A STUDY ON CONSTRUCTION OF KANSEI DATABASE WITH GIRDER BRIDGE FOR ASSESSMENT OF AESTHETICS

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Abstract: In the last years by the recognition and social capital maintenance of join local people of importance of bridge scenery and design we have get new business, and we have real understood the reflection which be given to the users sensitivity engineering science. We make as object the bridge and subject the design and with questionnaire we make an examine, we made verification of each different judgment, we applied the social capital maintenance into the sensitivity engineering science and we verify the necessary sensitive kind of database, maintenance structure method, and discuss about how we can tie the design.

Key Words : Aesthetic of landscape, Girder Bridges, Kansei engineering, Kansei database, Aesthetic assessment and design

1.Introduction

In the past an important point at the bridge structure was the maintenance of quantity than the quality. After has been taken important of the life quality, composure ,etc late 1980's the people become more interested in scenery design of bridge ,and has past 10 years since the importance of scenery design has been recognized by the society.

The object of civil engineering is local people be able to join from the step of planning ,so has begun a new shape of business. But considered the sense of local people and till now nobody has joined to the bridge structure. From now we have to improvement the sense of the local people so they will become able to reflect at the bridge planing and design.

As for measure the above we used the sensitivity engineering science and we tried to judge the scenery design of bridge ,but in the study of[1]~[2]we have only indicated the possibility of apply the sensitivity engineering science method to bridge structure and we did not make reference of structure, maintain, and design reflect.

In [3]~[4] although there are many examples about the bridge design senses which the general users and designer engineering bring the difference in the judgment of civil engineering and general users by fitting the technique of sensitivity engineering science there are not examples of how sensitivity database construction examine.

In this part of study we compare and verify the sensitivity of general users and designer engineering with sensitivity of bridge structure engineering. After this we make clear the

difference of every judgment and then we examine how sensitive database reflect to the scenery design.

2. Judgment of scenery design

2.1 The technique of sensitivity engineering science

In this part of study we occupy the big number of bridge , stand up the cable stayed bridge and arch bridge and compare this bridge . There is not consideration which respond to scenery design but people have chance to see lot of bridge's object and by sensitivity engineering science technique we used the database which we have analyzed and examine the designer technique,this process appears in figure 1.As for make image concert we collect 43 piece of modification image, and with 90 bridge's photograph we enforcement a questionnaire with 40 university student (20 university student women,20 university student men) and 15 bridge structure engineering and next occur factor analysis of all subject ,every woman university student and every man university student and we examined the sensitivity of people for the bridge and how classify. Next we make details division of bridge, extract the elements, we make item/category list, and by used the quantity theory1 we try to judge the elements design and after we used the quantity theory1 results and we made clear the influence which has been given by the image modification to design elements, and then with the result of questionnaire and bridge's photograph image we construct sensitivity database by take in the result of quantity theory1 analyze, and also we formed the sensitivity database which constructed and by used scenery design system we consider that is possible to make direct connection in scenery design of practical business.

2.2 Questionnaire investigation

The investigation object person is the designer engineering and university student. The investigation subject by side A4size we form a yearbook and we showed 90 judgment photograph, by spare investigation we consider the good used of scenery design of bridge by selection of sensitive word, by 5 step of questionnaire paper(-2,-1,0,+1,+2) of SD measure we entry the judgment and we receive a formula.

