	R	0,80		2,10		1,7
16.	wall E 1	East / ground floor + f	irst floor	wall				10,95	5,86	64,2	60,1
17.	window E 1	East / ground floor		window	Е	R		1,08	1,26		1,4
18.	window E 2	East / ground floor		window	Е	R		1,08	1,26		1,4
19.	window E 3	East / first floor		window	Е	R		1,08	1,26		1,4
20.	wall E 2	East / attic floor		wall				10,95	1,585		17,4
21.	roof N	North		roof			6,605	6,461		42,7	41,1
22.	skylight window N 1	North		window	N_45	R	0,51	0,50			0,3
23.	skylight window N 2	North		window	N_45	R	1,01	1,26			1,3
24.	roof S	South		roof			6,605	6,461		42,7	41,4
25.	skylight window S	South		window	S_45	R	1,01	1,26			1,3
								Gesam	t thermiso	che Hülle:	316,6



# Appendix 1c: Definition of the supply system types

## **Explanation of table colours:**



blue = to be used only if necessary; if not compatible to the national definitions or values the most similar ones were to be used



## Variants basis, hg-cond, hg-pellet, hg-hp, dhw-el, dhw-sol

variant						
variant N°	1-0	1-11	1-12	1-13	1-21	1-22
variant name	basis	hg-cond	hg-pellet	hg-hp	dhw-el	dhw-sol
variant type	basis	variation heat	variation heat	variation heat	variation hot water	
short description	low temperature	generator condensing boiler	generator wood pellet boiler	generator electric heat pump	system  decentral electric	thermal solar
	boiler	_				system
building						
thermal envelope						
envelope surface area				C 1-1-1		see plans
thermal bridges				(+ tabi		relope areas, if apportive thermal bridges
air tightness	no blower door	no blower door	no blower door	no blower door	no blower door	no blower door
air-tightness	measurement	measurement	measurement	measurement	measurement	measurement
solar gains						
total solar energy transmittance (for radiation perpendicular to the gl						1,6
external shading correction factor (all directions)  alternatively: horizon angle						1,6 O°
frame area fraction of windows						1,3
heating system						
heating system						
heat generation (heating)	low temperature			electric heat		
type	boiler (not condensing)	condensing boiler	pellet boiler	pump (soil/water)	= var. 1-0	= var. 1-0
energy carrier	natural gas central heating	natural gas	wood pellets	electricity	= var. 1-0	= var. 1-0
location	room (attic)				= var. 1-0	
control temperature	adjusted in dependence of outdoor temperature		= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
further specification	maximum values for supply / return temperature: 70°C / 55°C		= var. 1-0	maximum values for supply / return temperature: 55°C / 45°C	= var. 1-0	= var. 1-0
thermal power	18 kW	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
heat distribution (heating)						
type	water pipes	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
location	completely inside of the thermal envelope, vertical central string			= var. 1-0	= var. 1-0	
control temperature	control of heat distribution temperature according to outdoor air temperature		= var. 1-0		= var. 1-0	
electric consumption pump	electric power = 80 W / running time = 18 h/d x 365 d/a	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
heating pipes (if detailed input required)						
string 1	main string /	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
pipe length	heating room 2 x 2 m	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
insulation thickness	20 mm			= var. 1-0	= var. 1-0	
alternatively: U-value	0,20 W/(m <sup>2</sup> K) main string /	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
string 2	vertical	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
pipe length	2 x 6 m 20 mm	= var. 1-0	= var. 1-0 = var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
insulation thickness alternatively: U-value	0,20 W/(m <sup>2</sup> K)	= var. 1-0 = var. 1-0	= var. 1-0 = var. 1-0	= var. 1-0 = var. 1-0	= var. 1-0 = var. 1-0	= var. 1-0 = var. 1-0
string 3	distribution in		= var. 1-0		= var. 1-0	
pipe length	rooms 2 x 60 m	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
insulation thickness	-		= var. 1-0	= var. 1-0	= var. 1-0	
alternatively: U-value	0,40 W/(m <sup>2</sup> K)	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
heat emission (heating) type	radiators	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
control	thermostatic valves (regulation range:		= var. 1-0		= var. 1-0	
	2K)	- var. 1-0	- var. 1-0	- var. 1-0	- val. 1-0	- val. 1-0



variant

variant N

variant name

short description

hot water system

heat generation

type

energy carrier

location

further specification

eat storage

type

location

volume heat loss per day

heat distribution

type

location

temperature electric consumption pump

heating pipes (if detailed input required)

string 1

pipe length insulation thickness alternatively: U-value

string 2

pipe length insulation thickness alternatively: U-value

string 3

pipe length insulation thickness alternatively: U-value

ventilation system

type

specification

1-0	1-11	1-12	1-13	1-21	1-22
basis	hg-cond	hg-pellet	hg-hp	dhw-el	dhw-sol
basis	variation heat	variation heat	variation heat	variation hot water	variation hot water
basis	generator	generator	generator	system	system
low temperature boiler	condensing boiler	wood pellet boiler	electric heat pump	decentral electric	thermal solar system
generator for space	generator for space	generator for space	combined with heat generator for space heating (see above)	electric water	combined with heat generator for space heating (see above) + additional thermal solar system
(see above)	(see above)	(see above)	(see above)	electricity	(see above)
(see above)	(see above)	(see above)	(see above)	inside thermal envelope	(see above)
hot water storage	= var. 1-0	= var. 1-0	= var. 1-0	none	= var. 1-0
central heating room (attic)	= var. 1-0		= var. 1-0	-	
120 liter	= var. 1-0	= var. 1-0	= var. 1-0	-	400 liter
1,75 kWh/d	= var. 1-0	= var. 1-0	= var. 1-0	-	2,6 kWh/d
without hot water circulation completely inside of the thermal envelope, vertical	= var. 1-0 = var. 1-0	= var. 1-0 = var. 1-0	= var. 1-0 = var. 1-0	without hot water circulation in the kitchen and in the bathroom	= var. 1-0 = var. 1-0
central string 60°C	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
-	= var. 1-0	= var. 1-0	= var. 1-0	none	= var. 1-0
main string /					
heating room	= var. 1-0	= var. 1-0	= var. 1-0	none	= var. 1-0
2 m 10 mm	= var. 1-0 = var. 1-0	= var. 1-0 = var. 1-0	= var. 1-0 = var. 1-0	-	= var. 1-0 = var. 1-0
0,30 W/(m <sup>2</sup> K)	= var. 1-0 = var. 1-0	= var. 1-0 = var. 1-0	= var. 1-0 = var. 1-0	-	= var. 1-0 = var. 1-0
main string / vertical	= var. 1-0	= var. 1-0	= var. 1-0	none	= var. 1-0
6 m	= var. 1-0	= var. 1-0	= var. 1-0	-	= var. 1-0
10 mm	= var. 1-0	= var. 1-0	= var. 1-0	-	= var. 1-0
0,30 W/(m <sup>2</sup> K) distribution in	= var. 1-0	= var. 1-0	= var. 1-0	distribution in	= var. 1-0
kitchen and in bathroom / WC	= var. 1-0	= var. 1-0	= var. 1-0	kitchen and in bathroom / WC	= var. 1-0
10 m	= var. 1-0	= var. 1-0	= var. 1-0	10 m	= var. 1-0
-	= var. 1-0	= var. 1-0	= var. 1-0	-	= var. 1-0
0,40 W/(m <sup>2</sup> K)	= var. 1-0	= var. 1-0	= var. 1-0	0,40 W/(m <sup>2</sup> K)	= var. 1-0
none	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
none	none	none	none	none	none



## Variants basis, sys-el, vent-exh, vent-rec, sys-cond/sol/rec

variant	4.0	4.04	4 44	4 40	4
variant N°	1-0	1-31	1-41	1-42	1-51 sys-
variant name	basis	sys-el	vent-exh	vent-rec	cond/sol/rec
variant type	basis	variation heating & hot water system	variation ventilation	variation ventilation	variation heating & hot water system
short description	low temperature boiler	electric resistance system	exhaust ventilation system	ventilation system with heat recovery	condensing boiler + solar dhw system + ventilation system with heat recovery
building					
thermal envelope					
envelope surface area			definition see plan Itside envelope are		
thermal bridges		no releva	nt constructive therm blower door	al bridges blower door	blower door
air-tightness	no blower door measurement	no blower door measurement		measurement: n50 <pre></pre>	
solar gains					
total solar energy transmittance (for radiation perpendicular to the g			0,6		
external shading correction factor (all directions)  alternatively: horizon angle			0,6 30°		
frame area fraction of windows			0,3		
heating system					
heat generation (heating)					
type	low temperature boiler (not condensing)	eletric heated water storage	= var. 1-0	= var. 1-0	condensing boiler
energy carrier	natural gas	electricity	= var. 1-0	= var. 1-0	natural gas
location	central heating room (attic)	= var. 1-0	= var. 1-0		= var. 1-0
control temperature	adjusted in dependence of outdoor temperature	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
further specification	maximum values for supply / return temperature: 70°C / 55°C	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
thermal power	18 kW	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
heat distribution (heating)					
type	water pipes completely inside of	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
location	the thermal envelope, vertical central string control of heat	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
control temperature	distribution temperature according to outdoor air temperature	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
electric consumption pump	electric power = 80 W / running time = 18 h/d x 365 d/a	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
heating pipes (if detailed input required)					
string 1	main string /	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
pipe length	heating room 2 x 2 m	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
insulation thickness	20 mm	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
alternatively: U-value	0,20 W/(m <sup>2</sup> K) main string /	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
string 2	vertical	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
pipe length insulation thickness	2 x 6 m 20 mm	= var. 1-0 = var. 1-0	= var. 1-0 = var. 1-0	= var. 1-0 = var. 1-0	= var. 1-0 = var. 1-0
alternatively: U-value	0,20 W/(m <sup>2</sup> K)	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
string 3	distribution in rooms	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
pipe length	2 x 60 m	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
insulation thickness	-	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
alternatively: U-value	0,40 W/(m <sup>2</sup> K)	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
heat emission (heating) type	radiators	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
(Jbc	thermostatic valves	— val. 1-0	- val. 1-0	- val. 1-0	var. 1-0
control	(regulation range: 2K)	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0



variant

variant N°

variant name

variant type

short description

hot water system

heat generation

type

energy carrier

further specification

heat storage

type

location

volume

heat loss per day

heat distribution

type

location

temperature electric consumption pump

heating pipes (if detailed input required)

string 1

pipe length insulation thickness alternatively: U-value

pipe length insulation thickness alternatively: U-value

string 3

pipe length insulation thickness alternatively: U-value

ventilation system

type

specification

1-0	1-31	1-41	1-42	1-51
basis	sys-el	vent-exh	vent-rec	sys- cond/sol/rec
basis	variation heating & hot water system	variation ventilation	variation ventilation	variation heating & hot water system
low temperature boiler	electric resistance system	exhaust ventilation system	ventilation system with heat recovery	condensing boiler + solar dhw system + ventilation system with heat recovery
generator for space	combined with heat generator for space heating (see above)	= var. 1-0		combined with heat generator for space heating (see above) + additional thermal solar system
(see above)	(see above)	= var. 1-0	= var. 1-0	(see above)
(see above)	(see above)	= var. 1-0	= var. 1-0	(see above)
hot water storage	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
central heating room (attic)	= var. 1-0	= var. 1-0		= var. 1-0
120 liter	= var. 1-0	= var. 1-0	= var. 1-0	400 liter
1,75 kWh/d	= var. 1-0	= var. 1-0	= var. 1-0	2,6 kWh/d
without hot water circulation	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
completely inside of the thermal envelope, vertical central string	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
60°C	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
-	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
main string / heating room	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
2 m	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
10 mm	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
0,30 W/(m <sup>2</sup> K) main string /	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
vertical	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
6 m	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
10 mm 0,30 W/(m <sup>2</sup> K)	= var. 1-0 = var. 1-0	= var. 1-0 = var. 1-0	= var. 1-0 = var. 1-0	= var. 1-0 = var. 1-0
distribution in kitchen and in bathroom / WC	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
10 m	= var. 1-0	= var. 1-0	= var. 1-0	= var. 1-0
- 0,40 W/(m²K)	= var. 1-0 = var. 1-0	= var. 1-0 = var. 1-0	= var. 1-0 = var. 1-0	= var. 1-0 = var. 1-0
0,40 W/(III-K)	- val. I-U	- val. I-U	- val. I-U	- vdl. I-U
none	= var. 1-0	exhaust ventilation system	ventilation system with heat recovery	ventilation system with heat recovery
none	none	DC fan	heat recovery 80%, DC fan	heat recovery 80%, DC fan



# **Appendix 1d: Country sheets**

Country Germany
Region whole country

Type of requirements / method used to proof the compliance

Calculation according to the German Energy Saving Ordinance (Energieeinsparverordnung EnEV 2007) simplified method (EnEV vereinfachtes Verfahren)

calculation building: seasonal balance (according to DIN V 4108-6) calculation system: table values (according to DIN V 4701-10 Annex C)

Requirements to be complied: maximum values for thermal transmittance and primary energy demand

Requirements in force since

October 2007

#### **Resulting U-values**

			1								l
Variant N°		1-0	1-11	1-12	1-13	1-21	1-22	1-31	1-41	1-42	NEW
variant name		basis	hg-cond	hg-pellet	hg-hp	dhw-el	dhw-sol	sys-el	vent-exh	vent-rec	sys- cond/sol /rec
-values	U-value defined for temperature difference between room and										
roof	external air	0,18	0,2	0,33	0,33	0,18	0,2	-	0,18	0,33	0,33
walls	external air	0,4	0,46	0,5	0,5	0,35	0,48	-	0,35	0,5	0,5
windows	external air	1,5	1,5	1,5	1,5	1,5	1,5	-	1,5	1,5	1,5
door	external air	2,0	2,0	2,0	2,0	2,0	2,0	-	2,0	2,0	2,0
floor above soil	soil	0,35	0,35	0,5	0,5	0,3	0,35	-	0,35	0,5	0,5
estricting limit		maximum primary energy demand	maximum primary energy demand	maximum heat transfer coefficient	maximum heat transfer coefficient	maximum primary energy demand	maximum primary energy demand	-	maximum primary energy demand	maximum heat transfer coefficient	maximum heat transfer coefficient
emarks								realisation practically not possible (compliance only by inserting U- values <			

#### Mean heat transmission losses (basis for cross country comparison)

		Correction factor oss-country arison)				Simplifi	mplified heat transfer coefficient						
Element	[m²]	[-]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	
roof	82,5	1	14,9	16,5	27,2	27,2	14,9	16,5	-	14,9	27,2	27,2	
walls	133,4	1	53,4	61,4	66,7	66,7	46,7	64,0	-	46,7	66,7	66,7	
windows	26,5	1	39,8	39,8	39,8	39,8	39,8	39,8	-	39,8	39,8	39,8	
door	1,9	1	3,8	3,8	3,8	3,8	3,8	3,8	-	3,8	3,8	3,8	
floor above soil	72,3	0,6	15,2	15,2	21,7	21,7	13,0	15,2	-	15,2	21,7	21,7	
sum	317		127	137	159	159	118	139	0	120	159	159	
Mean heat transmis	ssion												
losses per m <sup>2</sup> envel	lope		0,40	0,43	0,50	0,50	0,37	0,44	-	0,38	0,50	0,50	

(basis: external dimensions, not considering thermal bridges)

Country
Region Austria whole country

Type of requirements / method used to proof the compliance

In Austria the relevant regulation is the net energy demand for heating per  $m^2$  depending on the proportion of building volume to building survace (lc = V/A). The requirements are regulated in the OIB directive 6 "Energieeinsparung und Wärmeschutz" from April 2007 and are calculated with a reference climate with 3.400 degree days. The calculation method is defined in the Austrian Standard ÖNORM B 8110-6, which is based on the ISO EN 13790. Main estimations, which were not provided: "heavy construction" (brick or concrete) and air exchange rate 0,4/h with window ventilation. The heating system has no influence on the U-Values. The current requirement (until 31.12.2009): HWB = 26 \* (1 + 2/lc).

The data of the model building: Ic = 1,69m;  $HWB < 56,76 \text{ kWh/m}^2a$ .

Requirements in force since

April 2007

#### **Resulting U-values**

Variant N°		1-0	1-11	1-12	1-13	1-21	1-22	1-31	1-41	1-42	NEW
variant name		basis	hg-cond	hg-pellet	hg-hp	dhw-el	dhw-sol	sys-el	vent-exh	vent-rec	sys- cond/sol /rec
J-values	U-value defined for temperature difference between room and										
roof	external air	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2
walls	external air	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35
windows	external air	1,4	1,4	1,4	1,4	1,4	1,4	1,4	1,4	1,4	1,4
door	external air	1,7	1,7	1,7	1,7	1,7	1,7	1,7	1,7	1,7	1,7
floor above soil	soil	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4
Restricting limit		net energy demand for heating									
emarks											

#### Mean heat transmission losses (basis for cross country comparison)

	Element area (external dimensions)	Correction factor				Simplifi	ied heat tr	ansfer coe	efficient					
	(only for cre compa													
Element	[m²]	[-]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]		
roof	82,5	1	16,5	16,5	16,5	16,5	16,5	16,5	16,5	16,5	16,5	16,5		
walls	133,4	1	46,7	46,7	46,7	46,7	46,7	46,7	46,7	46,7	46,7	46,7		
windows	26,5	1	37,1	37,1	37,1	37,1	37,1	37,1	37,1	37,1	37,1	37,1		
door	1,9	1	3,2	3,2	3,2	3,2	3,2	3,2	3,2	3,2	3,2	3,2		
floor above soil	72,3	0,6	17,4	17,4	17,4	17,4	17,4	17,4	17,4	17,4	17,4	17,4		
sum	317		121	121	121	121	121	121	121	121	121	121		
Mean heat transmi	ssion													
losses per m <sup>2</sup> enve	lope		0,38	0,38	0,38	0,38	0,38	0,38	0,38	0,38	0,38	0,38		

(basis: external dimensions, not considering thermal bridges)

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Country
Region
Czech Republic
whole country

Type of requirements / method used to proof the compliance

Calculation method according to the requirements of the Act no. 406/2000 Coll. on Energy Management, its amendment no. 177/2006 Coll. as amended by no. 406/2006 Coll. and the Code of Practice no. 148/2007 Coll. on Energy Demand of Buildings as amended. A specific technical regulation in this field is the Czech standard ČSN 73 0540 "Thermal Protection of Buildings" (and a set of relevant standards), which the abovementioned statutes are related to and make its requirements binding. Valid requirements for U values are set forth in the second part of the standard i.e. in ČSN 73 0540-2 as of April 2007. Two groups of U values are prescribed: recommended values and required values. Required U-values were used in this table.

Requirements in force since

April 2007

#### **Resulting U-values**

Variant N°		1-0	1-11	1-12	1-13	1-21	1-22	1-31	1-41	1-42	NEW
variant name		basis	hg-cond	hg-pellet	hg-hp	dhw-el	dhw-sol	sys-el	vent-exh	vent-rec	sys- cond/sol /rec
U-values	U-value defined for temperature difference between room and										
roof	external air	0,24	0,24	0,24	0,24	0,24	0,24	0,24	0,24	0,24	0,24
walls	external air	0,38	0,38	0,38	0,38	0,38	0,38	0,38	0,38	0,38	0,38
windows	external air	1,7	1,7	1,7	1,7	1,7	1,7	1,7	1,7	1,7	1,7
door	external air	3,5	3,5	3,5	3,5	3,5	3,5	3,5	3,5	3,5	3,5
floor above soil	soil	0,45	0,45	0,45	0,45	0,45	0,45	0,45	0,45	0,45	0,45
Restricting limit		U-values	U-values	U-values	U-values	U-values	U-values	U-values	U-values	U-values	U-values
emarks											

#### Mean heat transmission losses (basis for cross country comparison)

not considering thermal bridges)

	Element area (external dimensions) (only for cr compa	Correction factor oss-country arison)				Simplifi	ed heat tr	ansfer coe	efficient			
Element	[m²]	[-]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]
roof	82,5	1	19,8	19,8	19,8	19,8	19,8	19,8	19,8	19,8	19,8	19,8
walls	133,4	1	50,7	50,7	50,7	50,7	50,7	50,7	50,7	50,7	50,7	50,7
windows	26,5	1	45,1	45,1	45,1	45,1	45,1	45,1	45,1	45,1	45,1	45,1
door	1,9	1	6,7	6,7	6,7	6,7	6,7	6,7	6,7	6,7	6,7	6,7
floor above soil	72,3	0,6	19,5	19,5	19,5	19,5	19,5	19,5	19,5	19,5	19,5	19,5
sum	317		142	142	142	142	142	142	142	142	142	142
Mean heat transmis	ssion											
losses per m <sup>2</sup> enve	lope		0,45	0,45	0,45	0,45	0,45	0,45	0,45	0,45	0,45	0,45

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CountryPolandRegionwhole country

Type of requirements / method used to proof the compliance

Values defined in "Technical conditions to be fulfilled by new and modernised buildings". There are no differences in required U values for different types of heating, but there are differences between rooms with different internal temperature. Ex. different type of living rooms that computational temperature is over 16 C, for other room (like halls, staircases, cellars) it is between 8 an 16 C.

Requirements in force since

October 2002

#### **Resulting U-values**

## Mean heat transmission losses (basis for cross country comparison)

	Element area (external dimensions) (only for cro					Simplifi	ied heat tr	ansfer coe	efficient			
Element	[m²]	[-]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]
roof	82,5	1	24,8	24,8	24,8	24,8	24,8	24,8	24,8	24,8	24,8	24,8
walls	133,4	1	40,0	40,0	40,0	40,0	40,0	40,0	40,0	40,0	40,0	40,0
windows	26,5	1	53,0	53,0	53,0	53,0	53,0	53,0	53,0	53,0	53,0	53,0
door	1,9	1	4,9	4,9	4,9	4,9	4,9	4,9	4,9	4,9	4,9	4,9
floor above soil	72,3	0,6	26,0	26,0	26,0	26,0	26,0	26,0	26,0	26,0	26,0	26,0
sum	317		149	149	149	149	149	149	149	149	149	149
Mean heat transmis	ssion											
losses per m <sup>2</sup> envel	lope		0,47	0,47	0,47	0,47	0,47	0,47	0,47	0,47	0,47	0,47

(basis: external dimensions, not considering thermal bridges)

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Country
Region Sweden
Lund

Type of requirements / method used to proof the compliance

From the Swedish regulation for building (Regelsamling för byggande - Boverkets byggregler, BBR, 2006)

Requirements for housing

Maximum specific energy consumption 110 kWh/m2 floor area (internal) in south Sweden, 130 kWh/m2 floor area (internal) in north Sweden. Household electricity is not included in the specific energy consumption.

For one ore two family houses with direct-acting electric heating system is the requirement for maximum specific energy consumption 75 kWh/m2 floor area (internal) in south Sweden, 95 kWh/m2 floor area (internal) in north Sweden. Household electricity is not included in the specific energy consumption.

Maximum Um for the total building 0,50 W/m2K Minimum ventilation 0,35 l/s m2

Requirements in force since

2006

#### **Resulting U-values**

			ı								
Variant N°		1-0	1-11	1-12	1-13	1-21	1-22	1-31	1-41	1-42	NEW
variant name		basis	hg-cond	hg-pellet	hg-hp	dhw-el	dhw-sol	sys-el	vent-exh	vent-rec	sys- cond/sol /rec
U-values	U-value defined for temperature difference between room and										
roof	external air	0,16	0,16	0,16	0,3	0,03	0,3	0,03	0,3	0,3	0,3
walls	external air	0,21	0,21	0,21	0,34	0,04	0,34	0,04	0,34	0,34	0,34
windows	external air	1,2	1,2	1,2	1,5	0,8	1,5	0,8	1,5	1,5	1,5
door	external air	1,1	1,1	1,1	2,0	0,8	2,0	0,8	2,0	2,0	2,0
floor above soil	soil	0,16	0,16	0,16	0,47	0,01	0,27	0,01	0,47	0,47	0,47
Restricting limit		Maximum specific energy consumption 110 kWh/m2 floor area			Maximum Um for the total building 0,50 W/m2K		Maximum specific energy consumption 110 kWh/m2 floor area	Electric heating system with maximum specific energy consumption requirement 75 kWh/m2 floor area	Maximum Um for the total building 0,50 W/m2K	for the total	for the total
Remarks		calculated energy consumption for the building 110 kWh/m2. With exhaust ventilation system	Same as 1-0	Same as 1-0	calculated energy consumption for the building 78 kWh/m2. heat pump	Same as 1- 31	Solar energy is "free" energy. Calculated energy consumption for the building 107 kWh/m2,. With exhaust ventilation system	for the building 76 kWh/m2.		for the building 108 kWh/m2.	

