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Research on the Interrelations between Waterside Designs and the Approachability of Urban Riverfront space

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Abstract

In this research, the riverfront space are examined with regard to their function as public places that are adjacent to water. Certain characteristics of waterside designs are evaluated, and the interrelations between these characteristics and the approachability of the urban riverfront space are analyzed. It is found that developing the riverfront space more comfortable and natural encourages people to use the waterside recreation. Some of the ways that comfort and naturalness can be improved are as follows: provide richly varied environment in the high water channel, reduce the horizontal distance between the low water channel and place from which it is viewed, keep to a minimum the gradient from which the low water channel is viewed, and change from man-made surface materials to plants and natural stones.

Research Goal

In recent years, waterfront space have come to be viewed as a precious amenity. Developing a high-quality waterfront space is considered to be part of developing a high-quality living environment. In this research the riverfront space are examined with regard to their function as public places that are adjacent to water. Certain characteristics of waterside designs are evaluated, and interrelations between these characteristics and the approachability of the urban riverfront space are analyzed. In this way, suggested developments for more approachable waterside designs are explored. The research was carried out according to the flow chart shown in Figure 1.

Method of Investigation and Analysis

1) *Method of Investigation*

Twenty-six urban river sites possessing a wide variety of waterside designs were chosen for research. All were located in the Osaka-Kobe area of Japan. This research has been proceeded by collection data through the physical environment survey and cognitive evaluation of riverscape.

The physical environment survey was conducted in September 1989 by an average of two people for each site. Using field and map-based survey methods, horizontal and vertical distances were measured from the low water channel to the point from which the low water channel was viewed (photographed). The riverfront space was also measured

