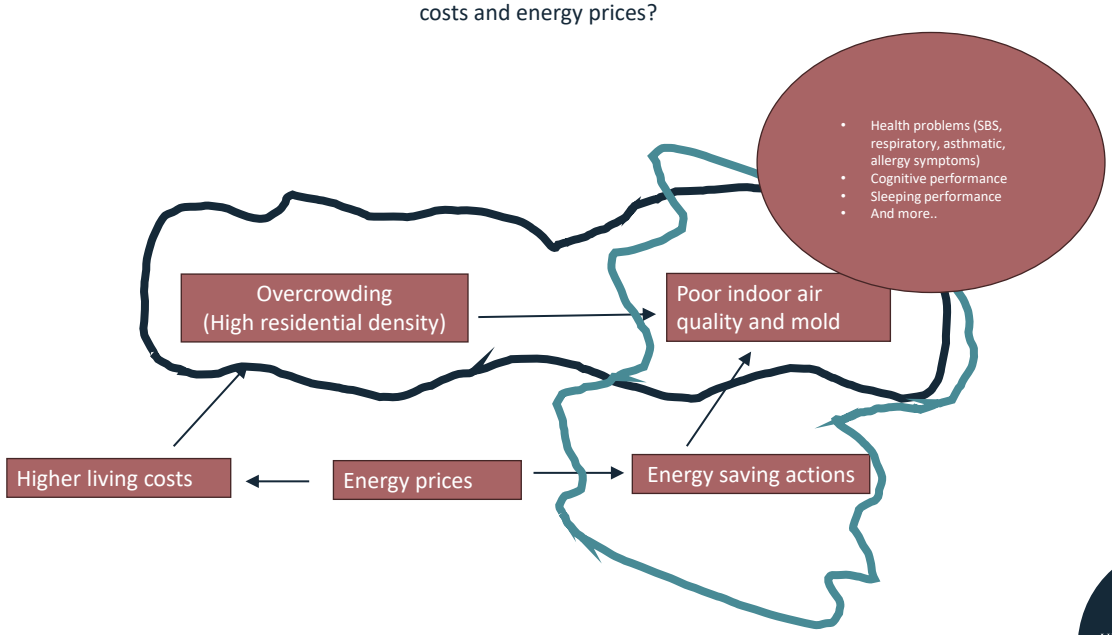
HÖGSKOLAN I BORÅS

Poor indoor air quality and mold in homes in the wake of overcrowding and higher living costs and energy prices?

1

Poor indoor air quality and mold in homes in the wake of overcrowding and higher living costs and energy prices?

