



جامعة الإسكندرية  
ALEXANDRIA  
UNIVERSITY



---

Faculty of Engineering  
Department of Architectural Engineering

**A PROPOSED FRAMEWORK TO DESIGNING HIGH  
EFFICIENCY BUILDINGS IN LIMITED  
RESOURCES ENVIRONMENT**

**AL FARAFRA CASE STUDY**

**A thesis submitted in partial fulfillment of the requirements for  
the degree of Doctor of Philosophy**

**In**

**Architectural Engineering**

**Presented by**

**Nourhane Mohamed Ali Hassan El Haridi**

**B.Sc. Architectural Department, Faculty of Engineering,  
University of Alexandria, Egypt, 2005**

**M.Sc. Architectural Department, Faculty of Engineering, University of  
Alexandria, Egypt, 2014**

**2018**

## ABSTRACT

Desert vernacular architecture has always been the nucleus of green architecture and sustainable buildings. But nowadays, Energy as an important element of green buildings describes an integrated approach to the design process and new construction in hot climates. Green architecture is not considering as just building science, but the location and other environmental impact factors represent an importance in green desert architecture.

The concepts of green, ecological, sustainable, vernacular architecture and new hot arid desert design guidelines are discussed in this context. The first part lists a general conceptual background and a literature review on the international experiences, green development in the hot deserts and the main theories of the passive and active constructions in the hot arid climates, especially a detailed focus on the architecture of the western desert of Egypt as an example for the hot desert. The next part, an analytical review discusses the different international rating systems and the comparative analysis that approved a necessity of extracting New Self-Sufficient Benchmarks in the hot arid desert (NSSGB) in order to improve building energy performance through simulation that play a significant role as a tool of the establishment of green buildings in limited resources environment as improved through the novel framework and the new steps of modelling simulation in hot arid deserts. The third part is a practical case study at AL Farafra oasis as application for the new framework to approve mainly the ability of this novel framework to achieve a high energy consumption and designing high efficient green buildings in hot deserts through the simulation of the six selected and studied design guidelines phases forming a new framework in hot desert by testing the different steps of simulation in the hot desert at Al Farafra in the western desert of Egypt such as the orientation, the building configuration and site, the building skin and envelope , passive treatments , active systems and the ventilation appliances in order to achieve an accepted new hot arid criteria and new design steps of guidelines in hot arid zones .Consequently, the new framework approve some main categories of the New Self-Sufficient Green Benchmarks (NSSGB) using modelling simulation as a tool for designing high efficiency green buildings in hot desert.

Finally the new framework adopted in this research has achieved and approved a high green buildings performance with a high energy and water efficiency, as results, therefore this new framework has accomplished the ability of applying the new adopted green criteria for hot deserts in this research. By consequence, designing green buildings in limited resources environment were based on the achievement of high energy consumption and thermal comfort requirements.

**Key words:** Hot climates, passive architecture, active systems, energy efficiency, modelling simulation, green architecture.