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INTERNATIONAL RESEARCH CONFERENCE

14TH INTERNATIONAL RESEARCH CONFERENCE

"Security, Stability and National Development in the New Normal"

09TH - 10TH SEPTEMBER 2021

BUILT ENVIRONMENT AND SPATIAL SCIENCES

ABSTRACTS

GENERAL SIR JOHN KOTELAWALA DEFENCE UNIVERSITY

14ᵀᴴ INTERNATIONAL RESEARCH CONFERENCE

SECURITY, STABILITY AND NATIONAL DEVELOPMENT IN THE NEW NORMAL

BUILT ENVIRONMENT AND SPATIAL SCIENCES

ABSTRACTS

General Sir John Kotelawala Defence University
Ratmalana, Sri Lanka

This book contains the abstracts of papers presented at the Built Environment and Spatial Sciences Sessions of the 14th International Research Conference of General Sir John Kotelawala Defence University, Ratmalana, Sri Lanka held on 9th and 10th of September 2021. No part of this publication may be reproduced, stored in a retrieval system or transmitted in any form, without prior permission of General Sir John Kotelawala Defence University, Ratmalana, Sri Lanka.

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Message from the Chief Guest

It is with great pleasure that I send this message to the publication of selected conference papers, under a theme that seems more relevant today than ever.

Throughout the history, security has always been the central notion of our existence as a nation. It will continue to be, as long as the geographical realities that define the country's location remains so. This centrality causes our development paradigm to always have a nexus with security, undeniably linking itself to the overall stability of the country.

As the world was compelled to enter into a 'new normal' with the COVID-19 pandemic, the traditional focus on maintaining the hard component of security was overshadowed by the need to replenish its soft component. The world has recently witnessed struggles of global powers with the highest military might, to maintain and uphold their health security. The less-talked about soft security has emerged to overshadow its counterpart, calling us to re-think and re-define the security-development nexus.

COVID-19 posed an unprecedented challenge to Sri Lanka and all developing economies, calling those States to experiment with new ways for achieving national development while managing the novel challenges to their security and stability. In this backdrop, I am delighted to see that the KDU has made allowance for this paradigm shift and hosted its International Research Conference - 2021 along the theme, 'Security, Stability and National development in the New Normal'.

I congratulate all scholars who have contributed to the conference, in particular, those who have shared their research and findings. My heartiest appreciation goes to the Vice Chancellor, Faculty and the staff of KDU whose undying commitment has made this event a reality, even during the pandemic situation.

Steering a country forward in turbulent times is a task that needs meticulous inputs from the country's intellectual body. I am certain that the KDU Research Conference – 2021 has made its mark in this endeavour.

Mr Lalith Weeratunga
Principal Advisor to His Excellency the President of Sri Lanka

Message from the Secretary, Ministry of Defence

It gives me immense pleasure to forward this message on the occasion of the 14th International Research Conference of the General Sir John Kotelawala Defence University (KDU). At the outset, I must appreciate the leadership and guidance which the Vice Chancellor has rendered to maintain the continuity of this highest academic event of the University despite times of great national and international challenges due to the COVID-19 pandemic which has devastated the world.

This year's conference theme: 'Security, Stability and National Development in the New Normal' has taken the current realities of our time into the consideration and how to achieve security and development in times of instability. In this context, I strongly feel that this is an important and commendable approach with innovation demonstrated by the KDU in focussing the attention towards a timely pertinent theme.

The national developments reiterate the importance of a Defence University especially when our motherland is facing unprecedented challenges due to the pandemic. Therefore, I must highlight that our ministerial guidance and blessings, have given the potential for the KDU to actively dwell on a developmental approach to research with Security and Stability as core drivers. This approach will enable the KDU to reach a leading position to guide and influence policy decisions through the knowledge and insights gained from its expansive research programmes.

Furthermore, I believe that the great minds that will lead research deliberations at this conference should actively contribute to aid the great endeavour of steering our beloved motherland towards greater heights in the security and economic spheres, as it is the ultimate responsibility of all Sri Lankans at this time of concern. Finally, I wish that the KDU IRC 2021 will provide a sheer guidance and lead the way towards national development mitigating all current and emerging challenges posed by this devastating pandemic situation. As I extend my sincere well wishes towards the Vice Chancellor, his team and all the participants of this conference for its successful execution and for their future endeavours, I would like to assure that my blessings and support will be with KDU at all times.

General Kamal Gunaratne (Retd)
WWV RWP RSP USP ndc psc MPhil
Secretary
Ministry of Defence

Message from the Vice Chancellor

As the KDU celebrates its 40th anniversary, the International Research Conference is entering its 14th year and adapting to the new normal conditions and unprecedented challenges that have forced many programmes to be called off indefinitely. The evolution and continuity of the research conference into the successive 14th year adapting to challenges bears testimony for the success of the KDU as a seat of learning that can withstand any challenge national or international in nature.

The sheer number of papers that the conference received this year demonstrates the enthusiasm shown by presenters both locally and internationally even at a time of a grave crisis that has put educational institutions under severe stress, and it affirms the faith scholars have had on KDU. As the only defence university in Sri Lanka, KDU has been committed to research and knowledge production that will influence and shape the policy deliberations of security and development. These are core pillars of the stability and existence of any society, and it is our national responsibility to provide such insights through the organization of premier research dialogues.

This year's theme 'Security, Stability and National Development in the New Normal' bears witness to the civil military fusion that KDU has created and its commitment to achieving balance and resilience in times of global crises to safeguard and advance the security and developmental interests of the motherland.