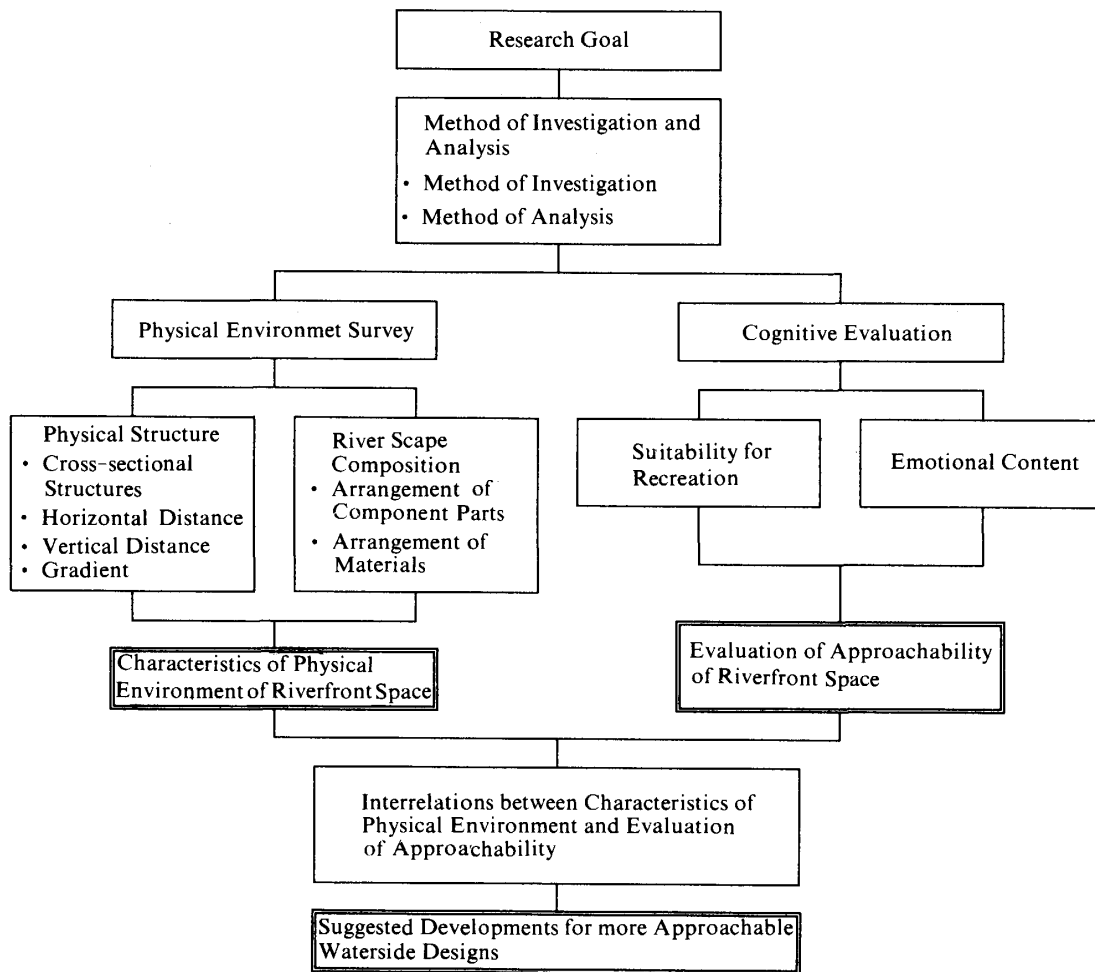


Fig. 1 Research flow chart

in cross section at each site. Cross sections were classified into one of four types: type-1 (no high water channel), type-2 (exist high water channel with single tier), type-3 (exist high water channel with two tiers), type-4 (exist high water channel with three tiers or more). Dividing the photographer's horizontal distance from the low water channel by vertical distance gave the gradient from which the low water channel was viewed. Slide photos, as will explained later, were divided by the arrangement of component parts and the arrangement of materials within them, as shown in Figure 2.

Cognitive evaluation of the riverscape (slide photos) taken at 26 urban river sites was carried out in October 1989. The evaluation subjects were 56 students in the department of Agricultural Engineering of the University of Osaka Prefecture. As shown in Table 1, the items chosen for evaluation were four level terms describing the degree of "suitability for recreation" and five level terms describing the degree "emotional content". All the slide photos of riverscape were taken with a standard lens that reproduced the scenes as closely as possible to the way they would be seen by the human eye. All photos were taken at a 75° angle to the flow of the low water channel, and from a height of 1.6 m, or about 5 of declination.