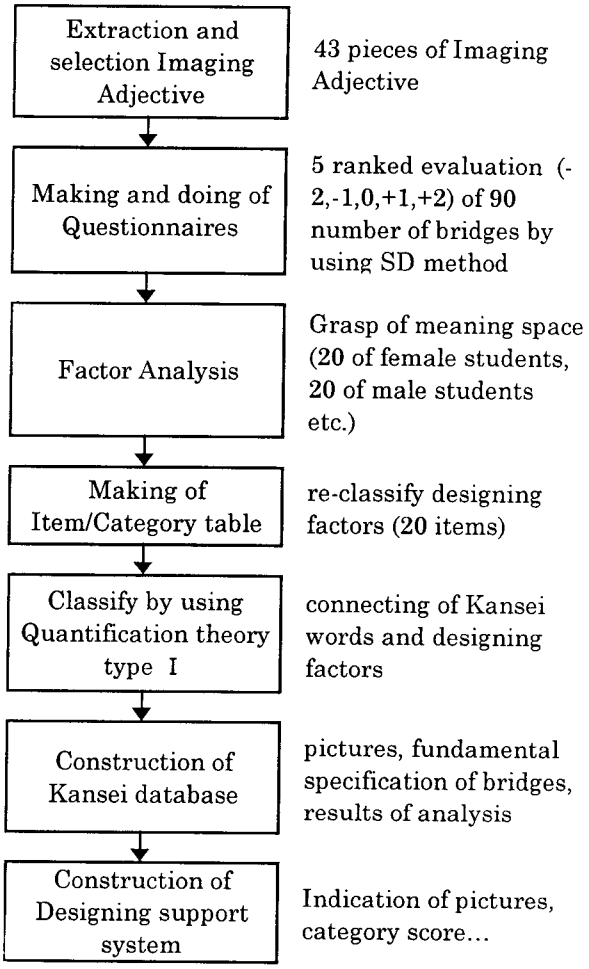

Figure-1 The procedure of this study

3.The difference of judge of every evaluator

3.1 Result of factor analyzed

We call factor analysis the method to make explanation of many variable factor. In this section the factor analyze is the result of questionnaire with university student and bridge structure engineering, we grasp the space meaning of beautiful bridge which is expressed by the image modification. List 1 show the load factor analyze of questionnaire's results. In the list 1 is the turn of load quantity, and the object which we made by the 15 bridge structure engineering questionnaire result.

In the result of factor analyze we extract 6th

factor:[aesthetic senses –art nature],[dynamic] , [relief sense] , [area nature] , [material sense] , [present beauty]. Under list 1 show the construction rate and accumulation rate which we have get from factor analyzed. The accumulation rate is over 80%,we can say that is a result which we can trust.

Next occurred the christening of factor by the impression which we have took from every factor of list 1.

Christening has been judgment from the impression which we have took from the modification which is including into every factor.

Table-1 Results of Factor Analysis (bridge engineers)

