Earthquake Disaster Mitigation Policy in Japan

by

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ABSTRACT

This paper presents the state-of-the-art of earthquake disaster mitigation policy in Japan. The status that Japan is prone to have damage from earthquake is dictated. The outline of large-scale earthquake such as Tokai, Tonankai and Nankai, Japan and Chishima Trench and Tokyo Metropolitan Earthquakes, the result of estimated damage, and the countermeasures such as their general measures, disaster reduction strategy and emergency response plan are also introduced.

KEYWORDS: disaster mitigation, large-scale earthquake, the Central Disaster Management Council, Tokyo Metropolitan Earthquakes

1. INTRODUCTION

People's lives and economical property were greatly lost up to now because numerous large-scale earthquakes and tidal wave (tsunami) happened under the plate and the topographical condition. To protect national land as well as citizen's lives, livelihoods, and property from natural disasters including earthquake is an important national policy.

Along with a series of reforms of the central government system in 2001, the Cabinet Office was established to handle the general affairs which Prime Minister should be in charge. The Cabinet Office performs planning, making and executing of general and important policy. As for the area of disaster management, the Director-General for Disaster Management is mandated for the necessity of unifying the policies among related government organizations. Japan's disaster management system addressed all of the disaster phases of prevention, mitigation and preparedness, emergency response as well as recovery and rehabilitation. With clear roles and responsibilities of national and local governments, the relevant stakeholders of the public and private sectors cooperate in implementing various disaster countermeasures. The Central Disaster Management Council (CDMC) is established in the Cabinet Office based on the Disaster Countermeasures Basic Act. The council, whose chairperson is Prime Minister, promotes comprehensive disaster countermeasures including deliberating important issues on disaster reduction. In this paper, the outline of earthquake disaster mitigation policy in Japan is introduced.

2. EARTHQUAKES IN JAPAN

Figure 1 shows the plate around Japan. Japan locates the peripheral part between oceanic plate (Pacific Plate and Philippine Sea Plate) and inland plate. Pacific Plate sinks under inland plate and Philippine Sea Plate at Chishima Trough, Japan Trough and Izu-Ogasawara Trough. Also Philippine Sea Plate sinks under inland plate at south-western trough, Nankai Trough, Suruga Trough and Sagami Trough. This indicates that Japan, locating on the complex crust structure, has more earthquakes comparing with other countries and have much damage from past earthquakes. The earthquakes over 6 minus of earthquake intensity in Japanese scale happened 13 times (25 times when each aftershock was counted from the Hyogoken Nambu Earthquake in 1995 to the Noto Hanto Earthquake in 2007).

There are two types of large-scale earthquakes which heavy damages were brought. One is the type that occurs near the boundary of plate, and this is divided into the type occurred

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between the plates and the type occurred within oceanic plate. The typical example of earthquake occurred between the plates was the Kanto Earthquake in 1923 and the Nankai Earthquake in 1946. This kind of earthquake occurs when the deformation recovers after the deformation with plate's sinking in reaches its limit. Its frequency is generally said every several hundred years. The Tokai, the Tonankai and Nankai Earthquake occurred in near future are predicted as this type.

The other type is the one in inland shallow area that strain energy is accumulated by deformation of inland plate resulted from plate's sinking in and the energy is released by the disruption of underground fault. The typical example of this kind of earthquake was the Hyogoken Nambu Earthquake in 1995, the Niigataken Chuetsu Earthquake in 2004, and the Noto Hanto Earthquake in 2007.

