PASSIVE HOUSE DESIGN AND CONSTRUCTION

form follows climate
AS PASSIVE HOUSE PLANNERS WE HAVE TO DESIGN ROOM CLIMATE
THE SUSTAINABLE BUILDING

- Aesthetics
- Cost Effective Solutions
- Pro-Active Worldwide Advocacy
- Land Use and Urban Footprints
- Functionality
- Socio-Economic Consideration
- Use of Renewables Building Materials
- The Minimalizing of Energy Use
THE SUSTAINABLE BUILDING

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THE MINIMALIZING OF ENERGY USE

USE OF RENEWABLES BUILDING MATERIALS

FUNCTIONALITY

LAND USE AND URBAN FOOTPRINTS

COST EFFECTIVE SOLUTIONS

AESTHETICS

PRO-ACTIVE WORLDWIDE ADVOCACY

SOCIO-ECONOMIC CONSIDERATION

THE SUSTAINABLE BUILDING
WHAT DO WE WANT?

INCREASE CULTURAL LIFE
DO NOT GO SLOWER IN THE WRONG DIRECTION
HOW DO WE GET THERE?

DEVELOPING A PATTERN LANGUAGE OF SUSTAINABILITY
PASSIVE HOUSE EXPERIENCE CENTER IN QUINGDAO/ CHINA

SCULPTURE

Architects:
Ludwig Rongen, Rongen Architekten, Wassenberg/Germany
Michael Tribus, Tribus Architecture, Lana/Italy
Gernot Vallentin, ArchitekturWerkstatt Vallentin, Munich/Germany

Building Services: Werner Cieslok, INCO, Aachen/Germany

Certification Passive House:
Laszlo Lepp, Berthold Kaufmann, Passive House Institut, Darmstadt/Germany
WARM AND HUMID CLIMATE
PHTEC in Qingdao/ China

The climatic requirements are characterized by hot summers with a high moisture.
WARM AND HUMID CLIMATE: PHTEC in Qingdao/China
WARM AND HUMID CLIMATE: PHTEC in Qingdao/China
The compact building with a generous interior atrium is naturally illuminated by skylights and glazed public spaces on each floor. The balcony zone serves as shading zone. Large Sufficient thermal mass and consistent passive sun protection are combined with an effective cooling and dehumidifying technology.
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A Construction in reinforced concrete with a curtain facade is a practical and cost-effective solution to avoid thermal bridges at the surrounding balconies.
BUILDING PROCESS

- On Site Quality Control: possible correction during construction process

- Building construction supervision concerning Passive House requirements

- Workshop Building construction
WARM AND HUMID CLIMATE: PHTEC in Qingdao/China
MONTESSORI SCHOOL, AUFKIRCHEN
FRIST CERTIFIED PASSIVE HOUSE SCHOOL WORLDWIDE
COMPACTNESS AND ORIENTATION
DESIGN IDEA:
THE ROOF GOES FROM GROUND TO GROUND
The building has been optimized for compactness and zoning in order to implement the Passive House Standard as cost-effective as possible.

For this purpose, the building structure has a north-south orientation, in order to give the main rooms the majority of the solar gains — the special rooms and the administration are orientated to the north.

Development and auxiliary rooms are organized inside the building as a "supply zone".
COMPACTNESS AND ORIENTATION

House services above the siderooms/sanitary

special rooms to the north

main rooms to the south

skylight – light from above to the corridor
- Floor as an inner street with an inner facade - a small town
- Full of light - but no outside view - atmosphere of concentration
The facade is just a small part of the building envelope. Roof and base together form the majority of the building envelope.

wall: 13%, glazing 12%, base 35%, roof 38%
The construction is designed as a hybrid construction in order to create an optimum use of the advantages of solid construction (sound insulation, fire protection, storage mass) and timber construction (thermal insulation).
leading detail – base connection:

The very simple concrete construction makes the curves possible without extra investment cost.
leading detail – wall and roof:

The very simple concrete construction makes the curves possible without extra investment cost.
WOODEN ROOF ELEMENTS
assembly hall with view to multipurpose rooms and classrooms
14 YEARS EXPERIENCE OF PASSIVE HOUSE STANDARD:

