2012

Construction Abstracts

Second Annual International Conference on Construction 18-21 June 2012, Athens, Greece

Edited by Gregory T. Papanikos

THE ATHENS INSTITUTE FOR EDUCATION AND RESEARCH

Construction Abstracts

2nd Annual International Conference on Construction

18-21 June 2012, Athens, Greece

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Preface

This abstract book includes all the abstracts of the papers presented at the *2nd Annual International Conference on Construction, 18-21 June 2012,* organized by the Athens Institute for Education and Research. In total there were 20 papers and 24 presenters, coming from 10 different countries (Algeria, Australia, Canada, France, Iran, Korea, Turkey, Saudi Arabia, UK and USA). The conference was organized into 7 sessions that included areas Architecture and Construction, Sustainable Urban Design, New Materials and Novel Technologies and other related fields. As it is the publication policy of the Institute, the papers presented in this conference will be considered for publication in one of the books of ATINER.

The Institute was established in 1995 as an independent academic organization with the mission to become a forum where academics and researchers from all over the world could meet in Athens and exchange ideas on their research and consider the future developments of their fields of study. Our mission is to make ATHENS a place where academics and researchers from all over the world meet to discuss the developments of their discipline and present their work. To serve this purpose, conferences are organized along the lines of well established and well defined scientific disciplines. In addition, interdisciplinary conferences are also organized because they serve the mission statement of the Institute. Since 1995, ATINER has organized more than 150 international conferences and has published over 100 books. Academically, the Institute is organized into four research divisions and nineteen research units. Each research unit organizes at least one annual conference and undertakes various small and large research projects.

I would like to thank all the participants, the members of the organizing and academic committee and most importantly the administration staff of ATINER for putting this conference together.

Gregory T. Papanikos
President

FINAL CONFERENCE PROGRAM
2nd Annual International Conference on Construction, 18-21 June 2012, Athens, Greece

PROGRAM

Conference Venue: Metropolitan Hotel of Athens, 385 Syngrou Ave., 175 64, Athens, Greece

Organization and Scientific Committee

1. Dr. Gregory T. Papanikos, President, ATINER.
2. Dr. Nicholas N. Patricios, Head, Architecture & Engineering Research Unit, ATINER & Professor, School of Architecture, University of Miami, USA.
3. Dr. George Poulos, Vice-President of Research, ATINER & Emeritus Professor, University of South Africa, South Africa.
4. Dr. Nicholas Pappas, Vice-President of Academics, ATINER & Professor, Sam Houston University, USA.
5. Dr. Howayda Al-Harithy, Professor, American University of Beirut, Lebanon.
6. Dr. Stavros Alifragkis, Academic Member, ATINER, Adjunct Lecturer, Hellenic Army Academy & Research Associate, School of Architecture, National Technical University of Athens, Greece.
7. Dr. Thomas Attard, Associate Research Professor, Arizona State University, USA.
8. Ms. Despoina Kapodistria, Master Student, University of Cambridge, UK.
9. Dr. Regina Leffers, Professor, Indiana University Purdue University Fort Wayne, USA.
10. Ms. Ezgi Yurdakul, Ph.D. Student, Iowa State University, USA.
11. Dr. Margarita Kefalaki, Director of Communication, ATINER.
12. Ms. Lila Skountridaki, Researcher, ATINER & Ph.D. Student, University of Strathclyde, U.K.
13. Mr. Vasilis Charalampopoulos, Researcher, ATINER & Ph.D. Student, University of Strathclyde, U.K.

Administration: Fani Balaska, Stavroula Kiritsi, Eirini Lentzou, Konstantinos Manolidis, Katerina Maraki & Celia Sakka

C O N F E R E N C E P R O G R A M

(The time for each session includes at least 10 minutes coffee break)

Monday 18 June 2012

08:30-09:30 Registration

09:30-10:00 Welcome and Opening Remarks

- Dr. Gregory T. Papanikos, President, ATINER.
- Dr. Nicholas N. Patricios, Head, Architecture & Engineering Research Unit, ATINER & Professor, School of Architecture, University of Miami, USA.

10:00-11:30 Session I: Architecture and Construction

Chair: Dr. Margarita Kefalaki, M., Director of Communication, ATINER.

1. Wienand, N., Head, Sheffield Hallam University, UK. Architectural Technology: Theories, Myths and Legends.
2. Suyuk Makakli, E., Assistant Professor, Maltepe University, Turkey. The Relationship between Architecture and Technology.
3. Holdsworth, S., Lecturer, RMIT University, Australia & Thomas, I., Professor, RMIT University, Australia. Academic Development and Sustainability Education with Universities: Learning From Practice.

