International Conference for Sustainable Design of the Built Environment
SDBE 2018

Book of Abstracts

Editors
Heba Elsharkawy
Sahar Zahiri
Jack Clough
Foreword

The International Conference for Sustainable Design of the Built Environment SDBE 2018 forms one of the key deliverables of the British Council Newton Institutional Links Fund project: Building Capacity for Sustainable Development of the Built Environment (BC-SDBE) launched in April 2016. The aim of the BC-SDBE institutional link project is to bridge the gap between the rapidly developing advancements in research and training in sustainable development of the built environment globally, and the demanding professional development required in the construction labour market. The main objective of BC-SDBE project is to build capacity in education, research, innovation, and exploitation of state-of-the art sustainable development strategies to help promote and sustain socio-economic growth in Egypt.

Following the great success of SDBE 2017 conference where 112 papers were published in the proceedings, SDBE 2018 conference offers yet, another unique opportunity for academics, researchers, architects, urban designers, engineers, and professionals to meet and share the latest knowledge, research and innovations on low carbon building design, building performance, simulation tools and energy efficient building-related technologies. The conference theme is ‘Research in Practice’ where the focus is on showcasing sustainable design, building energy performance, sustainable planning of neighbourhoods and cities, emphasising a balanced approach to environmental, socio-economic and technical aspects of sustainability in practice based on research.

The book of abstracts includes all 110 accepted papers under 12 themes clustered into 6 thematic groupings. The full conference proceedings are available to download at http://newton-sdbe.uk/conferences/sdbe-2018/

On behalf of the SDBE 2018 Organising Committee, I hope the research papers hereby presented help stimulate further ideas for research in the near future.

Yours sincerely,
Heba Elsharkawy
BC-SDBE Principal Investigator
Keynote Speakers

Philip Jones, Professor, Welsh School of Architecture, Cardiff University

Phil Jones is Professor of Architectural Science at the Welsh School of Architecture, Cardiff University, where he currently co-directs the University’s Energy Systems Research Institute. His research area is in low energy, low carbon, and sustainable design in the built environment. He currently directs the Low Carbon Built Environment Project, including ten demonstrations of energy positive buildings and low carbon retrofits. He chairs the Welsh Government’s Building Regulation Advisory Committee. He chairs the Board of Directors of Warm Wales, a community interest company which helps to mitigate fuel poverty in Wales. He has chaired two European COST Action networks, Low Carbon Urban Built Environments (2005-2009), and Smart Energy Regions (2012-2016). He is Master Academic Adviser on Tianjin University’s Low Carbon Buildings ‘111’ project (2014-2018). From 2015 to 2017 he was Distinguished Visiting Research Professor at University of Hong Kong and continues to collaborate with their Sustainable High-Density Cities Laboratory.

Ashraf Salama, Professor, Head of Department of Architecture, University of Strathclyde

Ashraf M. Salama is Chair in Architecture and Head of the Department of Architecture at the University of Strathclyde Glasgow, UK. He has led three schools of architecture over the past 25 years in Egypt, Qatar, and the United Kingdom. He is a licensed architect in Egypt and was the Director of Research and Consulting at Adams Group Architects, Charlotte, North Carolina. Prof. Salama is the Chief Editor of ArchNet-IJAR, collaborating editor of Open House International, and editorial board member for numerous international journals. He also serves on the scientific and review boards of several international organizations in North America, Europe, and South East Asia. Professor Salama is the recipient of the 2017 UIA Jean Tschumi Prize for Excellence in the Architectural Education and Criticism. Professor Salama has published 9 books and over 170 articles and book chapters. His research interests and involve theories and methodologies of design studio teaching in architecture and urbanism; learning environments and workplaces; users-centred assessment of designed environments; adaptive urbanism and the spatial practice of migrant communities; liveability and diversity in rapidly growing contexts. He established and is currently leading the efforts CRAUCGS-Cluster for Research on Architecture and Urbanism of Cities in the Global South.
Patrik Schumacher, Director, Zaha Hadid Architects

Patrik Schumacher is principal of Zaha Hadid Architects and is leading the firm since Zaha Hadid’s passing in March 2016. He joined Zaha Hadid in 1988 and was seminal in developing Zaha Hadid Architects to become a 400 strong global architecture and design brand. He has been a partner since 2003 and a co-author on all projects. In 2010 Patrik Schumacher won the Royal Institute of British Architects’ Stirling Prize for excellence in architecture together with Zaha Hadid, for MAXXI, the National Italian Museum for Art and Architecture of the 21st century in Rome. He is an academician of the Berlin Academy of Arts. In 1996 he founded the Design Research Laboratory at the Architectural Association in London where he continues to teach. Patrik Schumacher is lecturing worldwide and is currently a guest professor at Harvard’s GSD. Over the last 20 years he has contributed over 100 articles to architectural journals and anthologies. In 2008 he coined the phrase Parametricism and has since published a series of manifestos promoting Parametricism as the new epochal style for the 21st century. In 2010/2012 he published his two-volume theoretical opus magnum “The Autopoiesis of Architecture”. Patrik Schumacher is widely recognized as one of the most prominent thought leaders within the fields of architecture, urbanism and design.

Sean Smith, Professor, Director of the Institute for Sustainable Construction, Edinburgh Napier University

Sean leads the Institute for Sustainable Construction, the CIAT Centre of Excellence in Architectural Technology and is Professor of Construction Innovation at Edinburgh Napier University. He has been an invited guest scientist in government construction research institutes in Canada, Italy and Germany. In 2009 and 2015 his research teams were awarded the Queen’s Anniversary Prize for the positive impact of their work for industry, environment and society for the ‘development of Robust Details’ and ‘Timber engineering and sustainable construction’. Over 1 million new homes across the UK have used his technical designs. He has supported over 80 low carbon innovative construction products to market, co-inventor of 17 patented products and led the formation of the Construction Scotland Innovation Centre. He currently chairs the Scottish Government working group for new housing construction skills.
Mina Hasman leads Skidmore Owings and Merrill’s sustainability and wellness operations and long-term vision, for the London office. She challenges existing best-practices by developing new systematic and design-based approaches applied and tested in complex, international projects. Mina embraces multi-disciplinary research and collaboration with others to deliver sustainable design solutions that yield long-term environmental, societal and cost benefits.

Mark Jenkinson, Head of AMO Cities & City Director London Siemens Global Center of Competence Cities, Sustainability and Cities.

Based out of Siemens’ Global Centre of Competence for Cities at one of the world’s most sustainable buildings, the Crystal in the east of London, Mark oversees Siemens’ account management approach to cities world-wide.

In March 2013, Mark also took on the role of City Director for London – a key focus of the role is to support London’s sustainable development through the provision of smart, efficient technological solutions and services for building, energy and transport infrastructure.

Mark joined Siemens in 1993 and since then has taken on a variety of roles and responsibilities across Siemens in a wide range of industries and markets in the UK, across mainland Europe, the Middle East and Asia. Mark has participates in a number of committees including the Royal Docks Advisory Board and sits on UEL Industry Advisory Board for Civil Engineering.
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**Education for Sustainability**

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**Chapter Four: Sustainable Construction Technologies, Resource Efficiency, and Renewable Energy and Green Technologies**

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**Thermal Comfort, Health and Wellbeing**

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Chapter One: Building Performance Simulation, Building Performance Evaluation and Optimisation, and Building Information Modelling (BIM)
Assessing the Thermal Performance of Concrete-based Construction Systems in Hot Climates

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Abstract: The aim of this study is to evaluate the thermal performance of different types of concrete-based construction systems under the Egyptian climatic conditions. The study examines the thermal performance of a case study of reference roof-top space with an area of 144 square meters (12*12m) situated in a hot-temperate climate (Cairo, Egypt). It represents the evaluation of using typical construction system (solid slab) compared to flat plate, wide module and Slab and beam systems in a widely used concrete formwork construction systems in typical practice in Egypt. Dynamic thermal parameters including thermal admittance and window to wall ratio beside the thermal resistance and its reciprocal (U-value) were used in this evaluation. Different types of construction systems were simulated using the dynamic thermal simulation software Design-Build to investigate their thermal performance upon roof-top space, in addition to estimate costs and saving benefits of each system. The purpose of this study is to demonstrate the potentials of these construction systems from environmental and financial viability standpoints to enable appropriate solutions to be chosen at the early stages of a design. The results of the study suggest that applying wide module system (so-called hollow blocks slabs) with inner columns to decrease loads and span of the slab can be considered as a favourable scenario, and can be a better choice for architects and structural engineers in designing buildings for hot climates.

Keywords: Thermal performance, construction systems, concrete-based slabs, thermal simulation, hot climates.
Abstract: This study investigates pathways that can potentially link Building Information Models (BIM) to building performance simulation (BPS) models. It aims to create an interoperability guide for novice architects through a consistent unit-based model testing methodology. For this study, we used Autodesk Revit to create the BIM models. For BPS models, we used OpenStudio and DesignBuilder, both of which leverage EnergyPlus (EP) as a simulation engine. In the first part of the research, we investigated data translation using the Industry Foundation Classes (IFC) and the Green Building XML schema (gbXML). The results indicated that the pathway via IFC includes more intermediate steps but it concerns specific tested software and this conclusion cannot be generalized. Thus, the main study focused on software interoperability using the gbXML schema. We investigated eight unit-based models using a consistent testing pattern procedure. Interoperability issues were observed, classified and documented, mostly referring to missing data or geometry distortion. The paper concludes with a discussion of the impact of the identified limitations on the energy simulation field and a possible new research direction using non-manifold topology.

Keywords: Building Information Modeling, Building Performance Simulation, IFC, gbXML, EnergyPlus
Usability assessment of building performance simulation tools: a pilot study

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Abstract: Due to climate change, the built environment is facing increasingly strict environmental targets. Thus, architects are challenged to design evermore high-performing buildings, a task for which they can no longer depend solely on their experience and intuition. Building performance simulation (BPS) tools have become central in this context to support the design process. Yet, several studies show that such tools are still not widespread among practitioners at early design stages. Despite significant efforts made to deliver more “architect-friendly” tools, a gap remains between the expected use and the reality, highlighting the need to adapt the design-approach when developing such tools. A user-centred design approach seems promising for increasing the usability and acceptance of BPS tools, and should be fine-tuned through multiple iterations between BPS developers and potential users via usability assessments. However, as usability assessment has its origins in the domain of human-machine interaction, no methodology has been proposed yet specifically for BPS tools. This paper is the result of a first interdisciplinary pilot study, describing and evaluating a usability assessment method for a new BPS tool that supports the low carbon building design process. Usability, the reliability of the tool and its usefulness are amongst the dimensions that have been assessed with a selected population of future users. Moreover, recommendations and guidelines for the reproducibility of the test are provided. The study shows that both, the quantitative and qualitative results gathered through a usability assessment are insightful to develop a BPS tool that is efficient, satisfactory, pleasant to use and widely adopted by designers.

Keywords: UX, Usability, Building Performance Simulation, User Test
Towards generation of holistic renovation scenarios using Multiple Criteria Decision Making – Case of Energy Consumption, Investment Cost, and Indoor Comfort

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Abstract: Recent research in building renovation field seeks methods for development of more holistic renovation scenarios that live up to a broader set of sustainability objectives/criteria. The aim in this paper is to apply one of these methods – a Multiple Criteria Decision Making (MCDM) method – for evaluation of holistic renovation scenarios for an apartment block. It aims at addressing the interactions or trade-offs of the considering objectives and criteria with each other when the renovation scenarios are being developed, which is one of the major issues in this field. The intention is to demonstrate the principles and capabilities of the method, and for the sake of simplicity, the demonstration is limited to involve renovation of a few significant building components, sustainability criteria, and a limited amount of renovation measures. As such, it firstly indicates details about the key components of a sustainable renovation related to sustainability criteria and renovation approaches. The performance of a total of 55 renovation scenarios are simulated and evaluated in terms criteria for Energy Consumption, Investment Cost, and Thermal Indoor Comfort. The trade-off between the criteria is addressed using Pareto-front approach, and the optimal solution is determined using MCDM-based rating method (application of Multiple Attribute Decision Making (MADM) methods). Therefore, the paper demonstrates how application of simulation and MCDM methods in the early design stages of holistic renovation projects may improve a decision-making process, which has focus on obtaining sustainable building renovations.

Keywords: Renovation, Sustainability, Holistic renovation, Multiple Criteria Decision Making (MCDM).
Sensitivity Analysis for Energy Modelling based on Daylight Simulations

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Abstract: Simulation techniques for modelling the lighting and energy performance of buildings are becoming widely available. Previous research by the authors found the outcomes of lighting simulation to be substantively influenced by individual settings of various model parameters (e.g., ambient reflections and grid size), particularly for complex façades. This study postulates that this influence is also reflected on predicted energy consumptions since daylight availability affects the artificial lighting needed to meet illuminance targets and the heat transferred from the façade. To test this hypothesis, a sensitivity analysis was performed investigating the influence of various daylight simulation settings on predicted energy loads. The sensitivity analysis was based on annual simulations using a shoebox model with simple and complex façade configurations under Cairo and Nottingham climates. Daylight simulations were conducted using RADIANCE while energy analysis was run through EnergyPlus. The results were statistically analysed for annual cooling, heating, lighting and total energy loads. The analysis showed that fast-low precision daylight simulation settings of ambient reflections overestimated lighting and cooling energy loads, and underestimated heating requirements. The differences were statistically and practically significant particularly in terms of lighting loads. The results were largely dependent on climatic conditions, and the differences consistently increased in case of complex façade systems. The findings from this study are discussed in the context of the challenges that façade designers need to tackle when using simulation tools at early design stage towards obtaining plausible performance outcomes.

Keywords: Daylight, Energy, Simulation, Sensitivity, RADIANCE
Design of the external envelope and interior spaces of school buildings to improve environmental performance efficiency in Cairo – Egypt

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Abstract: Basic education schools are one of the most important pillars in the education system of the pre-university education stage. They play an important role in the formation of a child’s identity and culture since the young age. Despite the efforts exerted by the successive Egyptian governments to provide a number of schools to accommodate the increasing number of students, there is a lack in the efficiency of the environmental performance of the existing schools and of a fixed architectural model that is applied in most of the different climatic regions. The study examined modern design methods and standards for schools to avoid many of the existing problems faced by school buildings in Egypt. This aims to produce a new generation of highly efficient and functional school buildings capable of providing a healthy and educational environment for students and teachers, conservation of energy consumption, decrease of operating and maintenance expenses of buildings, application of sustainability principles.

Keywords: Design, Basic Schools, High-efficiency Schools, Environmental Performance, Simulation Programs
Energy performance analysis in early design stages through parametric simulations: case study of a mixed-mode building

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Abstract: Building Energy Simulation (BES) tools have an important role in early design stages, since they include energy performance parameters in the decision-making process. However, processing a large number of simulations can be unfeasible, costly and time-consuming, especially when architectural conceptual design phase is considered. Therefore, the development of computer codes can facilitate this process. The aim of this work was to develop a code in Python language, which could perform parametric analyses of a mixed-mode office building in EnergyPlus, considering random variables related to its design process. Ten parameters were chosen, including materials properties, envelope dimensions and geometry related variables. Ranges of variation for each variable were settled according to practical restrictions resultant from the building industry. Results showed that the code operates properly and can easily be used to create a set of design scenarios, proving to be a useful tool to architectural designers. A specific case study is presented, in order to illustrate the application of the method and its potential benefits in an integrated design process.

Keywords: Python, Parametric analysis, EnergyPlus, Early design stage
Climate Change Impact on Energy consumption and Thermal performance in low-income houses in Brazilian Savanna

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Abstract: Climate change has presented itself as a substantial challenge to be faced by society in the 21st century. Rising temperatures is a potential threat to ecosystems but also for humans. They directly affect buildings thermal behaviour, increasing energy consumption to maintain its users’ thermal comfort. Thus, studies on climate change related to the building thermal performance and the search for its mitigation have gained importance. This study aims to analyse the impact of climate change on thermal performance and energy consumption in low-income houses located at the Tropical Savannah climate (Aw), as well as to suggest strategies to mitigate the impact on these buildings. The study area is the city of Cuiabá, State of Mato Grosso, Brazil, located in the Brazilian Savannah Ecosystem, with tropical sub-humid climate, the second most common climate in the world. Climatic projections were designed based on the “morphing” methodology, considering the A2 scenario of the Fourth Intergovernmental Panel on Climate Change (IPCC) and time slices 2020 (2011-2040), 2050 (2041-2070) and 2080 (2071-2100). Building thermal performance and energy consumption were simulated using the EnergyPlus software. Climate change will impact the annual mean dry-bulb air temperature in the 2020s, 2050s and 2080s, increasing it by 1.5 °C, 3.0 °C and 5.9°C in relation to the base scenario, respectively. It will influence the building thermal performance, increasing the percentage of annual cooling degree-hours from 51.8% in 1961-1990 to 88.6% in 2080s, whilst the heating degree-hours will reach 0%. In turn, the building energy consumption will increase by 43.6% in 2080s. Based on these results, it is essential to adopt passive strategies to mitigate the impact of climate change, focusing to improve building efficiency and thermal comfort, collaborating with vulnerable communities to absorb future climate impacts.

Keywords: Climate change, thermal performance simulation, energy efficiency simulation, Energy Plus
Title: Environmental benefits of using cross-laminated timber with hempcrete insulation in buildings

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Abstract: The build environment, one of the largest energy consumers, is also responsible for around 40% of CO₂ emissions in Europe. Under the threat of climate change, legislators and policy-makers keep amending building-related regulations and standards to diminish the building industry’s impact on the environment. Along with this trend, architectural practices, one of the main generators of innovation in the built environment, have been shifting towards more sustainable designs and use of materials in construction. Part of this endeavour is represented by the recently increased use of cross-laminated timber (CLT) in high-rise buildings and the expansion of hempcrete use. Both of these materials are becoming increasingly popular due to the benefits they offer to a sustainable building economy due to their specific characteristics. Both CLT, made out of cross-bonded hardwood panels, and hempcrete, a dried mixture of lime and woody fibres extracted from hemp, have very low embodied energy and also locked CO₂ during their growth. Hempcrete has also excellent thermal properties. However, so far they have been considered separately in construction. Thus, this paper investigates the environmental benefits of using them together, pondering the pros and cons of doing so. Specifically, it explores the performance CLT and hempcrete together can achieve with a construction technique using a panel of CLT with hempcrete as insulation. The research method used is material exploration and computer modelling with the use of dynamic energy simulation.

