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Sri Lanka

KDU iRC
INTERNATIONAL RESEARCH CONFERENCE

ABSTRACTS

Ecumenopolis: Global Collaboration and Asian Renaissance

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MESSAGE FROM THE SECRETARY TO THE MINISTRY OF DEFENCE

It is with great pleasure that I am issuing this message to the International Research Conference 2018 of the General Sir John Kotelawala Defence University (KDU) as the Secretary to the Ministry of Defence and the ex-officio Chairman of the Board of Management, KDU.

I wish to place on record my sincere appreciation to KDU for playing a leading role in molding the future of the military as well as civilian youth who are in pursuit of high quality tertiary education in Sri Lanka. Today, KDU has gained recognition as an excellent seat of learning and disseminating knowledge that empowers attitudes and develops skills of the young graduates. It also contributes immensely to the much needed research and innovation.

KDU IRC is an annual event in its calendar eagerly anticipated by many due to the significance it holds in providing a platform for both local and international intelligentsia to congregate, confer and disseminate knowledge. I am sure that, under this year's theme, securing professional excellence through collaboration, the conference will encompass a wide range of topics that are of utmost benefit for potential scientific and socio economic advancement in Sri Lanka.

While expecting to see great minds from all over the world meet and share their thoughts and knowledge at this event, once again I express my sincere appreciation to the Vice Chancellor and KDU staff for the enthusiasm and commitment shown towards making this scholarly experience a memorable one for its participants.

I wish that this international research conference would be highly productive for all participants – a conference that enriches the much needed research culture to ensure the nation's growth enabling to face its future challenges.

Kapila Waidyaratne
President's Counsel
Secretary

MESSAGE FROM THE VICE CHANCELLOR

I am delighted that we have been able to organize the 11th International Research Conference of General Sir John Kotelawala Defence Univeresity (KDU IRC – 2018) conducted on the overarching theme, "Securing Professional Excellence through Collaboration" and convened over two days, 13th and 14th September 2018 at the university premises. Hence, it is with great pride that I pen down my thoughts on this Abstract Book of KDU IRC-2018.

KDU IRC-2018 is a world class forum that brings professionals and researchers of various disciplines to a common platform to disseminate their valuable research findings. They are able to present, discuss and deliberate their research findings with peers and experts, both local and international, as well as engage in lively discussions on contemporary matters. The resource personnel of the conference are eminent Sri Lankan and foreign researchers, academics and professionals with international recognition including those of our own staff at KDU.

We are proud to have internationally eminent, Sri Lankan born scientists, such as, Prof. Mohan Munasinghe and Dr. Sarath D. Gunapala, as guest speakers at the inauguration of the conference. They have made our motherland proud in the international arena as renowned experts and intellectuals in their respective fields. Further, this conference is enriched with the participation of many local and foreign academics in varied disciplines; along with personnel from the tri-services and the police, thus making our conference the only research conference in Sri Lanka that brings together civilian professionals and their counterparts in security forces.

What is special about this conference is that the research papers are automatically uploaded to Google Scholar with H-Index Citations. The best papers are published in journals and others as proceedings. In addition, provision is given for live telecast of oral presentations through YouTube, and presentations on Skype, for international authors. The plenary sessions, pre/post-conference workshops and oral and poster presentations, would no doubt generate productive discussion and constructive criticism which would in return instigate thoughts for development in future.

I wish to record our gratitude to the Ministry of Science, Technology and Research and the National Science Foundation, not forgetting the Ministry of Defence, for their consistent support in co-organizing our conference, and my sincere appreciation of the academic and administrative staff of KDU together with our well-wishers for their invaluable contribution towards the success of this mammoth event.

Finally, I wish you, the presenters, good luck with your scholarly presentations at KDU IRC-2018 and the participants a memorable and thought provoking experience.

JJ Ranasinghe VSV, USP, psc, MSc (DS) Mgt
Rear Admiral
Vice Chancellor

MESSAGE FROM THE CONFERENCE CHAIR

On behalf of the Executive Committee, I am honoured and delighted to welcome you to the 11th International Research Conference of General Sir John Kotelawala Defence University (KDU IRC-2018); bearing the theme, Securing Professional Excellence through Collaboration. Over the past 11 years, KDU IRC has grown to be a major international research conference, continuing with its tradition of high-quality and broad international participation in all areas of research. Hence, it is a pride and honour to preside over this prestigious research conference in Sri Lanka.

I am very pleased to welcome you to KDU IRC-2018 which is based on fundamental concerns to all scientists and non-scientists alike. This conference also enables the exchange and dissemination of useful information on multilateral initiatives. Therefore in bringing us together, KDU IRC -2018 allows to seek out and forge new partnerships, and to engage relevant sectors in advancing the social and economic well-being of mankind.

KDU is gratified to have a line-up of highly renowned keynote and plenary speakers consisting of experts who would shed light on research and issues. In addition, this is an opportunity for undergraduates, researchers and practitioners to share their research and contribution towards the success of the respective professions, through oral and poster presentations.

The successful organization of KDU IRC -2018 required the talents, dedication and invaluable time of many academic and administrative staff of KDU, volunteers and strong support from our sponsors; the Ministry of Science, Technology and Research, and the Ministry of Telecommunication, Digital Infrastructure & Foreign Employment. Special gratitude and appreciation goes to the Presidents, Coordinators and the members of the numerous committees of the faculties. Without their wise advices and suggestions; outstanding organization, planning and performance, we would not have had such an excellent conference.

I hope KDU IRC -2018 would offer the participants a platform to exchange ideas, discover novel opportunities, reacquaint with colleagues, meet new friends and broaden their knowledge.

