Arrangement/Analysis for earthquake observation records aiming for enhancement in accuracy for evaluating earthquake intensity of buildings

AZUHATA Tatsuya (Ph.D), Head
ARAI Hiroshi (Dr. Eng.), Senior Researcher
Structural Standards Division, Building Department
INOUE Namihiko, Senior Researcher
Standards and Accreditation System Division , Building Department

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1. Foreword

We introduce the outline of arrangement/analysis methods deliberated in the comprehensive technological development project titled Development of aseismic capacity for buildings corresponding to the sophistication of earthquake vibrations information. With respect to the earthquake behavior of actual buildings, since the dynamic interactive effects of structures/grounds have affect, we have made it a subject to comprehend this quantitatively.

2. Outline of method

We will illustrate the flow of method in the Figure 1. According to simultaneous observation for ground and the inside of building (apex and bottom), the Fourier spectrum ratio, which indicates relations between the ground surface and the inside of building, is obtained. From the Fourier spectrum ratio, the original dimension of sway model or sway rocking model is fixed including input loss effects. Using identification results, coupled system responses receiving foundation fixation and dynamic interaction effects can be obtained by analysis using the random vibration theory and compared.[1)]

For instance, in regard to the observation building shown in Figure 2, the Fourier spectrum ratio is indicated in Figure 3 from observation records. In proportion to the ratio of massive deformation of ground spring, the building deformation of the coupled system is clarified to greatly be reduced in comparison with the foundation fixed system.

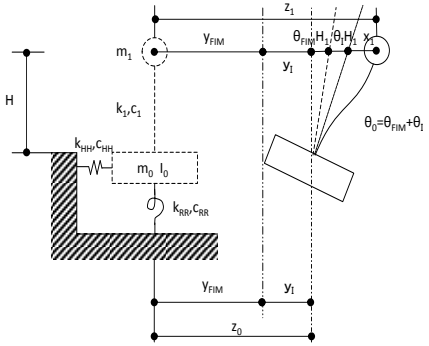
3. Conclusion

In order to make technological data for deliberating designing earthquake intensity for buildings, we have currently been applying the methods illustrated herewith to still more observation buildings and compiling its results.

[Reference]

1) Okano, Azuhata, others: Building response decreasing effects presumed from observation records, collected papers of the Architectural Institute of Japan

① Fourier Spectrum ratio calculation for (building apex/ground surface, building bottom/ground surface, building apex/building bottom.)



Sway Rocking model

② Identification and original dimensions and input loss effects of Sway Model (S. Model) or Sway Rocking Model (SR Model) from Fourier Spectrum ratio.

※Spectrum Fitting method

③Obtain earthquake response of series model (S model or SR model) earthquake responses receiving foundation fixed model and dynamic interactions and compare using the random vibration theory.

*Deliberate two cases: A case to consider dynamic interactions of inertia only (II); a case to consider both interactions of inertia and input (II+KI).

Figure 1 Flow of method

Height：14.03m

Flat surface size：8.06m×65.7m

Class of ground：2nd class

Upper part structure：Wall type RC structure

Foundation structure：PC pile (PC 杭)

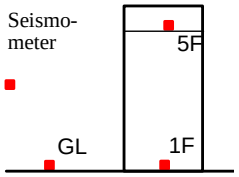
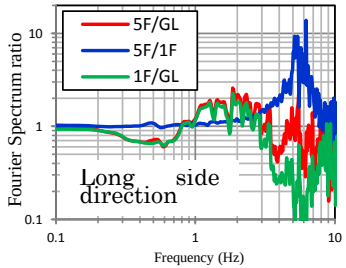


Figure 2 An example of observation building



(The 2011 off the Pacific coast of Tohoku Earthquake)

Figure 3 Fourier Spectrum ratio

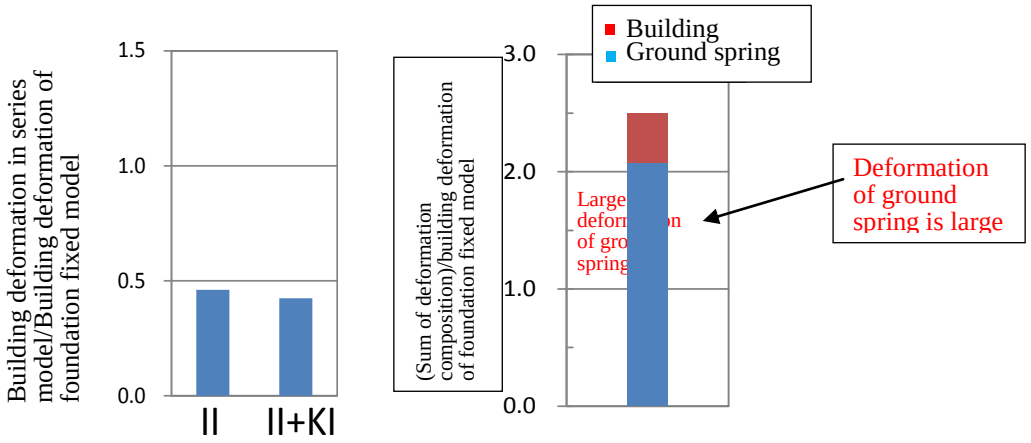


Figure 4 Examples of analysis results