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LIFE Cycle Habitation - Designing Green Buildings

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Abstract

The overall goal of the EU project "LIFE Cycle Habitation" is to design and build prototypes for carbon-neutral and "LIFE cycle"-oriented buildings to make energy-efficient settlements the standard of tomorrow in line with the EU 2020 objectives. Therefore 7 residential units of different types and styles and a community centre are designed in an integral planning approach to demonstrate highly resource and energy-efficient prototype buildings in Böheimkirchen, Lower Austria.

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Keywords: Sustainable Building; Renewable Resources; Energy-efficiency; Building Simulation; Innovative Energy Concept

1. Introduction

A relatively large percentage of energy and resource consumption occurs in the building sector [1]. This concerns the production of building materials, the construction of buildings and also the energy consumption during the use phase caused by the users. Energy for space heating and increasingly for space cooling is needed especially for buildings of low energy standard. Furthermore, energy for domestic hot water and appliances (like cooking stove, washing machine, light and other electrical devices) is required. During the life cycle of buildings additional energy and resource consumption is caused by demolition and disposal of buildings or building parts at the end of their lifetime.

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With its high consumption of energy and thus mostly fossil fuels for the majority of processes, the building sector is also one of the biggest perpetrators of CO_2 emissions. In addition, it produces construction waste as a consequence of demolition or remodelling of buildings as well as at the construction site (packaging, plastic pipes, clippings of insulation materials etc.), which is difficult to recycle or dispose of. The aspects of deconstruction, recycling and disposal were particularly highlighted in Austria due to a massive increase of building waste in the last years [2]. Although, according to the "Federal Waste Management Plan 2011" by the Ministry of Life [3], the total amount of waste decreased by 500,000 t to 53,543,000 t, waste from the building sector still accounts for 12.7 % of total waste in Austria (6,870,000 t). A prognosis for 2016 foresees an increase to 7,395,000 t.

The demand for alternative solutions is also stated by a recently introduced supplementary document in addition to the waste framework directive 2008/98/EG, which supports the goal of a minimum recycling rate of 70 % of non-hazardous construction and demolition waste until 2020 [4]. This document also includes duties for the demolition of buildings approved after the 1st of January 2016 regarding the separation of materials to prepare for the re-use of high-quality recycling materials.

The overall objective of the EU project "LIFE Cycle Habitation" is therefore to demonstrate innovative building concepts that significantly reduce CO_2 emissions, mitigate climate change and contain a minimum of grey energy over their entire life cycle. The ultimate goal is to design and build prototypes for carbon-neutral and "LIFE cycle"-oriented residential buildings and make energy-efficient settlements the standard of tomorrow in line with the EU 2020 objectives. To this end, a highly resource and energy-efficient building compound is being built in Böheimkirchen, Lower Austria, consisting of 7 residential units and a community centre.

2. Method

The assessment of building components usually considers criteria such as insulation effect, absence of thermal bridges and, on the part of consumers, costs for the selection of materials. Constructions with sufficient insulation and no thermal bridges can be achieved with various materials, if building physics are considered and implementation is done carefully. Ecological assessment of different building materials, however, yields varying results. A comprehensive ecological assessment requires consideration of the whole life cycle.

The concept of Life Cycle Habitation (see Fig. 1) is therefore based on energy-efficient building solutions (passive house components, improved household appliances, thermal insulation etc.) and on the utilization of regionally available renewable resources for building materials to reach a lower energy demand in production as well as shorter transport distances. In addition to this, deconstruction is considered from the planning process on to promote recycling and composting after the use period. For further reduction of the carbon footprint it is also necessary to have an energy system using locally available renewable resources.

To reach these goals, solutions in three strands, which were developed in prior research projects, are further evolved and implemented so as to reduce CO_2 emissions and to decrease waste of resources significantly over the entire life cycle:

- Highly energy-efficient and sustainable building materials are used: straw bales are regional renewable resources with very low "grey energy"; they store CO_2 and provide high thermal insulation.
- Innovative construction types: load-bearing as well as pre-fabricated modular building elements are produced by local SMEs (Small and Medium Enterprises) that are efficiently coordinated [5].
- Energy supply: the thermal and the electrical energy demand are supplied by renewable energies with a focus on solar energy and biomass [6].

For merging these innovations into an overall concept a number of state-of-the-art tools for architecture, civil engineering and building simulation are used.