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Functional Design in Structural Engineering and its Influence on Architectural Design

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ABSTRACT

Everything existed in the world has a structure. Since middle Ages until now, architectures and constructors, always, invented new procedures, methods and materials for buildings implementation and structures combination with architecture to obtain novel and new solutions. Attention to the type of space covering, foundations, slabs, columns and roofs is an inseparable part of Architecture design. Combination of architecture and structure refer to the integration of art, aesthetic values, technology, materials and their manner, function and implementation. Structural design can be considered as a process to arrange materials in three space dimensions, to the extent that provides some determined purposes in possible maximum efficiency. Many of individuals are familiar with the expression" Form is following the function". All the people can distinguish type of used structures in relative to their function in constructions such as bridges, dams, sports performances, power plates, hospitals, silos and etc. But the results will be noticeable in conditions when functional requirements are under consideration which determined the art of structure engineering. In this paper, first, the effective factors of structural design will investigate and clarify and then the effect of these factors on function, aesthetics and architectural forms will analyze.

KEYWORDS: Architecture, Functional design, Structural design, Aesthetic, Structural efficiency.

1. INTRODUCTION

In Oxford dictionary, the first definition for "Art" refers to a skill which acquired through knowledge and practice. Definition of art in Dehkhoda[1] is: "Degree of human perfection which includes awareness, sagacity and erudition and its appearance will become the artists dominant within others". As though in academic years, structural design is combination of determining the size of needed elements in a particular structure and their analysis to control stresses and deformations against limitations which set by standards. Is there art in structural design when reach a higher position than skills dependent on very meticulous mental rules?

Structural design can be considered as a process of regulating materials in three space dimensions, so that provides some determined purposes in maximum possible efficiency. To achieve such purpose, first, the principles of "purpose" and "efficiency" should be specified.

An engineer should consider structural purpose as straight as possible to freight imposed load which transfer to footing. The word of "possible" indicated that this purpose don't interfere in the function which structure is making for. The structure of a building must synchronize with a transparent space within final coat such as a bridge which should allow flowing water in bottom or crossing the vehicles. If these requirements were in contrast and maladjustment with explicit function of structure, in some cases one or both of them are in danger.

What is structural efficiency? An engineer may explain it as the proportion of benefit (product) to cost (capital). Applied materials in a structure can measure in order to exactly evaluate the cost. Unfortunately, it is not useful because different materials relative costs are omitted and also, majority of important costs such as construction and installation are not under consideration.

In evaluating process of likely structural volume, Designer must apply various forces, their combination and internal forces which may be effective in beneficial age of structure. This will be possible through guidance of committees which compile rules and standards. Can be a building design with high costs safe against earthquake or aircraft clash? If, no, can be minimum devices use to minimize the building damages against above forces?

During analysis, high proficiency is needed in use of theoretical concepts and analytical techniques for mathematical modeling of structure. All theories are approximate and designer should carefully choose method which is more familiar with the reality of that structure and also apply it in geometrical image and materials characteristics. To achieve this purpose, designer should be aware of the process of theories, principles and rules development.

Through investigating the summery of above contents, it became clear that strong insight and imagination are necessary factors for structural design even it can be explain as an arts in the majority of limited technology

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states. Larger part of this art is exposed to the appropriate form of structure, replacing and moving the materials in space to perform needed function with maximum efficiency. Current computer software and structural theories just can prepare structure analysis according to the basic geometry which clarified already.

2. EFFECTIVE FACTORS ON STRUCTURE NATURE

Effective factors on form and nature of structure can be summarized as follow:

1) Structure must be adapted with spatial needs, circulation and defined function of a building (educational, religious, commercial, power plant, industrial and etc.).

2) Structural form should be select in a way which corresponds to existed limitation, according to the nature of constructing land. These include topography, soil nature and different kind of rocks, obstacles existed within site such as underground facilities and perspective buildings of site.

3) Static and resistance of building.

A. Structural form should be chose corresponding to mechanical characteristics and the materials production methods.

B. Structure must be resistant adequately against forces influence on construction and should have essential safety against materials buckling and breakage.

C. The structure should undergo against load without excessive change in picture. It should not create vibrations and fluctuations which will cause fear in consumer and also should not interfere in facilities and other ancillary services.

