Drying out capacity and snow melting risk for ventilated wooden roofs - a parameter study

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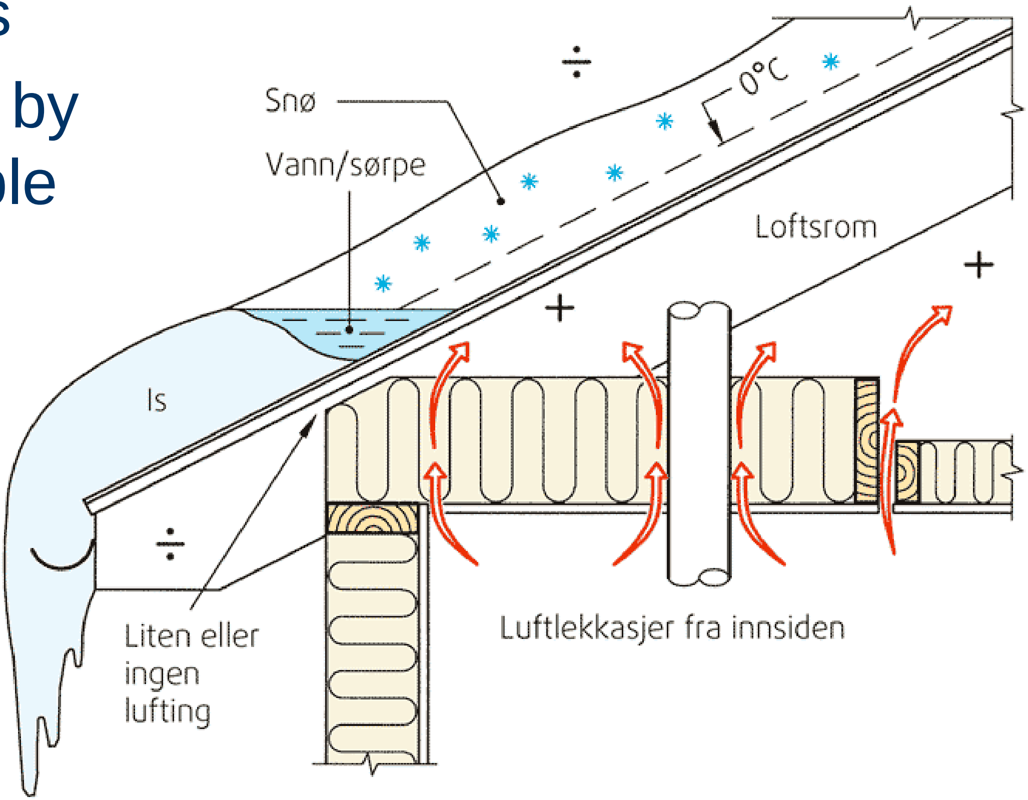
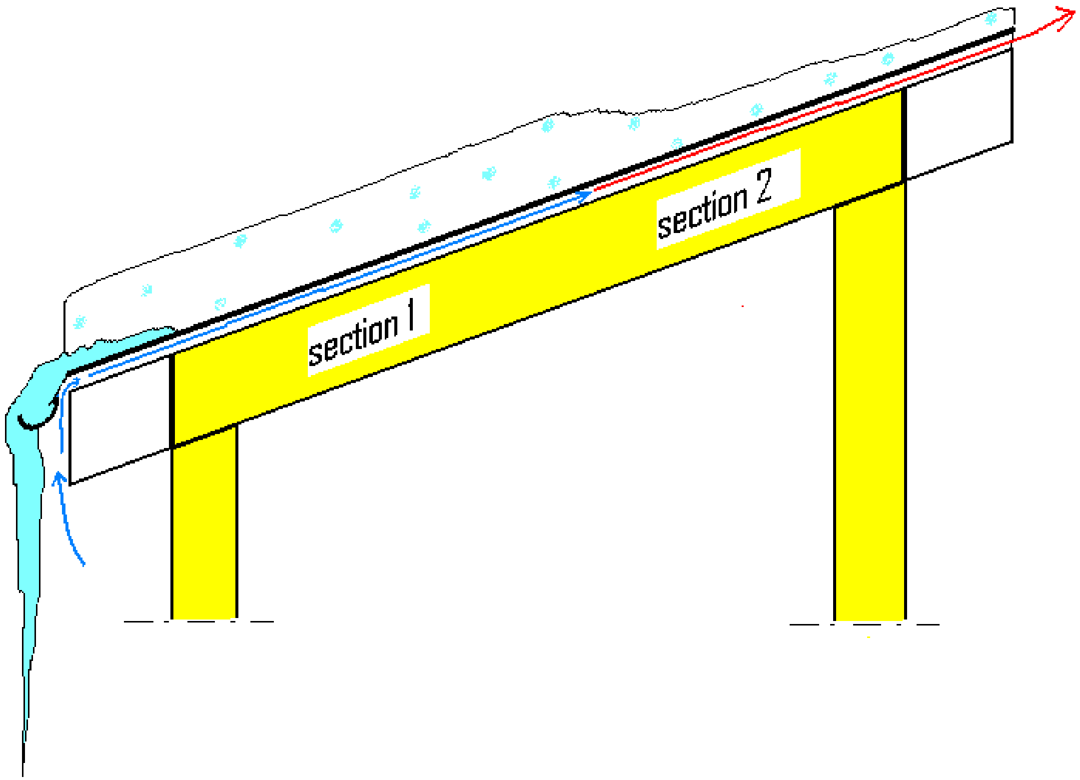
Snow melting and ice production at the cold roof eaves may lead to trouble:

