

## **Abstract (quoted from email conversation)**

### **Snow Load Failures in Denmark**

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Regarding the snow failures in Denmark last February a report (in Danish) has been made, but unfortunately it is not useful for registration because my former colleagues at SBI had to promise the building owners that the damages would be presented in such a way that the insurance companies could not identify the buildings. This means that no specific details are given. However, the primary conclusion is simple enough: Severe underdesign. The possibility for accumulating snow during drifting has either been ignored or the code has been used wrongly.

The load was unique, we had a snow storm for 2 or 3 days with high wind speed, the wind coming from the same direction for all days and a temperature of about -2C. Usually it is much colder during a snow storm in Denmark. The high temperature caused the snow grains to be much denser than usual, which in turn meant that when the snow had settled on the leeward side it was less likely to blow off again. So the snow load on low roofs were very high, much higher than the characteristic code load.

The about 12 investigated damages can be divided into 3 classes:

1. A lower building meeting a higher and the lower being on the leeward side.
2. Secondary beams on large flat or slightly curved roofs where drifting has caused local accumulation - possibly initiated by ventilation ducts etc.
3. Where a flat, slightly inclined roof meets a curved roof, but with no difference in height.

The last one could partly be blamed on the codes. To avoid future failures we have in Denmark introduced a supplementary load case as a recommendation in the National Annex to the European code for Snow load, EN 1991-1-3. I believe similar supplements are due in at least Norway and Finland.

The Danish Standard Committee on load and safety believes that there are no need for further changes in the codes, but awareness of the influence of obstacles on snow drifting should be sharpened. This is based on the fact that there are, as said, in all cases severe structural failures, mostly in design, but also in construction, so compliance with the code might (most likely) have prevented any damage.