How do owners equip their buildings for hot summers?

A pleasant and productive atmosphere in spite of high outside temperatures: efficient systems technology makes this possible in new buildings. With existing buildings, simple steps, adjusting the systems and retrofit table technical equipment can all help to lower room temperatures.

Outside temperatures of over 36° C and room temperatures of over 30° C were no rare occurrence in the last few summers. Productivity drops off quickly at such temperatures. It is scarcely possible to concentrate in offices with no air conditioning. Whether users feel comfortable in a building depends on the degree of thermal comfort in the offices. There are many standards in our highly regulated society, e.g. the Workplace Directive (ArbStättV) and technical rules which define the indoor climate and therefore the "target" at an office workplace. Above all, ArbStättV requires "room temperatures conducive to health". From thresholds of 26° C and 30° C upwards, employers must take steps with varying degrees of urgency.

Comfort in summer, a problem for the owners?

When building owners let their premises to employers, they are well advised to implement compliance with the specifications contained in ArbStättV at the planning stage and not to leave it to the relevant employers. The letting process takes into account the quality of comfort provided by cooling by answering the question whether air conditioning is present or not. But the sensitivity towards uncomfortable interior conditions has increased through legal interpretations, construction methods, measurement techniques and complaints. The quality of the air conditioning could be easily contractually agreed by means of the annual proportion under the target (JUA) during the period of use: e.g. the room temperature in that case has to be under 26° C for x percent of the period of use and under 30° C for y percent.

Without technical equipment, it is only possible to establish comfortable room temperatures in a few buildings. To achieve this, it is absolutely essential to combine the aspects of façades, density of usage and occupation, construction physics, ventilation and air conditioning as well as building automation as part of integrated planning.

Analytical models and thermal as well as dynamic simulation procedures use powerful computing technology and expert operation to deliver transparent statements for the room conditions to be expected and therefore precise details for the specification of technical equipment as well as forecasts of the internal room temperature under defined climatic conditions. Simulations represent a good way of comparing different versions and combinations of different trades, e.g. air conditioning, ventilation, sunshades.

Indirectly forearming new buildings – avoiding conversion costs

Good planning tools for ensuring a comfortable interior climate in a new building allow investors to pull all the levers until legally relevant limits of comfort are reached. This enables system technology and passive heat insulation to be downsized. Optimised design leads to the lowest possible investment. The claim of "air conditioned" can then be used in marketing the building. No defined level of performance or energy efficiency is usually guaranteed in the process. This reduction to the minimum requirements is often misunderstood as the objective when buildings are first let, and usually only helps the initial investor but not future users or owners. Although there is air conditioning in such cases, it offers no reserve whatever for any additional consumption, perhaps due to a change of usage, e.g. additional server rooms or different occupancy. The usage cycle of a building is significantly longer than the period for which the forecast data on which the planning is based, match the actual usage. Equipping existing buildings with appropriate air conditioning is a valuable marketing criterion. That is why we take great care to agree the demands of flexibility and potential for third-party utilisation for repaying the cooling costs, synchronicities of producers and consumers and the degree of redundancy built into the systems engineering in consultations between the investors, owners and/or users. With documented and defined reserves of capacity, the owner saves himself the need for conversions to existing buildings when the planning foundations in buildings are changed significantly for the first time after short time spans of a few years. Any existing buildings not affected by conversions result in the largest customer benefit: cost savings. This is not necessarily associated with notable additional investment at the time the building is erected. The intensive process of clarifying the requirement as well as the flexibility and quality of the planning concept in this regard can today prevent or reduce the investments of tomorrow. For example, two to three smaller systems instead of one large one offer sufficient flexibility and reserves for additional requirements by means of the indirect preparation they represent.

Improved thermal comfort in existing buildings: diagnosis, balance sheet, measures adopted

Whether the structure is sound or poor, the need for air conditioning changes repeatedly in the usage phases of a building, mostly due to re-letting but also if the nature of the use changes or tenants complain of the conditions. Improvements in room conditions can be achieved by owners commissioning specialist planners to adjust the existing systems and by changing the control parameters after making their diagnosis. The automation to be found in office buildings with high-quality equipment represents an essential tool of the trade of integrated planning in bringing together the functions arising from open and shady façades, detecting people's presence and ventilation and air conditioning equipment. Reasons not immediately discernible may be behind the fact that the rooms are too hot.

Building diagnoses and the causes of rooms being too hot may include:

- uninsulated hot water pipes behind shaft walls as wide as the room with wall surfaces >40°C
- unequal air volume flow balance resulting in hot air being drawn in unintentionally,
- inappropriate behaviour on the part of users in their use of sunscreens, window positions and the way in which lights are operated,
- simultaneous heating and cooling operating in rooms (lack of interlocks),
- poorly set systems or building control technology inadequately updated.

Stock-takes of the cooling capacity are essential for assessing how to cope with tenants' requirements. Unfortunately, they are often limited to composing a list of all the cooling loads. Repayments on the cooling loads must also always be shown in the balance sheet for each system and area. Capacity balance sheets and their sources such as the cooling load calculation should be enclosed with building documentation in a form that can be updated. As simulation and calculation programs are used, source code files, software licences and operating expertise are required components of the building documentation. In our experience of projects, this is only seldom achieved and can be compensated if the author of the existing planning is entrusted with updating the records to take account of new demands from tenants.

Retrofitting existing buildings

A series of sensible measures can be adopted in order to keep the cost of making alterations to the building structure low when improving or rectifying the level of thermal comfort. Evidence of their effect is usually only provided indirectly by users not (or no longer) complaining. In special cases, the effect of the steps taken can be demonstrated by measurement data obtained from monitoring the building.

