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2nd International Conference

CONSTRUCTION, REAL ESTATE, INFRASTRUCTURE AND PROJECT (CRIP) MANAGEMENT

Abstract of Papers

Organised by

NICMAR

National Institute of Construction Management and Research

November 10 - 11, 2017

Pune India

About the National Institute of Construction Management and Research (NICMAR)

The National Institute of Construction Management and Research (NICMAR) has been constituted as a not-for-profit organisation with the objective of engaging in activities for the promotion of education, training, research, professionalism and skill formation at all levels of the Construction Management, Real Estate Management, Infrastructure Management, and Project Management (CRIP). Besides this, NICMAR's objectives include undertaking special projects, collaboration with other organisations, dissemination of knowledge through seminars/conferences, etc; publishing literature, undertaking consultancy and taking necessary actions conducive to fulfillment of the objectives of the Society. Under the Bombay Public Trust Act, 1950, NICMAR was registered as a Public Trust in 1982. The NICMAR Society was constituted in 1984, registered under the Societies' Registration Act, 1860. The Board of Trustees, the Board of Governors and the Director General, referred in the Memorandum of Association as the 'Chief Executive' of the Society, are responsible for all the decisions and actions related to NICMAR. At the Institute level, there is an Academic Council chaired by the Director General which is responsible for all academic decisions. There is also a 'Research Advisory Board', an 'Academic Advisory Council' and a 'PGP Executive Committee' to provide advisory support in these areas. There is a well developed internal organisational structure with well defined roles and responsibilities for regular administration and management of the Institute. NICMAR takes pride in being a unique, specialised institute in the country dedicated to provide post graduate education in Construction, Real Estate, Infrastructure and Project (CRIP) Management and allied areas in the country. Its educational programmes primarily involve imparting/acquiring particular knowledge and skills specifically needed for professionals in construction and allied industries such as real estate, projects and infrastructure. NICMAR received a UNDP grant which enabled the Institute to involve eminent academicians from Massachusetts Institute of Technology, USA; University of Michigan, USA; University of Loughborough, UK; International Labour Organisation, Geneva; Indian Institute of Management, Ahmedabad and other institutes in India, and eminent practitioners from India in development of the first full-fledged curriculum for a two year Post Graduate Programme in Advanced Construction Management in the late eighties. NICMAR places strong emphasis on research and industrial consultancy. NICMAR faculty have published and presented a large number of research papers in national/international journals and conferences. NICMAR faculty members have been invited speakers at several conferences and won medals for their paper presentations. The Institute's work in research has led to its recognition as a Scientific and Industrial Research Organisation (SIRO) by Department of Scientific and Industrial Research, Government of India consistently since 1990. NICMAR has undertaken sponsored research studies for various organisations including Government of Maharashtra, organisations in public and private sectors, and professional associations. The Institute faculty members published/presented over 257 papers in the last year. The Institute has also successfully carried out many consulting studies. In order to ensure that the Institute's educational programmes are substantially benefited from research and consulting studies, there is strong emphasis on case writing by faculty members. As of now, our faculty members have registered over 331 cases/teaching notes/technical notes. Thus, education, research, industrial problem solving and training efforts are all directed to make available a professionally competent human resource to carry out the many challenging jobs that need to be effectively performed in the Institute's chosen areas of concentration.

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Mr. D. K. Sen – Whole – Time Director & Sr. Executive Vice President (Infrastructure), Larsen & Toubro Ltd., Mumbai

Mr. Rajendra Jagtap – Chief Executive Officer & Director, PSCDCL.

Dr. Debashish Bhattacharjee – Vice President, New Materials Business, Tata Steel Ltd.

Dr. Rangan Banerjee – Head of the Department, Department of Energy Science and Engineering, IIT Bombay

Mr. Debasis Mitra – Senior Director (Operations), Shapoorji Pallonji & Co. Ltd., (SPCL), Mumbai

Mr. Nitin Vijaivergia (GST Expert) – Partner - Indirect Tax, PricewaterhouseCoopers Pvt. Ltd., Pune

Mr. Virinder Kaul – General Manager, AFCONS Infrastructure Ltd., A Shapoorji Pallonji Group Company, Mumbai

Mr. Gopal Dey – Senior Manager, Plant Dept., AFCONS Infrastructure Ltd. - A Shapoorji Pallonji Group Company, Mumbai

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Abstract of Papers
2nd International Conference

On

Construction, Real Estate, Infrastructure and Project (CRIP) Management

November 10 - 11, 2017

Chief Editor : **Dr. Mangesh G. Korgaonker**
Editor : **Dr. Jonardan Koner**

Organised by
NICMAR
National Institute of Construction Management and Research
Pune India

Convener's Message

On behalf of the organizing committee, I welcome you to the 2nd International Conference on Construction, Real Estate, Infrastructure and Project (CRIP) Management (ICCRIP 2017) during November 10–11, 2017 at National Institute of Construction Management and Research (NICMAR), Pune, India. The conference brings together Academicians, Researchers, Industry Practioners and Engineering/Architecture/Planning students with the aim to stimulate research and discussions across the broad spectrum of CRIP management.

We have received papers from eminent academicians, practitioners and students from India and abroad. The papers selected for presentation in this conference have gone through the 'Blind Review Process' and we are sure the selected papers will add an intellectual stimulus across a broad range of CRIP sector issues around the globe. The inaugural address shall be delivered by the chief guest, the guests of honor and the chief patron. There are plenary addresses by the keynote speakers. At the end of 2nd day of ICCRIP – 2017, there will be a valedictory address by leading experts from the industry and eminent academicians. It is our belief that ICCRIP – 2017 will serve as a good forum for enhancing skills, furthering the cause of research & publications in the CRIP domain and networking among the leaders from industry, educational institutions and the various participants.

The conference theme is divided into five categories namely: Category 1: Research Paper on Construction, Real Estate, Infrastructure and Project (CRIP) Management; Category 2: Industry Outlook / Practice Presentations; Category 3: Engineering / Architecture Students' Project / Thesis Work; Category 4: Poster Presentations; Category 5: Workshop on Construction, Real Estate, Infrastructure and Project (CRIP) Management.

I hope like our previous international conference, ICCRIP – 2016, this conference will also achieve its objectives and make a valuable contribution to the CRIP sectors.

Dr. Jonardan Koner
Professor and Dean – Admissions, Research & Publications,
NICMAR

Acknowledgement

I express my heartfelt gratitude to the Chief Patron, Dr. Mangesh G. Korgaonker, Director General, NICMAR, for his constant support, guidance and encouragement. I am grateful to the Chief Guests, Mr. D. K. Sen - Whole-Time Director & Sr. Executive Vice President (Infrastructure), Larsen & Toubro Ltd., Mumbai and the Guests of Honour, Mr. Rajendra Jagtap - Chief Executive Officer & Director, Pune Smart City Development Corporation Ltd. for cordially accepting our invitation.

I thank the Keynote Speakers, Dr. Rangan Banerjee - Head of the Department, Department of Energy Science and Engineering, Indian Institute of Technology Bombay, Mr. Debasis Mitra - Senior Director (Operations), Shapoorji Pallonji & Co. Ltd., (SPCL), Mumbai, Mr. Nitin Vijaivergia (GST Expert) - Partner - Indirect Tax, PricewaterhouseCoopers Pvt. Ltd., Pune, Mr. Virinder Kaul - General Manager, AFCONS Infrastructure Ltd., A Shapoorji Pallonji Group Company, Mumbai, Dr. Debashish Bhattacharjee - Vice President, New Materials Business, Tata Steel Ltd. and Mr. Gopal Dey - Senior Manager, Plant Dept., AFCONS Infrastructure Ltd. for accepting our request to share their words of wisdom and enlightening the participants with their valuable guidance.

I acknowledge the support and co-operation from our sponsors, Shapoorji Pallonji & Co. Ltd., Larsen & Toubro Ltd., A.P. Hospitality Services, State Bank of India, Bank of Maharashtra, Saraswat Bank, Canara Bank, Andhra Bank, Avanse Financial Services Pvt. Ltd., The Credila, (an HDFC Ltd. Company), ICICI Bank, HDFC Ltd., Janata Sahakari Bank Ltd. and Bank of Baroda without whom the conference would not have been a reality.

I extend a special word of appreciation to the 'Reviewers' for reviewing the papers within the strict deadlines and giving quality feedback.

I am obliged to the Conference 'Co-Convenor Committee', Dr. Vishwanath Lele, Dean-Placements & Industry Relations, Dr. Kirti Rajhans, Head-Student Activities, Dr. Sudhir Ambekar, Assistant Professor, Dr. Vishal Patyal, Assistant Professor, Dr. Amit Hiray, Assistant Professor, Dr. Tushar Jadhav, Assistant Professor, Dr. Amol Pawar, Associate Professor, Dr. Dipayan Roy, Assistant Professor, Prof. Avadhoot Dixit, Assistant Professor, Prof. Shekhar Nagargoje, Assistant Professor and Prof. Priyanka Bendigiri, Assistant Professor, NICMAR for their cooperation in organising this conference.

I am thankful to the 'Co-Editors' Dr. Kirti Rajhans, Dr. Rahul Deshpande, Dr. Amol Pawar, Dr. Sudhir Ambekar, Dr. Vishal Patyal, Dr. Shobha Ramalingam, Dr. Amit Hiray, Dr. Tushar Jadhav, Dr. Dipayan Roy and Prof. Priyanka Bendigiri for finalising this book and arranging the poster presentations.

I am grateful to the paper presenters, research scholars from different universities and institutes, who have submitted their research papers/thesis/poster papers and contributed in a meaningful manner to add value to this conference.

Lastly, I would like to extend my gratitude to all the participants, organizers, faculty, staff of NICMAR for all their effort and support for making this 2nd International Conference on CRIP Management (ICCRIP – 2017) at NICMAR, Pune campus, a huge success.

Dr. Jonardan Koner
Conference Convener, ICCRIP – 2017
Professor and Dean – Admissions, Research & Publications,
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Content

Application of Rammed Stone Column in Ship Side Launching Jetty

C. S. Gokhale
Professor and Dean-School of Construction Management, National Institute of Construction Management and Research, Pune
Email: cgokhale@nicmar.ac.in

Abstract

Launching of ship is one of the most important operations in the entire ship construction process. Newly constructed ships are launched by various methods such as longitudinal launching systems, vertical launching system and side launching system. Due to space constraints and various other reasons and associated advantages; the use of side launching is becoming increasingly popular. The state of Goa has a large number of small and medium shipyards. Majority of such shipyards are located along rivers. As the shipyards are located on river banks close to the sea, the soil encountered is normally marine clay which is not competent to safely carry large loads. For such large infrastructural projects, the role of ground improvement has gathered immense importance. The use of rammed stone column as a ground improvement technique is of recent origin. The method is generally adopted in clayey soils. Initially, its use was restricted to oil tank foundations. However in the last 10 years, it is being increasingly used for various other structures also. This paper discusses the application of rammed stone column to support ship side launching beams and keel beam. The jetty under consideration is for side launching for flat bottom vessels having dimensions up to 90 m x 14 m and weighing up to 2000 tonnes located on the banks of the river Zuari in the state of Goa.

Keywords: *Shipyard; Jetty; Side Launching; Rammed Stone Column; Side Launching Beam*

Converting Nirmalaya Waste into Manure

Sourabh Porwal
Student, REUIM, National Institute of Construction Management and Research, Pune
Email: srbhporwal@outlook.com

Abstract

With the commencement of this project, treatment of Nirmalaya waste is effectively possible which can reduce pollution from the environment. It can prove to be an asset by recycling/reusing into manure and further be used for agriculture operations. By adopting the methods used in the project, one can lessen the burden of waste on environment and increase the consumption of natural organic resources instead of other chemical fertilizers harming the environment. In recent years, treatment of waste is the biggest challenge to be solved. With the increase in population, such problems also increase on a large scale. Dumping of this waste does not provide an environment-friendly solution.

Hence, there is a strong need to recycle this waste. Recycling of waste into organic manure contributes to economy. Presently, a large amount of Nirmalaya waste generated from temples is dumped into rivers, dumping grounds, and anywhere, which pollutes the surrounding environment. Bioculum method and Natural method adopted in this project provide a cost effective solution for the treatment of waste. With the bioculum method, the waste can be converted into manure in 30 to 35 days, while with the use of natural technique, it takes around three months. In bioculum method, powder is sprayed over the heap of waste and the required amount of moisture is added. The heap is turned every week for proper preparation and compost will be ready in 30 to 35 days. In natural process, a masonry pit is constructed with alternate gaping after every layer for the purpose of aeration. The waste is dumped into the ground and the compost is ready in around 90 days. It was concluded that both the methods successfully produced manure and effectively led to the reduction of waste from the environment and had a positive impact on economic production of manure.

Keywords: *Recycling; Bioculum Method; Natural Method; Organic Manure; Waste Reduction; Cost Effective Solution*

Evaluation of Quality Assessment Framework in Indian Building Construction Projects

Marimuthu K[1], Benny Raphael[2], Ananthanarayanan K[3] and Ekambaram Palaneeswaran[4]

[1]PhD Research Scholar, BTCM Division, Department of Civil Engineering, Indian Institute of Technology, Madras, Chennai

[2]Associate Professor, BTCM Division, Department of Civil Engineering, Indian Institute of Technology, Madras, Chennai

[3]Professor, BTCM Division, Department of Civil Engineering, Indian Institute of Technology, Madras, Chennai

[4]Associate Professor, Civil and Construction Engineering, Swinburne University of Technology, Melbourne, Australia

Email: marimuthukan@gmail.com

Abstract

Quality is one of the most important parameters for project performance evaluation. It is not considered as important as time and cost in practice, which results in a half-hearted attempt to achieve quality at project sites. However, during the operational and maintenance period, the facility may deteriorate faster than expected if it is not planned and executed well. Achieving high project performance in time, cost and quality all together is a complicated process. However, it is an essential facet of today's competitive project environment. Quality is often evaluated in a subjective manner and assessment varies from person to person. Because of this reason, the stakeholders usually take advantage on the parameters of quality. The purpose of this study is two-fold: (1) identify the critical factors influencing quality performances, and (2) check the applicability of an

existing quality assessment framework- Construction Quality Assessment System (CONQUAS) for building construction projects in India. An E-mail based online questionnaire survey was conducted to rank the critical factors influencing quality performances using three indices, i.e., relative importance index, frequency index, and severity index. The top seven critical factors identified are: (1) project supervision, (2) site inspection and testing, (3) PM competency, (4) clear objectives/ stakeholder focus, (5) teamwork, (6) quality culture, and (7) project planning and scheduling process. Cronbach's alpha value was greater than 0.7, which indicated the high reliability of the data. Spearman's rank correlation coefficient was 0.811 between the factors of project supervision, and site inspection and testing. The independent sample t-test indicated that there existed a significant difference in the mean values of structural, architectural, and mechanical & electrical building components between the Indian context and CONQUAS model, $t=6.284 > 1.9771$ (critical value), $p<0.05$. Mann-Whitney U test also indicated that there was a significant difference in the building components across the group. The implication of this study would help in building the common ground for quality assessments among the stakeholders by adopting existing models.

Keywords: *Building Construction; CONQUAS; Quality; Quality Assessment; Quality Management*

Factors Responsible for Delay in Different Types of Construction Projects

Satyam V Shinde

Student, U.G., Civil Department, Pimpri-Chinchwad College of Engineering and Research Ravet, Pune
Email: satyamshinde5@gmail.com

Abstract

The developing countries like India have more focus on infrastructure development and civil construction projects which is major contributor to the national economy. Delay in construction projects causes cost overrun which affects the country in terms of loss of revenue. In this study, we analyse the factors which cause the delay in different types of construction projects. The responsible factors are analysed from different types of references and general discussions. The projects are mainly classified into public and private. This analysis helps us in planning and scheduling as well as reducing delay. From the analysis, some recommendations are made for reduction in delay.

Keywords: *National Economy; Delay; Overrun; Projects; Reduction*

Internet of Things for Construction Industry in India

Vishal Sale[1], Nachiket Kulkarni[2], Sameer Jain[3] and Vybhav M[4]

[124]Student, National Institute of Construction Management and Research, Pune
[3]Assistant Professor, National Institute of Construction Management and Research, Pune
Email: sameerjain@nicmar.ac.in

Abstract

Internet of Things (IoT) is bringing smartness in the routine life. It has also changed the typical work culture of industries, commercial services along with social and behavioural patterns of the society. It has contributed to the overall comfort and wellbeing of the society by organising the processes, methods, and reducing the scope of human error. This study shows how to reduce the human effort and bring in the necessary automation in construction industry to track various on-site activities and enhance productivity on the construction site.

Keywords: *Internet of things; Construction; Automation*

From Minimum to Zero – A Sustainable Transition in Formwork Management

Murali Jagannathan

Assistant Professor, School of Construction Management, National Institute of Construction Management and Research, Pune
Email: mjagannathan@nicmar.ac.in

Abstract

The construction sector is fraught with materials that have adverse effects on sustainability in almost all major stages of its lifecycle viz., its sourcing, usage and disposal. In construction, the three such main raw materials that form the backbone are cement (concrete), wood (formwork) and steel (structural and reinforcement steel). Fortunately, there are sustained efforts to make concrete production and disposal more sustainable. Though steel production may not be environment-friendly, its usage and disposal does not create any major wastage or disposal issues. Formwork in the form of timber or plywood, on the other hand, is a material that is not consumed in the process of construction, thereby ultimately resulting in a near 100% wastage upon its complete usage. The paper adopts the Waste Hierarchy (WHP) framework for analyzing the various alternatives available in order to make the formwork activity sustainable. Under this framework, the paper reviews the existing formwork practices that can best replace the traditional wood and timber based formwork systems. It was observed that the 3D printing technology has the potential to completely eliminate the usage of formwork and could be the best alternative to the conventional formwork systems. The author opines that the analysis of the formwork systems from the sustainability point of view under an accepted framework (WHP) is the main contribution to the body of knowledge.

Keywords: *Formwork; Sustainable; Waste; Wood; Timber*

Opportunities and Barriers for Productivity Improvement through Reduced Labour Dependency

Murali Jagannathan

Assistant Professor, School of Construction Management, National Institute of Construction Management and Research, Pune
Email: mjagannathan@nicmar.ac.in

Abstract

One of the major reasons for the construction sector to continue to be an unorganized sector is the sustained dependency on labour force in spite of recent advancement in building science and technology. There is a widespread belief that being a labour oriented industry makes construction less productive and hence costlier. Gone are the days when construction firms could hire workmen at competent rates which justified their reluctance to embrace technology. The need of the hour is to manage construction execution with a minimum skeletal labour force and with an increased dependency on productivity enhancing equipment/techniques that are both cost effective and user friendly. The paper first identifies the factors that need to be evaluated in order to determine the acceptability of the alternate method and/or technique. The most labour intensive activities in the construction sector are then listed down and an alternate technique/method is mapped against the labour intensive activity. This is done through an extensive survey of available literature and informal discussions with the stakeholders. The acceptability of this technique (and hence the opportunities and barriers in its use) is then evaluated as per the factors identified initially.

Keywords: *Technology; Alternate; Labour; Productivity; Time*

PPP in Food Sector in India: Present and Future

Murali Jagannathan

Assistant Professor, School of Construction Management, National Institute of Construction Management and Research, Pune
Email: mjagannathan@nicmar.ac.in

Abstract

While more than 20% of the Indian population is below the poverty line and struggling to meet the day to day food requirements, annual food wastage is to the tune of about 67 million tons. Food is wasted at all stages from production to final retail distribution. Every year the government is spending money in terms of several crores in order to increase the production so that the entire nation can be fed. Public Private Partnerships (PPPs) which is lauded for its innovative approach has led to a revolution in the infrastructure sector in India. While India is not new to private participation in this sector, the focus is more on food production enhancement rather than wastage reduction and

innovative storage. This paper explores the current status of PPP implementation in the storage and distribution stage of the food and agriculture sector. The current extent of PPP penetration and the future sectors wherein PPP implementation may be beneficial and possible limitations for the same is explored in the Indian context. The paper concludes by identifying the key areas to be focused for a sustained growth in wastage reduction through PPP implementation.

Keywords: *PPP; Wastage; Storage; Food; Warehouse*

A Case Study on Application of Value Stream Mapping in Granite Factory

Prashun Kanti[1], P Avinash Reddy[2], P Veera Vinay[3] and B. Ravinder[4]

[123]Student, PGP QSCM, National Institute of Construction Management and Research, Hyderabad
[4]Assistant Professor, National Institute of Construction Management and Research, Hyderabad
Email: bravinder@nicmar.ac.in

Abstract

The construction industry plays a major role within any economy. It influences as well as is influenced by the nation's gross domestic product. However, the construction industry is commonly characterized as a backward industry, one that fails to innovate in comparison to other sectors. Waste generating activities for each work centre were identified and different analysis tools were used to reveal the root cause for each issue. A future Value Stream Mapping (VSM) was then proposed to serve as a guide for future lean activities. The implementation of VSM as a lean tool to the construction site differs greatly from manufacturing organization. Further, researchers have identified correlation between the lean theory and its practices in the construction sector. The applicability of the adopted VSM methodology was studied in a granite factory which has a production capacity of 850 sq. ft of granite slabs per day. With the help of the conducted study and cost analysis it was observed that if VSM is being applied to the granite factory then the owner can save INR 0.5 per sq. ft. of granite slabs produced and hence around INR 1.332 lakhs per annum. A detailed value stream mapping procedure for the factory has been developed and validated within this case study. This study contributes to a better understanding of the applicability and potential benefits of VSM tool in terms of cost benefits and quality improvements.

Keywords: *Lean Construction; Value Stream Mapping; Wastages in Granite Factory; Waste Reduction; Cost Analysis*

Defect Analysis in Construction Projects in India

Arun Chandramohan

Professor, National Institute of Construction Management and Research, Goa
Email: arunc77@gmail.com

Abstract

Quality is one of the key elements that contribute to the success of the stakeholders in the real estate sector. Based on the observation every non-conformance issue that hampers the project leads to errors which becomes defects that consumes resources. For elimination of errors and minimization of cost overrun in the real-estate construction projects, root cause analysis of the non conformance issues and errors need to be analysed. The study was carried out based on real-time site audit data from 15 sites of major construction companies in India between January 2014 and December 2015. The non-conformance issues that occurred in the construction site were classified into documentation, evaluation, structural, material maintenance and work related issues. The root causes of these issues were then analyzed and Ishikawa's fish bone diagram was developed for each of the common issues. The factors that caused the issues were then grouped into 5 categories *viz*. lack supervision, unaware of system, in-adherence to the system, improper utilization/ wastage and miscellaneous causes. The main attributes that cause the non conformance issues were analyzed and found with the aid of Pareto 80-20 rule. This study provides an easy tool for the site personnel to analyze the problem and prevent it from recurring.

Keywords: *Quality Management System; Fishbone Diagram; Project Issues; Root Causes*

Experimental Study on Self Compacting Concrete Using Superabsorbent Polymer

A. Mohanraj[1], V. Senthilkumar[2] and S. Loganayagan[3]

[123]Assistant Professor, Bannariamman Institute of Technology, Erode
Email: mrmohanpro29@gmail.com

Abstract

Self Compacting Concrete (SCC) is a type of concrete that gets compacted under its self-weight. SCC is a concrete which can be placed and compacted into every corner of a formwork; purely by means of its self-weight, eliminating the need of either external energy input from vibrators or any type of compacting effort. This paper discuses about self compacting self curing Concrete which uses Superabsorbent Polymers (SAP) as a self curing agent. There is a significant influence on the strength of the concrete because of internal curing using SAP. However, if the quantity of SAP added in the concrete exceeds the limit, it may lead to additional void formation in the concrete mass which

in turn would have a negative effect on the hardened concrete. This effect of SAP on concrete leads to improvement in workability and placing on concrete. This paper focuses on the physical properties of hardened SAP induced concrete and to compare them with ordinary M40 grade concrete. The concrete mix limits the percentage of superplastizer to 2 % and varies the percentage of SAP. Nearly 18 trials were carried out, from which the mix for M40 grade of concrete and percentage of SAP to be added is obtained. All the trials satisfied the workability tests specified in EFNARC.

Keywords: *Super Absorbent Polymers; Superplastizer; Workability; Hardened Property*

Feasibility Study on Concrete Prepared with GGBS, Lime and Fly Ash

Tenepalli Jai Sai[1], Shriram.B[2], Muhammed Afsal K C[3] and Sachin Samuel Mathew[4]

[1]Assistant Professor, National Institute of Construction Management and Research, Pune
[234]Alumni, Advanced Construction Management, National Institute of Construction Management and Research, Indore
Email: jaisaitenepalli@gmail.com

Abstract

For the growth of the economy, infrastructure development is essential, and cement is an integral part of this evolution. As cement manufacturing is a highly polluting process, alternatives are being developed to make it sustainable. One such alternative is Pozzolanic Portland Cement, which involves partial replacement of cement with pozzolans. Another option is geopolymer, an alkali-activated binder. Even though geopolymer binder is not used widely in construction, previous and on-going studies have shown promising results. In this ongoing laboratory investigation, an attempt to produce concrete is carried out by substituting cement with various proportions of ground granulated blast slag (GGBS), lime and Fly-Ash. To assess the response of this GGBS concrete, cubes were prepared and crushed for compressive strength at different ages. The test results showed a compressive strength of 20 N/mm^2 at a proportion of 42.5% and 60% of GGBS after 120 days age of concrete. The addition of GGBS which has certain amounts of Bouges compounds has attributed to the strength of concrete. With this in view, the study investigates the possibility of producing sustainable and green concrete by completely replacing cement with GGBS, Lime, and Fly-Ash.

Keywords: *GGBS; Complete Cement Replacement; Sustainability*

Managing Operation and Maintenance of Green Building: A Case Study

Anand Prakash[1], Sudhir Ambekar[2], Vishal Patyal[3] and Dipayan Roy[4]

[1]Associate Professor, School of General Management National Institute of Construction Management and Research, Pune

[234]Assistant Professor, School of General Management, National Institute of Construction Management and Research, Pune

Email: aprakash@nicmar.ac.in

Abstract

Environment friendly green buildings are designed for effective and efficient transformation of resources into desired outputs. Built industry, traditionally, has paid great attention to this conversion in terms of its effect on profitability but not on its harmful environmental effects. As pressures for green buildings rise, issues pertaining to their operation and maintenance for being sustainably responsible become imperative given increasing legislative and regulatory frameworks. Such green buildings are believed to keep minimal harmful wastes in their sub-systems of operation and maintenance comprised electrical system, HVAC (heating, ventilation, and air conditioning) system, plumbing system, fire-fighting and fire protection system, and extra low voltage system. This paper introduces a particular approach to addressing the concept of "green building" applying Leadership in Energy and Environmental Design (LEED). This paper describes a case study of an Indian company at which the approach was used. This case company is considered as pioneer in creating green infrastructural solutions for the IT & ITeS sector by reducing degradation of environment; efficiently use of energy, water and other resources; and protecting occupant health and improving productivity.

Keywords: *Green Building; IT & ITeS; Leadership in Energy and Environmental Design (LEED); Maintenance; Operation; Triple-Bottom-Line (TBL)*

Identifying, Analysing and Reduction of Constraints by Micro Scheduling in Construction Industry

Venkatesh Poondru[1], Pavan Kumar Bennur Basvaraj[2], Bhanuteja N[3] and B.Ravinder[4]

[123]Student, PGP QSCM, National Institute of Construction Management and Research, Hyderabad

[4]Assistant Professor, National Institute of Construction Management and Research, Hyderabad

Abstract

In today's modern and complex construction methodologies, understanding of project activities and coordination between people have become vital for the success of the any project. The main motto of this study is to break the Work Breakdown Structure of the project to a minute level where the understanding of the activities is high. This study is conducted on In-situ Slab casting works which is going on as of now in Ameerpet Interchange station, Hyderabad Metro Rail Project, Andhra Pradesh.

We worked on breaking the activities involved in slab casting to a level where all the departments involved in it can understand their roles and responsibilities clearly and act accordingly. All the activities which were broken will be sequenced and a schedule is prepared from it. This schedule will be monitored and the actual data will be updated against the schedule prepared. Then, it is analysed and constraints for delay is charted out. Those delays will be recorded and precautionary measures will be taken for the next slab. This is a continuous process which extends throughout the project. However, in this study we have restricted to three slabs. The results were measured in the form of 'Cycle time of slabs' & 'Productivity of labour'. This could be further developed at the site level and applied for all the activities as each and every activity has different constraints. This may be helpful for the organization for risk mitigation.

Keywords: *Slab; Cycle Time; Productivity; Risk; Micro Schedule*

Determinants of Capital Structure for Infrastructure Construction Companies in India: An Empirical Study

Harish Kumar Singla

Associate Professor, National Institute of Construction Management and Research, Pune
Email: hsingla@nicmar.ac.in

Abstract

The study aims to find out the factors affecting capital structure in Indian infrastructure companies. For this purpose data of 56 infrastructure companies were selected and their financial data were taken for a period of four years i.e. 2011-14. The dependent variable in the study is leverage i.e. capital structure variable. Leverage is defined as the ratio of total debt to equity. There are three explanatory variables i.e. the independent variables, namely Tangibility (ratio of total fixed assets to total assets, Profitability (PBDITA), Growth (company's growth is measured by the percentage change in the value of total assets) and Size defined as natural logarithm of assets. Data were analyzed using, simple OLS, Panel data OLS using fixed effect and random effect. It was observed using Hausman test that fixed effect is the best fit model for the study. The results of panel data fixed effect show that tangibility is the only factor that is significantly affecting the capital structure.

Keywords: *Capital Structure; Leverage; Growth; Tangibility; Profitability; Size*

Investigating Constructability Improvement Barriers in the Indian Construction Industry

Ashish Goel[1], Ram Charan Pottem[2], Prathamesh Pinge[3] and Charles Mathew[4]

[1]Assistant. Professor, National Institute of Construction Management and Research, Pune
[234]Alumni, PGP, ACM, National Institute of Construction Management and Research, Pune
Email: agoel@nicmar.ac.in

Abstract

Past research has established the positive contribution of Constructability improvement to project success in terms of time, cost and quality, especially for Design Build (DB) procurement system. However, the literature also suggests that constructability improvement programs face multiple barriers at project and organisation level, both from client and contractors' side. A review of constructability literature reveals lack of studies conducted in Indian context and the present research aims to fill this gap. In this research, an effort has been made to identify and analyse the most prominent barriers to constructability improvement prevalent in the Indian construction industry. In the first part, 46 barriers were identified through literature review and ranked on the basis of a survey conducted amongst construction contractors. Out of 46 barriers, 'Lack of Coordination between design team and execution team during design stage' was found to be the most important followed by 'No system for documentation of lessons learned' and 'No Accessibility to existing Knowledge database'. The study also delved into the reasons for constructability barriers and found that 'Poor inter-department Communication and Co-ordination' at contractors' end was responsible for almost 25% of all constructability issues, followed by 'Lack of Management Support (contractor)', 'Lack of Knowledge and Skill in Project Team (contractor)' and 'Lack of Technology and Resources (contractor)'. Thus, most of the constructability issues could be attributed to contractor's management, his project personnel and resources. In the second part, a Constructability Review and Improvement (CRI) Model is developed which integrates constructability improvement ideas in Design and Construction Phases of project lifecycle. The model uses the tools and techniques already suggested in the reviewed literature and places emphasis on the deployment of a Constructability Champion and a Constructability review team as the main drivers of constructability improvement initiatives in Design and Construction Phases of the project.

