

# Natural Resources and Sustainability

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## ABSTRACT

Modern construction worldwide is based on fossil resources like steel, concrete, oil and gas. In Germany the building sector consumes approx. 50% of all fossil resources used to build, maintain and operate the build environment.

Natural resources like earth and wood offer an enormous potential to reduce building services, enable low-tech buildings and to decrease the carbon footprint of the construction industry.

A new movement towards earth, wood and other natural building materials is evolving globally. In Germany a number of research projects in this field are developing inventive solutions for construction, resulting into the development of standards and a number of innovative pilot projects. Along with Austria and Switzerland, Germany plays a leading role with regard to a new natural build environment.

**Keywords:** *earth, wood and timber, low-tech, lifecycle, natural build environment*

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## 1. INTRODUCTION

Around half of the world population lives in buildings erected out of earth as earth is one of the oldest building materials of the human kind. Those constructions are most often simple, non-durable huts being located in developing countries, however, the material is also used in applications such as historic buildings around the world, whereof a number are listed as UNESCO World Heritage. Since the 1980s eco movement, earthen architecture is developing further in various countries. In Germany, the earthen construction association 'Dachverband Lehm' established in collaboration with a network of ambitious manufacturers an in-depth technical knowledge for earthen building materials. Recent DIN standards ensure nowadays a very high product quality and enable a wider application.

Timber but also the fast growing grass bamboo, have induced in forested areas a similar tradition as a building material. Especially for timber construction, several pilot projects with innovative, material optimised solutions have recently been erected in Europe, not only exceeding the limit for high-rise buildings but also offering cost and time efficient solutions through prefabrication.

## 2. LOW-TECH BUILDING SYSTEM OUT OF EARTH AND WOOD

When it comes to the internal environment, natural building materials are characterised through an outstanding humidity buffer capacity, adsorbing around three times more moisture from the air in comparison to conventional materials (e.g. gypsum plaster boards). Applied to the interior, they lead to relative stable and healthy humidity levels indoors ranging between 40% and 60%. In addition, natural building materials are not only low emitting but are able to adsorb harmful substances such as VOC's from the air. Through these specific material properties they contribute to an improved indoor environmental quality as established in H-House, a European Research Project. In combination with vapour permeable envelope construction, earth and timber materials allow modern energy efficient and highly airtight buildings to be naturally ventilated. Fitted out with energy efficient building technology and renewable energy resources these building could be build as low energy and as well as plus energy buildings.

ZRS, a Berlin based architectural and engineering practice, has successfully built and monitored a number of residential buildings in and around Berlin, following this low-tech approach. In collaboration with Prof. Hausladen the idea of vapour active, energy efficient, natural construction has been adapted to a multi storey production building for Flexim GmbH in Berlin Marzahn which is currently under construction.

Building regulation rarely assess the ecological footprint of construction. Trough the use of renewable resources in combination with a low-tech approach the impact on the build environment can significantly be reduced.

- 1 Existing situation before dismantling
  - 1.1 Foundation
  - 1.2 Historic timber structure
- 2 Re-erection at new location
  - 2.1 New foundation and floor slab (reinforced concrete)
  - 2.2 New landscape level
  - 2.3 Re-erection of historic timber structure
- 3 Integration low-energy house
 

Highly-insulated vapour permeable building shell from sustainable raw materials (timber, wood fibre insulation, earth)

  - 3.1 Doubled roof structure, U-value: 0,15 W/m<sup>2</sup>K
  - 3.2 Exterior wall, U-value: 0,13 W/m<sup>2</sup>K
  - 3.3 Wooden window triple glazing, U-value: 1,0 W/m<sup>2</sup>K
  - 3.4 Floor build-up insulated, U-value: 0,1 W/m<sup>2</sup>K
- 4 Regenerative heat generation
  - 4.1 Hot water collector
  - 4.2 Stratified storage tanks
  - 4.3 Wood boiler
  - 4.4 Surface heating for heat distribution

