

DISASTER RESPONSES OF SUPER HIGH-RISE CONDOMINIUMS TO GREAT EAST JAPAN EARTHQUAKE

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Abstract

This paper clarifies how super high-rise condominiums in the Tokyo metropolitan area (TMA) responded to the Great East Japan Earthquake (GEJE) on 11 March 2011. Super high-rise condominiums highly depend on kinds of equipments, and the dependency could cause serious confusions in disasters. On the other hand, various facilities and concentrated management systems super high-rise condominiums usually have could be useful resources to recover from emergencies. For revealing what confusions and responses actually appeared in the GEJE case, we conducted questionnaire and interview surveys. Firstly, we listed condominiums of 20 or more stories in the TMA and identified 323 associations. Questionnaires were sent to them all and 107 answers were collected. The questionnaire included 5 categories of question: 1) general descriptions of the condominium, 2) damages from the earthquake, 3) preparation for disasters, 4) temporary usage of common facilities at the earthquake, and 5) management of condominium association. Secondary, interviews were conducted with 9 condominiums to figure out the detail of questionnaire answers. The surveys revealed that almost all condominiums had suffered from elevator failures and that common facilities on lower floors had worked as places for temporary and overnight refuges. Such uses were necessarily not preliminarily expected.

Key words

Disaster Response; Great East Japan Earthquake; super high-rise condominium; Tokyo Metropolitan Area

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1 INTRODUCTION

1.1 Introduction

This paper clarifies how super high-rise condominiums in the Tokyo Metropolitan area (TMA) responded to the Great East Japan Earthquake (GEJE) on 11 March 2011 at 14:46 JST. As Nakashima et al. in [1] summarized, GEJE caused enormous damage over a large region of Northeast Japan. Although the damage TMA suffered was less than the main affected area had, the shake was the most destructive that super high-rise condominiums in the TMA have ever experienced.

To cite previous studies, Yoshimoto in [2] clarified behaviors of high-rise apartment residents at 1995 Hanshin Awaji Earthquake. Hanse in [3] pointed out problems of disaster refugees in super high-rise buildings. Park in [4] examined feelings of high-rise living residents by floor plans. This study mainly focused on emergency usages of common spaces in the GEJE.

“Safety and disaster prevention” was pointed out by Lee (2007) in [5] as one of the most important factors for sustainability assessment of super high-rise residential complexes. They highly depend on kinds of equipments, which could cause serious confusions in disasters. At the same time, various facilities and concentrated management systems those condominiums are equipped with could be useful resources to recover from emergencies.

As Okada reported in [6], disaster response is a matter of community and social governance as well. For achieving adaptive governance, Djalante et al. in [7] extracted four characteristics to help increase resilience to natural hazards: polycentric and multilayered institutions, participation and collaboration, self-organization and networks, and learning and innovation. For large developments such as high-rise condominiums, the point is how adaptively individual resident, condominium and neighborhood community can work together.

1.2 Method

For revealing disaster responses of super high-rise condominiums to the GEJE, we conducted questionnaire and interview surveys.

Firstly, we listed condominiums of 20 or more stories in the TMA and identified 323 associations. Questionnaires were sent to them all and 107 answers were collected (Tab.1). The questionnaire included 5 categories of question: 1) general descriptions of the condominium, 2) damages from the earthquake, 3) preparation for disasters, 4) temporary usage of common facilities at the earthquake, and 5) management of condominium association.

Secondary, interviews were conducted with 9 condominiums to figure out the detail of questionnaire answers.

Tab. 1: Questionnaire Survey

Objects	Condominiums of 20 or more stairs in the Tokyo Metropolitan Area
Periods	From August to December 2011
Collection Rate	33% (107 Collected out of 323 Mailed)
Answerers	Management Companies (45), Onsite Managers (31), Board Members (27), Others (4)

2 DAMAGES BY THE EARTHQUAKE

2.1 Overview of Super High-Rise Condominiums in the Tokyo Metropolitan Area

Development of super high-rise condominiums began in the 1970's and the number as well as the height increased afterwards (Fig.1). Fig.2 shows the variety of common facilities they have.

