

Structural Analysis Of Historic Buildings Restoration Preservation And Adaptive Reuse Applications For Architects And Engineers

Historic structures need to be restored in line with international guidance and charters developed by architects and archaeologists, but technical understanding of structural engineering and materials is crucial, particularly with respect to response to earthquake loading. This guide to structural assessment and restoration of masonry monuments and historical buildings outlines the techniques, materials and design procedures used. It begins with principles, theory and practice and then presents case studies. The assessment focusses on Building materials and construction techniques used in the past The mechanics of masonry The structural behaviour of masonry monuments and historical buildings In-situ investigation and laboratory tests for existing and restoration materials. The restoration elaborates on Techniques and materials available for structural restoration Structural analysis and design Deciding on the restoration scheme Emergency measures and protective measures. An essential reference for building professionals, owners, managers, and individuals planning to purchase or renovate a building

An architect and engineer must consider many aspects of any building that is being evaluated for an adaptive re-use project. Careful and precise evaluation of an existing building's structure, systems, and materials are necessary for both design considerations and for financial feasibility analysis. This professional guide to evaluating structural and material integrity of existing buildings covers everything from

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foundation issues to decorative details, identifying the causes of building failures as well as techniques for repair. The book considers building assessment issues for structures of different scales: midsize commercial, small commercial and residential buildings. Building repairs on adaptive re-use or historic preservation projects are an essential consideration in the financial outlook of a project, and this book details each step in the assessment process in an easy-to-understand way.

This publication summarizes and describes the conclusions of more than 300 experimental tests carried out from 2011 to 2014 as part of the Seismic Retrofitting Project (SRP), and characterizes the material properties and structural behavior of the components of the four building prototypes selected for this project. The SRP aims to design and test easy-to-implement seismic retrofitting techniques, both traditional and state-of-the art, as well as maintenance programs that improve the structural performance of earthen historic buildings in Peru and other countries in Latin America. The performed tests were developed and carried out by the Escuela de Ciencias de Ingeniería of the Pontificia Universidad Católica del Perú (PUCP) in collaboration with the Getty and SRP consultants. Some of these tests were performed for the first time on earthen materials and/or structural components, providing valuable information to the field. Therefore, this publication is of significant value to engineers and conservation architects working in seismic areas. Partial results of this testing program have been published in the proceedings of several international conferences. However, this publication provides a more comprehensive overview and a deeper understanding of the mechanical behavior of materials and structural components of historic earthen buildings in Peru. The performed tests also provided valuable information to the numerical models that

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have been developed by TecMinho, University of Minho, Portugal to analyze the seismic capacity of each of the building prototypes. The results of this modeling phase are the subject of the SRP publications: Recommendations for Advanced Modeling of Historic Earthen Sites; Modeling of Prototype Buildings; and, Simplified Calculations for the Structural Analysis of Earthen Historic Sites.

Since its publication in 1982 Sir Bernard Feilden's Conservation of Historic Buildings has become the standard text for architects and others involved in the conservation of historic structures. Leading practitioners around the world have praised the book as being the most significant single volume on the subject to be published. This third edition revises and updates a classic book, including completely new sections on conservation of Modern Movement buildings and non-destructive investigation. The result of the lifetime's experience of one of the world's leading architectural conservators, the book comprehensively surveys the fundamental principles of conservation in their application to historic buildings, and provides the basic information needed by architects, engineers and surveyors for the solution of problems of architectural conservation in almost every climatic region of the world. This edition is organized into three complementary parts: in the first the structure of buildings is dealt with in detail; the second focuses attention on the causes of decay and the materials they affect; and the third considers the practical role of the architect involved in conservation and rehabilitation. As well as being essential reading for architects and others concerned with conservation, many lay people with various kinds of responsibility for historic buildings will find this clearly written, jargon-free work a fruitful source of guidance and information. A reference for engineers and regulatory officials involved in the preservation or restoration of buildings, or in

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strengthening them to meet new codes or increased load from a change of use. The treatment is suggestive rather than inclusive or prescriptive. Acidic paper. Annotation copyright Book N

