

# SEISMIC EVALUATION AND RETROFIT OF OLD BUILDINGS LOCATED ALONG THE SPECIFIC EMERGENCY TRANSPORTATION ROADS IN TOKYO

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## Abstract

In 1996 the Tokyo Metropolitan government has appointed the emergency transportation roads with a length of about 2,000km. In June 2011, the Tokyo Metropolitan government appointed the specific emergency transportation roads with distances of about 1,000km. There are about 5,000 old buildings that were built using the old seismic code (before June 1981) along these roads. After the East Japan great earthquake disaster occurred on 3.11 2011, the reports of the seismic evaluations of about 5,000 old buildings were required. About 4,000 old buildings are considered to be not seismic evaluated. They are imposed with the duty to be seismic evaluated from April 2012 to March 2014. And Tokyo Metropolitan government wishes to retrofit them until March 2020.

## Introduction

Hanshin Awaji great earthquake disaster occurred in 1995. The old buildings and the electric wire poles collapsed and fell down, and many roads were closed down by the wreckage. The rescue teams and the fire brigades could not approach to the suffering spots. Then the number of victims increased. In 1996 the Tokyo Metropolitan government has appointed the emergency transportation roads with a length of about 2,000km.

On March 11, 2011, the East Japan great earthquake disaster occurred. The Tokyo Metropolitan government made the regulation for the promotion of retrofitting the buildings located along the emergency transportation roads in Tokyo and appointed the specific emergency transportation roads with distances of about 1,000km.

### 1. Emergency transportation roads

After the Hanshin Awaji great earthquake disaster in 1995, the Ministry of Construction notified to the local governments that they should make emergency transportation roads network, which became basic to make the earthquake disaster prevention emergency strategy. This was a 5-year plan based on the special law measures that include: the earthquake disaster prevention measures, the disaster prevention duties plan and the local disaster prevention plan. And also a plan of the effective earthquake measures shall be promoted to keep the emergency transportation usable after the earthquake.



*Photo. 1 Great fire disaster*



*Photo. 2 Overturned building*

The emergency transportation roads are the national express highways, the general national highways, the highways connecting them and the roads connecting each disaster prevention bases appointed by the governor.

1<sup>st</sup> class emergency transportation roads: are the roads connecting the capital central government office building with the Tachikawa local disaster prevention center and important harbors, air ports, and so on.

2<sup>nd</sup> class emergency transportation roads: are the roads connecting 1<sup>st</sup> class roads with ward cities, towns and villages government offices and the main disaster prevention bases (the organizations for 1<sup>st</sup> action like police, firefighting and medical care).

3<sup>rd</sup> emergency transportation roads: are the roads connecting the other disaster prevention bases (the wide area of transportation bases, storage warehouses and so on).

## **2. Tokyo Metropolitan government earthquake disaster prevention measures**

The Tokyo Metropolitan government made the earthquake disaster prevention measures. One of them is the planning promotion measure of the seismic assessment and the retrofitting.

### **a. Seismic retrofitting of the buildings located along the highways:**

It shall be appointed the highways whose obstructions shall be prevented at the event of an earthquake. And it shall be promoted the seismic retrofitting of the buildings, whose heights are over the constant height, located along them. Their seismic assessments shall be compulsory, and the cost subsidies of their seismic assessments and retrofitting shall be implemented based on the Ordinance to promote the seismic retrofitting of the buildings located along the emergency transportation roads in Tokyo.

### **b. Fire-proof and seismic retrofitting of the wooden housing populated areas**

It should be promoted the maintenance strategy of the wooden housing populated areas in the maintenance areas determined by the promotion plan to prepare the disaster prevention of the city. And also their fire-proof and seismic retrofitting should be promoted. It should be promoted the 10 years plan of the fire-proof of the wooden housing populated areas to accelerate the improvement remarkably.

It should be implemented the cost subsidies of the seismic assessments and retrofitting of the wooden housings in the maintenance areas.

### **c. Buildings that shall be mainly planned to be seismic retrofitted**

The important public buildings shall be seismic assessed immediately in disaster prevention, and be promoted for seismic retrofit as soon as possible.

It is strongly recommended to work on the seismic retrofits of the department stores, the hotels and so on in the private specific buildings by the law on seismic retrofit promotion.

It also shall be promoted the seismic retrofit of the condominiums by the expense furtherance of their seismic assessments and retrofit and so on, and by the spread enlightenment by the condominium enlightenment corps

It shall be promoted the seismic retrofit of the wood houses by a prompt enforcement of their seismic assessments and the cooperation with the reform constructions.

