Re-examination on total collapse ratio of wooden houses during the 1923 Kanto earthquake

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During the 1923 Kanto Earthquake (September 1, 1923, MJ8.1), many buildings had been damaged in a wide area mainly in the Tokyo metropolitan area. In Moroi and Takemura (2002), the seismic intensity distribution of the Kanto Earthquake was estimated by means of the total collapse ratio and half-collapse ratio of wooden houses using data from Matsuzawa (1925) (Figure 1). In addition, according to studies by Midorikawa et al. (2001a,2001b,2003,2004,2005), the total collapse rate of wooden houses (TCR below) in units of municipalities is estimated based on earthquake reports such as the Kanagawa prefectural agricultural association report (1925), the Kanagawa prefectural earthquake disaster report (1927) and the Yokohama city earthquake disaster report (1926). Comparing their TCRs, there was some consistency with each other, but there were some regions where TCR was somewhat different. Therefore, TCR during the Kanto Earthquake was re-examined retroactively from their references in both studies. As a result, it was confirmed that TCR calculated from the building damage investigation report, which was referred to in both studies, was almost consistent with the exception of areas where fires, run-off, landslides etc. were almost common. For this reason, Moroi and Takemura (2002) are used for TCR except in Kanagawa Prefecture. However, TCR in Moroi and Takemura (2002) is the value for the entire district, village, town and city, therefore, its value maybe represent with relatively rigid ground and few residences, such as mountains and plateaus in each municipality. Consequently, TCR is dealt with the value at the point where many dwellings were located in the city areas and residential densely populated areas. TCR in Kanagawa Prefecture is based on data in a small section of the village by Midorikawa et al. (2001a, 2001b, 2003, 2004, 2005). Figure2 shows the distribution of TCR. Next, in order to estimate JMA seismic intensity of the Kanto Earthquake from TCR described above, the fragility curve for TCR must be chosen. Miyakoshi et al. (2000) shows the fragility curve that converted the horizontal axis of the fragility curve for tombstone falling intensity and TCR from the tombstone falling intensity to the peak ground acceleration (PGA) for each earthquake occurred before the 1952 Tokachi-oki Earthquake. In this study, the horizontal axis was converted to PGA by the same processes, and moreover, PGA had been converted to JMA seismic intensity by Fujimoto and Midorikawa (2005). When the fragility curves for TCR that converted from the tombstone falling intensity to JMA seismic intensity due to the past earthquakes have been compiled, it is most suitable for TCR at the time of the Kanto Earthquake is the fragility curve before 1951 for the 1995 southern Hyogo Earthquake in Yamaguchi and Yamazaki (2000) (Fig. 3). This fragility curve is used to estimate JMA seismic intensity distribution from TCR in the Kanto Earthquake. JMA seismic intensity distribution of the Kanto Earthquake (Figure 4) estimated from this study is slightly less in areas with a seismic intensity of 7 and 6 plus than that of the seismic intensity distribution (Figure 1 and Figure 2) of Mori and Takemura (2002). In particular, in Mori and Takemura (2002), the eastern area of Saitama Prefecture had become JMA seismic intensity of 7 and 6 plus, but in this study the intensity ranged from 6 minus to 5 plus. In Moroi and Takemura (2002), JMA seismic intensity shows 7 when TCR become more than 30%, in the range of when TCR from 10% to 30%, JMA seismic intensity become 6 plus. On the other hand, the fragility curve in this study is shown in Figure 3, the area with JMA seismic intensity of 7 and 6 plus has become less than that of Moroi and Takemura (2002), and these areas with JMA seismic intensity of 6 minus and 5 plus had remained almost the same as Moroi and Takemura (2002). It can be seen that the seismic intensity of the Kanto Earthquake was simulated accurately.

Keywords: Kanto earthquake, Total collapse ratio of wooden houses, Damaged buildings, Estimation of seismic intensity