		Factors					
		1st	2nd	3rd	4th	5th	6th
Aesthetic sence, artistic sence	desirable	0. 199472	0. 085098	0. 033114	-0. 00659	-0. 0656	0. 084662
	stylish	0. 199332	-0. 02475	-0. 02957	0. 052187	-0. 01085	0. 122861
	beautiful	0. 197351	0. 091384	0. 003568	-0. 07382	-0. 00777	0. 084693
	elegant	0. 19575	0. 08583	-0. 03767	0. 003628	0. 020436	-0. 02241
	graceful	0. 195733	-0. 04505	-0. 08033	-0. 10732	-0. 03533	-0. 02336
	refined	0. 192468	0. 07301	0. 021623	-0. 00516	-0. 09785	0. 056937
	friendly	0. 191661	0. 08025	-0. 0603	0. 100951	-0. 00984	0. 04081
	comfortable	0. 190584	0. 061273	0. 008588	-0. 04525	-0. 04488	0. 056067
	harmonious	0. 18517	0. 141532	-0. 00467	-0. 03447	-0. 0465	0. 062833
	pretty	0. 184747	0. 013283	-0. 16644	-0. 07682	0. 016567	-0. 04438
	liberal	0. 182918	0. 11662	0. 012103	0. 038113	-0. 04092	-0. 07661
	attractive	0. 182766	0. 126286	0. 024996	0. 00261	-0. 15557	-0. 15203
	luxurious	0. 179029	-0. 14771	0. 024646	0. 075618	0. 029104	0. 067053
	modern	0. 178696	-0. 09263	0. 061896	-0. 05155	-0. 09926	0. 17764
	artistic	0. 177406	-0. 16295	-0. 06797	0. 149375	-0. 04871	0. 062756
	much open feel	0. 165188	0. 097182	-0. 00407	-0. 07074	-0. 0312	-0. 06565
Activity	definite	0. 12826	0. 289066	-0. 04446	-0. 05744	-0. 02061	0. 098689
	natural	0. 123436	0. 27649	-0. 06531	0. 024327	-0. 07471	-0. 16912
	practical	0. 034998	0. 269475	0. 24832	-0. 11171	0. 132824	-0. 02808
	balanced	0. 158275	0. 222002	0. 072754	-0. 01712	0. 006964	0. 080447
	functional	0. 11375	0. 209831	0. 19675	-0. 01336	-0. 07921	-0. 05596
	melted into landscape	0. 159557	0. 204589	-0. 03083	0. 126691	-0. 06365	0. 010112
	dynamic	0. 143797	-0. 18318	0. 157348	-0. 16815	-0. 17966	-0. 11172
	much presence feel	0. 134942	-0. 20182	0. 184177	-0. 03814	0. 106416	0. 03784
	impressive	0. 166361	-0. 21194	-0. 01254	0. 061031	0. 065058	0. 042953
	much three-dimensional effect	0. 141339	-0. 21769	0. 078709	-0. 19082	-0. 11338	-0. 12066
	unique	0. 135282	-0. 26585	-0. 02893	0. 247079	-0. 02932	0. 053698
Relief	strong	0. 039117	-0. 09122	0. 414259	-0. 09694	0. 139295	-0. 15149
	weighty	0. 026899	-0. 16991	0. 377878	-0. 09683	0. 040106	-0. 26388
	stable	0. 075517	0. 112925	0. 332075	-0. 06083	0. 294201	-0. 05625
	feminine	0. 091534	-0. 07244	-0. 31545	-0. 16704	0. 259852	-0. 12233
Local Identity	included local identity	0. 141383	0. 032343	-0. 05466	0. 382048	0. 120831	-0. 13298
	included game sense	0. 152208	-0. 22713	-0. 05407	0. 244122	0. 016241	0. 109554
	symbolic	0. 161922	-0. 20677	0. 001964	0. 211986	0. 065414	0. 051068
	youthful	0. 165428	0. 004821	-0. 03774	-0. 28561	0. 137635	0. 195931
Material sence	Japanesque	0. 024976	0. 075253	0. 111429	0. 385265	0. 526753	-0. 12282
	colorful	0. 145235	-0. 11466	-0. 11651	-0. 17848	0. 306138	0. 137614
	warm	0. 161265	0. 035536	-0. 15309	-0. 01896	0. 245766	-0. 17221
	much material sense	0. 079233	0. 03057	0. 130189	0. 366414	-0. 39604	-0. 27166
Modern beauty	straight	-0. 04369	0. 197605	0. 194524	0. 200449	0. 119538	0. 489812
	urban	0. 138313	-0. 12722	0. 146555	-0. 08681	-0. 14821	0. 338974
	noble	0. 169409	-0. 09709	0. 169447	-0. 0744	0. 05595	-0. 18143
	soft	0. 136958	0. 037287	-0. 28938	-0. 09664	0. 060904	-0. 30597
	eigenvalue	21. 40827	5. 546708	3. 980525	1. 886647	1. 31262	1. 210171
	contribution rate	49. 78668	12. 89932	9. 257034	4. 387552	3. 049446	2. 814351
	accumulated contribution rate	49. 78668	62. 686	71. 94303	76. 33059	79. 38003	82. 19438

Table-2 Order of partial correlation coefficient (stable←→unstable)

Order	stable←→unstable					
	Bridge engineer		Female student		Male student	
	Adjective	Partial correlation coefficient	Adjective	Partial correlation coefficient	Adjective	Partial correlation coefficient
1	Height of view point	0.488	Clearance	0.595	View distance	0.518
2	Clearance	0.417	View distance	0.539	Cross section of substructure	0.303
3	Drainpipe	0.351	Cross section of substructure	0.405	Height of view point	0.298
4	Number of pier	0.334	Color of railing	0.380	Clearance	0.296
5	Shape of substructure	0.306	Number of pier	0.367	Shape of substructure	0.295
6	Color of railing	0.270	Height of view point	0.354	Number of pier	0.244
7	Color of girder	0.269	Color : background - substructure	0.351	Color : background - superstructure	0.239
8	Color : background - substructure	0.267	Color of girder	0.317	Color of girder	0.221
9	Obstacle	0.257	Pillar of illumination	0.225	Obstacle	0.221
10	Color : background - superstructure	0.188	Shape of substructure	0.221	Color of railing	0.214
11	Cross section of substructure	0.164	Landscape	0.181	Color : background - substructure	0.209
12	Parallel bridge	0.142	Drainpipe	0.170	Incident angle of view	0.207
13	Landscape	0.123	Shape of main girder	0.167	Parallel bridge	0.206
14	Inspection path, added bridge	0.118	Color : background - superstructure	0.155	Railing type	0.182
15	Incident angle of view	0.113	Railing type	0.127	Pillar of illumination	0.171
16	Two-dimensional shape	0.071	Inspection path, added bridge	0.125	Landscape	0.153
17	Railing type	0.055	Two-dimensional shape	0.108	Inspection path, added bridge	0.060
18	View distance	0.041	Incident angle of view	0.050	Drainpipe	0.048
19	Pillar of illumination	0.018	Obstacle	0.042	Shape of main girder	0.034
20	Shape of main girder	0.018	Parallel bridge	0.025	Two-dimensional shape	0.027

