



World Construction Symposium

W107

Global Challenges in Construction Industry

28 - 30 June 2012
Colombo, Sri Lanka



Programme and Abstracts

Ceylon Institute of Builders (CIOB)

International Council for Research & Innovation in Building and Construction (CIB - W107)

Building Economics & Management Research Unit (BEMRU), Department of Building Economics,
University of Moratuwa



WORLD CONSTRUCTION SYMPOSIUM 2012

GLOBAL CHALLENGES IN CONSTRUCTION INDUSTRY

28 - 30 June 2012

at
Cinnamon Grand Hotel
Colombo, Sri Lanka

Organised by
Ceylon Institute of Builders (CIOB),
International Council for Research and Innovation in Building and
Construction (CIB - W107)
and
Building Economics and Management Research Unit (BEMRU),
Department of Building Economics, University of Moratuwa, Sri Lanka

© Ceylon Institute of Builders (CIOB)
ISBN: 978-955-4516-01-4

All rights reserved. Reproduction of this volume or any parts thereof may be made only after obtaining the specific approval of the publishers. The publishers are not responsible for any opinions or statements made in the papers.

Published by:
Ceylon Institute of Builders (CIOB),
No. 48, CSCT Building,
Thalawathugoda Road,
Pitakotte,
Sri Lanka.
Tel : 0094-11-3140355
Fax : 0094-11-2885933
Email : info@ciob.lk; ciobconference2012@yahoo.com
Web : <http://worldsymposium.ciob.lk>

CONTENTS

Messages..... 03

Keynote Speaker..... 11

Organising Committee..... 15

Scientific Committee..... 16

Symposium Information..... 17

Symposium Programme..... 18

Social Programme..... 20

Conference Session Plan At-A-Glance..... 21

Detailed Session Plan 22

Abstracts..... 31

Acknowledgements..... 89

MESSAGES

H.E. Mahinda Rajapaksa
President of the Democratic Socialist Republic of Sri Lanka



I am pleased to send this message of greetings to the World Construction Symposium 2012 being held in Colombo.

Organized by the Ceylon Institute of Builders in partnership with the International Council of Research and Innovation in Building and Construction of the Netherlands, and the Department of Building Economics of the University of Moratuwa, with the Singapore Institute of Building Limited as its International Strategic Partner, this symposium is a significant event in the context of the new challenges facing the Construction and Building Industry in Sri Lanka today.

This year's symposium focuses on the issue of Global challenges in the Construction Industry with special emphasis on "Sustainable Construction in Developing Countries". It takes place in the midst of Sri Lanka's post-conflict reconstruction and development programme and in the current context of a boom in the Construction Industry. This industry is fast developing and providing increased opportunities to all stakeholders and especially to foreign investors. The emphasis on Tourism Development is a further driving force behind it.

The presence of more than 100 international delegates from many countries who will interact with more than 200 delegates from Sri Lanka will provide a significant opportunity for the exchange of new knowledge and experience in the fields of engineering and construction among professionals, consultants, contractors, construction entrepreneurs, academics and students of construction.

The Construction EXPO 2012 which will take place concurrently with this symposium will give the participating delegates a good opportunity to explore business opportunities and partnerships in Sri Lanka.

I welcome all foreign delegates to this symposium and trust they will take with them the best memories of the beauty and hospitality of Sri Lanka and the progress we are making in the Building and Construction sector.

I wish the World Construction Symposium 2012 and the associated Construction EXPO 2012 every success.

Hon. Lakshman Yapa Abeywardena
Deputy Minister of Economic Development



It is with great pleasure that I send this message and extend my warm welcome to all delegates from Sri Lanka and overseas who participate in the World Construction Symposium and International Construction EXPO 2012 at the Cinnamon Grand Hotel and BMICH respectively during the period of 28 June to 01 July 2012 which is jointly organized by the Ceylon Institute of Builders in collaboration with International Council for Research and Innovation in Building and Construction (CIB) in the Netherlands and the Department of Building Economics of the University of Moratuwa.

I consider this Symposium is very timely and relevant to Sri Lanka in the context of its current economic development effort, particularly in the infrastructure and urban development areas. Sri Lanka is now emerging as a strong nation with rapid economic development. Construction industry is the barometer of a nation's economic development. Sri Lanka's construction industry too is booming and expanding into new areas of innovation resulting in economic benefits to larger segment of the population.

The World Construction Symposium 2012 will be an ideal platform to exchange views and experiences on various issues related to construction industry. It is my fervent hope that the Symposium will benefit all those participating in achieving their professional and academic expectations whilst giving opportunities to all stakeholders to build new contacts and alliances benefiting the construction industry in Sri Lanka.

I wish the World Construction Symposium 2012 all success.

Prof. Chitra Weddikkara
Chairperson
World Construction Symposium 2012



It is with appreciation that I take up the invite to give a message as the Chairperson of the World Construction Symposium on Global Challenges in Construction Industry and it is with great pleasure that I welcome all participants to the event.

As an event where global industry experts and academics in construction gather to exchange views and findings, I believe this symposium is timely, discussing relevant and important topics. The theme of 'Global Challenges in Construction Industry' was aptly chosen as Sri Lanka, having come out of a civil war, is poised to further develop its infrastructure. In having understood the need to position ourselves in the global market, we questioned ourselves 'How should we meet the inevitable challenges?' I am sure that all participants from around the world will look forward to identifying challenges and understanding how to face them: unraveling the answers.

In acting as a platform for knowledge sharing, it also offers Sri Lankan professionals and academics to meet specialists from overseas. In conducting the event, I believe CIOB, the professional body for builders in Sri Lanka, who work to inspire, educate and train builders and professional in Sri Lanka, will receive international exposure which they richly deserve. The event is also strengthened by the research excellence of its organising partners, the Building Economics and Management Research Unit of the Department of Building Economics, University of Moratuwa, Sri Lanka and the International Council for Research and Innovation in Building and Construction (CIB - W107); who too will stand to gain much in the academic field.

I hope all invitees would take this opportunity to meet and learn from colleagues in the global construction industry, making it a stimulating and educative symposium

Dr. Rohan Karunaratne
President
The Ceylon Institute of Builders (CIOB)



The Ceylon Institute of Builders (CIOB) is pleased to organise the ‘Global Challenges in Construction Industry’ World Construction Symposium, together with the CIB Netherlands and the University of Moratuwa, Sri Lanka. The CIOB with its roots in the year 1961 has a solid history of acting as the professional body in the building and construction industry in the island. Hence, we are honoured to be part of this symposium that would help industry stakeholders develop an understanding of challenges faced by the global industry, while having an opportunity to expand their international network.

Invitations for the symposium have been extended to professional and academic participants from over 30 countries, thereby bringing in various inputs from across the globe. Companies developing technologies to circumvent or meet these issues are expected to provide new insights. And leading academics and students have been invited to enlighten the audience on recent scientific findings. Therefore, I strongly believe that our invitees would find the symposium to be of great significance.

I would also like to take this opportunity to mention ‘Construction Expo 2012’, which will be held in parallel to the Symposium at the BMICH, Colombo. It would be the first, largest international construction event to be held in Sri Lanka. I invite companies who are interested in adopting new technologies and innovations to come and visit Construction Expo 2012.

Let me thank the ministries and professional institutions who have helped us in organising the ‘Global Challenges in Construction Industry’ International Symposium. I am much grateful to CIB Netherlands and the BEMRU, Department of Building Economics, University of Moratuwa who have been an integral part of the organising team.

Eng. Saliya Kaluarachchi
Secretary
The Ceylon Institute of Builders (CIOB)



It is indeed a privilege to be part of the organising committee of an international symposium that would stand as a milestone for most of its participant countries, including host country Sri Lanka. The symposium will bring together professionals and academics from around the world to discuss and present papers on issues that we all in the global construction industry have come to find as challenges.

I should first extend my sincerest appreciation to the International Council for Research and Innovation in Building and Construction (CIB), the global body that stands for the development of the industry, for their solid guidance in organising this event.

I would like to express my gratitude to the Building Economics and Management Research Unit (BEMRU), the research arm of the Department of Building Economics at the University of Moratuwa, Sri Lanka for their unwavering support. Their valued academic input will strengthen the local input of symposium, and I hope that its participants too will gain from the knowledge transfer.

I would also like to thank Ministry of Construction and Engineering Services, Housing and Common Amenities, Ministry of Economic Development, Ministry of External Affairs, Ministry of Labour and Labour Relations, Ministry of Land and Land Development, Senior Ministry of National Resources with other national bodies such as Institute of Engineers of Sri Lanka, Chamber of Construction Industries Sri Lanka, Federation of Chambers of Commerce and Industries of Sri Lanka, Organisation of Professional Association, Institute of Quantity Surveyors Sri Lanka and other construction related Professional bodies, the management of BMICH, the management of Cinnamon Grand Hotel for the assistance provided.

Mr. Kalana de Alwis
Mr. Sagara Gunawardena

Co-Chairmen
World Construction Symposium 2012



It is with great pleasure and enthusiasm we write this message and extend our warm welcome to all delegates from Sri Lanka and overseas who participate in the W107 World Construction Symposium and International Construction Expo 2012 at the Cinnamon Grand Hotel and BMICH respectively during the period of 28 June to 01 July 2012 which is jointly organized by the Ceylon Institute of Builders in collaboration with International Council for Research and Innovation in Building and Construction (CIB) in the Netherlands and the Department of Building Economics of the University of Moratuwa.

Sri Lanka after the emergence from the period of brutal terrorism of three decades was able to achieve many economic milestones surpassing many other countries in the region. Today our nation is breathing with peace and harmony and with the development of the country. Sri Lanka National economy has started to boom and rapid development is taking place all over the country. The Construction industry has shown a considerable improvement in all sectors concerned.

The World Construction Symposium 2012 will be an International platform to exchange views and experiences on various issues related to construction industry for both local and International delegates, who will carry back memories of creating new skills, technology and learning for the development of the construction industry.

KEYNOTE SPEAKER

Deshamanya Dr. Roland Silva

Chancellor

University of Moratuwa



Deshamanya Dr. Roland Silva the current Chancellor of the University of Moratuwa is an Architect, Archaeologist and Conservator by profession. He was the president of the Institute of Architects, Sri Lanka during 1971-1972; President of the Council of Archaeologists during 1996-1998; and, the president of the World Body of Conservators, ICOMOS, during 1990-1999. He was the Commissioner of Archaeology, 1983-1991; Director General of the Central Cultural fund, 1980-1997; UNESCO Chair, Post Graduate Institute of Archaeology, 1998-2002. He carries a Doctor of Letters from Leiden University. Dr. Roland Silva is a Fellow of the Sri Lankan Institute of Architects; Fellow of Council of Archaeologists; Associate of the Royal Institute of British Architects; Postgraduate in Archaeology (London); Postgraduate in Studio dei Monumenti (Rome); and, Doctor of Science - Honoris Causa (Moratuwa). He has been decorated with the Golden Medal - Architecture (1997), Gold Medal - Archaeology (1996) and International Gazzola Prize for Conservation (1999). He was awarded Vidya Jyothi (1992); Puravidya Vidjjana Shiromani (1997); Memorial Medal, ICOMOS Russia (1998); and, Honra ao Merito, ICOMOS, Brazil (1998).

ORGANISING COMMITTEE

Chairperson	Prof. Chitra Weddikkara
Co-Chairs	Mr. Sagara Gunawardena Mr. Kalana Alwis
Advisors	Dr. Rohan Karunaratne Eng. Saliya Kaluarachchi
Organising Committee	Mr. Ruwan de Silva Eng. Jayakish Thudawe Eng. Mega Kularathna Mr. Rangi Hewage Eng. Ashoka Randeni Mr. Mahanama Jayamanne Mr. Sudath Amarasinghe Dr. Tissa Meepe Eng. Walter Perera Mr. I. D. Wijeratne
Scientific Committee Chairs	Dr. Sepani Senaratne Dr. Yasangika Sandanayake
Conference Secretariat	Ms. Chandani Hadiwattege Ms. Saranga Gunawardena Ms. Pabasara Wijeratne
Event Director	Mr. Samantha Abeywickrama

SCIENTIFIC COMMITTEE

Chairs

Dr. Sepani Senaratne	<i>University of Moratuwa, Sri Lanka</i>
Dr. Yasangika Sandanayake	<i>University of Moratuwa, Sri Lanka</i>

Members

Dr. Vasantha Abeyssekara	<i>University of Southern Queensland, Australia</i>
Prof. Dilanthi Amarathunga	<i>University of Salford, United Kingdom</i>
Dr. Harsha Cabral	<i>President's Counsel, Sri Lanka</i>
Dr. Kapila Devapriya	<i>University of Moratuwa, Sri Lanka</i>
Prof. Rohinton Emmanuel	<i>University of Glasgow, Scotland</i>
Dr. Nirodha Fernando	<i>University of Moratuwa, Sri Lanka</i>
Dr. Richard Haigh	<i>University of Salford, United Kingdom</i>
Mr. Suranga Jayasena	<i>University of Moratuwa, Sri Lanka</i>
Prof. Mike Kagioglou	<i>University of Salford, United Kingdom</i>
Mrs. Gayani Karunasena	<i>University of Moratuwa, Sri Lanka</i>
Prof. Mohan Kumaraswamy	<i>University of Hong Kong, Hong Kong</i>
Prof. Craig Langston	<i>Bond University, Australia</i>
Prof. Florence Y. Y. Ling	<i>National University of Singapore, Singapore</i>
Prof. George Ofori	<i>National University of Singapore, Singapore</i>
Mrs. Kanchana Perera	<i>University of Moratuwa, Sri Lanka</i>
Prof. Srinath Perera	<i>University of Northumbria, United Kingdom</i>
Prof. Janaka Ruwanpura	<i>University of Calgary, Canada</i>
Prof. P. D. Rwelamila	<i>University of South Africa, South Africa</i>
Prof. Alfredo Serpell	<i>Catholic University of Chile, Chile</i>
Mr. Indunil Seneviratne	<i>University of Moratuwa, Sri Lanka</i>
Prof. Martin Sexton	<i>University of Reading, United Kingdom</i>
Dr. Nayanthara de Silva	<i>University of Moratuwa, Sri Lanka</i>
Prof. Lalith de Silva	<i>University of Moratuwa, Sri Lanka</i>
Dr. Keith Skelton	<i>Scott Wilson Ltd, Sri Lanka</i>
Dr. Ben O. Uwakweh	<i>North Carolina A&T State University, USA</i>

SYMPOSIUM INFORMATION

World Construction Symposium Inauguration

The World Construction Symposium and Construction EXPO inauguration is on 29 June 2012 from 09.30 am to 12.00 noon at the Bandaranaike Memorial International Conference Hall (BMICH), Bauddhaloka Mw, Colombo 07.

World Construction Conference

The Conference is on 29 June 2012 from 01.30 pm to 05.30 pm and on 30 June 2012 from 08.30 am to 06.00 pm at the Cinnamon Grand Hotel, 77, Galle Road, Colombo 03.

Symposium Secretariat

Ceylon Institute of Builders (CIOB), No. 48, CSCT Building, Thalawathugoda Road, Pitakotte, Sri Lanka

Tel : 0094-11-3140355

Fax : 0094-11-2885933

Email : info@ciob.lk; ciobconference2012@yahoo.com

Website : <http://worldsymposium.ciob.lk>

Language

The official language of the symposium is English. There will be no simultaneous translation.