Dr Upali Rajapaksha
Conference Chair
11th International Research Conference

MESSAGE FROM THE PRESIDENT OF THE SESSION

It is an honor for me to write a message for the International Research Conference of General Sir John Kotelawala Defence University which will be held on 13th and 14th of September 2018 at KDU under the theme "Securing Professional Excellence through Collaboration". I, the Dean of the Faculty of Built Environment and Spatial Sciences extend my warm welcome to all local and international participants who attend the event which is of prime significance. Conferences are generally an integral part of the academic discourse. So the conference sessions held under the faculty theme "Ecumenopolis - Global Collaboration and Asian Renaissance" will be an opportunity to move ahead in the area of future planning in terms of intellectual growth, identification of challenges and so forth.

Architecture, Quantity Surveying and Surveying Sciences are no more in isolation. In this age of globalization and modern technology, there is a serious understanding for the linkage between Architecture, Quantity Surveying and Surveying Sciences Research and this Conference can be the prime motivation for the wings of change particularly in this part of the world. This is the point that we have to spread the effects of it, so we can positively transform the mindset of the people and bring forth qualitative change in the society through a meaningful research in the fields of Spatial Sciences. It is about time that we all sit together, seriously ponder on working out some solid framework for the coming generations and facilitate these disciplines according to the national need. I encourage the students to participate in such activities virtually. The youth of today, the pillar of the future world, has an enormous potential, thus it is essential to give an opportunity to express their views, conduct research and experiment, to bring a positive change in the contemporary world. I wholeheartedly wish the Conference organizers and the participants for success in this conference.

Dr A Ranjith Rupasinghe
President
Built Environment and Spatial Science

Plenary Session

USE OF HIGH RESOLUTION AND ACCURATE LiDAR DATA FOR UNDERSTANDING AND SOLVING PROBLEMS OF URBAN LANDSCAPE

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LiDAR technology uses laser to measure coordinates of large number of points on an object. The unique characteristics of LiDAR technology is that it gathers these data at a high speed, very accurately, and without missing any detail on the ground. In view of these properties, LiDAR has been found to be in use has been finding use in several applications including urban landscape. Urban landscape is marked with complexities of high order in terms of scale of objects present, details that are required to be known, variety of the objects and difficulty in carrying out traditional surveys. LiDAR therefore becomes the most appropriate technology to measure urban landscape. The data generated are coordinates of billions of points which represent every object present there. Along with LiDAR a digital camera is also often employed. This complements the geometric information given by LiDAR with the colour information thus making the data completed. LiDAR data from all three platforms, viz., aerial, mobile, and terrestrial are useful for urban landscape. There is a trend worldwide now to capture cities with these data. Recently we have captured such data for the City of Chandigarh and Bangalore in India.

The LiDAR data along with photographs provide several options to develop solutions for solving urban problems. These include urban drainage planning, urban flood modelling and forecasting, roof top solar potential estimation, revamping municipal property tax collection from buildings and billboards, urban transport planning, safe city, urban biomass estimation, air pollution modelling and disaster management. This talk will cover the principle of LiDAR technology, its operation in field, and some case studies on city mapping including developmental planning and roof top solar potential estimation. The talk will also outline the possibilities of financial models which should be adopted in order to generate these data and use the same for cities.

ENERGY POVERTY OF OUR LUXURIOUS BUILDINGS

Dr Upendra Rajapaksha
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With the issues arising due to lack of buildable land plots, high-rise office complexes and apartments can be considered as appropriate solutions in space utilization and green land conservation. This can be seen as a trend in global context where Sri Lanka is no exception. However, at the same time the urge to live in urban contexts has paved way to popularize extensively luxurious buildings. Thus, the more concern for high end luxury living has intensified the craving for energy. Available data demonstrate that Sri Lanka's contemporary urban building sector consumes excessive amounts of energy – national average of energy foot print of our typical office and multi-level apartments is around 250-300 kWh/M2/a or well above whereas some buildings have energy foot prints as high as 400 kWh/m2/a. This situation is problematic for a country with no renewable resources to produce energy.

The most luxurious buildings that do exist in Colombo demand excessive levels of energy for operation and show poverty in respect to energy demand. The reason for this is poor climate response of architectural design. A recent on-site thermal performance investigation performed on luxurious building sector in Colombo City on weekends reveals that indoor air temperature reaches 40 Degrees C or above easily during the day when the air conditioner is in off mode and when there are no occupants and equipment is not in operation. This suggests that solar heat gain through the building facades which make the building indoors hot ovens. Another investigation on air conditioned mode of office buildings reveals that there are situations where indoor air temperature during office hours in multi zones across the plan depths and lengths deviates up to 10.50 from the set point temperature (240 ^{0}C). The work highlights the severity of heat stress on indoor environments and thus energy sustainability, an issue to be addressed by optimizing the interplay of architecture with climate. Poor daylight efficiency and stressful behaviour of occupants due to overheated indoor environments are other concerns that need to be addressed. It is becoming vital to introduce a new definition to Luxury buildings; which in turn will enable the occupants to enjoy all comforts but without disabling the ability of the future generations. There are a number of design interventions that can be integrated with the plan form, sectional form and envelope at the design stage to achieve the above. Yet, it is unfortunate that we in Sri Lanka have failed to explore this through architecture, design and construction, rather, following trends and applying just only mechanical gadgets to claim buildings as energy efficient or carbon neutral.

ECUMENOPOLIS: GLOBAL COLLABORATION AND ASIAN RENAISSANCE: QUANTITY SURVEYOR'S ROLE

Prof Kanchana Perera
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University of Moratuwa, Sri Lanka

