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Bridge design in Japan and overseas - importance of discussion and competition

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1. Introduction

This paper discusses the low level of recognition of civil engineering design, particularly bridge design, in Japan. Among the measures stimulating good design and its popularity are: discussion on aesthetics of bridges, implementation of competition, increase of public involvement, and - instead of "cost evaluation" practiced by the clients - participation of landscape architects and other professionals in evaluation of design proposals.

2. Discussion - an important way of promotion of aesthetics in engineering design

Engineering design, for example bridge design, has less recognition and appreciation from general public comparing with architecture. Although civil engineers are as responsible as architects for the shaping of man's environment, the profession of engineering, civil and structural, has been gradually dehumanized by its very own soul - science and technology. The general public has a lack of knowledge of structural engineering and the majority associate it with construction. In many countries, such as Japan, anonymity is part of engineering design. The low level of social awareness of civil engineering has been caused by engineers themselves, who, unlike architects, have been reluctant to formulate broader philosophies for structural design. Engineers have slowly begun to publish their opinions about art in engineering concerning mainly bridge design, but they have not really succeeded in developing a coherent approach to aesthetics and to the philosophy of design.

The debate on the aesthetics of bridges in the world, had its turning point in 1980 at the 11-th International Association for Bridge and Structural Engineering (IABSE) Congress in Vienna, when engineers compared bridge design with building design and acknowledged that although bridges do not provide "enclosed space", they also organize space and spatial flow (Slater 1980). Engineers believed in the existence of "design rules" (Leonhardt 1980), and possibility of adoption of a unified language system for bridge appearance (Tahara and Nakamura 1980). Eight years later, at the First Oleg Kereny Memorial Conference in London, engineers emphasized the "engineering design philosophy" as the provision of adequate strength and stiffness, satisfaction of minimal requirements for future maintenance, anticipated useful life for at least 100 years, and pleasing appearance. On the other hand, they recognized the necessity of the reunification of architecture and engineering, giving examples of light-weight structures and their concepts with architectural and engineering origins, such as the Olympic Stadium in Tokyo (Happold 1988).

Nowadays, engineers accept that the concept of utility should be broadened, to include aesthetic principles (Menn 1990). However, in Japan for example, discussion among engineers is more oriented towards the structural aspects and financial impact of design than toward appreciation of its aesthetic qualities. Although, recently, in Japan bridge design is discussed more often in public, it still does not attract as much interest as architectural or product design. Discussion on aesthetics usually concentrates around such criteria, as those listed by Billington (1983) - efficiency, economy and elegance. The emerging tendency however is to see engineering, and particularly bridge design, as an amalgam of art and science (Billington 1991). The idea, which has already been reflected through the long history of bridge construction, perceives the art of structural engineering as a conception of form which starts as an intuitive experience, and progresses by successive aesthetic and analytical developments (Holgate 1992). This tendency is parallel to all environmental movements that are opposed to the dehumanization of engineering.

This "human" aspect has recently begun to be reflected in Japanese bridge design as shown by the increase in freedom for form selection, by the tendency to improve already existing forms, by the stylization of forms, and by the growing participation of architects and industrial designers in bridge design. The recent discussion in Japan has been mainly motivated by the will to enliven towns where certain scenery, including bridges, can be remembered by people (Kido 1993; Kido et al. 1995). This trend is associated with the development of "*keikan sekkei*" (aesthetic design), which has close links with planning and landscape design. Gradually, the understanding of bridge design and its evaluation is becoming more comprehensive and related to: design of built form; structural design; spatial design; urban design; and landscape design (Shinohara 1995).

Except discussion among professional designers and critics, it is necessary to promote public discussion on engineering projects, to educate the society about the technical aspects, and to explain design approach in order to win the understanding from the public. The main purpose of engineering projects is to serve the public, to make the life more comfortable, safe, etc. In Japan, public opinion is considered during design process but final decision is not always made in regard of local inhabitants. It seems that the winning of acceptance from the public needs different approach. There are conflicts resulting from environmental issues. The public is usually against large engineering projects, such as dams, water barriers, bridges, etc., on ground of environmental pollution and damage to natural environment. Those issues should be carefully studied by engineers and other professionals before introduction of such large projects to the public. Later, the design should show understanding for local demands and express the attitude of harmony with local environment.

