On the manual for aesthetic design of bridges

Autor(en): **Tahara, Yasuji / Nakamura, Yoshio**

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I

On the Manual for Aesthetic Design of Bridges

Manuel pour la conception esthétique de ponts

Manual für den Entwurf ästhetischer Brücken

YASUJI TAHARA
Consulting Engineer
Japan Bridge and Structure Institute Inc.
Tokyo, Japan

YOSHIO NAKAMURA
Prof. Dr. Eng.
Tokyo Institute of Technology
Tokyo, Japan

SUMMARY
The Manual for Aesthetic Design of Bridges is presented and commented. It contains some illustrations of archetypal configuration for the aesthetic design of bridges and the general aspect of the feeling of aesthetic consciousness which must be indispensable for the design.

RESUME
Le Manuel pour la conception esthétique de ponts est présenté et commenté. Il illustre la configuration de l'archétype esthétique des ponts et le concept général de l'esthétique, élément indispensable dans la conception.

ZUSAMMENFASSUNG
Das Manual für den Entwurf ästhetischer Brücken wird vorgestellt und diskutiert. Es illustriert Archetypen zur Gestaltung ästhetischer Brücken und bespricht den allgemeinen Aspekt ästhetischen Bewusstseins, das bei der Gestaltung unerlässlich ist.

1. INTRODUCTION

1.1 Foreword

It is undeniable that we had received an obvious indication of keen interest in 'Aesthetics in Bridge and Structural Engineering' from the general treatise delivered by Prof. F. Leonhardt at the closing session of the 10th Congress in Tokyo and the warning thesis by Prof. L. Beedle against the biased view of overemphasizing of materialism spreading over the recent world. It has been decided that the purpose of our Manual should be planned in the first place to upgrade to any small extent the average aesthetical level of bridges in Japan so that at least any distastefulness of bridge in appearance should be removed from our sight and the guideline should indicate by examplified cases the methods aiming at a more flexible use and practical quick-effect approach. Under such consideration, it is aimed at also filling up the shortcoming in the design concept arising from the too much dependancy on the mere technical learning of the guideline and hence to awakening the general and basic attention to the preparation of mental or sensuous attitude of those who are going to engage themselves in the design of truly beautiful bridges.

1.2 Aesthetics in Engineering Product

There is an old saying in the West, 'Ploughing the field and forgetting the seeds'. That means, any creative work must be consecrated with his own spirit of the creator. A bridge is also a creation of man after all. If any aesthetic consciousness is contained in a creative object, and when it is introduced into the mind of those who contemplate this object and awakens the feeling of aesthetic consciousness, then this beauty has obtained universality and ubiquity, and has gained an objective beauty.

Viewing this in terms of bridge, the contemplation of a beautiful bridge not only gives many of these people in the society living with such a bridge happiness and blessings, but also is effective to promote and enhance their vitality to live tomorrow and lessen their distress and agony of life. This is, indeed, the real value and usefulness of beauty. In other words, the usefulness of beauty is always linked with its contribution to the fulfillment of man's life and to enhancement of the total value of human character. But, the fact is that the beauty exists not merely in such a engineering product like as a bridge but also in natural things or in work of art. However, there may be noticed some differences between the beauties of engineering product and artistic article or natural things in the basic recognition of the pure aesthetic value and of the incidental aesthetic value intensive in the purposeless or purposeful pertinence in principle. Therefore, the judgement of values in art and in nature may be considered to be independently determined by the differences in the human attitude whether he takes the approach of aesthetic contemplation of the object or whether he takes the approach of utilizing it for his own selfish purpose. On the other hand, in the case of such engineering aesthetics as the case of bridges, the first and topmost demand for a bridge is the intrinsic value which is the value of purposeful pertinence whereby it can perfectly serve for the useful demand of the tranist of goods and people.