Keywords: *Constructability; Project Success; Construction Management; Design-Build; India*

Impetus of Infrastructure Status to Affordable Housing

Alok Singh

Assistant Professor, National Institute of Construction Management and Research, Delhi NCR (Bahadurgarh)
Email: asingh@nicmar.ac.in

Abstract

The infrastructure and the real estate are two components of the construction industry. The affordable housing is sub-part of the housing segment and housing segment is part of real estate development. The government of India during its Union Budget 2017-18 accorded 'Infrastructure Status' to 'Affordable Housing'. The paper elaborates about the infrastructure status to affordable housing by incorporating: the understanding of affordable housing for buyers and developers, the way industry sees it; whether the infrastructure status is an opportunity or a challenge; whether it will promote collaboration or competition; whether it will augment supply or it will shrink price and the way it will characterize urbanization. This paper aims to understand how status of infrastructure to affordable housing will impact overall development of affordable housing per se; and how affordable housing with infrastructure status will create opportunity for infrastructure sector per se. The paper also aims to study impact of infrastructure status to affordable housing on: Land Acquisition & Analysis, Project Planning, Approval & Financing, Strategy & Positioning, and Disposition - the five stages of residential real estate development process model in India. The paper finally tries to figure out-how lucrative the infrastructure status to affordable housing is for infrastructure companies and for real estate developers.

Keywords: *Infrastructure Status; Affordable Housing; New Business Environment; Five Stage Model; Urbanization*

Construction Equipment Financing - Need of Innovation in Tough Market Conditions

Sarbesh Mishra

Professor, National Institute of Construction Management and Research, Hyderabad
Email: sarbeshmishra@nicmar.ac.in

Abstract

The mechanization of the construction industry in recent times constitutes construction equipment a major part of the construction activities. The construction equipment amounts to 25% of the total cost of the project. Hence, financing decision of the construction equipment plays a vital role in the success and profitability of the project. Construction equipment can be procured by hiring or buying. This decision is influenced by various factors such as type of the project, scale of operations, tax rate,

government policies etc. Procuring construction equipment and machinery is a high cost affair for most construction firms. With over 90% of all construction activity executed by smaller players, the activity is widely dispersed. These players, because of the monopolistic nature of construction, with the government being the largest buyer of these services, face an erratic and unpredictable workload. As such the existing equipment stock itself is highly underutilized. At present it is estimated that the country has an operating stock of construction equipment valued at INR 75,000crores and dormant stock of INR 110,000crores. With the increase in the size and complexity of construction, construction equipment has become an indispensable part of every project. Several gigantic projects, which were beyond comprehension in the past have now been designed and are using sophisticated and heavy construction equipment. In fact, all aspects of construction in some way or other depend upon equipment. Thus if a proper use is made of the construction equipment, they can contribute to economy, quality, safety and speed of a project. About 20 percent of the cost of a typical construction project in 2000 was accounted for by the machinery and equipment. The current ratio may be over 30 percent. Buy or lease? That is a question being faced by many rural building businesses, even as credit becomes more readily available. While virtually everyone understands the simplicity of buying, leasing is far more complicated. Deciding the best strategy is a tough move for anyone. There is no one correct answer that fits every situation or every building business. Equipment leasing is generally a loan in which the lender buys and owns equipment and then 'rents' it to a building business at a flat monthly rate for a specified number of months. At the end of the lease period, the business may purchase the equipment for its fair market value (or for a fixed pre-determined amount), continue leasing, lease new equipment or return it. Although lease financing is generally more expensive than bank financing, in most instances it is more easily obtained. Leasing of equipments and real assets is a prominent source of private capital formation and contributor to GDP in many developed and developing economies across the world. With equipment leasing (excluding real estate and consumer asset financing) as a % of private capital formation estimated at 16.4% for US, 16.2% for Germany, 23.8% for Brazil, 20.6% for UK and 2.2% for China in 2008. In contrast, leasing penetration in India is abysmally low and is estimated at 1.5% of private capital formation in financial year 2010, which roughly translates into INR 20,000crores of annual leasing volumes. In India, Earth Moving and Construction Equipment (ECE) industry is expected to grow at a healthy CAGR of 20 to 25 per cent over the next few years, from financial year 2013-2014 levels of 48,000 units. This would bring the market to between $16 billion and $21 billion by 2020, up from today's $3 billion. Nevertheless India's ECE market is still underdeveloped: ECE penetration of construction industry is very low compared to other developed countries, indicating there is a significant room for growth. The selection of appropriate equipment is a crucial decision making

process as it involves huge capital investment. The purpose of the present study is to develop a model pertaining to the factors influencing the selection of construction equipment. In the present study an attempt has been made to create sustainable business model for ECE industry with innovation in the available financing arrangements.

Keywords: *Construction Equipment; Construction Project; Construction Company; Operating Stock; Lease; Asset Financing; CAGR; Earth Moving and Construction Equipment Industry (ECE)*

Critical Review of Integrated Townships Development in Ahmedabad

Jay H. Shah[1] and Anup Shah[2]

[1]Student, M. Tech, Infrastructure Engineering Design, CEPT University, Ahmedabad

[2]Associate Director, CBRE South Asia Pvt. Ltd, Ahmedabad
Email: jayshah596@gmail.com

Abstract

Availability of land parcels for development and development of major infrastructure in the city plays a significant role in the economic growth of the city and its potential to compete in the global markets to attract more investments. As the urban settlement grow bigger the need of capital and planned effort becomes more important. Ahmedabad as a city has seen phenomenal growth in the last few decades propelled by the entrepreneur nature of the people, political will and the geographical advantage. Thus, as a city it offers lots of potential for the future development and opportunities for the investments. One of the key advantage of the city of Ahmedabad has been the city planning and urban development planning by public agencies. These agencies are involved in the preparation of city development plans and their implementation in terms regulating urban land uses and space provisions and carrying out land and infrastructure developments. The city planning has been done by the civic authorities as a planner without indulging in the business activity of buying/ realigning by planning / then selling for profit. This model has been followed by a large part of the other urban development bodies leading to higher probability of corruption. As a result the private developers in the city have played the role of investor of the city in development of individual sites and properties within given frameworks of public plans and regulations for profit. Ahmedabad city has lots of opportunities in manufacturing and industrial sectors, which have seen continuous growth and significant investment of Indian and global companies equally. This development shall attract immigrants to the location and create continuous demand of housing. To cater large scale integrated cohesive development, Gujarat government implemented Township Policy – 2009. These developments have attracted large national developer and local developers to start investing in housing sector in Ahmedabad. Adani Group, Godrej Properties, Sandesh Group, Goyal Group etc are few names, who took the lead in accordance and they started planning for the

integrated townships development in Ahmedabad peri-urban area under Gujarat Integrated Township Policy-2009. The township developments by these prominent developers were aimed at providing better housing stock with state of the art infrastructural facilities and lifestyle amenities. It is important to note that even with such policy of integrated development new integrated township development projects have become extremely difficult to implement due to lack of space and huge cost especially in larger cities. So largely developer/ investor focus has been developing such scale projects in tier 2 -3 cities, like Jaipur, Ludhiana, Indore, Nagpur, Kolkata and Chandigarh, Kochi and Ahmedabad. The residential sector offers the largest opportunity set to investors/ end user equally in the city of Ahmedabad. In Ahmedabad, AUDA gave permission to 9 integrated residential townships. It is important to note here that the private developer would only be concerned with the feasibility of a project and profitability. Being privately developed projects, there shall be no public pressure, nor there be inclination to the cost it might inflict upon the community (social costs) or the benefits which might be gained by such development (social benefits). Due to limited response at the state level, Gujarat Integrated Township policy has been curtailed and is not available for the developers to benefit from the same. Thus, the study was to understand the strategic approach of the developers at that time of master planning and launching the construction of this projects; the current status of this four township by comparing different infrastructure, price, planning, sustainable parameters and through SERVQUAL analysis for this township to know reaction of existing customer satisfaction. Further, this study also includes the planning of township effect on the city as well as on developer.

Keywords: *Gujarat Integrated Township Policy-2009; Comparative Analysis; Integrated Township Development in Ahmedabad*

Lean Construction Practices in a Highway Project - A Case Study on the National Highway NH 218

R. Sathish Kumar

Senior Associate Professor, National Institute of Construction Management and Research, Hyderabad
Email: sathishkumar@nicmar.ac.in

Abstract

Lean construction is a production and management based approach to a project. It is a way to design production systems to minimize the wastage of materials, time, and effort in order to generate the maximum possible amount of value. Lean Construction extends from the objectives of a lean management system to maximizing the value and minimizing the waste. A study was done to analyze the lean construction practice in a highway project. The main objective of the study is to analyse and implement the lean construction practices in the construction of a highway. The study is based on a

live project 'Improvements to Road from NH-218 to Andhra Pradesh Border leading to Mehaboobnagar via Chincholi [km 92.000 to km 108.200]'. An analysis on the design of the highway pavement is also done where a change in design is recommended which resulted in considerable cost savings.

Keywords: *Lean Construction; Waste Minimization; Macadam Construction; Million Standard Axles; Design Thickness*

Pathway to Net Zero Energy Building

Patil Vrushali Maharu[1], Khan Bilal Ahmed Farooq[2], Shaikh Ahmed Husain[3] and Girish B. Mahajan[4]

[1234]Student, Civil Engineering Department, AIKTC, Mumbai University
Email: me.vrushalipatil@gmail.com

Abstract

Natural resource depletion is a crucial environmental problem, currently faced by the world. Fossil fuel consumption results in emission of greenhouse gases which is directly responsible for global warming and climate change. Globally people are taking efforts to shift to renewable sources of energy like solar, wind, biogas and geothermal energy. In India about 65% of the electricity generated by thermal power plants, 22% from hydroelectric power plant, 3% from nuclear power plant which are responsible for 71% of greenhouse gas emission of country. This study discusses design of Net Zero Energy Building (NZEB), as a solution for reducing the effect of greenhouse gases emission. Solar energy, a renewable source, is used for generation of electricity. This work contains planning, structural designing, modeling, costing as well as designing and installation of solar panel system in proposed residential NZEB. Hollow bricks are used for construction which results in durability and sustainability of the building. NZEB users consume renewable energy and hence they contribute towards the economy of the nation. NZEB is an appropriate solution to overcome the problem of electricity generation in developing country like India.

Keywords: *Net Zero Energy; Renewable Energy; Greenhouse Gases; Solar Energy; Economy*

Study on Total Quality Management System Practices in Indian Construction Industry

Renuka Prasad.H[1] and Venkatesan Renganaidu[2]

[1]Student SODE, National Institute of Construction Management and Research, Pune
[2]Professor, National Institute of Construction Management and Research, Hyderabad

Abstract

Today, quality management has become one of the important forces leading to organizational growth and a company's success in national and international markets. The main aim of this research is to

study 'The Total Quality Management System Practices' in the Indian construction industry. The literature review revealed the existence and practice of numerous standard quality procedures including ISO 9000 and ISO 9001Total Quality Management system. In order to check the practices of these procedure two detailed case studies have been carried out in two major Indian constructions project sites. The study reveals that the Total Quality Management system is developed from the elements in the quality standard and the processes followed throughout the construction phase. The Total Quality Management system is also evolved at all levels in the organization from the top management to the support staff level, subcontractors and suppliers. Involvement by all parties throughout the construction phase will ensure that the required quality of the end product is up to client expectations, legal and other requirements.

Keywords: *Total Quality Management; Construction Industry; Quality Standard; Quality Procedure; Quality Practice*

Critical Analysis of the Success Factors of Public- Private Partnership Projects in Kerala

Nivea Thomas[1] and Anu V. Thomas[2]

[1]Student, PG, T. K. M. College of Engineering Kollam, Kerala
[2]Associate Professor, K. M. College of Engineering Kollam, Kerala
Email: niveathomas93@gmail.com

Abstract

Public-Private Partnerships (PPPs) have been widely applied across the world to provide a sequence of important public services owing to the limited funds available with the governments for infrastructure development. Despite more and more successful operations of PPPs, some project failures are still reported in the literature like cost overruns, schedule overruns, and stakeholder dissatisfaction. Performance evaluation of PPP projects throughout the project lifecycle is necessary and there is an utmost need to identify the factors critical to the success of a project. A questionnaire survey was carried out in the state of Kerala to understand the success factors influencing PPPs and their underlying relationships. A total of 60 critical success factors were identified from literature and by holding discussions with PPP practitioners. Among the 60 factors considered, 'selection of the right project' was identified as the most critical factor for success in PPP projects. Factor analysis employed to understand the underlying relationships among the factors, categorized the factors into seven groups, namely, (1) stakeholder satisfaction; (2) technical and engineering structure; (3) project management framework; (4) partnership skills; (5) favourable environment; (6) client satisfaction and environmental analysis and (7) project selection. Further analysis indicates client satisfaction and environmental analysis as the most significant of all the factors having negative

influence on cost performance. The research findings will provide insights to PPP practitioners on factors contributing to the success of PPP projects and guide their efforts to achieve better project performance.

Keywords: *Public-Private Partnerships; Stakeholder; Relationships; Project Performance; Factor Analysis*

Interrelationship of the Critical Risk Factors in Construction Projects

Muhammed Ansar P.[1] and Anu V. Thomas[2]

[1]Student, PG, T. K. M. College of Engineering Kollam, Kerala
[2]Associate Professor, K. M. College of Engineering Kollam, Kerala
Email: anutri.anu@gmail.com

Abstract

The construction sector in India is a major contributor to economic growth of the nation and provides employment to about 40 million people. The construction industry, however, is plagued by many issues like low productivity, severe skill shortage and limited mechanisation. There is strong evidence of inconsistent performance in over 60% of Indian construction projects especially on the key performance measures of cost, quality and schedule. Compared with many other industries, the construction industry is subject to more risk due to the unique features of the construction activities. Risk management aims at identifying sources of risk and uncertainty, determining their impact and developing appropriate management response. A questionnaire survey was conducted, in the state of Kerala in India, to identify the risk factors in construction projects and their underlying relationships. 55 critical risk factors were identified from the literature. Among the 55 factors considered, 'tight project schedule' was identified as the most critical risk factor for construction projects. Factor analysis performed on the risk factors categorized the factors into seven groups, namely (1) inefficient project team; (2) poor coordination of project team; (3) improper project planning; (4) environmental issues; (5) delays in obtaining administrative approval; (6) lack of quality of resources and (7) delays in obtaining technical and financial sanction. The results of regression analysis indicate that inefficient project team is the most significant of all the factors having negative influence on cost performance. This study provides an insight into the problems affecting the successful delivery of construction projects and provides directions in devising solutions and strategies for overcoming them.

Keywords: *Construction Sector; Key Performance; Risk Management; Coordination; Resources*

Capital Structure and Financial Performance: Evidences from Indian Real Estate Sector

Sudhir Ambekar[1], Dipayan Roy[2], Anand Prakash[3] and Vishal Singh Patyal[4]
[124]Assistant Professor, National Institute of Construction Management and Research, Pune
[3]Associate Professor, National Institute of Construction Management and Research, Pune
Email: sambekar@nicmar.ac.in

Abstract

One of the most important decisions for any firm is choice of financing for its investment needs. Firms can use internal sources such as retained earnings or external sources such as borrowings from financial institution, issue of stock to finance their investments. The mix of these external sources of financing is referred as capital structure of the firm. It is one of the most studied topics historically but there is a need to determine the impact of capital structure on financial performance of real estate firms. It is a challenging task owing to the presence of different sources of finance present in the real estate sector. The present study focuses on capital structure, profitability and firm valuation. The paper utilizes the panel data regression model to analyse data of six years on 35 listed real estate firms in India. The selection of fixed effect or random effect for this regression is based on Hausman test. The empirical finding suggests a significant relationship between capital structure and firm performance. It has a direct relationship with the measures of profitability where as an indirect relationship with the firm value. The findings may be useful for the real-estate developers to determine their capital structure for improving their financial performance. Further, this study may be useful for investors, customers and other stakeholders in deciding their investments in real estate firms.

Keywords: *Panel Data Analysis; Capital Structure; Profitability; Tangibility; Firm Valuation; Real Estate*

Study of Delays and Cost Overruns in Infrastructure Projects – Case Analysis

Harish L Reddy[1] and Sandeep Ashok Shinde[2]

[1]Assistant Professor, School of Construction Management National Institute of Construction Management and Research, Pune
[2]Student, PGPPM, School of Distance Education, National Institute of Construction Management and Research, Pune
Email: hreddy@nicmar.ac.in

Abstract

India has set an ambitious target of investing USD 1 trillion in infrastructure during the twelfth five year plan period. Given this factor, infrastructure development has been a key focus area in every Indian state. Many of these projects have been invariably riddled with issues of schedule and cost overruns. It is a known fact that a large number of infrastructure projects in India have been delayed

due to regulatory clearances, environmental issues and problems pertaining to land acquisition. Also, there are challenges in the tendering phase that affect the viability of the project thus delaying implementation. The construction phase is beset with overruns and disputes and last but not the least, skill sets are weak all across the value chain. This paper attempts to identify the pertinent issues mentioned above and also highlight the professional project management practices which can bring about a positive change in the completion of projects on time and within budget. Key stakeholders in the infrastructure sector are interviewed and few key projects are analysed. The external reasons for delays that are beyond the control of implementing agencies and internal reasons that can be curtailed at the project level with proper planning and management are investigated. The study also dwells on the proposed actions and possible recommendations for expediting infrastructure projects in India. Three projects are investigated *viz.* Amravati 5 x 270 MW PH-1 Thermal Power Project; Bandra Worli Sea Link (Officially called Rajiv Gandhi Sea Link), Mumbai and Expansion and Modernization of Netaji Subhas Chandra Bose International (NSCBI) Airport.

Keywords: *Infrastructure; Schedule Delays; Cost Overruns; Project Cases; Project Management*

Comparative Study on Adoption of Mobile Applications on Real Estate Projects between Clients and Contractors

Nikshubha Bhardwaj[1], Pritam Das[2], Abhishek Morajkar[3], Deepak Meghani[4], and Darshan A. Mahajan[5]

[1234]Student, PGP ACM, National Institute of Construction Management and Research, Pune
[5]Associate Professor, School of General Management, National Institute of Construction Management and Research, Pune
Email: dmahajan@nicmar.ac.in

Abstract

Most of the construction projects are getting equipped with information technology tools. The traditional paper based working has limitation *viz.* Unavailability of work performance data, Lack of timely feedback, Duplication of data, Inaccuracy in work performance information, Data inconsistencies and so on. Working with the traditional style or using traditional file systems creates barriers during project life cycle. Key project stakeholders like contractors, clients, consultants, project managers have difficulties to work in project due to traditional and manual methods of working. The questionnaire was administered to more than 120 respondents in Pune, India which includes the users like managers, engineers, and site Engineers working from both client side and contractor side. The data were collected from 70 such respondents to know their views on the adoption of mobile application technology. This study used basic descriptive statistics and RII on the collected data. This research has examined degree, purpose, significance, challenges, selection criterion for the implementation of mobile application from the client and contractor side. The data

analysis shows that the users from the client side and contractor sides are aware of mobile applications with its advantages for the real estate projects. Both the parties have shown willingness in the adoption of mobile applications on the construction sites. Some differences of opinion can be seen in challenges in implementation, source selection criterion and significance by the client and contractor side users.

Keywords: *Clients; Contractors; Mobile Application; Project Processes; Real Estate Project*

Buyer Behaviour in Real Estate in Pune City

Deepak Sundrani

Associate Professor, National Institute of Construction Management and Research, Pune
Email: deepaksundrani@nicmar.ac.in

Abstract

The present study identifies the relative importance of the various sub-factors for location preferences of recent home-buyers. In this paper, seven sub-factors of location are considered and a sample of 548 recent home-buyers of Pune city is drawn. The respondents are asked to rank the sub-factors affecting the choice of location from 1 to 7 (1 being most important and 7 means least important). For hypothesis testing, Medians are compared using Mann Whitney test. This study concludes that proximity to the place of work is the most important consideration of the recent home-buyers in new buildings. Although, many researchers have discussed the importance of location, this is the first study that empirically tests the relative importance of the various sub-factors of location. This study will be useful to the professionals in the field of Real Estate marketing

Keywords: *Buyer Behaviour in Home-Buying; Real Estate; Relative Importance; Location*

The Realty Growth Trajectory of India and China- Inexorable Comparison

Shakil Malek[1] and Saiyed Farhana[2]

[1]Director, F. D. Mubin Institute of Engineering and Technology, Bahiyal, Dist. Gandhinagar, Gujarat
[2]Assistant Professor, Charusat University, Changa, Anand, Gujarat
Email: shakil250715@yahoo.co.in

Abstract

The real estate boom is the main driving force of the economic growth in India in recent years. However, the real estate market in India is still in the nascent period and immature. This is a common phenomenon that many real estate projects cannot meet the deadlines because the Indian real estate companies lack a scientific management technology to address the risks. This paper presents a general overview of the history of India's real estate industry and the current situation of India's real estate market as compared with that of China. The purpose of this study is to showcase the risks in the real estate sector of India in comparison to China. India has been seen as an emerging

third pole in the global economy after the US and China, it becomes essential to manage the risks in the real estate sector which are contributing highest to its economy. Hence, the paper intends to spot those risks which have entered in the real estate sector.

Keywords: *Real Estate Industry; India; China; Risk Management; Construction Industry*

Development of Post Occupancy Construction Quality Assessment Model for a Rigid Pavement

B. Nithin Krishna[1] and Vinay Topkar[2]
[1]Senior Engineer, Shapoorji Pallonji and Company Private Limited, Mumbai
[2]Professor, Veermata Jijabai Technological Institute, Mumbai
Email: nkrishna.reddy@hotmail.com

Abstract

Any constructed facility should conform to predetermined quality standards and specifications in order to serve the purpose for which it is constructed. Hence, it is necessary to evaluate a constructed facility to check the extent to which quality standards and specifications are met. While traditional quality audit and inspection type of assessments are subjective in nature and hence objected by the contractors, therefore, an objective quality assessment model is needed this would consider the test results of both materials and workmanship to ascertain quality of a constructed facility objectively. The developed model will be comprehensive, rational, objective, and sensible post occupancy construction quality assessment model for a rigid pavement which would give an idea of how the resources are being used to attain desired workmanship in constructing a particular rigid pavement. The proposed model includes collection of Construction Quality Characteristics related to materials and workmanship in constructing a rigid pavement system from literature survey; standards and specifications; finalizing Acceptance Quality Characteristics based on preliminary survey of construction experts; preparing Schedule survey form incorporating the finalized Acceptance Quality Characteristics; identifying sample from the population for Schedule survey; conducting Schedule survey; developing an objective Construction Quality Index from Schedule survey responses and project site data. An Alternate Acceptance Quality Characteristics were identified and an alternate Construction Quality Index was developed for the ease of model application on a rigid pavement system. The developed model would be helpful in examining the level of quality achieved on a rigid pavement, to compare different stretches of rigid pavements and also to appraise contractor's ability in providing quality facilities.

Keywords: *Quality Assessment; Quality Level; Construction Quality Characteristic; Acceptance Quality Characteristic; Construction Quality Index*

Implementation of the Last Planner System in the Indian Construction Industry

Deep Vasant Shah[1], Naaga Arjun U[2], Nevash K V[3] and Sumit N Sutariya[4]

[1234]Student, PGP ACM, National Institute of Construction Management and Research, Pune
Email: arjun.1495@gmail.com

Abstract

In the current scenario, construction projects are executed by the traditional 'push' approach (without an idea of the end in mind) which has resulted in improper project execution that leads to delays and cost overruns. In contrast, Last Planner System (LPS) which is a lean construction technique is a 'pull' based approach. In LPS, the site engineer/ foreman responsible for the execution of the work is involved in the planning process. This paper which is a part of ongoing post graduate research discusses on the various issues that are prevalent in the construction and maps them against the advantages of the LPS technique. The purpose of the study is to understand the relevance of LPS in the Indian construction industrial scenario. This objective is achieved by first identifying the most important issues in the Indian construction sector through a literature review. LPS is identified as a solution to afore mentioned issues. The discussion in this paper needs to be further validated through extensive surveys and interviews. However, the authors believe that the study would further encourage stakeholders to apply such lean techniques in the Indian construction industry.

Keywords: *Construction; LPS; Issues; Planning; Technique*

Conceptual Framework for Selection of Project Delivery Model for Construction Projects using Transaction Cost Economics

Imad ul Arfin[1] and Debopam Roy[2]

[1]Alumnus/ Assistant Engineer, National Institute of Construction Management and Research / SM+D Interior Design LLC, Dubai, UAE
[2]Assistant Professor, National Institute of Construction Management and Research, Pune
Email: droy@nicmar.ac.in

Abstract

Transaction cost is the cost incurred for making an economic exchange. The basic premise of transaction cost economic (TCE) theory is that the decision to outsource, rather than to undertake work in-house, is determined by the relative costs incurred in each of these forms of economic organization. The main premise of TCE is that in addition to costs of production, there are also costs of transactions between parties. When transaction costs are high it is argued that it is cheaper to transact within the firm rather than between the firms. The main determinants of TCE are asset specificity, uncertainty, and frequency. The choice is however not limited to these two extremes, but also include a large number of hybrid forms of contractual relationship between the principal and the

agent (the contractor). The key is to assess the efficiency properties of alternative contracting modes, by comparing the total project costs, which is a sum of the contract price and the transaction costs. In construction sector, the most frequently used models for project delivery are Design Bid Build (DBB) and Design Build (DB). In DBB, the client appoints a contractor only for the construction, as per drawings provided by the client, whereas in DB the contractor has a wider role, whereby he provides the design as well as construction. This paper proposes a conceptual framework to select the suitable project delivery model for a construction project, using the theoretical lens of TCE theory. This framework explains how the appropriate project delivery model should be selected based on factors like number of contracts, frequency of purchase, and competition.

Keywords: *Transaction Cost Economics; Design Bid Build; Design Build; Selection of Contract Type; Total Project Cost*

Factors Affecting Cost Overrun in Micro-Companies Undertaking Public Works

Nikhil Soman[1], Grace Mary Abraham[2] and Unnikrishnan S[3]

[1]Student, PG, Department of Civil Engineering, Amal Jyothi College of Engineering, Kanjirappally
[2]Assistant Professor, Department of Civil Engineering, Amal Jyothi College of Engineering, Kanjirappally
[3]Assistant Professor, Department of Civil Engineering, Sree Buddha College of Engineering, Pattoor

Abstract

A majority of projects undertaken by the Public Work Department (PWD) are micro projects. They are generally executed by micro-companies. The main goal of any company is to make maximum profit within the bid cost and duration with an acceptable quality. Most of the projects undertaken by micro-companies end up in cost overrun. The objective of this study is to investigate the current scenario of cost overrun in Kerala and identify the factors that causing cost overruns in public construction works undertaken by micro-companies. This study collected work details from public authorities, personal interview session and ranking of factors based on Relative Importance Analysis (RIA). The reliability of factors is calculated using Cronbach's alpha. Thirty factors considered for the study are categorized into seven groups namely contract related, time related, cost related, quality related, human resource related, communication related and risk related. Out of the thirty factors, delay in receiving payment was the predominant factor causing cost overrun in micro-companies undertaking public works.

Keywords: *Cost Overruns; Micro-Companies; Reliability; Cronbach's Alpha Value; Relative Importance Index*

Carbon Nanotubes as a New Material in Construction Industry

Dakshayani Pramod Shete

Assistant Professor, Savitribai Phule Pune University, Pune
Email: shete.dakshayani@gmail.com

Abstract

Nano science and technology is spreading rapidly in construction field due to their advantages in terms of reduction in self weight of members. Steel is used as a conventional method in RCC construction; however corrosion affects its durability. There is a new material which is used at experimental stage known as Carbon Nano-tubes to avoid corrosion. This paper discusses reviews the parameters of research which are carried using Carbon Nano-tubes. Further, a discussion is made on Carbon Nano-tubes as a construction material, its advantages, and disadvantages. Lastly, a comparison is made between conventional reinforcement materials steel and Carbon Nano-tubes usage in modern construction.

Keywords: *Carbon Nano-Tubes; Elastic Properties; Physical Properties; Advantages; Disadvantages*

Land Use and Land Cover Change Detection Using Remote Sensing Data and GIS: A Case Study of Thrissur District, Kerala

Sooraj Krishnan[1], Amal Anto[2], Amalu Prem[3], Aneesha A[4], Mili Markose[5] and Tetmy Thomas[6]

[1]Assistant Professor, Department of Civil Engineering, Jyothi Engineering College, Thrissur
[23456]Student, Jyothi Engineering College, Thrissur
Email: soorajkrish90@gmail.com

Abstract

Land use and land cover (LULC) change have been among the most important perceptible changes taking place around us. The Remote Sensing and Geographic Information System have proved to be very important in assessing and analyzing land use and land cover changes. The temporal information on land use and land cover helps to identify the areas of change in a region. The present study aims at understanding and detecting land use and land cover change in Thrissur district, Kerala. Thrissur is the fastest growing city and cultural capital of Kerala. The changes in paddy, vegetation, settlements, barren land, forest and water bodies were mainly focused. Landsat satellite image obtained from USGS, which covered the time frame between 1992, 2002 and 2015, were used. Analysis of data was accomplished through integrated use of Arc GIS (version 10.3) software package along with Microsoft office analytical tools. The change analysis reveals that large areas of forest land are being lost continuously to irreversible development process. The land use and land cover change analysis shows that major changes have happened in settlement, paddy fields and

barren land. The changing trend for future years and solution for changes in different classifications in Thrissur district were also predicted.

Keywords: *Land Use And Land Cover (LULC); Geographic Information System (GIS); Arcgis; United States Geological Survey (USGS); Landsat*

Analysis of the National Civil Aviation Policy 2016 of India

K. Chandrashekhar Iyer[1] and Soumya Jain[2]

[1]Professor, Civil Engineering Indian Institute of Technology, Delhi, New Delhi
[2]Research Scholar, Civil Engineering Indian Institute of Technology, Delhi, New Delhi
Email: soumya.jain21@gmail.com

Abstract

India's first civil aviation policy was released in June 2016. It was formulated after extensive stakeholder consultations and it received generally a positive response from experts in the aviation sector. With India emerging as the fastest growing aviation market in the world, a comprehensive roadmap for the sector was the need of the hour. The National Civil Aviation Policy 2016 attempts to cover all aspects of civil aviation with special emphasis to affordability and regional connectivity.

