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Ethics Behind the Duality between Structure and Ornamentation

ABSTRACT

The differences between the concepts of ‘structure’ (and thus concepts of ornamentation) within the professions of architecture and structural engineering create non-ethical differences to arize between their value systems. The objective of this paper is to analyse the various meanings and interpretations of the concepts of \`structure\` and \`ornamentation\` within these professions, in order to understand the origins and underlying significance of these value differences. However, this analysis addresses both the conceptual and physical evidence of these differences, which occur in buildings and structures.

A literature survey has been done in order to identify and establish the variations of these concepts in Gothic cathedrals, 18^{th} century iron bridges, and modern framed buildings. In addition to these, twenty contemporary buildings with ‘suspended glass systems’ have been analysed in order to reveal the current concepts of \`structure\` and \`ornamentation.\` These concepts of ‘structure’ and ‘ornamentation’ are then further interpreted by relating them to similar concepts within the field of the philosophy of ethics.

The outcome of the paper demonstrates that the basis of the conflict between the architectural and structural engineering professions emanates from a more elevated contest vis a vis the natural order of things and human culture.

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INTRODUCTION

There are considerable differences between the value systems of the professions of architecture and structural engineering. Popular approaches usually point out the scientific objectivity in the field of structural engineering, and various levels of artistic subjectivity in the field of architecture as the basis for and underlying origin of these value differences. According to M. Pultar (2000), the fact that these professions collaborate on the design of a building, but also have strong conflictual aspects in respect of their value systems, is not ethical. This collaboration results in the formation of a team, whose members are, in fact, in opposition and, therefore, declare different values about buildings and structures to society.

On the other hand, these differing and oppositional value systems are also simultaneously reflected in the physical characteristics of buildings. Buildings are designed either to favour one of these value systems, or to establish a balance between them. This might affect the forms of the buildings, the organization and dimensions of their structural members, the relationship between structure and non-structure, etc. The research objective of this paper is to analyse and discuss the differences between the value systems of the structural engineering and architecture professions by identifying and observing the material reflections of these differences in buildings and structures.

The paper contains an analysis of such material differences, which are viewed as indicators of the varying concepts of 'structure' (building structure) in the fields of architecture and structural engineering, since ‘structure’ is a basic concept common to both of these professions. However, modern and contemporary approaches to design define ‘ornamentation’ as the binary opposite of ‘structure,’ and because of this a healthy understanding of the concepts of ‘structure’ requires an equally healthy understanding of the corresponding concepts of ‘ornamentation.’ Opposite concepts, such as structure and ornamentation, can be capable of signaling both positive and negative values in respect of each other.

Variations in the meanings of the concepts of ‘structure’ and ‘ornamentation’ within the examples of various architectural and structural engineering approaches are analysed in this article in order to identify the differences between the value systems of these two professions. Comparison of these living value systems presents a good basis for a discussion on ethics.

The first two parts of this paper contains the following issues:

1. A documentary research about structure and ornamentation relationship in Gothic cathedrals, and 18th century bridges, which are pre-modern products of another type of building team.
2. Analysis and discussion of typical examples of early-modern and late-modern architectural approaches to building structures and ornamentation, together with the corresponding examples of structural engineering approaches of ‘design of the optimum,’ ‘design for structural efficiency,’ and ‘optimization of design.’ In these parts of the paper only one typical example is analysed for each approach, and post-modern classicism is ignored.
3. An empirical research about the relationship between structure and ornamentation in twenty contemporary buildings, which contain suspended glass systems.[i] Suspended glass systems are new structural systems, which are used all over the world in order to achieve ultimate transparency on the elevations of the buildings. These buildings are analysed, because one part of each building represents the architectural value system, whilst the other part (the suspended glass surface) represents the structural engineering value system. These value systems correspond to the late-modern architectural approach and a new structural engineering approach.

The most effective material differences between the concepts of `structure,` which are identified by the analysis of the above examples, are interpreted by relating them to various concepts, which are produced within different philosophies of ethics. In the third part, various concepts of ‘minimum structure’ are related either to Aristotle’s concept of “golden mean,” or to I. Kant’s concept of “will,” or to G. Deleuze and F. Guattari’s concept of “minimum.” The fourth part contains interpretations about the ethics behind the various concepts of ornamentation, which are defined with the help of an analysis of the same examples.

In order to be able to analyse the various concepts of ornamentation, the meaning of the concept of ornamentation, which has to cover all these variations, was accepted as different from its usual meaning. It is accepted as a means of poetics, rather than aesthetics or symbolism. Poetics differs from aesthetics and symbolism, because it forms relationships between even the binary opposites. It separates and then relates things. On the other hand, symbolism is a way of expressing differences, whilst aesthetics is always about singular objects, also when it is in the form of phenomenological aesthetics. (Antoniades, 1992; Bachelard, 1994) The only common characteristic between aesthetics, symbolism, and poetics is the pleasure, which they give. Thus, in this text, the concept of ornamentation is used to point out sources of pleasure, which relate different things –even the binary opposites- to each other. According to this concept, either the whole building, or only its smallest parts can be ornamental. However, as the dimensions of the ornamental parts get smaller, the concept of ornamentation gets closer to its usual meaning.

On the other hand, the meaning of the concept of ‘structure’ (building structure) covers all possible variations of itself, and thus there is no need to produce a more general meaning for it.

1. CONCEPTS OF STRUCTURE

Differences within the value systems of architecture and structural engineering in respect of the variety of the concepts of `structure,` can be analysed by directing the following questions to sample buildings or structures, because it is possible to follow the change with the help of these questions.

1. How many hierarchical levels exist in the structure? What is the relationship between these levels?
2. Is it possible to separate the structure from other parts of the building?
3. Is it possible to imagine the structure as an organization of individual members?
4. Is the structural material natural or factory-made?
5. Are the details of the structure simple or complicated?
6. Does the building contain any non-load bearing elements?
7. Is there a tendency to use the minimum amount of structural material?
8. Is the deflection of the structure perceivable?
9. Is there more than one structural system, which is designed to incorporate two different value systems?

The most important characteristic of Gothic cathedrals in respect of the above questions is the existence of two different structures within them. The first is the structure of walls, and the second is a composition of linear members (columns and ribs), which are integrated into the walls. Both the walls and the linear members are made out of stone. (Figure 1) The walls and linear members support each other in resisting different types of loads such as the weight of the building, and the earthquake loads. This is a kind of structural solidarity, which also exists in natural structures. For example, the structure of a leaf contains both the surface of the leaf and the veins in it. If there was no danger of an earthquake, both the walls, and the linear members of the Gothic structure could have functioned alone. Thus, there are two integrated structures within the Gothic cathedrals, but no non-load bearing elements.