Keywords: cross-laminated timber, hempcrete, energy efficiency, overheating, building performance analysis
A Study on the Application of Thermal Insulation Techniques under a Mild Mediterranean Climate

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Abstract: The construction sector is currently responsible for a large portion of the total energy use worldwide. In many countries, efforts are being made to reduce energy consumption through improvements of overall energy efficiency in buildings. However, a majority of the standing constructed facilities in Lebanon are lacking in terms of design and material considerations and as such pertain low energy efficiency, increased risk of mold condensation, and general tenant discomfort. As such, this paper focuses on the performance of different thermal insulation techniques in mild Mediterranean climates and their effect on building energy consumption and indoor thermal comfort. More specifically, the study analyzes the heat exchange through the surfaces and thermal bridges of the two most adopted construction types of mid-budget residential buildings in Lebanon. The objective is thereby four-fold: (1) Identify existing thermal “weak points” in construction by means of a thermal imaging camera, a nondestructive tool gaining momentum in the civil engineering research field, (2) Simulate, in 2D and 3D, different scenarios for insulation positions and structural thermal breaks in order to assess the thermal performance in winter and summer climatic conditions, (3) Study and integrate human comfort levels and the mitigation of health implications, and (4) Assess the economic feasibility of implementing the decided combination of optimum solutions. Experiments were conducted and results showed significant reductions in building energy consumption in general, and promised decreased likelihood of mold condensation, the extent of which depends on the architectural plans.

Keywords: Thermal imaging, thermal bridges, thermal comfort
A comparative simulation of thermal performance in high-rise structural timber buildings

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Abstract: Current building science research is focusing more effort on residential occupant comfort analyses, particularly regarding summertime overheating in buildings that do not utilize mechanical air-conditioning. This paper presents a comparative study using whole-building energy model simulation data to examine occupant comfort in high-rise residential buildings constructed with cross-laminated timber structures and operating without mechanical cooling or heating. The research focuses on a comparative simulation of thermal performance in high-rise structural timber buildings. The study also discusses the influence of the cladding materials on the performance of the case study buildings. Two existing UK buildings (Bridport and Stadthaus) are modelled, validated, and simulated for summer conditions using a typical reference year weather file; the buildings are similar structurally, but exhibit different envelope systems and room dimensions. The resulting indoor conditions are compared for temperature values (average, minimum, and maximum), thermal comfort standards (CIBSE and BSEN 15251), and for correlation between indoor and outdoor temperatures. The Bridport building, which utilizes a brick façade, larger windows, and rooms, exhibits a wider range of temperatures during the study period (9.0°C) as well as more hours within acceptable comfort standards. The Stadthaus building, which utilizes a fibre cement siding, smaller windows, and short rooms, exhibits a small range of temperatures (8.2°C), but did exceed comfort levels for both the CIBSE and BSEN standards. Both building models show a strong correlation between indoor and outdoor temperatures for both day and night. Overall, this simulation demonstrates that an envelope with more thermal mass, such as brick, helps minimize the maximum temperatures, while the size of the rooms and windows might increase the temperature range in the space.

Keywords: Whole-building energy modelling and simulation, high-rise structural timber buildings, thermal behaviour, design parameters, comparative study
Energy Performance Analysis of Large-Scale Public Buildings in China

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Abstract

China is now one of the fastest-growing countries in the world, where the increase in urbanisation rate is rapid. In order to accommodate the fast-growing urban population, which increased from 17.9\% to 54.8\% from 1978 to 2014, it is estimated that approximately 2 billion m\textsuperscript{2} of new buildings will be constructed each year, which is the sum of all in developed countries. The drawback of such rapid growth in building developments, China's total energy consumption increased from 0.57 billion tons of standard coal to 4.3 billion tons of standard coal from 1978 to 2015. In order to improve the existed environmental issues such as global warming and air pollution, which are threatening human's health in some of the major cities in China such as Chengdu, Beijing and Shanghai, it is doubtless that improvement in building energy performance has the immediate need. More importantly, large-scale public buildings are found to consume a large portion of total energy in China. This paper therefore aims to (1) perform a thorough review of the current situation of the energy performance of large-scale public buildings in China; (2) investigate the reasons of high energy consumption in large-scale public buildings in China. Through the literature review, it found that China's large-scale public buildings account less than 4\% of the total urban construction area, but their energy consumption accounts for about 22\% of the total energy consumption in urban construction area. Its energy use intensity is about 10 times of the residential building and 7 times of the public building. Large-scale shopping mall has the highest energy use intensity among different types of large-scale public buildings.

Keywords: Large-scale Public Buildings, Building Energy Performance
Comparative Study of energy consumption optimization for Educational buildings in Jordan

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Abstract: This paper introduces a comparative study between energy consumption optimization of school’s sector for the all 8 orientations (N-S), (E-W), ((NE-SW) and (NW-SE), likened with a previous research (Al-Arja et al, 2015) energy consumption index. The study will be conducted in classrooms of public schools as a case study using Design Builder (DesignBuilder, 2011) as the thermal simulation program, to establish numerical comparisons for different parameters such as; orientation, window area, glass panes, thermal insulation, and solar protection devices. The link with the previous research (Al-Arja et al, 2015) will be through finding optimum construction solutions for new schools buildings to be built in Jordan, and establish a benchmark for thermal performance as the Energy Consumption Index for educational buildings in Jordan, as a hot-arid climate

Keywords: Orientation, Energy consumption Index, Thermal Simulation, Educational Building, Energy Efficiency.
Sunlight Directing System: The Effect of Surface Topology on Daylighting Performance

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Abstract: Sunlight directing systems (SDS) are used in façade design to improve visual comfort, avoid direct sunlight and reduce energy consumption. A successful application of the SDS is based on how to control light bounces in accordance with distinctive characteristics of SDS. In addition to the factor of cross-section design which, in particular, can largely affect how light is directed.

Many studies in the literature have been conducted for SDS to increase daylight availability. Most of these studies have focused on design characteristics of a simple SDS, but the effect of surface topology of SDS units on daylight have been rarely examined. Correspondingly, this paper aims to examine the characteristic of surface topology of SDS (i.e. flat, curved) to increasing daylight availability with minimal direct sunlight penetration for deep-floor spaces. The study also integrated different SDS parameters of; angle of rotation, depth and spacing between SDS units within the tested parameters.

The study used a mid-size southern office space located in hot climate of Cairo, Egypt. Research method incorporated parametric modelling tool ‘Grasshopper’ linked with daylight simulation engine ‘RADIANCE’ through DIVA daylight simulation tool to carry out daylight simulations.

The results demonstrated that the distance between SDS units is the first influential parameter mostly improves daylight performance with a minimal direct sunlight. While the depth and the rotation angle come in the second place. Finally, the surface topology has the weakest influence.

Keywords: Daylight, façade, sunlight-directing system, RADIANCE
Upgrading the Energy Performance of Existing MiddleE Class Suburban Residential Buildings in the Gulf Region

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Abstract: The economic, political, and cultural developments in the GCC states of the past four decades have led to a rapid and unsustainable urban development. Due to the low price of energy, for a long time there has not been an economic necessity to implement energy saving measures for residential buildings. Reinforced concrete structures and uninsulated walls made of concrete hollow blocks are omnipresent. Yet, the energy consumption of buildings in the Gulf region is unnecessarily high. Since the dependence upon oil is intended to be reduced, reforms are necessary. In contrast to many other countries, sustainable solutions have not yet adequately been implemented. Many essential actions for energy savings are missing. Until today, there is still too little awareness for energy efficiency in buildings. The suburban residential buildings contain a large number of deficits. The building regulations are not sufficiently supporting energy efficient construction methods. Effective incentives are missing. Retrofit strategies are urgently needed. The transition to more sustainable solutions is overdue. Fundamental transformations are necessary. Within this paper, typical suburban residential buildings will be analysed regarding their energy performance. Based on this analysis, a series of improvement options will be identified, evaluated, and prioritised according to their efficiency and economic feasibility (e.g. optimisation of building envelope, reduction of thermal bridges, installation of external shading, thermal massing, and solar energy generation). Thereafter, implementation strategies will be developed to demonstrate how the energy efficiency of existing residential buildings can be effectively increased.

Keywords: Energy efficiency, retrofitting, green building, sustainable design
Light Shelf System in Energy Conservation to enhance Daylight Performance on Overcast Condition in Buildings

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Abstract: Daylighting represents an important factor in human's life and well-being. It increases the production of the hormone and causes more productivity in space. In recent studies, advanced and innovative daylighting systems could improve the illumination level in interior space by using innovative materials. And they could enhance healthy indoor environment by using physical laws of reflection, absorption and refraction to illuminate working plane level in the proper rooms. The current study aims at improving window position in buildings according to daylighting requirements, designing recommendations to enhance internally daylighting performance, and reducing energy consumption by using artificial lighting during daytime, and enhancing human health and poor perception of ambient nature by using visual perception sense.

In the same context, this paper aims to use light shelf system (which are reflective surfaces that reflects direct sun lights inside the interior space to enhance natural lighting inside the place) with innovative materials and achieve daylighting requirements. Determining daylight availability and annual daylight glare probability (DGP%) in winter are used in simulation analysis to measure daylighting distribution in bed room area. The main target and outcome of the paper is creating a simulation and testing the light shelf system using Diva plug-in for Rhinoceros, to figure out the best material, geometry, location, and inclination of lighting shelves to reach the maximum performance design of the shelf itself and with the building envelope.

Keywords: Light shelf system, Daylighting, Visual comfort, Daylight Glare Probability, Innovative materials
Assessment of Thermal Behaviour and Energy Consumption of Small Mosques in Hot-arid Climate of Najran City, KSA

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Abstract: In the hot-arid region of Saudi Arabia, buildings need air-conditioning systems to provide a satisfactory level of thermal comfort. Mosque buildings are unique in their function and pattern of operation, thereby requiring a careful design to ensure optimal thermal and energy performance. The objective of this study is to investigate the internal thermal behaviour and energy use of small popular mosques located in the hot-arid climate of Najran City in the Kingdom of Saudi Arabia. The research uses several methods, including selecting a case study of a small mosque, carrying out continuous environmental monitoring using data logging equipment, and collecting annual electric energy consumption and evaluating number of worshippers during the typical five prayers per day. Results indicate the occurrence of energy waste. Thus, thermal comfort is not achieved due to inappropriate building envelope design coupled with improper operation. This study recommends the consideration of passive design strategies in the early design stage and the assurance of a systematic operation schedule for energy use, which can lead to remarkable energy saving without compromising thermal comfort.

Keywords: Energy Efficiency, Thermal Performance, Mosques, Hot-Arid Climate, Saudi Arabia.
Investigating the Impact of Renewing Floor Coverings on the Energy Performance of Dwellings with Suspended Timber Floors, Tested under Controlled Conditions

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Abstract: Dwellings with suspended timber floors are commonplace in the UK, making up almost a third of the overall housing stock. Floor coverings, such as carpets and vinyl, are often used in these types of dwellings to achieve thermal comfort, aesthetics and energy. Over time, due to general wear and tear, the quality and performance of floor coverings can deteriorate. This deterioration affects the overall performance of these coverings as a whole and so it becomes necessary to replace them. Developments in the production of floor coverings and underlay have resulted in the opportunity to replace floor coverings with more robust materials, which can demonstrate improved energy efficiency.

The Energy House at the University of Salford is a full-scale replica of a typical UK home (pre 1920’s Victorian Terrace), contained within a controlled environment. This facility was originally fitted with a synthetic carpet and laminate on top of rubber-based underlay material. After 6 years of heavy use, all floor coverings within the house were replaced with new materials. Tests were conducted throughout the transition from old coverings to new, under steady state conditions; this included measurements of energy consumption, heat flux density, air tightness, and the global heat transfer coefficient.

The original floor coverings were found to improve the overall energy consumption by 2.7%, heat flux through the floor by 16.9%, air tightness by 3.3% and the global heat transfer coefficient by 3.0%.

By replacing the original coverings with new materials, the improvement to the overall energy consumption rose to 4.8%, heat flux rose to 27.1%, air tightness to 6.0% and the global heat transfer coefficient by 5.0%. Thus, it can be demonstrated that by replacing old floor coverings for this building type, the energy performance of those coverings can be almost doubled.

Keywords: Building Performance, Pre-1920 Housing, Thermal Performance, Suspended Timber Floors, Retrofit, Floor Coverings, and Controlled Environment
Implementation of BIM Technologies in Architectural Engineering Education

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Abstract:
The recent years have witnessed a rise in the demand for the adoption of Building Information Modelling (BIM) technology within the Architecture, Engineering, and Construction (AEC) Industry. BIM in the (AEC) industry has become an essential tool for facilitating processes throughout building design and life-cycle. For this reason, academic institutions are competing to provide their students with the required skills to operate BIM effectively. In the case of Oman, university-led BIM training is still at an early stage of implementation and development. However, several universities have been carrying out a wide range of competitions and courses to provide students with an experience in this domain. This article aims to investigate the application of BIM Technologies in architectural engineering education in Oman and to provide a summary of current trends in this area. The article aims to purpose practice guidelines and effective strategies for teaching BIM (Building information modeling) from an academic perspective. It describes how BIM was utilized throughout the architectural teaching and design process in architecture and interior design department, at the University of Nizwa. Moreover, it presents several case studies which offer a pioneering example in the adoption of BIM to enhance the student skills and familiarize them with advanced technologies relevant to their future careers. Such examples could pave the way for prospective partnerships between academic institutions and the (AEC) industry. Findings of this article highlight the importance of implementing BIM technologies in architectural education. It also emphasizes the value of BIM for the design process in the currently competitive working environment.

Keywords: BIM, Technologies, Architecture, Education.
Building Information Modelling (BIM) application in relation to embodied energy and carbon (EEC) considerations during design: A practitioner perspective

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Abstract: Buildings’ carbon emission reduction efforts in buildings have mainly been focused on operational energy reduction and, as operational energy is reduced, embodied energy and carbon (EEC) becomes more significant. However, there is currently a lack of legislation and guidance relating to embodied carbon in buildings. This, together with the United Kingdom (UK) construction industry fragmentation, creates a significant barrier to dealing with EEC during building design. In this context, Building Information Modelling (BIM) empowers communications and stores information into one single digital model and has therefore potential to facilitate EEC considerations to be included in building design.

This research takes a qualitative approach and looks at the design process in relation to EEC considerations and BIM application and how the latter can facilitate the inclusion of EEC in design considerations. Through semi-structured interviews with the construction industry professionals, this research investigates BIM application in relation to EEC information during design. EEC’s current role in building design and the drivers and challenges EEC considerations are being mapped. EEC information processes and how BIM facilitates EEC information exchange and storage as well as the actors involved are revealed. The overall aim of this research is to inform practice and policy to enable EEC reduction through BIM and meet overall carbon targets.

Keywords: BIM, embodied energy, embodied carbon, building design process, industry perspective
Chapter Two: Education for sustainability
Integrating Energy Performance Assessment Tools in Architectural Design Studio Education

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Abstract:
Contemporary architects rely on various digital and information technology tools starting from early design stages to construction and manufacturing stages. All these tools are reshaping our approach to architectural design, and consequently, to architectural education. As the environmental issues raise in our current approach to architectural design, available technologies are employed to solve these issues in every possible way. Departing from this point of view, energy performance assessment (EPA) tools seem to be useful in the architectural design pedagogy as it affects major design decisions and may completely alter the design process itself. The aim of this paper is to investigate empirically the potential of employing EPA tools in architectural design studio education with the focus on its impact on the design process. A workshop study was held in the design studios of the second year of the department of Architecture at the faculty of Fine Arts, Helwan University, Cairo, Egypt. A number of thirty six students were selected from the three studios of the department out of the total of hundred ninety eight students to participate in the study as an experimental group. Evaluation of the validity of this study was based on the students’ feedback on the experiment through short structured questionnaire, and semi-structured interviews either individually, or in groups. The students of the experimental group could make better judgements on the environmental aspects in their design process. This confirms the applicability of the integration of EPA tools in architectural design studio education to enhance the understanding of the knowledge gained in environmental design projects. Furthermore, this study can help mapping out strategic recommendations for further studies for a model of implementing such tools in the design studio pedagogy.

Keywords: architectural education, design studio, energy performance assessment (EPA), ICT.
Towards an Ecological Architectural Education in Kuwait

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Abstract: Kuwait has been increasingly experiencing rapid changes in its constructed environment, affecting in its way its natural environment and ecosystem. With the plans for “New Kuwait” and the continued development of mega projects in the region, architectural education has an integral role to play in changing the current practices and discourse concerning the new and existing. This paper provides insights into the means in which multi- and cross disciplinary approaches that consciously engage proactive ecological principles and methods in urban and architectural designs can be implemented: firstly, through a critique supported by existing theories and discourse; and secondly, using Kuwait’s Free Trade Zone area in Shuwaikh as a case study. The paper alludes that the desert landscape can no longer be viewed as a “tabula rasa” for urban development but a delicate ecosystem with high ecological value. Additionally, the paper provides the argument that smaller scale tactile urban and architectural interventions can aid the move towards a way of sustainability that is resilient for combating the challenges we will face in the future projected changes in the climate. The story of the conventional ways of new construction in Kuwait that has been supported and encouraged by the public and private sectors since the 1950s needs to change to consider the current environmental challenges to pave way for a kind of sustainable development that is beneficial for all.

Keywords: Architectural Education, Landscape Urbanism, Ecological Sustainability, Critical Thinking, Kuwait
Fit for purpose? Sustainability and the design studio

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Abstract: The design studio is the primary means of educating architects. Since its emergence over a century ago, the pedagogy of the design studio has remained remarkably consistent despite changing demands placed upon the built environment. Preparing architects for the global challenge of sustainable design must be of primary importance to educators and requires critical and deep learning due to its holistic and interdisciplinary nature. The design studio seems the ideal environment for encouraging deep learning for sustainability through its potential to foster independent and deep learning. Despite this, sustainability is often viewed as additional, optional or even neglected entirely. The study examines a RIBA Part 2 design studio architecture course in the UK and considers whether the design studio pedagogy is fit for purpose in the context of contemporary architectural challenges. Conducted over two years, sampling two consecutive cohorts of students, the research adopts an ethnographic approach to reveal the structural and pedagogic issues that inhibit sustainable design. The findings suggest that the design studio, in its current incarnation, is not fit for the purpose of training practitioners to effectively engage with sustainability. Its introverted focus has led to a self-referential environment in which good design is defined by a “hidden agenda”. A lack of effective interdisciplinary working, limited pool of teaching staff and an absence of meaningful exposure to attitudes beyond the profession are all contributing factors. As a result, sustainability is not viewed as synonymous with design quality, but additional to it.

