Code On Envelope Thermal Performance For Buildings

Residential buildings account for 27% of the final energy use in the European Union. In cold climates, space heating represents the largest proportion of the energy demand in residential buildings. By implementing energy efficiency measures (EEMs) in existing buildings, energy use can be significantly reduced. The Energy Performance of Buildings Directive states that renovations of buildings offer an opportunity to improve energy efficiency. Renovations that include measures implemented with the specific purpose of reducing energy use are referred to as energy renovations. In addition to improving energy efficiency, an energy renovation can also improve the indoor environment. Sweden, like many other European countries, faces the challenge of renovating an ageing building stock with poor energy performance. Improving energy efficiency and performing energy renovations in a cost-effective manner is central, and optimization approaches are often used to identify suitable EEMs and energy renovation approaches. New buildings usually feature better energy performance compared to older buildings, and one approach for reducing energy use in the building sector could be to demolish old buildings with poor thermal performance and build new buildings with better thermal performance. The aim of this thesis is to evaluate energy renovations of multi-family buildings with regard to space heating demand, life cycle costs, indoor environment and primary energy use. The choice between energy renovation of a multi-family building and the demolition and construction of a new one is also investigated with regard to life cycle costs (LCCs). A Swedish multi-family building in which energy renovation has been carried out is used as a case study. The building was originally constructed in 1961 and has a lightweight concrete construction. The renovation included improving the thermal performance of the building envelope and replacing the exhaust air ventilation system with a mechanical supply and exhaust air ventilation system with heat recovery. The methods used in the studies include dynamic whole building energy simulation, life cycle cost analysis and optimizations, and a questionnaire on indoor environment perception. Extensive field measurements have been performed in the building prior to and after renovation to provide input data and to validate numerical predictions. In addition to the studied building, the analysis of the choice between energy renovation and the demolition and construction of a new building includes three other building construction types, representing common Swedish building types from the 1940s, 1950s and 1970s. The analysis shows that the energy renovation led to a 44% reduction in space heating demand and an improved indoor environment. The indoor temperature was higher after the renovation and the perception of the indoor temperature, air quality and noise in the building improved. The EEMs implemented as part of the energy renovation have a slightly higher LCC than the optimal combinations of EEMs identified in the LCC optimization. It is not cost-optimal to implement any EEMs in the building if the lowest possible LCC is the objective function. Attic insulation has a low cost of implementation but has limited potential in the studied building with its relatively good thermal properties. Insulation of the façade is an expensive measure, but has a great potential to reduce heat demand because of the large façade area. Façade insulation is thus required to achieve significant energy savings. Heat recovery in the ventilation system is cost-effective with an energy saving target above 40% in the studied building. The primary energy factors in the Swedish Building Code favor ground source heat pumps as a heat supply system in the studied building. The LCC of renovation is lower compared to demolishing and constructing a new building. A large proportion of the LCC of demolition and new construction relates to the demolition of the existing building. In a building