

# **Composite Materials In Maritime Structures Volume 2 Practical Considerations Cambridge Ocean Technology Series**

This book is an attempt to present an integrated and unified approach to the analysis of FRP composite materials which have a wide range of applications in various engineering structures—offshore, maritime, aerospace and civil engineering; machine components; chemical engineering applications, and so on.

This book deals with all aspects of advanced composite materials; what they are, where they are used, how they are made, their properties, how they are designed and analyzed, and how they perform in-service. It covers both continuous and discontinuous fiber composites fabricated from polymer, metal, and ceramic matrices, with an emphasis on continuous fiber polymer matrix composites.

This book addresses the concepts of material selection and analysis, choice of structural form, construction methods, environmental loads, health monitoring, non-destructive testing, and repair methodologies and rehabilitation of ocean structures. It examines various types of ocean and offshore structures, including drilling platforms, processing platforms and vessels, towers, sea walls and surge barriers, and more. It also explores the use of MEMS in offshore structures, with regard to military and oil exploration applications. Full-color figures as well as numerous solved problems and examples are included to help readers understand the applied

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concepts.

A compact presentation of the foundations, current state of the art, recent developments and research directions of all essential techniques related to the mechanics of composite materials and structures. Special emphasis is placed on classic and recently developed theories of composite laminated beams, plates and shells, micromechanics, impact and damage analysis, mechanics of textile structural composites, high strain rate testing and non-destructive testing of composite materials and structures. Topics of growing importance are addressed, such as: numerical methods and optimisation, identification and damage monitoring. The latest results are presented on the art of modelling smart composites, optimal design with advanced materials, and industrial applications. Each section of the book is written by internationally recognised experts who have dedicated most of their research work to a particular field.

Readership: Postgraduate students, researchers and engineers in the field of composites.

Undergraduate students will benefit from the treatment of the foundations of the mechanics of composite materials and structures.

Durability analysis can be defined as the prediction methodology of safe residual behaviour after a given life time under a complex mechanical loading history in combination with a program of environmental variations. This was, and is a central problem for the reliability of structural components whatever are the basic material systems. With composite systems, combination of different materials in interaction, an integrated material structure design becomes possible. If one of the phases is a polymer, the composite system has time dependent properties and as consequence durability analysis has to be performed taking into account the internal time factor in combination with strong influences from temperature

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changes and moisture diffusion. Insurance companies need information on durability and reliability in order to cover the risks, and in the event of failure lawyers have to arrive at an agreement on the responsibilities of the different actors involved in the construction. This book is an overview of the state of the different aspects of safe structural integrity for a given lifetime of composite structures, with special emphasis on polymer matrix composites. It is of interest for scientists and engineers involved in composites and for designers of composite structural components.

Composite Materials presents recent developments and state-of-the-art achievements in the science and technology of composites. It identifies and discusses key and emerging issues for future progress in the multidisciplinary field of composites. By bringing together leading experts and promising innovators from research institutions and academia, Composite Materials highlights unresolved issues and identifies opportunities for long-term research needs to provide the reader with a vision for the future in various fields of application of composite materials. A few of the many future directions highlighted in the book are increasingly multifunctional properties; complex, hybrid and nanoreinforced materials; and tailoring in multiple dimensions and directions. The wider areas covered include, but are not limited to, the following: biomedical engineering, civil engineering, aerospace engineering, automotive engineering, and naval engineering. Composite Materials is designed to increase the reader's understanding of the state of the art of composite materials in a variety of industrial sectors and to explore future needs and opportunities. It will therefore be of use to professionals working in the composites industry, research centers, and academia, who already have a graduate-level knowledge of composite materials.

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Composite Materials in Maritime Structures: Volume 1, Fundamental Aspects Cambridge University Press

Biomaterials is currently one of the most important fields of study. This is because of the high degree of interdisciplinarity and the many practical solutions it provides in relation to medicine, biology, chemistry, and physics. This Special Issue provides readers with research from the domain of composite biomaterials in different applications, from controlled drug release systems to tissue engineering.

