Active House - Comfort Score

activehouse

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Vision

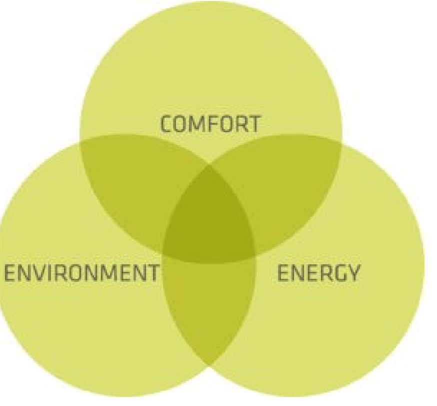
CREATING BUILDINGS FOR PEOPLE AND PLANET

Active House is a vision of buildings that create healthier and more comfortable lives for their occupants without impacting negatively on the climate – moving us towards a cleaner, healthier and safer world.

COMFORT *– creates a healthier and more comfortable life*
An Active House creates healthier and more comfortable indoor conditions for the occupants, ensuring a generous supply of daylight and fresh air, combined with a comfortable indoor temperature and absence of disturbing noise. Materials used have a neutral and where possible positive, impact on comfort and indoor climate.

ENERGY *– contributes positively to the energy balance of the building*
An Active House is energy efficient. It utilises smart energy sourcing, energy needed is supplied by renewable energy sources integrated in the building or from the most sustainable source from the nearby collective energy system or electricity grid.

ENVIRONMENT *– has a positive impact on the environment*
An Active House interacts positively with the environment through an optimised relationship with the local context, focused use of resources, and its overall environmental impact throughout its life cycle.



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Key principles

KEY PRINCIPLES OF ACTIVE HOUSE

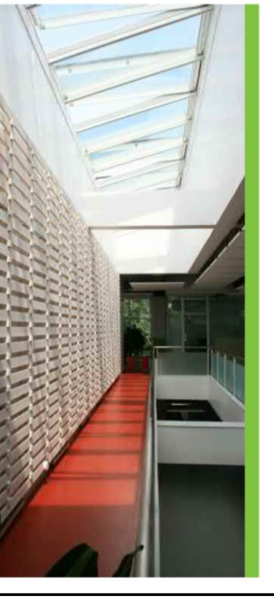
THE ACTIVE HOUSE KEY PRINCIPLES ARE AS FOLLOWS

COMFORT
- a building that provides an indoor climate that promotes health, comfort and sense of well-being
- a building that ensures good indoor air quality, adequate thermal climate and appropriate lighting levels and acoustical comfort
- a building that provides an indoor climate that is easy for occupants to control and at the same time encourages responsible environmental behaviour.

ENERGY
- a building that is energy efficient and easy to operate
- a building that substantially exceeds the statutory minimum in terms of energy efficiency
- a building that exploits a variety of energy sources integrated in the overall design.

ENVIRONMENT
- a building that exerts the minimum impact on environmental and cultural resources
- a building that avoids ecological damage
- a building that is constructed of materials with focus on re-use and re-purpose.

LangFang Office, Beijing China.
Photo: *Velux China.*



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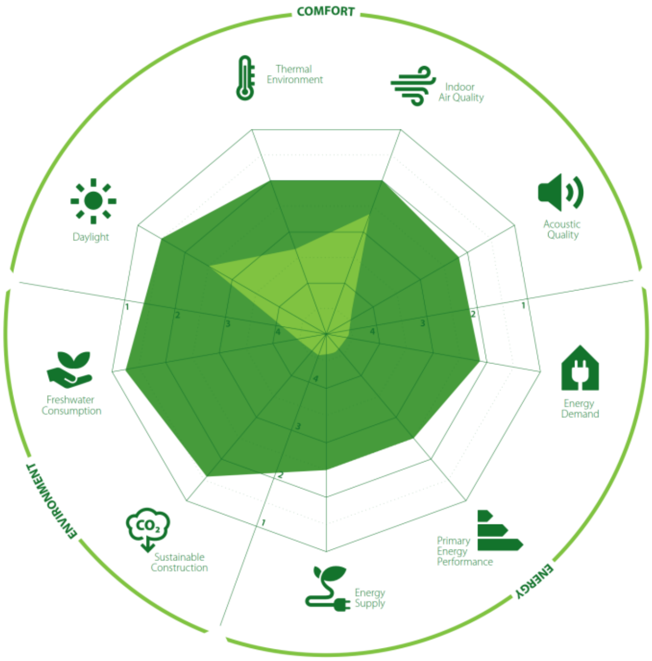
COMFORT
Thermal Environment
Indoor Air Quality
Acoustic Quality
Energy Demand
Primary Energy Performance
ENERGY
Energy Supply
Sustainable Construction
ENVIRONMENT
Freshwater Consumption
Daylight

