



Outrigger Design for High-Rise Buildings

An output of the CTBUH Outrigger Working Group

Hi Sun Choi, Goman Ho, Leonard Joseph & Neville Mathias



Outrigger Design For High Rise Buildings

Y. K. Cheung, P. K. K. Lee



Outrigger Design For High Rise Buildings:

Outrigger Design for High-Rise Buildings Hi Sun Choi, 2017-07-03 Outrigger systems are rigid horizontal structures designed to improve a building's stability and strength by connecting the building core or spine to distant columns much in the way an outrigger can prevent a canoe from overturning. Outriggers have been used in tall narrow buildings for nearly 500 years but the basic design principle dates back centuries. In the 1980s as buildings grew taller and more ambitious outrigger systems eclipsed tubular frames as the most popular structural approach for supertall buildings. Designers embraced properly proportioned core and outrigger schemes as a method to offer far more perimeter flexibility and openness for tall buildings than the perimeter moment or braced frames and bundled tubes that preceded them. However the outrigger system is not listed as a seismic lateral load resisting system in any code and design parameters are not available despite the increasingly frequent use of the concept. The Council on Tall Buildings and Urban Habitat's Outrigger Working Group has addressed the pressing need for design guidelines for outrigger systems with this guide a comprehensive overview of the use of outriggers in skyscrapers. This guide offers detailed recommendations for analysis of outriggers within the lateral load resisting systems of tall buildings for recognizing and addressing effects on building behavior and for practical design solutions. It also highlights concerns specific to the outrigger structural system such as differential column shortening and construction sequence impacts. Several project examples are explored in depth illustrating the role of outrigger systems in tall building designs and providing ideas for future projects. The guide details the impact of outrigger systems on tall building designs and demonstrates ways in which the technology is continuously advancing to improve the efficiency and stability of tall buildings around the world.

Outrigger Design for High-Rise Buildings Hi Sun Choi, Leonard Joesph, Neville Mathias, 2017-06-05 Addresses the need for design guidelines based around the role and impact of outrigger systems in tall buildings. Written by CTBUH experts in tall building technologies. This new edition features updated design considerations to reflect current practices expanded systems organisation and examples and updated recommendations and suggestions for future research. The Council on Tall Buildings and Urban Habitat's Outrigger Working Group has addressed the pressing need for design guidelines for outrigger systems with this guide now in its second edition providing a comprehensive overview of the use of outriggers in skyscrapers. This guide offers detailed recommendations for analysis of outriggers within the lateral load resisting systems of tall buildings for recognising and addressing effects on building behaviour and for practical design solutions. It also highlights concerns specific to the outrigger structural system such as differential column shortening and construction sequence impacts. In this edition a new chapter explores the use of hybrid outrigger systems that can tune the stiffness of outrigger trusses use leverage of the outrigger arms to drive non linear damping devices and use yielding materials that absorb seismic energy. Several project examples are explored in depth illustrating the role of outrigger systems in tall building designs and providing ideas for future projects. The guide details the impact of outrigger systems on

tall building designs and demonstrates ways in which the technology is continuously advancing to improve the efficiency and stability of tall buildings around the world The new second edition features updated design considerations to reflect current practices expanded systems organisation and examples and updated recommendations and suggestions for future research

Advances in Energy Science and Equipment Engineering II Volume 2 Shiquan Zhou, Aragona Patty, Shiming Chen, 2017-09-19 The 2016 2nd International Conference on Energy Equipment Science and Engineering ICEESE 2016 was held on November 12-14 2016 in Guangzhou China ICEESE 2016 brought together innovative academics and industrial experts in the field of energy equipment science and engineering to a common forum The primary goal of the conference is to promote research and developmental activities in energy equipment science and engineering and another goal is to promote scientific information interchange between researchers developers engineers students and practitioners working all around the world The conference will be held every year to make it an ideal platform for people to share views and experiences in energy equipment science and engineering and related areas This second volume of the two volume set of proceedings covers the field of Structural and Materials Sciences and Computer Simulation Computer and Electrical Engineering

Sustainability Trends and Challenges in Civil Engineering Lakshman Nandagiri, M. C. Narasimhan, Shriram Marathe, S.V. Dinesh, 2021-09-02 This book presents the select proceedings of the International Conference on Civil Engineering Trends and Challenges for Sustainability CTCS 2020 The chapters discuss emerging and latest research and advances in sustainability in different areas of civil engineering which aim to provide solutions to sustainable development The contents are broadly divided into the following categories construction technology and building materials structural engineering transportation and geotechnical engineering environmental and water resources engineering and RS GIS applications This book will be of potential interest to beginners researchers and professionals working in the area of sustainable civil engineering and related fields

Smart Sensors Measurements and Instrumentation Santhosh K V, K. Guruprasad Rao, 2021-05-10 This book presents the select proceedings of Control Instrumentation and System Conference CISCON 2020 held at Manipal Institute of Technology MAHE Manipal It examines a wide spectrum covering the latest trends in the fields of instrumentation sensors and systems and industrial automation and control The topics covered include image and signal processing robotics renewable energy power systems and power drives performance attributes of MEMS multi sensor data fusion machine learning optimization techniques process control safety monitoring safety critical control supervisory control system modeling and virtual instrumentation The book is a valuable reference for researchers and professionals interested in sensors adaptive control automation and control and allied fields

