11th World Congress on Structural and Multidisciplinary Optimisation
07th -12th, June 2015, Sydney Australia

Parameter Optimization for the Integrated Optimal Design of Super Tall Buildings with Viscous Damping Walls

Xi Zhan[1], Xin Zhao[1,2],Yimin Zheng[1, 2,]

[1] Department of Structural Engineering, Tongji University, Shanghai, China, 22zx@tjadri.com
[2] Tongji Architectural Design (Group) Co., Ltd., Shanghai, China, 22zx@tjadri.com

Abstract

Viscous damping walls can effectively suppress the vibration amplitude of the super tall building structures under both earthquake and wind. Comparing with other viscous dampers, viscous damping walls can dissipate more energy due to shear type mechanism and larger contacting areas. There are differences in economic cost and energy-dissipating capacity between viscous damping walls with different parameters and viscous damping walls with better parameters cost more. By the introduction of viscous damping walls in super tall buildings, the material consumption of main structures can be reduced by the reduction of earthquake action and an integrated optimal design of super tall buildings with viscous damping walls was adapted in this paper. A parameter optimization method of viscous damping walls was proposed in this paper to consider the overall costs of the structure including the cost of material consumption and the cost of viscous damping walls and optimal number of the viscous damping walls. A super tall building located in high seismicity area was applied in the last part of the paper to illustrate the proposed parameter optimization method. Numerical analysis results show that the proposed method is reasonable and effective.

Search the optimal parameter method based on the integrated optimal structural design for tall buildings with viscous damping walls was proposed for parameter optimization to minimize the structure overall cost with the optimization variable of parameters provided by the manufacturer, and the optimal parameters of viscous damping wall and corresponding optimal additional damping ratio for the structure and optimal number of viscous damping walls will be derived.

There are different overall costs with different parameter combinations and minimum overall cost corresponds to optimal parameters of viscous damping wall and the corresponding optimal additional damping ratio and optimal number of optimal damping wall. when the damping coefficient c=3522 and velocity exponent a=0.45, the overall cost is minimal and corresponding optimal additional damping ratio for the structure is 5.91% and optimal number of viscous damping is 186 in the case study.

Results show that the optimal parameters corresponding to the minimum total cost is not the biggest, and parameter or additional damping ratio is not the higher the better. Economy and effect should be taken into comprehensive consideration and parameter optimization can take a maximum of the economic effect viscous damping wall should have.

Parameter optimization with integrated optimal structure can both ensure the additional damping ratio and reduce the overall cost of integrated optimal structure. This is especially important for popularizing the use of viscous damping wall.

Parameter combinations provided by manufacturers are taken as optimization variables and the method proposed in this paper has high maneuverability which is practical and can promote the popularization and application of viscous damping wall.