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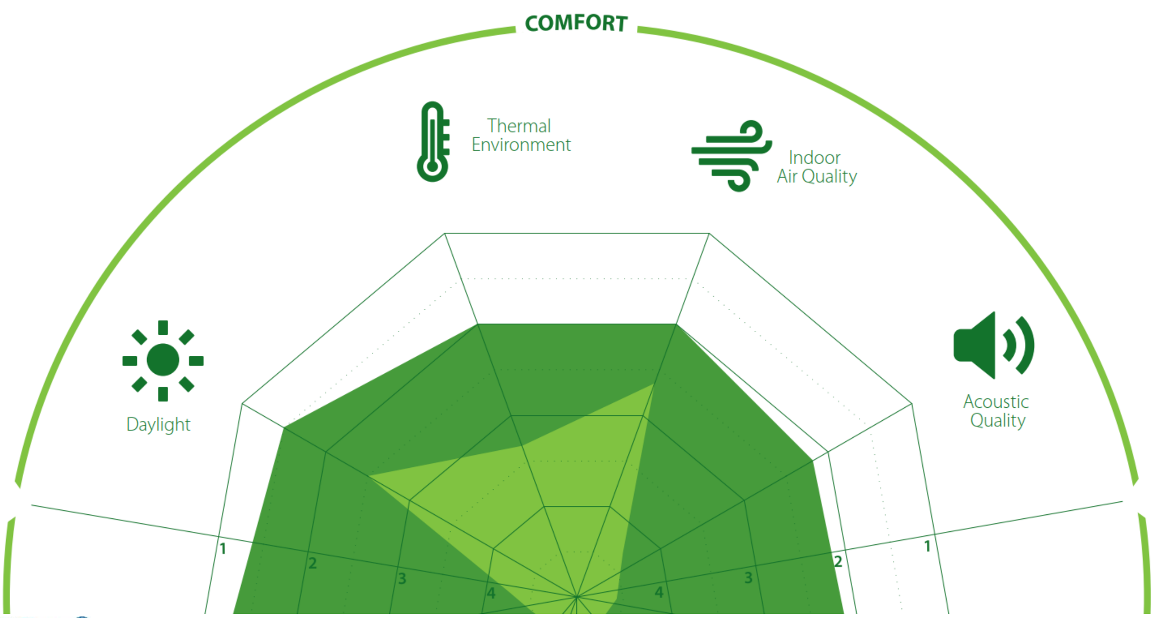
COMFORT
Thermal Environment
Indoor Air Quality
Acoustic Quality
Daylight

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EXAMPLE OF THE USE OF QUALITATIVE CRITERIA, BASED ON CHAPTER 2.1 ENERGY DEMAND.

ASPECT	CRITERIA	ARGUMENTS	YES/NO
Demand on individual products and construction elements	Have the chosen products and construction solutions been evaluated from a cost-effective, life cost perspective and maintenance view?	All main solutions (roof, wall, foundation and windows) have been calculated from a cost-effective perspective within the individual solutions' lifetime. An evaluation of maintenance of technical solutions will be carried out.	YES
Architectural design solutions	Have architectural design solutions been used to reach a holistic approach of the building and to reach a low energy demand?	During the design phase, alternative design solutions have been modelled in BIM and the predicted performance of energy, indoor comfort and environment has been evaluated. The results were used to adjust and optimise the architectural design solution.	YES
Demand on individual appliances	Have the best energy performing solutions for appliances been chosen?	All white goods are minimum class A+ and all installed/in-built lamps are LED and evaluated for light quality.	YES

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TABLE 1: EXAMPLE CALCULATION OF AVERAGE DAYLIGHT FACTOR USING DEFAULT NUMBERS FOR DIFFERENT ROOMS IN A HOUSE

