In Prestressed Concrete Bridge Construction

Bridge Engineering: Classifications, Design Loading, and Analysis Methods begins with a clear and concise exposition of theory and practice of bridge engineering, design and planning, materials and construction, loads and load distribution, and deck systems. This is followed by chapters concerning applications for bridges, such as: Reinforced and Prestressed Concrete Bridges, Steel Bridges, Truss Bridges, Arch Bridges, Cable Stayed Bridges, Suspension Bridges, Bridge Piers, and Bridge Substructures. In addition, the book addresses issues commonly found in inspection, monitoring, repair, strengthening, and replacement of bridge structures. Includes easy to understand explanations for bridge classifications, design loading, analysis methods, and construction Provides an overview of international codes and standards Covers structural features of different types of bridges, including beam bridges, arch bridges, truss bridges, suspension bridges, and cable-stayed bridges Features step-by-step explanations of commonly used structural calculations along with worked out examples Examining the fundamental differences between design and analysis, Robert Benaim explores the close relationship between aesthetic and technical creativity and the importance of the intuitive, more imaginative qualities of design that every designer should employ when designing a structure. Aiding designers of concrete bridges in developing an intuitive understanding of structural action, this book encourages innovation and the development of engineering architecture. Simple, relevant calculation techniques that should precede any detailed analysis are summarized. Construction methods used to build concrete bridge decks and substructures are detailed and direct guidance on the choice and the sizing of different types of concrete bridge deck is given. In addition guidance is provided on solving recurring difficult problems of detailed design and realistic examples of the design process are provided. This book enables concrete bridge designers to broaden their scope in design and provides an analysis of the necessary calculations and methods.

An effective, viable design solution for the elevated viaduct guideway for Universal Freight Shuttle (UFS) system championed by Texas Transportation Institute (TTI) is presented. The proposed precast elevated UFS bridge system is analyzed for the operational vehicular loading as provided by TTI and a number of design alternatives for the various bridge components are provided. These includes: the design of the fully precast deck panels for long continuous spans, design of the shear connectors resisting interface shear at bridge deck-girder interface, design of structurally efficient and cost-effective trough girders and its design alternative with I-girders, and economic and long-term serviceable design of bridge piers. A literature review and study of the existing precast bridges is presented for the state-of-the-art and practice, design specifications and publications by AASHTO, State Department of Transportation and other agencies. These existing systems are refined to determine the most appropriate specification for the proposed bridge components by integrating the planning, design, fabrication and construction techniques to ensure high precision freight shuttle movement, construction feasibility, safety, life-cycle cost, durability and serviceability requirements. The design concept presented is a deviation from the conventional railways and highways design. The best practices and specifications of AASHTO and AREMA are combined suitably in this research to suit the major requirements of the project. A combination of the design philosophy with appropriate construction techniques has been blended to devise a system which is efficient for offsite manufacture of components for construction of the bridge and adaptable to the different bridge configurations. Based on the design results, it is found that precast concrete deck panels in combination with precast, prestressed concrete trough girders provides the most efficient superstructure solution for this project. The Damage Avoidance Design for the precast bridge piers along with the precast superstructure provides a system with comparable structural performance along with other benefits such as long term serviceability, economical sections, practically transportable units, modular simplicity for relocation as desired and ability to offer space for commercial usage. The steps for construction of the bridge is schematically presented and sequentially explained. The electronic version of this dissertation is accessible from http://hdl.handle.net/1969.1/150928

Since the first prestressed concrete bridge was built and launched by Freyssinet in 1941, such structures have soared to greater heights due to computer-aided design and innovative materials. Rosignoli, a consulting engineer practicing in Italy and abroad, distills aesthetic/environmental consciousn