Ecumenopolis is a fictitious city, a single planet-wide city, where all inhabitants of the Earth live. Science fiction writers have long dreamed of a completely urbanized planet - a planet that is no longer "natural" and consisting of only a vast city. Ecumenopolis can be considered as a development arising out of urbanization and the growth of population, transport needs and human network. Ecumenopolis is overlooked as a city where the technology is used as an enabler and solution. We continue to witness the way technology progresses and changes the ways in which work is produced and maintained. The move will be first from metropolis to megalopolis and then to Ecumenopolis. Since this evolution is inevitable, it is important to start planning now itself for the Ecumenopolis to make it fully livable and comfortable for the mankind. With the concept of high urbanization, concerns on spatial development and related planning efforts, dynamics of modernization, utilizing information and communication technology, problems specific to urban areas such as flooding, garbage disposal, global warming and air pollution, fundamental changes in lifestyles, consumption behavior and production conditions do arise. Under circumstances, global collaboration will be very much necessary for the type of urban development envisaged. This is in other words, a global consensus as to how people should live in 'one city'. In global collaboration, people across the world communicate with one another for learning, knowledge sharing etc., using on line tools. Professionals can play a significant role in global collaboration to fix problems associated with the setting up of the Ecumenopolis. Complex interactions among human settlements, ICT and collaboration of professionals will help to build new urban spaces and landscapes of innovation and promote economic development, cultural interactions, political dynamics and social inequalities within cities and urban regions. Quantity surveyor as a professional involved in the built environment can help to properly manage the cost and value dimensions involved in city development. The future quantity surveyor will indeed be a smart technologist, who can collaborate with other professionals to develop integrated urbanization (Ecumenopolis) by simultaneously playing the roles of a BIM manager, cost manager, dispute manager, sustainability and cost coordinator, value management team leader, carbon accountant, data manager, interpreter, and manipulator. With this increased and diversified roles the quantity surveyors have to inculcate the skills and competencies expected of him in an Ecumenpolis. Professional bodies will also have to have a fresh look at their professional boundaries. Redefining of the role, skills and competencies of quantity surveyors is required to develop in themselves in ecological and political awareness, notions of public good, epistemological feelings at least provisionally, self-reflection and a knowledge on networking and information security and people management as they are to ensure a livable Ecumenopolis.

EVOLUTION OF THE GEODETIC CONTROL NETWORK OF SRI LANKA

Mr A Dissanayake
Deputy Surveyor General, Geodetic Branch, Surveyor General Office, Colombo

Geodetic control network provides a common reference system for establishing the coordinate positions of all geographic data. The main features of geodetic control network are geodetic control stations, which are precisely measured horizontal or vertical locations on monumented points used as a basis for determining the position of other points. These stations have published the datum values derived from observations that tie them together in a network of triangles. Establishing a network of stations with precise horizontal locations in Sri Lanka commenced in 1857 by selecting these stations on top of prominent hills and forest areas which were not fairly possible to reach, with two base lines, one being at Negombo between Kandawala and Halgasthota and other being at Baticaloa between Vaunativu and Tavelamunai. The two base line distances were measured and pre-determined accurately using INVAR tapes.

This network of horizontal stations comprised of 110 locations formed with 159 triangles across the country starting from Negombo base line and ending up with Batticaloa base line, computing sides of each triangle of the network by physically measuring its included angles with the help of accurately measured initial base line distance of Negombo. Finally, the computed distance based on included angle observations of the side of triangle comprising of Battcaloa base line was compared with its pre-determined distance and the network of triangles were adjusted fixing the pre-determined distances of the two base lines. The computation of this horizontal network was done by Mr. J. E. Jackson, and published in 1932, in which the accuracy was found around 1:20,000. In the computation, the shape of Sri Lankan region was approximated to the local ellipsoid - Everest 1830 - to determine the geographical coordinates in Latitude and Longitude, and finally Transverse Mercator projection was applied to derive Two Dimensional (2D) horizontal coordinates. In 1992, with the advancement of survey measurement technology, the network was recomputed and adjusted physically by measuring all the sides of triangles in addition to measuring included angles of all the triangles of the network, known as Triangulateration. In this technique, the included angles were measured using Wild T3 survey instrument while MRA7 distance Tellurometer was used to measure distances between stations, which were apart at significant distances. It was able to improve the horizontal accuracy of the network to around 1: 40,000 with the method of Triangulateration. In this approach, the network adjustment of observations was performed by using a special geodetic network adjustment software.

During the period of 1996 - 1999, a new horizontal control network was established by using Global Positioning System (GPS) observations with establishing eleven (11) principal stations known as AA points in the country at the accuracy of 1: 700,000 and densifying the network further, it was carried out establishing two hundred and seventy-three (273) primary control stations, known as A points. In determining these control stations, GPS baseline observations were adjusted using the same network adjustment software used in Triangulateration. Due to the prevailing unrest of the Northern part of the country at that time, densification was not able

to be carried out in that region. However, in between 2010 and 2012, primary control network was expanded to establish control stations in Northern area, adding 69 points. The secondary control network, comprising of stations known as B points to the accuracy of 1:100,000 and the tertiary control network comprising of stations known as C points to the accuracy of 1:50,000 were established in further densification. The new horizontal network is based on global ellipsoid WGS84 and SLD99 datum, which was established using seven (7) parameter transformation (Bursa Wolf) to select Everest 1830 local ellipsoid as the reference ellipsoid for subsequent determination of horizontal coordinates.

Due to the refinement of the old systems with Triangulation and Trilangulateration and the establishement of the present horizontal control network using GPS, some control stations have three different sets of coordinate values, and stations which were not incorporated in establishing present coordinate system have only coordinates on old systems. As a result, all the coordinates of old surveys and maps prepared based on such surveys have to be transformed into the present system in order to be aligned with the SLD99 datum.

With the difficulties of maintaining the horizontal control network due to the cost involved in its establishment and maintenance, which would mainly include cost for monumentation, replacement of damaged or destroyed control stations and densification, a necessity arose to move to a more robust and reliable system. Moreover, with the increase of users in the application of geographical information with ubiquitous computing supported by high use of Mobile Phones and Personnel Digital Assistants (PDAs) connected on the Internet for various Geographical Information System (GIS) based applications and advancement of state of the art of surveying equipment, control stations are required to be established efficiently to meet the accuracy standards at various levels depending on the purposes and time lines of the tasks.

