International Conference on
INTEGRATED DESIGN
BUILDING OUR FUTURE
The University of Bath
29 June - 01 July 2016
BOOK OF ABSTRACTS
Editors
Stephen Emmitt
Kemi Adeyeye
Preface

This volume contains the papers presented at ID@50: Integrated Design International Conference held on June 29-01 July, 2016 in Bath, UK. This conference is organised and hosted by the Centre for Advanced Studies in Architecture at the Department of Architecture and Civil Engineering, University of Bath.

There were 52 submissions. Each submission was reviewed by at least 2.0 scientific committee members. The committee decided to accept 51 of the 92 submissions received. This final volume includes 4 keynote lectures.

The conference thanks EasyChair for the free use of their online conference management system.

May 29, 2016
Bath

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EDITORIAL

Prof Stephen Emmitt
Conference Chair, Director of the Centre for Advanced Studies in Architecture, (CASA), Department of Architecture and Civil Engineering, University of Bath

The Department of Architecture and Civil Engineering, along with the University, celebrates its 50th anniversary this year (2016). The Department is unique, being the only combined Department of Architecture and Civil Engineering in the country. This has allowed us to explore integrated teaching and research over a 50-year period. The ethos of the Department was, and still is, integrated design and this is reflected in the theme of the conference, Integrated Design: Building our Future. The conference celebrates various aspects of integrated design, ranging from the strategic to the detailed view. The conference is organised in conjunction with the Detail Design in Architecture (DDiA) network, hence the wide range of issues addressed within the papers.

All papers were peer reviewed by members of the international scientific committee. The blinded review process subjected each paper to a minimum of two reviews and revised papers were further reviewed prior to acceptance. This has resulted in a set of high quality papers. The papers cover a range of topics, from issues about how best to teach integrated design and engender collaborative working; through to the human aspects of collaboration; the digital aspects surrounding BIM and ICTs, the technical aspect relating to new and existing buildings, materials and the issue of detailing. Contributors come from a wide geographical base, further reflecting the interest in the subject area. We have tried to reflect a little on the past 50 years, celebrate our current challenges and opportunities surrounding integrated design and tilt a little toward the future. With rapid advances in digital technologies we are well positioned to deliver a greater proportion of our buildings in an integrated manner, thus delivering better value to clients, users and society.

I would like to take this opportunity to thank our reviewers and everyone behind the scenes who have helped to make this conference such a success. I would also like to extend my gratitude to Taylor & Francis who have provided the best paper award on behalf of Architectural Engineering and Design Management.

BIOGRAPHY

Stephen Emmitt is an architect and Professor of Architectural Practice at the University of Bath, Department of Architecture and Civil Engineering. He is head of the research group Centre for Advanced Studies in Architecture (CASA) and also Editor-in-Chief of the international journal Architectural Engineering and Design Management. His research and teaching interests are centered on multi-disciplinary working, design management and delivering value through architecture.
KEYNOTE LECTURE 1

Why designers need to go beyond design

Lady Prof Rachel Cooper
Director of Imagination Lancaster, Lancaster University UK

ABSTRACT: Over the last twenty-five years we have been proving the value of design, improving the process of design, integrating design disciplines, (my examples, process protocol, design and crime, design for health, design for growth and prosperity, design for social responsibility), but I will argue we now need go beyond design. Design has the capacity to drive innovation, lead thinking and influence change... and the urban and human challenges are so great that there is an appetite to listen. However we need to ensure we have the evidence and understand how to apply it (my examples wellbeing and density). So if we want to have influence we need the knowledge. This design integration process then encourages us to apply creative insight to a range of issues (my examples ‘the sharing city thought experiment). I may also look at the imperatives coming out of the Foresight Future of cities programme and discuss how designers can take a lead on rethinking urban governance to address future urban challenges.

Keywords – Design value, Design process, Innovation, Integrated design, Urban governance

BIOGRAPHY

Professor Rachel Cooper is Director of ImaginationLancaster, an open and exploratory design-led research centre conducting applied and theoretical research into people, products, places and their interactions. Professor Cooper’s research interests cover: design thinking; design management; design policy; and across all sectors of industry, a specific interest in design for wellbeing and socially responsible design. She has published extensively on these topics, including books ‘Designing Sustainable Cities’, ‘Constructing Futures’ and ‘The Handbook of Wellbeing and the Environment’ (Wiley Blackwell).

She is also series editor of the Ashgate series Design for Social Responsibility covering topics such as designing for sustainability, inclusivity, service design, sport, health, transport and policy. She is currently working on Liveable Cities, an Engineering Physical Sciences Research Council funded six-year research programme working to identify design and engineering solutions that will lead to low-carbon, resource-secure, future cities in which societal wellbeing is prioritised. Also ‘The Creative Exchange’, an Arts and Humanities Research Council Knowledge Exchange hub looking at the growth of the creative industries through exploring the ‘digital public space’.

She was a member of the 2014 Blackett review on the Internet of Things and a Lead Expert for the UK Government Foresight program on the Future of Cities (2013-2015). She is on the Academy of Medical Sciences Working group
addressing ‘the health of the public 2040’ and on the Expert Steering Group for The Prevention Research Initiative. She is also a non-executive Director of the Future Cities Catapult.
KEYNOTE LECTURE 2

Integrating Technology in Emerging Markets: Building Codes and Construction Standards

Mr Stephen Forneris AIA,
Principal and Board Director, Perkins Eastman, New York, USA

ABSTRACT: What happens when you accept a project in another part of the world only to discover that the country has no viable building code or construction standards? There are few or limited regulations regarding fire, wind, or any type of man-made or natural disaster. You are in a serious earthquake zone and there are no earthquake codes. A trip to the building department reveals no municipal infrastructure for administering and monitoring building codes and standards. What do you do?

This lecture will uncover the reality and challenges of working in developing markets. Why are these countries so different and what challenges professionals face if they want to integrate technologies used in more developed markets for these emerging markets? Do professionals have any obligation to address this disparity at all? If a professional does decide to take on this challenge, how can they effect change in an area commonly the ground of governments and municipalities? We will also touch on how the legal systems impact this integration and in many cases can impede progress.

Finally this lecture will offer some potential strategies to formally addressing these issues when working in emerging markets. How can designers and practitioners keep people safe and build upon lessons learned not just locally but globally.

Keywords – Building codes, Construction standards, Emerging markets, Technology, Integration

BIOGRAPHY

Stephen Forneris is a principal and board director at Perkins Eastman with 23 years of experience in the field of architecture. Mr. Forneris shares his time between New York City and Ecuador where he manages the firm’s Guayaquil office and Latin American practice. Having opened his own firm in Ecuador back in 1994 in association with Timothy DeNoble and Christopher Grey, Mr. Forneris returned to live principally in the USA in 2001. Since his return, he has maintain a continuous stream of projects under development and construction in Ecuador. He remains an authority of building and construction practices in Latin America and was asked to serve on the committee to draft the 2008 Ecuadorian building code.

After the 2001 El Salvador earthquake Mr Forneris met with then US Senator Christopher Dodd to discuss his observations and recommendations on the state of construction in Latin America. Based upon Mr. Forneris’s article for ICC Building Standards Magazine, Senator Dodd wrote the 2001 code and safety for the Americas CASA Act to translate the most current US building codes from English to Spanish and teach them along with USAID aid reconstruction funds.
President Bush signed this into law in 2002. In the fall of 2011, Mr. Forneris instructed classes at Yale University School of Architecture regarding the international practice of architecture. Later that year he organized a symposium that built off the content of this class titled Catastrophe and Consequences: A Campaign for Safer Building. Mr. Forneris continues to appear as a guest lecturer at New York University on topics of low income housing in developing countries.

Mr. Forneris is fascinated with exploring ways to simply communicate architecture and technical concepts. In 2011 he published a guide to building an earthquake resistant house in Spanish and English that used drawings as well as references back to the latest seismic resistant codes. This book was later published in French and English and serves as a test of concept that safe buildings do not cost more money than unsafe buildings.

This pursuit of improve communication between designers and users led to his producing a film in conjunction with a design brief for a project. He has gone on to explore film production and works in program development pieces, project delivery as well as documenting the design process so clients better understand how and why the team developed the building. In support of the production, Mr. Forneris and his team worked to developed project presentation apps and storage applications for simple film and data on iPhones and iPads.
KEYNOTE LECTURE 3

Integrated Design and the Ecology of Tectonics

Prof Anne Beim
Head of Centre for Industrialized Architecture (CINARK), the Royal Danish Academy of Fine Arts (KADK)

ABSTRACT: One of the fastest growing markets of the construction industry is general refurbishment and energy renovations of existing buildings. Due to this there is an increased attention towards the architectural consequences of energy renovation among Danish architects – how do we design architectural solutions that improve the energy performance without losing or harming the cultural heritage?