Then, based on this conception, when the technical function is expressed in a most rationalized, simplified and refined Gestalt, and when the beauty which is incidental to the so-called effective and useful function and which also reveals itself naturally from its Gestaltung captures the heart of those people who contemplate on it, then this bridge shall be appreciated as an aesthetic object indeed and the beauty of such sort, of engineering product, we call it

Technical Beauty. While, the category of such technical aesthetics in bridge structure may be judged as existing only when the origins of form, and function of the structure, and the origin of structural materials and their textures are composed into one integral of the Structural Gestaltung in a complete harmony so that its concrete exterior appearance may invite the aesthetic judgement or taste of those who contemplate on it. However, looking at the materials and texture of a bridge, they generally consist of steel, concrete or stone and nothing else nowadays. Moreover, its functional formation is fundamentally of the style of beam, arch, rigid frame or cable structural type which is all rationalized in terms of unitary statical basis of the structure as a rule. That is, as for Gestaltung of its own appearance of bridge, it is doomed to have a narrow limited range of choice in expressing its technical aesthetics so far as the aforementioned three basic origins of these materials or textures, forms and function are concerned.

But, in the genre of technical aesthetics as in the case of bridge, the object in a certain set environment is expressed more or less connected with or responding to such environment and is generally contemplated in one setting of Gestaltung with the environment. This naturally enhances the beauty of both the bridge and the environment in one setting. From this viewpoint, for the origins composing the object of technical aesthetics, it must add, besides the earlier described three basic origins, all such important relations as social environment including those of the surrounding landscape, the history and legend of the bridge location as well as other poetic natural scenery and features. Thus, the diversity which no longer is the diversity of only the said three basic origins for the artificial product of technology, but is the diversity so intricately and delicately interwoven with the origins of natural and humanistic environment, has the same effect as that of the creation of so-to-speak a total beauty as if various different tones of voices join in a chorus of the new synthetic.

1.3 Basis of Aesthetic Design

The fundamental of creation is the consecration of spirit into beauty as mentioned at the out set of the above 1.2. In other words, by concrete expression of one's inner thought or feeling into a Gestalt of an object, let the contemplators aquire by themselves the comprehension of the technical process of expression for introducing the aesthetic thought or feeling of the creator himself. The aesthetic feeling by empathy is inherently held by man and loved by him. But its extent and degree may change due to his inherent nature or due to his posteriori surrounding formed by his living environment, education and experience of life after his birth. It must not be ignored that the materialization of aesthetic bridges may really begin with freeing our heart and mind from the distorted civilization caused by the tendency that economy alone should be almighty as it was during the post-war era.

The guideline shown in this paper claims for the cultivation of the feeling of beauty as its just preference. Similarly, the number of approaches of guideline shown below are no more than some examples of partial or fragmentary aesthetic expression of itself in case by case and they are so-to-speak a list of archetypes which are often showed in the Manual. Speaking in terms of the Japanese Judo, these are the archetypes of art which will be cultivated and polished up by the ceaseless exercise and practice of ordinary training. In an actual fight, it is necessary to add to the physical technique the spiritual art of Judo, namely the human spirit. The true essence of Judo may be well demonstrated only when and if each basic archetype or its variation of Judo are freely applied to a upmost form individually or in combination according to the necessity of cases and timing during the fight. And it must be noticed

too that this may be successful only when the player is free from all worldly thoughts and intentional contrivance for getting the victory. Therefore, together with the learning and digesting of the basic technique as shown in the guideline, here it becomes necessary above all to have applied training of mental feeling e.g. 'Zen' to the actual design with linkage to the cultivation of aesthetic consciousness and its upgrading at all times. A genious can create a master piece with no much labor and effort, while a layman may acquire and digest a creative feeling to some extent by hard training and self-striving. Thus it may be possible for him to built and create a really beautiful bridge.

2. GUIDELINE

2.1 Principle of Guideline

The purpose of Guideline is to find design conventions in bridge form. In other words, we try to find some archetypal cognition about bridge appearance.

We should try to find this type of cognitions as many as possible and give names to them. When we try to do it, we would be surprized at the proverty of our vocabruaries about bridge appearance.