Marine Composites: Design and Performance presents up-to-date information and recent research findings on the application and use of advanced fibre-reinforced composites in the marine environment. Following the success of their previously published title: Marine Applications of Advanced Fibre-reinforced Composites which was published in 2015; this exemplary new book provides comprehensive information on materials selection, characterization, and performance. There are also dedicated sections on sandwich structures, manufacture, advanced concepts, naval architecture and design considerations, and various applications. The book will be an essential reference resource for designers, materials engineers, manufactures, marine scientists, mechanical engineers, civil engineers, coastal engineers, boat manufacturers, offshore

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platform and marine renewable design engineers. Presents a unique, high-level reference on composite materials and their application and use in marine structures Provides comprehensive coverage on all aspects of marine composites, including the latest advances in damage modelling and assessment of performance Contains contributions from leading experts in the field, from both industry and academia Covers a broad range of naval, offshore and marine structures

Marine Structural Design, Second Edition, is a wide-ranging, practical guide to marine structural analysis and design, describing in detail the application of modern structural engineering principles to marine and offshore structures. Organized in five parts, the book covers basic structural design principles, strength, fatigue and fracture, and reliability and risk assessment, providing all the knowledge needed for limit-state design and re-assessment of existing structures. Updates to this edition include new chapters on structural health monitoring and risk-based decision-making, arctic marine structural development, and the addition of new LNG ship topics, including composite materials and structures, uncertainty analysis, and green ship concepts. Provides the structural design principles, background theory, and know-how needed for marine and offshore structural design by analysis Covers strength, fatigue and fracture,

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reliability, and risk assessment together in one resource, emphasizing practical considerations and applications. Updates to this edition include new chapters on structural health monitoring and risk-based decision making, and new content on arctic marine structural design.

This book is the first to deal with the important topic of the fire behaviour of fibre reinforced polymer composite materials. The book covers all of the key issues on the behaviour of composites in a fire. Also covered are fire protection materials for composites, fire properties of nanocomposites, fire safety regulations and standards, fire test methods, and health hazards from burning composites.

Lightweighting is a concept well known to structural designers and engineers in all applications areas, from laptops to bicycles to automobiles to buildings and airplanes. Reducing the weight of structures can provide many advantages, including increased energy efficiency, better design, improved usability, and better coupling with new, multifunctional features. While lightweighting is a challenge in commercial structures, the special demands of military vehicles for survivability, maneuverability and transportability significantly stress the already complex process. *Application of Lightweighting Technology to Military Vehicles, Vessels, and Aircraft* assesses the current state of lightweighting implementation in land, sea, and air vehicles and recommends ways to improve the use of

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lightweight materials and solutions. This book considers both lightweight materials and lightweight design; the availability of lightweight materials from domestic manufacturers; and the performance of lightweight materials and their manufacturing technologies. It also considers the "trade space"--that is, the effect that use of lightweight materials or technologies can have on the performance and function of all vehicle systems and components. This book also discusses manufacturing capabilities and affordable manufacturing technology to facilitate lightweighting. Application of Lightweighting Technology to Military Vehicles, Vessels, and Aircraft will be of interest to the military, manufacturers and designers of military equipment, and decision makers.

Structural health monitoring (SHM) is a relatively new and alternative way of non-destructive inspection (NDI). It is the process of implementing a damage detection and characterization strategy for composite structures. The basis of SHM is the application of permanent fixed sensors on a structure, combined with minimum manual intervention to monitor its structural integrity. These sensors detect changes to the material and/or geometric properties of a structural system, including changes to the boundary conditions and system connectivity, which adversely affect the system's performance. This book's primary focus is on the diagnostics element of SHM, namely damage detection in composite structures.

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The techniques covered include the use of Piezoelectric transducers for active and passive Ultrasonics guided waves and electromechanical impedance measurements, and fiber optic sensors for strain sensing. It also includes numerical modeling of wave propagation in composite structures. Contributed chapters written by leading researchers in the field describe each of these techniques, making it a key text for researchers and NDI practitioners as well as postgraduate students in a number of specialties including materials, aerospace, mechanical and computational engineering. Contents: Damage Detection and Characterization with Piezoelectric Transducers — Active Sensing (Z Sharif Khodaei and M H Aliabadi) Modeling Guided Wave Propagation in Composite Structures Using Local Interaction Simulation Approach (Yanfeng Shen and Carlos E S Cesnik) Design and Development of a Phased Array System for Damage Detection in Structures (Bruno Rocha, Mehmet Yildiz & Afzal Suleman) Degradation Detection in Composite Structures with PZT Transducers (Wiesław M Ostachowicz, Paweł H Malinowski & Tomasz Wandowski) Numerical Modelling of Wave Propagation in Composite Structures (Sourav Banerjee) SHM of Composite Structures by Fibre Optic Sensors (Alfredo Guemes) Impact Detection and Identification with Piezoceramic Sensors — Passive Sensing (Z Sharif Khodaei and M H Aliabadi) Readership: Researchers



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and NDI practitioners as well as postgraduate students in a number of specialties including materials, aerospace, mechanical and computational engineering.

