SOC1.1

Thermal comfort in open spaces

Objective

The objective is to increase the attractiveness of public spaces by taking microclimatic effects into account during planning. This promotes a pleasant, varied climate in the district throughout the year, which meets the different individual thermal needs of users.

Benefits

The following benefits for companies, municipalities and/or users can therefore be achieved:

- Attractive and versatile public spaces
- Promotion of the well-being and health of users
- Contribution to improving the microclimate and energy demand for air conditioning in buildings
- Reduction of the heat-island effect (urban heat island)
- Long-term use of open spaces through adaptability to climate change

Contribution to sustainability goals

	CONTRIBUTION TO THE SUSTAINABLE DEVELOPMENT GOALS (SDG) OF THE UNITED NATIONS		CONTRIBUTION TO THE GERMAN SUSTAINABILITY STRATEGY	
Significant	3.4	Reduction of premature mortality; promotion of health/well-being	3.1.a/b	Health and nutrition
	3.9	Effect of chemicals, air, water and soil pollution	3.2.a	Air pollution
	11.5	Impact of disasters		
	13.1	Resilience and adaptability		
Moderate	1.5	Reduction of vulnerability to climate-induced extreme events	13.1.a	Climate action
Low	11.6	Reduction of environmental pollution in cities		

Outlook

With climate change advancing, climate adaptation in cities is increasingly of great importance for the quality of life of the inhabitants. The contents of this criterion will therefore be integrated together with ENV1.5 Urban climate in the next system version for new buildings. The content of the criterion will be adapted and developed.

Share of the total score

	SHARE	WEIGHTING FACTOR
City Business Event	**2.6 %**	**3**
Commercial	**1.8 %**	**2**
Industry	**2.7 %**	**3**

ASSESSMENT

The climate-conscious planning of the district is evaluated in criterion SOC1.1 Thermal comfort and ENV1.5 Urban climate. In the present criterion, the microclimatic effects in the district are evaluated by ensuring basic comfort in open spaces (indicator 1), by considering wind comfort (indicator 2) and perceived temperature (indicator 3). The objective is not to create a homogeneous climate in the district, but to create a pleasant, varied climate that meets the different individual thermal needs of the users. A maximum of 100 points can be achieved.

NO.	INDICATOR		POINTS
1	**Basic comfort**		
	City **Business** **Event** **Commercial**		**max. 70**
	Industry		**max. 80**
1.1	**Microclimate analysis**		
	City **Business** **Event** **Commercial**		**max. 10**
	Industry		**max. 20**
	Analysis of the microclimatic conditions in the planned open spaces by a qualified person.	**City** **Business** **Event**	10
		Commercial	10
		Industry	20
1.2	**Solar radiation on 21 December in hours**		
	City **Business** **Event** **Commercial**		**max. 10**
	■ ≥ 1 h (At least 80 % of the surfaces in the study area are exposed to 1 hour of solar radiation on 21 Dec.)		5
	■ ≥ 3 h (At least 80 % of the surfaces in the study area are exposed to 3 hours of solar radiation on 21 Dec.)		10
1.3	**Shading of the study areas in percentages**		
	City **Business** **Event** **Commercial**		**max. 10**
	Industry		**max. 30**
	■ ≥ 10% of the surfaces in the study area are protected by trees, rigid or adaptive/flexible shading systems or buildings from summer sun	**City** **Business**	5
		Event	5
		Commercial	5
		Industry	15
	■ ≥ 30 % of the surfaces in the study area are protected by trees, rigid or adaptive/flexible shading systems or buildings from summer sun .	**City** **Business**	10
		Event **Commercial**	10
		Industry	30

