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Book review

Y.B. Yang, J.-D. Yau, Y.S. Wu, Vehicle–Bridge Interaction Dynamics with Application to High-Speed Railways, World Scientific Press, New Jersey, London, Singapore, Beijing, Shanghai, Hong Kong, Taipei, Chennai, ISBN 981-238-847-8, 2004 (pp. xxiii + 530, many figures, tables, references and 10 appendices, £ 60, US$ 98).

The authors, from National Taiwan University, Tamkang University and Sinotech Engineering Consultants Ltd. of Taiwan respectively, have written a comprehensive book dealing with the vibration of bridges subjected to moving vehicles and trains. They concentrate on the effect of high-speed loads on structures—an important subject in both the theory and practice of bridge engineering all over the world.

The authors have divided the book into two parts (Moving Load Problems and Interaction Dynamic Problems) and 11 chapters. The first chapter introduces the reader to the problem and describes both the bridge and vehicle theoretical models as well as a survey of the basic literature dealing with the topic.

The simply supported beam subjected to one or more loads is solved in the second chapter. The impact factor is defined for the deflections, bending moments and shear forces in the beam. Under certain conditions on, e.g., speed, axle distances of vehicles and natural frequencies of the bridge beam, resonance and cancellation phenomena may occur. This last event should be better defined (mathematically, experimentally, and especially its consequences).

The third and fourth chapters deal with the dynamics of bridges resting on elastic or elastically supported bearings. These types of supports are popular for bridges in seismic regions because they could, under certain conditions, damp the induced vibrations. Even here, the resonance and cancellation may occur. The authors put together the governing equations of curved beams in the fifth chapter. In this case, vertical, horizontal, torsional and radial coupled vibrations of bridges are induced. They may be separated in only a few cases.

In the second part of the book, vehicle–bridge interactions are deeply analysed. The sixth chapter condenses the individual elements of both the vehicle and bridge and the authors introduce the interaction element. They study the effect of rail irregularities, mass, ballast and vehicle stiffness as well as damping on the dynamic behaviour of bridges.

The pitching effect is tackled in the seventh chapter. The equations of motion are solved numerically and the two-axle systems in a vehicle or in the whole train and the riding comfort are studied as a function of track irregularities, elasticity and damping. The eighth chapter introduces the concept of contact forces for which an element of vehicle–bridge interaction is also defined. Several numerical examples accompany the explanations. Two-dimensional models of a bridge

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with the moving vehicles are considered in the ninth chapter together with the governing equations. The numerical examples support the theory with respect to the train speed and riding comfort.

The advanced 3D models of the bridge–vehicle interaction are introduced in the tenth chapter. They require rapid computers and long computer time; nevertheless, the authors succeed in presenting numerical results also in this field. They tackle the dynamic characteristics of the bridge–rail–train system and their interaction considering track irregularities together with, naturally, the speed effect. The 11th, and last, chapter studies the simultaneous dynamic action of earthquakes together with moving trains on bridges. Ground vibrations are separated in the vertical and horizontal components and the authors apply well-known seismic records to their evaluations. They analyse the contact forces between wheels and rails and study the response and stability of both the bridge and train.

The ten additional appendices explain the derivation of some equations. The comprehensive list of references gives a broad survey of the subject. The references come from all over the world—it is only a pity that the research activities of the European Rail Research Institute (ERRI) and the Office for Research and Experiments (ORE) are not mentioned.

The book is well and understandably written at a high level. The authors apply modern computational methods and present some new problems for international scientific discussion. Paramount is the simultaneous action of moving loads together with the seismic forces and their effect on the dynamic behaviour of bridges. In summary, the book can be warmly recommended to anybody who is working in structural dynamics, scientists, engineers and students of bridge engineering and generally to anybody who wishes to gain a wealth of knowledge and insight into the problem.

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