Development of Falling Exterior Wall Hazard Visualization Tool for Buildings

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1. Foreword

Based on the results of a hammer sounding inspection of exterior walls included in periodic reports as required in the Building Standards Act, among other things, we studied techniques to visualize, on street view images, areas where falling exterior walls could cause damage or injuries with the aim of ensuring the safety of pedestrians against the falling external walls of a building. These techniques, when developed, are intended to be utilized for giving guidance to owners and managers of buildings.

To be more specific, we newly developed the Falling Exterior Wall Hazard Visualization Tool, a function for evaluating the level of safety against falling exterior walls, etc., in everyday life or during a disaster, which was added to the landscape simulator (a free software package developed by the Ministry of Land, Infrastructure, Transport and Tourism).

In addition, we conducted a case study utilizing this visualization tool in collaboration with working-level representatives of local governments and condominium management companies and examined its operability and whether any improvements needed to be made to its visualization method.

2. Overview of Falling Exterior Wall Hazard Visualization Tool

An operational flow of this visualization tool is shown as follows:

(1) Prepare three-dimensional (3D) data of buildings and street views

Prepare the 3D data of the exterior wall surfaces of a building by utilizing computer-aided design (CAD) data of the building and point group data obtained by a moving object measuring vehicle, among other things, and understand the spatial configuration of the exterior wall surfaces and under-roof areas of the building.

(2) Display data on diagnosis results of hazard from exfoliation of exterior walls

Identify the sections of exterior walls where wall exfoliation hazards may exist, through diagnosis and measurements by using a sounding inspection device and an infrared ray sensor. Display them in the form of texture data that show the surface distribution of risk sources per each wall surface (Figure 1).

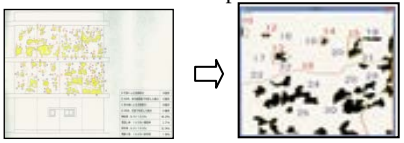


Fig. 1 Example of showing, in the form of texture data, sections of exterior walls where wall exfoliation hazards may exist as described in exterior wall investigation reports

(3) Prepare building data together with hazard risk information

Sterically dispose of the sections of exterior walls where wall exfoliation hazards may exist as displayed in the form of texture data, on the exterior wall surfaces of the building (Figure 2).

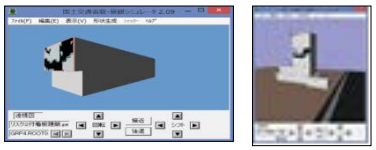


Fig 2. Example of displaying, on the exterior wall of a building, sections where wall exfoliation hazards may exist (black out sections are sections where wall exfoliation hazards may exist)

(4) Prepare 3D image of hazard risks

Sterically analyze the extent of influence that all hazardous sections of a building or a group of buildings may have over the surrounding spaces (Figure 3).

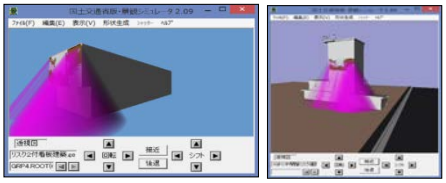
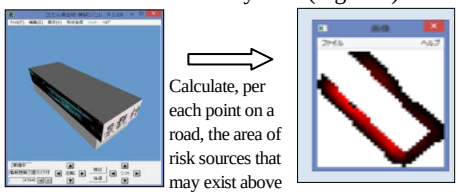


Fig. 3 Example of displaying areas where falling exterior walls could cause damage or injuries

(5) Analyze extent of influence over ground surface

Output GIS data that can be used for automatic hazard avoidance, etc., by calculating the hazardous areas of road where wall exfoliation hazards may exist (Figure 4).



Calculate, per each point on a road, the area of risk sources that may exist above

Fig. 4 Example of displaying areas of road where falling wall hazards may exist

(6) On site verification

Superimpose the computer graphics (CG) image of hazard risks over the actual images of the hazardous areas on a display screen of a mobile terminal (Figure 5).

Fig. 5 Example of superimposed image displayed on the screen of a mobile terminal

3. Major challenges requiring improvement that have been identified through the case study

(1) From the standpoint of efficiency improvement and cost reduction, in addition to the diagnosis and measurement of hazardous areas where wall exfoliation hazards may exist, it is necessary to develop a technique that enables the preparation of 3D data of building wall surfaces and the steric disposition of data of such hazardous areas at the same time.

(2) It is necessary to put up a roadside display showing the impact of falling exterior walls, including not only the extent and frequency of wall exfoliation hazards but also the impact strength of a fallen wall if a wall exfoliates and falls.

(3) As the number of buildings for which periodic reporting is required is limited, in order to enhance the safety of continuous road spaces, it is necessary to conduct a complete diagnosis and investigation of exterior walls by designating roads, such as emergency transportation routes and evacuation routes.

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http://www.nilim.go.jp/la/ieg/index.htm