



School of Housing, Building and Planning

DESIGN OPTIMISATION : Between Aesthetic and Functional Consideration

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DECLARATION

I hereby declare that the dissertation, submitted in partial fulfilment of the requirements for the degree of Housing, Building and Planning (Quantity Surveying) and entitled “Design Optimisation : Between Aesthetic and Functional Consideration”, represents my own work and has not been previously submitted to this or any other institution for any degree, diploma or other qualification.

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INTRODUCTION

CHAPTER 1

INTRODUCTION**1.1 RESEARCH PROBLEM**

One of the important criteria for any successful civilisation is its unique architecture or splendid municipal architecture. This statement can be strengthened by referring to Ching in his book, *Architecture : Form, Space, and Order*, “*At times, judgement on design may be good because people feel it follows current design trends or because of the impression it will make on others – it is in fashion or it enhances a status*”. Lars Charles Mazzola, 1996 emphasised that, “..... the characteristics of an advanced civilization also harnesses more and more powerful forms of renewable energy.....”. He added that the advancement of civilisation is stage by stage, by determined individuals who preserve the wisdom of the past, who are engaged in the lifelong process of civilizing themselves, who seek new forms of inquiry and knowledge, and who work collectively for the well-being of all creatures”.

Even our country has been independent for about 48 years, our country still lacking the glorious and splendour architecture which can remain as a great empire. This study of design optimisation between aesthetic and functional is one of the awareness as a citizen to fulfil the endeavour of development for a great civilisation.

To provide a great civilisation, architecture plays a big role in fulfilling a good quality of living. A consciousness on building management can settle many problems to the occupants; for example, good air ventilation, circulation and flow can provide a good physical condition and comfortable.

Some factors are difficulty to incorporate into a very personal, intellectual architectural expression such as the needs of others, or the constraints of space and building materials. Sometimes, people who are contributed and responsible on developing these buildings are less concerned about how importance planning for functionality and designing for aesthetic to those kind of buildings.

A good architecture is not just concerned on aesthetic value but it also appropriate with it function. In the developed country all the citizen should be aware on giving a good service and concern about the others, their buildings should not just nice and pleasing to the eye but also safe to the buildings' user. Disable persons who always find the difficulties to excess some areas in building (vertical movement between the levels) should also take into account.

1.2 RESEARCH STATEMENT

There is no specific definition about design optimization in architecture, but design optimization can be related to the concept of excellent design. The concept of design excellent in the context of building construction is to design with ambitiously, carefully

and serious investigation into all elements of the building structures. Design excellent will achieve when the perceived benefits are not just at the aesthetic value; where people will see it as a beautiful design but also functional and useful; where there is less criticisms from the clients and users.

Ching has concluded that a design may be good in the judgement of the designer, client, or the people who experience and used the design, for any of several reasons: (i) a design may be good because it function well – it work,(ii) a design may be good because it look good – it is aesthetically pleasing,(iii) a design may be good because it is affordable – it is economical, efficient, and durable and (iv) a design may be good because it recreates a feeling remembered from another time and place – it carries meaning.

1.3 RESEARCH AIM

A justification for this study of design optimisation is **to find out which task shall be taken by the designers in order to design with high aesthetic value by means of the very desirable quality for the purpose it was design for – or the expectation that the design excellent perform as required when it is transformed into the structure.**

1.4 RESEARCH OBJECTIVE

- To find out whether in practice, designers concern about design optimisation between aesthetic and functional.
- Investigate whether existing design/ building obtain the objective of design optimisation between aesthetic and functional.
- To find out what is the best methodology or approach in order to achieve design optimisation.



DESIGN
OPTIMISATION :
Aesthetic and Functional
Behind the History

CHAPTER 2

DESIGN OPTIMISATION: AESTHETIC AND FUNCTIONAL BEHIND THE HISTORY**2.1 DEFINITION**

Design is one of the highest endeavours to which we can aspire: the making of unambiguous proposals to reshape our environment to make it better suited to men's and women's needs (Anthony et al., 1988, p.3). The concept of design optimisation for this study conveys the idea of balance, of harmonic, of dynamic symmetry, of honest expression of the size of structural elements and in general, of a pleasing and satisfying wholeness, such as we often are able to recognise in other art. For the result, design optimization should fulfil the goal of instilling in every creation a personally meaningful quality, expression the fitness and functional through the broadest range of usefulness to the human occupants. Design optimisation links the desire for good performance in the goals to the decisions that result in good performance (Anthony and John).

