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## On Bridge-Environment Relations in Japanese Cities

Relations entre pont et environnement dans des villes japonaises

Verhältnis von Brücke und Umwelt in japanischen Städten

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### SUMMARY

Specific natural scenery, diverse terrain conditions, and an intensive expansion of communication requirements, colliding with major lack of space, mean that Japanese cities already contain numerous bridge constructions, showing an accelerated demand for many more in future. Those aspects, together with a definite impact of cultural heritage, display some characteristic features of bridge-environment relations, discussed in this paper.

### RÉSUMÉ

Le milieu naturel spécifique, les conditions variées et la croissance intensive des nécessités du trafic, face à l'insuffisance de l'espace, font que les villes japonaises sont bien pourvues en ponts. A l'avenir, elles auront encore besoin de nombreux ponts nouveaux. Ces problèmes, liés de plus à l'influence de l'héritage culturel, donnent un caractère particulier aux relations entre le pont et l'environnement, analysé dans l'article.

### ZUSAMMENFASSUNG

Eigenartige Naturszenenerie, mannigfaltige Geländebedingungen und eine intensive Expansion der Verkehrserforderungen trotz großem Raumangel bewirken, daß japanische Metropolen, bereits durch zahlreiche Brückenkonstruktionen geprägt, künftig noch viele mehr nötig haben werden. Diese Faktoren, von kultureller Tradition stark beeinflußt, ergeben gewisse besondere Eigenschaften in der Beziehung von Brücke und Umwelt, wie in diesem Beitrag erörtert.



## 1. INTRODUCTION

A bridge represents one of the most spontaneous constructions accompanying the human genus from its very beginning. Conformity with nature of the primitive bridge beam, arch, and suspension systems, together with the inborn character of their structural substance, formed a perfect bridge-environment unity and, therefore, satisfied automatically all presently accepted requirements of environmental consistency. Within ages, because of the unconcerned activity of men, bridge constructions became less innate, more and more formally unjust, thus injuring the natural harmony of the "genius loci". Nevertheless, gradually a return to all-over structural simplicity, resulting in a more consonant bridge project, was felt necessary. But it was only the first half of this century that problems of bridge aesthetics and environmental fitness became important factors of bridge design. Competent research in that area resulted later in mature references, like /1/ or /2/; relevant, practice oriented Japanese particulars have been discussed in /3/, /4/, /5/, /6/, and /7/. This report concentrates on those matters confined to the conditions presently typical for large Japanese metropolies - by the examination of few characteristic case features.

## 2. BACKGROUND

Bridge constructions in Japan developed rapidly after World War II, parallel to the country's outstanding achievements in the technical civilization, as a whole. An accelerated demand for easy communication resulted in a considerable expansion of the rail- and highway network, connecting presently - by land-links (bridges or tunnels) - all the four main islands of Japan: Kyushu, Honshu, Shikoku, and Hokkaido. Simultaneously, a vigorous growth of the country's metropolitan regions has been observed, creating the situation that already big cities became much bigger - forming urban organisms of multi-million inhabitants, thus introducing new problems concerning the cities' "domestic" traffic. Present formulation of up-to-date strategies for future technology development of Japanese cities, Technopolis Program /8/, can make those problems only more acute.

## 3. GENERAL STATEMENTS

The most inherent attribute of Japanese cities having, presently, an essential impact on any sort of urban infrastructure, is major lack of space. Fig. 1 is a good illustration of that state, showing the characteristic cityscape of old Tokyo: congestion of differently shaped buildings and communication facilities at the place of the multilevelled intersection of Kanda-River, Marunouchi Subway Line, JR Chuo and Sobu Lines, and of a road bridge (the picture was made from), near Ochanomizu Station. Rapid and unrestrained formation of that urban space and no much understanding for aesthetical arguments at the time of construction created an inhospitable area, with little relation to the original environment, to-day difficult to be improved.