This paper examines the policy in the light of current scenario of the sector vis-à-vis its challenges and opportunities. The policy is then analysed on the major themes of the sector, such as regional connectivity, airport infrastructure financing, and airport charges, both at national and global levels. Data sources at the national level will be government documents including previous policies of the Ministry of Civil Aviation (MOCA), reports of the Planning Commission, audit reports of the Comptroller and Auditor General (CAG) and news articles voicing the opinions of airlines as well as other stakeholders, while at the global level data available in various research articles on aviation policies of developed and developing countries will be relied upon. It has been less than a year since the civil aviation policy was rolled out and it is too early to evaluate the outcomes. Hence, this paper could only evaluate the rationale behind policy formulation and its possible implications on the aviation sector as a whole. The above analysis reveals that focus on affordability and regional connectivity is well-thought out and being implemented appropriately. However, many building blocks to these focus areas such as streamlining of taxation system and infrastructure financing through public private partnership have not been given due attention.

Keywords: *Regional Connectivity; PPP Airport Projects; Airport Project Financing; Aviation Policy*

A Study of the Delay Causes in High-rise Construction in Indian Metropolitan Cities

Aaditya Pratap Sanyal[1] and S. P. Bhattacharya[2]

[1]Research Scholar, Department of Architecture and Planning, Indian Institute of Technology, Kharagpur
[2]Assistant Professor, Department of Architecture and Planning, Indian Institute of Technology, Kharagpur
Email: apsanyal@iitkgp.ac.in

Abstract

Construction projects across the world are plagued with time and schedule overruns. Schedule overruns are caused due to a wide range of factors, factors associated from site-related issues to the issues related to payment. In recent years, India has seen a rise in the real estate industry with a boom in high-rise construction especially in the metropolitan cities. Many of these projects have been delayed causing financial problems to the developer as well as the clients. Although the principal reasons for construction delays are comparable across different locations within a country, several factors pertaining to local industry, socio-economic issues, cultural effects and project characteristics also contribute to construction delays. On these grounds, it can also be hypothesised that in a country as diverse as India, the causes of delay may vary across different states and regions. This research tries to ascertain the causes of construction delay associated to the various high-rise projects developed by private developers across various locations in India, identified through a questionnaire survey and analysed using statistical methods. The findings of this study show that there are certain similarities in the delay causes, but there is a difference between their importance levels.

Keywords: *Delay Factors; High-Rise; India; Real Estate Projects; Relative Importance Index*

Applicability of Program Management Principles in Smart City Development Mission – A Framework towards Successful Implementation

Aritra Halder

Assistant Professor, School of Construction Management, National Institute of Construction Management and Research, Delhi NCR (Bahadurgarh)
Email: ahalder@nicmar.ac.in

Abstract

The Government of India launched the Smart Cities Mission on June 25th, 2015 with the sole objective of promoting sustainable and inclusive cities which can provide core infrastructure, decent quality of life with a focus on the clean and sustainable environment to its citizens. The scope of smart city mission largely differs from traditional project management paradigms due to the diverse nature of the strategic components and deliverables comprising of retrofitting of an existing city combined with urban re-development and green-field extension. To augment this, there is also the added dimension of implementing smart solutions like intelligent traffic management system, energy management system and public health management systems. In this context, the application of

Program Management principles as proposed by The Standard for Program Management (PMBOK®) can be an effective aid to evaluate and implement in the Smart City Mission. The program management differs from conventional project management in the basic mechanism of delivering the objective. The programs are groups of related projects managed in a coordinated way to obtain benefits and control not available from managing them individually. The present study aims to formulate a simple framework that can synergize the fundamental tenets of program management and the Smart City Mission which can be utilized further to develop strategies that will help to deliver world class urban infrastructure to the citizens of the country.

Keywords: *Smart City; Program Management; Infrastructure; Strategy; Urban Re-Development*

Causes and Propagation of Concrete Cracks and Different Crack Models for Crack Propagation Study

Salim. P. M[1] and Seshadri Sekhar T.[2]

[1]Research Scholar, Civil Engineering Department, Gitam University, Hyderabad
[2]Professor and Dean, National Institute of Construction Management and Research, Hyderabad
Email: rawther.salim@gmail.com

Abstract

The concrete is susceptible to cracking due to various reasons. The cracking of concrete is basically due to the low tensile strength of the materials. The causes, propagation and consequences of cracks along with different types of crack models were analysed in this study. The concrete cracking may be occurring in plastic state or in hardened state. The cracks in concrete have multiple impacts on the performance and durability. The cracks in concrete are more vulnerable in the case of nuclear power plant structures as the cracks will reduce the radiation shielding efficiency. For concrete dams, cracks make serious problems in the performance. Corrosion induced cracking is one of the major problems in reinforced structures. The cracking of concrete structures is induced by internal and external mechanisms. The cracks in concrete may be of structural or of non structural origin. Due to the variations of material property and the environmental conditions the propagation of concrete cracks cannot be easily predicted. By using computer software the fracture behaviour can be easily simulated. This will be very useful for the analysis of structures for the safety evaluation. The real time electronic monitoring systems are also available to monitor the crack propagation and to the structural health evaluation at early stages. Even though full prevention of cracking is practically impossible, the cracks in concrete can be avoided to a greater extent by the execution of proper design and quality control. This can be effectively implemented by the proper coordination of engineers at different levels starting from the design stage to the execution.

Keywords: *Concrete Cracks; Crack Models; Structural Cracking; Tensile Strength; Crack Propagation*

Challenges in Housing Micro Finance

Shruti Hasyagar[1], Rushabh Rathod[2], Krishnakant Sharma[3], Laveena Veer[4] and Srividhya Raju Sridharan[5]

[1234]Student, National Institute of Construction Management and Research, Pune
[5]Assistant Professor, National Institute of Construction Management and Research, Pune
Email: ssridharan@nicmar.ac.in

Abstract

This paper is an outcome of a survey based study on India's housing micro finance. The survey captures borrowers responses on challenges faced in obtaining housing micro finance. A simultaneous survey on lenders covers their responses on challenges in disbursing and recovering housing micro finance. We draw some important inferences on the actual challenges perceived by lenders and borrowers in contrast with existing myths on micro finance lending. We also draw a comparison between different types of micro finance lenders and the perception of borrowers towards them. We use parametric and non parametric tests to analyze the responses and draw valid conclusions based on it.

Keywords: *Micro Finance; Low Cost Housing; Affordable Housing*

Fibre Reinforced Polymer Wrapped Concrete Beam

R. Gowri Shankar[1] and T. Ravindaran[2]

[12]Assistant Professor, P.A. College of Engineering and Technology, Pollachi, Coimbatore
Email: shnkrgautam@gmail.com

Abstract

Glass fiber-reinforced polymer (GFRP) application is used to repair the structures which are structurally weak over their life time. This paper shows the mechanical behavior of reinforced concrete beam wrapped with GFRP (Glass Fiber Reinforced Polymer) sheet. A total of three beams, with (150×200) mm rectangular cross section and of span 1200 mm were casted and tested. This study investigates the strength, ductility and energy absorption of R.C beam and R.C beam strengthened with GFRP sheets single and double layer. One beam was used as control specimen and remaining beams were strengthened with full wrapping of GFRP. The GFRP sheets were wrapped as external reinforcement on the beams bonded with epoxy resins and tested using a two point loading. The comparison has been made between results of two sets. The final result shows that the beams strengthened with GFRP have higher energy absorption capacity and ductility factor.

Keywords: *Beam; Glass Fiber Reinforced Polymer Sheet; Reinforced Cement Concrete Beam; Flexural Behavior*

Partial Replacement of Fly Ash with Slurry Sand in Fly Ash Bricks

T.Ravinadaran[1], R.Gowri Shankar[2] and D.Sabarivel [3]

[12]Assistant Professor, P.A. College of Engineering and Technology, Pollachi, Coimbatore
[3]Lecturer, P.A. College of Engineering and Technology, Pollachi, Coimbatore
Email: ravindaranthangavel@gmail.com

Abstract

In the present study, an experimental investigation has been carried out on the partial replacement of fly ash with Slurry Sand in fly ash bricks. This study consists of fineness modulus test, specific gravity test and compressive strength test. It is observed that fly ash and Slurry Sand have similar properties. Hence, fly ash is replaced with 50% of M-sand. The findings of this study helps in identifying an alternate solution for the replacement of fly ash and also reuse the by-products of M-sand manufacturing process. This study puts forward the application of M-sand towards sustainable development. It will also help as an alternate solution to the declining availability of natural raw materials and to maintain eco-balance.

Keywords: *Compressive Strength; Fly Ash Brick; Slurry Sand; Sustainable Development*

Experimental Study on Strength and Durability of Self-compacting Concrete with Cementitious Materials

Neha S.N[1] and Akshay N.K[2]

[1]Student, N.M.A.M Institute of Technology, Karnataka
[2]Assistant Professor, G Madegowda Institute of Technology, Mandya
Email: nehashridhar6@gmail.com

Abstract

Self-compacting concrete is less time consuming and economical when compared to conventional concrete. The increasing demand of cement as well as decreasing amount of production of cement results in the replacement of cement by waste products. This study made an attempt to explore whether the usage of the waste products like fly ash and micro silica when partially replaced with cement effect the strength and durability of concrete. The idea was to prepare a concrete of strength M60 with mix ratio 1:1.23:1.83 with water to cement ratio 0.33. Cement (53 OPC) was partially replaced by fly ash with a constant amount of micro silica (50kg/m^3). The replacement of cement was done from 0% to 50% with decreasing amount of superplasticizer from 0.9%-0.6% by weight of cement and constant slump flow of 780 mm was maintained. These results were obtained during the experimental investigation. The compressive strength was found to be increasing till 30% replacement and then started decreasing. The maximum increase was by 10% than nominal mix. The

cylinder split tensile strength showed increase till 10% then started decreasing. The increase was 17% than the nominal mix. The flexural strength for 30% replacement showed 11% increase in strength than the nominal concrete, after 30% the flexural strength decreased. The rapid chloride penetration test showed that as replacement percentage increase charge passing decreased. This shows that concrete with more percentage of fly ash offers good resistance to chloride penetration.

Keywords: *Cementitious Material; Fly Ash; Micro Silica; Replacement; Cement*

Seismic Performance of Buildings with Heavy Loads

Md. Jaweed Jilani Khan[1], Bellam Sivarama Krishna Prasad[2], Seshadri Sekhar T.[3] and Md. Abdul Majeed[4]

[1]Research Scholar, Civil Engineering Department, GITAM University, Hyderabad
[2]Professor and Head, Civil Engineering Department, GITAM University, Hyderabad
[3]Professor and Dean, National Institute of Construction Management and Research, Hyderabad
[4]Structural Consultant, Hyderabad
Email: jaweedjilani@yahoo.com

Abstract

This study is focused on the seismic design of buildings with heavy loadings. The data centre buildings are those which support very heavy loads. Basically, a data centre is the facility to accommodate important assets of any organization which includes data and I.T systems. Unlike common buildings the data centre buildings are special type of structural buildings. The data centre buildings need to sustain very heavy loads from the telecommunication systems and components of I.T, which houses computers, server, storage and equipments etc. The data centre building can be best explained by two components, first by its architectural and structural layout which typically decides the boundary of room, location of walls, supporting columns, doors, windows, isle, and raised floors and second by the equipment layout which describes the equipments to be provided in the room. In a typical data centre, building a fully occupied rack with servers and storage data networks will weigh approximately 650 to 1000 kg. The data centre buildings are to be structurally designed to support heavy loads of approximately 8 to13 kN/m^2 which is completely contrary to the design load of 4 to 5 kN/m^2 as applied in many commercial buildings. The structural design of data centre buildings depends on various factors such as location of columns and beams, sunken slabs to accommodate the raised floors, loading governed by Tier level defined by Uptime, TIA 942 guidelines on minimum seismic requirements for lateral force resisting system. A 3D analytical model of G+3 storied is modelled and analysed using the structural design and analysis tool 'ETABS 2016' to study the seismic performance of the data centre buildings. The analytical model includes all important structural elements like strength, stiffness, mass and structural deformability. The

results of the study showed that seismic design of data centre building differs drastically from that of commercial buildings with normal loading.

Keywords: *Data Centre; Structural Layout; Lateral Force; Analytical Model; Seismic Design*

Integrated Cost and Schedule Monitoring–Challenges with Developing Construction Industry

Rohit Saraogi
Director, Technical PMP, AECOM, Ahmadabad

Abstract

The most important dimensions of project management are cost and schedule of the project. There is a need to strike proper balance among these aspects for success of any project .The planning, monitoring and control of these dimensions are very important. The importance of measuring the cost and schedule in an integrated manner is further important to organisations in view of getting correct information on current project progress and forecasting. Therefore, the schedule and cost data of projects need to be integrated. In developed countries with matured project management practices the schedules are loaded with cost and their progress is measured together, using earned value management techniques. In developing countries, the level of maturity of project management practices is lower and often the cost and schedule are placed and measured separately. This leads to improper forecasting and incorrect health status check for the projects. This is one of the reasons for projects being running behind the schedule and having cost overrun. This study deals with the issue by identifying the present practices of cost and schedule measurement in the developing countries like India. The issues faced by organisations in integrating cost and schedule for both planning and monitoring of projects. This study concludes that the integrated way of cost and schedule monitoring gives us the best way to exercise control over projects. Further, this integration may be helpful for the organisations to use Earned Value management for progress monitoring and forecasting.

Keywords: *Cost, Schedule; Cost Schedule Integration; Earned Value Management*

Construction Delays and its Analysis: Maharashtra State (India)

Rakesh Lalit Metha[1], Suraj Vasant Gaikwad[2] and Gaurang Abhay Sakare[3]
[123]Student, Walchand College of Engineering, Sangli
Email: metha.rakesh@gmail.com

Abstract

In almost every construction project, delay is an inevitable yet controllable phenomenon. The Indian construction industry encounters an enormous amount of delays in projects. Delay affects both the time and money in form of schedule and cost overruns respectively. Due to impressive and dynamic

growth in the Indian construction sector, planned efforts are essential to limit these undesirable delays, which occur due to various reasons. On account of the surge in the rate of Residential Building Construction, the task of Identification and Analysis of the delays in Residential Projects of Maharashtra (India) has been attempted by several authors. The aim of the research is to provide insight to the construction stakeholders and researchers. A Questionnaire Survey was administered for Maharashtra state involving 33 Contractors, 38 Consultants, and 29 Developers. The data analysis is performed by using Importance Index to rank the identified delays, Principle Component Analysis, and Correlation Analysis to check the extent of agreement amongst the stakeholders (i.e. contractors, consultants, and developers). The findings of this study revealed that the finance related issues, as well as labour related problems as the dominating causes of delays..

Keywords: *Residential Projects; Construction Delays; Importance Index; Correlation Analysis; Principal Component Analysis*

Green Building Construction Management and its Integration with Building Information Modelling (BIM)

Avinash Purandare[1], R. A. Sandeep[2], Mansham Sharma[3], Aman Lawania[4] and Yash Nagda[5]

[1]Associate Professor, National Institute of Construction Management and Research, Pune
[2345]Student, PGP, National Institute of Construction Management and Research, Pune
Email: sandeep.ramya@gmail.com

Abstract

The purpose of this study is to achieve and promote new buildings construction and to retrofit existing buildings while satisfying low energy criteria. This means improving energy efficiency of buildings and energy systems, developing sustainable building concepts and promoting renewable energy sources. 'Green' or 'sustainable' buildings use key resources like energy, water, materials, and land more efficiently than normal buildings. With more natural light and better air quality, green buildings typically contribute to improved employee health, comfort, and productivity. A green building depletes the natural resources to the minimum during its construction and operation. Our study also includes implementation of Building Information Modelling (BIM) along with green concept so as to visualize the problems and risks which are involved in the project at various stages. Building Information Modelling (BIM) is process that supports virtual design and construction methodologies. With the help of BIM we can reduce the cost of wastage to a large extent. By using BIM the productivity increases which in turn reduce operating cost of construction. The aim of our study is manage the construction of green buildings using building information modelling tools, its timely completion within minimum possible cost. It also includes, minimize the demand of non-renewable resources, maximize the utilization efficiency of these resources, when in use, and

maximize the reuse, recycling, and utilization of renewable resources as it increases the use of efficient building materials and construction practices. It also optimizes the use of on-site sources and sinks by bio-climatic architectural practices; uses minimum energy to power itself, uses efficient equipment to meet its lighting, air-conditioning, and other needs, maximizes the use of renewable sources of energy, uses efficient waste and water management practices, and provides comfortable and hygienic indoor working conditions.

Keywords: *Construction Management; Green Building; Building Information Modelling*

Importance of Material Management in Construction Industry

Rajarajeswari Chidamabaram[1] and Sukirtha Suresh[2]

[1]Student, School of Building and Environment, Sathyabama University, Chennai
[2]Professor, Sathyabama University, Chennai
Email: rajichidambaram@yahoo.in

Abstract

This study considers the importance of material management in building construction site. This study considered the procurement practices and factors affecting material management in context with time, cost and quality. The reduction of wastage, handling of material, on time material delivery, and tracking technologies are sorted out effectively in the systematic manner. For determining, each of its aspects in detail causes for damage, poor security, pre-planning in procurement before facing force majeure. The problems relating to material management are discussed in order to achieve effectiveness in all types of construction projects. The results in this study helps in reducing overall cost and smooth running of the project activities.

Keywords: *Material Procurement; Material Handling; Wastage Reduction; Material Selection; Managerial Aspect*

Ground Water Quality Assessment of Panvel Region

Muzzammil Shaikh[1], Shabiimam M. A[2], Shivaji M Sarvade[3] and Dayashankar Paswan[4]

[14]Student, Anjuman -I- Islam's Kalsekar Technical Campus, Panvel, Navi Mumbai
[23]Assistant Professor, Anjuman -I- Islam's Kalsekar Technical Campus, Panvel, Navi Mumbai
Email: dr.shabiimam@gmail.com

Abstract

Evaluation of ground water quality is an important issue to assure its safe and stable use. In this paper ground water quality assessment of Panvel and surrounding region has been investigated. Panvel is the most occupied town in Raigad district. The city is developing rapidly due to its close proximity to Mumbai and JNPT port. Urbanization and agricultural actions have huge effect on ground water quality of the study area. The groundwater development along the coast results in

induced flow of saline water into the aquifers of freshwater and thereby resulting in the intrusion. The intrusion of salt water into the aquifers along the coastal area is becoming one of the major concerns around the world. In this study various ground water and sea water samples were collected from different sources randomly, like from hand pump, borewell, dugwell. The ground water and sea water samples were analysed according to IS standards. The study reveals that, hardness is high in ground water samples in all the locality of Panvel region. In addition to this, alkalinity and turbidity are major issues in old Panvel and Akurli region.

Keywords: *Ground Water; Coastal Region; Salt Water Intrusion; Ground Water Quality; Water Contamination*

Review of Pollutant Removal in Water and Wastewater by Electro Coagulation Technique

Shaikh Kafil Sabir[1], Shabiimam M. A[2], Dhaval S Shah[3] and Khan Sohail Akram[4]

[14]Student, Anjuman -I- Islam's Kalsekar Technical Campus, Panvel, Navi Mumbai
[23]Assistant Professor, Anjuman -I- Islam's Kalsekar Technical Campus, Navi Mumbai
Email: shaikhkafil23@gmail.com

Abstract

Electro coagulation is a technique which is used to remove pollutants like dye, heavy metals, oil & grease, etc. from water and waste water. It is also considered as electro flotation because flotation occurs due the formation of hydrogen bubbles at the cathode due to hydrolysis. Chemical coagulation is generally used for destabilization pollutants; the widely used coagulants are aluminum and iron metal salts. Electro coagulation is a chemical-free technique and less sludge producing during the process with no trace of secondary pollutants. Different metals have been used as an electrode to form metal hydroxide after reacting with water when a potential difference is applied between the electrodes. The aim of the study is to review the effective and efficient for pollutant removal by Electro coagulation for different industrial effluent their optimum operating condition, mechanism and factors affecting mechanism. The various parameters like initial pH, initial pollutant concentration, applied current density, inter-electrode distance and electrolysis time with monopolar and bipolar configuration. The various advantages and disadvantages of electro coagulation have been reported in this review.

Keywords: *Electro Coagulation; Industrial Dye; Aluminium Electrode; Iron Salts; Electrolysis*

Challenges and Opportunities of Kolkata Port

Jonardan Koner

Professor and Dean - Admissions, Research & Publications, National Institute of Construction Management and Research, Pune
Email: koner1234@gmail.com

Abstract

The 12 major ports, placed under the Union List of the Indian Constitution, are statutory bodies (trusts) administered by the Government of India under the Indian Ports Act, 1908 and the Major Port Trust Act, 1963. The Indian Ports Act (1908) lays down the rules regarding safety of shipping and conservation of ports for the entire port sector and regulates matters pertaining to the administration of port duties, pilotage and other charges. The Major Port Trust Act (1963) lays down the institutional framework for the major ports in India. Accordingly, each major port is governed by a Board of Trustees appointed by the Government of India. The composition of these Boards reflects greater government representation compared to private interest groups. The trustees exercise limited power and are bound by directions on policy matters and orders from the Government of India. The port trusts are expected to serve public interest rather than maximising profits or revenues, while at the same time, ensuring optimum deployment of assets. Kolkata is the earliest major port in the country. But the nucleus of the present day Kolkata Port lies much earlier - with the grant of trading rights to the British Settlement in Eastern India by the Moghal Emperor Aurangzeb. The city of Kolkata has a synergistic linkage with the port. In course of time, the power to rule this vast country passed from the East India Company to the British Crown. The affairs of the Port were brought under the administrative control of the Government with the appointment of a Port Commission in 1870. The Kolkata Port was initially conceived to promote and protect the British colonial interest. However, with the advent of freedom in 1947, the Port was called upon to champion the National cause. The Port took over the responsibility in the wake of the aftermath of Second World War and the partition of the country. The Port which was once considered the most important port in the country still remains the premier port which has been rightly called the gateway to Eastern India and is the guiding factor for the trade and commerce of vast hinterland comprising the entire Eastern India including Bihar and Eastern Uttar Pradesh and the two land-locked Himalayan Kingdoms of Nepal and Bhutan. The Commissioners for the Port of Kolkata ran the port till January 1975 when Major Port Trusts Act, 1963, came into force. The history of Kolkata Port has been a continuous story of struggle and success - it's a saga of uninterrupted development, improvement and achievements. Kolkata Port is a port of contrast and contradictions. Kolkata Port is the only riverine Major Port in India, situated 232 km up-stream from the Sandheads, having arguably the longest navigational channel amongst Major Ports of India and its navigational channel is one of the longest

in the world. At one end at Kidderpore, it has the lowest draft and the other end at Sandheads, it has the deepest draft (more than 50 m) amongst Indian and world ports. What was described as 'one of the best and most convenient ports out of Europe' by the Lt. Governor of Bengal in 1877, still retains a pre-eminent position among the nation's ports on the strength of its infinite variety of availability of draft throughout 232 km long navigable channel. It is not for nothing that it has been able to surpass every target set for it and set all-time records in almost every walk of port activity. It could attain this only because of its professionalism and commitment to perfectionism. In the recent past, Kolkata Port has been adjudged as the best managed port in the country. Despite it being 126 miles away from the sea, Kolkata is, by far, the best choice for eastern gateway to this continental country. Kolkata Port Trust remains one of the pioneering and most promising ports of India. It has two dock systems - Kolkata Dock System at Kolkata with the oil wharves at Baj Baj and Haldia Dock Complex at Haldia, having a combination of facilities with a lot of attractive packages. The study aims to find out the challenges and opportunities of the Kolkata port in the current economic context.

Keywords: *Major Port; Port Commission; Hinterland; Draft; Kolkata Dock System*

Emerging Technologies for Colour Removal from an Industrial Dye

Khan Rizwan Aslam[1], Shabiimam M. A[2], Dhaval S Shah[3] and Mohammed Shafique[4]

[14]Student, Anjuman -I- Islam's Kalsekar Technical Campus, Panvel, Navi Mumbai
[23]Assistant Professor, Anjuman -I- Islam's Kalsekar Technical Campus, Navi Mumbai
Email: rizwanmagazine@outlook.com

Abstract

A large number of industries generate waste containing colour causing substances. The majority of compounds responsible for colour are not readily biodegradable. In this paper various method of decolourization of industrial waste water were studied, i.e., Filtration techniques (ultrafiltration, reverse osmosis, etc.: - very effective but high cost due to frequent membrane fouling), Oxidation system (Ozone O3, Hydrogen Peroxide H_2O_2, etc.:- high reactive but high cost), Precipitation system (coagulation/flocculation: - high sludge and in some cases ineffective), Adsorption system (pre-treatment of wastewater, high cost). The result showed that two new emerging techniques: Electro coagulation and Photo-Oxidation process was superior in efficiency and cost effective as compared to above techniques.

Keywords: *Photo-Oxidation; Electro Coagulation; Industrial Dye; Coagulation; Colour Removal*

Application of Critical Chain Project Management (CCPM) for Residential Construction Project: A Case Study

Monaben Prakashbhai Prajapati[1], Neetu B. Yadav[2] and Neeraj D. Sharma[3]

[1]Student, M.E., Construction Engineering and Management S.N.P.I.T. & R.C., Umrakh, Bardoli, Gujarat
[2]Assistant Professor, Civil Engineering Department, S.N.P.I.T. & R.C., Umrakh, Bardoli, Gujarat
[3]Principal and HOD, Civil Engineering Department, Umrakh, Bardoli, Gujarat
Email: pmp7001@gmail.com

Abstract

Critical Chain Project Management is a scheduling tool which is used for planning and managing projects based on the resources that are required to execute project tasks within predefined time and budget. In this study LYNX based step by step process of scheduling was identified for residential construction projects. The detail process of scheduling starts with identification of tasks, resources, activities, calculation of labour productivity, labour assignment and at last assign duration for each activity based on which resource availability. Lastly, this study prepared final CCPM schedule for particular set of activities.

Keywords: *Critical Chain; LYNX Scheduler; Project Management; Scheduling; Software*

A Study on Pedestrian Facilities at Various Road Stretches in Hyderabad

T.Pavan Kumar[1] and P.Sravana[2]

[1]Student, PG., Department of Civil Engineering, Transportation Engineering, JNTUH, Hyderabad
[2]Professor, Department of Civil Engineering, Transportation Engineering, JNTUH, Hyderabad
Email: Pavan.civil14@gmail.com

Abstract

In growing metropolis, increase in vehicular traffic is one of the early effects of urbanization, economic growth and increase in the floating population. The vehicular traffic in the dense areas of the growing city puts lot of pressure on the pedestrian movement and it often results into safety concerns of both pedestrian and moving vehicular traffic. Also, in densely populated areas and central business districts, it is one of the most important goals of urban local bodies to improve pedestrian traffic and movement. At long stretches and busy ring roads, pedestrians are prone to serious threats at uncontrolled mid block crossings in mixed traffic conditions. Hence, it is important to provide seamless movement to fast moving vehicles without any obstacles such as signals or crossings. This paper attempts to analyze the crossing behaviour of pedestrians like crossing speed, compliance with signal, level of service of pedestrians and pedestrian vehicular interactions under mixed traffic conditions. A field survey has been conducted in 8 concentrated areas of Hyderabad, in order to perform traffic analysis. The main objective of this study is to investigate the pedestrian road crossing behaviour at the uncontrolled mid block location under mixed traffic condition and has been modelled using simple regression analysis, multiple linear regression analysis. Based on

observations, factors influencing pedestrian crossing speed had been studied and a design crossing speed has been determined for adult and old pedestrians and proposals have been made in order to create seamless vehicular traffic flow and to improve safety and comfort, which plays a vital role in planning pedestrian facilities

Keywords: *Pedestrian; Mid Block Crossings; Crossing Behaviour; Mixed Traffic Conditions*

Analysis of Dome with Different Center Rise and Different Support Conditions

Rohit Singh Rajawat[1], Mitul D. Lad[2] and Nirav Patel[3]
[12]Student, Navrachana University, Vadodara
[3]Assistant Professor, Navrachana University, Vadodara
Email: rohit25.rajawat@gmail.com

Abstract

A dome may be defined as a thin shell generated by the revolution of a regular curve about one of its axes. The procedure of designing domes was clearly explained and from the analysis and design, we get the Meridional Reinforcement, Hoop Reinforcement of a dome and ring beam reinforcement. The spherical dome is the simple geometry and this produces simple answer to the stress distribution within the shell. Dome is a structure which can easily distribute the stresses as compared to any plate structure. In this study, we have analysis our dome with respect to different center rise changes and with respect to the base diameter (D). Change in center rise with respect to its diameter (D) such as (D/2), (D/3), (D/4), (D/5) ,(D/6), (D/7), (D/8), (D/9) and (D/10) with different support condition such as fixed support and hinge support is analysed. We have also taken the different stress distribution, shear force and bending moment in this different condition.

Keywords: *Center rise; Analysis; Stress*

Seismic Evaluation of Building with Fixed Based, Shear Wall and Base Isolation

Jagat Chaudhary[1] and Nirav Patel[2]
[1]Student, Navrachana University, Vadodara
[2]Professor, Navrachana University, Vadodara
Email: jagatjchaudhary@gmail.com

Abstract

Base isolation is a powerful seismic resistant structural system. It has lower horizontal stiffness and large lateral stiffness and can provide good control of vertical displacement and storey drift of the building under earthquake loads. In the present study, the main focus is to evaluate seismic performance of the building with base isolation, building with fixed base and building with shear wall. The study also evaluates the performance of the base isolated building by taking different shapes of building with rubber isolator and by taking same floor area as 576 m^2. An earthquake load is applied to a building of G+5storey located in seismic zone five [IBC-2012 and IS 1893-2002

Code]. The parameters like lateral displacement, base shear, base moment and displacement were found by SAP2000 software. The performance of each building was evaluated by SAP2000 Software. For the structure with base isolation, the natural period of building is increased and relative displacement is decreased.

Keywords: *Base Isolation; Shear Wall; Base Moment; Base Shear; Acceleration; Storey Drift*

Schedule Estimation Model on Facade in High-rise Building

Swapnali S. Onkar [1], Sangmesh Ghale[2], M.V Kaulgi[3] and S.V Pathaskar[4]

[1]Student, D. Y. Patil College of Engineering, Akurdi, Pune
[2]Professor, D. Y. Patil College of Engineering, Akurdi, Pune
[3]HOD, Mathematics Department, D. Y. Patil College of Engineering, Akurdi, Pune
[4]HOD, Civil Department, Mathematics Department, D. Y. Patil College of Engineering, Akurdi, Pune
Email: swapzonkar@gmail.com

Abstract

With increasing competitive market in the construction industry and use of upcoming speedy and efficient techniques, construction managers have to be more careful in the process of decision making. Many existing studies show that schedule management focus on the planning stage particularly on schedule estimate which is based on the labour and equipment resources. Prevention of delay is a major challenge. It is very important to identify the factors responsible for the delay. Similar study is undertaken for the activity of Facade construction. This activity was selected because of its importance in construction activity in terms of schedule estimation for high rise construction. Facade, in spite of being an exterior protective element, construction of interior works and finishing activities can only start after the facade is constructed. So, to avoid delays in other dependable activities and to develop schedule estimation model for facade, an in depth case study was conducted. The results of the case study have been used in Monte Carlo Simulation. Finally, by using the results of the simulation a schedule estimation model for facade construction is developed, after conducting multiple regression analysis. This model will help the project managers to perform schedule estimate easily, quickly and accurately and overcome construction delay and time extension.