Keywords: Sustainable architecture, design studio, sustainable pedagogy.
Sustainable Information and Communication Technology (ICT) Initiatives in UK and Irish Universities and Colleges: Identifying and Overcoming the Barriers to Implementation.

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Abstract: Energy is one of Ireland’s and the UK’s biggest commercial and environmental concerns. Despite government campaigns for everyone to play their part in minimising its consumption, reports suggest an estimated 20–30% of energy generated is wasted. Further and higher education institutions (FHEs) are no exception to this wastage using an extensive collection of ICT equipment and technology for teaching and research. Such technology is often left running when not in use creating energy waste, increasing running costs and carbon emissions. Conducted over the course of three consecutive stages, this research employed positivistic and anti-positivistic paradigms, utilised inductive, abductive and deductive methodologies and employed comparative, correlative and evaluative research methods that answer the research question and sub questions. This research showed that a gap in knowledge within the sector existed. That gap in knowledge – the identification of barriers to FHEs implementing sustainable ICT initiatives – is central to this research, as is how the gap was eventually bridged. Data were gathered throughout this research using surveys and questionnaires. Seven barriers to implementing ‘greener’ ICT initiatives were eventually identified with three of them (stakeholder engagement, lacking managers and cuts in funding) found to be widespread. Each of the barriers existed to various extents, in both countries and were experienced by a range of FHE managers with most underpinning one another. Finally, this research demonstrated that overcoming the barriers proved possible via the use of a smartphone web app named the ED web app. This simple to use and inexpensive ICT solution is easily replicated and engages with stakeholders in tackling energy waste in any organisation. These findings validated this research’s theory and ultimately answered the research question and its sub-questions.

Keywords: Sustainable, Information Communication Technology (ICT), Universities and Colleges, Stakeholders, Barriers.
Are dispositional mindfulness traits effective in sustaining pro-environmental behaviour?

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Abstract: Anthropogenic climate change and the destruction of ecosystems worldwide threaten to create irreversible and unpredictable environmental tipping points causing irreversible effects to many species, including our own. The search for sustainable solutions to these issues has lead to the investigation of the role of mindfulness in supporting pro-environmental behaviours (PEB’s). Previous mindfulness/sustainability research identifies a strong correlational relationship between the practice of PEB’s and the existence of dispositional mindfulness, however, there is a clear gap in our understanding as to how and why mindfulness traits may become active during the adoption and sustaining of PEB’s. This study utilised the qualitative method of semi-structured interviews to investigate the lived experience of 9 participants committed to the long-term practice of PEB’s, and to identify if dispositional mindfulness traits were active in supporting them over time.

Thematic analysis identified that specific dispositional mindfulness traits (present-centred awareness, mindful intention, non-judgment, and nonreactivity) successfully combined with a pre-existing ecologically-focused ethical worldview and environmental education/nature-connection experiences to create a sustained intention to lead a pro-environmental lifestyle. Participants utilised these traits to regulate their daily behaviours with a focus on: maintaining a present-centred awareness of the interconnected relationship between individual behaviours and negative environmental impacts, negotiating counterintentional barriers within their environment, and navigating negative psycho-social experiences that arise through the intention to act sustainably in an unsustainable society. These results suggest that promoting mindfulness practice can be an effective component in the adoption of PEB’s, specifically if mindfulness is taught alongside environmental education and nature connection experiences.

Keywords: mindfulness, pro-environmental behaviour, environmental education, nature connection, pro-environmental ethics.
New Territories: Digital Materiality from Natural systems to Environmental Impact

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Abstract: Digital fabrication, between advancements in software, simulation, and machinery, is pushing practice today towards more complexity in design, allowing for unparalleled explorations. Yet at no time have questions of material knowledge become more relevant and crucial, as technological advancements approach a radical reinvention of the design process. As more designers look towards tactile crafts for material know-how, a parallel interest in natural behaviors has emerged trying to embed environmental performance into the designed objects. New Territories, a yearly architecture and design course on digital design and materiality, allows students to explore processes of digital fabrication in intersection with environmental behaviors and hands-on material experiments. The aim throughout the course is to explore the design of building systems, such as modular facades, intelligent cladding, or adaptable seating, by embedding current digital technologies with an understanding of the environment and physical material behavior. This paper will highlight the importance of learning from nature and physical material explorations to design these active and sustainable systems. It will detail the work done over the course of three years, on themes of building behaviors, environmental responsiveness, concrete plasticity, and material composites. Through the work, the paper will elaborate on the design process, describing the different material experimentations, digital and analog methodologies, and the final results. It will shed light on the persisting importance of material knowledge in intersection with advanced digital fabrication, and the significance of learning from natural systems and bio-properties to embed an active performance in today’s design process.

Keywords: digital design, digital fabrication, materiality, environmental behavior, building materials
Teaching about Nearly Zero Energy Buildings in the Architecture curriculum in Havana, Cuba

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Abstract: Nearly Zero Energy Buildings paradigm is changing the way buildings are designed worldwide. In order to have professionals more prepared to face this goal a design workshop has been implemented for Architecture students at the Technological University of Havana, Cuba. In this paper the background of the environmental design and teaching of nearly zero energy buildings in the architecture curriculum of Havana is explained. The objective of this paper is describe an academic experience with transdisciplinary and integral program designed in order to optimize building’s energy use. From the program consist of a main subject of architectural design, elective and optional subjects, and professional practice. The main subject consisted of architectural design of buildings in urban and rural contexts. The optional subjects were directed towards renewable sources of energy, participation and social impact and the principles of bioclimatic design in hot-humid contexts. The professional practice was aimed at diagnosing energy consumption of different buildings types in real contexts. Finally, the paper discusses the main results and lessons learned from experiences with this educational program through different study methodologies such as historical analysis of sustainability in architecture studies of Havana in last 40 years, presentation of transformations made to program of subject in last two courses as well as exhibition of some results by student work carried out in different contexts.

Keywords: Nearly Zero Energy Buildings, Architecture Education, Havana, Sustainable design, Passive design, low energy design
Video creation as assessed coursework in sustainability subject areas.

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Abstract: Due to the holistic nature of sustainability and importance of raising understanding across all types of actors in society, e.g. from public organisations to private companies to communities to individuals, requires practitioners to communicate with multiple different audiences and across multiple platforms to reach and engage all those who have an impact on its uptake and implementation. In higher education preparing students for this wider, multi-disciplinary landscape involves teaching how to effectively engage public as well as disciplinary audiences. The creative communication skills needed to engage such audiences can be illustrated to students through methods used to creatively engage students in their studies. Improving student engagement is a common strategy to improve depth of learning and technology can play a role in stimulating student interest in engaging with an academic activity. The increasing public uptake and acceptance of video creation and uploading indicates that this type of creative activity could enhance student engagement with assessed coursework. To investigate this a series of trials utilising video creation as assessed coursework is reported for a postgraduate course in carbon footprinting and undergraduate courses in energy & buildings, across campuses in Dubai and Edinburgh. The trials provide insight on the value of video creation in stimulating creativity, effects on student satisfaction, issues for design & implementation and an assessment framework.

Keywords: engagement, coursework, assessment, education, video
Paper 168

Developing a framework for embedding Education for Sustainability (EfS) within the built environment sector in Egypt

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Abstract: Education for Sustainability (EfS) is a growing movement that seeks to prepare researchers, educators and practitioners for a career that embraces sustainable values and principles. Historically, this approach has been integrated to varying degrees across the globe, with developed countries typically applying this approach more widely than developing countries. Building Capacity for Sustainable Development of the Built Environment (BC-SDBE) project, has been set up to improve EfS within the Architecture and Engineering disciplines within Egypt. The aim of the project is to develop a viable framework for embedding sustainability principles, theories and applications into education and training. Achieving sustainable development in Egypt requires proactive engagement of stakeholders from educators, practitioners, developers, and policy makers. The first stage of the research undertaken in this project has gathered data surrounding the opinions on the current curricula through a stakeholder survey, themed workshops and open-ended questionnaires. In the second stage of the research, results from a workshops held in Cairo surrounding the required skills for achieving holistic sustainability within the built environment sector are presented. This is followed by an open-ended questionnaire aimed at engaging academic groups involved in education in the built environment, which was undertaken during the second stakeholders’ workshop. The aim of this questionnaire is to reveal concepts and generate in-depth discussion surrounding curricula issues in Egypt and achieve consensus for the development of a proposed strategic framework which EfS at the heart of the education policy agenda in Egypt, progressively at all levels of education and professional training of graduates and practitioners in the built environment. This paper presents and discusses results from the second stage of the project methodology.

Keywords: Curricula Development, Educational Framework, Sustainable Built Environment, Questionnaire, Interviews, Workshops
Assessing the Value of Environmental Analysis Tools in a Performance-Based Design Studio

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Abstract: It is well acknowledged that performance based analysis integrated early in the architectural design studio can yield better understanding of green building by means of continuous improvement to design alternatives. Integrating the analysis tools for advanced understanding of solar gain, daylight, wind flow, energy simulation at the early stages of design can provide students with quantified feedback between building geometry and measurable performance data. This helps in the evaluation of multiple design proposals and allows the students to make informed design decisions utilising a performance-based approach as a guiding tool. While students often excel in the application and analysis of these tools, a problem always emerge in the readiness of the students to apply the rest of their course work and specifically during the advanced level studios. An exploratory study in form of a questionnaire for a number of students was implemented following their tool learning to help indicate problematic areas in the learning process by identifying the limitations of the tools used, the application methodology and challenges associated with the data output interpretation and validation. A focus group exercise was later implemented where student projects where analysed, suggestions to a particular bundle of tools was documented and a development of the course content was proposed. The course outline was modified to suit the results of the questionnaire and the future outline development strategy is presented for further discussion and feedback.

Keywords: Course Development, Environmental Analysis Tools, Design studio, Performance-based, Simulation
Paper 6

The energy savings assessment of an Integrated Shading System for Typical Office Spaces in Southern Europe

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Abstract: The issue of energy retrofitting of existing aged building stock for the improvement of indoor environmental conditions forms fields of high interest and extensive research. The present research aims to evaluate the integration of an adaptive louver shading system for the improvement of the indoor thermal comfort as well as of the energy efficiency of the building envelope of existing office buildings in Southern Europe. The system was evaluated by means of thermal analysis simulation using IES-VE 2017 software. In terms of thermal performance, cooling (CDH) and heating (HDH) degree-hours were selected as a quantitative indicator for the thermal performance evaluation of each geometrical configuration. The thermal performance analysis indicates that appropriate geometrical configurations of the louver shading system ensure suitable solar shading and adequate insolation during the cooling and heating period respectively and thus drastically reduce the annual degree-hour values compared to those of the reference scenario. Moreover, it indicates a notable reduction of the cooling and heating loads of the space under study, which leads to the decrease of its annual energy consumption. The research study confirms the positive contribution of the system under study as a solar shading and heat gains regulation system. The parallel investigation of thermal performance and energy consumption aspects offers a holistic and comprehensive approach to the investigation of the comfort conditions of the indoor built environment, while, at the same time, it establishes the concept of prosthetic renovation as a renewable energy strategy for the improvement of energy efficiency and indoor comfort of existing buildings.

Keywords: existing building stock, integrated shading system, thermal performance, energy consumption, thermal comfort
Paper 19

A comparative analysis of thermal performance of building envelope types over time

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Abstract: Different building envelope construction methods have a direct impact on indoor temperature and relative humidity variations with respect to prevailing outdoor climatic conditions. The purpose of this study is to explore how indoor temperature varies in buildings that were built at different times and therefore have varying wall construction types. Three residential buildings in Beirut were selected to represent construction methods of the 1920s, 1940s and 1970s. The buildings were chosen within the same street to ensure similar climatic and urban conditions. Climatic data loggers were installed inside and outside in the three locations to measure indoor and outdoor temperatures and relative humidity as well as outdoor solar radiation, wind direction and intensity. The collected data helped assess and evaluate the indoor environments with respect to the temperature variations. Results indicate a clear fluctuation of the hourly temperatures in the three spaces varying across the coldest and warmest days. In addition, the performance of the walls also differs on these days, thus having an impact on the internal temperature variations. The study shows that the performance of the sandstone wall is the most suitable because of the temperature differences between the external and internal surfaces of the wall and because of the resulting indoor temperatures. This research thus validates and contextualizes the role of building technologies in relation to indoor temperature variations. It creates a foundation for understanding the performance of different types of walls in existing buildings.

Keywords: external walls, construction methods, internal temperature, Mediterranean climate
Bio-mimicry as a tool for minimizing energy consumption and improvement of thermal comfort: The case of office buildings.

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Abstract: Throughout history, architects have dealt with nature as an optimal inspired model for building design forms, stylistic inspirations and possibly for recent approaches to decoration. A yelling for a different attitude of dealing with nature has almost begun; achieving the scientists’ view, to learn from nature rather than to control it. Translating biological adaptations into architectural solutions through bio-mimicking various levels of an organism’s behavior can be easily contributed as a new approach of re-thinking in nature, and expressing the massive co-operation between one of the most natural complexity sciences such as; the Biology Science and Architecture in which the biologists are getting their seats at the designing table as well. No information is available regarding the integration between Architecture and Biology especially in terms of both the energy efficiency and the thermal comfort of a building. The paper presents a theoretical basis, and cases study analytical strategies. The Bio-mimetic levels and approaches in Architecture and its advantages when applying in the light of building sustainability and energy efficiency are defined. The Bio-mimicry in cooling and ventilation systems and its relation to the thermal comfort of the building are also been discussed. The East gate building in Zimbabwe, the CH2 building in Australia are analyzed as case studies for the same bio-mimetic selection prototype (the termites’ mound). Summarily, our results provide evidence that each mimicking level achieved in a building can lead to massive financial savings, minimized energy consumption amount, and a better level of thermal comfort as well.

Keywords: Bio-mimicry, Termites mound, Breathing structure, Energy efficiency, Thermal Comfort.
Energy efficient prefabricated housing units: Product review and the development of a Cypriot paradigm

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Abstract: This paper aims to examine the features and elements that govern the design and construction process of a bioclimatic, smart, prefabricated housing unit. The study is based on a review of the current literature and a taxonomy of current and proposed applications based on different prefabricated building typologies and fabrication methods. The proposed research also aims to evaluate the design implications and the performance of construction and energy components that maximize the unit’s design and energy potential. All cases will be addressed in terms of the challenges faced both by conforming to and enhancing the architectural design concept, as well as by optimizing the overall design performance and minimizing the energy consumption of the building. The paper delves also into the investigation, assessment and categorization of the main characteristics of existing integrated technologies through case studies, analysing the type and the use of each case. Thereafter, an evaluation of the performance of the various typologies under examination is carried out in order to identify the best practices for different applications. Subsequently, a preliminary proposal for a "Prefabricated, ECO Smart Housing Unit", based on local technical knowledge, and the prevalent fabrication conditions in Cyprus, is presented based on the conclusions drawn from the assessment and categorization of previous sections. The ultimate aim of this effort is to critically present the breadth of typologies and the plethora of alternatives that can be applied on a green prefabricated building unit, in ways that maximize its design and energy potential.

Keywords: Prefabricated housing units, Passive Design Strategies, Renewable Energy Technologies, Integrated Technologies, Evaluation Methodology
Comparative Study of Daylighting Performance for single Vs. Double Skin Façade Office Building for hybrid Ventilation: A Simulation analysis of Two Case Studies by design-builder software

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Abstract: The research aims to investigate that a shading devices combination within double skin facades (DSFs) could not only decrease direct solar heat gain but also shows that shading device configuration has the main impact on the air temperature, thermal comfort and the annual energy consumption in a DSF air cavity but also to maintain the balance of hybrid ventilation. Based on two case studies of an office building; the first with Single Skin Façade (SSF) and the second with Double Skin Façade (DSF); the impact of double skin façade on lighting performance is examined within typical summer conditions in hot arid one like Egypt using Energy Plus. The simulation was applied to the south facade to test significant effects of double skin façade on illuminance values. Simulation results show that a DSF can achieve high lighting performance with better energy efficiency than an SSF; also the basic characteristics of width of the cavity and the shape of shading devices (vertical or horizontal) are examined simulated, while it was concluded that horizontal shading devices at 90-degree angle were more effective to reduce the energy efficiency at south facade by 6.4% and also increase thermal comfort inside the spaces. Comparing the single and double skin facade, the area percentage of the office space with at least 200 to 2700 lux is found in a range of 10%, 50% respectively.

Keywords: Double Skin Façade, Single Skin Façade, Solar heat gain, Hybrid Ventilation, Energy efficiency.
The Investigation of Scheduled Evaporative Cooling for a Sustainable House Model in Riyadh

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Abstract: Architecture shouldn’t restrict, but reflect the wise and conscious practice of architects towards sustainability. As one of the harshest climatic conditions, Riyadh, the fast-developing capital of Saudi Arabia, stands as one of the challenging environments for architects to deliver competitive and social-responsive concepts, while achieving energy efficiency and environment friendly principles. This study aims to investigate the thermal and energy performances of a contemporary conceptual form for residential villa in hot-arid climate. By exploring different passive strategies including natural ventilation and daylighting, in addition to evaporative cooling, this paper is verifying the architectural decisions of recalling the court-yard, and the introduction of sloped-roof attic concepts to the modern house design in Riyadh. A detached single-family villa is used as case study. After satisfying Saudi national building codes and ASHRAE 62.2 standards, the utilization of indirect-scheduled evaporative cooling is investigated using DesignBuilder software tool. Integration with other strategies and the HVAC system is attempted by investigating their impact in terms of sources efficiency, environment consciousness and social effectiveness. Added to the social values of the private semi-exterior areas, the introduced ventilated glazed-shell court and unoccupied roof showed potential decrease in the annual energy consumption by almost 40%.