The structural pattern of build environment more or less reflects our unconsciously conditionned recognition system, i.e., linguistic system. While a culture enjoys abundant and expressive vocabruaries about snows, the others not. While there are cultures provided with plenty of vocabruaries of colors; others may be very poor in this regard. This seems to reflect or even motivate the difference of cultural patterns. Once we give a name to a phenomenon not designated so far, we would be directed to increasing our sensibility to it. It is truely said by linguists that our image about the world is perfectly controlled by our own language.

So, in our case, we understnad that what is needed first is to develop widely acceptable language system for bridge appearance before setting up standards.

Our language system should be of following nature.

(1) Bridge appearance language system provides a guideline as a whole. But it is not design standard. It only suggests various important aspects in bridge appearance.
(2) The main purpose of it is to furnish us with common words to talk about bridge appearance.
(3) Giving a name is in itself highly evaluative action. Further evaluative discriptions are not necessarily required.
(4) In order not to spoil our rich visual experiences, the text should discribe phenomena as they are seen with modest theoretical comments. Our approach may be called rather phenomenological.
(5) Text should contain as many illustrated examples as possible including past ones.
(6) Quotations from other environmental design experiences are recommendable.
(7) Comparative or juxtaposed illustrations are recommendable.
(8) Lost or dead terminologies about bridge visual experiences are recommended to be recollected. This is because a historical approach, together with a synchronous approach, is also expected to provide an important objective tool.

2.2 Tentative terminologies

Tentatively about 70 terms have been proposed and classfied into three

categories, i.e. Bridge Configuration, Bridge in Landscape, Color and Texture. These are arranged in hierarchical order shown in Table 1.

Table 1: Proposed terms

1 Bridge configuration
2 Girdir configuration
3 Slenderness
4 Hunch
5 Girdir cross section
6 Visual continuity
7 Seamy side of girdir
8 Pier configuration
9 Slimness
10 Section shaping
11 Pier articulation
12 Orderly pier arrangement
13 Abutment configuration
14 Abutment volume
15 Abutment-girdier interface
16 Pier-girdir interface
17 Direct support
18 Indirect support
19 Semi-direct support
20 Flying lateral beam
21 Non symmetrical pier-beam arrangement
22 Major structure silhouette
23 Emphasized major silhouette
24 Spans articulation
25 Disturbing minor members
26 Emphasized vertical silhouette
27 Proportion
28 Excessive perspective curvature
29 Hazardous utilities
30 Parapet
31 Major structure -deck interface
32 Sheltered bridge
33 Cumber silhouette
34 Bridge in landscape
35 Bridge view
36 Horizontal visual angle
37 Vertical visual angle
38 Angle of elevation
39 Distance
40 Viewpoint field
41 Terrain-bridge interface
42 Abutment-terrain interface
43 Pier-water interface
44 Pier-terrain interface
45 Bridge site
46 Approach road
47 Footstep access
48 Silhouette interference
49 Doubled bridge silhouette
50 Landscape interference
51 View from bridge
52 On-bridge balcony
53 Bridge ends plaza
54 Under bridge view
55 Bridge as land mark
56 Garden bridge
57 Bridge naming
58 Color and texture
59 Light and colors
60 Color semantics
61 Bridge colors and site
62 Lights
63 High lit surface
64 Foot lighting
65 Road surface lighting
66 Texture and materials
67 Textured surface
68 natural texture
69 Texture contrast
70 Weather proof steel
71 road pavement
72 Wooden bridge

2.3 Brief introduction of some examples

(1) Abutment-girdir interface (No. 15)

The first example is picked up from "Abutment Configuration" which is included in Bridge Configuration.