Keywords: *Construction Management; Facade; Scheduling; Multiple Regression*

Prioritization of Rigid Pavements for Maintenance Based on Pavement Condition Index in Rural Areas

Pradeep Sanjay Kothawade[1] and A.R.Kambekar[2]
[1]PG Scholar, Construction Management, BVB's Sardar Patel College of Engineering, Andheri, Mumbai
[2]Head of Civil Engineering Department, BVB's Sardar Patel College of Engineering, Andheri, Mumbai
Email: pradeepkothawade007@gmail.com

Abstract

Road network is an essential component in the development of the rural areas. Maintenance is needed for any type of pavement whether it is rigid or flexible and if, timely maintenance is not provided then reconstruction will become unavoidable. Pavement Condition Index (PCI) is simple and inexpensive way to monitor the condition of surface of road, identify maintenance and rehabilitation needs, and helps in spending the road maintenance budget. PCI is a numerical rating for the condition of road from 0 to 100 by measuring severity, extent and type of distresses present on the road surface. In this paper, rigid pavements in the rural area of Vikramgad Taluka, Palghar District, Maharashtra State of India are considered. Based on field visit, the most commonly observed distresses are surface deterioration, longitudinal cracking, transverse cracking and corner breaks. These distresses are considered for evaluating condition of the pavement. The weightage of each distress is determined from the questionnaire survey and then PCI of each road is evaluated. The road with lowest PCI will have highest maintenance priority and vice-versa. In this study, 10 concrete roads were evaluated and priority ranking is given for their maintenance. This method of prioritization helps in effective utilization of allocated financial budget for the road maintenance.

Keywords: *Pavement Condition Index (PCI); Pavement Maintenance; Prioritization; Rigid Pavement; Rural Roads*

Evaluation of Pavement Condition Index for Flexible Pavement in Rural Areas

Mohd Shoyeb Ansari[1] and A. R. Kambekar[2]
[1]PG Scholar, Construction Management, BVB's Sardar Patel College of Engineering, Andheri, Mumbai
[2]Head of Civil Engineering Department, BVB's Sardar Patel College of Engineering, Andheri, Mumbai
Email: shoyebansari65@gmail.com

Abstract

Rural roads play a key role in the development of rural areas since it provides access to various market centres and necessary services. Maintenance of these roads is important to keep them in usable condition and to reduce deterioration and is generally carried out after evaluation of road condition. Therefore, emphasis must be given on evaluation of road condition as inaccurate evaluation may lead to the implementation of improper maintenance measures. This may lead to further deterioration and unnecessary expenditures to prevent such deterioration. Several methods are available for evaluating the condition of road. The proposed study attempts to evaluate the road

condition based on surface condition survey. In all, 13 pavement distresses are considered in the study. Surface condition survey is then carried out on five rural roads in villages of Jawhar Taluka, Palghar District, Maharashtra, India. The Pavement Condition Index (PCI) of the road is then calculated which reflects the condition of road on a rating scale of 0 to 100, 0 representing the failed condition and 100 representing the excellent condition. The results obtained from the study can be used for selection of appropriate maintenance strategy and prioritization of roads for maintenance.

Keywords: *Flexible Pavement; Pavement Condition Index; Pavement Distresses; Road Maintenance; Rural Roads*

Study on Project Marketing Strategies of Indian Construction Organizations

Ashwin N[1] and Devang Desai[2]
[1]Student, PGP Project Engineering and Management, National Institute of Construction Management and Research, Pune
[2]Associate Professor, National Institute of Construction Management and Research, Pune
Email: ashwinproff@gmail.com

Abstract

The construction industry is typically characterized by extreme competitiveness, high uncertainty and risks, and generally low profit margins where the contractors constantly seek ways to outbid their competitors through competitive bidding. The impact of globalization and technological changes have also made difficult for construction organization to survive in the competitive world, especially in developing countries such as India. Competitive bidding is predominantly determined by how low a contractor can bid relative to other bidders. Hence contractors often neglect marketing activities and often fail to realize the importance of marketing. Marketing mainly deals with customers and aims to manage profitable customer relationships. In this context, marketing may help construction companies to differentiate themselves from their competitors, cultivate and/or keep clients, and thereby create competitive advantage. The aim of the study is to analyze marketing approach of Indian construction companies and strategies used to focus on improving the competitive potential, ensuring long-term and stable positioning of these companies. In order to identify the marketing functions of Indian construction companies and the extent to which these contractors carry out traditional marketing practices, data are collected by analyzing the literature relevant to marketing in construction and other data sources like websites, advertisements, publications etc. We also seek to find out the factors that a construction organization needs to consider while developing their marketing strategies. The result of our study may give a comprehensive understanding of marketing functions which may be applicable for construction

majors looking to expand their business and also for new enterprises looking to venture into construction industry.

Keywords: *Marketing Management; Project Marketing; Construction Companies; Marketing Mix; Relationship Marketing*

Seismic Analysis of Multi-storey Building using Software

Priyal Patel[1], Moksha Shah[2] and Rahul Shah[3]
[12]Civil Engineering, Navrachana University, Vadodara
[3]Faculty, Navrachana University, Vadodara
Email: patelpriyal0711@gmail.com

Abstract

The present study analyzes the square shape building of 625 m^2 area for 12 storey, 15 storey, 20 storey and 25 storey buildings having a two-different bay size, 5 m x 5 m and 6.25 m x 6.25 m. Each floor height is 3 m and total height of the structures is 36 m, 45 m, 60 m and 75 m. Loads and load combinations are considered as per Indian Standard 1893-Part 1 (2002). The present study compares the different parameters such as storey drift, storey shear and displacement of the structure under lateral loads using software E-TABS.

Keywords: *Seismic Load; Storey Shear; Storey Drift; Seismic Zone*

Heavy Metals in Fly Ash: Its Impact on Human Health and Environment

Dayashankar Paswan[1], Shabiimam M. A[2], Muzzammil Shaikh[3], Ajay Nadar[4] and Shifa D Maniyar[5]
[1345]Student, Anjuman -I- Islam's Kalsekar Technical Campus, Panvel, Navi Mumbai
[2]Assistant Professor, Anjuman -I- Islam's Kalsekar Technical Campus, Panvel, Navi Mumbai
Email: dayashankarp95@gmail.com

Abstract

Thermal coal power plant is a huge industry which has a major contribution in the energy production sector. However, this also produces the fly ash as a by-product during the combustion process. Generally fly ash is a composition of SiO_2, lime (CaO), FeO_2 and Al_2O_3. It is classified as Class C and Class F, wherein Class C fly ash is usually alkaline in nature and it contains more lime (CaO) than Class F. Class F is acidic in nature, contains less than 10% of lime and requires more cementing material during it's application. Based on its source, it may contain one or more heavy metals like Arsenic (As), Beryllium (Be), Boron (B), Cadmium (Cd), Chromium (Cr), Cobalt (Co) and Lead (Pb) etc. These heavy metals are highly toxic, and it can be a potential threat to the human health and environment. This paper reviews various utilization of fly ash and the significance of heavy metals and its impact on the human and environment.

Keywords: *Fly Ash; Heavy Metals; Health Impacts; Chromium; Cadmium; Fly Ash Utilization*

Establishing Maintenance Strategy and Computation of Future Value of Components of Existing Flexible Pavements

Samiksha Appasaheb Patil[1] and A.R.Kambekar[2]
[1]PG scholar, Construction Management, BVB's Sardar Patel College of Engineering, Andheri, Mumbai
[2]Head of Civil Engineering Department, BVB's Sardar Patel College of Engineering, Andheri, Mumbai
Email: shami.sp82@gmail.com

Abstract

Maintenance of existing roads is vital to keep their asset value intact, however is quite challenging due to the budget constraints. Maintenance management system aims at establishing cost effective repair and maintenance policies based on deterioration extent of the road. This study attempts to establish long-term financial plan for existing flexible pavements based on their current conditions. In this study, rural road network in the state of Maharashtra is inspected for visual distresses and roads are categorized based on Pavement Condition Index (PCI) scale. Seven road case studies are considered ranging from very poor to very best condition. Accordingly, maintenance / repair alternatives are developed as per extent of road deterioration and maintenance needs. The Maharashtra State Government Public Work Department (PWD) standards are adopted for maintenance treatments. Long-term financial strategy for same network is developed for next 10 years. Effectiveness (life) of maintenance alternatives chosen is taken as criteria for maintenance treatment intervention (frequency) during 10 years plan. Finally, annual financial budget is proposed. Net Present Value (NPV) of life cycle costing is used to forecast exact value of investment to be made in each year of design period of 10 years. This study may be useful to adopt long-term maintenance strategy for any rural road network having various road conditions from the most poor to the best.

Keywords: *Maintenance Alternatives; Pavement Condition Index (PCI); Maintenance Intervention Levels; Future Value; Net Present Value (NPV) Method*

Comparative Assessment of Project Risk Management and Agile Project Management in the Prospect of Civil Infrastructure Projects

Pulok Ranjan Mohanta
Student, RCG School of Infrastructure Design and Management, Indian Institute of Technology, Kharagpur, West Bengal
Email:pulokmohanta@gmail.com

Abstract

Civil infrastructure projects are commonly known for inherent uncertainty as they are vulnerable to various risks, managing of which decides the fate of the projects. Numerous literature is available

describing the risks and their nature. Quite a few describe the views on risk management as well. The risks are managed traditionally by following waterfall approach as that of the project as a whole. This strategy holds good if the projects are of a familiar type. But when dealing with unfamiliar circumstances and a lot of uncertainty in terms of frequent change in the scope is involved within the project, it increases the complexity and hence adds to the difficulty in managing the risks and hence the project. Though the project risk management is not a new concept, the circumstances in which the projects are executed now are very different from the old days, when the approaches for risk management were being formulated. Researchers and practitioners are recently emphasizing the importance of exploring different approaches, including practices from so-called 'Agile Methods', in order to cope with the innovation and dynamism of certain industries and project types. The aim of this article is to present a review of the traditional project risk management methodology and emphasize the easiness of risk management in the large infrastructure projects when they are managed in the agile way.

Keywords: *Agile Methods; Civil Infrastructure; Construction Project Management; Project Risk Management; Scope Change*

Review on Arsenic Contamination, Health Impacts and its Treatment Methods

Shifa D Maniyar[1], Shabiimam M. A[2] and Dayashankar Paswan[3]
[13]Student, Civil Engineering, Anjuman -I- Islam's Kalsekar Technical Campus, Panvel, Navi Mumbai
[2]Assistant Professor, Anjuman -I- Islam's Kalsekar Technical Campus, Panvel, Navi Mumbai
Email: shifa99maniyar@gmail.com

Abstract

Arsenic is a naturally occurring substance mainly found in traces of the soil and rocks. In various human activities, arsenic is obtained as a by-product. Arsenic is a heavy metal having high toxicity, poisonous and cancer causing properties which is harmful to the human health and environment. Arsenic can be released from rocks and soil and get mixed with ground water under certain geochemical conditions such as neutral or alkaline pH of the ground water and low oxygen and high iron concentration of the ground water. Main sources of exposure to arsenic are contaminated water and the food which is prepared with contaminated water. Direct and indirect consumption of arsenic for a long period can lead to skin and internal organ diseases such as kidney, liver, bladder, and lungs cancer etc. Developmental effects, cardiovascular diseases, neurotoxicity and diabetes can also be caused by arsenic exposure. Oxidation, coagulation, filtration, ion-exchange, lime precipitation, reverse osmosis, and membrane techniques, etc. are commonly used treatment techniques for removal of arsenic that has been studied in this review paper.

Keywords: *Groundwater Contamination; Arsenic; Oxidation; Drinking Water; Treatment Technologies*

Exploring the Critical Success Factors for Effective Stakeholder Engagement of Public Private Partnership Projects in the Infrastructure Sector

Anand Lokhande
Research Scholar, CMR University, Bangalore India
Email: lokhandeanand@yahoo.co.in

Abstract

The growth in the infrastructure sector is one of the important levers of any country's progress. However, this cannot be achieved without large scale funding that is needed for these long gestation projects. The government relies on the ability of the private sector to invest in this sector through the mechanism of the public private partnership projects. The success of these projects is dependent on the ability of the private sector to provide financial support, higher level of skills, efficient and effective program coordination and goal directed project management. Management of public private partnership projects needs special acumen and enhanced ability to interact with different stakeholders throughout the course of the project. These projects face variety of challenges while engaging with the stakeholders during different phases and therefore, it is imperative for the project manager to adopt suitable techniques to tackle them. The measure of success at every stage of the project is characterized by different factors. This paper focuses on the critical success factors related to the stakeholder engagement in public private partnership projects in the infrastructure sector. The identification of these success factors will reveal the importance and their role in enabling effective stakeholder engagement. The study also deals with categorizing these success factors, based on the various characteristics of public private partnership projects, like procurement process, risk allocation, sharing of authority between the two partners, commitment and responsibility to project delivery and transparency in communication all leading to strong stakeholder engagement.

Keywords: *Project Management; Stakeholder Engagement; Public Private Partnership Project*

Feasibility Study of Improving Properties of Black Cotton Soil Using Lime, Stone Dust with Recron Fibre

Omkar Anilrao Gadewar

Student, National Institute of Construction Management and Research, Pune
Email: omkargadewar23@gmail.com

Abstract

The construction of roads in most of the places across the world faces major problems due to weak sub grade soil. One such weak sub grade often encountered is Black Cotton (BC) soil. Soil

stabilization has become a major issue in construction engineering and the research regarding the effectiveness of using natural wastes are rapidly increasing. In the present study, an attempt is made to find out the improvement of strength in black cotton soil mixed with varying percentage of lime & stone dust and Recron fiber, by conducting a series of tests. It has been found that there is a significant variation in the liquid limit, plastic limit, plasticity index of black cotton soil samples containing lime and stone dust. The liquid limit decreased from 64.20 % to 45.00 %, plastic limit decreased from 35.14 % to 31.72 %, plasticity index decreased from 29.06 % to 13.00 % by replacing the BC soil by lime (15 %). The liquid limit decreased from 64.20 % to 50.00 %, plastic limit decreased from 35.14 % to 33.78 %, plasticity index decreased from 29.06 % to 14.14 % by replacing the BC soil by stone dust (20 %). The Unconfined Compressive Strength (UCS) of soil, using lime (15 %), stone dust (20 %) and varying percentage of Recron fibre (R) by weight of soil, increases upto 1.00 % and thereafter it decreases at 3 and 14 days of curing.

Keywords: *Black Cotton Soil; Lime; Stone Dust; Recron Fiber; Atterberg's Limit; Unconfined Compressive Strength*

Building Information Modeling (BIM) for Construction Safety: An Indian Stakeholders Perspectives

C.Vigneshkumar[1] and B.Sunantha[2]
[1]Doctoral Research Scholar, Department of Civil Engineering, Indian Institute of Technology, Delhi
[2]Adhoc Faculty, Department of Civil Engineering, National Institute of Technology, Calicut, Kozhikode
Email: vigneshkumarchellappa@gmail.com

Abstract

Safety is usually apprehended as the most significant criteria of a construction project. Enhancing employee health and safety returns benefits to the project in specific and the industry in general. Accidents and other safety concerns are still issues in the construction industry that needs added investigate and additional ladder to assist, avoid and solve these issues. Building Information Modeling (BIM) is a clever representation based procedure that provides imminent plan, build and manage building and infrastructure. Users of BIM tools point towards the skills to envisage the final design down with the construction procedure as a valuable quality of using BIM. This paper attempts to discover the facts and practices of the Indian stakeholders towards BIM on construction safety. According to the study outcome, a huge proportion of the engineers who utilize BIM believe that BIM helps to abolish safety hazards and enhance worker safety. The study results propose that development in safety performance across the construction industry may be due in part to get larger use of BIM in the Indian construction industry. This article introduces readers to the perception of BIM, its uses and benefits, mainly with importance to the construction safety.

Keywords: *Safety; BIM; Hazards; Construction Projects; Stakeholders*

Dimensional Study on Quality Management Practices in Mass Rapid Transit System Works with respect to Managerial Satisfaction and Comfort Level Satisfaction

Priyanka Prabhakaran[1], S.Anandakumar[2], V.Krishnamoorthy[3] and S.Janani[4]
[14]Assistant Professor, Kongu Engineering College, Anna University, Erode
[2]Professor, Kongu Engineering College, Anna University, Erode
[3]Associate Professor, Kongu Engineering College, Anna University, Erode
Email: priyacivil80@gmail.com

Abstract

The purpose of the study is to examine the effect of quality management practices in the construction of metro rail project with reference to managers and users comfort level satisfaction. It also aims to compare various antecedents of quality management practices and satisfaction levels. A cross sectional research on engineers and metro users was made through the questionnaire method and analysed using SPSS software. The population of the study consists of managers and metro users in Tamilnadu. The study was conducted during the period of September 2016 to February 2017. The study identified ten dimensions of quality management practices such as execution difficulties, material specifications, price hike of materials, replacement methods, design requirements, safety aspects, structural resistance, onsite-efficiency, man-power & work time and satisfactory outcome with respect to Manager's satisfaction. The study also identified other ten dimensions such as reduction of traffic congestion, punctual reach, smart ticketing system, ladies coach, fare, underground parking facility, lift provision, frequency of trips, ease of access to workplace and comfort level with respect to Metro User's satisfaction. Further, the study also confirmed that there is significant impact on reduction in traffic congestion, punctual reach, smart ticketing system and underground parking facility. The findings of the study may help the policy makers regarding quality management practices in the construction works of metro rail project and services offered to the public.

Keywords: *Quality Management; Metro Rail Project; Highly Viewed Variables; Manager's Satisfaction; Comfort Level*

Upgradation of Shake Table to Auto Simulation Level

Vishal Kumar[1], Ruvin Shain Dsouza[2], Sushrith S Bangera[3] and Vinod Kunte[4]
[1234]Student, N.M.A.M. Institute of Technology, Mangalore
Email: singh.vishal0025@gmail.com

Abstract

The occurrence of an earthquake causes a wide range of destruction and damage to the infrastructure in a given area, even causing injury or loss of lives. The purpose of the project is to design and develop an earthquake simulation table to be used for analysis of scaled model structures for educational purposes. The primary goal of the shake table is to replicate the earthquake conditions based on input of earthquake data collected from various sources. Mechanical modifications are made to the shake table to give maximum possible accuracy of the uniaxial motion. The secondary goal is to test framed structures representing various conditions loaded on to the shake table and use the results to suggest remedial measures. The main objectives of this project are: to achieve auto-simulation of the earthquake shake table, to run the table using collected earthquake data and to study the effects of scaled model frame structures showing various conditions. The previous table was run and the points where improvements need to be made were worked out. After the mechanical modifications were completed, the method of simulation of table was worked out. A circuit system was set up where a microcontroller is used to digitally control the system and feed data to the table. Scaled models representing 3 conditions, namely: long column – short column condition, floating column condition and soft storey condition were fabricated and tested. An accelerometer is used to act as a check to validate the resulting motion and to see the vibration of different storey of the models. The results and conclusion obtained from testing various models are discussed in paper. The results of the research if taken into account while designing of buildings in earthquake prone areas will help in making structures safer.

Keywords*:* *Shake Table; Microcontroller; Accelerometer*

Axiomatic Design Approach for Constructability Improvement of Construction Projects

S. P. Sreenivas Padala[1] and J Uma Maheswari[2]
[1]Research Scholar, Indian Institute of Technology, Delhi
[2]Assistant Professor, Indian Institute of Technology, Delhi
Email: sreenivasiit@gmail.com

Abstract

It is a well-known fact that design and construction phases are fragmented. In general, this design and construction phases are governed by functional and logical requirements respectively. Additionally, the information-driven design process occurs often in a top-down approach unlike the

workflow-driven construction process which is sequenced with a bottom-up approach. These fundamental differences in these two phases led to fragmented design and construction processes. Further, with the advent of Information Technology (IT) platforms, the design and construction teams spread across the globe aggravate the fragmentation. In reality, major decisions take place in design phase without focussing on the constructability issues resulting in changes, repetition, redesign or rework. Therefore, integrating the design and construction processes is essential to have minimal rework in design. There are several solutions such as Building Information Modelling (BIM), Value Stream Mapping (VSM) etc. for integrating the design and construction phases. However, owing to the drawback in the available solutions, there is a need to find an alternate solution for the integration. Thus, the objective of the present study is to integrate the design and construction using Axiomatic Design approach to ensure minimal changes or rework. To achieve this objective, a Set-based Axiomatic Design approach was proposed. Axiomatic design is a matrix-based approach that can map the functional requirements to the design parameters and subsequently to the construction parameters. Set-based design recommends evaluating design and construction solutions concurrently. This concept was applied on a case illustration and the initial results were also discussed.

Keywords: *Integration; Set-Based Design; Axiomatic Design; Constructability*

Impact of Demonetization on Real Estate Market in India with reference to Pune City

Jonardan Koner

Professor and Dean - Admissions, Research & Publications, National Institute of Construction Management and Research, Pune
Email: koner1234@gmail.com

Abstract

On 8th November 2016, Prime Minister Mr. Narendra Modi announced the Government of India's decision to cancel the legal tender character of ₹500 and ₹1,000 banknotes with effect from 9th November 2016. He also announced the issuance of new ₹500 and ₹2,000 banknotes in exchange for the old banknotes. The demonetization of the highest denomination currency notes is a part of several measures undertaken by the government to address tax evasion, counterfeit currency and funding of illegal activities. The requirement to deposit currency notes in excess of specified limits directly into bank accounts has resulted in the declaration of hitherto unaccounted income, subject to higher tax and other penalties. These demonetization measures have had a significant and immediate impact on the state of the Indian economy. These measures are also expected to result in long-term impact on certain industries and sectors. These measures have resulted in a significant decrease in

liquidity in the short term, which is expected to ease gradually with the introduction and circulation of the new currency notes. As a result of these measures and increased deposits with banks, the bank deposit base has increased significantly. The financial savings are expected to increase as a result of the shift from unproductive physical asset based savings to interest-bearing financial assets. This, in turn, is expected to enhance the liquidity position of banks, which can be leveraged for lending purposes. The real estate sector in India has traditionally involved a significant level of informal funding in the form of cash transactions. As the demonetization measures are expected to result in decreased informal funding sources, the real estate sector is expected to be adversely affected. Cash transactions are most common in secondary sales, and resale transactions are expected to decline. While these measures are expected in the long term, to promote transparent pricing in the real estate sector, decreased liquidity resulting from lower informal funding sources is expected to significantly weaken the demand for resale properties. Luxury and high-end real estate transactions have also typically involved large cash transactions, with a significant proportion funded from informal sources, and not from banks and other financial institutions. Luxury property rates are therefore expected to decrease as a result of fewer purchasers with significant liquidity. These measures are expected to adversely affect investors in projects with insufficient audit and funding procedures. The objective of this study is to measure the immediate impact of demonetization on the real estate demand of residential sectors in Pune city. This paper also measures the awareness of people about demonetization and its benefits.

Keywords: *Demonetization; Illegal Activities; Tax Evasion; Cash Transactions and Liquidity*

Impact of GST on Construction Industry

Nagaraj Mantha[1] and Mohita Maggon[2]
[1]Professor, National Institute of Construction Management and Research, Hyderabad
[2]Assistant Professor, National Institute of Construction Management and Research, Delhi NCR (Bahadurgarh)
Email: nmantha@nicmar.ac.in

Abstract

In its form of being a single indirect tax that covers all goods and services, the Goods and Services Tax (GST) may be termed as one of the most radical tax reform which is likely to have a long standing and a remarkable effect on India's economy. The GST, once fully implemented in two or three years' time is expected to eliminate the conflicting and cascading tax structures that are prevalent. There is a general ill-feeling that these conflicting tax structures have confounded the entire industrial sector in the past. The GST may impact the construction industry in different terms. The construction material is likely to become dearer. Due to land prices being less, the affordable housing sector may become cheaper. While the other sectoral components of the construction space

like the real estate and commercial sectors are expected to get costlier. In a way high value realty may feel the pinch. As minimal change is only visualized in the overall gross cost of construction, hence the impact on real estate developers and builders may not be significant. The builders and developers can offset the expected increase in the construction costs by virtue of input tax credits on various items homogeneously viz. GST collected on consultant's bill or that on a bag of cement. As regards to the infrastructure sector - Goods and services for infrastructure projects enjoy a large number of concessions and exemptions under Central and State laws, since the sector is of national importance. Yet, the multiplicity of taxes and general construct of contracts give the infrastructure sector a heightened degree of complexity from the perspective of indirect taxes. The key issue for this sector is the continuity of current concessions and exemptions under GST and its plausible impact on credit chains and costing. In this paper an attempt is made to elucidate the impact of GST on various sectoral components of the construction space.

Keywords: *GST; Real Estate; Infrastructure; Taxes; Construction*

Comprehensive Analysis of Real Estate Regulatory Authority (RERA) Act and Recommendations for Betterment

Shah Geet[1] and Naik Kartik[2]
[12]Student, Advanced Construction Management, National Institute of Construction Management and Research
Email: gtshah16@gmail.com

Abstract

Real estate industry in India is increasingly becoming important from the GDP point of view. The Real Estate Regulatory Authority (RERA) that came into force from 1st May, 2017 is expected to reduce ambiguity and any unethical practices prevalent in the Real Estate field. The act is aimed at streamlining the Real Estate transactions with a three-month registration period for promoters & developers under Real Estate Regulatory Authority (RERA). The act can bring transparency in Real Estate scenario. The paper presents a comprehensive analysis of the Real Estate Regulatory Authority (RERA) Rules formulated by major states (like Delhi, Karnataka, Rajasthan, Tamil Nadu, and Maharashtra). The paper proposes to identify the gaps and suggests nullifying any shortcomings in the rules of each state's Real Estate Regulatory Authority (RERA) Rules.

Keywords: *RERA; Real Estate Industry; Metropolitan Areas; Transparency*

Critical Factors for Delay in Construction of High Rise Building

B. B. Das[1], Eldho Thomas[2] and Ammu Menon[3]
[1]Assistant Professor, Department of Civil Engineering, National Institute of Technology, Karnataka
[23]Student, P. G., Department of Civil Engineering, National Institute of Technology, Karnataka
Email: bibhutibhusan@gmail.com

Abstract

Delays are a major cause of concern which affect the overall construction time of high rise buildings. In India, not much research has been conducted to understand the critical factors causing delay in high rise building construction. With this in view, this paper studies and analyses the critical factors that are responsible for delay in construction of such projects in India with the help of an elaborate questionnaire survey. Responses have been collected from professionals with varying levels of experience in construction industry. From the responses, percentage contribution of these factors to delay in each phase of construction has been found and they are ranked with respect to their Relative Importance Index (RII).

Keywords: *Construction; High Rise Building; Delay; Relative Importance Index*

An Experimental Study on Properties of No-Fine Concrete Using Supplementary Cementitious Materials

Sriteja Babu D[1], Vamsi P[2] and Vinay Mohan Agrawal[3]
[12]Student, PGP ACM, National Institute of Construction Management and Research, Goa
[3]Assistant Professor, National Institute of Construction Management and Research, Goa
Email: sriteja1234@gmail.com

Abstract

Pervious concrete also called no-fines concrete is manufactured without fine aggregate; it consists of coarse aggregate, cement and water. Its main advantage is that it provides direct drainage and helps to percolate water through the pavement into the permeable base. In the present experimental study, samples of pervious concrete were mix-designed based on NRMC – 522R: 2006 & IS 12727:1989 and were tested for desired engineering properties i.e. permeability and compressive strength. Further, the samples have been tested with partial replacement of cement with supplementary cementitious materials like Ground Granulated Blast Furnace Slag (GGBFS) and Silica fume in the proportion ranging from 7.5 to 20 percent. This paper identifies that most of the mixes with supplementary cementitious materials improved the water permeability of pervious concrete while a few combinations have shown slight but acceptable decrease in the compressive strength maintaining the desired permeability. This paper emphasises the use of GGBFS and Silica fume in no-fine concrete without compromising on strength and desired permeability which is also sustainable.

Keywords: *No-fine concrete; GGBFS; Silica fumes; Permeability; Cement Replacement; Compressive Strength*

Emerging Models in the Practice of Real Estate Development in India

Rajiv Gupta

Professor, National Institute of Construction Management and Research, Hyderabad
E-mail: rajivgupta@nicmar.ac.in

Abstract

In India, the development of real estate occurs in the organized and unorganized sectors. The organized real estate segment also referred to as the corporate real estate is characterized by the professional practice of real estate construction by companies incorporated under law and usually listed with the stock exchange. The unorganized sector is characterized by entities carrying out the real estate activity such as contractors, builders, developers etc. in their individual capacity as proprietors or as a legal entity of a partnership firm or an incorporated private limited company.

The traditional methods of real estate development of launching the project, seeking bookings and handing over the built space are challenged by several leading real estate companies. Instead, the emergence of innovative methods of project launching, pricing, selling and project management to deliver superior customer value is observed. The driving factors of this change are customer requirements, regulations, competition, technology and the economy. This paper examines these phenomena which are unfolding in the current built space environment by studying and examining the practices adopted by some of the leading real estate companies in India and proposing a model which can be replicated by other developers. It is hoped that this model can be benchmarked as best practices for the Indian real estate sector.

Keywords: *Built Space; Real Estate Development; Real Estate Pricing; Property Development*

Quality of Work Life Policies in the Indian Construction Sector

Soumi Rai[1], Hemanth Bharadwaj B. N.[2], Vivek M. V.[3], Manasa[4] and Oshan M.[5]

[1]Associate Professor, National Institute of Construction Management and Research, Pune
[2345]Student, National Institute of Construction Management and Research, Pune
Email: srai@nicmar.ac.in

Abstract

Quality of Work Life (QWL) of employees is an important consideration for employers interested in improving Human Resource Productivity (HRP). QWL has assumed increasing interest in industries as well as developing countries and it is defined as all the organizational inputs which aim at the employee's satisfaction and enhancing organizational effectiveness. There has been ample research studying QWL, but very little attempts have been made on QWL in construction industry. As people

everywhere suffer from the many unfortunate and sad crises and outcomes brought by organizations, QWL deserves more intensive and in-depth research, especially examining QWL linkage with the whole well – being. The objective of this study is to outline the various aspects of QWL and its implications on Employee's Job Satisfaction, Salary and Rewards, Growth, Social Environment, Productivity and Well-Being, in particular with respect to the construction industry. In the present research, we are correlating the above factors to the construction industry to understand its significance in improving the HRP.