- Leakage of trapped water
- Damaged tiles and gutters
- Serious accidents caused by falling roof ice hitting people on the ground



Calculation model, snow melting



Airflow through the ventilation gap system

Driving forces:

Δp_v - wind pressure difference

Δp_t - "stack effect" pressure difference

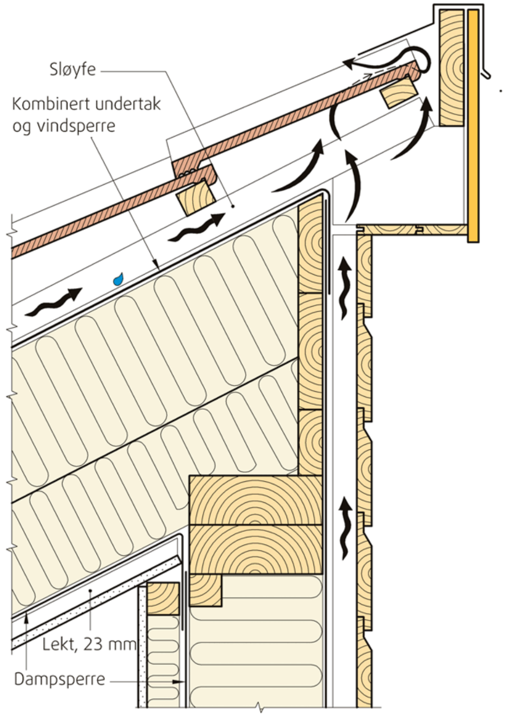
Heat balance, section 1, $t_{air\ flow} < 0\ ^oC$:

$q_{roof1} = q_{snow1} + q_{airflow}$

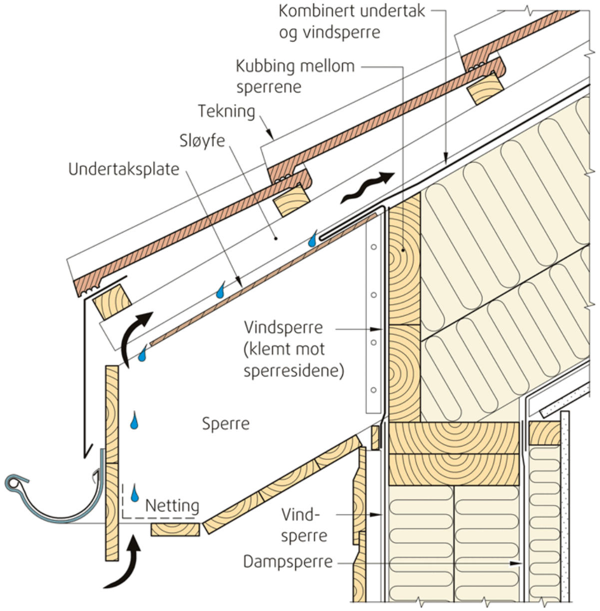
Heat balance section 2, (snow melting section), $t_{air\ flow} = 0\ ^oC$:

$q_{roof2} = q_{snow2} + q_{snow\ melting}$

Some results for ventilated shed roofs

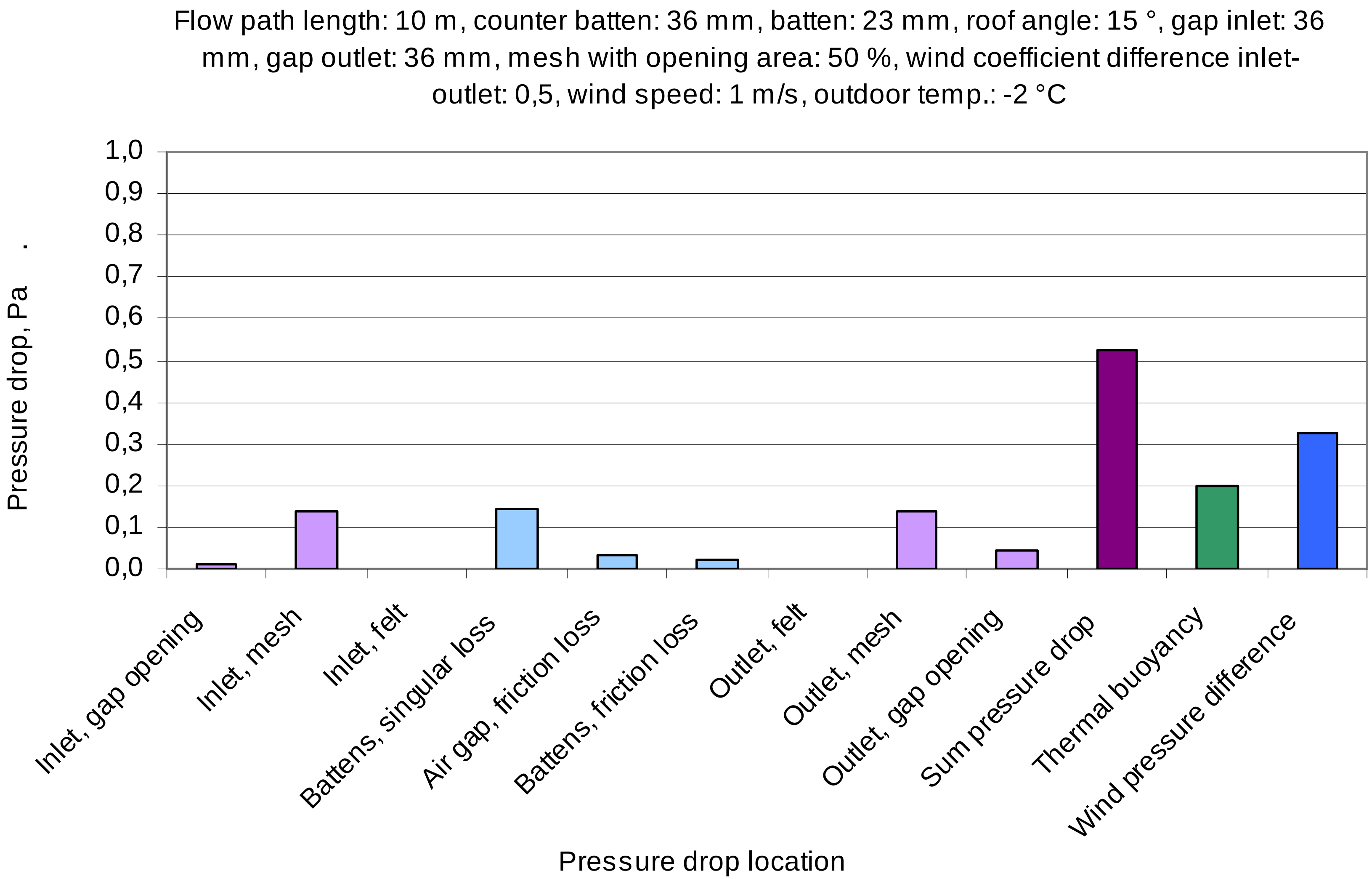


- Dimensions and design of the ventilation gap system has been kept constant