NO.	INDICATOR	POINTS
1.4	**Wind protection measures** City Business Event Commercial	
	■ The building structure is optimised for the city climate, so that negative effects for the common areas (wind tunnel effects, handling of fall winds from high-rise buildings, etc.) are avoided. Wind protection measures are used for areas affected by gusts of wind.	10
1.5	**Improvement measures for microclimate** City Business Event Industry Commercial	**max. 30**
	The measures of the analysis were planned/implemented:	
	■ Between 33 and 100% of the recommended measures are implemented	10 – 30
2	**Wind comfort** City Business Event Commercial	**max. 10**
2.1	**Examination in all categories** City Business Event Commercial	**max. 10**
	■ Examination with division into all categories (A-C). The requirements are not met or have not been documented.	3
	■ Examination with division into all categories (A-C). The requirements are fulfilled on average for at least 50 % of all the common areas examined.	5
	■ Examination with division into all categories (A-C). The requirements are fulfilled for at least 80 % in each of the examined common areas.	10
3	**Perceived temperature** City Business Event Industry Commercial	**max. 20**
3.1	**Percentage reduction of hot or cold periods (number of hours h) compared to the base variant** City Business Event Industry Commercial	**max. 20**
	■ ≥ 30 %	3
	■ ≥ 40 %	7
	■ ≥ 50 %	14
	■ Demonstrably no stress days available or demonstrable reduction of stress days by at least 80%.	20

SUSTAINABILITY REPORTING AND SYNERGIES

Sustainability reporting

As key figures / KPIs, it is useful to communicate values for operating temperature, air speed, surfaces and room air humidity. Basic data and the results of a thermal simulation can be used for reporting according to “Level(s) - Common EU framework of core environmental indicators”.

NO.	KEY FIGURES/KPI	UNIT
KPI 1	Wind comfort	[-]
KPI 2	Perceived temperature	[%]
KPI 3	Shading	[-]

Synergies with DGNB system applications

- **DGNB NEW BUILDINGS:** Contents of the criterion will be integrated into the next system version.

- **DGNB BUILDINGS IN USE:** Indirectly, if a high level of thermal comfort is achieved, it has a positive impact on the evaluation of user satisfaction (BIU criterion SOC2-B).

APPENDIX A - DETAILED DESCRIPTION

I. Relevance

City **Business** **Event** **Industry** **Commercial**

The (thermal) comfort in public spaces is of great importance for daily and seasonal use and attractiveness. High microclimatic and bioclimatic quality promotes a healthy living environment and the well-being of the district users. At the same time, attractive open spaces encourage people to meet and engage in interpersonal exchange, thus making a significant contribution to the social stability of the district. The objective is not necessarily to provide a climate that is as homogeneous as possible, but to provide differentiated microclimatic conditions for different users.

II. Additional explanation

City **Business** **Event** **Industry** **Commercial**

The objective is to achieve a high quality of stay even on hot, stormy and/or days with high humidity. The buildings orientation and the open space design can optimise solar radiation, reduce overheating and reduce or increase air movement. The potential of necessary drainage and rainwater retention measures can be used to create bioclimatic added value through surface and artistically designed water elements in addition to the design quality.

In view of the negative effects of climate change, the positive influence on comfort in public spaces in general and in inner-city locations plays a central role in municipal climate adaptation strategies. It is therefore important to take bioclimatic effects into account in the development and implementation of the district.

To create and secure high-quality public spaces is a central requirement of the “LEIPZIG CHARTER on Sustainable European Cities”, which was adopted in 2007 and is being continued at the national level as part of urban development policy. The same objective can be found in the United Nations Human Settlements Programme - HABITAT, formulated in the Habitat Agenda 1996.

III. Method

City **Business** **Event** **Industry** **Commercial**

The comfort must be presented for high quality and important common areas such as city squares, parks of the district, common areas at the factory premises. For event areas, this includes the inner courtyards of exhibition stands or spectator stands. However, all permanently roofed event rooms (e.g. concert halls) are not relevant.