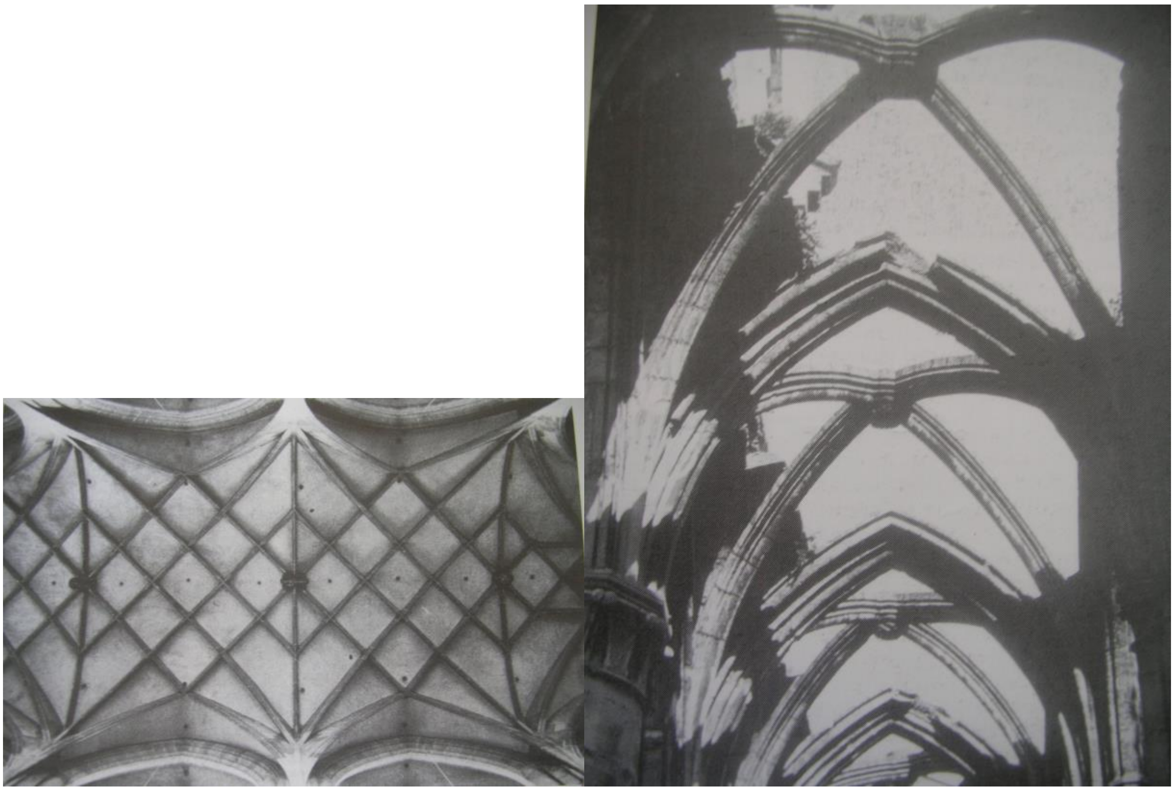


Figure 1. a. South aisle vault, Ourscamp
b. Nave vault, St.George, Dinkelsbühl (Mainstone, 1975: 131-2)

In comparison to classical architecture, the pieces of structural stone had to be as small as possible in the Gothic cathedrals, because of the lack of economic support from the political and government authorities. Ordinary people from the villages had to carry out the construction work on these buildings, moving the pieces of stone for the building from one place to another. (Deleuze, Guattari, 1993: 362-8) These structures are much lighter than the structures of classical buildings. Gothic builders observed and paid attention to the cracks and deformed parts of these light structures in order to improve their structural design properties. It was accepted that these structures would perform perceivable deformation and be subject to a degree of movement. (Cowan, 1992)

The 18th century iron bridges, which were the products of the industrial revolution and modernization, contained a single structure. T. Telford's Iron Bridge can be accepted as an example of this type of structure. (Figure 2) There was no conceptual separation between the load bearing and non-load bearing parts of these bridges.

Every item performed a structural function. Although these bridges were built with modern structural materials, their structures were very different from the structural systems of contemporary bridges. The reason for this was the lack of mathematical methods of analysis, which provide a kind of standardization to the forms of the systems. The structure of each 18^{th} century bridge was of an individual design, and each design was continuing during the construction. These structures cannot be identified as structural systems, because the concept of a ‘system’ denotes a standardized type of organization, which would allow the application of mathematical methods of analysis possible. (Billington, 1983: 52)

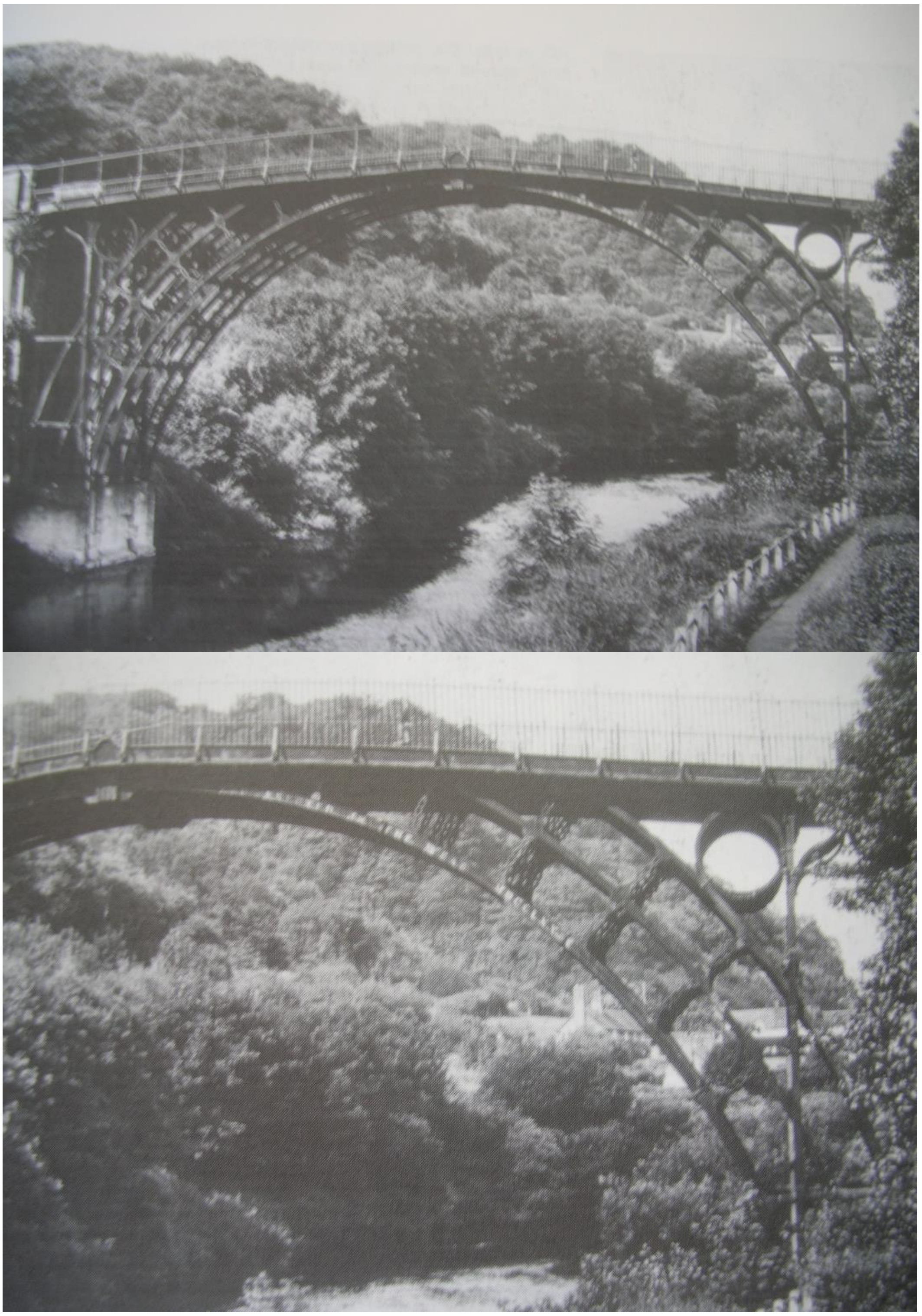


Figure 2. Iron Bridge, T. Telford, 1779, Coalbrookdale. (Mainstone, 1975: 109)

