OPINION OF USERS AND OWNERS ABOUT SAFETY PERFORMANCE OF BUILDING STRUCTURE (CONCEPT OF PERFORMANCE-BASED DESIGN STANDING ON QUESTIONNAIRES)

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SUMMARY

Nation-wide questionnaires were conducted as one of the investigations in the Japanese national project to extract opinions from the people widely on performance of building structure and its levels and to investigate the propriety of the frameworks of performance-based engineering, by means of sending questionnaires by mail in 1997-1998 in Japan. About 3,000 general users (ordinary residents), 800 owners (including suppliers, tenants, etc.) of buildings were chosen as the objects of the survey. In this investigation, we focus on earthquake resistant safety which is one of the most important problems in Japan where big earthquakes sometimes occur and they gives us serious damage. It is clear from the research, the general users in Japan take great interests in earthquake resistant safety of houses or buildings and recognize prevention of giving troubles to surroundings important as well as safety of human lives in buildings. As for the responsibility of earthquake damage of buildings, the users and the owners think that the lie of responsibility varies with the damage of the surrounding buildings and that it is difficult for self-responsibility to be applied to the safety problem under the present condition. They take negative attitudes toward determining the performance and its levels of buildings and taking responsibility for them from lack of knowledge of building structure.

INTRODUCTION

Performance of building structure and its levels should be decided based not only on dynamic approach but also on demands by the people, such as general users and owners of buildings or society. For the purpose of extracting opinions from the people widely on safety performance and its levels and investigating the propriety of the frameworks of performance-based engineering, nation-wide questionnaires were conducted as one of the investigations in the Japanese national project "Development of a New Engineering Framework for Building Structures." In this paper, opinions of general users and owners of buildings about safety problems, especially an earthquake resistant safety problem which is a very important for lands of earthquakes including Japan and about responsibility for safety of buildings are discussed from statistical observation from the results of the questionnaires.

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OUTLINES OF QUESTIONNAIRES

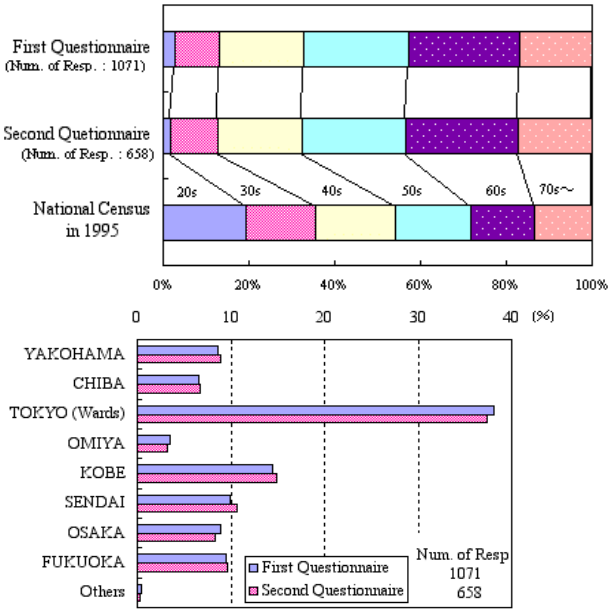
In this Investigation, the four questionnaires were conducted for ordinary residents as general users of buildings (twice), building owners and building experts to gather information from people of many walks of life by means of sending questionnaires by mail. The common questions to the users, the owners and the experts and the specific questions according to the standpoints of the respondents were prepared. In the written request of the questionnaires, it was clearly written that the investigation was concerned with earthquake resistant design and formed a part of products by the national project. The outlines of the questionnaires for the general users and the owners of buildings which are concerned with this paper are described below.