In principle, all outdoor living areas that are critical in terms of thermal comfort should be examined. Outside common areas for visitors, which are designed for a longer stay in a specific location, must be included in the examination for event areas. This includes, for example, spectator stands at a football stadium or an open-air theatre (but not the pitch or the stage itself).
In addition, at least the following number of common areas must be subjected to an examination:

- For districts smaller than 10 hectares = min. 2 common areas
- For districts larger than 10 hectares = min. 2 common areas plus 1 common area per additional 10 hectares (e.g. with 22 hectares = 2 + 1 = 3 common areas)
- A maximum of 10 common areas per district must be examined.

The qualities of the common areas need to be determined separately and an average value is to be formed. A distinction is made between “classic” outdoor spaces and “special forms” such as spectator areas. The assessment is as follows:

Classic outdoor spaces for **City** **Business** **Industry** **Commercial**: Evaluation of indicators 1 - 3 as described below.

Specifics for **Event**: Evaluation of indicators 2 – 3 (simulations), with the following regulations:
For fully enclosed building types (e.g. football stadiums), only the evaluation of thermal comfort may be sufficient; this must be justified accordingly or confirmed/documented by a qualified expert.
For large-area special types with different comfort zones, the area-weighted average of all zones is to be calculated to verify the reduction of stress days. For the full point score, the reduction to 0 stress days must be demonstrated separately for each area.
Thus (depending on the case) a maximum of 50 POINTS each for indicator 2 and 3, or a maximum of 100 POINTS only for indicator 3, can be achieved per living area. For the overall evaluation of the criterion, the average value for all examined spaces has to be calculated.

It is recommended to use appropriate holistic software tools/simulation programs for the evaluation.

Indicator 1: Basic comfort

Indicator 1.1: Microclimate analysis
The analysis should explain how to react to the climatic conditions on site and how to plan a pleasant climate in the open spaces. A climate adaptation strategy should serve as the basis for the analysis. If none is available for the municipality, heat maps, landscape frame plans, main wind direction in winter/summer etc. can also be used.
The analysis should also show how open spaces can meet different microclimatic requirements of users (e.g. sunny warm places and windless and shady outdoor spaces that are available at the same time).

Indicator 1.2 – 1.5: Basic comfort
The comfort of public spaces is of great importance for daily and seasonal use and for their attractiveness.

The public spaces of the district should offer good urban climatic conditions throughout the year (enough sun and protection from cold winds and rain in winter and protection from sun and overheating in summer). Otherwise, spaces remain unattractive and only partially usable during the day or year. For this reason, common areas should be exposed to sunlight ("solar access") and offer shading in summer. Wind protection measures are intended to minimise unpleasant strong and cold air movements.
City squares and parks are of great importance for the urban environment, because the quality of stay depends mainly on the comfort of the place. Comfort in summer can be increased especially by green spaces, open water surfaces, the choice of materials (absorption and reflection properties) and shading elements. In winter, especially solar radiation is relevant. Wind protection is particularly relevant from autumn to spring and should help to reduce high wind speeds close to the ground. It should be noted that maximising wind protection can result in a conflict of objectives with the ventilation assessed in the "City climate" criterion.

5 basic indicators (green spaces, water areas, solar radiation, shading, wind protection) are used to evaluate basic comfort. Further points can be achieved by demonstrating an appropriate integral process for improving planning.

If it is proven by expert opinion that the objectives from the analysis are achieved, the maximum score can be given.

Indicator 2: Wind comfort
The wind comfort in the district has to be demonstrated by a qualified study or simulation.

The wind limiting speeds are defined differently for different boundary conditions of use (area types). For example, the permissible wind speeds on footpaths and cycle paths are less strict than within covered passages.
A detailed, yearly wind comfort study has to be executed for each investigated common area by means of a wind tunnel test or a flow simulation using CFD (Computational Fluid Dynamics) software.

