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Article / Book Information

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Title(English)	Experimental and numerical study on dynamic behavior of double concave friction pendulum bearing for base-isolated buildings
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論 文 要 旨

THESIS SUMMARY

系・コース： Department of, Graduate major in	建築学　　　　系 都市・環境学　　コース	申請学位（専攻分野）： Academic Degree Requested	博士　　（　工　学　） Doctor of
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要旨（英文 800 語程度）
Thesis Summary（approx.800 English Words）

　　An isolation system can significantly reduce the deformation of the superstructure by focusing the deformation on the isolation layer. When friction pendulum bearings (FPBs) are applied, this deformation will be highly related to the friction coefficient. Therefore, the influence of the friction dependencies on the maximum displacement is of vital importance. However, the reliability of proposed friction dependencies under real ground motions (GMs) and the effect of friction dependencies on the maximum response displacement remain unclear. Thus, the friction dependencies were combined in friction models and further validated by full-scale dynamic tests under unidirectional (1D) and bidirectional (2D) orbits. Further, the contribution of friction dependencies to the maximum displacement and superstructure acceleration was assessed under various GMs and various base isolation systems (BISs). This paper has five chapters. The subject of research is the Double Concave Friction Pendulum (DCFP) bearing used for seismic isolated buildings, and the dynamic behavior of it is discussed by full-scale experiments and numerical analysis.

　　In Chapter 1, "Introduction", as a background of the research, we investigated the DCFP bearings in general and pointed out that the influence of friction coefficient and various friction dependencies on the dynamic response when using DCFP bearings are important. From the above background, it is stated that the purpose is to understand the dynamic behavior the DCFP bearing under one-directional and two-directional horizontal excitations, to grasp the influence of various dependencies, and to propose the optimum design under various GMs.

　　Chapter 2, "Behavior of DCFP bearings under unidirectional excitations (1D)", conducted full-scale dynamic experiments and numerical analysis of DCFP bearings in 1D. The specimens are full-scale DCFP bearings and the parameters are slider diameter, surface pressure, velocity, and number of cycles. From the experimental results, various dependencies of surface pressure, velocity, and temperature on the coefficient of friction are clarified. In addition, we conducted seismic response analysis using a 1D single-degree-of-freedom (SDOF) shear system model, examined the effects of velocity and temperature dependencies on the maximum response, and concluded that the effect of temperature dependency is particularly large.

　　In Chapter 3, "Behavior of DCFP bearings under bidirectional excitations (2D)", following Chapter 2, full-scale dynamic experiments and numerical analysis of DCFP bearings in 2D were conducted. We proposed analysis models that consider 2D deformation, and verified its validity by comparing it with the results of full-scale experiments. In addition, seismic response analysis was performed using a 2D SDOF shear system model to clarify the effects of an additional perpendicular ground motion component on temperature and velocity, and in turn, on friction coefficient and maximum response displacement. Further, the influence of characteristic parameters of GMs and BISs on the response increase from 1D to 2D was discussed.

　　In Chapter 4, "Response spectra of various DCFP bearings under various GM classifications", parametric study of DCFP systems under various GMs using the analysis model constructed in Chapter 3 is conducted and a preliminary design method is proposed. In the analysis, the parameters are the classification of input GMs (based on magnitude and distance to fault), the friction coefficient of the DCFP bearing, and the isolation period. The analysis results are represented as response spectra, and the selection of the optimal isolation period and friction coefficient of the seismic isolation layer using DCFP bearing was discussed under various GM classifications based on response displacement and response acceleration. Also, the effect of bidirectional behavior and temperature change on the response was studied. Based on these parametric studies, some general rules and notes about the optimal preliminary design were summarized

　　Chapter 5, "Conclusions", summarized the findings obtained in each chapter. In short, this paper clarified various dependencies of the friction coefficient by full-scale experiments of real-size DCFP bearings, and discussed the selection of the optimum seismic isolation period and friction coefficient of DCFP bearings under various ground motion classifications based on the bidirectional model that applies these dependencies.