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Solar systems on sloping roofs in the building stock – Summary Account

Reference number: SWD-10-08.18.7-17.08

1. Reasons for the research study/general situation

Solar energy can make an important contribution to reducing carbon dioxide (CO_2) emissions. Mainly as a result of government funding, an estimated 2.4 million solar systems have been installed on sloping roofs in the past ten years, most of them on roofs in the building stock. But adequate techniques of installation are hardly dealt with in current building regulations.

2. Aims of the research project

It has been the aim of this research project to inspect and document typical examples of failure and to develop recommendations for the proper installation of solar facilities on roofs, which may contribute to minimizing the risk of damage in the construction of energy-supplying systems and to promote effective and sustainable solar facilities on roofs.

2.1 Practical experience

In a survey among 1,912 officially appointed building experts, the participants specified cases of damage to solar and solar-thermal facilities on sloped roofs. On the basis of a questionnaire, 145 instances of damage have been evaluated in detail. Typical examples of damage, classified according to different roofing materials, are described and illustrated by photographs.

82% of the damage occurred within a period of four years after installation.

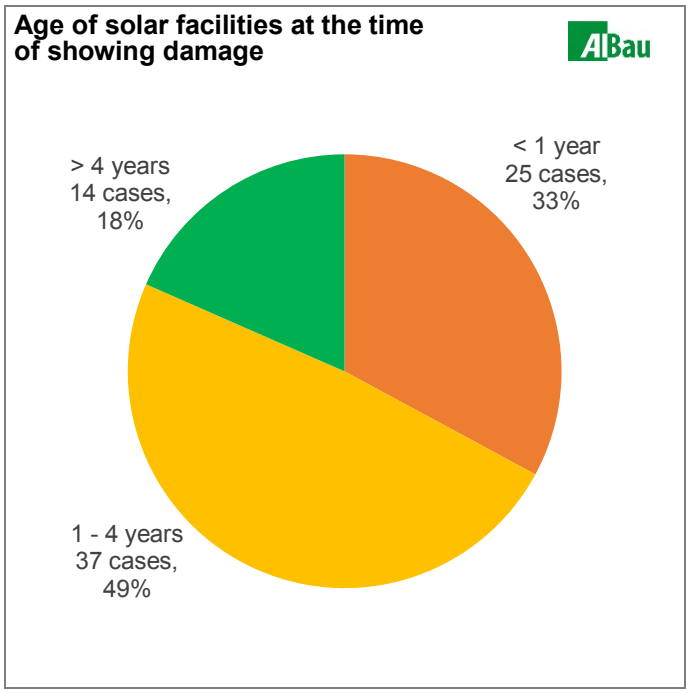

Fig. 1
Data provided by participants in the survey concerning the period between installation and the first occurrence of damage. The percentage is based on the total number of 76 cases specified.

Damage resulting from overloading the roof substructure or the framework of module systems was found to be less frequent.

