QUESTIONNAIRE SURVEY ON A BEHAVIOR OF BUSINESSES, ETC. AROUND SHINJUKU STATION DURING THE GREAT EAST JAPAN EARTHQUAKE

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ABSTRACT: In this paper, according to the survey, it was able to grasp reality of high-rise building-specific damage that occurred at the Great East Japan Earthquake (“the 3.11 Earthquake”), initial response of regional businesses, and support to the people who were unable to return home. In addition, we clarified the future issues learned from the actual situation and proposed efforts to enhance disaster prevention in cooperation with the local communities to minimize the disruption of a large-scale earthquake.

Key Words: Businesses, Around Shinjuku Station, Initial Response, Collaboration with Local Communities, High-rise Building, DCP

1. PREFACE

In case of large-scale earthquake such as Tokyo Inland earthquakes, the cluster of high-rise buildings in the Shinjuku West Gate area with a huge day time population is expected to see a large number of injured people inside the buildings, arrest of functions including broken elevators and essential utility outage, and confusion caused by people unable to move or return home. Under such circumstances, as public support is limited, collaborative effort in local communities is required to address the problems and challenges that emerge shortly after a disaster. Since 2008, a full-scale collaboration among local communities and businesses around Shinjuku Station has started (Murakami, Hisada¹⁾, Shindo et al.²⁾, Kojima³⁾ etc.).

At the occurrence of The Great East Japan Earthquake on March 11th, 2011 at 2.46pm, public transport in Tokyo Metropolitan area was paralyzed and many people had difficulty returning home. In Shinjuku, where an earthquake of intensity 5 lower was observed, not only communication function went down with both landlines and mobile lines flooded but also a large number of people who were

stranded by shutdown of the major railway lines poured into the public facilities and the evacuation centers in the Shinjuku ward. In these circumstances, it is estimated that the high-rise buildings in the West Shinjuku area suffered various damages and the building management companies as well as the tenant businesses implemented assistance activities. However, not many survey researches have been published on what activities actually took place.

Photo 1 The West Gate of Shinjuku Station at the time of the Great East Japan Earthquake
(Left: around Shinjuku Station, Right: a lobby on the ground floor of a building near the station)

A questionnaire survey on damages caused to the Metropolitan area by the Great East Japan Earthquake was conducted by Tokyo Fire Department⁴⁾, targeting households and offices in the areas in charge. It investigated how furniture and fixtures fell and moved against how they had been fixed and in relation to building structure. How preventive measures had been taken was also questioned. The survey encouraged to implement preventive measures and described the importance. Midorikawa et al.⁵⁾ conducted a questionnaire survey targeting high-rise apartments in Chuo ward, which determined the extent of damage to rooms by apartment floor, and discussed future counter measures for long-period ground motion. Another research was conducted by Hida, Nagano⁶⁾ with a questionnaire for the residents of high-rise RC apartments of more than 24 stories with strong motion observation in place in Kanto and Kansai regions. Their research studied mental state of the residents and the scope of damage inside the buildings.

With the above mentioned researches in mind, this paper focused on damage situation and initial response of management companies and tenants of high-rise buildings mainly used for business purposes. More precisely, based on a questionnaire survey by the Disaster Prevention Countermeasure Conference for Shinjuku Station Areas West Gate Division (hereinafter called “West Gate Division”), for which the authors serve as the secretariat, targeting the business members operating in the Shinjuku West Gate area (hereinafter called “the questionnaire”), this paper comprehends the damage situation and the initial response during the 3.11 Earthquake and examines problems and challenges that may be faced when an inland earthquake hits Tokyo. Also, it clarifies the problems of community collaboration in regional disaster prevention and delineates a direction of the countermeasures.

2. THE OUTLINE OF THE QUESTIONNAIRE SURVEY ON BEHAVIOR OF BUSINESSES IN THE GREAT EAST JAPAN EARTHQUAKE

2.1 Respondents and collection of the questionnaire

The questionnaire survey consists of two questionnaires; one for the companies which manage and

understand the entire situation of the buildings (hereinafter called “management company/-ies”) and the other one for the tenants of the buildings. The management companies were asked to distribute the tenant questionnaire to some of their own tenants. The survey started on April 10, 2011 for the management companies in charge of 22 buildings.

16 management companies and 23 tenants responded to the questionnaire. The respondents were free to choose from 2 kind of the questionnaires mentioned above, so that some businesses like a hotel, which were the only tenant of their building, chose the questionnaire for the tenants, not the one for the management companies.

2.2 Contents of questionnaire

The questions for both the management companies and the tenants respectively were designed as is shown in the following chart. See the appendix for the details of the questions.