11:30 -13:00 Session II: Sustainable Urban Design

Chair: Alifragkis, S., Academic Member, ATINER, Adjunct Lecturer, Hellenic Army Academy & Research Associate, School of Architecture, National Technical University of Athens, Greece.

1. Tracada, E., Principle Tutor in Built Environment, University of Derby, UK. Biourbanism and Self-Organised Built Environment and Sustainable Communities during Times of Socio-Political and Economical Turmoil. (Monday, 18th of June, 2012)
2. Robson, K., Lecturer, RMIT University, Australia. Can Sustainable Construction Be Affordable?
3. Raso, V., Lecturer, RMIT University, Australia & Gharehbaghi, K., Lecturer, RMIT University, Australia. Optimisation of Infrastructure Systems for Melbourne.
4. Warren-Myers, G., Lecturer, Deakin University, Australia. Housing Typologies and Renovation: The Consideration of Sustainability in the Victorian Residential Market.

13:00-14:00 Lunch

14:00-15:30 Session III: New Materials and Novel Technologies I
Chair: Tracada, E., Principle Tutor in Built Environment, University of Derby, UK.

1. *Raju, G., Emeritus Professor, University of Windsor, Canada. Non Destructive Electrical Methods to Determine the Quality of Concrete.
2. Attard, T., Associate Research Professor, Arizona State University, USA & Zhou, H.N., Researcher, Arizona State University, USA. Sustainability of Strength and Ductility of Fatigue Damaged Concrete-Encased Steel Girders Rehabilitated Using CFRP and a Newly Developed Carbonflex Composite.
3. Meisam, M. H., PhD Student, Isfahan University of Technology, Iran. . New Techniques for Punching Shear Strengthening of Two-Way Flat RC Slabs.

15:30-16:30 Session IV: Project Management
Chair: *Raju, G., Emeritus Professor, University of Windsor, Canada.

1. Jones, B., Professor, California Polytechnic State University, USA. Computer Integrated Construction through IPD, BIM and Collaborative Engineering.
2. Aladag, H., Researcher, Yildiz Technical University, Turkey, Isik, Z., Assistant Professor, Yildiz Technical University, Turkey & Akkaya, D., Researcher, Yildiz Technical University, Turkey. Integrating Sustainable Key Performance Indicators in Construction Company and Project Success.

20:30-22:30 Greek Night and Dinner (Details during registration)

Tuesday 19 June 2012

09:00-10:30 Session V: New Materials and Novel Technologies II
Chair: Wienand, N., Head, Sheffield Hallam University, UK.

1. Richardson, A., Professor, Northumbria University, UK & Coventry, K., Professor, Northumbria University, UK. Concrete Porosity with Polypropylene Fibres and Silica Fume.
2. Bouguerra, E.H., Professor, Saad Dahlab University, Algeria. Phase Change Materials in Material Buildings for Energy Conservation. (Tuesday 19 June 2012)
3. *Gopu, V., Professor and Endowed Chair, University of New Orleans, USA, Maher, R., Structural Engineer, New Orleans, USA, Montgomery, S. Mathematician, U.S. Army Corps of Engineers, USA & Price, C., Researcher, Engineer Research & Development Center (ERDC), USA. Quality of Reinforced Concrete Housing in Asia.

10:30 -12:00 Session VI: Methodologies
Chair: *Gopu, V., Professor and Endowed Chair, University of New Orleans, USA

1. Choi, J., Assistant Professor, Korea University of Technology and Education, Korea. Development of an Alternative Estimating Method for Industrial Piping Construction Projects. (Tuesday, 19th of June, 2012)
2. Dimitriadou, E., Ph.D. Student, University of Bath, UK & Shea, A., Lecturer, University of Bath, UK. Experimental Assessment and Thermal Characterization of ETFE foil
3. Mahal, M., Student, Harvard University, USA. New Methodologies in Design and Digital Fabrication: A Case Study in Tropical Architecture.

12:00-13:00 Lunch

13:00-14:00 Session VII: New Materials and Novel Technologies III
Chair: Patricios, N.N., Head, Architecture & Engineering Research Unit, ATINER & Professor, School of Architecture, University of Miami, USA.

1. Fouchal, F., Assistant Professor, GEMH-ENSCI, France & Gouny, F., Ph.D. Student, GEMH-ENSCI, France. Geopolymer Binder for Wood and Earth Construction: Shear and Pull-Out Characterization.
2. *Hussain, R.R., Assistant Professor, King Saud University, Saudi Arabia. Process for Inhibiting Macro-Cell Corrosion during RC Construction Maintenance.