#### Mean heat transmission losses (basis for cross country comparison)

not considering thermal bridges)

	Element area (external dimensions)	Correction factor				Simplifi	ed heat tr	ansfer coe	efficient			
	(only for cre compa											
Element	[m²]	[-]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]
roof	82,5	1	13,2	13,2	13,2	24,8	2,5	24,8	2,5	24,8	24,8	24,8
walls	133,4	1	28,0	28,0	28,0	45,4	5,3	45,4	5,3	45,4	45,4	45,4
windows	26,5	1	31,8	31,8	31,8	39,8	21,2	39,8	21,2	39,8	39,8	39,8
door	1,9	1	2,1	2,1	2,1	3,8	1,5	3,8	1,5	3,8	3,8	3,8
floor above soil	72,3	0,6	6,9	6,9	6,9	20,4	0,4	11,7	0,4	20,4	20,4	20,4
sum	317		82	82	82	134	31	125	31	134	134	134
lean heat transmi	ssion											
osses per m <sup>2</sup> enve	lope		0,26	0,26	0,26	0,42	0,10	0,40	0,10	0,42	0,42	0,42

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Country Denmark Region whole country

Type of requirements / method used to proof the compliance

Monthly calculation according to the SBi direction 213, Calculation of buildings energy demand.
- heating demand is based on prEN ISO 13790:2005, which elaborates on EN 832 and EN ISO 13790.

- heat loss from installations is calculated as defined in prEN 15316 part 2.3 og part 3.2.
- boilers is calculated according to prEN 15316 part 4.1 methode II and part 3.3.
- calculation tool: Be06, version 2,7,5,3

Requirements to be complied: maximum primary energy demand, maximum values for overall thermal transmittance and maximum U-values for constructions.

This new building must have an energy consumption less than 70+2200/A, having a dimensioning transmission loss less than 8 W/m² through the thermal envelope or meet maximum U-values for the constructions.

Requirements in force since

January 2006

#### **Resulting U-values**

'ariant N°		1-0	1-11	1-12	1-13	1-21	1-22	1-31	1-41	1-42	NEW
variant name		basis	hg-cond	hg-pellet	hg-hp	dhw-el	dhw-sol	sys-el	vent-exh	vent-rec	sys- cond/sol /rec
J-values	U-value defined for temperature difference between room and										
roof	external air	-	0,25	0,25	0,25	0,25	0,25	0,15	0,25	0,25	0,25
walls	external air	-	0,28	0,28	0,28	0,28	0,28	0,18	0,28	0,28	0,28
windows	external air	-	1,51	1,51	1,51	1,51	1,51	1,51	1,51	1,51	1,51
door	external air	-	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5
floor above soil	soil	-	0,3	0,3	0,3	0,2	0,3	0,17	0,3	0,3	0,3
_											
estricting limit		-	transmission	overall dimensioning transmission loss (8 W/m² thermal envelope)	transmission	maximum primary energy demand	overall dimensioning transmission loss (8 W/m² thermal envelope)	maximum primary energy demand	transmission	overall dimensioning transmission loss (8 W/m <sup>2</sup> thermal envelope)	
emarks		Non- condensing gas boiler is illegal in Denmark, variation 1- 11 is thus used as base case for the other calculations.	Overall dimensioning transmission loss ≤ 8.0 W/m²K, incl. thermal bridges	Estimated efficiency of pellet burner is 80 % for full and part load.			Fulfills the requirement for Low Energy class 2, which is approx. 25 % better than minimum Building Regulation requirement.		Exhaust ventilation air flow of 50 l/s (2 toilets and 1 kitchen) and infiltration of 0,13 l/s m².	efficiency 65%. Same ventilation rate as	Fulfills the requirement for Low Energy class 2, which is approx. 25 % better than minimum Building Regulation requirement.

#### Mean heat transmission losses (basis for cross country comparison)

not considering thermal bridges)

	Element area (external dimensions)	Correction factor				Simplifi	ied heat tr	ansfer coe	efficient			
	(only for cro compa											
Element	[m²]	[-]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]
roof	82,5	1	-	20,6	20,6	20,6	20,6	20,6	12,4	20,6	20,6	20,6
walls	133,4	1	-	37,4	37,4	37,4	37,4	37,4	24,0	37,4	37,4	37,4
windows	26,5	1	-	40,0	40,0	40,0	40,0	40,0	40,0	40,0	40,0	40,0
door	1,9	1	-	2,9	2,9	2,9	2,9	2,9	2,9	2,9	2,9	2,9
floor above soil	72,3	0,6	-	13,0	13,0	13,0	8,7	13,0	7,4	13,0	13,0	13,0
sum	317		0	114	114	114	110	114	87	114	114	114
Mean heat transmis	ssion											
losses per m <sup>2</sup> enve	lope		_	0,36	0,36	0,36	0,35	0,36	0,27	0,36	0,36	0,36

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Country UK
Region England & Wales

Type of requirements / method used to proof the compliance

SAP 2005 (www.bre.co.uk/sap2005) Seasonal energy balance

Requirements to be complied with: maximum CO2 emissions, maximum U-values, minimum heating efficiency

Requirements in force since

2005

#### Resulting U-values

			I								
/ariant N° variant name		1-0	1-11	1-12	1-13	1-21	1-22	1-31	1-41	1-42	NEW sys-
		basis	ng-cona	hg-pellet	hg-hp	dhw-el	dhw-sol	sys-el	vent-exn	vent-rec	cond/sol /rec
J-values	U-value defined for temperature difference between room and										
roof	external air	-	0,16	0,25	0,25	0,16	0,25	0,16	0,2	0,25	0,25
walls	external air	-	0,33	0,35	0,35	0,22	0,35	0,21	0,35	0,35	0,35
windows	external air	-	1,8	2,2	2,2	1,5	2,2	1,5	1,8	2,2	2,2
door	external air	-	2,0	2,2	2,2	0,8	2,2	2,0	2,0	2,2	2,2
floor above soil	external air	-	0,22	0,25	0,25	0,2	0,25	0,2	0,23	0,25	0,25
Restricting limit			maximum CO2 emissions	maximum U- values of elements	maximum U- values of elements	maximum CO2 emissions	maximum U- values of elements (although only small margin left on CO2 emissions)	maximum CO2 emissions	maximum CO2 emissions	maximum U- values of elements	maximum U- values of elements
emarks		not possible - minimum boiler efficiency is 86% (condensing)				condensing boiler; improved thermal bridging	condensing boiler	improved thermal bridging	condensing boiler	condensing boiler	condensing boiler

## Mean heat transmission losses (basis for cross country comparison)

not considering thermal bridges)

	Element area (external dimensions) (only for cro					Simplifi	ed heat tr	ansfer coe	fficient				
Element	[m²]	[-]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	
roof	82,5	1		13,2	20,6	20,6	13,2	20,6	13,2	16,5	20,6	20,6	1
walls	133,4	1	-	44,0	46,7	46,7	29,3	46,7	28,0	46,7	46,7	46,7	1
windows	26,5	1	-	47,7	58,3	58,3	39,8	58,3	39,8	47,7	58,3	58,3	
door	1,9	1	-	3,8	4,2	4,2	1,5	4,2	3,8	3,8	4,2	4,2	1
floor above soil	72,3	1	-	15,9	18,1	18,1	14,5	18,1	14,5	16,6	18,1	18,1	]
sum	317		0	125	148	148	98	148	99	131	148	148	
Mean heat transmis	sion												
losses per m <sup>2</sup> envel	ope		-	0,39	0,47	0,47	0,31	0,47	0,31	0,41	0,47	0,47	[W/(m²

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Country
Region
The Netherlands
whole country

Type of requirements / method used to proof the compliance

Energy use calculations for the heating season (October 1 - April 30) according to (for building as well as system):

\* Dutch Standard NEN 5128: Energy performance of residential functions and residential buildings - Determination method (NNI, March 2004).

\* Dutch Guideline NPR 5129: Energy performance of residential functions and residential buildings - Calculation program (EPW) with handbook (NNI, April 2005).

\* EPW for Windows Version 2.02 (NNI, 2006)

Requirements to be met:

- \* EPC <= 0,8 (EPC = Energy Performance Coefficient, based on primary energy demand), and
- \* Minimum Rc values (heat resistance) for thermal envelope

Requirements in force since

2006 (EPC  $\leq$  0,8), 1992 (Rc  $\geq$  2,5 W/(m<sup>2</sup>K))

#### **Resulting U-values**

ariant N°		1-0	1-11	1-12	1-13	1-21	1-22	1-31	1-41	1-42	NEW
variant name		basis	hg-cond	hg-pellet	hg-hp	dhw-el	dhw-sol	sys-el	vent-exh	vent-rec	sys- cond/sol /rec
-values	U-value defined for temperature difference between room and										
roof	external air	-	-	-	0,24	-	-	-	-	-	0,24
walls	external air	-	-	-	0,24	-	-	-	-	-	0,27
windows	external air	-	-	-	1,3	-	-	-	-	-	1,8
loor	external air	-	-	-	2,0	-	-	-	-	-	2,0
loor above soil	soil	-	-	-	0,23	-	-	-	-	-	0,23
stricting limit		-	-	-	EPC<=0,80	-	-	-	-	-	EPC<=0,80
marks		to meet EPC<=0,8. The effect of low	Not possible to meet EPC<=0,8. The effect of low performance	Wood pellet boiler is no option in Dutch calculation software		to meet EPC<=0,8. The effect of low	Not possible to meet EPC<=0,8. The effect of low performance	to meet EPC<=0,8. The effect of low	Not possible to meet EPC<=0,8. The effect of low performance	to meet EPC<=0,8. The effect of low	boiler (97,5%) radiators mech. Ventilation +
		of heating and ventilation system can not be	of heating and ventilation system can not be	(except for complicated procedure using 'declaration		of heating and ventilation system can not be	of heating and ventilation system can not be	of heating and ventilation system can not be	of heating and ventilation system can not be	of heating and ventilation system can not be	heat recovery (80%) solar collector (2,7
			compensated by improved U-values.	of quality'). Wood pellet boiler not used as primary heat generator in new					compensated by improved U-values.		m2)

#### Mean heat transmission losses (basis for cross country comparison)

	Element area (external dimensions) (only for cr compa	Correction factor oss-country arison)				Simplifi	ed heat tr	ansfer coe	efficient			
Element	[m²]	[-]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]
roof	82,5	1	-	-	-	19,8	-	-	-	-	-	19,8
walls	133,4	1	-	-	-	32,0	-	-	-	-	-	36,0
windows	26,5	1	-	-	-	34,5	-	-	-	-	-	47,7
door	1,9	1	-	-	-	3,8	-	-	-	-	-	3,8
floor above soil	72,3	0,6	-	-	-	10,0	-	-	-	-	-	10,0
sum	317		0	0	0	100	0	0	0	0	0	117
lean heat transmis osses per m² envel			_	_	_	0,32	_	_	<b>-</b>	_	_	0,37

(basis: external dimensions, not considering thermal bridges)

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CountryBelgiumRegionFlanders

Type of requirements / method used to proof the compliance

Method described in the decree of the 5th of march 2005. Three requirements are imposed: one limits the annual characteristic primary energy use, a second one limits the average thermal transmitance, and a third one gives the maximal values of the thermal transmittance.

Requirements in force since

2005

#### **Resulting U-values**

'ariant N°		1-0	1-11	1-12	1-13	1-21	1-22	1-31	1-41	1-42	NEW
variant name		basis	hg-cond	hg-pellet	hg-hp	dhw-el	dhw-sol	sys-el	vent-exh	vent-rec	sys- cond/sol /rec
-values	U-value defined for temperature difference between room and										
roof	external air	0,19	0,4	0,09	0,4	0,11	0,31	-	0,19	0,21	0,46
walls	external air	0,19	0,39	0,09	0,47	0,11	0,31	-	0,19	0,21	0,45
windows	external air	1,76	1,76	1,76	1,76	1,76	1,76	-	1,76	1,76	1,76
door	external air	2,9	2,9	2,9	2,9	2,9	2,9	-	2,9	2,9	2,9
floor above soil	external air	0,35	0,35	0,35	0,4	0,35	0,35	-	0,35	0,35	0,35
stricting limit		Primary energy consumption	Primary energy consumption	Primary energy consumption	Average thermal transmitance	Primary energy consumption	Primary energy consumption	Primary energy consumption	Primary energy consumption	Primary energy consumption	Average thermal transmitance
narks		in addition: exhaust air ventilation system (mandatory)	It is not possible to use this system and fullfil requirements , even with a zero average thermal	This variant is the same as variant 1-0							

#### Mean heat transmission losses (basis for cross country comparison)

		Correction factor oss-country arison)	Simplified heat transfer coefficient												
Element	[m²]	[-]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]			
roof	82,5	1	15,7	33,0	7,4	33,0	9,1	25,6	-	15,7	17,3	38,0			
walls	133,4	1	25,3	52,0	12,0	62,7	14,7	41,4	-	25,3	28,0	60,0			
windows	26,5	1	46,6	46,6	46,6	46,6	46,6	46,6	-	46,6	46,6	46,6			
door	1,9	1	5,5	5,5	5,5	5,5	5,5	5,5	-	5,5	5,5	5,5			
floor above soil	72,3	1	25,3	25,3	25,3	28,9	25,3	25,3	-	25,3	25,3	25,3			
sum	317		118	162	97	177	101	144	0	118	123	175			
Mean heat transmis	ssion														
osses per m <sup>2</sup> enve	lope		0,37	0,51	0,31	0,56	0,32	0,46	_	0,37	0,39	0,55			

(basis: external dimensions, not considering thermal bridges)

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Country
Region
Luxembourg
whole country

Type of requirements / method used to proof the compliance

The calculation has been done according to the Luxembourg "Règlement grand-ducal" (short: RGD) from 30.11.2007 (LuxEeB).

The RDG gives minimum requirements for U-Values, air-tightness, thermal bridges, summer requirements, insulation of pipes for heat transfer / hot water transfer and specific fan power for ventilation. Additionally there are main requirements for the heating and primary energy consumption.

Requirements in force since

2008

#### **Resulting U-values**

Variant name         basis         hg-cond         hg-pellet         hg-hp         dhw-el         dhw-sol         sys-el         vent-exh         vent-rec         cond/sol /rec           U-values         U-value defined for temperature difference between room and         vent-exh         v	/ariant N°											
U-values			1-0	1-11	1-12	1-13	1-21	1-22	1-31	1-41	1-42	
Toof   external air   0,2   0,21   0,21   0,21   0,15   0,21   - 0,21   0,25	variant name		basis	hg-cond	hg-pellet	hg-hp	dhw-el	dhw-sol	sys-el	vent-exh	vent-rec	cond/sol
walls	J-values	temperature difference										
windows   external air   1,35   1,35   1,35   1,35   1,5	roof	external air	0,2	0,21	0,21	0,21	0,15	0,21	-	0,21	0,25	0,25
external air 1,5 1,5 1,5 1,5 1,5 1,5 1,5 1,5 2,0 2,0 1  external air 0,3 0,3 0,3 0,3 0,3 0,25 0,3 - 0,3 0,35 0,4 1  Restricting limit maximum primery energy demand maximum heat energy energy energy demand maximum heat energy energy energy demand maximum heat energy energy energy energy energy demand maximum heat energy ene	walls	external air	0,24	0,25	0,25	0,25	0,19	0,25	-	0,26	0,32	0,32
floor above soil  external air  O,3 O,3 O,3 O,3 O,3 O,3 O,3 O,25 O,3	windows	external air	1,35	1,35	1,35	1,35	1,2	1,35	-	1,5	1,5	1,5
Restricting limit    maximum primery energy demand   maximum heat energy demand   maximum primery energy demand   maximum heat energy energy demand   maximum primery energy energy demand   maximum primery energy	door	external air	1,5	1,5	1,5	1,5	1,5	1,5	-	1,5	2,0	2,0
primery energy demand d	floor above soil	external air	0,3	0,3	0,3	0,3	0,25	0,3	-	0,3	0,35	0,4
primery energy demand d												
not possible, only with U- Values <	estricting limit		primery energy	heat energy	heat energy	heat energy	primery energy	heat energy	primery energy	primery energy	heat transfer	
	emarks								not possible, only with U- Values <			

#### Mean heat transmission losses (basis for cross country comparison)

not considering thermal bridges)

	(external dimensions)	Correction factor				Simplifi	ied heat tr	ansfer coe	efficient			
	compa											
Element	[m²]	[-]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]
roof	82,5	1	16,5	17,3	17,3	17,3	12,4	17,3	-	17,3	20,6	20,6
walls	133,4	1	32,0	33,4	33,4	33,4	25,3	33,4	-	34,7	42,7	42,7
windows	26,5	1	35,8	35,8	35,8	35,8	31,8	35,8	-	39,8	39,8	39,8
door	1,9	1	2,9	2,9	2,9	2,9	2,9	2,9	-	2,9	3,8	3,8
floor above soil	72,3	1	21,7	21,7	21,7	21,7	18,1	21,7	-	21,7	25,3	28,9
sum	317		109	111	111	111	90	111	0	116	132	136
Mean heat transmis	ssion											
osses per m <sup>2</sup> enve	lope		0,34	0,35	0,35	0,35	0,29	0,35	-	0,37	0,42	0,43

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Country
Region France
Alsace (H1b)

Type of requirements / method used to proof the compliance

The used method is based on several steps:1) use the "reference" U values of each building fabric component to calculate the building overall Uvalue Ubat 2) make sure the result is lower than  $1,2 \times$  the "refrence" Ubat 3) calculate the project consumption (C in kWh/m2 primary energy) and the reference consumption Cref 4) Check compliance in having C < Cref and C < Cepmax which is an absolute figure depending only on the energy and the location 5) depending on the result, iterate by modifying some Uvalues to comply with the "lowest" effort.

Requirements in force since

September 2006

#### **Resulting U-values**

/ariant N°		1-0	1-11	1-12	1-13	1-21	1-22	1-31	1-41	1-42	NEW
variant name		basis	hg-cond	hg-pellet	hg-hp	dhw-el	dhw-sol	sys-el	vent-exh	vent-rec	sys- cond/sol /rec
-values	U-value defined for temperature difference between room and										
roof	external air	0,2	0,3	0,2	0,3	0,2	0,2	0,2	0,2	0,2	0,3
walls	external air	0,36	0,45	0,36	0,45	0,2	0,36	0,36	0,36	0,36	0,45
vindows	external air	1,8	1,8	1,8	2,1	1,8	1,8	1,8	1,8	1,8	2,1
door	external air	1,5	1,5	1,5	1,5	1,3	1,5	1,5	1,5	1,5	1,5
floor above soil	external air	0,27	0,3	0,27	0,3	0,2	0,27	0,27	0,27	0,27	0,3
marks						with special treatment of thermal bridges in the case of interior insulation					

## Mean heat transmission losses (basis for cross country comparison)

not considering thermal bridges)

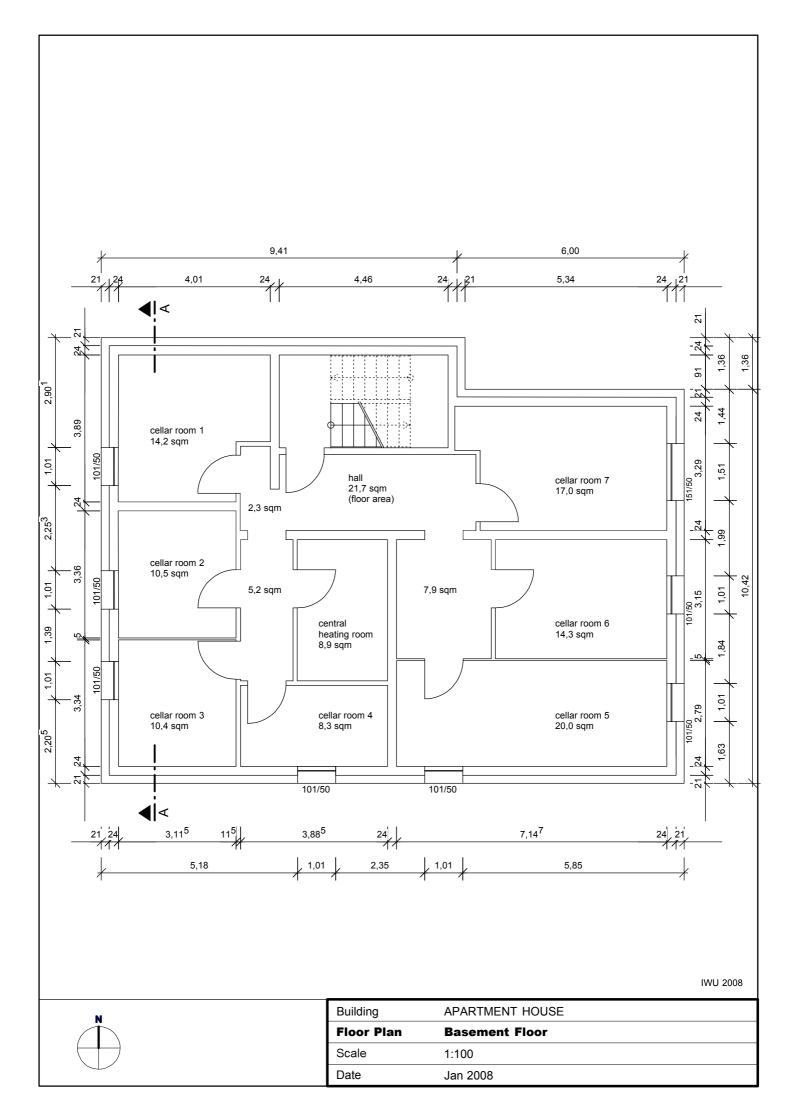
	Element area (external dimensions) (only for cr	Correction factor oss-country arison)				Simplifi	ied heat tr	ansfer coe	efficient			
Element	[m²]	[-]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]
roof	82,5	1	16,5	24,8	16,5	24,8	16,5	16,5	16,5	16,5	16,5	24,8
walls	133,4	1	48,0	60,0	48,0	60,0	26,7	48,0	48,0	48,0	48,0	60,0
windows	26,5	1	47,7	47,7	47,7	55,7	47,7	47,7	47,7	47,7	47,7	55,7
door	1,9	1	2,9	2,9	2,9	2,9	2,5	2,9	2,9	2,9	2,9	2,9
floor above soil	72,3	1	19,5	21,7	19,5	21,7	14,5	19,5	19,5	19,5	19,5	21,7
sum	317		135	157	135	165	108	135	135	135	135	165
Mean heat transmis	ssion											
osses per m² envelope		0,43	0,50	0,43	0,52	0,34	0,43	0,43	0,43	0,43	0,52	

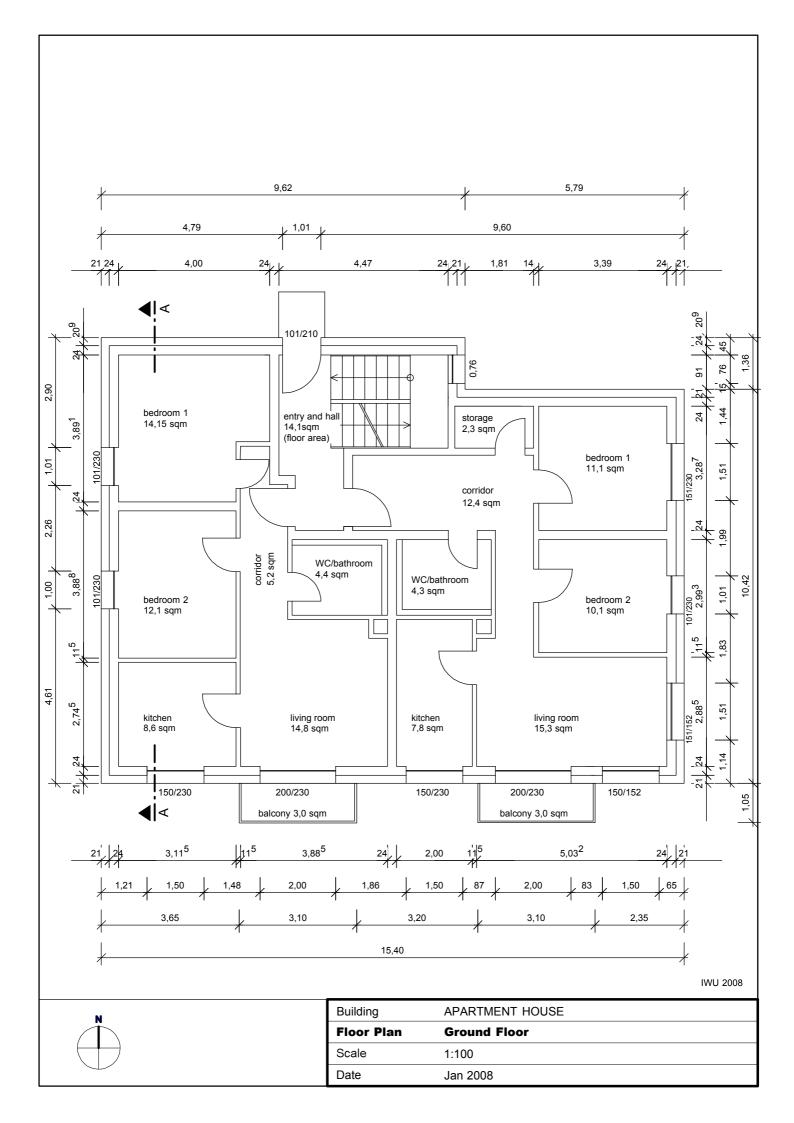
[building 1 - results.xls]fr 03.12.2008 16:36

