

THE PSYCHIC RESPONSIBILITY OF ENGINEERING

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Synopsis

The primary task of engineering is to serve society – not scientific vanity. The above statement might seem of no significance to most "modern" engineers, for whom finite elements, Stoke's fifth-order theory and visco-elastic concrete are of greater importance. However, the most important task of engineers is the "Psychic Safety" of their structures. It is of deep concern that not only are most engineers not aware of this "psychic responsibility" but those who are, only just mention this important subject without going any further to either define, or evaluate this responsibility.

This paper attempts to define and evaluate the "Psychic Responsibility" in relation to the various parameters that govern the environment/structure/psychic interaction.

Introduction

Engineering can be divided into three activities:

- i) Quantification of forces
- ii) Material Physics
- iii) Psychic responsibility

Most enginners are aware of the first two requirements, but it is a sad fact that the third and quite important requirement is often neglected and in most cases not even recognised.

The psychic responsibility of engineering can be defined as the psychological effect of our structures on our fellow beings, on society and on the environment. It can be measured in terms of the comfort, contentment and well-being our structures contribute to the beings in the vicinity of our structure.

It is of paramount importance to understand the impact our structures have on our fellow beings. Ugliness can create mental ill-health, aggression, a depressed outlook towards life and even culminate into revolution.

An attempt to evaluate psychic responsibility will be futile without first attempting to define what is beautiful or what is ugly. The next paragraphs will therefore be devoted to defining what is aesthetics, as related to civil/structural engineering.

Aesthetics as related to engineering can be defined collectively as:

- i) It is an activity of imagination accompanied by a pleasurable excitement of nervous system – i.e. a psychological definition.
- ii) It is an external manifestation of lines, colours, form felt with a pleasurable emotion – an experimental definition.
- iii) It is the production of some temporary/permanent object, which is fitted, not only to supply an active utility but also an enjoyment to both the producer and to the "spectator".

These three stages of the definition can be related to the "three parties" of a construction activity; the designer, the constructor and the occupants/spectators respectively. A "Total Engineering" structure would confirm to all the three requirements above. Thus an aesthetic structure is just not an imagination one but also encompasses practicalability and utility.

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It is not an easy task to define Aesthetics but the aftermath of aesthetic experiences could be summed as: To evoke in oneself a feeling one has experienced, and then, by means of a "constructional object" transmit that feeling that others may experience the same feeling - the greater the feeling evoked, the better the structure aesthetically.

A further stage into the investigation of the evaluation of the aesthetics of structures can now be undertaken. It was mentioned earlier that a feeling is evoked whenever an aesthetic experience is undergone. Similarly a feeling of repulsion is undergone when "ugly" structures are seen. It is by studying these two categories of structures that the following guide has been produced.

The elements that have a bearing towards making a structure beautiful or ugly can be classed under:

- a) Identity
- b) Simplicity
- c) Blendability
- d) Functionability

Identity

This is considered to have an important bearing onto a psychological behaviour of beings. A structure created for any utility must not only be fit for that utility but must PORTRAY to an "alien" its function: A hospital must "feel" like a hospital (although this is now getting away from conventional engineering responsibilities). This though essential, is not enough. Of greater importance is the feeling evoked in the occupiers e.g. a block of flats may without doubt portray its function to an alien, but if the occupier does not feel any identity with the structure, the structure fails to evoke the feeling of identity in the occupier - and thus a failed design.

A feeling of identity is related to structural form. A "place" where open space is required should be created by using engineering imagination - not retreating to one of the conventional answer and avoiding a new solution and thus creating an identity conflict, e.g. a lounge of a hotel may be required to provide an "open space" by having no supports in the lounge area, yet most engineers would suggest a concept of as many columns as possible, as the "best" solution instead of exploring other venues not only from structural point of view but also from aesthetic and user point of view.

Another venue in which we engineers are very guilty is lack of appreciation of structural form in three dimensions. This may be partly due to our training system which dichotomizes everything into either a plate frame or a grid but never as a three dimensional structure. It is not suggested here that an "accurate" three dimensional analysis should be undertaken but rather an understanding of a real structure in three dimensions be sought via intuition and experimentation. An understanding of structure in three dimensions is vital to identity especially for structures curved either in plan or elevation as such structures can only take identity viewed in three dimensions.

Simplicity

Although this is the simplest of words, it is probably the most abused word in engineering. Every excuse for not venturing into new structural form is given on grounds of non-simplicity. However, nature itself is not 'simple' e.g. the earth revolves around the sun not in a circle but in an elliptical form, but is a circle simpler than an edipse? or is it because our thinking is so restrictive that we can only think in terms of what is familiar to us? Thus the definition of simplicity itself has to be sought before one attempts to incorporate simplicity into the search of an aesthetic structure.