Keywords: Structural Health Modelling; Non-Destructive Inspection; Diagnostic SHM; Aerospace Engineering; Microelectromechanical Systems; Acoustic Emission Monitoring; Accelerometers Review: 0

Fiber composites, like metals, exhibit a form of degradation in service described as fatigue. Engineers must understand composite fatigue because it is a causative agent of design and structural failures. Engineers need to increase their knowledge of the mechanisms which result in degradation in order to predict the life of a composite under specified conditions and produce composites with greater durability. This book provides an extensive account of contemporary research on fatigue from a selection of internationally recognized researchers. Part one introduces the concept, delivering a historical review of the fatigue behavior of fiber-reinforced plastics and illustrating fatigue test methods and fatigue under multiaxial stress systems. The second part reviews current research on micromechanical aspects, emphasizing long-term behavior, interface performance, delamination, and damage accumulation. The next two sections cover the analysis and testing of fatigue behavior and detail physical, micromechanical, computational, statistical, and life-prediction models for

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constant and variable stress. The final parts offer an overview of the wide range of composite fatigue-related problems experienced by engineers in aerospace, marine, and structural engineering.

Presentations by advanced materials specialists from around the world. Of special interest in this volume are the presentations on application areas such as automotive and civil engineering, nanomaterials, ceramic/metal composites, smart materials, and composite structures.

This book collects major research contributions in composite materials and sandwich structures supported by the U.S. Office of Naval Research. It contains over thirty chapters written by experts and serves as a reference and guide for future research.

In Carbon Fiber Composites, the reader is introduced to a wide range of carbon fiber composites, including polymer-matrix, metal matrix, carbon-matrix, ceramic-matrix and hybrid composites. The subject is examined in a tutorial fashion, so that no prior knowledge of the field is required. In contrast to other books on composites, this book emphasizes materials rather than mechanics, as the prominence of composite materials has resulted from their increased presence in applications other than structure. Provides up-to-date information on the entire spectrum of carbon fiber composites Emphasizes processing as the foundation of

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composite materials development Addresses the processing, properties and applications of each type of material systematically

Methods and practices for constructing sophisticated prestressed concrete structures. Construction of Prestressed Concrete Structures, Second Edition, provides the engineer or construction contractor with a complete guide to the design and construction of modern, high-quality concrete structures. This highly practicable new edition of Ben C. Gerwick's classic guide is expanded and almost entirely rewritten to reflect the dramatic developments in materials and techniques that have occurred over the past two decades. The first of the book's two sections deals with materials and techniques for prestressed concrete, including the latest recipes for high-strength and durable concrete mixes, new reinforcing materials and their placement patterns, modern prestressing systems, and special techniques such as lightweight concrete and composite construction. The second section covers application to buildings; bridges; pilings; and marine structures, including offshore platforms, floating structures, tanks, and containments. Special subjects such as cracking and corrosion, repair and strengthening of existing structures, and construction in remote areas are presented in the final chapters. For engineers and construction contractors involved in any type of prestressed concrete construction, this book enables the

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effective implementation of advanced structural concepts and their economical and reliable translation into practice.

Focusing on all aspects of composites, this book covers the composition, structure, and physical properties of composites. You'll study the manufacturing methods of fiber reinforced plastics and post fabrication techniques, as well as the latest composites applications. Topics include: thermosets, thermoplastics, non-resinous matrices, reinforcements, fiber types, hybrids, physical properties of composites, design principles, environmental effects on composites, manufacturing and inspection techniques, and more.

