Research concerning impeding factors and measures to overcome them to improve living safety (Research period: FY 2016–2017)

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1. Background of the study

In recent years, the demand for ensuring and improving the safety of residents has been growing with the increased number of natural disasters and accidents associated with a super-aging society.

Past studies have accumulated knowledge in specific fields of housing, including earthquake resistance, fire control, prevention of accidents within houses, and crime prevention. The analyses of causes have produced outcomes that would reach solutions, some of which have been useful in preparing and revising laws, regulations, and standards.

Since houses are private property, however, the progress of improve measures is often slow, especially in already constructed houses due to impeding factors, such as that most of the safety measures in houses are up to the self-support of residents and that the knowledge of construction and cumbersome procedures are required for ordinary residents.

2. Outline of research findings

The author extracted effective measures that residents could implement as focused implementation points of safety measures by presenting the chain of impeding factors (hazard)*1 in ETA*2 or FTA*3 for specific types of natural disasters and accidents related to houses and then disconnecting the links to prevent natural disasters and accidents from becoming connected (table 1).

Then, focusing on already constructed houses, the author presented points to overcome to eliminate impeding factors for residents to autonomously implement safety measures and make it easier for them to engage in voluntary actions (table 2).

The author also explored effective measures based on hearing investigations with those who are assigned to already constructed houses and surveys responded to by residents who renovated their houses (table 3).

*1 Impeding factor (hazard): Factors that produce causes of natural disasters and accidents. Impeding factors are sometimes called the source of potential hazards and risks in JIS Q 0073. It is roughly categorized as ones that come from the natural environment, ones that come from the social environment, and ones that come from individual people. For example, major earthquakes and tsunamis are impeding factors that come from the natural environment and occur first. Then, as impeding factors that come from the social environment and individual people become linked, the level of damage increases and forms a major disaster. A large earthquake in areas without people, such as on the moon, does not become a major disaster.

*2 ETA (Event Tree Analysis): A method that traces the link of impeding factors to analyze expected damage. This method becomes useful when analyzing natural disasters. It is also used to examine measures to prevent specific disasters and the progress or the spread of accidents.

*3 FTA (Fault Tree Analysis): A method to analyze natural disasters and accidents by tracing the origin of impeding factors that cause the disasters and accidents. It becomes useful when analyzing daily disasters where the disasters and accidents can be artificially prevented. It is sometimes used to calculate the probability of onset in addition to the analysis of causes.

Timing to implement measures	Type of measures	House-related disasters in major earthquakes	House-related accidents (tripping, falling, crushing, drowning, heat shock)
Measures before onset	Measures to prevent disasters and accidents	Select location for building houses. Ground improvement New construction or reconstruction Earthquake resistance diagnosis, earthquake resistance renovation Keep inside built-in storages organized. Prevent furniture from falling. Avoid placing furniture in bedrooms. Measures to prevent falling objects Installation of a breaker with earthquake detection function (already installed microcomputers) Crime prevention measures	Maintain good health and strength. Eliminate steps on floors. Install something to hold on to such as handrails. Remove obstacles. Use non-slipping floors or apply non-slipping materials on stairs. Improve lighting devices. Keep balconies organized. Reduce temperature difference among rooms by insulating a house. Avoid hot bath or long bath. Keep bathrooms and dressing rooms heated. Warm up a body by pouring hot water on the body first.
	Measures to reduce damages	Store food, water, and dairy goods. Have emergency bags ready. Purchase fire/earthquake insurance. Carry whistles.	Use soft floor materials. Reduce obstacles. Notifying someone before taking a bath Install emergency call system.
Measures to implement at onset	Measures to reduce damage	Protect oneself from collapsing houses or falling furniture. Rescue victims. Evacuate to the height. Initial fire responses	Call 119 Emergency measures (e.g. CPR, recovery position)

Table 1: Example of focused points to implement safety measures in houses (self-support)

Timing	Main impeding factors	Issues to be examined
Prior phase	The effectiveness or necessity of renovation is not recognized.	Advertisement and public relations to report the effectiveness and necessity of the improvement of earthquake resistance, improvement of the thermal environment of a house, and measures to prevent accidents in a house
	Lack of opportunity to renovate (a wish to wait until the next reconstruction or remain living in the current house as it is)	Avoid missing a good opportunity for renovation (when a used house is purchased or when preparing for a house as one's final abode)
Preparation phase (consultation)	Uncertainty as to which should be prioritized Lack of knowledge and information concerning renovation	Advice from neutral third parties (e.g. architects, physicians, care managers) Advice from those who renovated in the past Distribution of information of actual renovations through the Internet
	It is difficult to accept renovations where the effects are not visible, and customers become reluctant (especially earthquake resistance and thermal environment.)	Effective use of technologies to make the thermal environment visible (thermography cameras) Observation of renovated houses (to experience actual houses and use talks of those who renovated houses based on their experiences)
	Procedures are troublesome.	Enrichment of information concerning systems and procedures
	Monetary burden (especially for those who live on national pension)	Enrichment of subsidy, financing, tax incentives Improvement of priority areas (limited to the first floor) and implementation procedures (reduction of load through integrated construction)
Implementation phase	Uncertainty in the quality of construction Anxiety toward responses to problems	Improvement of contractor information, introduction of examples of constructions Use of inspections and defect liability insurance

Table 2: Main impeding factors and challenges associated with the renovation of already constructed houses

- ♦Increase the recognition and interest toward the necessity of renovation.
- ♦Increase the number of experts and those with experiences in renovation who can provide proper advices.
- ♦Use technologies that make invisibles visible.
- ♦Publicize excellent examples of renovations.

Table 3: Main measures that are effective when specifically worked on

3. Summary

The author successfully narrowed down effective ways to promote safety measures as he organized impeding factors for implementing safety measures in already constructed houses and associated challenges and examined them through investigations targeted to those who were in charge of construction and those who renovated their houses.