The building of the federal environment agency in Dessau

Example for sustainable building
Contents:

• History and sites of the federal environment agency (FEA)
• General aims for the new office building in Dessau
• Energy-related aims and solutions
• Aims concerning building materials and indoor air quality
• Operating results
History

• FEA has been established in 1974 as federal institution.

• It has to counsel the federal government and the public in all environmental aspects or questions.

• FEA has about 1,500 employees in 6 different locations (legal seat in Dessau, 3 sites in Berlin, one in Hessen, one in Saxony and seven environmental monitoring sites).
Locations of the federal environment agency

- **Main location**
  Dessau-Roßlau, Wörlitzer Platz 1

- **Further locations:**
  - Berlin-Grunewald, Bismarckplatz 1: German Emissions Trading Authority
  - Berlin-Dahlem, Corrensplatz 1: Environment and Human Health, Laboratories
  - Berlin-Marienfelde, Schichauweg 58: Water, Laboratories
  - Bad Elster, Heinrich-Heine-Str. 12: Drinking Water and Swimming Pool Water Hygiene
  - Langen, Paul-Ehrlich-Str. 29: Air quality, air monitoring

- **7 sites to measure air quality:**
  Neuglobsow, Schauinsland, Schmücke, Sylt, Waldhof, Zingst, Zugspitze
## Locations of the FEA in numbers

<table>
<thead>
<tr>
<th>Surfaces of the properties</th>
<th>Berlin, Bismarck-platz</th>
<th>Berlin, Correns-platz, Bötticher Str., Haus 23</th>
<th>Berlin, Schichauweg</th>
<th>Langen</th>
<th>Bad Elster</th>
<th>Dessau</th>
<th>Messstellen</th>
<th>Sum / average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main / usable floor area (HNF) in m²</td>
<td>12.667</td>
<td>6.730</td>
<td>6.780</td>
<td>2.512</td>
<td>4.619</td>
<td>17.674</td>
<td>1.935</td>
<td>59.647</td>
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<tr>
<td>BGF:HNF</td>
<td>1.85</td>
<td>1.72</td>
<td>1.64</td>
<td>2.22</td>
<td>2.08</td>
<td>2.28</td>
<td>1.70</td>
<td>1.95</td>
</tr>
<tr>
<td>Part of total NGF</td>
<td>21%</td>
<td>11%</td>
<td>11%</td>
<td>4%</td>
<td>8%</td>
<td>30%</td>
<td>3%</td>
<td>100%</td>
</tr>
<tr>
<td>Part of total BGF</td>
<td>20%</td>
<td>10%</td>
<td>10%</td>
<td>5%</td>
<td>8%</td>
<td>35%</td>
<td>3%</td>
<td>100%</td>
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<tr>
<td>Number of employees (05.2012)</td>
<td>261</td>
<td>109</td>
<td>84</td>
<td>41</td>
<td>69</td>
<td>927</td>
<td>20</td>
<td>1511</td>
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<tr>
<td>Date</td>
<td>Event Description</td>
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<tr>
<td>5/1992</td>
<td>Political decision to relocate the federal environment agency to Sachsen-Anhalt</td>
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<tr>
<td>5/1996</td>
<td>Changing of the Law creating the FEA</td>
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<tr>
<td>11/1997 - 5/1998</td>
<td>Competition concerning the urban design of the project; unanimous decision to realise the conception of „sauerbruch hutton architects“</td>
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<tr>
<td>6-10/2000</td>
<td>Exposition EXPO 2000</td>
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<tr>
<td>1/2001</td>
<td>Approval of the conception</td>
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<tr>
<td></td>
<td>Beginning of the preparation of the realisation of the project</td>
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<tr>
<td>4/2002</td>
<td>Laying the foundation and beginning of the works</td>
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<tr>
<td>7/2003</td>
<td>Topping out ceremony</td>
<td></td>
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<tr>
<td>5/2005</td>
<td>Completion of the building and relocation to Dessau</td>
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</tbody>
</table>
# Main numbers of the FEA‘s office building

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of employees</td>
<td>ca. 900 (actual)</td>
</tr>
<tr>
<td>Gross volume (cubature)</td>
<td>195,000 m³</td>
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<tr>
<td>Gross floor area</td>
<td>35,000 m²</td>
</tr>
<tr>
<td>Usable floor area</td>
<td>ca. 17,700 m²</td>
</tr>
<tr>
<td>Costs</td>
<td>70,0 Mio. €</td>
</tr>
</tbody>
</table>
General objectives for the FEA‘s building in Dessau

- Exemplary implementation of a sustainable, environmental sound administrative building
  - integrative planning
  - Energy
  - Air hygiene and construction materials

- Flexible office concept, standardization, transparency

- Quality assurance and monitoring

- Exemplary design with regard to accessibility to people with disabilities

- Economic viability (investment and operating costs)
Cascade of objectives to reduce the energy demand

