CHALMERS
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Probabilistic analysis of hygrothermal conditions and mould growth potential in cold attics

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Research on cold attics

- Started with
  - Numerical model of an attic in HAM-Tools
- Supported by
  - Interest from building industry in different technical solutions for the prevention of mould growth
- Closing phase
  - Recommendations for different technical solutions based on the risk for mould growth

Probabilistic analysis

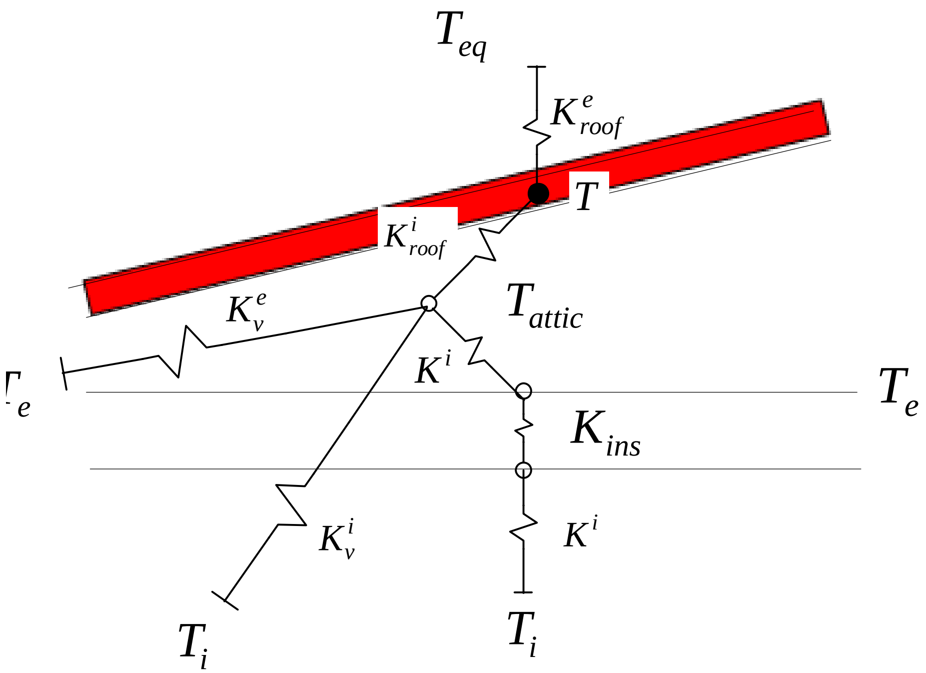
- Monte-Carlo simulations
  - 6 scenarios
  - 100 samples per scenario

- Two numerical models
  - Simple and complex
  - 25 sec or 120 sec per sample

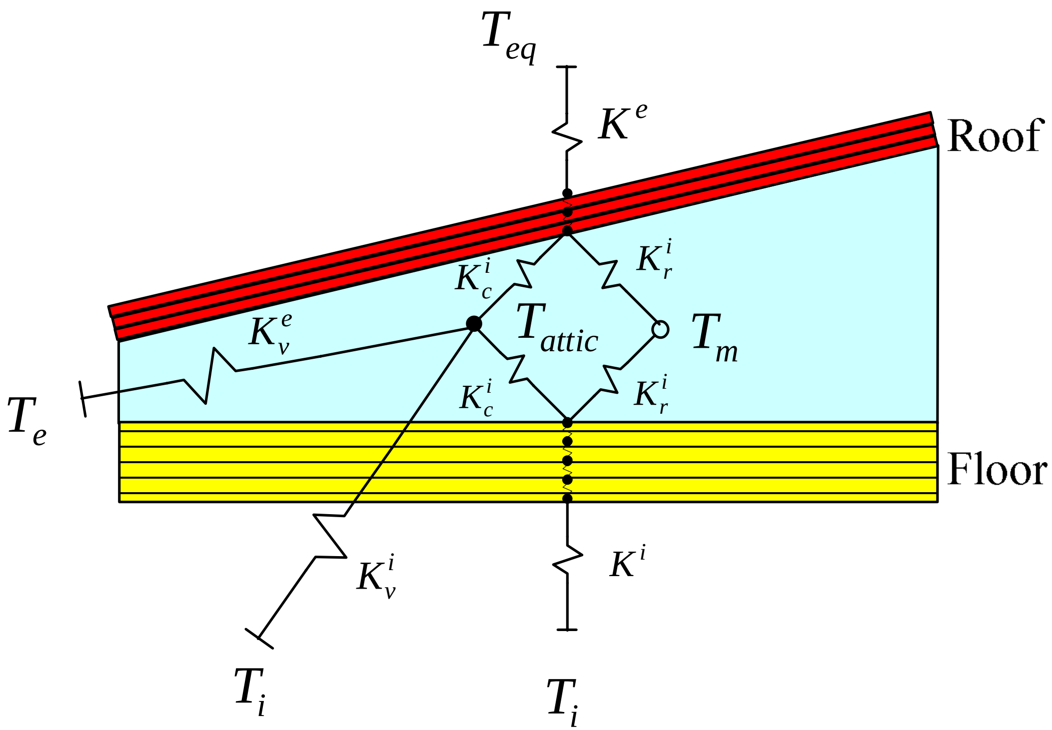
For all 600 samples:

