

VALUE ENGINEERING AND ITS ROLE IN THE CONSTRUCTION PROJECTS

The design dimension for any building shall be consistent with all the levels of human needs and requirements. However, by studying the reality of United Arab Emirates society which consists of a large number of expatriates of approximately 169 nationalities, some design problems may occur, consequently, and make an obstacle against buildings' design efficiency.

Keywords: *engineering projects, functional efficiency, civilization functions, shapes and cost effectiveness, commercial and residential buildings*

Design and schematic Dimensions of Construction projects

The design dimension for any building shall be consistent with all the levels of human needs and requirements which had been addressed earlier in the first part of this chapter. However, by studying the reality of United Arab Emirates society which consists of a large number of expatriates of approximately 169 nationalities, some design problems may occur, consequently, and make an obstacle against buildings' design efficiency. Those problems are presented in the following:

- Existence of new styles of buildings imported from the west that may not be appropriate to the behavioral patterns of eastern society, which led to a confusion in the behavioral of people in society as a result to the enforcement of these imported styles of buildings, and resulted new behavioral of population, as well.
- Quoting new designs fit the new style of buildings led to system duplicity as whole and a disturbance in the architectural thought occurred. As workers in architectural designation in UAE are belong to different societies with its own cultures, which results in transferring of these cultures to the Buildings in UAE, thus inadequacy of these buildings with Emirati society.
- Many new fields appeared in the design process as a result of the growth industrial society and new technologies which are used in UAE dramatically widely which led to the occurrence of the concept of specialization in design. Therefore, the architect is no longer controlling alone with design process and he becomes in need to a group of specialized engineers such as electrician and sanitary engineer...etc. This group with its ideas and experiences has detach of society and gave a vision ultimately that does not express the actual needs of targeted category, but is subject to personal desires [1].
- Relationship between government agencies responsible for design approval and users had been lagged significantly of what before and became more complex and detached; most of the times, the relationship was zero [2].

Elements affecting the functional efficiency of the design (tabl. 1)

Design process is related in its primary form with function concepts and their achievement. It can be defined as the laboratory by which validity of design is measured, in consistent with mind and logic. The more the architectural design is efficient and suitable for functional purposes, the higher its value and admiring. However, if the design or some of its parts was contradicting the useful utility without a strong cause, the building value will decrease [3].

Four principles of building design were developed in order to that the function can be achieved under its wide concept:

- structural function, so structures can resist any internal or external pressures that may include different climatic changes of wind, cold, living and dead loads. Structural function involve that all design elements and components are structurally supportive in a way that resists the factors resulting from age [4];
- civilizational function which can be clearly witnessed by the spirit of the Residential unit, its nature, shape, design lines, holes, entries, exits, and the relationship of used patterns with the surrounding civilizational patterns. It represents the visual image of the building and aims to achieve some basic human needs for users of this building;
- interactive function is making a healthy interaction between the user and the elements of the Residential unit according to the study consistent with the design targeted category which is going to use the building.

As time passes, design process gained some rules that put the design in valid architectural frameworks from the functional point of view. Thus, these rules were called the architectural standard rates in which many researchers have categorized according to the different functional buildings [5]:

- natural function, which means the harmony between the building and the surrounding environment, in addition to the positive interaction between them in regards of natural ventilation and lighting, and bringing about the visual coherence between the building and its surround, which give the design more strength and convenience [6].

Table 1

The Functional Efficiency of the Design

The functional efficiency of the design			
Structural Function: Structure Resistance for any external or internal pressures that may involve different climatic changes.	Civilizational Function: The spirit of the residential unit, its character, shape, design lines, holes, entries, exits, and used style.	Interactive Function: Bring about proper interaction between the user and the elements of the residential unit.	Natural Function: Integrating residence with its surrounding environment to create a positive interaction between them

Architectural Elements of Commercial and Residential Building, and its Relation to Cost

Linking the architectural elements to cost as a defining method depends on deficiencies in the design that may result in an increase in the cost of commercial or residential building. The Followings are some architectural elements affecting cost.

External Shape of Commercial or Residential Building (tabl.3)

Unit shape architect is one of the major influences on cost; the more the building shape was simple, the less the cost of its value unit of measurement was (Cost of square meter of total area), the higher, narrower and more complex the building was, the more the walls to floor ratio was, then its value unit of measurement will be higher.

