

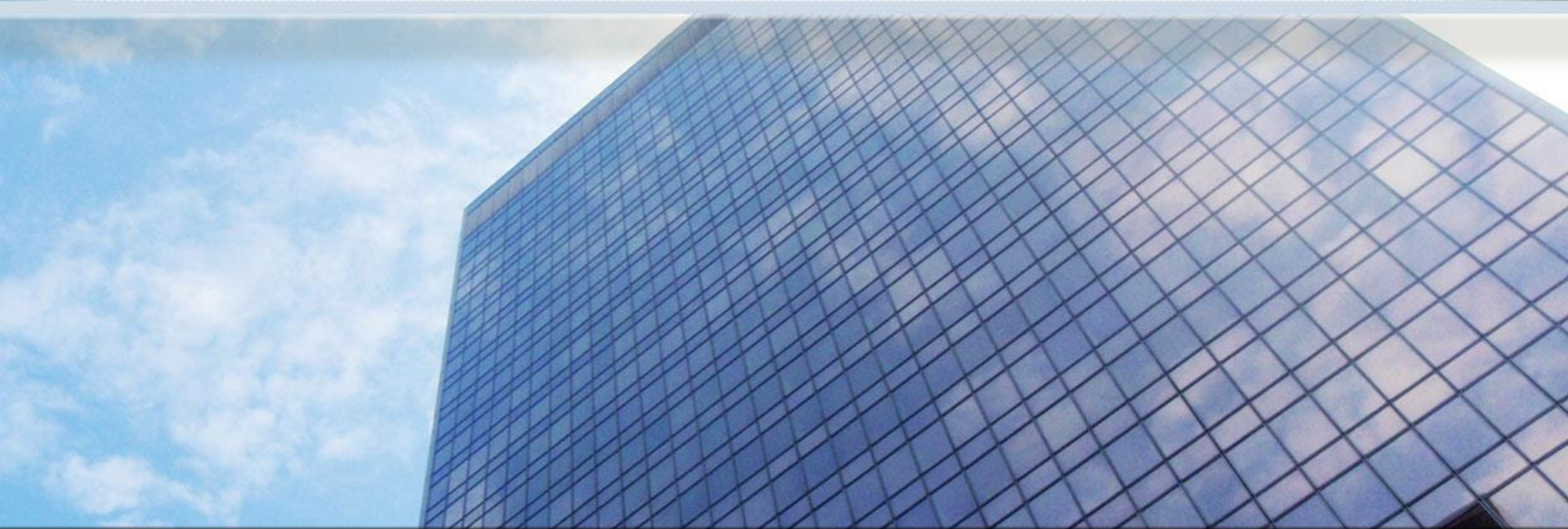
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Modeling to predict positive pressurization required to control mold growth from infiltration in a building in College Station, Texas