D. Materials should not involve in excessive fatigue or inappropriate movement with other materials.

E. Structure should withstand forces of earthquake and other lateral forces like storm and etc.

4) Structure should be strength against fire and allow consumers to escape and firefighter to access.

5) Structures materials must have proper strength against corrosion and other factors.

6) Structure must be pleasant through aesthetic at least visually in high level (figure 1).

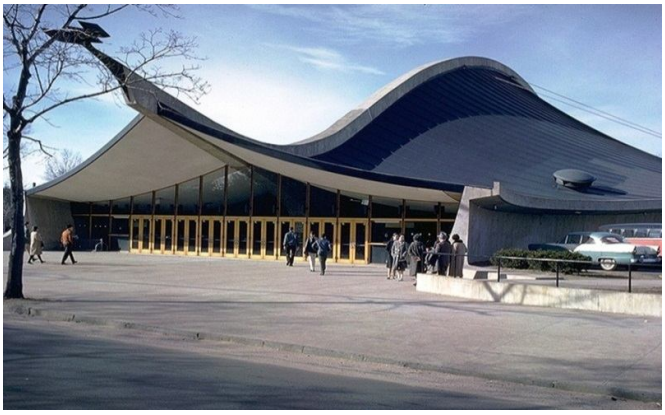

Figure 1: Visual impacts of Structure fit to Architecture function, David S. Ingalls Rink, Yale University, US[19]

7) Structure should have minimum costs needed for constructing and repairing in order to achieve appropriate standards which admitted between employer and design parts.

8) Selected standard materials and elements, economically or commercially, must be available in appropriate extent in place where plan is implementing.

9) Construction and installation of structure should be possible for each location through available techniques.

10) Prediction the behavior of used structure should be possible according to contents and computer models.

Executing these factors is influenced by internal and external policies of designer group, human communication problems, opinions, communications, also creativity, stimulus and skills level of designer. Based on above factors, some questions will arise as follow:

The question of first factor is that to what extent structural efficiency should be influenced by functional needs? How is it worth to reach functional efficiency against structural efficiency?

The effect of building constructing site characteristics on form (second factor) is proved finely in engineering magazines through investigating the performed projects. Choosing a form in harmony with materials characteristics (third factors- part A) is an interesting subject for authors about structural design principle (figure 2).

Factors from third-B to third-E caused questions about estimating the imposed load, safety factor dimensions and selecting construction principles. Indeed, lots of contents are published in engineering literature and books like Blockley.

Figure 2: The effect of buildings constructing site qualifications on Structural form, Eden Project, England [20]

To design resistant building against earthquake forces (fourth factor), strength of building in violent earthquake cannot be guarantee and providing such requirement definitely will not be economical. Accepting some deterioration is a confirmed philosophy about this case but through confidence that structures of important buildings such as hospitals and fire-fighting stations and high risk functions like oil tank, remain safe although some reformation took place.

There are two main philosophical observations about determining the safety factors of structure. First observation refers to the identifying of risk that people and owners accept about their own life and capital. This case can be compare through observing likely dangers in traveling with different transportation vehicles, in road accidents or sport events; different individuals accept such risk during their trips, exercising and sport championships. But they have more expectation about the safety of their buildings where they are living, working, entertaining and etc. [1]

Current and conventional methods of constructing and implementing which determined by economy in some part and also historical industry development in other, have a noticeable effect on form (eighth and ninth factors), although in most cases, designer is not aware about such new methods because they became a habit in his mind. This kind of form effectiveness from constructing approaches indicated finely in current literature about design philosophy.

Little attention directed to the theoretical planning process (tenth factor) of structural behavior which added to simplifying and idealizing art. Even in the contents of books about structural theory, there is a tendency towards interpreting the question about what factors of building rules are omitted, what cases remain and how the accuracy of calculation is under control? Several examinations implemented to compare calculations through different computer methods and also compare between the accuracy of theory and exact behavior. This depends on general knowledge about structural design philosophy.

