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This work has not previously been accepted in substance for any degree and is not concurrently submitted in candidature for any degree.

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STATEMENT 1

This thesis is being submitted in partial fulfillment of the requirements for the degree of ....PhD...........(insert MCh, MD, MPhil, PhD etc, as appropriate)

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STATEMENT 2

This thesis is the result of my own independent work/investigation, except where otherwise stated.
Other sources are acknowledged by explicit references.

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GREEN ARCHITECTURE AS AN APPROACH FOR INCREASING ENERGY EFFICIENCY IN EGYPTIAN BUILDINGS

A thesis submitted to the University of Wales, Cardiff in fulfilment of the requirement for the degree of Doctor of Philosophy

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I gratefully acknowledge the generous support from all of you.
Engy Samy Hussien

Dedication

This thesis is dedicated to my family.

Thank you very much for all your love, sacrifice and patience.

Abstract

In the light of the growing global concerns about environmental problems and the importance of achieving sound management of the natural resources, this research proposal was developed. Though Egypt is now enjoying a secured energy supply for the short and medium terms, yet it is mainly dependent on fossil fuels. Building sector in 2007 was responsible for 23% of the total energy consumption in Egypt and is expected to reach 35% by 2030 and the construction sector growth rate was 15.8%.

Developing an environmental assessment tool was the approach adopted by this study to address the building sector energy consumption levels in Egypt. The success of these tools in reshaping the design and practice worldwide has long been established. In the absence of an existing adequate measure to assess environmental buildings and with the concept of modern environmental design emerging in Egypt, the current study proposes the Egyptian Green Code for Buildings.

The Egyptian Green Code for Buildings is an assessment tool specifically designed for the Egyptian environment. Three phases of surveys (questionnaires and interviews) were developed to create, evaluate and validate the proposed code. With the collaboration of the field specialists represented in: governmental officials, architects in practice and academics. The results reveal that this research has developed an understandable code, with categories relevant to the Egyptian environment, achievable credits and satisfactory overall classifications.

The proposed code will insure a minimum level of applying green architecture principles in Egyptian buildings. It presents a unified, coherent and accurate method of assessment. It allows the designers and decision makers to identify the key points that need to be addressed to enhance the overall performance of a building and in turn make it beneficial to the environment. The application of the proposed code will result in green concepts being more in the centre of the architecture practice in Egypt and opening the possibilities to introducing new concepts and measures to achieve sustainability.

Thesis Content

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CHAPTER 2: COMPARATIVE REVIEW OF ENVIRONMENTAL IMPACT ASSESSMENT PROGRAMS

CHAPTER 3: EGYPTIAN ENVIRONMENTAL SITUATION REVIEW

CHAPTER 4: RESULTS FROM SURVEY PHASE I

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List of Acronyms

Acronym	:	Definition
AEO	:	Annual Energy Outlook
BRE	:	Building Research Establishment
CDM	:	Clean Development Mechanism
CITES	:	Convention for International Trade in Endangered Spaces
CMS	:	Convention on Migratory Species
CNG	:	Compressed Natural Gas
CNS	:	Communication & Navigation Systems
CO2	:	Carbon Dioxide
DNA	:	Designated National Authorities
ECCDM	:	Egyptian Council for Clean Development Mechanism
ECEP	:	Energy Conservation and Environment Project
ECES	:	Egyptian Center for Economic Studies
EEAA	:	Egyptian Environmental Affairs Agency
EEC	:	Energy Efficiency Council
EEHC	:	Egyptian Electricity Holding Company
EEI	:	Emerging Environmental Issues
EEIF	:	Egyptian Environmental Initiatives Fund
EEPP	:	Earth Education Partnership Program
EESA	:	Egyptian Energy Service Association
EGCB	:	Egyptian Green Code for Buildings
EHMIMS	:	Egyptian Hazardous Materials Information and Management System
EIAP	:	Environmental Impact Assessment Programs
EPF	:	Environmental Protection Fund
EPM	:	Environmental Planning and Management
EQI	:	Environmental Quality International
ERF	:	Environmental Revolving Funds
ERSAP	:	Economic Reform and Structural Adjustment Program
ESP	:	Environmental Sector Program
EU	:	European Union
FAO	:	Food and Agriculture Organization
FDI	:	Foreign Direct Investments
FEA	:	Friends of the Environment in Alexandria

Acronym	:	Definition
FEDA	:	Friends of the Environment and Development Association
FEI	:	Federation of Egyptian Industry
GHG	:	Green House Gases
HKGBC	:	Hong Kong Green Building Council
ICA	:	Institute of Cultural Affairs
IEA	:	International Energy Agency
IPCC	:	Intergovernmental Panel on Climate Change
MALR	:	Ministry of Agriculture and Land Reclamation
MAP	:	Mediterranean Action Plan
MENA	:	Middle East and North Africa
MHUUC	:	Ministry of Housing, Utilities, and Urban Communities
MLD	:	Ministry of Local Development
MLF	:	Multilateral Fund Ozone
MOEE	:	Ministry of Electricity and Energy
MOFA	:	Ministry of Foreign Affairs
MOHP	:	Ministry of Health and Population
MSEA	:	Ministry of State For Environmental Affairs
MSEA	:	Ministry of State for Environmental Affairs
MTI	:	Ministry of Trade and Industry
NAP	:	National Action Plan
NAPOE	:	National Association for Protection of Environment
NEAP	:	National Environmental Action Plan
NEES	:	National Energy Efficiency Strategy
NREA	:	New and Renewable Energy Authority
NRI	:	Nile Research Institute
SAP	:	Strategic Action Program
SDU	:	Sustainable Development Unit
SHW	:	Solar Hot Water
TOE	:	Ton Oil Equivalent
UNCED	:	United Nations Conference on Environment and Development
UNDP	:	United Nations Development Program
UNFCCC	:	United Nations Framework Convention on Climate Change
USAID	:	United States Agency for International Development

Chapter 1: Introduction

1.1 Introduction

As the Intergovernmental Panel on Climate Change (IPCC) highlighted, there is now a lot of scientific evidence showing that climate change is a serious and urgent issue and is directly related to energy consumption levels and CO_2 emissions (Bert et al., 2007). The environmental impacts from the building sector (residential and commercial) is considerable, with 38% of the world primary energy consumption and Green House Gas (GHG) emissions, and 67% of all power plant generated electricity in 2008 (International Energy Agency (IEA) Statistics Division, 2009). Addressing buildings design was the approach adopted by many countries to protect environmental resources. They have developed or are developing programs and tools for assessing actual and potential environmental changes caused by the new or existing buildings.

Environmental impact assessment programs for buildings were one of the measures adopted to address building sector energy consumption levels. These programs have developed quickly in the past 15 years, with more than 30 programs actively used to assess buildings performance all over the world. The goal of these assessment programs is to help in protecting natural resources, health and environmental quality. Also to establish a base that environmental programs could be compared on. Therefore, most of

EIAP quantify the environmental impacts of a building in an attempt to minimize them. The success of these programs in reshaping the design and practice has been established as they assist in improving environmental performance of buildings (Yudelson and Fedrizzi, 2008, Hasegawa, 2003).

Though Egypt is now enjoying a secured energy supply for the short and medium terms, yet it is mainly dependent on fossil fuels (94%) of which proven reserves are relatively limited (Ministry of Energy and Electricity, 2009). The development and efficient management of Egypt's primary resources is considered as the core strategy to the energy policy framework for the Egyptian energy strategy 2012 aiming to generate 3% of the total energy demands from renewable energies (New and renewable energy authority, 2009). The introduction of Egypt's environmental protection law in 1994 was to encourage environmental assessment and brings it to the centre of attention. The law was meant to be helping the deteriorating conditions of the Egyptian environment. At present there are no environmental standards being used for assessing environmental buildings, despite the acknowledged importance of such programs (Egyptian Environmental Affair Agency, 2009, Ministry of Housing, 2009).

There are number of problems that face the Egyptian environment. The Egyptian population reached 81,714 million with annual growth rate of 1.75%. Available resources in Egypt are suffering to meet the escalating demands for this population. Energy consumption growth rate reached 5.7% in 2007 (National institution for statistics and general information, 2009, Egyptian Environmental Affair Agency, 2009). For the Egyptian environment to meet these consumption levels with the current methods, it will mean more environmental problems. Total CO_2 emissions in Egypt reached 187.11 Million metric ton in 2007, out of which more than 70% was emitted by the energy sector including about 35% attributed to the electricity sector (Ministry of Energy and Electricity, 2008).

Clearly, immediate action in the Egyptian building sector is essential if we are to avoid more deterioration. In the absence of an assessment tool for environmental buildings in Egypt, decisions about what is considered green are made by individuals which subject it to be bias sometimes.

Therefore, this study has proposed to develop an assessment code for green buildings specifically designed for the Egyptian environment as an adopted method to address current environmental problems caused by building sector. The Egyptian Green Code for Building (EGCB) was developed in participation with the architectural society to help architects and governmental officials make more environmentally conscious decisions in designing buildings. The development process of this tool, the need for it, its categories, credit and the barriers that might face its application in the Egypt, will be investigated in this research.

1.2 Research Aim and Objectives

The research aim was to explore the possibility of introducing an environmental impact assessment code for buildings designed specifically for the Egyptian environment as an adopted approach to address current problems facing the building sector in Egypt. To achieve this aim the following objectives were derived:

- Study the current situation in Egyptian architecture and discuss what is considered the right methodology for green buildings in order to raise the quality of buildings design.
- Investigate the need for a new assessment tool for buildings in Egypt and what would be its main features.
- Propose an assessment code that supports achieving environmental targets in Egyptian buildings as an adopted approach for addressing the current situation.
- Develop and validate proposed indices that formulate an assessment code specifically designed for Egypt conditions.
- Identify the barriers that might face the application of the new code in Egypt.
- Develop a protocol for applying and sustaining acceptable environmental quality in Egyptian buildings.

1.3 Hypothesis and Research Questions

The main hypothesis that instigated this research was that Egypt needs a new code for environmental building assessment as an approach to address building sector environmental problems and the development process should involve decision makers, users and developers from the built environment in order to achieve a comprehensive vision. In order to understand this hypothesis, this study was prompted to answer the following research questions as involving in developing an assessment tool will face certain fundamental issues:

- Are the current environmental laws and strategies actively used in the Egyptian architecture practice?
- What is considered environmental building in contemporary Egypt?
- Does Egypt need a new assessment code for environmental buildings from the architectural society's point of view?
- How should such a program be initiated? How can the full range of environmental responsibilities be handled with limited resources?
- What elements should be emphasized in the first stage of application of that new tool? What are the new code main categories that are relevant to Egypt? Are the limited resources and knowledge available to implement the code affect the breadth and sophistication of the program's initial development and application?
- What would be the reaction in the Egyptian environment regarding the new code? How might it be evolved?
- What are the main barriers that will likely face the application of the proposed code?

These questions will be answered in relation to the resources and culture in Egypt during the course of this study.

1.4 Scope and Limitation of The Research

This research is focused on investigating the development process of a new assessment code for green buildings in the Egyptian environment, what it could be composed of, how it will be perceived and the barriers it will face in application. The following limitations have been adopted to control the breadth of the current study:

Point of investigation: there are number of methods to address environmental impacts caused by building sector but this research will only investigate the possibilities of introducing an assessment code for buildings as a measure to deal with the situation in Egypt, further investigation into other methods could be direction for future projects.

Respondents' selection: a controlled target group from the architectural society in Egypt was selected to manifest three points of views; 1) decision/policy makers: represented by governmental officials working in building and environment sectors, 2) users: represented by architects in practice, and 3) developers: represented by academics from architecture departments in Egyptian universities. Equal numbers from each group were approached to take part in the research survey; the selection process will be explained in more details in Chapter 4.

Projects selection: due to the strict time limitation of the study the projects selected to be analyzed in Chapter 3 as an example of what is considered environmental building in contemporary Egyptian architecture had the following limitations for selection; 1) modern architecture: restricted to projects that were either constructed or operated in the past decade; this particular investigation does not include any project prior to 1996, 2) environmental building: the projects have been advertised as green or environmentally friendly, and 3) diversity: as the current Egyptian code for building is comprehensive which does not differentiate between types of buildings, therefore the selected projects had to represent a wide range of buildings types representing the Egyptian situation.

1.5 Research Significances

The justification and importance for undertaking this research was presented in the introduction section of this chapter. The following outcomes are highlighted as the advantage of offering a new environmental assessment code for buildings in Egypt:

Scientific relevance:

At a national level, this research will contribute towards filling the research gap in investigating the possibilities of development of an Egyptian code for environmental buildings. Future directions for addressing current barriers hindering the development of any new environmental mitigation will be offered and a list of indices (code) for the most important categories to be included in any future assessment program for buildings in Egypt.

Practical relevance

- This study (if applied) not only can improve building quality in Egypt but also can reduce energy consumption levels for building sector, ensuring a minimum level of applying green concepts in the Egyptian architecture.
- For architects in practice and governmental officials, the findings of this study will present them with a unified tool to assess environmental buildings for better decision making.
- People will benefit from lower energy and maintenance costs as a result of better environmental conditions as well as benefiting from healthy life style.

From an optimistic point of view, this research will enable to enhance the understanding of what the Egypt architecture need to start its transition to more environmental approaches in design, and hopefully this study will be applied into the Egyptian environment. Even though the study is explicitly to be applied in the Egyptian environment, similar approach can also be implemented in other countries provided the same weather and economical conditions.

1.6 Research Methodology

Applying a standard for improving buildings quality was the line of research proposed in this study as an approach to improve the current state of building sector in Egypt. A combined methodology from quantitative and qualitative approaches has been adopted due to the evaluating nature of the study subject. This has allowed statistically reliable information obtained from numerical measurement to be backed up by and enriched by information from the research respondents' explanations.

Quantitative approach

A quantitative methodology was used to address the numerical representation of the target group's observations on the proposed code development phases, for the purpose of describing and explaining the satisfaction that those observations reflect about the code. Quantitative methodology presented the objective point of view of the research which included; collection, analysis and interpretation of data by observing figures and numerical patterns, based on the results of especially designed and administrated three phases of questionnaires.

Qualitative approach

Although the analysis of the qualitative data was time consuming, and less able to be generalized, two reasons have driven this study to choose a qualitative approach, firstly, to present the subjective opinion about the need for this research from our target group point of view depending on their different backgrounds. Secondly, to obtain detailed explanations on the questionnaires answers to understand what are the driving forces for the development of the research. The qualitative method included; collection, analysis and interpretation of data by the author based on; three phases, individual, semi structured in-depth interviews that use the respondents' observations and experience.

1.7 Research Structure

The thesis is structured into three parts consisting of seven chapters, as shown in Figure 1-1. The first part is the literature review contained in Chapters 2 and 3, reviewing, internationally, environmental impact assessment programs for buildings and, nationally, Egypt's environmental situation. The second part presents the research investigations in Chapters 4, 5 and 6. The development processes for the new proposed code its procedures, results, evaluation and analysis. The final part is the overall conclusion, recommendations and future work directions presented in Chapter 7. A brief of each chapter is shown below.

Chapter 1: summarizes the content of the study with description of the research background, importance, aim, objectives, scope, justification, methodology and the content of thesis chapters.

Chapter 2: reviews comparatively the environmental impact assessment programs for buildings currently in use in the world, emphasizing on its intended roles, categories, credits weightings and the methodologies used to develop them.

Chapter 3: presents the current situation for the Egyptian environment, building sector share, negative impacts on the environment and the action plans proposed toward current problems. Projects from the Egyptian environment are critically discussed to understand what is considered environmental buildings in modern Egypt.

Chapter 4: describes the first phase of questionnaires and interviews conducted in Egypt; procedures, results and analysis are presented. The architectural society of Egypt's knowledge about environmental issues has been investigated. The need for the new code is established and the main features and categories of the proposed code will be selected by our target group.

Chapter 5: presents the results from second phase of questionnaires and interviews aiming to; evaluate the new code first version, find out how it will be perceived in Egypt and what are the main modifications and refinements it needs to achieve satisfactory results in Egypt from our respondents point of view.

Chapter 6: describes the application of the new code on a proposed building to assess the final version from a more practical point of view. Our target group overall satisfaction about the final version of the code is comprehensively measured. The barriers that will face the new code application in the Egyptian environment have been investigated.

Chapter 7: concludes the findings of the study and presents a summery of the results gained from this research. Recommendations for the Egyptian environment and directions for future work are included in this chapter.

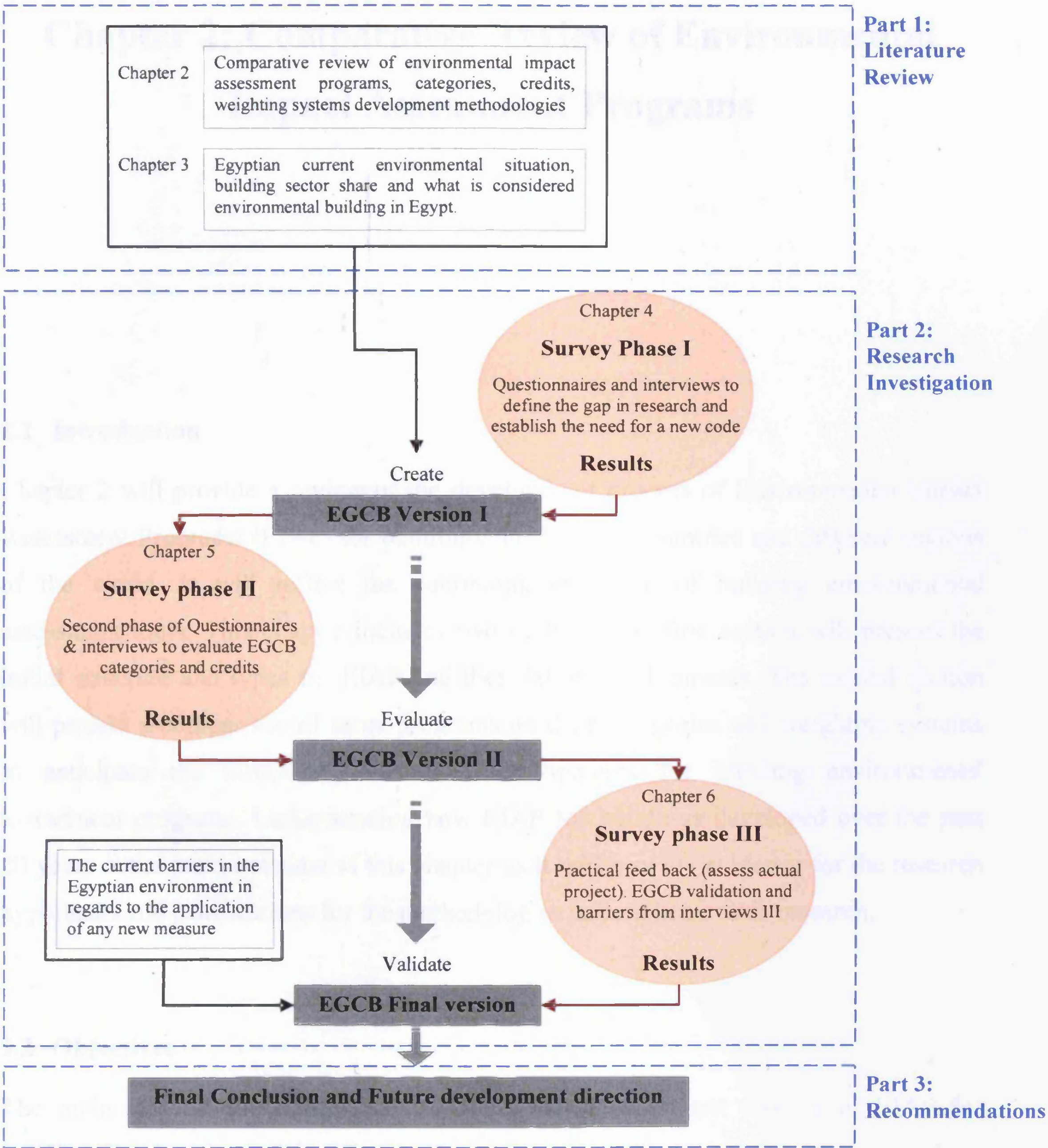

Figure 1- 1: The research flow.

Chapter 2: Comparative Review of Environmental Impact Assessment Programs

2.1 Introduction

Chapter 2 will provide a review of the development process of Environmental Impact Assessment Programs (EIAP) for buildings for different countries and different regions of the world. It will reflect the continuing evolution of building environmental assessment tools. This chapter includes two sections: the first section will present the initial structure and types for EIAP and their latest developments. The second section will present a comparison of some programs on their categories and weighting systems to anticipate the directions of future developments for building environmental assessment programs. Understanding how EIAP for buildings developed over the past 20 years is the main outcome of this chapter as it will provide evidence for the research hypothesis and justifications for the methodologies undertaken in this research.

2.2 Objectives

The main aim of this chapter is to review the development process of EIAP for buildings; its categories, weighting systems and methodologies used in developing these programs. It will serve as a starting point in developing an evaluation tool especially designed for the Egyptian environment. To achieve this aim some objectives have been adopted:

- Review and compare different types of EIAP for buildings from variety of regions, emphasizing on their categories of assessment, weighting systems and their latest developments.

- Investigate the future development direction for EIAP for buildings.

2.3 The development of EIAP for buildings

Building sector[1] contribute significantly to energy consumption all over the world. According to (WBCSD, 2009) building sector is responsible for 40% of the world primary energy consumption with the resulting carbon emissions, as shown in Figure 2-1. A lot of experts believe that the building sector in the world could help reducing 1.8 billion tones of CO2 before Kyoto target in 2012 (WBCSD, 2009). According to the (UNEP, 2007):

> *"...significant gains can be made in efforts to combat global warming by reducing energy use and improving energy efficiency in buildings."*

There are number of ways that a building could affect its surrounding environment on its life time. During different stages; row materials, construction, operation and demolition, also, through different components, buildings could have a huge impact on the environment. For example: soil pollution, emissions into the air, water spills, waste generation, resource consumption, local impacts, impacts associated with transportation and effects on biodiversity (Gangolells et al., 2009). In addition to the previous environmental impacts, buildings affect people's health directly. As (Theodore et al., 1996) reported, there are a lot of health problems that could be linked to buildings directly especially to poor indoor quality i.e. the sick building syndrome.

According to (WBCSD, 2009, UNEP, 2007) it has long been established that to achieve an energy-efficient world, governments, businesses and individuals must transform the

1 : Building sector is the sum of residential sector and commercial sector. The energy use in the residential sector is the energy consumed by households, excluding transportation uses. The commercial sector (the services sector and sometime the institutional sector) which consist of businesses, institutions, and organizations that provide services (schools, stores, correctional institutions, restaurants, hotels, hospitals, museums, office buildings, banks, and stadiums).

building sector. One of the approaches that have been adopted to address the building sector effects on the environment were developing programs to assess buildings performance. Environmental impact assessment programs (EIAP) for buildings were originally conceived as guidance to recognize best practice, promote green buildings and to provide a unified and coherent base for buildings to be compared on. Recent studies showed that EIAP have been a key factor in improving buildings design as well. This movement towards sustainable and green buildings has been growing rapidly since the second half of the 80s leading to the development of various methods for evaluating the environmental performance of buildings. The number of EIAP for buildings has increased significantly in the past two decades, as shown in Figure 2-2. From 4 programs in the 80s to more than 25 program now actively used worldwide. This increase in the number of EIAP for buildings or the revolution as Yudelson describe it, will likely continue over the next few years (Jameson & Sargent, 2009, Cole et al., 2005, Yudelson & Fedrizzi, 2007).

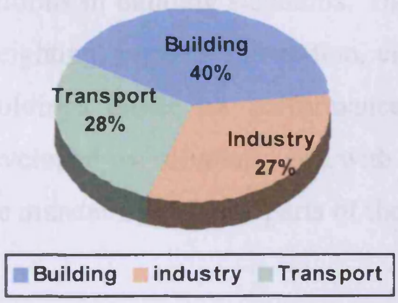

Figure 2- 1: Total energy consumption of the world. (Source: WBCSD, 2009)

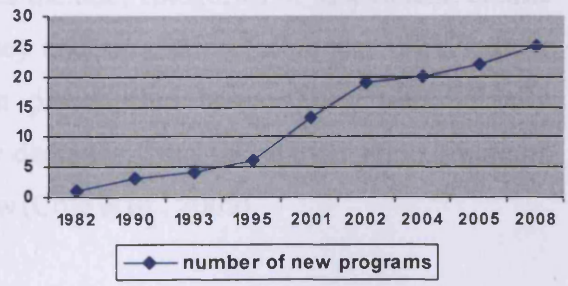

Figure 2- 2: The time line progress for the environmental programs

In countries all over the world -especially the developed countries- there is a growing interest in understanding how to reduce the building sector impacts on the environment. This is partially manifested in continues development of EIAP for buildings, either by introducing new assessment tools, or by developing and refining the existing ones. In recent years, the market for evaluating building performance was increasing, with clients demanding buildings that meet the highest efficiency standards and have minimum effects on the environment. Environmental buildings or green buildings from the market point of view could potentially save money on energy bills, cut global warming pollution and help to secure future energy. Therefore there are growing demands for building classified as green or environmentally friendly. Another aspect that confirms the current success of EIAP for building is that a lot of conferences have been and still are held for the environmental impacts of buildings and the best way to develop and assess it. EIAP are now considered a driving force to develop buildings industry (Cole et al., 2005, Yudelson & Fedrizzi, 2007, USGBC, 2008).

EIAP were first conceived as a mean to quantify the success of a building in achieving reduced impacts on the environment during its life time. They were also developed to comply with standards from organizations like ANSI, ISO, ASHARE, ASTM and CEN. The structure and components of EIAP are always changing to cope with the latest editions in building standards. These changes include; categories of assessment, credits weighting, impacts calculation, cost efficiency and simulation techniques. EIAP assess buildings either on performance bases on prescriptive bases. They were initially developed as voluntary, but with the higher demands from the market some programs are mandatory in some parts of the world now (Cole et al., 2005).

EIAP were first designed to assess certain aspects of buildings mostly energy, water and material use. They were also firstly designed for certain types of buildings. New developments to EIAP for buildings included expanding the assessment categories to include every stage and component of a building during its life time. The new generations of programs are moving towards a more comprehensive view of assessment rather than it being for only one type of buildings or one aspect of building elements. New additions to BREEAM 2008 and LEED 2009 included the introduction of new versions to assess new types of building (USGBC, 2009, BREEAM, 2009). EIAP also assess buildings in different stages; designing, construction, operation and demolish. With number of these programs being in use for several years spotting the developments directions for EIAP for buildings could be recognized and analyzed.

In the first generation of EIAP assessments were usually made by a qualified third party (for example, BEPAC (DEH, 2000). In recent years web based assessment have been introduced. This came as a reaction to the market demand for an easy to use initial assessment. EIAP outcomes are a certificate grade or a report to acknowledge the grade of a building in achieving its environmental targets. Recent additions to EIAP for building included the introduction of an outstanding rate for outstanding innovations in green building (BREEAM, 2009). This comes as a result of the current need on the market for green buildings to be recognized as the best.

The success of EIAP in reshaping the building industry is undeniable. In recent years, EIAP have been playing a big role in moving the building industry into a more environment conscious directions, as presented in (Cole et al., 2005):

> *"...There is little doubt that building environmental assessment methods have contributed enormously to furthering the promotion of higher environmental expectations, and are directly and indirectly influencing the performance of buildings..."*

This current success of EIAP for buildings is considered one of the most recognized ones in the world. This success derives from the ability of these programs to offers a common ground for designers, governments and buildings owners, to assess building performance and be recognized for good practice (USGBC, 2008).

The author intended this chapter to focus on programs that deal with evaluation and assessment of buildings to serve as a starting point in developing a specific program aimed at the Egyptian environment needs.

2.4 Types of Building Assessment Methods

EIAP for buildings could be divided to two types according to what they assess in a building. The first type assesses one or more of the building aspects to find out how it will affect the environment and how well the building's elements will score against environmental standards, for example on energy efficiency or materials choice. Programs like R-2000 and ENERGY STAR assess mainly building energy efficiency (NRC, 2009, ENERGY STAR, 2009). These types of assessment methods sometimes are specifically designed for a certain type of buildings like P-mark for prefabricated houses and GreenCalc for Dutch office buildings (Horvat et al., 2005, GreenCalc, 2009). Some programs perform the assessment only at one stage of a building life. These programs are usually design decisions support tools, for example ATHENA for design stage only and NovoClimat for after operation stage only (ATHENA, 2009, AEE, 2009). The assessed buildings either pass the assessment and given a certificate or a qualification grade, or fail to qualify and be given guidance on how to improve the assessed element of their building.

The second type of EIAP assesses building as a whole against a set of categories to find out the building total impacts on the environment. These types of programs always include a wide range of categories of assessment ranging from site design and energy efficiency to water usage and recycling management. They also cover different building types with specific consideration for each type, for example in BREEAM, LEEDS and HK-BEAM there are specific versions to assess homes, schools, retail and healthcare. These programs assess a building on different stages; design, construction, operation, maintenance and demolition stage in some programs (USGBC, 2009, BREEAM, 2009, HK-BEAM 2009). Usually a certificate or a qualification grade is awarded to the assessed building to define its standard. Table 2-1 presents EIAP that will be reviewed in this study.

		Program	Country	Year	Application
1	B.E	R-2000	Canada	1982	in use (2009)
2	B.E	P-mark	Sweden	1989	in use (2009)
3	W.B	BREEAM	UK	1990	in use (2009)
4	W.B	BEPAC	Canada	1993	Not in use
5	B.E	Ecoprofile	Norway	1995	Not in use since 2001
6	W.B	HK-BEAM	Hong Kong	1996	in use (2009)
7	B.E	GreenCalc	The Netherlands	1997	in use (2009)
8	W.B	HQAL	Japan	2000	No information found
9	B.E	Energy Star	US	2000	in use (2009)
10	B.E	Novoclimat	Quebec	2000	in use (2009)
11	B.E	ATHENA	Canada	2000	in use (2009)
12	W.B	LEED	US	2000	in use (2009)
13	B.E	ECO-QUANTUM	Netherlands	2000	in use (2009)
14	B.E	BEAT	Denmark	2000	in use (2009)
15	B.E	LCAid	Australia	2000	in use (2009)
16	W.B	GBTool	International	2002	in use (2009)
17	B.E	Green Globes	Canada	2002	in use (2009)
18	B.E	BEES	US	2002	in use (2009)
19	W.B	NABERS	Australia	2004	in use (2009)
20	W.B	CASBEE	Japan	2004	in use (2009)
21	W.B	CEPAS	Hong Kong	2005	Never been used
22	W.B	EECRB	Egypt	2005	Under development
23	B.E	Minergie-ECO plus	Switzerland	2006	in use (2009)
24	W.B	Green Building Regulatory	Dubai	2008	Under development

B.E: building elements assessment
W. B: whole building assessment

Table 2- 1: The environmental impact assessment programs in this chapter arranged by year of start.

2.5 Programs and Tools

2.5.1 Programs that assess certain aspects of the building.

2.5.1.1 R-2000 Program (Canada, 1982)

Developed in Canada in 1982 the R-2000 is a voluntary program encouraging builders to build energy-efficient houses that are environmentally friendly and healthy. It includes an energy efficiency standard for new houses that is continuously updated. It also includes comprehensive training and education courses for builders. The R-2000 standard assesses energy consumption performance for a house through a series of technical requirements: (minimum envelope requirements, ventilation system requirements, combustion system requirements, energy performance target, lights and appliances, indoor air quality and environmental features/eco-management) (NRC, 2009, NRC, 2007, Horvat et al., 2005, Adair, 1996). During the first few years of application the R-2000 program didn't attract the anticipated Canadian building practice (Horvat et al., 2005), this was due to:

- Copying R-2000 homes by uncertified builders that lead to a failure of real application of the program standards.
- Being more expensive (6-10%) to build R-2000 home in comparison to regular building.

Being flexible is what helped the R-2000 (2005 edition) program stay in the current market and being able to be applied to any type of homes. Another advantage is producing homes with 30%-40% energy savings (NRC, 2009, NRC, 2007, Horvat et al., 2005, Adair, 1996).

2.5.1.2 P-mark system (Sweden, 1989)

P-mark came as a reaction to the manufacturers of prefabricated houses in Sweden need for an assessment program that assures the market of the quality of their houses. P-mark is a voluntary program. It was developed for design and after construction stages. P-mark authorities use the method of unannounced inspections to assure quality control procedures after operation. 5% of the finished houses is inspected and measured annually. The inspections are on performance bases for the finished homes on air-tightness of the building envelope, air exchange rates, air-tightness of ducts, sound pressure levels and heat requirement, to verify compliance with P-mark requirements P-mark certificate is considered a form of quality assurance in Sweden. One advantage to the application P-mark was that it has helped the Sweden market in reducing complaints from people about the failure of prefabricated homes. The upgrades that have been made to the P-mark in recent years involved improving the assessment categories to include: 1) Testing for ventilation, air-tightness of houses and ventilation ducts, 2) Inspection for HVAC performance, water-tightness of the kitchen or toilet (Anneling, 1998, Horvat et al., 2005).

2.5.1.3 BEPAC (Canada, 1993)

The Building Environmental Performance Assessment Criteria (BEPAC) is a voluntary EIAP specifically for commercial buildings. It assesses the building on five categories: energy use, indoor environment, ozone protection, resource conservation, and transportation. BEPAC was Canada's first non-residential environmental assessment tool and has influenced a lot of the programs that followed for example: BREEAM Canada, GBTool, C-2000 and GreenGlobes. On its first version it used an experienced third party to undertake the assessment. As a reaction to concerns regarding the costs of using an expensive third party to carry out the assessment in BEPAC; the self-assessment version of BEPAC was developed. It allows facility staff to evaluate their own buildings. It contains a program for user training. This new addition has been criticized as the facility staff might be not experienced enough to carry out an assessment. BEBAC label consistency has been questioned and this led to the assessment not being used much in the Canadian market (SDIC, 2009, Marshall, 2008, DEH, 2000, Bond, 1999).

2.5.1.4 Eco-profile (Norway, 1995)

Eco-Profile is a simple environmental assessment method which was developed to be easy to use to encourage the uptake of the scheme. It assesses life cycle effects of a building on external environment, resources and indoor climate. The program uses 82 parameters to assess the building performance and then given a grade. The grading scale is: 1 for Low environmental impact, 2 for Medium impacts and 3 for Greater impact (Boonstra and Pettersen, 2003, Strand and Fossdal, 2003). Eco-Profile is not currently used in the Norwegian market. It has not been marketed since 2002 due to funding limitations with the Norwegian Building Research Institute. Even though more than 60 commercial buildings have been assessed by this program in 2000-2001 it is not considered a successful one as it didn't continue, as presented in (Boonstra and Pettersen, 2003):

> *"...so far Eco-profile cannot be said to have been a success..."*

Some of the suggested improvement for the program included simplifying the program by presenting one index instead of three and reducing the number of the assessed parameters. Another direction for improvement will have to include updating the weighting of parameters. (Boonstra and Pettersen, 2003, Strand and Fossdal, 2003)

2.5.1.5 GreenCalc (The Netherlands, 1997)

GreenCalc is an assessment program for Dutch buildings especially commercial and industrial. It uses computer tool to calculate the building's environmental load in terms of cost. It is divided into four modules: 1) material module: choice of materials, quantities and insulating values. 2) Energy module: energy consumption in operation phase (use of building, air-conditioning, ventilation and lighting. 3) Water usage: water consumption in the operation phase (facilities, sanitary facilities and rainwater). 4) Mobility: accessibility from home to work place; location, public transport and own transport. Assessment is performed in comparison to a benchmark building designed to 1990's standards. The benchmark for environmental index for 1990's building is 100 and current building is 150-300. The program predicts that buildings in 2050 will achieve environmental index of 2000. The latest version of the program GreenCalc+ has tried to cope with the highly developed market of green buildings. It included expanded simulation modeling with the designer being able to evaluate the effects of better insulation, glazing, efficient lighting systems, and solar energy systems as design options. GreenCalc updated its energy consumption prediction method to be able to calculate the Energy Performance Norm option (Seo et al., 2005, GreenCalc, 2009).

2.5.1.6 Eco-Quantum (The Netherlands, 1998)

Eco-Quantum is a LCA based computer tool. It starts by entering building data, then the calculation section and finally the output results. It has two versions; one for offices and the other for domestic buildings. It calculates the environmental effects during the entire life span of a building. This includes the impact of energy, the maintenance during the use phase and the differences in the durability of parts of the construction related to the life span of the building. The program has an advantage of being easy to use. As a reaction to the evolving market for environmental assessment, Eco-Quantum V3 latest additives included improving assessment categories. Not only it assess materials and energy flow, it now also takes into account the possibility for selective demolition, recycling, ozone depletion, human toxicity and product reuse (Kortman, 1999, Breedveld, 2007, Forsberga & Malmborgc , 2004, EcoQuantum, 2009)

2.5.1.7 ENERGY STAR (US, 2000)

ENERGY STAR is a program to improve the energy efficiency of buildings. It is operated by the US Environmental Protection Agency and the US Department of Energy. It assesses products as well as buildings, for example; lighting fixtures, home electronics, office equipments, heating and cooling equipment. The building certificate is for residential (single/multi-family and renovated houses) and commercial buildings. Criticisms to ENERGY STAR buildings came from it being more expensive than other conventional buildings especially on design and material aspects. Studies proved that these costs are accepted because the building saves on running costs (i.e., the HVAC system). In recent development to the program and as a reaction to meet the escalating demands for energy savings, modifications have been applied to its minimum energy saving requirements. Initially in 2000 the ENERGY STAR label required a building to be at least 30% more energy efficient (heating, cooling and water heating) than a comparable one built to the 1993 Model Energy Code. Also the building should be 15% more efficient than the state energy code. New modification in 2007 demanded that a building must be at least 15% more energy efficient than homes built to the 2004 International Residential Code IRC (Tathagat, 2007, ENERGY STAR, 2009, Horvat et al, 2005).

2.5.1.8 NovoClimat (Canada, Québec, 2000)

NovoClimat was initially conceived to allow Quebec builders to increase the energy efficiency of their homes. It was developed by the Quebec Agency for Energy Efficiency. The assessment is done to the building in construction stage and after completion. A typical Novoclimat home will score EnerGuide rating of between 78 and 80. It is a voluntary program inspired by Canada's National Model Energy Code. What makes this program different is the fact that it connects energy efficiency and air-tightness to the durability of the building envelope. The new Novoclimat 2007 aimed directly to quantify the effects it makes to a building, by setting a goal to improve a building's energy performance by a minimum of 25% (AEE, 2009, AEE, 2005 Horvat et al., 2005).

2.5.1.9 ATHENA (Canada, 2000)

Athena is North American software for Life Cycle Assessment (LCA) for buildings. It assesses industrial, institutional, office, multi-unit/single family residential homes and also assesses both new buildings and renovations to existing buildings. It is for design stage only to help in deciding which materials to use as it recognizes more than 90 materials and simulates over 1,200 different assembly combinations (structural and envelope). According to ATHENA institute 2009, this software takes into account the environmental effects of: material manufacturing, (including resource extraction and recycled content), related transportation, on-site construction, regional variation in energy use and other factors, building type and assumed lifespan, maintenance, repair and replacement effects, demolition and disposal, operating energy emissions and pre-combustion effects, embodied primary energy use, global warming potential, solid waste emissions, pollutants to air, pollutants to water and natural resource use. ATHENA (4) Impact Estimator, is the newest version of the program and was released in 2009. As most of the new generation of EIAP, ATHENA (4) newest edition included improving simulation modeling. The software will help designers choose a design from up to five design scenarios. It is also more flexible in handling data flows with more impact measures. Another new feature is the ability to choose new regions to assess (ATHENA, 2009).

2.5.1.10 Green Globes (Canada, 2000)

Green Globes is a system to manage the assessment of environmental designs. It is an online assessment for green buildings. The system requires the client (i.e. property manager, owners of commercial and multi-residential buildings) to complete an online confidential questionnaire at design stage. Another stage of the assessment is an online report from a third-party at the construction stage. The categories of assessment for green Globes are: site, energy, water, emissions and indoor environment. It was developed based on BREEAM/Green Leaf as their upgrade or as their web-based tool. It was much anticipated and there was an immediate uptake to it with more than 100 users registered for existing building assessments only in 2002. One of the reasons for the huge uptake could have been that the program was filling the gap for an online assessment method that is related to BREEAM. To be certified a building will have to achieve at least 35% of the total number of 1,000 points. New edition of Green Globes are in the line of developing the program to consider the building surrounding environment and not only the building itself. The new tool for Continual Improvement of Existing Buildings (CIEB) will look at aspects such as resident transportation opportunities (ECD, 2009, Boonstra & Pettersen, 2003, Green Globes (2009).

2.5.1.11 HQAL (Japan, 2000)

The Housing Quality Assurance Law (HQAL) is an EIAP for all types of residential unites. It assesses buildings on: Structural stability, Fire safety, Reduction of deterioration, Thermal environment, Air quality, Lighting-a visual environment, Sound environment and Consideration for senior citizens/special needs. It was initiated to improve the Japanese housing market and make it more durable, and to address the "sick house" problem in Japan. It has three grades, 1 meaning minimum requirements for building codes and regulations have been met and 3 meaning special quality standards have been applied. HQAL verify- at its first stage of assessment- how satisfactory are the standards used in the building. If the building meets the requirements, it will be awarded a grade. If the building didn't meet the requirements, it will be given directions for improvement. These directions could include; changing the type of wood used in the structure, treatments applied for decay resistance, adequate waterproofing, and insulation (Chew & Sutapa, 2008, OECD, 2003, Horvat & Fazio 2005).

2.5.1.12 BEAT (Denmark, 2001)

The Building Environmental Assessment Tool (BEAT) is a LCA based tool. BEAT is a relation database designed using Microsoft Access. The user must supply: type of building, estimated lifetime of the building, geometry of the building, number of floors above/below ground, roof pitch, number of windows in the building, percentage of facade area covered by windows and natural or mechanical ventilation. BEAT assessment is for design stage only. It can be used both for supporting the general design choices early in the design phase, and later for supporting the more detailed design choices. The total environmental effects are the sum of multiplying the environmental effect by a weighting factor. Motivated by both the increased requirements to the energy performance of buildings and the recent developments for simulation tools for building assessment, the Danish Building Research Institute (SBi) is studying a project to develop BEAT. SBi is studying how to facilitate the use of BEAT by integrating it into new simulation software called BSim. This will allows both energy and environmental assessments to be performed in one operation. The new program is expected to be flexible in respect to the anticipated Canadian Environment Network (CEN) requirements. Early signs of the anticipated merge suggest that it is useful to support decision during design phase (DBRI, 2006, Pedersen, et at., 2008).

2.5.1.13 LCAid (Australia, 2001)

LCAid is the Environmental Life Cycle Assessment Design Aid software package developed by department of public works and services categories. It is to identify the largest impacts over the building life cycle. It is user friendly decision making tool used to evaluate the environmental performance of design options over its life span. The program inputs are: raw materials, building product manufacture, energy, and water. Outputs include: resource extraction, emissions to air, water, land and waste, demolition reuse, recycling and disposal. The software outputs identify the areas that have the greatest impact on the environment so it could be reduced by other solutions. LCAid improvements included to separates the environmental impacts within each indicator into four stages; construction, operation, maintenance and demolition (Eldridge, 2002, Graham, P. 2000).

2.5.1.14 BEES (US, 2002)

Building for Environmental and Economic Sustainability (BEES) is a program to help making an environmental but cost effective building. BEES measures the life time effects of the building and its components. The categories of assessment are in terms of:

Global warming, Acidification, Eutrophication, Resource Depletion, Indoor Air Quality, Solid Waste, First Cost and Future Cost. The software strength comes from the extensive assessment for economic performance of a building using the American Society for Testing and Materials (ASTM) standard. It produces results for environmental performance and economic performance and an overall performance as shown in Figure 2-9. All stages of buildings construction are analyzed from the row material manufacture and transportation to the waste management. The program is constantly developing by adding assessment categories and new materials to the software database in order to keep up to date with the latest editions in the green designs. BEES 4.0 function to the newest data from U.S. EPA and have more than 200 building products in its database (BEES, 2007, Lippiatt, et.al., 2002).

2.5.1.15 EECRB (Egypt, 2005)

The energy efficiency code for residential and commercial buildings (EECRB) in Egypt will be discussed in detail in Chapter 3 in point 3.4.3, as part of the current situation of the Egyptian environment.

2.5.2 Programs that assess the whole building.

2.5.2.1 BREEAM (UK, 1990)

The Building Research Establishment Environmental Assessment Method (BREEAM), initiated as a tool for assessing the environmental performance of a building. BREEAM assessment is divided into 9 categories: Management, Health & Comfort, Energy, Transport, Water, Materials, Land Use, Ecology and Pollution. It was initially started as a questionnaire based tool. These questionnaires were designed for each stage of a building from design to post-operation. The actual credits were given to a building only on two stages: concept design stage and the preparation of construction stage. One criticism for BREEAM was that finished buildings sometimes differ from the design.

This has been addressed in the latest version of BREEAM (2008) by introducing a post construction assessment. This assessment will ensure that all the specifications stated in the design are carried out in the actual building (BREEAM, 2009, BERR, 2008, Howe, 2008). Another criticism for BREEAM was that design teams used to copy whole paragraphs of the checklists provided by BREEAM and put it in the design specification to get the credits from the assessor. Also a lot of credits could have been obtained from number of very small additives to the design (for example parking sheds). These credits will help buildings in getting a high rating without necessarily being green as a whole. In BREEAM 2008 mandatory credits was introduced to address this problem. These credits will ensure a minimum application of a holistic view of green concept in the rated buildings. Also by making the Code for Sustainable Homes and BREEAM or equivalent mandatory in April 2008, this will secure sustainable measures in larger developments (BREEAM, 2009, BERR, 2008, Howe, 2008, Glasson et al., 2005).

BREEAM initially didn't include benchmarks for number of criteria; it used to make reference to them. This was designed to help BREEAM being flexible. In BREEAM 2008 a lot of credits have been expanded especially setting benchmarks for CO2 emissions to align with the new Environmental Performance Certificate (EPC). BREEAM assess new and existing building for deferent types of buildings: Courts, homes, Industrial buildings, Multi-Residential, Prisons, Offices, Retail and Education. Latest developments in BREEAM 2008 included expanding the assessed building types to include BREEAM Healthcare and BREEAM Further Education. As a reaction to the evolving market of green buildings and the urge to use the highest environmental developments in buildings industry; a new rating level (BREEAM outstanding) has been introduced in 2008. This will enable innovative designs to be recognized for being leaders in their domain (BREEAM, 2009).

2.5.2.2 HK-BEAM (Hong Kong, 1996)

The Hong Kong Building Environmental Assessment Method (HK-BEAM) is a voluntary environmental assessment program for buildings. It was originally developed by Real Estate Development Agency but it is owned now by BEAM Society. The program main assessment categories are: site, materials, energy, water, indoor environment and innovative aspects and its award classifications are Platinum, Gold, Silver, and Bronze. It was the first program to finalize its assessment only when the building is completed. HK-BEAM is updating periodically to keep up with the industry standards and regulations. New versions were released on 1999, 2003 and 2005. The latest version HK-BEAM 4/04 has a lot of modifications to respond to the developing market of green buildings. BEAM 2004 highlighted the increasing importance of Indoor Environmental Quality (IEQ); by making it necessary to obtain minimum credit for it in order to be eligible for a grade. The grade awarded is based on percentage of applicable credits gained both for IEQ and overall assessment. BEAM is considered a very successful assessment tool. Though being voluntary program, in 2003, over 100 buildings have been submitted for voluntary assessment which account for 25% of commercial space, and approximately 10% of dwellings. This indicates a high market acceptance to the scheme. This could be owed to the fact that the industry has been an active partner in developing BEAM. As a reaction to the increased importance of web-based tools in environmental assessment, HK-BEAM is currently undergoing studies for the development of a tool for preliminary self-assessments on the web. (HK-BEAM, 2009, Huang et al., 2000, WBCSD, 2007, Burnett, 2004, Edmunds & Chan, 2004).

2.5.2.3 LEED (US, 2000)

Leadership in Energy and Environmental Design (LEED) is a voluntary rating program. It evaluates the environmental performance of almost all types of buildings (new construction, existing buildings -operations and maintenance- commercial interiors, core and shell, schools, retail, healthcare, homes and neighborhood development). It was developed by U.S. Green Building Council (USGBC's) to give the building market worldwide a unified tool to assess green buildings on, so they would be easier to compare. LEED have been criticized for having the same weight for all of its assessment categories. In the latest version LEED 2009 or V3, a development have been made to address these concerns by having different weightings for credits depending on their ability to impact the environmental and health. It also award more points for energy efficiency and CO2 reductions. As all of the new generations of EIAP, LEED 2009 will include an online tool intended for quick and easy assessment (USGBC, 2009, Yudelson & Fedrizzi 2007, BSRIA 2009).

2.5.2.4 GBTool (International 2000)

GBTool was initially to evaluate; commercial, institutional and residential buildings both new and existing. From 2005 and due to the growing market for green buildings, new building types have been added; hospital, hotel or motel, industrial office, public institutional, public assembly, restaurant or food service, retail, school or university, supermarket and mixed-use project. GBTool was initially for design stage assessment, but from 2005 the assessment could be carried out for all stages of building, provided that benchmark model information is available. This came as reaction to the growing demand for the program in recent years and as a reaction to questionnaires on how to improve the program. One more additive to the program in 2005 was that it now allows comparisons to be made with LEED and Green Globes. GBTool have always been criticized for being a frame work tool and the user are expected to use other simulation programs to calculate and predict different categories impacts for example energy efficiency and air quality. The assessment is done in seven general performance categories: Resource Consumption, Environmental Loadings, Indoor Environmental Quality, Service Quality, Economics, Pre-Operations Management and Commuting Transport. The categories scores are weighed according to predetermined weighting system to provide uniformity and comparability. In 2002, a new version has been introduced with more refinements and automation. One raised issue about the program is the amount of information it require to perform an assessment. The program compares the assessed building against a benchmark one (regionally defined) to find out the percentage of environmental achievements. It requires not only the data provided from the design team about the assessed building, but also, data for the benchmark building from a national team of experts. GBTool is now being used as a base for developing a website-based system for environmental assessment GB-WSAT (GBC, 2005, Yang et al., 2005, Cole, 2002).

2.5.2.5 NABERS (Australia, 2003)

National Australian Buildings Environmental Rating System (NABERS) is a voluntary EIAP for existing buildings; office buildings and homes. It rates a building according to its actual measured performance during operation. Its main categories are: refrigerant use, water use, storm water runoff and pollution, sewage outfall volume, transport, landscape diversity, toxic materials, waste, Indoor air quality and occupant satisfaction. As the new direction for the new generation of assessment tools to be more comprehensive, in 2008 NABERS incorporated the Australian Building Greenhouse Rating (ABGR). It has been re-named NABERS Energy for offices. One of the Latest additives to NABERS also was that it now incorporates a web-based planning tool; BASIX. BASIX certificate will be mandatory for any development approval (NABERS, 2009, Yang et al., 2005).

2.5.2.6 CASBEE (Japan, 2004)

Comparative Assessment System for Building Environmental Efficiency (CASBEE) is specially designed assessment tool for the Japanese culture. It assesses energy consumption, resource productivity, local environments and indoor environment. CASBEE assess all stages of building form design to post-operation. In 2006 a number of local authorities introduced CASBEE into their building administration; therefore, its assessment is now carried out in many buildings in Japan. CASBEE like all EIAP are constantly evolving and its latest edition released in 2006 included and the introduction of CASBEE-H specified for detached houses. Another additive is the introduction of a brief web-based version that make a provisional assessment of a building in two hours (Murakami et.al., 2002, JSBC, 2006, Kibert, 2007).