A new feature, having presently much influence on the appearance of Japanese metropolies, mostly maritime, is their gradual stepping into the nearby sea area by building artificial islands and suitable bridge routes; most of them have been constructed in Tokyo and Osaka bays. A representative cityscape is given in Fig. 2, showing a part of the Osaka Harbour with the Minato Viaduct No.1 (foreground), the cable stayed Aji-Gawa Bridge, and the mono-cable Hokko Bridge of the Hanshin Expressway Public Corporation, farther back. The chosen bridge types positively dominate over the traditional port environment. Elevated expressway proves to be an integral part of urban life; shown spiral access ramp uses well the limited space, conforming the feeling of economy.

Tracing of urban expressways may be very difficult. A modern arrangement is demonstrated in Fig. 3 where curving between towering buildings of down-town Osaka, and aligning to the existing rivers, was found necessary.

#### 4. SOME PARTICULARS

Present-day bridges in Japan, urban in particular, are considered public spaces to be shaped with special care. Therefore, in bridge design a close co-operation of experts in structural mechanics, bridge engineering, architecture, and environmental design is being practiced /9/.

An example of a modern urban expressway, conform with local tradition of the spot, is shown in Fig. 4. It is the Senba Rooftop Expressway of the Higashi-Osaka Route which, in order to maintain the textile wholesale function of this district, was constructed in the rooftop fashion, accomodating many shops underneath.

It was already mentioned that in Japan many elevated urban expressways are located over, or are bordering, the pretty frequent water-courses, as the only public spaces still available for construction. Fig. 5 illustrates certain part of the Nakamura-River in Yokohama, between China Town and Motomachi Shopping Center. Because of the popularity of that place, many footbridges have been thrown across the river, under the expressway construction, to organize the pedestrian traffic. Most of those bridges have been specially designed, to comfort the demands of bridge aesthetics and environmental fitness; this concerned the form and the colour of total structures and of all their details.

Some particular learning on urban bridge-environment relations in Japan results from Figs. 6 and 7. Extensive construction of elevated urban roads has developed some new space below them. Depending upon the local situation, this space is used in a variety of ways. Priority is given to facilities benefitting the public, such as: plazas, parks and parking lots, whereby all those places are designed with much attention for their aesthetical expression and environmental consistency. Thus, Fig. 6 pictures an environmentally sound leisure place at the Shirokita Channel fishing pond under the Osaka-Moriguchi Route, and Fig. 7 - attractive mural painting on expressway piers, in order to brighten up the monotony of the accomodated parking area.

New Japanese trends in the development of urban transportation systems result from Fig. 8. It is suggested to integrate various means of communication in one construction including, from top to bottom: expressway, railway, pedestrian zone with shops, recreation areas, parking lots, etc., and subway. For environmental reasons, at the usual street level green areas, together with planted trees and shrubs, are anticipated.

There are already some elements of such transportation systems completed. Fig. 9 shows the structure of the Hanshin Expressway Wangan Route incorporated with the trunk line of the New Osaka Transportation System, penetrating the reclaimed land of the Osaka South Port; it is visible that aesthetics was here an essential factor of design.

Footbridges are becoming very important elements of Japanese cityscape. The necessity to arrange the urban communication facilities in a threedimensional manner, specially - to improve the pedestrian communication within the areas of intense accumulation of people, causes that footway bridges, promenades and plaza platforms are often applied to meet those needs. Fig. 10 demonstrates the modern Osaka Castle Promenade, crossing smoothly a rather dense urban area on the way to old Osaka Castle - an attractive place in respect of tourism. The fully screened construction protects the numerous passers-by against any bad weather influence, but leaving an unrestrained view on the surroundings by skillfully glassed walls and roofing; suitable detailing and colouring produces an aesthetically affirmative impression of this construction.