"Simplicity" for the purpose of assessing aesthetics of a structure will be defined as a form that can be constructed. The degree of simplicity however would vary and thus it is the degree of simplicity rather than simplicity which will be the governing factor.

Some designers are of the opinion that one must not deviate from some "natural" forms. To give but a crude example a farmer using a plow is no closer to nature than one using a modern tractor as both forms of construction were evolved by man. Similarly a circular column is no more natural than say a triangular one.

Another theme of simplicity is repetition. Repetition of elements, if used effectively, can create a structure both aesthetic and simple. How to use repetitive elements effectively requires insight and thought – it is sad to note that most designers do not consider the appearance of repetitive elements seriously save for the thought of having reduced their work.

Blendability

This aspect concerns the interaction of the structure with its environment. A structure may have identity, it might be simple yet it might not blend with the environment. The blendability of the structure may be defined in terms of degree of intrusion of the structure on the environment.

Blendability is influenced by the support systems of the structure, the material used, the colour, the form and the environmental background e.g. a bridge across a gorge could be either in steel, concrete or timber; suspended, arched or cantilevered with finishes to blend. However, all the above would depend on the environmental setting i.e. is the setting rural or urban and what sort of vegetation there is in the vicinity of the structure and other such factors. Thus blendability factor is a measure of intrusion of structure on its environment.

Some writers (Jean-Jacques Rousseau in particular) are of the opinion that man should not blend with nature but rather nature should become "artificial". A noble thought! However, I think nature is elegant and thus would not entertain Rousseau's opinion.

Functionability

It is a paradox, yet functional structures are beautiful. A Concorde aeroplane the shape of which is simply dictated by its performance requirements is still pleasing. However, most structures cannot be designed on the basis of structural performance alone and if other functions like purpose for use e.g. living room – are kept in mind, one could unfold a pleasing structural form. Some of the factories/ware houses which are functional structures are quite imaginative and aesthetic. Functionability is a measure of providing a utility with the "optimum" structural form.

As engineering theory goes, anything without figures is incomplete and so this paper would fail in its purpose if some attempt was not made to give numerical value to the above factors.

Numerical Evaluation

Maximum points

i) <u>Identity</u>	
a) to the User	15
b) to Outsider	10
c) 3 dimension appreciation	15
ii) <u>Simplicity</u>	
a) Ease of design	10
b) Ease of construction	10

iii) <u>Blendability</u>	
a) Super systems	10
b) Colour	10
c) Material used	10
iv) <u>Functionability</u>	
a) Degree of functionability	15
	<hr/> 100

If a structural form is evaluated on the above basis with the maximum point allocated as indicated, a degree of aesthetic value can be obtained. A total of 70 points or over would indicate the structure is aesthetically acceptable while under 30 indicates a "fiasco".

Conclusion

It will let Trotsky's "Revolutionary and Socialist Art" represent my inspirations: "There is no doubt that, in the future - an farther we go the more true it will be - such monumental tasks as the planning of city gardens, of houses, railroads and ports will be of interest not only to engineering architects, but large population of masses as well In this struggle, architecture will again be filled with the spirit of mass feelings and moods only on a much higher plane, and mankind will educate itself plastically..... The wall between art and industry will come down. The great style of the future will be formative - not ornamental. But it would be wrong to look at this as liquidating of art, but rather as voluntary giving way to technique.

To make an ideal "structure" one must have besides the knowledge of properties of the material and methods of its use, both imagination and taste. Does this mean that industry will absorb art, or art will lift industry upto itself on Olympus? But from the objects attained - there is no difference between either answer.

Man, who will learn how to move rivers and mountains will not only be able to add to his own life, richness, brilliancy and intensity, but also a dynamic quality of the highest degree. Man at last will begin to harmonize himself in earnest and will make his business to achieve beauty by giving the movements of his own limbs the utmost precision, purposefulness and econmy in his work".

Appendix

References

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| Ahm Powl: | Some thoughts on Engineering Design |
| Dunican Peter: | Presidential address: 1. Struct. E 1977-78 |
| Leonhardt Fritz: | Looking back on 45 years as a Structural Engineer
1. Struct. E March 1976. |
| Tolstoy Leo: | What is Art? Trans. by Almyer Maude (1899) |
| Tröstky Leon: | "Revolutionary and Socialist Art" Trans. by Rose Strunsky. |