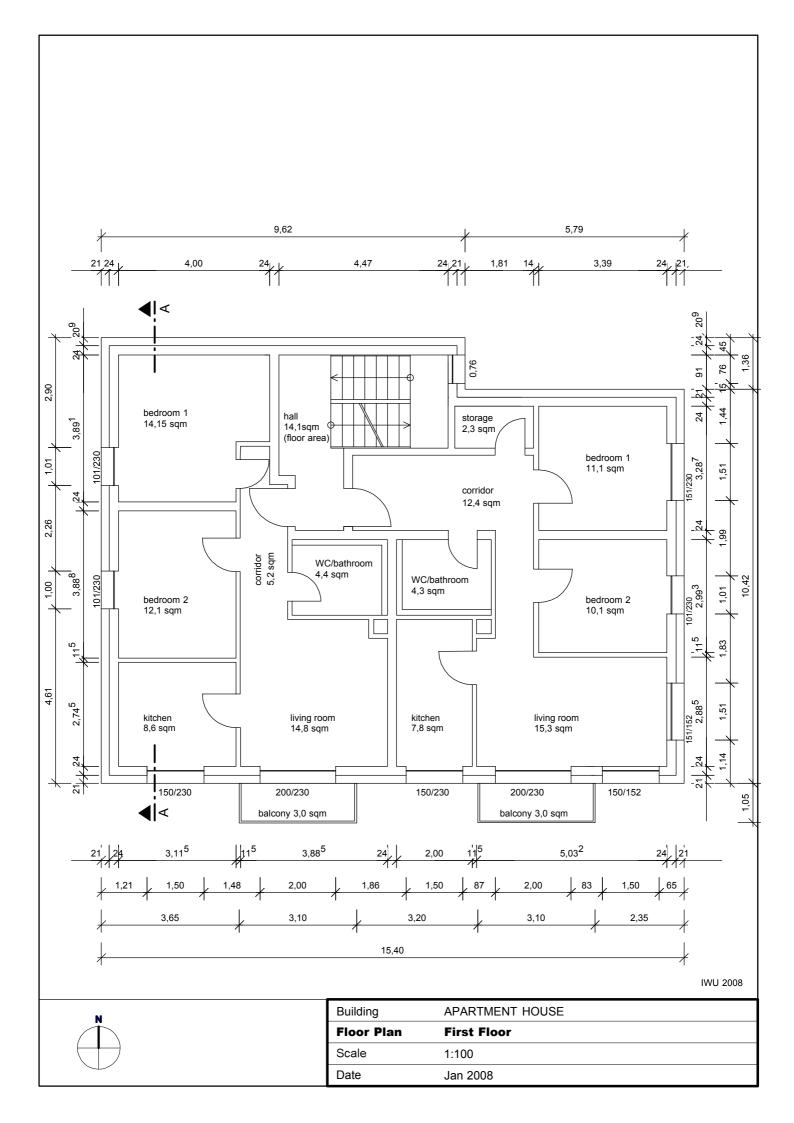


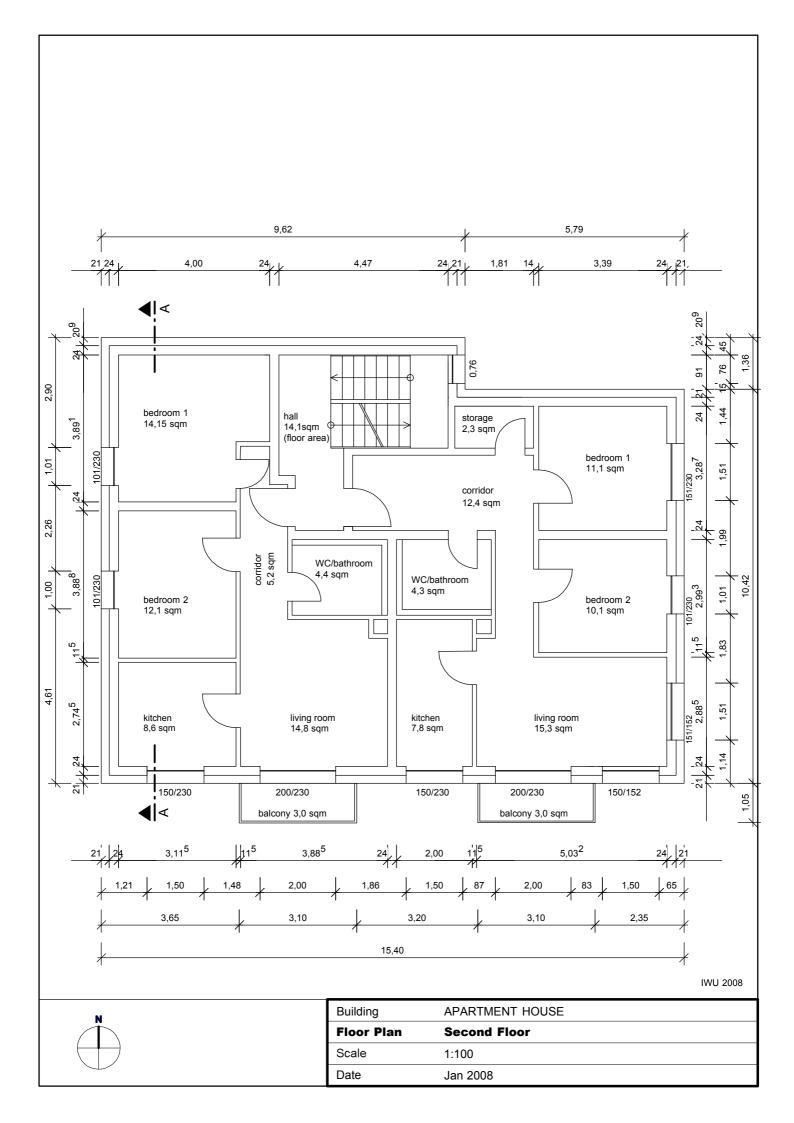
# Appendix 2: Definition of Model Building 2 – multi-family house

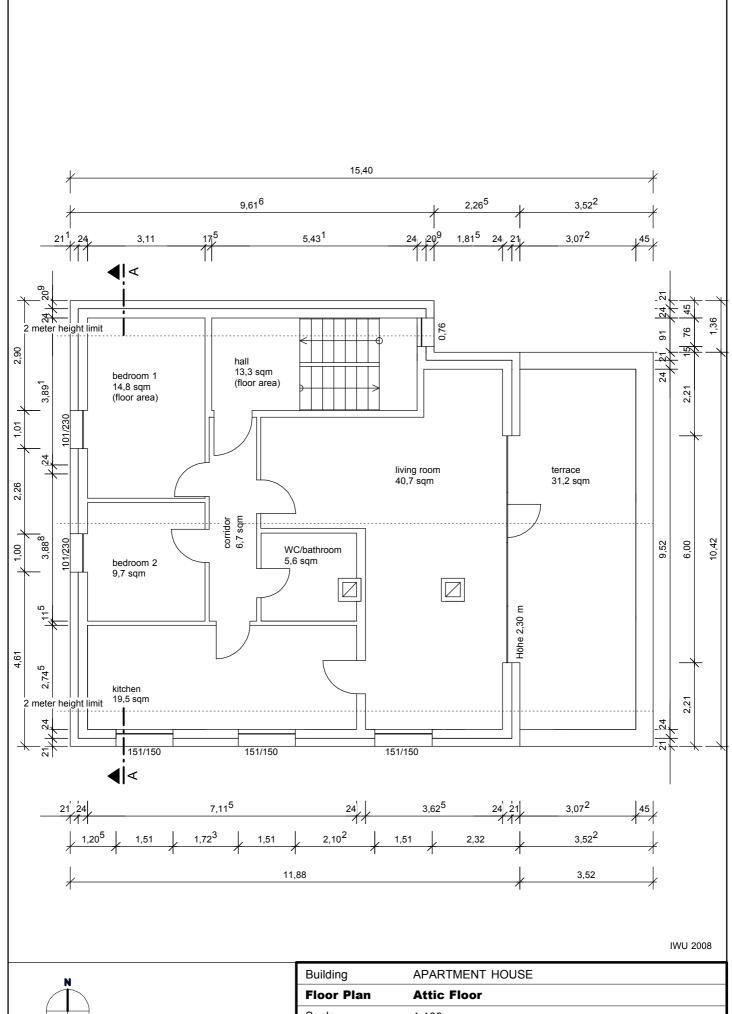
**Appendix 2a: Plans** 





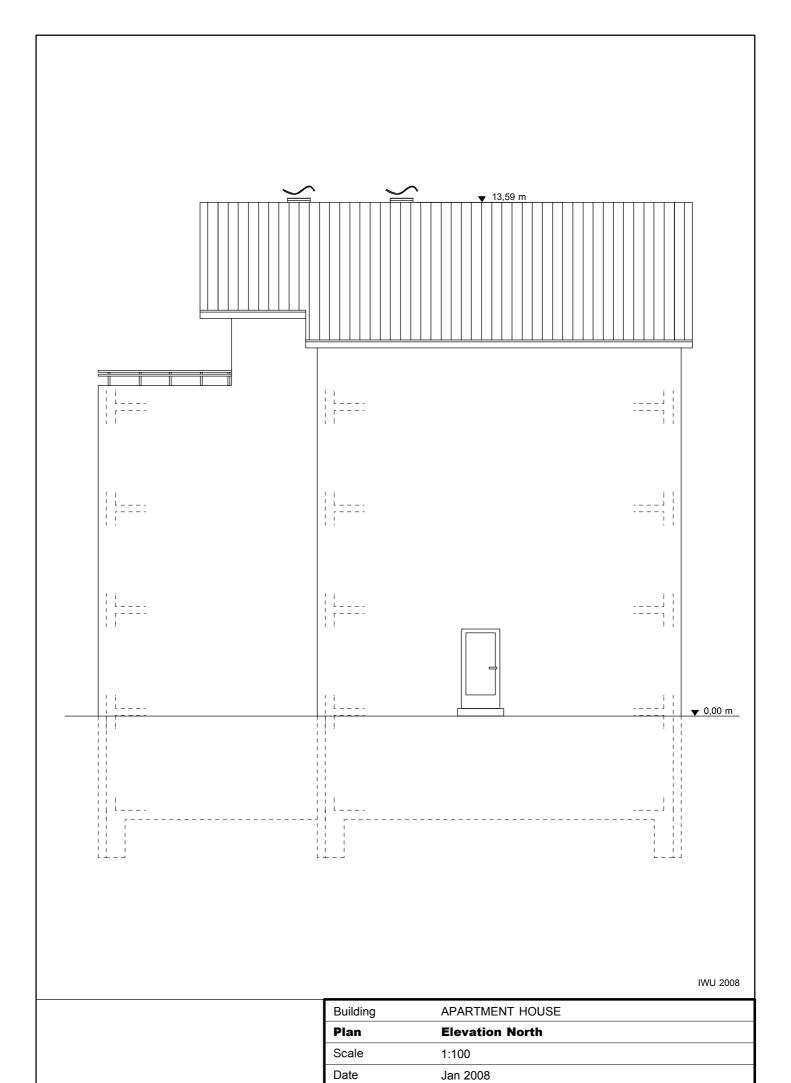


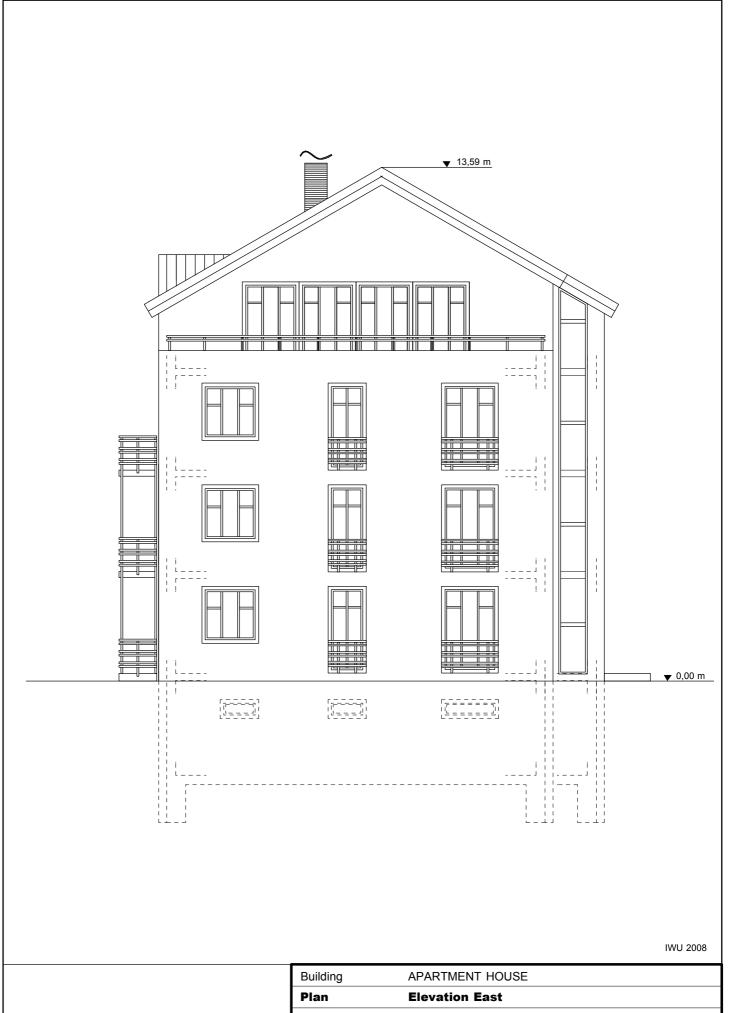






Building	APARTMENT HOUSE
Floor Plan	Attic Floor
Scale	1:100
Date	Jan 2008

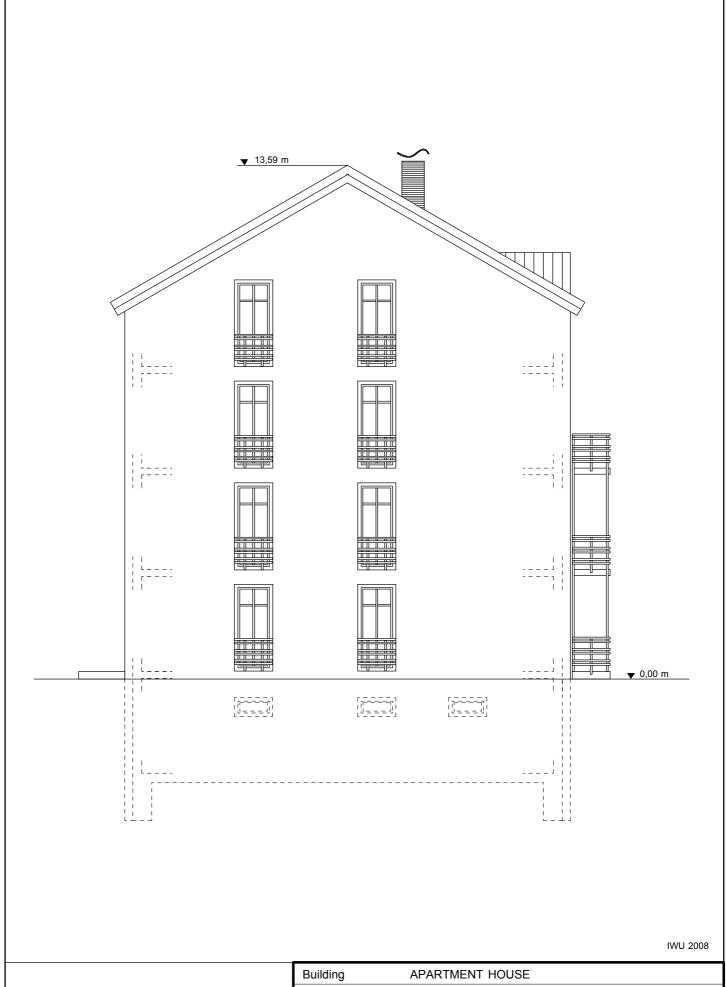




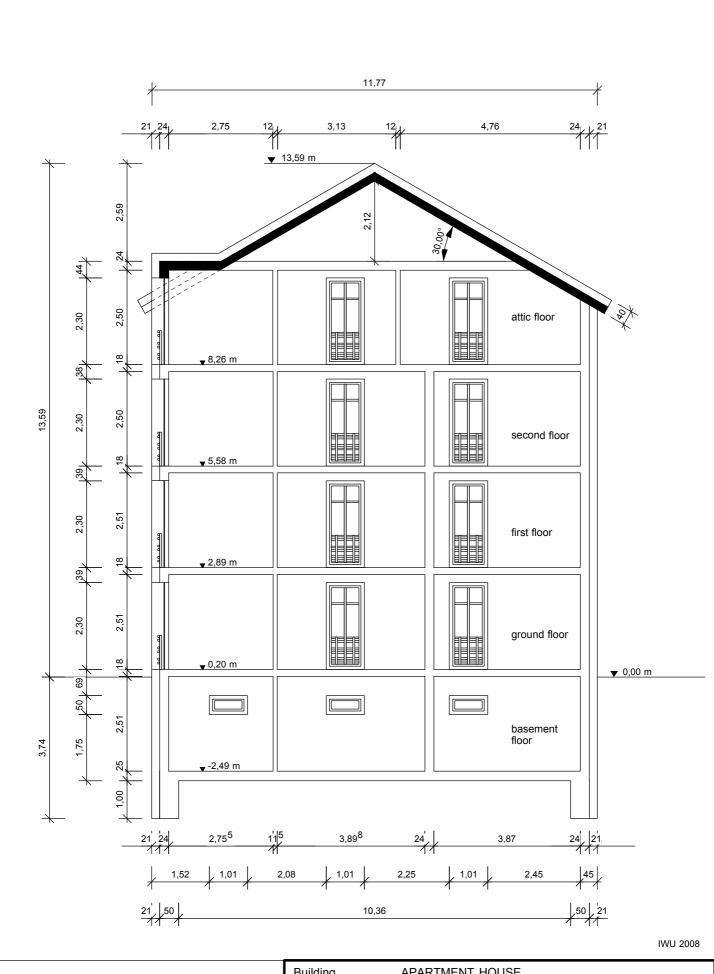
Building	APARTMENT HOUSE
Plan	Elevation East
Scale	1:100
Date	Jan 2008



Building	APARTMENT HOUSE
Plan	Elevation South
Scale	1:100
Date	Jan 2008



Building	APARTMENT HOUSE
Floor Plan	Elevation West
Scale	1:100
Date	Jan 2008



Building	APARTMENT HOUSE
Plan	Section A - A
Scale	1:100
Date	Jan 2008



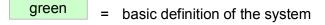
# Appendix 2b: Detailed envelope area calculation (external dimensions)

	name area element (free)	further specification / location	dedicated envelope area type	dedicated orientation for windows	reductio n area: insert "R"	width	length	height	number (if <> 1)	addition al area	gross surface area	net surface area	specific loss
						[m]	[m]	[m]		[m²]	[m²]	[m²]	[W/K]
1.	cellar ceiling		floor to cellar			10,42	15,40			13,083	173,6	158,2	0,0
2.	staircase floor basem	ent	floor to soil		R	3,10	4,94					15,3	0,0
3.	staircase wall to base	ment West	wall to cellar				3,10	2,76				8,6	0,0
4.	staircase wall to base	ment East	wall to cellar				1,74	2,76				4,8	0,0
5.	staircase wall to base	ment South	wall to cellar				4,90	2,76			13,5	11,5	0,0
6.	staircase door to base	ement	door to cellar		R		1,01	2,00				2,0	0,0
7.	staircase wall to soil N		wall to soil				5,15	2,76				14,2	0,0
8.	staircase wall to soil E		wall to soil				1,36	2,76				3,8	0,0
9.	wall North ground floo	r	wall				15,40	2,87			44,2	42,1	0,0
10.	entrance door North		door		R		1,01	2,10				2,1	0,0
11.	wall North first + seco	nd floor	wall				15,40	2,69	2			82,9	0,0
12.	wall North attic floor		wall				11,88	1,95		1,816		25,0	0,0
13.	wall East ground floor		wall	_			11,78	2,87			33,8	23,7	0,0
14.	window East staircase		window	Е	R		0,76	2,69				2,0	0,0
15.	window East ground f		window	E	R		1,51	2,30				3,5	0,0
16.	window East ground f		window	Е	R		1,01	2,30				2,3	0,0
17.	window East ground f		window	Е	R		1,51	1,52				2,3	0,0
18.	wall East first + secon		wall				11,78	2,69	2		63,4	43,1	0,0
19.	window East staircase		window	E	R		0,76	2,69	2			4,1	0,0
20.	window East first + se		window	Е	R		1,51	2,30	2			6,9	0,0
21.	window East first + se		window	Е	R		1,01	2,30	2			4,6	0,0
22.	window East first + se	cond floor 3	window	Е	R		1,51	1,52	2			4,6	0,0
23.	wall East attic floor		wall				11,78	1,95		19,908	42,9	27,6	0,0
24.	window East staircase		window	Е	R		0,76	2,00				1,5	0,0
25.	windows East attic flo		window	Е	R		6,00	2,30				13,8	0,0
26.	wall South ground floo		wall				15,40	2,87			44,2	25,8	0,0
27.	window South ground		window	S	R		1,50	1,52				2,3	0,0
28.	window South ground		window	S	R		2,00	2,30	2			9,2	0,0
29.	window South ground		window	S	R		1,50	2,30	2			6,9	0,0
30.	wall South first + seco	ond floor	wall				15,40	2,69	2		82,9	46,1	0,0
31.	window South first + s		window	S	R		1,50	1,52	2			4,6	0,0
32.	window South first + s		window	S	R		2,00	2,30	4			18,4	0,0
33.	window South first + s	second floor 3	window	S	R		1,50	2,30	4			13,8	0,0
34.	wall South attic floor		wall				11,88	1,95		1,575	24,7	16,8	0,0
35.	window South attic flo		window	S	R		1,50	2,30				3,5	0,0
36.	window South attic flo	or 2	window	S	R		1,50	1,50	2			4,5	0,0
37.	gable dormers		dormer wall				1,50	0,50	3			2,3	0,0
38.	side wall dormers		dormer wall				1,10	0,325	6			2,1	0,0
39.	wall West ground floo		wall				11,78	2,87			33,8	29,2	0,0
40.	window West ground		window	W	R		1,01	2,30	2			4,6	0,0
41.	wall West first + second		wall				11,78	2,69	2		63,4	54,1	0,0
42.	window West first + so	econd floor	window	W	R		1,01	2,30	4			9,3	0,0
43.	wall West attic floor		wall				11,78	3,64			42,9	38,2	0,0
44.	window West attic floo		window	W	R		1,01	2,30	2			4,6	0,0
45.	ceiling second floor (b	palcony floor attic)	flat roof			3,52	10,42					36,7	0,0
46.	tilted roof North		tilted roof			6,801	11,88			-3,565		77,2	0,0
47.	tilted roof South		tilted roof			6,801	11,88			-7,65		73,1	0,0
48.	tilted roof dormers		dormer roof			1,732	1,45		3			7,5	0,0
49.												0,0	0,0
50.												0,0	0,0
									Gesam	t thermiso	he Hülle:	1001,3	0,0



# Appendix 2c: Definition of the supply system types

# Explanation of table colours:



= to be used only if necessary; if not compatible to the national definitions or values the most similar ones were to be used



