Damage Detection of RC Columns in Shaking Table Tests by Singularity Analysis of Their Acceleration Responses

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Summary

Quick state judgement of important infrastructures such as bridges is required especially after the earthquake. The application of accelerometers which are already installed on many infrastructures can realize this judgement, but the method to detect the damage of structures from only the acceleration information has not been established yet. In this study, by applying singularity analysis based on wavelet transform to the acceleration data, we tried to detect the damage of structures. As a result of applying wavelet transform to the acceleration data measured on RC columns which had damage by shaking table test, we could detect singular points of the acceleration waveform which occurs at points where the signal itself or its derivative changes discontinuously. By comparing the singular points with the strain data of rebar and video records, it was shown that most of the singularities occurred when RC columns had damages such as cracks and rebar yielding.

Keywords: Acceleration; Damage detection; Singularity; Wavelet transform; RC columns.

1. Introduction

Rapid restoration after the earthquake has been required. To realize this, it is necessary to establish the system which can make the early accurate judgment of availability of infrastructure such as a bridge which plays an important role as space for passage of emergency vehicles, movement of rescuers, and escape routes. Damage diagnosis of structures after the earthquake has been done by mainly human-based visual inspection and using some inspecting devises until now. However, these methods and techniques require a long time to inspect all structures and will hinder their early recovery and reconstruction. Thus, the system which can automatically judge the existence of damage in real time is required. On the other hand, it cannot be said that the maintenance budget of infrastructure has being sufficient, so it is necessary to establish the early diagnosis system for structures after the earthquake in a limited budget and time.

Techniques using such as an optical fiber sensor and an AE sensor have been researched and developed as real time damage detecting techniques. The optical fiber makes measurement of the local strain of bridges possible by installing them on the whole girders. The AE sensor measures high-frequency acoustic wave that occurs when such as reinforced concrete damages. However, it is difficult to install these expensive sensors on many structures.

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