



Carbon Emission Assessment for Super Tall Buildings with Viscoelastic Coupling Dampers

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Abstract

Due to its huge material and energy consumption, super tall buildings exert great impact on the environment. Embodied carbon is an important tool to measure the environmental impacts of super tall buildings. The embodied carbon of super tall buildings could be optimized by integrating the energy dissipation devices in the structural system. Viscoelastic coupling dampers (VCDs) is a kind of efficient energy dissipation devices. By replacing coupling beams in structural configurations, VCDs can effectively increase the level of inherent damping of structure, and thus reduce the internal forces of structural members subject to lateral loads. Optimization for the sectional dimension of structural components is made possible, accompanied by reduction in embodied carbon. A super tall building located in high seismicity area is presented as an example to illustrate embodied carbon based integrated structural design method. The results for a real super tall building project show that the proposed method is reasonable and can effectively reduce embodied carbon and total cost of super tall buildings.

Keywords: embodied carbon; carbon emission assessment; integrated optimal seismic design; super tall buildings; viscoelastic coupling dampers.

1 Introduction

“The scientific evidence is now overwhelming: climate change presents very serious global risks, and it demands an urgent global response” [1]. Since the beginning of the Industrial Revolution (taken as the year 1750), the burning of fossil fuels and extensive clearing of forests has contributed to a 41.7% increase in the atmospheric

concentration of carbon dioxide, from 280 to 396.8 parts per million (ppm) in 2014 [2].

The construction industry is a substantial contributor of global CO₂ emissions, with almost a quarter of total global CO₂ emissions attributable to energy use in buildings [3]. Symons and Symons (2009) [4] in UK found that structural engineers can control 57% embodied carbon of the total embodied carbon, which accounts for 5% of the whole carbon emissions across the UK. Reducing