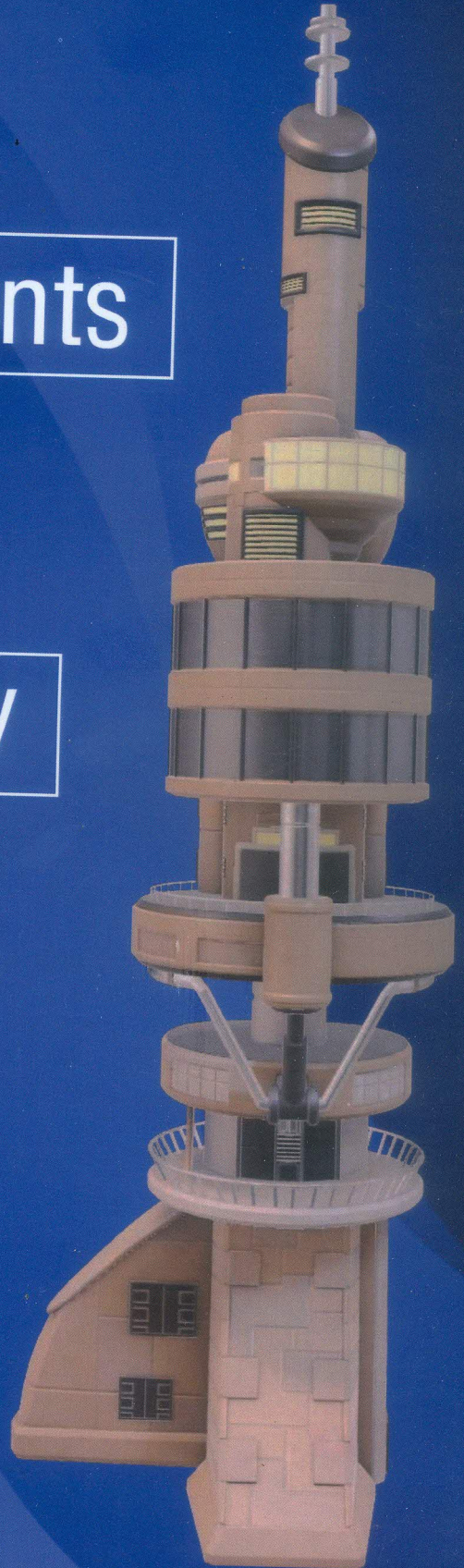


Recent  
Advancements  
in  
Building  
Technology

Zishan Raza Khan





# **Recent Advancements in Building Technology**

**Zishan Raza Khan**

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*Mohammad Affan & Anwar Ahmad*

# Sustainability Rating Parameters for Existing Residential Buildings of India

Shafat Husain Dar & Zishan Raza Khan

Department of Civil Engineering, Integral University, Lucknow

Sustainable building is a multidimensional concept, but attention to the issue often goes solely to environmental criteria, ignoring the substantial importance of social, economic and technical criteria. Inadequate research has been carried out till now to support the development of sustainable performance for existing residential buildings of India taking into consideration the local conditions. The purpose of this research is to provide a better understanding of the concept of a green building assessment tool and its role in achieving sustainable development through developing a holistic green building rating tool for existing residential buildings in India in terms of the dimensions of the sustainable development and according to the local context. This research assessed international green building rating tools such as LEED, CASBEE, BREEAM, and others and then defined new assessment criteria considering the local conditions of India. A total of 8 main criteria and 37 sub-criteria were adopted for the research. The main assessment criteria were categorized, into the four dimensions of sustainable development viz., environmental, social, economic and technical. Weights of main and sub-criteria were calculated and multiplied to obtain credit points to be allocated to each sub-criterion and the parameters. Thus, the outcome of the research was a suggested green building assessment framework that suits the Indian context in terms of environmental, social, economic and technical perspectives. A user-friendly software interface of the tool was developed in Dev-C++ to make it easier to use. Finally, the tool was validated by performing a case study of a residential hostel in Bengaluru and the results were compared with that of GRIHA as the building has already been rated by the same.

