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主　論　文　の　要　旨

論文題目　Seismic Performance Evaluation of an Eight-Story Steel-Reinforced Concrete Building Using Performance Curves of the Building
(8 階建 SRC 造建物の建物性能曲線による耐震性能評価)

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論　文　内　容　の　要　旨

Destructive earthquakes caused much serious earthquake damage of buildings, and that is the main reason of the large casualties. The number of refugees will increase after the main earthquakes. In order to recover the social order and make the refugees go back to their homes as soon as possible, the safety of the buildings should be confirmed. And the buildings should be judged strong enough to withstand the following aftershocks, which may even cause much more structural damage than the main shocks. As a result, a quick and effective evaluation method for the earthquake damage in main shocks and for the prediction of the residual seismic capacity (related with the collapse of the building) of the buildings in the aftershocks should be developed.

However, the current evaluation methods of the earthquake damage cannot satisfy the requirement mentioned above. One kind of method is based on the visual observation of the cracks of the structural elements. Although the observation method can help know the distribution and sizes of the cracks of some essential structural elements in the main shocks, it is impossible to quickly and effectively assess the residual seismic capacity after the main shock and neither to judge whether the residual seismic capacity of the building can withstand the strong aftershocks. Another kind of method is based on monitoring the changes of the dynamic characteristics (such as fundamental frequency and modal shapes) of a building. However, that method mainly focused on the earthquake damage detection of a building in main shocks, but cannot predict the collapse risk of the building in aftershocks.

In order to evaluate the earthquake damage in the main shock and predict the safety of the building in aftershock, the method based on performance curve ($S_a - S_d$ curve) was brought out in recent years. Firstly, the performance curve can show the performance changes of the building from small responses to the maximum response; the linearity and nonlinearity of the earthquake response of the building can also be observed directly. Secondly, the predication of the structural safety of a building in the aftershocks can be made when the Demand Spectrum is employed. One of the most important problems is how to get fundamental response, which can be used to obtain $S_a - S_d$ curve. In the past research, Wavelet Transform Technology (WTT) has already been employed to solve the problem.

However, the past research was mainly based on the experiment and theory analysis. Therefore, in order to make the method widely applied in real buildings, there are some problems we need to solve as follows: (1) The application of $S_a - S_d$ curves for real buildings is rare in the past research because of lack of the valuable field measurement data. (2) There is no research on how to use $S_a - S_d$ curve to evaluate the earthquake damage, and the most important point is how to define the initial secant stiffness of the $S_a - S_d$ curve. (3) In order to realize the automatic calculation by computer, an automatic selection method of the fundamental response should be set up. Based on those research background mentioned above, the research in this paper was carried out.

The main objective of this research in this paper is to study the application of the $S_a - S_d$ curves of real buildings using field measurement data. In the paper, earthquake response records of an 8-story Steel-Reinforce Concrete building were studied. We used the field measurement data to evaluate the seismic performance of the building. Compared with the previous research, we brought out some new thoughts and got some new calculation results in the paper, as follows: (1) Massive of measurement earthquake response data of a real SRC building were accumulated, and we used the data to test the application of the $S_a - S_d$ curves for real buildings. (2) We brought out a simple method to define the initial secant stiffness of the $S_a - S_d$ curves, and the usefulness of the method was evaluated and confirmed. (3) An automatic selection method of the fundamental response based on the energy theory was brought out in this paper. (4) We used the $S_a - S_d$ curves of the superstructure and the rotation motions of the foundation to evaluate the soil stiffness during earthquakes.