Keywords: *Construction; India; Life; Quality; Work; QWL*

Wastage Factors and Lean Technique Analysis - A Study of Indian Construction Sites

Venkatesan Renganaidu

Professor, National Institute of Construction Management and Research, Hyderabad
Email: rvenkatesan@nicmar.ac.in

Abstract

Poor site management causes huge wastage at the construction site and ultimately results in time overrun, cost overrun thus resulting in customer dissatisfaction. Lean construction techniques are aimed at reducing wastage and increasing value to the customers. Globally, many studies have been carried out to overcome wastage at the construction site by applying various Lean construction techniques but a very few studies have been carried out in the Indian scenario. The objectives of the current study are: (i) To identify the key wastage causing factors at the construction site and (ii) To identify the potential lean technique solutions, to overcome these problems. In order to accomplish these objectives, a critical review of relevant literature and case study analysis were carried out. This is further coupled with a structured questionnaire survey at multiple Indian construction sites to gather information on key wastage causing factors. Relative Important Index (RII) and Factor Analysis were carried out on the responses. The results of this study reveal that delay in approvals, adverse site conditions and poor coordination are the top three key wastage causing factors at the construction site. Value stream mapping, 5S and Last planner are the most recommended and used lean construction techniques to resolve these problems. The study can be further extended to quantify these causes and the impact of application of these techniques.

Keywords: *Wastage Factors; Lean Construction; Value Stream Mapping; Last Planner; 5S*

Stage-Wise Identification of Critical Factors Influencing Cost Overrun in Bridge Construction Projects

Gibson George Abraham[1] and Mohamed Asim[2]

[1]Student, TKM College of Engineering Kollam, Kerala
[1]Professor, TKM College of Engineering Kollam, Kerala
Email: gibssabraham@gmail.com

Abstract

Cost overrun is one of the major problems faced by the bridge construction industry in Kerala. The construction of bridges is complex and most of these projects exceed the estimated cost after the completion of works. These cost overruns can occur due to several factors caused by different stakeholders. The main objective of this study is to identify the stage–wise critical factors impacting cost performance across the design consultants, contactors and client perspectives who are involved in public bridge works in Kerala. In this study, the bridge construction is divided into three stages and 25 attributes influencing cost overrun were identified from the literature. The impact of these attributes on cost overrun was measured through a questionnaire survey. The stage-wise critical factors were identified using Factor Analysis. 42 respondents participated in the survey and the critical factors affecting cost overrun were identified for each stage. The critical factors that affect stage 1 are climatic conditions and contractor inefficiency, improper site management, improper planning of project team, inaccurate project planning and monitoring, political and labour issues, delay and mistakes throughout the project, variations in prices and lack of coordination. The critical factors that affect stage 2 are climatic conditions and improper planning of contractor, inefficiency of contractor and client, coordination and techniques used in project, design error and productivity, improper site management and delay issues. The critical factors affecting stage 3 are project characteristics and capability of contractor, lack of planning throughout the project, improper utilization and errors in design and tender, improper utilization of resources and insufficient planning of consultants, lack of management skills, productivity and contract period, poor communication and improper planning and scheduling. Managing these factors can reduce cost overrun to an extent.

Keywords: *Bridge Construction; Stage-Wise; Cost Overrun; Cost Performance; Critical Factors; Stakeholders*

Stock Prices of Real Estate Companies in India – Performance and Determinants

P. Hanumantha Rao

Associate Professor, National Institute of Construction Management and Research, Hyderabad
Email: hanu.finance@gmail.com

Abstract

The stock market index is not only an indicator of the performance of the stock market but also to a great extent throws some light on how the economy of the country is performing. The stock market index reflects the movement of share prices but what determines the share prices of a company has always been a matter of debate among the investors. An investor aims to buy stocks at a lower price and sell at higher price thereby earning returns. However, once an investor decides to buy a share, it will be very difficult to predict whether the price will go up or down. There are a number of financial measures like earning per share, dividend per share, price earnings ratio, return on net worth etc. which have an influence on the share price. The study aims to assess the stock market performance of real estate companies in India, identify various financial measures affecting share prices of top 10 real estate companies based on net profits and study the quantum of impact of these measures. The data is compiled from the annual reports of these companies for last five years 2011-12 to 2015-16. The multiple regression model is developed by taking share price as an independent variable and factors like earning per share, dividend per share, price earnings ratio, return on net worth etc. are taken as a dependent variable.

Keywords: *EPS; DPS; P/E Ratio; Stock Price; Real Estate; RONW; Investors*

Factors Affecting Delay in Real Estate Projects in India

Ravindranadh Chowdary K[1], Lalit B Limbani[2], Mayank M Kaushik[3], Namrata S[4] and Neha Pradhan[5]

[1]Assistant Professor, National Institute of Construction Management and Research, Hyderabad
[2345]Student, PGP in Advanced Construction Management, 29th Batch, National Institute of Construction Management and Research, Hyderabad
Email: kravindranadh@nicmar.ac.in

Abstract

The Real Estate sector is one of the most globally recognized sectors. In India, Real Estate sector is the largest employer after agriculture and is expected to touch US$ 180 billion by 2020. With the sanctioning of the construction of affordable housing for urban poor under the Pradhan Mantri Awas Yojana, by the Ministry of Housing and Urban Poverty Alleviation, the real estate sector in urban area has been in great demand. Also, the Government of India has introduced Real Estate Regulation Act (RERA) to control over the issues raised by the buyers pertaining to the timely completion of projects and registration of property etc. The objective of this study is to identify the factors of delay

by collecting data from the ongoing projects, analysing and comparing them with results coming out of the case study. A questionnaire survey and a case study on an ongoing project were used for analysis in this paper. The questionnaire survey was used to collect responses from working professionals in the Real Estate industry in India. Ranking of the delay factors is done using the Relative Importance Index (RII) based on the importance of a factor perceived by the respondents. The Factor Analysis using IBM SPSS software package was carried out to consolidate the 46 delay factors into 6 major factors. Further, a case study on a live project was conducted to identify the delay factors and compare them with the results arising from the questionnaire survey.

Keywords: *Real Estate; Delay; Relative Importance Index (RII); IBM SPSS*

A Study on Adaptability of Alternative Walling Materials in Building Construction

Rajput B. L.[1], Agarwal A. L.[2] and Pawar A. D.[3]

[1]Assistant Professor, School of Construction Management, National Institute of Construction Management and Research, Pune

[2]Senior Professor, School of Construction Management, National Institute of Construction Management and Research, Pune

[3]Associate Professor, School of Construction Management, National Institute of Construction Management and Research, Pune

Email: babalurajput@nicmar.ac.in

Abstract

The aesthetic design of building and use of construction materials have to correspond to local building traditions and to the user's way of living. Appropriate technology is important when discussing building construction materials. The use of technology has to be in accordance with the local conditions and at the same time be durable, reliable and functionally built. In construction, various building materials are used to construct different elements of the structure. In the past few years, market has provided varieties of alternative construction materials with better functional performance, economical, faster and safer construction. Response of the customers is very slow in adapting to and accepting new building materials, unless and until these materials are used/ practiced in the real-life building projects, rather than believing and accepting based on the quality laboratory test results. In any building structure, construction of partition walls is a major work. In this study, various alternative materials available in the market are technically compared along with their adaptability under different building situations. This study will help the builder to select appropriate materials of partition wall to enhance aesthetics and building functionality.

Keywords: *Adaptability; Alternative Materials; Building; Construction*

Management Aspects of the Successful Delivery of Public Private Partnership in Infrastructure Projects

Sayyed Faisal Faheem Sayyed Zameer[1], Rajendra Magar[2] and Fouaz Parkar[3]

[1] Student, Construction Engineering and Management, A.I.K.T.C, Mumbai University, New Panvel
[2]H.O.D, Civil Department, A.I.K.T.C, Mumbai University, New Panvel
[3]Assistant Professor, Civil Department, A.I.K.T.C, Mumbai University, New Panvel
Email: faisal.zkc@gmail.com

Abstract

The collaboration between the public and the private sectors is an important issue that has attracted the attention of most governments around the world. Public Private Partnership (PPP) is one important approach among many that meets this goal. The PPP projects are initiated to improve the mutual distribution of costs, risks and profits between the public and the private sectors for infrastructure projects through appropriate utilization their strengths and addressing their shortcomings. Interestingly, most PPP investment projects have been terminated in Maharashtra (13 per cent) followed by Chhattisgarh (10 per cent), Gujarat (nine per cent), Kerala (seven per cent) and MP (seven per cent). Poor preparations, flawed risk-sharing, inappropriate business models and fiscal uncertainties to vested interests leading to the development of skewed qualification criteria are the certain key reasons for the failure of PPP projects in India. This research aims at identifying the critical success factors that influence PPP projects in India based on the previous similar studies supported by a structured questionnaire survey. This study is carried out to analyze the impact of twenty four factors for PPP projects to be adopted in India. These factors have been collected from previous researches and they have been grouped into five dimensions: 1) legal 2) risk management 3) project efficiency 4) project performance and 5) political and environmental. The survey was conducted using an online questionnaire and also by distributing printed copies. This survey focused on public and private organizations located in India. The survey results show that there are some significant factors that have a strong impact on implementing the PPP projects in India. The factors were then ranked in terms of their importance to each of the parties involved, using the Mean score ranking. These factors are 'creating new opportunities for the private sector, the qualification of contractor and consultant, and PPP supporting in accelerating projects development'. The study has also suggested the government to set up an independent institution for overall co-ordination and management of PPP projects in the country. It is noted that a stable macroeconomic framework, a sound regulatory structure and effective regulation, sustainable project revenues, investor-friendly policies, transparency & consistency; liberalization of labour laws and good corporate governance are certain basic requirements to achieve success in the PPP sector in India. These findings provide an idea of the factors that could attract potential partners to engage in PPP projects. This research

ultimately attempts to develop a new practical framework to help the decision makers both in the public and private sectors in selecting the optimum PPP contract for the construction industry in India by taking the most important Critical Success Factors (CSFs) into account. Knowing the risk factors gives a better understanding in allocating them to the parties involved in PPP projects.

Keywords: *Public Private Partnerships; Critical Success Factors; Construction Industry; India*

Impact of Automation on Employee Behaviour in Indian Construction Industry

V. Pramadha

Senior Associate Professor, National Institute of Construction Management and Research, Hyderabad
Email: vpramadha@nicmar.ac.in

Abstract

The construction industry in India contributes to 7.74% of the National GDP amounting to 2184.66 billion INR (as of the last quarter of 2016). The Government's initiatives like "Make in India" and its investments in infrastructural development illustrate an upward growth in revenues from this sector. The construction sector worldwide and especially in India is highly labour intensive. The rapid pace of growth demands that the work should be performed at a better speed encompassing lesser risk and improved quality. Research studies reveal that the technologies available today can automate upto 45 % of all the activities performed by human beings and they have resulted in automation of 60 % of all the occupations in the world today. Application of automation results in reduction in human efforts, increases the productivity at the construction site, reduces time, augments the construction safety and results in improved Quality of Work. Large volumes of construction orders require the skilled workforce in huge numbers. Despite the fact that India is the world's second largest manpowered nation, it still experiences the shortage of skilled workforce. Automation also indemnifies the wastage and poor quality of work done by unskilled labour. However, automation is not always welcomed by the employees as they consider that it is replacement of their services and do not understand its role as an important supplement in the era of mega and fast track construction. Even the most advanced countries like Japan and Australia had to face the wrath of the employees, during the initial implementation of automation. The prime objective of this paper is to understand the obstacles in implementing automation in the Indian construction sector and its impact on behaviour of the employees.

Keywords: *Automation; Manpower; Skilled Workforce; Fast Track Construction; Employee Behaviour*

Innovative Financing Measures for Infrastructure Sector

Ankita Gupta[1], Chalapathi Gelli[2], Initha V[3] and Rajni Kant Rajhans[4]

[123]Student, PGP ACM, National Institute of Construction Management and Research, Delhi NCR (Bahadurgarh)

[4]Assistant Professor, National Institute of Construction Management and Research, Delhi NCR (Bahadurgarh)

Email: architectinitha@gmail.com

Abstract

There has been a growing emphasis on infrastructure development, which is highly evident from their contribution to the Gross Domestic Product (GDP), with partial or complete ownership of the private sector in the form of Public-Private-Partnership (PPP). Though the infrastructure companies are generating high operating profit, their net profit is negative owing to their huge finance costs. Thus, the attempt of the paper is to understand the problems in the financing of the infrastructure sector and suggest relevant innovative financing measures. The data pertaining to the listed companies of infrastructure industry were collected from various secondary sources. The chosen companies representing the industry account for approximately 84% of the industry revenue as per their market share of 2016. The findings from the study of industry representatives show that their finance costs have a huge percentage in their profit margin which substantially decreases further, though they are operationally good. It also talks about the underlying issues of the huge finance costs such as the conventional sources of funds, capacity of player, funding constraints and finance costs burden which are also the key issues plaguing the industry as a whole. The comparative analysis of the companies brings in the interpretation of the industry and allows us to discuss in detail the finance costs as in revenue, profit and operating profit to understand the issues in the financing.

Keywords: *Sources of Fund; Operating Profit; Finance Costs; Innovative Finance*

A Case Study on the Effectiveness of Water Conservation Measures Implemented by Jalanidhi, Kerala

Anjali Ajay[1] and Seema K. Nayar[2]

[1] Student, T. K. M. College of Engineering Kollam, Kerala India

[2]Professor, T. K. M. College of Engineering Kollam, Kerala India

Email: anjaliajaypblm@gmail.com

Abstract

For a long time, water supply services have been the responsibility of the government and external support agencies. Financial crisis, combined with the structural arrangement of these water supply programmes, led to the decentralized community managed schemes. In 2001, Kerala Rural Water Supply and Sanitation Agency (KRWSA) implemented Jalanidhi projects based on the demand-

driven approach. Jalanidhi facilitated the provision of rural water supply and sanitation at the local level. However, these schemes face some challenges like water quality problems, poor operation and maintenance, deteriorating source sustainability, lack of continuous professional support to Grama Panchayats (GP) or communities and emerging climate changes. Sustainability plans should be prepared especially for the over-exploited and critical sources. It is necessary to plan, prepare and implement source sustainability measures for all the existing sources of drinking water supply schemes. KRWSA implemented water conservation measures in some Jalanidhi schemes. In this study, performance evaluation of the selected water conservation structures (check dam and point recharge) implemented by Jalanidhi is done statistically using SPSS based on twelve attributes. The study of Water Conservation Structures (WCS) was conducted in six schemes in Mutholi GP of Kottayam district in Kerala. Performance evaluation of these measures adopted by Jalanidhi was done with SPSS and the check dam was found to perform better.

Keywords: *Water Conservation; Jalanidhi; Checkdam; Point Recharge*

Developing a Framework for Sustainability Ratings of a Self-sufficient Ecovillage

Pavan Totla[1], Aakash Sakargayen[2], NiyanthVashist[3], Saurabh Pandey[4] and Swapnil Wassan[5]

[1]Assistant Professor, National Institute of Construction Management and Research, Pune
[2345]Student, National Institute of Construction Management and Research, Pune
Email: ptotla@nicmar.ac.in

Abstract

About 70% of the total population in India resides in villages, and rural areas having workforce of around 51% contribute about 17% to the nation's GDP. The objective of this paper is to determine the necessary set of infrastructure measures required for self-sustaining livelihood in the rural area in general. Our paper discusses the various parameters that a village must identify with to become self-sustaining and eco-friendly. Literature review on the said subject helped us understand about the various schemes initiated by Government of India like Sansad Adarsh Gram Yojana, and Pradhan Mantri Adarsh Gram Yojana etc. for converting underdeveloped villages into sustainable eco-villages. It also helped us understand the key factors that contribute to the making of a successful model village like committed leadership, full community involvement, consensual & participatory rule-making and strict enforcement. The research methodology adopted here is based on the field survey of some existing Indian model villages through actual site visits and questionnaire based data collection. Major conclusions were drawn after meeting and discussing with the Subject Matter Experts of Ralegan Siddhi (a model village), District Ahmednagar, Maharashtra including interacting with Shri. Anna Hazare. The sustainability rating parameters for a village and their relative

importance were identified. Our research study will help analyze the gap in an Indian village between underdevelopment and sustainability, reasons for the gap and how to bridge the gap. Our research work outcome is a framework for sustainability rating of a village and includes 13 rating parameters which are necessary for assessing a village in terms of self-sufficiency and eco-synergy.

Keywords*: Self-Sufficient; Eco-Friendly; Model Village; Sustainability Rating Framework; Rural Infrastructure*

Analysis of Saturation Flow at a Signalized Intersection in Vadodara City

Hiral Luhana[1], Priyal Desai[2], Kavya Nair[3] and Vaidehi Jain[4]

[123]Student, Navrachana University, Vadodara
[4]Assistant Professor, Navrachana University, Vadodara
Email: hiral.luhana@yahoo.com

Abstract

Signalised intersections are one of the most critical elements that influence the performance of urban road network. Majorly, the intersections are now signalised for the safe and efficient movements of the large volume of traffic on road network. The design, the capacity and function of a signalised intersection consisting of heterogeneous motorised traffic thus critically depends on Passenger Car Unit (PCU) and saturation flow. For such purpose, the actual classified vehicular traffic flow during saturated green intervals and peak hours is measured in the field at different approaches of two intersections to calculate the saturation flow. The PCU values for different vehicles have been estimated based on area and clearance time ratio of different vehicles as compared with that of the standard car as obtained from field data. The saturation flow of different vehicles obtained has been converted into PCU by applying the IRC value obtained from the field and the one obtained using the PCU factors as per IRC-SP-41. Also, the saturation flow obtained from the empirical formula suggested by IRC-SP-41 is calculated and the results are then compared. Based on the comparison, appropriate remedial measures have been suggested for the increment in the saturation flow.

Keywords: *Signalised Intersection; Saturation Flow; Heterogeneous Traffic; Passenger Car Unit*

Urban Transit System in Aundh-Baner-Balewadi Smart City

Vatsal Pandey[1], Srishti Bajpai[2], Priyanka Bendigiri[3] and Amol Mohabey[4]

[124]Student, National Institute of Construction Management and Research, Pune
[3]Assistant Professor, National Institute of Construction Management and Research, Pune
Email: amol.rim8@nicmar.ac.in

Abstract

Pune is a major centre of learning and is emerging as a prominent location for IT and manufacturing industries. It has the eighth largest metropolitan economy and the sixth highest per capita income in

the country. Also, Pune is the only city among the top eight in the country without a Metro Mass Transit System. The city's lack of public transportation, along with an un-stemmed rise of private vehicles, has resulted in massive congestions and very low average speeds. Due to the lack of proper public transit system in the city, only 5% commuters use the public transport system while others prefer private vehicles resulting in increased traffic and pollution. Further, the problems are intensified with a limited traffic rule adherence and dilapidated walking and cycling infrastructure. The condition is exacerbated by infrastructural gaps such as ring-roads, newly planned metro and BRT corridors. Mobility is a critical factor for urbanization, in which urban transit system plays an important role and the same has been considered in the smart city mission as well. By undertaking various traffic and transportation surveys in the proposed Aundh-Baner-Balewadi (A-B-B) smart city area, the paper outlines an action plan to develop and implement an effective transit and feeder system in the demarcated study area.

Keywords: *Transit; Feeder; Smart City; Aundh-Baner-Balewadi; Infrastructure*

Analysis of Rectangular and Circular Elevated Water Tanks

Rudrasinh Chauhan[1], Harsh Patel[2], Nirav Patel[3] and Prutha Vyas[4]

[12]Student, Navrachana University, Vadodara
[34]Assistant Professor, Navrachana University, Vadodara
Email: rvchauhan92@gmail.com

Abstract

Elevated tanks are used to store a variety of liquids, e.g. water for drinking and fire fighting, liquid petroleum, petroleum products and similar liquids. Water tanks are used to store to tide over the daily requirement of water by localities, industries, cities and towns, etc. This paper applies the optimization method to structural analysis and design of rectangular and circular elevated water tanks. A computer program is used to solve the numerical examples. Comparison of different forces in rectangular and circular elevated water tanks has been carried out. Then the results were compared and tabulated along with the graphs.

Keywords: *Elevated Water Tank; Graph Comparison; Tank Capacity*

Assessment of Ground Water and Impact Evaluation in Kharghar and Manasarovar Region

Ajay Nadar[1], Shabiimam M. A[2], Shivaji M Sarvade[3] and Pankaj Mehta[4]

[14]Student, Civil Engineering, Anjuman -I- Islam's Kalsekar Technical Campus Panvel, Navi Mumbai
[23]Assistant Professor, Department of Civil Engineering, Anjuman -I- Islam's Kalsekar Technical Campus Panvel, Navi Mumbai
Email: ajaytamil79@gmail.com

Abstract

The primary objective of this study is to evaluate the groundwater quality parameter in the surrounding wells of Kharghar and Mansarovar regions in the Raigad district of Maharashtra. Kharghar and Manasarovar are the two growing residential hubs due to close proximity to Navi Mumbai and coastal area. At the seacoast in a coastal aquifer, fresh groundwater from inland terrestrial sources discharges into the sea, flowing over denser seawater that intrudes inland**.** The groundwater contamination is creating health hazards and causes many deficiencies and diseases in humans. Therefore, it is necessary to evaluate the quality of ground water. Ground water samples collected from various bore wells from residential areas and sea water samples were collected from Kharghar and Mansarovar coastal areas during the summer season in 2017. The various ground water and sea water quality parameters were analysed as per IS standards. The study reveals a few cases where total hardness is found to be high. Concentration of other major constituents is found within the permissible limit. During the last few years, the utilization of surface and ground water for drinking and agricultural purposes has increased due to exponential growth in population. Hence, the periodic ground water quality assessment is of prime importance owing to its impact on the human health.

Keywords: *Ground Water; Coastal Area; Salt Water Intrusion; Water Quality; Water Contamination*

The Bubble Deck Slab-An Innovation in Construction

V Srihari

Professor, National Institute of Construction Management and Research, Hyderabad
Email: vsrihari@nicmar.ac.in

Abstract

The present paper describes an innovative method, named as Bubble deck slab. The Bubble deck slab is a method of eliminating concrete from the centre of a floor slab, which is not involved in any structural function, automatically reducing the structural dead load. Bubble deck slab uses hollow spherical or elliptical balls made by recycled plastic. The reuse of 1 kg of plastic waste can eliminate

100kg of concrete. The plastic bubble slabs are capable of reducing the amount of concrete necessary to construct a building by more than 30 percent and eliminate 35 to 50 percent of self-weight. The reduction in concrete volume will also reduce the shear resistance. The shear capacity of a Bubble deck is measured to be 81% as compared to a solid deck. This provides a wide range of cost and construction benefits. The present paper describes about principles, types and characteristics of Bubble deck slab. This technology is environmentally green and sustainable by avoiding or minimizing the production of concrete. This process will further reduce global CO_2 emission levels. The focus on Bubble deck system can recycle most of the plastic waste and also bring many green design related aspects to the construction sector. The Bubble deck method of approach in construction sector will give good rating as per green building rating system.

Keywords: *Bubble Deck; Recycled Plastic Balls; Weight Reduction; Flexural Strength; Deflection; Fire Resistance*

Use of Recycled Construction and Demolition Waste as a Coarse Aggregate

Kavya Nair[1], Isheet Shah[2] and Vaidehi Jain[3]

[12]Student, Navrachana University, Vadodara
[3]Assistant Professor, Navrachana University, Vadodara
Email: kavya.nair.016@gmail.com

Abstract

Production and utilization of concrete in present scenario has rapidly increased resulting in increased use of Natural Aggregates (NA) as the largest concrete component leading to critical shortage of natural resources. One of the possible solutions to tackle this is to use demolished concrete. Instead of dumping the demolished waste, it can be recycled and the natural aggregates can be replaced by Recycled Coarse Aggregate (RCA). This would reduce the impact on landfills too. The NA cannot fully be replaced by RCA, as it would lack in its concrete properties. A suitable proportion of NA and RCA should be chosen for construction. This paper shows the tests performed to find the values of basic concrete properties for different chosen proportions of NA: RCA. The tests performed are for flakiness and elongation index, aggregate crushing value, aggregate impact value, aggregate abrasion value, specific gravity and water absorption. The proportions chosen for NA: RCA are 100:0, 70:30, 50:50 and 0:100.The results are then compared and it is also checked if the values obtained by the tests performed are as per the values suggested by IRC-37 for flexible pavement. Based on the result, a proportion is chosen and suggested for effective utilization of resource and preservation of environment by reducing impact on landfills. However, it is suggested to use RCA with a good quality.

Keywords: *Natural Aggregate (NA); Recycled Coarse Aggregate (RCA); Demolished Waste; Concrete Properties*

Crisis Management in Civil Construction

Yash K. Patel[1], Tirth D. Patel[2] and Piyush J. Patel[3]

[1]Student, U. V. Patel College of Engineering, Ganpat University Mehsana, Gujarat
[2]Assistant Professor, U. V. Patel College of Engineering, Ganpat University Mehsana, Gujarat
[3]HOD, U. V. Patel College of Engineering, Ganpat University Mehsana, Gujarat
Email: ykpatel.yp@gmail.com

Abstract

The research includes a description of crisis management aspects in construction. A crisis is a situation that creates significant financial, legal and regulatory risk and poses threat to health and safety of employees, customers or the public, which puts the business at risk. A risk is a possibility while a crisis is an occurrence. No business is immune from a crisis; preparation and planning are the key factors for handling any crisis. Crisis management is a process to overcome a crisis with minimal damage. Both qualitative and quantitative approach is used for the data collection and analysis. For this research, various individuals related to the construction sector were surveyed based on their mind-set and the organizations in which they are currently working. Construction firms that can escape from a crisis with zero or minimum damage may strategically have competitive advantages over existing rivals. Considering all these issues, this study describes the concept of crisis management in terms of the construction sector.

Keywords: *Crisis Management; Construction Sector; Risk; Preparation; Project Planning*

Application of GIS in Construction Management

Kush M. Patel[1], Tirth D. Patel[2] and Piyush J. Patel[3]

[1]Student, U. V. Patel College of Engineering, Ganpat University, Mehsana, Gujarat
[2]Assistant Professor, U. V. Patel College of Engineering, Ganpat University, Mehsana, Gujarat
[3]Head of Department, U. V. Patel College of Engineering, Ganpat University, Mehsana, Gujarat
Email: kushpatel2806@gmail.com

Abstract

Construction of large scale projects such as townships, industries, dams, canals etc. is a challenging task and so is to complete these kinds of projects within the time limit and the estimated cost. Conventional project management tools such as bar charts and the critical path method are still used by project managers in India, which somewhat fail to provide accurate data of project resulting in poor management of a project. This study presents integration of Geographic Information System (GIS) with various project management softwares as well as AutoCAD for monitoring the progress of a project by 3-D visualization. GIS is a software, which, with input is able to display 3-D view of

a building. With time as a fourth dimension, the progress of a construction task can be displayed as 4-D view. ArcScene module of ArcGIS software is used to generate 3-D view of progress. The 3-D view of building depends on the progress information updated in the schedule worksheet of MS Project. The 4D model of progress monitoring is beneficial to all the stakeholders like project managers, client, and site engineers. Project manager can have effective control over main parameters of construction project which are time, cost and quality by using GIS based project management system.

Keywords: *Construction; Geographic Information System; 3-D View; Project Management; 4-D View*

Causes and Mitigation of Delays in Construction Projects

Rambabu Mukkamala[1], Rajesh Avunoori[2] and Savya Saachi[3]

[1]Assistant Professor, National Institute of Construction Management and Research, Hyderabad
[23]Student, National Institute of Construction Management and Research, Hyderabad
Email: rmukkamala@nicmar.ac.in

Abstract

Time overruns has been a noteworthy issue in numerous Indian construction projects. The successful execution of construction activities and keeping them within recommended plan and cost is imperative for compelling time execution and cost execution. This work concentrates on noteworthy factors creating time overruns in Indian construction industry. A valid questionnaire for the overview was produced taking into account factors for time overruns recognized from writing survey. These factors are assembled into 9 groups for time overruns and disseminated among three parts in particular Real Estate, Infrastructure and Indian Construction Industry. The information from the survey was broken down measurably and analysed with the help of SPSS software. A Relative vital list system was utilized to establish the most noteworthy variables influencing time overruns. The result accomplished from the survey revealed that the major causes for time overruns are clearances on delay, drawing revision and clearances from consultant/client/PMC, incompetency of labour, unrealistic planning and not using monitoring and controlling tools & technologies, lack of leadership qualities in managers, procurement planning and procurement process. The study highlights the noteworthy factors and a few recommendations are given to control time overruns in Indian construction industry. The objectives of this paper are to identify the factors influencing time overruns in construction projects, to evaluate their relative importance to determine the common factors of delay in various sectors of Indian construction industry- Real Estate, Infrastructure and to formulate recommendations for improving time performance.

Keywords: *Reliability Analysis; Relative Importance Index; Correlation; Time Overrun; Monitoring and Controlling*

Sustainable Building – A Case Study on Bannari Amman Institution

A. Mohanraj[1], Karthiga Alias Shenbagam[2] and G. Anusha[3]

[12]Assistant Professor, Bannari Amman Institute of Technology
[3]Associate Professor, Bannari Amman Institute of Technology
Email: karthis47@gmail.com

Abstract

The green building concept is gaining importance in various countries. These are buildings ensuring that waste is minimized at every stage during the construction and operation of the building, resulting in low costs according to the experts in the technology. In this paper, a green campus of Bannari Amman Institute of Technology (BIT) in Erode (Sathyamangalam), Tamil Nadu is discussed. BIT is nestled on the banks of the river Bhavani, BIT's campus provides environment for natural learning in harmony with nature, away from the odds of city life. The spacious and the earth hugging buildings punctuated with landscaped courtyards and pathways are designed to emphasize the business ethics and character of an excellent centre for learning. The average people spend about 48 hours a week working in this institution. It stands to reason that the spaces where they occupy so much of their time should treat them well. The building combines a roof covered in solar panels with a streamlined, well-insulated design and a series of heat exchangers and heat pumps in order to achieve such a high level of energy performance. This paper elaborates the features of the Institution like better air quality, more natural day-lighting and increased temperature control. Also, the Institution is designed to reduce the overall impact of the built-up environment on human health and the natural environment by efficiently using energy, water and other resources, protecting occupants' health, reducing waste, pollution and environmental degradation, ensuring sustainability and use of natural materials that are locally available.

Keywords: *Water; Air Quality; Solar; Energy Efficient; Sustainability*

Investigation of On-site Productivity Variations in a Large Scale Residential Project Using Control Charts

Debabrata De[1], Akshat Medatwal[2], Saransh Gupta[3], Appalabattula Suryadhar[4], Swapnil Jain[5] and Shobha Ramalingam[6]

[12345]Student, ACM, National Institute of Construction Management and Research, Pune
[6]Assistant Professor, SOCM, National Institute of Construction Management and Research, Pune
Email: debabratade87@gmail.com

Abstract

Poor productivity in construction is a major concern for an organization. Lower productivity rate can delay the project and lead to cost overruns. This could be due to technical issues such as incomplete drawings, non-availability of specified material, wrong distribution of resources, improper sequencing of activities or process related issues such as time consumed to do repetitive tasks, improper method of doing the task and so on, leading to variations in the process and productivity rate. The objective of this study is to investigate the variation in productivity in the process and identify areas for improvement for repetitive tasks in large scale residential projects in India. Focusing on the process, data was collected for concrete piling in three residential towers in Kolkata. The data was analyzed using statistical process control techniques such as the control chart. The findings highlighted the variations in the process. The special causes for the variation were further investigated through the records maintained at the site office and by interviewing respective personnel on the project. The identified factors and the variation in the process are expected to guide in the direction of productivity improvement for similar residential projects.