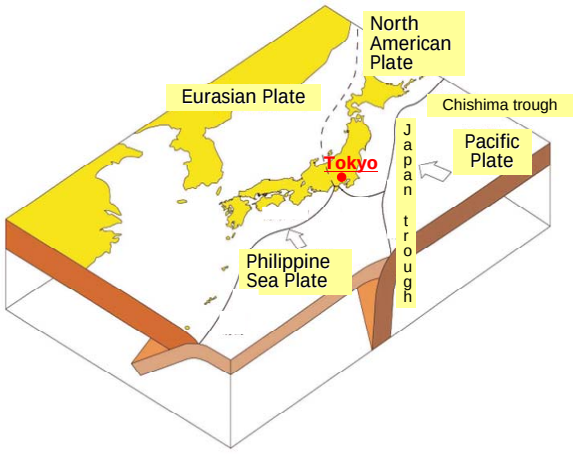

Fig.1 Plates around Japan

3. COUNTERMEASURES AGAINST LARGE-SCALE EARTHQUAKES

The main cause of many casualties in the Hyogoken Nambu Earthquake in 1995 was reported as building collapse and crushed body with it and more than 80% of casualties were resulted from it. The fire around dense area of house also added the number of casualties. In addition, some problems were reported from this disaster such as the delay of quick response to grasp the degree of disaster, that is, the number of casualties and collapsed houses because of insufficient information gathering, severe difficulty of rescue activities for evacuation, life saving and emergency transportation due to the destruction of transportation facilities and heavy traffic congestion, material conveyance, medical activity, voluntary activity, life reconstruction for people requiring assistance during disaster such as elderly.

Various policies have been executed on the basis of past experience. The CDMC has estimated the damage of earthquake and some countermeasures are proposed for the large-scale earthquakes in the next few decades, such as the Tokai Earthquake, Tonankai and Nankai Earthquake, Earthquakes around the Japan and Chishima Trenches, and Tokyo Metropolitan Earthquakes. Figure 2 shows the location of four large-scale earthquakes above mentioned. The outline of countermeasures and so on against these earthquakes is following below.

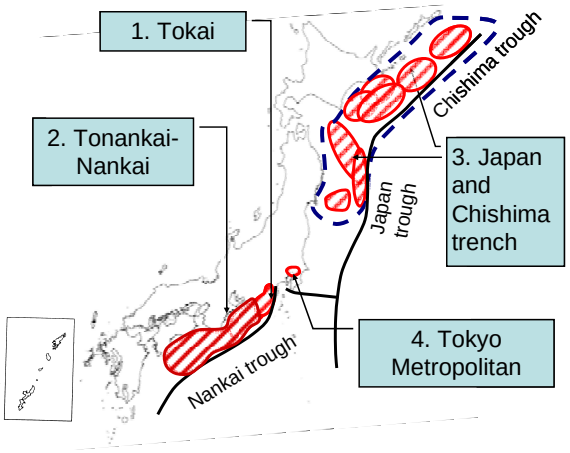

Fig.2 Outline of large-scale earthquakes

3.1 Flow of planning countermeasures against large-scale earthquakes

Figure 3 shows the planning flow of measures for earthquake in government.

Firstly, the area of epicenter and earthquake model is supposed, and the intensity and distribution of earthquake tremor and so on are estimated. Next, the damage of death person

and collapsed buildings are estimated on the basis of earthquake tremor and so on. Following, general measures, in other words, master-plan for mitigating the damage are regulated on the basis of the damage estimate results. Next, strategy by regulating quantitative damage reduction targets and the underpinning measures are decided. Finally, emergency response plan, that is, contingency operation plan for all of governments, including concrete function and the degree of backup are decided.

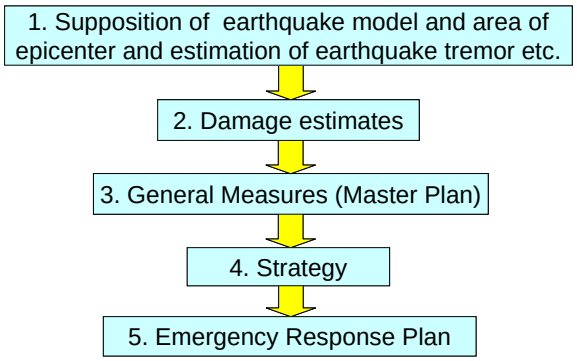

Fig.3 Flow of planning countermeasures against large-scale earthquakes

3.2 Countermeasures for Tokai Earthquake

Figure 4 shows the time history and location relating to the Tokai, the Tonankai and Nankai Earthquake. After the Ansei-Tokai Earthquake in 1854, strain on the earth's crust along Suruga Trough has been building up ever since, approximately 150 years. Therefore, it is believed that there is a high possibility of the Tokai Earthquake occurring.

Under the Act on Special Measures for Large-Scale Earthquake, the mitigation for disaster damage is aimed by designating the areas for intensified measures against the earthquake in advance, where the observation system has been reinforced and earthquake response system in the case of a prediction report being announced has been developed for the large-scale earthquake with a possibility of being predicted just before it occurs.