After all these years and all of the comprehensive changes, the school building is still an excellent example of a Passive House. The changes were successfully managed in terms of both structure and building services. The designers, users and building management expect the concept to continue to be successful in the coming years.
LOHAS ACADEMY IN GOESAN/ COREA
BUILDING AS PART OF THE LANDSCAPE
HOT/HUMID + COLD/DRY CLIMATE

The hot and humid climate in summer and the cold and dry climate in winter are equally respected in the architecture and house technology.
Exxtension of the LOHAS Academy
By ArchitekturWerkstatt Vallentin

Existing LOHAS Academy
By Seung H-Sang
MASTERPLAN
The dehumidification is integrated into the ventilation system. Heating and hot water are provided by a thermal solar system with support of a ground water heat pump. The building requires both: cooling and dehumidification to ensure the necessary comfort during the monsoon season. All possible passive sun protection measures are taken in order to keep the primary energy value as low as possible.
The concept is paying attention to the high consumption levels for cooling and dehumidification. It integrates them into the passive house concept.
RENEWABLE MATERIALS
ECOLOGICAL SETTLEMENT - PRINZ EUGEN PARK MUNICH
DEVELOPMENT PLAN OF THE PRINZ EUGEN PARK MUNICH

How do concept tenders of urban land work?

- Land is sold only at market value (no price competition)
- To buy this land you have to fulfill several criterias (selection criterias)
- Criteria are measurable and verifiable

Selection Criterias:

- Housing criterias
- Ecological criterias
  (Materials are renewables/ use of timber construction)
- Community-promoting criterias

The Land is awarded to the offer with the best concept.
AXONOMETRIC PLAN OF THE „BAUGEMEINSCHAFT TEAM 3“
<table>
<thead>
<tr>
<th>Material</th>
<th>Thickness (mm)</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Timber Formwork</td>
<td>24</td>
<td></td>
</tr>
<tr>
<td>Battens</td>
<td>24</td>
<td></td>
</tr>
<tr>
<td>Air space + battens</td>
<td>40</td>
<td>weather-proofing membrane</td>
</tr>
<tr>
<td>Gypsum fibre boards</td>
<td>2x18</td>
<td></td>
</tr>
<tr>
<td>Mineral wool WLG 032</td>
<td>240</td>
<td>Pillars 80/240 (e=62.5)</td>
</tr>
<tr>
<td>Gypsum fibre boards</td>
<td>2x18</td>
<td></td>
</tr>
<tr>
<td>Mineral wool WLG 035</td>
<td>60</td>
<td></td>
</tr>
<tr>
<td>Gypsum board</td>
<td>15</td>
<td></td>
</tr>
</tbody>
</table>

Fire protection: 2x18 mm gypsum fibre boards

U-value: U=0.14 W/(m²K)
Atrium Houses

Atrium row
24 mm Timber Formwork
24 mm Battens
40 mm Air space + battens
weather-proofing membrane
15 mm Lower deck plate
280 mm Cellulose
Pillars 80/280 (e=62,5)
15 mm OSB
60 mm Mineral wool WLG 035
15 mm Gypsum board

d=47,3 cm mit U=0,135 W/(m²K)

NAWAROs
Yard Houses

Garden yard apartments
24 mm Timber Formwork
24 mm Battens
(40 mm Battens only South facade)
weather-proofing
membrane
15 mm Lower deck plate
360 mm Mineral wool WLG 032
  timber I-beam 60/360
  (e=62.5)
18 mm OSB
60 mm Mineral wool WLG 035
15 mm Gypsum board

d=52.6 cm with U=0.08 W/(m²K)
Attica Detail

- Cellulose insulation: 45 kg/m³
- Soft wood (fir/spurc)h: 482 kg/m³
- OSB: 619 kg/m³
- MDF: 720 kg/m³
### RENEWABLE RESOURCES CALCULATION

