IBO Passivhaus Bauteilkatalog – a catalogue of building elements specified for Passivhaus standard

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ABSTRACT

We present the IBO Passivhaus Bauteilkatalog, a catalogue of construction details which will be published in 2005 in German and English language. IBO, the Austrian Institute for Healthy and Ecological Building has a record in this field as author of Ökologischer Bauteilkatalog – Bewertete gängige Konstruktionen [Catalogue of ecologically assessed building elements]. Wien, New York: Springer 1999.

Contents

Collection of building elements, with several variants, specified for Passivhaus standard and low-energy building design,

- with technical description,
- physical parameters and
- ecological life cycle analysis.

Technical descriptions focus on airtight building component connections without thermal bridges, and on technical safety, amended with information on production processes, on prefabrication and on demands on building site management.

The physical discussion treats thermal-, noise-, and fire protection, diffusion of vapour and thermal storage characteristics.

Topics of the ecological analysis are ecological impact categories of building materials – Global Warming Potential (GWP 100), Acidification (AP), Primary Energy Input (non renewable) (PEI nr) – durability and maintenance needs of constructions as well as demolition, recycling and disposal.

Technical advice on avoiding hazardous influences (fibres, dusts, toxic exhalations) from building materials during construction and during use of the building is given for each building element.

Attached are cost assessments for Austria for all building elements described.

KEYWORDS

passive house standard, building elements, building element connections, physical analysis, ecological impact analysis
INTRODUCTION

Catalogues of building elements are a useful source of reference for students, planners, construction companies and their clients. They demonstrate the state of art by giving examples and they provide all critical data. What can be regarded as state of art in building construction changes these days with the development of highly energy-saving building envelopes. And what can be regarded as complete set of data to be provided to describe all relevant aspects of a building element changes as well. Data on the environmental impact of producing building material and on the impact of (separable or inseparable) connections of the components of a building element on their recycling properties become available. Ecological data emerge as a third dimension to consider – along with technical and economic data. The IBO Passivhaus catalogue of construction elements integrates expertise for building according to the Passivhaus standard – probably the most advanced building standard for energy-conscious construction – and ecological analysis and optimisation of building construction.

PASSIV HAUS STANDARD

The Passivhaus standard has been developed by Wolfgang Feist [1998] and collaborators. The standard defines an building envelope specified to provide thermal comfort with

- an annual maximum energy requirement ≤ 15 kWh/m² (residential surface area)
- an annual maximum primary energy input for all services (heating, ventilation, warm water supply, domestic electricity) of ≤ 120 kWh/m², or ≤ 40 kWh/m² if domestic electricity is not considered [Passivhaus Insititut 2004]
- a maximum heating capacity ≤10W/m².

To achieve such little energy requirements under Central European climate conditions, passive houses need a.o.

- airtight building envelopes (n50 ≤ 0,6/h)),
- controlled ventilation with efficient heat recovery (recovery rate > 75 %).
- thermal losses through the envelope ≤ 0,15 W/m².K for opaque elements, ≤ 0,7 W/m².K for window glazing, and ≤ 0,8 W/m².K for complete windows (frame and glass).
- Linear thermal bridges (outside) ≥ 0,01 W/m.K should be avoided [Feist 1998].

So far, several thousand passive houses have been built in Europe at building costs that not necessarily exceed costs of standard reference buildings by more than 5% [Kaufmann, B. et al. 2002] . A EU-funded THERMIE project, CEPHEUS, built and monitored building projects comprising 221 residential units in Austria, France, Germany, Sweden, and Switzerland [Krapmeier & Drössler 2001, www.cepheus.de]. In Austria, passive house construction has become a demand-driven market. A reference book seems helpful to guide planners and construction companies, especially those who are about to start their first passive house project.

OBJECTIVES

To create

- a reference for architects and building engineers
- information material for clients
- a reference on ecological criteria for public subsidies for housing (Wohnbauförderungen)
- Information and knowledge transfer for planners and building contractors who are on the threshold to building "ecological passive houses".

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General objectives are:

- Reducing costs für ecological building construction: Deficient information forces up prices!
- Increasing quality levels in building construction
- Dispelling misconceptions about costs, comfort and reliability.