KDU IRC is a platform of cooperation and diplomacy, and it encourages academic collaboration across Sri Lanka's higher education institutions. Research conferences are the ultimate networking events, and we are proud to provide these spaces of engagement where Sri Lankan and international scholars can present their findings and deliberate on the way forward for the nation and for the global community to thrive at a time humanity's resolve is tested by the pandemic. I wish all the very best for the academics, practitioners and policy makers who want to showcase their research and experience at our research conference.

Finally, I appreciate the dedication and hard work of all those who worked tirelessly over the last several months contributing in diverse ways to make the KDU IRC 2021 a reality under the trying circumstances, especially the IRC Chair, the Secretary, and the organizing committees headed by the Deputy Vice Chancellor (Defence and Administration).

Major General Milinda Peiris
RWP RSP VSV USP ndc psc MPhil (Ind)
Vice Chancellor
General Sir John Kotelawala Defence University

Message from the Conference Chair

KDU International Research Conference in its 14th iteration is held amidst celebration of its 40th anniversary and situated in local and global environment that is challenged by a new form of microbial security threat in the form the Covid19 outbreak. KDU stands strong and unbowed to maintain the continuity of this apex academic event this year on the theme, Security, Stability and National Development in the New Normal.

Challenged with the most potent wave of the pandemic, we remain undeterred thanks to the leadership of the Vice Chancellor. The organizing committee has put their heart and soul into adapting and evolving the conference formats that could withstand and confront the new normal conditions in organizing the international research conference.

Academic communities in the world are beacons of hope and resilience and given the sheer number of research papers that were submitted to the conference this year is a testament that KDU remains a space of hope for such communities and a sacred ground where research is encouraged even at trying times.

The theme of this year was a conscious decision to confront the realities that Sri Lanka and the world had to encounter since March 2020, that Covid 19 was a harbinger for a new reality. Universities are centres of resistance and renaissance and the KDU in Sri Lanka sets an example to all other institutions to emphasize the will to confront any challenge.

In this context KDU research conference is nourished by the presentations and deliberations of esteemed plenary speakers and research presentations that will provide vital insights into the key themes of security, stability, and national development. I extend gratitude and best wishes to all presenters who believe in the research culture evolved by the KDU and may you be treated to the finest KDU hospitality that transcend from physical to the cyber space and may you all be contributors to a greater cause for the sake of all humanity.

Dr Harinda Vidanage
PhD (Edin)
Conference Chair

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ORAL PRESENTATIONS

Accuracy Analysis for Total Station Based on the Reflectorless Distance Measurement Using ANOVA

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Reflectorless distance measurement (REDM) was used to form various platforms in specific total stations for engineering projects, land surveys etc. It provided rapid measurement by saving time and field hands for surveyors; hence, the reliability of the measured distance from an object has great importance. Also, it increased personal safety without approaching unsafe surfaces. This study aimed to investigate the accuracy difference between the reflector and reflectorless distance of the total station with ten different materials and two different environmental conditions. The study was conducted outdoor using Sokkia SET530R and Trimble M3 total stations. Ten different materials were tested typically in construction fields. Two different conditions were investigated, including dry and wet targets. Two dissimilar incident angles were also inspected, 000 and 300 respectively. The experiment was evaluated by taking the reflector reading as true value to check the accuracy of reflectorless measurement. It concluded that Sokkia SET530R total station gained deviations between 12-23 mm for all conditions and incident angles. The Analysis of Variance (ANOVA) tables proved that eight materials were reflected with good accuracy except for granite and plywood materials for the Sokkia total station ($P<0.05$). In addition to that, the results of all materials showed a deviation between 5-8 mm for Trimble M3 total station at an incident angle of 000 for both dry and wet conditions.

Keywords*: ANOVA, reflectorless, total station*

Detecting Urban Expansion Trends in Weligama Urban Council using Remote Sensing and GIS

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The extensive history goes back to urban development, and human convinced build-up area and urban spreading through the specific region is one of the most important areas of human-induced urban expansion. Due to the unplanned urban expansion, Urban sprawl is a prominent issue in the cities nowadays. In today's world, these have become important topics in many scientific fields. This study probes the expansion of the 13 GN divisions in the Weligama urban council area. The main objective of this research is to find the urban land expansion index (SI). Remote sensing and GIS (Geographical Information Science) provide some methods for finding the expansion index using satellite imagery. Satellite images were used in 2005, 2010, 2015, and 2020 as primary sources taken by USGS earth explore. By using the NDBI (Normalized Difference Built-up Index) extract the built-up area and then the urban expansion index/sprawling index (SI) were calculated to identify the expansion of the study area. Finally, the maps of expansion of the built-up areas were prepared in Weligama urban council area to identify the urban expansion index. Considering such context for the town planning, it is better to use the expansion and sprawl analysis method to determine the extension patterns to create sustainable development. As per the results, the region has slightly expanded between 2005 and 2010, but between 2010 to 2015 and 2020 it takes a moderate speed for expanding the Weligama urban council area. Consequently, the final output shows that the urban expansion has happened along the beachside to the city center area.

Keywords: remote sensing, GIS, NDBI (Normalized Difference Built-up Index), SI (Sprawling Index/ Urban Expansion Index), urban sprawl

Severity Classification of the Forest Fired Area by Utilizing Remote Sensing and GIS: A Case Study in Ella Sri Lanka

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The burning of forest areas in Sri Lanka can be considered as one of the foremost issues that should be addressed. Human influence could be identified as the major cause of forest fires in Sri Lanka. Hence, identification, mapping, and taking necessary actions for forest fires are vital in the current context. The forest fire that occurred in the Ella area in 2019 was the focus of the case study. First, the burned location identification was the crucial part of the study due to the unavailability of a proper database of forest fires in Sri Lanka. Hence, with the use of newspaper articles and reports, the forest-fire area was identified at the beginning. Then by utilizing Sentinel-2 satellite images through the Normalized Burn Ratio (NBR) forest fire area was identified. Further, with occupying the difference of NBR (dNBR) mapped the severity of the fire by following the United States Geological Survey (USGS) fire classification scheme. The analysis was performed in Quantum GIS (QGIS) open-source software platform since the Semi-automatic Classification Plugin (SCP) provided the best framework for analysis. Even if immediate satellite images just after the incident were not present, mainly due to the cloud coverage, the analysis was able to obtain a considerable output. Consequently, owing to the study, 73.82 hectares of areas were identified as burned due to the wildfire and 15.65% of the area was highlighted as a high severity of the burn. In conclusion, the applied methodology could be used by any organization for forest scare mapping, and it is vital in future planning.