with a high internal volume to floor area ratio, it is not always possible to renovate to the same energy performance level as when constructing a new building. A more ambitious renovation approach is also needed compared to a building with a smaller volume to floor area ratio. Nära 27 % av den totala energianvändningen i den Europeiska Unionen sker i bostäder. I länder med kallt klimat används den största delen till uppvärmning. Genom att implementera energieffektiviseringsåtgärder i befintliga byggnaden kan energiprestandan signifikant förbättras. Europeiska Unionens direktiv om byggnaders energiprestanda framhåller att ett tillfälle att förbättra byggnaders energieffektivitet finns då byggnader ska renoveras. Byggnadsrenoveringar som innehåller åtgärder som implementeras med det primära syftet att minska energianvändningen kallas ofta energirenoveringar. Utöver energieffektivisering kan energirenoveringar ofta förbättra inomhusmiljön i byggnaden. Som många andra Europeiska länder står Sverige inför utmaningen att renovera ett åldrande byggnadsbestånd med låg energiprestanda. Kostnadseffektivitet är centralt vid energirenoveringar och energieffektivisering och optimeringsansatser är vanliga för att identifiera vilka energieffektiviseringsåtgärder som bör implementeras. Nya byggnader har som regel bättre energiprestanda jämfört med äldre byggnader, och en ansats till ett minska energianvändningen i byggnadssektorn överlag är således att riva äldre byggnader med låg energiprestanda och konstruera nya byggnader med bättre energiprestanda. Syftet med denna avhandling är att utvärdera energirenoveringar av flerfamiljshus avseende effekterna på uppvärmningsbehov, livscykelkostnader, inomhusmiljö och primärenergianvändning. Valet mellan energirenovering kontra att riva och bygga en ny byggnad analyseras också utifrån ett livscykelkostnadsperspektiv. För att studera detta har en svensk flerfamiljsbyggnad som genomgått energirenovering studerats. Byggnaden konstruerades 1961 och har en lättbetongstomme. När byggnaden renoverades förbättrades prestandan hos byggnadens klimatskal och frånluftsventilationssystemet byttes ut mot ett balanserat mekanisk ventilationssystem med värmeåtervinning. Metoderna som använts i studierna i denna avhandling är dynamisk byggandssimulering, beräkning och optimering av livscykelkostnader, samt en enkätstudie om hur de boende uppfattar sin inomhusmiljö. Omfattande mätningar har utförts i byggnaden och har använts som indata och för att validera resultaten. Utöver den studerade byggnaden har tre andra byggnadstyper inkluderats i analysen av valet mellan energirenovering och att riva och konstruera en ny byggnads. Dessa byggnadstyper representerar vanliga svenska byggnadstyper från 1940-, 1950- och 1970-talet. Analyserna visar att den renovering som genomfördes i byggnaden ledde till en minskning av uppvärmningsbehovet med 44 % och en förbättring av inomhusmiljön. Inomhustemperaturen var högre efter renoveringen, och de boende uppfattade temperaturförhållanden, luftkvalitet och bullersituationen som bättre efter renoveringen. De energieffektiviserande åtgärder som implementerades vid renoveringen gav en något högre livscykelkostnad än de åtgärder som identifierades som optimala genom livscykelkostnadsoptimering. Det är inte kostnadseffektivt att implementera några energieffektiviseringsåtgärder som del av renoveringen om den lägsta livscykelkostnaden är målsättningen. Vindsisolering är en förhållandevis billigt åtgärd att genomföra, men har begränsad potential i den studerade byggnaden vars vind redan har relativt god termisk prestanda. Fasadisolering kräver en större investering, men har större potential att minska energianvändning på grund av den stora fasadytan. Detta innebär att det är nödvändigt att isolera fasaden för att uppnå hög energibesparing. Värmeåtervinning i ventilationssystemet är kostnadsoptimalt om ett energisbesparingsmål på mer än 40 % ställs på energirenoveringen. Primärenergifaktorerna i den svenska byggnadskoden gynnar bergvärmepump som energitillförselsystem i de studerade

