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Strategies of building stock renovation for ageing society

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ABSTRACT

The existing building stock has an immense impact on preserving a social, economic and ecologic sustainability – especially in Central Europe with low rates of new construction. This paper focuses on life-cycle based renovation strategies considering not only structural and thermal refurbishment, but also the social aspects of an ageing society needs, as well as a preservation of cultural heritage.

For a case study of a specific housing block of the Red Vienna historic period, several refurbishment variants were developed and evaluated in a quantitative as well as qualitative way for the economic (life cycle costs and yields), ecologic (CO_2 emissions) and socio-cultural impacts (monument protection, accessibility, assisted living).

According to the research, there are great potentials in structural refurbishment of the building stock for support of assisted living models. These prove to be substantially more cost efficient than the institutional care, providing a better comfort for the inhabitants, as well as the necessary social mix by a trans-generation housing in the social housing facilities.

1. Introduction

The greatest challenge to meet the Nearly Zero Energy Buildings policy aims by 2020 (EPBD, 2010) will be the refurbishment of the already existing buildings, particularly in Austrian context. The housing stock, as the largest one with most extensive percentage of buildings older than 50 years, plays thereby crucial role. With more than 220,000 housing units (Wiener Wohnen, 2013), the Viennese social housing stock is an especially large one. The assets from specific period of Red Vienna—as protected historic monument, counts 65,000 housing units (Lexikon, 2014) in 382 buildings (Lexikon, 2014a). The stock was erected in the period from 1918 to 1934, as a result of the huge housing demand and unacceptable living conditions, providing modern housing for the working class. Meanwhile those 80 years old buildings of Red Vienna are marked with an insufficient state of repair, inappropriate size and standard of the units according to modern life style. The result is an urgent need of thermal and structural refurbishment. An appropriate renovation, considering the building-hull refurbishment with the most sustainable effect over the life-cycle in terms of economy, ecology and monument conservation, has to be determined. Furthermore an ageing society with the tendency to two person-households (Statistik Austria, 2013) leads to a change in housing requirements. At the same time, an ageing society causes an increasing demand for care giving institutions. To delay the move into a home for the elderly creates a necessity for small affordable and barrier-free housing units, prolonging the stay of high-maintenance persons at their beloved home. Therefore, structural renovations in the existing housing stock are necessary. Alternatively the new construction of homes for the elderly can cover the increasing demand of care, however causing additional costs and resources consumption. Besides the large demand of refurbishment, the Viennese social housing stock has the task to supply inexpensive housing units providing affordable housing for everyone in society.

With the current new construction rate in Austria of 1% (Kletzan-Slamanig et al., 2011), the future building activities will be increasingly focussing on refurbishment or conversion of existing buildings. The implementation of energy-efficiency measurements in the existing context is a much more complex issue than the new construction – it usually occurs in the inhabited state, which poses numerous constraints to the reconstruction process and methods. This is a highly participative process where different interests of the stakeholders have to be negotiated, considering not only the holistic assessment but also the long-term impacts of the refurbishment on the life-cycle of the existing construction. However, several studies have shown that the thermal renovation of existing

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buildings did not result with the expected (calculated) reduction of consumption (Haas et al., 1998; Haas and Biermayr, 2000; Galvin, 2010). It has meanwhile been recognised that the reduction of energy consumption is strongly related to the behaviour and life style of the occupants, which are not considered in the current calculation methodologies. Korjenic and Bednar (2011), also exploring Viennese protected housing stock, show that the change in life style plays a large role in the energy consumption. Especially after modernization of the heating system, individual room stoves will be removed, and the life style will change towards higher comfort of heating the whole apartment, consequently higher energy consumption. Sunikka-Blank and Galvin (2012) go even further in their study where they identify the so called prebound effect – the calculated energy consumption of existing buildings based on energy performance rating exceeds the actually measured consumption by 30%. They imply that the potentials in energy and CO_2 savings through a change in occupant behaviour may be larger than policies foresee in the methodological practices. Despite the prescriptive-normative approach of the current policies, strict building codes and state subsidies (in Austria and Germany), the expected refurbishment rate remains rather low – 80% of the German housing stock is still lacking of the state-of-the-art technology, the general acceptance of energy-efficiency measures far from expected (Stieβ and Dunkelberg, 2013). The prescriptive approach has been criticised as hindering the actual innovation in the sector of sustainable building and refurbishment (Gann et al., 1998), requiring for a generation of more knowledge on the process, methods and tools, but also the development of new concepts and services (Häkinnen and Belloni, 2011). New knowledge and techniques for knowledge sharing and transparency on refurbishment process is necessary, in order to learn more about the needs and demands of all stakeholders (users, municipal-housing companies, planners) by creating a platform where the interests can be negotiated in various social network-forms (Gluch et al., 2013; Gluch and Räisänen, 2009). In their study of "network project" for energy efficient renovation they conclude that the use of tools such as life cycle costing (LCC) within multidisciplinary refurbishment process shows positive effects between stakeholders, facilitating knowledge sharing and creating a common data basis for discussion.

