

**Hygrothermic building simulation
as an adequate tool
for energy-related optimisation of buildings (old and new)
(Status: February 2010)**

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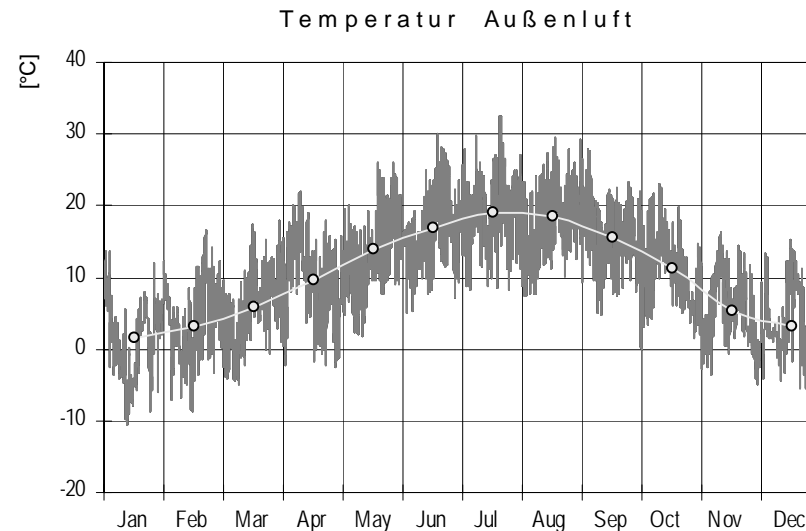
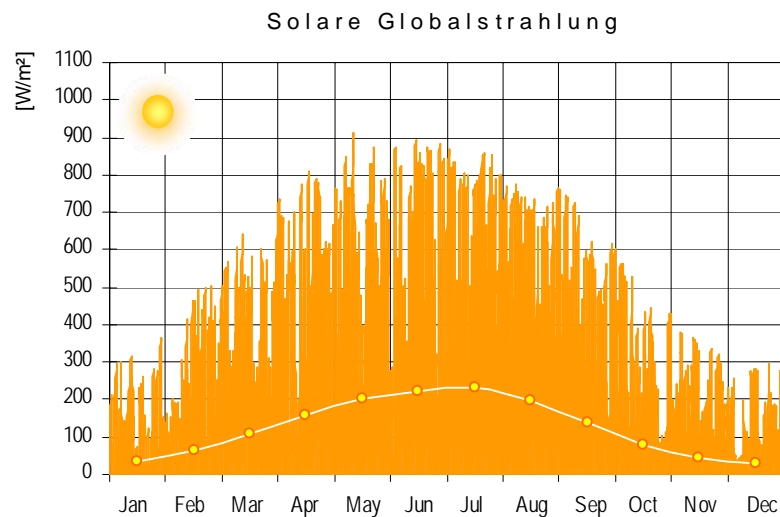
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01. Building Planning

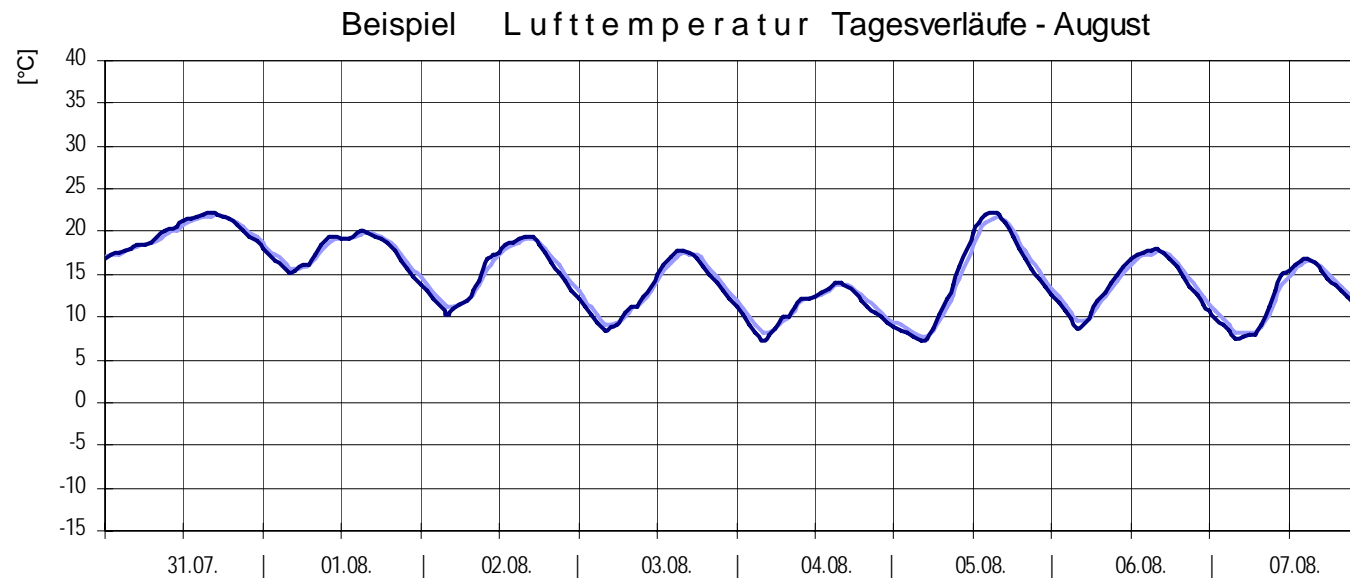
Requirements of a residential building in its actual climatic surroundings