Also this tendency has sparked an interest in reclaiming and the re-use of building materials and components – how do we diminish waste and pollution of the construction industry and how do we re-use the energy and the value already embedded in the existing constructions?

Design strategies that involve integrated design are often approached from an engineering perspective where performative and technical aspects are centre for attention. However, from an architectural perspective both functional, cultural, and aesthetic dimensions, which also include the aspect of time are equally important to consider. Different strategies for integrated design can be discussed when introducing the 'ecology of tectonics'. Based on the double-sided concept of; construction and construing it offers a holistic and environmental mind-set, which defines the architectural design from a circular lifetime perspective where structures are designed for disassembly and for re-use.

This discussion will be exemplified by resent work of selected Danish architects and student work from the graduate Program: Settlements, ecology & tectonics.

Keywords – Ecology of Tectonics, Integrated design, Refurbishment, Renovation

BIOGRAPHY

Anne Beim is an architect MAA located in Copenhagen, Denmark. She received her M.Arch. in 1990 and holds a Ph.D. in Architecture gained in 2000 from the Royal Danish Academy of Fine Arts School of Architecture. Part of her PhD studies has been conducted under Professor Marco Frascari and Professor David Leatherbarrow as a visiting scholar at PennDesign, University of Pennsylvania. Since 2004 she has been in charge of forming the research center CINARK - Centre for Industrialized Architecture, which serves to bridge the gab between the Royal Danish Academy of Fine Arts School of Architecture, the construction industry and the architectural profession. In 2008 she was appointed professor of Architectural Technology, at the Royal Danish Academy of Fine Arts School of Architecture in Copenhagen. From the fall of 2014 she has been the initiator and co-chair of the Graduate Program; Settlement, Ecology and Tectonics.
From 2008-2010 she was the Chair of the Architecture Committee of the Danish Arts Foundation and since 2013 - the Chair of the Admission Board of the Architects Association in Denmark.

Her research is particularly focusing on how architectural ideas translate into the world of constructions defined by building culture and tectonics – the latter considered as an essential part of the architectural creation and in regard of its ecological dimension. The challenges provided by the rational pragmatism of the construction industry, for which deep knowledge into material qualities, construction principles and detailing are important design parameters of the architect, have her special attention.

She has managed and conducted several research projects and published a number of books and scientific articles within this field. Among others she has authored/co-authored the books: Towards an Ecology of Tectonics: The Need for Rethinking Construction in Architecture (2014), Building the Future: Visions in Industrialised Housing 1970 - 2001 (2012), Three Ways of Assembling a House (2009), Tectonic Visions in Architecture (2004), and Ecology and Architectural Quality (2002).

For more info about CINARK see: https://kadk.dk/en/cinark/about-cinark
KEYNOTE LECTURE 4

Integrated Project Delivery in Emerging Markets

Mr Rodrigo Rubio Vollert
Chief Operations Officer, ARPRO, Colombia

ABSTRACT: The development of world class buildings in emerging markets poses complex challenges to the construction industry. Diverse teams with uneven skills must align their interests around an alien building that is introducing new materials and construction methods in unfamiliar market. Substantial efforts are required to align design and construction teams with different origins and expertise around an integrated solution. Special caution is essential to execute, control and follow the plans, specs and drawings that guide all actions to (hopefully) the same goals. Cultural differences impose additional stress during the delivery and control of construction planning and cost. A labour-intensive local culture will clash against a global construction logic based on design + shop-drawing + fabrication + installation sequences that increase accuracy and integration requirements. The paradox of introducing global facts inside local markets has to be solved avoiding over-simplified solutions that reject the local market.

Plans and specs delivered by designers in a market not fully developed greatly differ from the design scope of large-scale international projects. However, in countries with a local practice used to face rapid growth, such projects will encounter local design teams demanding involvement beyond the successful compliance with local regulations. On the other hand, local suppliers certainly not well equipped for complex construction tasks do have significant labour capabilities greatly needed. Local construction companies not used to conduct pre-construction services, thorough constructability reviews, and detailed planning exercises may find themselves in leading roles. Success is determined by the ability to add forces.

In order to succeed delivering complex projects in emerging markets. Innovative team building centred on advanced communication techniques may foster precise roles and mutual trust. Conveying meaning instead of transferring information may raise managerial capabilities. Team integration, strict communication protocols, and mutual trust are critical conditions for a successful delivery of integrated projects in complex environments.

Keywords – Emerging markets, Communication, Innovation, Integrated project delivery

BIOGRAPHY

Rodrigo Rubio-Vollert is an Architect from Universidad de los Andes (Bogotá, Colombia) with a Master’s degree in Design Studies from Harvard University. His 27 years professional experience comprises architectural design, design management, project management, construction, research and architectural education. He was founder of GIV, a research group on housing and urban development, and was appointed Head of the School of Architecture at Universidad de los Andes in 2002.
He has published “Progressive Housing Prototypes” (Ed. Uniandes 2002), Lessons from Chilean Housing Policy” (Bitacora 10, 2006) and “Urgent Cities: Intervention on Rapid Growth Urban Areas” (Ed. Uniandes 2006). As a researcher, Mr. Rubio leaded the “CatArSys” research project, a software development for automated design delivery of housing prototypes under Bogotá’s District Program for “Building on owned Land”.

In 2007 Mr Rubio was appointed Vice President of Design at Arias Serna Saravia, where he leaded the design team for the Trump Ocean Club in Panama, a 70 stories high mix-use development. He is currently the Chief Operating Officer of ARPRO ARQUITECTOS-INGENIEROS S.A. His role at ARPRO S.A. includes the supervision of management innovation in all design and construction activities of the company, the development of new markets, and the management of the ELLISDON-ARPRO Joint Venture in charge of the construction of Bogotá’s ATRIO towers designed by Rogers, Stirk, Harbour and Partners (London).
ABSTRACT: Louis I. Kahn was one of the pioneer architects in the 20th century architecture. He aspired to use natural light in order to shape his architecture. Richard Kelly was a pioneer lighting designer, who had significant influence on the modern architectural lighting design in the 20th century. Kahn and Kelly designed the luminous environments in the three art-gallery and museum buildings, the Yale University Art Gallery, the Kimbell Art Museum and the Yale Centre for British Art. The collaboration between the architect and the lighting designer, "a perfect communion" resulted in well-developed daylighting and artificial lighting solutions.

This study aims to investigate the collaborative work between Louis I. Kahn and Richard Kelly from both theoretical and pragmatic perspectives. In terms of theoretical perspective, a detailed overview of their collaborative work is provided through literature review. In terms of pragmatic perspective, the background of their cooperation and their technical details are presented here. In addition, daylighting performance analysis of these three buildings is provided through digital modelling.

This study emphasizes that the lighting design solutions produced together by Louis I. Kahn and Richard Kelly, especially the way of using daylight, have had significant impact on architectural space and luminous environment in the museums. The additional supportive work by other experts showed how collaborative design work can generate more holistic design solutions, which satisfy both aesthetical and technical requirements. More importantly, this collaborative working method provides a useful reference and guidance for the current relation between architecture and lighting design.

Keywords – Louis I. Kahn, Richard Kelly, Collaborative lighting design, Luminous environment.
INTEGRATING STUDENTS THROUGH A MULTIDISCIPLINARY DESIGN PROJECT
Pooley, A.¹, Wanigarathna, N.¹

¹Department of Engineering and the Built Environment, Anglia Ruskin University, Chelmsford, CM1 1SQ, UK

ABSTRACT: Design as a multidisciplinary endeavour needs to be reflected in learning and teaching strategies within higher education. This paper discusses a design project where quantity surveying (QS) and architecture students worked together on a proposal for a prototype Almshouse for the 21st century. The two groups of students worked alongside a client, and members of the local community, integrating context and content through one design project in an attempt to break down perceived professional and educational silos. The project and learning processes were recorded through student feedback, module evaluation and workshop observation. The project exposed both sets of students to each other’s disciplines, where the architecture students were engaged with the budget and the QS students were engaged in the design process. The authors discuss their experience of delivering this particular multidisciplinary project and how the experience might influence a future curriculum involving integration of disciplines and the use of live projects in built environment education. As such this paper focuses less on the physical outcomes of the project, and more on the ongoing dialogues within built environment education that talk of multi and interdisciplinary approaches to design, how they might be more readily adopted through learning and teaching strategies, and the challenges this approach continues to represent for higher education.