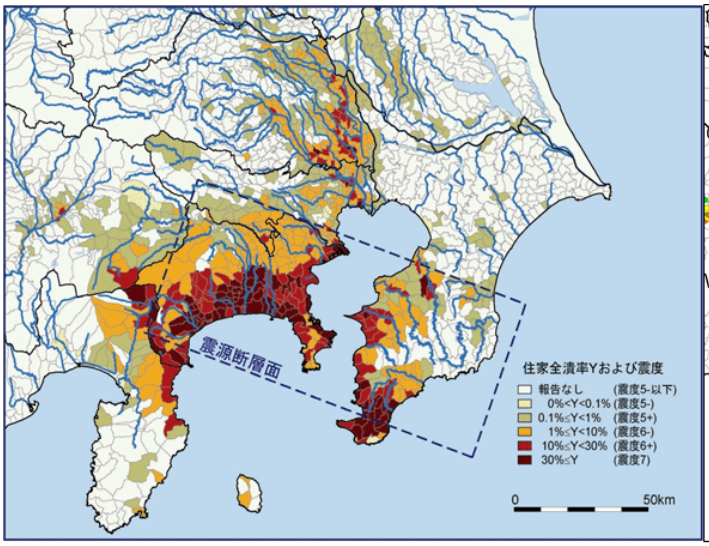

図1 大正関東地震における市区町村の住家全潰率（諸井・武村、2002）

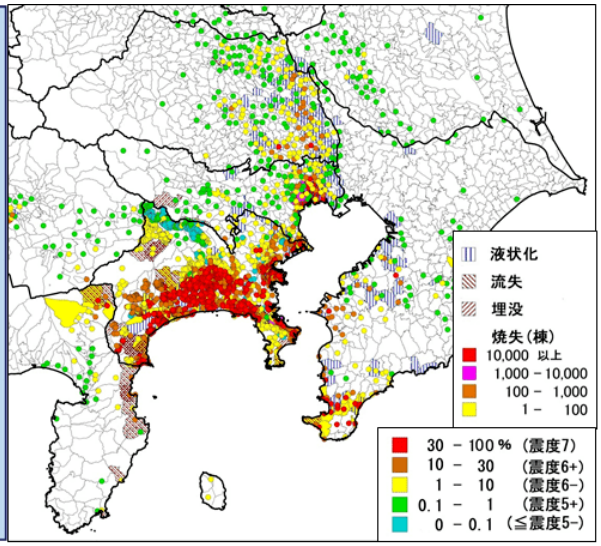

図2 焼失・流失・埋没被害(諸井・武村、2002)および液状化(若松、2011)の分布

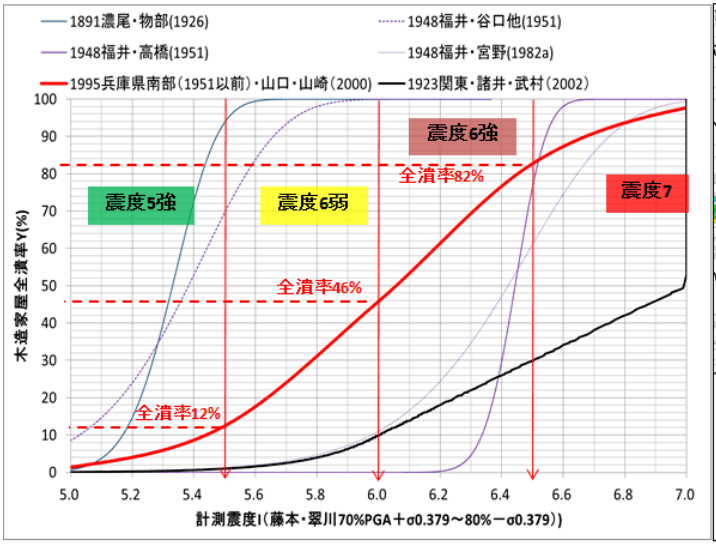

図3 選定した関東地震の木造家屋全潰率の被害率曲線（赤：山口・山崎（2000））

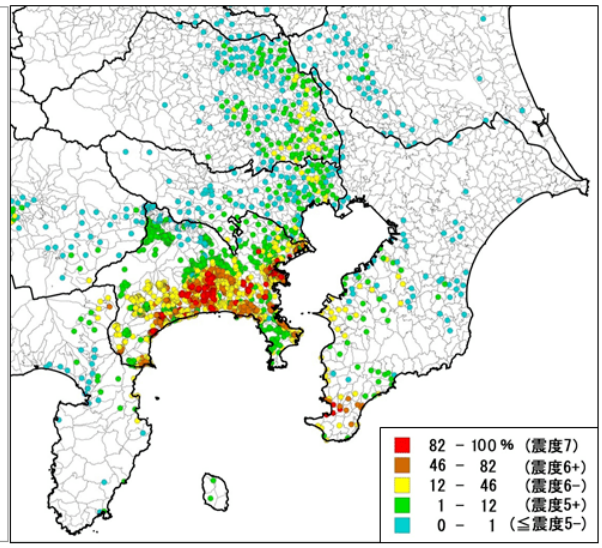

図4 液状化(若松、2011)および焼失・埋没・流失(諸井・武村、2002)の被害市区町村を除いた住家全潰率[1951年以前](山口・山崎、2000)

