ABOUT THE BOOK

"LATEST TECHNOLOGICAL ADVANCEMENTS IN CIVIL ENGINEERING" HAVE LED TO MORE SUSTAINABLE AND EFFICIENT CONSTRUCTION PRACTICES. KEY INNOVATIONS INCLUDE THE USE OF ADVANCED MATERIALS LIKE SELF-HEALING CONCRETE, 3D PRINTING FOR RAPID CONSTRUCTION, AND THE INTEGRATION OF SENSORS AND DATA ANALYTICS FOR SMARTER INFRASTRUCTURE MANAGEMENT.

ADDITIONALLY, DEVELOPMENTS IN GREEN BUILDING DESIGN AND RENEWABLE ENERGY INTEGRATION ARE HELPING CREATE MORE ENVIRONMENTALLY FRIENDLY STRUCTURES. THESE ADVANCEMENTS AIM TO ENHANCE THE DURABILITY, SAFETY, AND SUSTAINABILITY OF CIVIL ENGINEERING PROJECTS

nanoedge

9 789385 933899
₹699

LATEST TECHNOLOGICAL ADVANCEMENT IN CIVIL ENGINEERING

nanoedge

LATEST TECHNOLOGICAL ADVANCEMENT IN

Civil Engineering

Sandeep Chaudhary

Latest Technological Advancement in Civil Engineering

Latest Technological Advancement in Civil Engineering

First published in India in 2019 *by*

Lav Kush Colony, Rohta Road, Khadoli Mod, Meerut City, Meerut - 250002

First edition 2019

ISBN : 978-93-859338-9-9

Determination of Axial Load Distribution in a Plane-Piled Raft Foundation under Medium-Stiff Clay using Finite Element Analysis

Dr. Sanjeev Gill[a], Seema Rani[b]

[a] Professor, Deptt.of Civil Engineering. JBIT, Dehradun, Uttarakhand (India)
[b]Assistant Professor, Deptt.of Civil Engineering. JBIT, Dehradun, Uttarakhand (India)

ABSTRACT

The nonlinear finite element approach was utilized for the study of the piled raft foundation that is presented in this study. The behaviour of axial load distribution can be predicted using a three-dimensional nonlinear finite-element analysis. The fluctuation in axial load is nonlinear for each and every one of the piles. The measurement of axial load distribution in a pile field is extremely challenging and expensive.

Keywords- *raft foundation, axial load, and finite-element analysis*

1. INTRODUCTION

Piled raft foundation is a new type of foundation in which the total structural load is taken by pile through skin friction and the remaining load is taken by raft through contact with the soil. It is an economical foundation than the pile foundation and the settlement is less than the raft foundation.

2. LITERATURE REVIEW

Tayabji et.al (1986) developed the program JSLAB for analyzing pavements resting on a Winkler foundation. The model incorporates features similar to ILLI-SLAB, utilizing plate elements to model the slab and a bonded or unbounded base. Dowels were modeled with modified beam elements that incorporated the effect of shear deformations and elastic support provided by the concrete. As in ILLI-SLAB, aggregate interlock and keyways were modeled with springs Krauthammer and Western (1988) focus on the relationship between shear transfer capabilities across pavement joints and the effects on the behavior of the pavement. The approach of the present study is to develop a numerical model that could accurately represent the mechanism for shear transfer across reinforced concrete pavement joints and implement it in an existing finite element code. The tool is then used for the analysis of various pavements for which experimental data are available; the model is further refined until the numerical results are in good agreement with the experimental information.

Important papers which talk on piled raft foundations are Clancy and Randolph (1993) Prakoso and Kulhawy (2001), Lin and Zheng (2006), Sanctis and Mandolini (2006), Shukla et.al. (2010), Al-Mosawi et.al (2011), El-Garhy et.al (2013), Raut et.al (2015).

Based on literature review it has been found that not much work has been done on piled raft foundation by finite element method especially three-dimensional nonlinear finite element method to predict the axial load distribution in a pile in piled raft foundation.

3. FINITE ELEMENT ANALYSIS

For finite element discretization one fourth of piled raft with equivalent area of raft taken from a single pile with equivalent area of raft from pile forest model. The bottom degrees of freedom are completely fixed. On the x-axis plane and the plane parallel to it z translation is fixed. Similarly on the z-axis plane and plane parallel to it the x translations are fixed. The soil, pile and raft have been discredited as eight nodded brick elements. The material behaviour of pile and raft has been considered as linear elastic medium while the soil has been idealized as nonlinear material by Extended Drucker-Prager yield criterion. The total number of nodes is 1275 and the total number of elements is 800.

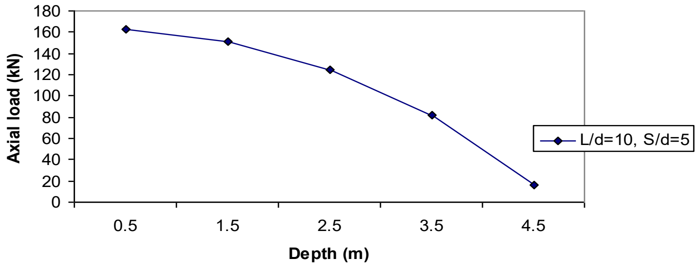


Fig.1. Axial load distribution in pile

4. RESULTS AND DISCUSSIONS

Fig.1 shows the axial load distribution for a single pile of length to diameter ratio of 10 for spacing to diameter ratio 5. The axial load is maximum in the top portion and then it decreases with depth. The variation of axial load distribution is nonlinear with depth.

Fig.2 shows the axial load distribution for a single pile of length to diameter ratio 20 and spacing to diameter ratio of 5. The axial load is maximum in the top portion and minimum at the bottom portion. The axial load distribution is nonlinear. When compared with the axial load distribution of pile of length to diameter ratio 10 it is found that at any depth, the axial load is greater for pile of length to diameter ratio 20. Thus the total load taken by pile of length to diameter ratio 20 is greater than the total load taken by pile of length to diameter ratio of

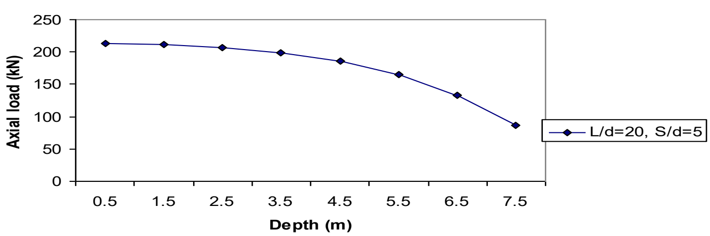


Fig.2 Axial load distribution in pile

Fig.3 shows the axial load distribution of pile of length to diameter ratio of 30. The variation of axial load distribution is nonlinear. At any depth the axial load distribution in a pile of length to diameter ratio 30 is greater than the axial load distribution of pile of length to diameter 10 and 20.

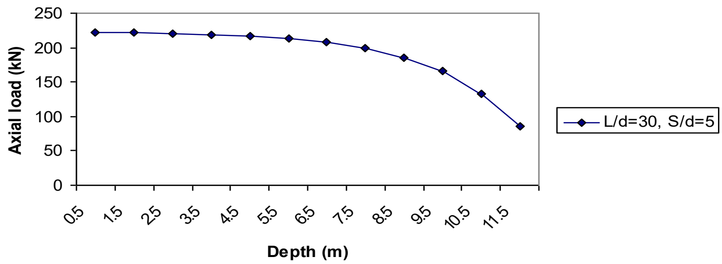


Fig.3 Axial load distribution in pile

Fig.4 shows the variation of axial load distribution in a pile of length to diameter ratio 40. The axial load distribution is maximum in the top portion and minimum at the bottom portion. The variation of axial load distribution is nonlinear. At any depth the axial load distribution is greater in pile of length to diameter ratio 40 than the piles of length to diameter ratio of 10,20 and 30. Fig.5 shows the axial load distribution of pile of length to diameter ratio of 50. Behaviour is similar as for piles of length to diameter ratio of 10, 20, 30 and 40. At any depth the axial load distribution is greater than the piles of length to diameter ratio of 10, 20, 30 and 40.

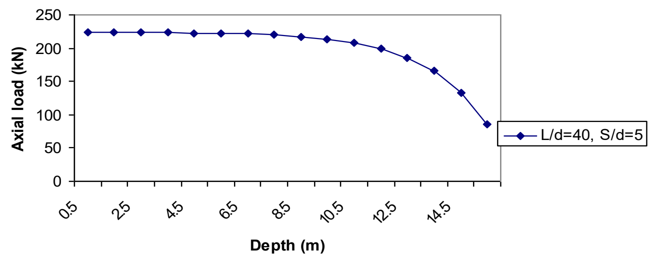


Fig.4 Axial load distribution in pile

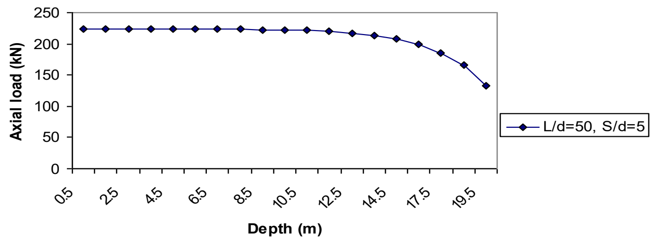


Fig.5 Axial load distribution in pile

5. CONCLUSIONS

Deflection (settlement) decreases nonlinearly with height. Elemental stre ss is highest at the top and diminishes with height. The pavement is stiff because the horizontal settlement is practically uniform. Non linear depth dependent nodal deflection and element stress. Dimensional nonlinear fin ite element analysis predicts axial load distribution in piles of varied leng th-to-diameter ratios.

For piles with lengthtodiameter ratios 10,20,30,40, and 50, the axial load distribution is highest at the top and lowest at the bottom. All piles have nonlinear axial load fluctuation. Field measurement of pile axial load dist ribution is challenging and expensive. Nonlinear finite element analysis s olves this.

REFERENCES

[1].Der-Guey Lin and Zheng-Yi Feng (2006) A Numrical Study of Piled Raft Foundations, Journal of the Chinese Institute of Engineers, Vol. 29, No. 6, pp. 1091-1097
[2].De Sanctis, L. and Mandolini, A. (2006). Bearing Capacity of Piled Rafts on Soft Clay Soils. Journal of Geotechnical and Geo environmental Engineering (ASCE), Vol.132. No.12, pp.1600-1610.
[3].El-Garhy,B., Galil,A.A., Abdel-Fattah A.A.,Raia,M.A.(2013) Behavior of Raft on Settlement Reducing Piles: Experimental Model Study, Journal of Rock Mechanics and Geotechnical Engineering,Vol.5 ,pp389–399
[4].Prakoso, W. and Kulhawy, F. (2001). Contribution to Piled Raft Foundation Design. Journal, Geotechnical and Geo environmental Engineering, ASCE Vol.127:No.17, pp.17-24.
[5].Raut J.M., Khadeshwar, S.R.and Bajad S.P.(2015)Load Sharing Ratio of Piled Raft Foundation,
[6].50th INDIAN GEOTECHNICAL CONFERENCE 17th – 19th DECEMBER 2015, Pune, Maharashtra, India Venue: College of Engineering (Estd. 1854), Pune, India
[7].Shukla, S.J.A Desai, A.K. Solanki, C.H.(2010)Study of the Behaviour of Piled Raft Foundations for Tall Buildings, Indian Geotechnical Conference – 2010, EOtrendz December 16–18, 2010, IGS Mumbai Chapter & IIT Bombay

Construction of House with Rainwater Collection

Bhaskar Singhal, Ankit Kumar Joshi

[a]Assistant Professor, Deptt. of Civil Engineering, JBIT Dehradun, Uttarakhand (India)

ABSTRACT

To collect and store rainwater for later use, before it seeps into the ground and becomes unusable, is known as rainwater harvesting. Water for human consumption, livestock, and crop irrigation have all been drawn from this source. Rainwater collected from homes, tents, and community buildings can be used to supplement the water supply. Storm water harvesting refers to the process of collecting water from the ground, usually in regions that have been specifically designed for this function. R drinking water rainfall may be the only available or cost-effective water supply in some locations. Most places where people live could benefit from installing a rainwater harvesting system because they are cheap, easy to build, and available in most places.

Keywords *- Rainwater, collection, aquifer, treatment, drinking water*

1. INTRODUCTION

Rainwater collected from rooftops often has a high quality and often does not need to be treated before being consumed. Even though some roofing materials can cause rainwater to contain contaminants that are hazardous to human health, rainwater can still be put to beneficial uses such as flushing toilets, washing clothes, watering the garden, and washing cars; these four activities alone can reduce the amount of water that is required to maintain a typical household by half. Rainfall catchment systems for homes are a viable option in regions that receive an annual rainfall totalling more than 200 millimetres (7.9 inches) on average but have no other readily available water resources (Skinner and Cotton, 1992). In a process known as groundwater recharge, overflow from rainwater harvesting tank systems can be utilised to refill aquifers.

Although this is a similar operation, it is important to note that rainwater harvesting should not be mistaken with groundwater recharge.

2. BASIC CONFIGURATION

Rainwater harvesting systems channel rainwater that falls on to a roof into storage via a system of gutters and pipes. The first flush of rainwater after a dry season should be allowed to run to waste as it will be contaminated with dust, bird droppings etc. Roof gutters should have sufficient incline to avoid standing water. They must be strong enough, and large enough to carry peak flows. Storage tanks should be covered to prevent mosquito breeding and to reduce evaporation losses, contamination and algal growth. Rainwater harvesting systems require regular maintenance and cleaning to keep the system hygienic. Around the world Currently in China and Brazil, rooftop rainwater harvesting is being practiced for providing drinking water, domestic water, water for livestock, water for small irrigation and a way to replenish ground water levels. Gansu province in China and semi-arid north east Brazil have the largest rooftop rainwater harvesting projects ongoing. In Rajasthan, India rainwater harvesting has traditionally been practiced by the people of the Thar Desert. In Bermuda, the law requires all new construction to include rainwater harvesting adequate for the residents. The U.S. Virgin Islands have a similar law. In the Indus Valley Civilization, Elephanta Caves and Kanheri Caves in Mumbai rainwater harvesting alone has been used to supply in their water requirements. In Senegal and Guinea-Bissau, the houses of the Diola -people are frequently equipped with homebrew rainwater harvesters made from local, organic materials. In the United Kingdom water butts are often found in domestic gardens to collect rainwater which is then used to water the garden. However, the British government's Code for Sustainable Homes encourages fitting large underground tanks to new-build homes to collect rainwater for flushing toilets, washing clothes, watering the garden and washing cars. This reduces by 50% the amount of mains water used by the home. In the Myanmar, the groundwater is saline and communities rely on mud-lined rainwater ponds to meet their drinking water needs throughout the dry season. Some of these ponds are centuries old and are treated with great reverence and respect.

Until 2009 in Colorado, water rights laws almost completely restricted rainwater harvesting; a property owner who captured rainwater was deemed to be stealing it from those who have rights to take water from the watershed. Now, residential well owners that meet certain criteria may obtain a permit to install a rooftop precipitation collection system. Up to 10 large scale pilot studies may also be permitted).The main factor in persuading the Colorado Legislature to change the law was a 2007 study that found that in an average year, 97% of the precipitation that fell in Douglas County, in the southern suburbs of Denver, never reached a stream-it was used by plants or evaporated on the ground. In Colorado you cannot even drill water well unless you have at least 35 acres. In New Mexico, rainwater catchment is mandatory for new dwellings in Santa Fe.In Australia rainwater harvesting is typically used to supplement the reticulated mains supply.

3. NEED FOR WATER HARVESTING

Water is an important natural resource and is the very basis of our life. We use water for drinking, irrigation, industry, transport and for the production of hydro-electricity. Water is a cyclic resource which can be used again and again after cleaning. The best way to conserve water is its judicious use. Rain water harvesting is one of the most effective methods of water management and water conservation. It is the term used to indicate the collection and storage of rain water used for human, animals and plant needs. It involves collection and storage of rain water at surface or in sub-surface aquifer, before it is lost as surface run off. The augmented resource can be harvested in the time of need. The collected water is stored and pumped in a separate pipe distribution. This is a very useful method for a developing country like India in reducing the cost and the demand of treated water and also economising the treatment plants operation, maintenance and distribution costs.

The scarcity of water is a well-known fact. In spite of higher average annual rainfall in India (1,170 mm, 46 inches) as compared to the global average (800 mm, 32 inches) it does not have sufficient water. Most of the rain falling on the surface tends to flow away rapidly, leaving very little for the recharge of groundwater. As a result, most parts of India experience lack of water even for domestic uses. Surface water sources fail to meet the rising demands of water supply in urban areas; groundwater reserves are being tapped and over-exploited resulting into decline in groundwater levels and deterioration of groundwater quality. This precarious situation needs to be rectified by immediately recharging the depleted aquifers. Hence, the need for implementation of measures to ensure that rain falling over a region is tapped as fully as possible through water harvesting, either by recharging it into the groundwater aquifers or storing it for direct use.

4. SCIENCE OF WATER HARVESTING

In scientific terms, water harvesting refers to collection and storage of rainwater and also other activities aimed at harvesting surface and groundwater, prevention of losses through evaporation and seepage and all other hydrological studies and engineering inventions, aimed at conservation and efficient utilization of the limited water endowment of physiographic unit such as a watershed. Rain is a primary source of water for all of us.

There are two main techniques of rainwater harvesting:

- Recharge to groundwater.
- Directly collected rainwater can be stored for direct use or can be recharged into the groundwater.

All the secondary sources of water like rivers, lakes and groundwater are entirely dependent on rain as a primary source.

The term water harvesting is understood to encompass a wide range of concerns, including rainwater collection with both rooftop and surface runoff catchment, rainwater storage in small tanks and large-scale artificial reservoirs, groundwater recharge, and also protection of water sources against pollution. The objective of water harvesting in India differs between urban and rural areas. In urban areas, emphasis is put on increasing groundwater recharge and managing storm water. On the other hand, in rural areas securing water is more crucial. There the aim is to provide water for drinking and farming, especially for life-saving irrigation, and to increase groundwater recharge.

Methods of Rainwater Harvesting

Broadly there are two ways of harvesting rainwater

1. Surface runoff harvesting
2. Roof top rainwater harvesting

Rainwater harvesting is the collection and storage of rainwater for reuse on-site, rather than allowing it to run off. These stored waters are used for various purposes such as gardening, irrigation etc. Various methods of rainwater harvesting are described in this section.

1. Surface runoff harvesting

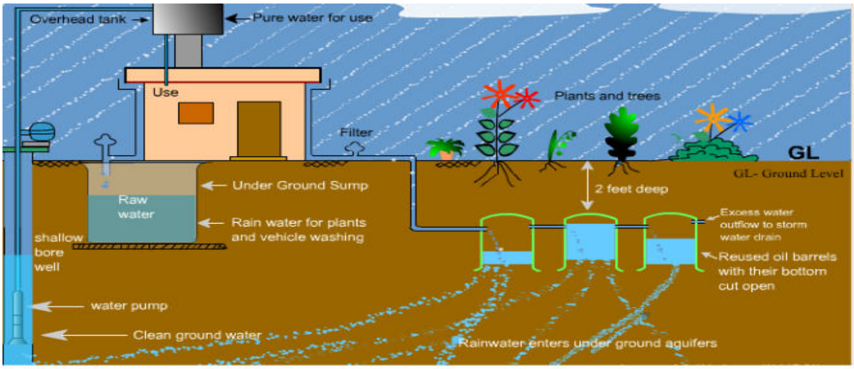
In urban area rainwater flows away as surface runoff. This runoff could be caught and used for recharging aquifers by adopting appropriate methods.

2. Rooftop rainwater harvesting

It is a system of catching rainwater where it falls. In rooftop harvesting, the roof becomes the catchments, and the rainwater is collected from the roof of the house/building. It can either be stored in a tank or diverted to artificial recharge system. This method is less expensive and very effective and if implemented properly helps in augmenting the groundwater level of the area.

ROOFTOP / RUNOFF RAINWATER HARVESTING FOR ARTIFICIAL RECHARGE TO GROUND WATER

Water harvesting is the deliberate collection and storage of rainwater that runs off on natural or manmade catchment areas. Catchment includes rooftops, compounds, rocky surface or hill slopes or artificially prepared impervious/ semi-pervious land surface. The amount of water harvested depends on the frequency and intensity of rainfall, catchment characteristics, water demands and how much runoff occurs and how quickly or how easy it is for the water to infiltrate through the subsoil and percolate down to recharge the aquifers. Moreover, in urban areas, adequate space for surface storage is not available, water levels are deep enough to accommodate additional rainwater to recharge the aquifers, rooftop and runoff rainwater harvesting is ideal solution to solve the water supply problems.



POTENTIAL AREAS

- Where ground water levels are declining on regular basis.
- Where substantial amount of aquifer has been de-saturated.
- Where availability of ground water is inadequate in lean months.
- Where due to rapid urbanization, infiltration of rain water into subsoil has decreased drastically and recharging of ground water has diminished.
-

ADVANTAGES OF RAINWATER HARVESTING

- To meet the ever-increasing demand for water. Water harvesting to recharge the groundwater enhances the availability of groundwater at specific place and time and thus assures a continuous and reliable access to groundwater.
- To reduce the runoff which chokes storm drains and to avoid flooding of roads.

- To reduce groundwater pollution and to improve the quality of groundwater through dilution when recharged to groundwater thereby providing high quality water, soft and low in minerals.
- Provides self-sufficiency to your water supply and to supplement domestic water requirement during summer and drought conditions.
- It reduces the rate of power consumption for pumping of groundwater. For every 1 m rise in water level, there is a saving of 0.4 KWH of electricity.
- Reduces soil erosion in urban areas
- The rooftop rainwater harvesting is less expensive, easy to construct, operate and maintain.
- In saline or coastal areas, rainwater provides good quality water and when recharged to ground water, it reduces salinity and helps in maintaining balance between the fresh-saline water interfaces
- In Islands, due to limited extent of fresh water aquifers, rainwater harvesting is the most preferred source of water for domestic use.
- In desert, where rainfall is low, rainwater harvesting has been providing relief to people.

5.CONCLUSION

The method of water collection helps farmers raise their income, and it is becoming increasingly widespread. The system is fragile, and in really dry years, it is not possible to prevent crop failure without aid from outside sources. For a more comprehensive understanding of the ground water system's resiliency, hydrological study is required. The local community has a strong familiarity with the technology, but the younger generations will need to be educated in order for them to understand the context of the situation more broadly. Rainwater collecting is an option worth considering as a supplementary source of water for human activities that do not include consumption, such as irrigation. When used as a supplement to municipal water supply, rainwater harvesting system's overall effectiveness improves in proportion to the area it covers. The technology would be particularly useful in heavily commercial areas that have a number of large buildings and storage facilities. These locations also have a smaller amount of lawn space, which allows for the water to be used for purposes other than irrigation.

REFERENCES

1. Behzadian, k; Kapelan, Z (2015). "Advantages of integrated and sustainability-based assessment for metabolism based strategic planning of urban water systems". *Science of The Total Environment*. Elsevier. 527-528: 220–231.
2. Zhu, Qiang; et al. (2015). *Rainwater Harvesting for Agriculture and Water Supply*. Beijing: Springer. p. 20. ISBN 978-981-287-964-6.
3. Everson C, Everson TM, Modi AT, Csiwila D, Fanadzo M, Naiken V, Auerbach RM, Moodley M, Mtshali SM, Dladla R (2011). *Sustainable techniques and practices for water harvesting and conservation and their effective application in resource-poor agricultural production through participatory adaptive research: report to the Water Research Commission* Jyotiba B. Gurav and D.G. Regulwar (2013) "Rainwater Harvesting – A Case Study", Sustainable Water Resources Development and Management, pp. 179-183
4. S.N. Kalia (2013) "Rainwater Harvesting – A Case Study Catch Water where it Falls", Sustainable Water Resources Development and Management, pp. 153-159
5. Ranjit Kumar Sharma, 'Rainwater Harvesting at N.I.T. Rourkela', Department of Civil Engineering, National Institute of Technology, Rourkela 2010.
6. M. Dinesh Kumar, Ankit Patel1 and O.P. Singh IWMI-TATA Water Policy Program, Hyderabad, India, Benaras Hindu University, Varenasi, India

An Insight into Cellular Light Weight Concrete

Dr. Sanjeev Gill[a], Manish Kumar[b]

[a] Professor, Deptt.of Civil Engineering. JBIT Dehradun, Uttarakhand (India)

[b]Assistant Professor, Deptt.of Civil Engineering. JBIT Dehradun, Uttarakhand (India)

ABSTRACT

Cellular Light weight Concrete (CLWC) is not a new invention in concrete world. It has been known since from the ancient times. It was made by using natural aggregates of the volcanic origin such as pumice, scoria, etc. The Greeks and the Romans used pumice in building construction. Lightweight concrete can be defined as a type of concrete which includes an expanding agentin that it increases the volume of the mixture while giving the additional qualities such as inability and lessened in the dead weight. The usage of Cellular Light-weight Concrete (CLC) blocks gives a prospective solution to building construction industry along with environmental preservation.

1. INTRODUCTION

Concrete is the most important construction materials. Concrete is a material used in building construction, consisting of a hard, chemically inert particulate substance, known as an aggregate that is bonded together by using cement and water. In upcoming years there has been an increasing in worldwide demand for the construction of buildings, roads and an airfield which has mitigate the raw material in concrete like aggregate. In some ruler areas, the huge quantities of aggregates that have already been used means that local materials are no longer available and the deficit has to be made up by importing materials from other place. Therefore, a new direction towards Cellular Lightweight Concrete in building and civil engineering construction is used. Light weight concrete maintains its large voids and not forming laitance layers or cement films when placed on the wall. This research was based on the performance of aerated lightweight concrete. However, sufficient water cement ratio is vital to produce adequate cohesion between cement and water. Insufficient water can cause lack of cohesion between particles, thus loss in strength of concrete. Likewise, too much water can cause cement to run off aggregate to form laitance layers, subsequently weakens in strength. Light weight concrete - or foamed concrete - is a versatile material which consists primarily of a cement-basedmortar mixed with at least 20% of volume air. It possesses high flow ability, low self-weight, minimal consumption of aggregate, controlled low strength and excellent thermal insulation properties. It can have a range of dry densities, typically from 400 kg/m3 to 1600 kg/m3 and a range of compressive strengths, 1 MPa to 15 MPa.

2. LITERATURE REVIEW

P.S. Bhandari and Dr. K.M. Tajne: In this research paper they have concluded that the compressive strength for cellular light weight concrete is low for lower density mixture. The performance of cellular lightweight concrete in term of density and compressive strength are investigated.

Hjh Kamsiah Mohd. Ismail, Mohamad Shazli Fathi and NorpadzlihatunbteManaf: In this study paper the main specialties of lightweight concrete are its low density and thermal conductivity. Its advantages, disadvantages and applications were studied thoroughly.

Satyendra Kumar Meena, Pushpendra Kumar Meena, Rakesh Kumar Meena, Rupayan Roy and Pawan Kumar Meena: It was studied that cellular lightweight concrete possesses high flow ability, low self-weight, minimal consumption of aggregate, controlled low strength and excellent thermal insulation properties. It has excellent resistance to water and frost, and provides a high level of both sound and thermal insulation.

K. Krishna Bhavani Siram: This paper shows that how the cellular concrete can be used as a replacement of burnt clay bricks. An attempt is made to compare cellular lightweight concrete (CLC) Blocks and Clay Bricks, and recommend a replacement material to red brick in construction industry.

Cellular concrete

Foamed concrete has a surprisingly long history and was first patented in 1923, mainly for use as an insulation material. The first comprehensive review on foamed concrete was presented by Valore in 1954 and a detailed treatment by Rudnai and Short and Kinniburgh in 1963, summarising the composition, properties and uses of cellular concrete, irrespective of the method of formation of the cell structure. Significant improvements over the past 20 years in production equipment and better-quality surfactants (foaming agents) has enabled the use of foamed concrete on a larger scale.

Cellular concrete, sometimes referred to as foam concrete, is a lightweight construction material consisting of Portland cement, water, foaming agent and compressed air. The foam is formulated to provide stability and prevent draining of water. Pozzolans such fly ash and fibers are often added to mix to customize compressive and flexural strengths. Cellular concrete typically contains no sand or aggregate.

Cellular lightweight concrete is slurry of cement, sand, water, fly ash and preformed stable foam generated by foam generating machine. By trapping air bubbles within the concrete, a lightweight insulating material is formed. It has fireproofing, insulation, sound attenuation and energy absorbing characteristics. Cellular concrete is either cast-in-place or precast; however, most applications call for a cast-in-place material.

Constituents of base mix

Ordinary Portland cement, Rapid hardening Portland cement and, high alumina and Calcium Sulfo aluminates have been used for reducing the setting time and also to improve the early strength of foam concrete.

Fly ash and ground granulated blast furnace slag have been used in the range of 30–70% and 10–50%, respectively and as cement replacement to reduce the cost, enhance consistence of mix and to reduce heat of hydration while contributing towards long term strength.
Silica fume up to 10% by mass of cement has been added to intensify the strength of cement. Alternate fine aggregates, viz., fly ash and lime, chalk and crushed concrete , recycled glass, foundry sand and were used either to reduce the density of foam concrete.

Making of cellular lightweight concrete

The components of foam concrete mix should be set by their functional role in order as follows:

a. Foaming agent
b. Binding agent
c. Water
d. Aggregate
e. Admixtures

3. Properties of foam concrete

Fresh state properties: As foam concrete cannot be subjected to compaction or vibration the foam concrete should have flow ability and self-compact ability. These two properties are evaluated in terms of consistency and stability of foam concrete.

Consistency: Flow time using marsh cone and flow cone spread tests are adopted to assess the consistency of foam concrete. The consistency reduces with an increase in volume of foam in the mix, which may be attributed to the (1) reduced self-weight and greater cohesion resulting from higher air content. (2) Adhesion between the bubbles and solidparticles in the mix increases the stiffness of the mix.

Stability: The stability of foam concrete is the consistency at which the density ratio is nearly one (the measured fresh density/design density), without any segregation and bleeding.

Physical properties

Drying shrinkage: Foam concrete possesses high drying shrinkage due to the absence of aggregates, i.e., up to 10 times greater than those observed on normal weight concrete. Autoclaving is reported to reduce the drying shrinkage significantly by 12–50% of that of moist-cured concrete due to a change in mineralogical compositions. The shrinkage of foam concrete reduces with density which is attributed to the lower paste content affecting the shrinkage in low- density mixes.

Low Density and High Strength: Due to its low density, foam concrete imposes little vertical stress on the substructure

- A particularly important attribute in areas sensitive to settlement. Heavier density (1000 kg/m^3+) foam concrete is mainly used for applications where water ingress would be an issue - infilling cellars, or in the construction of roof slabs for example.

Compressive strength: The compressive strength decreases exponentially with a reduction in density of foam concrete. The parameters affecting the strength of foam concrete are cement–sand and water–cement ratios, curing regime, type and particle size distribution of sand and type of foaming agent used. For dry density of foam concrete between 500 and 1000 kg/m^3, the compressive strength decreases with an increase in void diameter. For densities higher than 1000 kg/m^3, as the air-voids are far apart to have an influence on the compressive strength, the composition of the paste determines the compressive strength.

Flexural and tensile strengths: Splitting tensile strengths of foam concrete are lower than those of equivalent normal weight and lightweight aggregate concrete with higher values observed for mixes with sand than those with fly ash. Use of Polypropylene fibres has been reported to enhance the performance with respect to tensile and flexural strength of foam concrete.

Functional characteristics

Fire resistance**:** Foam concrete is extremely fire resistant and well suited to applications where fire is a risk. Test have shown that in addition to prolonged fire protection, the application of intense heat, such as a high energy flame held close to the surface, does not cause the concrete to spall or explode as is the case with normal dense weight concrete.

Thermal insulation: Foam concrete has excellent thermal insulating properties due to its cellular microstructure. The thermal conductivity of foam concrete of density 1000 kg/m^3 is reported to be one-sixth the value of typical cement– sand mortar.

Advantages of Cellular Lightweight Concrete

Cellular lightweight concrete does not settle, therefore no compaction.

It does not impose large loadings.

It is free flowing so spreads to fill all voids.

It has excellent load spreading characteristics.

Applications of Cellular Lightweight Concrete

Building Blocks: Blocks and panels can be made for partition and load bearing walls. They can be made with almost any dimensions.

Floor Screed: Foamed concrete can be used for floor screeds, creating a flat surface on uneven ground and raising floorlevels.

Roof Insulation: Foamed Concrete is used extensively for roof insulation and for making a slope on flat roofs. It has good thermal insulation properties and because it is lightweight foamed concrete does not impose a large loading on the building.oad Sub-Base: Foamed Concrete is being used road sub base on a bridge. Foamed concrete is lightweight so that theloading imposed on the bridge is minimized.

4. CONCLUSION

It can be concluded that the lightweight concrete has a desirable strength to be an alternative construction material for the industrialized building system. This study has shown that the use of fly ash in foamed concrete, either can greatly improve its properties. The properties of cellular lightweight concrete its advantages, disadvantages and applications were studied thoroughly.

REFERENCES

1. P.S. Bhandari and Dr. K.M. Tajne,’’ Cellular Lightweight Concrete Using Fly Ash’’, International Journal of Innovative Research in Science, Engineering and Technology (An ISO 3297: 2007 Certified Organization) Vol. 3, Issue 11, November 2014.
2. K. Krishna Bhavani Siram,’’Cellular Light-Weight Concrete Blocks as a Replacement of Burnt Clay Bricks’’, International Journal of Engineering and Advanced Technology (IJEAT) ISSN: 2249 – 8958, Volume-2, Issue-2, December 2012.

Survey of Seismic Consequences for Shear Wall

Dr. Sanjeev Gill[a], Bhaskar Singhal[b]

[a] Professor, Deptt. of Civil Engineering JBIT Dehradun, Uttarakhand (India)

[b] Assistant Professor, Deptt. of Civil Engineering JBIT Dehradun, Uttarakhand (India)

ABSTRACT

A devastating earthquake is the most dangerous and upsetting natural calamity there is. If you're building a multistory project that needs to withstand earthquakes, shear walls are your best bet. Shear walls are used to resist forces that are perpendicular to the wall's plane and can be found anywhere in a building, from the basement to the roof. In order to counteract the lateral stresses generated by natural disasters like earthquakes and high winds, structural elements called shear walls are installed. This document summarizes the findings of several studies on the topic of multistory buildings with and without shear walls. Most buildings in India are built with shear walls to withstand earthquakes. All buildings have structural walls, but their design and function vary, and their placement determines how well those walls resist lateral stress.

Key Words: *Shear Wall, Non- Shear wall Building, Earthquake, Lateral Forces*

1. INTRODUCTION

Earthquakes in general have a long history of wreaking havoc. Essentially, the response of the structure to ground motion is an important factor to consider when analyzing and designing any earthquake resistant structure. The loads or forces that a structure subjected to earthquake motions is required to resist, as well as the distortions caused by the movement of the ground on which it rests. Earthquakes can be measured in terms of energy release i.e. measuring amplitude, frequency, and location of seismic waves and also by evaluating intensity i.e. considering the destructive effect of shaking ground on people, structures and natural features. A building's properties include lateral stiffness, lateral strength, and ductility. Although the stiffness of the building decreases with increasing damage, lateral stiffness refers to the initial stiffness of the building. Lateral strength is the maximum resistance that a building has offered to relative deformation over its entire history. The ratio of maximum deformation to idealized yield deformation is referred to as ductility towards lateral deformation. Except in cantilevers, the effect of the vertical component of ground motion is generally regarded as insignificant and is ignored.

2. SHEAR WALL AND ITS PROPERTIES

A shear wall is a structural member located in various locations throughout a building, from the foundation level to the top parapet level that is used to resist lateral forces, i.e. forces parallel to the plane of the wall. Shear walls can be built from a variety of materials, but reinforced concrete (RC) buildings frequently include vertical plate-like Reinforced concrete walls (Figure 1) in addition to slabs, beams, and columns. In high-rise buildings, their thickness can range from 150mm to 400mm. Shear walls are typically installed along both the length and width of building.

These walls are more important in seismically active areas because shear forces on the structure increase during earthquakes. Shear walls should be stronger and stiffer. Shear walls are strong and stiff enough to control lateral displacements. Shear walls serve a dual purpose in that they serve as both lateral and gravity load-bearing elements. Concrete shear wall structures are typically regular in plan and elevation.

PURPOSE: These walls are mainly used

- To resist lateral loads of earthquake and wind.
- To resist gravity or vertical loads due to its self-weight and other living or moving loads.
- To resist shear as well as uplift forces on the building.
- To enhance the strength and stability of a structure.
- To provide adequate stiffness to the structure.

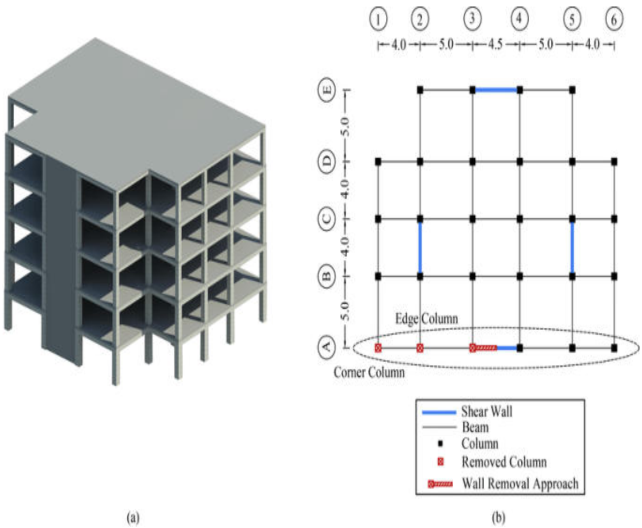


FIGURE 1: - SHEAR WALL IN BUILDING

FORCES ON SHEAR WALL

These walls mainly resist two types of forces;

1. Shear Force: Shear forces are generated in buildings due to ground movement and lateral forces such as wind, waves and earthquakes. These forces act throughout the height of the wall between the top and bottom wall connections.

2. Uplift Force: Uplift forces are produced on shear walls due to horizontal forces act on the top of the wall. These forces lift up one end of the wall and push the other end down.

ADVANTAGES OF SHEAR WALLS IN RC STRUCTURES

- Shear walls are resisting to horizontal lateral force and earthquakes.
- It has high in-plane stiffness and can resist lateral loads.
- Shear walls help in the control of deflection in vertical and longitudinal directions.
- RCC shear walls are simple for reinforcement detailing

- It reduces earthquake damage to all types of structural and non-structural structures.
- Well-designed shear walls not only provide adequate safety, but also a high level of protection against costly non-structural damage during moderate seismic events.

LITERATURE REVIEW

Concrete shear walls are the most common and useful shear wall type for any multistory building. Many researchers and scholars have studied the shear wall configuration in any building and the different types of shear walls. The resistance of a shear wall to lateral forces generated by an earthquake and wind force is studied. An effort was made to study these literatures and reach a conclusion on this topic.

Dr.B. Kameshwari et.al[1]

analyzes the impact of erosion and erosion between the floor of the building on the various configurations of shear wall panels on high-rise buildings. The blank frame is compared to various configurations such as i) Normal shear wall ii) Different shear wall layout iii) Diagonal layout of the barber window iv) Zig Zag haircut arrangement v) Impact of lifting the middle barber wall. From the study it was found that the Zig Zag shear wall improves the strength and durability of the structure compared to other models. In earthquake-prone areas the shear diagonal wall has been found to work well in the building.

B. R. Reddy et.al[2]

use Stadd Pro software to analyze and design earthquake-resistant structures using Shear wall. According to their research work, the construction made of shear walls not only provides extra strength but also increases the strength limits and efficiency of horizontal loads. Shaving walls have unusual behavior on a variety of loads. The research project was approved at the VITS block college building, Deshmukhi town Hyderabad using a shear wall. The behavior of the structure was assessed for the strength of the element, the reaction, the shearing center, the shear strength and the bending moment. A shear wall solution in a

multi-storey building based on both stretchable and elas- to-plastic behavior was also considered. The number of earthquakes was calculated and used in the same 3-storey building with 3 floors. The results of the models are calculated and analyzed for the effective area of the barber wall. After comparing the result it was found that the provision of a shear wall for this building would make the building completely resistant to earthquakes in zone II
Hyderabad. In addition to the fact that the manual and STAAD Pro results are almost identical, the STAAD Pro results save a significant amount of reinforcement.

P. Chandurkar et.al.[3]
investigated a building with Shear wall and outside Shear wall was considered and compared. As their research work the building walls provide an efficient binding system and provide great strength to withstand side load. The structures of these seismic shear walls control the structural response; therefore, it is important to evaluate the seismic response correctly. According to their research, the main focus was on finding a solution for the barbecue area in a multistory building. The function of the barber wall was studied with the help of four different models. One model was a blank frame structure system and the other three models were a two-dimensional structure. While the seismic load is used in the construction of the ten stories found in zone II, zone III, zone IV and zone V, parameters such as Lateral migration, story flooding and the total amount of cost required for the ground floor were calculated in both column-changing cases. . E-Tabs software accepted for review. From the analysis, it is noted that in the 10-story building, building a barbed-wire building in a short corner (model 4) will be economical compared to other models. So the large size of the barber wall does not apply to 10 cases or to less than 10 buildings. It was noted that the shear wall is economical and effective in high construction. From the research work it was noted that changing the location of the shear wall will affect the attraction of energy, so that wall should be in the right condition. And if the shear wall size is large then a large amount of horizontal force is taken by the shear wall. Providing shear walls in adequate areas greatly reduces migration due to earthquakes.

M. D. Kevadkar and P. B. Kodag[4]
performed a lateral load analysis of the R.C.C. Build (G + 12) by

considering 3 models. In this model 1 it has no bracing and shear wall, the second model with a different shaving wall system and the 3rd Model with Different bracing system computer-assisted analysis was performed using E-TABS to determine the effective back load system during major earthquakes. places. Property performance is assessed in terms of Lateral Displacement, Storey Shear and Storey Drift, Base shear and Demand Capacity (Workspace).

Anshuman.S et al.[5]

determined the shear wall solution in a multi-storey building based on its elastic and elastoplastic behavior. The magnitude of the earthquake is calculated and applied to the 15-story building in zone IV. The elastic and elastoplastic analysis was performed using both the STAAD Pro 2004 and SAP (2000) software packages. The shear strength, bending time and scaling of the story were calculated in both cases and the location of the shaving wall was established based on the results.

Romy Mohan et al.[6]

presented Dynamic Analysis of RCC buildings with Shear Wall. for analysis consider the two multi storey buildings, one of six and other of eleven storeys have been modeled using software package SAP 2000 for earthquake zone V in India. Six different types of shear walls with its variation in shape are considered for studying their effectiveness in resisting lateral forces. This paper also deals with the effect of the variation of the building height on the structural response of the shear wall.

Manoj S. Mendhekar et.al.[7]

mentioned ways in which the economy could be achieved to withstand the burden of the parties in a multi-storey building. In their study, seismic behavior, mechanisms of failure, and factors influencing structural responses were discussed. Many expressions were developed to measure the flexible strength of the smaller rectangular wall sections with straight reinforcement evenly distributed. In this study various aspects of the design and design of the barbers are discussed, and different types of barbers are discussed and their methods of failure. Algebraic expressions for calculating the flexibility of the shear wall sections were developed and a temporary interactive loading diagram was developed using these expressions. The results of both approaches have been quite positive. Also, the details of the composite wall were also mentioned and the difference between the solid shear wall and the jointed wall (open bar wall) was investigated. And the power-calculating relationships on the shaving wall of its design are shown. From their research it became clear that parts of the wall of the shear flange were expanded to be analyzed and designed and are very suitable.

Syed.M. Katami et.al[8]

presented the results of time history analysis which addressed the effect of openings in shear walls near- fault ground motions. A model of ten storey building with three different types of lateral load resisting system: Complete shear walls, shear walls with square opening in the centre and shear wall with opening at right end side were considered. From the results it was observed that shear walls with openings experienced a decrease in terms of strength. The maximum lateral displacement of complete shear wall is 17% less than that of shear walls with openings at centre whose displacement is found to be 8% less than that of shear walls with openings at right end.

Venkata Sairam Kumar.N et.al.[9]

reviewed various papers on shear walls and stated that shear walls are structural systems which provide stability to structures from lateral loads like wind, seismic loads. These structural systems are constructed by reinforced concrete, plywood/timber unreinforced masonry, reinforced masonry at which these systems are sub divided into coupled shear walls, shear wall frames, shear panels and staggered walls. The paper was made in the interest of studying various research works involved in enhancement of shear walls and their behaviour towards lateral loads. As shear walls resists major portions of lateral loads in the lower portion of thebuildings and the frame supports the lateral loads in the upper portions of building which is suited for soft storey high rise building. Building which are similar in nature constructed in India, as in India base floors are used for parking and garages or officers and upper floors are used for residential purposes. They have concluded with a broad note that researches were carried mainly on application of cyclic load tests and behaviour of different types of shear walls in cyclic application of loads. Researchers studied various parameters like enhancement of stiffness, drift, development forces in buildings and also to observe perfect location of shear wall location in building frame for construction. It was seen that any type of building which is tall and can be affected with lateral forces like earthquake and wind forces can be constructed with shear walls. Shear walls can be used as lateral load resisting systems and also retrofitting of structures. Internal shear walls are more efficient than external shear walls when compared with cyclic load tests by researchers.

Varsha.R. Harne[10]

considered a six storey RCC building which is subjected to earthquake loading in zone II to determine the strength of RC wall by changing the location of shear wall using STAADPro. Seismic coefficient method is used to calculate the earthquake load as per IS 1893 – 2002 (Part I). Four different models like structure without shear wall, structure with L type shear wall, structure with shear wall along periphery, structure with cross type shear wall were modeled for analysis. Compared to other models the shear force and bending moment, for structure with shear wall along the periphery is found to be maximum at the ground level and roof level respectively. Hence the shear wall provided along the periphery of the structure is found to be more efficient than all other types of shear wall.

Bhruguli H. Gandhi

explored the behavior of the barber wall openings under the action of an earthquake load. In this study, it is said that barbering walls are usually found on the sides of buildings or arranged in the form of a staircase that holds stairs and elevators. Due to operational requirements such as doors, windows, and other openings, the barber wall in the building contains many holes. Most apartment building, size and openings in the shear wall are made without considering its effect on the behavior of the building structure. In this study, the study was performed on 6-story frame-shear wall structures, using a straightforward stretch analysis with the help of a limited object software, StaddPro under earthquake loads in the same vertical analysis. Six types of models were created and analyzed, from the beginning, Concentric 20% opening, 40% focus opening, 50% focus opening, 60% focus opening, Eccentric opening 20%, Zigzag opening - 20%. The results reveal that the strength and vibration of buildings are affected by the size of the spaces and their locations on the barbecue wall. It is also tested that the high lateral inclination of the system can also be reduced by thickening the element in the model near the opening of the shaft wall. From a survey percentage of opening increases deviation up to 40% on average but after that as the opening percentage increases deviation increases much faster. At 20% opening the Eccentric zigzag has a slight deviation and the Eccentric Straight has a higher deviation and the loaded load has a smaller deviation than the Eccentric Straight. And the opening raises the lower pressures also increases equally by up to 40% and then after the Stresses increase significantly.

S.M. khatami et.al.

investigative the effect of flange thickness on nonlinear behavior of flanged shear walls. Four T-shape flanged shear walls were studied and analyzed using finite element method. The total volume of each model is similar, such that when thickness decreases in the model, the length of wing increases.

The results indicated that in the presence of lateral loads, the thickness has a significant effect on the shear absorption, ductility, displacement and crack pattern of the flanged shear walls. Numerical results show that shear walls with thick flanges behave more efficient than walls with thin flanges. It was found that, lateral strength resisted by shear walls with thin flanges is 1250 kN which is 14 percent decrease compared with thick flanged wall. Moreover, nonlinear behavior of flanged shear wall with thick flanges shows that strength and ductility are equivalent. Finally, the analyses indicated that while flange is in pressure, the global behavior is much more improved compared with condition which is in tension. The comparison of models indicated that finite element model used in this study is capable of predicting the nonlinear behavior of the models when these are different thickness. Results of analysis in four models and load- displacement of them indicated that model named -2500TSW had better behavior. It had resisted about 1248 kN. This load is 14% higher than other models. Also, ductility of this model showed a good agreement. Ductility in the model-2500TSW model is4.58 which is 3% higher than model-3100TSW. Results of analysis showed that model-3100TSW had better strength after yield, which was 18% higher than model- 2500TSW. Crack pattern in all of models showed that increase of thickness could decrease crack in shear wall.

4. CONCLUSIONS

It can be deduced from the aforementioned research that numerous scholars have investigated various earthquake-related issues and agreed that shear walls are the most effective means of mitigating the effects of lateral force during an earthquake. Manual research is supplemented with computational analysis using programmes like StaddPro and Etabs, among others. To determine where in the building shear walls can be placed to minimise the structural displacement caused by the walls, models are produced. Researching shear wall buildings raises concerns about openings in the shear wall as well. Openings in shear walls tend to cause building displacement. Other studies also found that the attractive forces changed when the shear wall's position changed. No building's shear wall location is morereduces displacements and reduces impact on the structure. Thus, building without shear wall is a subject of concern and need to be retrofitted in places of high earthquake and wind impact.
Future scope of studying this type of research work is an essential part of this review paper. Study of effect of shear wall building and without-shear wall building can be studied further by introducing a flange to column. Comparison can be made with a building without shear wall, with shear wall and with column flanges type structure. Moreover, placement of shear walls at different locations is an essential aspect to be thought of for further study.

REFERENCES

- Dr. B. Kameshwari, Dr. G. Elangovan, P. Sivabala, G. Vaisakh, Dynamic Response Of High Rise Structures Under the Influence Of Discrete Staggered Shear Walls, International Journal of Engineering Science and Technology (IJEST), ISSN: 0975-5462 Vol. 3 No.10 October 2011.
- B. Ramamohana Reddy, M. Visweswara Rao, “Earthquake resistant design of a building using shear wall”. IJMETR, Volume no: 2 (2015), Issue no: 10, October 2015, ISSN no: 2348-4845.
- P. P. Chandurkar, Dr. P. S. Pajgade, “Seismic analysis of RCC Building with and without shear wall”. IJMER, Vol.3, Issue 3, May-june 2013, pp- 1805-1810,2013.

- M. D. Kevadkar and P. B. Kodag, “Lateral Load AnalysisofR.C.C. Building”, IJMER InternationalJournalofModern EngineeringResearch, Vol.3, Issue.3, May-June 2013.
- Anshuman. S, DipenduBhunia and Bhavin Ramjiyani, “Solution of Shear Wall Location in Multi Storey Building”, International Journal of CivilandStructural Engineering, Vol.2, September 2011.
- Romy Mohan and C Prabha, “Dynamic Analysis of RCC Buildings with shear wall”, International Journal of Earth Science and Engineering, Vol.04, No.06, October 2011.
- Seyed M. Khatami, Alireza Mortezaei, Rui C. Barros, Comparing Effects of Openings in Concrete Shear Walls under Near-Fault Ground Motions, The 15thWorld Conference on Earthquake Engineering (2012)
- Venkata Sairam Kumar.N, Surendra Babu.R, Usha Kranti.J, “Shear Wall- A Review”. IJIRSET, Vol. 3, Issue 2, February 2014, ISSN: 2319-8753.
- Varsha R. Harne, Comparative Study of Strength of RC Shear Wall at Different Location on Multi- storied Residential Building, International Journal of Civil Engineering Research.ISSN 2278-3652 Volume 5, Number 4 (2014), pp. 391400.
- Bhruguli H. Gandhi, “Effect of opening on behaviour of shear wall”. IJTRE, Volume 3, Issue 4, December-2015, ISSN: 2347 – 4718.
- S. M. Khatami, A. Kheyroddin “The Effect of Flange Thickness on the Behavior of Flanged- Section Shear Walls”. ELSEVIER, Procedia Engineering 14 (2011) 2994–3000.
- C.V.R. Murty, “Earthquake Tip: 23- Why are Buildings with Shear Walls preferred in Seismic Regions”. IITK-BMTPC Earthquake Tips.
- C. V. R. Murty, Rupen Goswami, A. R. Vijayanarayanan, Vipul V. Mehta, “Earthquake Behaviour of Buildings”. GSDMA, Govetnment of Gujarat, September 2012.

- S.K. Duggal, “Earthquake Resistant Design of Structures”, Second Edition, 2013, Oxford University Press, ISBN- 0-19-808352-1
- IS 13920, (1993), “Indian Standard Code of Practice for Ductile Detailing of Reinforced Concrete Structures Subjected to Seismic Forces,” Bureau of Indian Standards, New Delhi.
- IS 875 (Part 2):1987, Code of Practice for design loads for buildings and structures, Second revision. Bureau of Indian Standards, New Delhi.
- IS 1893:2002 (Part 1), Criteria for earthquake resistant design of structures, Fifth revision. Bureau of Indian Standards, New Delhi.
- IS 456:2000, Plain and reinforced concrete code of practice, Fourth revision, Bureau of Indian Standards, New Delhi.

Innovative Research in Construction Technology for Urban Civil Engineering

Manish Kumar[a], Dr. Sanjeev Gill[b]

[a] Assistant Professor, Deptt. of Civil Engineering JBIT Dehradun, Uttarakhand (India)
[b] Professor, Deptt. of Civil Engineering JBIT Dehradun, Uttarakhand (India)

ABSTRACT

Since reform and opening up, the relationship between India's construction industry and economic market has fundamentally changed, laying a good foundation for updating and reforming indigenous building techniques. market investment. In the construction process of architectural engineering projects, the construction technology theoretical system of civil engineering, which is the basic structure of the entire building, should be studied in detail in the future to fully meet the strategic needs of the modern construction system. It is of great practical significance in that it plays a positive role in maximizing the profits of civil engineering by securing innovation in original and core technologies and focusing on improving civil engineering and building materials. This article comprehensively describes the authority and importance of civil building structural innovation from a global perspective, discusses and shares the structural engineering characteristics of civil engineering in the current era, and continuously deepens and effectively promotes civil engineering structural engineering innovation and reform. Improving the characteristics of buildings based on the summary of the construction experience of engineering oriented towards technological innovation.

1. INTRODUCTION

With the advance of modernization and technology, various new technologies are emerging and spreading, the advantages of traditional civil engineering construction technologies are partially weakened, and new construction technologies are gradually entering people's lives. Innovations in civil construction, in which the construction quality and volume of construction increase, directly push the limits of traditional construction thinking. Therefore, the optimization and perfection of future urban civil engineering technology will be used to eliminate the shortcomings and shortcomings of the traditional technology concept, maintain an effective technology form, and carry out continuous innovation and reform based on many years of practical technology operation experience. With the current resources and technological conditions, new technologies and old elements are precisely combined into a new technological form, adapting to a series of new requirements of "modern engineering innovation", highlighting and deepening civil construction, and representing the reform direction. numbers and the development of all industries to some extent. The need for structural innovations in civil engineering

On the other hand, with the current development of the civil engineering industry in Korea, the status of the whole industry keeps rising and the internal competition is getting fiercer every day. Civil engineering is the main axis of the national economy To take a place in the complex market economy situation, they should be combined to accelerate innovation. In addition, based on the "survival of the fittest system" propagated by the economic market, civil engineering companies must assume two things in order to adapt to the trend of the times, which is very important in the current market environment, and to gain a foothold in modern society. Further promotion of innovations in structural engineering with regard to structural engineering means and technology concepts. [1] In addition to optimizing innovation mechanisms, companies must also continuously improve their sense of innovation. Whether it is the construction industry or the life service industry, companies can produce the best results if they have a strong sense of innovation, including civil engineering, and this sense is maintained at all stages of industrial development. Overall, civil engineering in India is still developing and has some gaps with developed countries. This gap is mainly reflected in two aspects: construction technology and construction management. Compared with other countries, domestic civil engineering in the construction technology they have adopted is seriously lacking in technological innovation. Therefore, civil engineering in India should reexamine its shortcomings and weaknesses from its own point of view, strengthen the consciousness of constant self-innovation, expand the wide development space of civil engineering based on innovation, and at the same time secure the overall quality of the building project. . Nonetheless, it can follow the trends of the times to promote sustainable, healthy and rapid development of the Indian building industry.

2. CHARACTERISTICS AND CURRENT STATUS Of CIVIL CONSTRUCTION TECHNOLOGY

Features of construction technologies of civil engineering

Different from other projects, civil engineering buildings have such features as variety, mobility, stationery and assistance, making it takes the lead in civil engineering construction, and the derived construction technologies of civil engineering are widely promoted and applied. But seen from current status of its practical application, due to regional differences, different regions have different demands on civil engineering construction; quality of construction technologies directly determines quality and safety of the whole project to some extent. [2] Furthermore, during the process of actual development of projects, the determined projects generally cannot be arbitrarily altered except special situations, due to the feature of variety of the project itself; it imperceptibly increases complexity of the project construction. Therefore, in order to effectively guarantee overall quality of the engineering project, work demand one very department should be strengthened; specific position duties of every department should be cleared to improve construction technologies and construction qualities of civil engineering from the real sense.

Currentstatusofconstructiontechnologyofcivilengineeringbuildings

At present, domestic civil engineering has experienced rapid development, especially in recent years, almost the whole country has become a large-scale construction site. Construction Problems New constructions are appearing all the time and the sphere of influence of evil continues to expand, posing a serious threat to the development of the entire building industry in India. For example, in the initial design and planning phase of a project, serious errors in the actual project in the preparation or design of a specific plan due to the lack of experience of the current civil engineering personnel. This not only negatively affects the construction quality of underground buildings, but also leads to a huge waste of investment in the initial construction stage. [2] If the good development of civil engineering is not fundamentally promoted, the management must accelerate the establishment of a complete system of management systems, and strictly control and manage the work content and work quality of each department to effectively manage construction quality. Improve your civil engineering.

Construction technology innovation strategy for urban engineering structures

Building an innovation mechanism

Through an in-depth analysis of the characteristics and current status of civil engineering technology, the importance of innovation in civil engineering technology should be recognized as part of the reform and innovation process of civil engineering technology in the future, and related innovation mechanisms should be prepared. Based on this, it is necessary to organize and complete the staff for innovation projects. Afterwards, various innovative design technologies suitable for corporate development can be researched and developed, and gradually converted into internal core technologies for corporate development. The rapid development of the construction industry and the constant development of construction technology have a direct impact on improving the requirements for comprehensive and professional qualifications of internal staff of architectural firms. proportion and has some passive influence on the innovation of civil construction technology. [3] Therefore, companies must first conduct strict selection and integration of incumbent construction personnel, intentionally recruit technical talent, provide regular or non-regular training for construction personnel, or prepare various training courses and educational activities in the company. Inspire your construction staff to do just that with a variety of vibrant and engaging curricular activities. The professional qualities of the staff must be strengthened to actively engage in research while absorbing new knowledge, new technologies and new concepts. Second, employ eminent professors or industry practice application experts to deepen staff's theoretical knowledge, combine theory and practice, improve design accuracy and regularization, and reduce the frequency of various serious safety accidents. In addition, a corresponding compensation system should be established. Construction workers who perform well should be rewarded with bonuses. In the event of a major accident during construction due to personal fault, it should be severely criticized, employees in serious situations should be dealt with, and timely dismissal by the judicial authorities, work initiative and positive attitude of employees should be fully promoted. Through the implementation of a reward system.

Emphasis on innovative concept of construction technology in civil engineering

In order to ensure the quality and safety of the entire construction process, modern construction enterprises must widely promote the concept of technological innovation in all construction departments, and maintain this concept before and after construction, so that civil construction technology brings advantages. It plays an important role in improving the quality of building projects. In order to convert technological innovation capabilities into tangible profit growth for companies, renewal of architectural engineering skills and improvement of economic benefits for companies are required, which also contributes to improvement of economic benefits for companies. [3] The renewal of civil engineering technology is not only a requirement of the project, but also a development requirement necessary for social development. Some outdated technological means are gradually eliminated as society develops and replaced by some advanced technological means and innovative thinking. Civil engineering industry related departments in India can leverage some advanced overseas experiences and introduce some advanced innovative concepts to improve the quality of civil engineering buildings in India.

Improving the application of innovative technologies

Currently, the introduction and application of advanced construction technology in civil engineering not only affects the quality of civil engineering, but also directly affects the cost and efficiency of the main body. Therefore, in the process of practical development of civil engineering, construction companies should gradually break down the limitations of traditional construction technology concepts and incorporate modern innovative technology concepts into the construction process, such as the construction process of basic project structures. Use construction methods such as steel structures, concrete structures or foundations. Through the continuous innovation of pile anchor support technology, rotary drilling technology, automation technology, post-tensioning technology and boring pile technology, enterprises achieve better development and huge economic development benefits and social benefits. [3] In addition, the application of innovative construction technologies must meet the needs of sustainable development, focus on environmental protection, and scientifically and wisely use various advanced construction technologies to prevent the serious environmental impact of civil construction. to avoid. We realize the harmonious and friendly development of humans and nature.

4. Development trend of construction technologies of municipal civil engineering

Intelligence

With the rapid change and current social progress, modern intelligent information technology is widely used in building construction, and the powerful function of information technology makes construction more convenient and faster. [4] In addition, by using information technology in the field of civil engineering, accuracy and safety can be secured in the material handling process at the construction site, and actual feedback on the construction status of the work site is provided during ground work. The real-time detection system sends personnel to the project detection center to effectively reduce the occurrence of accidents.

Mechanization

Accuracy and efficiency of scientific technology and accounting work by designing and utilizing information and data provided by advanced science and technology at each construction stage, such as initial cost calculation in the actual civil engineering process, to comprehensively realize detection and control of the entire construction environment.

Recording

Due to the diversification of energy sources, the crisis of pollution and energy consumption is becoming more serious. Due to the popularization of energy saving and emission reduction, the feeling of low-carbon energy and energy saving is gradually permeating into all walks of life, and sustainable development is being pursued in all walks of life. It's done. We had a long way to go. Because building projects have high resource consumption, especially the gradual increase in demand for construction raw materials, future civil engineering must gradually develop in an ecological direction to realize and improve the optimization and use of construction raw materials to the fullest. Through scientific construction technology, construction equipment and decoration materials meet people's needs for energy conservation and environmental protection in the current era of green buildings.

CONCLUSION

Against the backdrop of the new era, India's civil engineering development faces many challenges, especially due to conflicts such as short project structure life, lack of security, etc., and the major cause of quality problems is a serious lack of innovation. Construction technology, construction technology improvement, and municipal civil innovation have become the core of development, and technological innovation has become the main method and direction of civil development in India.

REFERENCES

1. CongHe, Pengfei Wang. Future Prospects of Civil Engineering---Brief Discussion on Current Development Status and Development Trend of Civil Engineering [J]. TradeNews2011;16(05):339-341.
2. Ziheng Yi, Ge Bai, Aiping Lin. Discussion on Innovation and Development of Construction Technologies of Civil Engineering [J]. Construction Materials of Jiang xi2016;19(10): 108-110+113.
3. Zhaoyang Xie, Biaozu Yu, Lijun Zhang. Construction Technologies of Concrete Structure in Civil Engineering Buildings [J]. New Technology and New Products of India 2014;11(06):197-199.

Carbon Fibre as a Recent Material for Construction Use

Anil kumar[a], [Mohd]. Yusuf Ali[a]
[a] Assistant Professor, Deptt. of Civil Engineering JBIT Dehradun, Uttarakhand (India)

ABSTRACT

Over the ages as we have evolved, so has our engineering and researching skill sets. Even today, we are constantly innovating, researching and developing technology in pursuit of a sustainable future. Throughout this evolution, researches and engineers have found themselves in constant search for new and better materials to optimally manage the performance cost trade-off in the construction sector. Many new raw materials have been discovered and many ground-breaking composites have been developed, of which not all but some have proved to be a phenomenal success. Carbon fibre is one of these materials, which is usually used in combination with other materials to form a composite. The properties of carbon fibre, such as high stiffness, high tensile strength, low weight, high chemical resistance, high temperature tolerance and low thermal expansion makes them one of the most popular materials in civil engineering possessing strength up to five times that of steel and being one-third its weight, we might as well call it 'the superhero' of the material world.

1. INTRODUCTION

HISTORY:

The 20th century saw a roller coaster ride in the demand for carbon fibre. Threats to peace increased the demand for carbon fibre for defence purposes mid-century. A downturn in defence needs result in a reduction in production of carbon fibre toward the close of the century. By the beginning of the 21st century, new applications and new markets sent the production of carbon fibres on an upswing. Despite a downturn in 2007-2008, worldwide demand increased to approximately 40,000 metric tons in 2010. Carbon fibres have revolutionized the technology of materials. It is no wonder that the National Academy of Engineering voted carbon fibres one of the 20 top engineering achievements of the 20th century and the American Chemical Society named the development of high-performance carbon fibres a National Historic Chemical Landmark in September 2003.

WHAT IS CARBON FIBER?

Carbon fibres are a type of high-performance fibre available for civil engineering application. It is also called graphite fibre or carbon graphite; carbon fibre consists of very thin strands of the element carbon. Carbon fibres have high tensile strength and are very strong for their size. In fact, carbon fibre might be the strongest material. Carbon fibres have high elastic modulus and fatigue strength than those of glass fibres. Considering service life, studies suggests that carbon fibre reinforced polymers have more potential than agamid and glass fibres. They also are highly chemically resistant and have high temperature tolerance with low thermal expansion. and corrosion resistance.

Carbon fibre-reinforced composite materials are used to make aircraft and spacecraft parts, racing car bodies, golf club shafts, bicycle frames, fishing rods, automobile springs, sailboat masts, and many other components where light weight and high strength are needed. Carbon fibre's high strength, light weight and resistance to corrosion make it an ideal reinforcing material.

PROPERTIES OF CARBON FIBER

Carbon Fibre has High Strength to Weight Ratio (also known as specific strength):

Strength of a material is the force per unit area at failure, divided by its density. Any material that is strong and light has a favourable Strength/weight ratio. Materials such as Aluminium, titanium, magnesium, Carbon and glass fibre, high strength steel alloys all have good strength to weight ratios. It is not surprising that Balsa wood comes in with a high strength to weight ratio. The following figures are offered for comparison only and will vary depending on composition, alloy, type of spider, density of wood etc. The units are kN.m/kg.

TABLE 2.1-CARBON FIBRE HAS HIGH STRENGTH TO WEIGHT RATIO (ALSO KNOWN AS SPECIFIC STRENGTH)

Spectra fibre	3619
Kevlar	2514
Carbon Fibre	2457
Glass Fibre	1307
Spider Silk	1069
Carbon Epoxy Composite	785
Balsa axial load	521
Steel alloy	254
Aluminium alloy	222
Polypropylene	89
Oak	87
Nylon	69

Note that strength and rigidity are different properties, strength is resistance to breaking, and rigidity is resistance to bending or stretching.

Carbon Fibre is very rigid: Rigidity or stiffness of a material is measured by its Young Modulus and measures how much a material deflects under stress. Carbon fibre reinforced plastic is over 4 times stiffer than Glass reinforced plastic, almost 20 times more than pine, 2.5 times greater than aluminium. For more information on stiffness and how it is measured, plus a comparison table of different materials see my Young Modulus page.

Carbon fibre is Corrosion Resistant and Chemically Stable: Although carbon fibre themselves do not deteriorate, Epoxy is sensitive to sunlight and needs to be protected. Other matrices (whatever the carbon fibre is imbedded in) might also be reactive.

Carbon fibre is electrically Conductive: This feature can be useful and be a nuisance. In Boat building It has to be taken into account just as Aluminium conductivity comes into play. Carbon fibre conductivity can facilitate Galvanic Corrosion in fittings. Careful installation can reduce this problem. Carbon Fibre dust can accumulate in a shop and cause sparks or short circuits in electrical appliances and equipment.

Carbon Fibre at Home: The uses of carbon fibre in the home are as broad as your imagination, whether it is style or practical application. For those who are style-conscious, it is often tagged as 'the new black'. If you want a shiny black bathtub built from carbon fibre, or a coffee table then you can have just that, off the shelf. iPhone cases, pens and even bow ties – the look of carbon fibre is unique.

CONCLUSIONS

1. Carbon fibre plates are thin, strong and flexible; they can be designed and installed to provide a cost-effective solution which does not detract visually from the original design of the structure.
2. It has high stiffness, high tensile strength, low weight, high chemical resistance, high temperature tolerance and one of the most popular materials in civil engineering.
3. It possesses strength up to five times that of steel and being one-third it weight.
4. It has more applications in civil engineering, military, sporting goods, in medical, in automobile industry, etc. so use of carbon fibre in construction is always effective and provides high strength to the structure.

REFERENCES

1. Sha Yin (et al) "hybrid truss concepts for composite pyramidal lattice structures", vol. part B 43(2012), page no.1749-1755.
2. D.J. Bull (et al) "A comparison of multi-scale 3D X-ray tomographic inspection techniques for assessing carbon fibre composite impact damage", vol.75(2013) page no.55-61.

3. Mohit Sharma (et al) “Influence of fibre-matrix adhesion and operating parameters on sliding wear performance of carbon fabric polyether sulphone composites”, vol.271(2011), page no.2919-2927.
4. Salazar “Micro biosensors for glucose based on Prussian Blue modified carbon fibre electrodes for in vivo monitoring in the central nervous system”, vol.26(2010), page no.748-753.
5. Sang Yoon Park “Effect of vacuum thermal cyclic exposures on unidirectional carbon fibre/epoxy composites for low earth space applications”, vol.43 (2012)726-738.

A Review on Seismic Effect on Building Wall

Dr.Sanjeev Gill[a] , Mohd Yusuf Ali[b]
[a] Professor, Deptt.of Civil Engineering JBIT
Dehradun,Uttarakhand (India)
[b]Assistant Professor, Deptt.of Civil Engineering JBIT Dehradun,
Uttarakhand (India)

ABSTRACT

Earthquakes are the most volatile and distressing natural disasters. Shear walls are the most commonly used method for earthquake-resistant multistory structures. A shear wall is a structural component that can be found anywhere in a building, from the foundation to the top parapet level, and is used to protect against lateral forces that are parallel to the plane of the wall. Shear walls are structural members used to prevent lateral forces caused by earthquakes and wind. This paper provides a review of various researchers' work on the concept of multistory buildings with and without shear walls. Shear wall structures are the most commonly used type of earthquake resistant structures in India. The design and utility of these structural walls differ, and their position in any building plays an important role in resisting lateral force.

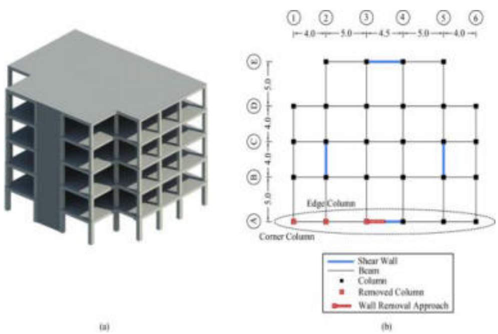
Key Words: Shear Wall, Non- Shear wall Building, Earthquake, Lateral Forces

INTRODUCTION

Earthquakes in general have a long history of wreaking havoc. Essentially, the response of the structure to ground motion is an important factor to consider when analyzing and designing any earthquake resistant structure. The loads or forces that a structure subjected to earthquake motions is required to resist, as well as the distortions caused by the movement of the ground on which it rests. Earthquakes can be measured in terms of energy release i.e. measuring amplitude, frequency, and location of seismic waves and also by evaluating intensity i.e. considering the destructive effect of shaking

ground on people, structures and natural features.
A building's properties include lateral stiffness, lateral strength, and ductility. Although the stiffness of the building decreases with increasing damage, lateral stiffness refers to the initial stiffness of the building. Lateral strength is the maximum resistance that a building has offered to relative deformation over its entire history. The ratio of maximum deformation to idealized yield deformation is referred to as ductility towards lateral deformation. Except in cantilevers, the effect of the vertical component of ground motion is generally regarded as insignificant and is ignored.

Shear wall and its properties:- A shear wall is a structural member located in various locations throughout a building, from the foundation level to the top parapet level that is used to resist lateral forces, i.e. forces parallel to the plane of the wall. Shear walls can be built from a variety of materials, but reinforced concrete (RC) buildings frequently include



vertical plate-like Reinforced concrete walls (Figure 1) in addition to slabs, beams, and columns. In high-rise buildings, their thickness can range from 150mm to 400mm. Shear walls are typically installed along both the length and width of building.

FIGURE 1:- SHEAR WALL IN BUILDING

These walls are more important in seismically active areas because shear forces on the structure increase during earthquakes. Shear walls should be stronger and stiffer. Shear walls are strong and stiff enough to control lateral displacements. Shear walls serve a dual purpose in that they serve as both lateral and gravity load-bearing elements.

Concrete shear wall structures are typically regular in plan and elevation.

Purpose:

These walls are mainly used

- To resist lateral loads of earthquake and wind.
- To resist gravity or vertical loads due to its self-weight and other living or moving loads.
- To resist shear as well as uplift forces on the building.
- To enhance the strength and stability of a structure.
- To provide adequate stiffness to the structure.

Forces on Shear Wall:

These walls mainly resist two types of forces;

1. Shear Force: Shear forces are generated in buildings due to ground movement and lateral forces such as wind, waves and earthquakes. These forces act throughout the height of the wall between the top and bottom wall connections.

2. Uplift Force: Uplift forces are produced on shear walls due to horizontal forces act on the top of the wall. These forces lift up one end of the wall and push the other end down.

Advantages of Shear Walls in RC Structures:

- Shear walls are resisting to horizontal lateral force and earthquakes.
- It has high in-plane stiffness and can resist lateral loads.
- Shear walls help in the control of deflection in vertical and longitudinal directions.
- RCC shear walls are simple for reinforcement detailing
- It reduces earthquake damage to all types of structural and non-structural structures.
- Well-designed shear walls not only provide adequate safety, but also a high level of protection against costly non-structural damage during moderate seismic events.