Structural Analysis of Historical Constructions contains about 160 papers that were presented at the IV International Seminar on Structural Analysis of Historical Constructions that was held from 10 to 13 November, 2004 in Padova Italy. Following publications of previous seminars that were organized in Barcelona, Spain (1995 and 1998) and Guimarães, Portugal (2001), state-of-the-art information is presented in these two volumes on the preservation, protection, and restoration of historical constructions, both comprising monumental structures and complete city centers. These two proceedings volumes are devoted to the possibilities of numerical and experimental techniques in the maintenance of historical structures. In this respect, the papers, originating from over 30 countries, are subdivided in the following areas: Historical aspects and general methodology, Materials and laboratory testing, Non-destructive testing and inspection techniques, Dynamic behavior and structural monitoring, Analytical and numerical approaches, Consolidation and strengthening techniques, Historical timber and metal structures, Seismic analysis and vulnerability assessment, Seismic strengthening and innovative systems, Case studies. Structural Analysis of Historical Constructions is a valuable source of information for scientists and practitioners working on structure-related issues of historical constructions

Rehabilitation of heritage monuments provides sustainable development and cultural significance to a region. The most sensitive aspect of the refurbishment of existing buildings lies in the renovation and recovery of

structural integrity and public safety. The Handbook of Research on Seismic Assessment and Rehabilitation of Historic Structures evaluates developing contributions in the field of earthquake engineering with regards to the analysis and treatment of structural damage inflicted by seismic activity. This book is a vital reference source for professionals, researchers, students, and engineers active in the field of earthquake engineering who are interested in the emergent developments and research available in the preservation and rehabilitation of heritage buildings following seismic activity.

Volume is indexed by Thomson Reuters CPCI-S (WoS). Increasing urbanization constitutes a mounting threat to cultural heritage sites around the world; especially in developing countries. Natural and man-made environmental hazards are causing more damage to historic constructions than ever before. The conservation of historical constructions is facing new challenges introduced by waves of immigration and industrialization. The present papers on this subject are organized into two volumes, and the topics of interest span the entire spectrum of structural analyses of historic constructions: including Materials and Structural Configuration, Structural Inspection and Monitoring, Structural Analysis and Assessment, Seismic Analysis and Evaluation, Strengthening Technologies, Rehabilitation and Retrofitting and Sustainable Utilization of Historic Constructions in China. It is the hope of the editors that this special collection will stimulate scientists and technologists to develop further theories and technologies and help them in their endeavors in

conserving historic constructions, now and tomorrow.

In this fascinating analysis of eighteenth-century vernacular houses of Middle Virginia, Henry Glassie presents a revolutionary and carefully constructed methodology for looking at houses and interpreting from them the people who built and used them. Glassie believes that all relevant historical evidence - unwritten as well as written - must be taken into account before historical truth can be found. He is convinced that any study of man's past must make use of nonverbal and verbal evidence, since written history - the story of man as recorded by the intellectual elite - does not tell us much about the everyday life, thoughts, and fears of the ordinary people of the past. Such people have always been in the majority, however, and a way has to be found to include them in any valid history. In *Folk Housing in Middle Virginia* Glassie admirably sets forth such a way. The people who lived in Middle Virginia in the eighteenth century are almost unknown to history because so little has been written about them. After Glassie selected the area - roughly Goochland and Louisa counties - for study, he selected a representative part of the countryside, recorded all the older houses there, developed a transformational grammar of traditional house designs, and examined the area's architectural stability and change. Comparing the houses with written accounts of the period, he found that the houses became more formal and less related to their environment at the same time as the areas established political, economic, and religious institutions were disintegrating. It is as though the builders of the houses

were deliberately trying to impose order on the surrounding chaotic world. Previous orthodox historical interpretations of the period have failed to note this. Glassie has provided new insights into the intellectual and social currents of the period, and at that time has rescued a heretofore little-known people from historiographical oblivion. Combining a fresh, perceptive approach with a broad interdisciplinary body of knowledge, ha has made an invaluable breakthrough in showing the way to understand the people of history who have left their material things as their only legacy. Henry Glassie is College Professor of Folklore at Indiana University. He is the author of *Pattern in the Material Folk Culture of the Eastern United States*, *Passing the Time in Ballymenone*, *Irish Folktales*, and *The Spirit of Folk Art*. He has served as president of the Vernacular Architecture Forum and the American Folklore Society. This book is intended for a wide audience - including carpenters, architects and structural engineers who deal with the repair and restoration of historic timber structures - and takes a practical approach. It deals with two types of structure: the oak frames of buildings dating from the middle ages, which still survive in some numbers, and the timber elements of masonry buildings from the late seventeenth century.