Keywords: Evaporative Cooling, sustainable house, hot climate, natural ventilation
Evaluating how Ireland has improved Building Regulations Compliance and Energy Efficiency

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\textbf{Abstract:} This paper reports a study of evaluating the revised Building Control System in Ireland to establish if they have improved Building Regulations compliance and energy efficiency in the construction of new buildings. The new system of accountability ensures how all involved in the design and construction process are responsible for compliance in a comprehensive mandatory certification procedure, ensuring the design team, building contractor and subcontractors all certify compliance that the work is compliant with the Building Regulations. The research is practice based among building regulation certifiers’ in Ireland to investigate the level of Building Regulations compliance since 2014 with the consequential improvements in energy efficiency. Research in Part L compliance has shown to be less than satisfactory, but since the new system was introduced, there is a high degree of accountability from both designers and constructors in the construction process. The findings suggest that the level of Building Regulations compliance have greatly improved, as certifiers are at risk of litigation from certification misstatement. Energy efficiency has improved in the construction of new buildings as Part L compliance is certified at design stage by the design certifier, construction is certified by the building contractor, sub-contractors and ancillary certifiers, and full compliance is certified by an assigned certifier who is responsible for overall compliance. The revised system provides responsibility on each certifier to detect and remedy non-compliant issues and the paper suggests a framework to assist certifiers’ in determining the risks to reduce the risk of litigation.

\textbf{Keywords:} Building Regulations, Building Control, Compliance, Energy Efficiency.
The Applicability Of Different Kinetic Façade Shading Systems In UAE

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Abstract: The world is rapidly changing and the increased reliance upon technology with the great complexity we face today, was exhilarating and bewildering as well as energy inefficient. However, architectural practice today has evolved and pursued various directions toward accommodating changes and movement in the architectural paradigm using different ways and for different purposes. The technological advancement available nowadays have pushed the use of kinetics in architecture far more than what has been possible previously. kinetic architecture has emerged to provide an optimal performance and adaptive solution to address the various and complex demands related to energy efficiency, user comfort and sustainability. This research focuses on the kinetic façade as an advanced shading technology which has been defined as the movement at the building skin that acts to adapt and respond to the surrounding changes of environmental conditions or varying occupants demands. It also provides different classification of kinetic façade through a review of different application of technologies with deployable responsive skins in buildings. However, the fundamental aim of this research is to provide a better understanding of how applicable is using kinetic shading system in United Arab Emirates. It also investigates the obstacle facing kinetic façade in a hot arid climate and which type is more suitable for the use in UAE. Finally, based on the analysis done in this research, a summary and conclusion has been made elucidating the appropriate application of kinetic façade to be used in UAE.

Keywords: Kinetic Façade, Kinetic Architecture, Classification, Shading system, UAE, Challenges and Limitation
Maximizing the Effectiveness of Solar Energy System by the Integrated Passive Cooling Strategies of Nizwa Eco-House

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Abstract:
This study addressed the impact of the integrated performance of the passive cooling strategies to reduce the cooling load and maximizing the energy productivity of the solar photovoltaic panels in Nizwa eco-house. Selected passive technologies or design features adopted in Nizwa eco house to reduce the temperature of buildings without energy consumption. Different scenarios examined to evaluate the effect of each strategy independently to identify the most significant one and collectively to investigate the integrated performance of these strategies altogether. Consequently, this research aims to examine the performance of the application of selected passive cooling strategies to improve thermal performance and to reduce the energy consumption of residential buildings in hot climate settings at Nizwa in the Sultanate of Oman. Four passive cooling strategies were applied in Nizwa eco-house assessed by computer simulation software (ECOTECT). The assessment procedure based on comparing the cooling load of the proposed baseline scenario, which is without passive cooling with the cooling load of the scenarios after applying the passive technologies. The comparative analysis showed significant reduction in energy consumption was achieved due to applying the integrated approach of the cavity walls, triple glazing, shading canopy and the green roof, consequently the number of solar panels will be reduced. The implementation of these strategies in the Nizwa Eco-house showed a significant effects on the energy balance when the produced energy by the solar panels compared with that consumed by the Eco House. The annual energy produced by the solar system is around 47.3 MWh, while the annual consumed energy by the Eco House is around 44.3 MWh achieving the goal of Zero Energy Balance and exceed this goal by an extra energy of 3 MWh annually.

Keywords: Solar photovoltaic, Cooling load, Energy efficiency, Ecotect.
Impact of Outer Shell Design on Energy Performance of Educational Buildings

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Abstract: Sustainability has emerged as the dominant theme in the debate on architecture and building in the last decade. About 50% of the total global electric energy is consumed by buildings with their different functions. There is a close connection between energy and buildings, which, as they are designed and used today, contribute to serious environmental problems because of their excessive consumption of energy and other natural resources. Buildings’ demands for heating, cooling, ventilation, and lighting cause severe depletion of invaluable environmental resources.

This research aims to investigate the green retrofit aspects of existing educational buildings within the Mediterranean climate area as part of the sustainable buildings approach. To achieve its objectives, the research adopted a comparative analytical approach via investigating the important strategies that achieve sustainability and environmental efficiency. Regional models that have applied sustainability retrofit strategies and maintained the use of natural resources in order to conserve energy consumption were analysed and discussed. The retrofitting of a private university’s existing building in Cairo, Egypt, was investigated as the applied case study. A thermal model was built using Design Builder to investigate the building thermal performance. Through the model, the impact of different building material strategies, alternatives, and modifications of outer shell were tested and analysed. Both economic and technical aspects of improving the overall performance of the building and its energy consumption were studied. The research concluded with suggesting the best alternatives for green retrofitting of existing buildings – through modifying its outer shell to reduce its energy consumption as part of achieving more sustainable and environment-friendly building stock.

Key words: Environmental design, Educational buildings, Energy efficiency, Building materials.
A state of the art review of the impact of Vertical Greenery Systems (VGS) on the energy performance of buildings in temperate climates

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Abstract: Rapid urbanization and climate change concerns have led to a growing drive to integrate nature into the built environment. It is expected that London will face increasing risks of flooding, overheating and drought, through hotter drier summers and warmer wetter winters. In response, the Mayor of London adopted new policies for encouraging the use of living roofs and green walls. Greenery systems are considered as promising solutions for improving energy and thermal efficiency of buildings as well as reducing pollution, encouraging biodiversity and water runoff, reducing Urban Heat Island (UHI) effects and improving the microclimate overall. The research aims to review the current state-of-the-art literature concerning the potentials and limitations of vertical greenery systems on energy and thermal performance of buildings in temperate climates. This review paper synthesises and summarizes the literature with regards to vertical green systems (VGS) when used as a passive design strategy to enhance energy savings in buildings. From the review of the literature, some key aspects to consider when designing VGS are outlined, such as climate influence, the plant species grown and the different operating mechanisms as associated such as shade, evapotranspiration, insulation and wind barrier. The results achieved from the literature review clearly indicate that green walls may be considered as key solutions to mitigate operational energy consumption of buildings as well as provide thermally comfortable indoor and outdoor environments. The results of this research will prove useful to builders, architects, engineers and policy makers as it will provide an in-depth understanding of the potential of VGS to mitigate building-related energy consumption in a renewable, sustainable, energy-efficient and cost-effective way.

Keywords: Green and living Walls, Vertical greenery systems, Green Façade, Energy Performance, Passive design
Impacts of climate change on a Zero Energy Building in the Brazilian Savannah

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Abstract: Considering the phenomenon of global warming and the need to reduce its causes and effects, the approach to the production of sustainable buildings has become more and more important. The increase in external temperatures results in higher energy consumption to maintain internal thermal quality, with Zero Energy Building (ZEB) being an alternative and a mandatory trend in some countries. ZEBs are buildings with energy efficiency strategies that also have its own energy generation source. The aim of this study is to demonstrate how climate change will impact the ZEBs, considering as a parameter the Fourth Report (AR4) of the Intergovernmental Panel on Climate Change (IPCC). The object of study is a house located at latitude 15°S in the centre of South America, and it was used computational simulation to create future climate scenarios of 2020 (2011 to 2040), 2050 (2041 to 2070) and 2080 (2071 to 2100). Energy consumption was predicted in the current scenario with and without photovoltaic energy generation, establishing a ZEB base case. Results showed that there will be an increase in energy demand over the years, and showed that the photovoltaic system will become out of date, that is, it will not be able to meet this new demand, from around 14.1% by the 2020s, 26.3% for the 2050s and 40.2% for the 2080 period. It provides subsidies for reflection on buildings energy consumption trends and de-characterization of the ZEB concept in a short period.

Keywords: Sustainable buildings, photovoltaic energy, global warming.
Supply Chains for Energy Efficient Housing using Mass Customisation: Adopting Japanese housing models in the UK

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Abstract: This study explores current housing supply chains to detect where processes of mass-customisation could be applied to increase the production of energy-efficient houses. Currently, most housebuilders in the property market overlook the advantages of providing energy-efficient houses. House buyers seeking sustainable options find few, or no possibilities to customise their houses in terms of energy qualities, restricted to furniture arrangements or aesthetic layouts. By contrast, Japanese house-manufacturers have realised that providing energy-efficient options (e.g. solar panels) result in an increase of sales, which is a consequence of applying a sophisticated customer-oriented marketing process called ‘mass-customisation’. A successful mass-customisation system relies on empowering customers in the design-decision-making process. Therefore, the relation of mass-customisation to energy efficiency is relevant in that it allows the users to choose the level of energy efficiency they want and can afford for their new house. This study compares the ways in which different housing companies involve customers in the design decision-making process by diagramming their supply chains. Nine housing companies were selected for this study: four housing manufacturers from Japan, three developers from the UK and two alternative models from the UK. This study concludes that there is potential for UK housebuilders to adopt mass customisation by implementing effective marketing and communication systems, but these have to be coherent with their business model and cash flow.

Keywords: Housing, Energy-efficiency, Mass-customisation, Manufacturing, Supply-chains
Modelling progress in the energy efficient retrofit in the private rented sector

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Abstract: The private rented housing stock in the UK is the least energy efficient sector of the housing market. One of the tools that the government is using to attempt to address this is the Minimum Energy Efficiency Standard (MEES) which came into effect in April 2018. This requires properties to let to achieve a minimum Energy Performance Certificate efficiency rating of E – therefore dwellings that score F or G will no longer be allowed to be let out on new tenancies. The regulations are then being rolled out to existing tenancies in 2020. The government is also consulting on increasing the minimum standard to a C by 2030 or 2035.

This paper examines the housing stock in the West Midlands Combined Authority (WMCA) area and more specifically the Walsall local authority area to identify the extent to which dwellings are at risk of non-compliance with the minimum E standard. It finds that approximately 7.5% of WMCA private rented stock is currently rated band F or G and is therefore at risk of not being lettable or re-lettable by 2020. It further finds that approximately 1% of the stock is unlikely to be able to be cost effectively improved, but currently the government provides exemptions for such properties. The paper also demonstrates that most non-compliant dwellings have the potential to be improved for a cost of less than £2,500, which is the proposed cost ceiling for compliance. It shows that this level of expenditure can be very cost effective with pay back periods of less than 2 years. If the proposed minimum band C rule were to be implemented this would be very problematic for potentially as much as 40% of the rented housing stock.

Keywords: retrofit, private rented sector, energy efficiency
The Role of Egyptian Residential Buildings Energy Code in Enhancing Sustainable Development in Egypt: Evaluation of Nine Years of Practice

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Abstract:
Achieving sustainable development in general, and in emerging countries in particular is a challenging process that requires the contribution of various governmental, institutional, and individual entities. The role of architectural design is essential in this process as it is considered as one of the earliest steps on the road to sustainability. Residential buildings sector is responsible for 40% of energy consumption in Egypt. Egyptian Residential Buildings Energy Code (ERBEC) was established in 2006 to address the minimum requirements of energy efficient building in Egypt. This study aims to evaluate the nine years of practice of the ERBEC, based on a structured questionnaire among the architectural firms in Egypt. A case study of fifty two architectural firms in Cairo were selected and categorized according to their sizes; large-scale, medium-scale, and small-scale. A questionnaire was designed and sent to the firms via email, and personal meetings with some firms’ representatives took place. The results of the study revealed that only little percentage of the large-scale firms have clear strategies for the use of the ERBEC in their design process; however, the application is limited to certain projects, or according to the client request. On the other hand, the percentage of small-scale firms is much less, and it is almost absent in the medium-scale ones. This demonstrates the urgent need of enhancing the awareness of the Egyptian architectural design community of the great importance of addressing the ERBEC starting from the early stages of the building design.

Keywords: Architectural Firms, Egyptian Residential Buildings Energy Code, Energy Efficiency, Sustainable Development in Egypt.
Success or Failure? Energy Concept and Post Occupancy Evaluation of a new built Energy-Surplus Day-care Centre for Children

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Abstract: This new construction of an energy-surplus day-care centre in southern Germany illustrates how ecological and economic sustainability can go along with innovative techniques and architectural design, targeting to reach high comfort and energy efficiency, and simultaneously providing child-oriented and pleasant surroundings. The intention of this lighthouse project was to increase awareness and interest for the topic of energy efficiency within the municipality and beyond. The energy concept, focusing on minimizing the energy need, includes a variety of features, partially influencing each other. Amongst others, these include a high level of thermal insulation, an optimized and demand-controlled ventilation system with preheated air and heat recovery in winter, a solar chimney for passive cooling and ventilation in summer, intelligent control systems and the use of renewable energy sources. In a monitoring phase, recording the building’s thermal performance in the first two years of its occupancy, it was proven, that the central goal, the production of a surplus of energy for the operation of the building, was met, even though the technical systems were not operated correctly in the first months. This underlines the need of implementing integrated planning processes into the (German) standard building planning phases (HOAI, 2013). The results of a post occupancy survey illustrate the occupants’ difficulties to handle the complex energy systems, thus emphasizing the necessity to involve the future occupants from an early planning stage on.

Keywords: energy-surplus building, post occupancy evaluation, integrated planning process, user participation
Abstract: Passive design replies to context of the local climate and location characteristics to maximize the comfort and health of end users with reducing energy use as well. The aim of this paper is to investigate the effect of applying selected passive cooling designs on the Housing Typologies in Fujairah Emirates. A double story villas in Fujairah Emirate in UAE was selected to act as a main case study. With the aid of IES simulation software, the building performance was evaluated before and after applying passive cooling strategies which include green roofs, shading device and evaporative cooling by roof pond. The new strategies achieved improvements, for example, the new shading device contributes to a better visual comfort and daylight factor was improved form 2% to 5%. Moreover, the new green wall reduced the U-Value from 2.97 W/m2K to 0.12 W/m2K. It is worth mentioning that these interesting findings may be applicable to the countries that share similar environmental and social context of UAE.

Keywords: Passive Design, arid, passive design strategies, UAE, IES
ADOPTING GREEN BUILDING MATERIALS AND MODERN TECHNOLOGY IN VERNACULAR APPROACH LEADS SUSTAINABLE FUTURE

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Abstract: At present, the effects of climate change is becoming increasingly apparent and as the economy rises and the population is moving up in developing country. Globally, it has been estimated that a building consumes approximately 40% of the total world’s energy and responsible for 50% of greenhouse gas emissions. It has been projected that building-related greenhouse gas emissions reached 8.6 billion metric tons CO2 equivalent in 2004, and expected to grow to 26% by 2030, reaching 15.6 billion CO2 under their high-growth scenario. This research paper presents the advantages of sustainability methods followed in vernacular style of architecture buildings. To resolve the energy consumption crises, it will be necessary to introduce the concept of ‘sustainable development’. Firstly the research consist of case study which was conducted on a village Jadi, chakrata Tehsilin dehradun district of uttarakhand state, India. Two types of houses namely Pakka houses, conventional building (constructed using conventional building materials) and katcha houses, vernacular house (constructed using green non-conventional building materials) to review with the sustainability concept and proves pakka houses doesn’t pay lesser foot print on environment and consume more energy. Secondly to provide a better solution for sustainable future, incorporating latest green technology in to vernacular styled shelters is highly recommended.

Keywords: sustainability development, vernacular architecture, green technology, carbon emission, building energy consumption
A framework for determining the most effective parameters for optimal life cycle analysis in the early stages of building design

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Abstract: Analysing a building’s environmental impacts through its whole life cycle requires a very complex method to be applied by designers. This is especially true at the early design stage, where most of the critical design decisions for environmentally friendly buildings are made. This complexity arises from a variety of areas, such as: unavailability of required databases; requiring a vast amount of data and details, including uneven levels of uncertainty at different phases; the effects of diverse external parameters such as climate; and, the lack of expertise in the building design area.

The main question addressed by this paper is: How can building designers be assisted to make better, more environmentally friendly life cycle decisions in the early design stages of a new project? The paper suggests that a prioritisation of the most effective parameters for minimising building environmental impact in each respective phase of a building’s life cycle can assist designers in making better decisions upfront that lead to greater benefits across the whole life-cycle. The paper puts forward a framework for determining these parameters by identifying the key difficulties and proposing the possible solutions. Addressing these difficulties leads to a proposal for a basic tool for designers, which will help to ascertain the most effective parameters for optimal life cycle analysis. Inputs, system function and outputs of the tool are defined as the results of this research.

Keywords: Life Cycle Assessment (LCA), early design stage, effective parameters
A Conceptual Model for Climatic-responsive Vernacular Architectural Forms

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Abstract: Indoor lighting, in terms of its spatial coverage, spectral range and extent is closely associated with occupants' behaviour, yet little is known about its links with now-abandoned 19th century vernacular architectural forms of dry-and-arid climates in central Asia. Sustainable use of energy for domestic purposes is a critical component of the resilience of urban systems to urban sprawl (and escalating energy demands), mineral resource shortage and changing climate. Domestic energy use is a function of occupants’ behaviour in adjusting themselves to space through movement, which is driven by interrelated light-space-time. A better understanding of such interactions, in the context of energy efficient Iranian vernacular architecture can allow the adoption of traditional styles in design of contemporary indoor living spaces, thereby indirectly influencing occupants’ lifestyles towards lesser use of artificial lighting and energy conservation. It is in trying to understand how vernacular style can be turned into purposeful action that each core domain of vernacular architecture, and the dynamic of light and human through them, should be determined and brought to bear. In doing so, we present a conceptual model, built through field observations - of five three historical buildings in Kashan, Central Iran - interview and archival studies. The model informs on how occupant’s perception of space and response varies with time, space configuration and lighting levels.

