Development of Maintenance BIM models for Utilization in Public Rental Housing Stock

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1. Introduction

Initiatives are now underway to introduce BIM and promote DX to improve productivity throughout the building lifecycle. On the other hand, due mainly to the financial constraints of local governments and the reduction in the number of engineering employees, proper maintenance of the large of public rental housing stock has become a challenge. Under such circumstances, we developed a BIM model (maintenance BIM model) for use in the maintenance of public rental housing stock, and created a draft of guide through the verification of application in the case study of actual public housing properties, etc. in order for local governments, etc., which are the management entities of public rental housing, to effectively introduce the maintenance BIM model.

2. Concept and structure of the maintenance BIM model

(i) Concept of the maintenance BIM model

Comprised of objects that are simple and can be easily created and adapted to the units used to handle maintenance information, the maintenance BIM model is designed for use with existing housing (stock). Spatial objects defined as maintenance BIM model are employed for intuitive and easy recognition of where and in what part of the building the inspection and repair points are located, and to create various maintenance information in units that can be spatially understood (**Fig. 1**).

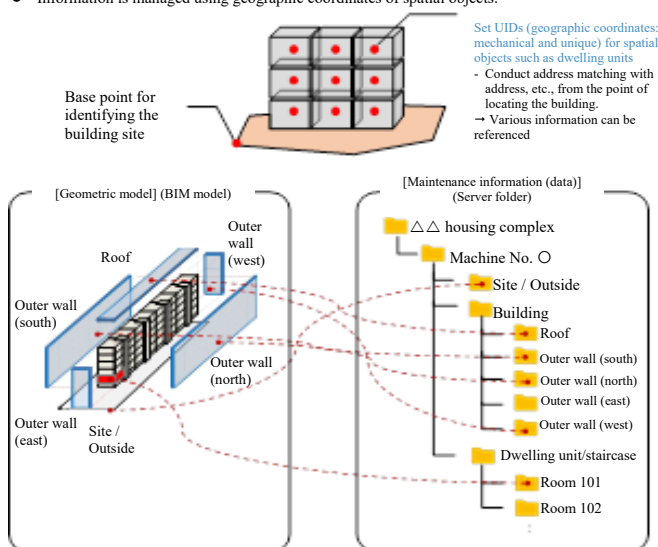### (ii) Structure of the maintenance BIM model

The maintenance BIM model for public rental housing is an integrated model that combines a "dwelling unit model" consisting of spatial objects such as dwelling units, common stairs, corridors, an "exterior model" that includes information on roofs and outer walls, etc., and an "outdoor facility model" that includes information on the site and outdoor ancillary facilities. A system that accumulates maintenance information is realized by linking these defined spatial objects with existing or new databases (including those using spreadsheet software such as Excel).

(iii) Data linkage using location information as a key

Spatial objects are assigned a unique identifier ("UID") based on location information (combination of latitude, longitude, and elevation of the geographic coordinates where the building site, etc., exists). A base point to determine location information is set to spatial objects. UID is stored as attribute information of the base point for each object. A database that can be linked to the maintenance BIM model is established for data linkage using location information as a key.

3. Case study to verify the application of the maintenance BIM model

With the cooperation of S and O Prefectures, we conducted a case study to verify the application of the maintenance BIM model in public housing complexes (actual properties).

- In the maintenance of public rental housing, management is based on units of spatial objects such as dwelling units.
- Spatial objects are "boxes" that can contain data in the maintenance BIM model.
- Information is managed using geographic coordinates of spatial objects.

Fig. 1: Conceptual image of the maintenance BIM model

(i) Validation of the structure of the maintenance BIM model and the way of information linkage.

Using the maintenance BIM models created for each subject complex and the Excel data (intermediate data table) created for BIM model linkage based on actual maintenance data, we confirmed the structure of the maintenance BIM models and how to organize maintenance information.

Regarding the utilization of maintenance BIM models, we also demonstrated the linkage between maintenance BIM models and maintenance data using a viewer and confirmed its usefulness in order to confirm the needs for the future development of viewers, etc., and the potential for their use in inspection and repair work (**Fig. 2**).

