SANDARBH

2018 - 2019

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Knowledge Skill Values

IPS ACADEMY INDORE

INSTITUTE OF ENGINEERING AND SCIENCE

CIVIL ENGINEERING DEPARTMENT


RAGGING IS CRIME

Magazine Coordinator
Mrs. Sonam Yadav
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Editorial Team
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Ms. Manya Trivedi
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Editing and Formatting
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Ms. Garima Bhargava
Mr. Dishank Garg
Ms. Madhyama Nagpure

Contents

Message from the Principal

It is a great pleasure to see the creative expressions of students who had contributed to Sandarbh. Civil Engineering Department has grown abundantly in the recent past. It continues to sustain its growth. People reading this magazine will realize the tremendous changes that are happening in the Department. The magazine is presenting a glimpse of the growth of the Department on many fronts. The Department has been simply unstoppable in its progress as it has been actively involved in various activities that have brought to light the hidden talents of the students and staff. The highly qualified and dedicated members of staff have always stood shoulder with the management and have carried out their duties with a level of commitment. This magazine has recorded achievements such as: conferences attended by staff members and students, competitions won by the hugely talented students, innovative projects carried out by students with the guidance of staff, among others. They stand as a witness to the monumental efforts taken by the management to make the college a centre of excellence in education and research.
I wish the management, staff and students of the college success in their future endeavors.

Dr. Archana Keerti Chowdhary
Principal

Editorial

It has given enormous gratification to coordinate the editorial team of ―SANDARBH‖ , our Civil Engineering Department‘ magazine in all aspects, covering academic activities, technical events of the students in contributing articles to the magazine.
This magazine would not have been concluded without the constant support of our principal who stood as a pillar of strength and support at all times. We would genuinely place thanks to our editorial team whose dedication and diligent towards completion of magazine was always part of the process. We would like to congratulate and express our hearty thanks and gratitude to our head of the department in believing the quality policy of educate enrich and excel in imparting professional education. This magazine is reflecting of our department quality in terms of all round excellence.
Last but not the least we want to express earnest gratitude to all the faculty members who gave constant support and guidance to enlighten young minds of the people through this magazine.

Editorial Team

Vision

Be the preferred destination locally, regionally and internationally for the Civil Engineering society as a leading department providing high quality programs and services in Civil Engineering fields.

Mission

To offer outstanding U.G. & P.G. education, research guidance, professional consultancy, outreach and manpower training as well as leadership in Civil Engineering fields.

Highlights of the Department

Faculties

- Patents by the Faculties 03
- Book Published by the Faculties 10
- Post Doctoral Program 01
- Special Awards 05
- Research Paper Published 51
- STTP/FDP/Seminars/Workshop Attended 87

Students

- Received Gold and Silver Medals 02
- Received Chancellor Scholarship 07
- Selected in IES and other public Sectors 10
- Established as an Entrepreneur 65
- Projects with IEDC (DST) 10
- Research Papers Published 206

Social Initiatives

- Weather Station installed.
- Road Safety Campaign Week

State of the Art Laboratories

- Instrumentation Lab
- Heavy Structures Lab
- Simulation Lab

Life Membership

- Indian Concrete Institute.
- Indian Water Works Association.
- Indian Water Resources Society
- Indian Geotechnical Society

Student Chapter

- Indian Concrete Institute.
- Student Council

Our Esteemed Alumina

- Akash Varshney - Virgin Atlantic Airways, London (0808CE041001
- Rachiyata Awasthi - Asst. Director Treasury (0808CE041032)
- Pratibha Mishra - SDO (0808CE041030
- Ashish Pandey – UPSC Engg. Services (AIR 120) (0808CE081008)
- Rajat Saklecha - IPS OFFICER (0808CE081042)
- Sunil Sagitra – UPSC Engg. Services (0808CE111080)
- Dayalu Rathod – SDO, PHE (0808CE111014)

Laboratories

- Strength of materials
- Engineering geology
- Instrumentation lab
- Transportation lab
- Software lab
- Project lab
- Fluid mechanics lab
- Survey lab
- Concrete /CMT lab I & II
- Theory of structure lab
- Geotechnical engineering lab

Major Softwares

- STAAD Pro
- Auto CAD
- AutoDesk Civil 3D 2009
- Primavera P 6.2
- Primavera Contractor
- ANSYS
- SAP 2000
- Abaqus 6.12
- ETABS
- GMS ver 6.5
- AFT Impulse 4.0
- STAAD Pro Foundation + Section Wizard
- Abaqus 11.2
- DIANA FEA
- MIDAS GEN

Major equipment

- Total station
- UTM & CTM
- Pumps & turbines
- Benkingum beam
- Bituminous testing apparatus
- Plate load test
- SCPT & DCPT
- Polariscope
- Fft analyser
- Data logger
- Weather station
- CBR

Expert Talk

"EARTHQUAKE DON'T KILL PEOPLE, BUILDINGS DO"

By: Dr. Amit Sharma
Civil Engineering Department

A survey by the National Disaster Management Authority found that in the past 25 years, more than 25,000 human fatalities were caused by collapse of buildings during earthquakes."The condition and quality of Indian building stock is poor when it comes to seismic performance, the performances of reinforced concrete buildings are unsatisfactory.

Rapid urbanisation, rising demand for homes, shrinking availability of land and an increase in the Floor Area Ratio are inducing developers to go for high rises."Earthquakes don't kill, buildings do. Unfortunately, many small and medium developers are cutting costs and so are not investing enough to make their buildings earthquake proof even though it is legally binding on them."

For example when we go to purchase an LED first we check whether it is suitable for us (searching of Model no. and company), secondly we asked for warranty of product. Then we decide which LED we need to purchase. But in case of home do we ask about the life of building, who has designed the building (Structural Engineer is involved in designing or not), whether the IS codes for seismic design of buildings are followed or not? Generally most of the people even don't asked such things due to lack of awareness.

During the 2001 Bhuj earthquake, reinforced concrete buildings collapsed during temblor of just 6-magnitude, when a well-designed reinforced concrete building is expected to collapse only when it is 7.5-magnitude or higher. The damage caused to these buildings was high compared to any other country for similar level of ground-shaking. So it's a no-brainer that the housing risk in India should be minimised to reduce loss of life and property in future earthquakes.

Today, India has a good range of seismic codes covering a variety of structures, ranging from mud or low strength masonry houses to modern buildings. However, the key to ensuring earthquake safety lies in having a robust mechanism that enforces and implements these design code provisions in constructions."The problem becomes more pronounced in the small town and villages because there the governance structures (municipalities) are weak and the implementation of seismic rules is tardy. This is further complicated as municipalities also don't have enough structural engineers who specialise in seismology to undertake monitoring.

We can design the safe building which will survive the earthquake but due to lack of awareness "Collapse of under designed buildings are killing people and not the earthquake."

Research Works by Students

Case Study on Self Healing Concrete

Dishank Garg, Garima Bhargava, Gitesh Panche, Dheeraj Sharma, Harsh Bali

Abstract—Self-healing concretes are being widely recognized as a reformative technique to improve the durability of concrete. Although, few review papers on self-healing concrete were published, a strong review on all facets of self-healing concrete cannot be found. In this paper, natural, chemical and biological processes of self-healing concrete technologies were completely reviewed. The main focus of the study is for the biological processes. The review presents a new insight into the research for the treatment of unforeseen cracking of concrete. The information presented in this paper can be considered significant for biotechnologists and bioprocess engineers to have comprehensive updates on the current status-quo of self-healing concrete.

Keywords—Self-healing concrete, chemical self-healing process, biological self-healing process, biological precipitation.

I. Introduction

Self-healing concrete is often defined as the ability of concrete to repair its small cracks autonomously. The idea of self-healing concrete was inspired from the natural phenomenon by organisms such as trees or animals. Damaged skin of trees and animals can be repaired self-governing. Remediating cracks in concrete structure is important for its service durability and structural safety.

Recently, developing self-healing concrete technology has become an significant objective for researchers in biotechnology and civil engineering sciences. During the 1980s, only very few articles can be found related to self-healing concrete, more over serious studies in this area were not established until late 1990's. Among the self-healing designing methods, biological methods are the latest ones.

Several processes are proposed for the design of self-healing concrete. This paper reviewed all processes of self-healing concrete technologies containing natural chemical and biological processes. Figure 1 shows the comprehensive taxonomy for self-healing concrete research.

Although several review papers have been published on self-healing concrete, an extensively reviewed on physical, chemical and biological processes have not yet been reported. For a biologist, the importance of a comprehensive review paper is to establish a quick macro snapshot from the body of knowledge. Thus, this paper aims to present a comprehensive review on self-healing concrete based on three key taxonomy, i.e. natural self-healing, chemical self-healing and biological self-healing. All the corresponding sub-taxonomies for all three key taxonomies are described in the subsequent sections.

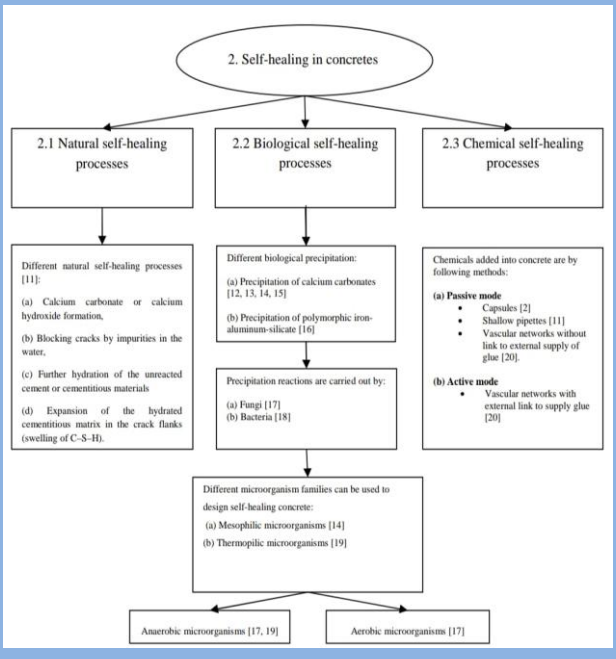


Figure 1- Natural Chemical and Biological Processes

II. Self-healing of concrete

A. Natural Self-healing process

In natural processes, four following processes can block crack (1) the formation of calcium carbonate or calcium hydroxide is another process to block crack (2) crack is blocked by impurities in the presence of water as shown in Fig. 2(B). (3) Crack is further blocked by hydration of the unreacted cement or cementitious material (Fig. 2(C)). (4) Crack is blocked by the expansion of hydrated cementitious matrix in the crack flanks (swelling of calcium silicate hydrate gel) as shown in Fig. 2(D). In many cases, more than one of these process or mechanisms (Fig. 2A to 2D) can happen simultaneously. In fact, most of these mechanisms can only partially fill the entrance of some cracks and cannot completely fill the cracks. This will be useful to prevent the development of cracks or prevention of deep penetration of harmful chemicals such as acids into the crack.

Among the proposed self-healing mechanisms in the natural process, formation of calcium carbonate and calcium hydroxide (Figure 2A) are the most effective methods to heal concrete naturally. This view is supported by the fact that some white residue can be found on the outer surface of the concrete cracks. This white residue is found to be calcium carbonate and has been widely reported including Wu et al. The fundamental mechanisms for the formation of calcium carbonate and calcium hydroxide are represented in Eqn. (1) to (3). At the first step, carbon dioxide is dissolved in water.

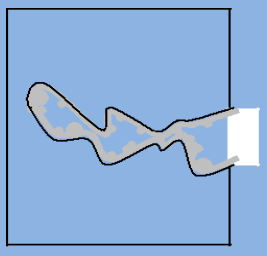
$$H_2O+CO_2 \leftrightarrow H_2CO_3 \leftrightarrow H^+ + HCO_3^- \leftrightarrow 2H^+ + CO_3^{2-} \quad \text{Eq. 1}$$

Free calcium ions are released as a result of cement hydration and dissipation through concrete as well as along the cracking surfaces, reacts with and . As a result, calcium carbonate crystals are formed. Reaction (2) and (3) can only happen at pH above 8 or between 7.5 and 8. The crystals grow both at the surface of the cracks and finally fills the gap.

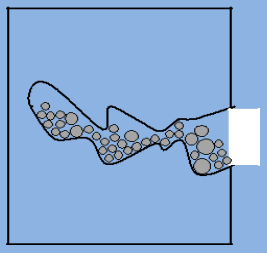
$$Ca^{2+}+CO_3^{2-} \leftrightarrow CaCO_3 \quad \text{Eq. 2}$$

$$Ca^{2+}+HCO_3^- \leftrightarrow CaCO_3+H^+ \quad \text{Eq. 3}$$

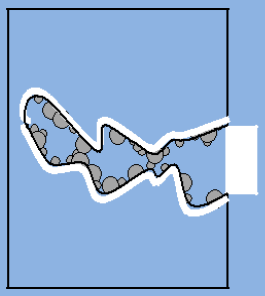
Neville (2002) claimed that, further hydration of anhydrate cementations components is mainly due to the natural self-healing properties in concrete. However, this process only applies to very young concrete and the formation of calcium carbonate most likely causes self-healing at later ages. Natural self-healing can be useful for cracks with widths up to 0.1–0.2mm.

