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Comparison of the results of a static monthly method according

EN ISO 13790 (WI14)

to a dynamical simulation routine

„TRNSYS“

Thomas Eiper

Institute of Thermal Engineering
Graz University of Technology, Austria

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Questions

-Is the static monthly procedure in comparison to the dynamical method accurate enough?

- Are the results of different procedures comparable?

- How important are variable estimates concerning energy need for space heating and cooling?

- Is it possible to calculate room temperature depended steerings/regulations with a static procedure?

- Where are potential improvements?

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Energy flow sheet and thermal efficiency of a building

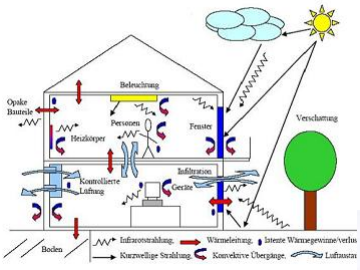
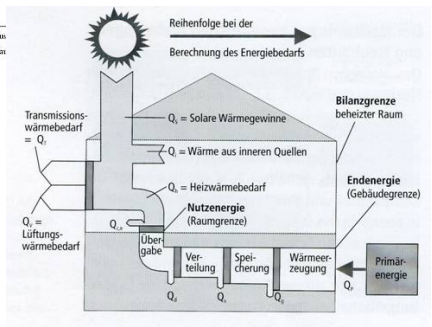


figure.: boundaries of the building procedure
DIN V 4701-10

figure.: thermal efficiency of a building, source: Raskop



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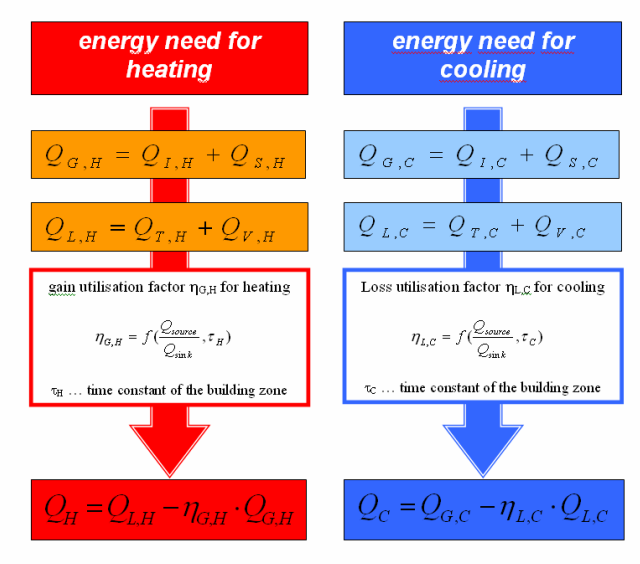
Static monthly procedure EN ISO 13790 (wi 14)



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Transient building simulation – „TRNSYS“

TRNSYS - Transient System Simulation Program

Developed since TRNSYS 1975 at SEL (Solar Energy Laboratory, University of Wisconsin, USA) by Klein, Duffie und Beckman. (since 1988 Multi Zone developed by TRNASSOLAR, Germany))

- Every zone has is own user behaviour, glazing, shading (everything in schedules or free input)
- Every zone is represented in one air node that incorporates the thermal capacity of the zone.
- Energy conservation for each zone
- Radiation exchange between the surfaces
- Internal and solar gains are included indirectly – absorption at surfaces and convective heat transfer to air node.