The Tokai Earthquake is the only one at present with a possibility of being predicted just before it occurs. Therefore, eight prefectures including Shizuoka prefecture which will have most damage in the Tokai Earthquake are designated as the areas for intensified measures under the act.

A death toll of approximately 9,200, total number of collapse or burned houses of 260 thousand and a maximum economic loss of 37 trillion JPY is estimated at the worst case when it occurs.

On the result of damage estimation, the CDMC decided the 'General Measures for Tokai Earthquake,' containing such main issues as 1) implementation of urgent upgrade of seismic resistance measures, 2) reinforcement of community capabilities against disasters, 3) establishment of a tangible disaster management system in the case of a warning declaration and 4) establishment of wide-area management system in occurrence of disaster.

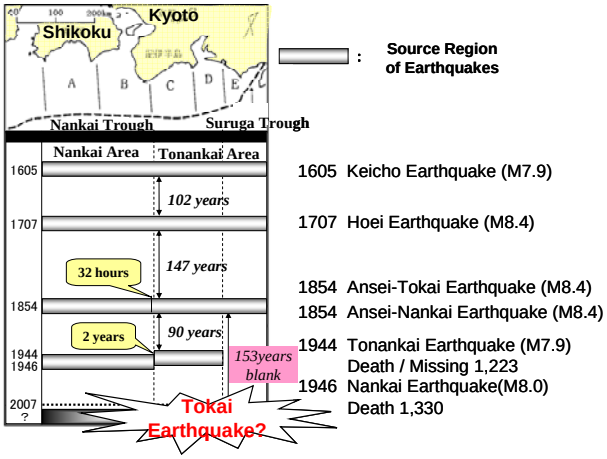

Fig.4 Time history and location relating to Tokai, Tonankai and Nankai Earthquake

As for the 'Tokai Earthquake Disaster Reduction Strategy,' the goal to halve the estimated death toll and economic loss in the next decade is set.

The CDMC also formulated the 'Guidelines for Tokai Earthquake Emergency Response Activities," and the activities of each disaster

management related organization were determined to execute rapid and proper emergency response activities in terms of each level, such as at the time of caution information, warning declaration and disaster occurrence. Furthermore, a detailed plan of action was decided to designate the content of concrete activities for emergency operations such as search and rescue, firefighting and medical activities, procurement of material, and transportation activities. In this detailed plan, two types of plan are made; one is predictive type when the prepared activities would be finished between the warning declaration and occurrence of earthquake, and the other is sudden type when no warning declaration is made and the earthquake occurs suddenly.

Start of emergency response after grasping the damage situation will be late when big disaster happens. For the Tokai Earthquake, in advance, that is, before disaster, the concrete and detailed plan of activity including the contents and volume of dispatch and material are set on the result of damage estimate to cope with that. Just after big disaster, preparing dispatch and procurement of material is started on the basis of this plan, and emergency response about rescue and medical activity is executed. Activity content will be amended after obtaining information.

3.3 Countermeasures for Tonankai and Nankai Earthquake

The Tonankai and Nankai Earthquakes with a magnitude of 8 or so have occurred at intervals of 100 to 150 years as well as the Tokai Earthquake. Most recently, it occurred in 1944 and 1946 respectively, and it is anticipated that the next ones will occur in the first half of this century.

Large damage over the wide area is predicted heavy tremor and big tsunami in the Tonankai and Nankai Earthquake. 'Act on Special Measures for Promotion of Tonankai and Nankai Earthquake Disaster Management' was regulated to advance the countermeasure for disaster management steadily.

Under the act, promoted area to advance the countermeasure for reduction of damage is designated and the set-up of the plan including the evacuation measure from tsunami and the arrangement of the facilities including observation site are regulated.

It is said that the maximum risk of death may be approximately 18,000, of which about 8,600 may be attributable to tsunamis. Total number of collapse or burned houses of 360 thousand and a maximum economic loss of 57 trillion JPY is estimated at the worst case when it occurs.

The general measures, the disaster reduction strategy and the guidelines for emergency response activities are decided. Concrete plan for activities were shown in the Secretary Organization of the CDMC in March, 2007.

3.4 Countermeasures for Trench-type Earthquakes in the Vicinity of the Japan and Chishima Trenches

There have been many large-scale earthquakes of magnitude 7 or 8 scale with plate's sinking occurring in the vicinity of the Japan Trench, extending in the oceanic areas from off of eastern Chiba to Sanriku, and in the vicinity of the Chishima Trench, extending from the areas off Sanrinku, Tokachi and Etrofu Island. There are many damages of tsunami, such as the Meiji Sanriku Earthquake in 1896 with casualties of 22 thousand and the Syowa-Sanriku Earthquake in 1933 with 3 thousands of death or missing people.