Keywords: *dNBR, forest fire, GIS, NBR, QGIS, remote sensing*

Analysis of Sediment Accumulation and Decumulation Pattern by Means of Bathymetric Surveys: A Case Study in Beruwala Fishery Harbour

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Hydrography is one of the main branches of surveying. In the modern world, the hydrography field plays a major role in safe navigation purposes and seafloor mapping. Bathymetry survey is the science of identifying and preparing charts about the behaviour of the ocean's floor. Also, bathymetric data provides an important foundation for the process of generating profiles of the seafloor, charts for safe navigation, coastal area erosion/accretion, sea-level variations, and so on. Due to the waves and currents, the sediments are transporting along the seabed and the seafloor may differ continuously. Therefore, hydrographers should collect hydrographic data for safe navigation purposes and other oceanographic requirements. The present study mainly focused on sediment accumulation and decumulation patterns utilizing bathymetric surveys in the Beruwala fishery harbour. The bathymetric data were collected by using a single beam echo-sounder in February 2012, September 2013, August 2017, and February 2019. Further, sand volumes were calculated by time series of bathymetric data using ArcGIS software with several tools (IDW, etc.) and results shows that sand accumulation is evident in February 2012 and February 2019. Further, sand decumulation is obvious in September 2013 and August 2017. Based on the obtained results, sand accumulation inside the harbour is evident during the northeast monsoon season and sand decumulation is evident during southwest monsoon season. So, this information is important for the maintenance of the harbour basin.

Keywords: *bathymetry, hydrography, monsoon, single beam echo sounder*

The Impact of Cost Reduction Methods on Cost Overruns in the Sri Lankan Construction Industry

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Construction Industry plays a major role in the development of a country. Cost is a basic criterion which measures the success of a project. Though the cost reduction methods are available in the industry, cost overrun has severely affected the status of the Sri Lankan construction industry. Thus, this paper aims to identify the impact of cost reduction methods which are currently used over cost overrun, on the identified management approaches in the Sri Lankan construction industry. This research was assessed through a detailed questionnaire survey and interviews. The number of distributed questionnaires were 60 and the response rate was 88%. Correlation and regression analyses were done with the use of SPSS software to analyse the collected data. The interview questions were assessed through the content analysis. The findings highlighted that there is a positive relationship between cost reduction and those identified management approaches (pre-contract, post-contract, human resource, material & change management). It is recommended to change the cost mitigation measures from traditional methods to new methods such as sustainable construction and value management strategies. Moreover, the implementation issues of these methods were identified and suggestions were made as making proper project planning with the use of actual project data and software skills. While this research focused on finding the impact of cost reduction methods, future research could develop and categorize the modern techniques to reduce the cost and time overruns in construction projects.

Keywords: *cost control, management, cost overruns, Sri Lanka*

Augmented Reality for Construction Project Monitoring: Challenges and Strategies for Adoption in Sri Lanka

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Construction project monitoring, which is governing effective decision making and successful project completion, is a key process in every construction project. However, construction project monitoring is not free from barriers, which necessitate the need for technological implementation as a possible solution to overcome such barriers. Though utilising augmented reality leads to achieving immense benefits, but there are challenges identified in implementing augmented reality within the construction industry. Therefore, this study aimed to investigate the challenges and strategies for implementing augmented reality for construction project monitoring in the Sri Lankan construction industry. A qualitative approach was adopted and expert interviews were selected as the data collection technique. Ten experts with experience in both Information Communication Technology (ICT) industry and the construction industry were interviewed to facilitate the in-depth input to the study. The collected data were analysed using code-based content analysis with NVivo 12 Software. The study identified the challenges for augmented reality implementation as the lack of knowledge on hardware and software, lack of accuracy and reliability, higher initial cost, privacy issues, health and safety issues, and lower battery life. Further, providing knowledge on augmented reality through education, training and workshops, carrying out feasibility studies, providing reduced tax-free facilities, using access control methods, implementing proper guidelines, and taking safety precautions have been identified as the possible strategies to overcome the challenges. The paper concludes by mapping the identified strategies to the challenges in implementing augmented reality in Sri Lankan construction industry.

Keywords: *augmented reality, construction industry, challenges, strategies*

An Overview of Various Techniques and Approaches of Concurrent Delay Analysis in the Sri Lankan Construction Industry

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Concurrent delay is a very complex and controversial topic in the construction industry. Analysis of the concurrent delays became challenging due to the absence of clear provisions in the standard form of contracts. Meanwhile, project parties try to pass the contractual liability to the other parties and make the situation more problematic. The lack of knowledge on the concurrent delay analysis procedure among project parties would be another reason to increase the complications. Even though various delay analysis techniques and approaches are available in the construction industry, all of them cannot be used to assess any concurrent delay situation. Hence this study aims to investigate the adaptability of various techniques and approaches for concurrent delay analysis in the Sri Lankan construction industry. The research was conducted based on expert interviews by adopting a qualitative research approach. The collected data was analysed via content analysis using NVivo software. Research findings revealed that the lack of proper record-keeping, the ambiguity of concurrent delays, and the lack of advanced scheduling software as the main challenges of concurrent delay analysis in the Sri Lankan construction industry. Further, the time impact analysis method and window analysis method are the most recommended Critical Path Methods (CPMs) for concurrent delay analysis in the Sri Lankan context. However, in some cases, one CPM is not adequate to analyse the entire delay of a project and research findings recommended to use a combination of CPMs in such situations. Ultimately, the study concluded that the selection of concurrent delay analysis techniques depended on the type of construction schedule of the project and available project records.

