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AN EXHAUSTIVE SURVEY FOR RENOVATING FACILITIES IN DENSELY BUILT-UP WOODEN HOUSE AREAS

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We report the progress of our research on buildings and their surroundings for disaster prevention in Chuo-3, Ota City, one of the areas in Tokyo, Japan that is Densely Built-up Wooden House Areas in Tokyo, Japan. We conducted an exhaustive survey of 383 buildings and roads in the northwest area of Chuo-3. The buildings and their surroundings were considered. Next, we conducted microtremor measurements on the ground in the area. The major findings of the investigation are summarized as follows. (a) Over 80% of the buildings are detached houses, and some have billboard architectures. Slate and pantile are used as the roofing material for all the buildings. (b) The buildings are densely packed. Some adjoin the frontal road with a separation of 2 m or less. (c) According to the mictotremor measurement of the ground, the H/V spectrum changed gradually from the west to the east.

Keywords: Statistics, Wall-face material, Billboard architecture, Narrow road, Microtremor measurement, H/V spectrum.

1 INTRODUCTION

The seismic retrofitting of old constructions is important in earthquake-prone countries. There are areas in Tokyo, Japan with Densely Built-up Wooden House Areas in Tokyo, Japan. These regions face the serious task of building seismic resistance and/or fireproof properties in the buildings in the entire area (Bureau 2012). Thus, studies related to ensuring the soundness and stability of the city and its buildings, are necessary, not only for disaster prevention but also for urban planning and community revitalization.

In this study, we targeted Ota City, Tokyo (see Figure 1), aiming to building renovating facilities. In the initial stage of the study, we conducted an exhaustive survey of 383 buildings and roads in the northwest area of Chuo-3, Ota City. We considered the structure classification, number of stories, building use, fence, underfloor ventilation opening, base, wall, roof shape, material, distance between buildings, distance from the frontal road, etc. Next, we conducted microtremor measurements on the ground at several points in the area of study.

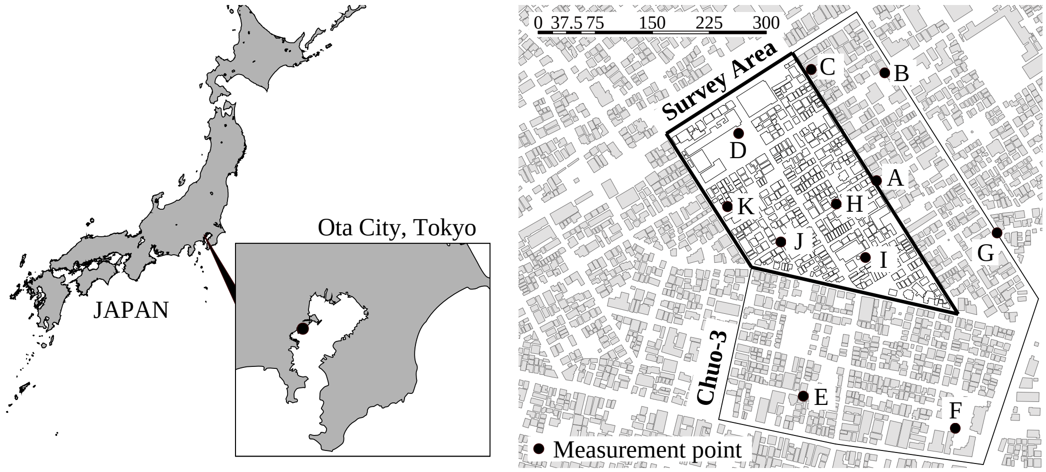


Figure 1. Location of Ota City.

Table 1. Items for visual investigation.

