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Title	Development of Microwave Non-destructive Inspection Equipment for Outer Wall Tiles [an abstract of dissertation and a summary of dissertation review]
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学 位 論 文 内 容 の 要 旨

博士の専攻分野の名称 博士（工学） 氏名 Alsalem, Hussain

学 位 論 文 題 名

Development of Microwave Non-destructive Inspection Equipment for Outer Wall Tiles

（外壁タイル用マイクロ波非破壊検査装置の開発）

When wall tiles delaminate from a building, visual distortion of the city and, in the worst case, serious injury to humans can occur when tiles fall. Therefore, wall tiles should be inspected regularly. However, the high cost of inspections, the need for qualified personnel, and other hurdles to completing inspections are high. From this perspective, several studies have been conducted to improve inspection accuracy, reduce costs, and increase inspection speed. In this context, research has focused on nondestructive inspection (NDI) techniques using electromagnetic waves. These techniques can detect voids and cracks in concrete and evaluate the depth of voids using a time/frequency domain network analyzer. However, this method is a complex and expensive system.

The use of multi-layer scanning (MLS) and electromagnetic wave intensity as data for analysis is a fundamental solution to this problem. By facilitating data analysis, measurement equipment can be made simpler, smaller, and easier to use. However, changes in reflection intensity between defective and healthy tiles have not been studied. We have mathematically modeled the process of reflection of signal intensity from defective and healthy tiles. The model made it possible to calculate the depth and area of the cavity in addition to the tensile strength required to remove the tile. The mathematical model simulation then demonstrated the possibility of improving the scanning layer.

- Chapter 1. Describe the existing technology for detecting voids and their characteristics and problems. Finally, it clarified the purpose of this research.
- Chapter 2. Explain the device used in calculating electromagnetic waves and the tiles used as a sample for the experiment. And explain the mechanism of void accruing under the tiles.
- Chapter 3. MLS theory and its importance, current models used in detecting the void under the tiles will be explained, and after that, the model for this study and the method of detecting voids using this model will be explained. Finally, the end of the tests and results will be touched.
- Chapter 4. This chapter will focus on estimating the adhesion strength of the tile to the concrete via electromagnetics wave reflection strength.
- Chapter 5. In this section, the importance of improving MLS will be addressed. Then the optimization method and experiment, and the result will be explained.
- Chapter 6. present the conclusions of this paper.