Table 1 Questions for management companies

1. Building outline 2. Damages occurred in the building on the day of the 3.11 Earthquake 3. Disaster control headquarters 4. Actions taken on the occurrence of the 3.11 Earthquake 5. Implement status of behaviors and actions in the disaster defense plan 6. evacuation from the building 7. Provision of information to remaining people in and around the building 8. Acceptance of stranded commuters 9. Overnight stay in common areas 10. Past seismic countermeasures 11. Future effort 12. Comments and others
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Table 2 Questions for tenants

1. Company outline 2. Damages occurred in the office 3. Safety confirmation of employees 4. Evacuation of employees 5. Decision of returning home 6. Overnight stay in the office 7. Past seismic countermeasures 8. Implement status of behaviors and actions taken in the context of disaster defense plan 9. Disaster control headquarters 10. Information collection activity 11. Provision of information to employees 12. Problems and reflection points 13. future effort 14. Others

2.3 Seismic intensity of the high-rise buildings in the Shinjuku West Gate area where the respondents of the questionnaire reside

Kubo et al.⁷⁾ reported the quake in the high-rise buildings in the Shinjuku West Gate area was observed in the Kogakuin University’s Shinjuku campus building, standing approximately 143 meters, with 29 stories above the ground and 6 underground stories. According to the report, intensity 4 on the 6th floor, 5 lower on the ground floor, 5 upper on the 22th and 6 lower on the 29th floor were respectively observed. It is necessary to keep in mind that the questionnaires in this paper are intended for the high-rise buildings and the tenants, which could differentiate the seismic intensity by floors.

3. RESULTS OF THE QUESTIONNAIRE

As described previously, the questionnaire had two separate questionnaire sheets; one for the building management companies and the other one for the tenants. The results therefore are also reported in two different parts.

3.1 Building management company

(1) Outline of the responding management companies

16 management companies responded to the questionnaire manage 16 buildings which are all high-rise buildings of more than 90 meters high, with a total floor space of 40,000m². They were built in the period between 1974 and 2008. The occupancy rate varied from building to building. 12 of them were multi-tenant buildings having more than 10 tenants. Through mostly used as office, some were used for restaurants, medical clinics, rental meeting rooms or lecture rooms. 6 buildings had a vibration control mechanism, 5 of which were built in 1990s or later and one in 1970s. (Table3, Fig.1, Fig.2)

Table 3 Outline of responding buildings

Building name	Built in	above the ground*	No. of tenants	vibration control mechanism	Building name	Built in	above the ground*	No. of tenants	vibration control mechanism
A	90s	20+	More than 200	No response	I	2000s	20+	10~100	Yes
B	80s	20+	10~100	No	J	2000s	20+	10~100	Yes
C	70s	20+	10~100	No	K	70s	20+	less than 10	No
D	90s	20+	10~100	Yes	L	80s	20+	less than 10	No
E	90s	20+	10~100	No	M	80s	20+	10~100	No response
F	90s	20+	10~100	Yes	N	80s	20+	10~100	No
G	70s	20+	10~100	Yes	O	70s	20+	less than 10	No
H	2000s	20-	10~100	Yes	P	80s	20+	less than 10	No

*) "20+": in and higher than 20th floor "20-": lower than 20th floor

Fig.1 Building completion year

Fig.2 Vibration control mechanism

(2) Damages occurred in the building on the day of the 3.11 Earthquake

Damages occurred in the buildings on that day were investigated in the categories of “infrastructure”, “outside the building” and “inside the building”. For “infrastructure”, the most common trouble found was with “incoming calls” with 12 reported cases (Fig.3), followed by “other communication means” with 7 reported cases. Damage to “mobile communication” was the biggest in the category of “other communication means” according to answers given to the open-ended question. Troubles with incoming calls were mostly caused by congestion. Damages to “electricity, gas and water supply” were caused by water leaked from sprinklers by flange misalignment or released fire door. It can be said that

no serious infrastructural damage occurred in the high-rise buildings of the Shinjuku West area. Some offices reported that automatic gas shutoff valves did not work in the Great East Japan Earthquake. Some buildings manually operated the valves, while others didn't. It is necessary to consider the possibility of earthquake fire; Earthquake motion where long-period components are superior may not activate automatic shutoff valves when it doesn't reach a preset velocity.

For the external parts of each building, no major damage was reported except one case that a part of the exterior wall fell off (Fig.4).

For inside a building, part of the ceiling collapsed (13 reported), and interior wall fell off (9 reported cases). 6 reported that the fire-retarding doors didn't close properly (Fig.5).

Fig.3 Infrastructural damage

Fig.4 External damage

Fig.5 Internal damage

As for the items with more than two reported cases of internal damage, buildings with and without a vibration control mechanism are compared as shown in Fig.6. The buildings with a vibration control mechanism were found less damaged than the one without it in the items other than “sprinkler was broken”, “unfixed shelves or office automation equipment widely moved” and “fire prevention equipment/fire-retarding doors in trouble”. The items of damage which the buildings with a vibration control mechanism require further sufficient examination.

Fig.6 Comparison of damage in the buildings with and without a vibration control

For the elevators inside the building, the most common damage was “entangled control wires or lopes” with 4 reported cases, followed by “loss of inner parts” with 2 cases and “dislocated door” with one reported case. The elevators were stopped under control soon after the 3.11 Earthquake. 4 office buildings had to wait at least one month to have the elevators recovered. Vertical movement of people in high-rise buildings is dependent on the elevators, and the result above exposed the vulnerability of tall buildings to earthquakes (Fig.7).

9 buildings completed their check on the damage on the day of the 3.11 Earthquake. 3 buildings completed on the following day and one after March 13. 3 buildings did not respond.