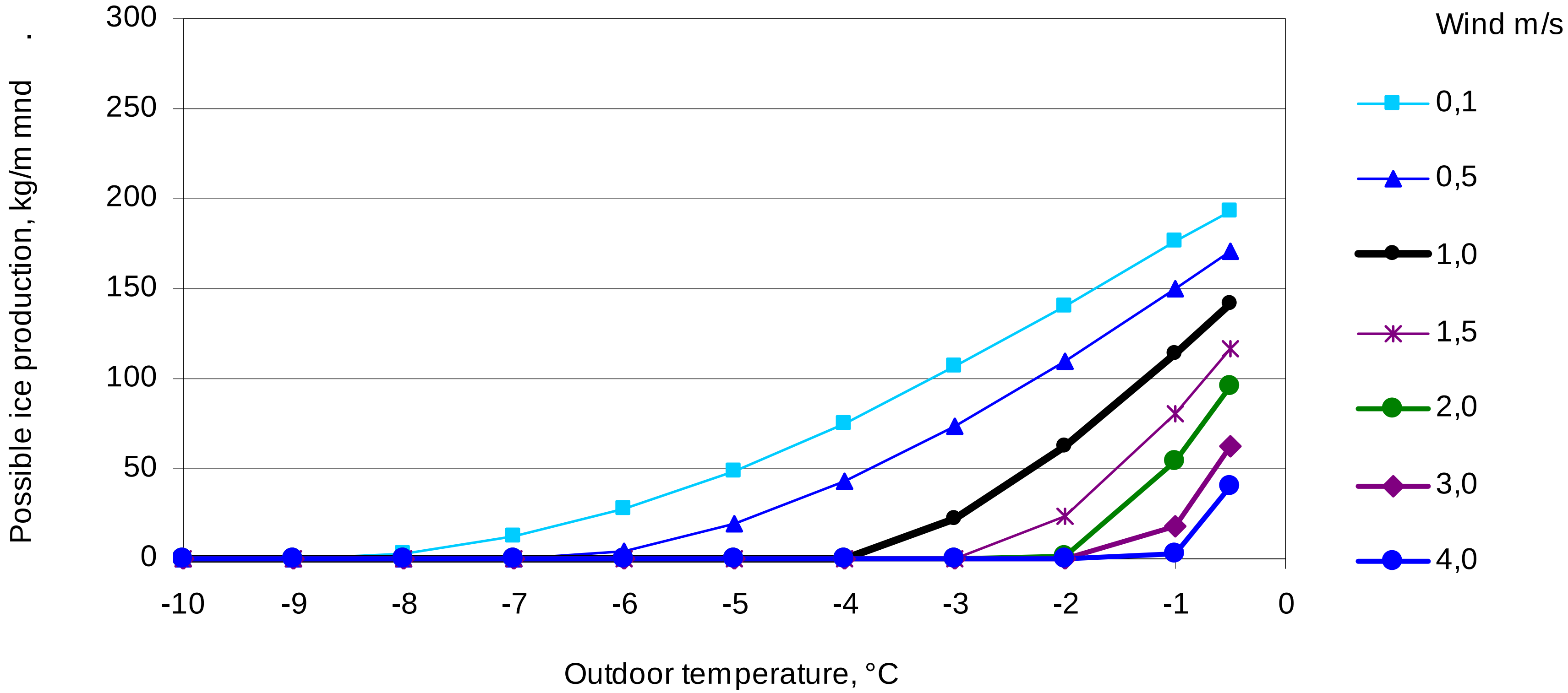


- The following parameters have been varied:
  - Wind speed
  - Outdoor temperature
  - Snow layer thickness
  - Roof angle
  - Thickness of insulation
  - Length from inlet to outlet