Keywords: Daylight, Human, Interior Space, Vernacular, Perception, Energy, Behaviour
Rethinking repetitive housing design typology in hot and humid climate: A case study in Malaysia

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\textbf{Abstract:} Repetitive housing in hot and humid climate in Malaysia are designed without much consideration for thermal comfort and adequate natural lighting. Over-heating and lack of natural lighting is a common problem. Due to this, active measure with air-conditioning installation and the use of artificial lighting during daytime is often seen as an instant problem solver. However, due to global warming and depletion of fossil fuels, the dependencies of active system must be reduced. Passive strategies is seen as the best approached in designing better future repetitive houses. Conventional layout and optimized layout using passive strategies is used to compare by performing thermal comfort simulation, daylighting and CFD simulation. Conventional layout uses the current standard practice for design layout and building policy requirements which only requires minimal opening, while optimized layout is based on modification of current standard design layout with improvements to opening requirements in the current building policy. Parameter input used for simulation is based on standard construction materials practiced in Malaysia. Result shows thermal comfort and daylighting improvement between conventional layout and optimized layout. Optimised layout is seen as the future design typology for repetitive houses in Malaysia. However, changes and improvements in the current building policy is essential to implement this.

\textbf{Keywords:} Passive strategies, housing, thermal comfort, daylighting
Chapter Four: Sustainable Construction Technologies, Resource Efficiency & Renewable Energy and Green Technologies
Compressive Strength of Interlocking Compressed Soil Blocks (ICSB) Produced Using Soil and Production Water from Oil Fields in Oman

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Abstract: Large quantities of water are used in the oil fields in the oil production process. Naturally, such water is always contaminated with oil compounds. Although production companies such as Petroleum Development of Oman (PDO) treat the water to many stages of refinement, yet a large quantity of it remains hazardous to man-use. Methods of treating production water are generally very expensive and similarly are the methods of their disposal. Normally, small quantity of treated water is recycled in the production process, but a large proportion has to be disposed-off. PDO uses deep injection at depths in excess of four kilometres inside the earth in order to avoid contamination of underground aquifers, an extremely expensive process. The research objective of the current research is twofold: to use the treated production water and thus help solving an expensive problem created by the oil production, and to provide a cheap alternative to the widely used concrete blocks in construction industry. For this purpose, soil and water were obtained from Marmoul and Nimir oil fields in Oman. Soil tests were performed to check the suitability of the soils for the production of Interlocking Compressed Soil Blocks ICSB and to select a suitable type of stabilizer to be used. Tests have shown that soil from both sites were suitable for the production of blocks. Both soils contained a small percentage of clay, and accordingly, cement was used as a stabilizer for making the compressed blocks. To determine the strength characteristics of the produced blocks a program of testing was designed to include mixes of different proportions of soil, cement and water. Results indicated that it is possible to use production water for the manufacture of ICSB with good strength suitable for both load-bearing and non-loadbearing applications.

Keywords: soil, blocks, strength, oil, PDO
Biological modeling as a tool for promoting sustainable construction technologies and improving the energy efficiency

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Abstract: It is generally known that nature is considered to be a unique and optimal encyclopedia for various sorts of technological ideas. A new approach of rethinking in nature can easily be contributed by bio-mimicking an organism’s form and construction to the building. There is strong evidence that imitating natures’ mechanisms, inventions and implementing natural innovation based on a scientific basis can significantly improve the quality of technological aspects and result in sustainable multi-functional structures and superior technologies. A gap in knowledge was found regarding the sustainable bio-mimicked construction system of a building and its impact on the energy efficiency. The paper presents a theoretical basis, and cases study analytical strategies. The Bio-mimetic levels and approaches in Architectural technology and its advantages when applying in the light of building sustainability and energy efficiency are defined. The Bio-mimicry in construction technologies and its relation to the energy efficiency of the building are also been discussed. The Sino Steel International Plaza in China and the Swiss Re headquarters in London are analyzed as case studies discussing their sustainable bio-mimicked construction technologies and its effect on the energy efficiency of the buildings. Summarily, our results provide evidence that there is a strong positive relationship between the sustainable construction technologies and the energy efficiency of a building and applying the sustainable bio-mimetic approach in construction technologies may lead to financial savings and a better level of energy efficiency in the building as well.

Keywords: Bio-mimicry, organism’s form, sustainable construction, sustainable technology, energy efficiency
Areas and principles of sustainability in assessing the adaptive reuse of restored Qatari heritage: a case study

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Abstract: In the recent years, due to the oil discovery and exportation, Qatar a small country in the Persian Gulf has typically experienced accelerated and complicated problems of urbanization. Affecting the direction of the rapid urbanization, there is a perpetual dispute, between the construction of new, modern identity and the promotion of traditional architecture as a possible way to establish new relations with the local history and culture.

The paper presents some significant examples of adaptive reuse projects, recently completed in Qatar, and shows the increasing demand to strengthen recognition of the local architecture and regenerate the consciousness of the national heritage values.

The interventions have been analyzed and compared concerning environmental, socio-economic and socio-cultural aspects derived from the adaptive re-use interventions.

Sustainability, as a cultural, social, environmental, and energy-saving value, is one of the most distinguished principles that should be applied to the whole process of heritage restoration.

The results show that there exist many common points between the re-use of Qatari heritage, the conservation of ancient natural materials, the promotion of cultural values, the synergism with the landscape, and the adjustment to the climate, to be applied to the restoration strategies and processes compatible with the heritage buildings and the environmental approaches. The concept of sustainability is thus addressed through its meaning of unity and harmony in a broad sense, including materials, use, ecosystem respect, social aspects, investments, costs, although different approaches, strategies and solutions at the urban, architectural, and archaeological scales.

The aim of the presented research, which is still under development, is to promote strategies, solutions and good practice that could be adopted in an innovative way for the restoration of the Qatari heritage. The aim is to define an approach that is persistent and will enhance the Arab culture about restoration while respecting sustainable principles.

Keywords: Architectural Heritage, Conservation, Change of use, Sustainability’s Assessment
Defining the Characteristics of Prefabricated Architecture as an Alternative Sustainable Construction Approach

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Abstract: Increasing population, international economic problems, energy crisis and worldwide environmental problems are considerable issues that are forcing the world to conceive innovative solutions that are fast, feasible, and sustainable. Prefabricated architecture is an architectural approach based on an offsite manufacturing process of building materials, components, or systems which are then installed together to form a larger assembly on-site. Prefabricated architecture is not a new trend; however, it has recently become a popular trend worldwide due to several advantages which promote sustainability such as: the quick construction process and assembly, high quality control, construction waste reduction, modular flexibility, cost reduction, affordability, consistency, improving energy efficiency, and environmental control. Although the various advantages of prefabricated architecture, its practices is still limited. This can be referred to the lack of knowledge about its characteristics and properties. This paper aims at determining the main characteristics of prefabricated architecture as an alternative construction approach that promotes sustainability. This is achieved through a comprehensive critical analysis of existing relevant literature to define these characteristics which include: the different terminologies, scales of prefabrication, sustainability aspects, and structural aspects. Defining these characteristics could facilitate design decision-making for optimum prefabricated buildings practices and push stakeholders to promote this trend and encourage its application.

Keywords: Prefabricated architecture, Scales of prefabrication, Sustainability aspects, Structural aspects
BAKE-OUT THE VOLATILE ORGANIC COMPOUNDS FOR RESIDENTIAL BUILDING – PRE OCCUPANCY- IN SUMMER AT EGYPT

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Abstract: The main objective of this study is to come up with a new method to extract the Volatile Organic Compounds (VOCs) emission for indoor spaces. Computational Fluid Dynamics (CFD) will be used in simulation to assess the Indoor Air Quality (IAQ). ANSYS FLUENT V.14 is the software used to simulate the VOCs emission using Solar Radiation Model, and Chemical Species & Transport Model. During simulation the conservation equation for momentum, energy and mass fraction for each VOC will be taken into consideration. The numerical model applied in this study are, two small spaces on the south facade orientation. These spaces are different in volume, they exist on the seventh floor of a residential building that’s eight stories high. The two spaces have glass windows of 3 mm thickness which are completely sealed from all sides, creating greenhouse effect for understudy, during summer time. The hot air which is comprised inside the space is used to bake-out the undesirable VOCs on the varnished surfaces. The results of this study show that the extracted VOCs concentration level are much higher not only in the larger volume but in the elevated temperatures as well, which leads to exceeding threshold limit values of LEED V.4 for Homes.

Keywords: Bake-Out, Indoor Air Quality (IAQ), Volatile Organic Compounds (VOC), Computational Fluid Dynamic (CFD), Emission and Concentration.
**Paper 179**

**Housing Affordability and Contemporary Construction Systems in Egypt: Simulating the Influence of Insulated Concrete Forms**

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**Abstract:**
This paper discusses the shortage of affordable housing addressed to low income groups in Egypt and illustrates the role that contemporary construction systems such as Insulated Concrete Forms (ICF) can play to improve affordability. The paper starts by defining the problem of housing affordability, and then analyses the gap between housing supply and demand. The study criticizes the use of conventional construction for the past decades to meet housing needs with limited exposure to contemporary building technologies experimented worldwide to attain sustainable affordable housing. The paper investigates ICF as a viable system in affordable housing in Egypt. Recently, ICF has been used in some projects and is gaining local popularity because of its competitive construction cost, time and quality. After the theoretical part of presenting the research problem and the overview of ICF, the paper applies a simulation of ICF system on the current Social Housing Project in Egypt ending in 2020 to study the influence of using ICF on the architectural and economic aspects of the project. Based on the findings, ICF can enhance housing affordability by targeting lower income beneficiaries with the same allocated budget, and can eventually decrease the gap between affordable housing's supply and demand.

**Keywords:** Housing Affordability, Construction Systems, Social Housing, Insulated Concrete Forms
How sensitive are whole-buildings life cycle assessment to lifespan choices?

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Abstract: Life cycle assessment (LCA) is an important technique to measure environmental impacts of products and processes. Its application to analyze whole-buildings’ environmental burdens has increased in the past years. Its results, however, carry uncertainties which may impair LCA’s assistance to environmental decision-making. Since choices are unavoidable in LCAs, it is crucial to analyze inherent uncertainties. Recent papers indicate lifespan as one of the main uncertainty drivers on whole-building LCAs, since future situations can not be assertively predicted. Literature also suggests that increasing a building’s reference service life (RSL) offers improved performance, as described terms of impact per year of RSL. This outcome however has been observed in highly industrialized and standardized construction contexts. Less controlled contexts, characterized by waste- and maintenance-intensive technologies, might not follow the same trend. This study assesses sensitivity of whole-building LCAs results to different lifespans illustrated by a Brazilian case study. Our chosen lifespan scenarios (50, 75 and 100 years) were inspired by the three design service life compliance levels admitted by the Brazilian performance standard. We then performed a sensitivity analysis to clarify the implications of longer building’s lifespan on other life-cycle phases, particularly maintenance. Cumulative Energy Demand (CED) and CML 2001 v.2.05 methods were selected for calculating embodied energy and global warming potential in SimaPro 7.3. Our results indicate that wastage inherent to building technologies, as well as use of poor quality materials indeed intensify maintenance routines, however it is not enough to make the annualized impact less attractive for longer lifespans. The sensitivity analysis indicates materials and services with higher repair program impacts and problematic impact categories. Findings from this research will support future sensitivity analysis in whole-building LCAs.

Keywords: Life cycle assessment; whole-buildings; lifespan; sensitivity analysis
Development of tools for the proper prediction of urban cooling potential associated with the implementation of cool and green roofs. Application to a case study

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Abstract: In Mendoza city, Argentina, the intensive sealing of surfaces, due to urban growth, increases the temperatures of the outdoor air and the surfaces of the urban-building envelope. Mitigation strategies aim to restore the thermal balance of cities, favouring losses and decreasing profits. Internationally, one the most efficient strategies is the application of cool and green roofs. The objective of the investigation is to generate reliable predictive tools that describe the microclimatic changes derived from the use of cool and green roofs, developed and used locally, over urban environments of arid regions. Methodologically, three stages were carried out: (1) Experimental test: evaluation of the thermal and optical performance of cool roofing materials of greater local application -aluminium and geotextile membranes- and vegetated roofs with greater hygrothermal efficiency in the region with the species Nassella tenuissima and Sedum spectabile. (2) Databases: generation of input data of materials and technologies of roof for urban climate forecasting software, ENVI-met, adjusted to the regional technology features through their optical and thermal characterization. (3) ENVI-met theoretical models: comparison of the thermal behaviour of 4 scenarios that differ in their cover technology with respect to a base case. As a result, the high degree of adjustment of the air temperature of the daily curves measured in comparison with the simulated curves is observed, which supports the reliability of the predictive results of ENVI-met in relation to the urban thermal behaviour. As a final conclusion, the combination of variables, such as the selection of plant species used in green roofs in relation to the local climate resources and diverse roofing technologies, would allowed to get different energy efficiencies measurements at object, building and urban scale. The adjustment of prediction tools through simulation that links models at different scale, such as Energy Plus and ENVI-met, would improve both sustainable buildings design and urban planning.

Keywords: urban passive cooling, roof technologies, green roofs, cool roofs, arid zones.
Can structures be created from their site?

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Abstract: Sustainability in buildings largely focuses on the operational period, rather than the construction and deconstruction phases. In the past, using local materials was the obvious and sustainable choice, 95% of which could usually be reused or recycled. Compare this with materials chosen in the past 100 years, where only 70% can be reused or recycled (Berge, 2009). This paper explores the reasons for using sustainable and local resources for building materials, focusing on a specific site within Snowdonia National Park, Wales.

The vernacular and historical architecture of North West Wales is discussed, along with geology, with a description of designs that have evolved from this. Traditional local materials are mapped, followed by discussion of the attributes and resources on the site.

A basic structure is proposed, using the site materials only, specifying stone foundations, bracken cob walls with clay plaster, a timber frame roof with reclaimed slate and shingle weather proofing. Local architecture was informative for this design. Assessment in regards to sustainability was limited, due to lack of data on natural building materials in relation to more commonly used materials on comparison sites.

Keywords: local, sustainable, materials, low-carbon, Wales
Are P3s Sustainable? A study of facility resource use effectiveness at a Canadian healthcare corporation

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Abstract: In recent years an increasingly diverse range of infrastructure delivery structures are being used with little empirical understanding of their long-term implications on operational performance, particularly resource use. Across Canada, and the province of Ontario in particular, this is marked by a notable shift favouring Alternative Finance and Procurement (AFP) approaches, including the use of Public-Private Partnerships (P3s). With focus on resource use during the operational phase, this paper provides a case study of a specific healthcare corporation in Ontario, Canada including an early P3 hospital delivered by Infrastructure Ontario under the Design-Build-Finance-Maintain (DBFM) structure, as well as a conventionally procured and operated facility. The article identifies the practical influences and challenges associated with the facility’s procurement and operations in order to consider broader implications for future research and to support planning and policy work. Using empirical data on Facility Management labour and energy use - supplemented by facility user surveys, interviews of key stakeholders and contractual study - findings show consistently better performance at the P3 facility, though after a short bedding-in period for energy performance. Many best practices were transferred from the P3 facility to the conventionally procured facility to improve data tracking and reporting, but internal accountability remains a challenge and budgeting factors negatively impact the conventionally procured facility. The mix of strong financial penalties and incentives within the P3 contract between Project Co and the hospital, which all proponents’ bids were subject to in the procurement phase, are identified as likely drivers for high performance of maintenance activities and energy use directly, and facility user satisfaction levels indirectly. Notably, the dramatic improvements in energy use at the P3 site is not matched by the facility’s water use, for which, unlike energy, conservation is not incentivised in the contract.

Keywords: Infrastructure delivery, facility operations, resource use, Public-Private Partnerships
Paper 30

Monitoring the built environment: Developing a dynamic tool to optimise renewable energy use and energy efficiency at a community scale using GIS

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Abstract: Within the framework of the well-recognised need for a more sustainable future, a number of ambitious targets and energy policies has been set, regarding CO₂ emissions and energy savings. As buildings are responsible for the 40% of the global energy consumption, it is crucial to optimise the contribution from renewable energy resources in the built environment, as well as to use the energy in the most efficient way. It is therefore necessary to enable the ability of in-depth monitoring in the built environment, at a larger scale than an individual building.

This study investigates the role that monitoring can play with regards to encouraging renewable energy use and optimising energy efficiency in the built environment, by developing a dynamic tool that can be used both at an individual building level and at community level.

A bottom-up methodology will be presented that incrementally aggregates buildings into a community level tool using a set of case studies. The number of buildings included within the tool will be gradually increased to collate information about a live monitoring experience of multiple buildings, located on different sites in South Wales. Besides new ways to use monitoring in the context of sustainability, the conclusions of the study cover a variety of aspects related to the monitoring process, including choice of sensors and meters, data management (collection, transmission, storage and processing), availability by other stakeholders, choice of platform to manage the monitoring data, and cost-benefit analysis.

Keywords: retrofits, live building monitoring, community level, energy efficiency, renewable energy
An optimisation design framework for residential buildings integrating air-source heat pump multi-supply system, active thermal storage, and onsite renewable energy

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Abstract: Domestic heating, cooling and hot water take a large proportion of total energy consumption in residential buildings, and contribute significantly to the greenhouse gas emissions, because the energy used is mainly from fossil fuels. Electrification of these three systems combined through an air-source heat pump (ASHP), and then decarbonisation the electricity by building integrated renewable power generation, will help to significantly reduce carbon dioxide emissions. Moreover, using building envelopes as active thermal storage by embedding the water loops of ASHP air-to-water system, can make the capital cost of the holistic system very competitive in comparison with conventional systems. Furthermore, such system can shift domestic energy consumption from peak usage period to local renewable generation’s peak output period, whilst still providing the needed comfort in time. Thus, the grid is less interrupted, and the occupants can have better financial benefits without compromising comfort needs. Such integrated and holistic system has large potential to play an important role in carbon reductions in the future housing sector. However, designing such system can be complicated and needs new approach to coordinate the stakeholders’ works. This paper uses a case study to present an optimised design framework for demand, storage and renewable generation integration through such ‘ASHP multi-supply system + thermally activated building + onsite renewable generation’ strategy, which helps future practice to design such systems properly and cost effectively. And the discussions in this paper about design issues will enable future improvements of component design and system efficiency.