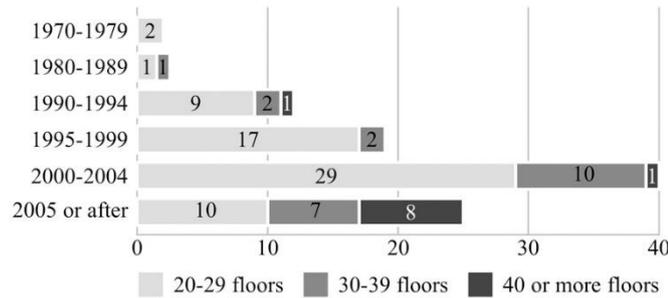


Fig.1: Number and Height of Super High-Rise Condominiums by Development Year

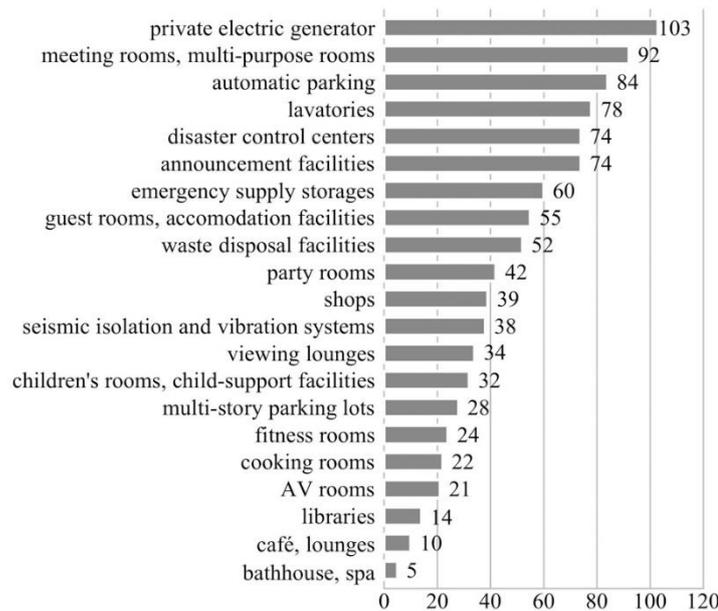


Fig.2: Common Facilities (multiple answers)

2.2 Damages by the Earthquake

The GEJE, measuring intensity 5-upper in case of the 23 wards, shook buildings badly. Although fatal cases were not reported, most condominiums answered to have suffered some damages (Fig.3).

The shakes brought infrastructure failures as well. Elevator failures were the most significant (Fig.4), and residents of almost all condominiums were forced to go up and down stairs until the recoveries. Fig.5 shows the downtimes by area. In Tokyo Metropolis and Saitama Prefecture, elevators began to work again within 6 hours at nearly three-fourth condominiums. However, one-third condominiums in Chiba Prefecture and Kanagawa Prefecture had to wait for the recovery until the following day. The time variance was not only due to the depth of physical damage but also due to the availability of outside mechanics to come over for recovering.

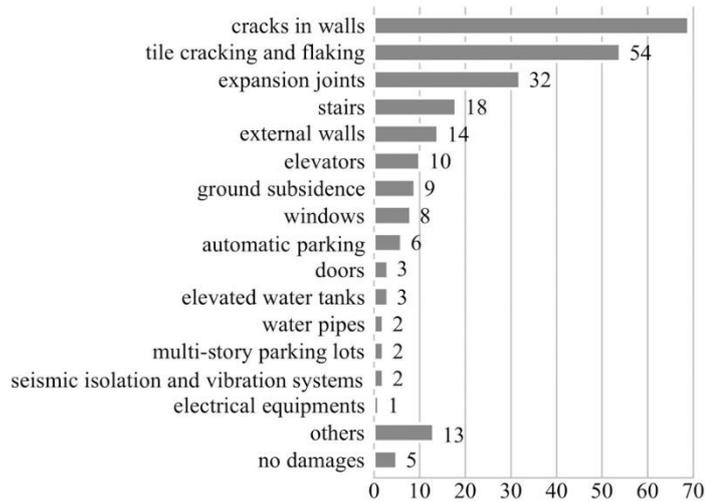


Fig.3: Damage to Common Portions (multiple answers)