Progress in Maritime Technology and Engineering collects the papers presented at the 4th International Conference on Maritime Technology and Engineering (MARTECH 2018, Lisbon, Portugal, 7–9 May 2018). This conference has evolved from a series of biannual national conferences in Portugal, and has developed into an international event, reflecting the internationalization of the maritime sector and its activities. MARTECH 2018 is the fourth in this new series of biannual conferences. Progress in Maritime Technology and Engineering contains about 80 contributions from authors from all parts of the world, which were reviewed by an International Scientific Committee. The book is divided into the subject areas below: - Port performance - Maritime transportation and

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economics - Big data in shipping - Intelligent ship navigation - Ship performance - Computational fluid dynamics - Resistance and propulsion - Ship propulsion - Dynamics and control - Marine pollution and sustainability - Ship design - Ship structures - Structures in composite materials - Shipyard technology - Coating and corrosion - Maintenance - Risk analysis - Offshore and subsea technology - Ship motion - Ships in transit - Wave-structure interaction - Wave and wind energy - Waves Progress in Maritime Technology and Engineering will be of interest to academics and professionals involved in the above mentioned areas. Among the modern materials, the composites have a few decades of history. However, there has been a tremendous advancement of this class of material in science and technology. During recent decades, composite materials have steadily gained ground in nearly all sectors. The composite materials have been used in various industrial applications such as buildings and constructions, aerospace, automotive and sports equipment, consumer products etc. Nanotechnology is rapidly evolving, and science, engineering, and technology have merged to bring nanoscale materials that much closer to reality. It is one of the fastest growing areas for research. Nanocomposite materials are helping improve products that we use every day and creating new, exciting products for the future. Composites and nanocomposites composed of reinforcements, nano-

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reinforcements, and matrices are well-known engineering materials. Keeping in mind the advantages of composite and nanocomposite materials, this book covers fundamental effects, product development, properties, and applications of the materials including material chemistry, designing, and manufacturing. The book also summarizes the recent developments made in the area of advanced composite and nanocomposite materials. A number of critical issues and suggestions for future work are discussed, underscoring the roles of researchers for the efficient development of composites and nanocomposites through value additions to enhance their use.

This book applies various concepts based on practical experimental considerations to industrial fields: aerospace structure, shipbuilding and marine engineering, automotive, and elevator composites. Written by prominent authors who contribute to the success of advanced composites technology and leading influential laboratories and companies, the book includes unique concept research, recent trends, and further insights. Particular effort is made to deal with notable constituent materials of advanced composites, even nanostructures. This book deals with applied research from the basics of a rare nanomaterial called halloysite nanotube, which is environmentally friendly and leads nanomaterials in advanced industrial composite materials and functional, structural materials with

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high practical value. This book includes practical nano-bridging techniques on nanostructures, manufacturing, analysis, and advanced composites' applications using the research know-how accumulated over the years by prominent experts in these areas.

The marine environment presents significant challenges for materials due to the potential for corrosion by salt water, extreme pressures when deeply submerged and high stresses arising from variable weather. Well-designed fibre-reinforced composites can perform effectively in the marine environment and are lightweight alternatives to metal components and more durable than wood. *Marine Applications of Advanced Fibre-Reinforced Composites* examines the technology, application and environmental considerations in choosing a fibre-reinforced composite system for use in marine structures. This book is divided into two parts. The chapters in Part One explore the manufacture, mechanical behavior and structural performance of marine composites, and also look at the testing of these composites and end of life environmental considerations. The chapters in Part Two then investigate the applications of marine composites, specifically for renewable energy devices, offshore oil and gas applications, rigging and sails. Underwater repair of marine composites is also reviewed. *Comprehensively examines all aspects of fibre-reinforced marine composites,*

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including the latest advances in design, manufacturing methods and performance  
Assesses the environmental impacts of using fibre-reinforced composites in marine environments, including end of life considerations  
Reviews advanced fibre-reinforced composites for renewable energy devices, rigging, sail textiles, sail shape optimisation and offshore oil and gas applications

The two volumes that comprise this work provide a comprehensive guide and source book on the marine use of composite materials. The first volume, Fundamental Aspects, provides a rigorous development of theory. Areas covered include materials science, environmental aspects, production technology, structural analysis, finite-element methods, materials failure mechanisms and the role of standard test procedures. An appendix gives tables of the mechanical properties of common polymeric composites and laminates in marine use. The second volume, Practical Considerations, examines how the theory can be used in the design and construction of marine structures, including boats, submersibles, offshore structures and other deep-ocean installations.