Considering the high demand for geospatial applications by GNSS users, who need control stations to meet expected spatial accuracies to collect reliable terrain information, Survey Department took an initiative to establish a Continuously Operating Reference Station Network (SLCORSnet), which comprises of GNSS reference receivers installed at well-established control stations at designated places, each is spaced approximately at a distance of 30-50 Km. These stations transmit continuously collecting GNSS raw data live to the control center based in Colombo at the Surveyor General's Office. The advantage of this system is that, it provides accurate position real-time position at any place within the corpus of this network with a survey grade Global Navigation Satellite System (GNSS) receiver, known as a rover receiver to accuracy less than 2-3cm. The present network is operational only in the Western part of the country with six reference stations established in Colombo, Kaluthara, Katana, Awissawella, Rathnapura and Kegalle. In determining position with this method, a rover position is determined through Virtual Reference Station (VRS) technology by applying RTCM correction transmitted from the control centre software based on the raw data collected continuously at reference stations. Also the online delivery of GNSS raw data in RINEX format and online post processing services of GNSS static observations are provided as online web services from the SLCORSnet website of the Survey Department. Once registered under the SLCORSnet website, a user can obtain these services during the subscription period. It should be emphasized that with a single receiver, a user connected to the system can perform RTK positioning, setting out surveys and establishing control points for subsequent detail surveys depending on the type of application.

Furthermore, the vertical control network of Sri Lanka is another essential reference network to determine the elevation of points of interests for various development projects. It consists of control stations with a series of Benchmark heights connected to the Mean Sea Level (MSL). MSL had been determined by great Trigonometrical Survey of India by observing sea level fluctuations with Tide Gauges established near coast in Colombo, Galle and Trincomalee during the period of 1884 to 1895. Establishment of the primary level net was carried out during 1926 to 1930 with fifty seven (57) Fundamental Benchmarks on large masses of rocks and seven (7) Standard Bench Marks built on large concrete blocks using precise levelling. The present vertical control network consists of fifty-two (52) FBMs, three (3) Secondary Benchmarks (SBMs) and twenty-one (21) new SBMs.

In future, possibility of establishing mobile CORS networks as and when required depending on the magnitude of the survey tasks and applications has to be studied. Another important task ahead in the responsibility of the Survey Department is to model height anomalies known as undulation using a GEOID model, through which orthometric height (heights based on MSL) at any place can be determined once ellipsoidal height of such a place in reference to global ellipsoid (WGS84) or local ellipsoid (Everest 1830) is known.

GEOSPATIAL TECHNOLOGIES BEYOND INFORMATION AGE

Dr Thilantha Lakmal Dammalage
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Belihuloya, 70140, Sri Lanka

Geospatial technology is a term used to describe the range of modern tools contributing to the geographic mapping and analysis of the Earth and human societies. At present, the advancement of geospatial technology is increasing at a mind-blowing pace by creating innovative opportunities in many fields. Traditionally, Governmental agencies, private corporations and consulting firms have been using the Geospatial technology as geographic information systems (GIS), the global positioning system (GPS), satellite-based and airborne remote sensing and computer simulations to acquire, manipulate and store geographic information for analysis and decision-making. However, the spread of geospatial technologies to the general public, and the geo-enabling of everything offer application benefits beyond Information age. We are approaching a new era of living, production, and work, where geospatial location becomes an integral dimension of any data, allowing connected information and decisions to be viewed through a hand held smart devise. Bolstered by innovative developments and growing user awareness of its potential, geospatial technology has become an essential element of major contemporary technology developments, notably including the Internet of Things, Big Data, Health, Augmented Reality, and Smart Cities. This talk will summarize the capabilities, challenges and state of the art applications of key developments in geospatial technologies that have allowed more widespread use of digital geographic information by the professionals and general public.

Technical Sessions

URBAN VEGETATION CHANGE AND ITS IMPACT ON COLOMBO CITY TEMPERATURE

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Land Surface Temperature (LST) varies with the nature of different land-use and land cover features. Therefore, in parallel to urbanization the increase of urban temperature is becoming a critical issue in most cities. This study is focused on an analysis of vegetation and built up change in Colombo municipality from 1996 to 2016 and its impact on LST. The relationship between LST with Normalized Difference Vegetation Index (NDVI) and Normalized Difference Built-up Index (NDBI) is discussed using data collected by Landsat 5 TM, Landsat 7 ETM+ and Landsat 8 OLI/TIRS satellite imageries of 1996, 2001, 2006, 2011 and 2016. Built-up and green area changes were identified by the NDVI and NDBI. Accordingly, vegetation and built up areas were changed rapidly in last two decades. The vegetation areas were reduced from 21.9 km^2 to 6.05 km^2 from 1996 to 2016 and built up areas were increased from 1996 to 2016 by 13.92 km^2 to 26.37 km^2 due to the rapid urbanization with the increment of population density. According to that, within the past two decades, Land Surface Temperature has also increased. The observed maximum LST has ranged from 26.36 ^0C to 35.70 ^0C and the minimum LST has ranged from 18.99 ^0C to 24.45 ^0C. There is an apparent inverse correlation between NDVI and LST and a strong positive correlation between NDBI and LST. According to the increasing trend of temperature, when the area of vegetation decreases, future city planning should be focused more on urban greening.

Keywords: LST, NDVI, NDBI, Landsat

EVALUATION OF SOLAR POTENTIAL BY DOMESTIC BUILDING TYPOLOGY

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Renewable energy is playing an ever important role in meeting energy requirements across the world. It exhibits favourable credentials such as an abundant and widely available resource base, inexhaustibility and environmental friendliness, which have contributed to its fast growth over the last two decades. Sri Lanka lies within the equatorial belt, a region where substantial solar energy resources exist throughout much of the year in adequate quantities for many applications. Due to the continuously increasing energy demand in the construction sector, there exists a potential for significant expansion of the use of this renewable energy within the region. This paper intends to demonstrate the effect of domestic building type on solar potential, by analysing solar potential in the real urban context of Colombo based on building type and characteristics. Accordingly, this paper studies real cases in Colombo's urban context by selecting five cases of real urban residential blocks. The buildings were analyzed based on form and dimensions and classified into characteristic buildings. The solar potential was calculated for the roofs of these characteristic buildings respectively. The results obtained showed obvious differences between the six different types of buildings, where the distribution of solar irradiation on roofs for each building type was vividly different based on the building form, owing to differences in roof area and building footprint.

