The Potential Green Architecture Design Strategies

In Egyptian Building Culture

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ABSTRACT: regarding the fact that creation of sustainable human settlements through sustainable building is one of the integral processes of sustainable development that demonstrates the four aspects or dimensions of sustainable development: the economical, ecological, social and technical dimension, this paper highlight the social aspect in order to ensure applying of green architecture principles and creation of a sustainable community for the new region Toshka southwest desert of Egypt.

The aim of this paper is to figure out the potential green architecture design strategies in Egyptian building culture in order to use them as a base to develop culturally accepted toolbox for green architecture design strategies for Toshka.

In order to outline a clear image for Egyptian building culture, two resources of building culture are investigated by field-based survey for selected local communities in Egypt. The first resource is the tradition building practices and the second is the current building practices.

Conference Topic: 9 Traditional solutions in sustainable perspective
Keywords: Building culture, green architecture, sustainable development and environmental design

INTRODUCTION

A show of hands was asked for at a sustainability conference in Canberra, a city possessed of an excellent bus service, as to who had arrived by bus. Apart from the speaker, only four other people in a room of a hundred raised their hands. This raised the question as to why a group of people apparently committed to projects about alternative technologies and sustainable lifestyle was apparently not committed to these things in their own lives. [1]

Indeed, there is great knowledge of green architecture, but there is a gap between theoretical principles and the implementation processes of this knowledge. We can’t apply those theoretical principles broadly in our building environment. The reasons may be economic, political or cultural obstacles. This paper explores methods and techniques by which we may ensure broad application of green architecture in the new urban settlements particularly in Toshka region - southwest desert of Egypt.

In order to create a sustainable new community in the desert and relocate people, the building culture of the people who are supposed to live there, must be a concern of the planners and architects. This study, as a part of PhD research, focuses on the potential green architecture design strategies in Egyptian building culture, addressing how an understanding of cultural issues could advance the application of green architecture in Egypt.

In order to obtain a clear view and insight into the Egyptian building culture, target groups from non-professional people are interviewed and questioned. A number of potentially suitable indicators were devised for the purpose of the survey. All data are analysed using SPSS 12.0; frequencies and correlations were used to investigate relationships between building culture aspects and green architecture principles.

2. BUILDING CULTURE AND NEW SUSTAINABLE URBAN DEVELOPMENT

2.1 CIB and its Agenda 21[2]

The International Council of Research and Innovation in Building and Construction (CIB) mentioned in its Agenda 21 for sustainable construction in developing countries that the creation of sustainable human settlements through sustainable building is one of the integral processes of sustainable development that demonstrates the four aspects or dimensions of sustainable development: the economical, ecological, social and technical dimension.

2.2 Priorities and building culture

The choice of other priorities or values other than climate comfort and environment protection in the building construction affects the degree of adaptation to climatic and environment. The next two examples from different culture demonstrate this fact:
2.2.1 Examples of Cultural Effects on Use of Green Design

The village of New Gourna (west Luxor, Egypt), designed by Egyptian urban planner, H. Fathy answers the extremely important question of how to create a culturally and environmentally valid architecture that is sensitive to ethnic and regional traditions. In his designs, Fathy has shown us that inexpensive houses can be built to house the poor. From a limited sustainability viewpoint Fathy’s work with traditional forms such as domes and vaults by the use of local materials (mud brick) to build low cost housing. [3]

In fact Egypt’s poor continue to erect the same reinforced concrete architecture while Fathy’s pioneering housing project of New Gourna lies derelict and abandoned. People refused to use the village. They claim that houses resemble the tombs and they now start to demolish them to build with reinforced concrete instead. Fathy brought those forms from Nubia region in south of Egypt, which has different culture to solve the problem of ceiling with the mud brick. [5] But in the Upper Egypt region, domes and vaults mostly are used for tombs.

In Malaysia, two different cultural groups respond quite differently to a similar climate.

3. BUILDING CULTURE AND GREEN ARCHITECTURE

3.1 Culture

“No one ever has, or ever will, see or observe – culture - only its effects and products”. The culture of any society is created throughout the history of this society. It is some behaviours that are influenced by economy, climate, and religion of the society, which appear through out, for examples, clothing, foods, social habits and building practices and so on. [7]

3.2 Green buildings

Building “green” is an opportunity to use our resources efficiently while creating healthier buildings that improve human health, build a better environment, and provide cost savings. [8]. Green building has been defined both in terms of its elements and rating systems.

The elements of green building, as described by most rating system, are: sitting, energy efficiency, water efficiency, building material efficiency and occupancy health and safety. Benchmarks for designing green building are incorporated in rating systems such as: BUILT GREEN™ [9], LEED™ program [10] and EcoHomes. [11]

4. BUILDING CULTURE IMAGE

4.1 Resources of building culture image (architecture ideology) [12]

Architects derive the values or tastes of their professional ideology from three different sources or references. The first is an approach involving a historical system of reference based on the values produced in the past.