Aesthetic in the context of quality is how well a building blends into its surrounding, the ability of a landscaping design to match the theme of adjacent structure, a building psychology impacts on its inhabitants and the use of bold new design concepts that capture people's imaginations (Frank et al.,1994). James Franklin also stated "*.... gets measured in terms of how well the specified requirements were met*

with no quantifiable deficiencies or error. It means being on time and in the budget with no discernible negligence – doing things the right way in sequential order.” (Capon, 1999)

“A great part of beauty... is derived from the idea of convenience or utility... The order and convenience of a palace are no less essential to its beauty than its mere figure and appearance.” (Capon, 1999)

2.2 THE VIEWS OF ANCIENT ARCHITECTURE

An ancient architecture has a good connection to the natural beauty and the environment. Beauty for the Greeks was not only the geometry architecture but also the grace of the human body in sculpture. Their architecture showed the relation between beauty and practical where both had been transformed in a combination of art and science. Most of ancient architecture related to mathematics theories and concepts where it shows off the wealth, extravagance, love and romance, immortal, and power.

The link between beauty and mathematics approached through either arithmetic or geometry (Capon, 1999). Archytas (Capon, 1999) has distinguished between arithmetic, the geometric, and the harmonic mean in the study of proportions (Capon, 1999). Plato has distinguished three principles of rhythm out of which all metrical systems in poetry, for example can be framed, 1:1, 1:2 and 2:3, and from Pythagoreans

like Archytas he would have learned of the importance of such numerical systems to the laws of symmetry and harmony which framed the universe (Capon, 1999, p.43).

Archytas has wrote in Philebus (Capon, p.113-189): *“True pleasures are those which are given by the beauty of colour and form straight lines and circles and the plane or solid forms which are formed out of them by turning lathes and rules and measurers of angles, for these I affirm to be not only relatively beautiful like other things, but they are eternally and absolutely beautiful.”*

Plato has state, (Capon, 1999) *“The efficiency of every structure is relative to the use for which nature or the artist has intended it.”*

The architects of Renaissance saw the proportions of the human figure as a reaffirmation that certain mathematical ratios reflected the harmony of their universe, anthropometric proportioning methods seek not abstract or symbolic ratios, but functional ones. They are predicted on the theory that forms and spaces in architecture are either containers or extensions of the human body and should therefore be determined by its dimension.

The function may not be the merely practical one where everything should have its proper place, but also may please: bodies are beautiful in proportion as they are useful or as the sight of them give pleasure. Functionalism was start developing in architecture in the nineteenth century (Capon, p.113). Viollet-le-Due in France proposed (Capon, p.113) the view that the beauty of a Gothic cathedral lay in the fact that its buttresses

and vaulting clearly expressed a structural purpose; and in 1851, Horatio Greenough wrote to Ralph Waldo Emerson, saying that he found in the principle that beauty follows from function a theory that “*will do for all structures from a bedstead to a cathedral... [seeing] in the ships, the carriages and the engines a partial illustration of the doctrine, and a glorious foretaste of what structure can be in this country*” (Capon, 1999, p.113).

Emerson (1860) has wrote, (Capon, p.113) “*Beauty rest on necessities. The line of beauty is the result of perfect economy. The cell of the bee is built at the angle which gives the most strength with the least wax.*” Herbert Spencer also said the same idea, “*Beauty follows the principle of economy*” (Capon, p.113).

2.2.1 Renaissance Theories

Pythagoras discovered that the consonances of the Greek musical system could be expresses by the simple numerical progression—1, 2, 3, 4 — and their ratios, 1:2, 1:3, 2:3, 3:4. This relationship led the Greeks to believe they had found the key to the mysterious harmony that pervaded the universe (Ching, 1996, p.298).