Fig.7 Damage in elevator

As for the elevator related damage items, the buildings with and without a vibration control mechanism were compared as shown in Fig.8.

Fewer troubles were reported by the buildings with a vibration control mechanism. However, according to some existing studies such as Architectural institute of Japan⁸⁾, it had been indicated that the percentage of damage to elevator was not only determined by the building structure but also by what year of the guide for design and construction of elevator was adopted (1972,1981, 1998, 2009). The older the guide was, the higher the damage rate was generated.

①entangled control wires and lopes

②loss of inner parts

③dislocated door

Fig.8 Comparison of damage in elevators with and without vibration control

(3) Disaster control/crisis management headquarters

Of the responding buildings, 11 (69%) formed their own disaster control headquarters. All of them responded that the headquarters were formed “immediately after the 3.11 Earthquake” within their respective disaster control centers. The activities included collection of information on damage situation both inside and outside of the building, announcement using an emergency broadcasting equipment and provision of assistance to stranded people. Of those which did not open a headquarters, 4 buildings described that “an earthquake of intensity 6 or more was conditioned by their rules to form a headquarters” and “no major damage was found” as the reasons for not formatting a headquarters (Fig.9).

If a disaster, such as a large-scale earthquake, occurs, certain activities including information gathering and internal announcements for the tenants would take place through a disaster control headquarters located in each building’s disaster control center, although a variation in handling was

observed during the Great East Japan Earthquake.

Fig.9 Disaster control center

(4) Provision of information by management companies on the occurrence of the 3.11 Earthquake

In the Shinjuku Station West area, where electric supply was not impacted by the Great East Japan Earthquake, people gathered information through the Internet and TV (Fig.10). Some said that they directly contacted a local administrative office or transportation facilities to get area-specific information.

In addition, the questionnaire asked the time required for the confirmation of the injured in the building. Among 11 buildings responded, one said approximately half an hour, 6 said less than two hours and 4 said more than two hours.

An accurate, smooth information gathering is important in giving directions and information via internal announcements through which building management companies asked the building users to behave in an orderly manner. Assuming that a large-scale earthquake occurs directly beneath the Tokyo Metropolitan area, information gathering equipment that can be used even under power outage is needed to address the situation in a similar way in the Great East Japan Earthquake. In addition, some systems are needed to share area information that is currently obtainable only through a direct contact with a local administrative office and transport facilities.

Fig.10 Provision of information on the day of the 3.11 Earthquake

(5) Behaviors and actions in the disaster defense plan

It is fundamental to comply with a disaster defense plan in the initial responses on the occurrence of an earthquake. In the questionnaire, 14 management companies responded that they could implement the actions set in their disaster defense plan including the formation of headquarters, collection and provision of information and making announcements (Fig.11). The management companies which could not take such actions as planned described that the reasons are “the emergency telephone system

was not used for communicating information”, “incoming call were disconnected and they could not contact the tenant companies”.

Regarding actions set in a disaster defense plan, a smooth evacuation is important in the case of fire. However, assuming an earthquake occurring directly beneath Tokyo, it is important to promptly grasp the situation while ensuring smooth communication and information flows in a building so that the building management company to encourage the tenants to behave in an orderly manner.

Fig.11 Actions in disaster defense plan

(6) Provision of information to remaining people in and around the building

The questionnaire asked how information was provided to the people remaining in and around the building. “Through announcements (in the building)” ranked top with 9 reported cases, followed by “communication by security guards” with 6 cases and “notice on the walls” with 5 cases. 5 management companies did not particularly provide information (Fig.12).

In an open-ended question, the contents of announcements made on the day were questioned. In general, information regarding “earthquake”, “building facility”, “safety” and “support for stranded commuters” were provided. The details are given in Table 4.

Fig.12 Means of information provision

Table 4 Contents of announcements

Announcement about...	Descriptions
Earthquake	An earthquake occurred
	Warning for aftershock
	Damage situation in the building
Building and facilities	Gas supply stopped
	Air conditioning equipment being checked
	Elevators stopped
Safety	Safety of individuals
	The building is safe
Handling of Stranded commuters	Information on establishment of emergency center
	Information on means of transportation around the building
	Overnight stay in the building
	Information on supply of stockpiled

(7) Acceptance of stranded commuters

In the Great East Japan Earthquake, many commuters around the Shinjuku West Gate area were unable to go home. Among the responding management companies, 6 accepted such people to their buildings and 2 of them provided material assistance (Fig.13).

In order to prevent potential confusion in the local area by the occurrence of numerous stranded people, in addition to protecting the employees staying in the buildings, the cooperation with the local buildings is required to temporarily accept “unorganized stranded people” who are for example in the area for shopping. A following research found that 5 respondents which did not accept any people to their buildings had actually been ready to accept a limited number of people referred by a local authority. Some of them however did not do so because they could not have reached a local authority. This

reaffirmed the need of informative communication along with a smooth referral.

Additionally, 8 management companies answered “some people stayed overnight in their common areas” to the question if there was anyone who stayed there overnight regardless of whether the building systematically accepted stranded people or not.

