Initiative to Achieve Effective City Fire Prevention Performance in Districts

(Period of Study: From FY 2014 to FY 2016)

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1. Introduction

Various fire control measures have been implemented in Japan. In recent years, local governments have especially focused on organizing densely built-up areas with high fire risks (see Photo 1). Macro indicators of fire risk, such as the fireproof area rate and the fire resistive area ratio, are generally used to identify densely built-up areas with high fire risks. However, it is not possible to evaluate by macro indicators the fire prevention performance that takes into consideration the placement of buildings and their area characteristics. Therefore, even if improvements have been made to densely built-up areas with particularly high fire risk within a district, there may be cases where they cannot be fully reflected as a substantive improvement in the district's total fire prevention performance.

Thus, we at the National Institute for Land and Infrastructure Management (NILIM) have been engaged in the development of methods to evaluate the effects of improvements in fire prevention performance that cannot be measured by macro indicators by using a city fire simulator. In this paper, we would like to present the current status of our study.

2. Selection of Representative Districts and Calculation of Fireproof area rate

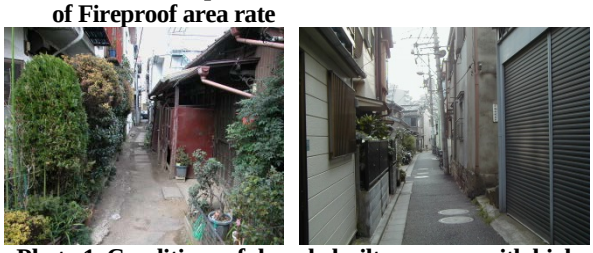

Photo 1. Conditions of densely built-up areas with high fire risks

From densely built-up areas with high fire risks in the Tokyo metropolitan area, we selected one representative district each from the following three types of districts by using the risk of spreading fire and difficulty of safety evacuation and firefighting as evaluation criteria: (A) districts where safety both in terms of fire prevention and safety evacuation requires improvement, (B) districts where safety primarily in terms of fire prevention requires improvement and (C) districts where safety primarily in terms of safety evacuation requires improvement. For these three representative districts, we developed GIS data necessary for the calculation of fire prevention performance, and then calculated the current rates of fireproof area rate and fire resistive area ratio by using these GIS data.

3. Evaluation of current conditions of fire spread by using a city fire simulator

We calculated the conditions of fire spread when a fire breaks out from one location in each of the three representative districts, by developing three-dimensional urban data for each of the buildings in the districts and using a city fire simulator that calculates the conditions of spreading of fire from the start of fire. In the case of representative district C, when calculating the conditions of spreading fire based on the assumption that a fire breaks out from a building at the southern end of the district with the speed of a south wind at 12 m/s, it follows that 22 houses would be burned to the ground one hour after the start of fire, 60 houses two hours after, and 123 houses three hours after. Thus, it has been confirmed that, with the lapse of time after the start of fire, the speed of a spreading fire tends to become faster (Figure 1).

4. Next Step

Based on the results of the simulation, etc., we will select a densely built-up area with a particularly high fire risk within each district and then confirm the effects of improvements in the district's total fire prevention performance, such as an increase in the fireproof area ratio and a reduction in the number of houses, buildings, etc., damaged or destroyed by fire, if we implement fire prevention measures, such as expanding the width of roads and enhancing the fire prevention performance of buildings concentrated in such densely built-up areas with high fire risks. Based on these results, we will develop a method for diagnosing the improvement effects of fire prevention measures in densely built-up areas and will provide technical assistance to local governments by using the method.

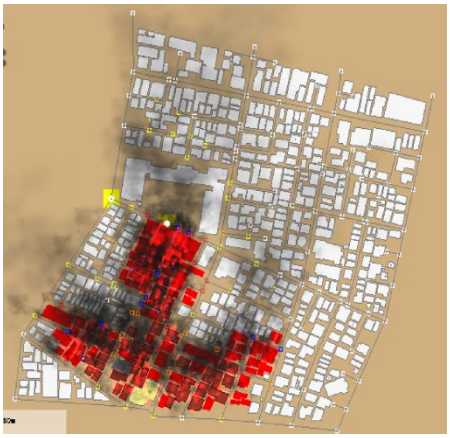

Figure 1. Conditions of spreading fire three hours after the start of fire in representative district C (Prepared using fundamental geospatial data published by the Geospatial Information Authority of Japan)