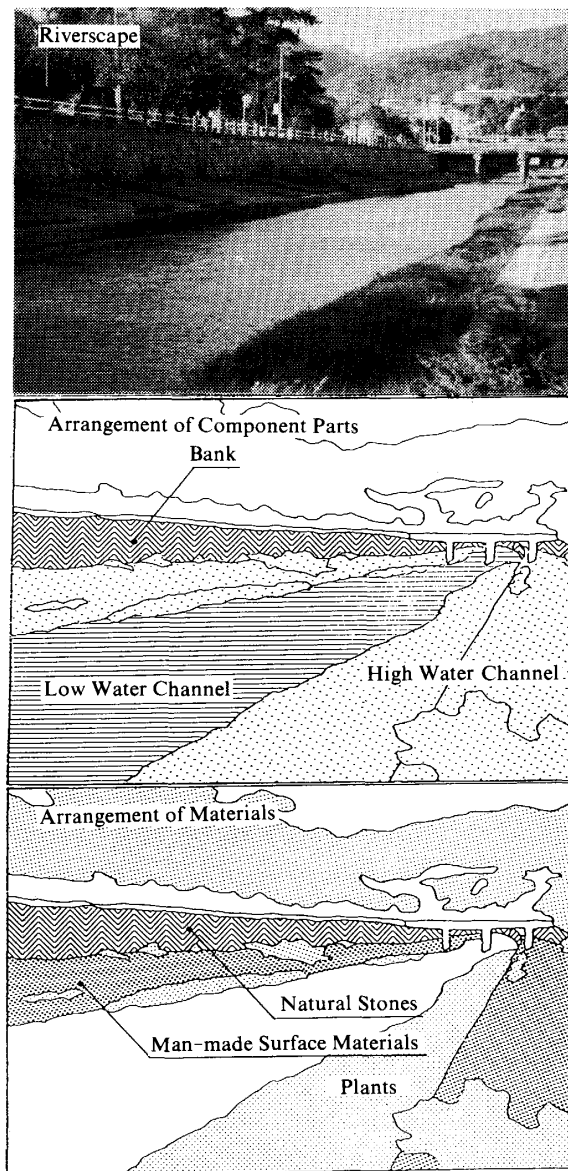


Fig. 2 Riverscape composition

Table 1. Items for cognitive evaluation

Suitability for Recreation (Four-level)	Emotional Content (Five-level)
Consciousness of the Water	Beauty
Affinity of the Water	Extension
Attractiveness of the Water	Nature
Suitability for Walking	Serenity
Suitability for Relaxation	Harmony
Suitability for Water Contact Activity	Variety

2) *Method of analysis*

The four-level having to do with "suitability for recreation" and the five-level having to do with "emotional content" were assigned values from 0~3 and from -2~2, respectively. Then the scores of each were averaged, and a factor analysis was carried out on the average scores having to do with "emotional content." Next, a correlative analysis was carried out between the average scores having to do with "suitability for recreation" and the results of the factor analysis mentioned above. Together with this, a correlative analysis was carried out between characteristics of physical environment and the riverscape composition of each slide photo, and correlation coefficients and graphs of these correlations were considered in the analysis of results. Cross-sectional structures were stereotyped and interrelations were analyzed between the stereotypes and average evaluation scores and factor scores. These relationships helped to suggest future developments for more approachable waterside design.

Results of Analysis and Consideration

1) *Interrelation between "suitability for recreation" and "emotional content"*

Table 2 shows factor loading and eigenvalue derived from the results of the "emotional content" factor analysis. In this research, a factor is only considered to be meaningful if its eigenvalue is 1.0 or more. In the case of the first factor, the loading for evaluation items such as beauty, serenity, and harmony is high; therefore, this factor was judged to show comfort. In the case of the second factor, the factor loading is high for items such as nature and variety; this factor was judged to show naturalness.

Table 3 shows average evaluation scores for "suitability for recreation" and correla-

Table 2. Factor loading and eigenvalue

	First Factor	Second Factor	Third Factor
Beauty	0.899	0.404	0.098
Extension	0.407	0.039	0.602
Nature	0.095	0.770	0.249
Serenity	0.731	-0.004	0.289
Harmony	0.947	0.049	0.279
Variety	0.095	0.903	-0.181
Eigenvalue	2.977	1.346	0.302

Table 3. Correlation between "suitability for recreation" and "emotional content"

		Suitability for Recreation					
		Consciousness	Affinity	Attractiveness	Walking	Relaxation	Water Contact Activity
Emotional Content	Comfort	0.465	0.672	0.462	0.683	0.611	0.214
	Naturalness	-0.598	0.546	0.700	0.644	0.676	0.732

tion coefficients between these and the first and second factor scores of "emotional content." From this table, it can be seen that there is a strongly positive correlation of 0.6 or more between the factor score of comfort and the following three aspects of "suitability for recreation": affinity, suitability for walking, and suitability for relaxation. There are also high correlations between the factor score of naturalness and virtually all aspects of "suitability for recreation," especially water contact activity (0.732) and attractiveness (0.700).

2) *Interrelation between characteristics of physical environment and evaluation of approachability of urban riverfront space*

Table 4 shows correlation coefficients between three aspects of characteristics of physical environment (horizontal distance from low water channel, vertical distance from low water channel, and gradient from which the low water channel is viewed) and the approachability of riverfront space. From this table, it can be seen that the aspects of approachability that correlate strongly with horizontal distance are consciousness of the water and naturalness. The negative correlation with consciousness of the water is especially strong (-0.729). The aspects of approachability that correlate strongly with gradient are consciousness of the water, water contact activity, and naturalness. On the whole, correlations between aspects of approachability and vertical distance are weak. One possible explanation is that the cognitive evaluation subjects could not accurately judge vertical distance from the slide photos they saw.