The essence of these structures was the speed with which they were constructed, in comparison to the slower erection of stone structures. These iron structures were designed and built by people who were experienced in the use of structural iron in the old coal mines. (Billington, 1983) In comparison to the stone bridges, the structural performance expectations from these iron bridges were extraordinary; they had to be light; they had to carry the dynamic loads of rail vehicles without collapse and plastic deformation.

On the other hand, modern reinforced concrete or steel frames are the most frequently used contemporary structures, which are designed by teams of architects and engineers. In these modern structures, factory-made materials, such as concrete and steel, are preferred to the natural ones. Because of the existence of the mathematical methods of analysis, these systems are expected to perform as organizations of many elements. Although the system is continuous, its pieces can be conceptualized as singular elements, which are affected by the adjacent pieces. Thus, joints gain an extra ordinary importance in contemporary structures. Joints are the keys for separation, and continuity; physical or imaginary, especially in the case of frame structures. It is very frequently accepted that ordinary frame members' details have been developed with simplicity in mind. (Barry, 1979) However, if one thinks about the consideration of the details at the joints, and the amount of calculation that has been done during the design, then it is actually almost impossible to say that any of these systems are simple. It would also be more accurate to replace the term `simple` with the term `operational;` i.e. operationally suitable for construction.

The existence of mathematical methods brought a basic standardization to all contemporary structures. This decreased the amount of material required to build these structures. However, the standardization of details with the help of modular co-ordination was also necessary in order to be operational in construction. This was the second reason for standardization which also serves to decrease the labour costs and time. This resulted in an emphasis on the repetition of the simple forms, at the expense even of the costs of the structural system, in order to ensure labour productivity.

The field of structural engineering has produced two different trends in structural design which also affected early-modern architecture during the first half of the 20th

century. The first of these trends was ‘design of the optimum,’ in which both the architectural and structural characteristics of the building were involved in the process of optimization. All the elements had the optimum (mathematically best in respect of the conflict between the amount of materials used and the labour costs) shape and size. This type of approach is `form follows formula.` (Billington, 1983: 173-5) The products of this trend are usually labeled as ‘match-box buildings.’ The Seagram Building, which is shown in Figure 3, is an example of this trend, although its surfaces are covered with glass. This trend started to become popular in the middle of 19th century, and continued until the 1960`s.

Figure 3. Seagram Building, Mies van der Rohe, 1958, NY. (Shepherd, 2002: 143,

https://www.archdaily.com/59412/ad-classics-seagram-building-mies-van-der-rohe/53834632c07a80946d00037c-seagram-building-mies-van-der-rohe-image)

At the beginning of the 20th century some engineer-architects, such as P.L. Nervi (1965) developed the concept of `structural efficiency` (the use of the minimum amount of materials) in order to achieve the `minimal structure.` This development shaped the second trend in structural engineering. These engineers designed very light but costly buildings, as a result of using complicated naturally occurring geometry and high quality labour. Their products are also known professionally as ‘form resistant structures.’ The Xochimilco Restaurant, which is shown in Figure 4 is an example of this trend. According to D.P. Billington (1983: 3-9) both these trends demonstrate and reveal the term `engineering aesthetics.` Since it is based on the physical rules of nature, the second trend can be described as `natural,` whilst the first trend is seen as `instrumental,` because it is based on the rules of human production.

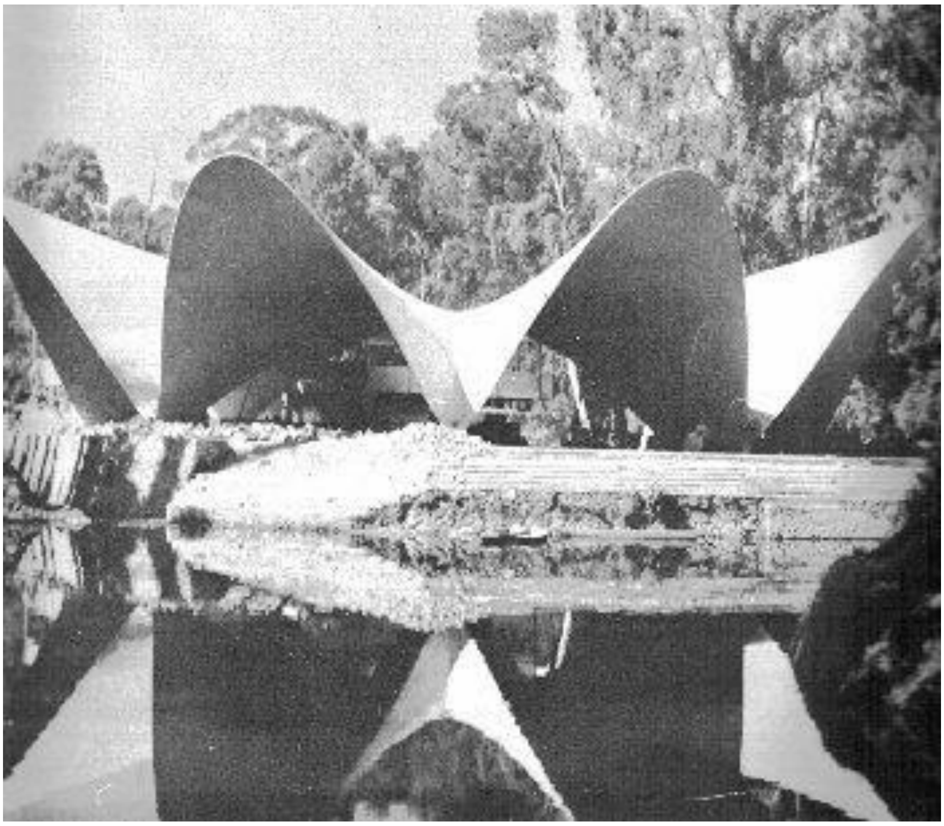


Figure 4. Xochimilco Restaurant, F. Candela, Mexico City.
(http://www.ketchum.org/-milo/candel-1.jpg)

However, the reflection of these engineering aesthetics in early-modern architecture was different. During this period frame systems became very popular in architecture. Architects were selecting the materials and the structural system, and designing the shapes of members and buildings in a manner similar to that of the `instrumental` approach of structural engineering. However, they were also designing the distances between the structural members and their dimensions as if they were following the `naturalistic` approach of structural engineering. The columns and beams of these frames became very slender, and the number of columns was reduced to the minimum. In other words, architects applied the rules of `naturalistic engineering aesthetics` to the objects of `instrumental engineering aesthetics` until the 1960's. Mies van der Rohe's Crown Hall, which is shown in Figure 5, as is a good example of this type of architectural approach to structures, on account of the large distance between the steel beams of this building.