A second approach takes off from regional or local values. Here a “contextual” design is essential, one that follows a thorough.

In third type of approach, the world practice and universalism are chosen as a reference system.

4.2 Criteria of building culture image

Green construction practices that correspond to the cultural values and habits are chosen to be address in the survey. The survey was designed to identify the norms and standards – knowledge and
experiences – expectations and preferences of the groups chosen to study.

4.3 Elements of building culture image

Depending on the green architecture principles and highly cultural impacted criteria, selected aspects of green architecture strategies from the following main topics have been chosen to be addressed in building culture survey.

Urban scale: Mixed land use, Compactness and Moving around city/village
Building management: Ownership, Design and construction management
Architectural scale: Construction system, Building materials, Climatic comfort and Passive climatic design features
Building services: Artificial lighting, Electric appliances, Potable water fixture and Energy supply
Landscape: Vegetation, Water bodies

5. BUILDING CULTURE SURVEY

5.1 Target groups

In order to outline a real building culture image Non-professionals people are targeted. Considering that all Egyptians are invited to live in the new region of Toshka southwest desert of Egypt, it would be impractical to execute a detailed survey for all Egyptians, Therefore four different main groups are identified to participate, distinguished by both climatic and cultural characteristics. The four regions are:

- Lower Egypt (all delta region including Cairo and Alexandria cities)
- Desert (all oasis in western desert)
- Upper Egypt (all cities and village along The Nile River Valley)
- Nubia (Nubians who live around the ari of Lake Nassir from Aswan to Abu sembel cities).

One city and one village are chosen to represent each group. Although both Desert and Nubia groups are low in population, they have very important tradition and current building practices that match with green architecture. [13]

5.2 survey instruments [14,15]

5.2.1 the questionnaire

In addition to some personal information of the respondents the questionnaire covered variety of green architecture strategies. For each aspect three questions are asked –current, past building practices and the preferences of respondents in future. Further question were asked for each aspect to determine the reasons behind such practices. SPSS (Statistical Package for the Social Sciences) program were used for analysis of the questionnaire data.

5.2.2 Interviews

More interviews were held in four regions of survey to get acquainted about advantages, disadvantages and possibilities of reuse of the green traditions building techniques that people mostly don’t use them any more.

5.2.3 direct observation

Direct observation survey in four region of study was conducted in order to record by photos common building practices and habits to be matched with the finding of questionnaire and interviews.

6. FINDING OF THE SURVEY

6.1 Urban scale
6.1.1 Mixed land use

56% of Respondents are familiar with mixed land use concept (different types of shops in the same street). This percentage increased to 65% when people were asked about their preference and increased also in urban areas to 68%.

6.1.2 Compactness and Moving around city/village

Respondents from cities prefer wide streets (15 or 20 m). In reverse, respondents from villages prefer narrow streets of 6 or 8 m width.

The average area of house/apartment is 110 m2. The average village house is 130 m2 while the city dwelling unit averages 90 m2.

Figure 3: covered and Narrow Street in west desert – Farafra Oasis Egypt

60% of respondents now use house type and the other use apartment type but 87% of respondents prefer house type in future. 73% of respondents use now attached houses type and the other use detached.

Figure 4: high raise buildings
6.1.3 Moving around city

Generally speaking, walking is the most common method of moving around the city. The second most common method is mass transportation, followed by the private car and finally the bicycle (Table I).

<table>
<thead>
<tr>
<th>Method</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walking</td>
<td>60%</td>
</tr>
<tr>
<td>Mass transportation</td>
<td>30%</td>
</tr>
<tr>
<td>Private car/ taxi</td>
<td>18%</td>
</tr>
<tr>
<td>Bike</td>
<td>11%</td>
</tr>
</tbody>
</table>

6.2 Building management

6.2.1 Ownership

71% own their houses. This percentage was higher in past 88% and is the preference of 88% of respondents. This percentage decreases to 58% for city dwellers and increases to 96% for villagers.

6.2.2 Construction & design management

53% of respondents are familiar with managing the process of design and construction themselves, and 74% would prefer this approach to construction.

6.3 Architectural scale

6.3.1 Construction system

The common construction systems in Egypt are shown in table II:

<table>
<thead>
<tr>
<th>Construction system</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mud brick wall + timber ceiling</td>
<td>13.5%</td>
</tr>
<tr>
<td>Stone wall + timber ceiling</td>
<td>2.2%</td>
</tr>
<tr>
<td>Concrete skeleton with stone</td>
<td>6.7%</td>
</tr>
<tr>
<td>Red brick with wood ceiling</td>
<td>9.0%</td>
</tr>
<tr>
<td>Concrete skeleton with foam brick</td>
<td>1.1%</td>
</tr>
<tr>
<td>Concrete with red brick</td>
<td>67.4%</td>
</tr>
</tbody>
</table>

There is a dramatic change from using the mud brick bearing wall system to using reinforced concrete system.