LITERATURE REVIEW

Concrete shear walls are the most common and useful shear wall type for any multistory building. Many researchers and scholars have studied the shear wall configuration in any building and the different types of shear walls. The resistance of a shear wall to lateral forces generated by an earthquake and wind force is studied. An effort was made to study these literatures and reach a conclusion on this topic.

Dr.B.Kameshwari et.al

analyzes the impact of erosion and erosion between the floor of the building on the various configurations of shear wall panels on high-rise buildings. The blank frame is compared to various

configurations such as i) Normal shear wall ii) Different shear wall layout iii) Diagonal layout of the barber window iv) Zig Zag haircut arrangement v) Impact of lifting the middle barber wall. From the study it was found that the Zig Zag shear wall improves the strength and durability of the structure compared to other models. In earthquake-prone areas the shear diagonal wall has been found to work well in the building.

B. R. Reddy et.al

use Stadd Pro software to analyze and design earthquake-resistant structures using Shear wall. According to their research work, the construction made of shear walls not only provides extra strength but also increases the strength limits and efficiency of horizontal loads. Shaving walls have unusual behavior on a variety of loads. The research project was approved at the VITS block college building, Deshmukhi town Hyderabad using a shear wall. The behavior of the structure was assessed for the strength of the element, the reaction, the shearing center, the shear strength and the bending moment. A shear wall solution in a multi-storey building based on both stretchable and elas- to-plastic behavior was also considered. The number of earthquakes was calculated and used in the same 3-storey building with 3 floors. The results of the models are calculated and analyzed for the effective area of the barber wall. After comparing the result it was found that the provision of a shear wall for this building would make the building completely resistant to earthquakes in zone II
Hyderabad. In addition to the fact that the manual and STAAD Pro

results are almost identical, the STAAD Pro results save a significant amount of reinforcement..

P. Chandurkar et.al.

investigated a building with Shear wall and outside Shear wall was considered and compared. As their research work The building walls provide an efficient binding system and provide great strength to withstand side load. The structures of these seismic shear walls control the structural response; therefore, it is important to evaluate the seismic response correctly. According to their research, the main focus was on finding a solution for the barbecue area in a multistory building. The function of the barber wall was studied with the help of four different models. One model was a blank frame structure system and the other three models were a two-dimensional structure. While the seismic load is used in the construction of the ten stories found in zone II, zone III, zone IV and zone V, parameters such as Lateral migration, story flooding and the total amount of cost required for the ground floor were calculated in both column-changing cases. . E-Tabs software accepted for review. From the analysis, it is noted that in the 10-story building, building a barbed-wire building in a short corner (model 4) will be economical compared to other models. So the large size of the barber wall does not apply to 10 cases or to less than 10 buildings. It was noted that the shear wall is economical and effective in high construction. From the research work it was noted that changing the location of the shear wall will affect the attraction of energy, so that wall should be in the right condition. And if the shear wall size is large then a large amount of horizontal force is taken by the shear wall. Providing shear walls in adequate areas greatly reduces migration due to earthquakes.

M. D. Kevadkar and P. B. Kodag

performed a lateral load analysis of the R.C.C. Build (G + 12) by considering 3 models. In this model 1 it has no bracing and shear wall, the second model with a different shaving wall system and the 3rd Model with Different bracing system computer-assisted analysis was performed using E-TABS to determine the effective back load system during major earthquakes. places. Property performance is assessed in terms of Lateral Displacement, Storey Shear and Storey Drift, Base shear and Demand Capacity (Workspace).

Anshuman.S et al.

determined the shear wall solution in a multi-storey building based on its elastic and elastoplastic behavior.

The magnitude of the earthquake is calculated and applied to the 15-story building in zone IV. The elastic and elastoplastic analysis was performed using both the STAAD Pro 2004 and SAP (2000) software packages. The shear strength, bending time and scaling of the story were calculated in both cases and the location of the shaving wall was established based on the results.

Romy Mohan et al.

presented Dynamic Analysis of RCC buildings with Shear Wall. for analysis consider the two multi storey buildings, one of six and other of eleven storeys have been modeled using software package SAP 2000 for earthquake zone V in India. Six different types of shear walls with its variation in shape are considered for studying their effectiveness in resisting lateral forces. This paper also deals with the effect of the variation of the building height on the structural response of the shear wall.

Manoj S. Mendhekar et.al.

mentioned ways in which the economy could be achieved to withstand the burden of the parties in a multi-storey building. In their study, seismic behavior, mechanisms of failure, and factors influencing structural responses were discussed. Many expressions were developed to measure the flexible strength of the smaller rectangular wall sections with straight reinforcement evenly distributed. In this study various aspects of the design and design of the barbers are discussed, and different types of barbers are discussed and their methods of failure. Algebraic expressions for calculating the flexibility of the shear wall sections were developed and a temporary interactive loading diagram was developed using these expressions. The results of both approaches have been quite positive. Also the details of the composite wall were also mentioned and the difference between the solid shear wall and the jointed wall (open bar wall) was investigated. And the power-calculating relationships on the shaving wall of its design are shown. From their research it became clear that parts of the wall of the shear flang were expanded to be analyzed and designed and are very suitable.

Syed.M.Katami et.al

presented the results of time history analysis which addressed the effect of openings in shear walls near- fault ground motions. A model of ten storey building with three different types of lateral load resisting system: Complete shear walls, shear walls with square opening in the centre and shear wall with opening at right end side were considered. From the results it was observed that shear walls with openings experienced a decrease in terms of strength. The maximum lateral displacement of complete shear wall is 17% less than that of shear walls with openings at centre whose displacement is found to be 8% less than that of shear walls with openings at right end.

Venkata Sairam Kumar.N et.al.

reviewed various papers on shear walls and stated that shear walls are structural systems which provide stability to structures from lateral loads like wind, seismic loads. These structural systems are constructed by reinforced concrete, plywood/timber unreinforced masonry, reinforced masonry at which these systems are sub divided into coupled shear walls, shear wall frames, shear panels and staggered walls. The paper was made in the interest of studying various research works involved in enhancement of shear walls and their behaviour towards lateral loads. As shear walls resists major portions of lateral loads in the lower portion of the

buildings and the frame supports the lateral loads in the upper portions of building which is suited for soft storey high rise building. Building which are similar in nature constructed in India, as in India base floors are used for parking and garages or officers and upper floors are used for residential purposes. They have concluded with a broad note that researches was carried mainly on application of cyclic load tests and behaviour of different types of shear walls in cyclic application of loads. Researchers studied various parameters like enhancement of stiffness, drift, development forces in buildings and also to observe perfect location of shear wall location in building frame for construction. It was seen that any type of building which is tall and can be affected with lateral forces like earthquake and wind forces can be constructed with shear walls. Shear walls can be used as lateral load resisting systems and also retrofitting of structures. Internal shear walls are more efficient than external shear walls when compared with cyclic load tests by researchers.

Varsha.R.Harne

considered a six storey RCC building which is subjected to Earthquake loading in zone II to determine the strength of RC wall by changing the location of shear wall using STAAD.Pro. Seismic coefficient method is used to calculate the earthquake load as per IS 1893 – 2002 (Part I). Four different models like structure without shear wall, structure with L type shear wall, structure with shear wall along periphery, structure with cross type shear wall were modeled for analysis. Compared to other models the shear force and bending moment, for structure with shear wall along the periphery is found to be maximum at the ground level and roof level respectively. Hence the shear wall provided along the periphery of the structure is found to be more efficient than all other types of shear wall.

Bhruguli H. Gandhi

explored the behavior of the barber wall openings under the action of an earthquake load. In this study, it is said that barbering walls are usually found on the sides of buildings or arranged in the form of a staircase that holds stairs and elevators. Due to operational requirements such as doors, windows, and other openings, the barber wall in the building contains many holes. Most apartment building, size and openings in the shear wall are made without considering its effect on the behavior of the building structure. In this study, the study was performed on 6-story frame-shear wall structures, using a straightforward stretch analysis with the help of a limited object software, StaddPro under earthquake loads in the same vertical analysis. Six types of models were created and analyzed, from the beginning, Concentric 20% opening, 40% focus opening, 50% focus opening, 60% focus opening, Eccentric opening 20%, Zigzag opening -20%. The results reveal that the strength and vibration of buildings are affected by the size of the spaces and their locations on the barbecue wall. It is also tested that the high lateral inclination of the system can also be reduced by thickening the element in the model near the opening of the shaft wall. From a survey percentage of
Opening increases deviation up to 40% on average but after that as the opening percentage increases deviation increases much faster. At 20% opening the Eccentric zigzag has a slight deviation and the Eccentric Straight has a higher deviation and the loaded load has a smaller

deviation than the Eccentric Straight. And the opening raises the lower pressures also increases equally by up to 40% and then after the Stresses increase significantly.

S.M. khatami et.al.

investigative the effect of flange thickness on nonlinear behavior of flanged shear walls. Four T-shape flanged shear walls were studied and analyzed using finite element method. The total volume of each model is similar, such that when thickness decreases in the model, the length of wing increases. The results indicated that in the presence of lateral loads, the thickness has a significant effect on the shear absorption, ductility, displacement and crack pattern of the flanged shear walls. Numerical results show that shear walls with thick flanges behave more efficient than walls with thin flanges. It was found that, lateral strength resisted by shear walls with thin flanges is 1250 kN which is 14 percent decrease compared with thick flanged wall. Moreover, nonlinear behavior of flanged shear wall with thick flanges shows that strength and ductility are equivalent. Finally, the analyses indicated that while flange is in pressure, the global behavior is much more improved compared with condition which is in tension. The comparison of models indicated that finite element model used in this study is capable of predicting the nonlinear behavior of the models when these are different thickness. Results of analysis in four models and load-displacement of them indicated that model named -2500TSW had better behavior. It had resisted about 1248 kN. This load is 14% higher than other models. Also, ductility of this model showed a good agreement. Ductility in the model-2500TSW model is
4.58 which is 3% higher than model-3100TSW. Results of analysis showed that model-3100TSW had better strength after yield, which was 18% higher than model- 2500TSW. Crack pattern in all of models showed that increase of thickness could decrease crack in shear wall.

3. CONCLUSIONS

From the above study it can be concluded that, different researchers had studied different type of problems related to earthquake and addressed that shear wall are more prominent to resist lateral force due to earthquakes. Analysis by software's such as StaddPro, Etabs etc. are also combined along with manual studies. Models are generated and shear walls are located at different positions in building

to find the least displacement of the structure due to shear walls. Openings in shear wall are also an issue of concern of study of shear wall buildings. Generally openings provided in shear walls increase displacement in building. Moreover some researches stated that change in positions of shear wall effect the attraction of forces. Location of shear wall in any building substantially reduces displacements and reduces impact on the structure. Thus building without shear wall is a subject of concern and need to be retrofitted in places of high earthquake and wind impact.
Future scope of studying this type of research work is an essential part of this review paper. Study of effect of shear wall building and without-shear wall building can be studied further by introducing a flange to column. Comparison can be made with a building without shear wall, with shear wall and with column flanges type structure. Moreover placement of shear walls at different locations is an essential aspect to be thought of for further study.

REFERENCES

1. Dr. B. Kameshwari, Dr. G. Elangovan, P. Sivabala, G.Vaisakh, Dynamic Response Of High Rise Structures Under the Influence Of Discrete Staggered Shear Walls, International Journal of Engineering Science and Technology (IJEST), ISSN : 0975-5462 Vol. 3 No.10 October 2011

2. B. Ramamohana Reddy, M. Visweswara Rao, "Earthquake resistant design of a building using shear wall". IJMETR, Volume no: 2 (2015), Issue no: 10, October 2015, ISSN no: 2348-4845.

3. P. P. Chandurkar, Dr. P. S. Pajgade, "Seismic analysis of RCC Building with and without shear wall". IJMER, Vol.3, Issue 3, May-June 2013,pp- 1805-1810,2013.

4. M. D. Kevadkar and P. B. Kodag, "Lateral Load Analysis of R.C.C. Building", IJMER

5. International Journal of Modern Engineering Research, Vol.3, Issue.3, May-June 2013.

6. Anshuman. S, Dipendu Bhunia and Bhavin Ramjiyani,

"Solution of Shear Wall Location in Multi Storey Building", International Journal of Civil and Structural Engineering,Vol.2,September 2011.

7. Romy Mohan and C Prabha, "Dynamic Analysis of RCC Buildings with shear wall", International Journal of Earth Science and Engineering,Vol.04, No.06, October 2011.

8. Manoj S. Medhekar, Sudhir K. Jain, "Seismic behaviour design and detailing of RC shear wall, Part 1: Behaviour and Strength". The Indian Concrete Journal, July 1993.

9. Seyed M. Khatami, Alireza Mortezaei, Rui C. Barros, Comparing Effects of Openings in Concrete Shear Walls under Near-Fault Ground Motions, The 15thWorld Conference on Earthquake Engineering (2012)

10. Venkata Sairam Kumar.N, Surendra Babu.R, Usha Kranti.J, "Shear Wall- A Review". IJIRSET, Vol. 3, Issue 2, February 2014, ISSN: 2319-8753.

11. Varsha R. Harne, Comparative Study of Strength of RC Shear Wall at Different Location on Multi- storied Residential Building, International Journal of Civil Engineering Research.ISSN 2278-3652 Volume 5, Number 4 (2014), pp. 391400.

12. Bhruguli H. Gandhi, "Effect of opening on behaviour of shear wall". IJTRE, Volume 3, Issue 4, December-2015, ISSN: 2347 – 4718.

13. S. M. Khatami, A. Kheyroddin "The Effect of Flange Thickness on the Behavior of Flanged- Section Shear Walls". ELSEVIER, Procedia Engineering 14 (2011) 2994–3000.

14. C.V.R.Murty , "Earthquake Tip: 23- Why are Buildings with Shear Walls preferred in Seismic Regions". IITK-BMTPC Earthquake Tips.

15. C. V. R. Murty, Rupen Goswami, A. R. Vijayanarayanan, Vipul V. Mehta, "Earthquake Behaviour of Buildings". GSDMA,

Govetnment of Gujarat, September 2012.

16. S.K. Duggal, “Earthquake Resistant Design of Structures”, Second Edition, 2013, Oxford University Press, ISBN- 0-19-808352-1

17. IS 13920, (1993), “Indian Standard Code of Practice for Ductile Detailing of Reinforced Concrete Structures Subjected to Seismic Forces,” Bureau of Indian Standards, New Delhi.

18. IS 875 (Part 2):1987, Code of Practice for design loads for buildings and structures, Second revision. Bureau of Indian Standards, New Delhi.

19. IS 1893:2002 (Part 1), Criteria for earthquake resistant design of structures, Fifth revision. Bureau of Indian Standards, New Delhi.

20. IS 456:2000, Plain and reinforced concrete code of practice, Fourth revision, Bureau of Indian Standards, New Delhi.

Recent Advancements in Reinforced Fiber Polymer Bars for Civil Construction

Dr. Sanjeev Gill[a] , Ankit Kumar Joshi[b]

[a] Professor, Deptt.of Civil Engineering JBIT Dehradun, Uttarakhand (India)
[b]Assistant Professor, Deptt.of Civil Engineering JBIT Dehradun, Uttarakhand (India)

ABSTRACT

Corrosion poses a significant threat to the integrity of concrete structures, leading to safety hazards and costly repairs. This study explores the potential of Fiber Reinforced Polymer (FRP) as a solution to improve the structural performance of corroded concrete. The research investigates the effects of corrosion on conventional reinforced concrete and highlights the benefits of incorporating FRP materials, specifically Glass Fiber Reinforced Polymer (GFRP) bars, in reinforcing structures. The study addresses the corrosion resistance, high strength-to-weight ratio, non-conductive properties, and other desirable characteristics of GFRP. Additionally, it examines the durability and usability of this innovative material, considering its susceptibility to alkaline environments, modulus of elasticity, and brittleness. By evaluating the existing body of knowledge, this research aims to enhance our understanding of FRP's potential to mitigate corrosion-related damage in concrete structures.

Keywords- *Reinforcement, Corrosion, Structure, Steel, Reinforced Polymer.*

INTRODUCTION

Reinforcement has become the fundamental unit of construction today which is used in numerous ways, some of the larger and better known uses including roadways, bridges, car parks, residential buildings and in industry; for example it is widely used in nuclear power plant. It is in general an excellent construction material. Concrete alone is good in compression, but reinforced concrete greatly increases the scope for making structures required to withstand other form of mechanical forces.

In a small percentage of instances reinforced concrete may deteriorate prematurely, but so widespread is the use of the material that problems can be encountered in a wide range of individual applications. It is reliably reported that in North America there are now some 300,000 concrete bridges requiring repairs, with costs estimated in terms of billions of dollars, in addition to the roadways and car parks requiring remedial attention. There are also lesser but significant problems with reinforced concrete in Europe and the Middle East. In India too around 60% of reinforced concrete structures require repair work which is harm to economy of our country. From a financial aspect the future costs over the next few decades for repairs and replacement throughout the world are likely to be staggeringly high. One is tempted to ask why, if reinforced concrete has been used for so long, is it only now that problems are arising, predominantly, though not exclusively, associated with corrosion of the reinforcing steel bars, or rebars as they are commonly called. Corrosion loss consumes considerable portion of the budget of the country by way of either restoration measures or reconstruction. Moreover, the repair operation themselves are quite complex and require special treatments of the cracked zone, and in most instances the life expectancy of the repair is limited.
Accordingly, corrosion monitoring can give more complete information of changing condition of a structure in time. Hence, protection of reinforcement from corrosion will ensures that the structure serves for desired service life. Engineers need better techniques for assessing the condition of the structure when the maintenance or repair is required. These methods need to be able to identify any possible durability problems within structures before they become serious.

2. CORROSION MECHANISM & REASONS

Corrosion is an electrochemical process. In this process oxidation of Iron (Fe + +) molecules naturally occurs immediately after the bars are manufactured and exposed to the atmosphere and will continue long as sufficient oxygen and moisture are available to react with the steel. So corrosion is consists of an anode and cathode process. Following are some reasons of corrosion of reinforcement.

Water Permeability:

It is the single largest factor for ignition and propagation of corrosion. Water not only takes part in chemical reaction but also works as a carrier for transporting harmful chemicals to concrete and rebars such as chloride ions. Higher permeability reduces resistivity of concrete. If the surface of the concrete is subject to long-term wetting, the water will eventually reach the level of the reinforcement, either through diffusion through the porous structure of the concrete, or by traveling along cracks in the concrete. Concrete roof decks, by their nature, are meant to be protected from moisture. However, the presence of moisture on roofing systems may result from failure of the roofing membrane, poor detailing of drainage facilities, or lack of maintenance of drainage facilities.

FIG.1: CORROSION IN REINFORCEMENT

Oxygen Permeability

Oxygen is very much an essential part for corrosion to occur; it also plays an important role in setting up corrosion cells. Oxygen permeability produced due to cracks, difference in cover thickness and heterogeneityof concrete.

Carbonation

In the major cause of corrosion, Carbonation of concrete has dual effect or reducing the alkalinity of concrete as well as releasing more water. Effect of carbonation increases with porosity of concrete, period of exposure and reduces with moisture in surrounding area. t is well known that if bright steel is left unprotected in the atmosphere a brown oxide rust quickly forms and will continue to grow until a scale flake from the surface. This corrosion process will continue unless some external means is provided to prevent it. One method is to surround the steel with an alkaline environment having a pH value within the range 9.5 to 13. At this pH value a passive film forms on the steel that reduces the rate of corrosion to a very low and harmless value. Thus, concrete cover provides chemical as well as physical protection to the steel. Concrete is permeable and allows the slow ingress of the atmosphere; the acidic gases react with the alkalis (usually calcium, sodium and potassium hydroxides), neutralizing them by forming carbonates and sulphates, and at the same time reducing the pH value. If the carbonated front penetrates sufficiently deeply into the concrete to intersect with the concrete reinforcement interface, protection is lost and, since both oxygen and moisture are available, the steel is likely to corrode. The extent of the advance of the carbonation front depends, to a considerable extent, on the porosity and permeability of the concrete and on the conditions of the exposure.

Chloride Ingress:

The best known and most damaging factor leading to corrosion is the chloride ingress (i.e. chloride entrance) most of failures are attributed it this structures in cold climates where salt is used as deicing agent has reportedly shown distress due to this factor. The chloride ingress can be by diffusion, capillary suction as well as by permeation. Diffusion of chloride ions occurs through slow moments through simple absorption can suck in large amounts of chloride permeation of chloride ions is through cracks in concrete. Chloride ions react with iron compound and create an iron – chloride complex (fecl2) which also react with hydroxides (OH-) and form hydrated iron oxide compounds. Simultaneously oxygen (O2) reacts with water (H2O) and formed hydroxides. Together, these two reactions form a corrosion cell. At low levels of chloride in the aqueous phase, the rate of corrosion is very small, but higher concentration increases the risks of corrosion.

3. COROSION IN RCC STRUCTURES

FIG.2 CORROSION IN RC STRUCTURE

Remedial Measures

The deterioration of concrete may be due to either corrosion of concrete/ reinforcement steel or formation of expansive chemical compounds such as calcium silicate hydrate (C-SH) or ettringite in aggressive environments. The loss due to corrosion of steel is heavy. To produce the durable concrete and resist the harmful effects of aggressive environment, the concrete should be produced with almost care. The following steps, implemented scientifically will help to produce durable concrete.
By Adopting the rich mix:
Adopting the Best Mix Proportion:
Increasing Depth of Concrete Cover to Reinforcement Concrete Coating and Sealers
Galvanizing
Fusion Bonded Epoxy Coating (FBEC) Coating of Re bars

4. FIBER REINFORCED POLYMER REINFORCING BARS (FRP)

FRP Bars are intended for use as concrete reinforcing in areas where steel reinforcing has a limited life span due to the effects of corrosion. They are also used in situations where electrical or magnetic transparency is needed. In addition to reinforcing for new concrete construction, FRP bars are used to structurally strengthen existing masonry, concrete or wood members. Corrosion of steel reinforcement in concrete structures causes deterioration of concrete resulting in costly maintenance, repairs and shortening of the service life of structures. Government agencies throughout the world have recognized the potential benefits to society if our infrastructure can last longer and are thus funding significant amounts of research in the field of FRP's. Corrosion of steel reinforcement in RCC makes its use very limited in corrosive environment, and it becomes important to choose such a reinforcing material which is non-corrosive. FRP re bars have demonstrated strong promises in this context. The main advantage of FRP is its excellent corrosion resistance, very high strength to weight ratio, and its non-Magnetizing/conductive nature, etc. FRP has also become more popular because of its diverse varieties available in the market. However for these advanced composite material with above advantages having some limitations also, FRP is a material having low elastic modulus, it shows linear stress vs strain behavior up to failure with no discernible yield point, and hence shows large deflections and wide cracks when loaded, reduced ductility of RCC members causes brittle failure. FRP is typically a two-component composite material consisting of high strength fibres embedded in a polymer matrix.

FIG.3 FRP BAR

The use of FRP reinforcements for concrete structures depends on their ability to perform reliably under service loads, the mechanical properties, e.g., strength and toughness properties, of the reinforcements are the most important properties if the reinforced structures are used as load-bearing members. It is known that for reinforced concrete structures the presence of FRP reinforcements may have little effect on the initiation of a crack, but they do provide considerable resistance to both propagation and opening of the crack. Cracks generally initiate at the locations where the principal tensile stress (or the strain energy release rate) exceeds the material tensile strength (or the fracture toughness) under service loads. Further propagation of these cracks will depend on the distributions and magnitudes of both principal tensile stress and material fracture resistance. In general, the mechanical performance, failure modes, and loading capacity of a reinforced concrete structure depend on, not only its structural geometry and loading conditions, but also the amount, location, and orientation of the FRP reinforcement used.

Fiber Reinforced Polymer (FRP) Composites

Fiber-reinforced plastic (FRP) (also *fiber- reinforced polymer*) is a composite material made of a polymer matrix reinforced with fibers.

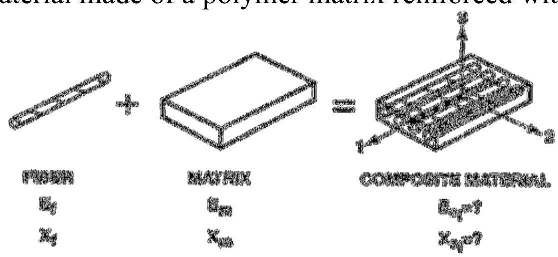


FIG.4 FRP COMPOSITES

The fibers are usually glass, carbon basalt or aramid although other fibers such as paper or wood or asbestos have been sometimes used. The polymer is usually an epoxy, vinylester or polyester thermosetting plastic and phenol formaldehyde resins are still in use. In the last decade, there has been a considerable increase in the interest of FRP (Fibre Reinforced Polymers) for concrete reinforcement in the construction industry. The most frequently used fibres for FRP reinforcement are carbon (CFRP), aramid (AFRP) and glass (GFRP). The most obvious benefit of FRP is that, unlike steel it is not susceptible to carbonation- or chloride- initiated corrosion in concrete. This fact makes the use of FRP reinforcement an interesting option for increasing the service life of concrete structures in severe environments. However, unlike steel FRP reinforcement may deteriorate due to the alkaline environment of concrete. The following chart shows the stress-strain relationship for various fiber materials in use.

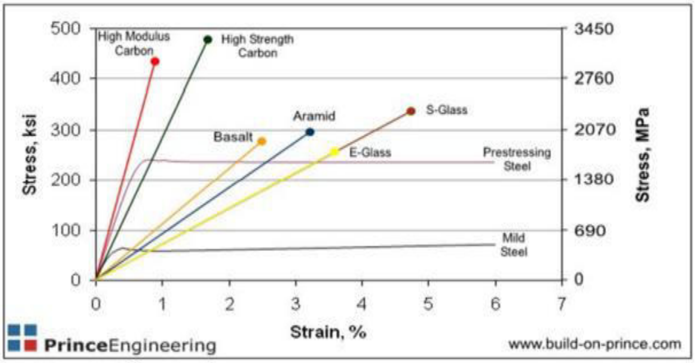


FIG.5 STRESS-STRAIN CURVE OF FRP BAR

Durability of FRP Reinforcement

FRP rebar is a composite material made up of high strength fibers embedded in a protecting matrix. It possesses very high strength to weight ratio and non- conductive/magnetizing nature. Glass Fiber Reinforced Polymer (GFRP) is an economically viable form of FRP and is being promoted widely as reinforcement for concrete. GFRP rebars are available in the market with high ranges of strength (up to 1500 MPa). FRP rebars are available in different surface texture (i.e. ribbed, sand coated, deformed, etc.) to achieve better bond strength with concrete and are manufactured by pultrusion process GFRP bars can be used in the area like coal and mining industries, tunneling, coastal construction, road construction, corrosive construction, etc. Fibre reinforced polymer (FRP) reinforcing bars offer a potentially attractive alternative to steel reinforcing bars. The former are non-corrosive and generally of a higher strength than their steel counterparts, however, at the expense of no ductility (i.e. no yield point and plastic plateau) and a reduced modulus of elasticity in the case of glass FRP (GFRP) bars. Fibre reinforced polymer bars have most commonly been used in aggressive environments such as coastal environments and water treatments plants instead of steel. Such structures may include dry-docks, sea walls, wharfs, box-culverts, reinforced piles, floating piers, tanks, facades, and retaining walls. Use of FRP bars has been made in Canada in recent years in bridge decks and roads owing to the seasonal use of de-icing salts which causes traditional steel reinforcement to corrode. Some concrete structures may be required to be devoid of metal, like all other engineering materials, FRP reinforcements can also be subjected to mechanical and physical deterioration throughout its life. When FRPs are used as reinforcement within concrete members, they can be expected to be exposed to a variety of potentially harmful physical and chemical environment. Although FRPs are not susceptible to electrochemical corrosion, it can be significantly damaged by other chemical or physical form of degradation if used improperly. The mechanical,physical and bond properties of FRP reinforcement may alter or remain unchanged in a particular combination of chemical and physical exposure condition. Unfortunately, durability of FRPs is not a straight forward issue and even might be more complex than corrosion of steel. Durability of FRPs depends on fiber type, resin type and their interface bond behavior. Furthermore, there are a variety of types of FRPs available commercially in the market thus different fibers and resins are characterized by their different behavior in elevated temperatures, environmental exposure and long-term phenomena. Durability of this material is severely affected by highly alkaline environment of concrete (pH=12.4-13.7), moisture and aqueous solutions, elevated temperature, freeze-thaw cycles, ultra-violet (UV) radiation, fatigue and impact loads Lots of research are going on in this context, but reliable design rules are still lacking.

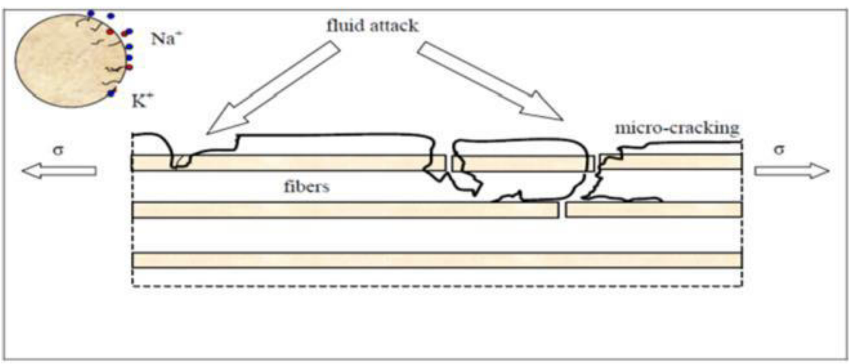


FIG.6 EFFECT OF ENVIRONMENTAL EXPOSURE

5.CONCLUSION

FRP seems to outperform steel reinforcement in corrosion resistance. Yet, past investigations show this material has major limits that make it incompatible with concrete. This experiment will examine these constraints. This study examines GFRP reinforced concrete beam durability and serviceability. Serviceability was determined by deflection and cracking. Three exposures tested the durability of GFRP reinforced beams.

Recent research has focused on the durability and serviceability of GFRP reinforcement and GFRP reinforced concrete members. Despite contradicting literature, no consensus has been achieved. This context's results are restricted and unclear. . Note that a durable material does not necessarily have good serviceability and vice versa. So, both features must be examined to determine this material's compatibility with concrete.

Hence, this work describes GFRP reinforced beam durability and serviceability experiments. This study examined FRP properties and exposure types for GFRP and steel tensile specimens and GFRP reinforced beams. Based on this, the study examines GFRP reinforced concrete beam serviceability and durability.

REFERENCES

1. Jeremy Lewis, The effects of corrosion in reinforced concrete with addition of fibres , The University Of Akron, December 2012

2. Clarke JL, editor. Structural design of polymer composites—EUROCOMP design code and handbook. UK: St Edmundsbury Press; 1996.

Building Materials for Water Proffing

Seema Rani[a] , Anil kumar[a]

[a]Assistant Professor, Deptt.of Civil Engineering, JBIT Dehradun Uttarakhand (India)

ABSTRACT

A man-made structure includes drawings, scales, quality control, construction and proper maintenance, which are used to support the various benefits of human society. The level of construction is a major factor and an important task that must be addressed and avoided prior to the demolition of the building. Water-related problems are silent killers and play a significant role in maintaining and maintaining the structure. Water can penetrate deep into the stone or concrete floor of the basement by capillary action. It is possible for water to seep into the ground at any point, depending on the strength of the concrete and the fullness of the outer surface. Each building can be selected as it also deals with the care issues involved outside of natural resources. Water is a major source of degradation or damage to a building. Due to the harmful effect of water, special attention should be given to the selection of high quality waterproofing materials to provide optimal performance. The life of waterproof materials is much shorter than the life of construction. This paper covers the use of waterproofing materials and identifies the types of waterproofing materials we commonly use.

Keywords *— waterproof materials, harmful water effect, construction quality.*

INTRODUCTION

Waterproofing is basically a process designed to prevent water from entering a building. It is the construction of an invincible barrier on foundations, roofs, walls, and other elements of a building. The function of the inert barrier is to prevent water ingress. The building's structures are waterproof and sometimes waterproof.

The waterproofing is usually done in different layers and sections to create more barriers to prevent water from entering the building. It helps to keep the building dry. Thus, it also protects the structure from damage caused by moisture and water exposure. The building is waterproofed through membranes and holes to protect the contents of the floor or inside and to protect the integrity of the building. A combination of such categories is referred to as creating a “Building Envelope”. Therefore, the compatibility of the materials, their interaction, the connection of the enclosed spaces of the buildings also judged the performance of the structure. And this performance is greatly hampered by external climatic factors, where rainwater and site flow play a major role. Therefore, protection from the weather, seapages from the ground and direct flow of water into the building can be effectively protected by the proper use of a waterproofing system.

Modern water protection systems deal with stable structures with a dual course in its operation at the well. Various and specific coats with specific chemical concentrations allow the process to perform many functions, easily. The same energy saving effect occurs due to the use of materials involved in this process. This includes coatings on the exterior and floor walls, which reduces the flow of heat to the building and thus reduces the burden of improving indoor air quality and space atmosphere. Waterproofing systems can also be referred to as "building protection and renovation" or "renewable engineering", due to their versatility and value. Waterproofing is not only a big part of the building process but also preserves the dignity of the landscape. (Grading here means extensively identifying, controlling and improving the area for proper construction). Therefore, the waterproofing system applies not only to the entire construction envelope, but also to certain parts of the building.

The need for waterproofing

It would not be wrong to say that a building is a living entity that needs proper care and attention. Also, problems with moisture and water should be avoided.

Water problems in a building can damage the building in the following ways:

1. Seapage using wall hangings, sill, extensions, brickwork joints, etc.
2. Absorption of groundwater in the basement and basement.
3. Explosion of pipes within the wall or under the ground floor.
4. Capillary protrudes from walls, joints, and columns.

How can you tell if your building has a waterproofing problem?

If there are any visible signs in the building, make sure we have a waterproofing problem.
1. Wet and wet walls
2. Growth of mold and mildew
3. Signs of decay
4. Mixing water
5. Water leak on the roof / roof
All of these problems can not only destroy the exterior of a building but also damage its interior and the foundation.

Benefits of waterproofing
1. It keeps the structure dry and strong.
2. The building becomes more comfortable to live in as it reduces internal humidity.
3. No damage to objects due to moisture and water vapor.
4. Sturdy and durable structure.

Types of waterproofing materials
It is important to treat your property as if you were choosing the right waterproof material. Therefore, you should analyze and understand the types of waterproofing materials for your building.
Polyurethane
This is used to prevent water from roofing. The polyurethane liquid membrane provides high flexibility, with many benefits such as:
1. Filling of capillary cracks.
2. Reduce water absorption in concrete.
3. Liquid strengthens the surface concrete.

Application Areas:
- Water tanks
- Pedestrian stairs
- The roof
- Bridges
- Parking area

Cementitious waterproof coating
This app provides a very simple program. The mixture contains sand, silica, organic chemicals, and inorganic chemicals. Also, these substances are combined with the function of lime as a sealant.

Application Areas:

- Water treatment plants
- Ports and harbors
- Parking area
- Channels

Bituminous waterproof membrane

Also known as bituminous coating, or asphalt coating, this membrane works effectively against water infiltration. Bituminous is mixed with natural adhesives. Therefore, its viscous quality makes it a very strong waterproofing material for the roof.

There are two ways to use bituminous:

1. **Roll roofing material method**
2. **Roofing felt method**

EPDM rubber

This waterproofing material is a synthetic rubber material made of propylene and ethylene. Typically, experts associate an EPDM rubber solution with a silicone compound. However, both vary depending on the chemical composition, use, and characteristics.

Also, EPDM rubber is highly adaptable and recyclable.

Application Areas:

- The roof
- Windows
- Wood

Rubberized Asphalt

Another excellent waterproof chemical, Rubberized Asphalt works effectively to protect buildings. The strength, flexibility, and resistance to moisture and the penetration of this vapor make it extremely durable and suitable for structural treatment.

Application Areas:

- The roof
- Plazas
- Parking spaces
- Terrace

Thermoplastic Waterproofing
One of the most effective waterproof materials is thermoplastic. This solid solution provides long-term protection in buildings. Therefore, its anti-inflammatory factor makes it suitable for all heavy treatments.
Application Areas:

- Decks
- Elevator pits
- Fountains

PVC membrane
This feature is often used to prevent water from roofing. Its vapor-permeable material gives it extra strength. The base of the PVC membrane uses polyester mesh or glass fiber.
Application Areas:

- The roof
- Tunnels
- Swimming pools
- Underground structures

Waterproofing paints
Waterproof paint protects the house from environmental damage and improves the health of the building. Therefore, it remains water resistant or completely waterproof. Waterproof paint can be used inside buildings in bathrooms, kitchens, basements, etc. Therefore, it could protect the bathroom and the basement from leaks and excess moisture.
The waterproof paint bathroom wall prevents moisture from entering the walls. Therefore, these paints are preferred over conventional paints as the first one will not stand firm against wet conditions as before. In addition, once moisture has penetrated the walls, mold and mildew will damage the structure and cause health problems.

Types of waterproofing paint

Epoxy paint for waterproofing

Epoxy waterproofing paints use strong chemicals to combat very wet conditions and protect the surface. They make waterproof paint on roofs and water-repellent paints.

Masonry waterproof paint

Made of a mixture of latex and ceramic paint, waterproof masonry paint is often used for roofing. Also, this paint absorbs chemicals and other liquids easily like water and prevents them from getting inside. It also provides cement with waterproof chemicals.

Acrylic waterproof paint

This type of paint is best suited for roofs and terraces made of rectangular blocks. Also, this paint on the roof and the balcony harmonizes and drains the water on the surface. Additionally, waterproofing paint is non-toxic and easy to apply.

PROCESS OF WATERPROOFING

Waterproofing is done horizontally, above the structure, retaining respiratory equipment, to prevent the flow of water and the rise of capillary water in it. The interior displays the water content of the structure and externally forms a protective film around it. Typically, the construction of a waterproofing system is done by creating many barriers to stop the ingress of water, so that it cannot enter the building. This development of multiple layers, materials and methods in them creates a kind of "envelope" of structure around the building. This envelope can be treated as a permanent feature or measure of a green structure by avoiding the ingress of excessive heat from the atmosphere. This can be done by applying various paints, adhesives and other finishes as well as blending that helps create a transition between outside and inside temperatures. This transition between temperatures helps the structure in the following ways:

- Small differences between indoor and outdoor temperatures cause minor weather symptoms and protect the building. This is done in such a way that the effect of compaction or expansion during the various seasons in the material construction of the building is reduced, by matching the room temperature with the external temperature.

- Reduce the burden on the HVAC system, and other procedures that a building occupant often uses to keep the room temperature stable. These reductions can best be attributed to energy savings, drinking water consumption and other utilization of resources. This usually moves the building to a green place.

TYPES OF WATERPROOFING METHODS

There are some common types of waterproofing methods used in construction industry. Waterproofing in buildings/structures is generally required for:

- Basement of structure
- Walls
- Bathrooms and kitchen
- Balconies, decks
- Terrace or roofs
- Green roofs
- Water tanks
- Swimming pools

The following waterproofing methods are commonly used in construction:

1. Cementitious Waterproofing
2. Liquid Waterproofing Membrane
3. Bituminous Membrane
4. Bituminous Coating
5. Polyurethane Liquid Membrane

1. CEMENTITIOUS WATERPROOFING METHOD:

Cementitious waterproofing is an easy way to prevent water from forming. Cement waterproofing materials are readily available in the market. This method is often used in wet indoor areas such as toilets. This method is usually a solid or flexible type that prevents water, but as it is used in indoor areas such as toilets, it is not exposed to sunlight and weather. Therefore, waterproofing with cement does not exceed the contract and the expansion process.

APPLICATIONS OF CEMENTITIOUS WATERPROOFING:
Cementitious waterproofing is used in the following type of structures:

1. Water Treatment Plants
2. Sewage Treatment Plants
3. Bridges
4. Dams
5. Railway & Subway Systems
6. Marine Cargo Ports & Docks
7. River Locks/Channels & Concrete Dykes
8. Parking Structures & Lots
9. Tunnels

LIQUID WATERPROOFING MEMBRANE METHOD:

Liquid membrane is a thin layer that usually includes the first coat and two coats of top coat used with a spray, roller, or trowel. It offers more flexibility than cementitious types of waterproofing. The liquid heals into a rubber wall. The elongation properties of coating can reach as high as 275%. The durability of a waterproof coat depends on the type of polymer the manufacturer uses to make the liquid waterproofing.
A waterproof membrane can be a liquid-coated liquid coated with polymer-modified asphalt. Polyurethane liquid membranes for different levels of trowel, roller, or spray are also available from various manufacturers.

2. BITUMINOUS COATING WATERPROOFING METHOD:

Bituminous coating is a type of coating used for waterproofing and flexible protective coat according to its composition and polymerization stage. Its flexibility and water protection can be influenced by the polymer level and fiber reinforcement. Bituminous coating is also called asphalt coating. The most common applications for bituminous coatings include areas under wet screed. It is an excellent protective agent and waterproofing agent, especially in areas such as concrete foundations. Bituminous coating is made of bitumen-based materials and is not suitable for exposure to the sun. They become very brittle and weak when exposed to prolonged exposure to the sun unless they are prepared with flexible materials such as polyurethane or acrylic-based polymers. The flexibility of the finished products always depends on the solid polymer content added to the bitumen.

3. **BITUMINOUS MEMBRANE WATERPROOFING METHOD:**

Waterproofing of bituminous membranes is a popular method used for low-grade roofing due to their guaranteed performance. Bituminous membrane waterproofing has a flashlight on the lining and adhesive membranes. Adhesive composites include asphalt, polymers and fillers; in addition, certain resins and oils may be added to improve adhesion properties. The self-adhesive type has a lower shelf life as membrane binding structures shrink over time. The torch on the membrane is exposed and covered with types. Exposed membranes usually contain granular mineral aggregate to withstand the aging and degradation of the weather and other types of membrane, the contractor needs to install a single protective screed to prevent membrane perforations.

4. **POLYURETHANE LIQUID MEMBRANE WATERPROOFING METHOD:**

The polyurethane liquid membrane waterproofing method is used for the flat roof area and is weatherproof. This method of waterproofing is expensive. The Polyurethane Liquid Membrane can provide high flexibility. Polyurethane is very sensitive to existing moisture, so before installing, one should be very careful checking the moisture content of the concrete slab, otherwise peeling or cracking of the membrane may occur after some time.

CONCLUSION

Water damage can be a major problem in a building. With water come moulds and a host of other problems that can damage the foundations, make building structures unsafe, and damage property inside the building. Wooden structures can decompose quickly due to water exposure, but water infiltration can also damage concrete and other building materials, especially in cold areas where water can freeze and create cracks. Insufficient waterproofing can be a problem year-round, not just during the rainy season. Some permeability in a building is desired, not least because building occupants generate humidity which must be safely vented. The goal of building waterproofing is to prevent as much water as possible from entering the building, and to provide outlets and drainage so that if water does get inside, it is not allowed to sit.

REFERENCE

1. Ar. Soma anil Mishra, Ar. prakool soni, Dr.R.K. Pandit (2014) 'water proofing system in construction, vol. 3, pp. 2321-2241.
2. Paul C. lanteri (2003) 'sealant joint rehabilitation.vol.21.
3. Khalid M. shaheen, leena j. sedeeq. (2013) 'effect of two component acrylic coating on intial water absorption of concrete surface'. vol.2, pp.38-45.
4. T. Subramani, a. Anbuchezian. (2017) 'water proofing concrete by using fake snow powder' vol.6, pp.2319- 4847.
5. Abhishek G H, lokesh J K. (2016) 'evaluation of different kinds of integral water proofing compounds as per IS codes' vol.5, 2219-8753.
6. Annu baby, Jeena Mathew. (2016) 'studies on properties of concrete with various waterproofing compounds'vol.21, 2278-1684.
7. Saurabh borle, gadget (2016) 'comparative study of conventional and morden water proofing techniques', Volume: 5 Issue: 1, pp. 32-36.
8. Richard Pkadlubowski AiA. (2010) 'water proofing' Vol. 27.

9. A. Geetha P. perumal (2011) ‘chemical reaction of waterproofing admixtures on the corrosion behavior of reinforced cement concrete’ (2014), pp. 407-411.
10. Dhiren J Panchal Nehal H shah ‘water proofing challenges and suggested temedial measures for high rise buildings’ (2015) vol-10.
11. Li Jiye, construction quality problems and prevention measures [M]. China Building Materials Industry Press.2003
12. Tomas u. ganiron. (2013) ‘influence of polymer fiber on strength of concrete, vol.55.
13. JC/T894-2002.SBS tire modified polyester felt waterproofing membrane[S]
14. Building materials (third ed.) [M]. Beijing: China ArchitecturalIndustry Press, 2003

Problems and Technological Solutions for Urban Drainage Network

Anil kumar[a], Manish Kumar[a]

[a]Assistant Professor, Deptt. of Civil Engineering, JBIT Dehradun, Uttarakhand (India)

ABSTRACT

The concentration of the inlet wastewater of urban sewage treatment plants is much lower than the expected level in the design stage, mainly because of the problems of construction, management and maintenance of the drainage systems. Through investigation of the urban drainage pipelines, primary problems of drainage network damage, local unreasonable elevation design, pipe blockage and drainage system confusion, etc. were found. Combining the local actual situation, some corresponding engineering and management measures and some feasible suggestions for drainage pipe construction, management and maintenance are put forward.

INTRODUCTION

Purpose: Providing adequate drainage in urban areas has been proven as a necessary component in maintaining the overall health, welfare, and economic well-being of a region. Drainage is a regional feature that affects multiple jurisdictions and all parcels of land. It is important to develop drainage policy that balances both public and private considerations. Certain underlying principles should be applied when planning drainage facilities. These principles apply to both water quantity and water quality management. Policy statements and technical criteria serve as the implementation tools for the underlying drainage principles.

Objectives: Drainage, flood control, and water quality protection. Drainage represents only one component of a larger urban system. The objectives are with respect to drainage, flood control, and water quality protection is to:

a. To protect the general health, safety, and welfare of the residents of the region.
b. To minimize property damage from flooding, including minimization of localized neighbourhood flooding.
c. To ensure that new buildings and facilities are free of flood hazard from major and smaller storm runoff events.
d. To minimize water quality degradation by limiting the amount of sediment generation and erosion of channels.
e. To encourage the retention of open space, particularly along natural drainage ways.
f. To plan for large and small flooding events by providing both major and minor drainage systems.
g. To implement reasonable, cost-effective best management practices (BMPs) for sediment control and water quality enhancement.
h. To manage stream and drainage channel corridors to maintain environmental diversity and to protect buildings and facilities from damage by channel erosion.
i. To stabilize channels to, among other things, minimize the disruption of existing infrastructure such as bridges and utility lines.
j. To comply with the applicable National Pollutant Discharge and Elimination System (NPDES) permit requirements.
k. To develop equitable methods to adequately fund construction, operation and maintenance, and administration of an up-to-date storm water management program.
l. To minimize future operating and maintenance expenses.
m. To educate the public on storm water policies and administrative procedures.
n. To build a regional storm water program based on understanding and cooperation with builders and developers, providing for effective administrative authority for the cities, counties and P-MRNRD.

Planning concepts: The following general principles apply when planning for and designing urban storm drainage systems (ASCE, 1992):

Drainage requires a regional solution: Drainage is a regional phenomenon that does not respect the boundaries between government jurisdictions or between public and private properties. Therefore, a successful plan must integrate regional jurisdictional cooperation, where applicable, to accomplish established goals

Storm drainage is a sub-system of the total urban system: Drainage is a sub-system of all urbanization. The planning of drainage facilities must be included in the urbanization process. The first step is to include drainage planning with all regional and local urban master plans. Storm water management facilities, such as open channels and storm drains, serve both conveyance and storage functions. When a channel is planned as a conveyance feature, it requires an outlet as well as downstream space to safely convey and mitigate adverse impacts from the design flows. The space requirements for adequate drainage may become a competing use for space with other land uses. If adequate provision is not made in the land use plan for the drainage requirements, storm water runoff will conflict with other land uses, will result in water damages, and will impair or even disrupt the functioning of other urban systems (Tulsa, 1993).

Urban areas have two drainage systems: Urban areas are comprised of two drainage systems. The first is the minor or primary system, which is designed to provide public convenience and to accommodate relatively moderate frequent flows. The other is the major system, which carries more water and operates when the rate or volume of runoff exceeds the capacity of the minor system.

Runoff routing is a space allocation problem: Analysis and design of drainage systems generally should not be based on the premise that problems can be transferred from one location to another.

Storm water runoff as a resource: Storm water runoff and the facilities to accommodate the runoff can be an urban resource when properly included in the urban system. Drainage ways can provide environments for various life forms such as aquatic life, mammals, birds, and vegetation. In many cases the drainage facilities can provide areas for active and passive recreation for citizens to enjoy. Although sometimes a liability to urbanization, storm water runoff can be beneficial as an urban resource. When storm water runoff is treated as a resource, water quality aspects become important. As such, it is important to implement best management practices (both structural and non-structural) for water quality and effective erosion and sediment control.

The problems of drainage network: The following problems were recognized through four months deep investigation into the drainage network.

1. Sewer damage Sewer was damaged by transformation of roads and bridges, construction of water pipes and gas pipes, crossover operation of sewer pipes.
2. Sewage pipes experienced deforming, disjoint, sink, water leakage and some other relevant issues, hence finally result in collapse of surrounding roads.
3. Unreasonable local elevation design Sewage only piled up in the pipes and even refluxed because the elevation design is unreasonable in the sewage pipe junctions.
4. Severe blockage of pipe networks the blockage in the sewer pipes which are not conducive to sewage collection was generally made of construction waste (such as stone, cement), mud, plastic, foam, etc.
5. The scour capability of low-speed flow is not high enough to rush the blockages into downstream pipe network thus garbage was easily stored in the slow flow pipe which forms a vicious cycle and results in more serious siltation.
6. The silting of the inverted siphon pipe across the river is the most serious part. To illustrate, a section of DN600 inverted siphon which was jammed by a large number of sand bags and garbage led to cross section reduction around 20cm2 and cut down the transmission capacity of the sewage.
7. Improper flap valve installation
8. The installation of flap valve is rigorous. It must be tilted installed at a bias angle between 8°–15° to make it function well under stress. The flap valve does not open freely for its aging. And it is opened by the bricks in order to drain the flood during the monsoon, so that the river water flows into the pipe network through the flap valve.
9. Quality problems of inverted siphon pipes in south China, there exists high density river network; it is commonly seen that inverted siphon pipes are used in the sewage network engineering.
10. The old inverted siphon pipes are made of steel reinforced concrete. In spite of its low cost, its permeability, subsidence-resistance and

seismic-resistance are quite limited. The inverted siphon pipes are embedded under the river bed, bearing pressure for a long time, which makes the wall of pipes cracked easily.

11. Manholes and manhole cover Manholes are always covered by construction site. As to the manhole covers, some problems do exist: firstly, the manhole covers are easily breaking for their using low-quality material manufacturing; secondly, some manhole covers experienced difficulty in opening after a long time enclose; thirdly, it is hard to distinguish sewage wells from rainwater wells and water supply wells due to irregular management.

12. Wasted rivers the functions of a river are mainly described as landscape in town. However, they are usually formed to receive the domestic sewage and waste water due to a series of difficulties such as lack of capital, planning and poor construction conditions. It attributes to the damage of the original functions and the ecological environment of river. Meanwhile, rainwater and river water are likely to enter drainage networks through wasted rivers.

13. Disorder of drainage system some non-professionals (such as real estate developers, construction workers) who do not understand the role of rain water pipes privately discharge sewers into rain water pipes without the application license, registration and approval, resulting in rain water mixed with sewers.

14. Some communities which should have had separate drainage systems have appeared the case that rain and sewage mixed under inadequate community supervision and regulatory measures and, lax supervision of final acceptance.

15. Incomplete drainage network construction the dirt holding rate is approximately 40% at present, which is way to reach the standard of 70%, indicating that the drainage network construction is incomplete.

16. It is still commonly seen that sewage was discharged directly to the rivers in some places, especially in the country side, further enhancing the pollution of rivers.

CONCLUSIONS

5. Carbon fibre plates are thin, strong and flexible, they can be designed and installed to provide a cost-effective solution which does not detract visually from the original design of the structure.

6. It has high stiffness, high tensile strength, low weight, high chemical resistance, high temperature tolerance and one of the most popular material in civil engineering.
7. It possesses strength up to five times that of steel and being one-third it weight.
8. It has more applications in civil engineering, military, sporting goods, in medical, in automobile industry, etc. so use of carbon fibre in construction is always effective and provide high strength to the structure.

REFERENCES

6. Sha Yin (et al) “hybrid truss concepts for composite pyramidal lattice structures”, vol. part B 43(2012), page no.1749-1755.
7. D.J. Bull (et al) “A comparison of multi-scale 3D X-ray tomographic inspection techniques for assessing carbon fibre composite impact damage”, vol.75(2013) page no.55-61.
8. Mohit Sharma (et al) “Influence of fibre-matrix adhesion and operating parameters on sliding wear performance of carbon fabric polyether sulphone composites”, vol.271(2011), page no.2919-2927.
9. Salazar “Micro biosensors for glucose based on Prussian Blue modified carbon fibre electrodes for in vivo monitoring in the central nervous system”, vol.26(2010), page no.748-753.
10. Sang Yoon Park “Effect of vacuum thermal cyclic exposures on unidirectional carbon fibre/epoxy composites for low earth space applications”, vol.43(2012)726-738.

Sustainibility of Building Materials

Bhaskar Singhal[a], Anil Kumar[a]
[a] Assistant Professor, Deptt. of Civil Engineering, JBIT Dehradun, Uttarakhand (India)

ABSTRACT

Sustainable development is one of the most important topics in construction industry. Building materials largely determine the buildings' energy consumption and environmental impacts, and have a significance impact on the sustainability of buildings. Based on the analysis of the environmental impacts of building materials and related academic research conclusions, this research proposes the selection criteriaof sustainable building materials for reference.

INTRODUCTION

Environmental economics and sustainable development have always been the focus of attention since 1970s and many environmental discussions have focused on the concept of ecologically sustainable development (ESD).

Construction process has a great impact on the depletion of natural resources and greenhouse gas (GHG) emissions caused by fossil fuel combustion, thus affecting global climate change and ozone depletion.

Sustainable development of construction industry

ESD is an efficient use of resources to meet current and future production needs while minimizing adverse impacts on the natural environment. The use of sustainable building materials, which is a way for the construction industry to contribute to protect the environment, has become the key point to minimize the environmental impact and achieve sustainable development.

Achieving sustainable architecture is not to limit the total amount of buildings, but to pay more attention to how sustainable building design and material selection and improve occupants' living condition. Berge (2009) pointed out that the ideal goal for a sustainable future is the reduction and replacement of raw material use, which is especially important when considering scarce and non- renewable resources. It is also important to reduce waste and loss in material processing, construction and throughout the building's whole life cycle. In addition, the recycle method during demolition must also be carefully planned and regulated, in order to ensure that these materials can be properly disposed and maintained to their original condition rather than being abandoned.

Environmental impacts of building materials

The construction industry consumes about 24% of the world's raw materials and a large amount of energy Traditional building materials, including steel, concrete, aluminum and glass, are all high- energy materials. The building uses a variety of materials at different stages and the choice of materials used in a building will affect its life cycle performance in turn. Therefore, the designer's choice of raw materials during the design phase can play an important role in the life cycle impact of the building Many studies have recognized the importance of material selection, making low-energy materials more considerable than building's operating energy. Choosing materials with high energy consumption will consume more energy in the initial production process and also lead to higher levels of greenhouse gas emissions. However, according to the results of Saghafi and Teshnizi (2011), the choice of sustainable building materials is a more difficult and challenging task, which reflect the environmental factors of building materials and construction technology. And it is also an unknown area with a large number of variables and uncertainties involved in analyzing and developing the environmental impacts of building materials.

Building materials have an impact on both the building and the natural environment throughout their life cycle. It is essential to select sustainable materials in the early stages of design, establish strategies for sustainable building materials and conduct market research. It is also suggested that the selection of materials will affect the overall performance of buildings, and sustainable building materials should be considered at an early stage from a life-cycle perspective. The life cycle of building materials is from cradle to grave, which is closely related to the life stages prior to the use of the building, including the extraction of raw materials, the manufacturing and transportation process, and the maintenance and renovation requirements during building operation.

Academic research

The selection of building materials is very important in buildings' life cycle assessment. The selection of building materials is not only closely related to the overall construction energy consumption in the production process, but also the overall energy consumption in the operating stage. If the material has the potential to be recycled or reused, the construction energy consumption can also be appropriately reduced.

Many studies have confirmed that construction industry consumes the most energy and releases greenhouse gases. With the development of building technology and manufacturing process, theenergy intensity of building materials has decreased, resulting in a significant reduction in energy consumption per unit area of production and manufacturing of building materials .

Concrete materials are one of the most commonly used materials in the construction area. Studies have shown that the initial construction energy consumption of concrete materials is relatively small while the overall construction energy consumption is very high due to the huge amount of concrete used in buildings. Asif et al. take Scottish dwellings as a prototype to analyze eight types of building materials (wood, concrete, glass, aluminum, slate, ceramic tile, gypsum board, moisture barrier and mortar), and the results show that concrete contributes to the highest energy consumption (up to 61%) , and wood and ceramic tiles account for 14% and 15% of the total energy, respectively;

meanwhile, the carbon dioxide emissions of concrete reach 99% of the total residential emissions.

It is also indicated that building materials with low initial construction energy consumption may not reduce the building's whole life cycle energy consumption. For example, although using wood has a positive effect on reducing environmental impacts such as carbon dioxide, some studies show wood will eventually be incinerated or landfilled, and thus will lead to carbon dioxide emissions into the environment. In an LCA study in New Zealand , three residential buildings of the same design were analyzed, but the materials used for the structures were different. The results revealed that the initial energy consumption of concrete structure and super thermal insulation building is higher than that of light structure (wood structure) by 8% and 14% respectively, but the whole life cycle energy consumption of concrete and super thermal insulation structure is lower than that of light structure by 5% and 31% respectively.

Even if the same raw materials are used, the material usage and the internal energy consumption are different through different processing methods. At the same time, building materials with lower initial building energy consumption may not produce lower full life cycle energy consumption. For example, one study conducted LCA analysis on two seven-story residential buildings that also used concrete, but one case used cast-in-place concrete and the other case used precast concrete. Precast concrete slabs have an environmental impact of 12.2% less than cast-in-place concrete, as precast concrete slabs can achieve greater spans between beams, reducing the number of mains and foundations, and reducing the amount of concrete used in the building.

In addition, methodologies such as the reuse of materials such as materials and ecological materials have recently attracted academic attention. Erlandsson etal. studied a new method of recycling materials and argued that if the basic functions are the same, then the strategy of reusing this material is better for the environment than building a new building. Some studies have reviewed the literature on the selection of existing building materials and proposed a simplified method for assessing the environmental load associated with the selection of product materials, i.e., the materials are divided into glass, ceramics, non-ferrous metals, non-ferrous metals, paper, and polymers. And wood, and durable, renewable materials as an alternative, can also promote reuse techniques and methods.

Criteria for the selection of sustainable building materials

Although many research are attempting to solve the problem of material selection, there is no uniform definition of “sustainable building materials” so far. Esin (2007) and Franzoni (2011) points out that sustainable building materials are materials related to resource and energy efficiency in the manufacturing process, and these materials should have little pollution and no negative impact on human health. Abeysundara et al. develops an evaluation matrix to help decision makers balance environmental, economic and social factors in sustainable materials assessment; Anastaselos et al.'s research takes environmental, economic and social aspects into consideration during the thermal insulation evaluation. Therefore, the design standards for sustainable building materials are mainly divided into the following aspects.

Firstly, sustainable building materials are often natural materials with low energy consumption and low maintenance costs, and should be easily dismantled and recyclable during demolition. The embodied energy consumption of building materials includes initial energy consumption and recurred energy consumption. The former is associated with the energy consumed in the construction phase, and the latter refers to the energy consumption required during the operation phase, including the processes of material replacement, repair and maintenance during the effective life cycle. However, the energy consumption of building materials is not only related to the embodied energy consumption of raw materials recycling and building materials processing, but also related to construction energy and transportation energy during on-site construction. The intensity of energy contained in building materials depends on energy, technology use and manufacturing processes, and will vary from region to region and from manufacturer to manufacturer. Low maintenance requirements could be achievedby the durability of design or repairing existing building materials to extend buildings' life cycle.

Secondly, sustainable materials should be environmentally friendly and reduce environmental hazards without releasing pollutants or other emissions that affect human health and comfort throughout the life cycle. Nowadays, indoor conditions have an important impact on the health, well- being and performance of users, as people often spend more than 90% of the time indoors. It is obvious from the research that building materials are an important factor in determining indoor air quality, among which formaldehyde and other volatile organic compounds (VOCs) released from building materials have serious adverse effects on human health, comfort and productivity. Materials containing pollutants may have adverse effects throughout their life cycle, affecting workers during the production process, affecting the occupants of the building during the use phase, and causing pollution during recycling and terminal treatment. Therefore, sustainable building materials are materials with low or no emissions of carcinogens, regenerating noxious substances or irritants,and have no negative impact on the building and the natural environment.

In addition, sustainable building materials are mainly derived from renewable energy sources, not non-renewable energy sources. They should also be sustainable throughout their life cycle and use less energy in the manufacturing process.

CONCLUSION

The selection of suitable building materials is an integral part of architectural design as the key point of design is to meet the users' health and comfort needs and to coordinate it with the materials' inherent characteristics. Assessing the characteristics and environmental impacts of building materials is the core of sustainable architecture, and designers are paying more attention to material selection. There will be more opportunities if materials could be taken into account early in the construction stage, i.e. at the development stage of the various codes and work plans.

REFERENCES

[1] Balderstone, S. (2004) 'Built heritage: a major contributor to environmental, social and economic sustainability', Sustainability Forum Discussion Paper.

[2] Bribian, I.Z., Capilla, A.V. and Uson, A.A. (2011) 'Life cycle assessment of building materials: comparative analysis of energy and environmental impacts and evalu- ation of the eco- efficiency improvement potential', Building and Environment, 46, 1133–1140.

[3] Thormark, C. (2006) 'The effect of materials choice on the total energy need and recycling potential of a building', Building and Environment, 41, 1019–1026.

[4] Saghafi, M.D. and Teshnizi, Z.S.H. (2011) 'Recycling value of building materials in building assessment systems', Energy and Buildings, 43, 3181–3188.

[5] Esin, T. (2007) 'A study regarding the environmental impact analysis of the building materials production (in Turkey)', Building and Environment, 42, 3860–3871.

[6] Zhang Y, He C Q, Tang B J, et al. China's energy consumption in the building sector: A lifecycle approach [J]. Energy & Buildings, 2015, 94:240-251.

[7] Blengini GA, Di Carlo T. The changing role of life cycle phases, subsystems and materials inthe LCA of low energy buildings. Energy Build 2010; 42 (6):869–80.

[8] Asif M, Muneer T, Kelley R. Life cycle assessment: a case study of a dwelling home inScotland. Build Environ 2005; 11: 023.

[9] Utama A, Gheewala SH. Indonesian residential high-rise buildings: a life cycle energy assessment, Energy Build 2009; 41 (11):1263–8.

[10] Peuportier BLP. Life cycle assessment applied to the comparative

evaluation of single-family houses in the French context. Energy Build 2001; 33 (5):443–50.

[11] Mithraratne N, Vale B. Life cycle analysis model for New Zealand houses. Build. Environ 2004; 39 (4):483–92.

[12] López-Mesa B, Pitarch Á, Tomás A, Gallego T. Comparison of environmental impacts of building structures with in situ cast floors and with precast concrete floors, Build. Environ 2009; 44 (4):699–712.

[13] Erlandsson M, Levin P. Environmental assessment of rebuilding and possible performance improvements effect on a national scale. Build Environ 2005; 40 (11):1459–71.

[14] Esin, T. (2007) 'A study regarding the environmental impact analysis of the building materials production (in Turkey)', Building and Environment, 42, 3860–3871.

[15] Abeysundara, Y., Babel, S. and Gheewala, S. (2009) 'A matrix in life cycle perspective for selecting sustainable materials for buildings in Sri Lanka', Building and Envi- ronment, 44, 997–1004.

[16] Anastaselos, D., Giama, E. and Papadopoulos, A.M. (2009) 'An assessment tool for the energy, economic and environmental evaluation of thermal insulation solu- tions', Energy and Buildings, 41, 1165–1171.

[17] Frontczak, M. and Wargocki, P. (2011) 'Literature survey on how different factors influence human comfort in indoor environments', Building and Environment, 46 (4), 922–937.

[18] Li, F. and Niu, J. (2005) 'Simultaneous estimation of VOCs diffusion and partition coefficients in building materials via inverse analysis', Building and Environment, 40 (10), 1366–1374.

Construction of Water Proof Buildings

Bhaskar Singhal[a] , Ankit Kumar Joshi[a]

[a] Assistant Professor, Deptt. of Civil Engineering. JBIT Dehradun, Uttarakhand (India)

ABSTRACT

A man-made structure is comprised of many parts, including plans, scales, quality control, construction, and regular maintenance. These elements are used to underpin the wide range of advantages provided by human societies. The degree of construction must be dealt with before demolition can begin, since it is both a major factor and a huge responsibility that must be avoided. Water problems are silent killers, and they have a major impact on how the structure is cared for and preserved. Water can travel large distances through the stone or concrete of the basement floor due to capillary action. Water can seep into the ground at any point; how often this is depending on the concrete's strength and how full the exterior surface is. Each building meets the requirements because, in addition to addressing the care challenges at hand, it also prioritises the sustainable use of natural resources. Water is one of the leading causes of damage to buildings and structures. The damaging potential of water necessitates giving considerable thought to the selection of water-resistant materials of the highest possible quality. Waterproofing materials have a much shorter lifespan than the building they are installed in. This page explains why and how waterproofing materials are used, as well as outlining the different types of waterproofing materials.

Keywords *— Water resistant material, harmful capillary movement, water proofing materia*

1.INTRODUCTION

Buildings are waterproofed. It seals foundations, roofs, walls and other building parts. Watertight structures exist. Waterproofing keeps water out. Buildings stay dry. It protects the building. water damage. Membranes and perforations waterproof the building's contents and structure. "Building Envelope" refers to such categories. Thus, the structure's performance was also determined by material compatibility, interaction, and building enclosures. Rainwater and site flow considerably impact this performance. Thus, a waterproofing system can protect the building from weather, groundwater, and direct water flow. Modern water protection systems deal with stable structures with a dual course in its operation at the well. Various and specific coats with specific chemical concentrations allow the process to perform many functions, easily. The same energy saving effect occurs due to the use of materials involved in this process. This includes coatings on the exterior and floor walls, which reduces the flow of heat to the building and thus reduces the burden of improving indoor air quality and space atmosphere. Waterproofing systems can also be referred to as "building protection and renovation" or "renewable engineering", due to their versatility and value. Waterproofing is not only a big part of the building process but also preserves the dignity of the landscape. (Grading here means extensively identifying, controlling and improving the area for proper construction). Therefore, the waterproofing system applies not only to the entire construction envelope, but also to certain parts of the building.

2.THE IMPORTANCE OF WATER TIGHTNESS

A building, in a sense, is a living organism that requires attention and care just like any other living thing. Water and moisture issues should be avoided as well. The following are examples of the kinds of damage that can be caused by water leaks in a building. One method of seepage is the use of a variety of wall attachments; sills, extensions, brickwork joints, etc. Secondly, the basement and the basement absorb groundwater. Third, a pipe explosion in the wall or underneath the floor.

Fourth, the capillaries protrude through the brickwork, the mortar, and the pillars.

When does a building have a water proofing issue, and how can you tell?

Make sure we have a waterproofing problem if there are any obvious symptoms in the structure.

- The walls are drenched and the floor is soaked
- Developing a fungal or bacterial growth The Telltale Symptoms of Decay
- Water-Mixing
- Water seepage through the roof.

Any of these issues can ruin a building's appearance, interior, and even its foundation. One advantage of waterproofing is that it ensures the building remains dry and sturdy. Two, the humidity inside the building is decreased, making it a more pleasant place to live. Third, water vapors and condensation don't harm anything. Strong and long-lasting construction**.**

The Many Waterproofing Materials

Thinking about your house as if you were picking out a waterproof coating is crucial. Thus, it is important to research and comprehend the various waterproofing materials available for the structure in question.

Polyurethane

As such, it serves as a roof's water barrier. The liquid polyurethane membrane's adaptability comes with several advantages, including (but not limited to) the following:

1. Sealing capillary cracks.
2. Concrete water absorption should be minimized.
3. Liquid fortifies the concrete's outer layer.

Application Areas:

- Water tanks
- Pedestrian stairs
- The roof
- Bridges
- Parking area

Cementations waterproof coating

This app provides a very simple program. The mixture contains sand, silica, organic chemicals, and inorganic chemicals. Also, these substances are combined with the function of lime as a sealant.

Application Areas:

- Water treatment plants
- Ports and harbors
- Parking area
- Channels

Bituminous waterproof membrane

Also known as bituminous coating, or asphalt coating, this membrane works effectively against water infiltration. Bituminous is mixed with

natural adhesives. Therefore, its viscous quality makes it a very strong waterproofing material for the roof.
There are two ways to use bituminous:

3. **Roll roofing material method**
4. **Roofing felt method**

EPDM rubber
This waterproofing material is a synthetic rubber material made of propylene and ethylene. Typically, experts associate an EPDM rubber solution with a silicone compound. However, both vary depending on the chemical composition, use, and characteristics.
Also, EPDM rubber is highly adaptable and recyclable.
Application Areas:

- The roof
- Windows
- Wood

Rubberized Asphalt
Another excellent waterproof chemical, Rubberized Asphalt works effectively to protect buildings. The strength, flexibility, and resistance to moisture and the penetration of this vapor make it extremely durable and suitable for structural treatment.
Application Areas:

- The roof
- Plazas
- Parking spaces
- Terrace

Thermoplastic Waterproofing
One of the most effective waterproof materials is thermoplastic. This solid solution provides long-term protection in buildings. Therefore, its anti-inflammatory factor makes it suitable for all heavy treatments.
Application Areas:

- Decks
- Elevator pits
- Fountains

PVC membrane

This feature is often used to prevent water from roofing. Its vapor-permeable material gives it extra strength. The base of the PVC membrane uses polyester mesh or glass fiber.
Application Areas:

- The roof
- Tunnels
- Swimming pools
- Underground structures

Waterproofing paints

Waterproof paint protects the house from environmental damage and improves the health of the building. Therefore, it remains water resistant or completely waterproof. Waterproof paint can be used inside buildings in bathrooms, kitchens, basements, etc. Therefore, it could protect the bathroom and the basement from leaks and excess moisture.

The waterproof paint bathroom wall prevents moisture from entering the walls. Therefore, these paints are preferred over conventional paints as the first one will not stand firm against wet conditions as before. In addition, once moisture has penetrated the walls, mold and mildew will damage the structure and cause health problems.

Types of waterproofing paint

Epoxy paint for waterproofing

Epoxy waterproofing paints use strong chemicals to combat very wet conditions and protect the surface. They make waterproof paint on roofs and water-repellent paints.

Masonry waterproof paint

Made of a mixture of latex and ceramic paint, waterproof masonry paint is often used for roofing. Also, this paint absorbs chemicals and other liquids easily like water and prevents them from getting inside. It also provides cement with waterproof chemicals.

Acrylic waterproof paint

This type of paint is best suited for roofs and terraces made of rectangular blocks. Also, this paint on the roof and the balcony harmonizes and drains the water on the surface. Additionally, waterproofing paint is non-toxic and easy to apply.

3.PROCESS OF WATERPROOFING

Waterproofing is done horizontally, above the structure, retaining respiratory equipment, to prevent the flow of water and the rise of capillary water in it. The interior displays the water content of the structure and externally forms a protective film around it. Typically, the construction of a waterproofing system is done by creating many barriers to stop the ingress of water, so that it cannot enter the building. This development of multiple layers, materials and methods in them creates a kind of "envelope" of structure around the building. This envelope can be treated as a permanent feature or measure of a green structure by avoiding the ingress of excessive heat from the atmosphere. This can be done by applying various paints, adhesives and other finishes as well as blending that helps create a transition between outside and inside temperatures. This transition between temperatures helps the structure in the following ways:

- Small differences between indoor and outdoor temperatures cause minor weather symptoms and protect the building. This is done in such a way that the effect of compaction or expansion during the various seasons in the material construction of the building is reduced, by matching the room temperature with the external temperature.
- Reduce the burden on the HVAC system, and other procedures that a building occupant often uses to keep the room temperature stable. These reductions can best be attributed to energy savings, drinking water consumption and other utilization of resources. This usually moves the building to a green place.

4. TYPES OF WATERPROOFING METHODS

There are some common types of waterproofing methods used in construction industry. Waterproofing in buildings/structures is generally required for:

- Basement of structure

- Walls
- Bathrooms and kitchen
- Balconies, decks
- Terrace or roofs
- Green roofs
- Water tanks
- Swimming pools

The following waterproofing methods are commonly used in construction:

6. Cementitious Waterproofing
7. Liquid Waterproofing Membrane
8. Bituminous Membrane
9. Bituminous Coating
10. Polyurethane Liquid Membrane

5. CEMENTITIOUS WATERPROOFING METHOD

Cementitious waterproofing is an easy way to prevent water from forming. Cement waterproofing materials are readily available in the market. This method is often used in wet indoor areas such as toilets. This method is usually a solid or flexible type that prevents water, but as it is used in indoor areas such as toilets, it is not exposed to sunlight and weather. Therefore waterproofing with cement does not exceed the contract and the expansion process.