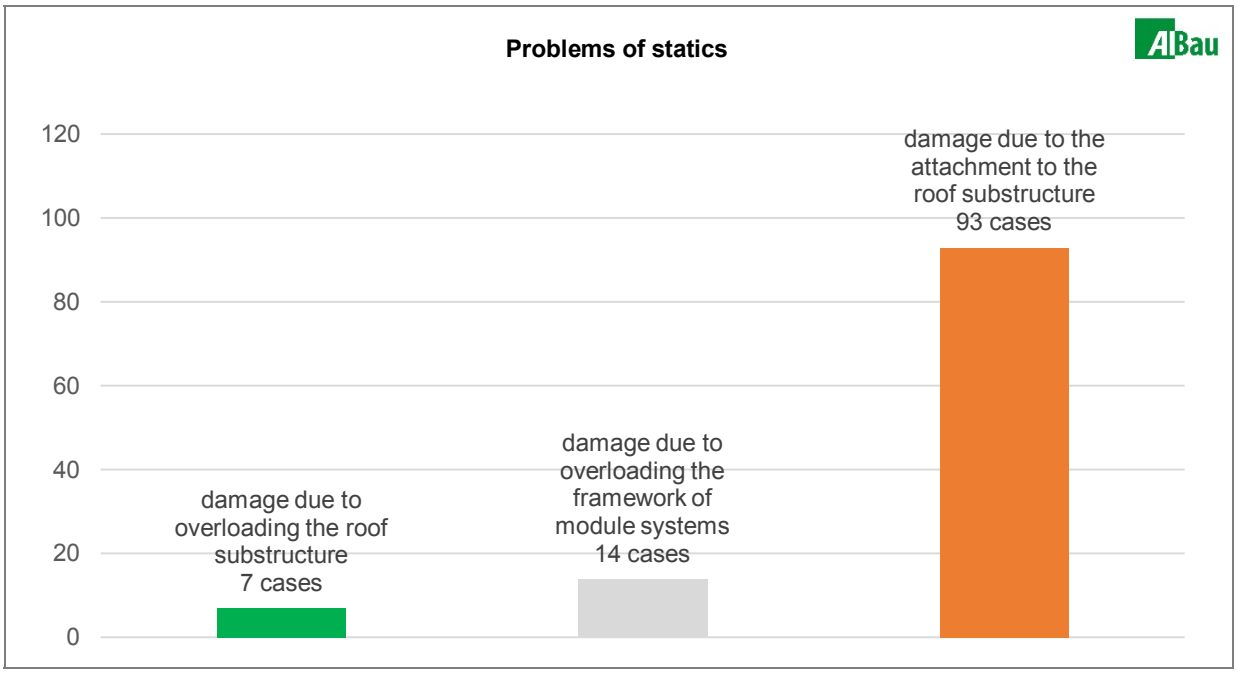

Fig. 2: Information provided by participants on problems of statics (multiple answers possible)

Damage due to dampness became evident by dripping water in the interior of the building.

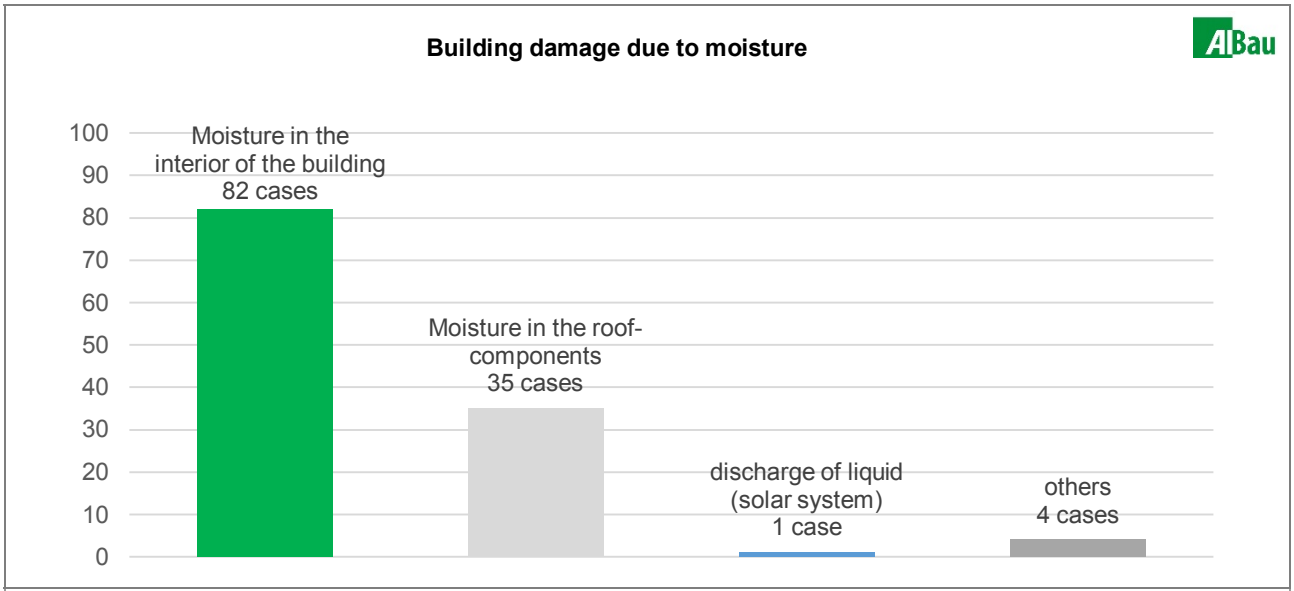

Fig. 3: Specifications made by participants concerning damage due to moisture (multiple answers possible)

Given the great number of roofs with small-size brick and stone tiles, a considerable part of damage occurs with this type of roofing. But with fibre-cement profiled sheets, zinc standing seam roofings and sandwich elements, there is a greater risk of damage compared with roofing materials used on sloping roofs.