2.5.2.7 CEPAS (Hong Kong 2005)

In August 2005, the Hong Kong Government's Building Department launched the Comprehensive Environmental Performance Assessment Scheme (CEPAS), a new buildings' rating system. It could assess various types of buildings. It assesses different stages; pre-design, design, construction, operation & demolition, with separate result for each stage. The certificate awarded will be valid for five years. It assesses Resource Use; Loadings; Site Impacts; Neighborhood Impacts; Indoor Environmental Quality; Building Amenities; Site Amenities and Neighborhood Amenities. It also considers other social-economic factors, such as impacts on surroundings, communal interactions, building economics, transportation, and heritage conservation. Even though being a voluntary scheme, local governments seem to be the most active in introducing CASBEE for practical use. Having considered Hong Kong two schemes HK-BEAM and CEPAS, in December 2006, the Provisional Construction Industry Co-ordination Board recommended the adoption of HK-BEAM as the integrated model for Hong Kong, subject to BEAM society agreeing to incorporate the desirable features of CEPAS into BEAM to create a more comprehensive scheme (HKSAR, 2006, Endo, et al., 2007, Endo, et al., 2008, CSD, 2008).

2.5.2.8 Minergie-ECO plus (Switzerland, 2006)

Minergie-ECO plus was advertised as a new, user friendly method for evaluating the sustainability of buildings. Launched in June 2006 Minergie-ECO plus is a quality label for new and renovated buildings of almost all types. Its assessment requirements are compatible with the European Energy Performance Building Directive (EPBD). The market in Switzerland was prepared for the launch of an assessment program for green buildings with over 7600 buildings that have been certified in the nineties with

MINERGIE label (15% of the market). Minergie-ECO plus stresses on the energy efficiency aspects of a building. It has two unique features that define this program. Firstly, that it make assessment for small buildings (less than 500m2). Secondly, that it encourages the use of renewable sources of energy. (IEA, 2007, MINERGIE, 2007, MINERGIE, 2009).

2.5.2.9 Green Building Regulatory Guidelines for Dubai (Ras Al-Khimah, 2008)

The initiative of Dubai is under development by Rakeen. The new regulations ascertain the evolution of the Emirate into an eco-friendly and sustainable destination. As a minimum all green buildings shall conform to standards within schedule to assess performance on: site selection, building orientation, water efficiency, energy efficiency, ventilation and indoor quality, grey water recycling and building control system. This initiative has emerged now due to number of reasons; it will reduce the demand on Emirate power grid by at least 50%, reduce the carbon foot print by more than 50%, produce net construction savings, increase projects value and improve return investments (Rakeen, 2008, Puckett, 2008).

2.6 EIAP comparison

A comparison between eleven of the past EIAP for buildings is described in the next part of the research in order to collect information on the main features of EIAP and establish the most common categories and weighting methods used. The availability of the information needed to conduct a comparison was the main reason for choosing these programs. Viewing similarity and differences between EIAP will provide a starting point for anticipating future developments directions for building environmental assessment tools, how they are likely to evolve, how they will be used and how they will dovetail with other variables changes. The comparison will be on the following four points:

- Nature, purpose and targeted building group.
- Categories of assessment.

- The weighing method for credits.
- Building stage application.
- New added features

The first point is the nature of assessment in EIAP and from the comparison presented in Table 2-2 it shows that all of the programs in the comparison are voluntary (the only exceptions found from the literature review was the Japanese HQAL and the Code for Sustainable Homes in the UK which became compulsory from August 2008). The second point in the comparison is the purpose of the assessment and from the table there is a split over the purpose of an EIAP, some programs aim to label a building through life cycle based analysis and graphical results presentation giving design and materials options to achieve the best result possible like BEES, LC-Aid and CEPAS. The second type uses a rating system usually accompanied with checklists of detailed environmental categories and gives points and weight to each category aiming for the building assessment to achieve an overall score, for example BREEAM, LEED and GB-Tool. This type does not give design options; it will only assess the design produced. The last point of comparison on Table 2-2 is the targeted building group. Most of EIAP target all types of buildings or have different version for each type but still target most common types of buildings; residential and non-residential, with exception for some programs specifically designed for residential units or office buildings. All of EIAP could be applied to new building and all but one program could be applied to existing ones.

Results for the most common categories assessed are presented in Table 2-3, they indicate that the most common categories that can be found in every program are: energy efficiency, material efficiency, water conservation, indoor quality and performance maintenance. The next common categories which can be found in some programs but not all include; site design and environmental loading, airborne emission, solid and liquid waste. Some programs have specific categories that only address a specific need for that program, such categories are; visual quality, noise, acoustics and system controllability.

Four types of EIAP weighing systems are presented in Table 2-4; the first group assesses the building factors basically in yes or no answers and the benefit of such a rating scheme is a reduction of the time used for the assessment and a minimization of the degree of subjectivity in the assessment process. The second group which is the most commonly used in EIAP uses an additive approach; simple (1 for 1), equal weights, pre-weighted credits, weighted after scoring or weighted by expert panel. The additive approach are used in HK-BEAM and CEPAS ratings for most factors are not scalar (Cole et al., 2005), a building either satisfies the requirement to receive credit or it fails to do so.

The comparison in Table 2-5 indicate that most of the assessments rely on the accuracy of information supplied by designers and owners for design and construction stages. The assessment and certification processes of the BREEAM, CEPAS, HK-BEAM and CASBEE include for the validity of the assessment results, the after operation stage for the buildings, and, for CEPAS the rating only lasts for five years and afterwards the building should get a new assessment to keep or improve its certificate.

In Table 2-6, a question is raised about the recent developments made to EIAP and what were their main directions? In this table CEPAS will be ignored as it does not have improvement yet and the current version is the only version available for it. The first point of the comparison is regarding the introduction of new building types to be assessed in recent developments of the programs. More than half of the programs included an expansion of the number of buildings type they are able to assess. Whole buildings assessment programs are specifically adopted a policy of expanding its coverage of building types in recent years. For example; (CASBEE 2006) and (BREAAM 2008) now assess 10 different types, (LEED 2009) assess 8 types and GBTool assesses 13 different type of buildings. A consideration for building size may be introduced in the new generation of EIAP as current ratings are not distinguished based on the size of a building, however, the impact differences from conservation of energy, between a 10,000 m^2 and a 100,000 m^2 building is huge. The second point in Table 2-6 is regarding the introduction of new categories to the assessment or at least expanding existing ones. All of the new developments of the assessed programs have introduced some sort of modification or refinement to the categories of its assessment. Examples from the previous review include; for Eco-Quantum V3, the introduction of selective demolition, ozone depletion and human toxicity. More categories of assessment to include the building surrounding environment were introduced in Green Globes. New categories for specific benchmarks for CO2 emission were introduced in (BREEAM 2008) and more points for CO2 reduction in (LEED 2009).

The third point of comparison in table 2-6 is regarding the introduction of a web based assessment in recent developments of EIAP. Half of the assessed program have introduced a web based assessment or currently developing one. This indicates that the future for EIAP will have a web based orientation. (BEAM 2004, BREEAM 2008, LEED 2009, NABERS and CASBEE) all have a web based assessment tool mainly intended for a provisional assessment.

Table 2- 2: Comparison of EIAP on Nature, Purpose and Targeted Building Group.

Nature, Purpose and Target Building Group of EIAP												
		BREEAM	LEED	GB-Tool	CASBEE	BEPAC	HKbeam	BEAT	BEES	LC-Aid	ATHENA	CEPAS
Nature of assessment	Voluntary	■	■	■	■	■	■	■	■	■	■	■
	Mandatory											
Purpose of assessment	B. labelling				■		■	■	■	■	■	■
	B. Rating	■	■	■		■						
Target Building Group	Residential B.	■	■	■	■	■	■	■	■		■	■
	Non-residential B	■	■	■	■	■	■	■	■		■	■
	New B.	■	■	■	■	■	■	■	■	■	■	■
	Existing B.	■	■	■	■	■	■	■	■		■	■

Table 2- 3: Comparison of EIAP on the categories of assessment.

Categories of Assessment												
		BREEAM	LEED	GB-Tool	CASBEE	BEPAC	HKbeam	BEAT	BEES	LCAid	ATHENA	CEPAS
Resource Consumption	Embodied energy	■		■	■	■	■	■	■	■	■	■
	Operation energy	■	■	■	■	■	■	■	■	■	■	■
	Land		■	■	■	■	■		■	■		■
	Water	■	■	■	■	■	■	■	■	■	■	■
	Materials	■	■	■	■	■	■	■	■	■	■	■
Environmental loading	Airborne emission	■		■		■	■	■		■	■	■
	Solid	■	■	■		■	■	■		■	■	■
	Liquid waste			■		■				■		■
	Other loadings			■						■		■
Indoor Environment	Air Quality	■	■	■	■	■	■	■	■	■	■	■
	Thermal Quality	■	■	■	■	■	■	■	■	■	■	■
	Visual Quality			■	■	■	■		■	■	■	■
	Noise & Acoustics			■	■					■		■
	System controllability			■	■		■			■		■
Longevity	Adaptability	■	■	■	■	■	■	■	■		■	
	Performance maintenance	■	■	■	■	■	■	■	■	■	■	■
	Contextual Factors			■	■		■			■		■
	Load immediate surroundings			■	■					■		■

Table 2- 4: Comparison of EIAP on the weighting system used for each one.

The weighing system		BREEAM	LEED	GB-Tool	CASBEE	BEPAC	HKbeam	BEAT	BEES	LCAid	ATHENA	CEPAS
Pass / Fail											■	
Additive approach	Simple (1 for 1)											
	Equal weights						■					
	Pre-weighted credits	■						■	■			
	Weighted after scoring		■	■		■				■		
	Weighted expert panel											■
Special					■							

Table 2- 5: Comparison of EIAP on the application to the stage of the building

Application to Stages of Building	BREEAM	LEED	GB-Tool	CASBEE	BEPAC	HKbeam	BEAT	BEES	LCAid	ATHENA	CEPAS
Planning	■	■	■	■	■	■	■	■		■	■
Design	■	■	■	■	■	■	■	■		■	■
Construction	■		■	■	■	■	■	■	■	■	■
Operation	■	■	■	■	■	■	■	■	■	■	■
After operation	■			■		■					■
Demolition			■	■		■			■	■	■

Table 2- 6: Comparison of EIAP on the newest added feature

Application to Stages of Building	BREEAM	LEED	GB-Tool	CASBEE	BEPAC	HKbeam	BEAT	BEES	LCAid	ATHENA	CEPAS
New building types	■	■	■	■		■				■	
Expanded categories or new ones	■	■			■	■		■	■	■	
Web based assessment	■	■	■	■		■					

2.7 Discussion

Climate change and its effects on our world have been established by a lot of researches. Environment protection has become the centre of attention in all sectors of human activities. Efforts are being made around the world to combat climate change or at least mitigate its effects. The building sector is responsible for 40% of the world primary energy consumption. Buildings have direct impacts not only on their environment but also on people heath. Therefore, a considerable amount of researches have been devoted to improve the building sector standards. EIAP was one of the approaches offered to address the building sector negative impacts on the environment. EIAP was originally conceived as helping tools to evaluate building components and performance from an environmental point of view. Aimed at finding out how a building will score against a set of environmental standards, hoping to determine its most influential effects. At first EIAP followed standards like ISO, ASHARE, and CEN as guidance, now it is considered a driving force to improve these standards. EIAP could now be considered a focus for building industry. The escalating number of EIAP in use or under development in the world is evidence on the success of these programs.

The green building movement has been supported not only by the building industry but also by the market. Meeting the highest efficiency standards and having the least effects on the environment is becoming increasingly demanded by Clients (i.e. governments, companies and individuals).

The comparative review between EIAP conducted in this chapter can be summarized as follow:

1. EIAP were first conceived as voluntary but recent developments have included the introduction of mandatory minimum requirement (i.e. credits) for some programs. This was to ensure a holistic view of the green concepts. Some programs are currently being used on mandatory basis (for example; In 2006 CASBEE have been adopted as mandatory requirement by a number of local

authorities in Japan, and for NABERS 2009, BASIX certificate will be mandatory for any development to be approved in Australia, and finally the Code for Sustainable Homes 2008 is now mandatory in the UK).

2. The new developments of EIAP are directed toward more comprehensive programs that could assess almost all types of buildings (for example new building types have been added to BREAAM 2008, LEED 2009 and GBTool).

3. Assessment after the building operation is another new development that is enforced by EIAP new developments. It will give an actual view of whether the design has produced a real environmental building (for example; P-mark inspections for air-tightness and HVAC performance, also, post construction assessment have been introduced in BREEAM 2008).

4. Recent developments to EIAP have included the introduction of web based assessments. This came as a reaction to the need in the market for a quick initial assessment for the concept design. Programs that introduced a web based assessment are: BEAM 2004, NABERS, CASBEE, BREEAM 2008, and LEED 2009.

5. Improving simulation models is also another common development direction for EIAP. Programs that have improved their simulation models include: BEAT, GBTool and ATHENA 4. Also, the introduction of new regions to be able to choose from in the assessment has been introduced in ATHENA 4 and LEED 2009.

6. The expansion of the categories was another noticeable improvement in EIAP. New categories specifically regarding CO2 emissions are being introduced (for example: LEED 2009, and BREEAM 2008).

7. The final observation is about the introduction of special classifications for innovative designs (for example, in BREEAM 2008 outstanding grade). The current growing market for green buildings is demanding the highest possible achievable grade for their building to be recognized as the best practice.

The past review has provided a base for developing this research main outcome. The influence of the reviewed programs on the development of a proposed Egyptian code to assess green buildings is undeniable.

2.8 Summery

Chapter 2 presented a comparative review of EIAP for buildings from different regions and countries of the world to give a comprehensive vision on EIAP evolution, its intended role and future development directions. This chapter served as a starting pointing in understanding assessment program's development processes and the methodologies used in evaluating them, as it will aid in choosing the methodologies undertaken by this study. In the next chapter a more focus view on the Egyptian environment will be presented.

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Chapter 3: Egyptian Environmental Situation Review

3.1 Introduction

Chapter 3 will serve as an overview of the current situation in the Egyptian environment. It includes two main sections. The first section will present Egypt's general indicators, the pressures and forces influencing environmental decision making and the current action plans proposed by the Egyptian government to face the serious problems threaten its environment. The second section will present four examples from the Egyptian environment; El-Gouna Resort, The Library of Alexandria, Sierina Movanbic Hotel and Sharm El Shiek Hospital, which are considered environmental buildings in modern Egypt and were selected by our target group to be analyzed. Establishing the research problems is the main outcome of this chapter and providing justifications for the hypothesis of the study and reasons for the proposed line of research.

3.1.1 Objectives

The main aim of this chapter is to highlight the current problems that face the Egyptian environment and to serve as a starting point in understanding what is considered green or environmentally friendly architecture in modern Egypt. To achieve this aim some objectives have been developed:

- Review the current energy situation in Egypt from energy resources to consumption levels.

- Present how the buildings sector compares to other sectors in Egypt on energy consumption levels and its share of the total CO_2 emissions.
- Review the current impacts from energy consumption levels on the Egyptian environment.
- Review the measures and action planes proposed by the Egyptian government towards addressing the current environmental problems.
- Analyze what are considered to be environmentally friendly buildings in modern Egyptian architecture.

3.2 General indicators

3.2.1 Egyptian energy resources

This part of the research will present the current energy production indicators for Egypt. This will identify the growing problem regarding energy supply and consumption, and its effect on the environment. Egypt's energy resources are: 1) oil, 2) natural gas, 3) hydropower, 4) coal and in addition to good potential of 5) renewable energy resources as shown in Figure 3-1. Though Egypt is now enjoying a secured energy supply situation for the short and medium terms, yet it is mainly dependent on fossil fuels (92%) whose proven reserves are relatively limited (EIA, 2009, WRI, 2003, Georgy & Soliman, 2007). The development of the renewable resources of energy and its efficient management is considered as the core strategy to the Egyptian energy strategy (NREA, 2009).

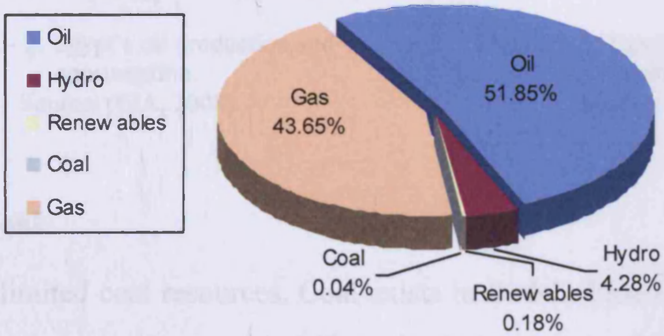


Figure 3- 1: Total energy production by source in Egypt 2004/2005 (Georgy & Soliman, 2007).

3.2.1.1 Petroleum

Petroleum energy includes crude oil and natural gas. Egypt has reserves of crude oil in the Gulf of Suez, the Sinai Peninsula, and the western desert. Natural gas is found in the Nile Delta, the western desert, Obeiyed, Khalda and the Gulf of Suez (EIA, 2009). According to (ESIS, 2008) crude oil reserves in Egypt are 4.2 billion barrels and natural gas reserves are 76 trillion cubic feet. As shown in Figure 3-2, Egypt's oil production levels are falling (from 950,000 barrels of oil per day (b/d) to 664,000 b/d in 2007) and its consumption levels are rising to 653,000 b/d in 2007 (EIA, 2008). According to Eng. Sameh Fahmy, Minister of Petroleum: (Fahmy, 2006):

> *"Another challenge facing the sector is the depletion of reserves causing production plateaus…"*

If the current rates continued, Egypt will become an oil importer country in the near future (EIA, 2008, Selim, 2007). As shown in Figure 3-3, Egypt Natural Gas production is increasing rapidly as it reached 1.9 trillion cubic feet (Tcf) in 2006 an estimate of 1.57% of the world total (EIA, 2008). Gas is considered the future of the petrol industry in Egypt.

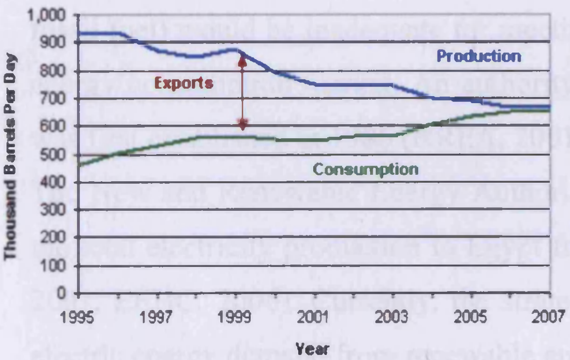


Figure 3- 2: Egypt's oil production and consumption.
Source: (EIA, 2008)

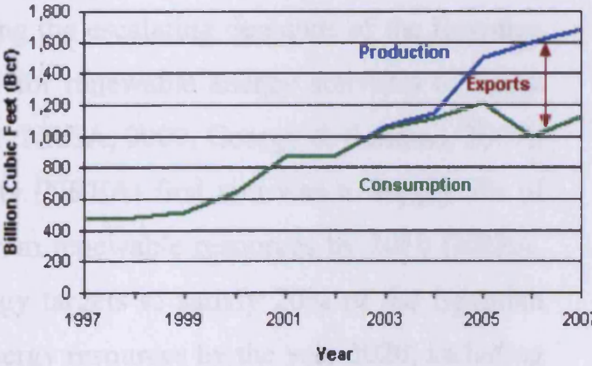


Figure 3- 3: Egypt's gas production and consumption.
Source: (EIA, 2008)

3.2.1.2 Coal

Egypt has limited coal resources. Coal exists in Bedah, Eioun Mousa, and Maghara. Maghara is the most important, with estimated reserves of 27 Million Short Tons (MST); 21 MST could be extracted using modern machinery. Coal is used mainly as a raw material and about 1 to 1.2 MST of coal is imported annually for the iron and steel industries. In 2007, Egypt's total production of coal was 0,028 MST (Low, 2005, IEA, 2006, Georgy & Soliman, 2007, EIA, 2009).

3.2.1.3 Hydropower

Aswan Reservoir, High Dam, and the Esna Hydropower Station are the main sources of hydro power in Egypt (Georgy & Soliman, 2007). New hydropower potential resources are emerging at Nagah Hamady and Assiut (Younis, 2008). A feasibility study for constructing a peak load hydropower station at Attaka on the Red Sea is being considered (EEAA, 2001). In 2005, hydropower accounted for 4.28% of the total energy production in Egypt and 12% of the total electricity production (2952 MW) (Georgy & Soliman, 2007). Recent renewals in the high dam resulted in 5% increase in electricity production (Younis, 2008).

3.2.1.4 New and Renewable Energy

From the 1980's Egypt has started recognizing that traditional energy sources (i.e. fossil fuel) would be inadequate for meeting the escalating demands of the Egyptian energy consumption market. An authority for renewable energy activities in Egypt was first established in 1986 (NREA, 2001, NREA, 2009, Georgy & Soliman, 2007). The New and Renewable Energy Authority (NREA) first aim was to supply 3% of the total electricity production in Egypt from renewable resources by 2010 (NREA, 2001, EEHC, 2006). Currently, the strategy targets to satisfy 20% of the Egyptian electric energy demand from renewable energy resources by the year 2020, including about 12% from wind power (NREA, 2009). To some degree all the renewable energies in Egypt are being exploited. Egypt was among the first developing countries to use renewable energy resources, especially in solar energy and biomass. Renewable energies account for 0.18% of the total energy production in Egypt in 2005. Savings from Renewable sources are estimated at 0.395 MTOE in 2005 (Georgy & Soliman, 2007).

I. Solar Energy

Solar energy is considered one of the most important renewable energy resources in Egypt. Egypt lies in the Solar Belt between latitudes 22 and 32 with a daily 9-11 hours of clear sunshine. The German Aerospace Centre (DLR) has estimated the economically proven solar energy potential for Egypt as 73,656 TWh/year, with an average total solar radiation 1900-2600 kWh/m2/year. A lot of experts have agreed that high cost is the main barrier in using solar energy in Egypt on full scale (FMER, 2007, Georgy & Soliman, 2007, Younes, 2006, NREA, 2001). The applications of solar energy in use in Egypt are:

(1) Solar thermal water heating for domestic and commercial sectors;

Domestic Solar Water Heating (DSWH) system was first introduced to Egypt in 1980. an estimate of 200.000 DSWH are actively used in Egypt in 2005, particularly in new desert cities. Solar water heaters account for 65% of the total energy savings in Egypt from 1990 to 2000. the Egyptian renewable energy strategy include the installation of 1.25 million typical DSWH by 2020, (NREA, 2001, Georgy & Soliman, 2007)

(2) Solar thermal electricity generation;

The first solar thermal integrated power plant is due to open in 2009/2010 with capacity of 150 MW. Another two plants are planed for 2020 with capacity of 300 MW each (Georgy & Soliman, 2007, Younes, 2006).

(3) Photovoltaics

Four projects are using PV systems in Egypt; The Desert Development Center at Sadat City, Basaisa project in Al-Sharkiya Governorate, the project at Meet Abou-El Kom village, in Al-Menoufia Governorate, and the pumping system at Nobareya area. PV systems installed in Egypt produced 5.2 MW in 2005. Plans to increase it to 10 MW are under development. (NREA, 2001, EL-Hefnawi, 2005, Georgy & Soliman, 2007, EL-Shimy, 2009)

II. Wind Energy

Wind energy is considered the fastest growing renewable energy in Egypt and with the most envisaged potentials. The first complete Egyptian wind atlas was published in December 2005. It provides a base for all the decisions currently being assessed regarding wind energy in Egypt. Suez Gulf Coast, Western Desert and parts of Sinai are considered the most important areas in Egypt to develop wind energy. Average wind speed is 11m/s in Gulf of Suez area and 7m/s in east Owainat area. The Egyptian Supreme Council of Energy future plans to produce 12% of total electricity from wind energy by 2020. Total wind energy installed in Egypt reached 365 MW in 2008, with plans to increase it to 12650 MW by 2020. Zafarana is considered the largest wind farm in Egypt with 850 million kWh annually with savings of 190,000 Ton Oil Equivalent (TOE). 3000 MW wind farms are planed to be implemented at Gabal El-Zait on Suez Gulf with 700 Km2 area already been divided for it (Mohamed, 2007, Mortensen, et al., 2006, EWEA, 2008, GWEC, 2009 Rashed, 2008).

III. Biomass Energy

Biomass energy in Egypt accounts for 5 MTOE / year (2005) with energy potential of 17 MTOE / year. The total amount of Biomass resources is 60 MT/year and only 30% are being used to produce energy. Biomass energy resources in Egypt are: non-Plantation biomass, fuel crops and municipal waste. 800 biogas family units have been constructed in rural villages. Potential for small biogas plants is estimated as more than 1 million units. Currently several projects are being research by NREA to integrate small pilot projects for biomass usage in Egypt (FMER, 2007, UNEP, 2003, NREA, 2001, NREA, 2009, Georgy & Soliman, 2007)

3.2.2 Water resources

Water recourses in Egypt are: the northern interior basin, the Nile basin, The northeast coast basin, and the Mediterranean coast basin. The Nile Waters Agreement (1959) allocated 55.5 km3/yr to Egypt, which is considered the main water source in Egypt. The water used in 2000 was estimated at about 70 km3 which is already far in excess of the available resources (Bates, et al., 2008). Egypt uses 1,055 cubic meters (278,702 gallons) of water/person/year. Domestic usage in 1996 accounted for 7% of the total surface water withdrawals (FAO, 2005, Hvidt, 1995, Bayoumi, 2009). With growing population and reduction in water availability, as shown in Figure (3-4), the Egyptian water policy has focused on integrating water management and reuse methodologies Efforts have been directed at reducing water waste in households and public buildings (NCWCP, 2009, MSEA, 2008). Programs for treating domestic wastewater are available only in areas with wastewater collection networks (i.e. Egyptian large cities). In 2004, 1.0 Billion Cubic Meters (BCM) of primary treated wastewater from domestic sewage was being used in irrigation. In the Mediterranean coasts, the Red Sea coasts and the Sinai Peninsula there are plants where desalination is being used to provide domestic water supply (Attia, 2004). Significant water savings can be made by improvements in recycling water measures and systems in Egypt. Egypt is expected to increase its recycled water amount 10 times by 2025 (Lazarova & Bahri, 2004).

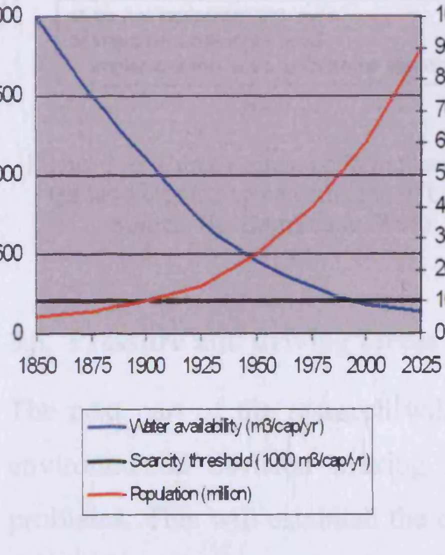


Figure 3- 4: Evolution of the per capita water share in Egypt.
Source: (Viala, 2008)

The Targeted Housing Plans for the 6th 5-year Plan and 1st Year 2007/08 Compared to 2006/07**

Description	2006/07		Targeted 2007/08		6th 5-year plan	
	Number	Relative Importance %	Number	Relative Importance %	Number	Relative Importance %
Urban Housing						
Economy	140	50	145	47.5	650	50
Medium	40	14.3	45	14.8	160	12.3
Upper medium	15	5.3	15	4.9	90	6.9
Total	195	69.6	205	67.2	900	692
Economy housing in reclamation and rural areas	85	30.4	100	32.8	400	30.8
Total	280	100	305	100	1300	100
Public Sector	14	5	16	5.3	150	11.5
Private Sector	266	95	289	94.7	1150	88.5

Figure 3- 5: The targeted housing plans in Egypt.
Source: (ESIS, 2007)

3.2.3 Construction sector

In 2006/2007, construction sector growth rate was 15.8% and accounted for 6.2% of the total Gross Domestic Product (GDP) in Egypt (ESIS, 2007a). Long term strategies of the Ministry of Housing, Utilities and Urban Development (MHUUD) have successfully raised the populated area of Egypt from 4% to 5.5%. The main direction of increase was toward new urban communities in the desert. In 2006/2007, 280,000 housing units have been built 95% by private sector and 5% by public sector, as shown in Figure 3-6. 23 new cities are to be built as part of the long term strategy of MHUUD (ESIS, 2007). 70% of the construction industry implements the laws and codes organizing construction with some violations, as shown in Figure 3-6. Most of the violations take place during projects construction, as shown in Figure 3-7 (El-Demirdash, 2008).

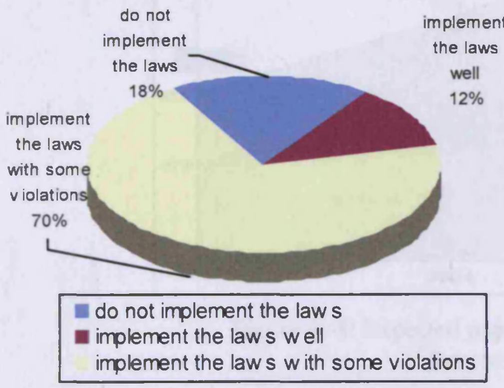


Figure 3- 6: Current situation in implementing the laws organizing construction in Egypt. Source: (El-Demirdash, 2008)

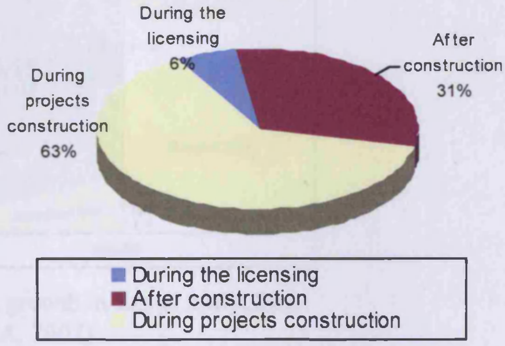


Figure 3- 7: Timing of violations. Source: (El-Demirdash, 2008)

3.3 Pressure and driving forces

The next part of the research will present the current driving forces that influence environmental decision making in Egypt as it demonstrate the major casus of problems. This will establish the current environmental crises that face the Egyptian environment. Reviewing the current pressure forces as; growing population, energy consumption levels, buildings sector share of consumption and the negative impacts on the Egyptian environment, were the main influence to this research scheme and its line of investigation.

3.3.1 High population growth rate

The total population of Egypt is estimated at 83,082,869 in July 2009 (CIA, 2009). Egypt is ranked the 16th in the world. With population growth rate of 1.642% (CIA, 2009). Egyptian population more than doubled in the last 30 years. The population have risen from 36 million in 1976 to 76.5 million in 2006, according to the Central Agency for Mobilization and Statistics –CAPMAS (MSEA, 2007). With the latest birth rate estimated at 21.7 births/1,000 in 2009 (CIA, 2009), Egypt population will at least reach 96 million by 2020, as shown in Figure 3-8. The rate at which the population in Egypt is growing is considered one of the most influential driving forces in a lot of policy and strategy decisions in Egypt.

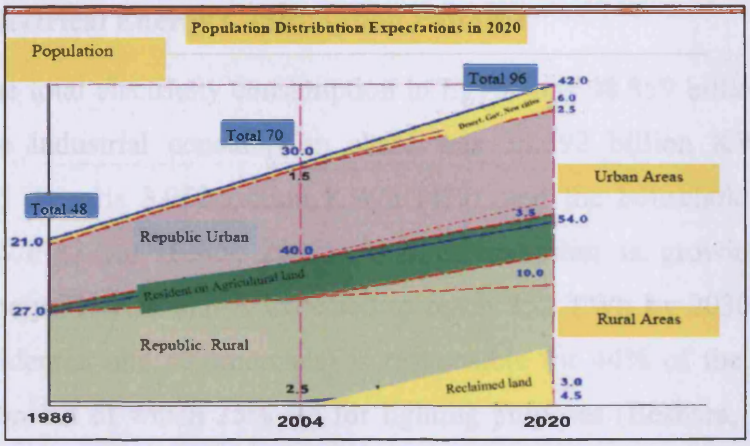


Figure 3- 8: Expected population growth in Egypt until 2020.
Source: (MSEA, 2007).

3.3.2 High energy consumption rate

3.3.2.1 Total Energy Consumption

Egypt's total energy consumption has risen from 69.6 MTOE in 2007 to 74.3 MTOE in 2008, achieving annual growth rate of 6.5% and recording 0.7% of the world total (BP, 2009). Total energy consumption by fuel type is presented in Table 3-1 and Figure 3-9 showing that fossil fuels are the main energy source with 95% and hydropower and renewable energies does not exceed 5% of the total energy. Residential and commercial sector are known collectively as building sector in Egypt. Building sector in 2007 was responsible for 23% of the total energy consumption in Egypt and is expected to reach 35% by 2030 (Beshara, 2008).

Energy consumption by sector, 2009, MTOE	
Oil	32.6
Natural gas	36.8
Coal	1.0
Total fossil fuels	70.4
Hydroelectric	3.9

Table 3- 1: Total energy consumption by fuel 2008. Source: (BP, 2009).

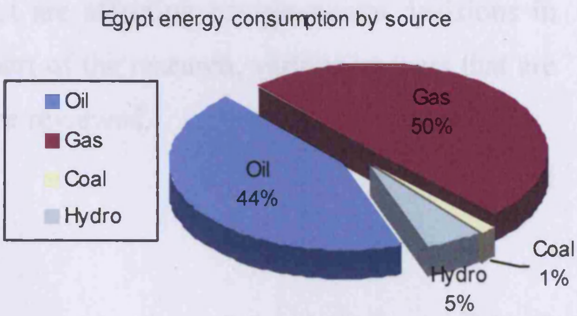


Figure 3- 9: Percentage of total energy consumption by fuel. (BP, 2009)

3.3.2.2 Electrical Energy Consumption Patterns

In 2007, the total electricity consumption in Egypt was 98.859 billion KW/h (ESIS, 2007). The industrial consumption share was 34.592 billion KW/h (35%), the agricultural share is 3.952 billion KW/h (4%), and the household usages 36.565 billion KW/h (37%) (ESIS, 2007). This consumption is growing at a rate of approximately 7%/year and is expected to reach 353 TWh by 2030. The buildings sector (residential and commercials) is responsible for 44% of the total electricity consumption out of which 25% are for lighting purposes (Beshara, 2008). In 2000, field survey has been conducted to examine residential energy pattern consumption. As shown in Figure 3-10, the results of the survey showed that lighting loads represent 34% of the total consumption followed by the refrigerators 22%, washing machines 18%, and air conditioning 12% (Yassin, et al., 2006, Yassin, 2007). Lighting only is responsible for 20% of the total energy consumption in Egypt according to the Minister of Electricity and Energy Hassan Yunis (ESIS, 2008).

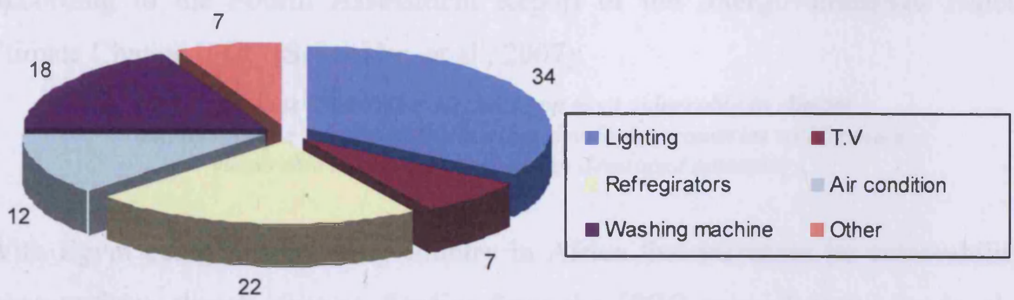


Figure 3- 10: Percentage of energy consumption share for each type of equipment in buildings sector in Egypt in 2000 (Yassin, et al., 2006).

3.3.3 Energy consumption impacts on the Egyptian environment

From the previous review the forces that are affecting environmental decisions in Egypt have been identified. In the next part of the research, various impacts that are affecting the Egyptian environment will be reviewed.

3.3.3.1 Energy related CO2 emissions

In 2006, the total CO2 emissions from consumption of fossil fuels was 151.62 (Million Metric Tons of CO2) and Egypt was ranked 30 on the world (EIA, 2009). In 1990, CO2 represented about 72% of the total GHG emissions in Egypt and 88% of it was from energy sector (EEAA, 1999). As shown in Figure 3-12, residential sector in 1999 accounted for 11 % of the total CO2 emission in Egypt (Earth Trends, 2003).

CO^2 Emissions by Sector, 1999 (in million metric tons of CO2)	
Public electricity & heat production	33
Other Energy Industries	5
Manufacturing Industries and Construction	29
Transportation	18
Residential	11
Other Sectors	8
Total Emissions All Sectors:	105

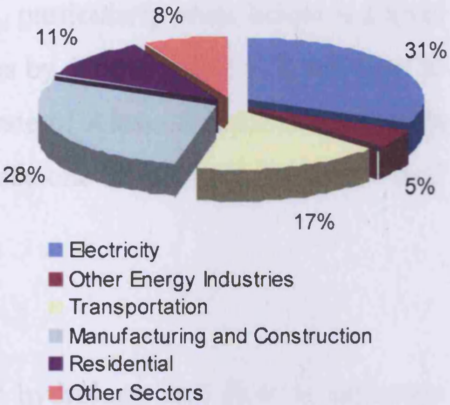


Figure 3- 11: CO2 emission by sector in Egypt 1999 (Earth Trends, 2003).

3.3.3.2 Climate change and effects on Egypt

According to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change IPCC (Schneider, et al., 2007):

> *"Africa is likely to be the continent most vulnerable to climate change…there is high confidence that developing countries will be more vulnerable to climate change than developed countries;…"*

With Egypt being a developing country in Africa that increases its vulnerability to impacts from climate change. Studies from the IPCC using 1-meter sea-level rise have projected a 1% estimated land lose in Egypt (IPCC, 1995). Although green house gases in Egypt do not exceed 0.6% of world total emissions, climate change impacts from rising temperature, rising in sea water levels and changing in rainfall patterns, will certainly affect the Egyptian environment. Currently, there are no accurate studies on negative impacts that Egypt will endure due to global climatic changes (MSEA, 2007, MSEA, 2009). Predictions on the anticipated climate change impacts on Egypt include:

I. Sea level rise

Climate change on coastal resources is ranked as the most serious threat to Egypt. Costal zone around the Nile delta is currently subsiding at 3-5mm/year (Agrawala et al., 2004). More than 40% of the Egyptian population is located in Egypt's coastal zone. UNEP and Alexandria University studies have proved that sea level rise would cause the submergence of a clear part of the delta, particularly areas below sea level (MSEA, 2007, MSEA, 2009). If the sea water rises by 50 cm by 2050, it will lead to displace nearly 1.5 million people in the governorate of Alexandria alone (Agrawala et al., 2004, Sawahel, 2005). It will also mean to lose one of the most fertile low land in Egypt (MSEA, 2007, MSEA, 2009).

II. Water resources deficiency

The effects of climate change on the Nile river hydrology and flow is uncertain (Bates, et al., 2008). It might lose 30 - 60% from its main resources (MESA, 2007, MSEA, 2009). By 2025, water availability in Egypt is projected to be less than 1,000 m3/person/yr and a general increase in irrigation demand is also expected (Bates, et al., 2008). Research in new desalination technology is required as its current high cost might be the barrier of using it in the future. (Bates, et al., 2008)

III. Agricultural crops deficiency

Temperature rises will be likely to reduce the productivity of major crops in Egypt and increase their water requirements (Bates, et al., 2008). A prediction of farming productivity decrease 50% (MESA, 2007, MSEA, 2009). A decrease of 11% for rice and 28% for soybeans is expected by 2050. Climate change on agriculture in Egypt could be reduced by adaptation techniques (Boko, et al., 2007).

3.4 Agenda for actions

3.4.1 General action plans

The Egyptian government has long realized the need for mitigation measures to address the current environmental threats. Different action planes have already been established or still under development. 1994 witnessed the first major step toward acknowledging that the current environmental situation in Egypt needs direct action plan on a policy level. The issuance of Law 4/1994 for the protection of the environment came as a first step toward addressing the Egyptian problems regarding the lake of legislations to tackle environmental threats. The law has established near and long term plans for environmental management. Egypt has ratified a considerable amount of international environmental protection protocols to mitigate climate change, for example, the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto's Protocol (EEAA, 2007).

Several ministries in Egypt have initiated its own plans for addressing the environment. The Ministry of Electricity and Energy have established several projects in the field of New and Renewable Energy (Wind - Solar - Hydro - Bio). The Ministry of Water Resources and Irrigation have implemented projects for shore protection (EEAA, 2007). Annual guidance books and reports are published by MSEA and EEAA. Another milestone was the establishment of the National Committee of Climate Change (NCCC) in 1997 and its re-structure by Prime Minister Decree No. 272/2007 (EEAA, 2007). This committee directly addresses mechanisms and means of implementation of national policies to address climate change in Egypt. The establishment of the Egyptian Designated National Authority (DNA) for Clean Development Mechanism in 2005 came as a result to the ratification of Kyoto protocol for Promoting Renewable Energy Technologies in Developing Countries (CDM) (one of the Kyoto protocol implementing tools). In 2007, a total of 39 projects have been approved in different areas addressing the environment (i.e. New and Renewable Energy, Industry, Waste Recycling, Forestation, Energy Efficiency, and Fuel Switching to Natural Gas) (MSEA, 2008). . More detailed information on these projects is in Appendix (4).

Specific programs have been established to address specific targets. For example: the issuance of Initial National Communication (INC), in 1999 to make an inventory for greenhouse gases. Also, the foundation of a National Action Plan for Climate Change was set, followed by the establishment of the national network for monitoring emissions from factories and cement companies in 2007. Programs to control pollution from vehicle exhausts have been developed, including a project for garage relocation outside residential blocks (EEAA, 2007, MSEA, 2008). Another example is The Egyptian Green Building Council, which has been launched in January 2009 under the Chairmanship of The Minister of Housing, Utilities and Urban Development. It will be specifically responsible for introducing and managing green buildings in Egypt (Osman & Hassanein, 2009).

3.4.2 Efficient and national use of energy in the building sector

The building sector in Egypt is currently responsible for 58% of the total electricity consumption (Beshara, 2008). One of the first examples for the actions taken to address Egyptian building sector energy efficiency was in 1987. MHUUD issued a decree that new buildings in new communities should be equipped with solar water heating systems to be licensed. This decree was partially active from 1988 to 1993 (Georgy & Soliman, 2007). This decree is not actively used now in practice. Some of the reasons for the failure of this initiative have been identified by (Georgy & Soliman, 2007) as:

> *"...poor quality, lack of maintenance and after sales service, and non existence of enforced standards and codes..."*

In 2003/2004, studies for energy efficiency opportunities in governmental buildings and public lighting have lead to the Energy Efficiency Initiatives in Governmental Buildings (EEIGB). EEIGB was firstly applied on the buildings of the Ministry of Electricity and Energy. Governmental buildings are expected to save 10% of its annual electricity consumption which will lead to a total save of 0.2 MTOE and 0.61MT of CO2 (Yassin, et al., 2006, Yassin, 2007, Beshara, 2008).

A recent attempt to address building sector energy consumption level was initiated by the Minister of Industry. Energy efficiency labels and standards for household equipments were issued for three selected appliances; refrigerators, air conditioners and washing machines. This initiative has started on a voluntary basis in 2007 (Yassin, et al., 2006, Yassin, 2007, Beshara, 2008). These labels are directly aimed to manage the demand side of building sector and to help consumers chose the right equipments. New laps for testing the selected appliances are being initiated in NREA. The current laps for testing energy consumption comply with max and minimum requirements of ISO/IEC 17025 and the Egyptian standards 3795/2008 (NREA, 2009).

3.4.3 The development of energy codes for buildings in Egypt

This part of the research will present some trials in the development of Egyptian environmental codes for buildings. The code of practice currently in use in Egypt is a general regulations and guidance for buildings construction. Certain regulation to be adopted in buildings to attain license for construction, for example certain dimensions and minimum area requirement for windows in the north façade no less than 20% of the total façade area. As a whole the current code of practice does not mention environmental requirements for buildings and it does not have a bench mark for minimum environmental requirements. At the moment the Housing and Building Research Centre (HBRC) is the institution liable for producing codes of practice in Egypt. HBRC is an independent government research establishment subordinate to the Ministry of Housing, Utilities, and Urban Communities started from 2004. HBRC does not have a code to assess environmental buildings as a whole. The minimum requirements for a building to be qualified as environmental have been left for individual interpretations (the full list of Egyptian codes by HBRC in Appendix 8). Efforts have been made by HBRC and the Organization for Energy Planning (OEP) to introduce green architecture in Egypt but there is no evidence that they have succeeded in changing any design practices in Egypt towards improved energy efficiency (Huang, et al., 2003).

A team of experts in coordination with HBRC and OEP have developed Egypt's first energy code for residential and commercial buildings. This project was co-funded by a grant from UNDP to the Egyptian government. The first draft of the energy efficiency code for residential buildings was first released in 2003 (Huang, et al., 2003). This code was enacted by Ministerial Decree in 2005, but never enforced (Hussein, 2009). Moreover, the new Housing Law of 2007 which creates new implementing structures for building regulations is not related to this energy efficiency code (JCEE, 2008). The energy efficiency code for commercial buildings is expected to be finalized in 2008 (Yassin, et al., 2006, Yassin, 2007, Beshara, 2008)

The new code is proposed to be applied in new communities within Cairo and Alexandria governorates, where 50% of all the country's construction occurs. The new code is proposed to be on a voluntary basis at first. HBRC has provided technical information for; building envelope, ventilation and air-conditioning, lighting from buildings survey in Egypt. The code was developed on the guidance of US standards such as ASHRAE-90.1, or California's Title-24 (Huang, et al., 2003), brief description of the code content is presented in Table 3-2. Expected savings from the application of this energy efficiency code could reach 20 to 25% of the total energy consumption for building sector (Yassin, 2007).

Another attempt that has to be recognized in the field of developing Egypt's environmental codes, is the development of "The Green Architecture Design Strategies Toolbox" (GADS). GADS is a pre design tool which has been designed to be flexible, easy to use and adaptable computer based tool. GADS main categories of assessment are presented in Figure (3-12). It is described by its authors (El Fiky, et al., 2006) as:

> *"...It is a collection of green architecture design strategies to be used by architects and urban designers in order to incorporate the green architecture principles in the new urban settlements generally in hot arid zones and particularly in Egypt's vast desert.*

The tool has been developed as a part of a PhD research. It has been tested by Dutch and Egyptian architecture students. The final refinement phase came from the application of the program by architects in practice. A test case study has been applied to Toshka region in Egypt (El Fiky, 2006, El Fiky & Cox, 2006, El Fiky, et al., 2004). GADS software is not currently used or adopted by any governmental authority or institution in Egypt.

Code Chapters	Description
Chapter 3: Requirements for the building envelope	The maximum allowable U-values or minimum insulation R-values for the opaque elements of the building, and varies the maximum allowable U-factor and Solar Heat Gain Coefficient (SHGC) for glazing as a function of the Window-to-Wall or Skylight-to-Roof ratios.
Chapter 4: Natural ventilation and thermal comfort.	Minimum requirements for openable window areas and opening areas to the ventilation shaft, and recommended ventilation rates for naturally ventilated buildings.
Chapter 5 an 6: The heating, ventilation, and air-conditioning system	Minimum efficiency requirements for unitary and packaged air-conditioning equipment, minimum efficiency requirements, requirements for duct and piping insulation and controls for split systems, and minimum efficiency requirements, and requirements for piping insulation and controls for service water heating equipment.
Chapter 7: lighting	Contains mandatory requirements for lighting controls and control of daylighted areas, and prescriptive requirements for lighting power density and daylighting.
Chapter 8: Electrical system	Minimum efficiency requirements on the electric power system, including the transformers and motors.
Chapter 9: Whole building energy performance.	Permits the calculation of whole-building energy performance using a dynamic computer simulation in lieu of the prescriptive requirements in the earlier chapters. If the whole-building energy performance of the proposed building is shown to be lower than that of a reference building, the proposed building is deemed to comply with the standard. This allowance of an alternate performance "path" for compliance is similar to the approach taken in various US building energy standards such as ASHRAE 90.1 or California's Title-24.

Table 3- 2: Structure of the energy efficiency code for residential buildings.
Source: Huang, et al., 2003

1. URBAN 1.1 Urban fabric 1.2 Land use 1.3 Public Landscape 1.4 Streets 1.5 Open spaces 1.6 Transportation and accessibility 1.7 Infrastructure	2. ARCHITECTUR 2.1 site selection 2.2 Form, zoning and orientation 2.3 Building Envelop 2.4 Construction Systems 2.5 Building Materials partially used 2.6 Building facilities and installations 2.7 Private Landscape

Figure 3- 12: GADS main categories of assessment.
Source: (El Fiky, et al., 2006)

The latest effort in advertising green architecture in Egypt was in January 2009 with the launch of The Egyptian Green Building Council (EGBC). EGCB was first approved in 2007 under the Chairmanship of The Minister of Housing, Utilities and Urban Development (EGCB main administrative structure in Appendix 8). The Egyptian Green Building Code and Green Certification System will be established by a national committee which is currently under development. HBRC developed and tested a green building model for Toshka region in 2008. The model attempted to improve thermal comfort by using deferent techniques. Elements that have been applied and tested were: air catch, shading roof, thermal insulation, different building materials and active concrete (Osman & Hassanein, 2009, Hussein, 2009, El-Demerdash, 2008).

3.5 Analysis of the Egyptian environmental architecture

3.5.1 Procedures and sampling

This part of the research will present four contemporary projects from the Egyptian environment, to review what is considered environmentally friendly building in Egypt. This review will help in understanding what the Egyptian building need to accomplish green principles and presenting weaknesses in implementation of green methods in the current examples. Our target group respondents, presented in detail in Chapter 4, have been given a list of buildings to choose what they considered green buildings and which ones to consider for analysis (full questionnaire in Appendix 1). Results from questionnaire phase I - section B, presented in details in 4.5.2 in Chapter 4, have suggested four examples to be analyzed; El-Gouna Resort, Library of Alexandria, Sierina Movanbic Hotel and Sharm El Sheik Hospital. The list of projects presented to the respondents in the questionnaire has been chosen in respect to few limitations:

- **Time limits**; in order to reflect contemporary Egypt, the projects chosen have to be either operated or designed in the past ten years 1995 - 2005.
- **Environmental design limits**; all projects nominated have been either designed or advertised as environmental buildings in Egypt, with supporting

published information about its features.

- **Diversity limits**; as the current Egyptian code for buildings does not have standards for specified buildings types, the conducted review of the current Egyptian situation had to be comprehensive as well, therefore, projects from different places and different types of buildings were considered.

Data have been collected about the four proposed projects including; concept of the design, plans, elevations, photos, electricity bills and sustainability features. Field visits to all projects have been conducted and brief interviews with occupants (when possible) have been done to get a complete vision about the projects. The projects review analysis have five parts for each project; 1) defining the project: to present the project location and designers, 2) project description: to present general information about the project content 3) environmental features: to review the green concepts used in the project, 4) assessment of the project: to evaluate the project and finally, 5) development direction: to present future direction of how this project could be developed in order to achieve more green targets.

3.5.2 Al Guna Resort

I. Defining the Project

Designer	:	Michael Griffith, Ramy Aldahan, Souhear Faried.
Date	:	1997-2003
Location	:	22 Km, North Hurgada
Customer	:	Orascom company for tourism development.

II. Project description

The project concept was to build a vernacular village surrounded with number of artificial lakes. It has a main pedestrian spin that links all the parts of the village. The project consists of a number of hotels 5, 4, and 3 stars, 200 villas, pharaoh museum (to the tourists that have no time to go to Aswan), shopping mall, health club, aquarium, open-air theater, number of cinemas, and a small car racing track. Five hotels in El Guna have received Green Globes awards (El Gouna, 2009). Figures 3-14 show the project under construction, Figure 3-13 present the project plan and 3-14 show the project concept perspective.

