AN INVESTIGATION OF THE RECENT EARTHQUAKE DISASTERS FROM A VIEW POINT OF URBAN ENGINEERING

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SUMMARY

Japan is located in the circum-Pacific earthquake belt. There had been big serious earthquakes with this reason at old years ago. In the modern period, when the big Kanto earthquake came, almost buildings in and around Tokyo area had been collapsed absolutely. The first regulation for the seismic design had been planned after the big and serious disasters by this Kanto earthquake. Those rules have been improving with consideration from many accidents at the Fukui earthquake, at Niigata earthquake, at the Miyagi earthquake and so on. Japanese people and structural engineers who were working in the design field for the buildings had confidence to protect their country from disasters by the earthquakes. They believed firmly that there would not be similar disasters in Japan, when engineers had researched at Northridge in Los Angels in 1994. However, the big most serious disasters called the Hanshin-Awaji Earthquake Disaster had occurred. At Kobe. In this paper, we try to find various causes and problems that made serious disasters from social scientific point of views and put some suggestion in the future.

INTRODUCTION

Five years and seven months have been passed after the big earthquake attacked and made terrible disasters at cities and outskirts around Kobe and Kinki areas. We could see the remarkable sentences in the editorial article of news paper “New York Times” as followings immediately after this big earthquake occurred. “It will be remarkable for us to see how Japanese people will perform reconstruction against the disasters at this earthquake, because there have been the most advanced technology for the seismic problem in the world and this big earthquake occurred in Japan.”
These Japanese reconstruction has been considered as the large revival project against the disasters in the world.

SOCIAL TEACHING AT HANSHIN-AWAJI EARTHQUAKE DISASTER

The harmful influence of administration without mutual relationship

There would be big serious influence against all of regions and life of people when large disasters occur. It is evident for us to do action against disasters with all our social energy quickly. It will be necessary to perform urgent actions corresponded with scale of disasters. We take it for granted that government must declare a state of emergency and set up measure against disasters on a spot, because there are unprecedented serious disasters over ten billion yen in the most modern city of the world.
It would be possible to estimate the scale of disasters after several hours passed, as it would not be able to know the situation of disaster soon after disasters will occur. When we search our conscience for this earthquake disaster, we feel that there will be mistake to arrange something in the governmental action. We point out the serious problem as followings.

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(1) There was fatal problem on the first action of disaster prevention system.

As over 70 years had passed in Japan from the very large serious earthquake disaster that was named the Kanto earthquake disaster, Japanese people had experience to destroyed all of cities in Japan with World War II about 50 years ago. After World War II, Japanese islands had suffered from destruction of nature with Fukui earthquake disaster, the typhoon at the Ise bay, a localized torrential down pour in Nagasaki, a heavy snow fall in the north area of Japan and so on.
However, people mistook to establish a measure for urban disaster prevention against emergency disaster without consideration for important things by only going into making bubble money on the marvelous economical restoration. It was said that self-governing bodies hesitated to issue the demand on preparation of action for the self-defense Forces. Smooth actions between local self-governing bodies and central governments could not be performed. It would be considered that relationship between officers and municipal officers could not be kept good partnership. Initial action with the self-defense Forces was stopped not on clear decision, because they are reliable for people. It would be a main cause to enlarge disasters at Hanshin-Awaji earthquake.

(2) Effective measures would not be performed by the central government

Government appointed suddenly a politician to the Minister that had to manage jobs with including treatment for disaster about the earthquake problems. However, he didn't set up the Minister's office on the spot, as he visited at Kobe by helicopter at several times only. He would not understand correctly that he had to treat the serious earthquake disasters. If he opened his branch office on the spot actually, the plan for rescue and restoration would be worked out one after another by connecting with local officers and municipalities carefully. It was not too much to say that restoration works were delayed as a result, as the quick response would not be performed after the earthquake.
However, offices in the Hyogo prefecture and in the municipalities around Kobe city considered that the central government would be unreliable. They made cooperation system with commercial companies and residents. It was important that some self-governing bodies worked with cooperation each other. Another strong helper was power from volunteers. There had not been powerful. At that time, true works were performed systematically with volunteers. It was the first action in real meaning with them in Japan. The urgent works for suffers were progressed by people without rescue from the central government.

Old disaster experiment was not used effectively

All of people in Japan including governmental officers had been bewildering for a little long time with serious big earthquake that occurred after a long time since the Kanto disasters in 1923. Nobody could image that a vast serious earthquake would occurred at Kobe. Japanese nation recognized that they were made by a surprise attack, because they were paying attention to much earthquakes in the Tokai area. People see that Japanese all cities had been superficially prospering after World War II with marvelous restoration. As certainly these cities have been arranged as the modern cities, they have typical defects as followings.

