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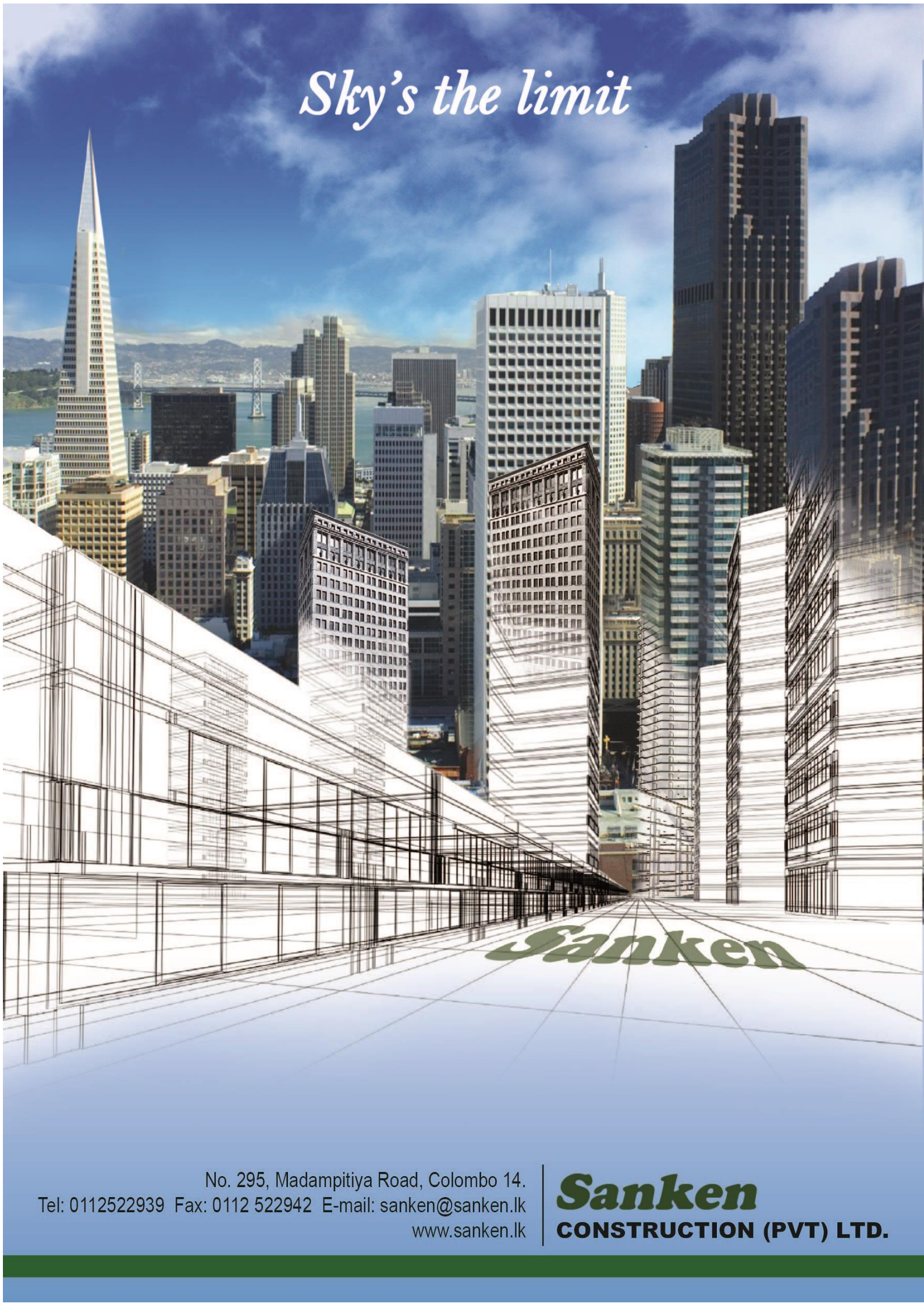

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MESSAGE FROM THE DIRECTOR GENERAL...

It is indeed a great pleasure to issue a message to this refereed Journal published in parallel to the Construction Excellence Award Ceremony, the annual event organized by Construction Industry Development Authority (CIDA) for the recognition of outstanding achievements and exemplary contributions made by the stakeholders of the construction industry, taking the industry in to new heights.

Building sector has consumed more than 40% of the energy produced world over emitting 30% of green house gases becoming one of the major polluters fuelling the global warming and other related environmental impacts.

The construction sector still largely follows the traditional method of construction, where high resource consumption including manpower is evident, creating a further pressure on the fast depleting natural resources.

In this context, it is imperative to introduce creative and innovative approaches, through well coordinated research, to address the challenges presently being faced by the Construction Industry. The introduction of energy efficient environmental friendly green buildings and less labour resource required technologies, are vital to achieve the concept of sustainable construction.

According to the Construction Industry Development Act No.33 of 2014 enacted by the Parliament, more emphasis has been given to research and development, ensuring continuous upliftment of construction standards and quality.
Around 10% of the Construction Industry Development Fund, which is to be set up under the provisions of the Act, has been set apart for research and publications in the field, related to construction, rewarding and encouraging the inventions, applications and propagation of environmentally friendly and cost effective construction technologies.

The objective of this Journal is to create a platform for the dissemination of new and innovative approaches being applied in the Construction Industry, creating an increased dialogue among the construction community, leading to further refining of those approaches ensuring their enhanced applications.
We would like to express our gratitude for those who made professional contributions to this Journal by sending their valuable articles and research findings.

We also thank the Editorial Committee for their continued professional support for this refereed Journal vetting all the scientific articles. The publication of this refereed journal would not have been possible without their commitment and professional contributions.

I also appreciate the able leadership and continuous guidance received from the Hon. Minster for making this Journal a success. We must also thank the Secretary and the Staff of the Ministry for their continued assistance and support. I must thank the Chairman for valuable advice and Director (Development) and staff of CIDA for their contributions to publish this Journal for the benefit of all stakeholders of the Construction Industry.

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A SURVEY ON SUSTAINABLE RESPONSES TO ECONOMIC RECESSION IN THE CONSTRUCTION INDUSTRY OF SRI LANKA

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Abstract

The construction industry is concurred a positive relationship with the cyclical economic fluctuations. Thus, the adverse economic conditions associated with the recession directly affect the construction industry. In response to the recession, the construction practitioners adopt various strategies, but many strategies have become reactive, which only consider the short-term economic perspectives. Therefore, the need arises for proactive strategies which focus on the long termism. Therefore, the aim of this research is to understand the recessionary effects and to promote sustainable responses in the Sri Lankan construction industry. The current research study follows a pragmatic knowledge claim which uses pluralistic approaches to focus on the research problem. A questionnaire survey was conducted among a sample of 35 and afterwards authors have conducted an expert interview survey from approximately one third of the respondents in the questionnaire survey. The purpose of conducting a qualitative study among a known sample is to elaborate their perspective in the subject area which further explores the findings generated from the closed structured questionnaire survey.

The results revealed critical adverse effects and sustainable responses during recession. 'Risk analysis and Contingency planning' is proactively mitigating most of the adverse effects. The recession responses have been mainly focused on two adverse effects: 'Liquidity of firms unstable' and 'Worsened profitability of construction firms'. However, the attitude of accepting the risk was eliminated with null consideration. Further, expert survey analysis derived that social benefits associated with sustainability have contributed mainly to gain the benefits over recessional threat as per the ST quadrant illustration of the SWOT matrix. It can be concluded that the findings of this research are valuable for all the stakeholders in preparing themselves for market volatility in a recession period.

Keywords: *Construction Industry, Recession, Sri Lanka, Sustainable Responses*

Introduction

The financial crisis during the years 2008 and 2009 is considered to be the most devastating economic event since the great depression in 1929 (Papademos, 2009). Growth in advanced economies had visibly declined into fragile and unstable economies due to domestic fiscal adjustment, tight credit conditions and sluggish labour market during economic recession. The market confidence in international financial markets had been deteriorated by the European sovereign debt crisis and led to heightened volatility in capital flows of Asian economies (Central Bank of Sri Lanka [CBSL], 2012). Thus, it signalled the impact to Sri Lanka which is a developing country in the Asian continent.

The consequences of recession derived visible effects in the construction sector, mainly in the form of postponing or abandoning of contracts and in the worst case scenario, construction companies ended up in bankruptcy. Contractors adopt various recession responsive strategies to realize their objectives of survival and development. However, many survival strategies innovated are reactive and focus on economic perspective. Hence, recession responses must be aligned with sustainability for long term proactive implication instead of ad-hoc strategies are being implemented. Though,

the sustainable responsiveness is suggested to cure the appalling effects of the recession in the construction industry, the assessment of the real benefits of sustainable responses should be highlighted in order to promote its application among construction stakeholders. However, competitive advantages of sustainable responsiveness have not clearly addressed in the existing literature. Hence, the benefit attributed in the concept sustainability must be considered to ascertain the real benefits of sustainable responsiveness during the recession. Therefore, this paper summarises the critical adverse effects during the recession, sustainable responses as well as the benefits of sustainable responses over adverse recessionary threats.

The paper begins with a review of literature which includes economic recession, critical recessionary adverse effects, sustainable responses and the benefits of the concept sustainability. The next section presents the research methodology followed by data analysis. The paper finally presents the conclusions of the research study and recommendations to clients and to indirect stakeholders.

Literature review

Overview of the Recent Economic Recession

The recent economic downturn in the year 2009 appeared as a significant deterioration in global macroeconomic conditions as well as sizable downward revisions to growth forecasts (Papademos, 2009). According to recently published highlights of recent economic developments by the Central Bank of Sri Lanka (CBSL, 2012), growth in advanced economies slowed a contrary weight down by domestic fiscal adjustment, tight credit conditions and sluggish labour market during the recent past. Thus, According to National Bureau of Economic Research (NBER, 2012), the recession is defined as, the economic recession is a period of falling economic activity spreads across the economy, lasting more than a few months, visible in real GDP, real income, employment, industrial production, and wholesale-retail sales. According to the SWOT (Strengths, Weaknesses, Opportunities and Threats) analysis, opportunities and threats are related to the external environment (Chen & Brunski, 2007). Thus, the recession as a generic systematic risk can be critically analysed under the threat component.

According to Verick and Islam (2010), the global crisis was emerging as isolated turbulence in the subprime segment of the US housing market mutated into a full blown recession by the end of 2007, which was known as the housing bubble burst. As a result of the overhang in the supply of housing opened up for financial institutions to extend vast numbers of mortgages at attractive rates. Consequently, the fundamental cause of the crisis was the combination of a credit boom and a housing bubble (Acharya & Richardson, 2009). Moreover, the capital regulations on banks reduce the amount of capital to hold against assets which was then resulted in the risk of mortgage defaults in the banking sector and rendered them insolvent when the housing bubble popped.

Adverse signs in construction sector during the recession

The construction industry plays a vital role in the national economy, and gets affected by macroeconomic fluctuations. In Sri Lanka, construction industry contributes 9.39% of GDP in the year 2012 (CBSL, 2012). Iteratively, result in adverse inferences to the national economy. Thus, the impact to the construction sector is explained in Table 1.

Table 01: Adverse Recessionary Effects

Adverse effects	Description
Financial difficulties	Late payment by clients resulted in construction companies face financial difficulties due to tight credit conditions and withdrawal of lending imposed by the banks (CBSL, 2012; Nistorescu & Ploscaru, 2010).
Reduced demand and supply	The sharp declining in public sector contracts resulted in falling the overall demand and increasing of the competition. In the supply perspective, the profitability of construction firms worsened by a sudden increase of lending rates due conservative risk management during the crisis (Goh, 2005; Gunaratne, 1993).
Unemployment	The high unemployment is a response to the shortfalls in aggregate demand, signalling the unstable economy. The drop in employment rates in Sri Lanka during the crisis was mainly due to the construction sector (CBSL, 2012).
Constraints on material and plant	The economic crisis is followed by a knock on effects of reduced demand for building materials and capital investment in machinery and equipment Therefore, building material manufacturing currently operate at close to half their capacity and there was a drop of building material imports by 24.1% (CBSL, 2012).
Procurement and supply chain	The recession creates the need to reduce spending without increasing the pressure on suppliers who are on the edge of bankruptcy in a recession. For instance, the drop in supply chain can be proven by the slowdown in construction resulted in decelerating of the construction sub-sector (CBSL, 2009; Cherif & Maira, 2011).
Future prospects led by customer confidence	In the worst case, the recession ends up into a liquidity trap in which people hoard money and refuse to spend no matter how much the government tries to expand the money supply which leads to reduce construction spending. Thus, many clients tend to adopt "wait and see" approach due to the uncertainty (Goh, 2005).

Recession Responsiveness in the Construction Sector

Recession responsiveness in the construction sector consisted of strategies that realise firms' objectives of continued existence and development in response to the recession (Lim *et al*, 2010). Moreover, Kaklauskas *et al*. (2011) produced a crisis management model optimising all the macro variables to mitigate the effects of recession. Similarly, Kunc and Bhandari (2011) explored the strategy development process through the relationship between changes in performance measures and strategic success factors. Thus, recession responses have identified under three categories as Contracting-related, Cost-control related and Financial-related strategies (Lim *et al*, 2010) as explained in Table 2.

Table 02: Recession Responses

Responses	Description
Contracting - related	Contractors adopt every possible way of procuring work to maintain their turnover (Lim *et al*, 2010; Hillebrandt, Cannon & Lansley, 1995).
Cost control - related	A more active role in managing projects, company's cash flow and procurement procedures during the prolonged recession is highlighted under the cost control related actions (Lim *et al*, 2010).

Financial-related	Managing the borrowing cost, capacity and the investment decision making are considered in financial related actions (Lim *et al*, 2010; Hillebrandt *et al*, 1995).

Tansey, Meng and Cleland (2013) have proposed a taxonomy, which utilises a well-known theoretical typology of Michael Porter's generic strategies (i.e. cost leadership, differentiation and focus) in responding to economic recession. They determined that the differentiation strategies were found to be the most frequently used. Cost leadership strategies and differentiation strategies under Porter's generic theory are aligned with cost control responses and contracting related responses under the classification by Lim *et al* (2010) respectively. Though the Government plays a major role in responding to recession, the scope of this study is limited to ascertain the responses at the hands of the controllable parties (i.e. construction stakeholders except the central Government who retains a higher power over any industry)

Another group of responses can be recognised as opportunity related strategies where all the firms are not equally affected by a recession. In fact, some firms even prosper during recessions. Thus, the recession be viewed as an opportunity to consider the real values of the business (Choppin, 1991). Hence, the existence opportunities may lead business either to sustain competitive advantage or to gain a completely new arrival (Rigby, 2001). Further, the environment plays a major role in shaping firms' business strategies which screens the recession as a hostile environmental condition (Lane & Lubatkin, 1998). Thus, Kunc and Bhandari (2011) explored that firms may reformulate their strategic objectives to gain the merit in recession.

Sustainable responsiveness in the construction sector

The sustainability meets the needs of the present without compromising the ability of future generations to meet their needs (Brundtland Commission, 1987). According to Kibert (2008) sustainability addresses three mutually reinforcing pillars as the ecological, social and economic issues which aligns with the triple bottom line concept. Thus, it is a single indicator prescribing sets of multi-disciplinary indicators.

One of the key reasons for the current economic downturn is the unsustainable business practices and the inadequate focus on making a balance between monitory gains along with social and environmental aspects (Kulatunga & Amaratunga, 2010; Chartered Institute of Building [CIOB], 2009). Hence, sustainable initiatives emerged as a solution to cure the adverse impact. Therefore, authors defined sustainable responses in the construction sector during the recession as:

"A long term, proactive strategic solution to mitigate adverse effects in the construction industry during the prolonged recession. The responses support the sustainable benefits which extend the responsibility of environmental integrity and social equity over economic development when selecting survival strategies for the long term healthy existence."

Competitive Advantages of Adopting Sustainability

Competitive advantages of sustainable responsiveness have not clearly addressed in the existing literature. Therefore, the competitive advantage of sustainability which underpins the sustainable responses is discussed. Many scholars have identified the benefits attributable in the concept 'sustainability' which is tabulated in Table 3 under the three mutually reinforcing pillars. Thus, the benefits of adopting sustainability in the internal environment can be reflected as 'strengths' according to the SWOT interpretation. According to Porter (1985), Competitive advantage grows out of value a firm is able to create for its buyers over the cost of creating it. Hence, Bansal (2001)

stated the sustainable development prompts the opportunity to build stakeholder commitment and competitive advantage.

Table 03: Strengths of Sustainability

Economic benefits
Life cycle cost reduction (Richardson & Lynes, 2007; (Bombugala & Atputharajah (2010)
Increased performance (LEED-EB Reference Guide, 2009; British Standards Institution, 2003).
Revenue generation (British Standards Institution; 2003; DTER, 2000).
True cost accounting (Purasinghe & Maguino, 2010).
Environmental benefits
Minimise negative environmental impact (SLEED-EB Reference Guide, 2009; Dissabandara & Peiris, 2010; DETR, 2000).
Reduced legal compliance issues (Sayce *et al*, 2007).
Favourable responses from pressure groups (Carswell & Smith, 2009).
Social benefits
Enhanced reputation (British Standards Institution, 2003).
Consumer confidence (DETR, 2000; Richardson & Lynes, 2007; DETR, 2000).
Attracting and retaining staff (Keeping & Shiers, 1996; British Standards Institution, 2003)
Collaboration (Hwang & Tan, 2012; Shah, 2007).

Methodology

The current research study follows a pragmatic knowledge claim in which Patton (as cited in Creswell, 2005) conveys the importance of focussing attention on the research problem and then uses pluralistic approaches. Therefore, sequential procedures associated with the mixed method approach was practised. Thus, the study follows three steps as discussed below.

Step One: A questionnaire survey was conducted among a sample of 35 consisting of consultants, contractors, financiers, academicians and clients in the construction industry. Each respondent's self-assessment on critical adverse effects and appropriate sustainable responses were ranked according to the relative importance index (RII).

Step Two: The authors conducted an expert interview survey for further investigation, from approximately one third of the previously selected respondents. The purpose of conducting a qualitative study among a known sample is to elaborate their perspective in the subject area which further explores from the findings generated from the closed structured questionnaire box. All the respondents have retained more than 10 years of experience in their role. In this expert survey, the respondents were selected according to the Mendelow's matrix for stakeholder mapping, under three groups: Key players, Keep satisfied, Keep informed as tabulated in Table 4. However, the category Minimal effort has been excluded from the expert survey because the power and interest of this group to influence the decision making is very minimal.

Table 04: Profile of Interviewees

Respondent	Reference number	Mendelow's stakeholder categorisation
Clients organisations	CLI-1, CLI-2	Key players
Construction consultants	CONS-1, CONS-2	
Construction contractors	CONT-1	
Government regulatory bodies	GOV-1	Keep satisfied
Financiers (Banks)	FIN-1, FIN-2	
Academicians (Construction)	AC-CON-1, AC-CON-2, AC-CON-3	Keep informed
Academicians (Economists)	AC-ECO-1	

Code-based content analysis captures significant findings from the interview transcripts. Major themes and sub themes were formulated in accordance with the objectives and the coding structure was developed accordingly. The QSR. NVivo 2010 computer software was used to simplify the work relating to analysis.

Step Three: SWOT analysis was used to analyse the real benefit of sustainable responses to minimise the recessionary threats. The basis of the data collection is in accordance with one quadrant, which is ST (Strengths - Threats) in the SWOT analysis as illustrated in the Table 5. The benefits inherent in sustainability have been considered as 'Strengths' while the adverse recessionary effects are considered as 'Threats'. The approach was more towards collecting qualitative ordinal data where respondent's self-assessment to determine the extent of strengths to minimise threats were ranked according to a Likert scale. Subsequently, data analysis was based on the central tendency measurement (i.e. median and the mode).

Table 05: SWOT analysis matrix

	Strengths (S) +	**Weaknesses (W) -**
Opportunities (O)+	Use strengths to make use of opportunities (SO)	Take advantage of opportunities by overcoming weaknesses (WO)
Threats (T) -	Use strengths to overcome or minimise threats (ST)	Minimise the effect of weaknesses and minimise or overcome threats (WT)

Source: Kaplan Financial Limited, 2010

DATA ANALYSIS AND RESEARCH FINDINGS

Adverse Recessionary Effects Recognized in the Construction Sector

As per the quantitative studies, the critical assessment of particular adverse effects was ranked according to RII as shown in Table 6, where 'Late Payment by clients' was marked as the most critical issue followed by 'Financial difficulties due to tight credit conditions'. The study revealed adverse effects under the headings 'Financing' and 'Demand and Supply' to be the most critical.

Table 06: Critical Adverse Effects: Quantitative findings

Adverse Effects	RII	Rank
Late payment by clients	0.89	1
Financial difficulties due to tight credit conditions	0.87	2
Increased competitiveness	0.85	3
Liquidity of firms unstable	0.80	4
Adopt “wait and see” approach	0.78	5
Postpone investment in property	0.78	5
Low investment levels	0.77	7
Growing the number of unsold built construction facilities	0.73	8
Decline in the value of public sector contracts	0.72	9
Worsened profitability of construction firms	0.71	10
Withdrawal of bank lending	0.71	10

Qualitative research finding justified the adversity of the effects that include in the Table 6 mainly late payment by clients, tight credit conditions, lower investment, contractor’s profitability is worsened, unoccupied construction facilities, cash flow problems. In addition to that, the following adverse effects have been recognised through the expert interview survey along with the justifications in Table 7.

Table 07: Critical Adverse Effects: Qualitative findings

Adverse effect	Justification
Unbalanced income distribution	Though contractors are graded, construction work is not always properly distributed resulting in some contractors getting more work than they can genuinely handle
Project Suspension	Projects suspended half way with all the temporary works remaining idled in the construction sites due to the credit crunch and lack of funds The knock-on effect generates many claims Contractors’ tendency to scale down work and postpone investments
Unemployment	Limited number of employees with many work opportunities
Labour redundancy	Laying-off staff during recession is a social threat Increased redundancy compensation being unfavourable to contractors
Foreign currency fluctuation	The transmission cycle of external recession has diffused recession from major economies to developing nations, mainly in the form of foreign funded projects
Inflation	Inflation during recession being transparent by way of increased salaries and wages, energy costs and subsequently resulting in increased construction cost

Sustainable Responses to Mitigate Adverse Recessionary Effects

Then the survey was carried out to assess appropriateness of the recession responses under four headings as discussed in the literature review: contracting related strategies, cost control related strategies, financing related strategies and opportunity related strategies. Figure 1 illustrates the responsive strategies identified in the quantitative studies along with abbreviated codes (Eg. CON1). The strategies marked above the dotted line have been ranked as per the quantitative survey, while below the line are the suggestions by the respondents in the questionnaire survey. The sustainable responses from among these responsive strategies have been highlighted.

Contracting - related responses	
CON 1	Minimising the cost of rework by quality output
CON 2	Forming partnership and developing reputation with clients
CON 3	Forward contracting with suppliers and subcontractors
CON 4	Maximise the number of biddings within the firm's competencies
CON 5	Negotiating for the lowest possible price for supplies
CON 6	Emphasising on cost, risk and resource management
CON 7	Specialising in a core expertise area
CON 8	Venturing into overseas markets
CON 9	Undertaking short-term and fast track projects
CON 10	Subcontracting work from other contractors
CON 11	Developing systems for follow up audits
CON 12	Renegotiating the terms of contracts
CON 13	Rescheduling of projects
CON 14	Forming public private partnerships (PPP)

Opportunity - related responses	
OPP 1	Reformatting the firm's strategic objectives
OPP 2	Developing aggressive marketing responses
OPP 3	Practicing innovative procurement methods

Cost control - related responses	
COS 1	Implementing stricter site management to reduce wastage
COS 2	Effective human resource management (HRM)
COS 3	Inventory management
COS 4	Freezing staff recruitment
COS 5	Exploring the use of alternative construction materials
COS 6	Implementing stricter procurement procedures
COS 7	Implementing stricter financial management on cash flow
COS 8	Adopting energy efficient practices
COS 9	Maintaining a group of core staff
COS 10	Restructuring the workforce into more productive teams
COS 11	Managing variations

Financing - related responses	
FIN 1	Negotiating alternative loan services
FIN 2	Establishing Security agreements with project owners & financial institutes
FIN 3	Investing into R&D to further explore business opportunities
FIN 4	Lease financing construction equipment
FIN 5	Investing surplus funds in financial investments
FIN 6	Adopting the "wait-and-see" mode
FIN 7	Investing in machinery that has a high liquidity value
FIN 8	Creating uncommitted financial resources
FIN 9	Arranging innovative financial agreements with contractors
FIN 10	Exploring project finance ventures

Figure 01: Recession Responses: Quantitative findings

The expert survey have identified the current practice of recession responses as detailed below in Table 8 in addition to what derived from the quantitative studies. These listed responses are the fresh contributions (marked with an * in the text) by the expert survey.

Table 08: Recession responses: Qualitative findings

Responses	**Justification**
Pricing strategies(CON 15)*	The most common strategy among contractors is to bid at the lowest possible price to procure the job. Also pricing at break-even point rather than pricing below the basic cost is another strategy adopted. As opposed to these views, adding a mark-up for their potential risk is another strategy in the current practice.
Scale downCON 16)*	Some activities can be scaled down until such time that the worst situation has passed. This is indirectly aligned with the questionnaire survey findings, 'Undertaking short-term and fast track projects' (CON 9) is a scaled down strategy during recession.
Phase completion(CON 17)*	Some of the advantages of phase completion were identified. Completing a phase and getting an accurate idea about the targets and profit margins would help them to adjust for the next phase. On the contrary, if the project was commenced as one package, they would have faced worst effects without early warning. Thus, this forward planning mitigates the severe adverse exposure to recession.
Pre-sell(CON 18)*	In mega condominium construction projects, selling their units through pre-sell will generate early cash flows that could be used to manage cash flow problems
Price adjustmentCON 19)*	The ICTAD price fluctuation formula method is the only strategy for price adjustment in the current practice. Though Hudson formula is also applicable, it does not yield the right answer fitting into an extraordinary situation. The researchers recommend innovative solutions for price adjustment to overcome barriers in existing formulae.

It is concluded by all the experts that most of the current strategies are reactive, while some are simply accepting the risk. FIN-2 stated that contractors concentrate on profit rather than the best value for money and start panicking when disaster occurs. The experts proposed the most proactive strategies which should have been practiced to mitigate recessionary adverse effects as tabulated in Table 9. 83% of the respondents proposed Risk analysis & Contingency planning as the most applicable response.

Table 09: Proposed sustainable responses during recession

Code	Expert interviewee / Proposed strategy	CONS-1	CONS-2	CONT-1	AC-CON-1	AC-CON-2	AC-CON-3	AC-ECO-1	FIN-1	FIN-2	CLI-1	CLI-2	GOV-1	% OF RES.
***	The advisory role	√			√				√				√	33 %
CON 20*	Hedging for price fluctuation						√	√	√	√				33 %

Code	Expert interviewee / Proposed strategy	CONS-1	CONS-2	CONT-1	AC-CON-1	AC-CON-2	AC-CON-3	AC-ECO-1	FIN-1	FIN-2	CLI-1	CLI-2	GOV-1	% OF RES.
CON 21*	Diversification		√	√	√	√	√		√		√	√	√	75 %
FIN 3	Research & Development (R&D)	√	√	√		√					√		√	50 %
CON 22*	Training & Development (T&D)		√			√		√			√		√	42 %
CON 15	Bidding strategies / Cost modelling	√		√	√		√							33 %
FIN 2	Employer's guarantees			√			√	√	√	√			√	50 %
CON 3/18	Forward contracting and Pre-sell	√			√		√	√						33 %
COS 5	Local resource utilisation	√	√	√		√							√	42 %
COS 12*	Risk analysis & Contingency planning	√	√	√	√	√	√	√			√	√	√	83 %
COS 13*	Performance appraisal and Monitoring	√		√				√			√	√	√	50 %

The Mapping of Sustainable Responses with Adverse Effects of Recession

It is commonly agreed by the experts that cherry picking of the strategies is not useful at the time of worst scenarios. Thus, proposed responsive strategies have to be matched with the adverse effects, according to the survey findings as illustrated in the Table 10. It illustrates a matrix in which the header row represents different recession responses categorised under four headings; contracting related responses, cost control related responses, financing related responses and opportunity related responses, while the header column represents the adverse effects in the construction industry during recession. This matrix was developed based on the analysed data derived from quantitative and qualitative studies.

An overview of Table 10 shows 'Risk analysis and Contingency planning'(COS 12), as one of the cost control strategies, marked quite frequently as a recession response to mitigate most of the listed adverse effects. Recession responses have been mainly focussed on minimising two adverse effects. They are 'Liquidity of firms unstable' and 'Worsened profitability in construction firms'. In a greater emphasis, the attitude of accepting the risk must be eliminated entirely with null consideration. Though adopting a wait and see mode was recognised as an adverse effect, this research study focuses on recommending the opportunity of using different recession responses to minimise its impacts.

In the detailed analysis of Table 10, late payments by clients can be minimised by adopting three responses as suggested. Risk analysis and Contingency planning (COS 12), client's financial

capabilities have to be assessed prior to undertaking a project and a buffer contingency allocation is suggested by experts for a smoother operation of construction activities during the period of lagging payment by the client. In the same platform, a guarantee (FIN 2) from the client is a solution in order to assure timely payment. However, it is not practiced in Sri Lanka; therefore, experts have suggested establishing a screw accounting system and setting up a sinking fund as solutions. Further, reformatting of strategic objectives (OPP 1) is a subjective strategy that varies based on the top management's strategic direction. According to the experts, profit orientation and risk attitude of the top management directs the decision making of the contractor whether to proceed with the particular client or not. Similarly, experts have mapped the remaining adverse effects to recession responses with similar justifications. Moreover, special attention has to be given to the sustainable responses which have been highlighted in the matrix for the long term proactive existence.

Table 10: The Matrix of Mapping Recession Responses to Adverse Recessionary Effects

	Recession Responses			
Adverse Recessionary Effects	**CON**	**COS**	**FIN**	**OPP**
Late payment by clients		12	2	1
Financial difficulties due to tight credit conditions	18	12	1*,2,5,8*,9, 10	
Increased competitiveness	1,2,3,4,6,7,14,15	8,12,13	3	2*,3
Liquidity of firms unstable	3,4,5*,6,8,9*,10*,11,1 4,15,16,17,18,20,21	1,3,4*,6,7,8 ,9,11,12	1*,2,5,7*,8*9 ,10	1,3
Postpone investment in property		12	9,10	3
Low investment levels	7,8,14	12	9,10	2*,3
Growing the number of unsold built construction facilities	17,18	12		2*
Decline in the value of public sector contracts	14,18	12		3
Worsened profitability in construction firms	1,3,4,5*,6,8,9*,10*,15, 16,17,18,20,21	1,3,4*,6,8,9 ,11,12,13	1*,2,5	1,2*,3
Withdrawal of Bank lendings		12	1*,2,10	2*
High unemployment of professionals	4,7,22	2,9,10,12		
Reduce spending - Inflation	3,4,5*,9*,14,19,20	3,12		
Bankruptcy threat	2,7,10*,14,15,16,17,1 8,21	7,11,12		1,3
Growth of the construction sub-sector decelerating		12		2*
Bankruptcy threat of suppliers	5*	12		
Drop in the volume of imports of building materials	3,8,20	12		

Adverse Recessionary Effects	Recession Responses			
	CON	**COS**	**FIN**	**OPP**
Reduced demand for building materials	4,5*	5,12		
High unemployment of non-professionals	4,9*,22	2,10,12		
Drop in capital expenditure on machinery	9	12	4*,7*	
Increasing labour redundancy cost	4	2,12		
Foreign currency fluctuation	3,8,20	12		
Project suspension	12,13*,16,17	12,13		3

* The strategies which cannot be recognised as sustainable responses

Appraising the Strengths of Sustainability to Cure Recessionary Threats

Though the sustainable responsiveness is suggested to cure the appalling effects of the recession as discussed in the previous subsection, the assessment of the real benefits of sustainable responses should be highlighted in order to promote its application among construction stakeholders.

Therefore, ST quadrant of SWOT matrix was developed to ascertain the extent of using strengths of sustainability to overcome or minimise recessionary threats. The list of competitive advantages of adopting sustainability is shown in the rows of the matrix, categorising under economic, environmental and social benefits. Adverse effects in the construction industry during the recession are tabulated in the columns of the matrix, grouping under six main headings such as financing, demand and supply, unemployment, constraints on material and plant, procurement and supply chain and future prospects led by customer confidence. Each intersection of a column and a row is ranked by the experts using a Likert rating of 1 to 5 scale (Never to Always), stating that, to what extent the particular sustainability strength minimise the particular adverse effect as shown in below illustration.

Table 11: The matrix of Sustainability Strengths – Recessional Recessionary Threats

ST Quadrant	**Recessionary Threats**
Strength of sustainability	Likert Rating (1-5)

In the mere overview of the results, the respondents have become neutral in the highest number of statements which is ‘Sometimes Minimise’. Further, there could not be seen any relationship of sustainability ‘always minimise’ adverse effect. Moreover, the respondents marked ‘Mostly Minimise’ in a lesser number of statements. Furthermore, there are a few sustainability advantages never minimises threats in the construction industry, leaving no relationship.

In the positive side, increased performance and revenue generation are having positive relationship in minimising adverse effects under the Economic benefits. As an environmental benefit, reduced legal compliance issues as a competitive advantage of sustainability marked significant in minimising adverse effects. More importantly, it must be emphasised that the social benefits contributed considerably for the threat minimisation among them, enhanced reputation, consumer confidence and

attracting and retaining staff as sustainability benefits have contributed significantly in minimising the adverse effects.

Conclusions

The construction industry is a significant source of income generation to the country's GDP which leads to a direct consequence in stagnation of the industrial position during the economic recession in a dynamic moving environment. 'Late payment by clients' and 'Financial difficulties due to tight credit conditions' have been the critical adverse effects according to the quantitative studies. Expert interviewees have also disclosed further adverse effects, namely: foreign currency fluctuation, inflation, labour redundancy, project suspension and unbalanced income distribution among firms act as a barrier in the construction industry to move forward during a prolonged recession.

Current strategies to overcome difficulties in the economic recession have been considered inefficient and appeared the need of an optimal extraordinary solution to mitigate the adverse effects in the construction sector. Therefore, sustainable responses were introduced as a proactive strategy for long term healthy existence. The strategies which are sustainably appropriate according to the questionnaire survey findings include: minimizing the cost of re-work by quality output, implementing stricter site management to reduce wastage, establishing security agreements with project owners and financial institutes and reformulating the firm's strategic objectives under each respective heading (i.e. contracting, cost control, financing, opportunity). Additionally, advisory role, hedging for price fluctuation, diversification, R&D, T&D, bidding strategies/cost modelling, employer's guarantees, forward contracting and pre-sell, negotiation with stakeholders, local resource utilization, risk analysis & contingency planning and performance appraisal & monitoring were highlighted in the expert interview survey.

Consequently, the paper has presented a mapping of adverse effects with its respective recession responses to avoid the ad-hoc selection of strategies. The direct links have been made between different strategies and adverse effects, conferring with the experts. Moreover, in a greater emphasis, the attitude of accepting the risk must be eliminated entirely. The strategy 'risk analysis and contingency planning' is recognised by the experts as an effective recession response to mitigate most of the listed adverse effects. Once the sustainable responses were figured out from different sources, the extent of sustainable benefits to minimise adverse threats during the recession was then evaluated. The respondents have become neutral in the highest number of statements, which is 'sustainable benefits sometimes minimise threats'. Furthermore, it must be emphasised that the social benefits contributed for the threat minimisation mostly. In consideration to the economic benefits, mainly 'increased performance' and 'revenue generation' reasoned to mostly minimise recessional threats. While, reduced legal compliance issues as a competitive advantage of sustainability have contributed most in minimising the adverse effects.

However, none of the strategies would yield any benefits if implemented only at the occurrence of a recession. Hence, a continued process of proactive strategies has to be implemented. Only proactive strategies will result in minimising the adverse effects of recession. Eventually, it is fostered that the sustainable responses proactively address to minimise adverse effects during a recession.

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GUIDELINES FOR CONSTRUCTION OF LOW TRAFFIC VOLUME RURAL CONCRETE ROADS IN SRI LANKA

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Abstract

The purpose of the study was to develop guidelines for construction of low traffic volume rural concrete roads in Sri Lanka. Thus a survey was carried out to study current concrete road construction practice and find out very important facts, which could be used to improve current construction practice.

Contraction joints are a main feature of concrete roads and it facilitates load transfer in between panels. Although several specifications are available regarding contraction joints, they are not followed. As a result, incorrect contraction joints were observed during the survey. Curing of concrete pavement within seven days of construction is essential and effective curing was a rare incidence. An experiment was carried out to study effective curing. A comparison of various kinds of concrete producing methods and their performance are important findings of the study. Slump tests were carried out to find out most suitable rage of slump for local road concreting work.

Introduction

Road pavements can be categorized into two main groups, flexible and rigid. Concrete roads belong to rigid pavement category due to concrete being a rigid material. Concrete have been used for road construction in Sri Lanka and one of the earliest roads is Charley road. However, construction of low traffic volume rural roads using concrete was popularized recently with increasing of funds.

Damage to concrete pavement due to stagnation of rain water on the surface, is negligible compared to bituminize roads and its life span is higher than bituminize roads. Maintenance cost of concrete pavement is lesser than bitumen roads and are suitable for roads those have poor attention, such as most of local roads in Sri Lanka. Water does not penetrate to sub base of concrete pavement since pavement itself being water proof and as a result load bearing capacity of sub base not decrease, even though environment is wet. Thickness of concrete pavement is smaller than bituminize road, hence require less material for construction. However, initial construction cost of concrete pavement is higher than flexible pavement and it is impossible to carry out stage construction. Alternative roads should be introduced during construction as well as until concrete reach sufficient strength to bear particular traffic load. (Gurchandran S, 2008)

Problem Statement

"Standard Specifications for Construction and Maintenance of Roads and Bridges" can be followed for construction of local concrete roads in Sri Lanka. But most details in this specification are related to concrete paving using pavers. Pavers are impossible to use for construction of low traffic volume local roads. Since road geometry is not sufficient for such heavy machinery.

One qualitative parameter of a concrete pavement is surface undulation. Surface undulation of asphalt roads or concrete pavements is measured by standard straight edge. It should be modified to measure surface undulation of local concrete roads. Full depth joints are frequent in local roads and those are

weak under load transfer between panels. Water is widely used for curing concrete and it is evaporated in few minutes after application. This will adversely affect effective curing and a water retaining material can be used to overcome this problem.

Concrete Road Condition Survey

Different kinds of concrete paving methods and surface characteristic can be seen in Sri Lanka. A survey was done on 24 numbers of roads which are located in southern province, to collect concrete road condition data. Road pavement behavior was studied with that collected data.

According to the survey, contraction joint spacing is less than 5m in 45% of the roads and these joints are not straight in 41% of the roads. Wooden planks have been used to provide contraction joint in 45% of the roads and have not been removed on 98% of the roads. According to the survey results no camber has been provided in 92% of the Roads. Curing had been done on 70% of the roads while curing material had been provided only in 4% of the roads. According to the specifications, instructions had been given to provide separation membrane between the pavement and the sub-base layer, but polythene sheeting had been used as a separation membrane only in 25% of the roads.