III. Environmental features

- **Form**: as a village that imitates old Cairo creating an image of traditional architecture and also due to climate restrictions the form concentrated on courts, domes, and volts as a method of achieving better climate conditions. In the project façade the utilization of domes, volts, and shaded terraces, with different shapes and sizes has made diversity that every project would have its own character, yet, they are all related (Albenaa, 1999), as shown in Figure 3-17. Although the owners and designers are different for each part of the project, they all embrace the court concept with deferent sizes as a solution to the plan form. Hierarchies of courts are shown in Figure 3-18.
- **Energy conservation features**: 1) energy efficient design; the designers have tried to break the sharpness of the local climate by the details in the facades form in order to minimize the use of air conditioning. Domes for residential and recreational units, shaded pedestrian spines and terraces shown in Figure 3-16 and ventilation exhaust towers to increase air movement in outdoor corridors shown in Figure 3-18. 2) The construction system for most of the village is bearing walls and concrete ceilings to minimize heat transported into indoors spaces (Albenaa, 1999). 3) Air conditioning systems: the hotels, administration, and recreation facilities have central air conditioning systems. The villas and cabinets each one has a split air condition installed in the roof.
- **Construction materials**: the main construction of bearing walls used local rocks, and local clay for dome and volts (Albenaa, 1999). Local rocks were used also as main material in all outdoor corridors, shaded terraces and indoor finishes as well, as shown in Figure 3-19.
- **Recycling of water:** the project has a water treatment station (desalinating sea/well water and utilizing treated waste). It reuses domestic water after filtration in irrigation for the greeneries (El Gouna, 2009).

IV. Assessment of the project

Al Gouna resort have maintain a lot of the environmental elements presented by the designers on its first phase, mainly because it is form based elements not technology based. Although the project has used environmental solutions like domes, court design, shaded terraces and ventilation tours, it still uses air-condition systems in all units of the project either central system or individual. There is no evidence on using energy efficient equipment on the project, not for air conditioning, lighting, heating, refrigerating, laundering, cooking or media. Recycling of construction materials or wastes has not been mentioned in the concept design and it does not have any waste recycling collecting points on site.

The use of modern technology to use the perfect conditions on site to generate energy from renewable resources has not been studied and was neglected on the original concept due to cost management reasons. If this project were to be assessed by an environmental impact assessment program like BREEAM or LEED it would not achieve any rating as environmentally conscious building with the international standards required. Overall it is a very good attempt in the Egyptian environment that showcase that design elements could have an impact on the overall satisfaction of occupants and could be first step toward a more environmental buildings.

V. Development direction

Al Gouna project future environmental development from the author point of view could focus on two directions:

1. The introduction of renewable sources of energy to produce the project requirement of electricity. Solar systems both active and passive will be preferable because of the site location, also, wind mills at the project boundary could be considered.
2. Recycling systems for solid wastes and for rain water to use as irrigation water could be considered.

Figure 3- 13: bird eye view of the village (Albenaa, 1999).

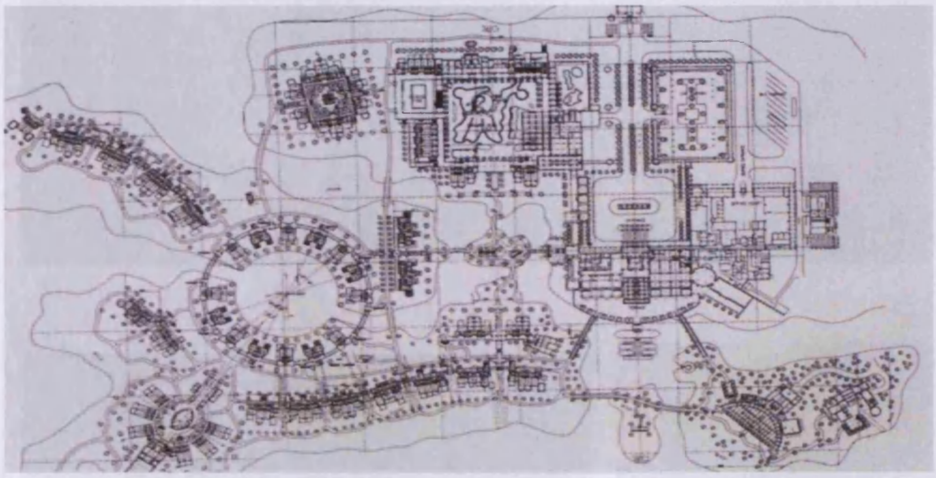
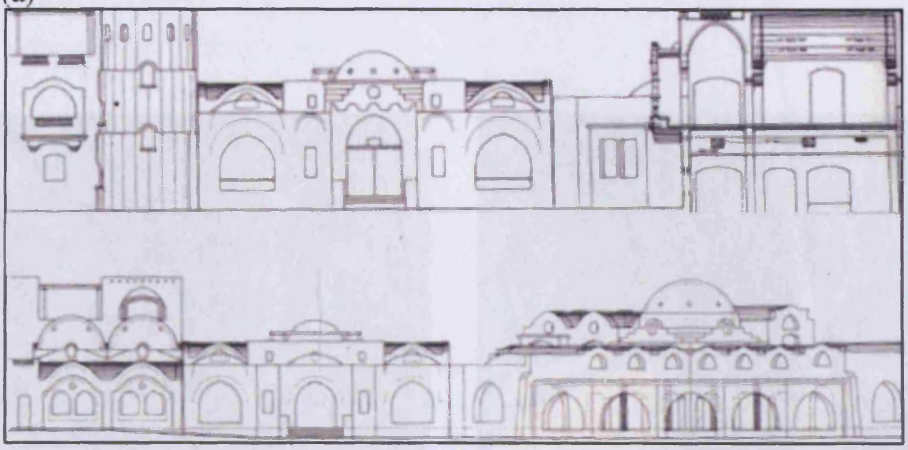


Figure 3- 14: a partial plan of hotel and its villas (Albenaa, 1999).

Figure 3- 15: Perspective from the lake to the project (Albenaa, 1999).

(a)



(b)

(c)

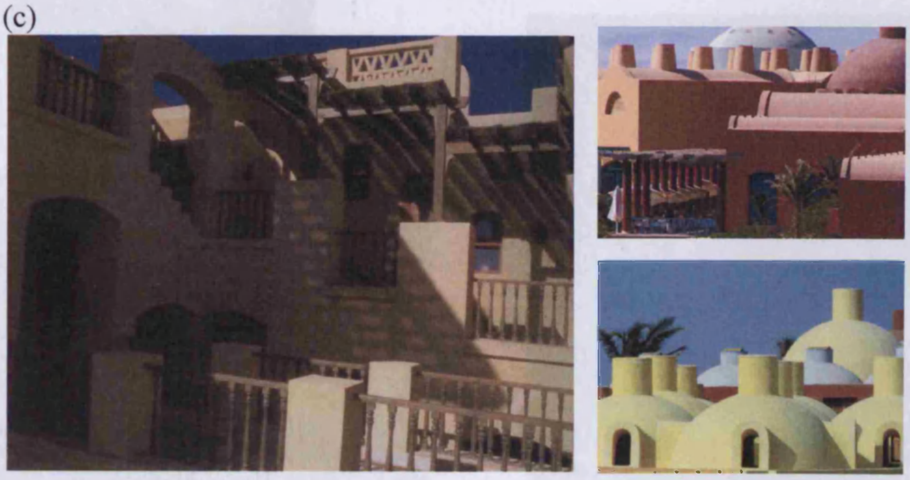


Figure 3- 16: Façade Form, the project facades in the designer drawing and after construction, noticeably, the use of domes, volts, and shaded terraces.
(Source: Albenaa, 1999, El Gouna, 2009)

(a) Elevations.
(b) Elevation composition.
(c) Domes, volts and shaded areas.

Figure 3- 17: The project plan, noticeably the court hierarchy from personal to local spaces. (Source: Albenaa, 1999)

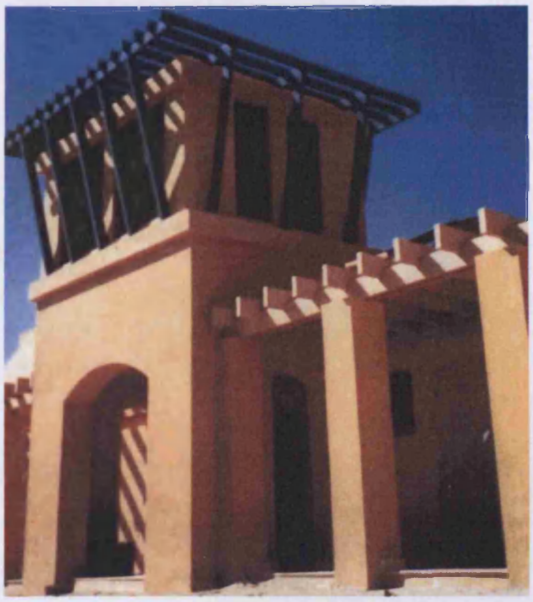


Figure 3- 18: Modern style ventilation towers, maximize air movement in outdoor corridors. (Source: El Gouna, 2009)

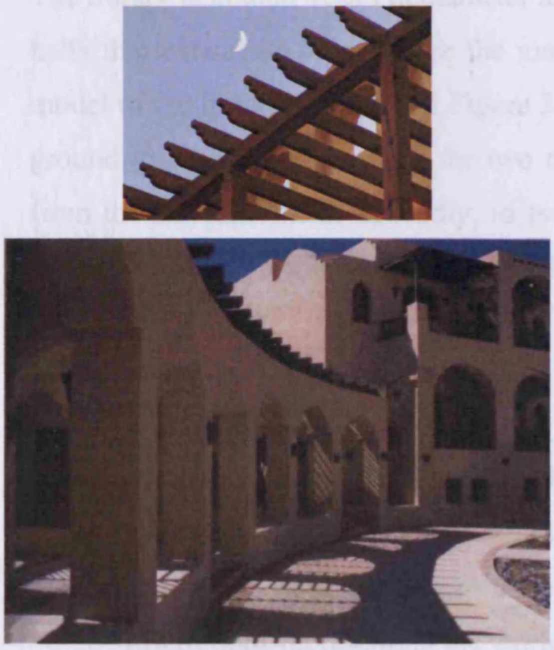


Figure 3- 19: The façade composition to maximize shades. (Source: Albenaa, 1999)

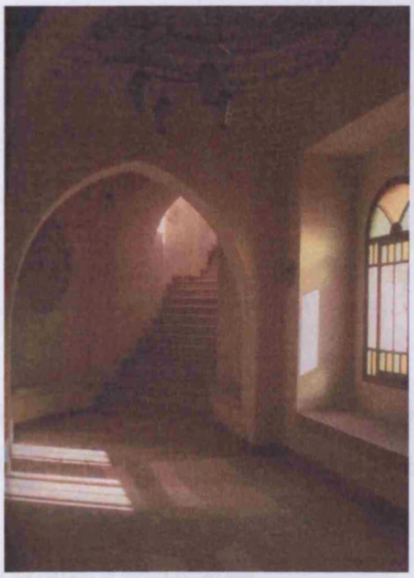


Figure 3- 20: Interior of hallway between residential parts and recreational facilities, local rocks as finishing materials. (Source: Albenaa, 1999)

3.5.3 Alexandria Library

I. Defining the Project

Designer	:	The Norwegian architecture firm Snohetta and Hamza Associates
Date	:	February 2001
Location	:	Alexandria
Customer	:	The Egyptian Government, UNESCO

II. Project description

The concept of the new design of the library has immerged from both historical and modern backgrounds. The dramatic history of the building and its new resurrection has been a main element in designing the form. The Egyptian sun is symbolically represented in the library circular shape, presented in Figure 3-21. The form of the library is sloped toward the sea for maximizing daylight. The incorporation of new technology has also been another important direction in designing the new library. The library is in total 160m in diameter and 70000 m^2 in area. The open-plan reading halls that extend on 7 levels are the main feature of the library, a computer study model of the library is shown in Figure 3-22. The form of the library is sunk into the ground (5 levels underground) for two reasons. Firstly, to appear as it is emerging from the Egyptian land. Secondly, to provide a controlled environment in order to protect the most precious contents in the library (Khoueiry, 2001, TLA, 2006).

III. Sustainability features

- **Material sustainability**: The building has been designed to have an estimated life span of 200 years. A lot of information has been published about the building being covered in Aswanian granite engraved with inscriptions representing the world civilizations, Figure 3-23.
- **Passive solar convectors**: the library roof has overhead skylights incorporated for maximum utilization of daylight, shown in Figure 3-24. The 5 meters wide skylights slope to face north for the best light. They have been

described as "hot box" because they will move air from underground levels upwards if the air conditioning system failed (Khoueiry, 2001, TLA, 2006).

IV. Assessment of the project

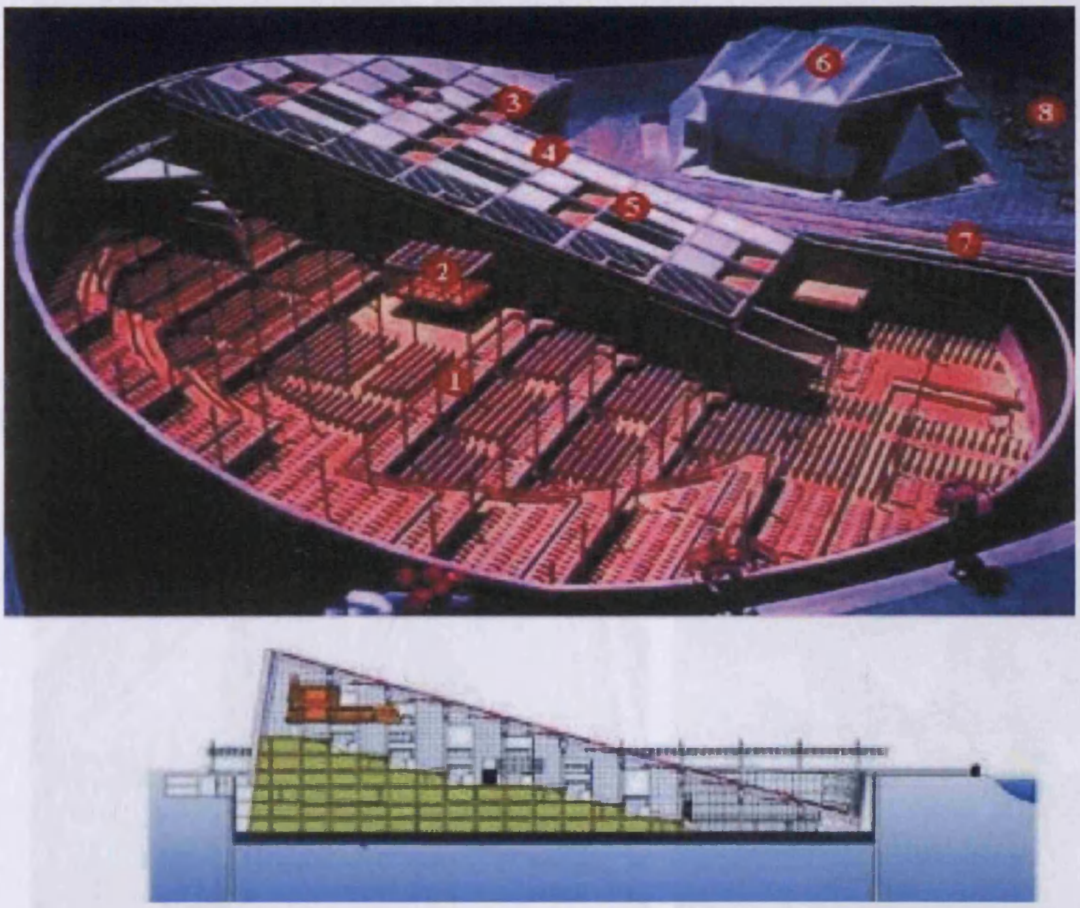
The library has been publicized as the first green building in modern Egypt and in fact it does have an overall vision of sustainability but it failed to deliver a coherent modern green building. The two green concepts presented in the library are: firstly, material sustainability outside cladding and inside finishing materials, secondly, energy conservation represented in the solar panel collectors on the main reading hall roof. The library form required the building to have five floors underground which is not typically used in Egypt especially by the sea and require a huge amount of energy to ventilate and air condition. The soil extracted from the project site was never recycled or reused. Indoor air quality and comfort is solely achieved by air-conditioning systems. Recycling for water and waste concepts were not a part of the design or operation plans. The library could have been an excellent pioneer model to present modern green concepts and how effective they could be in the Egyptian environment; instead it stressed more on the design concept and form than sustainability.

V. Development direction:

Library of Alexandria project future environmental development plans could include the next points:

- Solar active systems will be considered a good solution to integrate with the passive system that already been in use at the ceiling. It could supply the building with its electricity needs.
- Recycling systems is essential to a project of this size, recycling systems for rain and drinking water to reuse them as irrigation water and recycling system for solid wastes as well.

Figure 3- 21: Alexandria Library north facing side.
(Source: TLA, 2006)



1. Reading room with main book storage below
2. Viewing platform
3. Restaurant
4. Public entrance
5. Offices and ancillary spaces
6. Existing conference center
7. High-level walkway
8. Corniche road

Figure 3- 22: A computer Study model of the library main elements, and a section to notice the four floors under sea level. (Source: TLA, 2006)

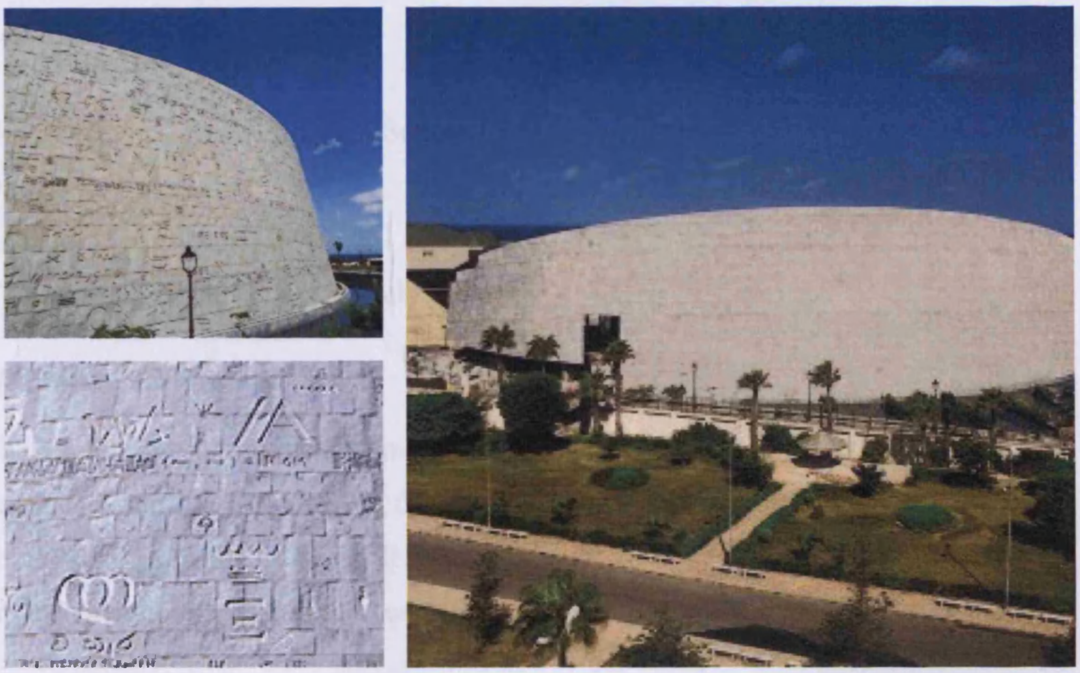


Figure 3- 23: Shots of the granite exterior of the library, etched with letters from as many of the world's alphabets as could be found. (Source: TLA, 2006)

Figure 3- 24: The roof glazing and cladding from outside to notice its huge size, ad from inside to notice the light distribution. (Source: TLA, 2006)

3.5.4 Serriena Movanbiek Hotel

I. Defining the Project

Designer : Rami Aldahan, Sohear Faried

Date : 1999

Location : North Beach

Customer : Movanbiek Hotels

II. Project description

The Hotel consists of reception, restaurant for 150 person, diving center, 178 residential unit, mall, open air theater, swimming pool, mini golf club and tennis court yard (Albenaa, 1999a). It was originally designed and advertised to be an environmental village that merges with its surroundings.

III. Sustainability features

- **Building form**: evolved from the spirit of the area, local materials and respect to local climate: 1) stepped form towards sea for maximum benefit of view, 2) design of semi closed clusters as a consideration for hot climate of the area for maximum shade as shown in Figure 3-25, 3) domes and volts are the main elements in covering the hotel deferent spaces as shown in Figure 3-26, to minimize the air conditioning systems usage on units which is considered as a form of energy sustainability, but still all units have air conditioning systems.
- **Material efficiency**: the project has maximum utilization of local materials with the resort construction system being bearing walls and some of it even used local bricks on site, domes and volts are made of local clay and the landscape on site especially in the open air theater used a top soil local bricks almost like granite, examples are shown in Figure 3-27.

IV. Assessment of the project

Serriena hotel achieved its main goal of merging in harmony with its surrounding environment with maximum integration of local bricks and clay in the construction systems and finishing materials. The designers set a goal of energy reduction by 15% in comparison to other projects with the same size and achieved it by building form, construction system and finishing materials. The project does not adopt any technological green concept for example renewable energies, which could be perfect in the site of the project to use PV cells or wind turbines and also it does not use any energy conserving equipments and this could make a huge savings especially in air conditioning system. Recycling of water or waste is not incorporated in the project.

V. Development direction:

Future development or extension for the project could use the next suggestions:

- Incorporating more energy efficient equipments especially in air conditioning and lighting as it will make huge savings in energy consumption.
- In this area the use of renewable sources of energy to produce the project requirement of electricity will be a good demonstration for sustainability in the project. Solar systems both active and passive will be preferable because of the site location, and could be introduced as first phase to generate outdoor lighting, also wind mills are suggested along shore line and it will not take much area to interfere with beach activities.
- Recycling systems for water and rain could be introduced to the project to use this water as irrigation water, as water price in this area of Egypt is relatively higher than most of the country. Recycling system for solid wastes.

Figure 3- 25: The hotel site plan, noticeably, all using the court design.
(Source: Albenaa, 1999a)

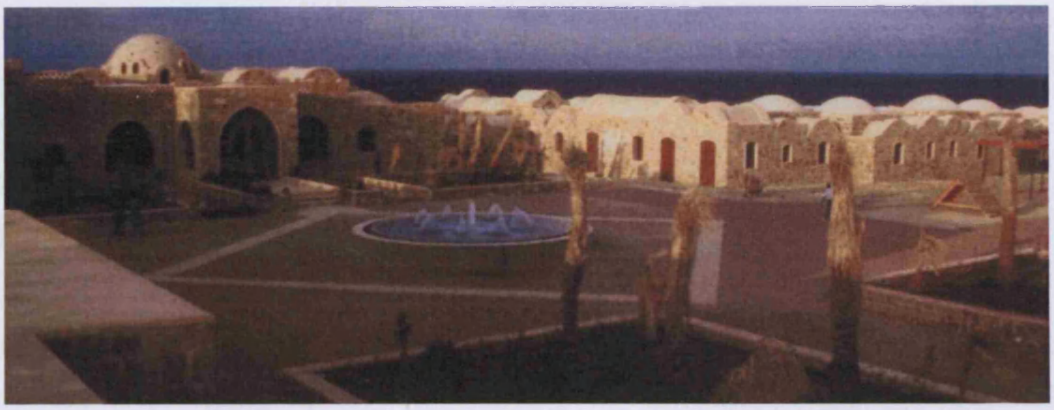


Figure 3- 26: Domes and volts used to cover most units and local materials for cladding.
(Source: Albenaa, 1999a)

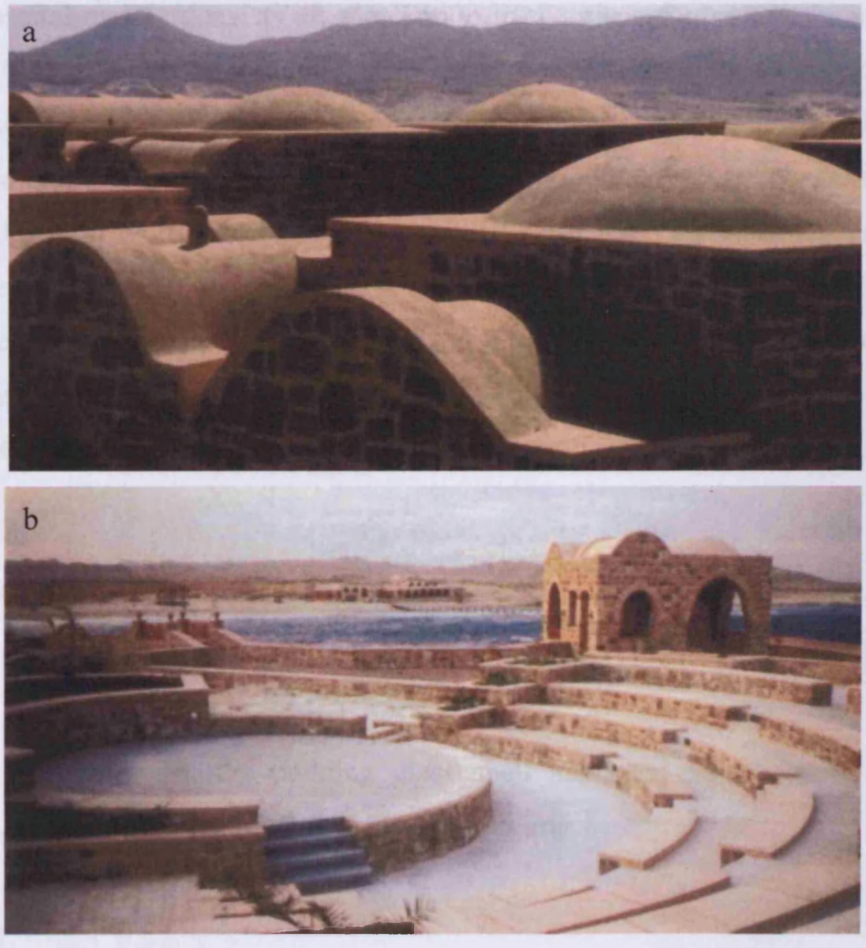


Figure 3- 27: Using local materials in construction and landscape.
(Source: Albenaa, 1999a)

a) Domes and volts are made of local clay.
b) The project landscape is made of local bricks.

3.5.5 Sharm Elshieak Hospital

I. Defining the Project

Designer	:	Moharam Bakhoom Associate
Date	:	1999
Location	:	Sharm Elshieak
Customer	:	Sharm Elshieak City Council

II. Project description

The hospital mainly consists of: a reception in the glassed pyramid shape to be the land mark of the project and relate it to the pharaoh civilization, as shown in Figure 3-29, and the hospital departments and residential units in a linear mass behind the pyramid and as a background to it, as shown in Figure 3-30, and conferences room for 100 person with panoramic views to all Sharm Elshieak city. The project was designed to be a landmark for Sharm Elshieak and to be near the touristic areas to provide top medical services to them (Albenaa, 1998). This project has very limited architectural information published about it and its design & Construction Company was not available to give any more information about it.

III. Sustainability features

- **Local materials**: most of the building exterior is covered with granite which considered a local material.
- **Natural light**: the building glass shell has been advertised as a way to maximize the use of natural light in building.

IV. Assessment of the project

Sharm Elshieak Hospital proposed concept by the city council was to build an eco building that could be a landmark for Sharm and could set a new trend in designing eco buildings in this area, instead, the actual building have made a lot of compromises on the environmental side of the design to the form side of the design and to effect on site. The use of glassed pyramid allowed heat to penetrate to the building for 9 to 11 hours daily which maximize energy requirement for central air conditioning of the hospital to balance the overheat mass and in this case when not using energy conserving equipments the effect become worse and the open linear form of the departments again participated in a raising energy demands for air conditioning as it produced no shades on the façade. The preliminary objective of the project of being an environmental building could have targeted much more areas than the actual building did; areas like: building form, construction materials, recycability, renewable sources of energies and energy efficient equipments.

V. Development direction

Future extension or developments for Sharm Elshieak Hospital could consider the next points:

- The use of renewable sources of energy to produce the project requirement of electricity. Solar skin active systems will be preferable to integrate with the glassed pyramid.
- The building extension form could take a more closed and composed form to maximize shades and minimize energy requirements.
- Using site to plant gardens in an effort to moderate the surrounding environment could have positive effect on energy consumption and water recycle system could be introduced.

Figure 3- 28: Sharm Elshiek Hospital, noticeably, the dominate shape is the glassed pyramid.
(Source: Albenaa, 1998)

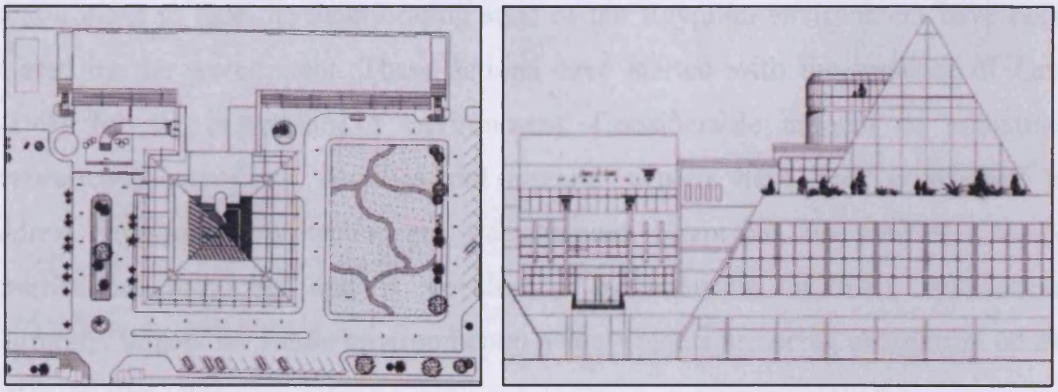


Figure 3- 29: Site plan and elevation showing the relation between the hospital masses.
(Source: Albenaa, 1998)

3.6 Discussion

From the previous literature review, Egypt is now facing a challenge of meeting the demands of its growing population and protecting its environment at the same time. One of the most influential forces that control policy making in Egypt is its rapidly growing population. Egypt population is currently estimated at 83 million with annual growth rate of 1.6%, which led to an annual growth rate of 6.5% for total energy consumption and 7% for total electricity consumption. The majority of Egypt's energy demands are being supplied from fossil fuel sources (92%).

Though Egypt have huge potential for renewable energies it only account for 0.18% of the total energy production. The national energy strategy is to satisfy 20% of the total electricity demands from renewable energies by 2020. Solar energy is not currently being used to the full of its potential in Egypt mainly due to high costs. On the other hand, wind energy is considered to have the highest application potential in Egypt with estimate of 12% of the total electricity by 2020.

Egypt is a developing African country which suggests that the impacts of climate change on its environment would be dramatic. Currently there are no accurate specific studies for the impacts of climate change on the Egyptian environment. Predictions of the impacts include; submerge of a clear part of the delta, millions of people will be displaced, 50% decrease in farming productivity, and water shortage crises.

Action plans to face the deteriorating state of the Egyptian environment have been offered by the government. These actions have started with the issuance of Law 4/1994 for the protection of environment. Considerable amount of ministries departments, authorities, comities and research centers have been established to address environment protection and management. Egypt has also ratified a lot of international protocols and is developing mechanisms for their application. Currently, targets for future environmental achievements are being announced on all Egyptian strategies.

A review of selected examples of environmental buildings in Egypt has shown that architecture practice in Egypt mainly use buildings form and orientation to achieve energy efficiency. Recycling principles and renewable energy technologies were not represented in the examples. All of the projects will fail an assessment using an international assessment tool as they lack a comprehensive vision for green buildings; they will only tackle one or two principles of sustainability.

Building sector is growing rapidly in Egypt. 280,000 housing units are built annually with growth rate of 15.8% and projection of 1.300.000 unit by 2012. Private sector is the major contributor of the construction industry (95%).. Most of the construction industry (70%) in Egypt has some sort of violation in its application to the construction laws and 63% of the violations occur in construction phase. Thus, a conclusion that laws and codes controlling construction in Egypt are not currently enforced enough could be assumed. The building sector is responsible for 23% of the total energy consumption in Egypt and expected to reach 35% by 2030. It is also responsible for 58% of the total electricity consumption which produces 11% of the total CO_2 emissions in Egypt.

Recent efforts made by the Egyptian government in addressing the building sector energy consumption levels could be summarize in three initiatives. First, a project for applying energy efficiency strategy in governmental buildings (EEIGB) to save 10% of its annual electricity was activated in 2007. Second, an energy efficiency labels and standards for household equipments were issued on a voluntary basis in 2007. Third, a code for energy efficiency in residential building have been developed and enacted in 2005, but never enforced. Another initiative was the development of an assessment tool box. GADS software will evaluate designs and its impacts on the environment. This initiative is not adopted by the government. Finally, the importance of introducing green buildings as a holistic approach to improve the building sector have been recognized by the Egyptian government. In 2009, the Egyptian Green Building Council (EGBC) was launched.

A comprehensive environmental assessment tool for buildings is needed in the Egyptian environment to map the way for green designs. In the next chapters of the research the Egyptian Green Code for Building EGCB will be developed as the author's solution to help architects, planners and decision makers into making a more environmentally conscious decision in designing Egyptian buildings.

3.7 Summary

The review of the current environmental situation in Egypt and the serious problems affecting it has been presented in Chapter 3. Egyptian building sector energy consumption levels have been discussed with the action planes proposed by the government. Four projects have been presented in this chapter as examples of the current environmental principles in use in the Egyptian architecture. This chapter served as a justification point to the line of the research that will be undertaken in the next chapters of the study, showing the urgency of the research problem.

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Chapter 4: Results from Survey Phase I

4.1 Introduction

This chapter will describe the results of the first questionnaire survey which has been conducted in Cairo, Egypt. Details of the procedures, questions, methods, results and analysis will be discussed. As established in Chapter 2 in the literature review, environmental impact assessment programs can raise the standard for building design to achieve a better quality of life, and in Chapter 3 we have established that the building sector in Egypt is key in addressing current environmental problems. Thus, in this part of the research we will describe the first survey conducted in Egypt (questionnaires and interviews) that started the process of composing the design of a new proposed green code for buildings. This led to the first version of the code to be created, as an approach to address the current environmental problems cased by the building sector. Details of the procedures, questions, results and analysis will be discussed.

4.2 Objectives

This chapter mainly aims to:

- Assess how informed the architectural society are on the current environmental situation in Egypt at different levels.
- Define the gap in which a new code for assessing environmental buildings could be introduced.

- Choose the projects that would define what is considered an environmental building in modern Egypt.
- Establish which categories for environmental assessment will be of importance in the Egyptian environment.

4.3 Methodology

Considerable material is now emerging from the area of combining quantitative and qualitative methods, particularly in survey work and from work on participatory impact assessment(Creswell, 2008, Holland and Campbell, 2005). In order to achieve the objectives of this chapter two types of methods were adopted:

- Quantitative, based on a questionnaire survey.
- Qualitative, based on individual interviews.

Questionnaire I schedule comprised three question sections as shown in Appendix (1), each section targeted to collect different types of information as follows:

Section A: collected information on how informed architects are on the current environmental situation in Egypt at different levels, the first level dealing with the knowledge about the legislation and current crises itself, the second aiming to discover where the respondents get their information from.

Section B: to gain inside information on what is considered to be an environmental building in Egypt and which projects would best describe the modern Egyptian environment.

Section C: to collect information on the issue of the need for a new code for environmental building assessment in Egypt and what are the most important categories to be included in this code in its first stage of application. The respondents have been asked to choose which categories to include in the new code from a list provided with the most common categories used in the assessment for buildings, and they were asked to sort them according to importance.

The interviews followed the distribution of the questionnaire and were conducted only with the respondents who agreed on being interviewed in the relevant questionnaire section. The first questionnaire distribution resulted in 23 interviews in total; six from governmental officials, five from architects in practice and twelve from academics. The main objective of the interviews was to understand in more detail about the respondents answers in the questionnaires and any further comments at this stage of the research (the why and how factor). All the interviews were transcribed, translated and stored in a database. Important quotes that had a direct impact in developing EGCB will be highlighted. The interview questions were semi-structured in three sections, each section targeted different criteria as follows:

Section 1: explanation of the respondents' choices in the questions of the questionnaire and more detailed on why these answers.
Section 2: outline information on what is considered an environmental building in Egypt.
Section 3: asking the respondents how they envisage the new code and its development especially in regards to the weighing of the categories and its importance to the Egyptian environment.

4.4 Procedures

4.4.1 Sampling

In order to get a comprehensive view of the environmental situation in the building sector in Egypt, three types of respondents were targeted by the questionnaire; 1) governmental officials working in the Ministry of Housing and the Ministry of State for Environmental Affairs, 2) architects in practice working in major construction companies and 3) academics from architecture departments in Egyptian Universities. The Engineers' Union database has been used to generate a list of names and contact details for architects in Egypt. The database has been sorted by the type of current work into four groups' governmental officials, architects in practice, academics and unknown. As Cairo is the capital of Egypt and the most likely place to adopt the new code and be the first to use it, all the names situated outside Cairo have been neglected as shown in Figure 4-1.

In order to keep all the respondents equal in importance a randomized selection process has been generated to select 100 names of each category to send invitation to participate in the study and find out whether they will agree to complete the questionnaire, aiming at 20% response factor (Creswell, 2008). The responses to the invitation letter were 10% from governmental officials, 14% from architects and 25% from academics. Another database for correspondent address for 30 contacts ten in each category have been generated by the author from previous contacts with assured indications of interest in the field of study. The final data base included 20 governmental official, 25 architects in practice and 35 academics, a randomized selection has been conducted to equal all the numbers to 20 in each category as they are equal in importance.

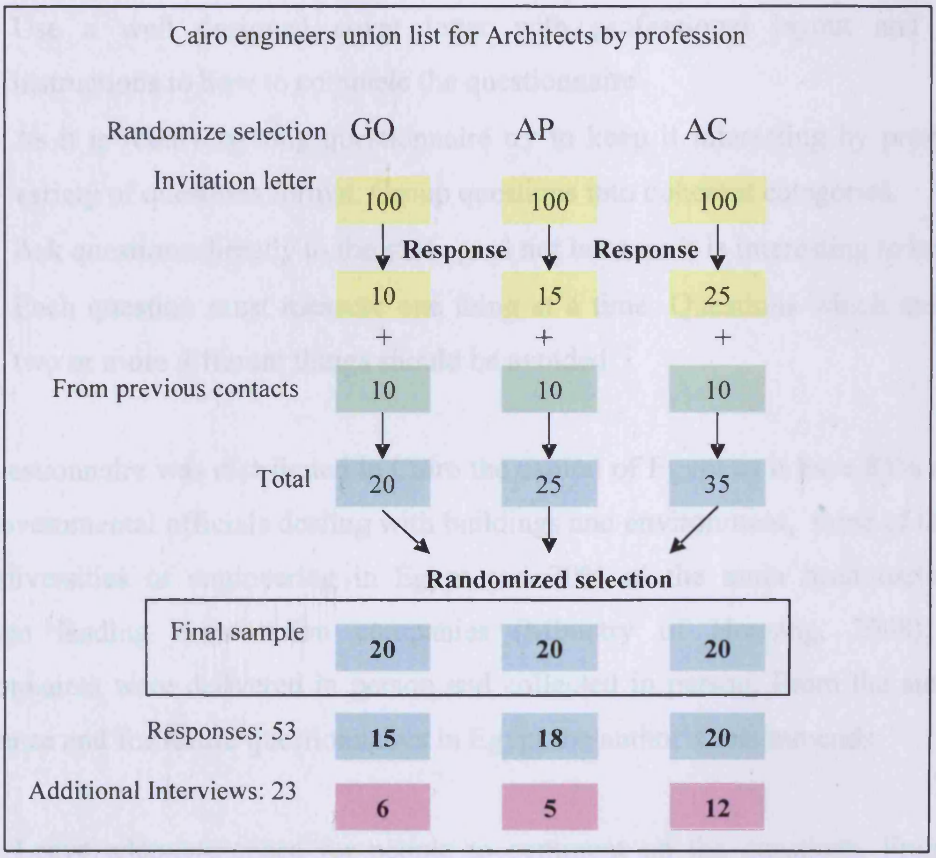


Figure 4- 1: Sampling process for our target group.

4.4.2 Preparing the questionnaire

The first questionnaire was prepared based upon its aims and the type of information that needed to be collected, it was kept simple and concise (Creswell, 2008). The questionnaire was developed twice before distribution. First, a draft was produced, translated into Arabic by the author and sent out to academic staff asking them to give their opinion whether the construction of the questionnaire and its questions were suitable for examining the subject matter. The responses from the draft questionnaire suggested that more details need to be added to the questions to be fully understood and less open ended questions and may be transfer it to multiple choices questions. The questionnaires were further developed and reviewed several times including with postgraduate students in Welsh School of Architecture. Criticisms that came as a result of the pilot questionnaire were:

- Use a well designed cover letter with professional layout and clear instructions to how to complete the questionnaire
- As it is relatively long questionnaire try to keep it interesting by providing variety of questions format. Group questions into coherent categories.
- Ask questions directly to the study goal not because it is interesting to know.
- Each question must measure one thing at a time. Questions which measure two or more different things should be avoided.

The questionnaire was distributed in Cairo the capital of Egypt as it have 85% of the total governmental officials dealing with buildings and environment, three of the top five universities of engineering in Egypt and 70% of the main headquarters of Egyptian leading construction companies (Ministry of Housing, 2008). The questionnaires were delivered in person and collected in person. From the author's experience and for future questionnaires in Egypt the author's recommends:

- Leave adequate space for people to comment on the questions. From the current experience if the space is not enough more details will have to be obtained by interviews or comments could be written in unexpected places leading to difficulties in the analysis phase.

- Keep it short, the longer the questionnaire is the more it is likely to be ignored and not completed.
- To avoid low response the questionnaire is recommended to be delivered and collected by hand as the mail services in Egypt are very slow.

4.4.3 Research questions

The questionnaire and the interviews phase I were designed to answer the following research questions

1. Does the Egyptian environment as it stands now need a new code for building assessment from the architectural society point of view?
2. Are the current environmental laws and strategies actively used in the Egyptian environment? Are there any environmental assessment measures in use now in the Egyptian architecture?
3. Which categories of assessment will be considered important for buildings in Egypt?
4. What is considered green building in contemporary Egyptian architecture?

4.4.4 Methods of analysis

Answers were analyzed using the EXCEL program (graphical illustration). Most of the data were nominal data, the results were analyzed threw descriptive analysis, such as frequency to produce a situation analysis on each of the questionnaire questions. The statistical tests selected were considered sufficient to answer the research questions. The answers that have been unanswered are presumed as missing values and would not be included in the calculation and analysis. Interviews obtained as a result from the questionnaire were transcribed, translated and entered into database to collect qualitative answers in regards to questionnaire questions which had a direct impact on the results.

4.5 Survey results and analysis

During the first trip to Egypt; 60 questionnaires were equally distributed to three types of recipients: governmental officials (15 responses and 6 interviews), architects in practice (18 responses and 5 interviews) and academics (20 responses and 12 interviews), for the full version of the questionnaire please refers to Appendix (1). In total 53 completed questionnaires were collected and 23 interviews were conducted. In the following section the full analysis of the results obtained from questionnaire and interviews phase I will be presented.

4.5.1 Results from questionnaire section A

4.5.1.1 Answers to question 1

All the questions on this part are designed to test the level of knowledge of the participants as representatives of the architectural society in Egypt, knowledge about the current environmental situation in Egypt. Question 1 was related to the familiarity about the Egyptian law for environment 1994 with the respondents and what was their source for this information, furthermore, the application of this law and whether it is actively used in practice or not. Question 1 (a) and (b) are shown in

Figure 4-2.

The results shown in Figure 4-3 indicate that the academics are the most knowledgeable about the Egyptian law for environment with 100%, followed by the governmental officials with 80%, and then the architects in practice with 62%. Totally, 80 % of the respondents are knowledgeable about the Egyptian law for environment.

Question 1 (a) asked only the respondents who answered yes about knowing the environmental law (44 in total). They were asked about the source of their information and the results shown in Figure 4-4 indicates that 70.5% of them received this information through college education channels followed by 16% who received this information as a systematic part of their job then 6.5% received it through specialized magazines, 4.5% from newspapers and finally 2.5% known about the law for environment through newspaper or media (radio – television).

Results about the application of the environmental law in Egypt are presented in Figure 4-5 indicate that 90% of the academics thinks that the environmental law is not actively used in Egypt, 85% of the architects in practice, 65% of the governmental officials and in total 80% of the respondents believe that the law for environment is not actively used in Egypt.

This indicated that the Egyptian law for environment 1994 is widely known to the architectural society in Egypt and the main source of the information for it comes from college education. Furthermore, the majority of the respondents agreed that the Egyptian law for environment is not actively complied with in the Egyptian architecture.

1. Are you familiar with the Egyptian Law for environment 1994?

☐ Yes ☐ No

If your answer is yes;

(a) Where did you obtain your information from?

- ☐ Education (undergraduate courses)
- ☐ Newspaper
- ☐ Specialized magazines (private buy)
- ☐ Receive it as a systematic part of your job
- ☐ Media (radio – television - internet)

(b) How would you describe the application of this law in practice?

☐ Active ☐ Not active

Figure 4- 2: Question number 1 (a) and (b) in questionnaire I.

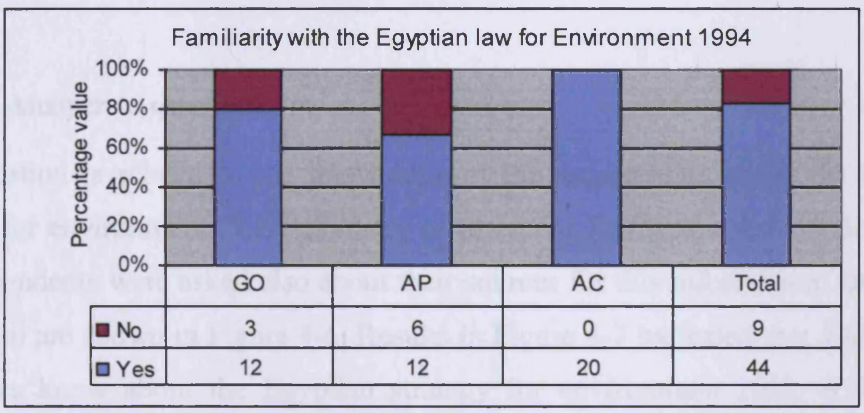


Figure 4- 3: knowledge about the Egyptian law for environment, the highest percentage for academics and the lowest is for architects in practice.

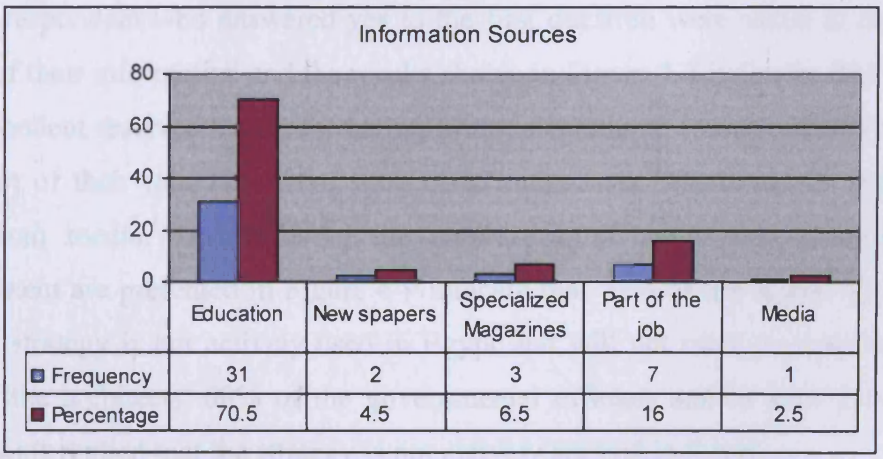


Figure 4- 4: The sources of information on the Egyptian law for environment; indicates that education is the main source of information.

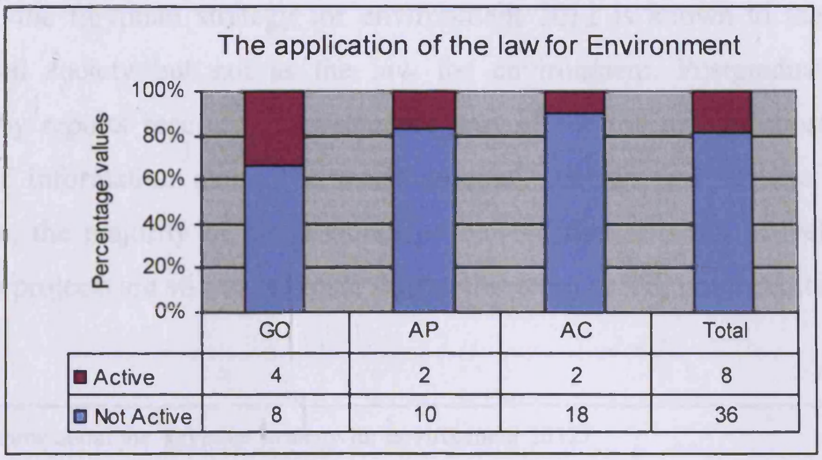


Figure 4- 5: The application of the environmental law, active or not-active.

4.5.1.2 Answer to question 2

This question is related to the knowledge of the respondents about the Egyptian strategy for environment 2012 (Ministry of State For Environmental Affairs, 2007). The respondents were asked also about their sources for this information. Question 2 (a) and (b) are shown in Figure 4-6. Results in Figure 4-7 indicated that 100% of the academics know about the Egyptian strategy for environment 2012, 65% of the governmental officials and 50% of the architects. Overall 75% of the respondents have some knowledge about the environmental strategy.

The 39 respondent who answered yes to the first question were asked to define the source of their information and the results shown in Figure 4-8 indicates that 65 % of the respondent received their information from postgraduate courses, 17.5% received it as part of their job, 10% from specialized magazines, 5% from newspaper and 2.5% from media. Results about the application of the Egyptian strategy for environment are presented in Figure 4-9 indicate that 75% of the academics believe that the strategy is not actively used in Egypt and will not meet its aims this way, 90% of the architects, 60% of the governmental officials and in total 75% of the respondents replied that the strategy is not actively applied in Egypt.

Therefore, the Egyptian strategy for environment 2012 is known to the Egyptian architectural society but not as the law for environment. Postgraduate courses followed by reports received as systematic part of the job are the most common sources of information about the environmental strategy. As for the strategy's application, the majority of the respondents believe that it is not actively used as most of its projects are still in proposal stages, therefore, it will not meet its aims.

2. Did you know about the Egyptian strategy for environment 2012?

□ Yes □ No

If your answer is yes;

(a) Where did you obtain your information from?

□ Education (postgraduate courses)

□ Newspaper

□ Specialized magazines (private buy)

□ Receive it as a systematic part of your job

□ Media (radio – television - internet)

(b) How would you describe this strategy application towards its aims?

□ Active □ Not active

Figure 4- 6: Question number 2 (a) and (b).

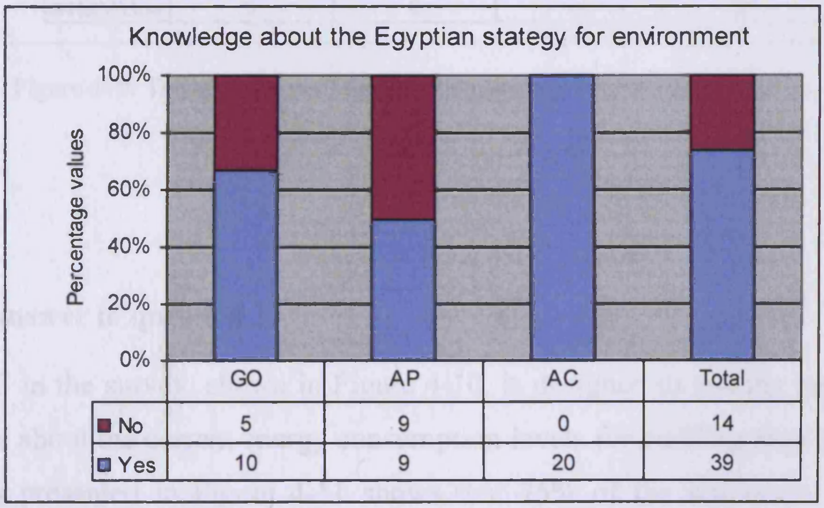


Figure 4- 7: The respondents' knowledge about the Egyptian strategy for environment, the highest percentage for academics and the lowest is for architects in practice.