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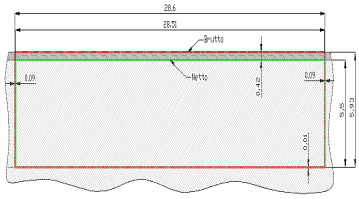
Sonnenkraft – office zone 2

Geometrical data

Location: St.Veit – Austria / office
Useful area: 157 [m²]
Net volume: 439 [m³]
External wall area: 79,5 [m²] (U=0,246 [W/m²K])
Roof: 157 [m²] (U=0,17 [W/m²K])
Window area: 31 [m²] (U= 1,45 [W/m²K], g=0,58 [-])
Orientation of the building: south
Orientation of the zone: north
Spec. Heat capacity: 20.617 [Wh/K]



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Sonnenkraft – office zone 2

Characteristics

- Occupancy: MO – FR je 12 persons during 7:00 to 17:00
- Lighting: 17 [W/m²] MO – FR 7:00 to 17:00
- Heat flow from appliances : 2760 [W] MO- FR during 7:00 to 17:00
- Air conditioning system: control of air heat recovery in dependency of indoor air temperature. Night cooling with higher air exchange rate during summer.
- Shading device with a effectiveness of 60%
- Inner glass-wall (A=80m² /U=5,4 [W/m²K]) to neighboring zone that has higher indoor air temperature than the calculated zone.

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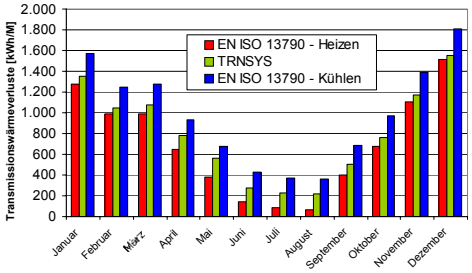
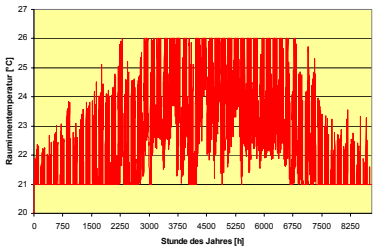
Sonnenkraft – office zone 2

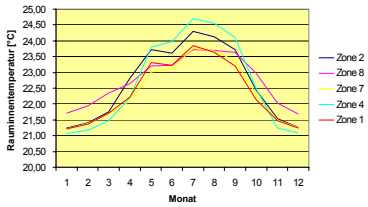
Transmission loss



Indoor air TRNSYS



Indoor air TRNSYS



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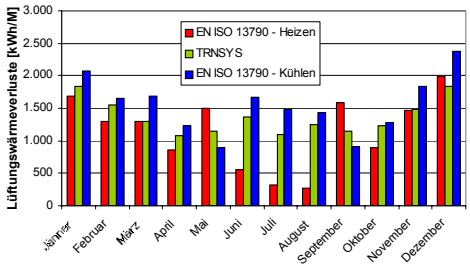
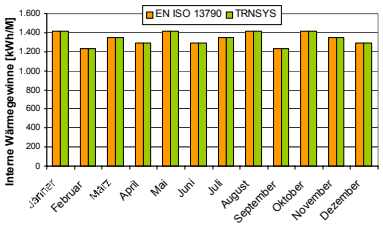
Sonnenkraft – office zone 2

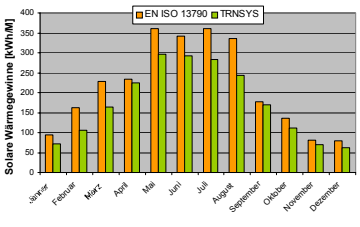
Ventilation losses (control strategy)



Internal gains



Solarl gains (shading !!)



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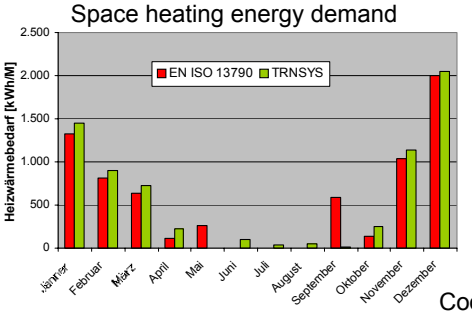
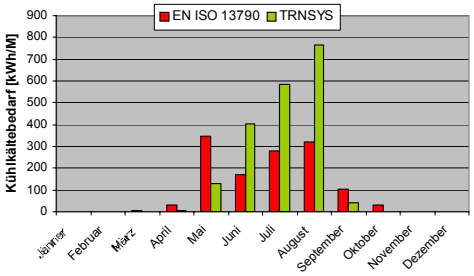
Sonnenkraft – office zone 2