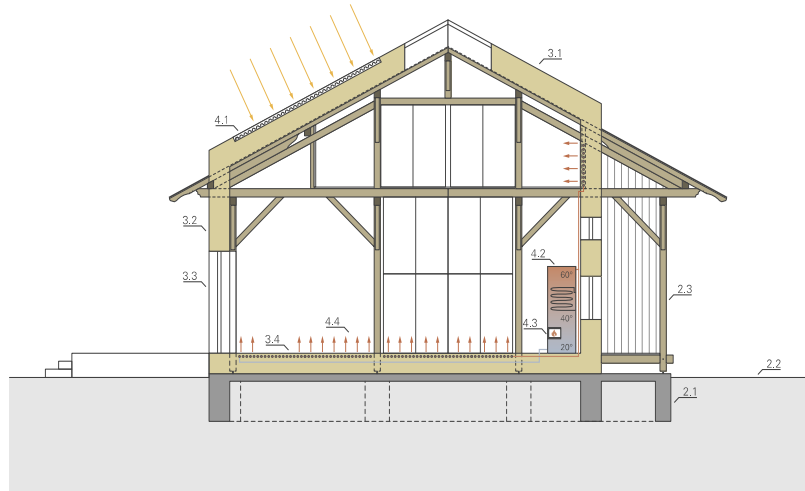


Figure 1: Natural low-tech building system, the peat barn in Schechen, Bavaria, © ZRS-Berlin.de.

### 3. CIRCULAR CONSTRUCTION WITH EARTH AND TIMBER

Using reversible joints and constructions earth, timber and other natural materials can be reused endlessly while transforming buildings over centuries. This has been a common strategy until the end of the 19th century, before the consumption-oriented period started, where fossil resources were depleted.

A historic peat barn in Schechen, Bavaria has been relocated and transformed three times since its initial construction in the year 1810. In 2006 it was dismantled in Kolbermoor 15 km away from its current location. The integration of a new workshop and two flats was done in timber, earth and natural fibres as a reversible construction, following the historic model, without compromising energy efficiency and airtightness.

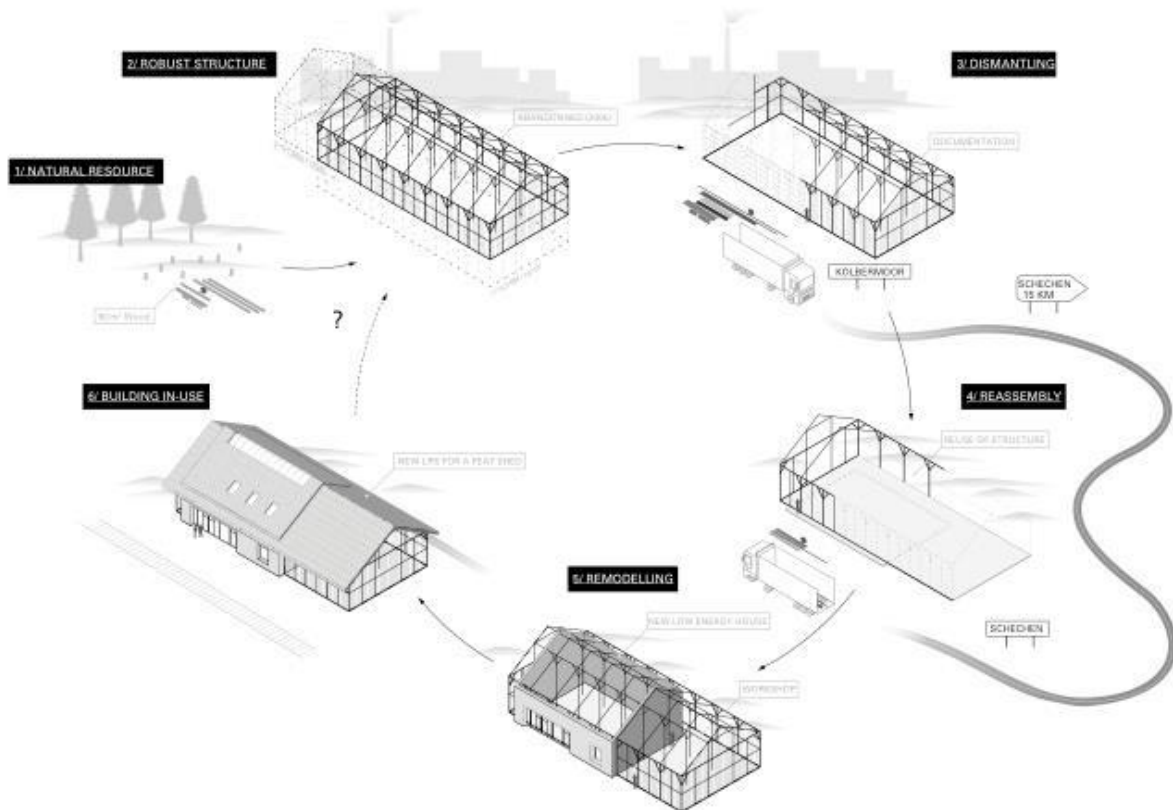


Figure 2: Life cycles of the peat barn in Schechen, Bavaria © ZRS-Berlin.de.