Dress Code

Symposium - Business, Lounge or National

Dinners - Smart Casual

Registration

Symposium delegates can collect their materials at the registration desk, located at the Cinnamon Grand Hotel. Opening times of the registration desk will be from 08.30 am to 06.00 pm on 28 - 30 June 2012.

Secretariat Room

During the symposium, the secretariat room is located adjoining the Oak Room of the Cinnamon Grand Hotel, where the main conference is being held. The opening hours of the secretariat will be from 08.30 am to 06:00 pm on 28 – 30 June 2012.

Certificate of Attendance

A certificate of attendance will be issued to all participants, during the conference sum-up.

Liability

The organising committee is not liable for personal accidents, loss or damage to private properties of registered participants during the Symposium. Participants should make their own arrangements with respect to personal insurance.

Disclaimer

Whilst every attempt be made to ensure that all aspects of the Symposium mentioned in this announcement will take place as scheduled, the Organising Committee reserves the prerogative to make last minute changes should the need arise without prior notice.

SYMPOSIUM PROGRAMME

Thursday, 28 June 2012

07.30 pm	Welcome Reception	Atrium Cinnamon Grand Hotel
----------	--------------------------	-----------------------------------

Friday, 29 June 2012

World Construction Symposium and EXPO

09.30 am	Opening Ceremony – International Construction EXPO 2012	BMICH
12.15 pm	Lunch	Atrium (Cinnamon Grand)

Friday, 29 June 2012 (Contd.)

World Construction Conference

01.30 pm	Conference Inauguration Keynote Speech by Deshamanya Dr. Roland Silva, Chancellor, University of Moratuwa	Oak Room (Cinnamon Grand)
03.00 pm	Tea / Coffee Break	Outside Ivy Room
03.30 pm	Parallel Sessions <i>(There will be THREE parallel sessions)</i>	Ivy Rooms
05.30 pm	End of Programme	

Saturday, 30 June 2012

08.30 am	Country Paper Presentations by Delegates	Oak Room (Cinnamon Grand)
10.00 am	Tea / Coffee Break	Outside Ivy Room

10.30 am	Parallel Sessions <i>(There will be TWO parallel sessions)</i>	Ivy Rooms
12.15 pm	Lunch	Atrium (Cinnamon Grand)
01.30 pm	Parallel Sessions <i>(There will be TWO parallel sessions)</i>	Ivy Rooms
03.00 pm	Tea / Coffee Break	Outside Ivy Room
03.30 pm	Parallel Sessions <i>(There will be TWO parallel sessions)</i>	Ivy Rooms
05.00 pm	Tea / Coffee Break	Outside Ivy Room
05.15 pm	Conference Sum-up	Ivy Room
	Rapporteur's Report by Dr. Kapila Devapriya Dr. Nirodha Fernando	
06.00 pm	End of Programme	
7.30 pm	Cultural Dinner	Waterside, Cinnamon Lakeside Hotel

Sunday, 01 July 2012

09.30 am	City Tour for Foreign Delegates (Optional)
05.00 pm	Return to Hotel

SOCIAL PROGRAMME

Welcome Reception

Day/Date	Thursday 28 June 2012
Time	07:30 pm onwards
Venue	Atrium, Cinnamon Grand Hotel
Dress code	Smart Casual

Cultural Dinner

Day/Date	Saturday 30 June 2012
Time	07:30 pm onwards
Venue	Waterside, Cinnamon Lakeside Hotel
Dress code	Smart Casual

City Tour for Foreign Delegates (Optional)

Day/Date	Sunday 01 July 2012
Time	9:30 am onwards
Details	Tour of Colombo city including visits to Zam Gems, Exclusive Designer Jewellery Store and ODEL the largest department store in Colombo
Dress code	Casual

CONFERENCE SESSION PLAN AT-A-GLANCE

Friday, 29 June 2012						Saturday, 30 June 2012																																			
08.00 - 08.30	Registration					Registration																																			
08.30 - 09.00						International Construction EXPO 2012				Opening Ceremony																															
09.00 - 09.30														World Construction Conference 2012 Inauguration Ceremony Keynote Speech and Guest Speeches				Tea / Coffee Break																							
09.30 - 09.45																						Tea / Coffee Break				Session 2A		Session 2B													
09.45 - 10.00																														S5019		S5005									
10.00 - 10.15																																		S5023		S5049					
10.15 - 10.30																																						S5082		S5020	
10.30 - 10.45																																									
10.45 - 11.00																										S5089		S5044													
11.00 - 11.15																														Q&A		Q&A									
11.15 - 11.30	Lunch				Lunch																																				
11.30 - 11.45									Session 3A		Session 3B																														
11.45 - 12.00													S5046		S5030																										
12.00 - 12.15																	S5013		S5048																						
12.15 - 13.30																					S5054		S5084																		
13.30 - 13.45									S5068		S5066																														
13.45 - 14.00													Q&A		Q&A																										
14.00 - 14.15									Tea / Coffee Break				Tea / Coffee Break																												
14.15 - 14.30																	Session 4A		Session 4B																						
14.30 - 14.45																					S5029		S5041																		
14.45 - 15.00	S5087		S5085																																						
15.00 - 15.15					S5058		S5027																																		
15.15 - 15.30	S5081		S5037																																						
15.30 - 15.45					Q&A		Q&A																																		
15.45 - 16.00	Tea / Coffee Break				Tea / Coffee Break																																				
16.00 - 16.15																	Session 1A		Session 1B		Session 1C																				
16.15 - 16.30																							S5014		S5040																
16.30 - 16.45									S5042		S5091																														
16.45 - 17.00													S5010		S5092																										
17.00 - 17.15									S5083		S5047		S5075																												
17.15 - 17.30															S5056		S5077																								
17.30 - 17.45									S5057		S5072		S5043																												
17.45 - 18.00															Q&A		Q&A																								
17.45 - 18.00									Conference Sum-up				Conference Sum-up																												

DETAILED SESSION PLAN

Friday, 29 June 2012

Session 1A

Theme : **Project Financing and Risk Management**
Session Chair : Prof. Florence Y. Y. Ling
Coordinator : Mr. Indunil Seneviratne
Venue/Time : Ivy Room A - 3.30 pm – 5.30 pm

Time	Paper ID, Title and Author(s)
3.30 – 3.45 pm	S5014 - A Conceptual Framework for Client Financed Construction and Non-Traditional Approaches for Financing Construction Work <i>Vasantha Abeyssekera</i>
3.45 – 4.00 pm	S5042- Cost Overrun Assessment for Green Construction Project <i>C. S. Arun , Lakshmi Narayanan, Ashish Gaurav and Neethu Krishna</i>
4.00 – 4.15 pm	S5010 - Monetary Retentions for Subcontract Work: A Risk-Based Approach <i>Vasantha Abeyssekera and Mohantha Soysa</i>
4.15 – 4.30 pm	S5083 - Implementing Enterprise Risk Management in a Chinese Construction Firm Based in Singapore <i>Zhao Xianbo, Hwang Bon-Gang and Low Sui Pheng</i>
4.30 – 4.45 pm	S5056 - Risks and Risk Assessment Methods in Industrial Maintenance in Sri Lanka <i>W. M. P. U. Wijeratne, B. A. K. S. Perera and M. L. D. De Silva</i>
4.45 – 5.00 pm	S5057 - Risk Management in Electrical Distribution System in Sri Lankan Hotel Industry <i>P. C. Wanigasinghe, B. A. K. S. Parera and W. M. P. U. Wijeratne</i>
5.00 – 5.30 pm	Q&A

Friday, 29 June 2012

Session 1B

Theme : Construction in Developing Countries
Session Chair : Prof. P. K. S. Mahanama
Coordinator : Mr. Suranga Jayasena
Venue/Time : Ivy Room B - 3.30 pm – 5.30 pm

Time	Paper ID, Title and Author(s)
3.30 – 3.45 pm	S5040 - The Use of Alternative Building Materials in Developing Countries: Addressing Challenges Faced by Stakeholders <i>E. C. Mpakati-Gama, S. C. Wamuziri and B. Sloan</i>
3.45 – 4.00 pm	S5091 - Preservation of Private Houses in Fort of Galle, Sri Lanka: A Case Study... <i>Samitha Manawadu</i>
4.00 – 4.15 pm	S5092 - Significance of Meaningful Built Environments in Sustainable Development with Special Reference to Ayurveda-Eco Tourism in Sri Lanka <i>Marini Samaratunga, Pulathisi Vithana, H. L. Obeyesekera and Rohan Karunaratne</i>
4.15 – 4.30 pm	S5021 - The Economic Cost of Landslides in Hali-ela Divisional Secretariat of Sri Lanka <i>G. R. S. R. C. Samaraweera, R. M. L. Rathnayaka, D. J. Jagoda and H. G. D. Sriyani</i>
4.30 – 4.45 pm	S5047 - Study on Sick Building Syndrome in Office Environment <i>H. A. N. Wijerathne, G. I. Karunasena and B. H. Mallawaarachchi</i>
4.45 – 5.00 pm	S5072 - Preventive Methods Used for Health and Safety Hazards in Hotel Industry in Sri Lanka <i>P. A. D. Rajini, C. S. P. Fernando and S. A. I. S. Serapperuma</i>
5.00 – 5.30 pm	Q&A

Friday, 29 June 2012

Session 1C

Theme : Sustainability and Energy Management
Session Chair : Prof. Bon-Gang Hwang
Coordinator : Dr. Nayanthara De Silva
Venue/Time : Ivy Room C - 3.30 pm – 5.30 pm

Time	Paper ID, Title and Author(s)
3.30 – 3.45 pm	S5061 - Impact of Green Concept on Business Objectives of an Organisation <i>K. G. A. S. Waidyasekara and R. L. N. Sandamali</i>
3.45 – 4.00 pm	S5059 - Developing a Framework to Benchmark Operational Energy in Sustainable Commercial Buildings in Sri Lanka <i>M. N. K. De Silva and S. R. Chandratilake</i>
4.00 – 4.15 pm	S5051 - Green Building Concept to Facilitating High Quality Indoor Environment for Building Occupants in Sri Lanka <i>B. H. Mallawaarachchi, M. L. De Silva, R. Rameezdeen and S. R. Chandrathilaka</i>
4.15 – 4.30 pm	S5075 - Building Energy Consumption Factors: A Literature Review and Future Research Agenda <i>M. N. K. De Silva and Y. G. Sandanayake</i>
4.30 – 4.45 pm	S5077 - Sustainability Evaluation Framework for Energy Power Plants in Sri Lanka <i>S. D. Wijesooriya, Y. G. Sandanayake and K. M. G. K. Konara</i>
4.45 – 5.00 pm	S5043 - Sustainable Project Management for Green Construction: Challenges, Impact, and Solutions <i>Bon-Gang Hwang and Jac See Tan</i>
5.00 – 5.30 pm	Q&A

Saturday, 30 June 2012

Session 2A

Theme : Procurement & Integrated Project Delivery
Session Chair : Prof. Dilanthi Amarathunga
Coordinator : Mrs. Gayani Karunasena
Venue/Time : Ivy Room A - 10.30 am – 12.15 pm

Time	Paper ID, Title and Author(s)
10.30 – 10.45 am	S5019 - Developing Sustainable Relationships Through Public Private People Partnership (4P) Projects <i>Weiwu Zou, Junqi Zhang and Mohan Kumaraswamy</i>
10.45 – 11.00 am	S5023 - Adaptability of Integrated Project Delivery in a Construction Industry <i>Himal Suranga Jayasena and Nawodanie Senevirathna</i>
11.00 – 11.15 am	S5082 - Electronic Procurement System: A Case of Ministry of Water Supply and Drainage in Sri Lanka <i>K. A. P. Gunawardhana and G. I. Karunasena</i>
11.15 – 11.30 am	S5033 - Investigation of BIM Adoption Strategies in Indian AEC Industry <i>Aruna Muthumanickam, Koshy Varghese and Ashwin Mahalingam</i>
11.30 – 11.45 am	S5089 - Building Information Modelling for Sri Lankan Construction Industry <i>Himal Suranga Jayasena and Chitra Weddikkara</i>
11.45 – 12.15 pm	Q&A

Saturday, 30 June 2012

Session 2B

Theme : **Project and Stakeholder Management in Construction**
Session Chair : Dr. Richard Haigh
Coordinator : Mrs. Kanchana Perera
Venue/Time : Ivy Room B - 10.30 am – 12.15 pm

Time	Paper ID, Title and Author(s)
10.30 – 10.45 am	S5005 - Strategies to Overcome Challenges Faced in Managing Construction Projects in the United Arab Emirates <i>Florence Y. Y. Ling, Mohammed F. Dulaimi and Pei Jing Ho</i>
10.45 – 11.00 am	S5049 - Understanding Project Culture in Construction: A Literature Synthesis <i>A. U. A. A. Samaraweera and Sepani Senaratne</i>
11.00 – 11.15 am	S5020 - Importance of Design Phase Stakeholder Management for Successfully Achieving Objectives of Building Projects: A Sri Lankan Perspective <i>Y. D. C. Weerakkody and W. B. M. Thoradeniya</i>
11.15 – 11.30 am	S5060 - Team Role Concept and Team Formation in Design Teams in Sri Lanka <i>D. A. Saranga Gunawardane and Sepani Senaratne</i>
11.30 – 11.45 am	S5044 - Does “Front-End Planning” Work for the Singapore Construction Industry? <i>Bon-Gang Hwang and Jia Wei Ho</i>
11.45 – 12.15 pm	Q&A

Saturday, 30 June 2012

Session 3A

Theme : **Multinational Construction Practices**
Session Chair : Prof. Mohan Kumarasamy
Coordinator : Mr. Indunil Senaviratne
Venue/Time : Ivy Room A - 1.30 pm – 3.00 pm

Time	Paper ID, Title and Author(s)
1.30 – 1.45 pm	S5046 - Comparison of Key Competences of Clients and Design-Build Contractors in the Construction Market of the People's Republic of China (PRC) <i>Bo Xia, Albert P. C. Chan and Jian Zuo</i>
1.45 – 2.00 pm	S5013 - Resolving Retention Polarity: The Perceptions of Structural Steel Subcontractors <i>Vasantha Abeysekera</i>
2.00 – 2.15 pm	S5054 - Conceptual Framework of Decision Support Model for the Selection of Structural Frame Material to Achieve Sustainability and Constructability in Singapore <i>Yun Zhong, Evelyn Ai Lin Teo, Florence Yean Yng Ling, George Ofori</i>
2.15 – 2.30 pm	S5068 - Use of Recycle Glass as a Coarse Aggregate in Concrete <i>Gayal Kuruppu and Ravihansa Chandratilake</i>
2.30 – 3.00 pm	Q&A

Saturday, 30 June 2012

Session 3B

Theme : **Construction Quality and Productivity**
Session Chair : Prof. Lalith de Silva
Coordinator : Mrs. Kanchana Perera
Venue/Time : Ivy Room B - 1.30 pm – 3.00 pm