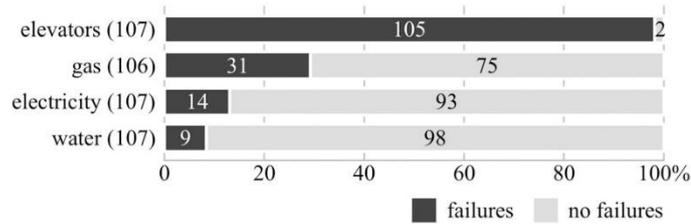


Fig.4: Failure of Building Infrastructures

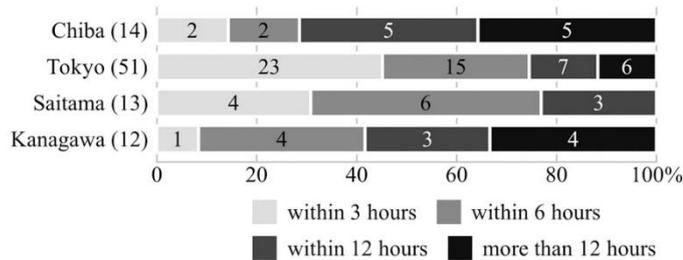


Fig.5: Elevator Downtime by Area

3 RESIDENTS' BEHAVIOR AND UNUSUAL COMMON SPACE USAGE

3.1 Residents' Behavior at the Earthquake

As Fig.6 shows, onsite managers, management companies, board members and residents responded to emergencies soon after the shake. Guiding residents' evacuation to safer places was one of those actions because residents soon crowded at common spaces such as entrance lobby and meeting room (Fig.7). The taller the buildings are, the larger numbers the refugees were found (Fig.8).

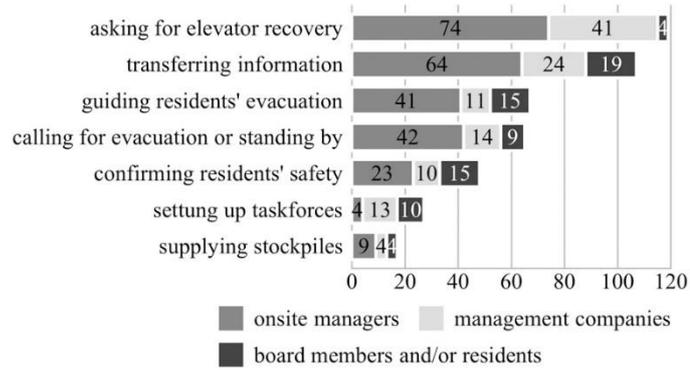


Fig.6: Responds to Emergencies (multiple answers)

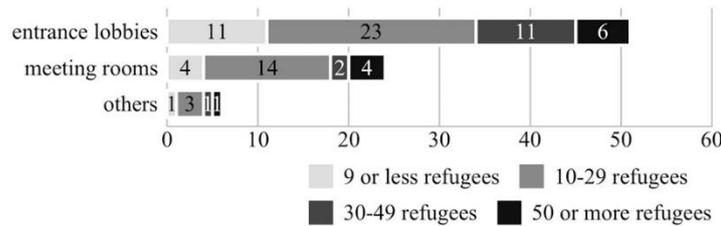


Fig.7: Refugees immediately after Earthquake

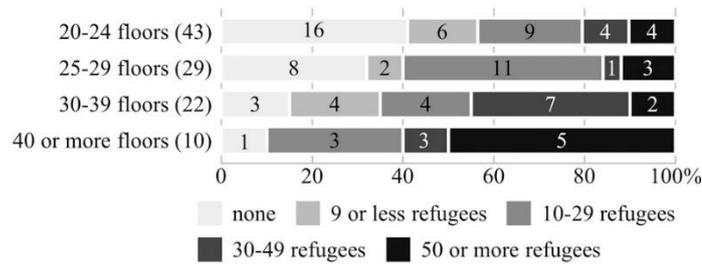


Fig.8: Number of refugees by Building Height

3.2 Unusual Usage of Common Spaces

At the earthquake, some common spaces were used in unusual manners because of unusual behaviours of residents. Tab.2 summarizes the typical usages in interviewed condominiums.

While the elevators were shut down and aftershocks followed frequently, some residents were not able to climb upstairs home, and others walked downstairs by fear. In most condominiums, the residents overcrowded at the entrance lobby and move to other spaces in search for more comfort.

According to the questionnaire, meeting rooms, entrance lobbies, party rooms and disaster control centres were major spaces offered for temporary and overnight refuges (Fig.9). Some condominiums answered to have expected such usages, but overnight refuges were little expected (Fig.10). Concerning the location, most spaces actually unutilized were on the lower floor. Some interviewees answered that it was because of the sense of security and accessibility to outside environment.