Questionnaire for Users

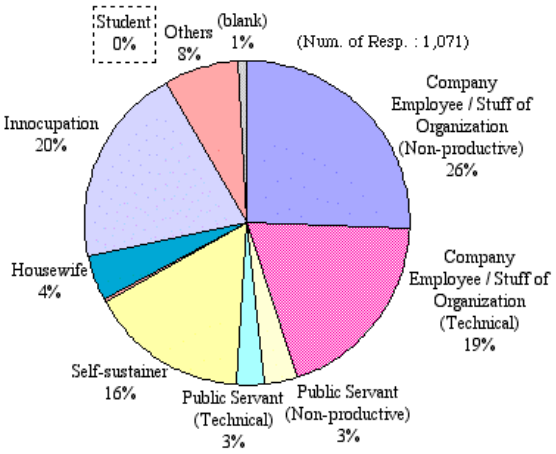
The questionnaires for general users of buildings were conducted twice considering the contents and the volume in August and December of 1997. The outline of the questionnaires is shown in Table 1 and Figure 1. The main purpose of the first questionnaire was to extract the fundamental consciousness on safety problem or earthquake resistant design. The questionnaires were sent by mail to ordinary residents sampled randomly using telephone dictionaries, living in the Metropolitan area including the central areas of Tokyo, Yokohama, Chiba and Omiya

Table 1 : Outline of Questionnaires for Users

Area	Cities	First Questionnaire			Second Questionnaire		
		Num. of Distribution (d_1)	Num. of Recovery (r_1)	Ratio of r_1/d_1 (%)	Num. of Distribution (d_2)	Num. of Recovery (r_2)	Ratio of r_2/d_2 (%)
Metropolitan Area	TOKYO (Wards)	1,200	411	34.2	411	248	60.3
	YOKOHAMA	200	90	45.0	91	57	62.6
	CHIBA	200	72	36.0	71	45	63.4
	OMIYA	100	37	37.0	36	21	58.3
	unknown	-	3	-	1	1	100.0
	Sub-Total	1,700	613	36.1	610	372	61.0
Hanshin Area	OSAKA	350	95	27.1	94	56	59.6
	KOBE	350	155	44.3	153	97	63.4
	Sub-Total	700	250	35.7	247	153	61.5
Localities	SENDAI	300	107	35.7	108	70	64.8
	FUKUOKA	300	101	33.7	101	63	62.4
Total		3,000	1,071	35.7	1,066	658	61.7



(a) Ages of Respondents



cities, Hanshin area including Kobe and Osaka cities, Sendai and Fukuoka cities. The amount of the responses

(b) Ratio of Respondents of Each Area to All **(c) Occupations of Respondents (First Questionnaire)**

Figure 1 : Constitution of Users in Questionnaire

was 1,071 and the recovery percentage reached 35.7%. The second questionnaires were sent only to the respondents of the first questionnaire to know the detailed opinions on the earthquake resistant design. The ratio of the second effective responses to the first was 0.617 as shown in Table 1. As compared with similar questionnaires, a higher recovery percentage was obtained. The constitution of the respondents was shown in Figure 1. Most of the respondents have the ages of 40s-70s, and male respondents accounted to about 90% of all.

Questionnaire for Owners

The outline of the questionnaire for building users is shown in Table 2. The survey of the consciousness of the building owners was made on 815 members of various kinds of organizations, who were selected randomly. The positions of the respondents include owners, suppliers, tenants, etc. as shown in the table. “Building owners” is a term of these in the investigation. The questionnaires were basically sent and recovered by direct mail but were sometimes did through the organizations. The questionnaire was conducted in February of 1998. The recovery percentage was about 60%. The responses are sometimes summed for every group according to uses of the buildings with which the respondents were concerned most deeply.

Some of the questions in the questionnaires were slightly changed according to the characteristics of the users and the owners, as possible as the unity of the questions was kept, because people of many walks of life were included in the respondents. On the other hand, there were some specific questions only for the users or only for the owners.

Table 2 : Outline of Questionnaires for Owners

Categories of Owners							Num. of Distribution (d)	Num. of Recovery (r)	Ratio of r/d (%)
Use of Building	Position								
	owner	supplier	orderer	tenant	manager	maker			
Private Hi-rise Dwelling	*	*					75	34	45.3
Public Residence		*					80	60	75.0
General Office Building	*	*					158	93	58.9
Public Building			*				90	83	92.2
Department Store & Hotel	*			*			52	39	75.0
Social Infrastructure	*			*			88	33	37.5
Private Hospital	*			*	*		150	50	3.3
Public Hospital	*				*		13	11	84.6
Facility of Dangerous Article	*			*	*		35	35	100.0
Few-story Dwelling						*	74	58	78.4
total							815	496	60.1

CONSCIOUSNESS AND THINKING ON SAFETY

Fundamental Consciousness on Safety

Earthquake resistant safety is one of the most important problems in Japan where big earthquakes sometimes occur and they give us serious damage. We investigate how general people are conscious of earthquakes among danger in their daily life, or how they are conscious of earthquake resistant safety in preserving safety of houses.