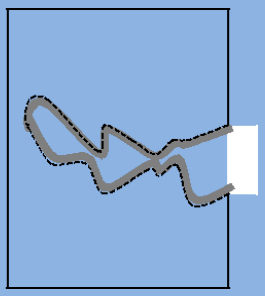


(A) Formation Of Calcium Carbonate



(B) Blocking by impurities





III. Biological Self-Healing Process

The use of microorganisms to design self-healing concrete has been categorized as biological strategy by several researchers . Microorganisms can grow almost everywhere such as soil, water and oil reservoir, acidic hot springs and industrial wastewater. The use of microorganisms to design self-healing concrete has been suggested by several researchers. Gollapudi et al. introduced biological self-healing concrete as environment friendly process [16]. Microorganisms are mostly divided into three important categories: bacteria, fungi, and viruses. Among these microorganisms, special strains of bacteria capable of precipitating certain chemicals are used to design the biological self-healing concrete. Precipitation of polymorphic iron-aluminum-silicate($(Fe_5AI_3)(SiAl)O_{l0}(OH)_5$) and calcium carbonate ($CaCO_3$) are the most important processes use for designing the biological self-healing concretes.

Microorganisms can be added to the biological self-healing concrete through different ways. These includes the addition of microbial broth directly into the fresh concrete; additions in the form of spores, immobilized form onto silica gel or activated carbon, encapsulated form, or using the vascular networks as described under the chemical method to distribute the microorganisms.

The pH, temperature and moisture content of the concrete are typically not suitable for the growth of bacteria. Hence, in certain cases, opposing form of bacteria (spore) is used instead of using fresh microbial broth. Alternatively, encapsulated microorganisms can also be used to withstand the harsh condition of concrete. Encapsulation of microorganisms are however an expensive and complex method. The use of vascular networks to distribute the microbial broth throughout the cementitious matrix is another way of protecting the microorganisms from inappropriate conditions. However, these methods are complicated and subjected to lack of constructability using current technology.

The use of immobilized microorganisms onto silica gel or activated carbon is a suitable way in terms of financial aspect. However, the effect of using these materials on strengthening of concrete is still not completely clear. Jonkers et al., (2010) showed that applying $6\times10^{8}/cm^3$ bacterial spores to design self-healing concrete resulted in a decrease in strength of less than 10% for 3, 7 and 28 days cured specimens [76]. This study showed that the effects of bacteria on concrete straightness are not considerable. However, it can be very effective to repair cracks and extension of concrete durability.

IV. Biological precipitation of calcium carbonate

The pH of fresh concrete is usually between 10 to 13.The temperature of fresh concrete can go up to 70°C. After the drying of concrete, there is not enough water. Therefore, the selected bacteria needs to display high resistance against high pH, temperature, and serious limitation of water. Usually mesophilic microorganisms cannot grow normally in these conditions. To solve this problem Ghosh and Mandal (2006) successfully used thermophilic bacteria to design self-healing concrete.

Microbial calcium carbonate can be precipitated as a by-product during urea hydrolysis, photosynthesis, and sulfate reduction . As a microbial sealant, calcium carbonate showed its positive potential in selectively consolidating simulated fractures and surface fissures in granites and in the consolidation of sand. Calcium

carbonate can be found in three-precipitated form of mineral crystals. They have similar chemical formula but different structures, namely calcite, aragonite and vaterite. The most stable form of calcium carbonate is calcite. Aragonite is meta-stable and can be converted into calcite over time. Vaterite is rarely found in nature Only calcite is of greater interest for developing self-healing concrete.

Several factors affecting the precipitation rate of biological calcite are (1) concentration of the dissolved inorganic carbon content, (2) pH, (3) concentration of calcium ions ( ) concentration, (4) presence of nucleation sites. Microbial metabolisms can provide first three of these factors and the cell wall of the bacteria acts as nucleation site.

Bacterial calcium carbonate precipitation on concrete surface can reduce permeability towards gas and capillary water uptake. Carbonate precipitation is found throughout the world, especially in the oceans. This type of bacterial culture and medium composition has a profound impact on the morphology of calcium carbonate crystal. For example, precipitation of calcite can be raised by magnesium. Several microbial metabolic pathways can contribute to the precipitation of biological mineral. For instance, the famous pathways to precipitate calcium carbonate are anaerobic sulphide oxidation, ammonification, denitrification, sulfate reduction and photosynthesis.

The primary role of bacteria to precipitate calcium carbonate is attributed to their ability to increase the pH of the environment through different bacterial metabolisms. Apparently, biological calcium carbonate precipitation using ureo-lytic bacteria is one of the most popular way to design self-healing concrete. These bacteria are able to produce extracellular urease enzyme. The hydrolysis of urea to carbon dioxide and ammonia can be catalyzed by urease enzyme. The hydrolyzed ammonia and carbon dioxide increases the pH and carbonate concentration in the bacterial environment, respectively. A series of biochemical reaction takes place to form calcium carbonate as shown in Eqn. (4) to (10).

Urea is hydrolyzed to carbamate and ammonia in the presence of urease as shown in Eqn. (4)

Carbamate is spontaneously hydrolyzed to form ammonia and carbonic acid as in Eqn. (5).

$NH_2COOH + H_2O \rightarrow NH_3 + H_2CO_3$ Eq. 5

Carbonic acid is hydrolyzed to form carbonate ion and hydrogen ion as shown in Eqn. 6.

$H_2CO_3 \leftrightarrow HCO_3^- + H^+$ Eq. 6

Ammonia spontaneously hydrolyses to form ammonium and hydroxide ion as shown in Eqn. 7.

$2NH_3 + 2H_2O \leftrightarrow 2NH_4 + 2OH^-$ Eq. 7

The reaction in Eqn. (7) constantly produces hydroxide ion, this gives rise to a pH increase, which shifts the overall equilibrium of bicarbonate ion ( ) towards the formation of carbonate ions as shown in Eqn. (8).

$HCO_3^- + H^+ + 2NH_4 + 2OH^- \leftrightarrow CO_3^- + 2NH_4 + 2H_2O$ Eq. 8

Bacterial cell wall has negative charge and for this reason, cell wall is able to draw positively charged calcium ions (Ca2+) to

deposit on their cell wall surface (Eqn. 9). The Ca2+ ions then react with the CO ions leading to the precipitation of calcium carbonate) at the cell surface as shown in Eqn. (10). This precipitation serves as the nucleation site.

Ca^{2+} + Cell → Cell – Ca^{2+} Eq. 9

Cell – Ca^{2+} + CO_3^{2-}→ $CaCO_3$ – Cell ↓ Eq. 10

Based on the microbial pathway for the precipitation of calcium carbonate, urea has to be present in the self-healing concrete to initiate the necessary biochemical reactions. Biological precipitation of calcite can be detected using x-ray diffraction (XRD). Calcite crystals can also be observed by scanning electron microscopy (SEM). Talaiekhozani et al. (2013) have prepared some pictures of biological calcium carbonate precipitation on the surface of concrete. This study is carried out through the isolation of microorganisms from soil. The isolated microorganisms could help in concrete healing process after one-month observation. Healed concrete cracks are show in figure 8 (from (a) to (c)). Also, similar type of microscopic picture has been prepared by Zwaag and Routes (2010) that can be observed in figure 8(d). In this picture, bacteria and their calcium carbonate precipitation are clearly observed.

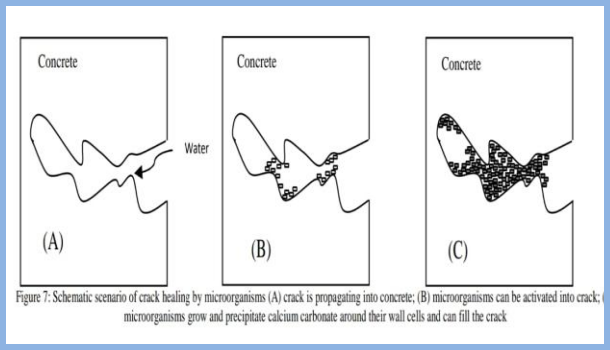


Figure 7: Schematic scenario of crack healing by microorganisms (A) crack is propagating into concrete; (B) microorganisms can be activated into crack; microorganisms grow and precipitate calcium carbonate around their wall cells and can fill the crack

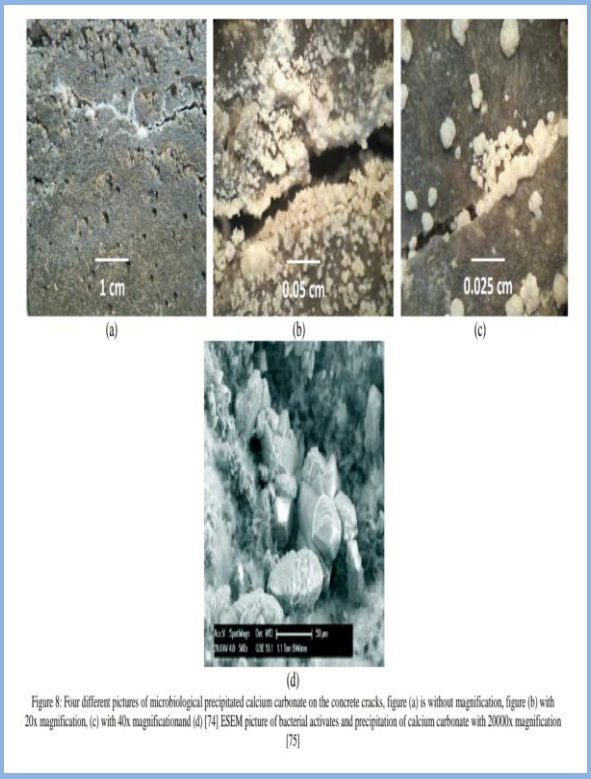


Figure 8: Four different pictures of microbiological precipitated calcium carbonate on the concrete cracks, figure (a) is without magnification, figure (b) with 20x magnification, (c) with 40x magnificationand (d) [74] ESEM picture of bacterial activates and precipitation of calcium carbonate with 20000x magnification [75]

V. Material and Methods

I. Size of Cracks in Concrete

According to the analysis and study by different authors, that the cracks healed by autogenously healing was observed in various sizes such as0.05 mm to 0.87 mm, 5 to 10µm, 100µm , 200µm , 205µm and 300µm.

II. Encapsulation Light Weight Aggregate

LWA is also used for improving the self-healing property of the concrete. The ordinary aggregate of size 2-4mm which was replaced by the light weight aggregate of same size corresponding to a healing agent content of 15 kg m-3 concrete [27] this change will affect its compressive strength. Capacity to heal cracks was substantially improved for concrete containing in LWA encapsulated healing agent.

VI. Test

I. Effect on the Strength Test

As amalgamation of healing agent to concrete may have unwanted negative effects on the mechanical properties. The consolidation of a high number of bacteria (5.8 X 108 cm-3 cement stone) shown to be negative effect on the compressive strength development as bacterial test specimen appeared almost weaker then control specimen. Tensile strength is the ability of a material to withstand a pulling (tensile) force. The tensile strength of the specimen was found to be 0.007 N/mm2 [26]. It is observed that bacterial concrete shows the better tensile strength as compare to the conventional tensile strength as shown in table 2.

Table 2. Comparison of compressive strength of conventional concrete and bacterial concrete

S.No.	No. of days	Split tensile strength of conventional concrete cylinders, N/mm^2	Split tensile strength *B. sphaericus* concrete cubes, N/mm^2	% increase in Strength
1.	3	3.78	4.30	13.75
2.	7	4.62	5.28	14.28
3.	28	4.85	5.74	18.35

II. Treatment Procedure

For the treatment procedure the specimen is immersed in the 0.3 and 0.6 L of a 1 day old stock culture of B. sphaericus prior to deluge in the nutrition solution for 24 days due to this ureo lytic activity primarily result from bacteria inside
the specimens. Selection of the treatment based on the commercial availability according to their different mechanisms in table 3.