Methods and practices for constructing sophisticated prestressedconcrete structures. Construction of Prestressed Concrete Structures, Second Edition,provides the engineer or construction contractor with a completeguide to the design and construction of modern, high-qualityconcrete structures. This highly practicable new edition of Ben C.Gerwick's classic guide is expanded and almost entirely rewrittento reflect the dramatic developments in materials and techniquesthat have occurred over the past two decades. The first of the book's two sections deals with materials andtechniques for prestressed concrete, including the latest recipesfor high-strength and durable concrete mixes, new reinforcingmaterials and their placement patterns, modern prestressingsystems, and special techniques such as lightweight concrete andcomposite construction. The second section covers application tobuildings; bridges; pilings; and marine structures, includingoffshore platforms, floating structures, tanks, and containments.Special subjects such as cracking and corrosion, repair andstrengthening of existing structures, and construction in remoteareas are presented in the final chapters. For engineers and construction contractors involved in any type ofprestressed concrete construction, this book enables the effectiveimplementation of advanced structural concepts and their economicaland reliable translation into practice.

This edited volume brings together findings and case studies on fundamental and applied aspects of structural engineering, applied to buildings, bridges and infrastructures in general. It focuses on the application of advanced experimental and numerical techniques and new technologies to the built environment. This volume is part of the proceedings of the 1st GeoMEast International Congress and Exhibition on Sustainable Civil Infrastructures, Egypt

2017.
The concept of prestressed concrete appeared in 1888 when P.H. Jackson was granted the first patent in the United States for prestressed concrete design. Jackson's idea was perfect, but the technology of high strength steel that exhibited low relaxation characteristics was not yet available. It was not until Eugene Freyssinet defined the need for these materials that prestressed concrete could be used as a structural building material. Unfortunately, although Freyssinet, a brilliant structural designer and bridge builder, lacked the teaching qualities necessary to communicate his ideas to other engineers. It would take Gustave Magnel to write the first book of design in prestressed concrete, communicating this idea to designers worldwide. Magnel designed and built the legendary Walnut Lane Bridge in Philadelphia, which revolutionized prestressed concrete in America. Simultaneously, Urlich Finsterwalder, the German bridge builder and designer, was revolutionizing the construction means and methods for prestressed concrete bridges. For example, Finsterwalder invented the free-cantilever construction method of prestressed concrete bridges, which allowed long span bridges to be constructed without stabilized shoring. He then designed stress-ribbon bridges, which would eventually allow prestressed concrete to span distances only steel suspension bridges could achieve. However, it wasn't until Paul Abeles and his peer, H. von Emperger studied and tested prestressed concrete that the idea of 0?partial prestressing0?+ emerged. Initially, Freyssinet and Magnel were adamant that prestressed concrete should

not be allowed to exhibit any tensile forces at sustained loading. Later, the Roebling family developed the first stress--relieved wire followed by the first stress-- relieved strand. T.Y. Lin once again brought prestressed concrete back into the spotlight when he organized the First Prestressed Concrete World Conference in 1957. Shortly after this conference, Lin published a technical paper in the Prestressed Concrete Institute (PCI) Journal that introduced a new Load Balancing technique which allowed most structural engineers to design prestressed concrete very easily.

Advanced composite materials for bridge structures are recognized as a promising alternative to conventional construction materials such as steel. After an introductory overview and an assessment of the characteristics of bonds between composites and quasi-brittle structures, Advanced Composites in Bridge Construction and Repair reviews the use of advanced composites in the design and construction of bridges, including damage identification and the use of large rupture strain fiber-reinforced polymer (FRP) composites. The second part of the book presents key applications of FRP composites in bridge construction and repair, including the use of all-composite superstructures for accelerated bridge construction, engineered cementitious composites for bridge decks, carbon fiber-reinforced polymer composites for cable-stayed bridges and for repair of deteriorated bridge substructures, and finally the use of FRP composites in the sustainable replacement of ageing bridge superstructures. Advanced Composites in Bridge Construction and Repair is a technical guide for engineering professionals requiring an understanding of the use of composite materials in bridge construction. Reviews key applications of fiber-reinforced polymer (FRP) composites in bridge construction and repair Summarizes key recent research in the suitability of advanced composite materials for bridge structures as an alternative to conventional construction materials