Figure 5. Crown Hall, Mies van der Rohe and Kornacker, Illinois Institute of Technology, Chicago. (Mainstone, 1975: 247)

After the 1960`s, the variety of building forms within architecture increased with the advent of late-modern architecture. This increase in the variety of forms was the cause of the disappearance of the `instrumental` aesthetics, because many architects began to reject the rectangular prismatic forms, slender columns, etc. These forms of architecture were not designed by considering the physical rules of nature as was the case with the 'naturalistic' structural engineering approach. Polymer Engineering Center, which is shown in Figure 6, exhibits this architectural approach very well.

Figure 6. Polymer Engineering Center, Cox Sanderson Ness, Victoria, Australia. (Boschetti, 2002: 62)

Since this architectural trend was very strong, a new trend in structural engineering appeared in order to decrease the conflict between architecture and structural engineering. This trend which is called 'optimization of design' depends on the acceptance of the artistic characteristics of the architectural proposal, as they stand, and the optimization of the structural system without changing these characteristics. (Billington, 1983) Many late-modern buildings were built as a result of this trend in the field of structural engineering.

Many of the early and late-modern frames had non-load bearing surfaces as well as their structural systems. This brought the binary opposite concepts of the `load bearing` and the `non-load bearing` into the technical terminology of the architectural and structural engineering professions for the first time. These non-load bearing parts can be either transparent and brittle as in the case of glass facades, or opaque and rigid as in the case of non-load bearing brick walls. Although the rigid non-load bearing surfaces might contribute to the strength of these structural systems –as, for example, during earthquakes-, their structural roles are usually ignored during the structural analysis. (Hürol, Wilkinson, 2005)

Perceivable movements and deformations of most of the modern structural systems are accepted as signs indicating the danger of future collapse. Thus, the dimensions of the frame elements are designed by the structural engineers in order to avoid any perceivable movement, deformation and deflection. When these modern structural systems are compared with the Gothic structures and the structures of the 18th century bridges, in respect of their deformation and deflection, a different value system is clearly revealed, since perceivable deflection was acceptable for the Gothic structures and the 18th century bridges.

On the other hand, \`suspended glass systems\` are contemporary structural systems which are realized with the help of cable-trusses. They serve the function of achieving the ultimate transparency (\`dematerialization\`) on the surfaces of the 21st century buildings. According to the results of the analysis of the twenty buildings with suspended glass systems in this paper, structural systems of suspended glass surfaces are secondary structural systems, which are always dependent on a main structural system. There is a clear duality in the structure of the building as the main structural system and the structural system of the suspended glass surface. These secondary systems can even be regarded as parasites on the main building structure. These light systems have three main parts: cable-trusses, which carry the glass surface, the glass surface and its connnections to the cable-trusses, and the structural members, which connect the cable-trusses to the main building structure. (Atakara, 2002: 3)

There are very different types of applications of this system. The Science Museum, which is shown in Figure 7, is an early example of the use of suspended glass systems.

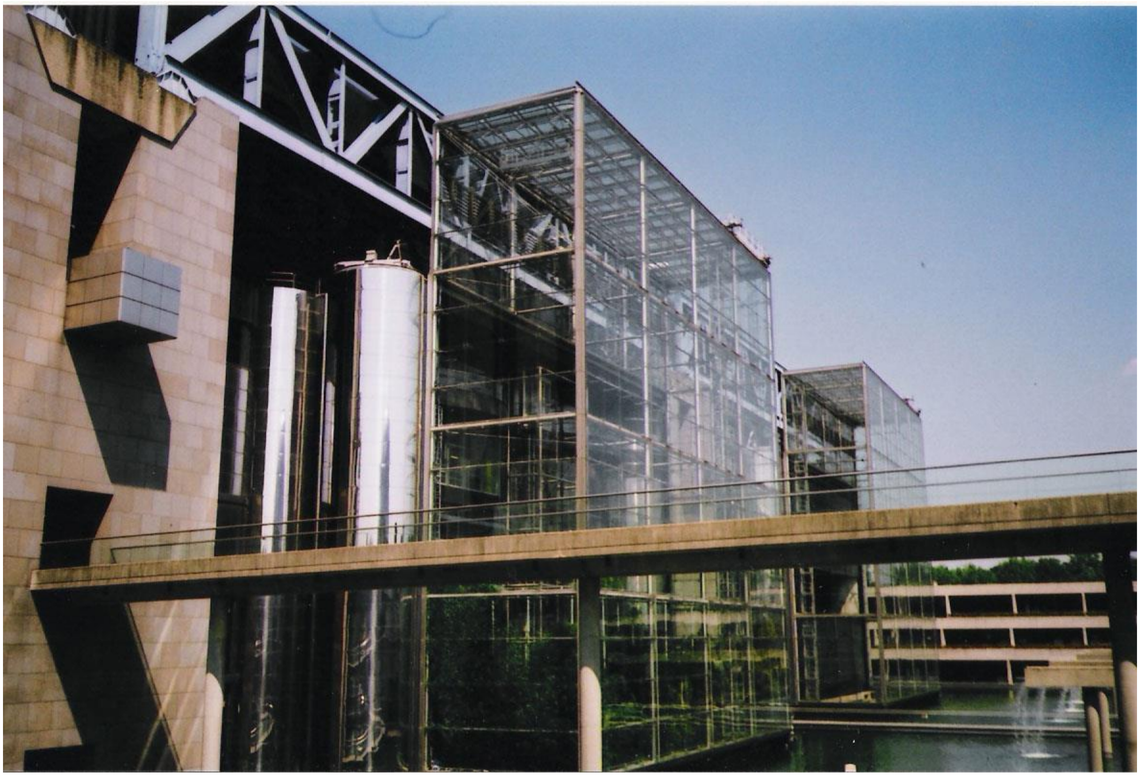


Figure 7. Science Museum, Adrian Fainsilber (architecture) Peter Rice (engineering), Paris, 1980. (Photo: B.C. Al)

P. Rice (1994: 111-112), who is the founder of these systems, said that he was simply attempting to minimize the amount of structural material used, and not trying to create a particular image. This is similar to the `design of the optimum` approach. However, he was thinking clearly in a one-to-one scale concept and calculating the shape and size of the structural elements according to his own values. Thus, the hierarchy between the different design scales, which considers the details as the latest issue to design within the design process, was changed in Rice's design attitude.