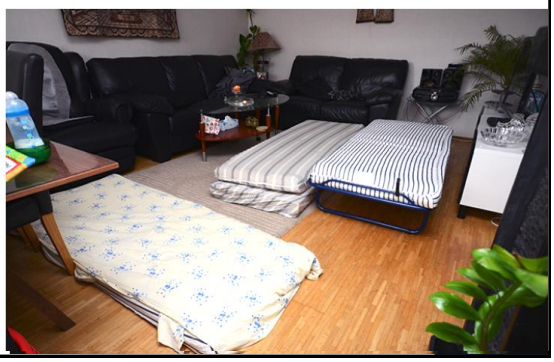


2

Source: Nordiska museet, 1949, Solna

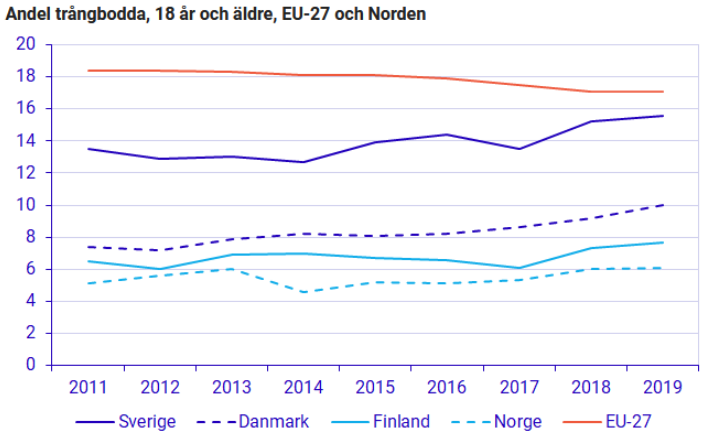
2022

2015



3

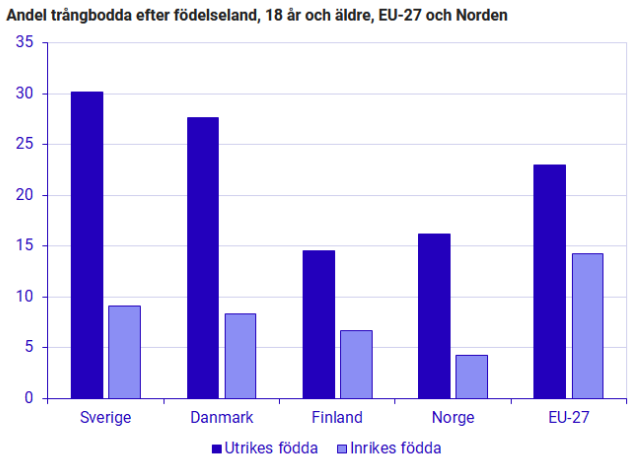
Overcrowding - High residential density



Källa: EU-SILC, 2019.

4

Overcrowding - High residential density



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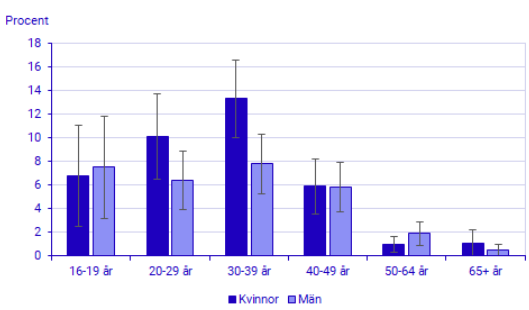
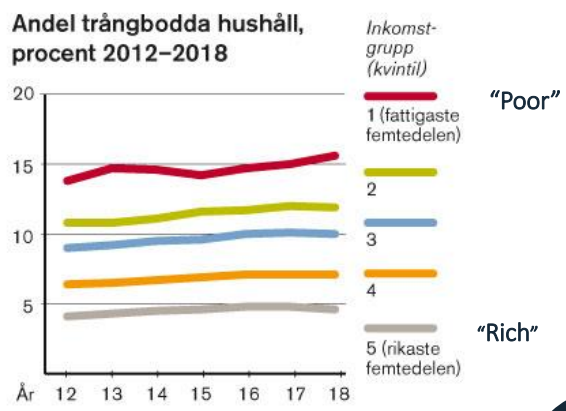
Overcrowding - High residential density

