New trends and new models for analysing dynamic interactions

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Summary

Vibration problems in structures is become a major topic for structural engineers due to the slenderness of the designed structural systems. In a classical design approach, loads act on the structures and the structural response is calculated through a model which is usually does not interact with the loading. In the past, the analysis of wind effects on bridges or flexible structures have changed such a calculation approach; flow induced vibrations have highlighted that the studied system was no longer the structure itself but a coupled system including the fluid and the structure.

Such coupled problems are now very common; to date, the last one is certainly the human-induced vibration problems met in footbridges, but seismic design also involves complex models for soil-structure interaction. The interaction between vehicles and bridges, for high speed tracks, is a topic becoming more and more pregnant. All these coupled vibration problems require sophisticated techniques, but more drastically new modelling approaches for structural engineers. This keynote will address the new trends for analysing dynamic interactions; emphasis will be nevertheless given to major problems met today in bridges: human-induced vibrations and flow-induced vibrations.

Keywords: dynamic interaction, parametric resonance, human induced vibrations, wind induced vibrations.

1. Introduction

Majority of today's structures is subjected to load which varies with time. In fact, with the possible exception of dead load, no structural load can really be considered as static. However, in many cases the load variation is low enough, which allows the structures to be treated as static. For tall buildings or large bridges, subjected to wind and earthquake for instance, the dynamic effect associated with the load must be accounted for in the proper evaluation of safety and serviceability of these systems.

Many of the civil engineering structures are designed on the basis of static or pseudo-static analysis. This assumption largely simplifies these analyses and a dynamic analysis is much more involved and time consuming than an equivalent static one. Structures thus designed have been found to be safe, though no idea could be obtained from this as to the extent of its safety as also to its actual behaviour. With high speed digital computers, and the tremendous development made in the analytical and numerical procedures, more accurate representation of the structural behaviour due to dynamic loads have now become possible. Large systems having internal intricacies and huge dimensions are now daringly attempted.

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