17:00-20:00 Urban Walk (Details during registration)

20:00- 21:00 Dinner (Details during registration)

Wednesday 20 June 2012
Cruise: (Details during registration)

Thursday 21 June 2012
Delphi Visit: (Details during registration)

Hande Aladag
Researcher, Yildiz Technical University, Turkey,

Zeynep Isik
Assistant Professor, Yildiz Technical University, Turkey
&
Durmus Akkaya
Researcher, Yildiz Technical University, Turkey

Integrating Sustainable Key Performance Indicators in Construction Company and Project Success

The leading power of construction industry may provide stable economic growth, which in turn has the potential to increase international rivalry with its own dynamics. The construction companies competing in international markets have to seek and implement the ways of gaining competitive advantage such as performance assessment in order to survive and improve success as well as coping with the rivals and sustaining the competition.

Nowadays, increasing awareness on sustainable development as well as environmentally friendly technological improvements and new management techniques force companies to transform their traditional ways of performance assessment considering the perspectives of sustainability such as "environmental", "economic", and "social" values. In pursuit of sustainability a company can have many advantages in national and international markets such as; declining costs and risks while increasing profitability, having clean technology, increasing reputation and growth rate of the company, coping with recent changes in technology and the ability to serve with latest techniques.

In this respect, in the field of performance evaluation Sustainable Key Performance Indicators (SKPIs) dealing with "economical, social and environmental" values should be added in addition to Key Performance Indicators (KPIs) which only measure time and production costs.

In this research, the effects of KPIs and SKPIs on success will be investigated separately and the comparison of SKPIs with the existing traditional KPIs will be established. Also it is aimed to determine social and environmental proceeds of SKPIs, in addition to the proceeds of KPIs such as increasing the company's and industry's success with their contributions to the country's economy.

Thomas L Attard
Associate Researcher Professor, Arizona State University, USA
&
Hongyu Zhou
Researcher, Arizona State University, USA

Sustainability of Strength and Ductility of Fatigue Damaged Concrete-Encased Steel Girders Rehabilitated Using CFRP and a Newly Developed Carbonflex Composite

Combining high load capacity and high ductility, concrete-encased steel, also known as steel-reinforced concrete (SRC), sections are gaining rapid popularity in building and bridge structures. In recent years, steel bridge girders have been encased into concrete to form the concrete-encased sections for various purposes, such as protecting the encased steel section from environmental-induced damage. The fluctuating nature of traffic loads causes these bridge girders to be susceptible to fatigue damage. This paper presents the experimental results of three fatigue-damaged concrete-encased steel girders that were repaired and subsequently rehabilitated using either conventional carbon-fiber-reinforced-polymer (CFRP) or a newly developed carbon-based composite termed "CarbonFlex" that sustain the high strength of carbon fiber while integrating significant energy dissipation and viscous damping. The restoration of the load capacity and ductility of concrete-encased steel girders that were retrofitted using either material was compared, and the benefit of using the CarbonFlex for retrofitting the fatigue-damaged flexural members is discussed. A iterative approach for analyzing the nonlinear load-deflection responses of CFRP or CarbonFlex retrofitted SRC sections with/ or without the presence of fatigue crack on the encased steel has been developed into a program called CSRAP-Flex. The computed moment-curvature and load-deflection responses using proposed CSRAP-Flex algorithm presented excellent accuracy in reproducing the experimental test results. Both experimental and computational results indicate that the CarbonFlex retrofitted girder provides excellent ductility as a result of the ductile strain-stress behavior of CarbonFlex, as well as the composite's large shock-absorption capability that enables the substrate structure to sustain the sudden burst of energy released from fracturing of the repairing welds. As a result, a significant amount of strength (67%) is sustained after the peak load is attained; conversely, the CFRP retrofitted beam exhibits a sharp decrease in strength as the retrofitting CFRP laminate ruptured immediately after the peak load.

El Hadi Bouguerra
Professor, Saad Dahlab University, Algeria

Phase Change Materials in Material Buildings for Energy Conservation

The effect of phase change material (PCM) integration in building components is investigated in mild climates. The incorporation of PCMs in building materials is particularly interesting since it permit to the thermal storage to become a part of the building structure and is completely passive. Simulations in a typical family house were made and the effect of incorporating PCMs on different buildings components was analyzed. Results show important reduction in cooling energy even in those climates characterized by low day/night temperature swings. Even if large quantities of PCM are necessary, a reduction of 20% can be obtained with reasonable thickness of PCM wallboards. The best position for PCMs is found to be on surfaces that undergo large temperature variations (connected to the outdoor air) like the ceiling for example. This position present the better compromise between energy reduction and PCM quantity used.

