SOC1.4

Visual comfort

Objective

Our objective is to ensure sufficient, uninterrupted supply of daylight and artificial light in all interior areas in constant use. Visual comfort forms the basis of general well-being and efficient, productive work. Natural light has a positive effect on the mental and physical health of humans. In addition, good use of daylight provides a great deal of potential energy savings in terms of artificial light and cooling.

Benefits

User satisfaction is closely linked to feelings of comfort and well-being. Forecasts providing users with information regarding daylight hours, their surroundings, weather conditions, etc. are highly important in this regard. Visual comfort strongly affects user productivity and satisfaction.

Contribution to overriding sustainability goals

	CONTRIBUTION TO THE SUSTAINABLE DEVELOPMENT GOALS (SDGS) OF THE UNITED NATIONS (UN)	CONTRIBUTION TO THE GERMAN SUSTAINABILITY STRATEGY
Low	7.3 Energy efficiency	7.1.a/b Resource conservation

Outlook

It is expected that the importance and evaluation will remain unchanged.

Share of total score

	SHARE	WEIGHTING FACTOR
Office	3.1%	3
Education	2.7%	3
Residential	3.2%	3
Hotel	2.0%	2
Consumer market Shopping centre Business premises	3.4%	3
Logistics Production	3.2%	3

EVALUATION

In order to ensure sufficient, uninterrupted supply of daylight and artificial light, visual comfort is evaluated on the basis of seven indicators depending on the specific use. The availability of daylight in the entire building and at the permanent workstations is assessed via indicators 1 and 2. Available direct view to the outside are acknowledged via indicator 3. Indicator 4 evaluates the sun/glare protection system in place. The artificial light conditions, the colour rendering index of the daylight and the duration of exposure to daylight are assessed in indicators 5 to 7.In this criterion, a maximum of 100 points can be awarded.

NO.	INDICATOR		POINTS
1	**Availability of daylight for the entire building**		
1.1	**Daylight factor (DF)**		
	Office **Education**		**10–18**
	Residential		**20–40**
	Hotel		**16–34**
	50% of the usable area (NUF) has a daylight factor (DF) of		
	■ ≥ 1.0% (with documentation via simulation or in accordance with DIN V 18599 with detailed documentation of the obstruction index I_{VJ}) or ≥ 2.0% (with documentation via in accordance with DIN V 18599 with a flat estimate of the obstruction index I_{VJ} = 0.9)	**Office** **Education** **Residential** **Hotel**	10 20 16
	■ ≥ 1.5% (with documentation via simulation or in accordance with DIN V 18599 with detailed documentation of the obstruction index I_{VJ})	**Office** **Education** **Residential** **Hotel**	14 30 25
	■ ≥ 2.0% (with documentation via simulation or in accordance with DIN V 18599 with detailed documentation of the obstruction index I_{VJ})	**Office** **Education** **Residential** **Hotel**	18 40 34
	Consumer market		
	Areas illuminated via side windows have a daylight factor of at least 1.0% and areas illuminated via skylights have a daylight factor of at least 2.0%. The area illuminated with daylight is determined by superimposing all areas illuminated with daylight (combined area).		**Max. 45**
	■ The combined area features the following shares of the usable area (NUF): ■ A ≥ 15% of the NUF ■ A ≥ 25% of the NUF ■ A ≥ 50% of the NUF		**+ 15–35** 15 25 35

- Uniformity of the daylight supply in the area illuminated by the skylights: **+ 10**

The distance between the midpoints of the skylights is not greater than the clear room height. As an alternative, uniformity ($g_1 = D_{min}/D_{average}$) of the area illuminated via skylights of more than 0.5 can be documented via a daylight simulation.

Shopping centre

Daylight factors of at least 2.0% **10–30**

- A ≥ 15% of the NUF 10
- A ≥ 25% of the NUF 20
- A ≥ 50% of the NUF 30

Business premises

Areas illuminated via side windows have a daylight factor of at least 1.0% and areas illuminated via skylights have a daylight factor of at least 2.0%. **10–40**
The area illuminated with daylight is determined by superimposing all areas illuminated with daylight (combined area).

The combined area features the following shares of the usable area (NUF):

- A ≥ 5% of the NUF 10
- A ≥ 10% of the NUF 25
- A ≥ 15% of the NUF 40

Production buildings

50% of the usable area (NUF) has a daylight factor (DF) of **15–30**

- ≥ 0.5% (with documentation via simulation or in accordance with DIN V 18599 with detailed documentation of the obstruction index I_{VJ}) 15
  or
  ≥ 2.0% (with documentation via in accordance with DIN V 18599 with lump sum approach for the obstruction index $I_{VJ} = 0.9$)
- ≥ 0.75% (with documentation via simulation or in accordance with DIN V 18599 with detailed documentation of the obstruction index I_{VJ}) 20
- ≥ 1.0% (with documentation via simulation or in accordance with DIN V 18599 with detailed documentation of the obstruction index I_{VJ}) 30

Not applicable for **Logistics**

2 Availability of daylight at permanent workstations

2.1 Annual relative motive exposure

Office **Education** **Logistics** **8–16**

Annual relative motive exposure

- ≥ 45% (with documentation via simulation or in accordance with DIN V 18599 with detailed documentation of the obstruction index I_{VJ})
  or: ≥ 60% (with documentation in accordance with DIN V 18599 with lump sum approach for the obstruction index I_{VJ} = 0.9) — 8
- ≥ 60% (with documentation via simulation or in accordance with DIN V 18599 with detailed documentation of the obstruction index I_{VJ}) — 12
- ≥ 75% (with documentation via simulation or in accordance with DIN V 18599 with detailed documentation of the obstruction index I_{VJ}) — **Logistics** — 16

Logistics **6–12**

Share of the roof surface area represented by translucent skylights (industrial work share)

- ≥ 0.5% — 6
- ≥ 2.0% — 9
- ≥ 4.0% — 12

Not applicable for **Residential** **Hotel** **Consumer market** **Shopping centre** **Business premises** **Production buildings**

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3 Visual contact with the outside

3.1 Available lines of sight to the outside

Shopping centre **Business premises** **Max. 30**
Consumer market **Max. 18**

- Direct visual link to the outside for all office rooms — **Shopping centre** — +5
  Direct visual link to the outside for 80% of all break and social rooms — **Business premises** **Consumer market** — +9
- Share of the total net sales area represented by the open façade area (not including the shop façades in the mall) 0% to 5% — **Shopping centre** **Business premises** — + 0–15
- There are shop areas with direct lines of sight to the outside — **Shopping centre** **Business premises** — +5
- 0% to 50% of the façade area of the shop areas has a direct line of sight to the outside — **Shopping centre** **Business premises** — + 0–5
- A direct visual link to the outside is possible from all checkout workstations. — **Consumer market** — +9

Office **Education** **Hotel** **Logistics** **Max. 16**

Residential **Max. 20**

(If the building has both a sun protection system and a glare protection system at the same time with different classifications, the evaluation will be carried out on the basis of the better classification.)