# Variants basis, hg-bnc, hg-pellet, hg-hp, dhw-el, dhw-sol

variant							
variant N°	2-0	2-11	2-12	2-13	2-21	2-22	
variant name	basis	hg-bnc	hg-pellet	hg-hp	dhw-el	dhw-sol	
variant type	basis	variation heat generator	variation heat generator	variation heat generator	variation hot water system	variation hot water system	
description	condensing boiler for heating and hot water + exhaust ventilation system	low temperature boiler (non- condensing)	wood pellet boiler	electric heat pump	decentral electric	thermal solar system	
building							
thermal envelope					definition	see plans	
envelope surface area				(+ tabl	e with outside env		
thermal bridges	blower door	blower door	blower door	blower door	blower door	blower door	
air-tightness	measurement: n <sub>50</sub> < 1,5 h <sup>-1</sup>	measurement: $n_{50} \leq 1,5 \text{ h}^{-1}$	measurement: $n_{50} \le 1,5 \text{ h}^{-1}$	measurement: $n_{50} \leq 1,5 \text{ h}^{-1}$	measurement: $n_{50} \leq 1,5 \text{ h}^{-1}$	measurement: $n_{50} \le 1,5 \text{ h}^{-1}$	
	1150 2 170 11	1150 2 1,0 11	1150 2 1,011	1 1150 2 170 11	1150 <u>2</u> 1,0 11	150 2 170 11	
solar gains total solar energy transmittance (for radiation perpendicular to the g	la l					,6	
external shading correction factor (all directions)					0,6		
alternatively: horizon angle frame area fraction of windows						30° 0,3	
heating system							
heat generation (heating)							
type	condensing boiler	low temperature boiler (not condensing)	pellet boiler	electric heat pump (soil/water)	= var. 2-0	= var. 2-0	
energy carrier	natural gas	natural gas	wood pellets	electricity	= var. 2-0	= var. 2-0	
	central heating						
location	room (cellar, outside the thermal envelope)	= var. 2-0	= var. 2-0	= var. 2-0	= var. 2-0	= var. 2-0	
control temperature	adjusted in dependence of outdoor	= var. 2-0	= var. 2-0	= var. 2-0	= var. 2-0	= var. 2-0	
	temperature						
further specification	maximum values for supply / return temperature: 70°C	= var. 2-0	= var. 2-0	maximum values for supply / return temperature: 55°C	= var. 2-0	= var. 2-0	
thermal power	/ 55°C 30 kW	= var. 2-0	= var. 2-0	/ 45°C = var. 2-0	= var. 2-0	= var. 2-0	
thermal power	30 KW	- Val. 2=0	- vai. 2-0	- vai. 2=0	- vai. 2=0	- Val. 2=0	
heat distribution (heating) type	water pipes	= var. 2-0	= var. 2-0	= var. 2-0	= var. 2-0	= var. 2-0	
location	pipes between heat generator and vertical string outside the thermal envelope (non- heated cellar), vertical central string and distribution in all storeys inside the thermal envelope		= var. 2-0	= var. 2-0	= var. 2-0	= var. 2-0	
control temperature	control of heat distribution temperature according to outdoor air temperature	= var. 2-0	= var. 2-0	= var. 2-0	= var. 2-0	= var. 2-0	
electric consumption pump	electric power = 160 W / running time = 20 h/d x 365 d/a	= var. 2-0	= var. 2-0	= var. 2-0	= var. 2-0	= var. 2-0	
heating pipes (if detailed input required)							
string 1	main string / heating room (outside thermal	= var. 2-0	= var. 2-0	= var. 2-0	= var. 2-0	= var. 2-0	
pipe length	envelope) 2 pipes x 5 m	= var. 2-0	= var. 2-0	= var. 2-0	= var. 2-0	= var. 2-0	
insulation thickness	20 mm	= var. 2-0	= var. 2-0	= var. 2-0	= var. 2-0	= var. 2-0	
alternatively: U-value	0,20 W/(m <sup>2</sup> K) main string /	= var. 2-0	= var. 2-0	= var. 2-0	= var. 2-0	= var. 2-0	
string 2 pipe length	vertical 2 pipes x 11 m	= var. 2-0 = var. 2-0	= var. 2-0	= var. 2-0 = var. 2-0	= var. 2-0 = var. 2-0	= var. 2-0 = var. 2-0	
insulation thickness	20 mm	= var. 2-0	= var. 2-0 = var. 2-0	= var. 2-0	= var. 2-0	= var. 2-0	
alternatively: U-value	0,20 W/(m²K) distribution in	= var. 2-0	= var. 2-0	= var. 2-0	= var. 2-0	= var. 2-0	
string 3	rooms	= var. 2-0	= var. 2-0	= var. 2-0	= var. 2-0	= var. 2-0	
pipe length	2 pipes x 40 m x 4 storeys	= var. 2-0	= var. 2-0	= var. 2-0	= var. 2-0	= var. 2-0	
		= var. 2-0	= var. 2-0	= var. 2-0	= var. 2-0	= var. 2-0	
insulation thickness	0 40 M//~ 2V)					- var 2.0	
alternatively: U-value	0,40 W/(m <sup>2</sup> K)	= var. 2-0	= var. 2-0	= var. 2-0	= var. 2-0	= var. 2-0	
	0,40 W/(m²K)					= var. 2-0 = var. 2-0	



variant

variant N° variant name

variant type

description

hot water system

heat generation

type

energy carrier location

further specification

heat storage

type

location

volume

heat loss per day

heat distribution

type

location

temperature

electric consumption pump

heating pipes (if detailed input required)

string 1

pipe length insulation thickness alternatively: U-value

string 2

pipe length insulation thickness alternatively: U-value

string 3

pipe length insulation thickness alternatively: U-value

ventilation system

type

specification

2-0	2-11	2-12	2-13	2-21	2-22
basis	hg-bnc	hg-pellet	hg-hp	dhw-el	dhw-sol
basis	variation heat	variation heat	variation heat	variation hot water	variation hot wate
	generator	generator	generator	system	system
condensing boiler for heating and hot water + exhaust ventilation system	low temperature boiler (non- condensing)	wood pellet boiler	electric heat pump	decentral electric	thermal solar system
					combined with hea
combined with heat generator for space heating (see above)	combined with heat generator for space heating (see above)	combined with heat generator for space heating (see above)	combined with heat generator for space heating (see above)	electric water heaters	generator for space heating (see above + additional thermal solar system
(see above)	(see above)	(see above)	(see above)	electricity	(see above)
(see above)	(see above)	(see above)	(see above)	inside thermal	(see above)
,	,	,	,	envelope	
hot water					
storage central heating	= var. 2-0	= var. 2-0	= var. 2-0	none	= var. 2-0
room (cellar, outside the thermal envelope)	= var. 2-0	= var. 2-0	= var. 2-0	-	= var. 2-0
500 liter	= var. 2-0	= var. 2-0	= var. 2-0	-	500 liter + 700 liter solar buffer
2,8 kWh/d	= var. 2-0	= var. 2-0	= var. 2-0	-	2,8 + 3,2 kWh/d
hot water circulation	= var. 2-0	= var. 2-0	= var. 2-0	pipes without hot water circulation	= var. 2-0
completely inside of the thermal envelope, vertical central string	= var. 2-0	= var. 2-0	= var. 2-0	in the kitchen and in the bathroom	= var. 2-0
60°C	= var. 2-0	= var. 2-0	= var. 2-0	= var. 2-0	= var. 2-0
electric power = 60 W / running time = 24 h/d x 365 d/a	= var. 2-0	= var. 2-0	= var. 2-0	none	= var. 2-0
main string /	= var. 2-0	= var. 2-0	= var. 2-0	none	= var. 2-0
heating room 2 pipes x 5 m	= var. 2-0	= var. 2-0	= var. 2-0	Horic	= var. 2-0
20 mm	= var. 2-0	= var. 2-0	= var. 2-0		= var. 2-0
0,20 W/(m <sup>2</sup> K) main string /	= var. 2-0 = var. 2-0	= var. 2-0 = var. 2-0	= var. 2-0 = var. 2-0	none	= var. 2-0 = var. 2-0
vertical 2 pipes x 11 m	= var. 2-0	= var. 2-0	= var. 2-0	-	= var. 2-0
20 mm	= var. 2-0	= var. 2-0	= var. 2-0	-	= var. 2-0
0,20 W/(m <sup>2</sup> K)	= var. 2-0	= var. 2-0	= var. 2-0	distribution to taps	= var. 2-0
distribution to taps in bathrooms / WCs and kitchens	= var. 2-0	= var. 2-0	= var. 2-0	in bathroom and kitchen of each apartment	= var. 2-0
2 pipes x 75 m	= var. 2-0	= var. 2-0	= var. 2-0	1 pipe x 75 m	= var. 2-0
20 mm 0,20 W/(m <sup>2</sup> K)	= var. 2-0 = var. 2-0	= var. 2-0 = var. 2-0	= var. 2-0 = var. 2-0	10 mm 0,30 W/(m <sup>2</sup> K)	= var. 2-0 = var. 2-0
5,20 W (III K)	val. 2-0	val. 2-0	val. 2-0	0,00 W/(III K)	VJI. 2-0
exhaust ventilation system	= var. 2-0	= var. 2-0	= var. 2-0	= var. 2-0	= var. 2-0
DC fan	= var. 2-0	= var. 2-0	= var. 2-0	= var. 2-0	= var. 2-0



# Variants basis, vent-nomec, vent-rec, sys-el, sys-sol/rec

variant					
variant N°	2-0	2-31	2-32	2-41	2-42
variant name	basis	vent-nomec	vent-rec	sys-el	sys-sol/rec
variant type	basis	variation ventilation	variation ventilation	variation heating and hot water system	variation hot water and ventilation system
description	condensing boiler for heating and hot water + exhaust ventilation system	no mechanical ventilation system	ventilation system with heat recovery	electric resistance system	solar dhw system + ventilation system with heat recovery
building					
thermal envelope					
envelope envelope surface area			definition see plan		
thermal bridges			tside envelope are nt constructive therm		
air-tightness	blower door measurement: n <sub>50</sub> < 1,5 h <sup>-1</sup>	no blower door measurement	blower door measurement: n <sub>50</sub> ≤ 1,5 h <sup>-1</sup>	blower door measurement: n <sub>50</sub> ≤ 1,5 h <sup>-1</sup>	blower door measurement: n <sub>50</sub> < 1,5 h <sup>-1</sup>
solar gains total solar energy transmittance (for radiation perpendicular to the glexternal shading correction factor (all directions)  alternatively: horizon angle frame area fraction of windows			0,6 0,6 30° 0,3		
heating system					
heat generation (heating) type	condensing boiler	= var. 2-0	= var. 2-0	direct electric heating (electrical	= var. 2-0
energy carrier	natural gas	= var. 2-0	= var. 2-0	resistance) electricity	= var. 2-0
location	central heating room (cellar, outside the thermal envelope)	= var. 2-0	= var. 2-0	decentral	= var. 2-0
control temperature	adjusted in dependence of outdoor temperature	= var. 2-0	= var. 2-0		= var. 2-0
further specification	maximum values for supply / return temperature: 70°C / 55°C	= var. 2-0	= var. 2-0		= var. 2-0
thermal power	30 kW	= var. 2-0	= var. 2-0		= var. 2-0
heat distribution (heating)					
type	water pipes pipes between heat generator and vertical string outside the thermal envelope (non- heated cellar), vertical central string and distribution in all storeys inside the thermal envelope	= var. 2-0 = var. 2-0	= var. 2-0	none	= var. 2-0
control temperature	control of heat distribution temperature according to outdoor air temperature	= var. 2-0	= var. 2-0	thermostatic control	= var. 2-0
electric consumption pump	electric power = 160 W / running time = 20 h/d x 365 d/a	= var. 2-0	= var. 2-0	-	= var. 2-0
heating pipes (if detailed input required)	main string /				
string 1	heating room (outside thermal envelope)	= var. 2-0	= var. 2-0	-	= var. 2-0
pipe length insulation thickness	2 pipes x 5 m 20 mm	= var. 2-0 = var. 2-0	= var. 2-0 = var. 2-0	-	= var. 2-0 = var. 2-0
alternatively: U-value	0,20 W/(m <sup>2</sup> K) main string /	= var. 2-0	= var. 2-0	-	= var. 2-0
string 2	vertical	= var. 2-0	= var. 2-0	-	= var. 2-0
pipe length insulation thickness	2 pipes x 11 m 20 mm	= var. 2-0 = var. 2-0	= var. 2-0 = var. 2-0	-	= var. 2-0 = var. 2-0
alternatively: U-value	0,20 W/(m <sup>2</sup> K) distribution in	= var. 2-0	= var. 2-0	-	= var. 2-0
string 3	rooms	= var. 2-0	= var. 2-0	-	= var. 2-0
pipe length	2 pipes x 40 m x 4 storeys	= var. 2-0	= var. 2-0	-	= var. 2-0
insulation thickness	0,40 W/(m <sup>2</sup> K)	= var. 2-0	= var. 2-0	-	= var. 2-0
alternatively: U-value heat emission (heating)	0,40 W/(M²K)	= var. 2-0	= var. 2-0	-	= var. 2-0
type	radiators	= var. 2-0	= var. 2-0	direct	= var. 2-0
control	thermostatic valves (regulation range: 2K)	= var. 2-0	= var. 2-0	thermostatic control	= var. 2-0



variant

variant N°

variant type

description

hot water system

heat generation

type

energy carrier location further specification

heat storage

type

location

volume

heat loss per day

heat distribution

type

location

temperature

electric consumption pump

heating pipes (if detailed input required)

string 1

pipe length insulation thickness alternatively: U-value

string 2

pipe length insulation thickness alternatively: U-value

string 3

pipe length insulation thickness alternatively: U-value

ventilation system

type

specification

2-0	2-31	2-32	2-41	2-42
basis	vent-nomec	vent-rec	sys-el	sys-sol/rec
			variation heating	variation hot water
basis	variation ventilation	variation ventilation	and hot water	and ventilation
			system	system
condensing boiler for heating and hot	no mechanical	ventilation system	electric resistance	solar dhw system
water + exhaust	ventilation system	with heat recovery	system	ventilation system
ventilation system		,	5,2	with heat recovery
				combined with hea
combined with heat			electric water	generator for space heating (see above
generator for space	= var. 2-0	= var. 2-0	heaters	+ additional
heating (see above)				thermal solar
				system
(see above)	= var. 2-0	= var. 2-0	electricity inside thermal	(see above)
(see above)	= var. 2-0	= var. 2-0	envelope	(see above)
hot water	= var. 2-0	= var. 2-0	none	= var. 2-0
storage central heating				
room (cellar,	= var. 2-0	= var. 2-0		= var. 2-0
outside the thermal	- Val. 2=0	- Val. 2=0	·	- Val. 2=0
envelope)				500 liter
500 liter	= var. 2-0	= var. 2-0	-	+ 700 liter solar
2.8 kWh/d	= var. 2-0	= var. 2-0		buffer 2,8 + 3,2 kWh/d
2,6 KWII/U	= VdI. Z-U	= Vdl. 2-0	-	2,0 + 3,2 KWII/U
hot water	= var. 2-0	= var. 2-0	pipes without hot water	= var. 2-0
circulation			circulation	
completely inside of the thermal			in the kitchen and	
envelope, vertical	= var. 2-0	= var. 2-0	in the bathroom	= var. 2-0
central string				
60°C	= var. 2-0	= var. 2-0	= var. 2-0	= var. 2-0
electric power = 60				
W / running time = 24 h/d x 365 d/a	= var. 2-0	= var. 2-0	none	= var. 2-0
main string / heating room	= var. 2-0	= var. 2-0	none	= var. 2-0
2 pipes x 5 m	= var. 2-0	= var. 2-0	-	= var. 2-0
20 mm	= var. 2-0	= var. 2-0	-	= var. 2-0
0,20 W/(m <sup>2</sup> K) main string /	= var. 2-0	= var. 2-0	-	= var. 2-0
vertical	= var. 2-0	= var. 2-0	none	= var. 2-0
2 pipes x 11 m	= var. 2-0 = var. 2-0	= var. 2-0 = var. 2-0	-	= var. 2-0
20 mm 0,20 W/(m <sup>2</sup> K)	= var. 2-0 = var. 2-0	= var. 2-0 = var. 2-0	-	= var. 2-0 = var. 2-0
distribution to taps			distribution to taps	
in bathrooms / WCs	= var. 2-0	= var. 2-0	in bathroom and	= var. 2-0
and kitchens			kitchen of each apartment	
2 pipes x 75 m	= var. 2-0	= var. 2-0	1 pipe x 75 m	= var. 2-0
20 mm	= var. 2-0	= var. 2-0	10 mm	= var. 2-0
0,20 W/(m <sup>2</sup> K)	= var. 2-0	= var. 2-0	0,30 W/(m <sup>2</sup> K)	= var. 2-0
ovhoust		vontilation		vontilation
exhaust ventilation	none	ventilation system with heat	= var. 2-0	ventilation system with hea
system		recovery		recovery
		heat recovery 80%,	= var. 2-0	heat recovery 80%



# **Appendix 2d: Country sheets**

Country Germany Region whole country

Type of requirements / method used to proof the compliance simplified method (EnEV vereinfachtes Verfahren) calculation building: seasonal balance (according to DIN V 4701-10 Annex C)

Requirements to be complied: maximum values for thermal transmittance and primary energy demand

Requirements in force since

October 2007

# Resulting U-values

odel building N°							2				
uilding type						apartmer	t building				
ariant N°		2-0	2-11	2-12	2-13	2-21	2-22	2-31	2-32	2-41	2-42
variant name		basis	hg-bnc	hg-pellet	hg-hp	dhw-el	dhw-sol	vent- nomec	vent-rec	sys-el	sys- sol/rec
-values	U-value defined for temperature difference between room and										
tilted roof	external air	0,25	0,2	0,22	0,22	0,2	0,22	0,2	0,22	0,08	0,22
flat roof	external air	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,08	0,3
dormer roof	external air	0,4	0,4	0,3	0,3	0,3	0,3	0,3	0,3	0,08	0,3
walls	external air	0,3	0,24	0,5	0,5	0,33	0,5	0,26	0,5	0,08	0,5
dormer walls	external air	0,4	0,4	0,3	0,3	0,3	0,3	0,3	0,3	0,08	0,3
cellar ceiling	cellar air or soil	0,4	0,4	0,5	0,5	0,4	0,5	0,4	0,5	0,08	0,5
floor to soil	cellar air or soil	0,4	0,4	0,5	0,5	0,4	0,5	0,4	0,5	0,08	0,5
walls to soil	cellar air or soil	0,4	0,4	0,5	0,5	0,4	0,5	0,4	0,5	0,08	0,5
walls to cellar	cellar air or soil	0,4	0,4	0,5	0,5	0,4	0,5	0,4	0,5	0,08	0,5
door to cellar	cellar air or soil	3	3	3	3	3	3	3	3	1,5	3
outside door	external air	2	2	2	2	2	2	2	2	1,5	2
windows	external air	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	0,8	1,5
stricting limit		maximum primary energy demand	maximum primary energy demand	maximum heat transfer coefficient	maximum heat transfer coefficient		maximum heat transfer coefficient		maximum heat transfer coefficient		maximum heat transfer coefficient
emarks											

# Mean heat transmission losses (basis for cross country comparison)

	element area	correction factor (only for cross- country comparison)				he	at transfe	r coefficie	nt			
Element	[m²]	[-]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]
tilted roof	150,4	1	37,6	30,1	33,1	33,1	30,1	33,1	30,1	33,1	12,0	33,1
flat roof	36,7	1	11,0	11,0	11,0	11,0	11,0	11,0	11,0	11,0	2,9	11,0
dormer roof	7,5	1	3,0	3,0	2,3	2,3	2,3	2,3	2,3	2,3	0,6	2,3
walls	454,4	1	136,3	109,1	227,2	227,2	150,0	227,2	118,1	227,2	36,4	227,2
dormer walls	4,4	1	1,8	1,8	1,3	1,3	1,3	1,3	1,3	1,3	0,4	1,3
cellar ceiling	173,5	0,6	41,6	41,6	52,1	52,1	41,6	52,1	41,6	52,1	8,3	52,1
floor to soil	0	0,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
walls to soil	0	0,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
walls to cellar	0	0,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
door to cellar	0	0,6	-	-	-	-	-	-	-	-	0,0	-
outside door	2,1	1	-	-	-	-	-	-	-	-	3,2	-
windows	127,4	1	191,1	191,1	191,1	191,1	191,1	191,1	191,1	191,1	101,9	191,1
sum	956,4		422	388	518	518	427	518	396	518	166	518
Mean heat transm												
losses per m2 enve	elope		0,44	0,41	0,54	0,54	0,45	0,54	0,41	0,54	0,17	0,54

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Country Austria
Region whole country

Type of requirements / method used to proof the compliance

In Austria the relevant regulation is the net energy demand for heating per  $m^2$  depending on the proportion of building volume to building survace (lc = V/A). The requirements are regulated in the OIB directive 6 "Energieeinsparung und Wärmeschutz" from April 2007 and are calculated with a reference climate with 3.400 degree days. The calculation method is defined in the Austrian Standard ÖNORM B 8110-6, which is based on the ISO EN 13790. Main estimations, which were not provided: "heavy construction" (brick or concrete) and air exchange rate 0,4/h with window ventilation. The heating system has no influence on the U-Values. The current requirement (until 31.12.2009): HWB = 26 \* (1 + 2/lc). The data of the model building: lc = 1,92m; HWB < 52,94 kWh/ $m^2a$ .

Requirements in force since

April 2007

# Resulting U-values

N10							2				
odel building N° iilding type							2 it building				
• • •						apar tinen	it building				
riant N°		2-0	2-11	2-12	2-13	2-21	2-22	2-31	2-32	2-41	2-42
variant name		basis	hg-bnc	hg-pellet	hg-hp	dhw-el	dhw-sol	vent- nomec	vent-rec	sys-el	sys- sol/rec
values	U-value defined for temperature difference between room and										
tilted roof	external air	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2
flat roof	external air	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2
dormer roof	external air	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2
walls	external air	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35	0,35
dormer walls	external air	0,7	0,7	0,7	0,7	0,7	0,7	0,7	0,7	0,7	0,7
cellar ceiling	cellar air or soil	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4
floor to soil	cellar air or soil	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4
walls to soil	cellar air or soil	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4
walls to cellar	cellar air or soil	0,6	0,6	0,6	0,6	0,6	0,6	0,6	0,6	0,6	0,6
door to cellar	cellar air or soil	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5
outside door	external air	1,7	1,7	1,7	1,7	1,7	1,7	1,7	1,7	1,7	1,7
windows	external air	1,4	1,4	1,4	1,4	1,4	1,4	1,4	1,4	1,4	1,4
estricting limit		heat need for space heating	heat need for space heating	r heat need for space heating	heat need for space heating						
marks											

# Mean heat transmission losses (basis for cross country comparison)

	element area	correction factor (only for cross- country comparison)				he	eat transfe	er coefficie	ent			
Element	[m²]	[-]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]
tilted roof	150,4	1	30,1	30,1	30,1	30,1	30,1	30,1	30,1	30,1	30,1	30,1
flat roof	36,7	1	7,3	7,3	7,3	7,3	7,3	7,3	7,3	7,3	7,3	7,3
dormer roof	7,5	1	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5
walls	454,4	1	159,0	159,0	159,0	159,0	159,0	159,0	159,0	159,0	159,0	159,0
dormer walls	4,4	1	3,1	3,1	3,1	3,1	3,1	3,1	3,1	3,1	3,1	3,1
cellar ceiling	173,5	0,6	41,6	41,6	41,6	41,6	41,6	41,6	41,6	41,6	41,6	41,6
floor to soil	0	0,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
walls to soil	0	0,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
walls to cellar	0	0,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
door to cellar	0	0,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
outside door	2,1	1	3,6	3,6	3,6	3,6	3,6	3,6	3,6	3,6	3,6	3,6
windows	127,4	1	178,4	178,4	178,4	178,4	178,4	178,4	178,4	178,4	178,4	178,4
sum	956,4		425	425	425	425	425	425	425	425	425	425
Mean heat transm	ission											
losses per m2 enve	elope		0,44	0,44	0,44	0,44	0,44	0,44	0,44	0,44	0,44	0,44

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Country Czech Republic
Region whole country

Type of requirements / method used to proof the compliance

Calculation method according to the requirements of the Act no. 406/2000 Coll. on Energy Management, its amendment no. 177/2006 Coll. as amended by no. 406/2006 Coll. and the Code of Practice no. 148/2007 Coll. on Energy Demand of Buildings as amended. A specific technical regulation in this field is the Czech standard ČSN 73 0540 "Thermal Protection of Buildings" (and a set of relevant standards), which the abovementioned statutes are related to and make its requirements binding. Valid requirements for U values are set forth in the second part of the standard i.e. in ČSN 73 0540-2 as of April 2007. Two groups of U values are prescribed: recommended values and required values. Required U-values were used in this table.