Key words: Air-source heat pump, Multi-supply system, Thermally activated building, Renewable electricity, Holistic integration
The choice and architectural requirements of battery storage technologies in residential buildings

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Abstract: This study has been undertaken to gain a better understanding regarding the choice and architectural implications of battery storage technologies in a future built environment benefiting from renewable energy systems and energy storage technologies. As no models or tools have been found dealing specifically with the size of energy storage systems, this work has partially addressed this shortcoming through the consideration of a framework, within which these issues are explored. The study assessed the requirements of nine battery technologies for different residential building scales at the distribution level in the UK using quantitative methods. Three scenarios for 2030 were considered; the business as usual scenario, a scenario assuming electrification of heating and energy efficiency measures and a scenario in which one electric vehicle is assumed for each house. After deriving the nominal capacity for each technology and identifying key aspects for building integration, several spatial and other requirements, including footprint, volume, mass and cost for the scales of interest were estimated in each scenario considering daily autonomy. The investigation led to a schematic characterisation of the battery technologies according to their suitability across these requirements and their applicability in different building scales. The study showed that the architectural implications of the battery technologies’ integration considering daily autonomy are of little importance to designers. Attention should be given when more than one day of autonomy is applied. The choice of the most suitable technology according to its applicability in different building scales and different daily autonomy periods should also be carefully assessed.

Keywords: battery technologies, energy storage, residential buildings, scenario modelling, architectural implications
Paper 146

Numerical Investigation of Geometrical Design for Transpired Solar Collector Performance

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Abstract: In the UK, a large amount of energy has been used for heating and cooling the buildings. Without designing an efficient envelope, it is not possible to improve the performance of buildings and achieve a reduction in building energy consumption and greenhouse gas emissions. One method of reducing building energy dependency and limiting greenhouse gas emissions is through introducing newly solar thermal technologies like transpired solar collectors (TSCs) into the building envelope. It contains a perforated metal sheet attached at a certain distance to the building wall to create a plenum and the metal profile is heated by solar radiation, which then transfers the heat to the plenum air. While, the air is cross the perforation hole and then sucked to the building inside by a fan as part of ventilation services. TSCs is one of the most efficient solar thermal conversion technologies and parametric study indicated that geometrical design like the geometry of perforated-hole has a huge influence on TSCs performance. Literature reviews and industrial reports displayed that there are different types of holes available for TSCs design such as the round hole, square hole, and another special hole like star/cross. However, there is no or limited study on the impact of the different shape of a hole on TSCs performance. This paper presents a numerical investigation with using ANSYS Fluent software on TSC performance due to the absorber plate profile with two different types of holes (round hole and square hole). The results indicate that (i) the profile with round hole provide 14% higher outlet temperature compared to the profile with a square hole and (ii) the collector with higher heat transfer coefficient absorber plate would give higher outlet temperature.

Keywords: Solar energy; Transpired Solar Collector; Energy Performance; Hole Shape; Numerical modelling
Exploring Potential of Utilizing Smart Materials & Systems in Abu Dhabi, UAE

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Abstract: For centuries, materiality has been merely an element or part of building shelter, however, recently it became a major instrumental and contributor in the design of building’s façade. The new researches and investigations, that are exploiting and experimenting materials, has made architects to start considering the usage of these materials in new, innovative and unexpected ways and in different unconventional conditions and situations. Great deal of the newly advanced and developed materials shows a capability of directly and immediately reacting to different external conditions or to changes in climate, temperature, heat, light, electric field or movement by altering their physical or chemical properties or performing an energy exchange. “Smart Materials” is the term that has been continuously used to define and categorize these materials that have changing properties and can reversely modify their shape, color, elasticity or mechanical characteristics. These materials are of extreme importance for architectural envelopes since they help the building skin to continuously react and adapt to different environmental and climatic changes. This research paper’s goal is to exploit the true meaning of smart materials along with their characteristics and benefits. This paper will include an in-depth understanding of the several types and classifications of smart materials. In addition, this paper will provide an analysis of the weather and climatic conditions of Abu Dhabi, UAE, together with the different suitable climatic design considerations. It will also investigate on the effectiveness, permeability and the applicability of utilizing these smart materials in Abu Dhabi, UAE. As an epilogue and based on the information conducted within this research, summary and conclusion has been made.

Keywords: Smart Materials, Architecture, Sustainability, Climate, UAE
Chapter Five: Sustainable Urban Design
Paper 17

Outdoor thermal environment in Havana

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Abstract: Based on the Heat Island Effect, indoor environment is influenced by specific outdoor conditions in the urban context. Precedent research works carried out by the authors have intended to characterize the influence of morphology on Havana’s urban microclimate, based on a theoretical model and experimental field work, in order to find ways to improve outdoor thermal environment. The present paper presents a comparison between measured and simulated temperatures and the results from evaluating by simulation of outdoor thermal environments in some selected public spaces in Havana both before and after some transformation proposals.

Simulation were carried out with ENVI-met 4.0, and some corrections are proposed to get results that are closer to reality. The results obtained confirm the urban heat island effect and that it is possible to improve urban microclimate as well as indoor thermal environment, should some simple design principles be taken into account, when acting intervening in public spaces.

Keywords: Urban microclimate, urban heat island, outdoor thermal environment, ENVI-met simulation
Revitalizing Old Neighbourhoods of Cities contributes to their Sustainability and preserves their Urban Structure and Identity: A case study from Jordan (Jabal Amman and Jabal Al-Weibdeh Neighbourhoods)

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Abstract: In recent decades, the landscape of cities has changed significantly because of urban sprawl, which is usually accompanied by many serious problems including inefficient land use, high car dependency, low density and high segregation of uses.

This paper discusses the approach of “revitalizing old cities areas” as a challenge for transformation of cities into more sustainable urban structures that aims at minimizing the problems of city’s urban sprawl. The study adopts a descriptive-case study methodology to review the revitalization future strategies on two of the old attractive areas of Amman city (Jabal Amman and Jabal Alweibdeh neighbourhoods) considering the UN Habitat five principles of sustainable neighbourhood planning (efficient street network, high density, mixed land-use, social mix and limited land-use specialization) that support the three key features of sustainable neighbourhoods and cities: compact, integrated and connected. Both neighbourhoods (Jabal Amman and Jabal Alweibdeh) have unique urban characters rooted back to the Transjordan period in the 1920s - 1940s where they were the elite residence and accommodated the political activities of Amman.

The study focuses on the role of revitalizing Amman’s old neighbourhoods through discussing the following research questions: What is the emergent overall urban structure of Amman city today? How does it affect Amman’s old neighbourhoods? What is the anticipated future for revitalizing the old neighbourhoods of the city? and how will this affect Amman’s Structure, Sustainability and Identity in general?

Finally, the study comes into its “Conclusion” by putting the strategy of “Revitalizing Old Neighbourhoods of Cities” in its local and international perspective as one way of preserving the city’s sustainability as well as its traditional and cultural identity. The study recommends expanding the project of “Amman Downtown Plan and Revitalization Strategy” to include the two adjacent old neighborhoods (Jabal Amman and Jabal Alweibdeh) as they are considered as influential structures in Amman’s history and heritage. The reviewed UN Habitat principles in this study could be applicable to both neighborhoods and any future implementation and application of these principles on any of the neighbourhoods could be tested in further studies.

Keywords: Jabal Amman, Jabal Al-Weibdeh, UN Habitat five principles, Urban Revitalization, Urban Identity
The Role of Open Green Spaces in Improving the Quality of life in Residential Cities - An Analytical study of public parks in Greater Cairo

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**Abstract:** Public parks all over the world are considered natural respirator for the cities, in Greater Cairo they play a role in enhancing the social quality of life for residents where they help them to be more connected to the city. The paper aims at examining the relationship between the quality of public parks and the social, environmental and aesthetical quality of life for residents within the residential cities. Taking into consideration users' needs including aesthetic qualities, moral objectives, social interactions, and community development, a framework associated with the help of a questionnaire is proposed as criteria for evaluating the quality of open green areas, specially public parks in Greater Cairo, these criteria derived from the literature review then analysed thoroughly by global public parks as cases study, proved being vital in improving the quality of life of existing cities. Three public parks in Cairo had been selected as cases study; The International Park, the Giza Park, and the Family Park, all located very near to residential neighbourhoods. The findings assist in indicating that public parks in Greater Cairo are unable to raise the quality of life due to many design problems and lacking of some elements that need to be added in order to gain the adequate quality and enhance quality of life of residents nearby.

**Keywords:** Quality of life, public parks, users' needs, residential cities
Sustainable Vertical Urbanism as a design approach to change the future of hyper density cities
High Density & Not Highrise

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Abstract: This paper will mainly focus on introducing Sustainable Vertical Urbanism (SVU) as an approach for designing hybrid buildings and upgrading the public realm, making full use of the vertical dimension in hyper density cities. The article explores some more recent case studies of optimized quality density in US, Europe and Asia. The article set out to answer the questions since density is the key of sustainable urbanism, what are the drivers and different planning approaches in relation to establishing an optimal density? The article will analyse the outcomes of three different interviews done by the Author to specialists in the field of urban design, architecture design and construction developers. The aim of these interviews to study what is the ideal density model for tomorrows sustainable cities and explores how sustainable vertical urbanism could help us to create highly liveable, economical vibrant, mixed-use and resilient neighbourhoods of the future.

Keywords: Vertical Urbanism, Vertical public realm, City Vitality, Hyper density, Mixed use, Place making, new vertical Unusual functions
Paper 34

Exploration of Neighbourhood Public Parks’ quality: Users’ perception and Utilization pattern in Nigeria

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Abstract: Neighbourhood public parks are natural environment of rural areas for users’ leisure, recreation, psychological and physical comfort. Fewer studies have explored the users’ perception, utilization pattern and quality of public parks in Nigeria. Hence, this empirical study explores the quality of neighbourhood public parks in two rural areas in South-west, Nigeria. Users’ perception and utilization pattern were studied through appropriate documentation of the influence of the physical and spatial qualities of public parks. The 200 quantitative data were collected through the use of survey questionnaires at Ikogosi cold and warm spring in Ekiti state and Olumirin waterfalls, Erin-Ijesa, South-west, Nigeria. The study’s findings established through descriptive and regression analyses of SPSS software suggest: [1] the tourists’ perceptions on environmental sustainability on Ikogosi and Olumirin parks do not vary significantly among the tourists of diverse age groups, gender, education, length of residency, and frequency of utilization [2] the recreationist’ patronage/character and well-being do not vary significantly at the two recreational parks, while significant values were seen at the two parks in response to quality/aesthetics and maintenance /cleanliness respectively. [3] Parks’ quality and aesthetics, maintenance and cleanliness, as well as safety have shown to be significant predictors of the tourists’ utilization patterns. It is recommended that both the physical and the spatial qualities of the public parks studied needed further improvement in order to enhance the tourists’ needs and expectations. Aspects of parks’ maintenance, safety and the quality are recommended to be considered in the future planning, management, and design. This paper has contributed to filling the knowledge gap in areas of human and environment relationships towards promoting parks’ environmental sustainability in Nigeria.

Keywords: Public Park; Parks’ quality; Environmental sustainability; Tourists’ utilization pattern; Nigeria
Power, Transport Strategy, and the Environment: An analysis of the environmental discourse surrounding a proposal to develop a new park-and-ride facility for Bath

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Abstract: Park-and-ride (P&R) is a transport mode change parking facility, which abstracts car passengers onto public transport at the city periphery, reducing congestion and air pollution. However, this is a contested space, with environmental arguments used both in favour of and against such developments. This study interrogates the power relationships surrounding a proposed P&R facility in Bath through discourse analysis, illustrating how organisations and individuals used the power of various environmental discourses to affect the trajectory of the development proposal. The research was based upon Foucauldian discourse analysis, also borrowing from Flyvbjerg’s phronetic planning research. The primary data source was a transcript of Bath and North East Somerset Unitary Authority’s January 2017 Cabinet meeting, whose single agenda item was to choose between two greenfield sites in the World Heritage Site setting for a new P&R. Despite expectations that transport policy would be driven by business and economic considerations, forces for environmentalism, and for preservation of Bath’s green setting, proved stronger. The council struggled to engage effectively with opponents. Campaigners waged an effective campaign through professionalism, skilled networking, and expert use of new and old media. This case study provides support for developing a collaborative and transformational approach to policy making.

Keywords: Discourse analysis, phronetic planning research, power, environment, park-and-ride
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Setting contextual life-cycle objectives in urban design: requirements for a decision-support method

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Abstract: A variety of building labels and norms exist that set evermore-ambitious environmental and energy performance targets. In parallel, a growing number of building performance evaluation tools are adopting the life-cycle assessment (LCA) methodology to allow verifying if a project, based on its detailed description, reaches these targets. However, such norms and tools seem unsuited to the district scale, where environmental impact considerations are often left out of the urban planning and design process. There specifically appears to be a lack of decision-support instruments that can relate urban-scale performance targets to concrete design choices, taking into consideration the project’s specificities (e.g., climatic context), but without requesting design information that is not yet available. This paper presents the first phase of a collaborative research and development project, aiming at developing a novel decision-support method to integrate life-cycle objectives from the masterplanning stage. In this first phase, we investigate barriers and requirements from a practice-oriented perspective in the Swiss context by: (i) exploring urban-scale LCA-based methods and tools, and (ii) engaging with key stakeholders who hold complementary roles in a case study district project, which aims to be low-carbon. These exchanges are conducted in the form of a focus group and a questionnaire to gather qualitative and detailed information. Our findings notably highlight the mismatch between the ambitious objectives set by regulations and labels and the (lack of) means available to practitioners to support them in achieving these objectives. Specifications for a novel tool are derived from the practitioner’s feedback, as well as information on relevant design parameters and performance indicators.

Keywords: Life-cycle assessment, building environmental performance, urban planning and design, user requirements, environmental impact targets
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Intermediate urban regions role in improving informal areas in Egypt. Case study of Boulaq Ad-Dakrour

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Abstract: The informal areas are increasing significantly, especially in developing countries, affecting on economic and social life aspects in adjacent urban community that creates an inter-region area between formal and informal settlements with an urban characteristics to qualify it to be an economic center serving its surrounding areas, reducing urban poverty and absorbing the migration movement to urban centers.

The research aims to study the intermediate urban regions and their important role in improving and preserving surrounding areas in the urban areas or developing and upgrading the informal areas, which aims to find and introduce new framework for developing informal areas based on multi-dimensional aspects by activating the role of the intermediate regions for a sustainable urban progress.

We have found a way, which we believe is the first of its kind, to accurately analyse the intermediate region status in great Cairo, Egypt, setting an upgrading system as a development centre point for its surrounding within a specific legislative executable collaborative framework for the region. The paper suggests a conceptual framework for achieving an affective sustainable intermediate urban region, indeed, it can help in minimizing the informal areas growth with the focusing on multi-dimensional aspects such as economic, administrative, social and urban aspects.

Keywords: Intermediate urban regions, inter-regions, adjacent area, Egyptian informal areas, Boulaq Ad-Dakrour.
The Impact of modifications to residential morphologies on the outdoor microclimate in hot dry climate cities

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Abstract: In 1991, the Iraqi Kurds established an autonomous state of Iraqi Kurdistan and has flourished in stark contrast to the remainder of Iraqi and Syria. The capital of Kurdistan is the historic city of Erbil; the city has expanded dramatically since 1991, in a series of concentric rings around the central Citadel, to accommodate Iraqi Kurds from both Iraqi and the returning diaspora.

The rapid urban expansion has moved away from using the principles of design in a hot dry climate, the traditional organic designs of narrow, winding streets. This organic morphology has been superseded by a grid iron planning grid, with street widths designed to accommodate motor vehicles. The alignment of these grid iron street patterns has been driven by geometry rather than referencing urban micro climatic needs and has increased energy demands.

Recent developments in urban climatic modelling have enabled researchers to investigate the impact of urban morphology on the urban micro climate. ENVI-met, a holistic three dimensional hydrostatic model has been used by researchers to investigate urban micro climates.

This paper uses ENVI-met to predict climatic variables in the modern grid iron urban pattern of Erbil, focusing on the prediction of Dry Bulb Temperature, Mean Radiant Temperature and wind speed. These predictions were compared to weather stations located in the urban development of Erbil, in common with other researchers, good agreement was achieved during the day light hours, less so during the night time. Using ENVI-met the orientation and street canyon widths have been investigated to achieve the highest wind speeds around buildings. These higher wind speeds can be utilised to increase natural ventilation of buildings, this will decrease the need of mechanical cooling leading to a reduction in energy consumption and will lead to more energy efficient designs.

With low rain fall and very limited water service provision, a blue/green environmental strategy was not possible. And due to limited possibilities to manipulate the urban street canyons to provide shade, meant that the possibilities of reducing the Dry Bulb Temperature and the Mean Radiant Temperature were restricted.

To reduce the Mean Radiant Temperature the use of external mesh shading was explored. This reduces the sky view factor and therefore limits solar gain. The ENVI-met climatic model demonstrated significant reduction in the Mean Radiant Temperature.

Keywords: Urban Microclimate, ENVI-met validation, Modification urban morphology, Shading meshes, Mean Radiant Temperature.
Explo\'ing sustainability in providing low-cost housing in Khartoum- Sudan

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\textbf{Abstract:} The Sudanese housing policies encompass two main types of programs. The first one addresses the needs of all sectors of the population for the provision of plots through site and services schemes. The second type provides small built core units (Incremental housing) for the low-income groups. The aim of the paper is to examine the evolution of sustainable design of the core units built by the public sector for low-income families. The research selected some low-cost housing projects provided in different periods of time e.g. Duim project _1949, El shabiya project _1963, Al Iskan Project _1975 and state fund projects _2001 as case studied. The analysis focused on four parameters: the size of the project, the target group of inhabitants, the design of the core unit and the construction including building materials and technologies, these parameters are compared to U.N. Habitat principles of sustainable housing. The research found that old projects had comprehensive approach including socio-\_economic surveys of the intended inhabitants, while new projects put more emphasis on quantities of built units than on quality of housing. Former projects used cheap traditional building materials and technologies which is more sustainable than the expensive imported materials used in new projects. The research identified the introduction of mixed housing of different income levels in new projects that guaranteed social sustainability.