Table 3. The different type of treatment according to the mechanism and composition

Group	Subgroup	Composition of conventional technique/nutrient solution
Biodepositio n treatment	Ureolytic mixed cultures	1. Urea, NBP 2. Urea, calcium acetate 3. Urea, calcium chloride 4. Urea, NBP calcium acetate 5. Urea, NBP calcium chloride
	Bacillus sphaericus	1. Ureas, NBP 2. Urea, calcium acetate 3. Urea, calcium chloride 4. Urea NBP, calcium acetate 5. Ureas NBP, calcium chloride

III. Capillary Water Suction

Increase in water penetration resistance was determined by a sorptivity test, based on the RILEM 25 PEM (II-6) was carried out. Capillary water suction used to find out the absorption capacity of the bacterial concrete as compared to the conventional concrete. The value lower than 1 shows the relative decrease of water absorption and the value greater than 1 indicates the relative increase in water absorption. The result was expressed as the relative capillary absorption index as proposed by . By performing the experiment on the various specimens it was found that the conventional concrete shows the lower value of relative capillary index. Willem De Muynck et al. also compare the pure culture and ureo lytic mixed culture from his study it was found that the pure culture of B. Sphaericus had value of relative capillary index was lower as compare to the ureo lytic mixed culture due to addition of the soluble calcium ions.

IV. Gas Permeability

RILEM- CEMBUREAU method was used to find the Gas permeability using the principal as the Hagen- Poiseuille relationship for laminar flow of a compressible fluid through a porous body having small capillaries under steady state. Martin Sommer oxygen permeability experiment used measure the rate of flow of oxygen. It was found that the reduction of permeability in bacterial concrete as compare to the conventional concrete.

V. Water Permeability Test

For self-healing nature of concrete water permeability is also an important factor. After the splitting test the concrete specimen was broken completely. During the splitting test some fluid come out of the tube and emigrated into the cracks and then the specimen put in the curing room to wait till the solution become gel and the polyurethane foam formed after this cylinder were immersed into the water for 3 days. Take out cylinder after 3 days and dried it. The dry cylinder was fitted inside the PVC ring. During the water permeability test the vacuum saturation allows to establish a steady flow condition in a specimen which was first vacuumed in the vacuum chamber for 2-3 hours and then de-mineralized water was added into the chamber. The cylinder was kept immersed completely into the water for 24 hours due to the completely immersed specimen the vacuum stopped. Then cylinder was taken out and prepare for the water permeability test. The whole setup kept watertight so that the specimen was in saturated state throughout the whole process of the measurement. The time for the decrease the water level from h0tillhfin the glass tube was measured for 30 days of testing this water related with the water permeability of the cracked specimen. By the help of the Darcy's law, the coefficient of water permeability of the specimen can be calculated by the following equation:

$$K=atln(h_0/h_f)At$$

Where k coefficient of water permeability (m/s); a is the cross-section area of the glass tube (m2); A is the cross-section area of the cylinder (m2); T is the thickness of the cylinder (m); t is the time of water falling from h0 to hf (s); h0 and hf are the initial and final water levels (cm). After performing the experiment it was found that the value of k range from 4 X 10-6 m/s to 7 X 10-6 m/s and the final k was 10-6 m/s which indicate that silica gel in the crack had limited capacity to decrease the water permeability. The initial crack width was 0.5 mm and decreased to 0.35 mm.

Vi. Compressive Strength

Table 4. Comparison of compressive strength of conventional concrete and bacterial concrete

S.No.	No. of days	Compressive strength of conventional concrete cubes, N/mm^2	Compressive strength of *B.sphaericus* concrete cubes, N/mm^2	% increase in Strength
1.	3	19.24	25.16	30.76
2.	7	23.66	34.58	46.15
3.	28	34.52	45.72	32.21

Compressive strength of the concrete is the capacity of the structure to resist the load acting on them. By the adding of bacteria to the concrete it improves the compressive strength of concrete as compare to conventional concrete. The compressive strength of concrete was improved by 14.92% by adding Bacillus subtilisJC3 as compare to the conventional concrete. It was found that B. sphaericus improved the compressive strength of concrete by 30.76% in 3 days, 46.15% in 7 days and 32.21% in 28 as compared to conventional concrete shown in table 4.

VII. Oxygen Consumption Measurement

Oxygen consumption measured when oxygen consumed by aerobic bacterial metallic conversion of calcium lattice. For the study the optical oxygen micro sensors were used for analysis of water submerged control and bio chemical healing agent containing mortar specimens and it can be calculated by calculating the change in oxygen concentration in the linear part of the gradient in the diffusive boundary layer using Fick's first law of diffusion.

$$J = - D_{OXYGEN} * dC(z) / dZ$$

Where D_{OXYGEN} is the diffusion coefficient of O2 in water, and C(Z) is the conc. of O2 at depth Z.

VIII. Stress-Strain Behavior of Concrete

The stress-strain behavior of concrete gives the value of toughness. The test were performed on the cylindrical
specimen prepared in universal testing machine of 3000KN capacity and the following data was obtained as shown in table 5.

Table 5. The Stress-Strain behavior of bacterial concrete of grade M60 as compare to controlled concrete

Controlled concrete		Bacterial concrete	
Strain	Stress, MPa	Strain	Stress MPa
0	0	0	0
0.0001	3.27	0.0001	2.83
0.0002	6.41	0.0001	5.66
0.0003	9.01	0.0002	8.49
0.0004	12.98	0.0003	11.32
0.0005	15.32	0.0003	14.15
0.0006	18.65	0.0004	16.99
0.0007	21.10	0.0004	19.82
0.0008	24.55	0.0005	23.20
0.0009	28.56	0.0006	25.70
0.0010	36.00	0.0007	31.00
0.0011	38.80	0.0008	34.60
0.0012	42.30	0.0010	40.00
0.0014	47.60	0.0011	46.70
0.0016	61.00	0.0012	54.90
0.0023	72.61	0.0014	61.00
0.0027	65.70	0.0015	82.40
0.0033	36.80	0.0023	94.21
0.0034	30.30	0.0033	51.00
0.0035	29.15	0.0035	36.08

VII. Conclusions

Introducing the bacteria into the concrete makes it very beneficial it improves the property of the concrete which is more than the conventional concrete. Bacteria repair the cracks in concrete by producing the calcium carbonate crystal which block the cracks and repair it. Many researchers done their work on the self-healing nature of concrete and they had found the following result that bacteria improves the property of conventional concrete such as increase in 13.75% strength increased in 3 days, 14.28% in 7 days and 18.35% in 28 days. The development of calcium carbonate crystal Decreases the water permeability by decreasing the width of cracks from 0.5 mm to 0.35 mm. Compressive strength was increased by 30.76% in 3 days, 46.15% in 7 days and 32.21% in 28 days and in mathematical modal it was found that the bacterial concrete shows the better value of stress and strain as compared to controlled concrete for the high strength grade of concrete.

According to De Muynck et al. the regular inspection for the concrete will be less need due to use of self-healing material used in the concrete. In a publication wiktor and jonkers et al. quantified the cracks healing capacity of the concrete containing LWA (light weight aggregate) Encapsulation self – healing agent. They observed that the width of the cracks was less than 0.46 mm for bacteria- based specimens. From the capillary water suction test it was found that the bacterial concrete shows the lower values of relative capillary index as compare to the ueo lytic mixed culture and from the gas permeability tests it was found that the permeability decreases in bacterial concrete as compare to the conventional concrete.

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Irrigation using Wireless Sensor Technique

Ram Patel, Gajendra Rathore, Mohit Gupta

Abstract: Today's drip irrigation is very useful because water is limited. It is not unlimited and free forever. Drip irrigation system is best method to solve this problem in agriculture field to improve the water resources, crop's automatic, locate, time, and drip irrigation is very good choice.
There is some kind of method to save water with drip irrigation like design of fussy drip irrigation and so on.
"In this paper main purpose to describe the many type of irrigation method and how is it work in agriculture?"

1. Introduction

India is called country of agriculture. Here 70-80% depends on agriculture. According to human population, agriculture is only one source to grow the seeds of food. Using of water without planning the ground water level is decreasing day by day, the lack of rains and land of water is decreasing also. It means the volume of water on earth and its level is down day by day. Today drip irrigation is necessary to control the level of water on earth. Drip irrigation system is provided the root to zone of plant drop by drop which results in saving of huge amount of water.
The target of this system is following:
a) Save energy and water resources.

b) Manually and automatic control the system.
c) To increase the productivity of crop.
e) To increase the efficiency of water.
F) Selection of irrigation based on the different parameter.

2. Water Management

The main requirement of paddy is wet soil for its growth and sufficient water management according to need. Flooding is unnecessary if the weeds can be removed manually but if not then the fields are flooded to suppress weed growth and maintain nutrients such as phosphorus, potassium, and silica and calcium iron. Water is needed only at three critical stages, at the initial seedling period (10 days), flowering and panicle initiation stage. After the transplantation till the seedlings grow it needs standing water at a depth of 2-5 cm. Then till the dough stage of the crop, 5cm of water should be maintained. Then at last, water should be drained out from the field 7-15days before the harvest. The amount of water required for a given crop depends on state of development of soil, quantity and type of fertilizer given, quality of water used. The paddy needs a lot of water. Another big concern here is that the water should not be in excess nor it should be less than the required amount. Both are very harmful for the cultivation of paddy. Therefore, we need a method by which the amount of water in the field can be monitored regularly and the water level can be controlled.

3. What is irrigation?

Irrigation is the artificial application of water to the land or soil. It is used to assist in the growing of agricultural crops, maintenance of landscapes, and revegetation of disturbed soils in dry areas and during periods of inadequate rainfall. Additionally, irrigation also has a few other uses in crop production, which include protecting plants against frost, suppressing weed growing in grain fields and helping in preventing soil consolidation. In contrast, agriculture that relies only on direct rainfall is reffered to as rain-fed or dry and farming.
Irrigation is a system that is installed in land of agriculture to improve the efficiency of water.
Conventional irrigation methods like overhead sprinklers condition promotes

infections by leaf meld fungi. Flood type methods consume a large amount of water, but the among crop rows flinches from the incidental rainfall.

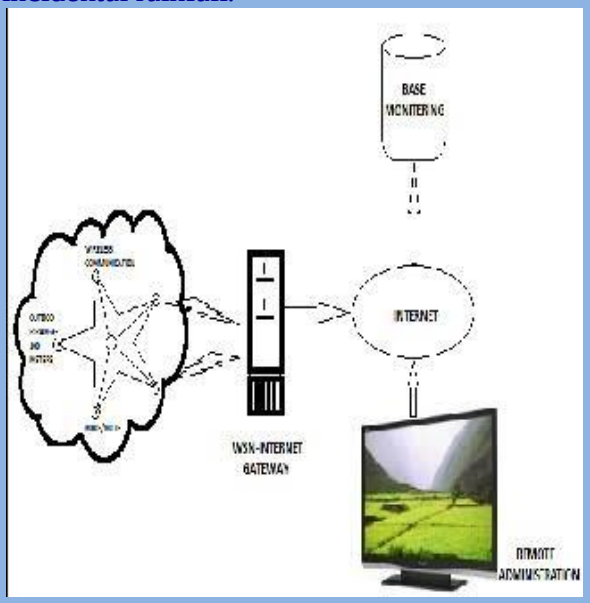


Fig.1 Block Diagram of wireless network system for irrigation

Implementation of automatic requires are following
1) The actual collection of water requirement.
2) For the remote transmission technology for water information and the control.
3) Drip irrigation control decision making.

4. Need of the Project

Irrigation is an artificial application of water to the soil. An irrigation system is a system that delivers water to an area where water is needed but not normally present in the required amounts. Generally, it is used for agriculture and landscaping. Additionally, irrigation also has other uses in crop production, which include protecting plants against frost, suppressing weed growing in gain fields and helping in preventing soil consideration. In contrast, agriculture that relies only on direct rainfall is referred to as rain-fed or dry and farming.

5. System Hardware Design

System Composition

System based on wireless network, is made up of drip irrigation system. Due to real timing monitoring information of soil moisture, temperature, light intensity the crop water use law.

Drip Irrigation System

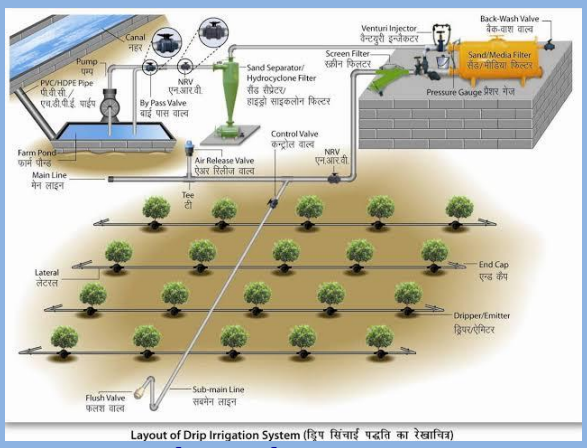
Drip irrigation requirements throttle filter pressure gauge should be installed at water source. Soil moisture sensor buried under the root of plant near the surface, light intensity and temperature sensor fixed to the side pole.