This research evaluates the use of precast, prestressed bridge deck panels on new and existing precast, prestressed concrete girders. The evaluation focuses on the ease of construction and the ability of the system to develop composite action with the concrete girders. A system developed by the Connecticut Department of Transportation (CDOT) and Precast/Prestressed Concrete Institute New England Region (PCINER) was chosen for testing from available systems because it is representative of the current geometry of precast bridge deck panels. The CDOT system was evaluated in a series of large scale tests in which the panels were placed on a 40 ft prestressed concrete girder and subjected to three point loading. The CDOT system is compared to a new system developed as part of the research program. The new system addresses durability and ease of construction issues that are problematic with current joint details. The strength and geometry of both the current and new joint details are evaluated and compared in a series of direct shear tests. A final, large scale specimen was designed, constructed, and loaded to evaluate the new system. It was concluded that the behavior of the new system is comparable to that of the

CDOT system. In addition, the new system is easy to construct and minimizes deck penetrations, thereby enhancing durability. This research has the potential to impact the way in which the aging highway system is rehabilitated and replaced by reducing the associated time and costs of construction while decreasing disruption to the traveling public.

This book is an essential purchase for all those involved in bridge construction and innovative building techniques, such as bridge owners, design offices, bridge consultants, and construction equipment suppliers.

Also available via the Internet.

Prestressed concrete decks are commonly used for bridges with spans between 25m and 450m and provide economic, durable and aesthetic solutions in most situations where bridges are needed. Concrete remains the most common material for bridge construction around the world, and prestressed concrete is frequently the material of choice. Extensively illustrated throughout, this invaluable book brings together all aspects of designing prestressed concrete bridge decks into one comprehensive volume. The book clearly explains the principles behind both the design and construction of prestressed concrete bridges, illustrating the interaction between the two. It covers all the different types of deck arrangement and the construction techniques used, ranging from in-situ slabs and precast beams; segmental construction and launched bridges; and cable-stayed structures. Included throughout the book are many examples of the different types of prestressed concrete decks used, with the design aspects of each discussed along with the general analysis and design process. Detailed descriptions of the prestressing components and systems used are also included. Prestressed Concrete Bridges is an essential reference book for both the experienced engineer and graduate who want to learn more about the subject.

An extensively illustrated handbook summarizing the current state of the art of design and construction methods for all types of segmental bridges. Covers construction methodology, design techniques, economics, and erection of girder type bridges; arch, rigid frame, and truss bridges; cable-stayed bridges; and railroad bridges.

This textbook imparts a firm understanding of the behavior of prestressed concrete and how it relates to design based on the 2014 ACI Building Code. It presents the fundamental behavior of prestressed concrete and then adapts this to the design of structures. The book focuses on prestressed concrete members including slabs, beams, and axially loaded members and provides computational examples to support current design practice along with practical information related to details and construction with prestressed concrete. It illustrates concepts and calculations with Mathcad and EXCEL worksheets. Written with both lucid instructional presentation as well as comprehensive, rigorous detail, the book is ideal for both students in graduate-level courses as well as practicing engineers.

This book was written with a dual purpose, as a reference book for practicing engineers and as a textbook for students of prestressed concrete. It represents the fifth generation of books on this subject written by its author. Significant additions and revisions have been made in this edition. Chapters 2 and 3 contain new material intended to assist the engineer in understanding factors affecting the time-dependent properties of the reinforcement and concrete used in prestressing concrete, as well as to facilitate the evaluation of their effects on prestress loss and deflection. Flexural strength, shear strength, and bond of prestressed concrete members were treated in a single chapter in the of flexural strength has third edition. Now, in the fourth edition, the treatment been expanded, with more emphasis on strain compatibility, and placed in Chapter 5 which is devoted to this subject alone. Chapter 6 of this edition, on flexural-shear strength, torsional strength, and bond of prestressed reinforce ment, was expanded to include discussions of Compression Field Theory and torsion that were not treated in the earlier editions. In similar fashion, expanded discussions of loss of prestress, deflection, and partial prestressing now are presented separately, in Chapter 7. Minor additions and revisions have been made to the material contained in the remaining chapters with the exception of xv xvi I PREFACE Chapter 17. This chapter, which is devoted to construction considerations, has important new material on constructibility and tolerances as related to prestressed concrete.