Pavement Strength and Thickness Measurement

Three concrete core samples (See Figure 01), with diameter 150 mm were taken from roads and are shown in Table 01. Mix proportion of those pavements was 1:2:4 concrete. Thickness and strength of samples are shown in Table 01. According to Table 01, specified design strength of 15N/mm^2 was achieved only at Wadihitiniwasa road, Akurassa. Specified pavement thickness was 150 mm and that had not been maintained even in single case.

Concrete transit trucks are used to transport concrete from batching plant to site. Even though those trucks have been design to transport concrete, it was observed that those trucks are being used as concrete mixes. Thus, unmixed concrete was observed to be discharging from concrete transit trucks during the road condition survey. All these facts prove that concrete transit trucks are not suitable for mixing concrete.

Table 01: Core Strength Reading

Location	No	thickness (mm)	Strength (N/mm^2)
Beligaswatta Kohilawala Para	01	140	9.96
Wadihitiniwasa Para, Beliatta	02	95	16.45
Dewana Piwisum Para, Ihalabeligalla	03	140	10.76

Evaluation of Effectiveness of Curing Material

Saw dust was used as water retaining material at Napekanda road Akkurassa while coir dust was used at Beligaswatta road Beliaththa since these materials were freely available. Effectiveness of curing depends on water retaining ability of such materials. An experiment was carried out to compare this feature on 2009 which was a sunny dry day. Thus rate of evaporation is the maximal. One meter by one meter rectangles were marked on the selected pavement. At the same time 27000 cm^3 of coir dust and 27000 cm^3 of sandy soil were measured. After that measured coir dust was spread on the 1st

rectangle evenly and sandy soil was spread on the 2nd rectangle similarly, while keeping the 3rd rectangle as a monitoring surface. Water was spread on the coir dust and sandy soil to saturate conditions at 6:30 am. If water was spread over the 3rd rectangle at the same time, it had to be spread more twelve times to maintain the wet condition as same as wet condition in coir dust and sandy soil. According to the test results shown in Table 02 it can be concluded that it is essential to use a water retaining material for effective curing.

Table 02: Water Retaining Material Testing Data

Time	Time deference (Minutes)	Slab without material	Coir dust	Sandy soil
6:30		√	√	√
7:30	60	√	×	×
8:50	80	√	×	×
9:55	65	√	×	×
10:45	50	√	×	×
11:20	35	√	×	×
11:55	35	√	×	×
12:50	55	√	×	×
13:42	52	√	×	×
14:33	51	√	×	×
15:30	57	√	×	×
16:30	60	√	×	×

Note: - (√) Water spread (×) water not spread

Surface Undulation Measurements Using Modified Straight Edge

Surface undulation of a concrete pavement is evaluated by a straightedge. This instrument is 3 meter long. If there is a camber in a 3 meter wide low traffic concrete road, this instrument cannot be used to measure concrete roads undulations, because average width is insufficient. In this case standard straightedge was modified to evaluate undulations on local concrete pavements.

An aluminum rectangle hollow box of 1.5 m length, 50 mm height and 25mm thickness was used as the modified straight edge. Length of the selected straight edge was 1.5 m. Two supports of height 20 mm were fixed at both ends of the straight edge. A wedge was prepared from a steel plate with handle. This can be used to measure space between concrete surface and straight edge. The length of the wedge was 350 mm and height 50 mm as shown in Figure 02.

Readings were taken at Kahaduwa Milidduwa road at Galle. Twenty readings were recorded at 20 m intervals along the centerline and 750mm apart from either side of the center line. Since support height is 20 mm, undulation is defined as the deviation from 20 mm. Results observed are shown in Table 03.

Figure 01: Concrete Core Samples

Figure 02: Modified Straightedge

Construction of Contraction Joints

Contraction joint is very important for better performance of a pavement. Most of joints observed during the survey were full depth contraction joints. Full depth contraction joints are weak in load transfer between slabs. A trial was done to construct half depth contraction joints at Napekanda road Akkurassa.

Location for a contraction joint was identified and a 14 mm wide groove was prepared on both side of form work as shown in Figure 04. Thereafter, plywood was covered with polythene sheet as shown in same picture and was inserted into the groove. The objective of covering the plywood with polythene sheet is to prevent the concrete from sticking to plywood. Concrete was then poured into either side of the joint. The plywood sheet was then removed slowly, 4 hours after pouring of concrete without removing the polythene sheet. Construction cost of full depth and half depth joint is almost same.

Table 03: Surface Undulations Reading

Chainage	LHS Reading (mm)	Undulation (mm)	RHS Reading (mm)	Undulation (mm)
+000	22	2	25	5
+020	27	7	25	5
+040	30	10	30	10
+060	40	20	15	-5
+080	30	10	20	0
+100	20	0	22	2
+120	20	0	26	6
+140	27	7	32	12
+160	28	8	33	13
+180	30	10	24	4
Average		7.4		5.2

Figure 04: Construction of Half Depth Contraction Joint

Camber

Camber for concrete pavements should be kept between 1.7% and 2 %(Gurchandran S 2008). Instructions had not been given to provide camber in some rural concrete roads and as a result, camber was not provided on 92% of the concrete roads. Construction of camber is not difficult and 2% camber was achieved at Napekanda road without much more effort. Based on this study, it is recommended that 1.7% to 2% camber should be provided on all local concrete roads to increase their lifespan.

Slump

The recommended slump for concrete pavement in India is 25mm to 50mm if paving is done by pavers. The slump was measured during construction of Aduranwila Ehalagedara road and it was between 75 mm and 125 mm. It is thus recommended that a slump of 65 mm can be maintained with a tolerance of ±10mm in order to limit excess use of water in concrete.

Conclusion

Irregular cracks form as a result of stresses inside concrete pavement and such cracks reduce lifetime of pavements. Contraction joint should be provided in the interval of 6 m. Half depth joint is the most efficient joint in this case.

Permanent marks on the pavements were observed on 50% of roads due to human and animal activity. Access to pedestrians, vehicles or animals should not be allowed before concrete has gained sufficient strength, in order to avoid permanent marks. Barricades are suggested as a solution for this purpose. During the site visit at Agunukolapalassa, structural damage on the pavement was observed due to heavy vehicle movements and these damages are more critical than permanent marks.

Low water cement ratio concrete is being used for local road concrete pavements. (Sammir1998). Curing should be done for at least 7 days for such concrete. According to the survey, curing was done on 70% of the roads and coir dust or saw dust had been used as water retaining material only in a few cases.

Concrete transit trucks have been designed to transport concrete from plant to site. However, these trucks have been used as concrete mixer. In such cases poor mixing of concrete were observed. This practice should not continue.

Drawbacks and acceptable practices were both identified during site visits as well as interviews held with persons who are in the field managing local concrete roads.

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ESTIMATION OF LABOURPRODUCTIVITY AND MANAGEMENT IN RURAL BRIDGECONSTRUCTION PROJECTS IN SRI LANKA

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Abstract:
Construction is a labor-intensive industry as well as improving labour productivity in construction projects remains one of the major challenges being faced by the construction managers and contractors as poor productivity of construction workers is one of the reasons of cost and time overruns in construction projects. This study is primarily undertaken to estimate the labour productivity and management in rural bridge construction projects in Sri-Lanka. Twenty rural bridge construction projects were selected from across Sri-Lanka those were varied from 6-30m in length as per the different site conditions. The most significant ten ranked factors affecting labour productivity were identified via a closed-ended questionnaire survey. These include: Skill of labour, Lack of instructions & supervision ,Improper or insufficient equipment/tools, Site Conditions, A shortage of experienced labour, Shortage of materials, Weather Conditions, Quality Control, Quality of workmanship and Delay of instructions & supervision. Onsite data collection was done by selecting the most critical items of work and the findings revealed that actual productivity rates are significantly lower than the estimated productivity rates. Based on the outcomes of this research, recommendations were established for improving labour productivity and management in selected critical items in future rural bridge construction projects.

Keywords: *Labour Productivity, Construction Industry, Relative Important Index & Rural Bridges Project.*

Introduction

Labour is the most important resource in construction projects, because it combines all the resources such as materials, plant, equipment, management, finance etc. In most of the construction firms financial soundness depends on labour productivity. The construction material costs are usually fixed through specification, profits and overheads are largely controlled by the competition. Productivity is an effectual and efficient use of all resources; labor, plant, materials and management (Prokopenko 1987). The article (Quesnay 1987) indicates productivity for the first time after the word invented in 1766. More than a century afterwards, in 1883 it is defined as "Faculty to produce" and was developed to "the correlation between output and resources utilized to get that end product". Thomas et al. (1990) stated that there are three models of productivity measurements which are considered as Economic Models, Project Specific Model and Activity Oriented Model. From these methods, Activity- Oriented Model defined the productivity relative to project sites as shown in Eq (1).

Labour Productivity = Labour output /Man-Day (1)

Moreover, this model can be identified as the most accurate method as productivity measurements. Labour productivity is one of the most challengeable difficulties in the field of construction. Considerable long term economic growth is accomplished by enhancement of labour productivity and it directs to an increase in output growth (Mahmud 2006).Further research (Yates and

Guhathakurta 1993; McTague and Jergeas 2002) found that labour cost includes 30 -50 % of the total project's cost in most of the countries. Moreover, Horner et al. (1989) showed that 10 % increase in construction labour productivity is produce annual savings of nearly billion to the British economy.

In Sri Lanka, rural development is engaged with economic development of people as well as higher social conversion. Furthermore, it is the route to reduce poverty, unawareness and disparity of prospects. For that, it is the major urgency to improve rural roads and bridges as particularly connected rural population with typical economic development by enhancing their standard of living. Recently, most of the construction projects are implemented as accelerated projects in Sri-Lanka. Sri-Lankan government has recognized the requirement of rural bridges for the speedy development and proposed construction of 210 bridges as Phase 1 and 1000 bridges as Phase 2 with minimum facilities to enhance living standard of people- and widening transportation (UK Sri-Lankan News Portal 2011). Bridges are constructed between 6-30 m span lengths on steel beams without pears.

Hence, the researcher identified that it is one of the major challenges to be faced by the construction managers to improve labour productivity of construction projects in rural areas. Because producing more with less can directly affect profitability as well as long-term survival of the firm. Therefore in this research an attempt was taken to estimate the labour productivity and management in rural bridge construction projects in Sri-Lanka. The objectives of this study are to identify the common factors influencing labour productivity and select the most significant factors which are affecting labour productivity in Sri Lankan rural bridge construction projects; to compare actual productivity rates with estimated rates in some identified items and to make recommendations for improving labour productivity and management in selected items in future rural bridge construction projects.

Review of labour productivity from previous studies

A routine of studies has been carried away to find out the factors affecting labor productivity in construction projects. Shaddad and Pilcher (1984) identified 76 factors affecting construction labour productivity. In addition, Horner and Talhouni (1996) in their research paper found people related, project related and site related factors affecting labour productivity. According to (Kadir et al. 2006) technology, human/labour, management and external are the major types of factors affecting construction labour productivity in Malaysia.

In a survey carried out by (Abdulaziz and Camille2012) identified and assorted 45 factors affecting construction labor productivity in Kuwait. Furthermore in a journal published by (Khaled and Remon 2013) categorized productivity factors as: human/labor, industrial and management. Recently (Yil and Chan 2013) did a survey of a systematic review on construction labour productivity which aimed to investigate the form of the art and trends in critical labour productivity.

Research defined by (Wijeratnaand Wijekoon2012) indicates ten factors which affect labour productivity in Sri-Lankan construction industry. This study is very similar to this research which was conducted in Sri-Lanka known as the "Evaluation of labour productivity in bridge construction projects".

The author identified the requirement of conducting a survey on the relevant matter in Sri-Lanka since recently, most of the construction projects are implemented as accelerated projects.

Nevertheless, recently conducted researches are considered labour productivity among urban areas. By considering the importance of rural development in Sri-Lanka as a developing country, the present study carried out study of labour productivity in rural areas. The literature review was conducted to meet one of the objectives of this research from existing studies through different types of material types. Based on the secondary data the researcher identified possible factors (26) affecting labour productivity in bridge construction and those factors were sorted into four groups as: (1) Technological; (2) Human/Labour; (3) Management, and (4) External. The outline of the factors is given below.

Table 02: List of Possible Factors Considered for the Research

Factor No	Group	Factors Affecting on Labour Productivity
1	**Technological**	Clarity of technical specification
2		The extent of variation/change order during execution
3		Design /Construction difficulty
4		Site Conditions
5		Site restricted access
6		Quality Control
7	**Human/Labour**	Skill of labour
8		Quality of workmanship
9		A shortage of experienced labour
10		Non discipline labour and use of alcohol and drugs
11		Motivation of labour
12		Health & Safety
13		Labour Absenteeism
14		Employee Age
15	**Management**	Unrealistic Scheduling
16		Expectation of labour performance
17		Shortage of materials
18		Construction method
19		Payment delay
20		Improper or insufficient equipment/tools
21		Delay of instructions & supervision
22		Lack of instructions & supervision
23		Unproductive Time (Internal Delay, Extra Break, Waiting & Relaxation)
24		Degree of Bilateral Communication
25		Working over time
26	**External**	Weather Conditions

Methodology

The respondents of the study were taken across the Sri-Lanka. Slovin's (1960) formula used to determine the sample size which illustrated as in Eq.(2)follows.

$$n = \frac{N}{[1+(N\times e^2)]} \quad (2)$$

Where:n=Sample Size,N=Population Size,E=Margin of error & 1=Constant value

From the calculation, the respondents of the study are composed of 20 out of population of 210. This result is further sustained byRoscoe's simple rules of thumb. In the second rule, it states for a simple experimental research with tight experimental controls can be used 10-20 samples. Relative importance index (RII) was used to determine the relative importance of various factors affecting labour productivity as shown in Eq.(3).Factors were ranked according to the importance level.

$$RII = \frac{4n_4+3n_3+2n_2+1n_1}{4(n_1+n_2+n_3+n_4)} (3)$$

Where:n_1=the number of respondents who selected "1", n_2=the number of respondents who selected "2", n_3=the number of respondents who selected "3"and n_4=the number of respondents who selected "4".

Hence, the respondents were asked to mark each factor according to their effect on labour productivity. Marks were allocated as 4 for most important; 3 for important; 2 for less important, and 1 for not important.

A data sheet was designed to collect quantity of work performed and the number of hours actually used for the selected item of work from the most critical items in the BOQ from 20 bridge construction projects to contrast actual labour productivity rates with estimated rates. Actual productivities of selected items were calculated by using site data and estimated productivity values were taken from the rate analysis in HSR (Highway Schedule of Rates). Data so received were carefully shortlisted to find out the productivity drop as in Eq.(4).

$$ProductivityDecrese(\%) = \frac{EstimatedProductivity-ActualProductivity}{EstimatedProductivity} \times 100\% (4)$$

Analysis of the data

Questionnaire Survey

The overall perceived effects of the factors surveyed are summarized in Table 2.The most significant ten ranked factors affecting labour productivity in rural bridge construction projects in Sri-Lanka, are as follows.

1)Skill of labour; 2)Lack of instructions & supervision; 3)Improper or insufficient equipment/tools; 4)Site Conditions; 5)A shortage of experienced labour; 6)Shortage of materials; 7)Weather Conditions; 8)Quality Control; 9)Quality of workmanship, and 10)Delay of instructions & supervision.

Table 02: Overall RII & Ranking of Factors affecting Labour Productivity According to Preliminary Survey Results

Factor No	Group	Factors Affecting on Labour Productivity	RII	Rank
7	Human/Labour	Skill of labour	0.938	1
22	Management	Lack of instructions & supervision	0.913	2
20	Management	Improper or insufficient equipment/tools	0.900	3
4	Technological	Site Conditions	0.888	4
9	Human/Labour	A shortage of experienced labour	0.875	5
17	Management	Shortage of materials	0.863	6
26	External	Weather Conditions	0.850	7
6	Technological	Quality Control	0.838	8
8	Human/Labour	Quality of workmanship	0.825	9
21	Management	Delay of instructions & supervision	0.813	10
11	Human/Labour	Motivation of labour	0.800	11
16	Management	Expectation of labour performance	0.800	11
18	Management	Construction method	0.800	11
3	Technological	Design /Construction difficulty	0.788	12
12	Human/Labour	Health & Safety	0.788	12
19	Management	Payment delay	0.788	12
5	Technological	Site restricted access	0.775	13
15	Management	Unrealistic Scheduling	0.775	13
13	Human/Labour	Labour Absenteeism	0.763	14
2	Technological	The extent of variation/change order during execution	0.738	15
23	Management	Unproductive Time (Internal Delay, Extra Break, Waiting & Relaxation)	0.738	15
1	Technological	Clarity of technical specification	0.713	16
10	Human/Labour	Non discipline labour and use of alcohol and drugs	0.713	16
14	Human/Labour	Employee Age	0.625	17
24	Management	Degree of Bilateral Communication	0.613	18
25	Management	Working over time	0.550	19

Site Data Collection

Actual Productivity, Estimated Productivity and the Averages Productivity Decrease for all five activities (A1-A5) were calculated. Total labourhrs recorded includes not only the standard productive time but also the non-productive time. Overtime too was considered when calculating the total labour hrs. Research defined by Amarasekera (2010) carried out a study on estimating

labour productivity in Sri Lankan construction industry. Further, the researcher identified to evaluate the skilled and unskilled labour relationship as one unit rather than differentiating into two. Consequently, the author of this study identified the importance of this relationship and converted total labourhrs (Skilled & Unskilled) into one unit rate by using daily wages. The actual productivity calculated and the estimated productivity including productivity decrease for Activity A1 are shown in Table 3.

Table 03: Activity A1-Actual and Estimated productivity results

Project No	Quantity Installed	No of hrs worked	No of labours (Daily Average)		Equivalent Factor		Total No of labourHrs	Actual Productivity (m3/hr)	Estimated Productivity (m3/hr)	Productivity Decrease (%)
			Skilled	Unskilled	Skilled	Unskilled				
P1	6	16	3	5	1.33	1	143.84	0.042	0.051	18.576
P2	3.7	12.8	2	4	1.33	1	85.248	0.043	0.051	15.278
P3	5	16	3	4	1.33	1	127.84	0.039	0.051	23.655
P4	n/a									
P5	3.5	18	2	7	1.33	1	173.88	0.020	0.051	60.709
P6	1.65	20	4	6	1.33	1	226.4	0.007	0.051	85.774
P7	7	15.5	4	8	1.33	1	206.46	0.034	0.051	33.818
P8	6	15	3	7	1.33	1	164.85	0.036	0.051	28.954
P9	2.8	16	3	8	1.33	1	191.84	0.015	0.051	71.510
P10	3	12	4	5	1.33	1	123.84	0.024	0.051	52.713
P11	10	20	2	8	1.33	1	213.2	0.047	0.051	8.443
P12	4.15	12	3	5	1.33	1	107.88	0.038	0.051	24.909
P13	4.33	14	3	5	1.33	1	125.86	0.034	0.051	32.845
P14	4.7	6	6	8	1.33	1	95.88	0.049	0.051	4.314
P15	20	102	2	8	1.33	1	1087.32	0.018	0.051	64.095
P16	n/a									
P17	n/a									
P18	4.7	12	3	5	1.33	1	107.88	0.044	0.051	14.957
P19	3.71	10	2	6	1.33	1	86.6	0.043	0.051	16.375
P20	n/a									
Average Productivity Drop (%)										**34.808**

The findings of the site data collection sheet results revealed that actual productivity rates are significantly lower than the estimated productivity rates. The lowest average productivity drop was performed as 34.8% for activity A1and highest productivity decrease showed in activity A4 with an average drop of 85.58%.A5, A3 and A2 were identified 2nd, 3rd and 4th, respectively with an average productivity drop of 62.21%, 67.8% and 70.35%. The Average Productivity Decrease for all activities calculated is given in Table 4.

Activity No	Description of the Activity	Average Productivity Decrease (%)
	Concrete for Structure	
A1	*Concrete grade15 (37.5 mm) as screed in foundation.*	34.81
A2	*Concrete of grade 20 (19mm) in abutment & wing walls.*	70.35
A3	*Concrete of Grade 30 (19mm) in foundation base, abutment, wing walls, capping beam, ballast walls & curtain walls.*	67.80
	Formwork	
A4	*Rough finish formwork for foundation base.*	85.57
A5	*Smooth finish formwork for abutment, wing walls, capping beams, ballast walls & curtain walls.*	62.21

Table 04: Average productivity decrease in Activities A1-A5

Conclusions

From this study, skill of labour, lack of instructions & supervision ,improper or insufficient equipment/tools, site Conditions, a shortage of experienced labour, shortage of materials, weather conditions, quality control, quality of workmanship and delay of instructions & supervision were identified as ten most significant factors that affects labour productivity in rural bridge construction projects in Sri-Lanka. Consequently, it is important to have a proper control on above factors to improve productivity up to large extent as well as to get higher profits from the projects.

The highest productivity decreased showed in Activity A4.According to results fixing rough formwork is quite difficult in bridge construction as most of them are in awkward shapes. Therefore it is suitable to use more traditional, labor-intensive formwork systems for their better adaptability. Weather condition is unpredictable, it can be caused delays due to revised schedules as well as damages causing rework. Brief understanding of weather pattern, water table, soil type as well as good scheduling can eliminate problems due to unexpected weather condition. This result is further sustained by ranking skill of labour, site condition, shortage of experienced labours and weather condition as most significant factors.

It was identified high labour input is required in Gr.20 rather than Gr.30 and in contrast with Gr.15 concrete, it does not need large amount of skilled labour involvement like Gr.20 and Gr.30 and also since it is not a complicated process, it showed the lowest productivity drop among others.

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DESIGNING FOR THE SOCIO-CULTURAL SUSTAINABILITY; CASE OF NORTHERN COMMUNITIES IN SRI LANKA[1]

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Abstract

Even though the term sustainability today has acquired the top attention in all fields, much focus on its full meaning seems to be restricted exclusively to the areas of environmental and economic sustainability. The present day contexts of sustainable development show that the social dimensions have become silent indicators. The disciples of community development, settlement planning, architectural design are predominantly reasoned out through the technology and economy and it has far less attention on the social and cultural aspects of the communities in measuring its sustainability. This results that the socio- cultural values, the aspects such as cultural identity, social uniqueness, ethnic distinctiveness, sense of place, and the community belongingness have been severely affected by various world movements within the process of globalisation.

Therefore this factor should be dealt appropriately by each discipline. In this, architecture, planning and urban design can impact on the continuity and reinstatement of social and cultural features inherited by them. How this can be done? The Northern Communities in Sri Lanka would be a fine case study to illustrate how their built form designs facilitate their socio-cultural sustainability.

This paper will bring out the needs to consider the aspects of socio-cultural sustainability in the fields of architecture, urban design and settlement planning, highlighting the traditional architecture and settlement design as an authentic solution to the challenges of sustainable development. It will explore the key design and planning principles of the Northern communities of Sri Lanka which contribute to the socio- cultural sustainability while achieving socially responsive development.

Key Words: Socio-cultural sustainability, community architecture, settlement planning, built- form design and cultural identity

Introduction

Although sustainability has largely been defined at the global and national level, only recently has it begun to be applied to cities and communities (Mitlan & Satterthwaite, 1994). It is observed that creating cities, towns and communities that are economically, environmentally as well as socially sustainable, and meet the challenges of population growth, migration and climate change will be one of the biggest tasks of this century (Saffron Woodcraft, Tricia Hackett, Lucia Caistor-Arendar, 2011). Mostly the "social sustainability" is largely overlooked in mainstream sustainability debates and the priority has been given to economic and environmental sustainability in particular in the context of planning, housing and community building. Thus sustainability of today has been mainly recognised trough only certain type of indicators such as climate change, global warming, energy crisis, water and air quality, greenhouse gas emissions, etc. (United Nations, 2007).

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[1] This Article is based on the conference paper titled *"sustainable Communities-The socio cultural component in sustainability",* presented by the Author at *'World Habitat Day Conference', organized by Institute for Construction Training and Development (ICTAD)*, held on October 28, 2010 in Colombo, Sri Lanka

The indicators such as loss of social identity, community belonginess, cultural integrity and diversity are seen as mostly silent indicators in today's contexts of sustainable developments. Up to now many countries do not consider them as criteria for green building or development rating systems. Thus at present our societies are experiencing numerous social issues such as mental frustrations, violence, increased crime rates, depression, ethnic conflicts, community sharing and social responsibilities in terms of both individuals and community levels. Thus they become no more sustainable. Therefore the current practice of community and settlement development should ensure that these socio-cultural dimensions are recognised appropriately. One way of comprehending this matter is to analyse a case study which contains unique socio-cultural features and continuing built form traditions. The case study of Northern communities in Sri Lanka is chosen for this purpose.

This Article is based on the conference paper titled *"Sustainable Communities-the socio cultural component in sustainability*", presented by the Author at 'World Habitat Day Conference', organized by the Institute for Construction Training and Development (ICTAD) in 2010 in Colombo in Sri Lanka.

Understanding Socio-Cultural Sustainability

Culture is the aspects of our human natures, our subjectivities, our shared meanings, knowledge (Lederach, J.P. 1995) and our memories. It is argued that the essence of a culture is not its artifacts, tools, or other tangible cultural elements, but how the members of the group interpret, use, and perceive them. It is the values, symbols, interpretations, and perspectives that distinguish one people from another (Banks, J.A., Banks, & McGee, C. A. 1989). Culture is the bond of similarity ('identity') that grounds our sociability (International Journal of environmental, cultural, economic and social sustainability, 2006). It is also the multilayered combinations of which forms persons in the plural: It is ways of seeing, ways of thinking, ways of meaning, ways of relating to each other and ways of connecting with nature. It is 'the way in which a group of people solves problems and reconciles dilemmas" (Trompenaars, 1998).

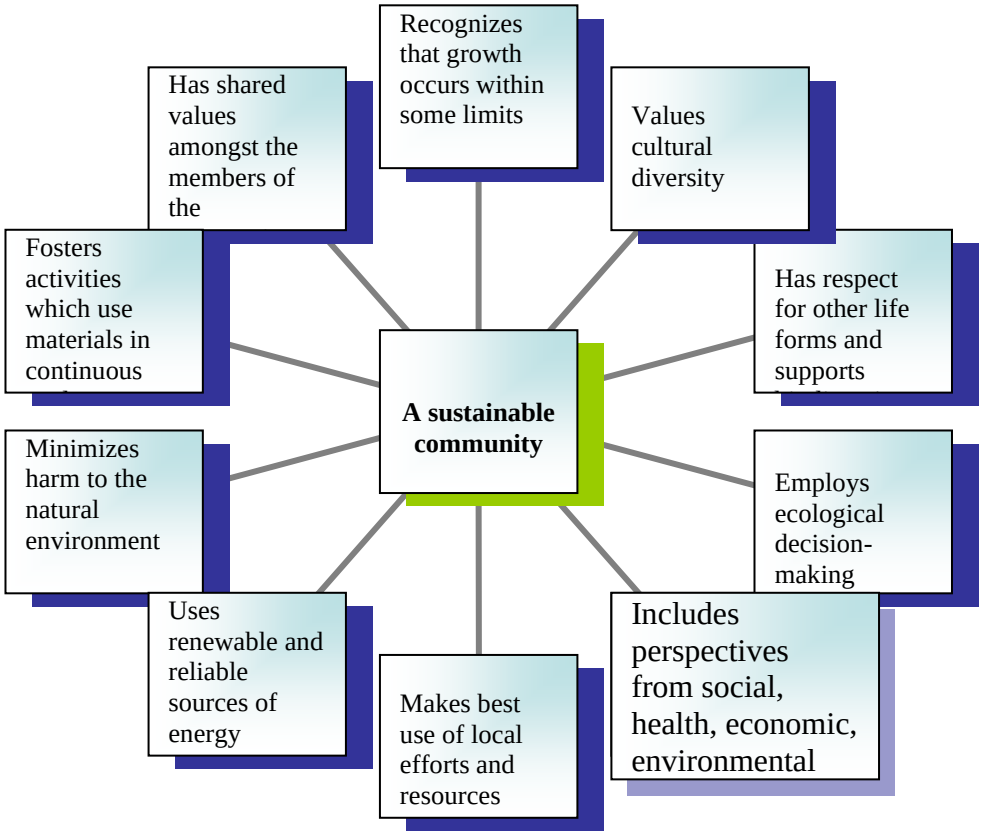
Merriam Webster Dictionary defines society is a community, nation, or broad grouping of people having common traditions, institutions, and collective activities and interests (Merriam Webster). Society is our systems of regulation and governance. It is a long-standing group of people sharing cultural aspects such as language, dress, norms of behavior and artistic forms. Society is a group of people who meet from time to time to engage in a common interest. It is the sum total of all voluntary interrelations between individuals.

Sustainability is often defined as "meeting the needs of today without compromising the ability of future generations to meet their own needs" (The Brundtland Report, 1987). Four key areas of environmental, social, cultural and economic elements are considered under the sustainability concept. Decisions made and actions taken in any of the elements of the sustainable development affects the others thus sustainable approach is intended to simultaneously incorporate social, environmental and economic values in to the development decision-making (Tyler, 2000). It is concerned that the balance of these four interests are achieved with the connections needed between each of them.

Sustainability is primarily about adapting to a new ethic of living on the planet and creating a more equitable and just society through the fair distribution of social goods and resources in the world (Darlow, 1996). The consumption-based lifestyles and decision-making practices that are based solely upon economic efficiency are questioned by the sustainable development. Its ethical foundations set off beyond obligation to the environment and the economy and it is seen as a holistic and creative process (Newman & Kenworthy, 1999). It is also a fact that sustainable development is based on society's always changing worldviews and values (Williams, 2003).

Socio cultural sustainability is about how individuals, communities and societies live with each other and set out to achieve the objectives of development models, which they have chosen for themselves taking also into account the physical boundaries of their places and planet earth as a whole (Colantonio, A, Dixon, T, 2009).

The following figure shows the key characteristics (Ontario Round Table on Environment and Economy) that a sustainable community should possess;



The Key Themes and Domains of Social Sustainability in traditional and emerging trends are given below;

Traditional	Emerging

Basic needs, including Housing	Demographic change (aging, international migration)
Education and skills	Empowerment, Participation and Access
Equity	Identity, Sense of Place and Culture
Employment	Health and Safety
Human rights	Social mixing and cohesion
Poverty	Social Capital
Social justice	Well being, Happiness and Quality of life

Source: Colantonio, A. (2009)

The social sustainability indicators in the contexts of traditional and emerging trends are also identified;

Traditional	Emerging
Static	Intergenerational with uncertainty
Mainly Quantitative	Hybrid
Product	Process
Descriptive	Strategic
Mono-dimensional	Multi-dimensional
Target oriented	Principles and Objectives driven
Top down selection	Deliberative and reiterative selection

Source: Colantonio, A. (2009)

Sustainability Challenges in Sri Lanka

Sri Lankan traditional vernacular architecture and design possessed the sustainability of the past. The complete environmental harmony with built and un-built was mainly supported through sustainable life style. Their designs, architecture, aesthetics, the living was totally inspired through the nature and its happenings. Many key religions routed down to the Sri Lankan's life explains temporal divisions of three worlds, the past, present and future (C. Olson, 2009) and brings out fact that all three are inter-related; the past lives in present and present in future. This explains the concept of sustainability – harmonizing with present needs and future aspirations. Traditionally the buildings designed and constructed by peasants and villagers worked out logical solutions by living close to the nature and their mode of living had to be symbiosis with natural life (Holy T.M., 2006). Their activities became more intuitive and cultural. They believed the rocks and trees had souls. They performed special respects and asked for the forgiveness or pardon when they remove the stones from the ground or disturb the earth or cut branches from trees for the purpose of building their shelters.

In Sri Lanka, yet majority of the population particularly outside of Colombo lives in sub-urban and rural environments. Currently Sri Lanka has 22% of urban population and around 85% of rural population from the total population (World Bank). The contemporary building and community development practices seen in many Sri Lankan towns across the country lack the holistic approaches which consider environment friendliness and contextual compatibility which are the key contributing factors in achieving sustainability in designs. This proves that without the social dimension the new settlements struggle to become cohesive and sustainable living communities, with a sense of place, belonging and identity. In this more than other types of developments, the construction of houses, townships and community infrastructure seem to be the top priority in the present (National Housing Development Authority), thus the social dimension is a prime factor in the settlement planning in the Northern communities of Sri Lanka,.

Sustainability through Socially Responsive Builtform Designs in Sri Lankan Northern Communities

In traditional societies the house is not just a structure, rather an institution created for a complex set of purposes. For them building a house is a cultural phenomenon. The form and organizations of their houses are generally influenced by the cultural milieu to which it belongs. The form is modified by various factors such as climatic conditions, method of construction, materials available, and technology. Therefore social cultural forces are primary and other factors are secondary (Rapoport, Amos, 1969).

Sri Lanka being a country which has a history of more than 2000 years, the people of different regions of the island have unique and distinguished traditions of living where the complete environmental harmony with built and un-built was mainly supported through their sustainable life styles. The life styles of the Sri Lankan communities which are brought down from their ancestors over a long period of time are distinct and have their own characteristics. The social system and cultural background of Sri Lankan Northern communities can be termed as Dravidian and based on Hindu religion originally. They possess unique socio-cultural traditions which support the community sustainability and own a set of complex customs and a caste system rooted against each group laying down their services to be rendered (Library of Congress).

Jaffna, the main city of northern Tamils in North yet seems has not changed very much from its past and in the city and the village, the social and cultural life is prominent with continued traditional living patterns. In the olden days village houses were built using locally available material mostly by the occupants themselves with the help of the neighbours. This practice is still in existence in remote villages. The settlement planning and built form designs of these communities are based on strong cultural traditions and philosophical approaches. Most of the situations they have followed the ancient treaties such as Manasara and Vastushathra which describe on the built form and urban character of the city, detailing planning and urban design principles and functional and environmental relationships (Mahendra Sharma, 2010).

Concept of space

The traditional rules in perceiving the space which is related to the Hindu system of worldview are defined through “Silpa Sasthras” and astrology. "Vastu Sastra" and astrological considerations were reflected in the planning of most of the houses and settlements (OOCities). The suburban and rural settlements were developed around the temples (Kovils) located at the centre by clustering of dwellings followed the caste hierarchy. The streets were circumferential and not radial. In urban settlements, the privacy is a key social requirement and plots subdivided demarcated with Palmyra fences having access through narrow lanes and alley ways. For an example, the method of locating a house within a plot is based on Hindu cosmological space and the centre area of the divided site is to be occupied by the prime god and prohibited for buildings and this naturally allows the building to have a central courtyard.

Concept of Territory

The Hindu cultural understating is that the location will not have any meaning without demarcating its territory through which a person can fit into his personal domain within the symbolic universal system (Shamasastry, R. 1915). This idea is manifested through the establishment of a high live fence and a compound wall in many traditional houses Northern communities.

Concept of House Form

Domestic vernacular house forms of Jaffna can be grouped into two categories, namely Village houses or huts and traditional court yard houses or 'Natsar' houses. The simplest form of Jaffna House is a single room unit called “Veedu” which has a live fence, a low level walk (“Nadai”) leading to the entrance, two platforms on either side of the entrance (OOCities). This unit as a concept with its all attributes has been maintained and unchanged in all later house forms.

Courtyard Houses

Courtyard houses can be seen as a global form of domestic buildings in all parts of the world (Hubpages). The house forms in Jaffna are significant with central courtyard arrangement and culturally integrated features of domestic architecture. The significantly identifiable elements of traditional houses in Jaffna are fence of palmyrah leaves, *Thinnai* (raised platform), *Nadai* (walkway) and *Mutham* (open space), low eaves and the courtyard. The importance and the respect to the life status, psychological protection, privacy, affection, status or activities such as sleeping, relaxation, meeting people, or the ritualistic performances in the marriage, religious activities, festivities etc are facilitated in their houses or settlement designs. The iconic elements of the buildings affect in sustaining their socio cultural needs, psychological comfort, balance, mental security, etc. (OOCities).

Planning and design of Built form for socio-cultural sustainability

It is accepted to have dark spaces with limited outside connections in Hindu Culture (Yatin Pandya, 2005). A small window with timber sash usually placed on the south side can be seen as a climatic reason which helps to minimize the heat gain into the building. The low level of eaves requires a man has to bend and walk in physically sensing the entry and also it reduces the light gain. The platform is used for sitting and generally the verandah facing courtyard near kitchen is the dining place. In Hinduism, the marriage is regarded as sacred and the respect of marriage is expressed in the houses. Traditionally the “Thulasi Madam” (a bed of holy tree is placed at the centre of the courtyard) was seen as a special activity to be performed by each woman by going around early morning praying for early marriage and also for married women for blessing of their husbands in the traditional society.

In Courtyard houses (Figure 1-5), more open verandah spaces are designed for people to have wedding ceremonies at home. The courtyard is used to light the sacred fire. The high fence around the premises expresses the need for privacy in their culture. All areas are facing inward and the internal courtyard other than entrance verandah. It is the responsibility of the family to care and protection of children, handicapped, old and infants. Since the activity spaces are arranged around the courtyard, it is easy for the house wife to look after the children as the courtyard becomes the children‟s play area and as well as the elders who usually relaxes in the courtyard verandah (OOCities). The courtyard becomes the family activity area where children and parents interact constantly. Religious ceremonies such as “Thaipongal” are celebrated in the courtyard. The houses are provided with ample places such as raised platform, verandahs, courtyards, entrance gate areas for meeting people and interacting with visitors in all levels without disturbing to the other activities of the house. The design of traditional houses of northern communities is a fine sustainable design

example to show the strong social and cultural relationship between the lifestyle and house form. It proves that such aspects are the influencing factors of their designs sustaining their culture.

Construction methods and Building Materials

The construction methods and material selections of the buildings of majority of Jaffna village houses are load bearing walls built out of random lime stone rubbles with lime- sand mortar as a binder. These materials needed for such wall construction was richly available in Jaffna region. Though clay for making bricks was very scarce in Jaffna peninsula, it has been noticed clay bricks too had been used in wall construction in a limited way, in many places mixed with random lime stones. This may be the logic behind the use of bricks in small quantities mixed with lime stone.

Timber from palmyrah palm is used as another local material for the construction of these houses. This provides almost entire roof frame work of these houses. Over a long period heavy solid wood had been used for columns and beams. Nicely decorated doors and heavy door frames, exposed ceiling frame work, ceiling boards and column capitals had been made in timber. The roof cladding of most of these houses was half round tiles which give better comfort conditions in this dry climate. These types of tiles had been replaced later by flat "Calicut" type tiles.

Current Trends and Some Observations

The contemporary building and community development practices seen in many Sri Lankan new towns across the country lack the holistic approaches which consider environment friendliness and contextual compatibility which are the key contributing factors in achieving sustainability in development. It is questionable up to what extent they represent their social and cultural identity, community sustainability.

Key issues related to the sustainability recognized in sub-urban communities are:

Lack of identity in newly built communities and loosing of identity in existing towns
Architectural monotony, prototype designs, lack of creativity
Lack of sense of place, uninteresting public spaces and streets
The demolition, devalue or rather neglect of traditionally important buildings
Feeling of less belonginess in new sub-urban communities
Lack of culturally and socially based design and planning principles

In many parts of Sri Lanka, the unique features of traditional architecture and urban design are mostly disappeared in the contemporary buildings and constructions. Instead, western styles such as “American fashioned Houses” have been transplanted since several decades ago and they do not reflect either life styles of the communities or suite to the climatic, environmental and economic conditions of this country. Mostly these new constructions are contextually inappropriate. They do not contribute for the community identity and thereby sustainability. The contemporary design and planning approaches should be primarily based on the socio-cultural contexts of a given community and their environment and economic sustainability. Considering one or some of these in isolate manner will not bring positive results and they all should be equally treated.