The conservation of historic structures has been given special attention due to their cultural, social and economic importance. However they often show considerable structural vulnerability and have been seriously damaged by natural disasters including earthquakes. An excessive loss of architectural heritage

has occurred because of earthquakes. A safety assessment and restoration practice on historical structures has been tackled extensively by professionals including architects and engineers. However, structural assessment of historical buildings is a complex task. Complexity comes from insufficient understanding of the characteristic of historical materials, limited knowledge of the seismic response of historical structures and yet-unknown structural deterioration due to the past natural disasters. Today it is perceived that nonlinear FEM analysis permits detailed study of historical masonry structures. However, in some cases, its application poses difficulties. The difficulties derive from the definition of material properties, the definition of a complex geometry and the analysis procedures. The results depend on the material properties considerably. However, it is not easy to describe appropriately the behaviour of historical materials including masonry in the FEM analysis. The definition of a complex geometry is challenging although the discretisation of accurate geometry is crucial. As for the analysis procedure, one of the difficulties is observed in seismic assessment. FEM-based nonlinear dynamic analysis permits close observation of seismic response of a historical masonry structure but it requires excessive computational effort, for a large-scale structure in particular. On the other hand, pushover can be adopted more efficiently than nonlinear dynamic analysis but the obtained result can be less reliable. All these considerations indicate that the understanding of FEM approaches still needs to be deepened to adopt more accurately and at the same

time efficiently for the analysis of historical structures.

The present research discusses the applicability of existing nonlinear FEM approaches to the study of masonry historical structures. The FEM analysis is adopted to the analysis of real and complex structures including mixed steel and masonry vaulted systems belonging to the Hospital de Sant Pau in Barcelona and a large single-nave church damaged by the 2009 Abruzzo earthquake. As a final outcome of the research, the conclusions provided criteria and guidelines for the analysis of these types of structures under vertical loading and seismic forces. The achievement of the research will contribute to both engineers and researchers who are involved in the conservation of historical masonry structures especially by means of FEM analysis.

This open access book focuses on the development of methods, interoperable and integrated ICT tools, and survey techniques for optimal management of the building process. The construction sector is facing an increasing demand for major innovations in terms of digital dematerialization and technologies such as the Internet of Things, big data, advanced manufacturing, robotics, 3D printing, blockchain technologies and artificial intelligence. The demand for simplification and transparency in information management and for the rationalization and optimization of very fragmented and splintered processes is a key driver for digitization. The book describes the contribution of the ABC Department of the Polytechnic University of Milan (Politecnico di Milano) to R&D activities regarding methods and ICT

tools for the interoperable management of the different phases of the building process, including design, construction, and management. Informative case studies complement the theoretical discussion. The book will be of interest to all stakeholders in the building process - owners, designers, constructors, and facility managers - as well as the research sector.

Boothby presents a comprehensive explanation of the empirical, graphical, and analytical design techniques used during the late nineteenth century in the construction of both buildings and bridges in wood, stone, brick, and iron.

Numerical Modeling of Masonry and Historical Structures: From Theory to Application provides detailed information on the theoretical background and practical guidelines for numerical modeling of unreinforced and reinforced (strengthened) masonry and historical structures. The book consists of four main sections, covering seismic vulnerability analysis of masonry and historical structures, numerical modeling of unreinforced masonry, numerical modeling of FRP-strengthened masonry, and numerical modeling of TRM-strengthened masonry. Each section reflects the theoretical background and current state-of-the art, providing practical guidelines for simulations and the use of input parameters. Covers important issues relating to advanced methodologies for the seismic vulnerability assessment of masonry and historical structures Focuses on modeling techniques used for the nonlinear analysis of unreinforced masonry and strengthened masonry structures Follows a theory to practice approach

Wood is a natural building material: if used in building elements, it can play structural, functional and aesthetic roles at the same time. The use of wood in buildings, which goes

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back to the oldest of times, is now experiencing a period of strong expansion in virtue of the sustainable dimension of wood buildings from the environmental, economic and social standpoints. However, its use as an engineering material calls for constant development of theoretical and experimental research to respond properly to the issues involved in this. In the single chapters written by experts in different fields, the book aims to contribute to knowledge in the application of wood in the building industry.

Community and federal involvement--Selecting a moving contractor--Specifications and licenses--Selecting the best procedure for the move--Planning a route--Documentation--Interim protection prior to the move--Selecting and preparing the new site--Preparing the structure for the move--Conclusion--Case study: Relocation of the Gruber Wagon Works.