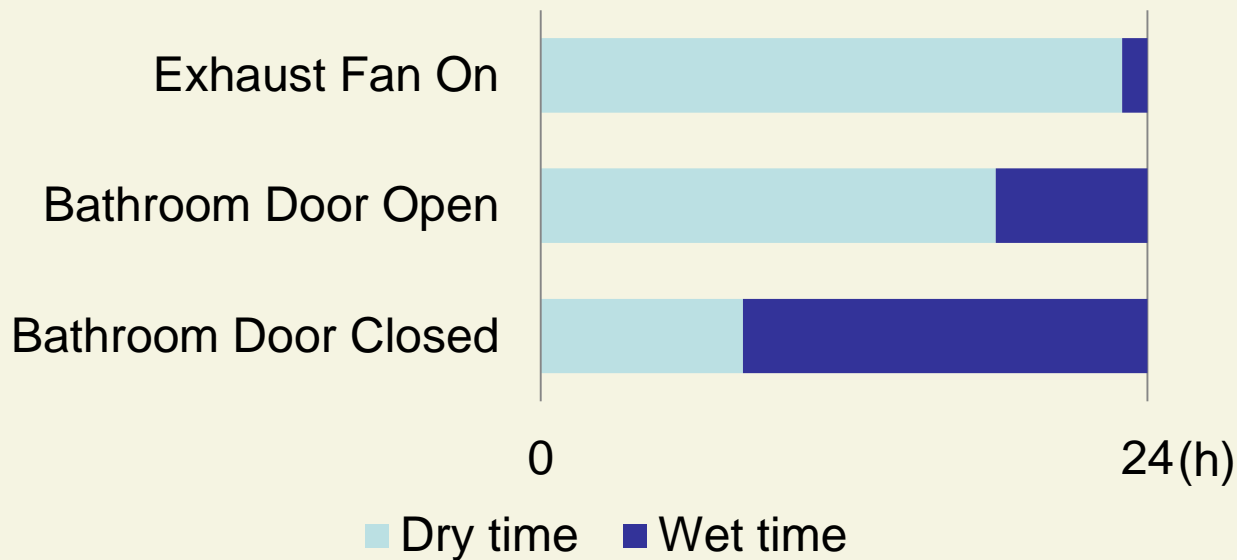
Outline

- Prevention of Mold growth
- Modeling Building Infiltration
- Results, Discussion and Conclusions

Prevention of Mold Growth

- Battle of dry time and wet time

Daily dry/wet time ratio



Modeling Mold Growth

Under conditions favorable for mold growth:

$$\frac{dM}{dt} = \frac{1}{7 * \exp(-0.68 \ln T - 13.9 \ln RH + 0.14W - 0.33SQ + 66.02)} * k_1 k_2$$

(Per day)

Under conditions unfavorable for mold growth:

$$\frac{dM}{dt} = \begin{cases} -0.00133, & \text{when } t - t_1 \leq 6h \\ 0, & \text{when } 6h < t - t_1 \leq 24h \\ -0.000667, & \text{when } t - t_1 > 24h \end{cases}$$

(Per hour)

Hukka and Viitanen (1999)

Modeling Mold Growth

Table 1. Mould Index for Experiments and Modeling. New determinations for index levels 3 and 4 are presented using bold fonts.

Index	Description of the growth rate
0	No growth
1	Small amounts of mould on surface (microscope), initial stages of local growth
2	Several local mould growth colonies on surface (microscope)
3	Visual findings of mould on surface, < 10 % coverage, or, < 50 % coverage of mould (microscope)
4	Visual findings of mould on surface, 10 - 50 % coverage, or, >50 % coverage of mould (microscope)
5	Plenty of growth on surface, > 50 % coverage (visual)
6	Heavy and tight growth, coverage about 100 %

Mold Index (Viitanen, Ojanen et al. 2011)

Border Line of Favorable Condition

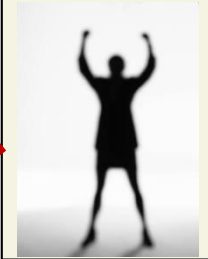
- Critical RH
 - Material dependent
 - Temperature dependent
 - For a gypsum board at 22°C, it is between 89% to 95% (Johansson, Ekstrand-Tobin et al. 2012)

Where Worst Case Happens

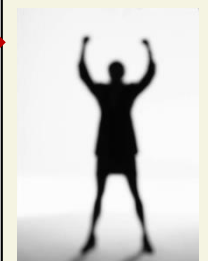
- Temp. ↓ RH ↑
- Worst case scenario
 - Location
 - Temperature