Keywords – integration, multidisciplinary, design, challenge
STAKEHOLDER INTEGRATION AND ITS RELATIONSHIP WITH THE REQUIREMENTS CRUNCH POINT IN THE DESIGN OF MAJOR HOSPITAL PROJECTS

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Abstract: Integration is required to overcome a requirements crunch-point that exists when frozen design conflicts with the expectations of some parties. This point in time (and its impact on various stakeholders) has been witnessed first-hand by the lead author over a 30 year period in hospital building. A retroductive reasoning approach to ethnography explores expert knowledge of the implementation of new technologies and innovation through design into construction. It was found that failures in communication and visualisation were exacerbated by static healthcare standards and guidance, and equipment and activity data. Also, that the requirements crunch point resulted in newly completed hospitals failing to meet client expectations and unduly changing working practices. Recommendations are made on how integration can overcome the ‘requirements crunch point’ in hospital buildings.

Keywords: requirements crunch point (RCP), integration, stakeholders, technology, and uncertainty
THE PERCEIVED BENEFITS OF INTEGRATED PROJECT IDEOLOGY IN THE SOUTH AFRICAN CONSTRUCTION INDUSTRY

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ABSTRACT:
The management of construction projects is a complex undertaking that involves many participants in pursuit of the successful delivery of our built environment. An effective process is based on collaboration with an integrated and productive team all working towards a single goal. Current preferred project delivery, procurement and contracts policies create fragmentation of the design and construction processes, resulting in client dissatisfaction.

To better understand user perceptions relative to the use of current project delivery mechanisms within the South African construction market, a self-administered questionnaire was on two separate occasions administered to professionals from various disciplines. Forty-nine completed questionnaires were included in the analysis of the data from the respective populations.

The research findings showed that alternatives to design-bid-build are preferred, whilst other findings include that the lack of coordinated design information impacts on the ability to deliver projects to program and a less fragmented and adversarial construction delivery process would improve client satisfaction levels. It was notable that use of standard forms of project delivery was due to the lack of awareness of alternatives and that those alternatives would enable an environment for improved contract delivery.

Conclusions include that problems are inextricably linked and that project delivery systems that integrate processes will reduce waste, enhance delivery and realise client satisfaction. Recommendations include the use of appropriate forms of project delivery, the integration of design and construction, with specific attention being paid to the greater awareness of and provision for alternative delivery methodologies, including contracts that integrate the delivery process.

Keywords – client satisfaction; integrated project delivery; alternate delivery methods
A Preliminary Study on Current Practices and Barriers in Design Analysis and Decision Making at Conceptual Design Stage of Taiwan Green Building Projects
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ABSTRACT: Delivery of green building (GB) is of major importance in Taiwan Architectural, Engineering, Construction and Operation (AECO) industry today. However, limited research on adoption of new decision making processes for delivering GB projects causes difficulty for project stakeholders to realize the value of GB. In addition, decision making at early project stages has a critical impact on GB project outcomes. Hence, generation and exchange of vital information among project stakeholders for decision making at early stage are fundamental to overcome current obstacles. Moreover, the adoption of Building Information Modelling (BIM) can assist in generating and exchanging of quality information for GB decision making. This study aims at disclosing current practices and barriers involved in design analysis and decision making process at conceptual design (CD) stage of GB projects in Taiwan. Investigations were conducted by adopting a series of semi-structured interviews with a few leading architects and project owners, who are majorly responsible for decision making at CD stage of Taiwan GB projects. Through this study, a knowledge base may be developed from these project experiences collected to help project stakeholders to understand barriers they might face and solutions they can apply for decision making at early stage of their projects. Current applications and future potentials of BIM in assisting design analysis and decision making at CD stage in Taiwan GB projects are also discussed in this study. The result of this research can also assist in questionnaire design for a survey of larger scale and wider coverage. In the future, this serial of survey can serve as a foundation for developing a conceptual framework of BIM-enabled GB design management to improve decision making at CD stage of Taiwan GB projects.

Keywords – Green Building, Design Analysis, Decision Making, Conceptual Design Stage, Building Information Modeling
OCCUPANT PRODUCTIVITY AND ITS RELATION TO INDOOR ENVIRONMENT QUALITY
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ABSTRACT:
The purpose of this paper is to draw an understanding of the relationship between indoor environmental quality factors and occupant productivity in an office environment. Employee productivity has an enormous impact on organisational performance. There is a need to understand indoor environment quality to provide conducive and efficient work environment. This paper investigates the physical environment in an office and limits its focus to indoor air quality, thermal comfort, lighting and daylighting and noise and acoustics. The study reviews a broad range of literature focusing the indoor environment, occupant productivity and green buildings. A wide range of books, journals and conference papers were examined to investigate the topic. The study indicates that green building design helps to enhance the indoor environment quality for occupants. Indoor environment quality parameters like temperature, relative humidity, air temperature, air movement highly affect occupant comfort and productivity. The pollutants in the air along with inefficient ventilation reduce the indoor air quality and may lead to diseases like SBS (Sick Building Syndrome) and Asthma. Noise and acoustic design strategy and daylighting design strategy also play a crucial role in defining a healthy indoor environment. Ignoring these indoor factors could lead to a decrement in occupant comfort and productivity, thus resulting in financial loss to the employer. The paper provides a good starting point for future researchers interested in the area of indoor environmental quality, occupant productivity and green building design.

Keywords – Occupant Productivity, Indoor Environment Quality, Occupant Comfort
Energy saving and carbon reduction potential of utilization of
PSBS in high rise domestic buildings in northeast China
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Abstract: Straw bales are a natural building material which have good levels of thermal insulation and great potential for energy saving. This paper focuses on evaluating the carbon-reduction and energy saving ratio which can be achieved by using panelized straw bales in high raise domestic buildings, and comparing this with conventional high raise domestic buildings in northeast China. The potential energy savings are modeled using IES simulations, followed by analysis and discussion of the applicability of panelized straw bale systems in the urban environment in northeast China. The data analysis and conclusion follow the acquisition of embodied energy and embodied CO2 analysis and simulation results. The IES simulations contain degrees of both heat losses in winter and heat gain in summer in reference high raise buildings which use conventional wall and panelized straw bale system façades.

Keywords — Prefabricated straw bale panel, IES simulation, Embodied carbon, Embodied energy, In use energy
**ABSTRACT:** Urban form is generally economically driven; as a result little attention is paid to how the surrounding urban geometry affects the energy performance of a building. Instead building designers tend to rely upon a fabric first approach to energy management. This work explores the interdependent relationships that develop between buildings at the scale of the city street. We use dynamic thermal simulations of multiple buildings at the scale of a neighbourhood to study the effects of urban form on the regulated loads of modern non-domestic buildings. Simulations are based upon the area of Moorgate within the City of London with simulations of buildings in their standalone setting are compared against identical buildings in various urban settings, both for the current climate and a possible future climate within the lifetime of the building. In this way the effects of urban form were compared to the effects of improving the building fabric. We find that not only do identical buildings behave differently as a direct response to the form of the surrounding urban setting, but that these performance patterns become increasingly significant with lowered operational loads (as a result of the mitigation agenda) and predicted warming trends. The results imply that the current fabric first approach to meet carbon reduction targets and avoid dangerous climate change may not be adequate.

**Keywords** – building form, urban climate, energy management.
Abstract: Building information modelling (BIM) gains increasing popularity in architectural and engineering practice. In the course of its development, visual representations were separated from the information model. They are no longer intimately connected to the information to be persisted and exchanged. Instead, visualizations are created silently in software applications when they are needed. For the full potential of BIM to be unfolded, architects and engineers should actively participate in the process of visualization generation. They should be allowed to flexibly create, modify, reuse, and select visualizations as they fit their needs.

To this end, a framework is proposed that creates visualizations from explicitly formulated visualization specifications and selected information of a building model. Billie is a proof-of-concept prototype implemented as a local Java application. It is based on a modular architecture following the paradigm of the visualization pipeline and can be extended both on the data and on the visualization side. Visualization descriptions can be given as precompiled classes or with a domain specific language.

