VENTILATIVE COOLING
IN THE AUSTRIAN REGULATORY CONTEXT

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a. Preventing from Summerly Overheating
b. Limiting Technical Cooling Demand

a. Preventing from summerly overheating
WITHOUT TECHNICAL COOLING, mandatory
for all new and significantly renovated residential buildings
requirements according to OIB RL 6 (2015)
calculation procedure according to ÖNORM B 8110-3 (2012)

b. Limiting the technical cooling demand, mandatory
for all new and significantly renov. non residential buildings
requirements according to OIB RL 6 (2015)
calculation procedure according to ÖNORM B 8110-6 (2012)
together with ÖNORM H 5057 (2011)

Requirements according to OIB RL 6 (2015)

- Residential houses obligatorily
  have to offer summerly comfort without technical cooling,
  proven by simplified dynamic (hourly) energy balance
  against standardized climate and standardized usage patterns.
  Night Ventilation definitvely may be included.
- Non residential houses obligatorily
  have to keep within the limits of the net cooling demand,
  defined as the „outside induced cooling demand“,
  proven by monthly energy demand calculation.
  Night Ventilation may be included.

a.
National Code B 8110-3 (2012)
Thermal protection in building construction
Part 3: Avoidance of summerly overheating

Background and Scope of Application

- Part of the OENORM B 8110 series „Thermal protection in building construction”
- Revised and relaunched in March 2012
- Valid for all types of rooms with constant human occupancy, without technical cooling

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Definition of „Summer Comfort“

- Max. 27°C operative Temperature in each room
- Max. 25°C operative Temperature in sleeping rooms at night

both on a statistically hot, mid-July, clear summer‘s day, occuring in infinite periodic repetition

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Calculation Procedure: Dynamic Heat Balance acc. to EN ISO 13791

Input parameters

- Climate
- Geometry
- Thermal Properties
- Solar properties, including shading
- Internal load profiles
- Ventilation

Calculation Procedure

Input parameters

- **Climate**
- Geometry
- Thermal Properties
- Solar properties, including shading
- Internal load profiles
- Ventilation

Site sensitive, hourly climate data, defined as a constantly repeated, mid summer's design day (obligatory)

to be taken from OENORM B 8110-5, defined by the mean day temp of 15. July plus an hourly defined day/night swing of $\pm$7K

further referring to
EN 13791 (sky temp.)
EN ISO 13370 (ground temp.)

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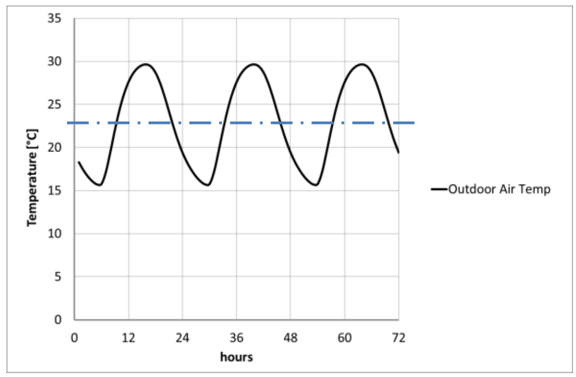
Calculation Procedure

Input parameters

- **Climate**



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Calculation Procedure

Input parameters

- Climate
- **Geometry**
- Thermal Properties
- Solar Properties, including Shading
- Internal Load Profiles
- Ventilation

Orientation sensitive input of the building's / room's envelope and volume

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Calculation Procedure

Input parameters

- Climate
- Geometry
- **Thermal Properties**
- Solar Properties, including Shading
- Internal Load Profiles
- Ventilation

U-Values of both opaque and transparent building elements

including U-values, density, specific heat, conductivity

usable termal mass calculated according to simplified method of EN 13786

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Calculation Procedure

Input parameters

- Climate
- Geometry
- Thermal Properties
- **Solar Properties, including Shading**
- Internal Load Profiles
- Ventilation

g-values (SHGC) of transparent layers according to manufacturers‘ information

Fc values (shading coefficients) of blinds according to EN 13363

additionally referring to

- EN 13561 and EN 13659 and EN 13791 (wind resistance)
- EN 13791 (fixed obstacles)

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Calculation Procedure

Input parameters

- Climate
- Geometry
- Thermal Properties
- Solar Properties, including Shading
- **Internal Load Profiles**
- Ventilation

Mandatory lists of hourly internal load profiles and hygienic ventilation rates

for residential buildings, office buildings, schools and hospitals,

given in [W/m²], [W/workplace], [m³/h,pers]