#### 4. FUTURE VISION – DIE NACHWACHSENDE STADT (THE NATURAL REGROWING CITY)

The Berlin based network “Die Nachwachsende Stadt” (NWS) (the natural regrowing city) is researching, designing and building resource positive projects inside the existing urban fabric. The design focuses on social aspects like participation and well being of the inhabitants, general environmental and resource aspects. The NWS is a mixed used city with short distances between working and living spaces.

Projects realised by the network like the Artis carpenter workshop showcases how a clean industry can be integrated into an inner city context. The trade building protects the adjacent residential scheme against noise emitters (noisy street and concert hall) and delivers heating energy to its neighbours. A NWS vision is a mixed-use project at Gotenstraße in Berlin-Schöneberg combining housing with a founding centre for new Berliners with a refugee background. The building is designed as a seven-storey timber structure with visual surfaces as a low-tech low energy building.

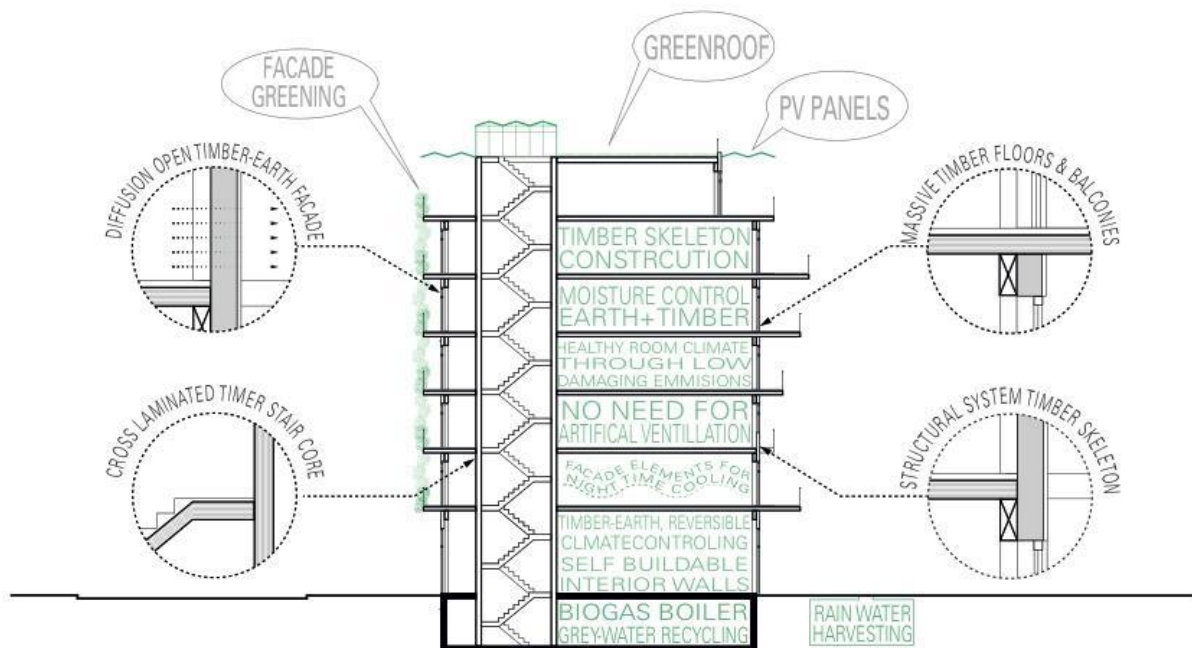


Figure 3: NWS incubator Gotenstraße, Berlin, © ZRS-Berlin.de

#### 5. CONCLUSION AND OUTLOOK

Traditional, natural building methods offer globally an enormous potential to be transformed into a resource positive architecture of the post fossil society. Research and pilot projects as well as an open-minded society are needed to start the transformation process. If high-tech-oriented countries like Germany start to use their engineering potential for a global low-tech idea a dialogue between different cultures is possible and can be the driving force of the urgently required change.

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