There is no any theory to be equally proper and satisfying in structural design use. Relation between classical theories and standard rules to design reinforced concrete roofs is a primary sample. Planning process of standard rules based on theory is a very complex activity. In these cases, more approximation and simplicity should be obtained through usual practices and specific geometry of functional structure to achieve a normal and permanent design method. These factors should develop to materialize applied factors which omitted in main theories (such as flowage in concrete, defect in column geometry and etc.)

Many of engineers look standards as unnecessary limitation about creativity potential and design skills. Many feel still that standards are set by universities and are a wide and unessential series. Nevertheless, the results of these disputes caused more participation in design philosophy. So, because of a wide and different serious question in building design, reasonable decisions should be made to answer the questions before designer can move forward. Certainly, lots of answers are provided in contracts and many of them are influenced by design standards, total of these responses will form design philosophy.

3. FUNCTIONAL AND STRUCTURE

Lots of people are familiar with the expression of "Form follows function". All individuals can distinguish type of structures which used in relative to their function in constructions such as bridges, dams, sports performances, power plates, hospitals, silos and etc. But the results will be noticeable in conditions when functional requirements which determined the art of structure engineering, be under consideration. As a simple illustration, demands for mass buildings after war and desire to have economic societies in crowded centers of

town lead engineers towards designing taller buildings. Nowadays, low-income families' unwillingness about tall buildings causes many changes in this matter.

Because of two reasons, structural engineer should have different knowledge about functional design: first, he can feel cautiously his circumstances during design process, it is not important to understand how these factors will influence directly on his work. Second, if designer determined these demands difficult and costly, he can provide useful alternatives to obtain more efficient structural form without noticeable changes in function.

4. EFFECTOFFUNCTIONALNEEDSONSTRUCTURALDESIGN

According to above contents conclude that functional needs play important role in determining the structural form. These needs include dimensions and locations of surface which should be supply in plan, location of main points needed for supports, amount of imposed loads and essential combination for internal spaces. In most cases, these factors determine different kind of structural systems which apply in length and location of columns, form and type of final surfaces and covering [2] (figure 3).

Transporting imposed loads is the main purpose of structural design and its implementation even though they just undergo their own weight. In some cases which load imposed directly in separated places such as structures used in main pylons, a skeletal structure is suitable.In most cases, imposed load into picture is extensive, such as silos, storage and reservoirs. Sometimes the place of imposed load is different like bridge and suspension floors. Such extensive and mobile loads need to continuous surfaces rules. Need to supply continuous lines in crane, is a support to form two parallel rails, so often the function of imposed load supports have a direct influence on structural form [3].

Figure 3: Effect of function on Architecture of Structural Design, Allianz complex, Germany [21]

A shelter is resistant against cloud, rain, snow and also heat. This caused designing the closed and surrounded surfaces for all parts of buildings. Needs like preserving private place, sound insulation, providing building standards and principles and local and native agreements are considered as main demands. These determined factors are imposed load on structure and widely are those which structure should undergo against it. Sometimes, proposed structural form may help engineer, according to the functional needs such as internal separator and closed walls in apartments provide resistance higher than structure engineer' need but sometimes will produce problems such as office buildings with large opening without internal walls.

5. THREEDIMENTIONALDESIGNS (3D)

A multi-story building with more details can be considered as an effective example of the influence of three dimensional designs on structural design. Nowadays, personal interests in designing internal space of office building, make possible accessing of consumers to more flexible spaces [4]. Large and without column openings which normally are not less than 8 meter, are need in structural systems, so that light partitions can install between different offices according to the consumers demands and needs. Such buildings (figure 4) often constitute a central core includes elevators, stairs and bathrooms and external structure skin. The opening of floor bars from central core to exterior skin, make each floor free from interior columns. In designing very high buildings, designers consider external skin as a vertical cantilever with box section to resist against lateral forces.