Categories	Contents	Items
Basic Information	Type	Detached house, Apartment house, others
	Story	One-story, Two-story, others
	Use	House, Store, House combined with store
	Usages	Dwelling, Vacant house, others
Structure	Structure Classification	Wood, RC, S, Mixed, others, unknown
	Roof Form	Gable, Hipped, Gambrel, Pavilion, Pent, Flat, others, unknown
	Roofing Material	Pantile, *Hongawara*, Wave tile, Slate, Metal plate, Mixed, others, unknown
	Foundation	*Ishibadate*, Sill laying, Independent foundation, Continuous footing, others, unknown
	Underfloor Ventilation Opening	Yes, No
	Wall-Face Material	Spraying, Clay wall on bamboo lathing, Siding, Tiling, Stone pitching, others, unknown
	Mist Removal Eave of Opening	Yes, No
	Storm Door of Opening	Yes, No
	Billboard Architecture	Yes, No
Reconstruction	Reconstruction	Yes, No
	Part	Front, Back, Both sides of house
Surroundings	Direction of Entrance	North, South, East, West
	Width of Frontal Road	[mm]*
	Fence	Yes, No
	Sort of Fence	Wood, Mortal, others
	Size of Fence	Length [mm]*, Height [mm]*
Distance from House	to Frontal Road	[mm]*
	to Adjacent Building	Front, Back, Both sides of house [mm]*

*measurement

2 OUTLINE OF INVESTIGATION

2.1 Objective Area

Ota City is located in Tokyo Bay, and its earthquake-occurrence probability is relatively high. In Figure 1, Chuo-3 is surrounded by a thin line. In the Tokyo Bay area, the estimated probability of earthquakes with an intensity of a lower six on the Japanese seven-stage seismic scale is high. The estimated probability in Chuo-3 at 73.8% is also high (Ota 2015, National 2015). Furthermore, Ota City suffered from the Great Kanto earthquake (M7.9) in 1923.

We targeted the northwest area of Chuo-3, marked by a bold line in Figure 1.

2.2 Exhaustive Survey

We conducted an exhaustive survey of 383 buildings and roads in the aforementioned area. The items listed in Table 1 were investigated by visually for each building. They are classified into five categories: basic information, structure, reconstruction, surroundings, and density, i.e., measurement distances from all quarters to the house. For some buildings, we chose plural items.

2.3 Microtremor Measurement on Ground

We conducted microtremor measurements of the ground to clarify the surface conditions. The measurement was performed at several points on the free ground in the area of study. In Figure 1, measurement points A to K are shown in a topographical map.

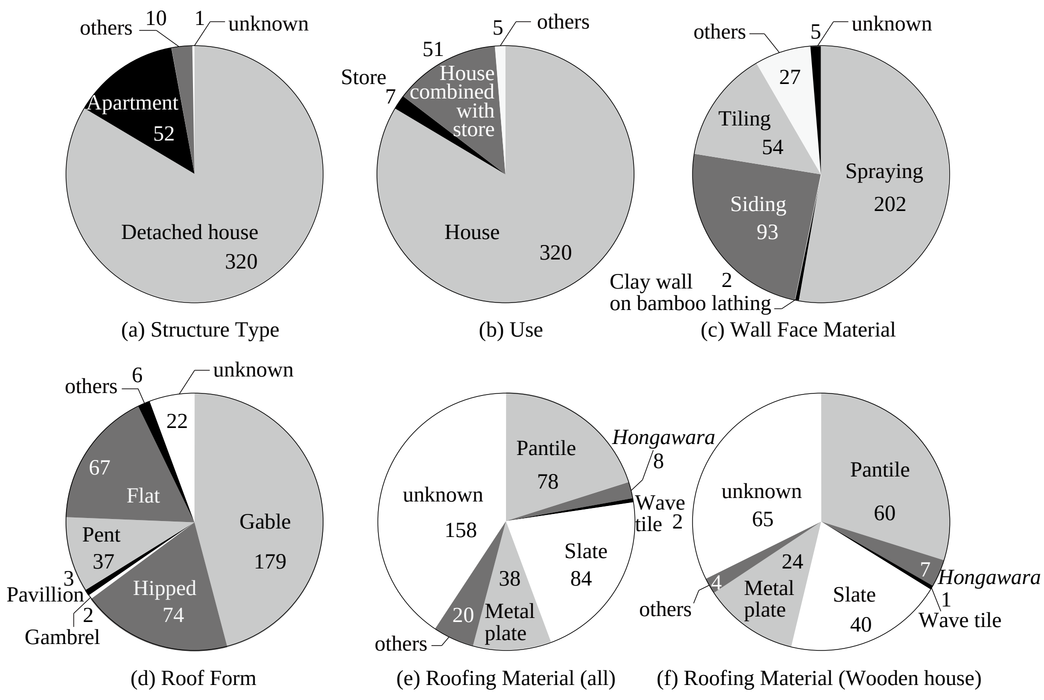


Figure 2. Statistical data for structures.