## **3. Ordinance to promote the seismic retrofitting of the buildings located along the emergency transportation roads in Tokyo**

The urgency of a plan for the capital in the event that a large earthquake occurs has been pointed out. To protect the life and property of citizens and to provide a system of capital it shall be promoted the seismic retrofits of the buildings located along the highways to prevent the closing of the emergency transportation roads. Because they support the evacuation, firefighting, emergency transportation of emergency relief supplies at the time of the earthquake, and the recovery and reconstruction activities. This ordination has been promulgated on March 18, 2011. The East Japan great earthquake disaster occurred on March 11, 2011.

In this ordination the specific emergency transportation roads with distances of about 1,000km are appointed as shown in Fig. 1. The buildings located along them shall be required to be planning their seismic retrofit especially.

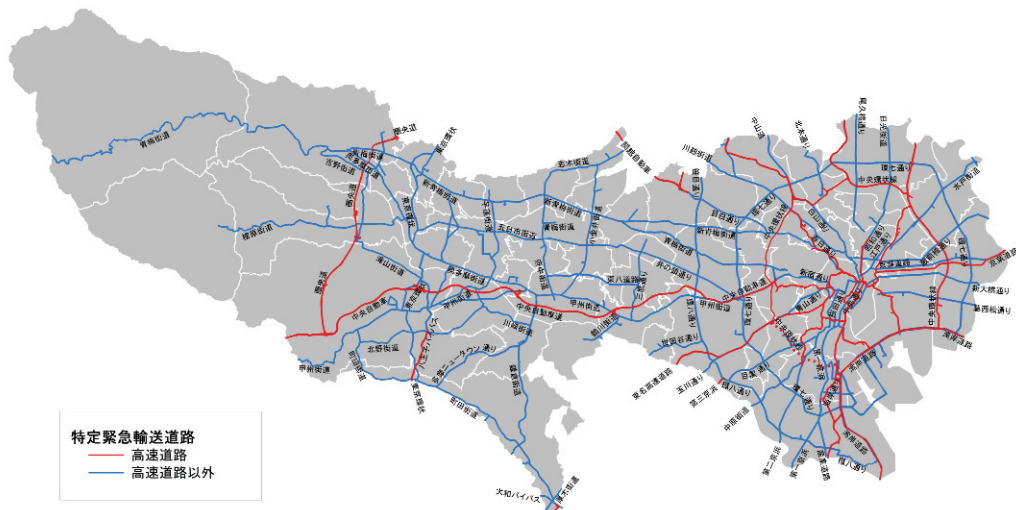


Figure 1. Specific emergency transportation roads with distances of about 1,000km

### 3.1 Buildings located along the specific emergency transportation roads

These buildings correspond to either of the following items.

- These buildings are located in the specific emergency transportation roads.
- These buildings were built before May, 1981, which means they were designed according to the old seismic building code.
- These building heights are approximately the values shown in Fig. 2 and 3.

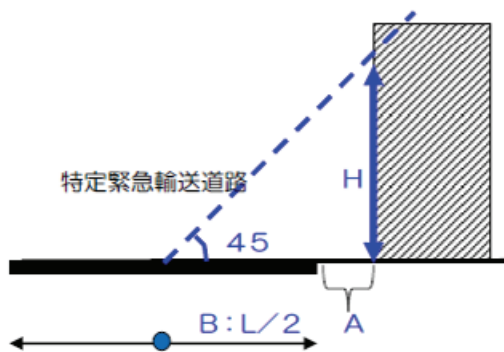


Figure 2. Front road width  $L$  is over 12m.  
 $H \geq A + L/2$  (m)

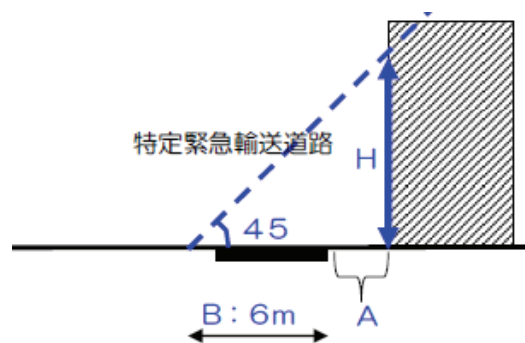


Figure 3. Front road width  $L$  is less than equal 12m.  
 $H \geq A + 6$  (m)

### **3.2 Duty report seismic states**

The owners of the buildings located along the specific emergency transportation roads are obligated to report their seismic states.

