Criteria and Algorithms for Certified Passive House Components: Opaque construction systems

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Contents

Note: Certificates are currently only being issued for arctic, cold, cool-temperate and warm-temperate regions (see Section 2.3). Criteria for all climate zones except the cool-temperate climate zone are subject to modifications as these criteria are currently in the experimental phase.

Legal note: For all construction details, only the heat flow shall be examined. The absence of condensation and internal moisture transport processes and protection from entry of moisture as well as other aspects relating to building physics, practical construction or structural stability are not covered by these investigations. The applicant, designer or manufacturer are responsible for this as necessary. The PHI assumes that the submitted documents are free of third-party rights. By submitting the documents for certification, the applicant declares that he or she is in possession of all rights to the full extent.

1 Preface

Passive House buildings provide optimal thermal comfort with minimum energy costs, and they lie within the economically profitable range with reference to their life-cycle costs. In order to achieve this level of comfort and the low life-cycle costs, the thermal quality of the components used in Passive Houses must meet stringent requirements. These requirements are directly derived from Passive House criteria for hygiene and comfort as well as from feasibility studies. The Passive House Institute has established component certification in order to define quality standards, facilitate the availability of highly efficient products and promote their widespread application, and to provide planners and building owners with reliable characteristic values for input into energy balancing tools. The present document contains the criteria and algorithms for the calculation and certification of opaque building components.

2 Certification criteria

2.1 Verifying Passive House suitability, certificate

Passive House suitability is verified using the U-value of the areal building components and the linear thermal transmittance, the minimum surface temperature of areal building components (comfort criterion) and the temperature factor at the coldest point of the constructions being examined (hygiene criterion). Documents (detail sets, verification of thermal conductivities …) to be provided by the person applying for a certificate form the basis for this. Opaque building systems can be certified in the categories construction system, floor slab system, wall system and roof system.

The information contained in the certificate and the respective data sheets includes the manufacturer and system description, certificate category and suitability for the climate zones and the relevant characteristic values for input in the Passive House Planning Package and designPH.

2.2 Criteria for issue of the certificate

For issue of the certificate, the following criteria must be complied with in the context of certification:

2.2.1 Criteria to be fulfilled depending on the climate zone

Table 1: Adequate certification criteria

Climate zone	**Hygiene criterion**	**Comfort criterion**	**Efficiency criteria**		
	$f_{Rsi=0.25\ m^2K/W}$ ≥[3]	U-value of the installed window[1] ≤	U-value of the exterior building component $U_{opaque} * f_{PHI}^2$ ≤	Purely opaque details $f_{Rsi=0.25\ m^2K/W}$ ≥[3]	Absence of thermal bridges Ψ_a ≤[4]
	[-]	[W/(m²K)]	[W/(m²K)]	[-]	[W/(mK)]
1 Arctic	0.80	0.45 (0.35)	0.09	0.90	0.01
2 Cold	0.75	0.65 (0.52)	0.12	0.88	
3 Cool, temperate	0.70	0.85 (0.70)	0.15	0.86	
4 Warm,temperate	0.65	1.05 (0.90)	0.25	0.82	
5 Warm	0.55	1.25 (1.10)	0.50	0.74	
6 Hot	None	1.25 (1.10)	0.50	0.74	
7 Very hot	None	1.05 (0.90)	0.25	0.82	

1 applies for vertical windows with a test size of 1.23*1.48 m. The criteria for other transparent building components can be taken from the relevant certification criteria. Value in brackets: respective reference glazing.
2 $f_{R,\ PHI}$: Reduction factor: always 1, exception: areas in contact with the ground and towards the unheated basement in the climate zones 1-4: 0.6
3 $f_{Rsi=0.25\ m^2K/W}$ ≥ see Section 3.8
4 as a thermal bridge loss coefficient based on external dimensions and length. Specific constructions such as inner edges are exempted from this criterion.

2.2.2 Airtightness of all standard building components and connection details

A professional quality standard must be ensured in the building and at the connection details in terms of planning as well as execution, and will be checked during the certification process based on the documents submitted.

2.2.3 Special cases

Regularly occurring or recurrent penetrations and geometric features of the building components are taken into account in the U-value calculation of the standard building components. The criteria for the thermal bridge coefficients must be complied with under consideration of these special cases.