- site selection to support sustainable urban development (centrally located, re-use of a derelict former commercial-industrial site in the inner city)
- use existing buildings as far as possible
- minimise the surface-volume ratio of the building
- provide a high level of thermal insulation
- utilise solar gains as extensively as possible
- install technical equipment and installations as energy-efficient as possible
- utilise waste or waste water heat
- cover remaining demand with renewable energy sources as far as possible
Energy-related targets

• Annual heating requirement \( \leq 30 \text{kWh/(m}^2\text{·a)} \), 50% lower than required by the Thermal Insulation Ordinance of 1995; consumption 2009: 37 kWh/(m\(^2\)\text{BGF·a)}

• Electricity requirement 20...25 kWh/(m\(^2\)\text{GFA·a)}; consumption 2009: 30 kWh/(m\(^2\)\text{BGF·a)}

• Create acceptable climate conditions mainly without mechanical cooling

• Cover basic heat and electricity requirement via the local utility

• Cover > 15% from renewable energy sources (solar-based cooling, geothermal heat exchanger, photovoltaic system)

• Technical and economic monitoring
Measures to reduce the energy demand of the building

Quality of the thermal insulation (k-value)

- Foundation / Ceiling of cellar: 0.251
- exterior wall: 0.155
- windows: 1.0
- roof: 0.123

Air ventilation with high energy efficiency (74%)

Geothermal heat exchanger (length: 5100 m; air flow rate: 76,000 m³/h; expected energy gain: ca. 200 MWh/a); real 2009: 113 MWh/a

Photovoltaic array, expected electricity supply: 25 MWh/a; real 2009: 29 MWh/a

Solar panels for the provision of cold, expected energy supply: 140 MWh/a; real 2009: 100 MWh/a
Annual primary energy demand
- Projections -

- Thermal Insulation Ordinance: 28.1 kWh/(m³·a)
- EnEV (low-energy-house standard): 17.8 kWh/(m³·a)
- FEA with EnEV-standard: 10.8 kWh/(m³·a)
- Passivhaus-standard: 6.8 kWh/(m³·a)

1) primary energy
Stand 09/2005
- Target: < 30 kWh/(m²\text{BGF} \cdot \text{a})
- Planing status: ca. 35kWh/(m²\text{BGF} \cdot \text{a})
- First estimate: ca. 38 kWh/(m²\text{BGF} \cdot \text{a})
- Main measures:
  - Optimised use of daylight
  - Use of energy-efficient lighting sources and lighting control as a function of light intensity and movement
  - Use of energy-efficient work equipment
  - Installation of an efficient mechanical cooling system low in pressure losses
  - Provision of cooling mainly via an adsorption cooling machine
Air ventilation concept

concept

Central mechanic air ventilation system with heat recovery; Pre-cooling and pre-heating by geothermal energy; heat recovery system for the data center to heat forum and atrium“

Technical data:

$q_v = 76,000 \text{ m}^3/\text{h}$

$Q_{el} = 25 \text{ kW}$

Functional diagram air ventilation (day in winter)

Source: Zibell + Willner + Partner
Use of renewable energy ressources - example: geothermal heat exchanger
Geothermal heat exchanger - construction, 2002
Reducing operating hours in order to improve efficiency

![Bar chart showing reduction in operating hours for heat and cold.](chart)

- **Heat**
  - Planung / 1.Hj. 2007: 2361 hours
  - ab Juni 2010: 1592 hours (58% reduction)

- **Cold**
  - Planung / 1.Hj. 2007: 502 hours
  - 2. Hj. 2007 / 2008: 113 hours (77% reduction)
  - ab Juni 2010: 212 hours

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Federal Environment Agency, Section Z 5 Facility Management - Wörlitzer Platz 1 - 06844 Dessau-Roßlau

26th of August, 2013
Geothermal heat exchanger: elevation of the temperature 2007 bis 2010 (final energy)
Energy gains of the geothermal heat exchanger

- Energy gain heating: 102,150 kWh
- Energy gain cooling: 43,600 kWh
Hygienic analysis of the geothermal heat exchanger (GHE)

Sampling from 26/06/2012
and analysis by FEA / II 1.3
Consumption of heat and electricity of the office building Dessau (external supply)

Adjusted by weather conditions

- **Electricity**
- **Heat**

<table>
<thead>
<tr>
<th>Year</th>
<th>Electricity</th>
<th>Heat</th>
<th>Total kWh</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>1,024,000</td>
<td>960,438</td>
<td>1,984,438</td>
</tr>
<tr>
<td>2006</td>
<td>1,840,000</td>
<td>1,420,965</td>
<td>3,260,965</td>
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<tr>
<td>2007</td>
<td>1,853,000</td>
<td>1,375,385</td>
<td>3,228,385</td>
</tr>
<tr>
<td>2008</td>
<td>1,774,000</td>
<td>1,300,252</td>
<td>3,074,252</td>
</tr>
<tr>
<td>2009</td>
<td>1,518,000</td>
<td>1,306,424</td>
<td>2,824,424</td>
</tr>
<tr>
<td>2010</td>
<td>1,321,000</td>
<td>1,274,382</td>
<td>2,595,382</td>
</tr>
<tr>
<td>2011</td>
<td>1,355,000</td>
<td>1,127,855</td>
<td>2,482,855</td>
</tr>
<tr>
<td>2012</td>
<td>1,372,000</td>
<td>1,078,910</td>
<td>2,450,910</td>
</tr>
</tbody>
</table>