Keywords: *Productivity; Process Variations; Statistical Process Control; Control Charts; Construction*

Qualitative Content Analysis Using NVivo for Research in Construction, Real Estate, Infrastructure and Project Management

Nilesh Agarchand Patil[1], Boeing Laishram[2] and Hake S. L.[3]
[1]Research Scholar, Department of Civil Engineering, IIT, Guwahati
[2]Associate Professor, Department of Civil Engineering, IIT, Guwahati
[3]Associate Professor, D. V. V. P. College of Engineering, Ahmednagar
Email: p.agarchand@iitg.ernet.in

Abstract

There are various Computer Assisted Qualitative Data Analysis Software (CAQDAS) tools for qualitative data analysis. Amongst the CAQDAS tools, NVivo is used the most to store, organize and analyze the qualitative data from the literature as well as the field study in various types of research. NVivo also seems well suited for many of the problems faced in Construction, Real Estate, Infrastructure and Project (CRIP) management research, but its uses are limited in research in these areas. This article explains the systematic method of Qualitative Content Analysis (QCA) from

literature review as data source for research in CRIP management using NVivo10 as a CAQDAS tool. The method includes the five steps procedure of QCA through literature review to develop the grounded theory in NVivo10. The five steps of QCA include: (i) importing and classification of the documents; (ii) coding of the data; (iii) displaying of the data; (iv) analysis of the data; and (v) developing a theory. Though the example used in this paper is for identification of sustainability barriers in Public-Private Partnerships (PPPs) for infrastructure development, the emphasis is on the general principles to show how various CRIP management research topics could be explored using this method. The article elaborates the coding procedure of QCA through open and axial coding which are used as free and tree nodes respectively in NVivo. The study also presents the guidelines for applying NVivo as CAQDAS tool for QCA through literature to construct the grounded theory in the field of research in CRIP management and related research areas. The paper presents a critical insight on application of NVivo to develop the grounded theory using literature review in CRIP management research which has not been the focus in the majority of previous research studies.

Keywords: *Qualitative Content Analysis; Qualitative Data Analysis; CRIP Management; Public-Private Partnerships; NVivo*

A Conceptual Paper on Identifying Criteria for BIM Adoption in Project-based Organization

Vijayan Chelliah[1] and Laishram Boeing Singh[2]

[1]Phd Scholar, Indian Institute of Technology, Guwahati
[2]Associate Professor, Indian Institute of Technology, Guwahati
Email: vijayan@iitg.ernet.in

Abstract

The aim of this paper is to identify the factors mediating the adoption of Building Information Modelling (BIM) in Project-Based Organization (PBO). Since, there is a growing consensus on BIM adoption around the world, the existing literature falls short of systematically exploring the relationship between the PBO and BIM adoption. The study reviews literature on two distinct contexts namely, technology adoption and characteristics of PBO. Literature-Based Discovery (LBD) is chosen as a method for investigation, when two or more mutually isolated contexts are analysed, to identify the connecting dots. The criteria for BIM adoption are identified through Technology-Organization-Environment (TOE) theory, Innovation Diffusion Theory (IDT) and Institutional theory and focused at organizational level implementation. The theory used in this research is used as the framework for observation and understanding, which shapes both what we see and how we see it. The main factors that were identified as playing a significant role in PBO adoption of BIM were: relative advantage, complexity and scale, compatibility, trial-ability,

familiarity, interdependence, uncertainty, time pressure, institutional difference, distance and dispersion, and isomorphic pressure which are formulated under three categories namely,(i) Organization, (ii) Technology, and (iii) Environment. The constructs framed in this research are based on theoretical perspective. This will provide future direction for further empirical analysis. BIM implementation in PBO has received comparatively little attention in the extant literature. Further, while BIM adoption as well as PBO characteristics have been separately identified, very little work exists that links these two sets of constructs. This paper seeks to contribute to the body of knowledge on the link between criteria for BIM implementation and PBO.

Keyword: *Building Information Modelling (BIM); Project-Based Organization (PBO); Literature-Based Discovery (LBD); Technology Adoption; Institutional Theory*

Integration of CAD (Computer Aided Drafting), Building Information Modelling (BIM) and GIS (Geographic Information System) in Smart City Projects for Efficient Asset Management - An Indian Scenario

Harshvardhan Khantadia

Student, National Institute of Construction Management and Research
Email: harshvardhan9191@gmail.com

Abstract

Prime Minister Narendra Modi, on June 25, 2015 launched the 100 Smart Cities Mission. This mission aims at urban renewal and retrofitting of the selected cities and towns in different parts of India so as to make them citizen friendly and sustainable. A total of ₹980 billion (US$15 billion) has been approved by the Indian cabinet for the development of 100 smart cities and ₹48,000 crore (US$7.5 billion) for rejuvenation of 500 others. With many resources to be managed for this extensive work, it is imperative to make use of cutting edge technologies for efficient asset management. By the virtue of such widely distributed network of roads, services, etc., today, in the era of sustainability and competitiveness, the local governments face the challenge of asset management in minimizing the cost of ownership and streamlining their asset management resources. Asset management operation being the systematic process of maintaining, upgrading and operating physical assets is possible with the help of the triad namely Computer Aided Drafting (CAD), Building Information Modelling (BIM) and Geographical Information Systems (GIS). When combined on a common platform, these can give us precise and high performance results in comparison to traditional approaches. In this paper, the focus is on technology as an asset as it is the need of the day to solve the most complicated asset management problems pertaining to the smart cities. The research will involve the ways in which the triad namely CAD, BIM and GIS will help the smart city projects to function in a seamless and a precise manner.

Keywords: *Computer Aided Drafting; Building Information Modelling; Geographical Information Systems; Smart City Solutions; Asset Management*

Climate Change Impact Assessment of Areas with Varying Altitudes-A Study

S.Suresh Ragul[1] and S. Sundara Moorthy[2]

[12]Student, Kongu Engineering College, Perundurai, Erode
Email: Ss.Sureshragul@gmail.com

Abstract

Recent decades have seen record high average global surface temperatures. Average Global surface temperature has increased by 0.6°C during the twentieth century due to the occurrence of climate change. The present paper analyses the impact of global warming on the meteorological parameters for Chennai and Ooty of Tamilnadu by studying the data collected from SWAT from 1980 to 2013. Trend and seasonal analysis has been undertaken in order to identify recent annual or seasonal warming trends that might be attributed to the climate change and also used to identify the impacts of warming on the meteorological parameters by using SPSS software. Rainfall and runoff variations were calculated with respect to the yearly temperature variation in which temperature is considered as significant parameter throughout the study. Also, SPSS is used to forecast an unknown value, on the basis of some real, known values, using techniques that don't use too many scientific details. Descriptive Analysis (DA) and Correlation Co-efficient Analysis (CCA) are used to identify the climate change impacts on the study area.

Keywords: *Global Warming, Trend Analysis, Seasonal Analysis, Rainfall, Runoff, Temperature, SPSS, Descriptive Analysis (DA), Correlation Co-efficient Analysis (CCA)*

Blue Ocean Strategy for Project Based Organizations

Shibarghya Chatterjee[1], Esther Nivedita D[2], Abhisek Dutta[3], Joy Bhowmick[4] and Mona N Shah[5]

[1234] Student, Project Engineering & Management, National Institute of Construction Management and Research, Pune
[5] Professor and Dean –SOPRIM, National Institute of Construction, Management and Research, Pune
Email: mnshah@nicmar.ac.in

Abstract

Recent years have seen the emergence of a number of project based companies thus increasing the existing competition. As a result, there is a much higher need for project portfolio management that enables companies to realize their benefits and create value for the company. Companies have resorted to developing innovative strategies and subsequently suitable portfolios have been created for the implementation of the strategies to survive in the changing market environment. One such strategy is the Blue Ocean Strategy. This study aims to understand how Blue Ocean Strategy can be

implemented in project based companies to create a distinctive advantage for them and identify the optimal project portfolio for the same. The study also discusses in brief about the potential scope of applying Blue Ocean Strategy in Real Estate Project segment as an illustrative example.

Keywords: *Strategy Optimization; Blue Ocean Strategy; Project Based Organizations; Real Estate; Creating Distinctive Advantage; Value Maximization; Value Innovation*

Automation through ICT in Urban Areas Using Advancement of Technology

Sachin Jain[1] and Sameer Jain[2]
[1]Associate Professor, National Institute of Construction Management and Research, Pune
[2]Assistant Professor, National Institute of Construction Management and Research, Pune
Email: sachinjain@nicmar.ac.in

Abstract

Population from rural area is shifting towards city areas around the world; and it has noticed that India is not an exception. Also due to change in the needs of populations which are living in city, traditional methods are not enough for making a quality life for citizens. Hence, in this paper we try to explore various high technology areas, like ICT, Automation and use of robots, which can help in improving overall quality of life in city areas. In this paper various technological advancements are considered which can help in developing infrastructure and housing of city and result in modern city development.

Keywords: *Modern City; Automation; ICT, Robotics*

Urban Vulnerability: A Review of the Methodologies Adopted Globally to Assess Vulnerability of Cities

Pratishtha Garg[1], Shekhar V. Nagargoje[2], Saurav Dey[3], Nandish S K[4] and Aayush Jaiswal[5]
[1345]Student, REUIM, National Institute of Construction Management and Research, Pune
[2]Assistant Professor, National Institute of Construction Management and Research, Pune
Email: snagargoje@nicmar.ac.in

Abstract

A city's ability to be competitive whilst supporting the well being of its citizens can be compromised by risks from climate change to infrastructure deficit, and unplanned growth to outbreak of diseases. At global level, The Rockefeller Foundation has adopted the City Resilience Framework to guide the development of city resilience strategies across the world. At national level, Integrated Research and Action for Development in Delhi, a centre of excellence on urban development and Climate Change, with other reputed institutes undertakes research focussed on vulnerability assessment of Indian cities. This paper aims to document and analyse several methodologies of urban vulnerability assessment adopted at Indian and global level. The paper analyses these methodologies and the

overall process adopted in each of these for its potential replication in other cities in India, and brings out the inherent challenges, gaps and opportunities in achieving this. The study indicates that the overall process adopted was unique in each study and that differences in the methodologies have arisen due to a number of contextual factors, including the governance structures, industrial makeup, population and demographic conditions, as well as the implementing teams' prior experience and level of understanding with quantitative and qualitative assessments. Data availability, subjective indicators and inter-departmental coordination were quoted as some of the key challenges experienced by the implementing partners. Drawing from these experiences, and with the aim of developing an index further, this paper contributes recommendations on adopting a methodology. The proposed methodology can then be tested on the Indian cities to develop a ranking highlighting the most to least vulnerable city.

Keywords: *Vulnerability; Resilience; Methodology; Governance; Urban Development*

Would Property Become Cheaper in India after Demonetization?

P. Ammani

Associate Professor, National Institute of Construction Management and Research, Hyderabad
Email: pammani@nicmar.ac.in

Abstract

Post demonetization in November 2016, there were speculations on how it would affect the Indian real estate market. Some were of the view that the prices would come down at least by thirty percent, but builders are of the opinion that prices would remain same and demand will increase. On the other hand experts say that demonetization could bring down interest rates and force cuts in real estate prices. Hence, need has been felt to understand the impact of it on Indian real estate sector. In the present study a micro and macro environment analysis has been done to understand the good and bad about demonetization to the Indian real estate sector. The perceptions of the customers have been captured to understand their mindsets regarding investments after demonetization. Some of the findings include that there is no considerable change in real estate prices, in fact the prices have escalated by 3-4% in many clusters over the past four years and chances are high that demand for housing would increase with home loans becoming cheaper. The primary research also shows that there is no change in customer's willingness to invest in real estate.

Keywords: *Demonetization; Property; Real Estate; Micro and Macro Environmental analysis; Customer Perception*

Key Determinants of the Process of Building Redevelopment Projects in Mumbai City

Vinod Vanvari[1] and Sumedh Mhaske[2]

[1]Research Scholar, Department of Civil and Environmental Engineering,Veermata Jijabai Technological Institute (VJTI), Matunga, Mumbai

[2]Associate Professor, Department of Civil and Environmental Engineering,Veermata Jijabai Technological Institute (VJTI), Matunga, Mumbai

Email: vbvanvari@rediffmail.com

Abstract

The commercial capital of India, Mumbai city which was once known for mills, bollywood, business and health care is witnessing activity 'Redevelopment of Buildings' since last decade and half. As city has unique geometry and geography coupled with high housing prices, building redevelopment activity is taking pace saliently and steadily in city and its suburbs. Due to multiple stakeholders, numerous considerations and constraints, this activity has become multidimensional, complex and quite risky. Some projects are sailing through completion while some are stalled due to one or other reasons. Processes of building redevelopment projects are though time consuming and complex, has a specific pattern. The purpose of this work is to study this process and find its determinants for one segment of projects i.e. building redevelopment projects of housing societies. The objective is to evolve frame work of system so as to optimize time required for process through its determinants.

Having established objectives, hypothesis is tested through analysis of data collected from field for sample size of 25 projects, followed by pilot questionnaire. Data and facts are collected through structured questionnaire and interviews. Objective data is analyzed through SPSS software while facts are assimilated in flow charts. Study reveals two kinds of factors, one who contribute the process and the others who hinder the process. Furthermore, study also reveals that there are few key determinants such as communication, transparency, managing risk, area increase and leadership by managing committee members which if ensured, redevelopment project get accomplished swiftly and that too to their desired objectives. Many studies and schemes are carried out for redevelopment of slums and cluster development etc. by government bodies. However segment of people living in housing societies is unattended one. This study is probably first in kind for this segment. Outcome of research work is of immense value in terms of guidance to the stakeholders, particularly tenants.

Keywords: *Determinants; Process; Building Redevelopment; Factors; Relative Importance Index*

Analysis of Critical Factors in Implementation of Project Management Software in Indian Roads and Highways Construction Industry

Siddesh K.Pai[1], Thakur Aman Singh[2], Ankur Mittal[3] and Neeraj Anand[4]

[1]Assistant professor, National Institute of Construction Management and Research, Goa
[2]Student, ACM, National Institute of Construction Management and Research, Goa
[3]Associate Professor, University of Petroleum and Energy Studies, Dehradun
[4]Professor, University of Petroleum and Energy Studies, Dehradun
Email: siddeshp@nicmar.ac.in

Abstract

Project management software has the capacity to help plan, organize, and manage resource tools and develop resource estimates. Project management software has been around for a number of years now and as a result, it does far more than just manage the projects themselves. The aim with these is to handle all aspects and complexities of larger projects and help keep costs down. Project software can help to determine which events depend on one another, how exactly they depend on each other, and what happens if things change or go wrong. In addition, they can schedule people to work on various tasks, and detail the resources physical, financial or anything else that are required, and this is called resource scheduling. There are various good project management software applications out there, with Microsoft Project being one of the most popular mid-range project management packages, and the likes of Primavera being popular at the higher end. People also use project management software to deal with uncertainties in the estimates of the duration of each task; arrange tasks to meet various deadlines; and juggle multiple projects simultaneously, as part of an overall objective. The study aims to understand the critical factors, why this software's being popular in construction industry, still not being used extensively for project implementation. The paper focuses on statistically analyzing the key challenges faced by construction industries for implementing this project management software.

Keywords: *Project Management Software; Roads and Highways Sector; Principle Component Factor Analysis; Microsoft Project; Primavera*

Status of Defluoridation Techniques in India: A Review Study

Atique Barudgar[1], Shabiimam M. A[2] and Sayyed Sageer[3]

[13]Student, Civil Engineering, Anjuman -I- Islam's Kalsekar Technical Campus Panvel, Navi Mumbai
[2]Assistant Professor, Department of Civil Engineering, Anjuman -I- Islam's Kalsekar Technical Campus Panvel
Email: dr.shabiimam@gmail.com

Abstract

Pure water is scarce and not easily available to all. The water may be contaminated by natural sources or by industrial effluents. One such a contaminant is fluoride. Fluoride if taken in small

amount is usually beneficial, but the beneficial fluoride concentration range for human health is very small between 0.7-1.4 ppm. In this review study, problem due to excess fluoride and its defluoridation technique status has been done. Removal of fluoride is important because it has a number of adverse effects on human health including effect on IQ of child, skeletal fluorisis, and dental fluorisis and even in minute doses accumulates in body. Studies have shown that major of the kidney diseases have a great inclination of toxicity of fluoride. Close to 1% of population of India is affected by it expanding in 19 states. Membrane filtration, precipitation, Nano filtration, ion exchange and adsorption etc. have been used for fluoride removal. Now days, biosorption method is very effective technique for removal of fluoride from water. This technique involves the low cost adsorbent such as rice husk, saw dust, Moringaoleifera extract, and red mud. Defluoridation methods can be broadly divided into three categories i) chemical additive method ii) contact precipitation and iii) adsorption method. In precipitation method, Nalgonda technique which is evolved in India is successfully applied in some parts of country. This paper discusses various Defluoridation technique used across India and current status of Defluoridation in India.

Keywords: *Fluoride; Defluoridation; Adsorption; Water Contamination; Low-Cost Adsorbent*

Use of Online Marketing Strategies by Real Estate Developers in Mumbai-Pune Region

A.S. Purandare[1], Abhinav Agrawal[2,] Amrapali Jadhav[3], Mithun Kumar[4] and Prafull Jadhav[5]

[1]Associate Professor, National Institute of Construction Management and Research, Pune
[2345]Student, PGP REUIM, National Institute of Construction Management and Research, Pune
Email: abhinav.rim8@nicmar.ac.in

Abstract

This paper intends to investigate the potential of the online marketing in Indian context, risks associated with online marketing, effect of the changing Indian economy on online strategies implied to real estate, consumer ease and accessibility to these strategies, analysis of strategies of top realtors/developers in Mumbai-Pune region and try to draw comparisons with the top realtors of the world, impact and adoption of online marketing strategies by brokers, brokerage firms and other online portals and new digital marketing trends like Bartering.

Keywords: *Real Estate Marketing; Online Marketing; Website; Online Brokerage Marketing, Internet Marketing*

Solid Waste Management – Compositing Machine

Kirti Bhushan Zare[1] and Gambhire Dhirajkumar Gopal[2]

[1]Assistant Professor, D. Y. Patil Institute of Engineering, Management and Research, Akurdi, Pune
[2]Student, D. Y. Patil Institute of Engineering, Management and Research, Akurdi, Pune
Email: kaprekirti07@gmail.com

Abstract

All non-hazardous solid waste from a community that requires collection and transport to a processing or disposal site is called refuse or municipal solid waste (MSW). Refuse includes garbage and rubbish. Garbage is mostly decomposable food waste; rubbish is mostly dry material such as glass, paper, cloth, or wood. There are main six types of solid waste which includes, Municipal Solid Waste (Organic kitchen waste vegetables, fruits etc.), Hazardous Wastes (Toxic wastes, Reactive wastes, Ignitable waste, Corrosive wastes) Industrial Wastes(Food processing industries, fertilizer and pesticide industries), Agricultural Wastes (The waste generated by agriculture includes waste from crops and livestock), Bio-Medical Wastes (diagnosis, treatment or immunization of human beings or animals or in research activities pertaining there to or in the production or testing of biological). Now days, there is lot of problems regarding the waste disposal of solid management. Waste prevention, or source reduction means consuming and discarding less, is a successful method of reducing waste generation. Composting is the decomposition of organic Solid Waste Management by microorganism in warm, moist, aerobic and anaerobic environment. Main advantages of composting include improvement in soil texture and augmenting of micronutrient deficiencies. It also increases moisture holding capacity of the soil and helps in maintaining soil health.

Keywords: *Solid Waste Management; Waste Disposal; Waste Recycle; Composting Machine; Green Energy*

Analyse Risk Factors for PPP Types of Projects

Hake S. L.[1], Sonawane S. E.[2], Damgir R. M[3] and More V. B.[4]

[1]Associate Professor, D. V. V. P. College of Engineering, Ahmednagar
[2]Student, P.G., K J College of Engineering, Pune
[3]Associate Professor, Government College of Engineering, Aurangabad
[4]Assistant Professor, MET BKC, Nashik
Email: drsandeephake@gmail.com

Abstract

Public Private Partnership (PPP) is collaboration between public and private sector players for implementation of different project. In this study the data related to risks in public private partnership projects is collected and the data contains certain risk factors. These factors are likely to influence all

kind of project such as road projects, water supply schemes, airport facilities which are under PPP. In this study the market survey was done by using manual questionnaire survey and web based survey monkey application. Both the results are compared with each other and applied on a case study for highway project. This survey will provide detailed analysis of risk in such infrastructure projects. Then finally a case study of some projects was carried out under PPP to correlate our results. This study can be helpful for the contractor at the time of tendering for PPP type of project.

Keywords: *PPP; Risk Factor; Highway Project*

Seismic Analysis of R.C.C. Framed Buildings with Floating Columns

Nitin G. Bhalekar[1], Mahesh R. Nalamwar[2] and Dhananjay K. Parbat[3]

[1]Student, P.G., Civil Engineering, Amravati University, Yavatmal, Maharashtra
[2]Assistant Professor, Civil Engineering, Amravati University, Yavatmal, Maharashtra
[3]Student, Govt. Polytechnic, Nagpur
Email: ni3bhalekar1991@gmail.com

Abstract

The term Floating column is a vertical element which rests on a beam at its lower end. Such columns do not go all the way up to the foundation and introduce a discontinuity in the load transfer path. These types of columns are frequently used to facilitate parking space for vehicles. This paper presents a comparative study of the performance of structures with and without floating columns under earthquake excitation. A 3D analysis is of multistorey space frame is carried out. The analysis is done using Extended Three Dimensional Analysis of Building Systems (ETABS). The results of storey drift and base shear obtained for frames with and without floating columns are compared. Storey shear will be more for lower floors, than that for the higher floors due to the reduction in weight when we go from bottom to top floors.

Keywords: *Floating Column; Seismic Zones; ETABS; Drift; Displacement*

An Exploratory Case Study on Communication Management in Indian Building Construction Projects

Ayushi Srivastava[1], Gangadhar Mahesh[2] and V. Anand[3]

[1]Student, National Institute of Technology Karnataka, Surathkal
[2]Professor, National Institute of Technology Karnataka, Surathkal
[3]L&T Construction, Chennai
Email: gangadhar.mahesh@gmail.com

Abstract

Communication management, as an essential part of project management is relatively a growing field in Indian construction industry. With an increase in complex projects as a result of booming economy, it is important to explore and establish the present state of project communication and

communication management in Indian construction industry. The need is to investigate and analyse the major issues faced by the projects and build a suitable approach to communication management. In this context, the case study presented here explores an ongoing critical project which involves construction of a commercial building in Bangalore for a reputed IT company. The project is a fixed lump sum contract between the client and the general contractor, and a management contract between the client and the Project Management Consultant. The study is made with the perspective of the contractor and uses semi structured interviews with various stakeholders of project and site personnel of the contractor. The project is currently at mid of the contract duration. The study is aimed at recognising the underlying basis of communication management in Indian context and identifying critical issues. It also provides insight to the level of awareness, skills and approach to handling communication in a complex Indian construction project.

Keywords: *Communication Management; Indian Construction Industry*

Understanding Sustainability in Real Estate

Prieya Arun

Architect, Sathyabama University, Chennai
Email: prieya@gmail.com

Abstract

Implementation of sustainability in the real estate should be made mandatory or make it as a policy rule by the government, so that we do not replenish our resources and save it for our future generations. Sustainability has recently become a back burner of funds through credit system. This is quite evident in the commercial real estate sector. Stakeholders in the market catch up the different opportunities sustainability provides in terms of value in the real estate market. The worldwide discussion of the greenhouse effect is a public issue and the growing environmental awareness is gathering momentum. This awareness implies that there is a market for sustainable developed real estate within the real estate sector. Valuing these buildings comes with several problems and difficulties compared to green buildings. This paper examines the development of sustainability in Chennai commercial real estate from the valuer's perspective. Value in terms of commercial real estate is not certain because of the impact of green buildings in the real estate market. This qualitative research will take a closer look at both an existing price premium and the future expectations of a price premium for green buildings in Chennai & India. This is because the valuation factors used to determine the value of a sustainable property is very similar to that of traditional property. These factors are the same limited cause there are less number of green buildings in Chennai property market. The main factor being different from that of traditional

buildings is the lower operating expenses. By making extinction between buildings that are only tested on their energy use and buildings that are tested on multiple categories, the idea of what is commonly seen as 'green' changes. The state should because of this reason subsidize the development of green energy and buildings which use green energy, to make buildings really environmentally friendly on all fronts beside low energy use. The government intervention is taken into consideration the valuers may benefit something out of this rating or credit based system. Rainwater harvesting is mandatory in Chennai likewise if other energy efficiency features are made mandatory by the government the real estate sector can gain a sustainability factor and improve the value of the property. By changing the way we look at energy reducing buildings, we can estimate the real environmental benefit in a better way and develop more environmental friendly buildings where the pollution of buildings is weighted in its value. The actual objective is creating a better environment by less pollution and this research contributed to that by showing the advantages for investors to invest in green buildings.

Keywords: *Sustainability; Future generations; resources; commercial real estate sector; greenhouse; Chennai; Stakeholders; energy efficiency; policy*

Design of Perpetual Pavement as Sustainable Alternative to the Conventional Flexible Pavement: A Case Study- Guna to JUET Campus (NH-3), Madhya Pradesh, India

Anukrati Joshi[1], Sapana Jaiswal[2], Santosh Sharma[3] and Anuj kr.Yadav[4]

[123]Student, Under Graduate, Jaypee University of Engineering & Technology, Guna
[4]Assistant Professor, Department of Civil Engineering, Jaypee University of Engineering & Technology, Guna
Email: santoshsharma1feb@gmail.com

Abstract

The transportation infrastructure plays an important role to ensure the timely delivery of goods from origin to destination efficiently and it can be done by the various modes available for the movements. Out of all these modes door to door connectivity is possible by the roads only. The aim of this study is to compare the design of existing flexible pavement based on the conventional approach of Indian Road Congress Method (IRC) with the latest advances in pavement technology by utilizing proper strength of materials to make it sustainable for longer duration. In flexible pavement the total pavement structure "bends" or "deflects" due to traffic loading. With the help of these methods, the thickness of various layers of flexible pavement will be calculated and compared. Flexible pavements are those in which bituminous (or asphalt) materials are used as a binding material. Flexible pavement are preferred over rigid pavement as they have a great advantage that these can be strengthened and improved in stages with the traffic growth. The flexible pavements are less

expensive in terms of initial investment and maintenance. This study includes data analysis of various flexible pavement designs and their estimation procedure.

Keywords: *Flexible Pavement; Perpetual Pavement; Indian Road Congress; Bituminous Material; Traffic Growth*

Risk Identification and Assessment for Public-Private Partnership Type of Highway Development Projects in India

Ravindra Shrivastava[1] and Ajaya M. Ramachandra[2]

[12]Assistant professor, National Institute of Construction Management and Research, Delhi NCR (Bahadurgarh)
Email: rshrivastava@nicmar.ac.in

Abstract

Infrastructure plays a paramount role in the economic growth of a country. Infrastructure investments in India have been growing on consistent basis. India has set an ambitious target of investing USD 1 trillion in infrastructure during the Twelfth Five Year Plan period. The Highway sector is critical for emerging economies like India due to existing infrastructure gap and enhanced transportation requirements. A completed highway projects have multiple effect on the economy. The Public-private partnerships (PPPs) are an effective and established strategy for procuring highway project however due to its long gestation contractual timelines, it is very sensitive in terms of risk sharing and contractual obligation between all the stakeholders. Although numerous countries have implemented PPPs for infrastructure development in recent years, not all projects have been successful. Most PPP failures result from inappropriate risk allocation and a lack of information on success factors in specific countries. In conjunction with the increasing growth, there are many types of potential risks that affect highway projects. Properly assessing risks (financial, governments political and construction), ensuring value for money and protecting the public (and end users') interests are essential in PPP highway projects. The objective of this paper is identification and assessment of all critical risk factors affecting the National highway development project in India. The detailed literature review specific to PPP and highway projects has been done to identify the critical factors influencing the National highway development projects under public private partnership. The data for this study will be gathered through a detailed questionnaire survey and further assessment of risk factors has been done. By knowing the critical risk factors through this assessment gives a better understanding in allocating them to parties/stakeholders involved.

Keywords: *Public Private Partnership; Optimal Risk Allocation; Life Cycle Perspective; Critical Risk Factors*

Performance of Concrete Using Waste Plastic Granules and Waste Tyre Rubber Chips as Partial Replacement of Fine and Coarse Aggregates

K. Srujan Varma[1] and L.V. Shiva Prasad[2]

[1]Assistant Professor, Department of Civil Engineering, KITS, Warangal, Telangana
[2]Student, P.G., Department of Advanced Construction Management, National Institute of Construction Management and Research, Pune
Email: shivaprasad.lv007@gmail.com

Abstract

This paper presents the behaviour of M30 grade concrete with partial replacement of fine and coarse aggregate with plastic granules and waste tyre rubber, cubes, cylinders and beams were cast with varying percentages of plastic granules(0%, 5%, 10%, 15%, 20%, 25%) and waste tyre rubber chips (0%, 5%, 10%, 15%, 20%, 25%) by volume of fine and weight coarse aggregates, compression test, split tensile test and Flexural tests were performed on the test specimens and it was found that the strengths gradually reduced upon increase of the percentages of plastic and tyre rubber and up to 20 percent gave desirable strength.

Keywords: *Plastic Granules; Waste Tyre Rubber Chips; Compression Test; Split Tensile Test; Flexural Test*

A Case Study on Wastage Consideration in Building Interior Projects

Murali Jagannathan

Assistant Professor, School of Construction Management, National Institute of Construction Management and Research, Pune
Email: mjagannathan@nicmar.ac.in

Abstract

In the age of increasing Foreign Direct Investments (FDI), business houses in India are developing swanky office spaces with high end finishes meeting international standards. Small time interior finishing contractors are now entering into mainstream contracts with major clients in order to deliver high end finishing solutions. This has necessitated having in place, an effective contract management process within the organizations of owners and building interior contractors. Building interior projects are more vulnerable to disputes than the projects that involve pure civil works because of a) interfacing issues with other trades b) an individual's perception about the appearance that may lead to frequent changes in colour, texture, orientation etc. c) financial strengths of small time contractors and d) the very nature of materials involved in high-end interior works which are fragile, expensive and generally imported. These additional complexities add another dimension to the task of managing such contracts. This case study illustrates one such scenario that revolves around an issue pertaining to consideration of wastage in the bill of quantities. The learning from the

case would help us to understand the subtle complexities involved in managing building interior projects.