Tab.2: Unusual Usage of Common Spaces and Relationship with Neighbors

Completion No. of stories No. of units EV downtime	Usage of common spaces	Relationship with neighbors
	1) Immediately after the earthquake 2) Elevator downtime 3) Overnight	4) Care of non-resident refugees 5) Disaster provision for neighbors
A 1992 25 stories 366 units 5 hours	1) 15 residents crowded in the lobby. 2) The Board opened a meeting room to the residents. 3) 8 upper floor residents stayed 2 nights at a meeting room on the 2 nd floor by fear of aftershocks.	4) None. 5) The condominium attached taps to underground water tanks for emergencies. The government permitted it on condition that they share the 300 tons of water with neighbors at disasters.
B 2001 26 stories 217 units 7 hours	1) 15 residents crowded in the lobby. According to the Board, 180 residents stay in the condominium in daytime usually. 2) Several residents moved to a lounge on the 2 nd floor, stayed there for an hour and walked upstairs home. 3) None.	4) None. 5) None. The condominium participates in a wide-area neighborhood association, but carries out disaster drills independently.
C 2002 26 stories 166 units 4 hours	1) Several residents crowded in the lobby. 2) None. 3) None.	4) None. 5) The condominium has a meeting room directly accessible from outside, although it has not been used for disaster recovery purposes.
D 2004 22 stories 224 units 20 hours	1) More than 50 residents walked downstairs by fear, evacuated to a park in front according to annual disaster drill, and walked upstairs after a moment. 2) The Board opened a party room on the 1 st floor for a resident in a wheel chair. It had a sense of safety because of the closeness to outside environment. 3) None.	4) None. 5) None.
E 2005 45 stories 644 units 4 hours	1) 30 residents crowded in the lobby. Some residents tried to walk upstairs, but the Board advised to stay. 2) The lobby was overcrowded, and the Board guided 100 residents to the inner garden on the 3 rd floor. A pregnant woman was guided to the disaster control center. No common spaces usages were found on upper floors. 3) None.	4) The condominium invited 10 kindergarten children waiting for parents' pickup at an overcrowded park in front to the entrance lobby. 5) None. But the condominium often invites neighbors to residents' events in order to develop community ties.
F 2005 47 stories 587 units 6 hours	1) 20-30 residents crowded in the lobby. 2) None. 3) 6 shop staffs were difficult to go home and stayed a night at meeting room on the 3 rd floor.	4) None. 5) None.
G 2006 29 stories 187 units 3 hours	1) 60 residents waked downstairs by fear and evacuated to a park in front. 2) The Board opened a meeting room for the residents. 3) 7-8 upper floor residents stayed a night at a meeting room on the 2 nd floor by fear of aftershocks.	4) None. 5) At the development of condominium, landowners hoped to contribute for the area and provided water tank, meeting room and emergency supply storage for the neighborhood community.
H 2007 47 stories 869 units 2 hours	1) No residents came downstairs, but 20 residents could not climb upstairs and crowded in the lobby. 2) None. 3) Several condominium staffs were difficult to go home and stayed a night at party room on the 2 nd floor.	4) None. 5) The condominium participates in area liaison council of super high-rise residential buildings. The council is studying emergency electric generation systems.
I 2007 20 stories 678 units 2 hours	1) 20-30 residents evacuated to a park in front. 2) None. 3) None.	4) None. 5) None. The condominium is going to separate from a wide-area neighborhood association because of communication difficulties.

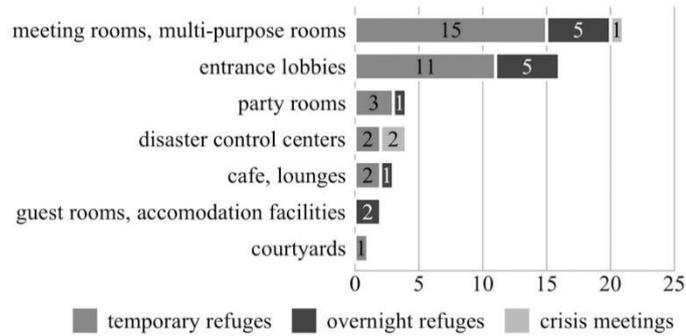


Fig.9: Unusual Usages of Common Spaces (multiple answers)

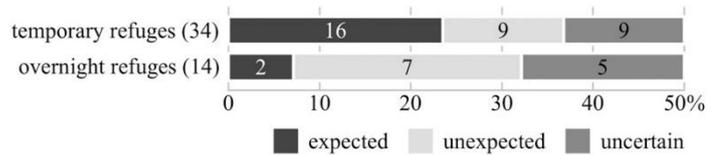


Fig.10: Expectations of Unusual Usages

3.3 Relationship with Neighbours

It is often required to collaborate with neighbourhood community for reducing disaster damages. As Tab.2 shows, some disaster provisions for neighbours were found in interviewed condominiums. Case A ready to share tank of water, case C with a meeting room directly connected to neighbourhood and case G willing to equip water tank, meeting room and supply storage for neighbours are typical patterns, although they did not have to work actually at the GEJE.