Green building has now become a flagship of sustainable development in this century that takes the responsibility for balancing long-term economic, environmental and social health. It offers an opportunity to create environmentally efficient buildings by using an integrated approach of design so that the negative impact of building on the environment and occupants is



## **Conundrum of Quality in Construction Projects**

**Tushar Sarkari & Zishan Raza Khan**

**Department of Civil Engineering, Integral University, Lucknow**

Quality management is one of the most important considerations in any infrastructure construction project. Cost of Quality is one of the most significant parameters for analyzing the quality performance of any construction Project. It becomes increasingly necessary to pay attention to measurement of cost of Quality and optimizing it. Quality costs may be regarded as a criterion of quality performance but only if valid comparisons can be made between different sets of cost data. Clearly the comparability of sets of data is dependent on the definitions of the categories and elements used in compiling them.

Regardless of the varied different costing methods, the concept of identifying the value of quality encompasses one primary idea which is to link all areas of improvement to a price or customer expectation that's quantifiable, and thereby sufficiently actionable to scale back the general cost of quality. This research chapter deals with identifying the major types of cost of quality and the prime factors which affect this. The data was collected through Questionnaire survey by identifying the top 24 factors which affect the cost of Quality. Data analysis was done through Relative Importance Index Method and Pareto Analysis to obtain the desired results. The field survey showed that the Internal Failure cost have the utmost impact on the Cost of Quality. Prevention and Appraisal cost also provide huge Impact on Cost of Quality as compared to External Failure Costs. Based on these results, several points of Optimizing Cost of Quality have been suggested.

Due to the development of the economy in the developed countries, competition has led to the survival of the fittest. Due to increased competition in the market, there is an increasing obligation on the construction companies to improve their internal quality and strengthen management. It specifically means that companies need to improve quality control in order to satisfy the needs of quality assurance of customers.

Quality is a quite wide word that has a lot of meanings and for different people often means

## **Retrofitting of Reinforced Concrete Column employing Jacketing approach**

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Columns are important structural elements in a framed structure for the transfer of loads, so finding a method to increase the axial load carrying capacity of deteriorated compression members without compromising its strength is necessary. In this experimental study, a total of 15 columns were cast; 12 of them with same dimensions (120mm x 120mm x 720mm) and the rest three columns with dimensions of (240mm x 240mm x 720mm) under similar environmental conditions. Moreover, 6 columns are set as reference columns denoted by C and C\* with dimensions of (120mm x 120mm x 720mm) and (240mm x 240mm x 720mm) respectively, just to set an exact benchmark for comparison with retrofitted columns denoted by C1, C2 and C3 respectively. In our case, a strengthening method using ferrocement jacket (wire mesh) to improve the confinement of a column is to be investigated and compared with reference column specimens. The conclusion of this thesis indicated that there was an increase in the observed ultimate load carrying capacity of various columns retrofitted with different techniques. The results indicated an increase in the ultimate load carrying capacity of columns and it was found that the retrofitted columns C1, C2 and C3 were 3.43, 3.94 and 1.62 times greater than the control specimen C. Also, RC Jacketing with and without dowel rebar increase the ultimate load carrying capacity of retrofitted columns C2 and C1 by 80% and 91% compared to control specimen C\*. Hence It was concluded that from the comparison of columns with different jackets, RC Jacketing with rebar is preferred from the strength consideration.

The alteration of existing structures to make them more resistant to ground motion or soil failure caused by earthquakes is known as retrofitting. The major purpose of the retrofit is to protect the lives of building inhabitants in the event of an earthquake (this is referred to as "life safety" performance in building regulations). Column behaviour in tall structures is critical because column failures can lead to other structural failures and catastrophic building collapse.