A toolkit for giving our historic built environment a second life Conservation of our existing structures has obvious economic and social value. Moreover, historic structures provide an excellent laboratory for studying aspects of structural engineering, materials science, forensic engineering, and building design. Structural Investigation of Historic Buildings: A Case Study Guide to Preservation Technology for Buildings, Bridges, Towers, and Mills provides a practical guide for consulting structural engineers and others on dealing with issues unique to historic structures. Emphasizing structural evaluation and condition assessment based on sound preservation philosophy, but without burdening the reader with tedious calculations, the book discusses the role of the structural engineer in the evaluation and preservation process and discusses such topics as structural safety, analysis, and conservation. Engaging case studies, drawn from the author's own practice, include: The Montague Building and Watauga Hall The Restoration of St. Helena's

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Church Market Hall Rehabilitation Differential Settlement at St. Philip's Moravian Church James Madison's Montpelier Relocating the Cape Hatteras Lighthouse The Timber Trusses of Burr, Town, and Haupt The Cornish-Windsor Covered Bridge A New Covered Bridge for Old Salem The Tohickon Aqueduct Each case study features a description of the project and its history, a condition assessment, structural analysis, discussion, recommendations, and a description of the subsequent intervention as executed with drawings and photographs. Both a foundational text for students anticipating a career in preservation and a guide for seasoned structural engineers, *Structural Investigation of Historic Buildings* gives preservation-minded professionals the tools they need to ensure that potential candidates for restoration, rehabilitation, or adaptive reuse do not meet the wrecking ball without a second chance.

Increasing demand on improving the resiliency of modern structures and infrastructure requires ever more critical and complex designs. Therefore, the need for accurate and efficient approaches to assess uncertainties in loads, geometry, material properties, manufacturing processes, and operational environments has increased significantly.

Reliability-based techniques help develop more accurate initial guidance for robust design and help to identify the sources of significant uncertainty in structural systems.

Reliability-Based Analysis and Design of Structures and Infrastructure presents an overview of the methods of classical reliability analysis and design most associated with structural reliability. It also introduces more modern methods and advancements, and emphasizes the most useful methods and techniques used in reliability and risk studies, while elaborating their practical applications and limitations rather than detailed derivations. Features: Provides a practical and comprehensive overview of reliability and risk

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analysis and design techniques. Introduces resilient and smart structures/infrastructure that will lead to more reliable and sustainable societies. Considers loss elimination, risk management and life-cycle asset management as related to infrastructure projects. Introduces probability theory, statistical methods, and reliability analysis methods. Reliability-Based Analysis and Design of Structures and Infrastructure is suitable for researchers and practicing engineers, as well as upper-level students taking related courses in structural reliability analysis and design.

Structural Analysis of Historical Constructions. Anamnesis, diagnosis, therapy, controls contains the papers presented at the 10th International Conference on Structural Analysis of Historical Constructions (SAHC2016, Leuven, Belgium, 13-15 September 2016). The main theme of the book is "Anamnesis, Diagnosis, Therapy, Controls", which emphasizes the importance of all steps of a restoration process in order to obtain a thorough understanding of the structural behaviour of built cultural heritage. The contributions cover every aspect of the structural analysis of historical constructions, such as material characterization, structural modelling, static and dynamic monitoring, non-destructive techniques for on-site investigation, seismic behaviour, rehabilitation, traditional and innovative repair techniques, and case studies. A special focus has been put on six specific themes: - Innovation and heritage - Preventive conservation - Computational strategies for heritage structures - Sustainable strengthening of masonry with composites - Values and sustainability, and - Subsoil interaction The knowledge, insights and ideas in Structural Analysis of Historical Constructions. Anamnesis, diagnosis, therapy, controls make this book of abstracts and the corresponding, digital full-colour conference proceedings containing the full papers must-have literature for researchers

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and practitioners involved in the structural analysis of historical constructions.

Structural Analysis of Historic Buildings offers the most' complete, detailed, and authentic data available on the materials, calculation methods, and design techniques used by architects and engineers of the nineteenth and early twentieth centuries. It provides today's building professionals with information needed to analyze, modify, and certify historic buildings for modern use. Among the many important features of this book not available in any other single volume are: * More than 350 line drawings and diagrams taken directly from original sources such as the Carnegie Steele Company's Pocket Companion (1893) and Frank Kidder's The Architect's and Builder's Pocketbook (1902) * Hard-to-find data on period structural components, such as cast-iron columns and beams, wrought-iron columns and beams, and fireproof terra cotta floor arches * Methods for determining what kind of loads structural components were originally designed to bear and methods to determine if they are still capable of performing as intended * Extensive coverage of historical foundation systems and empirical design methods for load-bearing masonry buildings For any building professional involved in the rapidly growing field of restoring, preserving, and adapting historic buildings, Structural Analysis of Historic Buildings is an invaluable structural handbook.