Space heating energy demand



Cooling energy demand



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Oberlandesgericht Linz – office zone 6.4

Geometrical data

Location: Linz – Austria / office

Useful area: 91 [m²]

Net volume: 273 [m³]

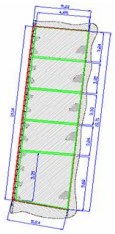
External wall area: 154 [m²] (U=0,3 [W/m²K])

Roof: 91 [m²] (U=0,3 [W/m²K])

Window area: 22,6 [m²] (U=1,4 [W/m²K], g=0,591 [-])

Orientation of the zone: south-west

Spec. Heat capacity: 14.908 [Wh/K]



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Oberlandesgericht Linz – office zone 6.4

Characteristics

- Occupancy : MO – FR je 14 Persons between 12 to 13 o´clock
- Lighting: 10 [W/m²] MO – FR 7 to 18 o'clock
- Control of lighting by shading state
- Heat flow of appliances: 1500 [W] MO- FR between 12 to 13 o´clock
- Higher air exchange rate during night in summer
- Shading : - wingwall
  - active shading between 7 to 16:30 with 55% efficiency

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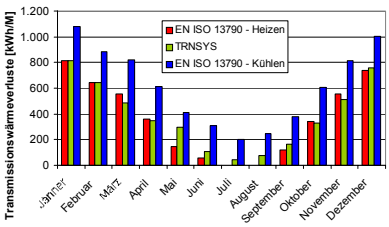
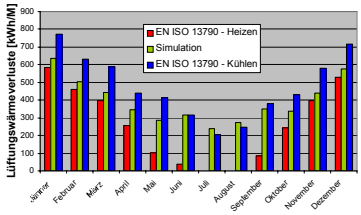
Oberlandesgericht Linz – office zone 6.4

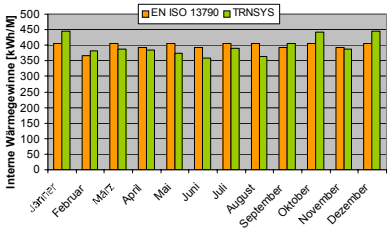
Transmission loss



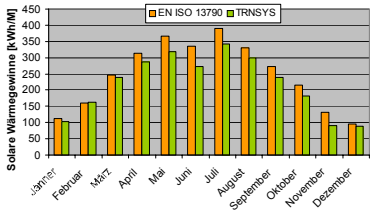
Ventilation loss



Internal gains



Solar gains



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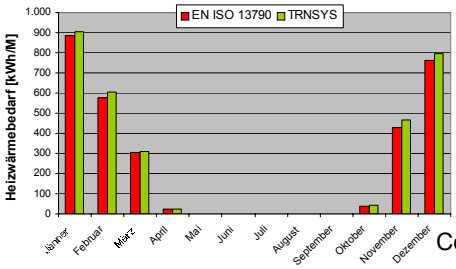
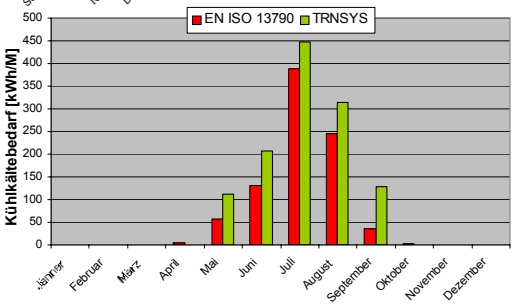
Oberlandesgericht Linz – office zone 6.4

Space heating energy demand



Cooling energy demand



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Christophorus building – office zone 15

Geometrical data

Location: Stadl-Paura / office

Useful area: 69,5 [m²]

Net volume: 194 [m³]

External wall area: 46,82 [m²]

(U=0,143 [W/m²K]