Requirements in force since

April 2007

# Resulting U-values

							_				
Model building N° Building type							2 nt building				
• • •						apai tillei	it building				
/ariant N°		2-0	2-11	2-12	2-13	2-21	2-22	2-31	2-32	2-41	2-42
variant name		basis	hg-bnc	hg-pellet	hg-hp	dhw-el	dhw-sol	vent- nomec	vent-rec	sys-el	sys- sol/rec
J-values	U-value defined for temperature difference between room and										
tilted roof	external air	0,24	0,24	0,24	0,24	0,24	0,24	0,24	0,24	0,24	0,24
flat roof	external air	0,24	0,24	0,24	0,24	0,24	0,24	0,24	0,24	0,24	0,24
dormer roof	external air	0,24	0,24	0,24	0,24	0,24	0,24	0,24	0,24	0,24	0,24
walls	external air	0,38	0,38	0,38	0,38	0,38	0,38	0,38	0,38	0,38	0,38
dormer walls	external air	0,30	0,30	0,30	0,30	0,30	0,30	0,30	0,30	0,30	0,30
cellar ceiling	cellar air or soil	1,05	1,05	1,05	1,05	1,05	1,05	1,05	1,05	1,05	1,05
floor to soil	cellar air or soil	0,85	0,85	0,85	0,85	0,85	0,85	0,85	0,85	0,85	0,85
walls to soil	cellar air or soil	0,85	0,85	0,85	0,85	0,85	0,85	0,85	0,85	0,85	0,85
walls to cellar	cellar air or soil	1,3	1,3	1,3	1,3	1,3	1,3	1,3	1,3	1,3	1,3
door to cellar	cellar air or soil	3,5	3,5	3,5	3,5	3,5	3,5	3,5	3,5	3,5	3,5
outside door	external air	1,7	1,7	1,7	1,7	1,7	1,7	1,7	1,7	1,7	1,7
windows	external air	1,7	1,7	1,7	1,7	1,7	1,7	1,7	1,7	1,7	1,7
testricting limit											
Remarks		*U= 0,30 for the light roof with slope over 45° U=0,38 for the heavy roof with slope over 45°		:							

# Mean heat transmission losses (basis for cross country comparison)

	element area	correction factor (only for cross- country comparison)				he	eat transfe	r coefficie	nt			
Element	[m²]	[-]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]
tilted roof	150,4	1	36,1	36,1	36,1	36,1	36,1	36,1	36,1	36,1	36,1	36,1
flat roof	36,7	1	8,8	8,8	8,8	8,8	8,8	8,8	8,8	8,8	8,8	8,8
dormer roof	7,5	1	1,8	1,8	1,8	1,8	1,8	1,8	1,8	1,8	1,8	1,8
walls	454,4	1	172,7	172,7	172,7	172,7	172,7	172,7	172,7	172,7	172,7	172,7
dormer walls	4,4	1	-	-	-	-	-	-	-	-	-	-
cellar ceiling	173,5	0,6	109,3	109,3	109,3	109,3	109,3	109,3	109,3	109,3	109,3	109,3
floor to soil	0	0,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
walls to soil	0	0,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
walls to cellar	0	0,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
door to cellar	0	0,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
outside door	2,1	1	3,6	3,6	3,6	3,6	3,6	3,6	3,6	3,6	3,6	3,6
windows	127,4	1	216,6	216,6	216,6	216,6	216,6	216,6	216,6	216,6	216,6	216,6
sum	956,4		549	549	549	549	549	549	549	549	549	549
Mean heat transm												
losses per m² enve	elope		0,57	0,57	0,57	0,57	0,57	0,57	0,57	0,57	0,57	0,57

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Country Poland Region whole country

Type of requirements / method used to proof the compliance method

Requirements in force since

October 2002

# Resulting U-values

Model building N°							2				
Building type							z nt building				
Variant N°			ı	1							
		2-0	2-11	2-12	2-13	2-21	2-22	2-31	2-32	2-41	2-42
variant name		basis	hg-bnc	hg-pellet	hg-hp	dhw-el	dhw-sol	vent- nomec	vent-rec	sys-el	sys- sol/rec
J-values	U-value defined for temperature difference between room and										
tilted roof	external air	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3
flat roof	external air	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3
dormer roof	external air	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3
walls	external air	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3
dormer walls	external air	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3
cellar ceiling	cellar air or soil	0,6	0,6	0,6	0,6	0,6	0,6	0,6	0,6	0,6	0,6
floor to soil	cellar air or soil	0,6	0,6	0,6	0,6	0,6	0,6	0,6	0,6	0,6	0,6
walls to soil	cellar air or soil	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5
walls to cellar	cellar air or soil	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5
door to cellar	cellar air or soil	2,6	2,6	2,6	2,6	2,6	2,6	2,6	2,6	2,6	2,6
outside door	external air	2,6	2,6	2,6	2,6	2,6	2,6	2,6	2,6	2,6	2,6
windows	external air	2	2	2	2	2	2	2	2	2	2
estricting limit		maximum primary energy demand	maximum primary energy demand	maximum heat transfer coefficient	maximum heat transfer coefficient		maximum heat transfer coefficient		maximum heat transfer coefficient		maximum heat transfer coefficient
?emarks											

# Mean heat transmission losses (basis for cross country comparison)

	element area	correction factor (only for cross- country comparison)				he	eat transfe	r coefficie	ent			
Element	[m²]	[-]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]
tilted roof	150,4	1	45,1	45,1	45,1	45,1	45,1	45,1	45,1	45,1	45,1	45,1
flat roof	36,7	1	11,0	11,0	11,0	11,0	11,0	11,0	11,0	11,0	11,0	11,0
dormer roof	7,5	1	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3
walls	454,4	1	136,3	136,3	136,3	136,3	136,3	136,3	136,3	136,3	136,3	136,3
dormer walls	4,4	1	1,3	1,3	1,3	1,3	1,3	1,3	1,3	1,3	1,3	1,3
cellar ceiling	173,5	0,6	62,5	62,5	62,5	62,5	62,5	62,5	62,5	62,5	62,5	62,5
floor to soil	0	0,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
walls to soil	0	0,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
walls to cellar	0	0,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
door to cellar	0	0,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
outside door	2,1	1	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5	5,5
windows	127,4	1	254,8	254,8	254,8	254,8	254,8	254,8	254,8	254,8	254,8	254,8
sum	956,4		519	519	519	519	519	519	519	519	519	519
Mean heat transm	ission											
losses per m2 enve	elope		0,54	0,54	0,54	0,54	0,54	0,54	0,54	0,54	0,54	0,54

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Country Sweden Region Lund

Type of requirements / method used to proof the compliance

From the Swedish regulation for building (Regelsamling för byggande - Boverkets byggregler, BBR, 2006)

Requirements for housing

Maximum specific energy consumption 110 kWh/m² floor area (internal) in south Sweden, 130 kWh/m² floor area (internal) in north Sweden. Household electricity is not included in the specific energy consumption. For one ore two family houses with direct-acting electric heating system is the requirement for maximum specific energy consumption 75 kWh/m² floor area (internal) in south Sweden, 95 kWh/m² floor area (internal) in north Sweden.

Household electricity is not included in the specific energy consumption.

Maximum Um for the total building 0,50 W/m<sup>2</sup>K

Minimum ventilation 0.35 l/s m<sup>2</sup> 2006

Requirements in force since

# Resulting U-values

del building N°							2				
ilding type						apartmen	t building				
riant N°		2-0	2-11	2-12	2-13	2-21	2-22	2-31	2-32	2-41	2-42
variant name		basis	hg-bnc	hg-pellet	hg-hp	dhw-el	dhw-sol	vent- nomec	vent-rec	sys-el	sys- sol/rec
values	U-value defined for temperature difference between room and										
tilted roof	external air	0,15	0,15	0,1	0,2	0,2	0,2	-	0,2	0,2	0,2
flat roof	external air	0,12	0,12	0,1	0,2	0,12	0,2	-	0,2	0,2	0,2
dormer roof	external air	0,15	0,15	0,1	0,2	0,2	0,2	-	0,2	0,2	0,2
walls	external air	0,15	0,15	0,12	0,2	0,2	0,2	-	0,2	0,2	0,2
dormer walls	external air	0,15	0,15	0,12	0,2	0,2	0,2	-	0,2	0,2	0,2
cellar ceiling	cellar air or soil	0,67	0,67	0,17	0,67	0,67	0,67	-	0,67	0,67	0,67
floor to soil	cellar air or soil	0,25	0,25	0,18	0,25	0,25	0,25	-	0,25	0,25	0,25
walls to soil	cellar air or soil	0,34	0,26	0,34	0,26	0,26	0,26	-	0,26	0,26	0,26
walls to cellar	cellar air or soil	2,08	2,08	0,53	2,08	2,08	2,08	-	2,08	2,08	2,08
door to cellar	cellar air or soil	1,1	1,1	1,1	1,1	1,1	1,1	-	1,1	1,1	1,1
outside door	external air	1,1	1,1	1,1	1,1	1,1	1,1	-	1,1	1,1	1,1
windows	external air	1,2	1,2	1,2	1,5	1,5	1,5	-	1,5	1,5	1,5
stricting limit		Maximum specific energy consumption 110 kWh/m2 floor area	Maximum specific energy consumption 110 kWh/m2 floor area	Maximum specific energy consumption 110 kWh/m2 floor area	Maximum Um for the total building 0,50 W/m <sup>2</sup> K		Maximum Um for the total building 0,50 W/m <sup>2</sup> K			Maximum Um for the total building 0,50 W/m <sup>2</sup> K	Maximum Um for the total building 0,50 W/m <sup>2</sup> K
marks		calculated energy consumption for the building 103 kWh/m². (Um = 0,43 [W/(m²K)])		calculated energy consumption for the building 109 kWh/m². (Um = 0,43 [W/(m²K)])	for the	calculated energy consumption for the building 104 kWh/m². (Um = 0,50 [W/(m²K)])	Solar energy is "free" energy. Calculated energy consumption for the building 81 kWh/m <sup>2</sup> .		calculated energy consumption for the building 79 kWh/m². With exhaust air heat pump	calculated energy consumption for the building 104 kWh/m². (Um = 0,50 [W/(m²K)])	

# Mean heat transmission losses (basis for cross country comparison)

	element area	correction factor (only for cross- country comparison)				he	eat transfe	r coefficie	nt			
ement	[m²]	[-]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]
tilted roof	150,4	1	22,6	22,6	15,0	30,1	30,1	30,1		-	30,1	30,1
flat roof	36,7	1	4,4	4,4	3,7	7,3	4,4	7,3	-	7,3	7,3	7,3
dormer roof	7,5	1	1,1	1,1	0,8	1,5	1,5	1,5	-	1,5	1,5	1,5
walls	454,4	1	68,2	68,2	54,5	90,9	90,9	90,9	-	90,9	90,9	90,9
dormer walls	4,4	1	0,7	0,7	0,5	0,9	0,9	0,9	-	0,9	0,9	0,9
cellar ceiling	173,5	0,6	69,7	69,7	17,7	69,7	69,7	69,7	-	69,7	69,7	69,7
floor to soil	0	0,6	0,0	0,0	0,0	0,0	0,0	0,0	-	0,0	0,0	0,0
walls to soil	0	0,6	0,0	0,0	0,0	0,0	0,0	0,0	-	0,0	0,0	0,0
walls to cellar	0	0,6	0,0	0,0	0,0	0,0	0,0	0,0	-	0,0	0,0	0,0
door to cellar	0	0,6	0,0	0,0	0,0	0,0	0,0	0,0	-	0,0	0,0	0,0
outside door	2,1	1	2,3	2,3	2,3	2,3	2,3	2,3	-	2,3	2,3	2,3
windows	127,4	1	152,9	152,9	152,9	191,1	191,1	191,1	-	191,1	191,1	191,1
		.										
sum	956,4		322	322	247	394	391	394	0	364	394	394
ean heat transm	ission											
sses per m² enve	elope		0,34	0,34	0,26	0,41	0,41	0,41	-	0,38	0,41	0,41

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Country Denmark Region whole country

Type of requirements / method used to proof the compliance

- Monthly calculation according to the SBi direction 213, Calculation of buildings energy demand.

   heating demand is based on prEN ISO 13790:2005, which elaborates on EN 832 and EN ISO 13790.

   cooling demand is based on prEN ISO 13790:2005.

   heat loss from installations is calculated as defined in prEN 15316 part 2.3 og part 3.2.

- bollers is calculated according to prEN 15316 part 4.1 methode II and part 3.3. calculation tool: Be06, version 2,7,5,3

Requirements to be complied: maximum primary energy demand, maximum values for overall thermal transmittance and maximum U-values for constructions.

This new building must have an energy consumption less than 70+2200/A, having a dimensioning transmission losse less than  $8~\text{W/m}^2$  through the thermal envelope or meet maximum U-values for the

Requirements in force since

# Resulting U-values

Model building N°							2					
Building type							t building					
Variant N°		2-0	2-11	2-12	2-13	2-21	2-22	2-31	2-32	2-41	2-42	
variant name		basis		hq-pellet		dhw-el	dhw-sol	vent-	vent-rec	sys-el	sys-	
			3	31	<b>J</b> 1			nomec			sol/rec	
U-values	U-value defined for temperature difference between room and											
tilted roof	external air	0,15	-	0,09	0,17	0,09	0,17	-	0,12	< 0,08	0,2	[۷
flat roof	external air	0,15	-	0,1	0,2	0,1	0,25	-	0,15	< 0,08	0,2	[۷
dormer roof	external air	0,15	-	0,1	0,2	0,1	0,2	-	0,15	< 0,08	0,2	[٧
walls	external air	0,2	-	0,13	0,25	0,13	0,33	-	0,18	< 0,08	0,3	[V
dormer walls	external air	0,4	-	0,3	0,4	0,3	0,4	-	0,4	< 0,08	0,4	[۷
cellar ceiling	cellar air or soil	0,3	-	0,17	0,3	0,17	0,3	-	0,3	< 0,08	0,3	[V
floor to soil	cellar air or soil	0,3	-	0,3	0,3	0,3	0,3	-	0,3	< 0,08	0,3	[ν
walls to soil	cellar air or soil	0,25	-	0,19	0,25	0,19	0,3	-	0,25	< 0,08	0,3	[٧
walls to cellar	cellar air or soil	0,3	-	0,25	0,3	0,25	0,3	-	0,3	< 0,08	0,3	[ν
door to cellar	cellar air or soil	2	-	2	2	2	2	-	2	< 0,8	2	[V
outside door	external air	2	-	2	2	2	2	-	2	< 0,8	2	[۷
windows	external air	1,46	-	1,39	1,46	1,15	2	-	1,46	< 0,8	1,8	Ľ٧
												ĺ
Restricting limit		maximum primary energy demand and maximum U- values	n.a.	maximum U- values	maximum primary energy demand and maximum U- values	maximum U- values	per m² thermal envelope, excl. windows and doors) and		maximum primary energy demand and maximum U- values	n.a.	maximum primary energy demand and maximum U- values	
Remarks			Non- condensing boilers are illegal in Denmark.	Unrealistic high insulation thickness of facades and roofs in a real building. Resuested due to high losses from DHW system (storage (storage tank).		Unrealistic high insulation thickness of facades and roofs in a real building.	Anticipated 100 m² solar collector.		flow same as 2-11 and	Not possible to meet the requirements in the case of electric heating and DHW.		

# Mean heat transmission losses (basis for cross country comparison)

	element area	correction factor (only for cross- country comparison)				he	at transfe	r coefficie	nt			
Element	[m²]	[-]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]
tilted roof	150,4	1	22,6	-	13,5	25,6	13,5	25,6	-	18,0	-	30,1
flat roof	36,7	1	5,5	-	3,7	7,3	3,7	9,2	-	5,5	-	7,3
dormer roof	7,5	1	1,1	-	0,8	1,5	0,8	1,5	-	1,1	-	1,5
walls	454,4	1	90,9	-	59,1	113,6	59,1	150,0	-	81,8	-	136,3
dormer walls	4,4	1	1,8	-	1,3	1,8	1,3	1,8	-	1,8	-	1,8
cellar ceiling	173,5	0,6	31,2	-	17,7	31,2	17,7	31,2	-	31,2	-	31,2
floor to soil	0	0,6	0,0	-	0,0	0,0	0,0	0,0	-	0,0	-	0,0
walls to soil	0	0,6	0,0	-	0,0	0,0	0,0	0,0	-	0,0	-	0,0
walls to cellar	0	0,6	0,0	-	0,0	0,0	0,0	0,0	-	0,0	-	0,0
door to cellar	0	0,6	0,0	-	0,0	0,0	0,0	0,0	-	0,0	-	0,0
outside door	2,1	1	4,2	-	4,2	4,2	4,2	4,2	-	4,2	-	4,2
windows	127,4	1	186,0	-	177,1	186,0	146,5	254,8	-	186,0	-	229,3
sum	956,4		343	0	277	371	247	478	0	330	0	442
Mean heat transmi	ission											
losses per m² enve	elope		0,36	-	0,29	0,39	0,26	0,50	-	0,34	-	0,46

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Country
Region

England & Wales

Type of requirements / method used to proof the compliance

Requirements to be complied with: maximum CO2 emissions, maximum U-values, minimum heating efficiency

# Resulting U-values

Requirements in force since

2005

Model building N°							2				
Building type						apartmer	t building				
/ariant N°		2-0	2-11	2-12	2-13	2-21	2-22	2-31	2-32	2-41	2-42
variant name		basis	hg-bnc	hg-pellet	hg-hp	dhw-el	dhw-sol	vent- nomec	vent-rec	sys-el	sys- sol/rec
J-values	U-value defined for temperature difference between room and										
tilted roof	external air	0,11	-	0,25	0,25	0,11	0,25	0,16	0,25	0,11	0,25
flat roof	external air	0,11	-	0,25	0,25	0,11	0,25	0,16	0,25	0,11	0,25
dormer roof	external air	0,11	-	0,25	0,25	0,11	0,25	0,16	0,25	0,11	0,25
walls	external air	0,3	-	0,35	0,35	0,2	0,35	0,33	0,35	0,2	0,35
dormer walls	external air	0,3	-	0,35	0,35	0,2	0,35	0,33	0,35	0,2	0,35
cellar ceiling	external air										
floor to soil	external air	0,25	-	0,25	0,25	0,2	0,25	0,25	0,25	0,2	0,25
walls to soil	external air										
walls to cellar	external air										
door to cellar	external air										
outside door	external air	2,2	-	2,2	2,2	2	2,2	2	2,2	2	2,2
windows	external air	2,1	-	2,2	2,2	1,8	2,2	1,8	2,2	1,3	2,2
estricting limit		maximum CO <sub>2</sub> emissions		maximum U- values of elements	maximum U- values of elements	maximum CO <sub>2</sub> emissions	maximum U- values of elements	maximum CO <sub>2</sub> emissions	maximum U- values of elements	maximum CO <sub>2</sub> emissions	maximum U- values of elements
emarks			not possible - minimum boiler efficiency is 86% (condensing)						maximum U- values of elements (although only small margin left on CO <sub>2</sub> emissions)		

# Mean heat transmission losses (basis for cross country comparison)

	element area	correction factor (only for cross- country comparison)				he	at transfe	r coefficie	nt			
Element	[m²]	[-]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]
tilted roof	150,4	1	16,5	-	37,6	37,6	16,5	37,6	24,1	37,6	16,5	37,6
flat roof	36,7	1	4,0	-	9,2	9,2	4,0	9,2	5,9	9,2	4,0	9,2
dormer roof	7,5	1	0,8	-	1,9	1,9	0,8	1,9	1,2	1,9	0,8	1,9
walls	454,4	1	136,3	-	159,0	159,0	90,9	159,0	150,0	159,0	90,9	159,0
dormer walls	4,4	1	1,3	-	1,5	1,5	0,9	1,5	1,5	1,5	0,9	1,5
cellar ceiling	173,5	1	43,4	-	43,4	43,4	34,7	43,4	43,4	43,4	34,7	43,4
floor to soil	0	1	0,0	-	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
walls to soil	0	1	-	-	-	-	-	-	-	-	-	-
walls to cellar	0	1	-	-	-	-	-	-	-	-	-	-
door to cellar	0	1	-	-	-	-	-	-	-	-	-	-
outside door	2,1	1	4,6	-	4,6	4,6	4,2	4,6	4,2	4,6	4,2	4,6
windows	127,4	1	267,5	-	280,3	280,3	229,3	280,3	229,3	280,3	165,6	280,3
				_								
sum	956,4		475	0	538	538	381	538	459	538	318	538
Mean heat transm				ı								
losses per m <sup>2</sup> enve	elope		0,50	-	0,56	0,56	0,40	0,56	0,48	0,56	0,33	0,56

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Country The Netherlands Region whole country

Type of requirements / method used to proof the compliance

Energy use calculations for the heating season (October 1 - April 30) according to (for building as well as \* Dutch Standard NEN 5128: Energy performance of residential functions and residential buildings - Determination method (NNI, March 2004).

\* Dutch Guideline NPR 5129: Energy performance of residential functions and residential buildings - Calculation program (EPW) with handbook (NNI, April 2005).

\* EPW for Windows Version 2.02 (NNI, 2006)

- Requirements to be met: \* EPC <= 0,8 (EPC = Energy Performance Coefficient, based on primary energy demand), and \* Minimum Rc values (heat resistance) for thermal envelope (Rc >=2,5 m2K/W)

Requirements in force since

2006 (EPC <=0,8), 1992 (Rc >= 2,5 W/(m<sup>2</sup>K))

# Resulting U-values

Model building N°							2				
Building type						apartmer	t building				
Variant N°		2-0	2-11	2-12	2-13	2-21	2-22	2-31	2-32	2-41	2-42
variant name		basis	hg-bnc	hg-pellet	hg-hp	dhw-el	dhw-sol	vent- nomec	vent-rec	sys-el	sys- sol/rec
U-values	U-value defined for temperature difference between room and										
tilted roof	external air	< 0,08	< 0,08	< 0,08	0,24	< 0,08	0,12	0,1	0,19	< 0,08	0,19
flat roof	external air	< 0,08	< 0,08	< 0,08	0,24	< 0,08	0,12	0,1	0,19	< 0,08	0,19
dormer roof	external air	< 0,08	< 0,08	< 0,08	0,37	< 0,08	0,32	0,32	0,32	< 0,08	0,37
walls	external air	< 0,08	< 0,08	< 0,08	0,24	< 0,08	0,12	0,1	0,19	< 0,08	0,32
dormer walls	external air	< 0,08	< 0,08	< 0,08	0,37	< 0,08	0,32	0,32	0,32	< 0,08	0,37
cellar ceiling	cellar air or soil	< 0,08	< 0,08	< 0,08	0,23	< 0,08	0,12	0,1	0,19	< 0,08	0,23
floor to soil	cellar air or soil	< 0,08	< 0,08	< 0,08	0,37	< 0,08	0,37	0,37	0,37	< 0,08	0,37
walls to soil	cellar air or soil	< 0,08	< 0,08	< 0,08	0,37	< 0,08	0,37	0,37	0,37	< 0,08	0,37
walls to cellar	cellar air or soil	< 0,08	< 0,08	< 0,08	0,37	< 0,08	0,37	0,37	0,37	< 0,08	0,37
door to cellar	cellar air or soil	< 0,8	< 0,8	< 0,8	3,4	< 0,8	2	2	2	< 0,8	2
outside door	external air	< 0,8	< 0,8	< 0,8	2	< 0,8	2	2	2	< 0,8	2
windows	external air	< 0,8	< 0,8	< 0,8	1,8	< 0,8	1,2	0,8	1,3	< 0,8	2
Restricting limit		EPC<=0,80	EPC<=0,80	EPC<=0,80	EPC<=0,80	EPC<=0,80	EPC<=0,80	EPC<=0,80	EPC<=0,80	EPC<=0,80	EPC<=0,80
Remarks		EPC=0,84, so not possible to meet EPC<=0,80 all heating pipes within thermal envelope	Not possible to meet EPC<=0,8. The effect of low performance of heating and ventilation system can not be compensated by improved U-values.	(except for complicated procedure using 'declaration of quality'). Wood pellet boiler not		Not possible to meet EPC<=0,8. The effect of low performance of heating system can not be compensated by improved U-values.			Efficiency heat recovery = 75%	Not possible to meet EPC<=0,8. The effect of low performance of heating system can not be compensated by improved U-values.	Efficiency heat recovery = 75%

# Mean heat transmission losses (basis for cross country comparison)

	element area	correction factor (only for cross- country comparison)				he	at transfe	er coefficie	ent			
Element	[m²]	[-]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]
tilted roof	150,4	1	-	-	-	36,1	-	18,0	15,0	28,6	-	28,6
flat roof	36,7	1	-	-	-	8,8	-	4,4	3,7	7,0	-	7,0
dormer roof	7,5	1	-	-	-	2,8	-	2,4	2,4	2,4	-	2,8
walls	454,4	1	-	-	-	109,1	-	54,5	45,4	86,3	-	145,4
dormer walls	4,4	1	-	-	-	1,6	-	1,4	1,4	1,4	-	1,6
cellar ceiling	173,5	0,6	-	-	-	23,9	-	12,5	10,4	19,8	-	23,9
floor to soil	0	0,6	-	-	-	0,0	-	0,0	0,0	0,0	-	0,0
walls to soil	0	0,6	-	-	-	0,0	-	0,0	0,0	0,0	-	0,0
walls to cellar	0	0,6	-	-	-	0,0	-	0,0	0,0	0,0	-	0,0
door to cellar	0	0,6	-	-	-	0,0	-	0,0	0,0	0,0	-	0,0
outside door	2,1	1	-	-	-	4,2	-	4,2	4,2	4,2	-	4,2
windows	127,4	1	-	-	-	229,3	-	152,9	101,9	165,6	-	254,8
sum	956,4	1	0	0	0	416	0	250	184	315	0	468
Mean heat transm	ission											
losses per m2 env	elope		-	-	-	0,43	-	0,26	0,19	0,33	-	0,49

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Country Belgium Region Flanders

Type of requirements / Method described in the decree of the 5th of march 2005. Three requirements are imposed : one limits the annual characteristic primary energy use for each dwelling, a second one limits the average thermal transmittance for the whole building, and a third one gives the maximal values of the thermal transmittance.