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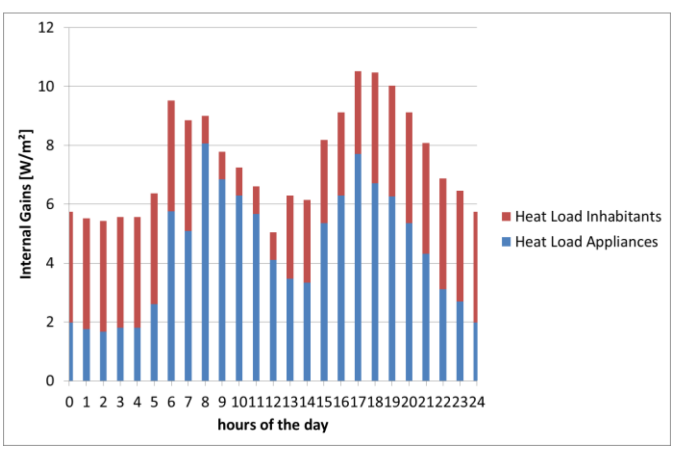
Calculation Procedure

- **Internal Load Profile, exemplary for residential use**



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Calculation Procedure

Input parameters

- Climate
- Geometry
- Thermal Properties
- Solar Properties, including Shading
- Internal Load Profiles
- **Ventilation**

- Window ventilation by formula,
  V [m³/h] = f(A_w , H_w , ΔT)
- Mechnical ventilation up to 1,5 ACH in occupied rooms and up to 2,5 ACH in unoccupied rooms, taking into account the thermal load from vents

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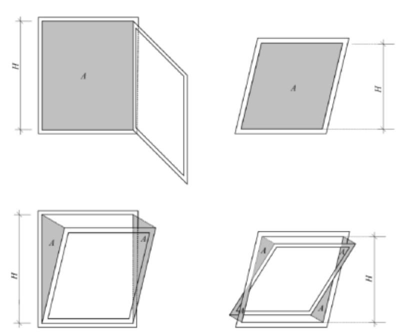
Ventilative Cooling by Window Opening

$$\dot{V} = 0{,}7 \cdot C_{\mathrm{ref}} \cdot A \cdot \sqrt{H} \cdot \sqrt{\Delta T}$$

with
C_{ref} … Discharge Coefficient
C_{ref} = 100 $m^{0,5}/(h.K^{0,5})$



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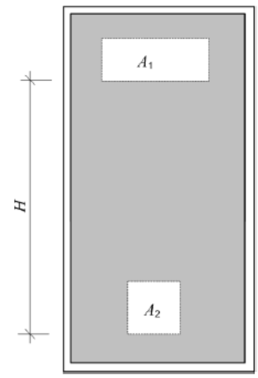
Ventilative Cooling by Window Opening

$$\dot{V} = 0{,}7 \cdot C_{ref} \cdot A \cdot \sqrt{H} \cdot \sqrt{\Delta T}$$

with $C_{ref} = 300\ m^{0,5}/(hK^{0,5})$

with $A_{eff} = \sqrt{\dfrac{1}{\dfrac{1}{A^2{}_{oben}} + \dfrac{1}{A^2{}_{unten}}}}$



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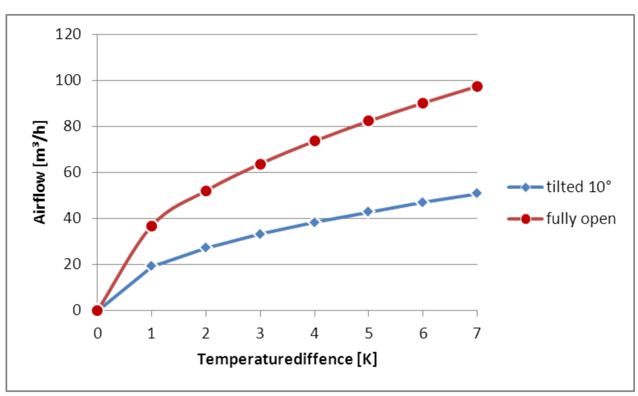
Ventilative Cooling by Window Opening

$$\dot{V} = 0{,}7 \cdot C_{ref} \cdot A \cdot \sqrt{H} \cdot \sqrt{\Delta T}$$

W = 40 cm

H = 120 cm



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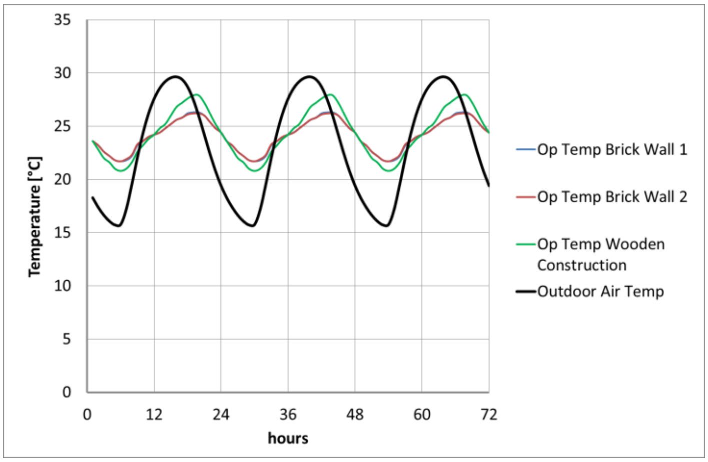
Exemplary Outputs

taken from a specific residential room, comparing the effects of three different wall types, Holzer 2013



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Learnings

- ✓ ÖNORM B 8110-3:2012 offers a well applicable method of evaluating the risk of summerly overheating, for rooms without mechanical cooling.
- ✓ Effects of Ventilative Cooling can be taken into account both for mechanical and for window-based solutions.
- ✓ The physical principle of a periodically repeated dynamic heat balance leads to robust and highly comparable outputs, given in a daily run of the room's operative temperature.

