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Assessing the Resilience of LEED Certified Green Buildings

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Abstract

The Leadership in Energy & Environmental Design (LEED) green building certification program is dedicated to the design of sustainable buildings by incentivizing reductions in energy, water, and building materials consumption, while at the same time enhancing occupant health and overall community connectivity. While green buildings certified by the program do reduce the environmental footprint of buildings, they must also be designed for resilience to withstand external stressors that may arise over the buildings' lifetime for it to be truly sustainable. Therefore, a resilient building should be able to adapt and remain functional while under pressure from more frequent and severe climatic events. The goal of the study was to analyze existing inherent overlaps between resilient design principles and the LEED certification system. Synergistic opportunities together with improvements for better integrating resilient design into the LEED checklist, and hence green buildings, by modifying existing or proposing new credits were discussed. The use of climate projections instead of historical climate data during design was recommended. Regional priority credits need to be specified further to address the unique regional needs of each project to improve resilience in light of a particular region's future climate outlook.

Keywords: LEED; Green building; Resilience; Natural disaster, Regional priority

1. Introduction

Both in the United States and throughout the rest of the globe, human populations are increasing. As more people inhabit the world, more buildings are needed for homes, workplaces, and services. Especially in developed countries, current infrastructure has been designed and built using codes or design constraints that were adapted from past climate data. However, the climate of the near future is predicted to be drastically different than climate trends of a few decades ago. It is imperative that new buildings, such as those to accommodate the expanding population, are designed to withstand stresses and loads that would be imposed by the future climate, rather than designed for past conditions.

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The societal and economic impacts of a short-term approach to the problem could result in inflated problems for future generations. A real solution to the problem would be to incorporate resilience into the design and construction of buildings and infrastructure so that structures are able to withstand and recover from such events rather than fail and crumble.

The goal of the study was to assess the current emphasis the Leadership in Energy & Environmental Design (LEED) green building certification system places on building resilience, and to integrate resilience into the certification system to better reflect the needs for resilient structures due to a changing global climate. Improvements in the form of credit modification or new credits were proposed. As more buildings are designed to be resilient, the social and economic consequences of natural disasters would be dampened, and major structural catastrophes caused by severe weather could be eliminated.

An example of severe weather resulting in structural failures in the U.S. would be hurricanes. Hurricane Katrina, a category 5 hurricane, devastated the southeastern region of the U.S. in 2005. The preliminary damage report estimated structural damages within the commercial and residential sectors to total around $100 billion mainly throughout the three states that suffered the greatest damages: Louisiana, Mississippi, and Alabama [1]. Hurricane Sandy, a category 3 hurricane, struck the U.S. east coast in 2012 either damaging or destroying almost one million structures within the commercial and residential sectors [2]. By incorporating resilience within the LEED rating system, the devastating effects of these types of disasters could be lessened.

2. Background

LEED is a green building certification program developed and administered by the United States Green Building Council (USGBC). The USGBC was established in 1993 to promote sustainability in the building and construction industry [3]. The LEED certification system was initially released in March 2000 and has been updated and revised since then. The latest version of the rating system is LEED v4, which was used as a basis in this study.

The LEED rating system places strong emphasis on sustainability, defined by the United Nations as providing a decent standard of living for everyone today without compromising the needs of future generations [4]. Investigation of individual credits reveals that most are tied to either reducing resource consumption, or to promote and strengthen communities.

There are multiple rating systems under LEED, in order to provide flexibility and to cover a wide range of different projects and building types, from building design and construction, to building operations and maintenance, or neighborhood development. Each of these rating systems further breaks down into separate scorecards such as new construction, retail, hospitality, or healthcare, as the needs and design of each of these buildings would be distinctly different from each other. While there are variations in the credits and the distribution of points within each scorecard, the scorecard for new building design and construction was analyzed in this study. The maximum number of points a project can earn is 110. Points within the scorecard has been divided into the following eight categories, where each carries different number of prerequisites and potential number of credits [5;6]:

1. Location and Transportation – 16 credits
2. Sustainable Sites – 10 credits
3. Water Efficiency – 11 credits
4. Energy and Atmosphere – 33 credits
5. Materials and Resources – 13 credits
6. Indoor Environmental Quality – 16 credits
7. Innovation – 6 credits
8. Regional Priority – 4 credits

Within these categories, there are prerequisites and credits. Prerequisites are requirements that must be fulfilled for a project to be considered for LEED certification. Credits are requirements that earn a project points towards certification. Credits can be worth a single point, or multiple points depending on the importance and complexity of the credit itself. To calculate a project's score, all of the points awarded via credits are summed. This score is then compared to set ranges and awarded the appropriate certification [5]. The point ranges set for each level of certification in LEED v4 are: Certified for 40-49 points; Silver for 50-59 points; Gold for 60-79 points; Platinum for 80-110 points.

Beyond sustainability in the form of resource consumption reduction, it is also important to provide a high level of