Age and overcrowding



Overcrowdning and income



Källa: Boverket

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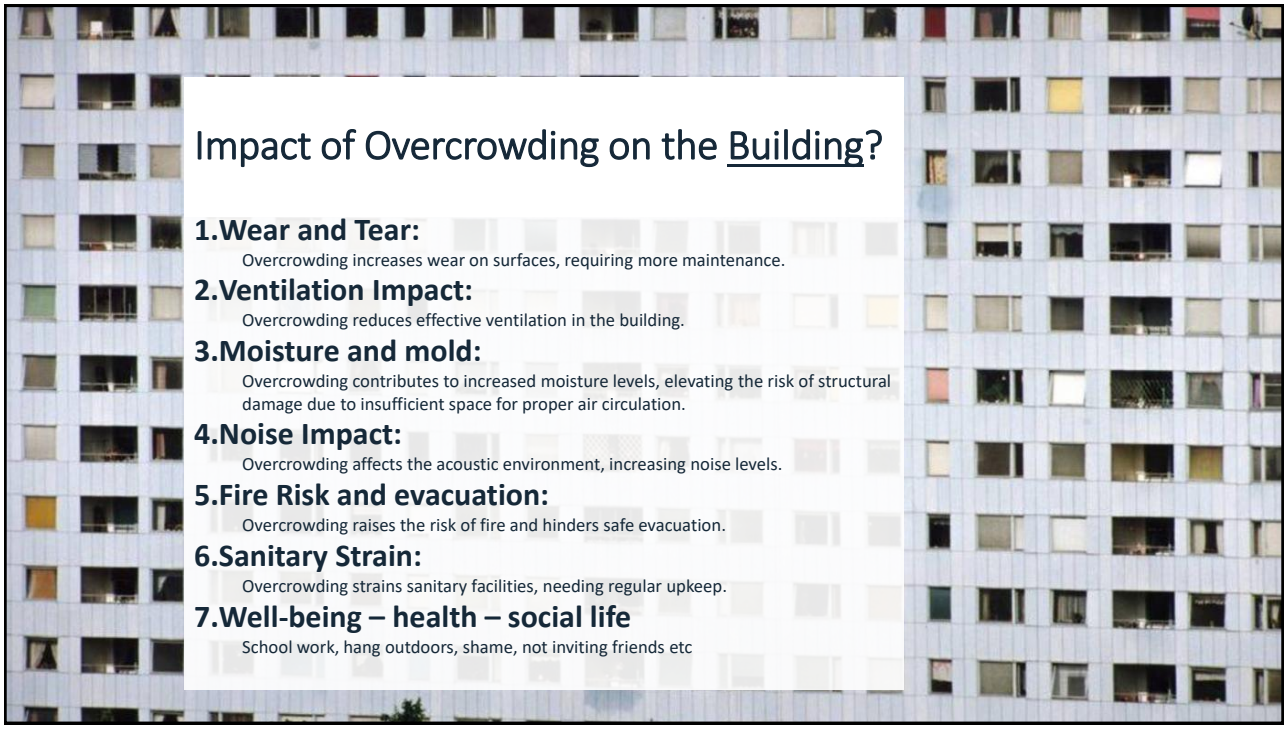

Impact of Overcrowding on the Building?

1.Wear and Tear:
Overcrowding increases wear on surfaces, requiring more maintenance.

2.Ventilation Impact:
Overcrowding reduces effective ventilation in the building.

3.Moisture and mold:
Overcrowding contributes to increased moisture levels, elevating the risk of structural damage due to insufficient space for proper air circulation.

4.Noise Impact:
Overcrowding affects the acoustic environment, increasing noise levels.

5.Fire Risk and evacuation:
Overcrowding raises the risk of fire and hinders safe evacuation.

6.Sanitary Strain:
Overcrowding strains sanitary facilities, needing regular upkeep.

7.Well-being – health – social life
School work, hang outdoors, shame, not inviting friends etc

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Humans
Moisture production: 40 g/h per person
CO_2 production: 15-20 l/h per person

Habits, behaviours in relation to residential density/overcrowding:

- Showering
- Cooking
- Laundry and dry tumbling*
- Human breathe and dermal diffusion

- Window opening* due to thermal- and IAQ discomfort
- **Indoor doors closed due to noise and privacy !**

} Increased water and moisture load
Increased moisture production
Increased temperature
Affecting ventilation balance