Many researches were conducted about relation between cost and external shape. The most important study was held by British Institute work team in 1960's in many buildings that differ in shape and height,

similar in area and other elements (tabl.2). It turned out that total cost of this group of buildings goes up when the perimeter of the building to its floor space ratio increased; when the building is more complex. This increase may appear clearer when floors increase without making a change in any of their sizes [7]. Increase in cost can be analyzed on the following figures (fig.):

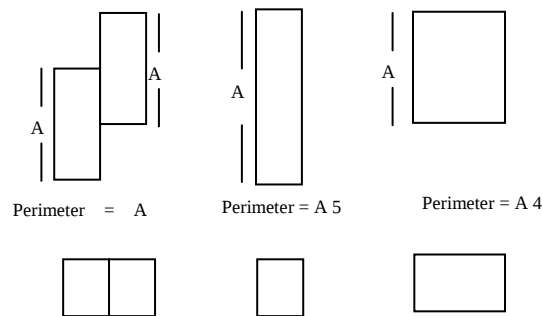


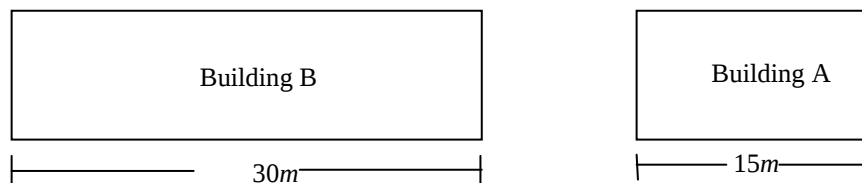
Fig. Increase in cost analyze

It is obvious that the previous analysis suggests that square shape (tabl.3) is the simplest and least cost despite of that the circular shape is the least in perimeter, because there are many implementation obstacles that may increase cost by 20...30 % [8].

By studying the effect of doubling a rectangle-shaped building length with fixation of height, number of floors and other factors, the value unit of measurement will reduced by 17,25 % [7].

Table 2

Comparison of Schematic Shape



Assessment	Building (A)	Building (B)
Floor area	120 m ²	240 m ²
Length of surrounding walls	46 m	76 m
Length of walls for each m ² of floor area	0,383 cm	0,317 cm

Table 3

External shape Relation with the cost

SQUARE:	RECTANGLEL:	CIRCLE:
Simplest shapes and least in cost	Cost increase of square shape due the increase in ratio of the circumference of the rectangle	Least shape in perimeter. However, implementation obstacles increase cost by 20-30%
External Walls - Constructing works. - Finishing works. - Painting works		
Preliminary works: - Digging works. - Building signing works - Reclamation works		
Concrete Works - Foundations - Pillars - Floor slabs		

Size of Residential Unit

Size of residential unit is one of the most influencing factors in any economic study addressing computing the cost of Residential buildings for what this factor represents as a significant impact on cost. For instance, value unit of measurement in an independent existing residential unit will increase significantly of what it may be for the same building if it was a repeated model in a total of residential towers existing in one area. This process can be interpreted of course by the theory of prices skid with the increase in workload. Even design team expenses are applicable to this theory. Many businesses will not differ much if project size increases [9]. We can add also the possibility of intensive usage of machineries and odds of reducing of wastage in the construction materials and completion of the work rates that may decrease in the case of the single model. Building size influenced by three main factors related directly also to cost. These factors can be summarized in the followings:

Residential unit level (Space dimensions)

Residential unit level is considered as one of the important and effecting factors in residential unit cost where value unit of measurement of 3 bedrooms house decreases by 4,3 % of value unit of measurement of 2 bedroom house, while value unit of measurement of 4 bedroom house decreases by 3,9 % of value unit of measurement of 3 bedrooms house [10].

Riners researches (one of the member of English Buildings Foundation) researches confirmed that cost of level meter of net areal tend to decrease by 4,7 % of level increase by 10 % due to value fixation of electrical, sewage and carpentry works despite the increase in space.

From the above, it is clear that in the case of increasing the unit size, the value unit of measurement will decrease to a specific level then remain fixed at level called (value unit of measurement minimum limit) which is the requested limit to reach in studying Value Engineering. Thus, cost reduction policy by decreasing the housing level is deficient and has a limited influence due to inverse proportionality between unit area and cost of flatted meter. Therefore, continuing in decreasing the level will adversely affect the accepted rates for user needs and requirements.