The book is structured as shown below:

Part 1: Introduction, Methodology, Reference
Part 2: Construction elements
Part 3: Connections
Part 4: Functional units
Part 5: Building materials
Part 6: Glossary, Literature, Index
Part 7: Cost assessments

**ON: PART 2: CONSTRUCTION ELEMENTS**

![Figure 1. Typical cross sections of an external wall: organic cover coat or silicate-based plaster (1), 40 cm expanded polystyrene or cork (2), 18 cm reinforced concrete (3), 0.5 cm plaster or clay-based plaster (4).](image)

Typical cross sections are technically described with:

- a drawing (see Fig. 1),
- a table specifying the layers (see caption of Fig. 1),
- a table of physical parameters: heat transition coefficient [W/m².K], sound reduction index [dB], moisture behaviour [kg/m².a], effective storage mass [kg/m²],
- a text considering suitability criteria, giving technical advice for construction and maintenance and discussing the functionality of the layers and their proper sequence in the construction.
The ecological evaluation features primary energy input, global warming potential and acidification that has to be accounted to the production of the building element, per square meter and per layer (Fig. 2). Material choices make quite a difference here.

Another chart (Fig. 3) rates the potential of a construction at the end of its life cycle: can layers be separated, re-used, recycled or disposed? Material choices make no difference (in the case shown).

ON PART 3: CONNECTIONS

Connections of building elements in passive houses must be specified with attention on avoiding thermal bridges and on assuring an uninterrupted airtight layer. A detailed drawing (Fig. 4) is supplemented with charts about the spatial distribution of isothermic lines and temperature values along the inner surface of a corner (Fig. 5). Where necessary, also a chart on a dynamic simulation of moisture distribution within the construction will be provided.
Figure 4. Connection detail. Foundation slab without continuous footing, connected to an external wall (below ground level).

**Bauphysik / Building Physics**

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Figure 5. Spatial distribution of isothermic lines (left) and temperature values along the inner surface of the corner shown in Fig. 4 (right).
ON PART 4: FUNCTIONAL UNITIES

Functional unities are defined as "connected layers in a building element providing, together, a certain technical service".

Examples are

- composite thermal insulation systems
- insulation between lightweight construction elements
- interior plastering

Functional unities that serve the same function are being compared in the catalogue for their ecological impact of their production and for their recycling potential.

ON PART 5: BUILDING MATERIALS

Building materials are described in detail: ecological life cycle, toxicology (during production, in the construction process, during use, when deposited), supplemented with quantitative data:

- physical values: bulk density [kg/m3], thermal conductivity [W/m.K], vapour diffusion resistance [m], specific thermal capacity [kJ/kg.K],
- ecological impact per kg mass: global warming potential in (GWP100) [kg CO2 eq.], acidification AP [kg SO2 eq.], primary energy input PEI non renewable [MJ].

ON PART 7: COST ASSESSMENTS

Cost assessments are calculated according to the Austrian norm ÖNORM B 2061 for all typical cross sections and will be published separately, on the internet only.

CONCLUSIONS

Almost all common construction elements can be specified to comply with the Passivhaus standard. The environmental impact of building material production, that have to be assigned to a given building element can often be diminished considerably by choosing suitable materials. Also, whether a given construction element can be separated, its parts be used again or recycled, and whether it can be disposed without problems or with difficulties, can be influenced to a remarkable extent by material choice.

The IBO Passivhaus Bauteilkatalog can be expected to become an important reference in the years to come.

ACKNOWLEDGEMENTS


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REFERENCES


Passivhaus Institut 2004, PHPP 2004, („Passivhaus Projektierung-Paket“, a software package that supports any calculations necessary for planning a building according to the Passiv Haus standard). Passivhaus Institut, Darmstadt (www.passiv.de)

www.cepheus.at, Information website about Austrian CEPHEUS (= Cost Efficient Passive Houses as EUropean Standards) projects

www.cepheus.de, Information website about non-Austrian CEPHEUS projects (i.e. in France, Germany, Sweden, Switzerland)