

Book review

Cable Supported Bridges: Concept and Design, 3rd edn

Niels J. Gimsing and Christos T. Georgakis. John Wiley & Sons, Chichester, UK, 2012, ISBN 978-0-470-66628-9, £115, 600 pp.

This publication is the second update of the original book published in 1983. The authors maintain that this edition is more than just a simple updating of the second edition and is necessary due to the recent construction of notable cable supported bridges and issues related to dynamic actions gaining in prominence. Two new chapters have been added to cover dynamic actions and structural health monitoring. However, potential readers should be aware that this book is definitely not a design guide and a subtitle 'Conceptual Design' rather than 'Concept and Design', would be a more accurate reflection of its contents.

In the first chapter, the evolution of cable supported bridges is examined, exploring early linear elastic and statically indeterminate design methods, and how the development of subsequent structural forms can be traced to developments in analytical methods in the early days of cable supported bridges. The current edition includes references to the recently completed Stonecutters Bridge in Hong Kong and the Forth Replacement Crossing in Scotland, which is under construction, but more information on the technical aspects of the analyses and design would have been beneficial.

Chapter 2 describes the various types of cables and appears substantially unchanged from the second edition, albeit that the section on corrosion protection has been updated to include dehumidification, which the authors advise was used for the first time in the Akashi Kaikyu Bridge in Japan. Sections 2.4 and 2.5 discuss 'The single cable as a structural element' and 'Static analysis of cables'. Although unchanged from the second edition, they are particularly relevant to those new to the design of cable supported structures and the computational aspects of engineering design of statically indeterminate structures of relatively low stiffness. All too often, the mathematics behind the analysis is hidden from view within complex computer software that, these days, includes time-dependent analyses. The absence of significant recognition of the role of computers and modelling guidance is a definite oversight and rather dates the publication. Be clear, this is not a manual to be used for detailed design purposes – there are too many gaps and lack of rigour in the subject matter – but it is still a useful introduction to the subject.

Chapter 3 considers the different types of cable systems and explains, with the aid of case studies, the merits of each. Suspension, fan, harp, hybrid and multi-span cable systems are described, along with associated forms of pylons. Various mathematical equations are given, but these are largely geometrical expressions for forces and quantities that would be generated accurately by modern software. More interesting is section 3.9, which explains the interrelationship of vertical and torsional oscillations, an important consideration for the design of cable supported structures.

The merits of different types of decks for carrying load between cable anchor points, assisting the cable systems to carry the load globally and the distribution of concentrated forces, are summarised in chapter 4. In section 4.2, the supporting conditions (vertical, longitudinal and lateral) are discussed and, for those who are not experienced in the design of these types of bridges, provide a good introduction to the effects of articulation

on their behaviour. Section 4.3 describes the 'Distribution of dead load moments' or, more particularly, the interaction between deck deflections, bending moments and cable forces during the erection stages. A stepped procedure for determining the distribution of bending moments is outlined, although in practice computer analysis programs would be used to undertake the process. In section 4.4, the decks of many cable supported bridges are studied and principal dimensions are identified in diagrams and photographs. What struck me is how little duplication there has been between different bridges – evidence that, even if spans are very similar, the different loading requirements and conditions in various parts of the world dictate that each design solution will be unique.

Chapter 5 is dedicated to pylons, including their analysis and resistance to buckling. These tall slender elements are subjected to significant lateral and longitudinal deflections; consequently, the determination of second-order geometrical effects becomes particularly important. Chapter 6 is devoted to cable anchorage and connection, arguably the most critical elements of these bridges in practice, although not complex in global analytical terms. In reality, the stress fluctuations in anchorage components affect their fatigue life and are considered further in chapter 8. Chapter 7 is devoted to erection, cable supported bridges being perhaps the most challenging of all bridge forms to construct. The sequence of erection is an integral feature of every cable supported bridge design and is computationally complex.

Chapter 8 is an entirely new chapter, incorrectly titled 'Aerodynamics', as it actually explains the effect of the interaction between structures and wind, aeroelasticity. This subject was a fundamental omission from the second edition. The concepts of torsional divergence, coupled flutter, buffeting and vortex shedding are explained and appropriate mathematical expressions are derived as part of this process. The new chapter examines the effects of wind on bridge components, including cables and hangers, and the effect and structural and mechanical importance of damping on vibrations.

The final chapter, titled 'Particular issues', is also content introduced for this third edition. The issues covered include pedestrian-induced vibrations, made infamous by the once 'wobbly' Millennium Bridge in London, seismic design and structural health monitoring. The latter subjects are not covered in detail, which is disappointing given their importance. Some trimming of chapter 1, on the evolution of cable supported bridges, would have allowed these subjects to have been treated with more rigour without creating a more voluminous read.

Pleasingly, this book is comprehensively referenced for those wishing to delve into further detail. While not a manual for detailed design, the contents of the book provide a comprehensive knowledge base for students and experienced engineers seeking to expand their understanding of these structures, which themselves continually challenge the boundaries of what is possible.

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