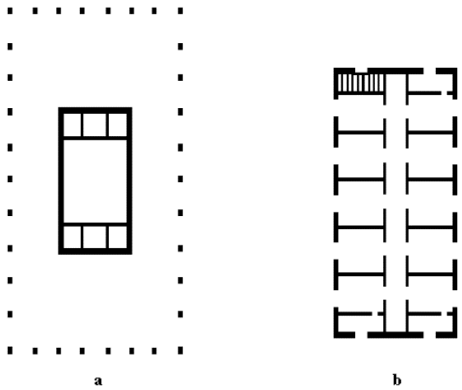

Figure 4: Type plane of (A) High-rise office building and (B) High-rise building of dormitory [5]

In other words, residential buildings, suites and different kind of special boarding houses, need to many interior walls; there are less need to space flexibility in these buildings. Indeed, space arrangement can repeat for each floor so inside walls will repeat in all height of building and each story and provide a complete significance about force transformation into ground (figure 4-B).

Through such plans, use of heavy bearing walls with needed sound insulation between unites or adjacent rooms will be simply possible. In this condition the openings of floor are small and there is no any pressure to adjust resistance, stiffness and lightness like those observed in the floors of an office building. Such structure may construct through brick bearing walls in a building with 13 story height[1] (figure 5).

All unessential functional needs may cover space between columns. In Menzies construction of Monash University in Melbourne, rooms in north front of building (figure 6) designed for superior personnel residency and therefore they were larger than rooms designed for students in south front. Columns of first floor were located in about 6 meter distance from each other so in north front, architect engineer placed four windows in upper view to produce 0.1 meter distance from a column. Of course, inside transverse walls should be placed on column axis in order that the width of rooms was multiple of 1.5 meter in north front and 1.2 meter in south front.

There are similar limitations between distances of columns (thus in openings of floors and roof) and needed space for automobiles in multilevel parking, desirable width of corridors and aspects of production line in factories. If a multi-story building had a basement for automobile parking, usually, the space to park a car will determine distance between columns in all height of buildings.

Figure 5: A sample of high-rise residential buildings with repeating plans in each floor, Marina city, US [22]

[1]One sample of towers in developing of Collins Palos in Melbourne is related to an office construction with 35 story and spaces without column which a15 story hotel with closed column placed on it. This building has a central Anteroom which separated in hotel height. Changing in column distance forced designer to use prestressed concrete system to transform loads to lower roof of office building columns.

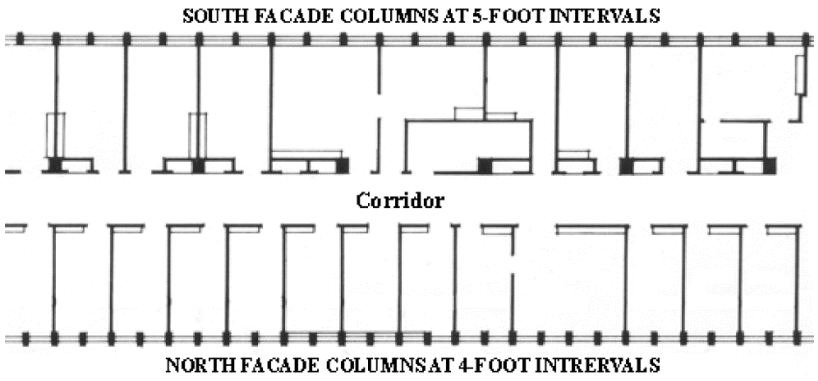

Figure 6: Menzies construction, Monash University, parts of type plane of floors [5]

Other functional needs refer to supplying open space in ground floor of multi-story buildings. This floor may devote to galleries, large stores or huge entrance hall. In some cases, a space without column needs under the buildings, in a way that don't lose the perspective of public square or green space view. This will cause essential design of a big breaking joint in structural system include closed columns or bearing walls to one column with more and taller dimensions. These transfer girders with needed huge opening carry heavy load but also reduce the number of existed members against lateral forces and provide resistance just in sections where these problems are in high level.

Supplying turning direction of automobile, products and people is the main aspects of functional design. This will influence on classification and in some cases affected on the size of spaces, rooms, corridors, stairs and halls. It is important to mention that functional designs are more complex problems in hospitals which are not relative to studied subjects of this paper [6].

Darlowoffered interesting explanations about structure relationship with function of shopping centers. Addition to the need of flexibility in spaces arrangement, it also is essential in mechanical and electrical installations. Usually, two space measures are needed for such functions: adjacent large and small stores. To design such functions, a network constitute of columns in size of 5 to 10 meter is needed. Comfort creation of opening without damaging its resistance is considered as an advantage of use beams and slabs in such buildings. Flat slabs are cheaper but they are not suitable in creating the opening. Precast concrete is not applied in these cases because it is not proper for stairs with irregular forms and nonsymmetrical loadings [7].