This volume contains the proceedings of the 11th International Conference on Structural Analysis of Historical Constructions (SAHC) that was held in Cusco, Peru in 2018. It disseminates recent advances in the areas related to the structural analysis of historical and archaeological constructions. The challenges faced in this field show that accuracy and robustness of results rely heavily on an interdisciplinary approach, where different areas of expertise

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from managers, practitioners, and scientists work together. Bearing this in mind, SAHC 2018 stimulated discussion on the new knowledge developed in the different disciplines involved in analysis, conservation, retrofit, and management of existing constructions. This book is organized according to the following topics: assessment and intervention of archaeological heritage, history of construction and building technology, advances in inspection and NDT, innovations in field and laboratory testing applied to historical construction and heritage, new technologies and techniques, risk and vulnerability assessments of heritage for multiple types of hazards, repair, strengthening, and retrofit of historical structures, numerical modeling and structural analysis, structural health monitoring, durability and sustainability, management and conservation strategies for heritage structures, and interdisciplinary projects and case studies. This volume holds particular interest for all the community interested in the challenging task of preserving existing constructions, enable great opportunities, and also uncover new challenges in the field of structural analysis of historical and archeological constructions.

Auth : University of London.

This new edition of the definitive guide to recording America's built environment provides a detailed reference to the recording methods and techniques that are fundamental tools for examining any existing structure. Edited by the Deputy Chief of the Historic American Building Survey/Historic American Engineering Record, this revised edition includes information on recent technological advances such as laser scanning, new case studies, and expanded material on the documentation of historic landscapes.

Structural Analysis of Historic Buildings Restoration, Preservation, and Adaptive Reuse Applications for Architects and Engineers John Wiley & Sons

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The successful preservation of an historic building, complex or city depends on its continued use and daily care that come with it. The possibility of continued use depends on the adaptation of the building to modern standards and practice of living, requiring changes in constructional or structural features. Conservation engineering is the process of understanding, interpreting and managing the architectural heritage to safely deliver it to posterity, enhancing private or public utility vis a vis minimum loss of fabric and significance. These two objectives are sometimes conflicting. With increasing global interest in conservation engineering it is essential to open the debate on more inclusive definitions of significance and on more articulated concepts of safety by use of acceptable and reliable technologies, integrating further the activity of all the professions involved in conservation. This proceedings set of 6th Conference on Structural Analysis of Historical Constructions (Bath, UK, June 3-6, 2008) presents the latest findings on the subject. Keywords: Conservation Engineering, Historic Buildings, Structures Assessment & Monitoring, Experimental Materials This present book describes the different construction systems and structural materials and elements within the main buildings typologies, and it analyses the particularities of each of them, including, at the end, general aspects concerning laboratory and in-situ testing, numerical modeling, vulnerability assessment and construction maintenance. Structural Analysis of Historical Constructions. Anamnesis, diagnosis, therapy, controls contains the papers presented at the 10th International Conference on Structural Analysis of Historical Constructions (SAHC2016, Leuven, Belgium, 13-15 September 2016). The main theme of the book is "Anamnesis, Diagnosis, Therapy, Controls", which emphasizes the importance of all steps of a restoration process in order to obtain a thorough understanding of the

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Make any renovation job go smoother. Building renovation, conservation and reuse represents more than half of all construction work - and is projected to increase to 80% by 2004. Structural Renovation of Buildings, by Alexander Newman, puts a single, convenient source of information about all aspects of structural renovation and strengthening of buildings at your fingertips. While its focus is largely on low and midrise buildings, you can apply the principles it clarifies to buildings of any size - steel-framed, masonry, or wood. Whether you're repairing deteriorated concrete...rehabilitating slabs on grade...strengthening lateral-load resisting systems...renovating a building facade...handling seismic upgrades or fire damage, you'll find this time-and-trouble-saving guide loaded with practical tips, methods, and design examples. It's also heavily illustrated with autoCAD generated details, supplier illustrations of materials, procedural techniques, and much, much more.