The refurbishment process for municipal housing features a high social and political impact, largely diverging the interests of stakeholders, limited financial means, and high influence of the occupants' on the life-cycle of the buildings. Public goods such as affordable housing, energy efficiency-environmental protection as well as the preservation of cultural heritage are at stake – joint efforts are necessary to share the scarce resources. This is a typical "tragedy of commons" dilemma as described by Hardin (1968), a situation where non-cooperative individuals will try to increase their benefit at the expense of the so-called "co-operators". Public goods experiments have shown in most cases that a collective benefit does not happen (Helbing et al., 2010). However Milinski et al. (2002) claim that by alternating the public goods game with indirect reciprocity (give and you shall receive) is built on the reputation and can sustain a high level of cooperation, which leads to higher profits for all players. In order to solve the "tragedy of commons" dilemma, tools for creation and mediation of new common knowledge are necessary, serving as a joint knowledge base and creating a common understanding. Therefore it is important to support the development of social networks, where social diversity provides for self-organization (Santos et al., 2008).

Using the case study of a municipal housing block, a qualitative and quantitative evaluation of ecologic and economic impacts of different refurbishment scenarios was proposed in order to achieve transparency in communication and negotiation in multidisciplinary refurbishment process. Considering the needs of ageing society, the structural reconstruction in the existing housing stock combined with the institutions for mobile nursing and assisted living was compared to the new construction of homes for the elderly. By this approach, a Tool Box for balancing and negotiation regarding the sustainability as well as affordability was developed; furthermore the importance of the building stock as a resource for the care for the elderly instead of constructing new buildings for inpatient was demonstrated.

This paper is structured as following: In the following chapter, the case study and developed strategies will be described, as well as the applied methods. In chapter three the findings of qualitative and quantitative analysis will be elaborated. In the first subsection, the results of life-cycle analysis and cultural-historical evaluation of different façade-systems variants for thermal refurbishment will be presented. In the second subsection the analysis-results of different structural refurbishment strategies, based on the best performing façade-system according to the findings from the previous subsection, will be presented. In chapter four the life cycle costs for structural refurbishment are compared the public gross expenses for various nursing services, demonstrating the value of existing stock as social capital. Finally, chapter five discusses the multiple synergies such as modernization and preservation of the building stock, conservation of resources by using the existing buildings instead of new construction, and thereby increasing the life-quality through enabling the housing in a familiar habitat in/for all life stages.

2. Case study

For the evaluation of life-cycle oriented refurbishment strategies for the existing social housing stock, a case study methodology was applied. As specific reference object the housing estate "Elderschhof" (11.414 m^2 gross floor area, 6 floors, 125 housing units) in the second Viennese district was chosen, which is owned by the state Vienna and administered by Wiener Wohnen (Fig. 1). It was erected in the years 1931–1932 and is an example of the block typology of the era of Red Vienna. Elderschhof displays all of the typical characteristics and problems of the Red Vienna building period. One of the most important issues is the limited accessibility, since the ground floor of the buildings is elevated by one stair flight. Even, the latter installation of elevators, such as in the case of Elderschhof, did not solve this problem, since the elevators – leading only to the ground floor – are not accessible from the street level. The apartments are quite small, which is also typical for this

Fig. 1. Elderschhof Housing Block, Elderschplatz 1–2, 1020 Vienna, 1931, Architect: Ludwig Davidoff.