3.2 Analysis by quantification theory type I

Users of bridges are various. When the users evaluate the landscape of bridges, some users evaluate in the same way, and the others evaluate differently. Partial correlation coefficient analyzed by quantification theory type I is the number expressing the effect on every item. As this coefficient is higher, the item is more important. The orders of partial correlation coefficients are shown in Table-2. Table-2 is the case of "stable ← → not stable".

As higher order, partial correlation coefficients are more increasing. For example, in the case of "stable←→unstable", the effect of view distance is very large about the questionnaire to male students and female students. However the effect of view distance is very small about the questionnaire to bridge engineers, and its order is 18. In the case of "straight←→curved" the orders of partial correlation coefficients about the landscape are the highest about all questionnaires. And the orders of partial correlation coefficient about the obstacle are all low.

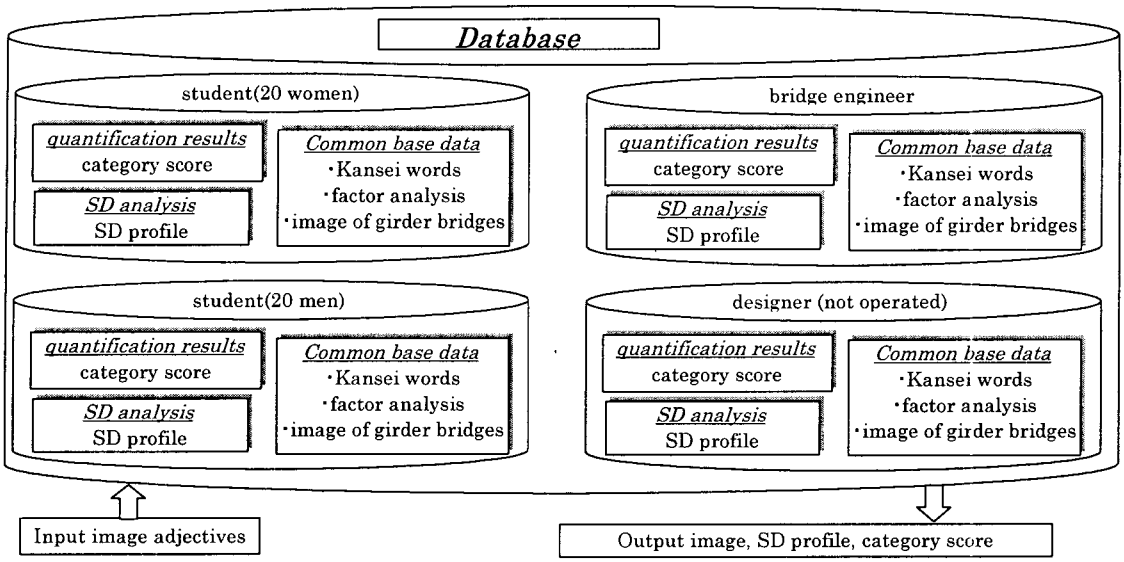

Figure-2 Constitution of Kansei database

4. Application Method of Kansei Database to Designing Bridges

There are some problems written below in the systems of landscape design, which have been used for neural network and expert system and so on. The important problems are that we cannot grasp the difference in the evaluation about the elements of landscapes and their changes, and that we have to make trials how to change the about the elements of landscapes to improve the evaluation. The constitution of Kansei database is shown in Figure-2. The results of questionnaire to male and female students and bridge engineers, the SD profiles of each bridge, the category scores of each adjective, basic data of the girder bridges and their pictures are registered in this Kansei database. The picture of Kansei database system for input is shown in Figure-3. A designer can refer kansei of the bridges, or image adjective in other word, to this database. The pictures applied to the image adjectives, SD profiles, the category scores and some pictures of bridges in higher ranking and lower ranking on the category scores are expressed in the monitor. The designer can design the bridges based on these results. Some bridges in higher ranking and lower ranking on the category scores, which is the part of output data, are shown in Figure-4. These pictures are expressed in the monitor for each total score of some adjectives chosen in Figure-3.