- Visual contact to the outside is possible 8
  Residential 10
- Visual contact to the outside in the direct field of vision of the workstation/from the living areas or hotel rooms is possible 12
  Residential 15
- Visual contact to the outside in the direct field of vision of the workstation/from the living areas or hotel rooms is possible, even when the glare protection system or sun protection system is closed 16
  Residential 20

Not applicable for **Production buildings**

4 Absence of glare in daylight

4.1 Absence of glare due to sun/glare protection system

Office **Education** **Max. 16**

(If the building has both a sun protection system and a glare protection system at the same time with different classifications, the evaluation will be carried out on the basis of the better classification.
Annual relative motive exposure).

- Sun/glare protection system available (with no additional documentation of the quality in accordance with DIN 14057) 8
- Sun/glare protection system = class 1 12
- Sun/glare protection system ≥ class 2 16

Consumer market **12**

- Requirements in accordance with workplace regulation A3.4 Section 4.2 have been complied with

Logistics **Max. 13**

- Sun/glare protection system < class 1 6
- Sun/glare protection system = class 1 9
- Sun/glare protection system ≥ class 2 13

Production buildings **24**

- Light-diverting systems in combination with glare protection with direct light filtering available.
  or:
  Use of skylights with high share of diffuse northern light (e.g. saw-tooth roof)

Not applicable for **Residential** **Shopping centre** **Business premises** **Hotel**

5 Artificial light

5.1 Minimum requirements for artificial light

Office **Education** **Hotel** **Consumer market** **Business premises**

- The requirements for lighting in accordance with DIN EN 12464-1 have been complied with. — **16**; **Hotel** **12**; **Consumer market** **15**; **Business premises** **20**

5.2 Artificial light overfulfilment

Office **Education** **Hotel** **Consumer market** **Business premises**

Possible overfulfilment features:

- Colour rendering $R_a \geq 90$
- Illuminance on the walls $Ev_{Wall} \geq 150$ lx
- Automatic or individual adjustment of the illuminance via artificial light (> 800 lx)
- Automatic or individual adjustment of the light colour via artificial light in the range of warm white (3000 K) to daylight white (6500 K) (for new hotels: 6000 K)

Additionally for **Education**

- Light management with brightness and presence control depending on daylight
- In classrooms: Additional lighting for the blackboard that can be switched on and off separately

Additionally for **Consumer market** **Business premises**

- Artificial light planning takes into account the results of a daylight analysis (e.g. via suitable zoning and management)

Office **Education** **Consumer market** **Business premises** — **Max. 10**

Hotel — **Max. 8**

Number of features implemented:

- 1 — 3
- 2 — 6; **Hotel** 5
- ≥ 3 — 10; **Hotel** 8

Shopping centre (does not apply for tenant areas) — **Max. 30**; **+ Max. 10**

- Numerical criteria in accordance with DIN EN 12464-1 have been complied with for artificial lighting:
  $\bar{E}_m$: Maintained illuminance value
  UGR_L: Glare limitation
  R_a: Colour rendering — +5

- Automatic adjustment of the artificial light in areas supplied with daylight via dimmable lights or incremental light management — +5

Possible overfulfilment features: **+ Max. 20**

- Increased colour rendering Ra ≥ 90
- Cylindrical illuminance E cyl ≥ 150 lx
- Automatic adjustment of the illuminance via artificial light (> 800 lx) possible
- Automatic adjustment of the light colour via artificial light at least in the range of warm white (3000 K) to daylight white (6000 K)
- Artificial lighting concept that encourages ambiance (e.g. zoning, pools of light)
- A concept for preventing light pollution at night is planned and implemented
- All mall entrances and transition areas are designed as adaptation zones for dark adaptation.
- Artificial light planning takes into account the results of a daylight analysis (e.g. via suitable zoning and management)

Number of features implemented:

- 1 — 5
- 2 — 10
- 3 — 15
- ≥ 4 — 20

Logistics **Max. 28**

Production buildings **Max. 38**

- Numerical criteria in accordance with DIN EN 12464-1 have been complied with for artificial lighting: **Logistics** +20 / **Production buildings** +30

  $\bar{E}_m$: Maintained illuminance value
  U_o: Uniformity of illuminance
  UGR_L: Glare limitation
  R_a: Colour rendering

Possible overfulfilment features: **+ Max. 8**

- Increased colour rendering Ra ≥ 90
- Automatic or individual adjustment of the illuminance via artificial light (> 800 lx)
- Automatic or individual adjustment of the light colour via artificial light in the range of warm white (3000 K) to daylight white (6000 K)

Number of features implemented:

- 1 — 4
- 2 — 6
- 3 — 8

Not applicable for **Residential**

6 Daylight colour rendering

6.1 Colour rendering index R_a

Office **Education** **Production buildings** **4–8**

Residential **15–20**

Hotel **Logistics** **8–15**

Shopping centre **5–10**

Colour rendering index R_a for the combination of glazing and sun/glare protection, all areas lit with daylight in constant use

- $R_a \geq 80$ 4
  - **Residential** 15
  - **Hotel** 8
  - **Logistics** 5
  - **Shopping centre**
- $R_a \geq 90$ 8
  - **Residential** 20
  - **Hotel** 15
  - **Logistics** 10
  - **Shopping centre**

Not applicable for **Consumer market** **Business premises**

7 Exposure to daylight

7.1 Duration of exposure to daylight

Residential **5–20**

Hotel **8–15**

- Duration of exposure to daylight on 17th January ≥ 1 h and duration of exposure to daylight at the equinox ≥ 4 h, achieved for at least 40% of the living spaces (at least one living space per residential unit)/guest rental unit (hotel)
  Residential 5
  Hotel 8
- Duration of exposure to daylight on 17th January ≥ 1 h and duration of exposure to daylight at the equinox ≥ 4 h, achieved for at least 60% of the living spaces (at least one living space per residential unit)/guest rental unit (hotel) 10
- Duration of exposure to daylight on 17th January ≥ 1 h and duration of exposure to daylight at the equinox ≥ 4 h, achieved for at least 80% of the living spaces (at least one living space per residential unit)/guest rental unit (hotel)
  Residential 15
  Hotel 13
- Duration of exposure to daylight on 17th January ≥ 1 h and duration of exposure to daylight at the equinox ≥ 4 h, achieved for 100% of the living spaces/guest rental units (hotel)
  Residential 20
  Hotel 15

Not applicable for **Office** **Education** **Consumer market** **Shopping centre** **Business premises** **Logistics** **Production buildings**

SUSTAINABILITY REPORTING AND SYNERGIES

Sustainability reporting

Appropriate key performance indicators (KPIs) include communicating indicators regarding daylight, direct visual links to the outside, artificial light qualities and glazing qualities, as well as durations of exposure to daylight.