byggnaden. Kostnaden för att energirenovera är lägre än att riva och bygga en ny byggnad. En stor andel av kostnaderna vid rivning och nybyggnation är kopplad till rivning och bortforsling av rivningsmassa. I byggnadstyper med stor inre volym i förhållande till uppvärmd golvyta är det inte alltid möjlig att energirenovera till en energiprestanda som är lika god som en ny byggnad. Det krävs också en mer ambitiös renovering för att uppnå samma energiprestanda som en byggnad med mindre inre volym i förhållande till uppvärmd golvyta.

This book results from a Special Issue published in Energies, entitled “Building Thermal Envelope". Its intent is to identify emerging research areas within the field of building thermal envelope solutions and contribute to the increased use of more energy-efficient solutions in new and refurbished buildings. Its contents are organized in the following sections: Building envelope materials and systems envisaging indoor comfort and energy efficiency; Building thermal and energy modelling and simulation; Lab test procedures and methods of field measurement to assess the performance of materials and building solutions; Smart materials and renewable energy in building envelope; Adaptive and intelligent building envelope; and Integrated building envelope technologies for high performance buildings and cities.

The use of novel materials and new structural concepts nowadays is not restricted to highly technical areas like aerospace, aeronautical applications or the automotive industry, but affects all engineering fields including those such as civil engineering and architecture. Addressing issues involving advanced types of structures, particularly those based on new concepts or new materials and their system design, contributions highlight the latest developments in design, optimisation, manufacturing and experimentation. Also included are contributions on new software, numerical methods and different optimisation techniques. Optimisation problems of interest involve those related to size, shape and topology of structures and materials. Most high performance structures require the development of a generation of new materials, which can more easily resist a range of external stimuli or react in a non-conventional manner. Particular emphasis is placed on intelligent structures and materials as well as the application of computational methods for their modelling, control and management. Optimisation techniques have much to offer to those involved in the design of new industrial products. The formulation of optimum design has evolved from the time it was purely an academic topic, able now to satisfy the requirements of real life prototypes. The development of new algorithms and the appearance of powerful commercial computer codes, with easy to use graphical interfaces, have created a fertile field for the incorporation of optimisation in the design process in all engineering disciplines. This proceedings volume is the first from a new edition of the High Performance Design of Structures and Materials and the Optimum Design of Structures conferences, which follows the success of a number of meetings that originated in 1989. Topics covered include: Composite materials & structures; Material characterisation; Experiments and numerical analysis; Steel structures; High performance concretes; Natural fibre composites; Transformable structures; Lightweight structures; Timber structures; Environmentally friendly and sustainable structures; Emerging structural applications; Optimisation in civil engineering; Evolutionary methods in optimisation; Shape and topology optimisation; Aerospace structures; Structural optimisation; Biomechanics application; Material optimisation; Life cost optimisation; Intelligence structures and smart materials.

SIGNIFICANT CHANGES TO THE INTERNATIONAL RESIDENTIAL CODE, 2018 Edition, provides a comprehensive analysis of notable changes since the 2015 IRC--including the origins, implications, and real-world applications of those changes--within a single, easy-to-use resource. The text covers changes made to building, energy, mechanical, fuel gas, plumbing, and electrical provisions of the IRC. Each analysis presents the affected code sections and identifies changes with strikethroughs and underlines to highlight modifications to the existing language. In addition, a brief summary, detailed illustrations, and thoughtful discussion of the changes’ significance help readers interpret the code’s technical jargon and understand its practical applications to real-world scenarios. Close attention to detail, logical organization, and thorough, yet concise coverage makes this text an ideal resource for students and professionals transitioning from the 2015 IRC. Important Notice: Media content referenced within the product description or the product text may not be available in the ebook version.

Special edition of the Federal Register, containing a codification of documents of general applicability and future effect ... with ancillaries.

This book brings together the papers presented at the Smart and Sustainable Built Environments Conference, 2018 (SASBE).This latest research falls into two tracks: smart and sustainable design and planning cities; and the technicalities of smart and sustainable buildings. The growth of smart cities is evident, but not always linked to sustainability. This book gives an overview of the latest academic developments in increasing the smartness and sustainability of our cities and buildings. Aspects such as inclusivity, smart cities, place and space, the resilient city, urbanity and urban ecology are prominently featured in the design and planning part of the book; while energy, educational buildings, comfort, building design, construction and performance form the sub-themes of the technical part of the book. This book will appeal to urban designers, architects, urban planners, smart city designers and sustainable building experts.