(1) There are large area of wooden houses remained at the center of the big cities without redevelopment.

(2)There are a few area for parks, green areas and open spaces with comparing to all area in the modern cities. This ratio for this values to all land is almost 1/3 and under with comparing to cities in Europe and USA.

(3)People had been keeping low consciousness to remain the historical cultures, as the self-governing bodies decreased old valuable buildings and facilities to manage their policy effectively.

There were two much profitable matters for urban disaster prevention in Japan with field survey of Mexican earthquake disasters in 1985 as followings.
One is fuel gas is supplied by tank trucks on the road in the each entrance of apartments with decision that buried pipes are more danger. Urban soil is quite weak under sinking the earth. Urban soil has been constructed by making new land at the creator lake in Mexico. If fire break out at the earthquake, only one building will be burst into flames. The other is many buildings were destroyed, because almost middle and high-rize buildings were reinforced concrete structures. Officers in Mexican central government and Mexico city remained lands as parks and open spaces, after they pull down broken buildings into pieces and carried out them to far places without making new buildings on that places. This treatment was performed from the disaster policy to consider the urban disaster.

Natural disasters have been increased such as typhoons, hurricanes, whirlwind, floods and forest fires in the world about 20 years ago. Especially, Japanese researchers and engineers had been interested in earthquake disasters. They organized many groups with researchers in commercial companies, government, self-governing bodies and learned society to detect the disasters. They have been studying many things on that spots in Mexico, 1985, at Loma Prieta in San Francisco, 1989, in Turkey, 1992, and at Northridge in Los Angles USA. We, Japanese engineers would study valuable teachings in those places.
There were no discussion about the progresses for Japanese seismic technologies, as earthquake engineers in Japan were at the top of the technical level. It would be true that such serious disasters would not occur, if they discussed about the earthquake disasters seriously based on the Mexican big disaster.
In fact, American progressed technology in urban risks especially for the earthquake disasters. As most effective actions had been performed in USA., there were a little urban disasters in 1989 and in 1994. We regret Japanese delay action against earthquake disasters

THE RULE TO SETTING EFFICIENCY OF THE BUILDINGS AND WHERE RESPONSIBILITY LIES AGAINST HANSHIN-AWAJI EARTHQUAKE DISASTERS.

The independent professional engineers need to design the buildings.

Generally speaking, designers for the buildings are personal and must be professional. There must be real professional engineers who have professional faculty and technology to make decisions in the building designs in both architectural and structural design. However, they must have integrity as talent. The status of the designers must be extremely high in the specialty. Soon after World War II, vivid designers in Japan worked seriously in making wonderful buildings apart from the construction companies. However, after that time, new general construction companies were born.
They enlarged to keep stuffs for designers in architectural, structural and constructional fields. They made all-in one system. The works in design had been transferred from professional people to traders. The responsibility for the building design had been fade and traders established their production system with their own economical convenience.
As designers would be still separated from constructors clearly in Europe and USA, there is the basic correct style for designers as professional. It had been clear that almost all of buildings damaged with Kobe earthquake were constructed those traders at Sannomiya district. It would be necessary to separate designers and constructors with consideration for seismic design and responsibility.

Strong self-examination for non-responsibility in the construction of building would be starting point.

There were a large number of deaths ever 6,500, destroyed buildings over 400,000, and several hundreds of thousands of refugees at Hanshin-Awaji earthquake disasters. Power to pursue the issue for responsibility to occur serious disasters in Hanshin-Awaji earthquake has been gradually weakened. We now perform our self-examination for this earthquake disasters quietly and deeply in our experiment for a long time.
Now, it is the time for the design rule from methods in general use to new design methods for structural efficiency. Our responsibility will be move serious and it will be impossible for us to reach the remarkable seismic structural design with considering building efficiency without those our self-examination. We describe some problem as followings.

(1) Was input motion at Kobe earthquake excessive?

People were surprised by over the ranges imaged in general for strong power as the local earthquake in the city, as this earthquake occurred at the area without consideration and quite severe disasters attacked to people.
It was showed zones with an intensity of 7 on the Japanese seven-stage scale passed near the center of Kobe City from east to west. It was at several years ago warned by earthquake professional that a earthquake with an intensity of 7 behavior in active faulting at the south point in Mt.Rokko we issue the next idea for the earthquake professionals.

a) Previous notice must be informed properly about the earthquake will occur in local area.

b) Exact information must be reported about magnitude of the earthquake at original point and amplified wave on the surface of the earth.

c) Actual real situation against the earthquake must be explained with considering the actual experiment at Kobe.