Example of pressure drop distribution through the ventilation gap system

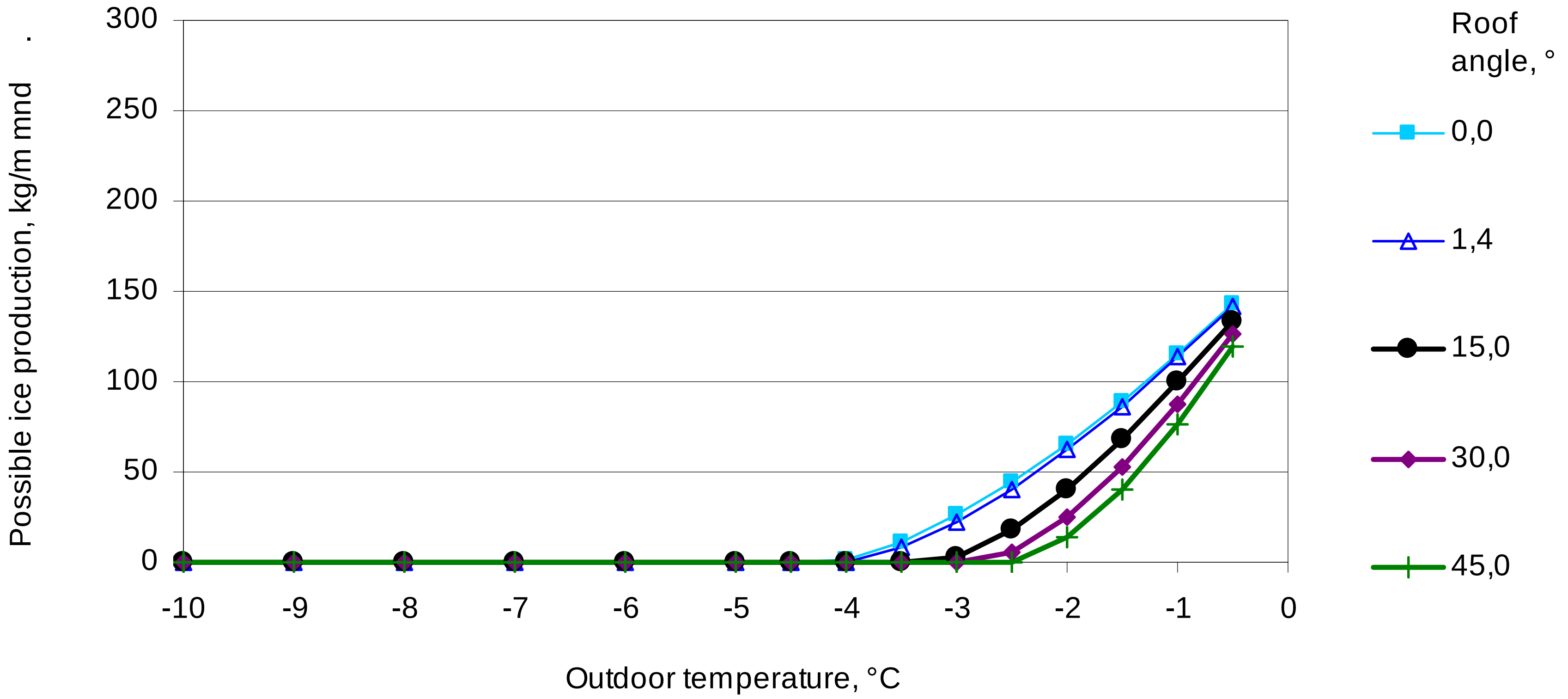


Maximum snow melting and ice production at outdoor temperatures close below 0°C



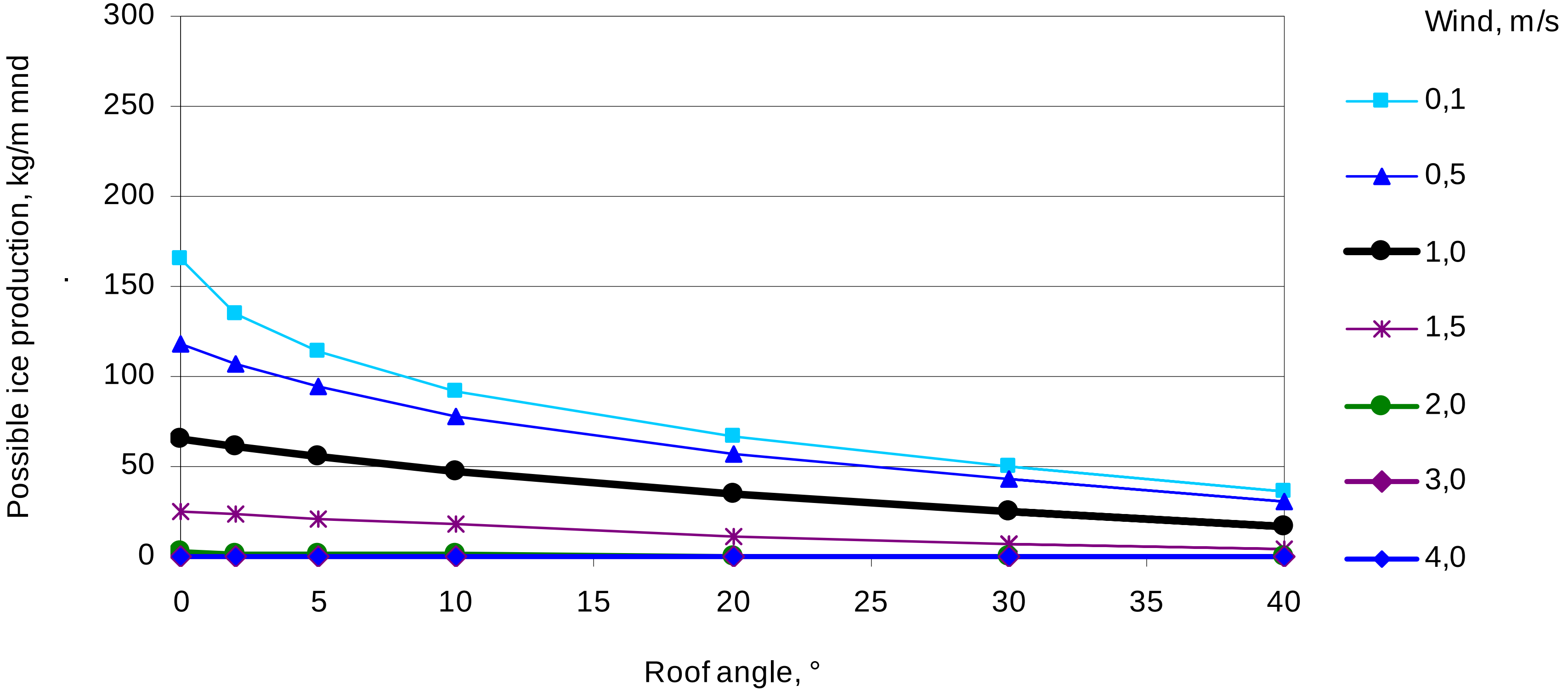
Snow: 0,5 m, roof angle: 1,4°, roof length: 10 m, insulation: 300 mm, counter battens: 36 mm, battens: 23 mm, gap inlet: 36 mm, gap outlet: 36 mm, mesh with opening area: 50 %

At outdoor temperatures close to 0°C the roof angle has low influence as the Δp from buoyancy also is close to zero