NO.	KEY PERFORMANCE INDICATORS (KPIS)	UNIT
KPI 1	Daylight factor (DF) for 50% of the usable area	[%]
KPI 2	Relative annual motive exposure	[%]
KPI 3	Share of the roof surface area represented by translucent skylights	[%]
KPI 4	Share of the rooms with direct visual link to the outside	[%]
KPI 5	Artificial light qualities: Colour rendering index, illuminance and rate of adjustment, light colour	[-]
KPI 6	Colour rendering index of the glazing	[%]
KPI 7	Durations of exposure to daylight (17th January and at the equinox) and share of rooms to which this information applies	[h]

Synergies with DGNB system applications

- **DGNB OPERATION:** Achieving high levels of quality in this criterion provides a great deal of potential for achieving high satisfaction rates during ongoing operation for criterion 9.1 of the Buildings in use (BIU) scheme (user satisfaction).
- **DGNB RENOVATED BUILDINGS:** High synergies with criterion SOC1.4 in the REN scheme.
- **DGNB INTERIORS:** High synergies with criterion SOC1.4 in the IR scheme.

APPENDIX A – DETAILED DESCRIPTION

I. Relevance

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II. Additional explanation

Visual comfort is achieved by means of balanced lighting, with no significant interferences such as direct and/or reflected glare, as well as by means of a sufficient level of illumination and individual adjustment to suit the needs of specific users. Here, user satisfaction is closely linked to feelings of comfort and well-being. Forecasts providing users with information regarding daylight hours, their surroundings, weather conditions, etc. are highly important in this regard. Additional criteria include absence of glare, light distribution and the light colour in the room. These requirements apply in principle to lighting with daylight and artificial light, where the evaluation of the daylight supply in the interior plays a particularly important role. For this reason, sufficient, trouble-free supply of daylight and artificial light must be ensured in all interior areas in constant use.

III. Method

Indicator 1: Availability of daylight for the entire building
The daylight factor (DF) and the corresponding shares of the usable area (NUF) must be determined. Documentation can be carried out either via simulation or in accordance with DIN V 18599 with detailed documentation of the obstruction index I_{VJ} (or, in the case of hotels, with a lump sum approach for the obstruction index IVJ).

Indicator 2: Availability of daylight at permanent workstations
The relative annual motive exposure and the corresponding shares of the permanent workstations must be determined. Documentation can be carried out either via simulation or in accordance with DIN V 18599 with detailed documentation of the obstruction index I_{VJ} (or, in the case of hotels, with a lump sum approach for the obstruction index IVJ).

Indicator 3: Visual contact with the outside
Visual contact with the outside must be determined qualitatively via the floor plan and the type of glare/sun protection used.

Indicator 4: Absence of glare in daylight
The sun/glare protection must be classified with regard to its glare protection function in accordance with DIN 14501, Section 6.3. For **Consumer markets**, compliance with the occupational health and safety guidelines (ASR) A3.4, Section 4.2 must be documented. For **Production buildings**, if skylights are used, the light share must be represented, and the glare protection system, if used, must be described.

Indicator 5: Artificial light

The evaluation of the indicator is divided into minimum requirements and possible overfulfilments. Points for an overfulfilment can only be awarded if the minimum requirements for the area under assessment are met. The evaluation can be carried out on an area-weighted basis for partial areas.

The reference values for lighting requirements are summarised in DIN EN 12464-1, divided by use. The following values must be considered:

- $\bar{E}_m$ Maintained illuminance value [lx]
- UGR_L Glare limitation [-]
- U_o Uniformity of illuminance [-]
- R_a Colour rendering [-]
- $E_{V\,wall}$ Illuminance on the walls [lx]
- L Luminance limits for lights at workstations with monitors [cd·m−2]

Indicator 6: Daylight colour rendering

The colour rendering index Ra for the combination of glazing and sun/glare protection, all areas lit with daylight in constant use must be determined.

Indicator 7: Exposure to daylight

The duration of exposure to daylight of the windows in a building must be established on 17th January and 21st March/21st September (equinox) using suitable shade calculations. When doing so, in accordance with DIN 5034, all external shading, e.g. due to adjacent buildings, topography, the courtyard/atrium, plants/trees, etc., must be taken into account.

IV. Usage-specific description

Education

Indicator 2: Availability of daylight at permanent workstations

The areas under evaluation are not just restricted to the workstations in the administration offices (usable area (NUF) 2 – Office work in accordance with DIN 277-1). The affected areas in usable area (NUF) 5 – Education, teaching and culture in accordance with DIN 277-1 must also be taken into account.

Consumer market **Shopping centre** **Business premises**

The issue of lighting plays a significant role in retail buildings. Firstly, the energy demand for artificial lighting is generally very high, meaning that optimisation involving increased use of daylight provides substantial potential savings. Secondly, retail buildings are generally subject to different requirements in terms of lighting than offices, for example, as both permanent and short stays play a role. As yet, daylight is only used to a very limited extent in retail buildings. However, the acceptability of the indoor climate is closely linked to comfort at the workstation, which naturally also includes employees in retail buildings. In addition, studies have clearly shown that lighting with daylight can positively affect purchasing behaviour, including in retail buildings. As the two groups under consideration – employees and customers – are fundamentally different from one another, the reference to each group under consideration is established separately and, if necessary, treated differently in the area of retail buildings.

*Employees**

For employees, visual comfort forms the basis of efficient, productive work. In addition, good use of daylight provides a great deal of potential energy savings in terms of artificial light and cooling. The acceptability of the indoor climate (thermal comfort, air quality, noise and lighting), particularly the lighting conditions, is closely linked to satisfaction. For this reason, sufficient, trouble-free lighting must be ensured in all interior areas in constant use. For psychological and physiological reasons, daylight is always preferable to artificial light, and a suitable connection to the outside world should be established.

*Employees are all persons working in continuously occupied areas. Continuously occupied areas include: Sales rooms, office rooms, kitchens, checkouts, customer service points, etc.

Customers

For customers, visual comfort is equally vital for ensuring well-being, and thereby also affects their length of stay. Studies have determined that purchasing activity is higher in retail buildings lit with daylight and have thereby established a positive monetary impact as well. Adjusting the interior lighting to suit the daylight situation also provides potential energy savings. In addition, accent lighting provides customers with important guidance to find their way through the building/store. Appropriate light planning, taking into account daylight and artificial light, must be ensured and must incorporate energy aspects, physiological aspects and functional aspects.

Indicator 3: Visual contact with the outside

Direct lines of sight from checkout workstations to the outside.

Visual contact with the outside must be established via graphical entries in the floor plan. This applies to all checkout workstations where the line of sight to a window or glazed door is not blocked by permanent installations. Transparent internal walls or open staircases (e.g. escalators) are not classified as blocking elements for the purposes of this indicator. The windows or doors that provide a view to the outside must be designed to be transparent at a height of 1 m to 2.2 m.

Definition

Mall spaces: All publicly accessible areas (i.e. areas that are not lockable) of the shopping street must be taken into

account, including food areas, open sales areas, open staircases, etc. Ancillary areas, etc. can be ignored by the auditor with proper justification.
Definition of rental space: The "rental space" must be considered to comprise all rentable floor areas listed in Appendix 1. Tenant fit outs, including light separating walls, may be ignored.