***IF ELECTRICITY AND HEAT IS INCLUDED IN RENT..**

Photo: Anders Paulsson, Hem & Hyra 2020

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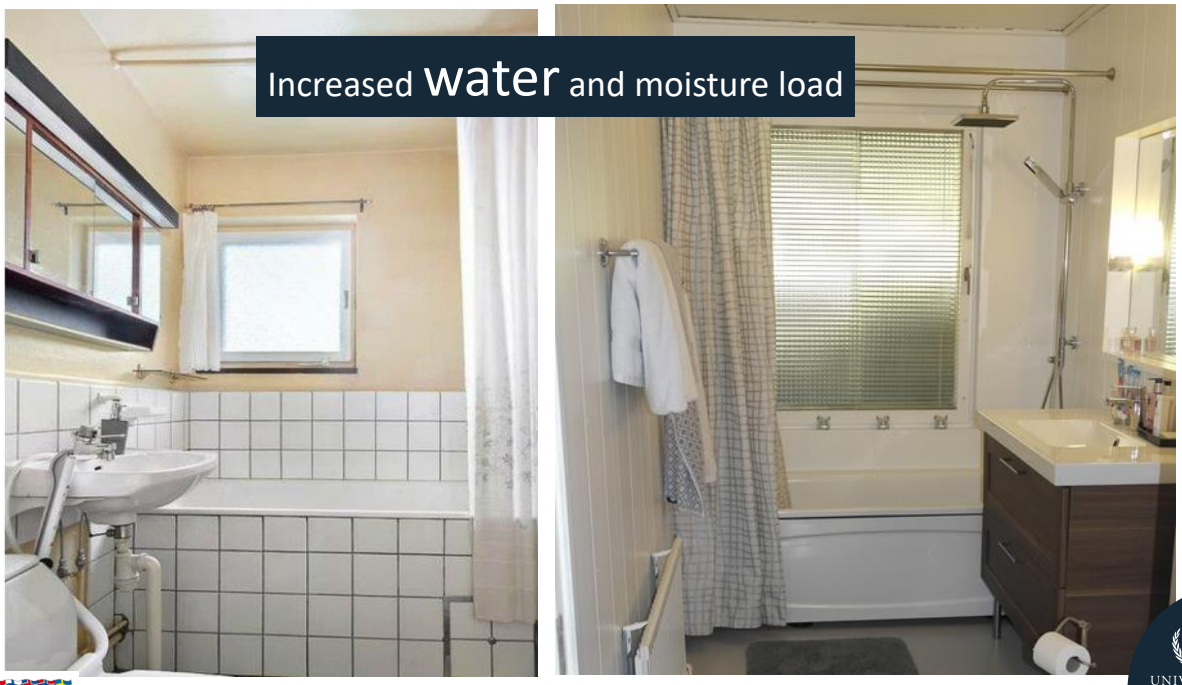

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Increased moisture production, vapour content and relative humidity

- Visible mold on indoor surfaces – health issues
- Mites → mite allergy

Photo: Töreboda kommun

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Simulation – WUFI computer calculations

Increased Temperature

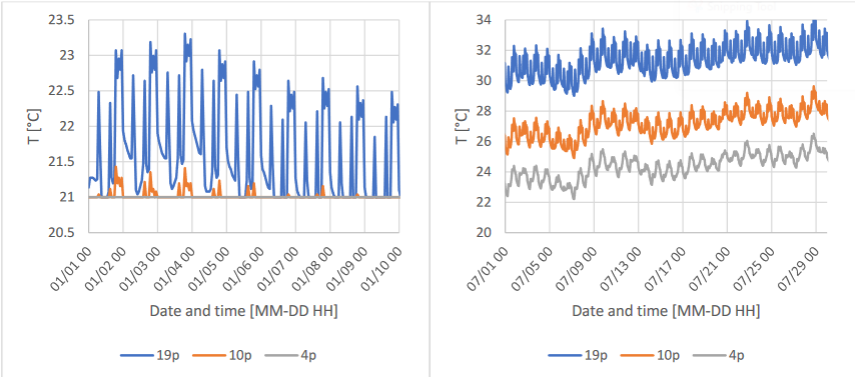

Figure 4. Resulting indoor air temperature during 10 days in the winter (**left**) and ten days in the summer (**right**). The legend in the bottom shows case abbreviations with line coloring.

REFERENCE: Abdul Hamid, A ; von Platten, J ; Mjörnell, K ; Johansson, D ; Bagge,H (2021) Determining the impact of high residential density on indoor environment, energy use, and moisture loads in Swedish apartments-and measures for mitigation. *Sustainability (Basel, Switzerland).* [Online] 13 (10), 5446-.

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Simulation – WUFI computer calculations

Increased Carbon dioxide

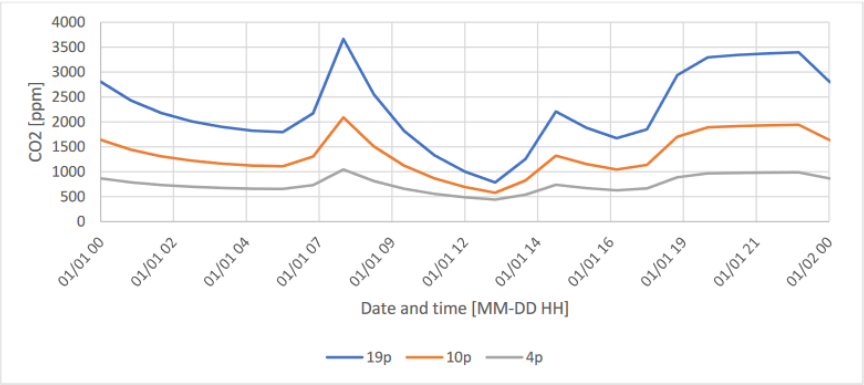

Figure 5. Resulting CO_2 concentrations during one day (24 h). The legend in the bottom shows case abbreviations with line coloring.