Requirements in force since

2005

# Resulting U-values

Model building N°							2				
Building type						apartmer	t building				
Variant N°		2-0	2-11	2-12	2-13	2-21	2-22	2-31	2-32	2-41	2-42
variant name		basis	hg-bnc	hg-pellet	hg-hp	dhw-el	dhw-sol	vent- nomec	vent-rec	sys-el	sys- sol/rec
U-values	U-value defined for temperature difference between room and										
tilted roof	external air	0,1	0,08	-	0,35	0,08	0,08	-	0,1	< 0,08	0,1
flat roof	external air	0,39	0,3	-	0,35	0,2	0,4	-	0,4	< 0,08	0,4
dormer roof	external air	0,1	0,08	-	0,4	0,08	0,08	-	0,1	< 0,08	0,4
walls	external air	0,15	0,12	-	0,49	0,15	0,36	-	0,34	< 0,08	0,5
dormer walls	external air	0,1	0,08	-	0,4	0,08	0,1	-	0,1	< 0,08	0,1
cellar ceiling	cellar air or soil	0,35	0,29	-	0,4	0,25	0,4	-	0,4	< 0,08	0,4
floor to soil	cellar air or soil	0,86	0,86	-	0,08	0,86	0,86	-	0,86	< 0,08	0,86
walls to soil	cellar air or soil	0,88	0,88	-	0,08	0,88	0,88	-	0,88	< 0,08	0,5
walls to cellar	cellar air or soil	0,79	0,79	-	0,08	0,79	0,79	-	0,79	< 0,08	0,5
door to cellar	cellar air or soil	2,9	2,9	-	2,9	2,9	2,9	-	2,9	< 0,8	2,9
outside door	external air	2,9	2,9	-	2,9	2,9	2,9	-	2,9	< 0,8	2,9
windows	external air	1,64	1,35	-	1,76	0,9	1,64	-	1,64	< 0,8	1,76
Restricting limit		Primary energy consumption	Primary energy consumption	-	Maxiamal average thermal transmitance	Primary energy consumption	Primary energy consumption for some apartments and maximal thermal transmittance for others		Primary energy consumption for some apartments and maximal thermal transmittance for others		Maximal average thermal transmitance
Remarks				not possible to meet the requirements for the penthouse				Not allowed in Flanders		not possible to meet the requirements	

# Mean heat transmission losses (basis for cross country comparison)

	element area	correction factor (only for cross- country comparison)												
Element	[m²]	[-]	[W/K]											
tilted roof	150,4	1	15,0	12,0	-	52,6	12,0	12,0	-	15,0	-	15,0		
flat roof	36,7	1			-				-	14,7	-			
dormer roof	7,5	1			-				-		-			
walls	454,4	1			-				-		-			
dormer walls	4,4	1	0,4	0,4	-	1,8	0,4	0,4	-	0,4	-	0,4		
cellar ceiling	173,5	0,6	36,4	30,2	-	41,6	26,0	41,6	-	41,6	-	41,6		
floor to soil	0	0,6	0,0	0,0	-	0,0	0,0	0,0	-	0,0	-	0,0		
walls to soil	0	0,6	0,0	0,0	-	0,0	0,0	0,0	-	0,0	-	0,0		
walls to cellar	0	0,6	0,0	0,0	-	0,0	0,0	0,0	-	0,0	-	0,0		
door to cellar	0	0,6	0,0	0,0	-	0,0	0,0	0,0	-	0,0	-	0,0		
outside door	2,1	1	6,1	6,1	-	6,1	6,1	6,1	-	6,1	-	6,1		
windows	127,4	1	208,9	172,0	-	224,2	114,7	208,9	-	208,9	-	224,2		
	056.4	.	250	207	0	ECE	225	440	0	442		F22		
sum	956,4		350	287	0	565	235	448	0	442	0	532		
Mean heat transmi	ission													
losses per m² enve	elope		0,37	0,30	-	0,59	0,25	0,47	-	0,46	-	0,56		

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Country Luxembourg Region whole country

Type of requirements /

The calculation has been done according to the Luxembourg "Règlement grand-ducal" (short: RGD) from

method used to proof the compliance

The Calculation has been usine according to the Eucenhood's regional grains used. (Class 1062) its answer requirements, insulation of pipes for heat transfer / hot water transfer and specific fan power for ventilation. Additionally there are main requirements for the heating and primary energy consumption.

Requirements in force since

2008

# Resulting U-values

Model building N°							2				
Building type						apartmer	t building				
/ariant N°		2-0	2-11	2-12	2-13	2-21	2-22	2-31	2-32	2-41	2-42
variant name		basis	hg-bnc	hg-pellet	hg-hp	dhw-el	dhw-sol	vent- nomec	vent-rec	sys-el	sys- sol/rec
J-values	U-value defined for temperature difference between room and										
tilted roof	external air	0,2	0,2	0,2	0,2	0,14	0,2	0,2	0,25	-	0,25
flat roof	external air	0,2	0,2	0,2	0,2	0,14	0,2	0,2	0,25	-	0,25
dormer roof	external air	0,2	0,2	0,2	0,2	0,14	0,2	0,2	0,25	-	0,25
walls	external air	0,24	0,24	0,25	0,25	0,13	0,25	0,215	0,32	-	0,32
dormer walls	external air	0,2	0,24	0,25	0,25	0,13	0,25	0,215	0,32	-	0,32
cellar ceiling	cellar air or soil	0,4	0,4	0,4	0,4	0,3	0,4	0,4	0,4	-	0,4
floor to soil	cellar air or soil	0,4	0,4	0,4	0,4	0,3	0,4	0,4	0,4	-	0,4
walls to soil	cellar air or soil	0,4	0,4	0,4	0,4	0,3	0,4	0,4	0,4	-	0,4
walls to cellar	cellar air or soil	0,4	0,4	0,4	0,4	0,3	0,4	0,4	0,4	-	0,4
door to cellar	cellar air or soil	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	-	2,5
outside door	external air	2	2	2	2	2	2	2	2	-	2
windows	external air	1,25	1,35	1,35	1,35	0,8	1,35	0,95	1,5	-	1,5
estricting limit		maximum primary energy demand	maximum primary energy demand	maximum heat transfer coefficient	maximum heat transfer coefficient	maximum primary energy demand	maximum primary energy demand	maximum primary energy demand	maximum heat transfer coefficient	maximum primary energy demand	maximum heat transfer coefficient

# Mean heat transmission losses (basis for cross country comparison)

	element area	correction factor (only for cross- country comparison)	Neat transfer coefficient   Next   Next										
Element	[m²]	[-]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	
tilted roof	150,4	1	30,1	30,1	30,1	30,1	21,1	30,1	30,1	37,6	-	37,6	
flat roof	36,7	1	7,3	7,3	7,3	7,3	5,1	7,3	7,3	9,2	-	9,2	
dormer roof	7,5	1	1,5	1,5	1,5	1,5	1,1	1,5	1,5	1,9	-	1,9	
walls	454,4	1	109,1	109,1	113,6	113,6	59,1	113,6	97,7	145,4	-	145,4	
dormer walls	4,4	1	0,9	1,1	1,1	1,1	0,6	1,1	0,9	1,4	-	1,4	
cellar ceiling	173,5	0,6	41,6	41,6	41,6	41,6	31,2	41,6	41,6	41,6	-	41,6	
floor to soil	0	0,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	-	0,0	
walls to soil	0	0,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	-	0,0	
walls to cellar	0	0,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	-	0,0	
door to cellar	0	0,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	-	0,0	
outside door	2,1	1	4,2	4,2	4,2	4,2	4,2	4,2	4,2	4,2	-	4,2	
windows	127,4	1	159,3	172,0	172,0	172,0	101,9	172,0	121,0	191,1	-	191,1	
sum	956,4		354	367	371	371	224	371	304	432	0	432	
Mean heat transm			0.07	2.22	2.22	0.00	2.00	0.00	2.22	0.45		0.45	
losses per m <sup>2</sup> env	еюре		0,37	0,38	0,39	0,39	0,23	0,39	0,32	0,45	-	0,45	

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Country France Alsace (H1b) Region

Type of requirements /

The used method is based on several steps:1) use the "reference" U values of each building fabric component method used to proof the compliance

method used to proof the compliance

to calculate the building overall Uvalue Ubat 2) make sure the result is lower than 1,2 x the "refrence" Ubat 3) calculate the project consumption (C in kWh/m2 primary energy) and the reference consumption Cref 4)

Check compliance in having C < Cref and C < Cepmax which is an absolute figure depending only on the energy and the location 5) depending on the result, iterate by modifying some Uvalues to comply with the "lowest" effort.

Requirements in force since

September 2006

# Resulting U-values

Model building N°							2				
Building type						apartmen	t building				
Variant N°		2-0	2-11	2-12	2-13	2-21	2-22	2-31	2-32	2-41	2-42
variant name		basis	hg-bnc	hg-pellet	hg-hp	dhw-el	dhw-sol	vent- nomec	vent-rec	sys-el	sys- sol/rec
U-values	U-value defined for temperature difference between room and										
tilted roof	external air	0,2	0,2	0,2	0,2	0,15	0,2	0,2	0,2	0,15	0,2
flat roof	external air	0,27	0,2	0,2	0,27	0,15	0,27	0,2	0,27	0,15	0,3
dormer roof	external air	0,2	0,2	0,2	0,2	0,15	0,2	0,2	0,2	0,15	0,2
walls	external air	0,36	0,3	0,3	0,36	0,2	0,36	0,3	0,36	0,3	0,4
dormer walls	external air	0,36	0,3	0,3	0,36	0,2	0,36	0,3	0,36	0,3	0,4
cellar ceiling	cellar air or soil	0,27	0,2	0,2	0,27	0,15	0,27	0,2	0,27	0,2	0,27
floor to soil	cellar air or soil	0,27	0,2	0,2	0,27	0,15	0,27	0,2	0,27	0,2	0,27
walls to soil	cellar air or soil	0,2	0,2	0,2	0,2	0,15	0,2	0,2	0,2	0,2	0,2
walls to cellar	cellar air or soil	0,2	0,2	0,2	0,2	0,15	0,2	0,2	0,2	0,2	0,2
door to cellar	cellar air or soil	1,5	1,5	1,5	1,5	1	1,5	1,5	1,5	1,5	1,5
outside door	external air	1,5	1,5	1,5	1,5	1	1,5	1,5	1,5	1,5	1,5
windows	external air	1,8	1,6	1,6	1,8	1	1,8	1,6	1,8	1,4	2
Restricting limit		Cref	Cref	Cref	Cref	СерМах	Cref	Cref	Cref	Cref	Cref (+Ubatref)
Remarks		reference Psi values for thermal briges				needs also special treatment of thermal bridging to get compliance					

# Mean heat transmission losses (basis for cross country comparison)

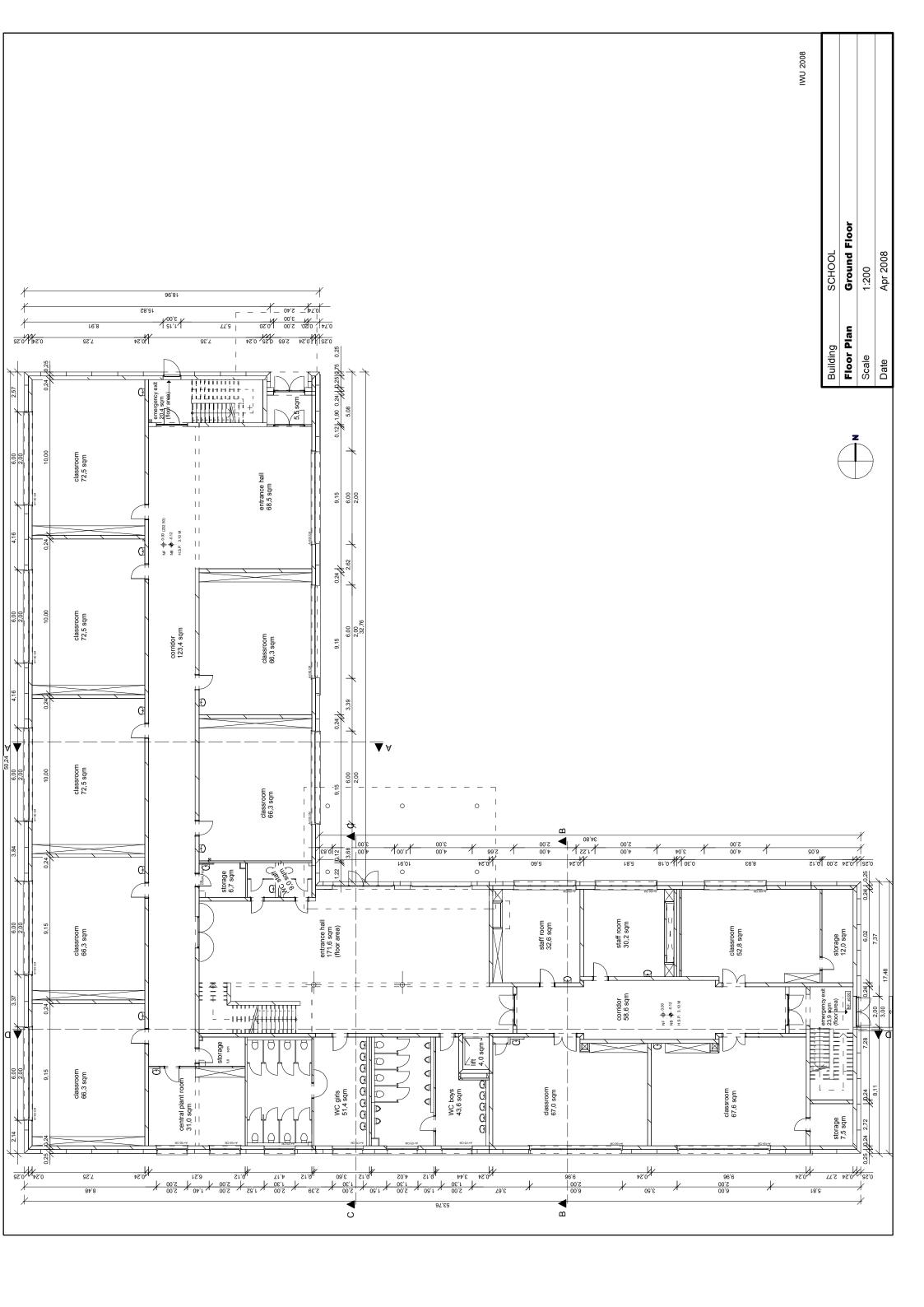
	element area	correction factor (only for cross- country comparison)				he	eat transfe	r coefficie	ent			
Element	[m²]	[-]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]
tilted roof	150,4	1	30,1	30,1	30,1	30,1	22,6	30,1	30,1	30,1	22,6	30,1
flat roof	36,7	1	9,9	7,3	7,3	9,9	5,5	9,9	7,3	9,9	5,5	11,0
dormer roof	7,5	1	1,5	1,5	1,5	1,5	1,1	1,5	1,5	1,5	1,1	1,5
walls	454,4	1	163,6	136,3	136,3	163,6	90,9	163,6	136,3	163,6	136,3	181,8
dormer walls	4,4	1	1,6	1,3	1,3	1,6	0,9	1,6	1,3	1,6	1,3	1,8
cellar ceiling	173,5	0,6	28,1	20,8	20,8	28,1	15,6	28,1	20,8	28,1	20,8	28,1
floor to soil	0	0,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
walls to soil	0	0,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
walls to cellar	0	0,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
door to cellar	0	0,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
outside door	2,1	1	3,2	3,2	3,2	3,2	2,1	3,2	3,2	3,2	3,2	3,2
windows	127,4	1	229,3	203,8	203,8	229,3	127,4	229,3	203,8	229,3	178,4	254,8
sum	956,4		467	404	404	467	266	467	404	467	369	512
Mean heat transm												
losses per m2 enve	elope		0,49	0,42	0,42	0,49	0,28	0,49	0,42	0,49	0,39	0,54

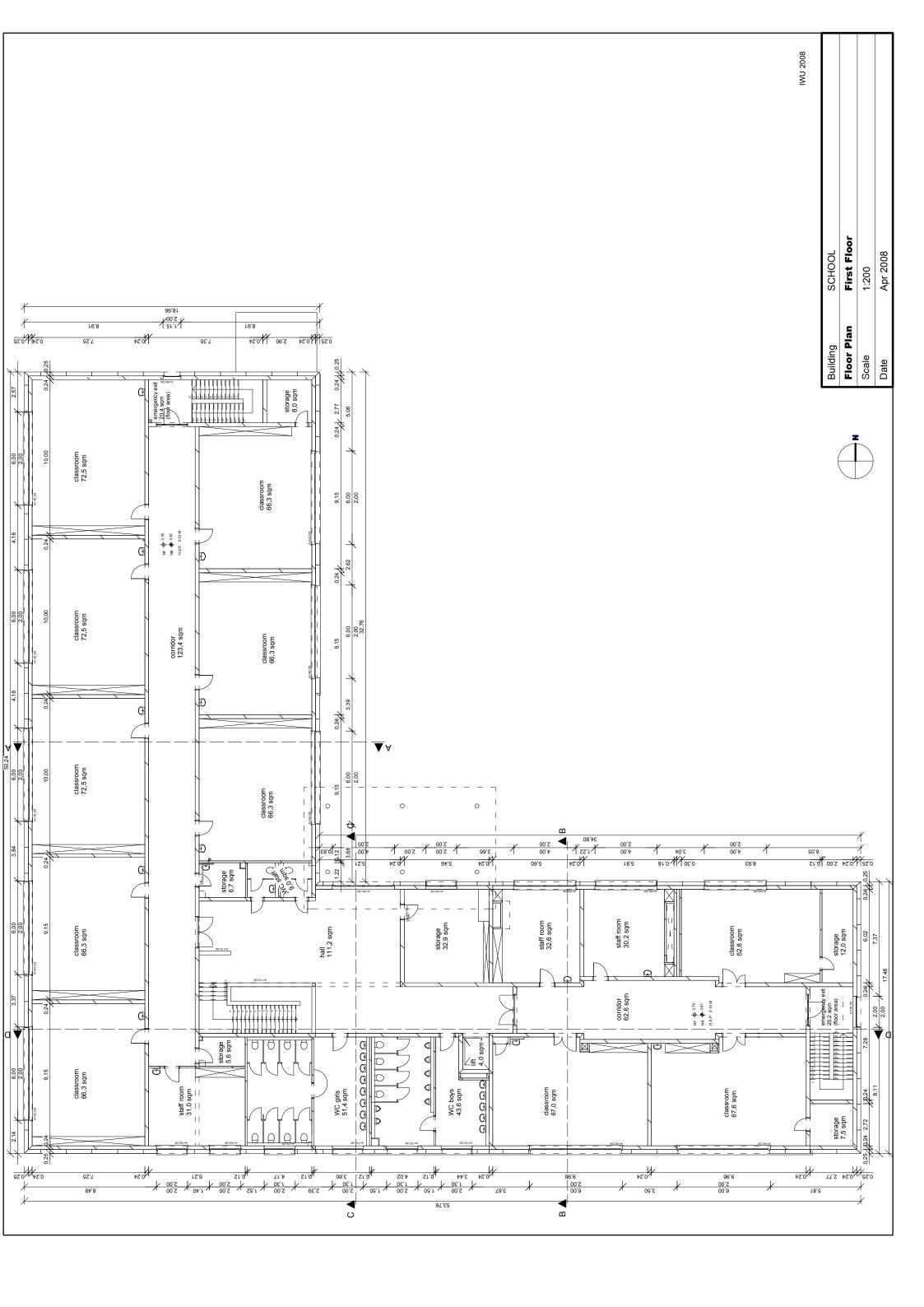
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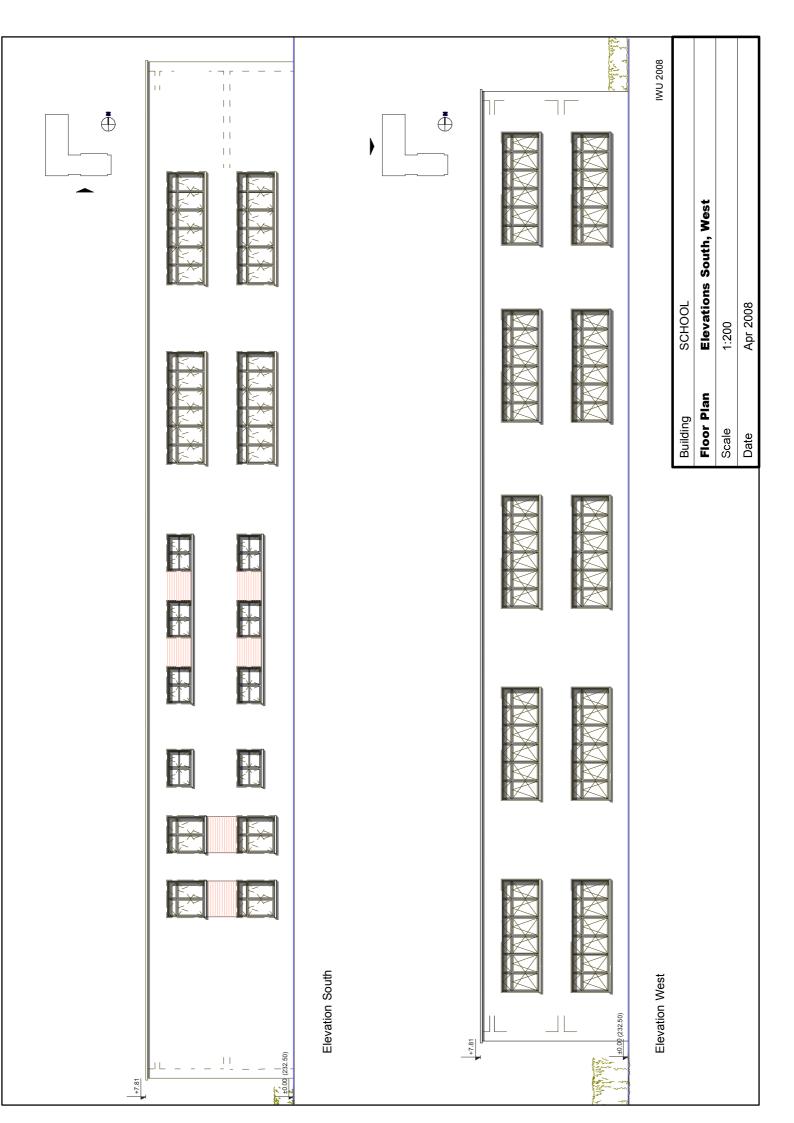
# Appendix 3: Definition of Model Building 3 – school