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New technologies play an increasingly important role in the analysis, monitoring, restoration, and preservation of historic structures. These technological systems continue to get more advanced and complex, for example: 3D digital construction and documentation programming, 3D imaging data (including laser scanning and photogrammetry), multispectral and thermographic imaging, geophysical data, etc. This book will present the latest nondestructive technologies used in the characterization, preservation, and structural health monitoring of historic buildings. It will include numerous case studies, as well as theoretical explanations about each of the methods and technologies used in each. City of Brick and Steel is a guide to the hidden structure

that keeps over a million buildings in New York City buildings standing. We explain the basics of structure within the main types of buildings that make up the city as it is today. We also include descriptions of common types of damage and how to identify the different types from visible clues. The buildings date from the mid-1600s to the present and cover structure ranging from carpentry by farmers building their own houses to record-breaking steel and concrete high rises. The well-known skyscrapers and brownstones are examples of a broad spectrum of building types, each with its own particular structure, its own history of use, and its own patterns of aging.

Structural analysis of architectural heritage is a new and growing branch of engineering. Knowledge of the history of architecture, material characteristics, instruments and techniques for investigations, diagnosis and restoration are all vital aspects for the correct understanding of structural behaviour and the ability to make correct decisions for repair and strengthening techniques. Designed for use by all professionals involved or interested in the preservation of monuments, the purpose of this book is to contribute to the development of new approaches in the area. Many of the examples examined, including the Colosseum, the Tower of Pisa, the Pyramid of Chephren, the Tilla Kari Mosque in Samarkand, the temples of Angkor and Konarak, the Santa Maria Vieja Cathedral, the domes of St Peter, Hagia Sophia, the Pantheon, St Ignatio de Loyola and St Charles, are the result of projects and studies carried out during Giorgio Croci's distinguished career. The book

features numerous black and white photographs and illustrations by the author.

Conservation in the built environment raises fundamental questions which have been debated for centuries - what is worth preserving, how is it possible, why is it important? This book takes a modern approach to the meaning of a heritage structure and its conservation. The historical evolution of conservation is briefly addressed, considering prominent individuals and cases; along with the history of construction, focusing on materials and related structural elements, with insight on the sizing rules adopted by masons. This explains structural decisions made during the construction process and allows comparison of scientific theories from the 18th century to modern understanding of limit analysis.

Damage and collapse mechanisms for masonry construction, as the most widespread structural form for historical buildings, is described. Excess permanent loading and settlement is differentiated from environmental and anthropogenic actions such as earthquake or incorrect intervention. The team of authors brings together unique expertise, with high level research and leading practice with archetypical cases from around the world. The book addresses the history of conservation by exploring materials and structures and the history of construction and damage, so it is of value to students and professionals in civil engineering and architecture, as well as archaeologists and art historians. The preservation of heritage architecture is a cultural objective rigorously pursued by communities and nations wishing to promote their history, civilisation and aesthetic

achievements. Structures built in the remote past by traditional methods have suffered the consequences of extreme loading events, such as earthquakes, over long time periods. Retrofitting is an approach based on recent technological developments and scientific knowledge, whereby modern construction methods and materials are applied to the repair and strengthening of historical structures. This book aims to inform on current retrofitting techniques, their application to various types of historical architecture and their effectiveness to fulfil their purpose. Retrofitted structural forms covered in the book vary widely from age old places of worship, such as churches, mosques and temples, as well as castles and palaces to more modern, distinguished private residences or public buildings, some of them designed by well known architects. Their methods of construction range from traditional, such as stone or brick masonry to more recent textile block systems and even reinforced concrete frameworks. Reference is made to detailed visual inspections of damaged structure providing valuable insight into possible causes of failure; such inspections are usually combined with material characterisation which is an essential input to numerical modelling for assessing the behaviour of the structure before and after retrofitting. The book describes strengthening techniques for masonry walls including re-pointing, injection grouting and the use of steel ties. The use of reinforced concrete is proposed in the form of cast-in-place walls, jackets or tie-beams; that of carbon fibre reinforced laminates for strengthening walls and slabs. Innovative use of materials, such as shape memory

alloys, self-compacting concrete or thin lead layers is also suggested. Particular attention is given to methods for moderating the consequences of destructive earthquakes. Seismic energy absorbing devices and base isolation systems are two effective means of providing protection against future seismic events although their application is often met with many technical challenges in practice. Retrofitting of Heritage Structures Against Earthquakes will be of interest to members of academic institutions, government or private cultural preservation establishments and specialist consultant engineers. The book contains very practical, technical advice on many issues; this would be of considerable interest to construction companies specialising in repairs and maintenance of historical structures.

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