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A Sustainable Design Strategy for the Restoration of Historical Buildings

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Abstract

The present paper firstly deals with the steel structure's contribution to existing building safety factor increase. In a second stage, the response of the structural masonry–steel system after rehabilitation of the whole building with additional steel roofs is analyzed. The building at hand was chosen as a representative sample of the architectural wealth of the plethora of the so-called neoclassical buildings available in the town of Veria. The analysis includes a description of the building's characteristics and pathologies, with an estimation of the structural performance under an optimization process when using steel structures for its enhancement. The last part of the paper concerns conclusions, recommendations and proposals for renovation, maintenance, strengthening and extension of historic buildings of this type.

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1. Introduction

Whereas it is rather easy to build new «green» or «sustainable» buildings, it is much more complex to renovate existing building stock that fulfills sustainability standards. Nevertheless, old buildings are the major consumers of energy and one of the largest sources of greenhouse gas emissions as they are replaced by new buildings only at an

extremely low rate. As the demand for green buildings grows, the market of sustainable renovation is gaining strong momentum and it is set to become one of the dominant sectors of the construction industry.

According to the report «Europe’s Buildings under the Microscope» of the Building Performance Institute Europe, there is about twenty five billion square meters of floor space in the EU, Switzerland and Norway and approximately 40 percent of the residential building stock built prior to 1960. About 68 percent of the energy consumption in Europe refers to these buildings.

Therefore, the sustainable renovation sector offers great potential for environmental protection, job creation, and healthy in-door environment and comfort for its users and therefore, in view of necessity and benefits, there is a strong need to systematically address the evolving field of sustainable renovation of the historical buildings stock.

2. Sustainable renovation and expansion of buildings

Renovation is an important economic and societal demand and an increasingly great part of the global construction industry. The use of the so-called steel-framed structure has found a niche market in this sector, particularly in strengthening and extension of buildings. Frequently, the increase of operating roofs may be necessary for its reuse giving functionality and viability, leading to a possible extension of building lifetime. All materials are measured against the standard structural steel the later being the material of most frequent choice.

This paper discusses the importance of rehabilitation taking into account all the three elements of sustainable development, economic growth, social progress and effective protection of the environment. The ways in which a steel structure design solution addresses these issues are combined not only with the construction process (namely speed, prefabrication, safety, waste minimization etc.), but also with the expansion of existing building lifetime. The selection of a steel-framed structure^{1,2,3} in order to achieve high level of sustainability for the building rehabilitation has numerous advantages being for instance, the speed of construction, construction financial cost, design flexibility, partial and total structural resistance, efficiency of the structural system and recyclability.

As is well-known, sustainability indicators for existing buildings are grouped under the three pillars of sustainable development: 1) environmental protection, 2) society and 3) safety and resistance (see Fig. 1).



Fig. 1. Sustainability indicators for the restoration of historical buildings.

The impact of these factors should be evaluated and quantified. The following sections describe in brief these sustainable indicators and how they are affected during the rehabilitation intervention in a historical building.

3. The restoration of a historical building in the town of Veria in the framework of a sustainability design

The analysis includes a description of the building characteristics and pathologies with an estimation of the structural performance under an optimization process when using steel structures for its strengthening. The building at hand was chosen as a representative sample of the architectural wealth of the so-called neoclassical buildings in the town of Veria in Northern Greece.

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