Modern insulation requirements change the rules of architectural design in low-energy homes - DTU Orbit (04/11/2019)

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In the design of very well-insulated homes, there is a need for a more nuanced design that takes into account winter and summer conditions. In this paper, we compare a traditional design for a typical Danish single-family house with large glazing areas oriented towards the south and smaller glazing areas towards the north, and a design with an even window distribution where the glazing-to-floor ratio is the same for each room. We found that the use of solar gains through south-oriented windows is not as important as is traditionally believed because, in well-insulated homes, space heating demand is not reduced much by having larger south-facing windows. Furthermore, we found that there is a g-value above which the additional solar gains through south-oriented windows do not help reduce space heating demand, and it becomes important to use solar shading or glazing with solar-control coating as a cheaper alternative to reduce overheating.

Maximum window sizes from an overheating perspective were identified that are larger than the optimal window sizes for space heating demand. However, we show that the difference in space heating demand with optimal window size and with larger window sizes is small, so it is up to the building owner to decide whether or not he wants larger glazing areas to allow for more daylight. And windows can be positioned in the façade with considerable architectural freedom. However, we do recommend an even distribution of the glazing-to-floor ratio, because this generally provides an improved thermal indoor environment in south-oriented rooms and will ensure a better daylight level especially in north-oriented rooms. We also show that the optimal window size is influenced by thermal zone configuration and that there is a need for models in which a difference is made between zones with direct and with non-direct solar gains.

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