6. Today Irrigation System:
Surface Irrigation

Surface irrigation is known as the combination of techniques where water is present and divided into every row of plant soil by gravity. It is very traditional way to provide the water to soil of plants. Surface irrigation is done by flood irrigation.
The distribution of water is uncontrolled. For example, surge irrigation a significant degree of management. The process of surface irrigation can be described using four phases. As water is moved to end point of the top of land it will flow or advance over the field length. The advance phase refers to that length of time as water is moved to end point of top the field and flows or advances over the field length. After the water reaches the end of the field it will either run-off or start to pond. The period of time between the end of the advance phase and the shut-off of the inflow is termed the wetting, pounding or storage phase. As the inflow ceases the water will continue to runoff and infiltrate until the entire field is drained. The recession phase describes the time period

while the water front is retreating towards the downstream end of the field. The depth of water applied to any point in the field is a function of the opportunity time, the length of time for which water is present on the soil surface.
These are of three types:
a) Level basin
b) Furrow basin
c) Border strip

Drip irrigation:
Drip irrigation is also called trickle irrigation, micro irrigation and localized irrigation. It is an irrigation method that saves water for future. Water is allowed to drip to the root of plant.
There are two ways either onto the soil surface or directly onto the root zone by a network that is installed in a land to irrigation. It is done with the help of narrow tubes which delivers water inside the plant under the ground. Modern drip irrigation is also called trickle irrigation, micro irrigation and localized irrigation. It is an irrigation method that saves water for future. Water is allowed to drip to the root of plant.
There are two ways either onto the soil surface or directly onto the root zone by a network that is installed in a land to irrigation. It is done with the help of narrow tubes which delivers water inside the plant under the ground. Modern drip irrigation has arguably become the world's most valued innovation in agriculture since the invention of the impact sprinkler in the 1930s, which offered the first practical alternative to surface irrigation. Drip irrigation may also use devices called micro-spray heads, which spray water in a small area, instead of dripping emitters. These are generally used on tree and vine crops with wider root zones. Careful study of all the relevant factors like land topography, soil, water, crop and agro-climatic conditions are needed to determine the most suitable drip irrigation system and components to be used in a specific installation



Layout of Drip Irrigation System (ड्रिप सिंचाई पद्धति का रेखाचित्र)
Fig. layout drip irrigation


Figure: Sprinkler Irrigation

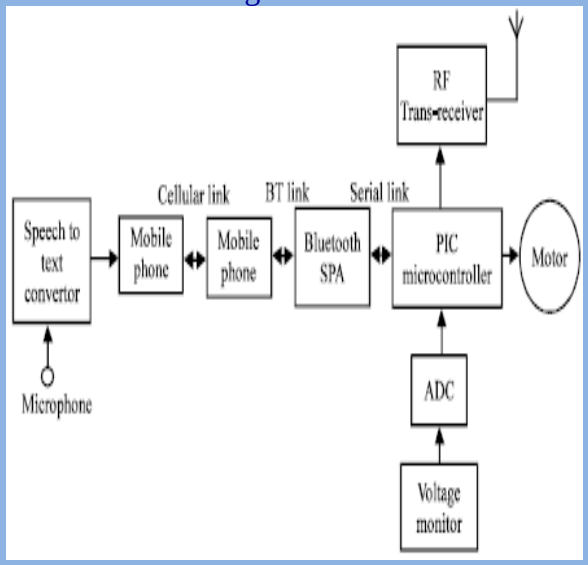
Sprinkler Irrigation
In sprinkler irrigation delivery of water is through a pressurized pipe network to the nozzles of sprinkler which spray the water into the air. In other words we can say that, it is a type of artificial rain. The basic components of this irrigation are water source, pressure pump to pressurize the water, a pipe network to distribute the water over the field, the
Sprinklers to spray the water over the ground and Valves to control the water flow.

7. Advantage

(a) It saves water due to possibility of using saline water.
(b) Efficient and welfare use of fertilizers.
(c) Installation is easy & flexibility in operation.
(d) Suits to all types of land terrain & also suitable to waste water.
(e) Enhances plant growth and yield and better quality of produce.
(f) Weed growth is less.
(g) Saves labour works.
(h) No soil erosion which saves land.

8. Zig-bee system for drip irrigation:

ZIGBEE system is efficient for water management in the irrigated agricultural cropping systems. The system is based on soil condition identification and consists of zigbee module for communication purpose. In order to produce "More cropper drop" Zigbee is a low-cost, low-power, wireless mesh network standard. The low cost allows the technology to be diffused in room of controlling and watching petition. Mesh networking provides high reliability and more extensive range.



Block diagram of agricultural zigbee irrigation system

9. Working

Soil moisture sensing network is used to monitor the moisture contained in soil. Three different sensors are used to monitor three layers of soil. And according to that further action is taken by microcontroller as the output of network is given to the microcontroller. Indicator indicates whether the soil is dry or wet. Microcontroller is the heart of the system; it controls the overall irrigation system. It takes the input from moisture sensor 1, 2, 3 etc. & according to the written program it turns ON or OFF the motor pump. It also indicates the condition of soil. Also it provides the data to the PC through zigbee module. When soil is dry motor is on and when soil is wet motor is off. Thus microcontroller controls the operation of motor. Zigbee module is a communication technology just like a Bluetooth but different that it is a full duplex communication. It is used here to have wireless link between PC & the main irrigation system. So that data can be logged into PC. In our project we have one master and one slave device. AC or DC motor can be used for whole system. On the basis of soil moisture detection, motor ON/OFF working will be done. Provision of water and considering the need of water to the crop is done by controlling motor. Along with this the valves are made on depending on the state of the soil. LCD is also used at field .It indicates message from the microcontroller soil state, motor state.

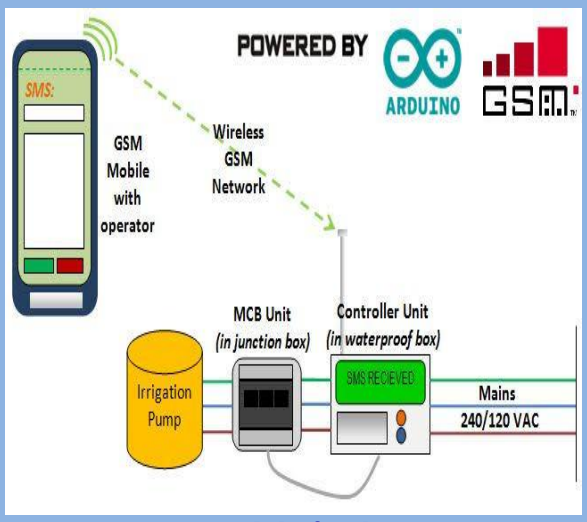


Fig. ZIGBEE module for drip irrigation

10. Advantage

The system becomes advantageous because -

1. Moisture level of soil is measured. So that, we can provide water as per requirement of the soil. It prevents water clogging of soil.
2. Valves are controlled in our system. Therefore labour is not required for valve controlling.
3. Message is sent to the user's pc so he can understand the moisture level and user can handle the situation also at the distant location.

11. Future Scope

In our work, we deploy 200 sensors for the delivery of water level information to the monitoring station.

When the number of sensors is increased, then there is a large amount of power consumption by sensors to deliver the water/packet information to the monitoring station. So it is mandatory to minimize the power consumption by using optimization techniques.

12. Conclusion

In this paper we are using fertility meter and ph. meter to determine the percentage of potassium, phosphorus, nitrogen which is the most important ingredients of soil. Now after measuring fertility of soil, we have implanted the automatic plant irrigator for DRIP irrigation through wireless. Both techniques will help to judge fertility and moisture content of soil. This application of sensor-based irrigation has some advantages such as preventing moisture stress of trees, diminishing of excessive water usage, ensuring of rapid growing weeds, measuring fertility of soil.

Lightweight Concrete by Replacement of Aggregates by Expanded Polystyrene Beads

Shubham Chouhan, Shobhit Jain,Sohel A. Ansari, Richa Patel & Rashi Parihar

Abstract:

With the increase in developmental activities and construction of high rise buildings the requirement of innovations in lightweight materials have been needed greatly. In this paper, an attempt is made to find a lightweight concrete mix by replacing the aggregates completely by expanded polystyrene (EPS) beads, which can be used to build partition walls and other non- structural building blocks, and properties of such material are studied. Apart from lightweight or dead load reduction, it is more energy saving and environment friendly, with advanced thermal and sound insulation capacity.

Keywords:

Expanded polystyrene (EPS), fly ash, workability, compressive strength

1. Introduction

The Expanded Polystyrene is a stable, low density Foam, which consists of 98% of air and 2% of polystyrene material. It has closed structure and cannot absorb water. It has good impact resistance. Polystyrene is packaging material in many industries. Polystyrene is non-biodegradable material, so it creates disposal problems. Utilizing crushed polystyrene in concrete is good waste disposal method.

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The polystyrene beads can be easily merged into mortar or concrete to produce lightweight concrete with a wide range of density. An application of polystyrene concrete includes walls, cladding panels, tilt up panels and composite flooring, also as the material of construction for floating marine structures. One of the main problems associated with the use of conventional lightweight aggregates produced from clay, slate and shale in concrete is that these porous aggregates absorb very large amount of the water mixed in concrete. This is affecting the performance of the concrete, apart from the fact that it is difficult to maintain specific water content during the casting.

Also, this absorption of water by the aggregates will mean that the additional water will be required to maintain the slump at acceptable levels. These increased water contents requires higher cement contents, even without any benefit. And that's where requirement of such EPS concrete came into picture.

EPS concrete

2. Objective

In this study the complete replacement of coarse and fine aggregate was done by Expanded Polystyrene (EPS) beads to reduce its density.

Most research on EPS concretes has shown a decrease in the durability performance and the engineering properties of concrete with increasing the amount of polystyrene aggregate in mixtures and an increase in strength with smaller EPS bead size concrete.

Based on above mechanism & combinations the main objectives of this study are:

1.) To make the concrete mix design of very light weight with more benefits as high strength and low density.

2.) Reducedisposalproblem by using polystyrene waste from different industries as a concrete ingredient.

EPS concrete cubes

3. Problem Definition

We performed work for certain mixes according to a ratio of mass of expanded polystyrene to that of cement percentage (R) for a water cement ratio 0.35.

R= $MassofEPS/MassofCement$ ×100

In this work we studied effects of different ratios of mass of EPS to that of cement, like density, workability, compressive strength.
Following table gives the quantity of Cement and EPS beads required for different values of R:

Value of R (%)	**Amount of cement (in kg.)**	**Amount of EPS (in gm)**
1.2	2	**24**
1.4	2	**28**
1.6	2	**32**
1.8	**2**	**36**

A. MaterialsSpecification

- Cement – Ultratech ordinary Portland cement of 53 grade conforming IS 12269.
- Fly ash – 20% cement is replaced by fly ash in mass.
- EPS beads – expanded polystyrene beads of particle size 5 to 8 mm are used as Aggregate.
- Water: Potable drinking water conforming to be code is 456-2000.

B. Experimental Investigation and Authentication

We have casted cubes of size 100X100X100mm.Following material proportion and various dosage combinations of cement and EPS for0.35w/c ratios have been studied.

- Cement: 2 kg
- Fine aggregate: 0 kg
- Coarseaggregate:0 kg
- EPS : as per the value of R
- Water:W/c ratio is0.35
- Fly ash: Replacement of cement 20%,

4. Tests on Concrete

4.1 Workability Test (Slump Cone Test)

The concrete slump test is an empirical test that measures the workability of fresh concrete. More specifically, it measures the consistency of the concrete in that specific batch. This test is performed to check the consistency of freshly made concrete.
The concrete containing EPS beads gives more and more workability than normal concrete and the workability increases with increase in EPS beads content. Obtained slump values from bottom were 24 cm, 26.5 cm and 28 cm. for different water content.

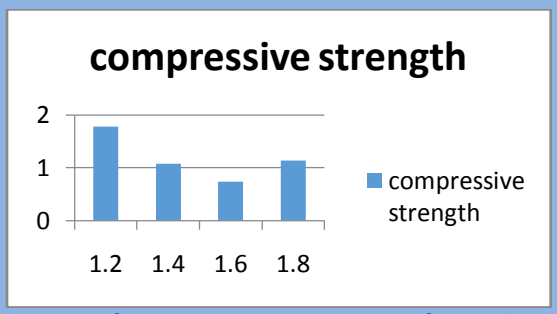
4.2 Compressive Strength Test

Compressive strength test of the cube was carried out on Universal Testing Machine (UTM). The load applied on specimen uniformlyupto it fails.

The compressive strength after the age of 7 days curing for concrete containing varying amount of expanded polystyrene (EPS) in cube having dimensions 75x75x75mm. There is systematic decrease in compressive strength as amount of EPS increases. The decrease of compressive strength may be due to low content of cement as compare to that of EPS.