Advances in Construction Materials and Structures Jaganathan Jayaprakash, Kok Keong Choong, Mohammed Parvez Anwar, 2021-01-20 This book comprises select and peer reviewed proceedings of the International Conference on Recent Trends in Construction Materials and Structures ICON 2019 The contents cover various latest developments and emerging technologies in sustainable

construction materials utilization of waste materials in concrete special concrete maintenance of heritage structures earthquake engineering and structural dynamics The book also provides effective and feasible solutions to current problems in sustainable construction materials and structures This book is useful for students researchers and industry professionals interested in concrete technology and structures *ICSBE 2022* Ranjith Dissanayake, Priyan Mendis, Kolita Weerasekera, Sudhira De Silva, Shiromal Fernando, Chaminda Konthesingha, Pradeep Gajanayake, 2023-08-09 This book highlights the latest knowledge and innovations in the fields of civil engineering and construction industry striving for a sustainable built environment It consists of high quality and innovative research findings selected from the proceedings of the 13th ICSBE 2022 under the themes of sustainable construction urban green infrastructure and planning rainwater harvesting and water conservation high performance concrete indoor environmental quality and indoor plants wind and hydro power energy waste and wastewater management for enhanced sustainability impacts of climate change carbon footprint global climate model and landscaping material flows and industrial ecology sustainable materials etc **Recent Advances in Computational and Experimental Mechanics, Vol—I** D. Maity, P. K. Patra, M.S. Afzal, R. Ghoshal, C. S. Mistry, P. Jana, D. K. Maiti, 2022-01-01 This book Vol I presents select proceedings of the first Online International Conference on Recent Advances in Computational and Experimental Mechanics ICRACEM 2020 and focuses on theoretical computational and experimental aspects of solid and fluid mechanics Various topics covered are computational modelling of extreme events mechanical modelling of robots mechanics and design of cellular materials mechanics of soft materials mechanics of thin film and multi layer structures meshfree and particle based formulations in continuum mechanics multi scale computations in solid mechanics and materials multiscale mechanics of brittle and ductile materials topology and shape optimization techniques acoustics including aero acoustics and wave propagation aerodynamics dynamics and control in micro nano engineering dynamic instability and buckling flow induced noise and vibration inverse problems in mechanics and system identification measurement and analysis techniques in nonlinear dynamic systems multibody dynamical systems and applications nonlinear dynamics and control stochastic mechanics structural dynamics and earthquake engineering structural health monitoring and damage assessment turbomachinery noise vibrations of continuous systems characterization of advanced materials damage identification and non destructive evaluation experimental fire mechanics and damage experimental fluid mechanics experimental solid mechanics measurement in extreme environments modal testing and dynamics experimental hydraulics mechanism of scour under steady and unsteady flows vibration measurement and control bio inspired materials constitutive modelling of materials fracture mechanics mechanics of adhesion tribology and wear mechanics of composite materials mechanics of multifunctional materials multiscale modelling of materials phase transformations in materials plasticity and creep in materials fluid mechanics computational fluid dynamics fluid structure interaction free surface moving boundary and pipe flow hydrodynamics multiphase flows propulsion internal flow physics

turbulence modelling wave mechanics flow through porous media shock boundary layer interactions sediment transport wave structure interaction reduced order models turbo machinery experimental hydraulics mechanism of scour under steady and unsteady flows applications of machine learning and artificial intelligence in mechanics transport phenomena and soft computing tools in fluid mechanics The contents of these two volumes Volumes I and II discusses various attributes of modern age mechanics in various disciplines such as aerospace civil mechanical ocean engineering and naval architecture The book will be a valuable reference for beginners researchers and professionals interested in solid and fluid mechanics and allied fields

EASEC16 Chien Ming Wang, Vinh Dao, Sritawat Kitipornchai, 2020-12-22 This book presents articles from The 16th East Asian Pacific Conference on Structural Engineering and Construction 2019 held in Brisbane Australia It provides a forum for professional engineers academics researchers and contractors to present recent research and developments in structural engineering and construction

Recent Developments in Sustainable Infrastructure Bibhuti Bhusan Das, Salim Barbhuiya, Rishi Gupta, Purnachandra Saha, 2020-07-03 This book comprises select peer reviewed proceedings of the International Conference on Recent Developments in Sustainable Infrastructure ICRDSI 2019 The topics span over all major disciplines of civil engineering with regard to sustainable development of infrastructure and innovation in construction materials especially concrete The book covers numerical and analytical studies on various topics such as composite and sandwiched structures green building groundwater modeling rainwater harvesting soil dynamics seismic resistance and control of structures waste management structural health monitoring and geo environmental engineering This book will be useful for students researchers and professionals working in sustainable technologies in civil engineering