6. STRUCTURAL DESIGNWITHSPECIFICINDUSTRIAL PORPOSES

Relation between function and form is usually more direct in designing industrial structures than residential buildings. Providing a roof is the main purpose of structure designing in most factories to safe their labors and machinery against atmosphere flows. But materials and goods flow within factory and production line arrangement may influence on buildings image.

In most industrial constructions, main structure should undergo roof crane and substructure should keep heavy machinery. Needs for such functions overcome to structural form (figure 7). Atkins identified and introduced three kind of industrial structures:

- Boilers containers
- Oil refineries
- Stone breaker and Steel producer factories

Which main structure keeps the machine and sometimes form it like a real machine home and also the appropriate form of final coating was suggested by form and size of mechanical machinery [8].

Figure 7: Relation between forms of function and structure: A) Self-retaining conveyor belt, B) Retained conveyor belt by wall through a crane with jib [23]

It is completely clear that functional needs will suggest a form which is specific for its structural function. This method applied in Europe to determine the form of container specific for wastewater treatment in spherical form, because use of core function became essential by such function to provide a steady coating for resistance against internal pressure. At first, these containers were constituted of a drum body with a short cone in its upper and lower parts (figure 8-A).

Increasing high transition stress in connection between drum and cone is the limitations of this form. Finsterwaldar designed a container like eggshell form in 1950, first group of such containers completed in Berlin in 1957 (figure 8-C). High reduction of vertical bending moment and tensile stress were the results of new form so that prestressing in vertical direction was not necessary. [10]

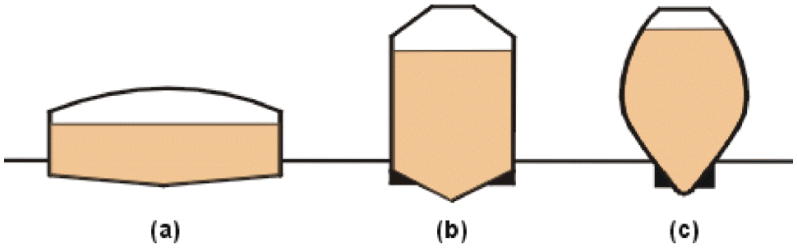

Figure 8: Structural and functional consolidation in containers [10]

7. INTEGRATIONOFFUNCTIONANDSTRUCTURALFORM

As mentioned before, function of a bridge needs to a horizontal straight surface to determine width and location of bridge. In old bridges (figure 9-A), this surface shall be constructed so strength to cover the distance between closed transverse beams and they themselves stood on main stringers. Nowadays it is a normal alternative to unite all of bridge surface in structural function through its integration as a compressive and resistant beam against axial stresses. Equivalent of transverse beams and old stringers are designing, today, as stiffener. This kind of bridge structure identified as a surface with vertical principal axis. Use of main beams with box section was the final development which the flanges of main old beams were united to form upper and lower surfaces, while webs stayed to form boundary and inside webs of box section (figure 9-B).

Excellent coordination between form and function was proved finely in design of last suspension bridges which stiffing trusses and bridge surface systems are replaced through aerodynamic design of a main beam with box section (figure 10).

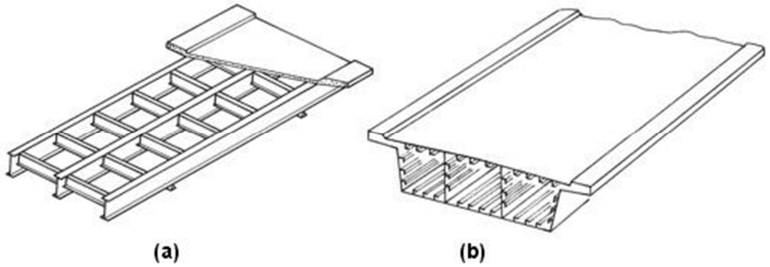

Figure 9: Integration development of form and structural function: A) Old bridge constructing which surface of bridge separately placed on beams and transverse beams, also, stood on main beams B) Today bridge constructing which the surface of bridge, not only diffused the forces but performed as a beam upper web with box section. [11]