REFERENCE: Abdul Hamid, A ; von Platten, J ; Mjörnell, K ; Johansson, D ; Bagge,H (2021) Determining the impact of high residential density on indoor environment, energy use, and moisture loads in Swedish apartments-and measures for mitigation. *Sustainability (Basel, Switzerland).* [Online] 13 (10), 5446-.

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Simulation – WUFI computer calculations

Increased Relative humidity

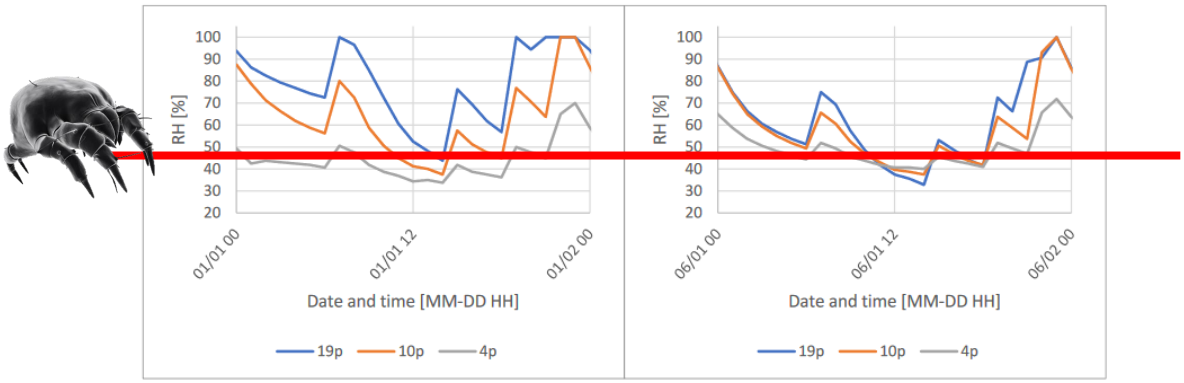

Figure 6. Resulting RH of indoor air with different residential densities, during a winter day (**left**) and summer day (**right**). The legend in the bottom shows case abbreviations with line coloring.

REFERENCE: Abdul Hamid, A ; von Platten, J ; Mjörnell, K ; Johansson, D ; Bagge,H (2021) Determining the impact of high residential density on indoor environment, energy use, and moisture loads in Swedish apartments-and measures for mitigation. *Sustainability (Basel, Switzerland)*. [Online] 13 (10), 5446-.

Simulation – WUFI computer calculations

Relative humidity on interior surface Gypsum board

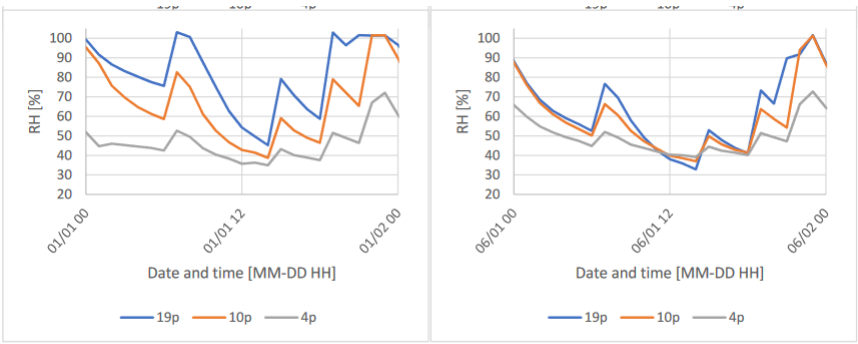

Figure 7. Resulting T and RH at the interior surface of the gypsum board during a winter day (**left**) and a summer day (**right**) with different residential densities. The legend in the bottom shows case abbreviations with line coloring.

REFERENCE: Abdul Hamid, A ; von Platten, J ; Mjörnell, K ; Johansson, D ; Bagge,H (2021) Determining the impact of high residential density on indoor environment, energy use, and moisture loads in Swedish apartments-and measures for mitigation. *Sustainability (Basel, Switzerland)*. [Online] 13 (10), 5446-.

