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Aesthetics in Structural Engineering

Esthétique dans les constructions de génie civil

Ästhetik im konstruktiven Ingenieurbau

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Esthétique dans les constructions de génie civil

Ästhetik im Ingenieurbau

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SYNOPSIS
The necessity of taking the aesthetic design of structures seriously is substantiated. The basics of aesthetics are treated briefly. Guide-lines for obtaining a good appearance of engineering structures are tentatively formulated; their purpose and limits however should not be overlooked.

RESUME
La nécessité de prendre au sérieux l'aspect esthétique de structures est soulignée. Les principes de l'esthétique sont traités brièvement. De premières recommandations – dont il ne faut cependant pas oublier le but et les limites – sont faites pour la réalisation de constructions de génie civil esthétiques.

ZUSAMMENFASSUNG
Die Notwendigkeit, die schönheitliche Gestaltung der Bauwerke ernst zu nehmen, wird begründet. Grundfragen der Ästhetik werden kurz behandelt. Versuchsweise werden Richtlinien für die schönheitliche Gestaltung von Ingenieurbauwerken formuliert, deren Zweck und Grenzen nicht übersehen werden dürfen.

1. INTRODUCTION

A wave of dissatisfaction is moving over our human societies, especially where technical and economical progress has led to a level of the standard of living as high as it was never known before. Step by step we become aware of what we have made wrong during the last hundred years. The mistakes are many-sided which threaten our basis for living. We become aware of the significance of ecology in nature, of environmental qualities and especially of the psychic needs of humans which were almost buried by the prevailing materialistic philosophy of life.

To the environmental qualities, which are important for the well being of men, belong the aesthetic values of the environment, which are greatly determined by our buildings and structures. The built environment in its present state is, however, most unsatisfactory with regard to its aesthetics. The Swiss architect, Rolf Keller, complained this deficiency in his book ' Bauen als Umweltzerstörung ' [1], in which he proves by many photos, taken in the elsewhere beautiful Switzerland, how ugly most sets of modern buildings are. This has consequences. An ugly environment causes social problems, dissatisfaction, aggression and even crime, as it thrives in ugly districts of our big cities.

The wave of dissatisfaction is to a great extent caused by the ugliness of built environment, especially in our cities. This does not concern our architects only, but also us civil engineers as well as the clients or even more our whole society, which, being possessed by the prevailing materialistic cost-profit-thinking, has forgotten the significance which aesthetics have for the happiness and satisfaction of man.

Therefore, it is necessary to deal profoundly with aesthetics in order to regain the almost lost capability to give beauty to our structures and environment and to become conscious of the values of beauty. For this reason we established a task group ' Aesthetics for Engineering Structures ' [+)] in IABSE whose members started to discuss the basics of aesthetics in writing , first results shall be displayed in the following. Primarily, prejudices and false opinions must be overcome like the old saying ' de gustibus non disputandum est ' - how can one argue about taste ? -. This is only an excuse for those who never gave thorough thoughts to aesthetics.

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Members of the Task Group:

A. A. Bagon, Brussels
D. P. Billington, Princeton
A. L. Elliott, Sacramento
F. R. Khan, Chicago
R. E. Slater, Bognor Regis
F. Leonhardt, Stuttgart
W. A. Schmid, Zürich
Y. Tahara, Tokyo
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2. TO THE BASICS OF AESTHETICS

2.1 Have objects aesthetic values?

In old philosophical treatises one finds on one side the opinion that ' beauty is no quality in things themselves, it exists merely in the mind which contemplates them, and each mind perceives a different beauty, depending upon the experiences of the observer ' (David Hume 1757). On the other side some philosophers say that beauty is a quality of things themselves: ' Beautiful is what generally and necessarily is felt to be beautiful ' (Immanuel Kant, Jean Paul, and others). All our experiences tell us clearly that the second interpretation is true: all objects have aesthetic values independently whether man appreciates them or not. The question is now, if aesthetic qualities can be brought home to the consciousness of man and be evaluated or judged by man.