S.NO	Value of R(%)	Compressive strength (N/mm2)
1	1.2	1.786
2	1.4	1.083
3	1.6	0.742
4	1.8	1.144

Cubes after compressive test



Graph of compressive strength after 7 days

The compressive strength of another set of cubes having dimension 100x100x100mm of same R (1.8 after curing of 28 days are given here

Values of R	cubes	Compressive strength(N/mm2)
1.8	Cube 1	0.680
1.8	Cube 2	0.750

5. Conclusion

The following conclusion drawn from the study:

- ✓ Increase in the EPS beads content in concrete mixes reduces its compressive strength.
- ✓ All EPS concrete without any special bonding agent shows good workability and could easily be compacted and finished.
- ✓ The replacement by using EPS has shown a positive application as alternate material in building non-structural members.
- ✓ Obtained result suggests the EPS concrete has scope for non structural application, like wall panel, partition wall, etc.

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Logistical and Structural Design Challenges of the World's Tallest Statue

Aaditya Thakre, Abhishek Goswami, Akshay Tiwari, Akshay Nasre, Akshay Verma

Abstract

The statue of Unity is 182m tall unveiled at the sadhu-bet island in narmadadistric of Gujrat. complexed in 2018 this project is surrounded by remote, mountains terrains presenting extraordinary difficulties.
This robustness and durability of statue is concrete, e.g. the coupling walls above the ankles provide additional redundancy.
The structural design was carried out in accordance with relevant Indian standards as well as reference to british and Australian standard for durability and permeable cladding consideration.
The current tallest statue in the world with so many difficulties in construction still the project team managed to complete its construction in healthy way with no harm to living or environment. discussed in this presentation. The report on logistic and structural design challenges.

I. Logistics & Materials

The height and uniqueness of the statue structure would make the design and construction of it difficult in almost any location. In the case of the statue, considering the relatively remote location (a four-hour drive from Ahmedabad or a twohour drive from Baroda, the nearest airports) and that the statue will be constructed atop a small hillock in a river basin just downstream from the Narmada dam material delivery, staging, and erection also posed unique challenges. As of the writing of this paper, additional geotechnical testing of the hillock has been completed and the leveling of the hillock has started in March of 2015. The stone removed in the leveling process will be used as backfill where the hillock edges need to be built-up at the edges of the hillock supporting the podium. The hillock has several facture planes that have been detected which will require remediation, via epoxy or grout injection and grouted anchor rods, as part of the foundation construction.

The proximity to the Narmada dam, an immense and monumental structure in its own right, is a considerable benefit to the statue construction. Although very different in the type of construction and materials, the dam's initial construction and subsequent additions has proven that large quantities of high quality concrete can be mixed and placed in this mountainous and remote region.

However, the challenge at the site will be in achieving the required concrete strength. Although the dam utilized concrete with a strength of approximately 16 MPa (160 kg/cm2) (Charlwood, 2009), the design of the statue (including the podium and foundation) calls for concrete strengths from 40 MPa up to 65 MPa (fcu). The statue will require approximately 52,000 m3 of concrete, reinforced with approximately 12,000 tonnes of grade 500 MPa rebar. Additionally, the statue composite cores, suspended space frame, cladding substructure, and podium framing will comprise approximately 5,000 tonnes of structural steel with a minimum grade of 355 MPa.

The structural steel in the cores and space frame of the statue is comprised of W360 (W14) I-shapes. The concrete will be supplied from site batching plants. The rebar will be supplied locally. However, the structural steel will likely be imported.
While the required material quantities are significant, they pale in comparison to the quantities required for the dam construction and the JV team was confident that thesequantities could be

transported via trucks, barges, and temporary bridges.

Eight months of the year, the island is accessible on at least one side via land as the water levels recede post monsoon season. During the monsoon season, water levels typically rise five meters, and up to 20 meters, with very strong currents Several options were evaluated for maintaining access to the island during the Monsoon floods. These included a cofferdam, a rock bridge, and an elevated steel bridge.

Access to the island is planned via two methods. Primarily, a built-up rock bridge which will be constructed at the normal flood level, and then a Bailey bridge will be constructed above the high flood levels. The Bailey bridge will have two lanes, one dedicated to vehicle and material movement, and the second dedicated to worker access.

Laydown and fabrication areas will be established on the land side, near the entrance to the Bailey bridge. Materials will be delivered to the island via the Bailey bridge and placed via two tower cranes and several mobile cranes.

As part of a 'Loha' campaign, iron tools have been collected from farmers across India with the intent of it being melted and converted into rebar for use in the statue foundation. Thus the people, and in particular, the farmers of India, will be an integral part of statue structure

II Construction Sequence

Although the structure is irregular, the construction and building sequencing has been made as simple as possible. The composite core construction follows a methodology that is typical for composite columns and walls in tall buildings, while the suspended space frame can be either welded or bolted in place.
For simplicity, the space frame attachments have been kept to a radial module of 45 degrees around the cores, and with a uniform vertical distribution of horizontal primary members at 11 meters. The lengths of the horizontal and diagonal struts are to be adjusted in length to meet the statue's exterior profile. W360 (W14) wide flange structural steel shapes have been utilized for the primary core and space frame members to allow for simple flange-toflange connections.
The two proposed alternatives for connecting the suspended space frame members to the composite core included:

1. Bolted W360 stubs, shop-welded to the internal steel shapes in the cores, that breach the core wall to allow for bolted field connections.

2. Field welded connections to embed plates that are welded to the internal steel shapes in the cores. (These types of connections are typically used for steel beam to concrete core connections, albeit typically with straight concrete walls.)

In either case, the W360 shapes are to be interconnected and temporarily braced by 150 mm x 150 mm (6" x 6") steel angles that stabilize the shape prior to concreting the cores. The 150 mm x 150 mm angles geometrically fit within the cores so as not to obstruct the core wall rebar placement. Option One allows for easier field connections, but then dictates a jump-form system, rather than the possible use of a slip-form system which may seem ideal for the cylindrical cores on first consideration. Option Two would allow for slip-form construction, but would create difficulties for the embedded plates to maintain the curve of the cylindrical cores. Considering the geographic location and erection process, the ease of field bolting rather than field welding along the

cores was the preferred method and Option One was deemed the better choice. At the exterior of the structural space frame lies a structural steel subframe that supports the cladding. The cladding system was designed to have overlapping panels allowing for vertical and horizontal movements at the panel extents, Therefore, while the subframe will adequately support the weight of the cladding and also resist earthquake and wind forces, the serviceability constraints the panels is less than for typical façade elements. The final claddingmaterial was still under selection and the subframe will need to be considered integrally with the final cladding type by the façade contractor.
Accordingly, the simplified construction sequence has been considered as follows:

- Level the hillock base to receive the foundation mat (currently ongoing as of the writing of this paper).
- Inject and stabilize fracture planes.
- Install rock anchors
- Cast foundation mat
- Tension rock anchors
- Erect the structural steel W360 vertical shapes embedded in the composite core walls
- Connect the W360 shapes with the internal bracing of the 150 mm x 150 mm (6” x 6”) angles
- After structural steel is erected 5-10 meters above the foundation, begin casting the cores and wing walls.
- Begin erecting the structural steel space frame from the concrete cores, following the above operations
- Continue with internal steel work followed by the casting of the cores (by jump forms)
- Follow the above with cladding installation connecting to the space frame
- Repeat until completed

Due to the irregular shape the statue was slightly unbalanced for gravity loading. In a conventional building this would require a strategy to compensate for the tendency to lean.

The cladding will be assembled onto the space frame backup on the ground, with all final alignment adjustments made. The cladding will be removed from the space frame backup, the space frame will be erected into the total framing system. The panels will be moved back to the storage until scheduled for erection on the statue. This process will minimize the requirement for work at height and expedite the cladding process

III Structural System Description

The key challenge of the structural design was to determine a structural system that could minimize large and undesirable movements inherent to the structure due to the shape and slenderness of the statue’s core, as well as adequately resist loads due to gravity, wind, and earthquakes while still allowing the legs and feet to be seen. Considering the varying form, the slenderness ratio varies between 16 and 19. Which is significantly higher than the generally accepted norm of limiting slenderness ratios of tall buildings, which are generally between 8 and 14 Added to the slenderness is the challenge presented by the large wind loads acting on the statue which, also conversely to most buildings, has a significantly larger wind sail area near the top of the structure. Likewise, the same can be said when considering other tall statues from around the world. Compared to the exposed surface area, most statues have relatively wide bases for lateral stability and to resist lateral loads due to wind and earthquakes (as modified from http://www.statueofunity.in).
After considering various options, including options for steel framing only and non composite cores with a steel space frame, the current system, comprising two semijoined, cylindrical, composite

concrete cores, surrounded by a structural steel space frame to support the exterior cladding was decided on. The structural steel space frame will attach to and hang from the cylindrical concrete cores. The lateral stiffness, constructability, and redundancy of the coreswhere the primary drivers in the design is not strength.

The concept for the semi-joined cores was a result of the exposed legs of the statue while coupled for most of the height, cores remain separate (uncoupled) when passing through the exposed legs. The diameter of the cores has been taken as the extent of the leg diameter. The embedded structural steel shapes within the concrete cores provide a connection for the structural steel space frame to attach to, but also add some stiffness and strength to the system. The cylindrical cores house the lifts and stairs. In the podium levels the cores will be connected to "wing walls" to distribute the gravity and lateral loads to the foundation mat. Each core will have an approximate diameter of 10 meters with exterior wall thicknesses ranging from 850 millimeters to 500 mm with internal and wing wall thicknesses of up to one-meter-thick

IV Codes and Standards

The structural design was carried out in accordance with relevant Indian Standards and in comparison with the international standards, including but not limited to, IS 875:1987 (Parts 1 to 5), IS 1893:2002, IS 456:2000 IBC 2009, ASCE7 10, ACI 318 08, AISC 325 05 as well as will reference to British Standards (BS 7543 for durability considerations) and Australian Standards (AS/NZS 1170.2:2002 for consideration permeable cladding for the structure).

V Redundancy, Robustness, and Durability

The Trust and their advisors were rightfully concerned about the statue's ability to stand up to the test of time. Therefore, the robustness and durability of the structure were primary concerns resulting in an initial design that was understandably conservative for these (as well as the design loading).

The statue's structure is inherently robust and redundant. The cylindrical core walls are robust in that the stresses due gravity are relatively low, and considering an accidental event, would likely only do localized damage to the wall, with the loads redistributed around the damaged area accordingly. For example, in the figures below, a wall panel at the highly stressed "ankle" level has been removed from the cylindrical cores. For gravity loads and even code design lateral loads, the stresses surrounding the missing panel are less than 6 kPa (less than one-tenth of the concrete compressive design strength at that level. Additionally, the coupling walls above the ankles provide additional redundancy. The structural steel space frame members, governed by strength design, were more highly stressed, and thus are not as robust, but like all space frames, are inherently redundant: should a single member fail, there is an alternate load path via the connecting members.

VI Structural Design for Lateral Loads

In following the design philosophy utilized in the Narmada dam and as required by the authorities during the initial design, the lateral load strength design philosophy was generally conservative, utilizing the more stringent of Indian Standards (IS) and international standards, using increased importance factors, considering an increased design life span, and adopting a "code + 1" approach for seismic and wind lateral load design where based on geographic parameters. Additionally, a site-specific

seismic response spectrum was developed and incorporated into the seismic design. The JV team expects that the "code + 1" philosophy will be reconsidered as the EPC team design progresses. The statue base was raised above the design flood level of 56+ meters to prevent against flood loads that would arise from monsoon rains or a surge due to a sudden release from the Narmada dam upstream. Additionally flood loads to 63+ meters were also considered, but were found to be insignificant to the overall structural lateral design.

VII Wind Load Determination

Although independent of the final design and wind tunnel analysis, the initial analysis results demonstrated that wind loading, and not seismic actions, governed the lateral load design of the statue. To determine this, seismic and wind forces prescribed by Indian Standards were compared with ASCE7 10 based wind forces for the design criteria wind speed of 50 meters/seconds.

Table 1: Key Wind Load Design Parameter Comparison

Key wind load design parameter	**Adopted values**	**remarks**
Basic wind speed	V=50ms	Basic wind velocity for Gujrat coastal zone
Probability factor	K1 = 1.0	for general building & structure
Terrain factor	K2 = 1.27@top	For catogery 2 terrain & class C structure
Topographic factor	K3 = 1.0	For terrain slope less than 3deg

As shown in Table 1 the following comparisons, the wind loads will govern the lateral load design of the statue. Wind story shears were found to be approximately 2.5 times greater than those from earthquake loads and overturning moments similarly are greater by a factor of approximately 1.5 comparing wind to seismic forces. The following figures, also demonstrate the relative conservativeness of the IS standards as considered in the initial design, and in particular for assumed 50 m/s wind speed.

Wind loads were calculated based on IS 875: Part 3 – Code of Practice for Design Loads for Buildings and Structures. Although the project site is on the cusp of the 44 meters/ second to 39 meters/second wind speed range, considering the final geometry and cladding are still to be refined, a conservative, basic wind velocity of 50 meters/second (three-second gust, 50 years return period) was considered (refer to the wind map of India). The more severe of the two estimates using the static method of load estimation (which implies a steady wind speed) as well as the gust factor method (which includes dynamic wind components) of IS 875 were considered for the design.