2.3 Assignment of climate zones (regions with identical requirements)

These certification criteria and a certificate that is issued based on these are valid for the respective indicated climate ones and climates with lesser requirements. These climate zones are as follows:

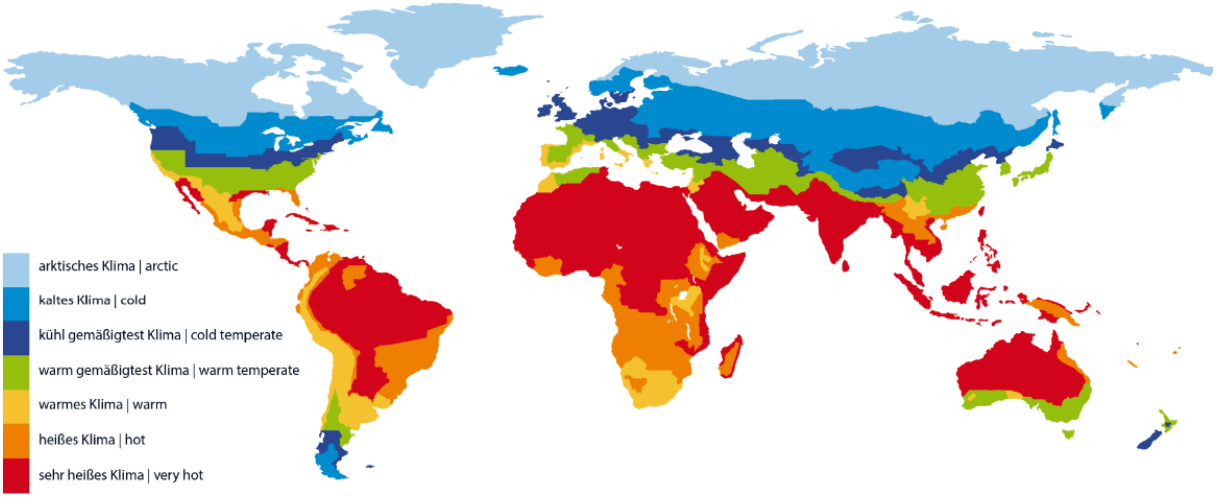
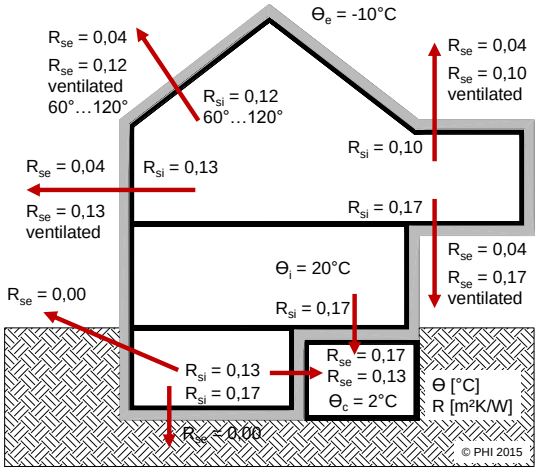


Figure 1: Assignment of regions with identical requirements, based on studies by the PHI

3 Boundary conditions, calculation

All calculations will be carried out by the Passive House Institute. Calculations performed by the manufacturer or third parties shall only be accepted in exceptional cases and after prior consultation.

3.1 Temperatures and heat transfer resistances for heat flow simulation



R_{si} is always set as 0.25 m²K/W for calculating the temperature factors.

3.2 Minimum value of the thermal transmittance, thermal conductivities

The U-value is calculated in accordance with general technical rules; interruptions of the insulation layers of the

standard building component are included in its thermal resistance. The resulting U-value must correspond with the criterion.
In principle, the rated value of the thermal conductivity is taken into account when calculating the U-values. This applies unless other provisions have been made known by the Passive House Institute.
If there is no rated value, then a nominal value of the thermal conductivity determined by a recognised materials testing institute in accordance with the relevant norms can be used as a basis. Similarly to the rated value additions, this nominal value is normally multiplied by 1.20 and the result is used in the calculation, see Section 4.2.