There are many type of earthquakes occurred in the vicinity of plates or inside the plate. Also, so-called 'tsunami earthquake' which did not have so heavy tremor but bring much damage by tsunami happened. The Miyagiken-oki Earthquake is said to occur at intervals of approximately 40 years and imminence of earthquake occurrence is pointed out in this area.

It is said that the maximum risk of death may be approximately 2,700 in the type of the Meiji Sanriku Earthquake, total number of collapse or burned houses of 21 thousand and a maximum

economic loss of 1.3 trillion JPY is estimated in the type of the Miyagiken-oki Earthquake. The general measures for this earthquake focusing on issues such as the promotion of tsunami disaster countermeasures, the construction of towns capable of withstanding tremors and addressing problems unique to snowy and cold areas, is decided. In addition, the guidelines for emergency response activities are decided.

3.5 Countermeasures for Tokyo Metropolitan Earthquakes

In the capital area around Tokyo, the Kanto Earthquake occurred in 1923 and brought heavy damage. The earthquake with magnitude 8 or so like the Kanto Earthquake occurs every 200 or 300 years in the boundary of plate around the Sagami Trough, extending from the Sagami Bay in southeast direction. The next earthquake with same level will be expected to occur after 100 or 200 years, however, some earthquakes with magnitude 7 or so may happen in southern Kanto area during this period.

Figure 5 shows the distribution of collapsed buildings due to seismic activity in Tokyo Metropolitan Earthquakes. In the worst case, 11 thousand of casualties, total number of collapse or burned houses of 850 thousand and a maximum economic loss of 112 trillion JPY are assumed. On the basis of the result, 'General Measures for Tokyo Metropolitan Earthquakes' for each entity's countermeasure in all of stages, from prevention stage to post-earthquake stage. In metropolitan area, the core functions such as government, administration, business are highly accumulated and a number of buildings and population are concentrated. To secure the continuity of capital functions such as politics, administration, business and economy function in essential for the countermeasure of wide-area disaster emergency response crossing over prefectures should be solved when big earthquake occurs in this area.

Figure 6 shows the outline of 'Tokyo Metropolitan Earthquakes Disaster Reduction Strategy.' Disaster reduction goal such as to halve the estimated death toll and to reduce the estimated economic loss by 40% in ten years is set through upgrade of seismic resistance of houses and buildings, fix of household furniture, improvement of densely populated urban area, nourishment of voluntary disaster management organization, reinforcement of transportation facilities and promotion of tackling business continuity.

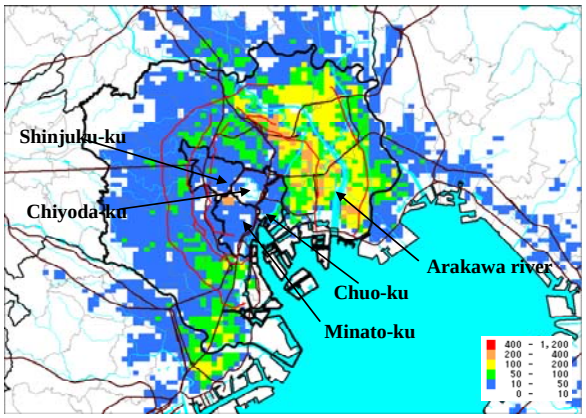

Fig.5 Distribution of collapsed buildings due to seismic activity in Tokyo Metropolitan Earthquakes