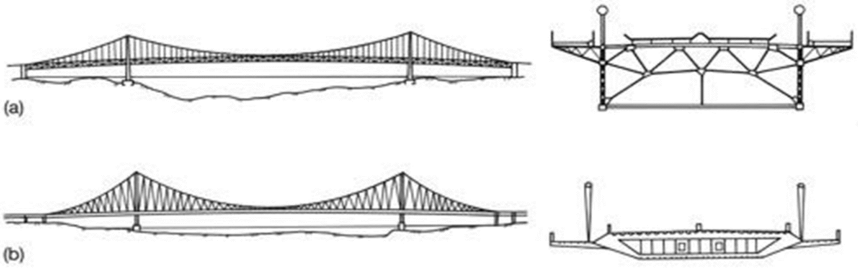

Figure 10: Change in design of suspension bridge, compare design and cross section between Forth Road Bridge (1964) and Severn Bridge (1966) [11]

Through above formation we can conclude that characteristics of functional needs can have a noticeable effect on limitations of structure engineer or can offer him unexpected opportunities to seek more useful significant about efficiency of forces transfer (figure 11).

Figure 11: form and function coordination in designing of Akashi Kaikyo Suspension Bridge in Japan. [23]

8. FLEXIBLITY INDESIGNING

It should be emphasis that the value of functional necessities will change through lifestyle, industrial processes and social needs development. Building envelope should not design very rigid, strong and appropriate just for a particular function. In today architecture world, there are individuals such as hospital designers and especially followers of Hi-Tech architecture who are tending to design flexible constructions (figure 12); in other hand, there are the followers of Mies Van der Rohe style and developers of modern office buildings who are trying to create simple spaces on this assumption that consumers make changes on their own interests in these offices.

Blake provided an interesting discussion about this issue; he expressed those old structures which designed during century developing, show better performance in adaptation with modern function than today structures. Because there is the fact that old constructions replied appropriately to the numerous alternatives of correct loading path. Therefore, if there was a doubtable relationship between form and function, designer group should not forget their responsibility about providing those that will need in the future; this will have an obvious effect on structural system [12].

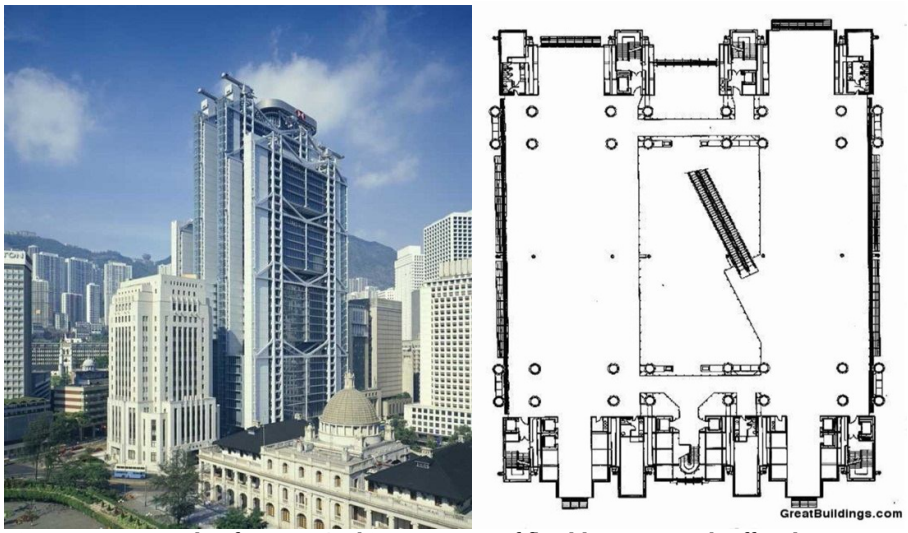

Figure 12: Example of Hi-Tec Architecture; use of flexible spaces with official operating, Hong Kong Bank [24]

9. AESTHETICINSTRUCTUREANDARCHITECTURE

In Oxford dictionary, aesthetic is defined as a science of conditions relative to the senses and perceptions or philosophy of beautiful perception. Purpose of aesthetic is to identify beauty and art and discussed about the combination of reactions and interior sensations, beauty, ugliness and etc." "Aesthetic" usually mentioned visual perception and in order to interpret architecture, lots of books emphasized on superficial compositions where architecture is considered equal with painting and sculpture.