Figure 3 is a graph of the negative correlation between consciousness of the water and

Table 4. Correlation characteristics of physical structure and evaluation of approachability

	Suitability for Recreation						Emotional Content	
	Consciousness	Affinity	Attractiveness	Walking	Relaxation	Water Contact Activity	Comfort	Naturalness
Horizontal Distance	-0.729	0.027	0.252	0.216	0.250	0.313	-0.154	0.485
Vertical Distance	-0.153	-0.182	-0.193	0.011	-0.056	-0.313	0.133	-0.027
Gradient	-0.636	0.133	0.397	0.170	0.226	0.548	-0.378	0.520

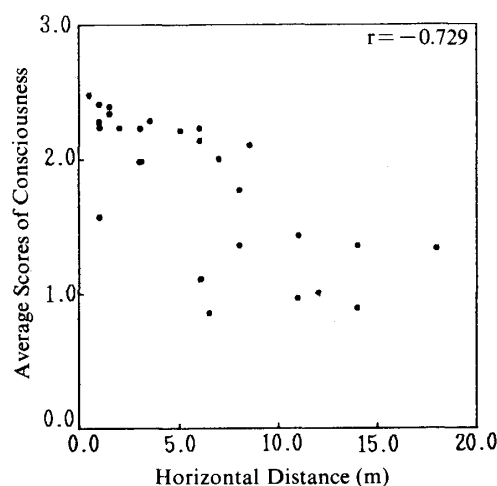


Fig. 3 Correlation between consciousness and horizontal distance

horizontal distance from the low water channel. As shown in the graph, consciousness of the water declines as distance from the low water channel increases, and the drop is particularly striking at a distance of 8 m. Figures 4 and 5 each show the correlation between gradient and different aspects of approachability. In the case of Figure 4, the aspect is water contact activity, and in the case of Figure 5 it is naturalness. Both graphs show that evaluations of approachability improve as the gradient from which the low water channel is viewed declines. When the gradient is gentler 2.0, almost all evaluations of naturalness fall on the plus side of the level, and a very gentle slope of 4.0 or more is associated with high evaluations for water contact activity. These results suggest that water contact activity is encouraged by a low gradient. In photo 1, the horizontal distance from the low water channel is 0.5 m, the shortest in any riverscape used in this research. Photo 2 shows a riverscape with an extremely gentle slope of 5.0.