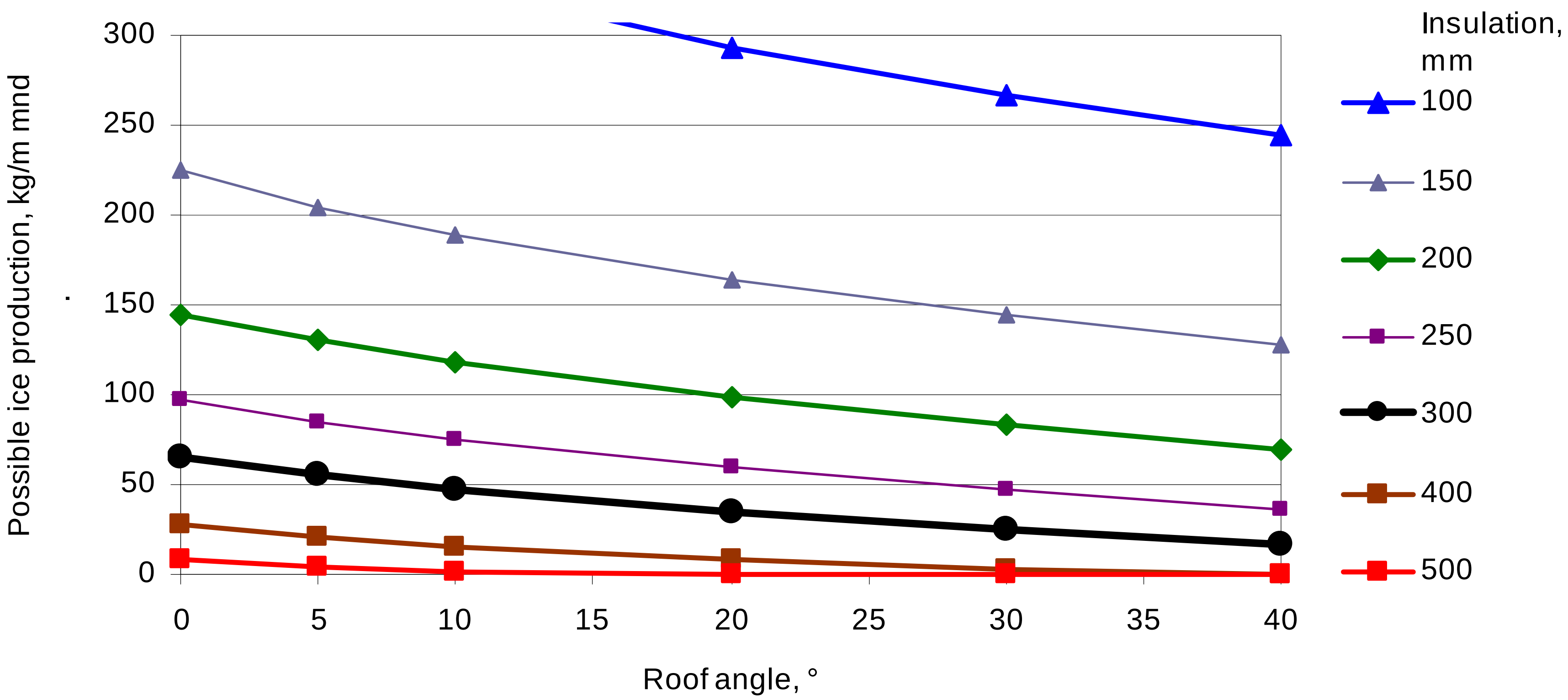
Snow: 0,5 m, wind: 1 m/s, roof length: 10 m, insulation: 300 mm, counter battens: 36 mm, battens: 23 mm, gap inlet: 36 mm, gap outlet: 36 mm, mesh with opening area: 50 %

Wind pressure difference between the inlet and the outlet of the ventilation gap system is the main driving force for the airflow



Snow: 0,5 m, outdoor temp.: -2 °C, ci-ce: 0,5, insulation: 300 mm, roof length: 10 m, counter battens: 36 mm, battens: 23 mm, gap inlet: 36 mm, gap outlet: 36 mm, mesh with opening area: 50 %

Increasing the thickness of the roof insulation layer is a very efficient measure to prevent snow melting



Snow: 0,5 m, outdoor temp.: -2 °C, wind: 1 m/s, ci-ce: 0,5, roof length: 10 m, counter battens: 36 mm, battens: 23 mm, gap inlet: 36 mm, gap outlet: 36 mm, mesh with opening area: 50 %

The calculation results seems to be in good agreement with experience form real houses

Some photos from Trondheim, Norway, all taken the 6th of January 2011

Most of the pitched roofs shown on the pictures are 24 years old with 200 mm roof insulation

Snow melting and ice building on new houses are mainly caused by
- roof windows and
- inadequate designed roof unites for exhaust air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New, well insulated, horizontal, ventilated roofs seems to perform well

Horizontal, ventilated roofs
5 years old, ca. 300 mm roof insulation
no roof windows
no visible ice the last two winter seasons

Conclusions

For small roofs, < 10 m, with 300 mm roof insulation:

- Low risk of snow melting
  as the heat left for snow melting is minimal
- The main driving force is wind, even at low wind speeds
- The roof angle is of minor influence
  - nearly horizontal, ventilated roofs seems to perform well
- Snow melting and ice building on new houses
  are mainly caused by:
  - roof windows
  - inadequate designed
    roof unites for
    exhaust air