Each member of the suspended glass systems can also be visualised as separate from the others. All details within this `parasitic` system have structural roles, including the pieces of glass. Specialized structural engineers design and test these details. The materials, which are used in these suspended structures, belong to the advanced building technology of the 21st century. These are glass, steel, and silicon. The glass is of a specially produced type in order to reduce its brittle character. (Rice, Dutton, 1995) It can also be anticipated that the recent nano-technology research carried out can be integrated into these systems. (Coontz, 2000; Atakara, Hürol, 2004)

Suspended glass surfaces are the 21st century correspondents of the modern non-load bearing transparent surfaces. However, unlike other non-load bearing surfaces they are structural. Structural engineers accept them as a third category, which is different from both the structural systems and the non-load bearing systems. They analyse the safety of these systems through the use of mathematical methods, but their expectations of these systems are lower than the ordinary structural systems. The structures of suspended glass systems are allowed to deform and deflect much more than other structural systems. Perceivable deflection is permitted for these systems. (Rice, Dutton, 1995)

The various concepts of structure, which are studied in this part of the article in order to clarify the differences between the value systems in architecture and structural engineering, can be seen together in Table 1.

Table 1. Various concepts of structure.

2. CONCEPTS OF ORNAMENTATION

Differences between the value systems of architecture and structural engineering in respect of the variety of their concepts of `ornamentation,` can be analysed by directing the following questions to the same sample buildings. It is possible to follow the change in the relationship between the concepts of structure and ornamentation with the help of these questions.

1. Does any type of ornamentation exist in that particular building?
2. What are the physical tools of architectural expression?
3. Do ornamentation and structure follow the same order? Does the ornamentation conceal the order of the structure?
4. Is the order of the structure clear, or is it ambiguous?
5. Are the structural details visible or hidden?
6. What is the level of complexity of the structural details?

7. Do the structural details possess very small pieces in comparison to the other elements within the building?

Gothic cathedrals are dramatic and inspiring in respect of their ornamentation. After exhausting the structural possibilities of their style, the Gothic builders turned their attention to decorative elaboration. In many of the Gothic cathedrals it is not very easy to differentiate structure from ornamentation. (Moore, 1890). The structural elements, such as ribs take part on the same stone surfaces with other continuous lines, and because of this structural elements look as if they are part of the ornamentation. Both the lines of structure and the lines of ornamentation direct and lead the eye to the upper parts of these sublime buildings.

The ornamentation of these buildings is very detailed, but not the ordinary elements of construction (such as the pieces of stone). G. Hartonian (1994: 7) refers to these type of lines of ornamentation as `lineaments,` and explains their role as that of concealing the order of construction. The combined effect of the lines of ornamentation and structure also gives these structures a somewhat ambiguous character.

The iron bridges of the 18th century combine structure and ornamentation in a different manner from that of the Gothic cathedrals. It was not possible for the designers of these bridges to separate the structure from the ornamentation, because they did not have any concept of a structural system in those days, and the design of these bridges continued throughout their construction as a type of trial and error approach. In other words, both the ornamentation and the elements of construction were designed as parts of the structure. The structure was ornamental. For example, the two circles between the arch and the deck of the Iron Bridge (Figure 2) are structural as well as ornamental.

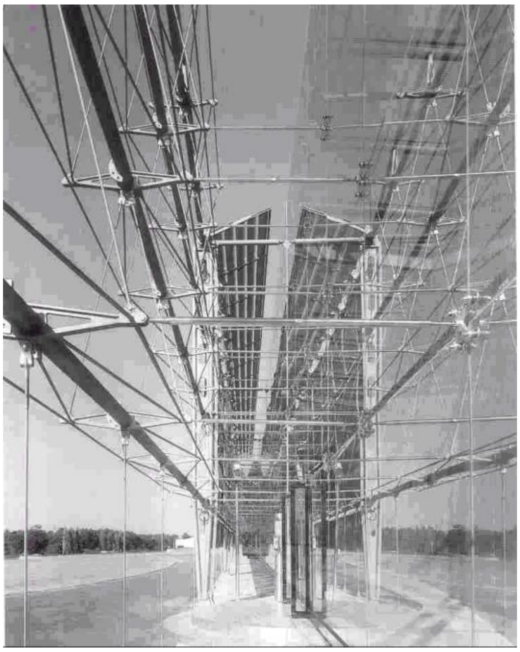
Most of the early-modern buildings with frame structures are known as the products of instrumental rational thought. In order to bring speed and economy to the production of these buildings, ornamentation was rejected by the modern architects. For example, according to A. Loss, who was one of the pioneers of modern architecture, ornamentation is a crime. (Hartoonian, 1994: 43-55) Many people initially reacted negatively to this approach. They thought that such light and non-ornamented buildings were neither safe, nor beautiful. Reactions against the Eiffel Tower in 1887 is an early example of such attitudes of the people. (GaenBler, Möller, 1978) It took time for people to accept the totally new image of modern buildings with their transparent surfaces and light structures as the source of a new conceptualisation of meaning in architecture. As a result of this process, technological expression became immanent to the meaning of architecture for the first time.

Reinforced concrete and steel frames were popular between the 1920`s and the 1960`s. Architects were exposing the structural system of the building in order to let people see and understand these structures. They were trying to be honest and transparent about the structure by not hiding it. Since the structural system was exposed, its design became very important. The geometry of these structures replaced ornamentation. During this period many buildings contained wide and transparent non-load bearing surfaces in order to reflect the lightness of the structure.

Since being able to conceive of the frame members as separated as well as continuous, is very important, the joints between these members play a vital role in the aesthetics of the building. According to G. Hartoonian (1994: 17) the details of the joints of modern structures replaced traditional ornamentation. However, these details are not perceivable externally. They are hidden either within the structural material (such as in reinforced concrete), or behind the cladding (as in the case of steel members). They form hidden complexities.

People got used to the differences created by the use of the new building technology around the 1960`s, and they started to find it meaningless and boring. They were reacting against ‘concrete high-rise blocks,’ ‘match-box buildings,’ ‘monotonous environments,’ and ‘lack of identity.’ (Davis, 1990: 70-83, 173-180) The economy was in a much better state than before, and it was time to remember aesthetics, meaning, and ornamentation. After the 1960`s architects departed from the `instrumental` approach to design. They started to prefer historical forms and images of architecture, or to imitate the forms of the buildings, which are designed with a `naturalistic` approach to structural engineering. However, the aim of these architects in their pursuit of the imitation of the `naturalistic` approach was to find new forms, and to express their own personal identities. This period also corresponded to the post-modern concept, viz. `rejection of the rejection of history,` which brought the traditional understanding of ornamentation back into architecture. (Venturi, Brown, Izenour, 1985; Jenks, 1987) J. Habraken (2003) expresses the contemporary general situation by stating that no contemporary architect wishes to design background buildings.

Buildings with suspended glass systems also belong to this period. These buildings combine two types of surfaces, in other words, there is a duality in the design of the surfaces of these buildings. The first type of surface is the surface which has a framed structure. Thus, there is no ornamentation, and the details are hidden in the joints. However, the second type of surface is a combination of glass surfaces and cables without typical window-frames. The extreme transparency of these surfaces, create a sense of a totally new technology. This can be identified as the effect of the 'aesthetics of the new,' which looses its significance when people become accustomed to it. However, this is not the only aesthetic quality of these systems. The reflections through the glass surface, visuality of the life within the building, and the ambiguity of the structure created by cables, struts, and bolts also add an ornamental character to these systems. Here, the fine details of the structure replace the ornamentation as seen in Figure 8, and the duality within the same building creates a different sense of aesthetics.