Jaehyun Choi
Assistant Professor, Korea University of Technology and Education, Korea

Development of an Alternative Estimating Method for Industrial Piping Construction Projects

The reliable forecast is the key element to the project success especially for most industrial construction projects that generally apply cost-reimbursable contracts for the major construction contract packages. The achievement of the reliable forecast depends on the project controls capability of measuring and tracking trends of performance and identifying and mitigating risks after an agreed baseline estimate and milestone schedule has been established. This research involves developing a project management system for the piping construction projects. Piping construction as a part of mechanical package usually takes over 30% of total efforts for the industrial construction projects, thus is typically recognized as a critical work scope for the similar kinds of construction projects. Therefore, the piping construction under budget and within schedule is one of the crucial tasks for management, and it takes accurate prediction of performance throughout the project execution process. The researcher suggests an alternative model be utilized to accurately forecast piping work efforts required for the piping construction. The model developed incorporates difficulty factors to estimate the level of efforts more accurately and the validation of the model is in progress. The researcher proposes to apply the difficulty factors to the piping construction by identifying and quantifying the effects of those difficulty factors. Furthermore, by applying the difficulty factors as the construction methods or sequence changes in the process of piping construction, the accuracy of estimating the level of efforts required for the remaining work scope improves significantly.

Eleni A. Dimitriadou
Ph.D. Student, University of Bath, UK
&
Andrew Shea
Lecturer, University of Bath, UK

Experimental Assessment and Thermal Characterization of ETFE foil

Co-polymer facade materials have been an exceedingly popular option over the past few decades in the building industry as part of an attempt to replace glazing and some of the disadvantages that accompany its use. ETFE membrane, the material whose initials stand for Ethylene TetraFluoroEthylene, seems to be the most promising case of this category. ETFE has been successfully used so far in high-profile projects as an innovative solution to issues that are related to energy-saving design challenges. In addition, it has presented significant savings on cost and structural support needs in comparison to conventional glazing due to its light weight and high visible light transmittance.

There is a lack of published investigation on the thermal behavior of ETFE. This study focuses on the examination of heat transfer through an ETFE membrane, which is compared with heat transfer occurring through a glazed roof subject to the same environmental conditions. This paper explores the heat transmission due to long-wave radiation through the material via scaled modeling of both ETFE and glazing under real weather conditions. The scale-model experiment measured surface and air temperatures, heat losses and solar gains, which are necessary to examine the material's impact on the overall energy consumption of a building. The paper concludes with an analysis of the experimentation results which indicate lower temperatures under night-time clear sky conditions below the ETFE roof, in relation to those below the glass roof. That results to a higher heating energy requirement within the ETFE model in comparison to the glazed model. The variations in the internal air and radiant temperatures as well as the energy consumption of each test model are compared and the results will assist in future work on evaluating the suitability of ETFE use in a broader spectrum of building applications and on minimizing energy use.

Fazia Fouchal
Assistant Professor, GEMH-ENSCI, France
&
Fabrice Gouny
Ph.D. Student, GEMH-ENSCI, France

Geopolymer Binder for Wood and Earth Construction: Shear and Pull-Out Characterization

The development of sustainable construction using earth material like wood frame construction with earth shows a new interest. The problem of such structures (wood and earth) is cracks which can occur along the year at the interface between earth bricks and wood frame. This can lead to a decrease in thermal efficiency of the building and obviously to aesthetic problem. Wood and unstabilised earth bricks are hygroscopic materials and show a different behavior with temperature and moisture variation. A material must be used at the interface in order to compensate swelling-shrinkage phenomena due to temperature and humidity fluctuation. Geomaterial binder appears as a good candidate to be used at their interface.

The aim of this work is to investigate the shear and pull-out behavior of a multi-material assembly in order to validate the feasibility.

Laboratory scale samples have been made for mechanical tests, morphological and structural experiments. Two different bricks were used for tests. Geomaterial binder is synthesized from metakaolin powder, silicate alkali solution and silica industrial waste. Tested samples consist on wood/ geomaterial layer/earth/ geomaterial layer/ wood.

First results show that geomaterial binder have good ability to stick on wood and earth bricks. A part of the binder is absorbed by wood and earth before the strengthening of the sample. This is confirmed by cartography X experiments which reveal the creation of a potassium layer interface. However the nature of the brick has an influence on mechanical properties and the earth brick seems to be the limiting parameter.

Vijaya Gopu
Professor and Endowed Chair, University of New Orleans, USA

Robert Maher
Structural Engineer, New Orleans, USA,

Speler T. Montgomery
Mathematician, U.S. Army Corps of Engineers, USA,
&
C. Price
Researcher, Engineer Research & Development Center (ERDC), USA

Quality of Reinforced Concrete Housing in Asia

Reinforced concrete has become a common choice for housing construction in areas of Asia once dominated by timber and masonry construction. This paper explores the use of reinforced concrete for housing in several regions of Asia and examines how construction practices vary based on material availability, the skill of local workers, building code enforcement, and the area's vulnerability to natural and man-made hazards. Regional variation in reinforced-concrete construction practice is reflected quantitatively in material strengths and properties and qualitatively in common design flaws and design features. An analysis of existing structures in this region should consider this variation. Additional research is recommended for improving the quality of reinforced concrete in regions that replace traditional construction with new reinforced concrete construction.