To demonstrate and test different aspects of the framework, several use cases were developed during the past years. These use cases are now consolidated and presented together with the prototypical implementation. A use case combines a data set and a visualization description. The available data sets reflect different project types and sizes (ranging from a carport to an airport) and various information model content (e.g. geometry, cost, schedule data). The specified visualizations are adopted from various project tasks, such as progress control or cost control.
Building Information Modelling and International Property Measurement Standards: Promising Prospects

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ABSTRACT: Industry studies show that identical properties placed in different parts of the world can be found to vary by up to 24% in area measurements due to local norms and practices. To address this discrepancy, the International Property Measurement Standards Coalition (IPMSC) has prescribed standard measurement (IPMS) guidelines that can be universally applied. As these principles currently exist primarily in theory, this paper explores the scope of their practical applicability using Building Information Modelling (BIM). The paper utilises as-built BIM data to extract and process embedded information to yield visualisations and schedules compliant with the IPMS specifications. The information thus synthesised can be utilised – in processes like valuation, facility management, etc. – with ease and universal acceptability. Functioning under the pretext that BIM and IPMS are universally standardised and accepted, this paper serves as a proof-of-concept for using BIM in extracting and sharing property measurement information. Two standalone foci of the AEC industry – BIM and IPMS – have been brought together under one template in this paper, to complement one another, and to produce an integrated solution.

Keywords- BIM, IPMS, Measurement, Data Extraction, Area Scheduling
EXPLORING POTENTIALS OF USING BIM DATA FOR FORMWORK DESIGN THROUGH API DEVELOPMENT

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ABSTRACT: Utilising advances in computing – like Building Information Modelling (BIM) – Architecture, Engineering & Construction (AEC) industry has leaped forward tremendously through automation. Iterative tasks and calculations that were earlier synonymous with design process have now been made redundant by utilising and further developing BIM tools. This paper uses BIM authoring tool and its Application Programming Interface (API) to automate one such iterative production-oriented activity – design of formwork for structural concrete walls. Inputs are extracted from the BIM data available to contractors, then this extracted information from semantic BIM model is transferred to API environment. Computation is carried out on the raw data pulled out from BIM to design formwork systems and yield their quantities and specifications, hence streamlining design processes and reducing the effort expended by construction planners. The paper elaborates upon the development of API to extract, process and yield information using BIM data. Building further, this research provides the basis for automation of formwork design, production, layout, and even 4-dimensional simulation, hence holding tremendous commercial potential. Additionally, when worked out in unison with the site database, this can further fine-tune construction logistics planning.

Keywords- Building Information Modelling, API Development, Formwork Design, Parametric Modelling, Design Automation.
THE EMERGENCE OF BUILDING INFORMATION MODELLING ASSESSMENT METHODS (BIM-AMs)
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ABSTRACT: Building Information Modelling Assessment Methods (BIM-AMs) are used to evaluate the implementation of BIM and improve its adoption in practice. Over the past nine years there have been at least 16 BIM-AMs developed in academia and industry, each offering a unique perspective on BIM performance. Despite the continual growth of BIM-AMs, the field as a whole is still under-examined. Most previous studies tend to focus only on introducing new methods, rather than comparing and contrasting the diverse range of existing models. This paper addresses this gap, by analysing the similarities and differences between these assessments. A critical evaluation of the current AMs covers several features, including their simplicity and complexity, the most evaluated measures, whether the AM assesses projects, organisations, teams or individuals and the forms of communication of the results. This is followed by a representation of limitations and roles of BIM-AMs. This comprehensive comparison enriches the current research agenda of BIM-AMs. It helps to collectively reflect the extensive body of knowledge on BIM-AMs and recommends directions for future research.

Keywords – BIM, Assessment Methods, performance measurement, maturity models, comparative method.
ABSTRACT: A most effective way of learning is to intrinsically motivate students by challenging concrete tasks; this paper describes a number of cases (11 in total) in which students were challenged to design, elaborate technical and practical features, and actually built, too. All cases have a similar approach: the initial development of a concept is an individual assignment for all students (to generate as much ideas as possible), then the most promising concept is selected (often part of a competition) and continued with technical and practical elaboration by a group of students. This group becomes in most cases a wider group when the actual realization takes place.

A valuable source of challenging assignments can be found in contributions to festivals and events. Festivals offer ample opportunities, because most of the festivals are developing activities in addition to their core business of "music and food". Contributions to festival are preferred because it really doesn’t require much to inspire and motivate students for this kind of assignments. The demand for a distinctive structure, that stand out in a festival is motivating in itself, the intention to actually realize the project helps a lot, too. There is also an additional opportunity, offered by the limited duration of a festival (1-5 days). This provides a great scope for experiments and innovations. Combined with the challenge to develop an integral object within technical and pragmatic constraints provides a good basis for attractive education to students.

Keywords: design-based learning, DBL, proof of concept, integral design, teamwork
EVALUATION ASSESSMENT CARROUSEL; PROVIDING FEEDBACK IN DIFFERENT STAGES OF A PROBLEM BASED LEARNING-ASSINGMENT
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**ABSTRACT:** Design-Based Learning (DBL) as method of teaching is broadly accepted. However, there is much debate about the method used to assess the outcome and the design process. Reflection on the process as well as on the contents is extremely important in DBL. Since reflection has to be learnt as part of learning how to design too, an evaluation method has been developed that is suitable for evoking abundant feedback to students. The method, called Evaluation Assessment Carousel, is used for individuals as well as design teams and allows (many) guest critics to be involved. The Evaluation Assessment Carousel may be used for informal mid-term evaluations, but also for formal final presentations that are meant for formative marks of design assessments. This document describes briefly the method and explains how this is used in different set ups.

**Keywords:** design-based learning, DBL, assessment, integral design, feedback
Integrative Systems of Disruption: Designing Platforms for Contemporary Sociocultural Dialogue
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ABSTRACT: Contemporary sociocultural discussions arise upon the perceptions of its participants. Moreover, these dialogues represent significant problems within the society regarding aspects of culture, economy and/or politics. Due to this intertwined nature of the generated problems they can be identified as ill-structured problems (ISP) which have no defined path of progression or a defined boundary. The research focuses on identifying methods of progression for ill-structured sociocultural problems through disruptive innovation. A process in which a new product or service disrupts existing markets and value networks. The Sri Lankan state university holds strategic advantages in aspects which benefits a disruptive design solution for sociocultural problems. The availability of integrated knowledge, requisition of state funds to solve greater societal problems which are either ignored or suppressed by the existing government, availability of politically neutral grounds for the discussion of social issues, are prominent among the said strategic advantages. Gathered empirical data of four platforms are used to develop a generalized process of solving various sociocultural problems through integrative systems of disruption. The research was funded by the Senate Research Committee of the University of Moratuwa under the grant number SRC/ST/2015/19.

Keywords – Design Based Research, Disruptive Innovation, Ill-structured problems, Integrative Communication Platforms, Sociocultural dialogues
ABSTRACT: One of the key issues to achieve a properly functioning building is the consideration of physical and functional interactions between building subsystems (i.e. building fabric, structural system and service systems) adequately during various phases of design. Additionally, as a comparatively recent fact, degrading natural environment compels architects to focus on environmental sustainability issues while designing.

Active involvement of the students in the teaching-learning process is a commonly used method in architectural education, and comparatively recently, it is becoming favourable at other fields of education. At Istanbul Technical University, Department of Architecture (ITU-DoA), MIM 431 Construction Project course, given every term by various academicians, aims to teach students how to deal with (mainly physical) interactions between building subsystems while designing. Students practice using and integrating their knowledge on different building subsystems, which were gained during separate courses, by designing and detailing a small-scaled building. At the 2015/16 fall term, for a 7-student group directed by the author, environmental sustainability was selected as the primary focus of design, and LEED certification system’s criteria were determined to be their guide in their study.

In this paper, together with a brief explanation of the general structure of the architecture education in ITU-DoA, the process and outputs of the design studio directed by the author is presented and discussed in terms of gaining experience in building subsystems’ integration and working with environmental sustainability concept.

Keywords – Learning-by-doing, building subsystems’ integration, environmental sustainability.
ABSTRACT: Students of architecture are predominantly taught in the design studio environment, through active projects, encouraging independent learning. Architectural precedent is often seen as a key driver in generating design solutions and analysing appropriateness. Typologies, understood as systems for categorising precedents, and the subsequent formation of types, can be used to extract relevant design information for use in the design studio. This study examines how novice designers may use typologies to construct critical frameworks for design. By interpreting design through the Critical Method, as a process of conjecture and analysis, typologies may help to frame problems, generate design solutions and assess suitability.

