Innovative Energy Concepts for sustainable buildings in Tropical Climates

Dr.-Ing. Robert Himmler

GIZ Workshop „Nexus Plus Energy Buildings“

18.08.2016
Sustainable buildings and neighborhoods

Theory...

- **Energy Plus Buildings**
  Energy and sustainability concept for zero and plus energy buildings

- **Master of Sustainable Design**
  Development of a new Curriculum “Master of Sustainable Design”

- **Life Cycle Costs of Buildings**
  Calculation of economic efficiency of energy saving measures

... and Practice!

- **EGS-plan Germany**
  - Established 20 years ago
  - More than 60 engineers working on zero energy and energy plus buildings

- **energydesign (Shanghai) Co., Ltd.**
  - established 10 years ago
  - 10 employees

- **EGS-plan (Bangkok) Co., Ltd.**
  - Established one year ago
  - 6 employees
Engineering Services of EGS-plan

Energy and Sustainability Concepts

Computational Building Simulation

Design Services (HVAC, Electrical)

Measurement and Verification

Sustainable Building Certification (LEED, DGNB)

Development Services and Technical Cooperation
How to achieve energy efficiency in buildings?

- **Location**
- **Building envelope**
- **Technology**

**Energy Design**
Further Energy Plus Projects of EGS-plan in Germany

HHS Architekten, Kassel
EGS-plan, Stuttgart

HHS Architekten, Kassel
EGS-plan, Stuttgart

Reference Projects in China and Vietnam

DALIAN BEST CITY PASSIVE HOUSE

Ho Chi Minh City MegaCity Project, Vietnam Research Project

Zhangjiang Science and Culture Exchange Centre, Shanghai first DGNB Project in China

office-administration-mixed use, Qingdao, app. 80,000m², construction started
The Pruksa+ Project in Bangkok

Idea:

• Design of a Pilot single family house
• Fulfil Energy Plus Standard
• Sustainable Building Certification according to DGNB

Project Partners:

• Project Owner
• General Contractor
• Architect
• DGNB certification
• Energy Design
• DGNB certification

(source: unexpected architects)

Bangkok

The plant Estique

Simulation Study about Passive Measures (early project stage)

- Base-line: 219.4 kWh/(m²a)
- Infiltration n50 = 0.6 1/h: 196.3 kWh/(m²a)
- Infiltration & Full Shading: 154.7 kWh/(m²a)
- Infiltration & Full Shading & Insulation: 121.4 kWh/(m²a)
- Infiltration & Full Shading & Windows: 140.9 kWh/(m²a)
- Infiltration & Full Shading & Shading & Windows: 96.5 kWh/(m²a)
- Photovoltaics: 86.8 kWh/(m²a)

End Energy [kWh/(m²a)]

- 56.0 % reduction
Building Physics

Roof:
Mineral Wool
(10 cm, U < 0.3 W/m²K)

Wall:
Mineral Wool
(5 cm, U < 0.6 W/m²K)

Window:
Glazing: $U_g = 1.7$ W/m²K; $g = 0.33$; $\tau = 0.66$
Frame: $U_f = 1.7$ W/m²K

External Shading
Internal Thermal Insulation – Insulated Frames

Metal Studs for internal Insulation

Insulated PVC frame (Pruksa+: double glazing)

Internal Insulation (Mineral Wool) before closing the Wall
Implementation of Air tightness on the Construction Site

Compressed Tape between Frame and Wall

Construction Tape at Suspended Ceiling (roof) and wall

Pipe through external wall

Compression Tape
Blower Door Test to check Air Tightness

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Change [1/h]</td>
<td>0.5</td>
<td>1.5</td>
<td>3.0</td>
<td>3.5</td>
<td>4.5</td>
</tr>
<tr>
<td>Air Flow [m³/h]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pressure Difference Outside - Inside [Pa]</td>
<td>0,0</td>
<td>0,5</td>
<td>1,0</td>
<td>1,5</td>
<td>2,0</td>
</tr>
<tr>
<td>Over Pressure (Pruksa+)</td>
<td>0,0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Under Pressure (Pruksa+)</td>
<td>0,0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Over Pressure (Reference House)</td>
<td>0,0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Under Pressure (Reference House)</td>
<td>0,0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Hybrid Ventilation Concept

March - November:
- Air-Con switched off
- Mechanical Ventilation
- Energy Recovery
- Filtered Air
- Sound Absorbent

December - February:
- Air-Con switched off
- Natural Window Ventilation
- No Energy Consumption for mech. Ventilation
Optimized Load Curve with Ice Storage

without ice storage...

Solar Yield

Air-Conditioning

Appliances

Electric Load [W] / PV Power [W]

Total Demand
PV Generated
Appliances / Light

Energy Supply with 5 kW PV field and 1000 l ice storage

- PV Field (5 kW)
- Public Grid
- Household appliances
  - Water cooled Cold Water Chiller
  - Fan Coils (6.8 kW)
  - Bathroom
- Dry Heat Rejection
- 1000 l Ice Storage
- Domestic Hot Water Storage
Annual Energy Balance

Annual Energy Balance

annual energy costs: 14,000 THB!
Further Sustainability Features 1

Measurement and Verification

Handicapped Accessibility

Life Cycle Assessment

Acoustic Comfort

Further Sustainability Features 2

Daylight / Visual Comfort

Thermal Comfort

Green Products

DGNB Gold Anticipated

In past: air conditioning systems, which use air for heat transfer

Problems with:
- high energy demand
- floor to floor height
- thermal comfort (draft)
- noise emission
- Investment costs for suspended Ceiling
- maintenance
- area efficiency (HVAC)
Innovative Radiative Cooling Systems

Office Concept of an innovative Office Building

- Reduce floor height, increase floor area
- Reduce HVAC spaces and shafts
- Reduced energy demand
- Better comfort
- Reduce construction and operation costs
Technical Description: Concrete Core Cooling

- Pipe material is high density, networked polyethylene (PEX)
- Projected Lifetime: 100 years
- Pipe Modules (10 – 30 m²) are placed on reinforcement and covered by concrete
- Pipe collectors are either in raised floor or from ceiling
- During concreting pipes are pressurized
- Pipe diameter: 17 – 20 mm
- Pipe distance: 15 – 30 cm
- Flow: 10 bis 15 kg/hm²

[Source: REHAU]
INFOSYS in Hyderabad / India

VAV System

Concrete Core Cooling System
Concrete Core Cooling in Hyderabad – Extreme Hot and Humid Climate! → Condensation?
Measurement Results after two years – Comparison between VAV and radiant Cooling

- 35% lower energy demand
- Better thermal comfort
It is not only about energy, but also about quality of life!

Thank you for your attention!
More Events: Innovation & Lifestyle Night (German-Thai Chamber of Commerce, 29. October 2016)

Pandora Green Industry and Lifestyle Campus, Chiang Mai (finished: 10/2016)

[source: OIA architects]
44 Srijulsup Building, Floor 12, Rama 1 Road,
Rong Muang, Pathumwan,
10330 Bangkok, Thailand

admin@egs-bkk.com
www.egs-bangkok.com