Sarah Holdsworth
Lecturer, RMIT University, Australia
&
I. Thomas
Professor, RMIT University, Australia

Academic Development And Sustainability Education With Universities: Learning From Practice

Current global trends provide qualitative and quantitative evidence of a world in crisis, describing the decline of our environmental and social systems. A dramatic change in our mindset and behaviour is required if this is to change, and education is seen as a means of addressing and resolving these environmental and social crises. However, current approaches to education are more aligned to educational practice than to praxis and are not necessarily the best models to achieve this transformative change. Sustainability education has been advocated as one way of achieving what is required

Despite international calls for sustainability education, and the arguments for a transformation of education, the principles of sustainability education have not yet been integrated into mainstream curricula. This is especially critical in universities, as they have a responsibility to lead society towards a sustainable future. Academic development is a key way to create change in academic learning and teaching praxis; we need academic development programs that are effective and efficient in facilitating sustainability education within universities. Currently there is a lack of support for the training, time and recognition from peers that would legitimise sustainability within universities.

This paper investigates how sustainability education is currently being implemented within universities and how we currently prepare our tertiary educators to teach and challenge students. Specifically, it identifies the requirements of academic development programs which will provide educators with the capabilities to deliver sustainability education. In order to determine what against the three themes identified in the framework. The results of the case studies are used to 'ground' the framework, and identify the features of academic development programs that are most likely to result in lasting change for sustainability. The findings of this research are transferable to universities around the world, as well as to other institutions aiming to develop academic development programs in sustainability.

Raja Rizwan Hussain
Assistant Professor, King Saud University, Saudi Arabia

Process for Inhibiting Macro-Cell Corrosion during RC Construction Maintenance

Chloride induced corrosion under coupled environmental effects of high humidity and high temperature often found in gulf marine environment is a very serious threat for durability of reinforced concrete structures. In the previous research, the authors experimentally corroborated re-corrosion in the repaired reinforced concrete patches in the form of macro-cells. But, whether this formation of macro-cell is influenced by the coupled effect of high temperature and high relative humidity remained a question and formed the basis of this research. This coupled effect is investigated by laboratory controlled experimentation at varying temperature at 30, 40 and 50°C and a high ambient relative humidity of 85% in environmental control chambers. Specimens were prepared having total chloride concentration in mixing water 3% and 5 % by mass of binder. From the experiment results interesting and novel observations, trends and behaviours have been identified. A non-uniform and non-linear corrosion reaction was observed even after the breaking of passive layer. Furthermore, a decrease in electrochemical corrosion potential and corrosion mass loss at 50º C in comparison to 30 and 40º C temperature conditions was seen. This may be due to the reduction of oxygen solubility in the pore solution at high temperature and blockage of concrete pores at high relative humidity. It is expected that a stable oxide layer may have developed under limiting oxygen controlled corrosion reaction. This can form basis for the development of a new technique to passivate steel bar embedded in chloride contaminated concrete and improve the method of repairs.

Barry K. Jones
Professor, California Polytechnic State University, USA

Computer Integrated Construction through IPD, BIM and Collaborative Engineering

The paper discusses a proposal for an integrating partnership for decision making at pre-construction stages of major construction projects. The environment proposed is one that fully utilizes the strengths of intelligent collaborative computer agents that interact with the muti-discipline pre-construction team to interrogate and refine the design solution before construction commences: An environment where the knowledge and intelligence of all domain-contributing agents can be employed. Better opportunities therefore exist to concurrently view the effect of decisions that impinge on the many contributors. All contributors are collaboratively drawn into the design and pre-construction process. Time is saved because a concurrent problem solving approach is adopted rather than a sequential problem solving approach that has typified pre-construction activities. BIM and IPD form essential tools and strategies in this decision environment.

Experts can still be geographically or functionally distributed, this also presents the opportunities to take advantage of recent technology in communication systems (co-operative distributed, broad band, etc.). The complexities of the design process can be broken down over numerous agents in different countries. Systems architecture for computer support of the design process can be more efficiently designed. Finally, the environment proposed could be extended to continually monitor and assist safety decisions throughout the life cycle of construction projects.

The author's investigation measured the views of practitioners in the main building professions; architecture, engineering and construction management before proposing the collaborative system that is called for. The conclusion of the work is a conceptual model of the system proposed, a definition of the contractors' construction management computer agents and a specification based on scenarios of how they would interact with design agents. In addition the assistance of BIM and IPD will be discussed.