A pilot study with novice designers was undertaken to assess the impact of pre-determined typologies on the design process. Initial findings suggest architectural types may help students in the conjectural phase of design, however, pre-determined categorisation may restrict individual interpretation and limit analysis. This paper describes initial findings and the developing conceptual model for interpreting built precedent and incorporating it into design studio teaching.

Keywords –Typology, precedent, design studio, independent learning, Critical Method
THE CITY OF FUTURE: BIOURBANISM AND CONSTRUCTAL LAW
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ABSTRACT: Nowadays dynamic elements in urban fabric are often concealed by the insertion of stylish new architecture; real patterns of social life (‘bios’), have been replaced by rigid geometric grids and compact building blocks. New Urbanism and Biourbanism affirm that cities are now risking to be unstable and deprived of healthy social interactions. As an expansion of older historical urban fabric patterns, harmonious architecture can have a positive impact on the fitness of both human body and mind. Not only Biourbanism attempts to reinstate balance and lost values in the urban fabric, but also reinforces human-oriented design emergences in micro and macro scales. As a multifaceted discipline, it embraces laws of physics, such as Constructal Law and acknowledges its noticeable and unremitting influence to urban human behaviours.

Urban life and behaviours are based upon systems of human communication formed by dynamic patterns; we are now talking about negotiating boundaries between human activities, changes in geographic mapping and mainly about sustainable systems to support uninterrupted growth of communities worldwide. Therefore, as a vital shift in architectural education, not only Biourbanism offers the opportunity to explore patterns and linguistics deeply imbedded into the built environment, but also enables scholars and communities to come together and participate actively into fast and innovative urban interventions. Projects developed during educational and professional training aim at reinstating memorable and preferential paths of communication, favouring everyday life rituals of the body and mind. Hence, by following everlasting laws of physics and formulas inherited from nature, architectural forms can be considered as the real innovation in urban design and planning of the City of the Future.

Keywords – Biourbanism; Constructal Law; Theories of human behaviours; Patterns of life; Living Urban Fabric.
ABSTRACT: Hospitals are at the heart of the healthcare service and emergency planning. Disruptions in hospitals may inflict large consequences to health and safety of a community especially in case of emergencies. Since hospitals’ services are essential for effective emergency and disaster response, breakdowns (or outages/interruption) may cause direct and/or indirect impact in the form of delayed or hampered response. Therefore, hospital resilience is negatively affected by uncertainties and interdependencies-induced threats and/or failures. The dependency/interdependency and complexity of the infrastructures, which provide services to hospitals, are numerous. This increases the risk of interdependency-induced failures to hospital services and the impacts can get propagated to people and society that use the hospital services. In addition to that, hospital operational uncertainties are inevitable and might also cause failure/interruption to hospital services. Hence, there is a need to identify and map these uncertainties and interdependencies for more resilience-informed decisions on hospitals’ operation in case of emergencies. In response to this need, this paper aims to introduce an integrated resilience-based framework in which hospital decision-making process is improved through a collaborative environment to cope with uncertainties and interdependencies-induced failures. Methodologically, a comprehensive literature review has been adopted to identify the external and internal interdependencies of a typical hospital and map them through system dynamic approach. In addition to this, the authors have theoretically assessed whether different digital construction technologies, such as Building Information Modelling technologies, could be used in order to identify, visualise and map the operational uncertainties. The study concludes that the idea behind this integrated operational framework could provide resilience-based strategies which actively contributes to improve current practices in hospital organizations and also to introduce protocols (Business Continuity Plans) that help stakeholders to produce effective strategies in the case of disasters. 

Keywords – Building Information Modelling, Dependency, Hospital, Interdependency, Infrastructure, Resilience, Uncertainty
INTEGRATED DESIGN FOR FLOOD RESILIENCE
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ABSTRACT: Both historic and recent natural events continue to reveal weaknesses in the capacity and capability of buildings to respond and cope with natural events such as flooding. The subject of this paper is both topical and significant because the prevailing approach continues to overlook this fundamental factor for resilience, in favour of larger scale technocratic, infrastructure solutions. Recent examples have however shown that levees, dams and dikes do fail, so resilient buildings should be considered as part of a comprehensive climate change and environmental management strategy. Integrated design for resilience is a process that engages design, planning, engineering, social and political solutions to proactively deliver an effective and usable built environment. It offers a coherent framework for the collaborative and holistic design, delivery and management of building-level resilience at both the macro and micro scale. This paper presents historic and contemporary case study examples with the view to define for further evaluation, the multi-variant components and benefits thereof, of the integrated design approach for resilience. It concludes with a series of practical design recommendations for resilience and scope for further research.

Keywords – Architecture, Flooding, Integrated design, Resilience
Green and blue-space significance to urban heat island mitigation

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Abstract: It has long been recognised that cities exhibit their own microclimate and are typically warmer than surrounding rural areas. This effect known as the urban heat island (UHI) results from the inadvertent modification of surface properties that lead to greater absorption of solar radiation, reduced cooling from slower wind speeds, and lower water evaporation rates. Cities contain fewer green and blue-spaces than rural areas, with the existing under constant threat from increasing population densities. The reduced water evaporation rates in cities as a result of the loss of such features is considered a major factor in increasing the magnitude of the UHI. This paper seeks to identify the fundamental principles of how green and blue-space affect canopy- and boundary-layer temperatures in the mitigation of urban heat risks. To address this, the paper presents a review of current understanding from city-planning, urban climatology, and heat island and climate change studies. The findings highlight recent research that suggests the cooling influence of both features are mainly relevant for canopy-layer conditions, with green-space offering greater heat stress relief when it is most needed. Any contribution to the cooling of the boundary-layer climate is attributed mainly to green-space increasing surface roughness that improves convection efficiency rather than evaporation, while little evidence exists for blue-space that support significant boundary-layer influence. This in turn has significant bearing on how these features should be used in future urban growth strategies that aim to deliver a reduced UHI and enhanced climate change resilience.

Keywords: Urban heat island mitigation; Urban cooling; Green-space; Blue-space; Evapotranspiration
Abstract: Sri Lanka has been ruled by three consecutive Euro-Christian nations for nearly 450 years from 1505 to 1948. During their conquests they attempted to introduce their own denomination of Christianity to the country, i.e., Portuguese – Catholic, Dutch – Reformed and British – Anglican. Thus the architectural typologies of the churches built by the colonials differed. The most notable typology of the Portuguese churches was the typically longitudinal plan with three naves and a plain front façade. The principal typology of the Dutch churches was the Greek cross plan with high gable façades. The preferred architectural style of the British churches may best be described as the Victorian Gothic. With the advent of the British in the beginning of the 19th century the persecution of Roman Catholicism imposed by the Dutch came to an end. This triggered off a revival that gave rise to a new architectural programme reflecting more indigenous and tropical characteristics in church architecture. The ultimate form generated in this programme, was articulated mostly by the integration of two side verandahs. It is particularly noteworthy that the retrofitting of these new elements resulted in the evolution of the preceding Portuguese typology. This paper intends exploring the origin and the development of this particular model of church architecture, created as an alternative to the tropical church. The spatial progression and building techniques in selected three architectural examples of 19th Century Catholic churches are systematically observed and analyzed in the light of their adaptations to the oriental religious practices and environmental conditions.

Keywords: Colonial Church typologies, Tropical church architecture, Churches with wooden pillars, Churches with side verandahs
The Fire-resistance Performance of Timber Columns after Repair and Reinforcement for Historical Buildings
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ABSTRACT: The main methods of repair and reinforcement for historical buildings in Taiwan include new elements to replace, replacing the rotten parts with new materials, and W-E-R method. Epoxy is one of the most popular adhesive materials to be used with the repairing technique. For timber structure, fire is a type of disaster at potential risk that can result in severe damage. In addition, with a rise in temperature, the performance of adhesive of epoxy will decrease and will end up with structural damage until the air temperature reach 224°C which is earlier than an expectation. The poor performance of fire-resistance will not only result in structural collapse at early stage of fire but also have an effect on people escaping and property saving. It was found that completion applicability and the convenience of the repair methods were the main issues rather than the performance of fire resistance while considering the selection of repair methods. This study investigated the repair methods applying to historical buildings. The analysis will also be executed for the performance of fire-resistance of the repaired timber elements after fire exposures. This study focusing on the elements of Taiwan historical buildings will perform the survey of applying repair methods and arrange the experimental investigation of full-scale timber elements. This study reveals that the residual compressive strengths of the repaired vertical elements after fires are obviously different. The compressive strength of the element is repaired with epoxy reduced by 15% due to the poor fire-resistance performance of the adhesive material. For the repair of timber elements, both the performances of load-bearing and fire-resistance shall be taken into consideration. It is also suggested that the fire proof painting or other techniques shall be adopted for the repair methods to extend the life circle of historical buildings.