For more than half a century, this book has been a fixture in architecture and construction firms the world over. Twice awarded the AIA's Citation for Excellence in International Architecture Book Publishing, Mechanical and Electrical Equipment for Buildings is recognized for its comprehensiveness, clarity of presentation, and timely coverage of new design trends and technologies. Addressing mechanical and electrical systems for buildings of all sizes, it provides design guidelines and detailed design procedures for each topic covered. Thoroughly updated to cover the latest technologies, new and emerging design trends, and relevant codes, this latest edition features more than 2,200 illustrations--200 new to this edition--and a companion Website with additional resources.

As well as taking stock of the current and proposed legal instruments, the book looks at the wider policy and economic aspects of coping with climate change. It provides a comparative overview of key issues across Europe, the United States, Asia-Pacifi

The Code of Federal Regulations is the codification of the general and permanent rules published in the Federal Register by the executive departments and agencies of the Federal Government.

Low Carbon Cities is a book for practitioners, students and scholars in architecture, urban planning and design. It features essays on ecologically sustainable cities by leading

exponents of urban sustainability, case studies of the new directions low carbon cities might take and investigations of how we can mitigate urban heat stress in our cities' microclimates. The book explores the underlying dimensions of how existing cities can be transformed into low carbon urban systems and describes the design of low carbon cities in theory and practice. It considers the connections between low carbon cities and sustainable design, social and individual values, public space, housing affordability, public transport and urban microclimates. Given the rapid urbanisation underway globally, and the need for all our cities to operate more sustainably, we need to think about how spatial planning and design can help transform urban systems to create low carbon cities, and this book provides key insights.

This book is about the optimization of the characterization of the thermal properties of building envelopes, through experimental tests and the use of artificial intelligence. It analyses periodic and stationary thermal properties using measurement approaches based on the heat flow meter method and the thermometric method. These measurements are then analysed using advanced artificial intelligence algorithms. The book is structured in four parts, beginning with a discussion of the importance of thermal properties in the energy performance of buildings. Secondly, theoretical and experimental methods for characterizing thermal properties are analysed. Then, the methodology is developed, and the characteristics and properties of the algorithms used are explored. Finally, the results obtained with the algorithms are analysed and the most appropriate approaches are determined. This book is of interest to researchers, civil and industrial engineers, energy auditors and architects, by providing a resource which improves energy audit tasks in existing buildings.

This paper addresses the evolution of ASHRAE Standard 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings , with regard to the continued long-term increase in thermal performance levels required of commercial building envelope and fenestration systems. The trend of increasing thermal performance levels for building envelopes has had a significant impact on design and the materials, systems, and products available for use in exterior building envelopes. This is particularly true when considering buildings of size or simplicity that do not warrant thermal modeling of the entire building or envelope system to validate compliance with mandated energy performance levels. As a widely recognized, and most often code-mandated, standard, ASHRAE 90.1 significantly impacts the selection of materials, products, and systems available for compliance with required energy standards. As increases continue through the most recent edition of ASHRAE 90.1 and as U-values become more stringent for materials, products, and systems in specific envelope applications, identifying options for the design of buildings becomes more challenging. The demand for additional options also increases, which will hopefully spur greater interest in the development of new and improved envelope materials, systems, and products to meet the demands of aesthetics and the more stringent energy performance requirements. As requirements for energy performance increase, the number of buildings and envelope systems evaluated by thermal modeling to confirm compliance with new standards is also likely to increase. Compliance with the new ASHRAE 90.1 "prescriptive" requirements has been challenging and appears likely to become even more so. This paper includes consideration of a 20-year period (1999-2019) of evolving ASHRAE 90.1 standards and criteria for prescriptive building envelope thermal performance, and specific examples of the types of restraints currently being experienced by designers is included.