Summer time



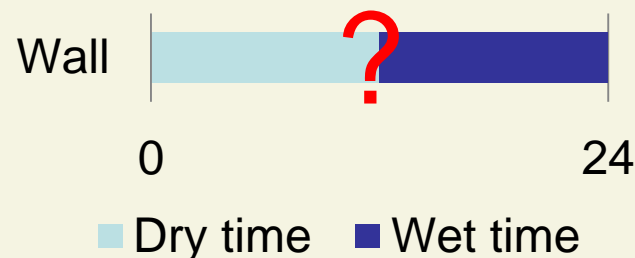
Winter time



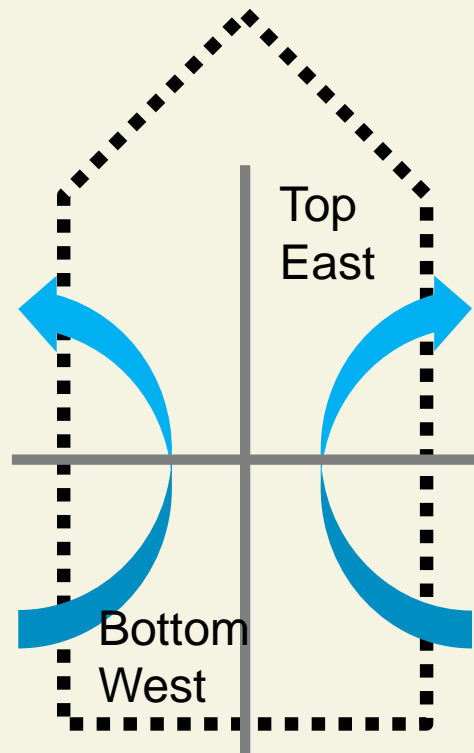
Time Share of Favorable / Unfavorable Conditions

- Exfiltration: Unfavorable condition
 - If the indoor RH is well controlled
- Infiltration: Further review needed
 - If it exceeds critical RH, then it is favorable condition

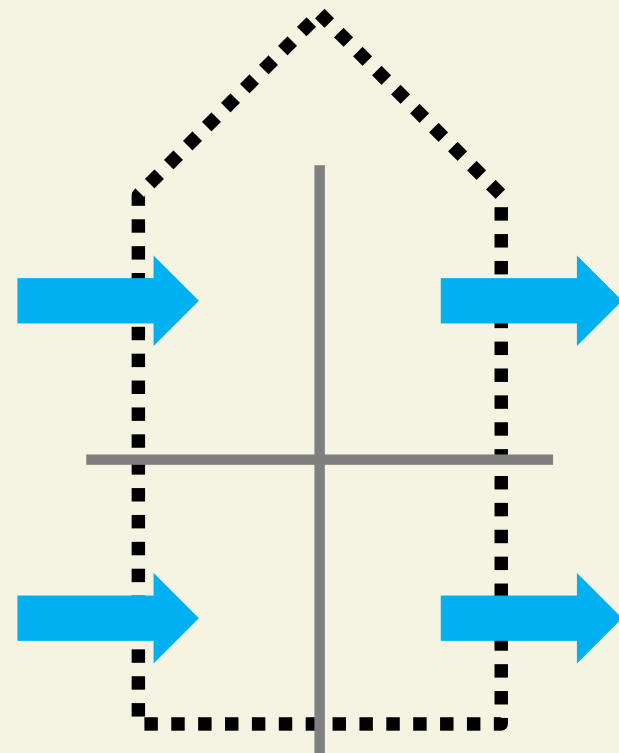
$$RH_{24^{\circ}C} = P_w / P_{s@24^{\circ}C}$$



Now Infiltration or Exfiltration?

