How are we Restructuring Fragile Cities Faced with Earthquake Disasters?

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1. Foreword

Three years already have passed since the Great East Japan Earthquake, which brought on unprecedented damages, and the Act on Regional Development in Tsunami Disaster came into effect in December 2011, and a damage projection of a major Nankai Trough earthquake was publicized in fiscal 2012 from the Cabinet Office, predicting tremendous damages by earthquake tsunami in the coastal cities.

Furthermore, a damage projection of a Tokyo-area epicentral earthquake was publicized in December last year from the Cabinet Office, estimating a magnitude 7-class earthquake occurring with a probability of 70% within 30 years, predicting a death toll of 23,000, total collapse of 175,000 buildings and 415,000 to be burnt to the ground in the worst case.

In Japan's cities in which population and industries are concentrated, the enhancement in preventive strength against such earthquake disasters is an urgent issue; though a variety of disaster preventive countermeasures are constantly prepared, in order to enhance the cities' disaster prevention capabilities, further effective countermeasures must be taken expeditiously.

2. Current tasks and direction to be tackled by research and development.

Meanwhile, due to the existence of the following tasks to proceed with urban disaster prevention measures, R&D corresponding to these has been required as well as the activation of new scientific knowledge in technological development.

(1) A big change in social economy and diversification in urban disasters: From local cities faced with population decline to mega-cities complicated by high density, a variety of urban disasters have been presumed, under such circumstances a stance to always verify as to whether or not there are risks of new crucial disaster phenomena occurring is constantly required.

(2) Restriction of time and budget in disaster prevention measures: Despite how much time remains allotted until the occurrence of a huge scale earthquake, and in addition, with the rigorous budget restrictions, the key point is to what extent fragile areas can be fixed in place and concentrated and effective disaster preventive measures can be prepared.

(3) Interpretation is easy to understand for damage forecast and disaster preventive effect: In order to urge cities disaster prevention measures, the understanding of people involved such as regional inhabitants is indispensable, and from preconditioned damage forecasts to content of disaster preventive measures, and in regard to those effects, tools capable of explaining matters plainly is important.

(4) Limitations of damage forecast simulator and improvement efforts: Urban disasters cannot be reproduced and verified beforehand, inasmuch as there is no alternative but to depend on complementary experiments and forecasts by simulators based on damaged scenarios in the past, as well as endeavoring to improve simulators through experiments or the like for newly presumed disaster phenomena, not only by upgrading but also accelerated dissemination by simplification is necessary.

(5) A variety of countermeasures of hard/soft and urban restructuring: From hard countermeasures improvement for infrastructures or the like and reconstruction promotion for decrepit buildings to soft countermeasures such as smooth guidance for evacuees, urban reconstruction countermeasures, disaster prevention countermeasures are required to effectively be carried out among measures for urban reconstruction.

I will introduce the content of research currently being carried out in the Urban Planning Division and visions for the future in the following.

3. Tsunami prevention urban construction and development for assistance tools for liquefaction countermeasures

In the Great East Japan Earthquake, in the damaged coastal cities, evacuation against tsunami, security of functions for disaster prevention preparedness facilities, a broad array of fragility of liquefaction or the like was clarified. For this reason, coastal cities nationwide are deliberating preparedness against these problems, and to reflect to the project of configuring tsunami prevention city has become imperative.

Accordingly, in a study on disaster prevention structuring

assistance technology, we have been engaging with earthquake proof safety for important lodgment facilities and resilience of lifelines, substitution by other facilities and the development of methods for ensuring of cooperative network.

In addition, in the onslaught of a tsunami, adding in the collapse of buildings and effects of fires, in order for inhabitant including vulnerable people such as the elderly to smoothly and safely evacuate, a case study is being implemented in the multiple coastal cities facing the Nankai Trough, as well as developing tsunami evacuation simulators by road and vehicles. Hereafter, we will verify the efficiency of simulators, and reflecting this in tsunami disaster prevention urban creation plan formulation in each city and utilization in the urban area can be expected.

Furthermore, based on the liquefaction damage occurring in the Great East Japan Earthquake, in addition to calculation software capable of judging easily in regard to possibility of liquefaction damages from ground conditions or the like, as a countermeasure against liquefaction for housing land, we will develop a calculation software capable of judging an effect in conformity with the ground condition of underground water level declining construction method and grid underground wall construction method to be publicized. By utilizing these, in addition to configuration of liquefaction risk degree maps as a pre-earthquake countermeasure, as a post-earthquake countermeasure, configuration of an effective liquefaction countermeasure cam be expected.

4. Development of a bloc performance forecast evaluation tool for improvement promotion of congested urban districts

In case of large scale earthquakes or the like, in view of presuming tremendous damage of congested urban districts, the housing life basic plan (nationwide plan) aims to mostly eliminate “conspicuously dangerous congested urban districts” of about 6,000ha (for fiscal 2012) in fiscal 2020.

At the same time, since roads in congested urban areas are narrow and residential land is also narrow and small and due to the difficulty to adapt to the restrictions of the Building Standards Law, cases of difficulty in reconstruction are many, and there are problems with difficulty in the replacement construction of decrepit timber housing due to high risks of fire spreading and collapse.

In this regard, in the Development of Coordinated Replacement Building Rule Formulation Technology in the Congested Urban Districts, we investigated the environmental level of existing congested urban districts, and are currently proposing a tool for calculating the condition of sun shadow hours prescribed in the Building Standards Law and daylight conditions in addition to evaluation tools for safety, using fire and evacuation simulations based on buildings in urban districts and conditions or the like of roads.

Utilizing these research results, we are proceeding with deliberations for guidelines of coordinated replacement building in the congested urban districts; we have already held repeated hearings targeting academic experts and local public authorities, when using preferential measures such as consolidated building design system, and will prepare an evaluation tool to compare how far the bloc performance varies, advancing deliberations with reference to conditions to carry out designated permission in the Building Standards Law.

According to this research, the coordinated replacement buildings in the congested urban districts will appropriately be carried out utilizing the designated method of the Building Standards Law, and the promotion of the disaster prevention measure and the enhancement of living environment in regular life will be expected.

5. Future efforts for the improvement of fragile urban structure

Furthermore, on the assumption of changes in situations in the urban districts and complexity in escaping in evacuation actions in case of disasters, we will verify the scope of fragile parts of cities in view of disaster prevention, stemming conditions, the degree of effects or the like and a study on fragile part of cities against fire in the urban districts in earthquakes and evaluations for disaster preventive effects, which will implement evaluation and verification for disaster prevention countermeasures based on those, to be carried out in three years from the next fiscal year.

This study corroborates the features of new materials in fire in urban districts by fire experiment or the like, as well as reflecting to a fire evacuation simulators, carrying out a case study reflecting the actual state of fragile congested urban districts, effects of fire on the decrepit congested land with wooden houses and effects of fire on sloping land, complexity situations in evacuation and the relevancy to disaster prevention effects for those, we have made to develop a method for evaluation/verification in respect to disaster prevention effects for those.

Regarding measures for restructuring of cities in each city and responding to various problems, we would like to actively engage with research and development (R&D), so as for fire prevention measures to be promoted with a focus placed on priority and effectiveness.