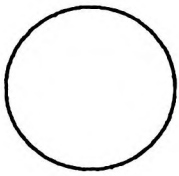
The architects of Renaissance, believing that their buildings had to belong to a higher order, return to the Greek mathematical system of proportions (Ching, 1996, p.298). Seemed conceiving music to be geometry translated into sound, architecture was mathematic interpreting into spatial units (Ching, 1996, p.298). Greeks developed an

unbroken progression of ratios that formed the basis for the proportion of their architecture and manifested themselves not only in the dimensions of a room or façade, but also in the interlocking proportions of a sequence of spaces or an entire plan (Ching, 1996, p.298).

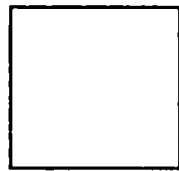
“Beauty will result from the form and correspondence of the whole, with respect to the several parts, of the parts with regard to each other, and of these again to the whole; that the structure may appear an entire and complete body, wherein each member agrees with the other, and all necessary to compose what you intend to form.”

- Andrea Palladio (Capon, 1999)

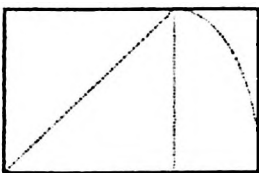
2.2.2 7 Ideal Plan Shapes for Rooms (Ching, 1996, p.298).



Circle



Square



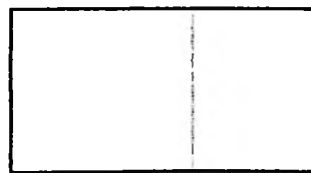
1 : $\sqrt{2}$



3 : 4



2 : 3



3 : 5



1 : 2

Andrea Palladio (1508-80) proposed these seven “most beautiful and proportionable manners of rooms” (Ching, 1996, p.299).

2.3 THE VIEWS OF MODERN ARCHITECTURE

The beginning of the 20th century was filled with ideologies that would solve all social and economic problems through architectural solutions. Architecture can change or even influence people behaviour and attitude in the way it has been presented. The choosing of colours, shape, light, and texture can change a feeling and mood of human performance. As Edward Robert De Zukro stated in his book, ‘A Century of Functionalism’, “Architecture should reflect and contribute to the moral or ethical ideals of men in the way that the building should be true, not dishonest”. He also stated that the society of forms should achieve its goals through harmonious cooperation.

Yang Mian has emphasised in her essay, *Ideal Building Standard* in 2000, throughout the 1900s most cities especially in Europe evolved from the Roman pillars along with Gothic doors and windows and imposing eaves of the 1930s, to the Soviet architecture of the 50s, to the amber-yellow glass, yellow ceramic tiles, blue glass and white ceramic tile matchbox architecture to green glass, granite, extruded aluminium to today’s, stylish outer garments. From these clues, modern architecture underwent a most rapid and active modernisation. A third-war may lack a smooth evolutionary of this process: from the ancient to the modern, and from a perspective of cultural power. Their

modern architecture almost tries to show attraction by the cultures within the societies and the adaptation of their civilisation.

There are many movements that characterised the progress of new century and it would be proper to say that the International style was the culminating style of the many modern movements in architecture. The concept of functionalism has had a great influence on modern architecture thought, and it is a fundamental concept in modern architecture (Edward Robert, p.7). The principal in modern architecture is general and never associates with any one particular style. Bruno Taut stated in '*Modern Architecture*' aesthetic as follows: "*The aim of Architecture is the creation of the perfect, and therefore also beautiful, efficiency.*" (Edward Robert, p.9)

Study of a modern theory of architecture would not be complete without the inclusion of Le Corbusier. His interest in art and architecture as an emotional expression and an industrial solution promoted an architecture of technology and pure form which spawned generations of followers as well as adversaries. He reduced daily life to its most fundamental to reveal the essence of what is, or at least what could be, modern. But limiting a study to such a narrow subject matter would necessarily ignore the much advancement made by so many others. Adolf Loos, Mies van de Rohe, Walter Gropius, Eric Mendelsohn, Alvar Aalto and countless more who contributed to orthodox modernist architecture provided the fountain of ingenuity for the followers.