The area types defined under wind comfort aspects are divided into

- Area type I: Area type I includes (public) areas where people move around as pedestrians or cyclists or similar with the primary aim of moving forward. The short name of area type I is therefore traffic area. Traffic areas are e.g. car parks, parking decks, footpaths and cycle paths, public roads.

- Area type II: Area type II includes areas where people go for a stroll or for a short stay outdoors. These areas require a higher quality of stay than those of area type I. Area type II includes areas such as bus and train platforms or (aerodynamically open or semi-open) station halls. The short name for area type II is "movement area". Movement areas are e.g. bus and train platforms, squares and parks, pedestrian zones, building entrances, covered streets, station halls.

- Area type III: Areas that are classified as area type III must meet the highest standards in terms of the quality of stay. They are intended to provide a feeling of comfort even during longer stays. Wind draughts are often classified as very problematic on such surfaces, since the desired feeling of comfort is significantly impaired. Many areas of area type III are therefore, depending on the location, often designed as (fluidically) closed areas such as shopping malls or (mainly) covered stadiums or similar. However, area type III also includes those areas where larger wind movements are not acceptable due to their specific use, such as open-air swimming pools or summer terraces for high-quality recreation, for which the choice of location is therefore of great importance. The short name for area type III is “Recreational area”. Examples for recreational areas are terraces with seats, sports stadiums and swimming pools, covered shopping arcades.

Internationally, the mean wind limit speeds of 5 m/s averaged over an hour have become established for the assessment of wind comfort conditions. The assessment is based on the excess frequency of this average wind speed.

In wind comfort tests, the number of hours per year wind speeds of 5 m/s are exceeded is checked. The determined excess hours per year are then evaluated using a 3-stage comfort criterion. The comfort levels include the categories:

- Category A - Rating: good
- Category B - Rating: moderate
- Category C - Rating: unsatisfactory, needs improvement

For the evaluation, the selected area types are to be subdivided according to the respective category in the following table and then evaluated.

TABLE 1 Assessment of wind comfort based on the frequency of exceeding average hourly wind speeds according to NEN 8100

AREA TYPE	PERCENTAGE OF EXCESS HOURS PER YEAR		
	COMFORT CRITERION (V > 5M/S)		
	A (GOOD)	B (MODERATE)	C (UNSATISFACTORY, NEEDS IMPROVEMENT)
I. Traffic areas [pass through]	5 – 10 %	10 – 20 %	> 20 %
II. Movement areas [strolling]	2.5 – 5 %	5 – 10 %	> 10 %
III. Recreational areas [Sitting]	> 2.5 %	2.5 – 5 %	> 5 %

The following applies to the content assessment of the comfort criterion:

Category A: In evaluation category A (good), no obstruction or nuisance is to be expected due to excessively high wind speeds. The wind comfort is generally considered good.

Category B: Category B (moderate) includes areas that are rated less than good in terms of the desired or required comfort, but still sufficient (moderate). Improvements in wind comfort should be aimed if they can be implemented by simple measures.

Category C: For category C (in need of improvement), “comfort” can only be spoken of to a very limited extent, as disturbing wind speeds generally occur regularly. At measuring points assigned to category C, improvement measures should be implemented to achieve more favourable wind comfort.

Note: The assessment criteria listed in table 1 refer to inland conditions. Experience has shown that wind sensations are perceived as less disturbing in coastal regions than within the country.

Indicator 3: Thermal effect complex
The outdoor comfort evaluation must be applied to a situation in midsummer. The objective should therefore be to reduce the periods that are assigned to the thermal sensation “warm”. This concerns the evaluation area (26 °C < Perceived Temperature (PT) < 32 °C or 20 °C < PT < 26 °C).
For winter conditions, the evaluation area “pleasant” is the basis (0 °C < PT < 20 °C). With regard to the respective use of the common area to be evaluated, the comfort must be assessed in a time-resolved manner. In order to show a potential for improvement, a person who is directly exposed to the local climate - i.e. without wind protection and sun protection measures - is considered the basic variant.
To calculate the perceived temperature, a simulation/calculation must be carried out by using a suitable program. Alternatively, the methods described in VDI 3787 Part 2 can be applied.