With the ongoing settlement developments in Northern region, the proposed concept plan of Mankulam urban centre is developed with the religious and cultural activities. Though the different

zones provide opportunities to develop community parks, facilities and interconnections, and creation of a centre as an open space and a religious centre, overall it may not be a true reflection of the society and cultures of these communities.

Conclusions

The life styles of a particular community which are brought down from their ancestors over a long period of time are distinct and have their own characteristics. The radical change of them through the global influences or world trends or through the imported styles or technology would negatively impact on their sustainability (Sahid Yusuf, Anjum Altaf, Kaoru Nabeshima, 2004).

Interest in traditional architecture and urbanism as an authentic solution to the challenges of sustainable development is growing around the world. To recycle, adapt and prolong the useful lives of buildings and structures whose fabric embodies previously embodied energy of materials and are better adapted to local climate would seem to be an important part of sustainable design concept. Is this, or is the locally adopted or regionally developed building design criteria given recognition for them to be called "green" and conferred through the global sustainable standards? As seen in many cases, the contemporary popular green standards and designs under the flag of sustainability seem not foster the continuity of the cultural components. Thus as Newman and Kenworthy (Newman & Kenworthy, 1999) explain the Sustainability should be understood as a vision and a process, not an end product.

What each and individual built components of communities, for example the roof of a building, mean for them? For instance, for the average suburban house with its pitched roof and so on helps to sustain the romance that they are local and indigenous. It provides a feeling of protection. People do feel comfortable with this iconography (Figures 7 & 8). In order to sustain some kind of psychological security, such fundamental icons should be sustained. Thus a flat roof- a green roof instead of a pitched roof, perhaps may not be the answer for sustainable architecture in the terms of social, community and cultural sustainability.

In this context, should we re-explore who we are, how we practiced sustainability, what we can inspire from our tradition and how best we can restore our community identities through the practice of architecture? Rather than trying to obtain the sustainable standards of west, shouldn't we try to apply some of the sustainable methods and principles which have been practiced for several centuries within our cultures? The recently established [2] Sri Lanka Green Building Council recognizes the need for socio-cultural dimension in green building evaluation and certification aiming to issue the socio-cultural sustainability. This resulted introducing a complete new criteria under the section, titled "the socio-cultural awareness" which will cover the key areas of achieving social and cultural sustainability and provide possibilities to earn credits to be qualified for Green Building recognition.

2 Sri Lanka Green Buildings Council assessment criteria document is introduced with the new criteria section, titled "The Socio-Cultural Awareness"

.

The design of traditional houses and settlements of northern communities is a good example to show the strong social and cultural relationship between the lifestyle and house form. It proves that such aspects are the influencing factors of their designs sustaining their culture. It may be not too late to re-explore our way of practicing sustainability and it shows the positive signs of realizing the importance of the socio-cultural component in whole sustainability concept in Sri Lanka.

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Figures:

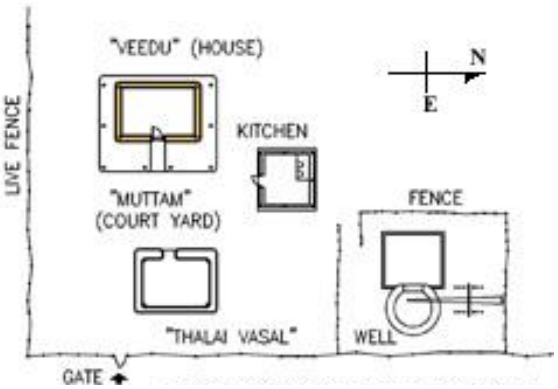

Figure 1: Layout showing the main elements of Jaffna Village House (Source: Author)

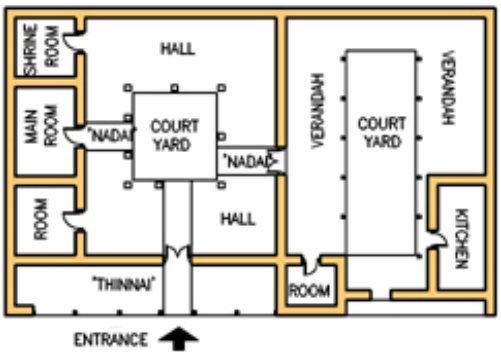

Figure 2: House Plan with Tow Court Yards in Jaffna (Source: Author)

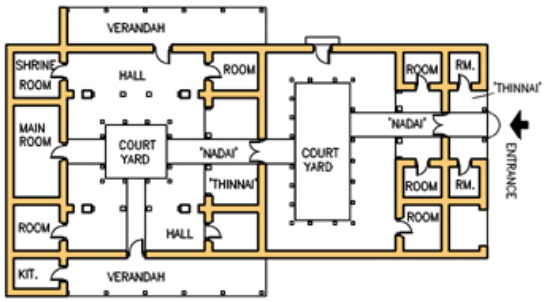

Figure 3: Plan of a house with two court yards (Source: Author)

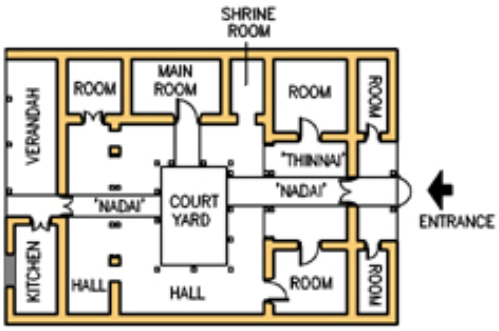

Figure 4: Plan of a House with one court yard (Source: Author)

Figure 5: A courtyard house, the level changes had been eliminated. Note the front "thinnai" of traditional courtyard houses had been replaced by a long verandah. (Source: Author)

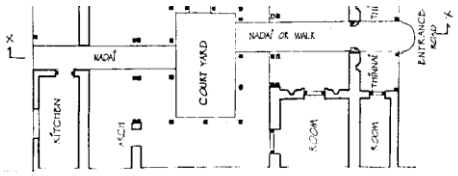

Figure 6: Jaffna Court yard House (Source: Author)

Figure 7: Jaffna Market with unique architectural design features- People do feel comfortable with this kind of iconography (Source: Author)

Figure 8: Jaffna Memorial Tower – Designed with identifiable architectural Language (Source: Author)

Figure 9: A house which is older than 100 years in Jaffna. Verandah plays a key role, as a space for meeting people and leisure activities. (Source: Author)

Figure 10: Central court yard of a old house- acts as a space for family and house activities. (Source: SLIA, The Architect Journal)

Figure 11: A contemporary housing in recent settlements in Jaffna shows lack of responds to the people's physical and psychological comfort. (Source: Author)

EFFECT OF FLY ASH AND MICRO SILICA ON COMPRESSIVE STRENGTH OF HIGH-STRENGTH/ HIGH-PERFORMANCE CONCRETE

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Abstract:
High strength/ High performance concrete (HPC) exceeds the properties and constructability of normal concrete. Normal and special materials such as fly ash, micro silica are used to make these specially designed concretes that must meet a combination of performance requirements.There are many good reasons to view fly ash and micro silica as resources, rather than a waste. In many cases, concretemade with fly ash and micro silica performs better than concrete made without them.

In this study, compressive strength of concrete with fly ash and micro silica (micro SiO_2) is studied. It found that compressive strength of concrete with fly ash is equal or higher when fly ash amount is between 5~15% by weigh, and concrete strength reduces when fly ash content is increased beyond 15% by weigh. Itindicates that up to10% by weight of micro silica in concrete is effective.Howeverthe optimum level of micro silica in concrete is 3-8%by weight.

Key Words: *Fly ash, micro silica, high strength concrete, high performance concrete*

Introduction

Concrete is the second most consumed material after water and it shapes the built environment around the world. According to U. S. geological survey, mineral commodity summaries January 2015, the cement production in the world in 2014 is 4.18 billion metric tons [1]. The concrete production was 25 billion metric tons according to Cement Sustainability Initiative (CSI) report [CSI, 2009] [2].Fly ash and silica fume can be used as cementious materials to enhance strength and durability properties of concrete [3]. These materials can be added as a last step in cement production or when the concrete is made. In the developed world most cement is made industrially into concrete and sold as ready-mix concrete. On a smaller scale, and more commonly in developing countries, concrete is made in situ on the construction site by individual users.Concrete are defined mainly into different categories; conventional concrete, high-strength/ high-performance concrete and nano-engineered concrete etc.

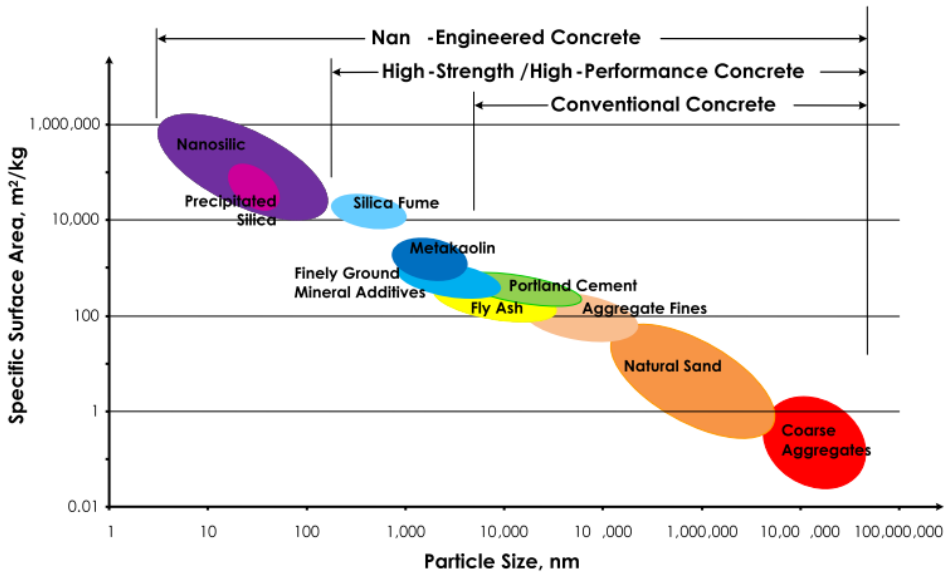


Figure 01: materials for High strength/ High performance concrete

High-performance concrete (HPC) exceeds the properties and constructability of normal concrete. According to Figure 1, it is clear that, adding fly ash and micro silica become essential when high strength/ high performance concrete are designed. Supplementary cementitious materials (SCM) such as fly ash and micro silica improve concrete properties mainly in two ways; first it help to generate more Calcium-Silicate-Hydrate (CSH) in the pozzolanic reaction with Ca(OH)2, and second it provide denser concrete due to better particle packing. Finally these concrete would be high strength and durable [4,5]. Limitations are given in most of the standards for different type of supplementary cementing materials (SCM) based on their cementing properties.

American Concrete Institute (ACI) defined high-performance concrete as a concrete meeting special combinations of performance and uniformity requirements that cannot always be achieved routinely using conventional constituents and normal mixing, placing, and curing practice [6]. High performance of concrete is achieved by reducing porosity, in-homogeneity, and micro-cracks in the hydrated cement paste and the transition zone. Consequently, there is a reduction of the thickness of the interfacial transition zone in high-strength concrete. The densification of the interfacial transition zone allows for efficient load transfer between the cement mortar and the coarse aggregate, contributing to the strength of the concrete. For very high-strength concrete where the matrix is extremely dense, a weak aggregate may become the weak link in concrete strength [7, 8]

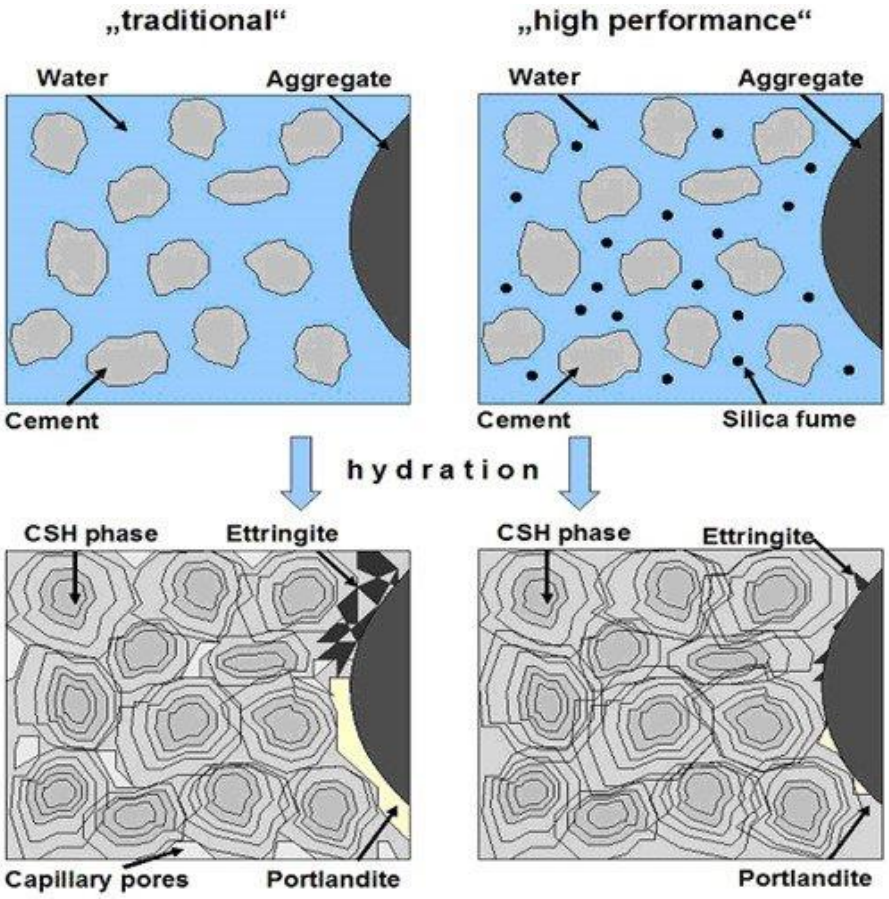
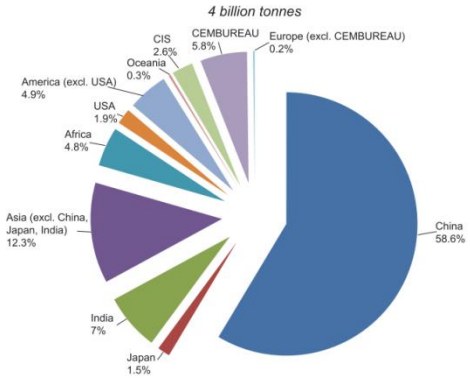


Figure 02: microstructure of High strength/ High performance concrete

Cement is the main ingredient in concrete. World cement production by each country and development of cement types in the world from 1995 to 2012 are shown in Figure 3& 4 [1] and the cement industry is responsible for about 5% of all man-made CO2 emissions in the world [2].



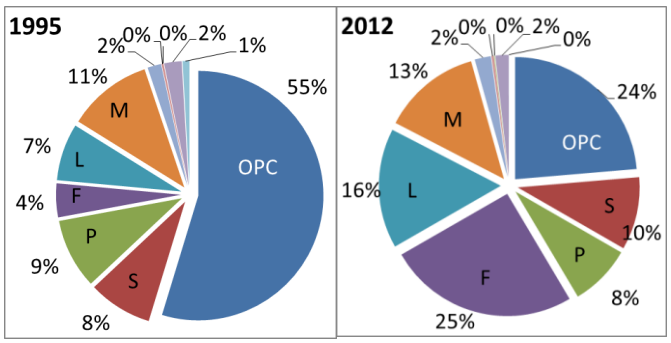


Figure 03: Word cement production 2013 by region and main countries

OPC – Ordinary Portland cement, S – Slag cement, P – Pozzolan Cement, F – Fly Ash Cement, L – Limestone Cement, M – Multiple Blend Cement, and all other types.

Figure 4: Production of different cement types by Holcim 1995 – 2012

Experimental Program

Chemical compositions of cement and Supplementary Cementing Materials (SCM) were analysedusingX-ray fluorescence (XRF) analyser according to EN 196-2 [11] standard. Percentages of Silicon dioxide (SiO_2), Aluminum oxide (Al_2O_3), Ferric oxide (Fe_2O_3), Calcium oxide (CaO), Magnesium oxide (MgO), Sulfur trioxide (SO_3), sodium oxide (Na_2O), Potassium oxide (K_2O), chloride content (Cl) and Loss on ignition (LOI) are measured individually..

Table 01: Concrete mixture proportions – comparison of concrete performance with FA and mS

Concrete Test	Cement OPC (Kg)	Sand (kg)	Coarse aggregates (kg)	Water (l)	Chemical admixture (ml)*	Fly Ash (Kg)	Micro Silica (Kg)
C1 (OPC)	435.00	774	1026	174	4350		
C2 (OPC+1%mS)	430.65	774	1026	174	4350		4.35
C3 (OPC+3%mS)	421.95	774	1026	174	4350		13.05
C4 (OPC+5%mS)	413.25	774	1026	174	4350		21.75
C5 (OPC+10%mS)	391.50	774	1026	174	4350		43.50
C6 (OPC+20%mS)	348.00	774	1026	174	4350		87.00
C10 (OPC+5%FA)	413.25	774	1026	174	4350	21.75	
C11 (OPC+10%FA)	391.50	774	1026	174	4350	43.50	
C12 (OPC+20%FA)	348.00	774	1026	174	4350	87.00	

C13 (OPC+30%FA)	304.50	774	1026	174	4350	130.50
C14 (OPC+40%FA)	261.00	774	1026	174	4350	174.00
C15 (OPC+50%FA)	217.50	774	1026	174	4350	217.50

*A high range polycarboxilate type super plasticizer, Brand name: Supercrete

Concrete cube specimens of 150mm X 150mm X 150mm were prepared according to BSEN 12390-3standard [12]. These specimens were cast from as given in tables 1, 2 and 3, Compressive strength of concrete cubes tested at 7 days, 28 days, 60 days and 90 days for compressive strength. Mix designs of world tallest building (Burj Dubai) [10] was analyzed and four mixes of C80 and C60 were done with local materials and compare performances. Apart from that, high pwrformance concrete C70, C80 and C90 are done with ordinary Portland cement (OPC) and Portland pozolana cement (PPC) and compare results.

Table 02: Concrete mixture proportions – trials with concrete mixes used in Burj Dubai tower

Concrete Test	Cement OPC (Kg)	Sand (kg)	Coarse aggregates (kg)	Water (l)	Chemical admixture (ml)*	Fly Ash (Kg)	Micro Silica (Kg)
C80 Burj1	380	908	910	132	4200	60	44
C80 Burj2	384	847	865	155	7500	96	48
C80 Burj3	400	830	847	160	7500	100	50
C60 Burj4	376	888	908	169	3000	82	25

*A high range polycarboxilate type super plasticizer, Brand name: Glenium 233

Table 03: Concrete mixture proportions – G70, G80, G90 concrete with OPC and PCC

Concrete Test	Cement OPC (Kg)	Cement PPC (Kg)	Sand (kg)	Coarse aggregates (kg)	Water (l)	Chemical admixture (ml)*	Fly Ash (Kg)	Micro Silica (Kg)
G70OPC	400		760	900	170	7000	125	20
G80 OPC	420		740	900	170	7500	145	30
G90 OPC	435		740	900	150	7500	145	40
G70PPC		400	760	900	170	7000	125	20
G80 PPC		420	740	900	170	7500	145	30
G90 PPC		435	740	900	150	7500	145	40

*A high range polycarboxilate type super plasticizer, Brand name: Glenium 233

Results and Discussions

Table 04: Chemical compositions of cement and Supplementary Cementing Materials (SCM)

Material	SiO2 (%)	Al2O3 (%)	Fe2O 3 (%)	CaO (%)	MgO (%)	SO3 (%)	K2O (%)	Na2O (%)	Cl (%)
cement	20.38	4.79	3.26	64.40	0.98	2.21	0.04	-	0.01
micro silica	98.93	-	0.31	-	0.17	-	-	0.57	-
fly ash	52.03	32.31	7.04	5.55	1.30	0.07	0.68	1.00	-

According to chemical analysis, it showed that fly ash taken from Norochcholai power plant, can be categories as class F according to general standards. This fly ash low in lime 5.55% (under 15%), and contain a greater combination of silica, alumina and iron 84.34% (greater than 70 percent). Micro silica bought from local supplier has purity of 98.93%.

Strength Performance of concrete with fly as hand micro silica are shown below tables.

Table 05: Compressive strength of concrete(150mmX1500mmX150mm cubes) with fly ash

Compressive Strength (MPa)	7 days	28 days	60 days	90 days
C1 (OPC)	46.3	57.7	59.3	62.1
C10 (OPC+5%FA)	46.9	58.6	62.7	65.3
C11 (OPC+10%FA)	53.0	61.4	64.1	66.5
C12 (OPC+20%FA)	46.5	58.6	62.4	65.4
C13 (OPC+30%FA)	40.9	51.9	57.8	61.9
C14 (OPC+40%FA)	35.3	50.3	56.2	60.0
C15 (OPC+50%FA)	32.4	45.5	54.0	58.2

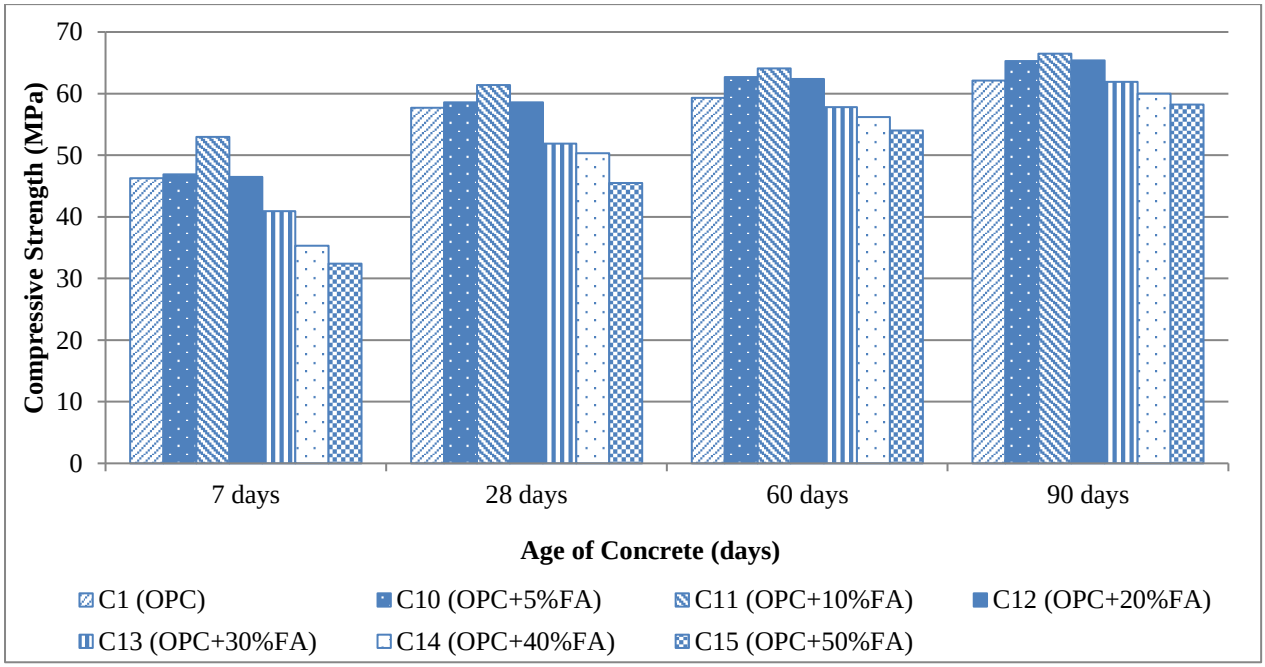


Figure 05: Compressive strength of concrete with fly ash

Table 06: Compressive strength of concrete (150mmX1500mmX150mm cubes) with micro silica

Compressive Strength (MPa)	7days	28days	60days	90days
C1 (OPC)	46.3	57.7	59.3	62.1
C10 (OPC+1%mS)	48.7	57.4	60.2	61.7
C11 (OPC+3% mS)	50.1	62.2	63	63.9
C12 (OPC+5% mS)	48.9	62.1	63.2	65.1
C13 (OPC+10% mS)	52.6	57.7	60.4	61.6
C14 (OPC+20% mS)	49.3	54	55.4	58.7

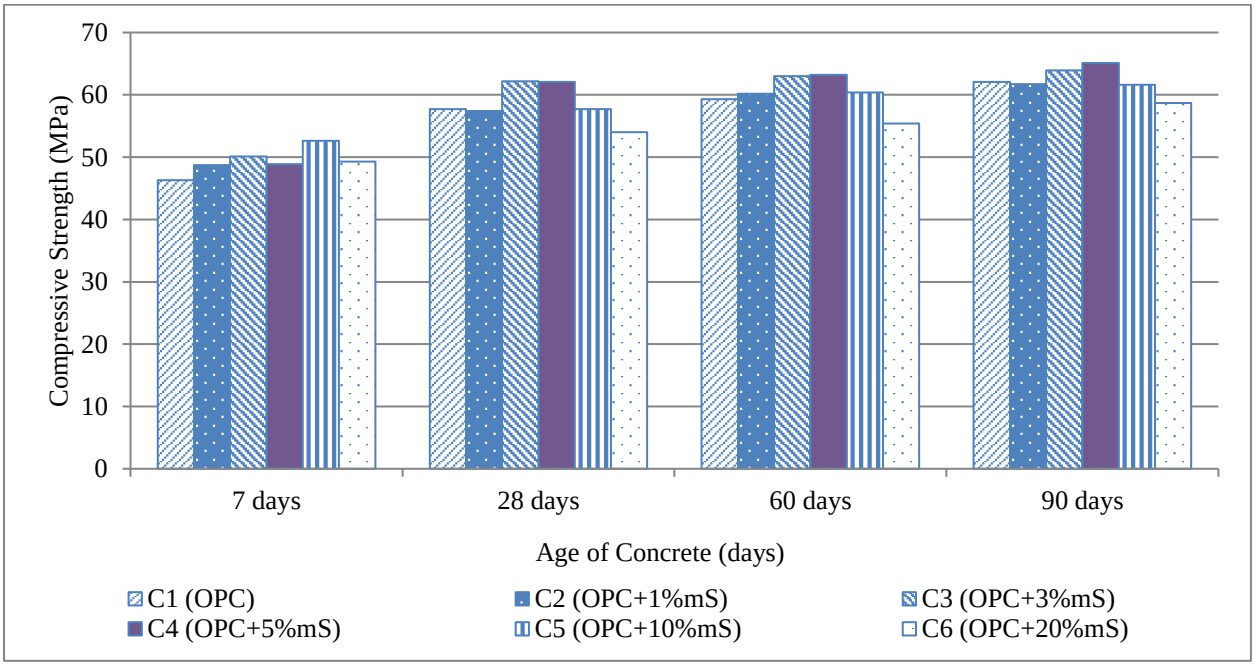


Figure 06: Compressive strength of concrete with micro silica

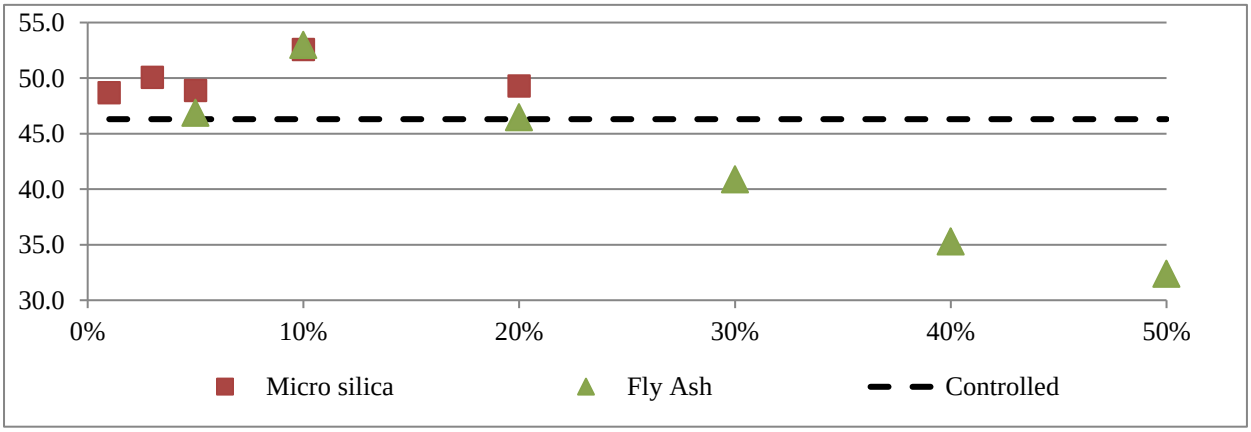


Figure 07: Compressive strength of concrete with nano silica, micro silica, fly ash and bottom ash

at 7day

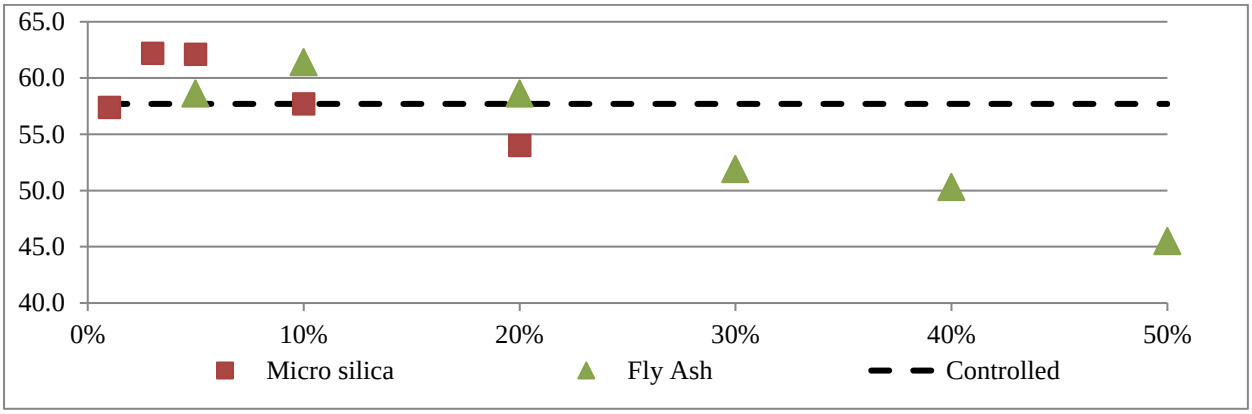


Figure 8: Compressive strength of concrete with nano silica, micro silica, fly ash and bottom ash at 28day

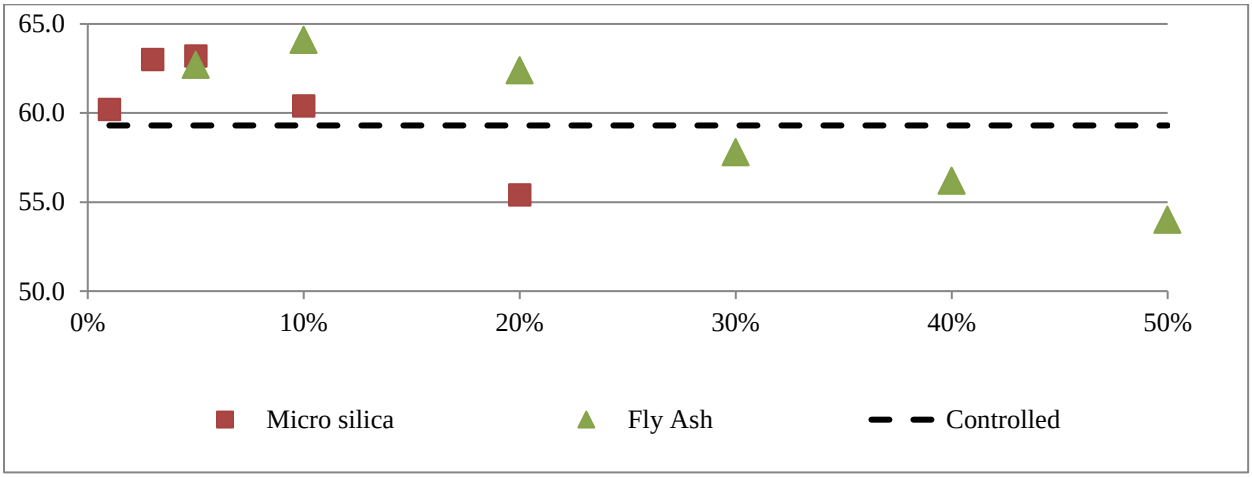


Figure 09: Compressive strength of concrete with nano silica, micro silica, fly ash and bottom ash at 60day

Table 5, Figure 5, 7, 8 and 9show that cement can be replaced by fly ash up to 20% - 30% without losing strength of concrete at late ages (60day and 90 days). However, early strength of concrete is affected by fly ash when it uses more than 20%. The best amount of fly ash in concrete would be 10% by considering optimum benefits towards strength. Main benefits of fly ash are workability of concrete mix even at very high percentages. These are really useful for concrete which is to be pumped for longer distances, especially for high rise structures. Main issue with high volume fly ash is to get required strength when increased the amount of fly ash. As the precaution, micro silica is added into system to boost strength with fly ash.

Table 6, Figure 6, 7, 8 and 9show that cement can be easily replaced by micro silica up to 10% without losing strength of concrete at all ages. The best amount of micro silica in concrete would be 3-8%. Main issue when dealing with micro silica is losing workability of concrete mix at higher percentages of micro silica. High range super plasticizers are always recommending using with micro silica.

Table 7 shows that optimum amount of Cementitous materials are used in all mixes without exceeding the maximum limit defined by most of the standards [13]

This is because concrete mixes having high cement content may give rise to shrinkage, cracking and creep of concrete also increases with the cement paste content. In thick concrete sections restrained against movements, high cement content may give rise to excessive cracking caused by differential thermal stresses due to hydration of cement in young concretes [14, 15]

For high strength concretes, increasing cement content beyond a certain value, of the order of 550 kg/m^3 or so, may not increase the compressive strength. From these considerations as well as those of overall economy, the maximum cement content in the concrete mixes are limited to 550 kg/m^3 for pre stressed concrete structures.

Always, more than 21% of cement is replaced by other cementitious material (fly ash, GGBS, micro silica). Micro silica is used in all 10 mix designs, 60Kg to 112 Kg (5% to 9%) per cubic meter of concrete. Fly ash is used in 7 mix designs, 15Kg to 50 Kg (12% to 24%) per cubic meter of concrete**.**

Table 07: Summary of cementitious material used mix designs of the Burj Dubai Tower

Concrete Grade	Member	Level	Req. flow/ Slump	Req. E-modulus	Cement (Kg)	PFA (Kg)	GGBS (Kg)	Micro Silica (kg)	Total cementitious materials (Kg)
C80	Column & Wall	B2~L40	550±75	43,000 (@90D)	380	60(12 %)		44 (9%)	484
C80	Column & Wall	L41~ L108	600±75	41,000 (@56D)	384	96(18 %)		48 (9%)	528
C80	Column & Wall	L109~L126	650±50	41,000 (@56D)	400	100(18%)		50 (9%)	550
C60	Column & Wall	L127~L154	650±50	37,600 (@28D)	376	94(19 %)		25 (5%)	495
C50	Beams & Slabs	B2~L108	500±75	-	328	82(19 %)		25 (6%)	435
C50	Beams & Slabs	L109~L154	600±50	-	338	112(24%)		25 (5%)	475
C35	Blinding	-	125±25	-	300			15 (5%)	315
C50	Internal Column, Wall and Slabs	-	150±25	-	160		240(57%)	20 (5%)	420
C50	Pile Cap Foundation, Retaining wall, Parking Slab	-	150±25	-	160		240(57%)	20 (5%)	420
C60	Pile	-	600~750	-	315	105(23%)		30 (7%)	450

According to Table 5,6 and figure 5,6 , it is clear that, adding fly ash and micro silica become essential when high strength/ high performance concrete are designed.

Table 08: Results of trail mix (Burj Dubai mix designs with local materials)

Sample Ref.	Description	Compressive Strength (MPa)		
		1D	7D	28D
C80 Burj1	Column & walls B2~L40	27.7	62.3	81.7
C80 Burj2	Column & walls L41~L108	39.3	68.4	83.0
C80 Burj3	Column & walls L109~L126	38.0	72.1	93.0
C60 Burj4	Column & walls L127~L154	22.6	47.4	62.3

As shown in the Table 7, it can be concluded that it is not difficult to achieve high strength concrete performance with local raw materials to get strength requirements for high rise building in Sri Lanka. Mix designs related to above 4 mixes can be found in Table 2.

28 days of strength of mixes T_C80_20, T_C80_14 and T_C80_10 are above grade 80 and full fill requirements. 28 days of strength of mixes T_C60_20 is above grade 60 and full fill requirements.