3.3 Thermal bridge calculation, absence of thermal bridges

Absence of thermal bridges is verified by means of multi-dimensional heat flow simulations. The fundamental principles for this, especially regarding the specified calculation approaches for building components that are in contact with the ground, are to be found in the publications by the PHI.
In special cases, such as the connection situation of the internal edge to the exterior wall, the equivalent Ψ-value may exceed 0.01 W/(mK); the requirements of the hygiene criterion will remain unaffected by this. The Ψ-value for the installation thermal bridge of the window frame in the case of window and door installation situations can also exceed 0.01 W/(mK). The maximum thermal resistance of the installed element will remain unaffected by this. The final decision regarding the need for compliance shall be made by the Passive House Institute.

3.4 Airtightness

This should be verified by detail representation, text descriptions of the creation of the airtight layer, the materials used for this and a general description of the overall system. The graphical representation should be such that the layers and connections of the membranes and sealing materials to the walls and windows frames are recognisable.
All connection details must be planned and executed in a permanently airtight manner.
The airtight layers must be clearly identified in the submitted documents (e.g. outlined in red ink).

3.5 Doors, windows and French windows

A reference Passive House frame specified by the Passive House Institute or an actual Passive House frame equipped with glazing corresponding to the reference glazing of the selected climate zone shall be used for window and French window connections in the submitted construction system.
French windows shall be tested in a connection situation in the area of the balcony connection without any influence by the ground.
Component size: window: 1.23 m * 1.48 m., French window: 1.10 m * 2.20 m, roof window: 1.14 m * 1.40 m.
Other specifications for certified French windows and patio doors: see "Criteria and algorithms for certified Passive House components: Transparent building components".

3.6 Special regulations

If selective penetrations form part of the construction system to be certified, a distinction should be made:
Dowels or other attachment elements occurring regularly across the area should be converted to the overall U-value of the wall system; this must remain below the required U-value. Selective thermal bridge loss coefficients are determined by means of 3-dimensional heat flow simulations.
Regularly occurring projections (e.g. in the foundation or base of the wall, balcony attachments etc.) should also be determined by means of 3D heat flow simulations and should be converted to the linear thermal bridge; the equivalent Ψ-value thus calculated must remain below 0.01 W/(mK).
In the context of certification of the system, the corresponding outdoor temperatures shall be adopted for opaque building components in the case of rooms or hollow spaces outside of the thermal envelope area. The unheated basement is the only exception.

3.7 Geometric specification

The external dimension is the reference dimension for effective lengths for U-value calculation.

3.8 Calculation of f_{Rsi}

The temperature factor $f_{Rsi=0.25\ m^2K/W}$ defines the coldest point which can occur on the interior surface of a construction system. For example, if the temperature factor is 0.7, then 70% of the temperature difference between the inside and outside air is still present at the interior surface. If the temperature factor is achieved, then mould and condensation formation can be safely prevented at normal outdoor temperatures, indoor temperatures and indoor air humidity levels. The colder the outdoor climate is, the higher the requirement for the temperature factor will be. 0.25 m²K/W in the index means that the heat transfer resistance to be used is 0.25 m²K/W.

Calculation of the temperature factor f_{Rsi}: $$f_{Rsi} = \frac{\theta_{si} - \theta_a}{\theta_i - \theta_a}$$