Figure 5: mud brick and red brick systems, Delta

The use of mud brick system decreased gradually from 29% in the past to 13.5% now. It is only preferred by 8% of respondents. The use of concrete skeleton and red brick system increased gradually from 40% in the past to 67% now, and is preferred by 68% of respondents.

There is trend toward the use of mixed techniques (like concrete skeleton with mud brick, stone, timber, foam brick, soil cement and light weight concrete).

6.3.2 Building materials

The common brick used in Egypt are as shown in table III:

<table>
<thead>
<tr>
<th>Kind of brick</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red brick from &quot;Tafla&quot;</td>
<td>22.2</td>
</tr>
<tr>
<td>Fired clay brick</td>
<td>41.1</td>
</tr>
<tr>
<td>Mud brick</td>
<td>15.6</td>
</tr>
<tr>
<td>Cement brick</td>
<td>3.3</td>
</tr>
<tr>
<td>Quarry stone</td>
<td>5.6</td>
</tr>
<tr>
<td>Foam brick</td>
<td>1.1</td>
</tr>
<tr>
<td>Random fired clay brick</td>
<td>11.1</td>
</tr>
</tbody>
</table>

The type of brick being used has changed from mud brick to fired red brick. The use of mud brick decreased gradually from 30% in the past to 16% now, with 10% of respondents preferring it. The use of red brick increased from 49% in the past practice to 74% now with the 74% percent of respondents expressing preference.

83% of respondents are familiar with timber openings, 84% are using it, and 71% prefer it.

66% of respondents are familiar with reusing old building components such as (windows, doors, timber ceiling, potable water fixtures and). This habit is rooted in past practices. 71% of residences employ the technology and 71% also prefer it.

31% of respondents are familiar with using recycled building materials. This habit is also rooted in past practices, with 28% employing it and 35% preferring it.

6.3.3 Climatic comfort

Approximately 52% of respondents are familiar with and prefer using artificial techniques for heating and cooling (air conditioning, fans and electric heater) in addition to passive treatments.

There is trend to use air conditioning instead of using fans and electric heater. For air conditioning, in past practice is 2%, current practice is 15% and 21% of respondents prefer its use.

6.3.4 Passive climatic design features

The common passive climatic treatments are: light colour, courtyard, wide wall section, small deep windows, wind tower, louvers, and Hi-Tech insulation.

Uncommon feature are: double wall, hollow block wall, domes, and vaults.

The common passive climatic design features are show in table IV:
Table IV: passive Climate features

<table>
<thead>
<tr>
<th>Climate feature</th>
<th>Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wide wall section</td>
<td>23</td>
</tr>
<tr>
<td>Double wall</td>
<td>2</td>
</tr>
<tr>
<td>Courtyard</td>
<td>25</td>
</tr>
<tr>
<td>Wind tower (MALQAF)</td>
<td>14</td>
</tr>
<tr>
<td>Small and deep windows</td>
<td>17</td>
</tr>
<tr>
<td>Louvers</td>
<td>14</td>
</tr>
<tr>
<td>Hi-tech insulation</td>
<td>14</td>
</tr>
<tr>
<td>Domes and vaults</td>
<td>1</td>
</tr>
<tr>
<td>Light color</td>
<td>40</td>
</tr>
</tbody>
</table>

Examining the data for the Nubian region alone, domes and vaults were used in the past by 50%, in current practice by 16%, with 50% of residents preferring this approach. Overall in desert areas they are preferred by 33%, although in non-desert areas they are not preferred at all.

Figure 6: courtyard, Vault and dome in Nubia

6.4 Building facilities
6.4.1 artificial lighting
72% of respondents are familiar with florescent lamp. The use of florescent lamp is gradually increasing. 43% employed fluorescent lamps in past practices, 72% current practices and 88% prefer this form of lighting.

6.4.2 Electric appliances
13% of respondents are familiar with low energy appliances. The use of low energy appliances is gradually increasing, 7% employed low energy appliances in past practices, 13% prefer this kind of appliances.

6.4.3 Potable water fixture
14% of respondents are familiar with dry fixture (Faucet aerators, Low-flow showerheads, Low-flu). The use of dry fixture is gradually increasing 11% past practices, 14% current practices, with 30% of respondents preferring such fixtures.

6.4.4 Energy supply
There is little increase for renewable energy (solar energy 31% and wind energy 3%) in addition to natural gas 16%.

The common energy used is shown in table V.

