

Code On Envelope Thermal Performance For Buildings

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[Energy Efficiency in Buildings](#) - José

Manuel Andújar 2020-04-28

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. *Residential Thermal Performance and the Michigan Energy Code* - Thomas William Philp 1980

Building Technology Project Summaries - 1980

Quantitative Thermal Performance Assessment of Building Envelopes - Emergent Practices and Infrared Thermography - Milad Mahmoodzadeh 2022

Since many buildings in Canada were built prior to the advent of national and provincial energy codes and standards, quantifying building envelope thermal performance in existing buildings is an important step in identifying retrofit opportunities. Due to the lack of building codes or standards for existing buildings in

Canada, development of a rapid and robust quantitative approach to evaluate and rank buildings for vertical envelope retrofits is required. Hence, this dissertation sought to develop quantitative approaches to evaluate existing building envelope thermal performance in Canada and beyond.

Following current professional practices, in Chapter 1, a comprehensive study was conducted on 49 campus buildings at the University of Victoria (UVic) to evaluate potential energy savings from vertical envelope retrofits, and to further validate those savings through more detailed energy models and parametric analyses for a subset of buildings. To this end, the thermal performance of a building envelope was quantified based on its heat loss coefficient (UA), obtained from multiplying its surface area (A) by its thermal transmittance (U-value). Heat loss calculations were used as a metric to inform envelope rehabilitation

prioritization, while considering other data such as age and physical condition in parallel. Archetype energy models for selected buildings were used to evaluate the impacts of envelope retrofits on energy and GHG savings. The outcomes of this study allowed the University to weigh the benefits of improved energy performance from envelope retrofits against associated capital cost expenditures. Also, the implemented methodology and studied parameters unveiled a new horizon in evaluating the thermal performance of existing building envelopes in Canada, where a building code for existing buildings has not yet been established. Considering the economic findings of the envelope retrofits studied, it was concluded that in the absence of an existing building energy code, the University would likely require additional incentives, such as higher utility costs, higher carbon taxes, or qualifying for

utility incentive programs to justify improving existing building envelope performance on the basis of energy only. The strength of the proposed methodology in Chapter 1 was in its balance of effort and ultimate decision-making utility, where reasonable thermal bridging approximations based on simulation models for existing buildings can yield data accurate enough to inform a ranking exercise on a large breadth of subject buildings. However, since numerical models do not consider degradation of building materials, real moisture content, and errors associated with manufacturing and installation, actual building envelope thermal performance differs from 3D simulation models. To study this limitation, in-situ thermal assessments of building envelopes were performed to quantify their actual thermal performances. To this end, Chapters 2 to 4 of this dissertation

attempted to determine the viability of an external infrared thermography (IRT) survey technique for quantification of heat losses through the opaque building envelope, and also explores its potential application in identifying and comparing sources of air leakage. The experiments were performed on wood-framed wall assemblies commonly used in Canada due to growing interest among designers, builders, and governments to encourage the use of wood as a building material. In these studies, (Chapter 2 to Chapter 4), thermal transmittances (U-values) of wall assemblies were estimated with external IRT and compared with 3D computer simulations. Furthermore, the impact of the accuracy of U-values estimated with IRT on the deviation of energy simulation outputs with metered data was examined. Finally, a novel relative quantitative infrared index (IRI) was proposed as a means to facilitate

rapid evaluation and subsequent ranking of building envelope thermal performance. From the experiments in Chapters 2 & 3, it was found that the U-values obtained with IRT were comparable with simulated values suggesting IRT can be a reliable tool for estimating the thermal performance of wood-framed wall assemblies. Results also demonstrated that thermal imaging artefacts including nonlinear characteristics of infrared (IR) camera focal array, a.k.a. non-uniformity corrections (NUC) and vignetting could have a substantial influence on the accuracy of results, in particular energy model outputs. This limitation was resolved by introducing a practical approach where thermal images were taken from different incident angle. Overall, IRI was found to be a reliable metric for relative quantitative comparison of building envelope thermal performance regardless of boundary conditions.