## **Flexural Behaviour of Engineered Cementitious Composite Beam in Modern Buildings**

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This study has been done to analyze the change in strength, ductility and crack control behavior of Reinforced concrete beam when it is strengthened with steel and basalt reinforcement and Engineered Cementitious Composite (ECC) layer at the bottom of the beam. In order to investigate the influence, different thickness of ECC layer is casted, 25mm, 35mm, and 45mm. In order to check all the behavior, the enhanced beams are compared to the regular Reinforced Cement Concrete (RCC) Beams with same dimension and rebar position. Specimens are tested in two- point bending and the crack patterns are seen. The experimental result shows that in steel rebar and ECC enhanced beams the cracks start to appear on later stage as compared to regular RCC beams. In case of basalt rebar ECC enhanced beam there are very minor cracks develop at initial stage in concrete section, not in ECC section, on further loading cracks starts to develop in ECC layer, after removing the load the beam comes back to its original position, now both using ECC layer and basalt rebar in concrete beam increases the bond strength, overall load carrying capacity and first crack load can be concluded. To summarize, applying ECC layer can reduce the crack width and delays the initial cracking time and makes cracks uniformly distributed in beams.

The civil engineering profession recognizes the reality of limited natural resources, the desire for sustainable development and the need for conservative consumption of resources. loading conditions. Strain hardening materials are well suited for applications that eliminate conventional reinforcement or for the structures in seismic regions where high ductility is desired. In addition, these materials offer fatigue and impact resistance and are attractive for use in industrial structures, highways, bridges, earthquake, hurricane, and high wind The design and implementation of these systems requires one to acknowledge and use the strain-hardening response that is attributed to multiple cracking. It contains highly dense polyvinyl alcohol (PVA) /polyethylene (PE) fibers which provides durability and ductility. ECC has the

## **Retrofitting of Short Column and its Implications**

Khawaja Fahad Ahmad, Mohd. Kashif Khan,

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**In this chapter a new technique for the strengthening of concrete columns is adopted. Retrofitting is the process of addition of new features or modification to the old structures and bridges, i.e. it reduces the damage vulnerability of an existing structure due to seismic activities. Retrofit of columns was applied to those places where the design of structure may go wrong and due to seismic activities. It is defined as “Modifying existing equipment or structures with additional or new components or members” Ultimate load carrying capacity of various columns retrofitted with different techniques.**

Column are the very important structural elements in a any structure for the transfer of loads. It is designed to resist lateral and axial forces and transfer them safely to the footings in the ground. It is like a leg on which structure stands. Columns support floors in a structure. Slab and beams stresses to the columns so, it is important to design strong columns. In recent past years, various methods have been proposed to strengthen, repair or retrofit/damaged reinforced concrete columns but very few methods have been proposed to improve the ductility or increased the overall axial load carrying capacity of the RC columns.

Retrofit of columns was applied to those places where the design of structure may go wrong and due to seismic activities. It consists of added concrete with longitudinal and transverse reinforcement around the existing column. This type of strengthening improves the axial and shears strength of column while the flexural strength of column and strength of beam and column remains same. A major advantage of column jacketing is that it improves the lateral load capacity of the building. The most common types of jackets are Steel jacket, Reinforced concrete jacket, Fiber reinforced polymer with high tension materials like carbon fiber, glass fiber etc. Strengthening or retrofitting has received considerable attention due to its high strength, light weight and high resistance against corrosion and ease of fabrication.

Many Materials were used for Column jacketing that they are bear the load of the structures from which some Strengthening techniques were discussed below:

## **Behavior of Inclined Tension Pile and its Structural Effects**

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A study on tension pile for different angles is presented here. The Comparison experimental study carried out using the circular and square pile in clay, loamy and sand Soil. The Specific gravity of clay, loam and sand soil is 2.70, 2.65 and 2.55 respectively. The combination of mild steel piles and model tank 600 mm x 600mm x 750 mm is assessed the actual pile bearing capacity more closely than analytical models based on empirical calculation rules. Results were successively compared with actual test results which were measured during pile tests. The bearing capacity of tension piles involves interactions between the tension-pile with the neighboring sediments, often use is made of empirical relations between soil properties and skin friction.