ROOM	DF SCORE		HOURS		NO. OF PEOPLE		WEIGHTED SCORE
Kitchen	3	x	2.5	x	3	=	22.5
Living room	2	x	3	x	3	=	18
Bedroom parents	1	x	0.5	x	2	=	1
Bedroom child	2	x	1.5	x	1	=	3
SUBTOTAL			19				44.5
TOTAL AVERAGE SCORE							2.3

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Daylight

ASPECT	CRITERIA	ARGUMENTS	YES/NO
View	Are windows located to offer the best possible views to the exterior environment (sky and surroundings)?		
Visual transmittance	Are windows that provide a view to the outdoors selected to have the highest possible visible transmittance?		
Glare management	Is dynamic shading present to avoid risk of glare?		
Daylight in secondary rooms	Have circulation zones and bathrooms access to daylight?		
Blinding of bedrooms	Do bedrooms have the possibility to block out all light coming from windows to create a full dark environment to sleep in?		
Room reflectance	What surface reflectances have been used in the daylight calculations? It is recommended to use the following values (typical ranges in brackets) Ceiling: 0.7 (0.7 to 0.9) Walls: 0.5 (0.5 to 0.8) Floor: 0.2 (0.2 to 0.4)		
Single or multiple openings	Does the room have access to daylight from more than one orientation and/or height?		
Simulation method	Has dynamic model simulation been used to determine the DA, rather than determining the DF?		

Daylight option 1 – daylight factor (standardized method)

ASPECT	VALUE	CRITERIA	SCORE
Daylight factor per room		The amount of daylight in a room is evaluated through the fraction of the room, $F_{plane,\%}$, that have a daylight factor higher than the target daylight factor (D_T): 1. $F_{plane,\%}$ > 70 % of the occupied space 2. $F_{plane,\%}$ > 60 % of the occupied space 3. $F_{plane,\%}$ > 50 % of the occupied space 4. $F_{plane,\%}$ > 40 % of the occupied space Daylight factors are calculated using a validated daylight simulation program according to EN 17037.	

D_T depends on location and by that the median external diffuse illuminance $E_{v,d,med}$. Values of $E_{v,d,med}$ for different nations / capitals are shown in Annex 1 together with the corresponding values of D_T.

$$D_r = \frac{Illuminance\ level}{E_{v,\ d,\ med}} = \frac{illuminance\ level}{E_{v,\ d,\ med}} = \frac{300\ lx}{E_{v,\ d,\ med}}\ x100\ \{\%\}$$

$E_{v,d,med}$ can be calculated using hourly values of the diffuse horizontal illuminance from the sky using yearly weather data. $E_{v,d,med}$ is median of the 4380 highest hourly values, equivalent to the 75th percentile of the yearly data.

Daylight option 2 – daylight autonomy (dynamic calculations)

The calculation preconditions for the climate based daylight-modelling relies on the method described in EN17037 - Daylight in Buildings, Daylight provision calculation method 2. For a space with vertical and/or inclined opening with a given target illuminance of 300 lx, at least 25% of the yearly hours, the results shall be above the target value. The minimum illumination limit is 300 lx in residential buildings. In case office or other public buildings are evaluated, the limit is 500 lx.

ASPECT	VALUE	CRITERIA	SCORE
Target daylight level per room		The amount of daylight in a room is evaluated through daylight levels with a target illuminance of 300 lux in dwellings or 500 lx in office or other public buildings. $DA_{300/50}$ 1. > 70% of the occupied space 2. > 60% of the occupied space 3. > 50% of the occupied space 4. > 40% of the occupied space	

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Thermal environment

ASPECT	CRITERIA	ARGUMENTS	YES/NO
Individual control, winter	Is it possible to adjust the temperature at room level according to momentary needs, e.g. with adjustable thermostats?		
Individual control, summer	Is it possible to manually influence the thermal conditions in each room, e.g. by opening windows or adjusting solar shading? In the case of mechanical cooling systems, is it possible to adjust the temperature at room level, e.g. with adjustable thermostats?		
Night cooling	Is it possible to remove excess heat that has built up during the day, through high volume night-time ventilation with cool outdoor air?		
Overheating, winter	Is it possible to remove unwanted excess heat in winter, e.g. on sunny days, without creating uncomfortable draughts?		
System interface	Have the climate system interfaces (e.g. wall thermostats) been selected to be as intuitive and simple as possible?		
Draught	Have ventilation openings (including windows, ventilation grilles and mechanical ventilation devices) been located and detailed so that discomfort caused by draught is minimised? Typical airspeeds within the living zone should remain below 0.2 m/s in winter and 0.5 m/s in summer **Note:** *Adjustability (e.g. of operable windows and ventilation grilles) is an important issue to take into account in this context.*		

