Bridge Deck Erection Equipment

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A best practice guide

Members of IABSE Working Group 6
(Edited by Steve Harridge and Max Meyer)

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Foreword

Impressive machines and the exciting construction methods they allow for building daring and innovative bridges can be found in this book which offers very helpful and most informative guidelines to everyone involved in design and construction of bridges. *Bridge Deck Erection Equipment* illustrates the large variety of erection equipment that is available today to build bridges better, faster and more precisely and provides valuable insight into their planning and use.

Bridges are becoming more and more complex for many reasons. We want to see bridges that add to our quality of life and which contribute to 'Baukultur' (the culture of the built environment). Environmental issues fortunately have entered the public conscience and high performance materials as well as modern analysis methods allow bridges that were not possible before. All these issues, and sometimes, just sheer size, make it necessary to move away from the classic ways of using scaffolding and cranes to build bridges.

Especially for larger bridges, no successful design is possible without bearing the construction process in mind from the start. The possible options to build a bridge form part of the context which determines a given design task, and good design stems from considering all such boundary conditions. Ignoring the reality of available erection methods will lead to unrealistic designs which will later be altered beyond recognition, or get abandoned altogether for economic reasons.

In this sense, this volume closes a gap which some of us did not even know existed. This book makes us aware and grants us access to expert know-how not available to many of us so far. A rich diversity of images brings us closer to the complex contents of this book and the many innovations in bridge building techniques which are described here. Building bridges is always a team effort and here a team of renowned international experts have gathered to generously share their experience with us. Bridge-building has also become global, with workers and contractors coming from all over the world, and so have the methods and machines for erecting decks. Also, it is important to see how bridges get built in different locations such as Europe, China, India and the USA, because these examples can be translated to our local individual contexts.

International associations such as the International Association for Bridge and Structural Engineering (IABSE) are a good platform for international collaboration amongst colleagues and we can be grateful that in this case the outcome has become this book, published by ICE Publishing which has the potential to become the standard work for our community.

Mike Schlaich

About the authors

Jan de Boer

Jan de Boer was educated at the Hogeschool Utrecht. He joined the family business, a contracting firm specialising in bridge construction and civil works for the Dutch polders. He transformed the company into a European group specialising in bridge-building techniques based on jacking and skidding technologies. He has been involved in more than 2500 projects in this field in many European countries.

He is an active member in different working groups of civil engineering societies, such as IABSE, the Dutch Concrete Society and other bridge associations. One of his major contributions is the initiative to create broadly accepted guidelines for this field of activities.

Michael Däbritz

Michael Däbritz received his degree in civil engineering and welding engineering in 2005 from the Technical University of Dresden, Germany. He started his professional career at PeinigerRöRo, the former name of thyssenkrupp Infrastructure, with site management of heavy scaffolding projects for tunnels and bridges in Europe, mainly focusing on movable scaffolding systems.

In 2008 and 2009, he worked as project manager for form travellers and movable scaffolding projects for Doka Austria. He returned to thyssenkrupp in 2010, where he took over the management of the movable scaffolding department in 2013. He is now engaged with many international heavy-scaffolding projects, not exclusively in bridge construction. One of his major fields of activity is the deconstruction of viaducts within existing infrastructure.

Steve Harridge

After six years working for an international steel contractor, Steve Harridge joined Tony Gee and Partners in the UK, working on design-build bridge projects and developing erection schemes for many types of complex structures in over 40 countries. These were mostly on behalf of contractor clients.

He opened TG's Hong Kong office in 1982 and later took responsibility for the firm's international work. He became a partner of the firm in 1984 and an executive director in 2006, retiring from full-time work in 2013. He now does occasional Expert Witness and other advisory tasks. He is a fellow of the Institution of Civil Engineers and the Institution of Structural Engineers in the UK, and was elected a fellow of the Royal Academy of Engineering in 2015.

Elie Homsy

Elie Homsy holds degrees from the University of Texas at Austin and from the Lebanese American University. He is a senior vice president and fellow at Parsons, with 35 years of experience in complex construction technologies, supervising the construction engineering efforts on many large-scale, high-tech transport projects in the Americas, the Middle East, Asia and Africa. His main contributions in construction engineering include the development of means and methods, temporary works, material and equipment selection, constructability reviews, planning, phasing and scheduling.

Elie is an active member of many other committees dealing with bridge and transport technologies, such as the American Segmental Bridge Institute (ASBI) and the Post Tensioning Institute (PTI). He is also a former Board of Directors Chair of, and a volunteer with, Bridges to Prosperity. Elie has been elected to the US National Academy of Construction.

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Mohan Jatkar gained his bachelor's and master's degrees in structural engineering from the College of Engineering, Pune, India. He joined the design section of Gammon India in 1980 and over the years worked on various assignments for the design of bridges, power stations, temporary works and so on. Since 2011, as executive director (technical), he was responsible for design and construction planning functions. He is now technical advisor at Gammon Engineers and Contractors.

His main areas of interest are front-end engineering, resolution of interface technical issues and training. He is a member of various professional bodies and member-secretary for the Indian Roads Congress Committee on Temporary Structures.

Tristan Lecomte

Tristan Lecomte received his master's degree in civil engineering from the National Institute for Applied Sciences (INSA) in Lyon. He then gained a specialised degree in steel structures at the Centre des Hautes Etudes de la Construction, in Paris. He first joined SYSTRA in 2003 as a structural engineer and worked on the design of railway bridges. In 2009, Tristan joined the technical head office of VINCI Construction Grands Projets, becoming involved in the design, specification and fabrication of permanent steel structures. In regards to bridge erection, he supervises the design, outsourcing and commissioning of bridge deck erection equipment and large temporary works.