Nowadays, with the increasing need for infrastructures and the decreasing availability of space, both structural and geotechnical engineers are challenged to design, analyse, and evaluate more expensive and strategic structural systems (e.g. high-rising buildings, offshore platforms, multi-story highways, etc.) submitted to extreme lateral loadings (e.g. earthquakes, gusty winds, terrorist attacks, etc.). Inclined or tension piles are sometimes used to provide sufficient lateral stiffness but also in order to avoid interference between the piles and underground pipes (for example in power-plant structures).

The use of piles for deep foundations is state-of-the-art for many different kinds of buildings. Nowadays a multiplicity of quay constructions is founded on complex pile grillages with a lot of interbreeding piles. But also, in structural engineering and bridge construction piles are often used as foundation elements.

Tension pile (at different Angles) foundations are widely used in the geotechnical engineering to sustain uplift load from the superstructure, such as offshore floating platforms, submerged floating tunnel, etc. In the past few decades, quite a few studies have been conducted to investigate the capacity of tension pile foundations, but the design of tension pile foundations still needs much empirical treatment.



## Effects of Air Quality at Construction Site with captive RMC Plant

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The project investigates the concentration of the pollutants Sulphur dioxide, nitrogen oxides, particulate matter (PM<sub>10</sub>) generated from sources like RMC plant over the ambient air quality of the Lucknow. Lucknow is a big city and it is not possible to measure the concentration of these major pollutants in all areas, so we have restricted our study to some RMC plant in Lucknow city. The major pollutants as suggested by the Central pollution control board (CPCB) in an industrial area are Sulphur dioxide, oxides of nitrogen (NO<sub>x</sub>), particulate matter (PM<sub>10</sub>). The rate of emission and concentration of these gases in the ambient air is studied by the following laboratory methods –

1. Modified West and Gaeke method for determination of sulphur dioxide in ambient air,
2. Modified Jacob and Hochheiser method for determination of nitrogen oxides in ambient air,
3. Cyclonic flow technique for the measurement of PM<sub>10</sub>.
- 4 High volume sampler HVS for TSP.

The results will show the concentration of emissions of the above cited gaseous and suspended solid pollutants and will be compared with the permissible concentrations as per the standards given by CPCB for an industrial area and major precautions can be taken to reduce the concentration level of these pollutants.

The human behavior over the last few decades has changed the global atmospheric condition. The emission from automobiles, industrial emission, urban development, intensification of agricultural practices has escalated the levels of the harmful gases like CO<sub>2</sub>, CO, SO<sub>2</sub>, NO and Particulate Matter (PM) coming from RMC plant which probably changing the condition of the atmosphere and in turn harming us. The study aims at assessing the rate of air pollution in RMC plant at Lucknow with the focus on the Particulate Matter 10, Sulphur Dioxide and Nitrogen Dioxide. The study also reveals the major cause of the air pollution in RMC plant at Lucknow

## **Structural Response of Concrete under Extreme Temperature**

Md Sharique, Anwar Ahmad

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Concrete slabs are considered to be an important structural element in reinforced concrete structures because they support the structure and transfer the loads to the columns or walls, so any failure or damage occurs in the slab may cause a partial failure of the structure. Concrete, as a construction material, for years retains primacy in construction and its strength is fairly sensitive to temperature effects. Extreme temperature conditions significantly affect the concrete compressive strength and its development. Therefore, analytical study is conducted on hardened Concrete slab to achieve the required mechanical properties of concrete such as deformation, stress, strain and shear stress placed in extreme climatic temperature conditions (-20 to 55°C) in a region of India (Lucknow, Siachen) using ANSYS. For the analysis two different type of concrete Normal cement concrete or conventional concrete and Sulphur concrete. Cross-sectional dimension of slab (5000\*3000\*150 & 5000\*3000\* 175) mm is analyzed. Results shows the Conventional slab as compared to Sulphur concrete slab deforms more at varying temperature. Deformation of slab decreases with the increase of thickness. In lower temperature region the conventional concrete slab performs better in deformation than Sulphur concrete slab but at higher temperature Sulphur concrete slab performs better in deformation, stress and strain.