Danger in Daily Life (for users)

Figure 2 shows the danger that the users think serious in their daily life comparatively among the cities. “Earthquake” is the third to “Disease” and “Traffic accidents” in serious problems in their daily life. Large difference between the above higher three and the other danger is seen in the figure. The difference in areas isn’t much large.

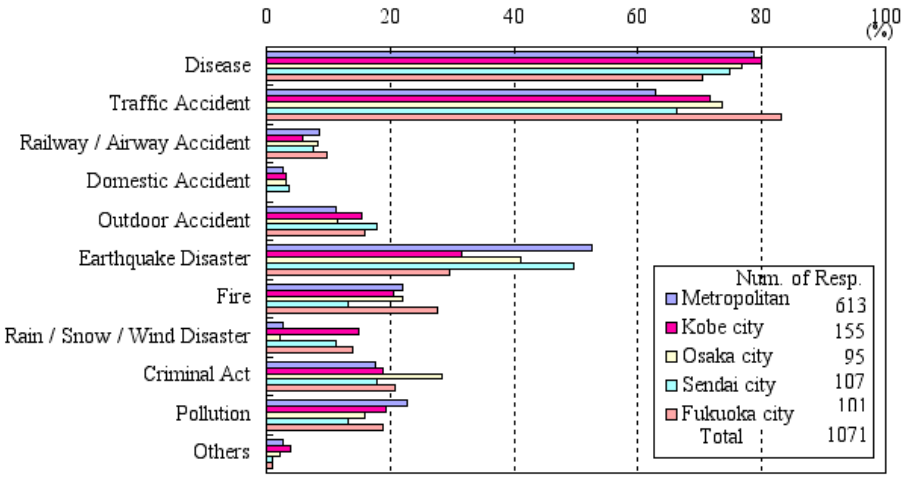
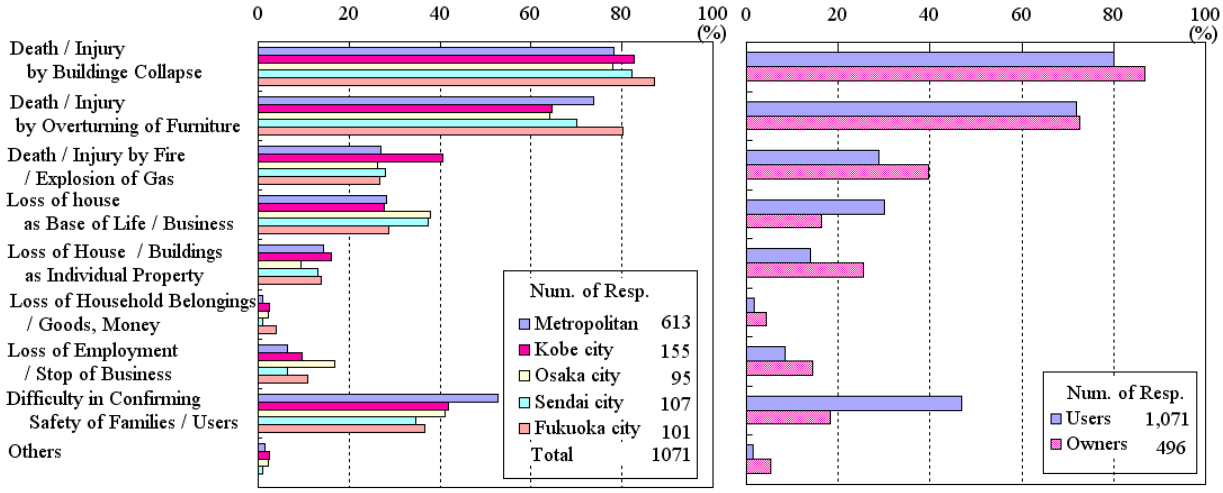