Urbanization and growing wealth in developing countries portend a large increase of demand for modern energy services in residential, commercial and public-service buildings in the coming decades. Pursuing energy efficiency in buildings is vital to energy security in developing countries and is identified by the Intergovernment Panel on Climate Change as having the greatest potential for cost-effective reduction of CO2 emissions by 2030 among all energy-consuming sectors. Building energy efficiency codes (BEECs), along with energy efficiency standards for major appliances and equipment, are broadly recognized as a necessary government intervention to overcome persistent market barriers to capturing the economic potential of energy efficiency gains in the residential, commercial and public-service sectors. Implementation of BEECs help prevent costly energy wastes over the lifecycles of buildings in space heating, air conditioning, lighting, and other energy service requirements. Nonetheless, achieving the full potential of energy savings afforded by more energy-efficient buildings requires holding people who live or work in buildings accountable for the cost of energy services. Compliance enforcement has been the biggest challenge to implementing BEECs. This report summarizes the findings of an extensive literature survey of the experiences of implementing BEECs in developed countries, as well as those from case studies of China, Egypt, India, and Mexico. It also serves as a primer on the basic features and contents of BEECs and the commonly adopted compliance and enforcement approaches. This report highlights the key challenges to improving compliance enforcement in developing countries, including government commitment to energy efficiency, the effectiveness of government oversight of the construction sector, the compliance capacity of building supply chain, and financing constraints. The report notes that the process of transforming a country s building supply chain toward delivering increasingly more energy-efficient buildings takes time and requires persistent government intervention through uniformly enforced and regularly updated BEECs. The report recommends increased international support in strengthening the enforcement infrastructure for BEECs in middle-income developing countries. For low- and lower-middle-income countries, there is an urgent need to assist in improving the effectiveness of government oversight system for building construction, laying the foundation for the system to also cover BEECs.

Buildings are one of the main causes of the emission of greenhouse gases in the world. Europe alone is responsible for more than 30% of emissions, or about 900 million tons of CO2 per year. Heating and air conditioning are the main cause of greenhouse gas emissions in buildings. Most buildings currently in use were built with poor energy efficiency criteria or, depending on the country and the date of construction, none at all. Therefore, regardless of whether construction regulations are becoming stricter, the real challenge nowadays is the energy rehabilitation of existing buildings. It is currently a priority to reduce (or, ideally, eliminate) the waste of energy in buildings and, at the same time, supply

the necessary energy through renewable sources. The first can be achieved by improving the architectural design, construction methods, and materials used, as well as the efficiency of the facilities and systems; the second can be achieved through the integration of renewable energy (wind, solar, geothermal, etc.) in buildings. In any case, regardless of whether the energy used is renewable or not, the efficiency must always be taken into account. The most profitable and clean energy is that which is not consumed. Building Sustainability in East Asia: Policy, Design and People illustrates the holistic approaches and individual strategies to building sustainability that have been implemented in construction projects in Asia. Top-down and bottom-up approaches (from formulating policy to constructing individual buildings) are effective in terms of the sustainable development of cities, and this book covers both, illustrated with a range of case study developments.

