B³-RETROTOOL:

DEVELOPMENT OF A MULTI-SCALE AND MULTI-CRITERIA PRE-ASSESSMENT TOOL FOR THE SUSTAINABLE RETROFIT OF BRUSSELS CAPITAL REGION

Trachte S.[1a], Galán González A.[2], Evrard A.[1], Athanassiadis A.[2]

1: Architecture et Climat, University of Louvain la Neuve (UCL), Belgium
2: Building, Architecture and Town Planning, University of Brussels (ULB), Belgium

Sophie Trachte, Architect, Postdoctoral Researcher UCL,
Aránzazu Galán González, Architect
Arnaud Evrard, Architect-Engineer, Postdoctoral Researcher UCL,
Aristide Athanassiadis, Architect-Engineer, urban planner, Aspirant FNRS

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ABSTRACT

This research offers a new vision of Brussels Capital Region (BCR) as an Urban Metabolism in which the building blocks are one key element to enhance heritage value, to achieve important improvements in the energy performance and to reduce environmental impact of existing residential building stock. Four scales were integrated in the study: the city, the neighbourhood, the city block and the residential buildings. This research also focused on the definition of criteria for each of these scales to identify building and built environment typologies and propose suitable urban or architectural interventions in for each typologies to preserve heritage value reduce relevant energy use and environmental impact.

The main objective of this study was to achieve a pre-assessment tool to retrofit the city, the neighbourhood, the city block and the residential buildings based on an integrated multi-criteria and multi-scale approach in order to meet the environmental, social and economic challenges of the contemporary world and thus foster the transition towards sustainable development

This research also pinpoints the importance of transforming city blocks, as a basic unit of the urban matrix. The originality of this project is thus to identify new determinants in designing modern, economic and efficient city blocks using a multi-criteria and multi-scale approach. The key is probably to consider these aspects in a non-compartmentalized, complementary way, in order to reach a global objective through a sustainable and responsible approach.

INTRODUCTION

Twenty-five years after the publication of the Brundtland Report and twenty years after the publication, in Rio de Janeiro, of the 27 principles defining the concept of sustainable development, issues of resource conservation and limiting emissions (atmospheric or others) are at the centre of many discussions, both environmental, economic or social and more specifically at the urban scale.

In fact, cities mobilize, transform and consume large amounts of natural resources (energy and non-energy resources). As they do so, they exert significant pressure on the environment (removal of energy and materials, releases to air, water and soil) and on the associated political, social and economic scales. Un-refurbished buildings represent a large proportion of the building stock and the first cause of CO2 emissions in the building sector. Residential buildings account for the 2/3 of final energy consumption in the building sector and 70% of buildings floor area.

[a] Sophie Tracte, Auteur, sophie.trachte@uclouvain.be

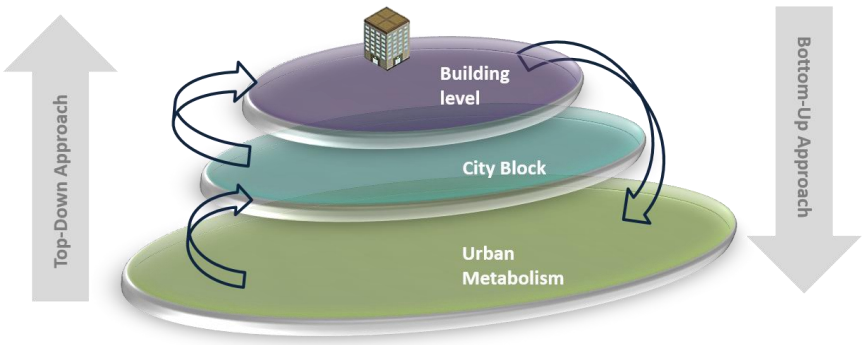
Some considerable progress have been made in the last 20 years concerning the energetic consumption of urban transportation, the energetic performance of buildings, greenhouse gas emissions, waste production and treatment. Yet, all these issues are generally analyzed in a fragmentary way and overlapping methodological tools are still underused or inexistent. Moreover, little work combines all environmental, economic and social fields to understand the functioning of the city in order to achieve sustainable and resilient urban systems.

In this context, it is urgent to seek new ways to build and renovate city's infrastructure and superstructure, including consideration of environmental objectives into strategies for sustainable buildings renovation and sustainable management of urban metabolism. However, the renovation or retrofitting of the built environment is not an easy task as it often involves taking into account the local and national heritage.

