TEC1.3

Quality of the building envelope

Objective

Our objective is to minimise the energy demand for room conditioning of buildings while at the same time ensuring high thermal comfort and preventing building damage.

Benefits

A well-planned building envelope is a requirement for achieving high user comfort and low energy costs.

Contribution to overriding sustainability goals

	CONTRIBUTION TO THE SUSTAINABLE DEVELOPMENT GOALS (SDGS) OF THE UNITED NATIONS (UN)		CONTRIBUTION TO THE GERMAN SUSTAINABILITY STRATEGY	
Significant	7.3	Energy efficiency	7.1.a	Resource conservation
Moderate	8.4	Global resource efficiency and decoupling of economic development	7.1.b	Resource conservation
			8.1	Resource conservation
	12.2	Use of natural resources		

Outlook

The different levels of quality of the building envelope defined in the criterion will be adjusted to correspond to technical and, potentially, legislative developments in the medium term.

Share of total score

	SHARE	WEIGHTING FACTOR
Office Education Residential Hotel	3.0%	4
Consumer market Shopping centre	2.6%	3
Business premises		
Logistics Production	3.3%	4

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EVALUATION

The quality of the building envelope is evaluated via four indicators, which are intended to create the conditions required to ensure high thermal comfort with the lowest possible energy demand. The heat transfer coefficients (indicator 1), existing thermal heat bridges (indicator 2), airtightness (indicator 3) and summer heat protection (indicator 4) are evaluated depending on the specific use. In this criterion, a maximum of 100 points can be achieved or a maximum of 105 points including bonuses.

NO.	INDICATOR		POINTS
1	**Heat transfer**		
1.1	**Heat transfer coefficients**		
	Evaluation of the indicator is not possible (see Appendix A Detailed description)		**0**
	Office **Education** **Shopping centre** **Business premises** **Logistics** **Production** **Hotel**	W/(m²·K)	**Max. 40**
	Consumer market		**Max. 45**
	Opaque exterior components *	≤ 0.28	**20**
	Transparent exterior components *	≤ 1.50	
	Curtain wall	≤ 1.50	
	Glass roofs, strip lights, skylights	≤ 2.50	
	Opaque exterior components *	≤ 0.24	**30**
	Transparent exterior components *	≤ 1.28	
	Curtain wall	≤ 1.28	
	Glass roofs, strip lights, skylights	≤ 2.13	
	Opaque exterior components *	≤ 0.20	**40**
	Transparent exterior components *	≤ 1.05	
	Curtain wall	≤ 1.05	
	Glass roofs, strip lights, skylights	≤ 1.75	
	For: **Consumer market**		**45**
	Note for **Logistics** **Production**: Buildings with low heating levels must be evaluated via indicator 1.3		
1.2	**Maximum value for the specific transmission heat loss H'_T**		
	Residential	W/(m²·K)	**Max. 40**
	Freestanding A_N < 350 m² of the façade area	≤ 0.4	**20**
	Freestanding A_N > 350 m² of the façade area	≤ 0.5	
	Semi-detached	≤ 0.45	
	Other	≤ 0.65	
	Freestanding A_N < 350 m² of the façade area	≤ 0.34	**30**
	Freestanding A_N > 350 m² of the façade area	≤ 0.43	
	Semi-detached	≤ 0.38	
	Other	≤ 0.55	

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Freestanding an < 350 m² of the façade area	≤ 0.28	**40**
Freestanding an > 350 m² of the façade area	≤ 0.35	
Semi-detached	≤ 0.32	
Other	≤ 0.46	

1.3 **Heat transfer coefficients**

Logistics **Production**	W/(m²·K)	**Max. 40**
The following U-values apply to the exterior components of building areas with low heating levels (target indoor air temperature between 12 °C and 19 °C).		
Opaque exterior components *	≤ 0.5	**20**
Transparent exterior components *	≤ 2.8	
Curtain wall	≤ 3.0	
Glass roofs, strip lights, skylights	≤ 3.1	
Opaque exterior components *	≤ 0.43	**30**
Transparent exterior components *	≤ 2.4	
Curtain wall	≤ 2.6	
Glass roofs, strip lights, skylights	≤ 2.64	
Opaque exterior components *	≤ 0.35	**40**
Transparent exterior components *	≤ 2.0	
Curtain wall	≤ 2.1	
Glass roofs, strip lights, skylights	≤ 2.2	

* If not included in the components curtain wall, glass roofs, strip lights and skylights.