Table 09: High strength concrete with OPC cement

Grade	Description	Compressive Strength (MPa)		
		1D	7D	28D
G70 (OPC)	Self compacting Concrete	41.2	71.2	85.6
G80 (OPC)	Self compacting Concrete	43.6	79.5	87.2
G90 (OPC)	Self compacting Concrete	46.8	84.8	105.7

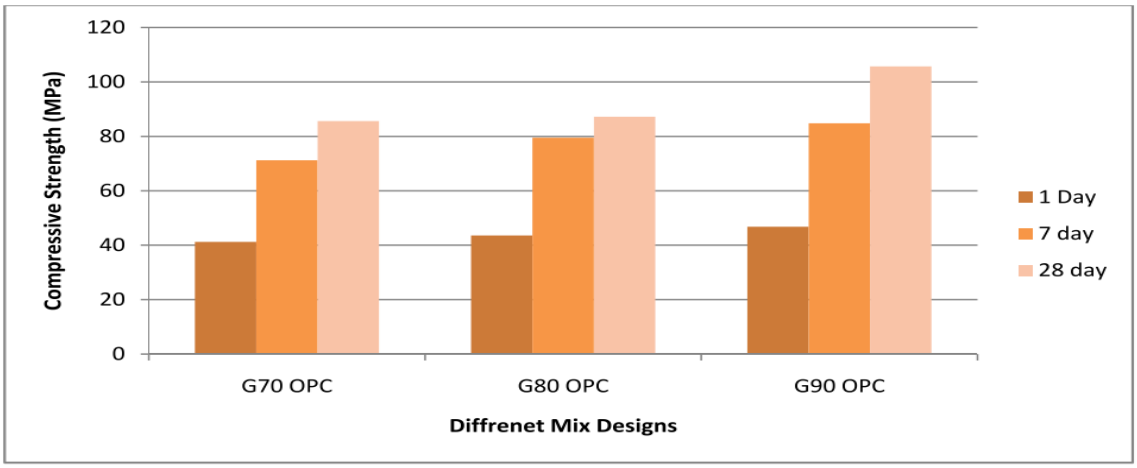


Figure 10: High strength concrete with OPC

Table 10: High strength concrete with Fly ash cement (Extra, 25% fly ash)

Sample Ref.	Description	Compressive Strength (MPa)

		1D	7D	28D
G70 Extra (25% Fly Ash)	Self compacting Concrete	37.2	68.2	83.0
G80 OPC Extra (25% Fly Ash)	Self compacting Concrete	38.0	77.2	86.2
G90 Extra (25% Fly Ash)	Self compacting Concrete	42.1	82.3	103.4

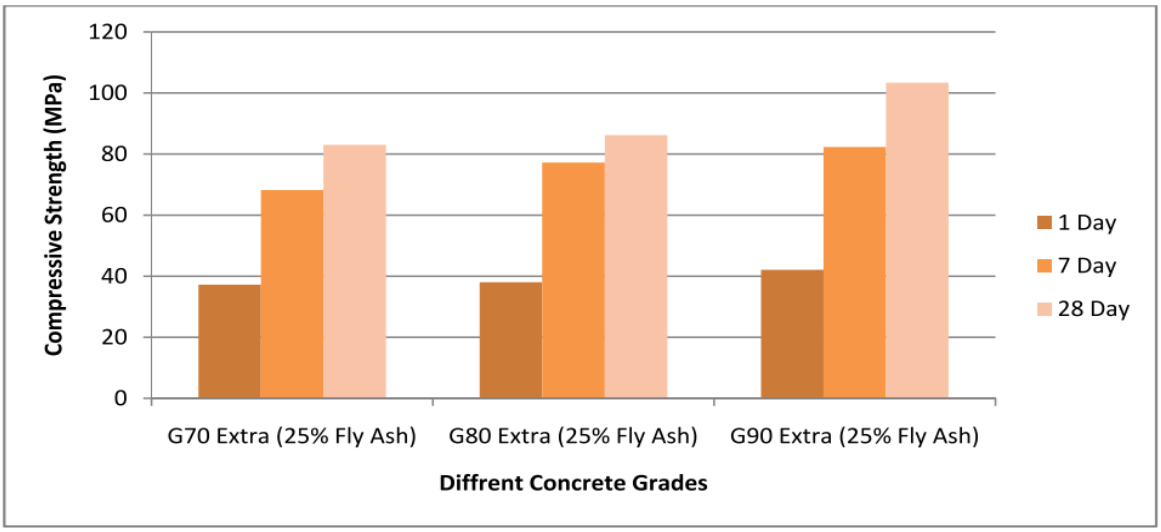


Figure 11: High strength concrete with Fly ash

Conclusions &Recommendations

Test results obtained in this study indicate that up to 20%-30% fly ash could be advantageously blended with cement without adversely affecting the strength. However, optimum level is 10% fly ash in term of maximum strength.

Further, a higher amount of fly ash can be used in concrete if a turnery blend like nano silica or micro silica is added into the system. As an example a mix design of world tallest building (Burj Dubai), the fly ash percentage in Grade 80 concrete used for columns and walls level 109~126 were high as 100Kg (18%) with 50 Kg (9%) of micro silica, the usage of cement in this mix design was as low as 400Kg, and other materials sand 830 kg, coarse aggregates (10mm) 847 Kg, admixtures 3% and water: binder ratio was 0.3

In Sri Lanka, in most of the projects fly ash are used in the range of 20-25%. Micro silica with fly ash is used in most of the high risebuilding projects in the world to get higher strength and extended durability. It is always recommend optimizing mix designs either with blended cement, cement replacementmaterials such as fly ash (with or without micro silica) to get highest performance with theconcrete.There will always be a better option with blended cement or blended materials with ordinary Portlandcement.

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AN ANALYSIS OF ENVIRONMENTAL FACTORS IN OPEN OFFICE LAYOUTS

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Abstract

'Cellular office layouts' and 'open office layouts' are the main office layout designing techniques available for a Facility Manager. However, latter is the widely used technique out of the two. The researcher, being a member of Facility Management team of Sri Lanka Telecom, observed that there are so many grievances exist among the occupants of 'open office layouts'.

The productivity of an employee directly depends upon his Job satisfaction level. Among few others, satisfaction level about his work place is one of the factors that affect the Job satisfaction level. Hence providing a proper working environment in maintaining employee's satisfaction level is a very important aspect in terms of Facility management.

The researcher, through literature survey identified 21 attributes that affect the **O**verall **E**nvironmental **S**atisfaction level (Satisfaction level about his work place) of an employee. The survey done among the selected sample implies that the identified factors have a direct impact upon Overall Environmental Satisfaction level of employees. Hence inclusion of said factors as far as possible, in designing a layout is a vital aspect.

Further a detailed analysis about customer requirements and their interdependencies is very important prior to design a layout. The success of the proposed layout will depend upon inclusion of such identified requirements and interdependencies.

User awareness about the functionality of the layout, the design considerations (or assumptions) is also very important in maintaining the office layout as intended.

Finally the offices are to be checked routinely for their performance levels after handing over.

Key words: *Open office layouts, Office environment, Environmental satisfaction in open plan environments.*

Introduction

"Is there any relationship between working environment and the performance of the worker and hence the performance of the Organization?" Above is a very famous and widely asked question over the years. Number of researches have been done in this regard and proved that there exists a relationship between the two. (i.e.:- Performance of the employee will increase with the increase of his overall environmental satisfaction level and hence the organizational performance).

On the other hand most of the works in modern organizations are project based, where teamwork is very vital. While developing office layouts with improved working environment with a focus to teamwork, a facility manager can adopt two main methods namely "Open Office layouts" and

"Cellular office layouts". Open office layouts are the more preferred and widely used option among the two.

The researcher is interested in finding the attributes of such high performing open office layouts and verifies the impact of said attributes on the occupant's Overall Environmental Satisfaction level.

Accordingly, 21 attributes were identified through literature survey done and the same will be used as the base for the questionnaire.

Valuable information was collected from the survey done on selected sample. More information as well as drawbacks and suggestions for improvements were gathered from the descriptive questions in the questionnaire and interviews with selected individuals.

Further the suggestions and improvements to the betterment of the open office layouts will be described using the gathered information from the interviews done with senior members of Facility Management team.

2. Literature Review

2.1. Organizational Management Approach

Different management approaches were adopted in managing organizations over the past. As (Stalworth & Kleiner, 1996, p.35), pointed out, before 1930s the focal point of the management approach was to physical environment. It was changed to social environment after 1930s. However during recent past, the physical environment has move in to a more prominent role again.

In the meantime modern organizations are facing lots of difficulties to adapt to the changes taking place in its environment. Accordingly (Becker, 2002, p.154), suggested a theme for modern organizations irrespective to its type, "Do more and better with less".

Number of researches were done to ascertain how to "Do more and better with less" with an emphasis towards physical environment. An architectural magazine in United Kingdom, Gensler is one of them and came up with remarkable results. As per (Gensler, 2005), a better working environment would increase the employee's productivity by 19 %. Further, 79% of his surveyed professionals say that the quality of working environment is very important for their job satisfaction.

For the better performance, an employee must fit in to his working environment. As per (Stallworth & Kleiner, 1996) there are two types of person- environment fits.

Ability of the working environment to satisfy the needs of the employee.
Ability of the employee to satisfy the demands of the environment.

When these two types of fits are satisfied, ie:- employee is satisfying the demands of the environment and is working on an environment where his requirements are satisfied, the working environment is said to be in its optimal design.

Hence an office layout should be at its optimal design.

What are the main layout types which can be used for office design? The terms used for office types differ widely across the countries and different organizations.
As per IU (Space Planning Guidelines Office Space, 2013), office types are categorized as

Traditional : Built construction, fully enclosed, full heights/walled space with a door, sound insulation, individual lighting control and individual atmosphere/HVAC control.

Flexible : Systems installed, partial –height wall, panel – based defined area of space with a door, individual lighting control with shared atmosphere. Heights governed by applicable codes.

Open : Systems installed partial – height wall, panel – based defined area of space without a door, with shared lighting and atmosphere.

All though different terms are used, there are two widely used concepts which can be adopted in designing office layouts. They are "Open office layouts" and "Cellular office layouts". Although these concepts are widely used, it is hard to find an acceptable definition, (Haynes, 2008, p.189). However some useful definitions developed by Michel Brill for his research works are given below.

Cellular office: A work space that has four walls to the ceiling and a door.
Open office: A work space whose perimeter boundaries doesn't go up to ceiling.

Frequent changes are a common factor in the organizational environment today. Ability of the organizations to cope up the changes is the success or failure for the organization over its competitors. Hence the agility and mobility of the organization is a very vital factor today. Capability of the organizational structure to cater its structural changes, with a minimal cost is very essential. As per (Bradley, 2003, p.70), designing office layouts to incorporate the above aspects is called a "minimalist zero based approach'.

When considering the minimalist –zero based approach, the open office layouts are the preferred option over the other, since it has the capability of catering the changes at lesser time and lesser cost.

2.2. Attributes of a high performing Open Office Layout

It is understood that Open office layouts, with a minimalist – Zero based approach is the most suitable methodology for office layout designing (where ever possible).

Are there any factors which could affect the quality and performance of such open office layouts? Identifying and incorporating such factors in office layout designing will be very useful for the betterment and productivity of the organization.

Accordingly literature survey was done to identify such factors.

Large numbers of researches have been done in this context. Few of them are described below which was observed as important.

Magazine in United States for General Services Administration, (GSA, 2006) has recognized such high performing layouts as "**Innovative work places**". Further (GSA, 2006, p.9) has identified seven characteristics of an "Innovative workplace" and name them as "**Hallmarks of the productive workplace**". They are,

Spatial equity
Healthfulness
Flexibility
Comfort
Technology
Reliability
Sense of place.

A team lead by Michel Brill in United States through his researches, has identified 10 most important "**work place qualities**" that effects worker performance through working environment, (Brill et al, 2001, p.19). The 10 "**work place qualities**" are,

Ability to do distraction free solo work
Support for impromptu interactions
Support for meetings and undistracted group work.
Workplace comfort, ergonomics and enough space for work tools.
Workspace side by side work and dropping into chat
Located near or can easily find co-workers
Workplace has good places for break
Access to need technology
Quality lighting and access to daylight
Temperature control and Air quality.

A research done on satisfaction level of the employees about their workplaces, by Jeniffer Veitch and her team in Canada, discuss about 18nos of **E**nvironmental **F**eature **R**atings, (EFR), **(**Veitch et al, 2002). The 18 items are,

Amount of lighting on the desktop.
Overall air quality in your work area.
Temperature in your work area.
Aesthetic appearance of your office
Level of privacy for conversations in your office
Level of visual privacy in your office
Amount of noise from other peoples conversations
Size of your personnel work place to accommodate your work, materials and visitors.
Amount of background noise you hear at your workstation.
Amount of light for computer wok.
Amount of reflected light, glare in the computer screen.

Air movement in your work area.
Your ability to alter physical conditions in your work area.
Your access to a view outside from where you sit.
Distance between you and other people you work with.
Quality of lighting in your work area.
Frequency of distractions from other people.
Degree of enclosure of your work area by walls, screens or furniture.

Space planning guidelines developed for UN Secretariat building UN (Office space planning guidelines, August 2012, p.7), give following recommendations in developing office arrangements.
Provide more opportunity for team work/collegiality
Improve flexibility in space use
Allocate office space in a rationalized, simplified and streamlined way
Realize organizational values of openness
Use daylight and views
Reduce wasted double circulation

Although the attributes described by different researches are seemed to be different, in nut shell all of them are more or less similar when elaborated.

2.3. Development of Questionnaire

One objective of the research is to identify the factors affecting high performing office layouts. The 18 EFRs described by (Veitch et. al, 2002) is considered as the base for attributes for the research since they are comprehensive and easy to measure.

However it is observed that the factors contributing to teamwork within the employees are not included in 18 items described above. Improving teamwork within the groups is one of the reasons, for selection of open office layouts in designing office arrangements. Hence 04 items which are related to support for team work are added to the above 18 factors.
Item nos 12, 13, 16 are deleted from the list since they are observed not relevant.

02 more items were included to cater for the condition of furniture and availability of places for break.

Accordingly the selected attribute list comprises of 21 items. They were grouped to 04 independent variables for easiness of evaluation. Accordingly the selected attributes under 04 independent variables are as follows.

	Attributes	**Related variable**
a.1.	Disturbance at work station from others noise.	a. Privacy in your workstation.
a.2.	Disturbance at workstation due to others work.	
a.3.	Support for privacy from nearby furniture, walls etc.	
a.4.	Level of visual privacy in your ws.	
a.5.	Distance between yours and others ws	

a.6.	Conversational privacy in your ws.	
a.7.	Disturbance from background noises	
a.8.	Additional space allocated for your belongings and for visitors.	
a.9.	Attractiveness of your ws.	
a.10.	Suitability of furniture provided.	
a.11.	Availability of free areas for breaks.	
b.12	How close your team mates are located relative to you	b. Boost for team Work
b.13.	Facilities provided with to have sudden meetings	
b.14.	Availability of meeting rooms, conference rooms.	
b.15.	Facilities provided with to maintain the connectivity with your team mates.	
c.16.	Adequacy of lighting for your ws	c. lighting aspects of the workplace.
c.17.	Adequacy of lighting on your monitor	
c.18.	Disturbance from light reflected from the monitor.	
c.19.	Access to daylight from your ws.	
d.20.	Ability of controlling the temperature of your ws.	d. Ventilation within workplaces.
d.21.	Internal air quality of ws	

ws - work station

A questionnaire was developed to get the satisfaction level of the employees in a particular working environment with respect to the identified 21 attributes. The satisfaction level of the employee is obtained using a likert scale responses (ie:- seven option statements).

Table 01: Questionnaire used for the survey

Q #	Question	Very Un satisfactory	Un satisfactory	Bit un Satisfactory	Neutral	Bit Satisfactory	Satisfactory	Very Satisfactory	
1	Noise from other people's conversations while you are at your workstation								Satisfaction with Privacy & your workstation
2	Frequency of distraction from your work due to other people.								
3	Degree of enclosure (cover) of your work area by walls screens or furniture (Higher the better).								
4	Level of visual privacy within your workstation.								
5	Distance between you and others (workstations) near by (higher the better).								
6	Level of privacy for conversations in your office (higher the better).								
7	Amount of background noise (not speech) you hear at your workstation (lesser the better).								
8	Size of personnal workspace allocated for your work, materials and visitors.								
9	Aesthatic appearance of your workstation.								
10	Comfort of the furniture you are provided with								
11	Availability of free areas for breaks.								
12	How close do your team mates (peers, superiors , subordinates)are located with respect to you								Satisfaction with Team work
13	Facilities provided within office to have sudden discussions with your team mates								
14	Availability of meeting/ conference rooms in the office area.								
15	Facilities provided within office to have connectivity with your team mates.								
16	Amount (Sufficiency) of lighting in your work area								Satisfaction with lighting
17	Amount of lighting (sufficiency) on your computer screen.								
18	Amount of reflected light on your computer (lesser the better).								
19	Access to day light from your workstation								
20	Ability to control temperature in your work area								Satisf actio n
21	Overall air quality in your work area								
22	Your overall satisfaction level with the working environment								

21	How old are you ?	18-29	30-39	40-49	50-59	50-59
22	What is your sex ?	Male	Female			
23	Job category	Admin	Technical	Finance	Marketing	HR
24	Highest Educational Qualification	A/L	Diploma	Degree	Post	PHD

25	Your comments/suggestions about Privacy and workstation provided with ?								
26	Does the workstation and work environment improve the team work within your team ? Comments / Suggestions								
27	What about the Lighting Arrangements provided for the office environment? Comments/Suggestions								
28	What about theVentilation arrangements provided for the office environment? Comments/Suggestions								
	Name & Designation	Date				Signature			
	Temperature								
	Humidity								
	Flux Level								

2.4. Sample Selection

Sri Lanka Telecom (PLC) (Hereafter referred as SLT) has been selected to execute the survey considering following reasons.

SLT is a public listed company, a leading player in telecommunication sector and ranked within best 10 companies in Sri Lanka over the years. It has over 7000 employees all over the island and over 3000 employees in SLT head office (SLT-HQ). Out of 3000 employees in SLT-HQ, 438 are executives.

Due to large competition among the key players, it has under gone number of changes in various aspects. Working environment to the employees is a prime concern in SLT, since management believes that a good working environment will enhance the performance of employees.

Space is a prime concern in SLT-HQ and suburbs and open office concepts are widely used in developing/refurbishing offices in such areas.

Considering the practical difficulties in gathering information from all the grades, the sample is narrowed down to executives in SLT-HQ.

Hence the researcher is left with executives in following groups to select his sample.

* Administration group
* Human Resources group
* Finance group
* Marketing Group
* Regional group
* IT group

While executing the survey it is important to maintain the facilities provided to the participants at a constant level (similar) as far as possible (as a control to make the comparisons viable).

However the facilities required by the technical groups like Network, IT, Marketing are differed largely inter groups as well as Intra groups. Hence said groups were eliminated from the study. Accordingly the researcher is left with following groups.

Administration group - 16 executives. Scattered in CTO building. Small in number.
Human Resource Group - 31 executives in HQ – 7th floor. But not refurbished recently using open office concepts.

Finance Group - 46 executives, in two floors of two buildings. Refurbished recently.

It is decided to select a sample who possess similar requirements thereby the requirements can be considered as a constant for the study.

Considering the facts described above, researcher selected the 46 executives in the Finance group as his sample to execute the survey.

2.5. Execution of Survey

The survey was conducted in the two offices separately. The questionnaire was given to the participants and started at one instance. Sufficient time was given to complete the questionnaire. The questionnaire consisted three categories.

Questions aimed to gather occupant's demographic characteristics like gender, age etc.
Questions aimed to gather the satisfaction level of employee about identified attributes.
Descriptive questions where the comments and suggestions about occupant's office can be written.

In addition some clarification questions were also asked from the selected individuals after analyzing the data.

Special care was taken to maintain the surrounding environment to be equal to all participants answering the questionnaire. Some controls also are introduced to identify any differences. They are;

Starting the questionnaire to all at one time.
Measure temperature, lighting intensity, dry and wet bulb temperatures at each occupant desk.
Locate and mark every occupant on a diagram where locations of ACs, locations of doors, windows are visible.
Absentees were given the questionnaire at a similar time in similar conditions.
In addition to above questionnaire, interviews were held with senior officers in FM division of SLT, to get their views and recommendations towards improvements.

2.6. Data Analysis

The collected data is summarized and marks were allocated for the occupant's satisfaction level as per fundamentals of likert scale. Marks allocation was done as per bellow

Very Unsatisfactory	:- 01 marks	Un satisfactory	:- 02 marks
Bit Unsatisfactory	:- 03 marks	Neutral	:- 04 marks
Bit Satisfactory	:- 05 marks	Satisfactory	:- 06 marks
Very Satisfactory	:- 07 marks		

Accordingly each and every occupant's responses in the two offices were allocated with marks and summarized on **Table: 02** and **Table: 03.**

The summarized data were statistically analyzed using Regression and Correlation coefficient techniques using MS- Excel software.

Following hypotheses are identified for the hypothesis testing

Alternative Hypotheses

H_{1a} : Higher the level of Privacy in work station, higher will be the degree of Overall Environment Satisfaction level of the employee.

H_{1b} : Higher the level of boost for teamwork from the work station, higher will be the degree of Overall Environment Satisfaction level of the employee.

H_{1c} : Higher the level of Lighting aspects of the work station, higher will be the degree of Overall Environment Satisfaction level of the employee.

H_{1d} : Higher the level of ventilation satisfaction of the work station, higher will be the Overall Environmental Satisfaction level of the employee.

Null Hypotheses

H_{0a} : There is no influence on executive's Overall Environment Satisfaction level from Privacy aspects in his work station.

H_{0b} : There is no influence on executive's Overall Environment Satisfaction level from Boost for the team work in his work station.

H_{0c} : There is no influence on executive's Overall Environment Satisfaction level from lighting aspects of the work station.

H_{0d} : There is no influence on executive's Overall Environment Satisfaction level from ventilation aspects of the work station.

The 'Pearson's correlation coefficient' was used to test the hypothesis with a significance level of (α) 0.05, at a confidence level of 95 %.

Table 02: Results of the Questionnaire at Asset Arcade office (Marks as per likert scale)

Variable Attribute &	Privacy in the work station											Support for the Team work				Lighting to your workstation				Air quality & Therm Comfort in workstation		Composite Score				Overall satisfaction
	a											b				c				d						
Respondent / Q. No	a1	a2	a3	a4	a5	a6	a7	a8	a9	a10	a11	b12	b13	b14	b15	c16	c17	c18	c19	d20	d21	a	b	c	d	(OES)
1	6	6	6	6	6	6	6	6	7	7	7	6	7	7	7	6	6	7	6	3	5	69	27	25	8	6
2	2	3	3	5	6	4	3	3	4	5	6	4	6	6	4	6	6	4	5	2	2	44	20	21	4	3
3	2	2	1	2	4	1	2	2	3	4	4	2	4	1	2	4	4	5	4	1	4	27	9	17	5	2
4	2	2	4	4	2	2	2	4	5	3	1	1	1	3	2	4	4	4	1	1	2	31	7	13	3	1
5	4	4	3	2	5	5	3	3	4	4	2	5	4	2	4	3	2	4	7	2	2	39	15	16	4	4
6	1	1	1	1	1	1	1	1	4	4	1	1	4	4	4	6	6	4	1	1	1	17	13	17	2	2
7	4	4	4	4	4	1	4	7	6	6	6	4	6	6	6	4	4	4	4	7	4	50	22	16	11	4
8	4	5	4	4	4	5	4	6	6	6	5	4	6	4	4	5	4	4	1	2	4	53	18	14	6	4
9	1	2	3	3	6	4	3	6	6	6	4	5	6	6	6	6	6	6	2	1	5	44	23	20	6	6
10	4	2	2	2	2	2	3	6	6	6	5	4	4	6	6	6	6	6	6	3	3	40	20	24	6	4
11	1	2	4	4	6	2	2	6	6	6	4	6	6	1	4	4	4	4	1	1	3	43	17	13	4	4
12	1	2	2	3	6	1	2	5	6	5	4	6	4	6	6	6	6	6	2	2	1	37	22	20	3	5
13	4	3	6	6	6	4	3	6	6	6	4	6	4	6	6	6	6	5	5	3	6	54	22	22	9	6
14	4	4	5	5	6	4	6	3	6	6	4	6	6	7	6	2	4	6	6	1	4	53	25	18	5	6
15	6	6	6	5	6	6	6	6	6	5	5	4	6	6	6	6	6	6	5	4	5	63	22	23	9	6

Table 03: Results of the Questionnaire at HQ - 6 floor (Marks as per likert scale)

Variable Attribute & Respondent / Q. No	Privacy in the work station a											Support for the Team work b				Lighting to your workstation c				Air quality & Therm Comfort in workstation,d		Composite Score				Overall satisfaction (OES)
	a1	a2	a3	a4	a5	a6	a7	a8	a9	a10	a11	b12	b13	b14	b15	c16	c17	c18	c19	d20	d21	a	b	c	d	
1	6	6	7	5	6	5	4	7	7	2	4	4	6	5	6	6	6	3	5	6	3	59	21	20	9	6
2	6	6	5	5	4	5	5	3	5	4	2	4	5	4	5	5	6	5	3	5	4	50	18	19	9	5
3	6	5	6	6	5	5	6	6	6	6	4	5	5	4	7	6	6	6	3	5	5	61	21	21	10	6
4	6	6	5	5	5	4	6	5	6	6	2	6	4	5	6	5	5	4	5	5	4	56	21	19	9	6
5	6	6	7	4	5	**6**	7	5	5	6	3	6	5	5	6	5	5	4	3	5	5	60	22	17	10	6
6	2	3	4	4	5	4	5	6	6	6	6	5	5	4	6	5	5	4	3	3	2	51	20	17	5	5
7	4	4	5	3	6	5	5	3	5	5	3	4	5	5	6	6	6	6	2	2	3	48	20	20	5	5
8	2	3	4	4	5	5	6	6	6	5	3	4	5	5	6	5	5	4	4	3	4	49	20	18	7	5
9	6	5	6	6	5	5	5	1	4	5	3	4	3	3	3	4	3	4	2	2	2	51	13	13	4	3
10	4	3	2	3	4	5	4	2	6	6	4	5	4	4	4	5	5	4	3	2	3	43	17	17	5	4
11	5	5	4	4	3	3	4	2	6	6	2	4	4	5	6	5	6	4	3	2	4	44	19	18	6	5
13	4	4	3	4	3	4	5	5	6	6	5	6	6	6	7	5	6	5	3	3	4	49	25	19	7	7
14	4	5	5	5	6	5	4	5	7	6	5	6	6	5	6	5	6	5	3	3	4	57	23	19	7	6
16	5	6	6	6	5	5	5	6	6	6	4	5	5	5	6	5	6	5	4	3	4	60	21	20	7	6
17	5	5	5	6	5	5	6	6	5	5	4	5	5	4	5	4	5	3	3	2	4	57	19	15	6	5
18	6	5	6	6	5	5	5	6	7	7	5	6	7	7	6	6	6	5	5	3	5	63	26	22	8	7
19	4	3	4	3	3	4	5	5	6	6	5	6	5	5	5	5	5	4	3	3	4	48	21	17	7	5
20	3	3	2	3	3	4	4	5	6	6	5	3	3	4	6	5	5	5	3	3	4	44	16	18	7	3
22	4	3	3	4	4	4	4	5	5	5	3	4	5	4	4	5	5	4	3	3	4	44	17	17	7	4
23	5	5	6	5	6	6	6	6	7	6	3	5	6	6	5	5	5	5	3	3	4	61	22	18	7	6
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27	3	4	5	5	4	3	4	5	5	5	3	4	5	5	4	5	5	4	3	3	5	46	18	17	8	4
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33	2	2	3	3	2	3	4	4	5	5	3	2	2	3	2	4	3	3	2	2	1	36	9	12	3	2
34	5	4	5	5	3	3	4	4	5	5	3	3	3	4	3	4	4	3	4	3	2	46	13	15	5	3

2.7. Results of the Study

Following are the results observed after analyzing the collected data.

None of the demographic characteristics studied (i.e. Age, Gender, Job category, educational level) observed to have a relationship with the Overall environmental Satisfaction level of occupant. Overall Environmental Satisfaction level of Employee (OES) increases with the increase of aspects related to Privacy in Workstation (P ws).

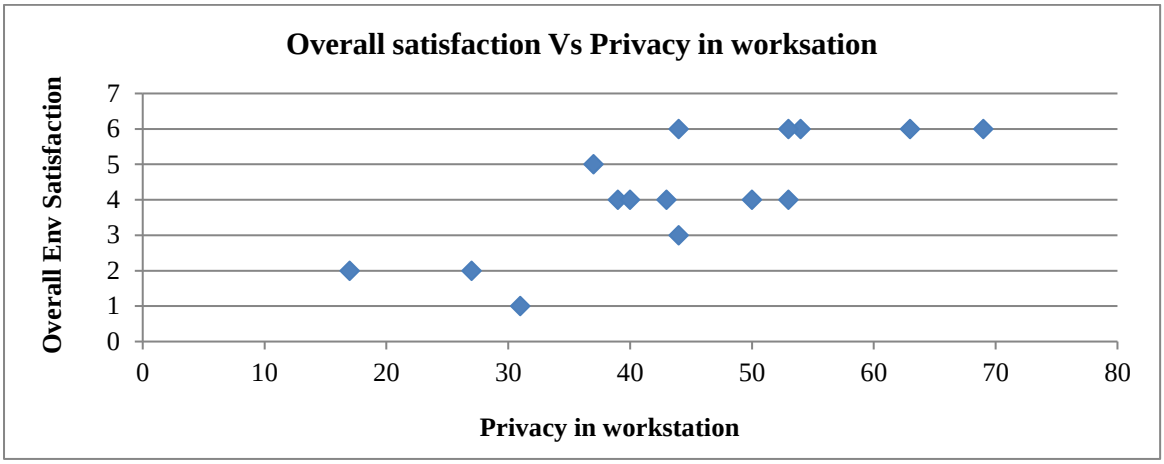

Figure 01: Level of (OES) Vs. (P ws) of Occupants in Asset Arcade Office.

From the Linear Regression Analysis,
R square = 0.6114, Intercept = -0.0384 Satisfaction Coeff. = 0.0957, Std. Error =1.071

Hence Y = -0.384 + 0.0957 X

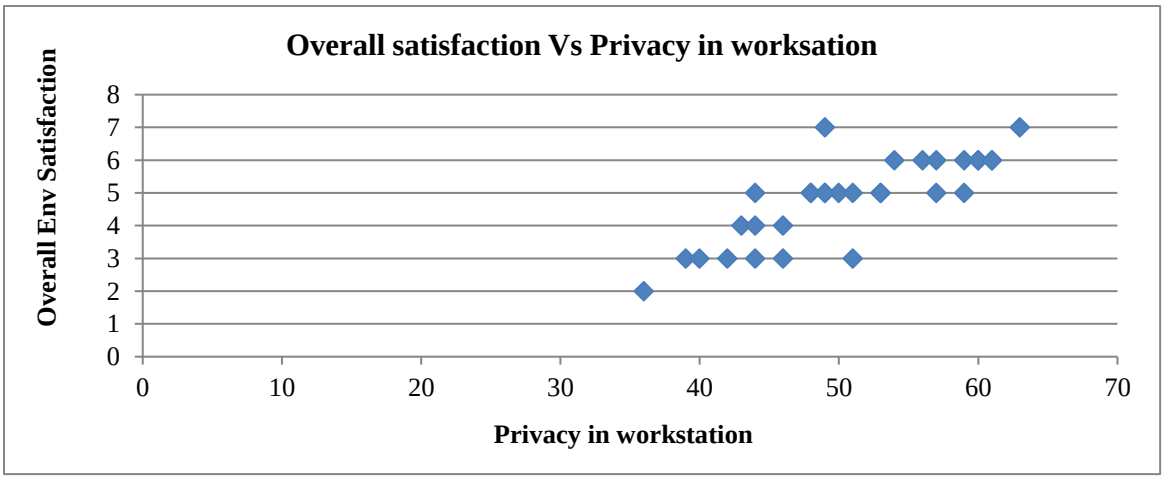

Figure 02: Level of (OES) Vs. (P ws) of Occupants in HQ – 6th Floor.

From the Linear Regression Analysis,
R square = 0.6540, Intercept = -2.4847, Satisfaction Coeff. = 0.1438, Std. Error =0.7788

Hence, Y = -2.4847 + 0.1438 X

Overall Environmental Satisfaction level of Employee (OES) increase with the increase of aspects related to Boost for Teamwork in Workstation (T wk).

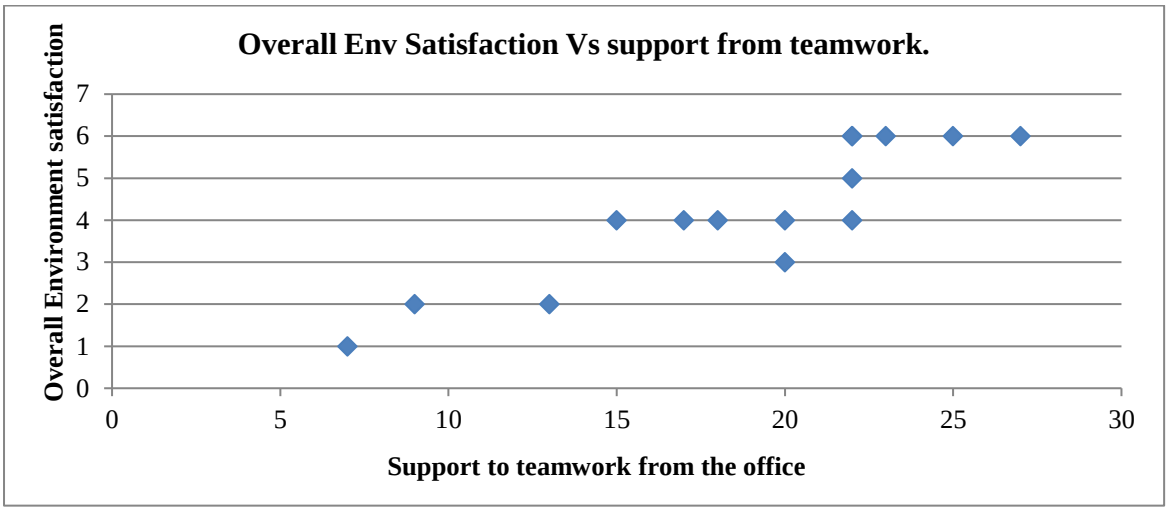

Figure 03: Level of (OES) Vs. (T wk) of Occupants in Asset Arcade Office.

From the Linear Regression Analysis,
R square = 0.8061, Intercept = -0.7069 Satisfaction Coeff. = 0.261, Std. Error =0.7568

Hence Y = -0.7069 + 0.261 X

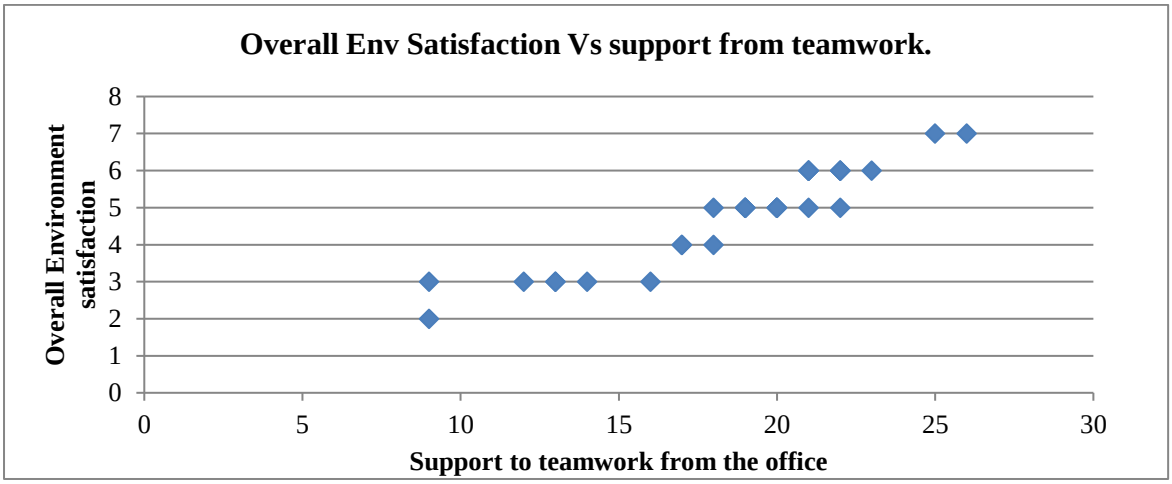

Figure 04: Level of (OES) Vs. (T wk) of Occupants in HQ-6th Floor Office.

From the Linear Regression Analysis,
R square = 0.8931, Intercept = -0.6979, Satisfaction Coeff. = 0.2947, Std. Error =0.4329

Y = -0.6979 + 0.2947 X

Overall Environmental Satisfaction level of Employee (OES) increase with the increase of aspects related to Lighting Level on work place (L gt).

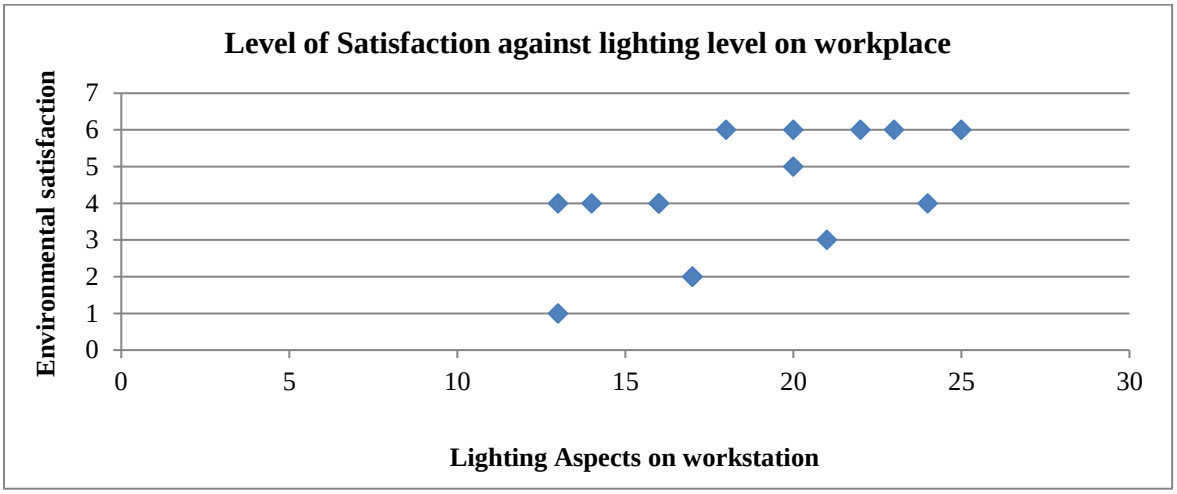

Figure 05: Level of (OES) Vs. (L gt) of Occupants in Asset Arcade Office.

From the Linear Regression Analysis,
R square = 0.3322, Intercept = -0.3455 Satisfaction Coeff. = 0.2444, Std. Error =1.4045

Hence Y = -0.3455 + 0.2444 X

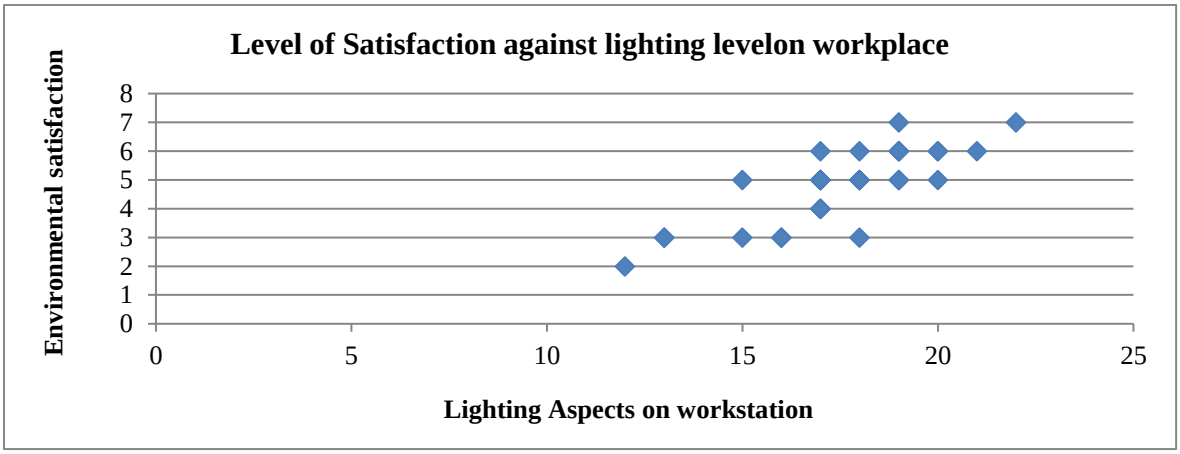

Figure 06: Level of (OES) Vs. (L gt) of Occupants in HQ-6th Floor Office.

From the Linear Regression Analysis,
R square = 0.6384, Intercept = -3.1897, Satisfaction Coeff. = 0.4565, Std. Error =0.7962

Hence Y = -3.1897 + 0.4565 X

Overall Environmental Satisfaction level of Employee (OES) increase with the increase of aspects related to Ventilation on work place (V nt).