Structural Engineering Handbook, Fifth Edition Mustafa Mahamid, Edwin H. Gaylord, Charles N. Gaylord, 2020-04-17 Publisher's Note Products purchased from Third Party sellers are not guaranteed by the publisher for quality authenticity or access to any online entitlements included with the product The industry standard guide to structural engineering fully updated for the latest advances and regulations For 50 years this internationally renowned handbook has been the go to reference for structural engineering specifications codes technologies and procedures Featuring contributions from a variety of experts the book has been revised to align with the codes that govern structural design and materials including IBC ASCE 7 ASCE 37 ACI AISC AASHTO NDS and TMS Concise practical and user friendly this one of a kind resource contains real world examples and detailed descriptions of today's design methods Structural Engineering Handbook Fifth Edition covers Computer applications in structural engineering Earthquake engineering Fatigue brittle fracture and lamellar tearing Soil mechanics and foundations Design of steel structural and composite members Plastic design of steel frames Design of cold formed steel structural members Design of aluminum structural members Design of reinforced and prestressed concrete structural members Masonry construction and timber structures Arches and rigid frames Bridges and girder boxes Building design and considerations Industrial and tall buildings Thin shell concrete structures Special structures and nonbuilding

structures Structural Systems for Tall Buildings I. D. Bennetts, 1995 If you're an engineer or architect you can't afford to be without this unique database of structural systems used in the design of some of the most important tall buildings erected to date Structural Systems for Tall Buildings reviews all major types of structural systems including lateral load resisting systems gravity load resisting systems and systems for the future The book explains how each is typically used for a given design problem and discusses the pros and cons for each major type You'll find a handy classification system of tall buildings by structural type plus solutions to special problems such as floor vibrations damping for structural sway lateral load design and new experimental structural designs like outrigger stabilizers Filled with hundreds of drawings and photographs this incomparable sourcebook features contributions from some of the most renowned engineers in the world With the help of this expert guide you'll always be able to choose the best structural option for any project one that can handle expected loads is cost effective and efficient to construct and delivers the architectural solution sought by the client **BOOK JACKET Title Summary** field provided by Blackwell North America Inc All Rights Reserved *Materials and Technologies in Construction and Architecture* Batyr Yazyev, Stepan V. Litvinov, Anton S. Chepurnenko, Anastasia Lapina, Oksana Akay, 2018-09-20 International Conference on Construction and Architecture Theory and Practice of Industry Development CATPID 2018 Selected peer reviewed papers from the International Scientific and Technical Conference Construction and Architecture Theory and Practice of Industry Development CATPID 2018 October 8-12 2018 Rostov on Don Russia *Tall Building Structures* Bryan Stafford Smith, Alex Coull, 1991-07-17 Examines structural aspects of high rise buildings particularly fundamental approaches to the analysis of the behavior of different forms of building structures including frame shear wall tubular core and outrigger braced systems Introductory chapters discuss the forces to which the structure is subjected design criteria which are of the greatest relevance to tall buildings and various structural forms which have developed over the years since the first skyscrapers were built at the turn of the century A major chapter is devoted to the modeling of real structures for both preliminary and final analyses Considerable attention is devoted to the assessment of the stability of the structure and the significance of creep and shrinkage is discussed A final chapter is devoted to the dynamic response of structures subjected to wind and earthquake forces Includes both accurate computer based and approximate methods of analysis **Steel, Concrete, and Composite Design of Tall and Supertall Buildings, Third Edition** Mustafa Mahamid, Bungale S. Taranath, 2025-03-28 An essential guide to designing tall and super tall buildings thoroughly revised for the latest standards and advances This fully updated guide clearly explains the structural systems codes and calculations used in the design and construction of tall and supertall buildings This new edition has been reconceived to provide more practical and applied information to help you understand the design procedures and code provisions involved The book discusses the latest versions of relevant codes and standards including the 2018 IBC ASCE 7 16 ACI 318 and AISC 360 341 Readers will learn how to correctly apply these building codes and standards **Steel Concrete and Composite Design of Tall**

and Supertall Buildings Third Edition addresses the latest materials technologies and construction techniques being used in the field including the use of BIM for tall buildings and monitoring methods for building movement Brand new case studies in this edition encompass a variety of tall and supertall buildings from North America Asia and Europe that illustrate real world applications Chapters cover Wind Effects Seismic effects Lateral Systems for Steel Buildings Lateral Systems for Concrete Buildings Lateral Systems for Composite Construction Gravity Systems for Steel Buildings Gravity Systems for Concrete Buildings Composite Gravity Systems Analysis Techniques Performance Based Design Special Topics This practical reference is ideal for engineering students consulting engineers architects engineers employed by federal state and local governments and educators

Proceedings of the Fourth International Conference on Tall Buildings Y. K. Cheung,P. K. K. Lee,1988 Steel, Concrete, and Composite Design of Tall Buildings Bungale S. Taranath,1998 Taranath provides case studies of buildings constructed in the past two decades to give insight into why and how structural systems were chosen Particular emphasis is placed on wind and seismic forces Large-scale Structural Testing Mohsen A. Issa,Y. L. Mo,2003 *Tall Buildings--2000 and Beyond* Lynn S. Beedle,Dolores B. Rice,1990 Habitat and the High-rise Tradition and Innovation Lynn S. Beedle,Dolores B. Rice,1995

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