Earthquake Disaster Reduction Policy in Japan: Focusing on the Retrofitting of Existing Nonconforming Houses

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Introduction

This paper tries to introduce the basic structure of the Japanese Earthquake Disaster Reduction Policy and outline the recent changes it has undergone. The policy program of promoting the retrofitting of existing nonconforming houses will be used as a case study to demonstrate the difficulties inherent in earthquake disaster reduction.

A paradigm shift in disaster management policy after the 1.17 earthquake of 1995

Since 1960, Japanese disaster reduction policy has been so successful that the annual number of deaths from disasters has fallen to under a thousand. However, the great Hanshin Awaji Earthquake of 1995 (the 1.17 Earthquake) killed 6,434 people, the highest number of deaths from one incident in the history of Japan since the end of WWII. The earthquake totally destroyed 104,906 housing buildings, and the direct economic damage of the earthquake was approximately 10 trillion yen, as much as 2% of the national GDP.

The 1.17 earthquake disaster caused a paradigm shift in Japanese earthquake disaster reduction policy, which shall be discussed in the following paper. The first aspect of the shift is the transfer of the disaster response focus from prediction to evaluation. The Japanese government had long been expecting developments in earthquake prediction technology. Indeed, the Large-Scale Earthquake Countermeasure Special Act, legislated in 1978, assumes that earthquakes are entirely predictable. The law has been only applied in the Tokai earthquake, which at the time, was regarded as the earthquake that required the most urgent response, yet was predictable. However, the Tokai earthquake has still not occurred and, at the time, nobody believed that an earthquake would hit Kobe before the Tokai earthquake. In addition, the Meteorological agency of Japan finally acknowledged that the current level of scientific and technological knowledge still allowed the possibility that signs of a forthcoming earthquake might be missed. For these reasons, the Japanese government has shifted its investment from short-term prediction to long-term assessment, which enables policy-makers to identify where there is a high risk of an earthquake occurring.

The second aspect of the paradigm shift is the move in focus from prevention to reduction. Disaster response plans and their institutional arrangement had been so ineffectual that the Murayama cabinet, the socialist coalition government, that had had no major experience of large scale crisis management, was subject to significant public criticism. The Japanese government assumed that no such catastrophe would require a response, since Japanese seismic technology was believed to be advanced enough to predict its arrival.

The third aspect of the shift was the move from restoration to recovery. Japan has an established restoration program, which guarantees that the local government will reconstruct all damage inflicted by natural disasters on public facilities and infrastructure very quickly. The 1.17 earthquake was no exception. Most of the damaged infrastructure was reconstructed over the next year or two. However, the social and economic activity of the damaged area did not recover to the same degree. On the back of this and combined with the effects of the macro-economic depression during the mid 1990s in Japan, the Kobe economy was so severely damaged that the GDP fell by 10.2% from its previous level in 2004. The restoration of damaged facilities was not sufficient to prompt a recovery in social-economic activities.

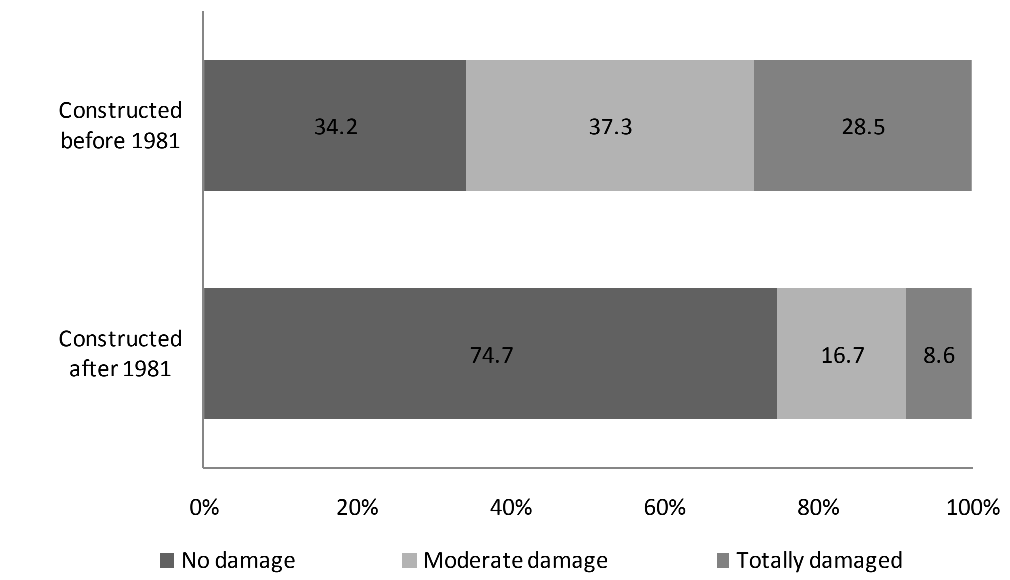
The fourth aspect of the shift involves a move in focus from regulation to incentives. The 1.17 earthquake made clear the limitations of the government's capability to cope with disasters. For example, an academic survey conducted immediately after the earthquake showed that only 1.7% of people who had been buried under the debris of collapsed houses were rescued by the governmental rescue team. Others were rescued by themselves (34.9%), by family members (31.9%), and by friends and neighbors (28.1%). Thus, "self-help" became a primary disaster response method. To promote "self-help," the incentive approach is regarded as a more suitable policy method than the regulative approach.