Logistics

The requirements for visual comfort vary for office and industrial areas.
For offices with a usable area (NUF in accordance with DIN 277-1) of ≥ 400 m² or ≥ 20 permanent workstations, the visual comfort for both office and industrial areas must be analysed.

1. Number of office workstations ≥ 15% of the total workstations or ≥ 20 permanent office workstations:

Evaluation by share of office area and share of industrial area:

For the evaluation, the share of office area and the share of industrial area must be analysed in the individual indicators.

$$\text{Points}_{\text{total}} = \text{points}_{\text{office share}} \times (\text{number of office workstations} / \text{number of total workstations}) + \text{Points}_{\text{industrial work share}} \times (\text{number of industrial workstations} / \text{number of total workstations})$$

2. Number of office workstations < 15% of the total workstations and < 20 permanent office workstations:

Evaluation by share of industrial area:

For the evaluation, the share of industrial area must be analysed in the individual indicators.

$$\text{Points}_{\text{total}} = \text{points}_{\text{industrial work share}}$$

For indicator 2: Availability of daylight at permanent workstations:
In the hall area of logistics buildings, the use of daylight via the external walls is only possible to a limited extent due to the extent of the halls. For this reason, the halls are supplied with daylight via skylights, if at all. The low area shares are balanced out by the fact that the light output of skylights is many times higher than vertical windows (approx. four times higher). The problem of stored goods being exposed to unwanted heat and UV radiation can be balanced out by not situating the skylights in shelving areas where there are no permanent workstations, and instead concentrating them in the order picking area and similar permanent workstations.

Appendix 1

APPENDIX 1 AREAS OF THE SCHEMES TO BE TAKEN INTO ACCOUNT

Office

SCHEME	USE GROUP	FLOOR AREA AND ROOMS		INDICATOR						
				1	2	3	4	5	6	7
NEW OFFICE BUILDINGS	1_Residential and recreation (Share for social rooms)	1.2 1.3 1.4 1.5	Common rooms Break rooms Waiting rooms Dining rooms	x		x		x		
	2_Office work	2.1 2.2 2.3 2.4 2.5 2.6 2.7	Office rooms Open-plan offices Meeting rooms Design rooms Rooms with counter(s) Control rooms Surveillance rooms	x	x	x	x	x	x	

Education

NEW BUILDINGS EDUCATIONAL BUILDINGS	1_Residential and **recreation** (Share for social rooms)	1.2 1.3 1.4 1.5	Common rooms Break rooms Waiting rooms Dining rooms	x		x		x	x	
	2_Office work (Share for admin-istration)	2.1 2.2 2.3 2.4 2.5 2.6 2.7	Office rooms Open-plan offices Meeting rooms Design rooms Rooms with counter(s) Control rooms Surveillance rooms	x	x	x	x	x	x	

	3_Production, manual and machine work, experiment (Share for industrial work)	3.2 3.3 3.4 3.5	Workshops (where these are permanent workstations) Technological laboratories Physics, engineering physics and electrical engineering laboratories Chemistry, bacteriology and morphology laboratories			x	x	x	x	
	5_Education, teaching and culture	5.1 5.2 5.3	Classrooms with fixed seating (lecture halls, including experimental lecture halls; auditoriums) General classrooms and practice rooms without fixed seating (classrooms and group rooms, seminar rooms, student workspaces) Special classrooms and practice rooms without fixed seating (work and craft rooms, training rooms, language laboratories, special drawing classrooms, rooms for graphic design, painting and sculpture, rooms and practice booths for singing, language and instrumental training, rooms for home economics lessons)	x	x	x	x	x	x	

Residential

NEW BUILDINGS RESIDENTIAL BUILDINGS	1_Residential and recreation	1.1 1.2 1.3 1.4 1.5	Living spaces Common rooms Break rooms Waiting rooms Dining rooms	x		x			x	x

Consumer market

NEW BUILDINGS RETAIL BUILDINGS	1_Residential and recreation (Share for social rooms)	1.2 1.3 1.4 1.5	Common rooms Break rooms Waiting rooms Dining rooms	x		x				
	2_Office work	2.1 2.2 2.3 2.4 2.5 2.6 2.7	Office rooms Open-plan offices Meeting rooms Design rooms Rooms with counter(s) Control rooms Surveillance rooms	x	x	x	x	x	x	
	1_Residential and recreation (Share for social rooms)	1.2 1.3 1.4 1.5	Common rooms Break rooms Waiting rooms Dining rooms	x		x		x		
	2_Office work (Share for administration)	2.1 2.2 2.3 2.4 2.5 2.6 2.7	Office rooms Open-plan offices Meeting rooms Design rooms Rooms with counter(s) Control rooms Surveillance rooms	x		x	x	x		
	4_Distribution and sales	4.5 4.6	Sales rooms Showrooms For NSC, indicators 4 and 5 are not taken into consideration	x		x	x	x		

Shopping centre

NEW BUILDINGS RETAIL BUILDINGS	1_Residential and recreation (Share for social rooms)	1.2 1.3 1.4 1.5	Common rooms Break rooms Waiting rooms Dining rooms	x		x		x		
	2_Office work (Share for administration)	2.1 2.2 2.3 2.4 2.5 2.6 2.7	Office rooms Open-plan offices Meeting rooms Design rooms Rooms with counter(s) Control rooms Surveillance rooms	x		x	x	x		
	4_Distribution and sales	4.5 4.6	Sales rooms Showrooms	x		x	x	x		
			For NSC, indicators 4 and 5 are not taken into consideration							
	Mall		All publicly accessible areas (i.e. areas that are not lockable) of the shopping street must be taken into account, including food areas, open sales areas, open staircases, etc. Ancillary areas, etc. can be ignored by the auditor with proper justification.	x					x	

Business premises

NEW BUILDINGS RETAIL BUILDINGS	1_Residential and recreation (Share for social rooms)	1.2 1.3 1.4 1.5	Common rooms Break rooms Waiting rooms Dining rooms	x		x		x		
	2_Office work (Share for administration)	2.1 2.2 2.3 2.4 2.5 2.6 2.7	Office rooms Open-plan offices Meeting rooms Design rooms Rooms with counter(s) Control rooms Surveillance rooms	x		x	x	x		
	4_Distribution and sales	4.5 4.6	Sales rooms (Checkout workstations) Showrooms (Workstations)	x		x		x		

Production buildings

NEW BUILDINGS INDUSTRIAL BUILDINGS	1_Residential and recreation (Share for social rooms)	1.2 1.3 1.4 1.5	Common rooms Break rooms Waiting rooms Dining rooms			x				
	2_Office work (Share for administration)	2.1 2.2 2.3 2.4 2.5 2.6 2.7	Office rooms Open-plan offices Meeting rooms Design rooms Rooms with counter(s) Control rooms Surveillance rooms		x	x	x	x	x	

