Analytic Methods of Modal in Real Spaces for Random Wind-induced Response of Long-Span Bridges

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Summary

Recently more and more passive dynamic dampers are used in long-span bridges. These kinds of structures belong to non-classical damping structure. By traditional decoupling method, the structural displacement and velocity response cannot analyzed as linear combination of displacement and velocity response of a series of standard oscillators. For the long-span bridge's motion equation, by using mode decomposition method decompose to a 2-DOF non-classic motion equation, and using real-space decoupling method , the structural displacement and velocity response are analyzed as a linear combination both displacement and velocity response of a series standard oscillators with clear engineering significances. Considering the correlation of series standard oscillator, variance of the structural displacement random response is analyzed and resolved into linear combination of displacement and velocity random response.

Key words: passive structure; non-classical damping; decoupling in real spaces.

1 Introduction

Recently more and more passive dynamic dampers are used in long-span bridges. These kinds of structures belong to non-classical damping structure [1-5]. In the analysis of this structure of the traditional random wind vibration response, generally using the frequency domain method[4], the response variance expressions with the approximate formula[5], or direct numerical integration, or the discrete equation obtained numerical solutions[6], or using a linear filtering process random wind spectrum to obtain approximate analytical solution[7,8].
The approximate solutions and the numerical solutions were inconvenience for random wind vibration control of structure optimization design [9,10], so it is necessary to obtain analytic solutions. Structures with TMD, TLD is a non classical damping structure, traditional methods can't resolve structure response decoupling as a linear combination of the response of single degree of freedom structure. So this kind of passive control structure could not establish analytical with clear physical and engineering significance.

In this paper for the long-span bridge's motion equation, by using mode decomposition method decompose to a 2-DOF non-classic motion equation, and using real-space decoupling method , the structural displacement and velocity response are analyzed as a linear combination both displacement and velocity response of a series standard oscillators with clear engineering significances. Considering the correlation of series standard oscillator, variance of the structural displacement random response is analyzed and resolved into linear combination of displacement and velocity random response.

1 Motion equation

Tuned mass damper (TMD), Circular-Tuned Liquid damper (T-TLD) and so on are common for use.

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