Boverket

We need to build more homes - according to the National Board of Housing, at least **67,300 every year** in the next 7 years.

Older buildings, especially apartments in multi-family houses from the 70s, need to be renovated (330 000 !) - both from an energy perspective and also upgraded due to wear and poor indoor environment. This must be done sustainably - people must be able to afford to move.

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Measures taken to reduce the energy costs of the house

Åtgärd	Total n
Sänkt inomhustemperaturen (till 18-21 grader eller mer)	600
Sänkt inomhustemperaturen (till under 18 grader)	193
Sänkt inomhustemperaturen i rum som inte används	490
Duschat kortare tid eller mer sällan	721
Undvikit att använda belysning i rum där ingen vistas	1104
Undvikit att använda belysning i rum där någon vistas	520
Undvikit att tvätta utan full laddning	642
Tvättat i 40 grader i stället för 60	494
Inte använt torktumlare/torkskåp	623
Anpassat tvätt och disk till tider med låga elpriser	468
Lagat mat på tider med låga elpriser	173
Avstått från att laga varm mat	94
Dragit ur kontakter när apparater inte används	610
Köpt energisnåla produkter och lampor	728
Tätat med lister runt fönster och dörrar	293
Slutat att använda handdukstork, elgolvvärme, bastu och badkar/spa	495
Nej, jag har inte gjort något av ovanstående	153
	1855

LOWER INDOOR AIR TEMPERATURE

Showered for a shorter time or less often

Avoid using lighting in rooms where no one is staying

Avoided washing textiles without a full load

Not used tumble dryer or tumble dryer

Unplugged when appliances are not in use

Bought energy-efficient products or lamps

Ref: Åsa Wahlström et. al , 2023
El och energi – Vad har svenskarna egentligen koll på
www.nav.se/om-nav/publikat/2023/11/Svenska-allmanhetens-energikunskaper-230929.pdf

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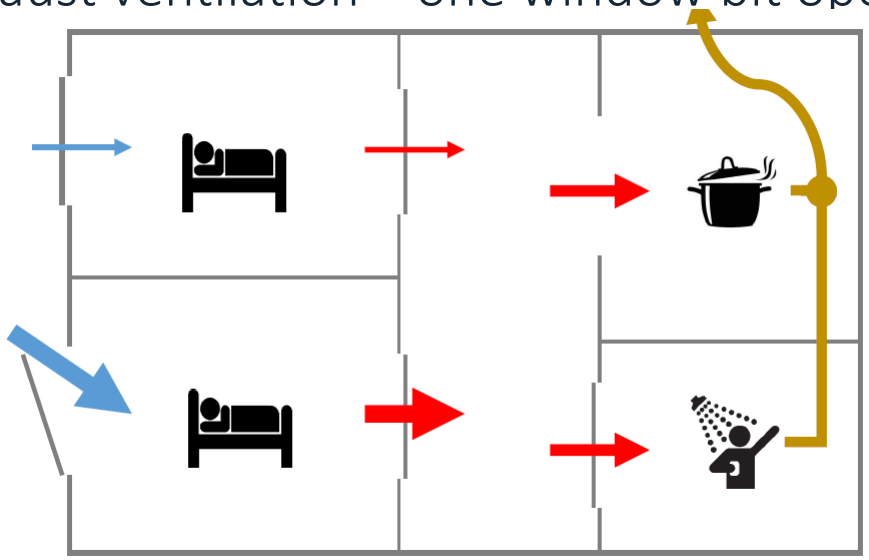
Exhaust ventilation – one window bit open