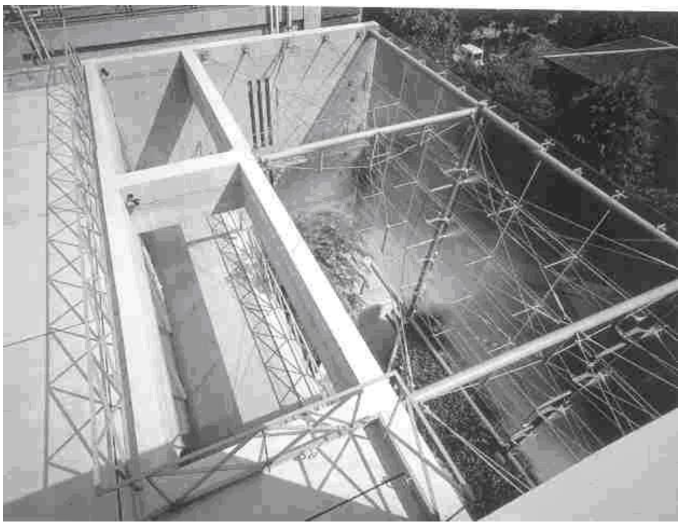


Figure 8. An example for the fine details of suspended glass systems. (Moore, 1994: 205)

The hidden details of the framed surface exist side by side with the fine and exposed details of the glass surface. The maximum transparency of the 20^{th} century joins with the dematerialization of the 21^{st} century. The architectural character of the framed surface comes together with the scientific character of the glass surface, which in itself, is, in reality, a parasite on the framed building. The whole building appears behind this duality of surfaces as a large cave in which life is perceived from the outside.

Various concepts of ornamentation, which are studied in this part of the article in order to clarify the differences between the value systems in architecture and structural engineering, can be seen in Table 2.

Table 2. Various concepts of ornamentation in relation to structure.

3. ETHICS BEHIND THE VARIOUS CONCEPTS OF MINIMUM

Analysis of Table 1, which outlines various concepts of structure, for the purpose of identifying the differences between the value systems of the architectural and structural engineering professions, shows that the most important variation in the concept of structure is due to the variation of the concept of 'minimum structure.' The concept of `minimum structure` creates contradictions, not only between the two professions, but also within each profession. The other variations in the concepts of structure -such as the acceptance or refusal of perceivable deflection, existence of singular or double structures,- do not create any conflicts between and within these professions. They change only from period to period. Thus, the concept of `minimum structure` can be viewed as the main source of the differences between the value systems of architecture and structural engineering.

In this part of the paper the concepts of `minimum structure` in architecture and in structural engineering are compared with similar concepts in the philosophy of ethics. The concepts of ethics, which are related to the concepts of `minimum structure` within this paper are Aristotle`s `golden mean,` I. Kant`s `will for control,` and G. Deleuze and F. Guattari`s `minimum as a source of desire.`

3.1. The Golden Mean

According to Aristotle (1999: 29) the minimum, or the maximum, are not good. The ‘golden mean’ is good for all free people. However, ‘mean’ does not mean the average of the extreme concepts. For example, if `mean` is a concept used in respect of bravery and fearfulness, it is not necessarily describing something, which is not brave and not fearful. Bravery is the ‘golden mean,’ because it is generally accepted as a good characteristic.

The ethics underlying the concept of the ‘minimum’ in the Gothic cathedrals (as the use of small pieces of stone), in 18th century bridges (as the achievement of lightness), and in the late-modern structural engineering (as the ‘optimization of design’) can be explained further by utilizing the concept of the ‘mean.’

Gothic builders preferred the minimum stone size for practical reasons. This was the only possible way of building those cathedrals. Thus, this tendency to minimize the amount of structural material used was for the well being of society, as in the idea of `mean.`

The designers of the 18th century bridges preferred to build light structures for the sake of speed of construction, and in order to satisfy the urgent transportation needs of merchants. The lightness of these structures was due to the use of iron as the structural material. This material was preferred for the urgent production of the rail bridges. Thus, this tendency to minimize the amount of structural material was also for the benefit of a large percentage of the population within these societies.

On the other hand, the idea of ‘optimization of design,’ which is in the service of the ‘art of architecture,’ is a response to the demands of the neo-liberal building market, and consumer society, and because of this some people might see it as the ‘mean.’ Its main characteristic is to give the right of decision about the aesthetic value of the building and the selection of the structural system, to the architects. This is necessary in order to express the differences in economic power between the people through the aesthetic characteristics of their buildings. The creation of the fashion for the elite

–as the symbolic capital-, capture of the fashion by the lower classes, and the continuous re-creation of the fashion, are covered by the concept of `culture industry.` (Adorno, Horkheimer, 1944)

Although the approach of ‘optimization of design’ leaves the selection of the structural system to the architects –including the selection of structural materials, type of structural system and the form of the structure-, it decreases the responsibility of the architects in respect of the aspect of technical design. For example, with the exception of the earthquake specifications and codes of a few countries, architects no longer have any legal responsibility to produce earthquake resistant building designs. (Paz, 1994) These codes mean that the structural engineer who makes the final optimization is responsible for the performance of the structural system. (Hürol, Wilkinson, 2005) This is the response of the authorities to the artistic tendencies within the neo-liberal building market, which might be acceptable for extraordinary buildings, but not for background buildings.

Neo-liberal philosophers, such as F. Fukuyama, might accept this situation as useful for society as a whole and for the future of humanity. (Derrida, 1994) According to this approach, the neo-liberal market represents society as a whole, and thus the approach described as the ‘optimization of design’ can be seen as the ‘golden mean.’

On the other hand, according to H.Ü. Nalbantoğlu (2000) this trend is a product of the myths of the star-cult, and spontaneous ideologies of professions, which rationalize the needs of the neo-liberal market. R. Sennett’s (1998) concept of the neo-liberal market is also harmful to most individuals. According to this approach, the neo-liberal market does not consider the ‘common good,’ as was the case in Ancient Greece. This point of view can also be explained by considering the ethics of A. Badiou (2001), which highlights the existence of the forgotten and ignored groups within the neo-liberal world. According to him, it is not ethical, if a group of people is ignored. Thus, the ‘optimization of design’ cannot be the ‘golden mean.’

3.2. Will for Control

I. Kant’s concept of ‘will’ explains the personal power to strive for good. However, the target is not the egoistic good, it is the general well-being of the society. Still, Kant’s concept of ‘will’ is different from that of Aristotle’s ‘mean.’ According to Kant, although the concept of good changes periodically and from person to person, there is an individual concept of good, which serves for the well being of everybody. (Kant, 2004: 28; 1959: 7)

The ethics behind the appearance of the 20th century structural engineering concept of ‘design of the optimum’ can be explained with the concept of ‘will for control.’

‘Design of the optimum’ is the way of achieving the most economic design for the buildings with framed structural systems. It is the ‘instrumental rational’ approach to the structural design of background buildings. It optimizes the amount of structural materials, and the amount of required energy to build the building with the minimum cost. In other words, it guarantees building economy through geometric simplicity and lower labour costs. This purist approach to building design enabled many governments to provide shelter for their people during and after the Ist and 2nd World Wars.