\textbf{Keywords:} low-cost housing projects, sustainability, core-unit, building materials and technologies
Social Shifts - Living in Gated Communities: A Case of Andalucía, Jordan

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Abstract: In global surge of neoliberal urban restructuring and emerging forms of spatial ordering, Amman stands witness to isolated urban development. Upper-end residential gated communities are faced with as much controversial debate as do their global counterparts. For some, they represent icons of post-consensus, fragmenting civic society, enclosing and excluding by walls and gates. For others, they are an efficient way of organizing urban development. Contested are issues and values of integration versus fragmentation, public versus private, inclusion versus exclusion, actual insecurity versus perceived insecurity. Andalucía is the first and one of few gated communities to be found in Jordan.

This research aims to investigate inhabitants’ motives for deciding to live in the gated community of Andalucía, Amman. Relating to factors established as reasons for making the decision to live in gated communities, the paper employed a survey research design investigating the agreement of motives with such factors. A structured questionnaire was administered in the context of face-to-face structured interviews. The total sample size was 100 subjects. The study hypothesized that the decision to live in a gated community is motivated by a set of factors including: security, privatization, prestige, lifestyle, and economic feasibility.

Results indicated significant effects for the following factors: total governance and total prestige. As well as significant effects for the following subcomponents: governance of landowner committee, governance of infrastructural services, image and exclusivity, supporting sense of community, and provision of amenities. The interactive relationship for the set of variables with decision to live in a gated community was reported significant. Contribution of each variable to the interactive model was only significant for total governance. The order of strength of contribution to the model from highest to lowest as follows: Total Governance, Total Economic Feasibility, Total Security, Total Prestige, and Total Lifestyle.

Keywords: Gated, Community, Jordan, Social, Shifts
The Sustainable redesign of existing buildings in Greece: The case of existing, typical residences

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Abstract: Residential buildings in Greece form an important part of the existing building stock. Furthermore, most of these buildings were built prior to the first Thermal Insulation Code of 1981. The present paper focuses on existing, typical residences built after 1920, which are found mostly in suburban areas and settlements all around Greece and tries to evaluate the effect of simple bioclimatic interventions on the improvement of their diurnal, inter-seasonal and annual thermal performance. The applied strategies include thermal insulation of building shell and openings, and shading and natural ventilation for the summer period. The study was performed within the framework of the 6th semester undergraduate course of “Special Topics on Environmental and Bioclimatic Design” in the NTUA, School of Architecture. The course attempts to educate students on assessing the thermal characteristics and performance of existing buildings and then propose and quantitatively evaluate the effect of low-tech and low-cost interventions with the use of energy simulation software. The results of the study are two-fold and involve the assessment of simple bioclimatic interventions to existing buildings’ energy performance and thermal comfort conditions on one hand and the teaching outcome of the course on the other.

Keywords: Greece, Typical residences, Existing buildings, Bioclimatic upgrade, Thermal modelling
RESILIENCE OF MEGA PROJECTS: A STUDY OF SOCIAL RESILIENCE IN LOMBOK INTERNATIONAL AIRPORT SURROUNDING AREA

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Abstract: Development of Lombok International Airport has resulted a transformation not only in the land use of Lingkar Bandara (area surrounding the airport), but also the livelihood of the villagers who live there. Located in agricultural land whereas the main occupation of local population are mostly farmers, the airport has brought service-based industry occupation which the local population need to adapt to. While development of the airport has brought positive economic growth, and infrastructure development, the transformation also generates friction and conflict of interests between stakeholders. Therefore, while development focuses more on economic and spatial planning, this study will assess social resilience against gentrification which is the ability to cope, adapt, and build positive transformation from the development of the Lombok International Airport. From the study, author finds out that the level of social resilience of Lingkar Bandara community are quite low. The conclusion was based from data collection from field works which fulfil social resilience three categories: coping capacity, adaptive capacity, and transformative capacity. Although the level to cope with the development is quite high by maximizing their informal network, the community level of awareness, and preparedness towards the possibility of gentrification is really low. Furthermore, high level of adaptation of local community results in disturbance to airport’s development and operation. Lastly, low level of building a positive development is low due lack of participation and communication between stakeholders which would jeopardize long-term economic gain from the airport development.

Keywords: Social resilience, sustainable development, rural development, mega project, airport development
Urban Regeneration to Reclaim Sustainability in Cities: The Case of Down Town Riyadh, KSA

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Abstract: As a result of rapid urbanization in developing countries over the past 20 years, cities have experienced massive growth beyond their traditional downtowns. In the case of the Saudi capital Riyadh, the expansion of the city and the emerging of new modern centres had caused the central downtown to lose its former role and to fall into a state of decline. In 2013 a new plan was introduced for a regeneration project in this area, with the goal of its revival and transformation into a national, historical, administrative and cultural centre. In order to understand this plan in terms of its contribution to sustainability, this research conducted an analysis based on the application of sustainability indicators from the International Sustainable Building Tool for Urban Planning. Results of the study demonstrated how plans were successful in accounting for most sustainability indicators. However, few essential issues were not considered and were highlighted as well. The study showed the significance of sustainability indicators as a methodology and how they can be an effective tool for driving successful science-based urban planning to inform decision making processes in a city.

Keywords: Sustainable development, urban regeneration, Sustainability indicators, Riyadh City.
Walkability as an Urban Indicator for a Sustainable Built Environment

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Abstract: As environmental problems became global in scale in late 1990’s, sustainability became a widely used term. Although there is a consensus about why environmental problems occurred and how cities can become sustainable again, there is not any evaluation method that objectively measures sustainability. As objective criteria, urban indicators were developed aiming to ensure a great base for evaluating the sustainability performance of built environment. Since their emergence, more than 700 urban indicator metrics were developed but still there is no urban indicators metric available in global standards. Even all metrics differ in terms of their concept and scope, the common ground of all is that the indicators are shaped around three main aspects: environmental, economic and social.

It is also accepted that being dependent on private cars due to the unrestrained growth in cities, people tend to walk less. In other words, walkability quality of urban started to become impoverished. As walkability started to be discussed within the architectural media, it has been thought as one of the most important aspects that makes cities sustainable.

In this study as literature review, the general properties of urban indicators and how they can serve for a sustainable and better built environment are defined. Afterwards, how walkability can contribute to these indicators or in which part walkability can be involved in these indicators are discussed. It is resulted that walkability is one of the most important indicators that can be listed both under environmental, economic and social aspects of sustainable built environment.

Keywords: walkability, urban indicators, sustainability, built environment
Reconsidering the Design of Urban Communities in the Hot Arid Regions of the Middle East: The Search for More Relevant and Sustainable Urban Guidelines

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Abstract:
The urban fabric of cities located in hot, arid regions across the Middle East has changed drastically in recent years. A lack of planning and urban design guidelines has led to sprawling cities suffering from pollution, a lack of green space, dilapidated infrastructure, congestion and high population density. Response to these critical issues has simply centred on design practices that create more new, gated communities. These gated communities implement models that are alien and unsustainable in this region and fragment the urban fabric of the society. There is an increasing need to consider more relevant and sustainable solutions for the design of new settlements that build on the heritage of the region and objectively respond to the present circumstances.
This paper aims to establish a series of design guidelines from which can evolve a more relevant and sustainable way of living in this urban context. Therefore, historic cities of the region were studied and analysed with the intention of interpreting emerging principles in way relevant to the contemporary urban context.
This comprehensive, comparative analysis was the basis of a set of design guidelines that could be relevant for future development in this region. Furthermore, these principles will be tested through a schematic, master plan design for an urban settlement located in New Cairo. The project presents an alternative to current urban practices in the region and will hopefully inspire others to consider a new approach to urban design in the hot arid regions of the Middle East.

Keywords: Sustainable urban design, Traditional settlements, Hot arid regions
The Interrelationship Between Urban Mobility, and Urban Form

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Abstract: Throughout human history, urban development of cities has become one of the most important phenomena that accompany the general development of human life on the planet. From this perspective, it is important for the urbanists to constantly revisit, review, and develop the principles of urban development in an innovative way. Neighbourhoods are the main ingredient of the city. Developing existing neighbourhoods and building new ones requires great care because of its direct impact on city form in terms of sustainability. As reducing greenhouse gas emission and rationalizing energy consumption are objectives of sustainable development and new trends in urban design depending on strategies of sustainable mobility and transportation systems which considered as governing factors to achieve those goals. Reducing private car reliance on travelling within the neighbourhood is a key strategy. The paper aims to understand the patterns of mobility within modern neighbourhood to enable urbanists to develop an adjacent shape commensurate with sustainability requirements for through documenting and analysing the interrelationship between patterns of mobility, transportation means and the urban form of New-Cairo’s neighbourhoods. In order to establish a clear understanding of the behaviour of residents in relation to patterns of mobility to assess the opportunities that urban form can provide to reduce reliance on the private car and enhance relying on green transportation such as walking, and cycling. The paper begins with an overview of the concept of urban mobility. The paper followed the post‐positivist paradigm (quantitative paradigm) with correlational strategy and multiple case studies with literal replication as research design. Primary data obtained through questionnaire prepared for a representative group of middle-class and upper-middle-class who chosen at random from inhabitants of New‐Cairo. The paper confirms that urban design has its direct impact on mobility patterns and transportation. The conscious urban design has its direct impact on sustainability.

Keywords: Urban Form, Urban Mobility, Pattern of Mobility, Sustainable Neighbourhood, Sustainable Transportation
IMPACT OF URBAN MORPHOLOGY ON MICROCLIMATE IN HOT DRY ARID CITIES: A STUDY IN CAIRO, EGYPT

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Abstract: Scientists are certain that the global warming is mostly being caused by human activities. Hotter microclimate is known as Urban Heat Island. Urban microclimate is an effective issue on the local and global climates which is influenced by urban morphology. Several literature propose different attempts to improve microclimate that could be achieved through planning a reasonable urban morphology. Unfortunately, modern cities in Egypt does not consider proper urban design principles reaching to hotter Microclimate. Cairo’s urban form features Wide Street, Low rise building, and Low density of buildings; as a result, shaded areas in the streets are scarce. The aim of this research is to confirm the influence of urban morphology on Microclimate. This research investigates the effect of different urban parameters (HEIGHT-WIDTH RATIO, STREET ORIENTATION, BUILDING SPACING, and VEGETATION) on microclimate in the residential area in new Cairo. Numerical simulations, using ENVI-met program, were performed for a hot summer’s day in Cairo for a street canyon. Analysing the effect of modifying the selected urban parameters on Microclimate. Study results indicate that the urban morphology impacts the urban microclimate. The study reveals that street width to building height ratio, vegetation, and orientation have a beneficial impact upon microclimate.

Keywords: Urban Morphology, Microclimate, Arid Climate, ENVI-met
Ward-wise Planning and Distribution of Parks and Gardens Using Network and Spatial Analysis, Case Study of City of Indore

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Abstract: The high rate of urbanisation in the developing countries has led to a rapid increase in the percentage of urban population making it difficult for cities to accommodate more inhabitants. In order to sustain this large and increasing urban population, infrastructural provisions in the growing urban centres becomes exorbitantly important.

Parks and Gardens (Public open spaces) can be seen as a crucial element of the urban infrastructure that have an immediate effect on the quality of life of the people. This significance of public open spaces needs to be understood by cities of developing countries to make the cities more liveable. This thesis deals with forming a distribution network of parks and gardens using ArcGIS so as to make the cities more liveable, environmentally sustainable and also reduce urban heat. The aim of the study is to use network analysis and spatial analysis to work out the distribution of parks and gardens around the city to improve accessibility.

The research methodology includes classification of parks and gardens into hierarchy based on area as per URDPFI guidelines in India, Selection of ward for study, network analysis (on ArcGIS) for analysing accessibility of parks, Spatial analysis (on ArcGIS) to identify potential areas for location of new parks.

The final result of the study includes provision of distributed and accessible network of parks across the city, identification of deficit areas in terms of availability and quality of parks and provision of new parks where required.

Keywords: Open spaces, Parks, Gardens, Network Analysis, Spatial analysis, Ward/Administrative divisions
Simulation Study on the Environmental Sustainability of Traditional Blocks in Xi’an City

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Abstract: Urban climate change and its impacts on living environment have become an important issue with the high-speed and large-scale urban development in most Chinese cities. The urban micro-climate affects the citizens’ living comfort and safety, which is strongly related to urban typology. Meanwhile, the traditional old blocks are the valuable historical urban components in Xi’an, a historical Chinese city. The balance between renewal and environmental improvement of old urban blocks have attracted significant attention in urban renovation, thereby indicating the need to study and improve the thermal environment in such urban areas. This study aims to reveal the relationship between the old urban block planning and current environmental conditions in Xi’an to develop a guideline for urban renovation in historical districts. Shuyuanmen District in Xi’an with a 300-year history is selected in this study. Urban environmental simulation program ENVI-met is used for simulation and evaluation. Solutions, such as the adjustment of building facade and open space planning and the addition of urban vegetation, for promoting urban thermal environment and urban convenience are simulated and evaluated. Moreover, a development method for the guideline to balance the living convenience and thermal environment in old urban blocks is proposed. The urban environmental simulation helped to indicate the specific locations need to be promoted, helped to revise the proposed solutions in the design step. This study contributes to sustainable urban planning in historical districts and provides recommendations for related policy development.

Keywords: environmental sustainability, traditional block, urban renovation, thermal environment.
Comprehensive Evaluation of Spatial Texture in Historic District: The Case of Sanxue Street Historic District

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Abstract: The protection and planning of historic districts is an important topic in urban development in recent years. To a certain extent, historical districts remain unchanged as times goes, in another word, they show us a picture of what the city looked like long times ago. With the development of the city and the changes in the way of life, several problems appeared in the historic district such as poor building quality and poor living environment. In my opinion, the spatial texture characteristics in historical districts are important factors affecting architectural function and living quality. Based on preserving the cultural value and community vitality of historical districts, the scientific analysis of the spatial texture of the districts is an effective way to improve the residential quality. In this paper, I use space syntax and ENVI-met software to analysis the spatial value and environmental value of Sanxue Street historical district. By integrating the spatial texture characteristics and microclimate characteristics of different regions in Sanxue Street historical district, I put forward several regional function suggestions and regional development directions to better protect and use this area.

Keywords: Historic district, spatial texture, spatial syntax, microclimate
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PUBLIC RECLAMATION OF BRIDGES, THE CAIRO CASE

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Abstract: The notion of city making, derived from the traditional top-down planning methods and predicting activities to occur in certain places designed to accommodate them, is insufficient to deal with the complexities of everyday life practices taking place in urban spaces. Citizens’ interventions that do not follow the planning regulations such as street vendors’ encroachments, appropriation of bridge’s sidewalks, and using spaces under bridges result in changes in the nature of public space accompanied by a wide range of grassroots struggles. The phenomenon of the unplanned use of public space known as insurgent public spaces is widely spread gaining tons of academic interest. It is crucial to understand the insurgent settings to achieve sustainable vibrant urban spaces. Cairo’s infrastructural networks, especially bridges, play a vital role in the struggles taken part by community to reclaim public space.

The aim of the paper is to investigate the phenomenon of informal use of bridges as insurgent public spaces in Cairo. A conceptual framework drawing on the notion of insurgency and informality will be applied to the case study for analysis. The case study mainly comprises of qualitative data based on direct observations and interviews. In conclusion, we discuss the physical, economic, social, cultural, and legal aspects behind the emergence of these insurgent spaces.

Keywords: Insurgent public spaces, Bridges, Cairo
Towards Place-Based Social Innovation Frameworks: Tools and Technologies

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Abstract: The paper concentrates on tools and technologies used for participatory processes in the context of sustainable urban planning and design. The paper aim is to explore and present how some recent tools and technologies are used to inform policies, strategies or overarching concepts for engaging stakeholders to work toward a common vision for change in their community. The capabilities of Scotland’s Place Standard tool, BREEAM-Communities assessment tool and the Smart City technologies that enable co-production in urban planning and design are analysed through literature review. The Akitivnyi Grazhdanin, a citizen engagement portal was established to devolve decision-making on aspects of Moscow’s smart city programme to citizens, provides a case study on the potential use of Smart City technologies to solicit citizens’ views on the city management and transformation. The paper discusses the impact of those tools and technologies in terms of supporting place-based collaboration, citizen engagement and participation, and their value to providing for an open and iterative design process. The research highlights the strengths and weaknesses of the analysed tools and technologies. In conclusion the paper makes recommendations as to how frameworks can best be shaped by such tools in order to achieve local ownership, and provide structure to a more inclusive development and sustainable urban design. Finally, the paper gives a high-level indication as to the next stage of planned research.

Key words: social innovation frameworks, engagement tools, smart city technologies
A Systematic Mapping Analysis to Guide Research on Comprehensive Life Cycle Assessment at Neighbourhood Scale

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Abstract: Urban settlements are not only bulk resource consumers, but also responsible for impressive loads to the immediate and global environments. As pollution, resource scarcity, climate change and extreme poverty are expected to worsen, sustainable urban planning approaches that regulate a balanced view of future developments must be increasingly consolidated. ‘Lifecycle thinking’ offers powerful and comprehensive conceptual approaches and methodologies to include sustainability solutions into city design, but applying such paradigm into urban contexts needs proper tools for accounting and defining sustainability measures and thresholds. Neighbourhoods represent both the minimum scale to consider urban spaces socio-economic dimensions and the typical operational scale for urban development projects. Assessments at this scale, therefore, offer an important complexity compromise. However, there is no consensual scientific approach for carrying out comprehensive life cycle assessments (LCA) at the neighbourhood scale. This paper aims at making a bibliometric analysis of existing literature and explores consistencies, limitations, challenges and research gaps on the topic to shed some light for future research. A systematic mapping analysis was performed in 1216 papers collected from all years and main databases, and relevant information was extracted and analysed from the 91 final sampled papers. Results show a publication spike from 2012, confirming the renewed interest in the subject and the scale; the main research groups, countries and journals investing in the theme and their different approaches; main challenges for applying LCA at neighbourhood scale; and the main research gaps, such as: the need for methodological choices standardization; the need for broader studies (comprehending more built environment components); the need for consequential studies; the lack of data and uncertainty analysis; among others.

