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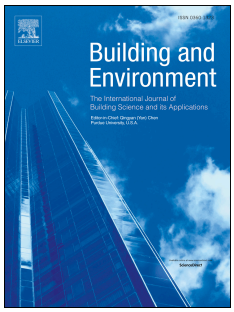

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Decision support to choose renovation actions in order to reduce house energy consumption – An applied approach

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ABSTRACT. *This paper focuses on improving the thermal performances of a set of houses built around 1970 and aims to develop a method for decision support regarding the choice of renovation solutions. The approach goes through two steps based on a multicriteria analysis. The first step allows the owner to choose a work package that meets his expectations at best. The second step is to specify the selected works by providing more detailed technical solutions, like defining the type of insulation (glass wool, sheep wool, etc.). The solution assessment on the various criteria is performed according to models, expert values or rules set by the experts involved in the project. One of the major challenges of the decision tool is to enable a merging of the project stakeholder points of view, based on a deep interaction between experts and owners. The output is not limited to the prescription of a renovation solution but enriches the house owner reflection in order to guide her/him into the whole renovation process. The article presents the approach, the method and an application to a house.*

KEY WORDS: *Decision support, Energy performance, House renovation, Multicriteria decision-making*

1 Introduction

Construction industry is a key sector for environment: in France it represents 44% of energy consumption and 21% of total CO_2 emissions (CGDD 2012). In parallel, it is responsible for about half of the extraction of primary resources, a third of the water consumption and a third of the waste of the European Union (EC 2014a). Since the annual replacement rate of the building is less than 1% (Pelletier 2008), reducing the energy consumption of the French construction sector requires the renovation of existing buildings. Several barriers were identified by an European ERABUILD project (Itard, Meijer et al. 2008) for the renovation of existing building by private owners: the lack of knowledge and information, the lack of cost effectiveness and of funding. In order to go beyond these barriers, in addition to current regulation and State proposals, local initiatives are required. Since 2006, a neighbourhood association ("Des fourmis dans le compteur", meaning 'Ants in the meter', where Ants refers to a well-known LaFontaine poem in which this animal carefully saves its resources) gathers house owners in order to share information and provide some help for the energy renovation of housing in Malartic district at Gradignan (near Bordeaux, France). The district consists of seven hundred houses that have been built at low cost in the 70s and are thermally deficient. Most of the inhabitants of these houses are also their owners. This paper focuses on improving the thermal performances of these houses by providing a framework and a method for supporting decisions regarding the choice of renovation solutions. In the following, a renovation solution is defined as a set of work actions (e.g. increasing wall insulation, changing the windows, etc.). The paper will expose the work carried out to develop a methodology for decision support. The issue is not only to propose a functional tool answering the decision problem but to propose a global decision support approach allowing the association to continue its works in autonomy. It requires to be able to identify, for a given house, the most relevant renovation solution but also to enclose the tool in a more global approach which can be continued by association co-operators without the help of experts.

The renovation project selection is a complex decision problem: there is a large number, even an infinity, of possible renovation solutions depending on how these solutions are defined, there are many possible criteria for the selection of a solution, many uncertainties and constraints, the preferences of the owner can widely vary, etc. (Nielsen, Jensen et al. 2016) identified 43 decision support tools to select renovation project in design or pre-design phase. These tools compose an interesting corpus, relevant for many renovation decision support contexts. However, only few of these tools are really usable for others case studies than those developed in the papers, because of insufficient availability of these tools or lack of updating of their databases (Nielsen, Jensen et al. 2016). Furthermore, few of these tools are adapted to the specific context of this work, i.e. the renovation of houses in France. This list of tools can be completed by different existing methods/approaches which have been proposed in the literature, as expert system (Taillandier, Aries et al. 2013), optimization (Juan, Gao et al.