Construction standards and promulgation technologies that can respond to needs of the society

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1. Introduction

The Building Department is working to respond to the various needs of citizens and society, which are in constant change with the movement of the world, and to realize a more reliable, safe, comfortable, and attractive architectural environment. Specific activities include preparing drafts for the establishment and revision of technical standards, including the Building Standards Act, based on scientific and technical knowledge. Other activities include field investigations at disaster-hit areas and the exploration of measures to take in the future, application and spread of investigation and research outcomes to society, and the provision of technical support for organizations inside and outside of Japan.

This paper introduces researches that the Building Department is now implementing or planning and their directions by keeping in mind recent hot topics, such as regional revitalization, environmental problems, urban redevelopment, and robustness improvement. This paper also discusses the direction of examining measures to respond to damage caused by massive typhoons (protective measures against strong winds) because massive typhoons have been occurring at a high frequency over the past few years.

2. Responses to regional revitalization and environmental problems

In 2015, the Basic Policy on Regional Empowerment for Japan's Growth was approved by the Cabinet of Japan. The basic policy aimed to accelerate regional revitalization, respond to environmental problems, and create spaces in which woods were used. To achieve these objectives, it promoted the development and the use of cross-laminated timber (CLT: thick wood panels created by layering and bonding wooden boards in alternating directions) to increase the number of wooden buildings, including the construction of wooden public buildings. A general technology development project, Development of Technologies to Install and Construct Mixed-Structure Architecture Using New Wooden Materials (2017–2021), is now underway to effectively use wooden materials, provide versatility in architecture, shorten construction periods, and realize various requests, such as responding to various needs to utilize the designability of wooden materials.

Here, a new architectural space is created by using CLT, large-scale wooden panels, and other wooden materials as structural members and combining them with RC structures and steel structures. In particular, creating a space where wooden materials are visible on the surface of the interior used to be difficult in mid-to-high-rise buildings. Yet, the project will present multipurpose design methods and bonding methods that can realize the necessary structural performance and durability by actively using the newly revised fire safety and evacuation regulations. These will be organized as three types of prototype architectural design examples, which are to be spread as general technologies (Figure).

Figure: A prototype building under consideration

3. Responses to urban redevelopment and robustness improvement

Cities in Japan are expected to be redeveloped into more compact and more robust ones. Fundamental technologies to smoothly meet these expectations are thus

essential.

The following two topics are going to be covered in the general technology development project that starts in FY 2020 titled the Development of Technologies to Contribute to the Redevelopment and Robustness Improvement of Cities Through the Rationalization of Structural Regulations Related to Architecture and the Ground (2020–2023): 1) what to do with already installed piles that pose challenges in renewing and redeveloping architecture in cities, and 2) the robustness improvement of deteriorating residential lands and retaining walls in hilly areas.

In 1), the project includes the development of methods to verify the structural safety of ways to reinforce installed piles and the ground and the methods of using newly installed piles along with already installed ones (different types of piles) as ways to reuse piles from past buildings that become obstacles upon renewing the structures. The developed methods are then going to be put into wide use. The project also includes the development of performance evaluation methods that take into account the ground properties that tend to become soft and loose when the ground soil is refilled after removing piles in cases where piles are removed. In 2), the project includes the development of technologies to diagnose and reinforce existing residential land and retaining walls to avoid deforming or collapsing deteriorated or damaged retaining walls and the ground of residential land due to earthquakes and, consequently, degrading the safety and utility of nearby traffic and houses standing there. In the end, by applying them in society, these developments will contribute to the redevelopment and improvement in the robustness of cities.

4. Responses to massive typhoons (protective measures against strong winds)

Typhoon #15 (Faxai) that hit Chiba in September 2019 caused serious damage to the outdoor materials of buildings, such as tiled roofs and wooden roof trusses. As the strong winds and rainwater invaded indoor spaces, damaged houses lost their functions as shelters. Restoration from the damage also required massive time and costs to restore the structures. According to the General Insurance Association of Japan, the annual amount of insurance payout for damage caused by strong winds and floods in recent years has been higher than the payout for earthquake damage.[1] Given the recent trend of extreme weather events, the improvement of the robustness of architecture against strong winds is considered a pressing issue.

Our on-site investigation of damage caused by Typhoon #15 (Faxai) found that significant damage was seen in window glass, roofing materials such as tiled roofs, wooden roof trusses, exterior finishes, outdoor fittings, eave soffits, and other parts of houses and low-rise retail stores.[2] Focusing on damage (photos) to roofing materials, wooden roof trusses, and outdoor fittings (large sash),

Scattering of roofing materials　　Damage to roof trusses

Outdoor fittings of stores
Damage and collapse of large sashes

Photo: Various building damage caused by strong winds

the NILIM is going to examine the following to reduce damage to them using the supplementary budget of 2019 and other funds. By doing so, the NILIM is going to propose testing and evaluation methods and their specifications to improve performance against strong winds and spread the technologies by reflecting them in the guidelines used by the applicable industries.

1) Roofing material: Observed damage caused by factors that include roofing materials installation methods (mainly fitting and binding methods) and the causes of the damage are examined to select and establish recommended methods to be used widely. Also, the diagnosis and renovation methods used on currently installed roofing materials and the wind resistance performance ranking of roofing materials are examined to find ways to guide the industry to more robust roofing.

2) Roof trusses: Examples of the specification for roof trusses based on standard wind speed will be proposed by conducting stress experiments using test specimens that reflect the actual conditions of roof beams and roofing boards.

3) Large sashes: Stress tests and evaluation methods will be developed by identifying the actual strength at the joint sections between a large sash and the building frame to present recommended specifications.

☞For more information:

1) The General Insurance Association of Japan: Insurance payouts for natural disaster damage
https://www.sonpo.or.jp/report/statistics/disaster/index.html
(For example, the total fire insurance payout for the damage caused by the heavy rains in July, Typhoon #21, and Typhoon #24 in 2018 was 1,357.8 billion JPY in total. This was higher than the 1,283.3 billion JPY payout for the damage caused by the Great East Japan Earthquake in 2011—the largest insurance payout for earthquake damage.)

2) The National Institute for Land and Infrastructure Management - Building Research Institute: Report of on-site investigation of building damage caused by the strong winds of Typhoon #15 (Faxai) in 2019, October 24, 2019
http://www.nilim.go.jp/lab/bbg/saigai/R1/taihu15.pdf