Influences and interactions: wind, rain, temperature, humidity, radiation, sound, fire,

→ Human primary needs: secure and comfortable living



→ these processes are dynamic (transient)



Example: air temperature day variation - August

Permanently changing outside conditions need to be considered for each day and night according to

- **location (on Earth) and**
- **season (Summer/Winter)**

01.01 Requirements of a building

- **Safety**
- **Usability / use**
- **Snugness and effects on health**
- **Energy consumption**
- **Damage-free**
- **Choice of building materials**
- **Observation in its entirety**

01.01.01 Safety

- **Stability**
- **Fire safety**
- ***Sound protection***
- ***Heat protection (minimal heat protection)***

The building must be secured against all possible influences:

- **Wind (hurricane)**
- **Earthquake**
- **Snow**
- **Loads (from its own weight and use)**
- **Fire**
- **Sound**

01.01.02 Usability / Use

- **Thermo-technical efficiency**
- **Sound-proof**
- **Visual usability**

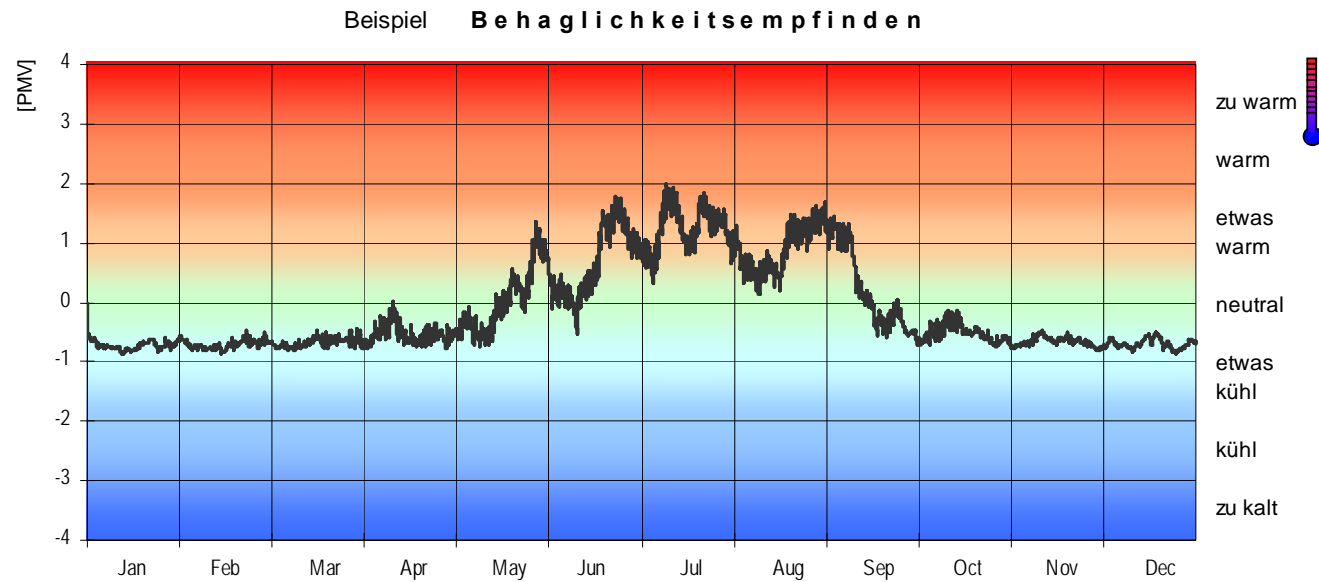
The construction of a building must correspond to its possible designated use.