Time	Paper ID, Title and Author(s)
1.30 – 1.45 pm	S5030 - Appropriateness of Lean Production System for the Construction Industry <i>Nimesha Vilasini, Thomas R. Neitzert and Pradeep R. Jayatilaka</i>
1.45 – 2.00 pm	S5048 - A Preliminary Literature Review into Lean Construction Implementation <i>Nilmini Thilakarathna and Sepani Senaratne</i>
2.00 – 2.15 pm	S5084 - Lean Construction in Large Chinese Construction Firms: A SWOT Analysis <i>Gao Shang, Low Sui Pheng, Hwang Bon-Gang and George Ofori</i>
2.15 – 2.30 pm	S5066 - Maintainability Approach for Lean Maintenance <i>Nayanthara De Silva, Malik Ranasinghe and C. R. De Silva</i>
2.30 – 3.00 pm	Q&A

Saturday, 30 June 2012

Session 4A

Theme : **Construction Research and Education**
Session Chair : Dr. Vasantha Abeysekera
Coordinator : Dr. Nayanthara De Silva
Venue/Time : Ivy Room A - 3.30 pm – 5.00 pm

Time	Paper ID, Title and Author(s)
3.30 – 3.45 pm	S5029 - Motivating the Construction Academic: A Conceptual Study <i>Ashoka Abeysekera and Vasantha Abeysekera</i>
3.45 – 4.00 pm	S5087 - The Impact of Training and Development on Career Advancement of Professional Women in the UK Construction Industry <i>Nirodha Gayani Fernando and Dilanthi Amaratunga and Richard Haigh</i>
4.00 – 4.15 pm	S 5058 - Fostering Creativity in Construction Education: Finding the Meaning of Creativity within Construction Industry <i>N. Gunarathne and J. Wijesundara</i>
4.15 – 4.30 pm	S5081 - A Literature Synthesis: Is Construction Industry Low Responsive to Change and Development? <i>Chandanie Hadiwattege and Sepani Senaratne</i>
4.30 – 5.00 pm	Q&A

Saturday, 30 June 2012

Session 4B

Theme : **Law and Dispute Resolution**
Session Chair : Dr. Harsha Cabral
Coordinator : Mrs. Gayani Karunasena
Venue/Time : Ivy Room B - 3.30 pm – 5.00 pm

Time	Paper ID, Title and Author(s)
3.30 – 3.45 pm	S5041 - Application of Concurrency in Delay Claims <i>Samurdi Baduge and Himal Suranga Jayasena</i>
3.45 – 4.00 pm	S5085 - Arbitration as an Alternative Dispute Resolution Method in the Construction Industry of Sri Lanka <i>Mahesh Abeynayake and Chitra Weddikkara</i>
4.00 – 4.15 pm	S5027 - Most Appropriate Dispute Resolution Strategy for Sri Lankan Construction Industry <i>Himal Suranga Jayasena and Yakupitiyage Himesh Kavinda</i>
4.15 – 4.30 pm	S5037 - The Impact of Inclusion of Arbitration Clause by Reference in Main Contract and Sub Contract Documents in the Construction Industry and Its Negative Connotations <i>Jagath Chandrawansa Korale and Chitra Weddikkara</i>
4.30 – 5.00 pm	Q&A

**Abstracts of the Proceedings of the
World Construction Conference 2012**

**Theme:
Global Challenges in Construction Industry**

**Edited by:
Dr. S. Senaratne
Dr. Y. G. Sandanayake**

**Building Economics and Management Research Unit (BEMRU)
Department of Building Economics
University of Moratuwa**

CONTENTS OF ABSTRACTS

Motivating the Construction Academic: A Conceptual Study <i>Ashoka Abeysekera and Vasantha Abeysekera</i>	39
An Analysis of Construction Law and Disaster Management Law Relating to Sustainable Development in Sri Lanka <i>Mahesh Abeynayake</i>	40
Arbitration as an Alternative Dispute Resolution Method in the Construction Industry of Sri Lanka <i>Mahesh Abeynayake and Chitra Weddikara</i>	41
Resolving Retention Polarity: The Perceptions of Structural Steel Subcontractors <i>Vasantha Abeysekera</i>	42
A Conceptual Framework for Client Financed Construction and Non-Traditional Approaches for Financing Construction Work <i>Vasantha Abeysekera</i>	43
Monetary Retentions for Subcontract Work: A Risk-Based Approach <i>Vasantha Abeysekera and Mohantha Soysa</i>	44
Cost Overrun Assessment for Green Construction Project <i>C. S. Arun, Lakshmi Narayanan, Ashish Gaurav and Neethu Krishna</i>	45
Application of Concurrency in Delay Claims <i>Samurdi Baduge and Himal Suranga Jayasena</i>	46
Developing a Framework to Benchmark Operational Energy in Sustainable Commercial Buildings in Sri Lanka <i>M. N. K. De Silva and S. R. Chandratilake</i>	47
Building Energy Consumption Factors: A Literature Review and Future Research Agenda <i>M. N. K. De Silva and Y. G. Sandanayake</i>	48
Maintainability Approach for Lean Maintenance <i>Nayanthara De Silva, Malik Ranasinghe and C.R. De Silva</i>	49
The Impact of Training and Development on Career Advancement of Professional Women in the UK Construction Industry <i>Nirodha Gayani Fernando, Dilanthi Amaratunga and Richard Haigh</i>	50
Fostering Creativity in Construction Education: Finding the Meaning of Creativity within Construction Industry <i>N. Gunarathne and J. Wijesundara</i>	51
Team Role Concept and Team Formation in Design Teams in Sri Lanka <i>D. A. Saranga Gunawardane and Sepani Senaratne</i>	52

Electronic Procurement System: A Case of Ministry of Water Supply and Drainage in Sri Lanka <i>K. A. P. Gunawardhana and G. I. Karunasena</i>	53
A Literature Synthesis: Is Construction Industry Low Responsive to Change and Development? <i>Chandanie Hadiwattege and Sepani Senaratne</i>	54
Does “Front-End Planning” Work for the Singapore Construction Industry? <i>Bon-Gang Hwang and Jia Wei Ho</i>	55
Sustainable Project Management for Green Construction: Challenges, Impact and Solutions <i>Bon-Gang Hwang and Jac See Tan</i>	56
Most Appropriate Dispute Resolution Strategy for Sri Lankan Construction Industry <i>Himal Suranga Jayasena and Yakupitiyage Himesh Kavinda</i>	57
Adaptability of Integrated Project Delivery in a Construction Industry <i>Himal Suranga Jayasena and Nawodanie Shyamen Senevirathna</i>	58
Building Information Modelling for Sri Lankan Construction Industry <i>Himal Suranga Jayasena and Chitra Weddikkara</i>	59
The Impact of Inclusion of Arbitration Clause by Reference in Main Contract and Sub Contract Documents in the Construction Industry and Its Negative Connotations <i>Jagath Chandrawansa Korale and Chitra Weddikkara</i>	60
Disaster Risk Reduction Measures in Bangladesh <i>Udayangani Kulatunga, Gayan Wedawatta, Dilanthi Amaratunga, Parvez Ahmed and Raman Biswas</i>	61
Use of Recycle Glass as a Coarse Aggregate in Concrete <i>Gayal Kuruppu and Ravihansa Chandratilake</i>	62
Strategies to Overcome Challenges Faced in Managing Construction Projects in the United Arab Emirates <i>Florence Y.Y. Ling, Mohammed F. Dulaimi and Pei Jing Ho</i>	63
Green Building Concept to Facilitating High Quality Indoor Environment for Building Occupants in Sri Lanka <i>B. H. Mallawaarachchi, M. L. De Silva, R. Rameezdeen and S. R. Chandrathilaka</i>	64
Preservation of Private Houses in Fort of Galle, Sri Lanka: A Case Study <i>Samitha Manawadu</i>	65
Teamwork in Facilities Management <i>N. H. C. Manjula and S. Senaratne</i>	67

The Use of Alternative Building Materials in Developing Countries: Addressing Challenges Faced by Stakeholders <i>E. C. Mpakati-Gama, S. C. Wamuziri and B. Sloan</i>	68
Investigation of BIM Adoption Strategies in Indian AEC Industry <i>Aruna Muthumanickam, Koshy Varghese and Ashwin Mahalingam</i>	69
The Purpose of Retentions: A Review of the Existing Literature <i>Priyanka Raina and John Tookey</i>	70
Preventive Methods Used for Health and Safety Hazards in Hotel Industry in Sri Lanka <i>P. A. D. Rajini, C. S. P. Fernando and S. A. I. S. Serapperuma</i>	71
Significance of Meaningful Built Environments in Sustainable Development with Special Reference to Ayurveda-Eco Tourism in Sri Lanka <i>Marini Samaratunga, Pulathisi Vithana, H. L. Obeyesekera and Rohan Karunaratne</i>	72
Understanding Project Culture in Construction: A Literature Synthesis <i>A. U. A. A. Samaraweera and Sepani Senaratne</i>	73
The Economic Cost of Landslides in Hali-Ela Divisional Secretariat of Sri Lanka <i>G. R. S. R. C. Samaraweera, R. M. L. Rathnayaka, D. J. Jagoda and H. G. D. Sriyani</i>	74
Lean Construction in Large Chinese Construction Firms: A SWOT Analysis <i>Gao Shang, Low Sui Pheng, Hwang Bon-Gang and George Ofori</i>	75
A Preliminary Literature Review into Lean Construction Implementation <i>Nilmini Thilakarathna and Sepani Senaratne</i>	76
Appropriateness of Lean Production System for the Construction Industry <i>Nimesha Vilasini, Thomas R. Neitzert and Pradeep R. Jayatilaka</i>	77
Impact of Green Concept on Business Objectives of an Organisation <i>K. G. A. S. Waidyasekara and R. L. N. Sandamali</i>	78
Risk Management in Electrical Distribution System in Sri Lankan Hotel Industry <i>P. C. Wanigasinghe, B. A. K. S. Parera and W. M. P. U. Wijeratne</i>	79
Importance of Design Phase Stakeholder Management for Successfully Achieving Objectives of Building Projects: A Sri Lankan Perspective <i>Y. D. C. Weerakkody and W. B. M. Thoradeniya</i>	80
Study on Sick Building Syndrome in Office Environment <i>H. A. N. Wijerathne, G. I. Karunasena and B. H. Mallawaarachchi</i>	81
Risks and Risk Assessment Methods in Industrial Maintenance in Sri Lanka <i>W. M. P. U. Wijeratne, B. A. K. S. Perera and M. L. De Silva</i>	82
Sustainability Evaluation Framework for Energy Power Plants in Sri Lanka <i>S. D. Wijesooriya, Y. G. Sandanayake and K. M. G. K. Konara</i>	83

Comparison of Key Competences of Clients and Design-Build Contractors in the Construction Market of the People's Republic of China (PRC) <i>Bo Xia, Albert P. C. Chan and Jian Zuo</i>	84
Implementing Enterprise Risk Management in a Chinese Construction Firm Based in Singapore <i>Zhao Xianbo, Hwang Bon-Gang and Low Sui Pheng</i>	85
Conceptual Framework of Decision Support Model for the Selection of Structural Frame Material to Achieve Sustainability and Constructability in Singapore <i>Yun Zhong, Evelyn Ai Lin Teo, Florence Yean Yng Ling, George Ofori</i>	86
Developing Sustainable Relationships Through Public Private People Partnership (4P) Projects <i>Weiwu Zou, Junqi Zhang and Mohan Kumaraswamy</i>	85

PAPER ABSTRACTS

MOTIVATING THE CONSTRUCTION ACADEMIC: A CONCEPTUAL STUDY

Ashoka Abeysekera*

Springfield Campus, University of Southern Queensland, Australia

Vasantha Abeysekera

Faculty of Engineering and Surveying, University of Southern Queensland, Australia

ABSTRACT

The main purpose of this study is to understand factors that motivate and demotivate a construction academic based on existing literature. An extensive examination of published literature failed to reveal any studies on motivation or demotivation of construction academics but for a few studies on motivation of academics in general. These studies revealed over 25 intrinsic and extrinsic factors which were differentiated between factors cited in conceptual and empirical studies. A further distinction was made between factors cited in studies focussed directly on motivation of academics, and factors cited in studies investigating a different topic. Factors so identified, provide a broad base for understanding 'what' factors affect motivation and demotivation of academics. However, these studies have not taken into account discipline specific, job level, and other contextual issues or prioritised factors based on importance. Moreover, 'how' these factors could be used for improving organisational performance focussing on different disciplines and roles within these disciplines have not been studied either. Nevertheless, an examination of these factors revealed that most fall within the control of the university management. As such, there is a need for understanding what management styles could be used for increasing motivation and minimising demotivation, and this is an area that needs investigation focussing on construction specific issues vis-à-vis context and job roles.

Keywords: *Construction Academic, Demotivation, Motivation, University Management.*

* Corresponding Author: E-mail - ashoka.abeysekera@usq.edu.au

AN ANALYSIS OF CONSTRUCTION LAW AND DISASTER MANAGEMENT LAW RELATING TO SUSTAINABLE DEVELOPMENT IN SRI LANKA

Mahesh Abeynayake*

Department of Building Economics, University of Moratuwa, Sri Lanka

ABSTRACT

Construction Law may be defined as the law that regulates built environment in relation to construction activities. This law also deals with physical planning techniques and protection of natural environment. Law governing in built environment in Sri Lanka is largely based on legislation. Main physical planning legislations in Sri Lanka are Urban Development Authority (UDA) Law No. 41 of 1978, Town and Country Planning Ordinance No. 16 of 1946, Municipal Council Ordinance and Urban Council Ordinance of 1947, Pradeshiya Sabhas Act of 1987, and their amendments. Provisions of these legislation are controlling construction activities in their regions. National Environment Act of 1980 controls EIA and EPL relating to the construction industry. The Sri Lanka Parliament enacted two legislations after the tsunami namely Tsunami (Special Provisions) Act No. 16 of 2005 and Disaster Management Act No. 13 of 2005 for the rehabilitation activities. These two Acts have mentioned planning and recovery techniques and elements of disaster management law. In the post tsunami reconstruction work, the government has given high priority to rebuild human settlements. However there are some discrepancies in these legislation and are not accepted in sustainability concepts. Hence, the aim of this research is to compare existing Construction Law and Disaster Management Law relating to the construction industry in Sri Lanka and recommend improvements to the Construction Law practices in order to make sustainability concepts more effective. Through a literature review of recent court cases, this research has analysed the basic concepts and discrepancies of the above mentioned law in Sri Lanka.

Keywords: *Planning Legislation, Environment, Disaster Management.*

* Corresponding Author: E-mail- abey92@hotmail.com

ARBITRATION AS AN ALTERNATIVE DISPUTE RESOLUTION METHOD IN THE CONSTRUCTION INDUSTRY OF SRI LANKA

Mahesh Abeynayake* and Chitra Weddikara

Department of Building Economics, University of Moratuwa, Sri Lanka

ABSTRACT

The construction industry in Sri Lanka covers a complex and comprehensive field of activities. Disputes might arise at any point during the construction process. Dispute resolution systems are changed with the interaction of the parties. Arbitration is a voluntary procedure available as an alternative resolution to litigation, however not enforceable as the means of settling disputes except where the parties have entered into an arbitration agreement. Construction claims tend to be of the most technical nature - intensive and multifaceted than most other commercial disputes. The desirable features of arbitration are fast, inexpensive, fair, simple, flexibility, confidentiality, minimum delay. Sri Lanka Arbitration Act No. 11 of 1995 stated arbitration principles and UNCITRAL Model Law. However, there is a necessity to reviewing and improving of the arbitration practice periodically in order to minimise the cost and complexity of the procedure.