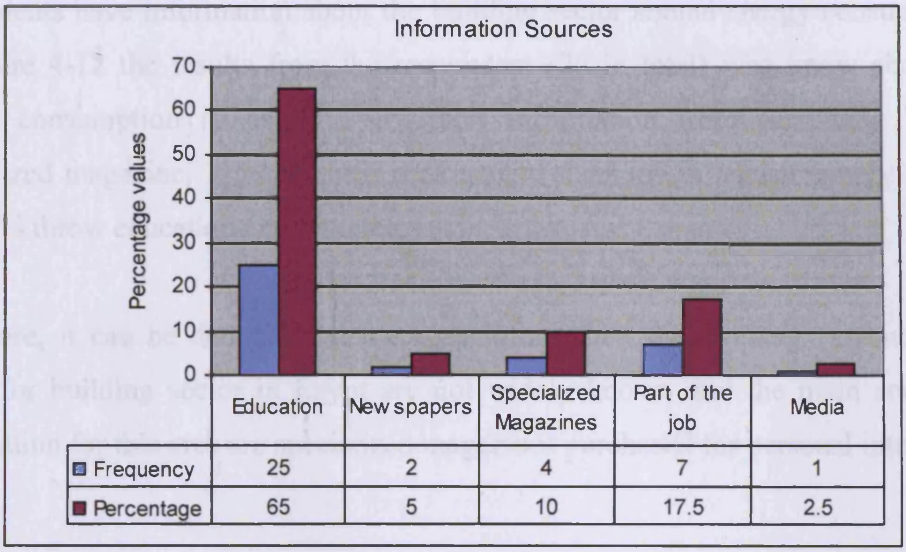


Figure 4- 8: Sources of information about the Egyptian strategy for environment.

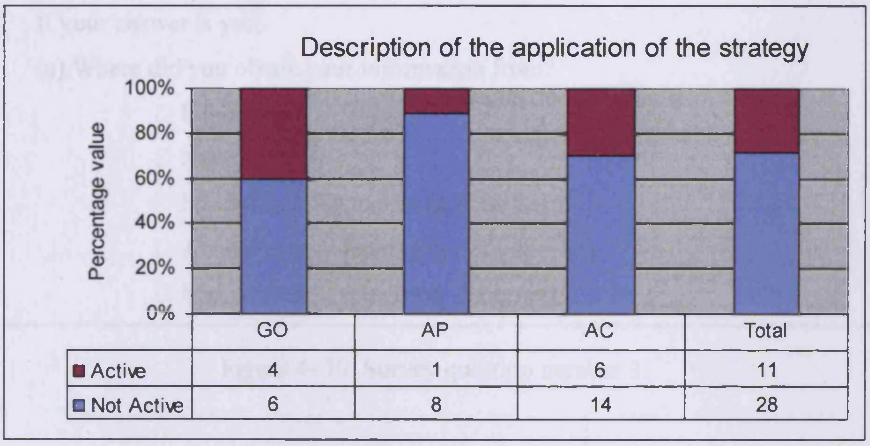


Figure 4- 9: The application of the Egyptian strategy for environment 2012.

4.5.1.3 Answer to question 3

Question 3 in the survey, shown in Figure 4-10, is designed to test the respondents' knowledge about the current energy consumption levels for building sector in Egypt. Results as presented in Figure 4-11 shows that 75% of the academics know the current energy consumption levels for buildings sector in Egypt, 30% of the architects, 30% of the governmental officials and in total only 50% of the respondents have information about the building sector annual energy consumption. In Figure 4-12 the results from the respondent (26 in total) who know about the energy consumption levels 58% got their information from personally buying specialized magazine, 31% received it as part of their job in annual energy reports and 11% throw education and research.

Therefore, it can be deduced that detailed information about energy consumption levels for building sector in Egypt are not widely known and the main source of information for this area are specialized magazines purchased for personal interests.

3. Are you aware of the current energy consumption levels for building sector in Egypt?

☐ Yes ☐ No

If your answer is yes;

(a) Where did you obtain your information from?

- ☐ Education
- ☐ Newspaper
- ☐ Specialized magazines (private buy)
- ☐ Annual energy report (part of your job)
- ☐ Media (radio – television - internet)

Figure 4- 10: Survey question number 3.

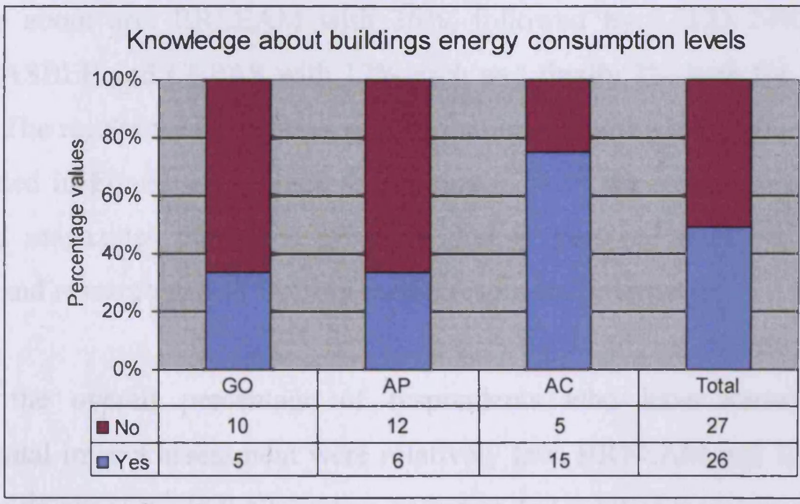


Figure 4- 11: The respondents' knowledge about the energy consumption levels for the building sector in Egypt.

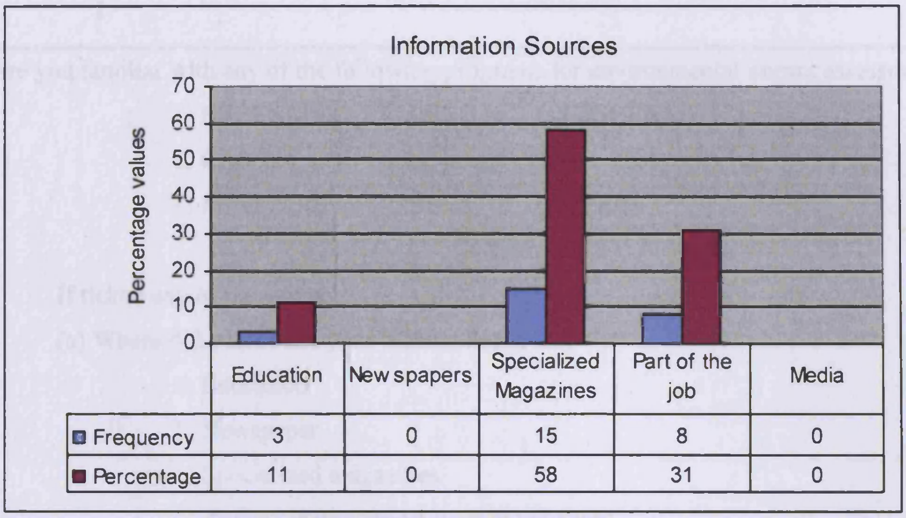


Figure 4- 12: Information sources for the Egyptian strategy for environment.

4.5.1.4 Answer to question 4

Figure 4-13 shown question 4 which is designed to test the respondents' knowledge about international programs for environmental impact assessment. Nine programs have been chosen to display variety of EIAP over time from the most common older generation to newer and more specialized ones. Results presented in Figure 4-14 shows that the programs which the major part of the respondents has some knowledge about are: BREEAM with 36%, followed by LEED 24%, then HK-BEAM, CASBEE and CEPAS with 12% each and finally 2% both for LC Aid and Minergie. The results for the sources of information about the international programs are presented in Figure 4-15 which shows that 62% of the information came from specialized magazines purchased privately due to personal interests, 27% throw education and research and 11 % from media resources (internet).

Although the overall percentage of respondents who have knowledge about environmental impact assessment were relatively law, BREEAM and LEED are the most common programs to the Egyptian audience and most of their knowledge come from specialized magazines purchased privately.

4. Are you familiar with any of the following programs for environmental impact assessment?

□ BREEAM □ LEED □ HK-BEAM

□ CASBEE □ LC Aid □ GB-Tool

□ MINERGIE □ BEES □ CEPAS

If ticked any of the above:

(a) Where did you obtain your information from?

□ Education

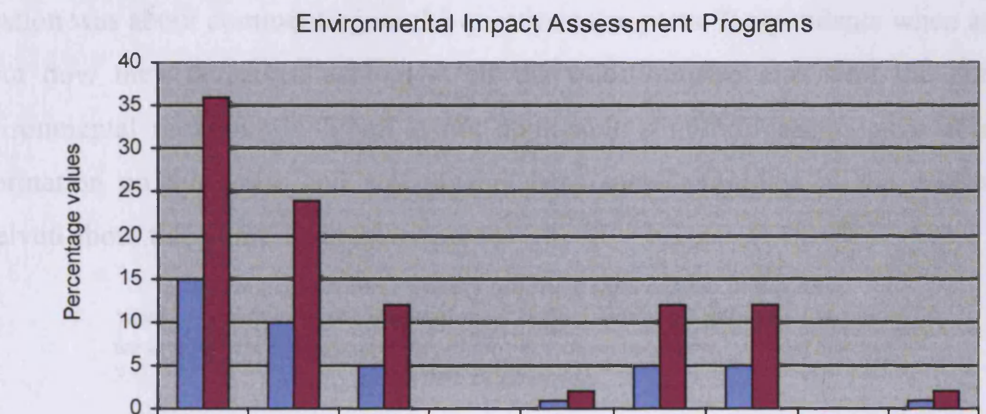
□ Newspaper

□ Specialized magazines

□ Annual energy report (part of your job)

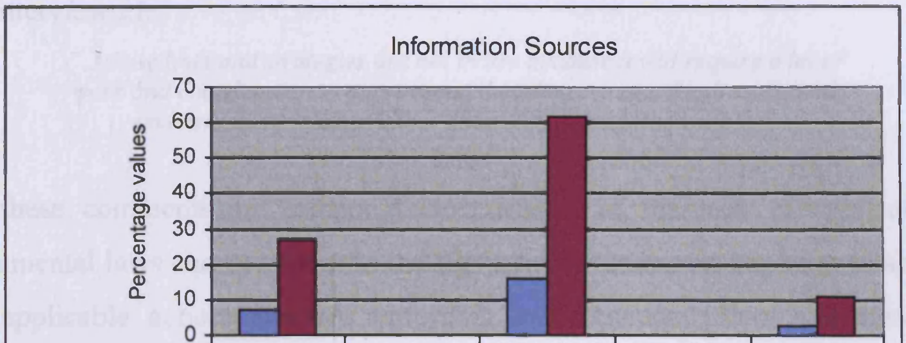
□ Media (radio – television)

Figure 4- 13: Question number 4 in questionnaire I.



	BREEAM	LEED	HK-BEAM	GB Tool	LC Aid	CEPAS	CASBEE	BEES	Minergie
Frequency	15	10	5	0	1	5	5	0	1
Percentage	36	24	12	0	2	12	12	0	2

Figure 4- 14: Knowledge about international environmental impact assessment programs.



	Education	New spapers	Specialized Magazines	Part of the job	Media
Frequency	7	0	16	0	3
Percentage	27	0	62	0	11

Figure 4- 15: Information sources for environmental impact assessment programs.

4.5.1.5 Results from interviews

In the 23 interviews that have followed the distribution of the questionnaire, the first question was about commenting on the questionnaire parts. Respondents when asked about how they perceived section A of the questionnaire and why the current environmental measures in Egypt is not applicable some comments gave detailed information on this issue and will present here some examples of the comments received about this point, from interview 4:

> *"...in practice, we don't usually use these information in our daily work.........if we read it somewhere it is for knowledge only...as long as we are not asked to design specifically for these measure..., it will not be the centre of attention..."*

From interview 12:

> *"....I receive this information as monthly or annually reports (to let us know)... but we are not obliged to take any action toward actively enforce action plans for it..."*

From interview 19:

> *"...this is the special subject of my research study...as academic... I know the environmental information related to buildings ... to keep our students most up to date with it ....but once the student are out in the practice field they don't follow it, nothing said they have to!"*

From interview 21:

> *"...these laws and strategies are not in use because it will require a lot of work and coordination to approve any building in regard to it...optional and very comprehensive that doesn't give exact measure... "*

From these comments and others a clear vision of the lack of application of environmental laws and strategies in the Egyptian environment has been established. More applicable actions towards enforcing environmental laws and sustainable strategy are required and actions to obligate the practice to address building sector consumption levels. The problems in current legislations will be investigated in detail in interviews phase III presented in Chapter 6.

4.5.2 Results from questionnaire section B.

4.5.2.1 Answer to question 5

Question number 5 from the questionnaire survey is shown in Figure 4-17. This part of the questionnaire was designed to establish what is considered to be environmentally conscious architecture in contemporary Egypt and to have the opinion of the respondent on which examples to examine from the Egyptian environment. The respondents were asked to choose from a given list of projects that have been selected in accordance with project limitation explained in Chapter 3. The results shown in Figure 4-16 indicate that the top five projects that have been chosen by our recipients were; El-Gouna resort 31%, Library of Alexandria 21%, Sierina movanbic hotel 19%, Sharm El Shiek hospital 12.5% and finally The Desert Development Center 8%.

Therefore, the previous five projects have been nominated as case studies to show what is considered environmental buildings in Egypt. The Desert Development Center was neglected as there was not enough information available for it to be analyzed compare to the others. The four selected projects have been analyzed in Chapter 3 of the thesis, the analysis contained; project description, presentation of its sustainable features, assessment of the project and finally development directions.

4.5.2.2 Results from interviews

In the interviews that have followed the questionnaire some comments about those examples have been made to justify the selection of those projects. From interview 5:

> *"These projects will reflect the current environmental trends in Egypt and it will be interesting to know if they are really working... "*

From interview 13:

> *"...Al-Gourna village should be included in studying environmental buildings in Egypt it would be a good show case for what we could do"*

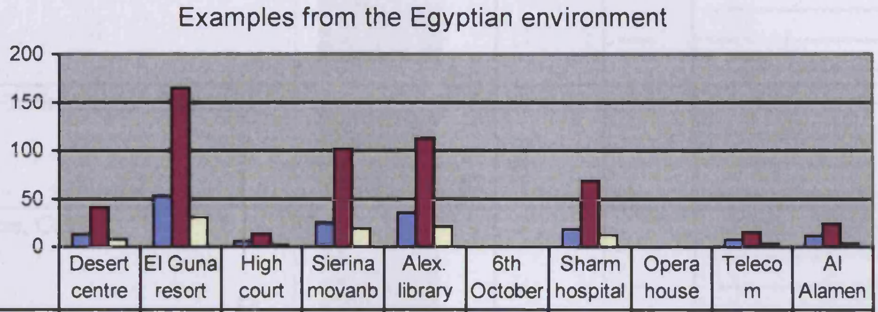
From interview 20:

> *"....if you really want environmental building, Al-Gourna village by Hassan fathey is a good example..... "*

From interview 20:

> *"...all the projects in that list are environmental here...in my opinion it would be good to analyze what principles they lack .... "*

It has been suggested from the interviews to study Al-Gourna village by Hassan Fathey, but it has been neglected as it will change the criteria for selection of all examples building as one of the limitation that it has to be a building that have been either built or operated in the last decade to show case a current situation.



	Desert centre	El Guna resort	High court	Sierina movanb	Alex. library	6th October	Sharm hospital	Opera house	Teleco m	Al Alamen
Inclusion	13	53	6	25	35	0	18	0	8	12
Importance	42	165	14	102	113	0	69	0	16	24
Overall percentage	8	31	2	19	21	0	12.5	0	3	3.5

Figure 4- 16: Which examples to include in the survey.

5. This question is designed to have an overview of what is considered environmentally conscious building in Egypt. In the following table:

(a) Please choose 5 of the next 10 buildings that in your opinion should be included in a survey that aims to define the current Egyptian environmental building. Please tick the box in the column entitled Include and if you have any comments or reasons for your decision please complete in the comment section.

(b) In the column entitled No. please mark the most important buildings to be included in the survey with numbers 1 to 5 with 5 meaning most important and 1 meaning less important.

Projects			Include	No.	Comments
1.	Desert Development Center, American University, Cairo.		☐	----	----------------------
2.	El-Gouna resort, Hurghada.		☐	----	----------------------
3.	Egyptian high court, Cairo.		☐	----	----------------------
4.	Sierina movanbic		☐	----	----------------------
5.	Library of Alexandria,		☐	----	----------------------

Projects			Include	No.	Comments
6.	6th of October private university		☐	----	-------------------- -------------------- -------------------- --------------------
7.	Sharm El Shiek hospital, Sharm El Shiek		☐	----	-------------------- -------------------- -------------------- --------------------
8.	Opera house, Cairo		☐	----	-------------------- -------------------- -------------------- --------------------
9.	Egyptian Telecom headquarter, 10th of Ramadan.		☐	----	-------------------- -------------------- -------------------- --------------------
10.	Al Alameen resort		☐	----	-------------------- -------------------- --------------------

Figure 4- 17: Question number 5 from the questionnaire survey.

4.5.3 Results from questionnaire section C.

Questions in section C of the questionnaire were about the need for a new environmental assessment code for buildings in Egypt and its components. The questions on this part were designed to define the gap in which a new code could be introduced, establish the need for it and to choose the main content of the proposed code, type and main categories. In the next part results from questionnaires and interviews regarding this section will be presented.

4.5.3.1 Answer to question 6

Question 6 (shown in Figure 4-18) aims to find out whether there is a need for a new assessment code for buildings in Egypt or improvements and modifications could be done to the existing building code. Also what type of program the proposed code should be. Results presented in Figure 4-19 shows that 100% of academics respondents, 75% of architects and 65% of governmental officials are in favor of introducing a new program which lead us to overall percentage of 85% of respondents agreeing on the need for a new program.

Figure 4-20 shows the results about the scope of the new code, it shows that 90% of all targeted respondents believe that the scope of the new program should be comprehensive, more detailed and explanation for this choice are made in the interview section. Results about the new code form are shown in Figure 4-21, 85% of governmental officials think the new code is better be in a paper form, 55% of the architects, 55% of the academics and 65% of the total respondents want the new code in paper form, 20 % wants it in both paper and electronic version and 15% of the recipients want the new code only in electronic form.

Therefore a new code for environmental assessment for buildings in Egypt is needed; this program preferably be comprehensive in its first phase of application and should come in a paper form.

6. Does the Egyptian environment in its current status needs a new program for assessing environmental buildings or improvement could be made upon the existing code for buildings?

☐ Need a new code ☐ Improvement upon the existing code

What type of code would be more suitable for first phase of application?

(a) Scope of the code:

- ☐ Comprehensive (for all building types)
- ☐ Specific (for residential buildings, schools, public buildings, etc.)

(b) Means of delivery:

- ☐ Electronic (computer based)
- ☐ Paper based (checklist)
- ☐ Both

Figure 4- 18: Question number 6 of questionnaire I.

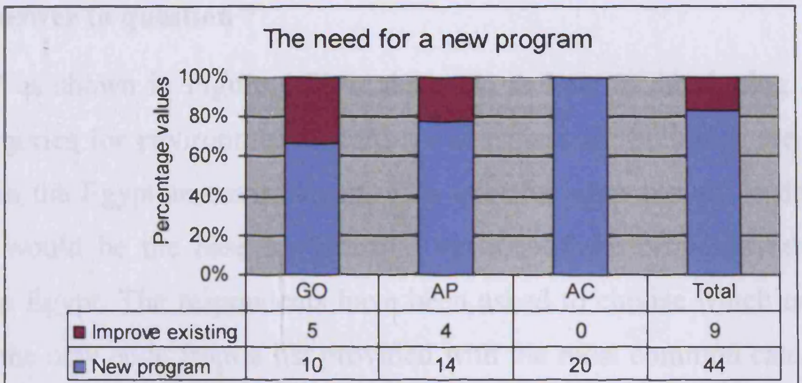


Figure 4- 19: The need for a new program.

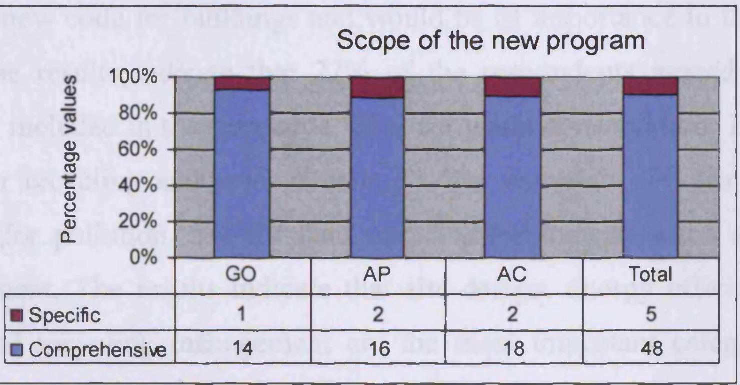


Figure 4- 20: Scope of the new code; specific or comprehensive.

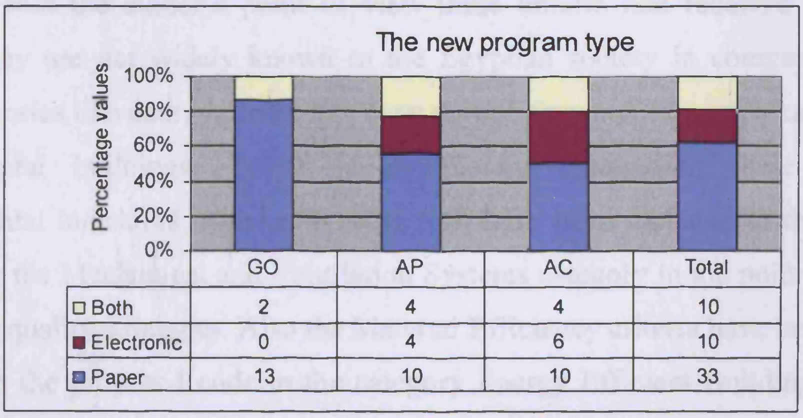


Figure 4- 21: Means of delivery of the new code.

4.5.3.2 Answer to question 7

Question 7 as shown in Figure 4-22 is designed to help in developing a vision of which categories for environmental impact assessment for buildings are considered important in the Egyptian environment. This question aims mainly to define which categories would be the base for the first version of the proposed new code for buildings in Egypt. The respondents have been asked to choose which categories to include in the new code from a list provided with the most common categories used in assessment for buildings, and were asked to sort them according to importance. The list provided was developed from the review of EIAP conducted in Chapter 2. Results presented in Figure 4-23 shows which categories of assessment should be included in the new code for buildings and would be of importance to the Egyptian environment, the results indicate that 22% of the respondents agreed on energy efficiency to be included in the new code, 20% for water conservation, 15% for site design, 13% for recycling and management, 7% for materials, 7% for health and wellbeing, 6% for pollution, 5% for land use, 3% for transportation and 2% for ecology assessment. The results indicate that site design, energy efficiency, water conservation and recycling management are the most important categories to be included in the first version of the proposed code.

The exclusion of Indoor Air Quality category and Material category came as a direct result of the low inclusion percentage they have received in the questionnaire analysis. From the author's point of view these criteria had received low scores because they are not widely known to the Egyptian society in comparison to the other categories like energy efficiency, even though they are very important to assess environmental buildings. To avoid completely eliminating these important environmental indicators, some references to it have been included in the proposed code under the Mechanical and Ventilation Systems category in the point ventilation and indoor quality strategies. Also the Material Efficiency criteria have been partially included in the proposed code in the category Energy Efficient Building under the point energy efficient building shell, the full categories description in Appendix (3).

7. This question is to establish which categories for environmental impact assessment to be included in the proposed code for Egypt and what are their important values in regards to Egyptian conditions.

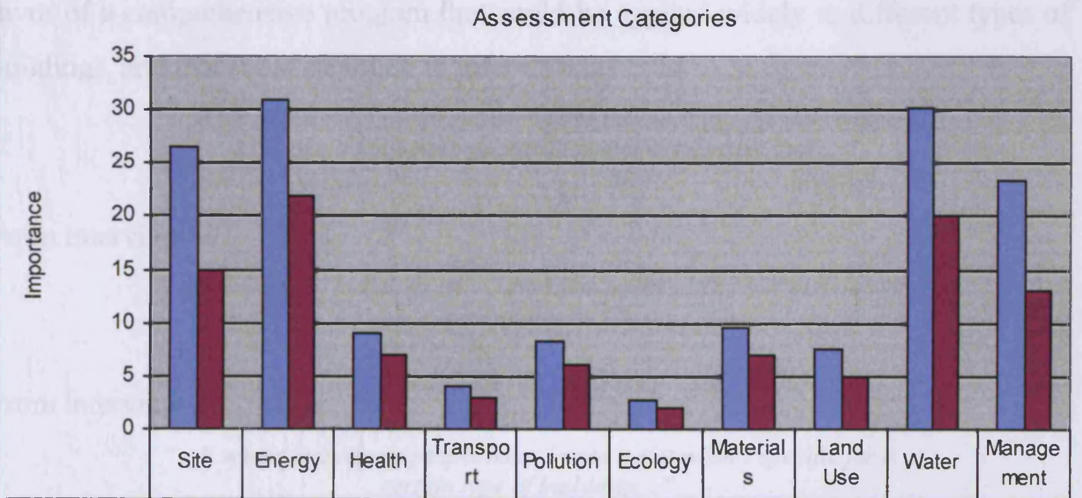
(a) Indicate which categories and subcategories to include by ticking the box in the column entitled In/Ex and if you have any comments or reasons for your decision please complete in the comment section.

(b) Indicate the importance of a category in the column entitled No. please mark the categories in relation to their importance for the Egyptian environment with 10 meaning most important and 1 meaning least important.

Assessment categories		In. Ex.	No.	Comments
1.	Site Design		----	-----------------------
1.1	Protecting Local Ecosystems			-----------------------
1.2	Water-Conserving Strategies			-----------------------
1.3	Building Orientation			-----------------------
1.4	Maximize the Potential of the Site			-----------------------
1.5	Connecting the building to the Community			
2.	Energy-Efficient Building		----	-----------------------
2.1	Embodied Energy			-----------------------
2.2	Annual energy use			-----------------------
2.3	Energy-Efficient Building Shell			-----------------------
2.4	Hot water supply systems			-----------------------
2.5	Lift and escalator systems			-----------------------
2.6	Mechanical and Ventilation Systems			-----------------------
2.7	Cooling Systems			-----------------------
2.8	Energy efficient appliances			-----------------------
2.9	Lighting systems			----
2.10	Renewable Energy Systems			
3.	Health and Well-being		----	-----------------------
3.1	Hygiene			-----------------------
3.2	Indoor Air Quality			-----------------------
3.3	Ventilation			-----------------------
3.4	Lighting quality			-----------------------
3.5	Acoustics and noise			--------------------
3.6	Thermal comfort			
4.	Transport		----	-----------------------
4.1	Local transport and amenities			-----------------------
4.2	Vehicular access			-----------------------
4.3	Transport-related CO2			--------
5.	Pollution		----	-----------------------
5.1	Air pollution during construction			-----------------------
5.2	Noise during construction			-----------------------
5.3	Water discharge			--------
6.	Ecology		----	-----------------------
6.1	Ecological impacts			-----------------------
6.2	Microclimate around the building Conservation and			-----------------------
6.3	enhancement of the site			--------
7.	Materials			-----------------------
7.1	Building reuse			-----------------------

Assessment categories		In. Ex.	No.	Comments
7.2	Adaptability and deconstruction		----	----------------------
7.3	Envelop durability			
7.4	Renewable materials			
7.5	Use of recycled materials			
8.	Land Use			----------------------
8.1	Land use			----------------------
8.2	Green-field and brown-field sites			----------------------
8.3	Landscaping and planters			--------
9.	Water			----------------------
9.1	Water-conserving landscaping strategies			----------------------
9.2	Conservation of water during construction		----	----------------------
9.3	Water-conserving fixtures			----------------------
9.4	Water use			----------------------
9.5	Water quality			----------------------
9.6	Water recycling			---------------
9.7	Effluent discharge to foul sewers			
10.	Management			----------------------
10.1	overall management policy, commissioning site			----------------------
10.2	management and procedural issues		----	----------------------
10.3	Construction Waste Recycling and Waste Management			----------------------
10.4	Operation and maintenance			

Figure 4- 22: Question 7 in the survey questionnaire.



	Site	Energy	Health	Transport	Pollution	Ecology	Materials	Land Use	Water	Management
Frequency	26.5	31	9.1	4	8.2	2.7	9.5	7.6	30.2	23.4
Percentage	15	22	7	3	6	2	7	5	20	13

Figure 4- 23: Categories of the code by importance.

4.5.3.3 Results from interviews

In the interviews that followed the questionnaire distribution a lot of comments came on this point, comments that had a direct impact on understanding how to develop the new code and how to design its categories. The first point that was raised by the respondents was the possibility of the new code to be a second part of the existing code for buildings in Egypt. Comment from interview 7:

"...the new code should be distributed as part two of the Egyptian code for buildings..."

Comment from interview 11:

"...a new code attached to the old one... will be advertise as environmental code or green code and could be an extension of the existing detailed one..."

From these comments and others it have been suggested to develop the new code as a second part for the existing code that we have now in Egypt, therefore, a lot of duplication in the technical explanations of the categories could be avoided.

The second point to be raised from interviews was regarding the scope of the new code, as demonstrated earlier in this chapter, the majority of the respondents are in favor of a comprehensive program that could be applied widely to different types of buildings, and this could be found in interview 3:

"...as we only have a comprehensive code for buildings the new one for environmental buildings should be comprehensive too"

From interview 17:

"...for variety of buildings type...the same as the old one or people will get confused..."

From interview 20:

"...It would encourage people more to use it if it wasn't specific for a certain type of buildings..."

As a direct result to these comments the new proposed code has been developed to be comprehensive and address different types of building. More specialized versions of the code could be developed later for specific types of buildings.

The third point to be raised in the interviews was regarding the design of the categories of the code itself and whether the respondents have theories on what each category could achieve. From interview 1:

"... For energy efficiency it could be a certain reduction 10- 25% and this could be achievable in Egypt..."

From interview 17:

"...The usage of renewable energies especially solar could have direct points relating to it if resulted in energy consumption reduction..."

From interview 22:

"...if for example you proposed 5 points for recycling water to irrigate plants on site, a lot of projects could achieve that...."

When designing the code categories, comments from interviews had direct impacts in designing the first version of the proposed green code for buildings in Egypt.

4.6 Preparing the Egyptian Green Code for Buildings (EGCB) version I

Based on the literature review of EIAP presented in Chapter 1 and the results from the survey phase I, EGCB first version was created. It has four categories; site design, energy efficiency, water conservation and waste management, the full EGCB first version is in Appendix (5). The proposed categories and points of assessment were adopted from various assessment programs that have been reviewed in Chapter 2. Table 4-1 present the categories of the proposed code and the original references that the final points included were based on. BREEAM, HK-BEAM, LEED and MINERGIE-ECOplus are the main programs used in developing EGCB first draft. Points were adopted and modified to the needs of the Egyptian environment and its current technological status.

Category		References
1.	**Site Design**	
1.1	Protecting Local Ecosystems	BREEAM, HK-BEAM, LEED. All plants references are to hot and humid climate (drought resistance). Reference from protecting areas for natural habitat by Ministry of Environment.
1.2	Water-Conserving Strategies	
1.3	Building Orientation	
1.4	Maximize the Potential of the Site	
1.5	Connecting the building to the Community	
2.	**Energy-Efficient Building**	
2.1	Massive Wall Construction	HK-BEAM, BREEAM, MINERGIE-ECOplus, and LEED. 1. Ventilation requirements and cooling systems for hot climate have been added from "Designing Elements: Egyptian Ministry of Housing" 2.Building orientation for solar access have been modified to the Egyptian environment requirements. 3. Energy calculation using E-Quest as it is already in use in Egypt. It is designed to perform detailed analysis of building design technologies using energy use simulation techniques but without requiring extensive experience in building performance modelling. 4. References to material energy efficiency have been omitted from the original text as it will not be included in the new code.
2.2	Stopping Radiant Heat Gains	
2.3	Embodied Energy	
2.4	Annual energy use	
2.5	Lift and escalator systems	
2.6	Cooling Systems	
2.7	Ventilation and Indoor Air Quality Strategies	
2.8	Lighting systems	
2.9	Hot water supply systems	
2.10	Building Orientation and Solar Access	
2.11	Building-Integrated Approaches	
2.12	Renewable Energy Applications for Buildings	
3.	**Water Conservation**	
3.1	Water-conserving landscaping strategies	HK-BEAM, BREEAM and LEED 1. The main introduction from the annual environmental indicator report 2006, Ministry of Environment. 2. Using soaker hoses and drip irrigation from the final recommendation of the annual progress report, Ministry of Agriculture, 2006.
3.2	Conservation of water during construction	
3.3	Water-conserving fixtures	
3.4	Water use	
3.5	Water quality	
3.6	Water recycling	
3.7	Effluent discharge to foul sewers	
4.	**Waste Management and Recycling Systems**	
4.1	Construction Waste Recycling and Waste Management	BREEAM, HK-BEAM, LEED As this section is new to the Egyptian environment a lot of the technical details originally found in the references programs have been simplified to be understood in the first application in Egypt.
4.2	Operation and maintenance	

Table 4- 1: The references used in developing EGCB first version categories.

4.7 Discussion and findings

Based on the answers to the research questions in the questionnaire and interviews phase I, the survey has found that:

4.7.1 From section A; knowledge about current environmental situation

Section A in the questionnaire aimed to collect information on how informed Egyptian architects are on the current environmental situation in Egypt at different levels, the first level dealing with the knowledge about the Laws and strategies of the current environmental situation itself, the second level aiming to discover where the respondents get there information from. Questionnaire and interviews results are:

- The Egyptian law for environment 1994 and the Egyptian strategy for environment 2012 are known to the architectural society in Egypt, with academics being the most knowledgeable followed by governmental officials and architects in practice. The main source of the information for it comes from college education and these measures are not actively used in the Egyptian architecture. More applicable actions towards enforcing environmental laws and sustainable strategy are required and actions to obligate the practice to address building sector environmental problems.

- For institutional authorities and designers detailed information about energy consumption levels for building sector in Egypt are not widely known. Personal interest is the driving force to obtain this information from specialized magazines.

- International assessment programs for buildings in whole are not commonly known to the architects in Egypt, with BREEAM and LEED being the most common programs to the Egyptian audience and most of their knowledge comes from specialized magazines to purse higher education.

4.7.2 From section B; what is considered environmental buildings in Egypt

This part of the survey gave an inside information on what is considered environmental buildings in Egypt and which projects would better describe the Egyptian environment. The results from section B of the questionnaire have been used directly in Chapter 2; four projects: El-Gouna Resort, Library of Alexandria, Sierina Movanbic Hotel and Sharm El Shiek Hospital have been analyzed in Chapter 2 of the thesis, the analysis contained; project description, presentation of its sustainable features, assessment of the project and future development directions.

4.7.3 From section C; the need for a new code for buildings

Section C of the survey raised the issue of the need for a new code for building assessment in Egypt and what are the most important categories to be included in this code in its first stage of application. Results from respondents' answers to this section could be summarized in:

- Egypt needs a new code for assessing environmental buildings; it is preferable for this program to be comprehensive in its first phase of application to serve different types of buildings and also preferable to come in a paper form.
- The new code will be developed as a second part of the existing Egyptian code for buildings; therefore, a lot of duplication in the technical explanations of the categories could be avoided.
- Site design, energy efficiency, water conservation and management are the most important categories to be included in any future assessment code for buildings. In designing the new code categories numerical reduction in consumption would be the best option if applicable as it leave very small room for error in assessment

Results from the first phase of questionnaire and interviews had a direct impact on developing EGCB version I as a conceptual proposed code for assessing buildings in Egypt.

4.8 Summery

Chapter 4 has presented procedures and results of the first phase of questionnaire and interviews. The need for an Egyptian code for assessing environmental buildings was established, the main features and categories was selected. Furthermore, this chapter acted as a first step in the development process of EGCB as the results obtained led to the completion of the proposed code first version. EGCB (version I) was created and ready to be evaluated in the next chapters.

Chapter 5: Results from Survey Phase II

5.1 Introduction

This chapter will describe the results of the second survey which has been conducted in Egypt (questionnaire and interviews); details of the procedures, questions, methodology, analysis and results will be discussed. From the results of the first phase of questionnaires and interviews which have been described in details in Chapter 4, the Egyptian Green Code for Buildings (EGCB) first version have been developed and was ready to be evaluated. Our target respondents will complete a second questionnaire followed by interviews to find out how the first version of the code will be perceived in Egypt and how it could be improved to satisfy the needs of the Egyptian environment. This chapter will serve as an assessment point for the proposed code to modify and refine its categories in compliance with the Egyptian environment to be ready to test on actual projects.

5.2 Objectives

This chapter mainly aims to assess how to improve EGCB version I on content, criteria and techniques, to achieve that aim two objectives have been developed:

- Measure comprehensively how each point of the new code was perceived on clarity of the language used, relevancy to the assessment, achievability of the point and satisfaction with the credit allocated for it.

- Investigate the validity of the classification system used in the code and the overall weighting of its categories.

5.3 Methodology

EGCB first version has been developed mainly from two directions; the first is the results of the comparative review that have been conducted on EIA programs described in Chapter 1 of the research, and second from the results of the first phase of questionnaires and interviews conducted in chapter 4. In order to achieve the aims of this chapter two types of methods were adopted:

- Quantitative, based on questionnaire survey and written feedback.
- Qualitative, based on individual interviews.

Questionnaire phase II schedule comprised two question sections as shown in Appendix (2), each section targeted different type of information as follows:

Section D: collected information on how each category of the code was perceived; the language used in explaining each point, the relevancy of the points to the overall assessment, credit achievability and the respondents' satisfaction with the credits allocated for each point. Section D has four parts as follows:

D-1: for site design category.
D-2: for energy efficiency category.
D-3: for water conservation category.
D-4: for recycling and waste management category.

Section E: raised the issue of credit weighting and overall grade as the respondents have been asked to give their opinion on the credit allocation for the code categories and the overall classification and whether it is achievable, satisfactory and reflect the Egyptian environment situation.

The interviews followed the distribution of the questionnaire and were conducted only to the respondents who agreed on being interviewed. The second questionnaire distribution have resulted in 41 interviews in total; 15 from governmental officials, 12 from architects in practice and 14 from academics, notably almost double the number of interviews from questionnaire phase II.

The main aim for the interviews was to record how the categories of the code were perceived and in detail how it could be improved. All the interviews have been transcribed, translated and stored in a database. Important quotes that had a direct impact in developing EGCB are highlighted in different parts of the results. The interview questions were structured in three sections, each section targeting different criteria as follows:

Section 1: the clarity of the language used in explaining the code categories and the relevancy of the code points to the Egyptian architectural elements and needs.

Section 2: the achievability of each point in the current Egyptian market and whether the credits allocated for each one reflect the Egyptian situation.

Section 3: the code overall classifications and different grades for buildings and directions for improvement.

5.4 Procedures

5.4.1 Sampling

The same target recipients as the first phase of questionnaire and interviews was approached and a third trip to Egypt were conducted, for the full version of the questionnaire II please refers to Appendix (3), 60 questionnaires have been equally distributed to our target recipients: governmental officials (18 responses and 15 interviews), architects in practice (17 responses and 12 interviews) and academics (20 responses and 14 interviews). As shown the number of interviews has doubled in comparison to the first phase due to a better response from our target group. The number of respondents agreeing to conduct a follow up interview has increased significantly in the second phase.

5.4.2 Preparing the questionnaire

Questionnaire II was prepared based upon obtaining information from our target group on the design of EGCB version I. As the results obtained from the questionnaires rely on how well designed the questionnaire format is, and also the respondents' attitude and motivation towards the subject that might result in bias information. The simplicity and clarity of the questionnaire design had to be considered cautiously by the author to give the exact information on which to build the final results on. Each of the 55 respondents have been handed EGCB first version (Appendix 5) and questionnaire II (Appendix 2). Due to the length of EGCB first version (40 pages) and the permitted time given by the respondent to thoroughly read it and not interfere with their work time especially for governmental officials, the author have allowed 12-23 days from the day the questionnaire was handed to the day it was collected depending on each respondent time. Furthermore, interviews have been conducted with the respondents who express their interest in an interview in a later date given another 9-17 days depending on the respondent's availability.

5.4.3 Research questions

The second questionnaire and the interviews that followed were designed to answer the following research questions about the code: criteria, content and techniques:

1. How will the respondents receive the proposed code first version?
2. Is the language used for explaining each category clear and understood?
3. Are the categories suggested in the code relevant to an assessment taking place in Egypt?
4. Is the credit allocated for each point achievable? Why?
5. Are the overall classifications and grades proposed in the code satisfactory?
6. How to improve each category of the code?

5.4.4 Methods of analysis

The statistical tests selected were as for the first phase survey. Answers were analyzed using the EXCEL program (graphical illustration). Most of the data were nominal data, and the results were analyzed threw descriptive analysis, such as frequency. The answers that have been unanswered are presumed as missing values and would not be included in the calculation and analysis. Interviews obtained as a result from the questionnaire were transcribed, translated and entered into database to collect qualitative answers in regards to questionnaire questions which had a direct impact on the results.

5.5 Survey results and analysis

The next part of the research will present the full analysis of the results obtained from survey phase II, in total: 55 questionnaires and 41 interviews.

5.5.1 Results from questionnaire II section D

5.5.1.1 Answers to question D-1; investigating site design category

All the questions on this part is designed to comprehensively assess the first category of EGCB; the language used in describing the category, the relevancy to the assessment, the achievability of the credits and the respondents satisfaction with the credit allocated for each point. Questions D-1 is shown in Figure 5-1, it aims mainly to find how to improved site design category.

For the point protecting local ecosystems, the results are shown in Figure 5-2 indicates that 90% of the respondents think the language used is clear, 82% indicate that the point is relevant to the assessment, 70% believe this point is achievable and 90% were satisfied with the credit allocated for this point. The results shown in Figure 5-3 show that for the point water conserving Strategies 95% of the respondent believe that the language used is clear, 90% think it is relevant, 90% indicate the point is achievable and 100% of the respondents were satisfied with credit allocation.

Figure 5-4 shows the results for the point building orientation 95% of the respondent are satisfied with the language used, 95% indicate that this point is relevant to the assessment, 95% believe that it is achievable in the Egyptian environment and all the respondents were satisfied with the credit allocated for this point. As for the next point maximizing the potential of the Site, the results are shown in Figure 5-5 shows that 55% of the respondents said that that the language used is clear, 70% believe it is relevant, 90% think this assessment is achievable and 70% are satisfied with the credit allocated for this point.

As a result to the relatively low number of respondents understanding the point maximizing the potential of the site it has been rephrased to be easier for recipients to understand. The results in Figure 5-6 is about the point connecting the building to the community show that 90% of the respondents indicate that the language used is clear, 75% believe this point is relevant to the assessment, 55% think it is achievable and 60% are satisfied with the credit allocated to this point.

5.5.1.2 Results from interviews about site design category

The questionnaires distribution have resulted in 41 interviews in total; 15 from GO, 12 from AP and 14 from AC, notably almost double the number of interviews from questionnaire phase I. Important quotes that had a direct impact in modifying EGCB will be highlighted in this section. In the interviews when asked about how to improve the point of site design there have been a lot of comments on adding a new subcategory for the utilization of renewable energies on site scale and make a new credit for it, for example one of the comments in interview16:

"...renewable resources on site scale as a proof of how essential to investigate renewable systems early in the design process... Solar systems need to have solar access, and wind systems require proper placement to be maximized..."

Another comment about the same category in interview 21:

"In site design for Egypt ... consider non-grid-connected photovoltaic systems for: crossing and caution lights, lighting at walkways and parking areas and telephone call boxes for emergencies"

Another comment in interview 39:

> *"If we are going to establish the urgent need for renewable sources of energies site could play a big part in it, ……., even if the designer intended to only demonstrate it on little things on site it could set a good example"*

From these comments and others a new subcategory for the utilization of renewable resources techniques on site scale has been added. It has been given one credit as the respondents suggested.

D-1. Site design

This section is about the first category in the code which is site design, in the table below information will be collected about:

- **Content:** the language used in text and whether it is clear and understood or not, and if not please indicate how to improve it in the space allocated.
- **Criteria:** whether the point is relevant to the assessment or not and whether it is achievable at this stage in the Egyptian environment.
- **Technique:** about credit allocated to each point and weather it is satisfactory or not or it is better to be removed from assessment, and if not satisfied or asking to remove it please indicate how to why it in the space allocated and how it could be improved.

Assessment categories				
1.	**Site Design**	**Content**	**Criteria**	**Credit allocated**
1.1	Protecting Local Ecosystems	☐ Clear ☐ Not clear ……………… ……………… ………………	☐ Relevant ☐ Not relevant ☐ Achievable ☐ Not achievable	☐ Satisfied ☐ Not satisfied ☐ Remove ……………………… ………………………
1.2	Water-Conserving Strategies	☐ Clear ☐ Not clear ……………… ……………… ………………	☐ Relevant ☐ Not relevant ☐ Achievable ☐ Not achievable	☐ Satisfied ☐ Not satisfied ☐ Remove ……………………… ………………………
1.3	Building Orientation	☐ Clear ☐ Not clear ……………… ……………… ………………	☐ Relevant ☐ Not relevant ☐ Achievable ☐ Not achievable	☐ Satisfied ☐ Not satisfied ☐ Remove ……………………… ………………………
1.4	Maximize the Potential of the Site	☐ Clear ☐ Not clear ……………… ……………… ………………	☐ Relevant ☐ Not relevant ☐ Achievable ☐ Not achievable	☐ Satisfied ☐ Not satisfied ☐ Remove ……………………… ………………………
1.5	Connecting the building to the Community	☐ Clear ☐ Not clear ……………… ……………… ………………	☐ Relevant ☐ Not relevant ☐ Achievable ☐ Not achievable	☐ Satisfied ☐ Not satisfied ☐ Remove ……………………… ………………………

How it could be improved --

Figure 5- 1: Question D-1 from questionnaire II.

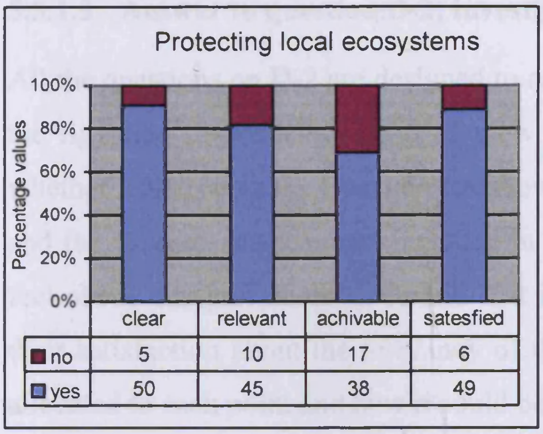


Figure 5- 2: Results about protecting local ecosystems point in EGCB version I.

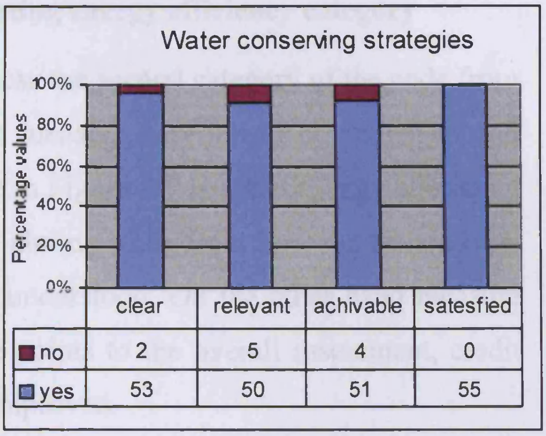


Figure 5- 3: Respondents result about water conservation on site design point.

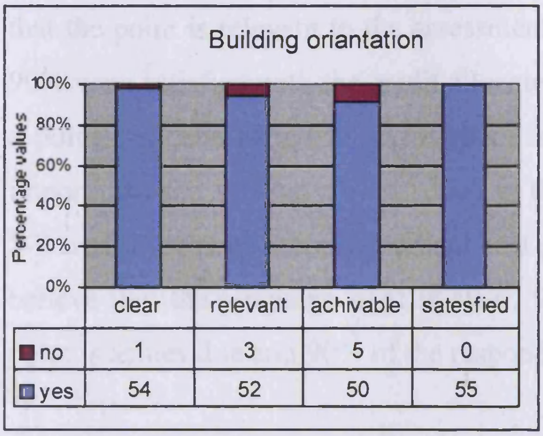


Figure 5- 4: Respondents' results about building orientation point in the code.

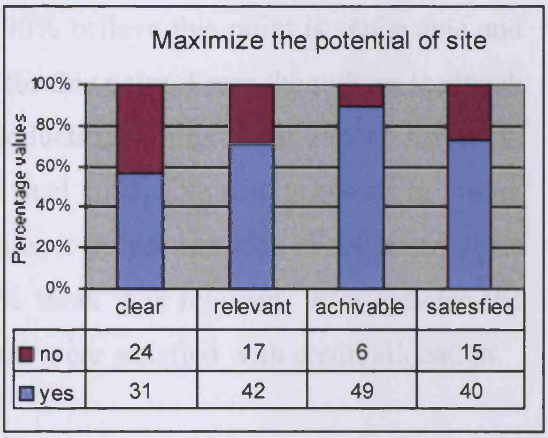


Figure 5- 5: Results about maximizing the potential of site point.

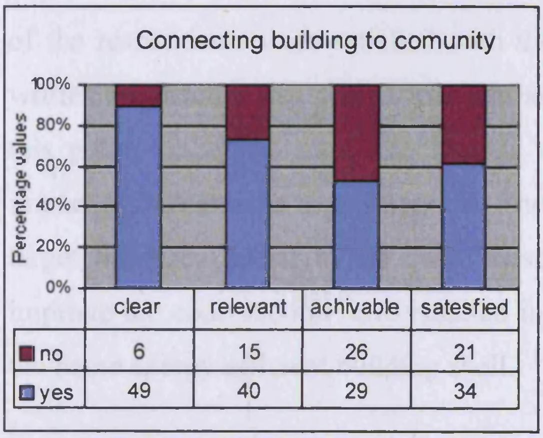


Figure 5- 6: Results about connecting the building to its surrounding community point.

5.5.1.3 Answer to question D-2; investigating energy efficiency category

All the questions on D-2 are designed to assess the second category of the code from the Egyptian respondents' point of view to measure how it will be perceived and whether it is acceptable. Questions as shown in Figure 5-7 is about Energy efficiency and the 12 assessment points included in it aiming to find out how the respondents feel about this part of the code and if it is understood. On the other hand measure their satisfaction about the relevancy of the points to the overall assessment, credit allocated to each point and how it could be improved.

For the first point massive wall construction, the results are shown in Figure 5-8 indicate that 90% of the respondents think the language used is clear, 75% indicate that the point is relevant to the assessment, 90% believe this point is achievable and 90% were satisfied with the credit allocated for this point. From the written feedback a point has been raised to add a small introduction to this point and its historical importance and this have been added to the final code. The results shown in Figure 5-9 are for the point stopping radiant heat gains, it shows that 95% of the respondents believe that the language used is clear, 95% think it is relevant, 90% indicate the point is achievable and 90% of the respondents were satisfied with credit allocation.

Figure 5-10 shows the results for the point embodied energy 90% of the respondent are satisfied with the language used, 80% indicate that this point is relevant to the assessment, 80% believe that it is achievable in the Egyptian environment and 70% of the respondents were satisfied with the credit allocated for this point. From the written feedback it has pointed out that as there is no materials section in the code, this point, embodied energy section, is the one to put a hint to materials and its impact on sustainable assessment on. Therefore an explanation of this point and its target has been added to the code. Results from written feedback in the how to improve the code section have resulted in the past three points to be grouped under the name energy efficient building shell.

As for the next point annual energy use, results from questionnaire are shown in Figure 5-11 95% of the respondents said that that the language used is clear, 100%

believe it is relevant, 90% think this assessment is achievable and 90% are satisfied with the credit allocated for this point. A small change to the presentation of this point came as a result of the written feedback; separate energy credits from electricity credits on points and make it clear the total for each part. The results in Figure 5-12 is about the point lifts and escalators systems show that 90% of the respondents indicate that the language used is clear, 75% believe this point is relevant to the assessment, 65% think it is achievable and 90% are satisfied with the credit allocated to this point. Annual energy use and lifts and escalators points have been grouped under the name energy use as a second part of the energy efficiency in building category.