Measures to improve the indoor climate in existing buildings:

Owners

- Reducing cooling requirements by means of external effects (e.g. active and passive sun-screening),
- Retrofitting air conditioning equipment for hygienic outside air exchange with cooling effect due to lower temperature of air feed and use of night-time cooling,
- Modifying the air currents in the room to take account of the sources of heat and to direct the air intake towards the people present,
- Reducing cooling requirements by means of internal effects (e.g. energy-saving technical devices such as LED lighting),

- Enhancing the level of comfort by means of radiation exchange with the cooled surfaces of thermally activated building components, cooling sails, ceilings and panels,
- Activating night-time cooling to exploit the storage effect of the building mass in periods of heat.

Users

- Using machines with low exhaust heat (screens, printers),
- Controlling actual requirements taking into account sunset, the diurnal cycle and the simultaneity of requirements,
- lighting control dependent on daylight.

Life cycle costs and rent including heating

When buildings are used by third parties, reducing investment in the building at the expense of running costs leads time and again to indoor climates which fail to meet the specifications contained in ArbStättV and in workplace guidelines. Owners who use their own buildings have been acting in a more far-sighted manner for years. They compare the costs of using with converting existing buildings and base their investment decisions on the life cycle costs. These developers create office space that cause neither discrepancies in meeting indoor climate conditions nor the need for conversions if there are minor changes to requirements. To do so, they use the decision-making horizon "Construction time **and** the cycle of building usage" The owners of buildings used by third parties can also achieve this (Fig.) as the difference in interests between tenant and lessor can be bridged. The life cycle costs are determined during certification from the German Sustainable Building Council and in accordance with HOAI (fee structure for architects and engineers) as a special service. The result can serve as the basis for determining the rent including heating which can help lessors and tenants: low costs as a result of well-founded decisions for the quality of the building as defined by the variable requirements.

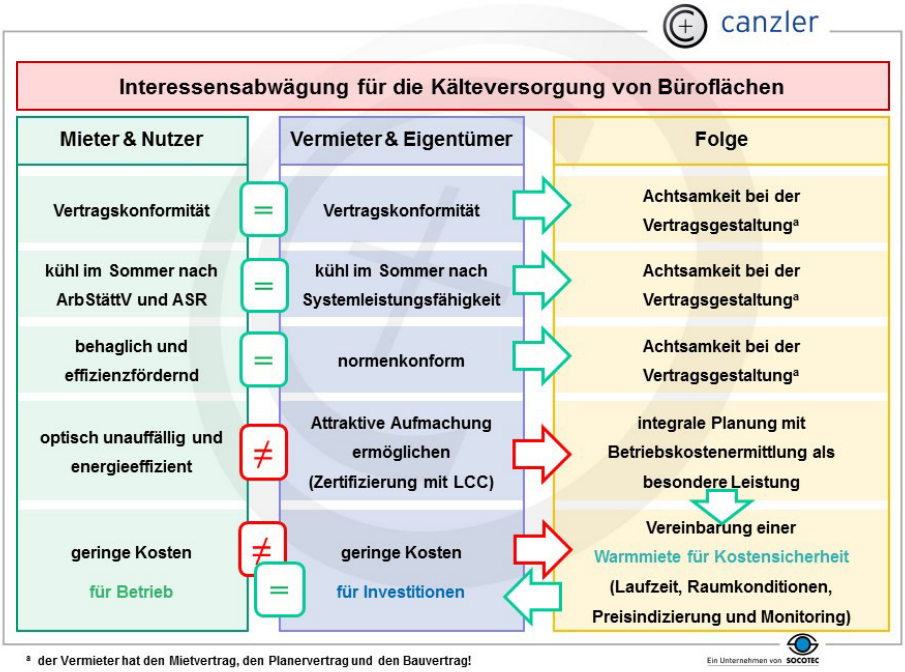

Fig.: Areas in common and conflicts of interest

Conclusion

In the case of new buildings, the air conditioning services are more than ever a question of meeting minimum requirements. Retrofitting existing buildings to enhance comfort in summer is a valuable marketing criterion. A statement on the efficiency of the air conditioning in office buildings is not normally used in the letting process and could easily be added. Building owners can benefit from integrated planning taking into account all the building trades and building life cycles as the most cost-effective decision for technical solutions is evidenced and implemented on their behalf. The overall package for the contracting parties tenant/lessor is thereby optimised: appropriate costs for needs-based usage.

Estimation of cooling quality:

Indoor temperatures for outside temperatures of 30° C and 36° C,
annual proportion under the inside temperature targets of 26° C and 30° C in accordance with VDI 2078. *Entries* could look as follows:
$t_{Soll,\ 30°\ C}$ = *25*° C, $t_{Soll,\ 36°\ C}$ = *27*° C; $JUA_{<26°\ C}$ = *96* %, $JUA_{<30°\ C}$ = *99* %. [t soll = t target, JUA = annual proportion under the target]

Author

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About Canzler
Canzler GmbH was founded in the Ruhr District in 1960 as an independent planning office for technical equipment. Since then the company has developed into a general planner and consultant for all phases of the life cycles of properties. The company performs architectural and engineering services across all disciplines as well as offering FM-Consulting and supports clients in the field of property management. At its locations in Berlin, Dresden, Erfurt, Frankfurt am Main, Hamburg, Munich and Mülheim an der Ruhr Canzler employs more than 120 people. Since 2008 Canzler has belonged to the internationally operating Socotec Group, an engineering services provider employing 5,000 people.

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