2.3.1 Modulor: A Modern Theory of Architecture

Modulor system has developed by Le Corbusier to order “the dimensions of which contains and which is contained.” He reviewed the measuring tools of the Greeks, Egyptians, and other great civilisations as being “infinitely rich and subtle because they convert the mathematics to the human body, gracious, elegant, and firm, the source of that harmony which move human, beauty.” The modular is actually a marriage between mathematics (the aesthetic dimensions of the Golden Section and the Fibonacci Series) and the proportions of human body (functional dimension) (Ching, 1996, p.302).

The modulor is not merely as a series of numbers with an inherent harmony, but as a system of measurements that could govern lengths, surfaces, and volumes, and “maintain the human scale everywhere.” It could “lend itself to infinity of combinations: it ensures unity with diversity... the miracle of numbers” (Ching, 1996, p.303).

2.4 BETWEEN AESTHETIC AND FUNCTIONAL

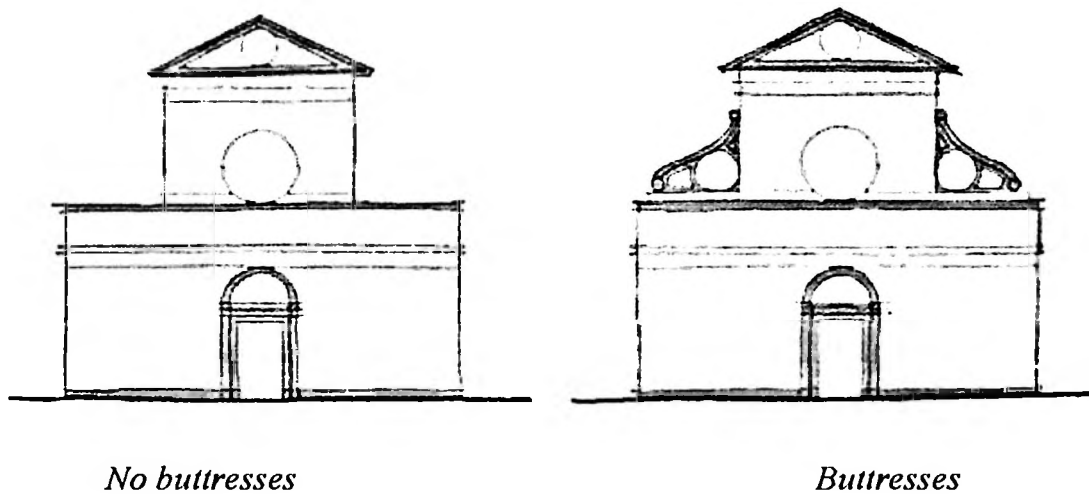
The idea of function is not a simple one. Function may be objective or subjective (Edward Robert, p.7). There are a various types of functions, such as the practical or material needs of the occupants of a building; the functional expression of structure; the psychological needs of the occupants; the social function of architecture; and the symbolic monumental function of architecture (Edward Robert, p.7). Designers shall

also consider about climate influence to their designs and make the designs become functional, for example in rain forest tropical country like Malaysia, where through out the whole year wet and hot, roof structure must be design to receive a load from rain and can avoid water from seep into the building and damage the structures when there is a heavy shower. That is worse when designer just design a beauty structure but lack of function where people feel not comfortable and safe stay inside that building.

Edward Robert stressed that functional may or may not involve a theory of beauty. Functional is more to the fitness and utility regarded to the best performance of the building, which is not really concern about its beauty. Functionalist theories of architecture are those which make strict adaptation of form to purpose the basic guiding principle of design and the principal yardstick by which to measure the excellence or the beauty of architecture. Harold A. Small had written in his essay “... *best or finest... are meaningless unless they are made in relation to specific criteria of judgment... a finer building than others which, by the standards of good facilities for exhibiting things, were far finer than it was.* “

In 2000, the American Institute of Architects (AIA) conducted a survey to understand public perceptions about architecture. It was found that nearly half of business clients felt that the design of a facility or its fit into its environment was not a priority. In addition, 90 percent of respondents felt that there was a greater value in architectural functionality than design.

Figure 1 Shows the function of aesthetic. The addition elements (buttresses) make a building more strength and also perform a beauty (Young, 1986).