	3.1_Production, manual and machine work, experiment (Share for industrial work)	3.1.1 3.1.2 3.1.3 3.1.4 3.1.5	Factory halls (where these are permanent workstations) Workshops (where these are permanent workstations) Technological laboratories Physics, engineering physics and electrical engineering laboratories Chemistry, bacteriology and morphology laboratories		x	x	x	x	x	
	3.2_Logistics halls (Share for industrial work)	3.2.1	Logistics halls (where these are permanent workstations)		x	x	x	x	x	
Logistics										
NEW BUILDINGS INDUSTRIAL BUILDINGS	1_Residential and recreation (Share for social rooms)	1.2 1.3 1.4 1.5	Common rooms Break rooms Waiting rooms Dining rooms	x		x				
	2_Office work (Share for administration)	2.1 2.2 2.3 2.4 2.5 2.6 2.7	Office rooms Open-plan offices Meeting rooms Design rooms Rooms with counter(s) Control rooms Surveillance rooms	x	x	x	x	x	x	

	3.1_Production, manual and machine work, experiment (Share for industrial work)	3.1.1 3.1.2 3.1.3 3.1.4 3.1.5	Factory halls (where these are permanent workstations) Workshops (where these are permanent workstations) Technological laboratories Physics, engineering physics and electrical engineering laboratories Chemistry, bacteriology and morphology laboratories	x	x	x	x	x	x	
	3.2_Logistics halls (Share for industrial work)	3.2.1	Logistics halls (where these are permanent workstations)		x	x	x	x	x	

Hotel

NEW BUILDINGS HOTEL BUILDINGS	1_Residential and recreation	1.1 1.2 1.3 1.4 1.5	Living spaces (guest rooms) Common rooms Break rooms Waiting rooms Dining rooms	x		x			x	x
	2_Office work (Share for administration)	2.1 2.2 2.3 2.4 2.5 2.6 2.7	Office rooms Open-plan offices Meeting rooms Design rooms Rooms with counter(s) Control rooms Surveillance rooms	x		x		x	x	

Areas to be taken into account:

Office **Education** **Consumer market** **Shopping centre** **Business premises**

1. Availability of daylight for the entire building

This indicator assesses the supply of daylight for the entire building. For this reason, the following area is evaluated here:
Usable floor area in accordance with DIN 277-2 including corridors in open-plan offices, group offices or combi-offices that directly share air with the workstations (in accordance with DIN V 18599, classification of the specified areas as circulation areas is not possible as a result).

Office Education Logistics Production buildings

2. Availability of daylight at permanent workstations

Corridors in open-plan offices, group offices or combi-offices that cannot be converted into workstations – contrary to DIN 277-2 and DIN V 18599, as well as indicator 1 – must not be allocated to the usable floor area that is taken into account, but are instead considered to be circulation areas and are therefore not taken into account.
This applies if the corridors
a) have a ceiling height lower than the surrounding offices (panelling for supply ducts) and
b) have a different source of artificial light (corridor lighting instead of office lighting)
In both cases, clear verification documentation must be compiled.

Office Education Logistics Production buildings Consumer market Shopping centre Business premises

3. Visual contact with the outside

Rooms in constant use

4. Absence of glare in daylight

Permanent workstations

5. Artificial light

Rooms in constant use

6. Daylight colour rendering

Rooms in constant use

Consumer market

5. Artificial light

At least 80% of the total usable areas to be documented and at least 80% of the permanent workstations

Logistics Production buildings Hotel

5. Artificial light

Permanent workstations

6. Colour rendering

Permanent workstations

Residential Hotel

1. Availability of daylight for the entire building

Rooms in constant use

3. Visual contact with the outside

Rooms in constant use

6. Colour rendering

Rooms in constant use

7. Exposure to daylight

Living spaces

Appendix 2

Indicator 1: Availability of daylight for the entire building

The availability of daylight for the entire building is documented using the usable area (NUF), which achieves a certain daylight factor (0.5 to 2.0%) at minimum. When calculating the daylight factors, the following effects must be taken into account in accordance with DIN 5034, regardless of the selected documentation process:

- All external shading, e.g. due to adjacent buildings, topography, the courtyard/atrium, plants/trees, etc.
- Reduction as the daylight passes through the façade (light transmittance of the glazing, frames/sash bars, dirt, unusual angle of incidence of sunlight).

In general, the methods listed below are permitted for assessment of the share of the usable area (NUF) to be evaluated.
As DIN V 18599-4 does not in principle take shading due to trees/plants into account, but these do still reduce the amount of daylight that reaches the building, if shading due to trees/plants is planned or already in place, daylight simulations must be used as a documentation method, if possible. If the simplified method in accordance with DIN V 18599-4 is used, plants must be assessed as obstructions to be on the safe side (estimate of the maximum height and width of the plants as building dimensions).

(1) Calculation using the simplified method of DIN V 18599-4

I. Breakdown of the rooms (zones) that are to be allocated to the usable area (NUF) into
a) Area supplied with daylight A_{DL}
b) Area not supplied with daylight A_{NDL}

The following applies to all rooms in the usable area (NUF) (see below): $A_{tot} = A_{DL} + A_{NDL}$