For the point cooling systems results in Figure 5-13 indicate that 90% of the respondents are satisfied with the language used in explaining the code, 90% think the point is relevant to the assessment, 90% believe the credits are achievable and 90% of the sample are satisfied with the credit allocated for this point. Thought the number agreeing on this point are relatively high a lot of the written feedback demanded more details to be added explaining the credits as it is important in the Egyptian environment. Figure 5-14 shows the results for ventilation and indoor air quality strategies 60% of the respondent think the langue used is clear and understood, 90% believe it is relevant to the code, 70% think it is achievable and 60% are satisfy with the credit allocated to this point. As the percentage for this point are relatively low all the comments from the written feedback have been taken into consideration in modifying this point, this has resulted in more details on the exact specification of the credit requirements to be added to the code; more detail on outdoor air intakes a minimum of 7 feet vertically and 25 feet horizontally from polluted and/or overheated exhaust (e.g., cooling towers, loading docks, fume hoods, and chemical storage areas). Consider other potential sources of contaminants, such as lawn maintenance, separate vehicle traffic and parking a minimum of 50 feet from outdoor air inlets or spaces employing natural ventilation strategies and create landscaping buffers between high traffic areas and building intakes or natural ventilation openings.

Figure 5-15 present the results for the point lighting systems, all the respondents agreed on the language used in the text being clear, 90% think the point is relevant to the assessment, 90% believe it is achievable and 90% are satisfy with the credit allocated for this point. Two more credit have been added when consumption reduced by 25% as a result of the written feedback. For the point hot water supply systems Figure 5-16 shows that 90% of the respondents think the language used is clear, 80% believe the point is relevant, 80% agreed that the assessment is achievable and 90% were satisfied with credits allocated for this point. From the written feedback a modification have been done as to separate credits for applying a solar-assisted hot water system and heat recovery systems, using tankless water heaters in areas that are remote and require small hot water amounts and minimizing the standby heat losses to be 1 credit each to make it easier for designer to achieve. As it have been suggested by the written feedback to group the relevant assessment together; cooling systems, ventilation and indoor quality, lighting systems and water supply systems have been grouped under one category named mechanical and ventilation systems.

The results from questionnaire about building orientation and solar access point are presented in Figure 5-17, 95% of the respondents thought the language used is clear, 90% believed it is relevant to the assessment, 90% indicated the assessment is achievable and 90% were satisfied with the credit allocated to this point. Figure 5-18 shows the results about building-integrated approaches point, 95% of the respondent understood the point clearly, all the respondent 100% thought it is relevant to the assessment, 90% believed it is achievable and 90% were satisfied with credit allocated to this point. The last point on this part of the questionnaire was renewable energy applications for buildings the results shown in Figure 5-19 shows that 55% of the respondents thought the point language used was clear, 90% believed it is relevant to the code assessment, 65% indicated that this point credits were achievable and 50% of the respondents were satisfy with the credit allocated to this point.

The relatively low percentages of respondents agreeing on the clarity and credits allocation for the last point have lead to a reconstruction for this point. Based on the written feed back the language used in describing the point have been revised and more detailed have been used in describing the method to get the credit for each part. More results about this point will be discussed, as interviews results have dealt with it in detail. From the written feedback on how to improve this part of the code the points: building orientation, building integrated approaches and renewable energy applications for buildings have been grouped under a new category named renewable energy systems.

5.5.1.4 Results from interviews energy efficiency category

In the interviews when asked about how to improve the point of energy efficiency some of the first comments were about the length of the point itself and with 12 categories it is very long and somewhat confusing. Comment from interview 10:

> *"It was tiring to read the whole section let along trying to address all the issues inside..... The points are good but too long as one part."*

From interview 40:

> *"From the beginning of the energy efficiency section it seemed like a big section with 12 categories ahead......... if it could be grouped under three or four sections it would be easier to manage."*

Therefore to address this point the category energy efficiency has been divided into 3 parts; energy efficient building, mechanical and ventilation systems and renewable energy systems. Comments have been made in the interviews about the content of the introduction for the energy efficiency point, basically, the introduction was full of numbers and details that would change annually and would be hard to change the code layout annually as well. Example on this was from interview 16:

> *".... The energy main introduction is very long"*

From interview 3:

> *"....do you think three pages as introduction will be read? I don't think so, the introduction need to be more precise and directly into the point"*

To address this point a more compact version of the introduction has been made, less numbered detailed and was divided into the new sections of the code each in regard to its content.

From interview comments on how to improve the renewable energy part of the code, a lot of comments have suggested adding a part that detail the availability of renewable energy resources in the Egyptian environment. From interview 15:

> *"In Egypt …… currently, the energy strategy calls for renewable resources to cover 5% of the electrical energy demand by 2020 this should be found in the green code for Egypt in my opinion"*

Another comment from interview 3:

> *"This code could have a part- as an introduction maybe- for the map that indicates where the renewable energy technologies could be implemented in Egypt as a guideline for architects when designing"*

Comments on the same point came from interview 40:

> *"The benefits of each source of renewable energy should be explained …. For example Solar Energy: clean energy that is highly recommended in future Egyptian architecture for number of reasons…… an interesting introduction to motivate new designs"*

From these comments a new part of the code was created titled available renewable energy resources, this part have been made as an introduction to the utilization of renewable energies in Egypt.

In EGCB first version all renewable techniques were under the same point, comments have been made about this part and how to improve it was mainly about separating each technique individually and make separate credit for each of them in order to potentially maximize the . Comments that helped in the refinement of this point were, from interview 4:

> *"…why are they grouped all in one?…it would be much easier to follow separately"*

Comment from interview 36:

> *"Solar, wind and photovoltaic's all deferent applications and all under one name with one description and one credit….. in this part more details are require and individual credit"*

Thus the last modification based on results from interviews was to separate renewable energy application for buildings by type to: passive cooling, solar hot water, wind and photovoltaic. Each point will have a separate credit in order to achieve maximum application for renewable techniques in buildings.

D-2. Energy efficiency

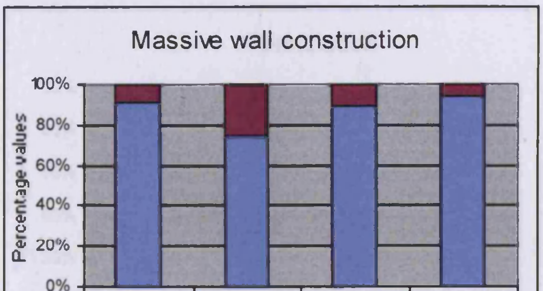
This section is about the second category in the code which is energy efficiency, in the table below information will be collected about:

- **Content:** the language used in text and whether it is clear and understood or not, and if not please indicate how to improve it in the space allocated.
- **Criteria:** whether the point is relevant to the assessment or not and whether it is achievable at this stage in the Egyptian environment.
- **Technique:** about credit allocated to each point and weather it is satisfactory or not or it is better to be removed from assessment, and if not satisfied or asking to remove it please indicate how to why it in the space allocated and how it could be improved.

Assessment categories				
2	**Energy efficiency**	**Content**	**Criteria**	**Credit allocated**
2.1	Massive Wall Construction	☐ Clear ☐ Not clear ……… ………	☐ Relevant ☐ Not relevant ☐ Achievable ☐ Not achievable	☐ Satisfied ☐ Not satisfied ☐ Remove ……… ………
2.2	Stopping Radiant Heat Gains	☐ Clear ☐ Not clear ……… ………	☐ Relevant ☐ Not relevant ☐ Achievable ☐ Not achievable	☐ Satisfied ☐ Not satisfied ☐ Remove ……… ………
2.3	Embodied Energy	☐ Clear ☐ Not clear ……… ………	☐ Relevant ☐ Not relevant ☐ Achievable ☐ Not achievable	☐ Satisfied ☐ Not satisfied ☐ Remove ……… ………
2.4	Annual energy use	☐ Clear ☐ Not clear ……… ………	☐ Relevant ☐ Not relevant ☐ Achievable ☐ Not achievable	☐ Satisfied ☐ Not satisfied ☐ Remove ……… ………
2.5	Lift and escalator systems	☐ Clear ☐ Not clear ……… ………	☐ Relevant ☐ Not relevant ☐ Achievable ☐ Not achievable	☐ Satisfied ☐ Not satisfied ☐ Remove ……… ………
2.6	Cooling Systems	☐ Clear ☐ Not clear ……… ………	☐ Relevant ☐ Not relevant ☐ Achievable ☐ Not achievable	☐ Satisfied ☐ Not satisfied ☐ Remove ……… ………
2.7	Ventilation and Indoor Air Quality Strategies	☐ Clear ☐ Not clear ……… ………	☐ Relevant ☐ Not relevant ☐ Achievable ☐ Not achievable	☐ Satisfied ☐ Not satisfied ☐ Remove ……… ………
2.8	Lighting systems	☐ Clear ☐ Not clear ……… ………	☐ Relevant ☐ Not relevant ☐ Achievable ☐ Not achievable	☐ Satisfied ☐ Not satisfied ☐ Remove ……… ………
2.9	Hot water supply systems	☐ Clear ☐ Not clear ……… ………	☐ Relevant ☐ Not relevant ☐ Achievable ☐ Not achievable	☐ Satisfied ☐ Not satisfied ☐ Remove ……… ………
2.10	Building Orientation and Solar Access	☐ Clear ☐ Not clear ……… ………	☐ Relevant ☐ Not relevant ☐ Achievable ☐ Not achievable	☐ Satisfied ☐ Not satisfied ☐ Remove ……… ………
2.11	Building-Integrated Approaches	☐ Clear ☐ Not clear ……… ………	☐ Relevant ☐ Not relevant ☐ Achievable ☐ Not achievable	☐ Satisfied ☐ Not satisfied ☐ Remove ……… ………
2.12	Renewable Energy Applications for Buildings	☐ Clear ☐ Not clear ……… ………	☐ Relevant ☐ Not relevant ☐ Achievable ☐ Not achievable	☐ Satisfied ☐ Not satisfied ☐ Remove ……… ………

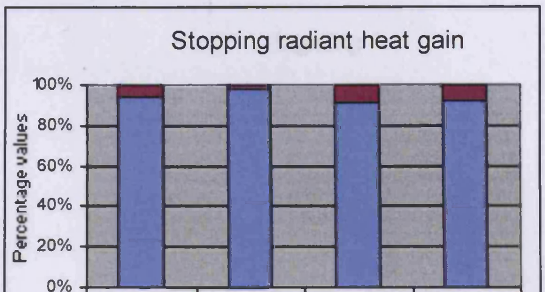
How it could be improved ---

Figure 5- 7: Question D-2 in the survey questionnaire II.



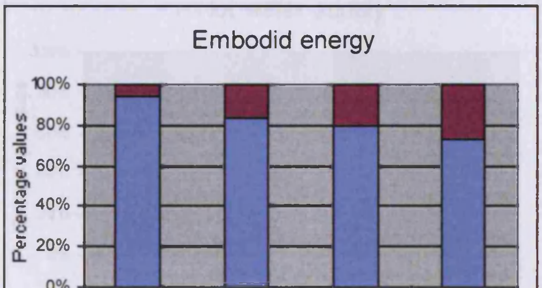
	clear	relevant	achivable	satesfied
no	5	14	6	3
yes	50	41	49	52

Figure 5- 8: The results from questionnaire about massive wall construction point.



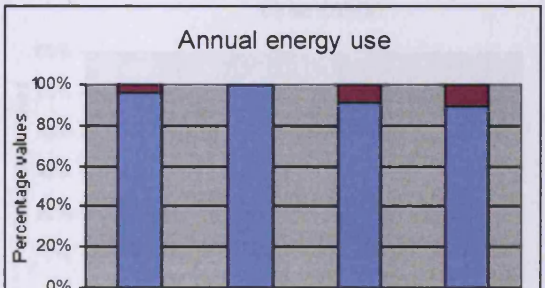
	clear	relevant	achivable	satesfied
no	3	1	5	4
yes	52	54	50	51

Figure 5- 9: Questionnaire results about stopping radiant heat gain point in EGCB version I.



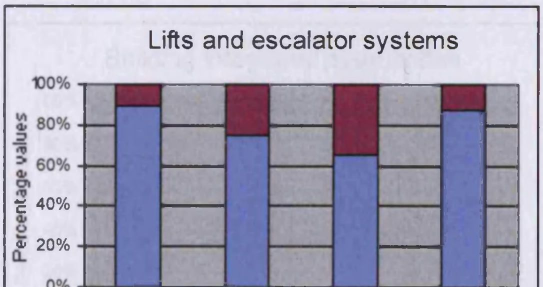
	clear	relevant	achivable	satesfied
no	3	9	11	15
yes	52	46	44	40

Figure 5- 10: Results about the embodied energy point of the code.



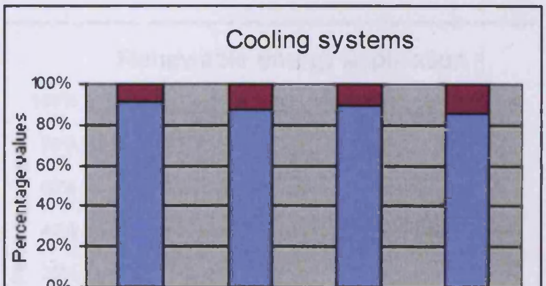
	clear	relevant	achivable	satesfied
no	2	0	5	6
yes	53	55	50	49

Figure 5- 11: Respondents reaction to the point annual energy use.



	clear	relevant	achivable	satesfied
no	6	14	19	7
yes	49	41	36	48

Figure 5- 12: The results from questionnaire about lifts and escalator systems point.



	clear	relevant	achivable	satesfied
no	5	7	6	8
yes	50	48	49	47

Figure 5- 13: Results on cooling system point from the energy efficiency category.

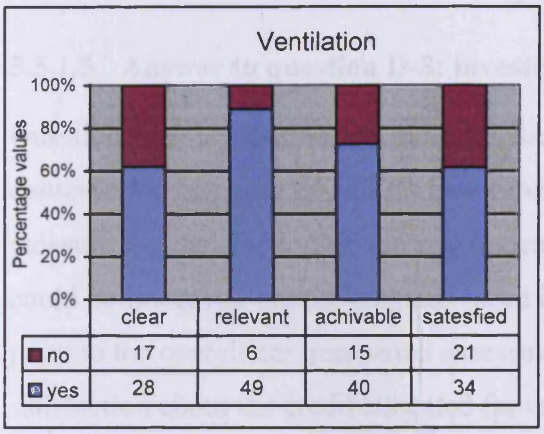


Figure 5- 14: Results from questionnaire II about the ventilation point.

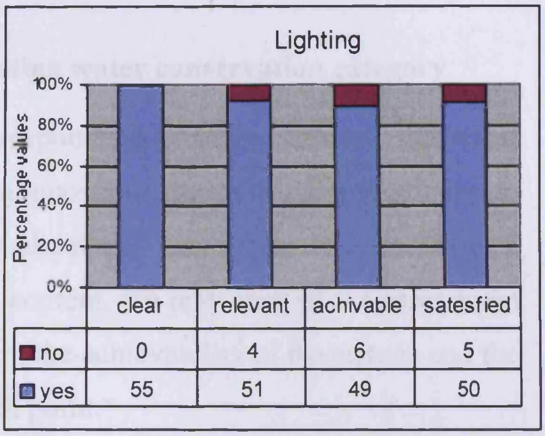


Figure 5- 15: Results about the lighting point from Egyptian respondents' responses.

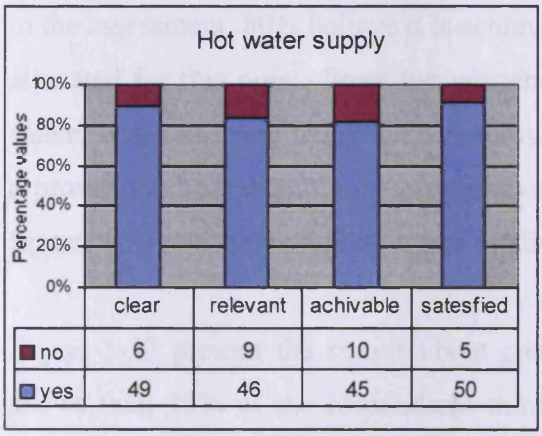


Figure 5- 16: Results about the point hot water supply from energy efficiency category.

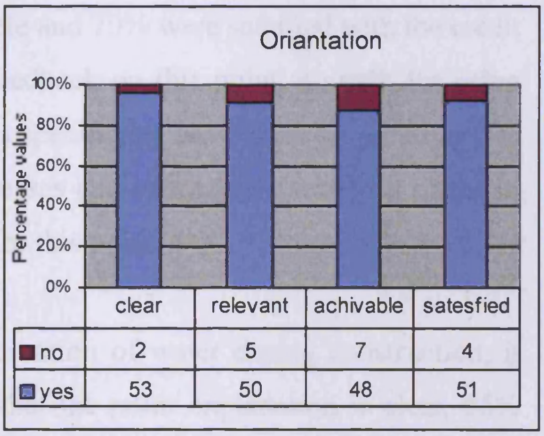


Figure 5- 17: Egyptian respondents' results on the orientation point.

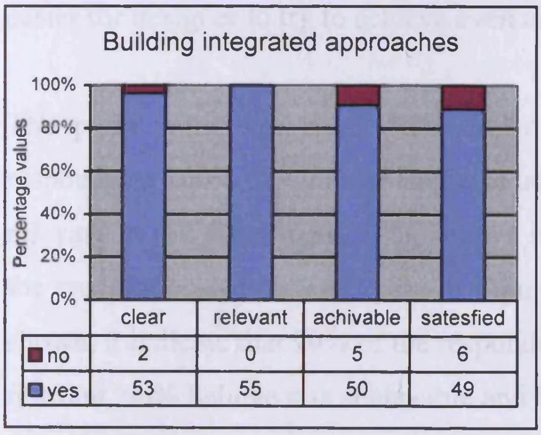


Figure 5- 18: Questionnaire phase II results on building integrated approaches point.

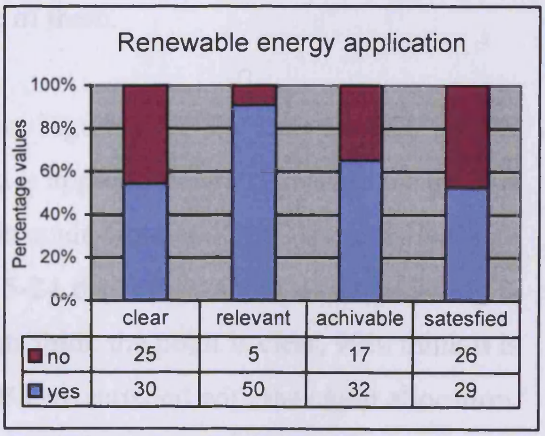


Figure 5- 19: Results about renewable energy application point in the code.

5.5.1.5 Answer to question D-3; investigating water conservation category

Question D-3 is designed to measure the respondents' reaction towards the water conservation category on EGCB first version, questions shown in Figure 5-20 aim to measure the satisfaction of the respondents about this part of the code and how it could be improved on; the language used in content, the relevancy of the assessment point to the overall environmental assessment, the achievability of the criteria and the satisfaction about the credit allocated for each point.

The results for water conserving landscaping strategies are shown in Figure 5-21, 95% of the respondents agreed on the language clarity, 85% indicate point relevancy to the assessment, 80% believe it is achievable and 70% were satisfied with the credit allocated for this point. From the written feedback on this point, a credit for using soaker hoses and drip irrigation technologies specifically have been proposed as it is a proven method to minimize evaporative losses and concentrate water on plants in Egypt. This resulted in adding a new credit for this point.

Figure 5-22 present the results about conservation of water during construction, it shows that; 95% of the respondents think that the point explanation is clear, 55% believe it is relevant, 70%indicated that it is achievable and 55% are satisfied with the credit allocation. As the numbers for the point relevancy and satisfaction were relatively low a modification have been done based on the written feedback, it has been suggested to split this points into two sections with one credit each, to make it easier for designer to try to achieve even one of them.

The point water use results are shown in Figure 5-23 it indicate that all the respondents 100% thought the language used is appropriate, 95% indicate the point is relevant to the assessment, 90% believe it is achievable and 95% are satisfied with the credit allocated for each part. In Figure 5-24 the results about water recycling is shown, it indicate that 90% of the respondents think the point is clear, 90% think it is relevant, 90% believe it is achievable and 80% are satisfied with the credit allocation. From the written feedback more points have been proposed for this section.

Therefore the point has been changed into four credits instead of three and a point for harvesting rainwater has been introduced to the assessment. Figure 5-25 presents the results about effluent discharge to foul sewers point; it shows that 60% of the respondents think the langue used is clear, 70% believe it is relevant, 50% think it is achievable and 60% are satisfied with its credits. In the section how it could be improved a lot of the written feedback was about this point and most of them agreed on it needing more explaining, thus, detailed information on the reports needed have been added. A lot of the respondents have written that the language used needed to be more technical, therefore, a rephrasing of this point have been done.

5.5.1.6 Results from interviews about water conservation category

In the interviews when asked about how to improve the point of water conservation there have been a lot of comments on adding two new subcategories; water conserving fixtures and water quality. Water conserving fixture deals with the plumbing fixtures on building and water quality deals with the quality of potable water delivered to the building users making sure is satisfactory. Examples of the comment made in interviews are from interview 5:

> *"One of the most effective means to limit demand for water is to reduce the requirements associated with necessary plumbing fixture........Though water quality is not in the hand of the designer, fresh water plumbing installations should comply with the referenced good practice guides and demonstrating that the quality of potable water meets the referenced drinking water quality standards at all points of user"*

Another comment about the same category in interview 27:

> *"In my opinion a credit should be allocated for considering showerheads that require less than 2.5 gallons per minute and incorporate levers for reducing flow between 2.1 and 1.5 gallons per minute ..... the designer could specify low-flow toilets that use less than 1.6 gallons per flush."*

Another comment in interview 31:

> *"..... Using aerators to reduce flow in lavatory faucets to as low as 1 gallon per minute......... when applicable specify self-closing, slow-closing, or electronic faucets"*

Based on these comments and others the new subcategories water conserving fixtures and water quality have been added to the code.

D-3. Water conservation

This section is about assessing water conservation strategies, in the table below information will be collected on:

- **Content:** the language used in text and whether it is clear and understood or not, and if not please indicate how to improve it in the space allocated.
- **Criteria:** the point itself and whether it is relevant to the assessment or not and whether it is achievable at this stage in the Egyptian environment.
- **Technique:** about credit allocated to each point and weather it is satisfactory or not or it is better to be removed from assessment, and if not satisfied or asking to remove it please indicate how to why it in the space allocated and how it could be improved.

Assessment categories				
3.	**Water**	**Content**	**Criteria**	**Credit allocated**
3.1	Water-conserving landscaping strategies	□ Clear □ Not clear …………… ……………	□ Relevant □ Not relevant □ Achievable □ Not achievable	□ Satisfied □ Not satisfied □ Remove …………………… ……………………
3.2	Conservation of water during construction	□ Clear □ Not clear …………… ……………	□ Relevant □ Not relevant □ Achievable □ Not achievable	□ Satisfied □ Not satisfied □ Remove …………………… ……………………
3.3	Water quality	□ Clear □ Not clear …………… ……………	□ Relevant □ Not relevant □ Achievable □ Not achievable	□ Satisfied □ Not satisfied □ Remove …………………… ……………………
3.4	Water recycling	□ Clear □ Not clear …………… ……………	□ Relevant □ Not relevant □ Achievable □ Not achievable	□ Satisfied □ Not satisfied □ Remove …………………… ……………………
3.5	Effluent discharge to foul sewers	□ Clear □ Not clear …………… ……………	□ Relevant □ Not relevant □ Achievable □ Not achievable	□ Satisfied □ Not satisfied □ Remove …………………… ……………………

How it could be improved ---

Figure 5- 20: Question D-3 in the survey questionnaire phase II.

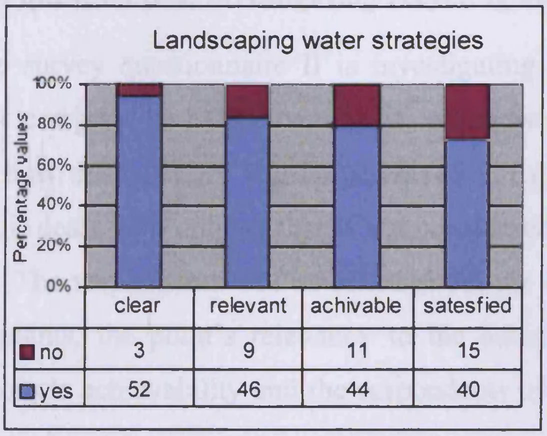


Figure 5- 21: Results from questionnaire II about landscaping strategies for water conservation.

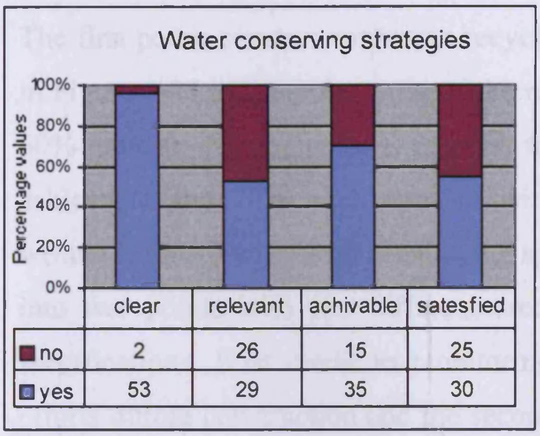


Figure 5- 22: Results from respondents' point of view about the water conservation part.

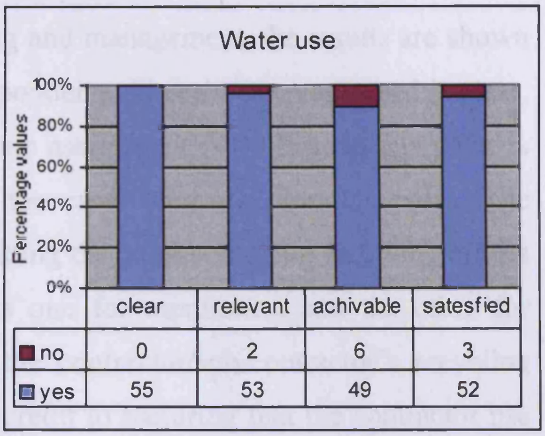


Figure 5- 23: The results from questionnaire about water use point.

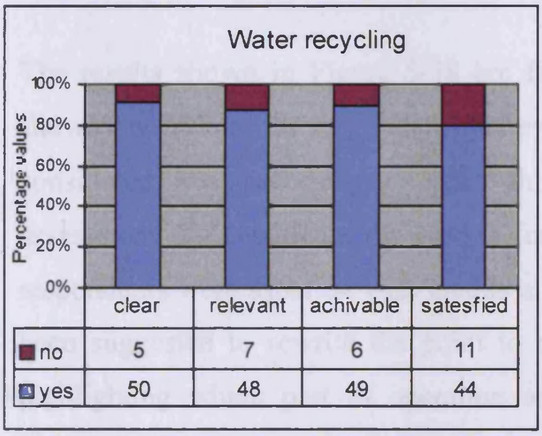


Figure 5- 24: Questionnaire II results about water recycling strategies.

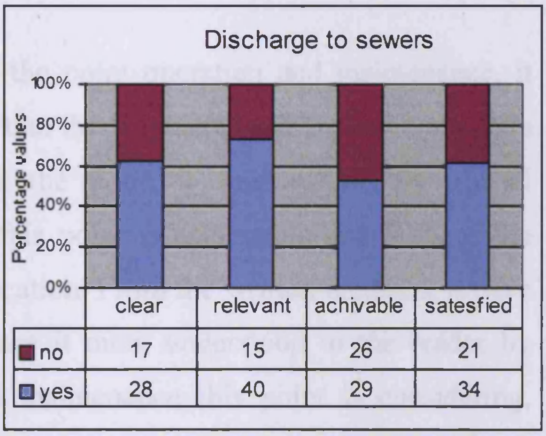


Figure 5- 25: Results from questionnaire II about the point discharge to sewers strategies.

5.5.1.7 Answer to question D-4; investigating recycling and waste management

Section D-4 in the survey questionnaire II is investigating recycling systems and waste management category in EGCB version I, as shown in Figure 5-26, it is designed to assess how this category will be perceived in Egypt and whether it will achieve its aims as it deals with options that is not considered in most of the current buildings in Egypt. The respondents will be asked about the code's language clarity in explaining the points, the point's relevancy to the assessment in the Egyptian environment, the point's achievability and the respondents overall satisfaction about credits allocated to each point.

The first point; construction waste recycling and management, the results are shown in Figure 5-27 indicate that 90% of the respondents think the language used is clear, 60% indicate that the point is relevant to the assessment, 70% believe this point is achievable and 70% were satisfied with the credit allocated for this point. The written feedback suggested considering splitting the point contractor recycling efforts into two points with two different credits one for monitoring and the other for specifications. First credit to monitoring the contractor/sub-contractor's recycling efforts during construction and the second credit to requiring that the contractor use safe handling, storage, and control procedures, and specify that the procedures minimize waste in order to minimize the impacts from any hazardous materials or waste used in construction

The results shown in Figure 5-28 are for the point operation and maintenance, it shows that 60% of the respondents believe that the language used is clear – which is considered low percentage - 85% think the point is relevant to the overall assessment, 90% indicate the credits for this point is achievable and 80% of the respondents were satisfied with credits allocation. From the written feedback it have been suggested to rewrite the point to make it more understood to the reader by highlighting which part of operation and maintenance this point is considering, therefore, three sections have been generated one for manual the second for energy management and the third for operator training.

5.5.1.8 Results from interviews about recycling and waste management

Comments from the interviews conducted after the questionnaires distributions have raised two issues about the recycling systems and waste management category. First, it has been suggested to split the first point of construction waste recycling and waste management into two points with two different credits, example from interview 5:

> *"On the last category....this point is totally left for the contractor and it should be supervised or at least specification to what exactly needed to be done on site..."*

Comments from interview 27:

> *"Recycling...specification for contractor....for ground cover at the end of the project, stockpile topsoil or existing rocks instead of buying after..."*

Comments from interview 40:

"As for the recycling systems and waste management category I would suggest trying to explain what the minimum expectation of the contractor is, for example which materials will be recycled...."

Thus, the point waste recycling and waste management have been splat into two points with two different credits, the first for specifying the specific job-site wastes that will be recycled during construction (corrugated cardboard, all metals, clean wood waste, gypsum board, beverage containers, and clean fill material). The second credit was to be given for stockpiling appropriate existing topsoil and rock for future ground cover.

The second issue raised by interviews was adding a summery for all credits attainable after each category; this point has been raised in several parts of the code and again has been raised in this section, comments from interview 7:

"To summarize...why don't you add a section at the end of each category with all credits for each section, may be as a table."

Comments from interview 16:

"On the code arrangement....a summery of credits at the end would be very helpful so every designer could see from the beginning which categories he will have to work on to get the credits he desires."

Comments from interview 29:

"Finally...I was expecting a final summery at the end to collect a final view of all the categories of the code."

Comments from interview 33:

"After reading the whole code ... you can get more confused as what didn't you account for in each category... a summery would be helpful...like the BREEAM have at the end – checklist-"

Therefore, a summery of the total credits attainable by each category was added to the code at the end of each section and this summery was applied to all categories of the code, also, an overall checklist was added at the end of the code.

D-4. Recycling Systems and Waste Management

This section is about recycling and waste management strategies, in the table below information will be collected about:

- **Content:** the language used in text and whether it is clear and understood or not, and if not please indicate how to improve it in the space allocated.
- **Criteria:** the point itself and whether it is relevant to the assessment or not and whether it is achievable at this stage in the Egyptian environment.
- **Technique:** about credit allocated to each point and weather it is satisfactory or not, and if not satisfied or asking to remove it please indicate how to why it in the space allocated and how it could be improved.

Assessment categories				
4.	**Recycling& management**	**Content**	**Criteria**	**Credit allocated**
4.1	Construction Waste Recycling and Waste Management	☐ Clear ☐ Not clear …………… …………… ……………	☐ Relevant ☐ Not relevant ☐ Achievable ☐ Not achievable	☐ Satisfied ☐ Not satisfied ☐ Remove …………………… ……………………
4.2	Operation and maintenance	☐ Clear ☐ Not clear …………… …………… ……………	☐ Relevant ☐ Not relevant ☐ Achievable ☐ Not achievable	☐ Satisfied ☐ Not satisfied ☐ Remove …………………… ……………………

How it could be improved ---

Figure 5- 26: Question D-4 in the survey questionnaire II.

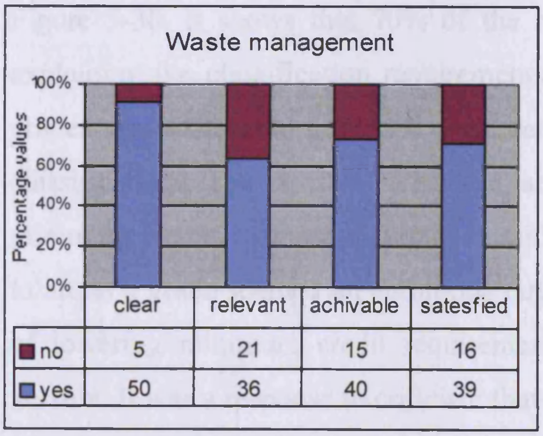


Figure 5- 27: The results from questionnaire about Construction waste.

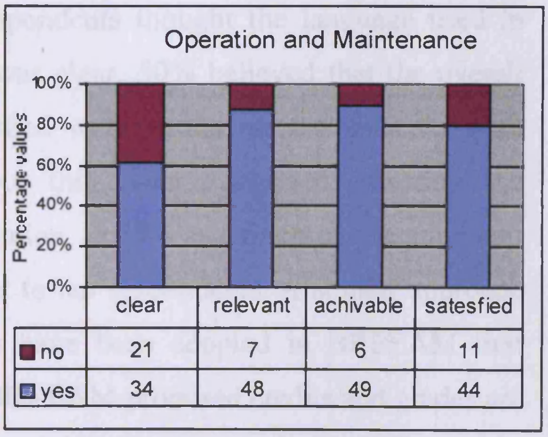


Figure 5- 28: Results about operation and maintenance point in the code.

5.5.2 Results from questionnaire II section E; investigating credits weighting, overall grade and classifications.

Section E of the questionnaire, shown in Figure 5-29, was designed to; measure the Egyptian target group reaction and satisfaction with the proposed overall grade system for the code and its awarded classifications, and to investigate the achievability of these credits, also to present the respondents opinion about the five years check option proposed by the new code. The overall assessment grade is based on the literature review for EIAP conducted in Chapter 1, and the grades most of them used. Based on the percentage of applicable credits gained, given the importance of each part of EGCB it is necessary to obtain a minimum percentage of credits from each part in order to qualify for an overall classification. Proposed award classifications starts with the bronze grade which equal minimum requirements with 25% of the total credit attainable, the second classification is silver with minimum 50%, the third is gold class with minimum requirements of 75% of the total credits and finally the platinum classification with minimum requirements of 90% of total credits attainable of EGCB. Awarded classification require minimum credit in each category; site design, energy efficiency, water conservation and recycling and management, in order to make sure that not all of the total credits obtained by a building came from one or two categories and ignored the others.

Results about the respondents' reaction to the code classifications are presented in Figure 5-30, it shows that 70% of the respondents thought the language used in explaining the classification requirements was clear, 50% believed that the overall grades are achievable and 65% were satisfied with credits requirements for each classification. The written feedback about this point suggested lowering the minimum credits required to obtain classification, as 25% as a minimum requirement to attain a grade seemed an ambitious target to our respondents. A similar approach of lowering minimum credit requirements have been adopted in BREEAM first version. It was a response to criticism that BRREAM proposed credits and grades are relatively hard to achieve and also to encourage people to uptake the scheme (BREEAM, 2008).

Figure 5-31 present the results from the respondents on the after-operation recheck proposed by the code and it shows that 90% thought the language used in explaining this point was clear, 90% believed it is achievable and 80% of the respondents were satisfied about adding the after-operation recheck to the code assessment. Some of the respondents suggested to reduce the recheck time to three years instead of five and this option was discussed further in the interviews and was not supported enough by the target group therefore it was ignored.

5.5.2.1 Results from interviews about credits weighting, overall grade and classifications.

Comments from the interviews regarding the classification section of the code were concentrated on two points, first, the minimum requirements for each classification especially the bronze grade, as it represents the minimum code requirement, most of the respondents believe that 25% of the total credits attainable by the code is a high percentage, for example comments from interview 3:

"The code classifications ... minimum requirements for a grade like in the bronze are too high... and will put off some designers and clients from applying for the code."

Comments from interview 19:

"...25% of the total credits as a minimum classification considered very ambitious....in my opinion it could start from may be 15%...to encourage small projects to think environmentally..."

Comments from interview 25:

"...the total classification theory is ok, but the credit allocated for each grade could be revised to be more flexible..."

The second point raised in the interviews was the recheck period to maintain the classification awarded by the code. When discussed with the respondents most of them agreed on doing the recheck and few of them wanted to change the check period to three years as the comments next will present, but the majority of the respondents wanted to keep it as five years check to be able to notice the actual impacts. Examples on comments about this point are from interview 6:

"...the recheck after operation is better be after three years to spot the areas of deficiency early on after operation..."

Comments from interview 13:

> *"The recheck option is essential especially in Egypt as the people occupying green buildings will need to improve their knowledge on how to use and maintain this building…"*

Comments from interview 40:

> *"…five years is the right period to recheck a building in my opinion…if there are any deteriorations it will be noticeable."*

Therefore, the current recheck period to maintain a classification was to be remain as five years check and the classifications minimum requirements were revised and in EGCB final version it started from 16% of the total credits as a bronze grade.

E. Credits weighting and overall grade

This section of the questionnaire is about the classifications awarded by the code and the credit requirements for each grade, in the table below please indicate your opinion on: 1) the overall grade requirements and its achievability in the Egyptian environment, 2) the proposed recheck after operation of the buildings to keep the classification awarded and whether to keep this option.

Assessment categories				
5	**Code overall grades**			
5.1	Overall grades and code classifications.	☐ Clear ☐ Not clear	☐ Achievable ☐ Not achievable	☐ Satisfied ☐ Not satisfied
5.2	After-operation recheck and re-awarded classifications	☐ Clear ☐ Not clear	☐ Achievable ☐ Not achievable	☐ Satisfied ☐ Not satisfied

How it could be improved --

Figure 5- 29: Question E in the survey questionnaire phase II.

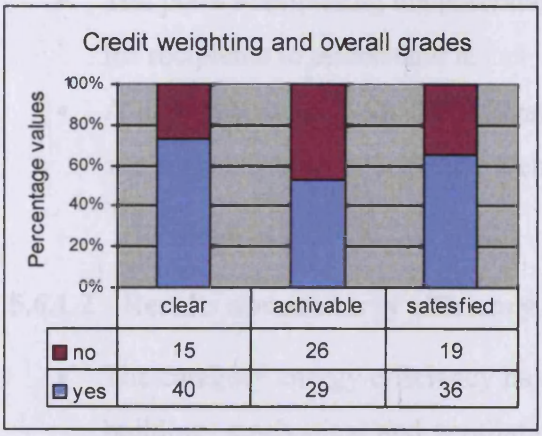


Figure 5- 30: The results from questionnaire about the code classifications.

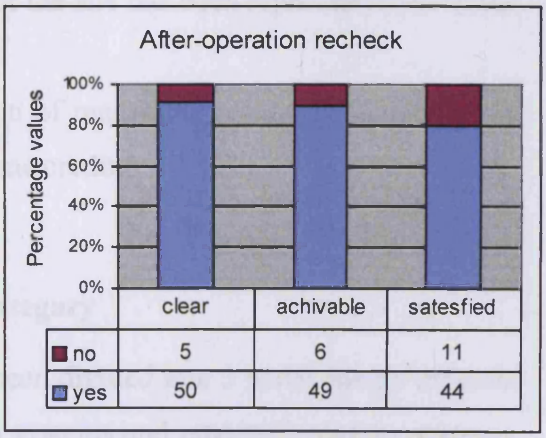


Figure 5- 31: Results about the after-operation recheck and re-awarded classifications

5.6 Discussion and findings

Based on the questionnaires, written feedback and interviews the second survey has resulted in modifying EGCB version I and its categories. Modifications made to the two sections of the survey, firstly, section D regarding the refinements made to EGCB categories, and secondly, the results from section E regarding the overall grades and awarded classifications. Summery of the results, modifications and refinements will be presented below.

5.6.1 Results from questionnaire section D

Section D collected information on the code categories and comprehensively assessed how the different categories of the code were perceived with our target group. Section D investigated categories language clarity and understandability, different points' relevancy to the code environmental assessment, the achievability of the credit allocated for each point and the satisfaction about the amount of credits allocated for each point in regards to the Egyptian current environmental situation. Modifications and refinements that have been made to EGCB (version I) according to the results from the survey phase II are:

5.6.1.1 Results about site design category

- The point maximizing the potential of the site has been rephrased to be easier for recipients to understand it.
- A new subcategory for the utilization of renewable resources techniques on site scale has been added and given one credit.

5.6.1.2 Results about energy efficiency category

- The category energy efficiency has been divided into 3 parts; energy efficient building, mechanical and ventilation systems and renewable energy systems. Energy efficient building include: energy efficient building shell and energy use. Mechanical and ventilation systems deal with: cooling systems, ventilation and indoor quality, lighting systems and water supply systems. Renewable energy systems include: building orientation, building integrated approaches and renewable energy applications for buildings.

- A new part of the code was created titled available renewable energy resources in Egypt to serve as an introduction to the utilization of renewable energies in Egypt.
- The points; massive wall construction and cooling systems, both had an introduction added with their historical importance to Egypt.
- The points; renewable energy applications for buildings and embodied energy; have been completed with an explanation of their targets and methods to achieve credit allocated for them.
- For the point annual energy use credits have been separated into credits for energy efficiency and credits for electricity efficiency.
- Ventilation and indoor air quality strategies point have been rewritten with more details on the exact specification of the credit requirements.
- For the point lighting systems, two credits have been added when consumption reduced by 25%.
- Hot water supply systems point has been separated into; applying a solar assisted hot water system and installing heat recovery systems with separate credit for each point.

5.6.1.3 Results about water conservation category

- A credit for using soaker hoses and drip irrigation technologies have been added to the landscaping strategies.
- The point conservation of water during construction was split into two sections with one credit each, to make it easier for designer to try to achieve at least one of them.
- A credit for harvesting rainwater has been added to the point water recycling which makes it four credits in total.
- Detailed information on the reports needed for the point effluent discharge to

foul sewers have been added.

- Two new points have been added to the water conservation category; water conserving fixtures and water quality. Water conserving fixture deals with the plumbing fixtures on building and water quality deals with the quality of water delivered to the building users making sure is satisfactory.

5.6.1.4 Results about recycling and waste management category

- The point construction waste recycling and management have been splat into two points with two different credits, first credit for monitoring the contractor's recycling efforts during construction and the second credit to requiring that the contractor use safe handling, storage, and control procedures, and specify that the procedures minimize waste in order to minimize the impacts from any hazardous materials or waste used in construction stage.
- Operation and maintenance point has been rewritten to make it more understood, three sections have been generated; the first for manual operation the second for energy management and the third for operator training.

5.6.2 Results from questionnaire section E about the code overall grade and awarded classifications

- Lowering the minimum credits required to attain classification from 25% as a minimum requirement to 16% for a bronze grade.

5.6.3 Results from interviews

Results from section 1 of the interviews about the clarity of the language used in explaining the code categories and the relevancy of the code points to Egypt have led to direct modifications to the code. The energy efficiency category has been divided into 3 parts; energy efficient building, mechanical and ventilation systems and renewable energy systems to be easier for user to understand. For better understanding to the point renewable energy application for buildings, it has been divided by type to: passive cooling, solar hot water, wind and photovoltaic. Each point will have a separate credit in order to achieve maximum application for renewable techniques in buildings. Summery of the total credits attainable by each category was added to the code at the end of each section

Results from interviews section 2 about the achievability of each point and credits allocations led to splitting of some points in the assessment to be easier to achieve. Waste recycling and waste management have been split into two points with two different credits, the first for specifying the specific job-site wastes that will be recycled during construction (corrugated cardboard, all metals, clean wood waste, gypsum board, beverage containers, and clean fill material). The second credit was to be given for stockpiling appropriate existing topsoil and rock for future ground cover. New points of assessment that have been added to the code as a result to the interviews are: the use of renewable resources techniques on site scale, available renewable energy resources, water conserving fixtures and water quality.

The main result from section 3 in the interviews about the code overall classifications was to revise the minimum requirements to attain a grade and lower it. In EGCB final version classifications started from 16% of the total credits as a bronze grade.

5.7 Summery

Results from the second phase of questionnaire and interviews have been presented in Chapter 5. This chapter has served as an evaluation phase in the process of developing EGCB, giving information on how the code could be modified specifically to the Egyptian audience. All modifications and refinements suggested in the survey results have been generated into the code and EGCB second version was ready for pilot application on a selected project to gain results from a more practical point of view. The next chapter will present results from the final phase of evaluation of EGCB.

Chapter 6: Results from Survey Phase III

6.1 Introduction

This chapter will describe the results from EGCB application on a proposed project from Egypt and will also present the results from interviews phase III. From the results of Chapters 4 and 5 the final version of EGCB was developed taking into consideration all modifications proposed from our respondents and was ready for an application to measure if the assessment is achievable and if there is any final refinements to the code from application point of view. Reading for All National Library was the building that has been chosen to be tested; results from the application will be presented in this chapter. This chapter will also discuss the third and final phase of interviews results aimed at investigating if the final version of the code would be accepted in Egypt and what are the problems that could face the application of the proposed code. This chapter will serve as final assessment point for EGCB trying to put it on the track for an actual application in Egypt.

6.2 Objectives

This chapter mainly aims to:

- Assess the final code from a more practical point of view as it present the results from the application of EGCB on an actual proposed building.
- Comprehensively measure the satisfaction about the final version of the code and its application.
- Review and investigate the major problems and common barriers connected to the execution of the new code.

6.3 Methodology

This chapter aims to assess the second version of EGCB that has been developed from the results of the second phase of questionnaires and interviews conducted in Chapter 5. In order to achieve the aims of this chapter two types of methods were adopted:

- Quantitative, based on the results from the code application and interviews.
- Qualitative, based on the final phase of interviews.

The first section of this chapter; the application of the code on an actual proposed building, collected qualitative information on how the code works and whether its assessment achievable. The building assessment was constructed in two parts targeting different criteria as follows:

Section E: presents information on the points achieved by the proposed project on the four categories of the code: Site design, Energy efficiency, Water conservation and Recycling and management.

Section F: measures the applicability and achievability of the overall classification.

The interviews phase III was the final assessment point by our targeted respondents for EGCB on its final form. All the interviews have been transcribed, translated and stored in a database. Important quotes will be highlighted in different parts of the results. The respondents have been handed the final EGCB version (Appendix 3) with the results from the case study application. They were asked to participate in a final interview. The interviews questions were structured in three sections, each section collected different type of information as follows:

Section 1: measures the satisfaction of the respondents about the final version of EGCB, the modifications that have been done to the categories, the case study application and the overall grade system of the code

Section 2: collects information on the reaction of the respondents towards EGCB and its ability to be applied in Egypt.

Section 3: asks about the anticipated problems that would face the application of EGCB or any environmental assessment program in Egypt.

6.4 Procedures

6.4.1 Sampling

Reading for all (national library) is the case study project which has been suggested in the interviews phase two to be the application project. Reasons for choosing this project are:

- The new design of the library has been advertised as an environmentally conscious building and it would be interesting to find out how it will score on EGCB.
- It is to be implemented in six different places in Egypt and to have an environmental rating it would set a good example for the code.
- All the relevant environmental assessment reports and calculation required in EGCB have already been made and the author has full access to it. The documents includes: full detailed working drawings, design concept elements and site analysis, energy efficiency report and calculations, water requirements and fixtures, procedures handbook for the contractor, documented instructions to operate on energy efficiency and a report of all plants intended on site.

The third phase of interviews has the same target recipients as the first and second ones. 55 questionnaires have been distributed in phase II out of which 48 have indicated their interest in receiving the final version of EGCB and 46 indicated their availability to do a final interview to comment on EGCB application (15 governmental officials, 13 architects in practice and 18 academics). EGCB final version was sent to the respondent at least 14 days before the interview took place.

6.4.2 Research questions

Chapter 6 was designed to answer the following research questions:

- Is the code in its current state ready for application?
- What are the modifications that application of the code could have on

categories content and techniques? Is the grade of the code achievable?

- Is the credit allocated for each point of the code relevant and satisfactory?
- How would the code be perceived in Egypt?
- What are the foreseen problems that could hinder EGCB application?

6.5 Application of EGCB results and analysis

6.5.1 Results from the application of EGCB section E

The next part will present the results from applying the new code EGCB version II on the library project. All categories of the code have been taken under consideration (for the complete EGCB version, please refer to Appendix 3). Credits attainable by the project on different categories will be presented, the final overall grade for the project and the results from the application process and its effect on EGCB development.

6.5.1.1 Results from E-1 about site design

Site design category consists of six points; the results for the library project application and the total credit gained will be presented next. For the first point protecting local ecosystems, one credit was attainable by the project on the use of native plants and consulting with local gardeners about them. To understand how the decision to give this credit was made, the next explanation is offered. This point credit is attainable when proof of considering landscaping element from the local environment is presented in the design. The author had access to the landscaping report of the project (summery of the report in Appendix 7). The report included the methodology for using these specific plants in accordance with the Egyptian environment and their compatibility with existing plants. The report had 3 parts; the first one is the site drawings references with numbered tables and specifications of the plants. The second part considered each proposed plant, why it was chosen and its relation to the Egyptian conditions. The third part of the report was design as guidance to implementing these plants and how to maintain them.

On the second point water-conserving strategies, two credits were attainable by the library the first credit for using native and drought-resistant planting materials to minimize the need for site irrigation and a list of all plant used is submitted. The second credit for using grey water from sinks and water fountains for site irrigation or using soaker hoses and drip irrigation techniques that minimize evaporative losses and concentrate water on the plants' roots, the system requirement report was prepared by qualified engineer and was also submitted.

The library scored one credit on the point building orientation for developing a floor plan that minimizes east and west facing glass to maximize the day lighting contribution and all planes with theory details on it were submitted. For the next point maximize the potential of the site, one credit was achieved by the project on considering existing and new landscaping as a means of providing shading in the warmer months and the report of all plants intended was submitted. The next point renewable energies didn't score any points and on the final point connecting the building to the community the library project scored one credit for linking the library to the surrounding communities through safe pedestrian pathways and designing the building so that the media centre and cafeterias can be shared with the community all the design concept sketches and the layout was submitted.

The library scored six out of possible eleven credits on the first category site design as shown in Table 6-1, which indicated that even for a small project most of the points on this category could be achieved. The only category that didn't score any credits was the renewable sources of energy on site scale and this could shed some light on the fact that renewable energies still isn't considered as an applicable option in design in Egypt even for environmental buildings.

6.5.1.2 Results from E-2 about energy efficiency

The second category in EGCB assessment is energy efficient building it contain three parts energy efficient building shell, mechanical and ventilation systems and renewable energy systems. In the first part energy efficient building shell the first point was stopping radiant heat gains and the library scored two credits for it, the first one from incorporating radiant barriers in the roof assemblies to reduce up to 95% of radiant heat gain and all the roof details and the system used were submitted. The second credit came from selecting a light color for the exterior finish to reflect solar radiation with all the finishing colors and materials tables submitted. On the next point embodied energy one credit was achieved by the project for selecting locally made products and construction materials with the locations maps submitted.

The project achieved three credits for the point annual energy use; two credits came from the reduction in the annual energy consumption by 14% and one credit for the reduction in the maximum electricity demand by 15%. The credit given is relative to the respective benchmark criteria evaluated from the baseline building model. The documents presented included the plan to install control systems and devices that will switch off or dim the output of lighting installations when and where illumination is not required, also, efficient electricity system proof was submitted (theatre, main reading hall, projection rooms, café, and administration area lights).