Fig.13 Acceptance of stranded people, material assistance and overnight stay in building

(8) Earthquake countermeasures before the occurrence of the Great East Japan Earthquake, and problems and reflection points in the initial responses taken during the 3.11 Earthquake

The questionnaire asked about the efforts of earthquake countermeasures taken before the 3.11 Earthquake in an open-ended question. The answers returned included “bi-annual disaster drills”, “manuals or contingency plans”, “stock of food and emergency supplies” and “furniture fall prevention”.

Problems and reflection points regarding the initial responses taken during the 3.11 Earthquake are shown in the next table. The building management companies, despite their basic disaster preparation, found problems and reflection points, such as “stock shortage in terms of variety and volume”, “insufficient information gathering” and “contents of in-building announcements”. Regarding countermeasures necessary in the event of an earthquake, it is important that concerned parties share a clear image of what would happen through disaster drills based on an anticipation of damage, for example. Periodic reviews of current preparation are needed as well.

Table 5 Problems and reflection points for the building management companies regarding their handling during the 3.11 Earthquake

① Support for visitors
• Materials and equipment to support visitors were not enough
② Acceptance of stranded commuters
• It was difficult to accept/support stranded commuters along with addressing people in the building
• No stock of food and blankets to provide
• No stock of food and blanket as the building was not meant for a temporarily shelter
• Not enough bath rooms
③ Collection and provision of information
• A dedicated person to collect area information should have been appointed
• Ways to provide information to visitors need a review
④ In-building communication and announcements
• Communication with the tenants was not smooth as telephone lines were congested
• People in the building should be more informed of the extension numbers to avoid using mobile phones
• The building did not make an announcement that the building was safe. As a result, people inside rushed to the emergency staircase, which prevented the management company from reaching the site quickly.

- A system is important to make an announcement immediately after an earthquake occurred
- ⑤ Disaster drills
- With a partial review of disaster defense plan, disaster drills should be implemented to encourage people to be able to take more practical actions.
- ⑥ Long-period ground motion
- Preparation for long-period ground motion is needed

(9) Earthquake countermeasures after the Great East Japan Earthquake

Based on the problems and the reflection points discovered in the Earthquake, an open-ended question was asked regarding the future earthquake countermeasures which the respondents considered. The answers included disaster drills focusing on earthquakes, review of the defense plans, the manuals and the evacuation plans.

Building management companies which manage a fire prevention property with a certain amount of total floor area are obliged by *Japanese Fire Service Amendment Bill 2009* to include large-scale earthquakes in the disaster defense plan. The training text books for the staffs at a disaster control center of a building management company¹¹⁾ explain self-defensive fire-fighting operations at the time of an earthquake. However, as for disaster drills, they show only the guidelines for how to handle a fire emergency. It is therefore expected that the focus of regular drills at companies is placed on evacuation drills. Earthquake drills particularly assuming a strong local earthquake are ideally conducted based on the characteristics of the buildings and the community. Concerned parties will need to collaborate to review the concept of earthquake countermeasures to be taken in the community and design and implement their earthquake drills.

3.2 Tenant

(1) Responding tenants

23 tenants responded to the questionnaire; 19 of which used the buildings as office. 3 tenants used them as accommodation and one as clinic. 14 of the 19 office tenants had their own headquarters, 4 tenants on a low level floor (GF to 9th), 6 tenants on a mid-level floor (10th to 19th) and 13 on a high-level floor (<20th). For the multi-floor users, their highest floors were counted.

Table 6 Responding tenants and their use of building

Company name	floor	use	Company name	floor	use	Company name	floor	use
A	upper floors	office	I	middle floors	office	Q	lower floors	office
B	upper floors	office	J	upper floors	office	R	upper floors	office
C	upper floors	office	K	lower floors	clinic	S	upper floors	office
D	middle floors	office	L	lower floors	office	T	upper floors	office
E	middle floors	office	M	upper floors	office	U	upper floors	office
F	middle floors	office	N	upper floors	office	W	middle floors	office
G	lower floors	office	O	upper floors	accommodation	X	upper floors	accommodation
H	middle floors	office	P	upper floors	accommodation			

(2) Damage found in the tenants' office space

Damage found in the office of the tenants was investigated in the two separate categories of “infrastructure” and “inside the office”. For “infrastructure”, the most common trouble found was “other communication means” with 10 reported cases, followed by “incoming call” with 7 reported cases (Fig.14). “Mobile phone” and “the Internet” were mentioned as “other communication means”.

For inside the office, troubles of flaked interior wall were reported by 7 tenants. 6 reported part of the ceiling collapsed, and 4 said their unfixed office automation equipment moved. As well as the building management companies mentioned, damages were found mostly in non-structural components

(Fig.15). For “others”, some reported their servers and TVs overturned.

Fig.14 infrastructural damage

Fig.15 Damage in the office

Photo 2 Damages in a local building (27th floor) (left : part of the ceiling fell/right : displaced OA equipment)

(3) Safety confirmation of employees

21 tenants answered that they confirmed the safety of the employees, which is the basis for the initial responses to be taken in an office during an earthquake. The timing and the method were also asked in an open-ended question. 9 of 21 tenants confirmed the safety of the employees immediately after the 3.11 Earthquake. 10 tenants answered that they used “a safety confirmation method of the company” and 7 said “by telephone”. The questionnaire asked the scope of the target of the employee confirmation. 10 answered “only the employees” and 11 said “both the employees and the family members” (Fig.16).

