

# Way sounding of Housing Reinforcement for Effective Reduction of Earthquake Fatalities -Background and Concept-

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## 1. Introduction

It has been popularized to examine seismic performance of dwellings in Japan since the 1995 devastated Kobe earthquake, mostly based on a simple scoring method using so-called Diagnostic Table. But, no significant shift from the scoring examination to the actual reinforcement process can be seen up to now. We sounded the reason why the execution of reinforcement goes slow by slow, through an analysis of the characteristics associated to the diagnostic table, and, with special emphasis on fatality reduction, we explored the better way of housing reinforcement. What we stressed is to place [risk to deaths] as the one unacceptable.

## 2. Problems on Diagnostic Table and Recommended Score

The Diagnostic Table developed to examine wooden dwellings, most popular in Japan, is composed of 6 major structure-regarded elements as one for the understructure and five for superstructure. By means of eye watching and simple test, a score in a range between 0.2-1.5 is given for each of elements and the one unified score is deduced to evaluate the level of seismic performance of a wooden dwelling under question by multiplying all the elemental scores. Thus derived unified score ranges 0 to 2.25, indicating increasing values as of better seismic performance. The recommended unified score is given as 1.5 from the reason above which almost no damage suffers even under violent seismic shaking as high as 7 on the Japan Seismic Intensity Scale.

According to the data of diagnostic examination in Japan, however, existing dwellings with the score bigger than 1.5 are very little and so it seems no realistic to make a target of as high as 1.5. What is important for us, in such situation, is to explore other goals with lower unified scores.

## 3. Relation among Damage Index, Unified Score, and Seismic Intensity

Okada and Takai(2003) developed a useful relation of unified score to structural damage index via seismic intensity, using real data of diagnostic examination of existing wooden dwellings and empirical damage functions in Japan. Based on their study, we introduced 4 step-wise goals(=permissible damage levels) of [no or minor damage, damage with penetration of rain, damage beyond repair, high danger to death]. And, what we found are, for example, that the necessary score so as to prevent danger to death is around 0.3 and it is much lower than the recommended score.

## 4. Exploration of Realistic Paths for Reinforcement

Characteristic analysis of the diagnostic table gives information on which way we can reinforce a weaker dwelling to stronger one targeting a certain goal score. Found are that the capability of reinforcement depends on the difference of initial score and target score as the larger difference gives lesser attainable, and the recommended score of 1.5 is too ideal.

## 5. Conclusions

By analyzing of the simple diagnostic method for wooden dwelling and by employing the relation of structural performance as a function of seismic intensity, we could succeed to propose a realistic way for developing effective reinforcement with emphasis on significant reduction of fatalities in earthquakes.