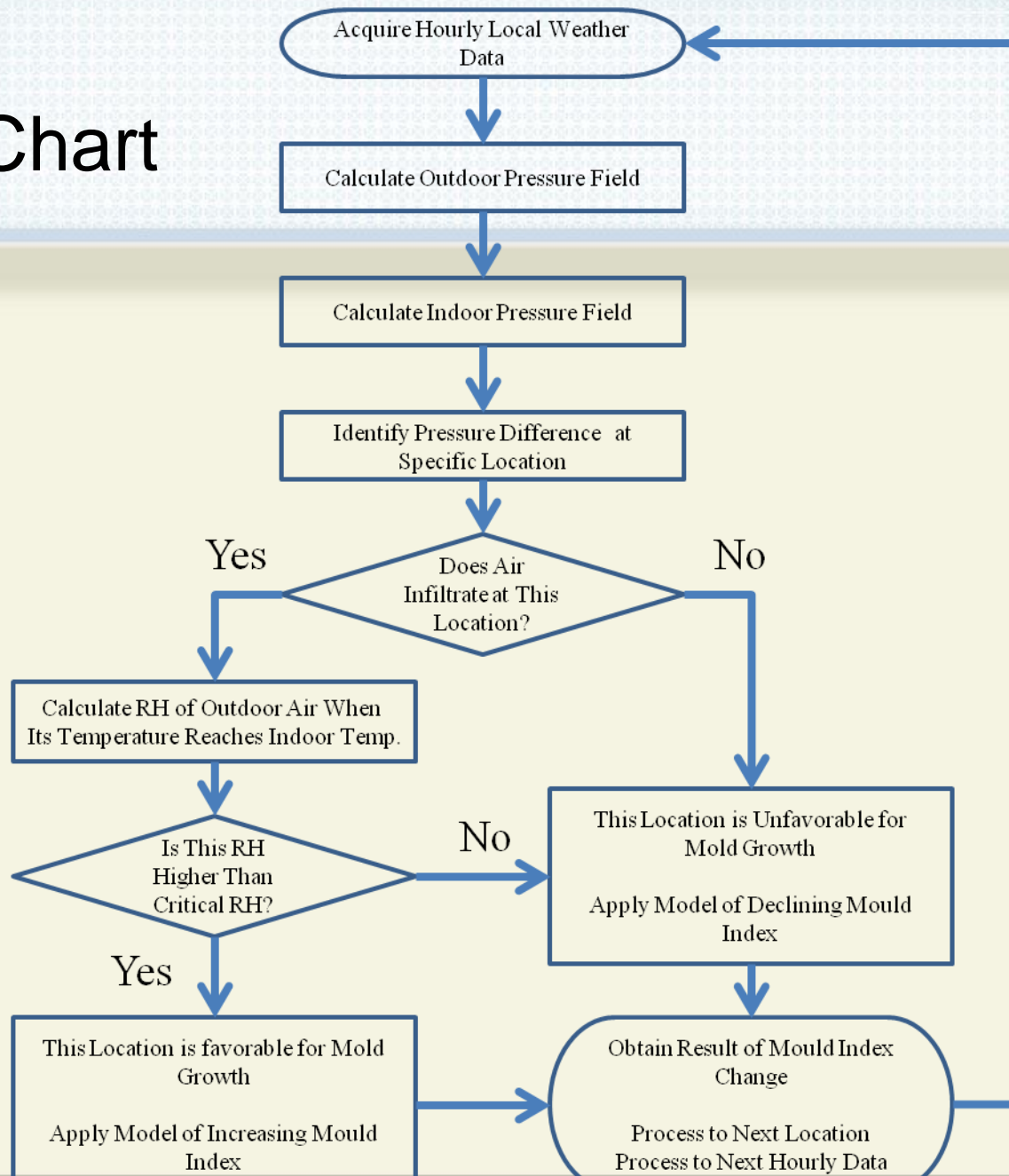


Stack effect



Wind effect

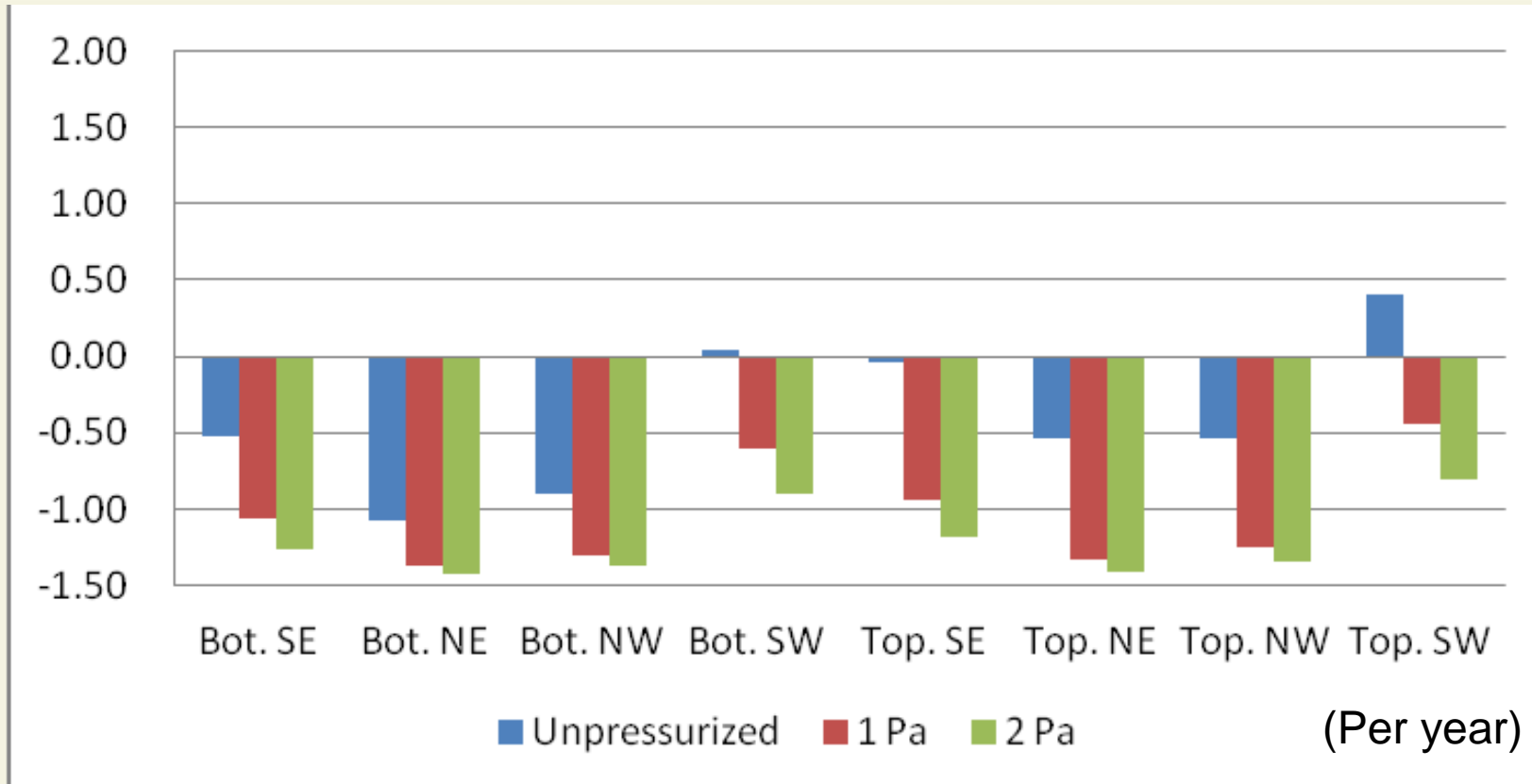