Max Meyer

Max Meyer has a master's degree in civil engineering and an honorary doctorate of science from ETH in Zurich, Switzerland. He has been working in Asia for more than 30 years and is presently VSL International's Group technical officer. His expertise is in the development of alternative designs, construction concepts and in the detailing of prestressed and stay-suspended structures. He has been involved in the conceptual and detail design of bridge deck erection equipment and temporary works and in the construction engineering for many state-of-the-art bridge projects all over the world.

Alessandro Rovera

Alessandro Rovera gained his master's degree in civil engineer at the Politecnico di Milano. After two years working as an independent professional engineer, he has been working for more than 30 years with Gruppo de Eccher, Italy. As project manager, he worked on various bridge projects in Italy and internationally, developing innovative construction methods, including design and fabrication of the relevant bridge deck construction equipment.

He was part of the team that opened DEAL, a Rizzani de Eccher subsidiary, in 1994, becoming chief executive officer in 2004. He has been involved in many high-tech projects around the world, developing and implementing state-of-the-art equipment for many kinds of bridge deck construction methods and helping the company to advance in the field of permanent and temporary structures design, as well as in the fields of post-tensioning, bearings, expansion joint and anti-seismic devices.

Giulio Maria Scotto

Giulio Maria Scotto gained his bachelor's degree in structural engineering at the University of Firenze, Italy, with his master's thesis prepared at the Ecole Nationale des Ponts et Chaussées, France. After work experience in Freyssinet, Italy, and Italferr, he spent more than 10 years in the technical department of Condotte, being involved in design and construction of both high-speed railway lines and highways, with most of his time spent on site assistance.

Since 2012 he has worked for Freyssinet. He was appointed director of the construction methods department in 2014. The main activities of the department are launched bridges, steel structures and erection methods.

He became a member of the Italian Order of Engineers in 1999.

Philippe Vion

Philippe Vion is a graduate of the Conservatoire National des Arts et Métiers, Paris, where he received a bachelor's degree in civil engineering.

He worked for 33 years for SETRA, the technical arm of the French Road Directorate, and 8 years for SYSTRA, an engineering company, as chief engineer in the civil and structural engineering department. Since January 2017, he has worked for VINCI Construction Grands Projets as chief structural engineer in the design and engineering department.

Philippe's main contribution is in the design and project management of large road bridges, but he also designs various rail bridges for metro, mass transit and high-speed rail projects.

He is a member of associations dealing with bridge and transport technologies, such as the Fédération Internationale du Béton (FIB), the Association Française de Génie Civil (AFGC) and the International Association of Bridge and Structural Engineers (IABSE).

Introduction

Over the last 30 years, the methods for building medium- to long-span bridges have changed dramatically. Pressure to shorten construction time has demanded an increase in the productivity of bridge deck construction, which has led to the use of more sophisticated methods and equipment. The machines that have been developed are commonly called Bridge Deck Erection Equipment (BDE).

New methods of deck construction have allowed bridges to be built in urban areas with much less disruption to the public than would have been possible a generation ago. With the burgeoning demand for high-level urban roads and light rail systems, this progression has not come a moment too soon. Medium- to long-span bridges are now built using equipment that was rarely used 30 years ago, thus requiring permanent works designers to adapt their designs to cater for the techniques now available to them. The benefit to the public is a saving in materials, better value for money and a reduction in environmental disruption while new projects are built.

The purpose of this book is to provide a Best Practice Guide for the bridge construction industry, ranging across the whole spectrum of stakeholders, from the prime client, the main contractor, the permanent works designer, the deck construction contractor, the temporary works designer and the supplier of the equipment, through to the operators who work on the site. It is not a 'recipe book' for the design of BDE. The emphasis here is the need for an integrated approach to bridge design and construction that respects the needs of all the stakeholders and manages the engineering interfaces between temporary and permanent works.

The book is written in four sections. Section 1 gives a classification of different bridge types and covers project management and safety aspects of bridge construction. Section 2 discusses in detail the various types of BDE. In Section 3 there is important information about conceptual bridge design and detailing which should help bridge engineers to make their designs easier to build. It also covers BDE design, the mechanical and electrical components of BDE, precasting and lifting attachments. Section 4 gives recommendations for the industry that will hopefully contribute to an improvement in bridge design and construction.

It covers all aspects of the methods associated with building many types of bridge, principally concrete ones although many of the topics discussed are equally applicable to the construction of steel or steel/concrete composite bridges.

There has been a notable trend among main contractors and even some of the established specialist deck construction contractors to reduce their in-house engineering teams. With this dispersal of expertise, there is a risk that the next generation of bridge builders will find it harder to acquire the level of understanding of bridge construction techniques that currently exists. This book should help to maintain the current levels of knowledge within the industry. It should also be regarded as important reading for engineering students as it is essentially a book of practical engineering guidance.

The intention of the book is to fill the gap in current published information with advice for all the stakeholders listed above. It does not purport to be a manual on permanent works bridge design. There are already many of those available, although some detailing aspects are discussed that can improve the ‘buildability’ of bridges.

The authors are all industry leaders in their field of expertise. Each has written one or more of the chapters but the core aim of the book is to produce a single source of information, avoiding duplication – a distillation of the knowledge of us all.