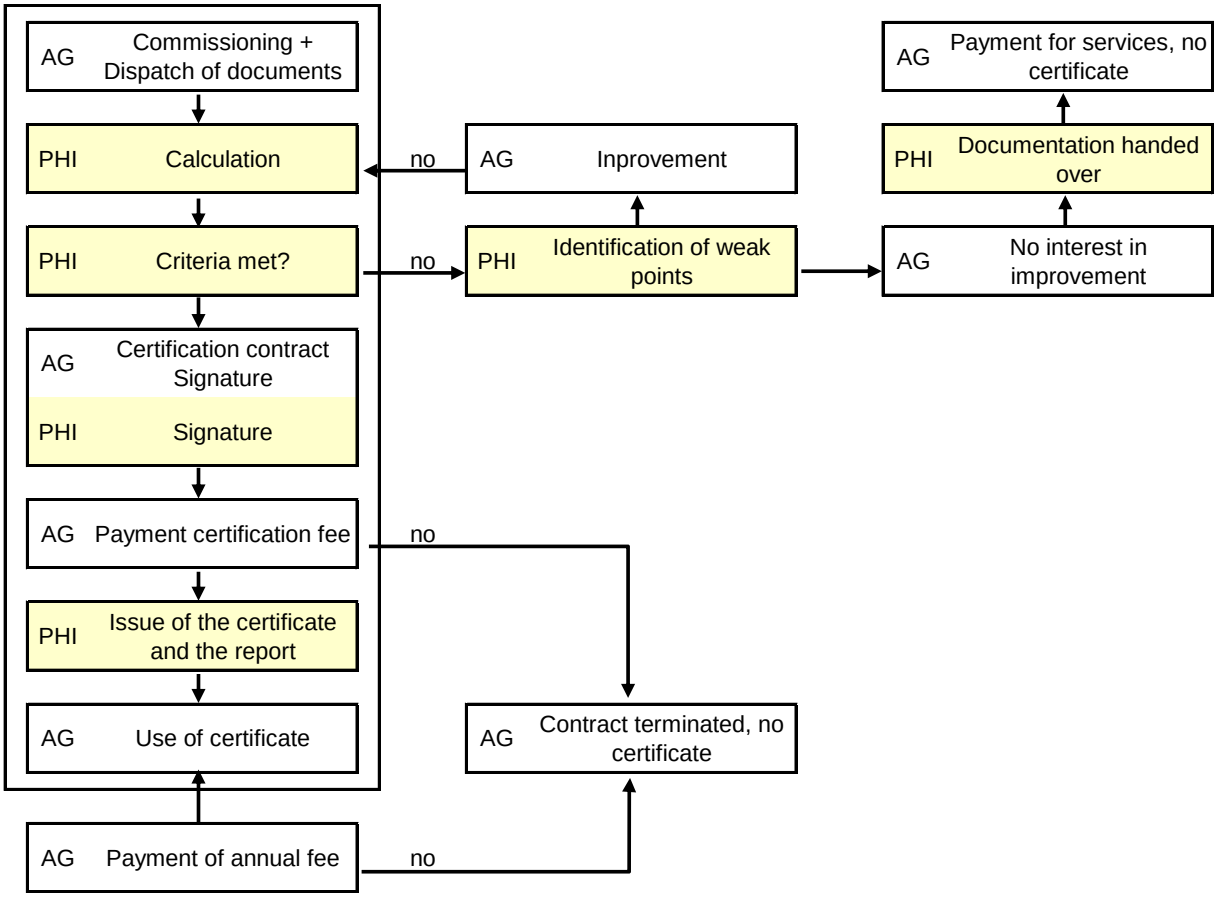
with θ_{si} : minimum interior surface temperature as per multi-dimensional heat flow calculation [°C]

θ_a : outside temperature as per multi-dimensional heat flow calculation [°C]

θ_i : inside temperature as per multi-dimensional heat flow calculation [°C]

4 General information, services provided by the Passive House Institute

4.1 Certification procedure



4.2 Documents required

The applicant should provide the following documents to the PHI for the calculation, and also any other documents requested.

1. Detail drawings of the required connection situations submitted as dxf or dwg files and as pdf files or publishable image files in the formats pdf, bmp, jpg or png. Materials with different thermal conductivities should be shown

differently.
The drawings of all standard building component assemblies should be shown with at least 3 recurrent interruptions or standard construction elements (if present) and the required connection situations formed with at least 2 metres of the respective building component and depiction of the sub-constructions or the assigned interruptions.
Depending on the special features of the system specific to the manufacturer, construction elements or dummy constructions may be provided by the PHI if necessary. These may be specified for example for window frames, floor slab assemblies or basement constructions for use during the certification procedure.
Tables should be provided with information relating to rated values of the thermal conductivities, layer thicknesses and descriptions of materials for all building component assemblies. The latest template provided by the PHI is to be used for this. All materials, including those outside of the standard assemblies of the building components should be listed and specified in detail.

2. The rated values of the thermal conductivities of the materials used for the chosen assemblies and connections must be verified either in accordance with DIN V 4108-4, DIN EN ISO 10077-2 or DIN EN ISO 10456, or if different from these, based on a general building permit or a general building approval examination (including CE marking, or a declaration of conformity). The PHI reserves the right to apply a security surcharge of up to 20% of a rated value if it is not possible to state a rated value for the thermal conductivity. Different thermal conductivities of anisotropic materials depending on the direction of heat flow shall be taken into account. For example, a factor of 2.2 shall be adopted for wood.