Keywords: Solar potential, Domestic buildings, Urban context

EVOLUTION OF THE SRI LANKAN SHOPHOUSE: RECONSIDERING SHOPHOUSES FOR URBAN AREAS

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The very fact that shophouses and their proportions contribute to the growth of the evolution of tropical architecture is a phenomenal feature. Most of the shophouses in Ambalangoda and the down South have been destroyed due to street widening as people cannot afford to live in a house at such an edge of the street due to skyrocketed land prices, people prefer modern buildings with concrete and glass as they believe that owning a traditional dwelling as being a symbol of poverty these days. This fact could be justified as Hasan Fathy discovered the clay arch in Egypt pre-dating the Romans; he discovered that the normal village people instead wanted the glamour associated with materials such as marble and steel. People thought that using the traditional form would put them into the poverty stricken bracket. If these shophouses are completely destroyed, we would not have a gene pool. We need an area in which these shophouses thrive, posterity would be understood. Thus there is continuity from the past to the present. Although there are rules in the breach to protect these traditional buildings some of them are on the verge of being demolished. Although the shophouses have been` demolished there are sights of evolution of it into the contemporary world as these shophouses yield a sustainable way of building town dwellings with relation to the urban fabric.

Keywords: Shophouses, Traditional, Sustainable

IMPACT OF RECREATIONAL PARKS ON SOCIAL INTERACTION: A STUDY OF THE FACTORS RELATED TO INTERACTION AMONG VISITORS WITH SPECIAL REFERENCE TO SELECTED EXAMPLES IN COLOMBO DISTRICT

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Recreational parks are considered as important public spaces in urban areas which enhance the quality of life by means of improving health conditions, social interaction and recreation among urban population. Several recreational parks have been established recently in Colombo District as a part of physical development implemented by the government after the end of civil war. Although these parks seem to be used frequently by the urban population, it is necessary to ensure that the objectives of these establishments are achieved.

This study aims at examinimg the social interaction among urban people who use these parks, which is one of the objectives and is expected to be improved. The primary objective of this study is to find out the impact of recreational parks on social interaction in relation to some important factors related to interaction among visitors of these parks. Identifying the factors that should be improved to enhance social interaction is the secondary objective of this study. The study was carried out with special reference to three (03) selected recreational parks located in Colombo District. A total of 150 individuals (50 from each park) from different age groups were selected as participants among the people who visit the selected parks. Stratified random sampling method was used to select the participants. Primary data were collected using a researcher made questionnaire regarding the factors related to interaction such as distance from residence to park, purpose of visiting, opportunity to improve interaction among own relations, opportunity to build up new relationships, opportunity for communication among visitors, and use of built spaces and landscape elements. Data were analysed descriptively. Social interaction among visitors was identified in different levels in relation to the factors considered. Further, some aspects related to the above factors were identified to be improved for enhancing social interaction.

Keywords: Recreational parks, Social Interaction, Colombo District

APPLICATION OF GIS IN CONSTRUCTION MANAGEMENT

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Geographic Information System (GIS) has been used in many fields of Science including engineering. GIS is a Computer based tool which is used to solve engineering problems related to spatial data. The potential importance of GIS for construction management in the construction industry has not been adequately realized. GIS technologies have the potential to solve space related problems of construction management involving, integration of information, urban planning, project site selection, soil studies, hydrology and environmental studies. It was found that the construction industry in Sri Lanka is reluctant to apply the GIS in the construction projects. Therefore, this study was aimed to analyse the implementation issues of the application of GIS in the field of quantity surveying as a part of construction management in engineering. Interviews were conducted to gather data from senior quantity surveyors in the fields of construction and project management. The sample was 40 and the selection method was purposive sampling specially based on the direct involvement in the project under the capacity of decision making. The study was done by using only the primary data and the analysis was done by developing a comprehensive content analysis. It was found that there are key issues in the implementation of GIS including unawareness and the overlapping with other specific techniques. The respondents have proposed possible ways of implementing GIS in the construction management for enhancing the productivity of projects specially by doing a proper cost benefit analysis.

Keywords: Geographical Information System (GIS), Construction Management, Custom Application, Project Management

PERFORMANCE ASSESSMENT AND WHOLE LIFE COST COMPARISON OF SELECTED SUSTAINABLE BUILDING COMPONENTS OF ABC GREEN UNIVERSITY

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The ABC Green University is constructed with the support of high technical methods and skilful labour. After analysing the built drawing and the final accounts, it was found that there are number of variations in the elementals and their costs, especially the cost of sustainable construction elements is comparatively higher. It is proved that the whole life cost of the sustainable construction increases due to the high maintenance cost and the replacement cost. Sustainable building design and construction is the practice of creating structures and using processes that are environmentally responsible and resource efficient throughout the life cycle of a building. In this research, it was aimed to conduct a performance assessment and a whole life cost analysis on sustainable construction elements of the ABC green University. The methodology adopted for the process is the case study method and the primary data was accumulated through interviews from the technical persons who have been involved in this project. Apart from that questionnaires were distributed among the expertise on the sustainable construction and the whole life cost procedures. Data analysis was done through a content analysis and descriptive data analysis. The findings exemplify that the cost of sustainable construction is higher in the short run and the cost can be covered in the long run. Though, proper cost benefit analysis should be done to each case before applying the sustainable construction methods. Further, it is recommended that the sustainable constructions should represent the real concept itself. Detailed performance assessment and a whole life cost calculation can be used to identify suitable alternative materials to reduce the cost.