Michael Mahal
Student, Harvard University, USA

New Methodologies in Design and Digital Fabrication: A Case Study in Tropical Architecture

For more than one hundred years now, architecture has been far behind other industries with regards to its means of construction and fabrication. Currently, there is a gap between the conception of ideas and forms, and the way these are realized through the construction process. Some architects and designers have overcome this and are using new means and methods of simulating and fabricating buildings; however, the standard for construction in architectural practice is actually leaving little room for the role of the architect at all. In many countries, architects play a large part in the beginning phases of the design, and then have little or no responsibilities in the construction process. This is a sure path to making the architect obsolete in his own profession.

This paper will propose a new methodology of practice where the role of the architect is, once again, to build. The discourse of architecture is moving in this direction, but it is by no means the standard. The claim will be made here, that informed design decisions of geometries and construction assemblies with the intent to digitally fabricate, will improve the efficiency and quality of the design and construction process. This project will include an explanation of which software and fabrication tools aid in the realization of projects, as well as a proposal of work flows and design examples that illustrate how modeling software can be used for output data that is not limited to two-dimensional paper documents.

This proposal will be illustrated through a case-study of a climatically responsive house in Miami, Florida. This will be done in order to show how informed design strategies, linked to climate, construction and culture can form a new methodology for architects from the design conception through the construction phase. New wall assemblies and passive design strategies will illustrate how the role of the architect today should be directly linked with the contracting role of builders. By claiming that the construction and design processes should be considered as one practice, I will illustrate how this combination can increase the efficiency and quality of the building process.

Mohammad Hasan Meisam
PhD Student, Isfahan university of Technology, Iran

New Techniques for Punching Shear Strengthening of Two-Way Flat RC Slabs

Flat concrete slabs have been suffering from weakness in shear resistance in many buildings and parking structures. Therefore, many research works in recent decades have been concentrated on novel strengthening techniques of two-way concrete slabs against punching shear. As an attempt to this move, results of an experimental work on 4 flat two-way slabs with central loading are presented in this paper. The reinforced concrete (RC) slabs were designed according to ACI 318-05 code provisions. One of the slabs served as control specimen and three others were strengthened with different materials and procedures. The first slab was strengthened with new shape of steel stirrups, the second with M16 screw and nuts and the third one with CFRP rods. The strengthening was performed at 24 points with identical arrangement for all three slabs. Specimens were tested under monotonic central load through a steel plate using a hydraulic jack up to failure. The control slab failed due to punching shear during the loading; however, test results showed that all strengthening techniques were successful to prevent from punching shear. The results also showed significant increase in loading carrying capacity and displacement ductility for all strengthening procedures.

Gorur Raju
Emeritus Professor, University of Windsor, Canada

Non Destructive Electrical Methods to Determine the Quality of Concrete

There is a great need to explore and develop non-destructive testing methods of concrete to ensure proper curing and it possesses required strength in construction and in service. Development of such methods will not only ensure the quality of plastic concrete but also provide a tool for continuous monitoring of strength of concrete over its life. Isolated experiments using electrical methods have been reported in the literature without any connection being explored between the electrical properties and quality of concrete. This study was designed to explore and develop experimental methods that result in a relationship between the electrical and mechanical properties of concrete. Concrete is an insulating material from the electrical point of view and large volume of theory and experimental techniques are available to study the insulating properties of materials used in electrical and electronic equipments. This study was oriented to examine whether those theories and experimental techniques, could be applied to concrete, with suitable modifications to its specific nature and properties. To facilitate this objective, several equivalent circuits were investigated to represent concrete as an insulating material. Simple measurement of resistivity alone has been undertaken by several previous investigators and it was felt that this information is not sensitive enough for making any conclusive comments on the quality of the concrete because the response of resistance to a stimulus is frequency independent. Therefore, a more sophisticated method based on fundamental electrical theory was developed in this study. The frequency and duration of application of the applied electrical field generate specific responses that vary with the quality of the concrete and its compositions. The electrical methods are also more sensitive to moisture content and internal defects such as cracks and voids. The experiments for various concrete mixes and sample dimensions were conducted with continuous monitoring as the process of curing progressed from casting to final stage. These experiments, conclusions drawn, proposal for a diagnostic method and possibility of future developments are discussed in this paper.