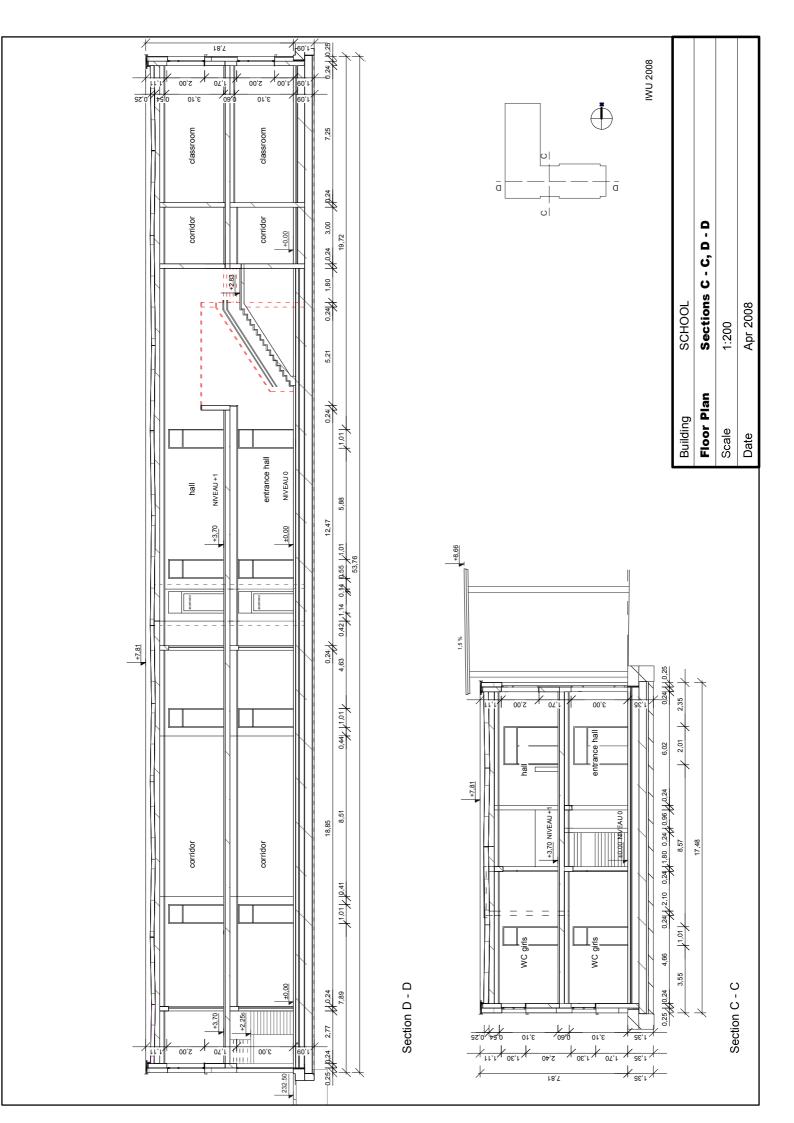
Appendix 3a: Plans

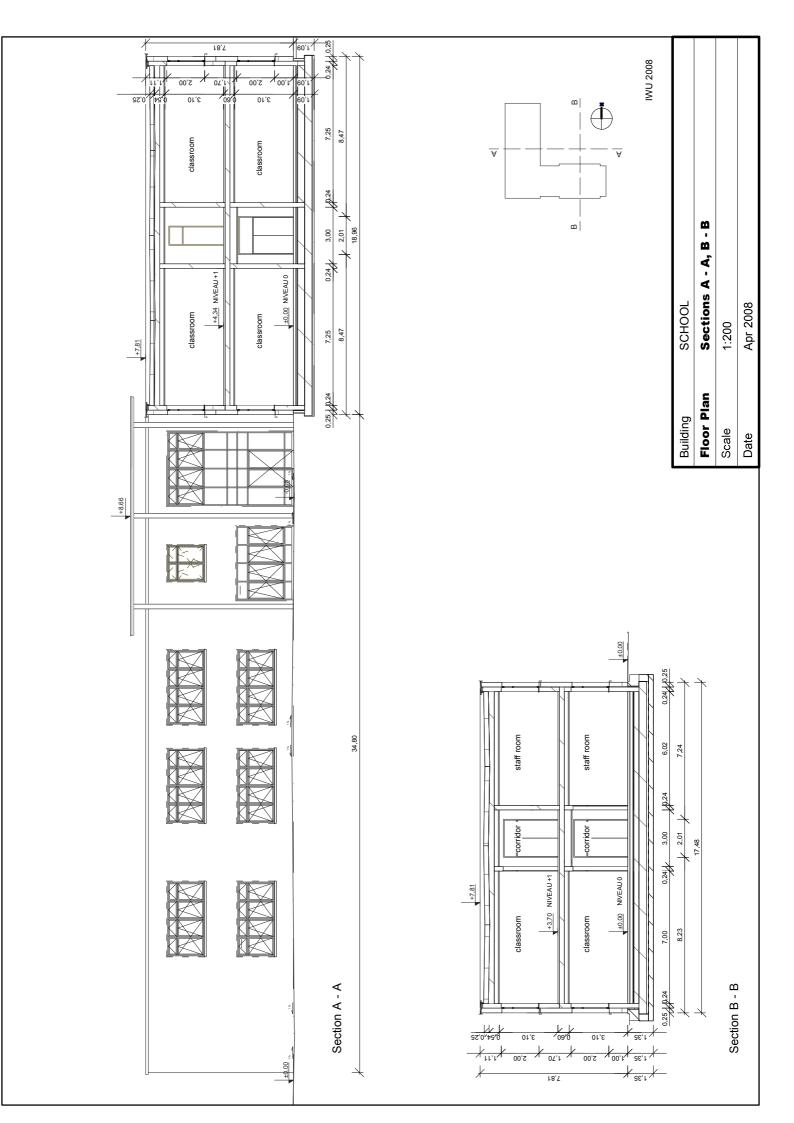














# Appendix 3b: Detailed envelope area calculation (external dimensions)

	name area element (free)	further specification	/ location		dedicated orientation for windows	reductio n area: insert "R"	width	length	height	number (if <> 1)		gross surface area	net surface area	specific loss
							[m]	[m]	[m]		[m²]	[m²]	[m²]	[W/K]
1.	floor 1	central and Eastern	building partition	floor			17,48	53,76					939,7	0,0
2.	floor 2	Northern building pa	artition	floor			32,76	18,96					621,1	0,0
3.	facade N1a	orientation North	part. N, ground	wall to soil N	I			18,96	1,09				20,7	0,0
4.	facade N1b	orientation North	part. N, external air	wall N				18,96	7,81			148,1	136,3	0,0
5.	door N1	orientation North	part. N	door N		R		2,00	3,00				6,0	0,0
6.	door N2	orientation North	part. N	door N		R		1,15	3,00				3,5	0,0
7.	window N1	orientation North	part. N	window N		R		1,15	2,00				2,3	0,0
8.	facade N2a	orientation North	part. E, ground	wall to soil N	ı			34,80	1,09				37,9	0,0
9.	facade N2b	orientation North	part. E, external air	wall N				34,80	7,81			271,8	187,8	0,0
10.	door N3	orientation North	part. E	door N		R		1,15	2,00				2,3	0,0
11.	window N2	orientation North	part. E, ground floor	window N		R		4,00	3,00		-2,30		9,7	0,0
12.	window N3	orientation North	part. E, first floor	window N		R		4,00	2,00				8,0	0,0
13.	window N4	orientation North	part. E, ground floor	window N		R		4,00	3,00				12,0	0,0
14.	window N5	orientation North	part. E, first floor	window N		R		2,00	2,00				4,0	0,0
15.	window N6	orientation North	part. E	window N		R		4,00	2,00	6			48,0	0,0
16.	facade E1a	orientation East	part. N, ground	wall to soil E				32,76	1,09				35,7	0,0
17.	facade E1b	orientation East	part. N, external air	wall E				32,76	7,81			255,9	183,9	0,0
18.	window E1	orientation East	part. N	window E		R		6,00	2,00	6			72,0	0,0
19.	facade E2a	orientation East	part. E, ground	wall to soil E				17,48	1,09				19,1	0,0
20.	facade E2b	orientation East	part. E, external air	wall E				17,48	7,81			136,5	126,5	0,0
21.	door E1	orientation East	part. E	door E		R		2,00	3,00				6,0	0,0
22.	window E2	orientation East	part. E	window E		R		2,00	2,00				4,0	0,0
23.	facade S1a	orientation South	ground	wall to soil S	3			53,76	1,09				58,6	0,0
24.	facade S1b	orientation South	external air	wall S				53,76	7,81			419,9	335,1	0,0
25.	window S1	orientation South		window S		R		6,00	2,00	4			48,0	0,0
26.	window S2	orientation South		window S		R		2,00	1,30	8			20,8	0,0
27.	window S3	orientation South		window S		R		2,00	2,00	4			16,0	0,0
28.	facade W1a	orientation West	part. N, ground	wall to soil W	/			50,24	1,09				54,8	0,0
29.	facade W1b	orientation West	part. N, external air	wall W				50,24	7,81			392,4	272,4	0,0
30.	window W1	orientation West		window W	/ W	R		6,00	2,00	10			120,0	0,0
31.	roof 1	central and Eastern		roof			17,48	53,76					939,7	0,0
32.	roof 2	Northern building pa	artition	roof			32,76	18,96					621,1	0,0
33.													0,0	0,0
34.													0,0	0,0
35.													0,0	0,0
36.													0,0	0,0
37.													0,0	0,0
38.													0,0	0,0
39.													0,0	0,0
40.													0,0	0,0



# Appendix 3c: Definition of the supply system types

# **Explanation of table colours:**



blue = to be used only if necessary; if not compatible to the national definitions or values the most similar ones were to be used



# Variants basis, hg-bnc, hg-pellet, hg-hp, vent-nomec

variant					
variant N°	3-0	3-1	3-2	3-3	3-4
variant name	basis	hg-bnc	hg-pellet	hg-hp	vent-nomec
variant type	basis			variation heat generator	variation ventilation
valiant type	condensing boiler for	variation rical generator	variation ricat generator	variation float gonorator	variation vontilation
	heating and hot water +	low temperature boiler			no mechanical
description	exhaust ventilation	(non-condensing)	wood pellet boiler	electric heat pump	ventilation system
	system				
L. 9 P					
building					
thermal envelope					
envelope surface area			definition see plans		
thermal bridges			outside envelope areas evant constructive thermal		
thermal bridges	blower door	blower door	blower door	blower door	a a blassa da sa
air-tightness	measurement:	measurement:	measurement:	measurement:	no blower door measurement
	n <sub>50</sub> <u>&lt;</u> 1,5 h <sup>-1</sup>	n50 <u>&lt;</u> 1,5 h-1	n50 <u>&lt;</u> 1,5 h-1	n50 <u>&lt;</u> 1,5 h-1	mousurement
sunblinds / shading system					
type		exte	ernal, white, 45° inclina	ntion	
control			manual		
solar gains					
total solar energy transmittance (for radiation perpendicular to the glazing)			0,6		
correction factor to account for the proportion of the frames			0,7		
external shading correction factor (all directions)  alternatively: partial shading correction factor and respective angle			0,9		
- for the horizon (by other buildings, topography)			0,9 (10°)		
- for overhangs (e. g. canopies, balconies etc.) above the component by	4		1,0 (0°)		
<ul> <li>partial shading correction factor for lateral building protrusions (fins)</li> </ul>			1,0 (0°)		
heating system					
g system					
heat generation (heating)					
<b></b>	condensing boiler	low temperature		electric heat pump	
type	condensing boiler	boiler (not condensing)	pellet boiler	(soil/water)	= var. 3-0
energy carrier	natural gas	natural gas	wood pellets	electricity	= var. 3-0
Land Con-	central plant room				
location	(inside the thermal envelope)	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
control temperature	adjusted in dependence	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
control temperature	of outdoor temperature	- vai. 3-0	- vai. 5-0		- vai. 5-0
	maximum values for supply / return			maximum values for supply / return	
further specification	temperature: 70°C /	= var. 3-0	= var. 3-0	temperature: 55°C /	= var. 3-0
	55°C			45°C	
thermal power	166 kW	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
heat distribution (heating)					
type	water pipes	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
location	all ducts inside the thermal envelope	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
	control of heat				
control temperature	distribution temperature	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
control temperature	according to outdoor air	Vai. 0 0	Vai. 0 0	vai. 0 0	var. 0 0
	temperature electric power = 225 W /				
electric consumption pump	running time = 9 h/d x	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
	200 d/a				
heating pipes (if detailed input required)					
string 1	main string / horizontal	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
pipe length insulation thickness	2 pipes x 113 m 20 mm	= var. 3-0 = var. 3-0	= var. 3-0 = var. 3-0	= var. 3-0 = var. 3-0	= var. 3-0 = var. 3-0
alternatively: U-value	0,20 W/(m <sup>2</sup> K)	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
string 2	main string / vertical	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
pipe length insulation thickness	2 pipes x 142 m 10 mm	= var. 3-0 = var. 3-0	= var. 3-0 = var. 3-0	= var. 3-0 = var. 3-0	= var. 3-0 = var. 3-0
alternatively: U-value	0,26 W/(m <sup>2</sup> K)	= var. 3-0 = var. 3-0	= var. 3-0 = var. 3-0	= var. 3-0 = var. 3-0	= var. 3-0 = var. 3-0
string 3	distribution in rooms	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
pipe length	2 pipes x 842 m	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
insulation thickness alternatively: U-value	10 mm 0,26 W/(m <sup>2</sup> K)	= var. 3-0 = var. 3-0	= var. 3-0 = var. 3-0	= var. 3-0 = var. 3-0	= var. 3-0 = var. 3-0
Entitional Contract	5,20 M (III N)	vai. 0 0	val. 0 0	va 0-0	va 0-0
heat emission (heating)					
type	radiators	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
control	thermostatic valves (regulation range: 2K)	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
	, against runger 210)				



variant N°

variant name

variant type

description

### hot water system

### heat demand hot water

utilisation type

net heat demand

### heat generation

type

energy carrier location

further specification

# heat storage type

location

volume heat loss per day electric power storage load pump

### heat distribution

type

location

temperature

electric consumption pump

# heating pipes (if detailed input required) string 1 pipe length insulation thickness alternatively: U-value string 2

atternatively: U-value string 2 pipe length insulation thickness alternatively: U-value

pipe length insulation thickness alternatively: U-value

### ventilation system

type

heat recovery fraction

mechanical air flow rate

electric consumption fans specific fan power

total pressure difference

heat recovery system

minimum supply air temperature humidification dehumdification

cooling

# lighting

type lamp ballast control

type of lighting maintained illuminance

luminous efficiency of the light source + ballast efficiency of luminaire

electric power (design value)

electric power (maintained value)

3-0	3-1	3-2	3-3	3-4
basis	hg-bnc	hg-pellet	hg-hp	vent-nomec
basis	variation heat generator	variation heat generator	variation heat generator	variation ventilation
condensing boiler for				
heating and hot water +	low temperature boiler	wood pellet boiler	electric heat pump	no mechanical
exhaust ventilation	(non-condensing)	wood pellet bollel	electric rieat purip	ventilation system
system				
hot water for WC / no showers	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
0,085 kWh/d x 200 d/a = 17kWh/(m <sup>2</sup> a)	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
combined with heat	combined with heat generator for space	combined with heat generator for space	combined with heat generator for space	= var. 3-0
generator for space heating (see above)	heating (see above)	heating (see above)	heating (see above)	= Val. 3-0
(see above)	(see above)	(see above)	(see above)	= var. 3-0
(see above)	(see above)	(see above)	(see above)	= var. 3-0
-	-	-	-	= var. 3-0
hot water storage	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
central plant room	- var. 3=0	- var. 3=0	- vai. 5*U	- vai. 3-0
(inside the thermal	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
envelope) 749 liter	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
4,07 kWh/d	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
73 W	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
hot water circulation	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
completely inside of the	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
thermal envelope 60°C	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
26 W x 9 h/d x 200 d/a	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
		1		
main string / horizontal	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
2 pipes x 6 m	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
20 mm	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
0.20 W/(m <sup>2</sup> K)	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
main string / vertical	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
2 pipes x 72 m 10 mm	= var. 3-0 = var. 3-0	= var. 3-0 = var. 3-0	= var. 3-0 = var. 3-0	= var. 3-0 = var. 3-0
0.26 W/(m <sup>2</sup> K)	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
distribution to taps in				
WCs	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
1 pipe x 22 m	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
10 mm	= var. 3-0 = var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
0.26 W/(m <sup>2</sup> K)	= Val. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
supply/exhaust ventilation system	= var. 3-0	= var. 3-0	= var. 3-0	none
with heat recovery 75%	= var. 3-0	= var. 3-0	= var. 3-0	
constant volume	= var. 3-0	= var. 3-0	= var. 3-0	-
10 m <sup>3</sup> /h/m <sup>2</sup> x 2724.9 m <sup>2</sup> = 27249 m <sup>3</sup> /h	= var. 3-0	= var. 3-0	= var. 3-0	-
21.5 kW x 9 h/d x 200 d/a	= var. 3-0	= var. 3-0	= var. 3-0	-
0.79 W/(m <sup>3</sup> /h)	= var. 3-0	= var. 3-0	= var. 3-0	-
supply: 960 Pa exhaust: 750 Pa	= var. 3-0	= var. 3-0	= var. 3-0	-
integrated fluid circulation system, 75% heat recovery	= var. 3-0	= var. 3-0	= var. 3-0	-
18°C	= var. 3-0	= var. 3-0	= var. 3-0	-
none	= var. 3-0	= var. 3-0	= var. 3-0	-
none none	= var. 3-0 = var. 3-0	= var. 3-0 = var. 3-0	= var. 3-0 = var. 3-0	-
TOTIC	- var. 5-0	- vai. 3-0	- vai. 5-0	
flourescent tubes	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
low loss	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
manual	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
direct	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
300 lx	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
80 lm/W 80%	= var. 3-0 = var. 3-0	= var. 3-0 = var. 3-0	= var. 3-0 = var. 3-0	= var. 3-0 = var. 3-0
9.6 W/m² x 2724.9 m²				
= 26.16 kW	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0
6.4 W/m <sup>2</sup> x 2724.9 m <sup>2</sup> = 17.4 kW	= var. 3-0	= var. 3-0	= var. 3-0	= var. 3-0



# **Appendix 3d: Country sheets**

Country Region

Germany whole country

Type of requirements / method used to proof the compliance Requirements to be complied:

- maximum values for thermal transmittance
- primary energy demand for heating, hot water, ventilation, cooling/air-conditioning, lighting

The maximum primary energy demand is determined by means of a reference building.

Calculation according to the German Energy Saving Ordinance (Energieeinsparverordnung EnEV 2007)

simplified procedure for non-residential buildings / one-zone model

calculation according to DIN V 18599

Requirements in force since

October 2007

# **Resulting U-values**

Nodel building N° Building type				3 school		
suliding type				SCHOOL		
/ariant N°		3-0	3-1	3-2	3-3	3-4
variant name		basis	hg-bnc	hg-pellet	hg-hp	vent-nomec
J-values	U-value defined for temperature difference between room and					
roof	external air	0,56	0,56	0,56	0,56	0,52
wall	external air	0,9	0,8	0,9	0,9	0,7
wall to soil	soil	0,9	0,8	0,9	0,9	0,7
windows	external air	2,0	2,0	2,0	2,0	1,5
doors	external air	3,0	3,0	3,0	3,0	2,0
floor	soil	0,9	0,9	0,9	0,9	0,7
Restricting limit		maximum heat transfer coefficient	primary energy demand and primary energy demand	maximum heat transfer coefficient	maximum heat transfer coefficient	primary energy demand
Remarks						

# Mean heat transmission losses (basis for cross country comparison)

	element area	correction factor (only for cross- country comparison)		heat	transfer coeffic	cient	
Element	[m²]	[-]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]
roof	1560,9	1	874,1	874,1	874,1	874,1	811,7
wall	1242	1	1117,8	993,6	1117,8	1117,8	869,4
wall to soil	226,8	0,6	122,5	108,9	122,5	122,5	95,3
windows	364,8	1	729,6	729,6	729,6	729,6	547,2
doors	17,8	1	53,4	53,4	53,4	53,4	35,6
floor	1560,9	0,35	491,7	491,7	491,7	491,7	382,4
sum	4973,2	]	3389	3251	3389	3389	2742
Mean heat transn	nission						
losses per m² env	relope		0,68	0,65	0,68	0,68	0,55
(not considering the	ermal bridges)						

 $[W/(m^2K)]$ 

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Country Region Austria whole country

Type of requirements / method used to proof the compliance

In Austria the relevant regulation for the heating demand is the net energy demand for heating per  $m^3$  depending on the proportion of building volume to building survace (lc = V/A). Additionally to the heating demand service buildings (e.g. schools) have to fullfil a regulation for the externally induced cooling demand per  $m^3$ . The requirements are regulated in the OIB directive 6 "Energieeinsparung und Wärmeschutz" from April 2007 and are calculated with a reference climate with 3.400 degree days. The calculation method is defined in the Austrian Standard ÖNORM B 8110-6, which is based on the ISO EN 13790. Main estimations, which were not provided: "heavy construction" (brick or concrete). In Austria, the heating system has no influence on the U-Values. The current requirement (until 31.12.2009): HWB = 9\*(1+2/lc) kWh/ $m^3a$ . The data of the model building: lc = 2,79 m; HWB < 15,4 kWh/ $m^3a$ .

Requirements in force since

April 2007

### **Resulting U-values**

Model building N° Building type				3 school			
Variant N°		3-0	3-1	3-2	3-3	3-4	1
variant name		basis	hg-bnc	hg-pellet	hg-hp	vent-nomec	
U-values	U-value defined for temperature difference between room and						
roof	external air	0,2	0,2	0,2	0,2	0,2	[W/(m²
wall	external air	0,35	0,35	0,35	0,35	0,35	[W/(m²
wall to soil	soil	0,4	0,4	0,4	0,4	0,4	[W/(m²
windows	external air	1,4	1,4	1,4	1,4	1,4	[W/(m²
doors	external air	1,7	1,7	1,7	1,7	1,7	[W/(m²
floor	soil	0,4	0,4	0,4	0,4	0,4	[W/(m²
Restricting limit		net energy demand for heating	net energy demand for heating	net energy demand for heating	net energy demand for heating	net energy demand for heating	
Remarks		in the OIB directive 6. The requirement for heating and cooling demand will be achieved by using the minimum	in the OIB directive 6. The requirement for heating and cooling demand will be achieved by using the minimum	in the OIB directive 6. The requirement for heating and cooling demand will be achieved by using the minimum	in the OIB directive 6. The requirement for heating and cooling demand will	in the OIB directive 6. The requirement for heating and cooling demand will be achieved by using the minimum	

# Mean heat transmission losses (basis for cross country comparison)

	element area	correction factor (only for cross- country comparison)		heat	transfer coeffic	ient	
Element	[m²]	[-]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]
roof	1560,9	1	312,2	312,2	312,2	312,2	312,2
wall	1242	1	434,7	434,7	434,7	434,7	434,7
wall to soil	226,8	0,6	54,4	54,4	54,4	54,4	54,4
windows	364,8	1	510,7	510,7	510,7	510,7	510,7
doors	17,8	1	30,3	30,3	30,3	30,3	30,3
floor	1560,9	0,35	218,5	218,5	218,5	218,5	218,5
sum	4973,2	]	1561	1561	1561	1561	1561
Mean heat transmis	sion						
losses per m² envel	оре		0,31	0,31	0,31	0,31	0,31
(not considering therm	nal bridges)						

 $[W/(m^2K)]$ 

Country
Region
Czech Republic
whole country

Type of requirements / method used to proof the compliance

Calculation method according to the requirements of the Act no. 406/2000 Coll. on Energy Management, its amendment no. 177/2006 Coll. as amended by no. 406/2006 Coll. and the Code of Practice no. 148/2007 Coll. on Energy Demand of Buildings as amended. A specific technical regulation in this field is the Czech standard ČSN 73 0540 "Thermal Protection of Buildings" (and a set of relevant standards), which the abovementioned statutes are related to and make its requirements binding. Valid requirements for U values are set forth in the second part of the standard i.e. in ČSN 73 0540-2 as of April 2007. Two groups of U values are prescribed: recommended values and required values. Required U-values were used in this table. According to the Czech regulations for the new buildings the maximum U-values as mandatory values do not depend on the energy efficiency of the heat supply system or of the lighting system.