2 Thermal heat bridges

2.1 **Thermal heat bridge correction factors**

Evaluation of the indicator is not possible		0
Office **Education** **Residential** **Hotel**	W/(m²·K)	**0–15**
Thermal heat bridge correction factor ΔU_{WB} in W/(m²·K)	≤ 0.05	10
	≤ 0.02	15
Consumer market **Shopping centre** **Business premises**	W/(m²·K)	**0–15**
Thermal heat bridge correction factor ΔU_{WB} in W/(m²·K)	0.1	5
	≤ 0.05	10
	≤ 0.02	15
Logistics **Production**		**0–30**
Thermal heat bridge correction factor ΔU_{WB} in W/(m²·K)	0.1	10
	≤ 0.05	20

	≤ 0.02	30

NO.	INDICATOR		POINTS
3	**Airtightness**		
3.1	**Airtightness measurement**		
	Air exchange rate(at a pressure difference of 50Pa) n50 in h-1		
	Note for the point calculation: a linear interpolation is possible (n50-value)		
	Office **Education** **Residential** **Hotel**		
	Buildings – interior volume ≤ 1500 m³	n_{50} ≤ 1.5	5
	Buildings – interior volume > 1500 m³ applies additionally:		
	Air exchange from external surfaces	q_{50}: 2,5	
	Buildings – interior volume ≤ 1500 m³	n_{50} ≤ 1.0	10
	Buildings – interior volume > 1500 m³ applies additionally:		
	Air exchange from external surfaces	q_{50}: 2,0	
	Buildings – interior volume ≤ 1500 m³	n_{50} ≤ 0.6	15
	Buildings – interior volume > 1500 m³ applies additionally:		
	Air exchange from external surfaces	q_{50}: 1,8.	
	Consumer market		
	Buildings – interior volume ≤ 1500 m³	n_{50} ≤ 1.5	10
	Buildings – interior volume > 1500 m³ applies additionally:		
	Air exchange from external surfaces	q_{50}: 2,5	
	Buildings – interior volume ≤ 1500 m³	n_{50} ≤ 1.0	15
	Buildings – interior volume > 1500 m³ applies additionally:		
	Air exchange from external surfaces	q_{50}: 2,0	
	Buildings – interior volume ≤ 1500 m³	n_{50} ≤ 0.6	25
	Buildings – interior volume > 1500 m³ applies additionally:		
	Air exchange from external surfaces	q_{50}: 1,8	
	Business premises **Shopping centre**		
	Buildings – interior volume ≤ 1500 m³	n_{50} ≤ 1.5	10
	Buildings – interior volume > 1500 m³ applies additionally:		
	Air exchange from external surfaces	q_{50}: 2,5	
	Buildings – interior volume ≤ 1500 m³	n_{50} ≤ 1.0	20
	Buildings – interior volume > 1500 m³ applies additionally:		
	Air exchange from external surfaces	q_{50}: 2,0	
	Buildings – interior volume ≤ 1500 m³	n_{50} ≤ 0.6	30
	Buildings – interior volume > 1500 m³ applies additionally:		

	Air exchange from external surfaces	q_{50}: 1,8	
	Not applicable for **Logistics** **Production**		
3.2	**Joint permeability of windows and doors**		
	Office **Education** **Residential** **Hotel**		
	Joint permeability Q in accordance with DIN EN 12207		**Max. 15**
		Class 2	5
		Class 3	10
		Class 4	15
	Not applicable for **Consumer market** **Shopping centre** **Business premises** **Logistics** **Production**		

NO.	INDICATOR		POINTS
4	**Summer heat protection**		
4.1	**Simplified method**		
	Office **Education** **Residential** **Consumer market** **Hotel**		
	Solar transmittance parameter	$S \leq x\, S_{max}$	**5–15**
		x = 1	5
		x = 0.8	15
	Logistics **Production**		
	Solar transmittance parameter	$S \leq x\, S_{max}$	**10–30**
		x = 1	10
		x = 0.8	30
	Business premises **Shopping centre**		
	Solar transmittance parameter	$S \leq S_{max}$	**15**
	Alternative (documentation in accordance with DIN 4108-2:February 2013) simulation		
	Office **Education** **Residential** **Consumer market** **Shopping centre** **Business premises** **Hotel**		
	Number of overtemperature hours	≤ x Kh/a	**5–15**
		x = 500	5
		x = 350	15
	Logistics **Production**		
	Number of overtemperature hours	≤ x Kh/a	**10–30**
		x = 500	10
		x = 350	30
4.2	**AGENDA 2030 BONUS – CLIMATE ADAPTATION** Resilient thermal comfort: The frequency of exceeding for the building in the heating and cooling period is determined using future climate data predictions for 2030 and 2050. The results are used in the decision-making process at the planning stage.		**+5**

SUSTAINABILITY REPORTING AND SYNERGIES

Sustainability reporting

Appropriate key performance indicators (KPI) include communicating information regarding heat transfer coefficients, thermal heat bridge correction factors, the results of the airtightness measurement, solar transmittance parameters and, if necessary, the number of overtemperature hours. The results of a thermal simulation can be used for reporting in accordance with the "Level(s) – Common EU framework of core environmental indicators".

