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Solar shading – quickly designed

Simple diagrams for thermal insulation in summer

The current version of the Energy Conservation Directive (EnEV 2013) [1] (Sections 3 and 4) stipulates minimum requirements for thermal insulation of residential and non-residential buildings in summer. The requirements in these sections apply to buildings to be constructed, i.e. new buildings. Evidence of thermal insulation in summer is not required for the refurbishment of buildings. An exception is contained in Section 9 (4 and 5) where the usable area is extended by more than 50 m² (4) and where a new energy appliance is installed (5).

Verification of thermal insulation in summer has been included in the EnEV as part of the design since the 2009 version. This version of EnEV refers to DIN 4108-2:2013-02 [2] for the purpose of providing evidence of thermal insulation in summer. Permissible methods of providing evidence are

- simplified solar heat gain coefficient method in accordance with No. 8.3 and
- thermal building simulation in accordance with No. 8.4 of DIN 4108-2.

For the latter method, DIN 4108-2 defines the boundary conditions to be applied.

The objective of the design of thermal insulation in summer is to avoid unreasonable temperatures for the building occupants and to define minimum requirements regarding thermal insulation in summer. Furthermore, the use of energy-intensive air-conditioning devices for the purpose of air conditioning should be avoided, which must be welcomed from the point of view of climate protection. DIN 4108-2 provides a reliable verification method for engineers, architects and building physics specialists. Why then do we need a new, simplified ift diagram method when there is already a "simplified method" in existence in DIN 4108-2? The solar heat gain coefficient method requires the designer to input boundary conditions such as type of construction, increased night ventilation, window area etc. for the planned building. The solution offered by the method is not the maximum g_{tot} value of solar insulation. This must be established by the designer/engineer by calculating the g-value of the glazing to EN 410 and the reduction factor F_c for the additional solar insulation. The result indicates whether evidence has been provided for the building and whether the permissible solar heat gain value has been exceeded or not. The method therefore only determines whether the design solar insulation is permissible and does not provide a trial-and-error method for finding a solution. Documentary evidence must at least be provided for the most unfavourable room in the building. The

standard neither defines this room nor provides criteria for its definition. This means that the engineer/designer has to carry out additional calculations to support the result. Even though, normally, the calculations for verification are carried out with software support, they are nevertheless laborious and the data required for the design are not always available immediately. Therefore, the objective of the new method for providing evidence is to provide a reliable, standard-conforming and uncomplicated method to all those involved in the design and execution process which requires as few input parameters as possible. The new simplified diagram method only requires the net floor area of the room, the intended window areas and glazing which, in residential buildings, typically consists of thermal insulation glazing. The diagram in Figure 2 shows the possible solutions for thermal insulation in summer for a given situation. There is also the option to increase the window area in order to increase the amount of daylight entering the room. DIN 4108-2 defines requirements for residential and non-residential buildings. Diagrams for non-residential buildings have not been produced, since the requirements are of such an exacting nature that, for a proportion of window area f_{WG} of 30%, the permissible solar heat gain coefficient is nearly 0. In the case of non-residential buildings it is normally advisable to use thermal building simulation, in particular in cases where additional requirements have to be taken into account, such as the Workplaces Ordinance. In this case, verification in accordance with the simplified method could provide a good indication, but would not be sufficient.