Sustainability Mattersis a compilation of some of the best research papers by students from the National University of Singapore's inter-disciplinary graduate programme in environmental studies, the MSc in Environmental Management [MEM]. This collection is for the period 2009/10 to 2011/12. As the period covers 3 academic years, the papers have been split into two volumes: Sustainability Matters: Asia's Green Challenges, and Sustainability Matters: Asia's Energy Concerns, Green Policies and Environmental Advocacy. These two volumes are the third and fourth compilation by the programme, and respectively comprise sixteen and fourteen of the best research papers completed during this period. The papers have been edited for brevity. These papers analyze the many challenges to effective environmental management in the context of different countries including India, Sri Lanka, Bangladesh, China, Hong Kong, Nepal, Singapore, and Thailand, and propose insightful solutions. The first compilation, Sustainability Matters: Environmental Management in Asia, was published in 2010 (World Scientific) and comprised the best papers from 2001/2 to 2006/7. The second, Sustainability Matters: Challenges and Opportunities in Environmental Management in Asia was published in 2011 (Pearson), and comprised the best papers from 2007/8 to 2008/09. Contents: Volume 1:Air Pollution:Development of Urban Traffic Pollution Control Strategies in Asian Cities: A Case Study from Chennai, India (Ashwinkumar Dakshinamurthi and Rajasekhar Balasubramanian)Assessment and Abatement Measures for Vehicular Air Pollution in Colombo, Sri Lanka (Chamila Weerathunghe and Rajasekhar Balasubramanian)Waste Management:Recycling in Singapore the Singapore Model: Strategies and Ways to Improve (Tan Puay Cheow and Lye Lin Heng)Municipal Solid Waste Management in Southeast Asian Cities: The Next Steps (Boey Yinyin Edris and Rick Reidinger)Lessons for Integrated District-Level Food Waste Recycling Programs: A Review of Eight International Cases (Amireeta Rawlani and Kua Harn Wei)Singapore's Municipal Solid Waste Management: A Sustainable Model (Wendy Wong Shih Ling and Rick Reidinger)Utilization of Landfill Gas as a Renewable Source of Energy in India (Subhashini Kashinath and Zhou Zhi George)The Potential Role of Water Hyacinth in Wastewater Treatment in Nepal (Ram Bahadur Singh Maharjan and Chou Loke Ming)Improving Leachate Water Quality using a Wetland Treatment System in Lorong Halus — A Pilot Study (Christian Budiman and Ting Yen-Ping)Life Cycle Assessment of an Urban Waste Refinery (Celia Chua Bee Hong and Kua Harn-Wei) A Study of the 3Rs (Reduce, Reuse, Recycle)Programs in Primary Schools, Singapore (Kelly Yong Kim-Lian and Victor R Savage)Urban Studies:Assessing Skywalk Systems as a Response to High Density Living in Hong Kong (Patricia Woo and Malone-Lee Lai Choo)The Management of Visitor Pressure on Coastal Parks of Singapore (Karen Lim Hui Khian and Chou Loke Ming)Sustainability in Singapore: An Ecological Footprint Perspective (Xin Jing Jing and Victor R Savage)Seagrasses in Singapore: Current Status and Long-Term Management Plans (Michelle Chng Wei Ping and Chou Loke Ming)The Singapore's Bus System: An Analysis of Commuters' Satisfaction and Potential Improvements (Jan Martin Hecker and Lee Der Horng)An Assessment of Sustainable Cities (May Yadana Aung and Chou Loke-Ming)Urban Greenery as a Mitigation Strategy for Urban Heat Island Effect in High Density Commercial Districts of Dhaka (Nabanita Islam and Wong Nyuk-Hien)The Potential for Residential Water Conservation in Dhaka, Bangladesh (Sonia F Hoque, Asanga Gunawansa and Md. 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(Md Rashed Bhuyan and Tracey Skelton)Energy and Climate Change:Wind: The Alternative Source of Power for Singapore After Solar Energy? (Chew Keng-Hui and Lanry Yung)The Economics of Wind Energy (Alan Yau Wai-Hoo and Benjamin K Sovacool)Print Media and Climate Change: A Comparison of the 1992 Rio Summit and the 2009 Copenhagen Conference (Davina Loh and Victor R Savage)Green Business:Green Business Strategies in the Precision Engineering Industry in Singapore (Gan Chin-Yean and Audrey Chia)The Second Green Revolution: A Review of the Challenges and Prospects (Leong Li-Sun and Victor R Savage)Towards Broader Implementation of Corporate Sustainability and Sustainability Reporting in the Construction Industry in Singapore (Kaia Margit Davis-Tan and Audrey Chia) Readership: Graduate students, academics and researchers in environmental management/science. Keywords:Environment;Management;Sustainability;Asia;Corporate Environmental Management;Biodiversity and Planning;Marine Environment;Environment and Economic Development;Energy Sustainability;Renewable Energy;Urban Pollution and Waste Management;Sustainable Infrastructure;Transportation;Recycling;Urban Studies;Green Business