Given the increasing use of fibre-reinforced polymer (FRP) composites in structural civil engineering, there is a vital need for critical information related to the overall durability and performance of these new materials under harsh and changing conditions. Durability of composites for civil and structural applications



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provides a thorough overview of key aspects of the durability of FRP composites for designers and practising engineers. Part one discusses general aspects of composite durability. Chapters examine mechanisms of degradation such as moisture, aqueous solutions, UV radiation, temperature, fatigue and wear. Part two then discusses ways of using FRP composites, including strengthening and rehabilitating existing structures with FRP composites, and monitoring techniques such as structural health monitoring. Durability of composites for civil and structural applications provides practising engineers, decision makers and students with a useful and fundamental guide to the use of FRP composites within civil and structural engineering. Provides a thorough overview of key aspects of the durability of composites Examines mechanisms of degradation such as aqueous solutions, moisture, fatigue and wear Discusses ways of using FRP composites, including strengthening and rehabilitating existing structures An increase in the use of composite materials in areas of engineering has led to a greater demand for engineers versed in the design of structures made from such materials. This book offers students and engineers tools for designing practical composite structures. Among the topics of interest to the designer are stress-strain relationships for a wide range of anisotropic materials; bending, buckling, and vibration of plates; bending, torsion, buckling, and vibration of solid

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as well as thin walled beams; shells; hygrothermal stresses and strains; finite element formulation; and failure criteria. More than 300 illustrations, 50 fully worked problems, and material properties data sets are included. Some knowledge of composites, differential equations, and matrix algebra is helpful but not necessary, as the book is self-contained. Graduate students, researchers, and practitioners will value it for both theory and application.

The two volumes that comprise this work provide a comprehensive guide and source book on the marine use of composite materials. This second volume, Practical Considerations, examines how the theory can be used in the design and construction of marine structures, including ships, boats, offshore structures and other deep-ocean installations.

Smart Composites: Mechanics and Design addresses the current progress in the mechanics and design of smart composites and multifunctional structures.

Divided into three parts, it covers characterization of properties, analyses, and design of various advanced composite material systems with an emphasis on the coupled mechanical and non-mechanical behaviors. Part one includes analyses of smart materials related to electrically conductive, magnetostrictive nanocomposites and design of active fiber composites. These discussions include several techniques and challenges in manufacturing smart composites

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and characterizing coupled properties, as well as the analyses of composite structures at various length and time scales undergoing coupled mechanical and non-mechanical stimuli considering elastic, viscoelastic (and/or viscoplastic), fatigue, and damage behaviors. Part two is dedicated to a higher-scale analysis of smart structures with topics such as piezoelectrically actuated bistable composites, wing morphing design using macrofiber composites, and multifunctional layered composite beams. The analytical expressions for characterization of the smart structures are presented with an attention to practical application. Finally, part three presents recent advances regarding sensing and structural health monitoring with a focus on how the sensing abilities can be integrated within the material and provide continuous sensing, recognizing that multifunctional materials can be designed to both improve and enhance the health-monitoring capabilities and also enable effective nondestructive evaluation. Smart Composites: Mechanics and Design is an essential text for those interested in materials that not only possess the classical properties of stiffness and strength, but also act as actuators under a variety of external stimuli, provide passive and active response to enable structural health monitoring, facilitate advanced nondestructive testing strategies, and enable shape-changing and morphing structures.

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Fibre reinforced polymer-based composites are set to meet the demand for improvements in construction processes. FRP materials are suitable for use in piping, walls and columns. This volume explores their structural application in construction.

This highly comprehensive, introductory book explains the basics of structural health monitoring aspects of composite structures. This book serves as an all-in-one reference book in which the reader can receive a basic understanding of composite materials, manufacturing methods, the latest types of optical fiber sensors used for structural health monitoring of composite structures, and demonstrated applications of the use of fiber sensors in a variety of composite material structures. The content draws upon the authors' and distinguished contributors' extensive research/teaching and industrial experience to fully cover the structural health monitoring of composite materials using fiber optic sensing methods.