This research is ultimately aims to assess significant attributes of arbitration in construction industry of Sri Lanka. This paper reports on findings gained from the literature review and preliminary survey conducted to explore the current status of arbitration as an alternative dispute resolution method in Sri Lankan construction industry. Current findings indicate that the construction professionals have minimum level of satisfaction on the current arbitration practice; however, they believe that arbitration is an effective mechanism for dispute resolution. The results of this study enabled to gain an understanding on the current arbitration practice and its significance and offer suggestions to improve current arbitration practices in the Sri Lankan construction industry.

Keywords: *Arbitration, Construction Industry, Dispute Resolution.*

* Corresponding Author: E-mail - abey92@hotmail.com

RESOLVING RETENTION POLARITY: THE PERCEPTIONS OF STRUCTURAL STEEL SUBCONTRACTORS

Vasantha Abeysekera*

Faculty of Engineering and Surveying, University of Southern Queensland, Australia

ABSTRACT

This study aims to understand the perceived polarity between main contractors and subcontractors with a view to resolving problems connected with retentions in an environment where a sliding-retention regime is utilised with a retention rate of 10% for work below NZ \$ 200,000. Eight structural steel subcontractors operating in Auckland were interviewed. Contrary to popular belief, subcontractors are not averse to retentions with most taking a middle ground. Nevertheless, the apparently fair practice of using back-to-back contract terms is not seen as fair and reasonable. Most solutions acceptable to subcontractors impact negatively on contractors' cash flow highlighting the need for some form of reciprocity from subcontractors (price discounts, improved performance, etc.) to induce contractors to offer favourable retention regimes. This highlights the need for a theory on 'retention reciprocity' to supplement the five theories on retentions. However, given that not all contractors can be expected to display reciprocity fairness, an interventionist approach may be necessary in order to neutralise any imbalances in power between the contracting parties possibly through amendments to the Construction Contracts Act, and when doing so, there is a need to exercise much caution as the outcome of chaotic systems could be quite unpredictable.

Keywords: *Reciprocity, Retentions, Construction Contracts Act.*

* Corresponding Author: E-mail- vasantha.abeysekera@usq.edu.au

A CONCEPTUAL FRAMEWORK FOR CLIENT FINANCED CONSTRUCTION AND NON-TRADITIONAL APPROACHES FOR FINANCING CONSTRUCTION WORK

Vasantha Abeysekera*

Faculty of Engineering and Surveying, University of Southern Queensland, Australia

ABSTRACT

The basic premise of the client-financed-construction philosophy is that those who commission service providers must not only pay for their services for the cost of their labour, materials, plant and equipment but do so in a manner that adds value to all parties. A new framework for proposing, evaluating and implementing such systems has been conceived which is used for evaluating three non-traditional approaches for financing construction work, and thereby validating the framework. The three approaches, namely, 'rolling advance payment', 'rolling material price advance', and 'direct financing' have been described and analysed with the 'rolling advance payment' approach being described as a revolutionary approach for solving problems connected with financing contractors and as an approach that has much potential to add value to all parties. The two systems are particularly useful as a crisis management system in projects saddled with cash flow problems bringing 'life' to almost 'dead' projects with potential benefits to all parties. The paper calls for good construction project management as an essential condition for implementing these schemes with particular attention given to risk management and local construction culture.

Keywords: *Cash Flow, Construction Contracts, Contractor Finance, Risk Management.*

* Corresponding Author: E-mail- vasantha.abeysekera@usq.edu.au

MONETARY RETENTIONS FOR SUBCONTRACT WORK: A RISK-BASED APPROACH

Vasantha Abeysekera*

Faculty of Engineering and Surveying, University of Southern Queensland, Australia

Mohantha Soysa

Costpro Limited - Construction Cost Consultants, New Zealand

ABSTRACT

The subcontracting culture in New Zealand is such that the same retention regime imposed on contractors is imposed on subcontractors by and large. This paradoxically fair contractual practice of back-to-back terms results in high retention rates (10%) and long defects liability periods set from contractor's practical completion which has caused concerns for subcontractors with no rational basis for resolving such concerns. This study investigates this phenomenon from a risk based perspective to understand the link between risk and retentions particularly in relation to current practice. Accordingly, it is found that current retention rates do not show an association with overall risk computed as a product of likelihood and consequence based on contractors' perceptions. However, when risk is viewed through these two components, it is seen that trades with high default risks for either likelihood or consequence results in high retention rates. Additionally, it is also seen that high risk is associated with subcontractor-harsh retention regimes with some exceptions lowering the strength of this association suggesting the need to investigate such trades to understand whether there are other overwhelming reasons for such exceptions. Thus, it is concluded that risk and retention regimes are linked to this extent although for a given level of risk, subcontractor friendly or unfriendly regimes could be achieved by a mix of different retention rates and release mechanisms. In this regard, it is seen that contractors seem to prefer high retention rates than longer defects liability periods for trades which have high risk levels. A further understanding about this relationship could be developed by undertaking a study on perceived overall risk levels and perceived retention regimes.

Keywords: *Contracting Culture, Defects Liability Period, Retentions, Retainage, Subcontracting.*

* Corresponding Author: E-mail - vasantha.abeysekera@usq.edu.au

COST OVERRUN ASSESSMENT FOR GREEN CONSTRUCTION PROJECT

C. S. Arun*, Lakshmi Narayanan, Ashish Gaurav and Neethu Krishna
Department of Civil Engineering, National Institute of Technology Calicut, India

ABSTRACT

Green construction projects are initiated in complex and dynamic environments resulting in circumstances of high uncertainty and risk, which are compounded by demanding cost and time constraints. This paper describes a systematic way to consider and quantify uncertainty in green construction process based on LEED rating system adopted by Indian Green Building Council (IGBC). The system incorporates knowledge and experience acquired from many experts, project-specific information, decision analysis techniques, and a simulation model to predict risks for different green ratings in the construction schedule at the initiation of a project. The model provides sensitivity analyses for different outcomes wherein the effect of critical and significant risk factors can be evaluated. The study focuses on lessons learned from past projects and describes a risk assessment process involving typical inputs and expected outputs. The paper also investigates practical applications of risk management in green construction industry.

Keywords: *Uncertainty, Risk, Cost, Green Construction.*

* Corresponding Author: E-mail- arun@nitc.ac.in

APPLICATION OF CONCURRENCY IN DELAY CLAIMS

Samurdi Baduge*

VFORM Consultants (Pvt.) Ltd., Sri Lanka

Himal Suranga Jayasena

Department of Building Economics, University of Moratuwa, Sri Lanka

ABSTRACT

It was observed that the consideration of concurrency in delay claims in Sri Lankan construction industry is significantly low. A study was conducted to identify key reasons for low consideration of concurrency in delay claims analysis. A three-round study method was adopted. First was a pilot study by means of interviews to explore concurrent delay practice in Sri Lanka. Second was a round of semi-structured interviews among key parties to a contract to identify significant causes affecting consideration of concurrency in delay claim analysis. Third round was a document survey aiming to identify lapses in documents which could affect successful practice of concurrent claim analysis. The study concludes that quality of documents is the most significant cause affecting the consideration of concurrency in delay claims analysis and identifies number of lapses in documents which contribute to low consideration of concurrency in delay claims. In addition to improving documentation practices, enhancing employers' awareness on concurrency is also suggested as a necessity to improve concurrent delay analysis practice in the Sri Lankan construction industry.

Keywords: *Concurrent Delay, Claims Management, Construction, Sri Lanka.*

*Corresponding Author: E-mail- samurdi_baduge@yahoo.com

DEVELOPING A FRAMEWORK TO BENCHMARK OPERATIONAL ENERGY IN SUSTAINABLE COMMERCIAL BUILDINGS IN SRI LANKA

M. N. K. De Silva* and S. R. Chandratilake

Department of Building Economics, University of Moratuwa, Sri Lanka

ABSTRACT

Benchmarking of operational energy efficiency stands for an influential tool to promote the efficient use of energy in buildings. This research stands for developing a framework to benchmark operational energy efficiency in sustainable commercial buildings in Sri Lanka. The developed framework offers the opportunity to achieve advance efficiency in energy, compares to the buildings which are just built to code. The benchmark is to be served as a referencing point of comparing and contrasting best practices within local context, while offering a realistic energy goal and eligibility to sustainability. The developed framework can be adapted to any context in order to benchmark operational energy consumption as well as any other sustainability domains such as water, indoor environmental quality and site development. The motivation behind this paper is to provide an energy benchmarking framework to evaluate the facility, which gives competitive advantages and better approach to the up-coming challenges in the fast growing world.

Keywords: *Operational Energy Benchmark, Sustainability Initiatives, Operational Energy Aspects, Operational Energy Indicators, Weighted Average Method.*

* Corresponding Author: E-mail -nawodads@gmail.com

BUILDING ENERGY CONSUMPTION FACTORS: A LITERATURE REVIEW AND FUTURE RESEARCH AGENDA

M. N. K. De Silva* and Y. G. Sandanayake

Department of Building Economics, University of Moratuwa, Sri Lanka

ABSTRACT

The Sri Lankan energy supply system faces several major strategic challenges due to high annual electricity demand growth rate and hence it is required to double the electricity generation capacity in every ten years. Ministry of Power and Energy predicted regular power cuts in the foreseeable future due to lack of rainfall within the hydro-catchments areas. In the coming years, oil price hikes will have a great impact on the operation of thermal power plants. Sri Lanka has now become the highest electricity bill spender in Asia and the status of energy poverty seems rather alarming. Sri Lankan energy statistics confirm that the building sector has contributed heavily on the energy, exceeding the industrial and transportation sectors. Occupant behaviour toward energy consumption have a significant impact on energy poverty and the initiation of large scale development projects after the three decades conflict pave the way to energy poverty to step up. In order to alleviate energy poverty, it is important to investigate the factors influencing the building energy consumption and their impact on power crisis. Therefore, the aim of this paper is to critically review the factors affecting building energy consumption. A comprehensive literature review and a desk study of Sri Lankan energy reports were used out to investigate the power crisis in Sri Lanka and the factors influencing building energy consumption. Five factors and 40 sub factors identified from the literature review will be used to identify critical factors affecting building energy consumption during the next phase of the study.

Keywords: *Energy Poverty, Power Crisis, Building Energy Consumption, Building Energy Consumption Factors.*

* Corresponding Author: E-mail - nawodads@gmail.com

MAINTAINABILITY APPROACH FOR LEAN MAINTENANCE

Nayanthara De Silva*

Department of Building Economics, University of Moratuwa, Sri Lanka

Malik Ranasinghe and C.R. De Silva

University Moratuwa, Sri Lanka

ABSTRACT

The concept of lean maintenance is promoted to eliminate maintenance waste and to maximise efficiency of the manufacturing process for overall cost reduction. The optimum usage of labour, material and technology is thus, proposed to eliminate waste during the maintenance process. This paper proposes a maintainability approach to minimise maintenance waste in order to promote lean maintenance concept to the construction industry. The approach has widened the focus of existing lean maintenance concept by moving its boundaries from the maintenance phase to early phases of the development process.

Eight challenges of lean maintenance have been established from fifty one maintainability causes of high-rise buildings. Their impact to maintenance cost was evaluated using a case study and found 40% reduction in the maintenance cost as wastage.

Keywords: *Lean Maintenance, Building Maintainability, Maintenance Cost, High-Rise Buildings.*

* Corresponding Author: E-mail - endds@becon.mrt.ac.lk

THE IMPACT OF TRAINING AND DEVELOPMENT ON CAREER ADVANCEMENT OF PROFESSIONAL WOMEN IN THE UK CONSTRUCTION INDUSTRY

Nirodha Gayani Fernando*

Department of Building Economics, University of Moratuwa, Sri Lanka

Dilanthi Amaratunga and Richard Haigh

School of the Built Environment, University of Salford, United Kingdom

ABSTRACT

The redressing the gender imbalance in the UK construction industry has been emphasised on numerous occasions and many researchers have identified that women can contribute in an immense way towards the construction industry development. However, construction industry has failed to attract and retain women who are interested in a construction career. Participation of women is still very low in some parts of the industry, in particular, at a time when skilled people at all levels of the industry are in demand. Further, Training and Development (T&D) activities have been identified as one of the vital element for professional women's career advancement in the construction industry. However, most of the concepts related to competitive advantages of T&D on professional women's career advancement are imprecise and unstructured in the construction industry. There is little evidence of an accepted theoretical framework for applying the ideas and there is even less in the way of empirical evidence concerning the validity and utility of these concepts. This paper presents the how much/how little impact T&D has on women's career advancement. This paper is based on data collected from professional women in the UK construction industry.

Keywords: *Career Advancement, Construction, Training and Development, Women.*

* Corresponding Author: E-mail - nirodhafernando@uom.lk

FOSTERING CREATIVITY IN CONSTRUCTION EDUCATION: FINDING THE MEANING OF CREATIVITY WITHIN CONSTRUCTION INDUSTRY

N. Gunarathne* and J. Wijesundara

Department of Architecture, University of Moratuwa, Sri Lanka

ABSTRACT

Many industries today attempt to meet their global challenges through two simple words: creativity and innovation. Construction industry more related to being a creative industry find no exemption. It constitute of realising buildings in Architecture and infrastructure in Engineering through technological interventions. It is an industry that relates to artistic, scientific and technical knowledge. Education in construction industry should also consider this complex nature and fostering creativity will differ from one subject area to another. One such basis for determining a definition and identifying a nuance of the creativity would be to interpret the creative definition into the education objectives: Knowledge, Skills and Attitudes. The composition of these three may differ from one discipline to another but a similar mechanism could be used to educate to foster creativity in any knowledge base either artistic, scientific or technical.

First step in this process is to find a working definition to creativity or innovation in the particular knowledge base, discipline or field. It could be done by simply asking “what does it meant to be creative in construction industry?” for the purpose of this paper or asking a similar question pertaining to any industry in a similar manner to kick-off a series of inner thoughts.

Keywords: *Creativity, Innovation, Construction Education, Education Objectives, Skills, Knowledge, Attitudes.*

* Corresponding Author: E-mail - niranji75@gmail.com

TEAM ROLE CONCEPT AND TEAM FORMATION IN DESIGN TEAMS IN SRI LANKA

D. A. Saranga Gunawardane* and Sepani Senaratne

Department of Building Economics, University of Moratuwa, Sri Lanka

ABSTRACT

Construction is a collaborative activity which combines efforts of number of participants. Hence, teamworking in construction is inevitable. The purpose of teamworking is to exploit the benefit for the team as a whole by a particular combination of actions by team members of the team. But, if not properly managed, teams may result in process losses and inefficiencies as well. Therefore, practitioners in the industry should find ways to improve team performance. Since construction project teams consist with many sub teams such as design teams, performance of the construction industry can be improved, when team performance of sub teams are also improved. 'Team role' concept relates to team performance. Belbin's (1981, 1993) team role framework is regarded as one of the most prominent team role theory. But use of this concept in construction teams is questionable. Accordingly, this study explored consideration of team role concept in team formation in one major sub team in construction: design teams. To explore this research problem, three case studies of in-house design teams which were involved in building construction projects with separated procurement arrangement were conducted in Sri Lanka. Semi-structured interviews were used as main data collection technique. The findings revealed that individuals are assigned to design teams considering their functional roles rather than team roles and team selection is affected by several other factors such as special requirements of the project, experience of the members, qualifications required, availability of human resources, recommendations and workload. However, the study revealed implications particularly to design team selectors on how to apply team role theory in construction context.