Keywords: Performance Assessment, Whole Life Cost, Sustainable Building, Green University

IMPACT OF DECISION MAKING ON THE CREDIBILITY OF BILL OF QUANTITIES (BOQ)

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There is a strong statement of society that the estimated cost in Bill of Quantities is very less than the actual cost incurred. Further, it means that there is a significant gap between the estimated cost and the actual cost which cannot be accepted. The argument is that the trustfulness of the clients on the BOQ has been understated and the BOQ is prepared for documentation purposes. Therefore, this study was aimed at finding the reasons for the gap arisen between the estimated value of BOQ and the actual value incurred. Data collection was done through interviews by taking a sample of 50 people involved in preparing and using BOQs in the construction field. The main dimensions were focused on the role of a quantity surveyor in this regard, types of procurement strategies, defects of cost estimating methods and the parameters of cost estimations. One of the main findings was that the clients have added extra cost to the estimated cost which had not been specified at the point of BOQ preparation. Some of the quantity surveyors believe that the rate adjustments should be more practical by addressing them to the modern complex market. Further, it seems that the accountability of both quantity surveyors and the clients should be enhanced to avoid the misinterpretation of the said statement regarding the BOQ. Then the credibility on the BOQ can be enhanced up to the expected level.

Keywords: BOQ, Credibility, Decision Making

REVIEW OF THE BUILDING SCHEDULE OF RATES (BSR) FOR WORK NORMS

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The Building Schedule of Rates (BSR) for standard work norms should be reviewed due to some technical problems raised in the current construction industry. It was found that there are some work norms that have not been recognized in the BSR. The role of a quantity surveyor has been widely recognized through the BOQ preparation. Therefore, the trust on the duty of the quantity surveyor is understated due to the rates which are not allocated in the BSR. As the methodology, an expert analysis was done to find the new variables for work norms which should be included in the BSR. Around 30 professional quantity surveyors have been interviewed to get the opinion regarding the missing variables. Most of the respondents said that the BSR rates should be changed according to the changes available in the market. The given rates are somewhat old, and the new items have not been identified. Specially, the modern technology introduces new materials and methods for the building works which have been developed after the development of the existing BSR rates. According to their opinions, some of the rates for items can be identified indirectly using some of the rates given in BSR. But, to get the real picture, the BSR standard should be updated.

Keywords: Review, BSR, Work Norms

SEA LEVEL PREDICTION MODEL FOR COLOMBO COASTAL AREA USING MATLAB SOFTWARE

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Sea level rise can be explained as an increase in the volume of water in the oceans of the world. But the rates of rise over local areas are variable. There are several reasons for the rise of the sea level; mainly thermal expansion of the sea and melting of ice caps. Sea level has significant impact on construction industry near coastal areas in the world. It also affects Sri Lankan coastal areas especially the Colombo coastal area. So, it is necessary to do an analysis on the tide gauge data collected from 2006-2018 in the Colombo coastal area, and build a model to predict the sea level to minimize the impact from rising sea level for future construction projects. The tide gauge data collected can be displayed as a frequency distribution with time as the x axis and Sea Level as the y axis. Missing values will be filled with linear interpolation. Then the wave type distribution will be decomposed until a residual can be gained from it using Empirical Mode Decomposition (EMD) method. After that the residual will be selected from the Intrinsic Mode Functions (IMFs) that has been created from the EMD process. The selected residual will be then curve fitted using a polynomial interpolation technique of a higher degree. Then the fitted curve extrapolated to a given time domain, following which the prediction results can be given. Analysis of the sample data of 8 months of Tide gauge data resulted in an unreliable prediction result but it was closer to the current prediction levels of the Intergovernmental Panel on Climate Change.

Keywords: Sea level rise, Prediction, Tide Gauge data, Intrinsic Mode Functions, Residual, Curve fitting, Polynomial interpolation

VOLUME ESTIMATION FOR HIGHWAY CURVES USING END-AREA RULE

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The volume calculation of road sub surface materials in highways is important in project cost estimation prior to the construction, and in investigations after the construction. Usually it is done with the linear measurements and a level line as the field measurements, and the end-area-rule is the most widely used equation in the calculation. This theory provides the volume between two consecutive sections which should be parallel to each other. Curve shape is often neglected in most of the construction projects due to the difficulty of conducting an advanced control network survey. Therefore, calculated material volume of a road bend might drastically deviate from the original material volume. This study was carried out to develop a physical model to determine the volume between two cross sections which are not parallel. Initially the scope of the study was limited to a circular curve with uniform variation of cross section. The volumes between two cross sections for different angles were measured using the mathematical and physical models in order find the correlation between them. It was found that the end-area-rule is valid for circular curves and the developed physical model provides an acceptable estimation of volume. The outcome of the research would assist construction professionals to identify the error of the previously used method and to overcome the predicament.

Keywords: Circular curves, Volume calculation, End-area-rule

COMPARATIVE STUDY ON METHODS FOR 3D MODELLING WITH TRADITIONAL SURVEYING TECHNIQUE AND TOTAL STATION TECHNIQUE

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Three-dimensional modelling of the natural surface of the Earth is very important in understanding the irregularities of the Earth surface. It is a vital tool in planning large development projects such as designing of high ways, airports, hydropower plants, reservoirs; building sites etc. Two technical approaches are being used for the above task in conventional land surveying. The first step is to carry out horizontal surveying and producing a survey plan which depicts the horizontal projection of the area of interest. The second step is to carry out levelling in order to obtain heights with reference to datum over evenly spread grid points covering the required area. With the introduction of Electro-Magnetic Distance Measurements, a new equipment known as total station is available for land surveyors to capture three dimensional coordinates of points on the ground. This new technology is comparatively much faster than the conventional two-fold technique of collection of horizontal coordinates through surveying and obtaining heights through levelling. This research paper evaluates accuracies of conventional surveying and levelling methodology and the modern Electro-Magnetic Distance Measurements. It also compares the precision of the output of the conventional surveying contour plan and the digital terrain model empirically and statistically in order to evaluate pros and cons of conventional and modern surveying techniques. For this evaluation, a total station and an automatic level was used to survey the study area, employing both methods and analysing data from each method empirically, statistically and comparing the outcome of aforesaid methods. After the analyses of data it was revealed that both techniques are comparatively equal in precision but the total station is far more efficient than the conventional surveying and levelling method. The final outcome of the study is that the total station is more suitable for an engineering survey done for general purposes.