Precast prestressed concrete panels have been used as subdecks in bridge construction in Iowa and other states. To investigate the performance of these types of composite slabs at locations adjacent to abutment and pier diaphragms in skewed bridges, a research project which involved surveys of design agencies and precast producers, field inspections of existing bridges, analytical studies, and experimental testing was conducted. The survey results from the design agencies and panel producers showed that standardization of precast panel construction would be desirable, that additional inspections at the precast plant and at the bridge site would be beneficial, and that some form of economical study should be undertaken to determine actual cost savings associated with composite slab construction. Three bridges in Hardin County, Iowa were inspected to observe general geometric relationships, construction details, and to note the visual condition of the bridges. Hairline cracks beneath several of the prestressing strands in many of the precast panels were observed, and a slight discoloration of the concrete was seen beneath most of the strands. Also, some rust staining was visible at isolated locations on several panels. Based on the findings of these inspections, future inspections are recommended to monitor the condition of these and other bridges constructed with precast panel subdecks. Five full-scale composite slab specimens were constructed in the Structural Engineering Laboratory at Iowa State University. One specimen modeled bridge deck conditions which are not adjacent to abutment or pier diaphragms, and the other four specimens represented the geometric conditions which occur for skewed diaphragms of 0, 15, 30, and 40 degrees. The specimens were subjected to wheel loads of service and factored level magnitudes at many locations on the slab surface and to concentrated loads which produced failure of the composite slab. The measured slab deflections and bending strains at both service and factored load levels compared reasonably well with the results predicted by simplified Finite element analyses of the specimens. To analytically evaluate the nominal strength for a composite slab specimen, yield-line and punching shear theories were applied. Yield-line limit loads were computed using the crack patterns generated during an ultimate strength test. In most cases, these analyses indicated that the failure mode was not flexural. Since the punching shear limit loads in most instances were close to the failure loads, and since the failure surfaces immediately adjacent to the wheel load footprint appeared to be a truncated prism shape, the probable failure mode for all of the specimens was punching shear. The development lengths for the prestressing strands in the rectangular and trapezoidal shaped panels was qualitatively investigated by monitoring strand slippage at the ends of selected prestressing strands. The initial strand transfer length was established experimentally by monitoring concrete strains during strand detensioning, and this length was verified analytically by a finite element analysis. Even though the computed strand embedment lengths in the panels were not sufficient to fully develop the ultimate strand stress, sufficient stab strength existed. Composite behavior for the slab specimens was evaluated by monitoring slippage between a panel and the topping slab and by computation of the difference in the flexural strains between the top of the precast panel and the underside of the topping slab at various locations. Prior to the failure of a composite slab specimen, a localized loss of composite behavior was detected. The static load strength performance of the composite slab specimens significantly exceeded the design load requirements. Even with skew angles of up to 40 degrees, the nominal strength of the slabs did not appear to be affected when the ultimate strength test load was positioned on the portion of each slab containing the trapezoidal-shaped panel. At service and factored level loads, the joint between precast panels did not appear to influence the load distribution along the length of the specimens. Based on the static load strength of the composite slab specimens, the continued use of precast panels as subdecks in bridge deck construction is recommended.

This manual contains updated information on the current practices in the use, design, and construction of post-tensioning. The 6th Edition has been extensively rewritten and expanded from the 5th Edition. The Manual contains 12 new chapters that give design guidance on modern applications of post-tensioning. All of the original chapters have been totally revised and modified to reflect the current industry practices. New topics include Seismic Design, Post-Tensioned Concrete Floors, Parking Structures, Slab-on-Ground, Bridges, Stay Cables, Storage Structures, Barrier Cables, Dynamic and Fatigue, Durability, Inspection and Maintenance, and Field and Plant Certification. The Manual provides the industry standard for design and construction of post-tensioned structures. This book is an invaluable resource for practicing engineers, architects, students, educators, contractors, inspectors, and building officials. The 6th Edition of the Post-Tensioning Manual provides basic information and the essential principles of post-tensioning. Throughout the United States accelerated bridge construction is becoming increasingly popular to meet growing transportation demands while keeping construction time and costs to a minimum. This research focuses on eliminating the need to form full-depth concrete bridge deck overhangs, accelerating the construction of concrete bridge decks, by using full-depth precast prestressed concrete deck panels. Full-depth precast overhang panels in combination with cast-in-place (CIP) reinforced concrete are experimentally and analytically investigated to assess the structural performance. Experimental loaddeformation behavior for factored AASHTO LRFD design load limits is examined followed by the collapse capacity of the panel-to-panel seam that exists in the system. Adequate strength and stiffness of the proposed full-depth panels deem the design safe for implementation for the Rock Creek Bridge in Fort Worth, Texas. New failure theories are derived for interior and exterior bridge deck spans as present code-based predictions provide poor estimates of the ultimate capacity. A compound shear-flexure failure occurs at interior bays between the CIP topping and stay-in-place (SIP) panel. Overhang failure loads are characterized as a mixed failure of flexure on the loaded panel and shear at the panel-to-panel seam. Based on these results design recommendations are presented to optimize the reinforcing steel layout used in concrete bridge decks.