Modification factors to modify the basic wind velocity to take into account the effects of terrain, local topography, size, etc., have been included as shown below. Wind design parameters for the design.

Considering the atypical surface geometry, and without the benefit of a wind tunnel test, in order to capture the unique parameters for wind loading, the initial design utilized the code based wind loads incorporated into an approximate surface model from various windward angles using Rhinoceros 5.0 and Grasshopper

along with custom components. The wind force distribution, on the broad (Y-direction) and narrow (X-direction) profiles of the statue, as seen in Graph 2, resulted in a logical distribution considering the statue shape.

VIII Considerations for Permeable Cladding

With wind being the dominant lateral load, due consideration was given to incorporating porous or permeable cladding and also to considering the inherent porosity of the cladding system (conceived as overlapping panels with open joints). Thus, that wind might flow through the cladding and space frame to reduce wind loads was considered.

However, after consulting reputable wind tunnel consultants and researching structures with permeable cladding (Robertson, 2002), this tact for attempting to reduce the global wind loads was abandoned. As the design further evolves, however, given the oblong plan shape of the statue, crosswind acceleration is expected to be captured during the wind tunnel testing. Where crosswind effects might exceed the primary windward effects, providing air-permeable cladding in some locations may benefit the performance.

IX Seismic Load Determination

Per Indian Standard IS 1893:2002, the statue site is regarded as a moderate seismicity region and is specified as Zone III. Additionally, the initial geotechnical and seismic hazard assessment classify the IS seismic Zone Factor as III, however, following the "code + 1" philosophy, a Zone Factor of IV has been conservatively incorporated into the design. Coincidentally, the Zone IV peak ground acceleration (0.24 x g = 2.354 m/s2) is essentially the same of as the 2.36 m/s2 value specified in the sitespecific seismic hazard analysis report, seen in Table 2 (Choudhury, 2011).

As mentioned, due to the relatively high code prescribed wind speeds and the statue being a relatively low-mass structure with a large wind sail area, wind loading, not seismic actions, governed the lateral load design.

Additionally, international standards for spectral accelerations from the USGS were also considered as design check. However, the Ss and S1 values of 0.11g and 0.04g, respectively (for both UFC and EU Code), also indicated that this was a low seismic risk area.

X Structural Analyses

The structural performance of the statue under gravity and lateral loads utilized several three dimensional structural finite element models. The models incorporated all elements of the lateral and vertical load resisting system and represent the spatial and vertical distribution of the statue mass and stiffness

XI Dynamic Properties

The primary lateral load resisting system is the two composite concrete cores. Whichever way the cores move, so will the rest of the statues. The mode shapes and dynamic periods roughly relate to those of a building of similar height, rationalized for the differences in mass.
The first three natural periods and mode shapes of the statue were tabulated. Similar to tall buildings, the first two modes are predominantly in translation, with some degree of coupled secondary rotation, while the third mode is in torsion. Secondary rotations in the first two modes are manifestations of the irregular nature of the structure.

XII Lateral Story Drift

Since the statue is a unique structure, the code or general practice limits for deflections due to wind for buildings (intended to ensure finishes and cladding are not damaged and preserving human comfort) are not necessarily applicable. Additionally, except for the observation deck, there are technically no conventional stories in the statue; however, inter-story drifts (taken at approximately five-meter intervals) were calculated for seismic and wind loads. These were found to be well within drift limits for conventional buildings. Thus, despite of the extreme slenderness of the statue cores above the feet, the adopted lateral load resisting system provided adequate rigidity to satisfactorily control the statue's lateral response.

After multiple iterations involving parametric studies varying the core wall thicknesses, concrete strengths, reinforcing ratios, and structural steel within the cores, the design achieved an overall drift performance well within the norms of conventional design, with the tip of the statue drifting to approximately H/600, which is better than the commonly used in Indian design practice of H/400 or H/500 We expect that this will be further refined, and perhaps relaxed as more data becomes available in further design stages.

Key seismic load design parameters	**Adopted values**	**Remarks**
Seismic zone	4	High zone
Zone factor	Z= 0.24	Effective peak ground acceleration in g=2.36m/s^2
Importance factor	I=1.5	For general buildings
		&strucures
Type of soil	Type 1	Hard soil
Response reduction factor	R=3	Ordinary RC shear wall lateral system

Table 2: Key seismic load design parameters

XIII Supplemental Damping

Although the initial lateral drift responses on the order of H/600 would indicate otherwise, the use of passive or active damping was considered as a possibility during the initial design (subject to the wind tunnel analyses). Therefore, space was been allotted in head and neck region of statue for a damper should one be needed as determined by the EPC contractor.

XIV Strength Design

Generally, the design of the cylindrical concrete cores was governed mostly by stiffness considerations; therefore the wall stresses have been found to be low. However, there are tension forces due to lateral loads at the lower extremes (near the ankles) and these tension forces are carried down through the core wing walls to the foundation. These tension forces were determined to be able to be resisted by the composite cores' reinforcing bars along with the embedded structural shapes. Contrarily, the structural steel members in the suspended space frame were governed by strength design and were designed accordingly

XV Foundation

In March of 2015, the leveling of the hillock atop Sadhu-Bet Island began in order to receive the foundation mat of the

statue. As the mat sits atop strong rock, piling was not required, but grouted rock anchors to take the localized tensions are required.

There are significant tensions in the foundation due to overturning moments from the lateral loads. These will be resisted by rock anchors socketed into the rock and tensioned at the foundation level. Additionally, measures to stabilize the fracture planes found in the geotechnical investigation, such as grouting and anchor rods across the planes, were also considered.

Based on the site investigation results carried out in 2010 and again in 2013 (WAPCOS, 2013) the average bearing strength of the rock was found to be 2300 kN/m2, which is more than sufficient to support the statue and the associated lateral forces. As this is bearing on rock, settlements were expected to be inconsequential.

Estimation of a Reinforced Building

Mayank Bariya, Mehul Sihare, Mohak Garg, Mukul Sitole , Panjak Bopche, Parv Jain, Sherya Malviya

Abstract

Many items influence and contribute to the cost of a project, each item must be analyzed, quantified and priced. Such determination of probable cost for construction of any given project is building construction estimation. In preparing an estimate the quantities of different items of wok are calculated by simple menstruation method and from these quantities cost is calculated. It is necessary for the quantities of the materials including those of reinforcement to be known for estimating the cost of a structure. Accurate quantities of concrete and brick work can be calculated from layout drawings. In accordance with the requirements of standard method of measurements of building work, the quantities are normally described. There are different methods for estimating the reinforcement quantities. It can be worked out using two methods: Long wall-Short wall method and Center line method. In this paper, the quantity and cost estimation of the building are carried out on the basis of PWD, MP. It highlights on the center line method being suitable for the estimation of buildings having walls with similar cross section

Key Words: Estimation, Cost, Building, Methods, Quantity

1. Introduction

Building cost estimating concerns on diverse forms of construction of residential properties, high rise civil works. Quantities of concrete and brickwork for estimating its cost can be calculated from the layout drawings. Such estimations are prepared in order to make the project economical. Estimate is prepared before actual construction, and then it must be put into the construction documents. The object of preparing estimate is to know the quantities of various items of work, labour, and material. Decide if the proposal can match the available funds to complete the project. Obtain the sanction of the estimate from the qualified authorities for the completion of the project. Invite tenders based on the estimate for the execution of the project. Various activities like earthwork in excavation, masonry in foundation and basement etc. can be estimated by either of the two methods.

1.1 Long Wall and Short Wall Method

In this method the walls along the length of room is considered to be the long wall and the wall perpendicular to long wall is said to be short wall. The External lengths of the walls running in the direction out to outs and the internal lengths of wall running in the transverse direction in to in and calculate the quantities by multiplying length, breadth, and height.

Length of long wall = center to center length + half breadth on one side + half breadth of other side.

Length of short wall= center to center length-half breadth of one side – half breadth of other side.

This method is accurate and simple and the chances of any error are less

1.2 Centre Line Method

In this method, total lengths of centre line of all walls, long and short has to found out. Here the total centre line multiplied by breadth and depth of respective items gives the total quantity of each item. For excavation in foundation, concreting in foundation, all footings and super structure, the length will remain same.

One has to be cautious by considering the junctions, meeting points of partition or cross walls, etc. For rectangular, circular polygonal buildings having no cross walls, this method is found to be simple. Buildings having single partition walls or cross walls with two junctions , the earth work in foundation trench and foundation concrete, one breadth of trench or concrete from total centre length has to be deducted for two junctions. Similarly for footings, one breadth of footing for two junctions from the total centre length is to be deducted. This method is easy and quick for the buildings having walls with same cross sections and less number of junctions.

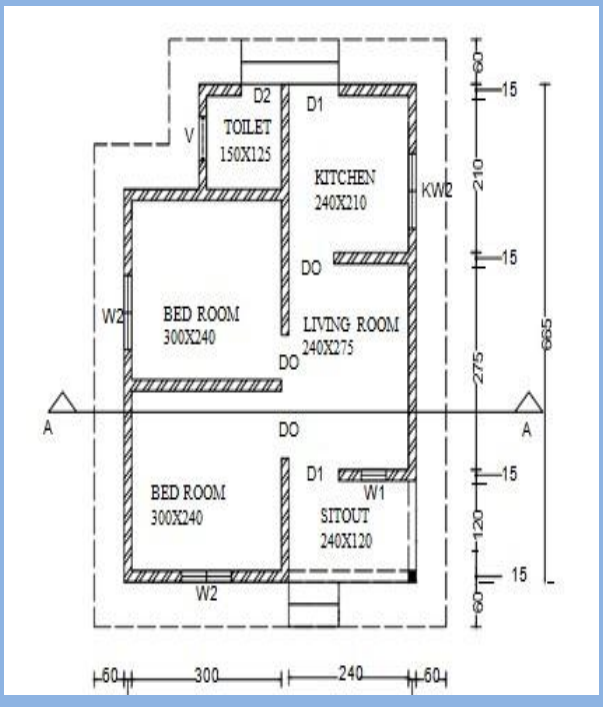
S. No.	description	no.	L (M)	B (M)	H (M)	Q	UNIT	RATE/ UNIT	AMOUNT (RS.)
1	Site clearing and setting out					L.S			3000
2	Earthwork excavation in all classes of soil except hard rock for foundation and pillar footing removing all roots.								
	Foundation	1	43.8	0.6	0.6	15.68	m^3	203	3182.634
	Pillar Footing	1	0.9	0.9	0.6	0.486	m^3	203	98.658
4	R.R. Masonry								
	Foundation	1	43.8	0.6	0.6	15.68	m^3	3550	54873
	basement	1	43.05	0.45	0.45	8.718	m^3	3550	30513
5	concrete block masonry in cemet mortar 1:6 with approved good quality cement block on superstructure of all thickness								
	walls	1	40.8	0.15	2.85	17.44			
	deduction for openings								
	doors								
	D1	2	1	0.15	2.1	0.63			
	D2	1	0.8	0.15	2.1	0.252			
	D3	3	0.9	0.15	2.1	0.851			
	windows								
	w1	1	0.5	0.15	2.1	0.63			
	w2	2	1	0.15	1.5	0.45			
	kw1	1	1	0.15	1.5	0.225			
	ventilator	1	0.9	0.15	0.6	0.081			
	sit out	1	3.6	0.15	2.1	1.134			
						13.08	m^3	4000	52304
6	supplying and fixing of concrete doors with shutters								
	d1	2					no.	1700	3400
	d2	1					no.	1100	1100
	wood shutters for D1	2					no.	2800	5600
	fibre shutters for D2	1					no.	2000	2000
7	supplying and fixinf of windows and aluminum shutters								
	w1	3					no.	1900	5700
	w2	1					no.	1000	1000
	aluminum shutter for w1	3					no.	2900	8700
	aluminum shutter for w2	1					no.	1500	1500
	ventilator	1					no.	800	800
8	reinforced cement concrete 1:1.5:3 mix M20 grade using 20mm machine crushed blue metal including all formwork, watering curing etc. Complete but excluding the cost reinforcement								

2. Literature Review

In Estimating and Costing in Civil Engineering (Theory and practice including specification and valuation), B.N Dutta has focused on various methods of estimating and costing of quantities. It emphasizes on the calculations of quantities of materials, tools, equipment, labours etc. and cost associated with them. It consists of numerous examples of estimation of buildings, RCC works, culverts, bridges, etc. Method of preparing preliminary estimates, analysis of rates, specification, methods of measurements have been dealt in detail with illustration. Many technical data have been included. In Design and Estimation of a reinforced building.

3. Plan and Estimate of Residential Building

Above figure is a plan of sample residential building which has been estimated using center line method. The plinth area of the considered building is 396 sq.ft. Estimation of the residential building is done by center line method.