Moreover, outcomes of the IRT air leakage study in Chapter 4 indicated that combined qualitative and quantitative IRT approaches could potentially be implemented by practitioners to identify sources of air leakage and thermal bridges in buildings and compare their relative severity. Since blower door testing is gradually being introduced as a building code requirement to measure building envelope airtightness in an increasing number of Canadian jurisdictions, performing IRT simultaneously is potentially valuable exercise in this context. Ultimately, the methodologies outlined in Chapters 2 to 4 can help decision-makers to characterize building envelope retrofits from a performance perspective, and potentially serve as a basis for governments to develop policies to improve existing building energy performance. The methodologies in Chapters 2 to 4 prompted opportunities to

utilize the emergent technology of small unmanned aerial vehicles (UAVs) equipped with an infrared camera for quick thermal assessments of building envelopes. The last chapter of this dissertation, Chapter 5, outlines advantages and limitations of aerial IRT (UAV-IRT) surveys compared to conventional stationary IRT. Furthermore, a set of best practices for UAV-IRT were presented to minimize dynamic measurement uncertainty. It was concluded that with the current IR camera technology, aerial surveys for quantitative thermal assessment of building envelope are not as accurate as with conventional infrared thermography; further investigations by manufacturers and researchers are recommended.

Office Buildings - Pranab Kumar Nag

2018-12-31

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.

Research and Innovation in the Building Regulatory Process - Patrick W. Cooke 1977

Architecture & Sustainable Development (vol.1) - Magali Bodart 2011-07

This book of Proceedings presents the latest thinking and research in the rapidly evolving world of architecture and sustainable development through 255 selected papers by authors coming from over 60 countries.

Energy Retrofit of the Existing Building Envelope in Jordan - Sameh Shamout 2016

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 resources, 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.

Building Sustainability in East Asia - Vincent S. Cheng 2017-03-22

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.

Significant Changes to the International Residential Code 2018 Edition -

International Code Council 2017-12-11

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.

Moisture and Buildings - Arianna Brambilla 2021-05-28

One in three homes, on average, suffer from excessive dampness and mould proliferation, with significant health and economic impacts. The combination of new construction methodologies, stricter

airtightness requirements and the changing social and cultural context that influences the way we live inside buildings has created unprecedented challenges for the built environment. In modifying indoor and outdoor environments and the building envelopes that serve as a filter between the two, we are changing the physical parameters of the ways in which buildings behave and respond to climatic stimuli. Understanding and predicting the way in which buildings and moisture may interact should be an important step in the design process, aiming to minimise possible negative long-term consequences. Understanding and predicting the way in which buildings and moisture may interact is, today more than ever, essential yet difficult, as the experience of the past has lost its applicability. Moisture-related issues never have a simple solution, since they involve multiple factors, including design,

construction, maintenance, materials, climate and occupation pattern. Thus, while the topic is attracting growing attention among researchers, designers and practitioners, the pace with which actual change is occurring is still too slow. *Moisture and Buildings* provides a critical overview of current research, knowledge and policy frameworks, and presents a comprehensive analysis of the implications of moisture and the importance of accounting for it during the design process. It responds to the urgent need for a systematic organization of the existing knowledge to identify research gaps and provide directions for future developments. The ultimate goal is to increase awareness of the multifaceted implications of hygrothermal phenomena and promote integrated design processes that lead to healthier and more durable constructions. Presents advanced knowledge on

hygrothermal processes and their interaction with buildings Integrates the three key areas of moisture transport and its impact on buildings, including durability, human health and comfort Considers the most useful computational tools for assessing moisture and building interactions Includes a section on the main European, American and Australian building codes Explains the risks of mold growth to human health, including growth models to assessment methods [Publications of the National Bureau of Standards 1978 Catalog](#) - United States. National Bureau of Standards 1979

Sunset Area Community Planned Action - 2011

Brick and Block Masonry - From Historical to Sustainable Masonry - Jan Kubica 2020-07-06