Another modern pedestrian bridge, shaped according to the traditional design of Japan, is one built in Nagoya and given in Fig. 11. Many present bridges follow that idea but numerous are also less traditional, adjusting to the conventional character of the adjacent urban area. Because of the usually small



Fig. 1 Urban space in old fashion: Tokyo - Ochanomizu



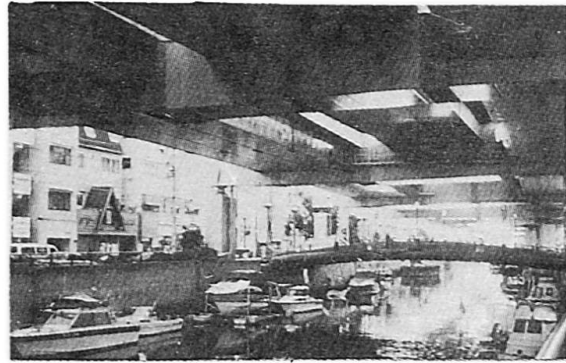
Fig. 2 Impact of harbour on urban space: Osaka



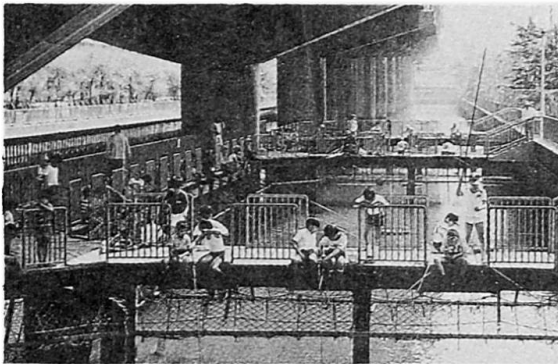
Fig. 3 Modern urban space: Osaka - Ikeda Route



**Fig. 4** Semba Rooftop Expressway:  
Osaka



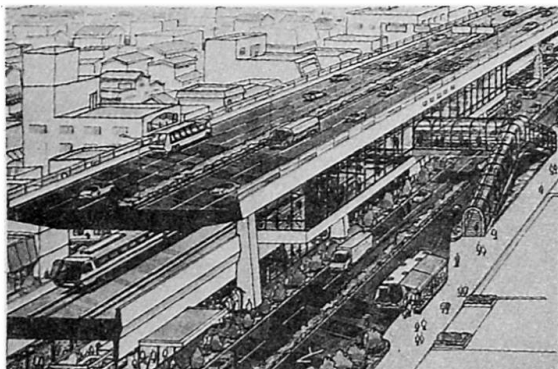
**Fig. 5** Expressway/water-course



**Fig. 6** Co-existence of structure and  
environment: Osaka - Moriguchi  
Route



**Fig. 7** Coherence of Structure and  
art: Osaka



**Fig. 8** Idea on integrated urban  
communication



**Fig. 9** Modern expressway/trunk  
combination: Osaka - Wangan  
Route



**Fig.10** Modern footway promenade:  
Osaka



**Fig.11** Modern footway bridge:  
Nagoya - Shirakawa



scale of those structures, environmentally fair detailing is here more important than elsewhere, becoming a prominent design factor.

The effect of bridge accessories on the esthetical perception of bridges, urban in particular, became major point of interest in Japan; corresponding manual is expressed by /10/. It was found that such accessories as railing, newel post, illumination post, walkway pavement, drainage pipe, and noise barrier, may exert a large impact on the overall bridge impression. Concerning the railing, its shape, quality of materials, and colour, are influential factors of design. The purpose of the newel post is to accentuate the bridge versus the normal road; its form and materials depend mainly upon regional characteristics and historical backgrounds. Walking space is essentially governed by the pavement that must promote the feelings of comfort and safety of the pedestrians, having a proper moving line and rhythm, and being well balanced with bridge railings and illumination posts. Drainage pipes may spoil the bridge view and, therefore, it is desirable to place them inconspicuously. Noise barriers, necessary to comfort the nearby inhabitants, should be well incorporated into the local environment and the esthetical image of bridge.

## 5. CONCLUSIONS

Present bridge design in Japan, urban in particular, is effectively controlled by the demands of aesthetics and environmental consistency. Bridges are public spaces treated with extra care. Therefore, much attention is paid to make them attractive objects determining the cityscape. Appropriate co-operation of bridge engineers and environmental designers is very much successful. Accumulated experience caused that professional aesthetic design manuals could be developed. Symbiosis of old national culture and high standards of bridge science and technology is a characteristic feature of Japanese achievements in that field.

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