3. Bridge designers

In Japan there are many groups participating in bridge design and usually it is hard to know who exactly is responsible for a certain project. Although the majority of bridges, which are designed according to guidelines, are not outstanding, they can satisfy the demand for economical and mechanically correct structures. The most innovative structures are produced in Japan as a result of cooperation between structural engineers and architects or industrial designers, or they are produced by a group of structural engineers who call themselves "civic designers". Architects, product designers, and "civic designers" are at the forefront in the pursuit of original concepts and in their realization.

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Only concepts for important bridges are customarily worked out by committees of experts from various fields. Rarely, in comparison with the European countries, engineering proposals are chosen in a competition. Only recently, open international competitions for projects which cost is around 60 ml. yen or more, have been introduced in Japan. In most cases however, the client invites three, five or ten companies to participate in closed competition. The result is based rather on "prize competition" than on originality and quality of work. The whole process of awarding proposals is not transparent.

Japan has considerable achievements in aesthetic bridge design. Bridges represents several design styles dependent on characteristics of designers involved, which can be summarized as structure-oriented, landscape-oriented, preservation-oriented, symbolic, and thematic design [Kido, 1995]. Japan style in general is inspired by a new version of traditional Japanese aesthetics, characterized by ambiguity, complexity and contradictions. Japan style, based on notions of ephemerality and transience of material, and on the continuity of spiritual values, pursues phenomenal and ephemeral qualities in design. A sentiment towards symbolism and associations is visible in major bridge projects. However, comparing with Europe, Japan does not have famous names of designers, which results from anonymity and the fact that designers work under the names of large companies. This situation is discouraging designers from experiments with original structures and forms. In contrast to architecture, where Japan is a home for the most innovative and outstanding designs, Japanese engineering design is known in the world for its record spans rather than for original ideas. While there are famous Japanese architects, there is lack of engineering designer personalities, such as Calatrava, Schlaich, Menn, etc. Also, nowadays, the most innovative design do not come from Japan. It is rather Europe who is leading in experimental and innovative design of engineering structures and forms.

4. Competition - a method to promote better design

One of reasons that civil engineering design is unpopular in Japan, is what has already been said, that competitions for engineering design are practiced very seldom in this country. Competitions may effectively allow to discover capable individuals who would be aesthetically sensitive and conceptually innovative - in the sense of form and structure. Billington (1998) cites three main reasons for competitions: "to bring forth new ideas, to involve general public, and to achieve elegant and economical designs". Among the new ideas that have come form design competitions are new structures, such as the concrete hollow box, the decks - stiffened arch, prestressed concrete, and the cantilever method of construction. Breaking ground ideas of R. Maillart, E. Freyssinet, F. Dischinger, and U. Finsterwalder were all results of competitions. Today famous designers, such as C. Menn, F. Leonhardt, S. Calatrava have brought new ideas out of competitions. Remarkably, new forms for girder bridges, arch bridges, and cable-stayed bridges all came from countries where such competitions are common.

The most notable example of a country where design competition have long tradition is Switzerland. The Swiss have evolved a method of carrying out competitions which has helped them create a tradition of bridge design that has commanded world-wide attention. In contrast to Europe, in the United States where such competitions are not common, there has been considerable discussion recently about the lack of technical innovation. The successful aesthetic design is the one implementing innovative structural design, and that structure respectively affects bridge form. The history of the twentieth century engineering design competitions for bridges in Europe suggests that those competitions can play an important role in the bridge design profession.

5. Conclusion

In spite of great achievements of Japanese engineering there are certain aspects which Japan can learn from overseas and in conclusion may develop methods for better engineering design. Those methods are public discussion on bridge projects and their structural and aesthetic aspects, and enforcement of more open competitions which will promote design of innovative and original structures. As a result, similarly to architecture, Japan may succeed in having outstanding engineering structures designed by famous Japanese and foreign designers.

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