APPLICATIONS OF CEMENTITIOUS WATERPROOFING:

Cementitious waterproofing is used in the following type of structures:

10. Water Treatment Plants
11. Sewage Treatment Plants
12. Bridges
13. Dams
14. Railway & Subway Systems
15. Marine Cargo Ports & Docks

16. River Locks/Channels & Concrete Dykes
17. Parking Structures & Lots
18. Tunnels

LIQUID WATERPROOFING MEMBRANE METHOD:

Liquid membrane is a thin layer that usually includes the first coat and two coats of top coat used with a spray, roller, or trowel. It offers more flexibility than cementitious types of waterproofing. The liquid heals into a rubber wall. The elongation properties of coating can reach as high as 275%. The durability of a waterproof coat depends on the type of polymer the manufacturer uses to make the liquid waterproofing. A waterproof membrane can be a liquid-coated liquid coated with polymer-modified asphalt. Polyurethane liquid membranes for different levels of trowel, roller, or spray are also available from various manufacturers.

BITUMINOUS COATING WATERPROOFING METHOD:

Bituminous coating is a type of coating used for waterproofing and flexible protective coat according to its composition and polymerization stage. Its flexibility and water protection can be influenced by the polymer level and fiber reinforcement. Bituminous coating is also called asphalt coating. The most common applications for bituminous coatings include areas under wet screed. It is an excellent protective agent and waterproofing agent, especially in areas such as concrete foundations. Bituminous coating is made of bitumen-based materials and is not suitable for exposure to the sun. They become very brittle and weak when exposed to prolonged exposure to the sun unless they are prepared with flexible materials such as polyurethane or acrylic-based polymers. The flexibility of the finished products always depends on the solid polymer content added to the bitumen.

BITUMINOUS MEMBRANE WATERPROOFING METHOD:

Waterproofing of bituminous membranes is a popular method used for low-grade roofing due to their guaranteed performance. Bituminous membrane waterproofing has a flashlight on the lining and adhesive membranes. Adhesive composites include asphalt, polymers and fillers;

in addition, certain resins and oils may be added to improve adhesion properties. The self-adhesive type has a lower shelf life as membrane binding structures shrink over time. The torch on the membrane is exposed and covered with types. Exposed membranes usually contain granular mineral aggregate to withstand the aging and degradation of the weather and other types of membrane, the contractor needs to install a single protective screed to prevent membrane perforations.

POLYURETHANE LIQUID MEMBRANE WATERPROOFING METHOD:

The polyurethane liquid membrane waterproofing method is used for the flat roof area and is weatherproof. This method of waterproofing is expensive. The Polyurethane Liquid Membrane can provide high flexibility. Polyurethane is very sensitive to existing moisture, so before installing, one should be very careful checking the moisture content of the concrete slab, otherwise peeling or cracking of the membrane may occur after some time.

6. CONCLUSION

- Water damage can be catastrophic. Water penetration can damage the building's foundations, structure, and valuables.
- Water penetration can degrade concrete and other construction materials as quickly as wood rots, especially in colder locations where water freezes and causes fractures.
- Poor waterproofing may be a year-round concern. Permeability allows occupant humidity to be safely vented outside.
- Waterproofing a building entail preventing water from entering and preventing it from pooling.

REFERENCE

1. T. Subramani, a. Anbuchezian. (2017) ‘water proofing concrete by using fake snow powder’ vol.6, pp.2319- 4847.
2. Abhishek G H, lokesh J K. (2016) ‘evaluation of different kinds of integral water proofing compounds as per IS codes’ vol.5, 2219-8753.

3. Annu baby, Jeena Mathew. (2016) ‘studies on properties of concrete with various waterproofing compounds’vol.21, 2278-1684.
4. Saurabh borle, gadget (2016) ‘comparative study of conventional and morden water proofing techniques’, Volume: 5 Issue: 1, pp. 32-36.
5. Richard Pkadlubowski AiA. (2010) ‘water proofing’ Vol. 27.
6. A. Geetha P. perumal (2011) ‘chemical reaction of waterproofing admixtures on the corrosion behavior of reinforced cement concrete’ (2014), pp. 407-411.
7. Dhiren J Panchal Nehal H shah ‘water proofing challenges and suggested temedial measures for high rise buildings’ (2015) vol-10.
8. Li Jiye, construction quality problems and prevention measures [M]. China Building Materials Industry Press.2003

Use of Recycled Aggregates as Concrete

Dr. **Sanjeev Gill , Mohd Yusuf Ali**

[a] Professor, Deptt.of Civil Engineering, JBIT Dehradun, Uttarakhand (India)
[b]Assistant Professor, Deptt.of Civil Engineering, JBIT Dehradun, Uttarakhand (India)

ABSTRACT

Worldwide, cities generate about 1.3 billion Tonnes of solid waste per year.Building materials account for about half of all materials used and about half the solid waste generated worldwide. The waste, generated in the construction, maintenance, repair and disposal phases of a building, is called Construction and Demolition (C&D) Waste. Management of C&D waste is a problem faced not only in India but by the global community and quantum of waste produced occupies a huge fraction of the total solid waste generation by mass. Furthermore, a continued environmental awareness instigates the pressure for reuse of construction materials instead of classifying them as waste materials. Using construction waste material as an aggregate for developing new concrete product is technically viable and may, in some circumstances, be environmentally beneficial. The recent government initiative to stop sand mining insists the need to recycle, reuse and substitute natural aggregates in order to ensure environmental sustainability.This research work aims at making one such experiment where recycled aggregates are produced from C&D waste thus paves a way, for the effective management of concrete debris.The concrete waste was collected from the waste yard in the college campus, segregated, crushed in jaw crusher, sieved, washed and used for concreting for a mix proportion of M25, as a replacement for natural course aggregates in proportions of 0%, 30%, 60% and 100%. On testing, the compressive strength was found to be increasing and split tensile strength and flexural strength were observed to be nearly equal to that of normal concrete mix. Therefore, use of recycled concrete aggregate showed acceptable performance with respect to mechanical properties.The recycled aggregates obtained from waste concrete are more angular and have higher absorption and specific gravity than natural coarse aggregates *and it resulted in increased strength and improved load carrying capacity. However, further studies to determine the effect on durability and improvement on workability are necessary.*

Key words: *C&D waste, Recycled aggregate, Fineness modulus, Slump test, Specific gravity.*

1.INTRODUCTION

Concrete is the premier construction material across the world and the most widely used in all types of civil engineering works. Among the ingredients for concrete, aggregates, i.e. inert granular materials such as sand, crushed stone or gravel form the major part. In recent years due to continued large scale extraction, use of aggregates from natural resources has been questioned at an international level. This is mainly because of the running down of quality primary aggregates and greater awareness of environmental protection. Hence the use of recycled aggregate from construction and demolition waste (C&D waste) in concrete isgaining momentum these days. Recycled aggregate concrete may become the need of the day in the years to come.

2.RECYCLED AGGREGATES

The main source for recycled aggregates is construction and demolition waste. Most of the waste materials produced by demolishing structures are disposed by dumping them as landfill or for reclaiming land. But with the demand for land increasing day by day, the locations, capacity and width of the land that can receive waste materials are becoming limited. Added to it, the cost of transportation makes disposal a major problem. Hence, reuse of demolition waste appears to be an effective solution and the most appropriate and large-scale use would be to use it as aggregates to produce concrete for new construction. Recycled aggregate concrete utilizes demolition material from concrete and burnt clay brick masonry constructionas aggregate.

3.SOURCES OF CERAMIC WASTE

Coimbatore city Municipal Corporation says that population of the city is 10.09 lakhs and the quantity of garbage generated is 601 MT/day which includes concrete debris, steel, glass, plastic waste, broken bricks etc.

It was estimated that an average of 1 MT/year of concrete waste was produced from testing of various concrete specimens. Waste concrete cubes and cylinders were collected from Structural Technology Center laboratory of our Institution. The collected waste were taken to a crusher unit nearby and crushed into various sizes. After screening, the materials were separated into the size of coarse aggregate required for replacement in concrete.

OBJECTIVES

To replace natural coarse aggregate by the recycled coarse aggregate in various percentages (0%, 30%, 60% and 100%)

To study and compare the mechanical properties - compressive strength, split tensile strength, flexural strength of hardened concrete specimens with and without recycled aggregates

MATERIALS USED

The materials used are PPC cement of grade 43, River sand of size passing through 4.75 mm IS sieve and retaining on 150 micron IS sieve, natural coarse aggregate & recycled coarse aggregates size 20mm and 12.5mm is usedin the ratio 60:40 and potable water available in the campus. The collected waste specimens are shown in Figure 1 and the recycled aggregatesare shown in Figure 2

FIGURE 1 TESTED CONCRETE WASTE

FIGURE 2 RECYCLED AGGREGATES

PHYSICAL PROPERTIES OF MATERIALS

The physical properties like specific gravity and fineness modulus are done on fine aggregates, coarse aggregates and recycled aggregates as per Indian standards. The test resultsare shown in Table 1.

TABLE 1 PHYSICAL PROPERTIES OF AGGREGATES

S.No	Properties	Specimen	Test result
1	Fineness modulus	Fine aggregate	2.31
		Coarse aggregate	2.88
		Recycled aggregate	2.84
2	Specific gravity	Cement	3.15
		River sand	2.12
		Coarse aggregate	2.60
		Recycled aggregate	2.66

CONCRETE MIX DESIGN

Concrete mix design for M25 grade is done as per IS: 10262 – 2009. The results of concrete mix design are tabulated in Table 2.

TABLE 2 MIX PROPORTIONS

Weight	W/C	Cement	Fine aggregate	Coarse aggregate
Kg/m^3	186	414	552	1173
Ratio	0.45	1	1.34	2.83

INVESTIGATIONS ON HARDENED CONCRETE

To determine the mechanical properties of concrete specimens with and without recycled aggregates, cubes of size 150 mm, cylinders of size 150 mm diameter and 300 mm length and prisms of size 500 x 100 x 100 mm were cast, cured and tested at 7 and 28 days after curing. The batching details of the concrete mix are presented in Table 3.

TABLE 3 BATCHING DETAILS

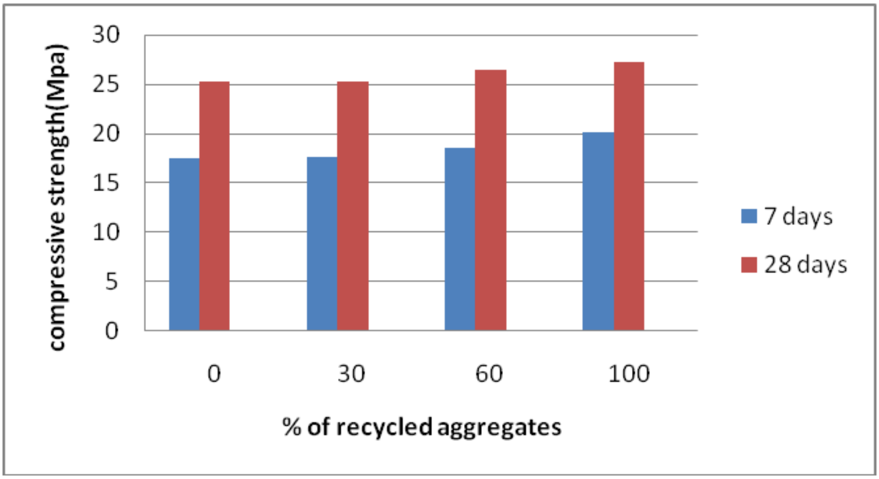
Percentage replacement ofrecycled aggregates (%)	Cubes (150x150x150 mm)		Cylinders (150x300mm)		Prisms (500x100x100 mm)	
	7 days	28 days	7 days	28 days	7 days	28 days
0 %	3	3	3	3	3	3
30 %	3	3	3	3	3	3
60 %	3	3	3	3	3	3
100 %	3	3	3	3	3	3

1. COMPRESSIVE STRENGTH TEST

The compressive strength of concrete cube specimens was determined by conducting compression test on Compression Testing Machine of capacity 1000 kN. The specimens were tested at 7^{th} and 28^{th} days after curing until failure. The load at failure was observed and the compressive strength (f_{ck})was calculated by the following formula

Cube compressive strength, $f_1 = \dfrac{\text{Load at Failure iz N}}{\text{Area of cube in mm}}$

The r
esult of compressive strength test is shown in Figure 3



SPLIT TENSILE STRENGTH TEST

The cylindrical specimens with various percentages of recycled aggregates at 7 and 28 daysafter curing were placed horizontally on Compression Testing Machine of capacity 1000 KN. The load is applied gradually and tested until failure. The split tensile strength (£) was calculated by the formula:

Split tensile strength, f= 2P

OLD

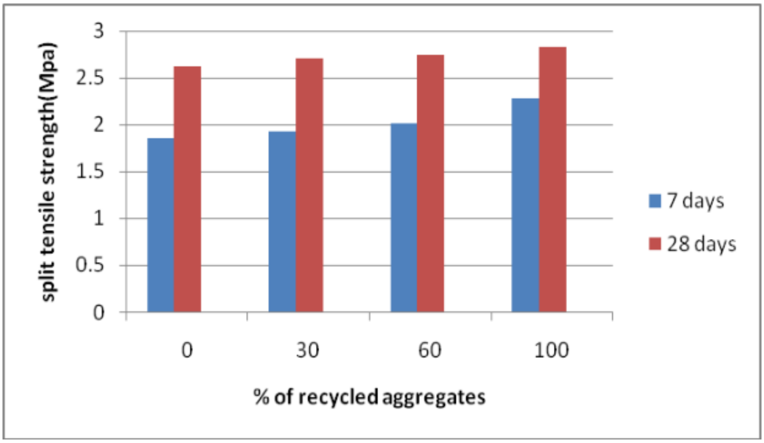
Where,

P=compressive load on cylinder in N Concrete Using Recycled Aggregates

L = length of the cylinder = 300 mm

d = diameter of the cylinder = 150 mm

The result of split tensile strength test is shown in Figure 4



. FIGURE 4 SPLIT TENSILE STRENGTH TEST RESULTS

FLEXURAL STRENGTH TEST

The prism specimens were cast with various percentages of recycled aggregates, cured and tested after 7 and28 days curing. The specimens were subjected to two point loading, the loadis gradually increased untilfailure. The flexural strength (fi) was calculated by the following formula:

If $a < 13.3$

Where,

b = Breath of beam (mm),d = Height of beam (mm)
a = Distance of crack from shorter length of beam (mm)l = Length of the prism (mm)
The result of flexural strength test is shown in Figure 5.

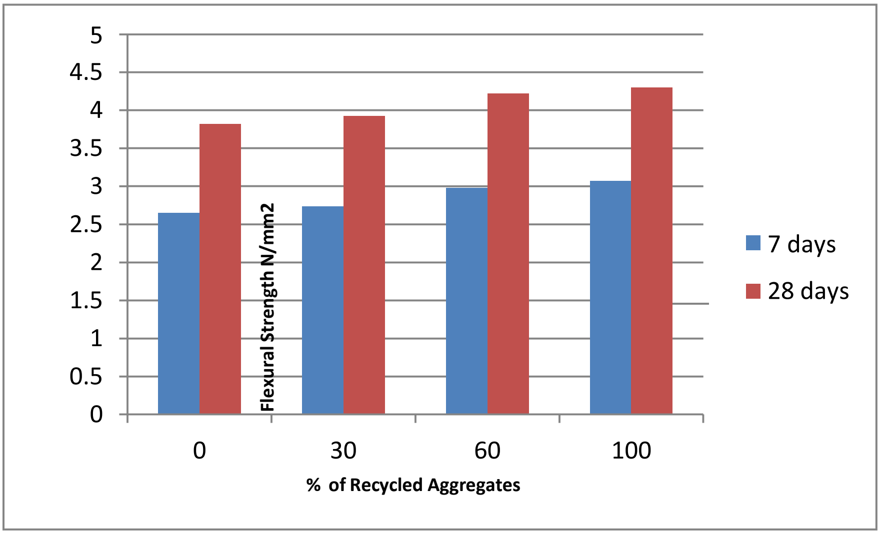


Figure 5 Flexural strength test results

5. CONCLUSIONS

In this study it is found that there is not much variation in strength between ordinary concrete and 30% replaced aggregate concrete, which proves the previous works.

But when the percentage of aggregate replaced increases there is a constant increase instrengths, which is a controversy to the previous works.

Because it has been found that recycled aggregates obtained from recycling concrete are more angular and have higher absorption and specific gravity than natural coarse aggregates it may result on increase of strength and improved load carrying capacity.

However, further studies to determine the effect on durability and improvement on workabilityare necessary.

REFERENCES

[1] Tomas U. Ganiron Jr, (2015), “Recycling Concrete Debris from Construction and Demolition Waste”, International Journal of Advanced Science and Technology Vol.77, pp.7-24.

[2] Roz-Ud-Din Nassar and Parviz Soroushian, (2012), “Strength and durability of recycled aggregate concrete containing milled glass as partial replacement for cement”,
Construction and Building Materials , Vol. 29. pp. 368–377

[3] Markandeya Raju Ponnada1 and Kameswari P, (2015), “Construction and Demolition Waste Management – A Review”, International Journal of Advanced Science and Technology, Vol. 84, pp.19-46.

[4] Jitender Sharma and Sandeep Singla, (2014), “Study of Recycled Concrete Aggregates”`, International Journal of Engineering Trends and Technology (IJETT), Vol. 13, No. 3, pp. 123 – 125.

[5] Dr.K.Ramadevi and Mrs. Abinayaa.A, (2017), “Alternate Materials in Building Construction”, International Journal of Engineering Technology, Management and Applied Sciences, Vol. 5, No. 5, pp. 791-794.

[6] Hardik Gandhi et al, (2011), “Study on Use of Recycled Coarse Aggregate In Concrete”, National Conference on Recent Trends in Engineering & Technology, 13-14 May, pp. 1-4.

[7] IS 10262-2009, Recommended Guidelines for Concrete Mix Design (Bureau of Indian Standards, 2009).

[8] IS 2386 (Part III) – 1963, Methods of test for aggregates for concrete, Part 3: Specific gravity, density, voids, absorption and bulking (Bureau of Indian Standards, 1963).

[9] Himanshu Kumar and G. Premkumar, Behaviour of High Performance Concrete By Using Recycled Aggregate on Beam Under Static and Cyclic Loading. International Journal of Civil Engineering and Technology , 8(3), 2017, pp. 210 –219

[10] Ing John K. Makunza , Sustainable Concrete Made From Recycled Aggregates, International Journal of Civil Engineering and Technology, 7(3), 2016, pp. 241 – 251.

[11] Santosh Kumar, Sonu Pal, Prof. N. Kisku, Prof. V. Pandey, Experimental Investigation of Recycled Aggregate Concrete Using Pre-Soaked Slurry Two Stage Mixing Approach. International Journal of Civil Engineering and Technology, 8(1), 2017, pp. 89–97.

Use of Bamboo as a Sustainable Material for Construction Industry

Dr. Sanjeev Gill[a], Anil Kumar[b]

[a] Professor, Deptt.of Civil Engineering, JBIT Dehradun, Uttarakhand (India)

[b]Assistant Professor, Deptt.of Civil Engineering, JBIT Dehradun, Uttarakhand (India)

ABSTRACT

India is the second-biggest producer of bamboo worldwide. The increased dependency on conventional construction materials is held responsible for the degradation of the environment and reduced wood resources, which has led to thought on using bamboo as a substitute for wood and steel. Bamboo is percieved as a sustainable, quickly developing, and crude economic material. The investigation endeavors to legitimize selecting bamboo as an appropriate material for efficient and judicious development and evaluating the literature on how it could be utilized in the construction industry. Bamboo as a composite material can be used for various interior and exterior purposes in buildings like foundation, flyovers, dwellings, multistory buildings, large span structures, and interiors of airports, recreational buildings.

Keywords: Bamboo Environment Economic Sustainable Construction Material Composite

1.INTRODUCTION

India supplies a large percentage to the total world's bamboo forest land. Approximately, 123 species in 23 genera are located in India. More than 39% of the entire region under Bamboo is out there within the North Eastern states, which is additionally the chief in availability of dense bamboos, in green sound culms and number of green sound weight. Results show that green sound bamboos are obtained in most abundance in Arunachal Pradesh (26660 lakhs), then by Assam (20460 lakhs), Manipur (20350 lakhs) and Mizoram (19530 lakhs). Bamboo community lives nearby the plantations and conventionally depends on bamboo for their sustenance. Due to the climate difference across India, the species of bamboo and the building materials found in varied climatic zone are quite diverse. Hence, the conventional building systems and classification that has grown around some centuries in reaction to the available building materials and local climate are also quite diverse.

Since, in the North Eastern region, approachability is a huge issue, people construct with locally available materials to the greatest extent, like- Mizo houses, Adi Gallong houses, and Riang houses which uses bamboo as the principal material for construction. These are classic houses on hills that are built on stilts made of bamboo and have woven mats of bamboo for walls. In Bihar, Bengal, and Orissa, houses built on the river planes with bamboo are found in rural and tribal areas. Reinforcement material in lime surki flat slabs were made out of bamboo, whereas mats of splits or flattened bamboo was used for the walls. Conventional dwelling houses in Central India, has walls that made out of broad bamboo mats layered with mud plaster with broad bamboos used for ver- tical support. The roof of these houses was made out of purlins of bamboo and layering of country tile or dried grass with wooden trusses. In the desert areas, bamboos are used as reinforcement in boundary walls, walls, and in the principal roof structures. It is also used for walls in a wattle and daub system in South India, accompanied by compounded mud layering or plastering and pitched roofs in village areas whereas in cities, it was used mainly in roofs for both flat lime surki and pitched roofs.

Traditional materials are being reformed and treated to escalate their strength and durability and one such material is bamboo. In contest of this research, regarding how sustainable bamboo is as a construction material, it can be said that bamboo is a functional rated composite plant with a brief regenerative growth cycle which makes it a green material for construction.

Characteristics of bamboo alters due to the large-scale variety of general families and species. It is a 'grass' that is hollow-stemmed, firm, woody, enduring, and perennial in nature. Due to a peculiar rhizome-dependent process, bamboos are one of the most rapid-growing plants and their growth is three-times more rapid than a number of other plant species. Some bamboo species could reach their final length of between 20 and 30 m high in a few weeks and with a growth-speed of 50 cm every day throughout the season while other species are ascertained to rise skyward as fast as 8 in. in a day. It belongs to the family of the true grass called 'Poa- ceae' and is actually the greatest family member of the Poaceae, with about 91 genera and greater than 1000 species. Bamboos are a sustainable and extremely adaptable resource with multipur-pose uses, traditionally associated with Southeast Asia and South America region for finest suited cultivating environment.

As a construction material, bamboo has a solid fiber and its compressive strength is twice more in comparison with concrete and its tensile strength is almost equal to steel. Experimental stud- ies have shown that the ultimate tensile strength of bamboo and mild steel varies between 140 N/mm^2–280 N/mm^2. Findings show that full-growth of bamboo during cultivation depends on the species and it obtains its hardwood like properties (i.e. hardness, strength, stability) as compared to the growing years of hard- wood which takes (50–100) years to mature completely. Even though the construction industry in recent years has known the potentials of bamboo in varied constructional works, the bigger question remains is how sustainable is the bamboo material? Bamboo is a really exceptional green building material. It is a sustainable material that requires very less energy to nurture, restrains soil erosion, supplies biofuel, extends wildlife refuge, and manufactures a wholesome food source for both humans and wildlife. It offers crucial restoration from the consequences of global climate change by producing oxygen a lot more than other species of plants and traps high quantities of CO2. The primary harvesting often takes 3 to 5 years, considerably quicker than wood forests which usually want twenty-five years. It produces twelve times more green building material than wood and provides a great variety of functional commercial items for eco-friendly daily use along with shelter and transportation, thus, decreasing the rate of timber consumption. Additionally, bamboo roots help in restraining erosion as it creates barrier for water which the developed countries use as a defensive component for their agricultural crops and villages from washing constantly.

2. Bamboo as a construction material

Bamboo as a raw resource in structural & non-structural works can emerge as one of the most eco-friendly as well as most effective construction modes in recent times. The various components of a building where Bamboo can be used as an alternative to conventional building materials are:

Trusses /Roof Structure: Bamboo trusses can be easily used for constructing roof trusses using bamboo rafters and purlins. It supplies sufficient sturdiness to the structure and is a verified protection in opposition to force of nature and animals. They are also comparatively lighter in weight, which is why it is easy to install.

Walls: Bamboo is vast used for partitions and walls where post and beams are the focal components for the structural frame- work. An infill in the middle of the framing members is needed to finish the wall. The aim of the infill is to shield against animals, wind and rain and to provide privacy so that the complete stability of the structure when exposed to horizontal forces is ensured. The elasticity of Bamboo empowers the structure to be earthquake resistant with few chances of it to fall and if it does, it will cause comparatively lesser damage to property and life.

Flooring: Split or flattened bamboo or mats are used for flooring. Their insulating nature allows the floors to be warm during the winters and cool during the summers, thus acting as a perfect flooring material. Bamboo stems are split with a fixed width and then connected for split bamboo flooring, whereas in flattened bamboo flooring the split bamboos are flattened so that there is a plane and uniform surface

Foundation: There is a very restricted use of bamboo as a foundation material due to its decaying property when it comes in contact with a damp ground. However, this problem can be tackled to some extent by treating the bamboo with some effective chemical or preservatives. Regardless of their brief life, bamboo can be used as foundation materials through various ways like direct contact, preformed concrete, concrete columns or bamboo piles.

Scaffolding: The advantageous properties of heavy load bearing capacity of bamboo makes it a very convenient material for high rise construction scaffolding. The cane extension is carried out by lashing the cane ends together with several ties. The ties are arranged in such a way that forces acting vertically down- wards wedges the nodes in the lashing. This process has the great benefit that the joints can be re-tensioned to the correct degree without any problem and can be quickly released again.

Various researchers have studied bamboo and their applications in the construction industry. A brief overview of these studies is summarized in the section below.

3. LITERATURE REVIEW

A study found in the construction industry states that bamboo envelope performs better than a conventional brick & reinforced cement building and owing to the cost-efficient and green construction, it can be one of the major replacement of steel for concrete reinforcement. Bamboo has a greater compressive strength than brick, concrete, and wood and shows the property of tensile strength that contests steel.

Bamboo has various applications in a building as it contributes towards the design of almost all the parts starting from the roof to the foundation like building, support structures, piers, walls, floor, roof, and room dividers amid other things. The structures that are treated with chemicals or preservatives have a life span of 40 years and has been proved vigorous enough to withstand earthquakes. It may not be possible to change the entire scenario of the building industry overnight, but little steps like rethinking the wall systems while keeping the structure intact can lead to a significant change in the choice of building materials.

Nayak et al. conducted a study that compared the cost of steel reinforcement with bamboo reinforcement with the aim of improving the economical aspect along with ecological benefits. Through this investigation, it was realised that a few species of bamboo have ultimate tensile strength equivalent to mild steel at yield point, and acts very well in buckling. Also, it was confirmed that in earthquake prone areas, the failure of bamboo is minimum as the absorption of energy is extreme at the joints. The study concluded that use of advanced bamboo reinforcement technique is a good conclusion for a low-cost structure as it is three times cheaper than steel reinforcement technique.

Akwada et al. investigated the bamboo material and how sustainable is it for use in construction works and other industrial uses. The results indicated that bamboo can be the answer to the sustainable development goal for worldwide industries. The research finding using the LCA test analysis on the bamboo from cultivation to the end of its disposal systematically shows that the environmental impact of bamboo products are sustainable and it improves the atmospheric conditions of our societies.

Gill et al. investigated the performance of bamboo material in engineering structure as well as in building reinforcement. The aim of their study was to enhance the usage of bamboo in the con- struction industry so that it contributes to an eco-friendly develop- ment in which culture, environment, and tradition are also considered along with technology and economics. The study con- cluded that bamboo could be used as a replacement material for reinforcement of steel because of its low cost and high tensile strength.

Harison et al. conducted an experimental study using bam- boo as the substitute of steel to provide the best alternative of a construction material for low-cost housing and to attain the aim of working with regard to economical and green construction. After a comparative analysis of PCC and bamboo reinforced concrete in terms of compressive, split tensile and flexure strength, the study suggested that there was a remarkable improvement in compres- sive strength and bending strength of bamboo reinforced concrete in comparison to plain cement concrete whereas the split tensile strength was almost similar. The results showed reasonable possi-bilities of bamboo reinforcement being used as a substitute of steel reinforcement in contemporary buildings for low-cost green construction.

Bagchi et al. studied various researches done on bamboo as a building material to replace the standard building concrete mate- rial. They believe there is a need for advancement in the building sector due to the growing population and one of the materials which can be used in construction is bamboo since it has high com-pressive and tensile strength in contrast with concrete and steel and is more affordable than concrete, hence, acceptable for low-income groups. The conclusion showed that bamboo is good alter- native green building material given its high strength and low cost. And prior to using it as a structural material it is important to test the particular bamboo species to understand its properties as bam- boo type vary in different places.

4.Thermal properties of a bamboo building envelope

Increased energy consumption, high manufacturing costs, high transportation costs and increased waste production are some of the problems arising due to ignorance towards the choice of mate- rial selection in buildings. Solutions like adopting traditional materials and modifying and treating them to increase their strength and durability are being taken up, and one such material is bam-boo. It can contribute towards the design of almost all the parts starting from the roof to the foundation.

A study was carried out through various case studies in India for calculating the CPWD Sustainability Index of bamboo. The aim was to quantify the thermal transmittance values of wall assemblies with bamboo as a walling material and comparing it with conventional brick-RCC envelope and ECBC prescribed envelope. It was found that there was a significant change in cooling loads by changing only the envelope properties. Hence, bamboo walls perform better than the conventional brick & RCC envelope that is the general trend in almost all types of construction in India.

Maturity & purpose of bamboo

Bamboo is functional for various intentions at different stages: Less than 30 days is fit for consumption

Between 6 and 9 months for weaving baskets

2 to 3 years for making ply boards or lamination 3 to 6

years for use in construction works

Greater than 6 years bamboo slowly lacks its strength up till 12 years old.

Uses of bamboo material

General uses: Bamboo is one in all the foremost acceptable crop for agricul-ture because it adapts to varied climate and rainfall conditions and it's a short growth cycle implying that it grows faster than wood species, while taking-up less water within the process. It also includes a viability as a construction material as its lastingness is larger than that of a gentle steel, which makes it among the world's best naturally engineered material, and a vital component of earth-quake prone construction. Bamboo shoots are rich in nutrients like low calories, high fibre content, and low fat, thus providing nutri- tion to millions worldwide. They're conventionally employed in local medicinal systems in South Asia because it is verified to per- form as natural remedy, with features including the flexibility to lower cholesterol, antioxidant and anti-inflammatory properties. Bamboo can even be used as a source of fuel, and also in thermal practices, replacing furnace and diesel oils. Bamboo produces almost 35% more oxygen than similar stands of trees and it shields against UV rays almost 60% better as compared to cotton fibres making it environmentally beneficial yet.

Architectural uses
Several institutes have involved in study and expansion in the field of, treatment methods, science of materials, construction sys-tems, building elements, and items made out of bamboo for the last few decades. One of the organisations developed a reformed wall system with Bamboocrete [Fig. 1(a)] - an upgradation of Wat-tle and daub system [Fig. 1(b)]; and also a building process for multi-level bamboo building. In industries, by adopting wood pro-cessing technique bamboo has been processed into products such as Ply bamboo and Strand Woven Bamboo, which can be used in high-end technological applications. Its use in housing construc-tion has since ages back, used as, trusses, poles, rafter, ceiling, flooring window, roof, and door frames, fence posts, footbridges, and, the wall. At present, in Ghana, the bamboo species can be advanced into panels which can be used in the structural uses fields in the form of Curtain Ply bamboo, Bamboo Composite Board, Mat Ply bamboo, Laminated Bamboo of Strips, Bamboo Particle- board, and Ply bamboo.

The Building Materials & Technology Promotion Council (BMTPC) that comes under the Ministry of Housing & Urban Pov- erty Alleviation, Govt. of India is actively involved in development of bamboo based technologies and to push these technologies within the North-Eastern Region including other bamboo growing areas, by encouraging commercial production of bamboo based products, construction of demonstration houses and putting in place of Bamboo Mat Production Centres for processing of bamboo, etc. IWST, Indian Wood Science Institute, Bangalore has devel- oped treatment method for bamboo and developed a bamboo- wood – plastic composite which might be utilized in several build- ing applications. One among the architects have worked on pre-fabricated bamboocrete wall panels, prefab houses, bamboo con-struction systems with BRC- bamboo ferroconcrete roof, BFRC-bamboo fiber concrete, freeform bamboo roofs, tensegrity and synergetic structures with bamboo, compressed blocks with bamboo and paper waste with mud etc (Figs. 2 and 3).

Advantages of bamboo

It is light-weight, sturdy and versatile.
It is sustainably beneficial.
Cost efficient as compared to other construction materials.

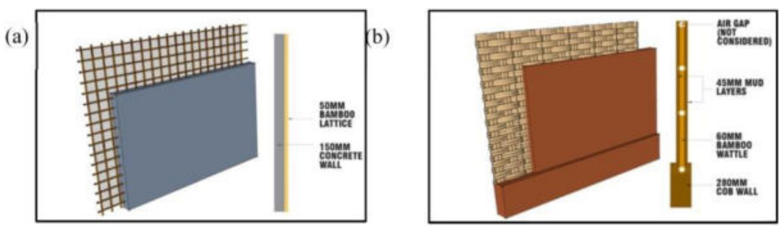


FIG. 2. (A) BAMBOOCRETE WALL; (B) WATTLE & DAUBWALL.

Fig. 3. (a) Cocoon House, Trichy; (b) Bamboo Symphony, Bangalore; (c) Kontum Indochine Café, Vietnam. Source of Fig. 3. (a) https://architecturelive.in/cocoon-house-trichy-mansaram-architects-neelam-manjunath/. Source of Fig. 3. (b) https://www.archdaily.com/782059/bamboo-symphony-manasaram-architects. Source of Fig. 3. (c) https:// www.archdaily.com/392710/kontum-indochine-cafe-vo-trong-nghia-architects.

Self-renewing resource of nature. One of the fastest growing plant Highly productive
Most suitable material for earthquake-resistant constructions.
Easy to repair, cut, reposition, handle and sustain, in the absence of complicated tools or equipments.

Disadvantages of bamboo

Susceptibility to fire
Due to the round figure, joining is very hard and complex in bamboo
Bamboo reduces in diameter and weight along its length Water absorbing capacity
Larger spans are difficult to construct because it is difficult to urge splits of uniform cross-section
Poor resistance to fungi and bacteria
Requires preserving otherwise it will lose its strength

Discussion
Bamboo may be a natural resource with immense possibilities as a artefact in housing industry. Its structural attributes like seis-mic resistant, high tensile and compressive strength etc. models it distinct. Bamboo is being slowly recognized as a renewable, fast- growing & economic staple that may replace the contemporary materials, if treated carefully. It encourages the economic expan-sion and also conserves natural woods

resources to guard our eco- logical environment by providing a replacement of wood.

5.CONCLUSION

The literatures gathered from the various studies administrated proposes that bamboo is that the most possibly crucial non-timber material and rapid-growing woody biofuel, which has induced ready interest within the preservation, processing, application and avocation of bamboo as a substitute to wood. The high tensile property of bamboo is often used as a substitute material for steel reinforcement thanks to its cost efficiency. Bamboo reinforcement approach will be used for both distribution and main and reinforcement because it was earlier finished steel. It's 3 times more cost effective than steel reinforcement technique. The employment of bamboo as a sustainable artifact has showed large possibility because the character and attributes of bamboo are ready to allow it. However, it still arises the question regarding the method of preservation, hence, it's important to perceive and carry out con- tinuous study on productive and eco-friendly method which uses fewer chemical additives to lower the negative impact to the environment. Hence, the disadvantages of bamboo will be eradicated if safety measures are taken.

REFERENCES

Akwada Damenortey Richard, Akinlabi Esther, Bamboo Use in Construction Industry: How Sustainable is it? [Conference] // Conference on Infrastructure Development and Investment Strategies for Africa. - Livingstone, Zambia: [s. n.], 2015, p. 13.

J. Atanda, Environmental impacts of bamboo as a substitute constructional material in Nigeria [Book Section], Case Stud. Constr. Mater., Vol. 03 2015.

Baksy Aniket, The Bamboo Industry in India [Report]. - [s.l.] : Researching Reality Internship, 2013..

[1] Dr. Sanjeev Gill, Dr. Amit Kumar Bansal, Aninash singhal, Comparative Study of Bamboo Material [Journal]. - Dehradun: International Journal of Scientific & Engineering Research, 8 (10) (2017).

ECOFRIENDLY BRICKS BY USING FLYASH

Bhaskar Singhal[a], Seema Rani[a]

[a] Assistant Professor, Deptt. of Civil Engineering, JBIT Dehradun, Uttarakhand (India)

ABSTRACT

Concrete, steel and bricks are commonly used materials in construction practice, of which, bricks are most commonly used constituent. Masonry walls are commonly used in partition thereby large numbers of brick elements are required in construction of building. In this paper, various types of manufacturing of bricks were studied. Optimum percentage of fly ash using various combinations of material in the brick like lime, cement and clay are studied and their effect on different properties of bricks have been discussed. The parameters considered in this study are compressive strength, water absorption and durability of bricks with fly ash, and are checked with codal provisions for brick elements.

Keywords: *Bricks fly ash, cement, compressive strength, lime*

1. INTRODUCTION

In India, thermal power plant is largest source of energy. The 65% electricity consumed in India is generated by thermal power plant. In India there are 132 thermal plants, from that, 41 thermal plants are in western region, 27 thermal plants in northern region, 36 thermal plants in eastern region and 28 thermal plants are in southern region. The total units in thermal plants are 431. The production of fly ash (FA) depends on thermal power stations; there are 431 units for generation of power and ultimately for production of FA. From above information, understood the production of FA is in large quantity. The percentage of fly ash production is increases as development in country. Following figure1 shows that the production of FA in 2010 is 160 million tons in India and the utilization of FA is less than 50 million tons means the uses of FA in our country is nearly 35% of total fly ash production. The remaining FA is 75% which is totally waste and wastes are unwanted or unusable materials that are dumped on the open space ground. The dumping of waste pollutes the environment and destroys the cultivated land hence the engineers are obliged to find sustainable solution for this problem. To overcome this pollution, engineers implement such techniques that FA is used in production PPC cement, construction material such as concrete, mortar, and fly ash bricks. Fly ash help in increasing the strength of construction material cause fly ash have cementitious property, due to this property FA used in bricks manufacturing. There are various types of bricks manufactured in India; some of common bricks used in construction are: common burnt clay bricks, sand lime bricks (Calcium Silicate Bricks), engineering bricks, concrete bricks and fly ash clay bricks. From this, normal clay bricks, sand lime bricks, and concrete bricks are commonly used in construction practice. The optimum combination of fly ash to produce good quality of brick was studied. The various parameter of bricks were checked with IS code provision and recommended test were studied.

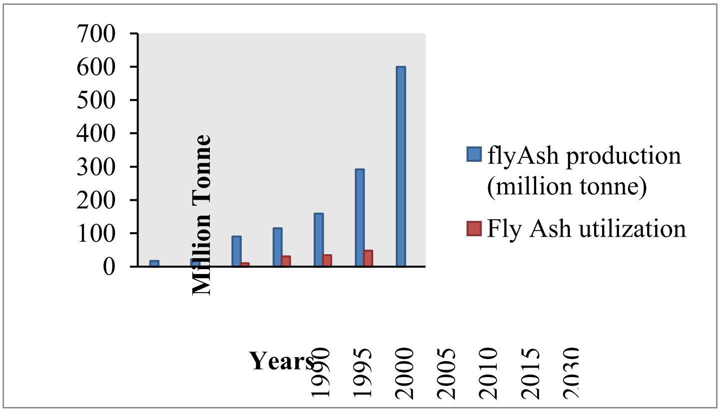


FIG. 1: FLY ASH SCENARIO IN INDIA.

He observed that lime reacts with oxide like silica, alumina and iron oxide of FA to develop different types of bearing phases; these phases reacted with water and formed hydrates. These hydrates-maintained strength in FA-lime compacts and concluded that optimum compaction pressure by this compact by water/steam process is 200–250 kg/cm2 [1].

Kumar focuses on manufactured cost-effective house development by using FA-lime-Gypsum. The most basic building material for construction of houses is the usual burnt clay brick. Fuel is utilized in making these bricks. Also, continuous removal of topsoil, in producing conventional bricks, creates environmental problems. He did feasibility study on the production of FA–lime–gypsum (FaL-G) bricks and hollow blocks to solve the problems of housing shortage and at the same time to build houses economically by utilizing industrial wastes.

The compressive strength, water absorption, density and durability of these bricks and hollow blocks were investigated. He observed that these bricks and hollow blocks had sufficient strength for their use in low-cost housing development. Tests were also conducted to study the influence of type of curing on the increase in strength and hardening of the bricks and blocks with time; he also observed that the hot water curing lead to a greater degree of hardening and higher strength, earlier compared to ordinary water curing.

Based on the experimental result he concluded that FaL-G is a hydraulic binder that was reactive upon addition of water. The strength of FaL-G bricks and hollow blocks increases at a faster rate in initial days of curing and subsequently at a relatively lower rate. Gypsum has more noticeable binding action than lime. Being lighter in weight, FaL-G bricks and hollow blocks will reduce the dead weight and material handling cost for buildings. Water absorption increases with increased FA content and it decreases with an increase in the density of FaL-G bricks and hollow blocks. FaL-G bricks and hollow blocks with suitable phosphogypsum content have better resistance to strong curing temperature, influences the process of hardening of FaL-G [2].

Gadling *et al*. studied on comparatives study between normal bricks and fly ash bricks; so fly ash used as waste product and environment is directly protected by reducing solid waste disposal. The average compressive strength of fly ash brick is 1305 psi (9 N/mm^2). In clay bricks, fly ash can also be used for the manufacturing process. The result of 40% fly ash with 60% clay will be the good combination. Fly ash used as raw material replacing the clay to make fired bricks is an effective measure of saving land and decreasing pollution. The properties of the bricks improved with the firing temperature. Fly ash does not modify the hydration properties of the bricks but it does make them lighter. In fact, all the bricks with fly ash have a lower density. Fly ash bricks show less damage than conventional bricks when exposed to salt crystallization cycles. This improvement is due to the reduction of the surface area of the bricks [3].

Cengizler *et al.* studied on methods of FA brick production and the leaching behaviour of heavy metals was discussed. The method of producing non-fired FA bricks seems to be an
advantageous way to confront the challenges for environment and ecologically sustainable development. He also mentioned economical benefits that will also contribute to the country economy, while increasing demand for greener building products will be met locally and also globally [4].

2. INDIAN STANDARD RECOMMENDATIONS

The material selection as per IS code provision that gives specification of material used in the manufacturing of bricks.
a) Cement b) Fly ash c) Lime d) Water e) Stone dust

Cement

Physical analysis of 43 Grade Portland cement as per IS 8112:2013.

Aggregates

Fine aggregate from a natural sources for concrete as per IS 383-1970. Methods of test aggregate for concrete as per IS 2386-1963.

Fly Ash

Fly ash governed by IS 3812(part 1) 2003. The BIS specification limits for chemical and physical requirements are given in Tables 1 and 2.

IS 12894: 2002 Pulverized Fuel Ash-Lime Bricks Specification (First Revised)

In this, code test of tolerance and dimension for fly-ash brick is given (clause 5.1 and 5.2 pg no. 62). The most commonly used and manufactured brick size is the "Imperial Brick". It is 230 mm long ×110 mm wide ×70$^{1/3}$ mm high with a mass between 3 and 5 kg, depending on the materials used, the degree of verification and the perforations provided.

IS 3495 Method of Testing of Burnt Clay Building Bricks

Determination of Compressive Strength (IS 3495-1992-part 1 Pg. No.1 Clause No.4) *Apparatus:* A compression testing machine, the compression plate which shall have a ball seating in the form of portion of a sphere, the centre of which coincides with the centre of the plate, shall be used.

Preconditioning: Remove unevenness observed in the bed faces to provide two smooth and parallel faces by grinding. Immerse in water at room temperature for 21 h. Remove the specimen and drain out any surplus moisture at room temperature. Fill the frog (where provided) and all voids in the bed face flush with cement mortar (1 cement, clean coarse sand of grade 3 mm and down). Store under the damp jute bags for 24 h, followed by immersion in clean water for 3 days. Remove, and wipe out any traces of moisture.

Procedure: Place the specimen with flat faces horizontal, and mortar filled face facing upwards between two 3-ply plywood sheets each of 3 mm thickness and carefully centered between plates of the testing machine. Apply load axially at a uniform rate of 14 N/mm^2 (140 kgf/cm^2) per minute till failure occurs and note the maximum load at failure. The load at failure shall be the maximum load at which the specimen fails to produce any further increase in the indicator reading on the testing machine. Compressive strength (N/mm^2) = maximum load at failure(N)/ area of bed surface(mm2)

Determination of Water Absorption (IS 3495- 1992-part 2 Pg. No.3 Clause No.4) Apparatus: A sensitive balance capable of weighing within 1% of the mass of the specimen; and a ventilated oven.

Preconditioning: Dry the specimen in a ventilated oven at a temperature of 105 to 115°C till it attains substantially constant mass. Cool the specimen to room temperature and obtain its weight ($m1$). Specimen, warm to touch shall not be used for the purpose.

Procedure: Immerse completely dried specimen in clean water at a temperature of 27±2°C for 24 h. Remove the specimen and wipe out any traces of water with a damp cloth and weigh the specimen. Complete the weighing 3 min after the specimen has been removed from water. Water absorption, percent by mass, after 24 h immersion in cold water is given by the following formula:

Determination of Efflorescence (IS 3495- 1992 part 3 Pg. No.5 Clause No.4)

Apparatus: A shallow flat bottom dish containing sufficient distilled water to completely saturate the specimens is used. The dish shall be made of glass, porcelain or glazed stoneware and of size 180 mm ×180 mm×40 mm depth for square shaped and 200 mm×40 mm depth for cylindrical shaped.

Procedure: Place the end of the bricks in the dish, the depth of immersion in water being 25 mm. Place the whole arrangement in a warm (for example, 20 to 30°C) well ventilated room until all the water in the dish is absorbed by the specimens and the surplus water evaporates. Cover the dish containing the brick with suitable glass cylinder so that excessive evaporation from the dish may not occur. When the water has been absorbed and bricks appear to be dry, place a similar quantity of water in the dish and allow it to evaporate as before. Examine the bricks for efflorescence after the second evaporation and report the results.

Report: The liability to efflorescence shall be reported as ‘nil’, ‘slight’, ‘moderate’, ‘heavy’ or ‘serious’ in accordance with the following definitions:

Nil - When there is no perceptible deposit of efflorescence. Slight - When not more than 10 percent of the exposed area of the brick is covered with a thin deposit of salts.

Moderate - When there is a heavier deposit than under ‘slight’ and covering up to 50 percent of the exposed area of the brick surface but unaccompanied by powdering or flaking of the surface.

Heavy - When there is a heavy deposit of salts covering 50 percent or more of the exposed area of the brick surface but unaccompanied by powdering or flaking of the surface.

Serious - When there is a heavy deposit of salts accompanied bp powdering and/or flaking of the exposed surfaces.

Fly-Ash Lime Brick (IS 2180 and IS 1077) Fly-ash lime brick has weight compressive strength less than 30 N/mm2 approximately 300 kgf/cm^2 for higher strength.

MATERIALS

The selection of ingredient of bricks which required property like durability, compressive strength, efflorescence, water absorption and economical as possible, is done. The following are the materials used in manufacturing of bricks.

Fly Ash

Two types of fly ash are commonly used in concrete: Class C and Class F. Class C are often high-calcium fly ashes with carbon content less than 2%; whereas, Class F are generally low- calcium fly ashes with carbon contents less than 5% but sometimes as high as 10%. In general, Class C ashes are produced from burning sub- bituminous or lignite coals and Class F ashes from bituminous or anthracite coals. Performance properties between Class C and F ashes vary depending on the chemical and physical properties of the ash and how the ash interacts with cement in the concrete. Class F fly ash possesses only pozzolonic properties whereas class C fly ash possesses both cementitious and pozzolonic properties.

Cement

Portland cement is the basic ingredient of concrete. Concrete is formed when Portland cement creates a paste with water that binds with sand and rock to harden. Cement is manufactured through a closely controlled chemical combination of calcium, silicon, aluminum, iron and other ingredients. Ordinary Portland cement of 43 grades was used for the entire work.

Clay

Clay is a fine-grained soil. It is a cohesive soil. The particle size is less than 0.002 mm. It is usually dark grey or black in colour. It has conspicuous odor. They differ from other grains in their chemical composition and physical properties. In chemical terms, they are hydrated alumina-silicates formed by the leaching process acting on the primary minerals in rock. Physically speaking, clay very often assumes a platy elongated shape. Their specific surface is infinitely greater than that of rough round or angular particles. Clay is one of the most mineral materials used all over the earth for bricks.

Surface Clays

Surface clays may be the up thrusts of older deposits or of more recent sedimentary formations. As the name implies, they are found near the surface of the earth.

Shale

Shale is clays that have been subjected to high pressures until they have nearly hardened into slate.

Fire Clays

Fire clays are usually mined at deeper levels than other clays and have refractory qualities.

Crush Sand

In a replacement of fine aggregate (sand) in fly ash bricks, crush sand is used as it is cost effective than the fine aggregate. There no specific grade for the crushed sand to maintain the quality of bricks.

Lime

Pure Lime

Pure Lime- which is also known as air lime, because it hardens on exposure to air. It is also called Fat lime.

Hydraulic Lime

It is also known as water lime, as it sets under water. The production process is interesting. First, quicklime is created by burning limestone, marble, chalk or shell at above 900ºC to drive off carbon dioxide. If the material being burnt is pure calcium carbonate,

then pure quicklime is produced. If the material being burnt contains impurities, typically an aluminum and magnesium silicate, then hydraulic quicklime is produced. Lime is created by adding quicklime to water, referred to as 'slaking'. With hydraulic quicklime, sufficient water is used to produce a dry powder. Pure lime is produced either as

Brick Type	Proportion	Mix No.	Compressive Strength (N/mm2)
Fly Ash + Lime	(90% FA, 10% Lime)	1	6.74
	(85% FA, 15% Lime)	2	6.95
	(80% FA, 20% Lime)	3	7.39
	(75% FA, 25% Lime)	4	8.36
(Fly Ash + Cement)	(90% FA, 10% Cement)	1	5.43
	(85% FA, 15% Cement)	2	5.65
	(80% FA, 20% Cement)	3	6.73
	(75% FA, 25% Cement)	4	6.93
(Fly Ash + Lime + Stone Dust)	(65% FA, 10% Lime, 25% Stone Dust)	1	7.39
	(60% FA, 10% Lime, 30% Stone Dust)	2	7.60
	(55% FA, 10% Lime, 35% Stone Dust)	3	8.26
	(50% FA, 10% Lime, 40% Stone Dust)	4	8.90
Clay Brick			4.56

putty or a powder.

3.TESTING

Compressive Strength

Minimum average compressive strength of brick shall not be less than 7.5 N/mm2 when tested as per IS-3495 (Part- 1):1976. The compressive strength of any individual brick shall not be fall below the minimum average compressive strength by more than 20%.

Water Absorption

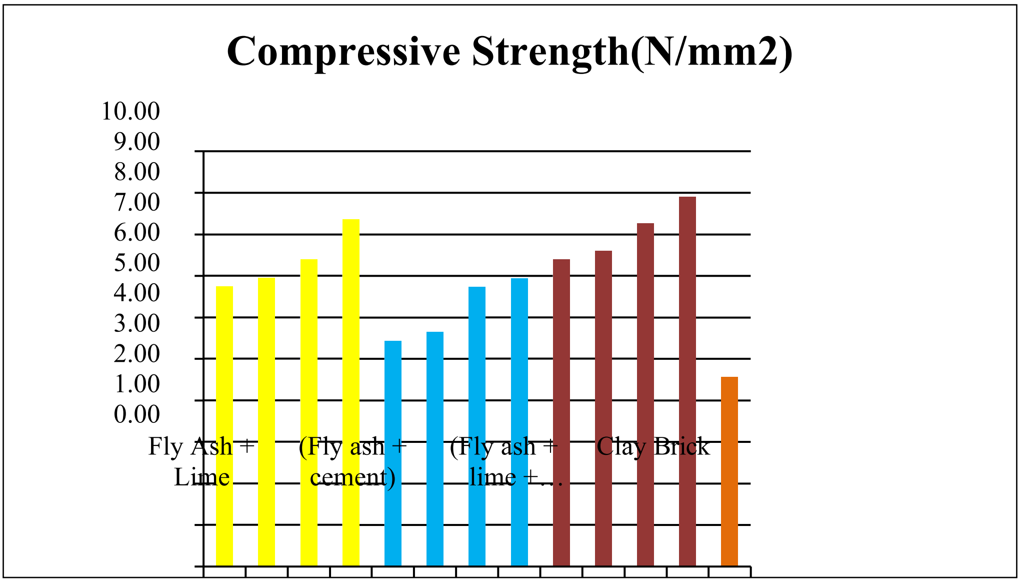
The bricks when tested in accordance with the procedure laid down in IS: 3495 (Part-2):1976 after immersion in cold water for 24 h, shall have water absorption not more than 20%.

Efflorescence Test

The bricks when tested in accordance with the procedure laid down in IS: 3495 (Part-3):1976 shall have the rating of efflorescence not more than ‘Moderate’.

Table 1: *Compressive Strength of Bricks [5].*

Fig. 2: Compressive Strength [5].



The Figure 2 shows the variation in compressive strength with respect to various combinations of fly ash with lime, cement, lime+ stone dust and clay respectively. Within each combination, fly ash is replaced from 50 to 80% at an interval of 10%. The combination fly ash + lime and fly ash +lime+ stone dust gives better compressive strength. In fly ash and lime combination, rate of gain of strength is slow in early period but in later period, strength gain was at higher rate. While combination of cement and fly ash rate of gain of strength is fast, later it decreases. In clay bricks, strength of brick is better but not ecofriendly and more fertilized soil used in manufacturing of clay bricks.

4. CONCLUSION

1. The manufacturing of bricks using fly ash is environment friendly.
2. The fly ash 70 to 80% used in manufacturing bricks is beneficial to increase in compressive strength.
3. Lime makes good combination with fly ash which increases durability of brick element.
4. Using fly ash in bricks reduces manufacturing cost of brick element.

REFERENCES

1. Basumajumdar A, Das AK, Bandyopadhyay N, *et al.* Some Studies on the Reaction between FA and Lime. *Bull Mater Science*, *Indian Academy of Sciences*. Apr 2005; 28(2): 131–136p
2. Kumar S. A Perspective Study on FA- Lime-Gypsum Bricks and Hollow Blocks for Low Cost Housing Development. *Constr Build Mater,* Elsevier Publication. 2002; 16: 219–525p.
3. Gadling PP, Varma MB. Comparative Study on Fly Ash Bricks and Normal Clay Bricks. *International Journal for Scientific Research & Development (IJSRD)*. 2016; 4(09): 673–676p.
4. Hakan Cengizler, Tayfun Cicek, Mehmet Tanrıverdi. Brief Overview of FA Brick Production. *Proceedings of XIIIth International*

Mineral Processing Symposium, Bodrum-Turkey. 2012; 1–12p.

5. Gawatre Dinesh W, Vairagade Laxmikant N. Strength Characteristics of Different Types of Bricks. *International Journal of Science and Research (IJSR)*. Oct 2014; 3(10): 2247–2252p.

6. Ramji Porwal. Comparative Study of the Properties of Fly Ash Clay Bricks and Clay Bricks. *GJESR Research Paper*. Nov 2014; 1(10): 51–60p.

Carbon Fiber: A Recent Material for Construction

Dimple Sharma[a] , Bhaskar Singhal[b]

[a] Assistant Professor, Deptt. of Civil Engineering, Beehive College of Engineering and Technology Dehradun, Uttarakhand (India)

[b]Assistant Professor, Deptt. of Civil Engineering, JBIT Dehradun Uttarakhand (India)

ABSTRACT

Over the ages as we have evolved, so has our engineering and researching skill sets. Even today, we are constantly innovating, researching and developing technology in pursuit of a sustainable future. Throughout this evolution, researches and engineers have found themselves in constant search for new and better materials to optimally manage the performance cost tradeoff in the construction sector. Many new raw materials have been discovered and many ground-breaking composite have been developed, of which not all but some have proved to be a phenomenal success. Carbonfiber is one of these materials, which is usually used in combination with other materials to form a composite. The properties of carbon fiber, such as high stiffness, high tensile strength, low weight, high chemical resistance, high temperature tolerance and low thermal expansion makes them one of the most popular material in civil engineering possessing strength up to five times that of steel and being one-third its weight, we might as well call it 'the superhero' of the material world.

Keywords- Carbonfiber, high chemical resistance, high tensile strength

---

1.INTRODUCTION

HISTORY

The 20th century saw a roller coaster ride in the demand for carbon fiber. Threats to peace increased the demand for carbon fiber for defense purposes mid-century. A downturn in defense needs result in a reduction in production of carbon fiber toward the close of the century. By the beginning of the 21st century, new applications and new markets sent the production of carbon fibers on an upswing. Despite a downturn in 2007-2008, worldwide demand increased to approximately 40,000 metric tons in 2010. Carbon fibers have revolutionized the technology of materials. It is no wonder that the National Academy of Engineering voted carbon fibers one of the 20 top engineering achievements of the 20th century and the American Chemical Society named the development of high performance carbon fibers a National Historic Chemical Landmark in September 2003.

WHAT IS CARBON FIBER

Carbon fibers are a type of high-performance fiber available for civil engineering application. It is also called graphite fiber or carbon graphite, carbon fiber consists of very thin strands of the element carbon. Carbon fibers have high tensile strength and are very strong for their size. In fact, carbon fiber might be the strongest material.

Carbon fibers have high elastic modulus and fatigue strength than those of glass fibers. Considering service life, studies suggests that carbon fiber reinforced polymers have more potential than agamid and glass fibers. They also are highly chemically resistant and have high temperature tolerance with low thermal expansion. and corrosion resistance.

Each fiber is 5-10 microns in diameter. To give a sense of how small that is, one micron(um) is 0.000039 inches. One strand of spider web silk is usually between 3-8 microns. Carbon fibers are twice as stiff as steel and five times as strong as steel, (per unit of weight). . The most important factors determining the physical properties of carbon fiber are degree of carbonization (carbon content, usually more than

92% by weight) and orientation of the layered carbon planes (the ribbons).
Carbon fiber-reinforced composite materials are used to make aircraft and spacecraft parts, racing car bodies, golf club shafts, bicycle frames, fishing rods, automobile springs, sailboat masts, and many other components where light weight and high strength are needed. Carbon fiber's high strength, light weight and resistance to corrosion make it an ideal reinforcing material.

2.PROPERTIES OF CARBON FIBER

Carbon Fiber has High Strength to Weight Ratio (also known as specific strength) Strength of a material is the force per unit area at failure, divided by its density. Any material that is strong and light has a favorable Strength/weight ratio. Materials such as Aluminum, titanium, magnesium, Carbon and glass fiber, high strength steel alloys all have good strength to weight ratios. It is not surprising that Balsa wood comes in with a high strength to weight ratio.The following figures are offered for comparison only and will vary depending on composition, alloy, type of spider, density of wood etc. The unitsare kN.m/kg.

TABLE 2.1- CARBON FIBER HAS HIGH STRENGTH TO WEIGHT RATIO (ALSO KNOWN AS SPECIFICSTRENGTH)

Spectra fiber	3619
Kevlar	2514
Carbon Fiber	2457
Glass Fiber	1307
Spider Silk	1069
Carbon Epoxy Composite	785
Balsa axial load	521
Steel alloy	254
Aluminum alloy	222
Polypropylene	89
Oak	87

Nylon	69

Note that strength and rigidity are different properties, strength is resistance to breaking, and rigidity is resistance to bending or stretching.

Carbon Fiber is very rigid

Rigidity or stiffness of a material is measured by its Young Modulus and measures howmuch a material deflects under stress. Carbon fiber reinforced plastic is over 4 times stiffer than Glass reinforced plastic, almost 20 times more than pine, 2.5 times greater than aluminum. For more information on stiffness and how it is measured, plus a comparison table of different materials see my Young Modulus page.

Carbon fiber is Corrosion Resistant and Chemically Stable

Although carbon fiber themselves do not deteriorate, Epoxy is sensitive to sunlight and needs to be protected. Other matrices (whatever the carbon fiber is imbedded in) mightalso be reactive.

Carbon fiber is electrically Conductive

This feature can be useful and be a nuisance. In Boat building It has to be taken into account just as Aluminum conductivity comes into play. Carbon fiber conductivity can facilitate Galvanic Corrosion in fittings. Careful installation can reduce this problem. Carbon Fiber dust can accumulate in a shop and cause sparks or short circuits in electrical appliances and equipment.

Fatigue Resistance is good

Resistance to Fatigue in Carbon Fiber Composites is good. However when carbon fiberfails it usually fails catastrophically without much to announce its imminent break.

Damage in tensile fatigue is seen as reduction in stiffness with larger numbers of stresscycles, (unless the temperature is high)

Test has shown that failure is unlikely to be a problem when cyclic stresses coincide withthe fiber orientation. Carbon fiber is superior to

E glass in fatigue and static strength as well as stiffness.
The orientation of the fibers and the different fiber layer orientation, have a great deal ofinfluence on how a composite will resist fatigue (as it has on stiffness). The type of forces applied also result in different types of failures. Tension, Compression or Sheer forces all result in markedly different failure results. Paper on test of carbon fiber composites intended for automotive use. American Institute of Aeronautics and Astronautics, test for materials to be used in wind turbines blades.

Carbon Fiber has good Tensile Strength

Tensile strength or ultimate strength is the maximum stress that a material can withstandwhile being stretched or pulled before necking, or failing. Necking is when the sample cross-section starts to significantly contract. If you take a strip of plastic bag, it will stretch and at one point will start getting narrow. This is necking. It is measured in Forceper Unit area. Brittle materials such as carbon fiber do not always fail at the same stress level because of internal flaws. They fail at small strains. (in other words there is not a lot of bending or stretching before catastrophic failure)

Weibull modulus of brittle materials

Testing involves taking a sample with a fixed cross-section area, and then pulling it gradually increasing the force until the sample changes shape or breaks. Fibers, such as carbon fibers, being only 2/10,000th of an inch in diameter, are made into compositesof appropriate shapes in order to test.Units are MPa this table is offered as a comparison only since there are a great number of variables.

TABLE 2.2- CARBON FIBER HAS GOOD TENSILE STRENGTH

Carbon steel 1090	3600
High density polyethylene (HDPE)	37

Polypropylene	19.7-80
High density polyethylene	37
Stainless steel AISI 302	860
Aluminum alloy 2014-T6	483
Aluminum alloy 6063-T6	248
E-Glass alone	3450
E-Glass in a laminate	1500
Carbon fiber alone	4127
Carbon fiber in a laminate	1600
Kevlar	2757
Pine wood (parallel to grain)	40
Stainless steel AISI 302	860
Aluminum alloy 2014-T6	483

Fire Resistance/Non Flammable

Depending upon the manufacturing process and the precursor material, carbon fiber can be quite soft and can be made into or more often integrated into protective clothing for firefighting. Nickel coated fiber is an example. Because carbon fiber is also chemically very inert, it can be used where there is fire combined with corrosive agents.

Carbon Fiber Blanket used as welding protection.

Thermal Conductivity of Carbon Fiber

Thermal conductivity is the quantity of heat transmitted through a unit thickness, in a direction normal to a surface of unit area, because of a unit temperature gradient, understeady conditions. In other words its a measure of how easily heat flows through a material. There are a number of systems of measures depending on metric or imperial units.

1 W/(m.K) = 1 W/(m.oC) = 0.85984 kcal/(hr.m.oC) = 0.5779 Btu/(ft.hr.oF)This table is only for comparison.
The units are W/(m.K)

Table 2.3- Thermal Conductivity of Carbon Fiber

Air	.024
Aluminum	250
Concrete	0.4 -0 .7
Carbon Steel	54
Mineral Wool insulation	.04
Plywood	.13
Quartz	3
Pyrex Glass	1
Pine	12

Carbon Fiber Reinforced Epoxy	24

Because there are many variations on the theme of carbon fiber it is not possible to pinpoint exactly the thermal conductivity. Special types of Carbon Fiber have been specifically designed for high or low thermal conductivity. There are also efforts to enhance this feature.

Low Coefficient of Thermal Expansion

This is a measure of how much a material expands and contracts when the temperaturegoes up or down. Units are in Inch / inch degree F, as in other tables, the units are not so important as the comparison.

Table 2.4- Low Coefficient of Thermal Expansion

Steel	7
Aluminum	13
Kevlar	3 or lower
Carbon Fiber woven	2 or less
Carbon fiber unidirectional	minus 1 to +8
Fiberglass	7-8

Carbon fiber can have a broad range of CTE's, -1 to 8+, depending on the direction measured, the fabric weave, the precursor material, Pan based (high strength, higher CTE) or Pitch based (high modulus/stiffness, lower CTE).In a high enough mast differences in Coefficients of thermal expansion of various materials can slightly modifythe rig tensions.

Low Coefficient of Thermal expansion makes carbon fiber suitable for applications where small movements can be critical. Telescope and other optical machinery is onesuch application.

3.APPLICATIONS

Civil Engineering

Several structural engineering applications utilize carbon fiber reinforced polymer because of its potential construction benefits and cost effectiveness. The usual applications include strengthening structures made with concrete, steel, timber, masonry, and cast iron; Retrofitting to increasing the load capacity of old structures like bridges; to enhance shear strength and for flexure in reinforced concrete structures.

Other applications include replacement for steel, prestressing materials andstrengthening cast-iron eams.

Carbon Fiber in Flight

Carbon fiber has gone to the moon on spacecraft, but it is also used widely in aircraft components and structures, where its superior strength to weight ratio far exceeds that of any metal. 30% of all carbon fiber is used in the aerospace industry. From helicopters to gliders, fighter jets to micro lights, carbon fiber is playing its part, increasing range andsimplifying maintenance.

Sporting Goods

Its application in sports goods ranges from the stiffening of running shoes to ice hockey stick, tennis racquets and golf clubs. ‘Shells’ (hulls for rowing) are built from it, and manylives have been saved on motor racing circuits by its strength and damage tolerance in body structures. It is used in crash helmets too, for rock climbers, horse riders and motorcyclists – in fact in any sport where there is a danger of head injury.

Military

The applications in the military are very wide ranging – from planes and missiles to protective helmets, providing strengthening and weight reduction across all military equipment. It takes energy to move weight – whether it is a soldier's personal gear or a field hospital, and weight saved means more weight moved per gallon of gas.
A new military application is announced almost every day. Perhaps the latest and most exotic military application is for small flapping wings on miniaturized flying drones, used for surveillance missions. Of course, we don't know about all military applications – some carbon fiber uses will always remain part of 'black ops' – in more ways than one.

Carbon Fiber at Home

The uses of carbon fiber in the home are as broad as your imagination, whether it is style or practical application. For those who are style-conscious, it is often tagged as 'the new black'. If you want a shiny black bathtub built from carbon fiber, or a coffee table then you can have just that, off the shelf. iPhone cases, pens and even bow ties – the look of carbon fiber is unique and sexy.

Medical Applications

Carbon fiber offers several advantages over other materials in the medical field, including the fact that it is 'radiolucent' – transparent to X-rays and shows as black on X- ray images. It is used widely in imaging equipment structures to support limbs being X- rayed or treated with radiation.
The use of carbon fiber to strengthen of damaged cruciate ligaments in the knee is being researched, but probably the most well known medical use is that of prosthetics – artificial limbs. South African athlete Oscar Pistorius brought carbon fiber limbs to prominence

when the International Association of Athletics Federations failed to ban him from competing in the Beijing Olympics. His controversial carbon fiber right leg was said to give him an unfair advantage, and there is still considerable debate about this.

Automobile Industry

As costs come down, carbon fiber is being more widely adopted in automobiles. Supercar bodies are built now, but its wider use is likely to be in internal components such as instrument housings and seat frames.

4. CONCLUSIONS

1. Carbon fibre plates are thin, strong and flexible, they can be designed and installed to provide a cost effective solution which does not detract visually from the original design of the structure.
2. It has high stiffness, high tensile strength, low weight, high chemical resistance, high temperature tolerance and one of the most popular material in civil engineering.
3. It possess strength up to five times that of steel and being one-third it weight.
4. It has more applications in civil engineering, military, sporting goods, in medical, in automobile industry, etc. so use of carbon fiber in construction is always effective and provide high strength to the structure.

REFERENCES

1 . Sha Yin (et al) “hybrid truss concepts for composite pyramidal lattice structures”, vol.part B 43(2012), page no.1749-1755.
2 .D.J.Bull (et al) “A comparison of multi-scale 3D X-ray tomographic inspection techniques for assessing carbon fiber composite impact damage”, vol.75(2013) pageno.55-61.
3 .Mohit Sharma (et al) “Influence of fiber-matrix adhesion and operating parameters on sliding wear performance of carbon fabric polyethersulphone composites”, vol.271(2011), page no.2919-2927.
4. P.Salazar “Microbiosensors for glucose based on Prussian Blue

modifide carbon fiberelectrodes for in vivo monitoring in the central nervous system", vol.26(2010), page no.748-753.
5. Sang Yoon Park "Effect of vacuum thermal cyclic exposures on unidirectional carbon fiber/epoxy composites for low earth space applications", vol.43(2012)726-738.

Prevention of corrosion in RCC by using Bacteria

Dimple Sharma[a], Anil Kumar[b]

[a] Assistant Professor, Deptt. of Civil Engineering, Beehive College of Engineering and Technology Dehradun, Uttarakhand (India)

[b] Assistant Professor, Deptt. of Civil Engineering, JBIT Dehradun,

Uttarakhand (India)

ABSTRACT

Steel gets oxidise (corrosion) in the present of oxygen and water. Even present of oxygenin the concrete pore will not cause a corrosion at high alkaline environment. Concrete contains microscopic pores which contain high concentrations of soluble calcium, sodium and potassium oxides, this creates alkaline condition of pH 12–13. The alkaline condition leads to a ‘passive’ layer forming on the steel surface. The dense passive layer over the reinforcement prevents the alkalinity. This paper involves in the prevention of corrosion bymaintaining alkalinity in concrete by using bacteria.

Key words: *Reinforced concrete, corrosion, passive layer, alkaline, bacteria.*

---

1. INTRODUCTION

Corrosion in concrete is majorly due to carbonisation and chlorination. When concrete carbonates to the level of the steel rebar, the normally alkaline environment, which protects steel from corrosion, is replaced by a neutral environment. Under these conditions the steel is not passive and rapid corrosion begins. The rate of corrosion due to carbonated concrete cover is slower than chloride-induced corrosion. Occasionally, a lack of oxygen surrounding the steel rebar will cause the metal to dissolve, leaving a lowpH liquid.

Carbon-dioxide combines with water to form acid in which reduce the pH of concrete by consuming the calcium hydroxide which is formed in hydration process of cement, at low pH corrosion begins. Prevention of carbonization, prevent the alkalinity in which corrosion do not take place. Chloride in the pore of concrete involves during the corrosion only, it just acts as the catalyst in the corrosion process. Presence of chloride in concrete pore isinert at alkaline condition.

2. CORROSION PROCESS

When the passive layer breaks down then rust will start appearing on the steel surface. The chemical reactions are the same whether corrosion occurs by chloride attack or carbonation. When steel in concrete corrodes it dissolves in the pore water and gives upelectrons:

The anodic reaction is $Fe \rightarrow Fe^{2+} + 2e^-$

The two electrons (2e) created in the anodic reaction must be consumed elsewhere on the steel surface to preserve electrical neutrality.

The cathodic reaction is $2e^- + H_2O + 1/22 \rightarrow 2OH^-$

The ion dissolve in the pore water would not see cracking and spalling of the concrete. Several more stages must occur for ‘rust’ to form. Ferrous hydroxide becomes ferric hydroxide and then hydrated ferric oxide or rust. This rust cause spalling and crack over the concrete.

Fe^{2+} and OH^- formed in anode and cathode combined to form ferrous hydroxide andfurther undergoes chemical reaction as below

$$Fe^{2+} + 2OH^- \rightarrow \underset{\text{Ferrous hydroxide}}{Fe(OH)_2}$$

$$4Fe(OH)_2 + O_2 + 2H_2O \rightarrow \underset{\text{Ferric hydroxide}}{4Fe(OH)_3}$$

$$2Fe(OH)_3 \rightarrow \underset{\text{Hydrated ferric oxide (rust)}}{Fe_2O_3 \cdot H_2O + 2H_2O}$$

Unhydrated ferric oxide Fe_2O_3 formed in the a bow reaction has a volume of about twicethat of the steel it replaces when fully dense. When it becomes hydrated it swells even more and becomes porous. This means that the volume increase at the steel/concrete interface is six to ten times . This leads to the cracking and Spalling as shown in fig.3, that we observe as the usual consequence of corrosion of steel in concrete and the red/brown brittle, flaky rust we see on the bar and the rust stains we see at cracks in theconcrete.

3. CARBONATION

Carbonation is the result of the interaction of carbon dioxide gas in the atmosphere with the alkaline hydroxides in the concrete. Like many other gases carbon dioxide dissolves in water to form an acid. Unlike most other acids the carbonic acid does not attack the cement paste, but just neutralizes the alkalinity in the pore water, mainly forming calcium carbonate that lines the pores:

$$\underset{\text{Gas}}{CO_2} + \underset{\text{Water}}{H_2O} \rightarrow \underset{\text{Carbonic acid}}{H_2CO_3}$$

$$\underset{\text{Carbonic acid}}{H_2CO_3} + \underset{\text{Pore solution}}{Ca(OH)_2} \rightarrow CaCO_3 + 2H_2O$$

There is a lot more calcium hydroxide in the concrete pores that can dissolve in the porewater. This helps maintain the pH at its usual level of 12–13 as the carbonation reaction occurs. However, as carbon dioxide proceeds to react with the calcium (and other) hydroxides in solution, eventually all the calcium hydroxide reacts, precipitating the calcium carbonate and allowing the pH to fall to a level where steel will corrode.