For the second part of the energy efficiency category; mechanical and ventilation systems, the first point cooling systems obtained one credit was obtained by the project for using ventilation tours as a form of free cooling is night-time ventilation. For the next point the ventilation and indoor air quality strategies one credit was achieved by the proposed project for using ventilation systems that will consume less electricity than those meeting the zero credit requirements (baseline) by 15% or more, the specialized report was submitted as part of the design criteria of the project. Lighting systems the next point of the assessment obtained one credit for using lamps and, where applicable, ballasts that will consume less electricity than those meeting the zero-credit requirements by 15% and all the specification for the lighting equipments was in the building specifications submitted to the energy report. On the last point for hot water supply systems, the project scored two credits, the first one for applying a solar assisted hot water system and heat recovery systems with the type, installation and equipments detailed in the specifications. The second credit came from installing energy efficient hot water supply system and equipment that will save 20% or more, the mechanical specifications and types of equipments used were attached to the final energy report.

The last part of the energy efficiency category in the code to be assessed was the utilization of renewable energy systems, the first point of it was building integrated approaches, the library achieved one credit for eliminating the additional costs associated with a typical solar system's structure by designing the building's roof assembly to also support the solar components used to supply hot water with all the details of the roof provided in the drawing details. The next point building orientation and solar access obtained two credits, the first one for establishing the building on an east-west axis that maximizes northern exposure for day-lighting and other solar systems, the second credit for ensuring that adjacent buildings or trees do not block the intended solar access. The last point was renewable energy applications for buildings; the library scored two credits on the point solar systems, the first one for using a solar heating system for hot water and the second one for using a solar heating system for heat recovery. The heat recovery system details for winter time were designed and submitted by a professional mechanical engineer.

The library scored sixteen out of possible fifty eight credits on the energy efficiency category as shown in Table 6-1. For a small project that didn't qualify for a lot of points for energy efficient mechanical systems it scored relatively good. The decision to make this project environmentally friendly had its most effect on this category as most of the systems required for energy efficiency were already prepared by qualified professionals engineers. Notably the utilization of renewable energy applications didn't include any new installation for renewable energies it was only confined to tested (trusted) systems that have been used in Egypt before and proven good results. The previous results indicate that to encourage designers to use some of the new technologies that are suitable for the conditions of the Egyptian environment could have some difficulties in application, and will certainly needs some forms of incentives to justify the application of the new technologies.

6.5.1.3 Results from E-3 about water conservation

On the first point water-conserving landscaping strategies the project scored two credits, the first one for using soaker hoses and drip irrigation technologies and the second one .for using gray-water from lavatories and water fountains for underground site irrigation and designing the system to meet local regulations. A professional report was provided describing the species of plants and confirms that after a period of establishment of the plants and vegetation is complete, irrigation will not require/ fractionally require the use of fresh water supply.

The next point was conservation of water during construction two credits were achieved by the project, one for including disincentives in specifications to the general contractor for excessive water use and incentives for reducing consumption during construction. The second credit came from minimizing watering requirements by specifying appropriate times of year when new landscaping efforts should occur. Specifications that the general contractor is responsible for water cost during construction were submitted. For the point water use the project obtained one credit for the usage of water efficient devices that leads to an estimated annual savings of 15%, all the report from water calculator used is submitted along with a list of all fixture intended and all their details was submitted. On the next point, water recycling, one credit w as achieved by the project for implementing a rainwater collection system to provide water for irrigation and the details for the system and installation was submitted.

The library scored total credits of six out of possible seventeen in the water conservation category and for a building that have been advertise as environmentally friendly it could have made more effort in achieving a better results in water conservation strategies, as most of them are relatively easy to achieve especially for small projects. The only category that didn't get any credit was the water quality point and the author believe that this is because in Egypt those checks for the quality of drinking water is not performed regularly or as a part of the operation process of a building, checks are made in water stations to comply with the referenced good practice guides but not in buildings.

6.5.1.4 Results from E-4 about recycling and waste management

The final category in the code is recycling systems and waste management, for its first point construction waste recycling and waste management, the library project obtained one credit for requiring that the contractor use safe handling, storage, and control procedures, and specify that the procedures minimize waste in order to minimize the impacts from any hazardous materials or waste used in construction. The second point operation and maintenance scored one credit for energy management by providing fully documented instructions that enable systems to operate at a high level of energy efficiency.

Recycling systems and waste management category could be considered one of the least applied categories of the code in the Egyptian environment. Recycling of construction waste or maintenance after operation in the majority of the cases are not considered when designing a project, having said that, the library project achieved two out of possible seven in this category which indicate that it has some consideration for building operation management.

Category	Point description	Credit
Category (1): Site Design	The use of native plants and consulting with local gardeners about them	1
	Using native and drought-resistant planting materials to minimize the need for site irrigation. List of all plant used is submitted.	1
	Using grey water from sinks and water fountains for site irrigation or using soaker hoses and drip irrigation techniques that minimize evaporative losses and concentrate water on the plants' roots.	1
	Developing a floor plan that minimizes east- and west-facing glass to maximize the daylighting contribution.	1
	Considering existing and new landscaping as a means of providing shading in the warmer months.	1
	Linking the building to the surrounding communities through safe pedestrian pathways and designing the building so that the media centre and cafeterias can be shared with the community.	1
Total credit achieved		**6/11**
Category (2): Energy Efficiency	Incorporating radiant barriers in the roof assemblies to reduce up to 95% of radiant heat gain.	1
	Selecting a light color for the exterior finish to reflect solar radiation.	1
	Selecting locally made products and construction materials. Some construction materials will be from local areas	1
	Reduction in the annual energy consumption by 14%.	2
	Reduction in the maximum electricity demand by 15%.	1
	Using ventilation tours as a form of free cooling is night-time ventilation	1
	Using ventilation systems that will consume less electricity than those meeting the zero credit requirements (baseline) by 15% or more.	1
	Using lamps and, where applicable, ballasts that will consume less electricity than those meeting the zero-credit requirements by 15%	1
	Applying a solar-assisted hot water system and heat recovery systems	1
	Installing energy efficient hot water supply system(s) and equipment that can save 20% or more energy	1
	Eliminating the additional costs associated with a typical solar system's structure by designing the building's roof assembly to also support the solar components used to supply hot water	1
	Establishing the building on an east-west axis that maximizes northern exposure for daylighting and other solar systems.	1
	Ensuring that adjacent buildings or trees do not block the intended solar access.	1
	Using a solar heating system for hot water.	1
	Using a solar heating system for heat recovery.	1
Total credit achieved		**16/58**
Category (3): Water Conservation	Using soaker hoses and drip irrigation technologies	1
	Using gray-water from lavatories and water fountains for underground site irrigation and designing the system to meet local regulations.	1
	Including disincentives in specifications to the general contractor for excessive water use and incentives for reducing consumption during construction.	1
	The usage of water efficient devices that leads to an estimated annual savings of 15%.	1
	Implementing a rainwater collection system to provide water for irrigation.	1
	Minimize watering requirements by specifying appropriate times of year when new landscaping efforts should occur.	1
Total credit achieved		**6/17**
Category (4): Recycling	Requiring that the contractor use safe handling, storage, and control procedures, and specify that the procedures minimize waste in order to minimize the impacts from any hazardous materials	1
	Providing fully documented instructions that enable systems to operate at a high level of energy efficiency	1
Total credit achieved		**2/7**
Silver rating with 30 credits out of possible 93 credits		30/93

Table 6- 1: Credits obtained by the library project description and total credits.

6.5.2 Results from the application of EGCB section F

This part of the research will present the results for the overall grade and qualification for the library and its classification. EGCB (final version) had four categories in total with maximum attainable credits of 93 as shown in Table 6-1. The library scored six out of possible 11 credits on the first category site design, 16 out of possible 58 on the energy efficiency category, 6 out of possible 17 in the water conservation category and 2 out of possible 7 for the recycling systems and waste management category. As shown in table 6-2, bronze classification indicates the minimum requirement for a project to be qualified. The library scores in the four categories of assessment entitled the project for a silver classification, which consider a very good start for a small project and could set up a good example for small projects to achieve classification.

Award classifications	Site Design	Energy Efficiency	Water Conservation	Recycling and Management	Overall
Total credit attainable	11 credits	58 credits	17 credits	7 credits	93 credits
Platinum ****	10-11	45-58	14-17	6-7	75-93
Gold ***	8-9	30-45	10-13	4-5	52-72
Silver **	6-7	16-30	6-9	2-3	30-49
Bronze *	3-5	8-15	3-5	1	17-26

Min requirements for qualification are the bronze.

Table 6- 2: Over all grade and classification for EGCB.

6.6 Results from interviews phase III

The results from the final phase of interviews will be presented in this part of the research. The interviews phase III followed the distribution of EGCB final version to the respondents that indicated their interest in receiving it in questionnaire II. 55 questionnaires have returned from phase II, 48 respondents have indicated their interest in receiving the final version of EGCB and 46 indicated their availability to a final interview to comment on the code final version (15 governmental official, 13 architect in practice and 18 academics). The interviews questions were structured in three sections as shown in each section collected different type of information; the results from these interviews will be presented below.

6.6.1 Results from interviews section 1: measuring the overall satisfaction about the code content and techniques

Questions in section 1 of the interview were designed to measure the satisfaction of the respondents about the final version of EGCB and the modifications that have been done to the categories as shown in Table 6-3. The respondents answers to question one about the first part of the code, the introduction part with aims and benefits of the code, results shown in Figure 6-1 indicated that 85% of the respondents believe the language used is clear, 90% indicated that this part is relevant to the code and 80% were satisfied about this part. The results from the second question regarding the overall grades of the code and its classifications; platinum, gold, silver and bronze are presented in Figure 6-2, it indicate that 80% of the respondents think the explanation of the grades is clear, 70% believe those grades are achievable and 80% indicated their satisfaction about the current classifications.

Answers to the third question about the code modified categories are presented in Figure 6-3, 80% of the respondents think that the language used in the categories is clear, 90% believe the credits allocated for the code points are achievable and 90% express their satisfaction with the credit allocated for each category. Figu re 6-4 presents results about question 4 in the interview about the case study section in the code 70% of the respondents thought it has enough information and was understood, 90% believe this part is relevant to the assessment and should be included, 80% of the respondents are satisfied to include the case study to the final code.

Therefore from the previous results it could be conducted that there is an overall satisfaction about EGCB content; the introduction, the code categories, overall classification and the added part for the case study and EGCB final version deliver what the architectural society of Egypt expected.

Questions for interviews phase III				
	Section 1	**Is it?**	**Is it?**	**Are you?**
1	What is your reaction to the first part of EGCB regarding the introduction, aims and benefits?	☐ Clear ☐ Not clear	☐ Relevant ☐ Not relevant	☐ Satisfied ☐ Not satisfied
2	How would you describe the section about the grade classification of the code?	☐ Clear ☐ Not clear	☐ Achievable ☐ Not achievable	☐ Satisfied ☐ Not satisfied
3	What is your reaction to the categories of the code and the final credit allocated for each point?	☐ Clear ☐ Not clear	☐ Achievable ☐ Not achievable	☐ Satisfied ☐ Not satisfied
4	How would you describe the case study part of the code?	☐ Clear ☐ Not clear	☐ Relevant ☐ Not relevant	☐ Satisfied ☐ Not satisfied

Table 6- 3: Over all grade and classification for EGCB.

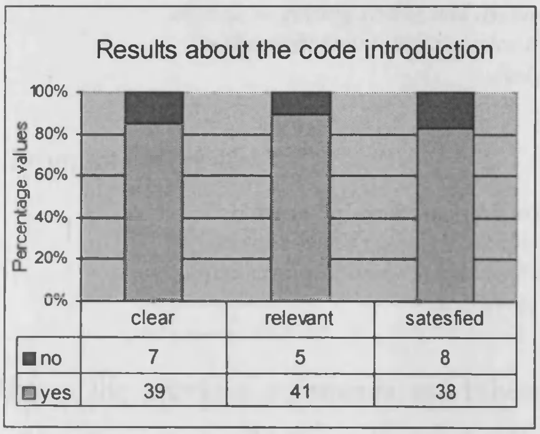


Figure 6- 1: The respondents' answers about the introduction part of EGCB.

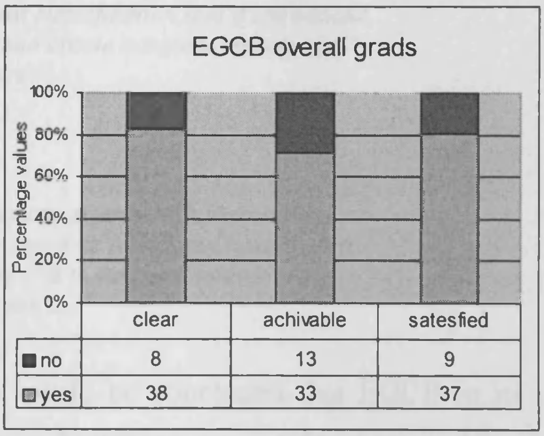


Figure 6- 2: The respondents' satisfaction with the classification grades of EGCB.

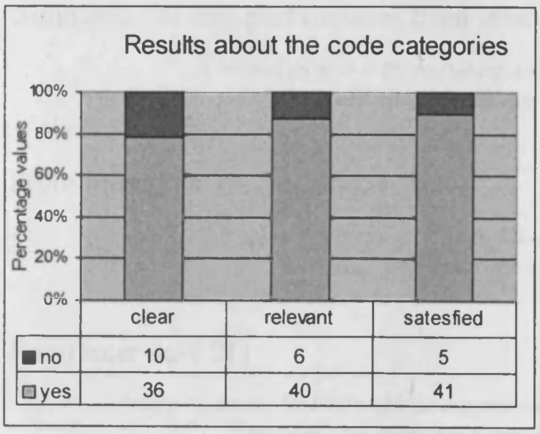


Figure 6- 3: The respondents' answers about the categories of EGCB.

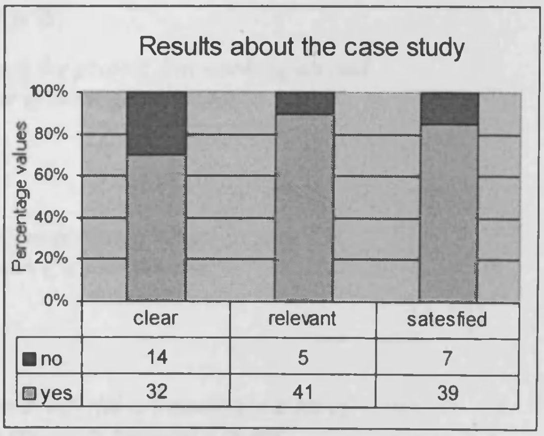


Figure 6- 4: The respondents' comments on the case study application in the code.

6.6.2 Results from interviews section 2: about EGCB application

Section 2 of the interviews was designed to collect information on the reaction of the respondents towards the actual application of EGCB. Answers to question 5 of the interview about the applicability of the code on its current state in the Egyptian environment, comments were mostly positive with some expectation of difficulties in the first stage of application, for example from interview 7:

> *"....the code in its current form could be applied to a number of selected projects first to achieve wide spread reputation and could be later introduced to the practice."*

From interview 16:

> *"Yes it is applicable... from what I read even small projects could have a chance in getting scores and assessment classification and if introduced in the right way to the practice it could create competition between designers"*

From interview 40:

> *"....the list of environmental procedures presented here is a very practical method ...and applicable in Egypt as it does not need a great deal of hustle and it is easy to follow... it is designed to encourage architects to use it..."*

From the previous comments and others it could be concluded that EGCB in its current version could be applied to the Egyptian buildings, some difficulties could be anticipated on its first stage of application which will be discussed in detail in section 3 of the interviews. Question 6 of the interview was design for measuring the willing to use the new code for buildings even if it is voluntary. Examples about the comments for this part include; from interview 8:

> *"...I would give it a try to assess some of the project I'm working on and it would be interesting if any of them got a rating"*

From interview 17:

> *"...it is good for the business to have some graded projects in your CV ... for sure I will apply for it even if it only for that..."*

From interview 21:

> *"...in my line of work as a governmental official... I could see a lot of current practices not using the code just because it is not obligatory....why go for a lot of trouble for it?... some form of incentives should be given so it will encourage people to use it."*

From interview 39:

> *"...though small project will hesitate to use it at first... in my opinion...this code should be obligatory to some projects... for big buildings at first, just to set examples..."*

Answers to this question, especially from architects in practice, suggested that giving the choice most of the respondents will try to achieve some classification for their buildings. "Giving our companies a good image" was the most common reason for trying to achieve a score on EGCB. Some comments also suggested that not having any form of obligatory measures for the code could be a downturn for its widespread application as some of the designers will not use unnecessary trouble to apply a code that is not required by the buildings law. Therefore, from the previous comments and others a conclusion that EGCB will be used by a part of the practice in Egypt even if it is voluntary code but it would be more effective if it have rigid measures for application.

6.6.3 Results from interviews section 3: about barriers and problems connected to EGCB application.

A review of previous and current problems that face the application of any environmental measure in Egypt will be presented in this section of the research. Results from section 3 in the interviews about the anticipated problems that would face EGCB application in Egypt will also be presented. Number of studies has been produced about the reasons for the failing of long term application of environmental measures in Egypt. Different ministries and agencies have different classifications for the source of problems. This research will adopt the classification made by the National Environmental Action Plan NEAP (MSEA, 2001). "Technical difficulties, legal problems, and knowledge gap" will be the main directions examined in the analysis. These directions have been the base for the design of the questions for section 3 of the interviews. Each of the following sections will contain; first, a review of the problem in Egypt, and then the results from interviews about the same difficulties.

6.6.3.1 Technical difficulties

I. Communication and coordination

The nature of environment related policies requires coordination between considerable amounts of authorities to be adequately applied. In order to develop, apply and monitor any environmental measure communication and coordination between several parties will have to be enforced. MSEA and EEAA are the main coordinators for any environment related measure in Egypt. There are a lot of ministerial departments, agencies, research institutions and local authorities that are namely responsible for applying environmental measures.

Communication and coordination problems between different sectors and authorities that deal with environment in Egypt have long been recognized by the government (Hassan, et al., 2005). One of the difficulties facing the environmental policy making and the application of any new environmental measure in Egypt have been identified by NEAP as coordination overload (MSEA, 2001). In 2001, NEAP has asked for a realistic assessment of the amount of coordination needed by the various institutions involved in the implementation of environmental policy in Egypt (MSEA, 2001). In 2005, a National Strategy for Environmental Communication (NSEC) has been produced. NSEC has identified communication problems in Egypt from two directions, first, between the government and the public (external), and second, between different sectors of MSEA and EEAA (internal). NSEC has offered a strategic framework for improving communication between environmental sectors. Its proposed plan asked for more coordination between current parties and asked for establishing of new authorities to monitor the plan application (Hassan, et al., 2005). Currently, this strategy is not actively used in Egypt.

Results from interviews phase III have mostly agreed with the previous review. From interview 7:

> *"...in my opinion the problem is coordination, coordination, coordination ...solve that and you will apply your code"*

From interview 18:

"...all new policies ask for more coordination ...it only makes matters worse to produce new comities to coordinate with...."

From interview 21:

"...we have large number of comities that are named as 'responsible'... thus, practical difficulties with coordination emerge."

From interview 26:

"... if all the coordination meeting were attended by governmental officials...no work would be done ..."

From interview 35:

"... a separate ministry for coordination would be a good solution..."

The respondents indicated that one of the most important barriers to the application of any new environmental measure in Egypt will have to be the coordination between different authorities dealing with environmental issues. 'Throwing responsibilities on each others' has been identified as a result of misunderstanding what coordination mean. Adding that for our field (architecture related measures) another layer of coordination is required with the building sector authorities.

II. Lack of expert human resources

The issue of applying environmental measures is relatively new to Egypt. The shortage of qualified and experienced staff to apply current measures has been identified by NEAP as serious limitation to the application of any new environmental measure in Egypt. Recommendations for successful implementation for any future environmental measure in Egypt will have to include the introduction of experts to all levels of government, civil society organizations, and the private sector (MSEA, 2001). One of the examples that the lake of experienced staff have led to the failing of the application of an environmental measure was for MHUUD 1987. The decree that all new buildings in new communities should be equipped with solar water heaters has not been used since 1993. Lack of technical staff for maintaining the heaters have been identified as one of the reasons for the failure of this initiative (Georgy & Soliman, 2007).

The general problem of the lack of expert human resources in Egypt has been discussed with our respondents. Examples of comments about those difficulties include; from interview 2:

> *"...not only the availability of technology but also the availability of related expertise is considered a barrier for new environmental measures application..."*

From interview 29:

> *"Environmental expertise is relatively low in Egypt... They exist and work on a very limited circle that is not in touch with the hole of the practice...for complete application Egypt would need more experts at lower level of decision making."*

From interview 43:

> *"In some cases... even officials working in enforcing environmental measures are not adequately knowledgeable about the full details of the regulations and its importance."*

For applying new measures addressing the environment contentious monitoring and follow-ups are required. Results from interviews have suggested that Egypt's human resources are weak in terms of environmental expertise to conduct such follow-ups.

6.6.3.2 Regulatory problems

I. Rationalizing environmental legislation

Egypt has a considerable amount of legislations, ministerial decrees and proposed action plans regarding the environment. Even though these legislations exist and not actively used, studies to the application of new environmental standards still propose new sets of measures to be adopted. For example from (Georgy & Soliman, 2007) point of view:

> *" Up till now there is no clear well defined legislation supporting neither Rational Use of Energy nor Renewable Energy utilization."*

The duplication and overlap in laws and strategies which address the environment have been recognized by the Egyptian government. Thorough revisions of existing legislation and regular reviews of the environmental legislations have been demanded by NEAP (MSEA, 2001).

Results from the interviews regarding this point include; from interview 1:

"...the reader could find the same topics with the same explanation mentioned in the law for environment and the environmental strategy and the national action plan...with different explanation for how to deal with it... or different development directions."

From interview 14:

"...for buildings standards all actions and plans taken are designed with the same people toward the same targets by the same language... change is much needed to address these problems."

From interview 23:

"...it has long been established that the current laws and strategies needs revision... it is actually doing it is the challenge...it will require a huge amount of coordination between different authorities."

From interview 29:

"...in the environment law no.4, 1994... Some subjects need explanation even for specialists... Technical and legal terms needs revisions... especially in buildings sections as it must be updated"

From interview 34:

"...in my opinion for building sector especially...one unified law or measure should be adopted... in this case every attempt will be measure against it...a lot could use the holes in the existing measures and the fact that they duplicate and contrast each other..."

The problems Egypt is currently having with its existing laws and regulation regarding the environment was one of the most frequently mentioned comments in the interviews. All of the interviews conducted in phase III have identified some sort of regulation problems as one of the barriers facing any development or application of new environmental measures - building assessment tools included.

II. Design of the environmental standards

The introduction of environmental laws in Egypt has been designed to address the final outcomes of the environmental situation. According to NEAP (MSEA, 2001):

"Traditionally, Egyptian environment related legislation has provided command and control style of regulations dealing with the end- of-pipe situations."

The style and design of the environmental laws and strategies are usually done on higher level of decision making. Involving the related sectors in developing environmental strategies has always been proposed but not applied in Egyptian policies. New legislations in most cases are hard to understand, with out of date information and being introduced on a voluntary basis. For the building sector, the existing regulation does not specify an approved method of testing green buildings, therefore, this gab in legislation are being used to introduce a lot of trends as environmental without any governmental checks. The absence of an Egyptian standards or codes to guide green construction is a main reason for delaying the introduction of green buildings in Egypt (Shafik, 2009).

Results from interviews about the style of environmental regulation in Egypt include, from interview 3:

> *"... the decree is not designed to encourage following it as it only deals with final results and don't give process directions... it needs to put process as active part of it."*

From interview 10:

> *"...the standards are optional and very strict and rigid..., doesn't offer room for innovation... and it doesn't follow any action taken ...as it should be able to make regular inspections."*

From interview 21:

> *"..In the parts dealing with buildings... it is very technical and sometime un-understandable language...It is a voluntary standards to follow ... the ministry of environment and the ministry of housing should look into ways to make it enforceable"*

From interview 32:

> *"..The law has a commanding voice to address environmental problems... With the absence of incentives when following the law like tax reduction it is even harder to follow... why the extra work?"*

Results from the interviews proposed a revision and change not only for the building standards part of the law but also for the whole environmental strategy design.

6.6.3.3 Knowledge gaps

One of the difficulties facing the implementation of environmental measures is the lack of awareness about the environmental problems facing Egypt. The benefits of environmental standards (in our research case the benefits of a new green building assessment code) in Egypt is also not widely known. This knowledge gap is not excluded only to the Egyptian public but also include professionals working in fields related to the environment (MSEA, 2001). In Chapter 4, a conclusion that the current legislations regarding the environment protection are not widely known even among specialized professions has been presented. Even though a lot of efforts are being made to improve awareness of environmental crises facing Egypt, there are still a lot of issues to cover (Georgy & Soliman, 2007).

I. Pricing environmental resources

Generally, the Egyptian people are not familiar with the importance of the environment and its direct effects on future generations. Very little knowledge about the importance of natural resources and how the current practices are affecting our environment are made available except for very specialized professionals or academics (El Fiky, et al., 2004). According to (MSEA, 2001):

> *"Natural resources need to be priced for their social value not for their market value. Currently those resources that have a market price are carrying a distorted price, usually much undervalued"*

The first knowledge problem raised in the interviews was about the lack of knowledge about the importance of environment, its resources and the negative impacts Egypt is facing. These knowledge deficiencies exist even among professionals (also confirmed by the results from questionnaire I in Chapter 4). Comments from interview 5:

> *"...there is no public awareness about the environmental problems... simply it is not made knowledgeable to them enough that the current situation is deteriorating..."*

From interview 12:

> *"For example: information about the importance of environmental resources... its direct impact on health, future generation and day to day life... this will make environment in the centre of attention."*

From interview 19:

> *"...media does not give the actual real picture...it concentrate on certain problems not the whole picture...pre-existing problems with government regulation, the natural resources we have..."*

From interview 30:

> *"For professionals, lack of familiarity with new energy standard & basic principles of energy-efficient building design among the building industry or regulating officials has resulted in major application problems."*

Environmental impacts that Egypt is now facing or expected to face need to be in the centre of attention if any new environmental measure hoped to take a wider application. Professionals involved in the buildings and construction process knowledge gaps about environmental data for building sector could be addressed by introducing regular courses to update their knowledge.

II. Data deficiencies that affect developing and monitoring

The lack of accurate compatible information on environmental condition in Egypt is considered a main obstacle in developing coherent applicable environmental standard (MSEA, 2001). In order to be able to develop a unified action plan, environmental data collected from different sources should be comparable. If the information supplied to develop a standard is inaccurate or out of date, the standard offerd will not be effective. According to (MSEA, 2001):

> *"The essential components for effective environmental monitoring are consistency and continuity... In Egypt there are many governmental and academic bodies collecting data but it is rare to find full comparability between any two sources."*

There are no available data about the actual enforcement of environmental standards in Egypt. The example of HBRC publishing the results of its 2007 study about violations in departments and authorities issuing licenses is recommended to be followed (El-Demirdash, 2008). Another reason for the lack of consistence information about environmental condition in Egypt is due to the lack of continues updates. According to (MSEA, 2001):

> *"Many Egyptian data sets have begun as part of a development project supported by donor funds. Unfortunately many lapses once the foreign-*

assisted project is finished. For decision making purposes, monitoring the state of the environment over time needs to be supplemented with information concerning violations of the laws."

From the interviews, examples about the comments made regarding this point include, from interview 10:

"...for monitoring environmental aspects, data should be the most up-to-date information, which is not available yet on wide usage in Egypt...this is a severe limitation on decision-making..."

From interview 11:

"...the quality of data... environmental data is collected regularly and accurately but may not be available"

From interview 2:

".. A lot of centers collect environmental data...few would exchange data and compare the results to give the whole picture..."

From interview 18:

"...funded projects especially foreign ones die with the end of the fund...no follow up or continuity to the results...like giving an environmental solution to this particular time only..."

From interview 25:

"From my work experience...if you want to propose a new project the data collected from different sources should be made comparable which it is not now..."

From interview 31:

"... Accurate continuous information about the application of environmental law or the renewable energy strategy are not available...no post-application monitoring."

Specific comments about the availability of regularly collected information on the environmental status in Egypt have been made. Doubts have been raised about the comparability and in some cases the accuracy of information collected. To develop an environmental assessment tools or to monitor existing ones the information supplied by environmental agencies should be reliable.

6.7 Discussion and findings

The final stage of validating EGCB included two stages. The first stage was the application of the second version of the code on a project from the Egyptian environment to identify the final modifications needed in the code from practical point of view. The second stage was the final set of interviews conducted with our target group to identify the common barriers that are likely to face EGCB application or any other environmental measure in Egypt. Summery of the results and discussion concluded in this chapter will be presented next.

6.7.1 Summery of results from EGCB application

The process of applying EGCB to the proposed project has resulted in some final modifications and refinements to the code categories which included;

- Adding a new credit for providing training for operations and maintenance staff.
- Adding a specification that all required energy related reports should come from specialized professionals.
- Elimination of duplicated credits between the solar hot water systems and the use of renewable energies were achieved.

Reading for all library project scores entitled the project for a silver classification with 30 credits, which consider a very good start for a small project and could set up a good example for small projects to achieve classification by our proposed code. Notably the category that didn't score any credits was the one related to the use of renewable sources of energy and this indicates that the Egyptian modern environmental buildings still does not include renewable energies technologies in the design process even though Egypt have perfect weather conditions for most of them.

6.7.2 Results from the final phase of interviews

The final phase of interviews was designed to measure how the new proposed code will be perceived in Egypt and what are the barriers and problems that are likely to face its application. EGCB final version is thought to deliver what the architectural society of Egypt expected as there was an overall satisfaction about the code categories, the overall classification and the added part for the case study.

From previous studies about barriers of implementation of any new environmental measure in Egypt and also results from interviews, the barriers that are most likely to face EGCB application are:

- The structure of the environmental decision making in Egypt and its multi sectors involvement is preventing the reach of a unified legislation.
- The huge amount of coordination required between different departments responsible for the application of environmental protection measures is considered a barrier to achieve applicable legislations.
- Egypt's human resources are weak in terms of environmental expertise which affect any application or follow up procedure to any environmental standard.

To improve these technical difficulties planning process have to be addressed.

Regulation barriers include:

- The absence of well defined, unified and coherent legislation supporting environmental issues.
- Egyptian environment related legislation design does not encourage following it due to the difficulty in understanding what it really aiming to achieve.

Rationalization of Egypt's environment related legislation is required to eliminate duplication and overlapping. Regular reviews to standards are to be placed as part of the standard itself. The involvement of development process of a new environmental tool should be included in the environmental laws and legislations.

Knowledge gaps are:

- Lake of knowledge among public and professionals on the importance of the environmental resources and the current environmental crises Egypt is facing.
- The environmental information collected in Egypt is not comparable.

The importance of natural resources should be more widely available and publicizes by the media to make it in the centre of attention to involve the public with its proposed measures. Relating the environment to impacts that will affect normal life will give it a social value not a market value as it have now. Developing and monitoring of new environmental impact assessment tools depend on reliable comparable data from different sources. Thus, coordination and comparability between different environmental centers in Egypt is needed.

6.8 Summery

Chapter 6 served as a final evaluation stage in the process of EGCB development. Results from the application of EGCB to a building in Egypt was presented and, furthermore, results from the third phase of interviews. The final refinements from a more practical point of view were included in the code final version. Barriers that will hinder the application of any new environmental measure in Egypt were discussed as well.

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Chapter 7: Conclusions and Recommendations

7.1 Introduction

This dissertation presented the possibility of introducing a new assessment code for buildings in the Egyptian environment and its development process. Chapter 7 concludes the overall discussions and findings of the thesis taking as its starting point the summary of the thesis problems followed by summery of conclusions based on thesis aim and objectives, then guidelines for improving the Egyptian environment and finally suggestions for future research directions.

7.2 Summary of The Thesis Problem

The Egyptian environment is now facing serious and escalating problems that will in time affect its ability to last and serve future generations. Building sector in Egypt consumes 24.5% of the total energy consumption, 43% of the total electricity consumption and therefore responsible for 30 million metric ton of CO^2 emissions annually, and with 5.7% energy consumption growth rate these numbers are expected to rise in the next few years.

The lack of coherent and unified standards for environmental buildings assessment in Egypt have led to several trends and experiences in the modern architecture that were called green but in fact they lack a lot of requirements to achieve minimum application of green concepts. This problem not only caused confusion among architects in practice, governmental officials and the public on what is considered environmental building in Egypt, but also has increased the difficulty of introducing a measure for assessing green buildings and reaching a common set of criteria. This research was conceived to fill the gap in Egyptian research about implementing new unified environmental building standards.

7.3 Conclusions Based on Thesis Aim and Objectives

The research aim was to investigate the possibility of introducing an environmental impact assessment code for buildings designed specifically for the Egyptian environment as an approach to address the environmental problems facing building sector in Egypt. The seven chapters of this thesis attempted to present the need for such a program and show the development process of a proposed code for green buildings in Egypt and the barriers it might face in applications.

7.3.1 Findings from the literature review

The first step toward achieving the research aim was to review international assessment tools for building as Egypt does not have any. From the reviewed literatures the relationship between building assessment tools and increasing the performance efficiency of buildings was presented as buildings assessment tools have contributed to achieve better building standards. Compilation of the most common features and categories for building assessment tool has been created to be included in the development of the Egyptian code.

Introducing a method or tool that support achieving environmental target was the approach that this study has adopted toward achieving green buildings in Egypt. The approach to this project has been to produce technically sound, easy to use and understandable standards, while stressing on the need to involve and inform the architectural society in Egypt with the code development process.

From reviewing the current environmental situation in Egypt,

- Building sector is one of the most influential sectors on CO_2 emissions as its high energy and electricity consumption levels mainly from fossil fuel sources.
- Current agenda for environmental actions in Egypt does not include a coherent unified applicable legislation, strategy or plan to address building sector energy consumption levels and the purpose and need for this research originated from that.

Analyzing Egyptian environmental buildings; El Gouna Resort, Library of Alexandria, Sierina Movanbic Hotel and Sharm El Shiek Hospital, have reveled what features are considered green in Egypt.

- Building orientation and form are the main methods to achieve energy efficiency rather than technological features.
- Supporting the installation of energy conservation equipments is not considered essential in current environmental buildings in Egypt.
- The concept of recycling for water and waste is not actively present in Egyptian architecture and also electricity from renewable sources of energies.
- From the authors' experience, the absence of good examples to showcase: the possibilities of these technologies, their importance and that they are achievable in Egypt is a big obstacle in following these principles.

Three phases of surveys have been conducted in this research study. Results of each phase came from questionnaires, written feedback and interviews, aimed at the architectural society of Egypt represented in governmental officials working in environment and building sector, architects in practice and academics from architecture department, as this target group opinion gave a comprehensive vision of how the proposed code by this study will be perceived in Egypt.

7.3.2 Findings from the first survey

New knowledge from the first survey includes;

- Egyptian environmental laws and strategies are widely known to the architectural society of Egypt.
- The building sector energy consumption levels are relatively unknown to the architectural society of Egypt, especially to architects in practice as it is not a common interest or an important issue when designing, and therefore it is left to personal interests.
- Academics are the most knowledgeable about national and international environmental laws, strategies and assessment programs, as their line of academic research provide them with reasonable access to different resources of information.
- Governmental officials relay on the reports they receive as a systematic part of their work as their main source of information and have very little knowledge on international standards for buildings assessment.
- Architects in practice knowledge is limited only to local codes and laws as it affect design directly, their main source of information in regards to environmental issues comes from college education and common knowledge as they are not offered any post graduation courses and this matter is left to personal interests.
- Current agenda for actions is not enough to face the deteriorating environmental situation in Egypt and the actual standards or strategies Egypt's have are not actively used as they are not obligatory. Further reflection on the results; the law 1994 for environment were taken as optional rather than as a necessary tool to improve quality of buildings.
- New code to assess environmental buildings is needed in the Egyptian environment now to provide a unified assessment standard.

7.3.3 Findings from the second survey

The second survey results could be summarized in the following points:

- Site design, energy efficiency, water conservation and waste management and recycling are the most important categories to be included in any future assessment tools for buildings in Egypt.

- Comprehensive assessment tools which cover different types of buildings will be more effective in the current Egyptian environment. To avoid any duplications any new proposed standards for buildings should come as a second part of the existing Egyptian code for buildings.
- After rigorous considerations, several modifications and refinements a reasonable first draft of a new code specifically designed to the Egyptian environment conditions and needs was offered by this research. Three phases of refinements and modifications have resulted in an understandable code, with categories relevant to the Egyptian environment, achievable credits and satisfactory overall classifications.

7.3.4 Findings from the third survey

Although the study has concentrated on the development process of the new code itself some references to the barriers facing its application in Egypt were inevitable. Development of a list of barriers that might face the proposed code application in the Egyptian environment has fulfilled an important objective of the study. Many barriers are hindering the development of any environmental standards in the Egypt, building assessment standards included.

- Lack of coordination between environmental authorities and administrative licensing authorities involved is a major weakness in the process of developing any new environmental mitigation.
- The absence of well defined, coherent and unified legislation supporting environmental buildings is another barrier that needs addressing.
- Developing and monitoring of new impact assessment tools for environmental depend on reliable data and information which need consistency and continuity over time which is a prime constraint on environmental decision making in Egypt at the moment, as there is no nation wide agreement on environmental data, therefore comparability of available data is compromised.
- Among the fundamental obstacles identified during this study regarding the development of assessment tool for buildings is the lake of knowledge about

environmental crises and green concepts both for governmental authorities and designers in practice; the lack of true knowledge as to the real principles and means of green architecture leads to the fact that the order and response are often oriented toward proven methods rather than towards solutions involving technical challenges.

7.3.5 Research significance

This research significance comes from the direct results both for science and practice as presented earlier. This study offered a proposed code for assessing green buildings as a mitigation measure to address the current environmental problems caused by building sector in Egypt. It also provided support in the development process of this code and has validated that such tool is needed in the Egyptian environment. EGCB allows the designers and dghecision makers to identify the key points that need to be addressed to enhance the overall performance of a building and in turn make it beneficial to the environment.

The new code is said to be appropriate for assessing buildings in the Egyptian environment as it have understandable language, categories relevant to the Egyptian environment and achievable credits. The application of the proposed code will result in green concepts being more in the centre of the architecture practice in Egypt and opening the possibilities to introducing new concepts and measures to achieve sustainability. Based on the authors' personal experience, EGCB will insure a minimum level of applying green architecture principles in Egyptian buildings and in its final version would be a rather accepted code for building assessment. The successful implementation of EGCB procedures will require significant effort, forethought and cooperation among many responsible parties in Egypt. This study recommend that the results of this research be widely disseminated to agencies working in the energy, environmental and building sectors, and other relevant programs where an understanding of the internal motivation of the participants would assist planning of interventions.

7.4 Recommendations and Guidelines

The following actions are recommended to support the ongoing efforts in the field of developing and applying environmental impact assessment measures in Egypt and to overcome existing barriers. It is to be adopted by the parliament, the government represented in the cabinet and concerned ministries.

- The revision of all laws and legislations related to the environmental buildings to eliminate existing duplications and overlaps to achieve a more unified, coherent and applicable legislation, that would involve: (i) encouraging private sector investment in energy efficiency and conservation projects, (ii) applying equipment and systems specifications on both local and imported products; and (iii) formulating appropriate understandable standard to help the public and professional make the right decision.
- Establishing a building quality control authority that would be responsible for the application and development of any new measure regarding buildings and also to train the members involved in planning and evaluating process.
- Encouragement and financial support for researches in the field of environment with more support for conferences and workshops which debates environmental topics.
- Addressing public and professionals awareness by: (i) developing local industries to produce energy efficient equipment and systems; (ii) improving the skills of architects, planners and engineers in the field of energy efficiency and green buildings; (iii) carrying out public awareness programs on energy efficiency and conservation; (iv) ensuring government commitment to finance green projects; and (v) facilitating access to financing from public and private financial institutions for green buildings investments.
- Finally, the researcher noted the difficulties of carrying out all the necessary questionnaire distributions during its sessions, and therefore strongly recommended that involving concerned ministries in gathering of information for future surveys.

7.5 Future Research Directions

The findings and recommendations are limited to the scope of this study. Many related issues and detail findings need further investigations in order to achieve a satisfactory green code for buildings in Egypt. The next suggestions for future research are recommended to refine the procedures carried out in this thesis:

- More investigation to develop and carry out a detailed implementation plan for any new environmental assessment tool for buildings in Egypt.
- It is recommended that future research focus on specific types of buildings to develop a more detailed assessment tools and more questionnaire surveys on how to introduce simulation program models.
- More investigation into alternative methods to address current buildings performance situation like a piloting actual green project.
- Further work to develop training manuals for staff in different ministries dealing with environmental buildings.

The work carried out in this thesis has suggested foundation for research on buildings assessment programs in the Egyptian environment. These contributions are hoped to broaden the scope of researches in similar fields. This research has presented EGCB as a first step towards solving some of the environmental difficulties that Egypt faces. The final version of EGCB is thought to be as comprehensive as practice in Egypt allows, offering the right balance of environmental objectives and targets. Although assessment is somewhat less complex than other assessment programs it is believed that this version offers flexibility to the Egyptian environmental and cultural conditions and opportunities for upgrading. As improved data and knowledge about relative importance of the various environmental aspects becomes available, additional aspects can be included, the relative weighting of 'credits' refined and the assessment criteria updated. As awareness will increased amongst the general public, commercial tenants, authorities and other building users, that healthy, high quality, efficient and environmentally sound buildings are important criteria we are anticipating wider uptake of the code.

Appendices

Appendix (1): Questionnaire I

Survey for the current need for a new building assessment program in the Egyptian environment.

Welsh School of Architecture, Cardiff University, Wales, United Kingdom

The survey questions are part of a PhD research investigating the need for a new assessment code for buildings in the Egyptian environment

This is the first of two questionnaires aimed at the architectural society of Egypt represented in governmental officials, architects in practice and academics.

The study was set up in order to understand better how the architectural society sees the building environment situation in Egypt especially in regards to energy efficiency. Also to investigate whether or not there is a current need for a new code for buildings. The survey will aid in defining which categories of environmental assessment categories is considered to be important in the Egyptian environment.

The answer respond from the questionnaire are strictly for research purposes. Confidentiality is guaranteed and the research will not affect individuals involved. The answers should reflect individual opinion and experience on the current situation of Egypt's buildings environment.

Any inquires and information on the questionnaire and the study please contact:

Engy Samy Hussein

PhD student
Welsh School of Architecture
Cardiff University
Bute Building
King Edward VII Avenue
Cardiff CF10 3NB
Wales, UK

T: 0044(0)7515856677
E: husseine@cf.ac.uk

Instructions

Please fill in the blank --------- , or check the suitable box ☐ or circle the objective answer (a,b,c,d)

About Yourself

1.1.Age ------------ yrs

1.2.Sex ☐ Male ☐ Female

1.3.Occupation: ---

1.4.Which of the following describes your work area?

☐ Governmental official ☐ Architect in practice ☐ Academic

1.5.How many years experience do you have in this field ------------------------- yrs

Section A. Establishing the level of knowledge about the current environmental situation in Egypt

1. Are you familiar with the Egyptian Law for environment 1994?

☐ Yes ☐ No

If your answer is yes;

(a) Where did you obtain your information from?

☐ Education (undergraduate courses)

☐ Newspaper

☐ Specialized magazines (private buy)

☐ Receive it as a systematic part of your job

☐ Media (radio – television)

(b) How would you describe the application of this law in practice?

☐ Active ☐ Not active

---

2. Did you know about the Egyptian strategy for environment 2012?

☐ Yes ☐ No

If your answer is yes;

(a) Where did you obtain your information from?

☐ Education (postgraduate courses)

☐ Newspaper

☐ Specialized magazines (private buy)

☐ Receive it as a systematic part of your job

☐ Media (radio – television)

(b) How would you describe this strategy?

☐ Realistic ☐ Ambitious ☐ Too ambitious

Please explain: ---

---

3. Are you aware of the current energy consumption levels for buildings sector in Egypt?

☐ Yes ☐ No

If your answer is yes;

(a) Where did you obtain your information from?

☐ Newspaper

☐ Annual energy report

☐ Specialized magazines (private buy)

☐ Receive it as a systematic part of your job

☐ Media (radio – television)

---

4. Are you familiar with any of the following programs for environmental impact assessment?

☐ BREEAM	☐ LEED	☐ GB-Tool
☐ CASBEE	☐ BEPAC	☐ HK-BEAM
☐ BEAT	☐ BEES	☐ LCAid
☐ ATHENA	☐ CEPAS	☐ MINERGIE

If ticked any of the above;

(a) Where did you obtain your information from?

☐ Newspaper

☐ Annual energy report

☐ Specialized magazines (private buy)

☐ Receive it as a systematic part of your job

☐ Media (radio – television)

Section B. Environmental Projects from the contemporary Egyptian Architecture.

5. This question is designed to have an overview of what is considered environmental building in Egypt. In the following table:

(a) Which of these buildings should be included in a survey that aims to define the current Egyptian environmental building? Please tick the box in the column entitled In/Ex and if you have any comments or reasons for your decision please complete in the comment section.

(b) In the column entitled No. please mark the three most important buildings to be included in the survey with numbers 1 to 3 and 1 meaning most important and 3 meaning less important.

Projects			In/Ex	No.	Comments
1.	Desert Development Center, American University, Cairo.		☐	----	------------------ ------------------ ------------------ ------------------ ------------------
2.	El-Gouna resort, Hurghada.		☐	----	------------------ ------------------ ------------------ ------------------ ------------------
3.	Egyptian high court, Cairo.		☐	----	------------------ ------------------ ------------------ ------------------ ------------------
4.	Sierina movanbic		☐	----	------------------ ------------------ ------------------ ------------------ ------------------

Projects			In/Ex	No.	Comments
5.	Library of Alexandria,		☐	----	------------------ ------------------ ------------------ ------------------ ------------------
6.	6th of October private university		☐	----	------------------ ------------------ ------------------ ------------------ ------------------
7.	Sharm El Shiek hospital, Sharm El Shiek		☐	----	------------------ ------------------ ------------------ ------------------ ------------------
8.	Opera house, Cairo		☐	----	------------------ ------------------ ------------------ ------------------ ------------------
9.	Egyptian Telecom headquarter, 10th of Ramadan.		☐	----	------------------ ------------------ ------------------ ------------------ ------------------
10.	Al Alameen resort		☐	----	------------------ ------------------ ------------------ ------------------ ------------------

* Limitations has been applied to buildings selected.

Section C. The Need for a New Environmental Assessment Program for Buildings in Egypt and its Main Components.

6. Does the Egyptian environment in its current status needs a new program or improvement could be made upon the existing one?

☐ Needs a new code ☐ Improvements upon the existing code

Comment---

If you answered (needs a new program) what type of code would be more suitable for first phase of application of a new code for buildings:

(a) Scope of the code:

☐ Comprehensive (for all building types)

☐ Specific (for residential buildings, schools, public buildings, etc.)

(b) Means of delivery:

☐ Electronic (computer based)

☐ Paper based (checklist)

☐ Both

---

7. This question is designed to develop which categories for environmental impact assessment to be included in the new code for Egypt and what are their important values in regards to the Egyptian conditions.

(a) Indicate which categories and subcategories to include by ticking the box in the column entitled In/Ex and if you have any comments or reasons for your decision please complete in the comment section.

(b) Indicate the importance of a category in the column entitled No. please mark the categories in relation to their importance for the Egyptian environment with 1 meaning most important and 10 meaning least important.

Assessment categories		In./Ex.	No.	Comments
1.	**Site Design**			------------------
1.1	Protecting Local Ecosystems			------------------
1.2	Water-Conserving Strategies		----	------------------
1.3	Building Orientation			------------------
1.4	Maximize the Potential of the Site			------------------
1.5	Connecting the building to the Community			------------------
2.	**Energy-Efficient Building**			------------------
2.1	Embodied Energy			------------------
2.2	Annual energy use			------------------
2.3	Energy-Efficient Building Shell			------------------
2.4	Hot water supply systems			------------------
2.5	Lift and escalator systems		----	------------------
2.6	Mechanical and Ventilation Systems			------------------
2.7	Cooling Systems			------------------
2.8	Energy efficient appliances			------------------
2.9	Lighting systems			------------------
2.10	Renewable Energy Systems			------------------
3.	**Health and Well-being**			------------------
3.1	Hygiene			------------------
3.2	Indoor Air Quality		----	------------------
3.3	Ventilation			------------------
3.4	Lighting quality			------------------
3.5	Acoustics and noise			------------------
3.6	Thermal comfort			------------------
4.	**Transport**			------------------
4.1	Local transport and amenities			------------------
4.2	Vehicular access		----	------------------
4.3	Transport-related CO2			------------------
5.	**Pollution**			------------------
5.1	Air pollution during construction			------------------
5.2	Noise during construction		----	------------------
5.3	Water discharge			------------------
6.	**Ecology**			------------------
6.1	Ecological impacts			------------------
6.2	Microclimate around the building		----	------------------
6.3	Conservation and enhancement of the site			------------------
7.	**Materials**			------------------
7.1	Building reuse			------------------
7.2	Adaptability and deconstruction		----	------------------
7.3	Envelop durability			------------------
7.4	Renewable materials			
7.5	Use of recycled materials			
8.	**Land Use**			------------------
8.1	Land use			------------------
8.2	Green-field and brown-field sites		----	------------------
8.3	Landscaping and planters			------------------

Assessment categories		In./Ex.	No.	Comments
9.	**Water**			--------------------
9.1	Water-conserving landscaping strategies			--------------------
9.2	Conservation of water during construction		----	--------------------
9.3	Water-conserving fixtures			--------------------
9.4	Water use			--------------------
9.5	Water quality			--------------------
9.6	Water recycling			--------------------
9.7	Effluent discharge to foul sewers			--------------------
10.	**Management**			--------------------
10.1	overall management policy, commissioning			--------------------
10.2	site management and procedural issues		----	--------------------
10.3	Construction Waste Recycling and Waste Management			-------------------- --------------------
10.4	Operation and maintenance			--------------------

About future contact

Would you be interested in receiving the results of this questionnaire?

☐ Yes ☐ No

Would you be interested in participating in a second questionnaire to test the proposed program?

☐ Yes ☐ No

Would you be interested in doing a follow-up interview for further discussion?

☐ Yes ☐ No

If yes, please give complete details to contact

Address: ---

Tel : ---

email : ---

Thank you for you participation, your contribution is very helpful.

Appendix (2): Questionnaire II

CARDIFF UNIVERSITY
PRIFYSGOL CAERDYDD

Survey for the current need for a new building assessment program in the Egyptian environment.

Welsh School of Architecture, Cardiff University, Wales, United Kingdom

The survey questions are part of a PhD research investigating the need for a new assessment code for buildings in the Egyptian environment

This is the second of two questionnaires aimed at the architectural society of Egypt represented in governmental officials, architects in practice and academics.

The study was set up in order to understand better how the architectural society sees the building environment situation in Egypt especially in regards to energy efficiency. Also to investigate whether or not there is a current need for a new code for buildings. The survey will aid in defining which categories of environmental assessment categories is considered to be important in the Egyptian environment.

The answer respond from the questionnaire are strictly for research purposes. Confidentiality is guaranteed and the research will not affect individuals involved. The answers should reflect individual opinion and experience on the current situation of Egypt's buildings environment.

Any inquires and information on the questionnaire and the study please contact:

Engy Samy Hussein

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Bute Building
King Edward VII Avenue
Cardiff CF10 3NB
Wales, UK

T: 0044(0)7515856677
E: husseine@cf.ac.uk

Instructions

Please fill in the blank --------- , or check the suitable box ☐ or circle the objective answer (a,b,c,d)

About Yourself

1.6. Age: ------------ yrs

1.7. Sex: ☐ Male ☐ Female

1.8. Occupation: ---

1.9. Which of the following describes your work area?

☐ Governmental official ☐ Architect in practice ☐ Academic

1.10. How many years experience do you have in this field ---------------- yrs

1.11. Have you participated in the first questionnaire

☐ Yes ☐ No

D-1. Site design

This section is about the first category in the code which is site design, in the table below information will be collected about:

- **Content:** the language used in text and whether it is clear and understood or not, and if not please indicate how to improve it in the space allocated.
- **Criteria:** whether the point is relevant to the assessment or not and whether it is achievable at this stage in the Egyptian environment.
- **Technique:** about credit allocated to each point and weather it is satisfactory or not or it is better to be removed from assessment, and if not satisfied or asking to remove it please indicate how to why it in the space allocated and how it could be improved.