Ching in his book wrote, proportioning systems for example; go beyond the functional and technical determinants of architecture form and space to provide an aesthetic rationale for their dimensions. They can visually unify the multiplicity of elements in an architectural design by having all of its parts belong to the same type of proportions. They can provide a sense of order in, and heighten the continuity of, a sequence of spaces. They can establish relationships between the exterior and the interior elements of a building. Those are meant the connection between functional and aesthetic.

The question of the nature of the conflict between functional and aesthetic design was raised, exemplified as design from the 'inside outwards' or from the 'outside inwards'. A rich collection of aspects of this verbally somewhat elusive subject was aired in discussion between people of very varied experience and interests, some of whom had brought with them an interesting variety of objects to illustrate their points, which included: the multi-functional nature of many objects; that functionality can

develop into styles having little real connection with its physical basis; that art in all its forms has never been so easily accessible as it is today but that nevertheless there is a low understanding of aesthetics and that it seems to be getting worse; that the eye has to be trained and that many schools make great efforts to do so; the value of the 'golden section' in producing designs pleasing to the eye; that there is an attraction in positively non-functional looks; the power of a multitude of different kinds of associations which are aroused by objects; the influence of the social character and prosperity of the market; that some societies welcome new things whilst others have conservative tastes; the commercial use of appearance; the commercial courage needed to market a novel design; the opportunities provided by new materials and the stages by which they cause designs to change; the importance of the design of an object, particularly if large, complicated and composed of many systems, having an overall unity and therefore having an overall designer; the fallacies of 'system design'; that progressive development is often needed to mature the design of a product; that the great effort that is commonly expended in development, manufacture, costing, quality and aesthetics, in putting a product on to the market is generally unrecognised.

(John Coates, January 1999)

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DESIGN
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CHAPTER 3

DESIGN FOR AESTHETIC**3.1 INTRODUCTION**

Architectural design is good when there is a balancing into its elements through the texture and colour, light, sound, layout and pattern, shape and line and also its scale. The fit-quoted statement that 'Beauty is in the eye of the beholders' is frequently used to damped discussion on this topic. The appreciation of beauty must, nevertheless, be a subjective one.

The factors which influence beauty discuss in this chapter based on Ching (1996, 2000, and 2005) and Young (1986) are:

- ✦ Shape and Line
- ✦ Texture
- ✦ Composition and Datum
- ✦ Unity
- ✦ Balance and Symmetry
- ✦ Proportion
- ✦ Scale
- ✦ Identity
- ✦ Colour
- ✦ Pattern
- ✦ Shade and Shadows

3.2 SHAPE AND LINE

A point has no dimension or scale. When made visible as dot, the point establishes apposition in space. As the dot moves across a surface, it traces the part of a line—the quintessential element of drawing. We rely principally on the line to portray the edges and contours of objects we see in visual space. In delineating these boundaries, the line naturally begins to define shape—the pictorial element which establishes the figures in our visual field and organises the position of a drawing.

—Francis D.K. Ching & Steven P. Juroszek

Lines have an emotional impact on eye (Young, 1986, p.111). Horizontal lines tend to be restful (Young,1986), represent stability (Ching, 2005), can be used to emphasize the length of a building (Young, 1986) and the plane upon which we stand or move (Ching, 2005); vertical lines on the tall buildings are stimulating and similarly can be used to emphasize verticality on a part or the whole of a building (Young, 1986) and can express a state of equilibrium with the force of gravity (Ching, 2005); inclined lines tend to be disturbing unless they relate to a specific function or structural component (Young, 1986, p.112). Curve lines are usually soothing (Young, 1996), gentle movement (Ching, 2005), can provide interest and rhythm (Young, 1986, p.112) and can express playfulness, energy and pattern of biological growth (Ching, 2005).

Lines should always relate to structure or functional elements and should not simply be added to a façade for no apparent reason (such as a change of colour or material for no functional purpose) (Young, 1986, p.111-112).