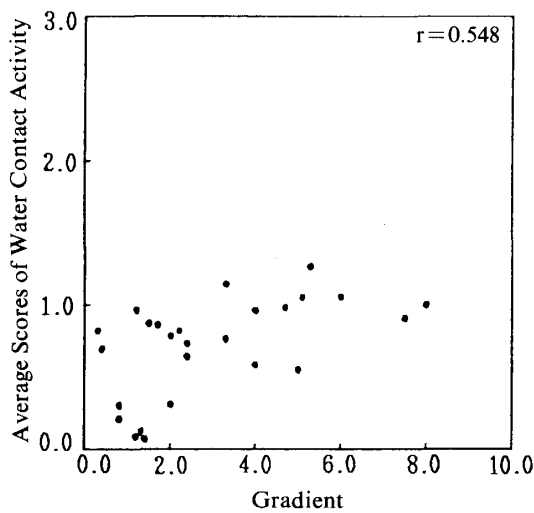


Fig. 4 Correlation between water contact activity and gradient

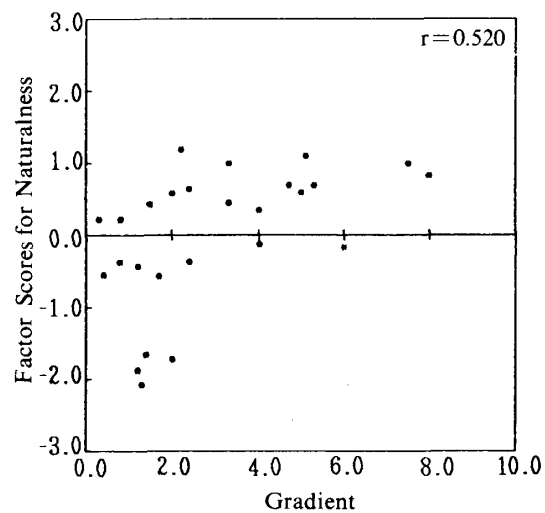


Fig. 5 Correlation between naturalness and gradient

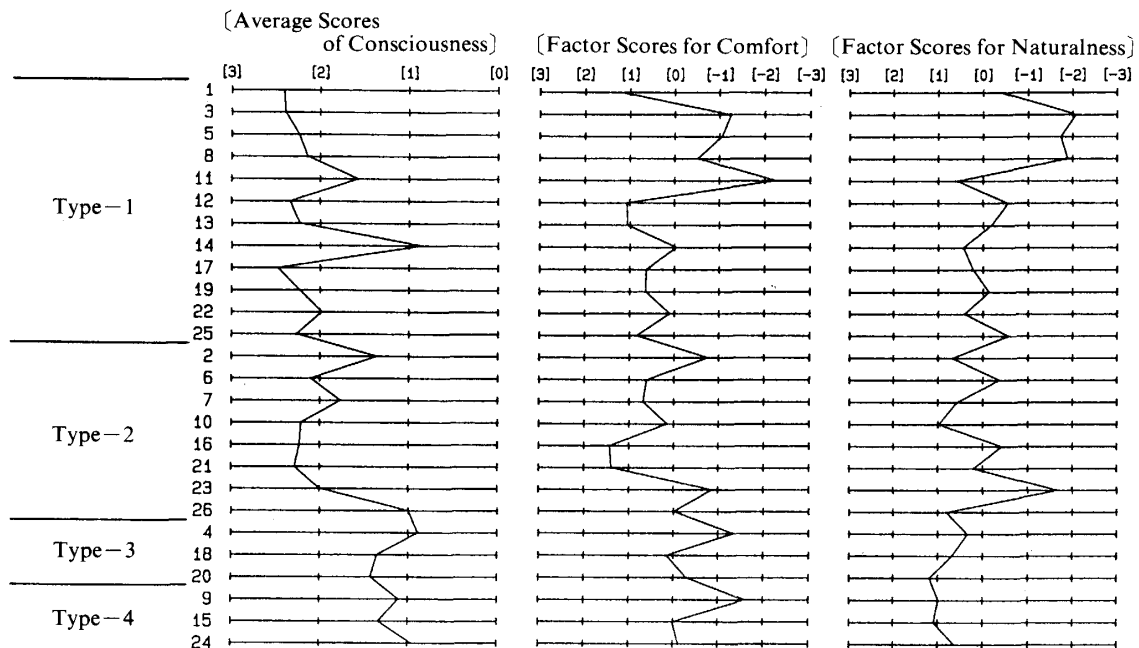


Fig. 6 Profiles are based on stereotypes of cross-sectional structures

The profiles in Figure 6 are based on stereotypes of cross-sectional structures. They show how cross-sectional structures relate to consciousness of the water and to factor scores for comfort and naturalness. From the first profile, it can be seen that consciousness of the water gradually declines as the cross-sectional structure of the riverfront space becomes more complex. With regard to comfort, factor scores are generally high when the cross-sectional structure is type-2, generally low when the structure is type-3 or more, and irregular when the structure is type-1. With regard to naturalness, factor scores are high when the cross-sectional structure is type-3 or more, and generally lower when the structure is type-1 or type-2. Photo 3 shows a riverscape with a type-2 structure.