Figure 2 : Danger in Daily Life (for Users)

Avoidant Trouble When Earthquake (for users and owners)

We investigated the most anxious troubles for the users and the owners when an earthquake occurs. Eight choices were prepared for this problem such as death and injury in the accident caused by an earthquake, economic loss, unstable living condition, etc. The anxiety in the problem to the users was about themselves and their families and that to the owners was about users in buildings. Figure 3(a) shows the regional comparison of the responses of the users to the problem and Figure 3(b) shows the comparison of the responses between users' and owners'. The most anxious trouble is death and injury by building collapse and the second one is death and injury by fire or explosion of gas, which is common to the users and the owners. The loss of houses as individual property, or household belongings or money is not thought very serious. The users living in the Metropolitan area are more anxious about the difficulty in confirming safety of families and the users living in Kobe city are more anxiety about death and injury by overturning of household furniture than the other cities, corresponding to the regional situation. The answers of the owners are almost the same as those of the users, but the owners are more anxious about loss of buildings as individual property than the users.

From the results of the above problems, we indicate that general users concern themselves with earthquakes and take earthquake resistant performance of housing seriously, and that the users and the owners are the most anxious about the death and injury by collapse of houses (buildings), or by fire or explosion of gas.



(a) Regional Comparison of Users' Responses **(b) Comparison of Users' and Owners' Responses**

Figure 3 : Avoidant Trouble When Earthquake (for Users and Owners)

Thinking of Earthquake Resistant Safety of Buildings

Houses or buildings are not only bases of living or commercial activities but also the components of cities. If houses or buildings are damaged by earthquakes, It is quite possible that the damage influences the surrounding buildings, objects and persons. We investigate how the users and the owners interpret earthquake resistant safety, and from what viewpoints they think of earthquake resistant safety.

Fundamental Thinking of Earthquake Resistant Safety

Big earthquakes are menaces to the safety of human lives in buildings, and sometimes the damage of the buildings by earthquakes influences the surrounding communities. The thinking of the users and the owners about the problem is shown in Figure 4. On the results of the users, the opinion that safety of human lives in buildings is prior to avoiding damaging the surrounding communities is comparatively few and the opinion that the importance of the both is much the same is representative. The owners also think the both important evenly, but the opinion that safety of human lives in buildings has priority is more in the responses of the owners than those of users.

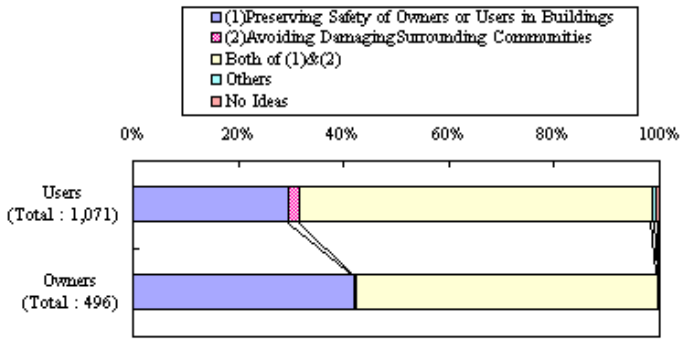
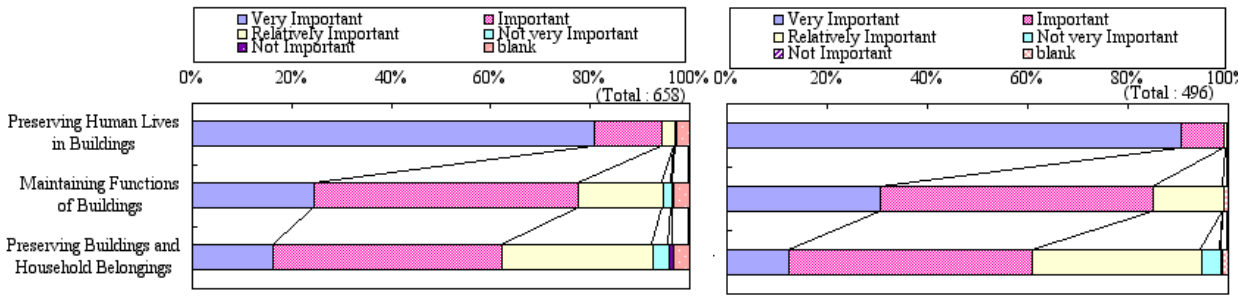