2.2 How feels and judges man aesthetic values?

Here lies the great difficulty of dealing with aesthetics because beauty cannot be rationally quantified (inspite of some modern trials to do so), but the judgement depends mostly upon feelings and sensitiveness, which are very different from man to man. However, as a child already we have some sensibility for beauty, we only have to look into the eyes of children radiating when the child gets enthusiastic about beautiful flowers. The sensitivity and the sensibility for beauty are by nature, however, different from man to man, and their development depends upon the impressions gained in their environment, upon experiences, upon influences of their fellow men in family, school, and in the circle of friends and companions.

Aesthetic values can affect the senses subconsciously or can be perceived consciously. The capability of judging aesthetic values - or briefly the taste - develops only by repeated evaluation and weighing of consciously perceived aesthetic values. Therefore, taste requires self-learning or self-education which can be promoted by exchange with or advice by others. First, one must learn to see und put up the question: Why do I feel that this or that object is beautiful or ugly? Such analysing of aesthetic values is not easy, but necessary for developing the ability of aesthetic judgement.

Since men have different gifts and talents and since they grow up in different surroundings with different cultural background there will always be differences of taste between individuals and groups. But in a distinct cultural circle develops some agreement of the majority of its members for the aesthetical judgement. Psychologists speak of ' normal ' human responses, where the word normal refers to the majority. This corresponds to the philosophy of Immanuel Kant who says that beautiful is what generally (by the majority) and necessarily is felt to be beautiful.

Since, however, beauty cannot be proved strictly we should always be tolerant in all matters of aesthetic taste and leave a zone of freedom between what is normally or generally considered to be beautiful or to be ugly.

The assumption that there is generally acknowledged beauty in specific objects is also proven by the wide agreement in judging the beauty of objects of classic art of all great cultures, which are visited and admired by millions of people year after year. The final judgement of aesthetic values is spoken out by history after fashionable art has fainted and been forgotten.

The ability of man to judge aesthetic values, the so-called aesthetic taste, depends, therefore, partially on the gifts like sensitivity, partially upon learning and training of aesthetic evaluation in some process of education.

2.3 Why is an object beautiful?

Education in the field of senses and feelings should always begin with the trial to ask for the causes of the feelings and hereby to raise emotional and affective experience into the clearness of perception and understanding.

If an object is generally considered beautiful, then we should ask ' Why is it beautiful ? '. It is necessary to analyse beauty or ugliness. In the past, this was done quite often and many answers can be found in literature. Old schools of master artists had their rules and guide-lines which undoubtedly have some validity also at present. Such rules or guide-lines have again to be elaborated for our building tasks, have to be checked at examples and to be displayed because they can be a valuable aid for the design of structures and can help to avoid at least bad aesthetic mistakes in design.

The highest degree of beauty is found again and again in nature, in plants, flowers, animals, crystals, and all around the wide cosmos; their beauty is of such a big variety in shapes and colours that its analysis is hampered from the beginning by respectful awe and admiration. Objects created by man are easier to analyse and to judge. By deeper penetration into the essence of beauty, we find in nature also rules and orders in most cases, however, often with exceptions as we find them also in masterpieces of art of creative man. As an answer to the difficult task to create beauty we will tentatively draft such guide-lines with regard to buildings and structures.

3. GUIDE-LINES FOR AESTHETIC DESIGN (Draft version)

We formulate tentatively here guide-lines for the aesthetic design of structures. Most of them can also be found in old literature investigating the beauty of classical architecture. The author found them confirmed especially at bridges.

3.1 The most significant supposition for good appearance of a structure are good proportions (three-dimensional) between structural bodies and blank, void spaces (e.g. bridge openings). Good proportions between height, length and width, between members in suspense or carrying members, between depth and span of girders, between bright and dark faces caused by light and shadow.