3) *Interrelation between riverscape composition and evaluation of approachability of urban riverfront space*

Table 5 shows correlation coefficients between riverscape composition and the approachability of riverfront space. From this table, it can be seen that consciousness of the water, water contact activity, and naturalness have a strong correlation with the percentage of space in the riverscape that is occupied by water. The positive correlation with consciousness of the water is especially strong at 0.874. Consciousness of the water, water contact activity, and naturalness are also strongly correlated with the percentage of space in the riverscape that is occupied by high water channel. The correlation with consciousness of the water is -0.607 , while the correlations with water contact activity and naturalness are both positive and stronger than 0.6. The percentage of space in the riverscape that is occupied by plant materials has a strong overall correlation with the perceived approachability of the riverfront space. Positive correlations with suitability for relaxation and naturalness are 0.7 or more. The percentage of space in the riverscape that is occupied by man-made materials has a negative correlation with all aspects of the perceived approachability of the riverfront space except consciousness of the water and affinity. The negative correlation with suitability for walking, suitability for relaxation, and naturalness is moderately strong. Correlations between approachability and the percentage of space in the riverscape that is occupied by bank and / or natural stones are fairly weak overall.

Figures 7–9 are graphs of the correlation between the percentage of space in the riverscape that is occupied by high water channel and three aspects of approachability:

Table 5. Correlation between riverscape composition and evaluation of approachability

		Suitability for Recreation					Emotional Content		
		Consciousness	Affinity	Attractiveness	Walking	Relaxation	Water Contact Activity	Comfort	Naturalness
Arrangement of Component Parts	Low Water Channel	0.874	-0.108	-0.412	-0.289	-0.348	-0.526	0.226	-0.688
	Bank	0.097	-0.329	-0.406	-0.343	-0.406	-0.382	-0.117	-0.343
	High Water Channel	-0.607	0.343	0.598	0.375	0.473	0.752	-0.228	0.632
Arrangement of Materials	Plants	-0.494	0.516	0.627	0.650	0.756	0.671	0.232	0.702
	Man-made Surface Materials	0.306	0.183	-0.206	-0.401	-0.447	-0.282	-0.054	-0.531
	Natural Stones	-0.074	0.139	0.237	0.170	0.076	0.274	-0.062	0.255

water contact activity, attractiveness, and naturalness. In all three graphs, the correlation is strongly positive. As the space in the riverscape that is occupied by high water channel increases, evaluations of water contact activity, attractiveness, and naturalness improve. When the space occupied by high water channel is 20% or more, most evaluations of naturalness are confined to the plus side of the graph. When high water channel occupies 25% or more of the riverscape, all evaluations of attractiveness are quite high. Photo 4 is the riverscape in which high water channel occupies a higher percentage of the riverscape (56%) than in any other riverscape.

Figures 10–12 are graphs of the correlation between the percentage of space in the riverscape that is occupied by plant materials and three aspects of “suitability for recreation”: suitability for relaxation, attractiveness, and affinity. In all three graphs, the correlation is strongly positive. As the space in the riverscape that is occupied by plant materials increases, evaluations of suitability for relaxation, and affinity improve. When