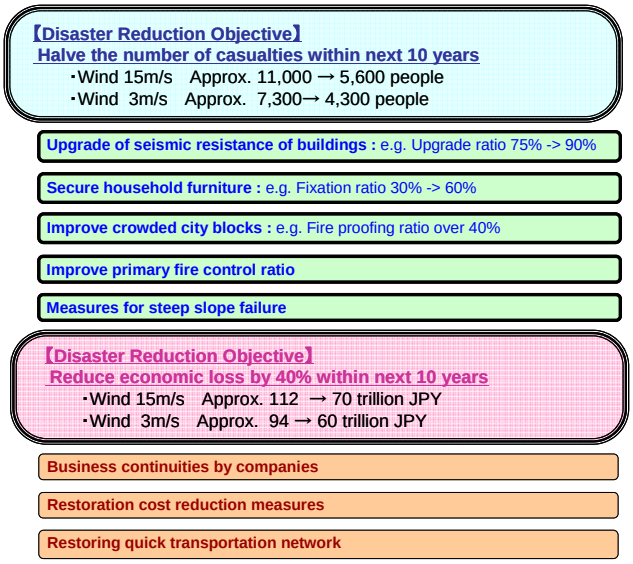

Fig.6 Outline of Tokyo Metropolitan Earthquakes Disaster Reduction Strategy

To execute emergency response activity properly and rapidly by related organizations for Tokyo Metropolitan Earthquakes, 'Guidelines for Tokyo Metropolitan Earthquakes Emergency

Response Plan' which regulates the contents for emergency activity, procedures and role for each related organization is decided. This regulates contingency operation plan for all of organizations in disaster.
The main contents are as follows;
1) Priority for setting place of establishment of emergency disaster management headquarter
2) Priority for setting place of establishment of local emergency disaster management headquarter
3) Act for maintaining business continuity for metropolitan function
4) Act for emergency rescue such as rescue, aid, medical and fire-fighting activity, procurement of food and water, and securing traffic for emergency transportation

The discussion and the examination of detailed plan of activity are in progress for the Tokyo Metropolitan Earthquakes.

Massive number of evacuees and people stranded without a means of returning home is estimated in this earthquake. In the general measures, the countermeasure is shown such as reducing evacuees to evacuation site, arrangement of evacuation system, secure of food, water and daily necessities, showing of proposal menu of emergency house and means of supporting evacuees. The measure for people stranded without a means of returning home, reducing the number of people's returning to their home is shown. Concrete countermeasure for this is stated as the problem which should be solved in near future in the disaster reduction strategy, so the committees for technical investigation on evacuation measures and so on for the Tokyo Metropolitan Earthquakes is set in the CDMC and discuss the matters.

3.6 Construction of Integrated Disaster Management Information System
Preparing the concrete measure when disaster happens is also important. In Cabinet Office, the Disaster Information Systems is arranged. This system can estimate the number of death person and complete collapsed buildings automatically on the basis of measured earthquake intensity, within 30 minutes. The result is offered to all of other ministries and this information is considered useful and important for initial response just after the occurrence of earthquake. Figure 7 shows the result of prediction of earthquake intensity distribution in the Niigataken Chuuetsu Earthquake.

Also, the 'Disaster information sharing platform' is now constructed. This system can integrate and see all of disaster information from other ministries on the common map using GIS concept. Up to now, this platform is linked with the system such as weather information, seismic intensity information, river information and lifeline status information in metropolitan area and all of the information above can be visible. The increase of the contents in coordination with other ministries such as medical information, or satellite picture will be continued. However, there are many problems to process this policy because the data in disaster is difficult to maintain their accuracy and security.

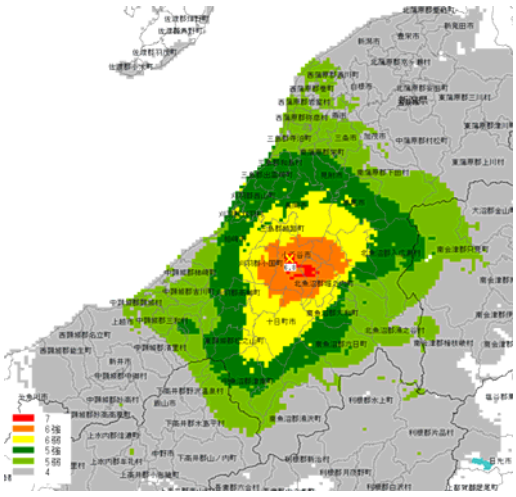

Fig.7 Result of prediction of earthquake intensity distribution in Niigataken Chuuetsu Earthquake from DIS

4. CONCLUSIONS

The outline of the disaster mitigation policy in Japan was introduced in this paper.

Large-scale earthquake may happen anytime, anywhere in Japan and everyone could have the damage from disaster. National people, community, company and government have strongly tackled with measures for safety. The countermeasure against natural disaster will be accelerated by adding the knowledge from various areas.

5. REFERENCES

1. Cabinet Office, Disaster Management in Japan. 2007