*Adjusted by weather conditions (Data from IEMB); Reference period up to May 2005 interpolated.*
Demands concerning air hygiene and construction materials

- Choose a structural design, elements of the construction and construction materials in a way, that
  - the building has a long durability
  - the elements and products, especially those with a short durability can easily be dismantled
- Using building materials which
  - have no or minimal emissions
  - are non or low toxic
  - are proved and have certified attributes (Umweltzeichen „Blauer Engel“ - blue angle -, AgBB …)
- Using reusable or recyclable materials
- Using materials which are renewable
- Using materials with a high recycled content
Choice of building materials
example material for the roof parapet

Decision on the basis of life cycle analysis

- global environmental effects:
  1. minimal effects for sheet of titanium zinc
  2. tinned copper sheet
  3. sheet of stainless steel
  4. sheet of aluminium

- local environmental effects
  1. minimal effects for aluminium- and stainless steel sheet
  2. tinned copper sheet
  3. sheet of titanium zinc highest effects

➤ Choice: tinned copper sheet
Construction materials for the office building

- Using regional products
  - f.e. stones from Thuringia

- Installation of clay walls

- External wall of wooden pre-fabricated elements (larch)
  - certified wood (FSC, PESC) nearby
  - covered with an emission free couche of fire protection

- Using wiring / cables free of halogens

- Using natural caoutchouc as floor covering material
  - free of PVC
  - free of emissions or low emission

- Tinned copper sheets for roof and window parapets
Quality assurance – air hygiene and building materials

Furniture
Wood-based materials low in formaldehyde

Wall surfaces
Zero-emission silicate paint systems

Floors
Low-emission flooring and adhesives

Metal components
Low-emission paints

Surfaces of wood-based panels
Low-emission glazing systems on larch

Quelle: GfÖB
Indoor air monitoring
TVOC* in indoor air

2 mg/m³

R 0.033
R 0.109
R 1.068
R 1.238
R 2.211
R 3.015
R 3.147

0,3 mg/m³

μg/m³

27.02.05 März 19.04.05 Mai Juni Juli August 14.09.05 Oktober Novem. Dezem. Januar 24.02.06
Quality assurance – Thermal insulation
Energy certificate for public buildings under the Energy Saving Ordinance (EnEV)

Distribution of the energy demand

IEMB, 2006
Certification in „gold“ (1,3) by the German Association of sustainable building (DGNB)

Ratio of performance

86,4 %
Costs of operating the building

2005: €567,769
2006: €1,170,956
2007: €1,313,745
2008: €1,374,731
2009: €1,358,691
2010: €1,303,957
2011: €1,159,869
2012: €1,154,422

* Guarding, cleaning, maintenance, electricity, heating, water and drainage, waste
Office building Dessau division of cost types 2012

For 2012: 29.32 €/m² BGF
General contentness with the building – inquiry results

(60) Zufriedenheit mit den Gesamtbedingungen am Arbeitsplatz

summer 2008

winter 2008
General contentness with the building – inquiry results basis to optimize operation

Offices direction outside

Offices direction atrium / forum

Korrelation von Zufriedenheit mit einzelnen Parametern und Zufriedenheit mit dem Raumklima

Kunstlicht
Tageslicht ohne Verschattung
Sonnenschutz insgesamt
Temperatur
Temperaturveränderung
Luftqualität
Geräuschpegel
Aussehen des Raumes
Einrichtung
Sauberkeit
Arbeitssituation

Korrelation von Zufriedenheit mit einzelnen Parametern und Zufriedenheit mit dem Raumklima

Kunstlicht
Tageslicht ohne Verschattung
Sonnenschutz insgesamt
Temperatur
Temperaturveränderung
Luftqualität
Geräuschpegel
Aussehen des Raumes
Einrichtung
Sauberkeit
Arbeitssituation
Building and art projects

Crosswords, Michael Sellmann, Berlin

Consequences, Elisabeth Heindl, München

Folded steles, Hans-Joachim Härtel, Erfurt
Reconstruction of the office building in Berlin, Bismarckplatz, Low-energy-standard
New office building in Dessau for 102 workplaces – zero-energy-standard
Thank you for your attention!
Contact:

Gerd Schablitzki
Head of section Z 5 Facility Management
Wörlitzer Platz 1
06846 Dessau-Roßlau
Germany
tel.: +49 340 2103 - 2113
e-mail: gerd.schablitzki@uba.de
www.umweltbundesamt.de