01.01.03 Snuggness and effects on health (Part I/II)

- Thermal snuggness (including humidity)

Summer / Winter diagramme

(keep it cool in Summer, keep it warm in Winter)



01.01.03 Snugness and effects on health (Part II/II)

- Acoustic snugness
no annoying sound from outside or from neighbours
- Snugness in connection with ventilation
no draft, good air supply (example: air conditioning)
- Air pollution control
No indoor pollution. Attention paid to provision of fresh air and effects on humans, such as :

Physiological effects :

Effects of indoor climate on human effectiveness, flexibility and sensitivity of hands, as well as on accident rate

Biological effects :

Effects of indoor climate in connection with allergies (asthma), respiratory infections, fungi, bacteria, viruses, etc.

- Visual snugness
Sun / daylight and lighting are of utmost importance for comfort and activities

01.01.04 Energy consumption

- **Energy costs**

The better a building has been designed with regard to energy aspects, the lower its financial needs will be

- **Energy supply**

**Choice of equipment / possible use of renewable energy sources
(sustainability of energy supply)**

- **Optimisation of energy sources**

Intelligent energy management

01.01.05 Damage-free

- **no melting water on building surfaces / no melting water within the building / no cracks**

- **Avoidance of fungus for example by proper layout of the buildings design**

01.01.06 Choice of building materials

- **Pollution-free**

Non-toxic building materials / no poisonous contents / correct choice of building materials used

- **Energy efficiency**

**Production energy (primary energy) / disposal energy
(environmental protection → sustainability in connection with energy supply)**

- **Green-Building**

CO₂ emission / CO₂ assessment (environmental protection)

01.01.07 Observation as a whole

- **Production**
- **Life-span / service life**
- **deconstruction / recycling / disposal**

01.02 Results of the building planning

- **Definition of the building**
- **Determination of its construction**
- **Choice of materials**

for new buildings and redevelopment of existing buildings

in consideration of all afore-mentioned requirements

02. Computer simulations of a building

- Taken into consideration are all afore-mentioned requirements (aspects) of the buildings individual phases of life
 - construction
 - operation and
 - deconstruction
- Why do you not ask questions *before* the planning / construction phase of a building in connection with those subjects which may arise later?
- Why not consider all engineering / technical questions which are important during the actual life-span of a building?
- Simulations give precise and verifiable answers to:
 - damage-free building
 - energy consumption and snugness
 - Heat protection during the Summer and usability

02.01 Damage-free

To determine this aspect, normally only non-varying climatic conditions are assumed.

Aims: Site-specific and dynamic basic conditions need to be chosen. A hygro-dynamic simulation needs to be made in order to define in how far the construction is damage-free

02.02 Energy consumption and snugness

These aspects are determined by means of average climatic data and heating periods.

Aim: Site-specific and dynamic basic conditions and resulting actual requirement times need to be taken into consideration in order to properly depict the thermic behaviour of a building.

02.03 Heat protection during the Summer and usability

Totally insufficient because the temperatures arising in the building are not included in the calculation.

Aim: Determination of actual overheating in a particular room in order to guarantee snugness.

03. Questions in connection with simulations

03.01 Why are there generally no dynamic calculations?

- Theory is comprehensive and complicated – therefore simplified observations have made their way
- Only numerical solutions are available worldwide / the use of mathematical solutions is only limited
=> therefore only able to be used by a few experts.
- There are only few engineering companies that carry out thermic simulations
- Hygrothermic simulations are not normally carried out

03.02 Why is there no software that offers observations as a whole including the choice of optimal building materials?

- There is no integration of a data base which takes all specific aspects regarding material and environment into account
- The time has come – *and also following political requirements!* – to combine all the aspects described above

in a single computer programme

03.03 Answers from dyAna® GmbH

We have

- **an analytic solution model for hygrothermic simulations,**
- **access to the world's largest data base with ecological, medical and environmental planning data and**
- **experienced employees who will find a solution for you**
- **our partner ADIC® Eco GmbH for integrated planning**

We are first in the market with this comprehensive simulation software!

Details on the software dyAna® are available on our website www.dyana.de

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