Keywords: *Construction Industry, Teamwork, Team Roles, Team Formation, Design Teams.*

* Corresponding Author: E-mail - sara9569@gmail.com

ELECTRONIC PROCUREMENT SYSTEM: A CASE OF MINISTRY OF WATER SUPPLY AND DRAINAGE IN SRI LANKA

K. A. P. Gunawardhana and G. I. Karunasena*

Department of Building Economics, University of Moratuwa, Sri Lanka

ABSTRACT

The Ministry of Water Supply and Drainage (MWS&D) has placed the highest priority to provide safe drinking water and adequate sanitation facilities to the community. It is imperative to ensure speed, transparency, Value for Money (VFM), and integrity in all the development spheres to achieve desired result, in line with on time completion, quality achievement, and cost efficiency when procure the goods, works, and consultancy and other services. However, majority of water supply projects of the Ministry have based on the funds from the foreign funding agencies even though, inadequate capacities of existing manual procurement process to work compatible with the funding agencies procurement policy is a critical issue. Accordingly, in this study explored the concept of e-procurement as an instrument to modernise, simplify, and improve the existing manual process.

Case study approach was selected and officers of the each and every profession of the MWS&D, National Water Supply and Drainage Board (NWS&DB), and the registered contractors of the Ministry were selected for collect the data on the existing manual procurement process, gaps, and requirements. Semi-structured interviews and observations were carried out as main data collection techniques. Experienced professionals in the field of procurement were also consulted to ascertain their opinions on verification of the feasibility of the scope of the proposed e-procurement system. Findings of the study analysed and presented by using Content Analysis and Cognitive Mapping.

Results verified the possibility of introducing and implementing the e-procurement system to the MWS&D by using available resources, infrastructure, and capacity with the Information Technology facilities and legal sanction on e-documents under the two phases.

Keywords: *E-Procurement System, Information Technology, Manual Procurement Process, Procurement.*

* Corresponding Author: E-mail - gayanik@uom.lk

A LITERATURE SYNTHESIS: IS CONSTRUCTION INDUSTRY LOW RESPONSIVE TO CHANGE AND DEVELOPMENT?

Chandanie Hadiwattege* and Sepani Senaratne

Department of Building Economics, University of Moratuwa, Sri Lanka

ABSTRACT

Construction faces many challenges, but one of its principle challenges is lack of innovation and research. This research tries to understand why the construction sector is slow to innovate and whether the industry needs to innovate. Further it discusses the role of academia as a prominent researching body in such a change. There are many reasons behind the slow responsiveness of the industry and it has been identified that economical characteristics of construction industry could be a major reason which creates lack of performance-based competition. Further, the inherent characteristics of the construction sector influence this slow innovation. Despite this slowness, there is a need for the industry to innovate with the global challenges taking place in the industry. Academia has an important role to play here in merging academic research to industry development needs. However, academics' choice in research area is mainly driven by the context, availability of funding and personal interest, rather than on industry requirements. It is believed that the Sri Lankan industry could be innovated with the correct cooperation of academia with the evidence from other countries. The PhD research which this research paper is based aims to merge academic research into construction industry requirements to build a better responsive industry. As a preliminary step, this paper reports on the literature findings on whether the industry is slow to innovate and the reasons behind this.

Keywords: *Construction Industry, Innovation, Development, Academic research.*

* Corresponding Author: E-mail - chandaniqs@yahoo.com

DOES “FRONT-END PLANNING” WORK FOR THE SINGAPORE CONSTRUCTION INDUSTRY?

Bon-Gang Hwang*

Department of Building, National University of Singapore, Singapore

Jia Wei Ho

Vestian Workplace Services, Shanghai, China

ABSTRACT

While technology advancement resulted in a spiral increase of complexity in construction projects, it tends to be unmatched with an equal increase in planning effort, especially at the pre-construction stage. Front-End Planning (FEP) is relatively new to the Singapore construction industry and its importance is not well recognised. As a result, this study aims to identify the implementation status of FEP in the Singapore construction industry and to analyse its impact on project performance, in order to encourage more organisations to practice and benefit from it. A questionnaire was developed and 327 projects from 27 companies were investigated. The analysis result revealed that about 40% of the companies and projects surveyed practiced FEP. In addition, the analysis reported that FEP can reduce project schedule and cost by up to 15%. Recognising the implementation status and impacts of FEP will be a starting point to improve project performance and to better manage projects, ultimately allowing the Singapore construction industry to significantly increase opportunities for project success.

Keywords: *Front-End Planning, Project Performance, Construction Industry, Singapore.*

* Corresponding Author: E-mail - bdghbg@nus.edu.sg

SUSTAINABLE PROJECT MANAGEMENT FOR GREEN CONSTRUCTION: CHALLENGES, IMPACT AND SOLUTIONS

Bon-Gang Hwang*

Department of Building, National University of Singapore, Singapore

Jac See Tan

National Institute of Education, Singapore

ABSTRACT

With augmenting cognizance of environmental issues and growing concern over climate change, sustainable construction is gradually put forth globally. However, construction of green buildings in Singapore still encounters impediments as there is a lack of proper project management framework for such projects. Based on the survey and interview results from 31 industry experts, this study aims to identify common challenges encountered during management of green construction projects and their impact on project performances, ultimately proposing some solutions to overcome the barriers. Findings from this study are: (1) main dissimilarities between conventional and green construction projects exist, especially in the level of details and communication required; (2) there is no paucity in sustainable knowledge in the Singapore construction industry; however, challenges against implementation of the knowledge exist, influencing project performances, and the lack of investment on management of green building construction is the most paramount barrier; and finally (3) to overcome the barriers, a project management framework for green building construction should be developed, possibly promoting adoption of sustainable management approaches for future green building projects.

Keywords: *Green Building, Sustainable Development, Project Management, Singapore.*

* Corresponding Author: E-mail - bdghbg@nus.edu.sg

MOST APPROPRIATE DISPUTE RESOLUTION STRATEGY FOR SRI LANKAN CONSTRUCTION INDUSTRY

Himal Suranga Jayasena*

Department of Building Economics, University of Moratuwa, Sri Lanka

Yakupitiyage Himesh Kavinda

Pasha Construction LLC, Republic of Azerbaijan

ABSTRACT

With the surge of increasingly complex and fast-track construction projects, disputes are inevitable. Skills in dispute resolution should be part of the tool kit of any practitioner in a managerial position. However, the last decade evidenced the incorporation of increasingly complex dispute-resolution clauses in construction contracts, typically involving several alternative dispute resolution (ADR) techniques and arbitration arranged in sequential tiers. While the industry followed the standard guidelines, it was not clear what exactly the industry expect from the resolution process. In this study, a hierarchical model is developed to organise attributes of ADR processes. This hierarchical presentation fits with the use of analytical hierarchy process methodology by a group of experts to prioritise ADR process attributes. Frequently the question is how to select the most appropriate resolution method that can fit well with the disputing parties' needs. Hence, dispute resolution strategy selection model is developed in this research based on the above AHP results. The Model is considered beneficial to the industry, as it provides construction professionals with a systematic and objective approach in the selection of ADR methods for Sri Lankan construction project disputes.

Keywords: *Dispute Resolution, ADR Method Selection, Construction, Sri Lanka.*

* Corresponding Author: E-mail- suranga@uom.lk

ADAPTABILITY OF INTEGRATED PROJECT DELIVERY IN A CONSTRUCTION INDUSTRY

Himal Suranga Jayasena* and Nawodanie Shyamen Senevirathna
Department of Building Economics, University of Moratuwa, Sri Lanka

ABSTRACT

Within the traditional procurement system, level of achievement of client and contractor objectives may vary depending on the type of procurement used. This may further create a gap between the expected and actual performance of the project. Integrated Project Delivery (IPD) is the modern development of the procurement systems in the industry where collaborative innovation is the path used to achieve the goals of a project. Appreciable characteristics and benefits of this concept convert the construction industry towards it. It is observed that United States of America is the first to develop and implement this concept specially focusing on the public sector. Although, the concept is not yet popular around the world, it is likely that the clients will demand for it in future due to economic and managerial advantages it brings. Thus, it is important that an industry be prepared to adapt the system as and when the need arises. Identifying this need, a literature synthesis on requisites and barriers for successful implementation of IPD is presented in this paper. The findings shall become valuable source for any construction industry to assess their readiness and take necessary steps to be ready to implement IPD system successfully.

Keywords: *Procurement, Integrated Project Delivery, IPD, Construction.*

* Corresponding Author: E-mail- suranga@uom.lk

BUILDING INFORMATION MODELLING FOR SRI LANKAN CONSTRUCTION INDUSTRY

Himal Suranga Jayasena* and Chitra Weddikkara

Department of Building Economics, University of Moratuwa, Sri Lanka

ABSTRACT

Building Information Modelling (BIM) is relatively a new buzzword in the Construction Industry; however BIM is not yet practiced in Sri Lankan construction industry and not many in the industry know about it. BIM is now becoming popular and likely to be industry standard for project design and hence a key tool in project procurement in future. Integration of BIM into project development life cycle would create deviations in traditional parameters of procurement systems. As a result, a construction industry in which building procurement is based on BIM is thought to be quite different from the today's systems. The industry needs to understand its potentials in order to develop strategies for BIM integration. Under this context, a research is conducted with broader aim of integrating BIM in Sri Lankan construction industry. This paper is presented with its preliminary findings from a literature review on features and requisites of BIM, developing logical conclusions in terms of BIM's potentials for Sri Lankan construction industry. It finds that BIM leads to a more efficient industry and will save both time and cost; and the technology is unlikely to be a significant barrier for BIM implementation.

Keywords: *Building Information Modelling, BIM, Procurement, Construction, Sri Lanka.*

* Corresponding Author: E-mail – suranga@uom.lk

THE IMPACT OF INCLUSION OF ARBITRATION CLAUSE BY REFERENCE IN MAIN CONTRACT AND SUB CONTRACT DOCUMENTS IN THE CONSTRUCTION INDUSTRY AND ITS NEGATIVE CONNOTATIONS

Jagath Chandrawansa Korale*

Director, SMB Plc. and Arbitrator

Chitra Weddikkara

Department of Building Economics, University of Moratuwa, Sri Lanka

ABSTRACT

In construction contracts an arbitration clause comes into being, as an exclusive clause in the main contract or by reference to another contract. In the dispute resolution process the Arbitrator derive his power from the arbitration agreement and from the applicable law which invariably makes it mandatory for the arbitration clause to be in writing. Such clause prevents Court jurisdiction since party autonomy will prevail. Therefore, it is important to identify which form of arbitration clause would serve the purpose, since the usage of such clause in the dispute resolution process may become void if it is incorporated by general reference. The Court will not allow proceedings unless the arbitration clause is properly constituted. The Arbitration Clause by reference in itself could lead to disputes! An arbitration clause in a contract comes into being through a separate agreement, as an exclusive clause in the main contract or by reference to another contract. Therefore, it is important to have a properly constituted clause, and if it is by specific reference or general reference, or both, it would pave the way for disputes. The arbitration clause is a self-contained co-lateral contract preventing Court jurisdiction and would survive even if the main contract is void. When the arbitration clause is incorporated with lacuna, the opposing party could successfully challenge its validity in Courts. Disputes can be compounded when a main contractor sub-contracts to another who in turn sub-contracts to others making reference to the terms of the main contract. In this context, this paper is presented with a literature review and English case law to show the importance of properly constituting an arbitration clause to reduce disputes in the construction industry.

Keywords: *Arbitration by Reference, Construction Industry, Dispute Resolution, Negative Connotations.*

* Corresponding Author: E-mail - jagathchandrawansa@yahoo.co.uk

DISASTER RISK REDUCTION MEASURES IN BANGLADESH

Udayangani Kulatunga*, Gayan Wedawatta and Dilanthi Amaratunga
School of the Built Environment, University of Salford, United Kingdom

Parvez Ahmed and Raman Biswas
Patuakhali Science and Technology University, Bangladesh

ABSTRACT

Disasters damage the entire economy of the country when they predominantly take place in developing countries. While no country in the world is entirely safe, lack of capacity to limit the impact of hazards has made developing countries being the most vulnerable nations to natural disasters. Bangladesh is being identified as a country that is vulnerable to climate change and subsequent natural disasters every year. Dense population and poverty has reduced the adaptability of Bangladesh in disastrous situations thus further increasing severity of impact from disasters. Owing to geographical settings, Bangladesh is currently ranked as one of the world's most disaster-prone countries in the world. The frequent natural hazards such as cyclones, storm surges, floods, droughts, tornados, riverbank erosions, earthquakes, arsenic contamination of groundwater and landslides account for significant losses in human lives and physical assets while effects are further reflected in social settings, ecosystems and the economic well-being of the country. This paper evaluates the types of natural disasters Bangladesh is subjecting to, how they have affected the Bangladesh community and existing disaster risk reduction strategies. Paper also evaluates four main domains of disaster vulnerability reduction measures namely physical, engineering, structural and organisational. Existing disaster risk reduction strategies adopted in Bangladesh are linked with the aforementioned four domains of disaster vulnerability reduction measures. A comprehensive literature review is used as the research method. Literature synthesis suggests that Bangladesh is being using a combination of disaster risk reduction measures ranging from technical to social measures.

Keywords: *Bangladesh, Natural Disasters, Risk Reduction, Vulnerability.*

* Corresponding Author: E-mail- U.Kulatunga@salford.ac.uk

USE OF RECYCLE GLASS AS A COARSE AGGREGATE IN CONCRETE

Gayal Kuruppu* and Ravihansa Chandratilake

Department of Building Economics, University of Moratuwa, Sri Lanka

ABSTRACT

Concrete is a composite material composed of sand and gravel, chemically bound together by hydrated Portland cement. It is the most widely used construction material in the developed world. As a result, the concrete industry is also one of the biggest consumers of natural resources specifically sand, gravel, rock and water. Numerous environmental problems and natural disasters are occurred because of the high extraction of natural resources. Due to that, researchers were focused on recycled materials for future development, while protecting the environment. Low cost, availability and simple process to recycle, glass concrete applications could be significantly applied in the construction industry. Therefore, primary aim of this research is to explore the applicability and adaptability of glass as a recycled material for concrete and concrete applications in Sri Lankan construction industry. This research problem will be approached through experimental studies. The empirical study will be conducted by testing the glass concrete applications in a laboratory. The results will be analysed to evaluate the concrete properties, which are made from glass coarse aggregates and glass concrete aesthetic applications. A total number of 10 cubes will be casted and tested for compressive strength, flexural strength, slump test, absorption test. It is expected that concrete which made of glass concrete aggregate 16% less strength in compression, flexure than conventional concrete. This paper intend to recommends that recycle glass can be used as an alternate coarse aggregate in concrete and will have wide applications in aesthetic workings.