Keywords: *Interior; wastage; quantity; rate; building*

A Feasibility Study on Public Water Transportation System within Pune City – A Smart City Initiative for Urban Infrastructure Development

Tapash Kumar Ganguli [1], Akash Lunkad [2], Pulkit Bansal[3] and Shweta Singh[4]
[1]Senior Professor and Dean Executive Education, National Institute of Construction Management and Research, Pune
[234]Student, National Institute of Construction Management and Research, Pune
Email: tapashganguli@gmail.com

Abstract

To accelerate the economic growth and to create sustained business environment the country needs to demonstrate the leadership in public water transport system like other modes of transport. The water transport is the cheapest mode of transportation system in the world. It is fuel efficient, environment friendly and cost effective. It has the potential to supplement the overburdened rail and road transportation in Indian context. This study carried out with the cooperation of Pune Municipal Corporation (PMC) to check the feasibility of public water transportation in Pune city as a drive towards smart city initiative for lessening the burden on road transport system. The literature study includes a brief review of current water transportation system followed by interviews conducted of the stakeholders based on structured questionnaire as a part of primary data collection and analyzed using Microsoft Excel. The findings reveals that water transportation can be considered best suited for reaching many corners of Pune city. Though initial investment is high but operational cost is very low, eco-friendly, feasible and will attract tourist. The PMC will also earn good revenue from the riverside development. While the present feasibility study is preliminary and exploratory in nature, it may not necessarily reflect the entire project life cycle including the final costing of the project. Further work to be initiated to get all these details. PMC has encouraged for carrying out this feasibility study as a part of Smart City Initiative and this study is expected to help PMC to think through in this direction.

Keywords: *PMC; Public Water Transport; Feasibility Study; Smart City*

Study of Cost Estimation Model for Plant Equipment – A Case Study of Water Treatment Plant

P.M. Deshpande

Senior Associate Professor, National Institute of Construction Management and Research, Pune
E-mail: pdeshpande@nicmar.ac.in

Abstract

In engineering project environment the cost estimation in required for different phases in project cycle for feasibility, detailed project report, tender biding and contracting. The cost estimate is the most needed to take the decisions. A viable estimate should also be produced with consistent definitions and a repeatable estimating process, is a need of engineering project cost estimation. This cost estimation should satisfy effort/cost, time schedule, risk, and needs to be reliable. In engineering projects, the cost of plant and machinery is a major cost and varies from 40 to 65 percent of total project cost depending on the technology, automation and type of project. The parametric cost estimation model is the solution to satisfy the different need of estimation. The parametric model for cost estimation based on equipment sizing and specification is an effective approach for cost estimation. The size of equipment is the result of the capacity of plant, this helps in estimating project cost for different plant capacities. Secondly, the engineering design information details are time dependent in project cycle; however, the estimation needs to be fairly accurate. The cost estimation based on parametric model is a solution for repetitive estimation in various project stages. This paper elaborates the principle and application of parametric model with the case study of water treatment plant.

Keywords: *Cost Estimation; Parametric Model; Project Cost*

Application of Lean Management Tools on Construction Project

Agarwal A. L.[1] and Rajput B. L.[2]

[1]Senior Professor and Dean-SODE, School of Construction Management, National Institute of Construction Management and Research, Pune
[2]Assistant Professor, School of Construction Management, National Institute of Construction Management and Research, Pune
Email: anilagarwal@nicmar.ac.in

Abstract

Construction activities remain in limelight for their chronic problems such as low productivity, inferior working conditions, poor safety, increased accidents, compromising on quality etc. In construction, lots of non-value adding as well as waste generating activities are practiced and many among those are left unnoticed or unattended. To improve project performance, tools like benchmarking, best practices, just-in-time (JIT), value engineering, re-engineering, lean management etc are evolved and successfully implemented in the manufacturing sectors. Many of these tools are

picked up from the production activities, modified as per requirement of the construction activities and implemented with positive results. The introduction of the concepts and framework of lean ideology is seen as an opportunity to address the existing problems of construction activities. This paper reviews various lean construction tools which can be used on construction project sites for improved performance. The review concludes that different tools like Last Planner System (LPS),Increased visualization, Huddle meetings, Deming cycle (Plan, Do, Check and Act (PDCA) cycle), Five 'S' can be used on sites.

Keywords: *Lean Management; Construction Project; Productivity; Process Improvement*

Study and Analysis of Land Use Models and its Application in Context of Pune City

Sharath N[1], Diksha Sharma[2], Harsha Mallampalli[3], Manjiri Patil[4], Ronit Sancheti[5], and Shekhar Nagargoje[6]

[12345]Student, REUIM, National Institute of Construction Management and Research, Pune

[6]Assistant Professor, National Institute of Construction Management and Research, Pune

Email: snagargoje@nicmar.ac.in

Abstract

Urban sprawl is characterized by an unplanned and uneven pattern of growth driven by multitude of processes leading to inefficient resource utilization. In India, urban planning emphasizes spatial land use planning but, it has to gain momentum for recognition of social and environmental dimensions. Unplanned and unorganized growths of towns and cities and limited civic amenities have created the need for continuous monitoring of the phenomenon of growth, thereby analyzing and mapping its pattern. It is of great concern to urban administrators and planners to provide basic amenities and infrastructure for the complex urban environment. The scope of this work is to analyze the current land use scenario with respect to the dynamic relationships among various land use patterns of Pune city. The rapid urbanization of Pune city has led to service level gaps in Urban Infrastructure and its social and environmental impact. An analytical characterization and measurement of the urban sprawl are required to gain better understanding of the phenomenon. Several urban sprawl models and strategies that have been proposed and implemented across the globe are studied and analyzed depending on the impact factors of a considered region. Hence the sprawl factors of the Pune city shall be determined through detailed study that will be carried out based on non-spatial data and assessment of different land use models.

Keywords: *Urban Sprawl; Land Use Models; Spatial Analytics*

Causes and Solutions of Traffic Congestion: A Case Study of Mahalaxmi Temple Area in Kolhapur, Maharashtra

Hrishikesh Khamkar[1,] Pranil Desai[2] and Vinay Mohan Agrawal[3]

[12]Student, School of Construction Management, National Institute of Construction Management and Research, Goa

[3]Assistant Professor, School of Construction Management, National Institute of Construction Management and Research, Goa

Email: hrishikeshkhamkar9@gmail.com

Abstract

Densely populated areas in any city are now-a-days facing a problem of traffic congestion throughout day. Places of religious importance attract more traffic than any other place. Allocation of adequate parking spaces and systematic traffic regulations can reduce the traffic congestion and accidents. A similar issue of traffic congestion is faced everyday by famous Mahalaxmi Temple Complex in the Kolhapur city, Maharashtra since long time. This temple is very famous and attracts thousands of tourists. Traffic congestion reaches the peak during any Hindu major festival celebration in the temple. In this paper, traffic congestion problems and its implications are analyzed by performing various traffic studies around all roads near the temple complex. Traffic and parking study was conducted on all roads approaching towards the main temple complex and it was observed that on many roads, traffic congestions can be decreased by just implementing certain changes in the traffic flow rules. Based on all traffic data, this paper identifies causes and suggested measures to reduce traffic congestion in the area.

Keywords: *Traffic Congestion; Traffic Study; Parking Space; Project Area; Traffic Data; Kolhapur City*

Modelling and Simulation of Earth Air Tunnel Heat Exchanger

M. Mubashshir Naved[1] and Amol M. Andhare[2]

[1]Research Scholar, Shri Ramdeobaba College of Engineering and Management, Nagpur

[2]Assistant Professor, Department of Mechanical Engineering, Shri Ramdeobaba College of Engineering and Management, Nagpur

Abstract

The Earth Air Tunnel Heat Exchanger (EATHE) is an efficient technique used to reduce the cooling load of a building. In the past years, many researchers had developed analytical and numerical models for the analysis of EATHE systems but were unable to recast into design equations and had used the trial-and-error method for the analysis. This paper focuses on modelling and simulation of the EATHE system for the geographical conditions, with average day temperature ranging from maximum 45°C for Nagpur [21.14° N, 79.08° E]. The method to calculate the Earth's Undisturbed Temperature (EUT) and more recently developed correlations for friction factor and Nusselt number

are used to ensure higher accuracy in the calculation of heat transfer. The developed equations can be utilized to calculate heat transfer, convective heat transfer coefficient, and length of pipe of the EATHE system. A longer pipe of smaller diameter buried at a greater depth with lower air flow velocity results in increase in performance of EATHE. In this paper a simple Excel based mathematical model has been developed in order to design the EATHE. This model helps in determining characteristic dimensions, air flow rate, selection of blower and economic investments in an EATHE system.

Keywords: *Earth Air Tunnel Heat Exchanger; Effectiveness of EATHE; Nusselt Number; Cooling Load; Pressure Drop*

Interior Design Value Addition: Potential and Perception

Anurag Gogna[1] and Nidhi Bindal[2]

[1]Assistant Professor, National Institute of Construction Management and Research, Delhi NCR (Bahadurgarh)
[2] Assistant Professor, Interior Architecture and Design, Pearl Academy, Noida (Delhi NCR)
Email: agogna@nicmar.ac.in

Abstract

'The Value of Design Fact finder report shows that in the UK, a rapidly growing business extracts more value from design than other business'. Design is often understood as having twin aspects of form and function dealing with beauty and utilitarian requirements of a space respectively. While form creation remains an aesthetic exercise and function generation remains a problem-solving exercise, the coming together of the two results in designs which are more than just beautiful forms and well thought of functions. This addition that leads to an enhanced experience and 'perception' of space, which we would like to call 'value' is being explored through this paper. Elaborating on design as a problem-solving process that results in a holistic solution, which when implemented helps solve or mitigate the initial problem, design processes can be classified into two broad categories based on the degree of stakeholder participation. First category, for the sake of this study and discussion can be called 'absolute' where the design is done by a team of consultants in isolation and user is not involved. For example, a more common problem, like solving the issue of having a hand-held writing device in the form of pencil design, a device that allows to cross water bodies like boat etc. This is the process followed in most of the design fields. The second category can be termed as 'customised' design where design is done in consultation with the end user. This is generally the case for the field of interior design. Both the designer and end user work in close coordination with each other, to finalize the solution. While it is relatively easier to judge the design value of a product which is a resultant of an absolute design process, based on the success of product being judged by its likability, marketability, economic success, widespread acceptance etc., establishing design value

of a product which is a resultant of customised design process is a little tricky. Through this research work, we attempt to understand the potential of adding value to the product (represented as interiors) through design. Also, if the potential matches the perception of the user and if not, what can be done to enhance the perception. For understanding these, we document the process and stakeholder involvement that is being used in the interior design industry in the design development process. Typically, the stakeholders involved in the design process include the consultants (i.e. the interior design, MEP services designers, and project management organizations etc.) and the clients (the landlord, and tenant etc.). Post analysing the process being used to understand the client requirements and finalize the design thereafter, a questionnaire survey will be carried out with the identified stakeholders. The questionnaire revolves around the aspect of value addition that the consultant feels they bring on board and the client side response to the same. This will enable us to identify the communication gap, if any that exists between the two sides. Then, from the responses received, where this gap is perceived to be minimum will be taken up as a detailed case study to understand the potential features of such engagement which led to a higher value addition in the whole design process. This study will assist both sides, by increasing the overall value potential provided by the consultants and value perceived by the clients in their future projects.

Keywords: *Building Interior Projects; Interior Design; Value Perception*

Alternatives to Conventional Air Conditioning Systems – A Review

Tushar S. Jadhav[1], Rahul M. Deshpande[2] and Mona N. Shah[3]

[1]Assistant Professor, National Institute of Construction Management and Research, Pune
[2]Associate Professor, National Institute of Construction Management and Research, Pune
[3]Professor and Dean –SOPRIM, National Institute of Construction Management and Research, Pune
Email: tjadhav@nicmar.ac.in

Abstract

The necessity of air conditioning for comfort and process applications is increasing at an exponential rate for the past few years and this trend is likely to continue in the coming years. Sustainable, affordable, green, smart and low carbon cities are the few terminologies that are gaining a lot of importance in the current and future projects across the globe. The outcome of all these terminologies is to have systems that are environment-friendly, sustainable and with lower life cycle cost. The present study reviews the possible alternatives to conventional air conditioning systems. The emphasis is laid on comparing the technologies that are superior in terms of parameters such as energy efficiency, initial and operating cost, space requirements, maintenance, etc. The scope of the work is limited only to Indian climatic conditions. Alternative technologies such as single stage evaporative cooling, two stage evaporative cooling, displacement ventilation and radiant cooling are

discussed in the present research. These alternatives to conventional air conditioning systems offer promising options towards achieving low carbon air conditioning. The outcome of this study gives an insight towards selection of alternative air conditioning systems which offer better results compared to conventional air conditioning systems. The paper assumes significance in light of the increased use of air conditioning and its resulting adverse effects on the city's sustainable ecosystem.

Keywords: *Low Carbon; Air Conditioning; Energy Efficiency; Alternative Technologies*

Housing Price Dynamics – An Empirical Evidence from India

Vandana Bhavsar[1], Harish Sundararaman[2], Nirmal Yemde[3] and Akshay Daga[4]

[1]Associate Professor, National Institute of Construction Management and Research, Pune
[234]Student, Real Estate and Urban Infrastructure Management, National Institute of Construction Management and Research, Pune
Email: vbhavsar@nicmar.ac.in

Abstract

With the aim to study the interrelationship of the housing markets in India, the present study empirically examines various demand side and supply side macroeconomic factors affecting house prices in the short run and long run. This study investigates the causal relationship between house price and macroeconomic variables in India using quarterly data (2009Q1:2016Q2). The case of India is intriguing and suitable, as the Indian economy is passing through a rapid phase of urbanisation combined with positive demographics, rising income levels, and increasing number of metropolitan cities in the recent past. The paper tries to explore – "what macro factors explain housing prices?" and consequently redressing gap in the extant literature. The results of the Autoregressive distributed model indicate that all variables are co-integrated in the long run. Findings suggest that private final consumption expenditure and construction cost are significantly related with house price in the long run and short run. However, housing loans affect house price in India in the short run only. Interestingly, inflation affects positively the house prices in the short run, whereas in the long run it affects negatively the house price. The findings hold significant implications for policy makers, government and investors since the enhancement of knowledge about the house price dynamics and working of housing markets in the country would help formulate housing policies at the macro level.

Keywords: *House Price Index; Private Consumption Expenditure/Gdp; House Loans; Granger Causality*

Risk Assessment for a BOT Highway Project

K.Srinivas[1] and Y.S.Kiranmayi[2]

[1]Assistant Professor, National Institute of Construction Management and Research, Hyderabad
[2]Professor, Director (CIQA & DEB), Dr. B.R.Ambedkar Open University, Hyderabad
Email: k_srinivas@nicmar.ac.in

Abstract

The role of infrastructure in the overall development of a nation cannot be underestimated. The infrastructure sector is subjected to a plethora of risks. Risk management needs to be given adequate attention for achieving the objectives of a project. Project sites where good risk management practices are implemented derive maximum advantage by way of managing risks. Considering this, a study has been carried out for a completed project executed in the state of Telangana (India) under NHAI. The study was carried out by administering a questionnaire to 150 respondents and the responses received were 65 (44%). The respondents were asked to identify the risks in four phases of a project namely Feasibility phase, Development phase, Execution phase and Operation phase and also the probability and impact of each of the identified risks. The severity of risk was determined based on the probability of occurrence of risks and consequence of identified risks and was categorised accordingly. The consequence of risk indicates the extent to which the project is exposed to that particular risk and the mitigation measures need to be taken accordingly to minimise the effect of risk. The implementation of good risk management practices resulted in cost and schedule underrun which is quite remarkable for an infrastructure project.

Keywords: *Risk Assessment; Probability; Consequence; Risk Severity; Risk Mitigation*

Factors Affecting Productivity in Indian Construction Sector

Santhosh Kumar[1], Sachin Batra[2] and Jai Sai Tenepalli[3]

[1]Alumnus, ACM, National Institute of Construction Management and Research, Indore
[2]Assistant Professor, National Institute of Construction Management and Research, Delhi NCR (Bahadurgarh)
[3]Assistant Professor, National Institute of Construction Management and Research, Pune
Email: sbatra@nicmar.ac.in

Abstract

It is significant for the contractors, clients, and consultants to check the productivity levels for construction jobs, as this, in turn, will help to estimate the time and cost of the construction projects. The productivity rates vary considerably based on the complexity of the structure, project site constraints, and other technical, managerial, social and cultural factors, etc. Predicting the effect of these factors will improve the ability of the stakeholders for optimal utilization of resources. This research, therefore, aims to estimate the most significant factors that affect the productivity of the main construction activities namely: excavation, formwork, reinforcement, concreting, block work,

plastering, and tiling. The research focuses on the construction industry in India. An extensive literature review was carried out on construction productivity which led to the identification of two factors affecting productivity: External (Environmental) and Internal (Organizational, Group, and Individual) factors. A questionnaire was used as a survey instrument to collect data. The study was conducted to establish the significant factors affecting productivity in Indian construction industry. The results revealed that the critical factors which affect productivity were Timings, Competence of Supervisors, Salaries, Materials, Systems and Procedures, and Group Dynamics.

Keywords: *Productivity; Environmental; Organizational; Group; Individual*

Impact of REIT on Indian Real Estate Market: An Industry Perspective

Shekhar Nagargoje[1], Rushikesh Girwalkar[2], Channappa Rajanal[3], Shubham Sahu[4], Roopesh Bhosle[5] and Kavin Sagar P[6]

[1]Assistant Professor, National Institute of Construction Management and Research, Pune
[23456]Student, National Institute of Construction Management and Research, Pune
Email: Roopesh24@yahoo.com

Abstract

Real Estate Investment Trusts or REITs, is a corporation or a business trust that combines the capital of many investors to acquire or provide financing for various real estate assets. REITs invest primarily in completed, revenue generating or income producing real estate assets and distribute a major part of the earning among their investors. It also deals with the study of the working mechanism of how REITs operate and the structure of REITs. The Finance Minister of the Government of India, Mr. Arun Jaitely, through the Financial Act, 2014, introduced tax incentives for the incomes and gains generated from investments made in REITs. Since then in India, we have come across various discussions referring to REIT. Though this concept is new to the Indian investor community, REITs have been operating in the United States since 1960 and so in Singapore, Australia and Hong Kong. The main focus of this paper is to study the impact that REITs have on various economies around the world and forecast the impact of REITs on the Indian Real Estate Market.

Keywords: *REITs Impact; REITs Forecast; REITs Benefits*

Energy Efficient Buildings through Water Conservation Measures

Avadhoot Vidyadhar Dixit

Assistant Professor, National Institute of Construction Management and Research, Pune
Email: adixit@nicmar.ac.in

Abstract

India's National Action Plan on Climate Change (NAPCC) under the Ministry of Environment, Forest and Climate Change (MoEFCC) has 8 national missions. Solar mission and energy efficiency are the foremost key points undertaken by the NAPCC. The mission believes that conserving energy and implementing measures for utilising energy should be ritual in everyday lives for us. Energy efficiency can be greatly achieved in residential, commercial and industrial buildings. LEED, IGBC, GRIHA are some of the organisations promoting energy efficiency. The current paper focuses on achieving energy efficiency in a residential building by way of water conservation. The paper takes a case of a building in India and proposes water conversation measures by use of special plumbing components which conserve water from taps in high rise buildings. This directly reduces the amount of water running down from taps. Less water from taps means less water required in the Over Head Water Tanks (OHWT). It signifies that less water needs to be pumped in the OHWT from the Under Ground Water Tank (UGWT). Thus, the energy required for pumping will be less. Moreover, use of solar panels for generating electricity and using it for pumping water from UGWT to OHWT will help save energy to a great extent making the building green and energy efficient. It is believed that the water conservation measure and use of solar energy for the pumping system is likely to conserve water by more than 20%. The paper then analyses the amount of energy saved in this energy efficient building. Thus, energy saved leads to reduction in CO_2 emissions adhering to the principles of climate change under the NAPCC.

Keywords: *Energy Efficiency; Water Conservation; Plumbing*

Layout Planning and Building Design for Low Carbon Buildings- A Review of Literature

Priyanka Bendigiri[1] and Mona N. Shah[2]

[1]Assistant Professor, National Institute of Construction Management and Research, Pune
[2]Professor and Dean, National Institute of Construction Management and Research, Pune
Email: pbendigiri@nicmar.ac.in

Abstract

Emission of greenhouse gases has been identified as the greatest challenge facing the human society with carbon dioxide (CO_2) as a major greenhouse gas. Most of the CO_2 emissions are associated with energy use in buildings and there are active as well as passive techniques to reduce this energy use. Mitigation policies are laid out to reduce the greenhouse gas emissions while adaptation policies are

laid out to cope up with the climate change. Designing buildings and layouts is a passive way to mitigate the climate change by reducing the greenhouse gas emissions. The present paper identifies the principles of layout planning and designing at a community level that can help less energy consumption in buildings resulting into less carbon emissions. It looks at global cases of communities that have been effective in the reduction of GHG emissions using effective policy intervention.

Keywords*: Low Carbon; Layout Planning; Building Design; Less Energy Consumption*

Evaluating Open Access in the Indian Power Sector Using the Transportation Model

Milind Jagtap

Associate Professor, National Institute of Construction Management and Research, Pune
Email: milind@nicmar.ac.in

Abstract

Power is a key resource for the development of Infrastructure assets in India. The Indian power sector has witnessed a significant turmoil over the last two decades. It has been providing significant amounts of subsidy to the domestic and agricultural consumers known as Low Tariff (LT) consumers, since long. This conservative strategy of the power sector largely compromised competition in the sector due to the provision of subsidy to the LT consumers. This kind of cross subsidy entails recovering more revenue from the industrial and commercial consumers known as High Tariff (HT) consumers, to make up for the loss of revenue to provide subsidies to the LT consumers. The cost of supply of electricity is the major decision variable. The LT consumer pays subsidized tariff of about 50 to 60 percent of the cost of supply and the HT consumers pay hefty tariffs of about 170 to 180 percent of the cost of supply. In order to encourage competition in the sector, a non-discriminatory open access to the power is allowed for the consumers, wherein it can switch over to a low cost power supplier. This calls for reducing the subsidy to LT consumers and introducing surcharge on HT consumers for the switch over to the new discom licensee. The economics of open access system are demonstrated using the transportation model, applied to the power scenario of the state of Maharashtra. The solution reveals an interesting thought process to practise open access in the power sector.

Keywords: *Cost of Supply; Subsidy; Surcharge; Tariff; Open Access*

Exploratory Analysis of Clean Development Mechanism (CDM) Projects in India

Avneet Singh[1], Isher Kaur[2], Mohsin Patel[3], Prachi Khandelwal[4] and Abhijat Arun Abhyankar[5]

[1234]Student, REUIM, National Institute of Construction Management and Research, Pune
[5]Associate Professor, National Institute of Construction Management and Research, Pune
Email: aabhyankar@nicmar.ac.in

Abstract

Climate change and global warming instigated by human activities in the past century have inadvertently disturbed the ecosystem and atmosphere of planet Earth leading to global occurrences of glacial retreat, accelerated sea level rise, more intense heat waves, food security, and irregular weather patterns. With the view to counter climate change, different steps taken globally focus more on renewable forms of energy. Clean Development Mechanism (CDM) is one of the three mechanisms adopted by the Kyoto Protocol which enables countries with carbon emission reduction commitment to implement the emission reduction projects in the developing nations. An exploratory analysis of all the registered projects is performed in the present study under CDM in India. It brings an insight into the various trends concerning locational analysis suited for a specific sector. The data for the study is extracted from the United Nations Framework Convention on Climate Change (UNFCCC) website. The top three states contributing to the major CDM projects in India are Tamil Nadu (277), Maharashtra (258) and Gujarat (226). The major contributing sectors to CDM projects are Energy Industries distribution (renewable/non-renewable). It was found that the number of projects in coastal and non-coastal states was different but the mean reduction was almost similar. Another finding of the study was that the number of projects across different sectors was location dependent.

Keywords: *Clean Development Mechanism; Joint Implementation; Emission Trading; United Nations Framework Convention on Climate Change; Kyoto Protocol; Statistical Analysis*

A Stylo-linguistic Analysis of Construction Contracts: A Review

Amit Hiray[1], Anirudh Koneru[2], Saicharan[3], Leela Krishna Yallamauchilli[4], Pramod Koppada[5] and T. Durga Sai Teja[6]

[1]Assistant Professor, National Institute of Construction Management and Research, Pune
[23456]Student, School of Advanced Construction Management, National Institute of Construction Management and Research, Pune
Email: hirayamit@gmail.com

Abstract

Construction contracts are a significant element of professional written and interpersonal communication in the construction sector. Although, there has been adequate research done on the various other genres of professional written communication, there is limited research evidence

available on the stylo-linguistic features of the language used in construction contracts. As these documents have a legal standing and subsequent impact on the professional interpersonal relationship among the stakeholders, it is imperative to examine the role the stylo-linguistic factors play in fostering or hampering this relationship. The euphonic or cacophonic tone, diction, syntactical compositions and semantic interpretations may influence the interpersonal communication positively or unfavorably. The stylo-linguistic analysis amalgamates the stylistic and linguistic analyses to evaluate the stylistic and linguistic features of a text. This paper reviews the available literature to measure the extent of work done in this context and attempts to identify the gaps, and proposes a conceptual framework for the stylo-linguistic analysis of construction contracts.

Keywords: *Stylo-Linguistic Analysis; Construction Contracts; Review; Conceptual Framework*

Vendors Rating System for Procurement of Materials - A Case Study on Metro Rail Project

P. Muralidhar[1] and SVS Raja Prasad[2]
[12]Associate Professor, National Institute of Construction Management and Research, Hyderabad
Email: muralidhar@nicmar.ac.in

Abstract

Procurement of materials for execution of construction projects is a challenging task. Much of the project cost is incurred towards procurement of materials in construction activities and substantial amount of working capital is locked up in the procurement process. Identifying the factors influencing the selection of vendors will assist the procurement department in placing the orders. The savings in materials cost will enhance the profit to the project. The present study is carried out at Metro Rail Casting Yard in the area of materials management. The vendor rating practices adopted in metro rail projects are different from other construction projects. The objective of the study is to delineate the vendor rating practices at a casting yard, classification of material and prioritizing the vendors based on organizational requirements and modifying the procurement process. The purpose of vendor rating is to minimize the delays, reduce the cost of procurement and identify the suitable vendors for a metro rail project. The fuzzy dematel method is adopted in rating the vendors for supply of materials in a metro rail construction site in India.

Keywords: *Procurement; Materials Management; Vendors Rating; Fuzzy Dematel*

Communication Plan for the Real Estate (Regulation and Development) Act, 2016 for Promoters to Resolve Unseen Consequences after Commencement of Work

Kalyani Amol Salvi
Faculty, Hiray College of Architecture
Email: kalyaniamols@gamil.com

Abstract

The Real Estate (Regulation and Development) Act, 2016 includes the requirement of fulfilment of information by the promoter for registration and disclosure of project data, documentation of real estate projects at different phases from commencement of work to formation of the legal entity. It emphasises accurate information from the Project Architect, Engineer and Chartered Accountant. During these stages of collection and documentation of information, if the data referred to is wrong or mistaken then the consequences are time consuming and aching for the RERA process of registration. If it is applied from top to bottom of the organisational tree of a real estate project, it will prove to be more efficient to demonstrate effectiveness of RERA registration. There is a necessity to study this registration process and duly filled forms mentioned in the sections of RERA according to its well-designed, practical application in a real estate construction project to reflect proposed and actual figures of cost and areas as same. The objective of this research is to find out communication technology and methods to develop an information management system through accurate documenting and reporting to the authorized person from one level of organization tree to the other level within an ideal timeframe. This can be structured from anticipated case studies of a mock real estate project of medium scale where this kind of studied communication is desirable to process RERA from the commencement of a real estate project within its desirable timeframe for the promoters to prove its convenience. The developed communication plan from this managerial research will show the type and purpose of information, format, frequency and responsible person for each given figure will guide the promoters for the RERA process.

Keywords: *RERA; Promoter's Registration under RERA; Communication Plan for RERA; Achieving Desirable Timeline; Practical Guidelines for Collection of Data*

Load-settlement Behaviour of Soil using Geosynthetic: A Review

Chimmani Krishna Vamsi[1], Krishna Sri Tirumal K[2] and Neeraj Chaudhary[3]
[12]Student, Amity University
[3]Assistant Professor, Amity University
Email: kkchimmani@gmail.com

Abstract

This paper discusses the influence of properties of the soil fill on the load-settlement behaviour by reinforcing the soil with the geosynthetic layers below the foundation at different depth levels. In

recent years, soil improvement is required to fulfil the desirable shear strength of the soft cohesive soils to satisfy the need of various construction activities on the sites underlain by pockets of loose soil. Geotextiles, the permeable fabrics when used along with the soil have the capability to separate, filter, drain and reinforce. The present work of investigation shows the use of various geosynthetics in order to improve the load-settlement behaviour. The coarse sand columns encased with the geotextile is the most effective way to reduce settlement and improve bearing capacity.

Keywords: *Load-Settlement Behaviour; Geosynthetics; Geotextile*

Studies on Surface Coatings of Concrete under Marine Environment

Shivaditya Akula
Student, Advanced Construction Management, National Institute of Construction Management and Research, Pune
Email: shivaditya1995@gmail.com

Abstract

The effect of surface coatings on concrete protection against a chemically aggressive environment was evaluated. Three surface coatings 1) Coal Tar Epoxy 2) Cashew oil 3) Acrylic coating, were applied on concrete surfaces. The protection was measured by the tests related with chemical resistance. The Chloride penetration, Carbonation effect, Compression and weight loss tests were used. Surface treatment acts as a barrier between the environment and concrete surface. This work intends to contribute to better understanding of the performance of surface coated concrete in the chemically aggressive environments by permitting results of Chloride content, Carbonation effect, Compression and Weight loss of several coated specimens. The performance of used coated concrete against the chemically aggressive environments was generally better than the performance of the uncoated concrete. The results indicated that the overall performance of the Cashew oil was better than the other used coatings.

Keywords: *Surface Coatings; Chemically Aggressive Environment; Coal Tar Epoxy; Cashew Oil; Acrylic Coating; Chloride Content Test; Compression Test; Carbonation Effect; Coated Specimens*

Challenges Faced by Today's Construction Project Manager in India

Sunkara Sai Teja
Student, MBA-Construction Project Management, RICS School of Built Environment, Amity University, Mumbai
Email: sunkarat.mc17m@ricssbe.edu.in

Abstract

In developing countries like India, the construction industry has a strong growth rate where it faces many challenges from the initial phase of a project to the closing phase. Efforts have been made to

mitigate these challenges but not on a satisfactory scale, since some of the challenges are very new to the industry and some are years old. The challenges faced by the project managers in the construction industry alter with respect to the environmental conditions around the site, type of project and the technology used. In spite of all the above terms, there are some other terms like managerial skills of an individual which can immensely alter the challenges. As the construction industry maintains a key role in the development of our country's economy, there is a need for sustainable strategies to resolve these challenges faced by project managers, which will reduce the cost over-runs and hurdles in a project. The paper deals with the challenges faced by project managers in the construction site as well as in the non-construction site and some recommendations are made to resolve the challenges. The sources used for this study are desk-learning conference papers, articles in blogs, and self-experience from construction sites. The following are some of the major areas where project managers will face challenges in a project: characteristics of work, human resources, schedule constraints, health and safety, ecological concerns, legal issues, governmental laws, and socio-political pressures.