Assessment categories				
1.	**Site Design**	**Content**	**Criteria**	**Credit allocated**
1.1	Protecting Local Ecosystems	☐ Clear ☐ Not clear ……………… ……………… ………………	☐ Relevant ☐ Not relevant ☐ Achievable ☐ Not achievable	☐ Satisfied ☐ Not satisfied ☐ Remove ………………………… …………………………
1.2	Water-Conserving Strategies	☐ Clear ☐ Not clear ……………… ……………… ………………	☐ Relevant ☐ Not relevant ☐ Achievable ☐ Not achievable	☐ Satisfied ☐ Not satisfied ☐ Remove ………………………… …………………………
1.3	Building Orientation	☐ Clear ☐ Not clear ……………… ……………… ………………	☐ Relevant ☐ Not relevant ☐ Achievable ☐ Not achievable	☐ Satisfied ☐ Not satisfied ☐ Remove ………………………… …………………………
1.4	Maximize the Potential of the Site	☐ Clear ☐ Not clear ……………… ……………… ………………	☐ Relevant ☐ Not relevant ☐ Achievable ☐ Not achievable	☐ Satisfied ☐ Not satisfied ☐ Remove ………………………… …………………………
1.5	Connecting the building to the Community	☐ Clear ☐ Not clear ……………… ……………… ………………	☐ Relevant ☐ Not relevant ☐ Achievable ☐ Not achievable	☐ Satisfied ☐ Not satisfied ☐ Remove ………………………… …………………………

How it could be improved --

D-2. Energy efficiency

This section is about the second category in the code which is energy efficiency, in the table below information will be collected about:

- **Content:** the language used in text and whether it is clear and understood or not, and if not please indicate how to improve it in the space allocated.
- **Criteria:** whether the point is relevant to the assessment or not and whether it is achievable at this stage in the Egyptian environment.
- **Technique:** about credit allocated to each point and weather it is satisfactory or not or it is better to be removed from assessment, and if not satisfied or asking to remove it please indicate how to why it in the space allocated and how it could be improved.

Assessment categories				
2	**Energy efficiency**	**Content**	**Criteria**	**Credit allocated**
2.1	Massive Wall Construction	☐ Clear ☐ Not clear …………… …………… ……………	☐ Relevant ☐ Not relevant ☐ Achievable ☐ Not achievable	☐ Satisfied ☐ Not satisfied ☐ Remove …………………… ……………………
2.2	Stopping Radiant Heat Gains	☐ Clear ☐ Not clear …………… …………… ……………	☐ Relevant ☐ Not relevant ☐ Achievable ☐ Not achievable	☐ Satisfied ☐ Not satisfied ☐ Remove …………………… ……………………
2.3	Embodied Energy	☐ Clear ☐ Not clear …………… …………… ……………	☐ Relevant ☐ Not relevant ☐ Achievable ☐ Not achievable	☐ Satisfied ☐ Not satisfied ☐ Remove …………………… ……………………
2.4	Annual energy use	☐ Clear ☐ Not clear …………… …………… ……………	☐ Relevant ☐ Not relevant ☐ Achievable ☐ Not achievable	☐ Satisfied ☐ Not satisfied ☐ Remove …………………… ……………………
2.5	Lift and escalator systems	☐ Clear ☐ Not clear …………… …………… ……………	☐ Relevant ☐ Not relevant ☐ Achievable ☐ Not achievable	☐ Satisfied ☐ Not satisfied ☐ Remove …………………… ……………………
2.6	Cooling Systems	☐ Clear ☐ Not clear …………… …………… ……………	☐ Relevant ☐ Not relevant ☐ Achievable ☐ Not achievable	☐ Satisfied ☐ Not satisfied ☐ Remove …………………… ……………………
2.7	Ventilation and Indoor Air Quality Strategies	☐ Clear ☐ Not clear …………… …………… ……………	☐ Relevant ☐ Not relevant ☐ Achievable ☐ Not achievable	☐ Satisfied ☐ Not satisfied ☐ Remove …………………… ……………………

Assessment categories				
2	**Energy efficiency**	**Content**	**Criteria**	**Credit allocated**
2.8	Lighting systems	□ Clear □ Not clear ………………… ……………… ………………	□ Relevant □ Not relevant □ Achievable □ Not achievable	□ Satisfied □ Not satisfied □ Remove ………………………… …………………………
2.9	Hot water supply systems	□ Clear □ Not clear ………………… ……………… ………………	□ Relevant □ Not relevant □ Achievable □ Not achievable	□ Satisfied □ Not satisfied □ Remove ………………………… …………………………
2.10	Building Orientation and Solar Access	□ Clear □ Not clear ………………… ……………… ………………	□ Relevant □ Not relevant □ Achievable □ Not achievable	□ Satisfied □ Not satisfied □ Remove ………………………… …………………………
2.11	Building-Integrated Approaches	□ Clear □ Not clear ………………… ……………… ………………	□ Relevant □ Not relevant □ Achievable □ Not achievable	□ Satisfied □ Not satisfied □ Remove ………………………… …………………………
2.12	Renewable Energy Applications for Buildings	□ Clear □ Not clear ………………… ……………… ………………	□ Relevant □ Not relevant □ Achievable □ Not achievable	□ Satisfied □ Not satisfied □ Remove ………………………… …………………………

How it could be improved --

D-3. Water conservation

This section is about water conservation strategies, in the table below information will be collected about:

- **Content:** the language used in text and whether it is clear and understood or not, and if not please indicate how to improve it in the space allocated.
- **Criteria:** the point itself and whether it is relevant to the assessment or not and whether it is achievable at this stage in the Egyptian environment.
- **Technique:** about credit allocated to each point and weather it is satisfactory or not or it is better to be removed from assessment, and if not satisfied or asking to remove it please indicate how to why it in the space allocated and how it could be improved.

Assessment categories				
3.	Water	Content	Criteria	Credit allocated
3.1	Water-conserving landscaping strategies	☐ Clear ☐ Not clear …………… …………… ……………	☐ Relevant ☐ Not relevant ☐ Achievable ☐ Not achievable	☐ Satisfied ☐ Not satisfied ☐ Remove …………………… ……………………
3.2	Conservation of water during construction	☐ Clear ☐ Not clear …………… …………… ……………	☐ Relevant ☐ Not relevant ☐ Achievable ☐ Not achievable	☐ Satisfied ☐ Not satisfied ☐ Remove …………………… ……………………
3.3	Water quality	☐ Clear ☐ Not clear …………… …………… ……………	☐ Relevant ☐ Not relevant ☐ Achievable ☐ Not achievable	☐ Satisfied ☐ Not satisfied ☐ Remove …………………… ……………………
3.4	Water recycling	☐ Clear ☐ Not clear …………… …………… ……………	☐ Relevant ☐ Not relevant ☐ Achievable ☐ Not achievable	☐ Satisfied ☐ Not satisfied ☐ Remove …………………… ……………………
3.5	Effluent discharge to foul sewers	☐ Clear ☐ Not clear …………… …………… ……………	☐ Relevant ☐ Not relevant ☐ Achievable ☐ Not achievable	☐ Satisfied ☐ Not satisfied ☐ Remove …………………… ……………………

How it could be improved ---

D-4. Recycling Systems and Waste Management

This section is about recycling and waste management strategies, in the table below information will be collected about:

- **Content:** the language used in text and whether it is clear and understood or not, and if not please indicate how to improve it in the space allocated.
- **Criteria:** the point itself and whether it is relevant to the assessment or not and whether it is achievable at this stage in the Egyptian environment.
- **Technique:** about credit allocated to each point and weather it is satisfactory or not, and if not satisfied or asking to remove it please indicate how to why it in the space allocated and how it could be improved.

Assessment categories				
4.	**Recycling& management**	**Content**	**Criteria**	**Credit allocated**
4.1	Construction Waste Recycling and Waste Management	☐ Clear ☐ Not clear …………… …………… ……………	☐ Relevant ☐ Not relevant ☐ Achievable ☐ Not achievable	☐ Satisfied ☐ Not satisfied ☐ Remove ……………………… ………………………
4.2	Operation and maintenance	☐ Clear ☐ Not clear …………… …………… ……………	☐ Relevant ☐ Not relevant ☐ Achievable ☐ Not achievable	☐ Satisfied ☐ Not satisfied ☐ Remove ……………………… ………………………

How it could be improved --

E. Credits weighting and overall grade

This section of the questionnaire is about the classifications awarded by the code and the credit requirements for each grade, in the table below please indicate your opinion on: 1) the overall grade requirements and its achievability in the Egyptian environment, 2) the proposed recheck after operation of the buildings to keep the classification awarded and whether to keep this option.

Assessment categories				
5	**Code overall grades**			
5.1	Overall grades and code classifications.	□ Clear □ Not clear	□ Achievable □ Not achievable	□ Satisfied □ Not satisfied
5.2	After-operation recheck and re-awarded classifications	□ Clear □ Not clear	□ Achievable □ Not achievable	□ Satisfied □ Not satisfied

How it could be improved --

About future contact

Would you be interested in receiving the results of this questionnaire?

☐ Yes ☐ No

Would you be interested in participating in a third questionnaire to test the final version of the code?

☐ Yes ☐ No

Would you be interested in doing a follow-up interview for further discussion?

☐ Yes ☐ No

If yes, please give complete details to contact

Address: --

Tel. : --

email : --

Appendix (3): EGCB final version

Egyptian Green Code for Building (EGCB)

Designing for Health, Safety, and Comfort

Final version 20/11/08

Table of content

1-1. Introduction

In Egypt we are moving from a period of less expensive energy and seemingly plentiful resources to a time in which building-related decisions will be more strongly influenced by energy and water availability. There is a growing concern about the environmental and societal implications of energy. Today, energy costs over the life of a building will far exceed the initial cost of the building. As prices rise, it will become even more critical to comprehensively address this issue.

This guide code was developed to promote long-term thinking and to build Egyptian buildings in ways that reflect values supportive of our planet. Our buildings can make a strong statement that saving energy and resources, while protecting our environment, is important. The message that we give to future generations should be embodied in the buildings they use. The Egyptian Green Code for Buildings (EGCB) is a pre-design guide tool. It contains the green design strategies organized properly in order to be used by architects and urban designers. It's an effective management tool to benchmark performance, prioritize improvement, and communicate achievements for a building or property portfolio.

New buildings that are planned, designed, built and commissioned to the standards set under EGCB will provide for safe, healthy, comfortable and efficient buildings that sustain the quality of life and workplace productivity, whilst minimizing the depletion of natural resources and reducing their environmental loadings. The label signifies levels of quality in respect to health and comfort, which are important considerations for building users (buyers, tenants, occupants), and levels of performance in respect of environmental and social dimensions, which are of importance to society as a whole. It is for the Client (developer, owner) to decide on whether to undertake an EGCB assessment and the performance standards that are considered appropriate for the building in the prevailing circumstances.

This document presents recommended design elements in 6 sections, each representing a key interrelated component of high performance building design. To effectively integrate energy-saving strategies, these options must be evaluated together from a whole-building perspective early in design process. A case study for designers can be found at the end of the document.

1-2. EGCB aims

Across Egypt we are again seeing signs that the supply of energy is not keeping up with rising demand. The price of natural gas is twice what it was in the 1990s. EGCB is a standard that defines building quality. It provides building users with a single performance label that demonstrates the overall qualities of a building. An EGCB assessed building will be safer, healthier, more comfortable, more functional and more efficient that a similar building which has not achieved the prescribed levels of performance. EGCB is the first initiative in Egypt to assess, improve, certify and label the performance of buildings. A program by which to benchmark and improve performance to ensure healthier, efficient, and environmentally sustainable working and living environments. The goal of EGCB is to lower energy consumption in Egyptian buildings and the use of renewable energies while improving the quality of life for the occupants.

- Establish a widely accepted standard for sustainable construction in Egypt;
- To assess, improve, certify and label the environmental performance of Egyptian buildings and reduce the environmental impacts of buildings throughout the planning, design, construction, management and demolition life cycle;
- A means by which to benchmark and improve performance;
- A driver for and means by which to assure healthier, higher quality, more durable, efficient, and environmentally sustainable working and living environments;
- Develop a user friendly and accurate method for evaluating building sustainability
- Cost savings through the more efficient use of energy and resources;
- Increased occupant satisfaction from healthy and productive accommodation;
- Assurance that best practice management is achieved and liabilities reduced;
- Enhanced corporate profile and marketability to potential building users;
- Stimulate demand for more sustainable buildings in Egypt, giving recognition for improved performance and minimizing false claims;
- Provide a common set of performance standards that can be pursued by developers, designers, architects, engineers, contractors and operators;
- Increase awareness in the building community, and ensure that environmental considerations are integrated right from the start rather than retrospectively.
- Making cost savings through more efficient use of energy and resources.
- Provides increased protection against environmental liability.
- Establishes a clear direction for continuous improvement and optimized performance.

EGCB is a regionally responsive green code; In Egypt's humid sub-tropical climate and dense urban living environment people need to be provided with options to enclosed, air-conditioned spaces, so that the provisions for natural ventilation and day-lighting figure prominently in the assessment of indoor environments. EGCB will provide for a comprehensive and fair assessment of the overall performance of a building in a range of key areas, at either the completion stage or during its life.

An assessment under EGCB is voluntary, providing an independently certified performance rating for a building in clearly defined terms. It embraces exemplary practices in the planning, design, construction, commissioning, management and operation of buildings in Egypt.

1-3. Credit theory

Credits have been broadly allocated by taking into account the international consensus as given by an analysis of weightings used in similar assessment methods operating elsewhere, as well as surveys and informed opinions of Egyptian architects, academics and governmental officials. Many of the assessments verifying compliance with the prescribed criteria in EGCB will be undertaken by a suitably qualified person acting on behalf of the Client, who will submit evidence in the form of documents, data and reports confirming compliance. Others will be based on evidence collected by the EGCB Assessor.

EGCB uses local performance standards, codes and guides where these are available (e.g. Egyptian code for building construction). Where these are not available (e.g. energy consumption) international or national standards, codes and guides are referenced. Where there are differences in the performance criteria set by the various authorities EGCB will generally avoid specifying the performance criteria (e.g. thermal comfort), allowing the Client to specify what they consider to be appropriate for their building. Credits are awarded for achieving higher levels of performance. It is intended that the assessment criteria be updated periodically as new information becomes available and as legal requirements evolve.

1-4. EGCB assessment categories

EGCB consists of three parts; part one serve as the introduction and the concept of the code, aims and credit theory. Part two detail the assessment categories for buildings on:

- Design - qualitative criteria
- Performance - quantitative criteria
- Process – maintenance and management

Part three is a case study established by the researcher to give guidance on how to use the code and how the overall assessment is calculated. Different assessment methods in use world-wide arrange performance aspects under different headings to reflect the preferences of EGCB the various performance aspects covered are grouped within the following 6 categories:

1. Site Design
    - Protecting Local Ecosystems
    - Water-Conserving Strategies
    - Building Orientation
    - Renewable Energy
    - Maximize the Potential of the Site
    - Connecting the building to the Community
2. Energy-Efficient Building
    - Energy-Efficient Building Shell
        - Massive Wall Construction
        - Stopping Radiant Heat Gains
        - Embodied Energy
    - Energy use
        - Annual energy use
        - Lift and escalator systems
3. Mechanical and Ventilation Systems
    - Cooling Systems
    - Ventilation and Indoor Air Quality Strategies.
    - Lighting systems
    - Hot water supply systems
4. Renewable Energy Systems
    - Available Renewable Energy Resources
    - Building Orientation and Solar Access
    - Building-Integrated Approaches
    - Renewable Energy Applications for Buildings
        - Daylighting
        - Passive Cooling

- o Solar Hot Water
- o Wind
- o Photovoltaics

5. Water Conservation
    - Water-conserving landscaping strategies
    - Conservation of water during construction
    - Water-conserving fixtures
    - Water use
    - Water quality
    - Water recycling
    - Effluent discharge to foul sewers
6. Recycling Systems and Waste Management
    - Construction Waste Recycling and Waste Management
    - Operation and maintenance

1-5. Simulation tools

Several available computer programs can provide building simulations on an hourly basis to predict the energy behaviour of the building's structure, air conditioning system, and central equipment plant. An energy analysis considers the building's key components, the building walls and roof, insulation, glazing, the lighting and day-lighting systems, as well as the HVAC systems and equipment. The analysis program can simultaneously assess and predict the results of choices associated with each component. For buildings in the design phase, computer models are generally useful for comparing alternatives and predicting trends.

The assessment of energy performance is based on estimations obtained from computer simulations. A building energy simulation program (e-Quest) will be recognized as a suitable tool for use in the building energy performance assessment provided that it has all the simulation capabilities required for modelling the features of the building being assessed, including its air-conditioning system. The Client shall submit documentation to confirm that the specific program used will have all the simulation capabilities required for modelling the building development being assessed and that the stated requirements are met. Evidence demonstrating fulfilment of requirement must be included in the submission for each building.

1-6. Credit weightings and overall grade

The weighing system, i.e. the relative number of credits given for compliance with a particular aspect, is a critical part of a building performance assessment method. It is logical that EGCB should seek to assign credits or weightings to assessment criteria somewhat in accordance with the significance of the impact – this have been partially accomplished by survey interviews and questionnaires- There is insufficient information available to provide an objective weighting for all issues, because of the difficulty in assigning an economic cost to environmental effects as diverse as, for example, the health of individuals, global warming and resource depletion. For a voluntary scheme there is also a need to consider the credits awarded with regard to technical difficulty and cost, otherwise take-up of the scheme will be affected.

1-6-1. Credit allocated

Credits have been broadly allocated by taking into account the international consensus as given by an analysis of weightings used in similar assessment methods operating elsewhere, as well as surveys and informed opinions of Egyptian architects, academics and governmental officials (appendices 2). Many of the assessments verifying compliance with the prescribed criteria in EGCB will be undertaken by a suitably qualified person acting on behalf of the Client, who will submit evidence in the form of documents, data and reports confirming compliance. Others will be based on evidence collected by the EGCB assessor after construction and the final grade will be granted after building construction phase.

1-6-2. Innovations

EGCB does not presume to be comprehensive in its coverage of all performance aspects. Under the heading of 'Innovation' the Client are encouraged to submit proposals for the award of credits for aspects not covered elsewhere in EGCB. In such circumstances the Client shall submit a proposal in which the performance gains are demonstrated.
Whilst innovative design solutions are encouraged, they do not necessarily justify credit. Innovation must demonstrate performance gains, such as through improved efficiency and/or improvements in the built environment. Indeed, it is anticipated that significant performance benefits will be realized from full and proper implementation of sound design, construction, installation, and operating practices.

1-6-3. Over all assessment

The Overall Assessment Grade is based on the percentage (%) of applicable credits gained. Given the importance of each part of EGCB it is necessary to obtain a minimum percentage (%) of credits from each part in order to qualify for the overall grade. The final grade and certificate will be granted after building construction and after EGCB assessor confirms the building eligibility. To keep the rating every 5 years a new report would be submitted for reassessment. The award classifications are:

Award classifications	Site design	Energy efficiency	Water conservation	Recycling and management	Overall
Total credit attainable	**11 credits**	**58 credits**	**17 credits**	**7 credits**	**93**
Platinum	10-11	45-58	14-17	6-7	75-93
GOLD	8-9	30-45	10-13	4-5	52-72
Silver	6-7	16-30	6-9	2-3	30-49
Bronze = min requirements	3-5	8-15	3-5	1	17-26

2-1. Site Design

Decisions made early in the design can often have a significant impact on many other aspects of the design (e.g. orienting the building linearly on an east-west axis is one important example. By maximizing well-controlled, North-facing glass and minimizing east- and west-facing glass, energy performance is greatly enhanced, comfort conditions are improved, and initial costs associated with cooling are reduced). By orienting your building effectively, you can maximize solar access and boost the effectiveness of day-lighting strategies, reducing the need for electrical lighting as well as heating and cooling loads. When considering the location for your building site, it is critical not only to consider your initial cost but also to evaluate environmental implications, how health and safety are influenced, and how well the building design is integrated into the fabric of the community.

Guidelines for Site Design

2-1-1. Protecting Local Ecosystems

The protection of local ecosystems is critical to an environmentally sensitive site design.
Protect or restore ecosystems and wildlife habitats on the site.

- 1 credit for developing a landscaping design that is compatible with existing plants and that uses native plants and consulting with local universities, cooperative extension offices, and master gardeners about local ecosystems and how to protect them.
- 1 credit for protecting areas for viewing natural habitat or developing interpretive nature trails through preserved wildlife habitats and ecosystems or using explanatory signage for different plants and trees.

2-1-2. Water-Conserving Strategies

The implementation of these commonsense ideas will help to drastically reduce your building water use and conserve water in the community.

- 1 credit for using native and drought-resistant planting materials to minimize the need for site irrigation.
- 1 credit for using grey water from sinks and water fountains for site irrigation or using soaker hoses and drip irrigation techniques that minimize evaporative losses and concentrate water on the plants' roots.

2-1-3. Building Orientation

To minimize energy use, maximize your potential by sitting your building correctly.
Establish the building on an east-west axis.

- 1 credit for developing a floor plan that minimizes east- and west-facing glass to maximize the daylighting contribution.
- 1 credit for using seasonal variations in wind speed and direction.

2-1-4. Renewable Energy

When evaluating site design issues, it is essential to investigate renewable systems early in the process. Solar systems need to have solar access, and wind systems require proper placement to be maximized.

- I credit for considering climatic conditions at the site to improve safety and save energy, consider non-grid-connected photovoltaic systems for:
  - crossing and caution lights
  - lighting at walkways and parking areas
  - telephone call boxes for emergencies.

2-1-5. Maximize the Potential of the Site

Understanding and using the ground conditions at the site will determine, to a great degree, both the economic and environmental success of the design.

- 1 credit for establishing floor grades that least impact site grading and using existing site contours to minimize grading.
- 1 credit for considering existing and new landscaping as a means of providing shading in the warmer months.
- 1 credit for stockpiling appropriate rock from site development for later use as ground cover.

2-1-6. Connecting the building to the Community

One of the measures of success of a building is the degree to which the building is a vital part of the community. If addressed early in the site selection and design phase, a building can be planned to serve the entire community.

- 1 credit for linking the building to the surrounding communities through safe bicycle routes and pedestrian pathways (through good site design). If applicable - consider designing the building so that the athletic fields, gymnasium, media centre and cafeterias can be shared at appropriate times with the community.

Total credit attainable

Credit requirement		Credit
Qualitative -Design credits	1 credit for developing a landscaping design that is compatible with existing plants and that uses native plants and consulting with local universities, cooperative extension offices, and master gardeners about local ecosystems and how to protect them.	1
	1 credit for protecting areas for viewing natural habitat or developing interpretive nature trails through preserved wildlife habitats and ecosystems or using explanatory signage for different plants and trees.	1
	1 credit for using native and drought-resistant planting materials to minimize the need for site irrigation.	1
	1 credit for using grey water from sinks and water fountains for site irrigation or using soaker hoses and drip irrigation techniques that minimize evaporative losses and concentrate water on the plants' roots.	1

	1 credit for developing a floor plan that minimizes east- and west-facing glass to maximize the daylighting contribution.	1
	1 credit for using seasonal variations in wind speed and direction.	1
	I credit for considering climatic conditions at the site to improve safety and save energy, consider non-grid-connected photovoltaic systems	1
	1 credit for establishing floor grades that least impact site grading and using existing site contours to minimize grading.	1
	1 credit for considering existing and new landscaping as a means of providing shading in the warmer months.	1
	1 credit for stockpiling appropriate rock from site development for later use as ground cover.	1
	1 credit for linking the building to the surrounding communities through safe bicycle routes and pedestrian pathways (through good site design). If applicable - consider designing the building so that the athletic fields, gymnasium, media centre and cafeterias can be shared at appropriate times with the community.	1
	Total design credits:	**11**
Total credit attainable :		**11**

2-2. Energy-Efficient Building

2-2-1. Energy-Efficient Building Shell

Because the building shell is typically responsible for 10%–20% of the total energy consumed in a building, focusing on this area of design can help you reduce energy consumption in your buildings. Increased insulation in the walls and ceiling helps to reduce heat loss and gain and improve comfort. Light-colored exterior walls and white roofs help to reduce cooling loads. These factors also contribute to reducing the size and cost of the HVAC system you will need. The useful life of building materials, systems, and equipment incorporated in buildings can vary considerably, so the building shell decisions you make as a designer will impact the first cost of the building as well as the long-term costs associated with operation, maintenance, and replacement.

Wall insulation should be selected based on the likelihood that it will never be replaced. When selecting your wall and roof systems, it is critical that you choose what is best for the life of the facility. Specify interior and exterior finishes that are durable and as maintenance free as possible, and integrate insulation levels that are appropriate for the life of the facility. Also, incorporate durable strategies that address air infiltration. If specified correctly, energy-efficient building shell elements can be effective in reducing our impact on the environment, and they will never need to be replaced.

Design Guidelines for an Energy-Efficient Building Shell

2-2-1-1. Massive Wall Construction

In hot and dry climates, high-mass construction techniques have been historically employed to moderate the heat gain experienced during the hot days. They delayed and reduced the impact until the night-time when ventilation strategies could cool the interior spaces.

- 1 credit for employing high-mass wall construction techniques to lag the heat gains using 16-inch brick-block and block-block cavity walls with rigid cavity insulation or adobe construction with insulation can delay thermal gains by up to 12 hours.

2-2-1-2. Stopping Radiant Heat Gains

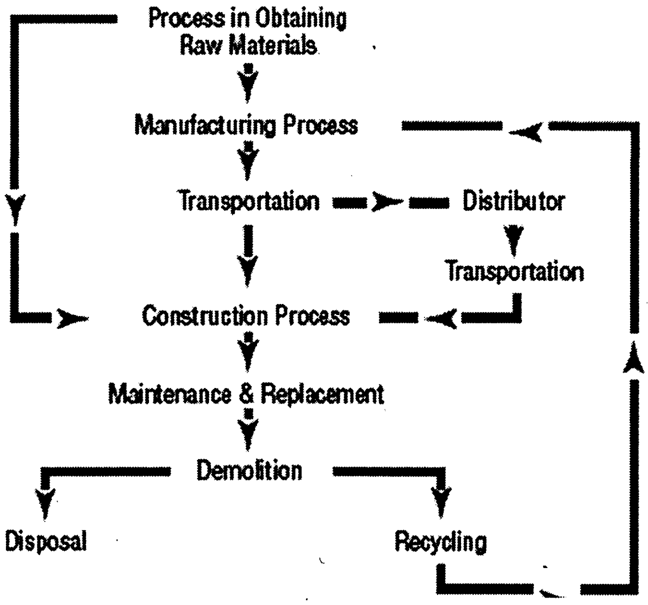
In hot and dry climates, creating a building shell that is massive and well-insulated can effectively address conduction gains and losses, but it is critical to also take into account radiant solar gains. In the warmer months, up to 90% of the cooling load coming from the roof area can be attributed to radiant heat gain. By addressing this problem, you can decrease your cooling load significantly.

- 1 credit for incorporating radiant barriers in the roof assemblies to reduce up to 95% of radiant heat gain. When solar radiation strikes a roof, a certain percentage of radiation is reflected away, and the balance is absorbed. When this occurs, it heats up that material, and the material reradiates downward. The low-emissive properties of the aluminium in the radiant barrier stop this radiant process, allowing only 5% of the radiation to pass through. Dust accumulation on radiant barriers reduces their performance. When possible, they should be suspended from the joists or rafters to reduce dust accumulation.

- 1 credit for incorporating highly reflective roofing systems to reflect solar gain away before it can create negative radiant impacts within the spaces below. This strategy is important, particularly in areas where radiant barriers cannot practically be installed.
- 1 credit for selecting a light colour for the exterior finish to reflect solar radiation.
- 1 credit for shading exterior walls with architectural elements (or landscaping) to enhance performance.

2-2-1-3. Embodied Energy

When selecting the building materials, consider that, in many cases, the amount of energy embodied in constructing the building is equal to more than two decades of a building's energy consumption. To seriously address the overall impacts of energy consumption, consider the energy involved in making each product, transporting the product to the site, and implementing the component into the building.



Figure▌: Total embodied energy diagram; products, materials, equipment and processes incorporated into construction.

- 1 credit for selecting locally made products and construction materials because often half or more of the embodied energy involved in constructing a building is related to transportation.
- 1 credit for encouraging the use of recycled products and evaluates the recyclability of products once the building has passed its useful life.
- 1 credit for considering how the typically wasted materials could be used in a new construction if an existing structures on the building site are to be demolished,
- 1 credit for demonstrating the embodied energy in the major elements of the building structure of the assessed building is reduced by 10% or more - proof that the design of structural elements and choice of materials results in lower embodied energy-.

The assessment covers only the elements and materials used in the building foundations, building core, walls, etc, the main elements that comprise the building structure, facade, and the roof. Interior services and fit-out components are not included. The Client shall provide a report detailing where changes in the design of the main structural elements, for example the use of less materials or alternative constructions, etc., that provide for a reduction in embodied energy beyond that which would result if the enhancements were not included.

2-2-2. Energy use

The Energy Use assessments take account of the specific characteristics of the building development, such as the type and usage of premises it houses and the range and operational characteristics of the systems and equipment required to meet the needs of users, and comprise three parts: .

- estimated Annual Energy Use (and where appropriate, Maximum Electricity Demand) for air-conditioning the building, and for lighting and equipment in air-conditioned areas;
- features and performance of specific systems and equipment; and
- testing and commissioning of systems and provisions that facilitate energy efficient management, operation and maintenance.

2-2-2-1. Annual energy use

The objectives are to reduce the consumption of non-renewable energy resources and the consequent harmful emissions to the atmosphere. Encourage energy conservation and methods to reduce maximum electricity demand.

(a) Estimated annual energy consumption

- 1 credit for a reduction in the annual energy consumption by 10%.
- 2 credits for a reduction in the annual energy consumption by 14%.
- 3 credits for a reduction in the annual energy consumption by 18%.
- 4 credits for a reduction in the annual energy consumption by 22%.
- 5 credits for a reduction in the annual energy consumption by 26%.
- 6 credits for a reduction in the annual energy consumption by 30%.
- 7 credits for a reduction in the annual energy consumption by 34%.
- 8 credits for a reduction in the annual energy consumption by 38%
- 9 credits for a reduction in the annual energy consumption by 42%
- 10 credits for a reduction in the annual energy consumption by 45%.

(b) Estimated maximum electricity demand

- 1 credit for a reduction in the maximum electricity demand by 15%.
- 2 credits for a reduction in the maximum electricity demand by 23%.
- 3 credits for a reduction in the maximum electricity demand by 30%.

The number of credits to be awarded will be determined with reference to the percentage reduction in the annual energy use and maximum electricity demand, respectively, of the assessed building relative to the respective benchmark (zero-credit) criteria evaluated from the Baseline Building model.

2-2-2-2. Lift and escalator systems

EGCB encourage the use of energy efficient lift and escalator installations in buildings with significant provisions for vertical transportation.

- 1 credit for complying with the Code of Practice for Energy Efficiency of Lift and Escalator Installations.

Total credit attainable

Credit requirement		**Credit**
Qualitative -Design credits	Incorporating highly reflective roofing systems to reflect solar gain away before it can create negative radiant impacts within the spaces below.	1
	Selecting a light colour for the exterior finish to reflect solar radiation.	1
	Shading exterior walls with architectural elements (or landscaping) to enhance performance.	1
	Selecting locally made products and construction materials - half or more of the embodied energy involved in construction is related to transportation -	1
	Encouraging the use of recycled products and evaluating the recyclability of products once the building has passed its useful life.	1
	Considering how the typically wasted materials could be used in a new construction if an existing structures on the building site are to be demolished,	1
	Complying with the Code of Practice for Energy Efficiency of Lift and Escalator Installations	1
	Total design credits:	**7**
Quantitative Performance credits	1 credit for employing high-mass wall construction techniques using 16-inch brick-block and block-block cavity walls with rigid cavity insulation or adobe construction with insulation can delay thermal gains by up to 12 hours.	1
	1 credit for incorporating radiant barriers in the roof assemblies to reduce up to 95% of radiant heat gain.	1
	1 credit for demonstrating the embodied energy in the major elements of the building structure is reduced by 10% or more.	1
	1 credit for a reduction in the annual energy consumption by 10%.	1
	2 credits for a reduction in the annual energy consumption by 14%.	2
	3 credits for a reduction in the annual energy consumption by 18%.	3
	4 credits for a reduction in the annual energy consumption by 22%.	4
	5 credits for a reduction in the annual energy consumption by 26%.	5
	6 credits for a reduction in the annual energy consumption by 30%.	6
	7 credits for a reduction in the annual energy consumption by 34%.	7
	8 credits for a reduction in the annual energy consumption by 38%	8
	9 credits for a reduction in the annual energy consumption by 42%	9
	10 credits for a reduction in the annual energy consumption by 45%.	10
	1 credit for a reduction in the maximum electricity demand by 15%.	1
	2 credits for a reduction in the maximum electricity demand by 23%.	2
	3 credits for a reduction in the maximum electricity demand by 30%.	3
	Total performance credits:	**16**
	Total credit attainable :	**23**

2-3. Mechanical and Ventilation Systems

In hot and dry climates, heating, ventilation, and air conditioning (HVAC) systems are typically responsible for 50%–60% of the energy consumed in buildings. By using the "whole-building" approach — looking at how all the building's design elements work together — your design team can factor in energy-saving choices that reduce heating and cooling loads and downsize the HVAC system needed. By not over-designing the HVAC system, you can reduce initial equipment costs as well as long-term operating costs. More importantly, HVAC systems have a significant effect on the health, comfort and productivity. A study by the Egyptian Environment Agency (EEA) found that half of the more than 5,000 public buildings in the country are facing noise control problems, lack of adequate ventilation, physical security issues, poor indoor air quality, comfort issues, below-standard lighting conditions, and unsatisfactory levels of fresh air.

The best HVAC design considers all the interrelated building systems while addressing indoor air quality, energy consumption, and environmental benefit. Optimizing the design and benefits requires that your mechanical system designer and your architect address these issues early in the schematic design phase and continually revise subsequent decisions throughout the remaining design process. It is also essential that you implement well-thought-out commissioning processes and routine preventative maintenance programs

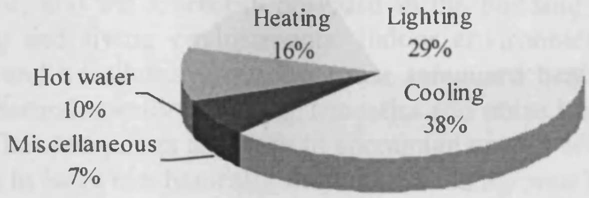


Figure 1: Egyptian public buildings energy distribution. In typical buildings, energy is primarily used for cooling and lighting.

To optimize the selection of efficient, cost-effective mechanical and ventilation systems, perform an energy analysis early in the process, during the schematic design phase. System optimization also improves indoor air quality, allows better humidity control, and potentially lowers construction costs due to a reduction in size of mechanical and electrical systems. Develop a clear understanding of how the building system wants to balance initial cost versus life-cycle cost, and point out the long-term advantages of investing in more energy-efficient and environmentally friendly approaches. In the schematic design phase, determine the mechanical system implications of all related site, daylighting, and lighting elements. When energy use and operating expenditures are considered at the outset of the design process, energy- and resource-efficient strategies can be integrated at the lowest possible cost.

2-3-1. Cooling Systems

Consider cooling systems appropriate for hot and dry climates that match the building loads and are not over-designed. Evaluate various cooling equipment sizes and models to select the unit that best matches the demand requirements.

- 1 credit for considering the use of direct or indirect evaporative cooling equipment – for hot and dry climates - which can reduce the need for mechanical cooling. The requirements for proper maintenance of these systems should also be evaluated.
- 1 credit for using natural gas and/or solar-driven absorption cooling as a method of reducing peak electricity consumption.
- A form of free cooling is night-time ventilation (if applicable). 1 credit for applying night-time ventilation strategies to cool interior mass and flush out stale air prior to morning occupancy. This purging cycle can be effective in dry areas with low night-time temperatures.
- 1 credit for reducing the use of CFC and HCFC refrigerants in order to reduce upper atmospheric ozone depletion,
- 1 credit for considering thermal (ice or water) storage in situations where peak load avoidance is critical. Thermal storage is a cost-saving technique that takes advantage of off-peak utility rate schedules where applicable. Some electric utilities promote thermal storage by offering an incentive for power usage that can be displaced from peak to off-peak time.

2-3-2. Ventilation and Indoor Air Quality Strategies

This section considers some of the broader issues of sustainable buildings as well as the most significant indoor performance issues. The broader issues include safety, provisions for maintaining hygiene, and the amenities provided in the building, which have impact on the quality of working and living environments. Indoor environmental quality (IEO) includes indoor air quality and ventilation provisions that safeguard health. Considerations of these issues, as well as thermal comfort, lighting, acoustics and noise impact on well-being, comfort and productivity. The next points are made to encourage energy efficient design and control of ventilation systems in large mechanically ventilated building/premises.

- 1 credit for using a heat recovery system, like an air-to-air heat exchanger, that will transfer the heat between air supplied to and air exhausted from the building.
- 1 credit for separating the ventilation of highly polluting spaces. Provide separate exhaust from kitchens, toilets, custodial closets, chemical storage rooms, and dedicated copy rooms to the outdoors, with no recirculation through the HVAC system.
- 1 credit for evaluating the use of an outdoor air economizer cycle that will allow up to 100% outdoor air to be introduced into the distribution system to provide space cooling.
- 1 credit for locating outdoor air intakes a minimum of 7 feet vertically and 25 feet horizontally from polluted and/or overheated exhaust (e.g., cooling towers, loading docks, fume hoods, and chemical storage areas). Consider other potential sources of contaminants, such as lawn maintenance. Separate vehicle traffic and parking a minimum of 50 feet from outdoor air inlets or spaces employing natural ventilation strategies. Create landscaping buffers between high traffic areas and building intakes or natural ventilation openings.
- 1 credit for locating exhaust outlets at a minimum of 10 feet above ground level and away from doors, occupied areas, and operable windows. The preferred location for exhaust outlets is at roof level projecting upward or horizontally away from outdoor intakes.

- 1 credit for provisions that can regulate the operation of the ventilation system(s) to reduce energy use whenever conditions permit.
- 1 credit for ventilation systems that will consume less electricity than those meeting the zero credit requirements (baseline) by 15% or more.
- 2 credits where the consumption is reduced by 25% or more,

2-3-3. Lighting systems

The objective of this part is to encourage the adoption of lighting equipment and controls that will provide for energy conservation.

- 1 credit for using lamps and, where applicable, ballasts that will consume less electricity than those meeting the zero-credit requirements by 15% or more.
- 2 credits where the consumption is reduced by 25% or more.
- 1 credit for installing control systems and devices that will switch off or dim the output of lighting installations when and where illumination is not required.

2-3-4. Hot water supply systems

To promote the use of energy efficient hot water supply systems to conserve energy.

- 1 credit for using heat pump water heaters or tankless (instantaneous) water heaters.
- 1 credit for using localized versus centralized hot water equipment by evaluating the types of loads served. A remote location may be best served by localized equipment.
- 1 credit for applying a solar-assisted hot water system and heat recovery systems.
- 1 credit for using tankless water heaters in areas that are remote and require small hot water amounts.
- 1 credit for minimizing the standby heat losses from hot water distribution piping and hot water storage tanks by increasing insulation levels, using anti-convection valves, and using heat traps.
- 1 credit for installing energy efficient hot water supply system(s) and equipment that can save 20% or more energy.

Total credit attainable

Credit requirement		Credit
Qualitative -Design credits	1 credit for considering the use of direct or indirect evaporative cooling equipment which can reduce the need for mechanical cooling. The requirements for proper maintenance of these systems should also be evaluated.	1
	1 credit for using natural gas and/or solar-driven absorption cooling as a method of reducing peak electricity consumption.	1
	1 credit for using night-time ventilation strategies to cool interior mass and flush out stale air prior to morning occupancy.	1
	1 credit for reducing the use of CFC and HCFC refrigerants in order to reduce upper atmospheric ozone depletion,	1
	1 credit for considering thermal (ice or water) storage in situations where peak load avoidance is critical.	1
	1 credit for separating the ventilation of highly polluting spaces.	1
	1 credit for provisions that can regulate the operation of the ventilation	1

	system(s) to reduce energy use whenever conditions permit.	
	1 credit for installing control systems and devices that will switch off or dim the output of lighting installations when and where illumination is not required.	1
	1 credit for using heat pump water heaters or tankless (instantaneous) water heaters.	1
	1 credit for using localized versus centralized hot water equipment by evaluating the types of loads served. A remote location may be best served by localized equipment.	1
	1 credit for using tankless water heaters in areas that are remote and require small hot water amounts.	1
	1 credit for minimizing the standby heat losses from hot water distribution piping and hot water storage tanks by increasing insulation levels, using anti-convection valves, and using heat traps.	1
	Total design credits:	**12**
Quantitative Performance credits	1 credit for using a heat recovery system, like an air-to-air heat exchanger, that will transfer the heat between air supplied to and air exhausted from the building.	1
	1 credit for evaluating the use of an outdoor air economizer cycle that will allow up to 100% outdoor air to be introduced into the distribution system to provide space cooling.	1
	1 credit for locating outdoor air intakes a minimum of 7 feet vertically and 25 feet horizontally from polluted and/or overheated exhaust.	1
	1 credit for locating exhaust outlets at a minimum of 10 feet above ground level and away from doors, occupied areas, and operable windows.	1
	1 credit for ventilation systems that will consume less electricity than those meeting the zero credit requirements (baseline) by 15% or more.	1
	2 credits where the consumption is reduced by 25% or more,	2
	1 credit for using lamps and, where applicable, ballasts that will consume less electricity than those meeting the zero-credit requirements by 15% or more.	1
	2 credits where the consumption is reduced by 25% or more.	2
	1credit for applying a solar-assisted hot water system and heat recovery systems	1
	1 credit for installing energy efficient hot water supply system(s) and equipment that can save 20% or more energy.	1
	Total performance credits:	**10**
	Total credit attainable :	**22**

2-4. Renewable Energy Systems

There is no shortage of renewable energy, and renewable energy can contribute to reduced energy costs and reduced air pollution. More importantly, the renewable energy systems that you design into your building will demonstrate to the people the technologies that will fuel the next century. Over the past two decades, the cost of renewable energy systems has dropped dramatically. Wind turbines can now produce electricity at less than 4 cents per kilowatt hour a seven fold reduction in energy cost. Concentrating solar technologies and photovoltaic's have dropped more than three fold during the past 20 years. With improvements in analytical tools, passive solar and daylighting technologies can be implemented into buildings with less than a two-year return on investment.

Design Guidelines for Renewable Energy Systems

2-4-1. Available Renewable Energy Resources

Egypt has a good potential of renewable resources. Since the early 1994- the first Egyptian law to protect the environment- renewable energy has been considered as an integral part of the Egyptian energy policy framework. Currently, the energy strategy calls for renewable resources to cover 5% of the electrical energy demand by 2020. The next map showed in Figure (2) has been generated in collaboration with the Egyptian environment ministry, the Egyptian environmental quality agency and New and Renewable Energy Agency (NREA) to indicate where the renewable energy technologies could be implemented in Egypt as a guideline for architects when designing.

- Biomass Energy: one of the most promising powers that is under utilization in Egypt. The architect could make its requirements as a fundamental part of the designing process in delta and all agricultural areas for number of reasons:
    - It does not require complicated technologies.
    - The raw materials needed will be available in low price
- Solar Energy: clean energy that are highly recommended in future Egyptian architecture for number of reasons:
    - Egypt has clear sun (94%) all year around. Direct daily solar intensity 5 - 7 KW/m2 per day.
    - Highly modular: It allow installations in different stages- as needed- without losing the economy of first size in installation of the system. Also it can be sized to any capacity.
    - Declining in price of kWh: The solar energy are priced directly by the peak generating capacity in watts, and indirectly by square foot. It reached 30cents/KWh
- Wind Energy: Another source of clean energy that could be implemented in Egypt and more suitable for urban projects along shore line both on Mediterranean sea and the Red sea because:
    - Egyptian average wind speed is 11 m/s which is relatively high.
    - A clean and renewable source of energy that produce no emissions of GHG or CO_2 that pollute the environment.
    - It uses only 5% of the project land.

- Wind energy systems are modular within the granularity of the turbine size. Standard wind turbines come in different sizes. For utility scale installations standard wind turbines is now in the 500-1,000 kW range.
- Wind energy cost/kWh are decreasing rabidly, wind power are the most suitable to the economics of Egypt, with a coast of 5cents/kWh.

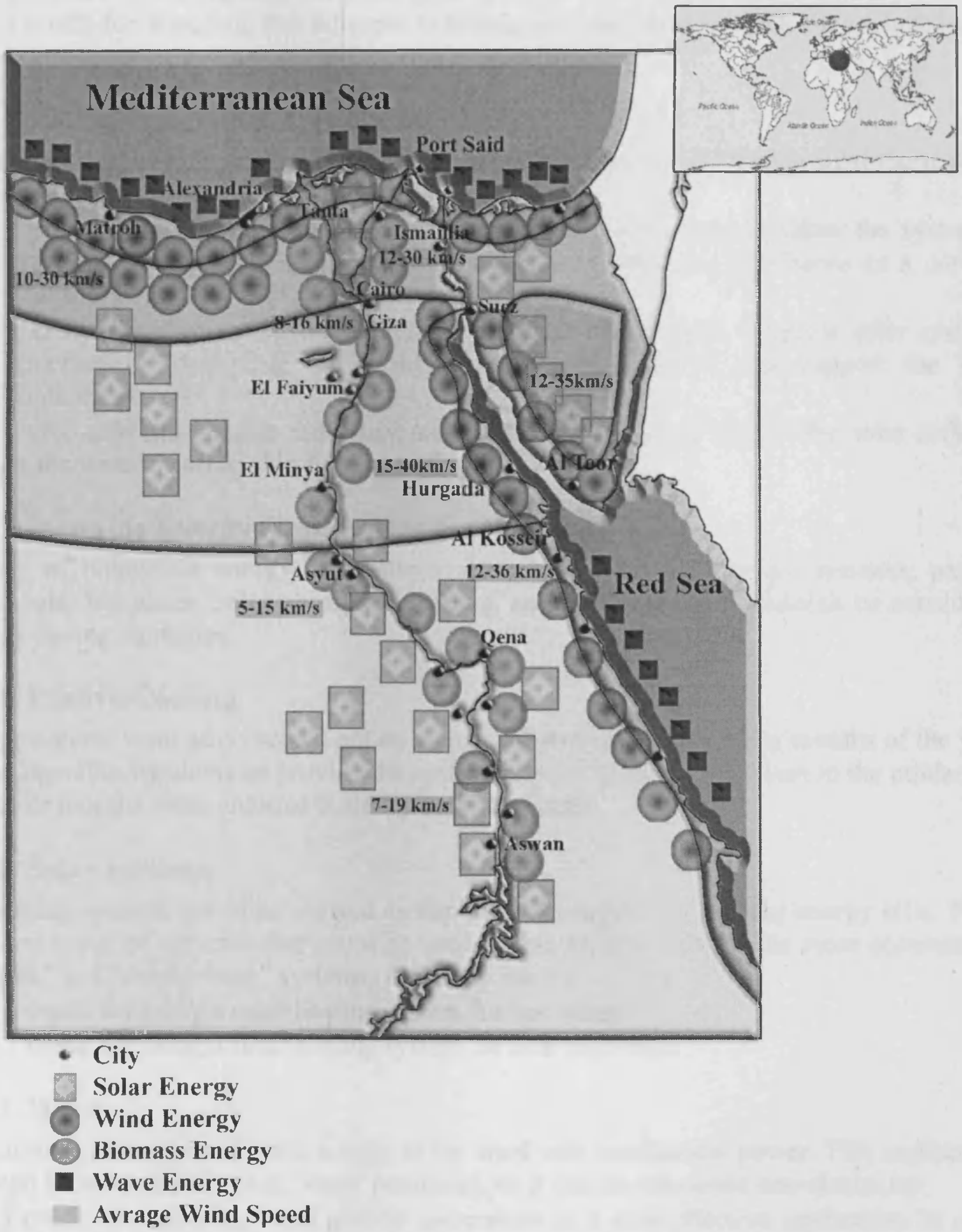


Figure (2): The renewable energy technologies that could be implemented in Egyptian architecture

2-4-2. Building Orientation and Solar Access

Employing renewable energy strategies cost effectively requires the building to be sited to maximize the locally available natural resources.

- 1 credit for establishing the building on an east-west axis that maximizes northern exposure for daylighting and other solar systems.
- I credit for ensuring that adjacent buildings or trees do not block the intended solar access.

2-4-3. Building-Integrated Approaches

To maximize cost effectiveness and improve aesthetics, consider integrating solar thermal and photovoltaic systems into the building shell.

- 1 credit for integrating solar systems into the overall design to allow the system to serve multiple purposes (e.g, a photovoltaic array that can also serve as a covered walkway).
- 1 credit for eliminating the additional costs associated with a typical solar system's structure by designing the building's roof assembly to also support the solar components.
- 1 credit for minimizing redundant materials by using the glazing of the solar collector as the waterproofing skin of the building.

2-4-4. Renewable Energy Applications for Buildings

A variety of renewable energy applications are effective in hot and dry climates; passive cooling, solar hot water, solar absorption cooling, and photovoltaics should all be considered as energy-saving strategies.

2-4-4-1. Passive Cooling

Although natural ventilation would not be a practical strategy in the hotter months of the year, consider operable windows to provide the opportunity for natural ventilation in the milder and even cooler months when interior building loads dominate.

2-4-4-2. Solar systems

Solar heating systems are often viewed as important strategies in reducing energy bills. There are several types of systems that could be used in this region. Two of the more common are "drainback" and "closed-loop" systems (Appendix no. 2)

- 1 credit for using a solar heating system for hot water.
- 1 credit for using a solar heating system for heat recovery.

2-4-4-3. Wind

Wind turbines convert the kinetic energy in the wind into mechanical power. This mechanical power can be used directly (e.g., water pumping), or it can be converted into electricity.

- I credit for applying wind electric generators as a cost-effective application in areas where the sustained wind speed exceeds 15 km/hour.
- I credit for addressing potential noise problems by properly sitting wind installations.

2-4-4-4. Photovoltaics

Photovoltaic modules, which convert sunlight into electricity, have numerous applications and can be designed as "stand-alone" applications or for utility "grid-connected" applications. (Appendix no. 2)

- 1 credit where 2% or more of building energy is obtained from renewable energy sources.
- 2 credits where 4% or more is obtained from renewable energy sources.
- 3 credits where 6% or more is obtained from renewable energy sources.

The Client shall submit a report providing details of the installations, and calculations showing the estimated energy use provided from renewable energy sources. In the case of systems that generate electricity from renewable sources (e.g. photovoltaic panels), the estimated amount of electricity that will be generated by the system for use by equipment in the building, either instantaneously or from an associated storage system. In the case of using systems that produce services direct from renewable sources, which will otherwise require the use of fuel or electricity to produce those services (e.g. hot water supply from solar panels or chilled water supply from absorption chillers powered by solar heat), the equivalent amount of electricity use that will be avoided

The calculation shall take due account of the diurnal and seasonal variations in the external environmental conditions (e.g. solar intensity and wind speed and direction) and in the demand for the electricity and/or services generated by the systems. Any energy use and losses by the systems shall be discounted from their output.

2-5. Water Conservation

Water resources in Egypt are becoming scarce. Surface-water resources originating from the Nile are now fully exploited, while groundwater sources are being brought into full production. Egypt is facing increasing water needs, demanded by a rapidly growing population, by increased urbanisation, by higher standards of living and by an agricultural policy which emphasises expanded production in order to feed the growing population. The population is currently increasing by more than one million people a year. Egypt uses 1,055 cubic meters (278,702 gallons) of water per person per year, withdrawn from streams, reservoirs, and wells. Combine the impacts of rising population with the demographic shift in people to more arid regions, and the pressure of providing clean water becomes more critical every year. The price of water is escalating at unprecedented rates. You can make considerable difference at your building in reducing community water use. By using water-conserving fixtures and implementing graywater or rainwater catchment systems, buildings can easily reduce their municipal water consumption 25%–75%.