Keywords: *concurrent delays, delay analysis techniques and approaches, critical path method, construction industry*

Contractor-related Cost Overrun Causes, Controlling Tools and Techniques: Study on Selected Building Construction Projects in Colombo District

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Construction projects in Sri Lanka often fail completion within the specified time and cost allotted for the projects. Hence, cost overrun and delays are major problems that construction projects frequently experience. Many stakeholder-related causes affect cost overrun in construction projects despite their attempt to minimize cost overrun using various methods. Among them, there is a considerable proportion of Contractor-related causes. Therefore, this study attempted to find significant Contractor-related cost overrun factors and apposite cost controlling techniques that can be used to minimize the likely impact of cost overrun on building construction projects in Sri Lanka. This study primarily focused on completed or ongoing building construction projects between the years 2010 to 2019 located in Colombo District. First, a literature review was carried out and Contractor-related cost overrun causes and cost controlling techniques in general were identified. Then, a questionnaire survey was conducted among eighty professionals who worked in building construction projects in the Colombo district belonging to contracting companies with above C3 level Construction Industry Development Authority (CIDA) grade. Sixty-two of them were responded to and considered as valid for further analysis. The ultimate result was obtained through the Relative Importance Index (RII) technique, and the results revealed 'poor project management skills' as the most significant contractor-related cost overrun cause. Besides, the results disclosed the implementation of the labour controlling mechanism as the most prominent cost controlling method that can be utilized for minimizing contractor-related cost overrun causes.

Keywords: *cost overrun, contractor causes, cost controlling techniques, cost controlling tools*

Effectiveness of Online Architectural Design Teaching: Perspectives of Students and Teachers

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Design teaching is an important process and the core of Architectural education. It reflects the theoretical knowledge as well as practical knowledge while enhancing the sensitivities and lateral thinking of the students. This pedagogy facilitates exploring, experiencing, creating and team work based on cognitive, technical and social skills. Architectural design teaching traditionally relies on the face-to-face classroom educational system. As Covid -19 pandemic has impacted every field of society including education, most of the educational institutions, universities and schools throughout the world have switched to online systems. Accordingly, architectural education also had to adapt to online systems to some extent even without having teaching methods specifically designed for online architectural education. This research was conducted to find out the effectiveness of online architectural design teaching in the Sri Lankan context according to the perception of students and teachers. Qualitative data were collected using a researcher made structured questionnaire distributed among teachers and students attached to Sri Lankan architecture schools. The questionnaire was made based on five design teaching and learning methods, i.e. group discussions, tutoring, critiques, field visits and group work. The purposive sampling method was used to select the sample considering the experience in both face-to-face and online architectural design teaching. The size of the sample was 175 including both students and teachers. The data were analysed by using the software OriginLab in order to assess the participants' perceptions. The overall results show that more than twice as many respondents perceive online teaching to be ineffective in comparison to those that are in agreement with its effectiveness.

Keywords: *architectural education, online architectural design teaching, effectiveness, perspectives of teachers and students, Sri Lankan context*

Assessing the Impact of Urban Block Typologies on Solar and Photovoltaic Potential in the Tropical Urban City of Colombo, Sri Lanka

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The increasing global energy crisis has brought about a shift towards the utilisation of renewable energy, particularly towards building-integrated photovoltaics. When considering the assessment of photovoltaics (PV) in urban regions, previous studies have focused on methods that take into consideration the urban block typologies, urban density, urban compactness indicators, or urban form. However, a requirement still exists to assess how the use of PV in tropical regions can be optimised via the use of facades. Coupled with the fact that semi-transparent PV implemented on windows can perform a dual role in generating electricity whilst minimising building cooling loads, it is imperative to understand how urban block typology can affect PV potential based on the shading effects caused within the block. This paper assesses four different urban block typologies in the urban and climatic context of Colombo, Sri Lanka and how they affect the total and average solar irradiation and the total photovoltaic generation capabilities of opaque and semi-transparent PV installed on building roofs and facades based on their orientation. It was found that although facades are unfavourably inclined towards tropical solar irradiation, they can generate higher amounts of electricity due to the more expansive façade area in high-rise buildings. Further, it was established that the building form in addition to the block typology affects the PV generation, especially when coupled with the building orientation, and that this can have a significant impact on the effectiveness of building envelopes for PV generation.

Keywords: *urban block typology, photovoltaic potential, building form*

Utilization of Cocowood for Affordable Engineered Wood Flooring in Sri Lanka

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Coconut wood or Cocowood has a long history of being utilized as a building material in Sri Lanka. Cocowood stem has three major parts from the inner core to outer skin such as; low-density wood, medium density wood and high-density wood based on the moisture content and the fibre bundle patterns. Cocowood is mainly used for roof construction and the utilizations are limited for certain lengths where timber logs less than 4'-0" in length are mostly abandoned in factory processes in Sri Lanka. The high-density stem fibre has properties similar to many hardwood timbers which are majorly used for luxury flooring products while the rest of the stems are under-utilized or used as firewood. Even though the utilization of Cocowood for flooring is practised in the international context, it has not been properly adopted in the local context. The objective of this research is to produce an affordable engineering flooring material that minimizes the material wastage of Cocowood by utilizing the medium density Cocowood stem and abandoned short length hard-density Cocowood logs. The research process identified the efficient use of Cocowood and the practical dimensions for an affordable Cocowood flooring material. Experiments resulted in 0'-6"x 0'-48" sized, ¾" thick, glue-lamed, aesthetically pleasing, engineered Cocowood tile that can be utilized as an alternative economic flooring material. The introduced tile is economical compared to the other timber flooring materials available in the current market.