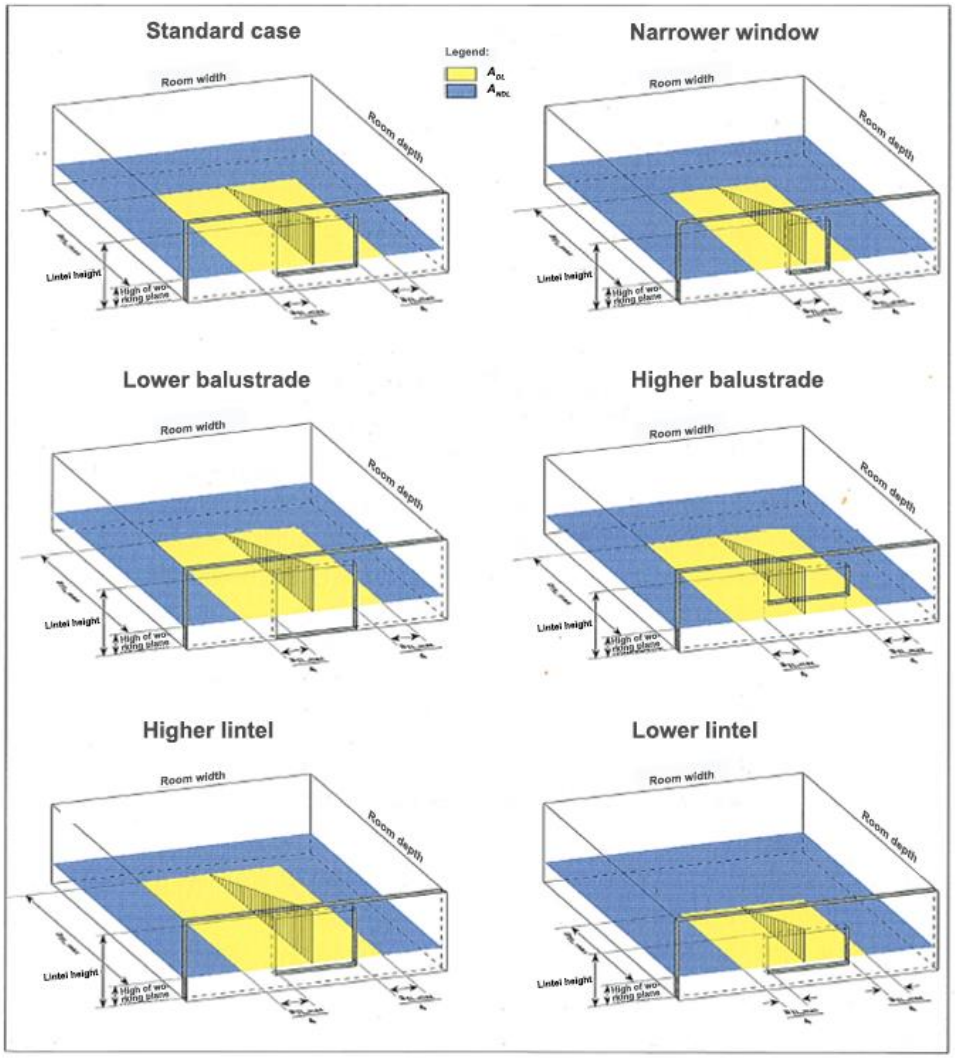

Fig. 4–21: Illustration of the effect of the window width and the lintel/ balustrade height on the area supplied with daylight

© *Heizen, Kühlen, Belüften & Beleuchten* – Bilanzierungsgrundlagen zur DIN V 18599 [Heating, cooling, ventilating and lighting – Fundamentals of balancing for DIN V 18599]; David, de Boer, Erhorn, Reiß, Rouvel, Schiller, Weiß, Wenning, published by Fraunhofer IRB Verlag, 2006, ISBN-13: 9-783-8167-7024-4

II. Reduction of the daylight factor D_{Rb} from the DIN V 18599-calculation

c) Adoption of the daylight factor D_{Rb} from the DIN V 18599 calculation, which only applies for the opening in the structural work.

d) Adoption of the approximated effective light transmittance $\tau_{eff,SNA}$ from the DIN V 18599 calculation.

e) Assessment of the actual effective daylight factor D_{eff}, taking into account reduction due to glazing, frames/sash bars, dirt, and non-vertical angle of incidence of sunlight, via the following equation:
$D_{eff} = D_{Rb} \cdot \tau_{eff,SNA}$

f) The obstruction index I_{Vj} must be determined in detail in accordance with DIN V 18599-4 (at least by storey or appropriate façade sections) and is incorporated into the assessment of D_{Rb}.
The lump sum approach to the obstruction index $I_{Vj} = 0.9$ – permitted in accordance with EnEV – does not sufficiently portray the actual shading in most cases and is therefore not permitted for documentation of this indicator.

This effective daylight factor D_{eff} applies in accordance with DIN V 18599-4 as an average value over the axis at half of the depth of the area supplied with daylight in parallel to the façade area under consideration (see below):

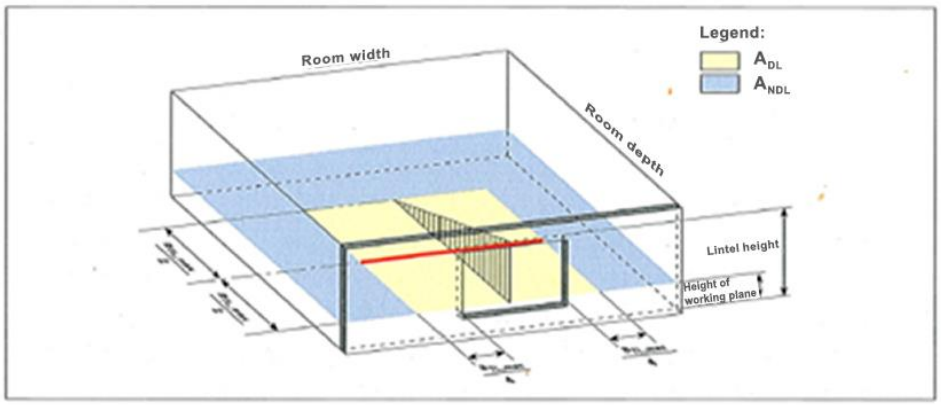

Fig. 4–28: Diagram of the check location for determining the daylight factor

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I. Assessment of the share $A_{1.0\%/1.5\%/2.0\%,j}$ of the area supplied with daylight A_{DL} in the room j that has a daylight factor of at least 1.0%/1.5%/2.0%, via linear **interpolation** of the depth of the area supplied with daylight $a_{1.0\%/1.5\%/2.0\%,j}$ that has a daylight factor of at least 1.0%/1.5%/2.0%:

$$a_{1,0\%,j} = \frac{a_{TL}}{2} + \frac{a_{TL}}{2} \cdot \left(\frac{D_{eff} - 1{,}0\%}{D_{eff}} \right)$$

$$a_{1,5\%,j} = \frac{a_{TL}}{2} + \frac{a_{TL}}{2} \cdot \left(\frac{D_{eff} - 1{,}5\%}{D_{eff}} \right)$$

$$a_{2,0\%,j} = \frac{a_{TL}}{2} + \frac{a_{TL}}{2} \cdot \left(\frac{D_{eff} - 2{,}0\%}{D_{eff}} \right)$$

II. The relevant depth of the area supplied with daylight $a_{1.0\%/1.5\%/2.0\%,j}$, which has a daylight factor of at least 1.0%/1.5%/2.0%, can be used together with the width of the area supplied with daylight $b_{DL,j}$ to derive the area in the room j with this daylight factor at minimum:

$$A_{1.0\%,j} = a_{1.0\%,j} \cdot b_{DL,j}$$

$$A_{1.5\%,j} = a_{1.5\%,j} \cdot b_{DL,j}$$

$$A_{2.0\%,j} = a_{2.0\%,j} \cdot b_{DL,j}$$

III. Assessment of the share of the total usable area (NUF) in the building that has a daylight factor of at least 1.0%/1.5%/2.0% by simply determining the sum of the relevant partial areas $A_{1.0\%/1.5\%/2.0\%,j}$ across all n rooms in the building that must be allocated to the usable area (NUF) that is to be taken into account, meaning that the following equations apply:

$$A_{NUF,1,0\%} = \sum_{j=1}^{n} A_{1,0\%,\,j}$$

$$A_{NUF,1,5\%} = \sum_{j=1}^{n} A_{1,5\%,\,j}$$

$$A_{NUF,2,0\%} = \sum_{j=1}^{n} A_{2,0\%,\,j}$$

The relevant partial area with a daylight factor of at least 1.0%/1.5%/2.0% is then compared to 50% of the usable area of the building, and the result can be classified in accordance with the evaluation table.

(1) Assessment via daylight simulations

When using daylight simulations to assess the daylight factor, it is not necessary to simulate all rooms within the usable area (NUF); it is sufficient to simulate a few representative rooms and apply the results to the remaining rooms in the usable area (NUF) via appropriate interpolation.