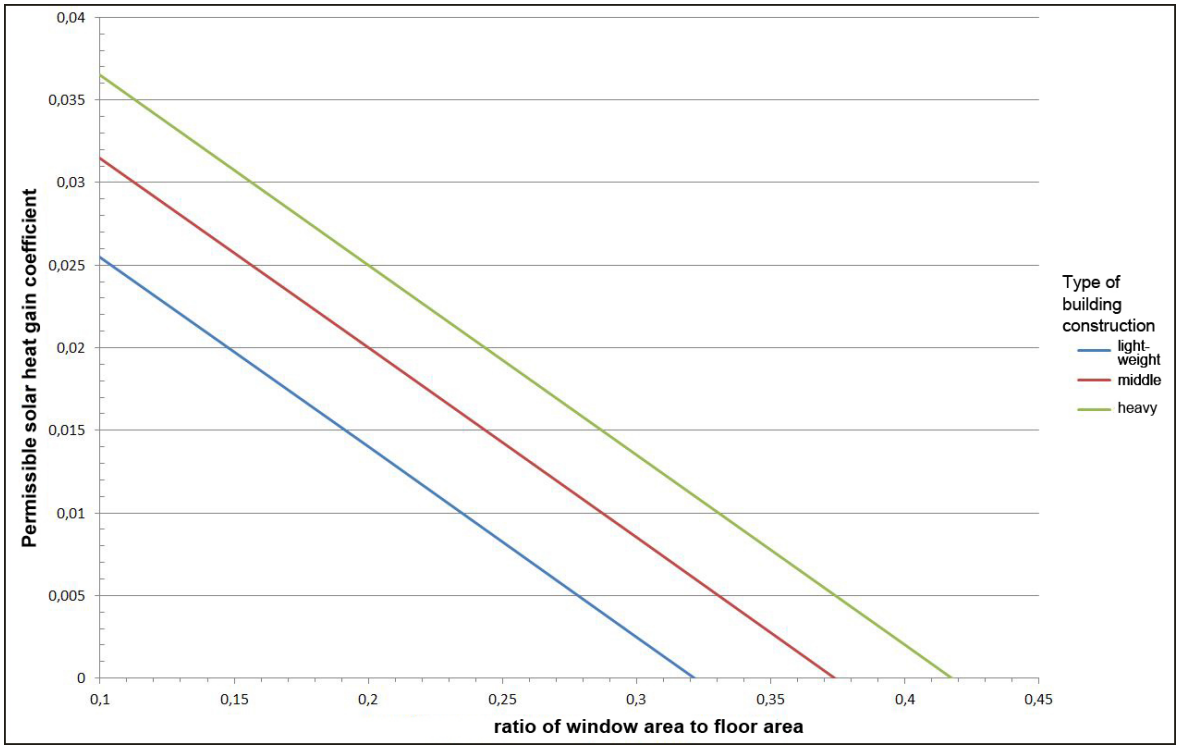

Fig. 1 Permissible solar heat gain coefficients for non-residential buildings

The simplified method of DIN 4108-2

For the purpose of verifying thermal insulation in summer, the engineer/designer checks whether the existing solar heat gain value S_{ex} exceeds the permissible solar heat gain value S_{perm} or not.

$$S_{ex} \leq S_{perm}$$

The permissible solar heat gain value is determined from the proportional solar heat gain values of Table 8 of DIN 4108-2 on the basis of the bonus/malus principle. These values include the climate region, the type of building construction, the ratio of window area to floor area, the window inclination and orientation, amongst others.

$$S_{perm} = \sum_x S_x$$

The existing solar heat gain value is calculated from the window area, the net floor area of the room and the g_{tot} value, which is determined by the total energy transmittance of the insulating glass unit and the reduction factor F_c of the solar shading device. Approximations of the F_c values can be taken from Table 7 in DIN 4108-2; alternatively, the values entered have to be established by measurement and must have a test certificate. For further details of the method for providing evidence, please refer to [2], [3] and [4].

The simplified ift diagram method

The method described above is less well suited to smaller joinery companies and for providing quick and reliable advice to architects, e.g. by a smaller window company or a specialist company for solar shading devices, because the calculation method requires data on the parameters of the building and can only be accomplished within an acceptable amount of time when software is used.

The ift diagram method for determining thermal insulation in summer immediately shows the potential solutions to the designer, and only requires a small number of input data. This is a significant advantage when it comes to advising on and selling windows, glass and solar shading. The method for providing evidence is equivalent to the simplified calculation method described in DIN 4108-2 and can therefore be used as a standard-conforming method for the verification of thermal insulation in summer in accordance with DIN 4108-2 . Currently, the diagrams can only be used for residential buildings and for vertical window areas. The method is based on the following assumptions, which are on the safe side and which do not have to be determined and checked by the user:

- lightweight construction
- summer climate region C

- increased night ventilation ($n \geq 2h^{-1}$)
- double or triple thermal insulation glazing

According to DIN 4108-2, it is possible to assume increased night ventilation for residential applications. The minimum input data required for verification referring to residential buildings are as follows:

- net floor area of the room(s)
- window area
- maximum g value of thermal insulation glazing

Figure 2 illustrates how simple the diagram is to use. The design is for a room in a residential building with a net floor area of 35 m² and a window area of 6 m². The total energy transmittance of the insulating glass unit must not exceed 64%, as stated in the diagram. This value is typically not exceeded by the thermal insulation glazing available in the market. These data are used for the design and verification. In our example, the required F_c value for additional solar shading is 0.75. This means that the design with thermal insulation glazing and an internal solar shading device ($F_c = 0.75$) would be sufficient. The important element in the diagram is the line for $F_c = 0.75$, since the point lies below the line. The option of not providing additional solar shading ($F_C = 1$)‘ is not possible because the point lies above the line for $F_C = 1$. This clearly demonstrates the advantages of this method; it can be used by the supplier of a solar shading system because he only needs to know whether thermal insulation glazing will be used or not.