This volume examines the applicability of nature-based solutions in ecological restoration practice and in contemporary landscape architecture by bringing together ecology and architecture in the built environment. Green infrastructure is used to address urban challenges such as climate change adaptation, disaster risk reduction, and stormwater management. In addition, thermal comfort nature-based solutions reintroduce critical connections between natural and urban systems. In light of ongoing developments in sustainable urban development, the goal is a paradigm shift towards a landscape that restores and rehabilitates urban ecosystems. The ten contributions to this book examine a wide range of successful cases of designing healthier, greener and more resilient landscapes in different geographical contexts, from the United States of America and Brazil, through various European regions, to Singapore and China. While some chapters attempt to conceptualize the interconnections between cities and nature, others clearly have an empirical focus. Therefore, this volume provides a rich body of work and acts as a starting point for further studies on restoration of ecosystems and integrative policies such as the United Nations Sustainable Development Goals.

Featuring a detailed analysis and presentation of innovative researches, methods, algorithms and technologies that deal with integrated intelligent systems for the efficient management of energy and indoor environment in buildings, this book encompasses the regulations, directives and standards regarding the energy and the indoor environment of buildings as well as a literature review and discussion on the current state-of-the-art for buildings' energy efficiency classification. Maximizing reader insight into this topic with the aid of simulation models for buildings and energy audits at office buildings are presented including tables and figures with the detailed information regarding the parameters, inputs, outputs and the outcomes of the surveys. This book also outlines the development of a Virtual Building Dataset (VBD) of office buildings as an innovative benchmarking and classification tool. The proposed methodology overcomes the difficulties and time required for collecting the necessary massive building constructional and energy bills data by creating them virtually using efficient stochastic simulation and by taking into account all parameters that may affect the energy performance and indoor thermal comfort of office buildings. The knowledge and ideas conveyed by the book are supported with equations and algorithms and 137 colored figures and 55 tables, and features a rich bibliography, references and web sources. The book contains the basic knowledge undergraduate and especially postgraduate courses on the emergent subject of energy management and saving in buildings. The innovative aspects and guides of the book give serious opportunities to the postgraduate students in this scientific area to further develop their research skills and capabilities.

Energy security is one of the most significant challenges facing Jordan. Addressing this will reduce the country's burdens and ensure its sustainable development, especially in the face of the country's sudden unplanned population growth. Jordan imports 96% of its energy re-sources, and its existing building stock is a high energy consumer with a performance level far below the standard of new constructions. Therefore, it has the potential to reduce energy demand on a large scale. This study focuses on optimising energy consumption in mixed-use buildings in Amman through retrofitting the building envelope using passive design solutions, with a special focus on improving thermal performance. It investigates the potential of achieving the requirements of the Jordanian Energy Efficient Building Code (JEEBC) for new buildings and the Passive House Standard (EnerPHit). The methodology of the study is divided into three main parts: i) Literature review. ii) Interview activity with local experts. iii) Development of a retrofit guideline. The interviews are qualitatively analysed to understand the current situation, issues and practices, possible obstacles and opportunities. The original contribution of this study is achieved by assessing the current situation of these buildings from the point of view of thermal performance, calculating thermal transmittance (U-Value) of different building envelope technologies for external walls, roofs, ground floors, internal partitions and windows. The proposed solutions, which are internal or external insulation, are presented in tables with suggested additional insulation thicknesses, achieved U-values, and the thermal performance improvement required for each building envelope component to achieve the study targets. Up-grading the thermal performance of the building envelope results in significant energy savings in buildings and improves the quality of the indoor environment. Post-retrofit calculations that meet the JEEBC requirements resulted in thermal performance improvements of up to 80% in external walls, 50% in cavity walls, 47% in insulated walls, 78% in external roofs, 48% in ground floors, 50% in internal partitions, and 46% in windows. Achieving Passive House U-value standards would mean these figures doubled for internal partitions and increased about 10% for other components. Keywords: Amman buildings, building envelope, energy-efficient buildings, energy retrofit, passive design strategies, thermal insulation.