NO.	KEY PERFORMANCE INDICATORS (KPIS)	UNIT
KPI 1	Heat transfer coefficients, differentiated by different exterior components	[W/m²*K]
KPI 2	Thermal heat bridge correction factors	[W/m²*K]
KPI 3	Air exchange rate	[1/h]
KPI 4	Solar transmittance parameter	[-]
KPI 5	Number of overtemperature hours, corresponds to Level(s) indicator 4.2: Time outside of thermal comfort range – Time out of range	[kh/a]
KPI 6	Number of overtemperature hours 2030 and 2050, corresponds to Level(s) indicator 5.1: Time outside of thermal comfort range – Time out of range 2030/2050	[kh/a]

Synergies with DGNB system applications

- **DGNB RENOVATED BUILDINGS:** Synergies exist with criterion TEC1.3 in the REN scheme.
- **DGNB INTERIORS:** Criterion PRO1.1 establishes an incentive for taking sustainability aspects of thermal comfort into account as well when selecting the rental space.

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APPENDIX A – DETAILED DESCRIPTION

I. Relevance

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II. Additional explanation

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III. Method

The required values are defined below and function as comparison values for the implemented design. The following methods are used for the evaluation of the implemented design:

Indicator 1: Transmission and diffusion via enveloping surface components
This indicator is evaluated depending on the selected EnEV version (2016). The worst average value must be used for the evaluation in each case.

Indicator 1.1: Diffusion via enveloping surface components
In order to prevent damage in the long term, the building envelope must always be designed to ensure that only non-critical amounts of condensation water occur in the enveloping surface components. Verification is carried out via an informal declaration by the specialist planner. If the specialist planner does not classify structural components as fundamentally non-critical, documentation of the vapour diffusion must be carried out for these components via a stationary or non-stationary calculation. This also applies to enveloping surfaces of building zones with highly different indoor climates
(e.g. cold storage rooms). If this verification is not carried out, no points can be awarded in this indicator.

Indicator 1.2: Transmission via enveloping surface components
When calculating the average value of each component category (no. 1–4, see evaluation), the components must be taken into account according to the share of the total area they represent. The heat transfer coefficients of components against unheated rooms or soil must additionally be weighted with a factor of 0.5. When calculating the average value of the base slabs immediately adjacent to the soil, areas more than 5 m away from the outer edge of the building may be disregarded.

Indicator 2: Transmission via thermal heat bridges
Indicator 2.1: Minimum heat insulation on thermal heat bridges
The thermal heat bridges must always be designed to ensure that the structural minimum heat insulation (moisture protection) is complied with throughout the entire area to provide long-lasting protection against damage. Verification is carried out via an informal declaration by the specialist planner. If the specialist planner does not classify thermal heat bridges as fundamentally non-critical, a two-dimensional isothermal calculation must be carried out for these design details in accordance with the mould criterion of DIN 4108-2. If this verification is not carried out, no points can be awarded in this indicator. The thermal heat bridge correction factor ΔU_{WB} is determined in accordance with DIN 4108-6.

Indicator 3: Airtightness of the building envelope
Indicator 3.1: Airtightness measurement
The measurement must include all building areas intended to be heated.

Buildings with an interior volume ≤ 1500 m³:

- Assessment of the air exchange rate n_{50} in H^{-1} at a pressure difference of 50 Pa in accordance with DIN EN 13829 (Method A or Method B).

For buildings with an interior volume > 1500 m³, the following also applies:

- Assessment of the air exchange from external surfaces q_{50} in accordance with DIN EN 13829 (Method A or Method B).

Indicator 3.2: Joint permeability of windows and doors
Documentation of the joint permeability Q in accordance with DIN EN 12207. The worst value of the components installed is used here. If there are differences in classes, deviations up to a 10% share of the total area (area of the windows and doors) can be ignored.

Indicator 4: Summer heat protection
Documentation of summer heat protection must be carried out in accordance with the version of DIN 4108-2 applicable for certification under public law (EnEV certification). As an alternative, documentation of the summer heat protection can be created in accordance with a newer version of DIN 4108-2.

Indicator 4.1: Simplified method
Assessment of the solar transmittance parameter S in the simplified method in accordance with DIN 4108-02. The documentation must include the rooms specified as relevant in the currently valid version of the EnEV.