Concrete remains the most common material for bridge construction around the world, and prestressed concrete is frequently the material of choice. Prestressed concrete bridges provide economic, durable and aesthetic solutions in most situations. The second edition has been updated to take account of Eurocodes and the content expanded in areas, such as: the inspection, maintenance and demolition of prestressed concrete bridges; integral bridges; temporary works and construction requirement. The first edition of this title sold very well for us and the a main competitive title – Design of prestressed concrete bridges, published in 2007 so there is a market gap for an up to date title. Prestressed concrete is a method for overcoming concrete's natural weakness in tension. Prestressing can be accomplished in three ways: pre-tensioned concrete, and bonded or unbonded post-tensioned concrete.

The Texas Department of Transportation designs typical highway bridge structures as simple span systems using standard precast, pretensioned girders. Spans are limited to about 150 ft due to weight and length restrictions on transporting the precast girder units from the prestressing plant to the bridge site. Such bridge construction, while economical from an initial cost point of view, may become somewhat limiting when longer spans are needed. This project focused on developing additional economical design alternatives for longer span bridges with main spans ranging from 150-300 ft, using continuous precast, prestressed concrete bridge structures with in-span splices. Phase 1 of this study focused on evaluating the current state-of-the-art and practice relevant to continuous precast concrete girder bridges and recommending suitable continuity connections for typical Texas bridge girders; the findings are documented in the Volume 1 project report. This report summarizes Phase 2 of the research including detailed design examples for shored and partially shored construction, results of a parametric design study, and results of an experimental program that tested a full-scale girder containing three splice connections. The parametric design study indicated that for bridges spanning from 150-300 ft, continuous precast, prestressed concrete girder bridges with in-span splices can provide an economical alternative to steel girder bridges and segmental concrete box girder construction. The tested splice connections performed well under service level loads. However, the lack of continuity of the pretensioning through the splice connection region had a significant impact on the behavior at higher loads approaching ultimate conditions. Improved connection behavior at ultimate conditions is expected through enhanced connection details. Recommendations for design of continuous spliced precast girders, along with several detailing suggestions are discussed in the report. Load Testing of Bridges, featuring contributions from almost fifty authors from around the world across two interrelated volumes, deals with the practical aspects, the scientific developments, and the international views on the topic of load testing of bridges. Volume 12, Load

Testing of Bridges: Current practice and Diagnostic Load Testing, starts with a background to bridge load testing, including the historical perspectives and evolutions, and the current codes and guidelines that are governing in countries around the world. The second part of the book deals with preparation, execution, and post-processing of load tests on bridges. The third part focuses on diagnostic load testing of bridges. This work will be of interest to researchers and academics in the field of civil/structural engineering, practicing engineers and road authorities worldwide.