The most primitive arrangement is shown in Fig 1-(a). The problem of its appearance is caused by the small odd space between the slab and the abutment uppersurface with the summit corner of which giving very hazardous impression. The abutment width, further, being wider than that of the beam results in looking somewhat idle or needless. A retreated abutment with a longer or a side span may be one of the possible solutions. But the type (b) is also possible if the above solution is not applicable. The solution (b) looks much simple in configuration and decisive or static in impression. Fig. 1-(c) shows an another solution. This seems more complicated than type (b), but its shape is producing much strained muscular sensation. While in type (a) the girdir seems to be put loosely on the abutment, type (c) is giving birth to such an

impression that the abutment is supporting up the girdir. The later effect may be emphasized with more designed abutment. Type (d) again shows a more simple but sophisticated design example.

On the other hand, type (b) may cause problems in maintenance of shoes and expansion joints compared with type (a). Type (c) or (d) is better in this regard. Consequently, if maintenance free rubber shoes and expansion joints can be applied in case of short spans, type (b) may be good. In case of longer spans with steel shoes, type (c) or (d) becomes worthy of consideration.

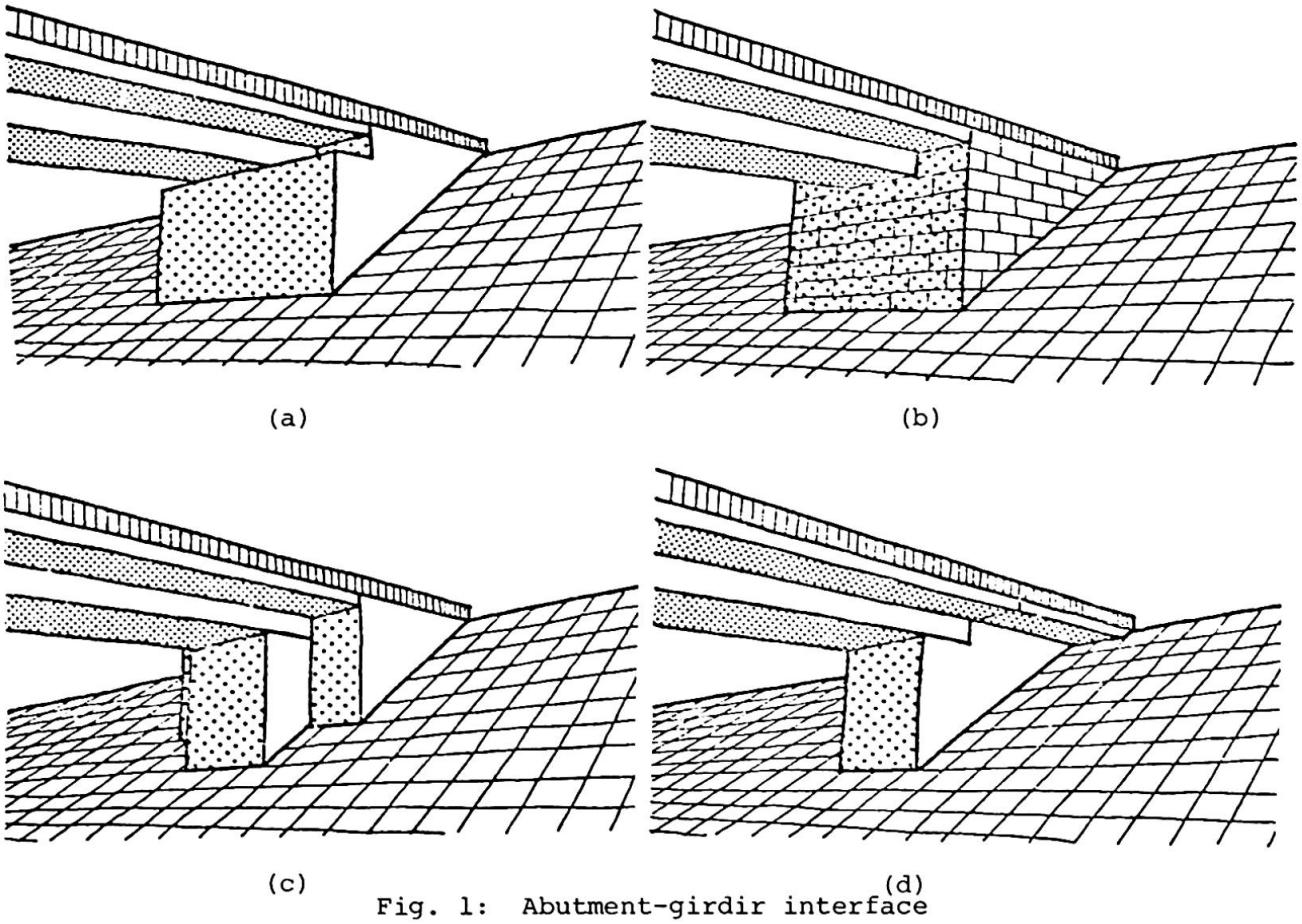

Fig. 1: Abutment-girdir interface

(2) Pier-terrain interface (No. 44)

How a bridge is integrated with terrain context is one of the most critical issue in "Bridge in landscape". This aspect of design is picked up as "Terrain-bridge interface". Among this, here is shown "Pier-terrain interface" (Fig. 2). This concerns how a pier-foot should be arranged. In many aspects of human environmental design, feet of vertical elements such as buildings, trees, columns seem to be of critical importance. In some cases as exemplified in isolated trees in western landscape gardens, foot of tree tends to be kept cleaned leaving no mischelaneous objects besides. This type of treatment allows to let the silhouette of tree trunk very impressive. On the other hand, feet of trees are apt to be slightly hiden by trimmed small bushes or stones in Japanese garden design convention, which produces some nuanced depth impression. Both solutions are quite meaningful and this princple can be applied to bridge design. The top case in Fig. 2 gives some hazardous impression compared with the other two cases. A hazardous column foot may cancell all the efforts to create a good bridge configuration.

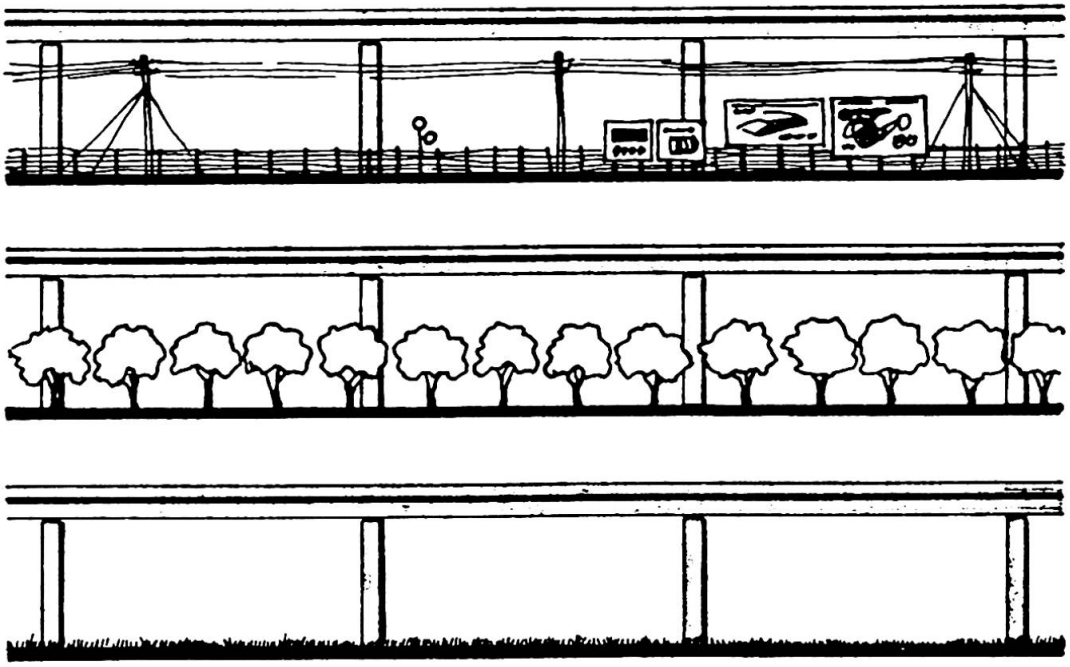

Fig. 2: Pier-terrain interface

(3) Silhouette interface (No. 48)