(2) Was the seismic rule was appropriate?

The disasters at Kobe earthquake have been seen in the all structural types. Buildings.
There were remarkable differences in the same structural types of buildings at the same location.
What did it mean? Japan is the earthquake island. All of the engineers in Japan has the pride to keep the splendid seismic structural rule for the design of buildings and foreign engineers also shows the high appraisal.
However, there were quite serious disasters in Kobe. Vibrations in buildings were quite strong and strength of earthquake was an intensity 6 or 7 on Japanese seven-stage scale though magnitude of this earthquake was not vast, and it was middle scale.
It was said that almost destroyed building were designed and constructed with old seismic rule seismic rule. However, it was correct or not?
There were not relations with old or new seismic rule with detecting destroyed building in more detail.

There were three big elements in destroyed buildings as following.

They had not suitable structural planning.

Quality for design and construction was not well.

There were destroyed buildings without solid soil in the site and proper structure for foundations .

There were serious damages in all structures at North ridge in Los Angles in 1994. Engineers in USA were surprised with their shock. What meaning was it? There were resemble situations in Mexico.
Those engineers felt that the responsibility rest with them, and they performed improvement for the seismic capability for the buildings with powerful energy in all countries. Now there were improved marvelous results with them. Almost Japanese engineers, who investigated disasters in foreign countries, told that such large earthquakes would not occur in Japan. They didn't image the similar situation in Japan. However, the big serious earthquake disaster had occurred in Kobe district.
There was responsibility for that serious disaster in all building industry with including governmental officers, and searchers in the laboratories. If is the most serious problem that nobody don't take on responsibility. It would be necessary to make clear each responsibility for government, building industry, and researchers.
If they will leave it as it is, we will not expect the progress by applying new seismic rule with the progress by applying new seismic rule with efficiency. There will not be authority without responsibility. And it would not be expected to keep safety and safe society.

URBAN AND SOCIAL SCIENTIFIC RESEARCH AGAINST THE HANSHIN-AWAJI EARTHQUAKE DISASTER

Hidden soft soil in Kobe area

It is clear that cities in Kobe have been located on the dip slender soil caved in from the Rokko mountains to the Osaka bay in Fig.1. These soil are layered from the east to the west. Researchers could recognize there were the coastline named Jyomon Kaishin at 6 thousand years old with surveying on the historical records in the middle of this zone, as there was the tremor with a seismic intensity of about 7.
The Rokko mountains had been made by heaping up with weathering granite soil on the surface layer. The land expansion have been made to prepare the ground for housing with destruction those rocks and carrying down to the direction for bay side.
There had been several or more over ten rivers in those time. With according to an old tradition, cities near Kobe were cities that had been developed on the soft soil. As we described about the similar land before in Mexico City, Spitak city, Erzincan city, bay area in San Francisco, and Northridge in Los Angles, Kobe area were located also on the 4th alluvium soil.
It was obvious that there were serious disasters area located on soft soil. We show some photographs about disasters in the Hanshin-Awaji Earthquake Disaster in Fig.2.

In experienced characteristic factors for damages in the structure at Hanshin-Awaji earthquake.

There have been many factors for damages in the structures that we could not see at the old earthquakes, though we described in the previous session about factors for general damages in the structures. The new points for damages world be showed followings.

(1) There were serious damages in 2 4 module structures, as people said loudly that there were big serious damages only in the Japanese traditional wooden structure method.

(2) Many serious damages in the joint parts between columns and girders for the steel structures were discovered with including the high-rize buildings that had been under construction. We could see those similar phenomena in the damages at Northridge earthquake in U.S.A. In the special cases, big serious damages in the large square-shaped and circular steel pipe were discovered . It was big problem.

(3) In many reinforced concrete structures, there and girders. It is the point that balance of each section area for the members is important. Especially, it is important to check the reinforcement at the top of columns on the construction work.

(4) It were clear with investigation that there were many damages for the pile foundations in the soil. There is not the clear idea about it. However, it would be necessary for up to declare the main cause with studying much more on the seismic structure in the next generation.

Just damage to maintain life lines.

