Energy Saving, Heritage Conserving Renovation Methods in Case of Historical Building Stock

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***Abstract*—**The majority of the building stock of Budapest inner districts was built around the turn of the 19th and 20th century. Although the structural stability of the buildings is not questioned, as the load bearing structures are in sufficient state, the secondary structures are aged, resulting unsatisfactory energetic state. The renovation of these historical buildings requires special methodology and technology: their ornamented facades and custom-made fenestration cannot be insulated or exchanged with conventional solutions without damaging the heritage values. The present paper aims to introduce and systematize the possible technological solutions for heritage respecting energy retrofit in case of a historical residential building stock. Through case study, the possible energy saving potential is also calculated using multiple renovation scenarios.

***Keywords*—**Energy efficiency, heritage, historical building, renovation, technical solutions.

I. Introduction

THE buildings are responsible for more than 40% of the primary energy usage of the European Union. The energy usage of the buildings has been increasing constantly in the last 20 years [1]. Although the newly designed buildings must comply to very strict regulations concerning energy usage, the ratio of these modern structures is insignificant compared to the vast majority of ineffective buildings. As in Hungary, the exchange rate of the buildings (including demolitions and new constructions) is only 1.7% [2], the existing building stock should also be taken into account when considering energy efficiency of buildings.

Similar to other downtown areas in Europe, Budapest has an outstanding city center with historical buildings. The most characteristic building types of the inner districts were built around the turn of the 19th and 20th century [3].

Especially on the eastern side of River Danube, the so-called Pest, the significant part of the downtown building stock is in a run-down condition, causing unsatisfactory energy intake and insufficient life quality conditions for the residents. Also, as these districts are some of the most populated areas of Budapest [4], the problems affect extensive number of people.

To protect the historical values, these buildings should be sustained instead of demolition, which complicates the question of energy efficiency retrofit: the historical buildings of Budapest have distinctive, sculptural façade and other architectural elements, which cannot be modernized by using the most common insulation technologies, also the renewable energy utilization has its own boundaries in case of dense urban fabric [5].

As part of a complex study concerning the building stock of Budapest, capital city of Hungary, the authors survey the energy saving possibilities in case of historical buildings by using heritage respecting modernization technologies.

II. Previous Studies

There have been studies dealing with rehabilitation possibilities in case of the turn of the century building stock. Pattantyús [6] in his collective study introduces the characteristic structures and their renovation methods in case of tenement houses of Hungary.

Szalay et al. [7] as well as Hunyadi and Becker [8] surveyed the energetics of the historical fenestration and offered solutions for heritage protecting renovations.

Csoknyai et al. [9] in the boundaries of Tabula Epsicope project [10] created a residential building typology for the Hungarian building stock, as well as offered solutions for energy saving renovation. The National Building Energetics Strategy also introduces a typology for the building stock and declares country level aims for energy saving [11].

The authors' previous paper [5] collected and assessed the rehabilitation limitations in detail in case of this particular building type.

III. Characteristic Heritage Building Type of Budapest

A. Building Stock Typology of Hungary

There had been attempts before to survey and create a typology of the Hungarian Building Stock. The National Building Energetics Strategy [11] defines 15 different residential building types. The downtown area buildings mainly belong to the type Nr. 10 of the typology.

The statistical characteristics of the group are the following: "built before 1945, brick or stone walls, more than ten flats in an apartment house. 15.3% of the buildings are in a run-down condition, 50.1% is satisfactory. Vast majority of them is situated in urban areas, 88.3% in Budapest" [11].

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