Zero Energy Light Weight Construction for Urban Densification:

A Methodology to Determine Urban Densification Potential through Roof Stacking

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Research information

Keywords
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Introduction / Context
Due the population and economic growth, globalization and European integration, land price and inner city problems, the urban sprawl phenomenon has appeared (EEA, 2006; Vasili, 2013). However, it is proved that urban sprawl has several side effects on the environment and increasing the level of CO2 emissions, which catalyzed the generation of several urban containment policies have evolved aiming to restrict urban sprawl. Cities can approach European carbon emission targets only through urban densification and by optimizing the usage of the existing cities' built environment and infrastructure. There are different methods for urban densification, such as infill development, demolition and erecting high dense buildings, or through roof stacking and increase the floors number of the existing buildings.

Question / Goal
This research aims to provide a model for decision support aid to increase density in the built environment on the different urban scales. The research objective is to develop a methodology (Figure 1) to identify primary potential for urban densification by providing more houses through roof stacking. It sets criteria (Figure 2) to measure and map that potential in terms of location and added floors, giving the guidance to urban planners and decision makers to set development programs based on quantified results and numbers.

Hypothesis / Methodology
A literature review covers the evidence behind increasing population in Europe observed in either high demand for housing in major cities or urban sprawl. Thus, roof stacking method was proposed as an approach towards compact cities and accommodating increasing population with minimum effects on the environment. Set of criteria were identified, followed by one workflow chart that illustrates the whole methodology and acts as a tool for decision making. Mapping analysis, post processing and setting visualization protocol were then defined and applied on Brussels city as a case study representing a capital city in the European context (Figure 3).

Results
According to the results, given that an area of 25 square meters is the space required to accommodate one single person, the potential to accommodate more population through roof stacking only is more than 830,000 additional inhabitants, which covers more than 400% of the need for accommodation to the expected population increase. However, a comprehensive strategy for densification should be followed to avoid the prospect increase in mobility and traffic consequences.

Conclusion
- Seven approaches present solutions for urban densification
- Roof stacking requires integrating urban, engineering and social aspects
- By stacking, 4 times the required livable spaces in Brussels is provided
- European cities have a great potential to be densified through roof stacking
- Lightweight construction techniques are vital for successful roof stacking, however its consecutive problems with acoustics and thermal mass should be taken in consideration

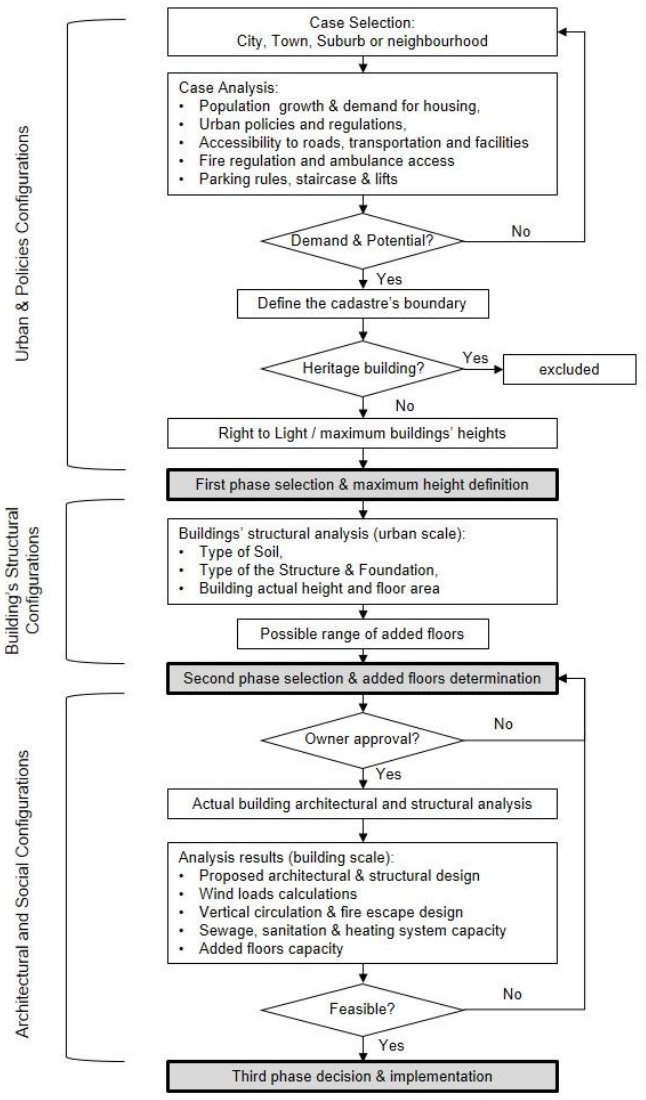

Fig. 1: Workflow Chart

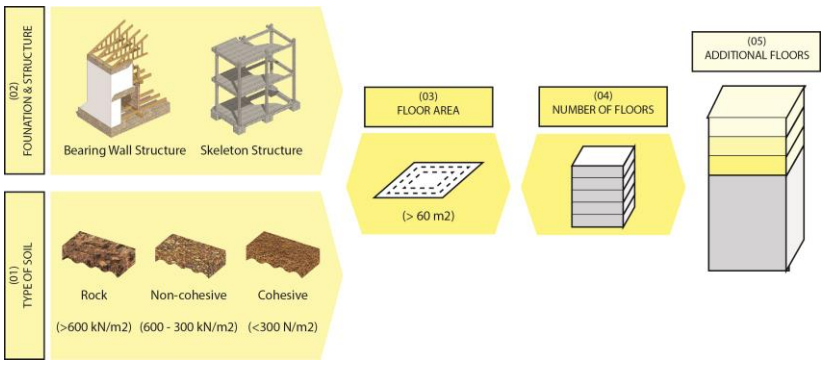

Fig. 2: Structural mapping and Screening Criteria

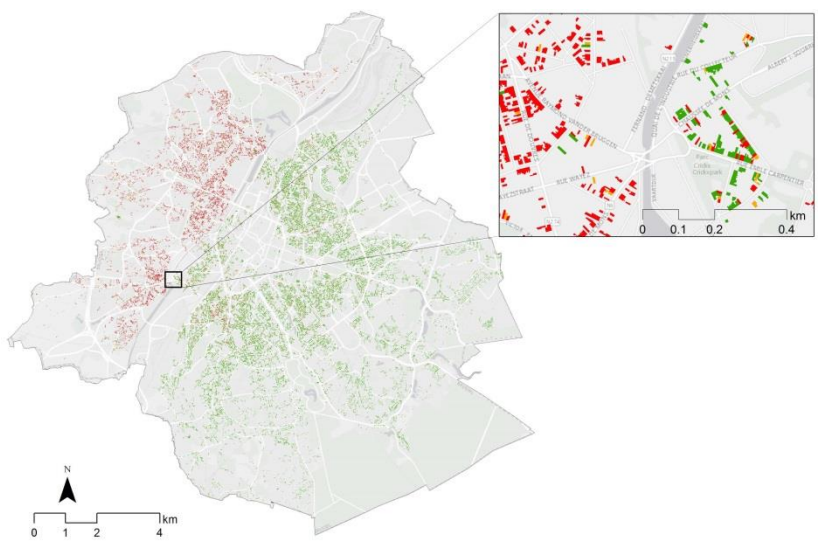

Fig. 3: Brussels Potential for Densification through roof stacking Map

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