Fig.16 Safety confirmation and the target

(4) Evacuation of employees

15 tenants ordered the employees to evacuate at the occurrence of the 3.11 Earthquake (Fig.17, left). The reasons why they ordered them to evacuate were asked in an open-ended question, and the answers included “risk of collapse” and “a prescribed temporary evacuation site”. The reasons given by those which did not issue an evacuation directive included “the area was a non-evacuation area”.

The same question was asked to the building management companies to find that no building ordered an evacuation (Fig.17, right). The reason included “no factor was observed such as fire that required an evacuation”, “the building had anti-seismic reinforcement works” and “safety was secured by a building system”. In summary, they did not order them to evacuate since the safety of the buildings had been secured

Fig.17 Decision of evacuation of employees

(5) Decision of returning home

The questionnaire asked whether the tenants companies decided a policy for the employees to return home after the 3.11 Earthquake. 13 issued such a policy (Fig.18). The details were given in answers to an open-ended question including “advised to stay in the office in principle” and “not to go home alone but to form a group of people leaving for a similar direction”. During the 3.11 Earthquake, people in the Metropolitan area were faced with a big challenge of walking back home. The estimated cause was that the businesses in the area had different policies of the employees’ returning home. When a large-scale earthquake happens in the Metropolitan area in the future, it will be necessary for each business entity to make an orderly move as an organization by setting rules to prevent the staff from moving freely and to let them wait in the office in principle as Council for the Alleviation of Subterranean Urban Earthquake Commuter Distress⁹⁾ advises. Such rules, which should aim to avoid regional confusion, will need to enhance the viability through the community collaboration in organizing ideas based on the understanding of the community and by the establishment of a system that encourages local businesses to mutually support temporary stop-over of the people.

(6) Overnight stay in the office

22 tenants answered that some people stayed overnight in the office on the day of the Great East Japan Earthquake (Fig.19). Food and other supplies for the people were secured “through emergency stockpile items of food and blankets” and “at near-by convenience stores”. In the future, it will be necessary to build a certain amount of stockpiles for people in anticipation of temporary stop-over.

Fig.18 Decision of returning home

Fig.19 Overnight stay in the office

(7) Behaviors and actions in the disaster defense plan

While approximately 87 percent of the responding management companies answered that they could implement the actions set in their disaster defense plan, one-third of them answered they could not. The reasons included “timings of evacuation could not been decided” and “lack of understanding of the plan and roles” (Fig.20). It was presumable that the difference of handling in a fire and in an earthquake had not been well understood. In general, if a fire disaster occurs at a high-rise building, it is important for the people inside to promptly evacuate to a near and safe place because it is happening only in that building. In the case of an earthquake, however, they are to stay inside in the first place, unless there is a fire in the building. Generally speaking, prior to the 3.11 Earthquake, disaster drills had been carried out assuming a fire disaster but not an earthquake. This difference of idea for evacuation does not seem to have been adequately understood by offices. Each business will be required to pull together the ideas for evacuation, decision criteria in the case of a disaster in the tenant office and concrete actions to take.

(8) Formation of disaster control/crisis management headquarters

When the Great East Japan Earthquake occurred, more than a half of the responding businesses, that are 15 tenants, formed their own disaster control headquarters in the office. Activities performed there were given in response to the open-ended questions as follows; “communication and direction to the employees remaining in the office”, “gathering information through TV and informing it to the remaining employees”, “safety confirmation of the employees and the families”, “understanding of damage and operation status of stores”, “recovery activities of damaged stores” (Fig.21).

Fig.20 Actions by disaster defense plan

Fig.21 Formation of disaster control headquarters

(9) Information collection activity on the day of the 3.11 Earthquake

The most common way of gathering information at the time of the Great East Japan Earthquake was “by TV” with 22 reported cases, followed by “by the Internet” with 19 cases and “informed by disaster control headquarters in other hubs, internal disaster control center, or building management company” with 9 reported cases. Also asked by an open-ended question of what information was provided then, the answers of which included “information on earthquake or transportation” and “operation status of building facilities”. Many companies used the Internet and TV to collect information, and this was because the infrastructures were functioning in the Tokyo Metropolitan area. However, assuming that an earthquake occurs directly beneath the Metropolitan area, it is also necessary to consider preparing means to collect information even under commercial power outage.

Fig.22 information gathering at tenants

(10) Provision of information to employees

The most common way to provide information to the employee in the office was “told around the office what was happening” with 14 tenants followed by “sent emails simultaneously” with 12 tenants and “posted information on internal systems” with 5 tenants (Fig.23). The detail of “other ways” was asked in an open-ended question, which received the answers including “on whiteboard” and “on in-house TV”. For the employees out of office, 19 tenants “made a phone call”, 16 “sent an email to each of them” and 4 “sent emails simultaneously” (Fig.24).

Also, an open-ended question which asked what information was provided to the employees both in and out of office received the answers including “status of public transportation” and “how to secure food supply”.

