Thermal and energetic behavior of buildings in the light of climate change - Requirements and solutions for sun protection systems

Zukunft Bau - Research project

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Summary

The current requirements on minimum summer heat protection as expressed in DIN 4108-2:2013-02 base upon calculations with climate files that describe actual average climate. These climate files have been amended for Germany in 2011. With the publication of these new climate boundaries there are also climate files available that describe actual extreme climate on the one hand and on the other hand and normal and extreme future climate situations for the period 2021 to 2050.

Regarding the comparison of actual and prospective average climate can be stated that due to the climate change in several cases a significant increase (in the 15 TRY-regions the degree-hours above a certain temperature will be raised by a factor 1,5 to 5,6) of the thermal load will occur. This climate intensification leads to the necessity to design sun shading systems adequately (average reduction of the F_C-value by $\Delta F_C = 0{,}25$). Beyond that all further constructional and planning possibilities have to be utilized. To ensure the same comfort level as actually expressed also for future climate conditions and to avoid a rising energy demand for cooling devices as a consequence of further climate change, natural (night) ventilation has to be implemented into the planning process as a self-evident part of the each buildings concept. Numerous practical examples of buildings carried out show that innovative solutions suit to ensure natural night ventilation in case of special requirements.

Since the new climate data sets have been published in 2011 a separate software tool allows to consider Urban-Heat-Island effects as well as a dataset correction depending on the altitude for each TRY-region. Calculations that consider these two influences of UHI-effect and altitude-based correction of the datasets lead to the following recommendation for the further follow-up of DIN 4108-2 or rather the EnEV as decree that expresses the minimum requirements for summer heat protection in Germany:

- The simulations using the standard datasets (Normal-TRYs) already show that the room climate varies in a wide scope for the 15 TRY-regions in Germany. When the influence of the altitude-based dataset correction is taken into account, this scope gets further expanded. As actually expressed in DIN 4108-2, in case of the proof of summer heat protection is done by dynamic simulations the climate datasets are predetermined. To represent the summer climate regions A, B and C the datasets of the TRY-regions 2, 4 and 12 have to be used for such calculations. This choice of datasets is lying on the safe side and especially in case of taking the altitude-correction into account for some higher regions in Germany (on a lower temperature level) unreasonably high requirements are resulting. For a simplified proofing method such an approach on the safe side is passable. For a detailed proofing method, such as dynamic simulations are, the results of the calculations lead to the recommendation that all 15 TRY-datasets if necessary including altitude-correction should be used. Such an opening of boundary conditions could also be realized by implementing an appropriate wording into the EnEV (like it is done in the actual EnEV), which “overrules” the requirement expressed in DIN 4108-2.

- When the simplified proofing method for summer heat protection shall offer the possibility to take the UHI-effect into account, this presumes that the altitude influence is also implemented. Calculations show that for several cases the influence of the altitude correction is larger than any UHI-effect. A meaningful implementation of the UHI-effect as well as the altitude dependency into the simplified proofing method would mean

    1. Preparation of single tables with specific values for each of the 15 TRY-regions instead of only distinguish between the regions A, B and C.
    2. Determination of a specific linear correction for the altitude dependency for each TRY-region:
       - places with a higher altitude compared to the reference place of the TRY-region would get positive specific value
       - placed with a lower altitude would be treated with a negative specific value
    3. Determination of specific values for the UHI-effect for all TRY-regions that have cities with more than 100.000 inhabitants

The research project should furthermore analyze how the actual requirements for summer heat protection in DIN 4108-2 could be aligned with the comfort level II requirements of DIN EN 15251 that are herein recommended for new buildings. A principle method how specific values for a simplified method basing on DIN EN 15251 calculations can be derived is shown in the full report of the project.