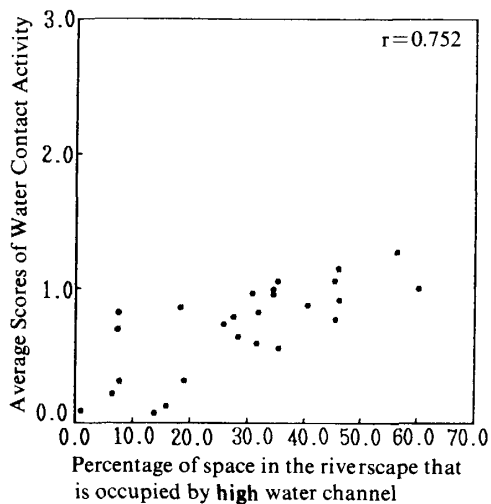


Fig. 7 Correlation between water contact Activity and high water channel

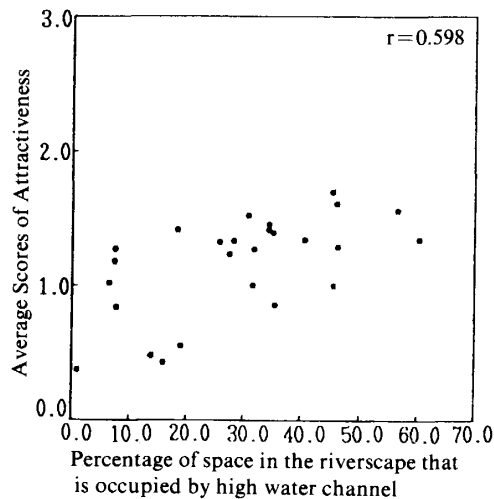


Fig. 8 Correlation between attractiveness and high water channel

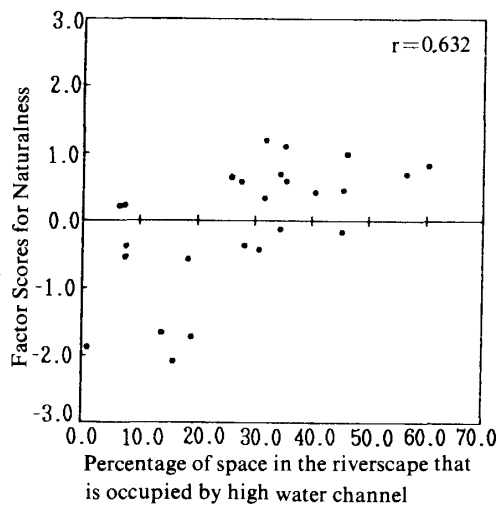


Fig. 9 Correlation between naturalness and high water channel

the space occupied by plant materials is 30% or more, evaluations of “suitability for recreation” tend to be higher overall, which suggests that the riverfront space is more likely to encourage recreational activity. Photo 5 is the riverscape in which plant materials occupy a higher percentage of the riverscape (51.8%) than in any other riverscape.

Figure 13 is a graph of the correlation between the percentage of space in the riverscape that is occupied by man-made materials and suitability for relaxation. The correlation is weakly negative. As the space in the riverscape that is occupied by man-made materials increases, evaluations of suitability for relaxation decline. In riverscape where man-made materials occupy 10% or more of the riverscape, relaxation activity is likely to be hindered.