' Good proportions ' needs of course a definition. There are many ' good proportions ' which may depend upon the wish to emphasize the height of a structure or its long stretching character. There are many ' good proportions ' whether massivness or lightness of a structure shall be expressed.

Good proportions shall sound harmonicly like harmonic accords of music (W. A. Schmid, Zürich, will demonstrate this). Occasionally contrast-proportions are suitable means for getting good appearance.

3.2 A good order of all the lines and edges of the structure which determine the appearance. One should limit the number of directions (in space) of all the lines, edges, truss members, etc. Too many directions cause unrest and disturb and worry the onlooker. The transition from straight lines to curves should be done with steady change of curvature. Good order must also be observed between the proportions within the structure. Order is also required when choosing the statical system of a structure, which should not be changed without need within one structural work.
Symmetry is a well proved element of order if the suppositions and requirements are favourable for symmetry.

3.3 Repetition of equal elements may be suitable, however not up to disgust or to monotony, which can be avoided by interrupting elements.

3.4 The compatible integration of the structure into its environment, landscape or city, is important especially with regard to the scale of the structure compared to the scale of the surroundings. For instance, a very long span of a beam bridge with a 10 m deep beam does not fit to an old town with small houses along the river bank and also not to a pretty small river valley.

The sizes of the structure and structural members must also be measured at the size of man - no gigantism which frightens man - no hurting brutalism.

The compatibility to the environment has also influence on the choice of building materials, the system of the structure and the choice of the colours.

3.5 The shape of structures for defined purposes or functions are usually influenced by such function, which should clearly be displayed. However, good appearance is not simply achieved just by choosing statically correct structures. Also the slogan ' form follows function ' does by itself not yet lead to good appearance, if the above guide-lines are not observed.

3.6 For engineering structures, especially for bridges, one should choose the pure basic shape of girder types (beams, arches, frames, suspensions, shells or folded plates ...). Simplicity must excel a good

solution without any additives, doodles, or extravagances. Engineering structures must be honest.

3.7 Colour is an important factor of aesthetic effects. We should use more colour at our structures. The colour must harmonize with the surroundings. Sometimes contrast colours can be beautiful, however, only in a harmonic composition of natural colours. Structures are not compatible with loud and flashy shock colours, especially not in the shape of abstract ornaments as they have been painted on some bridges and high-rise buildings by fashonable artists, induced by vanity.

4. PURPOSE AND LIMITS OF GUIDE-LINES

The draft guide-lines for aesthetic design can be demonstrated at good and bad examples of engineering structures and should be further developed. They shall, however, not be considered as strict rules for the design, which should always begin in individual freedom. The design of structures is anyway narrowed by the many constraints caused by the functional requirements, the local data and often by unreasonable codes, which all must be respected by the designer. Guide-lines can, however, be of great value in self-analysis, critical faculty for checking the design, especially with models, and hereby helping to get aware of aesthetic mistakes.

Beauty can in no case be secured by the application of such guide-lines only, the designer must furthermore have a good feeling for the appearance of forms, he must have sensivity for beauty, given to him in the cradle and developed to maturity by self-teaching and training. Young people with such gifts must be offered again suitable possibilities for developing these gifts at our schools and universities in the future.

Those who have gifts for arts can produce masterpieces of art by intuition without or outside rules or guide-lines and without rational processes. For engineering structures, however, it will be a rule that the ratio of the engineer has to take part in design as we can trace it in all beautiful engineering structures of the past, which have been created by our mater-engineers.

5. CLOSING REMARK FOR THE CONGRESS

During the half-day's session at the Congress in Vienna, there will probably be about 6 lectures with well chosen examples for good aesthetic design of engineering structures. The Japanese IABSE Group intends to present a Manual for Aesthetics in Bridge and Structural Engineering at the Congress.

[1] Keller, Rolf: Bauen als Umweltzerstörung
Verlag für Architektur Artemis, Zürich, 1973