(a) Vacant house (b) Billboard architecture (c) Narrow road

Figure 3. Statistical data for structures.

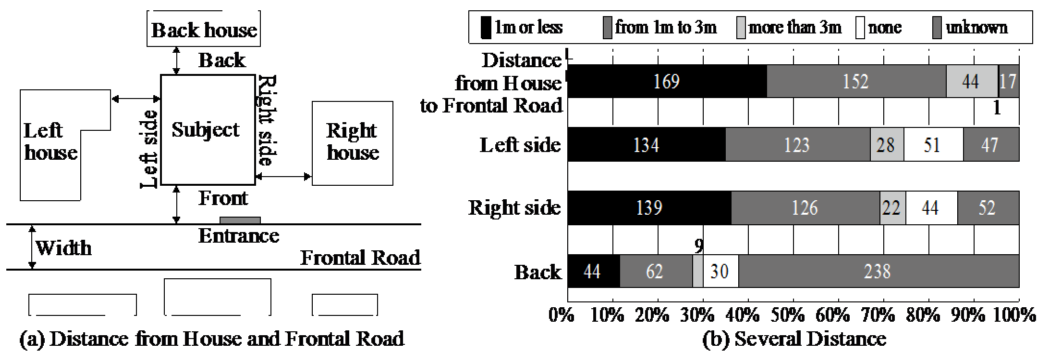


Figure 4. Measured distance around house.

3 RESULT OF INVESTIGATION

We investigated 383 buildings and roads in the northwest area of Chuo-3 on July 6 and July 13, 2014. The results of our exhaustive survey are shown in Figures 2 to 5, and the results of the microtremor measurements on the ground are shown in Figure 6.

3.1 Exhaustive Survey

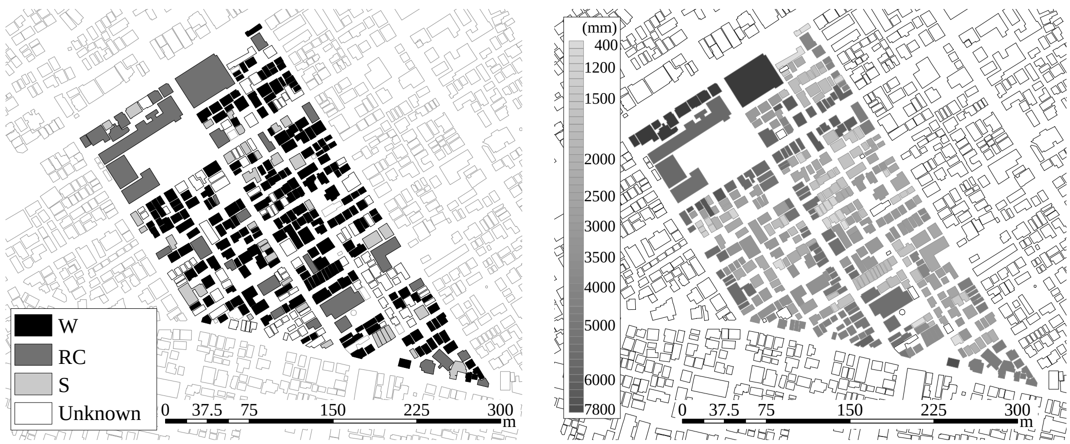
We classified the statistical data for the structures as shown in Figure 2. Of the buildings, over 80% were detached houses (see Figure 2(a)); 320 were used as houses, and 51 were used as both a house and a store (see Figure 2(b)). There were six vacant houses (Figure 3(a) shows an example; it is covered with ivy).

