碳纖維索斜張橋阻尼特性對地震反應影響之研究

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摘要

在跨徑較大的斜張橋中，長短不一的纜索體系所涵蓋的自振範圍很大，在車輛、地震或風雨荷載作用下，纜索的局部振動易與橋梁體系發生耦合振動的現象。研究結果顯示，碳纖維索斜張橋若不考慮纜索局部振動之影響，在計算應變能比例阻尼時將會些許高估部份振態之阻尼比，但比例並不大，而鋼索斜張橋與碳纖維索斜張橋相較，考慮及不纜索之局部振動，將對阻尼之分佈有著較大的差異。另外，當利用常數阻尼來計算大垮徑斜張橋地震反應時，往往可以得到較大的地震反應，屬於較為保守的分析模式；而當利用雷利阻尼理論來模擬其阻尼特性時，將會因選取的參考振態不同而產生極大的地震反應差異。

關鍵字: 斜張橋、纜索的局部振動、碳纖維索、地震反應、阻尼

A Study on Seismic Response Effects Relating to Damping Characteristics of Cable-Stayed Bridges with Carbon Fiber Composite Cables

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ABSTRACT

In large span cable-stayed bridges, self-vibration of cables covered a wide range due to unequal cable lengths in the system; coupled vibration is prone to occur when local vibration of a cable caused by the load of a vehicle, an earthquake, or the wind or rain resonates with the bridge system. Studies reveal that for carbon-fiber cable-stayed bridges, when calculating the strain proportioned damping, damping ratio of part of vibration modes will somehow be over-estimated if not taking the influence of local cable vibration into consideration; in a low proportion, though. Comparing with steel cable-stayed bridges, in a carbon-fiber cable-stayed bridge, whether or not considering the local vibrations has a more substantial effect on the damping distribution. Moreover, when using constant damping to calculate seismic reactions of a large span cable stayed bridge, more significant seismic reactions are often attained; therefore this is a more conservative analysis model. When using Rayleigh Damping theory to simulate damping characteristics, significant deviations in seismic reactions will occur due to different selection of referencing vibration modes.

Keywords: cable-stayed bridge, local vibration of cables, carbon-fiber cable, seismic response, damping