Figure 4 : Fundamental Thinking of Earthquake Resistant Safety

Purpose of Earthquake Resistant Design

There can be several purposes in earthquake resistant design, such as preserving human lives in buildings, maintaining functions of buildings, or preserving buildings and household belongings as individual property. We investigated how the users and the owners think of the importance of the above purposes. The five levels of importance were prepared for the problem for the above three purposes. Figure 5 shows the results of the users and the owners. The responses of the users are gained in the second questionnaire. For all items, the sum of percentages of “very important”, “important”, “relatively important” reaches more than 90% in the results of the users. Considering the percentage of each choice, the users recognize preserving safety of human lives to be the most important as the purpose of earthquake resistant design. The next is maintaining functions of buildings. Preserving individual property is not estimated highly compared with the others. The tendency of the owners’ opinions is almost the same as those of users.

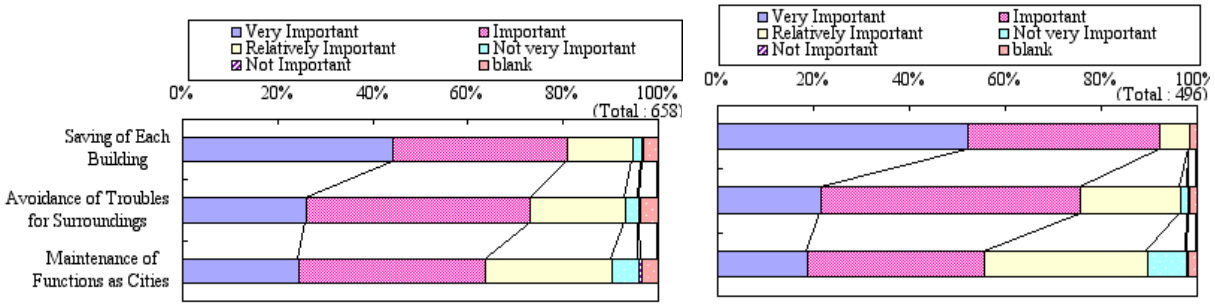


(a) Users **(b) Owners**

Figure 5 : Purpose of Earthquake Resistant Design

Viewpoint of Earthquake Resistant Design

How the viewpoints of earthquake resistant design are taken seriously for the users and the owners, such as saving of each building, avoidance of troubles for surroundings and maintenance of functions as cities was investigated. The same five levels of importance as the previous problem were prepared as the answers for this question. The results of the users and the owners are shown in Figure 6. In the responses of the users, saving of each building is the most important, and avoidance of troubles for surroundings takes the second place. The priority of maintenance of functions as cities is estimated low compared with the other two items. The owners estimates saving of each building to be more important than the users.

