

# Development of under-floor deterioration diagnosis equipment for preventive maintenance engineering of wooden building

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### 1. Background of the study

Nowadays, conversion is progressing from new social investment to 'stock-type society' which keeps past social capital long and takes care of it. Previously, damages, etc. were dealt with respectively and ex post facto. However, considering that damage risks due to aging will rapidly increase in the future, a strategic maintenance is required. This is based on the idea of 'preventive maintenance' which regularly inspects and diagnoses structure conditions, and takes measures prior to development of critical risks with the aim of reducing life cycle cost. Technological development in the inspection field is crucial for efficient preventive maintenance engineering. Particularly, development of the technology is required in order to efficiently inspect many target structures and to inspect locations difficult for visual confirmation.

Therefore, a comprehensive technological development project of Ministry of Land, Infrastructure, Transport and Tourism named 'Development of inspection and observation technology for preventive maintenance engineering of social capital' was implemented. In the wooden building field under the project, narrow and dark underfloor was focused on and the equipment for efficient under-floor diagnosis was developed.

### 2. Sorting out requirements, design and trial manufacture of deterioration diagnosis equipment

Requirements to be met by the deterioration diagnosis equipment, its design principle and contents of trial manufacture and improvements were decided after much discussion in 'Development Committee on deterioration diagnosis equipment for preventive maintenance engineering of wooden building' held by NILIM (Chairman: Professor of Kanto Gakuin University, Masao NAKAJIMA). The results of sorted out requirements to be met by the equipment are as follows.

\* As a result of survey of effective underfloor height of public housing and former Housing Loan Corporation housing (total about 64,000 buildings), the maximum dimension must be 30cm or less.

\*As it is difficult to give a diagnosis for preventive maintenance engineering by imaging only, it is indispensable to conduct palpation examination and moisture content measurement.

\*A small Phillips screw driver is comparatively suitable for the shape of tip section of palpation examination feature.

Based on the above, the underfloor deterioration diagnosis equipment was manufactured experimentally and its functionality was verified empirically.

### 3. Improvements of deterioration diagnosis equipment

As a result of the above verification test of function, the following improvements were required in view of necessity to increase diagnosis efficiency.

\*To enable to continuously conduct palpation examination in running and orthogonal direction in order to make it easy to continuously conduct palpation examination of underfloor horizontal bracing.

\*To introduce boring resistance measurement of screws, etc. which are easy to judge the presence or absence of biological deterioration in palpation examination.

\*To add a mechanism for sampling of the surface of deteriorated wood and hyphae, etc.

In case all of the above improvements are included, the chassis will be too large. Accordingly, two types of improved version of diagnosis equipment (picture) were manufactured as final products, one of which is to rotate palpation and moisture content measurement mechanism by 90° by remote control and another is to rotate by 90° manually, thereby making the chassis dimensions smaller.

This will lead to improvements in efficiency of preventive maintenance engineering for narrow underfloor to where no one can enter and of deterioration diagnosis aiming at performance evaluation of existing houses.



Picture: Under-floor deterioration diagnosis equipment for preventive maintenance engineering of wooden building (with function of rotation by remote control)