



## Going green in architectural education: An urban living lab experiment for a graduation green design studio in Saint Catherine, Egypt



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### ABSTRACT

Given the current energy crises, recent efforts have been directed at bringing energy efficiency and environmental awareness across the board into architectural education in Egypt. Although interest in sustainable design teaching and learning started more than 20 years ago at both post graduate and undergraduate level in Egypt, ecological illiteracy persists in architecture education. There is a large gap between what our schools of architecture offer, what the regulations currently specify, and what the market demands. This paper investigates the role of the graduation design studio in rooting an understanding of sustainability in architectural higher education, taking an experimental design studio case as an example. During this studio, the students developed a range of skills and techniques that were of value to their graduation projects and which will stand by them later as architects in the future. Students were able to experience climatic conditions and building technology in a specific context and associated with specific local vernacular architecture. Such experience was used to develop new adaptive and responsive climatic architecture approaches by means of physical hands on test cell models in a living lab environment. The design studio focuses on passive solar approaches suitable for a hot arid climate. The paper aims to show how this design studio could be a pilot model for green architectural education in Egypt.

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### 1. Introduction

With the ever-growing global interest in the use of energy and concern for resources, sustainable design and green building technology have become fundamental to the education of architectural students (Lee and Huang, 2011). Architectural educators are still struggling to prepare students to meet the current toll of mounting ecological challenges despite all the advances in design education (Guzowski, 2010). Some instructors have been fully aware of the importance of introducing climate-responsive design curricula to prepare their students for future climate challenges at both the urban and the architecture levels (Lenzholzer and Brown, 2013). Different researchers in the field suggest establishing new courses focusing on sustainable development and its formal impact upon the students, professors and professionals, as well as its informal impact onto society and culture (Al-Hagla, 2012). Yet the concept of connecting the social aspects of architecture with environmental priorities is not new in sustainable architecture and construction education but has been developed through interdisciplinary

courses and engagement with indigenous and local communities (Riley et al., 2006).

There are several theoretical and practical courses touching on sustainability issues (Taleghani et al., 2010); however, few new, green design studio practices are emerging, such as carbon neutral design, a concept which is yet to be fully defined and articulated for education (La Roche, 2012). When academics do address learning from vernacular architecture, it is usually to discuss its historic significance, aesthetics and documentation; they rarely show the connection to green and sustainable lessons (Heal et al., 2006). Some special courses at graduate and undergraduate levels do exist on vernacular architecture and sustainability but they are limited; examples include the masters courses at the Oxford Brookes (UK) and Florida Universities (US). Global projects have been established to help bridge the gap between sustainability and green architectural approaches in education. AHINI (Riley et al., 2006), EDUCATE (Altomonte et al., 2014) and EduCamp (Sewilam et al., 2015) are three examples of projects that target sustainable development and education.

As a way of introducing green design into architectural education, some studies have also been carried out on the construction of green buildings (Taleghani et al., 2011). One approach was to

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promote using green buildings as teaching tools for sustainability (Cole, 2014), which puts into practice the hypothesis that by building green, a cost effective, healthy and pleasing environment serves as a learning example and simultaneously sustains an indirect impact on the space users (Hoffman, 2009). Other research has followed the same concept by looking at combining pedagogical models with potential design criteria of architectural space (Vargas, 2016). Game based learning as a tool to improve green building education has been another approach (Juan and Chao, 2015) and some studies have focused on connecting building energy modelling for teaching energy efficient buildings through a class game exercise, with the aim of reducing the gap between education and practice (Reinhart et al., 2012).

On the local level, very few serious attempts have been found that call for the development of architecture teaching trends in Egypt (Gaber and Al-Ibrashy, 2010). There is still a gap between what is taught at architecture school and the current demand for green building in the local market (Dabaieh and Nour, 2013; Samir ElSawy and Safey ElDeen, 2014). Some educators, such as Salama, propose a revolution in the concepts and learning techniques used in architecture education, and he offers alternative methods in teaching (Salama, 2010, 2015). From here came the idea of this study to document and analyse a new approach for a graduation design studio in Egypt. Driven by the emerging need for green design education and practice, a group of design course educators decided to design a graduation project as a practical living lab. This graduation design studio adopted a dovetailing methodology that combines theoretical and practical tutoring, and coaches students how to apply green energy efficient technical solutions. The purpose of this design studio was to encourage graduates to make careers based on sustainable green design. The main objective of the studio was also to teach students sustainable green methods of design and construction in an especially harsh desert climate characterised by a distinctive vernacular nomadic culture and topographic context.