Keywords: *cocowood, building construction, moisture content, density, efficient use, glue-lam, engineered wood, dimensional stability, affordability, colour variation, texture variation*

Perceptions of Civil Engineering Undergraduates on Using Learning Management System (LMS) and Zoom Platform for Online Design Studio Teaching

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As the COVID-19 pandemic continues, 'online teaching and learning' became the only possible solution to continue the education programmes at universities. Though there are multiple solutions presented in the educational literature, many of the universities were not prepared to carry out complete online-based educational models in their degree programmes. Therefore, converting the teaching process; mainly studio base design teaching from physical to online was a whole new experience to most of the academia in developing countries. Further, it is a challenge to run these virtual teaching processes with limited technological resources for a long time. This study was conducted to investigate the perceptions of online based education using the Learning Management System (LMS) and Zoom platform for a studio base module. Thus, the methods were adopted to evaluate influencing factors of the online learning experience of the subject. Quantitative analysis was used where unstructured and structured questionnaires were conducted among students. Finally, the students' perceptions of online learning experience for a studio base module were presented.

Keywords: o*nline teaching/learning, Moodle, Learning Management Systems (LMS), Zoom, studio teaching, project-based learning, student perceptions, civil engineering curriculum*

Study on Development and Implementation of Safety Inspection Drones with Machine Learning Algorithms to Improve Construction Safety in Sri Lanka

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Most of the construction sites in Sri Lanka work under unsafe conditions due to limited resources. Due to these unsafe conditions, human lives are in danger at times. The construction industry holds a major position in the development process of Sri Lanka, as it significantly contributes, not only for Gross Domestic Product but also for Gross National Product. Unfortunately, the Health and Safety factors have become a secondary concern though the construction industry holds a major portion in the economy of the country. The traditional inspection methods currently practised in the industry seem to be outdated, time-consuming, less efficient, less effective, and increase the workload of safety officers. It is impossible to perform observations in multiple locations at the same time by a single safety officer because some locations in the sites are hard to reach, and there may be blind spots too. This study proposes an automated safety inspection method to increase the safety levels of construction sites. For this, the study reveals a comprehensive experimental discussion on how to blend image processing techniques with unmanned aerial vehicles. Image processing is the technical analysis of images by using complex algorithms, and in this scenario, unmanned aerial vehicles (drones/quadcopters) act as a flexible image providing source that can fly over the construction sites by providing real-time videos for the algorithm to analyse for safety hazards. The study was concluded by achieving two objectives, developing an algorithm with YOLO v3 architecture to detect safety hazards through drones, and measuring the accuracy and reliability of the automated detections.

Keywords: *construction safety, Image processing, unmanned aerial vehicles*

An Analysis of Professional Participation of Registered Licensed Surveyors in Land Partition

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Statistics of land ownership in Sri Lanka shows that approximately 82% of land in the country is under state control while only 17.7% is privately owned, and as a tool of administration and management of private lands, Partition Act (Amended) No:17 of 1997) has been enacted especially for clearing co-ownership disputes through litigation. Out of longer-term pending cases in the court, the main cases are partition cases followed by other land disputes. This situation urges the requirement of emphasizing 'private land administration and management as they are having "doing business" potential, due to clear title and less intervention by public sector decision-makers relative to public lands. This study aims to examine the professional involvement of Registered Land Surveyors (RLS) in partition cases as Court Commissioners and its relationship with laws delays in land litigation. Two provinces; 'Sabaragamuwa' and 'Southern', were selected purposively for the study, and statistics of RLS were analyzed. A simple Random sample of RLS s was drawn from Kegalle District in the Sabaragamuwa Province. Answers were obtained for a structured questionnaire. The study reveals that a large number of private lands which have development potentials remains stuck in the adjudication process of partition due to the lack of Court Commissioners which in turn leads to prolonged litigations. It was also revealed that 50% of the RLSs are reluctant to join this volunteer position due to drawbacks in the Partition Act. More than 70% of the RLS who are engaged with partition surveys are over 70 years of age and joining of new RLS with the courts for the last ten years is below 1 %. It is anticipated that if the situation continues and if appropriate remedial measures are not taken by the authorities and professional institutes, partition litigations would adversely affect the private sector land administration and management.

Key Words: *partition, appraisal for owelty, court commissioner, Registered Licensed Surveyor (RLS)*

Addressing Barriers to Integrate Social Sustainability in Construction Industry

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The social, ecological, and financial scopes of sustainability are all influenced considerably by construction operations. Regardless of the fact that there is significant literature on financial and ecological sustainability, diminutive was done to investigate social sustainability in the building industry. In light of this, the goal of this research is to look at the major barriers to social sustainability in the Sri Lankan construction industry. The findings of this study may fill in the information gap about the barriers to social sustainability, and improve social sustainability practices in the construction industry. Expert interviews were performed using a complete literature review and a qualitative research technique. The findings were analysed using content analysis. The findings show three major barriers, namely, thelack of awareness of the concept, deficiency of government support, and stakeholders' conflicts of interest and divergent points of view. Sub-barriers were then discussed under each main barrier. Further, the solutions to overcome these barriers were discussed briefly to improve the social sustainability in the Sri Lankan construction industry.