- 4.2 h or 20 h

Difference between the models



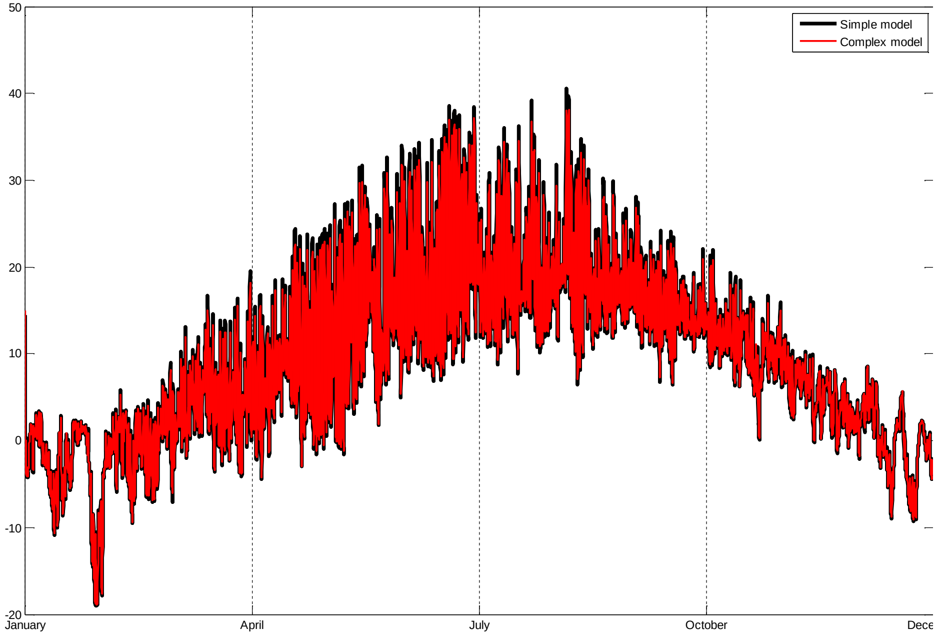
Simple
(code in Matlab)



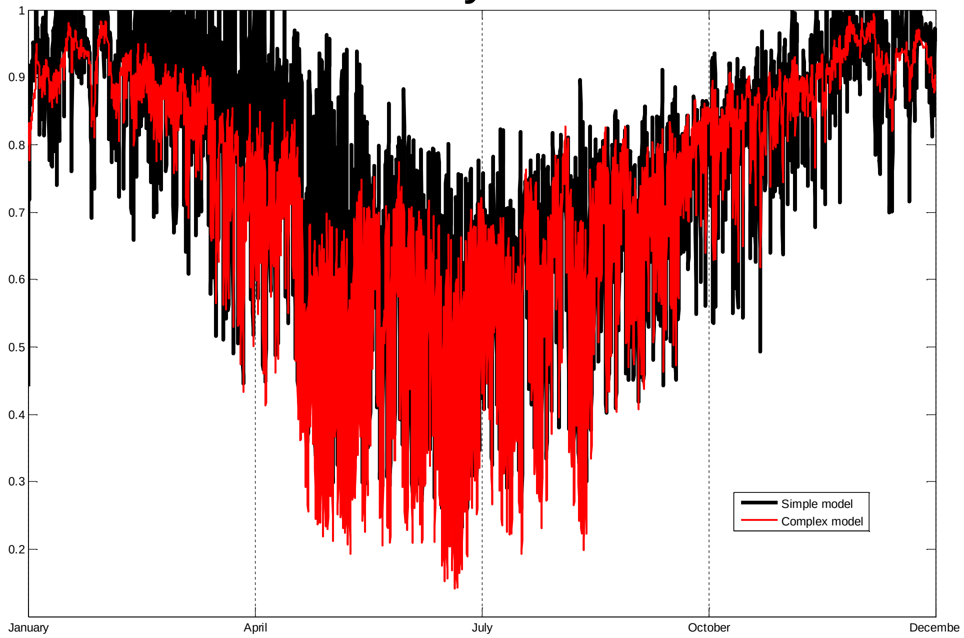
Complex
(HAM-Tools)