One of the principles in landscape design is apparently to be attentive to the relationship between the object in question and the other objects in a visual field. To keep the silhouette of a bridge unspoiled avoiding the visual interference with other objects is an elementary condition in this respect. Fig. 3 shows an example where two bridges are visually disturbing each other. This often happens when the two bridges are designed independently by different authorities. Fig. 4 is an another type of pattern in this category. Here, a bridge in the top interfere with a background natural landscape. The bottom case intends to improve this fault.

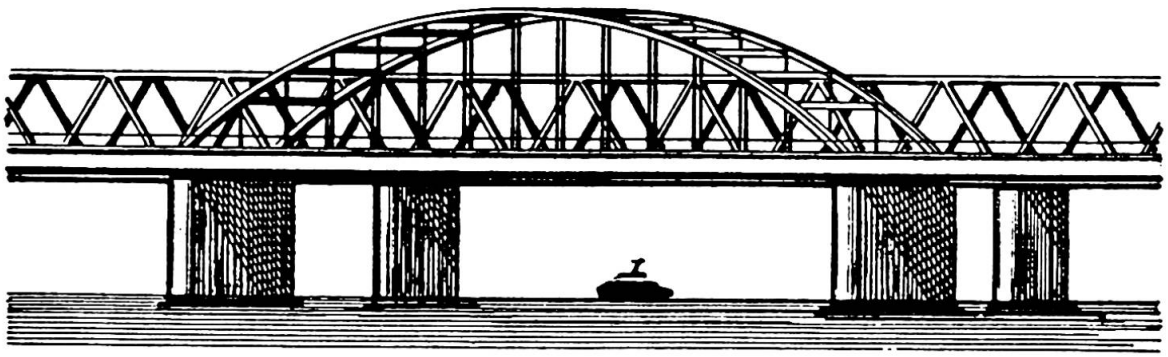

Fig. 3: Doubled bridge silhouette

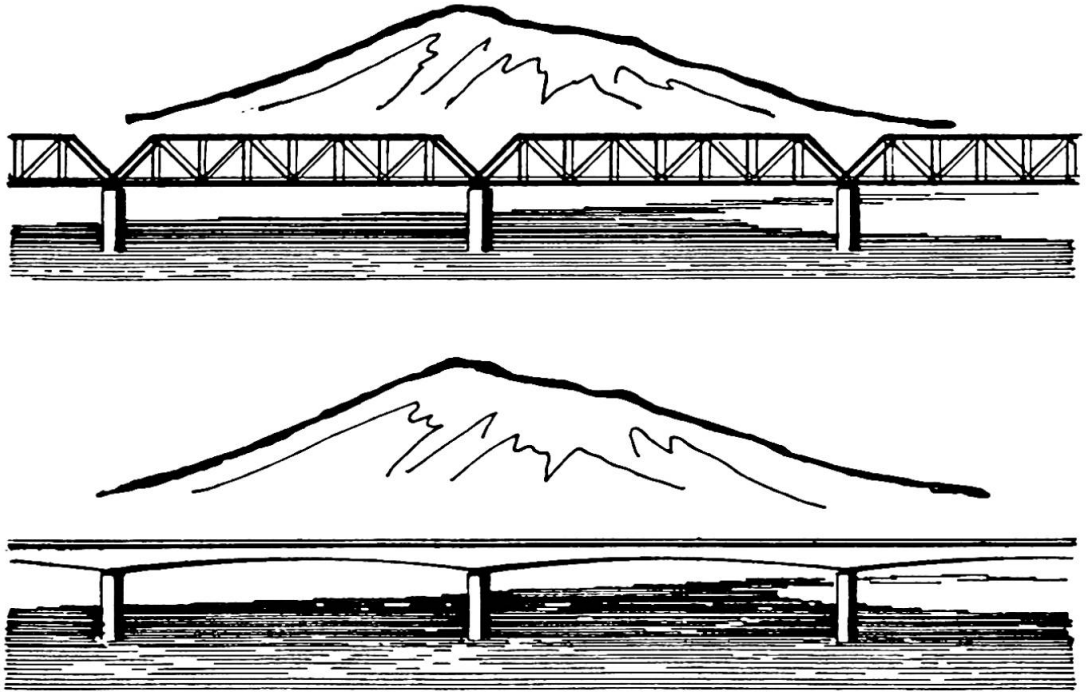

