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Book Review

Flow Induced Vibrations in Engineering Practice
P. Anagnostopoulos (Ed.); International Series on Advances in Fluid Mechanics, WIT Press, Southampton, UK

This book brings together five contributions on practical areas of flow-induced vibrations (FIV) which arise on structures exposed to an external flow environment. The first two chapters discuss the phenomenon of vortex-induced vibration (VIV) and its prediction by two different methods, computational fluid dynamics (CFD) and nonlinear wake oscillator models. The next two chapters deal with galloping, including wake induced galloping, and instability of (heat exchanger) tube banks and the final chapter instability of a rotating shaft in a fluid environment. The book is not therefore a comprehensive work on FIV since some important areas are not included (buffeting for example). Also the treatment of some of the topics is more focussed on particular aspects of the general problem dealing with areas which the authors are actively researching.

Anagnostopoulos, who is the book's editor, has contributed the first chapter on prediction of VIV using CFD. He has carried out many simulations of flow about both fixed and flexibly mounted circular cylinders using a two-dimensional finite element code. In the work described these cover the vortex shedding lock-in region of an isolated cylinder in uniform flow. These results and similar two-dimensional laminar flow simulations of others are compared with experimental results, many due to Williamson and co-workers showing the upper and lower branches of lock-in. The CFD simulations have generally been successful in predicting the lower branch but much less so the upper one. As the author remarks this is still a strongly developing area attracting a lot of activity including, as they become more possible, the increasing significance of three-dimensional simulations.

The second chapter (Massih and Forsberg) examines the use of nonlinear oscillators of the Van der Pol type as models of the wake effect of a cylinder undergoing VIV. Two of the most commonly used, the Iwan–Blevins model which is qualitatively based on fluid momentum considerations and the Hartlen–Currie model which is purely empirical, are reviewed. These methods have the advantage over CFD of much lower computation cost and are able to represent many features of VIV but have difficulty predicting all the response amplitude behaviour over the lock-in range.

The chapter on galloping (Pirner and Fischer) presents classical quasi-steady analysis (Den Hartog criterion) of this phenomenon for the motion of isolated flexible cylinders and also multi-cylinder cases involving wake interference. This extensive review of theory and measurements also includes a number of practical problems such as rain- or ice-induced effects and concludes with a very good section on damping devices.

Chapter 4 (Price) examines the instability which arises in heat exchanger tube banks due to feed-back effects of in-line vibration on the interstitial flow within the array varying the drag of the tubes and thus setting up an oscillatory instability. Price shows that the measured data when examined in detail does not justify the commonly used Connors' equation as a means of prediction.

The final chapter (Antunes) covers a rather different problem of stability of a rotating shaft surrounded by fluid. This is an interesting but quite specialized problem and a very extensive analysis is presented. However because of the dissimilarity of this type of flow (Taylor–Couette) from the others considered in this book it fits slightly uneasily with the other contributions.

An important point that is made by several of the contributors from the analysis of the work which they present is the conclusion, now increasingly accepted, that it is not appropriate to combine mass and damping parameters together as a single mass-damping parameter as has commonly been done in the past.

This is a useful contribution to the literature on FIV giving an up-to-date review of some of the most important problems and methods of prediction.

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