Keywords: Digital Terrain Model, Evaluation of accuracy of contour plans, Three-dimensional modelling

AN ANALYSIS OF LAND USE SUITABILITY OF A SELECTED ZONE IN WATTALA LOCAL AREA PLAN

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The Development Plan of an area is a main legal document that is prepared for development of that area, integrating Social, Economic, Physical and Environmental aspects with the views of stakeholders in addition to general public and Local Authority. Zoning is one of the tools used to control land use change on plots and it is defined based on existing potentials and possible impacts due to the rapid urbanization with the agglomeration of various economic activities which may take place in the area in future. This study area is confined to Handala Grama Niladhari Division which is identified as "Moderate Residential Zone" in Wattala Development Plan that encompasses Wattala Urban Council area which is still in draft level. Through this development plan, it is expected to create a sustainable development with the prime objective of uplifting the living standards of people living in the area by improving efficient environment for the residing people and preparation of strategies.

Aim of this study is to carry out suitability analysis of existing land uses in the selected area, to find out incompatible land uses and why it has taken place in an area within the development plan. Finally, this research analyses to what extent this Development Plan is effective for harnessing existing potentials and how far it can regulate the land use activities. This study reveals that 79% of the area is used for Residential or Commercial activities. 19 % of the area is consisted with water and marshy lands. 12.5% of the area has been neglected as barren or Waste lands. It is highlighted that development plan prepared for such a rapidly developing area is still being at draft level and is hindering the effectiveness of the enforcement of new planning regulation.

Keywords: Development Plan, Zoning, Land use, Planning Regulation

A REVIEW: PROBLEMS IN REFURBISHMENT PROJECTS

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Globally, the existing buildings take a significant portion of total stock. Due to the cyclical nature, the performance of a building is getting retarded when it is exposed to usage. Thus, in order to prolong the life of a building, refurbishment has become a popular concept. New construction and refurbishment process has salient differences. Even though there are some problems common to both new construction and refurbishment, the impact is different in refurbishment projects such as; difficulty in achieving cost, time and quality targets. Suitable approaches should be adopted in managing refurbishment projects. Sometimes, the same approaches used in new construction may not be always suitable for managing refurbishment projects due to certain differences. Thus, prior to determining approaches, it is necessary to identify the problems associated with refurbishment projects. Therefore, this study aims to identify problems present in refurbishment projects considering the two main stages of procurement and construction.

To achieve the aim, a comprehensive literature review was conducted by accompanying books, journals, articles, conference proceedings and other reliable resources. The literature findings manifest that the most important problems associated with refurbishment projects are inaccurate and incomplete information during design stage, determining client needs, restricted access, and unavailability of space on project for storage of materials, potentially reduced security and increased risk to health and/or safety from construction.

Keywords: Refurbishment projects, Problems, Procurement phase, Construction phase

STRATEGIES FOR ENHANCING RESEARCH AND DEVELOPMENT ACTIVITIES IN THE SRI LANKAN CONSTRUCTION INDUSTRY

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Research and Development (R&D) activities stimulate growth, sustainability and performance. However, the construction R&D expenditure is in the range of 0.01% - 0.04% of global value addition, compared to 3% - 4% in manufacturing and 2% - 3% in other industries. Thus, this research explores the possible strategies to promote R&D by investigating the perception of innovation, drivers and barriers. 12 experts representing three major sectors: research institutes, construction related academic institutions and large scale contracting organizations were interviewed and their views were analysed using a content analysis. According to more than 70% of participants, the thirst for innovation is yet to be realized by construction organizations and the focus is primarily on cost reduction and profit generation. Expert views reveal that commitment of employees and management is the most prominent aspect to promote R&D activities. Further, the attention given to construction R&D is minimal due to higher cost and invisibility of return on investment within a short period. The findings indicate that lack of collaboration between research institutes and construction organizations to undertake industry driven research, use of conventional industry practices and reluctance to innovation as contributors to minimal R&D in the construction industry. Many participants opined lack of government support as a critical concern to promote R&D. Therefore, this research suggests that developing a culture of innovation and increasing the competition in the market could drive construction R&D.

Keywords: Construction industry, Drivers and Barriers, Strategies, Research and Development

SPATIAL DISTRIBUTION OF FLOODS IN MATHARA DISTRICT: WITH SPECIAL FOCUS ON 2003 AND 2017 FLOOD EVENTS

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Floods are one of the most devastative disasters in the world, and it is most prominent in tropical regions of the world. Sri Lanka being located in between two tropics, witnesses flood every year due to the monsoon, convection rains and sometimes rain due to cyclones. Therefore, this study is mainly focused on Mathara district with the main objective of assessing the impact of floods along with its distribution. Both primary and secondary data were used for the study. Impact data was obtained from the Disaster Management Center and the flood inundation area, and rainfall data was obtained from the Department of Irrigation and Department of Meteorology of Sri Lanka respectively. A questionnaire survey was conducted on selected 100 households from the Peddapitiya Grama Niladhari Division (GND) of Akuressa Divisional Secretariat Division (DSD) which has the highest impact. Spatial analysis techniques were mainly used in this study, specially the weighted overlay method, to identify the affected regions. Statistical analysis methods of descriptive statistics were also used in order to identify the relationship between daily discharge and daily rainfall levels. According to the analysis Kirama ara, Digili oya, Kotapola oya and Urubokka oya tributaries of Nilwala river record the highest impact from floods. It is also clear that April, May and June are the most prominent time period due to the South West Monsoon (SWM) and September, and November due to Second Inter Monsoon (SIM) conventional rains. Comparison between 2003 floods with 2017established that the impact is more devastative in year 2017 flood.