Keywords: *social sustainability, barriers, construction industry*

Mitigating the Effects of E-learning in Higher Education Sector in Sri Lanka during the COVID-19 Pandemic

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This study sets out to examine the efficacy of e-learning in the Sri Lankan higher education sector that was ignited by the emergency created by the COVID-19 pandemic. Drawing a random sample of 350 undergraduates from seven major universities of Sri Lanka through the means of a questionnaire, the study was set against the key benchmarks derived out of a review of literature that affects e-learning. The study unearthed that unsatisfactory internet access, inability to correspond to the prerequisites of relevant subjects, psychological concerns enumerating due to shift in learning strategies, increased concerns about COVID-19, and lackadaisical attitude towards learning from home front, to be the noticeable factors having a larger bearing on the efficacy of online learning process. The study thus advocates proper infrastructure facilities and customization of teaching and learning process according to the subject content to elevate the standards of the e-learning process in the Sri Lankan higher education sector.

Keywords*: e-learning, pandemic, higher education, Sri Lanka*

POSTER PRESENTATIONS

Accuracy Assessment of UAV Mapping Based on Pattern and Density of Ground Control Points

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Unmanned aerial vehicles (UAVs) are very important for surveying purposes of the modern-day construction industry when considering the time and cost allocated for the surveys. The surveyors could use the images taken from high altitudes to obtain orthoimages, digital surface models, and digital terrain models in high temporal and spatial resolutions using the photogrammetric processing software. This study aims to analyze the effect of ground control points that govern the accuracy of the 3D surface model. Thus, the study focused on observing the effective distribution of ground control points. Hence, six different GCP combinations laid in four different laying patterns were examined. Data used for the study were collected using both field surveys and photogrammetric surveys. In the field survey, the X, Y coordinates of the ground control points were examined using a total station and Z coordinates with the automatic level instrument which is considered as the most prominent surveying technique in Sri Lanka. The edge layout and star layout illustrate the maximum accuracy among the four laying patterns in both planimetry and altimetry perspectives. Root Mean Square Error is the method used for error calculation. Based on the study conducted, it is concluded that commercial drones could be used to determine the terrain features with reasonable accuracy.

Keywords: *Unmanned Aerial Vehicles (UAV), Ground Control Points (GCP), Root Mean Square Error (RMSE), Digital Terrain Models (DTM), orthoimages*

An Analysis of Suitable Location for Establishing Telecommunication Tower at General Sir John Kotelawala Defence University, Southern Campus

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Wireless telecommunication is broadly utilized around the world and Sri Lanka, particularly due to increased use of mobile users, and the conversion of mobile phone into a primary essentiality of a person. High population density of the urban or suburban areas requires the establishment of telecommunication towers because the service providers consider low manufacturing cost and give maximum benefit. The telecommunication tower is the key device for supplying mobile users with a telecommunication network. The requirements of telecommunications towers are growing parallel to the growth of mobile users every year. This project aims to explore the coverage of the existing towers and to propose a new suitable location to establish a telecommunication tower that supplies the best coverage and capacity by optimizing the resources and cost-effectiveness. The study investigated Sooriyawewa area distressed with insufficient coverage from the existing towers for daily necessity, which causes the necessity to establish a new telecommunication tower. Data were collected from open-source platforms and the Survey Department of Sri Lanka, processed with ArcMap 10.5 licensed software. Population, Existing tower locations, Roads, Land use, Reservations, Elevation, Schools, and waterbodies were used as the data layers, and data was analysed using both vector-based and raster-based approaches in Geographical Information Science (GIS) environment. Conclusively, factor maps were prepared and the optimal locations were identified for establishing telecommunication towers, and validated with the existing locations.

Keyword*s: coverage, telecommunication towers, service providers, Geographical Information Science (GIS)*

A GIS Based Approach for Identifying a Suitable Location for Residence in the Ratnapura Municipal Council Area

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When considering Sri Lanka, with the developments in the country, the infrastructure of the urban city areas is being developed year by year. As a result of these conditions, people in rural villages are moving to cities for a better future. With the increasing demand for urban areas, countries are facing the problem of finding the best place to live in urban areas. Available lands in urban areas are limited. Accordingly, the government of Sri Lanka has faced some problems in finding enough spaces for all citizens for establishing their residential places. . This study focuses to develop a method from GIS (Geographical Information Science) providing some facilities for finding suitable locations for the new residential areas with respect to the criteria people desire. The integrating with the GIS data layers of the real world and the criteria of the people, the GIS can be defined as better solutions for finding suitable locations for new residential areas. In this research, the Ratnapura Municipal Council (MC) area was selected as the study area and distance from the roads, water features, religious places, service buildings, new town, and the police station have been selected as criteria for integrating with GIS. To identify the new residential locations, the reclassify and weighted overlay functions of Arc GIS software were used. 0.25% area has been established as new residential places in the Ratnapura MC Area. The digital data layers used in this study were 1:10000. If it was scaled up to 1:1000 data layers, the accuracy of the result may be high. Further, the results accuracy too would be satisfiable as suitable areas were inside the existing high residential zone.

Keywords: *GIS, spatial data, reclassify*

Implementation of Collaborative Procurement Method to Sri Lankan Construction Industry

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Construction procurement methods have developed for decades under four main categories to address different financial arrangements, different relationships between parties, different project delivery methods and to suit the client's requirements. The joint venture, partnering, alliancing and voluntary agreement were developed as sub-categories of Collaborative Procurement Methods (CPM). Currently, these methods are being practised all over the world considering the benefits it provides whereas less practice in Sri Lanka (SL) due to plenty of barriers. This study explored the current procurement practices in SL, implementation possibilities and barriers for successful practising of CPMs in the country. Further, proposals for mitigating the identified barriers are also recognized through this study. To achieve this aim, a comprehensive literature review, a questionnaire survey and a semi-structured interview survey were conducted. Less awareness of the concept and associated benefits, the government's promotion of traditional procurement method, and issues in trust-building among parties were identified as the foremost barriers for the successful implementation of CPMs. Moreover, the findings implied the requirement of cultural changes in Sri Lankans to experience these new procurement practices, challenges and to develop trust between parties within the construction industry.