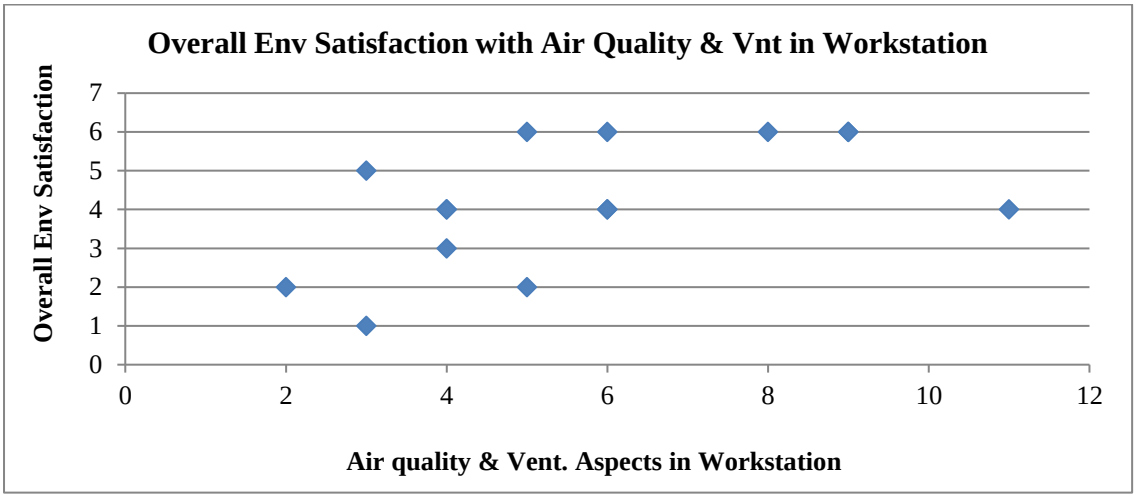

Figure 07: Level of (OES) Vs. (V nt) of Occupants in Asset Arcade Office.

From the Linear Regression Analysis,
R square = 0.3039, Intercept = 2.1964 Satisfaction Coeff. = 0.3536, Std. Error =1.4340

Hence Y = 2.1964 + 0.3536 X

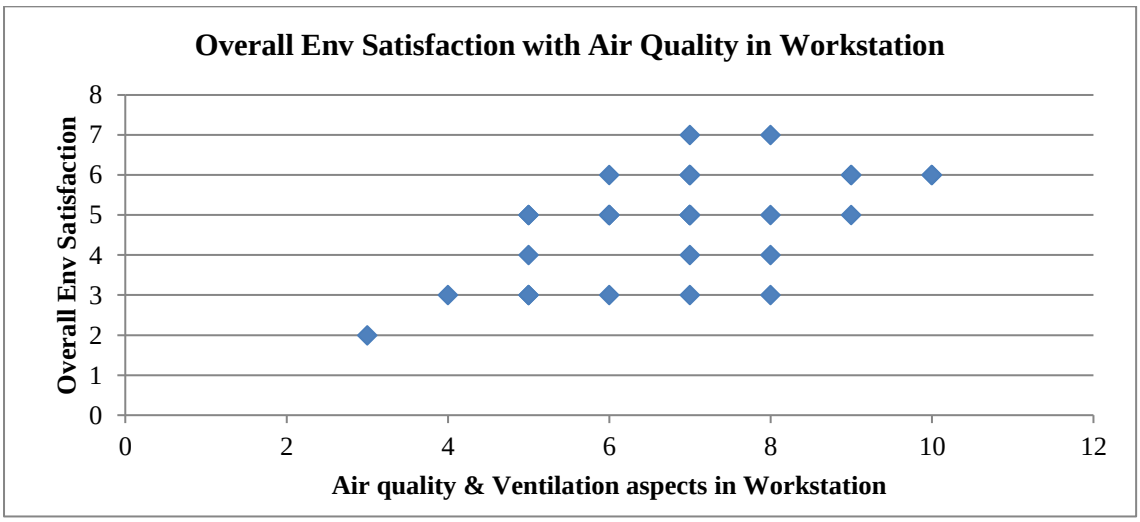

Figure 08: Level of (OES) Vs. (Vnt) in HQ-6th Floor Office.

From the Linear Regression Analysis,
R square = 0.3222, Intercept = 1.7796, Satisfaction Coeff. = 0.4447, Std. Error =1.09

Hence Y = 1.7796 + 0.4447 X

Table 04: Summery of the Results of hypothesis testing

Independent Variable	R Squared		Standard Error		Type of Relationship
	Asset Arcade	HQ – 6FL	Asset Arcade	HQ – 6FL	
P ws	61.14 %	65.40 %	1.0710	0.7788	Good Relationship
T wk	80.61 %	89.30 %	0.7568	0.4329	Good Relationship
L gt	33.22 %	63.84 %	1.4045	0.7963	Moderate Relationship
V nt	30.39%	32.22%	1.434	1.0900	Poor Relationship

2.8. Conclusion and Recommendations

The following conclusion and recommendations for the betterment of office layouts were derived from the data collected from survey, descriptive questions in the questionnaire and the interviews held with the senior officials of the Facility Management team of SLT.

Deep Analysis of the actual customer requirements and their dependencies are very important for the success of the layout.

It is always advisable to include identified 21 attributes as far as possible in the layouts since they will improve the overall Environmental Satisfaction Level of the employees and hence the productivity of the organization.

Verification and recommendation from the user department is very vital prior to execution of the proposed layout. It is encouraged to include one or few members from the User department to the design team to cater the interests of the user.

Prior to hand over the site, User awareness sessions to educate the user regarding functional aspects of the equipment and layout are very vital. Better to educate them about the design assumptions also.

It is always encouraged to incorporate higher flexibility where ever possible in the layouts.

Periodical checks on operation levels are vital to check whether the layout is performing at the desired functional efficiencies after the handing over (against expected levels at the design stage).

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STUDY ON NATIONAL POLICY ON SAND FOR THE CONSTRUCTION INDUSTRY

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Abstract

The Sand is a vital construction raw material which is defined as a mineral in the Mines and Minerals Act No. 33 (1992) of Sri Lanka and a sustainable resource which has to be conserved and managed properly while gaining efficacies. Thus river sand persists as the main source of sand in Sri Lankan construction industry over decades and in recent past with post war reconstructions and rehabilitation projects initiated, demand for river sand has increased immensely. Hence suppliers have augmented sand mining to cater for the increased demand irreversible resulting severe damages to the ecology of the respective areas. Ministry of Environment and Natural Resources developed the "Sri Lanka National Policy on Sand as a Resource for the Construction Industry" in the year 2006 with the aim of conserving sand as a sustainable natural resource while fulfilling the short term necessities of the industry. The aim of this paper was to review the compatibility of National Policy on Sand as a Resource for the Construction Industry with the prevailing scenario, after the three decades of war and to provide necessary suggestions to enhance the Policy. Comprehensive understanding of the Policy were identified through desk study and the compatibility of the Policy were observed through data collection from the five different stakeholders in sand industry representing policy developers, sand miners and transporter, contractors, non-governmental organisations and general public covering 17 number interviews. Findings revealed that the most dominant strengths of the Policy are providing a realistic guide and reduced environmental impact. Foremost weaknesses identified are enforcement issues, lack of awareness and applicability of the Policy to different eco systems. Thus recommendations have been suggested to overcome the identified weaknesses of the Policy as the final outcome of the research.

Keywords: *National Policy on sand, Sand Industry, Sand Conservation, River Sand, Strengths, Weaknesses.*

1.0 Introduction

Sand is a mineral as defined in the Mines and Minerals Act No. 33 of (1992) of Sri Lanka, and is the property of the State. As mentioned by Kamaladasa (2008) river sand persists as the main source of sand for the construction industry over decades. Department of Forestry and Environment Science (2009) stated that the demand for sand for building construction is approximately 7-7.5 million cubic meters per year, and as stated by Piyadasa (2012) rapid development has directed to an increased demand for river sand as a construction material in the recent years. Conferring to Abeynayake (2010) almost the entire sand requirement is manually or mechanically harvested from river beds, engraved from riversides, or excavated from sand deposits on previous riverbeds. The author further explained that due to the increased demand for sand, suppliers have increased sand

harvesting and that unlimited and unrestricted harvesting is resulting in heavy rates of soil erosion, increased river water turbidity and land degradation.

With continuous researches by the Ministry of Environment and Natural Resources (2005), it is recognized that the sound management of sand is necessary in order to minimize the risk of flooding and salt water intrusion. Hence, to control increased river sand mining for construction purposes Ministry of Environment and Natural Resources developed the "National Policy on Sand as a Resource for the Construction Industry" in the year 2006 with the supervision of The Government of Sri Lanka. The policy statement imitates "Sri Lanka's constitutional, international and national obligations, including the Mines and Minerals Act No.33 of 1992, the National Environmental Act No 47 of 1980, the Coast Conservation Act No 57 of 1981" (National Policy on Sand as a Resource for the Construction Industry, 2006,p.01) and any other pertinent legislation, policy statements and regulations. Although the policy was developed in the year 2006, according to the statistical surveys conducted by Department of Census and Statistics (2012) revealed that there is no significant reduction in sand mining during the last few years.

The review of performance under Caring for the Environment 2003-2007 illustrates that inadequate law enforcement measures on uncontrolled sand mining and delays in implementation of the National Policy on Sand, resulting in serious coastal erosion have also contributed negatively. Industry Report on Sri Lanka (2011) demonstrates that the construction industry has experienced a rapid growth during post-war scenario due to reconstructions and rehabilitations in affected areas and other development projects launched continuously creating an increased demand for sand mining and transportation disabling the Policy to perform at the expected intensities.

Rathnayake (2013) specified that although the legal framework for sand mining was introduced, its' objectives have not been achieved as expected and the policy domain extramural the acumen of local communities, police and even the supervisory body can still be seen to make decisions contradicting standing policy and regulations. Further, Ministry of Environmental and Natural Resources (2014) stated that Policy has not been revised during past 7 years. In this context it is essential to amend the existing Policy on sand to be compatible with prevailing boom in construction industry. Thus this paper intends to study the existing National Policy on Sand as a Resource for the Construction Industry and to provide suggestions to enhance the Policy to be compatible with the prevailing scenario in the construction industry with achievable objectives. This paper contents information on desk studies of National Policy and empirical findings gathered from stakeholders in sand industry.

2.0 Literature Review

2.1 Sand as a Global Construction Raw Material

The Global Environmental Alert Service of the United Nations Environment Program's (UNEP) report on March states "Sand, rarer than one thinks" [United Nations Environment Program (UNEP), 2014]. According to the UNEP statistics, every year between 47 and 59 billion tons of materials are mined globally, from which aggregates hold both the major share (from 68% to 85%) and the fastest extraction growth. Further it is demonstrated with a conventional estimate that yearly world's aggregate consumption exceeds 40 billion tons. Studies have estimated that aggregate consumption is twice the yearly volume of sediment generated by all of the rivers of the world.

Hence, the world's usage of aggregates for construction purposes, mainly for making concrete a year is appraised at 25.9 to 29.6 billion tons.

According to the United States Geological Survey (2012) use of sand and gravel for construction purposes was about 842 million tons in the year 2012, which was 1,200 million tons per year during the construction boom. The United States Geological Survey reports the percentage use of construction sand and gravel for several purposes and as estimated, about 44% is used as concrete aggregates, another 25% is consumed for road base and road stabilization, 13% used as bituminous mixtures and asphaltic concrete aggregates, 12% as construction fill, 1% for concrete products, while the remaining 3% is consumed for other miscellaneous uses.

When considering developed countries in most of the cases they try to import sand from developing countries to conserve natural resources in their region (Young & Griffith, 2009). The Palm Jumeirah, is an artificial set of sand islands in Dubai which consumed 186.5 million cubic meters of sand (Jan De Nul group, 2013). As its own sand resources have become fatigued Dubai imported sand from Australia, to construct BurjKhalifa tower (Delestrac, 2013) which is the highest building in the world with a height of 828 meters.

Having imported a remarkable amount of sand nearly 517 million tons, over the last 20 years, Singapore is considered by far the largest worldwide sand importer (UN Comtrade, 2014; Aquaknow, 2014) while maintaining the position as highest per capita consumer of sand at 5.4 tons of sand per inhabitant. Usually sand is imported to Singapore from Indonesia but also other neighbouring countries of Malaysia, Thailand and Cambodia.

2.2 Sand as a Resource in Sri Lankan Construction Industry

Even though global scenario is congeneric to the when considering Sri Lankan context, with regard to the sand scarcity that instigated by the proscription of sand mining of rivers during the year 2007-2008, price of a cubic meter of sand has increased abruptly up to Rs.9,000 range. During boom times the sand industry, which is actually a mixed sanctification has led to high prices and even environmental risks. Estimated demand and supply of river sand for Sri Lankan construction industry can be illustrated in a graph as in Figure 1.

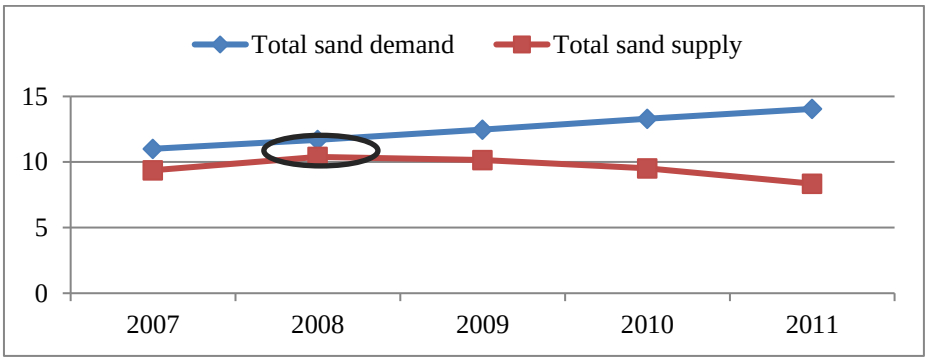

Figure 01: Supply and demand for river sand, 2007-2011 (values are m^3x10^6 per year)

Figure 1 denotes that demand for sand has kept increasing through the years but supply of sand has tend to decrease after the year 2008 from 10.39 m^3 to 8.35 m^3 in the year 2011. Nevertheless, actions have been initiated to propagate usage of sea sand for construction events at a concessionary

price instead of using river sand in order to keep the sand supply at a sufficient level to cater for the increasing demand. Hence, this matter has been settled up to a convinced level though sea sand usage is still not entirely acknowledged by the general public and the stakeholders in construction industry (NDB Stockbrokers, 2010).

Piyadasa and Naverathna (2008) stated the most critical damages occur due to excessive sand mining in Sri Lanka in the recent past. They are surface water quality changes due to salinity intrusion, negative effect to natural ecosystems and loss of biodiversity, affect to river base ecosystems, plants and animals, making geo, social and economic vulnerabilities of flooding and sea surges and reduce the river bank area and leads to coastal erosion. Specifically studies by Amarasekara (2006) and Piyadasa and Naverathna (2008) revealed over mining of Kelaniriver and Nilwala river causes many problems like salinization of drinking water respectively in Colombo and Southern areas due to the intrusion of sea water into the river, collapse of river bank and loss of river land.

2.3 River Sand Mining Management (RSM)

In order to conserve the limited natural resource, development of legal framework for proper planning and management of sand mining has been significant globally (Cho, 2006). Department of Irrigation and Drainage (DID) of Malaysia prepared a guideline as a planning and management tools to deal with the problems that arise from river sand mining in year 2009. In most of the developing countries in the world, mining and dredging regulations are frequently reputed without a proper scientific indulgent of the consequences which would occur, and a considerable number of projects are initiated lacking environmental impact assessments (Maya et al., 2012; Saviour, 2012).

As mentioned, result of sand mining has affected the provision, protection and regulation of ecosystem services in the surrounding areas (Ratnayake, 2008).Many studies and researches have been initiated to scrutinize the challenges in river sand mining around the globe throughout the past decades (John, 2009). Challenges prevailing in river sand mining management in global perspective can be identified as follows.

Catering for increasing demand for river sand as a construction raw material
Control over increasing prices of river sand due to legal barriers for sand excavation
Governing illicit river sand mining which runs on an extensive scale and transporting on an organised scale with tacit or direct political support
Development of suitable economical, environmental friendly substitutes for river sand for construction purposes
Impossibility of proper enactment of legal provisions due to political influences
Conserving natural resources while maintaining construction growth

A deficiency of appropriate scientific practice for sustainable river sand mining has directed to undiscerning sand extraction (John, 2009), though frail ascendency and corruption have directed to extensive illicit mining (Saviour, 2012; Ashraf et al., 2011). Sand transaction is a beneficial business which occurs both at national and international levels, and there is confirmation of illegitimate trading as the persuasive mafias in India (Ghosh, 2012).The supremacy is not lucidand comprises several layers of regulations regarding sand mining in national and international pacts

and no global standards have been established for that (Velegrakis et al., 2010; Radzevicius et al., 2010).

In Sri Lankan context, National Policy on Sand as a Resource for the Construction Industry introduced in the year 2006 specifically to control sand mining for construction purposes. Thus it vindicates that legal provision has been initiated in Sri Lanka in order to control illicit river sand mining while achieving short term goals and establishing path for sustainable development. However, the Ministry of Natural Resources and Environment has recognized the intimidations that unsustainable and excessive sand mining stances on the environment and society(Ranasinghe, Fernando, Dissanayake, & Rupasinghe, 2008). Currently construction front impasse a panic situation due to temporarily terminated sand extraction from most of rivers.

2.4 Review on National Policy on Sands a Resource for the Construction Industry

A survey conducted on the DeduruOya river basin by the Department of Geology of the University of Jayawardenepura revealed that sand mining has caused enormous damage to water resources. Nanayakkara (1999) described the connection between excessive sand extraction in the Ma Oya River and coastal erosion in north of the river mouth. Several media reports divulge that illegal mining of over 1,000 cubic meters of sand daily has generated environmental, social and health issues in the surrounding areas of the DeduruOya River. The destruction of land due to collapsing riverbanks as estimated by Phase one of the National Sand Study (NEI, 1992) is to be about 12 ha per year in the three main rivers of Western Province (Gunaratne, 2010).

Considering the situation the Ministry of Environment and Natural Resources has prepared the National Policy on Sand as a Resource for the Construction Industry for Sri Lanka in consultation with relevant Government Officers (Geological Survey and Mines Bureau (GSMB)), Academics (Peradeniya and Moratuwa Universities), Environmental Experts (Central Environmental Authority (CEA) and other environmental organisations), NGOs, the private sector and provincial level Authorities to control unlimited and illicit sand mining for construction purposes.

This policy statement has assisted some other existing Acts and Policies in developing the sand policy including Sri Lanka's constitutional, international and national obligations, including the Mines and Minerals Act No. 33 of 1992, the National Environmental Act of 1980, the Coast Conservation Act of 1981 and other relevant legislation, regulations and policy statements. National Policy on Sand as a Resource for the Construction Industry (2006) has the objectives as shown in figure 02.

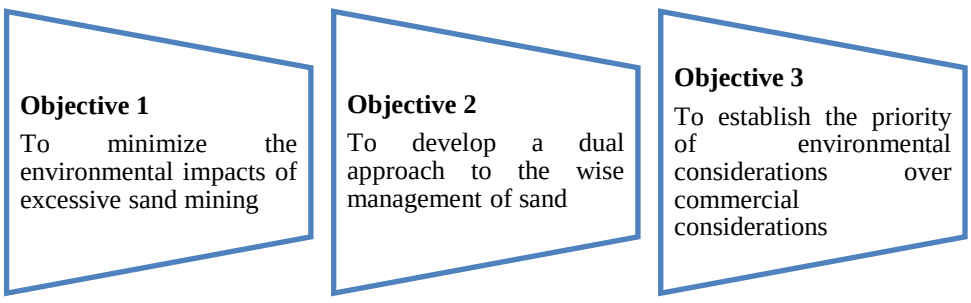

Figure 02: Objectives of National Policy on Sand

“To minimize the environmental impacts of utilizing Sri Lanka’s sand resources, while sustaining the economic benefits, recognizing that sand resources are both “renewable” (e.g. offshore sand) and “non-renewable” (e.g. dune and inland sand), both of which need to be managed sustainably”

The key impact of excessive river sand mining in Sri Lanka falls on the environment because sand mining alters natural ecosystems. River sand mining also has some positive impacts. The main benefit of river sand mining is the work it offers to sections of the community that have few other options. Rural people who live below the poverty line are relatively well paid for involvement in sand mining during certain months of the year (Gunaratne, 2010).

“To develop a dual approach to the wise management of sand resources,
(a) Through an effective system of policing within a strong regulatory framework; and
(b) Through the granting of incentives including skills training and alternate employment, for the development of sustainable alternatives, including manufactured and offshore sand and sand extracted from reservoir beds”.

Explanations of Mudunkotuwa (2004) demonstrates that during past decades the serious impact of exploitation of river sand mining has been deliberated at various forms by the professionals in order to identify the potential sources of river sand alternatives. Having established the dual approach Ministry has further introduced a license procedure called couple license system for the betterment of execution of the Policy.

As stated by the Ministry (2014) a Couple Licensing Procedure has been introduced to the system which confines illicit sand transportation.

“To establish the priority of environmental considerations over commercial considerations, assuring sound environmental governance and accountability at all levels. This includes determining extractable volumes while applying the precautionary principle and the provisions of the relevant laws; ensuring that extraction methods have low-impact; and putting in place a restoration program that reduces risks to the environment and to society”.

As mentioned by the Ministry (2014), GSBM will launch projects to perform volume calculations for sand extraction. Under that volume of sand generates, existing sand volume and volume to be extracted will be measured and mining license will be issued only up to the finalised extracting amount with minimum impact to the environment.

3.0 Research Methodology

Initially a desk study was carried out on a broader perspective to familiarize with the subject area of the National Policy on Sand as a Resource for the Construction Industry. It was identified that National Policy on sand was implemented in order to control and manage river sand mining for construction purposes and to conserve the natural resource. Further, it was revealed that with the current scenario in the construction industry authorities find it difficult to adhere to the policy while maintaining the supply of sand at a satisfactory level. Thus, this research is focused on reviewing the existing National Policy on Sand as a Resource for the Construction Industry through the

different stakeholders involved in sand industry in Sri Lanka. Semi structured interviews were used as the mode of data collection and the profile of interviewees as shown in Table 01.

Simple random purposive sampling was used as the base for sample selection. Stakeholders mentioned in Table 01 were selected as they are the key players in the construction industry with respect to the sand policy. Since National Policy on sand as a Resource for the Construction Industry is the core of the research, authorities involved in Policy development were selected as the major party for data collection with semi structured interviews. Accordingly, personnel from Ministry of Natural Resources and Renewable Energy, Central Environmental Authority and Geological Survey and Mines Bureau were selected for data collection. Additionally sand miners, suppliers and intermediaries from Hasalaka, Wilgamuwa and Manampitiya areas, which are considered as the highly affected areas due to illicit sand mining were also selected as the targeted samples. ICC, MAGA and Thudawe were selected as the contractors as they are C1 graded and highly sand consuming for their projects. Moreover Non-Governmental Organisations, namely Environment & Natural Resources Development Centre (ENRDC), Sri Lanka Environment Conservators and Sri Lanka Water Partnership were selected as they are the opposition parties which investigate whether the Policy is practicing in line with the Principles and redirecting to the proper path. Further, general public was selected to gather suggestions and proposals.

Table 01: Interviewee Profile

Title	Interviews	Respondents
Policy Developers	03	Ministry of Natural Resources and Renewable Energy, Central Environmental Authority, Geological Survey and Mines Bureau
Sand Miners and Transporters	05	Hasalaka,Wilgamuwa,Manampitiya
Contractors	03	C1 Contractors (ICC, MAGA, Thudawe)
Non-Governmental Organizations (NGO)	03	Environment & Natural Resources Development Centre (ENRDC), Sri Lanka Environment Conservators , Sri Lanka Water Partnership
General Public	03	Government Officer, Teacher, Student

Different semi structured interview guidelines were prepared for different stakeholders concerning their knowledge, awareness and applicability of the Policy in their fields and weaknesses of the Policy and suggestions for the improvement of the Policy. Code-based content analysis was used to identify the strengths and weaknesses of the National Policy on Sand as a Resource for the Construction Industry.

4.0 Research Findings

With reference to the data collected through semi structured interviews with the stakeholders in sand industry related to construction, content analysis was used to evaluate the strengths and

weaknesses of the National Policy on Sand as a Resource for the Construction Industry. Thus, strengths and weaknesses of the Policy were identified from each stakeholder.

Accordingly, "Policy provides a realistic guideline" was identified as the major strength of the Policy which was highlighted by the Policy developers *"Policy provides a realistic guideline for all the stakeholders in the sand industry in all means"*. Furthermore the scope or the coverage of the Policy has become strength of the Policy as it "*can be applied for all the scenarios irrespective of time constrain*". "*Mitigating environmental impacts*" of excessive sand mining to a significant level can be specified as another important strength highlighted by specially Policy developers and sand miners and transporters. In addition it has been identified that Policy "*provides a guide to enact the legal provision*" when necessity arises and according to Policy developers and Non-Governmental Organisations it "*delivers a platform reasonable to every* stakeholder" in sand industry.

With the Policy new license and permit procedure has been introduced to control excessive and illicit sand mining. Although it is like that in the Policy, as stated by Non-Governmental Organisations "*in actual scenario many misbehaves occur due to political influence and bribery and corruption"* which was identified as the most significant weakness in Policy implementing. Other specific strengths and weaknesses identified through interviews were analysed based on different perceptions of differentstakeholders as per Figure 03.

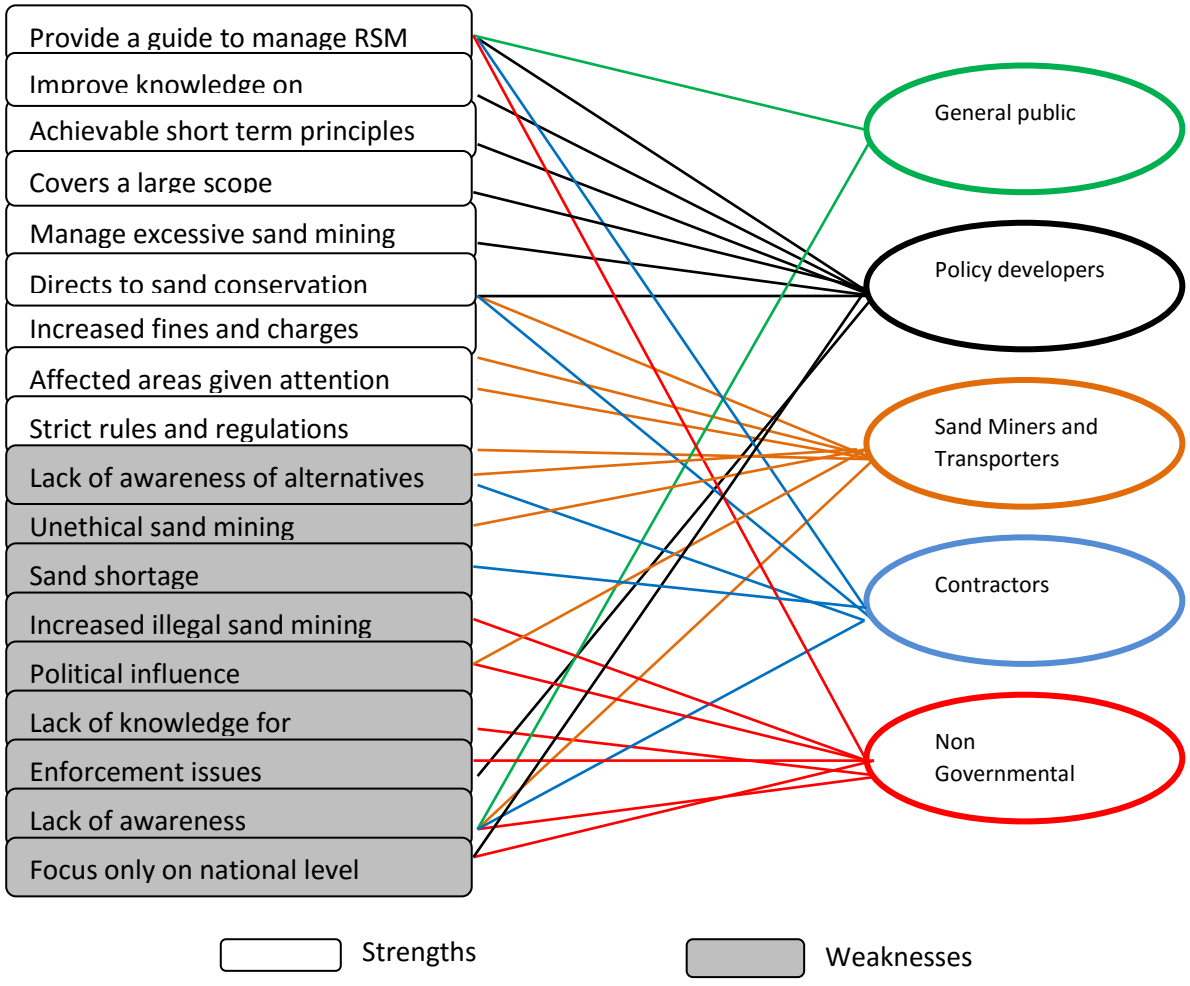

Figure 03: Perceptions of different stakeholders on National Policy on Sand

Moreover respondents suggested remedies for the identified weaknesses of the Policy with respect to the survey conducted as illustrated in Figure 04.

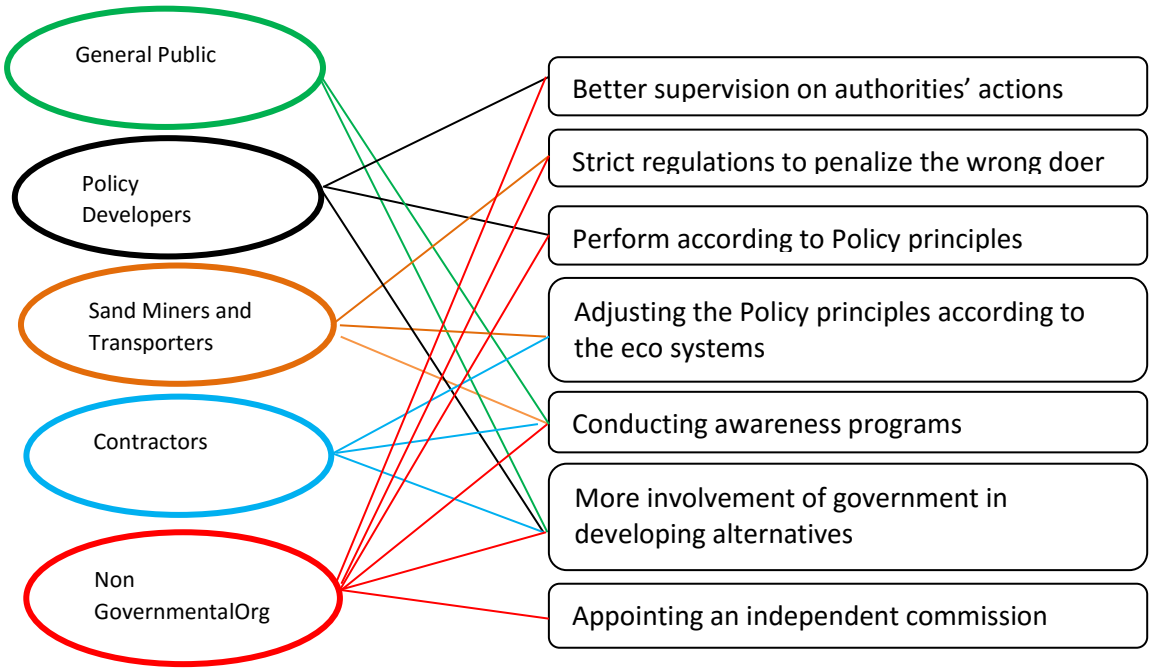

Figure 04: Remedies suggested by respondents

Figure 05 illustrates the mapping of weaknesses identified as shown in Figure 03 and Remedies suggested as in Figure 04 by the respondents through surveys.

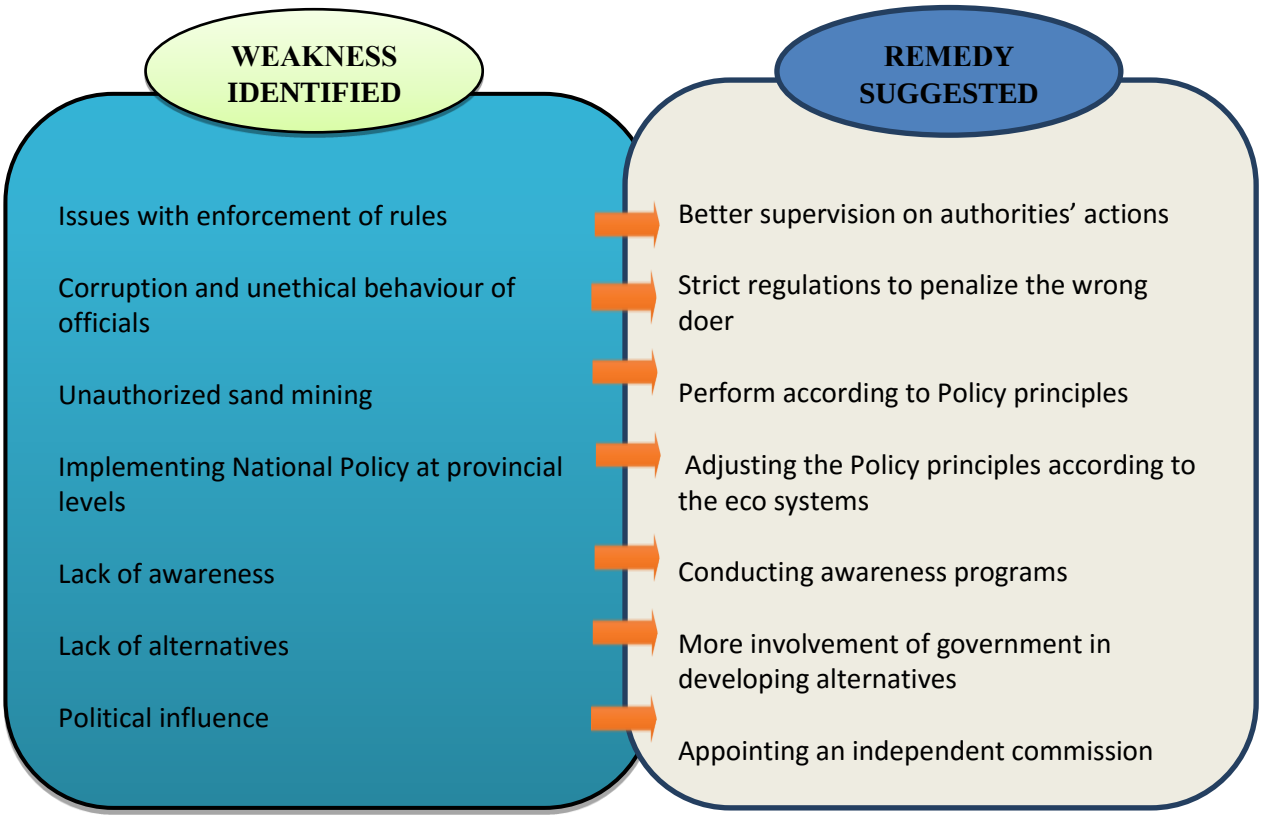

Figure 05: Weakness identified and remedies suggested for RSM

According to Figure 05, it is viable that even though the Policy is having the enough coverage required for the prevailing issues in the sand industry, enforcement of policy in order to overcome such issues is a key barrier. Secondary findings revealed that other than Sri Lanka, Sand Policy is practiced in countries like Malaysia, Singapore and India where sand mining occurs excessively(Cho, 2006;Gómez-pina et al., 2002;Dashwood, 2007). Even though the policies have been established when implementing those, there are many weaknesses identified similar to Sri Lanka. Hence, Malaysian government together with Department of Irrigation and Drainage has developed solutions with better supervision for over mining activities and enforcement of rules and regulations(Department of Irrigation and Drainage-Malaysia, 2009). In Sri Lankan context, in order to overcome that issue the Policy has decentralized the authority regarding sand industry among various different authorities. Specifically authority to issue permits and license is delegated to Geological Survey and Mines Bureau and controlling illegal sand mining is sanctioned to the Police of the country. According to principle 7 in the Policy a National Committee on Construction Sand representing the entire spectrum has been appointed as per Clause 4.2.1 to coordinate and overview the implementation of this Policy and further a District Committee on Construction Sand has been appointed at district levels to operate the actions. Accordingly, Policy itself has its own provisions to manage the authorities and enforcement of the rules.

Furthermore issues regarding sand industry such as changes in prices due to illegal sand miners' actions and threats to the registered sand miners also can be managed if the Policy principles are implemented properly. With reference to Sub Clause 7.1 (Review) the Minister in charge of the area shall present an annual status review of sand outlining the production and consumption trends, pricing, environmental, social and other relevant issues, needs for legislative reform together with report on revenues and royalties. Hence the authorities have to perform according to the Policy principles to manage those issues regarding the industry.

With regard to the issue mentioned about developing provincial level Policies, it is significant that National Policy is applicable to the entire spectrum but as per Sub Clause 4.5(a) sand mining is different form zone to zone considering the eco systems. Accordingly sand collection centers should be placed in that zone and the Divisional Secretary should be informed of the amount of sand allowed to extract. Therefore it is not necessary to develop Policies at provincial levels and only thing which has to be done is adjusting the Policy principles according to the eco systems of the different zones. Political influence in obtaining permits and licenses is another major issue in the Policy identified by the interviewees other than lack of awareness and alternatives.

Even though policy developers have considered all the possible loopholes they could predict at the development stage, according to findings there are many drawbacks in the Policy. Following are the recommendations presented at three different levels, national, industry and public respectively.

At national level, Policy has to amend to be compatible with the changing scenarios in construction industry. Enforcement of the rules should be more austere to achieve the aims and objectives of the Policy. Moreover corruption in government authorities should also be eliminated and managed properly when issuing mining licenses and permits as stated by the Policy Developers and Non Governmental Organisations. The officials having the authority should perform their duties and responsibilities without any favouritism and biasness. Rules should be introduced to penalize the

officials who support illegal activities in such circumstances. Further, Policy should be adjusted to be suitable for different provisions due to different eco systems. Therefore it is necessary to pay attention to the eco system rather than strictly adhering to the Policy when issuing licenses and permits. Hence a provisional regulations system should be developed keeping National Policy as the base.

At industry level, industry should pay special attention towards developing alternatives for river sand to conserve it as a sustainable resource. Before investing in such researches government should first analyze the global scenarios and evaluate the benefits to Sri Lanka to reduce wastage of financial and other resources.

Public level awareness among the stakeholders in sand industry should be improved in order to achieve the objectives of the Policy. Thus policy developers and other involved authorities should conduct awareness programs to improve the knowledge regarding the Policy among the stakeholders.