Flow Chart



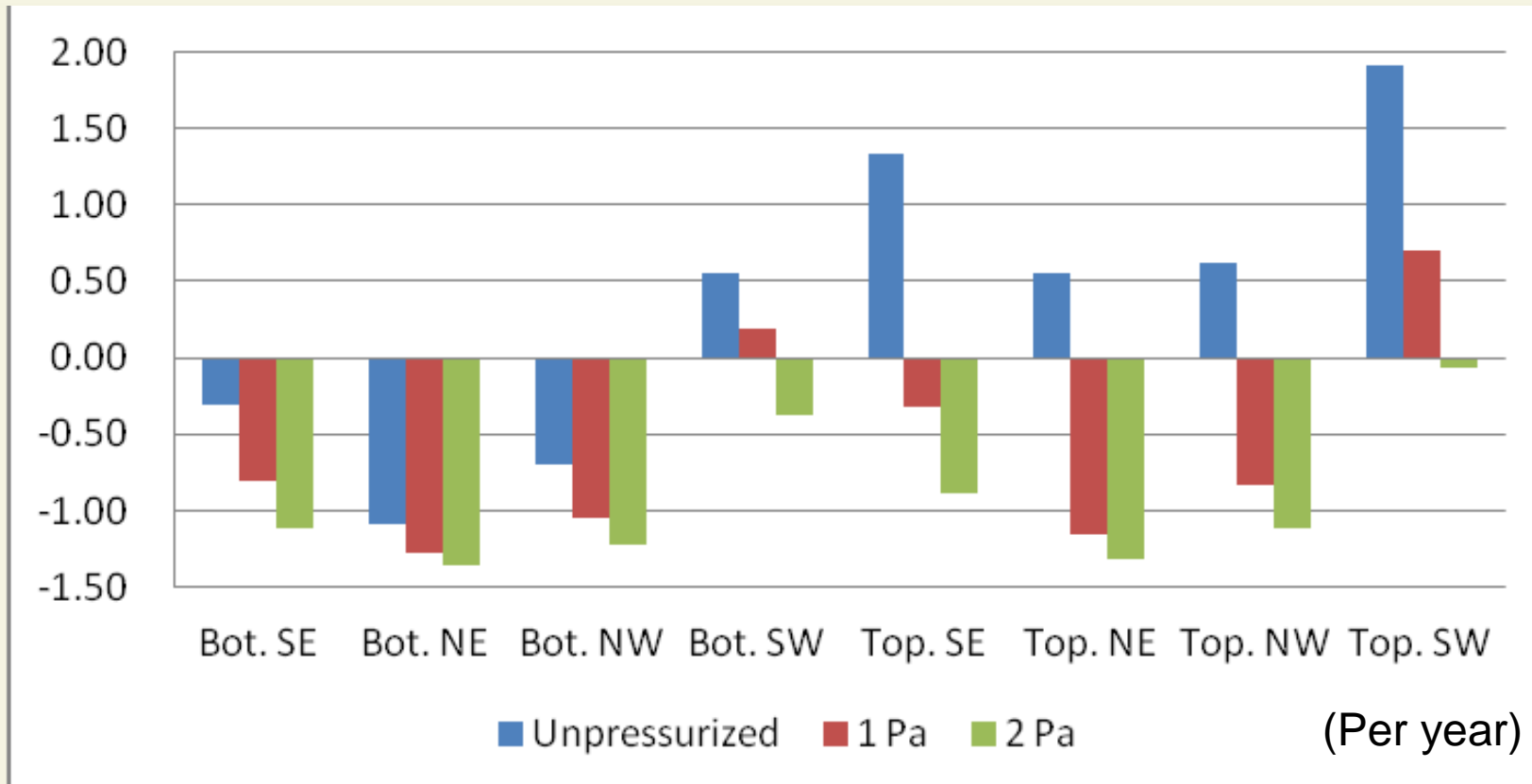
Simulated Scenarios

- 3m height, one floor building
- Temperature:
 - 22°C
 - 24°C
- Positive Pressurization:
 - Unpressurized
 - 1 Pa.
 - 2 Pa.