***Keyword**s: Collaborative Procurement Methods (CPMs), construction industry, joint ventures*

Career Development of Young Construction Professionals in New Millennium: Application of Sun Tzu's *Art of War* Principles

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The construction industry in the new millennium has shown a variety of challenges for young professionals. It is recognized that early career experience can play a significant part in lifelong professional capability, and the support and knowledge gained during the early years of post-graduate employment can influence future career direction and success. This study was conducted to identify the relevance of military strategies that are mapped with the career development of young construction professionals (Architects, Civil Engineers, Quantity Surveyors and Surveyors) while suggesting strategies to fill the barriers to career advancement. This study is based on the construction industry of Sri Lanka where a substantial number of young graduates enter the field not knowing the proper mechanism to build their future. The data collection was done through questionnaires and semi-structured interviews which were developed based on the Art of War. Data analysis was done by using both qualitative and quantitative techniques. It was identified that young professionals should have the inspiration to acquire the knowledge, skills and abilities of their peers by engaging deep job experience, adopting team member stance through professionalism and connectivity; handling office politics and conflicts effectively; maintaining flexibility and manoeuvrability; networking and soft skills. The outcome of the study elicits that there is a relationship between the tertiary education system and military strategies to the career development of young professionals. Therefore, it is strongly recommended to prepare a strategic agenda for the career development of young professionals by collaboratively working with the academia, industry and professional bodies, which is an important aspect to the individual, as well as to the organisational sustainability.

Keywords: *career development, young construction professional, military strategies*

Study of Quantity Surveying Roles and Skills Requirement under Green Building Development in Sri Lanka

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With the development of the construction industry, modern Quantity Surveyors diversify their roles as cost managers and perform multidisciplinary job practices at present. Green building is one of the recent trends in the construction industry. There is a tendency to adopt green concepts to building construction in Sri Lanka. When adopting green technologies to the buildings, a significant reformation to design, procurement, construction, and management processes is required. Therefore, the skills and activity requirements of construction industry professionals need to evolve with this recent development. Accordingly, this research attempted to identify principal quantity surveying duties and skills that continually evolve with the green building construction practices. At the outset, a detailed literature review and three preliminary interviews were carried out, and seven core skills and twenty-five roles of a quantity surveyor were identified that possibly to be influenced by green building development. Then, a questionnaire was formed and tested the same among fifty cost experts who work closely with the Green Building Council of Sri Lanka (GBCSL). At the time of the questionnaire survey, 76% of the experts responded, and later, the Relative Important Index (RII) formula was used to analyze the research findings.The ultimate results revealed that the ability of a quantity surveyor to appraise is the topmost skill requirement under green building development. Moreover, the results further denoted cost planning/controlling and bills of quantity preparation of green building as the prime quantity surveying activities to be performed as a cost specialist of green construction projects.

Keywords: *green buildings, quantity surveyor, skills*

Adequacy of the Advance Payment to the Contractor: A Study in Sri Lanka

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Payments are essential for the contractors to maintain their constructions. The accelerations and the decelerations of the constructions will depend on the way that the contractor receivs the payments. Advance Payment (AP) is crucial for a contractor as it is the first payment received by the contractor to commence the construction, and it is an interest-free loan received by the contractor from the employer to start the construction. Even though there are research that discuss the payment procedures, recovery methods, and the benefits of the AP, there is a research gap on the adequacy of the AP to the contractor to complete initial procurements and preliminaries for the mobilisation. Therefore, the aim of this paper is to investigate the adequacy of AP made for the mobilisation activities of construction projects in Sri Lanka. Following a mixed-method research approach, a questionnaire survey including both open ended and close ended questions was conducted to collect data in the Sri Lankan context. The qualitative data were analysed through manual content analysis, whereas SPSS, and Relative Important Index (RII) techniques were used to analyse quantitative data. Many respondents claimed that the AP is not adequate, and the allocation of AP percentage should be done according to the project value and further, it was recommended to have a range of 20-30% from project value. Moreover, the study revealed that the adequacy of AP is entirely dependant on the way that the AP is utilised by the contractor. The study can be continued with the perspective of employers and the consultants as further research.

Keywords: *advance payment, adequacy, contractor, employer, utilise, construction, Sri Lanka*

Developing a Cost-Effective Web-Based Communication and Information Management System for Construction Projects

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Construction projects face several problems due to the lack of well-organized communication and information management within construction sites. The traditional communication and information management system in the site is almost run on traditional processes which makes the project delayed, misled and inefficient. Certain IT solutions have been introduced from time to time for the construction industry, and they are costly as well as do not exactly suit Sri Lankan construction conditions. Being a third world developing country, cost-effective solutions that suit the Sri Lankan construction conditions are essential. Therefore, this study aimed to develop a low-cost web-based application to communicate, make decisions, and handle information within a construction site matching the Sri Lankan construction conditions. A web-based application was developed (prototype) according to the collected expert ideas by considering their experience related to the construction sites in Sri Lanka. Semi-structured interviews were adopted to collect the relevant data, and content analysis was used to analyse them. Eventually, considering all of the above, a web-based prototype was developed to manage communication and information within the construction site. Minimizing contradictions within the worksite by providing a virtual platform to communicate with relevant parties, managing information by providing virtual document store in relevant locations, notifying tasks, etc. are provided as functions by the system.

