Ain Shams University
Faculty of Engineering
Department of Architecture

Application of Eco-city Concepts in the Development of Urban Areas

With Special Reference to Residential Buildings

A Thesis Submitted in Partial Fulfillment of the Requirements of
The Master of Science Degree in Architecture

Prepared By

Arch. Diaa Madkour M. Bakr

Under the Supervision of

Prof. Dr. Yasser M. Mansour

Professor of Architecture
Faculty of Engineering – Ain Shams University

Assoc. Prof. Dr. Ahmed Atef El Desouky

Associate Professor of Architecture
Faculty of Engineering – Ain Shams University

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Ain Shams University
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Name : Diaa Madkour M. Bakr

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The Examining Committee:

P. Dr. M. Momen Afifi	Professor of Architecture – Department of Architecture, Cairo University
P. Dr. M. Ayman Ashour	Professor of Architecture – Department of Architecture, Ain Shams University
P. Dr. Yasser M. Mansour	Professor of Architecture – Department of Architecture, Ain Shams University
Dr. Ahmed Atef ElDesouky	Assoc. Professor of Architecture – Department of Architecture, Ain Shams University

Post Graduate studies:

Approval stamp **Approved**

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STATEMENT

This thesis is submitted to Ain Shams University for the degree of Master of Science in Architecture.

The work included in this thesis was accomplished by the author at the department of Architecture, Faculty of Engineering, Ain Shams University, during period from 2008 to 2011.

No part of this thesis has been submitted for a degree for a qualification at any other university or institute.

Name: Diaa Madkour M. Bakr

Signature:

Date:

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ABSTRACT

The research aims at reaching a practical design pathway for eco-house projects as a step for the sustainable development of urban areas; it explores the context of the eco-house by studying the eco-city concepts and the relation between eco-house and eco-city elements. The terms and theories accompanying eco-house design are discussed. The research studies the strategies and techniques used to achieve high performance of sustainability, and reaches a comprehensive design methodology for eco-house projects for designers to follow in order to reach a sustainable performance. The thesis studies The Carnegie Institute for Global Ecology as an example for integration of various strategies and techniques, and studies the Thomson foy house as an example for the application of the design methodology proposed.

OVERVIEW

It has been wide spread lately that earth faces global problems that threaten the life of living organisms. These problems would affect the earth like global warming, or affect the human life styles like energy crisis. Sustainable development concept was introduced as the solution for these problems.

This concept was applied in construction field as sustainable urban design and green buildings, it is vital that we evolve towards sustainability in urban form, transport, landscape, buildings, energy supply, and all of the other aspects of vibrant city living.

Techniques and strategies have been developed to reach the optimum performance of the building, reaching a high level of coherence with nature and synergy with its systems.

Architects should follow a design methodology that guarantees the application of environmental strategies and concepts to produce a building that would help in the confrontation against the global problems we face.

Research Problem

Construction sector contributes in the production of CO_2 and the depletion of resources of the planet, and despite the call for environmental design, architects still neglect environmental issues in their designs. One of the main reasons for architects staying away from addressing environmental aspects in their designs is the lack of a design pathway to follow as a guide to reach sustainable performance of the building.

Research goal

The research main goal is: Reaching a design methodology for eco-house projects as a step for the sustainable development of urban areas.

To fulfill this goal, the following objectives should be achieved:

1. In order to reach a solution, the main problems should be well identified.
2. Exploring the context of the eco-house by studying the eco-city concepts and the relation between eco-house and eco-city elements.
3. Discussing the terms and theories accompanying eco-house design.
4. Exploring the strategies and techniques used to achieve high performance of sustainability.
5. Exploring design maps and design systems to be integrated in a comprehensive design methodology.

Research methodology

To reach the previously mentioned objectives, the following methodologies will be adopted:

Methodology 1: This analytical methodology comprises three main aspects:

1. Reviewing different types of literature and data collection.
2. Analyzing and processing collected data.
3. Reaching results and gaining knowledge concerning the research issues.

This will be applied to objectives from 1 to 4, by exploring the latest literature through books, published papers, projects frameworks and up-to-date web sites, which will result in the formation of chapters 1 to 3.

Methodology 2: This deductive methodology involves reaching and developing a methodology for eco-house design.

This will be applied to objective 5, by studying design maps and deducing a comprehensive design methodology which will result in the generation of chapter 4.

Research scope and limitation

- The research focuses on the design of single family houses as a building type, which will have its effect on design elements concerning the height, the area and the spaces requirements and activities.
- The location is considered to be generic, where the methodology can be applied anywhere, taking into consideration climatic and parameters concerning the specific location. Still, at the end of the thesis, a brief was presented to study the application of the methodology on Cairo region.
- The design phase is limited to schematic stage, which would focus on the criteria for selection of the techniques and their basic calculations. This phase of design is essentially the proof-of concept phase. The project directions outlined in conceptual design are verified as being technically feasible, within budget, and able to deliver on design intents. Hopes meet reality during schematic design.

Research content

The research comprises of 5 chapters presenting the following:

Chapter one:

This chapter is concerned with the analytical preview of the elements, definitions and historical background for the thesis subject. It starts with identifying the global problems and methods of solution through sustainability concepts and the method of applying these concepts in urban design. Then it continues with the study of the city and its elements, and the study of historical development of the sustainable cities. The chapter focuses on residential buildings as an urban design element, and studies their relations with other city elements, and studies comprehensive definition of Eco-house and accompanying theories and systems.

Chapter two:

This chapter studies the concepts and strategies affecting the eco-house design concerning the comfort and well being of the occupants through the following aspects: 1-Thermal comfort. 2- Visual comfort. 3- Acoustical comfort.

The study of each aspect is addressed through four components:

1- Concept. 2- Values and units. 3- Parameters. 4- Techniques.

Chapter three:

This chapter addresses the techniques that aim at reducing the environmental impacts through two aspects: energy and resources.

Energy consumption impact on environment is based on two goals,

a) Reducing the need for energy of heating/cooling,

b) Using renewable energy sources.

As for resources, the environment suffers from depletion of resources as material, water and air; the depletion is through quantity decrease and pollution of these resources. This chapter addresses the techniques that would reach high performance from these resources, the chapter ends with a case study illustrating the combination of techniques in an integrated way.

Chapter four:

This chapter addresses the method of green design. First, it studies maps of design methods and their progress and evaluation. Then the chapter goes through a design method based on the structure of the environmental briefing (EB) method developed by Richard Hyde, the chapter supports EB stages by work of other theorists to reach a comprehensive design method to be a guide for designers of eco-houses, in which they can apply the environmental techniques addressed earlier through the thesis. The chapter gives an example by a case study illustrating the design method application on Thomson Foy house. The chapter ended with a study for the potential of applying the environmental design method on Cairo private houses.

Chapter five: Conclusions and recommendations:

The research reached several conclusions from the theoretical and analytical approaches along the pathway to reach the main goal. It also generated recommendations for the governmental sectors and educational institutions and researchers for future research work.

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