5.0 Conclusions

Sand is a mineral as defined in the Mines and Minerals Act No. 33 of (1992) of Sri Lanka. It is a property of the States and thus it is the responsibility of the states to conserve sand as a sustainable natural resource. However, Ministry of Environment and Natural Resources has recognized excessive and illegal sand mining which severely effects to the environment. Hence, as a solution National Policy on Sand as a Resource for the Construction Industry was developed and established in the year 2006. Even though Policy was established and implemented with many expectations according to the statistical surveys conducted by Department of Census and Statistics a considerable reduction of sand mining is not visible during last few years. Although the legal framework for sand mining was introduced, its' objectives have not been achieved as expected. Hence the necessity to enhance the Policy has aroused to be compatible with the varying scenarios in sand industry. Thus it is required to identify the strengths and weaknesses of the Policy in order to amend them accordingly. Hence the aim of this research was to review the existing National Policy on Sand as a Resource for the Construction Industry and to provide suggestions to enhance the Policy to be compatible with the changing scenarios in the construction industry. Policy enforcement issues, illegal sand mining, lack of awareness of the policy and alternatives for river sand and political influences were identified as the weaknesses and better supervision on authorities' action, strict regulations to penalize the wrong doer, adjusting the policy according to eco systems, conducting awareness programs and appointing an independent commission were proposed as remedies.

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CRAFTING A NATIONAL POLICY FOR CONSTRUCTION INDUSTRY IN SRI LANKA- AN APPROACH BASED ON STRATEGIC THRUSTS.

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Abstract:
Construction Industry basically involves in the activities of developing physical infrastructure related to all sectors of a country's economy. It is a fundamental economic sector which permeates most of the other sectors varying from Education to Transportation, as it transforms various resources into constructed physical economic and social infrastructure necessary for development. In order to meet the demand in construction while ensuring the efficiency in performing construction contracts, implementation of certain regulationary mechanisms is necessary.

The Construction Industry Development Act No 33 of 2014 embraces the regulationary framework, strategically developed for strengthening the operational machinery of the Construction Industry in Sri Lanka. The main objective being the formalization and standardization the activities of the construction industry, the Act has empowered a formation of an Advisory Council assigning the task of formulating and implementing a National Policy on Construction. The National Policy for Construction per se will carry a dynamic frame which will be changed from time to time, depending on the needs of a particular era. Thus, adhoc approach of administration of the Act will be inevitable until a formal time bound Policy is developed.

This paper discusses an approach using strategic thrusts depicted in the Roadmap towards Construction Industry Master Plan for Sri Lanka - 2014-2024 (RCIMP) , a publication launched in the year 2013, for developing a Policy while placing emphasis on practices of regional countries. In the context of Singapore model, its orientation towards Built Environment based Green Concepts, is proposed to develop strategic thrusts to overcome urbanization issues which would be the burning issues in the next decade. The Malaysian experience is taken for the policy framework as an ideal topology for the ICT development and R &D strategies, in order to shape the industry towards a highly dynamic and technology driven model,

1. Introduction

Sri Lankan Construction Industry, as the 2nd largest industry in the country, indicated over 20% unprecedented growth in 2014 compared with the previous year, while its share in the GDP stood at an impressive 9.7% (Central Bank Report 2014). Until 2010, during the last few decades, the domestic construction industry had a setback, as had its economy, productivity, and investment in R&D etc, due to the ethnic conflict, which impacted the entire macro economy. The country's construction production contributed to nearly 24% of the growth with sector GDP standing at Rs. 339 b (US$ 2.5 b), while the total number of employees in the sector surpassed 450,000 .

The economic landscape has changed quite dramatically upon eradication of the ethnic insurgency. In this post-conflict situation, the economy of Sri Lanka has been able to record many important milestones. The per capita income was expanded to over 3,625 U$ dollars in a relatively short period graduating Sri Lanka to a middle income country and an emerging market economy. The

monetary figures involved in the construction sector were however confusing, as probably a major portion was distributed among foreign constructors. Unprecedented growth experienced by many Asia-Pacific countries in their respective construction sectors, have led to an unsustainable bubble, where giant countries such as China & India tend to find cheap bases in Asia thus contributing heavily to the capital influx of our country.

Sri Lanka has improved a lot after the war as the country leads South Asian countries in terms of the 'Doing Business' rank (Doing Business rank in 2014 was 85). Sri Lanka has developed its rank in terms of dealing with construction and registering property sectors over the past couple of years having ended a 30 year crucial war. However Sri Lanka needs to work hard to get into the top 50 bracket in order to stand tall in the South Asia.

Construction Industry Development Act, no 33 of 2014, known as CID Act, transformed the industry to a different running mode. Gazetted with effect from 28th of December 2014, it transformed the Institute for Construction Training & Development (ICTAD) to Construction Industry Development Authority (CIDA), which is considered as a long felt need by all the stakeholders of the construction industry.

In developing an implementation plan, the standard practice is to first develop a Policy and then focus on an action plan, which is construed as an Act. However the Sri Lankan Construction Industry Development Act has been drafted to develop a National Policy, while implementing the Act by the eminent Advisory Council, which is appointed under the authorities of the Act. A national policy may be dual faceted, having a dynamic and a static frame while the core remains uniform. The CID act is formulated with the specific object of the overall development of the construction industry in Sri Lanka and encompasses the key areas such as regulation, training and development with an institutional mechanism for funding of such activities. The overall objective is to make the Sri Lankan construction industry more efficient and globally competitive, while emerging as a hub of sustainable technology in South Asia.

Accordingly under planning and regulation mechanism, in parallel to the physical construction already taken place in the country, CID Act has introduced new registration schemes for stakeholders. Property Developer Registration scheme is one such development proposed, with the aim of strengthening their image.

Property Developers play a major role in the construction industry contributing significantly to the Gross Domestic Product of Sri Lanka. Scattered and widely spread in a broader spectrum, Property Developers face many issues related to operational transactions which discourage the smooth flow of their activities.

As per provisions of CID Act, the regulatory body of the construction industry in Sri Lanka has also decided to register suppliers of construction materials, components and accessories for construction projects in Sri Lanka. This voluntary scheme will facilitate the procurement of construction materials by the contractors who are already registered with CIDA and also will enhance the opportunities, recognition and prestige of suppliers for the construction industry.
Lack of properly streamlined industry regulations, loop holes in regulating mechanisms, lack of construction contractor monitoring schemes, lack of centralized data systems are major challenges

standing in the way of a sustainable development path of the country, and the CID Act of Sri Lanka has measures depicted to arrest these challenges.

Within the next 5 years, the ongoing infrastructure facilities in Sri Lanka such as roads, irrigation water supply and drainage etc. will be completed, providing more comfortable living standards to the public. The proposed projects such as Central Highway with two destinations (Kandy and Dambulla) and extension of Southern Highway to Hambantota, will take a further period to commission. With the enhancement of infrastructure facilities, more people will be facilitated to achieve their productivity levels and accordingly, the national economy levels contributed by each working group will be increased. Further, it is expected that the construction industry will reach its best level of performance on successful implementation of this Construction Industry Development Act. Nevertheless, a proper mechanism for the guidance of this Act, vis-à-vis a national policy is imperative for the real growth of the sector.

Preparing a master plan with seven strategic management concepts to monitor and control the industry to increase the productivity levels of the each stakeholder attached to the industry, is a proactive project carried out by ICTAD, the predecessor of CIDA, during 2013. The identified seven strategies were to be implemented within 10 years period of time to shape the industry and to achieve the mentioned targets within the identified time frame.

2. International Best Practices in Construction Sector Development

The development of the construction sector in SL context can benefit from the examples of regional best practices. The comparative experiences of Malaysia & Singapore can be considered as relevant to Sri Lankan Construction Industry as these countries possess dynamic construction sectors, compared to other regional countries.

2.1 Malaysian Experience

Malaysia is a developing country, though it's most recent statistics indicate an economy closer to a developed country in the west. Sri Lanka can learn many lessons from this exemplary country with over 70,000 registered construction contractors. (ref. Table: Country Comparisons) Malaysia has developed a strategic approach to the development of its construction sector by preparation of a Master Plan to guide the development of the sector over the ten (10) year period from 2006 to 2016. The Malaysian Construction Industry Master Plan is a strategic policy model which identified the key strategic thrusts, for the development of the sector. These thrusts were used as a basis for preparation of Roadmap towards Construction Industry Master Plan for Sri Lanka 2014~ 2024 (RCIMP) , as they were found to be relevant for the development of the local construction sector as well, and could be used by our policy makers to decide on future plans at least for the next five years.

2.1.1 Strategic Thrusts for a Policy model for Malaysian Construction Industry

Malaysian Policy Model cum Master Plan, using following seven (07) strategic thrusts, recommended the consolidation of the construction sector, strengthening professionalism and the application of research and technology, and encouraging the sharing of best practices within the sector.

- Integrate the construction industry value chain to enhance productivity and efficiency
- Strengthen the construction industry image

• Strive for the highest standard of quality, occupational safety and health, and environmental practices
• Develop human resource capabilities and capacities in the construction industry
• Innovate through research and development and adapt new construction methods
• Leverage on information and communication technology in the construction industry
• Benefit from globalization including the export of construction products and services.

The structure for implementation of the Malaysian Master Plan included the role of the Construction Industry Development Board (CIDB), which has broad representation from construction industry stakeholders and the overall responsibility for monitoring the progress of the master plan implementation process.

2.1.2 Strengths and Weaknesses in the Policy model of Malaysian Construction Industry

Under the Master Plan the Malaysian construction sector has illustrated a policy model targeting a steady growth towards 2015. As reported by Department of Statistics Malaysia (*www.tradingeconomics.com*), GDP growth rate from Construction in Malaysia has indicated a 4.4 % growth in the first quarter of 2015 compared with the same period of 2014. GDP from construction in Malaysia averaged 2200 USD Million from 2010 to 2015, reaching an all time high of 2900 USD Million in the first quarter of 2015 from a recorded low of 1600 USD Million in the first quarter of 2010. In this backdrop, it is envisaged that mixed results have been experienced by Malaysia until 2015, passing signals that some of the thrusts proposed have no real impact on the growth of the sector.

Therefore, in mapping the Malaysian Policy Model, Sri Lankan approach should focus on different implementation strategies, that are ideal to local context.

2.2 Singapore experience

Singapore is currently in the 2nd place in the global index of world's most competitive economies, in addition to its being No 1 in the Doing Business rank. With a stable long standing government, elected several times repeatedly to govern the country during past two decades, Singapore has an inbuilt inheritance for success.

2.2.1 Policy model of Singapore Construction Industry

Eco friendliness being a theme of this smaller nation country with limited natural resources and growing needs, sustainable development is a key imperative. The Building and Construction Authority (BCA) of Singapore takes the lead in ensuring sustainability in the development of the built environment by formulation and execution of sound policies including instruments such as Green Building Master-plans. Though Sri Lanka still preserves a large portion of natural environment outside the metropolitan areas of the commercial capital Colombo, it has now become essential for a way forward in greening this metro city, which accounts for 1/3 rd of its gross national income , to reach the goals of sustainable development. Though concerted efforts of Singapore may not have a significant impact on the environmental sustainability of the world, Sri Lanka can shape its policy framework focusing the lessons learnt from Singapore.

2.2.2 Green model of Singapore

In the construction phase of Green Buildings, there can be an increase of approx. 20% of capital requirement depending on the degree of adaptations of green concepts. Notwithstanding, the running costs can be even as low as 40% compared to non green types. BCA and the Singapore Green Building Council (SGBC) have launched a joint programme, in order to recognise outstanding industry practitioners and professionals for their consistent contribution and significant achievements in the development of a green and sustainable built environment. Through this they intend to motivate their green workforce to constantly challenge the limits in developing innovative solutions for the green building sector. By recognising the talents and raising the profile of built environment careers, the industry will also be able to attract more entrepreneurs to join the green collar workforce and steer the industry towards greater heights. CIDA of Sri Lanka can learn from this example in crafting their corporate goals, as per the obligations under the CID act.

However, it is a sign of enthusiasm that there are few organizations operating in the green development arena in Sri Lanka, such as Green Building Council of Sri Lanka (GBCSL) and Ceylon Institute of Builders (CIOB), introducing concepts and training professionals, for propagation of these important practices. CIOB has affiliated with the BCA of Singapore for several green activities, which is a commendable move. Nevertheless the Country has a number of popular LEED (Leadership in Energy and Environmental Design of USA) certified constructions, spread across the length & breadth, ranging from outfits of textile to leisure industry.

Table 01: Country Comparisons for 2014

Country \ Indicator	Sri Lanka	Singapore	Malaysia
GDP - USD - Billion	75	390	327
GDP Growth rate	7.4	Negative	Below 2.0
Population- Million	20	5	30
Per capita income-USD	3500	56,000	10,800
No of Registered Construction Contractors	2500	2500	70,000
Construction Industry Growth rate %	20.2	3.0	Below 6.0
Doing Business - Rank-	85	1	6

(Source: Central bank Report - Sri Lanka / www.tradingeconomics.com / www.transparency.org)

3. Crafting a Policy framework

Sri Lankan Construction Industry Development (CID) Act revolves on following basic objectives, which is the core of the whole exercise.

Provision of strategic leadership to the stakeholders of the construction industry to stimulate sustainable growth, reform and improvement of the construction sector;

Registration & renewal of registrations of the stakeholders of the construction industry as may be prescribed from time to time;

Promotion of sustainable growth of the construction industry with special attention to the design and development of energy efficient buildings and structures;

Promotion of appropriate research and dissemination and publication of research work on any matter relating to the construction industry and its development.

Formulation, in consultation with other relevant authorities, the standards in construction industry and categorize such standards as compulsory and voluntary standards; and to implement the codes

of conduct, practices, procedures and processes and documentations relating to construction industry.

The seven strategic thrusts given in RCIMP, are inter-related with these objectives laid down in the CID Act and serve to achieve the overall vision of the Sri Lankan construction industry.

Relationships between strategic Thrusts depicted in the RCIMP are illustrated below.

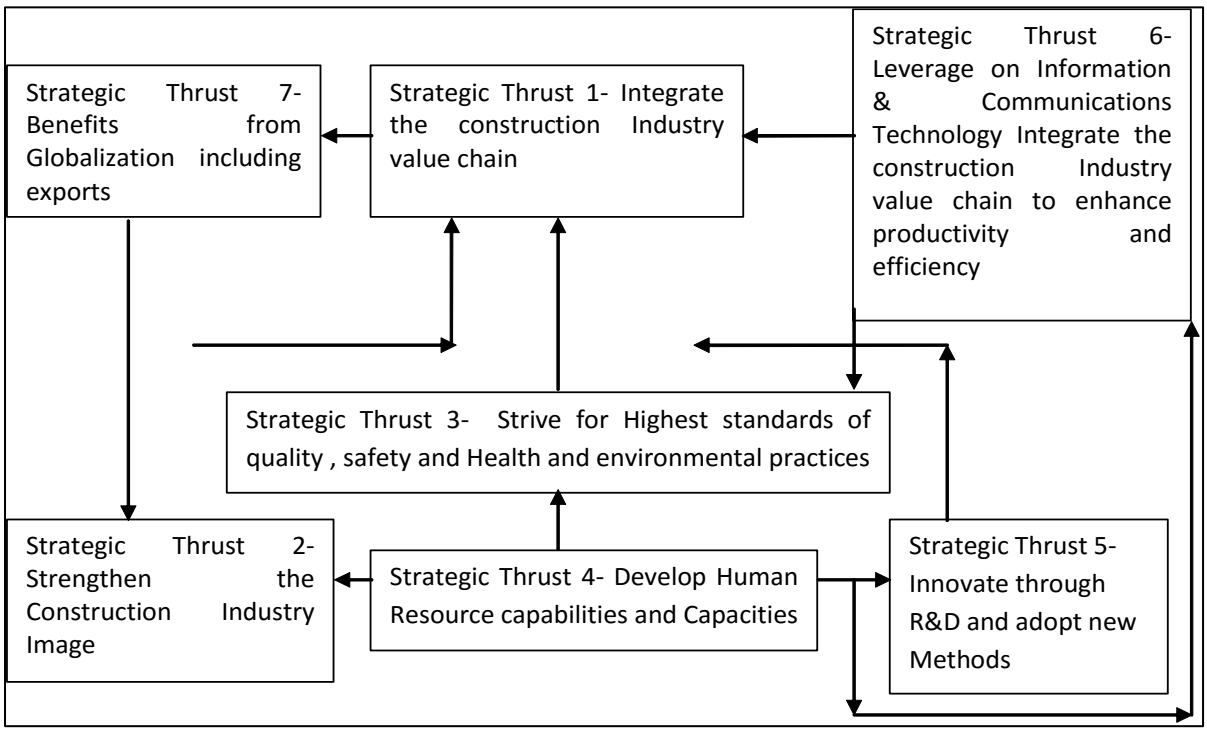

Figure 01: Strategic thrusts in a relationship

Arguably when the thrust areas are recognized as policy outlines, the seven thrusts can be formulated to achieve the desired goals and objectives of the Act, while leaving provision for dynamic changes within the core areas. Therefore the following framework is suggested as a basis for crafting a national policy for construction.

3.1 Suggested Policy framework

Policy 1: **Provide strategic leadership to the construction industry focusing the growth of small and medium scale industry while stimulating sustainable growth of all stakeholders ensuing sufficient work opportunities**

Strategies

1.1: Establishment of the "Construction Industry Development Authority and its operating fund, governing councils, committees : Setup the authority, its fund, board of management and the apex Advisory Council which informs and advices the Minister on all construction related issues in order to further develop the industry.

1.2: Public Private partnering: Promoting the involvement in the entirety in promoting the industry while working to help increase private participation in all infrastructure related work in the form of various operating mechanisms to increase the economic activity.

1.3: Consultation of professionals & constructors in policy making: Obtain assistance of Professional Associations and Trade Associations to help setup, increase role and involvement of associations in promoting the industry, empowering partnering mechanisms of such recognized associations. (Professional Bodies & National Construction Associations)

1.4: Networking: Liaising with foreign national bodies, donor agencies and financing agencies to do with construction in order to stimulate, improve and standardize the construction sector and benchmark with regional counterparts.

Policy 2: **Prepare and enforce regulations in the construction industry to strengthen the image and the value chain of the Construction Industry**

Strategies

2.1: Qualified Persons Listing & Registration: Liaising with Professional bodies to prepare and restructure existing guidelines to regulate the industry and conduct of professionals working in the construction industry in general and maintaining a register of such persons, including Foreign Consultants.

2.2: Construction Contractors registration and categorization: Strengthen existing guidelines in order to grade contractors and regulate their conduct, introduction and adoption of criterion to register Foreign Contractors while maintaining registers of the parties.

2.3: Property Developers registration and categorization: Develop and implement guidelines to register and regulate the Property Development Industry and maintain a register of such developers.

2.4: Registration of Material Suppliers / Plant & machinery and other Services: Develop criterion to register suppliers, in order to regulate them ensuring a regulated and quality assured supply.

2.5: Procurement guidelines with relevant to procuring Construction services, works and goods: Assist and liaise with relevant departments in developing and revising procurement guidelines for construction related works, services and goods.

2.6: Health and safety regulations: Liaising with relevant authorities to assist them in drawing construction industry related health and safety regulations and capacity building of local participants with implementation of necessary compulsory mechanisms.

2.7: Dispute Resolution Centres, guidelines and Acts (Adjudication & Payment Act) : Drawing up regulations, codes of conduct etc, for Dispute Resolution Procedures, Setting up an Adjudication Centre with a system of easy reference for construction related issues, developing and enacting an Adjudication & Security of Payment Act (SOPA) for Construction Industry.

Policy 3: **Improve quality and standard of construction**

Strategies
3.1: Codes of good practice: Introduce and promote codes of good practice and recognized standards in construction.

3.2: Rewarding and recognition schemes: Awarding for excellent constructions, recognition of professional contribution to excellent work, Recognition of Value Engineering in Construction Contracts.

3.3: Standardization: Work to standardize documents and procedures as recommended and approved for construction industry such as Standard Bidding Documents, forms & formats of contracts, Specifications and Best practices guidelines, etc.

3.4: Controlled materials: Introduce regulations and mechanisms to regulate the import and production of materials used in the construction industry through the supplier registration scheme etc, to maintain quality standards.

3.5: Industry statistics and Indices : Collect, collate and disseminate statistics vital to project trends in the construction industry, publishing Price Indices of key items, including material and other resources.

Policy 4: **Develop Human Resource Capabilities and Capacities in the Construction Industry**

Strategies
4.1: Divert allocated funding for responsible gap filling training: Create new curriculum for Construction Industry focused training, after need assessments for niche areas.

4.2: Standards for training and recognition of skills training: Work with the related agencies to introduce, revise and implement basic standards for training and liaise with vocational training authorities to develop National qualifications for skills certification in the construction industry.

4.3: Institute affiliations: Partnering with local and international training establishments, universities where possible, participate as representatives in the academic programs related to construction and assist in improving course curricula, structure and level of courses conducted.

4.4: Catalyst the attraction to the industry by youth: Nurture the Desire to Work in the Construction Industry amongst the Local Workforce by incentivizing through national rewarding and recognition schemes; safeguarding the employment through introduction of insurance schemes with pension benefits.

Policy 5: **Innovate through Research & Development and adapt latest Technologies/Concepts**

Strategies

5.1: Promote technology: Encourage the Adoption of New Construction Techniques and Technologies by introducing recognition schemes, tax evasions and bonus points for Registrations.
5.2: Market and Promote R&D Findings: Establish Sri Lankan Construction Industry Research Excellence Awards.

5.3: Stimulate R&D Activities through Industry Academic Collaborations: Establish Technology Incubators for nurturing and commercializing R & D outputs via strong linkages between academia and industry.

5.4: Establish Funding Requirements and Sources of Funding ; Identifying potential pool of funding, initiate and negotiate for incentives/assistance/sponsorship deals with donor agencies , foreign R & D agencies and develop coordinated program and partnerships between R&D institutes and the industry.

5.5: Promote Green Construction practices and low cost technologies: Cost effective solutions to upgrade thermal performance of building envelops, Environmental friendly construction practices and material recycling.

Policy 6: **Leverage on Information and Communication Technology as a Tool for development**

Strategies
6.1: Establishment of an Information Hub: Creation of a User-friendly Construction Knowledge and Information Web Portal for All the Stakeholders with two different domains for the general public and the other for the subscribers.

6.2: Establishment of Information Collection mechanism for the Construction Industry Portal: Legal provisions to facilitate the collection of the information effectively and regularly from sources / various parties.

6.3: Develop Local Construction Software Industry:
To leverage on latest ICT solutions to increase the competitive edge in the industry and to develop an ICT strategic plan for the holistic adoption of ICT to enhance productivity and competitiveness of the sector's supply chain partners.

6.4: Implement Online Stakeholder Registrations, Planning Submission and Building Plan Approvals: In order to improve the process efficiency, to develop on-line facilities for all types of Registrations , Licensing and Planning Submissions and Building plan approval systems, thus putting into action the conceptual "One Stop Shop" facility.

6.5 Implement Online Secured Tendering System for Public Sector Projects: Develop a Project Bank and data system approachable online, receive tender submissions online and direct them to the respective evaluators.

Policy 7: **Benefit from globalization including the export of construction and services**

Strategies

7.1: Setting up virtual incubators for awareness creation: Identify ventures possible to increase the activities of the domestic entrepreneurs to upgrade and modernize their capacity and skills to enter into this very competitive market.

7.2: Build Partnerships: Facilitate infrastructure developments through Build Operate & Transfer (BOT)/ Design Build Operate & Maintain (DBOM) / Design Build Maintain & Transfer (DBMOT) methods, venture outside by instigating through supplier credit schemes in appropriate overseas markets.

7.3: Financing Instruments: Enable banking sector expansions into Export/Import (EXIM) functions, enabling further facilities for the domestic construction industry to venture outside.

7.4: Dedicated Infrastructure Development Facilities: Set up a facility dedicated for mobilizing private financing, particularly with foreign capital and foreign contractor participation in PPP form for infrastructure development, in the form of venture capital companies.

These strategies, formulated with a vision for the next 5 years or so, can be considered as the basic qualitative platform for developing the Construction sector of Sri Lanka. While streamlining institutional operations of three key partakers, Client, Contractor & Consultant, in Public & Private sector organizations engaged in the industry, these can embrace developments in human capacity building as well. sectors such as the development of green townships and sustainable living are also areas which shall be pursued. The industry needs to transform its resources in the area of knowledge, entrepreneurial, competency and innovation. As such, the opportunities for foreign collaborations and partnerships shall be given prominence.

With policies focusing on incentivizing private sector or donor investments in order to boost construction activity, perhaps in large infrastructure projects, a positive picture can be created among investors for industrial space in addition to largely practised FDIs. However, the current economic activities show a slowdown in exports, as countries such as Iran and Iraq have reduced purchasing our Tea exports, as they lost buying powers with the slashing of Oil prices. As a result of strained finances government may not opt for borrowing further on large infrastructure projects, which could be conducive for building up suggested Partnerships and dedicated PPP models. However one needs to be optimistic in the light of this initiative, as it may pose various risks dampening one's confidence in returns, as it may take longer periods than expected.

One of the probable reasons for development of the construction industries of countries such as Singapore, Malaysia etc, is that the rights of the contractors of these countries are secured by assisting them to maintain cash flows by legal provisions. The Security of Payment Act (SOPA) enacted in these countries save their entrepreneurs from enormous hardships arising from cash flow problems caused to them by delays/defaults in payments by their errant employees. In this context, to safeguard Sri Lankan small & medium scale contractors, who cannot afford to have lengthy Dispute Resolution procedures, by way of assisting them to maintain their cash flow and thereby securing the employments of their employees, suggested inaction of a similar Act cannot be simply overlooked.

4. Conclusion

The implementation of the CID Act, is an onerous responsibility of the CIDA, which is the executing authority for the Act in Sri Lanka. This study focuses brief illustrations of responsibilities of similar regional organizations, namely BCA of Singapore & CIDB Malaysia. As a benchmarking strategy, Sri Lanka should always interact with such entities and get its resources upgraded in order to adapt world class practices. The implementation and action plans prepared by CIDA, aligning with the policy framework, shall turn on a new lead in promoting a Standardized Construction sector for Sri Lanka. Nevertheless, CIDA has to embark on R & D driven, ICT oriented model with focus on Human Resources development, as well. Such a task would require specific strategies to be adopted and implemented. Thus RCIMP, identifying strategic thrusts mapping with regional models to set apart towards a sustainable Industry, shall ultimately help develop a National Policy for Construction Industry in Sri Lanka. Such a policy, which is time bound, will help deliver a better physical infrastructure outfit for the sustainable development of the country.

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ISSUES RELATED TO PROMOTION OF ALTERNATIVES FOR RIVER SAND

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Abstract

Though, sand mining is imperative to continue constructions, it has become a disaster in terms of environmental sustainability due to uncontrolled and illegal sand mining. If the demand for sand could be partly met from alternative sources and thereby the environmental impact due to excessive river sand mining could be significantly reduced. The following alternative sources were identified that fit for present construction technology. Namely off shore sand and manufactured sand.

Action is therefore needed to encourage the construction industry for the use of recommended alternatives such as off shore sand and manufactured sand. To implement this, the use of off shore sand can be made compulsory for large construction projects including land and drain filling. Furthermore, licensing procedure of Geological Survey & Mines Bureau (GSMB) and Central Environmental Authority (CEA) should be revised in order to promote the recommended river sand alternatives.

The most important requirement is changing the mindset of specifiers and general public. Therefore, education on these alternatives and their properties is a must.

Apart from the river sand alternatives proposed it is necessary to explore the use of construction and demolition waste to produce fine aggregates to minimize the demand for river sand.

Therefore, implementing tasks and activities to overcome river sand mining an promoting alternatives are essential. This report will be an identification of issues related which should be overcome to mitigate this national issue in a productive way.

Alternative for River Sand

Off-Shore Sand

Offshore sand was found to be the best alternative to river sand. In Sri Lanka, the construction industry in Western province is responsible for 40% (Byrne, G., Nanayakkara, A. 2002) of the total sand demand. If this river sand were to be replaced by a reasonable amount of off-shore sand which is available in Western province, the immediate pressures on rivers could be mitigated. At present the price of off-shore sand varies between LKR 4800- 6400 at Sri Lanka Land Reclamation Development Corporation (SLLRDC) outlets. But, it is less popular because there is a possibility that shells and chlorides are present in it.

Manufactured Sand

Manufactured sand has been used for many years in all over the world in lots of construction applications including waterways and dam projects, highway and airport paving, bridges, power plants, all types of industrial and commercial constructions and concrete pre cast products of all kind.

It is identified that producing manufactured sand in macro scale is a very lucrative as a business in Sri Lanka. Investors also awaiting for such business. At present few quarry operators are deliberately manufacturing fine aggregate as an alternative for sand in normal concrete. This material can be produced at a competitive price to river sand when it is produced as a by-product.

Dune Sand & Land Based Sand

Dune Sand is available at coastal zones of Sri Lanka, especially North Western and South Western coastal belts which experienced very low rain falls and monsoon winds. Sandy beaches and spits, raised beaches, sand dune hills and barrier beaches are common in Northern, Northern -Western and Southeastern coastline of the Island.

It is understood that dune sands and land based sands are not environmentally friendly alternatives for the construction industry as this will create major environmental problems especially in water sensitive areas and also land based sand is another type of alternative which is available at river banks. Miners tend to use mechanized mining and thereby causing limitless destruction to the environmental eco-balance.

Therefore, Mining dune sand and land based sand is not recommended for construction activities as a solution of environmental sustainability.

For promoting proposed alternatives, it is required to determine a mechanism. The paper discussed below the issues to be addressed when preparing such mechanism.

Issues Identified with Respect to Implementation of Alternatives for River Sand

Licensing procedure

Though construction industry can not prevail with out quarry industry, it proceeds under many circumstances. Specially, the licensing procedure is very cumbersome. Nearly, 9 licenses from relevant government institutions to be sought when quarry operations are to be carried out making it cumbersome affair. Namely, they are license of;

GSMB
CEA,
Department of Archeology,
Local Authorities,
Explosives controller,
Grama niladhari,
Police
Disaster Management Centre,
Divisional Secretariat.

For operating a quarry or any business, short period of validity of license is a barricade. As this reason affects when obtaining financial assistance from banking institutions without a mortgage. Therefore, to motivate the new potential investors it is required to increase the licensing period at least for 3-5 years. But, the license should be reviewed or audited annually by monitoring the license holder’s adherence to the regulations and performance.

Further, issuing all licenses from one stop shop that consists of members from relevant government authorities is a good solution to minimize the issues through out the licensing process.

Tax Imposed on Quarry Operators

It is identified that high tax is imposed on crusher plants on explosives etc. in addition to the licensing payments. Therefore, it is required to revise the tax procedure reducing the tax imposed on explosives as royalty.

Acquisition of Lands

A basic need to operate a quarry is a large, bear land with a suitable rock having the required physical and mechanical properties.

At least 1 km^2 area of land surrounding the quarry should be a vacuum of buildings. The common practice is to remove the habitants when suitable land for quarry is found by renting, leasing or procuring the houses and habitats and transferring them at the end of the operation. Quarry operators have to spend huge sums of money for procuring, renting or leasing the surrounding lands and constructions. In addition to that provision of an access to the selected land is also expensive due to procuring adjacent lands.

People are used to construct temporary huts when quarry operation starts and conitinues and protests against health and safety issues.

The solution proposed for this issue is to publish the zoning plans available at local authorities and to prepare new zoning plans where required. The responsibility lies on Local Authorities.

Further, GSMB should conduct investigations on locations which are suitable for establishing at least one mega quarry in each district. When a transport cost is high for a particular district which has a high land area of coverage, number of locations shall be increased.

Promoting Investors

Dredging off-shore sand is a marine type work process which need high capital cost of investing. In Sri Lanka, SLLRDC has the sole authority that has the permit for off-shore sand supply.

Contractors are selected according to the Government Procurement Procedure conducted by SLLRDC. Mostly the contractors/ bidders are from European contries like Netherland, Belgium, Denmark. Most of them execute projects in Singapore, India and Gulf countries on regular basis. When SLLRDC decides to tender for dredging and bidders have excess resources, they submit solicited bids for dredging off-shore sand in Sri Lanka coastal zone.

It is required to call for expressions of interest from foreign investors by enriching them accurate data for investing and government institutions should take leadership for opening more and more international opportunities as well. Arrangements have to be done for explorations with respect to such explorations to introduce suitable locations/area for future off-shore sand extraction projects. National Aquatic Resources Research and Development Agency (CCD, NARA) is the only local institution that can play a major role in this regard.

A low cost machine to produce manufactured sand may be produced by the National Engineering Research Development Centre(NERDC), National Building Research Organization(NBRO) for small scale investors. Loan schemes or installment payments could be introduced for promoting and motivating. At least, to facilitate for first 10 investors, 50-75% of capital cost of investment for manufacturing sand should be granted on loan basis. Construction Guarantee Fund also can play a major role in this regard.

Non Availability of Washing and Grading Plant.

In terms of strength of structural elements concerns, off-shore sand should maintain its quality. The main issues with off-shore sand is Chloride and Shell content. Treating off-shore sand by removing chlorides and shells as per the SLS 1397 before use is a must.

Therefore, SLLRDC who play the main role in off-shore sand business should consider the implanting of washing and grading plant in order to fulfill the requirements. Currently, SLRDCC has no such plants. Initial Capital Cost of a plant having the feeding capacity of 180-200 tons per hour would be around LKR 100-120 million. With other costs including foundations, power and water supply, effluent/waste discharge etc. the total cost of the plant would be around LKR 175-200 million. Although, this is a huge cost which cannot be purely invested by SLLRDC alone, efforts taken to invest for such operations would bring out lot of benefits to SLLRDC. It has been planned to implement washing and grading plant during next 4 months.

Lands and water for washing.

As said, washing is a must to fulfill the specifiers criteria. Suitable lands for washing off-shore sand should be found and pipelines for supplying water to stock pile yard should be laid. As using fresh water for such activity is not appropriate, a suitable method for adopting should be defined by SLLRDC.

Specifications for alternative materials.

Although, many countries are used to off-shore sand and manufactured sand for their constructions, our construction community has no confidence of using them. The main reason for such issues is the lack of awareness on physical and mechanical properties of alternatives, less recommendations, additional costs and environmental concerns with respect to the construction activities.

For promoting sand alternatives and the different types of construction methods, specifications and standards should be prepared and revised to ensure the conformity of the quality aspects. In this point, CIDA, SLSI, NBRO, SSE, CECB, RDA etc. should take the leadership. It is experienced that large quantity of river sand is not ued effectively, but for embedding pipelines, land fillings etc. as specified in the common specifications used by the industry.

Therefore, educating the specifies and general public (House owners) is an essential for promoting alternatives. Presentations elucidating the benefits of alternatives in terms of environmental sustainability should be conducted. The scenario should clearly explain the environmental hazards damaging eco-systems during the gathering, meeting and discussions of stakeholders open to the public discussions. The role of community organizations as the Sri Lanka Water Partnership which provide forums from grass root level to macro level among the partners of the sand industry is very important at this juncture.

Meanwhile, a guide book including all the technical information on aggregates is another feasible solution to enhance the knowledge levels of consultants etc. This technical guidebook should be prepared by the relevant institutions such as Society of Structural Engineers and publish it for use as soon as possible. This book shall include different combinations of specifications relevant to the construction purpose. As New specifications which are approriate shall be obtained from the manufacturers and shall be published if satisfied.

A percentage of total river sand usage applicable for a project should be limited by a gazette noticification. Thereby, total river sand demand could be minimized.

Use of Construction Waste and Demolition (C & D) for Minimizing River Sand Demand

The cost of waste material is not only its value. It includes the cost of disposal including handling, transporting and tipping charges and cost of consequential losses. Thus it's more than we realize. Nowadays, global attention on waste management is high with the identification of the threat developed by the severe climate changes currently experiencing. Construction industry generates a large amount of construction and demolition waste in quantities that are fast increasing as more buildings are demolished and refurbished to age.

Sri Lankan Government involvement in categorizing construction and demolition (C & D) waste management under the broader umbrella of solid waste and has been a critical issue and is yet to begin. One way of C& D waste management is recycling and re-using them for construction activities. In Sri Lanka, there is no particular land space and thus disposal charges to dispose construction waste, in other countries disposal cost of waste being increased, due to the lack of land fill areas.

The recycled construction and demolition waste can be used for road constructions as per the finding of Construction Waste Management Project (COWAMP). Those results can also be used for derive specifications and design guidelines on the recycled C & D waste as a road construction material.

E.g. If rigid pavements are to be constructed, the main component is the concrete layer. Concrete is a combination of cement, aggregate, water and admixtures. Aggregates are inert granular materials such as sand, crushed stone or gravel and COWAMP have proved that use of recycled C & D is appropriate. Rammed earth construction is another option available.

However, recycled aggregate is not commonly applied in Sri Lankan construction activities, the demand is low and it is a de-motivating factor for the businessmen interesting on recycling business. An awareness programmes for specifiers should be conducted on applications. Businessmen should be motivated providing more opportunities in the construction market as recycling business is very lucrative. Moreover, it is required to disseminate the technology know-how for separating fine aggregates from C& D waste and the need of a plant for separation is raised. NERDC, NBRO as research oriented institutions can play a vital role in this regard. Such new inventions should be promoted among business community to support to re-cycling of C & D industry.

Conclusion

Number of studies have shown that mining of sand in the rivers for construction purposes is caused serious environmental problems to the country. The most serious of these problems are coastal erosion, pariculary in the Western and North Western Provinces, river banks collapses and salinity intrusion into the rivers. The latter is affecting drinking water and irrigation.

To minimize the negative impact due to sand mining, it is required to promote alternatives for river sand. The two alternatives recommended are off-shore sand and manufactured sand.

However, for promoting such alternatives in construction, critical issues prevailing should be addressed. The most important issues that should be addressed immediately are

Revising related government regulations such as GSMB & CEA licensing,
Revising Specifications for aggregates by the key government institutions such as CIDA, RDA, SLSI in order to open the opportunities for divert alternatives.
Improve off-shore sand quality by providing washing and grading plant by SLLRDC, and
Promote construction waste to reuse after archiving the quality for construction.

Therefore, government intervention and support on preventing this excessive and uncontrolled sand mining and promoting alternatives for river sand is highly essential. With the successful implementation of recommended solutions a well balance relationship between eco-systems and construction industry could be achieved.

Abbriviations

CCD	Coast Conservation Department
CECB	Central Engineering Consultancy Bureau
CIDA	Construction Industry Development Authority
COWMP	Construction Waste Management Project
GSMB	Geological Survey & Mines Bureau
NARA	National Aquatic Resources Research and Development Agency
NBRO	National Building Research Organization
NERDC	National Engineering & Research Development Centre
RDA	Road Development Authority
SLAB	Sri Lanka Accrediated Board
SLSI	Sri Lanka Standards Institution
SLLRDC	Sri Lanka Land Reclamation & Development Corporation
SSE	Society of Structural Engineers, Sri Lanka
UOM	University of Moratuwa

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ENFORCEMENT OF FOREIGN ARBITRAL AWARDS IN SRI LANKA

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Abstract

Arbitration has become very popular in resolving commercial disputes nationally and internationally. After many countries ratifying the New York Convention[3], arbitrations could be conducted in one country and enforcement may be made in another country in respect of commercial disputes which are considered as international. Sri Lanka ratified the New York Convention without any reservations and in 1995 an Act was passed, which is called 'Arbitration Act No. 11 of 1995'. After the introduction of this Act, any international contractor could resolve his disputes by arbitration and enforce its award in Sri Lanka, irrespective of the seat of arbitration, which could be a country of convenience for all contracting parties. However, when an award is made in favour of one party and if the assets of the opposing party are in another country, the successful party could enforce the award locally if it has grounds to believe that the assets of the opposing party are available in that country. The Arbitration Act of Sri Lanka provides this facility subject to restrictions imposed in Section 34 of the Act. The enforcement procedure and the hold ups in enforcement will be discussed in this paper with case references.