<table>
<thead>
<tr>
<th>Material</th>
<th>Townhouse</th>
<th>Atrium</th>
<th>Yard House</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nadelholz: Fichte/Tanne</td>
<td>290,73</td>
<td>573,99</td>
<td>91,51</td>
</tr>
<tr>
<td>Nadelholz: Kiefer/Douglasie</td>
<td>549,00</td>
<td>549,00</td>
<td>549,00</td>
</tr>
<tr>
<td>Nadelholz: Lärche</td>
<td>1,89</td>
<td>2,33</td>
<td>0,29</td>
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<tr>
<td>Laubholz: Buche/Esche/Robinie</td>
<td>728</td>
<td>0,61</td>
<td>0,85</td>
</tr>
<tr>
<td>3- und 5-Schichtholzplatten</td>
<td>472,00</td>
<td>472,00</td>
<td>472,00</td>
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<tr>
<td>Sperrholz</td>
<td>490,00</td>
<td>490,00</td>
<td>490,00</td>
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<tr>
<td>Formieschichtholz</td>
<td>465,00</td>
<td>465,00</td>
<td>465,00</td>
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<tr>
<td>OSB</td>
<td>619,00</td>
<td>19,72</td>
<td>6,78</td>
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<tr>
<td>Spanplatte</td>
<td>682,00</td>
<td>682,00</td>
<td>682,00</td>
</tr>
<tr>
<td>MDF</td>
<td>720,00</td>
<td>17,53</td>
<td>5,65</td>
</tr>
<tr>
<td>HDF</td>
<td>900,00</td>
<td>900,00</td>
<td>900,00</td>
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<tr>
<td>Holzlementplatte Duripanel</td>
<td>1350,00</td>
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<td>1350,00</td>
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<tr>
<td>Expanderter Kork</td>
<td>80,00</td>
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<td>80,00</td>
</tr>
<tr>
<td>Holzfaserdämmplatte</td>
<td>120,00</td>
<td>120,00</td>
<td>120,00</td>
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<tr>
<td>Zellulose Einblatt-Dämmstoff</td>
<td>45,00</td>
<td>198,65</td>
<td>131,22</td>
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<tr>
<td>Zellulose Faserplatten</td>
<td>80,00</td>
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<td>80,00</td>
</tr>
<tr>
<td>Hanf-Flachvlies</td>
<td>38,00</td>
<td>38,00</td>
<td>38,00</td>
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<tr>
<td>Mehrschichtparkett</td>
<td>591,00</td>
<td>591,00</td>
<td>591,00</td>
</tr>
<tr>
<td>Stabparkett</td>
<td>4,59</td>
<td>8,40</td>
<td>1,48</td>
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<tr>
<td>Korkplatten</td>
<td>450,00</td>
<td>450,00</td>
<td>450,00</td>
</tr>
<tr>
<td>Verbaute Nawaros ohne Fenster/Türen (kg)</td>
<td>143,777</td>
<td>316,809</td>
<td>59,856</td>
</tr>
<tr>
<td>Wohnfläche (m²)</td>
<td>653,68</td>
<td>1201,70</td>
<td>210,68</td>
</tr>
<tr>
<td>Nawaros</td>
<td>219,95</td>
<td>263,63</td>
<td>298,06</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>NAWAROS (kg / m² WF)</strong></td>
<td><strong>227</strong></td>
<td><strong>268</strong></td>
<td><strong>284</strong></td>
</tr>
</tbody>
</table>

**Storage volume of CO2:**

- **Townhouses:** 446 to 1497
- **Atrium:** 590 to **886**
- **Yard Houses:** 461 to **1094**

**Speichermenge CO2:**

- **271,889**
- **589,392**
- **109,758**
HIGH SCHOOL IN POLVA/ ESTONIA

CLIMATE

GERNOT VALLENTIN, DIPL. ING. ARCHITECT, CERTIFIED PASSIVE HOUSE DESIGNER, DEUTSCHER WERKBUND BAYERN
BUILDING DEVELOPMENT AND DESIGN IN DIFFERENT CLIMATES