Chloride attack

The chloride ion attacks the passive layer although in this case (unlike carbonation) thereis no overall drop in pH. Chlorides act as catalysts to corrosion. They are not consumed

in the process but help to break down the passive layer of oxide on the steel and allowthe corrosion process to proceed quickly as shown in fig.5. The effective recycling of chloride ions makes chloride attack more difficult to remedy as chlorides are therefore harder to eliminate.

Prevention of corrosion

Carbon dioxide and chloride present in the concrete are inert in the absence of the water and oxygen. Carbon dioxide in the pore of the concrete reacts with water to form carbonic acids which reduce the pH of the concrete. In the absence of water carbon dioxide is in active. Chloride in concrete is also in active at alkaline condition. In corrosion process carbon-dioxide acts as initiator and chloride acts as a catalyst. We can prevent corrosion by preventing the contact of water, carbon-dioxide and oxygen. Even in presence of water steel will not undergoes corrosion at alkaline environment.

Bio concrete

The bacteria and $Ca(OH)_2$ of pH 13 is added to the concrete in a capsule. The bacteria are Bacillus alkali-nitrulicus, an alkali-resistant soil bacterium, psychrophilic bacterium, [8] Bacillus pasteurii is added, which can survey at high pH of 9 to 13 and at the temperature range of 10 to 40 degree centigrade. [5]Capsule of 15 kg is added to a 1m3 of concrete. The spores became active when getting contact with water, still it will be inactive in concrete. When bacteria contact with carbon-dioxide and convert calcium hydroxide to lime stone. On reaction CO_2 is arrested from diffusion.

[9]Limestone will fill the crack and there is no possibility to leakage of water and diffusion of carbon-dioxide. Hear our primary aim is to prevent the carbon-dioxide penetration and then to prevent the water infiltration to concrete.

$$CO_2 + Ca(OH)_2 \rightarrow CaCO_3 + H_2O$$

In self-healing concrete capsule containing bacteria and calcium lactate is added. In atmosphere quantity of CO_2 is less to speed up the self-healing process calcium lactate is added in which it precipitate CaCO3 and liberate CO_2.

$$Ca(C_3H_5O_2)_2 + 7O_2 \rightarrow CaCO_3 + 5CO_2 + 5H_2O$$

$$J = D\frac{dc}{dx}$$

Where,

J - Quantity of a component passing through unit area per unit time

$\frac{dc}{dx}$- Concentration gradient/slope of molar concentration.

D - Diffusion coefficient, a material property that depends on permeability.

Diffusion of CO_2

[7]Concrete will carbonate whenever carbon dioxide and some water are available. The speed of carbonation depends on how fast the carbon dioxide and/or the carbonate ions can move into the concrete

and react with the cement paste. Diffusion is mass transport down a concentration gradient. Steady state diffusion follows Fick´s first law

4. WATER CEMENT RATIO TO REDUCE 'D'

Water cement ratio in the concrete plays an important role in the strength and durability ofthe concrete. It has also been estimated that on an average 23% of water by weight of cement is required for chemical reaction with Portland cement compounds.

This 23% of water chemically combines with cement and, therefore, it is called bound water. A certain quantity of water is imbibed within the gel- pores. This water is known as gel-water. It can be said that bound water and gel-water are complimentary to each other. If the quantity of water is inadequate to fill up the gel-pores, the formations of gel itself will stop and if the formation of gel stops there is no question of gel-pores being present. It has been further estimated that about 15 per cent by weight of cement is enof to fill up the gel-pores. Therefore, a total 38 per cent of water by weight of cement is required for the complete chemical reactions and to occupy the space within gel-pores. If water equal to 38 per cent by weight of cement is only used it can be noticed that the resultant paste will undergo full hydration and no extra water will be available for the formation of undesirable capillary cavities. On the other hand, if more than 38 per cent of water is used, then the excess water will cause undesirable capillary cavities. Therefore, greater the water above the minimum required is used (38 per cent), the more will be the undesirable capillary cavities. In all this it is assumed that hydration is taking place in a sealed container where moisture to and from the paste does not take place. Increases in cavity in a concrete increase the coefficient of diffusion in concrete. At a same time it is difficult to work in concrete at water cement ratio of 0.38.

5. CONCLUSION

Even through, we had a good design, material and scheduling it is impossible to attain strength and durability without good workman ship. For an example Masan will add water in mortar and shovel it. During this process fine partial cement settle down and only sand will available for the plating above. Hence workmanship is more important than any other in construction. For every problem there is a simple solution one of the simple solutions for the corrosion is to provide proper cover to the reinforcement. Nominal cover shall in any case not be less than 40 mm.

REFERENCES

1) *John P. Broomfield; "Corrosion of Steel in Concrete Understanding, investigation and repair", Taylor & Francis 270 Madison Ave,New York,NY 10016.*

2) *M.S. Shetty; "concrete technology theory and practices", S.Chandra and company ltd,Ram nagar , new Delhi.*

3) *IS10262-2007 "Recommended Guidelines for Concrete Mix Design", Bureau of IndianStandards, New Delhi, 2007.*

4) *IS456:2000, Code of practice for Plain and Reinforced Concrete, Bureau of IndianStandards, New Delhi, 2007*

5) *Achal, V., Mukherjee, A., Basu, P . C., and Reddy, M. S. (2009). "Strain improvement of sporosarcina pasteurii for enhanced urease and calcite production." Journal of industrial Microbiology and Biotechnology, 36, 981-988.*

Concrete Structures Reinforced with FRP Bar

Dr. Sanjeev Gill[a], Anil Kumar[b]

[a] Professor, Deptt.of Civil Engineering. JBIT Dehradun, Uttarakand (India)
[b]Assistant Professor, Deptt.of Civil Engineering. JBIT Dehradun, Uttarakand (India)

ABSTRACT

Fiber reinforced polymer (FRP) bars have been widely used in civil engineering used as a substitute for steel reinforcement because it has many advantages such as high strength-to-weight ratio, electromagnetic neutrality, light weight, ease of handling and nocorrosion. Moreover, the productive technology becomes more and more mature and industrialized so that FRP has become one economic and competitive structure material. Based on the recent researches, this paper mainly introduces progress in the studies on concrete structures reinforced with FRP bars. These contents in this paper includes the bond performance of FRP bars in concrete, Compression Behavior, flexural behavior, and ductility of concrete structure reinforced with FRP bars in the past few years in the world.

Key words- FRP Bars, Concrete Structure, Bond Performance, Pullout Behavior, CompressionBehavior, Flexural Behavior, and Ductility.

---

1. INTRODUCTION

Infrastructure decay due to corrosion of embedded reinforcing steel stands out as a significant challenge worldwide [1]. The use of FRP bars as reinforcement for concrete elements seems to be an effective solution for overcoming durability problems of traditional steel reinforced concrete structures due to the corrosion of metallic bars. For this reason, the replacement of steel with FRP bars is gaining popularity worldwide. It has many advantages such as high strength-to-weight ratio, electromagnetic neutrality, light weight, ease of handling, no corrosion, low weight to strength ratio (1/5 to 1/4 timesof the density of steel), high longitudinal tensile strength, and non-magnetic characteristics. Although the initial cost of FRP reinforcement is higher than steel reinforcement, the total life cycle cost of the structure or structural components reinforced with FRP is lower, as significantly less maintenance costs are required for structures or structural components reinforced with FRP. The application of FRP bars in civil engineering can be divided into two classes. One is to substitute steel bars in concrete structures, and the other one is to maintain and strengthen old structures. In the past few years, with the development of FRP material technique, more and more scholar began to focus on the application research work on FRP. This paper mainly introduces progress in the studies on concrete structures reinforced with FRP bars.

These contents in this paper include the bond performance of FRP bars in concrete, shear resistance, flexural behavior, compressive behaviour and ductility of concrete structure reinforced with FRP bars in the past few years in the world.

Bond strength and its factors: – The mechanics of bond stress transfer between FRP reinforcement and concrete has been investigated extensively. Bond stress is the shearing stress whose direction is parallel to the interface plane of FRP bars and concrete. The bond of an embedded bar, regardless of material, resists pull-out via three main mechanisms. The first is chemical adhesion between the two materials at their interface. The second is the friction bond which is due to coarseness in the surface of the bar. The third mechanism contributing towards the bond is mechanical bearing, such as that generated from the lugs on reinforcing bars upon the surrounding concrete [4].

Based on the studies on concrete reinforced with FRP bars, the factors that influencethe bond strength can be divided to several classes below:

The bond performance of FRP bars in concrete, which is the basic mechanical behavior, is the main factor of the mechanical performance, failure mode, serviceability, crack width, deformation and structure analyses and design.

2. PULLOUT BEHAVIOR OF FRP BAR WITH DIFFERENT STRENGTH OF CONCRETE

The bond performance of 88 concrete pull-out specimens prepared according to ACI 440.3R-04 and CSA S806-02 standards with FRP bars were investigated by Baena et. al. [5]. Rebars (reinforcing bars) made of carbon-fibre and glass-fibre reinforced polymer (CFRP and GFRP), as well as steel rebars, with a constant embedment length of five times the rebar diameter were used. The influence of the rebar surface, rebar diameter and concrete strength on the bond–slip curves obtained is analyzed. Hence, an averagebond stress is defined = P/ ? db lb where P is the tensile load, db is the rebar diameter, and lb is the embedment length. In his experiment, different strength of concrete was adopted. The experimental results confirm the tendency of rebars with larger diameters to have lower bond strength, especially in the case of higher strength concrete (M60). Pull-out test of normal-strength concrete and high-strength concrete were performed by Chaallal and Benmokrane [6]. The experimental bond strength results from pullout tests performed on GFRP rods embedded in NSC (Normal strength concrete) varied from 11.1 to 15.1 MPa with an overall average of 12.9 MPa. For the sake of comparison, pullout tests were performed on conventional deformed steel rebars using the same NSC overall average of 18 MPa. GFP rod bond strengths associated with HSC (high strength concrete) varied from 8.4 to 15.8 MPa, with an overall average of 12.1 MPa. For the sake of comparison, pullout tests were performed on conventional deformed steel rebars using the same HSC overall average of 30 MPa (which is 62% to 84% of that of steel deformed bars). Veljkovic et. al. [7] found in his experiment that the Ribbed GFRP bars develop bond strength differently according to concrete mechanical properties. Concretes with average compressive strength in range 25-40 MPa do not influence strongly the bond strength, while within range of 40-65 MPa, bond strength is enhancing significantly. Highest concrete strength delays onset of cracking in low covers, but allows smoother and faster crack advancement. Veljkovic et. al. [7] also uses DIC (Digital Image Correlation) technique for recording and evaluating of strain field of the specimens. Results shows that the both types of GFRP bars presented comparable, but still, in average, lower bond strength compared to steel ones under the same experimental conditions but the use of thin concrete cover (10 mm in this case) in combination with ribbed GFRP bars attained similar bond strength as steel bars and showed the real advantage of use of this GFRP bars instead of standard steel ones.

Golafshani et al. [8] did extensive research on bond behavior of steel and GFRP bars innormal concrete (NC) and self-compacting concrete (SCC) of 104 pullout specimens.

The results revealed that the bond behavior of GFRP bars in SCC shows better results as compared to the GFRP bars used in NC. This is due to the superior filling capacity ofSCC compared to NC. However, the bond strength variations of steel bars are less thanthat of GFRP bars.

3. FLEXURAL BEHAVIOR OF REINFORCED CONCRETE BEAMS WITH FRP BARS

Several experimental studies were conducted to investigate the flexural behavior of FRP reinforced concrete beams and comparison with that of steel reinforced concrete beams. Rafi et. al. [9] investigated flexural behavior of CFRP (Carbon fiber reinforced polymer) reinforcement RC beams and normal RC beams and compared the results of both. Test results show that the structural behaviors of CFRP reinforced concrete are similar to normal RC in many aspects. The CFRP RC beams displayed good bond between the reinforcement bars and concrete, with no signs of bond failure or slip. Beams failed due to concrete crushing at almost double the loads on the other hand steel RC beams failed due to steel yielding. The long-term flexural behaviors of a hybrid system consisted of continuous fiber-reinforced-polymer (FRP) rebar and fiber- reinforced-concrete (FRC) were investigated by the Wang and Belarbi [10], and the results shows that the ultimate flexural strength experienced minor reduction when exposed to combined environmental conditioning, including freeze–thaw cycles, high temperature (60°C), and de-icing salt solution. The degradation of concrete may be the main reason for the flexural strength degradation. The behaviour of GFRP (Glass fiber reinforced polymer) RC beams with different percentages of reinforcement ratio and concrete strengths under static and impact loading were investigated by the Goldston et. al. [3], the results reveals that the six GFRP RC beams were tested under static loading and the remaining six GFRP RC beams were tested under impact loading (using a drop hammer). To examine the failure modes and associated energy absorption capacities. Author reported that the 15-20% higher dynamic moment capacities compared to static moment capacities and Reinforcement ratio and the strength of concrete influenced the behaviour of GFRP RC beams. Escorcio and Franca [18] presented a rehabilitation solution to replace the tension steel reinforcement of a RC beam with GFRP bars, which is a material immune to corrosion. As per the author observation that the rehabilitated beams with GFRP bars exhibited a bilinear behaviour until failure in terms of load-deflection as expected since the ductile performance of the reference beam with steel reinforcement is not possible toreplicate due to the GFRP material linear elastic property until failure. An experimental study was conducted by Hosen et. al. [11] to investigate the performance of RC beams strengthened with SNSM (side near-surface mounted)-GFRP (Glass fiber reinforced polymer) bars. The results of this study showed that the Strengthening using SNSM (side near-surface mounted) -GFRP bars enhanced the first crack and ultimate loads up to 4.38 and 1.55 times compared with the control specimen. The use of GFRP as an SNSM reinforcement has exhibited a tri-linear response in load-deflection behavior and reduced the deflection at any load level of the specimens, which would address the serviceability concerns.

Compressive behavior of Reinforced Concrete columns with FRP bars

Few experimental studies were conducted to investigate the influence of replacing steel bars with GFRP bars on the behaviour of square and circular concrete columns. H. Karim et. al. [12] investigated the behaviour of concrete columns reinforced with FRP bars. A total of five circular concrete columns of 205 mm in diameter and 800 mm in height were cast and tested under axial compression. The specimens were reinforced either with GFRP bars and GFRP helices or only with GFRP helices. The experimental results showed that the GFRP-RC columns experienced two peak axial loads. The first peak load represents the maximum load carrying capacity of the gross concrete cross- section (concrete core and cover). The second peak load represents the maximum load carrying capacity of the concrete core confined by the FRP helices. M.Z. Afifi et.[13] also presented tests that were performed to investigate the axial compression behavior of circular concrete columns reinforced longitudinally with GFRP bars and transversely with newly developed GFRP spirals. A total of 12 full-scale RC columns were prepared to study five test variables: reinforcement type (GFRP versus steel); longitudinal FRP reinforcement ratio; and different volumetric ratios, diameters, and spacing of spiral reinforcement. The test results indicated that the GFRP and steel RC columns behaved in a similar manner. The average load carried by the longitudinal GFRP bars ranged between 5% and 10% of the maximum load. The test observations also indicated that failure of the GFRP RC columns with large spiral spacing or with small volumetric ratio (0.7%) was controlled by longitudinal bar buckling. Conversely, failure of the well- confined GFRP RC columns was attributed to the crushing of the concrete core and rupture of the GFRP spirals. The experiments were conducted to investigate the behavior of glass fiber reinforced polymer reinforced concrete columns (GFRP-RCCs) under an eccentric axial load by L. Sun et. al. [14]. Nine short columns (L/h = 4) were cast: three each with initial eccentricities of 175 mm, 125 mm, and 75 mm. The test results showed that the steel reinforced concrete columns fails in terms of steel yielding behavior on the other hand GFRP- RCCs experienced pressure-side concrete crushing failures. However, the glass fiber reinforced polymer (GFRP) bars in the concrete columns mostly remained intact after the concrete was crushed. Therefore the load-deformation curves of eccentrically loaded GFRPRCCs are on an overall basis differentfrom regular steel reinforced concrete columns in terms of yielding behavior, and thus damage is expected immediately after ultimate load is reached, and they exhibit brittle characteristics. Glass fiber reinforced plastic (GFRP) was used to reinforce concrete columns that were experimentally investigated under compression loading to assess structural behavior and performance by W. Prachasaree et. al. [15] specimens were prepared with varied longitudinal reinforcement, concrete cover, and lateral reinforcement. Based on this study, the amount of GFRP longitudinal and lateral reinforcement slightly affected the column strengths. While different types of lateral enforcement had little difference in strength, the spiral lateral reinforcement was the most effective in terms of the confining pressure and the inelastic deformation.

Durability of FRP bars under different temperature in Concrete

Galati et al. [2] perform an experimental investigation was carried out on concrete specimens reinforced with a FRP bar and subjected to thermal cycles with a maximum temperature value of 70°C and Galati et. al. [2] also observed that the most of the specimens the thermal treatment induced a slight degradation in the bond performance in terms of ultimate load and more extended micro cracking of the concrete (due to the different CTE (coefficient thermal expansion)) of GFRP bars and concrete when the bars are placed at a lower cover. Robert and Benmokrane [11] also accomplish an experimental investigation of the durability of the bond between GFRP bars and concrete. The GFRP bars were embedded in concrete and exposed to tap water at (23°C, 40°C and 50°C) to accelerate potential degradation. Robert and Benmokrane [11] were also use Fourier transform infrared spectroscopy (FTIR), differential scanning calorimetry (DSC), and scanning electron microscopy (SEM) to characterize how bar aging affected the bond between the GFRP bars and the concrete. Results demonstrations that aging did not significantly affect the durability of the bar–concrete interface under the conditions used in this study.

Role of Ductility in FRP reinforced concrete structures

The ductility and confinement efficiency can be better improved by using small GFRP spirals with closer spacing rather than larger diameters with greater spacing. Ignoring the contribution of GFRP bars in the design equation underestimated the maximum capacity of the tested specimens. Sun et al. [3] observed that the GFRP bars can play a specific role in improving ductility for large-eccentricity specimens while this effect is weak or insignificant with respect to small- eccentricity specimens. In the descending section of the load-deformation curve, the ductility of the GFRP reinforced concrete columns increased with increases in eccentricity. Therefore, it is recommended by the author that the configuration of stirrups in GFRP-RCCs should be strengthened when they are used in a small eccentric compression environment to improve ductility. Wang and Belarbi [10] investigate that the concrete properties was improved by adding fibers with a volume fraction of 0.5% has been proved to be an effective way to enhance the ductility of FRP reinforced system. When compared to the companion plain concrete beams, the FRC beams showed more than 30% increase in the ductility index for both unweathered and weathered.

Role of Stiffness in FRP reinforced concrete structures

Stiffness is defined as the capability to prevent bending or deflection of the specimens under loading. It is one of the most important characteristics of the RC structures under serviceability behavior. The SNSM-GFRP-strengthened specimens resulted in higher stiffness compared with the control specimen observed by Hosen et.al [11]. Test results revealed that the increasing the size of GFRP bars from 8 to 10 mm Ø increased the stiffness from 100% to 114% compared with the control specimen. Moreover, the increase in the bond length from 1600 mm to 1900 mm improved the stiffness by 35% and 15%, respectively, for 8-mm Ø to 10-mm Ø GFRP bars. In this study, the stiffness of the strengthened specimens mostly depended on the size of the SNSM bars. Baena et. al. [5] also observed that there is a high level of stiffness with no slip in the steel rebars, whereas the FRP rebars develop slip from the beginning (The slip values obtained for GFRP are greater than those for CFRP bars). The experimental results also confirm thetendency of rebars with larger diameters to have lower bond strength, especially in the case of higher grade of concrete.

Role of economy while using FRP reinforced concrete structures

Researcher all over the world are focusing on the use of GFRP bars in concrete structures owing to their advantages in comparison to normal reinforcing steel. Berg et.al. [16] presented a study of the bridge is almost entirely reinforced with GFRP, with a small amount of steel used also. Although the initial material cost for the GFRP reinforced deck was 60% higher than the steel reinforced deck the construction time forthe GFRP deck was considerably faster than the steel deck. The rate of concrete placement on the GFRP reinforced bridge deck was 51.15m3 per hour compared to
29.05 m3 per hour for the steel reinforced deck. This shows that the GFRP deck was able to reduce construction costs by 57% compared to steel. Additionally to that long term cost savings due to decreased need for maintenance works or increased service life of the bridge deck. Long term monitoring of this bridge and its twin will be conductedto determine comparisons between the long term behavior of both GFRP and steel reinforced bridge decks.

El Salakawy et. al. [17] presented a study of Wotton Bridge, in Quebec, Canada, is essentially a full-scale long term test comparing the performance of GFRP reinforcing bars to conventional steel reinforcing bars. Test results showed that the FRP portion of the bridge deck behaved very well. Author observed that the deflections were well withinthe limits set by the Canadian code and maximum recorded strains for the static truck loading were only 0.13% of the ultimate for FRP and just 4% for the service load over one year. Strain values in the concrete due to truck loads were significantly lower than the predicted cracking strain. Ongoing test data will be valuable to allow direct comparison between steel and FRP reinforced bridge decks.

4. CONCLUSION

With 20 years' studies on the mechanical behaviors of FRP bars RC structure, great progress has been made, and lots of design codes have been published worldwide. The corrosion of steel reinforcement in concrete and the resulting deterioration of structures prompted research on FRPs as potential reinforcement for concrete. State of art in research indicate that FRP reinforcement can be effectively used in beams and column in new concrete structural elements. There has been a significant progress in understanding the behaviour of FRP (GFRP mostly) bars in concrete but, the focus of most of these studies has been the modification in the flexural and shear strength capacities of concrete beams reinforced with FRP bars. The effectiveness of FRP reinforcement as main reinforcement and hoops steel in columns has also been reported. The level of understanding of structural behavior has reached a stage where several codes and design guidelines have been issued and developed around the world. FRP bars as reinforcement improve the flexure and shear behaviour but the analysis of onset and progression of cracking in FRP reinforced concrete beams by the complementary use of NDT techniques for the characterization of mechanical performance is still untouched. Therefore, studies are still needed to be investigated on the FRP bars RC structures, especially bond behaviors, flexural behaviour and compressive behaviour.

REFERENCES

1. *Robert, M. and Benmokrane, B., 2010. Effect of aging on bond of GFRP bars embedded in concrete. Cement and Concrete Composites, 32(6), 461-467.*
2. *Galati, N., Nanni, A., Dharani, L.R., Focacci, F. and Aiello, M.A., 2006. Thermal effects on bond between FRP rebars and concrete. Composites Part A: Applied Science and Manufacturing, 37(8), 1223-1230.*
3. *Goldston, M., Remennikov, A. and Sheikh, M.N., 2016. Experimental investigation of the behaviour of concrete beams reinforced with GFRP bars under static and impact loading. Engineering Structures,*

113, 220-232.

4. *Newman, N., Ayoub, A. and Belarbi, A., 2010. Development length of straight FRP composite bars embedded in concrete. Journal of reinforced Plastics and*
5. *Composites, 29(4), 571-589.*
6. *Baena, M., Torres, L., Turon, A. and Barris, C., 2009. Experimental study of bond behaviour between concrete and FRP bars using a pull-out test. Composites Part B: Engineering, 40(8), 784-797.*
7. *Chaallal, O. and Benmokrane, B., 1993. Pullout and bond of glass-fibre rods embedded in concrete and cement grout. Materials and structures, 26(3), pp.167- 175.*
8. *Veljkovic, A., Carvelli, V., Haffke, M.M. and Pahn, M., 2017. Concrete cover effect on the bond of GFRP bar and concrete under static loading. Composites Part B: Engineering, 124, 40-53.*
9. *Golafshani, E.M., Rahai, A. and Sebt, M.H., 2014. Bond behavior of steel and GFRP bars in self-compacting concrete. Construction and Building Materials, 61, 230-240.*
10. *Rafi, M.M., Nadjai, A. and Ali, F., 2007. Experimental testing of concrete beams reinforced with carbon FRP bars. Journal of composite materials, 41(22), 2657- 2673.*
11. *Wang, H. and Belarbi, A., 2013. Flexural durability of FRP bars embedded in fiber- reinforced-concrete. Construction and Building Materials, 44, 541-550.*
12. *Hosen, M.A., Alengaram, U.J., Jumaat, M.Z. and Sulong, N.H., 2017. Glass Fiber Reinforced Polymer (GFRP) Bars for Enhancing the Flexural Performance of RC Beams Using Side-NSM Technique. Polymers, 9(5), 180.*
13. *Karim, H., Sheikh, M.N. and Hadi, M.N., 2016. Axial load-axial deformation behaviour of circular concrete columns reinforced with GFRP bars and helices. Construction and Building Materials, 112, 1147-1157.*
14. *Afifi, M.Z., Mohamed, H.M. and Benmokrane, B., 2013. Axial capacity of circular concrete columns reinforced with GFRP bars and spirals. Journal of Composites for Construction, 18(1), 04013017.*
15. *Sun, L., Wei, M. and Zhang, N., 2017. Experimental study on the behavior of GFRP reinforced concrete columns under eccentric axial load. Construction and Building Materials, 152, 214-225.*
16. *Prachasaree, W., Piriyakootorn, S., Sangsrijun, A. and Limkatanyu, S., 2015. Behavior and performance of GFRP reinforced concrete*

columns with various types of stirrups. International Journal of Polymer Science, 2015.
17. *Berg, A.C., Bank, L.C., Oliva, M.G. and Russell, J.S., (2006). Construction and cost analysis of an FRP reinforced concrete bridge deck. Construction and Building Materials, 20(8), 515-526.*
18. *El-Salakawy, E., Benmokrane, B. and Desgagne, G., 2003. Fibre-reinforced polymer composite bars for the concrete deck slab of Wotton Bridge. Canadian Journal of Civil Engineering, 30(5), 861-870.*

Replacement of Concrete by Mixing Coarse Aggregate of Demolished Building Waste with Crushed Concrete

Dimple Sharma[a], Mohd Yusuf Ali[b]

[a] Assistant Professor, Deptt. of Civil Engineering. Beehive College of Engineering and Technology, Dehradun, Uttarakhand (India)

[b]Assistant Professor, Deptt.of Civil Engineering. JBIT, Dehradun, India

ABSTRACT

Large quantities of construction and demolition wastes are continuing being generated which are just being dumped in the landfills. This requires large areas of land which is becoming difficult to find. The best solution would be to recycle and reuse the demolished waste which would not only help in protecting the environment but also help in dealing with construction wastes. Consequently, it has a grave difficulty to produce ecological toxic waste and in addition, obligatory a huge sum of liberty. That says about the project reuse waste crushed concrete maters (WCC) from the lath wastage of crushed concrete replacing from coarse aggregate 20%, 30%, 40% (WCC), 3% of crushed coarse aggregate (lathe waste) to reduce the generation of demolition wastes. (The analysis of demolished crushed concrete aggregate (DCCA) concrete in regular mold cast is to be ready in (7, 14, 28) days hydration and examination to be conduct lying on concrete. Such as compressive strength, split tensile strength, & flextural strength.) The replacing of coarse aggregate uses of waste mater and required strength attain in the conventional M20 grade concrete.

Keywords *– Demolished Crushed Concrete Aggregate (DCCA), OPC (53 grade) cement, Lathe waste, Fine aggregate, coarse aggregate.*

1. INTRODUCTION

Since urban area is rising in excess of a moment in time, the stipulate used for innovative buildings and communications has stridently risen. With the vertical augment during the new-fangled structure the insist of usual aggregates have as well risen. The usage of natural aggregate is getting more and more intense with the advanced development in the infrastructure area. In order to reduce the usage of natural aggregate, recycled aggregate can be used as replacement materials. Many old buildings and structures have overcome their age and limit of use. Structures not the portion the vents inside their scenario. New construction for better economic growth and job opportunities. Creation of building waste resulting from natural as well as man-made disasters. Demolished concrete fritter away obtain following the destruction of the arrangement is a life form correctly process previous to the coarse aggregates of it be able to exist used in concrete production. Consequently, these process coarse aggregates utilize in the concrete in cast-off aggregate and concrete. The discarding of building waste is 5000 tons per day in Overall analyzation in India and South Asia. According to Hindu also 23.75 million ton waste. In generated yearly inside India in 2007. It grave harm to contaminate surroundings, huge and too inhabit an outsized quantity of space. Inside concrete engineering at in attendance internationally consume 8 to 12 billion tons of innate aggregate annually. Owing to incessant employ of expected sources similar to stone and sand is an additional main problem to alter climatic state and humiliating the Earth and to meet by means of insist in the future. Through the use again of demolished concrete waste in the appearance of cast- off aggregate concrete is viewable because an effort in the direction of preserving the natural resource and protect the environment and not wastefully equilibrium.

2. MATERIALS AND METHODS

Materials

Cement: Available Ordinary Portland Cement of 53grade former used. Grade cement is required to conform to BIS specification IS: 12269-1987 with a designed strength for 28days being a minimum of 53 MPa or 530 kg/sqcm.

Table 1 Physical Properties of Cement

Sr. No.	Physical Properties Of OPC53 Grade Cement	Result
1.	Specific gravity	3.15
2.	Standard consistency	33.65
3.	Finess test	1.70
4.	Initial setting time	30 mins
5.	Final setting time	8 hrs. 20 mins

Fine aggregate

Manufacture sand was used as fine aggregate. The exact gravity and fineness modulusbe 2.55 and 2.93 respectively.

Coarse aggregate

Nearby obtainable compressed stone be used as a coarse aggregate. Which contain thedimension of 20mm sizes used for the project.

Table 2 Physical Properties of Demolished Crushed Concrete and NormalAggregate

Sr. No.	Physical properties	DCCA	Normal coarse aggregate
1.	Specific gravity	2.45	2.70
2.	Impact value	28.30	13.45
3.	Water absorption	5.62	0.95
4.	Bulk density	2.59	0.72
5.	Crushing test	29	17.50
6.	Abrasion test	16.5	14
7.	Size	20mm	20mm

Water:

Mixing and hydration process is used as potable water resources. Preparing of concrete and for this purpose used in the water cement ratio is W/C of 0.35.

Test specimens:

Test specimens consisting of 150×150×150 mm cubes casting for Compressive strength, 150mm Ø* 300mm length cylinders for split tensile strength. And 150×150×700 mm beam for flexural strength. Using different percentage demolished crushed coarsed 20mm size aggregate for M20 grade of concrete mix were cast and tested as per IS: 516 and 1199.

Curing of concrete:

Casting of concrete subsequent to the completion of 24 hours mold resolve be detached then hydrated through using potable water. The cast concrete cube, cylinder and beams is completely engrossed in potable water for exact age of 7, 14, 28 days. After the completion of curing, it will be taken provided the room temperature in 24 hours after tested. Testing of hardened concrete:

Compressive strength.
Flexural strength.
Split tensile strength.

3. RESULT AND DISCUSSION

The Compressive Strength:

This concrete is poured into the mold and temper correctly, consequently because not to contain any void. The outside of these specimens be supposed toward existing complete even and smooth. This is complete by putting cement paste and dispersal easily resting on the entire area of the specimen. These specimens are tested by compression testing machine subsequent to 7 days curing, 14 days curing, 28 days aftercuring.

Table 3 Compressive Strength of concrete cubes

Grade	No. of days Curing	Comp- Strength of concrete	20% (DCC)	30% (DCC)
M20	7 days	20 N/mm^2	25.5 N/mm^2	23 N/mm^2
	14 days	24 N/mm^2	39.5 N/mm^2	37.65 N/mm2
	28 days	30 N/mm^2	42.45 N/mm^2	37.80 N/mm^2

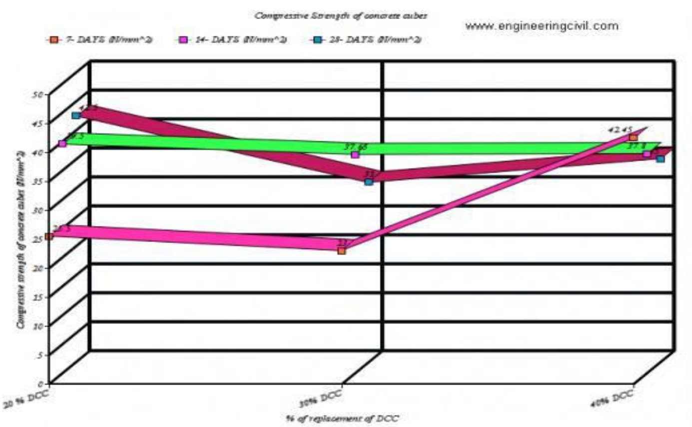


Figure 1 Strength analyses for Computer Assisted Qualitative Data Analysis Software

Figure 1 is represented by a 3-D view of the graph. It indicates the compressive strength of concrete cubes comparative for partial replacement of 20, 30, 40 % DCC hardened cubes in numbers of curing (hydrations) days status. Its maximum range of strength is analyzed the analytical reports.

Flexural Strength on Beam:

Flexural strength, also recognized as modulus of break or bends strength, or slantingcrack is a fabric property, defined as the stress in a material immediately previous to it yields flexure test. The modulus of crack is resolute by testing standard test in testing machines specimens of size 100 X 100 X 500 mm.

Table 4 Flexural Strength of concrete beams

Grade	**No. of days Curing**	**Flexural Strength of concrete**	**20% (DCC)**	**30% (DCC)**
M20	7 days	3.82 N/mm^2	4.79 N/mm^2	4.65 N/mm^2
	14 days	4.78	8.52	7.59

	N/mm^2	N/mm^2	N/mm^2
28 days	6.97 N/mm^2	9.62 N/mm^2	8.79 N/mm^2

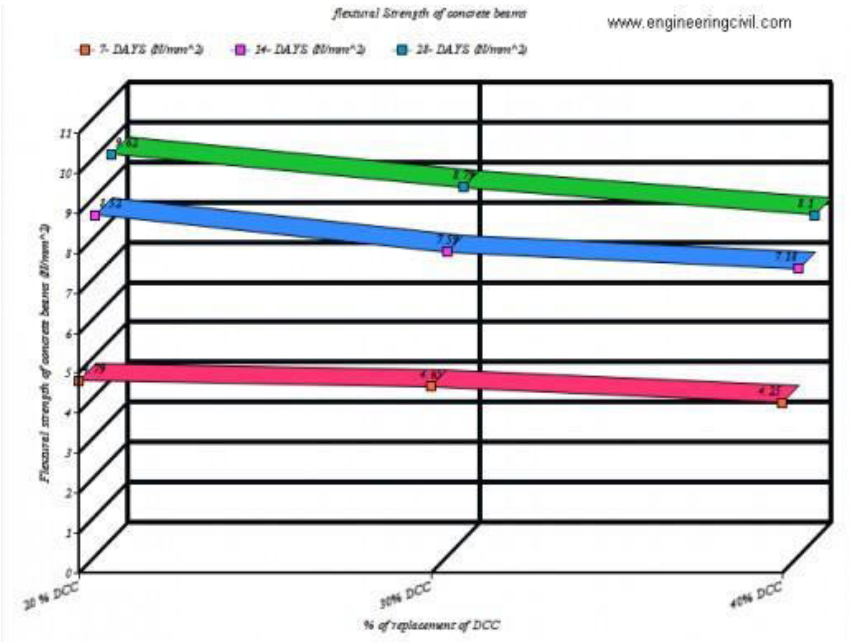


Figure 2 Strength analyses for Computer Assisted Qualitative Data Analysis Software

Figure 2 is represented by a 3-D view of the graph. It indicates the flextural strength of concrete beams comparative for partial replacement of 20, 30, 40 % DCC hardened beams in numbers of curing (hydrations) 7, 14, 28- days status. Its maximum range of strength is analyzed the analytical reports.

Split Tensile Strength:

The split tensile examination was conducted because for each IS 5816:1999. The size of the cylinder is 300mm length with 150mm diameter. The specimen was reserved in water for hydration for 7 days, 14 days and 28 days and for taking away were tested in wet condition through wipe water and gravel there on the surface. The experiment is approved absent by placing a cylindrical specimen horizontally between the loading surfaces of a compression testing machine (CTM) and the load is practical to breakdown of the cylinder along the vertical diameter.

Table 5 Split Strength of concrete cylinders

Grade	**No. of days Curing**	**Split Tensile strength of concrete**	**20% (DCC)**	**30% (DCC)**
M20	7 days	2.02 N/mm^2	2.56 N/mm^2	2.25 N/mm^2

	14 days	2.58 N/mm^2	2.78 N/mm^2	2.45 N/mm^2
	28-days	3.20 N/mm^2	3.54 N/mm^2	3.23 N/mm^2

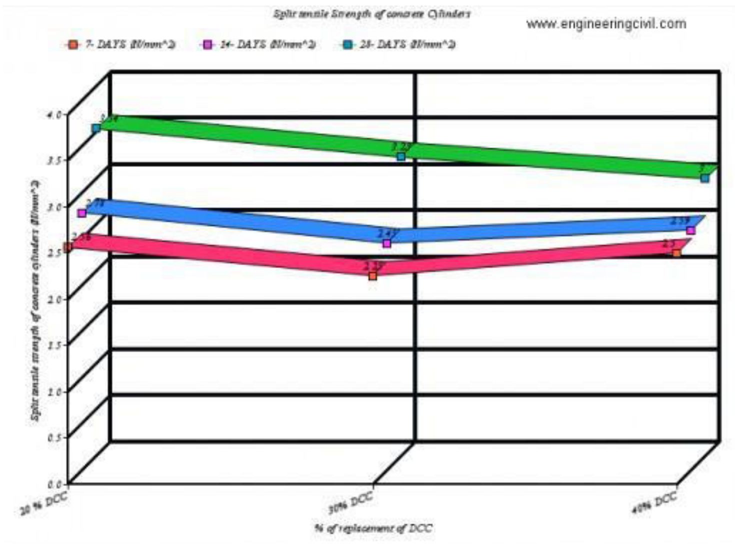


Figure 3 Strength analyses for Computer Assisted Qualitative Data Analysis Software

Figure 3 is represented by a 3-D view of the graph. It indicates the split tensile strength of concrete cylinders comparative for partial replacement of 20, 30, 40 % DCC hardened cylinders in numbers of curing (hydrations) 7, 14, 28-days status. Its maximum range of strength is analyzed the analytical reports.

Recommendation:

The result of the test, it is recommended that 40% DCC.

4. CONCLUSION

The use of recycled aggregates from construction and demolition wastes is showing prospective application in construction as an alternative to primary (natural) aggregates. Recycled aggregates are found to possess a relatively lower bulk density, higher crushing and impact values and higher water absorption as compared to natural aggregate. The compressive strength of recycled aggregate concrete is relatively lower than natural aggregate concrete. However, these variations are dependent on the original concrete from which the aggregates have been obtained.

REFERENCE

1. Mohd Monish, Vikas Srivastava, V.C. Agarwal, P.K. Mehta and Rakesh Kumar (2013) “Demolished waste as coarse aggregate in concrete” ISSN: 2278- 5213 Feb-2013.
2. Vaishali G. Ghorpade “effect of recycled coarse aggregate on the workability and shear strength of fiber reinforced high strength concrete” ISSN: 2319-8753 Vol. 2, Issue 8, August 2013.
3. Tammi Sai Krishna “An Experimental Investigation on Flexural

Behavior of Recycle

4. Aggregate Fiber Reinforcement Concrete" e-ISSN: 2395-0056 Volumes 02 Issue 04 July 2015.
5. Shaman Preet Singh, Rajwinder Singh Bansal "Strength evaluation of steel fiber reinforced concrete with recycled aggregates" e-ISSN: 2320-8163 Volume 4, Issue 1 (January- February, 2016).
6. Abhishek Mandloi, Dr. K. K. Pathak Utilization of Waste Steel Scrap for Increase in Strength of Concrete Waste Management ISSN (online): 2321-0613 Vol. 3, Issue 09, 2015.
7. Aiyewalehinmi E. O. and Adeoye T. E. "Recycling of Concrete Waste Material from Construction Demolition waste" Volume 2 Issue 10 (2016) pp10-19 ISSN (Online): 2321-8193 April, 2016.
8. Prakash Somani, Brahmtosh Dubey, Lavkesh Yadav, Jitendra Kumar, Abhishek kumar, Mahipal Singh "Use of demolished concrete waste in partial replacement of coarse aggregate in concrete" (SSRGIJCE) Volume 3 Issue 5 May 2016.
9. Jitender Sharma, Sandeep Singla "Study of Recycled Concrete Aggregates" (IJETT) Volume 13 Number 3 July 2014.
10. Mirjana Malesev, Vlastimir Radonjanin and Snezana Marinkovic, "Recycled Concrete as Aggregate for Structural Concrete Production" ISSN2071-1050 March 2010.

EFFECTIVENESS OF RECYCLED AGGREGATE MORTAR

Dr. Sanjeev Gill[a], Ankit Kumar Joshi[b]

[a] Professor, Deptt.of Civil Engineering. JBIT Dehradun, Uttarakhand (India)

[b]Assistant Professor, Deptt.of Civil Engineering. JBIT Dehradun, Uttarakhand (India)

ABSTRACT

The use of recycled fine aggregates in the production of mortar is an effective measure that can be taken to increase social and ecological values in today's society in light of the pressing problems associated with the over-exploitation of natural sand and the disposal of construction and demolition wastes. There are a number of methods for recycling fine aggregates. When formulating the recycled aggregate mortar, fluidity was advised as the most significant component to consider in order to reduce the additive effects of the W/C ratio, the quality of the recycled fine aggregates, and their content. The experimental results of this investigation show that the fluidity of recycled aggregate mortar significantly affects its mechanical and permeability qualities. The outcomes of using this mortar are compared to those of using regular mortar. The trials reveal that a higher percentage of water is required for recycled aggregate mortar to obtain the same fluidity as controlled mortar. This is due to the fact that recycled aggregate is known to have lower quality characteristics than regulated mortar, such as a higher initial water absorption and a greater volume of voids within the mortar. The properties of the recycled aggregate mortar's setting were affected by its fluidity, the quality of the recycled fine aggregates, and the content. Also, the setting periods of the recycled mortar were much quicker than those of the controlled mortar. However, the strength characteristics (compressive, tensile, and flexural), pulse velocity value, permeable void content, water absorption by immersion, and sorptivity of recycled aggregate mortar corresponding to fluidities of 110 2.5 mm and 160 2.5 mm were all lower than those attached to fluidities of 135 2.5 mm. Hence, recycled aggregate mortar with a moderate fluidity of

135 2.5 mm is feasible and has enhanced mechanical and permeability properties.
Keywords- *Recycled Aggregate Mortar, permeable void content, demolition wastes*

1. INTRODUCTION

Construction and demolition debris is produced during the building and breaking down of anything, including roads, bridges, flyovers, subways, and any other public works infrastructure. Likewise prevalent is debris from cyclones, floods, earthquakes, explosions, and war. Concrete, plastic, plaster, wood, metal, etc. are common examples of inert and non-biodegradable materials. According to the March 2007 issue of the Hindu published online, India produces almost 23.75 million tonnes of demolition garbage annually. In terms of weight, 40% of the demolition mess is made up of concrete, 30% of ceramics, 5% of plastic, 10% of wood, 5% of metal, and 10% of other miscellaneous materials. During the industrial revolution, demolition debris is simply discarded without being put to any useful purpose. The soil's fertility would be greatly diminished under such conditions. Rapid industrial growth has resulted in a serious shortage of natural aggregates (NA) for the creation of new concrete, and a massive volume of demolished concrete has been formed from crumbling and obsolete structures, both of which must be disposed of. Instead of using natural aggregates, concrete "garbage" might be used. production by using it as an aggregate. This "recycled" concrete can also be a reliable replacement for natural aggregates. The need to conserve natural resources (such as stone, river sand, soil, etc.) and energy, as well as the fact that C&D waste is transported over long distances only to be dumped, as well as the fact that it takes up valuable landfill space and degrades the processing of biodegradable and recyclable materials, call for increased attention to C&D waste. Construction and demolition waste generation and disposal have risen to the status of strategic issues in the industry, mostly as a result of the rapid urbanisation and industrialization taking place throughout the world. Disposing of these garbage causes serious environmental and ecological issues. Naturally, it is necessary to intervene and look for alternatives to trash disposal. Aggregate consumption is predicted to rise from 37,400 metric tonnes per year in 2010 to 51.7 billion metric tonnes in 2019 at an average annual rate of 37,400 metric tonnes. Natural aggregates (NA) are being used at such a rapid rate that it is putting enormous strain on the ecosystems around us. Because of this, the use of recycled aggregates (RA) in the construction industry is critical to reducing waste disposal and the use of natural resources, which have both social and environmental impacts. Concrete/mortar/other building components can be made using RCA and RFA recycled aggregates, two size fractions of recycled aggregates. This is an easy and sensible way to enhance sustainability in concrete/mortar/other building components.

2. READ THE SCHOLARLY PAPERS

Ping Hua Zhu has carried out a research on carbonation resistance of recycled aggregate concrete (RAC) subjected to different loading level was carried out. Three series of concrete mixtures were produced with loading level of 0.5, 0.8, and 1.2 of ultimately tensive strength of concrete. Carbonation resistance of recycled aggregate concrete reduces according with increasing water-binder ratio. There is an excellent linear relationship formed for recycled aggregate concrete between carbonation depth and square-root of carbonation.

Jodilson Amorim Carneiro has reported that the utilisation of recycled aggregate from construction and demolition waste (CDW) as replacement of fine and coarse natural aggregate has increased in recent years in order to reduce the high consumption of natural resources by the civil construction sector. In this work, an experimental investigation was carried out to study the influence of steel fiber reinforcement on the stress–strain behavior of concrete made with CDW aggregates.He concluded that the utilisation of recycled aggregate in substitution of natural aggregate increased the compressive, bending and tensile strength of the reference mixture. The inclusion of steel fiber and recycled aggregate increased all mechanical properties of the CDW-concrete and better controlled its fracture process. Further, a comparison between the analytical and experimental curves demonstrates that they are in good agreement indicating the possibility of their use to model the behavior of steel fiber-recycled aggregate concrete.

Xiaoliang Fang has investigated that in order to analyses the potential CO2 capture ability of recycled concrete aggregates (RCAs) subjected to accelerated carbonation, an empirical prediction model has been developed in relation to carbonation conditions and the characteristics of RCAs. In this research, two sources of RCAs were used: RCAs from a designed concrete mixture and RCAs obtained from crushing of old laboratory concrete cubes. He concluded that the maximum CO2 uptake of RCAs during accelerated carbonation depended mainly on the cement content as well as the initial CO2 uptake ratio (X^{0}_{CO2}). The particle size of RCAs played a significant role in affecting the cement content and the rate of CO2 uptake. The relative humidity (RH) during accelerated carbonation process was significant. Further, the developed empirical model may well predict the CO2 uptake of the RCAs from newly demolished concrete waste.

Sun-Woo Kim has described pullout test results on deformed reinforcing bars in natural and recycled fine aggregate (RFA) concrete. The effects of bar location and RFA grade on bond strength between reinforcing bar and recycled aggregate concrete (RAC) were analysed through the experimental program. He concluded that for higher grades of RFA, bond strength did not seem to be influenced by RFAr, at least for up to 60% RFAr. It can be noted that the location factor is influenced by the workability of concrete. Based on the cross-sections of all specimens after pullout tests, no significant differences were obtained in the amount of concrete segregation and settlement. Further, based on the RDM, no important freeze–thaw deterioration in concrete was detected after 300 freeze–thaw cycles in RAC specimens due to their relatively high air contents.

George Wardeh has presented the results of an experimental program carried out on 96 concrete pullout specimens prepared with natural and recycled aggregates using 10- and 12-mm diameter deformed steel bars. The study included six recycled concrete aggregate mixtures and two conventional concrete mixtures with C25/30 and C35/45 target class of compressive strength and S4 class of workability. He concluded that the bond strength of recycled aggregate concrete remains of the same order magnitude as that found for the reference normal concrete. In all cases, the evaluated values are equal to the values calculated by the formula of EC2 without safety factors and are therefore at least four times higher than the predicted values. Further, based on experimental results and data withdrawn from the literature, a modified expression was proposed to find the maximum bond stress of the recycled concretes taking into account the effect of concrete cover, the embedded length, and the replacement ratio.

Fuxing Wang has reported that recycled aggregates from construction and demolition waste after crushing, washing and grading which replace partly or all of the natural aggregates are reutilizable to form new concrete. Compared with natural aggregate concrete, mechanical performance and durability of recycled concrete are worse. The reason may be that the recycled aggregate (RFA) is formed of original aggregate and old cement adhering outer partly. In this paper, the superficial modification of recycled fine aggregate using fly ash grout, the physical attributes of RFA before and after modification and the effect on the mechanical performance of cement mortar were studied.

Wenlao Zhao has studied the use of recycled fine concrete and clay brick aggregates to respectively globally replace natural fine aggregates (sand) in the production of mixed mortar. The fundamental attributes such as the compressive strength and the shrinkage ratio of mixed mortar made of the recycled fine aggregates are tested and discussed in detail. The experimental results show that it is viable to produce mixed with recycled fine aggregate.

Joris Schoon has investigated with the aim to examine the use of fines generated out of recycled aggregates production as an alternative raw material for Portland clinker kilns with enumeration of possible limitations. Different technical set-ups were utilised to separate these fines from the recycled aggregates. In this research, it was shown that the fines fractions generated out of concrete recycling could be used as an alternative raw material (ARM) for Portland clinker production. However, a homogenisation phase adapted to the chemical variation of the recycled fines will be important. It was shown that the smaller the fines fractions are cut from the sand fraction, the better they are suited as ARM for Portland clinker production. The way these fines fractions are separated also affects the final quality of the treated sand fraction and therefore also its practical use in concrete as well as asphalt applications. Further, the use of fines extracted from recycled concrete focuses on some of the key issues identified within the Cement Sustainability Initiative, together with the already available alternative fuels and raw materials.

J. Alexandre Bogas has carried out the investigation to characterize the freezeethaw resistance of normal strength and high-strength concrete with partial or total replacement of fine natural aggregate (FNA) by fine recycled concrete aggregate (FRCA). The surface scaling, mass loss, length change, residual ultrasound pulse velocity and residual compressive strength were analysed for different FRCA replacement ratios (0%, 20%, 50% and 100%) subjected to 300 freezeethaw cycles according to ASTM C666 e Porches concluded that normal strength concrete was not freezeethaw resistant, regardless of the replacement rate of FNA with FRCA; the freezeethaw resistance was more influenced by the w/c ratio than by the type of aggregate used. Surface scaling appears to be more severe in concrete with FRCA, because its mortar is less resistant. In general, the internal freezeethaw resistance of concrete did not decrease with the inclusion of FRCA; the higher porosity of FRCA may better contribute to hydraulic pressure dissipation. In sum, FRCA appeared to be non-detrimental to the freezeethaw internal cracking resistance of concrete. Further, FRCA proved to be non-detrimental to the freezeethaw internal cracking resistance of concrete.

Siti Shahidah Sharipudin has made the attempt that has been placed on replacing the main ingredients in concrete mixtures with more sustainable materials with the objective to reduce the carbon footprint. One of the replacement materials is waste paper sludge ash (WPSA), a local industrial by-product produced abundantly by newsprint mills which possesses considerable cementitious properties. Parallel to this, the high amount of construction waste, especially concrete waste has become a difficult environmental issue to cope with in today's world. In conclusion, the replacing proportion of cement and fine aggregate with WPSA and FRCA up to 20% and 15% respectively contribute towards compressive strength by blending of WPSA and FRCA, exhibited favorable and equivalent compressive strength than those of control specimens. In this case, the alkalis released from the residual paste in FRCA together with cementitious reaction presence in the latter could be attributed to strength development.

Hawreen Ahmed has presented the effects of using supplementary cementing materials and recycled concrete aggregates (RCA) in concrete, with emphasis on the ability of using high volumes of fly ash (FA) and RCA to reduce the environmental impacts of the concrete's production process without jeopardizing most of its long-term durability characteristics. Three mix families (0% fine RCA, 50% fine RCA and100% fine RCA) were prepared and, for each of these three families, two incorporation levels (0% and 100%) of coarse RCA were used with 0%, 30% and 60% of FA without SP. In this research the w/b ratio of the concrete mixes was changed in order to maintain the workability of an equivalent conventional concrete. The worst-case scenario is obtained when fine NA were half or fully replaced with fine RCA, either with or without inclusion of coarse Scathe best-case scenario was obtained when the coarse NA were fully replaced with coarse RCA and 60% of FA included in concrete mixes with SP.The inclusion of coarse RCA only shows better performance than that of fine RCA.Including FA in RCA concrete is advisable. However, for the combined effect of FA and RCA, the compressive strength-GWP ratio depends on optimizing the proportion of FA *versus* RCA rather than on their individual contents.

Junxia Li has carried out the research to investigate potential use of RCF as microsilica sand substitute in the production of engineered cementitious composites (ECC), a unique high-performance fiber-reinforced cementitious composites featuring extreme tensile strain capacity of several percent. The results indicated that it is viable to use RCF as microsilica sand substitute in the production of ECC and the resulting RCF-ECCs possess decent compressive strength and strain capacity. The results clearly analysed the influence of RCF size and content on ECC properties. Micromechanics-based design principle can be utilised for ingredients selection and component tailoring of RCF-ECCs.

D.Pedro has carried out the analysis of the mechanical behaviour of high-performance concrete (HPC) incorporating fine and coarse recycled aggregates (FRA and CRA) was made. The recycled aggregates (RA) originated from rejected precast elements with compressive strengths of 75 MPa and were used to substitute natural aggregates (NA) in concrete mixes.To conclude, in the fresh state, it was possible for recycled HPC to have similar workability as that of the reference HPC (produced with natural aggregates only). In the hardened state, despite the decrease in performance of the RAC relative to the RC, extremely satisfactory values were
obtained, which were further increased with the presence of SF. For the modulus of elasticity, it was found that the highest value recorded by a mix incorporating 100% RA was around 41GPa (C100F100C-SF10). Finally, for bond strength, only a few concrete mixes were analysed.

Abdurrahmann Lotfy has presented the fresh, mechanical, and durability performance of a structural concrete mix classified as a C1 mix, by the

Canadian Standards Association (CSA) made with Controlled quality Recycled Concrete Aggregate (RCA). Seven mixes with water-to-binder (w/b) ratio of 0.40 and RCA content of 10%, 20%, and 30% by coarse aggregate volume replacement, 10%,
and 20% fine and coarse (granular) aggregate replacement by volume were produced and tested against two 0% RCA control mixes made with General Use (GU) cement, and General use Limestone cement (GUL), respectively. To conclude, using a controlled quality RCA as a replacement for virgin aggregates produced a concrete that met specifications and performed similarly to the control. All mixes showed similar slump and air content values after 15 minutes, and the control mix had the best retention after 45 minutes. However, the slump and air content for the RAC mixes did not vary greatly from the control, indicating that a 30% replacement of virgin aggregates with RCAs is a viable option. The splitting tensile strength results indicated a similar trend to the flexural strength results. The splitting tensile strength reduced as the replacement level of RCA increased. According to the control concrete, replacement of RCA by natural aggregate slightly increased water sorptivity, and chloride-ion permeability values. Moreover, the RCA mixes with more RCA resulted in higher water sorptivity and chloride-ion permeability values. In summary, the utilisation of a controlled quality RCA in structural concrete is a safe and viable option.

2. MATERIALS CHARACTERIZATION

3.

CEMENT-Ordinary Portland cement 43 (OPC 43) was used in this study. The chemical ingredient are exist in this type of cement which are given in the table below

S.N	ingredient	Percentage (%)
1.	Calcium oxide (CaO)	66.00

2.	Silica (SiO_2)	23.13
3.	Iron oxide (Fe_2O_3)	3.51
4.	Aluminum oxide (Al_2O_3)	4.41
5.	Sulfur trioxide (SO_3)	0.89
6.	Magnesium oxide (MgO)	0.78
7.	Others	1.27

B. AGGREGATE

Recycled fine aggregate are used in this study which are obtained from concrete waste, collected from the demolished buildings in area of Delhi.

4. CONCLUSIONS

To achieve the same fluidity as controlled mortar, RFAM requires more water. Recycled aggregate mortar's setting time is affected by its fluidity and RFA content. Time increases the RFAM's resistance to penetration thanks to the fluidity and RFA concentration. Quicker than controlled mortar, RFAM eventually became stable. The mechanical properties of RFAM are inferior to those of controlled mortar, as are its UPV, chemically bound water, and void content; however, its permeability is improved. Compared to controlled mortar,

ateriRFAM have more immersion water absorption and sorptivity. No matter how well they speak it. As fluidity changed, so did the mechanical and permeation performance of RFAM. [Cite] When compared to its fluidity at 1102.5 mm, the mechanical and permeability properties of RFAM diminish with increasing RFA content. Increases in RFA concentration lead to notable improvements in mechanical and permeation properties when RFAM fluidity is raised from 1102.5 mm to 1352.5 mm. The mechanical and permeability properties of RFAM dramatically degraded when its fluidity increased from 135 2.5 mm to 160 2.5 mm. As a result, fluidity may improve RFAM efficiency, which in turn lowers the inherent variability in RFA quality.

REFERENCES

1. Rattapon Somna, Chai Jaturapitakkul, A.M. ASCE, Wichian Chalee and Pokpong Rattanachu 2012, “Effect of the Water to Binder Ratio and Ground Fly Ash on Properties of Recycled Aggregate Concrete”. ASCE
2. MostafaTavakoli and ParvizSoroushin, Strength of recycled aggregate concrete made using field demolished concrete as aggregate, ACIMaterial Journal, volume 93, pp 182 – 190-1996.
3. De-jian YANG, Ya-han HAO and Tie-cheng W 2010, “Experimental Research on Recycled Aggregate Concrete for Highway Pavement”. ASCE.
4. Soutsos M. N., Tang K. and Millard S. G., (2010) “Concrete building blocks made with recycled demolition aggregate”, Construction and Building Materials, Vol. 25, No. 2, pp726–735.
5. Thomas C., Setién J., Polanco J. A., Alaejos P. and de Juan M. S., (2013) “Durability of recycled aggregate concrete”, Construction and Building Mals, Vol. 40, pp1054–1065.
6. Viviana Letelier, Ester Tarela, Pedro Munozb, Giacomo Moriconi 2016, “Combined effects of recycled hydrated cement and recycled aggregates on the mechanical properties of concrete”. Science Direct
7. Verma Ajay, Chandak Rajeev and Yadav R.K. 2012, “Effect of Micro Silica on The Strength of Concrete with Ordinary Portland Cement,” IJSR Vol. 1(3), 1-4, Sept
8. Rammurthy and GumasteProperties of recycled aggregate concrete, Indian Concrete Journal, volume 72, pp 49 – 53-1998.

Role of Bacteria in the Protection of RCC from Corrosion

Mr. Dimple Sharma[a], Dr. Sanjeev Gill[2]

[a] Assistant Professor, Deptt. of Civil Engineering. Beehive College of Engineering and Technology, Dehradun, Uttarakhand (India)

[b] Professor, Deptt.of Civil Engineering. JBIT Dehradun, Uttarakhand (India)

ABSTRACT

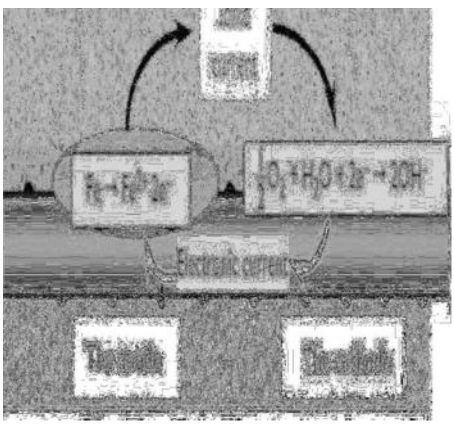
In the presence of oxygen and water, steel begins to oxidise, also known as corrode. Even the presence of oxygen in the pores of the concrete will not promote corrosion in an environment with a high alkaline concentration. The presence of small holes in concrete, each of which includes significant amounts of soluble calcium, sodium, and potassium oxides, results in an alkaline situation with a pH ranging from 12 to 13. The presence of alkali causes the surface of the steel to develop a layer known as a "passive" layer. The alkalinity is prevented by the dense passive layer that is placed over the reinforcement. The prevention of corrosion in concrete by the utilization of bacteria for the purpose of preserving alkalinity in the concrete is the focus of this research.

Keywords: *corrosion, passive layer, alkaline, bacteria, reinforcement.*

1.INTRODUCTION

When concrete carbonates to the level of the steel rebar, the normally alkaline environment, which protects steel from corrosion, is replaced by a neutral environment. Under these conditions the steel is the ion dissolve in the pore water would not see cracking and spelling of the concrete. Several more stages must occur for ‘rust’ to form. Ferrous hydroxide becomes ferric hydroxide and then hydrated ferric oxide or rust. This rust cause spelling and crack over the concrete as shown in fig.3.

Not passive and rapid corrosion begins. The rate of corrosion due to carbonated concrete cover is slower than chloride-induced corrosion. Occasionally, a lack of oxygen surrounding the steel rebar will cause the metal to dissolve, leaving a low pH liquid. Carbon-dioxide combines with water to form acid in which reduce the pH of concrete by consuming the calcium hydroxide which is formed in hydration process of cement, at low pH corrosion begins. Prevention of carbonization, prevent the alkalinity in which corrosion do not take place. Chloride in the pore of concrete involves during the corrosion only, it just acts as the catalyst in the corrosion process. Presence of chloride in concrete pore is inert at alkaline condition.



2.CORROSION PROCESS

When the passive layer breaks down then rust will start appearing on the steel surface. The chemical reactions are the same whether corrosion occurs by chloride attack or carbonation. When steel in concrete corrodes it dissolves in the pore water and gives up electrons:

The anodic reaction is Fe –> Fe^{2+} + $2e^{-}$

The two electrons (2e) created in the anodic reaction must be consumed elsewhere on the steel surface to preserve electrical neutrality.

The catholic reaction is $2e^{-}$ + H_2O + $^{1/22\ \text{–>}2OH–}$

Fig 1. Anode and cathode reaction of corroding bar Fe^{2+} and OH^{-} formed in anode and cathode combined to form ferrous hydroxide and further undergoes chemical reaction as below:

Unhydrated ferric oxide Fe_2O_3 formed in the bow reaction has a volume of about twice that of the steel it replaces when fully dense. When it becomes hydrated it swells even more and becomes porous. This means that the volume increase at the steel/concrete interface is six to ten times. This leads to the cracking and Spelling as shown in fig.3, that we observe as the usual consequence of corrosion of steel in concrete and thered/brown brittle, flaky crust we see on the bar and the rust stains we see at cracks in the concrete. Fig.2 shows the relative volume of the iron and its oxide formed in corrosion process.

3.CARBONATION

Carbonation is the result of the interaction of carbon dioxide gas in the atmosphere with the alkaline hydroxides in the concrete. Like many other gases carbon dioxide dissolves in water to form an acid. Unlike most other acids the carbonic acid does not attack the cement paste, but just neutralizes the alkalinity in the pore water, mainly forming calcium carbonate that lines the pores:

There is a lot more calcium hydroxide in the concrete pores that can dissolve in the pore water. This helps maintain the pH at its usual level of 12–13 as the carbonation reaction occurs. However, as carbon dioxide proceeds to react with the calcium (and other) hydroxides in

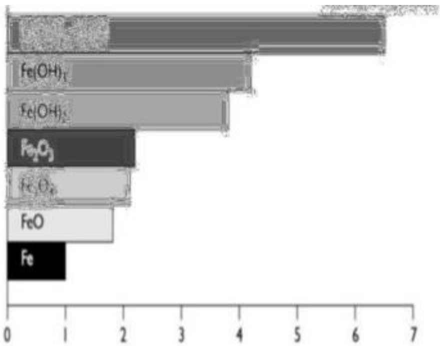


fig.2 Relative volume of iron and its oxides from Mansfield Corrosion, 1981, 37(5) 301–307

solution, eventually all the calcium hydroxide reacts, precipitating the calcium carbonate and allowing the pH to fall to a level where steel will corrode. This is illustrated in [1] Figure 4(a) and (b) which show the pH drop across the carbonation frontand the corrosion rate of steel as the pH changes. At the carbonation front there is a sharp drop in alkalinity from pH 11–13 down to less than pH 8. At that level the passive layer was created by the alkalinity, is no longer sustained so corrosion proceeds by the general corrosion mechanism will takes place.

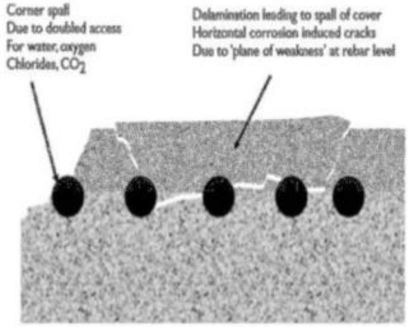
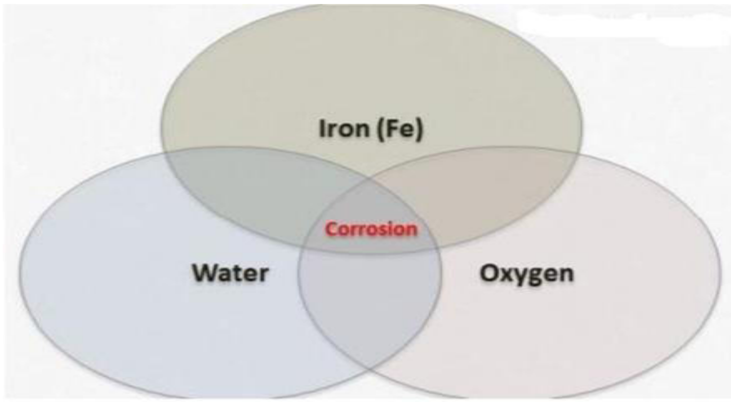


fig.3 Schematic of corrosion induced spalling at corners and delamination at the plane of the reinforcement



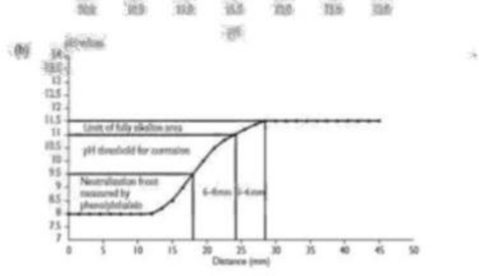


fig.4 (a) Corrosion of steel in aqueous solutions as a function of pH, showing the effect of the passive layer above pH 12.5. Adapted from Shalon and Raphael *JACI*, 1959, 30(12): 1251–1268. (b) The pH levels for carbonation, corrosion and phenolphthalein indicator.

$$CO_2 + H_2O \rightarrow H_2CO_3$$

Gas Water Carbonic acid

$$H_2CO_3 + Ca(OH)_2 \rightarrow CaCO_3 + 2H_2O$$

Carbonic Pore
acid solution

Reduce the pH of the concrete. In the absence of water carbon dioxide is in active. Chloride in concrete is alsoin active at alkaline condition. In corrosion process carbon-dioxide acts as initiator and chloride acts as a catalyst. We can prevent corrosion by preventing the contact of water, carbon- dioxide and oxygen. Even in presence of water steel will not undergoes corrosion at alkaline environment.

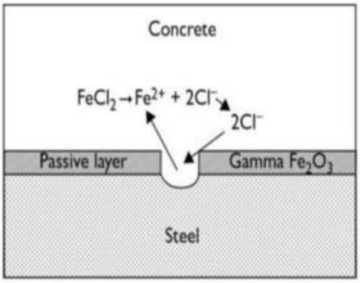


fig. 5
The breakdown of the passive layer and 'recycling' chlorides.

4.CHLORIDE ATTACK

The chloride ion attacks the passive layer although in this case (unlike carbonation) there is no overall drop in phi

Chlorides act as catalysts to corrosion. They are not consumed in the process but help to break down the passive layer of oxide on the steel and allow the corrosion process to proceed quickly as shown in fig.5. The effective recycling of chloride ions makes chloride attack more difficult to remedy as chlorides are therefore harder to eliminate. Fig.4 shows the recycling of chloride ion. Obviously a few chloride ions in the pore water will not break down the passive layer.
Prevention of corrosion Carbon dioxide and chloride present in the concrete are inert in the absence of the water and oxygen. Carbon dioxide in the pore of the concrete reacts with water to form carbonic acids which

The bacteria and Ca $(OH)_2$ of pH 13 is added to the concrete in capsules. The bacteria are Bacillus alkali- nitrulicus, an alkali-resistant soil bacterium, psychrophilic bacterium, [8]Bacillus pasteurii is added, which can survey at high pH of 9 to 13 and at the temperature range of 10 to 40 degree centigrade. [5]Capsule of 15 kg is added to a 1m3 of concrete. The spores became active when getting contact with water; still it will be inactive in concrete. When bacteria contact with carbon-dioxide and convert calcium hydroxide to lime stone. On reaction CO_2 is arrested from diffusion. [9]Limestone will fill the crack and there is no possibility to leakage of water and diffusion of carbon-dioxide. Hear our primary aim is to prevent the carbon-dioxide penetration and then to prevent the water infiltration to concrete.

$CO_2 + Ca(OH)_2 \rightarrow CaCO_3 + H_2O$

In self-healing concrete capsule containing bacteria and calcium lactate is added. In atmosphere quantity of CO_2 is less to speed up the self-healing process calcium lactate is added in which it precipitate CaCO3 and liberate CO_2. $Ca(C_3H_5O_2)_2+7O_2 \rightarrow CaCO_3+5CO\ 2+5H_2O$

5.DIFFUSION OF CO_2

Concrete will carbonate whenever carbon dioxide and some waters are available. The speed of carbonation depends on how fast the carbon dioxide and/or the carbonate ions can move into the concrete and react

$CO_2 + Ca(OH)_2 \rightarrow CaCO_3 + H_2O$

In self-healing concrete capsule containing bacteria and calcium lactate is added. In atmosphere quantity of CO_2 is less to speed up the self-healing process calcium lactate is added in which it precipitate CaCO3 andliberate CO_2.

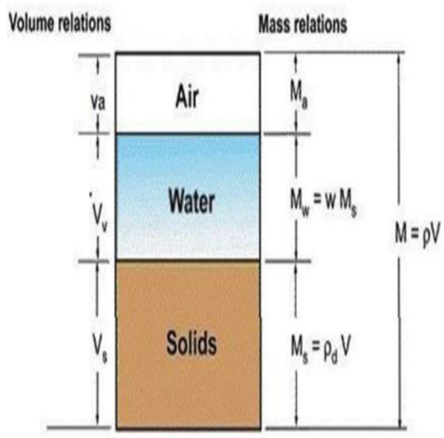
$Ca(C_3H_5O_2)_2+7O_2 \rightarrow CaCO_3+5CO\ 2+5H_2O$

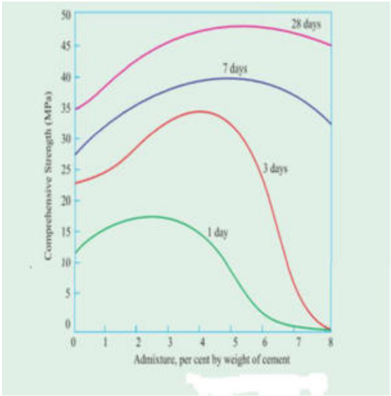
Concrete will carbonate whenever carbon dioxide and some waters are available. The speed of carbonation depends on how fast the carbon dioxide and/or the with the cement paste. Diffusion is mass transport downa concentration gradient. Steady state diffusion follows Fick´s first law

Cement ratio of 0.38. However, addition of water to the concrete for workability is not a good construction practice. Super plasticizer and new generation plasticizer is recommended for workability. Addition of plasticizer increases the strength up to optimum level above that it decreases the strength. [2] Fig.8 shows the variation of the compressive strength of the concrete at various volume of lingo-sulphonate. Hence optimum ratio of plasticizer is recommended. [2] Plasticizer reduce water content up to 10%, super plasticizer reduces about 20%, pc-based admixture reduces up to 30.

6.WATER CEMENT RATIO TOREDUCE 'D'

Water cement ratio in the concrete plays an important role in the strength and durability of the concrete. It has also been estimated that on an average 23% of water by weight of cement is required for chemical reaction with Portland cement compounds.





This 23% of water chemically combines with cement and, therefore, it is called bound water. A certain quantity of water is imbibed within the gel- pores. This water is known as gel-water. It can be said that bound water and gel-water are complimentary to each other. If the quantity of water is inadequate to fill up the gel- pores, the formations of gel itself will stop and if the formation of gel stops there is no question of gel-pores being present. It has been further estimated that about 15 per cent by weight of cement is eon to fill up the gel- pores. [2] Therefore, a total

38 per cent of water by weight of cement is required for the complete chemical reactions and to occupy the space within gel-pores. If water equal to 38 per cent by weight of cement is only used it can be noticed that the resultant paste will undergo full hydration and no extra water will be available for the formation of undesirable capillary cavities. On the other hand, if more than 38 per cent of water is used, then the excess water will cause undesirable capillary cavities. Therefore, greater the water above the minimum required is used (38 per cent), the more will be the undesirable capillary cavities. In all this it is assumed that hydration is taking place in a sealed container where moisture to and from the paste does not take place. Increases in cavity in a concrete increase the coefficient of diffusion in concrete. At a same time, it is difficult to work in concrete at water.

7.CONCLUSIONS

Masan will shovel mortar with water. Fine partial cement settles, leaving only sand for plating above. So, construction workmanship is paramount. Corrosion can be prevented by covering the reinforcement. Nominal cover must be 40 mm.