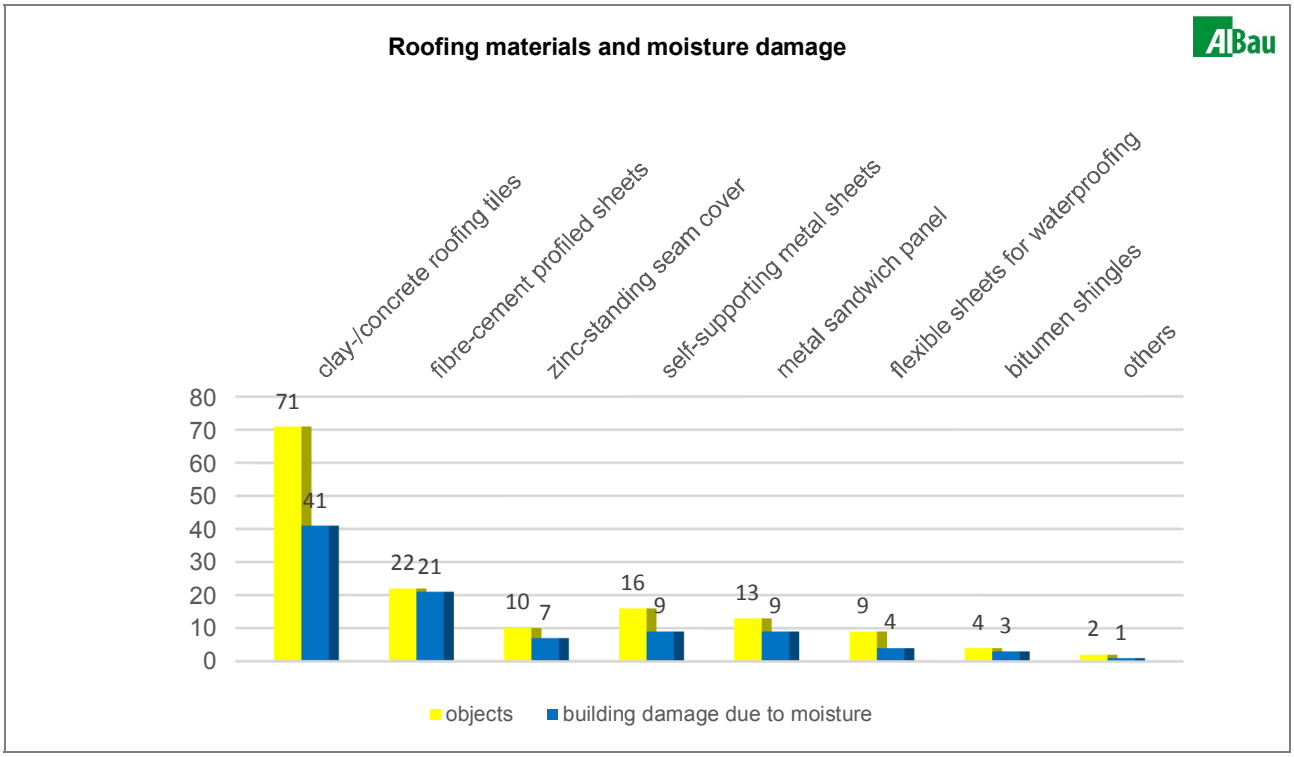

Fig. 4: Items with moisture damage compared with roofing materials used on sloping roofs (Database: 145 cases)

Fastening elements of solar facilities have to go through the roofing layer. As a result, the rain proofing of the material is often unnecessarily diminished.

Fig. 5
The bottom rib of this tile was completely removed, which caused a great gap in the roofing layer.

Fig. 6
The bottom rib of this tile was milled off only slightly more than necessary.

Fig. 7
Due to the new fastening installed closely to the old one, the load was removed from the fixation of the corrugated sheets with the result of leaks.

Fig. 8
Waterproofing elements placed one above the other/ screws narrowly fixed to each other led to damage and the risk of breaking

Serious moisture damage occurs to a comparatively small extent, because sloping roofs are generally error-tolerant constructions. Small quantities of penetrated moisture can usually dry out before accumulating and causing damage to the roof. If additional measures function properly (as extra drainage levels), leaks in the roofing layer do not necessarily have any negative consequences. Though the roof may become less rainproof, many small leaks go unnoticed without causing damage.

Apart from faulty installation, the risk of failure depends on the degree of sloping, on roofing materials and on the condition of the substructure (trussed sheets, underlays, sub-roofs).

2.2 Regulations

In the research study, practical field experience is compared with the specifications of regulations.

Most of them do not deal with the installation of solar systems in detail. For example, fastening elements are required to be rainproof and suited to the particular situation. But it is not made clear what this means with regard to individual cases. Especially when solar facilities are later installed on existing buildings, it is mostly left to planners and workmen to decide which type of installation is suited best.

2.3 Recommendations and suggestions

On the basis of practical experience and regulations (cf. the two previous paragraphs) recommendations and suggestions have been developed regarding fastenings, roof structures, roofing materials, additional measures, installation of electric cables, and safety against fire and lightning.

3. Conclusions

The very small rate of damage to solar facilities on sloping roofs – estimated by the authors at less than 0.5 % - can be reduced even further. The study is intended to make a contribution to this aim by describing practical examples and developing appropriate recommendations. The findings should be taken into account in the revision of current regulations, because they can help to establish uniform standards for evaluation, thus increasing constructional safety. This, in turn, will promote sustainable economic success for fitters and clients/investors. By supporting the installation of energy-generating roof surfaces we can make an effort to protect the basic conditions for life on earth.

4. Project Data

Short title: Solar facilities on sloping roofs

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