Keywords: *web-based, communication, construction site, information management*

Compact City as a Response to the New Normal: Designing Resilience to Encounter Pandemics

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The Coronavirus is a pandemic that defined the greatest crisis of the modern world, and it is the most critical challenge that the world has faced since World War II. Considering the effect and the scale of the outbreak, WHO declared Covid-19 as a global pandemic and identified the epidemic as an unprecedented socio-economic crisis and not just a health challenge. From early 2020, most of the countries in the world have been in lockdowns to prevent the spread, and these lockdowns critically restricted mobility resulting in empty city-scapes. The critical problem of the present is the incompatibility of the city forms to cope with the pandemic triggered by the inability to locate the 'New Normal' concept in the field of Urban Design. Non-resilience of cities is not a unique case to this pandemic but was common in the pre-pandemic world too. Modern cities being dependent on auto-mobiles had created an urban crisis, and the desire of the designers to initiate sustainable alternatives was always defeated by automobile transportation. The pandemic has however created a temporary momentum towards active transportation restricting car-travel, and the study identifies the necessity of concreting these temporary trends for the long run. Analysing the initiatives that the cities of the globe have taken, three main concepts could be identified as cycling, Avoid-Shift-Improve paradigm and 15-Minute city. The latter part of the study brings these concepts to the city fabric of Colombo and concludes by stressing the compatibilities of adapting these concepts to Colombo city.

Keywords*: COVID-19, walkability, cycling, 15 - minute city*

Use of Urban Pockets to Enhance Walkability in Office Neighbourhoods in Colombo Urban Context with Special Reference to Fort, Colombo

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Urban pockets have been recognized as resourceful collective spaces for urban functions in a modern-day city. Also, urban design and planning of major developed cities incorporate the walkability concept in order to minimize traffic, environmental, and health problems. Colombo is considered the commercial capital with a high density of office neighbourhoods that attract high density of vehicular movement. Fort is recognized as office neighbourhoods in the Colombo area where the traffic congestion is higher. Previous research considers the physical factors of the street in order to enhance walkability. They lacked consideration of the walking behaviour-flow, junctions, and small urban spaces in the process. The study aims to identify the undefined urban spaces that can be used as urban pockets by studying public behaviour patterns regarding walkability in office working hours in Colombo. In order to identify the possible urban spaces that can be developed as urban pockets, the research indemnify the current walking patterns and walkability of the area. The identified walking pedestrian flow laid over the identified leftover spaces which have the possibility to develop without changing the current urban context. Overall images for study area were developed with the existing and possible urban pockets based on walking patterns and the lack of walkable routes in order to enhance the walkability of office neighbourhoods.

Keywords: *walkability, walking behaviour, urban pockets*

Contribution of Architecture on Juvenile Rehabilitation Process in Sri Lanka

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The process of reintegrating juveniles to society from juvenile rehabilitation facilities is as important as the process of rehabilitation. If the rehabilitation process is not conducted properly it would rather be difficult to control the reconvicted/recidivism rates. Hence, the rehabilitation methods must adhere to certain attributes relating to the rehabilitation process, one key aspect being the built environment of the rehabilitation facilities. Humans by nature have an undeniable connection with their environment through physical, mental, emotional and spiritual means. This connection helps to keep a balance within ourselves. Most of the time, unlike adults, juveniles commit crimes or become victims without their own will. It is of paramount importance that this is understood and they are attended with the required special attention in the rehabilitation process. At the stage of admission to the rehabilitation facilities, these youngsters are more likely to be in a very weak state of mind, with the need of protection, self-value, freedom, and to obtain the sense of belongingness in the society as they are reintroduced. This requires improvement of interpersonal and intrapersonal skills before leaving the correctional facility to avoid reconviction/recidivism. The rehabilitation process influenced by architectural attributes was followed in this research would be to understand by location and site planning, spatial organization, provision amenities, supervision and security and visual character. In the Sri Lankan context, it shows that most of the juveniles from facilities that have considered these architectural attributes show comfort when reintegrating with the society as adults whereas others from contradicting facilities show difficulties when reintegrating with the society as adults.

Keywords: *juveniles, rehabilitation, architectural attributes*

Rethinking of the Adaptability in Mass Housing for Pandemic Situations

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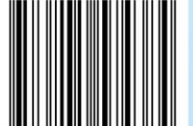
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Pandemics spread due to poor housing conditions. Diseases have resulted in inducing the concept of mass housing, evident from housing projects initiated after the Great Plaque in London. Current pandemic, i.e., the spreading of the COVID-19 virus affected physical health of humans at alarming rates. The relationship between the spread of pandemics and living environments is unexplored. The study intends to bridge the gap in literature, and explore methods that could be implemented to mitigate situations in future scenarios. The parameters by the WELL Building Standard®, of air, water and light have been considered. Results explicitly prove mechanical systems of residential housing units need a (MERV) of 8, as 70-85% of particles can be captured. Relative humidity between 40%-60% can limit spreading of COVID19 within housing interiors. Pressure difference between corridor spaces and rooms will prevent air circulating from source to another in hospitals, minimising spreading of pathogens. Similar strategy can be adopted into the housing context via mechanical ventilation systems. The most effective method to limit spreading of pathogens from room to room in hospitals is to design a buffer space. This can be adopted in the housing context, such as powder rooms in apartments. Airborne viruses that contain single-stranded RNA are reduced by 90% with a low dose of UV light and is eliminated through building glass layers. A set of adaptive guidelines have been derived, to be applied in designing mass housing and also in managing Built Environment in similar situations.

Keywords: *pandemic, mass housing, adaptability*