Keywords: Comprehensive Life Cycle Assessment, Life Cycle thinking, Neighbourhood Scale, District Scale, Urban Metabolism.
Urban Social Sustainability in the Era of Digital Technology: the case of NEOM, the World’s Future Global Hub across Three Countries

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Abstract: In October 2017, the launch of the mega city of NEOM has been announced, covering 26,500 km² of land in Saudi Arabia, Egypt and Jordan: a strategic location along one of the world’s most prominent economic arteries (the Red Sea), making it a global hub for trade, innovation and knowledge. As per http://discoverneom.com, NEOM focuses on nine specialized investment sectors: energy and water, mobility, biotech, food, technological and digital sciences, advanced manufacturing, media, entertainment, and liveability.

We think that NEOM demonstrates a new way of urban development that is closely related to sustainability principles and to the era of digital technology. In fact, it is a phenomenon that deserves observation, research and analysis. However, in many cases, the debate on urban sustainability has mainly focused on environmental and economic factors, often neglecting essential social aspects. The main focus of this paper is to examine how urban social sustainability could be achieved in NEOM alongside new urban development practices in the era of digital technology.

The paper starts out by defining and delineating a framework of urban social sustainability, with its key dimensions. It then moves on to the analysis of NEOM’s planning principles and design concepts, tackling its nine sectors and examining their relationship with urban social sustainability and liveability. At the end, recommendations for creating and maintaining a rich social life within NEOM’s urban spaces are suggested, showing how new urban planning practices in the era of digital technology should enhance equity, community and urbanity.

Keywords: Urban Social Sustainability; NEOM; Social Inclusion/ Cohesion/ Resilience; Social Exclusion; Pre-Urban Gentrification
Sustainable Urban Design Patterns in Arid Regions and its Comparison with Modern Patterns: the Case of Riyadh City

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Abstract: Saudi Arabia has witnessed a great development boom over the last few decades as a result of the oil discovery. This development boom has led to many environmental, social and economic changes, some of which are positive and others are negative due to not taking into account the specific characteristics of arid regions. Indeed, the current development manner has changed the urban pattern in many cities as a result of importing foreign urban patterns that are not compatible with the local conditions of these areas. Some argue that this was a natural consequence of the steady increase in population and rural-to-urban migration to obtain better livelihood opportunities in the large cities. However, in this paper, it is argued that when thinking about making the desert, which constitutes the majority of the Arab lands, a suitable ground for accommodating urban expansion, this is done only by studying the characteristics of the desert environments and studying what suits them from the urban patterns. The aim of this paper is to investigate the urban pattern of arid regions, and selected is Riyadh, the capital city of the Kingdom of Saudi Arabia, as a sample of these areas which is characterized by special climatic conditions. Additionally, the current urban pattern in Riyadh was investigated and compared with the traditional one in the past in order to highlight the best practices to deal with such environments and can be applied globally with some adjustments. The study shows that more research of the concept of urban development in the arid regions is needed to be carried out.

Keywords: Desert areas; arid regions; compact planning; urban pattern; Kingdom of Saudi Arabia; Riyadh.
“Contextual Urban design approaches – Sustainable Built Environments.”

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Abstract:
UN 2018 report says that 55% of the world’s population lives in urban areas, a proportion that is expected to increase to 68% by 2050. With present hegemony of global development framework is a concern; as majority of the built mass is to be built in developing countries. Such an approach has created vast building stocks largely not in sink with the local geographies /ecology. Driven by capitalism they are built for financial gains to benefit a selected few and more often, not within the reach of masses. The global architectural vocabularies of glass façade buildings are high on energy consumption and such built environs being built and continuing shall have a huge impact on climate change and thereby sustainability.

Interestingly most of global south especially Asian cities have backdrop of developments that are centuries old and have sustained except for the nature of development in the recent past. Typically each of these urban developments is strongly under pinned by the local cultures that have evolved over centuries are inherent to the local resources for all pillars of sustainability. Thus at this point in time it may be worthwhile to reexamine these urban design approaches that vouched for an application of nature’s law and patterns of systematic socio-cultural reinforced by religion using indigenous practices with regenerative economies that are distinctive and robustly contextual. The aim of the paper is to examine a typical contextual urban design approach that is sustainable and climatic responsive; characterized by an archetypal built morphology resilient to contextual socio-economic and environmental framework. The expected outcome of the paper is to bring on table a case study of typical contextual approach that thrived for centuries and responded to all pillars of sustainability for almost three centuries and continuing.

Key words: Urban design approaches, context, Sustainability, Climate change and Jaipur city.
Abstract: Cities all over the world are suffering from various chronic and severe problems which are related to fragile economic development, poor infrastructure, environmental degradation, climate change, human capital as well as social segregation and polarisation. Most of these complex problems are interwoven to the city's urban fabric that later cause non-equilibrium to the urban systems. Accordingly, a robust governance system is needed to untangle the complexity of all those challenges then effectively manage the city's urban systems. This paper aims to fill the theoretical and practical gap of urban resilience which is known for its complexity and multidisciplinary. A case study of Nuweiba in South Sinai, Egypt, is selected to come out with a city resilience framework. This framework aims to regulate the relationship between the local community and local authorities in order to move towards a more resilient state. The study in this paper is divided into three parts: The first is understanding the concept of resilience as well as the context of the chosen city, the second is analysing the dynamics and the driving forces which led to changes in the city seven capitals, while the third part is concerned with the assessment of responses towards the changes in city capitals to spiral it up for development.

Keywords: urban resilience, integrated planning, resilient cities, integrated sustainable development
Chapter Six: Thermal Comfort, Health and Wellbeing
Thermal comfort conditions and air quality in educational buildings in Cyprus during the heating period: the impact of natural ventilation

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Abstract: This paper aims to investigate the indoor comfort conditions in a typical classroom of a secondary school in Cyprus and explore the impact of natural ventilation on both thermal comfort and air quality. Natural ventilation is a significant parameter in the design of school premises as it affects human comfort conditions and thus students’ health, learning ability and performance. Within the frame of the present study indoor and outdoor environmental conditions were seasonally monitored. Various ventilation strategies and window opening patterns were examined in order to identify the best option to exploit natural ventilation as a means to achieve optimum air quality, especially during wintertime. The in-situ measurements of temperature and relative humidity were analysed in correlation with CO2 levels. Data was collected during both occupied and unoccupied hours. The measurements indicate values that often exceed the limits defined by standards. Moreover, the study shows that selected ventilation patterns, and window opening patterns, allow the improvement of air quality with minimum heat losses in wintertime. Conclusions present potential improvements in achieving better air quality and thermal comfort conditions. Educational buildings in Cyprus may utilize the proposed improvements, as well as other similar buildings in southern Europe, with climatic conditions and building typologies in educational architecture as those described in the Cypriot setting.

Keywords: thermal comfort, air quality, natural ventilation, educational buildings, Southern Europe
Assessing Energy use and Overheating risk for Retrofitting A Residential Tower Block Prototype in Northern Cyprus

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Abstract: This study evaluates the energy performance of a residential tower block (RTB) development in Northern Cyprus in providing thermal comfort for its occupants. Severe summer temperature conditions in the coastal city of Famagusta includes significant daily oscillations in air temperature (14°C-45°C) and high levels of solar radiation, which contributes to the overheating of thermally inefficient building envelopes. Notably, 43% of the domestic buildings in Northern Cyprus are RTBs. As could be expected in residential buildings located in a hot and humid climate the cooling and heating comprise the largest part of the total energy consumption (73%). The aim of this is to investigate the applicability of passive design elements for the case study using three representative residential tower blocks (RTBs) each representing a different orientation (south-west, south-east and north-west). The research adopts a ‘quantitative’ research design; primarily building performance evaluation using modelling and simulation. The selected three RTBs are modelled using Integrated Environmental Solutions (IES) software where extensive dynamic thermal simulations have been produced to test passive design measures applied to improve thermal comfort and energy performance. This paper presents an analysis of the thermal performance of the three RTBs before different retrofit scenarios are applied to optimize the buildings energy performance and occupants’ thermal comfort. According to the results of the dynamic thermal simulation, cooling energy consumption saving of around 81% are achieved. The findings demonstrate the necessity to consider passive design strategies for effective retrofitting of existing RTB developments in Northern Cyprus.

Keywords: Building performance evaluation, Dynamic thermal simulation, Overheating, Thermal Comfort, Retrofit.
Retrofitting improved environmental performance in refugee housing in Jerash 
Refugee Camp Jordan

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Abstract: Jordan is the second largest refugee host country in the world per capita. Around fourteen Jordanian refugee camps have transitioned from emergency shelters to permanent settlements, with Jerash Refugee Camp being one of the oldest and most deprived camps. The current housing in the camp is believed to be responsible for thermal discomfort and illness to its inhabitants. This study examined a retrofit strategy to improve occupant’s thermal comfort and indoor environment. Following a site visit, one house was selected and modelled digitally to represent a typical dwelling in the camp. This served as the baseline case against which to test the effectiveness of applying different several retrofit passive strategies, such as thermal insulation, natural ventilation, window size and passive heating, on the levels of indoor thermal comfort and indoor daylight quality. An epw weather file generated by Meteonorm for the camp’s location was used with the dynamic modelling software DesignBuilder, and PMV thermal comfort levels were analysed. Very low daylight levels in the house add to the poor environment and so daylight levels were evaluated using the Revit plug-in for Sefaira software. The results of the simulations showed that the proposed strategies did have an impact on the indoor thermal comfort values, especially the addition of thermal insulation to the building’s external envelope. The proposed passive strategies resulted in a shift in the hourly and daily-recorded PMV values to within the acceptable comfort range and an increase in the average daylight factor from 0.07% to 0.95%. The approximate cost estimation of the proposed retrofit strategy is around 21,243 JDs.

Keywords: PMV values, Thermal Comfort, Retrofit ,Design Builder, Sefaira , Longterm refugee settlements
Field Studies on Thermal Comfort Environment in Building Transitional Space

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Abstract
Transitional spaces have been widely applied in building designs nowadays, which are presented in the form of atria, lobbies, corridors and covered streets. As they have become common features, they account for 10-40% of the total volume of a building. However, maintaining an acceptable thermal comfort within transitional spaces poses challenges to building designers and engineers, as thermal discomfort has been revealed in such spaces of several newly constructed buildings. This paper aims to investigate the thermal environmental performance and people’s adaptive comfort in building transitional spaces by conducting field studies. On-site questionnaire surveys and physical measurements, were carried out during the summer period of 2017 and the winter period of 2018 in three selected case buildings in Cardiff, including The National Assembly for Wales – Senedd, Hadyn Ellis Building and Royal Welsh College of Music and Drama. The total responses collected from the questionnaire surveys during the summer period and the winter period were 736 and 580 respectively. This paper first presents the findings from the field studies. In-depth investigations on the human adaptability to thermal environment were then conducted, which identified strong correlations between the clothing value and the indoor operative temperature of transitional spaces. Regarding the open question on actions that people would take to overcome uncomfortable situations, nearly 80% of the respondents opted for self-adaptive actions when facing uncomfortable situations. The research work concluded that a fine control on indoor temperature for maintaining acceptable comfort level within building transitional spaces is not necessary due to people’s adaptability to thermal environment.

Keywords: Transitional spaces, thermal comfort, field studies, questionnaire survey, adaptability
Paper 144

Investigating resident experiences of a sustainable social housing development in the composite climate of Delhi

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Abstract: The Government of India aims to construct 12 million social housing dwelling units through the Housing for All by 2022 programme. It is vital to identify what the impacts and benefits of housing production at such a massive scale could be. This is no easy task in an inherently data poor environment. This paper describes the methodology and learnings from a field survey of 149 residents in a social housing development for local industry workers in Delhi, constructed using modular perforated bricks and flyash. The purpose of the resident survey was to gather subjective feedback from residents about their perception of the indoor environmental conditions (indoor temperature and air quality) in their homes during summer and winter using a rating scale. The survey results showed that residents perceived indoor temperatures in summer to be much more unsatisfactory than in winter. Only 12% of respondents rated their indoor conditions as ‘satisfactory’ in summer, whereas the same proportion rated it as ‘unsatisfactory’ in the winter. This indicates the inability of the dwelling units to provide comfortable indoor environment in the summer (in absence of air-conditioning). However in winter, higher levels of adaptation occurs wherein residents resort to warm clothing and blankets, along with a reduced heat loss due to small size/exposure of the dwelling units. Air inside dwellings was perceived to be still by one-third of occupants, though still air was desirable in winters. The lack of cleanliness and absence of maintenance regime was also evident from garbage accumulation and water logging in the open areas and along the streets in, and around the development, resulting in unhygienic living conditions. The study is part of a United Nations funded research project on mainstreaming sustainable social housing in India.

Keywords: Economically Weaker Section (EWS), social housing, householders’ survey,
Paper 201

A design-based framework for preventing accidents to workers in Indian construction workplace

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Abstract: Accident rates of construction industry in India is highest among all other industries, affecting macro to micro level projects and needs a comprehensive tools to prevent accidents to construction workers among all levels of projects. As like other countries, different initiatives were launched by Indian government to improve safety on Indian construction workplace, but still face poor safety outcomes. According to experts’ survey, it was found that design has the major impact on health and safety in construction projects. From researchers’ point of view, it was deduced that design can help to prevent risks and hazards associated with construction projects. Prevention through design (PtD) is an occupational health and safety approach which prevents or reduces the hazards in construction workplace by addressing workers safety in the design phase of the projects. The purpose of this study was to develop a framework for preventing accidents to workers among construction industry in India. Through literature survey, accidents data was determined for the desired framework and by reviewing literature, a comprehensive tool to prevent accidents to construction workers was determined. It can be expected that the developed framework from this study will be benefit to Indian construction stakeholders for improving their own safety performance. Further, it was recommended that PtD techniques can also be in-built into the Indian health and safety initiatives plans to improve safety performance of the construction industry.

Keywords: Accidents, Indian construction, Workers safety, design-based framework
Optimised external and internal constructions in buildings in hot and dry climates to support thermal comfort without air conditioning

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**Abstract:** In hot and dry climates, it is challenging to design a passive building – optimised to reach thermal comfort by using only passive systems - in which indoor temperatures are always below outdoor temperatures. This investigation seeks to study the correlations between the physical attributes of different external and internal constructions materials to understand which ones could be more suitable for being used as building materials within the context of Cairo, Egypt. Based on findings on a previous optimized room (including different ventilation strategies, size and arrangement of windows, external and internal shading systems), a digital model of a standard room was built up in the Energy Plus based software Primero Comfort, and different scenarios created out of a palette of external and internal constructions and materials were simulated. The results were then compared by using a self-developed “indicator of potential of passive optimisation”. The findings show that materials with a smaller U-Value perform better than the others. Interestingly, by looking more into detail at further correlations with other physical quantities, it is observable that materials and constructions with a high U-Value (>2.5) and a low TAD (Temperature Amplitude Damping <10) perform particularly poor, because of a strong transfer of solar radiation through external constructions. In conclusion, recommendations for the optimisation procedure, as well as for a selection for building materials and constructions used in practice that perform well in hot and dry climates are made.

**Keywords:** Thermal Comfort, Indicators for Passive Optimization of Buildings, Temperature-Amplitude-Damping, Hot and Dry Climates, Room Simulation
Paper 235

THERMAL COMFORT, ENERGY AND ECONOMIC SAVINGS WITH THE USE OF SIRASOL IN HOUSES OF THE WEST CENTER OF THE ARGENTINE REPUBLIC.

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Abstract: The high costs that energy has reached entails the danger of not being able to maintain the houses at an adequate temperature in the cold months. An economic and thermally feasible response to these situations is the inclusion of natural air conditioning systems in the spaces of homes. Strategies and conventional passive heating systems, such as direct gain, Trombe walls or greenhouses among others, that take advantage of solar thermal energy can raise the interior temperature of the spaces to reach thermal comfort levels. However, there are spaces that do not allow the inclusion of these systems because they are without facades oriented towards Ecuador. In this context, a passive solar radiant heating system called SIRASOL has been developed. The objective of the work is to evaluate the comfort conditions and the potential for energy and economic savings with the use of SIRASOL in single-family homes in the provinces of the Argentine Republic: Mendoza, San Juan and La Rioja, through mathematical analysis and Energy Plus simulation software. Based on simulations with the Energy Plus software of a home with and without the use of SIRASOL, an increase of 5 °C of the operating temperature was obtained, with an energy saving of 14.6% and 84% of comfort users. Extrapolating the energy savings of the homes of these provinces, it is noted that saving has two sides. a- INDIVIDUAL: the user will consume less energy, and b- SOCIAL: every 28 homes that the state builds, it will be possible to build another house considering the economic savings that implies.

Keywords: Energy and Economic Savings, Thermal Comfort, SIRASOL
Paper 241

Typological Analysis of Residence’s Implantations at Siqueira Campos Neighbourhood

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Abstract: The practice of self-construction is commonly accomplished without professional orientation in the Brazilian cities. In Aracaju, Brazil, it is not different and countless units are observed under this status that damages thermal comfort conditions, consequently to salubrity and energy efficiency. The objective is to analyse typology of residences’ implantations through studying their auto-interventions, as reforms and constructions. For this purpose, it was required to collect constructive characteristics of houses to identify applied techniques for improvement of thermal comfort and to monitor indoor air temperatures and air speed. It was identified one typical block at a consolidated central district and it was selected houses for data collecting of architectural design, indoor air temperature, and air speed. In addition, it was applied interviews to check thermal comfort residence perceptions. It was verified some dwellings have irregularities in openings for air inlet; considering Aracaju has a warm and humid climate. The solution more applied to gain some natural ventilation was a type of light well in roofing through some air can entry and promote cooling into dwellings, air renovation and satisfy thermal comfort perceptions of residents. However, that solution has improved thermal comfort in houses according to interviewees; despite not always residential openings have appropriate dimensions and air directors. It was observed some improvement in indoor air speed when the light well was associated with other openings due to air canalization. It is common some rooms have no windows to the outdoors in most of the dwellings in the neighbourhood and in the city because it is a social aspect of that low-income population. The contribution of this study is to document possible technical solutions, serving as a reference for futures neighbourhoods and for edition and supervision of current legislation.

Keywords: Thermal comfort, Health, Well-being, Residences, Light well