3. It is necessary to provide exact information about the geometry and number of sub-constructions, centre distances, and spacers in system-related area units and the additional use of materials if such elements are used, and where necessary, these should be shown as additional detail drawings. In the case of systems with approvals, the assigned technical data sheets must be provided. In addition, it is necessary to mention separately the ascertained point heat loss coefficients in [W/K].

4. Verification relating to water absorption of insulation materials that are in contact with the ground when fully submerged in water for a long time, water absorption due to diffusion, closed cell structure and the calculated poorest value (rated value) of the thermal conductivity in [W/(mK)]) which is to be used.

5. Complete documents relating to general building permits or comparable documents for load-transferring insulation materials in contact with the ground.

4.3 Services provided by the Passive House Institute

Certification procedure

1. Processing of the CAD drawings and preparation of the calculation models of the available details for subsequent heat flow simulations.
2. Calculation of the U-values of the standard building component assemblies.
3. Calculation of the equivalent thermal conductivities and U-values of the standard building component assemblies, thermal bridge loss coefficients, temperature factors and surface temperatures based on the submitted documents with reference to compliance with the certification criteria.
4. Additional calculation of variants for checking thermotechnical improvement or checking the creation of airtight levels in submitted connection situations. The costs for calculating variants shall be charged to the client after prior consultation.
5. Documentation of the results of the certification using isothermal images, specific value sheets and final evaluation of the construction system to be certified, in German or English.

Certificate (after a successful certification procedure and payment of annual fee):
Issue of the certificate by the Passive House Institute. Inclusion of the certified product in the Institute's own component database and the Passive House Planning Package (PHPP) database, and in the newsletters issued by the networks iPHA and IG Passivhaus, permission to use the component seal in the form of a vector graphics image.

4.4 Coming into force, temporary provisions, further development

The certification criteria and calculation regulations for Passive House suitable opaque building components shall become fully effective with the publication of this document. All previously published criteria shall cease to apply with the coming into force of these provisions. Previously issued certificates have the right of continuance. Old certificates may be changed upon request and applied for. Changes in layout with adaption of the Seal only will be made without charge; new calculations will incur costs. The Passive House Institute retains the right to make future changes.

4.5 Required connection details for the certification categories

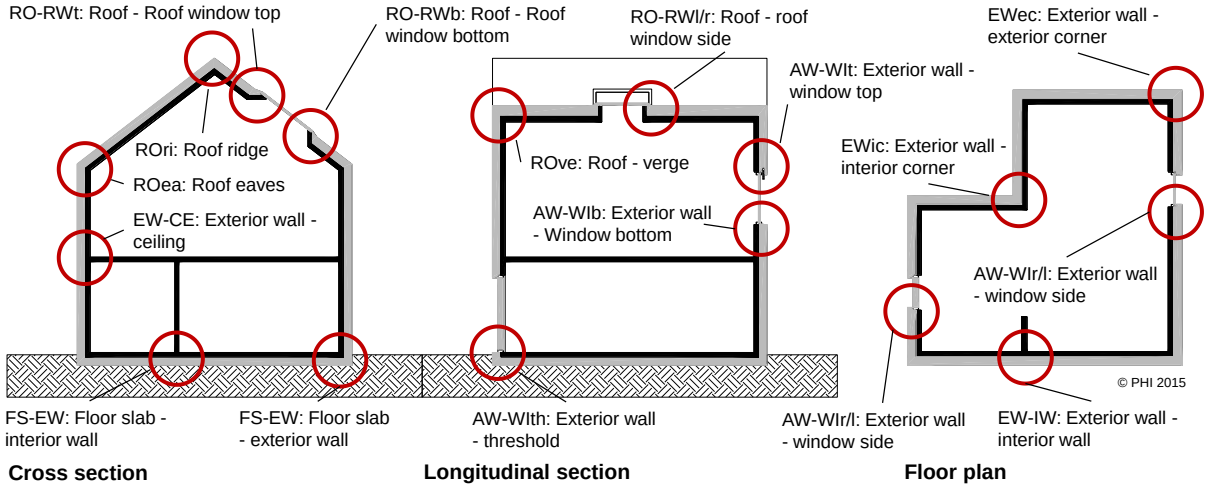


Figure 2: Required connection details

Table 2: Categories and connection details (individual details can be left out in agreement with the PHI). Abbreviations are explained below.