Comparison of HM states in the attic

Air temperatur in the attic



Relative humidity in the attic



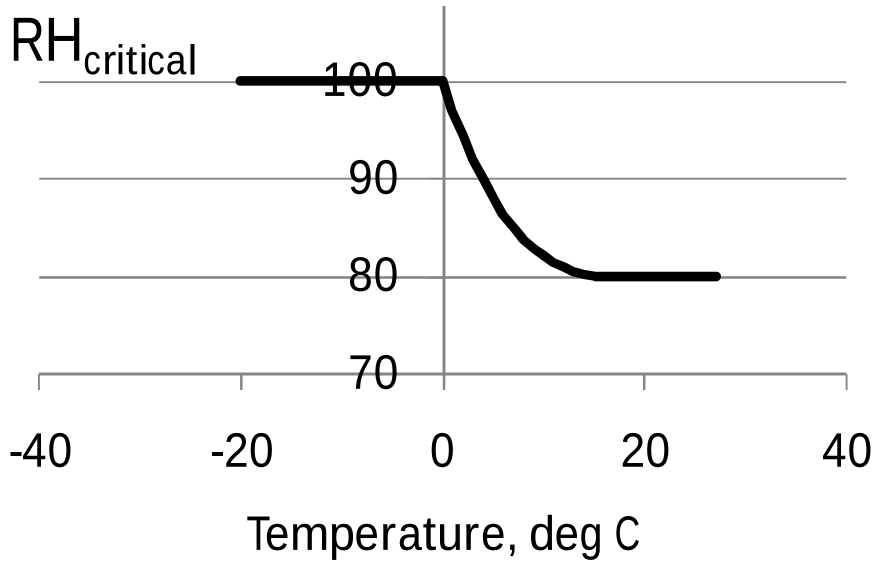
Simple model

Complex model

Risk assessment based on criteria for mould growth

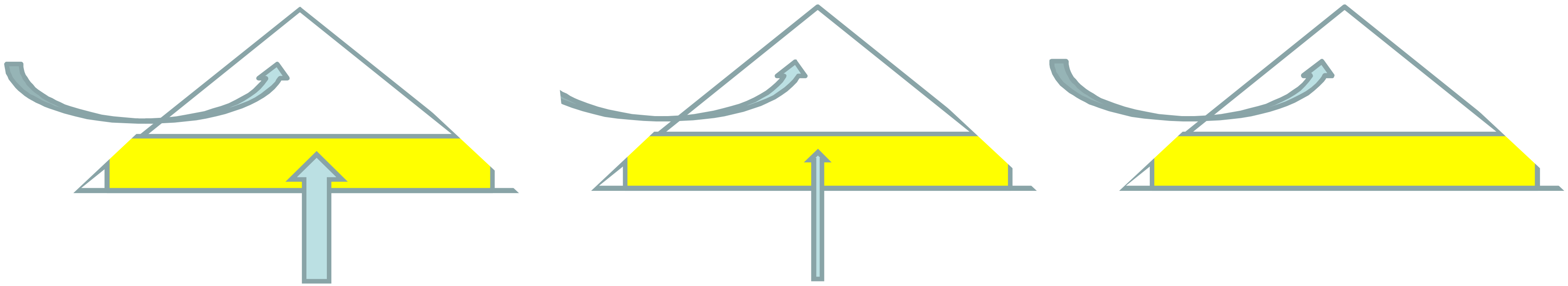
Mould growth potential
Definitely OK if M<1

