Consideration of real time individual building damage estimation using response analysis

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1. Introduction

Based on the planar seismic-motion distribution estimated from real-time seismic-motion observation data obtained immediately after the earthquake, we aim to establish an appropriate initial structure by the Strategic Innovation Promotion Program (SIP) We are developing a method to predict damage.
In the estimation of building damage caused by earthquake, a method using a fragility function is widely used. However, since this method is targeting a group of buildings within a wide area, individuality of the building can not be reflected.
Therefore, in this research, with consideration of using the individual building model, we construct a method to estimate the damage from building displacement by response analysis of individual building.

2. Method of response analysis

We choose "capacity spectrum method" for response analysis. Because, it is difficult to estimate the time historical seismic waveform in real time. The method need only response spectrum.
In order to verify the accuracy of the interlaminar deformation angle by the limiting yield strength calculation method, the interlaminar deformation angle by the nonlinear time history response analysis and the critical load strength calculation method was compared using multiple seismic motion. As a result, when the response analysis is performed by the critical strength calculation method based on the actual earthquake motion, the response value may become unstable due to the unevenness of the response spectrum in some cases. In order to mitigate this effect, we examined a method of reducing the error from the interstory drift by nonlinear time history response analysis by averaging the response analysis result (interlayer deformation angle) by giving multiple strengths.

3. Relationship between interstory drift and damage

In order to investigate the relationship between interstory drift and building damage by response analysis, we conducted a response analysis for 350,000 buildings whose building damage and building attributes are clear in the affected areas of several past earthquakes, The relationship of interstory drift was investigated.
In the response analysis, the building strength was given by the following two patterns method, and we investigated the relationship between the interstory drift and the building damage.

Pattern 1: Method of giving one building tolerance for each building attribute
Pattern 2: A method of giving strength to each building attribute / damage by building damage distribution and building damage rate for each building attribute, assuming that buildings with greater damage are weaker in yield strength.

In the pattern1, there is only few relationship between interstory drift and damage. On the other hand, there is stronger relationship in the pattern2. The reason is considered that the variation in the attribute is larger than the difference in the strength between the building attributes.

4. Parameter of estimate damage from interstory drift

We investigated the parameters of the damage probability curve for each disaster rank used when estimating building damage from interstory drift. The damage probability curve is a cumulative distribution function of the lognormal distribution, the median value for each damage degree as that parameter, and the relationship between the interlayer deformation angle according to the degree of damage in the previous section are referenced and the error from the actual damage is minimized The method was studied.

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