Brick and Block Masonry - From Historical to Sustainable Masonry contains the keynote and semi-keynote lectures and all accepted regular papers presented online during the 17th International Brick and Block Masonry Conference IB2MaC (Kraków, Poland, July 5-8, 2020). Masonry is one of the oldest structures, with more than 6,000 years of history. However, it is still one of the most popular and traditional building materials, showing new and more attractive features and uses. Modern masonry, based on new and modified traditional materials and solutions, offers a higher quality of life, energy savings and more sustainable development. Hence, masonry became a more environmentally friendly building structure. Brick and Block Masonry - From Historical to Sustainable Masonry focuses on historical, current and new ideas related to masonry development, and will provide a very good platform for

sharing knowledge and experiences, and for learning about new materials and technologies related to masonry structures. The book will be a valuable compendium of knowledge for researchers, representatives of industry and building management, for curators and conservators of monuments, and for students.

Publications of the National Bureau of Standards - United States. National Bureau of Standards 1974

Sustainable Urban Architecture - K.

Thirumaran 2021-04-29

This book presents select proceedings of the International Conference on Visionary Action towards Liveable Urban Environments (VALUE 2020). Various topics covered in this book include context responsive architecture, green architecture, energy efficient buildings, energy conservation, inclusive spatial

environments, security in buildings and cities, green/smart/ intelligent architecture, sustainable mobility and smart communities. This book will be a valuable reference for students, researchers, and professionals interested in built environment and allied fields.

Advances in Energy Science and Equipment Engineering II Volume 2 -

Shiquan Zhou 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.

Changes in Exterior Envelope Systems' Thermal Performance Requirements and Impacts Upon Design, Materials, Products, and Systems - William Jensen 2020

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.

Mechanical and Electrical Equipment for Buildings - Walter T. Grondzik 2014-09-22

The definitive guide to environmental control systems, updated with emerging technology and trends The Interactive Resource Center is an online learning environment where instructors and students can access the tools they need to make efficient use of their time, while reinforcing and assessing their understanding of key concepts for successful understanding of the course. An access card with redemption code for the online Interactive Resource Center is included with all new, print copies or can be purchased separately. (**If you rent or purchase a used book with an access code, the access code may have been redeemed previously and you may have to purchase a

new access code ISBN: 978111899616-4). The online Interactive Resource Center contains resources tied to the book, such as: Interactive Animations Interactive Self-tests Interactive Flashcards Case Studies Respondus Testbank (instructors only) Instructor's Manual (over 200 pages) including additional resources (Instructors only) Roadmap to the 12th Edition (Instructors only) Student Guide to the Textbook Mechanical and Electrical Equipment for Buildings, Twelfth Edition is the industry standard reference that comprehensively covers all aspects of building systems. With over 2,200 drawings and photographs, the book discusses basic theory, preliminary building design guidelines, and detailed design procedure for buildings of all sizes. The updated twelfth edition includes over 300 new illustrations, plus information on the latest design trends, codes, and technologies,

while the companion website offers new interactive features including animations, additional case studies, quizzes, and more. Environmental control systems are the components of a building that keep occupants comfortable and help make the building work. Mechanical and Electrical Equipment for Buildings covers both active controls, like air conditioners and heaters, as well as passive controls like daylighting and natural ventilation. Because these systems comprise the entire energy use and costs of a building's life, the book stresses the importance of sustainability considerations during the design process, by both architects and builders. Authored by two leading green design educators, MEEB provides the most current information on low-energy architecture, including topics like: Context, comfort, and environmental resources Indoor air quality and thermal control Illumination, acoustics,

and electricity Fire protection, signal systems, and transportation Occupant comfort and building usability are the most critical factors in the success of a building design, and with environmental concerns mounting, it's becoming more and more important to approach projects from a sustainable perspective from the very beginning. As the definitive guide to environmental control systems for over 75 years, Mechanical and Electrical Equipment for Buildings is a complete resource for students and professionals alike.