$$M = \frac{RH}{RH_{crit}}$$



Scenarios

2 ventilation flow rates: high and low



Leaky floor Less tight floor Tight floor

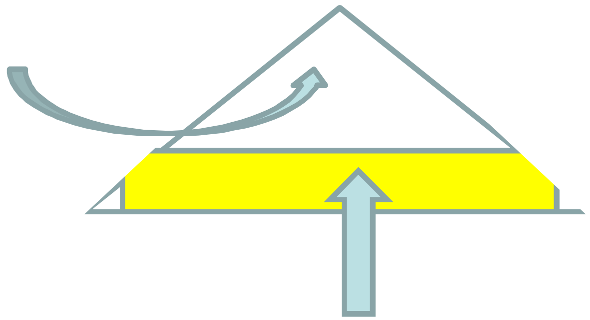
3 infiltration flow rates

Random variables and ranges

Ventilation flow rate (exterior air), 1/h

Low vent. $= N(2,1)$

High vent. $= N(7,5)$



Air infiltration (indoor air), 1/h

Leaky $= N(0.2,0.1)$

Less tight $= N(0.1,0.1)$

Tight $= 0$

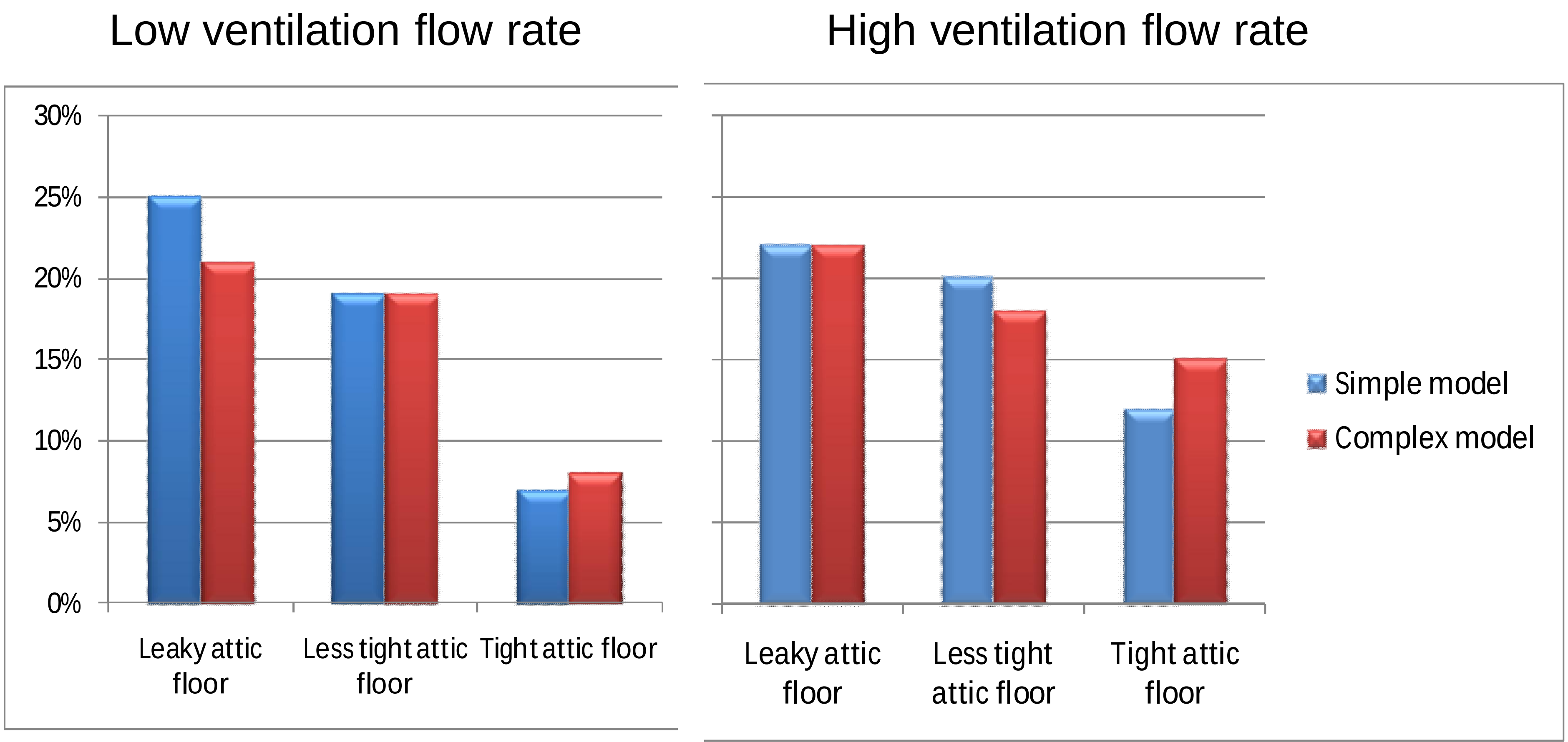
Indoor moisture supply, kg/m^3

$$\Delta v = N(0.004,0.002)$$

Climate data 1971-1990 GBG

$$year = random(0-30)$$

Results – how long time MP >1



Conclusions

- Reasonable good agreement between the results on MP
- Computational time saved with the simple model
- Further comparisons are required for more complex attic constructions and especially for variable air flow rates.