As a result of these observations, the objective of the project **B³-Retrotool** is to offer a new vision of Brussels Capital Region (BCR) as an Urban Metabolism in which the building blocks are proposed as the key to enhance heritage value, to achieve important improvements in the energy performance and to reduce environmental impact of the existing building stock.
This research attempts to initiate a sustainable transition and accelerate the renovation process by providing a decision making tool, which measures the impact of these processes.
The originality of the research is to offer a holistic and systemic approach to define suitable architectural interventions considering existing urban morphology, city blocks and buildings not only as a huge energy-consumer, but also as a resource for material and innovation. In this contribution the research methodology and the various steps to achieve the main outcome of the project will be presented.

RESEARCH METHODOLOGY

A top-down and bottom-up approach is used to link the scales inside themselves but also in between them in order to validate the hypothesis that, any improvement in whichever of the three levels is immediately perceived in the other two. The project proposal, that there could be integrated actions to be done in homogeneous building stocks to achieve more important impacts at the city scale, is hence reinforced.



Evaluation of the Brussels Urban Metabolism

This first part of the research project aimed to provide a general overview of Brussels current state of (un)sustainability from an Urban Metabolism approach. This approach considered the entire Brussels Capital Region as an urban system requiring input (resources) and producing output (waste, pollution, exports) flows. Indeed, this analysis allowed

contextualizing the importance and relevance of retrofitting the residential building sector and especially the part built before 1945.

This part of the research has included four steps: establishment of an accounting and assessment methodology suitable to Brussels context, data collection, mapping the Brussels' neighbourhood metabolism and proposition of methodological principles for sustainable retrofit.

Analysis of the city block level

The city block is not first defined as an architectural form but as a set of plots attached together that acquire meaning because of their dialectic relation with the surrounding roads grid. The urban block is formed by the complex dialogue between the distribution of properties, the constructions and different types of public space.

It is also possible to conceive the city block as a package composed by an edge and an interior: the edge is defined by a succession of buildings built in the plots aligned to the street, both continuous or not. The buildings that form this edge don't need to be homogeneous to be understood.

This second part of B³-RetroTool research project aimed to identify typology of city block and for each type to propose case studies and some methodological principles for sustainable retrofit. This part of the research has included four steps: definition of criteria for typological classification, data collection and mapping, analysis of case studies and proposition of methodological principles for sustainable retrofit.

Evaluation of the Brussels dwelling stock

The dwellings stock built before 1945 in Brussels has a great heritage value for Brussels Capital Region (BCR) and represents 60% of the built environment the latter of which is responsible for 62% of the region's energy consumption.

The goal of this part was to bring further knowledge on the specific building stock of Brussels by a bottom-up analysis based on the characterization of building typologies.

This part of the research focused only on the dwelling stock built before 1945 for three main reasons. First, this is the largest share of the Brussels dwellings stock (60%). Secondly different types of dwelling could easily be identified. Thirdly, this dwellings stock requires urgent improvements in terms of energy performance and inhabitancy. It included five steps: definition of dwelling typology, repartition and urban situation of the dwelling types, assessment of potential improvements of building stock, analysis of case studies and proposition of methodological principles for sustainable retrofit.

Pre-assessment tool

The tool developed is the synthesis of the research. The tool focuses on Brussels Capital Region through 5 scales of intervention (region, municipality, neighbourhood, city block and buildings) including and combining criteria on energy performances, environmental impacts and heritage value.

The tool provides to potential user comparative data of existing real estate elements at each scale (city, municipality, neighbourhood, city-block and building). It offers comparative values for aspects related to energy, environment and heritage and it allows making prospective of evolution according to retrofitting scenarios defined by each potential user/stakeholder.

CONCLUSION

The main outcome of the research is a pre-assessment tool supporting the retrofitting of Brussels in an integrated multi-criteria and multi-scale approach. This pre-assessment tool provides:

- A clear vision and comprehension of urban metabolism on different scales: city, municipality and neighbourhood;
- A clear identification of priority urban areas and city-blocks requiring an urgent retrofitting as well as a clear identification of different types of dwellings built before 1945 and their buildings specificities.
- Various retrofitting principles proposed for each type of dwelling and city-block and assessed through 3 axes (Energy, Environment and Heritage Value)
- Prospective scenarios, in the longer term, for each component of the Region (city, district, city-block, and building)

Although pre-assessment tool B³-RetroTool offers a great potential of use for the retrofitting sector in the Brussels Capital Region, it is still a BETA version. An additional year of work is foreseen in order to improve the usability of the software by different type of stakeholders (inhabitants, municipalities, administrations, real estate companies, architects, etc) and to increase the range of the results provided by this tool. The final version will be launched in December 2015.

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