Floor height in commercial or residential building (tabl.4)

Changing in the floor height with fixation in ground area and external and internal walls will affect the cost of commercial or residential building, increasing it in general in case of significance difference between floors heights in the buildings. Increase in height will make it more difficult to implement. Many elements influenced directly by increase in floor height [11]. Floor height is reflected on the followings:

- Concrete structure -External and Internal Walls;
- Finishing items Vertical -Vertical items of sewage system;
- Increase of Stairs and elevators cost, if any;
- Increase of foundations cost to support extra loads [11].

Increase in height, up to 3 meters, does not affect much in value unit of measurement, whereas the effect appears significantly in heights of more than 4 meters, which is the usual case in some public and commercial buildings such as trade centers or some residential buildings entries. There is a minimum limit for accepted heights in residential units of 2,7 for rooms, 2,6 for service facilities and 2,4 for lanes[8].

Table 4

Floor Heights

	• Floor Heights
Concrete Works	• Foundations • Pillars • Stairs
External Walls	• Constructing works • Finishing works. • Painting works.
Internal Walls	• Constructing works. • Finishing works • Painting works.
Sewage installation works	• Drainage vertical works. • Feeding vertical works

Floors number in commercial or residential building

The number of floors affects value unit of measurement of commercial or residential building mainly where cost of Residential unit is proportional to floors number up to specific level, which is a land floor and 4 floors. The more the floors are, the less the cost of unit is, because some facility basic costs like public facilities, foundations and stairwell will be allotted to a higher number of floors, which will reduce cost relatively, taking into consideration the necessity of adding some elements with increase in floors number, such as elevators, which will increase cost despite being distributed to a larger number of apartments for example with the need to a technological means to construct the building, in addition to increase periodic maintenance expenses and other expenses for each apartment [10].

Some researchers suggest that the previous relation is not an absolute one, and the main determiner in increasing the floors number is the land value i.e. residential communities is preferred to not exceed four floors height in addition to the land floor for economic reasons, except for high-cost location case in which high revenue may be gained. Mostly, floors heights are categorized into three categories in which construction type converges with cost in general as follows:

- 1- From one floor to three;
- 2- From four floors to seven;
- 3- Eight floors and more.

Items influenced directly by increase in floors number can be limited into several main items, which are [8]:

- Foundations and concrete structure;
- Construction materials distortions;
- Vertical movement elements.

Commercial or Residential Building Internal Design

Commercial or residential building internal design is one of the elements affecting building total cost; both primary and current one. It is important to know that building functional requirements may enforce the type of proper internal design. Moreover, desire to give building the flexibility feature and ability to adapt with developed modern functional requirements faster than before may lead to prefer specific constructing system such as tiles without bridges [9]. Internal design related directly to customs, traditions and beliefs that

can make a significant impact in internal design between different societies, then affecting the cost of some items directly related to internal design, which are:

- Construction and implementation technique;
- Internal walls, then finishing works related to internal walls length. However, with fixation of internal space, all measurement units of horizontal elements will remain fixed.

Movement Requirements inside Commercial or Residential Buildings

Increasing spaces of movement requirements is one of utilitarian loss factors in commercial or residential buildings, where it related by rates with total level of building or residential unit, for instance, in order to avoid the occurrence of excess cost where these rates ranged usually between 10...12 % of total level. Mostly, these rates considered as standard for internal design efficiency and absence of excess cost elements.

Holes in Commercial or Residential Buildings

Holes are affecting commercial or residential buildings cost e.g. apartment, for what these holes represent as windows consist of wood and glass. In the case of increase floors number significantly, building will need thicker aluminum profiles and thicker glass to resist wind pressure on the frontispiece [8]. Bearing in mind that many factors affect holes cost, which are [12]:

- Quality of holes cladding materials (Wood – Aluminum – etc.);
- Number of holes - Size of holes;
- Size of space (room) - Climatic factors and space orientation;
- Commercial or residential space quality.

Horizontal Assembly of Commercial or Residential Buildings

It is represented by the situation of apartments e.g. in the horizontal direction, i.e. the way they connect to each other. They formed groups of apartments that may separate, semi-continuous or connected. Horizontal assembly method influences apartments cost significantly, where many important design elements that are affected directly according to horizontal assembly, which are [8]:

- Foundations - External walls;
- Walls finishing-Public facilities.