A detailed outdoor comfort study using perceived temperature (Perceived Temperature PT, Universal Thermal Climate Index UTCI, etc.) must be carried out for each living area examined. In addition to wind comfort, other factors of outdoor comfort such as outside temperature, solar radiation etc. are taken into account. For the simulation, the warmest and coldest day of the past ten years have to be used (without outliers).

The evaluation of the perceived temperature is the most holistic approach to evaluate and optimise outdoor comfort. This method can also be used to evaluate the influence of seasonal measures (temporary sun protection) on outdoor comfort (see VDI 3787 Part 2). In the course of global warming and in hot regions of the world, this topic will become increasingly important in the future.

IV. Scheme-specific description

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APPENDIX B - DOCUMENTATION

I. Required documentation

City Business Event Industry Commercial

TABLE 2 Overview of documentation with abbreviations

SUPPORTING DOCUMENTS	ABBREVIATION
Qualified **declaration of intent** to implement the measures	A
Documentation with **relevant records/documents/expert opinions/** ■ B1: Urban development design including open space concept with marking and justification of the selected characteristic common areas ■ B2: Presentation of input parameters in the simulation and simulation results; verification of previous simulation results and, in the event of changes, proof of these changes by means of a modified simulation or on-site measurement	B
Photo documentation of the implemented measures	C
Site plan with marking of relevant indicators/measures	D

TABLE 3 Documentation per indicator

INDICATORS	City Business Event Commercial			Industry	
	PHASE 1	PHASE 2	PHASE 3	VZ	Z
1. Basic comfort	(A), B	B, C, D	B, C, D	(A), B	B, C, D
2. Wind comfort	A, B	B	B	A, B	B
3. Perceived temperature	A, B	B	B	A, B	B

APPENDIX C - LITERATURE

I. Version

Change log based on version 2020

PAGE	EXPLANATION	DATE

II. Literature

- Federal Ministry of Transport, Building and Urban Affairs (Ed.): Neue Freiräume für den urbanen Alltag, Modellprojekt im ExWoSt-Forschungsfeld „Innovationen für familien- und altengerechte Stadtquartiere", Berlin 2009.
- Gehl, Jan (2015): Cities for People, Jovis Verlag, ISBN 978-3-86859-356-3.
- Lohmeyer A., Bächlin W., Plate E. J., Seitz R. (1992): Städtebauliche Klimafibel - Hinweise für die Bauleitplanung, Ministry of Economics Baden-Württemberg (E.), Stuttgart.
- Mathey, J. et al.: Noch wärmer, noch trockener? Stadtnatur und Freiraumstrukturen im Klimawandel. In: Naturschutz und Biologische Vielfalt, Vol. 111, Bonn-Bad Godesberg: Bundesamt für Naturschutz, 2011.
- VDI 3785 sheet 1 Environmental meteorology - Methods and presentation of investigations relevant for planning urban climate, Dec. 2008.
- VDI 3787 sheet 2 Environmental meteorology - Methods for the human biometeorological evaluation of climate and air quality for urban and regional planning at regional level - Part I: Climate, Nov. 2008.
- VDI 3787 sheet 5 Environmental meteorology - Local cold air, Dec. 2003.
- VDI 3787 sheet 9 Environmental meteorology - Provision for climate and air quality in regional planning, Dec. 2004.
- VDI Commission on Air Pollution Prevention, 1988: Stadtklima und Luftreinhaltung – Ein Wissenschaftliches Handbuch für die Praxis in der Umweltplanung
- NEN 8100:2006 Wind comfort and wind danger in the built environment
- Explanations to NEN 8100:2006 according to the Windkomfortgutachten (wind comfort report) of Peutz Consult GmbH