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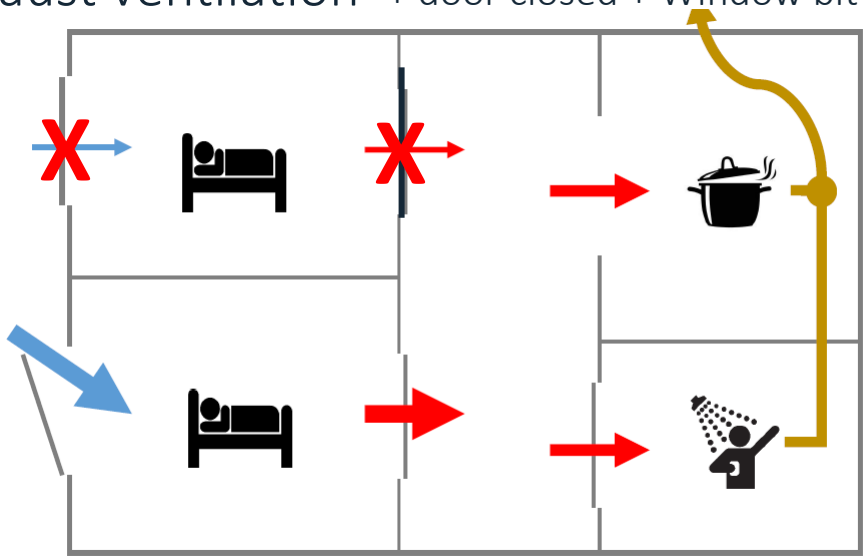
Exhaust ventilation + door closed + Window bit open



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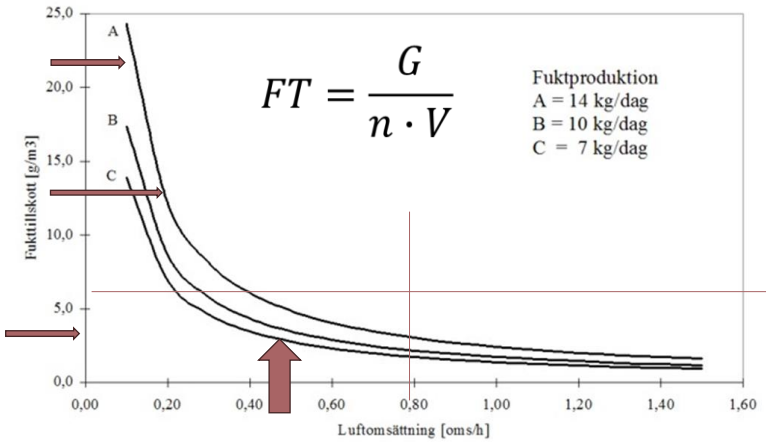
Moisture supply *(differemce vapour indoors-vapour outdoors)*



$$FT = \frac{G}{n \cdot V}$$

G=Moisture production (around 40 g/h in rest ; ”80 g/h activity” and person in rest = 1-2 kg/day

+ shower, cooking, wash laundry etc

n= ventilation ACR (normal dwelling)

V= Volume

FT= moisture supply A could be DOUBLED!

Bilden visar hur ökad luftväxling innebär lägre fukttillskott vid samma fuktproduktion i en bostad med volymen på ca 285 m³.

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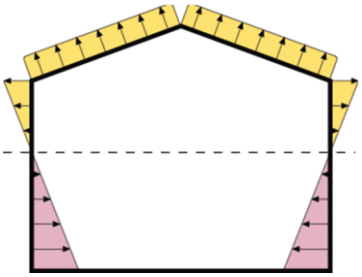
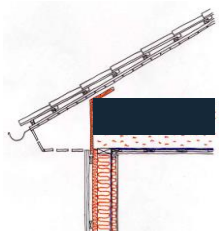
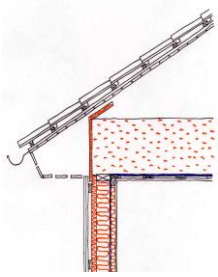


- Air tightness
- Preassure picture
- Vapour content indoor air
- Surface temperature
- U-value climate envelope



”warmer than outdoors”

100 mm insulation



”same as outdoors <u>if no</u> moisture suply”

500 mm insulation

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Short summary

1. **Combat Overcrowding:**
   - Address overcrowding in new and old buildings.
2. **Multidisciplinary Approach:**
   - Use diverse expertise for complex issues.
3. **Smart Tech and Affordability:**
   - Integrate tech, keeping costs reasonable. "Smart ventilation strategies"
4. **Renovation Focus:**
   - Prioritize indoor improvements in older structures.
5. **Sustainability and Community:**
   - Emphasize sustainability, involve local communities, educate on effective energy-saving measures. **Knowledge among residents, home owners**
6. **Knowledge in building physics**

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Thank you

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