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Thermal environment

Maximum temperature

ASPECT	VALUE	CRITERIA	SCORE
Maximum operative temperature per room		The maximum indoor temperature limits apply in periods with an outside T_{rm} of 12°C or more. For rooms/spaces in buildings without mechanical air conditioning and with adequate opportunities for natural (cross or stack) ventilation, the maximum indoor operative temperatures are: 1. $T_{i,o} < 0.33 \times T_{rm} + 20.8$°C 2. $T_{i,o} < 0.33 \times T_{rm} + 21.8$°C 3. $T_{i,o} < 0.33 \times T_{rm} + 22.8$°C 4. $T_{i,o} < 0.33 \times T_{rm} + 23.8$°C T_{rm} is the Running Mean outdoor temperature as defined in 'paragraph 3.12 External temperature, running mean' of EN 16798-1. For rooms/spaces in buildings with air conditioning, the maximum operative temperatures are: 1. $T_{i,o} < 25.5$°C 2. $T_{i,o} < 26$°C 3. $T_{i,o} < 27$°C 4. $T_{i,o} < 28$°C For bedrooms (especially at night time), a 2°C lower value than indicated above should be used as people are more sensitive to high temperatures when sleeping or trying to fall asleep. Also, in kitchens higher temperatures than indicated can be allowed periodically, e.g. during cooking activities. The system should be designed to achieve recommended values. The users can, however, choose their own settings. Reference: EN 16798-1.	

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Thermal environment

Minimum temperature

Minimum operative temperature per room		The minimum indoor temperature limits apply in periods with an outside T_{rm} of 12°C or less. For living rooms, kitchens, study rooms, bedrooms etc. in dwellings, the minimum operative temperatures are: 1. $T_{i,o} > 21$°C 2. $T_{i,o} > 20$°C 3. $T_{i,o} > 19$°C 4. $T_{i,o} > 18$°C The system should be designed to achieve recommended values. The users can, however, choose their own settings.	

1.1.2. QUANTITATIVE CRITERIA EVALUATION METHOD

- To objectify the risk of overheating, a dynamic thermal simulation tool is used to determine hourly values of indoor operative temperature at room level (e.g. in living rooms, kitchens and bedrooms, or office spaces). In buildings without mechanical cooling systems (like central air conditioning), adaptive temperature limits are used in the summer months. This means that the maximum allowable temperature inside is linked to the weather outside: limits go up during warmer periods.
- Requirements should be met for a minimum of 95% of occupied time.
- The score is based on the weighted average of all evaluated rooms. Occupancy hours should be included in the weighting.

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Indoor air quality

ASPECT	CRITERIA	ARGUMENTS	YES/NO
Individual control	Is it possible to manually influence the air exchange rate in the rooms (especially living room, kitchen and bedrooms), e.g. by opening windows, temporarily closing air grills, or if mechanical ventilation is installed, is it possible to adjust the airflow rate at three or more levels?		
Dampness	Is it guaranteed that there is sufficient extraction in rooms with periodic moisture-production peaks (esp. kitchens, bathrooms and toilets)? **Note:** *The minimum exhaust air flow for toilets, bathrooms and kitchens should be 35, 50 and 70 m3/h, according to category II of EN16798-1.*		
Low-emitting building materials	Have indoor climate-labelled materials been used? **Note:** *many labels exist, for example, Danish Indoor Climate label, M1 label, AgBB, GUT label, Blue Angel, GreenGuard Gold label.*		
Kitchen	Is a kitchen hood present with a capacity of at least 300 m^3/h with the exhaust directly to the outside?		
Outdoor air filtration	In case the building is situated at a location with poor outdoor air quality, is filtration present in the fresh air supply.		