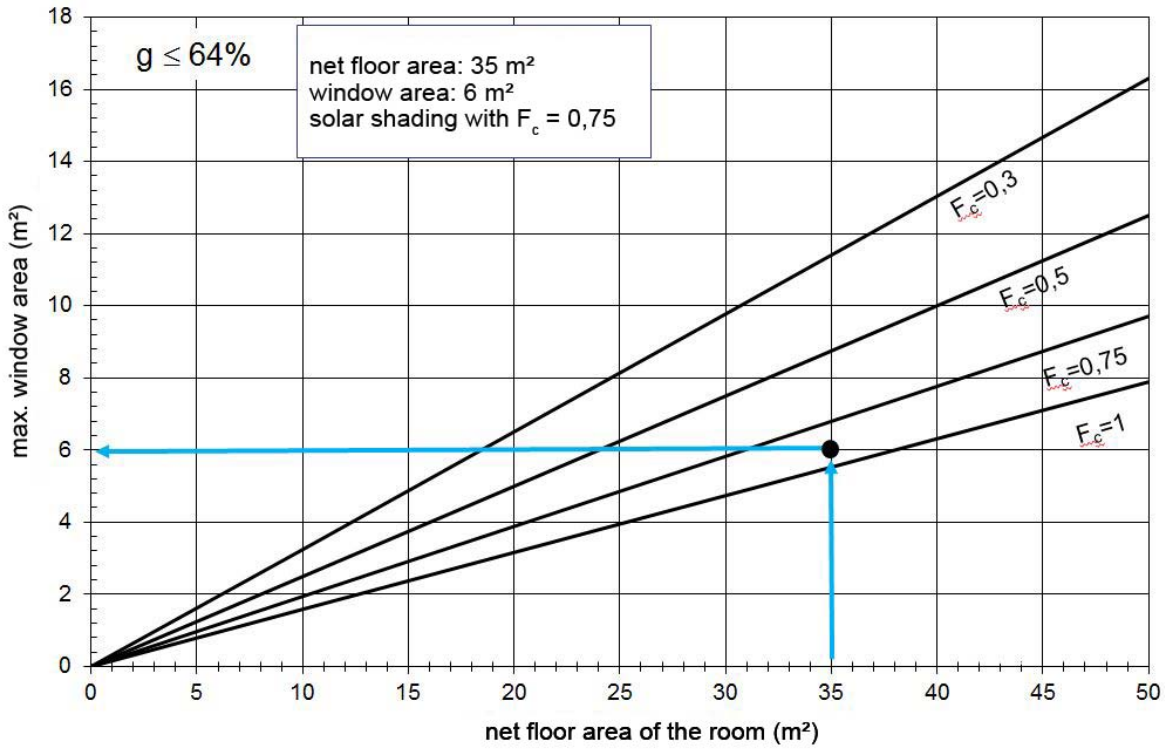

Fig. 2 Verification of thermal insulation in summer – residential building with thermal insulation glazing

Conclusion

The new ift diagram method described above facilitates simple, quick and uncomplicated design of thermal insulation in summer and is particularly helpful where several different trades are involved, since only a few input data are required. These diagrams will soon be published as Fachinformation [5] by the ift Rosenheim.

Bibliography

[1] Energy Conservation Directive 2013, Federal Law Gazette 2013 Part I No. 67, Bonn 21 November 2013

[2] DIN EN 4108-2:2013-02
Thermal insulation and energy economy in buildings – Part 2: Minimum requirements for thermal insulation
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[3] Proceeds of Building Physics Conference 2012, Ingenieurakademie West e.V. the new DIN 4108-2 – Minimum requirements for thermal insulation, Martin H. Spitzner, Michael Rossa

[4] VFF Guidance Sheet ES04 "Thermal insulation in summer", January 2013

[5] ift Fachinformation WA-21/1
"Thermal insulation in summer – Simplified verification method and diagrams"; in preparation.
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