As Hanshin-Awaji earthquake cut transport facilities such as rain ways and speed way into pieces, it had much time to repair those facilities. Those disasters were caused by the several destroyed bridges on the soft soil that was weakened with several rivers as we described before. However, we mention specially that ordinary roads on the ground and coastal routes were remained to work effectively for helping injured people and carrying commodities.
Communications facilities had been rescued with quick response by there equipment company within one week. There was serious problem in lake recovered for supplying water and gas. Many volunteers helped to work those facilities such as water and gas a little. However, it would be necessary for us to make the detail plans against supplying important materials such as water and gas, as we will be able to know where those would be destroyed with information about them.
It would be meet important to maintain the life lines quickly.

PROPOSAL FOR REDUCTION OF URBAN DISASTERS AS THE CONCLUSION FOR THIS PAPER.

Selection the suitable strong soil to construct urban cities.

There would be high risks for the disaster with construction of urban cities on the soft soil, grounds to prepare for housing at hilly district and reclaimed land. It is most important to consider the plan for construction of urban plan in detail, as it would be common serious problem to enlarge urban cities.

Serious problem to make houses in high-rize building.

There are much serious problem high-rize buildings with consideration about comfortable life and fire prevention. European countries stop to live in the high-rize buildings, and progress to live on lower buildings at the comfortable ground. It is basic concept to make houses for the suitable site at each natural features. It would be important to consider the seismic design with consideration there situation.
It would be good idea to make middle high buildings with 4 5 floors to live by rearrangement the wooden flat houses.
In Japan, there would be about 4 million houses in the urban cities. It would be possible to contract about ten million houses with rearrangement of wooden houses. It is important to progress the policy with keeping safety for urban disasters prevention by considerations from each situations on urban ei ties.

Consideration for the limitation to use cars.

There are plans to maintenance for speed ways with according to increase the passenger cars and big tracks mainly in the developing countries without advanced European countries and USA. It is the serious problem. After the Hanshin-Awaji earthquake was occurred, ears were not able to move smoothly by cutting the transport equipment. It was impressible to use coast ships.
Now, many countries re use the street cars or sub ways for carrying people in large quantities. There are many cities to make limitation for entering cars in the canter of Cities, and for making the new roads.
It would be necessary to make correct concept for increasing cars with consideration about the emergency situation such as earthquakes. Five years had been passed after the Kobe disasters occurred with the big serious earthquake. Lastly, I will expect to re-develop Kobe City and we express our regret over the death of about 6,500 people.

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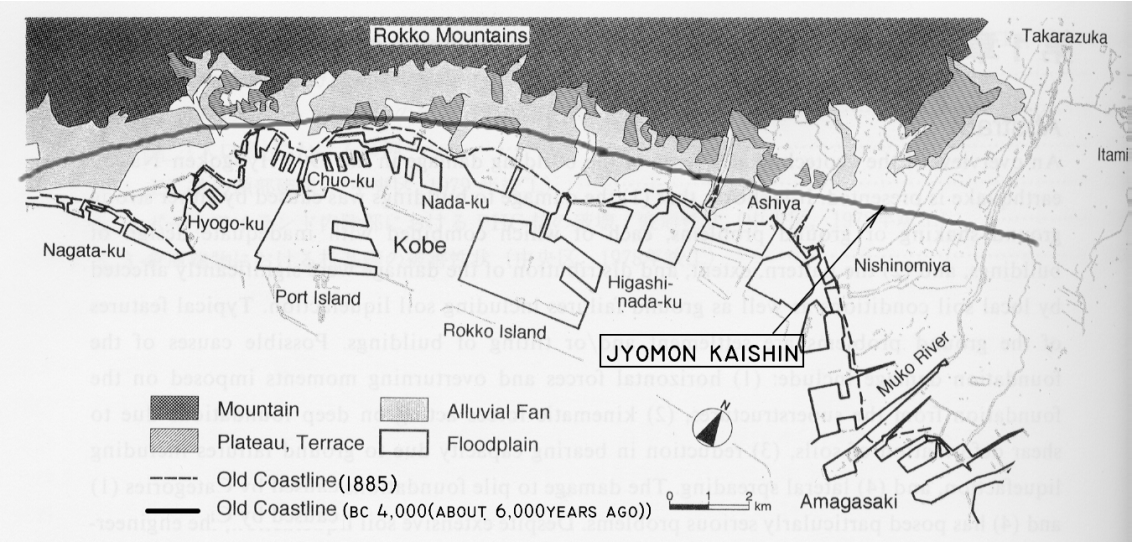

Fig.1 Geomorphological map of affected area with including JYOMON KAISHIN

Fig.2 Dreadful scenes at the Hanshin-Awaji Earthquake disaster