Predominant Periods of Multi-Degree-of-Freedom-System Analysis and Dynamic Soil-Structure Interaction for Building Structures

Mizuo INUKAI *, Toshihide KASHIMA[†], Taiki SAITO[††] and Tatsuya Azuhata[†]

[*] International Institute of Seismology and Earthquake Engineering(IISEE),
Building Research Institute (BRI)
Tsukuba, Ibaraki, 305-0802, Japan
e-mail: inkm@kenken.go.jp, Web page: http://iisee.kenken.go.jp

[†] IISEE, BRI
Tsukuba, Ibaraki, 305-0802, Japan
e-mail: kashima@kenken.go.jp, azuhata@kenken.go.jp

[††] Toyohashi University of Technology
Toyohashi, Aichi, 441-8580, Japan
Email: tsaito@ace.tut.ac.jp, Web page: http:// http://www.tut.ac.jp/

ABSTRACT

In this paper, the predominant periods of the multi-degree-of-freedom-system (MDOF) analysis are analysed and the dynamic amplification factors are shown. The analysis method is the assumption that, as well as the single-degree-of-freedom (SDOF) analysis, the MDOF analysis is applied to the predominant periods. That can give the dynamic amplification factors of the MDOF. At the results, it is cleared that the predominant period of the MDOF is close to be the period by the eigenvalues and in the short period, or in the high level modes, the dynamic amplification factors are high which should not be neglected.

In the SDOF analysis, the mass, the damping factor, and the stiffness can give the predominant period, and the response values. In the MDOF analysis, after the mass matrix $[M]$, the damping matrix $[C]$, and the stiffness matrix $[K]$ can give the eigenvalues, the modes and others, the MDOF is translated to a series of the SDOF equations, and the response values are analyzed. Therefore, in the MDOF analysis, the predominant periods of the MDOF system are not discussed.

So, the predominant periods of the MDOF analysis are also analyzed and the dynamic amplification ratios are shown. The analysis method is the assumption that, as well as the periodic motion $\ddot{y}$ ($=p\sin\omega t$) in the external force of SDOF analysis, the system of the periodic motion in the external force of MDOF analysis is applied and the system of the response values is also applied to be the periodic motion. The dynamic amplification matrix is proposed.

Figures show the spectra of the ratio of the dynamic amplification, on each floor in each period T ($=2\pi/\omega$) of a model building of 3 mass shear system. The values "0.39(s), 0.64(s) and 1.11(s)" are the periods calculated by the 3 eigenvalues. At the results, it is cleared that the predominant periods of the MDOF are close to be the periods by the eigenvalues, and in the short period, or in the high level modes, the dynamic amplification ratios are sometimes high which means that the higher level modes should not be neglected. The dynamic amplification at the predominant periods are usually different from the eigenvectors. In MDOF inelastic analysis, when some eigenvalues are real numbers, the motion seems to be overdamping. Analysis is also executed for inelastic analysis.

Moreover, soil-structure interaction are also analyzed in elastic analysis for the model building. Some effects to the building strcture model by the rocking on the ground are discussed in the sway-rocking model. The external force vector including moment is proposed. The predominant periods are close to the periods by the eigenvalues.

REFERENCES

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