Fig.23 Provision of information to employees in the office

Fig.24 Provision of information to employees out of office

(11) Past seismic countermeasures

The most common earthquake countermeasures prior to the 3.11 Earthquake was “preparing stockpiles”

with 18 tenants, followed by “fixing office furniture and automation equipment” with 16 tenants, “preparing manuals of initial responses in earthquake” with 14 tenants and “introduction of safety confirmation systems” with 13 tenants (Fig.25). Open-ended questions asking details of each option received the following answers.

The contents of drills answered were “processing safety confirmation systems”, “confirmation of damage situation”, “communication and evacuation” and “drills for business continuity at a backup hub”.

Emergency supplies currently in stock included “food”, “drinking water”, “toilet” and “emergency packs”. In addition, “helmets”, “warm meals” and “blankets” were what they felt necessary to be stocked in the future.

Actions taken by the tenants that had introduced the 3.11 Earthquake early warning system on receipt of a warning were “in-building announcements”, “security efforts such as wearing a helmet and going under a desk” and “staying temporarily in the building.”

Furniture that had been fixed by the responding tenants before the 3.11 Earthquake included “cabinets”, “book shelves”, “servers”, “lockers” and “large-size equipment.”

Fig.25 Past seismic countermeasures

(12) Problems and reflection points

Despite the fact that the tenants had taken various earthquake countermeasures as described above, many problems were found during the 3.11 Earthquake. Following table shows the problems or the reflection points they found, which were answered to the open-ended questions regarding the initial responses of the day.

Table 7 Problems and reflection points for the tenant companies regarding their handling during the 3.11 Earthquake

① Stockpiles
• The employees were not well informed of stockpile items and the storage locations. The number of helmets was not enough.
• Stockpiles for people unable to return home should be considered.
② Collection and provision of information
• Information needs to be simultaneously provided to all the employees.
• Provision of directions and information to the staffs who were working out of the office was inadequate.
• Handling of the people on a business trip had not been considered
③ Anti-earthquake measures
• The shelves storing emergency equipment that are not fixed need to be checked and fixed.
④ Handling of injured people
• There is a shortage of the staffs who are able to reach and treat injured people
⑤ Preparation of manuals

- There were no manuals or action guidelines to follow for the people who decided to stay in the building.
- There were no rules needed for an overnight stay in the office
- Roles of each staff were obviously either unclear or little understood
- The business continuity plans need to be reviewed.
- ⑥ Disaster drills in place
 - Disaster drills have been conducted but whether they are helpful at the time of an disaster is questionable.
- ⑦ Safety confirmation
 - Safety conformation was difficult without telephone or email.
 - The safety confirmation system did not work as planned; some people did not receive the email, and the confirmation of safety of all the employees was not achieved.

(13) Future effort

An open-ended question was asked for the tenants to hear about their future effort based on the problems they found in the 3.11 Earthquake. Regarding disaster drills, they answered “repetitive execution of earthquake drills” and “practice of the registration to the safety confirmation system”. The answers about manuals included “action guidelines for the people remaining in the building”, “manuals for the employees on a business trip”. Some additionally mentioned that they wanted “guidelines for the participation to regional disaster prevention activities” to be considered. Regarding stockpiles, they felt the necessity “to increase the variety” as well as “to thoroughly inform the people of the storage locations”. Other efforts they found needed were “the introduction of satellite telephone to contact remote areas” and “knowledge of disaster message phone service”.

4. EFFORT FOR IMPROVING REGIONAL DISASTER PREVENTION ABILITY

In order for a community to improve the ability to prevent disasters, both “self-help” effort and “mutual assistance” effort are required. While each business entity needs to help itself to improve the ability, community collaboration with other businesses in the same area is also necessary. This paper makes a preposition for the future improvement in light of the result of the questionnaire and based on the lessons learned from the 3.11 Earthquake. It should also be noted that in the Shinjuku West area, the impact of the 3.11 Earthquake to the lifeline utilities, for example large-scale blackouts, and the damage to the buildings themselves and the major facilities were limited.

4.1 Effort by self-help approach

(1) Effort of management company

Building management companies should minimize confusion of the tenants and the users of the building. For this, confirmation of what is happening in and around the building as well as appropriate provision of information to the people inside should be most prioritized. It is also desirable that the building accepts stranded people based on local circumstances and if only it has enough capacity.

① In-building collaboration to prepare for earthquake

This questionnaire revealed that the building management companies and the tenants conducted different activities including decision of evacuation. In general, the disaster control center of a building management company is run by several staffs and what could be done by the management company during a large-scale earthquake is quite limited. It is therefore necessary for them even in peacetime to collaboratively work with the tenants and relevant government offices on activities for the time of an earthquake. A cooperative relation is required to secure means of communication and provision of information and to clarify their respective roles and responsibilities in disaster countermeasures activities.

② Formation and operation of disaster control headquarters

Based on what happened in the area on the day of the 3.11 Earthquake, it would be necessary to form disaster control headquarters at the time of a disaster to cooperate with the tenants and the community. In the questionnaire, 4 buildings did not form headquarters during the Great East Japan Earthquake. It is also desirable to conduct earthquake drills in peacetime and check the viability of information sharing among the tenants and the community led by the disaster control headquarters of a building.