4. Conclusions

The estimate of the residential building was prepared successfully. In this paper, a review on the methods of estimating has been done. From this review, we have come to a conclusion that center line method of estimating is the most suitable method for the considered plan as the walls of the building are of similar cross section and have less number of junctions.

Soil Stablization Using Flyash And Stabilizers

Rishabh Dan, Shashvat Tiwari, Shivani Agrawal, Sourabh Sankhere

Abstract:

A considerably high increase in infrastructure development has been witnessed in India since last two decades due to which the construction of pavements is taking place at a fast rate. In this process, the pavements need to be laid on soft and unfavorable grounds for most of the times. California Bearing Ratio (CBR) value of such type of sub grade soils is very low due to which the thickness of pavement layers increases. This in turn requires large quantities of natural materials leading to depletion of valuable natural resources. Conversion of locally available difficult soil into suitable construction material would be an economical solution. So, the option is to modify the properties of the existing soil so that it meets the design requirements, which is also called soil stabilization. Cementing method of soil stabilization is an established procedure of improvement of ground used as sub-grade for pavements. In view of this, apart from the Conventional cement, several commercial stabilizers have emerged in the last few years. It is therefore necessary to evaluate the effectiveness of such new commercial stabilizers vis-a-vis that of traditional stabilizer, the Fly ash. In line with this, an attempt has been made in the present study to evaluate the effectiveness of one of the new commercial stabilizers viz., Zycobond, Terrasil manufactured by Zydex industries vis-a-vis that of traditional stabilizer, the Fly Ash. The scope of present study is limited to study the mechanism of stabilization process in terms of the macroscopic results of CBR values.

The study is confined to one type of soil and two commercial stabilizers viz., Zycobond and Terrasil of M/s Zydex make

Keywords:

Soil Stabilization, Fly ash, Terrasil, Zycobond, CBR value ,sub-grade

I. Introduction

In India, since last two decades, tremendous increase in infrastructure development has been taking place. As part of it, the development of pavements is taking place at a rapid pace. In the process, many a times, the pavements need to be laid on soft and un-favorable grounds, As California Bearing Ratio (CBR) value of such type of sub grade soils is very low due to which the thickness of pavement layers increases. This in turn requires large quantities of natural materials leading to depletion of valuable natural resources. Hence, of thickness of pavement layers by enhancing the CBR value of subgrade amounts to sustainable development, which is much desirable in a country like ours. At times, construction on such grounds may lead to distresses arisen from low shear strength, substantial total and differential settlement, excessive seepage and liquefaction. Conversion of locally available difficult soil into suitable construction material would be an economical solution. For many decades, Engineers and Researchers have attempted to solve problems posed by various types of soft grounds. Due to various reasons and there may be need to improve their strength and durability. When poor quality soil is encountered at construction site, the structure can be designed accordingly or the unsatisfactory soil can be replaced with a suitable soil borrowed from nearby area.

Another option is to modify the properties of the existing soil so that it meets the design requirements. This last alternative has led to the development of soil stabilization techniques. Soil stabilization methods using locally available cheaper materials have considerable scope in reducing the initial construction cost of the pavements.

But the various developmental activities necessitate making use of these lands, which are not having the desirable properties as an engineering material. The most frequent use of soil stabilization is in relation to the formation of sub-grades and sub-bases for road construction. Continued efforts are being made to improve the weak soil and hence its CBR values.

Over the years engineers have tried different methods to stabilize soils that are subject to fluctuations in strength and stiffness properties as a function of fluctuation in moisture content. Soil stabilization is a process of improving the engineering properties of the soil. Stabilization can be derived from thermal, electrical, mechanical or chemical means.
The first two options are rarely used. Chemical stabilization involves mixing or injecting the soil with chemically active compounds such as Portland cement, lime, fly ash, calcium or sodium chloride or with visco-elastic materials such as bitumen.

These additives are considered as chemically active additives since they react with soils forming cementing compounds. Chemical stabilizers can be broadly divided into two groups viz., the traditional stabilizers such as hydrated lime, Portland cement and Fly ash and the non-traditional stabilizers comprised of sulfonated oils, ammonium chloride, enzymes, polymers, and potassium compounds. Among these, the most widely used chemical additives are lime, Portland cement and fly ash, blast furnace slag. Cement stabilization has been widely used to improve soft soils and grounds. Many researches have focused on study of the properties of the cement stabilized soil. The main purpose of this research is to improve the CBR characters of the soft clayey soil.
Main objective of this experimental study is to investigate the effect of Zycobond and Terrasil on geotechnical properties of black cotton soil.

II. Literature Review

Aparna Roy (2014) studied the high plasticity soft soil stabilized with different percentages of Rice Husk Ash and a small amount of Cement. Observations are made for the changes in the properties of the soil such as MDD, OMC,CBR and UCS. The results obtained show that the increase in RHA content increases the OMC but decreases the MDD. Also, the CBR value and UCS of soil are considerably improved with the RHA content. From the observation of maximum improvement in strength, 10%RHA content with 6% cement is recommended as optimum amount for practical purposes by observing the tremendous improvement of CBR Value of soil.

Norazlan Khalid et al. (2014) studied the effectiveness of using mixtures of lime with palm oil fly ash (Lime-POFA) in soft soil stabilization was investigated by mean of laboratory testing to evaluate the California Bearing Ratio (CBR) value. The Palm Oil Fly Ash (POFA) additives used is a finely waste product material from the process of burning palm oil fibre. The POFA used is classified as Class-F fly ash accordingly to ASTM C618 and described as siliceous and aluminous materials with possess little or no cementitious value. The optimum of 6% hydrated lime used their study as an active additive to the various % mixtures of

POFA for the pozzolanic reaction. The result shown that the mixing of 6% Lime with 3% POFA was giving the higher CBR value for soaked and unsoaked condition. It shows the POFA can be used as additives to stabilized soft soil sub grade.

Lekha B.M, et al. (2013) studied the behaviour of Black Cotton (BC) soil with and without chemical stabilizer. Terrasil was used as stabilizer and it was used for different dosages and cured for 7, 14 and 28 days . Due to the chemical reaction, the soil mass densifies by minimizing the voids between particles and it makes the soil surface impervious. The chemical compositions and microstructures of soils were analyzed using X Ray Diffraction (XRD) and Scanning Electron Microscope (SEM) respectively.

Keerthi.Y, et al. (2013) studied the stabilization of clayey soil using cement kiln waste and established that the chemical compounds found in soil; quartz, feldspar, dolomite, calcite, montmorillonite, kaolinite etc. react with the chemical constituents found in different identified chemical stabilizers .Soil containing different properties in various percentages is mixed with CKD (Cement Kiln Dust) in different proportions and parameters like dry density and moisture content are found out. After examining the values obtained ideal values are obtained at 50% proportional mix of CKD in total percentage.

Gundaliya.P.J, Ozaa J.B (2013) studied BC Soil tested using three different stabilizing agents - 1.Cement waste dust collected from the cement plant 2. Cement Dust +Lime Powder 3. Lime Powder. The cement waste dust was found best agent as a stabilizer to improve the Atterberg's Limit and hence Plasticity Index of BC Soil as well as the compressive strength of the same. Laboratory tests were performed with different percentages of three stages, each of them ranging from 1% to 9%. The behaviour of BC Soil of Rajkot region was improved with stage no. 1, the percentage of Cement dust 7% of Cement dust in BC Soil is looking to be the appropriate mixing. Also in second stage, improvement is shown at 8% of combination of cement dust and Lime powder. Third stage was observed a best suited result at 9% of Lime powder in BC Soil. They concluded after obtaining results in laboratory under standard conditions to use the Cement dust as a stabilizing agent for the purpose to improve Plasticity Index of BC Soil compare to other two combinations.

Degirmenci et al. (2007) investigated phosphogypsum with cement and fly ash for soil stabilization. Atterberg limits, standard Proctor compaction and unconfined compressive strength tests were carried out on cement, flyash and phosphogypsum stabilized soil samples. Treatment with cement, fly ash and phosphogypsum generally reduces the plasticity index with increase in MDD with cement and phosphogypsum contents, but decreased as fly ash content increased. The OMC decreased and UCS increased with addition of cement, fly ash and phosphogypsum.

Amu et al. (2005) studied cement and fly ash mixture for stabilization of expansive clayey Soil. Three different classes of sample (i) 12% cement, (ii) 9% cement + 3% flyash and (iii) natural clay soil sample were tested for maximum dry densities (MDD), optimum moisture contents (OMC), California bearing ratio (CBR), unconfined compressive strength (UCS) and the Undrained Triaxial tests. The results showed that the soil sample stabilized with a mixture of 9% cement + 3% fly ash is better with respect to MDD, OMC, CBR, and shearing resistance compared to samples stabilized with 12% cement, indicating the importance of fly

ash in improving the stabilizing potential of cement on expansive soil.

III. Objective

Properties of soil depend upon properties of ingredients and their relative proportion. Addition of mineral in soil, while designing of foundations has become increasingly complex. This is due to the chemical composition and soil properties. Above complexity will be experimentally studied in this research. The study will investigate the effect over the various properties of soil with use of stablizers and flyash. Based on above mechanism & combination the main objectives of this study are:

1) To economize pavement construction by soil stabilization
2) Soil stabilization using waste material like flyash and stablizers like terrasil and Zycobond.

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IV. Methodology

The methodology adopted to achieve the required objectives is presented below. In the present work the methodology adopted is as follows:

A. Characterization of materials

The materials used in the present work are clayey soil, zycobond and terrasil. Characterization of these materials is as given in the following sections.

a) Characteristics of Clayey Soil

Subgrade soil, clayey soil used in the present work was collected from Rajendranagar, District Indore, Madhya Pradesh. The index and engineering properties of the soil used in this work are presented as in Table 1. The particle size distribution curve is shown

Table I. Characteristics of soil

Parameter	Value
Specific gravity	2.58
Shrinkage limit	6.5%
Liquid Limit %	60
Plastic Limit %	35.4
Plasticity Index %	24.6
MDD	1.54
OMC (%)	18
CBR Unsoaked %	3.58%
Gravel Size Particles %	0%
Sand Size Particles %	33%
Silt Size Particles %	42%
Clay Size Particles %	29%

b) Characteristics of Zycobond (ZB)

Zycobond is a sub-micron acrylic copolymer emulsion with long life of above 10 years for bonding soil particles. It imparts water proofing and resists water ingress through the unpaved areas like shoulders and slopes. Characteristics of the chemical stabilizer used in this work are shown in Table 2. It is manufactured by ZYDEX INDUSTRIES.A photograph of it is shown in Fig.3.

Parameter	Value
Colour	Milky White
Odour	No
Flash point	Above 100 C
Explosion hazard	No
Ignition temperature	Above 200 C
Solubility in water	Dispersible
pH value	5-6
Dosage	0.5%

c) Characteristics of Terrasil (TS)

Terrasil is nanotechnology based 100% Organosilane, Water soluble, Ultraviolet and Heat stable, Reactive soil modifier to waterproof soil subgrade. It is available in concentrated liquid form and is to be mixed with water in specified proportion before mixing with the soil. Characteristics of the chemical stabilizer. It is manufactured by ZYDEX Industries.

Parameter	**Value**
Appearance	Pale yellow liquid
Solid content	68+2%
Dosage	1%
Specific gravity	1.01
Solubility	Forms water clear solution

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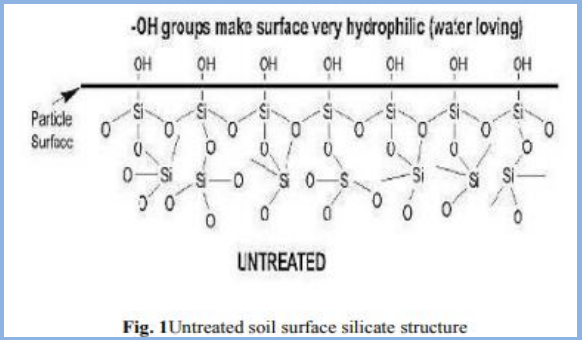


Fig. 1 Untreated soil surface silicate structure

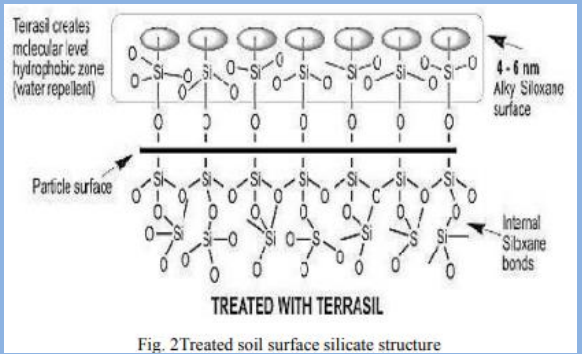


Fig. 2Treated soil surface silicate structure

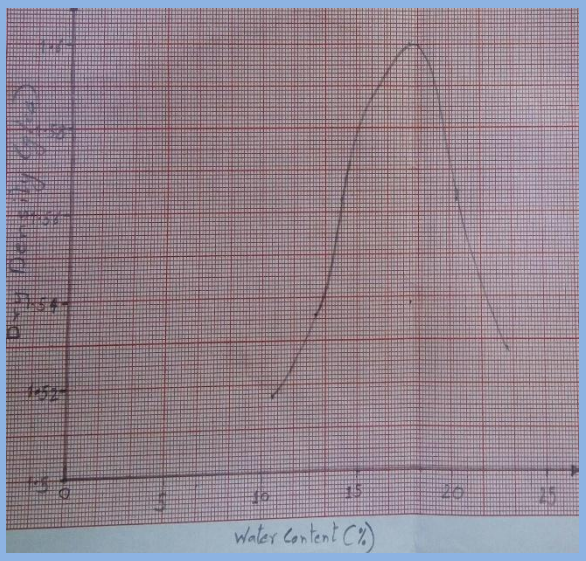
B. List of Experiments.