There are several broad kinds of shapes. Shapes are made up of various lines—straight, curved, and free and these lines can be used to emphasize or subdue the visual effect (Young, 1986, p.111). Certain shapes have symbolic associations and it is thus important that shapes that are chosen are appreciated and are clearly stated so that the eye is not confused (Ching, 2005, p.93). A shape that is almost square is disturbing as the eye is not sure whether it is seeing a square or a rectangle. Natural shapes, for example leaf and shell can represent the images and forms of our natural world, non-objective shape such as numbers and alphabets may carry meaning as a symbols and geometry and elicit shape may responses based on their purely visual qualities (Ching, 2005, p.93). The circle is a compact, introverted shape that has its centre point as its natural focus and also represents unity, continuity, and economy of form (Ching, 2005, p.94). Curvilinear lines and shapes can be seen to be fragments or combinations of circular shape. Curvilinear shapes are capable of expressing softness of form, fluidity of movement, or the natural of biological growth (Ching, 2005, p.94).

The shade and shadow, perspective or the form of building can affect shapes, especially where this is curved. The arrangement of shape is as important as the shapes themselves where it provides regularity without monotony and can be achieved on large facades by grouping shapes together and ensuring that the shapes between the shapes are pleasant and complement the shapes themselves (Young, 1986, p.111). The

eye tends to remain unconfused providing shapes are repeated and regularly arranged (Young, 1986, p.110).



Plate 1 Guggenheim Museum which is designed by the North American architect Frank O. Gehry, this unique Museum built on a 32,500 square meter site in the centre of Bilbao represents an amazing construction feat. On one side it runs down to the waterside of the Nervión River, 16 meters below the level of the rest of the city of Bilbao. One end is pierced through by the huge Puente de La Salve, one of the main access routes into the city.

3.3 TEXTURE

While lines are essential to the task of delineating contour and shape, certain visual qualities of surface and volume cannot be fully described by line alone. Even when we vary the weight of a line to imply a shift in the direction of a surface or an overlapping of forms, the effect is subtle. In order to accentuate shape and model the surfaces of forms, we rely on the rendering of tonal values. Through the interplay of tonal values we are able to convey a vivid sense of light, mass and space. And through a combination of lines and tonal values, we create the tactile sensation and appearance we call texture.

— Francis D.K. Ching & Steven P. Juroszek

Texture is the specific quality of surface that results from its three-dimensional structure. Texture is most often used to describe the relative smoothness or roughness of a surface, it can also be used to describe the characteristic surface qualities of familiar materials, such as the roughness of stone, the grain of wood, and the weave of a fabric.

Types of texture can be divided by two; tactile texture is real and can be felt by touch, visual texture can be seen by the eye. All tactile textures provide visual texture as well.

3.4 COMPOSITION AND DATUM

An introduction, a main body and a conclusion of written work can be an analogy for a whole building. Composition for building should be punctuated with vital elements; stop at the top and bottom generally in the form of square window whilst string courses formed pauses in the rhythm (Young, 1986).

One of the problems of many recent high-rise buildings is this lack of any definite punctuation especially the top-many buildings look as if they could easily have had several storeys more or less and that the termination was purely arbitrary (Young, 1986).

Young mentioned that the eye does not only need to be stopped at the end of the building but it also needs to be drawn to the focal point of the building. It is common to see a symmetrical building where is shown a balance between its compositions. For asymmetrical building its façade usually focus in the middle and, in the case of the entrance, is either set forward or recessed back to give emphasis.

While a datum refers to a line, plane, or volume of reference to which other elements in a composition can relate (Ching, 1996, p.346). It organises a random pattern of elements through its regularity, continuity, and constant presence (Ching, 1996, p.346). A preceding section illustrated the ability of an axis to organise the series of elements along its length (Ching, 1996, p.346). In effect, the axis was serving as a datum and a datum actually does not be a straight line, it also can be planar or volumetric in form (Ching, 1996, p.346). Ching stressed that a sufficient visual continuity to cut through or by pass all of the elements being organised can be effective ordering device for a linear datum. If planar or volumetric in form, a datum must have sufficient size, closure, and regularity to be seen as a figure that can be embrace or meet together the elements being organised within its field.

3.5 UNITY

Unity is the state or quality of being combined into one, as the ordering of elements in an artistic work that constitutes a harmonious whole or promotes a singleness of effect (Ching, 1996).