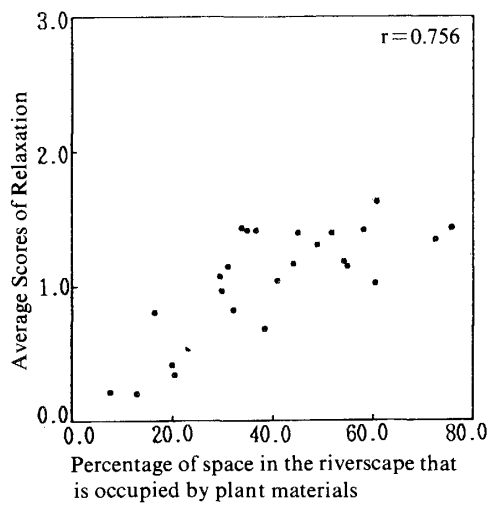


Fig. 10 Correlation between relaxation and plants materials

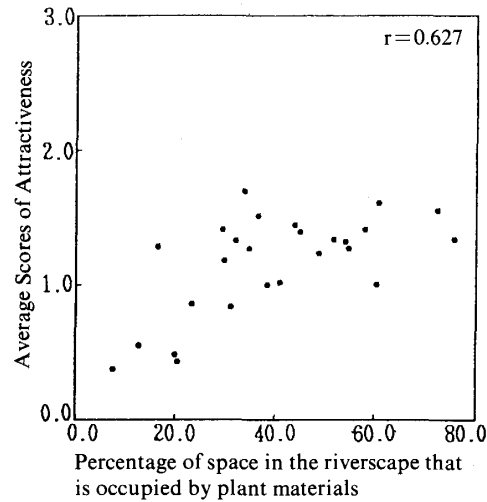


Fig. 11 Correlation between attractiveness and plant materials

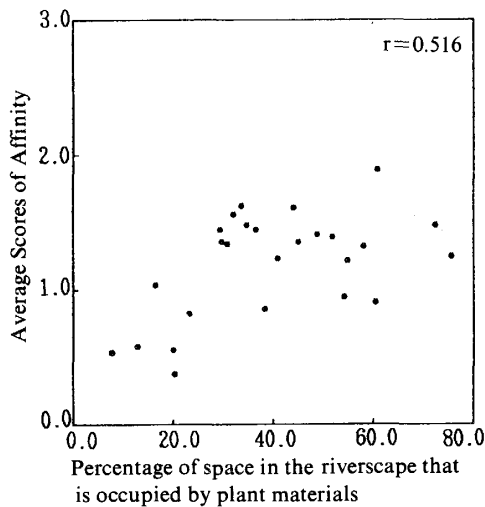


Fig. 12 Correlation between affinity and plant materials

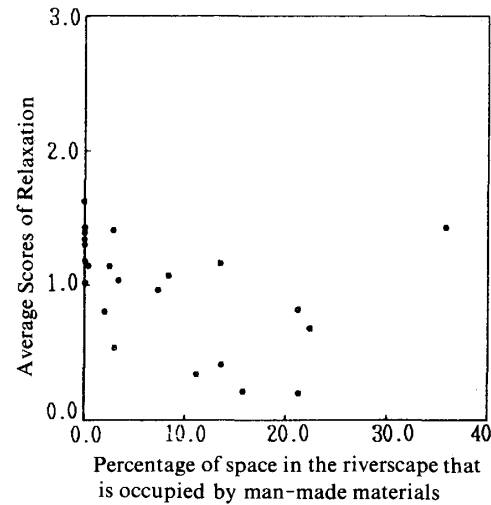


Fig. 13 Correlation between relaxation and man-made materials



Photo-1



Photo-2

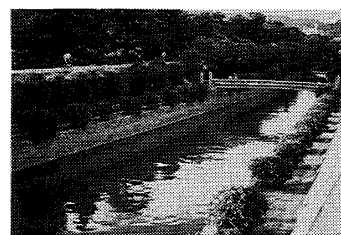


Photo-3

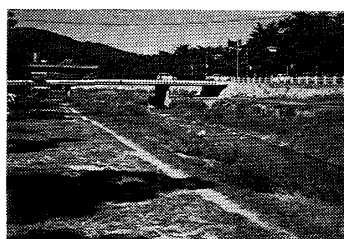


Photo-4

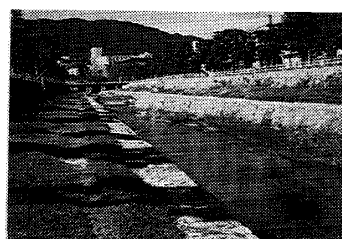


Photo-5

Conclusion

The above results of analysis and consideration makes the following point clear.

As evaluation of comfort improves, a feeling of affinity also arises. Relaxation activity is encouraged and evaluation of naturalness also improves. These changes are associated with heightened attractiveness in the riverfront space. Water contact activity and relaxation activity are encouraged.

As the horizontal distance from the low water channel becomes shorter, consciousness of the water increases. As the slope of the waterside space becomes gentler, evaluations of naturalness improve. In both cases, water contact activity is encouraged.

As the space occupied by high water channel expands to fill more of the riverscape, evaluations of naturalness and attractiveness improve. An expansion of the space occupied by plant materials also leads to improved evaluations of naturalness and attractiveness, and to a stronger feeling of affinity. These change are associated with encouragement of relaxation activity. Conversely, relaxation activity is hindered by an expansion of the surface covered by man-made materials.

From the above observations, it can be seen that the way to make riverfront space more comfortable and to improve evaluations of naturalness is to provide richly varied environment in the high water channel, reduce the horizontal distance between the low water channel and the place from which it is viewed, keep to a minimum the gradient from which the low water channel is viewed, and change from man-made surface materials to plants and natural stones.

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