Table V: Kind of energy used

<table>
<thead>
<tr>
<th>Kind of energy</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydro-electricity</td>
<td>81.0</td>
</tr>
<tr>
<td>Fuel energy</td>
<td>14.0</td>
</tr>
<tr>
<td>Natural gas</td>
<td>3.8</td>
</tr>
<tr>
<td>Biomass energy</td>
<td>1.2</td>
</tr>
</tbody>
</table>

6.5 Landscape
6.5.1 Vegetation
80% of respondents are familiar with vegetation practices for different kind of plants. 56% chose less consuming water plants. 34% use recycled water for irrigation of plants.

6.5.2 Water bodies
34% of respondents are familiar with water use for landscape and interior design. The use of water bodies varies depending on the region. The reason is mainly dryness of the air in the desert and south of Egypt (table VI).

Table VI: water use for landscape and interior design

<table>
<thead>
<tr>
<th>Region</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cairo, Delta and north costal</td>
<td>18</td>
</tr>
<tr>
<td>The New Valley Governorate</td>
<td>42</td>
</tr>
<tr>
<td>Upper Egypt</td>
<td>39</td>
</tr>
<tr>
<td>Nubian land</td>
<td>67</td>
</tr>
</tbody>
</table>

6.6 green old construction systems
By interview respondents from four regions of study about advantages and disadvantages of mud brick system and why people don’t use this system now days, the following advantages and disadvantages were the common comments.

6.6.1 advantages of mud brick system
- Good for natural environment
- Easy for maintenance
- Healthy
- Cheaper for living cost
- Cheaper for construction
- Climatically comfort for (hot - and cold period)

6.6.1 disadvantages of mud brick system
- The Symbolism is very bad since most people who still use these techniques are poor
- The appearance is not modern (bad finishing)
- Small size for spaces (3.5m)
- Underground water (supply the villages with potable water without any sanitation network) effects the building foundation
- Don’t bear more stories (maximum two stories)
- Needs a lot of maintenance
- Not resistible to rain
- Not durable
- Not Modern (bath room and kitchen)

7.FINDING ANALYSIS AND RESOLUTS
7.1 Sustainable building practices in Egyptian building culture
• Mixed land use (mixed residential area with shopping and some services)
• Small size of house/apartment - 90m2/5 person in cities and130m2/6 person in villages
• Attachment houses (row houses, compact system with attached house from three sides)
• Wide and shade streets with in villages (6 m)
• Low hight buildings (two or three stories)
• Transportation priority (walk, mass transportation, car then bike)
• Using timber in openings (Egypt import all its need of timber)
• Reused building materials
• Passive climatic design feature for (courtyard, deep and small windows, wide wall section and louvers)
• Using low energy consumed lamps (florescent)
• Using renewable energy (Hydro-electricity)
• Vegetation practices
• Using water bodies in hot arid areas

7.2 Unsustainable building practices in Egyptian building culture
• People manage the design and construction process themselves. They don’t have knowledge to react well with environment and don’t develop the economy.
• People possessing their houses although their low income 71% of respondents
• Using concrete construction system 67% of respondents
• Using red brick 74% of respondents
• Not using recycled materials
• Using artificial techniques for climatic comfort
• Using high energy consumed electric appliances
• Using high consumed potable water fixture 86% of respondents
• Use potable water for irrigation

7.3 general results
• The reasons behind some architecture green practices are not because of environmental awareness but because of economic reason for example. Most respondents don’t use private car and some of respondents still use mud brick system. Once they get money they will buy private car and demolish the mud brick house and build with concrete skeleton and red brick.
• Using tradition techniques features are welcomed for climatic comfort but with strong and durable building materials.
• The main reasons for wanting to own the house are privacy and adding more stories for new families of the original family members may be for three or four generations.
• Shaded and Narrow Streets are welcomed but to extent that cars could serve all houses (minimum 6 m).
• In Egypt electric power is very cheap so nobody is concerned about low energy consumed equipments.
• In Egypt potable water is very cheap so no body concern about dry fixture.

CONCLUSION

1-Directly we can use the set of sustainable practices in any new settlement in Egypt. For unsustainable practices some changing in people’s behavior is needed such as efficiency water use, energy saving, using bike. For that reason more research needed to study what could be changeable.
2-The tradition techniques in Egypt are good resource for green architecture practices and is deeply responds and meets social- culture needs of people who supposed to live in the new region of Toshka but to be more culturally accepted we have to find a way to recover their disadvantages.
3-In current PhD research, toolbox will be developed depending in the current and tradition building practices of Egyptian but to be more sustainable world experience (the third resource of architecture ideology) of green practices have to be introduced to Egyptian in order to figure out to what extend it match with Egyptian building culture.
4-Non-professionals aren’t concerned with some green practices, for example the kind of energy they used. Wisely we can use renewable energy without interrupting the people’s behavior.

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