Keywords – Historical buildings; Small-scale Timber columns; Repair and Reinforcement; Epoxy; Fire-resistance Performance
MECHANICAL PROPERTIES OF STANDARD AND COMMONLY FORMULATED NHL MORTARS USED FOR RETROFITTING

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ABSTRACT: Selecting materials for retrofitting of historic and heritage buildings can be challenging. These materials must be sufficiently compatible and durable without risk of damage to the existing fabric. Therefore, mechanical properties of the retrofitting mortars are of great importance.

Natural Hydraulic Lime (NHL) binders are classified according to their compressive strength at 28 days of aging and lime content using standard EN 459-1. The standard test, however, although important for quality assurance and consistency of binder production, does not reflect the performance of mortars manufactured and used on-site, since these use different aggregates and water/binder ratios.

This study investigates binder classifications, NHL 2, 3.5 and 5, from a single supplier and compares the standard formulation as defined in EN 459-1, with a formulation commonly used as a conservation mortar with 1:2 binder:aggregate ratio.

The 28 day compressive strength of mortars manufactured using a formulation typical for conservation differed in strength from the standardised samples used to classify the binders. At later ages, some mortars were found to have a greater compressive strength than that implied from their classification.

This study concludes that the prediction of aged mortar properties using the standard classification is problematic. The basis for development of a model to predict the performance of aged mortars based on chemical and physical properties of the binders is identified. The model we propose to develop from this work will allow conservators to predict strengths more accurately and reduce the risk of building damage attributed to the use of mortars with inappropriate strength.

Keywords – Mortars for retrofitting; Natural Hydraulic Lime; Mechanical properties
JOURNEYS IN THE CITY: 
EMPATHISING WITH THE USERS OF TRANSPORT BUILDINGS 
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ABSTRACT: Accessibility is a considerable and growing issue in the design of many public buildings including vital high use buildings such as train stations. Yet research methods for these buildings are poor. This paper suggests that one new approach to design is to use immersive, auto-ethnographic methods to achieve an empathetic understanding of design needs. The paper asks: what can we learn about the mobility requirements of station users when we are immersed in a train station environment, and what mobile research methods can we use to begin to explore this?

The paper reports on a study that used video diaries to explore Canary Wharf Station in a November evening rush hour in dry conditions, and specifically to study passenger behaviours on an island platform within the station. The analysis focused on how to improve mobility in the station from a user’s perspective. This use of auto-ethnography is discussed as part of a broader methodological debate about how to explore universal design issues from a user’s perspective, and in the context of empathetic design.

ABSTRACT: This paper assesses the quantity and quality of natural lighting in existing classrooms in Zaria and simulated classrooms in two other cities of Kano and Enugu, situated in the three climate zones of Nigeria as defined by the Koppen-Trewatha-Horn classification system. Using Climate Based Daylight Modelling, data for day lighting performance metrics of Daylight Autonomy (DA) and Useful Daylight Illuminances (UDI) were collected for both glazed and unglazed fenestrations. Based on the results, optimisation proposals were developed based on literature review and re-tested for the different orientations. It was discovered that for the glazed models, the best optimised retrofitted model achieved an improvement of 12.5% for the DA, 5% for the UDI<100 and a 12% DAui with a slight increase in the UDI>2000 over the existing model. For the unglazed models, the best optimised retrofitted model apart from also achieving the 60% DA requirement, achieved an improvement of 26% for the UDI>2000 together with a slight improvement in both UDI100-2000 and DAui over the existing prototype. The study concludes that climate-based daylight metrics such as daylight autonomy, useful daylight illuminances and daylight autonomy uniformity index (as developed by this author) are capable of comparative studies and evolved in retrofitting existing classroom windows for a more efficient use of day lighting in the tropics.

Keywords: Day lighting, Daylight Autonomy (DA), Climate Based Daylight Modelling, Useful Daylight Illuminances and Retrofitting
OUTWITH DOMAIN...WITHIN TERRAIN
EFFECTS OF EARLY DESIGN ENERGY MODELLING ON
ARCHITECTS’ DESIGN PRACTICE

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ABSTRACT: This paper examines the effects of early stage design energy modelling technology on architects’ design practice. Energy analysis in design has traditionally been the domain of the building services engineer with emphasis placed on verifying established building simulation models at late stages in design. Recently, however, with advances in digital design media, leading architectural firms are acquiring in-house design simulation for energy modelling. The effects of broadening the use of energy modelling technology on architecture design practice or the design process are however, poorly understood. Industry and academic attention has been gathering on the topic of building performance simulation with most of the focus placed on standardising the wide array of tools and narrowing the broad spectrum of analysis parameters. Few discussions examine approaches to energy analysis across the diverse design settings and the principles, assumptions and identities designers negotiate. The analysis draws on institutional theory utilising semi structured interviews and focus group with 19 participants across 3 large international architecture firms. Preliminary findings indicate differing organizational, team and project approaches with an emphasis placed on legitimating established design assumptions across the three firms. The implications of the findings are twofold. First, the analysis provides an initial overview of how early stage design energy modelling is considered in design in architecture practice in the UK. Second, the paper provides an understanding of how architects negotiate meaning on energy in design. There are also implications for energy policy development in the context of the built environment particularly concerning building performance.

Keywords – energy modelling, building performance, architecture, institutional logics, design practice
ABSTRACT: Although lean and green targets have significant overlaps, the approaches are disconnected in most cases. Effective integration from early stages of design will be useful for efficient outcomes in construction. Moreover, several research papers and industry reports highlight that the construction industry and built-environment are among leading sectors for energy consumption and greenhouse gas (GHG) emissions and the forecasts indicate increasing over the next decades. Hence our research aims at (a) exploring opportunities of integrating the two approaches at early stages of design and (b) developing lean-green integrated target model for whole-life values. The research methods in this ongoing exercise include focused literature review, surveys and case-studies. In this paper, a summary of interim findings from the ongoing research and an overview of the proposed conceptual model of effectively integrating lean and green objectives with efficient target value based design are presented.

Keywords – Lean thinking, Sustainability, Lifecycle, Target costing, Integrated Design
ABSTRACT: There is an unmet demand for affordable and sustainable walling materials for owner-builders in poor urban areas of the least economically developed countries (LEDCs). To ensure new materials meet needs, a Holistic Materials Design Requirements Framework (HoMDReF) is proposed which can assist researchers in new materials development.

Many rapidly growing countries in Asia and Africa have low economic development, with urban dwellers often living in inadequate housing. The lack of affordable, practical and sustainable construction materials is a significant barrier to achieving sustainable development.

Although several innovative materials have been developed that are more affordable and sustainable than “conventional” modern building materials, adoption has been very limited. Social science researchers have identified strong social, economic and cultural factors influencing the housing decisions by poor urban dwellers and these must be considered in addition to the technical and environmental factors usually focused on by researchers when developing innovative construction materials.

A multidisciplinary approach was used to identify the critical issues for walling materials for owner-builders in poor urban areas. Issues are presented in the HoMDReF under technical, environmental, economic and socio-cultural categories.

This problem-first approach has confirmed that the current techno-environmental focus of researchers is insufficient. Researchers must consider early on in the design how new materials will fit in with people’s values and the urban economic context.

KEYWORDS: design methodology; sustainable materials; urban poor; housing
ABSTRACT: Assessing the sound reduction through open windows is a critical element in the design of low carbon buildings. Current practice is simply to use a figure of 10-15 dB for the loss of sound through an open window, irrespective of window type, angle of sound to the window and the open area of the window. This overly simplistic approach is adopted due to the challenges in acoustically modelling and measuring open windows, as well as quantifying the characteristics of façade openings in a manner that can be used by engineers to undertake noise break in calculations.

Blanco, Nunes & Lo (2014) addresses the issues of quantifying the acoustic performance of open windows, based upon Napier University’s work (2007). The use of Finite Element Modelling and Finite Time Difference Modelling have then been shown to be useful tools in understanding the passage of sound through open windows, highlighting the effects of sound field conditions and the angle of incidence to the window/vents. Blanco, Nunes & Lo (2014) concludes with a simple way of characterising the acoustic performance of open windows, enabling consultants to obtain the overall sound reduction of vented façades.

This paper follows on from this point, assessing different window arrangements using 2D Finite Element Modelling FEM. Due to using 2D modelling, data presented in this paper is not comparable to test data, however the principle and the sound passage through different window arrangement is explored in detail through the results of FEM modelling.