The Maritime Engineering Reference Book is a one-stop source for engineers involved in marine engineering and naval architecture. In this essential reference, Anthony F. Molland has brought together the work of a number of the world's leading writers in the field to create an inclusive volume for a wide audience of marine engineers, naval architects and those involved in marine operations,

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insurance and other related fields. Coverage ranges from the basics to more advanced topics in ship design, construction and operation. All the key areas are covered, including ship flotation and stability, ship structures, propulsion, seakeeping and maneuvering. The marine environment and maritime safety are explored as well as new technologies, such as computer aided ship design and remotely operated vehicles (ROVs). Facts, figures and data from world-leading experts makes this an invaluable ready-reference for those involved in the field of maritime engineering. Professor A.F. Molland, BSc, MSc, PhD, CEng, FRINA. is Emeritus Professor of Ship Design at the University of Southampton, UK. He has lectured ship design and operation for many years. He has carried out extensive research and published widely on ship design and various aspects of ship hydrodynamics. \* A comprehensive overview from best-selling authors including Bryan Barrass, Rawson and Tupper, and David Eyres \* Covers basic and advanced material on marine engineering and Naval Architecture topics \* Have key facts, figures and data to hand in one complete reference book

Ageing of composites is a highly topical subject given the increasing use of composites in structural applications in many industries. Ageing of composites addresses many of the uncertainties about the long-term performance of composites and how they age under conditions encountered in service. The first

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part of the book reviews processes and modelling of composite ageing including physical and chemical ageing of polymeric composites, ageing of glass-ceramic matrix composites, chemical ageing mechanisms, stress corrosion cracking, thermo-oxidative ageing, spectroscopy of ageing composites, modelling physical and accelerated ageing and ageing of silicon carbide composites. Part two examines ageing of composites in transport applications including aircraft, vehicles and ships. Part three reviews ageing of composites in non-transport applications such as implants in medical devices, oil and gas refining, construction, chemical processing and underwater applications. With its distinguished editor and international team of contributors, Ageing of composites is a valuable reference guide for composite manufacturers and developers. It also serves as a source of information for material scientists, designers and engineers in industries that use composites, including transport, chemical processing and medical engineering. Addresses many of the uncertainties about the long-term performance of composites and how they age under conditions encountered in service Reviews processes and modelling of composite ageing including chemical ageing mechanisms and stress corrosion cracking Discusses ageing of composites in both transport and non-transport applications ranging from aircraft to implants in medical devices

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Developments in the Analysis and Design of Marine Structures is a collection of papers presented at MARSTRUCT 2021, the 8th International Conference on Marine Structures (by remote transmission, 7-9 June 2021, organised by the Department of Marine Technology of the Norwegian University of Science and Technology, Trondheim, Norway), and is essential reading for academics, engineers and professionals involved in the design of marine and offshore structures. The MARSTRUCT Conference series deals with Ship and Offshore Structures, addressing topics in the fields of: - Methods and Tools for Loads and Load Effects; - Methods and Tools for Strength Assessment; - Experimental Analysis of Structures; - Materials and Fabrication of Structures; - Methods and Tools for Structural Design and Optimisation; and - Structural Reliability, Safety and Environmental Protection. The MARSTRUCT conferences series of started in Glasgow, UK in 2007, the second event of the series took place in Lisbon, Portugal in March 2009, the third in Hamburg, Germany in March 2011, the fourth in Espoo, Finland in March 2013, the fifth in Southampton, UK in March 2015, the sixth in Lisbon, Portugal in May 2017, and the seventh in Drubovnik, Croatia in May 2019. The 'Proceedings in Marine Technology and Ocean Engineering' series is dedicated to the publication of proceedings of peer-reviewed international conferences dealing with various aspects of 'Marine Technology

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and Ocean Engineering'. The Series includes the proceedings of the following conferences: the International Maritime Association of the Mediterranean (IMAM) conferences, the Marine Structures (MARSTRUCT) conferences, the Renewable Energies Offshore (RENEW) conferences and the Maritime Technology (MARTECH) conferences. The 'Marine Technology and Ocean Engineering' series is also open to new conferences that cover topics on the sustainable exploration and exploitation of marine resources in various fields, such as maritime transport and ports, usage of the ocean including coastal areas, nautical activities, the exploration and exploitation of mineral resources, the protection of the marine environment and its resources, and risk analysis, safety and reliability. The aim of the series is to stimulate advanced education and training through the wide dissemination of the results of scientific research.

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