Keywords: Concrete, Recycled Materials, Glass, Glass Concrete, Glass Concrete Aesthetic Applications.

* Corresponding Author: E-mail- gayalkuruppu@yahoo.com

STRATEGIES TO OVERCOME CHALLENGES FACED IN MANAGING CONSTRUCTION PROJECTS IN THE UNITED ARAB EMIRATES

Florence Y. Y. Ling*

Department of Building, National University of Singapore, Singapore

Mohammed F. Dulaimi

Faculty of Business, The British University in Dubai, United Arab Emirates

Pei Jing Ho

Obayashi Corporation, Singapore

ABSTRACT

The problems faced when managing projects in the United Arab Emirates (UAE) are investigated and strategies to overcome the problems and improve project performance are recommended. The survey research design was adopted. The data collection instrument was a questionnaire. Data were collected via interviews with experienced personnel who have worked in the UAE construction industry. It was found that a high proportion of projects in the UAE experienced budget and schedule overruns. The findings show several unique challenges exist in managing projects in the UAE. The first is when foreign consultants fail to consider differences of language, culture, religion, customs and preferences, and this lead to disharmony and resentment. The second challenge is project-related issues such as contract documentation, technical details of construction, materials delivery and document approval and permits are not well-planned nor subject to rigorous risk analysis prior to project commencement. Finally, environment-related issues faced are extreme weather conditions which pose a challenge to foreign staff. It is recommended that foreign firms build closer relationships with clients and local authorities to establish trust that would help in a smoother process in obtaining approvals and resolving disputes. It is necessary to employ more foreign labour during Ramadan to compensate for the lower productivity on site due to fatigue and shorter working time. Protective measures must be taken to shield labourers from the intense heat and ultraviolet radiation. Cold water points and salt pills to replenish fluids lost through perspiration should be provided.

Keywords: *Challenges, International Construction, Multi-national Project Management, United Arab Emirates.*

* Corresponding Author: E-mail- bdgly@nus.edu.sg

GREEN BUILDING CONCEPT TO FACILITATING HIGH QUALITY INDOOR ENVIRONMENT FOR BUILDING OCCUPANTS IN SRI LANKA

B. H. Mallawaarachchi*, M. L. De Silva, R. Rameezdeen and
S. R. Chandrathilaka

Department of Building Economics, University of Moratuwa, Sri Lanka

ABSTRACT

Well-being is an important aspect determining the quality of life of an occupant. Hence, it is essential to have a good indoor environmental quality, as it affects the productivity and health of such occupants. Further, indoor air quality, acoustic, day-lighting and thermal comfort contribute to better indoor environment quality, and have a positive effect on an occupant's productivity and performance. Accordingly, many studies believed that the green building design will become more common practice once the human benefits are identified, primarily the productivity gains believed to be associated with the provision of high quality indoor environments. Hence, buildings are increasingly designed or required to be 'green' in recent years, giving the quality of the indoor environment new importance. Therefore, several green building assessment tools have been applied worldwide namely, Leadership in Energy and Environmental Design (LEED), Building Research Establishment Environmental Assessment Method (BREEAM), Comprehensive Assessment System for Building Environmental Efficiency (CASBEE) and Green Star etc in facilitating high quality indoor environment. Indoor Environmental Quality (IEQ) has considered as a major criteria in such tools. Thus, various IEQ factors relate to temperature and humidity, acoustic, ventilation, indoor air quality, day lighting and lighting quality, thermal comfort and access to views have been considered in these techniques. Similarly in Sri Lanka, GREENSL® Rating System is applied for buildings in local context so as to obtain green certification. Even though, it emerges IEQ as an important aspect, it is considerably less compared to other domains. Thus, four green assessment tools were suggested which can be applied for buildings in Sri Lankan context through the review of key research papers. Accordingly, such green building tools can be considered for Sri Lankan buildings as a new concept/tool or even the existing system can be further enhanced so as to provide a better quality indoor environment for building occupants.

Keywords: *Indoor Environmental Quality, Building Occupants, Green Building Concept, Green Assessment Tools.*

* Corresponding Author: E-mail- hmallawarachchi@gmail.com

PRESERVATION OF PRIVATE HOUSES IN FORT OF GALLE, SRI LANKA: A CASE STUDY

Samitha Manawadu*

Department of Architecture, University of Moratuwa, Sri Lanka

ABSTRACT

Fort of Galle is a declared World Heritage under the Criteria (IV) since 1988, and, since then, several actions have been taken to preserve its historic built environment in its authentic form. Establishment of Galle Heritage Foundation (GHF) as an organ under the Ministry of Culture and National Heritage was one of the pioneering and very important move taken towards this endeavour. GHF, closely working with the Special Planning Unit of the Galle Municipal Council (SPUGMC); Department of Archaeology (DOA); and other stakeholders for preservation of historic built fabric of the Fort. GHF plays a vital role in monitoring development activities within the fort; assisting in planning development activities; assisting in scrutinising development plans by residents and others; and, submitting their recommendations to the Planning Committee of Galle Municipal Council. The role and functions of the GHF in preservation of the historic built environment of the fort in its authentic character is distinctive.

A GHF initiated socio-economic survey of the Fort of Galle, revealed that, although numerous preventive measures that include monitoring of building activities and control of developments through specific guidelines etc were effective, the historic fabric of the fort was fast deteriorating and degrading, mainly due to facts such as negligence, poor maintenance, illegal constructions, and dilapidation of uses etc. Further, it has been found that the deterioration of the southern sector of the fort, where there is a high concentration of private dwelling houses, is much rapid than its northern counterpart with public and institutional buildings.

The socio-economic survey of the University of Ruhuna brought into light many valuable facts about the condition of private dwelling houses in the Fort, and, probable causes of their deterioration etc. There were altogether 60 houses, some of them were depicting high architectural characteristics of the colonial period that are worthwhile to retain for the posterity. The other houses, which are possessing elements of colonial architecture or their generic architectural characteristics were in the verge of collapse due to negligence, poor maintenance, and, dilapidation etc resulted from the poor affordability of the residents.

* Corresponding Author: E-mail - samithama@uom.lk

Having identified the necessity of preserving them for the posterity, GHF, through the Ministry of Culture and National Heritage, launched an international campaign to raise financial assistance for this endeavour.

In 2007, the Government of Sri Lanka received the Netherland Government Cultural Grant, mainly to preserve and maintain Dutch Heritage of the Country, and the Government, with the consensus of the donors, decided to allocate part of this grant for improvement of private dwelling houses, in order to regenerate traditional Dutch Streetscape of the Fort of Galle. GHF was entrusted with the task of implementing the project.

Having recognised the need of receiving expert advice from architect-conservators, GHF invited Centre for Heritage and Cultural Studies of the University of Moratuwa (CHCS), to assist them in preparation of plans for Refurbishment and Preservation of Private houses in the Fort. Necessary nitty-gritty's finalised, and CHCS was appointed as Consultants to advice the GHF. All preliminaries have been identified by the GHF based on the Socio-economic Survey conducted by the University of Ruhuna. About 60 private houses, which were eligible to receive financial assistance and technical guidance, too; had been identified. CHCS commenced the assignment, with an extensive Field Investigations and Preparation of Measured Drawings of selected houses. The cursory examination revealed that they had been renovated, modified and altered from time to time, without any records. Thus preparation of measured drawings and identifying original components had become a daunting task. A detail photographic recording completed the comprehensive documentation of Pre-refurbishment Stage.

This paper reports on a case study of the above project, elaborating on technical implications. Project, having recognised its contribution for preservation of Cultural Heritage, was awarded UNESCO-Asia Pacific Cultural Award 2010 (Merit Award).

Keywords: *Preservation, Refurbishments; Streetscape, Rescue Conservation.*

TEAMWORK IN FACILITIES MANAGEMENT

N. H. C. Manjula* and S. Senaratne

Department of Building Economics, University of Moratuwa, Sri Lanka

ABSTRACT

Teamwork is essential to Facilities Management (FM) organisations due to the presence of various parties and multi-functional nature. However, there is a lack of published researches on teamwork with regards to FM. The consideration given in literature in discussing ways to adopt the concept of teamwork in FM was very insignificant. Therefore, the research question formulated was; “how the concept of teamwork can be adapted to FM in Sri Lankan Real Estate and Development sector?” The ultimate aim of the study was to develop a guide for teamwork by understanding the nature of teamwork in FM. The research question was approached through case study research method using three cases in the Real Estate and Development sector of Sri Lanka. Semi structured interviews were conducted with FM practitioners of the selected cases. The findings asserted that the ideal team concept in general management does not go with FM team. Instead, the composition of FM team required to be flexible depending on several factors, namely; task, method of performance, facility type and size. However, few key members, who were common to any FM team, were recognised in the research as well. Further, specific requirements of teamwork in FM were identified. Based on findings, a guide for teamwork in FM in Sri Lankan Real Estate and Development sector was developed. This will be useful to FM practitioners who operate in similar contexts.

Keywords: *Facilities Management, Teams, Teamwork, Case Studies, Sri Lanka.*

* Corresponding Author: E-mail - chathuri9m@gmail.com

THE USE OF ALTERNATIVE BUILDING MATERIALS IN DEVELOPING COUNTRIES: ADDRESSING CHALLENGES FACED BY STAKEHOLDERS

E. C. Mpakati-Gama*, S. C. Wamuziri and B. Sloan

School of Engineering and the Built Environment, Edinburgh Napier University, United Kingdom

ABSTRACT

The rising concern on inefficient wood consumption associated with shelter development has led to policy and regulatory reforms to address such problems in most countries in recent years. The use of alternative building materials (ABMs) and technology, for example, have been proposed by decision makers as one of the ways of curbing deforestation hence promoting sustainable development. Although the use of alternative materials has enhanced housing stocks where these are appropriately employed, there are several problems faced by developers to embrace the proposed strategies more particular in developing countries. Focusing on the Sub Sahara Africa (SSA), this paper proposes strategies the decision makers would employ to promote the use of ABMs. In this paper, which is based on the extensive literature review of an ongoing academic research to find ways for promoting sustainability in developing countries, it is noted that cost of raw materials, flaw of sustainability definition as well as the lack of information related to the building sector are some of the limitations for building stakeholders to promote the use of ABMs. Therefore, the course of actions proposed is regarded as one of the possible ways for decision makers to take into consideration to improve the current situation in the building sector in SSA and beyond.

Keywords: *Alternative Building Materials, Building Challenges, Building Stakeholders, Developing Countries, Policy Strategies.*

*Corresponding Author: E-mail- e.mpakatigama@napier.ac.uk

INVESTIGATION OF BIM ADOPTION STRATEGIES IN INDIAN AEC INDUSTRY

Aruna Muthumanickam*, Koshy Varghese and Ashwin Mahalingam
Department of Civil Engineering, Indian Institute of Technology Madras, India

ABSTRACT

Building Information Modelling (BIM) is the process of creating digital parametric models for life cycle data management. Use of parametric modelling tools enables in integrating the building data from various stakeholders, on a virtual platform. On large-scale building projects with numerous stakeholders, a well-drafted strategy for BIM adoption becomes essential. This can be attributed to the complexity in the information exchange process between the various stakeholders. This paper focuses on investigating the strategies for BIM adoption in the Indian Architecture, Engineering and Construction (AEC) industry. What are the typical BIM goals on a project? What strategies can lead to effective BIM adoption? These are questions that this paper seeks to address. Case based investigation was carried out in three commercial building projects of comparable scale. A detailed investigation of the cases was carried out through interviews with the various stakeholders and documentation of the BIM adoption process. Case data were analysed to identify the strategies commonly adopted on projects. Further analysis enabled in developing a framework for BIM adoption strategies in the Indian AEC industry.

Keywords: *Building Information Modelling (BIM), BIM Adoption, BIM Goals, Strategy.*

* Corresponding Author: E-mail-aruna.muthumanickam@gmail.com

THE PURPOSE OF RETENTIONS: A REVIEW OF THE EXISTING LITERATURE

Priyanka Raina* and John Tookey

School of Engineering, Auckland University of Technology, New Zealand

ABSTRACT

Retention is a phenomenon practiced in the construction industry for well over a century. It is a contractual mechanism whereby a portion of money, due to the contractor/subcontractor is held back till the completion stage of the project. Half of it is released at the time of practical completion and the other half is released at the end of the defects liability or the maintenance period. Some countries have abolished this practice, others have tried to outlaw the practice but failed. Yet others seem to be content with the ongoing practice and find it useful, which is why it is important to understand as to why it is so. To achieve this objective it is first of all important to understand the 'purpose of retentions' or why are retentions used in today's construction industry even though the industry has undergone radical changes in the past century or so. A review of the current literature suggests that retentions exist for a variety of purposes. Hence there seems to exist some form of disconnect between the actual and the intended purpose of retentions. Perhaps it is important to understand whether retentions are actually serving the purpose they are set up for. In this paper the author through an extensive literature review has identified a number of purposes of retentions. Data has been collected from 27 publications including books, journal articles, magazines, reports etc. Ten main purposes/themes have been identified from the data. A matrix has then been formed with the purposes on one axis and author/publication on the other. This has been done to find out what most authors/publications have said regarding the purpose of retentions. Having found the numbers with the help of the matrix the purposes are numbered in the order of most recurring to the least recurring. The top three purposes of retentions are found to be performance security followed by defect rectification and motivation for early or timely completion.

Keywords: *Retentions, Construction Industry, Construction Contracts.*

* Corresponding Author: E-mail- priyanka.raina@aut.ac.nz

PREVENTIVE METHODS USED FOR HEALTH AND SAFETY HAZARDS IN HOTEL INDUSTRY IN SRI LANKA

P. A. D. Rajini*, C. S. P. Fernando and S. A. I. S. Serapperuma
Department of Building Economics, University of Moratuwa, Sri Lanka

ABSTRACT

Occupational safety and health is a discipline which aims at the promotion and maintenance of the highest degree of physical, mental and social well-being of workers. It involves the protection of workers in their employment from risks resulting factors, which are adverse to their safety and health condition. If there is a safety and health issue in an organisation, it will lead to various problems and puts the worker, their families, other people in the community, and the physical environment around the work place at a risk. Literature reveals that health and safety matter in hotel industry is a very broad and critical concept that should be taken in to consideration. However, a study which has been carried on health and safety hazards in hotel industry is hardly found in Sri Lanka. Therefore, in order to address the above gap, this research aims at identifying the health and safety hazards, causes of those hazards and the preventive measures that can be adopted to minimise these hazards in hotel industry of Sri Lanka.

A three step approach; a literature survey, a preliminary study and a detailed questionnaire survey, was carried out in achieving the aim of this research. The study identified 'Cuts and Burns' and 'Electrical Hazards' as the most critical health and safety hazards in hotel industry. According to the study the most critical causes for those hazards are 'Open Flames' and 'Contact with Electricity from Machines' respectively. Further, 'Inadequate Instructions' and 'Inadequate Safety Education' could be identified as the most critical factors that affect the overall health and safety hazards in hotel industry. As the findings revealed, the usage of preventive methods to mitigate health and safety hazards in hotel industry in Sri Lanka, is at a very low level and using PPE and fire protection methods and maintaining a good housekeeping procedure are the mostly practiced preventive methods. Further, there are lot more to implement in order to minimise/eliminate health and safety hazards.