Retrofit as a key policy agenda

The most effective "self-help" measure is retrofitting vulnerable houses. Strict building regulations exist in Japan, including the compulsory adherence to a building seismic standard. However, most of the houses that collapsed in the 1.17 earthquake were pre-existing nonconforming houses, which were built before 1981—the year when the significant amendment to the seismic standard was implemented, and had not been reinforced to comply with the current standard. These pre-existing nonconforming houses were estimated to make up as much as 25% of the total number of houses in Japan. Hence the retrofitting of those houses became a key policy agenda.

The cabinet office of Japan released the "Earthquake Disaster Reduction Strategy" in 2006. This strategy hoped to bring about a 50% reduction in future disaster loss, both human and economic. A numerical example of this is the strategy for the Tokai-Tonankai earthquake disaster reduction. The strategy aims to reduce the estimated number of deaths incurred by the earthquake by 4,200 from 9,200 and that 3,700 of the 4,200 lives saved are to be a result of retrofitting houses. In terms of economic loss, the predicted loss of 57 trillion yen was hoped to be reduced by 27 trillion, 19 trillion of which will be saved by retrofitting houses.

Why is retrofitting is regarded as the most important countermeasure for reducing earthquake disaster losses? It is worth looking at this question with two things in mind. The first is the fact that 90% of the deaths of the 1.17 earthquake were due to house collapse. Moreover, a survey conducted by the Architectural Institute of Japan has shown that 74.7% of buildings built under the old seismic standard (i.e., constructed before 1981) collapsed totally, while only 34.2 % of those built under the current standard (i.e., constructed after 1981) collapsed (Fig.1). These statistics give a strong rationale for the promotion of housing retrofit in order to reduce human loss. However, it should be noted that the 1.17 earthquake hit at 5:46 am., when most people were sleeping in their houses. If it had happened during the daytime, it is easy to imagine that the number of deaths caused by traffic accident would be very large. Before the 1.17 earthquake, the most important earthquake disaster reduction countermeasure was urban redevelopment, which focused on reducing the risk of fire. This countermeasure emerged from experiences during the Great Kanto earthquake of 1923 (the 9.1 earthquake), which hit Yokohama and Tokyo. Since this earthquake occurred around noon, more than 100,000 people were killed by large-scale fire. Thus, it is clear that earthquake disaster reduction policy reflects the lessons learned from the latest disaster.



Note: Entire buildings surveyed in a particular area of Chuo Ward, Kobe city.

Source: The Research Committee of The Great Hanshin-awaji Earthquake（2000）Fig. 3.5.3.2

Fig. 1 The ratio of buildings damaged, by year of construction.

The second context that we might look at to understand why retrofitting is so important, is the recognition of the huge burden of governmental disaster response in the wake of massive housing collapse. Under the disaster response framework in place at the time of the 1.17 earthquake, the local

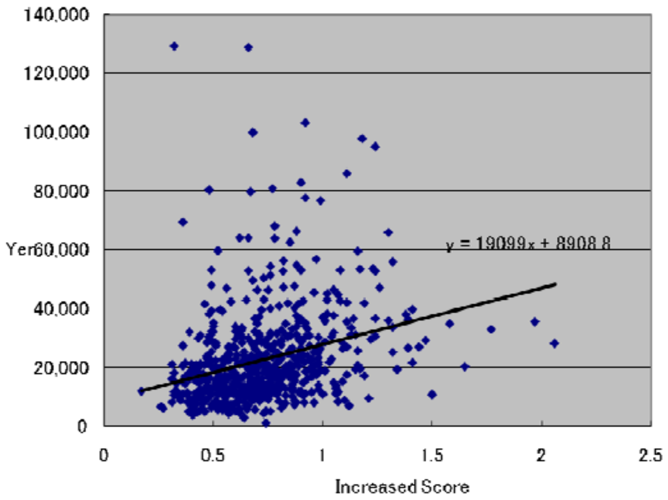
government had to provide 48,300 temporary houses and 80,500 permanent houses.
This cost was so great that the cost per family (including the price of the land) was approximately 30 million yen. Retrofitting is expected to reduce all these costs. It is not only the reconstruction costs that can be reduced, but also the cost of the debris disposal. In the case of the next Tokyo metropolitan earthquake that is expected to destroy houses, an academic study estimates that it will take 14.4 years to dispose of the waste generated by the earthquake.