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Learnings

- Commercial simulation software products usually aren't prepared to calculate the air flow through windows exactly according to formula (1).
- The calculation model isn't well prepared for stack effect ventilation.
- The method of periodically repeated dynamic heat balance isn't sensitive to transient effects of heat storage during heat waves of limited duration.

Learnings

- As regards the scope of the code, it's still is a point of discussion, how to define the summer performance of buildings with thermal mass activation but without Air-Conditioning:
  - By definition they are mechanically cooled.
  - By perception they are very much anticipated as free running mode buildings.

b.

National Code B 8110-6 (2014)

Thermal protection in building construction

Part 6: Principles and verification methods
Heating demand and cooling demand

National application, national specifications and national supplements to ÖNORM EN ISO 13790

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Background and Scope of Application

- Valid for all types of buildings with constant human occupancy, **WITH** technical cooling
- Limiting the outside induced net cooling demand
  KB* ≤ 1 kWh/m³a (newly built)
  KB* ≤ 2 kWh/m³a (major renovation)

  calculated by monthly energy balance against monthly mean outside temperature and mandatory 26°C inside temperature

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Calculation Procedure

$$KB_V = \frac{Q_{c,a}}{V}$$

$$Q_{c,j} = f_{corr} \cdot (1 - \eta_{c,j}) \cdot Q_{g,j,c} \Big|_{Q_{\ldots} \rightarrow Q_{\ldots}}$$

$$\eta_c = \frac{1 - \gamma_c{}^{a}}{1 - \gamma_c{}^{a+1}} \text{ wenn } \gamma \neq 1$$

$$\gamma_c = \frac{Q_{g,c}}{Q_\ell} \qquad a = a_0 + \frac{\tau}{\tau_0}$$

$$Q_\ell = Q_T + Q_V$$

$$Q_V = \frac{1}{1000} \cdot L_V \cdot (\theta_i - \theta_e) \cdot t$$

$$L_{Vc,FL} = c_{p,L} \cdot \rho_L \cdot V_V \cdot n_{L,m,c}$$

$$n_{L,m,c} = \frac{n_{L,FL} \cdot t_{Nutz,d} \cdot d_{Nutz} + n_{L,NL} \cdot t_{NL,d} \cdot d_{Nutz}}{t}$$

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Calculation Procedure

$$KB_V = \frac{Q_{c,a}}{V}$$

$$Q_{c,j} = f_{corr} \cdot (1 - \eta_{c,j}) \cdot Q_{g,j,c} \Big|_{Q_{\ldots} \rightarrow Q_{\ldots}}$$

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$$n_{L,m,c} = \frac{n_{L,FL} \cdot t_{Nutz,d} \cdot d_{Nutz} + n_{L,NL} \cdot t_{NL,d} \cdot d_{Nutz}}{t}$$

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Calculation Procedure

$$KB_V = \frac{Q_{c,a}}{V}$$

-20%

$$Q_{c,j} = f_{corr} \cdot (1 - \eta_{c,j}) \cdot Q_{g,j,c}\Big|$$

+10%

$$\eta_c = \frac{1 - \gamma_c^{\,a}}{1 - \gamma_c^{\,a+1}} \quad \text{wenn } \gamma \neq 1$$

...

$$\gamma_c = \frac{Q_{g,c}}{Q_\ell} \qquad a = a_0 + \frac{\tau}{\tau_0}$$

+50%

$$Q_\ell = Q_T + Q_V$$

+100%

$$Q_V = \frac{1}{1000} \cdot L_V \cdot (\theta_i - \theta_e) \cdot t$$

+100%

$$L_{Vc,FL} = c_{p,L} \cdot \rho_L \cdot V_V \cdot n_{L,m,c}$$

+100%

$$n_{L,m,c} = \frac{n_{L,FL} \cdot t_{Nutz,d} \cdot d_{Nutz} + n_{L,NL} \cdot t_{NL,d} \cdot d_{Nutz}}{t}$$

1,5 ACH
8 h/d

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Conclusion

- ✓ ÖNORM B 8110-6: 2014 offers a simplified method of taking into account night ventilation / Ventilative Cooling
- ✓ both for mechanical and for window-based solutions.
- ✓ Resulting in a reduction of the outside induced cooling demand in the exemplary range of 20%, ofering an object to optimization.

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Thank you !

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