Issues for 1955 accompanied by supplement: Construction volume and costs, 1915-1954.

This book brings together concepts from the building, environmental, behavioural and health sciences to provide an interdisciplinary understanding of office and workplace design. Today, with changes in the world of work and the relentless surge in technology, offices have emerged as the repositories of organizational symbolism, denoted by the spatial design of offices, physical settings and the built environment (architecture, urban locale). Drawing on Euclidian geometry that quantifies space as the distance between two or more points, a body of knowledge on office buildings, the concept of office and office space, and the interrelationships of spatial and behavioural attributes in office design are elucidated. Building and office work-related illnesses, namely sick building syndrome and ailments arising from the indoor environment, and the menace of musculoskeletal disorders are the alarming manifestations that critically affect employee satisfaction, morale and work outcomes. With a focus on office ergonomics, the book brings the discussion on the fundamentals of work design, with emphasis on computer workstation users. Strategic guidance of lighting systems and visual performance in workplaces are directed for better application of ergonomics and improvement in office indoor environment. It discusses the profiles of bioclimatic, indoor air quality, ventilation intervention, lighting and acoustic characteristics in office buildings. Emphasis has been given to the energy performance of buildings, and contemporary perspectives of building sustainability, such as green office building assessment schemes, and national and international building-related standards and codes. Intended for students and professionals from ergonomics, architecture, interior design, as well as construction engineers, health care professionals, and office planners, the book brings a unified overview of the health, safety and environment issues associated with the design of office buildings.

Originating from the 2019 International Conference on Building Information Modelling this book presents latest findings in the field. This volume presents research from a panel of experts from industry, practice and academia touching on key topics, the development of innovative solutions, and the identification future trends.

Practical solutions for sustainability In this timely guide, one of the world's leaders in advanced building technology implementation shows architects and engineers proven and practical methods for implementing these technologies in sustainably-designed buildings. Because of the very limited time architects are given from being awarded a project to concept design, this book offers clear and workable solutions for implementing solar energy, radiant heating and cooling floors, displacement ventilation, net zero, and more. It provides helpful tips and suggestions for architects and engineers to work together on implementing these technologies, along with many innovative possibilities for developing a truly integrated design. This book also explores and explains the many benefits of advanced technologies, including reduced greenhouse gas emissions, lower operating costs, noise reduction, improved indoor air quality, and more. In addition, Advanced Building Technologies for Sustainability: Offers detailed coverage of solar energy systems, thermal energy storage, geothermal systems, high-performance envelopes, chilled beams, under-floor air distribution, displacement induction units, and much more Provides case studies of projects using advanced technologies and demonstrates their implementation in a variety of contexts and building types Covers the implementation of advanced technologies in office towers, large residential buildings, hospitals, schools, dormitories, theaters, colleges, and more Complete with a clear and insightful explanation of the requirements for and benefits of acquiring the U.S. Green Building Council's LEED certification, Advanced Building Technologies for Sustainability is an important resource for architects, engineers, developers, and contractors involved in sustainable projects using advanced technologies.

This book focuses on the implementation of Quality Function Deployment (QFD) in the construction industry as a tool to help building designers arrive at optimal decisions for external envelope systems with sustainable and buildable design goals. In particular, the book integrates special features into the conventional QFD tool to enhance its performance. These features include a fuzzy multi-criteria decision-making method, fuzzy consensus scheme, and Knowledge Management System (KMS). This integration results in a more robust decision support tool, known as the Knowledge-based Decision Support System QFD (KBDSS-QFD) tool. As an example, the KBDSS-QFD tool is used for the assessment of building envelope materials and designs for high-rise residential buildings in Singapore in the early design stage. The book provides the reader with a conceptual framework for understanding the development of the KBDSS-QFD tool. The framework is presented in a generalized form in order to benefit

building professionals, decision makers, analysts, academics and researchers, who can use the findings as guiding principles to achieve optimal solutions and boost efficiency.