REFERENCES

1. John P. Broomfield; "Corrosion of Steel in Concrete Understanding, investigation and repair", Taylor & Francis 270 Madison Ave, New York, NY 10016.
2. M.S. Shetty; "concrete technology theory and practices", S. Chandra and company ltd, Ram nagar , new Delhi.
3. IS10262-2007 "Recommended Guidelines for Concrete Mix Design", Bureau of Indian Standards, New Delhi, 2007.
4. M.V. Seshagiri Rao, V. Srinivasa Reddy, M. Hafsa, P

Increase in Durability of Building Structures by using Microbial Concrete

Manish Kumar [a], Dr. Sanjeev Gill[b]
[a]Assistant Professor, Deptt.of Civil Engineering. JBIT Dehradun, Uttarakhand (India)
[b] Professor, Deptt.of Civil Engineering. JBIT Dehradun, Uttarakhand (India)

ABSTRACT

Concrete structures can develop cracks and fissures due to weathering, faults, ground subsidence, earthquakes, and human activity, which can shorten the structures' useful lives. Using microorganisms like Bacillus species to biomineralize calcium carbonate is a revolutionary method for repairing or cleaning up such structures. Bacillus sp. CT-5, which was isolated from cement, was employed in the current investigation to examine tests for compressive strength and water absorption. According to the findings, bacterial cells increased the compressive strength of cement mortar by 36%. When compared to control cubes, calcite deposition on treated cubes absorbed almost six times less water. The current research shows that Bacillus sp. generation of "microbial concrete" on built facilities improved the durability of building materials.

1.INTRODUCTION

The requirements for high durability for structures exposed to harsh environments, such as seafloor, offshore structures, tunnels, highway bridges, sewage pipes, and structures for solid and liquid wastes containing toxic chemicals and radioactive elements, may not be met using today's common Portland cement (OPC). It is widely acknowledged that the features of concrete's pore structure affect how long it lasts. Concrete deterioration mechanisms frequently depend on the potential for aggressive substances to harm the concrete by penetrating it. Concrete's permeability is influenced by its porosity and the connectivity of its pores. Concrete is more susceptible to the deteriorating processes brought on by penetrating substances the more open its pore structure is. In order for concrete structures to deteriorate, aggressive gases and/or liquids from the environment must first move into the concrete, which is followed by physical and/or chemical reactions that may cause irreparable damage . As a result, mechanical (compressive strength) and transport properties are crucial components of concrete durability.

Researchers' interest has recently started to grow in the microbiologically induced calcium carbonate precipitation (MICCP) that is caused by the metabolic activities of some particular microorganisms in concrete and improves the overall behaviour of concrete. The compressive strength of cement mortar was significantly improved (by about 18%) in earlier studies using aerobic microorganisms (Bacillus pasteurii and Pseudomonas aeruginosa) [Ramakrishnan et al. 1998; Ramachandran et al. 2001].

A number of intricate biochemical processes make up MICCP [Stocks-Fischer et al. 1999]. Some bacterial species produce urease as part of their metabolism, which catalyses the breakdown of urea into CO2 and ammonia, raising the pH of the environment where ions are presentCa^{2+} and CO_3^{2-} precipitateas$CaCO_3$.Possible biochemical reactions in medium to precipitate.

$CaCO_3$at the cell surface that provides a nucleation site can be summarized as follows.

Ca2++Cell-Cell-Ca2+ (1)

Cl+ HCO3-+NH3 NH4Cl +CO3 (2)

2+ Cell-Ca 2- +CO3 →Cell-CaCO31 (3)

Utilizing a selective microbial plugging process in which microbial metabolic activities promote the precipitation of calcium carbonate in the form of calcite, a novel method for the remediation of damaged structural formations has been developed [Gollapudi et al. 1995]. $CaCO_3$ demonstrated its positive potential as a microbial sealant by selectively consolidating simulated fractures, surface fissures, and sand plugging in granites [Zhong and Islam 1995; Achal et al. 2009a].
The most significant factors affecting concrete's durability and, ultimately, its performance, the compressive strength and concrete permeability tested using water absorption are the focus of the current work. This study looked into how cement-derived bacteria affected the compressive strength and water permeability of cement mortar.

2.MATERIALSANDMETHODS

Materials

Used was regular Portland cement that complied with IS 12269-1987. As fine aggregate, clean, properly graded, naturally occurring river sand that complies with IS 383-1970 standards and has a fineness modulus of 2.89 was used.

Microorganism

In this study, Bacillus sp. CT-5, which was isolated from cement sold commercially, was used. The Nutrient Agar (pH 8.0) medium was used routinely to maintain the culture. The isolate was grown in nutrient broth-urea (NBU) medium (8 g nutrient broth, 2% urea, and 25 mM $CaCl_2$). $CaCl_2$ and filter-sterilized urea were added to the medium for the nutrient broth. Information about the preparation and content of NBU medium was previously published [Achal et al., 2009a]. At 37 degrees Celsius, bacteria were grown in a shaking environment (130 rpm).

Compressive strength test

Bacillus sp. CT-5 was grown in NBU media in order to research the compressive strength test of cement mortar. The ratio of bacterial culture to water to cement was 0.47, and the ratio of cement to sand was 1:3 (by weight). According to IS 4031-1988, a 70.6 mm cube mould was used. With the addition of a grown culture of Bacillus sp. CT-5 that corresponds to an optical density of 1.0 (600 nm), sand and cement were thoroughly mixed. A vibration machine was used to cast and compact the cubes. All specimens were demolded and then allowed to cure in NBU medium at room temperature until compression testing was performed after 3, 7, and 28 days. Control samples were also made in a similar manner, but instead of using bacterial culture, they used water and NBU medium. Automatic compression testing was carried out.

Water absorption test

Absorptive test using the RILEM 25 PEM (II-6) was performed to ascertain the increase in resistance to water penetration. To ensure unidirectional absorption through the treated side, the mortar specimens were coated at the four edges that were closest to the treated side. The test cubes were coated, then dried at 45 °C in a ventilated oven to achieve a mass equilibrium of less than 0.1% between two measurements taken 24 hours apart. The treated side of the specimens was facing downward as they were submerged in 101 mm of water (water level about 2 mm above the base of the specimen). Every 15 minutes, 30 minutes; 1 hour, 1.5 hours, 3 hours, 5 hours, 8 hours, 24 hours, 72 hours, 96 hours, 120 hours, and 144 hours and168h)the specimens were removed from the water and weighed, after drying the surface with a wet towel. Immediately after the measurement the test specimens were submerged again. The absorptive coefficient, k [cm.s$^{-1/2}$],was obtained by using the following expression:

where Q is the amount of water absorbed [cm^3]; A is the cross section of the specimen that was in contact with water [cm^2]; t is the time [s], Q/A was plotted against the square root of time, then k was calculated from the slope of the linear relation between the form

er.

3.RESULTS AND DISCUSSION

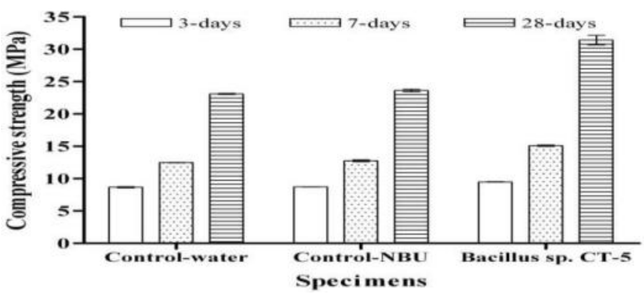
Compressive strength test

Figure 1 summarises the compressive strength of various cement mortar specimens after 3, 7, and 28 days. The compressive strength had significantly increased for the microbially-filled mortar cubes. The strongest mortar cubes (31 MPa) were made with Bacillus sp. CT-5 and incubated for 28 days, as opposed to those made with water (23 MPa) and NBU medium (24 MPa). At 28 days, mortar specimens made with bacterial cells had 36.15% greater compressive strength than the control. The cubes cured in microbial growth medium were stronger than those cured in water in the cell-free control groups, despite the fact that there was no discernible difference. The mortar cubes' strength appeared to be improved by the medium's high ionic strength, which contains urea and calcium chloride.

According to Ramakrishnan et al. (1998), Ramachandran et al. (2001), Ghosh et al. (2005), and Achal et al. (2009a), the deposition of CaCO3 on the microorganism cell surfaces and inside the pores of cement-sand matrix, which plug the pores within the mortar, is probably the reason why Bacillus sp. CT-5's compressive strength increased.

To determine whether the microbial calcite precipitation was the cause of the mortar samples' increased compressive strength, the mortar samples were taken out and subjected to SEM inspection. Figures 2a and 2b show scanning electron micrographs of a cement mortar matrix devoid of bacteria and a specimen made with Bacillus sp. CT-5, respectively. The sample showed that calcite crystals had formed into rod-shaped structures and had grown everywhere (typical shape of Bacillus species). The edges of the crystals were distinct and sharp, indicating that they had fully developed. We have previously described and documented Sporosarcinapasteurii's rod-shaped structure, which aided in the precipitation of calcite in sand columns [Achal et al. 2009b].

At 3 and 7 days, the compressive strengths of mortar cubes with all media did not significantly increase. The overall trend of an increase in compressive strength up to 28 days may be attributed to the behaviour of microbial cells within the cement mortar matrix. Although the mortar was still porous during the initial curing period due to the cement, the environment for microbes had completely changed, inhibiting proper growth. It's also possible that the high pH of the cement rendered the cells inactive, but as the curing time was prolonged, the cells slowly started to grow. Because of the various ions present in the media, calcite would precipitate during cell growth on both the surface of the cells and inside the cement mortar matrix. As a result, the cement mortar lost some of its porosity and permeability. The bacterial cells eventually either died



or changed into endospores, which served as an organic fibre and increased the compressive strength of the mortar cubes, once many of the matrix's pores had been plugged. This explains how cement mortar cubes made with microbial cells behaved at day 28 in terms of their increased compressive strength. An increase in matrix strength would have reduced mean expansion for concrete made with bacterial cells, enhancing the concrete's overall durability performance [Ramakrishnan et al.

2001]. This led to the conclusion that the main reason for the increase in compressive strengths is the consolidation of the pores within the cement mortar cubes with microbiologically induced calcium carbonate precipitation.

Fig.1.Effect of CT-5 on Cement Mortar Cube Compressive Strength at 3, 7, and 28 Days prepared with a 0.47 w/c ratio. (Controlling Bacillus sp. and NBU. Water is Replaced with Media in CT-5 Treatments and Media is Replaced with Bacterial Cells, respectively

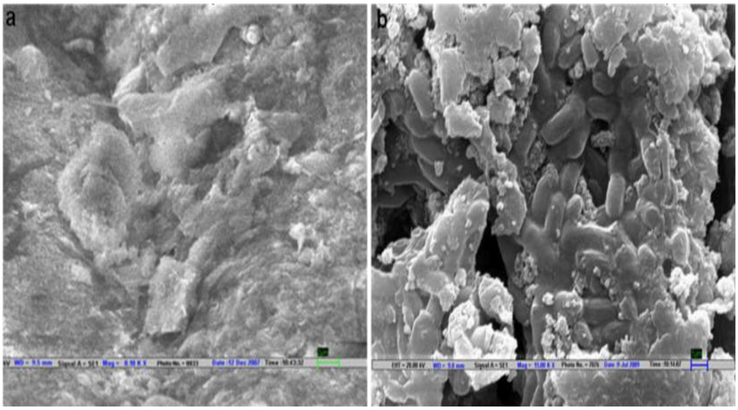
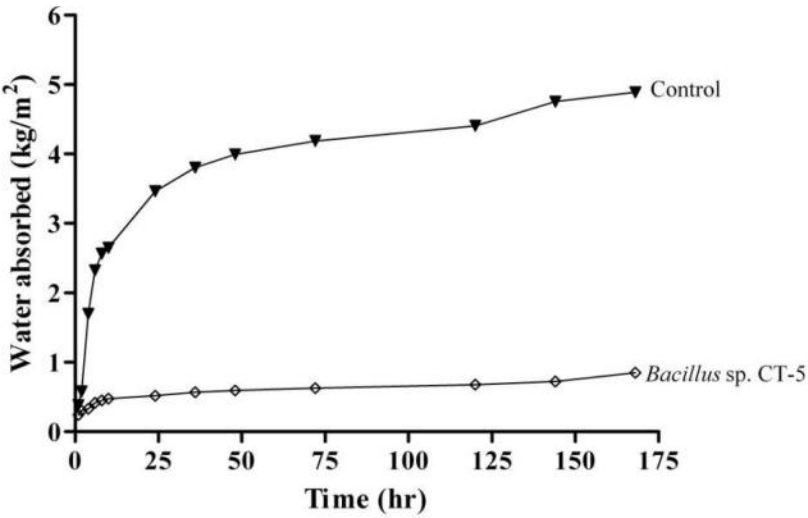


Fig. 2. Specimens of cement mortar captured in scanning electron micrographs. Matrix of Cement Mortar Prepared Without Bacteria and Dense Calcite Precipitation as Calcite Crystals with Rod Shaped Impressions Housed by Bacillus sp. CT-5

Water absorption test For mortar cubes with a w/c of 0.47, Fig. 3 illustrates the impact of the surface treatment on the rate of water absorption. The cubes treated with Bacillus sp. CT-5 absorbed almost six times less water over 168 hours than the control cubes. Compared to untreated specimens, the water uptake significantly decreased when bacteria were present (control). |

Fig.3.TheInfluenceoftheBacterialTreatmentontheRateofWater AbsorptionversusTimeforMortarCubes



The water absorption experiment showed that the permeability of mortar specimens treated with bacteria decreased. a layer of calcium carbonate crystals being deposited on.

The permeation properties were reduced as a result of the surface. As a result, the entry of dangerous substances may be restricted. After injecting CaCO3-forming reactants, Nemati and Voordouw [2003] observed a decrease in the permeability of sandstone cores. It is evident from this experiment that the presence of a layer of carbonate crystals on the surface by a bacterial isolate has the potential to enhance cementitious materials' resistance to processes that cause their degradation.

4.CONCLUSION

The use of bacterial isolates like Bacillus species that produce urease in concrete remediation is the significance of this study. Bacillus sp. CT-5 had a beneficial impact on the compressive strength of Portland cement mortar cubes, according to the study, which also showed an increase in strength. In order to assess the effectiveness of the bacterial isolate, a greater resistance to water penetration has been made. The creation of "Microbial Concrete" will serve as the foundation for a superior, alternative concrete sealant that is economical, environmentally safe, and ultimately increases the durability of building materials.

REFERENCES

1. Achal, V., Mukherjee, A., Basu, P. C., and Reddy, M. S. (2009a). “Lactose mother liquor as an alternative nutrient source for microbial concrete production by Sporosarcina pasteurii.” Journal of Industrial Microbiology and Biotechnology, 36, 433-438.

2. Achal, V., Mukherjee, A., Basu, P. C., and Reddy, M. S. (2009b). “Strain improvement of Sporosarcina pasteurii for enhanced urease and calcite production.” Journal of Industrial Microbiology and Biotechnology, 36, 981-988.

3. Claisse, P. A., Elsayad, H. A., and Shaaban I. G. (1997). “Absorption and sorptivity of cover concrete.” Journal of Materials in Civil Engineering, 9, 105-110.

4. Ghosh, P., Mandal, S., Chattopadhyay, B. D., Pal, S. (2005). "Use of microorganism to improve the strength of cement mortar." Cement and Concrete Research, 35, 1980-1983.

5. Gollapudi, U. K., Knutson, C. L., Bang, S. S., and Islam, M. R. (1995). "A new method for controlling leaching through permeable channels." Chemosphere, 30, 695-705.

6. Khan, M.I. (2003). "Isoresponses for strength, permeability, and porosity of high-performance Mortar." Building and Environment, 38, 1051-1056.

7. Nemati, M., and Voordouw, G. (2003). "Modification of porous media permeability, using calcium carbonate produced enzymatically in situ." Enzyme Microbial Technology, 33, 635-642.

8. Ramachandran, S. K., Ramakrishnan, V., and Bang, S. S. (2001). "Remediation of concrete using microorganisms." American Concrete Institute Materials J., 98, 3-9.

9. Ramakrishnan, V., Bang, S.S., and Deo, K. S. (1998). "A novel technique for repairing cracks in high-performance concrete using bacteria." Proc. Int. conf. on high-performance high-strength concrete, Perth, Australia, 597-618.

10. Stocks-Fischer, S., Galinat, J. K., and Bang, S. S. (1999). "Microbiological precipitation of CaCO. Soil Biology and Biochemistry, 31, 1563-1571.

11. Zhong, L., and Islam, M.R. (1995). "A new microbial process and its impact on fracture remediation." 70 Annual Technical Conference and Exhibition of the Society of Petroleum Engineers, Oct 22-25, Dallas, Texas.

The Role of High-Quality Cement in Construction

Namrata Sah[a], Dr.Sanjeev Gill[b]

[a]M.Tech Scholar, Deptt. of Civil Engineering, GBPUA&T Pantnagar, Uttarakhand (India)
[b] Professor, Deptt.of Civil Engineering. JBIT Dehradun, Uttarakhand (India)

ABSTRACT

As they say, a nation's greatest accomplishment is its building infrastructure. Cement and steel consumption per capita are useful indicators of a country's level of development because they are indispensable building materials. It's impossible to conceive of a world without concrete and the material that serves as its primary precursor, Ordinary Portland Cement (OPC). Although several forms of concrete have been produced for specific uses, they share the benefits of being easy to work with, inexpensive, versatile, strong, and long-lasting. The cement business is booming in India and elsewhere. Although there are many new options, it is crucial for an engineer to choose a high-quality cement. Poor cement quality is a common cause of construction failure. In this study, we'll examine how several criteria influence the choice of cement and the categorization of cement strength. Cement quality control is essential, as is the requirement for constant cement quality. By choosing cement of sufficient quality, the project can be protected to some degree.

1.INTRODUCTION

When it comes to cement production, India ranks second worldwide. Deregulation of the industry in 1982 opened the door to massive investment from both domestic and international companies. Several reforms and adjustments were made in India's cement business so that it would be more in line with government regulations and the industry's bottom line. There was a dramatic increase in cement production from nearly 5 million tonnes in 1952 to over 54 million tonnes in 1993. Poor cement quality and growing production costs as a result of government regulation over a long period of time have led to similarly subpar concrete construction.

Cement demand in India is expected to increase due to government's push for large infrastructure projects, leading to 45 million tonnes (MT) of cement needed in the next three to four years. India's cement demand is expected to reach 550-600 Million Tonnes Per Annum (MTPA) by 2025. The housing sector is the biggest demand driver of cement, accounting for about 67 per cent of the total consumption in India. The other major consumers of cement include infrastructure at 13 per cent, commercial construction at 11 per cent and industrial construction at 9 per cent. The partial relaxation of Government control from March 1982 and a total relaxation of control after March 1989 revived the cement industry and resulted in its phenomenal growth. This resulted in a competitive market and cement manufactures had to improve their quality of cement, as it was now a battle foe survival of the best.

After late 80s cement manufacturers took a huge step modernizing their old plants, which were in various stages of obsolescence. The wet process plants were converted to more economical and dry efficient process or semi-dry process plants. This leads to the production of high-quality cement. Several leading organizations diversified into cement manufacture and thereby created the much-desired consumer-oriented market with the range of brands available at competitive prices. The 33-grade ordinary Portland cement (IS: 269-1989) has virtually disappeared and is displaced by higher strength ordinary Portland cement of 43-grade (IS: 8112-1989) and 53-grade (IS: 12269-1987).

2.SELECTION OF HIGH-QUALITY CEMENT

Since there are various options available in market the consumer has a good option to select the product required. However, this process depends on the main factor of finance. With the financial constraints, the other factor to be considered is the specifications. It must be understood by the consumer that any good quality product is generally available at a higher price than a not so good quality product. It is therefore necessary for the consumer to know more about the benefits he gets when he selects high quality cement and how best he can put to use such benefits considering both technical as well as the economical aspects.

A high strength cement although preferable to a lower strength cement may not give a consumer the complete benefit until and unless it is giving consistently high strength with minimum variations. The high strength concrete if specified for any structure will also be more desirable from a durability point of view. It is often observed that low strength concrete is more vulnerable to environmental forces than high strength concrete but at the same time, high strength concrete too needs to be extremely carefully batched, mixed, transported, placed, compacted and cured. The durability requirements of the structure are as important, if not more, as the strength of the structure. A strong concrete may not result in high performance concrete if the durability requirements are not complied with. Selection of high-quality cement can only mean a good beginning but it does not assure the consumer of a final product, which is the strong and durable concrete structure. However, selection of poor-quality cement or cement of inconsistent quality is like taking a wrong step right at the beginning and will certainly lead to the poor-quality concrete structure if not a disaster.

3.CEMENT STRENGTH CLASSIFICATION

The most common type of cement used in India is ordinary Portland cement (OPC) and has generally grades viz. 33, 43, 45 grade depending upon the 28 days compressive strength.

IS: 10262-1982 gives us the recommended guidelines for concrete mix design, has generally classified the cement grade wise from A to F, depending upon 28 days strength as follows:

TABLE 1: CLASSIFICATION OF CEMENT GRADES A TO F AS PER IS: 10262-1982

Grade	Range of 28 days strength of cement (kg/cm^2)
A	325-375
B	375-425
C	425-475
D	475-525
E	525-575
F	575-625
*G	625-675

*Has been introduced in view of higher-grade cement available in India However, it may noted that some brands sold as 53-grade cement generally give 28 days strength of around 625 to 675 kg/Sq.cm and they can be classified even as G grade cement. However, most of the 53-grade cement available in the market generally falls in the category F or above and the 43-grade cement available in the market are generally in the category D. It must be ascertained either from the manufacturer or through laboratory tests the actual strength of the cement before it's use in the concrete mix design to get the maximum benefit of the additional strength and superior quality.

4.CEMENT SAVING DUE TO HIGH STRENGTH

The relation between the free water-cement ratio (W/C) and concrete strength for different cement strengths (grades A to F) is given in fig. 2 page 8 of IS: 10262-1982. This figure is used to determine the W/C of the concrete mix for specified target concrete strength if the cement grade is known. The target concrete strength (fm) is calculated using the following equation fm=fck+ (t*s) where ‘fck’ is the specified characteristic strength, ‘t’ is the statistical constant generally equal to 1.65 for the specified accepted proportion of low results of 1 in 20 (see table 2) and ‘s’ is the standard deviation, the values of which are selected depending on the degree of quality control expected under different site conditions (see tables 3 and 4).

TABLE 2: VALUE OF ’T’ (IS: 10262-1982)

Accepted proportion of low results	Time
1 in 5	0.84
1 in 10	1.28
1 in 15	1.5
1 in 20	1.65
1 in 40	1.96
1 in 100	2.33

Degree of quality control Expected (IS: 10262-1982) under different site conditions. Table 4: Recommended values of standard deviation IS: 10262-1982 standard deviation(s) for a different degree of control N/mm. Sq.

Grade of concrete	Very good	Good	Fair

(fm)			
M10	2	2.3	3.3
M15	2.5	3.5	4.5
M20	3.6	4.6	5.6
M25	4.3	5.3	6.3
M30	5	6	7
M35	5.3	6.3	7.3
M40	5.6	6.6	7.6
M45	6	7	8
M50	6.4	7.4	8.4
M55	6.7	7.7	8.7
M60	6.8	7.8	8.8
M10	2	2.3	3.3

From table 4 it can be seen that better quality control results in a lesser value of's' and 'fm' for same 'fck'. Therefore, cement consumption works out to be lower when the quality control is better. Hence, for concrete manufacture better quality control results in greater economy.

Percentage saving as compared to 'A' grade cement

5.RECOMMENDATIONS TO IMPROVE DURABILITY USING HIGH STRENGTH CEMENT

However, the durability requirements as specified in IS 456- under revision must be satisfied depending on the various exposure conditions. From table 5 it is obvious that concrete manufactured using a higher grade of cement even after considering that lower grade cement may be marginally cheaper than the higher-grade cement.

Requirement of durability as per IS: 456-2000. Maximum cement content, maximum water-cement ratio and a minimum grade of concrete for different exposures with normal weight aggregates of 20 mm nominal maximum size.

Note 1- Cement content prescribed in this is irrespective of the grades of cement and it is inclusive of Mineral Admixtures specifies in IS 456-2000. The additions such as fly ash or ground granulated blast furnace slag may be taken into account in the concrete composition with respect to the cement content and water-cement ratio if the suitability is established and as long as the maximum amounts taken into account do not exceed the limit of pozzolona and slag specified in IS 1489 (part 1) and IS 455 respectively.

Note 2- Minimum grade for plain concrete under mild exposure condition is not specified. The figure below shows that F grade cement can be utilized for 200 kg/cm. Sq. Reinforced concrete in mild environment condition only while C to E grade cement can be used for mild or moderate environmental conditions. However, for high-performance concrete generally, it is very important to go for a higher grade of concrete (above M25 grade). If this concrete is made with high strength cement, then it will fetch both technical as well as a financial advantage. shows the extent to which different grades of cement can be used for different environmental conditions and various grades of concrete.

Water cement ratio vs Average 28 days' strength of cement in (kg/ cm.sq.) It is generally observed that even today the structural engineers and architects specify the M15 and M20 grade of concrete in the coastal area. This has already led to serious durability problems and low performance of concrete structures. M15 grade concrete can be achieved with W/C much greater than 0.55 if 43 and 53 grades of cement are used and since 33-grade cement has now virtually disappeared from the market. All M15 grade concrete structures in coastal areas are therefore bound to be a happy hunting ground for concrete rehabilitation agencies as is being observed at present. The durability problem is most likely to multiply several times if, at the specification stage itself, proper precautions are not taken.

Even M20 grade concrete may not be the correct solution to the durability problem in the Urbanized/Industrialized coastal areas.

Lower grades of concretes with the generally poor type of quality control prevalent are observed to be of very poor durability, needing of extensive repairs within a few years. As good quality cement are now available it is strongly recommended to go in for higher grades of concrete i.e. above M25 grade. This will improve the performance of the structures; prove more economical in most cases and in the process of achieving higher strengths it will automatically comply with the durability requirements.

6.CONSISTENCY OF CEMENT QUALITY

Concrete mix design (CMD) is one of the techniques to determine the most economic proportions of cement, sand, aggregates, water and other additives. However, after choosing the economic proportions of various materials any change in their physical or chemical property will lead to considerable variations in the desired cohesiveness, workability, strength and durability. The maximum impact is always due to variation in cement properties and therefore it is not only essential that cement should have good strength, proper fineness and correct setting time but it is also essential that the variation of its chemical and physical properties especially the strength and fineness should be minimal. The good quality in minimizing variations is now possible with proper quality control monitoring systems and modern sophisticated instrumentation control systems the cement manufacturers have installed in their modern up to date plants.

7.QUALITY CONTROL IN CEMENT MANUFACTURE

While high strength is the indication of the good physical quality of cement, consistency of this high strength and other physical and chemical properties is an indication of good quality control and superior technology practiced by the cement manufacturing company.

The quality control in the cement manufacturing plant starts from the inspection and testing of the limestone. Only after extensive testing for its CaO content, it is utilized, making sure that CaO content is uniform.

The thoroughly crushed limestone powder is then stored in a stacker. It is reclaimed in vertical slices to get homogenous limestone, which is then conveyed, to the vertical ball mill, which ensures uniformly crushed limestone. After this, homogenization of the limestone is done in the blending silo by means of aeration. Thereafter homogenized materials are passed through series of suspension preheaters and are fed into the kiln for the production of clinker. Hourly samples of clinker are taken and tested to assure uniformly of quality. On line X-ray analyzers' help in ascertaining the variations in compound compositions of the cement so that immediate action can be taken to improve the quality of the product if required. The clinker is then processed through closed circuit grinding. This ensures proper particle size distribution. A device called high-efficiency cyclonic separator, which controls the grinding process right down to the specific micron size required, does this. After initial grinding in the tube mill, the materials move into the high-efficiency cyclonic separator. The separator separates the ground particles into two streams. The airflow exerts an aerodynamic force and separates the finer particles (between 5 and 30 microns) from the oversize coarser particles (above 30 microns), which are influenced by centrifugal and gravitational forces. The coarse particles are collected into grit collection and brought for recirculation into the grinding process. The fine particles are removed from the air stream in high cyclones mounted symmetrically around the separator housing. This process assures that cement has the ideal surface area and the ideal proportion of particle size between 5 to 30 microns. This process guarantees the highest number of a particle between 5 to 30 microns to the extent of over 50%. Hourly samples are taken and tested to assure uniformity of quality. The consistency of particle size is checked using sophisticated particle size analyzers, which immediately indicate the grain size distribution. Adjustments required in cement productions, if any, can be controlled in the plant to obtain the optimum particle size distribution and thereby assure consistent quality. If cement has a large number of particles finer than 5 microns it tends to set quickly producing high early concrete strength without a corresponding increase later on. This cement is also more susceptible to moisture attack and hydrates fast resulting in unnecessary wastage. On the other hand, if cement possesses a large number of particles above 30 microns it takes longer time than normal to set and will also display low initial strength which increases at a later stage. The cement is then transferred to the packinghouse where it is packed in woven HDPE and 4 ply paper bags and transported to various stockiest and construction sites. The hourly samples are also collected from the packinghouse to check the quality. Daily tests for various chemical and physical properties are done and various parameters are recorded to study the monthly variations and to improve the product quality from time to time and thereby minimize variations.

8.NEED FOR CONSISTENCY OF QUALITY

Many do clearly not understand the importance of consistency of cement quality hence a small illustrative example is given below. Assume that three brands of cement say AA, BB and CC are available having identical mean strength for a particular month of manufacture, say 600 kg/cm. Sq. However, the standard deviations for these cement during the same month were different and therefore the characteristic strength of this cement and its grade are worked out as below. Hence from the above, it can be observed that cement having identical mean 28 days strength for the month can be classified as F, E or D based on the variations (standard deviation). It is therefore of prime importance to control these variations to the barest minimum so that the cement can be classified as a higher grade. It is generally observed that monthly standard deviation if ranging between 15 to 25 kg/cm. Sq. can be considered as a good control for cement manufacture.

There are additional cost savings associated with using high-quality cement that are worth noting

Besides saving of concrete quantity and cement cost per cubic meter of concrete, there are several other advantage and savings due to the use of high strength cement. It is observed that the best advantage of specifying high strength cement is derived if, at the planning and design stage itself, high grades of concretes are specified. The higher-grade concretes may have a smaller cross-sectional area under identical conditions and thereby the quantity of concrete reduces considerably. The saving in concrete quantity can easily between 1% of 25% depending on the type of structural member, its layout and its function. However, in addition to this saving, higher grades of concrete will be less permeable and more durable than lower grades.

9. CONCLUSION

- Less use of reinforcing steel.
- Reduction in the required amount of formwork.
- Less work needed for final touches like plastering, painting, etc.
- Benefits include less time and fewer workers needed for building.
- The building's carpeted area will be expanded.

In short high cement if specified at the design stage itself and utilized for the high-grade concrete structure will be more economical than if the lower grade cement is specified. This will benefit the user in giving a structure, which is stronger, and more durable and economical. With high-grade cement, it is now possible to attain QUALITY SPEED AND ECONOMY. So, make your concrete structure 'fast' and to 'last'.

REFERENCES

1. .(IS: 8112-1989) 'Specification for 43 grade Ordinary Portland Cement' Bureau of Indian Standards, New Delhi.
(IS: 12269-1987) 'Specification for 53 grade Ordinary Portland Cement' Bureau of Indian Standards, New Delhi.
.https://storify.com/jackdawson/how-to-determine-right-quality-of-cement
2. punmia b.c." R.C.C.DESIGNS" laxmi publication (p) ltd.
3. .kumar sushil "Treasure of r.c.c. design" rajsons publication privt.ltd.
4. singh gurucharan, singh jagdish " Theory &design r.c.c. structure standard publishers distributors

Current Situations and Future Solutions for Plastic Pollution's Impacts on Aquatic Wildlife

Dr. Sanjeev Gill[2], Namra Fatima[3]

[a] Professor, Deptt. of Civil Engineering, JBIT Dehradun, Uttarakhand (India)

[b] M.Tech Scholar, Deptt. of Civil Engineering, UTU Dehradun , Uttarakhand (India)

ABSTRACT

Most everyday consumer goods are made of plastic in one way or another. According to Shaw and Sahni Journal of Mechanical and Civil Engineering 46–48 (2014), almost 280 million t of plastic are manufactured annually around the world, much of it ends up in landfills or the oceans. Plastics are cheap, strong, and lightweight, but these same qualities may also make them exceedingly dangerous to wildlife, especially if they get into the water. Five major ocean gyres—two in the Pacific, one in the Indian, and two in the Atlantic—are where plastics are most often found circulating once they have reached the sea. Rather than being solid islands of plastic, these oceanic trash patches contain a murky mixture of plastics (Kostigen 2008; Livingeco 2011).Similar issues have been discovered following recent research on the Great Lakes' surfaces (Erikson et al., Marine Pollution Bulletin, 77(1), 177–182, 2013). The possibility that plastics in the wild could entangle animals, cause ingestive illness, or transport exotic species is a major source of concern. In an effort to lessen the harm that plastics are doing to our ecosystems, a number of cutting-edge technologies have been tested to monitor or collect the plastics already present in our habitats and transform them back into oil.

Keywords: *Plastics, Microplastics, Ocean gyres, GreatLakes, Marinepollution*

1.INTRODUCTION

Around the world, around 280 million t of plastic are delivered every year (Shaw and Sahni 2014) for the assembling of items like capacity compartments, bundling mate-rial, or even cars. In the USA alone, approximately 48 million t of plastic are produced every year (Sarker et al. 2012b). Plastic has turned into an ideal medium utilized in tremendous measures of customer items since it is lightweight, strong, modest, and a decent cover. Sadly, inside the most recent 30 years, researchers have understood that the helpful properties of plasspasms additionally make them unfavorable to our environment. This is on the grounds that it is hard to wipe out plastic waste because of the way that it doesn't biodegrade in nature, yet just photodegrades into more modest pieces. The synthetic connections between the atoms that comprise plastic make them strong, yet in addition impenetrable to regular corruption (Shaw and Sahni 2014). The level of plastics that make up the complete metropolitan strong waste has risen 12 % throughout recent many years (EPA 2014). Close to 33% of the plastic created is utilized to produce single-use plastics (DiGregorio 2012, for example, espresso mug covers, stirrers, or straws.

Yearly, in excess of 35 million plastic jugs and 500 billion plastic packs are utilized by purchasers, large numbers of which end up in our seas and along our sea shores

(What a Waste 2010). Waterways, especially the sea gyres saw as in the Atlantic, Pacific, and Indian Seas, are turning into the last objective for the vast majority of these non-biodegradable polymers. These gyres are circulating flows brought about by the Coriolis impact, or de-flection of flows, because of Earth's revolution and surface breezes (NOAA 2008). Because of plastic waste, Earth's sea and freshwater biodiversity and ecosystems are adversely impacted. To take care of issues brought about by plastics, new advances are being directed which incorporate following junk through recurrence identification (RFID) labels and cell transmitters, having residents track plastic garbage utilizing their cell phones, utilizing robots or hindrances to gather plastic trash, and transforming plastics back into fuel.

Issues of Waterborne Plastics in Our Surroundings

The collection of plastics in our surroundings is a consequence of ill-advised removal or transportation spills. Since they are lightweight and tough, plastics are fit for voyaging significant distances; winding up in earthly environments, along coastlines, or drifting in the untamed sea (Zbyszewski and Corcoran 2011). For instance, pill bottles from India alongside oil and cleanser containers from Russia, Korea, and China have been tracked down on the southern pieces of Hawaii (Kostigen 2008). As plastics float in the seas, they are influencing marine natural life. Besides the fact that vagrant plastics end up in animals' stomachs or around their necks, yet there is likewise developing worry that plastics are going about as a mechanism for obtrusive animal categories. The hard surfaces of plastics are presently a substitute material for obtrusive species, for example, barnacles, mollusks, and green growth to append, contrasted with the regular material which recently conveyed intrusive species for a really long time (Gregory 2009). With the deluge of plastics as of now in the seas, the collection of obtrusive species might heighten at a consistently speeding up.

2.OCEAN TRASH PATCHES

The Unified Countries has assessed that 5-10 million t of plastic are flowing in the North Pacific Sea be-tween California and Japan, in spite of the fact that it is challenging to limit an accurate measure of flotsam and jetsam (Livingeco 2011). Assessed to be two times the size of Texas, the

North Pacific Subtropical Gyre is frequently called "The Incomparable Pacific Sea Trash Fix" (NOAA 2013). It is here where impacting flows trap plastics in a circulating design. Frequently confused as an island of plasspasm, the Pacific Sea Gyre is really a major undefined mess of huge and little plastic pieces expanding 100-ft profound (Kostigen 2008). Researchers have found other significant trash fixes that envelop the same amount of plastic with hypothesis that there might be more: the South Pacific Subtropical Gyre, the North and South Atlantic Subtropical Gyre, and the Indian Sea Subtropical Gyre (NOAA 2014). Following a 20-year study, the North Atlantic Sea and the Caribbean Ocean are assessed to have 200,000 plastic pieces for each square kilometer (Gill 2010), in this way meaning an issue of comparable greatness to the Pacific Sea.

A lot of the plastics circling the seas are accepted to come from coastlines, 10 % from fishing stuff, and 10 % from boats and ships (McLendon 2010). Around, 10,000 steel trailers plunge off freight ships into the sea every year (McLendon 2010). A delivery box conveying 28,000 plastic ducks was adrift out in the ocean between Hong Kong and the USA in the Pacific Sea a long time back (Nelson 2011). Something like 2000 of the ducks are accepted to be circling in the Incomparable Pacific Trash Fix, while others have been tracked down washed shorewards in Hawaii, Gold country, South America, Australia, and the Pacific Northwest (Nelson 2011). The sturdiness of plastics is noticed each time any of these ducks arise on shore still unblemished.

3. EFFECTS OF PLASTICS ON MARINE BIODIVERSITY

The greatness of plastic contamination conveyed to the ocean has altogether duplicated throughout recent many years. Customarily, natural life is harmed because of entrapment or ingestion of the plastics tracked down in the climate. For Procellariiformes like the gooney birds, shearwaters, or petrels, the presence of disintegrated plastic pieces are like many kinds of food they drink (Scourge and Burger 1997). Microplastics look like phytoplankton which are eaten by fish and cetaceans (Boerger et al. 2010). Ingested plastic trash has been found to diminish stomach limit, ruin development, cause inner wounds, and make gastrointestinal blockage (Plot and Georges 2010). Plastic trap with fishing nets or other ring-molded materials can bring about strangulation, decrease of taking care of effectiveness, and at times suffocating (Allen, Jarvis, Sayer, and Plants 2012). Because of regularinterest, pinnipeds frequently become caught in marine flotsam and jetsam very early on, which can contract their body as they develop consequently decreasing personal satisfaction (Allen et al. 2012). Around the world, no less than 23 % of marine well evolved creature species, 36 % of seabird species, and 86 % of ocean turtle species are known to be impacted by plastic trash (Stamper et al. 2009).

4. SEA TURTLES

Various examinations have shown that ingested plastic and tar are the essential guilty parties of pressure and non-normal passing for ocean turtles. Flotsam and jetsam including fishing line, ropes, nets, six pack rings, Styrofoam, and plastic sacks have been extricated from turtle gastrointestinal systems. Plastic sacks drifting in the water emphatically look like the state of jellyfish, an essential food hotspot for ocean turtles, consequently bringing about the ingestion of the packs (Mascarenhas et al. 2004).

Because of anthropogenic effect, the number of inhabitants in leatherback ocean turtles (Dermochelys coriacea) has consistently declined throughout recent many years, putting them on the IUCN's fundamentally jeopardized list (Shillinger et al. 2012). Throughout the previous 40 years, of the 371 examinations con-ducted on leatherback turtles, 37.2 % of them had plastic in their gastrointestinal parcels (Mrosovsky et al. 2009). In spite of the fact that it isn't known whether the plastic ingested was the reason for death, 8.7 % of the turtles had a plastic pack probably obstructing the entry of food (Mrosovsky et al. 2009). Plastic has likewise been found to hinder the entry of female eggs. In a reported report, re-searchers eliminated 14 bits of plastic from a female cloaca. This empowered the eggs to be laid, however sign of interior harm remained (Plot and Georges 2010).

Green turtles (Chelonia mydas) and blockheads (caretta) have been found in comparative predicaments. As indicated by Parker et al. (2005), the Public Marine Fisheries administration procured 52 blockheads through by-get in the Atlantic Sea. Of these, 35 % were found to have plastics in their gastrointestinal systems (Parker et al. 2005). In the western Mediterranean, 79.6 % of the 54 blockheads caught illicitly by anglers contained plastics in their gastrointestinal parcels (Tomas et al. 2002). In Paraiba, Brazil, a turtle taken in for recovery kicked the bucket in the wake of discharging 11 bits of hard plastic and 9 bits of plastic pack (Mascarenhas et al. 2004). Essentially, an adolescent green ocean turtle saw as insignificantly responsive, pooed north of 74 unfamiliar objects, including a variety of various types of plastics while being restored (Stamper et al. 2009). Preceding passing the flotsam and jetsam, the turtle was eating around 8 g of food each day. After the flotsam and jetsam passed, the food admission was all up to 100 g daily (Mascarenhas et al. 2004). Despite the fact that a few turtles might be able to do going plastic through their stomach related framework, it can in any case cause interior wounds. Those that can't pass the plastic will ultimately starve as plastics accumulate in their stomach depressions.

CETACEAN

Most cetaceans live distant from the coastline which restricts how much examination on the ingestion of marine de-bris. Assuming that plastic causes unnatural demise, cetaceans will doubtlessly sink to the lower part of the sea (Baird and Whore 2000). Sometimes, cetaceans will wash aground considering posthumous assessments. Due to cetaceans' echolocation abilities, mixed up utilization of plastic isn't plausible (Secchi and Zarzur 1999). Ingestion is doubtlessly in light of the fact that the trash was blended in with the ideal food. Two sperm whales (Physeter macrocephalus) were tracked down off the shoreline of northern California in 2008 with a lot of fishing gear in their gastrointestinal plots (Jacobsen et al. 2010). One of the sperm whales had a burst in the third compartment of the stomach brought about by nylon netting; the other had netting, fishing line, and plastic sacks totally hindering the stomach from the digestive organs (Jacobsen et al. 2010). On the bank of Nova Scotia, Canada, an adolescent porpoise (Phocoenidae) was found dead with a clustered piece of dark plastic in the throat trapped with three spined stickleback fish (Baird and Whore 2000). In Brazil, the stomach examination of a Blainville's bent whale

(Mesoplodon densirostris) showed the presence of a huge heap of blue plastic string possessing a significant piece of the stomach chamber (Secchi and Zarzur 1999). Inside the last 10 years, something like seven imperiled moving humpback whales (Megaptera novaeangliae) have been spotted towing mass measures of tangled nylon rope and other flotsam and jetsam including a crawfish pot and a float with marker post (Gregory 2009). A jeopardized North Atlantic right whale (Eubalaena glacialis) was found with fishing rope ensnared through its mouth. Because of its dangerous conduct, heros were simply ready to effectively eliminate 250 ft of the business fishing line and trusted the remainder of the rope would unstick from the mouth all alone (Foley 2014). Presently, there have not beenenough patterns found in gathered information that demonstrate ingested plastics are the essential driver of death contributing to the downfall of cetaceans (Simmonds 2012; de Stephanis et al. 2013; Baulch and Perry 2014). In any case, these models demonstrate the way that plastic marine de-bris can cause direct mortality of cetaceans or even make crippling situations that make the warm blooded creatures more inclined to predation or sickness.

BIRDS

Little plastics, for example, bottle covers are frequently mixed up via seabirds (Procellariiformes) for food. In a few examinations, it was found that jumping birds that benefited from fish in the water segment had less plastic in their stomachs com-pared to those that were surface eaters (Scourge and Burger 1997; Provencher et al. 2010). This could be on the grounds that birds that keep an eating regimen of zooplankton will most likely be unable to recognize plastics and their essential wellspring of food because of the variety or state of the plastic pieces (Avery-Gomm et al. 2013). Since most grown-up birds spew what has been ingested as a method for taking care of their chicks, they pass the bolus containing the plastic pieces onto their young. Birds, for example, the albatross and shearwater had more plastic in the primary district of their stomachs and gizzards, demonstrating that when these plastics were spewed, they would be passed to their young during taking care of (Moser and Lee 1992). Adolescent gooney bird and shearwaters were found to ingest a larger number of plastics than grown-ups (Avery-Gomm et al. 2013; van Franeker et al. 2011). Like other marine life, gulped plastic can discourage and harm a bird's stomach related framework, decreasing its scrounging capacities. Ryan (1988) inferred that ingested plastics could re-duce the wellness, development rate, and food utilization of seabirds, in light of the outcomes from a review utilizing vaults spasm chickens (Gallus domesticus).

How much plastic ingested by various types of birds might be a mark of the gathering of plastics in a space. A review completed by Moser and Lee (1992) found that North Atlantic shearwaters showed an in-wrinkle in utilization of plastics from 1974 to 1978 contrasted with 1976-1984. This connects with the in-wrinkle of plastic accessible in the seas. In 1995, a review finished by Auman et al. (1997) found that of the 251 Laysan Gooney bird (Phoebastria immutabilis) autopsied from Halfway Atoll in the North Pacific, just 6 contained no ingested plastic. One more review directed in the eastern North Pacific found that of the 353ingested things recuperated from 11 types of seabirds,29.2 % were modern pellets and 70.5 % were broken bits of regular use plastics (Scourge and Burger 1997). The stomach items in 67 fulmars appeared on the sea shores along the eastern North Pacific from 2009 to 2010 contained on normal 36.8 bits of plas-spasms (Avery-Gomm et al. 2013). Taking into account this represented 92.5 % of the fulmars, Avery-Gomm et al. (2013) hypothesized that this meant an expansion in the ingestion of plastics.

FISH

There have not been any tracked down distributed investigations about the impacts of plastics on fish; in any case, there is a lot of proof supporting that fish are consuming plastics. Of the 7 distinct species concentrated on in the North Ocean, as it were2.6 % of the 1203 gathered fish contained plastic pieces in the gastrointestinal systems (Foekema et al. 2013). At the point when the gastrointestinal lots of 504 fish were concentrated on in the English Channel, 36.5 % contained plastics (Lusher et al. 2013). Conflicting outcomes found among studies might actually show significant factors, for example, lo-cation, aggregation of plastics, and fish species. A review led in the North Pacific Focal Gyre viewed that as 35 % of the 670 fish tried had a consolidated complete of 1375 plastic pieces in their stomachs. This compares to around 2.5 pieces per fish. The majority of the plastic pieces were blue, white, or clear which are similar varieties as board ton, the essential food wellspring of fish (Boerger et al. 2010). In a comparable report done in the North

Pacific Subtropical Gyre, 9.2 % of 141 fish inspected had plastics in their stomachs (Davison and Asch 2011). In view of these outcomes, Davison and Asch (2011) speculate that somewhere in the range of 12,000 and 24,000 t of plastic are consumed by fish every year. Understanding the impacts of plastics when devoured by fish is of concern in light of the fact that the little pieces of plastic might work with the vehicle of retained contaminations to hunters inside the pecking order (Dau 2012; Teuten et al. 2009).

5.PLASTIC CONTAMINATION IN THE INCOMPARABLE LAKES

There have been many examinations led to decide the dispersal, ecological effect, and amount of plastic contamination in marine biological systems, yet little is had some significant awareness of freshwater plastic contamination. Researchers are currently understanding that similar issues saw in the sea gyres and along shorelines are emerging in ourcollections of new water (Blackwell 2012). The Incomparable Pools of North America are the biggest freshwater systems on the planet. Lake Huron, Lake Ontario, Lake Michigan, Lake Erie, and Lake Prevalent address the five assortments of freshwater in the Laurentian Extraordinary Lakes. Over the most recent couple of years, these frigid caused lakes to have been a focal point of study for the impacts of freshwater plastic contamination.

The shores of Lake Huron in Canada comprise one of the primary places where scientists contemplated the abundance, type, and dissemination of plastic contamination along the Incomparable Lakes (Zbyszewski and Corcoran 2011). As indicated by the creators, the modern side of the lake contained the most plastics; most of which were little pellets utilized for the development of fabricated merchandise. It was hypothesized that a considerable lot of the pellets were lost during creation or conveyed by the development of the cyclonic surface ebb and flow brought about by wind and changes in water temperature (Sheng and Rao 2006; Zbyszewski and Corcoran 2011). Likewise conceivable upset freight might have added to the collection of plastic on the shores of Lake Huron since this stream is important for a significant delivery course (Zbyszewski and Corcoran 2011).

In the mid-year of 2012, 5 Gyres Organization cruised through Lake Erie, Lake Prevalent, and Lake Ontario to lead the primary untamed water study of the lakes (Eriksen et al. 2013). While fishing the lakes for plastics, Erikson et al. found that Lake Erie reliably had the most thought degrees of microplastics com-pared to Lake Huron and Lake Unrivaled. Two explanations for this peculiarity could be that Lake Erie has the most populated coastlines, or it very well may be getting the microplastics from different lakes because of the south-ward streaming current (Dau 2012; Eriksen et al. 2013). Tests taken from Lake Erie additionally uncovered that the number of plastics was multiple times more noteworthy than the sum found in any examples taken from the seas. The majority of these examples were included microplastics which are under 5-mm wide (Dau 2012). This magnitude of microplastics was startling. Dau accepted that the lakes would contain bigger plastics that dissolved into more modest pieces as they cleared their path through lakes and waterways to the seas, a cycle that ought to require many years (Blackwell 2012). Eriksen et al. (2013) associated numerous with the microplastics gathered to be polyethylene and polypropylene microbeads from facial chemicals and other individual consideration items. At the point when customers discharge these microplastics down the channel, itis conceivable many clear their path through wastewater treatment plants and into the freshwater lakes, particularly assuming they are under .5-mm wide (Eriksen et al. 2013).

Whether on the shores or by all accounts, the two investigations show that the Laurentian Extraordinary Lakes are cooperating with microplastics and plastic pellets. The little size of these plastics makes them effectively accessible for ingestion, subsequently expanding the bioaccumulation of the synthetic fixings from in the plastic or from the assimilation of synthetics onto the plastics (Rochman et al. 2014; Teuten et al. 2009). When consumed, microplastics containing plasticizers, for example, bisphenol A (BPA) and phthalates have been made to influence bring forth progress and the turn of events and proliferation of posterity in creatures of land and water, shellfish, and, surprisingly, in-orders (Oehlmann et al. 2009). One more issue with microplastics is that they draw in destructive poisons, for example, polychlorinated biphenyls (PCBs) and dichlorodiphe-nyltrichloroethane (DDT) (Zbyszewski and Corcoran 2011). PCBs have been displayed to cause diseases in marine creatures or to adversely affect the immune framework, sensory system, endocrine framework, and regenerative framework (EPA 2013). There is hypothesis that these moment plastics can advance up the well-established pecking order, making comparable wellbeing dangers people (Dau 2012). Further investigations are expected to dissect the invasion of microplastics into the Incomparable Lakes and the important effects they have on the biodiversity ingesting them (Teuten et al. 2009).

6.MANAGING THE IMPACTS OF PLASTICS

The development of plastics in our sea surroundings and the impacts on natural life has been explored for more than 30 years. Information about sea flows acquired from satellite-followed Lagrangian strays have been utilized to anticipate the directions of drifting marine trash (Maximenko et al. 2012; Martinez et al. 2009). Lagrangian wanderers are instruments that have been utilized in seas, lakes, and streams to gauge water ebbs and flows and to gather other natural information, for example, temperature and saltiness. Researchers are by all accounts not the only individuals following rubbish. The Marine Trash Tracker is a resident science project that permits local area individuals to log marine flotsam and jetsam found along shorelines and streams utilizing their cell phones, which is then recorded utilizing GPS (Need to Track 2014). Finding and followingplastic garbage is basic to more readily comprehend which environments are generally powerless.

Regardless of the capacity to follow squander development, a solution to freeing our World's waters of plastic waste to limit its consequences for marine natural life stays a challenge. Despite the fact that the USA executed the Spotless Water Act and the USA and Canada keep on altering The Incomparable Lakes Water Quality Consent to lessen the contamination in areas of concern, more plastics keep on aggregating in the Incomparable Lakes every year (EPA 2012). These plastics definitely advance toward the ocean through organizations of waterways and streams and afterward into the sea gyres. Since the gyres are found in international waters, no nation is assuming a sense of ownership with tidying up the seas. All things considered, a few private organizations are attempting to tackle the issue. Creative advancements have been guided by privately owned businesses to help distinguish, limit, and take out plastics in our environments including following waste through radiorecurrence ID (RFID) labels and cell transmitters, utilizing robots or obstructions to gather plastic garbage, and transforming plastics back into oil.

7.TRACKING TRASH

Reusing is perhaps of the most distinguished practice benefit ready to decrease the effect of waste in our landfills and in our current circumstance through the reuse of materials. Whether or not or not an individual reuses, there is little proof that waste is winding up in its planned objective. It is a direct result of this absence of information that Massachusetts Establishment of Innovation is utilizing RFID labels and cell transmitters to follow trash and reusing in Seattle and New York (Greengard 2010). As per Greengard, "Garbage Track" permits re-searchers to follow where the rubbish has been, the means by which long it has been moving prior to being stored, and where the waste at last collects. Through this review, re-searchers desire to find more data about the US squander the executives framework, and afterward utilize the data to impact individuals' way of behaving and reusing endeavors. As the junk is followed, further examinations can likewise be intended to recognize where the greater part of the plastics are amassing and how can be forestalled further wounds to natural life in those areas. Presently, specialists have labeled in excess of 3000 bits of garbage with sensors that will switch off or on when they distinguish changes ready and area to assist with saving the half year battery (Greengard 2010). Despite the fact that there are no known investigationsto date that track plastics into and through our streams, it is conceivable this equivalent innovation could one day at any point be applied to following plastics that advance into the Incomparable Lakes or seas.

8.GATHERING PLASTICS IN THE INCOMPARABLE SEA TRASH PATCHES

Gotten from the plan of a fish fishing vessel and tiny fish tow, manta fishing boats have been used for the assortment of toxins from the sea for information examination (Ryan et al. 2009). The manta fish is put behind the boat where it skims the outer layer of the water gathering float subterranean insect plastic flotsam and jetsam. Albeit this innovation gathers drifting plastic flotsam and jetsam for study, it actually doesn't represent an answer for the more prominent test of eliminating the plasspasms from the seas. Plastics represent 60-80 % of our marine litter (Moore 2008), which is the reason finding an answer for this problem is essential.

An inventive model of a "plastic-eating drone" has been proposed as a potential answer for tidying up our sea's trash patches. While some might trust eliminating plastics in the gyres is derisory, Elie Ahovi, a modern plan understudy, considers contrast ently. Ahovi has proposed utilizing an independent gadget that would tow a catching net which would siphon the plastic trash from our sea waters (Boyle 2012). Sonic transmitters would be utilized as an impediment for marine life getting found out in the net. As per Boyle, the robot is intended to venture to every part of the seas for a long time, yet would it be a good idea for it assemble an excess of waste or the batteries run short, it would get back to a sea base where groups would discharge it of the plastic for reusing. On the off chance that Ahovi has planned a device that is sufficiently strong to assemble the plastic in the Incomparable Pacific Trash fix, comparative innovations could be material to new water frameworks tracked down on The planet. Should the proto-type be carried out, further examinations will be necessary to distinguish assuming that the waste expulsion is diminishing the ingestion of plastics.

The Sea Tidy up Cluster is one more noteworthy answer for tidying up plastics circling in the sea gyres. Planned by Boyan Support and executed with the assistance of a group of researchers, the Sea Tidy up Cluster involves the sea flows for gathering plastics (The Sea Tidy up 2014). Strong drifting blasts are appended to stages that are moored to the sea depths. The Cluster was planned so that impartially light marine life will drift underneath the blasts forestalling anynatural life entrapment, while permitting drifting plastic conveyed by the flows of the sea gyres to gather along the blasts on the outer layer of the water (The Sea Tidy up 2014). It is assessed that 7.25 million t of plastic waste could be eliminated from the sea; a large portion of as most would consider to be normal to be reasonable to be transformed into oil (Singh 2013; The Sea Tidy up 2014). As the Sea Tidy up Exhibit moves into the pilot stage, this plan may not just eliminate plastic as of now drifting in gyres that is harming untamed life, yet in addition might be utilized in streams to keep the plastic from truly arriving at the sea.

9.A BETTER APPROACH TO REUSE PLASTICS

While many individuals reuse family plastic things with the presumption they can be generally completely reused, something like 10 % of plastics are being reused once again into plastics. Most of plastics are arranged in landfills or burned (Sarker et al. 2012b). A few strategies for compound reusing including gasification or purifying are right now utilized (Sarker et al. 2012a). Warm debasement might be the new answer for reusing and reusing plastics like high-thickness and low-thickness polyethylene, polypropylene, and polystyrene, without bringing on additional ecological corruption (Livingeco 2011). During warm corruption, oil-based plastic is warmed to 25 to 430 °C and afterward changed over into fluid hydrocarbon fuel (Sarker et al. 2012c). The warm corruption is done in a sans oxygen treated steel reactor. Since burning or ignition doesn't happen, smoke isn't a result (Sarker et al. 2012c). This cycle brings about least waste. Byproducts from this cycle incorporate carbon dioxide comparable to two individuals breathing out for 24 h, water fume, and one cup of biodegradable burn (carbon) which is discarded month to month (Livingeco 2011). The Evolucient Framework planned by specialists from the Perfect Sea's Venture can change over 2700 lb of plastic into fuel through warm corruption north of a 24-h peri-od; each 8 lb represents 1 lady of fuel (Livingeco 2011).

As per Sarker et al. (2012b), assuming how much waste coursing in the sea gyres can be assembled utilizing assortment vessels, the waste can then be changed over into hydrocarbon fuel on the vessel or in seaward offices. The Perfect Sea's Task desires to introduce an Evolucient Framework on a breeze-controlled sailboat that will move around the Incomparable Pacific Trash Fixgathering the obscurity of plastic particles (Livingeco 2011). Any fuel that is required can be extricated from the Evolucient Framework. This innovation isn't just applilink to seas, yet can be used in the Incomparable Lakes to gather and discard the microplastics collecting in the freshwater.

10. CONCLUSION

Because of ingestion or trap in plastic garbage, more than 270 species, including turtles, fish, seabirds, and mammals, have encountered debilitated development, starvation, or demise (Laist 1997; Wabnitz and Nichols 2010). Specialists have accumulated a plenty of data about the quantity of species impacted by plastics in the seas, however the freshwater untamed life impacted in a lot more modest waterways, for example, the Incomparable Lakes, actually should be truly thought of. It is conceivable that the plastic-gathering robot could be utilized to gather most of plastics in the seas and Extraordinary Lakes or that the Evolucient Framework will be the better approach to reuse through warm debasement. Reusing is the ongoing answer for the abuse of plastics, yet the last objective of a lot of recyclable material is as yet being evaluated. Answers for guarantee mate-rials are reused or discarded appropriately should be created. Indeed, even with exploration, reusing, and new technologies, substitute bundling material ought to be used to diminish the reliance on plastic products. Plastics don't vanish and will stay in that frame of mind in-most certainly influencing untamed life, until the contamination is reduced. "Water is something each living organic entity on this planet can't survive without. On the off chance that this asset is valuable to the point that life can't exist without it, we ought not be sullying it" (Sherri Bricklayer as refered to in Blackwell 2012 para. 19).

REFERENCES

1. Allen, R., Jarvis, D., Sayer, S., & Mills, C. (2012). Entanglement of grey seals Halichoerus grypus at a haul out site in Cornwall, UK. Marine Pollution Bulletin, 64(12), 2815–2819

2. Auman, H. J., Ludwig, J. P., Giesy, J. P., & Colborn, T. H. E. O. (1997). Plastic ingestion by Laysan albatross chicks on Sand Island, Midway Atoll, in 1994 and 1995. Albatross Biology and Conservation, 239–244.

3. Avery-Gomm, S., Provencher, J. F., Morgan, K. H., & Bertram, D. F. (2013). Plastic ingestion in marine-associated bird species from the eastern North Pacific. Marine Pollution Bulletin, 72(1), 257–259.

4. Baird, R. W., & Hooker, S. K. (2000). Ingestion of plastic and unusual prey by a juvenile harbour porpoise. Marine Pollution Bulletin, 40(8), 719–720.

5. Baulch, S., & Perry, C. (2014). A sea of plastic: evaluating the impacts of marine debris on cetaceans. Marine Pollution Bulletin, 80(1), 210–221.

6. Blight, L. K., & Burger, A. E. (1997). Occurrence of plastic particles in seabirds from the eastern North Pacific. Marine Pollution Bulletin, 34(5), 323–325.

7. Davison, P., & Asch, R. G. (2011). Plastic ingestion by mesopelagic fishes in the North Pacific Subtropical Gyre. Marine Ecology Progress Series, 432, 173–180.

8. de Stephanis, R., Giménez, J., Carpinelli, E., Gutierrez-Exposito, C., & Cañadas, A. (2013). As main meal for sperm whales: plastics debris. Marine Pollution Bulletin, 69(1), 206–214.

9. DiGregorio, B. E. (2012, February). Tracking Plastic in the Ocean.

10. Eriksen, M., Mason, S., Wilson, S., Box, C., Zellers, A., Edwards, W., & Amato, S. (2013). Microplastic pollution in the surface waters of the Laurentian Great Lakes. Marine Pollution Bulletin, 77(1), 177–182.
11. Foekema, E. M., De Gruijter, C., Mergia, M. T., van Franeker, J. A., Murk, A. J., & Koelmans, A. A. (2013). Plastic in North sea fish. Environmental Science & Technology, 47(15), 8818–8824.
12. Gill, V. (2010). Plastic Rubbish Blights Atlantic Ocean. BBC News, 24.
13. Greengard, S. (2010). Tracking garbage. Communications of the ACM, 53(3), 19–20.
14. Gregory, M. R. (2009). Environmental implications of plastic debris in marine settings—entanglement, ingestion, smothering, hangers-on, hitch-hiking and alien invasions. Philosophical Transactions of the Royal Society, B: Biological Sciences, 364(1526), 2013–2025.
15. Jacobsen, J. K., Massey, L., & Gulland, F. (2010). Fatal ingestion of floating net debris by two sperm whales (Physeter macrocephalus). Marine Pollution Bulletin, 60(5), 765–767.
16. Kostigen, T. M. (2008). The world's largest dump: the great pacific garbage patch. Discover Magazine, 10.
17. Laist, D. W. (1997) Impacts of marine debris: entanglement of marine life in marine debris including a comprehensive list of species with entanglement and ingestion records. In J. M. Coe & D. B. Rogers (Eds.), Marine Debris: Sources, Impacts, and Solutions (pp. 99–140). New York: Springer.
18. Lusher, A. L., McHugh, M., & Thompson, R. C. (2013). Occurrence of microplastics in the gastrointestinal tract of pelagic and demersal fish from the English Channel. Marine Pollution Bulletin, 67(1), 94–99.
19. Martinez, E., Maamaatuaiahutapu, K., & Taillandier, V. (2009). Floating marine debris surface drift: convergence and accumulation toward the South Pacific subtropical gyre. Marine Pollution Bulletin, 58(9), 1347–1355.
20. Mascarenhas, R., Santos, R., & Zeppelini, D. (2004). Plastic debris ingestion by sea turtle in Paraíba, Brazil. Marine Pollution Bulletin, 49(4), 354–355.
21. Maximenko, N., Hafner, J., & Niiler, P. (2012). Pathways of marine debris derived from trajectories of Lagrangian drifters. Marine Pollution Bulletin, 65(1), 51–62.
22. Moore, C. J. (2008). Synthetic polymers in the marine environment: a rapidly increasing, long-term threat. Environmental Research, 108(2), 131–139.

Improvement in Construction Quality on Use of Carbon Fiber

Manish Kumar[a], Dr. Sanjeev Gill[b]
[a]Assistant Professor Department of Civil Engineering, JBIT Dehradun,Uttarakhand (India)
[b]Professor & HOD Department of Civil Engineering, JBIT Dehradun, Uttarakhand (India)

ABSTRACT

Over the past few decades, our research and technical skills has increased a lot. Even today we are innovating and developing the new trends in technology in pursuit of a safe and sustained future as the innovation leads to invention. Throughout this evolution, engineers are in constant research for new and better building materials and carbon fiber is one of these materials, which is used with someother fibers and a specific polymer to form a high performance composite mixture. The aim of this research paper is to study the benefits of using carbon fiber in differenttypes of industry &this paper also overcomes the drawbacks of using other building materials. The amazing properties of carbon fiber such as high tensile strength, high stiffness, low weight & high resistance to chemical and temperature makes it one of the most popular materials in construction industry due to these properties it has enormous applications in military, medical science, construction, automobile, aircraft industry etc. It actually works as a robust building material. It produces the structure that possesses both flexibility and durability. It is incredibly strong that's why it can also withstand earthquakes. It is more flexible in wind than the regular structures. It is also listed in the top 20 engineering achievements of 20th century. It is definitely the next generation building material as it can replace steel in the many structures and can reduce its construction and maintenance cost.

Keywords: *Carbon fiber, building material, steel, polymer, tensile strength, stiffness.*

1.INTRODUCTION

A. HISTORY

In the 18th century, Thomas Edison carbonized cotton and bamboo to make filaments for his early incandescentlight bulbs.

In the late 1950s-ryan made high tensile carbon fiber and in early 1960s first and commercial and practical use of carbon fiber is made in aircraft which makes them lighterand faster due to the light weight and high stiffness of carbon fiber. During 1970's experimental work to find alternative raw materials led to the introduction of carbon fibers made from petroleum pitch derived from oil processing. Unfortunately they have only limited compression strength and were not widely accepted.

The 20th century saw a tremendous increase in the demand for carbon fiber. Threats to peace increased the demand for carbon fiber for defense purposes, mid- century.

By the beginning of 21st century, new applications and new market sent the production of carbon fibers on an upswing.

Despite a global downturn in 2008-2009, worldwide demand for carbon fiber increased up to 45,000 metrictons in 2010. According to the global market forecasts, the annual growth rate of carbon fiber is expected to be around 17% by 2017.

B. WHAT IS CARBON FIBER?

C.

a) METHODOLOGY

Carbon fiber is a composite mixture of fiber such as aramid, aluminum or glass fibers bound together by a polymer which is most often epoxy or may be polyester, nylon etc.

The raw material used to make carbon fiber is the precursor. About 90% of the carbon fibers produced are made from polyacrylonitrile (pan). The remaining 10% are made from rayon. All these materials are organic polymers having long strings bound together by carbon atoms. During the manufacturing of carbon fiber variety of liquids and gases are used and the process is part mechanical and part chemical. Each fiber is 5-10 micronsin diameter. Carbon fibers are 2 times stiffer than steel and has high tensile strength. In fact the carbon fiber might be the strongest material.

Carbon fiber is mostly used where the combination of high strength and light weight is required.5 steps of production of carbon fiber are shown in the figure.

b) **PROPERTIES OF CARBON FIBER:-**

c)

1. CARBON FIBER HAS HIGH SPECIFICSTRENGTH:
Strength of a material is the ratio of force per unit area at the failure to the density. Any material which is strong and light such as aluminum, titanium, carbon, glass etc. has always high specific strength. The strength to weight ratio of carbon fiber is much more than that of steel, aluminum, or glass fiber. Table showing the specific strength of various materials. The units are in KN.m/Kg.

2. CARBON FIBER IS ELECTRICALLY CONDUCTIVE:
This property of carbon fiber is both useful and bit harmful too. In construction of ships, this property comes into play. Carbon fiber's conductivity can increase the galvanic corrosion in electrical fittings but proper and careful installation can reduce this problem. Carbon fiberdust is also harmful, which can cause short circuit in electrical appliances.

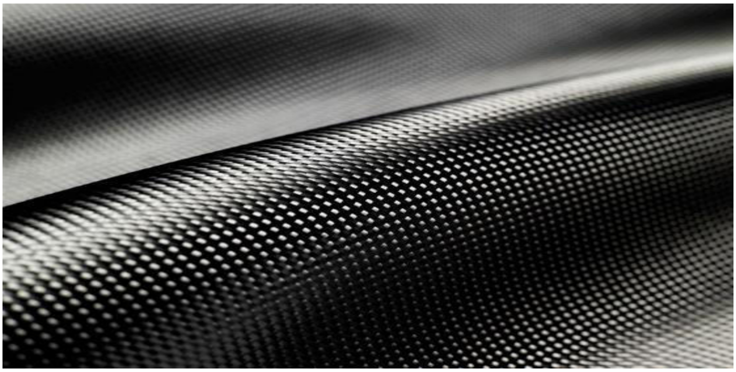
3. FATIGUE RESISTANCE IS GOOD:
Carbon fiber has a good resistance to fatigue. Carbon fibers when placed perpendicular to the direction of applied stress produced the most favorable condition of increased resistance to bending and to flexural fatigue. Resistance to fatigue greatly depends upon the orientation of fibers. Damage in tensile fatigue will lead to the reduction in stiffness with large no. of stress cycles.

4. CARBON FIBER HAS HIGH TENSILESTRENGTH:
Tensile strength is the maximum stress that a material can withstand safely while being stretched before failing. Carbon fiber does not losses its shape and dimensions on stretching. It is highly flexible and after stretching it regains its shape almost completely.

5.LOW COFFECIENT OF THERMAL EXPANSION: This is a measure of how much a material expands or contracts under the application of temperature when it goes up and down. As compared to steel, aluminum or glass, ithas comparatively low thermal expansion, which makes it ideal for applications where small movement can be critical.Table showing the thermal expansion of various materials. The units are in inch.

6.HIGH CORROSION RESISITANT:

Carbon fiber is chemically inert and stable. It does not corrode easily by the environmental factors such as temperature, humidity, moisture etc. although epoxy polymer used in carbon fiber is sensitive to light and needs protection.



CARBON FIBER IS VERY RIGID:

Rigidity or stiffness of any material is measured by its young modulus; it measures how much a material deflects under stress. Reinforced carbon fiber plastic is 4 times stiffer than glass and around 20 times stiffer than pine.

D. **APPLICATIONS OF CARBON FIBER:-**

1) CIVIL ENGINEERING:

Carbon fiber is used in several structural engineering applications due to its construction benefits and optimum cost. The applications include strengthening of structures made with concrete, steel, timber, cast iron etc. it can also replace steel due to its

high tensile strength and light weight. It is also used to increase the shear strength of old structures like bridges.

2) **INDUSTRIAL AUTOMATION & ROBOTICS:**

Carbon fiber reduces the motor and actuator loads and increases the response time. In the business of automation, where machines often run as fast as 24x7, carbon fiber reduces the inertial loads by replacing heavy metal components, which further reduces part fabrication time and which in turn increases the profit. In developed countries carbon fiber is used in making car's roof, alloys and other accessories

3) **AIRCRAFTS AND SPACECRAFTS:**

It is widely used in aircrafts and spacecraft components where its strength to weight ratio exceeds much more than that of any other material. It is applied in helicopters, gliders, flying jets where high strength and low weight is required. Carbon fiber increases the durability and lowers the maintenance cost.

4) SPORTS GOODS: -

It has wide applications in sports goods and equipments such as stiffening of shoes, hockey sticks, tennis racquets, golf balls etc. it is also to make helmets which act as a protector while playing games. It has high damage tolerance which can be very useful to save lives.

5) MILITARY: -

Military has various types of rough and tough equipments which are very hard and durable and act as a safeguard. Most of them are made from very strong materials like carbon fiber, examples- planes, tanks, missiles, helmets, soldier's personnel gear, machine guns, protective shield etc.

6) HOUSEHOLD APPLICATIONS: -

The applications of carbon fiber in home are far beyond our imagination starting from style, comfort, luxury or practical use. Carbon fiber is used in in bathtubs, coffee table, phone cases, pen stands, bow ties, chairs etc. The look of black carbon fiber is very attractive.

7) MEDICAL APPLICATIONS: -

Carbon fiber offers several applications to medical field. The most important is artificial limbs. It is alsoused in x-rays and appears black on x-ray images. It is also used to strengthen damaged ligaments in the knee. Carbon fiber is used for welfare equipment such as wheel chairs, care beds and portable slopes.

2. CONCLUSIONS

- Carbon fiber plates are very thin, strong, flexible and durable. They can be installed to provide the optimum cost solution and to give a sustainable future design.
- It has high tensile strength, high stiffness, low thermal expansion, high resistance to fire and corrosion than any other material like stainless steel, glass or aluminum thus making it one of the most important composite materials inindustry.
- The golden factor of carbon fiber is that it possesses strength up to 5 times than that of steel and weight one third to that of steel.
- It has enormous applications in civil engineering, medical field, sports, military,automobile and music industry.
- The history of carbon fiber in India is nearly of two decades. Though the technology has been developed mainly in defense and aerospace, its foray into other industrial sectors is only a matter of time. In India there is a complicated situation between either to reduce the production cost of carbon fiber or increase its fiber properties. But challenges like cost reduction, tensile and compressive strength improvement and alternative precursordevelopment still remain.

REFERENCES

1. Mohit Sharma – "Influence of fiber matrix adhesion and operating parameters on sliding wear performance of carbon fiber composites" vol.271 (2012)
2. S.Y Park – "Effect of vacuum thermal exposures on carbon fiber composites for low earth applications" vol.43 (2011)
3. Robert T. – "The carbon fiber industry: global market evaluation 2006-2010"
4. Chung, D.L carbon fiber composites, 1994
5. Edie D.D, the effect of processing on the structure and properties of carbon fibers

Impact of Surge on Water Supply System: A Sensitivity Study

Anil Kumar[a] ,Dr.sanjeev Gill[b]

[a]Assistant Professor Department of Civil Engineering JBIT, Dehradun (U.K)
[b]HOD Department of Civil Engineering JBIT, Dehradun (U.K)

ABSTRACT

The work that is being done now is comparable to the sensitivity analysis of surge analysis of water supply mains that was completed in the past. From the Narwana Branch to the canal water Pump House at Ismailpur and all the way up to the canal-based water works in Ambala city, a 1000mm DI K-9 water supply rising main has been installed. This work was done in the initial portion. The remainder of the pipeline, which is 14.3 kilometres long, was installed as a rising main from the canal pump house to the canal based work. The section of the pipeline that travelled from Narwana Branch to the pump house was laid using gravity. In a previous analysis, three different pumps with a discharge of 0.999 cumec were tested, and the results showed that the pipe thickness conformed to IS 8329: 2000 (re-affirmed 2005), which is the Indian Standard for Centrifugally Cast (Spun) Ductile Iron Pressure Pipes for Water, Gas, and Sewage – Specification (Third Revision). In this investigation, another test was carried out using 4 different pumps, each of which had a discharge of 1.332 cumec; the results of this test demonstrated that the pumps were dangerous. The analysis that deals with pumping mains was prepared according to the design and hydraulic data that was available as well as the guidelines provided by the Central Public Health and Environmental Engineering Organisation (CPHEEO). The findings can be found in an excel file created in Microsoft.