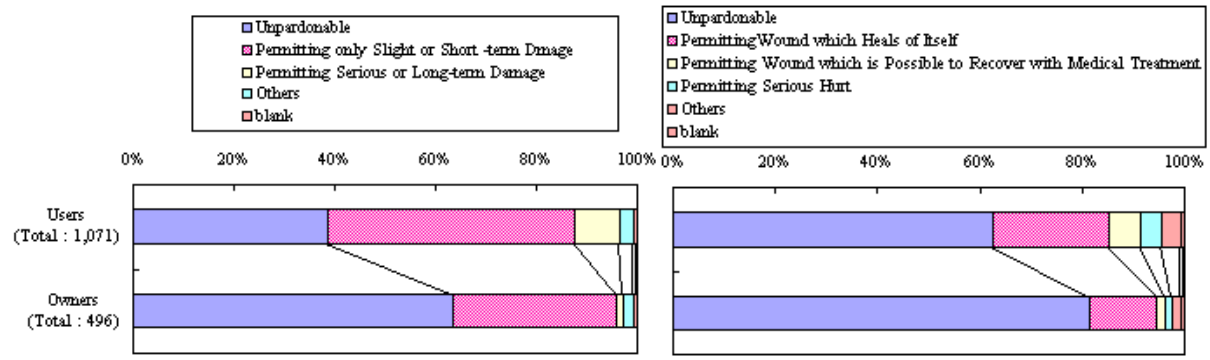


(a) Users **(b) Owners**

Figure 6 : Viewpoint of Earthquake Resistant Design

Influence of Damage by Earthquake on Surroundings

It has become clear that the users and the owners attach importance to preventing the damage of buildings by earthquakes from giving damage to the surroundings persons or objects in the above study. In the next place we made an investigation on the opinions of the users and the owners about to what degree influence of earthquake building damage on surrounding persons or objects should be permitted. In this problem two situation were considered, that is the case of influence on the surrounding buildings or roads, and the case of influence on the surrounding persons. Figure 7 shows the results of the problems. The opinion that none of influence should be permitted both on surrounding facilities and surrounding persons is representative in the results of the users. The opinion that only slight or short-term influence on surrounding facilities should be permitted can be also seen. It is clear that most of the users does not permit earthquake building damage to give great influence on the surrounding facilities or persons even in earthquake occurrence. The owners have severer eyes in this problem than the users.



(a) On Surrounding Buildings or Roads **(b) On Surrounding Persons**

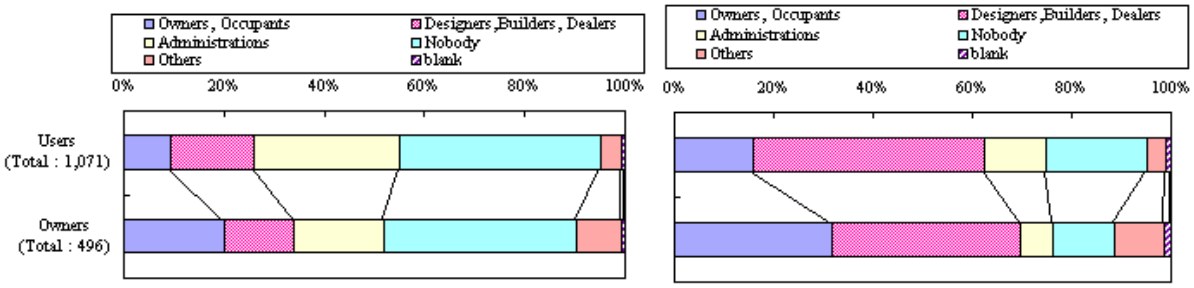
Figure 7 : Influence of Damage by Earthquake on Surroundings

Responsibility for Safety of Buildings

The solution of the problem of who is proper for decision-making of safety performance of buildings or where the responsibility exists for damage of buildings caused by earthquakes seems not to be clear in the present social system in Japan. In relation to the problem, it is said that self-responsibility, that is the principle that one has to decide on one's own responsibility, becomes important nowadays. We investigate how the users and the owners think of these problems from the questionnaire.

Responsibility for Earthquake Damage

The problem of who is responsible for earthquake building (house) damage is investigated on the users and the owners in two assumed cases separately : when the surrounding buildings (houses) are destroyed at 30% and at 10% by earthquakes. The objects of this problem were "houses" to the users, "buildings in relation to business" to the owners. The comparison of the results between the users and the owners is shown in Figures 8 for the two cases. In the opinion of the users, suppose that the surrounding houses are destroyed at 30% by an earthquake, the responsibility to the damage lies with nobody or administrations, and suppose that they are destroyed at 10%, it lies with designers, builders or dealers. The difference of the opinions in the two cases is clearly seen in the results of the owners, too. In the results of the owners, the voice that the responsibility to the damage lies with the owners increases, and the voice that that lies with administrations decreases obviously.



(a) When the surrounding buildings (houses) are destroyed at 30% by an earthquake

(b) When the surrounding buildings (houses) are destroyed at 10% by an earthquake

Figure 8 : Responsibility for Earthquake Damage

Subject of Decision-making about Safety Performance

In the next place, the problem of who should decide the safety performance of buildings (houses) is investigated. The objects of this problem were "houses" to the users, "buildings" to the owners. The comparison of the results is shown in Figure 9. The tendency of the users' opinions to this problem is similar to that to the problem about the responsibility for the building earthquake damage in case that the surrounding buildings are destroyed at 30%. The representative users' opinion may be that administrations should make a decision about safety performance of buildings and if great damage occurs by an earthquake, the administrations or nobody is responsible for the damage because an earthquake is an accident beyond human control. The owners' opinions is slightly different from the users'. The opinion that building owners should decide the safety performance of the buildings increases, on the other hand, the opinion that administrations should do decreases remarkably.