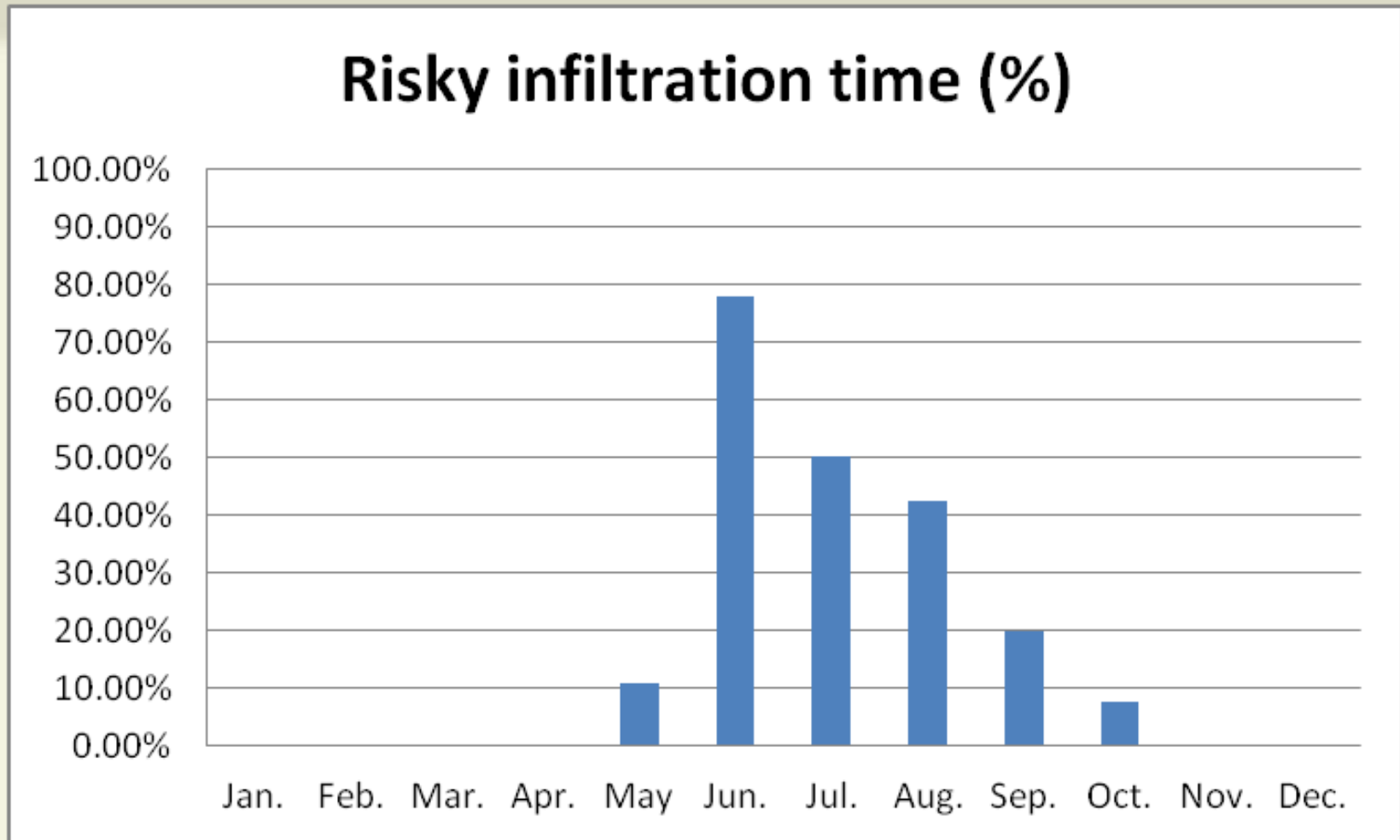
Mold index level change (24°C)