This approach is reminiscent of Kant`s `will,` because it seeks the general well-being of society from a certain perspective. This is the structural engineers’ perspective of the `common good.` According to the neo-liberal approach, ‘design of the optimum’ is useful only during economic crisis periods. On the other hand, the elimination of the pure and mechanical characteristics of ‘design of the optimum,’ might put it in the service of an architectural search for sustainable ecology as well.

G. Bachelard’s (1994: 228) concept of ‘simplicity,’ which brings a peaceful poetic life, can be helpful in the elimination of the mechanical characteristics of ‘design of the optimum.’ The main characteristics of this type of simplicity are having nothing more than necessary, having nothing considerably different from others, and having continuity with the environment and nature. The best examples of such simple buildings can be found amongst vernacular architecture.

3.3. The Minimum as a Source of Desire

According to Deleuze and Guattari (1993: 149-66), the demand for minimum creates a strong `desire.` Existence of this desire is a more important goal than the achievement of the object of desire. An example of the demand for the `minimum` as a source of desire is the love affairs of the chevaliers in the Middle Ages. The chevaliers` love depended on the demand of the minimum from the beloved woman who was already married to a noble man. The desire for this love, which has theatrical and sado-masochistic characteristics, was more important than the achievement of togetherness with this woman. (Deleuze, Guattari, 1993: 149-66) This type of love is a good example of the concept of minimum, because almost nothing is demanded from the beloved women.

The ethics behind the 'naturalistic' approach to structural engineering, which depends on achieving the minimum structure by achieving 'structural efficiency,' can be explained with this concept of the minimum, which is a source of desire. The 'naturalistic' approach to structural engineering, which minimizes the amount of structural material to its limit, has a certain aesthetic outcome, which can be described as the 'aesthetics of nature.' This approach produces `desire` as in the case of Deleuze and Guattari`s 'minimum,' because it always seeks for the least, finds different ways of achieving the least, and this never ends. This purist attitude usually corresponds to the aesthetics of extraordinary buildings –the buildings of power-, rather than the aesthetics of background buildings –the buildings of people, because finding new ways of achieving the structural minimum requires design, production and the application of new and expensive technologies.

3.4. Hybrid Approaches to the Ethics of the 'Minimum'

According to the above explanations, there are strong correspondences between the structural engineering concepts of 'minimum structure' (design of the optimum, optimization of design, and structural efficiency) and the various concepts of the 'minimum' in ethics. However, this is not valid for most of the concepts of 'minimum structure' in architecture. There is not any direct correspondence between most of the architectural concepts of 'minimum structure' and the concepts of minimum within the philosophies of ethics, which are considered in this paper. The ethics behind the concepts of 'minimum structure' in early-modern architecture, as well as in contemporary architecture in which suspended glass systems are used, can be explained by using more than one concept of the minimum from the philosophy of ethics. Some people might also think that the late-modern architectural approach to structures, as well as the structural engineering approach of 'optimization of design,' should also be explained with the help of hybrid concepts of ethics, as opposed to the pure concepts of the ‘minimum,’ such as the ‘golden mean.’

The early 20^{th} century architects` understanding of the ‘minimum structure’ differed from that of the understanding of the corresponding structural engineers. This architectural approach, which depended on the use of simple geometric shapes, the least amount of columns, and the minimum sizes of columns, considers the economic and aesthetic demands simultaneously. This attitude is understood as a mixture of the two structural engineering approaches: the naturalistic and instrumental approaches, which correspond to ‘structural efficiency’ and ‘design of the optimum.’ The characteristics of this mixture indicate a different interpretation of the structural engineering concepts of the ‘minimum.’ The exaggerated distance between the columns gives a false image of ‘structural efficiency,’ whilst the simplicity of the form gives a false image of the instrumental approach. The possibility of having long spans –other than the optimum- between the columns, cancels any similarity with the instrumental approach and Kant`s concept of `will,` whilst the use of rectangular prismatic forms cancels any similarity with the naturalistic approach and the concept of the ‘minimum’ of Deleuze and Guattari.

On the other hand, the buildings with ‘suspended glass systems’ indicate the recent trends in structural design, and they demonstrate some different characteristics in comparison to the other buildings, which were studied within this paper. The main difference depends on the division of roles between the architects and the structural engineers. Architects design the functional parts of the buildings, and structural engineers design the glass surfaces. Thus, a duality occurs in design, because of the duality which exists between the value systems underlying these two structures. The main building structure is usually designed according to ‘optimization of design,’ whilst the glass surfaces are designed in order to achieve ‘structural efficiency,’ which represents the ‘naturalistic’ approach to structural engineering design.

Although this ‘naturalistic’ approach seems to be similar to the previous one, there are three important differences between them. The first of these differences depends on the structural character of the glass surface. Since the suspended glass surface is accepted as non-load bearing, it is allowed to have perceivable deflection. Only, the strength, stability and the equilibrium requirements of these systems are considered, but not the requirement of the elimination of perceivable deflection. However, the previous ‘naturalistic’ approach did not (and does not) accept the existence of perceivable deflection. The second difference is the dependence of the suspended glass system on the main building structure. The new ‘naturalistic’ design creates ‘parasites’ of some other structures, whilst the previous one did not. The third difference is due to the aesthetic importance of the structural details of the suspended glass systems. Forms of the building and the structural members provided the aesthetic character of the building within the previous ‘naturalistic’ approach, whilst the ornamental character of the structural details took this role in the case of the new ‘naturalistic’ approach of suspended glass surfaces.

The characteristics of the `minimum structure` in the suspended glass systems (not in the main building) combines the ethics of Kant`s individual ‘will,’ and Deleuze and Guattari`s `desire for the minimum.` Each structural engineer might apply mathematic principles, which move in totally different directions during the design of these suspended systems. This will result in an individual creativity, which permits Kant`s individual ‘will’ to serve the common demand. On the other hand, the desire for `dematerialization` and extreme transparency, also indicate Deleuze and Guattari`s `desire for the minimum.`

4. THE ETHICS BEHIND THE VARIOUS CONCEPTS OF ORNAMENTATION

The ethics of ornamentation can be discussed by relating ornamentation to poetics. Unlike aesthetics and symbolism, poetics has strong connections with both ethics and politics, because it relates everything to each other. If ornamentation is poetical, it either introduces disorder or complexity into the order of things in order to relate different things to each other, or it avoids purism as a result of its hybrid properties.

In this paper an ecological approach to poetics is preferred rather than any spiritual approach, because there is a danger of purism and focusing on order (and ignoring disorder) within all spiritual approaches. Thus, poetic-ethics of ornamentation is defined as an ability to relate different things to each other –and especially to relate buildings to nature- by introducing disorder or complexity into the order of the structure, or by some other method.

In this part of the paper the poetics, and thus the ethics behind the ornamentation of Gothic cathedrals, 18th century bridges, products of the three structural engineering approaches –'design of the optimum,' demand for 'structural efficiency,' and 'optimization of design'-, the products of early and late-modern architecture, and buildings with suspended glass systems are discussed.

In Gothic cathedrals the structural stone surfaces are ornamented. The lines of structure are mixed with the lines of ornamentation. This type of ornamentation relates these buildings to nature by hiding the order of the stone pieces by introducing another form of order to it.