Keywords*:* surge analysis, Water Supply, hydraulic data

INTRODUCTION AND LITERATURE

Water hammer (or hydraulic shock) is the momentary increase in pressure inside a pipe caused by a sudden change of direction or velocity of the liquid in the pipe. Water hammer can be particularly dangerous because the increase in pressure can be severe enough to rupture a pipe or cause damage to equipment. A common instance of water hammer could be observed by turning off a shower instantaneously. The action emanating as a result of water hammer or surge sends a loud thud through the house. This can cause loosening of joints and bursting of pipelines if the pressure is high enough.

Lingireddy, et al. [1] carried out the analysis of pressure surge in pipeline system resulting from air releases. In their research, they noted that since air valve are integral parts of a long pipeline passing through elevations. Pressure surge propagation is quite inevitable. Pressure surge will occur due to the release of air accumulated in a pipeline in the course of transmission. But the effect of this would be reduced to a minimum if proper sized surge suppression device like orifice plate is installed in the system. The work specifically considered the pres- sure reduction in a pipeline system when a 12.5 mm orifice was installed in pipeline compared to a 75 mm ori-fice also installed. The pressure surge when a 12.5 mm orifice plate was installed reduced to about 30 meter of water while the pressure when a 75 mm orifice was in-stalled was still as high as 168 meters of water from a surge pressure of 210 meters of water.

1 APPURTENANCES

The rising main is to be designed for surge analysis manual. These are some essential protection devices used in the analysis, described below:

Air Valve:

Air valves are fitted to release the air automatically when a pipeline is being filled and also to permit air to enter the pipeline when it is being emptied. Additionally, air valves have also to release any entrained air, which might be accumulated at high points in the pipeline during normal operations Without air valves, vacuum may occur at peaks and the pipe could collapse or it may not be possible to drain the pipeline completely.

Zero Velocity Valve:

Zero velocity valves are special type of spring-loaded non-return valves intended for upsurge control. The valve closure occurs gradually with the reduction in velocity following power failure, resulting in full closure at zero velocity. The springs are designed in such a manner that the valve remains full open when 25% of designed velocity is achieved. In case of closure of pump, disc starts closing in relation to decrease of velocity and fully closes when velocity drops near to zero. Thus upstream water column is prevented from creating water hammer wave. The Zero velocity valves are usually provided with bypass which allows a small amount of reverse flow. Bye pass arrangement keeps pressure balance on both sides of disc. It also prevents creation of vacuum in downstream side.

Butterfly Valve:

Valve shaped like a butterfly. Butterfly valve used to regulate and stop the flow spatially in case of large conduits. Optimal for automated operation with a low operating torque and 90 degree operating angle. These valve have little resistance to flow (allow smooth flow).They are sometime cheaper than sluice valve for large sizes and occupy large space. Butterfly valve with no sliding part have the advantage of ease of operation, compact size, reduced chamber valve house and improve closing and retarding characteristics.

Check Valve:

Check valves, also called non-return valves or reflux valves, automatically prevent reversal of flow in a pipeline. They are particularly useful in pumping mains when positioned near pumping stations to prevent backflow, when pumps shut down. The closure of the valve should be such that it will not set up excessive shock conditions within the system.

Gate Valve:

Gate valves are the normal type of valves used for isolating or scouring. They seal well under high pressure and when fully open, offer little resistance to fluid flow. Long stroke requires time to open andclose, not suitable for quick operation.

2 STUDY AREA

The present work is surge analysis of water transmission main in the city of Ambala. The pipe line had been designed for providing water from Narwana Branch to canal water Pump House Ismailpur and up to canal based water works, Ambala city.

The raw water outlet connection of canal based water supply scheme Ambala city was from Pinjokhra minor which generally runs for 15 days during running period of canal and remains closed for next 15 days of the month due to which a great problem was faced by Public Health Engineering Department to provide sufficient water supply to the inhabitants of Ambala city during the closer period of canal. The NSL at Ismailpur is 256.79m whereas at canal based water works is 268.64m. The inlet pipe to receiving chamber is approximately 3.5m.

Existing Coveyance System:

The pipe parameters are as follows

i. Total length of the total pipeline =14km
ii. Diameter of pipe = 1000 mm
iii. Material of the pipes= Ductile Iron(DI) Pipes
iv. Specification of pipes = K9 pressurepipe

Longitudinal Profile:

Figure given below has been drawn from the data given in the level book, source: PWD PHE Division, Haryana, Ambala City.

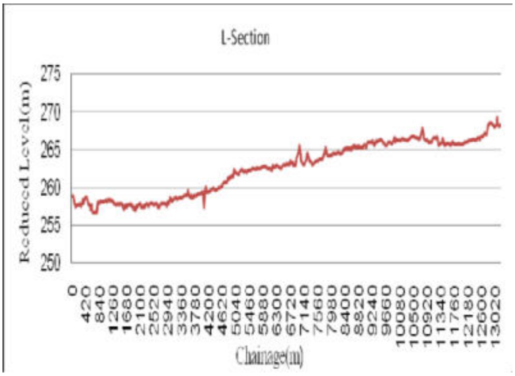


FIGURE 2. TOPOGRAPHICAL DETAIL OF THE PUMPING MAIN AREA

3 METHODLOGY

The calculation has been done manually and with the help of Hazen Williams Formula, taken from CPHEEO Manual. All the data is given by PWD PHE Division, Haryana, Ambala City.

Data Given:

Discharge of Single Pump (40m Head) Q_1 = 20,000LPM = 0.333 cumec

Earlier analysis has been done for 3 no. of pump andin this analysis we have increase one no. of pump, so No. of Pumps running at a time = 4

Total discharge (Q) = 4 x 0.333= 1.332 cumec

Internal Diameter of DI K9 Pipe =1.009m Area of cross section of DI K9 Pipe (A)= 0.799m^2

Normal Velocity of flow (V_o) = Q/A

= **1.66708 m/s**

FIGURE 1. LOCATION OF AMBALA CITY

Calculation:

As per Central Public Health and Environmental Engineering Organization (CPHEEO) Velocity ofpressure wave (C) = 1425/ | | {1+(kd/EC$_t$)}

Where, k = bulk modulus of water= 2.07 x10^8kg/m^2

D = diameter of pipe

= 1.009m (given)

C_t =Wall thickness of pipe

= 0.0135m (As per IS 8329:2000)

E = Modulus of Elasticity of Pipe Material

= 1.7 x 10^{10} kg/m^2

Velocity of pressure wave (C) = **1031.073m/s**

Internal Pressures:

Maximum Pressure rise in the closed conduit abovethe normal pressure (in m) as per CPHEEO Manual:

H_{max} = C V_o/g = (1031.073 x 0.8335)/9.81

= **87.68 m**

Static Head = **11.85 m**

Residual Head = **3.5 m** C_f value = 140

C values ranges from 90 to 140 depending on the diameter and velocity.

By Hazen Williams formula for frictional head

Frictional Head (H_f) = [Q x 10^9/(7.436 x C x $d^{2.63}$)]$^{1.852}$ x L = **7.16 m**

Total Head H = 87.68 + 11.85 + 3.5 + 7.10= **110.13**

Outside diameter of DI K9 pipe (as per IS 8329:2000)	1.048	m
Wall thickness ofpipe as per IS 8329:2000 (C_t)	0.0135	m
Area of cross section (A)	0.799193585	Sqm
Normal velocity inpipe line before sudden closure (V_0) as per CPHEEO manual	**1.25**	**m/s**
Velocity of pressure wave, C = 1425 / $\sqrt{1+(kd/EC_t)}$		
Bulk Modulus ofWater (k)	2.07E+08	kg/m^2
Internal Diameter ofpipe (d)	1.009	m
Wall Thickness (C_t)	0.0135	m
Modulus ofElasticity of Pipe Material (E)	1.70E+10	kg/m^2
Velocity of pressurewave (C)	**1031.072643**	**m/s**
Internal Pressure		
E Maximum rise in R pressure in the closed conduit above normalpressure (as per CPHEEO manual)= $V_0 x C / g$	**131.5128735**	m
Static Head	**12.85**	m
Residual Head	**3.5**	m

RESULTS

Following results has been drawn in tabular form.

TABLE-1: DETAILED CALCULATION SHEET INCLUDINGDESIGN PRESSURE CONDITIONS

Frictional Head, H_f =[Qx10^9/(7.436xC$_f$ xd$^{2.63}$)]$^{1.852}$xL when 4 pump is working		
Q x 10^9	1.152E+11	
C_f	140	
$d^{2.63}$	79475591.2	
L	14	km
Frictional Head	**25.88240831**	m
Friction due to fixtures (10% of Frictional Head)	**2.588240831**	
Total Head	176.3335226	m
Design Pressure Conditions as per CPHEEO Guidelines		

TABLE-2: FOURTH TRIAL WHEN TOTAL DISCHARGE IS 1.332CUMEC

Surge Analysis for DI K9 Pipe		
Discharge of Single pump	0.333333333	Cumec
No. of pumps	**4**	Nos
Total discharge (Q)	1.33332	Cumec
Length of Pipe (L)	14	Km
Internal dia of DI K9 pipe (as per IS 8329:2000)	1.009	m
1.5 times maximum sustained operating head	67.23097371	m
1.5 times maximum pipeline static head	24.525	m
Sum of maximum sustained operating head and maximum surge head	176.3335226	m
Sum of maximum pipeline static head and maximum surge head	147.8628735	m
Design Pressure (Maximum o fabove)	**176.3335226**	**m**
rounded up value	177	m
in kg/cm2	17.7	kg/cm2
in Mpa	**1.73637**	**Mpa**
Design Equation as per ISO 10803 for thickness calculation of DI pipes		
t1=[p(D-t1)SF]/(2Rm)		
Internal Pressure (p in Mpa)	1.48131	Mpa
Safety Factor (SF)	2.5	
Minimum tensile strength (Rm)	420	MPa
Outside Diameter of pipe (D)	1048	mm
Minimum thickness required (t1)	**4.599996604**	**mm**
Check with Ct	Unsafe	>13.5mm

After three trials fourth trial has been made for 4 no. of pump and minimum thickness has been unsafe for
1.332 cumec discharge, while it is safe for 0.999 cumec discharge.

RECOMMENDATIONS

4 Manual on Water Supply and Treatment (Third Edition)

For release of air only 1:12
For admission as well as release of air 1:8
Recommended sizes as per this criteria fall between 80mm and 125mm. an optimum 100mm size may be adopted. One number zero velocity valve is to be placed on the headed pipe just after the pump house. More than one valve may be provided on the same line to improve the reliability of arrangement. Butterfly valves are required for isolating or regulating flow in a pipeline. Since in this case, it is a single rising main with no branches, the decision to provide this (these) valve(s) is left to the Engineer-in- Charge. However, if these valves are to be provided, the following factors may be duly considered. The valve(s) should divide the total pipeline into appropriate segments. Ease of approach for operation.

7 CONCLUSIONS

In a previous investigation, a DI 1000 K9 pipe was constructed in accordance with the design and hydraulic data that was readily available. It was determined that the discharges from the 1000mm pipe line were safe at 0.999 cumec, but after doing sensitivity analysis, it was determined that it was not safe for discharges of 1.332 cumec when employing 4 numbers of pumps simultaneously. The calculated pressures at the discharge of the pumps while running one, two, three, and four pumps including the surge pressure are approximately 15 kg/cm2, 15.6 kg/cm2, 16.5 kg/cm2, and 17.7 kg/cm2 respectively. These pressures are lower than the 36 kg/cm2 pressure that is recommended by IS 8329:2000 as the Maximum allowable pressure including surge.

REFERENCES

1. Ductile Iron Pressure Pipes for Water, Gas and Sewage – Specification (Third Revision). Modi P.N. and Seth S.M. Hydraulics and Hydraulic Machines, S.B.H Publishers, Delhi 2000.

2. PWD PHE Division Haryana, Ambala City. Rajeshwari Raj Thesis,2013, "Design Of Surge Protection System For Water Supply Scheme In Una(HP)".

Preparedness for the Production of Rainwater

Dr.Sanjeev Gill[a], Seema Rani[b]

[a] Professor, Deptt.of Civil Engineering, JBIT Dehradun, Uttarakhand (India)
[b]Assistant Professor, Deptt.of Civil Engineering, JBIT Dehradun, Uttarakhand (India)

ABSTRACT

Rainwater harvesting is the process of collecting and storing rainwater for later use, prior to the rainwater's infiltration into the earth and rendering it unusable. This water source has been used to provide drinking water for people, water for cattle, and water for the irrigation of crops. The water supply can be supplemented with rainwater that has been collected from structures such as homes, tents, and community facilities. The term "storm water harvesting" refers to the practise of collecting water from the ground, which typically takes place in areas that have been particularly developed for the purpose of collecting water in this manner. R drinking water Rainfall could be the sole source of potable water that is either readily available or affordable in certain areas. Rainwater harvesting systems are not only inexpensive and simple to construct, but they are also readily available in the majority of locations where people live. As a result, almost anywhere that people reside might stand to gain from installing one.

Keywords *- rainwater, collection, aquifer, treatment, drinking water*

1. INTRODUCTION

Rainwater collected from rooftops often has a high quality and often does not need to be treated before being consumed. Even though some roofing materials can cause rainwater to contain contaminants that are hazardous to human health, rainwater can still be put to beneficial uses such as flushing toilets, washing clothes, watering the garden, and washing cars; these four activities alone can reduce the amount of water that is required to maintain a typical household by half. Rainfall catchment systems for homes are a viable option in regions that receive an annual rainfall totalling more than 200 millimetres (7.9 inches) on average but have no other readily available water resources (Skinner and Cotton, 1992). In a process known as groundwater recharge, overflow from rainwater harvesting tank systems can be utilised to refill aquifers. Although this is a similar operation, it is important to note that rainwater harvesting should not be mistaken with groundwater recharge.

2. BASIC CONFIGURATION

Rainwater harvesting systems channel rainwater that falls on to a roof into storage via a system of gutters and pipes. The first flush of rainwater after a dry season should be allowed to run to waste as it will be contaminated with dust, bird droppings etc. Roof gutters should have sufficient incline to avoid standing water. They must be strong enough, and large enough to carry peak flows. Storage tanks should be covered to prevent mosquito breeding and to reduce evaporation losses, contamination and algal growth. Rainwater harvesting systems require regular maintenance and cleaning to keep the system hygienic. Around the world Currently in China and Brazil, rooftop rainwater harvesting is being practiced for providing drinking water, domestic water, water for livestock, water for small irrigation and a way to replenish ground water levels. Gansu province in China and semi-arid north east Brazil have the largest rooftop rainwater harvesting projects ongoing. In Rajasthan, India rainwater harvesting has traditionally been practiced by the people of the Thar Desert. In Bermuda, the law requires all new construction to include rainwater harvesting adequate for the residents. The U.S. Virgin Islands have a similar law. In the Indus Valley Civilization, Elephanta Caves and Kanheri Caves in Mumbai rainwater harvesting alone has been used to supply in their water requirements. In Senegal and Guinea-Bissau, the houses of the Diola -people are frequently equipped with homebrew rainwater harvesters made from local, organic materials. In the United Kingdom water butts are often found in domestic gardens to collect rainwater which is then used to water the garden. However, the

British government's Code for Sustainable Homes encourages fitting large underground tanks to new-build homes to collect rainwater for flushing toilets, washing clothes, watering the garden and washing cars. This reduces by 50% the amount of mains water used by the home. In the Myanmar, the groundwater is saline and communities rely on mud-lined rainwater ponds to meet their drinking water needs throughout the dry season. Some of these ponds are centuries old and are treated with great reverence and respect.

Until 2009 in Colorado, water rights laws almost completely restricted rainwater harvesting; a property owner who captured rainwater was deemed to be stealing it from those who have rights to take water from the watershed. Now, residential well owners that meet certain criteria may obtain a permit to install a rooftop precipitation collection system. Up to 10 large scale pilot studies may also be permitted).The main factor in persuading the Colorado Legislature to change the law was a 2007 study that found that in an average year, 97% of the precipitation that fell in Douglas County, in the southern suburbs of Denver, never reached a stream-it was used by plants or evaporated on the ground. In Colorado you cannot even drill water well unless you have at least 35 acres. In New Mexico, rainwater catchment is mandatory for new dwellings in Santa Fe.In Australia rainwater harvesting is typically used to supplement the reticulated mains supply.

3. NEED FOR WATER HARVESTING

Water is an important natural resource and is the very basis of our life. We use water for drinking, irrigation, industry, transport and for the production of hydro-electricity. Water is a cyclic resource which can be used again and again after cleaning. The best way to conserve water is its judicious use. Rain water harvesting is one of the most effective methods of water management and water conservation. It is the term used to indicate the collection and storage of rain water used for human, animals and plant needs. It involves collection and storage of rain water at surface or in sub-surface aquifer, before it is lost as surface run off. The augmented resource can be harvested in the time of need. The collected water is stored and pumped in a separate pipe distribution. This is a very useful method for a developing country like India in reducing the cost and the demand of treated water and also economising the treatment plants operation, maintenance and distribution costs.

The scarcity of water is a well-known fact. In spite of higher average annual rainfall in India (1,170 mm, 46 inches) as compared to the global average (800 mm, 32 inches) it does not have sufficient water. Most of the rain falling on the surface tends to flow away rapidly, leaving very little for the recharge of groundwater. As a result, most parts of India experience lack of water even for domestic uses. Surface water sources fail to meet the rising demands of water supply in urban areas; groundwater reserves are being tapped and over-exploited resulting into decline in groundwater levels and deterioration of groundwater quality. This precarious situation needs to be rectified by immediately recharging the depleted aquifers. Hence, the need for implementation of measures to ensure that rain falling over a region is tapped as fully as possible through water harvesting, either by recharging it into the groundwater aquifers or storing it for direct use.

4. SCIENCE OF WATER HARVESTING

In scientific terms, water harvesting refers to collection and storage of rainwater and also other activities aimed at harvesting surface and groundwater, prevention of losses through evaporation and seepage and all other hydrological studies and engineering inventions, aimed at conservation and efficient utilization of the limited water endowment of physiographic unit such as a watershed. Rain is a primary source of water for all of us.

There are two main techniques of rainwater harvesting:

- Recharge to groundwater.

- Directly collected rainwater can be stored for direct use or can be recharged into the groundwater.

All the secondary sources of water like rivers, lakes and groundwater are entirely dependent on rain as a primary source.

The term water harvesting is understood to encompass a wide range of concerns, including rainwater collection with both rooftop and surface runoff catchment, rainwater storage in small tanks and large-scale artificial reservoirs, groundwater recharge, and also protection of water sources against pollution. The objective of water harvesting in India differs between urban and rural areas. In urban areas, emphasis is put on increasing groundwater recharge and managing storm water. On the other hand, in rural areas securing water is more crucial. There the aim is to provide water for drinking and farming, especially for life-saving irrigation, and to increase groundwater recharge.

5. Methods of Rainwater Harvesting

Broadly there are two ways of harvesting rainwater

- Surface runoff harvesting
- Roof top rainwater harvesting

Rainwater harvesting is the collection and storage of rainwater for reuse on-site, rather than allowing it to run off. These stored waters are used for various purposes such as gardening, irrigation etc. Various methods of rainwater harvesting are described in this section.

Surface runoff harvesting

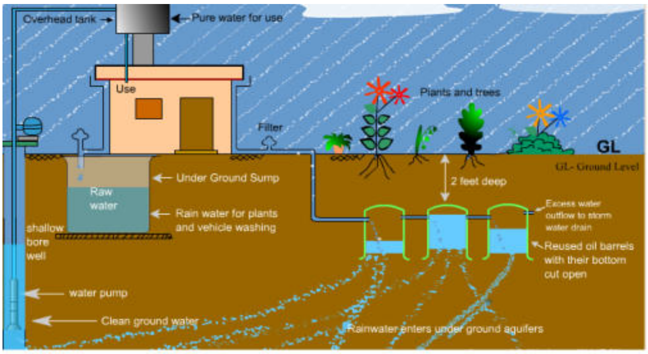
In urban area rainwater flows away as surface runoff. This runoff could be caught and used for recharging aquifers by adopting appropriate methods.

Rooftop rainwater harvesting

It is a system of catching rainwater where it falls. In rooftop harvesting, the roof becomes the catchments, and the rainwater is collected from the roof of the house/building. It can either be stored in a tank or diverted to artificial recharge system. This method is less expensive and very effective and if implemented properly helps in augmenting the groundwater level of the area.

6. ROOFTOP / RUNOFF RAINWATER HARVESTING FOR ARTIFICIAL RECHARGE TO GROUND WATER

Water harvesting is the deliberate collection and storage of rainwater that runs off on natural or manmade catchment areas. Catchment includes rooftops, compounds, rocky surface or hill slopes or artificially prepared impervious/ semi-pervious land surface. The amount of water harvested depends on the frequency and intensity of rainfall, catchment characteristics, water demands and how much runoff occurs and how quickly or how easy it is for the water to infiltrate through the subsoil and percolate down to recharge the aquifers. Moreover, in urban areas, adequate space for surface storage is not available, water levels are deep enough to accommodate additional rainwater to recharge the aquifers, rooftop and runoff rainwater harvesting is ideal solution to solve the water supply problems.



POTENTIAL AREAS

- Where ground water levels are declining on regular basis.
- Where substantial amount of aquifer has been de-saturated.
- Where availability of ground water is inadequate in lean months.
- Where due to rapid urbanization, infiltration of rain water into subsoil has decreased drastically and recharging of ground water has diminished

7. ADVANTAGES OF RAINWATER HARVESTING

- To meet the ever increasing demand for water. Water harvesting to recharge the groundwater enhances the availability of groundwater at specific place and time and thus assures a continuous and reliable access to groundwater.

- To reduce the runoff which chokes storm drains and to avoid flooding of roads.
- To reduce groundwater pollution and to improve the quality of groundwater through dilution when recharged to groundwater thereby providing high quality water, soft and low in minerals.
- Provides self-sufficiency to your water supply and to supplement domestic water requirement during summer and drought conditions.
- It reduces the rate of power consumption for pumping of groundwater. For every 1 m rise in water level, there is a saving of 0.4 KWH of electricity.
- Reduces soil erosion in urban areas
- The rooftop rainwater harvesting is less expensive, easy to construct, operate and maintain.
- In saline or coastal areas, rainwater provides good quality water and when recharged to ground water, it reduces salinity and helps in maintaining balance between the fresh-saline water interfaces
- In Islands, due to limited extent of fresh water aquifers, rainwater harvesting is the most preferred source of water for domestic use.
- In desert, where rainfall is low, rainwater harvesting has been providing relief to people.

8. CONCLUSION

This water collection system is becoming more common since it helps farmers increase their income. The system is vulnerable, and in really dry years, crop failure cannot be avoided without external assistance. Hydrological research is needed to fully comprehend the robustness of the ground water system. The local population has extensive experience with the technology, but the younger generations will require education to fully grasp the issue. To augment human activities that do not involve consumption, such as irrigation, rainwater collection is a viable option. A rainwater collecting system's efficiency as a supplementary source to municipal water supply grows in direct proportion to the region it serves. Commercial zones with many huge buildings and storage facilities would benefit greatly from the technology. In addition, the reduced amount of lawn space at these places means that the water can be put to better use elsewhere.

REFERENCES

1. Behzadian, k; Kapelan, Z (2015). "Advantages of integrated and sustainability-based assessment for metabolism based strategic planning of urban water systems". Science of The Total Environment. Elsevier. 527-528: 220–231.

2. Zhu, Qiang; et al. (2015). Rainwater Harvesting for Agriculture and Water Supply. Beijing: Springer. p. 20. ISBN 978-981-287-964-6.

3. Everson C, Everson TM, Modi AT, Csiwila D, Fanadzo M, Naiken V, Auerbach RM, Moodley M, Mtshali SM, Dladla R (2011). Sustainable techniques and practices for water harvesting and conservation and their effective application in resource-poor agricultural production through participatory adaptive research : report to the Water Research Commission.

4. Jyotiba B.Gurav and D.G. Regulwar (2013) “Rainwater Harvesting – A Case Study”, Sustainable Water Resources Development and Management, pp. 179-183.

5. S.N. Kalia (2013) “Rainwater Harvesting – A Case Study Catch Water where it Falls”, Sustainable Water Resources Development and Management, pp. 153-159.

6. Ranjit Kumar Sharma, ‘Rainwater Harvesting at N.I.T. Rourkela ’, Department Of Civil Engineering, National Institute of Technology, Rourkela 2010.

7. M. Dinesh Kumar, Ankit Patel and O.P. Singh IWMI-TATA Water Policy Program, Hyderabad, India Benaras Hindu University, Varenasi, India.

A Review Report on Tensile Properties and Bending Performance of Hybrid Composite Reinforced Ferro Cement

Bhaskar Singhal[a], Manish Kumar[a]

[a] Assistant Professor, Deptt. of Civil Engineering, JBIT Dehradun, Uttarakhand (India)

ABSTRACT

Reinforced with hybrid fibres Bending and tensile tests were performed on samples of ferro cement. In this research, we provide hybrid composites, which incorporate the advantages of many reinforcement types. Numerous hybrid composites were the subject of extensive study. The tensile and bending strengths reported in these several experiments are inconsistent with one another. Hybrid fiber's addition to Ferro cement is widely sought after because of the material's improved tensile strength, increased ductility, and strain hardening properties. Maintaining affordable building expenses in developing nations where basic building supplies are in short supply. This is the primary reason why finer materials do not increase the packing density. Increasing packing density and toughness is especially useful for applications involving safety structural parts that require ultra-high performance.

Keywords- *Ferro cement, Hybridization, Bending Properties, Tensile strength.*

---

1. INTRODUCTION

The use of wire meshes and a concrete binder that contains larger aggregate sizes is the primary distinction between regular concrete and reinforced concrete, despite the fact that reinforced concrete is the most common type of construction material on the planet. A material known as ferrocement has an extremely thin wall and is frequently used in the building industry. It is made up of hydraulic cement mortar and wire mesh that is tightly packed together. The mesh might be made out of metal or any other material that is suited for the job. Ferrocement is gaining popularity as a material for the construction of more complicated architectural structures such as domes, curved building components, water tanks, and even boats due to the material's adaptability. The use of ferrocement in construction and maintenance of existing structures is possible. A completely new category of material has been developed, one that is distinct from conventional types of reinforced concrete in terms of its qualities (strength, deformation, and possible applications). It is possible to produce thin panels or sections using only a thin coating of mortar as the covering for the uppermost layers of reinforcement. Because there has not been as much research done on ferrocement materials and how they should be utilised in structures, conventional reinforced concrete materials are utilised more frequently as load-bearing elements than ferrocement materials. This is mostly due to the fact that ferrocement materials are not as strong as conventional reinforced concrete materials. The problems of durability and corrosion that ferrocement faces are extremely important to its overall success. According to this description, a hybrid fibre is a type of synthetic fibre that is constructed using both micro and macro synthetic fibres.It is possible to break it down into the following permutations:.It is predicated on the fibre constitutive response, in which one of the fibres is more robust and rigid than the others. This results in a first-crack strength and an ultimate strength that are both more reasonable and robust. As a consequence of this, the post-cracking toughness and strain capacity are both improved when using the second type of fibre, which is more flexible. There is also the possibility of combinations depending on a variety of aspect ratios. In the case of fibre-reinforced concrete, the presence of short fibre bridges that span microscopic fractures not only limits the growth of the material but also delays its coalescence. Composites with long fibres have a higher fracture toughness than those with shorter strands because macro cracks do not have the opportunity to propagate.The process of hybridization involves the mixing of several types of fibres. Through the process of combining the fibres, it is possible to improve the properties of the concrete mix on a number of different levels. When compared to plain and single-fiber materials, the behavioural efficacy of this composite material is superior. In order to increase tensile strength, it has been suggested in earlier research that discontinuous fibres be incorporated into the material. The researchers are hoping that by utilising hybrid fibres, they will be able to improve the overall structural performance of ferrocement. The needs of a hybrid fibre ferrocement may only be ascertained by carrying out an exhaustive examination of the material. In order to categorise the behaviour of the composite, the first thing that has to be done is to conduct a series of tests using a technique that was developed specifically for categorising high-performance materials. Before something like this to take place, there needs to be a stress-strain link that possesses strain hardening properties.

MATERIAL DESCRIPTION

According to Naaman (2000), the definition of ferrocement has been expand

ed to include the stipulation that "the fineness of the mortar matrix and its composition should be suitable with the mesh and armature system it is supposed to encase." There is a possibility that the matrix will have discontinuous fibres. This definition was intended to emphasise the compatibility of the matrix with the reinforcement that is used to build a composite, as well as to present the opportunity to use discontinuous fibres or micro fibres to improve the mechanical performance of ferrocement as hybrid composites, should this become necessary. The form of hybrid reinforcement known as fibrous ferrocement has wire mesh as the primary reinforcement and mono fibre as the secondary reinforcement.

Since the publication of Naaman's study in 2000, there have been ongoing efforts to develop ferrocement as a high performance material or, as Naaman prefers to refer to it, a strain hardening material (Naaman 2007). Due to the interaction of fibres with wire mesh, ferrocement composites benefit from an increase in their structural qualities when fibre is used (Shannag and Bin Ziyyad 2007). Both mono (meaning only one kind) and hybrid (meaning both types) variants of the fibres can be utilised.Mechanical behaviour .By enhancing the mortar mixtures with the use of additives and fly ash as a partial replacement for cement, structural standards for ferrocement have been improved. This has led to an increase in the use of ferrocement (Arif et al. 2001). Altering the type of reinforcement used and the proportion of it used has also contributed to the improvement of ferrocement's characteristics.

Improvements In the Classification Of High Performance Cementations Composites

Today, several different types of cement-based composites are used in practical building applications, including the fabrication of structural parts. Because of this, it is essential to categorise the materials used in the construction of structures according to their performance. Because of material models and the material parameters that they relate to, structural engineering and materials engineering are now recognised as having a link between them. This reflects the behaviour of a material through its physical requirements, which direct its structural and mechanical behaviours. These behaviours include: (Stang and Li 2004). Compression strength, tensile strain behaviour, flexural response, toughness, and energy absorption are the features of cement-based composites that are significant for the classification of a material's performance. Other properties include flexural response. Because of the risk of failure caused by crashes in the compression zone, compressive strength is an essential property in the design of concrete (known as brittle failure). However, because FRCCs exhibit behaviour that is either quasi-brittle or strain-hardening, compression strength is not a relevant design criterion for these materials.

When the cement paste has reached a point where it is solidified, brittle failure behaviour can develop. At the first crack, which is no longer able to resist any stress, linear stress–strain behaviour is followed by an abrupt reduction of stress. On the other hand, failure in fibre concrete and a few other fibre-reinforced cementitious materials can be described as quasi-brittle. This results in a linear stress–strain behaviour, which is then followed by a softening behaviour. Strain-hardening materials, on the other hand, are defined by their capacity to withstand stress in a manner that is linearly inconsistent with their elastic behaviour. Almost immediately after achieving the first crack load, an increase in strain will take place due to the increasing levels of loading. This will result in substantial deformation.

When compared to brittle or quasi-brittle materials, the maximum strain value of a strain hardening material is often higher (Li 1997). A transition from quasi-brittle to strain hardening failure is only possible under conditions of'steady-state' cracking, which arises under two conditions: (1) the stress at the crack must equal the first crack peak; and (2) the crack opening displacement must be less than the fibre slip caused by the bridging stress. Cement structural specifications have been made to ensure that a transition from quasi-brittle to strain hardening failure is possible.Cement structural specifications have been made to ensure that a transition

According to EI Debs and Naaman, the addition of polyvinyl alcohol mono discontinuous fibre to ferrocement with only one layer of steel mesh but with various wire spacing results in better overall performance in terms of cracking behaviour, yield, and maximum strength than conventional ferrocement does. In another set of experiments, it was found that increasing the number of steel mesh layers from two to four in conjunction with a volume percentage of steel fibres in ferrocement ranging from 1.5 to 2 percent led to an increase in the strength of the material.

3. APPLICATION

The advantages of flexibility in the fresh casting stage and high ductility in the hard stage have made ECCs attractive for structural applications (Li 2008), including either on their own or in the form of a composite (hybrid) to support other structural materials. This includes applications where the ECCs are used to support other structural materials (Naaman 2007). It has been demonstrated that the one-of-a-kind characteristics of

ECCs as strain hardening cementitious composites (SHCCs) are capable of protecting structural elements constructed of RC from the damaging effects of an aggressive environment by narrowing the cracks that form in these elements (Maalej and Li 1995). Li et al. conducted research on the use of ECCs in concrete structures with the intention of repairing or retrofitting them (2000). According to the findings of the investigation, the use of ECCs is not limited to structures that are already in existence; rather, they are also suitable for protecting structures that have specific requirements, such as high impact resistance, crack width control, an aggressive environment, and a large damage tolerance.

Fischer (2010) had great success utilising stand-alone PVA–ECC panels in modular houses by employing them as floor slabs. The panel slabs that were put through their paces in the testing process had advantageous qualities such as relatively high flexural stiffness, ductility, maximum strength failure, and low cost.

The environmental benefits are in addition to the advantages brought about by the mechanical and economic aspects. This slab system is more appealing and sustainable thanks to the utilisation of waste materials as filler in the mixing matrix of the ECC floor slab. These waste materials may include FA or slag.

According to Li et al. 2004b, it is possible to create green ECCs for sustainable infrastructure in a variety of applications, such as pipelines, cement boards, electrical shafts, pavements, and as overlay systems in bridge decks (Zhanga and Li 2002).

4. MATERIAL DESCRIPTION

Because it offers the lowest coststrength ratio of all construction materials, concrete continues to be the most commonly utilised material. The issue with concrete is that it has a low tensile strength and behaves in a brittle manner. This causes failure and collapse fast after the first crack appears in the material. This issue, number 37, inspired researchers to study ways to improve the properties of concrete. Steel fibre-reinforced concrete, also known as SFRC, is a type of hybrid-reinforced cementitious material that was first developed in the early 1960s. The addition of steel fibre led to a considerable improvement in the tensile splitting strength, flexural strength, initial cracking strength, toughness, and impact resistance of the material. In addition to this, there was a decrease in fracture width, deflection, shrinkage, and creep (Tejchman and Kozicki 2010). ACI Committee 544 contains a set of guidelines that can be used for the design and specification of material properties (2002). As was mentioned before, the ASTM Standard (2011a) categorised FRC based on the type of fibre it was made of, including steel, glass, synthetic, and natural fibre.

The behaviour and qualities of mechanical systems

Flexural testing was used to undertake experimental investigations of steel fibre-reinforced beams with changing fibre content (Altun, Haktanir, and Ari 2007). The fibre content ranged from 0 to 60 kg/m3 of the beam's volume. Compression, elastic modulus, and toughness were some of the qualities that were mentioned. The findings showed that the increase in the fibre content did not cause a substantial decrease in the compressive strength, and the results showed that a capacity of good flexural strength could be attained by utilising 30 kg/m3 (1.25 percent volume fraction)

Shear testing were carried out on SFRC beams utilising a variety of stirrup configurations and fibre contents. Lim and Oh (1999) conducted an experiment, the results of which suggested that further shear reinforcement is not necessary in SFRC. However, other experiments revealed that a fibre volume percentage of 1.5 percent was sufficient to obtain excellent shear strength capacities (Juárez et al. 2007).

In order to investigate the tension stiffening and cracking behaviour of SFRC specimens with conventional longitudinal reinforcement, standard uniaxial tension tests are often carried out on these samples. There was reported to be an increase in the post-load yielding capacity, in addition to the development of various fracture forming behaviours. This was in comparison to the standard RC (Deluce and Vecchio 2013). Take note that the percentage of fibres present in the mixing matrix has a major impact on the FRC's capacity for withstanding tensile stress (Sujivorakul

2012). During tensile testing, synthetic FRC showed a crack behaviour that was comparable to that of natural FRC (Wang, Li and Backer 1990).

5.DURABILITY OF THE MATERIAL AND ITS APPLICATIONS

The application of a material in building is based, from a structural point of view, on the mechanical performance of the material as well as its durability. According to Li and Stang (2004), cementitious materials have a strong correlation between their structural level durability and their ductility. Corrosion can occur on steel rebars if there is not enough concrete covering them or if the permeability of the cracks that form around them is enhanced. The addition of fibre to concrete increases its resistance to cracking and narrows the cracks that do appear. When compared to conventional RC, there is an observed decrease in the permeability of concrete as well as an increase in the overall impact on the environment (Banthia and Bhargava 2007; Bentur, Diamond, and Berke 1997).

A durability performance evaluation of FRC in a hostile environment employing fractured fibre-reinforced shotcrete revealed difficulties with the material's durability as a result of sulphate and salt solution attack (Kaufmann 2014). According to the results of the test, environmental conditions very comparable to those seen in tunnel construction are present. It was demonstrated that steel fibres in cracks corrode, which leads to a loss of the structure's potential for residual strength. On the other hand, 39 uncracked samples demonstrated a higher level of resistance behaviour during a specified time period. In addition to this, it was found that polymer fibre had a greater level of durability in these kinds of conditions.

There are a number of different application possibilities made possible by the production of FRC using shotcrete or pre-casting procedures. Pipeline trench applications, sewage channel applications, tunnel lining applications, railroad track beam uses for high-speed trains, and precast concrete fence panel applications are some of the places that FRCs are put to use (Banthia et al. 2012). These are the broad applications of fibre reinforced concrete; constructions that are subjected to blast or impact loading are good examples of more particular applications of matrix-modified FRC. Bindiganavile, Banthia, and Aarup (2002), for instance, investigated the influence of impact load response on ultra-high-strength compact steel fibre reinforced concrete. The matrix was experimentally investigated under drop-weight impact load, and it contained Portland cement, SF (24 percent by weight of cement), and 6 percent steel fibre volume fraction (quasi-static loading). The material demonstrated three times the strength and energy absorption of regular FRC thanks to its unique composition. This demonstrates that as a result of the material's great resistance to impact, it is appropriate for use in strategically significant structures such as those associated with high-security or the military.

6. CONCLUSION

When performing the computational modelling, both the microscopic and the structural levels of detail were taken into account. One is able to reach the following conclusions by basing them on the findings that were presented in this section of the investigation:

• The results of the experiment that were done in order to ascertain the elastic modulus were corroborated, to some degree, by the FEM model that simulated the RVE (micro structural model) in order to compute the elastic modulus. According to the findings of the FE simulation, the values for the elastic modulus had moderately increased throughout the course of time. When compared to the findings of the experiment, the variances in the values that were acquired and those that were achieved via experimentation were less than 4%. This was determined by comparing the values that were obtained to those that were attained through experimentation.

• The application of the numerical model to the HFF panel while it was being treated to flexure gave remarkable results when compared with the experimental data using the elastic modules received from the nanoindentation test. These results were based on the fact that the numerical model was applied while the panel was being exposed to flexure. • The finite element modelling of the HFF–OWC slab demonstrated good composite action, and there were no symptoms of the slab fracturing as a result of horizontal shear transfer. This served as a strong indication that the elastic modulus that was empirically found is in good agreement with the FE model.

REFERENCES

1. Juárez, C. Valdez, P. Durán, A and Konstantin Sobolev. 2007. "The Diagonal Tension Behavior of Fiber Reinforced Concrete Beams." Cement and Concrete Composites 29 (5):402–408.
2. Ravichandran, A., Suguna, K. and Ragunath, P.N 2009. "Strength Modeling of HighStrength Concrete with Hybrid Fibre Reinforcement." American Journal of Applied Sciences 6 (2): 219–223.
3. Vandamme, M. and Ulm, F.-J 2009. "Nanogranular Origin of Concrete Creep." Proceedings of the National Academy of Sciences 106:10552–10557.
4. Vimonsatit, V. Wahyuni, Ade S. and Nikraz, N 2012. "Reinforced Concrete Beams with Lightweight Concrete Infill." Scientific Research and Essays 7 (14): 2370-2379.
5. Wahyuni, Ade S., Vimonsatit, V and Nikraz, N 2012. "Shear Behaviour of Ligthweight Sandwich Reinforced Concrete Slabs." Advances in Structural Engineering.
6. Wua, Min, Johannesson, B and Geiker, M 2012. "A Review: Self-healing in Cementitious Materials and Engineered Cementitious Composite as a Self-healing Material." Construction and Building Materials 28:571–583.

An Insight on the use of high-quality cement

Dr. Sanjeev Gill[a], Anil Kumar

[a] Professor, Deptt.of Civil Engineering, JBIT Dehradun, Uttarakhand (India)
[b]Assistant Professor, Deptt.of Civil Engineering, JBIT Dehradun, Uttarakhand (India)

ABSTRACT

Building is national pride. Per-capita cement and steel usage indicate a nation's development. Buildings have these two main parts. Concrete and Ordinary Portland Cement (OPC) are essential to life. Although there are many types of concrete designed for specific uses, these materials share several desirable qualities, including affordability, familiarity, versatility, strength, durability, wide availability, fire resistance, and weather resistance. Cement is growing rapidly worldwide, especially in India. Engineers must choose a good cement despite the many new brands. Many construction projects fail due to cement quality. This study discusses cement selection and strength classification. Cement quality control and consistency are vital. Selecting high-quality cement can help ensure project success.

1.INTRODUCTION

India produces second-most cement. Since its deregulation in 1982, the Indian cement industry has drawn substantial investments from Indian and global businesses. The cement business in India changed to fit government policy and manufacturing economics. Cement production rose from about 5 million tonnes in 1952 to over 54 million tonnes in 1993. Poor concrete structures arise from years of government control and escalating cement manufacturing prices. Due to the government's desire for massive infrastructure projects, India will need 45 million tonnes (MT) of cement in three to four years. India's cement demand would reach 550–600 MTPA by 2025. India's housing sector consumes 67% of cement. Infrastructure uses 13% of cement, commercial 11%, and industrial 9%. The cement business boomed after the government relaxed supervision in March 1982 and completely in March 1989. Cement manufacturers had to improve their quality to survive in a competitive market. After the 1980s, cement makers modernised their outdated plants.

2.**CHOOSING A SUPERIOR CEMENT**

Since there are various options available in market the consumer has a good option to select the product required. However, this process depends on the main factor of finance. With the financial constraints, the other factor to be considered is the specifications. It must be understood by the consumer that any good quality product is generally available at a higher price than a not so good quality product. It is therefore necessary for the consumer to know more about the benefits he gets when he selects a high-quality cement and how best he can put to use such benefits considering both technical as well as the economical aspects.

A high strength cement although preferable to a lower strength cement may not give a consumer the complete benefit until and unless it is giving consistently high strength with minimum variations. The high strength concrete if specified for any structure will also be more desirable from a durability point of view. It is often observed that low strength concrete is more vulnerable to environmental forces than high strength concrete but at the same time, high strength concrete too needs to be extremely carefully batched, mixed, transported, placed, compacted and cured. The durability requirements of the structure are as important, if not more, as the strength of the structure. A strong concrete may not result in high performance concrete if the durability requirements are not complied with.

Selection of high-quality cement can only mean a good beginning but it does not assure the consumer of a final product, which is the strong and durable concrete structure. However, selection of poor-quality cement or cement of inconsistent quality is like taking a wrong step right at the beginning and will certainly lead to the poor quality concrete structure if not a disaster.

3.CEMENTSTRENGTHCLASSIFICATION

The most common type of cement used in India is ordinary Portland cement (OPC) and has generally grades viz. 33, 43, 45 grade depending upon the 28 days compressive strength. IS: 10262-1982 gives us the recommended guidelines for concrete mix design, has generally classified the cement grade wise from A to F, depending upon 28 days strength as follows.

Table 1: Classification of Cement grades A to F as per IS: 10262-1982

Grade	Range of 28 days strength of cement (kg/cm^2)
A	325-375
B	375-425
C	425-475
D	475-525
E	525-575
F	575-625
*G	625-675

*It Has been introduced in view of higher-grade cement available in India However, it may note that some brands sold as 53-grade cement generally give 28 days strength of around 625 to 675 kg/Sq.cm and they can be classified even as G grade cement. However, most of the 53-grade cement available in the market generally falls in the category F or above and the 43-grade cement available in the market are generally in the category D. It must be ascertained either from the manufacturer or through laboratory tests the actual strength of the cement before it's use in the concrete mix design to get the maximum benefit of the additional strength and superior quality.

4.CEMENTSAVINGDUETOHIGHSTRENGTH

The relation between the free water-cement ratio (W/C) and concrete strength for different cement strengths (grades A to F) is given in fig. 2 page 8 of IS: 10262-1982. This figure is used to determine the W/C of the concrete mix for specified target concrete strength if the cement grade is known. The target concrete strength (fm) is calculated using the following equation fm=fck+ (t*s) where 'fck' is the specified characteristic strength, 't' is the statistical constant generally equal to 1.65 for the specified accepted proportion of low results of 1 in 20 (see table 2) and ‘s’ is the standard deviation, the values of which are selected depending on the degree of quality control expected under different site conditions (see tables 3 and 4).

Table 2: Value of ’t’ (IS: 10262-1982)

Accepted proportion of low results	Time
1 in 5	0.84
1 in 10	1.28
1 in 15	1.5
1 in 20	1.65
1 in 40	1.96
1 in 100	2.33

Table 3: Degree of quality control Expected (IS: 10262-1982) under different site conditions. Table 4: Recommended values of standard deviation IS: 10262-1982 standard deviation(s) for a different degree of control N/mm. Sq.

Grade of concrete (fm)	Very good	Good	Fair
M10	2	2.3	3.3
M15	2.5	3.5	4.5
M20	3.6	4.6	5.6
M25	4.3	5.3	6.3
M30	5	6	7
M35	5.3	6.3	7.3
M40	5.6	6.6	7.6
M45	6	7	8
M50	6.4	7.4	8.4
M55	6.7	7.7	8.7
M60	6.8	7.8	8.8
M10	2	2.3	3.3

From table 4 it can be seen that better quality control results in a lesser value of's' and 'fm' for same 'fck'. Therefore, cement consumption works out to be lower when the quality control is better. Hence, for concrete manufacture better quality control results in greater economy.

Table 5: Percentage saving as compared to 'A' grade cement

5. RECOMMENDATIONS TO IMPROVE DURABILITY USING HIGH STRENGTH CEMENT

However, the durability requirements as specified in IS 456- under revision must be satisfied depending on the various exposure conditions. From table 5 it is obvious that concrete manufactured using a higher grade of cement even after considering that lower grade cement may be marginally cheaper than the higher-grade cement.
Table 6: Requirement of durability as per IS: 456-2000. Maximum cement content, maximum water-cement ratio and a minimum grade of concrete for different exposures with normal weight aggregates of 20 mm nominal maximum size.

Note 1- Cement content prescribed in this is irrespective of the grades of cement and it is inclusive of Mineral Admixtures specifies in IS 456-2000. The additions such as fly ash or ground granulated blast furnace slag may be taken into account in the concrete composition with respect to the cement content and water-cement ratio if the suitability is established and as long as the maximum amounts taken into account do not exceed the limit of pozzolona and slag specified in IS 1489 (part 1) and IS 455 respectively.
Note 2- Minimum grade for plain concrete under mild exposure condition is not specified.

The figure below shows that F grade cement can be utilized for 200 kg/cm. Sq. Reinforced concrete in mild environment condition only while C to E grade cement can be used for mild or moderate environmental conditions. However, for high-performance concrete generally, it is very important to go for a higher grade of concrete (above M25 grade). If this concrete is made with high strength cement, then it will fetch both technical as well as a financial advantage. Table no. 7

shows the extent to which different grades of cement can be used for different environmental conditions and various grades of concrete. Water cement ratio vs Average 28 days' strength of cement in (kg/ cm.sq.) It is generally observed that even today the structural engineers and architects specify the M15 and M20 grade of concrete in the coastal area. This has already led to serious durability problems and low performance of concrete structures. M15 grade concrete can be achieved with W/C much greater than 0.55 if 43 and 53 grades of cement are used and since 33-grade cement has now virtually disappeared from the market. All M15 grade concrete structures in coastal areas are therefore bound to be a happy hunting ground for concrete rehabilitation agencies as is being observed at present. The durability problem is most likely to multiply several times if, at the specification stage itself, proper precautions are not taken. Even M20 grade concrete may not be the correct solution to the durability problem in the Urbanized/Industrialized coastal areas. Lower grades of concretes with the generally poor type of quality control prevalent are observed to be of very poor durability, needing of extensive repairs within a few years. As good quality cement are now available it is strongly recommended to go in for higher grades of concrete i.e. above M25 grade. This will improve the performance of the structures; prove more economical in most cases and in the process of achieving higher strengths it will automatically comply with the durability requirements.

6.CONSISTENCYOFCEMENTQUALITY

Concrete mix design (CMD) is one of the techniques to determine the most economic proportions of cement, sand, aggregates, water and other additives. However, after choosing the economic proportions of various materials any change in their physical or chemical property will lead to considerable variations in the desired cohesiveness, workability, strength and durability. The maximum impact is always due to variation in cement properties and therefore it is not only essential that cement should have good strength, proper fineness and correct setting time but it is also essential that the variation of its chemical and physical properties especially the strength and fineness should be minimal. The good quality in minimizing variations is now possible with proper quality control monitoring systems and modern sophisticated instrumentation control systems the cement manufacturers have installed in their modern up to date plants.

7.QUALITYCONTROLINCEMENTMANUFACTURE

While high strength is the indication of the good physical quality of cement, consistency of this high strength and other physical and chemical properties is an indication of good quality control and superior technology practiced by the cement manufacturing company. The quality control in the cement manufacturing plant starts from the inspection and testing of the limestone. Only after extensive testing for its CaO content, it is utilized, making sure that CaO content is uniform. The thoroughly crushed limestone powder is then stored in a stacker. It is reclaimed in vertical slices to get homogenous limestone, which is then conveyed, to the vertical ball mill, which ensures uniformly crushed limestone. After this, homogenization of the limestone is done in the blending silo by means of aeration. Thereafter homogenized materials are passed through series of suspension preheaters and are fed into the kiln for the production of clinker. Hourly samples of clinker are taken and tested to assure uniformly of quality. On line X-ray analyzers' help in ascertaining the variations in compound compositions of the cement so that immediate action can be taken to improve the quality of the product if required. The clinker is then processed through closed circuit grinding. This ensures proper particle size distribution. A device called high-efficiency cyclonic separator, which controls the grinding process right down to the specific micron size required, does this. After initial grinding in the tube mill, the materials move into the high-efficiency cyclonic separator. The separator separates the ground particles into two streams. The airflow exerts an aerodynamic force and separates the finer particles (between 5 and 30 microns) from the oversize coarser particles (above 30 microns), which are influenced by centrifugal and gravitational forces. The coarse particles are collected into grit collection and brought for recirculation into the grinding process. The fine particles are removed from the air stream in high cyclones mounted symmetrically around the separator housing. This process assures that cement has the ideal surface area and the ideal proportion of particle size between 5 to 30 microns. This process guarantees the highest number of a particle between 5 to 30 microns to the extent of over 50%. Hourly samples are taken and tested to assure uniformity of quality. The consistency of particle size is checked using sophisticated particle size analyzers, which immediately indicate the grain size distribution. Adjustments required in cement productions, if any, can be controlled in the plant to obtain the optimum particle size distribution and thereby assure consistent quality. If cement has a large number of particles finer than 5 microns it tends to set quickly producing high early concrete strength without a corresponding increase later on. This cement is also more susceptible to moisture attack and hydrates fast resulting in unnecessary wastage. On the other hand, if cement possesses a large number of particles above 30 microns it takes longer time than normal to set and will also display low initial strength which increases at a later stage. The cement is then transferred to the packinghouse where it is packed in woven HDPE and 4 ply paper bags and transported to various stockiest and construction sites. The hourly samples are also collected from the packinghouse to check the quality. Daily tests for various chemical and physical properties are done and various parameters are recorded to study the monthly variations and to improve the product quality from time to time and thereby minimize variations.

7. NEED FOR CONSISTENCY OF QUALITY

Many do clearly not understand the importance of consistency of cement quality hence a small illustrative example is given below. Assume that three brands of cement say AA, BB and CC are available having identical mean strength for a particular month of manufacture, say 600 kg/cm. Sq. However, the standard deviations for these cement during the same month were different and therefore the characteristic strength of this cement and its grade are worked out as below. Hence from the above, it can be observed that cement having identical mean 28 days strength for the month can be classified as F, E or D based on the variations (standard deviation). It is therefore of prime importance to control these variations to the barest minimum so that the cement can be classified as a higher grade. It is generally observed that monthly standard deviation if ranging between 15 to 25 kg/cm. Sq. can be considered as a good control for cement manufacture.

8. FURTHER ECONOMIC BENEFITS OF HIGH-STRENGTH CONSISTENT CEMENT

Besides saving of concrete quantity and cement cost per cubic meter of concrete, there are several other advantage and savings due to the use of high strength cement. It is observed that the best advantage of specifying high strength cement is derived if, at the planning and design stage itself, high grades of concretes are specified. The higher-grade concretes may have a smaller cross-sectional area under identical conditions and thereby the quantity of concrete reduces considerably. The saving in concrete quantity can easily between 1% of 25% depending on the type of structural member, its layout and its function. However, in addition to this saving, higher grades of concrete will be less permeable and more durable than lower grades.

9. CONCLUSION

- The preservation of the reinforcing steel.
- Reduction in the amount of formwork required.
- A decrease in the total amount of finishing work, including plasteri ng, painting, and other similar tasks
- A general reduction in the amount of time and labour required for building.
- An expansion of the buildings carpeted surface.

REFERENCES

1. (IS: 8112-1989) 'Specification for 43 grade Ordinary Portland Cement' Bureau of Indian Standards, New Delhi.
2. (IS: 12269-1987) 'Specification for 53 grade Ordinary Portland Cement' Bureau of Indian Standards, New Delhi.
3. IS: 456 'Plain and reinforced concrete' Bureau of Indian Standards, New Delhi.
4. Punmia b.c."R.C.C.DESIGNS" laxmi publication (p) ltd.
5. Kumar sushil "Treasure of r.c.c. design" rajsons publication privt.ltd.6
6. Singh gurucharan ,singh jagdish " Theory &design r.c.c. structure standard publishers distributors

Safety and Technological Consideration for High-Rise Construction

Bhaskar Singhal[a], Manish Kumar [a]

[a]Assistant Professor, Deptt.of Civil Engineering, JBIT Dehradun, Uttarakhand (India)

ABSTRACT

With the continuous development of the world economy, construction technology is also becoming more mature, and high-rise buildings take on a new meaning, which greatly reflects the country's economic strength. The construction industry plays an important role in India. It is not only the center of industry, but also an integral part of the country's economy. The construction industry is based on civil engineering. At the same time, the safety of engineering and related technologies is an important factor determining the sustainable development of the construction industry. Therefore, this study aims to analyze safety issues and technologies in high-rise building construction using underground construction methods.

1. INTRODUCTION

In recent years, India's urbanization process has gradually progressed, and high-rise buildings are becoming more and more booming. Although construction technology is relatively mature, risk prevention measures still need to be improved.

Construction characteristics of high-rise buildings in civil engineering Excavation and processing of the foundation is difficult. Due to the nature of the high-rise building itself, it is tall and heavy. Compared to other low-rise buildings, it has a large wind load and is highly affected by earthquakes. Both the overturning moment and shear force are greater than those of other low-rise buildings. Therefore, in order to effectively avoid these hazards, a deep landfill depth is required to increase the anchoring effect and reduce the impact of earthquakes.

The construction period is longer. Looking at the current situation of high-rise construction, most of the currently completed skyscrapers are over 20 stories, and most of the floors use standard floors, which not only provides great convenience in construction, but also has sufficient construction area and is advantageous for floating operation. conditions can be created. However, due to the high floor and high requirements for indicators, a full feasibility study is required. Therefore, it takes at least three years to complete the construction of each high-rise building from initial research to completion, which increases the difficulty of construction due to increased experience in poor operating environments such as rainy and snowy days.

High level of technical difficulty. Due to the special characteristics of high-rise buildings, it is inevitable to adopt the deep foundation method, which has high requirements for concrete structures, high precision of operation processes, and difficult operations [1].

There is a lot to do. The high hazards of working at heights, the increased amount of vertical transport and the uncertainty of the high-altitude climate have made the work more difficult and presented challenges to the construction workforce. They are under tremendous physical and psychological strain which makes fire safety, communications and vertical transport more difficult.

SAFETY AND TECHNICAL PROBLEMS IN THE CONSTRUCTION OF HIGH-RISE BUILDINGSIN CIVIL ENGINEERING

Material and equipment problems

Load capacity is an important factor for the safety of high-rise buildings. There are two types of support structures. One is rebar reinforcement. The second is concrete. In high-rise buildings, the quality of concrete plays an important role in load-bearing capacity. The quality of concrete is affected by many factors including quantity and service life. Inaccurate usage times will degrade performance during deployment. The above problems are common and directly affect the stability of the building. Therefore, construction units and construction personnel must pay much attention to the quality of concrete [2].

Compared to low-rise buildings, high-rise buildings require more equipment for construction workers to complete a variety of tasks.

Skyscrapers have many floors and are tall, so many projects need to be completed with the help of specialized equipment. Due to the long construction period, the equipment must be operated for a long time or left outdoors for a long time, which may cause wear or corrosion of the equipment due to the weather. Both states have safety risks in construction. When equipment breaks down, it not only affects the construction schedule, but also causes economic losses and can lead to major safety accidents, threatening personal safety, especially in the case of large work equipment. Regardless of whether construction units, facility use, or employees place importance on the safety of equipment, equipment must be regularly inspected, repaired, and replaced for normal operation and smooth construction.

device use problems. The operation of equipment creates persistent noise and causes certain physical injuries to construction workers, as well as negative emotions, and these negative emotions can be directly expressed at work, including cutting corners. Additionally, the upcoming construction period may require workers to work overtime, doubling machine uptime and accelerating equipment loss. The normal operation of the device cannot be guaranteed, increasing the possibility of security incidents.

2. IMPROPER ARRANGEMENT OF CONSTRUCTION SCHEDULE AND CONTENTS

Problems when excavating. Compared to other buildings, high-rise buildings have higher foundation requirements and more difficult foundation work. Also, the foundation must support more weight. Most high-rise buildings require a basement, making foundation treatment difficult. The basic processing method is based on different geologic conditions, taking actions tailored to local conditions, and designing various engineering processes in complex geologic conditions. Treatment regimens are more complicated and uncertainties increase. The safety risk is greater, and the construction pit can collapse, affecting the construction of the building and affecting adjacent buildings.

work at height. One of the challenges of high-rise building construction is the need for high-altitude work that severely tests the physical capabilities of construction workers, but the demands on their psychological quality are also greater. As the height of buildings continues to increase, the amount of material transported for construction also increases, creating a number of safety concerns, including: me. Falling from a high place, etc. In addition, due to the nature of high-rise buildings, once a fire breaks out, it is more difficult to extinguish and rescue.

The problem of irregular work. Actions do not conform to standards and may contain hidden security risks.

lead to serious accidents. For example, if the details are not standardized, it will affect the residents' experience. For example, cracks appear when painting walls, which can lead to more serious security issues and can also affect the user experience. Due to the current construction situation, this situation will arise from time to time, so great importance should be given to the construction unit.

During the construction process, many factors impede the construction process, such as: me. Disruptions to the original construction plan, such as lack of construction manpower and accidental landing of materials, difficulty in controlling the construction schedule, and drastic increase in construction costs.

3. IMPROVING THE CONSTRUCTION OF HIGH-RISE BUILDINGS IN UNDERGROUND ENGINEERING

Maintenance and supervision of construction machinery

Construction machinery may have different degrees of error when the temperature and humidity are high or low. Therefore, in order to effectively eliminate safety risks caused by equipment problems, regular maintenance work and effective monitoring of equipment can be carried out to find and solve problems in a timely manner, effectively reducing equipment-related accidents. When maintaining and monitoring equipment, attention must be paid to two aspects of the operation. First, equipment should be checked and repaired regularly to reduce accidents due to wear and tear of parts. The second is to standardize construction workers' work, improve scientific and rational use of equipment, conduct professional equipment use training, ensure construction workers can use appropriate equipment correctly, reduce incorrect work and non-standard work, etc. safety of construction.

Scientific research on the environment around high-rise buildings

The foundation is not solid or the core of safety technology elements. Therefore, preparations for intent, including geology and groundwater exploration, are required before digging the foundation. According to the results of exploration and scientific measures, measures should be taken to ensure the foundation of enterprises, including general drainage and specific area strengthening measures, to thoroughly eliminate the instability of foundation problems, fundamentally improve construction quality and solve problems. of building safety.

Reinforcement of safety awareness of construction workers and standardization of technology

In order to ensure the safety of the building, each connection in the civil engineering process must be strictly controlled and coordinated with each other to do a good job of monitoring and control. Some units that do construction work will also be part of project outsourcing. After all, regulations require workers to do a good job and send skilled personnel to monitor progress. If a job does not meet technical specifications, the operator must report this in a timely manner and request immediate correction. Technical quality must be guaranteed simultaneously with the warranty period. In addition, the safety awareness of construction workers should be further strengthened. Construction safety should be emphasized before construction, and safety work should be more standardized. In addition to technical training, regular safety training must also be conducted during the construction process.

Pay special attention to materials used in civil engineering

The quality of materials plays an important role in the safety of civil engineering works, and the safety of concrete, in particular, must be strictly checked because durability directly influences the stability and safety of buildings [3]. Therefore, construction parties must pay attention to every connection between concrete transportation and pouring, strictly monitor every detail, and timely solve problems to ensure construction quality.

4. CONCLUSION

In summary, the safety and technical problems of high-rise construction are common. In the construction industry, in order to take precautionary measures and ensure the quality of projects, it is necessary for each link of construction workers to join forces to strengthen safety awareness and strengthen the inspection of necessary engineering materials and equipment. It is forbidden to cut corners in strict accordance with construction safety rules. At the same time, it is necessary to analyze common problems and find key points to solve them.

REFERENCES

Cheng, Peng, Chen, Xin Fu, Wu, Lang. Construction Technology of High-Rise Building Structure [J]. Applied Mechanics & Materials, 2014 (580-583): 2316-2319.

Guo, Ya. Study on Concrete Construction Technology of High-Rise Building [J]. Applied Mechanics and Materials, 2015 (730): 93-96.

Carlos E. Ventura, Norman D. Smith. Structural Dynamic Properties of A Rc High-Rise Building During Construction [J]. Canadian Journal of Civil Engineering, 2011, 23 (04) : 950-9

Technological Innovations in Civil Engineering Construction

Anil Kumar [a], Manish Kumar [a]

[a]Assistant Professor, Deptt. of Civil Engineering, JBIT, Dehradun, Uttarakhand (India)

ABSTRACT

Architecture is an important means of changing people's living environment, creating important welfare for people's production and life, and civil engineering, an important means of building construction, plays an absolutely important role in building construction. The innovation that has borne fruit in civil engineering has a very important meaning and value in the development of civil engineering and the realization of human welfare. This article analyzes different methods of technological innovation in civil engineering, with the aim of promoting practical progress in civil engineering through useful discussion and exploration.

1. INTRODUCTION

The technological innovation of civil engineering construction is involved with the benefit achievements and the brand creation of engineering construction companies, and also closely related with the provement of people's living conditions. As civil engineering is the principal part of engineering construction, the construction parties of civil engineering must make technological innovation based on the changing and developing society, and use new technologies and new methods to make construction of projects. This paper makes analysis on several means of technological innovation of civil engineering construction, purposed to promote the practical development of civil engineering through helpful discussion and exploration.

3. **DISTINGUISH SEVERAL CONCEPTS WHEN ANALYZING TECHNOLOGICAL INNOVATIONS IN CIVIL ENGINEERING AND CONSTRUCTION**
4.

The so-called civil engineering refers to a general term of science and technology used in the construction of various types of engineering facilities, and it includes a number of disciplines and covers exploration, design, maintenance, repair and other technical activities. The final service objects of civil engineering construction is the building, while the building serves the production and life of people, so the final service object of civil engineering is people, by which civil engineering should have the characteristics of facilitating people's production and life and providing service for people. People's production and life is based on the constantly changing and developing society, so people must make innovation in the construction of civil engineering according to the social development and change, so as to meet the growing demands of people for materials and culture and to help people get a better material life and spiritual enjoyment
[1].
In substance, the social development is to let more people enjoy the facilities brought by social production development, where the "people" refers to the ultimate users of engineering construction who are the ultimate beneficiaries of civil engineering construction, and the "people" should also include the persons who participate in the construction, so we should focus on the harmony and security of people in the whole process of civil engineering construction and should pay attention to the common appeal of these two groups of people during the technological innovation of construction. In the construction of civil engineering, technology is primary. The construction of civil engineering needs manpower to undertake the work related to the design and practical operation. The design and service object of civil engineering is human beings, therefore in the course of civil engineering construction, we must concern about the convenience for the workers in the construction. We should not only make the construction meet the demand of customers to the maximum extent, but also consider the workers' health and convenience in the construction, trying to avoid security risks and incidents in the construction.

3. CONSTRUCTION TECHNOLOGY INNOVATION

After all, the construction and civil works of buildings are a natural process of reconstruction. Therefore, whether we can achieve a harmonious relationship between humans and nature in architecture is an urgent issue that we must address. Technological innovation in civil engineering is a necessary step in the development and improvement of civil engineering. In fact, technological innovation in civil engineering is the best means to achieve the original purpose of civil engineering [2]. Civil works are driven by people's needs, and technological innovation in construction allows builders to reduce pressure in many ways and protect personal safety during construction, while meeting the needs of customers to the fullest. In civil engineering, we continuously use new technologies and techniques to realize resource-saving and environmentally friendly construction, which is of great importance for the long-term development of projects and the sustainable development of human society. The importance of innovation in construction technology is also reflected in shortening the construction period and reducing labor costs. The use of new technology greatly reduces construction time, ensures and improves construction quality, and significantly reduces labor costs. Utilization of new technology means not only reduction in workload and labor cost but also significant reduction in labor intensity, so the use of new technology in civil engineering seems to be beneficial for harmonious development of society. Construction characteristics of high-rise buildings in civil engineering

Excavation and processing of the foundation is difficult. Due to the nature of the high-rise building itself, it is tall and heavy. Compared to other low-rise buildings, it has a large wind load and is highly affected by earthquakes. Both the overturning moment and shear force are greater than those of other low-rise buildings. Therefore, in order to effectively avoid these hazards, a deep landfill depth is required to increase the anchoring effect and reduce the impact of earthquakes.

The construction period is longer. Looking at the current situation of high-rise construction, most of the currently completed skyscrapers are over 20 stories, and most of the floors use standard floors, which not only provides great convenience in construction, but also has sufficient construction area and is advantageous for floating operation. conditions can be created. However, due to the high floor and high requirements for indicators, a full feasibility study is required. Therefore, it takes at least three years to complete the construction of each high-rise building from initial research to completion, which increases the difficulty of construction due to increased experience in poor operating environments such as rainy and snowy days. .

High level of technical difficulty. Due to the special characteristics of high-rise buildings, it is inevitable to adopt the deep foundation method, which has high requirements for concrete structures, high precision of operation processes, and difficult operations [1].
There is a lot to do. The high hazards of working at heights, the increased amount of vertical transport and the uncertainty of the high-altitude climate have made the work more difficult and presented challenges to the construction workforce. They are under tremendous physical and psychological strain which makes fire safety, communications and vertical transport more difficult.

4.CURRENT CIVIL ENGINEERING COURSES HAVE A NUMBER OF CHALLENGES (RELATIVELY SLOW FEET ASSIST TECHNOLOGY)

Before and even at the beginning of reform and opening up, India’s civil engineering is mainly purposed to build single and multi-storey residential houses. At that time, there is no demand for pit support technology. Therefore, there is no market for carrying out pit support technology at the time. Under the prevailing conditions of that time, this technology is still in its infancy and is little applied in India even though it has been widely used some big cities such as New York.
With the continued reform and opening up and the construction of India’s urbanization, India’s urban residential land is currently facing increasingly tense situation, among which some big cities in India, such as Beijing and Shanghai have their land price risen increasingly, and the conventional multi-storey building no longer meet the demand of the current real estate market, while the high-rise buildings more than 30 floors have be- come the mainstream of current housing construction in the building market. In this case, pit support technology has become one of the necessary technologies in the construction of civil engineering in India. According to the current situation, due to the lack of historic technology accumulation in India, the development of pit support technology is not mature [3]. Although the pit support technology has been able to help the construction companies in India construct tall building foundation, but due to little accumulation of this technology in historic development, we find the difficulties are far exceeded our ability at many times when we face the complex geo- logical structure and deal with relatively complex architectural design. For many complex real

problems, there is no mature solution, so that currently the design mistakes of high-rise building occur frequently in India.

5. LACK OF ENVIRONMENTAL PHILOSOPHY

In the past, there were dust, noise, garbage, solid waste and other problems in the construction of civil engineer- ing, which disturbed the normal production and life of the surrounding masses and affect the health of the workers at site. Now all sectors are increasingly emphasizing these environmental issues in India, so the lack of en- vironmental philosophy will make the construction parties have a high operating cost and a high administrative cost, and it is not conducive to the brand building for the construction parties.

The lack of environmental philosophy is also reflected by no pre-planning in the construction. In fact, the current civil engineering construction is purposed not only to meet the residential need of people but also to emphasize the harmonious development between human and nature and between human and society, that is, people pursue a satisfactory and harmonious life when they have their residential buildings, while house is just a part of the environment, so we should create a whole livable environment for human through building construction. For these, we should have a rational planning for the colorization and lighting and others of the residential area and even office area in our civil engineering construction, which is also an important reflection of environ- mental philosophy [4].

6. LACK OF AUTOMATION PHILOSOPHY

In the construction of civil engineering, the lack of automation philosophy will lead to an increase of large labor costs. We should introduce the automation, otherwise the labor cost will continuously rise [5]. At present, with the gradual disappearance of the demographic dividend, the migrant workers who come to cities from villages toengage in simple manual labor are gradually reducing, and the labor costs is continuously increasing. According to the statistics, from 1990 to 2000, the wage of migrant workers in India's urban areas basically keep balance, without change in the ten years; and from 2000 to 2010, the average wage of Chinese migrant workers has quadrupled or more for the ten years, that is, currently the low-end labor is continuously in a urgent demand and the labor cost is increased largely.

The lack of automation philosophy, will lead to an increase of labor cost and also cause a decrease of project quality. As mentioned above, the front-line workers in the construction of civil engineering, are low-end labors from rural areas or small towns, who have no much knowledge of architectural construction and no good com- prehension of the construction concept of the designer, and they only have average execution and have no appropriate professional and technical skills for the jobs that they carry out, so the quality of the work done by these workers should be improved. Currently there are frequent problems in quality of urban engineering construction in India, which is directly related with the low quality of overall workers. The use of automated tools for professional operation in place of workers will reduce labor costs and will get a good guarantee of quality.

7. SEVERAL EFFECTIVE MEANS TO SOLVE THE CURRENT TROUBLES

FOCUS ON THE DEVELOPMENT OF DEEP FOUNDATION PIT SUPPORT TECHNOLOGY

The current urban land gets less and less, both for residential and public use, and high-rise buildings gets more and more popular, while deep foundation pit support technology is mainly used for these high rise buildings in current urban construction. With the continued development of social technology and the incessant progress of our economy and society, high rise buildings have become normal in the urban construction. For high-rise buildings, there are strict anti-seismic performance criterions [6]. Concretely, we should make application and innovation of pile supporting system in the systematical project construction. The project construction is made under different geological conditions, so we should make accurate analysis of the geological conditions of the construction site during the actual construction. For those loose soil foundation, we must use the prestressed pile technology and cast-in-place pile technology to make the foundation deepest at maximum before the construction of the ground facilities, to avoid the unstable groundwork. If the groundwater level is exceptional, and for this geological condition, we must use casing water flushing and anchoring process to isolate groundwater, reducing the impact of groundwater on the building quality. The two cases mentioned above are common in the construction, and for the solution of a single problem of these, the application of civil engineering construction is relatively simple and straightforward. However, because of the complexity of the geography and the history in India, there are often multiple difficulties in many conditions of civil engineering construction, and for these more complex geographical conditions, we can use the civil engineering construction process to make reconstruction of the overall geological conditions that is not conducive to the construction and to make it meet the needs of high-rise buildings construction.

For example, Sichuan, Yunnan and Guizhou in India are earthquake-prone areas, and also densely populated areas of India, especially the Sichuan Basin. If the construction of high-rise building is made in the area of high seismic risk, the design and construction technology of civil engineering will face a baptism. For this situation, we can consider the combination method of temporary pile reinforcement technology, permanent technical guidance pile technology and underground wall supporting technology, which can meet the need for bearing and supporting and also prevent seismic disaster, to ensure the residents' safety at maximum in an earthquake.