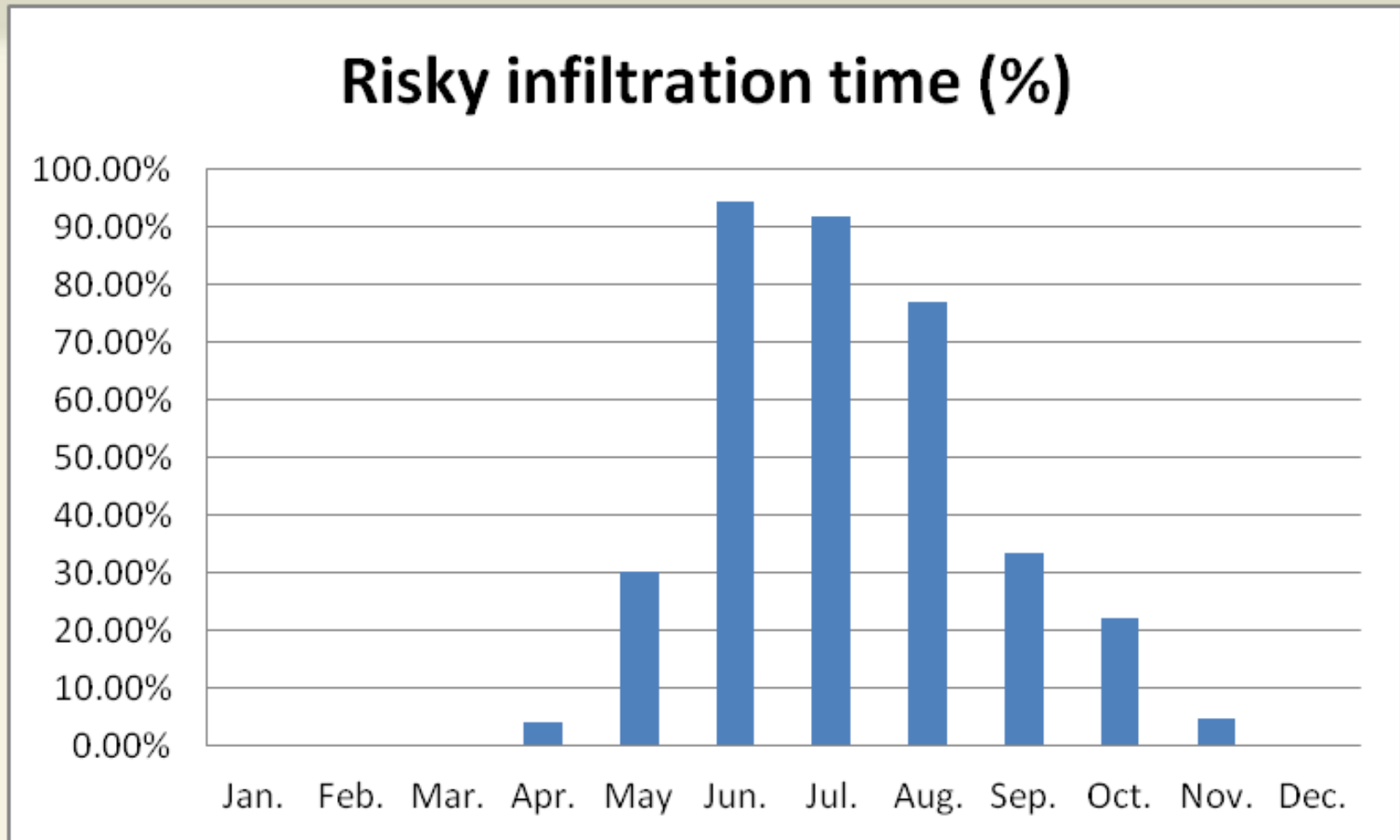
Mold index level change (22°C)



Risky infiltration time (24°C)



Risky infiltration time (22°C)



Conclusions

- Effective ways to control mold growth
 - Keep net mold index change negative
 - Positive pressurization (1-2 Pa.)
 - Raise indoor temperature set-point
- Pressurization is not necessary during colder months to control mold growth