Requirements in force since

April 2007

### **Resulting U-values**

Model building N° Building type				3 school		
diffulling type				SCHOOL		
ariant N°		3-0	3-1	3-2	3-3	3-4
variant name		basis	hg-bnc	hg-pellet	hg-hp	vent-nomec
J-values	U-value defined for temperature difference between room and					
roof	external air	0,24	0,24	0,24	0,24	0,24
wall	external air	0,3	0,3	0,3	0,3	0,3
wall to soil	soil	0,45	0,45	0,45	0,45	0,45
windows	external air	1,7	1,7	1,7	1,7	1,7
doors	external air	1,7	1,7	1,7	1,7	1,7
floor	soil	0,45	0,45	0,45	0,45	0,45
Restricting limit		U-Values	U-Values	U-Values	U-Values	U-Values
emarks						

# Mean heat transmission losses (basis for cross country comparison)

	element area	correction factor (only for cross- country comparison)	heat transfer coefficient							
Element	[m²]	[-]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]			
roof	1560,9	1	374,6	374,6	374,6	374,6	374,6			
wall	1242	1	372,6	372,6	372,6	372,6	372,6			
wall to soil	226,8	0,6	61,2	61,2	61,2	61,2	61,2			
windows	364,8	1	620,2	620,2	620,2	620,2	620,2			
doors	17,8	1	30,3	30,3	30,3	30,3	30,3			
floor	1560,9	0,35	245,8	245,8	245,8	245,8	245,8			
sum	4973,2	]	1705	1705	1705	1705	1705			
Mean heat transmis	sion									
losses per m <sup>2</sup> envelo (not considering therm			0,34	0,34	0,34	0,34	0,34	[W/(m		

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Country Region Poland whole country

Type of requirements / method used to proof the compliance

The calculation based on just accepted methodology for building performance calculation. It base on hourly climatic data and used asset rating methodology. Additional some requirements related to building thermal condition are updated and presented in "Ordinance about technical condition to be fulfilled by the buildings and theirs surroundings". In Poland max U values depend only on the building type (for windows also on location in climatic zone), and are independed from the heating system.

According to the Polish methodology thermal envelope size is calculatedd on external dimensions.

Requirements in force since

October 2002

# **Resulting U-values**

lodel building N°				3		
uilding type				school		
ariant N°		3-0	3-1	3-2	3-3	3-4
variant name		basis	hg-bnc	hg-pellet	hg-hp	vent-nomec
-values	U-value defined for temperature difference between room and					
roof	external air	0,5	0,5	0,5	0,5	0,5
wall	external air	0,55	0,55	0,55	0,55	0,55
wall to soil	soil	0,7	0,7	0,7	0,7	0,7
windows	external air	2,6	2,6	2,6	2,6	2,6
doors	external air	2,6	2,6	2,6	2,6	2,6
floor	soil	0,6	0,6	0,6	0,6	0,6
estricting limit		U-values	U-values	U-values	U-values	U-values
emarks		max. U-value of windows depending on climate: 2.3 or 2.6 W/(m²K)	max. U-value of windows depending on climate: 2.3 or 2.6 W/(m <sup>2</sup> K)	max. U-value of windows depending on climate: 2.3 or 2.6 W/(m²K)	max. U-value of windows depending on climate: 2.3 or 2.6 W/(m²k)	max. U-value of windows depending on climate: 2.3 or 2.6 W/(m²K)

# Mean heat transmission losses (basis for cross country comparison)

	element area	correction factor (only for cross- country comparison)		heat	transfer coeffic	cient	
Element	[m²]	[-]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]
roof	1560,9	1	780,5	780,5	780,5	780,5	780,5
wall	1242	1	683,1	683,1	683,1	683,1	683,1
wall to soil	226,8	0,6	95,3	95,3	95,3	95,3	95,3
windows	364,8	1	948,5	948,5	948,5	948,5	948,5
doors	17,8	1	46,3	46,3	46,3	46,3	46,3
floor	1560,9	0,35	327,8	327,8	327,8	327,8	327,8
sum	4973,2	] [	2881	2881	2881	2881	2881
Mean heat transn	nission						
losses per m² env	relope		0,58	0,58	0,58	0,58	0,58
(not considering the	ermal bridges)						

[W/(m<sup>2</sup>K)]

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Country Sweden
Region whole country

Type of requirements / method used to proof the compliance

From the Swedish regulation for building (Regelsamling för byggande - Boverkets byggregler, BBR 15, 2008)

Premises will be formulated so that the building's specific energy use highest amounts to 100 kWh per m2 floor area (Atemp) and years in climate zone south and 120 kWh per m2 floor area (Atemp) and years in climate zone north. For premises with ventilation over 0,35 l/s, m2 gets an addition to be done corresponding 70 (q-0,35) kWh per m2 floor area (Atemp) and years in climate zone south and 90 (q-0,35) kWh per m2 floor area (Atemp) and years in climate zone north, there q is it average ventilation during the entire heating season (l/s, m2). (BFS 2006:12).

General councils

2008

In the building's specific energy use does not be included activity electrical. (BFS 2006:12).

Requirements in force since

# **Resulting U-values**

Model building N° Building type				3 school		
Variant N°		3-0	3-1	3-2	3-3	3-4
variant name		basis	hg-bnc	hg-pellet	hg-hp	vent-nomec
J-values	U-value defined for temperature difference between room and					
roof	external air	-	-	-	0,15	-
wall	external air	-	-	-	0,15	-
wall to soil	soil	-	-	-	0,12	-
windows	external air	-	-	-	1,2	-
doors	external air	-	-	-	1,0	-
floor	soil	-	-	-	0,12	-
Restricting limit		Maximum specific energy consumption 166 kWh/m2 floor area, with ventilation 1,5 ac/h	-	Maximum specific energy consumption 166 kWh/m2 floor area, with ventilation 1,5 ac/h	Maximum specific energy consumption 166 kWh/m2 floor area, with ventilation 1,5 ac/h	-
Remarks		Difficult to meet the requirements without heat pump. Result 175 kWh/m2 floor area - more than restricting limit 166 kWh/m2. Wall to soil included in floor	not possible to meet the requirements	Difficult to meet the requirements without heat pump. Result 208 kWh/m2 floor area - more than restricting limit 166 kWh/m2. Wall to soil included in floor	Result 160 kWh/m2 floor area - less than restricting limit 166 kWh/m2. Wall to soil included in floor	not possible to meet the requirements

# Mean heat transmission losses (basis for cross country comparison)

	element area	correction factor (only for cross- country comparison)		hea	t transfer coeffic	cient		
Element	[m²]	[-]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	
roof	1560,9	1	-	-	-	234,1	-	
wall	1242	1	-	-	-	186,3	-	
wall to soil	226,8	0,6	-	-	-	16,3	-	
windows	364,8	1	-	-	-	437,8	-	
doors	17,8	1	-	-	-	17,8	-	
floor	1560,9	0,35	-	-	-	65,6	-	
sum	4973,2		0	0	0	958	0	
Mean heat transm								
losses per m <sup>2</sup> env			-	-	-	0,19	-	[W
(not considering the	rmal bridges)							

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Country Region

# Denmark whole country

Type of requirements / method used to proof the compliance Monthly calculation according to the SBi direction 213, Calculation of buildings energy demand. - heating demand is based on prEN ISO 13790:2005, which elaborates on EN 832 and EN ISO

- cooling demand is based on prEN ISO 13790:2005.

   heat loss from installations is calculated as defined in prEN 15316 part 2.3 og part 3.2.

   boilers is calculated according to prEN 15316 part 4.1 methode II and part 3.3.

   calculation tool: Be06, version 4,8,7,12

Requirements to be complied: maximum primary energy demand, maximum values for overall thermal transmittance and maximum U-values for constructions.

This new building must have an energy consumption less than 95+2200/A, having a dimensioning transmission losse less than  $7~\rm W/m^2$  (two storey) through the thermal envelope or meet maximum U-values for the constructions.

Requirements in force since

January 2006

# **Resulting U-values**

Nodel building N° Building type				3 school		
ariant N°		3-0	3-1	3-2	3-3	3-4
variant name		basis	hg-bnc	hg-pellet	hg-hp	vent-nomec
values	U-value defined for temperature difference between room and					
roof	external air	0,12	-	0,11	0,2	0,16
wall	external air	0,16	-	0,12	0,22	0,18
wall to soil	soil	0,2	-	0,15	0,25	0,25
windows	external air	1,2	-	1,0	1,3	1,25
doors	external air	1,2	-	1,2	1,2	1,2
floor	soil	0,2	-	0,15	0,2	0,25
stricting limit		Energy frame plus goodwill (6,7 kWh/m² per. year) for ventilation above 1,2 l/(s m²) = 102,4 kWh/m² per. year .	Non condensiing boiler is illegal in new Danish buildings!	kWh/m² per. year) for ventilation above 1,2 l/(s m²) = 102,4 kWh/m² per. year .	goodwill (6,7 kWh/m² per. year) for ventilation above 1,2 l/(s m²) = 102,4 kWh/m² per. year .	Energy frame = 95,7 kWh/m per. year.
narks				Efficiency at full load 92.3 % and at part load (20%) 89.3 %	COP = 3 (full load) 2.7 (50 % load)	

# Mean heat transmission losses (basis for cross country comparison)

	element area	correction factor (only for cross- country comparison)		hea	t transfer coeffic	cient	
Element	[m²]	[-]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]
roof	1560,9	1	187,3		171,7	312,2	249,7
wall	1242	1	198,7	-	149,0	273,2	223,6
wall to soil	226,8	0,6	27,2	-	20,4	34,0	34,0
windows	364,8	1	437,8	-	364,8	474,2	456,0
doors	17,8	1	21,4	-	21,4	21,4	21,4
floor	1560,9	0,35	109,3	-	81,9	109,3	136,6
sum	4973,2	] [	982	0	809	1224	1121
Mean heat transm	ission						
losses per m² enve	elope		0,20	-	0,16	0,25	0,23
(not considering ther	mal bridges)						

 $[W/(m^2K)]$ 

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Country Region UK England & Wales

Type of requirements / method used to proof the compliance

The calculation is based on the methodology that calculates monthly energy use and carbon dioxide emissions of a building given a description of the building geometry, construction, use and HVAC and lighting equipment. It was originally based on the Dutch methodology NEN 2916:1998 (Energy Performance of Non-Residential Buildings) and has since been modified to comply with the emerging CEN Standards. According to UK building regulation 2006, the maximum building fabric U - values are calculated to fulfil the requirement.

Requirements in force since

April 2006

# **Resulting U-values**

[building 3 - results.xls]uk

Variant N°   Variant name	Model building N°				3		
D-values	Building type				school		
D-values	Variant N°		3-0	3-1	3-2	3-3	3-4
roof external air 0,12 0,1 0,25 0,25 0,25 wall external air 0,2 0,15 0,35 0,35 0,35 wall to soil soil 0,2 0,15 0,35 0,35 0,35 0,35 windows external air 1,0 1,2 1,99 1,99 1,99 doors external air 0,7 0,7 0,7 0,7 0,7 0,7 floor soil 0,12 0,11 0,25 0,25 0,25 0,25 0,25 0,25 0,25 0,25	variant name		basis	hg-bnc	hg-pellet	hg-hp	vent-nomec
wall         external air         0,2         0,15         0,35         0,35         0,35           wall to soil         soil         0,2         0,15         0,35         0,35         0,35           windows         external air         1,0         1,2         1,99         1,99         1,99           doors         external air         0,7         0,7         0,7         0,7         0,7           floor         soil         0,12         0,1         0,25         0,25         0,25     **Restricting limit*  **maximum CO2** emissions**  **maximum CO2** emissions**  **maximum U-values of elements**  **maximum U-values of elements**  **elements**  **maximum U-values of elements**  **elements**  **elements**  **maximum U-values of elements**  **elements**  **maximum U-values of elements**  **elements**  **element	J-values	temperature difference					
wall to soil         soil         0,2         0,15         0,35         0,35         0,35           windows         external air         1,0         1,2         1,99         1,99         1,99           doors         external air         0,7         0,7         0,7         0,7         0,7           floor         soil         0,12         0,1         0,25         0,25         0,25    Restricting limit  Maximum CO2  emissions  maximum CO2 emissions  maximum U-values of elements  maximum U-values of elements  elements	roof	external air	0,12	0,1	0,25	0,25	0,25
windows doors         external air         1,0         1,2         1,99         1,99         1,99           floor         soil         0,7         0,7         0,7         0,7         0,7           Restricting limit             maximum CO2 emissions         maximum CO2 emissions         maximum U-values of elements         maximum U-values of elements	wall	external air	0,2	0,15	0,35	0,35	0,35
doors floor  soil  0,7 0,7 0,7 0,7 0,7 0,7 0,7 0,7 0,7 0,	wall to soil	soil	0,2	0,15	0,35	0,35	0,35
floor  Soil  O,12  O,1  O,25  O,25  O,25  O,25  Restricting limit  maximum CO2 emissions  maximum CO2 emissions  maximum U-values of elements  maximum U-values of elements  elements	windows	external air	1,0	1,2	1,99	1,99	1,99
Restricting limit  maximum CO2 emissions  maximum CO2 emissions  maximum U-values of maximum U-values of maximum U-values of elements  elements  elements	doors	external air	0,7	0,7	0,7	0,7	0,7
emissions emissions elements elements elements	floor	soil	0,12	0,1	0,25	0,25	0,25
Remarks	Restricting limit						
	Remarks						

# Mean heat transmission losses (basis for cross country comparison)

	element area	correction factor (only for cross- country comparison)		heat	transfer coeffic	cient		
Element	[m²]	[-]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	
roof	1560,9	1	187,3	156,1	390,2	390,2	390,2	
wall	1242	1	248,4	186,3	434,7	434,7	434,7	
wall to soil	226,8	0,6	27,2	20,4	47,6	47,6	47,6	
windows	364,8	1	364,8	437,8	726,0	726,0	726,0	
doors	17,8	1	12,5	12,5	12,5	12,5	12,5	
floor	1560,9	0,35	65,6	54,6	136,6	136,6	136,6	$\Box$
sum	4973,2		906	868	1748	1748	1748	
Mean heat transm	ission							
losses per m² enve	elope		0,18	0,17	0,35	0,35	0,35	[٧
(not considering ther	mal bridges)							

considering district study of

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Netherlands Country Region whole country

Type of requirements / method used to proof the compliance

- Energy use calculations:

  \* Dutch Standard NEN 2916: Energy performance of non-residential buildings Determination method (NNI, March 2004).
- \* EPU for Windows Version 2.0 (NNI, 2006)

Requirements to be met:

- \* EPC <= 1,4 (EPC = Energy Performance Coefficient, based on primary energy demand), and
- \* Minimum Rc values (heat resistance) for thermal envelope (Rc >=2,5 m2K/W)

Requirements in force since

2003 (EPC<=1,4), 1992 (Rc>=2,5 W/m2K)

# **Resulting U-values**

Model building N°				3 school			
Building type				SCHOOL			
Variant N°		3-0	3-1	3-2	3-3	3-4	
variant name		basis	hg-bnc	hg-pellet	hg-hp	vent-nomec	
U-values	U-value defined for temperature difference between room and						
roof	external air	0,1	-	-	0,37	0,12	[W/(ı
wall	external air	0,1	-	-	0,37	0,12	[W/(ı
wall to soil	soil	0,1	-	-	0,37	0,12	[W/(ı
windows	external air	1,3	-	-	1,8	1,3	[W/(r
doors	external air	2,0	-	-	2,0	2,0	[W/(r
floor	soil	0,1	-	-	0,37	0,12	[W/(r
Restricting limit		EPC <=1,4	Required Rc = 75,0 in order to meet restictions	Not achievable	EPC <=1,4	EPC <=1,4	
Remarks		Difficult to meet the requirements. Ventilation and fan energy are high, beause no fan control is applied (constant volume). The running hours are fixed (based on function).		Wood pellet boiler is not a standard option in the calculation method and should be considered as "other heating system", which has a relatively low efficiency		Infiltration rate is assumed to be the same as in the other calculations.	

# Mean heat transmission losses (basis for cross country comparison)

	element area	correction factor (only for cross- country comparison)		hea	t transfer coeffic	cient		
Element	[m²]	[-]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	
roof	1560,9	1	156,1	-	-	577,5	187,3	
wall	1242	1	124,2	-	-	459,5	149,0	
wall to soil	226,8	0,6	13,6	-	-	50,3	16,3	
windows	364,8	1	474,2	-	-	656,6	474,2	
doors	17,8	1	35,6	-	-	35,6	35,6	
floor	1560,9	0,35	54,6	-	-	202,1	65,6	
sum	4973,2	]	858	0	0	1982	928	
Mean heat transm	ission							
losses per m2 enve	elope		0,17	-	-	0,40	0,19	[W/(m <sup>2</sup>
(not considering ther	mal bridges)							

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Country Region Belgium Flanders

Type of requirements / method used to proof the compliance

Method described in the decree of the 5th of march 2005. Three requirements are imposed: one limits the characteristic annual primary energy consumption for the building, a second one limits the average thermal transmitance for the whole building, and a third one gives the maximal values of the thermal transmittance of each component.

Requirements in force since

January 2007

# **Resulting U-values**

Model building N°				3		
Building type				school		
Variant N°		3-0	3-1	3-2	3-3	3-4
variant name		basis	hg-bnc	hg-pellet	hg-hp	vent-nomec
l-values	U-value defined for temperature difference between room and					
roof	external air	0,4	0,4	0,4	0,4	0,4
wall	external air	0,6	0,6	0,6	0,6	0,6
wall to soil	external air	0,6	0,6	0,6	0,6	0,6
windows	external air	2,5	2,5	2,5	2,5	2,5
doors	external air	2,9	2,9	2,9	2,9	2,9
floor	external air	0,4	0,4	0,4	0,4	0,4
Restricting limit		Maximal values of the thermal transmittance coefficients				
Remarks						

# Mean heat transmission losses (basis for cross country comparison)

	element area	correction factor (only for cross- country comparison)		hea	transfer coeffic	cient		
Element	[m²]	[-]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	
roof	1560,9	1	624,4	624,4	624,4	624,4	624,4	
wall	1242	1	745,2	745,2	745,2	745,2	745,2	
wall to soil	226,8	1	136,1	136,1	136,1	136,1	136,1	
windows	364,8	1	912,0	912,0	912,0	912,0	912,0	
doors	17,8	1	51,6	51,6	51,6	51,6	51,6	
floor	1560,9	1	624,4	624,4	624,4	624,4	624,4	
sum	4973,2		3094	3094	3094	3094	3094	
Mean heat transmi	ssion							
losses per m² enve	lope		0,62	0,62	0,62	0,62	0,62	[W/
(not considering them	mal bridges)							

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Country Region Luxembourg whole country

Type of requirements / method used to proof the compliance

According to the "Règlement grand-ducal du 22 November 1995" there are only requirements for the mean U-value. The system parameters (heating, ventilation, ...) are not considered. In addition the calculated U-Values fulfill the target mean U-value demanded by the « Commodo-Incommodo procedure » (environmental procedure) which is normally applied to school buildings.

The new calculation method for non residential buildings is in development and will be completed in 2009.

Requirements in force since

November 1995

# **Resulting U-values**

Model building N°				3		
Building type				school		
/ariant N°		3-0	3-1	3-2	3-3	3-4
variant name		basis	hg-bnc	hg-pellet	hg-hp	vent-nomec
J-values	U-value defined for temperature difference between room and					
roof	external air	0,32	0,32	0,32	0,32	0,32
wall	external air	0,51	0,51	0,51	0,51	0,51
wall to soil	soil	0,51	0,51	0,51	0,51	0,51
windows	external air	1,14	1,14	1,14	1,14	1,14
doors	external air	1,71	1,71	1,71	1,71	1,71
floor	soil	0,51	0,51	0,51	0,51	0,51
estricting limit		mean U-Value				
Remarks		values comply with "Règlement grand- ducal du 22 novembre 1995" and with "Commodo- Incommodo procedure" (environmental procedure)	values comply with "Règlement grand- ducal du 22 novembre 1995" and with "Commodo- Incommodo procedure" (environmental procedure)	values comply with "Règlement grand- ducal du 22 novembre 1995" and with "Commodo- Incommodo procedure" (environmental procedure)	values comply with "Règlement grand- ducal du 22 novembre 1995" and with "Commodo- Incommodo procedure" (environmental procedure)	values comply with "Règlement grand- ducal du 22 novembre 1995" and with "Commodo- Incommodo procedure" (environmental procedure)

# Mean heat transmission losses (basis for cross country comparison)

	element area	correction factor (only for cross- country comparison)	heat transfer coefficient					
Element	[m²]	[-]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	
roof	1560,9	1	499,5	499,5	499,5	499,5	499,5	
wall	1242	1	633,4	633,4	633,4	633,4	633,4	
wall to soil	226,8	0,6	69,4	69,4	69,4	69,4	69,4	
windows	364,8	1	415,9	415,9	415,9	415,9	415,9	
doors	17,8	1	30,4	30,4	30,4	30,4	30,4	
floor	1560,9	0,35	278,6	278,6	278,6	278,6	278,6	
sum	4973,2	]	1927	1927	1927	1927	1927	
Mean heat transm	nission							
losses per m² envelope			0,39	0,39	0,39	0,39	0,39	
(not considering the	rmal bridges)							

 $[W/(m^2K)]$ 

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Country France
Region Alsace (H1b)

Type of requirements / method used to proof the compliance

- 1) use the "reference" U values of each building fabric component to calculate the building overall Uvalue = Ubatref and the project values to calculate Ubat
- 2) make sure the result is lower than 1,2 x the "reference" Ubat
- 3) calculate the project consumption (C in kWh/m2 primary energy) and the reference consumption Cref for the building with reference values for building fabric and energy systems
- 4) Check compliance in having C < Cref and C < Cepmax which is an absolute figure depending only on the energy and the location: this step is for housing only, it does not apply to the 3rd building case where compliance is checked with C < Cref 5) depending on the result, iterate by modifying some Uvalues to comply with the "lowest" effort. depending on the system that is selected.

Requirements in force since

September 2006

# **Resulting U-values**

Model building N° Building type		3 school					
Variant N°		3-0	3-1	3-2	3-3	3-4	
variant name		basis	hg-bnc	hg-pellet	hg-hp	vent-nomec	
J-values	U-value defined for temperature difference between room and						
roof	external air	0,3	0,27	0,3	0,27	0,25	
wall	external air	0,4	0,36	0,4	0,36	0,3	
wall to soil	external air	0,4	0,4	0,4	0,4	0,3	
windows	external air	2,2	2,1	2,2	2,1	1,6	
doors	external air	1,6	1,5	1,6	1,5	1,5	
floor	external air	0,3	0,27	0,3	0,27	0,25	
Restricting limit		Cref of the reference building with the same geometry with reference value for both envelope componenets and systems (non	with reference values for building envelope	building with the same geometry with reference value for both envelope componenets and systems (non	Cref of the reference building with the same geometry with reference value for both envelope componenets and systems (non	building with the same geometry with reference value for both envelope componenets and systems (non	
Remarks		Ine above mentioned values take into account the thermal bridges due to junction between floors and walls.	values take into	rine above mentioned values take into account the thermal bridges due to junction between floors and walls.	The above mentioned values take into account the thermal bridges due to junction between floors and walls.	This options is only possible if the building design incorporates ducts or features enabling different ventilation rates by natural ventilation for the different spaces of this school. It is very likely that this option would never be used because of the ventilation constraint	

# Mean heat transmission losses (basis for cross country comparison)

	element area	heat transfer coefficient						
Element	[m²]	[-]	[W/K]	[W/K]	[W/K]	[W/K]	[W/K]	
roof	1560,9	1	468,3	421,4	468,3	421,4	390,2	
wall	1242	1	496,8	447,1	496,8	447,1	372,6	
wall to soil	226,8	1	90,7	90,7	90,7	90,7	68,0	
windows	364,8	1	802,6	766,1	802,6	766,1	583,7	
doors	17,8	1	28,5	26,7	28,5	26,7	26,7	
floor	1560,9	1	468,3	421,4	468,3	421,4	390,2	
sum	4973,2	]	2355	2174	2355	2174	1831	
Mean heat transn	nission							
losses per m² envelope			0,47	0,44	0,47	0,44	0,37	[W/(m²l
(not considering the	ermal bridges)							

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