### **3.3 Duty conduct seismic assessments**

The owners of the buildings located along the specific emergency transportation roads are obligated to conduct their seismic assessments, when they have not conducted their seismic assessments. It shall be ensured the fulfillment of the obligations by the administrative guidance or the implementation instruction.

There is the possibility of the publication of the building names that have not their seismic assessments conducted after a certain period of time.

### **3.4 Effort obligation for the implementation of seismic retrofitting**

The owners of the buildings located along the specific emergency transportation roads are obligated to implement their seismic retrofitting, when the buildings have not enough seismic performance. It shall be promoted the implementation of their seismic retrofitting by the administrative guidance or the implementation recommendation.

### **3.5 Subsidy costs of the seismic assessment and retrofitting**

Tokyo metropolitan is able to subsidize the cost to the seismic assessment and retrofitting.

### **3.6 Others**

Tokyo metropolitan will provide the information of the progress situation of their seismic performance to citizens.

A penalty is defined for the person who will be in violation of the instruction when conducting the seismic assessment, or will make a false report, or will neglect to report of the seismic assessment and retrofitting. Tokyo metropolitan will publicize the names of the building owners who will not conduct the required seismic assessment without a good reason.

## **4. Spread information and environmental maintenance**

Seismic marks labeling system is provided as shown in Fig. 4. The mark “Pre-seismic assessment “is for the building which was designed by the old seismic code and was confirmed to comply with the seismic assessment standards. The mark “Pre-seismic retrofitting “is for the building which was designed by the old seismic code and was confirmed to comply with the seismic assessment standards by its seismic retrofitting.



*Figure 4. Tokyo Metropolitan seismic mark label*

This seismic mark labeling system is envisioned to raise the awareness and momentum of the seismic retrofiting to the citizen.

Tokyo Metropolitan will disseminate the reliable seismic retrofiting construction methods and instruments, educate the seismic assessment engineers and the seismic retrofiting contractors, and provide their information.

Tokyo Metropolitan will enhance consultations, carry out awareness-raising and provide the information of the seismic retrofiting using the earthquake hazard map, and so on.

## 5. Agreement on cooperation with related organizations

The Tokyo Metropolitan is in accord with the agreement on the cooperation with the Tokyo Association of Architectural firms, Japan Structural Consultant Association and Japan Aseismic Safety Organization to promote seismic assessment of the buildings located along the specific emergency transportation roads and to achieve Tokyo disaster resilience.

Tokyo Metropolitan and these 3 Associations do need the support and cooperation (in conjunction with each other) for the development of public awareness and consultation system, implementation of seismic diagnosis and Technical capabilities of the assessment engineers as that the owners of these buildings will tackle their seismic assessments smoothly with confidence.

## 6. Review the damage estimation

After the Great East Japan Earthquake, the expected distributions of seismic intensity by the 4 EQs near Tokyo were reviewed by the Headquarters for Earthquake Research Promotion as shown in Fig. 5.