System of Commercial Courts in Sri Lanka

In Sri Lanka, arbitration as a dispute resolution mechanism, has become very popular in the construction industry. One of the main reasons for this popularity is that it does not have any formalities which are required in a Court of Law. Sri Lanka also follows the New York Convention and we have been a party to the New York Convention without any reservation. Arbitration has been enacted in Sri Lanka by Arbitration Act No. 11 of 1995 and therefore, we have been conducting arbitration under the New York Convention since the year 1995 for almost 20 years now.

[3]United Nations Convention on the recognition and enforcement of foreign arbitral awards. (NewYork 10/6/1958).

In the Sri Lankan legal system, commercial disputes can be tried in the District Courts or in the Commercial High Court. Most of the disputes in contracts end up in the Commercial High Court as the District Court does not have jurisdiction to try commercial disputes, if the disputed matter is in excess of US$ 37,000/-. Arbitrations are consensual in nature and private in character. Arbitrations in Sri Lanka could be conducted in one of the arbitration centres or any other location where the parties desire to hold it. In most of the construction arbitrations where there is a lack of involvement of foreign parties, arbitration is done using ad-hoc procedure. However, Civil Procedure Code[4] is generally used in arbitration as lawyers are involved in the arbitration process. According to the Arbitration Act No. 11 of 1995, a party can opt to leave the Evidence Ordinance[5] out from the arbitration proceedings. However, when no such ordinance is applicable, still in order to regularize the arbitration hearings, principles of the Evidence Ordinance[6] are followed, and if there is a dispute between the parties in respect of the rules of evidence, the arbitrator will give a ruling mostly based on the Evidence Ordinance[7].

This is equally applicable for the Labour Tribunals although the Evidence Ordinance is excluded in the Labour Tribunals. Although the arbitration procedure is a private arrangement between the parties, enforcement of the arbitration will be a judicial proceeding and therefore, it will be held in public in the High Court[8]. Although there are many High Courts in the provinces, only the Colombo High Court has the power and jurisdiction to enforce the arbitral award. Therefore, if a party desires to enforce an arbitration award it is a mandatory requirement that enforcement papers have to be filed in the Colombo High Court. Although the term 'High Court' is mentioned in many places in the Arbitration Act, it is defined as "High Court of Sri Lanka Holden in Judicial Zone of Colombo or Holden in Such Other Zone as may be designated by the Minister with the concurrence of the Chief Justice by order published in the Gazette"[9].

Party Autonomy in Arbitration

The concept of party autonomy allows a party to select their arbitrators, seat of arbitration, procedural law as well as the substantive law in Sri Lanka. However, when it comes to enforcement of foreign arbitral awards, it takes a strictly judicial character and it is a requirement that a petition has to be filed by the party who is enforcing the award in the High Court of Colombo complying with the Civil Procedure Code of Sri Lanka[10]. Section 33[11] deals with the enforcement of foreign arbitral awards, where it is stated that: *"A foreign arbitral award irrespective of the country in which it was made shall subject to the provisions of Section 34 be recognized as binding and, upon*

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[4]Civil Procedure Code of Sri Lanka No. 2 of 1889 and amendments.

[5]Aribtation Act No 11 of 1995 of Sri Lanka, Section 17.

[6]Evidence Ordnance of Sri Lanka No. 14 of 1895 and amendments.

[7]*Ibid.*

[8]High Court of Sri Lanka, Colombo.

[9]Arbitration Act No. 11 of 1995 of Sri Lanka, Section 50

[10] Civil Procedure Code of Sri Lanka No. 2 of 1889 and amendments

[11]Arbitration Act No. 11 of 1995 of Sri Lanka

application by a party under Section 31, to the High Court[12], be enforced by filing the award in accordance with the provisions of that section."

Arbitration & Court Proceedings

The difference between the arbitration proceedings and the proceeding in a Court of Law came to the attention of Sri Lankan courts in the case of *StateTimber Corporation* vs. *Moiz Goh (Pte) Ltd.*[13] In this case the court held that enforcement proceedings of an arbitration is not a continuation of the judicial proceeding but it is a separate court proceeding. This was challenged because when the Arbitration Act[14] was enacted in the year 1995 (Section 5), it stated that if there is an arbitration clause in the contract and if the parties have agreed to refer the matters in dispute to arbitration, under this agreement the Court will have no jurisdiction to hear and determine such a dispute in case if either of the parties object to a judicial hearing. In this case the parties have referred this matter to arbitration before enactment of the Arbitration Act and once the arbitration award has been made, in order to enforce the arbitration award according to the previous law they had to file the award in the District Court[15]. The arbitration award had been made after enactment of the Arbitration Act although arbitration proceedings were conducted before enactment of the Arbitration Act. Therefore, the party who wanted to enforce the award had filed the enforcement in the District Courts, whereas the Court held that as the enforcement of the award is not a continuation of the arbitration proceedings, they should conform to the new Arbitration Act which was enacted in the year 1995. Accordingly, enforcement should have been filed in the High Court[16] in conformity with the Arbitration Act. It has been observed by Sarath N. Silva CJ, that: *"The phrase 'arbitration proceeding' is not synonymous with the proceedings before a court of justice for the enforcement of an arbitration award."*

In the higher courts in Sri Lanka the official language is Sinhala or Tamil and also there is the provision in the constitution of Sri Lanka stating that English is the link language. However Commercial High Courts work in English and also the Appellate Courts in Sri Lanka which are the Court of Appeal and Supreme Court where the media of language is English. However, if a foreign award is presented in the courts in a language other than English, it shall be translated into one of the official languages or English where applicable[17].

However, most of the Conditions of Contract that are used in the construction industry are in English. Lawyers prefer to make their submissions in English although the Sinhala or Tamil version is also acceptable for minor contracts where there is no invloment of foreign parties. When documents are filed to enforce an arbitration award the Claimant also has to file an affidavit which has to be certified by a Commissioner of Oaths or by a Notary. When filing an award for

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[12] High Court of Sri Lanka, Colombo

[13][2002] Bar Association Law Journal Report 44

[14]Arbitration Act No. 11 of 1995 of Sri Lanka

[15]Distict Court in Colombo

[16] High Court of Sri Lanka, Colombo

[17]Arbitration Act No. 11 of 1995 of Sri Lanka, Section 31(3)

enforcement there is a requirement in terms of Section 31(2)[18], that either the original award or a duly certified copy of the award should be filed in Court[19] and what is '*duly certified*' is also defined under Section 31(i) and (ii)[20]. The extracted wording of the Arbitration Act is given below:

"For the purpose of this subsection a copy of an award or of the arbitration agreement shall be deemed to have been duly certified if –

it purports to have been certified by the arbitral tribunal or, by a member of that tribunal, and it has not been shown to the Court that it was not in fact so certified; or
it has been otherwise certified to the satisfaction of the court."

The term *"....to the satisfaction of the Court"* is also defined in the Sri Lanka Courts. Courts will take a very strict view of this matter.

Enforcement of Arbitration Award

In order to enforce an arbitration award the awardee has to comply with Section 31 of the Arbitration Act[21]. Section 31 states that the award shall be made in the appropriate High Court[22] within one year after the expiry of 14 days of making the award. This timing is also interpreted in one of the cases in the Supreme Court. Fourteen days has been allowed mainly because if there are any arithmetical errors in the arbitration award, according to the Arbitration Act[23] a party could get it corrected through the arbitrator within a period of 14 days[24] and in order to compensate for these 14 days no papers could be filed before expiry of 14 days from the receipt of the award. However, it is not very clear whether the one year period mentioned in the clause is counted from the date of the award or after expiry of 14 days from the date of the award. Therefore, to be on the safe side, it is always preferable for the awardee to make an application within one year from the date of receipt of the award[25].

In a decided case in the High Court conducted in Colombo, it has been held that an award certified by an Attorney-at-law in Sri Lanka, cannot be accepted as a duly certified term in terms of Section 31 (2) (ii) of the Act. However, this has been overruled by the Supreme Court and held that the High Court has to decide this matter to the satisfaction of the Courts.[26]

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[18]Ibid Section 31 (2)

[19] High Court of Sri Lanka, Colombo

[20] Arbitration Act No. 11 of 1995 of Sri Lanka

[21]*Ibid*. 31

[22] High Court of Sri Lanka, Colombo

[23] Arbitration Act No. 11 of 1995 of Sri Lanka

[24]*Ibid.*, Section 31 and 33

[25]*Ibid*.

[26]Kristley (Pvt) Ltd *v* State Timber Corporation, [2002] 1 Sri LR 225 at page 239

Challenging the Arbitral Award

The objections for enforcement of a foreign arbitral award could be made under Section 34[27]. The grounds on which an arbitral award could be objected are very restricted and the application of objections shall be made within 60 days from the receipt of the award by the opposing party. In summary, the grounds for objections to be made are - incapacity, validity of agreement, proper notice not being given to the party against whom the award was given, notice of appointment of the arbitrator, arbitral proceedings or otherwise inability to present its case. Another ground which has been specified where an award could be challenged is that the dispute is not contemplated on or not falling within the terms of the submission to arbitration, or the decision made was done beyond the scope of the submission to arbitration. However, there are instances where the Supreme Court has separated out the portion that has not been submitted, with the portion which has been submitted to arbitration and the award made only in respect of the matter which has been submitted to arbitration.

Arbitral award could also be challenged on the ground that the composition of the arbitral tribunal or the procedure adopted in the arbitral tribunal does not conform to the agreement of the parties. However, there are further provisions mentioned under Section 34 (1) (b) of the Arbitration Act where the Court has the power to reject an arbitral award. Such rejection of the award has to be done on the information that has been provided by the parties and the court may not go into a voyage of discovery in finding the facts. The two grounds which have been specified under this section are that the dispute is not capable of settlement by arbitration under the laws of Sri Lanka or the enforcement of the award is contrary to public policy of Sri Lanka.

A decree entered by the High Court on a judgment on an arbitral award may be enforced in the same manner as a decree entered by a court in terms of the Civil Procedure Code.[28] Once the decree is entered by the High Court it cannot be appealed or revised against the Order of the High Court except as per the provisions laid down in Section 37 of the Arbitration Act[29] which states that a judgement or decree referred to the Supreme Court shall be revised or varied only on the grounds of a question of law and also having first obtained leave of the Supreme Court. There is also an interesting position provided in Section 37(4)[30] of the Arbitration Act where it states that parties could enter into an Exclusion Agreement at the time of entering into the Arbitration Agreement which excludes the right of appeal to the Supreme Court in relation to the award that has been made. However, if the award had been rejected or set aside by the Court of the country in which the arbitration award had been made, it could be fatal to recognize the enforcement of such an award in Sri Lanka.

There might be issues that could arise when a party makes an application to enforce a foreign arbitral award in Sri Lanka. The questions in respect of the enforcement of a foreign award, such as validity of the arbitration agreement or the procedure of the arbitration, may be determinated by law to which the parties are subjected to by the Arbitration Agreement or failing which to the law of the country where the arbitral award had been made. Therefore it could create a complicated

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[27] Arbitration Act No. 11 of 1995 of Sri Lanka

[28] Civil Procedure Code of Sri Lanka No. 2 of 1889 and amendments

[29] Arbitration Act No. 11 of 1995 of Sri Lanka.

[30] *Ibid.*

situation when issues are raised in respect of arbitration itself, such as procedure of arbitrtation, validity of the award etc.

Enforcement of Foreign Arbitral Awards

Sri Lankan courts have accepted the position that when foreign law is questioned in Sri lanka, it is considered as a question of fact which has to be proved through witnesses. This concept is common in normal litigation as well according to the Conflicts of Law principles. One cannot extend the foreign law in Sri Lanka by any other means except through the accepted principles of foreign law prevailing in our legal system.

The Sri Lankan Arbitration Act has not made a clear separation on the recoginition and enforcement of an arbitration award. Howver, these are two different concepts where recognition will act as *res judicata* for future litigation or arbitration. Without enforcing an award the party may not be able to derive any benefit although the award has been recognized by the High Court. However, recognition and enforcement are inexplicably linked.[31] .The Sri Lankan High Court does not have jurisdiction to relieve a decision of an arbitral award on the merits of the award. This is equally applicable whether the award was made locally or internationally.

The grounds which are established in Section 34 of the Arbitration Act are exhaustive and no further ground is allowed by a court in order to relieve the decision of an arbitral award. In the decided case of *Kristley (Pvt) Ltd. vs. State Timber Corporation*[32] it has been held that in order to challenge an arbitral award on the ground of incapacity, the required incapacity should exist at the time of entering into the agreement. In this case although Kristley was a registered firm in Australia, they have been re-registered thereafter for some period when the arbitration was pending. However the same company was re-registered before completion of the arbitration. The court held that temporary de-registration will not have any effect on their incapacity as they have the lawful capacity to enter into the contract at the time when they entered into the contract. And also at the same time they were re-registered during the process of arbitration and were active at the time of the final award.

Invalidity of Arbitration Agreement

It has been decided in the *Hotel Galaxy case*[33]by the Supreme Court of Sri Lanka that the arbitration clause is valid even if there are repudiatory breaches of the contract and the only ground by which arbitrtation could be challenged in respect of an arbitration clause is when the arbitration clause itself is invalid. To resolve the validity of an arbitration clause might create complex situations if laws of different countries are involved. However, the Sri Lanka Arbitration Act has clarified this situation by providing a provision stating that the Arbitration Agreement has to be decided in accordance with the law to which the parties have subjected the Arbitration Agreement. In case if it is not stated in the Arbitration Agreement the Act states that the law of the country where the award is made will govern. In the decided case *Pedcor Management Company Welfare Benefit*

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[31]Ibid

[32] Arbitration Law In Sri Lanka, K. Kanaga-Isvaran, PC & SS Wijeratne, 329

[33]*Hotel Galaxy (Pvt) Ltd., and Others v. Mercantile Hotels Management Ltd.,* [1987] 1 Sri LR 5

Plan v. Nations Pers. of Textiles Inc.,[34]it has been decided that the Federal Arbitration Act will override the choice of law decision made by the parties in respect of the Arbitration Agreement.

Breach of Natural Justice

Under the principles of natural justice the opposing party should be given adequate notice for them to defend the claims made by the opposing party. This provision is embedded in the Arbitration Act in respect of local and foreign arbitral awards[35]. In *Iran Aircraft Industry v. Avco Corporation*[36] and also in *Texaco Overseas Tankship Ltd. v. Okada Shipping Co. Ltd.*[37] it has been decided that the enforcement Court will not go into the details whether the arbitrator followed the principles of natural justice or not. In the latter case, the Japanese company claimed that they were unable to defend the arbitration case as notice had been delivered to its New York Counsel who was previously in charge of this contract. However, the Japanese Court rejected this argument stating that they have failed to inform the Claimant of their change of representative from New York to another location.

In *Parsons and Whittemora Overseas Co. Inc. v. SocieteGenerale de L' Industie due Papier*[38]it was held that their rights were not impinged by the foreign arbitral tribunal by refusing to reschedeule the hearing for the convenience of one of the witnesses. However, Court had noted that giving proper notice for the other party to present his case is essential but held that the American Corporation failed to establish this position to the satisfaction of the Court. When parties are nominating witnesses there is a risk on the party that such witnesses may not be available when they are required to give evidence in another country. This was considered as an inherent risk in international arbitration, and in this instance the witness' affidavit was available with the arbitral tribunal.

In *Minmetals Germany v. Ferco Steel*[39]the Respondent's position was that the arbitral tribunal had obtained evidence on their own by investigation and therefore they challenged the decision of the arbitrator. However, the challenge was not successful as Court held that the Respondent was given an opportunity to disclose such evidence and also to comment on it, whereas the Respondent failed to do so. Therefore if a party has failed to respond or state their position in an arbitral tribunal they cannot challenge the same circumstances in the enforcement court.

The Sri Lanak High Court will also refuse to recognize an award if they found that an arbitral award was made outsided the scope of the submission. However, there is a provision in our Arbitration Act for the court to separate out the portion that had been referred to the arbitral tribunal and the

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[34] 343 F.3d 355 (5th Cir. 2003)

[35] Arbitration Act No. 11 of 1995 of Sri Lanka, Section

[36] 18 Yearbook of Commercial Arbitration (1993) 599

[37] 10 Yearbook of Commercial Arbitration (1985) 483

[38]508 F. 2d 969 (2nd Cir.1974).

[39]*Minmetals Germany v. Ferco Steel* 24 Yearbook of commercial Arbitration (1999) 730

portion which had not been referred to the arbitral tribunal and to enforce the award only on the portion that had been referred to the arbitral tribunal.

The Sri Lanka court may also make a note of decisions made in other countries and in this context *LIAMCO v. Libya* [40]is an important case where the court allowed the award in spite of the arbitral tribunal awarding a large sum as consequencial losses. If the arbitral tribunal is improperly constituted, this could be challenged under Section 32 and 34 [41]. However, if these provisions are not allowed in the Arbitration Agreement the issue should be resolved in accordance with the law of the country where arbitration has taken place. Although there is a provision in order to challenge an arbitral award once the award is made it is preferable to raise this objection during the process of arbitration so that parties could save money and time.

When an arbitral award made in another country is objected by the other party on the ground that the award has not become binding on the parties or has been set aside or suspended by a court of the country in which or under the law of which the award was made, the party who wants to recognize or enforce the award may invoke any objection by furnishing a bond or other form of security in terms of Section 34(1)(a)(5) [42]. A considerable controversy could arise when an award is enforced by a country where enforcement had already been refused by the country where it had originally been made. In this instance, in the *Hilmarten case* [43] *and Chromalloy Aeroservices Inc. v. Arab Republic of Egypt*[44]are decisions where enforcement had been done in spite of being set aside by the Court in the country where the arbitral award had been made.

If one party is the state, in many instances they have raised objections such as public policy in order to defeat enforcement of an arbitral award. In an arbitration which has been decided locally, the Supreme Court has refused to entertain the objection of public policy on flimsy and vague grounds in the decided case. In *Lightweight Body Armour Ltd.*[45] both parties have readily accepted that the only grounds in which an arbitral award could be set aside is under Section 32 of the Arbitration Act which is the same as Section 34 of the Arbitration Act which is applicable for foreign arbitral awards. It has been recorded in this case that: "*It was conceded by all counsel at the inception of the hearing that the only grounds on which an Award could be set aside were contained in Section 32(1) of the Arbitration Act No. 11 of 1995. Indeed the application for setting aside the Award before the High Court was made only in terms of Section 32(1) of the Arbitration Act. Parties also*

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[40]*Libyan American Oil Co. v. Socialist People Libyan Arab Jamahirya, formerly Libyan Arab Republic* (1980) 20 ILM 1: 7 Yearbook of Commercial Arbitration (1982) 382.

[41] Arbitration Act No. 11 of 1995 of Sri Lanka

[42]*Ibid.*

[43]*Hilmarton Ltd. v. Omnium de treatment et de valorisation (OTV) Revue de l'arbitrage* 20 Yearbook of Commercial Arbitration (1995) 663.

[44] 939 F. Supp 907 (District of Colombia 1996)

[45] Supreme Court.(CHC) Appeal No. 27A/2006, Arbitration Law In Sri Lanka, K. Kanaga-Isvaran, PC & SS Wijeratne, 431

conceded that it was an immutable fact that Section 26 of the Arbitration Act provides clearly that an arbitral award is final and binding on the parties to the Arbitration Agreement."[46]

Public Policy

In Sri Lanka public policy has been invoked in many other cases and in Kristley*(Pvt) Ltd. vs. State Timber Corporation*[47] the arbitral award had been made on a certificate of quantity and quality which has been challenged at the arbitral tribunal stating that it was a forged document. A representative from the orgnization where the alleged test certificate had been issued has also given evidence to testify forgery before the arbitral tribunal, and he has also been cross examined lengthily. Furthermore, there had been evidence before the tribunal to show that the certificate in question was a forgery. However the arbitral tribunal has made the award based on this document stating that forgery had not been raised as an issue. Therefore, although public policy has been identified as the ground to refuse recognition or enforcement of an arbitral award, in the decided cases it is evident that court had taken a very serious view to reject enforcement of an award on the grounds of public policy.

The doctrine of public policy is somewhat open ended and flexible, and capable of wide and expansive definition. It is this flexibility leading at times to inconsistency and unpredictability in application which has led to judicial censure of the doctrine and earned it the reputation as one of the more controversial exceptions to the enforcement of arbitral awards. In *Richardson v. Mellish,* (18824) 2 Bing. 228, the court succinctly observed that public policy is *" ...a very unruly horse, and once you get astride it you never know where it will carry you. It may lead you from sound law. It is never argued at all but when other points fail."* The court in D.S.T. v. Rakoil, Deutsche Schachtbau-und Tiefbohrgesellschaftmbh v. Ras Al Khaimah National Oil Company (1987) Lloyds Report 246, stated that, *"Considerations of public policy can never be exhaustively defined, but they should be approached with extreme caution…. It has to be shown that there is some element of illegality or that the enforcement of the award, would be clearly injurious to the public good or, possibly, that enforcement would be wholly offensive to the ordinary responsible and fully informed members of the public on whose behalf the powers of the state are exercised."*

Arbitration is an alternate means of dispute resolution which has been introduced and developed in order to reduce the amount of time spent in litigation. In this light, the Arbitration Act contemplates that the Arbitral Award is not susceptible and not vulnerable to any challenge except that permitted under the Act. This is on the basis that it is conclusive as a judgment between the two parties and could only be set aside on the grounds explicitly set out in Section 32 of the Act, the onus of proving that it fell within the ambit of the said provision lies on the party making such an application. The legislative intent behind the Act is clear that a degree of finality attaches to the decision of the Arbitral Tribunal, which is the judge of both questions of fact and law referred to it.

Thus in exercising jurisdiction under Section 32 of the Act, the Court cannot sit in appeal over the conclusions of the Arbitral Tribunal by re-scrutinizing and re-appraising the evidence considered by the Arbitral Tribunal. A plain reading of Section 32 precludes judicial demolition of an Award

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[46] Arbitration Law In Sri Lanka, K. Kanaga-Isvaran, PC & SS Wijeratne, 434

[47] *Ibid*.329

on the facts elicited therein. The Court cannot re examine the mental process of the Arbitral Tribunal and contemplate its findings even where slim reasons are given by the Arbitral Tribunal for its findings, nor can it revisit the "reasonableness" of the deductions given by the arbitrator, since the Arbitral Tribunal is the sole judge of the quantity and quality of the mass of evidence led before it by the parties.

It is generally understood that the term public policy which was used in the 1958 New York Convention and many other treaties, covered fundamental principles of law and justice in substantive as well as procedural aspects. Thus instances such as corruption, bribery and fraud and similar serious cases would constitute a ground for setting aside. However the facts of this case do not bear out any such incident of illegality, fraud or corruption in order to validate a challenge on the ground of public policy.

It is also important that a court considering a challenge on the basis of public policy bear in mind the possibility of the misuse of this doctrine by a Defendant in order to avoid the consequences of the Arbitral Award. Certainly the uncertainty and inconsistencies concerning the interpretation and application of public policy could encourage the losing party to rely on the doctrine of public policy to resist, or at the very least delay enforcement of the arbitral award. Therefore the court must also bear in mind the very legitimate concern that it may afford an unsuccessful defendant and/or the state a second "bite" at frustrating enforcement." [48]

CONCLUSION

The Arbitration Act of Sri Lanka plays a very important role in the construction industry. Presently there are many construction projects conducted in Sri Lanka with the assistance of foreign funding agencies. Therefore, there is a great urgency of resolving disputes in an efficient and effective manner as disputes should not hamper the growing construction industry in Sri Lanka. From the decisions made in the past it is extremely encouraging that the Sri Lankan courts have taken a positive attitude and attempts have always been made not to disrupt the arbitral awards made by arbitral tribunals. If the courts take a restrictive attitude towards enforcing arbitral awards the entire percept of arbitration could become a waste of time and money, and also discourage people from involving in commercial activities. By giving careful thought and consideration to what is happening internationally in that sense the Sri Lankans courts have taken a positive approach preventing the losing parties from challenging the arbitral awards in an ad hoc and unreasonable manner which I believe has given added impetus to the construction industry.

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[48]Dr.B.P. Saraf J &S.M. Jhunjhunuwala J. on The Law of Arbitration and Conciliation, Page 361

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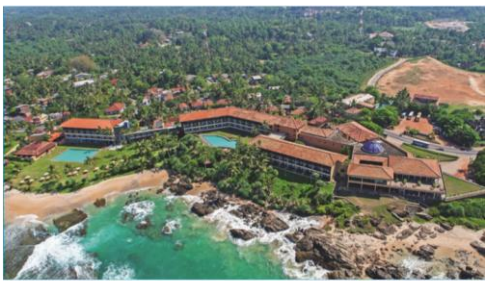
Siribopura Flyover



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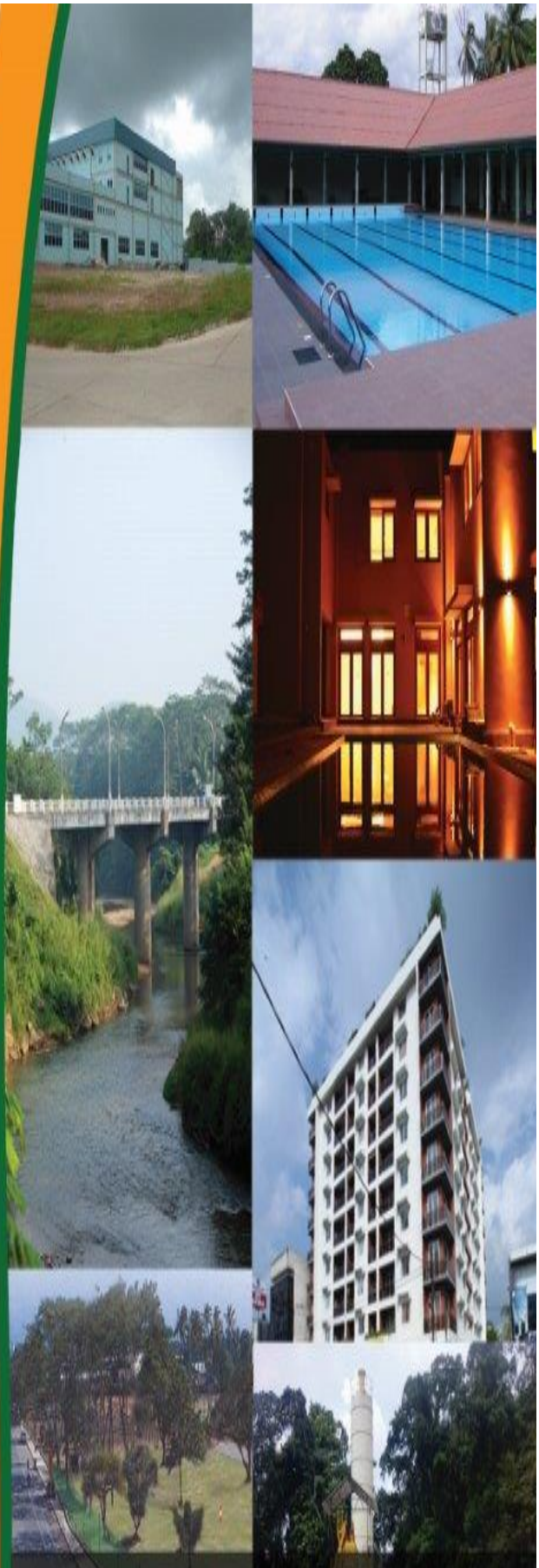

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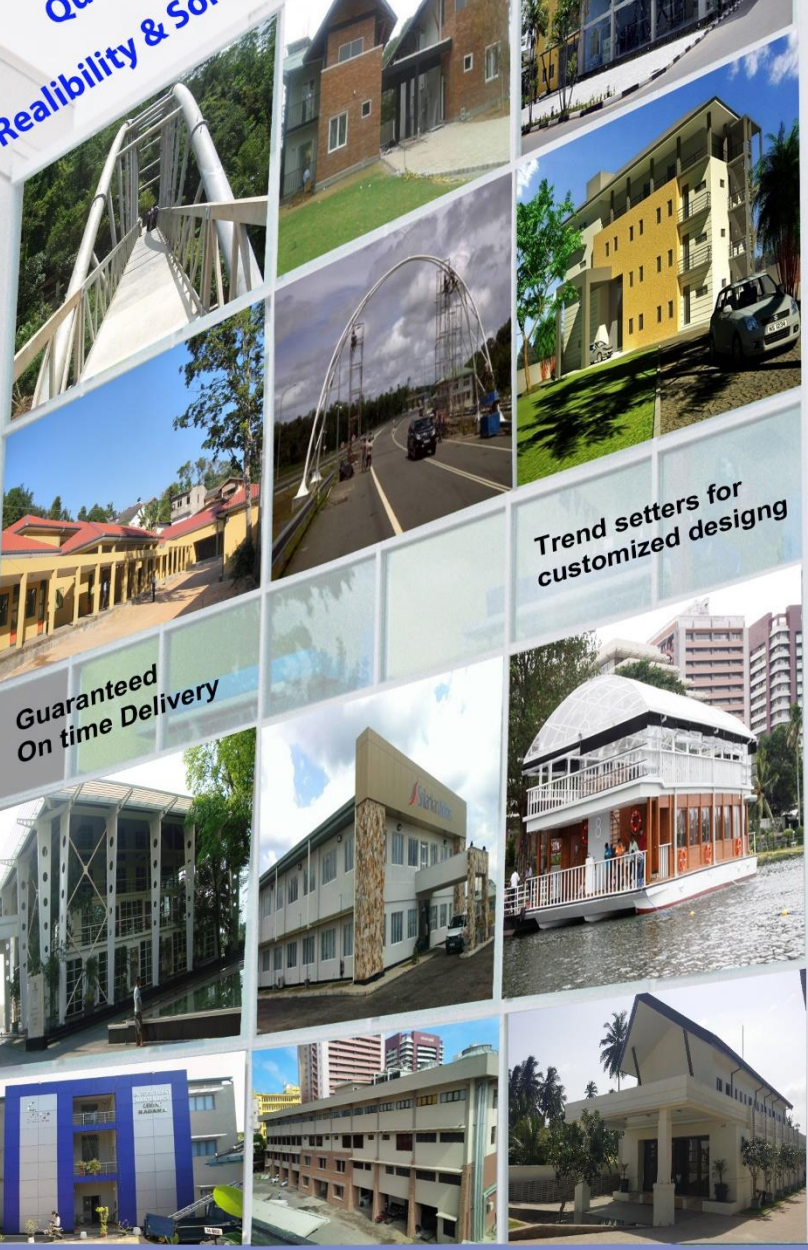

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1992	Merit	Manning town Housing Scheme - Alvitigala Mawatha by State Engineering Corporation of Sri Lanka
	Merit	Army Commander's Secretariat - Galle Face by Maga Engineering (Pvt) Ltd.
1993	Excellence	Kandalama Hotel by Link Engineering Ltd.
	Excellence	Factory –Pannala by International Construction Consortium Ltd.
1994	Excellence	King's Court Apartment Complex - Bambalapitiya by Tudawe Brothers Ltd
	Merit	Office Building - Navam Mawatha by Maga Engineering (Pvt) Ltd
1995	Excellence	Maternity and office Complex of Co-operative Hospital - Matara. by Matara Construction Co Ltd.
1996	Excellence	Office Building for Hemas Ltd Colombo 02. (Category I) by Maga Engineering (Pvt) Ltd
	Merit	Queen's Court Apartment Complex -Kollupitiya. (Category I) by Tudawe Brothers Ltd.
1997	Excellence	Light House Hotel -Galle. (Category I) by Maga Engineering (Pvt) Ltd
	Merit	Head Office Building of Development Holdings (Pvt) Ltd . Colombo 02. - (Category I) by International Construction Consortium Ltd.
	Merit	Hotel Blue Waters -Wadduwa.- (Category I) by Maga Engineering (Pvt) Ltd.

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	Merit	National College of Education at Polonnaruwa (Category I) by Link Engineering Ltd.
2001	Excellence	Premier Pacific International - Luxury Apartment Complex at Colombo 07. (Category I) by Tudawe Brothers Ltd.
	Merit	Lotus Tower - Luxury Apartment Complex at Colombo 07. (Category I) by Maga Engineering (Pvt) Ltd
	Merit	Class rooms, Library and Administration Building for the Advance Technical Institute at Mattakkuliya. (Category III) by Union Construction Engineering Ltd.
2002	Excellence	Information Technology Park at Malambe. by International Construction Consortium Ltd.
	Excellence	Speaker's Residence at Battaramulla by Link Engineering Limited.
	Excellence	Apollo Hospital at Narahenpita. (Category I) by Maga Engineering (Pvt) Ltd.
	Excellence	Hatton National Bank at Vavuniya by R R Group
2003	Excellence	Distribution Centre at Kelaniya. (Category I) by International Construction Consortium Ltd.
	Excellence	National College of Education, Jaffna. (Category (HI) by Euroville Engineers & Constructors (Pvt) Ltd.
	Merit	Luxury Apartments - Colombo 03. (Category II) by L H Piyasena & Co (Pvt) Ltd.
	Merit	Sports and Recreation Complex at Rattanapitiya. by Nawaloka Construction Company Ltd.

Year	Type of Award	Project and Recipient
	Merit	Vocational Training Centre at Narahenpita by Maga Engineering (Pvt) Ltd.
2004	Excellence	Home for the Aged at Colombo 10. by Tudawe Brothers Ltd
	Merit	Apartment Hotel for Global Towers at Wellawatta. by L H Piyasena & Company (Pvt) Ltd.
	Merit	Luxury Apartments at Colombo 03. by L H Piyasena & Company (Pvt) Ltd.
	Merit	Courts Complex at Trincomalee by Sierra Construction Ltd.
2005	Excellence	Cargo Building at the Katunayake Airport by Maga Engineering (Pte) Ltd.
	Merit	Sahanaya – Mental Health Care Centre at Gorakana by Nawaloka Construction Company Ltd.
	Merit	Commercial Centre at Bandarawela by Sierra Construction Ltd.
	Merit	Apartment Complex at Colombo 09 by Tudawe Brothers Ltd.
	Merit	Mixed Development at R A de Mel Mawatha –Colombo 7. by Maga Engineering Ltd.
2006	Excellence	St. Michaels Apartment Complex – Colombo 03 by Tudawe Brothers Ltd.
	Excellence	Factory Building to Orit Apparels (Pvt) Ltd. at Awissawella by R N Construction (Pvt) Ltd.
	Merit	Buildings and Structures for the Department of the Wild Life Conservation at Wasgamuwa. by Orient Construction Company (Pvt) Ltd
	Merit	Buildings and structures for the Department of Wild Life Conservation at Bundala. by Orient Construction Company (Pvt) Ltd
	Merit	Golden Residencies Apartment Complex at Kotahena by L H Piyasena & Co (Pvt) Ltd.

Year	Type of Award	Project and Recipient
2007	Excellence	Capital Residencies' Luxury Apartments at No. 65, Dharmapala Mawatha, Colombo 07. by Sanken Lanka (Pvt) Ltd.
	Excellence	'Golden Crescent' Luxury Apartments at Kollupitiya Road, Colombo 04. by L H Piyasena & Company (Pvt) Ltd.
	Excellence	Radiation Treatment Centre at Park Street, Colombo 02. by Maga Engineering (Pvt) Ltd.
	Merit	Skyline Residencies at Borella by Maga Engineering (Pvt) Ltd.
2008	Excellence	"Fairway Residencies" at Rajagiriya by Maga Engineering (Pvt) Ltd.
	Excellence	"Iceland Residencies", Colombo 03 by International Construction Consortium Ltd.
	Excellence	Building for National Institute of Nephrology, Colombo 10. by Tudawe Brothers Ltd.
	Merit	Model Green Factory at Thulhiriya by Maga Engineering (Pvt) Ltd
	Merit	6th Avenue Apartments, Colombo 05 by Tudawe Brothers Ltd.
	Performance	Improvement of Advanced Technological Institute, Jaffna by Euroville Engineers & Constructors (Pvt) Ltd.
2009	Excellence	Hospital for Hemas Hospitals (Pvt) at Wattala by International Construction Consortium Ltd.
	Excellence	Southern Zonal Officer Building for People's Bank at Anagarika Dharmapala Mawatha, Matara by Sathuta Builders (Pvt) Ltd.
	Merit	Apartment Complex for Sithma Development (Pvt) Ltd. at Havelock Road, Colombo 05 by Nawaloka Construction Co. (Pvt) Ltd.
	Performance Certificate	Upgrading of District Base Hospital at Elpitiya by V V Karunaratne & Company
2010	Excellence	"Fair Mount" – Luxury Apartment Complex by Maga Engineering (Pvt) Ltd.
	Excellence	Construction of a Boutique Hotel for Ulagalla Resort at Thirappane by International Construction Consortium (Pvt) Ltd.
	Excellence	OPD Building at Polonnaruwa General Hospital by Orient Construction Co. (Pvt) Ltd.

Year	Type of Award	Project and Recipient
2011	Excellence	Head Office for People's Leasing Co. Ltd. at Borella by Maga Engineering (Pvt) Ltd.
	Excellence	People's Bank Regional Head Office Building & Branch Office Building at Nugegoda by Sathuta Builders (Pvt) Ltd.
	Merit	Office Building for Greater Colombo Regional Support Centre (GCRSC) for NWS&DB Pelawatta. by Link Engineering (Pvt) Ltd.
	Merit	Extension to the Branch office for Commercial Bank of Ceylon Limited – Kotahena Branch by R N Constructions (Pvt) Ltd.
2012	Excellence	Head Quarters Building for Sri Lanka Customs at Fort by Maga Engineering (Pvt) Ltd.
	Excellence	House for Ambassador of Kuwait at Rosmead Place, Colombo 07 by Nawaloka Construction Company (Pvt) Ltd.
	Excellence	Jungle Beach Resort at Kuchchaveli, Trincomalee by International Construction Consortium (Pvt) Ltd.
	Excellence	"Trillium Residencies" Apartment Complex at Elvitigala Mawatha, Colombo 05 by Sanken Construction (Pvt) Ltd.
	Excellence	"Emperor Tower" at No. 75A, Galle Road, Colombo 03 by Sanken Construction (Pvt) Ltd.
	Merit	Shopping Complex for Crown Property Development (Pvt) Ltd. at Colombo 06 by Maga Engineering (Pvt) Ltd.
	Merit	Office Building for the Ministry of Environment & Natural Resources at 569, Pitakotte Rd, Pitakotte by Link Engineering (Pvt) Ltd.
	Merit	Bank of Ceylon Branch Office & Manager's Quarters at Kebithigollawa by A S B Constructions (Pvt) Ltd.
	Certificate of Appreciation	Building Complex for the Faculty of Technology under the South Eastern University of Sri Lanka Development Project – Phase 1A at Oluwil by Edward & Christie
	Certificate of Appreciation	Head Office Building for Valikamam South West Pradeshiya Sabha at Manipay, Jaffna by V V Ramanathan & Co. (Pvt) Ltd.