The wall-face material of over half the building was splaying, and that of approximately a quarter of the building was siding (see Figure 2(c)). There were 16 billboard architectures, i.e., wooden houses with a mortar wall only in the front (see Figure 3(a) for an example). As shown in Figure 5(a), buildings with various structure classifications are interspersed.

Nearly half of the buildings had gable roof; others had a hipped, flat, or pent roof (see Figure 2(d)). Slate and pantile were observed in the roofing material for all buildings, and in case of only wooden houses, it is the almost same ratio (see Figures 2(e) and (f)).

The distances to all quarters of the house were defined as shown in Figure 4(a), and the measurement results are shown in Figure 4(b). Nearly half of the buildings are located 1 m or less from the frontal road. The contour of the distance from the frontal road is shown in Figure 5(b). In the area divided into geographic sections, we found that the buildings were densely packed.

The distances between adjacent buildings were extremely small. Regarding the width of the frontal road, we found that 79 buildings adjoined the road with a separation of 2 m or less (see Figure 3(c) for an example).



(a) Structure Classification (b) Distance from house to Frontal Road

Figure 5. Structure classification and contour of distance from frontal road.

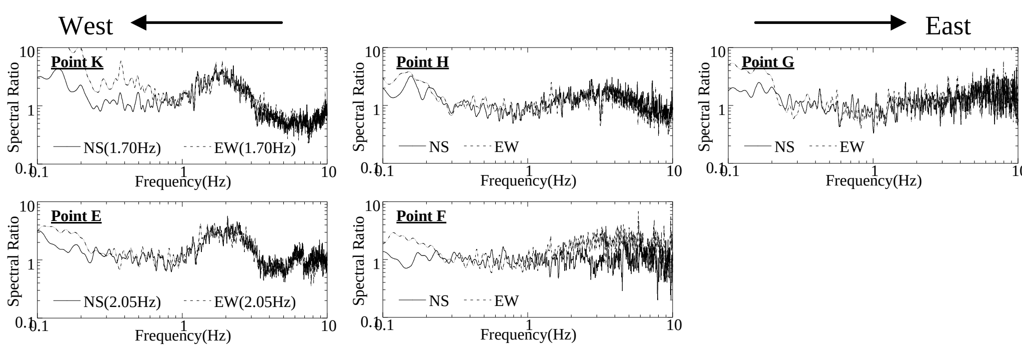


Figure 6. H/V spectra for microtremor measurements on ground.

3.2 H/V Spectra on Ground

Several velocimeters that can measure one vertical component and two horizontal components were used. Figure 6 shows the resultant H/V spectra for the NS and EW directions at points E, F, G, H, and K, which are ordered from the west to the east.

In the west, at points K and E, the natural frequencies are 1.70 and 2.05 Hz, respectively, for both directions. Thus, the peak value can be determined for the west side. On the other hand, the peak value gradually disappears toward the east.

4 CONCLUSION

We conducted an exhaustive survey of 383 buildings and roads in the northwest area of Chuo-3, Ota City, Tokyo, Japan. Information including the structural classification and characteristics of the buildings and the buildings' surroundings was collected. We also conducted microtremor measurements on the ground in the area.

Our findings are summarized as follows:

(1) Over 80% of the buildings were detached houses and were used as houses. There were six vacant houses. For over half of the buildings, the wall-face material was splaying, and for approximately a quarter of the buildings, it was siding. Moreover, there were 16 billboard architectures. Slate and pantile were used in the roofing material for all the buildings.

(2) Nearly half of the buildings were at 1 m or less from the frontal road. The buildings in the area divided into geographic sections were densely packed. A total of 79 buildings adjoined the frontal road with a separation of 2 m or less.

(3) According to the mictotremor measurements on the ground, the H/V spectrum changed gradually from the west to the east. The peak of the natural frequencies can be specifically determined in the west side, but the peak value gradually disappears toward the east.

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