(1) Assessment via daylight measurements

In accordance with DIN 5034, the daylight factors must in principle be measured with a completely overcast sky. Analogous to the daylight simulations, it is not necessary to measure all rooms within the usable area (NUF); it is sufficient to measure the daylight factors in a few representative rooms and apply the results to the remaining rooms in the usable area (NUF) via appropriate interpolation.

Indicator 2: Availability of daylight at permanent workstations

In general, the methods listed below are permitted for assessment of the relative annual motive exposure.
As DIN V 18599-4 does not in principle take shading due to trees/plants into account, but these do still reduce the amount of daylight that reaches the building, if shading due to trees/plants is planned or already in place, daylight simulations must be used as a documentation method, if possible. If the simplified method in accordance with DIN V 18599-4 is used, plants must be assessed as obstructions to be on the safe side (estimate of the maximum height and width of the plants as building dimensions).

Calculation using the simplified method of DIN V 18599-4

If the relative annual motive exposure is documented using DIN V 18599-4, the daylight supply factor $C_{DL,supp}$ must first be calculated. To do so, the obstruction index I_{Vj} must be determined in detail in accordance with DIN V 18599-4 and incorporated into the assessment of the daylight supply factor $C_{DL,supp}$ or the daylight factor of the opening in the structural work DRb.
The lump sum approach to the obstruction index I_{Vj} = 0.9 – permitted in accordance with EnEV – does not sufficiently portray the actual shading in most cases and therefore results in a significant points penalty for documentation of this indicator.
If partial areas exist in the rooms with the permanent workstations that are not supplied with daylight in accordance with DIN V 18599-4 (i.e. the area supplied with daylight is smaller than the floor area of the rooms), the area in the rooms that is not supplied with daylight must be taken into account with an annual relative motive exposure of 0% in the area-weighted averaging of the daylight supply factor.
As the daylight supply factor $C_{DL,supp}$ in accordance with DIN V 18599-4 refers solely to the daytime hours (= use time while there is daylight) but the relative annual motive exposure in accordance with DIN 5034 nevertheless covers the

entire use time (regardless of whether there is daylight), the daylight supply factor $C_{DL,supp}$ averaged over the area must then be corrected using the daytime and night-time hours in accordance with DIN V 18599-10, Annex A, as follows:

$$H_{Nutz,rel} = C_{TL,Vers,j} \cdot \frac{t_{Tag}}{t_{Tag} + t_{Nacht}}$$

mit

$H_{Nutz,rel}$ = relative, jährliche Nutzbelichtung nach DIN 5034

$C_{TL,Vers,j}$ = Tageslichtversorgungsfaktor nach DIN V 18599 - 4

t_{Tag} = jährliche Nutzungsstunden zur Tagzeit nach DIN V 18599 - 4, Anhang B

t_{Nacht} = jährliche Nutzungsstunden zur Nachtzeit nach DIN V 18599 - 4, Anhang B

For this correction, the annual hours of use for daytime and night-time in accordance with DIN V 18599-10, Annex A, must be used, which must be calculated for the site of the project as well as for the expected use times (= normal working hours, e.g. work days from 8 am–6 pm) in accordance with DIN V 18599-10, Annex A. The annual relative motive exposure HMot,rel determined in this way forms the basis for evaluation of this indicator.

Daylight simulation

When using daylight simulations to assess the relative annual motive exposure, it is not necessary to simulate all rooms within the usable area (NUF); it is sufficient to simulate a few representative rooms and apply the results to the remaining rooms in the usable area (NUF) via appropriate interpolation.

Indicator 3: Visual contact with the outside

Proof of the minimum window area proportions in accordance with DIN 5034 must be documented using suitable plans and descriptions.

In accordance with DIN 14501, Table 10, the assessment of the class (0 to 4) of the sun/glare protection with regard to visual contact with the outside is based on the vertical-vertical light transmittance $\tau_{v,n\text{-}n}$ and the proportion of the light transmittance that is diffuse $\tau_{v,n\text{-}dif}$:

DIN 14501 Table 10 Visual contact with the outside – Classification

$\tau_{v,\,n\text{-}n}$	$\tau_{v,\,n\text{-}dif}$		
	$0 < \tau_{v,n\text{-}dif} \leq 0.04$	$0.04 < \tau_{v,n\text{-}dif} \leq 0.15$	$\tau_{v,n\text{-}dif} \leq 0.15$
$\tau_{v,n\text{-}n} > 0.10$	4	3	2
$0.05 < \tau_{v,n\text{-}n} \leq 0.10$	3	2	1
$\tau_{v,n\text{-}n} \leq 0.05$	2	1	0
$\tau_{v,n\text{-}n} = 0.00$	0	0	0

If the sun/glare protection is implemented with horizontal slats, the following angles must be used as a basis for assessment of the light transmittances:

- Normal angle of incidence of sunlight (same as for screens)
- Angle of inclination of moveable slats: Max. opening angle (horizontal)
- Angle of inclination of fixed slats: As installed

If the sun/glare protection is implemented with vertical slats, the following angles must be used as a basis for assessment of the light transmittances:

- Normal angle of incidence of sunlight (same as for screens)
- Angle of rotation of rotatable slats: Max. opening angle (vertical)
- Angle of rotation of fixed slats: As installed

Indicator 4: Absence of glare in daylight

In accordance with DIN 14501, Table 8, the assessment of the class (0 to 4) of the sun/glare protection with regard to absence of glare in daylight is based on the vertical-vertical light transmittance $\tau_{v,n\text{-}n}$ and the proportion of the light transmittance that is diffuse $\tau_{v,n\text{-}dif}$:

DIN 14501 Table 8 – Glare control – Classification				
$\tau_{v,n\text{-}n}$	$\tau_{v,n\text{-}dif}$			
	$\tau_{v,n\text{-}dif} \leq 0.02$	$0.02 < \tau_{v,n\text{-}dif} \leq 0.04$	$0.04 < \tau_{v,n\text{-}dif} \leq 0.08$	$\tau_{v,n\text{-}dif} > 0.08$
$\tau_{v,n\text{-}n} > 0.10$	0	0	0	0
$0.05 < \tau_{v,n\text{-}n} \leq 0.10$	1	1	0	0
$\tau_{v,n\text{-}n} \leq 0.05$	3	2	1	1
$\tau_{v,n\text{-}n} = 0.00$	4	3	2	2

If the sun/glare protection is implemented in the form of horizontal slats, the following angles must be used as a basis for assessment of the light transmittances:

- Normal angle of incidence of sunlight (same as for screens)
- Angle of inclination of moveable slats: Max. closing angle (approx. 70° to 75°)
- Angle of inclination of fixed slats: As installed

If the sun/glare protection is implemented in the form of vertical slats, the following angles must be used as a basis for assessment of the light transmittances:

- Normal angle of incidence of sunlight (same as for screens)
- Angle of rotation of rotatable slats: Max. closing angle
- Angle of rotation of fixed slats: As installed

Indicator 5: Absence of glare in artificial light

The following methods are permitted for documenting the colour rendering:

(2) Artificial light simulation

The UGR value must be calculated using artificial light simulations and evaluated in accordance with DIN EN 12464-1 for selected, representative rooms.