However, apartments' horizontal assembly may be restricted by some limitations. After specific length of frontispieces, expansion joints must be situated, especially in countries with warm wet climate such as UAE.

Դ.Է. Բուկաի

ԱՐԺԵՔ ՍՏԵՂԾՈՂ ՏԵԽՆՈԼՈԳԻԱՆԵՐԸ ԵՎ ԴՐԱՆՑ ԴԵՐԸ ՇԻՆԱՐԱՐԱԿԱՆ ՆԱԽԱԳԾԵՐՈՒՄ

Ցանկացած շենքի նախագծման ծավալը պետք է համատեղելի լինի մարդկային պահանջմունքների և պահանջներին բոլոր մակարդակների հետ: Բայց ուսումնասիրելով Միացյալ Արաբական Էմիրությունների հասարակության իրականությունը, որը կազմված է մոտ 169 ազգությունների ներկայացուցիչների մեծ թվով վտարանդիներից, նախագծման ընթացքում կարող են առաջանալ որոշ խնդիրներ, որոնք խոչընդոտներ կառաջացնեն շենքերի արդյունավետ նախագծման ժամանակ:

Առանցքային բառեր. Ճարտարագիտական նախագծեր, ֆունկցիոնալ արդյունավետություն, քաղաքակրթության ֆունկցիաներ, ծախսերի ձևերը և արդյունավետությունը, առևտրային և բնակելի շենքեր

Д. Э. Боукэй

СОЗДАЮЩИЕ ЦЕННОСТИ ТЕХНОЛОГИИ И ИХ РОЛЬ В СТРОИТЕЛЬНЫХ ПРОЕКТАХ

Объем проектирования для любого здания должен быть совместим со всеми уровнями человеческих потребностей и требований. Однако, изучая реальное положение в обществе Объединенных Арабских Эмиратов, состоящем из большого числа эмигрантов примерно 169 национальностей, могут возникнуть некоторые проблемы при проектировании, которые создадут препятствия для эффективного проектирования зданий.

Ключевые слова: инженерные проекты, функциональная эффективность, функции цивилизации, формы и эффективность издержек, коммерческие и жилые здания

References

1. **Al-Hathloul Saleh Ali.** Tradition, continuity and change in the physical environment: the Arab-Muslim city. - Massachusetts Institute of Technology, 1981.
2. **Abdul-Baqi Ibrahim.** Islamic Prospective of Architectural Theory. – Cairo: Center for Planning and Architectural Studies, 1986. - P.119.
3. **Sami Irfan.** Function Theory in Architect. – Cairo: Nafe'eHouse of Printing and Publishing, 1967.
4. **Abdul-Wahab Salah Aldeen.** Tourism Development. – Cairo: Zahran Printing House, 1991.
5. A planning and implementation. The economics of housing - the minimum residential flat. – Cairo, 1979.
6. **Hani SaeedJamil.** Legislation in the tourism development plan: Master Thesis. – 1997. - P.70.
7. **SeeleLovor H.** Building economic. - London: The Macmillan press ltd., 1976. - P.150.
8. **Mohsen Abo Alnaga.** Residential units designs economics: Master Thesis. - 1984. - P.53, 60, 64, 65, 68.
9. **Ashworth.Altan.** Cost studies of building. - London group UK limited, 1988. - P.105, 108.
10. **Ismael Ahmad A'amer.** Analytical study for Mobarak Youth Housing Project: Master Thesis. - Engineering of Cairo, 2002. - P.39-40.
11. **MhdSoliman Mannoun.** Economic Limitations that controls buildings heights: Doctorate Thesis. - University of Cairo, 200. - P.100, 112.
12. **Stone P. A.** Housing, town development, land and costs. – London, 1967. - P.42.

Դիաա Էդին Բուկայի - Երեւանի Պետական Համալսարան, ասպիրանտ, +971556468646, sarco_sh2002@yahoo.com, 17/3/2015:

Դուա Էդին Բոյկէյ - Ереванский государственный университет, аспирант, +971556468646, sarco_sh2002@yahoo.com, 17/3/2015.

Diaa Edin Boukai - Yerevan State University, postgraduate student, +971556468646, sarco_sh2002@yahoo.com, 17/3/2015.

Ներկայացվել է՝ 28.03.2015թ.

Ընդունվել է տպագրության՝ 07.04.2015թ.