Keywords: Flood, Weighted Overlay, Mathara

A COMPARATIVE STUDY ON ANTHROPOMETRIC MEASUREMENT OF SRI LANKA DEFENCE SERVICE (SL ARMY, SL NAVY AND SL AIR FORCE) MALE SOCCER TEAMS

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Anthropometry is a branch of anthropology and is concerned with the measurement of the human body. The intent to do this research was because there was no comparison on the anthropometric measurements of Sri Lankan defence service male soccer teams. The purpose of this study was to identify the dependency of anthropometric for performance. In this research Anthropometric measurements of the Sri Lanka Air Force, Army, and Navy male soccer players were taken into consideration. A survey was used as the main data collection method and the total sample population (all soccer team members of defence services) was 29, 27 and 27 from the Air force, Army and Navy respectively. Interviews and measurement were conducted to those samples to gather this data. In addition, the latest Sri Lanka dialogue premier league result was used to identify and compare their performance. According to the results of the research, the Air Force is greater than the Army and the Army is greater than the Navy when considering Sitting height, Waist to hip ratio, Calf girth, Thigh girth, Leg length and Arm Span. Also, when considering the BMI and percentage of fat, the Air force is less than the Army and the Army is less than the Navy. For the Statically Analysis, the SPSS software was used as the tool in this research. According to the study, anthropometry characteristic of players affects their performance.

Keywords: Soccer, Anthropometry, Performance, Tri-forces

Poster Sessions

MORPHOLOGY OF THE EVOLVING COURTYARD WITH SPECIAL REFERENCE TO LIGHT HOUSE HOTEL IN GALLE

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With the rapid urban development and globalization, the vernacular architectural style of Sri Lanka has been affected by arbitrary and westernized style. Due to these influences the traditional architecture was declined with direct imitation of European architecture models. This caused the disappearance of regional cultural elements such as, courtyards. Vernacular form of courtyard was an expression of the climate of the region and national spatial model of the country. With global climatic issues, the built environment is intended to find more innovations on sustainable architecture. With this, once again, modern architecture paid its attention towards courtyards. As courtyards create a link to history and culture of the country the usage of it in modern architecture is found abundantly. Traditional courtyard was a central open space bounded with four built forms around. This central space was used for the spatial organization and to strengthen the building penetration of indoor and outdoor atmosphere. The courtyards were used for many cultural and social activities throughout the past. Modern adaptation of traditional courtyard is an old topic, which was discussed through many studies. But most of them were based on the value of courtyard usage and theories proving it. The issue here is that the use of practical application methods that have not been summarized. There aren't many studies on modern courtyard applications and about the morphology of the evolving courtyard. The goal of this paper is to study the application of traditional courtyard space in modern architecture through a case study on the Light House Hotel in Galle, by Architect Geoffrey Bawa. The paper is divided into three sections. Section one describes the origin and evolution of courtyards in history section two defines and describes the usage of courtyards I modernity, and finally conclude the paper with the case study on Light house hotel Galle

Keywords: Courtyards, evolution, morphology

IMPACT OF TRADITIONAL SPACE PLANNING ON THE SEMI-PUBLIC SPACES OF CONTEMPORARY SRI LANKAN HOUSES

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"Tradition" is the energy of a society and the most valuable asset they have inherited from the past. Since a majority of client population with traditional roots are looking for houses with a traditional semblance, such houses are on high demand. As a result, the field of contemporary Sri Lankan architectural phenomena has addressed by various traditional elements and concepts. Socially and culturally sound semi-public domains such as verandas, living and dining areas are the prominent testimonials which attract clients' demand for designs with traditional qualities. There is a contentious debate as to whether contemporary domestic spaces which "appear" as designs with traditional underpinnings are genuine intellectual application of traditional spaces for the betterment of occupants, or just Imitative and Insensible representation of traditional architecture. The main objective of the research is to evaluate traditional impacts and derive basic planning guidelines illustrating how to incorporate traditional space planning principles for contemporary houses. The first part of the research deals with a study of literature and a field survey conducted among selected pre-colonial and colonial Sri Lankan houses to accumulate the required data for evaluation and design concepts with a special reference given to semi-public domains. The second part is an analytical study of the semi-public spaces in three selected contemporary domestic buildings designed by three Sri Lankan master architects. Final part is the qualitative and quantitative evaluation of the data and experiences gathered in the first two parts of the research. Plot size manipulation, spatial progression, visual axis, geometry of spaces, degree of enclosure, privacy and natural lighting were found as the key factors of space planning and defining spatial qualities of the traditional Sri Lankan houses. Design guidelines were developed based on above factors which help to design domestic semi-public spaces for the physical and psychological comfort of the users.

Keywords: Sri Lankan house, Semi-public spaces, Traditional space planning

REDUCING THE CONCRETE WASTE WHILE OPTIMIZING THE COST, TIME & QUALITY IN SRI LANKAN CONSTRUCTION INDUSTRY

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Construction projects attempt to reduce wastage. In the present days, many projects are moving towards sustainable development while minimizing construction wastage. Among these construction waste material, waste has been recognized as a major problem in the construction industry. Construction Industry consumes a relatively large volume of material that have been wasted due to various reasons. It can happen due to the labour attitude towards the material, labour arrangement, and lack of knowledge in reusing or recycling the material. The main problem arising out of this waste is that it directly influences the project characteristic (Cost, Time & Quality). Along with this material waste 'Wasting Concrete' takes a high percentage that must be given considerable attention. The cost related to this concrete waste directly creates unnecessary expenditure for the employer's budget. As a result, most countries have found several factors to minimize the concrete waste where all stakeholders can collaborate with the project. This research aims to analysed analyse those factors within the Sri Lankan construction projects to reduce the concrete waste based on case studies of three on-going construction projects. Data will be collected by interviewing few stakeholders from each of the selected on-going construction projects. Based on the case study findings, a framework will be developed for the reduction of concrete waste in construction projects, which can lead to a cost effective and on-time completion of projects.

Keywords: Reducing concrete wastage, financial expenses, construction projects, Stakeholders