Alternative (only for documentation in accordance with DIN 4108-2: February 2013) **simulation**
If it is not possible to carry out documentation in accordance with the simplified method, a dynamic thermal simulation calculation can be carried out to assess the number of overtemperature hours for the purposes of evaluating the thermal conditions. This applies in particular if rooms or room areas suitable for the assessment exist in conjunction with the following structural facilities:

- Double façades or
- Transparent thermal insulation (TTI) systems.

In such cases, the thermal simulation must be carried out with consistent calculation boundary conditions in accordance with DIN 4108-2.

Indicator 4.2: Agenda 2030 bonus: Thermal comfort climate adaptation
The frequency of exceeding for the building in the heating and cooling period is determined using future climate data predictions for 2030 and 2050. The results are used in the decision-making process at the planning stage. The climate data used should be based on the UN IPCC "Mitigation" (SRES E1) emissions scenario. The "Medium-high" (SRES A!B) emissions scenario can be used as a second "worst-case scenario". Information regarding the assessment methodology and the possible areas of focus in the planning process can be found in the "Level(s) framework" published by the European Commission (Source: "Level(s) – A common EU framework of core sustainability indicators for office and residential buildings", Draft Beta v1.0, Brussels, August 2017).

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APPENDIX B – DOCUMENTATION

I. Required documentation

A range of different forms of documentation is listed below. The documentation submitted must comprehensively and clearly demonstrate compliance with the requirements for the target evaluation of the individual indicators.

Indicator 1: Transmission and diffusion via enveloping surface components:

- Declaration by the specialist planner that there are non-critical amounts of condensation water in the enveloping surface components, documentation of the vapour diffusion if necessary.
- List of the heat transfer coefficients for:
  - Opaque exterior components
  - Transparent exterior components
  - Curtain wall
  - Glass roofs, strip lights, skylights

Indicator 2: Transmission via thermal heat bridges

- Declaration by the specialist planner that the structural minimum heat insulation for thermal heat bridges has been complied with, documentation via isothermal calculations if necessary.
- Details of the selected thermal heat bridge correction factor ΔU_{WB}.
- Catalogue of the thermal heat bridges in accordance with DIN EN ISO 10211, taking into account the relevant thermal heat bridges in accordance with DIN V 4108-6.

Indicator 3: Airtightness of the building envelope

- Documentation of the airtightness measurement results. Assessment of the air exchange rate n_{50} in h-1 and, if applicable, calculation of the air exchange from external surfaces q_{50} in $m^3/(h\ m^2)$ at a pressure difference of 50 Pa in accordance with DIN EN 13829.
- Documentation of the joint permeability Q in accordance with DIN EN 12207 and details of the class calculated on the basis of the EnEV.
- The details must be taken from the relevant technical data sheet for the windows and doors as test bench values.

Indicator 4: Summer heat protection:

- Documentation of the solar transmittance parameter S in accordance with DIN 4108-02.
- Dynamic thermal simulation with calculation boundary conditions in accordance with DIN 4108-2: February 2013.

Indicator 4.2: Agenda 2030 bonus: Thermal comfort climate adaptation

- Results of the thermal simulation/calculation with the climate data for 2030 and 2050 used

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APPENDIX C – LITERATURE

I. Version

Change log based on version 2018

PAGE	EXPLANATION	DATE

II. Literature

- DIN 4108-2. Thermal protection and energy economy in buildings. Minimum requirements to thermal insulation. Berlin: Beuth Verlag. February 2013
- DIN 4108-3. Thermal protection and energy economy in buildings. Protection against moisture subject to climate conditions – Requirements and directions for design and construction. Berlin: Beuth Verlag. November 2014
- DIN 4108-6. Thermal protection and energy economy in buildings. Calculation of annual heat and energy use. Berlin: Beuth Verlag. June 2003. Corrigendum March 2004
- DIN EN 12207. Windows and doors – Air permeability – Classification. Berlin: Beuth Verlag. March 2017
- DIN EN 13829. Thermal performance of buildings – Determination of air permeability of buildings – Fan pressurization method. Berlin: Beuth Verlag. February 2001
- DIN EN 15026. Hygrothermal performance of building components and building elements – Assessment of moisture transfer by numerical simulation. Berlin: Beuth Verlag. July 2007
- DIN EN ISO 6946. Building components and building elements – Thermal resistance and thermal transmittance – Calculation method. Berlin: Beuth Verlag. April 2008
- DIN EN ISO 10211. Thermal bridges in building construction – Heat flows and surface temperatures – Detailed calculations. Berlin: Beuth Verlag. April 2008
- DIN EN ISO 13788. Hygrothermal performance of building components and building elements – Internal surface temperature to avoid critical surface humidity and interstitial condensation – Calculation methods. Berlin: Beuth Verlag. May 2013
- Sustainable Development Goals icons, United Nations/globalgoals.org