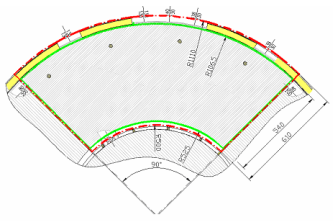
Window are: 20,84 [m²]

(U=1,4 [W/m²K], g=0,58 [-])

Orientation of the building: south - west

Orientation of the zone: north-west

Spec. Heat capacity: 9.586[Wh/K]



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Christophorus building – office zone 15

Characteristic

- Occupancy: MO – FR 4 Persons between 7:00 to 17:00
- Lighting: 17 [W/m²] MO – FR 7:00 to 17:00
- Heat from appliances: 920 [W] MO- FR between 7:00 to 17:00
- Air conditioning system: control of air heat recovery in dependency of indoor air temperature. Night cooling with higher air exchange rate during summer.
- Active Shading with 60 % efficiency

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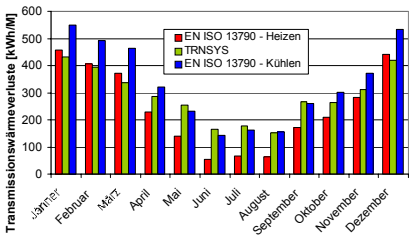
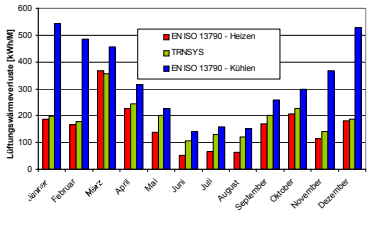
Christophorus building – office zone 15

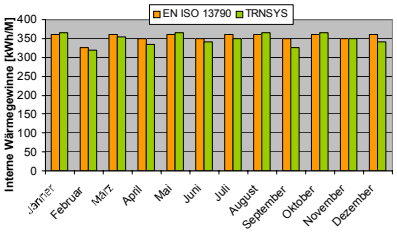
Transmission loss



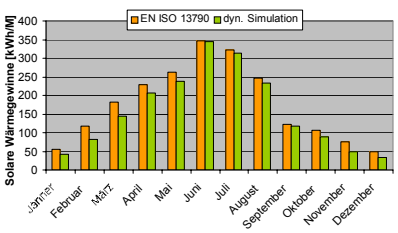
Ventilation loss



Internal gains



Solar gains



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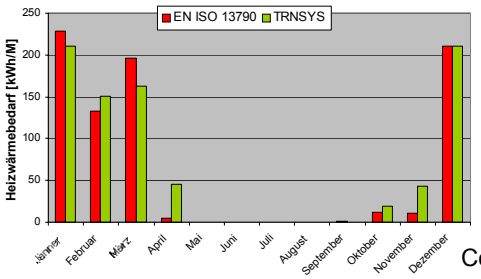
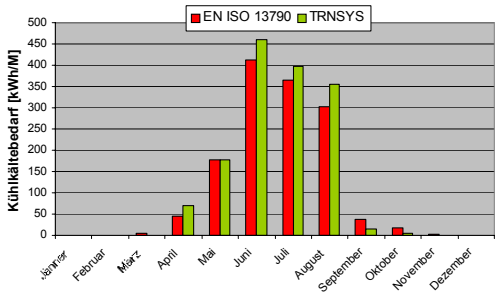
Christophorus building – office zone 15

Space heating energy demand



Cooling energy demand



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Limits of monthly calculation

- Indoor air temperature depended control of ventilation
- Control of air heat recovery by indoor air temperature
- Control of shading by solar radiation on surface
- Control of lighting by actual illumination in room
- Calculation of transmission losses between neighbouring zones with same indoor room temperatures

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Resume

- Good results of the monthly method without a control of the heat recovery, lighting or shading in dependency of indoor air temperature.
- If a control in dependency of the indoor air temperature or the actually solar gains is implemented, then a detailed dynamical simulation routine should be used
- Potential improvements still have to be developed

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