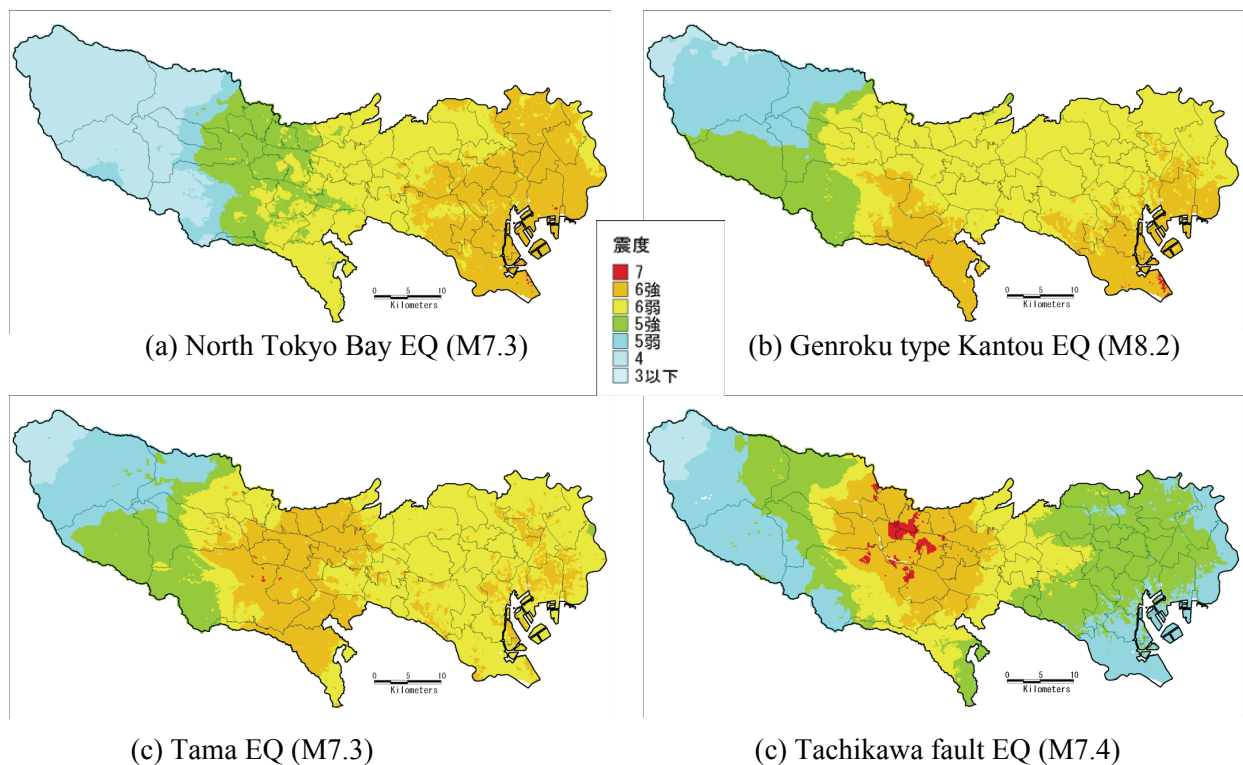
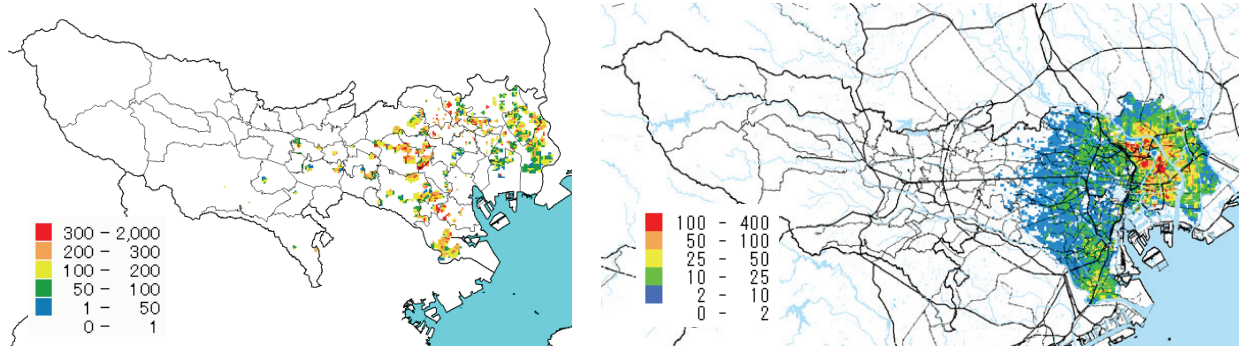


Figure 5. Expected distributions of seismic intensity

Tokyo Metropolitan has reviewed the damage estimation based on the Great East Japan Earthquake as shown in Fig. 6.



(a) Fire disaster map at evening (V=15m/s)

(b) Collapsed buildings disaster map

Figure 6. Disaster map by North Tokyo Bay EQ (M7.3) (Numbers of buildings)

The reason why the spread of damage has been prevented is considered to be the result of disaster prevention measures such as the seismic retrofit and the fire-proof as the areas of seismic intensity over 6-major are widened according to this damage estimation.

Tokyo Metropolitan continues to promote these measures, to strengthen the efforts of self-help and mutual assistance, and to promote further mitigation.

## 7. Present condition of these assessment

There are 4,958 buildings which are the target of this ordinance. From these groups: 4,082 buildings have submitted their seismic assessment and retrofit status report. Therefore 876 buildings have not submitted them yet.

The status reports state that: 209 buildings satisfy the required seismic performance, 216 buildings do not satisfy the required seismic performance, and 285 buildings have conducted their retrofit. Leaving left 3,372 buildings that did not have conducted their seismic assessment.