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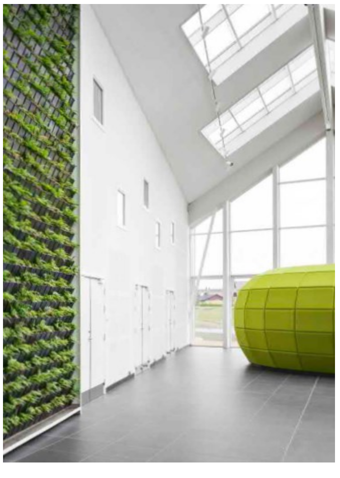
Indoor air quality



1.3.2. QUANTITATIVE CRITERIA EVALUATION METHOD

- Fresh air supply can be evaluated by examining indoor CO_2 concentrations at room level during occupancy. CO_2 is a good indicator of the amount of bio-effluents, pollutants from humans, in the air.
- CO_2 emission per person should be set at 20 l/h and 13.6 l/h per person for living rooms and bedrooms respectively (reference: EN 16798-1).
- The requirements should be met for a minimum of 95% of occupied time.
- The classification of the air quality is determined as the use-time-weighted hourly average of all room scores.
- The minimum requirements as specified in national codes should always be followed.

ASPECT	VALUE	CRITERIA	SCORE
Standard fresh air supply per room		The fresh air supply shall be established according to the below limit values for indoor CO_2 concentration in living rooms, bedrooms, study rooms and other rooms with people as the dominant source and that are occupied for prolonged periods: 1. < 400 ppm above outdoor CO_2 concentration 2. < 550 ppm above outdoor CO_2 concentration 3. < 800 ppm above outdoor CO_2 concentration 4. < 1100 ppm above outdoor CO_2 concentration	

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Acoustic quality

ASPECT	CRITERIA	ARGUMENTS	YES/NO
Inside system noise	Has extra attention been given to rooms that require extra quietness, such as bedrooms and study rooms?		
Acoustic privacy	Are inner walls and floor divisions designed to reduce noise transmission between rooms?		
External spaces	In case external spaces are present, such as a garden or balcony, have measures been taken to create a quiet environment?		

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Acoustic quality

1.4.2. QUANTITATIVE CRITERIA EVALUATION METHOD

- All main occupied spaces should be assessed.
- If the building has one or more bedrooms, the lowest scoring bedroom determines the overall score for the inside system and outside noise criteria. In that case, it supersedes the weighting of different rooms.
- Rather than assessing the minimum sound-insulating value of outer wall constructions, the resulting maximum indoor sound level is assessed. This way, the construction can be optimised for different locations with different external sound levels, with buildings on quiet locations needing fewer measures than buildings on sound heavy locations, while still scoring the same.
- The levels are aimed at setting ambitions for calculations at the design stage. After completion, when questions arise whether the ambitions are achieved, measurements can be done. These can be done by a professional, but also with a noise meter app on a smartphone.
- The limit values are based on ISO 140-4

ASPECT	VALUE	CRITERIA	SCORE
Inside system noise		The limit values are: 1. < 25 dB or noise level at or below background noise level 2. < 30 dB 3. < 35 dB 4. < 40 dB After completion, noise from all mechanical services in continuous operation is measured in all main occupied spaces. In case an adjustable mechanical ventilation system is present, the noise levels should at least be met at the ventilation rate that meets the indoor air quality ambition level. The noise levels from the table above can temporarily be exceeded to the next level, when the ventilation flow rate is increased due to removal of pollutants or humidity such as during cooking or showering.	
Outside noise		The maximum indoor noise levels from outdoor sources are: 1. < 25 dB 2. < 30 dB 3. < 35 dB 4. < 40 dB Noise from outside sources such as traffic or industry should be prevented from entering the building. Local outdoor noise level data can normally be found in so called noise contour maps that are made available online by local government. Assuming that calculations/measurements are done with operable windows and outside doors closed.	
Acoustic privacy		Within connected dwellings, such as apartment buildings, neighbours can be a source of noise, so it is important to have walls and floors that limit the noise transfer. Difference is made between airborne sound ($D_{nT,A}$) and contact sound ($L_{nT,A}$). The limit values are: 1. $D_{nT,A} \geq 62$ dB and $L_{nT,A} \leq 43$ dB 2. $D_{nT,A} \geq 57$ dB and $L_{nT,A} \leq 48$ dB 3. $D_{nT,A} \geq 52$ dB and $L_{nT,A} \leq 53$ dB 4. $D_{nT,A} \geq 47$ dB and $L_{nT,A} \leq 58$ dB	
		AVERAGE SCORE:	

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activehouse
Daylight
1.5
SCORE
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Thermal Environment
1.5
SCORE
activehouse
Indoor Air Quality
1.5
SCORE
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Acousitc Quality
1.5
SCORE

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