(3) Product data sheets with UGR values

Documentation of the glare limitation in accordance with DIN EN 12464-1 via product data sheets with UGR values

Indicator 6: Colour rendering

The following methods are permitted for documenting the colour rendering:

(4) Daylight

The colour rendering in daylight must always be evaluated for the combination of glazing and sun/glare protection in accordance with DIN EN 14501. To do so, the general colour rendering index Ra for the combination of glazing and sun/glare protection must be determined using spectral calculations in accordance with the method provided in DIN EN 410 and used as a basis for the evaluation.

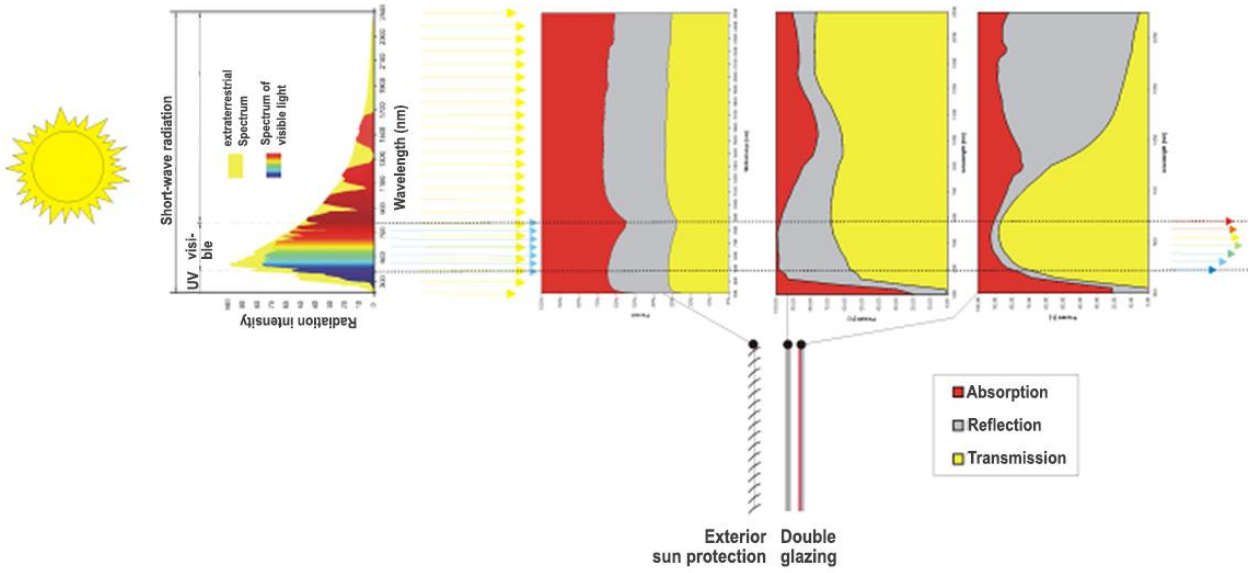
The following points must be taken into account in the spectral calculations:

I. If the sun protection also acts as the glare protection function when closed, it is sufficient to determine and evaluate the colour rendering index Ra for the combination of the glazing and the closed sun protection.

II. If there is no sun protection in place but glare protection is installed, the colour rendering index Ra for the combination of the glazing and the closed glare protection must be determined and evaluated.

III. If the sun protection does not act as the glare protection function when closed (e.g. if perforated slats are used), the colour rendering index Ra must be determined and evaluated for the combination of glazing and closed sun protection and closed glare protection (if installed).

Colour rendering for multi-pane glazing



Spectral filtering of the light as it passes through the façade:
Higher transmission of the green/yellow portion of the daylight results in colour distortion into green/yellow light → reduction in the R_a.

(5) Artificial light

The colour rendering of artificial light must be verified using manufacturer specifications for the lighting.

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.

In accordance with Appendix 2: "Permitted documentation processes"

Indicator 1: Availability of daylight for the entire building

- Basis and results of the completed daylight simulation.
- Measurement report for the completed daylight measurements.
- Calculation using the simplified method of DIN V 18599-4.

Indicator 2: Availability of daylight at permanent workstations

- Basis and results of the completed daylight simulation.
- Calculation using the simplified method of DIN V 18599-4.
- In the case of corridors with panelling and different artificial lighting that cannot be converted into workstations, clear and comprehensive documentation must be compiled, e.g. on the basis of photos, detailed plans and lighting concepts.

Indicator 3: Visual contact with the outside

- Documentation of the visual contact with the outside (where applicable in accordance with DIN 5034-1, Section 4.2.3 or 4.2.2) using suitable plans and calculations.
- Data sheets for the installed sun/glare protection systems.
- Photo documentation.

Indicator 4: Absence of glare in daylight

- Classification of the installed sun/glare protection.
- Data sheets for the installed sun/glare protection.

Indicator 5: Artificial light

- Basis and results of the completed artificial light calculation.
- Product data sheets with colour rendering.
- Spectral measurement of the light composition.
- Area configuration for area-weighted evaluation.

Indicator 6: Daylight colour rendering

- Basis and results of the spectral calculation in accordance with DIN EN 410 or DIN EN 13363-2.
- Manufacturer specifications for the glazing and sun/glare protection system used, e.g. in the form of data sheets or calculation results.
- Data in accordance with DIN EN 14501, manufacturer specifications or calculation (e.g. via software).

Indicator 7: Exposure to daylight

- Documentation of at least one guest room/living space.
- Floor plans, cross-sections, site plan.
- Sun progression chart.
- Calculation of the duration of exposure to daylight.

APPENDIX C – LITERATURE

I. Version

Change log based on version 2018

PAGE	EXPLANATION	DATE

II. Literature

- DIN V 18599 Part 4. Energy efficiency of buildings. Berlin: Beuth Verlag. December 2012
- DIN 5034 Part 1. Daylight in interiors. Berlin: Beuth Verlag. July 2011
- DIN 5034 Part 2. Daylight in interiors. Berlin: Beuth Verlag. February 1985
- DIN 5034 Part 3. Daylight in interiors. Berlin: Beuth Verlag. February 2007
- DIN EN 12464 Part 1. Lighting of work places. Berlin: Beuth Verlag. August 2008
- DIN EN 13363 Part 2: Solar protection devices combined with glazing – Calculation of total solar energy transmittance and light transmittance – Part 2: Detailed calculation method; German version EN 13363-2:2005. Berlin: Beuth Verlag. June 2005 incl. DIN EN 13363-2 Corrigendum 1 published April 2007
- German workplace regulation (ArbStättV). 12.08.2004; last changed 19th July 2010
- VDI 6011: Optimisation of daylight use and artificial lighting. Düsseldorf: Verein Deutscher Ingenieure e.V.
- DIN 6169: Colour rendering. Berlin: Beuth Verlag. February 1976