Year	Type of Award	Project and Recipient
2013	Excellence	Administrative Complex Building – Sethsiripaya Stage II at Sethsiripaya Premises, Battaramulla by Maga Engineering (Pvt) Ltd.
	Excellence	Hambantota Port Development Project Phase I - Administrative Complex by Maga Engineering (Pvt) Ltd.
	Excellence	Centara Passikudah Resort & Spa at Passikudah by Tudawe Brothers (Pvt) Limited
	Merit	Chaaya Bey Hotel Beruwala at Beruwala by International Construction Consortium (Pvt) Ltd.
	Merit	Dr. Neville Fernando Sri Lanka – Russia Friendship Teaching Hospital at Malabe by R N Constructions (Pvt) Ltd.
	Merit	Hikkaduwa Cultural Centre and Tsunami Research Centre (Tsunami Memorial Museum) Phase I at Peraliya, Hikkaduwa by Sripalie Contractors (Pvt) Ltd.
	Merit	Ceylinco Branch Office Building for Ceylinco Life at Gampaha by Sathuta Builders (Pvt) Ltd.
	Certificate of Appreciation	Mixed Development Apartment Complex at Dehiwala by L H Piyasena & Co. (Pvt) Ltd.
2014	Excellence	New Head of Mission Residence for Australian High Commission at Colombo 07 by Maga Engineering (Pvt) Ltd.
	Excellence	Mercedes Benz Centre" at Colombo 14 by Maga Engineering (Pvt) Ltd.
	Excellence	Commercial Development for Cargills (Ceylon) PLC at No. 420, Hospital Road, Jaffna by Nawaloka Construction Co. (Pvt) Ltd.
	Excellence	Club House & Swimming Pool for Havelock City Development at Colombo 06 by International Construction Consortium (Pvt) Ltd.
	Excellence	National Nanotechnology Park Phase 1 A at Mahenawatte, Pitipana, Homagama by Tudawe Brothers (Pvt) Limited
	Excellence	Prime Lands Head Office Building at No. 75, D S Senanayake Mawatha, Colombo 08 by Tudawe Brothers (Pvt) Limited

Year	Type of Award	Project and Recipient
2014	Merit	Hotel Complex for Airport Garden Leisure (Private) Limited at Seeduwa by Tudawe Brothers (Pvt) Limited
	Merit	Shinagawa Beach Hotel at No. 30, Old Guruniwasa Road, Balapitiya by N & A Engineering Services (Pvt) Ltd.
2015	Excellence	Housing for Relocation of Underserved Settlements in the City of Colombo at 194, Cyril C Perera Mawatha, Colombo 14 by International Construction Consortium (Pvt) Ltd.
	Excellence	Office Building for Citizen Development Business Finance PLC at Colombo 10 by Tudawe Brothers (Pvt) Limited
	Excellence	Warehouse Building for Nestle Lanka PLC Kurunegala Factory at Makandura, Gonavila by R N Construction (Pvt) Ltd.

Green Construction Award

Year	Type of Award	Project and Recipient
2012	Excellence	Design & Construction of Ulagalla Walawwa Resort (Boutique Hotel) by International Construction Consortium (Pvt) Ltd.
	Excellence	MAS Intimates Thuruli (Pvt) Ltd. by Maga Engineering (Pvt) Ltd.
2013	Excellence	Hatton National Bank, Nittambuwa by Tudawe Brothers (Pvt) Limited
	Excellence	CECB Head Office – Phase II by Central Engineering Consultancy Bureau
2014	Excellence	Factory Worker's Accommodation Building and Site Development Works for Variosystems (Pvt) Ltd at Badalgama by Nuwani Construction (Pvt) Ltd.
	Excellence	Hatton National Bank, Kalmunai by Niron Enterprises
2015	Excellence	National Nanotechnology Park, Phase I at Pitipana, Homagama by Tudawe Brothers (Pvt) Limited
	Excellence	Warehouse Building for Nestle Lanka PLC Kurunegala Factory at Makandura, Gonavila by R N Construction (Pvt) Ltd.

Electro Mechanical Construction Awards

Year	Type of Award	Project and Recipient
2014	Merit	Supply and Installation, Testing & Commissioning of Air Conditioning and Ventilation System – Colombo Gold Centre at Pettah by Frigi Engineering Services (Pvt) Ltd

Special Appreciation Awards for Government Institutions

Year	Type of Award	Project and Recipient
2014	National Award for Construction Performance	Auditorium at University of Wayamba by State Engineering Corporation of Sri Lanka
2014	Special ICTAD Award for Construction Performance	New Kallady Bridge at Batticaloa by State Development & Construction Corporation
2014	Special ICTAD Award for Construction Performance	Refurbishment of Water's Edge, Battaramulla by State Engineering Corporation of Sri Lanka
2014	Special ICTAD Award for Construction Performance	Paddy Storage Ware House at Marandagahamula by State Engineering Corporation of Sri Lanka

Construction Performance Awards for Building Projects
(assessed after completion)

Year	Type of Award	Project and Recipient
2012		**<u>Category I - value exceeding Rs: 150 million</u>**
	Construction Performance	Central Hospital Development Project by International Construction Consortium (Pvt) Ltd.
	Construction Performance	South Asian Institute of Technology & Management at Millagahawatte, Welivita, Malabe by International Construction Consortium (Pvt) Ltd.
	Construction Performance	Sri Sambuddha Jayanthi Mandiraya at 32, Havelock Road, Colombo 05 by Maga Engineering (Pvt) Ltd.
	Construction Performance	Vocational Training Centre at Matiyagane, Kurunegala by R H Steel Building Systems (Pvt) Ltd.
	Construction Performance	Courts Complex Tangalle by V V Karunaratne & Company
	Construction Performance	Empire Residential Development Project at 51, Braybrooke Place, Colombo 02 by Sanken Construction (Pvt) Ltd.
	Construction Performance	Office Building at No. 315, Vauxhall Street, Colombo 02 by Sanken Construction (Pvt) Ltd.
		<u>Category II - valued between Rs: 50 million & 150 million</u>
	Construction Performance	Extension to the Classroom Block Project – Stage I & II University of Moratuwa by State Engineering Corporation of Sri Lanka
	Certificate of Appreciation	New Life Housing Project at Madulkelle Estate, Kandy by Plantation Human Development Trust (PHDT)

Construction Performance Awards for Civil Engineering Projects (assessed after completion)	
2006	Improvements to Dr. N M Perera Mawatha by Maga Engineering (Pvt) Ltd. Rehabilitation and Asphalt overlaying of Peliyagoda - Puttalam Road by International Construction Consortium Ltd. Piling Works for Empire Residential Development by Nawaloka Construction Company Limited. Vehicular Bridge at National College of Education Rathnapura by Maga Engineering (Pvt) Ltd. Extension to the Water Treatment Works at Ambatale by Sanken Lanka (Pvt) Ltd
2007	Piling work for Colombo Sewerage Rehabilitation Project by Nawaloka Construction Company Ltd. Improvements to a Section of Matara – Hakmana Road by Maga Engineering (Pvt) Ltd. Improvements to a Section of Akuressa Road, Matara. by Maga Engineering (Pvt) Ltd.
2008	Wellawaya Water Supply Scheme by Maga Engineering (Pvt) Ltd. Road Sector Development Project Phase II – LCV : UVB – 04 R Bridges by Maga Engineering (Pvt) Ltd. Improvements to Weeraketiya – Middeniya Road by Maga Engineering (Pvt) Ltd. Improvements to Palavi – Kalpitiya Road from 1.0 km to 5.0 km by Maga Engineering (Pvt) Ltd. Road Sector Development Project Phase 3 – LCB : NC – 10 R by Maga Engineering (Pvt) Ltd.
2009	Rehabilitation & Improvements of Nagoda - Agalawatta Road ADB Funded Road Network Improvement Project Contract No. RDA/ADB/RNIP/LCB/C4 by International Construction Consortium Ltd. Rehabilitation & Improvements to Panadura - Ingiriya Road ADB Funded Road Network Improvement Project Contract No.RDA/ADB/RNIP/ICB/C3A by International Construction Consortium Ltd.

Construction Performance Awards for Civil Engineering Projects (assessed after completion)	
2009	Rehabilitation & Improvements to Padeniya – Puttalam Road (A-010) (from 62.90km to 124.27km) by Maga Engineering (Pvt) Ltd. Rehabilitation & Improvements to Jayanthipura – Tirukkondaimadu Road (A-011) (from 59.90km to 128.76km) by Maga Engineering (Pvt) Ltd. Improvements to Welikada – Nawala Road (from 0+000m to 2+700km) by Maga Engineering (Pvt) Ltd. Rehabilitation & Improvement to Bandarawela - Welimada Road (B044) Contract Package 04 (NCB) by Tudawe Brothers (Pvt) Ltd. Rehabilitation & Improvement to Bandarawela - Haliela Road (A016) Contract Package 03 (NCB) by Tudawe Brothers (Pvt) Ltd. Water Supply Galle District Phase II - Immediate Measures in Tsunami Affected Areas – Package 28 by Tudawe Brothers (Pvt) Ltd. Rehabilitation & Augmentation of Tangalle Water Supply Scheme by Sierra Construction (Pvt) Ltd. Construction of Bridge No. 5/2 on Kandy – Jaffna Road at Katugastota by State Development & Construction Corporation
2010	Balance Work & Re-construction of Bridge No. 36/3 (Warawala Bridge) on Kegalle - Bulathkohupitiya – Karawanella Road by Nawaloka Construction Company (Pvt) Ltd Implementation of Permanent Steel Bridge of Oddamavady under Batticaloa District by Progressive Builders & Resorts (Pvt) Ltd Construction of Suspension Bridge Across, Ma-Oya at Waddeniya by Sathuta Builders (Pvt) Ltd Construction of 1800 m^3 capacity Treatment Plant, Storage Tank Borehole Intake & Control Rooms for Radampola Water Supply Scheme by Valence Engineering (Pvt) Ltd Supplying & Laying of Water Distribution Mains in Bandaragama and Horana – Kaluganga Water Supply Project for Greater Colombo Contract No. KG/JBIC/KG-4 by Hovael Construction (Pvt) Ltd Thirukkovil Water Supply Scheme by Sierra Construction (Pvt) Ltd

Construction Performance Awards for Civil Engineering Projects (assessed after completion)	
2010	Greater Kandy Water Supply Project Phase 1 Stage II Ampitiya Improvement & Construction of Engineer's Quarters by Maga Engineering (Pvt) Ltd Rehabilitation of Matara – Wellawaya (A-002) Road by Maga Engineering (Pvt) Ltd. Hambantota Harbour By-Pass Road by Maga Engineering (Pvt) Ltd. Widening & Improvements of Palavi – Kalpitiya Road (5.0 - 9.0 km) by Maga Engineering (Pvt) Ltd. Widening & Improvements of Palavi – Kalpitiya Road (9.0 – 14.0 km) by Maga Engineering (Pvt) Ltd. Rehabilitation of Navatkuli – Kerativu – Mannar (A-32) Road by Maga Engineering (Pvt) Ltd. Regional Bridge Project using British Government Finance Assistance – Construction of Kelaniya Railway Crossing Flyover by Access Engineering Ltd. Out side Plant Works (Fiber Routes / Civil Works, Cable Laying & Jointing) of the Optical Fiber Network Development Project Phase – 01 & 01B by Access Engineering Ltd. USAID – Sri Lanka Tsunami Reconstruction Program USAID Contract # 386-C-00-05-00166-00 SLTRP Contract # 1B-06. Construction including detail design of Major Works at Hikkaduwa, Mirissa and Puranawella Fish Harbours by Access Engineering Ltd. Raising of Unichchai Tank Bund and the Construction and Completion of its Appurtenant Structure in Batticalloa by Access Engineering Ltd. Secondary Towns and Rural Community Based Water Supply and Sanitation Project – Sri Lanka Polonnaruwa Water Supply Project. Supply & Laying of distribution pipes & construction of elevated water towers for Polonnaruwa Water Supply Project by International Construction Consortium (Pvt) Ltd. Rehabilitation of A014 Medawachchiya – Mannar – Talaimannar Road (from 33.00.km to 37.00 km) by International Construction Consortium (Pvt) Ltd. Rehabilitation of Navatkuli – Kerativu – Mannar (A 32) Road (from 91+370 km to 92+370 km) Contract No : RDA/MMC/MAINT/NKM/07R by International Construction Consortium (Pvt) Ltd.

Construction Performance Awards for Civil Engineering Projects (assessed after completion)	
2010	Design & Construction of a Bridge Across Ambanganga at 800m down stream of the proposed Moragahakanda Main Dam by State Development & Construction Corporation
2011	**Category I - value exceeding Rs: 1000 million** Rehabilitation of – Siyambalanduwa – Pottuvil – Akkaraipattu (A-04) Road Contract No. : RDA/TAARP/ADB-EU/ICB/C3 by Maga Engineering (Pvt) Ltd. Southern Transport Development Project (JBIC Section) Package II – Dodangoda to Kurundugahahetekma by K D A Weerasinghe & Co., (Pvt) Ltd. Supply & Laying of Distribution Pipes and Construction of Elevated Water Towers Hambantota Water Supply Project by Sierra Construction (Pvt) Ltd. Rehabilitation and Upgrading of A-006 Ambepussa-Kurunegala-Trincomalee Road from Habarana to Kanthale (43.8 km) by International Construction Consortium (Pvt) Ltd. **Category II - valued between Rs: 500 million & 1000 million** KfW Water Supply Galle District – Phase II Immediate and Medium Term Measures in Water Supply to Tsunami Affected Areas by K D A Weerasinghe & Co., (Pvt) Ltd. **Category III - valued between Rs: 100 million & 500 million** Regional Bridge Project using British Government Finance Assistance – Construction of Nugegoda Fly Over by Access Engineering Ltd. Regional Bridge Project using British Government Finance Assistance – Construction of Sangupiddy Fly Over by Access Engineering Ltd. Construction of a Bridge Across Maoya on Pannala – Maningamuwa – Mellawagedara Road Contract No. RDA/WD/NWP/SIRUP /2006/105 by Access Engineering Ltd. Construction of Elevated Tower, Sub Office Building, Caretaker Quarters and Laying of Distribution System for Kaluwanchikudi Water Supply Scheme Stage II by V V Karunaratne & Company Construction of Denawaka Ganga Mini Hydropower Project by V V Karunaratne & Company Negombo Water Supply and Optimisation Contract Civil Works Sub – Contract 816/003 by Sanken Lanka (Pvt) Ltd.

Construction Performance Awards for Civil Engineering Projects (assessed after completion)	
2011	Improvements to Udawalawa – Thanamalwila Road (24.5 km) by Maga Engineering (Pvt) Ltd. Rehabilitation & Augmentation of Kirindi Oya Water Supply Project by Maga Engineering (Pvt) Ltd. Construction of Fly over Bridge near Level Crossing at Gampaha by State Development & Construction Corporation Rehabilitation & Improvements of Valachchenai Fishery Harbour Package No. 02 – Marine Structure by Nawaloka Construction Company (Pvt) Ltd. **Category IV – valued up to Rs: 100 million** Construction of 1000 m^3 Water Tower at Ippalogama Ranawiru Gammanaya water Supply Scheme by Lohitha Construction Rehabilitation of Navatkuli – Kerativu – Mannar Road (A 32), (94 + 370 TO 93 + 370 KM), RDA/MMC/MAINT/NKM/05R by V V Karunaratne & Company
2012	**Category I - value exceeding Rs: 1000 million** Improvements to Sooriyawewa – Meegahajandura Road to 4 Lane Standard (0+000 km – 9+050 km) Contract No. RDA/WD/SP/GOSL/176 by Maga Engineering (Pvt) Ltd. Rehabilitation and Upgrading of Puttlam – Trincomalee Road (A-012) from Puttlam to Anuradhapura Contract No. RDA/NHSP/ICB-01 by Maga Engineering (Pvt) Ltd. Phase I Stage II of Grater Kandy Water Supply Project Contract No.RSC/GR.KANDY/CIVIL/2008/3A&4A by Maga Engineering (Pvt) Ltd. Construction of Ja-Ela, Ekala & Kandana Water Supply Schemes Contract No. WSDP/TNC/C1 by Sierra Construction (Pvt) Ltd. Supply & Laying of Treated Water Pumping Main Distribution Pipes and Construction of Elevated Towers, Muttur Contract No. PW&ET/UWS/PE3/MUT/ICB by Sierra Construction (Pvt) Ltd. Provision of Engineering Services for Optical Fiber Network and ITS Management System by Sierra Construction (Pvt) Ltd. **Category II - valued between Rs: 500 million & 1000 million** Improvements to Parliament Road (AA 000) from Devi Balika Roundabout to Polduwa Junction. Contract No. RDA/WD/WP/SIRUP/2006/01 by Maga Engineering (Pvt) Ltd.

Construction Performance Awards for Civil Engineering Projects (assessed after completion)	
2012	**Category III - valued between Rs: 100 million & 500 million** Rehabilitation of A014 Medawachchiya – Mannar – Talaimannar Road from 37.0 km to 42.0 km & an Additional 2 km from 45.0 km to 47.0 km Contract No. RDA/ADB/CAARP/NCB/NRC 5E by International Construction Consortium (Pvt) Ltd. Improvements to Wellawaya – Ella – Kumbalwela Road (0+000 to 14+000 km) Contract No. RDA/DW/UVA/PPRD/11 by Hovael Construction (Pvt) Ltd. Non-Revenue Water Prevention, Reduction and Treated Water Conservation of Water Supply Scheme of Harispattuwa, Akurana and Ampitiya Zones Contract No. RSC-C/GR.KANDY/CIVIL/2008/60 by Hovael Construction (Pvt) Ltd. Rehabilitation of Internal Roads of Galle Fort -Packages I, II, III & IV Contract No. RDA/DW/SP/GOSL/2011/11,12,13,14 by K D A Weerasinghe & Co. (Pvt) Ltd.
2013	**Category I - value exceeding Rs: 1000 million** Construction, Completion and Commissioning of Gated Salinity Barrier Across Walawe River at Hambantota Contract No. SB/UWS/PB2/HAM/ICB by Access Engineering PLC Towns North of Colombo Water Supply Project - Stage II Construction of Mahara and Biyagama Water Supply Schemes Contract No. WSDP/TNC/C2 by Sierra Construction (Pvt) Ltd. Northern Road Connectivity Project (NRCP) Rehabilitation / Improvement to B437 Road from Vallai to Araly (0+000 km – 27+400 km) by K D A Weerasinghe & Co. (Pvt) Ltd. Rehabilitation & Improvement of 63 Km of Kandy – Jaffna Road (A009) from 257 Km to 320 Km Contract No. RDA/NRRP/CGF/CIB by Maga Engineering (Pvt) Ltd. Sub-Contract works of 25+5 Km of Paranthan – Mullaitivu Road (A035) from 00.00 Km to 30.00 Km Contract No. RDA/NRIP/PRP1/C11 by Maga Engineering (Pvt) Ltd. Rehabilitation & Improvement to A009 Road Section from Thonigala to Galkulama (98+000 Km – 122+170 Km) Contract No.RDA/NRCP/ICB/ADB/CP-02 by Maga Engineering (Pvt) Ltd. Rehabilitation & Improvements to A032 Road Section from Navathkuli to Kerativu Jetty (00+000 Km – 17+400 Km) Contract No. RDA/NRCP/ICB/ADB/CP-04

	by Maga Engineering (Pvt) Ltd.

Construction Performance Awards for Civil Engineering Projects (assessed after completion)	
2013	**Category II - valued between Rs: 500 million & 1000 million** Rehabilitation & Improvements to Ambepussa – Kurunegala – Trincomalee Road (A06) from 157+000 Km to 167+280 Km & Kantale to Ganthalawa (B196) Road by Access Engineering PLC Rehabilitation / Improvements to Section of Ambepussa – Kurunegala – Trincomalee Road (A06) from 167+280 Km to 178+000 Km Road Contract No. WB/RSAP II/KT/02 by Tudawe Brothers (Pvt) Ltd. World Bank Funded Provincial Road Project. Uva Province, Credit No 4630 LK Package "A" Contract No. Uva-04: Haggala – Ford – McDonald Road by Maga Engineering (Pvt) Ltd. Improvement & Rehabilitation of Hakmana – Beliatta – Tangalle Road Project, Section from 11+500 Km to 19+140 Km Contract No. RDA/RNIP/PRP1/CIA-1 by Maga Engineering (Pvt) Ltd. Rehabilitation & Improvements to A020 Road section from Anuradhapura to Rambewa (0+0000 Km – 14+500 Km) Contract No. RDA/NRCP/ICB/ADB/CP-03 by Maga Engineering (Pvt) Ltd Rehabilitation & Improvements to Road section from Manipay to Kaithady (0+000 Km – 14+020 Km) Contract No. RDA/NRCP/ICB/ADB/CP -05 by Maga Engineering (Pvt) Ltd. Rehabilitation & Improvements to Road section from Mankulam to Mullaitivu (0+000 Km – 13+000 Km) Contract No. RDA/NRCP/ICB/ADB/CP -07 by Maga Engineering (Pvt) Ltd. **Category III - valued between Rs: 100 million & 500 million** ADB Funded Eastern & North Central Provincial Roads Project – Phase I Contract No. ENCPRP/NCB/EPBP/02 by Access Engineering PLC Urgent Renovation at Unity Container Terminal (UCT), New North Pier in Port of Colombo by Access Engineering PLC Supply & laying of HDPE, DI pipes for water Transmission Main from Murunkan to Mannar with branch off to Vankalai Contract. No. P&D/C,N/ADB 5/2010/01 by K D A Weerasinghe & Co. (Pvt) Ltd. Widening of Bridge No. 1/1 on Security Access Road to Parliamentary Complex, Kotte by CML-MTD Construction Limited

	Asian Development Bank Funded Eastern and North Central Provincial Roads Project – Phase I Package EP-03 Contract No. ENCPRP/NCB/EP/03 by V V Karunaratne & Company

Construction Performance Awards for Civil Engineering Projects (assessed after completion)	
2013	Civil Works of Point Pedro Water Supply Scheme under ADB Assisted Conflict Affected Region Emergency Project – Component-B (Water Sector) Contract No. P&D/C,N/ADB/CARE/PP/2010/01 by Maga Engineering (Pvt) Ltd. Improvement & Rehabilitation of Bopale Junction - Kiriibbanara – Udamauara Road Section from 0+000 Km to 8+500 Km Contract No. RDA/RNIP/PRP1/CIA-2 by Maga Engineering (Pvt) Ltd **<u>Category IV – valued up to Rs: 100 million</u>** Rehabilitation of Demalawadiya Ambana Opalgala Road Contract No ENDRP-07 by Gamini Construction
2014	**<u>Category I - value exceeding Rs: 1000 million</u>** Chinese Government Funded Rehabilitation of Road Works in North Project - Rehabilitation & Improvement of Kandy – Jaffna Road (A-009) between Galkulama & Jaffna – Sub Contract Works of 40 km of Kandy – Jaffna Road (A-009) from 120 km – 207 km by International Construction Consortium (Pvt) Ltd. Rehabilitation and Improvement to Ambepussa – Trincomalee Road (A006) from Dambulla to Habarana (91+420 km – 112+920 km) by International Construction Consortium (Pvt) Ltd Northern Road Connectivity Project (NRCP) - Rehabilitation / Improvement to A009 Road Section from Dambulla to Thonigala (74+650 km to 98+000 km) by International Construction Consortium (Pvt) Ltd Northern Road Connectivity Project (NRCP) - Rehabilitation / Improvement to Section of Mankulam – Mullaitivu Road A 034 from 38+500 km to 49+100 km by International Construction Consortium (Pvt) Ltd Rehabilitation and Upgrading of Narammala – Giriulla – Dankotuwa Road (from 0+000 – 16+030) by CML-MTD Construction Limited Rehabilitation and Upgrading of CRWB Road (A004) from Nugegoda to Homagama Contract No. RDA/NHSP/ICB-05 by K D Ebert and Sons Holdings (Pvt) Limited Dialog Optical Fiber Network Project – Phase 2 & 3 by Access Engineering PLC

	Construction of a Flyover Project at Siribopura Contract No. LK/CPRPA/MAGA/C1A-3 by Maga Engineering (Pvt) Ltd. Improvements to Palavi – Kalpitiya Road (B349) Section from (14.0 km to 40.6 km) Contract No. RDA/RNIP/PRP2/PACKAGE-C/ C13 by Maga Engineering (Pvt) Ltd. Construction of Kegalle Bypass Road Stage III by Maga Engineering (Pvt) Ltd.

Construction Performance Awards for Civil Engineering Projects (assessed after completion)	
2014	**<u>Category II - valued between Rs: 500 million & 1000 million</u>** Improvement & Rehabilitation of priority road project – Bibile – Uraniya - Mahiyangana Road (22+000 – 39+580 km) by K D A Weerasinghe & Co., (Pvt) Ltd. **<u>Category III - valued between Rs: 100 million & 500 million</u>** Construction of Kadurugaldola Mini Hydro Power Project (KMPH) by Access Engineering PLC Transmission & Distribution of Kanthale Ganthalawa Pipe Laying (KGPL) by Access Engineering PLC Supply & Laying of DI Pipes, Fittings and Valves for Rajapihilla Transmission Line (15 km long) for Medawala Water Supply Improvement - Kandy by Maga Engineering (Pvt) Ltd. Giritale Dam Rehabilitation Work by Gamini Construction Laying of DI Pipes & Fittings from Mahaveli Intake to Kantale Water Treatment Plant by Subasinghe Contractors and Earth Movers **<u>Category IV – valued up to Rs: 100 million</u>** Outer Circular Highway Project (Southern Section) Temporary Toll Plaza Kothalawala Interchange by State Engineering Corporation of Sri Lanka
2015	**<u>Category I - value exceeding Rs: 1000 million</u>** Thihagoda – Kamburupitiya – Mawarala – Kotapola Road (TKMK) (24+000 km – 67+000 km) by Maga Engineering (Pvt) Ltd Rehabilitation & Improvements of Polonnaruwa–Thambala–Sungawila– Somawathiya Road (from 0+000 to 33+000km) Contract No. RDA/DW/NCP/GOSL/2011/289) by Consulting Engineers & Contractors (Pvt) Ltd.

	Rehabilitation & Improvement of Priority Road Project -2 Mahiyangane- Dimbulagala – Dalukkane Road (24.10 km – 72.807 km) Manampitiya – Aralaganwila – Maduruoya Road (0-3.0 km) Contract No. RDA/RNIP/PRP2/PKGC/C15 by K D A Weerasinghe & Co., (Pvt) Ltd. **<u>Category II - valued between Rs: 500 million & 1000 million</u>** Design, Supply and Construction of the Veyangoda Flyover Project. Contract No. RDA/SB/F/10/G by Access Engineering PLC Design Construction and Completion (Turnkey Project) Ampara Water Supply Project by Sanken Construction (Pvt) Ltd.
Construction Performance Awards for Civil Engineering Projects (assessed after completion)	
2015	**<u>Category III - valued between Rs: 100 million & 500 million</u>** Walkability Improvement and Asphalt Overlaying – Package 3 Contract No. MCUDP/CMC/W/08 by State Development & Construction Corporation **<u>Category IV - valued between Rs: 40 million & 100 million</u>** Construction of Kokawita Upper mini Hydro Power Project at Kokawita, Kalawana. Contract No. Terr/Kokaw/Upper/N/08/2009 by Nimna Enterprises

Other Awards

Awards for Effective Adaptation of Safety Measures in Construction	
2007	Skyline Residencies at Borella by Maga Engineering (Pvt) Ltd.
2008	Additions, Renovations & Refurbishment to the Ware House Complex at Orugodawatta by R N Construction Fairway Residencies at Rajagiriya by Maga Engineering (Pvt) Ltd.
2009	Arugambay Water Supply Project Package A - Construction of Pothuvil / Ulla Water Treatment Plant, Heda Oya Raw Water Intake and Raw Water Pipe Line by International Construction Consortium Ltd. Neuro Trauma Unit of the National Hospital, Colombo by Maga Engineering (Pvt) Ltd.

Awards for Human Resource Development	
2007	Maga Engineering (Pvt) Ltd (Head Office) by Maga Engineering (Pvt) Ltd.
2008	Maga Engineering (Pvt) Ltd (Head Office) by Maga Engineering (Pvt) Ltd.

Awards for Innovative Techniques in Construction	
2008	Gampola, Nuwara Eliya & Gampola Nawalapitiya Road Network Improvement Project by Soil Tech (Pvt) Ltd.
2010	Outside Plant Works (Fiber Routes/Civil Works, Cable Laying & Jointing) of the Optical Fiber Network Development Project Phase – 01 & 01B by Access Engineering Ltd.
2011	Arresting Ground Settlement at the South Asia Gateway Terminal at Colombo Harbour by Soil Tech (Pvt) Ltd.
	Production of manufactured sand as an alternative to River and Sea Sand for Concrete by International Construction Consortium (Pvt) Ltd.
	Introduction of micro panel system, to eliminate the use of Bricks and Block stones, and enhance the local construction industry to higher standards by Micro Construction (Pvt) Ltd.
2013	Urgent Renovation at Unity Container Terminal (UCT), New North Pier in Port of Colombo by Access Engineering PLC
	Proposal for Hybrid Fracture Grouting with cast-in-situ pile Foundation for Proposed 5 Storey Supermarket Complex by Soil Tech (Pvt) Ltd.

NATIONAL AWARDS FOR CONSTRUCTION EXCELLENCE – 2015

(FOR BUILDING PROJECTS)

NATIONAL AWARD FOR CONSTRUCTION EXCELLENCE – 2015

Category I - value exceeding **Rs: 600 million**

Housing for Relocation of Underserved Settlements in the City of Colombo

at 134, Sri Sangaraja Mawatha, Colombo 10

NATIONAL AWARD FOR CONSTRUCTION EXCELLENCE – 2015

Category II - value in between **Rs: 300 million & 600 million**

Warehouse Building for Nestle Lanka PLC Kurunegala Factory

at Makandura, Gonagila

NATIONAL AWARD FOR CONSTRUCTION EXCELLENCE – 2015

Category II - value in between **Rs: 300 million & 600 million**

Office Building for Citizen Development Business Finance PLC at Colombo 10

NATIONAL AWARDS CONSTRUCTION PERFORMANCE - 2015

(FOR CIVIL ENGINEERING PROJECTS)

(Assessed after completion)

National Award for Construction Performance 2015

Category I - value exceeding Rs: 1000 million

Thihagoda – Kamburupitiya – Mawarala – Kotapola Road (TKMK) (24+000 km – 67+000 km)

by Maga Engineering (Pvt) Ltd.

National Award for Construction Performance 2015

Category I - value exceeding Rs: 1000 million

Rehabilitation & Improvements of Polonnaruwa – Thambala – Sungawila – Somawathiya Road

(from 0+000 to 33+000km)

Contract No. RDA/DW/NCP/GOSL/2011/289)

National Award for Construction Performance 2015

Category I - value exceeding Rs: 1000 million

Rehabilitation & Improvement of Priority Road

Project -2 Mahiyangane- Dimbulagala – Dalukkane Road (24.10 km – 72.807 km) Manampitiya – Aralaganwila – Maduruoya Road (0-3.0 km)

National Award for Construction Performance 2015

Category II - valued between Rs: 500 million & 1000 million

Design, Supply and Construction of the

Veyangoda Flyover Project.

National Award for Construction Performance 2015

Category II - valued between Rs: 500 million & 1000 million

Design Construction and Completion

(Turnkey Project)

National Award for Construction Performance 2015

Category III - valued between Rs: 100 million & 500 million

Walkability Improvement and Asphalt Overlaying Package 3

Contract No. MCUDP/CMC/W/08

National Award for Construction Performance 2015

Category IV - valued between Rs: 40 million & 100 million

Construction of Kokawita Upper mini Hydro Power Project at Kokawita, Kalawana.

Contract No. Terr/Kokaw/Upper/N/08/2009

NATIONAL AWARDS FOR GREEN CONSTRUCTION - 2015

Excellence Award - 2015

Category I - value exceeding Rs: 300 million

National Nanotechnology Park, Phase I

at Pitipana, Homagama

Excellence Award - 2015

Category I - value exceeding Rs: 300 million

Warehouse Building for Nestle Lanka PLC
Kurunegala Factory

- ***ICTAD Award of Eminence - 2014***

Eng. S A Karunaratne

for his life time contribution to the upliftment of the Construction Industry & the profession of Engineering

- BSc Eng. (University of Peradeniya) 1
- MICE (UK) 1970
- Chartered Engineer
- MIE (SL) 1971
- MIStructE (UK) 1974
- FIStructE (UK) 1990
- FIE (SL) 1990
- HF (SSE-SL) 2009
- HLF (SL) 2014
- President SSE (SL) 2004, 2005, 2006, 2007, 2008
- Visiting Lecturer (MSc Structural – University of Moratuwa) 2006 to 2015
- Chairman - EuroCodes National Annexes (SLSI)
- Managing Director – STEMS Consultants (Pte) Ltd

- ***ICTAD Award of Eminence – 2014***

Archt. Jayantha Kithsiri Perera

for his life time contribution to the upliftment of the Construction Industry & the profession of Architecture

- FIA(SL) 1992
- M.Sc.(Arch.), B.Sc (BE)
- SLIA First Membership 1981
- President SLIA 2007/2009
- Chairman SAARCH 2009/2012
- Deputy Chairman ARCASIA Zone A 2010/2011
- Chair Communication CAA 2014/2017
- Director UIA Work Programme on Responsible Architecture 2014/2017

- ***ICTAD Award of Eminence – 2014***

Dr. (Eng.) Ananda Ranasinghe

for his life time contribution

to the upliftment of the

Construction Industry in General

- PhD, MEng, MTech, LLM, BScEng,
- CEng, FIStructE, FICE, FIESL,MSSE,
- Attorney-at-Law
- President IESL 2011/2012

- ***ICTAD Award of Eminence – 2013***

Eng. W J R De Mel

for his life time contribution

to the upliftment of the

Construction Industry & the profession of Engineering

- BSc Eng, C Eng
- M.Sc.(Construction Management)
- MICE, MIE

- ***ICTAD Award of Eminence – 2011***

Dr. E M G de Zylva

for his life time professional contribution

to the upliftment of the

Construction Industry

- MBA (Const. Mgt.) USA
- Doctoral Fellow – Institute of Professional Financial Managers (UK)
- Professional Member – Dispute Board Federation (Geneva)

- Fellow – Institute of Dispute Management Professionals (SL)
- Hon. Fellow – Institute of Quantity Surveyors (SL)
- Fellow – Institute of Project Managers (SL)
- Member Board of Governors of the National Arbitration Center (SL)
- Lecturer/ Examiner (Arbitration Diploma Courses) of the Institute of Commercial Law & Practice (SL)

- ***ICTAD Award of Eminence – 2011***

Vidyajyothi Prof. Lakshman Alwis

for his life time contribution

to the upliftment of the

Construction Industry & the

profession of Architecture

- B. Arch. (Melbourne) 1967
- ARAIA 1967
- RIBA (UK) 1968
- FIA (SL) – 1980
- Chartered Architect
- D. Sc (Honaris Causa) University of Moratuwa
- PG Diploma Architectural Conservation of Monuments & Sites, ICCROM Rome 1983
- President SLIA 1987/1988, 1988/1989
- Dean Faculty of Architecture, University of Moratuwa 1991 to 1999
- Professor of Architecture, University of Moratuwa 1991 to 2004
- Chairman, Board of Education, ARCASIA 94/95, 95/96
- President of ICOMAS 1995
- Director Conservation of Cultural Triangle Project, Dambulla 1995
- President, Rotary Club of Colombo 1996/1997
- Deputy Chairman ARCASIA 2001 – 2002
- Chairman, ICTAD 2004 to 2007
- Honorary Fellow, SLIA 2005
- Vidyajyothi (National Award) by the President of Sri Lanka 2005
- ICTAD Award of Eminence 2011
- SLIA Gold Medalist 2013
- Principal Architect / Chairman – Design Consortium Ltd

- ***ICTAD Award of Eminence – 2011***

Mr. H D Chandrasena

for his life time contribution

to the upliftment of the

- Fellow of the Institute of Quantity Surveyors Sri Lanka (F.I.Q.S. SL)
- Fellow of the Australian Institute of Quantity Surveyors (F.A.I.Q.S.)
- Fellow of the Royal Institution of Chartered Surveyors (F.R.I.C.S.)
- Fellow of the Institute of Dispute management Professionals (F.I.D.M. P)
- Associate of the Institute of Arbitrators Australia A.I.Arb (Aus) 1979
- Present Position – Chairman, Cost Consultancy Services (Pvt.) Ltd. Rajagiriya.
- Previous Position Asst. General Manager Consultancy Services and Chief Quantity Surveyor – State Engineering Corporation. Sri Lanka.
- Representative for Sri Lanka of the Australian Institute of Quantity Surveyors.
- Member, Board of Governors Sri Lanka National Arbitration Centre.
- Executive Committee Member Chamber of Construction Industry Sri Lanka.
- Past President Institute of Quantity Surveyors Sri Lanka
- Visiting Lecturer and Lesson Writer Open University Sri Lanka
- Member of the Dispute Adjudicators Panel – Institute for Construction Training and Development – Ministry of Housing Construction and Common Amenities.
- Member of the Executive Committee of the Institute of Dispute Management Professionals-Sri Lanka
- External Examiner Royal Institution of Chartered Surveyor Accreditation Panel 1998-2003 & 2008– to date (Department of Building Economic University of Moratuwa)
- Member of the main Planning Committee of the Urban Development Authority representing the Chamber of Construction Industry Sri Lanka.
- Visiting Lecture of Board Member of the Faculty of Architecture University of Moratuwa. (1974 to 1998)
- Member of the Consultative Committee and Steering Committee Member (Technical Publications) - Institute for Construction Training and Development (ICTAD)
- Member of the Construction Cluster of the National Council for Economic Development.
- Member of the Committee for Drafting Procedure for Contract Adjudication and Setting up of National Adjudication Centre- Sri Lanka.

CONSTRUCTION INDUSTRY DEVELOPMENT AUTHORITY

CETRAC
TO GO BEYOND

Ministry of Housing & Construction

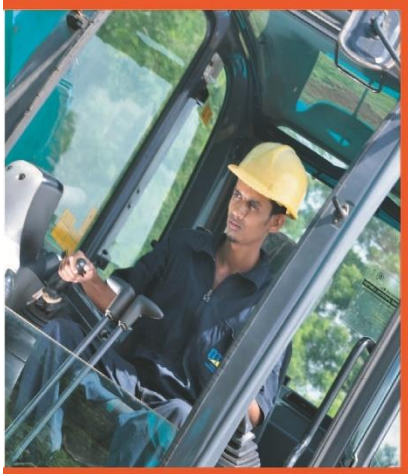
Construction Equipment Training Centre

No: 17, D P Wijesinghe Mawatha, Pelawatta, Battaramulla, Sri Lanka
Tele : 009411 2784413 / 2786829 Fax : 009411 2784411
E-mail : cetrac@sltnet.lk Web : www.cida.lk

CONSTRUCTION INDUSTRY DEVELOPMENT AUTHORITY

OTC

Ministry of Housing & Construction



Construction Equipment Operator Training College

Galkulama, Anuradhapura, Sri Lanka.

Tele : 0094 25 2050520-21 Fax : 0094 25 2050522

E-mail : cida@sltnet.lk Web : www.cida.lk