Publications - United States. National Bureau of Standards 1980

Smart and Sustainable Cities and Buildings
- Rob Roggema 2020-05-11

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. *Sustainable Energy And Environmental Technology - Proceedings Of The Asia-pacific Conference* - Lua Aik Chong

1996-06-17

Many of the challenges of medical ethics today were nonexistent during the time when Hippocrates wrote his famous oath. In an increasingly complex world, many more new ethical issues will impact on the practice of medicine in the 21st century: quality care, growing patient demand, high technology, the definition of death, and controversies relating to the right to live and the right to die. In addition, there will be questions raised with regard to issues and practices such as research on embryos, genetic engineering, experiments on animals and clinical trials, and the problems of limited medical resources. These can lead to grave dilemmas, causing uncertainty and confusion in the medical profession. This book is based on the lectures and essays on medical ethics by a number of leading Singapore doctors. It records the thoughts of the leaders on

medical ethics, and discusses a range of important and controversial issues. It will be a valuable reference for medical students as well as interesting and informative reading for both the professional and the lay reader.

Advanced Building Technologies for Sustainability - Asif Syed 2012-06-07

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.

Research and Innovation in the Building Regulatory Process - National Conference of States on Building Codes and Standards 1977

Research and Innovation in the Building Regulatory Process - 1978

From Poverty, Inequality to Smart City - Fumihiko Seta 2016-12-16
This book is a comprehensive document

visualizing the future of built environment from a multidisciplinary dimension, with special emphasis on the Indian scenario. The multidisciplinary focus would be helpful for the readers to cross-refer and understand others' perspectives. The text also includes case studies substantiating theoretical research. This method of composition helps the book to maintain rational balance among theory, research and its contextual application. The book comprises selected papers from the National Conference on Sustainable Built Environment. The chapters provide varied viewpoints on the core issues of urbanization and planning, especially in the economically diverse Indian market. This compilation would be of interest to students, researchers, professionals and policy makers.

Energy renovation of multi-family buildings in Sweden - Lina La Fleur 2019-09-18

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 byggnad. 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 billig 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 energibesparingsmål 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 möjligt 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.

Building Technology Publications - 1983

NBS Special Publication - 1982

Mainstreaming Building Energy Efficiency Codes in Developing Countries - Feng Liu
2010-10-12

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.

Research Handbook on Climate Change Mitigation Law - Geert Van Calster
2015-01-30

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-Pacific
Publications of the National Institute of Standards and Technology ... Catalog - National Institute of Standards and

Technology (U.S.) 1982

Comprehensive Energy Systems -
2018-02-07

Comprehensive Energy Systems provides a unified source of information covering the entire spectrum of energy, one of the most significant issues humanity has to face. This comprehensive book describes traditional and novel energy systems, from single generation to multi-generation, also covering theory and applications. In addition, it also presents high-level coverage on energy policies, strategies, environmental impacts and sustainable development. No other published work covers such breadth of topics in similar depth. High-level sections include Energy Fundamentals, Energy Materials, Energy Production, Energy Conversion, and Energy Management. Offers the most comprehensive resource available on the

topic of energy systems Presents an authoritative resource authored and edited by leading experts in the field Consolidates information currently scattered in publications from different research fields (engineering as well as physics, chemistry, environmental sciences and economics), thus ensuring a common standard and language

Building Information Modelling (BIM) in Design, Construction and Operations III - P. De Wilde 2019-12-10

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.

Publications of the National Bureau of

Standards ... Catalog - United States.
National Bureau of Standards 1979

Building Technology Publications - Center
for Building Technology 1982

Energy Research Abstracts - 1994-12

Construction Review - 1978
Issues for 1955 accompanied by
supplement: Construction volume and
costs, 1915-1954.

Publications of the National Bureau of

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National Bureau of Standards 1975

Research in Building Physics - J. Carmeliet
2020-12-17

This text provides a broad view of the
research performed in building physics at
the start of the 21st century. The focus of
this conference was on combined heat and
mass flow in building components,
performance-based design of building
enclosures, energy use in buildings,
sustainable construction, users' comfort
and health, and the urban micro-climate.