Vincent Raso
Lecturer, RMIT University, Australia
&
Koorosh Gharehbaghi
Lecturer, RMIT University, Australia

Optimisation of Infrastructure Systems for Melbourne

Infrastructure is an integral part of Australian and Melbourne economy, thus the precise implementation of the Infrastructure Systems is a must. This implementation highlights the importance towards the development of sustainable communities for Melbourne's future. The demands on Infrastructure services for Melbourne has been constantly increasing causing significant congestion within all main Infrastructure services. Rapid urbanisation in Australia is straining the public sector's ability to provide essential Infrastructure services. Although some progress is made in extending power, water, telecommunications, transportation and waste collection services, the delivery of these services lags far behind the needs, and the quality of some services remains poor.

Alan Richardson
Professor, Northumbria University, UK
&
Kathryn Coventry
Professor, Northumbria University, UK

Concrete Porosity with Polypropylene Fibres and Silica Fume

Purpose -This research examines the effects of Type 1 and Type 2 synthetic polypropylene fibres in concrete, with and without silica fume, regarding porosity. The raison d'être for the research is to examine the porosity of fibre concrete where the concrete may be subject to a hydrostatic pressure from water. The use of silica fume defines the positive benefits that can be achieved by utilising a waste/by product in a concrete mix.

Methodology – The standard for determining the penetration depth of water under pressure (BS 12390: part 8 2009) in concrete was used with two types of synthetic fibre (Type 1 and Type 2) and plain concrete, with and without silica fume were subject to a water pressure test over 72 hours to determine the depth of water penetration.

Findings - The findings showed that synthetic fibres when added to a concrete mix increase the porosity of the concrete when compared to plain concrete, however when additional silica fume is used at a dry rate of 10% to the dry mass cement content or 20% slurry content, the porosity of the concrete is significantly reduced.

Originality – Designers and contractors use fibre reinforced concrete to create water retaining structures. Low permeability equates to more consistent and better stored water quality. This research demonstrates the effectiveness of silica fume, which improves the performance of the concrete with regard to porosity and mitigates the effects of the synthetic fibre inclusion. Low absorption in concrete equates to low life cycle costs and good sustainability credentials through the use of a by product.

Kathryn Robson
Lecturer, RMIT University, Australia
&
N. Walter
Lecturer, RMIT University, Australia

Can Sustainable Construction Be Affordable?

It is a commonly held belief that building sustainable houses is more expensive than using traditional construction materials. Given Australia's housing affordability crisis, the implementation of mandatory 5 and now 6 green star ratings has caused controversy due to the increased cost to buildings. There is a general trend in the literature that housing affordability and sustainable initiatives are mutually exclusive. In the context of ensuring that Australian housing in the future is both sustainable and affordable there needs to be a focus on which practices contribute the most, in terms of overall benefit, both financially and sustainably.

This research examines a number of construction sustainable technologies to determine which have the greatest benefit for affordable housing construction. The methodology provides an analysis of the qualitative data in the form of a questionnaire presented to industry professionals. The quantitative data will involve a comparison of a number of sustainable and standard technologies currently used in housing construction. The research analyses the current sustainable building methods and technologies available including: energy use in residential and commercial buildings, sustainable aspects of ventilation systems, sustainable facade/HVAC, double skin facades, rain water harvesting tanks and grey-water/black-water recycling. In addition, the materials used in buildings and building design and fit-out of buildings have also been examined in terms of sustainable benefits and the question of affordability.

The findings of the research indicate that some of the most likely cost/benefit technologies that can assist with sustainable construction include the use of double skinned facades and energy saving appliance technologies. When these are coupled with the relatively low costs of smart design and building orientation, it is possible to achieve significant benefits in heating and cooling at very small increases in the unit cost. Although there are many sustainable building innovations that can be installed in residential buildings it is still possible to make use of the cost effect ones to ensure that new housing construction can remain affordable.

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The Relationship between Architecture and Technology

The development of civilisation is inseparably bonded to the technology that has the tendency to transform everything and architecture is affected by the thrust of technology through history.

Some technological advances have the potential to change conceptually the design practice with new functional solutions and aesthetical expressions. The technological development of architecture has been dependent on discoveries surrounding the best capacities of each material and architecture presents itself with different materials that made it. The Industrial Revolution's central material fact, industrialized iron brought new possibilities, and drastically changed most of the traditional modes of design and construction. New structure systems and building forms appeared without precedent in the previous history. Architects began to be confronted with engineered materials.

In time not only new produced engineer materials but also digital Technologies have transformed the methods and meaning of design and architecture. With new technological improvements, the conventional limitations of building design dissolved with unprecedented structures. Currently, construction industry is able to use several technologies such as information technology, modern science, e.g. nanotechnology, biotechnology, robotics etc.

In this study above mentioned technologies analysed briefly and among them nanotechnology became prominent as it has potential to be the Industrial Revolution of the 21st century. It promises a driver of change in the future by the understanding of materials and controlling their structure at the nanoscale. Since it is considered as the most influential technology of the time, nanotechnology is explicated in detail.

