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MULTI-CRITERIA DECISION-MAKING METHODS FOR PRELIMINARY DESIGN OF SUSTAINABLE FACADES

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Abstract:

The current design and construction trends towards sustainable development have led to increased attention to designing high performance building structures, emphasizing the reductions in energy consumption and CO_2 emissions. Facades have the potential to drastically affect the building energy performance and the comfort level of the occupants, therefore more attention and effort needs to be given to their design than at present. However, the involvement of various interdisciplinary professionals and the need for satisfying different design criteria makes the design process considerably complicated. This complexity is related to the required integration and provision of a balance between all necessary functions of a façade system, which can be conflicting with each other. Consequently, most designers still tend to use conventional design methods that lack consideration of all required criteria. Application of the Multi-Criteria Decision Making (MCDM) analysis is a useful tool to assist designers with this integration, since they generate the best solutions for achieving conflicting and multiple objectives. MCDM methods have been extensively used in management and optimization fields; however, their application to building technology, especially, in façade design is relatively recent. Currently, there are many MCDM methods available with their related benefits and drawbacks. Nevertheless, not all MCDM methods are appropriate in providing solutions to the façade design problem. This paper reviews and compares the most common MCDM methods for façade design. Accordingly, the most efficient methods for sustainable façade design will be introduced and used in a decision-making process to examine their efficiency in façade design.

Keywords: Multi-criteria façade design, Integrated design, Decision making, Sustainable facades

1 INTRODUCTION

With advances in technology, expectations and demands in relation to building facade performance have been increasing. The primary purpose of a building envelope is to protect the structure and its contents from exposure to the aggressive environment (excessive temperatures, precipitation, wind, humidity, solar radiation, etc.). Other considerations are aesthetics, human comfort (acoustics, indoor air quality, glare control, etc.), energy performance, environmental impacts, public safety, durability and sustainability [1]. During the past decade, designing “green” buildings, has received much attention and façades are one of the most important contributing elements in achieving the performance level attributed to green buildings. According to the Environmental Protection Agency [2], a green building is defined as “one that uses processes that are environmentally responsible and resource-efficient throughout a building’s life-cycle from siting to design, construction, operation, maintenance, renovation and demolition”.

With the increase in performance demands, the selection and design of façade components and systems get more complex. Also, combining the expertise and specifications from different disciplines to attain multiple (and sometimes conflicting) objectives must be performed at different stages in the life-cycle in consultation with all stakeholders.

Presently, façade design practices do not follow a rigorous process, and designers usually treat façades as secondary components of the building system, which are delegated to specialty subcontractors as part of the construction team [3, 4]. Unfortunately, this practice is counter-productive for achieving optimal façade performance. This is mainly due to the fact that modifications to the design are prohibitively costly if introduced at a late stage in the construction process and cannot address concerns from multiple

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