



## Sensitivity Analysis of Outrigger Systems for Super Tall Building Structures under Natural Vibration Period Constraints

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## Summary

With the increase of height and flexibility of modern super tall buildings, the structural natural vibration period become longer and longer. The long period components become the dominant factor in the structural design of super tall buildings. Due to lack of sufficient ground motion records with rich long period components, current researches on long period components were not fully conducted. To avoid serious structural damages caused by excessive long period responses, the natural vibration period of super tall buildings is commonly requested to be below certain limit in Asian super tall building development practices. The key factors which may cause significant differences on the natural vibration period could be easily found. A super tall building which is above 500 meters was taken as an example to show the sensitivity analysis results of outrigger trusses under natural vibration period constraints. The impacts of the parameters of both diagonal and chord members of the outrigger systems on the natural vibration period were thoroughly investigated. Using the weight of structural members as optimization objective, a period sensitivity index was defined. Through the sensitivity analysis, one may obtain the period sensitivity indices and the optimal outrigger scheme can then be derived for the super tall building structures.

**Keywords:** Sensitivity analysis; outrigger system; natural vibration period constraint; super tall building structures

## 1.Introduction

With the increase of height and flexibility of modern super tall buildings, the structural natural vibration period become longer and longer. Super tall building structures are sensitive to the wind load and earthquake action. Changes of building forms according to some aerodynamic rules can alleviate the wind-induced vibration, and it is also a common method to reduce the wind-induced vibration by limiting natural vibration period of the structure. Due to the lack of records containing long-period components under earthquakes, the long-period seismic research is far from sufficient nowadays. It is currently a common practice in Asia to set certain limits to natural vibration period in the structural design of super tall buildings to reduce long-period seismic responses due to the above reasons.