Generally, it conclude that aesthetic is a mental element to discover cognitive faculty which designers applied in front of a project needs or " elegance and beauty" is a clear solution. There is a pleasure in mathematics which indicates its easiness and an economical attempt while others solve it hardly or even may fail on it. It is clear that just originators pay completely attention to this aspect of architecture. Experts are able to recognize procedure selected by architecture to resolve functional needs without accord with architectural categories and admired it (figure 13).

"Significance" which viewers perceived through obvious and specified characteristics of a construction, is analyzed by many of experts in elementary and professional levels. However, in raw and elementary level when a veranda in neoclassic style is connected to building, is a sign of "public building" for most of the people or may mention to "city hall" or "museum", "Art gallery" or "classic church". In an upper level, a sloping roof may show a "shelter" or "security".

Perhaps a truss or a space frame, firstly, was a sign of "factory" which for someone is equal with a repetitive, hard and tiresome work in a cold and crowded place or is a classified workplace for someone else. So, architectures, for a long time, are trying to introduce a structural efficiency of space frame for nonindustrial functions like shopping centers and hotels. But it is not a long time which architectures are tended to change public opinion through introducing space frame structures namely "attractive" and "exciting" (figure 14).

Figure 13: Mies van der Rohe resolution for problem about angle of a building, Siegel Building, Chicago, 1947 [25]

Figure 14: Use of space frame structure like geodesic dome picture for exhibition function, USA Pavilion, Expo1967, Canada. [26]

Numerous problems can be observed in this matter. Various meanings of different people may be due to the geographical condition, social base and ex-experiments. Meaning of specific elements such as spatial truss may also change completely after a short time. As regards by an engineer, these meanings can be connected to a deeper and unattractive thought. In prior eras, engineers tend towards change in church form to achieve superiority in construction, installation way and structural function perception. Although, there are evidences in Abbot Sugerwritings, who was lived in 1081 until 115l, which expressed that height and proud of initial Gothic churches and tendency towards reaching to the maximum proportion of window to the wall level which was examined severally at that time, have completely relationship to the creativity faculty of designers influenced by conditions relative to theological studies [13]. Therefore, religious and social symbols are considerable and important factors in design and determining the reaction of different people to their environment buildings. Dimensions and size of building have a noticeable influence on its consumer and viewer. This is a reason for public opposition against multi-story office buildings and feelings related to alienation and faceless.

The nature of space which defines construction is another main factor in psychological effect of building[2]. Fearing of close space and sense related to the size and extent doesn't need to discuss. Interior space of a Gothic church or sport space with gothic roof cause different feeling than an office building with short roof. These experiments proved through examining fixed viewers in one place and also those who moved around the building. Different feelings will create in a viewer when moved from a closed and tight space to an open one or walking in three dimensions in the length of a helical stair, especially where half-storey levels are separated from each other.

Many of viewers attributed human mood and behavior and movement to the kind of building structure. In Scott writings it can be observed: "we describe architecture through my own mental phrases and meanings" [14]. Scully[22] called it "Anthropocentric[3]"procedure.

Spanish eminent engineer, Edward Torroja wrote in his book of "Structural philosophy" about architecture' simile:

"When we observed contents like … declining and rising forces, cannot prevent our smiling" (Torroja 1958a. 269).

According to the basic question of Torroja days will come that an engineer and designer able to differentiate between forces which will climb hurriedly from Gothic thin, suspension buttress and those which will move calmly on Panton massive columns" [15].

Also, Torroja discussed about "concrete gravity and dignity" and "steel unsteadiness and lightness" [15].

Such issues includes "steady" of a structure which attracted more attentions than transition capacity of structure weight [15] ; and "unsteadiness" of a structure which mentioned to the smallness of its sections, both of these are completely conformed with that a viewer tented to clarify a structure [16 , 17].