③ Installation of seismography

This paper indicates that collaborative behaviors by building management companies and the tenants will be effective in the future, and in order for them to do so, it is important that the building management companies understand the extent of damage in the building. However, the disaster control center of a high-rise building is located either in the basement or on the ground floor in general, making it difficult to understand what is happening in the building as earthquake shock can largely vary by floor. Installation of seismographs, just like fire alarm systems for fire protection, will enable the disaster control center to centrally monitor how people behave on the mid to higher floors and the information obtained can be provided appropriately across the building.

④ Measures for people unable to return home

At the occurrence of a large scale earthquake like the Great East Japan Earthquake, it is expected that a large number of people will be unable to go home. In order to minimize confusion in the community, it is desirable for each building in the area to provide appropriate information to stranded people and where possible, to accept people especially the elders or the injured who require assistance.

⑤ Implementation of in-building seismic countermeasures

In the 3.11 Earthquake, various damages were found both inside and outside of buildings mainly in non-structural components or the elevators. It is important to implement fall prevention measures for equipment and furniture more thoroughly. In particular, elevators are considered to require retrofitting in accordance with the latest guidelines in 2009.

(2) Effort of tenant

In the Shinjuku West Gate area, respective sky-scrapers, during office hours of weekdays, hold a few thousand people. The tenants are expected to primarily focus on ensuring the safety of the staff, and they should make it a general rule to prevent the people from leaving the office in order to avoid confusion in the community unless a fire breaks out.

① Thoroughgoing seismic countermeasures in the office

Furniture and equipment in the office need to be thoroughly fixed to prevent injuries and to secure enough space for the people to safely stay in the office. It is also desirable to prepare people who are able to engage in first aid activities in case someone suffers minor or moderate injuries.

② Thoroughgoing stand-by in the office

In order to prevent confusion in the area shortly after a large-scale earthquake, it is necessary for each tenant company to make it a general rule to make the people stay in the office until the situation is confirmed. For a thoroughgoing stand-by in the office, in addition to stockpiles which will be described later, the effort to secure means to obtain information on the safety of family becomes important. Additionally, if the air conditioning does not work in an air-tight high-rise building, evacuation to outside should be assumed to occur depending on weather conditions.

③ Review of stockpiles

To ensure people stay inside the office, even when utilities suffer epicentral earthquake damages, in addition to water and food, protection against cold as well as portable toilets are needed on the assumption that air conditioning or water and sewerage may be unavailable, which was suggested in existing reports such as Shinjuku survival book¹⁴⁾. While the Great East Japan Earthquake occurred in March, it is important secure water for the people suffering heat disorders assuming a similar earthquake

occurs in summer.

4.2 Effort by mutual assistance approach

Public assistance is unlikely to be expected shortly after a large-scale earthquake, as the damage spread through a wide area. Self-help effort is therefore most important but additionally, beyond independent efforts by respective businesses, joint disaster prevention and mitigation effort made by various parties in the community based on the idea of mutual assistance is meaningful in order for the community to solve its common problems and to achieve a quick recovery as a whole. District-Wide Business Continuity Plan (DCP) is a concept of regional disaster prevention by a joint effort of businesses in a community that has been proposed in existing reports such as Nishikawa¹¹⁾.

Practical DCP approach has been taken in the Shinjuku West Gate Area, as has been reported by Kogakuin University¹²⁾¹³⁾. For a further promotion of disaster prevention and mitigation activities, based on the lessons learned from the 3.11 Earthquake, the following efforts are proposed.

① Information sharing through community collaboration

During the Great East Japan Earthquake, information gathering across a wide area did not face a big problem as infrastructural damage was quite limited. However, if an epicentral earthquake causes a power outage, information gathering will become more difficult. An effort to share area specific information in the community is needed to understand what is happening there and to provide the information to stranded people. Prior to the 3.11 Earthquake, the Shinjuku West Gate area had formed the regional headquarters to collect, organize, and share local information. During the 3.11 Earthquake, however, no one gathered in the headquarters and the mechanism did not practically work. For a viable information sharing mechanism centered on regional headquarters, it should get set up by a minimum number of people. Also, it should establish an information sharing network (Fig.26) together with the disaster control centers of the buildings and the offices in the community to work cooperatively and share the above mentioned respective problems.

In the future, a permanent “regional disaster control center” run by the dedicated staff will need to be established. The center will engage in educational activities and conduct periodic drills for community disaster prevention at peacetime and have a mechanism to play a central role as regional headquarters in performing disaster control activities of community alliance in the event of an emergency. However, there are some legal issues yet to be solved to let the regional disaster control center lead the disaster control activities. A decision-making power needs to be transferred to the center, and the responsibility and indemnity in relation to the activities need to be considered.

Fig.26 Image of community collaboration centered on the Shinjuku West Gate regional headquarters

② Safety confirmation of building by community collaboration

It is indispensable to confirm the safety of the building to let the company employees stay for a long time and to accept people remaining in the neighborhood. The precise degree of damage in a building needs to be appraised by the specialists such as architects, who should be sourced within the community. The number of such specialists is often limited, and therefore the businesses in the area need to make an effort to send volunteers who support them.