<table>
<thead>
<tr>
<th></th>
<th>Arctic</th>
<th>Cold</th>
<th>Cool-temperatures</th>
<th>Warm-temperatures</th>
<th>Warm</th>
<th>Hot</th>
<th>Extremly hot</th>
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</thead>
<tbody>
<tr>
<td>Heat recovery</td>
<td>80%</td>
<td>80%</td>
<td>75%</td>
<td>75%</td>
<td>-</td>
<td>70%</td>
<td>70%</td>
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<tr>
<td>Humidity recovery</td>
<td>yes</td>
<td>yes</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>in humid climates</td>
<td>In humid climates</td>
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<tr>
<td>Electrical efficiency [Wh/m²]</td>
<td>0.45</td>
<td>0.45</td>
<td>0.45</td>
<td>0.45</td>
<td>0.45</td>
<td>0.45</td>
<td>0.45</td>
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<tr>
<td>Frost protection</td>
<td>Yes, not electrical</td>
<td>Yes, not electrical</td>
<td>yes</td>
<td>yes</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
The cold and dry climate requires extreme minimization of transmission losses and a clear orientation towards the south. During summer and especially in the transitional periods, passive sun protection measures are essential.
A large roof and shading balconies in combination with window blinds have been implemented.

south facade with balconies and rescue staircase
The compactness of the building has consequences for the interior of the building. All rooms are organized around the atrium with the skylight where the main staircase is located.
All structural elements of the three-story school building are built by using reinforced concrete. The outer wall is a timber-frame construction and placed in front of the concrete structure.
The idea for the school in Polva was to minimize the air change rates of the ventilation system, since transmission losses can no longer be minimized. Otherwise it would have been difficult to achieve the passive house standard.
A solar thermal system supplies about 80% of the annual heat requirement. Solar thermal energy is supported by a groundwater heat pump (heat distribution via floor heating). The concept is completed by the PV system and the Passive House ventilation system.
RESIDENTIAL PASSIVE HOUSE IN DORFEN/ GERMANY

LOW BUDGET
DESIGN IDEA: DIAGONAL ROOF RIDGE
This low budget project works with minimal architecture effort:
Diagonal lines at the walls, less windows, renewable materials
Low Budget project in Passive House standard – residential house in Dorfen

Floor area: 154 m²
Cubature: 626 m³
Heat demand (PHPP): 15 kWh/m²a
Primary energy demand (PHPP): 85 kWh/m²a
Air-tightness-test: 0.28 – h
Building expenses: 148,000 €
Parameter Building expenses/floor area: 961 €/m²
Total expenses: 221,000 €
Parameter total expenses/floor area: 1,435 €/m²
Building time: 2009
Simple materials and simple details provides the economic realization of the passive house standard (complete wooden construction).
Interior surface design is dominated by OSB floors, walls and ceiling
The use of simple materials enabled the economic realization of the passive house standard.
OFFICE BUILDING OF A WASTEWATER TREATMENT COMPANY
IN EITTING/ AIRPORT OF MUNICH - PASSIVE HOUSE PLUS
ACTIVE AND PASSIVE
CONSTRUCTION PRINCIPLE

Corbusier – Maison Domino 1914-15

Construction

Flexible interior development

Outer shell

corten steel in combination with photovoltaikpannels
Passive House Conference 2018 Vancouver/Canada Passive House – Form Follows Climate

A large skylight brings daylight into the building.

Plants help to improve the inner climate.
1. Basic case: CHP, 60 m² PV (facade), 200 m² PV (roof):

- Qh: 14 kWh/(m²a)
- PE: 84 kWh/(m²a)
- PER demand: 44 kWh/m²a
- PER generation: 60 kWh/m²a

2. Electricity, lightning, DHW optimized, 60 m² PV (facade), 650 m² PV (complete roof):

- PER demand: 30 kWh/(m²a)
- PER generation: 170 kWh/(m²a)
- PE: 56 kWh/(m²a)
The Plus standard is reached through the PV Modules on the top of the roof.

Components facade: Sunovation eForm 6.5kWp
Components roof: Polykristalline Module, Lightway, 40kWp
GERNOR VALLENTIN, DIP. ING. ARCHITECT, CERTIFIED PASSIVE HOUSE DESIGNER, DEUTSCHER WERKBUND BAYERN
INOVATIVE QUARTIERS - HOUSING FOR THE FUTURE
BUSINESS CAMPUS IN UNTERSCHLEISSHEIM/ MUNICH
SOCIAL
1. FLOOR
Thank you for your attention

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form follows climate