(ii) Confirmation of the method of inputting and storing inspection information with a portable terminal (tablet terminal) using the inspection application

We confirmed input items of inspection information and the methods of recording, storing, and viewing inspection information on actual properties, targeting daily inspections out of all the operations for maintenance.

We operated an inspection application installed on the tablet terminal (iPad) to perform a simulated inspection. Inspection routes and failure events were set up in advance, and the results were saved in the inspection application. Regarding recording of inspection results, we confirmed the operability, evaluation of functions, requests, etc., for each of the three recording methods (recording in checklist, recording in photographs taken on the site, and recording in drawing data) (**Fig. 3**).
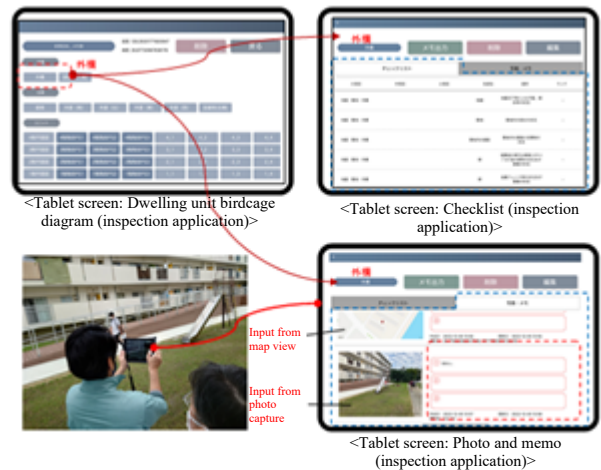
The saved inspection result data (CSV) was transferred from the tablet terminal (iPad) to Excel data, which was assumed to be used as a database, and stored as historical information; viewer software (Navisworks Manage) was used to confirm that the newly accumulated data was linked to the maintenance BIM model.

4. Guide to Maintenance BIM Model Introduction (the Guide)

Regarding the method for local governments, etc., who are responsible for management of public rental housing, an initial draft of a guide based on the questionnaire survey of public rental housing operators and case studies, etc. in public housing complexes was created to facilitate effective introduction of maintenance BIM models.

This Guide consists of two parts. In Part I, the structure, procedures, etc. of BIM model are presented to enable local governments to smoothly introduce maintenance BIM models for maintenance of public rental housing. Next, in Part II, for new construction and renovation of public rental housing, points of attention are presented using, as a reference, the
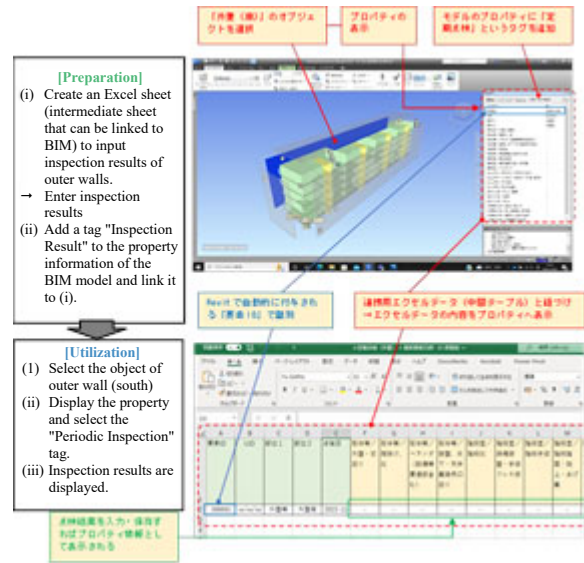
Fig. 2: Inspection results displayed in property information

<Tablet screen: Dwelling unit birdcage diagram (inspection application)>

<Tablet screen: Checklist (inspection application)>

<Tablet screen: Photo and memo (inspection application)>

Fig. 3: Inspection of outdoor facilities (playground equipment)

"Guidelines for the Creation and Use of BIM Models in Government Repair Projects (revised in March 2022)" by the Government Buildings Department.