In July 2006, construction began on an accelerated bridge project in Boone County, Iowa that was composed of precast substructure elements and an innovative, precast deck panel system. The superstructure system consisted of full-depth deck panels that were prestressed in the transverse direction, and after installation on the prestressed concrete girders, post-tensioned in the longitudinal direction. Prior to construction, laboratory tests were completed on the precast abutment and pier cap elements. The substructure testing was to determine the punching shear strength of the elements. Post-tensioning testing and verification of the precast deck system was performed in the field. The forces in the tendons provided by the contractor were verified and losses due to the post-tensioning operation were measured. The stress (strain) distribution in the deck panels due to the post-tensioning was also measured and analyzed. The entire construction process for this bridge system was documented. Representatives from the Boone County Engineers Office, the prime contractor, precast fabricator, and researchers from Iowa State University provided feedback and suggestions for improving the constructibility of this design.

The traveling public has no patience for prolonged, high cost construction projects. This puts highway construction contractors under intense pressure to minimize traffic disruptions and construction cost. Actively promoted by the Federal Highway Administration, there are hundreds of accelerated bridge construction (ABC) construction programs in the United States, Europe and Japan. Accelerated Bridge Construction: Best Practices and Techniques provides a wide range of construction techniques, processes and technologies designed to maximize bridge construction or reconstruction operations while minimizing project delays and community disruption. Describes design methods for accelerated bridge substructure construction; reducing foundation construction time and methods by using pile bents Explains applications to steel bridges, temporary bridges in place of detours using quick erection and demolition Covers design-build systems' boon to ABC; development of software; use of fiber reinforced polymer (FRP) Includes applications to glulam and sawn lumber bridges, precast concrete bridges, precast joints details; use of lightweight aggregate concrete, aluminum and high-performance steel

This book was written to make the material presented in my book, Stahlbetonbrucken, accessible to a larger number of engineers throughout the world. A work in English, the logical choice for this task, had been contemplated as Stahlbetonbrucken was still in its earliest stages of preparation. The early success of Stahlbetonbrucken provided significant impetus for the writing of Prestressed Concrete Bridges, which began soon after the publication of its predecessor. The present work is more than a mere translation of Stahlbetonbrucken. Errors in Stahlbetonbrucken that were detected after publication have been corrected. New material on the relation between cracking in concrete and corrosion of reinforce ment, prestressing with unbonded tendons, skew-girder bridges, and cable-stayed bridges has been added. Most importantly, however, the presentation of the material has been extensively reworked to improve clarity and consistency. Prestressed Concrete Bridges can thus be regarded as a thoroughly new and improved edition of its predecessor.

Prestressed Concrete BridgesDesign and ConstructionThomas Telford

Right from the inception of the implementation of prestressed concrete in the bridge construction field, it has been very popular. Even though this type of bridges has big advantages, cracking is a major problem. The cracking event, due to its detrimental effects on the structure is the most objectionable problem. In cracking shrinkage plays a very significant role. This implies that the study of shrinkage is essential to study the phenomenon of cracking. Due to many variables responsible for deck cracking, it is very difficult to study the overall effect of these variegated factors taken in the consideration at a time. This thesis aims to confluence as many such aspects as possible in a single plane of consideration with the help of Finite Element software namely ABAQUS. The goal of this research is to study shrinkage,

shrinkage effects, and factors affecting the shrinkage and ultimately to incorporate the shrinkage effects in Finite Element Modeling. Here the study is constrained to Prestressed Concrete Bridge. Thus, the research is carried to incorporate the shrinkage effects in FE Modeling of Prestressed Concrete Bridge. This is a difficult task as many finite element programs do not have pre-programmed methods for simulating the time dependent properties of concrete. Therefore, it is necessary to develop these methods. This study concentrates on trying to simulate the behavior of a simple span bridge as a means of developing the basic analytical method. In the research Abaqus has been selected and the selection has been justified for the purpose of analyzing time dependent effects in bridges. A parametric study has been carried out with a view to identifying the effects of various parameters of shrinkage in a structure. The effects of the parameters such as length of the span, girder spacing, deck thickness and modulus of elasticity of girder have been analyzed with the help of bridges modeled in Abaqus. The parametric study concludes that shrinkage strain increases with increase in length and spacing of girder. The shrinkage strain decreases with increase in compressive strength of girder and deck thickness.
First Published in 1999: The Bridge Engineering Handbook is a unique, comprehensive, and state-of-the-art reference work and resource book covering the major areas of bridge engineering with the theme "bridge to the 21st century."