Keywords: *Health and Safety Hazards, Causes, Preventive Measures, Hotel Industry, Sri Lanka.*

* Corresponding Author: E-mail - dame_uom@yahoo.com

SIGNIFICANCE OF MEANINGFUL BUILT ENVIRONMENTS IN SUSTAINABLE DEVELOPMENT WITH SPECIAL REFERENCE TO AYURVEDA-ECO TOURISM IN SRI LANKA

Marini Samaratunga*

Department of Architecture, University of Moratuwa, Sri Lanka

Pulathisi Vithana

Chartered Architect, Sri Lanka

H. L. Obeyesekera

International Tertiary Education Campus-Asia (Pvt) Ltd., Battaramulla, Sri Lanka

Rohan Karunaratne

The Ceylon Institute of Builders, Sri Lanka

ABSTRACT

Scarcity and the rapid decline of earth's natural resources is an outstanding global issue in the present context. Construction industry is highly responsible for utilising these resources at large. Therefore Eco-friendly Sustainable approach has become a key consideration and a current trend in present day Construction sector. In this arena, the words Green, Sustainable, Eco-friendly, Environmental, energy efficiency, Carbon-zero, Climate responsive and so on are interchangeable. All in all, the ultimate motive is to raise the living condition of our lives and protect the earth for today and tomorrow. In uplifting the living condition, physical aspects as well as psychological aspects often play significant roles. At present, professionals involved in construction sector are very much concerned about physical sustainability achieved through green technology and often tends to ignore psychological sustainability that could be achieved through conceptual or meaningful architectural approach.

Therefore, this paper focuses on the Architects approach to sustainable development through creating meaningful built environments. This is approached by relating architectural theories such as Psychology of Sustainability, Sensual Architecture and Conceptual Architectural theories to selected case studies. The selected case studies would focus on the current development projects in Sri Lanka, related to Ayurveda-Eco Tourism.

Keywords: *Ayurveda-Ecotourism, Conceptual Architecture, Meaningful Built Environments, Psychology of Sustainability, Sensual Architecture.*

* Corresponding Author: E-mail- marini_samaratunga@yahoo.com

UNDERSTANDING PROJECT CULTURE IN CONSTRUCTION: A LITERATURE SYNTHESIS

A. U. A. A. Samaraweera* and Sepani Senaratne

Department of Building Economics, University of Moratuwa, Sri Lanka

ABSTRACT

Construction industry being a project-based industry, understanding nature of project culture is of paramount importance. Culture at project level seems less researched; possibly due to understanding of project culture seems a tedious task since it is being shaped through different levels of cultures; national, industrial, organisational, professional and many other factors situational to a given project team. However, recent past shows some studies attempting to elaborate project culture in construction context. Some researchers tend to identify construction project culture through theories of organisational culture. This paper attempts to understand nature of project culture in construction through these extant literatures and also reveals limitations of these studies. Further, the study identifies some unique features related to a construction project, which challenges identifying a unique culture at project level in construction. These main unique features include: the fixed duration of the project; adoption of traditional method of procurement; entrance of key members to the project from time to time and effective communication. Further research will aim to explore this aspect fully in the light of these challenges.

Keywords: *Project Culture, Construction, Project Team.*

* Corresponding Author: E-mail - aparna.samaraweera@gmail.com

THE ECONOMIC COST OF LANDSLIDES IN HALI-ELA DIVISIONAL SECRETARIAT OF SRI LANKA

G. R. S. R. C. Samaraweera*, R. M. L. Rathnayaka, D. J. Jagoda and H. G. D. Sriyani

Department of Economics and Statistics, Sabaragamuwa University, Sri Lanka

ABSTRACT

Landslides which cause degradation of slopes through soil loss is one of the major climate related disasters in Sri Lanka and the highest number of landslides was recorded in Badulla district. This study attempts to identify the economic costs of landslides in Hali-Ela Divisional Secretariat Division (DSD) which recorded the highest number of displaced people in recent landslides in the Badulla District.

Primary data collected through a questionnaire was used for this study. Two stage cluster sampling technique was used to select 160 households in six Grama Niladhari (GN) divisions including Bogahamadiththa (20), Spreenweli (40), Panakenniya (20), Kandana (25), Bulatwatta (25) and Ketawala (30) from the 57 GNs in Hali-Ela DSD and the systematic random sampling technique was used to select households. Descriptive statistics, simple regression and chi-square test are used for the analysis.

Majority of the sample are in high (46.8%) and medium risk (34%) areas of landslides. Mean distance between house and the nearest recent landslide is recorded as 478m. Landslides have both direct and indirect economic costs. Regarding direct costs, mean damage cost and mean replacement cost for last five years are recorded as Rs. 115790.91 and Rs. 78954.55 respectively showing that only half of the damage is recovering. Regarding indirect economic costs, land value has been deteriorating due to landslides as found by the positive relationship between the land value and the distance to the nearest landslide using hedonic pricing approach. The uncertainty created by the risk of landslide reverses the overall development of the household (62%) including delay of housing construction (62%), agricultural activities (21.6%), road construction (9.3%) and getting electricity (5.2%).

Keywords: *Disaster, Economic Costs, Landslides, Hali-Ela, Sri Lanka.*

* Corresponding Author: E-mail-sumadi@sab.ac.lk

LEAN CONSTRUCTION IN LARGE CHINESE CONSTRUCTION FIRMS: A SWOT ANALYSIS

Gao Shang*, Low Sui Pheng, Hwang Bon-Gang and George Ofori
Department of Building, National University of Singapore, Singapore

ABSTRACT

In recent years, there has been a growing trend in applying lean principles outside of manufacturing. In the construction context, lean construction has become an established theme since the early 1990s. However, very limited studies are reported about its implementation in Chinese construction industry. This study undertakes a SWOT (strengths, weaknesses, opportunities, and threats) analysis of large Chinese construction firms, evaluating their potential strengths, perceived weaknesses as well as external opportunities and threats associated with the application of lean construction. This study is qualitative in nature. Using interview questions, face-to-face interviews were conducted with 27 Chinese building professionals from large construction firms in China. It highlights several constraints, ranging from lack of understanding of lean construction; to hierarchical organisational structures that discourage empowerment, use of low skilled workers and a high tolerance for an untidy workplace, and others. The opportunities are realised through government's push to upgrade firms' standards; role of jianli, collaboration with foreign construction firms, and promotion of prefabrication. Furthermore, intense competition, highly-demanding clients, rising material prices, and others are some of the foreseen threats to the adoption of lean construction. This study concludes with some suggestions to improve lean construction implementation in China. These include the establishment of a long-term philosophy and organisational culture that would call for leaders to be more pro-active on the jobsites, to understand the work flow, and to encourage foremen to be committed in work plans. It is also important to introduce, educate and reinforce the lean knowledge to the employees at all levels as they are the real implementers of lean construction.

Keywords: *Lean Construction, SWOT Analysis, Chinese Construction Firms.*

* Corresponding Author: E-mail- gaoshang@nus.edu.sg

A PRELIMINARY LITERATURE REVIEW INTO LEAN CONSTRUCTION IMPLEMENTATION

Nilmini Thilakarathna*

Department of Quantity Surveying, British College of Applied Studies, Sri Lanka

Sepani Senaratne

Department of Building Economics, University of Moratuwa, Sri Lanka.

ABSTRACT

Although all activities expend cost and consume time, Lean Principles state that only conversion activities add value and these should be made more efficient, whereas non value adding flow activities should be reduced or eliminated. Research into these lean principles in construction has found that considerable waste lies in flow processes of construction. By eliminating waste activities, processes can become 'lean' which provide 'more with less' resources. These flow wastes are recognised as a major weakness, which hinder performance and efficiency in the Construction Industry. Previous studies conclude that the construction industry workforce is ignorant of these flow activities that create waste and hinder construction performance.

However, the industry lacks an implementation framework to implement lean principles into the construction processes. This research aims to develop such an implementation framework through action research study for Sri Lankan construction contractors and achieve long-term sustainable benefits by becoming lean. The research is in its initial stage and the aim of this paper was to explore the literature on how LC is implemented in different contexts in construction industries in the world.

The findings reveal several benefits when applying lean principles in construction such as reduce sharing of non-value adding activities increase the output value through systematic construction of customer requirement and reduce process variability. The paper finally identifies the few barriers for implementing lean principles and provides some guidelines on how to overcome the identified barriers for effective implementation of lean principles.

Keywords: *Implementation, Lean Principles, Construction Industry, Literature Review.*

* Corresponding Author: E-mail- nilmini@bcas.lk

APPROPRIATENESS OF LEAN PRODUCTION SYSTEM FOR THE CONSTRUCTION INDUSTRY

Nimesha Vilasini* and Thomas R. Neitzert

Construction Management, Auckland University of Technology, Auckland, New Zealand

Pradeep R. Jayatilaka

Department of Production Engineering, University of Peradeniya, Sri Lanka

ABSTRACT

The manufacturing industry has been a constant reference point and a source of innovation for construction over many decades. The lean concept is one of such strategies adopted by the construction industry from the manufacturing industry to improve performance. In order to take benefit of lean techniques developed in the manufacturing industries, it is important to identify which categories of manufacturing systems are best applicable to construction. Many research studies have identified construction as a lean resistant industry because it differs from manufacturing due to site production, temporary multi-organisation and one-of-a-kind nature projects. The main objective of this study is to find different characteristics of construction processes and how lean techniques can be adopted to them. The method used for this study is a practice oriented research approach where it compares the characteristics of two construction processes with manufacturing process characteristics. In the attempt of visualising the existing process, value stream mapping techniques were used. It is identified that the construction process is a combination of fabrication and assembly processes with different characteristics such as layout, material flow, information flow, and work element. It can be concluded that certain construction techniques like pre-fabrication soften the construction peculiarities.

Keywords: *Assembly, Construction, Fabrication, Lean, Manufacturing.*

* Corresponding author: E-mail- nimesha.vilasini@aut.ac.nz

IMPACT OF GREEN CONCEPT ON BUSINESS OBJECTIVES OF AN ORGANISATION

K. G. A. S. Waidyasekara* and R. L. N. Sandamali

Department of Building Economics, University of Moratuwa, Sri Lanka

ABSTRACT

Today, the world is moving towards green concepts which focus on increasing efficiency of resources while reducing impact on human health, productivity and environment. As a result, many companies are incorporating the green practices into their daily operations. Whereas, the rest of the world moves towards sustainable development, a very few number of green buildings are functioning in Sri Lanka. Within this emerging culture, this research has addressed, how green building concept influences in achieving the business objectives of an organisation with many aspects than conventional buildings.

The research method used for this study was qualitative. Case studies were conducted to ascertain the research aim and objectives. Two green buildings were selected from apparel industries. Semi- structured interviews were conducted among a selected experts panel and mainly content analysis was used to analyse data. The results discussed compatibility of the green concept for Sri Lankan organisations and deliberated how the green process achieves the cooperative objectives of organisation and sub-objectives of individual departments. Moreover, it was found that there is a positive impact of green building concept to achieve business objectives of an organisation and discussed the benefits gained in terms of financial, social, environmental and technical aspects.

Keywords: *Green building, Organisational Objectives, Sustainability.*

* Corresponding Author: E-mail- anuradha@uom.lk

RISK MANAGEMENT IN ELECTRICAL DISTRIBUTION SYSTEM IN SRI LANKAN HOTEL INDUSTRY

P. C. Wanigasinghe*, B. A. K. S. Parera and W. M. P. U. Wijeratne
Department of Building Economics, University of Moratuwa, Sri Lanka

ABSTRACT

An uninterrupted service throughout the facility is a must for building services in the hotel industry because a large part of guest satisfaction with the hotel depends on building services. However, building services face many different types of failures due to various risk factors. Therefore, a risk management framework is an essential part of the building services of a hotel. In case of hotel buildings, the literature suggests electrical power distribution system (EPDS) to be the key building service which governs all other building services and failure in the EPDS can happen due to maintenance risks, operational risks, assets specific risks and human errors. This research was commenced through a study of three leading five star hotels in Sri Lanka. Based on the research findings, a risk management framework was developed to address risks in EPDS of a hotel facility. The risk management framework was developed based on these findings reveals effective practices that could be used to reduce failure in EPDS. The research also pointed that maintenance risk, unplanned operational risk, asset-specific risk and human errors as the main internal risk factors that lead to failures in EPDS. On the other hand, weather conditions was identified as the uncontrollable external risk factors in the hotel industry, a preventive and a predictive maintenance schedule, planned operations, training and development, and proper asset selection criteria were identified as the main risk management strategies used in the hotel industry. The paper proposed a risk management framework to overcome the identified risks in EPDS in hotel industry which consist of failure mode effect analysis, power monitoring panel and a risk mitigation plan to maintain continuous operations in the EPDS. The findings and recommendations of the study will be useful to those responsible for EPDS operations in the hotel industry for the purpose of reducing services failures.

Keywords: *Electrical Power Distribution, Risks, Service Failure, Risk management Framework.*

* Corresponding Author: E-mail - praween1986@gmail.com

IMPORTANCE OF DESIGN PHASE STAKEHOLDER MANAGEMENT FOR SUCCESSFULLY ACHIEVING OBJECTIVES OF BUILDING PROJECTS: A SRI LANKAN PERSPECTIVE

Y. D. C. Weerakkody*

Central Engineering Consultancy Bureau

W. B. M. Thoradeniya

University of Moratuwa

ABSTRACT

Contribution of the building design process for achieving the project objectives with a higher degree of success has been highlighted in several researches worldwide. Conventionally, success of a building project is judged in terms of, completion within the scheduled time, completion within the budget, and fully complying to the clients' satisfaction with minimum subsequent modifications and reworks. In achieving these, design phase of a building project alone offers the greatest scope. Irrespective of this awareness, instances are not rare to find, where clients are facing various difficulties in completing/operating their buildings. Research and many case studies from the industry have provided evidence for cost overruns, delay in completion, mismatch between the delivered product and the clients' expectations, and high cost and time expenditure on variations and modifications in building projects. The aim of this paper is to present the outcomes of a research, which identified the importance of acquiring the timely contribution of design phase stakeholders and effective coordination amongst them, throughout the design phase for better achievement of the project objectives. The discussion is based on findings of a comprehensive questionnaire survey carried out in Sri Lanka on a sample of design phase stakeholders who holds hands-on-experience in building trade. Based on findings recommendations are made to encourage higher investment on stakeholder management during the design phase.