Community ties worked in some condominiums. Non-resident refugees were rescued in case E, and similar cases were found in 5 out of 107 condominiums according to the questionnaires.

4 CONCOMINIUM MANAGEMENT AND DISASTER PROVISIONS

4.1 Condominium Management and Disaster Provisions

Fig.11 shows current agendas of condominium management. The second agenda was the disaster provisions. For super high-rise condominiums disaster provisions are serious, because they have huge numbers of resident and are sometimes asked by the municipality not to escape to public evacuation centres with limited capacities. The request of self-sustaining for super high-rise condominiums are getting stronger currently (Fig.12).



Fig.11: Agendas of Condominium Management (multiple answers)

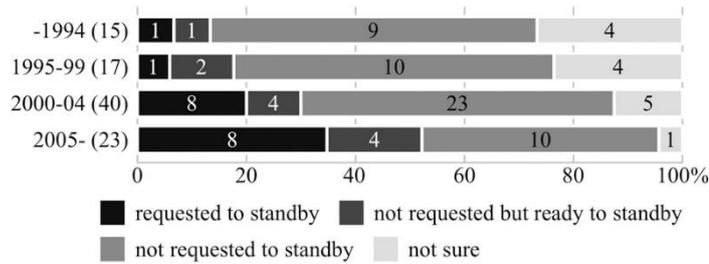


Fig.12: Request to Standby Home by Development Year

4.2 Review of Disaster Provisions

The GEJE provided condominiums opportunities to review their disaster provisions (Fig.13). New progresses had been made mainly in preparing disaster manuals, listing survivors in need of help, establishing disaster prevention task forces, and fostering condominium communities. In contrast, little attentions had been paid to fostering local communities.

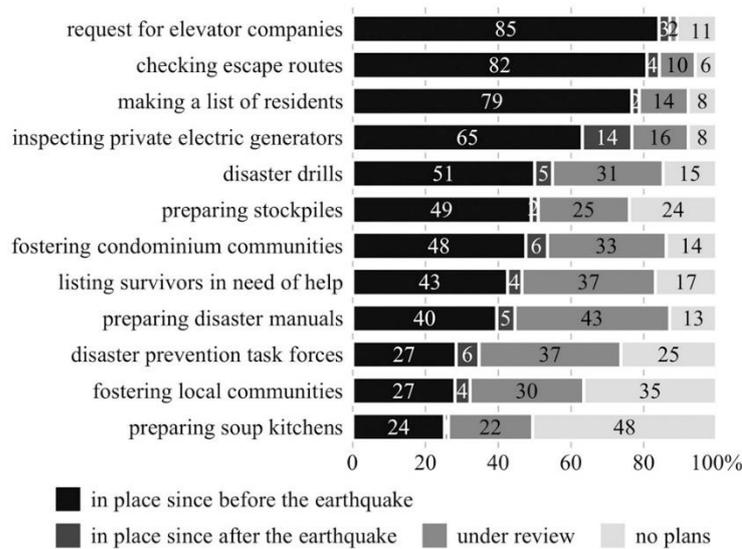


Fig.13: Change of Disaster Provisions after the GEJE

5 CONCLUSION

One of the most significant damages by the GEJE to super high-rise condominiums in the TMA was elevator failure. During the downtime the residents crowded in the entrance lobbies and the number was larger in taller condominiums. Dealing with the emergencies, common spaces on the lower floors such as entrance lobbies, meeting rooms and party rooms were used for temporary and overnight refuges, while these usages were not necessarily expected in advance. Although the cases were rare, some condominiums invited non-resident refugees as well, and some had disaster provisions for the neighbours.

Residents of super high-rise condominiums are sometimes asked to standby home at the time of disaster because of the small capacity of public evacuation centres. Therefore, most condominiums were reviewing their disaster provisions, however little attentions were paid to fostering local communities. To withstand greater disasters, it would be necessary to collaborate with communities outside as well. Further researches are expected on how to design incentives of condominium communities to contribute for the neighborhoods.

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