Structural members of the 18th century bridges have structural and ornamental roles simultaneously. Some members are more ornamental than structural, and some members are more structural than ornamental. This makes an understanding of the structure more difficult, and the meaning of ornamentation more abstract. It is a kind of dual order, which is combined into one. In respect of the Iron Bridge these orders appear as the order of the iron arch, and the order of the circular additions. Thus, the ornamental character of these structures relates them to nature through this type of dual order.

The 'design of the optimum' approach in structural engineering is a demand for purity, which considers only the order –as the optimum-, and eliminates any possibility of disorder. This is a mechanical order of production. Thus, the buildings and structures, which are produced with this purist approach, do not have any specific relationships with nature or with their environments. The demand for 'structural efficiency' is another purist approach, which searches for, and reflects the order in nature. Although this approach does not produce any disorder, it is still related to nature.

On the other hand, early and late-modern architecture can be defined as hybrids of the above structural engineering approaches -'design of the optimum' and demand for 'structural efficiency.' Modern buildings are poetic, because they are the products of hybrid approaches, and there are considerable effects of structurally efficient buildings (and thus nature) on them. This hybrid character of modern architecture gives it a freedom to add disorder to order. For example, in the case of early-modern buildings it was possible to have longer spans than the optimum span dimension, and because of this disorder it also became possible to imagine some other possibilities of disorder. In the case of late-modern buildings, because of the importance of the artistic form, which is different from that of the optimum form, it became possible to imagine other possibilities of disorder as well. The ‘optimization of design’ approach, which is the structural engineering version of late-modern architecture, shares the same characteristics with this architecture.

Actually, it is unfamiliar to discuss the poetic characteristics of any modern buildings, because of the strong effect of modern aesthetics on them. However, it is more difficult to approve the role of disorder in modern architecture with the help of aesthetics. Aesthetics is usually used to explain artistic characteristics through order and semiotics. On the other hand, a poetic approach can be used to question the shared disorder between different things, and to avoid seeing buildings as objects.

The order of the buildings with ‘suspended glass systems’ is dual: the main building structure, which is designed according to the ‘optimization of design,’ and structure of the suspended glass surface which is structurally efficient. Having dual orders, and being structurally efficient, creates poetic relationships between these buildings and nature. However, the way through which this new ‘structural efficiency’ is related to nature is different from the previous one. The new ‘structural efficiency’ relates the suspended surface not only to nature, but also to the main building structure, because the order of glass pieces follow the mechanical order of production and adapt to the order of the main building, whilst the structurally efficient small details of the suspended structure follow the rules of nature. These structural details are very fine, numerous, clearly exhibited, and of great variety. They create an ambiguity due to their small sizes, and with their dispersed character in space. These details can be accepted as ornamental especially because of their poetic characteristics. One can even use the term `structural ornamentation` for these details. The possibility of having perceivable deflection also makes these structures similar to the structures in nature.

5. CONCLUSION

Analysis of the various concepts of structure and ornamentation in the architectural and structural engineering professions, and discussions about the ethics behind these concepts, show that the differences between the value systems of these two professions are not simplistic or one dimensional. These discussions about the ethics behind the concepts of 'minimum structure' and ornamentation are outlined in Table 3.

Table 3. The relationship between ethics of the 'minimum structure' and the ethics of ornamentation.

Table 3 can be analysed in order to formulate a final discussion about the differences between the value systems of the architectural and structural engineering professions. During this analysis it is better to concentrate on the 'demand for structural efficiency' and 'design of the optimum' in order to understand the basic characteristics of the value system of structural engineering, and concentrate on the early and late-modern architecture in order to understand the basic characteristics of the architectural value system. This focus on certain types of approaches can lead us to a healthy analysis and results, which cover most of the contemporary buildings and structures.

With the help of this limitation it becomes clear that structural engineering approaches to the ethics of the 'minimum structure' are purist, whilst architectural approaches are hybrid. Thus, structural engineering approaches to 'minimum structure' –both 'design of the optimum,' and demand for 'structural efficiency'- are rational in order to be purist, whilst the architectural approaches (both early and late-modern) are poetic because of their hybrid character.

Design of the structurally efficient object is a sympathetic approach to ornamentation, because it depends on the re-production of the natural order. This is a rational and purist interpretation of nature, which also satisfies the human need for the poetical. However, structural engineers might also reject ornamentation through the instrumental rational approach of 'design of the optimum' by producing order for the sake of order. On the other hand, modern architectural approaches to ornamentation can be outlined as the reduction –but not elimination- of ornamental poeticism by means of formal aestheticism.

It is suitable to compare these structural engineering and architectural approaches with each other in order to make generalizations about the differences between the value systems of modern architecture and structural engineering. According to this comparison, the value system of structural engineering in respect of ‘minimum structure’ is rational and purist, whilst the value system of architecture is more poetic-ethical. On the other hand, the value system of architecture in respect of ornamentation reduces it to formal aesthetics, whilst the value system of structural engineering either ignores ornamentation, or gives it a rational and a poetic-ethical value, simultaneously. Thus, the architectural value, which is given to structures, is more poetic-ethical than the corresponding structural engineering value. Similarly, the structural engineering value, which is given to ornamentation, ‘can be’ more poetic-ethical than the corresponding architectural value.

The main cause of the poetic-ethical value development in architecture is an opposition to mathematical perfection and purism, which results in hybrid approaches. On the other hand, the cause of poetic-ethical value development in structural engineering is a strong concentration on nature, as in the case of structurally efficient design. One should also accept that the instrumental rational approach to structural engineering –design of the optimum- was a result of a pure and non-poetic ethics, which is the result of a strong concentration on the needs of the society.

The above differences between the value systems of architecture and structural engineering signify a strong conflict between nature and modern human culture, which is shared equally by both professions. During the construction of the Gothic cathedrals and 18th century bridges, the architect and the structural engineer was the same person, and they preferred to conceal the rigid order of human culture behind the natural lines of ornamentation.

On the other hand, the poetic-ethical characteristics of the contemporary buildings, which have suspended glass systems, are different from the other modern buildings. There are two reasons for this difference. The first reason is the exposition of architectural and structural engineering value systems side by side. A poetic approach to structure takes place beside a poetic approach to ornamentation. This is a particular poetic-ethical approach, which indicates a reciprocal respect for the value systems between these two professions. The second reason is the ornamental character of the details of the structure of suspended glass systems, rather than the form of the structure. This characteristic makes these structures more ornamental than the previous structurally efficient structures, because of the small size of the ornamental parts. The existence of the suspended glass systems is clear evidence for the poetic-ethical approach of structural engineering to ornamentation.

In order to achieve a more poetic-ethical value system in architecture and structural engineering, structural engineers can design visible structural details for buildings, and architects can continue to design the structural order (order+disorder) of the same buildings. It was previously possible for architects to design structural order for buildings, but it was not possible for structural engineers to design visible structural details. Thus, further research is necessary in order to understand more about the roles of visible structural details in structures and buildings.

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[i] The following buildings which contained suspended glass systems are analyzed in order to develop information about the contemporary value systems and the duality between structure and ornamentation.
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