

論文 / 著書情報  
Article / Book Information

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Title(English)	Equivalent SDOF model for estimating wind-induced energy dissipation and responses of base-isolated tall buildings
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Category(English)	Doctoral Thesis
種別(和文)	論文要旨
Type(English)	Summary

# 論文要旨

THESIS SUMMARY

系・コース： Department of Graduate major in	建築学 都市・環境学	系 コース	申請学位（専攻分野）： Academic Degree Requested	博士 Doctor of	（ 学術 ）
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## 要旨（英文 800 語程度）

Thesis Summary (approx.800 English Words)

The title of this doctoral dissertation is “Equivalent SDOF model for estimating wind-induced energy dissipation and responses of base-isolated tall buildings”. This study proposes a novel approach, the equivalent single-degree-of-freedom (ES) model, to accurately and efficiently estimate wind-induced energy dissipation (including steel-damper and upper-structure energy dissipation) and responses (including standard deviation of the isolation layer deformation, residual and maximum deformation of the base isolation layer, and maximum displacement distribution of the upper structure) of base-isolated tall buildings equipped with steel dampers. Furthermore, the study also extends the newly-proposed ES model to accurately and efficiently estimate the wind-induced energy dissipation (including oil-damper energy dissipation) and responses of base-isolated tall buildings equipped with oil and steel dampers. Additionally, the study attempts to predict the wind-induced energy dissipation based on ES model and energy balance. The dissertation is structured into six chapters as follows:

Chapter 1 introduces base isolation systems and their advantages in seismic performance, along with challenges in wind-resistant performance, such as wind-induced energy dissipation and responses. For time-saving time history analyses, there is a need to propose an SDOF model to replace time-consuming MDOF model. However, existing SDOF models in earthquake engineering are inappropriate for base-isolated tall buildings in wind engineering. This prompts the proposal of the novel ES model to estimate energy dissipation and responses of base-isolated tall buildings under strong winds.

Chapter 2 evaluates wind-induced energy dissipation and responses of MDOF models, idealized from base-isolated tall buildings with steel dampers, in both along- and across-wind directions using time history analyses. Three structural parameters (damping ratio, natural period of the upper structure, and yield shear force coefficient of the steel damper) are considered, and their influences on the energy dissipation and responses of MDOF models is investigated.

Chapter 3 proposes the ES model to replace the MDOF model for time-saving analyses. The ES model is modeled based on findings from Chapter 2 and the varying first mode shape of the MDOF model (elastic or plastic mode). Validation of the ES model is demonstrated through time history analyses, considering several values of the structural parameters. Comparative analysis shows the ES model accurately estimates (i) energy input, (ii) energy dissipation (including steel-damper and upper-structure energy dissipation), and (iii) responses (including standard deviation of isolation layer deformation, maximum and residual deformation of the isolation layer, and maximum displacement distribution of the upper structure). Additionally, the trend of the estimation error with structural parameters is analyzed.

Chapter 4 extends the newly-proposed ES model for practical use in base-isolated tall buildings with oil and steel dampers. The accuracy of the ES model in estimating wind-induced energy dissipation and responses is verified, showing accurate estimations of (i) energy input, (ii) energy dissipation (including oil-damper energy dissipation), and (iii) responses. Also, the trend of the estimation error with structural parameters is analyzed.

Chapter 5 presents a prediction method based on energy balance. The prediction accuracy of wind-induced energy dissipation for the two types of buildings (with steel dampers alone and with both oil and steel dampers) is verified, and prediction errors are discussed.

Chapter 6 summarizes conclusions and related remarks based on the study's findings, along with suggestions for future work.

Based on these conclusions, structural engineers can practically use the ES model to accurately and efficiently estimate wind-induced energy dissipation and responses in the initial stage of wind-resistant design for base-isolated tall buildings.

備考：論文要旨は、和文 2000 字と英文 300 語を 1 部ずつ提出するか、もしくは英文 800 語を 1 部提出してください。

Note：Thesis Summary should be submitted in either a copy of 2000 Japanese Characters and 300 Words (English) or 1 copy of 800 Words (English).

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