Therefore, feeling of security or insecurity within sensational rules of a building is a direct reaction to its structure. Scott indicated that if a building appears in a way that mentioned to an unsteady structure, it will create a feeling of difficult use, because "we copy ourselves in expressions of architecture" [14].

Coventry Cathedralin England and Gulf life Towerin Jacksonville of Florida are two architectural works which responded finely to the factors of unsteady feeling. In Coventry Cathedral roof gears which arose of a column from one side of church porch, don't reach directly the adverse column but place in a distance on next column. In Gulf life Tower, beside columns is omitted, it means that the edges of support story are set on cantilever with 12.8 meter. Although an engineer knows that the resistance of structure in these buildings was carefully measured and that corners of buildings are naturally under stress, but omitting all of them and high length of cantilever are disappointing (figure 15).

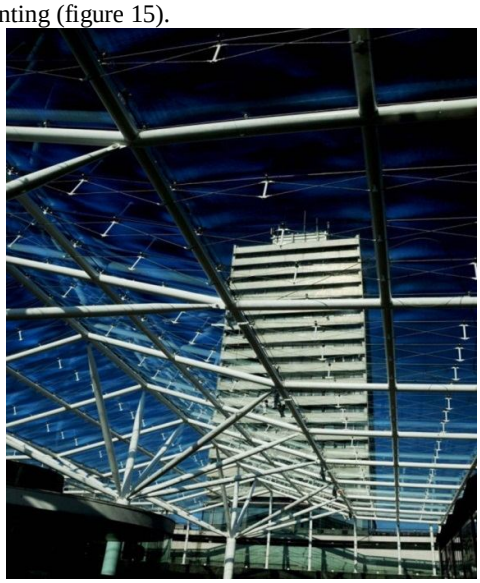

Figure 15: Feeling of insecurity will create through lack of symmetry in structure. Roof gears in Coventry Cathedral (1962) in England don't reach directly from a column to its opposite column. [27]

Architectures, often, attend to these factors as Aesthetic considerations in their plans. As Radolph indicated:

"Mies van der Rohe was clearly aware that thin columns in her designs would not create needed security feeling, thus she allowed clear walls continue to the extent which appear undividedly of columns, through use of denominator sections of window in H form" [18].

[2]Word of "space" was not applied in its architectural meanings until 18th century.
[3]Anthropocentric related to this belief that human is the lord of all creatures.

CONCLUSION

Everything existed in the world has a structure. Since middle Ages until now, architectures and constructors, always, invented new procedures, methods and materials for buildings implementation and structures combination with architecture to obtain novel and new solutions. Attention to the type of space covering, foundations, slabs, columns and roofs is an inseparable part of Architecture design. Combination of architecture and structure refer to the integration of art, aesthetic values, technology, materials and their manner, function and implementation.

Difference between architecture and engineer attributed to the role of architecture which reveal in creativity, innovation, feeling and its responsibility in front of employer, project subject and its conditions. While role of engineer is similar to inventing and it is not a new work creating. As other artists, creativity, feeling and personal perceptions are inspiration sources for architecture. But engineer generally, steeps in reformation and transition through mathematical description to obtain a specific purpose.

Supplier of economic conditions should be in best quality in section of influenced factors on good structure nature. Conditions like lower cost and more economical benefits are factors which should be under consideration in structure design. Characteristics of used materials have noticeable effects on the type of selected structure. Usually, production methods are different for each material and final form and resistance of structure against external forces will be various according to the type of used structural materials.

According to mentioned content about the effect of functional needs on structural design can conclude that if architectural structures design with enough sensitivity and skill, they will be effective in creating a beautiful picture of building. In section of integration of structure function and form, it can be concluded that characteristics of functional needs can have a noticeable effects on limitations of structural engineer or may provide unexpected opportunities to seek more appropriate of force transforming efficiency.

Through introduced discussions about aesthetic in structure and architecture, this important issue will show that separating from both technology and art is not desirable and correct. It is fundamental to understand that technology is considered as an essential element of architecture art and also art help technology to offer better service to human. This is not more real than the connection between architecture and structure. Connection between beauty and science was created to provide human mundane and spiritual needs.

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