8. COMBINE THE CONSTRUCTION TECHNOLOGY DEVELOPMENT OF CIVIL ENGINEERING AND THE ENVIRONMENTAL PROTECTION

With more and more frequent extreme weather and more and more frequent environmental problems, we have to concern about the environmental problems in the construction of civil engineering. In practice, the construction technology of civil engineering should be developed in coordination with the environmental protection. As an important way of human to change the nature, we will inevitably cause harm to the environment in the construction of civil engineering, and in future technological development, we should make the construction technology of civil engineering in adaptation and in coordination with the environmental development

Concretely, in the construction of civil engineering, we must focus on the effective planning of environmental protection, and in the use and development and design of building materials, we must pay attention to the combination with environmental protection, to maximize the harmonious development between human and nature. For the construction waste and garbage, we must carry out free-pollution disposal. Solid waste will be inevitably produced in the construction of civil engineering, and these solid wastes mainly including cement, brick, stone and tile brokens, are non-degradable, and will take up a lot of land for their piles, so we must adopt scientific and technological method to make harmless treatment in the construction of civil engineering. First, we can use large machinery to crush and process these solid waste for recycling; second, we can use new technologies and new tools in the construction to minimize the generation of waste; Third, we can establish and improve the matching system, set up specialized plants, use special process for recycling of the litter and waste generated from the industrial buildings, for example, we can crush the brick, stone, tile brokens and then use them to produce new materials, which can save labor costs and minimize the pollution of construction waste for the environment.

9. INTRODUCE THE AUTOMATED MACHINERY AND LIBERATE THE LABOR FORCE

From the current situation, the reduction of India's young labor force in a short term is a inevitable trend. The increase of labor costs in India is also an inevitable trend after the demographic dividend is being gradually consumed. In order to reduce labor costs, improve construction efficiency and enhance the quality of the projects, we currently must appropriately introduce the automated machinery and liberate the labor force.

In the specific operation, we first should introduce the concept of assembly line to make the working methods related to the assembly line involved in the construction of civil engineering. Currently, the first-line work of civil engineering construction must be done by manpower, for example, feeding and bricks laying needs large labor and high technologies and quality, so the construction is often in short of labor. Especially in the construc- tion of high-rise building, spider-men may have risk of fall from a height, and once such an incident occurs, it will very likely affect the entire progress of the project, so the construction parties can consider the cooperation with the technology companies and introduce the assembly lines of practical value for those work that has certain risk and needs large labor. At the same time, we should introduce the concept of standardized construction. In the past, the tools used at the construction sites are mostly extensive, and the large machinery such as forklifts and excavators are mostly operated manually, which make the construction effected largely by subjectivity and the quality of work cannot be guaranteed fully. Therefore, we should focus on the implementation of technolo- gy and determine the construction standards to ensure the quality of the project at maximum [8].

10. CONCLUSION

As the economy entered a new normal, India's real estate industry is facing an unprecedented reshuffle, and in this period, engineering construction companies should focus on the introduction of new technology, the innovation of project and the building of brands during the construction of civil engineering, further to take initiative in the market competition. For the technological innovation of civil engineering construction, we should pay attention to reduction of current lowend labor, prevention of the conflict between human and nature, and prevention of coarse engineering construction, and use modern technology and means to resolve the problems.

REFERENCES

1. Wu, L., Shen, J.Q., Li, J., *et al.* (2012) The Construction Technology and Innovation of Civil Engineering. *Information of Science and Technology*, No. 8, 12-13.
2. Yao, B. (2013) On Information Construction of Civil Engineering. *Civil Engineering Journal*, No. 9, 45-46.
3. Xie, Y.Q. (2012) Discussion and Analysis on Application and Development of Prestressed Technology of Civil Engi- neering. *Economic Yearbook of Chinese Entrepreneur in the World • Economics & Technology and Finance*, No. 1, 13-15.
4. Guo, Z.X. (2014) On the Innovation and Development of Construction Technology of Civil Engineering. *Jiangxi Building Materials*, No. 4, 78-79.
5. Xu, Q. (2014) The Innovation of Engineering Construction Technology. *India Engineering and Architecture*, No. 5, 62-63.
6. Li, G.J. (2014) Analysis on Civil Engineering Construction Technology and Its Development. Universal Cultural Geography, No. 8, 46.
7. Chen, Z. (2014) On the Innovation and Development of Civil Engineering Construction Technology. India Homes (Published in the Last Ten Days), No. 10, 157-158.

8. Huang, S.W. and Chen, J. (2015) Study on the Innovation and Development of Civil Engineering Construction Tech- nology. No. 1, 62-63.

An Insight of Transparent Concrete using Plastic Optical Fiber

Seema Rani [a] , Dr.Sanjeev Gill
[a]Assistant Professor, Deptt. of Civil Engineering, JBIT Dehradun, Uttarakhand (India)
[b] Professor, Deptt. of Civil Engineering, JBIT Dehradun, Uttarakhand (India)

ABSTRACT

Transparent concrete is a concrete-based building material with light transmission properties, usually due to optical optical elements embedded with optical fibers and glass powders. Light passes through the stone from one end to the other. Therefore, the fibers must pass through the entire object. Transparent concrete is also called translucent concrete and translucent concrete because of its properties. It is used in micro-construction as facade material and interior wall cladding. The size of the fiber in this project varies between 2µm and 2mm. To increase the transparency of concrete, an equal amount of cement is replaced with fine glass powder. Glass powder has the same bonding strength as cement. Cast specimens contain 95% concrete and 5% plastic fiber optics. Concrete is a cement mortar containing fine aggregate and cement. The fibers are disturbed in the shortest direction to increase the transparency of the concrete. The main purpose of this project is to create transparent concrete using plastic optical fiber and glass powder. It is a work to reduce the power consumption of lighting by using sunlight as a light source, detect the stress of the structure by using optical fiber, and use it for architectural purposes to improve the aesthetics of the building.

1. INTRODUCTION

Economic growth and advances in science and technology are driving ever-larger engineering structures such as skyscrapers, underground buildings, and landmarks to be constructed around the world. These buildings are isolated biospheres that rely solely on artificial light to

sustain people's visual activity. At the same time, most large buildings, such as skyscrapers, are close to each other and are all built in the same place. The importance of natural light is already well known because when many buildings are densely stacked, little natural light penetrates them. Translucent concrete is an advantageous solution for easier mining. By placing high numerical aperture plastic optical fibers (POF) or large-diameter glass optical fibers in concrete, the optical fibers transmit light effectively, with little loss of light transmitted through the optical fibers. Fiber optics are very good at guiding and capturing light. Light passes through the stone from one end to the other. Therefore, the fibers must penetrate the entire object. Transparent concrete is also called translucent and translucent concrete.
Concrete due to its properties. It is used for exterior and cladding interior walls in beautiful construction. The main purpose is to use this concrete for architectural purposes, which uses sunlight as a light source to reduce lighting power consumption, captures the tension of a structure by using optical fibers, and improves the aesthetics of a building.
Characteristics of Transparent Concrete

- High density concrete
- Synthetic fibers added to the blend add some flexibility without sacrificing strength.
- Optical fiber can run up to a run length of nearly 20m without loss of light.
- Prefabricated blocks are load bearing and provide equal effectiveness in both artificial and natural light.
- The color stays the same at the other end of the block.
- Multi-purpose building materials
- Lighting

2. LITERATURE REVIEW

Bhavin K Kashiyani (2013) et al. have studied how to integrate the advantages of concrete and optical fibers to develop transparent concrete by arranging high numerical aperture plastic optical fibers (POF) or large diameter glass optical fibers in concrete. The main purpose is to use sunlight as a light source to reduce lighting power consumption and use the optical fiber to capture the tension of structures and also use this concrete as an architectural purpose for a good aesthetic view of the building.

Padma Bhushan M.N.V (2013) et al., in this journal paper, light is passed through the stone from one end to the other. Depending on the fiber structure, this creates a specific light pattern on the other surface. Optical fibers transmit light so efficiently that there is virtually no loss of light transmitted through the fibers. The modeling of such translucent or transparent concrete blocks and their use as well as the associated advantages in the field of intelligent construction.

Prof Momin. AA (2014) et al., in this journal paper, the transparency of concrete samples with glass fibers is higher than that of samples with glass rods and also This is because the more transparent the material, the higher the transmittance of light. Therefore, this study concludes that light transmission is possible in concrete without compromising its compressive strength because the optical fibers and glass rods act as fiber reinforcements to increase strength and improve appearance.

Huan Shen (2013) et al. The excellent properties of transparent concrete and the development of intelligent transparent concrete based on intelligent sensor technology have been discussed in journal papers. Looking at its uses and the benefits it brings in the field of smart buildings, it can be seen that the power consumption of lighting can be reduced, optical fibers can be used to detect tension in structures, and this concrete can also be used in construction. The aesthetic outlook of the building is good.

Akshaya b kamdi (2013) et al. investigated in a paper detailing the manufacture, use and future applications of transparent concrete. However, while still partially in the development stage, this innovative new material has begun to be used in a variety of architectural applications and promises great opportunities in the future. Translucent concrete is one of the most exciting new interpretations of a historically rigid and uninspiring building material. It can be used almost anywhere glass or traditional concrete is used.

Basma F. Bashbash (2013) et al. Researched the development of translucent concrete using plastic optical fibers (POF) and developed a new alternative to anchor sustainability concepts in the Gaza Strip. The of lighting that can make part of the outer wall of the formwork is made of transparent concrete so that natural light can enter from the outside to the inside. Experimental results show that the optical fiber can be easily bonded with concrete and that POF can provide uniform light transmittance. This article also describes the mechanical effects of introducing POF into concrete samples. Intelligent transparent concrete can be considered as a “green” energy-saving building material, so it is a promising technology for on-site application in civil infrastructure.

3. DESCRIPTION OF THE TRANSPARENT CONCRETE PROJECT

Transparent concrete is a concrete-based building material with translucent properties due to embedded optical optical elements, mainly optical fibers. Light passes through the stone from one end to the other. Therefore, the fibers must penetrate the entire object. Because of its properties, transparent concrete is also called translucent concrete and translucent concrete. It is used for exterior and cladding interior walls in beautiful construction. The main purpose is to use sunlight as a light source to reduce lighting power consumption and It is also used for architectural purposes to sense the load of a structure by using optical fiber and to improve the aesthetics of a building. Ingredients Of Transparent Concrete

1. Cement
2. Fine Aggregate
3. Optical fiber
4. Glass powder
5. Water

Fig. 1 Transparent Concrete

Cement

Cement is a main component of the binder for concrete. It offers good adhesive properties for binding fine and coarse aggregates. The main components of cement are limestone and clay.

Fine aggregate

Sands are commonly used as fine aggregates. Sand can be either natural or artificial. The fine aggregate fills the voids present in coarse aggregate and minimizes concrete shrinkage. The size of the sand particles should be between 75 microns and 4.75 mm.

Optical Fiber

An optical fiber is a flexible, transparent fiber made of extruded glass (silica) or plastic, slightly thicker than a human hair. It can act as a waveguide or "light pipe" to transmit light between the two ends of the fiber. The field of applied science and engineering concerned with the design and application of optical fibers is referred to as fiber optics. Optical fibers are widely used in fiber optic communications, where they enable transmission over longer distances and at higher bandwidths than wire cables. Fibers are used instead of metal wires because they transmit signals with less loss and are also immune to electromagnetic interference. Fibers are also used for lighting and are wound in bundles so they can be used to transmit images, allowing for viewing in confined spaces. Specially designed fibers are used for a variety of other applications, including sensors and fiber lasers. Optical fibers typically include a transparent core surrounded by a transparent cladding material with a lower refractive index. The light is kept in the core by total internal reflection. As a result, the fiber acts as a waveguide.

Glass Powder

Glass powder is an extremely fine powder made from ground glass. It can be used in a number of industrial and craft applications and is often available through suppliers of glass and industrial supplies. High precision machining equipment is necessary to prepare it, as it needs to be very wet grinding to achieve particles of the desired size. Pigments can be added to make colored glass powders, and companies can also work with colored glass if they want to make powders of a particular color, like blue. The finished product can be hazardous and must be handled with care.

Water

Water plays an important role in mixing of concrete. Water should be clean, fresh and free from organic impurities. Reduction of water increase in strength of concrete and decreases workability. The ratio of minimum quantity of water required to the weight of the cement to obtain a desired concrete mix is called water cement ratio. The standard rate of water cement ratio is 0.45 to 0.55

4. TRANSPARENT CONCRETE MIX PORTION

In transparent concrete, 95% of the space is occupied by cement mortar, i.e., cement and sand. The remaining 5% are made up of plastic optical fibers (POF). To increase the transparency of concrete, cement is replaced with glass powder. Based on the design of the trial mixture, the proportion of binding solution will vary.

5. CONCLUSION

Transparent concrete can be developed by adding optical fibers or large-diameter glass fibers to the concrete mix. Transparent concrete has good light guiding properties, and the ratio of glass fiber volume to concrete is proportional to the transmittance. Transparent concrete does not lose its strength parameters compared to ordinary concrete and also has very important properties from an aesthetic point of view. It can be used for the best architectural aesthetics of buildings. It can also be used where light does not reach with sufficient intensity. This new type of building material can combine the green energy-saving concept with the self-recognition properties of functional materials. In the first phase, we completed research on literature research, data collection, and some basic tests.

REFERENCES

1. D.D.L. Chung. Cement reinforced with short carbon fibers: a multifunctional material. Composite materials: Part B.31:511-526, 2000.

2. F. Ansari. Practical implementation of optical fiber sensors in structural health monitoring. Journal of Intelligent Material Systems and Structures, 18(8):879-889, 2007.
3. H.Li, H.G. Xiao, J.P. Ooh Microstructure of a cement mortar with nanoparticles. Composites Part B Engineering, 35:185-189, 2004.
4. Jianping He, Zhi Zhou, JinpingOu, Minghua Huang, "Study on intelligent transparent concrete products and their performance", Dalian, China, 2011.
5. Kalymnios, D. Plastic optical fibers (POF) in sensor technology - current status and perspectives. 17th International Conference on Optical Fiber Sensors SPIE, 5855, 2005.
6. K.S.C. Kuang, M. Maalej, S.T. Quek. Hybrid optical fiber sensor system based on fiber Bragg gratings and optical plastic fibers for condition monitoring of engineering structures. Proc. of SPIE, 6174(61742P)： 1-12, 2006.
7. Scherafe, T. "Fabric Structure Outspace Applications: Recent Structural Developments Expand the Range of Fabric Options", Building Design and Construction, pp. 128–138, 1988
8. Victoria Bailey, "Translucent Concrete", MEEN 3344-001
9. Z. Zhou, J. P. Ou, and B. Wang. Smart FRP-OFGB bars and their application in reinforced concrete beams. Proceedings of the First International Conference on Structural Health Surveillance and Intelligent Structure, Japan: 861–866, 2003.

Innovative Practice of Structural Engineering

Manish Kumar[a], Anil Kumar [a]
[a]Assistant Professor, Deptt.of Civil Engineering, JBIT Dehradun, Uttarakhand (India)

ABSTRACT

At present, our country's economy is developing more and more rapidly, people's living conditions are gradually improving, and people's demands for quality of life are also increasing. A home is a place where people often come and go. The quality of housing is related to the safety of people's daily life and also affects economic development. Therefore, the construction industry must pay attention to improving the quality of life and provide people with quality housing. In civil engineering, based on quality assurance, construction units should fully consider economic benefits to ensure that construction units can achieve quality and cost reduction. In order to ensure that the quality of civil engineering works meets the standards presented by the state, the construction unit must plan the details of the building in detail and apply standardized construction techniques during the construction process. Therefore, in this article, we conduct an in-depth analysis of civil engineering innovations in civil engineering to facilitate the reference of relevant construction units.

1.INTRODUCTION

Investigation and analysis of current construction technology in the field of civil engineering

Features

Research shows that the current civil engineering construction in my country has the following characteristics: fixity, fluidity, gradual change, integrity, and complexity. The following is an analysis of the five characteristics of civil engineering constructiontechnology.

Firmly

In a real civil engineering project, the construction unit must ensure the stability of the project before embarking on other phases of construction. Otherwise, if a collapse occurs during the construction process, it will not only affect the lives of construction workers, but also the construction work. The unit also loses a lot of construction money and has to rebuild civil works. Therefore, in the process of introducing construction technology, it is necessary to analyze the types of construction technology and select a construction technology with strong strength to improve the stability of civil engineering in the application process. And the construction technology itself has certain stability, and it can also provide a good foundation for the construction stability of civil engineering. Typically, this type of construction technology is used with great strength.

It is widely used in the construction process of civil engineering [1].

Liquidity

Civil engineering work absolutely requires the participation of construction personnel. Construction personnel must understand the construction environment, analyze the application method of construction technology, and operate appropriate construction equipment. In this way, construction sites have some degree of flexibility. Generally, after completing the draft construction plan, the designer presents the safety construction and standard construction requirements to the construction staff. However, due to the fluidity of the construction site, there are also unknown changes in the construction situation that require the right skills. Managers should do a good job of overseeing the application of construction techniques to avoid problems that go unresolved during implementation.

Gradually

The continuous updating of science and technology and the change in people's ideas and concepts show that this age is constantly evolving, and the construction of civil engineering as a long-term project exists in this society. The construction industry should also pay attention to changes in construction technology. The construction industry has to move with the times. According to the changing actual needs, the construction technology and performance of construction should be improved technology should be improved, and the application efficiency of the technology should be optimized, so that the construction of civil engineering can follow the development of the times and the construction industry will not lag behind in the development of society.

State of the application of construction technology

Although the current construction technology can also have a certain impact on the construction quality of civil engineering, its core technical requirements need to be improved. The current construction technology can be improved according to the actual construction plan, so that the construction unit can be more standardized. Use construction technology to improve the quality of underground buildings. And to a certain extent, the new construction technology also meets the needs of the development of the construction industry, thus creating more advantages for the construction industry. Therefore, the improvement of construction technology needs to be improved. In addition, the current construction technology of civil engineering in our country requires the combination of different construction methods in the application process. Therefore, there are often deviations between the original construction plan and the original construction plan in real construction site construction. This requires the assembly to deal with it. The continuous improvement of the construction plan can ensure the quality of the civil engineering building. Materials, structure and environment are also factors that influence the use of construction technology. If the corresponding configuration is not well made, the construction technology cannot achieve good utility value. Therefore, it is more important to innovate the construction technology in civil engineering.

2. IN-DEPTH ANALYSIS OF STRUCTURAL ENGINEERING INNOVATIONS FOR CIVIL ENGINEERING

Formation of the concept of technological innovation

Improving the mechanism for monitoring and applying technological innovations. The economy is developing rapidly and competition between different industries is gradually increasing. As an important part of my country's economic development, the construction industry is an important part of China's economic development, and its development effects affect the improvement of my country's overall economy. Therefore, the construction industry must keep up with the development of the times and develop a new concept of development. For the construction industry, the application of construction technology is the most important thing in the development process. Effective construction technology can not only create a high level for the construction industry. The economic benefits can also make it possible to improve the quality of civil engineering on the basis of cost reduction. Therefore, the construction industry should do a good job in construction Technology innovation research and relevant professionals should actively participate in the process of construction technology innovation. In order to develop a new concept of technological innovation, the construction industry must also allocate sufficient technology costs to ensure that technical innovators can develop newer and more powerful construction technologies. More powerful construction technologies will bring more to the construction industry. The advantages. At the same time, in the process of technical innovation for construction technology, construction units also need to educate and train construction personnel on the application of new technologies, so that they understand the impact of new construction technologies on themselves and the whole construction project, z as in the construction of civil engineering, construction personnel must have the relevant monitoring mechanisms be clarified after well publicizing the concept of applying new technologies to strengthen the sense of responsibility of construction workers. The construction personnel can standardize the operation of the new construction technology, and the quality of the civil engineering is guaranteed. In addition, the construction unit should also set up a construction team to improve the quality of each construction worker in the construction team, so that the construction efficiency of civil engineering can be improved by combining the efforts of construction personnel with new construction technology.

3. DO NOT BE AFRAID OF ADVERSITY AND RISK, AND BOLDLY DEVELOP INNOVATIVE CONSTRUCTION TECHNOLOGY

The use of new construction technologies inevitably entails certain risks. Therefore, construction units must be able to develop a sense of risk management and continuously research and improve the process of using new technologies to carry out civil works. In order to improve the performance of construction technology, it is necessary to ensure the stable operation of new construction technology based on safe construction, and to solve problems in a timely manner when found. In

addition, it is necessary to practically examine whether the new construction technology can enhance market competitiveness and maintain the core concept of the technology. New construction technologies must also consider their impact on the built environment. Nowadays, environmental pollution in our country is serious. When innovating new construction technologies, we must carefully think about whether they will help protect our country's environment. Construction units must ensure that new construction technologies are in line with our country's environmental protection. The concept of environmental protection to enable the construction industry to achieve sustainable development using new construction technologies.
As an important part of civil construction technology, the underground mining engineering of projects using this technology can improve the stability of housing construction in our country, so it has the same seismic performance. So, to innovate Underground mining technology, our country construction industry should do a good job in the related research. Natural disasters are common in today's world. We cannot prevent the damage caused by nature, but we can prevent it. Protecting the environment is one aspect and at the same times the key to our own maintenance. Therefore, in house construction, it is very important to improve the earthquake resistance of house construction. The traditional underground pit technique can only be applied to buildings on the ground, and the stability is not good. Even in the event of an earthquake catastrophe, severe collapses occur again and again, which pose a danger to human life. For the research of new underground mining technologies, technical researchers integrate into it its pile anchor support system, which can be used in civil engineering, and also can improve the quality of civil engineering, especially in the construction site with bad environment. This kind of technology can reduce the construction risk, because the construction workers at the site with bad environmental conditions can use the two aspects of cast-in-place pile and prestressed anchor to control the construction process to some extent, so that the quality of cast-in-place pile can be controlled. A certain guarantee can also prevent the frequent occurrence of quality problems in civil engineering.

4. CONCLUSION

In short, for the innovation of civil construction technology, research on more effective technology based on the current more effective construction technology of our country's construction industry in combination with the actual development of our country's construction industry, further develop the technology, and help advanced scientific knowledge. It is new and has some application value. In the process of innovation, researchers must rapidly change the traditional concept of technology creation according to the actual needs of the construction industry, improve construction technology innovation plans, establish sound mechanisms for the use of new construction technologies, and ensure innovative construction technologies. used. Improve the quality of civil engineering. When using a new building design, building units must be able to actively implement it and make it the core of the project building. In this way, construction personnel can work properly and construction units can take advantage of new construction technologies to increase civil engineering costs and reduce economic costs.

REFERENCES

1. Sun Zhuozhen, Du an Xiaohong, Zhang Chunhua. Analyze the innovative practice research of civil engineering construction technology [J]. Architectural Engineering Technology and Design, 2018 (14): 12.
2. Dong Taotao. Analyze the innovative practice research of civil engineering construction technology [J]. Consumer Guide, 2017 (35): 134-156.
3. Li Jing. Analyze the innovative practice research of civil engineering construction technology [J]. Decoration World, 2018 (2): 25-47.
4. Li Wenzheng. Analysis of the current situation of civil engineering construction management and optimization countermeasures［J］. Sichuan Cement, 2017, (10): 137-138.
5. Li Xiaojun. Research on construction technology and innovation of civil engineering construction [J]. Sichuan Cement, 2017, (10): 120-121.
6. .Xu Xiaoqing. Research on how to strengthen the current civil engineering construction management [J]. Building Materials and Decoration, 2017, (44): 86-87.
7. Xiaoying Shi, Xiaojuan Wang, Shunqi Zeng. Investigation on Construction Technologies of Civil Engineering and Its Future Development [J]. Urban Construction Theory Research 2014; 15(07): 251-252.

Nano- Impact on Physical Properties of Construction Materials: Future of Civil Engineering

Mohd. Yusuf Ali [a] , Dr.Sanjeev Gill[b]

[a]Assistant Professor, Deptt.of Civil Engineering, JBIT Dehradun, Uttarakhand (India)

[b] Professor, Deptt.of Civil Engineering, JBIT Dehradun, Uttarakhand (India)

ABSTRACT

It is true that nanotechnology has become one of the most influential technologies of this century because it has fascinated almost all fields of technology to the extent that it has swept even the civil engineering field. Since the construction industry requires more material and energy resources, there is a construction sector that is particularly benefiting from nanotechnology. Of all the materials used in construction, concrete accounts for nearly 70% of the material volume and has a significant impact. The advent of nanotechnology has helped create materials that are stronger and more durable than conventional materials. Nanotechnology in concrete production refers to the production and addition of nano-sized particles in proper proportions to concrete using appropriate methods. The main purpose of using nanoscale materials in concrete is to improve compressive and flexural strength at a young age. This is possible because of its high surface area to volume ratio. It also helps to improve the pore structure of concrete. Nano scale materials help reduce porosity because they absorb less water compared to conventional cementitious materials. The presence of nano materials reduces the cement content of concrete compared to traditional concrete. This can be achieved without sacrificing strength properties, thus allowing the production of green concrete, so-called green concrete. This article attempts to explore how nanotechnology is used in construction and its impact on various nano materials. A particular focus is placed on concrete, as steel, glass, wood and paper influence the different properties of the material.

1. INTRODUCTION

Indeed, the term nanotechnology offers a wide range of very complex meanings and can vary from topic to topic. In general, it refers to the process of understanding, controlling, and reconstructing materials based on their size (0.1 to 100 nm) in order to design materials with new (new) properties and functions. Nanotechnology has many aspects and applications in almost all technological fields. Applications in civil engineering are very important as the industry itself deals with different types of building materials. Nanotechnology can be applied to improve the properties of various materials. Nanotechnology paves the way for infrastructure that is as economical as possible and provides a longer service life with low maintenance costs. The advent of nanotechnology has revolutionized the growth of civil engineering in areas such as the application of protective coatings to prevent corrosion and saltwater attack on pipes and to reduce heat transfer (fire retardants). The application of nanotechnology has been successfully demonstrated in the manufacture of insulators, nanosensors, and smart and green materials. In fact, nanotechnology is neither a new science nor a new technology, but an evolution of an existing technology. The word "nano" is derived from the Greek word "dwarf" meaning one billionth. A nanometer means one billionth of a meter. There are two approaches to nanoscale: top-down approach and bottom-up approach. A top-down approach means downsizing from the largest to the smallest, while a bottom-up approach means building materials from their atomic or molecular components.

2. NANOTECHNOLOGY IN CIVIL ENGINEERING

According to surveys conducted in Sweden and the UK, nanotechnology has emerged as a promising technology in the construction industry. More importantly, its influence on concrete products is very large. It has also been noted that the construction industry is one of the important sectors to be influenced by nanotechnology. Numerous research and development initiatives are organized to produce many more innovations in nanotechnology relevant to the construction industry. Venture capitalists and industrial companies have made numerous investments to unlock the potential of nanotechnology in the construction sector. By identifying these potential funds, the European Commission allocated huge funds in late 2002 to initiate research work called GMA1-2002-72160 "NANOCONEX". Nanotechnology is considered an important application for the advancement of civil engineering. Its applications are of great importance in the construction portfolio of civil engineering.

3. CONCRETE NANOTECHNOLOGY

Compared to the other materials used in construction, concrete is one of the most common and widely used building materials. Concrete is a heterogeneous, nano structured, multiphase building material consisting of small crystals of different sizes. It is widely used in almost all construction activities. Without concrete we cannot assume any construction. It occupies almost 70% of the volume of the structure. Cement is one of the most important ingredients in the manufacture of concrete, but it also has some disadvantages. Many investigations have been made to reduce the cement content in concrete. Nanotechnology has proven to be the best tool to solve many problems related to concrete components. With the help of nanotechnology, many properties of concrete are studied, such as the heat of hydration, the reaction of alkali aggregates, especially the reaction of alkali silicates. The presence of alkali and silica in cement and aggregate causes ASR. Replacing the amount of cement content with the use of pozzolona reduces the occurrence and severity of the alkali silicate reaction. The properties of concrete can be changed in many ways. One of the best options is the incorporation of nanoparticles. Nanoparticles in the form of nano silica, nano clays, nano titanium oxide (TiO2), nano iron (Fe2 O3), nano aluminum oxide (Al2 O3), Cuo, ZnO2 and ZrO2. Nanomaterials in concrete improve the pore structure of concrete, accelerate C-S-H gelation and improve the concrete's mechanical and durability properties. In particular, fly ash maximally improves the durability and strength of the concrete, but the addition of fly ash may reduce the early strength of the concrete. The problem of low strength in the early stages can be overcome by incorporating nano-silica, which improves the density and structure of the concrete. The addition of nano-silica improves segregation resistance, also increases the strength of the hardened concrete, provides greater resistance to water absorption and prevents calcium leaching. Nano-iron imparts self-awareness and also improves its compressive and flexural strength. Nano titanium helps the concrete to clean itself. It has been experimentally proven that nanotechnology increases the lifespan of bridges. According to a 2007 study conducted by the National Institute of Standards and Technology in the US, it was found that almost a quarter of all bridges in the country were damaged by attack by chloride and sulfate ions on concrete. The sulfate and chloride ions penetrated the concrete, causing cracks and leading to internal structural damage. They conducted an experiment to double the lifespan of structures by micro-changing the viscosity of the solution in the concrete to reduce the rate of penetration of chlorides and sulfates into the concrete. In fact, cracking in concrete is a major problem that leads to structural failure. The University of Illinois Urbana was working on healing polymers. This research also focused on microcapsule therapeutics and catalytic chemical agents. Microcapsules break through cracks formed in concrete. In doing so, the healing agent is released into the crack and comes into contact with the catalytic chemical agent. During this process, polymerization occurs and the crack surfaces stick together. It is particularly suitable for filling micro-cracks in columns and piers. Protecting existing structures from corrosion is also a challenge for engineers. In this context, textile cladding has become a common technique to increase the strength and durability of existing structures. This technology uses a fiberboard containing nano silica particles and a hardener. When the fiberboard is wrapped with the concrete surface, the nano particles penetrate the concrete cracks and seal the cracks in the concrete surface. It has also been experimentally demonstrated that self-consolidating nano fibre concrete columns fail at higher loads and greater deflections than reinforced concrete columns. It can also be seen that the nano fiber self-compacting concrete columns are stronger than the reinforced concrete columns.

Steel Nanotechnology

Steel is one of the most important and essential materials in the construction industry. Steel has good dielectric strength, but suffers from fatigue. Fatigue is a major problem leading to failure when subjected to cyclic loading. Addition of copper nanoparticles reduces steel fatigue. Adding copper nanoparticles to steel makes the surface of the finished steel smooth and uniform. This surface flatness can reduce stress, so there can be fewer stress risers in the steel, and fatigue cracking is also limited. A new generation of steel with higher corrosion resistance has also been developed. New stainless steels are also being developed for lightweight structures and robust bridges. MFX Steel Corporation U.S.A. has developed nanostructured modified steel. Due to its deformed structure, it has achieved higher strength, ductility and fatigue resistance than normal strength steel. These properties increase the life of the structure even in the most adverse corrosive environments. Nanotechnology is also used to produce carbon nanofibers that are much stronger than steel. In addition to being very light in weight, it has a very high level of strength. CNTs also have high thermal and electrical conductivity. In compression, carbon fibers are brittle, but carbon nanotubes are more flexible and compress without failure. It was experimentally proven that the reinforcing structure made of CNT has superior tensile strength compared to the existing reinforcing steel structure.

Glass nanotechnology

Nanotechnology can be applied to a variety of materials used in construction. Glass cleaning is an ongoing problem that can be solved if the glass can clean itself. Nano titanium dioxide glass is the best solution to this problem. Titanium dioxide breaks down organic waste. Titanium dioxide glass attracts rainwater, allowing the water to clean dirt from the glass. Nanotechnology is also successfully used in the manufacture of fireproof glass. Different types of protective coatings are developed by applying the nanoparticles to various compounds when a small layer of silica nanoparticles is placed between the glass plates and the layer between the glass plates serves as a fire retardant when heated. Nano TiO_2 coating is applied to the exterior of the building to prevent adhesion of contaminants and reduce maintenance costs. Because TiO_2 is hydrophobic, it can be used in anti-fog coatings.

Nanotechnology in Sensors

Self-sensing and automatic sensors are being developed using nanotechnology to sense stress on structures. Anti-collision airbags fitted to automobiles are manufactured using nanotechnology. Advanced sensors are being developed using nanotechnology. Nanotechnology is also used in electrical and mechanical systems to control the external environment (temperature, humidity, smoke, smog and noise). Some sensors mounted on structures indicate stress and strain oscillations acting on the structure. Some sophisticated devices are designed to monitor raw concrete properties such as moisture, temperature, and more. These sensors are very useful because they provide initial information about the structure and help initiate corrective action.

Nanotechnology in Concrete Pavement

Nanotechnology is best suited for road surface production. Sidewalks must be very stable, durable, weather-resistant, wear-resistant and slip-resistant. All these properties could be successfully realized by using a ZnO2-nano-silica-particle road surface. Road flooding leads to weathering and can be avoided with proper drainage and fast drainage. Hydrophobic roads made of nanoparticles enable rapid drainage. Nanotechnology is also used for water purification. Water quality and availability can also be improved with nanotechnology. Advanced methods and materials can be used to make water fit for reuse. You can also reduce the salt content of your water. Carbon fiber reinforced plastics are also produced using nanotechnology. Because it is very light, it has poor electrical properties. Plastic solar cells are also manufactured to generate solar energy, which is much cheaper than conventional silicon semiconductors. These cells save energy and are environmentally friendly by reducing the emission of carbon particles. Almost all developed countries are trying to use LED lamps instead of traditional lamps. More intelligent materials are being produced using nanotechnology. Smart materials are susceptible to external stimuli such as temperature, humidity, electric and magnetic fields.

4. CONCLUSION

The nanotechnology initiative is having a tremendous impact on engineering and its impact on civil engineering is profound and promising. Its presence is of great importance as civil engineering deals mainly with building materials such as concrete, steel, glass and wood. Nanotechnology has helped create the most efficient and effective materials with excellent technical properties. The maintenance costs of structures have dropped drastically with the advent of nanotechnology in the production of self-cleaning and self-repairing concrete. Nanotechnology has also helped improve the durability of materials by providing fire resistance and anti-corrosion coatings. The scope of nanotechnology is expanding to every corner of civil engineering, yet much education and research needs to be done to realize its benefits. Undoubtedly, nanotechnology will help create materials with new properties and excellent functionality. The materials made from nanotechnology also increase the lifespan of the structures over longer periods of time. A paradigm has already begun in the construction industry with the application of nanotechnology, and the technology will completely transform the construction industry. It will have great impact on technology and economy if nanotechnology is used properly in technology and economy as it has huge market potential and economic impact.

REFERENCES

1. Alireza Naji Givi, Surya Abdul Rashid and others---“Experimental investigation of the size effect of Si02 nano particles on Mechanical properties of binary blended concrete” –Composites (part-B) Vol-41,pp 673-677 ,2010

2. A.Sadrmomtazi, and A.Fasihi—“Influence of Polypropylene fibers on performance of Nano- Si02 incorporated mortar “–Iranian Journal of science and technology –Vol-34-pp385-395, 2010

3. Ali-Nazari, Shadi Riahi, Shirin Riahi and others –“An investigation on the strength and workability of cement based concrete performance by using ZrO2 Nano particles” –Journal of American Science –Vol-6, pp29-33 ,2010,

4. A.H. Shekari, M.S.Razzaghi—Influence of Nano particles on Durability and Mechanical properties of High performance concrete –25 th East- Asia –Pacific conference on structural engineering and construction -2011

5. A.M.Said, M.S .Zeidan and others –“Properties of concrete incorporating Nano-Silica “Construction and building materials –Vol-36, -pp 838-844 July 2012

6. Ali Heidari,Davoud Tavakoli –“A Study of Mechanical properties of ground ceramic powder concrete incorporating nano Si02 particles” –

7. Construction and Building Materials –Vol. 38 , pp 255-264, Sept 2012

8. Abell A B, Willis K L and Lange D A .1999, Mercury Intrusion Porosimetry and Image nalysis of Cement-Based Materials, J. Colloid Interface Sci. 211: 39–44

9. Adams, T. H. 1988, Marketing of fly ash concrete. In MSU seminar: Fly ash applications to concrete (January), 1.10, 5.10. East Lansing: Michigan State University.

10.ASCE. 2013, Civil Engineering. The Magazine of the American Society of Civil Engineers, 52-59.

11.ARI News (2005). “Nanotechnology in Construction – One of the Top Ten Answers to World’s Biggest Problems.”

12.www.aggregateresearch.com/article.asp?id=6279, June 1, 2007.

13.Bigley C. and Greenwood P. "Using Silica to Control Bleed and Segregation in Self-Compacting Concrete." Concrete, vol. 37, no. 2, p.43-45, 2003
14.Baierlein R 2003, Thermal physics. Cambridge University Press. ISBN 0-521- 658381
15.Bjornstrom J, Martinelli A, Matic A, Borjesson L and Panas I 2004 Accelerating effects of colloidal nano-silica for beneficial calcium–silicate– hydrate formation in cement, Chem. Phys. Lett. 392(1–3): 242–248
16.Bosiljkov V B 2003, SCC mixes with poorly graded aggregate and high volume of limestone filler, Cem.Concr. Res. 33(9): 1279–1286 Balaguru, P. N. 2005, "Nanotechnology and Concrete: Background, Opportunities and Challenges." Proceedings of the International Conference
17.– Application of Technology in Concrete Design,
18.Birgisson, B. 2006, "Nanomodification of cement paste to improve bulk properties of concrete." Presented at the National Science Foundation Workshop on Nanomodification of Cementitious Materials, University of Florida, Gainesville, FL.
19.Campillo, I., Guerrero, A., Dolado, J. S., Porro, A., Ibáñez, J. A., and Goñi, S. 2007, "Improvement of initial mechanical strength by Nano-
20.alumina in Belite cements." Materials Letters, 61(8-9):1889–1892.
21.Cardenas, H. E. and Struble, L. J. 2006, "Electrokinetic Nanoparticle treatment of hardened cement paste for reduction of permeability." Journal
22.of Materials in Civil Engineering, 18(4):554-560.
23.Cassar, L. 2005, "Nanotechnology and photocatalysis in cementitious materials." Proceedings of the 2nd international Symposium on
24.Nanotechnology in Construction. NANOC (Centre for Nanomaterials Applications in Construction), Bilbao, Spain, 277-283.
25.Future Perspectives", Denver, CO. BASF Group. 2008, http://www.basf.com. Accessed on April 1, 2013.
26.Goddard III, W.A., Brenner, D.W., Lyshevski, S.E. and Iafrate, G.J. "Properties of High-Volume Fly Ash Concrete Incorporating Nano-SiO2." Cement and Concrete Research, vol.34, p.1043-1049, 2004.
27.Liu, R., Zhang, Z., Zhong, R.; Chen, X.; Li, J. 2007, "Nanotechnology Synthesis Study: Research Report" Mann, S. (2006). "Nanotechnology and Construction," Nanoforum Report. www.nanoforum.org, May 30, 2008.

28.Scotland, UK, p.113-122. Bigley C. and Greenwood P. 2003. "Using Silica to Control Bleed and Segregation in Self-Compacting Concrete."
29.Concrete, vol. 37, no. 2, p.43-45
30.Roco, M. C., Williams, R. S., and Alivisatos, P. 1999, Nanotechnology Research Directions: IWGN Research Report. Committee on Technology, Interagency Working Group on Nanoscience, Engineering and Technology (IWGN), National Science and Technology Council.
31.Sobolev, K. and Gutierrez, M. F. 2005, "How Nanotechnology can Change the Concrete World," American Ceramic Society Bulletin, vol. 84,
32.no. 10, p. 14-16.
33.Song, Gl, Gu, H. and Mo,Y. 2008, "Smart Aggregates: Multi-Functional Sensors for Concrete Structures—a Tutorial and a review." Smart
34.Mater. Struct. vol.17.
35.Saafi, M. and Romine, P. 2005, " Nano- and Microtechnology." Concrete International, Vol. 27 No. 12, p 28-34. Sandvik Nanoflex Materials Technology. http://www.smt.sandvik.com/nanoflex.

Methods for Evaluation of the Soil Stabilization

Namra Fatima[a], Dr. Sanjeev Gill[b]
[a] M. Tech Scholar, Deptt. of Civil Engineering, UTU Dehradun, Uttarakhand (India)
[b] Professor, Deptt. of Civil Engineering, JBIT Dehradun, Uttarakhand (India)

ABSTRACT

Stabilization is a wide sense for the different techniques utilized and changing the properties of a dirt to further develop its designing presentation and utilized for an assortment of designing works. In the present soil stabilization is the serious issue for structural designers, either for development of street and furthermore for expanding the strength or dependability of soil and lessens the development cost. Soil stabilization can be made sense of as the modification of the dirt properties by compound or actual means to improve the designing nature of the dirt. The primary target of the dirt stabilization is to build the bearing limit of the dirt, its protection from enduring cycle and soil porousness. Because of fast development of urbanization and industrialization, minimization of modern waste is difficult issue in present days. To experience this inventive and modern examination on squander usage is acquiring significance now a days. Soil improvement utilizing the waste material like Slags, Rice husk debris, Silica rage and so on. In geotechnical designing has been recommended according to natural perspective. This paper audits because of impact heater slag, Fly ash and miniature silica when utilized as admixtures with dark cotton soil to work on different properties of soil.

Keywords: *Stabilization, Fly ash, Micro Silica, Blast Furnace Slag, C.B.R., U.C.S., B.C. Soil*

1. INTRODUCTION

Structural designing tasks situated in regions with delicate soil is quite possibly of the most well-known issue in many areas of the planet. The old common technique to delicate soil stabilization is to eliminate the delicate soil and supplant it with more grounded materials. The significant expense of this strategy has driven the scientists to search for elective techniques and one of these techniques is the course of the dirt stabilization. Soil stabilization is the strategy presented quite a long time back with primary reason to deliver the dirt equipped for meeting the necessities of the particular designing ventures. Furthermore, when the dirtat site are poor or when they have unfortunate property making them unacceptable for use in a geotechnical project, they might need to be balanced out. The improvement of soil can be characterized into a few classes, change or stabilization or both. The alteration can be directed by compaction or substitution of the first soil or blending soil in with another. While stabilization is the treatment of soils to empower their solidarity and strength to be worked on with the end goal that theyturn out to be absolutely reasonable for development. Many waste materials are utilized to adjust the attributes of delicate soils. The dirts are balanced out by lime, concrete, fly ash and so on. The designing properties of delicate soil subgrade layer might should be improved to make like soil really great for development by utilizing stabilization strategy. Asphalt subgrade stabilization depended on treatment with Impact heater slag, concrete, fly debris, and miniature silica seethe.

2. METHODOLOGIES

Mechanical Techniques for Stabilization

In this methodology, soils of various degrees are combined as one to get the ideal property in the soil. This might be finished at the site or at another spot from where it very well may be shipped without any problem. The last mix isthen compacted by the ordinary systems to get the necessary thickness.

Additive Technique For Stabilization:

The expansion of fabricated items into the dirt, which in suitable sums works on the idea of the soil. Materials, for example, concrete, lime, bitumen, fly ash and so on, are utilized as manufactured added substances.

-It improves the amount of the dirt thus, growing the dirt bearing breaking point.

-Stabilization upgrades the functionality and the strength of the dirt.

- It assists in reducing the dirt volume with evolving.

MATERIALS

1) Blast Heater Slag: -

Granulated Impact Heater Slag (GGBS) Impact heater slag is created as a side-effect during the production of iron in an impact heater. Liquid impact heater slag has a temperature of 1300-1600^{o}C and is chilled quickly to forestall crystallization. The granulated material subsequently delivered is known as granulated impact heater slag. Impact heater slag has a lustrous, confused, glasslike structure which should be visible to minute assessment which is liable for creating a solidifying result.

2) Fly Debris: -

Fly ash and base debris are important for ignition of non-flammable build-up or burning of sub-bituminous coal which had been created in a particularly colossal amount in electric plants and they are result of consuming coal that can be utilized without activators for soil stabilization.

3) Micro silica: -

Miniature silica smoulder is a modern waste delivered from the purifying system of silicon metal and ferrosilicon combination creation. It contains high measure of incredibly fine and amphrous size particles. Miniature silica rage has been utilized in structural designing fills in as a cover material in a mix with concrete materials or individual for soil stabilization and given extraordinary outcomes. Miniature silica seethe works on compressive strength, bond strength, scraped spot obstruction, and diminish penetrability, and its accessible in two circumstances: dry and wet.

3. LITERATURE REVIEW

- Amanpreet Tangri, Gagandeep "Impact of Impact Heater Slag on Different Properties of Clayey Soil: A Survey", Worldwide Diary for Logical Exploration and Improvement, ISSN (on the web): 2321-0613, Vol. 6, Issue 03, 2018.

In the present structural designing world once in a while the establishment soil isn't reasonable for development reason. This makes bunches of issue to structural architect during the execution. To make the risky soil appropriate for designing ventures is known as ground improvement. So with the end goal of ground improvement, we utilize various kinds of admixtures like concrete, lime, impact heater slag, rice husk debris, Fly ash and so forth. This paper audits because of impact heater slag when utilized alone or for certain different admixtures on different properties of clayey soil. From the trial results it has been found that by utilizing impact heater slag with admixtures like lime builds the worth ofU.C. S and C.B.R. furthermore, the variety is additionally tracked down in the compaction qualities of soil. In the wake of doing a survey of different examination papers we can finish up the by utilizing the impact heater slag we can lessen the natural contamination and it very well may be utilized for the stabilization of clayey soil. As we add Impact heater slag the

U.C.S and C.B.R esteem increments since cementation of soil by pozzolanic intensifies delivered during the response of soil with impact heater slag

- J Bala Krishna, "Soil Stabilization with Flyash", Global Diary of Exploration Sciences and High-level Designing, Volume 2, Issue 19, PP: 196 - 208, Jul - Sep:2017.

This exploration work presents the viability of sodium based soluble activators and class F Fly ash as an added substance in further developing the designing qualities of far-reaching Dark cotton soils. Sodium hydroxide centralizations of 10, 12.5 and 15 molal alongside 1 Molar arrangement of sodium silicate were utilized as activators. The activator to debris proportions was kept somewhere in the range of 1 and 2.5 and debris rates of 20, 30 and 40 %, somewhat to the absolute solids. The viability of this cover is tried by leading the Unconfined compressive strength (UCS) at restoring times of 3,7 and 28 days and is contrasted and that of a typical Fly ash-based fastener, likewise the best combinations were investigated for mineralogy with XRD. Reasonableness of soluble enacted Fly ash blend as a grouting material is likewise found out by concentrating on the rheological properties of the grout, for example, setting time, thickness and consistency and is contrasted and that of normal concrete grouts. Results shows that the ease of the grouts correspond very well with UCS, with an expansion in the previous bringing about a decline in the last option. In this work a groundbreaking thought of settling the extensive soil utilizing soluble base enacted Fly ash was examined. The compound sodium hydroxide and sodium silicate were utilized as a synthetic activator for the fly debris. The strategy for test planning, extent of substance added substance, relieving of test and changes in essential geotechnical properties of far-reaching soil

- Trama center. Rehana Rasool, trama center. Kshipra Kapoor, "Similar Concentrate on Stabilization of Soil with Ground Granulated Impact Heater Slag (GGBS)", Global Diary of Most recent Exploration in Science and Innovation, ISSN (Online):2278-5299, Volume 6, Issue 3, May-June 2017.

Use of modern waste materials in the improvement of risky soils is an expense proficient and furthermore ecological cordial technique as in it helps in lessening removal issues brought about by the different modern squanders. The primary target of the current review is to further develop different designing properties of the dirt by utilizing waste material Ground Granulated Impact Heater Slag (GGBS) as a choice to lime or concrete, to make it equipped for taking additional heaps from the establishment structures. This paper incorporates the assessment of soil properties like unconfined compressive strength test and California bearing proportion test. The dirt example was gathered from Lalru and expansion to that, various rates of GGBS (0%, 6%, 12%, 18 % and 24%). was added to track down the variety in its unique strength. In view of these outcomes CBR test was performed with the GGBS rates (0%, 6%, 12 %, 18 % and 24%). From these outcomes, it was seen that as ideal GGBS (18%) gives the most extreme addition in the CBR esteem contrasted and the wide range of various blends.
The review has been led to survey the capability of GGBS for stabilization of a similar sort of soil. Utilization of slag as an admixture for further developing designing properties of the dirts is a practical answer for utilize the locally accessible unfortunate soil.

- S.W. Thakare, Priti Chauhan, "Stabilization of Extensive Soil with Miniature Silica, Lime and Fly ash for Asphalt", Global Diary of Designing Exploration, ISSN:2319-6890(online), 2347-5013(print), Volume No.5IssueSpecial1pp:09-13 8 and 9 Jan 2016.

Geotechnical Designing properties of delicate clayey soil stores, for example, dark cotton soil might should be improved by stabilization to make such soils appropriate for development of street asphalts. Stabilization of such soils has been generally depended on treatment with lime, concrete and waste materials like fly debris. Miniature silica is squander material gotten from electric bend heaters. This paper presents the aftereffects of stabilization of neighborhood dark cotton soil with lime, Fly ash and miniature silica. Series of research center tests have been directed with fluctuating level of these stabilizers, added separately and in mixes, to decide their ideal rates. From the outcomes, it is seen that CBR esteem, for both splashed and unsoaked conditions, increments significantly by expansion of 5% miniature silica alongside 3% Fly ash and 3% lime. The asphalt planned with these better upsides of CBR demonstrated a noticeable decrease in its thickness prompting economy in the development of street asphalts on or utilizing delicate clayey soils.
Stabilization of dark cotton soil with lime, fly debris, lime and their mixes shows critical improvement in the unconfined compressive strength of soil to the degree of 3.8 times that of unstabilized soil. Ideal rates of miniature silica, lime and Fly ash for settling dark cotton soil are viewed as 5%, 3% and 3% separately. Dark cotton soil settled with lime, fly debris, miniature silica and their mixes shows observable improvement in absorbed CBR of soil to degree of 6.5 seasons of unstabilized soil. Dark cotton soil settled with lime, fly debris, miniature silica and their blends shows observable improvement in unsoaked CBR of soil up to degree of 1.8 seasons of unstabilized soil.

- Dayalan J, "Relative Concentrate on Stabilization of Soil with Ground Granulated Impact Heater Slag (GGBS) and Fly Debris", Global Exploration Diary of Designing and Innovation, e-ISSN: 2395 - 0056, p-ISSN: 2395-0072, Volume: 03 Issue: 05, May-2016

Stabilization is a wide sense for the different strategies utilized and changing the properties of a dirt to get to the next levelits designing presentation and utilized for an assortment of designing works. Soil stabilization has turned into the significant issue in development designing and the explores in regards to the viability of involving modern squanders as a stabilizer are quickly expanding. This concentrate momentarily depicts the reasonableness of the localfly ash and ground granulated impact heater slag (GGBS) to be utilized in the nearby development industry in a method for limiting how much waste to be arranged to the climate causing natural contamination. In this current review, different measure of Fly ash and GGBS are added independently for example 5, 10, 15 and 20% by dry load of soil are utilized to concentrate on the stabilization of soil. The presentation of settled soil are assessed utilizing physical and strength execution tests like explicit gravity, Atterberg limits, standard delegate test and California Bearing Proportion (CBR) test at ideal dampness content. From the outcomes, it was observed that ideal worth of Fly ash is 15% and GGBS is 20% for stabilization of given soil in light of not entirely settled.

The review has been led to evaluate the capability of fly ash and GGBS for stabilization of a similar sort of soil. It is seen that with the increments of fly ash and GGBS rate, ideal dampness content continues diminishing while greatest dry thickness continues expanding, consequently smaller capacity of soil increments and making the dirt thicker and harder.

- Abdelzaher E. A. Mostafa, Mohamed. S. Ouf and MokhtarF. Elgendy "Stabilization of Subgrade Asphalt Layer Utilizing Silica Smoke and Nano Silica" Worldwide Diary of Logical and Designing Exploration, Volume 7, Issue 3, Walk 2016

Numerous examinations have been completed on earth subgrade soil; utilizing a few kinds of stabilizers. Because of the expansion in rush hour gridlock loads and the significance of subgrade layer in fortify the asphalt segment to forestall the prior harm. In this study the initial step (in view of the planned exploratory program) tests were ready with and with no added substances; the pre-owned added substances were lime (L), silica seethe (SF), and nanosilica (NS). The attempted rates of lime were 2, 4, 6 and 8% and 5, 10 and 15% for SF, while 1, 2 and 3% utilized for NS. The subsequent step was to inspect the physical and mechanical properties of the pre-arranged blends utilizing changed delegate test, Atterberg limits test, free enlarging (FS%) test, unconfined compressive strength (UCS) and California Bearing Proportion (CBR) tests. At last, direct shear (DS) test was completed on the ideal blends from the subsequent step. All blends were tried after two restoring periods 7 and 28 days utilizing UCS and FS%. The outcomes demonstrated that the ideal dampness content (OMC) expanded, while the most extreme dry thickness (MDD) emphatically diminished for every single utilized added substance and versatility list (private investigator) diminished. The FS% diminished, and the most extreme decrease in FS% was happened at the two mixes (8% L + 15% SF) and (8%L+3%NS).

The UCS expanded by adding both SF and NS actuated by lime to the test soil , and the ideal rates of the two mixes were happened at 6%L+10%SF and 6%L+3%NS for customary and nanomaterials added substances individually. Thus, control tests and the two ideal blends have been arranged for CBR and DS tests. The DS test was completed at dry and lowered conditions, while CBR test was done at splashed condition. The outcomes showed that the greatest worth of CBR happened at 8% L + 10% SF, while DS results demonstrated that adding 6L+10SF and 6L+3NS, the dirt boundaries (union and inward grinding point) have been moved along

- Anil Kumar Sharma, P.V. Sivapullaiah, "Ground granulated impact heater slag changed Fly ash as an extensive soil stabilizer" The Japanese Geotechnical Society Soils and Establishments, 2016; 56(2):205-212

The capability of involving a fastener for stabilization of far-reaching soils that comprises of a combination of Fly ash and ground granulated impact heater slag (GGBS) is assessed in this review. The cooperative utilization of these two materials to shape a cover gives new chances to upgrade pozzolanic exercises that might lessen the swell potential and increment the unconfined compressive strength of sweeping muds. The impact of various rates of cover on as far as possible, compaction qualities and unconfined compressive strength of a misleadingly blended soil were inspected. The expansion of fastener was displayed to achieve a huge improvement in these dirt properties. It was found that as far as possible and versatility record of the extensive soil diminished impressively with the expansion of cover, while the strength gotten to the next level. Adding a limited quantity of lime (one percent) further superior the dirt properties by upgrading the pozzolanic reactivity of the cover. In view of the consequences of the unconfined compressive strength tests, the expansion of 20% folio is suggested as ideal substance. Moreover, the mineralogical and morphological investigations of soil example balanced out with ideal folio content recommended the development of hydrated particles and cementitious mixtures because of the response between the mud and the cover. Test results show that the utilization of GGBS blended Fly ash as fastener to balance out extensive

is appropriate for supportable development other than financial advantages.
In this review, a falsely blended far reaching soil was balanced out with various measures of folio, basically comprising of fly ash and GGBS at a blending proportion of 7:3. The goal of this exploration was to survey the impact of Fly ash GGBS put together cover with respect to the actual properties and unconfined compressive strength of the dirt.

- Chhaya Negi , R.K.Yadav , A.K. Singhai, "Impact of Silica Smoke on Designing Properties of Dark Cotton Soil", Worldwide Diary of Computational Designing Exploration, Vol, 03, Issue, 7.

Because of quick development of urbanization and industrialization, minimization of modern waste is difficult issue in present days. To experience this ennovative and forward-thinking research on squander use is acquiring significances now a days. Soil improvement utilizing the waste material like Slags, Rice husk debris, Silica rage and so on, in geotechnical designing has been recommended according to ecological perspective. The primary goal of this study is to assess the practicality of utilizing Silica seethe as soil stabilization material. In this paper the impact of Silica rage on designing attributes of far-reaching earth like Dark Cotton Soil has been introduced. A progression of research center examination has been led on dark cotton soil mixed with Silica smoulder content from 5% to 20% by weight of dry soil. The trial results showed a huge expansion in California bearing proportion and Unconfined compressive strength. The Differential free swell of the earth is decreased from half to 7% with expansion in Silica seethe content from 0% to 20% separately. The Delegate compaction results showed a little reduction in greatest dry thickness and expansion in Ideal dampness content. From this examination it very well may be presumed that the Silica smoulder as a possibility to work on the qualities of dark cotton soil.
The BC soil-Miniature Silica change the delegate compaction boundaries. The expansion of silica smoke to the dark cotton soil increments the ideal dampness content and diminishes the greatest dry thickness with the expansion in silica seethe content. The expansion of silica smoke to the dark cotton soil further develops the doused CBR significantly. The expansion of 20% silica smoke to the dark cotton soil builds the CBR strength by 72% around. There is a critical reduction in

the enlarging characteristics of the dirt. The level of breadth reduces from "High to Low"

4. CONCLUSION

Subsequent to doing a survey of different examination papers we can finish up the by utilizing the impact heater slag we can diminish the natural contamination and it very well may be utilized for the stabilization of clayey soil. The essential advantages of involving these added substances for soil stabilization are Cost Reserve funds: since slag is commonly less expensive than concrete and lime; and Accessibility: since slag sources are effectively accessible the nation over from adjacent steel plants. Squander the board one of the modern squanders should be possible monetarily. Utilization of slag as an admixture for further developing designing properties of the dirts is a prudent answer for utilize the locally accessible unfortunate soil.

Stabilization of dark cotton soil with lime, fly debris, lime and their mixes show critical improvement in the unconfined compressive strength of soil to the degree of 3.8 times that of unstabilized soil.

It is seen that with the increments of fly ash and GGBS rate, ideal dampness content continues diminishing while most extreme dry thickness continues expanding, subsequently smaller capacity of soil increments and making the dirt thicker and harder

REFERENCES

1 JBala Krishna, “Soil Stabilization with Flyash”,International Journal of Research Sciences and Advanced Engineering,Volume 2,Issue19,PP:196-208,Jul–Sep:2017.

2 Er.Rehana Rasool ,Er.Kshipra Kapoor,“Comparative Study on Stabilization Of
Soil with Ground Granulated Blast Furnace Slag (GGBS)”,International Journal of Latest Research in Scienceand Technology, ISSN (Online):2278-5299, Volume6,Issue3,May-June2017

S.W.Thakare, Priti Chauhan,“Stabilization of Expansive Soil with Micro Silica, Lime and Fly ash for Pavement”,International Journal

of Engineering Research ,ISSN:2319-6890(online),2347-5013(print), VolumeNo.5, Issue Special 1pp:09-13,8 &9Jan 2016

The Effects of Air Pollution on Human Health

Namra Fatima[a], Bhaskar Singhal[b]
[a]M. Tech Scholar, Deptt. of Civil Engineering, UTU Dehradun, Uttarakhand (India)
[b]Assistant Professor, Deptt. of Civil Engineering, JBIT Dehradun, Uttarakhand (India)

ABSTRACT

Dangerous synthetic substances break to the climate by various regular or potentially anthropogenic exercises and may cause antagonistic impacts on human wellbeing and the climate. Expanded burning of non-renewable energy sources somewhat recently is liable for the dynamic change in the atmospheric creation. Air poisons, like carbon monoxide (CO), sulfur dioxide (SO_2), nitrogen oxides (NOx), unstable natural mixtures (VOCs), ozone (O_3), weighty metals, and respirable particulate matter ($PM_{2.5}$ and PM_{10}), vary in their synthetic creation, response appropriate ties, discharge, season of deterioration and capacity to diffuse in lengthy or brief distances. Air contamination affects human wellbeing, influencing various frameworks and organs. It goes from minor upper respiratory disturbance to constant respiratory and coronary illness, cellular breakdown in the lungs, intense respiratory contaminations in kids and persistent bronchitis in grown-ups, exasperating previous heart and lung sickness, or asthmatic assaults. Furthermore, short-and long-haul openings have likewise been connected with untimely mortality and decreased future. These impacts of air toxins on human wellbeing and their instrument of activity are momentarily examined.

Keywords: *Airpollutant; Humanhealth; Cellularactions; Detoxificati*

1. INTRODUCTION

Despite the fact that a variety of natural occurrences (volcanoes, fire, etc.) have the potential to discharge a variety of pollutants into the environment, anthropogenic activities are the main contributor to environmental air pollution. However, a number of air pollutants are discharged by industrial facilities and other activities and may have adverse impacts on both human health and the ecosystem. Hazardous chemicals can accidentally escape into the environment. Any substance that has the potential to harm people, animals, plants, or other materials is by definition an air pollutant. In terms of people, an air pollution may increase the risk of death or serious disease, pose a risk to their health now or in the future, or all of these things. determining whether or not a material is dangerous to human health.

2. POLLUTANT CATEGORIES

The burning of fossil fuels for the production of energy and transportation is the primary cause of the major change in the composition of the atmosphere. Numerous air pollutants have been identified, each with unique chemical make-ups, reactions, emissions, environmental permanence, ability to travel over long or short distances, and potential effects on human and/or animal health. However, they do have some things in common, and they fall into one of four categories:

1. Pollutants that are gaseous, such as SO_2, NOx, CO, ozone, and volatile organic compounds.
2. Long-lasting organic contaminants, such as dioxins.
3. Heavy metals, including lead and mercury.
4. Particulate Matter.

Gaseous pollutants are mostly caused by the combustion of fossil fuels and play a significant role in changes in the composition of the atmosphere (Katsouyanni, 2003). Nitrogen oxides are released as NO, which combines quickly with ozone or other airborne radicals to generate NO2. Mobile and stationary combustion sources are the principal anthropogenic sources of emissions. Additionally, sunlight triggers a sequence of processes involving NO2 and volatile organic molecules that result in the formation of ozone in the lower atmospheric layers. On the other hand, incomplete combustion results in the production of CO. The main source of it is also the road system. While the combustion of sulfur-containing fossil fuels (mostly coal and heavy oils) and the smelting of sulfide-containing ores produce anthropogenic SO2, volcanic eruptions and oceans are its major natural sources. The latter account for just 2% of all emissions. The so-called volatile organic compounds (VOCs) are a significant class of substances that fuel combustion, particularly combustion processes for energy production and vehicle transport, which are the largest source of emission. This group of chemicals comprises chemical species with an organic character, including benzene. Even while most gaseous pollutants are breathed and primarily have an adverse effect on the respiratory system, they can also cause cancer and haematological issues (CO, benzene).

Continually present organic pollutants are a dangerous class of chemicals. They linger in the environment for a long time, and when they ascend the food chain, their effects are amplified (bio-magnification). Pesticides, as well as dioxins, furans, and PCBs, are among them. Dibenzo-dioxins (PCDDs) and polychlorinated dibenzo-furans (PCDFs) are generally referred to as "dioxins," although polychlorinated biphenyls (PCBs) are referred to as "dioxin like compounds" and can operate similarly in terms of dioxin-type toxicity (Schecter et al., 2006). Dioxins are produced anytime materials containing chlorine (such plastics) are burned, as well as during incomplete combustion. Dioxins are airborne pollutants that deposit on soil and water but do not affect groundwater supplies because they are not water soluble. Most dioxins in plants come from air and residue or pesticides and enter the natural order of things where they bio-amass because of their capacity to be steadily bound to lipids.

Weighty metals incorporate essential metal components, for example, lead, mercury, cadmium silver nickel, vanadium, chromium and manganese. They are regular parts of the world's outside layer; they can't be debased or annihilated, and can be shipped via air, and enter water and human food supply. Furthermore, they enter the climate through a wide assortment of sources, including burning, squander water releases and manufacturing offices. To a little degree they enter human bodies where, as minor components, they are fundamental to keep up with the typical metabolic responses. Be that as it may, at higher (in spite of the fact that relatively low) focuses they can become harmful (Jarup, 2003). Most weighty metals are hazardous in light of the fact that they tend to bio-gather in the human body. Bioaccumulation implies an expansion in the centralization of a synthetic in a biological life form over the long run, contrasted with the compound's focus in the climate. Compounds amass in organic entities any time they are taken in and put away quicker than they are separated (used) or discharged.

Particulate matter (PM) is the conventional term utilized for a sort of air contaminations, comprising of complicated and differing combinations of particles suspended in the breathing air, which shift in size and organization, and are delivered by a wide assortment of regular and anthropogenic exercises (Poschl, 2005). Significant wellsprings of particulate contamination are industrial facilities, power plants, re-combine incinerators, engine vehicles, development action, flames, and normal windblown residue. The size of the particles differs (PM2.5 and PM10 for streamlined width more modest than2.5 mm and 10 mm separately) and various classes have been characterized: Ultrafine particles, less than 0.1 mm in streamlined distance across, Fine particles, less than 1 mm, and Coarse particles, bigger than 1 mm. The size of the particles decides the site in the respiratory lot that they will store: PM10 particles store chiefly in the upper respiratory parcel while fine and ultra-fine particles can arrive at lung alveoli. Up to this point, no single part has been distinguished that could make sense of a large portion of the PM impacts. Among the boundaries that assume a significant part for evoking wellbeing impacts are the size and surface of particles, their number and their composition. The organization of PM changes, as they can ingest and move a huge number of poisons. In any case, their major com-ponents are metals, natural mixtures, material of biologic beginning, particles, responsive gases, and the molecule carbon center. There is solid proof to help that ultra-fine and fine particles are more dangerous than bigger ones (coarse particles), regarding mortality and cardiovascular and respiratory impacts. Moreover, the metal substance, the presence of PAHs and other natural parts like endotoxins, fundamentally add to PM poisonousness.

ROUTES OF OPENNESS

People enter in touch with various air poisons primarily by means of inward breath and ingestion, while dermal contact rep-loathes a minor course of openness. Air contamination contributes, by and large, to the tainting of food and water, which makes ingestion in a few cases the significant course of poison consumption (Thron, 1996). Through the gastrointestinal and respiratory parcel, retention of contaminations might happen, while various harmful substances can be tracked down in the overall flow and store to various tissues. Disposal happens partially by discharge (Rankle and Fowler, 2000).

HEALTH IMPACTS

Irregular air contamination occasions, similar to the notable London haze in 1952 and various short and long haul epidemiological examinations researched the impacts of air quality changes on hu-man wellbeing. A steady finding is that air contaminations add to expanded mortality and emergency clinic confirmations (Brunekreefand Holgate, 2002). The different sythesis of air pollut-insects, the portion and season of openness and the way that people are normally presented to poison combinations than to single sub-positions, can prompt assorted influences on human wellbeing. Human wellbeing impacts can go from sickness and trouble in breath-ing or skin aggravation, to disease. They likewise incorporate birth deserts, serious formative defers in kids, and decreased action of the resistant framework, prompting various illnesses. More-finished, there exist a few vulnerability factors, for example, age, nu-tritional status and inclining conditions. Wellbeing impacts can be recognized to intense, persistent excluding malignant growth and harmful. Epidemiological and creature model information demonstrate that basically impacted frameworks are the cardiovascular and the respiratory framework. In any case, the capability of a few different organs can be likewise impacted (Cohen et al., 2005; Huang and Ghio, 2006; Kunzli and Tager, 2005; Sharma and Agrawal, 2005).

3. EFFECTS OF AIR CONTAMINATIONS ON VARIOUS ORGANS AND FRAMEWORKS

Respiratory Framework

Various examinations depict that a wide range of air contamination, at high focus, can influence the aviation routes. In any case, sim-ilar impacts are additionally seen with long haul openness to bring down contamination focuses. Side effects like nose and throat ir-ritation, trailed by bronchoconstriction and dyspnoea, espe-cially in asthmatic people, are typically capable after openness to expanded degrees of sulfur dioxide (Balmes et al., 1987), nitrogen oxides (Kagawa, 1985), and certain weighty metals like arsenic, nickel or vanadium. Also particulate matter that enters the alveolar epithelium (Ghio and Huang, 2004) and ozone start lung irritation (Uysal and Schapira, 2003). In patients with lung sores or lung dis-facilitates, poison started irritation will deteriorate their con-dition. Besides air contaminations, for example, nitrogen oxides increment the helplessness to respiratory diseases (Chauhan et al., 1998). At long last ongoing openness to ozone and certain weighty metals diminishes lung capability (Rastogi et al., 1991; Tager et al., 2005), while the later are additionally liable for asthma, emphysema, and even cellular breakdown in the lungs (Kuo et al., 2006; Nawrot et al., 2006). Emphysema-like sores have additionally been seen in mice presented to nitrogen dioxide (Wegmann et al., 2005).

Cardiovascular Framework

Carbon monoxide ties to hemoglobin changing its con-arrangement and decreases its ability to move oxygen (Badman and Jaffe, 1996). This diminished oxygen accessibility can influence the capability of various organs (and particularly high oxygen-consuming organs like the mind and the heart), bringing about debilitated focus, slow reflexes, and disarray. Aside from lung aggravation, fundamental provocative changes are induced by particulate matter, influencing similarly blood coagulation (Riediker et al., 2004). Air contamination that actuates lung disturbance and changes in blood coagulating can block (heart) veins, prompting angina or even to myocardial infraction

(Vermylen et al., 2005). Side effects, for example, tachycardia, in-wrinkled circulatory strain and weakness because of an inhibitory impact on haematopoiesis have been seen as a result of weighty metal contamination (explicitly mercury, nickel and arsenic) (Huang and Ghio, 2006). At last, epidemiologic examinations have connected dioxin openness to expanded mortality brought about by ische-mic coronary illness, while in mice, it was demonstrated the way that weighty metals can likewise increment fatty oil levels (Dalton et al., 2001).

Nervous Framework

The sensory system is essentially impacted by weighty metals (lead, mercury and arsenic) and dioxins. Neurotoxicity prompting neuropathies, with side effects, for example, memory aggravations, rest issues, outrage, weariness, hand quakes, obscured vision, and slurred discourse, have been seen after arsenic, lead and mercury openness (Ewan and Pamphlett, 1996; Ratnaike, 2003). Particularly, lead openness makes injury the dopamine framework, glutamate framework, and N-methyl-D-Aspartate (NMDA) receptor complex, which assume a significant part in memory capabilities (Lasley and Gilbert, 2000; Lasley et al., 2001). Mercury is additionally answerable for specific instances of neurological can-cer. Dioxins decline nerve conduction speed and disabled mental advancement of kids (Thomke et al., 1999; Walkowiak et al., 2001).

Urinary Framework

Weighty metals can initiate kidney harm, for example, an underlying cylindrical brokenness proved by an expanded discharge of low atomic weight proteins, which advances to diminished glomerular filtration rate (GFR). Furthermore they increment the gamble of stone arrangement or nephrocalcinosis (Damek-Poprawa and Sawicka-Kapusta, 2003; Jarup, 2003; Loghman-Adham, 1997) and renal malignant growth (Boffetta et al., 1993; Vamvakas et al., 1993).

Digestive Framework

Dioxins actuate liver cell harm (Kimbrough et al., 1977), as demonstrated by an expansion in levels of specific chemicals in the blood (see following conversation on the fundamental cell components of activity), as well as gastrointestinal and liver malignant growth (Mandal, 2005).

- **Exposure During Pregnancy**

Somewhat critical to make reference to air contaminations can likewise influence the creating hatchling (Schell et al., 2006). Maternal openness to weighty metals and particularly to lead, expands the dangers of unconstrained fetus removal and decreased fetal development (pre-term conveyance, low birth weight). There are likewise proves proposing that parental lead openness is additionally answerable for intrinsic distortions (Bellinger, 2005), and sores of the creating sensory system, causing significant debilitation in infant's engine and mental capacities (Garza et al., 2006). Additionally, dioxins were viewed as moved from the mother to the hatchling through the placenta. They go about as endocrine disruptors and influence development and improvement of the focal anxiousarrangement of the hatchling (Wang et al., 2004). In this regard, TCDD is considered as a formative poison in all species inspected.

4. CELLULAR COMPONENTS ENGAGED WITH AIR CONTAMINATIONS ACTIVITIES

Normal cell component by which most air poisons apply their unfavorable impacts is their capacity to act straightforwardly as supportive of oxidants of lipids and proteins or as freerevolutionariesgenerators, advancing oxidative pressure and the enlistment of incendiary reactions (Menzel, 1994; Rahman and MacNee, 2000). Free revolutionaries (responsive oxygen and nitrogen species) are destructive to cell lipids, proteins, and atomic or mitochondrial-DNA, repressing their typical capability (Valko et al., 2006). What's more, they can obstruct flagging pathways inside cells (Valko et al., 2006). In eukaryotic high-impact living beings including people, free extremists are consistently produced during ordinary digestion and in light of exogenous environmental openings (for example light, tobacco smoke, metals and ozone). At the point when free extreme fixation expands, because of a mind-boggling of life form's guard, a condition of oxidative pressure happens. This oxidative state has been ensnared in a wide assortment of degenerative illnesses, for example, atherosclerosis, respiratory failures, stir up, constant fiery sicknesses (rheumatoid joint pain), waterfall, focal sensory system issues (Parkinson's, and Alzheimer's sickness), age related messes lastly disease.

Moreover, the poisonous impacts of weighty metals, aside from actuating oxidative pressure, can be additionally credited to their capacity to substitute different polyvalent cations (calcium, zinc, and magnesium) that capability as charge transporters, mediators in catalyzed responses, or as primary components in the maintenance of protein conformity. For sure, metals aggregate in cell organelles and disrupt their capability. For example it has been seen that lead collection in mitochondria prompts a few changes, for example, hindrance of Ca2þ take-up, decrease of the transmembrane potential, oxidation of pyridine nucleotides, and a quick arrival of gathered Ca2þ (Chavez et al., 1987). Besides, metals tie to proteins(Goering, 1993) and hinder countless proteins, including the mitochondrial ones (Rossi et al., 1993). Nucleic corrosive restricting proteins are additionally involved, while it has been demonstrated the way that metals can likewise tie to DNA, influencing the expression of qualities. For instance nickel enters the core, connects with chromatin and quiets the statement of qualities, for example, cancer silencer qualities, instigating carcinogenesis (Costa et al., 2003). At long last, a few metals disrupt different volt-age-and ligand-gated ionic channels applying neurotoxic effects. For example lead influences the N-methyl-D-aspartic corrosive (NMDA) receptor, subtypes of voltage-and calcium-gated potassium channels, cholinergic receptors and voltage-gated calcium channels (Garza et al., 2006; Toscano and Guilarte, 2005).