③ Establishment of the concept for behaviors on earthquake occurrence based on information sharing in community

This questionnaire found that the tenants decided in their sole discretion to evacuate despite the fact that the management companies had not instructed them to do so. Shortly after an earthquake in which there is no fire, if people start to evacuate immoderately, not only confusion is caused but also evacuees' safety could be risked. The above mentioned problem could have been avoided if information collected by the management companies had been appropriately provided to the tenants companies. In the future, it will be necessary to establish a system to share the safety information of the building across the tenants. Also, either by building or by area, each tenant is required to share the same concept of how to behave, which include evacuation, in an earthquake.

④ Disaster drills by community collaboration

Continuous execution of earthquake drills through community collaboration is indispensable as they are the venue where the efforts for disaster prevention/mitigation through both self-effort and mutual assistance approaches are practiced and evaluated. Necessary knowledge of earthquake countermeasures needs to be shared and the businesses in the area should come together to continuously promote a system under which the activities related to the strategies of regional disaster prevention based on the result of drills are reviewed.

5. CONCLUSION

It was fortunate that the Great East Japan Earthquake did not cause severe damage to the Shinjuku West Gate area. It is expected that the lessons learned are fully utilized and the efforts to prepare for epicentral earthquakes is further advanced through the leadership of the Disaster Prevention Countermeasure Conference for Shinjuku Station Areas. Shinjuku New Urban Center, which has played a pivotal role in Japan's economic activities since 1970s, is now facing a big turning point. It aims to be a safe and secure but vigorously attractive city by upgrading earthquake prevention efforts of the Shinjuku West Gate area to a wider area management in the future through which various approaches of community collaboration are practiced.

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APPENDIX

Table 8 Questionnaire for building management companies

Questions		Descriptions
Basic information	1. Building Outline	• Building name, year of completion, company name, scale (above grade/below grade), amount of total floor area, no. of tenants, construction, vibration control mechanism, building management (daytime/nighttime)
Initial responses in the 3.11 Earthquake	2. Damage found in the building on the day of the 3.11 Earthquake	(1) infrastructure (2) elevators (3) inside (4) outer walls (5) others
	3. Formation of Disaster Control Headquarters	• When, where, what activities, decision making division
	4. Actions taken on the occurrence of the 3.11 Earthquake	(1) Information gathering on the day (2) Handling on the day (understanding of injured people and damage, tenants' overnight stay, contents of internal announcements) (3) Handling from the following day onward (4) Problems and reflection points regarding handling of the 3.11 Earthquake
	5. Behaviors and actions in the disaster defense plan	• Items achieved according to plan and reason of failure
	6. Decision of evacuation from the building	• Reason for not issuing an evacuation directive, timing and place directed and the reasons
Handling of people unable to return home	7. Provision of information to stranded people in and around the building	(1) Means to inform stranded people of situation (2) Contents of info provided
	8. Acceptance of stranded commuters	• Request from Tokyo Met. Gov., reply to the request, no. of people accepted, impact of receiving people, material assistance to the people
	9. Overnight stay in common areas	(1) Did someone stay overnight in the common areas of your building? (2) For buildings with accommodation (hotel), were the guest rooms offered? If so, no. of the rooms used and no. of the people stayed
company effort and future countermeasure	10. Past seismic countermeasures	• Past seismic countermeasures
	11. Future effort	• Review of future countermeasures (plan to start review, structure/items to be reviewed, prospect of timing of drawing a conclusion)
	12. Comments and others	• Others: opinions, questions, items you think necessary to be discussed by Council and jointly worked out by community, requests to public administration

Table 9 Questionnaire for tenants

Questions		Descriptions
Basic information	1. Company outline	• Company name, capital, total no. of employees, office name, tenant floor, no. of enrollment, no. of people in the office on the day (no. of visitor)
Initial responses in the 3.11 Earthquake	2. Damage found in the office	(1) infrastructure (2) inside (3) other damage found
	3. Safety confirmation of the employees	• When, what, target and completion date and time
	4. Decision of evacuation of the employees	• Reason for not issuing an evacuation directive, timing and place directed and the reasons
	5. Decision of returning home	• Policy and the reason
Handling of people unable to return home	6. Overnight stay in the office	• If yes, no. of them and means to secure blankets and food

Questions		Descriptions
Company effort	7. Past seismic countermeasures	• Earthquake countermeasures taken prior to the 3.11 Earthquake (contents of disaster drills, availability of manuals, contents of stockpile, etc.)
Initial responses in the 3.11 Earthquake	8. Behaviors and actions taken in the context of disaster defense plan	• Items achieved according to plan and reason of failure
	9. Formation of Disaster Control Headquarters	• When, where and what activities
	10. Information collection activity	• Provision of information on area around office
	11. Means of provision of information to the employees	(1) Employees in the office (2) Employees out of office (3) Contents of info. Provided to employees in and out of office
company effort and future countermeasure	12. Problems and reflection points found during the 3.11 Earthquake	• Problems and reflection points found regarding past effort and handling of your company during the 3.11 Earthquake
	13. Future effort	• Review of future countermeasures (plan to start review, structure/items to be reviewed, prospect of timing of drawing a conclusion)
	14. Comments and others	• Others: opinions, questions, items you think necessary to be discussed by Council and jointly worked out by community, requests to public administration

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