Fig. 4: Landscape interference

(4) Under bridge view (No. 54)

"View from bridge" (No. 51) is also a very important factor in "Bridge in landscape". It gives us an impressive chance for landscape enjoyment. Therefore, "On-bridge balcony" (No. 52) and "Bridge-ends plaza" (No. 53) are worthy of comments. At the same time in this connection, "Under bridge view" cannot be forgotten. A classic example is given in Fig. 5. A bridge here plays a role of an interesting frame for distant landscape. Again in such case "Seamy side of girdir" (No. 7) is important. This kind of attention is especially requested in case of bridge planning in waterfront recreational places.

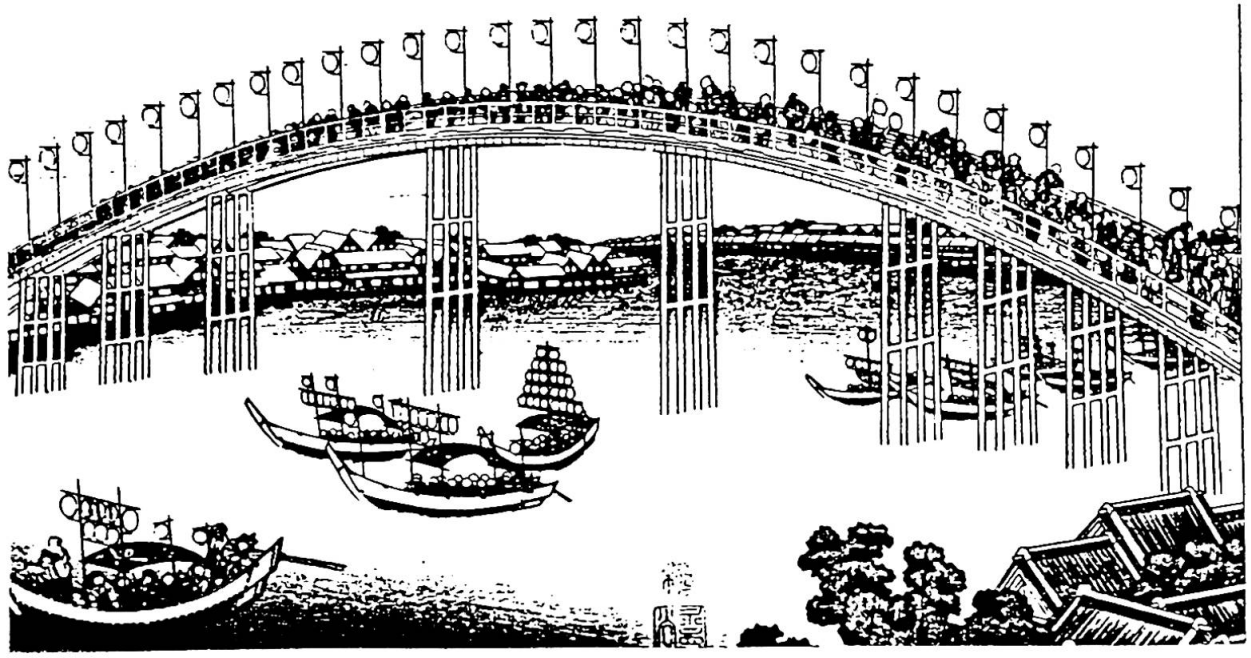

Fig. 5: Under bridge view