Design Guidelines for Conserving Water

2-5-1. Water-conserving landscaping strategies

The demand for water will be greatly impacted by the amount of site irrigation required. By limiting new landscaped areas and considering the type of plants and vegetation installed, water needs will be reduced. To reduce the reliance on potable water for irrigation relatively uncontaminated waste can be easily captured, stored, and used to fulfil non-potable needs.

- 1 credit for minimizing disruption to the existing site conditions, retaining as much existing vegetation as is practical and incorporating native and drought-resistant plants to minimize irrigation requirements.
- 1 credit for using soaker hoses and drip irrigation technologies to minimize evaporative losses and concentrate water on plants.
- 1 credit for use graywater from lavatories and water fountains for underground site irrigation and designing the system to meet local regulations, to:
    - get the graywater into the soil as soon as possible instead of storing it
    - irrigate below the surface of the ground only
    - deliver the graywater to biologically activate the soil where organic matter will quickly be broken down.
- 1 credit for the use of an irrigation system which does not require the use of municipal fresh water after a period of establishment is complete.

The Client shall provide a report prepared by a suitably qualified person describing the soft landscaping design, species of plants, etc, and confirm that, after a period of establishment of the plants and vegetation is complete, irrigation will not require/ fractionally require the use of municipal potable (fresh) water supply.

2-5-2. Conservation of water during construction

By including specifications addressing water during construction, you can save a considerable amount of water during your construction projects.

- 1 credit for including disincentives in specifications to the general contractor for excessive water use and incentives for reducing consumption during construction. Specify that the general contractor is responsible for water cost during construction.
- 1 credit for minimize watering requirements by specifying appropriate times of year when new landscaping efforts should occur.

2-5-3. Water-conserving fixtures

One of the most effective means to limit demand for water is to reduce the requirements associated with necessary plumbing fixtures.

- 1 credit for consider showerheads that require less than 2.5 gallons per minute and incorporate levers for reducing flow between 2.1 and 1.5 gallons per minute. Specify low-flow toilets that use less than 1.6 gallons per flush.
- 1 credit for using aerators to reduce flow in lavatory faucets to as low as 1 gallon per minute. When applicable specify self-closing, slow-closing, or electronic faucets where it is likely that faucets may be left running.

2-5-4. Water use

The demand growth has risen in recent years and additional water resources are still required to secure a full supply. The lack of reservoir sites and high development costs limit the development of further areas as water-gathering grounds. There are also opportunities to recycle used water and rain water in order to reduce the use of water.

- 1 credit for demonstrating that the use of water efficient devices leads to an estimated annual savings of 15%
- 2 credits for demonstrating to an estimated annual savings of 25%
- 3 credits for demonstrating to an estimated annual savings of 35%

2-5-5. Water quality

To ensure that the quality of potable water delivered to building users is satisfactory.

- 1 credit where fresh water plumbing installations comply with the referenced good practice guides and demonstrating that the quality of potable water meets the referenced drinking water quality standards at all points of use.

2-5-6. Water recycling

This section is to encourage harvesting of rainwater and recycling of grey water in order to reduce consumption of fresh water. Even in hot and dry climates, rainwater can sometimes be harvested and stored in cisterns for non-potable use. In most cases, water runs off the roof into gutters and downspouts, which carry the water to a storage device for future use.

- I credit for implementing a rainwater collection system to provide water for toilet flushing and irrigation. Using a durable storage container, and locate it away from direct sunlight and septic tanks and determining the necessary water treatment and filters for your area.

a) Harvested rainwater

- 1 credit for harvesting of rainwater which will lead to a reduction of 10% or more in the consumption of fresh water.

b) Provisions for grey water recycling

- 1 credit for the provision of plumbing and drainage systems that provide for separation of grey water from black water.

c) Recycled water

- 1 credit where recycled grey water will lead to a reduction of 10% or more in the consumption of fresh water.

2-5-7. Effluent discharge to foul sewers

To reduce the volumes of sewage discharged from buildings thereby reducing burdens on municipal sewage supply and treatment facilities.

- 1 credit for demonstrating a reduction in annual sewage volumes by 25% or more.

The Client shall submit a report prepared by a suitably qualified person detailing the capacities (volume, flow-rate, etc) of water using equipment for both the assessed building and a similar 'benchmark' (zero credit) building, Le., a building where flushing devices and appliances are not deemed to be efficient in water use. The report shall follow a format that details:

- type and number of devices using flushing water;
- frequency, duration and water consumption per use for each;
- sum of water volumes used for each for male and female users;
- estimated daily flushing water use;
- defined number of days of use of the facilities (work days, school days, etc) to annualize effluent discharge and any deduction for annual use of recycled water.

Total credit attainable

Credit requirement		**Credit**
Qualitative -Design credits	Minimizing disruption to the existing site conditions, retaining as much existing vegetation as is practical and incorporating native and drought-resistant plants to minimize irrigation requirements.	1
	Including disincentives in specifications to the general contractor for excessive water use and incentives for reducing consumption during construction. Specify that the general contractor is responsible for water cost during construction.	1
	Minimize watering requirements by specifying appropriate times of year when new landscaping efforts should occur.	1
	Where fresh water plumbing installations comply with the referenced good practice guides and demonstrating that the quality of potable water meets the referenced drinking water quality standards at all points of use.	1
	The provision of plumbing and drainage systems that provide for separation of grey water from black water.	1
	Total design credits:	**5**

Quantitative Performance credits	Using soaker hoses and drip irrigation technologies to minimize evaporative losses and concentrate water on plants.	1
	Using graywater from lavatories and water fountains for underground site irrigation and designing the system to meet local regulations	1
	The use of an irrigation system which does not require the use of municipal fresh water after a period of establishment is complete.	1
	Consider showerheads that require less than 2.5 gallons per minute and incorporate levers for reducing flow between 2.1 and 1.5 gallons per minute. Specify low-flow toilets that use less than 1.6 gallons per flush.	1
	Using aerators to reduce flow in lavatory faucets to as low as 1 gallon per minute. When applicable specify self-closing, slow-closing, or electronic faucets where it is likely that faucets may be left running.	1
	Demonstrating that the use of water efficient devices leads to an estimated annual savings of 15%	1
	Demonstrating to an estimated annual savings of 25%	2
	Demonstrating to an estimated annual savings of 35%	3
	Implementing a rainwater collection system to provide water for toilet flushing and irrigation. Using a durable storage container, and locate it away from direct sunlight and septic tanks and determining the necessary water treatment and filters for your area.	1
	Harvesting of rainwater which will lead to a reduction of 10% or more in the consumption of fresh water.	1
	Where recycled grey water will lead to a reduction of 10% or more in the consumption of fresh water.	1
	Demonstrating a reduction in annual sewage volumes by 25% or more.	1
	Total performance credits:	**12**
	Total credit attainable :	**17**

2-6. Recycling Systems and Waste Management

2-6-1. Construction Waste Recycling and Waste Management

Recycling efforts should begin during the construction of the building and engage the general contractor and all sub-contractors.

- 1 credit for specifying the specific job-site wastes that will be recycled during construction (corrugated cardboard, all metals, clean wood waste, gypsum board, beverage containers, and clean fill material).
- 1 credit for stockpiling appropriate existing topsoil and rock for future ground cover.
- 1 credit for monitoring the contractor and sub-contractor's recycling efforts during construction.
- 1 credit for requiring that the contractor use safe handling, storage, and control procedures, and specify that the procedures minimize waste in order to minimize the impacts from any hazardous materials or waste used in construction

2-6-2. Operation and maintenance

This section is designed to enable building operators to implement the design intent, be able to monitor the performance of the building, and maintain the performance. Enable building operators to measure, monitor and develop measures to improve the performance of the building's engineering systems, particularly concerning energy use.

a) Operations and maintenance manual

- 1 credit for providing a fully documented operations and maintenance manual to the minimum specified.

b) Energy management

- 1 credit for providing fully documented instructions that enables systems to operate at a high level of energy efficiency.

c) Operator training and operation and maintenance facilities

- 1 credit for providing training for operations and maintenance staff to the minimum specified; and demonstrating that adequate maintenance facilities are provided for operations and maintenance work.

Total credit attainable

	Credit requirement	Credit
Qualitative -Design credits	Specifying the specific job-site wastes that will be recycled during construction (corrugated cardboard, all metals, clean wood waste, gypsum board, beverage containers, and clean fill material).	1
	Stockpiling appropriate existing topsoil and rock for future ground cover.	1
	Monitoring the contractor and sub-contractor's recycling efforts during construction.	1
	Requiring that the contractor use safe handling, storage, and control procedures, and specify that the procedures minimize waste in order to minimize the impacts from any hazardous materials or waste used in construction	1
	Providing a fully documented operations and maintenance manual to the minimum specified.	1
	Providing a fully documented instruction that enables systems to operate at a high level of energy efficiency.	1
	Providing training for operations and maintenance staff to the minimum specified; and demonstrating that adequate maintenance facilities are provided for operations and maintenance work	1
	Total design credits:	**7**
	Total credit attainable :	**7**

Case study

Reading for All - National Library

As the case study project has been reviewed in detail in chapter 6 of the thesis, it have been omitted from this part.

Appendix (4): Approved CDM Projects in 2005

Initially approved CDM projects in 2005 are:

1. Installing a cogeneration unit with 14 mw power, GT model, operating on natural gas at the Al Sindian Company Paper Factory.
2. Collection and burning of biologically generated methane gas at waste dumpsites in Alexandria.
3. Replacing mazot with natural gas as fuel for Sinai Cement Company Factory (producing grey cement).
4. Implementing the first and second phases of the Greater Cairo Metro (network) line
5. Partial replacement of fuel by Biomass fuel in Assiout Cement Factory.
6. Establishing 85 mw wind farms at Za'farana with Spanish cooperation.
7. Establishing 80 mw wind farm at Za'farana with German cooperation.
8. Tree planting of the ring road surrounding Greater Cairo.
9. Reducing greenhouse gases (Nitrous Oxide) (N2O) in the acid production unit at Elnasser for Coke and Chemicals Company.
10. Replacing equipment and transforming fuel at the Dying and Chemical Materials Factory.
11. Reducing emissions of PFC gases at Misr Aluminum Company.
12. Fuel switching to natural gas in 311 Clay Brick factories at Arab Abu Sa'ed and El Saf areas.
13. Changing fuel type in boilers, dryers, and furnaces at the Alexandria Oil and Soap Company.
14. Changing fuel type used for power generation and industrial processes at Misr Fine Spinning and Weaving Co.
15. Changing fuel type used for power generation and industrial processes at Misr Beida Dyers Company.

The following is a list of projects granted final approval letters during 2006; these projects are being marketed to identify donors for their implementation.

1. Establishing N2O removal unit from exhaust gases at the Abu Qir Acid Plant.
2. Establishing a 120 mw wind farm at Al Zafarana.
3. Collection and burning of biologically generated methane gas at waste dumpsites in Alexandria.

Appendix (5): EGCB first version

Egyptian Green Code for Building (EGCB)

First version (draft 15/02/07)

To be tested as part of PhD research fulfilment

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Table of content

1. Introduction

In Egypt we are moving from a period of less expensive energy and seemingly plentiful resources to a time in which building-related decisions will be more strongly influenced by energy and water availability. There is a growing concern about the environmental and societal implications of energy. Today, energy costs over the life of a building will far exceed the initial cost of the building. As prices rise, it will become even more critical to comprehensively address this issue.

This guide code was developed to promote long-term thinking and to build Egyptian buildings in ways that reflect values supportive of our planet. Our buildings can make a strong statement that saving energy and resources, while protecting our environment, is important. The message that we give to future generations should be embodied in the buildings they use. The Egyptian Green Code for Buildings (EGCB) is a pre-design guide tool. It contains the green design strategies organized properly in order to be used by architects and urban designers. It's an effective management tool to benchmark performance, prioritize improvement, and communicate achievements for a building or property portfolio.

New buildings that are planned, designed, built and commissioned to the standards set under EGCB will provide for safe, healthy, comfortable and efficient buildings that sustain the quality of life and workplace productivity, whilst minimizing the depletion of natural resources and reducing their environmental loadings. The label signifies levels of quality in respect to health and comfort, which are important considerations for building users (buyers, tenants, occupants), and levels of performance in respect of environmental and social dimensions, which are of importance to society as a whole. It is for the Client (developer, owner) to decide on whether to undertake an EGCB assessment and the performance standards that are considered appropriate for the building in the prevailing circumstances.

This document presents recommended design elements in 6 sections, each representing a key interrelated component of high performance building design. To effectively integrate energy-saving strategies, these options must be evaluated together from a whole-building perspective early in design process. A case study for designers can be found at the end of the document.

1.1. EGCB Aim

Across Egypt we are again seeing signs that the supply of energy is not keeping up with rising demand. The price of natural gas is twice what it was in the 1990s. EGCB is a standard that defines building quality. It provides building users with a single performance label that demonstrates the overall qualities of a building. An EGCB assessed building will be safer, healthier, more comfortable, more functional and more efficient that a similar building which has not achieved the prescribed levels of performance. EGCB is the first initiative in Egypt to assess, improve, certify and label the performance of buildings. A program by which to benchmark and improve performance to ensure healthier, efficient, and environmentally sustainable working and living environments. The goal of EGCB is to lower energy consumption in Egyptian buildings and the use of renewable energies while improving the quality of life for the occupants.

- Establish a widely accepted standard for sustainable construction in Egypt;
- To assess, improve, certify and label the environmental performance of Egyptian buildings and reduce the environmental impacts of buildings throughout the planning, design, construction, management and demolition life cycle;
- A means by which to benchmark and improve performance;
- A driver for and means by which to assure healthier, higher quality, more durable, efficient, and environmentally sustainable working and living environments;
- Develop a user friendly and accurate method for evaluating building sustainability
- Cost savings through the more efficient use of energy and resources;
- Increased occupant satisfaction from healthy and productive accommodation;
- Assurance that best practice management is achieved and liabilities reduced;
- Enhanced corporate profile and marketability to potential building users;
- Stimulate demand for more sustainable buildings in Egypt, giving recognition for improved performance and minimizing false claims;
- Provide a common set of performance standards that can be pursued by developers, designers, architects, engineers, contractors and operators;

- Increase awareness in the building community, and ensure that environmental considerations are integrated right from the start rather than retrospectively.
- Making cost savings through more efficient use of energy and resources.
- Provides increased protection against environmental liability.
- Establishes a clear direction for continuous improvement and optimized performance.
- Provides comprehensive method of measuring environmental performance.
- Differentiates developments with higher environmental performance
- Quality mark stating that a building is ahead of regulations.
- Low running costs and improved health and well being for occupants.
- Method of demonstrating environmental credentials to funding organisations, client, investor, planning authority etc.

EGCB is a regionally responsive green code; In Egypt's humid sub-tropical climate and dense urban living environment people need to be provided with options to enclosed, air-conditioned spaces, so that the provisions for natural ventilation and day-lighting figure prominently in the assessment of indoor environments. EGCB will provide for a comprehensive and fair assessment of the overall performance of a building in a range of key areas, at either the completion stage or during its life.

An assessment under EGCB is voluntary, providing an independently certified performance rating for a building in clearly defined terms. It embraces exemplary practices in the planning, design, construction, commissioning, management and operation of buildings in Egypt.

1.2. EGCB assessment categories

EGCB consists of three parts; part one serve as the introduction and the concept of the code, aims and credit theory. Part two detail the assessment categories for buildings on:

- Design - qualitative criteria
- Performance - quantitative criteria
- Process – maintenance and management

Part three is a case study established by the researcher to give guidance on how to use the code and how the overall assessment is calculated. Different assessment methods in use world-wide arrange performance aspects under different headings to reflect the preferences of EGCB the various performance aspects covered are grouped within the following 6 categories:

1.2. Credit theory

Credits have been broadly allocated by taking into account the international consensus as given by an analysis of weightings used in similar assessment methods operating elsewhere, as well as surveys and informed opinions of Egyptian architects, academics and governmental officials. Many of the assessments verifying compliance with the prescribed criteria in EGCB will be undertaken by a suitably qualified person acting on behalf of the Client, who will submit evidence in the form of documents, data and reports confirming compliance. Others will be based on evidence collected by the EGCB Assessor.

EGCB uses local performance standards, codes and guides where these are available (e.g. Egyptian code for building construction). Where these are not available (e.g. energy consumption) international or national standards, codes and guides are referenced. Where there are differences in the performance criteria set by the various authorities EGCB will generally avoid specifying the performance criteria (e.g. thermal comfort), allowing the Client to specify what they consider to be appropriate for their building. Credits are awarded for achieving higher levels of performance. It is intended that the assessment criteria be updated periodically as new information becomes available and as legal requirements evolve.

1-6. Credit weightings and overall grade

The weighing system, i.e. the relative number of credits given for compliance with a particular aspect, is a critical part of a building performance assessment method. It is logical that EGCB should seek to assign credits or weightings to assessment criteria somewhat in accordance with the significance of the impact – this have been partially accomplished by survey interviews and questionnaires. There is insufficient information available to provide an objective weighting for all issues, because of the difficulty in assigning an economic cost to environmental effects as diverse as, for example, the health of individuals, global warming and resource depletion. For a voluntary scheme there is also a need to consider the credits awarded with regard to technical difficulty and cost, otherwise take-up of the scheme will be affected.

1-6-1. Credit allocated

Credits have been broadly allocated by taking into account the international consensus as given by an analysis of weightings used in similar assessment methods operating elsewhere, as well as surveys and informed opinions of Egyptian architects, academics and governmental officials (appendices 2). Many of the assessments verifying compliance with the prescribed criteria in EGCB will be undertaken by a suitably qualified person acting on behalf of the Client, who will submit evidence in the form of documents, data and reports confirming compliance. Others will be based on evidence collected by the EGCB Assessor.

1-6-2. Innovations

EGCB does not presume to be comprehensive in its coverage of all performance aspects. Under the heading of 'Innovation' the Client are encouraged to submit proposals for the award of credits for aspects not covered elsewhere in EGCB. In such circumstances the Client shall submit a proposal in which the performance gains are demonstrated.

Whilst innovative design solutions are encouraged, they do not necessarily justify credit. Innovation must demonstrate performance gains, such as through improved efficiency and/or improvements in the built environment. Indeed, it is anticipated that significant performance benefits will be realized from full and proper implementation of sound design, construction, installation, and operating practices.

1-6-3. Overall assessment

The Overall Assessment Grade is based on the percentage (%) of applicable credits gained. Given the importance of each part of EGCB it is necessary to obtain a minimum percentage (%) of credits from each part in order to qualify for the overall grade. To keep the rating every 5 years a new report would be submitted for reassessment. The award classifications are:

Grade	Site design	Energy efficiency	Water conservation	Recycling & management	Overall
Total credit	14 credits	55 credits	21 credits	10 credits	100
Platinum	13-14	45-55	19-21	8-10	Over 90
Gold	10-12	30-45	15-19	6-7	75-89
Silver	8-10	16-30	9-14	4-5	50-74
Bronze	4-8	14-28	4-9	2-4	25-49

Comments on grade classification

Point		Comments	

2-1. Site Design

Introduction:

Decisions made early in the design can often have a significant impact on many other aspects of the design (e.g. orienting the building linearly on an east-west axis is one important example. By maximizing well-controlled, North-facing glass and minimizing east- and west-facing glass, energy performance is greatly enhanced, comfort conditions are improved, and initial costs associated with cooling are reduced). By orienting your building effectively, you can maximize solar access and boost the effectiveness of day-lighting strategies, reducing the need for electrical lighting as well as heating and cooling loads. When considering the location for your building site, it is critical not only to consider your initial cost but also to evaluate environmental implications, how health and safety are influenced, and how well the building design is integrated into the fabric of the community.

2-1-1. Protecting Local Ecosystems

The protection of local ecosystems is critical to an environmentally sensitive site design. Protect or restore ecosystems and wildlife habitats on the site.

- 1 credit for developing a landscaping design that is compatible with existing plants and that uses native plants and consulting with local universities, cooperative extension offices, and master gardeners about local ecosystems and how to protect them.
- 1 credit for protecting areas for viewing natural habitat or developing interpretive nature trails through preserved wildlife habitats and ecosystems or using explanatory signage for different plants and trees.

2-1-2. Maximize the Potential of the Site

The analysis of the current environmental, social and cultural, health and heritage situation. Independent scientists conduct sampling, research and analysis to understand the current environment. They then review the potential impacts of the proposed project on the environment, and develop ways to minimize potential impact. Understanding and using the ground conditions at the site will determine, to a great degree, both the economic and environmental success of the design.

- I credit for considering climatic conditions at the site to improve safety and save energy, consider non-grid-connected photovoltaic systems for; crossing and caution lights, lighting at walkways and parking areas and telephone call boxes for emergencies.
- 1 credit for establishing floor grades that least impact site grading and using existing site contours to minimize grading.
- 1 credit for considering existing and new landscaping as a means of providing shading in the warmer months.
- 1 credit for stockpiling appropriate rock from site development for later use as ground cover.

2-1-3. Water-Conserving Strategies

The implementation of these commonsense ideas will help to drastically reduce your building water use and conserve water in the community.

- 1 credit for using native and drought-resistant planting materials to minimize the need for site irrigation.
- 1 credit for using grey water from sinks and water fountains for site irrigation or using soaker hoses and drip irrigation techniques that minimize evaporative losses and concentrate water on the plants' roots.

2-1-4. Building Orientation

To minimize energy use, maximize your potential by sitting your building correctly.

Establish the building on an east-west axis.

- 1 credit for developing a floor plan that minimizes east- and west-facing glass to maximize the daylighting contribution.

- 1 credit for using seasonal variations in wind speed and direction.

2-1-5. Connecting the building to the Community

One of the measures of success of a building is the degree to which the building is a vital part of the community. If addressed early in the site selection and design phase, a building can be planned to serve the entire community.

- 1 credit for linking the building to the surrounding communities through safe bicycle routes and pedestrian pathways (through good site design). If applicable - consider designing the building so that the athletic fields, gymnasium, media centre and cafeterias can be shared at appropriate times with the community.

Comments on site design category

Point		Comments	

2-2. Energy-Efficient Building

Introduction

The Energy Use assessments take account of the specific characteristics of the building development, such as the type and usage of premises it houses and the range and operational characteristics of the systems and equipment required to meet the needs of users, and comprise three parts: ..

- estimated Annual Energy Use (and where appropriate, Maximum Electricity Demand) for air-conditioning the building, and for lighting and equipment in air-conditioned areas;
- features and performance of specific systems and equipment; and
- testing and commissioning of systems and provisions that facilitate energy efficient management, operation and maintenance.

Because the building shell is typically responsible for 10%–20% of the total energy consumed in a building, focusing on this area of design can help you reduce energy consumption in your buildings. Increased insulation in the walls and ceiling helps to reduce heat loss and gain and improve comfort. Light-colored exterior walls and white roofs help to reduce cooling loads. These factors also contribute to reducing the size and cost of the HVAC system you will need. The useful life of building materials, systems, and equipment incorporated in buildings can vary considerably, so the building shell decisions you make as a designer will impact the first cost of the building as well as the long-term costs associated with operation, maintenance, and replacement.

Wall insulation should be selected based on the likelihood that it will never be replaced. When selecting your wall and roof systems, it is critical that you choose what is best for the life of the facility. Specify interior and exterior finishes that are durable and as maintenance free as possible, and integrate insulation levels that are appropriate for the life of the facility. Also, incorporate durable strategies that address air infiltration. If specified correctly, energy-efficient building shell elements can be effective in reducing our impact on the environment, and they will never need to be replaced.

In hot and dry climates, heating, ventilation, and air conditioning (HVAC) systems are typically responsible for 50%–60% of the energy consumed in buildings. By using the "whole-building" approach — looking at how all the building's design elements work together — your design team can factor in energy-saving choices that reduce heating and cooling loads and downsize the HVAC system needed. By not over-designing the HVAC system, you can reduce initial equipment costs as well as long-term operating costs. More importantly, HVAC systems have a significant effect on the health, comfort and productivity. A study by the Egyptian Environment Agency (EEA) found that half of the more than 5,000 public buildings in the country are facing noise control problems, lack of adequate ventilation, physical security issues, poor indoor air quality, comfort issues, below-standard lighting conditions, and unsatisfactory levels of fresh air.

The best HVAC design considers all the interrelated building systems while addressing indoor air quality, energy consumption, and environmental benefit. Optimizing the design and benefits requires that your mechanical system designer and your architect address these issues early in the schematic design phase and continually revise subsequent decisions throughout the remaining design process. It is also essential that you implement well-thought-out commissioning processes and routine preventative maintenance programs

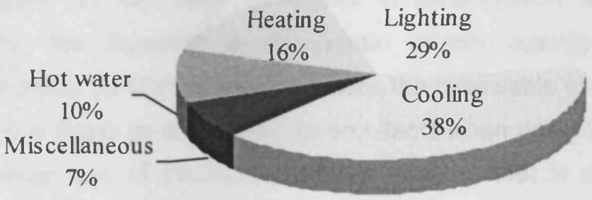

Figure 1: Egyptian public buildings energy distribution. In typical buildings, energy is primarily used for cooling and lighting.

To optimize the selection of efficient, cost-effective mechanical and ventilation systems, perform an energy analysis early in the process, during the schematic design phase. System optimization also improves indoor air quality, allows better humidity control, and potentially lowers construction costs due to a reduction in size of mechanical and electrical systems. Develop a clear understanding of how the building system wants to balance initial cost versus life-cycle cost, and point out the long-term advantages of investing in more energy-efficient and environmentally friendly approaches. In the schematic design phase, determine the mechanical system implications of all related site, daylighting, and lighting elements. When energy use and operating expenditures are considered at the outset of the design process, energy- and resource-efficient strategies can be integrated at the lowest possible cost.

There is no shortage of renewable energy, and renewable energy can contribute to reduced energy costs and reduced air pollution. More importantly, the renewable energy systems that you design into your building will demonstrate to the people the technologies that will fuel the next century. Over the past two decades, the cost of renewable energy systems has dropped dramatically. Wind turbines can now produce electricity at less than 4 cents per kilowatt hour a seven fold reduction in energy cost. Concentrating solar technologies and photovoltaic's have dropped more than three fold during the past 20 years. With improvements in analytical tools, passive solar and daylighting technologies can be implemented into buildings with less than a two-year return on investment.

Egypt has a good potential of renewable resources. Since the early 1994- the first Egyptian law to protect the environment- renewable energy has been considered as an integral part of the Egyptian energy policy framework. Currently, the energy strategy calls for renewable resources to cover 5% of the electrical energy demand by 2020. The next map showed in Figure (2) has been generated in collaboration with the Egyptian environment ministry, the Egyptian environmental quality agency and New and Renewable Energy Agency (NREA) to indicate where the renewable energy technologies could be implemented in Egypt as a guideline for architects when designing.

- Biomass Energy: one of the most promising powers that is under utilization in Egypt. The architect could make its requirements as a fundamental part of the designing process in delta and all agricultural areas for number of reasons:
    - It does not require complicated technologies.
    - The raw materials needed will be available in low price
- Solar Energy: clean energy that are highly recommended in future Egyptian architecture for number of reasons:
    - Egypt has clear sun (94%) all year around. Direct daily solar intensity 5 - 7 KW/m2 per day.

- Highly modular: It allow installations in different stages- as needed- without losing the economy of first size in installation of the system. Also it can be sized to any capacity.
- Declining in price of kWh: The solar energy are priced directly by the peak generating capacity in watts, and indirectly by square foot. It reached 30cents/KWh .

- Wind Energy: Another source of clean energy that could be implemented in Egypt and more suitable for urban projects along shore line both on Mediterranean sea and the Red sea because:

    - Egyptian average wind speed is 11 m/s which is relatively high.
    - A clean and renewable source of energy that produce no emissions of GHG or CO_2 that pollute the environment.
    - It uses only 5% of the project land.
    - Wind energy systems are modular within the granularity of the turbine size. Standard wind turbines come in different sizes. For utility scale installations standard wind turbines is now in the 500-1,000 kW range.
    - Wind energy cost/kWh are decreasing rabidly, wind power are the most suitable to the economics of Egypt, with a coast of 5cents/kWh.

2-2-1. Massive Wall Construction

In hot and dry climates, high-mass construction techniques have been historically employed to moderate the heat gain experienced during the hot days. They delayed and reduced the impact until the night-time when ventilation strategies could cool the interior spaces.

- 1 credit for employing high-mass wall construction techniques to lag the heat gains using 16-inch brick-block and block-block cavity walls with rigid cavity insulation or adobe construction with insulation can delay thermal gains by up to 12 hours.

2-2-2. Stopping Radiant Heat Gains

In hot and dry climates, creating a building shell that is massive and well-insulated can effectively address conduction gains and losses, but it is critical to also take into account radiant solar gains. In the warmer months, up to 90% of the cooling load coming from the roof area can be attributed to radiant heat gain. By addressing this problem, you can decrease your cooling load significantly.

- 1 credit for incorporating radiant barriers in the roof assemblies to reduce up to 95% of radiant heat gain. When solar radiation strikes a roof, a certain percentage of radiation is reflected away, and the balance is absorbed. When this occurs, it heats up that material, and the material reradiates downward. The low-emissive properties of the aluminium in the radiant barrier stop this radiant process, allowing only 5% of the radiation to pass through. Dust accumulation on radiant barriers reduces their performance. When possible, they should be suspended from the joists or rafters to reduce dust accumulation.

- 1 credit for incorporating highly reflective roofing systems to reflect solar gain away before it can create negative radiant impacts within the spaces below. This strategy is important, particularly in areas where radiant barriers cannot practically be installed.

- 1 credit for selecting a light colour for the exterior finish to reflect solar radiation.
- 1 credit for shading exterior walls with architectural elements (or landscaping) to enhance performance.

2-2-3. Embodied Energy

When selecting the building materials, consider that, in many cases, the amount of energy embodied in constructing the building is equal to more than two decades of a building's energy consumption. To seriously address the overall impacts of energy consumption, consider the energy involved in making each product, transporting the product to the site, and implementing the component into the building.

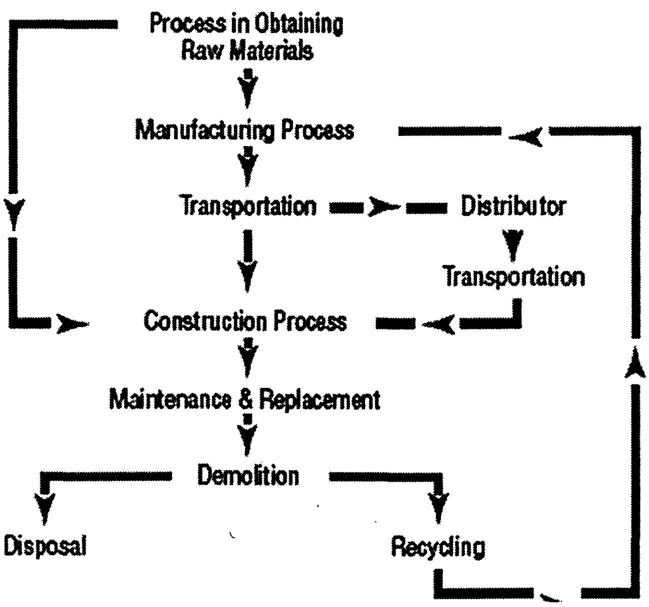

Figure 2: Total embodied energy diagram; products, materials, equipment and processes incorporated into construction.

Embodied energy is the total primary energy consumed during the life time of a product, ideally the boundaries would be set from the extraction of raw materials (inc fuels) to the end of the products lifetime (including energy from; manufacturing, transport, energy to manufacture capital equipment, heating & lighting of factory...etc), this boundary condition is known as Cradle to Grave. It has become common practice to specify the embodied energy as Cradle to Gate, which includes all energy (in primary form) until the product leaves the factory gate. The final boundary condition is Cradle to Site, which includes all energy consumed until the product has reached the point of use (i.e. building site).

- 1 credit for selecting locally made products and construction materials because often half or more of the embodied energy involved in constructing a building is related to transportation.
- 1 credit for encouraging the use of recycled products and evaluates the recyclability of products once the building has passed its useful life.
- 1 credit for considering how the typically wasted materials could be used in a new construction if an existing structures on the building site are to be demolished,
- 1 credit for demonstrating the embodied energy in the major elements of the building structure of the assessed building is reduced by 10% or more - proof that the design of structural elements and choice of materials results in lower embodied energy.

The assessment covers only the elements and materials used in the building foundations, building core, walls, etc, the main elements that comprise the building structure, facade, and the roof. Interior services and fit-out components are not included. The Client shall provide a report detailing where changes in the design of the main structural elements, for example the use of less materials or alternative constructions, etc., that provide for a reduction in embodied energy beyond that which would result if the enhancements were not included.

2-2-4. Annual energy use

The objectives are to reduce the consumption of non-renewable energy resources and the consequent harmful emissions to the atmosphere. Encourage energy conservation and methods to reduce maximum electricity demand.

(a) Estimated annual energy consumption

- 1 credit for a reduction in the annual energy consumption by 10%.

- 2 credits for a reduction in the annual energy consumption by 14%.
- 3 credits for a reduction in the annual energy consumption by 18%.
- 4 credits for a reduction in the annual energy consumption by 22%.
- 5 credits for a reduction in the annual energy consumption by 26%.
- 6 credits for a reduction in the annual energy consumption by 30%.
- 7 credits for a reduction in the annual energy consumption by 34%.
- 8 credits for a reduction in the annual energy consumption by 38%
- 9 credits for a reduction in the annual energy consumption by 42%
- 10 credits for a reduction in the annual energy consumption by 45%.

(b) Estimated maximum electricity demand

- 1 credit for a reduction in the maximum electricity demand by 15%.
- 2 credits for a reduction in the maximum electricity demand by 23%.
- 3 credits for a reduction in the maximum electricity demand by 30%.

The number of credits to be awarded will be determined with reference to the percentage reduction in the annual energy use and maximum electricity demand, respectively, of the assessed building relative to the respective benchmark (zero-credit) criteria evaluated from the Baseline Building model.

2-2-5. Lift and escalator systems

EGCB encourage the use of energy efficient lift and escalator installations in buildings with significant provisions for vertical transportation.

- 1 credit for complying with the Code of Practice for Energy Efficiency of Lift and Escalator Installations.

2-2-6. Cooling Systems

Consider cooling systems appropriate for hot and dry climates that match the building loads and are not over-designed. Evaluate various cooling equipment sizes and models to select the unit that best matches the demand requirements.

- 1 credit for considering the use of direct or indirect evaporative cooling equipment – for hot and dry climates - which can reduce the need for mechanical cooling. The requirements for proper maintenance of these systems should also be evaluated.

- 1 credit for using natural gas and/or solar-driven absorption cooling as a method of reducing peak electricity consumption.

- A form of free cooling is night-time ventilation (if applicable). 1 credit for applying night-time ventilation strategies to cool interior mass and flush out stale air prior to morning occupancy. This purging cycle can be effective in dry areas with low night-time temperatures.

- 1 credit for reducing the use of CFC and HCFC refrigerants in order to reduce upper atmospheric ozone depletion,

- 1 credit for considering thermal (ice or water) storage in situations where peak load avoidance is critical. Thermal storage is a cost-saving technique that takes advantage of off-peak utility rate schedules where applicable. Some electric utilities promote thermal storage by offering an incentive for power usage that can be displaced from peak to off-peak time.

2-2-7. Ventilation and Indoor Air Quality Strategies

This section considers some of the broader issues of sustainable buildings as well as the most significant indoor performance issues. The broader issues include safety, provisions for maintaining hygiene, and the amenities provided in the building, which have impact on the quality of working and living environments. Indoor environmental quality (IEO) includes indoor air quality and ventilation provisions that safeguard health. Considerations of these issues, as well as thermal comfort, lighting, acoustics and noise impact on well-being, comfort and productivity. The next points are made to encourage energy efficient design and control of ventilation systems in large mechanically ventilated building/premises.

- 1 credit for using a heat recovery system, like an air-to-air heat exchanger, that will transfer the heat between air supplied to and air exhausted from the building.

- 1 credit for separating the ventilation of highly polluting spaces. Provide separate exhaust from kitchens, toilets, custodial closets, chemical storage rooms, and dedicated copy rooms to the outdoors, with no recirculation through the HVAC system.

- 1 credit for evaluating the use of an outdoor air economizer cycle that will allow up to 100% outdoor air to be introduced into the distribution system to provide space cooling.

- 1 credit for locating outdoor air intakes a minimum of 7 feet vertically and 25 feet horizontally from polluted and/or overheated exhaust (e.g., cooling towers, loading docks, fume hoods, and chemical storage areas).

- 1 credit for locating exhaust outlets at a minimum of 10 feet above ground level and away from doors, occupied areas, and operable windows. The preferred location for exhaust outlets is at roof level projecting upward or horizontally away from outdoor intakes.

- 1 credit for provisions that can regulate the operation of the ventilation system(s) to reduce energy use whenever conditions permit.

- 1 credit for ventilation systems that will consume less electricity than those meeting the zero credit requirements (baseline) by 15% or more.

- 2 credits where the consumption is reduced by 25% or more.

2-2-8. Lighting systems

The objective of this part is to encourage the adoption of lighting equipment and controls that will provide for energy conservation.

- 1 credit for using lamps and, where applicable, ballasts that will consume less electricity than those meeting the zero-credit requirements by 15% or more.
- 2 credits where the consumption is reduced by 25% or more.
- 1 credit for installing control systems and devices that will switch off or dim the output of lighting installations when and where illumination is not required.

2-2-9. Hot water supply systems

To promote the use of energy efficient hot water supply systems to conserve energy.

- 1 credit for using heat pump water heaters or tankless (instantaneous) water heaters.
- 1 credit for using localized versus centralized hot water equipment by evaluating the types of loads served. A remote location may be best served by localized equipment.
- 1 credit for applying a solar-assisted hot water system and heat recovery systems.
- 1 credit for using tankless water heaters in areas that are remote and require small hot water amounts.
- 1 credit for minimizing the standby heat losses from hot water distribution piping and hot water storage tanks by increasing insulation levels, using anti-convection valves, and using heat traps.
- 1 credit for installing energy efficient hot water supply system(s) and equipment that can save 20% or more energy.

2-2-10. Building Orientation and Solar Access

Employing renewable energy strategies cost effectively requires the building to be sited to maximize the locally available natural resources.

- 1 credit for establishing the building on an east-west axis that maximizes northern exposure for daylighting and other solar systems.
- I credit for ensuring that adjacent buildings or trees do not block the intended solar access.

2-2-11. Building-Integrated Approaches

To maximize cost effectiveness and improve aesthetics, consider integrating solar thermal and photovoltaic systems into the building shell.

- 1 credit for integrating solar systems into the overall design to allow the system to serve multiple purposes (e.g, a photovoltaic array that can also serve as a covered walkway).
- 1 credit for eliminating the additional costs associated with a typical solar system's structure by designing the building's roof assembly to also support the solar components.
- 1 credit for minimizing redundant materials by using the glazing of the solar collector as the waterproofing skin of the building.

2-2-12. Renewable Energy Applications for Buildings

A variety of renewable energy applications are effective in hot and dry climates; passive cooling, solar hot water, solar absorption cooling, and photovoltaics should all be considered as energy-saving strategies.

Although natural ventilation would not be a practical strategy in the hotter months of the year, consider operable windows to provide the opportunity for natural ventilation in the milder and even cooler months when interior building loads dominate.

Solar heating systems are often viewed as important strategies in reducing energy bills. There are several types of systems that could be used in this region. Two of the more common are "drainback" and "closed-loop" systems (Appendix no. 2)

- 1 credit for using a solar heating system for hot water.

- 1 credit for using a solar heating system for heat recovery.

Wind turbines convert the kinetic energy in the wind into mechanical power. This mechanical power can be used directly (e.g., water pumping), or it can be converted into electricity.

- I credit for applying wind electric generators as a cost-effective application in areas where the sustained wind speed exceeds 15 km/hour.

- I credit for addressing potential noise problems by properly sitting wind installations.

Photovoltaic modules, which convert sunlight into electricity, have numerous applications and can be designed as "stand-alone" applications or for utility "grid-connected" applications.

- 1 credit where 2% or more of building energy is obtained from renewable energy sources.

- 2 credits where 4% or more is obtained from renewable energy sources.

- 3 credits where 6% or more is obtained from renewable energy sources.

The Client shall submit a report providing details of the installations, and calculations showing the estimated energy use provided from renewable energy sources. In the case of systems that generate electricity from renewable sources (e.g. photovoltaic panels), the estimated amount of electricity that will be generated by the system for use by equipment in the building, either instantaneously or from an associated storage system. In the case of using systems that produce services direct from renewable sources, which will otherwise require the use of fuel or electricity to produce those services (e.g. hot water supply from solar panels or chilled water supply from absorption chillers powered by solar heat), the equivalent amount of electricity use that will be avoided

The calculation shall take due account of the diurnal and seasonal variations in the external environmental conditions (e.g. solar intensity and wind speed and direction) and in the demand for the electricity and/or services generated by the systems. Any energy use and losses by the systems shall be discounted from their output.

Comments on energy efficiency category

Point		Comments	

2-3. Water Conservation

Water resources in Egypt are becoming scarce. Surface-water resources originating from the Nile are now fully exploited, while groundwater sources are being brought into full production. Egypt is facing increasing water needs, demanded by a rapidly growing population, by increased urbanisation, by higher standards of living and by an agricultural policy which emphasises expanded production in order to feed the growing population. The population is currently increasing by more than one million people a year. Egypt uses 1,055 cubic meters (278,702 gallons) of water per person per year, withdrawn from streams, reservoirs, and wells. Combine the impacts of rising population with the demographic shift in people to more arid regions, and the pressure of providing clean water becomes more critical every year. The price of water is escalating at unprecedented rates. You can make considerable difference at your building in reducing community water use. By using water-conserving fixtures and implementing graywater or rainwater catchment systems, buildings can easily reduce their municipal water consumption 25%–75%.

2-3-1. Water-conserving landscaping strategies

The demand for water will be greatly impacted by the amount of site irrigation required. By limiting new landscaped areas and considering the type of plants and vegetation installed, water needs will be reduced. To reduce the reliance on potable water for irrigation relatively uncontaminated waste can be easily captured, stored, and used to fulfil non-potable needs.

- 1 credit for minimizing disruption to the existing site conditions, retaining as much existing vegetation as is practical and incorporating native and drought-resistant plants to minimize irrigation requirements.

- 1 credit for using soaker hoses and drip irrigation technologies to minimize evaporative losses and concentrate water on plants.

- 1 credit for use graywater from lavatories and water fountains for underground site irrigation and designing the system to meet local regulations, to:

    - get the graywater into the soil as soon as possible instead of storing it

- irrigate below the surface of the ground only
- deliver the graywater to biologically activate the soil where organic matter will quickly be broken down.

- 1 credit for the use of an irrigation system which does not require the use of municipal fresh water after a period of establishment is complete.

The Client shall provide a report prepared by a suitably qualified person describing the soft landscaping design, species of plants, etc, and confirm that, after a period of establishment of the plants and vegetation is complete, irrigation will not require/ fractionally require the use of municipal potable (fresh) water supply.

2-3-2. Conservation of water during construction

By including specifications addressing water during construction, you can save a considerable amount of water during your construction projects.

- 1 credit for including disincentives in specifications to the general contractor for excessive water use and incentives for reducing consumption during construction. Specify that the general contractor is responsible for water cost during construction.

- 1 credit for minimize watering requirements by specifying appropriate times of year when new landscaping efforts should occur.

One of the most effective means to limit demand for water is to reduce the requirements associated with necessary plumbing fixtures.

- 1 credit for consider showerheads that require less than 2.5 gallons per minute and incorporate levers for reducing flow between 2.1 and 1.5 gallons per minute. Specify low-flow toilets that use less than 1.6 gallons per flush.

- 1 credit for using aerators to reduce flow in lavatory faucets to as low as 1 gallon per minute. When applicable specify self-closing, slow-closing, or electronic faucets where it is likely that faucets may be left running.

2-3-3. Water quality

To ensure that the quality of potable water delivered to building users is satisfactory.

- 1 credit where fresh water plumbing installations comply with the referenced good practice guides and demonstrating that the quality of potable water meets the referenced drinking water quality standards at all points of use.

The demand growth has risen in recent years and additional water resources are still required to secure a full supply. The lack of reservoir sites and high development costs limit the development of further areas as water-gathering grounds. There are also opportunities to recycle used water and rain water in order to reduce the use of water.

- 1 credit for demonstrating that the use of water efficient devices leads to an estimated annual savings of 15%
- 2 credits for demonstrating to an estimated annual savings of 25%
- 3 credits for demonstrating to an estimated annual savings of 35%

2-3-4. Water recycling

This section is to encourage harvesting of rainwater and recycling of grey water in order to reduce consumption of fresh water. Even in hot and dry climates, rainwater can sometimes be harvested and stored in cisterns for non-potable use. In most cases, water runs off the roof into gutters and downspouts, which carry the water to a storage device for future use.

- I credit for implementing a rainwater collection system to provide water for toilet flushing and irrigation. Using a durable storage container, and locate it away from direct sunlight and septic tanks and determining the necessary water treatment and filters for your area.

a) Harvested rainwater

- 1 credit for harvesting of rainwater which will lead to a reduction of 10% or more in the consumption of fresh water.

b) Provisions for grey water recycling

- 1 credit for the provision of plumbing and drainage systems that provide for separation of grey water from black water.

c) Recycled water

- 1 credit where recycled grey water will lead to a reduction of 10% or more in the consumption of fresh water.

2-3-5. Effluent discharge to foul sewers

To reduce the volumes of sewage discharged from buildings thereby reducing burdens on municipal sewage supply and treatment facilities.

- 1 credit for demonstrating a reduction in annual sewage volumes by 25% or more.

The Client shall submit a report prepared by a suitably qualified person detailing the capacities (volume, flow-rate, etc) of water using equipment for both the assessed building and a similar 'benchmark' (zero credit) building, Le., a building where flushing devices and appliances are not deemed to be efficient in water use. The report shall follow a format that details:

- type and number of devices using flushing water;
- frequency, duration and water consumption per use for each;
- sum of water volumes used for each for male and female users;
- estimated daily flushing water use;
- defined number of days of use of the facilities (work days, school days, etc) to annualize effluent discharge and any deduction for annual use of recycled water.

Comments on water conservation category

Point		Comments	

2-4. Recycling Systems and Waste Management

2-4-1. Construction Waste Recycling and Waste Management

Recycling efforts should begin during the construction of the building and engage the general contractor and all sub-contractors.

- 2 credit for specifying the specific job-site wastes that will be recycled during construction (corrugated cardboard, all metals, clean wood waste, gypsum board, beverage containers, and clean fill material).

- 1 credit for stockpiling appropriate existing topsoil and rock for future ground cover.

- 1 credit for monitoring the contractor and sub-contractor's recycling efforts during construction.

- 2 credit for requiring that the contractor use safe handling, storage, and control procedures, and specify that the procedures minimize waste in order to minimize the impacts from any hazardous materials or waste used in construction

2-4-2. Operation and maintenance

This section is designed to enable building operators to implement the design intent, be able to monitor the performance of the building, and maintain the performance. Enable building operators to measure, monitor and develop measures to improve the performance of the building's engineering systems, particularly concerning energy use.

a) Operations and maintenance manual

- 1 credit for providing a fully documented operations and maintenance manual to the minimum specified.

b) Energy management

- 1 credit for providing fully documented instructions that enables systems to operate at a high level of energy efficiency.

c) Operator training and operation and maintenance facilities

- 2 credit for providing training for operations and maintenance staff to the minimum specified; and demonstrating that adequate maintenance facilities are provided for operations and maintenance work.

Comments on recycling and waste management category

	Point		Comments

Appendix (7): Summery of the Landscaping Report

Many gardeners in Egypt that have a hot and dry climate to deal with often shy away from colourful annuals as they think they will not do well without constant watering and will require too much maintenance. There are, however, many annals that love just such a climate. The list below is the annuals that is used on site (section 3-a, 3-b, 3-c, 5-a, 5-b, 5-c) and they all can take the heat. Annuals best suited for the Egyptian hot and dry climates listed below are quite tolerant to dry conditions once a root system is established.

Section 3-a, 3-b, 3-c

1. African Daisy (Dimorphotheca)
2. Annual Vinca (Cataranthus roseus)
3. Calliopsis (Coreopsis tinctoria)
4. Gaillardia (Gaillardia pulchella)
5. Globe Amaranth (Gomphrena globosa)
6. Gloriosa Daisy (Rudbeckia hirta)
7. Gold Medallion (Melampoddium paludosum)
8. Moss Rose (Portulaca grandiflora)

Heat seeking varieties of annuals: The annuals is the list below are generally able to tolerate the Egyptian very hot conditions, but they do usually require additional moisture and that is why they are used in the central garden in the site main entrance to be under supervision all the time.

Section 5-a, 5-b, 5-c

1. Fan Flower (Scaevola aemula)
2. Mexican Bush Sage (Salvia leucantha)
3. Mexican Sunflower (Tithonia rotundifolia)
4. Moon Vine (Ipomoea alba)
5. Morning Glory (Ipomoea species)
6. Silk Flower (Abelmoschus manihot)
7. Sunflower (Helianthus annuus)

A combination of the varieties of annuals listed above can be great choices for this project in hot, dry climates. These heat and drought tolerant annuals provide a wide variety of colours, sizes, shapes and textures, enough to meet the needs of our gardens. Even with annuals that like a hot, dry climate, gardening in such conditions can be challenging. Water restrictions can thwart the efforts to provide adequate moisture to your plants so you need to be cognitive of the usual restrictions in your area. No matter what your climate, matching the types of flowers you plant to the climate in which they will be growing is one of the best ways to ensure a healthy garden and a healthy environment.

Number on site drawing	Name, specifications and implementation directions	Picture
1	Shinus molle: (The California Pepper tree) is tolerant of poor soil conditions and keeps its bright green colour all summer long. Their leaves look bright green and healthy even under drought conditions, but what really happens is that while the leaves stay green, their branches may hollow out and when the wind comes the branches snap off. Moderate water usage is recommended. Away from paving for root extension	
2	ROBUSTA The doom palm: native to the Egyptian Nile Valley of northeast Africa and having oblong or ovoid fruits the size of an orange with a distinctive aroma and taste. (Away from paving for root extension)	
3	The name Mesquite Tree (Prosopis) instantly brings up images of cowboys and the Old West. These trees grow very fast and definitely prefer little water after they are established. In fact, if you plant your mesquite in a lawn it will grow tall and lush with a very shallow root system -- and may very likely blow over with the first strong windstorm. Infrequent, deep watering is best because it encourages the roots to go deep into the soil. The Argentine Mesquite (Prosopis alba), shown, is among the fastest growing.	
4	Sycamore trees have been cultivated since a very long time. Pharaohs called them Nehet. Sycamores exist in all Egyptian districts of Delta and Upper Egypt, also in the oases.	

Appendix (8): List of the Egyptian Codes of practice

List of the Egyptian Codes of practice for the design criteria and construction specifications, prepared by Housing and Building national Research Centre:

1- Soil mechanics and design and construction of foundations, 2001.

2- Rural and Urban Highway works, 1998.

3- Design criteria and construction specifications for building works, 1994.

4- Design criteria and construction specifications for electrical connections in buildings.

5- Design criteria and construction specifications for preventing structures from fire (Part 1).

6- Requirements for the system of building services to limit the fire risk (Part 2).

7- Systems for detection and fire alarm (Part 3).

8- Design and construction of reinforced concrete structures.

9- Steel construction.

10- Design and construction of pipelines for potable water and sewage.

11- Design criteria and construction specifications for sewage installations ion buildings.

12- Water supply works and sewage water treatment in small housing congregations (Part 2).

13- Hot water supply and swimming pools works (Part 3).

14- Kitchens and hospitals preparation to get rid of garbage (Part 4).

15- Computation of loads and structural forces and building works.

16- Design criteria and construction specifications for electrical and hydraulic elevators in buildings (Arabic version).

17- Design criteria and construction specifications for electrical and hydraulic elevators in buildings (English version).

18- Design criteria and construction specifications for pumping stations (Sewage) (Volume 1).

19- Design criteria and construction specifications for treatment works (Sewage) (Volume 2).

20- Design criteria and construction specifications for purification plants (Potable water) (Volume 3).

21- Design criteria and construction specifications for lifts (Potable water) (Volume 4).

22- Design and selection basis for construction of external, internal and special plastering.