In spite of the fact that it is ostensibly a high priority, retrofitting has yet to be promoted sufficiently. In 2003, 75% of housing in Japan was earthquake-resistant. The earthquake reduction strategy has set a target of 90% of housing to be earthquake-resistant by 2015. However, the latest survey conducted by the cabinet office indicates that, by 2007, only 79% had been completed, indicating that the completion rate was slower than the policy-makers had hoped for.

Difficulties of retrofitting promotion

There are several reasons why retrofitting houses has been progressing slowly. The first reason is that there is a lack of an incentive for the house owners and retrofitting is not cheap. According to an organization of contractors who are involved with retrofitting, the average cost of retrofitting is approximately 1 million yen per wooden house. In addition, the indirect cost of retrofitting, such as the inconvenience caused during the retrofitting work, is also not cheap. Because these costs have been regarded as a major factor behind owners' reluctance to carry out retrofitting work, many local governments have introduced a subsidy program for house owners.

Even with the introduction of such subsidies, however, retrofitting has not become as popular as the policymakers expected. The second reason for this is that the retrofitting service market is immature. Retrofitting is not a standardized technology. Which technology is appropriate for the reinforcement of each house depends on the original structure of the building. Hence, the price of retrofitting varies, depending on the adopted technology. Fig. 2. shows the relationship between the retrofitting cost per square meter of the first floor area, and the increased score of the seismic resistance of the houses, collected by Shizuoka Prefecture in 2005. There seems to be only a little correlation between the two variables in terms of the price and quality of the retrofitting. In addition, the utility of the retrofitting can only be seen in the case of an earthquake. In other words, there are few benefits for the owners, in terms of usefulness, under normal circumstances. For these reasons, retrofitting services have also been used by dishonest providers as a way to cheat the consumer.



Source: Shizuoka Prefectural Government

Fig. 2 The relationship between the cost of retrofitting per square meter of the first floor and the increased seismic resistance score.

The third reason why retrofitting has been progressing so slowly is that there is some disagreement over the definition of “retrofitting.” The Ministry of Land, Transport and Infrastructure (MLTI) defined “retrofitting” as work carried out that increased the seismic resistant score of a building from less than 0.7 to no less than 1.0. Because a score of 1.0 is regarded as equivalent to that of the current building standard, this definition had been very common among retrofitting professionals.

On the other hand, some local governments had established programs that subsidized types of retrofitting that did not meet the definition mentioned above. These local governments insist that even a minor increase in the seismic resistant score should be recommended, since the risk of the death by house collapse must be reduced, even if it is minor reduction, or even in cases where the work cannot prevent the house from collapsing. From this point of view, establishing a standard definition of retrofitting will limit the scope of these subsidy programs and opportunities to conduct minor retrofitting work will be lost.

There is some strong evidence that calls into question the validity of retrofitting as a disaster reduction countermeasure. The strongest challenge is the argument that the seismic standard is not the most influential factor on the vulnerability of a house, instead is it the age of the house that determines its vulnerability. Indeed, Fig 1. shows that it is not clear what causes the vulnerability of a building, the adherence to the seismic standard or the age of the houses. This argument has strong implications for disaster reduction policy. If it is the case that the age of a house is more influential on its vulnerability that the adherence to a seismic standard, then it is clear that retrofitting is not the best way to reduce earthquake damage because more houses will become vulnerable over the next few decades.

The second challenge is the argument that retrofitting may increase social vulnerability. The number of one-person households who are 65 or over is rapidly increasing in Japan. Official population estimates indicate that the number will reach 4.3 million by 2030, an increase from 2.0 million in 2005. Even if their houses are retrofitted, it seems inevitable that these huge numbers of elderly people who have no support from family members will find it difficult to survive during a disaster. It may then be the case that public policy should try to prevent huge numbers of elderly people living alone. However, retrofitting may in fact maintain this trend. Most of the owners of pre-existing nonconforming houses are over 60. This means that promoting retrofitting has the effect of dooming these owners to stay in their houses until they die.

Conclusion

Retrofitting vulnerable houses will undoubtedly prove to be a powerful tool in reducing the effect of earthquake disasters over the next decade or two. However, it must be noted that a large-scale earthquake is something that happens only once every hundred or thousand years. It is fundamental that earthquake disaster reduction policy implement a long term strategy.

One key concept for that strategy should be “sustainability.” The average life of a Japanese house is said to be less than 30 years, which is the shortest among developed counties. If the lifespan of houses can be increased to hundreds or thousands of years, it then becomes not a risk but a certainty that the house will face a large-scale earthquake in Japan. In that case, seismic resistance would be an essential quality of any house. Retrofitting will then be regarded as a good investment as seismic-proof houses are likely to be traded at a higher price in the used house market. Parents are likely to be very happy to retrofit their houses if they foresee their children living in it in the future. With this in mind, disaster reduction policy has to be developed in coalition with other policy areas.