In any Engineering structure, slabs constitute the most important part, used for berthing purpose and also used to transmit the loading to other structural members. In general, slabs are classified as being one-way or two-way. Slabs that primarily deflect in one direction are referred to as one-way slabs. When slabs are supported by columns arranged generally in rows so that the slabs can deflect in two directions they are usually referred to as two-way slabs, this slab is also supported on all the four edges and having  $l_y/l_x$  ratio as  $< 2$ . Main reinforcement is provided along the both directions. This study is performed on two-way slabs. Concrete, as a construction material, for years retains primacy in construction of objects: the building constructions, hydro constructions, road constructions. This material is



## **Mechanical Properties of RedMud (Bauxite Residue) Modified Concrete**

Mohd Juned, Anwar Ahmad

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Now a day, various investigations and study has been presently going on to prepare an alternative or sustainable material for concreting. Now day's construction cost is very high with using conventional materials due to unavailability of natural materials. The problem can be solved by partial replacement of cement. The study is conducted to analyze the workability, compressive strength and split tensile strength of the concrete. Using partial replacement of Pozzolana Portland cement with red mud (Bauxite Residue). The thesis work focuses on the suitability of red mud obtained for construction. Five test groups will be constituted with the replacement percentages 0%, 5%, 10%, 15%, 20%, of red mud, for M25 grade of concrete and is tested for optimum percentage.

Industrialization and urbanization are the two worldwide phenomena. Though these are the necessity of the society and are mostly inevitable, one has to look into their negative impacts on the global environment and social life. The major ill effect of these global processes is the production of large quantities of industrial wastes and the problems related with their safe management and disposal. Second problem is the scarcity of land, materials and resources for ongoing developmental activities, including infrastructure.

Nowadays, the search for recycling alternatives of several industrial wastes or by-products is a common practice, conducted under legislation pressure but also attempting to eliminate cost of disposal and to avoid soil and water contamination. Many of these undesirable industrial rejects contain significant amounts of inorganic ingredients, such as silicon, aluminum, calcium and iron oxides. The current trend all over the world is to utilize the treated and untreated industrial by-products as a raw material in concrete, which gives an eco-friendly edge to the concrete preparation process.

Increase in industrialization and urbanization, the use of buildings also increased which results in continuous usage of construction material leads to scarcity of the concrete materials. To overcome the issues many research was done to use many industrial wastes as alternative



## **Evaluation and Challenges of Fire Safety Norms in Residential Building**

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Larger and devastating fires took place in numerous high rise buildings causing loss of life and property. It is difficult to fight a high-rise building fire as it quickly spreads upwards (due to Chimney Effect) and the external firefighting appliances may not be able to reach higher floors. Evacuating people especially invalids, old persons and children, without panic poses practical difficulty in most case. High-rise buildings and super high-rise buildings become more and more because of high population density and land price. Increase in number of high-rise buildings, fire accidents also increase as well. Evacuation is quite difficult and fire control is complex as the number of floors increases in high-rise building.

Heavy usage of electrical appliances should be avoided and good quality materials should be used. Loads in electrical wiring should be provided with a margin to avoid short-circuit in future on increasing electric load. Keeping in mind the thought "Prevention is better than protection" in every part of safety steps. The passage should be very clear and easily available at important part of building. Emergency exits should have a proper and planned movement. Shaft or OTS should be provided near the emergency exit or stairs. There should be proper ventilation for good visibility which can obtain by using good exhaust at the ventilation. Spiral stairs can be used to make easy movement across the floors in the building.

Spiral stairs can have much easier movement as compared to normal stairs as they create higher velocity by having good angular velocity. Circular movement creates angular velocity which on multiplying with radius according to area gives good linear velocity that's what needed for quick passage. Following safe practices in respect of electrical wiring would help to reduce fire incidents Prefer copper wiring / cables Use only ISI marked wiring/cables and related accessories Don't use 1sq.mm cable at all in the household

Use 10 Sq.mm cable for main connection between the electricity supply meter and the main switch on the distribution board in the house/flat and 6 mm cable for connection between distribution board and sub distribution board in each floor use 4 sq.mm cables