Keywords – Sound Reduction, Open Windows, Natural Ventilation, Acoustics, Vented Facades
STORYTELLING IN ARCHITECTURE – THE COMMUNICATION OF WELLBEING
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ABSTRACT: One of the key elements of a successful integrated design process is the productive, precise and constructive communication between the parties involved. This paper is focused on storytelling as a means to establish such communication between the client and the architect.

The importance of a design brief and the methods for forming one are already established and applied, usually resulting in a multi-layered analysis of the site, a working functional disposition, a range of stylistic references and more or less accurate budget objectives. However, the brief is seldom directly addressing the premise that the aim of architecture is to create spaces of wellbeing. Since every client has a unique deep perception of what wellbeing is for them, each client latently possesses a unique set of notions that can fundamentally inform the design. Those notions may or may not be coherent, rational or conscious, but they will affect the decision making and the outcome of the design process. The architect and the client can work together to express and develop those notions as a coherent narrative, i.e. a story. It makes sense to create this story before making design sketches, quantifiable data and architectural forms. Otherwise there is a risk of omitting the client’s wellbeing from the design process.

The paper presents and examines examples of the use of storytelling in the author’s architectural practice. It discusses the benefits and challenges of storytelling and underlines its importance as a design tool within the integrated design process and within architectural education.

Keywords – Storytelling, Integrated design, Design brief, Wellbeing, Atmosphere
FRAMING DURING PROJECT DEFINITION IN ARCHITECTURAL PRACTICE – AN INITIAL REVIEW OF THE LITERATURE

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ABSTRACT: Our research is based on the premise that within architectural practice, the development of a final project brief and concept design is influenced by the ability of designers to build a shared understanding of the ambitions for a project, and constraints on delivering these. This paper reports on a review of the literature examining how designers approach the briefing and concept design stages of a project, which suggests that understandings are gained, at both individual and team levels, by ‘framing’ the design situations created by those managing the process. Our findings are then discussed within the context of how attempts to control and manage the activities of designers during initial project definitions could influence the ability of the project team to build a shared understanding. We then offer suggestions for further research that may allow us to gain a more detailed understanding of the issues we have identified. This review is at a formative stage, underpinning research to explore the influence of commercial practices within architectural design on the activities of, and within, multi-disciplinary teams during a design project, with focus on the early ‘definition’ stages.

Keywords – Frames, framing, experiential learning, team framing, architectural practice, design management
MAPPING ONE YEAR’S DESIGN PROCESSES AT AN ARCHITECTURE FIRM SPECIALIZED IN SUSTAINABLE ARCHITECTURE – HOW DO SUSTAINABILITY CERTIFICATION SYSTEMS AFFECT DESIGN PROCESSES?

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ABSTRACT: The current study mapped how a Danish architecture firm integrated sustainability in their projects over a year. All the projects concerned were aimed at being sustainable within the framework of the DGNB certification system. The focus of DGNB is equally divided between environmental, economic and social aspects. During the mapping process, a picture was drawn of the state of the art for integrating DGNB in design processes and of the challenges involved. Case studies formed the basis of the study and helped substantiate the complexity of integrating DGNB’s criteria as design parameters in practice.

The framework for the study is the increased focus in recent decades on minimizing the energy consumption used for operating buildings, because the building industry accounts for 40% of the total energy consumption in the EU. This focus has led to more optimized design processes within the framework of the Integrated Energy Design (IED) method, in which many decisions related to indoor climate and energy consumption are made in the early stages of the design process and have therefore become an important design factor for both architects and engineers. The tendency is now to widen the perspective to design decisions in all phases of the entire lifecycle of a building. Life Cycle Assessment (LCA) moves to the fore in the design process to make it possible to meet the overall purpose of reducing CO₂ emissions and the general environmental impact of the entire building industry.

Keywords – IED, DGNB, Design method, Sustainability, Case study
ABSTRACT: The integration of decentralised building services into façade components presents advantages not only in functional terms, but also from a construction standpoint. However, this integrated approach seems to be too complex to allow for widespread implementation, having stand-alone examples instead of understanding it as a possible path to follow for the development of high-performance buildings. This paper seeks to define the main problems at design, construction and assembly stages to generate new knowledge based on practical experience; and to discuss the perceived barriers to overcome in order to promote widespread integration in façade systems.

The method chosen to achieve the objectives was an exploratory survey addressed to professionals with practical experience in the development of façade systems for office buildings, situated at any stage of the design and construction process. Hence, architects, façade consultants, system suppliers and façade builders were considered. The survey was conducted from mid-September to mid-November, 2015 and was distributed both as an online form and in printed format among several professional and research networks related with façade design and construction. 133 questionnaires were recovered, consolidating a final number of 79 valid questionnaires. Preliminary results show that the main problems of the overall process are related with coordination issues among different disciplines and stakeholders, while other problems such as costs and lack of knowledge have more impact on particular stages within the design and construction process.

Keywords – Integrated façade, survey, building services integration
How to educate for integrated design at the Royal Academy of Fine Arts, School of Architecture, KADK?

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ABSTRACT:
Motivation:
In August 2014, the structure and curriculum of KADK was re-organized. The bachelor study at the school of architecture is structured around six different subject fields, one for each semester: Settlement, Organisation, Materials, Aesthetics, Practices and Project.

Problem statement:
Every semester starts with a transdisciplinary six-week course. The involved lecturers for each course are representing all institutes in terms of their daily research. Instead of only promoting their individual field of knowledge, the lecturers are now asked to contribute to an integrated 'universe' of knowledge. The ongoing discussion about how to educate for applied construction at an academy of fine arts is a central issue for this paper.

Approach:
The course for 3rd semester under the heading MATERIAL-assemblages, makes explorations and synthesis in models and material visualizations of building elements scale 1:1 and 1:10. The intention of the course is to examine the materials in their interaction as it unfolds in the building element. Materials interact not only with each other but also with the conditions they work under, thus the building element can be perceived as an assemblage. In order to be able to maneuver in such complex situations, it is essential to know how materials relate to each other.

Results:
The transdisciplinary platform might threaten the integrity of the research expert, but the interpretations of the assemblage-models seem to create coherence between otherwise isolated fields of knowledge.

Conclusions:
The 6-week course MATERIAL-assemblages, unfolds a way to create research platforms and education in integrated design.

Keywords – Applied construction, Material assemblage, Educating transdisciplinarity, Emergence
UNDERSTANDING INFORMAL COMMUNICATION NETWORKS IN ENGINEERING DESIGN CONSULTANCY DECISION-MAKING: AN EXPLORATORY STUDY

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ABSTRACT: This research paper generates a deeper understanding of the various informal network roles that actors (managers and employees) play depending on their network position. The significance of hidden community structures and collaborative activities are analysed using Social Network Analysis (SNA) to capture and visualise the relationships. Data is collected from an in-depth case study of a single Engineering Design Consultancy working on a large infrastructure project.

The outputs of the study promote the growth of SNA as an analytical tool. Specific recommendations include: the identification of the main communication paths to be implemented in future projects; the overall encouragement of informal exchange; office restructuring; in-depth employee training; and the further use of SNA to highlight communication dysfunctions and to develop suitable remedial strategies.

This paper is an exploratory study. The results contribute to the bigger picture of providing a better understanding of informal communication networks throughout project teams. The comprehensive simulation and of the significance of informal social structures that operates ‘behind the chart’ in large construction project remains a challenge for future researchers.

Keywords – Informal networks, social network analysis, communities, project communication.
AN INVESTIGATION OF PERSON-CULTURE FIT AND PERSON-TASK FIT ON ICT ADOPTION IN THE CONSTRUCTION INDUSTRY
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ABSTRACT: Integrated work processes in the construction industry can be facilitated by suitable information and communication technology (ICT), which allows the project information to be digitally modelled, simulated, controlled and maintained. However, the introduction of ICT is not always successful. This paper examines individuals’ adoption behavior from the perspective of culture and task characteristics. Research has indicated the influences of cultural values and task characteristics on individuals’ adoption behavior, but individuals’ adoption behavior is contingent on the fit between an individual, organizational culture, and tasks. Thus, the missing links between person-culture fit, person-task fit and individuals’ adoption behavior are worth investigation. A questionnaire survey to explore the relationships between person-culture fit, person-task fit and individuals’ adoption behavior in this study shows that person-culture fit affects individuals’ adoption behavior through the mediation effect of person-task fit. The practical implication is that it reminds the ICT managers to pay attention to the human resource aspects. Successful ICT adoption needs employees to comply with new organizational cultural values and have special qualifications to fit the new work environment.