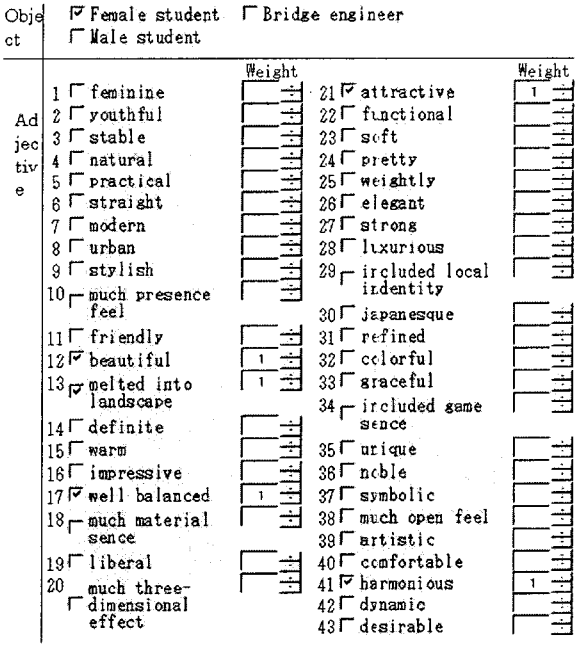

Figure-3 Picture of Kansei database system for input

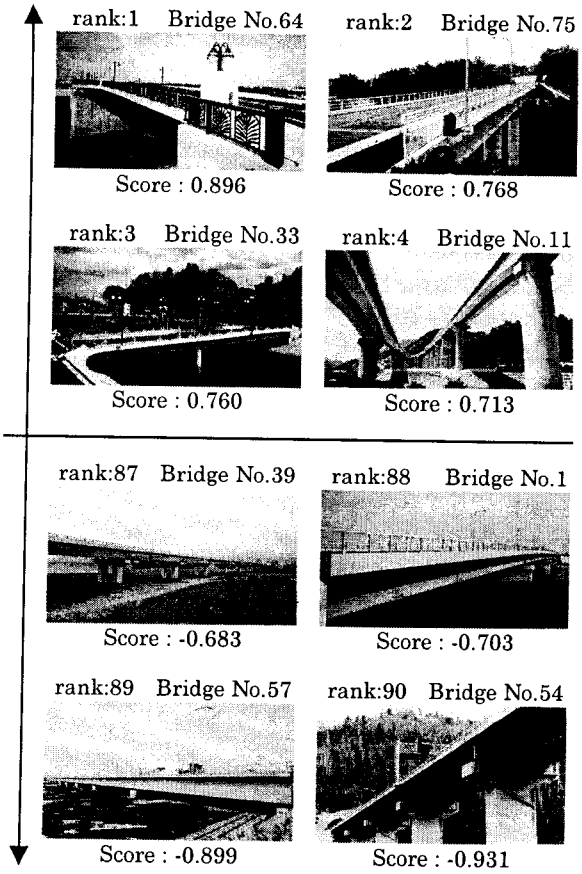

Figure-4 Total score of chosen image adjectives

5. Conclusion

The significance to verify the landscape design of bridge by quantification is increasing, in comparison with former situation, according to diversification of user's needs and progress in consciousness of participation.

It is proved that the Kansei engineering method grasps the relation between imaging adjectives and designing factors, which form the landscape design of bridge.

In addition, this study proved that validity of the trial of evaluation, dividing the designing factor into items and categories, and considering bridges to be the set of items and categories.

In the future, we are going to make questionnaires to specialists of bridge engineering and bridge designers besides students. Furthermore we are going to make additional examinations of Arch style bridges beside Girder bridges, and we enrich the Kansei Database. We will build the Kansei Database which is able to excellent utilities such as easy access for any users, and make program codes which systemize that procedure.

Then, we will be able to construct bridges that can make residents satisfied.

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