



Technical Note

# Barriers to green buildings at two Brazilian Engineering Schools

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## Abstract

The objective of this short communication is to identify and analyze the main barriers to the adoption of green buildings at two traditional Schools/Colleges of Engineering in the state of São Paulo, Brazil. The methodological process employed is the multiple case studies used to diagnose the main barriers to installing green buildings in these two cases. The intention, of the institutions, to adopt greener buildings has been observed, considering the commitment of top management and that the institutions have put forth to accelerate this greening process. However, the barriers to adoption are evident, especially those of a technical and cultural origin. Based on these results, the study proposes possible solutions and guidelines to overcome such barriers, aimed at facilitating the adoption of green technologies in the buildings at Higher Education Institutions (HEIs)/Schools/Colleges of Engineering.

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## 1. Introduction

With the creation of government incentive programs to facilitate the purchase of the first home, mass investments in infrastructure and the development of new technologies and materials for civil construction, the expansion of the civil construction sector in Brazil is evident. The sector is responsible for significantly collaborating with the Gross Domestic Product (GDP) (Revista Exame, 2013).

Furthermore, the civil construction sector is responsible for generating a significant quantity of solid waste around

the world, such as the nearly 45% of solid waste generated in the city of Shanghai, China (Yuan et al., 2011), from extracting and moving 6 billion tons of basic materials that comprise the production of construction components (Yuan et al., 2011) and the 20–40% of energy consumption in developed countries (Chau et al., 2010). Additionally, the buildings are responsible for one-sixth of the world consumption of freshwater, one-fourth of the wood harvesting and two-fifths of the matter and energy consumer worldwide (Alshuwaikhat and Abubakar, 2008).

With the increase in environmental awareness and a focus on preserving the environment, and considering the aforementioned environmental impacts, the concept of Sustainable Development emerged and began to be disseminated about 30 years ago. It is defined as meeting the needs of current generations without compromising the capacity of future generations to meet theirs (Wilkinson et al., 2001). The successful implementation of these concepts

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necessarily requires the involvement of the civil construction sector.

Thus, the concept and practice of “green buildings” is being developed. They are called green buildings because they strive for environmentally more sustainable buildings that can be energy efficient, less pollutant and provide a healthier environment for their users (Richardson and Lynes, 2007; Hoffman and Henn, 2008). According to Marker et al. (2014), green building is a hot subject because the general public is often surprised to learn that the construction and operation of buildings require more energy than any other human activity.

The construction of greener buildings tends to provide several advantages to the costumers, including the appreciation of the property, a 50% reduction in water consumption, 30% reduction in energy consumption and 80% reduction in waste generation, besides an average appreciation of 15% in the resale price (Green Building Council Brazil, 2012).

Moving toward an ecologically sound society requires strong support from HEIs (Wang et al., 2013) and as a consequence it has been an increasing level of attention to sustainability issues in HEIs (Yuan et al., 2013); However, the green building approach is rarely adopted, especially on Higher Education Institutions (HEIs), which are frequently compared to mini-cities (Alshuwaikhat and Abubakar, 2008) and, currently expanding, which represents an unparalleled opportunity to disseminate the concept and the practice of “green buildings” and sustainability (Finlay and Massey, 2012). Research and practice of green issues in commercial buildings are commonly explored to commercial buildings and less studied in HEIs (Scheuer et al., 2003). According to Zhou et al. (2013) the adoption of green building in HEIs should be funded by governments aiming at a more sustainable society.

Barriers to the adoption of green buildings, especially by HEIs, must be identified and studied carefully, since recent literature has little material and it predominantly refers to other countries, other than Brazil, which can hamper and delay the installation of environmentally more sustainable buildings. Additionally, barriers to green buildings identified in HEIs abroad can differ from those identified at Brazilian HEIs, and the solutions, when proposed, may not be enforceable or successful as they were in the their countries of origin (Richardson and Lynes, 2007).

Taking that into account and, in face of the fact that Engineering is the area that plays a fundamental role in planning and executing projects that aim at profitability, the preservation of natural resources and support for human scientific-technological development (Zhou et al., 2013), it can be assumed that the adoption of green buildings by Colleges/Schools of Engineering is part of a very close reality. However, that does not play out. The Colleges/Schools of Engineering encounter barriers to adoption for this type of construction and this paper aims, through a literature review and case studies, at showing how these barriers behave and

which ones are being faced in this context, casting a light on possible solutions for overcoming them.

For such, this study aims to achieve the following objectives:

- Review the literature about green constructions, sustainability at HEIs and barriers to the implementation of green buildings;
- Diagnose the main barriers to the adoption of green buildings at Schools/Colleges of Engineering in Brazil;
- Compare the barriers diagnosed in the case studies with those described by the literature review.

## 2. Literature review

### 2.1. Green buildings

Green building is the foundation of sustainable construction and building development (U.S. Green Building Council, 2012). The term “green building”, or “more sustainable building”, does not have an exact definition, but, nevertheless, these terms have been used frequently (Berardi, 2013). In one of the few definitions available, the U.S. Green Building Council (Bayraktar and Arif, 2013), in its document titled “*Building Momentum*”, defines a green building as one designed, constructed and operated to drive the development of the environment, health, economy and productivity about conventional constructions (Instituto para o Desenvolvimento da Habitação Ecológica, 2012). There is also the definition disseminated by IDHEA as being construction developed based on environmentally more sustainable planning, that is, that makes good and efficient use of natural resources, management and savings of water, waste management and that is energy efficient, has thermal acoustic comfort and rationally uses the materials available, opting, if possible, for sustainable products and technologies (Lee and Burnett, 2008).

This type of building has been crucial for developing environmental sustainability, being responsible for mass investments in new sources of renewable energies, which aim at promoting the migration to technologies for renewable energies, such as solar cells, used for civil construction; and it is also causing a significant change in the concepts of design projects, purchasing and management, aimed at reducing the impact on the environment caused by building construction (Chau et al., 2010).

Green buildings also motivated the creation of several certification systems, such as LEED (Leadership in Energy and Environmental Design), one of the most famous evaluation protocols and environmental certifications in the world, HK-BEAM (Hong Kong Building Environmental Assessment Method) and BREEAM (Building Research Establishment Environmental Assessment Method) (Paumgarten, 2003).

Especially LEED evaluates the building’s performance according to variables like sustainable location, efficient

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