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Biourbanism and Self-Organised Built Environment and Sustainable Communities during Times of Socio-Political and Economical Turmoil

In many cities, people are suffering by being restricted to live in unsuitable and often unhealthy spaces. Local authorities are not able to provide affordable housing and pretty often ageing population suffers by being excluded from social life and being confined in unsuitable high rise blocks. Thus, facilitated by the tutors, our undergraduate students in architectural courses recently carried out appropriate research and developed sketch scheme proposals for housing the so-called 'Modern age', alias 'ageing population'; we provided them with all necessary information about a site and they designed one or maximum two housing units inside a specified plot. They kept in mind though that local community links should be maintained and enhanced; ultimate aim was to create the neighbourhood of the future and, perhaps beyond.

All designs should guarantee accessibility to people with a range of physical and sensory disabilities. There was only one basic restriction: all designs for one or two units had to consider the use of 'recycled materials' as a 70%, at least, of the whole final solution. All solutions strived to provide accommodation and perhaps work space for the 'ageing' population. As a result we got a variety of solutions as combined efforts of a number of teams.

However, the most important thing was that, undergraduate students were able to test their abilities in research and design from the very beginning of their professional formation and directly contribute to academic activities of such importance. They had not only shared research findings with their tutors and peers, but also critically reflected on it and their final intend: to design for the 'ageing' population (by including their tutors and relatives today and them, in few years time). My paper will mainly focus to design thinking, co-designing and also socio-cultural issues in design, such as self-organisation and self build (by also including findings from my recent research activities inside a collaborative international project awarded funds from Leonardo Lifelong Learning European initiatives).

According several authors cities evolve their own organic and/or fractal form (and their complexity in neighbourhoods), as follows:

'Edges and interfaces are complex, fractal lines that make up a living city: they define spaces and built structures and not the other way

around. A city is made of interactive edges along which much of the human interaction that makes a city "alive" actually takes place.' (Salingaros, 2005)

And it is that exploration of self-organisation of edge areas and interfaces, which leads to functional developments of housing and integration of services. And finally this is one of the main aims of Biourbanism today.

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Housing Typologies and Renovation: The Consideration of Sustainability in the Victorian Residential Market

The sustainability of the existing housing stock is an area that receives limited recognition due to the focus on new homes and applicable rating tools. There is very little to encourage homeowners of existing houses, when renovating or refurbishing their homes to incorporate initiatives to improve the sustainability of the home. This research explores the different housing typologies in the Victorian market and the level of sustainability initiatives implemented during renovations or refurbishment. The research uses case studies of real renovations to examine initiatives implemented by homeowners across a broad subset of housing typologies. The research approach utilize observational inspection of homes in addition to an interview with the homeowner to understand their rationale for the renovation, implementation (or lack) of sustainability initiatives and key drivers or barriers for sustainability in the process.

This paper examines current environmental performance of the existing Victorian housing stock in order to evaluate likely opportunities for, and barriers to, improved performance when retrofitting, renovating or extending homes. Providing a greater understanding of areas to address in policy and building code requirements for sustainability in existing homes in the future.

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Architectural Technology: Theories, Myths and Legends

The professional discipline of Architectural Technology is one that sits somewhere between architecture, engineering and construction. In the United Kingdom it is represented by the Chartered Institute of Architectural Technologists (CIAT) who advocate that "The Chartered Architectural Technologist, MCIAT, will be able to analyse, synthesise and evaluate design factors in order to produce design solutions, which will satisfy performance, production and procurement criteria. This will be achieved through the design, selection and specification of material, components and assembly and the management, coordination, communication, presentation and monitoring of solutions which perform to the agreed brief and standards in terms of time, cost and quality". (http://www.ciat.org.uk/)

The subject is well established as a professional and academic discipline in the UK, as discrete from, yet complementary to mainstream architecture. The proposed paper seeks to examine the theoretical underpinning that supports the technical aspects of architectural design, contrasting historical precedents with current thinking and the role of mythology as inspiration in defining architectural technology.

A key aspect of this study will be an analysis of the differences in approach to technical design and the relationships between theoretical notions and evidence based design in defining the outputs of the different architectural disciplines. Central to this process is the examination of what theory means in this instance, its role in design generally and its application to architectural technology specifically. The significance and impact of the myths surrounding the role of technology in defining architecture and in the work of some of the legendary proponents of technology inspired architecture, will be expressed primarily in terms of the theoretical foundation it affords.

The paper will therefore endeavour to demonstrate the significance of theory in the technical design of architecture, the importance of a more expansive understanding of architectural technology as a concept and to illustrate the intrinsic value of myths and legends.

The resultant point of reference will be of interest to all the allied disciplines involved in the design aspects of construction.