Detail		**Category**				**Note**
Description	Abbrev-iation	Construction system (CS)	Wall system (EW)	Roof system (RO)	Floor slab system (FS)	
Exterior wall on floor slab	FSEW	X	X		X	
Interior wall on floor slab	FSIW	X			X	Not, if perimeter insulation is used
Exterior w. - external edge	EWEC	X	X			
Exterior w. - internal edge	EWIC	X	X			
Exterior wall - interior wall connection	EWIW	X	X			Only for timber construction
Exterior wall – ceiling intersection	EWCE	X	X			Only for timber construction
Exterior wall – eaves	ROEA	X	X	X		Altern.: FR-RP Flat roof - – roof parapet
Exterior wall – verge	ROVE	X	X	X		Not for flat roof
Roof – roof ridge	RORI	X		X		Altern.: MRri: Mono pitched roof –roof ridge
Exterior wall – window	WIBO	X	X		X	

bottom						
Exterior wall – window top	WITO	X	X			Altern.: with shading
Exterior wall – window sides	WISI	X	X			
Exterior wall - threshold	WITH	X	X		X	
Ext. wall terrace door side	WITD	X	X			If different to window side
Roof – roof window bottom	RWBO			X		
Roof – roof window top	RWTO			X		
Roof – roof window side	RWSI			X		
Number of required details		9-14	8-12	6	2-3	

5 Acronyms for categories, building components and connections

5.1 Abbreviations for subgroups of opaque construction systems

Abbreviations for **Opaque construction systems**		Abbreviation
	CONSTRUCTION SYSTEM	CS
	WALL SYSTEM	EW
	ROOF SYSTEM	RO
	FLOOR SLAB SYSTEM	FS

5.2 Abbreviations for building components

Abbreviations for **Building components**		Abbreviation
	Bodenplatte (floor slab)	FS
	Kellerdecke (basement ceiling)	BC
	Außenwand (exterior wall)	EW
	Kellerwand (basement wall)	BW
	Fenster (window)	WI
	Innenwand (internal wall)	IW
	Geschossdecke (internal ceiling)	IC
	Oberste Geschossdecke (top ceiling)	TC
	Kehlbalken (valley)	KB
	Gratsparren (hip rafter)	HI
	Flachdach (flat roof)	FR
	Pultdach (monopitch roof)	MR
	Satteldach (roof)	RO
	Dachfenster (roof window)	RW
	Dachoberlicht (skylight)	SL
	Raffstore (venetian blind)	V
	Balkon (balcony)	BC

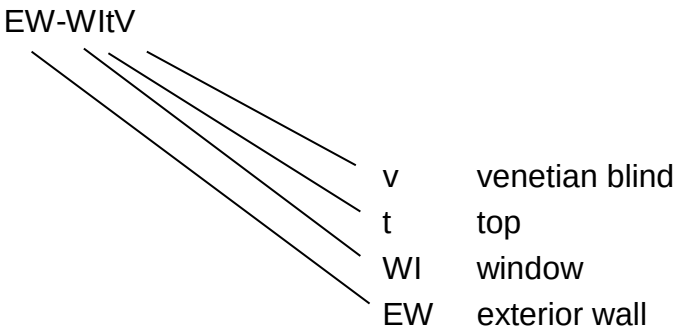
5.3 Abbreviations for specification of connections

Abbreviations for **Connections**	Abbreviation

	Innen (internal)	i
	Außen (external)	e
	Oben (top)	t
	Rechts (right)	r
	Links (left)	l
	Unten (bottom)	b
	Beheizt (heated)	h
	Unbeheizt (unheated)	u
	Hochpunkt (high point)	hp
	Tiefpunkt (low point)	lp
	Innenkante (inner edge)	ie
	Außenkante (external edge)	ee
	Attika (roof parapet)	rp
	Traufe (eaves)	ea
	Ortgang (verge)	ve
	First (ridge)	ri

5.4 Sample abbreviation code

Exterior wall – window top with venetian blinds



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