Respond to social demands by mobilizing knowledge, experience, and wisdom

FUKUYAMA Hiroshi (Ph.D. in Engineering), Director of Building Department

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1. Introduction

The world is constantly progressing and changing, and the social needs for buildings are changing along with it. With this in mind, the Building Department is working to realize a safer, more secure, more comfortable, and more attractive building environment. Examples of 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 are to apply and disseminate investigation and research outcomes to society, such as by conducting field investigations in disaster-hit areas, the study of future countermeasures, and the preparation of technical manuals for practical use and to provide technical support to organizations inside and outside of Japan.

In these activities, efforts are being made to collaborate with as many people as possible and gather their knowledge, experience, and wisdom in order to reflect the best and greatest results to society. Examinations are also being conducted together on the state of technology, standards, and systems so that Japan's technological capabilities can be further enhanced, they can be applied in society without fail, and Japan can become a more vibrant country. This paper introduces some of these activities using examples of the department's recent activities.

2. General Technological Development Project on Wood-Mixed Structure

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 wood was used. To achieve these objectives, it promoted the development and the use of cross-laminated timber (CLT) to increase the number of wooden buildings, including the construction of wooden public buildings. A General Technology Development Project on the development of technologies to install and construct mixed-structure architectures using new wooden materials (2017-2021) (shortened name: General Technology Development Projects on Wood-Mixed Structures) is now underway to effectively use wooden materials that fix carbon dioxide, provide versatility in architecture, shorten construction periods, and respond to the need to utilize the designability of wooden materials, and to utilize them to satisfy various demands such as regional revitalization.

Here, a new architectural space is being created with CLT, a large wooden panel, and other wooden materials as structural members and combining them with RC structures and steel structures. In particular, creating a space where wooden structural members are visible on the surface of the interior used to be difficult in mid-to-high-rise buildings. Yet, the project will conduct examinations based on various experiments and then present multipurpose design methods and bonding methods that can achieve the necessary structural performance, durability, and sound insulation performance by actively using the fire safety and evacuation regulations revised in 2018. The results of the study are compiled as design examples of several prototype buildings and are now being studied for dissemination as a general technology (Figure).

The purpose of this project is to present a general-purpose technology that can be used by many private companies and to establish it as a new general technology in the world so that it can respond quickly to social needs. Future expectations are that companies and universities with technological capabilities will use the technology as a basis for developing and implementing more advanced technologies, thereby increasing the technological capabilities of the entire Japan and meeting

the diverse needs of society.

A government building with a wooden structure installed within a large frame double-layer RC structure.

Figure: Design example of a building of wood mixed-structure

3. General Technological Development Project on Foundation and Ground

As a part of regional development, there is a need to redevelop cities into compact and strong cities, and basic technologies that can smoothly realize these goals are essential. The following two topics are covered in the General Technology Development Project that started in FY 2020 as 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 (May 2020) (shortened title: General Technological Development Project on Foundations and the Ground): what to do with already installed piles which pose challenges in renewing and redeveloping architectures in cities; and robustness improvement of deteriorating residential lands and retaining walls in hilly areas.

In the first topic, as a way to reuse piles from previous buildings, which is an obstacle when renewing buildings, a method is developed to verify the structural safety of the piles themselves and the ground reinforcement, as well as a method to use them together with newly installed piles (different types of piles) and put them into wide use. The project also covers the development of performance evaluation methods that take into account the ground properties that tend to become soft and loose when ground soil is refilled after removing piles in cases where they are removed. In the second topic, technologies are developed to diagnose and reinforce existing housing sites and retaining walls so that deteriorated or damaged retaining walls and housing sites will not be deformed or collapsed by earthquakes, interfering with traffic in the area and the safety and usability of the houses. In the end, by presenting and applying them to society, these developments will contribute to the redevelopment and robust improvement of cities.

This project is now in the process of establishing an all-Japan system in this field and exploring appropriate social applications of technologies that contribute to urban regeneration, such as the implementation of full-scale horizontal loading tests of piles reconstructed on the ground where piles were once removed, and large-scale horizontal loading tests of actual retaining walls as shown in Photo-1, conducted through the cooperation of the industry, academia, and the government.

Photo 1: Removal of existing piles in the experiment

4. General Technological Development Project on Suburban Housing

With regard to the revitalization of suburban cities, there is a need to revitalize suburban residential complexes to meet the needs of the future society. Thus, in the General Technological Development Project supervised by the Housing Department, which is titled, Development of Technology for Regeneration of Suburban Residential Areas for a Mature Society (2018 to 2022) (shortened title: General Technological Development Project on Suburban Housing), the department is currently developing technologies to sophisticate the durability evaluation technology needed to ensure continued use of buildings for many years and to ensure the necessary seismic performance for space expansion renovations that convert two housing units into one, with the cooperation of construction companies, specialized engineers, and academic experts.

5. Measures against strong winds for tiled roofs, wooden sheds, and front sashes

Typhoon Jebi (typhoon number 21) of 2018 and

Typhoon Faxai (typhoon number 15) 2019 (the typhoon landed on the Boso Peninsula) hit Japan in quick succession, causing extensive damage to the exterior materials of buildings, including tiled roofs, and to wooden structures. Strong winds and rainwater penetrated the interior, causing the loss of functionality of the house, which required a great deal of money and time to restore. Given the recent trend of increasing extreme weather events, improving the wind resistance of buildings is considered an urgent issue.

The NILIM focused on damage to roofing materials, wooden shed frames, and fixtures (front sashes) facing the outdoors of stores and conducted damage surveys together with specialized contractors involved in these works to identify issues. In addition, the NILIM led a working group of industry, academia, and government to study countermeasures to mitigate damage, and has conducted tests as shown in Photo 2. Then the team has proposed detailed countermeasure technologies for new buildings by reflecting the results in existing design and construction guidelines. In FY 2021, the team is also going to start to study the methods of wind resistance diagnosis and repair of existing roofing materials, and the wind resistance performance rank of roofing materials, which will lead to measures to promote more robust roofs.

Photo 2: Tension loading test on the upper part of a tile roof