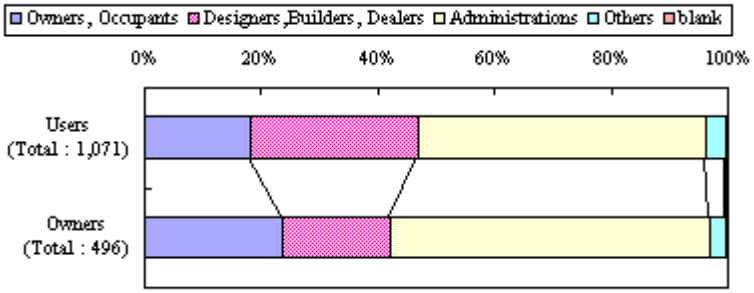


Figure 9 : Subject of Decision-making about Safety Performance

Self-responsibility for General Safety

In the third place, the opinions of the users and the owners about the possibility that the thinking of self-responsibility is applied to general safety problem is investigated. Four choices were given to the problems, that is “Self-responsibility should be applied to the safety problem.”, “Safety should be protected by the laws.”, “Self-responsibility cannot be applied to the safety problem because of need of technical knowledge.”, and “Self-responsibility cannot become familiar with Japanese natural features.” Figure 10 shows the results of the users and the owners to the problem. The opinions of them are divided on this problem into almost even three groups. It seems that the results shows that many users and owners think that it is difficult for self-responsibility to be applied to the safety problem under the present condition. The fact does not contradict with the results on the previous problem that the opinion that the responsibility for the earthquake damage of buildings lies with owners is low.

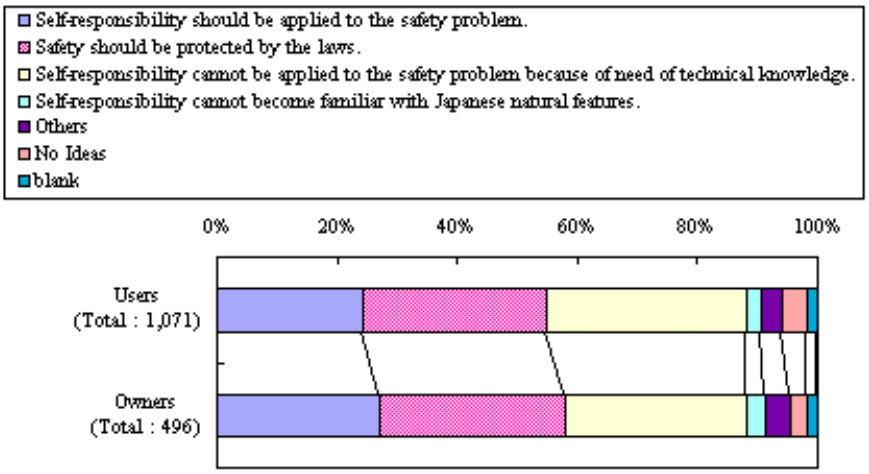


Figure 10 : Self-responsibility for General Safety

CONCLUSIONS

To investigate the consciousness on safety or the opinion of building performance, especially for earthquake resistant performance, the four questionnaires were conducted on about 3,000 ordinary residents as general users of buildings, 800 owners of buildings (including suppliers, tenants, etc.), and 700 building experts in 1997-1998 in Japan. In this paper, the results on the users and the owners were summed and the tendencies of them were analyzed. It is clear from the results that general users in Japan take great interests in earthquake resistant safety of houses or buildings and recognize prevention of giving troubles to surroundings important as well as preserving safety of human lives in buildings. As for the responsibility of earthquake damage of buildings, the users and the owners think that the lie of responsibility varies with the damage of the surrounding buildings and it is difficult for self-responsibility to be applied to the general safety problem.

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