Keywords: *Construction Project Manager; Challenges; Characteristics of Work; Health and Safety; Ecological Concerns*

The Hyderabad Outer Ring Road (HORR) Project: A Case Analysis of the Project and its Success

Ramakrishna Nallathiga
Associate Professor, National Institute of Construction Management and Research, Pune
Email: nramakrishna@nicmar.ac.in

Abstract

It is somewhat well laid down that the infrastructure development projects undertaken by government agencies would require pooling large amount of technical, human and financial resources. After 2006, the private sector has been looked upon to overcome the resource constraints in the form of the Public-Private Partnership (PPP), which also leverages the strengths of public sector. For quite some time now, the PPP has been considered as the way forward mechanism to undertake the road infrastructure development projects in India. However, as the PPP projects are developed technically no different from conventional development projects, public authorities also point to the issues associated with PPP mechanism in terms of higher costs of project development associated with procurement, profit booked by private partner and potential costs of time-cost-quality issues. Yet, it is well argued that private participation makes a significant difference when it comes to project success in terms of different project dimensions. This paper is an attempt to make an analysis of project success by performing a detailed case study of Hyderabad Outer Ring Road

(HORR) Project. The salient features of HORR project are discussed in details in terms of project scope, structure, finance and implementation. The case analysis reveals that the HORR project, in spite of its good conception on strategic and technical grounds, met with implementation difficulties that affected project success, in terms of the conventional measures of time, cost and quality. Yet, it is hoped that the HORR project, with its broader concept of 'Growth Corridor', would give rise to long term benefits to Hyderabad metropolitan region that outweigh its costs. The paper concludes that urban road development projects under the PPP model in India need careful conceptualisation, detailing and implementation approach in order to become successful.

Key words: *Infrastructure development; Project Success; PPPs; Urban Road Project*

Design of a Low-cost Air Cooling System with Humidity Control by Refrigerated Water

Anupam Mondal[1], Balaram Debnath[2], Vishal Vidyarthi[3], Arijit Mula[4] and Sanchayan Mukherjee[5]

[1234]Student, Department of Mechanical Engineering, Kalyani Government Engineering College, Kalyani, West Bengal

[5]Associate Professor, Department of Mechanical Engineering, Kalyani Government Engineering College, Kalyani, West Bengal

Email: balarambkp@gmail.com

Abstract

The systems available in the market to control the temperature and humidity of premises are quite expensive and therefore out of reach of the majority of population of India. The need of the hour is to devise and implement low-cost equipment. The cost of an air conditioning unit can be decreased by combining two less costly units, i.e., an air cooler and a domestic refrigerator, so that the total cost can be minimized and it becomes affordable to more consumers. In this paper, a model combining the two is presented keeping the basic features of the individual units intact. The refrigerator can work separately without affecting its normal operation and the amount of water vapour within the moist air along with the temperature can be controlled, which is not possible by a normal air cooler. So this unit can be used effectively in hot and humid areas. Apart from that it can be used in dry seasons also when the system runs in air cooler mode. The difference of mass of vapour in outside and room air can be calculated from dry bulb temperature and relative humidity of respective conditions. This amount of vapour is to be condensed by rejecting heat, and that can be achieved by direct contact of outside air with chilled water from the heat exchanger, placed inside the refrigerator. This chilled water, the outside air and the room air will exchange enthalpy among them and condense desired vapour content from outside air, resulting in cooling and dehumidification. This new model can save considerable amount of total costs. The variation in performance of the system with different parameters is also presented to show the sensibility of the system.

Keywords: *Air Conditioning; Refrigerator; Air Cooler; Heat Exchanger; Cooling and Dehumidification*

Use of Crushed Waste Glass in Airport Runway Pavement

Ankit Agarwal[1], Yash Shah[2], Aditya Patel[3] and Vaidehi Jain[4]
[1234]Student, Department of Civil Engineering, School of Engineering & Technology, Navrachana University, Vadodara
Email: 14103006@nuv.ac.in

Abstract

In last one decade air traffic in India has increased by multiple folds. Considering the above fact, Indian government has decided to have at least one airport in every district in India. Airport design and eventually runway design has become an important aspect in the growing airport industry. This paper focuses on the reuse of waste glass as a raw material in top layer of asphalt runway and presents the results of the research thus undertaken by the authors. The main objective of the research study was to focus on the use of very finely ground waste glass as a raw material and if possible find out the best proportion of waste glass that produces satisfactory results that surpass the standards laid down by respective authorities.

Keywords: *Airport Runway; Pavement; Top Layer; Bitumen; Waste Glass*

The Utility Brokerage Model: An Innovative Business Model for Government Utility Services under Public Private Partnership

T. G. K. Vasista[1] and Mohamed A. T. AlSudairi[2]

[1]Associate Professor & Academic Adviser, Department of Civil Engineering, Construction Engineering and Management, Kakinada Institute of Technological Sciences, Ramachandrapuram
[2]Professor, Management Information Systems, College of Business Administration, King Saud University, Riyadh, Saudi Arabia
Email: tgkvasista@gmail.com

Abstract

The service quality of urban engineering services such as water supply, sanitation, gas and electricity services have gradually deteriorated across India in contrast to the increasing contribution of these areas to the country's Gross Domestic Product (GDP). Public Private Partnerships (PPP) are emerging as a promising model for improving municipal services delivery. However the government business interaction continues to involve excessive transaction costs. Thus not all public private partnerships are beneficial to the society. Although PPPs have been viewed as a framework for describing inter-sectoral co-operative ventures between government/public and private sector, little attention has been paid in previous researches in finding a suitable e-business model to conduct the public service effectively and efficiently. The objective of this paper is to propose an innovative model called Web based Utility Brokerage Model out of the existing models for the utility sector

under Public Private Partnership. The purpose of this study is to build theoretical framework on finding the influence of proposed model on Public private Partnership strategy and people.

Keywords: *Business Model; Government Utility Services; PPP; Utility Brokerage Model*

Real Estate Project Investment Strategy in Context to Market Timing and Developer Experience

Jigar Vikram Pandya[1] and Vikram Patel[2]

[1]Research Scholar, Kadi Sarva Vishwavidhylaya, KSV University, Gandhinagar
[2]Professor, Adani Institute of Infrastructure Engineering, Ahmedabad
Email: jigarpandya18@gmail.com

Abstract

Real estate projects are difficult to time due to skewness in supply and demand. Real estate developers time their projects. There are multitude of factors which affect choice of project while choosing a location. Role of government planning body is critical as they decide on building byelaws such as setback, margins, shape and area of the land parcels allotted to the land owners using micro-planning tool; town planning scheme model. Early returns on investment is of utmost priority for every real estate developer since the returns are to be invested in a new project in an exapanding market when land values are on a rise. The study investigates a 15 year time cycle (2001 to 2016) in the city of Ahmedabad with stratified sample data of more than 200 completed real estate projects (residential and commercial) and inquires into the timing of project announcement in reference to the phases of market cycle, recovery, expansion, hypersupply and recession. A multiple linear regression analysis of the projects reveal interesting trend on decision making styles adopted by experienced developers as compared to new/amateur real estate developers. The key findings of the study reveal contrary to a popular belief a higher FAR does not impact project decision of location nor timing. Experienced real estate developers are likely to develop land located farther away from slums. High percentage of developers are likely to announce projects with larger land area in market conditions of expansion and hypersupply, away from slums and in relatively developed neighbourhoods. In the phases of recession, real estate developers tend to announce projects on poor locations, especially on land parcels with low yield value. The visibly intense market has deep rooted strategy of collective ethos that critically affects decision making on an investment and varying risk appetite of developers.

Keywords: *Real estate; Timing; Location; Developers; Ahmedabad*

Risk Factors Influencing Contractor's Price Bid in Construction Projects

Sahil Dhakla[1], M. Sagar[2], Bushpreet Singh[3], Y. Yogesh[4], Milind Phadtare[5]

[1234]Student, ACM, National Institute of Construction Management and Research, Pune
[5]Senior Professor and Dean – PGP, National Institute of Construction Management and Research, Pune
Email: mphadtare@nicmar.ac.in

Abstract

A multitude of factors influence the price offered by contractors for all projects; some factors tend to reduce the price (deflate) while some tend to increase the same (inflate). The study identified various factors impacting the bid price from the extant literature. Primary data was collected with the help of an undisguised and structured questionnaire administered personally for better response. Simple statistical tool was used for analyzing the data. Thus, the study identified the factors influencing the bid price of the contracting firm and also classified them into inflating and deflating factors in the Indian context.

Keywords: *Risk factors; Price; Bid; Contracting Firm*

Comparison of Risk Factors in BOOT and DBFOT Projects: A Case Study Approach

Indrasen Singh
Senior Professor and Dean, National Institute of Construction Management and Research, Goa
Email: isingh@nicmar.ac.in

Abstract

Public Private Partnership (PPP) is a well accepted alternative to develop roads and highway infrastructure development, where the government and private partner jointly contribute towards the construction of a new facility or up gradation and maintenance of the existing facility. Cost savings, risk reduction and improved performance are the aim of such partnerships. There are various project delivery models in PPP which are well recognized worldwide. The selection of right project delivery model contributes as an added advantage to time and cost savings and risk is reduced to a considerable extent. The projects undertaken by PPP route are either partly or wholly financed by debt leveraging revenue streams dedicated to the projects. Since such projects consume a long duration to complete and even more, the financial recovery may take 20 years or more depending on the scale of the project. The study focuses on the comparison of risk identification, assessment and allocation of two such modes of PPP namely BOOT and DBFOT. The cases of successfully completed projects executed through both the project delivery modes have been identified for an in-depth analysis and representation of the risks involved. A questionnaire was prepared consisting of comprehensive identification of the various risk factors involved in such projects. The questionnaire was floated across the various industry experts, academicians and professionals to identify the

severity and probability of the identified risk factors. Further, various risk mitigation strategies and effective project delivery model have been suggested for successful implementation of highway projects in the country.

Keywords: *BOT; BOOT; DBFOT; PPP; SPV*

Critical Complexity Factors in Client Contractor Relationships and Their Impact on Construction Projects

Kirti Rajhans[1], Ritika Pundhir[2], Ankitha J. Bharadwaj[3] and Dorothy Bhagabati[4]

[1]Associate Professor, National Institute of Construction Management & Research, Pune
[234]Student, National Institute of Construction Management & Research, Pune
Email: kirtirajhans@nicmar.ac.in

Abstract

The construction projects are always referred to as being complex and in recent years, along with the scale, the complexity of the construction projects is also increasing. As per Baccarini (1996), the construction process may be considered as the most complex undertaking in any industry. The construction industry faces immense difficulties in coping up with the increasing complexity in major construction projects. The reasons for the complexities in the construction projects have not been widely researched; yet it has been found that the process of construction and its contractual nature can in itself be thought of as a complex system. The Client and the Contractors are the two most important entities in any construction project. For the successful implementation of the construction projects, it is necessary to understand the factors creating complexity in client contractor relationships which further lead to more complexities in the entire construction process and have an adverse impact on the project life cycle. The present study aims to explore the critical complexity factors in client contractor relationships and its impact on the construction projects. The study, in this context, tries to examine various interpersonal, technical and situational factors leading to emergence of complexity in the construction projects during different stages of the project life cycle. The research is conducted on the basis of a detailed case study on the construction of A-Type School building of Kendriya Vidyalaya at Bagalkot, Karnataka, in which there are evidences of the above mentioned issues. After understanding the importance and effect of these issues on a construction project, a structured questionnaire was floated to the industry experts in order to validate the case study results and also to draw certain practical implications for future projects. The research findings provide recommendations to industry professionals for prevention of the emergence of complexities in construction projects. Also, remedial measures for better client contractor relationship and for the timely completion of projects are suggested.

Keywords: *Complexity; Construction Projects; Client Contractor Relationship*

Barefoot Model Village - Sittilingi

V. Rajeshwari
Student, SVS School of Architecture, Coimbatore, Tamilnadu
Email: rajislm.95@gmail.com

Abstract

This study addresses two main issues of current scenario of the construction industry, namely, lack of skilled labours for sustainable construction technologies and carbon dioxide emission due to the building industry. The economical growth of any country depends upon number of people in work and their productivity. Skills are the root of productivity. Efficient use of skills enables to do proficient work with increase in productivity. India is the second fastest-growing economy in the World and Construction industry is the second largest economic activity after agriculture. Presently, Indian construction sector is suffering from acute shortage of skilled labour and in the future situation will be more critical. As per a survey, about 83% of the workers are unskilled and majority of them are women. Training to worker is backbone for skill development. On the job training and certification methods are the measures to improve skill and employability factors**.** The quality of manpower influences success of the construction industry. India is known as the country of young people with median age of population being 24.6 years and one-third of the population is below 14 years of age. By 2025, India will be one of the youngest countries in the world. This demographic dividend can boost economic growth. By careful planning and efficient utilization of human resource, we will be ahead of developed countries within short time. But, the success depends on number of people in work and their productivity, which directly depend on their skills and how effectively those skills are used. Buildings alone are responsible for 38% of all human Green House Gases (GHG) emissions (20% residential, 18% commercial). It is the industrial sector which contributes the most to global warming. But according to the Intergovernmental Panel on Climate Change, it is also the sector which presents the most cost effective opportunities for the GHG reductions. GHG are released in the atmosphere during each stage of a building's life: Building construction, Building operation, Building renovation and deconstruction. The construction, renovation, and deconstruction of a typical building are on average responsible for the emissions of 1,000-1,500 kg of CO_2per m^2 (around 500 kg of CO_2per m^2 for the construction only). Depending on the region where the building is located and the building energy mix, operation emissions can vary from 0 to over 100 kg of CO_2per m^2 per year. The study identified a Village which is already developing towards self sustainable development for around 15 years. It is Sittilingi Village, Dharmapuri District, Tamilnadu, India. The study had tried to solve the above said issues for developing a sustainable village (Socially, Environmentally and Economically). Based on the study we propose an Institute of Humanitarian Living (An institute which teaches sustainable construction

technologies), a course on Life Academy (Agriculture and Economics College along with higher secondary school), and a Village Centre (Students & Public community discussion space).

Keywords: *Sittilingi; Productivity; Skilled Labour; Model Village*

A Study on Varying Provisions of Arbitration Clauses in Different Government Contracts in the Background of the Indian Arbitration and Conciliation (Amendment) Act-2015

Suman Gupta

Senior Engineer (Contracts), AFCONS Infrastructure Limited, Kolkata
Email: suman.juconst@gmail.com

Abstract

Alternative Dispute Resolution (ADR) is a cost-effective and time-saving remedy for resolution of commercial disputes. One such ADR remedy is Arbitration which refers to the settlement of disputes between parties to a contract by a neutral third party without consulting the court. The origin of arbitration in India can be traced in Ancient Hindu texts SMRITIS. It has also been used to resolve disputes during British Rule. Under the British Regime, a more specific arbitration act was enacted in 1940, as 'The Arbitration Act, 1940', the same was modified through an ordinance, post Independence. First comprehensive Arbitration and Conciliation Act came in effect in India in the year of 1996, as *The Indian Arbitration and Conciliation Act-1996 based* on UNCITRAL model. However, this act was also facing criticism from foreign and domestic arbitrator since it did not restrain timeline for the disposal of case and one of the main challenge was independence/ impartiality of the Arbitrator. Taking cognizance of the same and to make India an investment friendly nation Government of India made an amendment of the Indian Arbitration and Conciliation Act-1996. These amendments are based on the recommendation made by 246th Law Commission Report which came in to effect in Oct -2015. The heart and soul of the recent amended of Arbitration Act is the appointment of neutral, independent and impartial Arbitrators and restraining time period for disposal of case. Notwithstanding the enforcement of the Amended Act, the major Government contract clauses for arbitration appear not to be in consonance with provision of the Act with regard to appointment of Arbitrators and the neutrality of Arbitrator remains a major concern to the parties. To analyze the same, a comparison has been made for Arbitration clauses of a few major Government contracts clauses for appointment of the Arbitrator with respect to impartiality of the Arbitral panel as contemplated by the Arbitration and Conciliation Act-2015. Lastly, we conclude that in order to augment the growth of Indian infrastructure sector and create more employment as well as attracting private and foreign investments, India not only need an effective, independent and impartial arbitration mechanism to resolve the disputes in an early and efficient manner but also fair

contract condition of arbitration needs to be in accordance with the law so that the contractors/investors need not to knock court in each stages, be it prior to arbitration or completing of Arbitration.

Keywords: *Contracts; Claim; Disputes; Sharing of Risk; Arbitrator; Independent Arbitration Mechanism*

Comparative Study of Different Types of Enabling Structures for Cast-In-Situ Construction of Bridge Superstructure

Kaivan Bhayani[1] and Paresh Shah[2]

[1]Student, Institute of Construction Management and Research, Pune
[2]Professor and Dean, Faculty of Technology, CEPT University
Email: kaivanbhayani@gmail.com

Abstract

Infrastructure development is progressing rapidly across the country that includes many elevated structures. As a result, construction activities also have to be efficient. A majority of flyover projects still follows traditional cast-in-situ construction, wherein the staging system plays a major role in terms of the cost, time and resources. Therefore, it is necessary to decide which system is best suited to achieve lean cast-in-situ construction. There are four major types of enabling structures for cast-in-situ construction balanced cantilever segmental construction, incremental launching method, movable scaffolding system and fixed on-ground construction. Fixed on-ground cast-in-situ construction involves staging systems, which are erected on ground for the span-by-span construction. There are three systems in this method – frame (easy stage) system, truss- trestle (conventional) system and cuplock system. Of these, conventional system is the least preferred as it consumes more time, is costly and requires more labour and equipment. Cuplock system is a newer system, which has found uses primarily for construction of lighter girders (in metro rail projects). It consumes lesser time than the conventional system but more than the frame system, and is costly compared to the frame system although cheaper than the conventional system. The frame system is cheaper, speedier and requires fewer resources as compared to the other two systems. Hence, it is the most preferable staging system for cast-in-situ construction. Major criteria for selection of a particular system are safety, cost effectiveness, resource requirements and time required for the construction. This study attempts to compare different systems on basis of the previously mentioned criteria and identify the best possible system for the cast-in-situ superstructure construction.

Keywords: *Enabling Systems; Staging Systems; Frame System; Truss-Trestle System; Cuplock System; Bridge Superstructure*

Investigation of Mechanical Properties on Heat Cured Geopolymer Concrete

Sandeep L Hake
Associate Professor, D. V. V. P. College of Engineering, Ahmednagar
Email: drsandeephake@gmail.com

Abstract

Concrete is one of the most important construction materials next to water. Day-to-day demand of concrete is increasing with increasing demand of infrastructural development, but emission of large amount of CO_2 during production of cement is the major problem concern with environmental pollution. On the other side a huge amount of fly ash production from thermal power plant is another problem concerned with environmental pollution. Both these issues are partially solved by full utilization of fly ash by replacing cement from concrete in the production of geopolymer concrete. The present study is divided into three phase. In the first phase, the preliminary investigation has been carried out to study the effect of types of fly ash, concentration of sodium hydroxide, and sodium silicate-to-sodium hydroxide ratio by mass on low calcium fly ash based geopolymer concrete. In the second phase, the investigation is based on degree of heating, curing duration and testing age for different types of curing method (oven, steam, membrane and accelerated). In the third phase, mechanical properties such as short-term as well as long-term of fly ash based geopolymer concrete is investigated. In the preliminary investigation, the types of unprocessed (UPF-I, UPF-II, UPF-III) and processed (PF-I, PF-II, PF-III) fly ash, the concentration of sodium hydroxide (8M, 10M, 12M, 14M, 16M, 18M, and 20M), Sodium silicate-to-sodium ratio by mass (1, 1.5, 2, 2.5, 3, 3.5) is used. In the second phase degree of heating (60 ^{0}C, 80 ^{0}C, 90 ^{0}C, 100 ^{0}C, 120 ^{0}C, 150 ^{0}C), curing duration (6, 12, 18, 24 hours), and testing age (1, 3, 7, 14, 21, 28, 56 days) is used for types of curing method (oven, steam, membrane and accelerated). In the preliminary investigation, on the basis of experimentation the processed fly ash PF-I, 16 molar concentration of sodium hydroxide and sodium silicate-to-sodium hydroxide (2.5) ratio by mass is used for further study.

Keywords: *Geopolymer Concrete; Mechanical Properties; Fly Ash*

Project Management Software: An Effective Tracking Tool for Environmental Clearance Process

Mukund Phatak[1] and Abhishek Shrivas[2]

[1]Professor and Dean, National Institute of Construction Management and Research, Delhi NCR (Bahadurgarh)

[2]Assistant Professor, National Institute of Construction Management and Research, Pune

Email: mphatak@nicmar.ac.in

Abstract

Delay in prior environmental clearance has a direct impact on the development projects. The Environmental Impact Assessment (EIA) notification of 2006 made the prior environmental clearance mandatory for various development projects proposed across the country. The delay in this process causes cost and time over run of the projects. Although, the present EIA notification of 2006 has taken due care and has proposed the time frame for the various stages involved in the process of issue of Terms of Reference (TOR) as well as Environmental Clearance (EC). The time frame specified for grant of TOR is 60 days from the date of submission of application by the proponent to the concerned regulatory authority. But, it seems that these time frames are not adhering by the various regulatory authorities. The Ministry of Environment, Forest and climate change, Government of India (MOEF & CC) has tried to put the updated status of the clearance process of various projects on its website. The data available on the website is simply an eye wash. This study proposes to use the project management software as a tool to monitor the progress of clearance process stages with respect to the time frame mentioned in the EIA notification. This tool will automatically display the expected time line for a stage to be achieved in issue of TOR based on the date of receipt of the application. This being on the public domain will put pressure on the regularity authority to stick to the time frame stipulated in the notification. This revolutionary process will facilitate the monitoring of the whole activity and will compel the authorities to adhere to the time frame. This will put a check on the delay in the issue of TOR and environmental clearance. The scope of this study is limited to tracking of only TOR activity for 'A' and 'B' category projects.

Keywords: *Environmental Impact Assessment (EIA); Terms of Reference (TOR); Environmental Clearance (EC); State Level Impact Assessment Authority (SEIAA) and State Level Expert Appraisal Committee*

Sustainable Building Materials for Green Building

A. Mohanraj[1], K. Pavan[2], G. Rajkumar[3] and N Chandra Mohan[4]

[14]Assistant Professor, Bannariamman Institute of Technology, Erode
[23]UG Student, Bannariamman Institute of Technology, Erode
Email: mrmohanpro29@gmail.com

Abstract

The development in Technology depletes the resources or affects the environment. It has been a greater challenge for scientists and engineers to protect environment and natural resources without compromising the quality performance and comfort level of the society. However, few ideologies help in selecting the choice of ecological materials and construction systems. Carefully investigating and choosing the materials and the way they can be combined yields significant enhancement in the comfort and cost efficiency of houses, and greatly reduce its life cycle environmental impact. The first step in any approach to use ecological materials is to reduce the demand for new materials. During the designing and construction, methods are to be included which will make it easier to adjust, reuse and eventually dismantle the building. By selecting long-lasting, low maintenance materials, one can reduce the need for new materials. This study covers different types of the construction systems and materials and reviews the benefits of the particular system or materials.

Keywords: *Sustainable Materials; Construction Process; Cost; Efficiency; Maintenance*

Application of Activity Based Costing in Construction Sector: A Study in Indian Context

Debapriya Tripathy[1], Atul Dabral[2] and Pradeepta Kumar Samanta[3]

[12]Student, ACM, National Institute of Construction Management and Research, Pune
[3]Associate Professor, National Institute of Construction Management and Research, Pune
Email: samanta.pk@gmail.com

Abstract

The construction industry is the second largest industry of the country after agriculture. It makes a significant contribution to the national economy and provides employment to large number of people. Indian construction industry is going through changes in terms of adopting new methods of construction, better management solution and organizing construction industry with an idea of lean construction. Generally cost associate with construction project is huge compare to other industry. Hence it is important to have a sound costing method. Through the activity based costing (ABC) approach, the resources consumed can be traced back to the consuming activity and subsequently to a particular cost element. More importantly, the results indicate that the simulation model can identify a logistics option which would result in the lowest logistics cost without affecting the construction schedule. The dynamic cost management in the process of construction project based on

the activity-based costing is a continuous cycle process that adjusts the activities and the supply of resources of the next phase of construction project, according to the deviation between the budget cost and the actual cost, in order to control the project costs and achieve financial goals. The present paper delves into the use of ABC system over the traditional costing system for overall efficiency of the construction sector.

Keywords: *Activity Based Costing; Construction Sector; Budgeting; Traditional Costing; Lean Construction*

Plastic as a Construction Material

Lakshya Aggarwal[1], Rajat Chauhan[2], Himanshi Kaul[3], Vishesh Singh[4] and Uditya Kamal Verma[5]

[1245]Student, ACM, National Institute of Construction Management and Research, Goa
[3]Implementation Engineer, Innovative Systel, Mohali, Punjab
Email: lakshya.acm10goa@nicmar.ac.in

Abstract

This paper reckons a review on plastic as a construction material. Findings from the existing study affirm that plastic is a group of synthetic or natural organic material which can be shaped when soft and then be hardened. It includes many types of resins, polymers, resinoids, cellulose derivatives, etc. It is one of the most easily manufactured and available material which can be put to numerous uses due to its advantage of easy modularization. But this material has become threat to the environment because plastic is non-biodegradable and is responsible for causing many diseases. 300 million MT of plastic waste is generated globally of which only 10% is recycled. Since, the space available for landfill is limited it has become important to look for alternatives to dispose this waste. To circumvent this issue plastic waste can be utilised in construction Industry. Polythene, a type of plastic can be used in road pavements which increase its durability and make it economical. In Maharashtra (India) plastic mixed bitumen has been used to lay roads of length 1500 km. The use of plastic in bitumen increases the binding property of the bitumen, softening point, resistivity from water and lowers down the penetration and bleeding in summer. Plastic can also be used as admixture, aggregate in lightweight concrete and asphalt concrete, Fibre Reinforced Concrete, Synthetic aggregate or binder in concrete, resin in polymer concrete, components in artificial particle boards, Plastic reinforcement in plasters, etc. Substitutions of asphalt in pavements by polymers can be put into practice for the improvement of rutting resistance, thermal cracking, fatigue damage, stripping, and temperature susceptibility. The present study ensures that reusing waste plastic in concrete gives a good approach to reduce the cost of materials and solve some of the solid waste problems posed by plastics.

Keywords: *Organic Material; Plastic; Polymer; Environment; Fibre Reinforced Concrete*

Enhancement of Stone Column Performance for Ground Improvement: A Review

Amber Fatima[1], Yatendra Singh Rathore[2] and Neeraj Choudhary[3]

[12]Student, B.Tech, Civil Engineering, Amity University, Rajasthan
[3]Assistant Professor, Amity University, Rajasthan
Email: amber24fatima@gmail.com

Abstract

In urban areas, scarcity of land to build infrastructure has driven the geotechnical engineers to improve poor subsoil conditions through different techniques. Stone column is one of the stabilizing ground improvement techniques widely practiced. However, in case of very soft soil, under loading, stone column undergoes excessive bulging which leads to failure of overlying structure. To overcome this limitation, various remedial measures which are put forward have been discussed in this paper. The focus is on recent advancement of encasing these columns with geosynthetic products to enhance their performance in load bearing capacity. Also, use of alternative to stones is reported in some areas due to the high cost and scarcity of stone. The primary objective of this study is to compile all the aspects of Stone columns into one single source of information, for the researchers interested in this field.

Keywords: *Ground Improvement; Granular Column; Geo-synthetic Encasement; Geo-grids*

Recent Trends in Landfill Leachate Treatment

Sayyed Sageer[1], Shabiimam M. A[2] and Atique Barudgar[3]

[13]Student, Civil Engineering, Anjuman -I- Islam's Kalsekar Technical Campus Panvel, Navi Mumbai
[2]Assistant Professor, Department of Civil Engineering, Anjuman -I- Islam's Kalsekar Technical Campus Panvel, Navi Mumbai
Email: dr.shabiimam@gmail.com

Abstract

In many developing countries, using sanitary land filling is one of the most common methods for the disposal of Municipal Solid Wastes (MSW). Landfilling has many advantages for rapid disposal of solid waste. However, it generates heavily contaminated leachate which is a high threat for humans and environment. Improper land filling creates significant variations in both volumetric flow and chemical composition of leachate. Landfill leachate contains organic, inorganic pollutants and heavy metals. If the leachate penetrates into the groundwater, it creates serious contamination. Hence, proper leachate treatment is necessary before discharge. In the past few decades, several conventional treatments like coagulation, adsorption, Fenton's process, activated sludge, anaerobic digestion, etc., or a combination of the above methods have been utilized for the treatment of landfill

leachate. In recent study, techniques like membrane bioreactor, reverse osmosis processes are also found effective to treat the leachate, upto the disposal standards. In this article, we have discussed various conventional treatments and recent techniques available to treat the leachate.

Keywords: *Landfill; Leachate; Fenton's; Membrane Process; Solid Waste*

Ceramic Waste as a Building Material

Akash Agrawal

Assistant Professor, Department of Civil Engineering, SHUATS, Allahabad
Email: akash.agrawal@shiats.edu.in

Abstract

With the likes of 'Swatch Bharat Abhiyan' and 'Namami Gange' India has also taken up the worldwide problem of waste management. In this regard, frequent research is being carried out to find out techniques and methodologies of removal of waste and to find solutions of reusing the wastes generated by different sources. Several waste materials are generated from manufacturing processes, service industries, construction and demolition works and municipal solid wastes. The growing responsiveness about the environment has immensely contributed to the concerns related with disposal of these generated wastes. Solid waste management is one of the major environmental concerns in the world and with the scarcity of space for land filling and due to its ever increasing cost; waste utilization has become an attractive alternative to disposal. There are numerous researches that are being carried out to utilize these wastes in the construction industry where most of them are related to using these wastes in concrete. This will lead to utilization of wastes as well as reduction of usage of naturally occurring construction materials which in turn are depleting the natural resources due to the increasing demand of construction materials, meanwhile making concrete economical and also will reduce the disposal problems associated with these waste materials. This research work is based on making concrete with partial replacement of coarse and fine aggregates from ceramic wastes which can be replaced with traditional concrete that is used immensely. The results show that ceramic wastes can be utilized as a partial replacement of coarse aggregates in concrete up-to a level of 40%, with better strengths and similar workability, while the dead load is reduced.

Keywords: *Replacements; Ceramic wastes; Utilization of waste; Compressive strength; Strength of the concrete*