Dioxin causes a wide scope of unfavorable impacts (Birnbaum, 1994): they modify digestion by instigating various metabolic chemicals (for example CYPs, glutathione-transferase, tyrosine kinase and so on), homeostasis, through chemical regulation (for example estrogens, androgens glucocorticoids, insulin, thyroid hormones) and their receptors, and development and separation by slowing down development factors (for example EGF, TGFa, TNFa) and their receptors. At the cell level, dioxins communicate with the aryl hydrocarbon receptor (AhR) (Schwarz et al., 2000) which has an essential helix-circle helix space, going about as a record factor after atomic movement, permitting interaction of dioxins with DNA. The receptor-ligand complex ties to explicit locales on DNA, changing the declaration of various qualities.

All things considered from the information introduced above obviously most toxins assume a significant part in the commencement, advancement and movement of disease cells (Fig. 1).

5.NATURAL SECURITY

In our everyday life we are uncovered in various types of poisons. Wellbeing influences, as currently portrayed above, rely upon the contamination type, its fixation, length of openness, other existing together poisons and individual vulnerability.

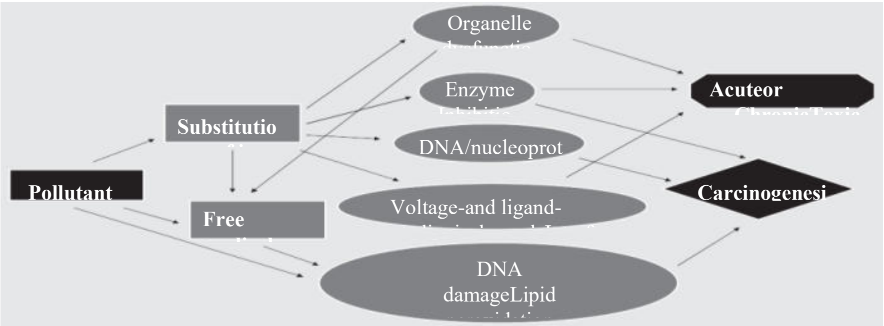


FIG.1.BASIC MECHANISMS OF CAR CINOGENESIS

Individuals living in urban communities are presented positively, as a con-grouping of expanded industrialization and requests for energy and engine vehicles. Word related openness is additionally a significant component that ought to be thought about. During the last ten years, wellbeing impacts of air contamination are concentrated on additional in created nations, while more and better environ-mental checking information are expected to arrangement limit levels. Furthermore endeavors ought to be heightened by going to the fitting lengths, to decrease the chance of hu-man poison openness.

The human body, to safeguard itself against the potential hurtful put-downs from the climate, is furnished with drug or xenobiotic utilizing proteins (DMEs or XMEs) that assume a focal part in the biotransformation, digestion as well as detoxification of xenobiotics or unfamiliar mixtures, including various types of contaminations. XMEs incorporate different catalysts like cytochrome P450 (P450 or CYP), epoxide hydrolase, glutathione transferase, UDP-glucuronosyltransferase, sulfotransferase, NAD(P)H quinone oxidoreductase 1, and aldo-keto reductase. These chemicals fundamentally partake in the transformation of xenobiotics to more polar and water-dissolvable metabolites, which are promptly discharged from the body. At long last, it ought to be noticed that, by and large, the synthetically responsive metabolites delivered during digestion, are similarly destructive and hence go through extra digestion to inert products. Thus, the ultimate result of a compound balancing the detoxification catalyst frameworks is the outcome the consequences for the different metabolic pathways.

Various substances of dietary nature are gainful, defensive, and steady of good wellbeing and the body's own normal chelation components. They incorporate supplements with regular chelating properties, which might assist with detoxifying the body, like cell reinforcements, spices, minerals, fundamental amino acids, other detoxifying or defensive specialists, and fiber (Kelly, 2004). Among them dietary cell reinforcements add to the living being's cell reinforcement protection framework, that incorporates a progression of cancer prevention agent enzymatic (for example peroxidase) and non-enzymatic mixtures, (for example, glutathione, or food-inferred like vitamin E, or polyphenols), as well as harm evacuation/fix proteins.

A few regular mixtures, like nutrients C, E, and An and polyphenols, tracked down in most of plant food varieties, between fere with or search ROS focus inside cells and sub-sequently shield the organic entity from the unfriendly impacts of oxidative pressure. For sure, as it has been shown by our gathering that the cell reinforcement movement of plasma in people following an eating regimen wealthy in vegetables, products of the soil oil was expanded in contrast with a typical eating routine (Kampa et al., 2002). This in-wrinkle can be primarily credited to polyphenols which display a great many organic exercises, including hostile to tumorigenic, against mutagenic, calming, and antiviral activities (Bravo, 1998; Hertog and Hollman, 1996) fundamentally because of their cell reinforcement properties and their capacity to apply inhibitory effects by influencing essential cell capabilities. To be sure the beneficial job of polyphenols in forestalling disease can be to some degree ascribed to their capacity to adjust catalysts that actuate or detoxify natural cancer-causing agents.

5. CONCLUSION

This short survey presents the unfavorable impacts of various (air) poisons in human wellbeing. As displayed, major impairments of various organs can be noticed. The principal conclusion drawn is that, considering expanded openness of people in a variety of contaminations, dietary mediations, wealthy in plant-determined food varieties, may safeguard or diminish their consequences for various organs. This decision is upheld by various epidemiological investigations on the valuable impact of a Mediterranean-type diet on human wellbeing.

REFERENCES

1. Badman, D.G., Jaffe, E.R., 1996. Blood and air pollution: state of knowledge and research needs. Otolaryngol. Head Neck Surg. 114, 2005.
2. Balmes, J.R., Fine, J.M., Sheppard, D., 1987. Symptomatic bronchoconstriction after short-term inhalation of sulfur dioxide. Am. Rev. Respir. Dis. 136, 1117.
3. Bellinger, D.C., 2005. Teratogen update: lead and pregnancy. Birth Defects Res. A Clin. Mol. Teratol 73, 409.
4. Birnbaum, L.S., 1994. The mechanism of dioxin toxicity: relationship to risk assessment. Environ. Health Perspect. 102(Suppl. 9), 157.
5. Boffetta, P., Merler, E., Vainio, H., 1993. Carcinogenicity of mercury and mercury compounds. Scand. J. Work Environ Health 19, 1.
6. Bravo, L., 1998. Polyphenols: chemistry, dietary sources, metabolism, and nutritional significance. Nutr. Rev. 56, 317.
7. Brunekreef, B., Holgate, S.T., 2002. Air pollution and health. Lancet 360, 1233. Chauhan, A.J., Krishna, M.T., Frew, A.J., Holgate, S.T., 1998. Exposure to nitrogen dioxide (NO2) and respiratory disease risk. Rev. Environ. Health 13, 73.
8. Chavez, E., Jay, D., Bravo, C., 1987. The mechanism of lead-induced mitochondrial Ca2+ efflux. J. Bioenerg. Biomembr 19, 285.
9. Cohen, A.J., Ross Anderson, H., Ostro, B., Pandey, K.D., Krzyzanowski, M., Kunzli, N., Gutschmidt, K., Pope, A., Romieu, I.,

Samet, J.M., Smith, K., 2005. The global burden of disease due to outdoor air pollution. J. Toxicol. Environ. Health A 68, 1301.
10. Costa, M., Yan, Y., Zhao, D., Salnikow, K., 2003. Molecular mechanisms of nickel carcinogenesis: gene silencing by nickel delivery to the nucleus and gene activation/inactivation by nickel-induced cell signaling. J. Environ. Monit. 5, 222.
11. Dalton, T.P., Kerzee, J.K., Wang, B., Miller, M., Dieter, M.Z., Lorenz, J.N., Shertzer, H.G., Nerbert, D.W., Puga, A., 2001. Dioxin exposure is an environmental risk factor for ischemic heart disease. Cardiovasc. Toxicol. 1, 285. Damek-Poprawa, M., Sawicka-Kapusta, K., 2003. Damage to the liver, kidney, and testis with reference to burden of heavy metals in yellow necked mice from areas around steelworks and zinc smelters in Poland. Toxicology 186, 1.
12. Ewan, K.B., Pamphlett, R., 1996. Increased inorganic mercury in spinal motor neurons following chelating agents. Neurotoxicology 17, 343.
13. Garza, A., Vega, R., Soto, E., 2006. Cellular mechanisms of lead neurotoxicity. Med. Sci. Monit. 12, RA57.
14. Ghio, A.J., Huang, Y.C., 2004. Exposure to concentrated ambient particles (CAPs): a review. Inhal. Toxicol. 16, 53.
15. Goering, P.L., 1993. Lead-protein interactions as a basis for lead toxicity. Neurotoxicology 14, 45.
16. Hertog, M.G., Hollman, P.C., 1996. Potential health effects of the dietary flavonol quercetin. Eur. J. Clin. Nutr. 50, 63.
17. Huang, Y.C., Ghio, A.J., 2006. Vascular effects of ambient pollutant particles and metals. Curr. Vasc. Pharmacol. 4, 199.
18. Jarup, L., 2003. Hazards of heavy metal contamination. Br. Med. Bull. 68, 167.
19. Kagawa, J., 1985. Evaluation of biological significance of nitrogen oxides exposure. Tokai J. Exp. Clin. Med. 10, 348.
20. Kampa, M., Nistikaki, A., Tsaousis, V., Maliaraki, N., Notas, G., Castanas, E., 2002. A new automated method for the determination of the Total Antioxidant Capacity (TAC) of human plasma, based on the crocin bleaching assay. BMC Clin. Pathol. 2, 3.

21. Katsouyanni, K., 2003. Ambient air pollution and health. Br. Med. Bull. 68, 143.
22. Kelly, F.J., 2004. Dietary antioxidants and environmental stress. Proc. Nutr. Soc. 63, 579.
23. Kimbrough, R.D., Carter, C.D., Liddle, J.A., Cline, R.E., 1977. Epidemiology and pathology of a tetra chlorodibenzodioxin poisoning episode. Arch. Environ. Health 32, 77.
24. Kunzli, N., Tager, I.B., 2005. Air pollution: from lung to heart, Swiss Med. Wkly 135, 697.
25. Kuo, C.Y., Wong, R.H., Lin, J.Y., Lai, J.C., Lee, H., 2006. Accumulation of chromium and nickel metals in lung tumors from lung cancer patients in Taiwan. J. Toxicol. Environ. Health A 69, 1337.
26. Lasley, S.M., Gilbert, M.E., 2000. Glutamatergic components underlying lead-induced impairments in hippocampal synaptic plasticity. Neurotoxicology 21, 1057.
27. Lasley, S.M., Green, M.C., Gilbert, M.E., 2001. Rat hippocampal NMDA receptor binding as a function of chronic lead exposure level. Neurotoxicol. Teratol. 23, 185.
28. Loghman-Adham, M., 1997. Renal effects of environmental and occupational lead exposure. Environ. Health Perspect. 105, 928.
29. Madden, E.F., Fowler, B.A., 2000. Mechanisms of nephrotoxicity from metal combinations: a review. Drug Chem. Toxicol. 23, 1.

Performance Evaluation of Ordinary Portland cement Containing Minerals

Namra Fatima[a], Manish Kumar[a]
[a]M. Tech Scholar, Deptt. of Civil Engineering, UTU Dehradun, Uttarakhand (India)
[b]Assistant Professor, Deptt. of Civil Engineering, JBIT Dehradun, Uttarakhand (India)

ABSTRACT

It is said that the construction of a nation's infrastructure is that nation's greatest achievement. Because cement and steel are such essential building resources, a nation's consumption of these commodities on a per capita basis can serve as a good measure of its degree of development. Concrete and the substance that acts as its principal precursor, Ordinary Portland Cement (OPC), are so essential to modern society that it is difficult to imagine a future without either of them. In spite of the fact that several kinds of concrete have been developed for specialized applications, the advantages that come with working with any kind of concrete include its low cost, adaptability, durability, and simplicity. The cement industry is thriving all throughout the world, including in India. It is essential for an engineer to select a high-quality cement, despite the fact that there are many new possibilities available. Inadequate cement quality is a common contributor to the failure of construction projects. In this investigation, we will investigate the factors that have a role in determining the type of cement used as well as the classification of cement strength. Controlling the quality of the cement and ensuring that it is consistent in quality are both absolutely necessary. By selecting cement of an adequate quality, it will be possible to provide some level of protection for the project.

Keywords *–high quality cement, OPC, steel, strength*

1. INTRODUCTION

When it comes to cement production, India ranks second worldwide. Deregulation of the industry in 1982 opened the door to massive investment from both domestic and international companies. Several reforms and adjustments were made in India's cement business so that it would be more in line with government regulations and the industry's bottom line. There was a dramatic increase in cement production from nearly 5 million tons in 1952 to over 54 million tons in 1993. Poor cement quality and growing production costs as a result of government regulation over a long period of time have led to similarly subpar concrete construction.
Cement demand in India is expected to increase due to government's push for large infrastructure projects, leading to 45 million tonnes (MT) of cement needed in the next three to four years. India's cement demand is expected to reach 550-600 Million Tonnes Per Annum (MTPA) by 2025. The housing sector is the biggest demand driver of cement, accounting for about 67 per cent of the total consumption in India. The other major consumers of cement include infrastructure at 13 per cent, commercial construction at 11 per cent and industrial construction at 9 per cent. The partial relaxation of Government control from March 1982 and a total relaxation of control after March 1989 revived the cement industry and resulted in its phenomenal growth. This resulted in a competitive market and cement manufactures had to improve their quality of cement, as it was now a battle for survival of the best.
After late 80s cement manufacturers took a huge step modernizing their old plants, which were in various stages of obsolescence. The wet process plants were converted to more economical and dry efficient process or semi-dry process plants. This leads to the production of high quality cement. Several leading organizations diversified into cement manufacture and thereby created the much desired consumer oriented market with the range of brands available at competitive prices. The 33-grade ordinary Portland cement (IS: 269-1989) has virtually disappeared and is displaced by higher strength ordinary Portland cement of 43-grade (IS: 8112-1989) and 53-grade (IS: 12269-1987).

2. SELECTION OF HIGH QUALITY CEMENT

Since there are various options available in market the consumer has a good option to select the product required. However, this process depends on the main factor of finance. With the financial constraints, the other factor to be considered is the specifications. It must be understood by the consumer that any good quality product is generally available at a higher price than a not so good quality product. It is therefore necessary for the consumer to know more about the benefits he gets when he selects high-quality cement and how best he can put to use such benefits considering both technical as well as the economic aspects.

A high strength cement although preferable to a lower strength cement may not give a consumer the complete benefit until and unless it is giving consistently high strength with minimum variations. The high strength concrete if specified for any structure will also be more desirable from a durability point of view. It is often observed that low strength concrete is more vulnerable to environmental forces than high strength concrete but at the same time, high strength concrete too needs to be extremely carefully batched, mixed, transported, placed, compacted and cured. The durability requirements of the structure are as important, if not more, as the strength of the structure. A strong concrete may not result in high performance concrete if the durability requirements are not complied with.

Selection of high quality cement can only mean a good beginning but it does not assure the consumer of a final product, which is the strong and durable concrete structure. However, selection of poor quality cement or cement of inconsistent quality is like taking a wrong step right at the beginning and will certainly lead to the poor quality concrete structure if not a disaster.

3. CEMENT STRENGTH CLASSIFICATION

The most common type of cement used in India is ordinary Portland cement (OPC) and has generally grades viz. 33, 43, 45 grades depending upon the 28 days compressive strength.

IS: 10262-1982 gives us the recommended guidelines for concrete mix design, has generally classified the cement grade wise from A to F, depending upon 28 days strength as follows.

TABLE 1: CLASSIFICATION OF CEMENT GRADES A TO F AS PER IS: 10262-1982

Grade	Range of 28 days strength of cement (kg/cm^2)
A	325-375
B	375-425
C	425-475
D	475-525
E	525-575
F	575-625
*G	625-675

*Has been introduced in view of higher-grade cement available in IndiaHowever, it may note that some brands sold as 53-grade cement generally give 28 days strength of around 625 to 675 kg/Sq.cm and they can be classified even as G grade cement. However, most of the 53-grade cement available in the market generally falls in the category F or above and the 43 grade cement available in the market are generally in the category D. It must be ascertained either from the manufacturer or through laboratory tests the actual strength of the cement before it's use in the concrete mix design to get the maximum benefit of the additional strength and superior quality.

5. CEMENT SAVING DUE TO HIGH STRENGTH

The relation between the free water-cement ratio (W/C) and concrete strength for different cement strengths (grades A to F) is given in fig. 2 page 8 of IS: 10262-1982. This figure is used to determine the W/C of the concrete mix for specified target concrete strength if the cement grade is known.The target concrete strength (fm) is calculated using the following equation fm=fck+ (t*s) where 'fck' is the specified characteristic strength, 't' is the statistical constant generally equal to 1.65 for the specified accepted proportion of low results of 1 in 20 (see table 2) and 's' is the standard deviation, the values of which are selected depending on the degree of quality control expected under different site conditions (see tables 3 and 4).

TABLE 2: VALUE OF'T' (IS: 10262-1982)

Accepted proportion of low results	Time
1 in 5	0.84
1 in 10	1.28
1 in 15	1.5
1 in 20	1.65
1 in 40	1.96
1 in 100	2.33

Degree of quality control Expected (IS: 10262-1982) under different site conditions.

Table 4: Recommended values of standard deviation IS: 10262-1982 standard deviation(s) for a different degree of control N/mm. Sq.

Grade of concrete (fm)	Very good	Good	Fair
M10	2	2.3	3.3
M15	2.5	3.5	4.5
M20	3.6	4.6	5.6
M25	4.3	5.3	6.3
M30	5	6	7
M35	5.3	6.3	7.3
M40	5.6	6.6	7.6
M45	6	7	8
M50	6.4	7.4	8.4
M55	6.7	7.7	8.7
M60	6.8	7.8	8.8
M10	2	2.3	3.3

From table 4 it can be seen that better quality control results in a lesser value of's' and 'fm' for same 'fck'. Therefore cement consumption works out to be lower when the quality control is better. Hence, for concrete manufacture better quality control results in greater economy.Percentage saving as compared to ‘A’ grade cement

6. RECOMMENDATIONS TO IMPROVE DURABILITY USING HIGH STRENGTH CEMENT

However, the durability requirements as specified in IS 456- under revision must be satisfied depending on the various exposure conditions. From table 5 it is obvious that concrete manufactured using a higher grade of cement even after considering that lower grade cement may be marginally cheaper than the higher-grade cement.

Requirement of durability as per IS: 456-2000. Maximum cement content, maximum water-cement ratio and a minimum grade of concrete for different exposures with normal weight aggregates of 20 mm nominal maximum size.

Note 1- Cement content prescribed in this is irrespective of the grades of cement and it is inclusive of Mineral Admixtures specifies in IS 456-2000. The additions such as fly ash or ground granulated blast furnace slag may be taken into account in the concrete composition with respect to the cement content and water-cement ratio if the suitability is established and as long as the maximum amounts taken into account do not exceed the limit of pozzolana and slag specified in IS 1489 (part 1) and IS 455 respectively.

Note 2- Minimum grade for plain concrete under mild exposure condition is not specified.

The figure below shows that F grade cement can be utilized for 200 kg/cm. Sq. Reinforced concrete in mild environment condition only while C to E grade cement can be used for mild or moderate environmental conditions. However, for high-performance concrete generally, it is very important to go for a higher grade of concrete (above M25 grade). If this concrete is made with high strength cement then it will fetch both technical as well as a financial advantage. shows the extent to which different grades of cement can be used for different environmental conditions and various grades of concrete.Water cement ratio vs Average 28 days’ strength of cement in (kg/ cm.sq.)

It is generally observed that even today the structural engineers and architects specify the M15 and M20 grade of concrete in the coastal area.

This has already led to serious durability problems and low performance of concrete structures. M15 grade concrete can be achieved with W/C much greater than 0.55 if 43 and 53 grades of cement are used and since 33-grade cement has now virtually disappeared from the market. All M15 grade concrete structures in coastal areas are therefore bound to be a happy hunting ground for concrete rehabilitation agencies as is being observed at present. The durability problem is most likely to multiply several times if, at the specification stage itself, proper precautions are not taken.

Even M20 grade concrete may not be the correct solution to the durability problem in the Urbanized/Industrialized coastal areas.

Lower grades of concretes with the generally poor type of quality control prevalent are observed to be of very poor durability, needing of extensive repairs within a few years. As good quality cement is now available it is strongly recommended to go in for higher grades of concrete i.e. above M25 grade. This will improve the performance of the structures; prove more economical in most cases and in the process of achieving higher strengths it will automatically comply with the durability requirements.

7.CONSISTENCY OF CEMENT QUALITY

Concrete mix design(CMD) is one of the techniques to determine the most economic proportions of cement, sand, aggregates, water and other additives. However, after choosing the economic proportions of various materials any change in their physical or chemical property will lead to considerable variations in the desired cohesiveness, workability, strength and durability. The maximum impact is always due to variation in cement properties and therefore it is not only essential that cement should have good strength, proper fineness and correct setting time but it is also essential that the variation of its chemical and physical properties especially the strength and fineness should be minimal. The good quality in minimizing variations is now possible with proper quality control monitoring systems and modern sophisticated instrumentation control systems the cement manufacturers have installed in their modern up to date plants.

8. QUALITY CONTROL IN CEMENT MANUFACTURE

While high strength is the indication of the good physical quality of cement, consistency of this high strength and other physical and

chemical properties is an indication of good quality control and superior technology practiced by the cement manufacturing company.
The quality control in the cement manufacturing plant starts from the inspection and testing of the limestone. Only after extensive testing for its CaO content, it is utilized, making sure that CaO content is uniform. The thoroughly crushed limestone powder is then stored in a stacker. It is reclaimed in vertical slices to get homogenous limestone, which is then conveyed, to the vertical ball mill, which ensures uniformly crushed limestone. After this, homogenization of the limestone is done in the blending silo by means of aeration.Thereafter homogenized materials are passed through series of suspension preheaters and are fed into the kiln for the production of clinker. Hourly samples of clinker are taken and tested to assure uniformly of quality. On line X-ray analyzers' help in ascertaining the variations in compound compositions of the cement so that immediate action can be taken to improve the quality of the product if required.The clinker is then processed through closed circuit grinding. This ensures proper particle size distribution. A device called high-efficiency cyclonic separator, which controls the grinding process right down to the specific micron size required, does this.After initial grinding in the tube mill, the materials move into the high-efficiency cyclonic separator. The separator separates the ground particles into two streams. The airflow exerts an aerodynamic force and separates the finer particles (between 5 and 30 microns) from the oversize coarser particles (above 30 microns), which are influenced by centrifugal and gravitational forces.The coarse particles are collected into grit collection and brought for recirculation into the grinding process. The fine particles are removed from the air stream in high cyclones mounted symmetrically around the separator housing. This process assures that cement has the ideal surface area and the ideal proportion of particle size between 5 to 30 microns. This process guarantees the highest number of a particle between 5 to 30 microns to the extent of over 50%. Hourly samples are taken and tested to assure uniformity of quality.The consistency of particle size is checked using sophisticated particle size analyzers, which immediately indicate the grain size distribution. Adjustments required in cement productions, if any, can be controlled in the plant to obtain the optimum particle size distribution and thereby assure consistent quality.If cement has a large number of particles finer than 5 microns it tends to set quickly producing high early concrete strength without a corresponding increase later on. This cement is also more susceptible to moisture attack and

hydrates fast resulting in unnecessary wastage. On the other hand, if cement possesses a large number of particles above 30 microns it takes longer time than normal to set and will also display low initial strength which increases at a later stage.The cement is then transferred to the packinghouse where it is packed in woven HDPE and 4 ply paper bags and transported to various stockiest and construction sites.The hourly samples are also collected from the packinghouse to check the quality. Daily tests for various chemical and physical properties are done and various parameters are recorded to study the monthly variations and to improve the product quality from time to time and thereby minimize variations.

9. NEED FOR CONSISTENCY OF QUALITY

Many do clearly not understand the importance of consistency of cement quality hence a small illustrative example is given below. Assume that three brands of cement say AA, BB and CC are available having identical mean strength for a particular month of manufacture, say 600 kg/cm. Sq. However, the standard deviations for these cement during the same month were different and therefore the characteristic strength of this cement and its grade are worked out as below.Hence from the above, it can be observed that cement having identical mean 28 days strength for the month can be classified as F, E or D based on the variations (standard deviation). It is therefore of prime importance to control these variations to the barest minimum so that the cement can be classified as a higher grade. It is generally observed that monthly standard deviation if ranging between 15 to 25 kg/cm. Sq. can be considered as a good control for cement manufacture.

There Are Additional Cost Savings Associated With Using High-Quality Cement That Are WorthNoting

Besides saving of concrete quantity and cement cost per cubic meter of concrete, there are several other advantage and savings due to the use of high strength cement.It is observed that the best advantage of specifying high strength cement is derived if, at the planning and design stage itself, high grades of concretes are specified. The higher-grade concretes may have a smaller cross sectional area under identical conditions and thereby the quantity of concrete reduces considerably. The saving in concrete quantity can easily between 1% of 25% depending on the type of structural member, its layout and its function. However, in addition to this saving, higher grades of concrete will be less permeable and more durable than lower grades.

10. CONCLUSION

A reduction in the amount of reinforcing steel used.
A decrease in the necessary amount of formwork has been implemented.
There will be a reduction in the amount of labor required for finishing touches such as plastering, painting, etc.
The construction process takes less time and requires fewer personnel, which is one of the many benefits.
There will be more carpeted space available within the building.
If high cement is defined during the design stage itself and used for the construction of a high-grade concrete structure, then the overall cost of the project will be lower than it would be if a lower-grade cement was specified. The end user will reap the benefits of this in the form of a structure that is not only more robust but also more long-lasting and cost-effective. Now that we have access to high-grade cement, it is conceivable to simultaneously achieve quality, speed, and economy. Therefore, ensure that your concrete structure is both "quick" and "long-lasting."

REFERENCES

1. (IS: 12269-1987) ‘Specification for 53 grade Ordinary Portland Cement’ Bureau of Indian Standards, New Delhi.
2. IS: 456 ‘Plain and reinforced concrete’ Bureau of Indian Standards

Hydro-Geochemical Characterization and Qualitative Assessment of Groundwater

Namra Fatima[a], Anil Kumar

[a]M. Tech Scholar, Deptt. of Civil Engineering, UTU Dehradun, Uttarakhand (India)
[b]Assistant Professor, Deptt. of Civil Engineering, JBIT Dehradun, Uttarakhand (India)

ABSTRACT

Artificial ground water recharge is a process of induced replenishment of the ground water via the assist of human activities. It's far the planned, human activity of increasing the quantity of groundwater available via works designed to grow the natural replacement or per colation of surface water into the groundwater aquifers, resulting in a corresponding increase in the amount of groundwater available for the concept. In an area like Musunuru Mandal in Andhra Pradesh, there is a need for recharge of groundwater identified by Jal Shakti Abhiyan. This study explains the demand and consumption of water and estimates the water budget in Musunuru village. In this study, the major source of water for agriculture is rainfall or bore wells (tube wells). To identify the water demand in the village and suggesting the best practice approach to reduce the risk of Musunuru with an experimental study on groundwater recharge techniques. Among all the recharge techniques this study chooses the low budget soak pit method with materials like a reused plastic drum and locally available construction materials in Musunuru. By using this proposed low budget soak pit method 85% of ground water recharge contributes.

Keywords: *Artificial ground water recharge; Water budget; Low budget soak pit; Agriculture; Jal Shakti Abhiyan.*

1.INTRODUCTION

Groundwater is the main source of Indian rural domestic, urban water requirements and irrigation requirements, is rapidly decreasing in many regions due to its wide-ranging withdrawal for different sectors. As per the central ground water board (CGWB) 2017, the government of India identified the 9 districts of Andhra Pradesh that are facing critical or overexploited groundwater levels and groundwater scarcity for different purposes like drinking, domestic and agricultural [1]. For the case study the Musunuru village of Krishna district by considering the present status and by applying different recharge techniques for increasing the groundwater levels. Continued efforts have been made in India to develop groundwater resources to meet the increasing demands of water supply, especially in the last few decades [2]. Groundwater production has already reached a critical stage in certain high demand areas, resulting in extreme water resource scarcity [3]. Overuse of groundwater services leads to lower groundwater levels, depletion in the ground water supply.

Artificial recharge is proving to be one of the groundwater management methods. There are different artificial recharging methods [3]. This study considers some of the techniques in detail like site characteristics and design guidelines, check dams, percolation tanks / spreading basins, recharge of dug wells/hand pumps, recharge shafts, injection wells, recharge trenches and Soak pits [4]. The methods include in this study and suggesting some of the daily use and cost-effective techniques that can be implemented for conserving the groundwater [5].

Soak pital so called a soak awayorleachp it is a sealed, porous-walled hollow space allowing water to soak step by step into the floor. Pre-settled effluent is discharged to the underground chamber from which it in filtrates into the encompassing soil from a group and storage/treatment area [6]. Soak pit method finds a low cost-effective method to increase/recharge groundwater in rural and urban areas [7]. It could be built and repaired with domestically available materials and this technique is easy to apply for all the members.

2.**GROUNDWATER RECHARGE TECHNIQUES/METHODS**

Groundwater is a precious and the most broadly dispensed useful resource of the earth and unlike some other mineral aid, it gets its annual replenishment from the meteoric precipitation. Different ground water recharge techniques for urban and rural regions are shown in Table 1. In the present scenario, nearly one-fifth of water used within the global is obtained from groundwater sources. Agriculture is the finest user of water accounting for 75% of all consumption [1]. Due to fast urbanization, infiltration of rainwater into sub-soil has considerably decreased and recharging of ground water as dwindled over the years. This creates a critical impact on the socio-economic and environmental degradation of the place. Therefore, it has to turn out to be vital to selling in-situ water harvesting to augment groundwater recharge. Groundwater recharge is the technique whereby the amount of water found in or flowing via the interstices of the sub-soil will increase via natural or artificial methods. Rainfall is the essential source for the replenishment of the recharge of floor water. Other sources include recharge from rivers, streams, irrigation water, and so forth.

Table1. Groundwater recharge techniques forur banand rural regions.

Urban Regions	Rural Regions
Recharge pits	Check dams
Recharge trenches	Dug well recharge
Tube wells	Recharge shaft
Recharge wells	Soak pits
	Percolation tank
	Surface spreading

3. DESCRIPTION OF STUDY AREA

Musunuru is a large village located in Musunuru Mandal of Krishna district, Andhra Pradesh with a total number of 1495 families residing [9]. The Musunuru village has a population of 6095 of which 2883 are males while 3212are females as per Population Census 2011. Musunuru is located at latitude 16°50’34’’N and longitude 80°57’44’’E. There are 16 villages comes under the Musunuru Mandal they are Ramanak kapeta, Surepalli, Lopudi, Gullapudi, Chakkapalli, Akkireddigudem,Chintalavalli,Korlagunta,Tallavalli,Musunuru,Yellapuram,Katrenipadu,Gopavaram, Balive, Chillaboyinapalle, Velpucherla. Musunuru Mandal map is presented as Appendices B. The total population is around 55,036 of which the urban population is zero and the rural population is 55,036, the number of borewells is 5250 and 55 different types of crops are cultivated throughout the year [10]. As per Jal Shakti Abhiyanin Musunuru Mandal 13 out of 16 villages are find out of exploited the groundwater and there this study considers the groundwater recharge technique to increase the groundwater level in the Musunuru [10]. The last five years of rainfall data in Musunuru Mandalare shown in Table 2. The major cultivated crops are paddy, mangoes, maize,palmoil,banana, and cotton,etc.These crops consume more water for cultivation purposes from the bore wells.

Table2. The last five years of rainfall data in Musunuru Mandal.

Year	Normal/in mm	Actual rainfall received in mm	Deviation %
2015	1039	869.4	-19.5
2016	1039	998.8	-4.02
2017	1039	810.2	-28.23
2018	1039	1087.8	+4.48
2019	1039	891.3	-14.21

Normalized water depth of rainfall in Musunuru Mandal (for last five years) =931.5mm

SO AKPIT DESIGN AND DIMENSIONS

Based on this study performed in Musunuru village the method low budget Soak Pit was adopted as an efficient and suitable technique to recharge the groundwater. The schematic diagram of the low budget soak pit is shown in Fig. 1. Soak pits were able to construct at the backyards of every house in Musunuru village. Grey water and rainwater are collected from the houses and they were diverted into the installed soak pits to recharge the ground water. The budget of soak pit is around 2000 rupees for each soak pit and constructed within two days with the help of two workers. This study suggests 1.5 m diameter and depth of 3 m trench with 3 feet diameter of a drum which appropriates for one family around five contributors and it takes 300 consistent liters per day. Excavation accomplished manually. The reused plastic drum used for gathering the wastewater, made 10 holes on the perimeter of the drum with 7 rows of 14 mm diameter each hole as shown in Fig. 2. After that, filled the trench with the aid of trade layers of brickbats and boulders with a mesh internet among of length 2 mm, every layer's thickness of 200mm. The water gets a lot filtered with the aid of this approach. Filling aggregates approximately depth 15 to 25 cm after the position of the drum which used for gathering the wastewater. Thereafter 10 to 15 cm height of the sand layer is provided after the aggregate. Kindly test the height of the drum which has to be 15 to 20 cm below the floor level. Attach the PVC elbow to source pipe and another end connected to the soak pit. Fix the pipe well and keep cover on the drum. Cover the pit and make certain that pit will no longer damage from any outside sources and if possible that assemble within the residence for its safety. Process of making the pit use like that we can open that once a few times for its maintenance purpose [11]. When we disposed of the wastewater through soak pit it needs to be deal with by some means the amount of quality has to be accelerated [6]. Wastewater after handled it could percolate into the ground and it will acquire the groundwater level as shown in Fig. 3. The efficiency of the soak pit is around 80 to 90%.

ADVANTAGES OF SOAK PIT METHOD

- This method allows recharging the nearest ground water source.
- Locally available materials will be used for the construction of design economically.
- For the installation of the design, a small area is only required.
- The village becomes drainage free.
- The village becomes mosquito-free which enables to lower the risk of various diseases.
- It creates healthy environmental surroundings.

DISADVANTAGES OF SOAK PIT METHOD

1. Primary treatment is required to prevent clogging, if primary treatment is not given wastage will clog and deplete the percentage of water percolation.
2. It requires a periodic renovation at least twice a year.
3. It is a tough attempt to clean the soak pit.
4. It should be avoided for high daily volumes of discharge.

4. METHODOLOGY

Collection Of Data

This research finds out the problem statement and select the location (Musunuru village) and then collects the required data like number of households, number of populations, number of bore wells, geographical area, crop details, and rainfall data.

Segregation Of Data

The collected data from the Musunuru village would be sorted out for the project to have a detailed understanding of the problem in the village and then analyzed the data to find out the water demand in the village and separated into two categories.

Domestic Water Demand

This study finds out the average domestic water consumption per each house hold in Musunuru village.

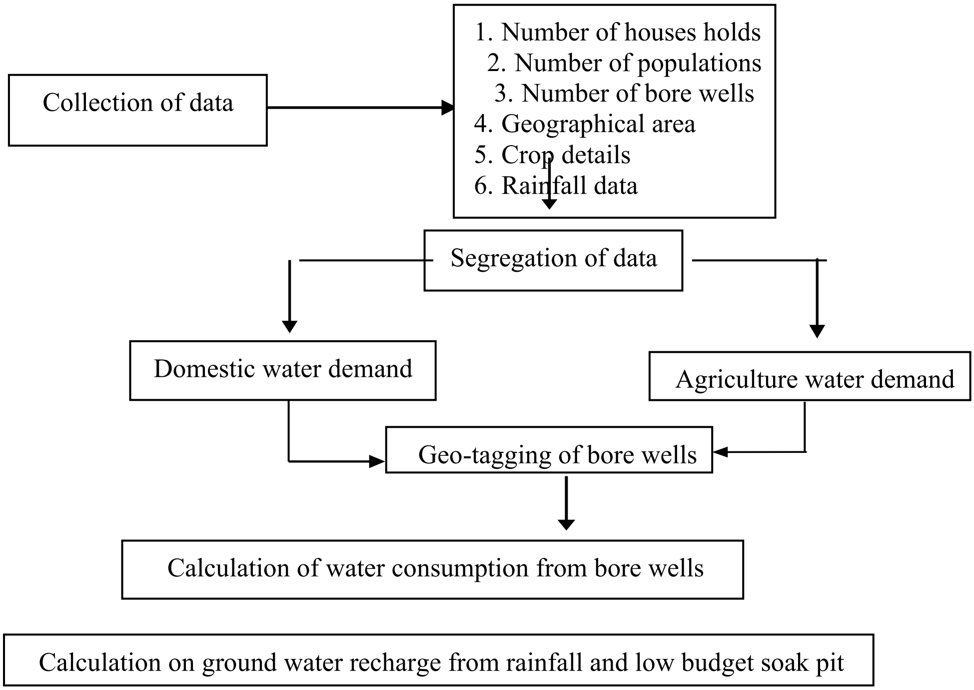
Agricultural water demand

This study finds out the total water demand for all the seasonal crops for agricultural purposes in Musunuru village.

Geo-tagging of bore wells

Geo-tagging of bore wells is performed to have a clear understanding of villages and bore wells in the Musunuru Mandal responsible for the depletion of groundwater, Where the larger number of bore wells are present there the water consumption is more. Geo-tagging was performed by the help of data having latitudes and longitudes as seen in Appendices A.

The flow chart is made to organize and describe all the key tasks that were conducted during the research work as presented below in Fig. 4.



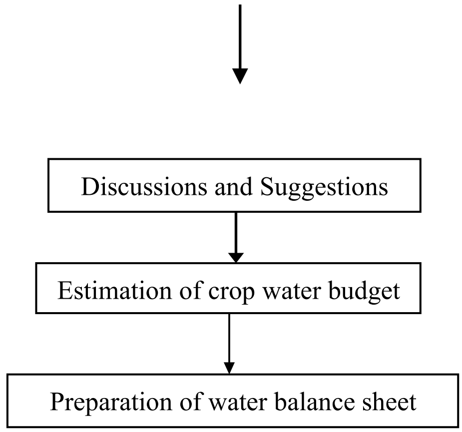


Fig.1. Step by Step process for a detailed study of the ground water in Musunuru village.

Calculation Of Water Consumption from Bore wells

This research carries out the calculation and finds out the water consumption for domestic and agricultural purposes from the village bore wells.

Calculation On Ground Water Recharge from Rainfall and Low Budget Soak Pit

This research performs the groundwater recharge estimation from the village rainfall and finds out the efficiency of groundwater recharge by implementing the low-budget soak pit method per annum.

Estimation Of Crop Water Budget

By studying on major cultivated crops in Musunuru village estimation of crop water requirement is prepared as shown inTable3.

Preparation Of Water Balance Sheet

This research performs a water balance sheet for crop water demand, domestic water demand, ground water recharge percolated from rainfall for the total area (5%), groundwater recharge percolated from the installation of low budget soak pit in Musunuru village.

Discussions And Suggestions

In this study discussions and suggestions have been taken for the better improvement of the research work.

CALCULATIONS

Water demand for Musunuru village

Water requirement in Musunuru village for domestic purpose

Total population =6,095Numberof households=1,495

Number of bore wells (tube wells) =453

Average domestic water consumption per each household in Musunuru village = 350 lit/day Estimated percentage of wastage of water (80%) =280lit/day

Total wastage of water per day =1495 x280 =4, 18, 600lit/day

Total wastage of water per annum =365x 418600 =15,27,89,000 lit/year =152MLY

Efficiency of groundwater recharge by Soak pit method (80 – 90%) = 0.85 x 4,18,600 = 3,55,810 lit/day Efficiency of ground water recharge by Soak pit method per annum =3,55,810 x365=12,98,70,650 lit/year =129.87 MLY

Water requirement in Musunuru village for agricultural Purpose

Geographical area of Musunuru village = 5461.3 acres Wetland of Musunuru village= 851.31 acres

Dry land of Musunuru village=3960.58acres

Total Agricultural area (cropped area) =4811.89 acres =1948.13Ha

Rainfall data in Musunuru village

Average rainfall data for last five years in Musunuru village= 822.50 mm

Average quantity of water obtained from the rainfall = 16016579.64 m^3 =

16016579.64 x1000 = 16016.57 MLY Average ground water recharge in Musunuru village = 5%

Quantity of water percolated from rainfall for agricultural area in Musunuru village = 800.82 MLY Quantity of water from rainfall for total area in Musunuru village= 18178.16 MLY

Quantity of water percolated from rainfall for total area in Musunuru village=908.908 MLY

S. No	Crop	rif (Area inha)	i (Area inha)	l (Area inha)	Water requirement (for crop growth in mm/1ha)	Total water requirement (mm /1ha)
1	Paddy	232	28	260	1240	322400
2	Palmoil	158	158	316	900	284400
3	Cotton	150	0	150	1300	195000
4	Banana	79	22	101	2200	222200
5	Maize	40	180	220	800	176000
6	Chillies	20	65	85	500	42500
7	Guava	18	4	22	432	9504
8	Groundnut	10	2	12	700	8400
	Total			1166		1260404

Table3.Water requirement for agriculture area in Musunuru village

Total water demand for all these a sonal crops=829.08 MLY

5. RESULTS

The water budget sheet is prepared by comparing both negative water demand and positive water demand for the Musunuru village as shown in Table 4.

Table4. Water budget sheet.

Water requirement data	Negative water demand	Positive water demand
Crop water demand	830MLY	0
Domestic water demand	152MLY	0
Ground water recharge percolated from rainfall for total area (5%)	0	908.908MLY
Ground water recharge percolated from the installation of soak pit	0	129.87MLY
Total water	-982MLY	+1038.778MLY

CONCLUSION

This study identifies the water demand in Musunuru village and installation of a low-cost soak pit method to recharge the groundwater that costs around 2000 rupees which serves a period of around 10-20 years. It recharges about 130 million liters per year. It calls for a periodic renovation for every six months and it could take a tough attempt to clean the soak pit.

Based on this study this paper suggests that this method of disposing of the wastewater in rural regions is effective and gives the top result of recharging the groundwater table. By using this method, the trouble of unhygienic circumstances close to the houses is prevented and the production of mosquitos is avoided. Hence the one-of-a-kind illness came about due to unhygienic situation and mosquitoes are averted. This method offers a healthful lifestyle to human beings living in that particular vicinity.

.

REFERENCES

1. Saxena, P., et al., Conservation of groundwater by artificial recharge in Delhi and Haryana State of India-Areview.Int.J. App. Bio. PharmaceuticalTech,2010.1(3):p.989-993.
2. Oweis,T.andA. Hachum,Water harvesting and supplemental irrigation for improved water productivity of dry farming systems in West Asia and North Africa. Agricultural water management, 2006. 80(1-3): p.57-73.
3. Asano, T., Artificial recharge of groundwater with reclaimed municipal waste water:current status and proposed criteria.WaterScienceandTechnology,1992.25(12):p. 87-92.
4. Greskowiak, J., et al., The impact of variably saturated conditions on hydro geo chemical changes during artificial recharge of ground water.Applied Geochemistry,2005.20(7):p.1409-1426.
5. Mohan, M.A.a.S., Effectiveness of Artificial Recharge Structures in Enhancing Ground water Storage: A Case Study. Indian Journal of Science and Technology, 2015.8(20):p. 1-10.
6. Somwanshi,R.,etal.,Study and development of village as a smart village. International Journal of Scientific & Engineering Research, 2016.7(6):p.395-408.
7. Idelovitch, E., R. Terkeltoub, and M. Michail, The role of groundwater recharge in wastewater reuse: Israel's Dan Region Project.Journal-American Water Works Association,1980.72 (7):p.391-400.

Recent Advancements and Applications of Reinforced Fiber Polymer Bars

Namrata Sah[a], Anil Kumar[b]

M. Tech Scholar, Deptt. of Civil Engineering, GBPUA&T Pantnagar, Uttarakhand (India)
Assistant Professor, Deptt. of Civil Engineering, JBIT Dehradun, Uttarakhand (India)

ABSTRACT
Corrosion poses a significant threat to the integrity of concrete structures, leading to safety hazards and costly repairs. This study explores the potential of Fiber Reinforced Polymer (FRP) as a solution to improve the structural performance of corroded concrete. The research investigates the effects of corrosion on conventional reinforced concrete and highlights the benefits of incorporating FRP materials, specifically Glass Fiber Reinforced Polymer (GFRP) bars, in reinforcing structures. The study addresses the corrosion resistance, high strength-to-weight ratio, non-conductive properties, and other desirable characteristics of GFRP. Additionally, it examines the durability and usability of this innovative material, considering its susceptibility to alkaline environments, modulus of elasticity, and brittleness. By evaluating the existing body of knowledge, this research aims to enhance our understanding of FRP's potential to mitigate corrosion-related damage in concrete structures.
Keywords- *Reinforcement, Corrosion, Structure, Steel, Reinforced Polymer.*

1.INTRODUCTION

Reinforcement has become the fundamental unit of construction today which is used in numerous ways, some of the larger and better known uses including roadways, bridges, car parks, residential buildings and in industry; for example it is widely used in nuclear power plant. It is in general an excellent construction material. Concrete alone is good in compression, but reinforced concrete greatly increases the scope for making structures required to withstand other form of mechanical forces. In a small percentage of instances reinforced concrete may deteriorate

prematurely, but so widespread is the use of the material that problems can be encountered in a wide range of individual applications. It is reliably reported that in North America there are now some 300,000 concrete bridges requiring repairs, with costs estimated in terms of billions of dollars, in addition to the roadways and car parks requiring remedial attention. There are also lesser but significant problems with reinforced concrete in Europe and the Middle East. In India too around 60% of reinforced concrete structures require repair work which is harm to economy of our country. From a financial aspect the future costs over the next few decades for repairs and replacement throughout the world are likely to be staggeringly high. One is tempted to ask why, if reinforced concrete has been used for so long, is it only now that problems are arising, predominantly, though not exclusively, associated with corrosion of the reinforcing steel bars, or rebars as they are commonly called. Corrosion loss consumes considerable portion of the budget of the country by way of either restoration measures or reconstruction. Moreover, the repair operation themselves are quite complex and require special treatments of the cracked zone, and in most instances the life expectancy of the repair is limited.
Accordingly, corrosion monitoring can give more complete information of changing condition of a structure in time. Hence, protection of reinforcement from corrosion will ensures that the structure serves for desired service life. Engineers need better techniques for assessing the condition of the structure when the maintenance or repair is required. These methods need to be able to identify any possible durability problems within structures before they become serious.

2.CORROSION MECHANISM & REASONS

Corrosion is an electrochemical process. In this process oxidation of Iron (Fe + +) molecules naturally occurs immediately after the bars are manufactured and exposed to the atmosphere and will continue long as sufficient oxygen and moisture are available to react with the steel. So corrosion is consists of an anode and cathode process. Following are some reasons of corrosion of reinforcement.

Water Permeability:

It is the single largest factor for ignition and propagation of corrosion. Water not only takes part in chemical reaction but also works as a carrier for transporting harmful chemicals to concrete and rebars such as chloride ions. Higher permeability reduces resistivity of concrete. If the surface of the concrete is subject to long-term wetting, the water will eventually reach the level of the reinforcement, either through diffusion through the porous structure of the concrete, or by traveling along cracks in the concrete. Concrete roof decks, by their nature, are meant to be protected from moisture. However, the presence of moisture on roofing systems may result from failure of the roofing membrane, poor detailing of drainage facilities, or lack of maintenance of drainage facilities.

FIG.1: CORROSION IN REINFORCEMENT

Oxygen Permeability

Oxygen is very much an essential part for corrosion to occur; it also plays an important role in setting up corrosion cells. Oxygen permeability produced due to cracks, difference in cover thickness and heterogeneityof concrete.

Carbonation

In the major cause of corrosion, Carbonation of concrete has dual effect or reducing the alkalinity of concrete as well as releasing more water. Effect of carbonation increases with porosity of concrete, period of exposure and reduces with moisture in surrounding area. t is well known that if bright steel is left unprotected in the atmosphere a brown oxide rust quickly forms and will continue to grow until a scale flake from the surface. This corrosion process will continue unless some external means is provided to prevent it. One method is to surround the steel with an alkaline environment having a pH value within the range 9.5 to 13. At this pH value a passive film forms on the steel that reduces the rate of corrosion to a very low and harmless value. Thus, concrete cover provides chemical as well as physical protection to the steel. Concrete is permeable and allows the slow ingress of the atmosphere; the acidic gases react with the alkalis (usually calcium, sodium and potassium hydroxides), neutralizing them by forming carbonates and sulphates, and at the same time reducing the pH value. If the carbonated front penetrates sufficiently deeply into the concrete to intersect with the concrete reinforcement interface, protection is lost and, since both oxygen and moisture are available, the steel is likely to corrode. The extent of the advance of the carbonation front depends, to a considerable extent, on the porosity and permeability of the concrete and on the conditions of the exposure.

Chloride Ingress:
The best known and most damaging factor leading to corrosion is the chloride ingress (i.e. chloride entrance) most of failures are attributed it this structures in cold climates where salt is used as deicing agent has reportedly shown distress due to this factor. The chloride ingress can be by diffusion, capillary suction as well as by permeation. Diffusion of chloride ions occurs through slow moments through simple absorption can suck in large amounts of chloride permeation of chloride ions is through cracks in concrete. Chloride ions react with iron compound and create an iron – chloride complex (fecl2) which also react with hydroxides (OH-) and form hydrated iron oxide compounds. Simultaneously oxygen (O2) reacts with water (H2O) and formed hydroxides. Together, this two reactions form a corrosion cell. At low levels of chloride in the aqueous phase, the rate of corrosion is very small, but higher concentration increases the risks of corrosion.

3. COROSION IN RCC STRUCTURES

FIG.2 CORROSION IN RC STRUCTURE

Remedial Measures

The deterioration of concrete may be due to either corrosion of concrete/ reinforcement steel or formation of expansive chemical compounds such as calcium silicate hydrate (C-SH) or ettringite in aggressive environments. The loss due to corrosion of steel is heavy. To produce the durable concrete and resist the harmful effects of aggressive environment, the concrete should be produced with almost care. The following steps, implemented scientifically will help to produce durable concrete.
By Adopting the rich mix:
Adopting the Best Mix Proportion:
Increasing Depth of Concrete Cover to Reinforcement Concrete Coating and Sealers
Galvanizing
Fusion Bonded Epoxy Coating (FBEC) Coating of Re bars

Fiber Reinforced Polymer Reinforcing bars (FRP)
FRP Bars are intended for use as concrete reinforcing in areas where steel reinforcing has a limited life span due to the effects of corrosion.

They are also used in situations where electrical or magnetic transparency is needed. In addition to reinforcing for new concrete construction, FRP bars are used to structurally strengthen existing masonry, concrete or wood members. Corrosion of steel reinforcement in concrete structures causes deterioration of concrete resulting in costly maintenance, repairs and shortening of the service life of structures. Government agencies throughout the world have recognized the potential benefits to society if our infrastructure can last longer and are thus funding significant amounts of research in the field of FRP's. Corrosion of steel reinforcement in RCC makes its use very limited in corrosive environment, and it becomes important to choose such a reinforcing material which is non-corrosive. FRP re bars have demonstrated strong promises in this context. The main advantage of FRP is its excellent corrosion resistance, very high strength to weight ratio, and its non-Magnetizing/conductive nature, etc. FRP has also become more popular because of its diverse varieties available in the market. However for these advanced composite material with above advantages having some limitations also, FRP is a material having low elastic modulus, it shows linear stress vs strain behavior up to failure with no discernible yield point, and hence shows large deflections and wide cracks when loaded, reduced ductility of RCC members causes brittle failure. FRP is typically a two-component composite material consisting of high strength fibres embedded in a polymer matrix.

FIG.3 FRP BAR

The use of FRP reinforcements for concrete structures depends on their ability to perform reliably under service loads, the mechanical properties, e.g., strength and toughness properties, of the reinforcements are the most important properties if the reinforced structures are used as load-bearing members. It is known that for reinforced concrete structures the presence of FRP reinforcements may have little effect on the initiation of a crack, but they do provide considerable resistance to both propagation and opening of the crack. Cracks generally initiate at the locations where the principal tensile stress (or the strain energy release rate) exceeds the material tensile strength (or the fracture toughness) under service loads. Further propagation of these cracks will depend on the distributions and magnitudes of both principal tensile stress and material fracture resistance. In general, the mechanical performance, failure modes, and loading capacity of a reinforced concrete structure depend on, not only its structural geometry and loading conditions, but also the amount, location, and orientation of the FRP reinforcement used.

Fiber Reinforced Polymer (FRP) Composites

Fiber-reinforced plastic (FRP) (also *fiber- reinforced polymer*) is a composite material made of a polymer matrix reinforced with fibers.

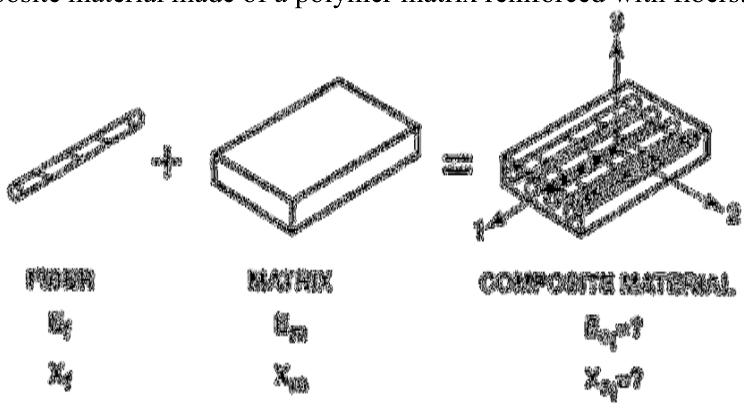


FIG.4 FRP COMPOSITES

The fibers are usually glass , carbon basalt or aramid although other fibers such as paper or wood or asbestos have been sometimes used. The polymer is usually an epoxy, vinylester or polyester thermosetting plastic and phenol formaldehyde resins are still in use.In the last decade, there has been a considerable increase in the interest of FRP (Fibre Reinforced Polymers) for concrete reinforcement in the construction industry. The most frequently used fibres for FRP reinforcement are carbon (CFRP), aramid (AFRP) and glass (GFRP). The most obvious benefit of FRP is that, unlike steel it is not susceptible to carbonation- or chloride initiated corrosion in concrete. This fact makes the use of FRP reinforcement an interesting option for increasing the service life of concrete structures in severe environments. However, unlike steel FRP reinforcement may deteriorate due to the alkaline environment of concrete. The following chart shows the stress-strain relationship for various fiber materials in use.

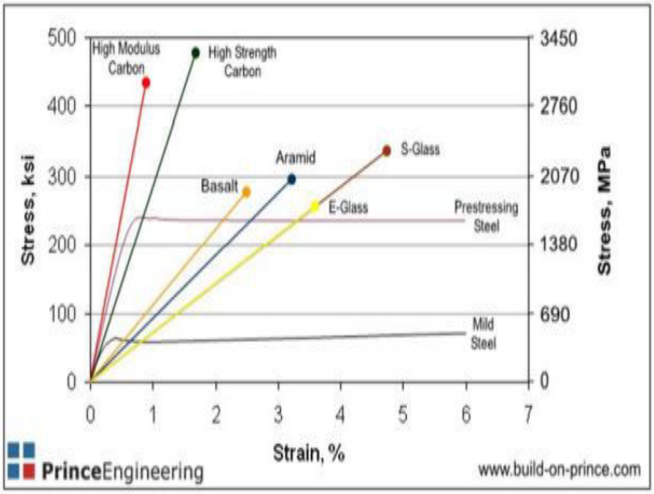


FIG.5 STRESS-STRAIN CURVE OF FRP BAR

Durability of FRP Reinforcement

FRP rebar is a composite material made up of high strength fibers embedded in a protecting matrix. It possesses very high strength to weight ratio and non- conductive/magnetizing nature. Glass Fiber Reinforced Polymer (GFRP) is an economically viable form of FRP and is being promoted widely as reinforcement for concrete. GFRP rebars are available in the market with high ranges of strength (up to 1500 MPa). FRP rebars are available in different surface texture (i.e. ribbed, sand coated, deformed, etc.) to achieve better bond strength with concrete and are manufactured by pultrusion process GFRP bars can be used in the area like coal and mining industries, tunneling, coastal construction, road construction, corrosive construction, etc. Fibre reinforced polymer (FRP) reinforcing bars offer a potentially attractive alternative to steel reinforcing bars. The former are non-corrosive and generally of a higher strength than their steel counterparts, however, at the expense of no ductility (i.e. no yield point and plastic plateau) and a reduced modulus of elasticity in the case of glass FRP (GFRP) bars. Fibre reinforced polymer bars have most commonly been used in aggressive environments such as coastal environments and water treatments plants instead of steel. Such structures may include dry-docks, sea walls, wharfs, box-culverts, reinforced piles, floating piers, tanks, facades, and retaining walls. Use of FRP bars has been made in Canada in recent years in bridge decks and roads owing to the seasonal use of de-icing salts which causes traditional steel reinforcement to corrode. Some concrete structures may be required to be devoid of metal, like all other engineering materials, FRP reinforcements can also be subjected to mechanical and physical deterioration throughout its life. When FRPs are used as reinforcement within concrete members, they can be expected to be exposed to a variety of potentially harmful physical and chemical environment. Although FRPs are not susceptible to electrochemical corrosion, it can be significantly damaged by other chemical or physical form of degradation if used improperly. The mechanical,physical and bond properties of FRP reinforcement may alter or remain unchanged in a particular combination of chemical and physical exposure condition. Unfortunately durability of FRPs is not a straight forward issue and even might be more complex than corrosion of steel. Durability of FRPs depends on fiber type, resin type and there interface bond behavior. Furthermore, there are a variety of types of FRPs available commercially in the market thus different fibers and resins are characterized by their different behavior in elevated temperatures, environmental exposure and long-term phenomena. Durability of this material is severely affected by highly alkaline environment of concrete (pH=12.4-13.7), moisture and aqueous solutions, elevated temperature, freeze-thaw cycles, ultra-violet (UV) radiation, fatigue and impact loads Lots of research are going on in this context, but reliable design rules are still lacking.

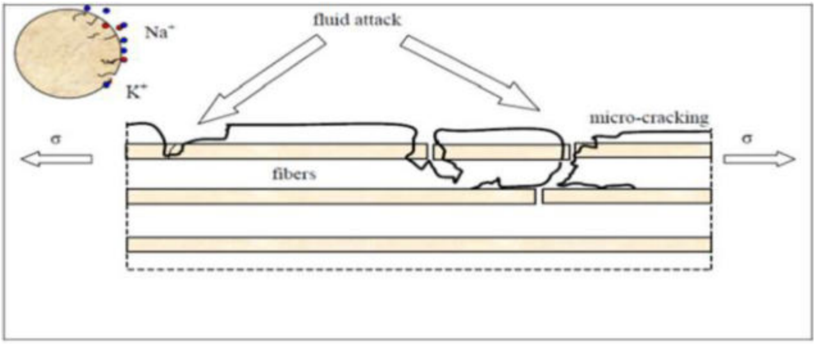


FIG.6 EFFECT OF ENVIRONMENTAL EXPOSURE

5.CONCLUSION

FRP seems to outperform steel reinforcement in corrosion resistance. Yet, past investigations show this material has major limits that make it incompatible with concrete. This experiment will examine these constraints. This study examines GFRP reinforced concrete beam durability and serviceability. Serviceability was determined by deflection and cracking. Three exposures tested the durability of GFRP reinforced beams.

Recent research has focused on the durability and serviceability of GFRP reinforcement and GFRP reinforced concrete members. Despite contradicting literature, no consensus has been achieved. This context's results are restricted and unclear. . Note that a durable material does not necessarily have good serviceability and vice versa. So, both features must be examined to determine this material's compatibility with concrete.

Hence, this work describes GFRP reinforced beam durability and serviceability experiments. This study examined FRP properties and exposure types for GFRP and steel tensile specimens and GFRP reinforced beams. Based on this, the study examines GFRP reinforced concrete beam serviceability and durability.

6. REFERENCES

1. Jeremy Lewis , The effects of corrosion in reinforced concrete with addition of fibers , The University Of Akron, December 2012
2. Corrosion Mechanism &Reasons, the Constructor Civil Engineering Home.
3. Professor & Head Of Department Civil Engineering, EFFECTS OF CORROSION. Department of Civil Engineering ,
4. RIT Jamshedpur
5. Professor & Head Of Department Civil Engineering, Corrosion of REINFORCEMENT CONCRETE & its protection. Department of Civil Engineering, RIT Jamshedpur.
6. Clarke JL, editor. Structural design of polymer composites—EUROCOMP design code and handbook. UK: St Edmunds bury Press; 1996..
7. ADVANTAGES & LIMITATIONS OF ‘FRP’. ACI 440R- 96, state-of-the-art report on fiber reinforced plastic reinforcement

Characterization of Strength and Durability of Bamboo in Construction

Mr. Anil Kumar[a], Dr. Sanjeev Gill[b]

[a]Assistant Professor, Deptt.of Civil Engineering, JBIT Dehradun, Uttarakhand (India)

[b] Professor, Deptt.of Civil Engineering, JBIT Dehradun,Uttarakhand (India)

ABSTRACT

Bamboo is the fastest-growing woody plant. Bamboo grows three times faster than most species. Despite knowing about the housing shortage, administrative authorities worldwide are unable to find a solution. Bamboo is the most promising material of the others. Bamboo building construction uses a structural frame comparable to timber frame construction. Bamboo is ideal because to its low weight, strength, beauty, and durability. These animals differ widely. Bamboo engineering starts with choosing the right species. Thus, bamboo species must be identified before use. It has been used in flooring, ceilings, walls, windows, doors, fences, house roofs, trusses, rafters, and purlins. It also supports bridges, water transit infrastructures, and skyscraper scaffoldings. This bamboo study can help to sustainable development, which should consider technology, economics, the environment, culture, and customs.

Keywords: *Bamboo, Reinforcement, Water absorption, Bonding Strength*

1. INTRODUCTION

The Industrial Revolution more and more new industrial materials have been invented and developed to meet heaver growing need so people in the industrial world. As a symbol of the industrialization cast-iron and later steel have been developed and widely used in mass production since the middle of the 19th century. Now people can find them everywhere: from building construction in the industry to the kitchen knife in the household. Another industrial material – aluminum – has been mass produced and used in industry no more than one hundred years, but now has taken over the place of steel in many fields because it is as strong as steel, but lighter Compared to steel, cements and plastics bamboo has many advantages like strength, elasticity and lightness, but also disadvantages in processing and connection. Its tube structure is very good for tensile and press loadings. At last, they found bamboo which is used for replacements of reinforcing bar in concrete for low cost constructions. Bamboo is available in commercial quantities using the established supply system. It is a renewable plant with a short rotation period. Bamboo grows to its full size for about a year. Another two or three years are required for the plant to gain its high strength. A natural material which is available in bulk and ease of use in the rural areas in the developing countries is bamboo. Bamboos occur mostly in tropical and subtropical areas, from sea level to snow-capped mountain peaks, with a few species reaching into temperate areas.

2. LITERATURE REVIEW

- **Wu, G., Chen, B., Yu, W., Yang, X., Wang, Y., & Xu, W. (2018)** several studies have investigated the mechanical properties of bamboo to better understand its strength and structural performance. An influential study by Wu et al. (2018) conducted extensive testing on bamboo culms from different species and ages. The results showed that bamboo's tensile and compressive strengths are comparable to or even higher than some traditional building materials, like timber. Moreover, the researchers highlighted the potential of bamboo to exhibit superior tensile strength compared to steel, making it a promising reinforcement material.

- **Amada et al. (1997**) investigated the mechanical and physical properties of Bamboo. They conducted rough investigation into the structure and purposes of the nodes, which they found to strengthen the Bamboo Culm. They also commented on the advantage Bamboo has over other natural building materials with its fast growth rate.

- **Mardjono (1998)** provided research with the effort to give some sort of organization of a system to building with Bamboo between cultures, species, and countries having varying designs. The objective of their research was to improve the functions of Bamboo buildings by this organization to provide privacy, safety, comfort, durability, and accessibility. Overall Bamboo used as a structural material suffers from an incredible disadvantage due to inadequate applied scientific research. They do feel that Bamboo products should be brought to the level of acknowledged and received building materials. The results of their research will be published as a thesis and guide for designing Bamboo structures to be dispersed to people in developing countries.

-

- **A study reported in International Standard Organization (ISO) (1999)** fashioned lab manual for determining the physical and mechanical properties of Bamboo. The purpose for publishing this manual is first of all so that these methods are available all over the world. Research is done in so many places, very precise, yet is stuck in the laboratories. With this document, the methods are made available. Secondly, this document gives a practical step by step explanation of how to perform each test specifically following the International Standard Complement Document "Determination of Physical and Mechanical Properties of Bamboo". Another complement document is Bamboo Structural Design (1999).

- **Janseen (2000)** conducted her study on building with Bamboo. This book covered a wide variety of aspects of Bamboo going back to the structure of the plant and its natural habitat. It gives calculations to show why it's economically competitive, mechanical properties, its many uses, its natural durability, and the preservation of the Bamboo.

In much more detail, it discusses the joints and building with pure Bamboo. In relation to this project, her book does touch on Bamboo used as reinforcement in concrete. Listed in her book are several things that are more of hassle than steel reinforcement. Of those, the bonding between the Bamboo and concrete is considered the biggest problem due to absorption of water and smooth wall of the Bamboo Culm.

- Janssen, J., Hernández, D. P., Ribeiro, P. D. M., & Teixeira, J. F. (2021) Structural design plays a crucial role in maximizing bamboo's strength and durability. A study by Janssen et al. (2021) focused on the structural design of bamboo trusses for lightweight construction. The research highlighted the importance of proper joint design and identified critical failure modes. By optimizing the truss design, the study demonstrated that bamboo trusses can achieve sufficient strength and stiffness for use in low-rise building structures.

- **Amada and Untao (2001)** mention that bamboo is the most effective material in construction by the superior character of bamboo such as being physically powerful, tough, and a low-cost material. Normally, the Culm of bamboo without surface layer with stand strongly to any loading with stronger fracture resistance. It suggests that the fibers in the node do not contribute any fracture resistance. The tensile strength of bamboo fibers almost corresponds to that of steel. The main discovery is that the fracture properties of bamboo depend upon the origin of fracture. In the nodes, it is found that the average fracture toughness is lower than the minimum value of the entire Culm, suggesting that the fibers in the node do not contribute any fracture resistance

- **Seinfeld (2001)** researched the remarkable current uses of Bamboo around the world. In the United States, it is almost completely used as decoration. A discussion is presented on the astonishing feature Bamboo brings to the table as mentioned in other articles. Another special feature about Bamboo is that harvesting Bamboo does not harm the plant, producing more of its timbers. Bamboo buildings are definitely a prospect of the future in the US; however, in Asia, the Pacific islands, and South & Central America, they are quite traditional. The main prevention of Bamboo structures in America are building codes. There are not standardized codes for buildings of Bamboo though there are attempts towards them. Bamboo is almost ill being looked to clean environmental pollution. It is a consumer of Nitrogen, which could soon be part of a huge effort to prevent air pollution.

- **Power (2004)** tells of a study conducted by the U.K. Department of International Development in response to a devastating earthquake that killed 40,000 people in Iran. The engineers were looking for cheap earthquake-proof housing to take the place of mud brick. They constructed a prototype Bamboo reinforced concrete house and used an earthquake simulator to find that the houses too sound during a 7.8 (on the Richter scale) earthquake. They found no cracking in the concrete, the Bamboo to be extremely resilient to earthquakes, and the cost to be split in half compared to mud-and-brick construction.

- **Liu, Q., Wang, H., Li, Y., Liu, Y., & Ren, H. (2019)** in recent years, researchers have explored the potential of bamboo composites to enhance its strength and durability further. A study by Liu et al. (2019) investigated the mechanical properties of bamboo scrimber, which is a composite material made by laminating bamboo strips. The research found that bamboo scrimber exhibits excellent load-carrying capacity, stiffness, and dimensional stability, making it a viable alternative to conventional timber and steel in certain construction applications.

- **The American Bamboo Society (2005)** provided a very intricate collection of specialized terms followed by their definitions relating to Bamboo. It also has a glossary of questions and answers common to someone new to the topic. These questions ranged from identifying Bamboo, preserving Bamboo, finding help with your Bamboo, to other topics not as closing connected to the research of this project.

3. DESIGNS FOR CONSTRUCTION OF BAMBOO SCAFFOLDS

The commonly used bamboo types are Kao Jue and Mao Jue. They should be 3 to 5 years old and air-dried in vertical positions under indoor condition for at least 3 months before use. The nominal length of both Kao Jue and Mao Jue is 6 m. All bamboo members should be free from visual defects, and meet the following requirements on the cross-sectional dimensions. This section provides detailed standards of design and construction of some typical types of single bamboo scaffold, including double-layered, truss-out and sign board bamboo scaffolds. When the recommended standards given in this section are not followed or when other types of bamboo scaffold not covered in this section are used, they should be designed by a design engineer. For a bamboo scaffold for demolition works, irrespective of its size, the design engineer should also ensure the bamboo scaffold is capable to withstand the increased wind load acting on the plastic sheeting.

Steel Brackets Scaffolds

Steel brackets are essential to the overall stability of a bamboo scaffold. The details of a steel bracket for the support of posts of a bamboo scaffold for construction site. All steel brackets should be securely mounted on the structural elements of a building with high quality anchor bolts and comply with the following requirements.

- The horizontal spacing between the steel brackets should not be larger than 1.3 m and
- The concrete strength of the structural element to which the steel bracket is fixed should be not less than 25N/mm^2.All anchor bolts should be installed strictly in accordance with the manufacturer’s recommendations.

There may be occasions that a post of a bamboo scaffold does not rest on the steel bracket; the design engineer should ensure that the loading from

them is aligned post can be effectively transferred to the steel bracket.
Guidelines for Bamboo Scaffolds

- Performance
- Design Engineer
- Drawings and Specifications

- Engineering Justification4. CONCRETE MIX PROPORTIONS

The same mix designs can be used as would normally be used with steel reinforced concrete. Concrete slump should be as low as workability will allow. Excess water causes swelling of the bamboo. High early-strength cement is preferred to minimize cracks caused by swelling of bamboo when seasoned bamboo cannot be waterproofed.

5. SIMILARITIES WITH STEEL REINFORCED CONCRETE

Bamboo reinforced concrete design is similar to steel reinforcing design. Bamboo reinforcement can be assumed to have the mechanical properties. Hen design hand books are available for steel reinforced concrete, the equations and design procedures can be used to design bamboo reinforced concrete if the above mechanical properties are substituted for the reinforcement. Due to the low modulus of elasticity of bamboo, flexural members will nearly always develop some cracking under normal service loads. If cracking cannot be tolerated, steel reinforced designs or designs based on unreinforced sections are required. Experience has shown that split bamboo performs better than whole culms when used as reinforcing. Better bond develops between bamboo and concrete when the reinforcement is-split in addition to providing more compact reinforcement layers.

6. CONCLUSIONS

Bamboo strengthening concrete Bamboo can replace steel in basic urban poor dwellings near bamboo farms.

• The main and distribution reinforcement now use bamboo reinforcement like steel reinforcement did.

• Bamboo sticks can be adapted to reinforce reinforced concrete beams.

• Bamboo can replace steel reinforcement due to its high tensile strength and low cost.

• Like steel reinforcement, bamboo is used for main and distribution reinforcement.

• Bamboo is far less elastic than steel.

REFERENCES

1. Concrete floors on ground," Portland Cement Association Concrete Information, ST-51.

2. Rahman M. M., Rashid M. H., Hossain M. A., Hasan M. T. and Hasan M.K, Performance Evaluation of Bamboo Reinforced Concrete Beam, International Journal of Engineering&TechnologyIJET-IJENS2011,Vol. 11No.04.

3. Concrete floors on ground, "Portland Cement Association Concrete Information, ST-51

4. University of Southern Californial Los Angeles (CA90089-2551)

5. Markos Alito(2005), Bamboo Reinforcement As Structural Material For The Construction Of Low-Cost Houses In Ethiopia, Addis Ababa University

6. F. Falade and T. A. I. Akeju (2002). ‘Structural Design and Economy of Bamboo Reinforced Concrete Beams’, Proc. Fifth International Conference on Structural Engineering Analysis and Modeling, SEAM

7. Ghavami, K. “Ultimate Load Behavior of Bamboo-Reinforced Light weight Concrete Beams,” Cement & Concrete Composites, Vol.17, pp281-288, 1995.

8. Lo, Cuo, Leung, 2004, “The Effect of Fiber Density on Strength Capacity of Bamboo”, Materials Letter, 58, pp 2595-2598.

9. Punamia, BC. ,Jain, A., Jain, A.K.“RCC Design (Reinforced Concrete Structure)”

10.CBRC(2009)Utilization of Bamboo Book2

11.Huang, Y., Song, X., Hu, Y., Yang, Y., & Hu, X. (2019). Mechanical properties and design values of bamboo scaffold boards. Construction and Building Materials, 213, 506-513.

12.Yung, P. S., & Pan, W. (2019). Bamboo scaffold construction for sustainable building in Hong Kong. Frontiers of Engineering Management, 6(2), 245-253.

13.Chan, G., Ye, K., & Wong, M. (2020). Experimental investigation on the flexural behavior of bamboo–steel composite scaffold planks. Construction and Building Materials, 242, 118141.

14.Kamarudin, M. K. A., Suardi, A. K., Sulaiman, O., & Jaafar, M. S. (2021). Bamboo scaffolding properties and its potential as a substitute for the steel scaffolding in the construction industry. IOP Conference Series: Materials Science and Engineering, 1099(1), 012023.