This paper discusses a relatively new experience in teaching and learning green architecture trends in a living urban lab environment. Motivated by the aim of nurturing a group of green architects capable of working towards a better future for the Egyptian building and construction market, a group of 22 graduate students was chosen to become key players in a design studio experiment that lasted for six months (from February to June 2008). The study will follow a descriptive and analytical approach using mixed qualitative and quantitative surveying. It will record the different studio pedagogical phases, from studies on the urban level to the production of detailed environmental interior solutions. It will discuss the different methodological phases applied when focus was on the urban living lab experimentation. As an outcome of the study, two sample projects are analysed as an example of the depth to which the students went in dealing with sustainable issues in their design projects.

The aim of discussing this design studio experiment is to show how it is capable of being a pilot model for sustainable architectural and urban design education in Egypt and beyond. It is also an experiment to fill in the knowledge gap in documenting design studio experience at architecture schools in general. It has revealed the challenge to find similar hands on green studio design oriented towards sustainable and environmental building practice.

## 2. Location, local architectural and climate in the case study

The town of Saint Catherine in Egypt's Sinai Peninsula was chosen as the location for this graduation project. The town is located at an elevation of about 1600 m above sea level and is a UNESCO World Heritage area. The local population is drawn from several

nomadic Bedouin tribes and their tent structure until recently is the most common vernacular dwelling type (Kamil, 1991). Over the years and due to changes in social activity in Saint Catherine, the local inhabitants began to abandon their mobile tent structures and establish themselves in non-mobile settlements (Dabaieh, 2013). Initially, the new dwellings used mainly stone together with palm or acacia tree wood as these are the main available local materials. More recently locals have begun constructing inefficient concrete skeleton houses with 23 cm brick walls and 10–15 cm thick reinforced concrete roofs (Ibrahim, 2010).

In terms of climatic characteristics, Saint Catherine is located in a semi-arid climatic zone. The fluctuations of temperature between day and night, both summer and winter, represent a challenge: hence, the environment presents an extreme case of how to achieve thermal comfort. It needs intelligent design to achieve indoor thermal comfort during both the hot summer days and the cold winter nights (Dabaieh and Elbably, 2015). Throughout the year the weather conditions in Saint Catherine are mostly extreme: for 90% of the time, the temperature falls below the body's level of thermal comfort. For 70% of the year, the weather is extreme cold and dry; while 20% lies within the hot range. In summer, the midday temperature can exceed 45 °C. In winter, temperatures can fall to around 0 °C at night; frost at night in winter is common (EMA, 2013).

## 3. Methodology

The methodology uses an explanatory analytical and descriptive approach to delineate the different phases of the research. A preparatory stage of literature search looked for documentation of similar design studio experience locally and internationally. The idea was to ascertain where we stand in Egypt compared to other examples that have been developed to teach in green architecture education.

### 3.1. Descriptive analysis for the design studio pedagogical process

The studio was divided into three main stages. The first stage was three weeks of intensive research and development supported by theoretical lectures and sessions. Several guest lecturers – a mix of practitioners and academics – were invited to share their knowledge and experience in the field. The aim of such sessions was to introduce the concepts of sustainable design and environmental solutions, together with techniques of how to study the local climate, culture, building materials, techniques and other related aspects. Students were also guided to read and search for information related to the theoretical lectures. The second stage was a three week urban living lab workshop on the project site, where students conducted a series of site survey activities, hands on building practice for test cells and monitoring. This was followed by the third and final stage, which was working at the studio on the choices for individual design projects that would suit the needs in the real project site. In this phase students developed their design proposal and presented their final outcome in the form of 2D drawings and physical 3D models using one-to-one follow up tutoring. The studio process is shown in Fig. 1.

In preparation for the project, the tutors and teaching assistants visited the graduation project site. They met representatives from the local communities and the leaders from the Bedouin tribes, and cooperated with the local NGOs (Non-Governmental Organisations) working on projects that support vernacular and traditional building techniques and traditional crafts in Saint Catherine. This phase was also intended as part of the preparation for the location of the test cell sites. It included decisions over what natural materials to use and the recruitment of local workers to assist in the

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