Keywords – ICT adoption, person-culture fit, person-task fit, person-environment fit theory
TOWARDS SUSTAINABLE ENERGY INTERVENTIONS
A Study of Historic and Modern Seaweed Houses With a Focus on Tectonic Analysis and Interpretation
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ABSTRACT:
Material and energy overuse of the past centuries has created a need for energy sufficiency and a sustainable building culture both in new constructions and in existing buildings. But conventional interventions like energy renovation neglect the embedded energy and the tectonics of the existing buildings. In the vernacular architecture problems of insulation and thermal radiation have also occurred. Their tectonic is rational, built upon material austerity and high levels of recyclability. Through a case study of a philanthropic project on revitalization of seaweed houses at the island Læsø, Denmark, this paper investigates if the historic seaweed material and building technique has informed new constructions. Furthermore, it discusses how new interventions can be integrated into the tectonics of an existing building and if the historic knowledge can contribute to the modern concept of energy interventions with a focus on material recyclability.

Keywords - vernacular architecture, tectonics, recycling, energy interventions
UNDERSTANDING THE COMPATIBILITY OF UK RESOURCE FOR DOWEL LAMINATED TIMBER CONSTRUCTION
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ABSTRACT: Dowel Laminated Timber (DLT also know as Brettstapel) is a technique of constructing large-scale solid timber panels for use as structural or non-structural elements. The technique utilizes smaller sawn timber sections mechanically fixed together with timber dowels by means of moisture movement. Moreover, as DLT utilizes locally sourced material and does not include adhesives it can be considered a natural low carbon value engineered product.

This paper presents the findings of an industry and academic collaborative project to determine the viability of producing DLT from UK Larch given the spread of Phytophthora Ramorum (commonly referred to as Ramorum disease). The work undertaken evaluated:
• The compatibility of Larch resource with the production method including a review of supply chain considerations in Scotland.
• Timber-dowel-timber connection research to determine optimized configurations relative to panel load span conditions.
• Structural appraisal of DLT systems for use in flatwise orientations for floor panel specification.
• Determination of intermediate floor panel to wall detailing in accordance with Eurocode 5.
• Appraisal of DLT panels trial in a new build project as floor panels.

Keywords - Brettstapel, product development, in-situ testing, engineered wood products
ORIGIN OF JOINT COURSES IN ARCHITECTURE 
AND CIVIL ENGINEERING AT THE UNIVERSITY OF 
BATH
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ABSTRACT: This paper reviews the origins of the Department of Architecture and Civil Engineering at Bath University and outlines the beginnings of joint education of architects and engineers within the Department. The circumstances surrounding the instigation of joint education and the people responsible are described. Original undergraduate degree programmes in Building Technology are examined and their early development considered. This will be undertaken from a personal perspective and will primarily consider the progress of the engineering courses from 1965 until 1984. The paper concludes with a number of personal observations by the author about the issues surrounding joint education from someone who began his studies as an undergraduate student of Building Technology at Bristol CAT in 1966 and who joined the Department as a lecturer in 1976 and who tutored joint design projects for over 28 years.

Keywords – Design Education, Joint Projects, Engineering
INTEGRATED DESIGN PROCESS
IN ARCHITECTURAL EDUCATION: THE CONSTRUCTION PROJECT STUDIO EXPERIENCE
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ABSTRACT: While the design act constantly approaches a final solution, technology introduces a vast amount of design possibilities. Therefore, it requires a multi-disciplinary design team, transfer of information and ideas between team members, and development of the design project through integration of design ideas and design principles of each expertise area into the design activity. Key role is the leading architect’s since it must be ensured that complex interactions between different areas of expertise are handled and appropriate choices are made while sub-systems are developed into a whole. Despite the fact that design synthesis and technological accommodation are so interwoven in the construction industry, in architectural education, the most cited problem is the gap between design studios and the so-called service courses, e.g., building construction, environmental design and structures. Although most design studios in architectural education distinguish between them, in fact, the solution is simple and well-known: an integrated design process in architectural education. The focus of this paper is on the “Construction Project” studio, held in the seventh semester at ITU, Department of Architecture, Turkey. The professional architecture office environment is simulated in this studio and each student is expected to design a “well-integrated” building. The studio structure orients students in retrieving knowledge, using the retrieved knowledge in decision making, and developing design by integrating different solutions appropriately. Meanwhile, experts with different disciplinary backgrounds are engaged with the projects, so that the students experience the team work with the role of leading architect. The design progressions are tracked and reported. Analysis of the design activities and the projects as the final output along with the feedback from the experts, allows a design framework to be described regarding both integration of the sub-systems and the iterative nature of design. Finally, the systematic process of the studio is presented and supported with results of a survey.

Keywords—inegrated design, architectural education, design process, design activity, construction project
ABSTRACT: Aesthetics in architecture is still an interesting research field, since exploring the roots of subjective experience of beauty creates a great divergence of views on aesthetics. Aesthetics has been studied in a large number of researches at building level. Also a vast amount of research on architectural details has been done with the functional and constructability point of view. Although “aesthetics” is sometimes defined as a design parameter for details, it remains largely shrouded in mystery, because of the dominant character of subjectivity in aesthetic perception.

In this paper, it is questioned, whether it is possible to list aesthetic aspects at detail level and to develop a systematic evaluative approach. Overall, an investigation on visual elements in a composition that trigger a particular feeling and the relation between tectonics and aesthetic judgement is attempted. In developing the approach, aesthetic approaches at building level are collected, analysed and their applicability to architectural details is investigated. A selected set of aesthetic aspects is adapted to detail level and an analysing tool is generated in a step-by-step fashion. The proposed tool allows for a “descriptive” holistic evaluation, consisting of building and detail levels, so that it reveals the detail’s whole-part interaction with the building. Also functionality and constructability reasons for form giving is analysed in line with aesthetic aspects for a better understanding of the detail. This approach is aimed to be a starting point for not only functional and constructible, but also aesthetic detailing. The tool is tested on architectural envelopes’ details, the results and usability of the tool is presented in conclusion.

Keywords – aesthetics, architectural detail, visual analysis, visual perception, tectonic aesthetics
ABSTRACT: This paper discusses the research design for a PhD project that examines how ‘early career architects’ engage with detailed design in architectural practice. The literature on detailed design in architectural practice points to a dominant discourse of experience informing decision making in preference to other forms of information, such as written guidance and standards. The literature gives only brief glimpses of recent graduates who can be considered ‘early career architects’ in relation to this dominant discourse. The literature also identifies that these ‘early career architects’ are encountering architectural practice as a discourse that is distinctively different to the discourse of architecture school. This research considers how these ‘early career architects’ learn to operate in an experience dominated setting. The research adopts an ethnographic approach using observation, diaries and interviews with participants to build a picture of their every-day actions and interactions during detailed design. The ongoing pilot study highlights a number of issues that this approach has raised and how they are being addressed in a practical way.

Keywords – Detailed Design, Ethnography, Experience, Early Career Architects, Architectural Practice
SPACE MANAGEMENT AND QUALITY OF LIFE OF OLDER ADULTS IN PUBLIC AND SUBSIDIZED HOUSING IN HONG KONG
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ABSTRACT: Public and subsidized (P&S) housing in Hong Kong is a mass housing programme initiated by the government to provide affordable housing to low-income citizens. Although there have been significant improvements in the design of P&S housing in the last five decades, spaces for conducting daily life activities are still limited. Due to changes in their mobility, older adults may spend more time within their living environment and may need additional space to maintain their quality of life (QoL). This study therefore assesses the effect of space management (SM) on QoL of older adults in P&S housing. A questionnaire survey was designed to investigate the relationships between SM items and QoL of older adults in selected P&S housing. The following SM items were identified: distances between rooms, sizes of various rooms and indoor barrier-free designs. On the basis of facets of the World Health Organization scale, the study examines the physical health, independence and overall QoL. The results of the statistical analysis indicate that for older adults, (1) distances between rooms, sizes of rooms and indoor barrier-free designs are significantly related to energy and fatigue, sleep and rest, activities of daily living and QoL; (2) distances between rooms significantly affect overall health; and (3) indoor barrier-free designs significantly influence mobility. The study recommends that the Hong Kong government review the minimum space requirements in P&S housing so as to create more space and walking distance for older adults in their unit flats. This will help them to perform their daily life activities and maintain good health.

Keywords: Barrier-free design, Distance, Older Adults, Quality of Life, Space Management.