Keywords: *Design Phase, Design Stakeholders, Effective Coordination, Success of Building Project, Timely Participation.*

* Corresponding Author: E-mail- deshapriya2001@yahoo.com.au

STUDY ON SICK BUILDING SYNDROME IN OFFICE ENVIRONMENT

H. A. N. Wijerathne, G. I. Karunasena* and B. H. Mallawaarachchi

Department of Building Economics, University of Moratuwa, Sri Lanka

ABSTRACT

Prevalence of harmful natural and artificial substances combined with poorly ventilated interiors can lead to various building related health problems among those who spend long periods indoors. A group of symptoms of unclear etiology divided into mucous membrane symptoms related to eyes, nose, throat, dry skin, together with general symptoms of headache and lethargy due to poor indoor air quality is defined as Sick Building Syndrome. Literature revealed many evidence of indoor air quality and other symptoms that affect to staff in office buildings in Sri Lanka. Thus purpose of this study is to appraise the impact of sick building syndrome on building occupants in an office environment.

Case study was selected as the research approach. Semi structured interviews were conducted with responsible parties on indoor air quality and occupants of three selected office buildings. Case studies revealed that uncomfortable indoor environment and unsystematic maintenance of existing indoor air caused prevalence of symptoms related to sick building syndrome among building occupants, such as lethargy and eye irritation. Results showed that occupants in three office buildings bore many common symptoms while working in same premises in same timing pattern. Further, findings showed that three office buildings that are already affected with sick building attributes have in fact complied with existing Indoor Environment Quality standards. This study discusses approaches to identify sick building syndrome in working environments and standards to mitigate unhealthy conditions in buildings. This study enhances the comprehension on sick building syndrome and attributes that can be applied to evaluate impact of poor indoor environment quality on sick building syndrome.

Keywords: *Building Occupants, Indoor Environment Quality, Office Environment, Sick Building Syndrome, Symptoms.*

* Corresponding Author: E-mail - gayanik@uom.lk

RISKS AND RISK ASSESSMENT METHODS IN INDUSTRIAL MAINTENANCE IN SRI LANKA

W. M. P. U. Wijeratne*, B. A. K. S. Perera and M. L. De Silva
Department of Building Economics, University of Moratuwa, Sri Lanka

ABSTRACT

Studies on industrial maintenance operations worldwide have identified several maintenance specific risks such as working at heights, the pressure of time, etc. However, there is a dearth of published research on risks and risk assessment methods in industrial maintenance in the case of Sri Lanka. This study therefore aims at identifying the risks and risk assessment methods in industrial maintenance in Sri Lanka. The main objectives of the study were to identify the occupational risks and safety issues in maintenance work and the risk assessment methods in place in the Sri Lankan context. This was undertaken through a study of three manufacturing organisations which are involved in producing fast-moving consumer products. According to the findings, the risks which affect maintenance work can be categorised as organisational risks, unsafe acts and local workplace risks. The findings indicate that the most typical risks associated with maintenance are cuts, slips and falls, with severe or fatal injuries the result of worker disregard for standard operating procedures and/or failure to use the protective equipment provided. It was also found that check lists, brainstorming, and decomposition techniques are the preferred methods in maintenance for risk identification while a risk-rating matrix is used for risk analysis. The findings of the study highlight the safety risks entailed in the maintenance operations of manufacturing organisations and the risk assessment tools used in identifying the risks. The findings of the research will be useful for those in industrial maintenance operations for the purpose of managing risks effectively by designing work environments that are risk-free and for educating workers on the importance of paying due attention to risks and the need to follow instructions that are in place on safety procedures in the workplace.

Keywords: *Maintenance, Risk Assessment, Risk Analysis, Safety Risk, Sri Lanka.*

* Corresponding Author: Email - pabasara_uw@yahoo.com

SUSTAINABILITY EVALUATION FRAMEWORK FOR ENERGY POWER PLANTS IN SRI LANKA

S. D. Wijesooriya

CBFA – Burj Khalifa, UAE

Y. G. Sandanayake* and K. M. G. K. Konara

Department of Building Economics, University of Moratuwa, Sri Lanka

ABSTRACT

Energy is essential for economic and social development of a country. Ever increasing energy demand forces public and private sector to install energy power plants without giving much attention to the sustainable issues. Existing power plants evaluation mechanisms were limited to few factors such as energy efficiency, economic aspects and quality of life. Therefore, the aim of this study is to develop a multidimensional framework to evaluate sustainability of energy power plants in Sri Lanka.

A comprehensive literature review and a preliminary survey were carried out to identify sustainability criteria and indicators. The study identified eight sustainability criteria and 37 indicators. Eight criteria include economic aspects, technological aspects, air quality, water quality, waste management, health, safety and social issues, energy resource, and land, forest and wildlife issues. Structured interviews with industry practitioners were used to prioritise the criterion and indicators. Data was analysed using Analytic Hierarchy Process (AHP) tool and the findings were used to develop a multidimensional framework to evaluate sustainability of energy power plants in Sri Lanka.

Results obtained from the survey showed that, 'economic aspects' followed by 'technological aspects' and 'air quality' are the most important criteria and 'land, forest and wildlife issues' is the least important criteria among the eight sustainability criteria studied. Survey findings further revealed 'availability of renewable energy resources' followed by 'plant process efficiency' as the most critical sustainability indicators among the 37 indicators. This multidimensional framework can be used to evaluate the sustainability of energy power plants and also in the approval granting process for the power plant projects in Sri Lanka.

Keywords: *Energy Power Plants, Sustainability Evaluation Framework, Sustainability Criteria, Sustainability Indicators, Analytic Hierarchy Process Tool.*

* Corresponding author: E-mail: yasangee@yahoo.com

COMPARISON OF KEY COMPETENCES OF CLIENTS AND DESIGN-BUILD CONTRACTORS IN THE CONSTRUCTION MARKET OF THE PEOPLE'S REPUBLIC OF CHINA (PRC)

Bo Xia*

*School of Civil Engineering and Built Environment, Queensland University of Technology,
Australia*

Albert P. C. Chan

*Department of Building and Real Estate, Hong Kong Polytechnic University, Hong Kong SAR,
China*

Jian Zuo

School of Natural and Built Environments, University of South Australia, Australia

ABSTRACT

Clients and Design-Build (DB) contractors are two key stakeholders in DB projects, and contribute significantly to the successful project performance. This study aims to identify and compare such key competences in the construction market of the PRC. After the survey of available literature and face-to-face interviews, a two-round Delphi questionnaire survey was conducted to identify the key competences of clients and DB contractors in DB projects. Relative importance of these identified competences were ranked and compared. The questionnaire results indicated distinct differences between the key competences of clients and that of contractors. The contractor's key competences emphasise on DB experience, corporate management capability, building and design expertise, financial capability, enterprise qualification and reputation. While the client's competences focus on the ability to clearly define the project scope and requirements, financial capacity, contract management ability, adequate staff, effective coordination with DB contractor and similar DB experience. Both clients and DB contractors should clearly understand the competence requirements in DB projects and possess all the necessary competences for the successful outcome of DB projects. The identification of these key competences provides clients and DB contractors with indicators to assess their capabilities before going for the DB option. Furthermore, the comparison of competences for clients and DB contractors will result in better understanding of DB system and improve the communication between these stakeholders.

Keywords: *China, Competence, Delphi Method, Design and Build.*

* Corresponding Author: Email - paul.xia@qut.edu.au

IMPLEMENTING ENTERPRISE RISK MANAGEMENT IN A CHINESE CONSTRUCTION FIRM BASED IN SINGAPORE

Zhao Xianbo*, Hwang Bon-Gang and Low Sui Pheng
Department of Building, National University of Singapore, Singapore

ABSTRACT

Despite the booming domestic construction market, an increasing number of Chinese Construction Firms (CCFs) have ventured overseas for market expansion, and thus are simultaneously exposed to higher business risks. Hence, they require not only project risk management (PRM) but also a more holistic and integrated approach to managing risks on an enterprise basis, which is known as enterprise risk management (ERM). The objective of this study is to examine ERM implementation in CCFs based in Singapore. As part of a larger research project, this current study adopts a case study approach in the first instance to understand the ERM implementation of a relatively large CCF based in Singapore. The information is collected through in-depth interviews with the senior management of the firm and document review. The empirical findings suggest that the firm has initiated an ERM program and established clear ERM ownership, a regular risk communication mechanism, and a risk-aware culture. However, the firm does not have a risk management information system, which may create inefficiency and hinder the involvement of staff at a lower level of the firm. The findings of this study provide valuable information about current ERM implementation status for practitioners and researchers.

Keywords: *Risk Management, International Construction, Construction Firms, Singapore.*

* Corresponding Author: E-mail - zhaoxb1984@gmail.com

CONCEPTUAL FRAMEWORK OF DECISION SUPPORT MODEL FOR THE SELECTION OF STRUCTURAL FRAME MATERIAL TO ACHIEVE SUSTAINABILITY AND CONSTRUCTABILITY IN SINGAPORE

Yun Zhong*, Evelyn Ai Lin Teo, Florence Yean Yng Ling, George Ofori
*Department of Building, School of Design and Environment, National University of
Singapore, Singapore*

ABSTRACT

The construction industry plays a significant role not only in economic growth, but also in environmental impacts. As the global recognition on sustainable development, the construction industry is now highly challenged from high material consumption, energy consumption, CO2 emission, and social problems. In addition, Singapore government has launched buildability appraisal system and productivity enhancement scheme to encourage construction industry improve productivity. Under the pressure of reducing environmental impacts and increasing productivity, economic goal is not the only factor that should be considered when doing decision making. There is a clear need for a link between economic performance, environmental performance and productivity performance. Sustainability philosophy and constructability philosophy are useful when establishing such a link. However, little has been done on the connection between constructability principles and sustainable development. This paper presents a holistic framework to show the factors that affect the decision making on selecting structural materials. Based on the framework, a decision support model is established using Multi-attribute value technique. The weights of 1st level factors and 2nd level attributes have been computed using AHP method and 1-5 likert scale method. The rating method is offered as well.

Keywords: *Building Structural Material, Multi-Attributes Value Technique, Sustainable Construction.*

* Corresponding Author: E-mail - g0700345@nus.edu.sg

DEVELOPING SUSTAINABLE RELATIONSHIPS THROUGH PUBLIC PRIVATE PEOPLE PARTNERSHIP (4P) PROJECTS

Weiwu Zou, Junqi Zhang and Mohan Kumaraswamy*

Centre for Infrastructure and Construction Industry Development, Dept. of Civil Engineering, The University of Hong Kong, Pokfulam, Hong Kong

ABSTRACT

Public Private Partnership (PPP) are sometimes used to procure public infrastructure, if deemed useful in mobilising private finance and expertise for generating innovations and enhanced 'value'. However, when delivering desired 'value' to specific end-users, we should not neglect 'overall value' for the sustainable development of the parent community/society. To address such holistic issues in suitable broader-based projects, wider-ranging 'Public Private People Partnership' (4P) arrangements are proposed to invite and integrate contributions from societal stakeholders through relevant bodies, e.g. social enterprises, NGOs, academia and professional institutions.

Selecting and integrating such stakeholders in a properly structured 4P procurement and operational framework can help formulate more widely acceptable and sustainable designs and mobilise more resources for procurement, construction, maintenance and operation of built assets. This will also help to address grass roots aspirations and concerns earlier, rather than try to resolve conflicts later. However, a major barrier to involving more stakeholders in already complex projects arises in managing their inputs, and relationships, while optimising outputs.

Based on literature review and structured interviews, this paper presents pros and cons of using 4P in selected scenarios such as post-disaster reconstruction. Initial findings confirm that a 4P approach requires superior relationship management. This paper also draws on another study that highlighted the often neglected importance of relationship management in 'traditional' PPP projects. Combining these findings, a case is made for improving relationship management by mobilising the additional P ('people') to appropriate extents in selected PPP projects, so as to identify, prioritise and harmonise diverse stakeholder objectives and target optimal 'overall value' with sustainable relationships aimed at common goals.

Keywords: *Public Private People Partnership, Relationship Management, Stakeholders, Sustainable.*

* Corresponding Author: E-mail - mohan@hku.hk

ACKNOWLEDGEMENTS

The Organising Committee would like to express its sincere appreciation to the following individuals and organisations who have contributed to the success of the symposium:

Chief Guest and Guest of Honors
All Distinguished Guests
All Distinguished Speakers
Keynote Speaker

All the Government and other Institutions including Institute of Engineers, Sri Lanka (IESL), Institute of Quantity Surveyors Sri Lanka (IQSSL), Chamber of Construction Industry (CCI), Organisation for Professional Associations of Sri Lanka (OPA), Federation of Chambers of Commerce and Industry of Sri Lanka (FCCISL)

International Strategic Partners – Singapore Institute of Building Ltd. and Construction Federation of India

Scientific Committee Members
Conference Session Chairs
Session Coordinators
Conference Secretariat

Cinnamon Grand Hotel
Printers – Senevi Creation

Gold Sponsor – Sierra Cables Plc.

Silver Sponsors – Abans Group of Companies, Ranjanas Ceramic Pvt. Ltd. and Siemens Ltd.

Bronze Sponsors – GTB Colombo Ltd, Bitumix (Pvt) Ltd, Zam Gems and Majestic Electric (Pvt) Ltd.

Official Airline – Sri Lankan Airlines Ltd.

Official Banker – Hatton National Bank Plc.

Print Media Sponsor – Associated Newspapers of Ceylon Ltd.

Electronic Media Sponsor – TV Derana and FM Derana

Official Communication Partner – Bharthi Airtel Lanka (Pvt.) Ltd.

And All Other Sponsors

AND All those who have helped in one way or another

CIOB, the professional body for builders in Sri Lanka, is a strong network Engineers, Architects, Surveyors and similar allied professions who work to inspire, encourage, educate and train students, builders and professionals in the country. The institute welcomes young entrants and mature professionals with or without a background in construction to achieve professional level careers in the industry. They are provided with a well structured development that eventually lead to gaining corporate membership of the Institute.

CIOB works with local with institutes, professional bodies and Government ministries to develop business opportunities and upgrade the Construction industry, expanding its horizons in contributing to the economy. It also provides feedback to the government on their policies affecting the industry while working with the Government to provide appropriate solutions to the problems affecting the industry

Taking the Sri Lankan construction industry to the world, CIOB collaborates with international partner organizations. Acting as the facilitator for national events, delegations as well as organizer of locally held international events, CIOB endeavors to uplift the standards of the Sri Lanka Construction Industry.

www.ciob.lk



International Council for Research and Innovation in Building and Construction (CIB)

International Council for Research and Innovation in Building and Construction, also known as CIB, acts as a global network for international corporations and information exchange in building and construction research and innovation.

CIB collaborates with organizations around the world supporting the development of the industry, while facilitating international knowledge transfer on topics of interest. It covers the technical, environmental, organizational and other aspects of the built research results, as well as the as the implementation and actual application of the results.

Established in 1953, CIB now has over 5000 experts around the world. Approximately 500 of its individual members and member organizations hold a research, university, industry or government background and active in all aspects of research and innovation.

www.cibworld.nl



UNIVERSITY OF MORATUWA – Department of Building Economics

Building Economics and Management Research Unit (BEMRU), the research arm of the Department of Building economics (DoBE) at the University of Moratuwa, Sri Lanka, specializes in research in Building Economics and Management in the country as well as internationally.

Established in 1990 under the headship of Professor Chitra Weddikkara, the unit's specialization has strengthened through collaboration with other organizations and institutes in the industry. BEMRU continues to develop and maintain close links with leading research institutes from around the world.

www.becon.mrt.ac.lk