- Atterberg Limits Test.
- California Bearing Ratio.
- Particle Size Distribution.
- Optimum Moisture Content.
- Specific Gravity.

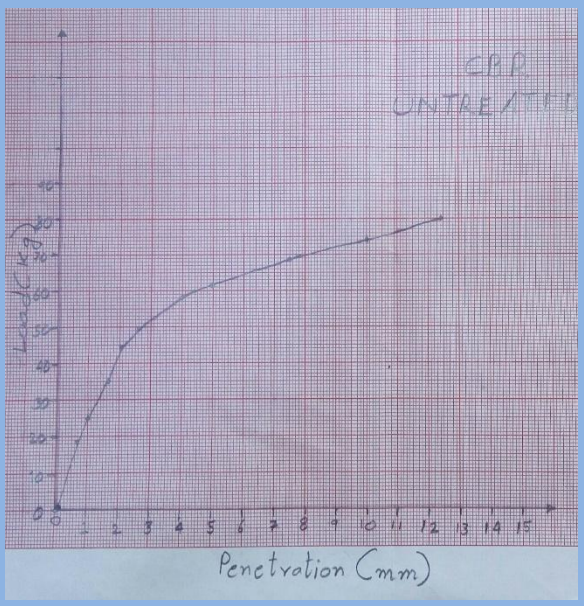
V. Results.

1. Compaction Results.

- **Natural Soil**

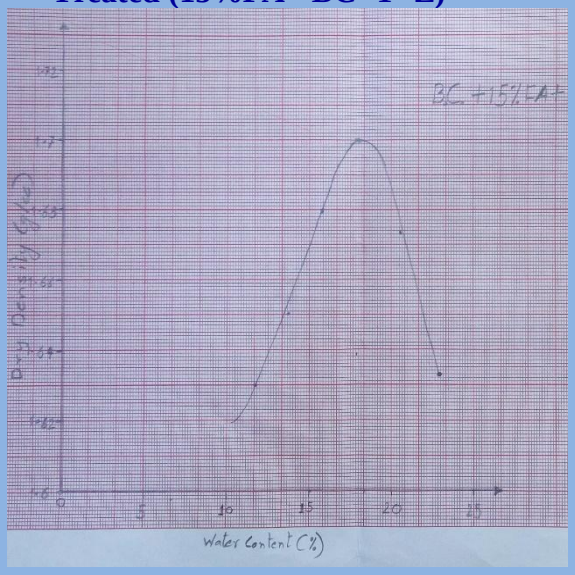


Mdd Vs OMC Graph For Natural Soil



CBR Untreated

- **Treated (15%FA+ BC+T+Z)**



MDD Vs OMC Treated Soil

CBR Treated

2. CBR Results.

Sample	MDD	OMC(%)	CBR(%)
Untreated	1.6	18	3.58
BC+15% Flyash+T+Z	1.7	18	9.38

VI. Design of Flexible Pavement

Design of flexible pavement is done using IRC 37-2012 catalogues for traffic of 5MSA.
Width considered-7m

Layers	Thickness (Mm)	Vol(M^3)	Unit Rate (Rs/Km)	COST(Lakh Rs)
GSB	380	2660	989	26.3
G BASE	250	1756	1438	25.25
DBM	96	672	7398	49.7
BC	40	280	8493	23.78
			TOTAL	125.03

For Untreated Soil

Layers	Thick Ness (Mm)	Vol (M^3)	Unit Rate (Rs/Km)	Cost (Lakh Rs)
G S BASE	150	1050	989	10.38
G BASE	250	1756	1438	25.25
DBM	50	350	7398	25.89
BC	25	175	8493	14.86
			TOTAL	76.38

For Treated Soil

VII. Future Prospects

Fly ash being a very fine material poses problem in mixing with soil resulting into inhomogeneous mass. Thus an efficient method of mixing fly ash could be devised.

VIII. References

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Design of Sewage Treatment Plan

Akshay Kathal, Aman Khare,Amit Kumar, Anshul Shrivastava,Md Amjad Hussain

Abstract:

The steady incremental in the city population results in the increase of domestic sewage generation. But still now there is no treatment plant. So it is required to construct a Sewage Treatment Plant with sufficient capacity to treat the increased sewage. The project deals with the design of the Sewage Treatment plant and its major components such screening chamber, grit chamber, sedimentation tank, secondary clarifier, trickling filter and sludge drying beds.

Rau is situated at an altitude of about 530 meters above MSL. The climate is subtropical, which is typical in this part of country. Summers are hot and dry followed by monsoon months, with approximately 32–35 inches of rainfall followed by mild winters in the months of December and January.

Summer daytime temperature can reach 45 °C with 20–25% humidity. Winter night temperature can fall to 5–6 °C with 20–25% humidity. Annual rainfall is about 32–35 inches (800 mm).

The town is situated at the altitude of 22°38'5"5N latitude and 75°48'41"E longitude. All the aspects of rau climate and topography, its population growth rate is to be considered while designing the project. By the execution of the project the entire sewage of the city can be treated effectively and efficiently.

So we are designing a sewage treatment plant for discharge of 10.15 MLD for rau for life span of 30 years the design is to be done with the help of 3d max. The results obtained are discussed and compared with the available literature

Keywords:

Receiving chamber, screen, Grit chamber, primary sedimentation tank (P.S.T.), Secondary sedimentation tank (S.S.T), Stabilization tank, Sludge drying beds

1. Introduction

Requirement of water is increasing day by day in various uses. But available resources are not enough to fulfill needs of civilization. To solve this problem sewage treatment is required to utilize water waster. The dirty water that comes from homes and businesses as a result of laundry, using the bathroom, and all the soapy water that comes from washing dishes and the likes in the kitchens what we call sewage or wastewater.

Sewage is liquid, consists of any one or a mixture of liquid waste origins from urinals, latrines, bath rooms, kitchens of a dwelling, commercial building or institutional buildings. Storm sewage is a liquid flowing in sewer during or following a period of rainfall and resulting there from. A Partially Separate Sewer System is the sewerage system in which the domestic sewage is carried with the storm water in the rain season.

Activated sludge is the active biological floc produced in activated sludge plants, largely composed of saprotrophic bacteria, protozoan flora (amoebae) and a range of other filter feeding species. Mixed Liquor Suspended Solids (MLSS) is the amount of suspended solids in the mix of raw water and activated sludge. Return activated sludge (R.A.S) is the activated sludge extracted from the system and mixed with raw water sludge to form the mixed liquor. Waste activated (W.A.S.) or Surplus Activated Sludge (S.A.S.) is

Surplus Activated Sludge (S.A.S.) is excess activated sludge that is extracted from the system to be directed to sludge treatment. Sludge Age is the average residence time of biological solids in the system. It can be defined as the average lifespan of bacteria in the system. Overflow rate / Surface loading is the discharge per unit of plan area. This parameter is the design factor in designing the settling tanks. Food to Micro-organisms ratio (F/M ratio) is the ratio between daily BOD load applied to Aerator System and total microbial mass in the system

Table : Characterization of Sewage

Sn	Parameter	Value
1	pH	7.2
2	COD	320 mg/L
3	BOD	190 mg/L
4	TSS	200 mg/L
5	Total Coliform	107 MPN/100 ml

2. Objective

The main object of treatment units is to reduce the sewage contents (solids) from the sewage and remove all the nuisance causing elements and change the character of the sewage in such a way that it can be safely discharged in natural water course applied on the land. In other words, the objective of sewage treatment is to produce a disposable effluent without causing harm or trouble to the communities and prevent pollution. Practically the treatment of sewage is required in big cities only where the volume of the sewage is more as well as the quantity of various types of solid, industrial sewage etc. is more and porous land or large quantity of water bodies is not available for the proper disposal of sewage.

As with increase in population need for water goes on increasing. Sewage treatment plant needs to be designed for rau to fulfill the demands of people. For 30 years. For initiation of this various elements of plant will be studied and their required capacity to fulfill everyone needs in respective years.

The main objective of this study are:

1. To treat waste water for rau and utilize it for various purpose.
2. Design of various component of treatment plant.

3) Problem Definition

We performed work for sewage treatment plant for RAU (Indore) with a design capacity of 10.15 MLD.

To concentrate biofloculated solids and produce a clear effluent. The objective of municipal and industrial waste water treatment is to extract pollutants, remove toxicants, neutralise coarse particles, kill pathogens so that quality of discharged water is improved to reach the permissible level of water to be discharged into water bodies or for agricultural land. Treatment of water thus aims at reduction of BOD, COD, eutrophication etc. of receiving water bodies and prevention of bio-magnification of toxic substances in food chain. Steps Involved in Waste Water Treatment: Various steps involved in treatment of waste water are as follows:

1. Preliminary Treatment. Screening: - In this treatment debris, gross solids, grit, oil and grease are removed by passing waste water through screens, grit chambers and skimming tanks.

2. Primary Treatment (1’ Treatment):-
Primary treatment of sewage removes 60% suspended solids, 30% COD, 35% BOD, 10% P and 20% total nitrogen.
It includes the following processes:

(i) Sedimentation :-About 50% suspended solids can be removed by gravitational settling under quiescent conditions.

(ii) Mechanical Flocculation and Coagulation: Fine suspended solids and

colloidal particles are removed by passing waste water through clariflocculator and using coagulants like alum and poly-electrolytes.

(iii) Neutralization: - Highly aci dic and alkaline waste waters are neutralized by lime slurry or NaOH and H_2SO_4 or CO_2 respectively.

3. Secondary (Biological) Treatment :(2' Treatment) :-The dissolved and colloidal organic matter in waste water/sewage is removed by aerobic or anaerobic processes. The effluent from primary sedimentation tank is first subjected to aerobic oxidation in processes such as aerated lagoons, trickling filters, activated sludge units, oxidation ponds etc. Then the sludge obtained in these aerobic processes, together with that obtained in the primary sedimentation tank, is subjected to anaerobic digestion in the sludge digester (Fig. 2). Secondary treatment removes about 80% COD, 90% BOD, 30% P, 50% total N and oil, grease, phenol, grit, scum etc.

4.Tertiary Treatment**:** Tertiary treatment is the final treatment meant for abolishing the secondary effluents and removal of fine suspended solids, traces of organics and bacteria. The sewage effluent from secondary treatment plant is introduced into a flocculation tank where lime is added to eliminate calcium phosphate. The solution then enters the NH3 stripping tower. Nitrogen present in waste water exists as NH+4 which is converted to gaseous ammonium ion at high pH(ll). Phosphorus is removed by adding ferric chloride or aluminium sulphate. The remaining organic materials are removed by desalination, ion exchange and finally chlorination is used for disinfection. The toxic, non-biodegradable chemicals in industrial waste water can be removed by adsorption (on activated charcoal), ion exchange, ultra-filtration, reverse osmosis and electrodialysis.

3. Element Specification

1) Screening chamber :-
To protect pump and other mechanical equipments.

2) Pumping Station :-
To pass sufficient discharge with a sufficient head in STP

3) Grit Chamber :-
It removes large grit particles.

4) Skimming Tank :-
Removes scum which specific gravity is less than 1

5) P.S.T tank :-
Removes large suspended organic matter.

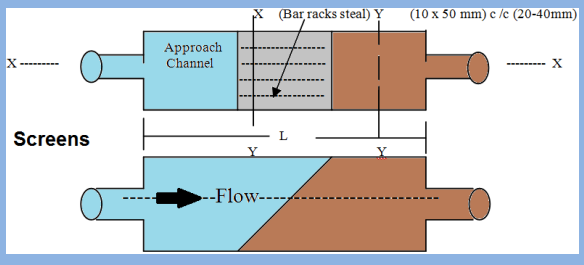
6) Biological Unit :-
All the secondary units are design to work under aerobic conditions because aerobic decomposition is faster and do not produce bad smell.As the rate of decomposition increases the detention time of unit decrease.

7) Secondary sedimentation Tank (SST) :- Main objective of this tank is to concentrate bio-flucculated solids and produce a clear effluent.

4. Design Specification

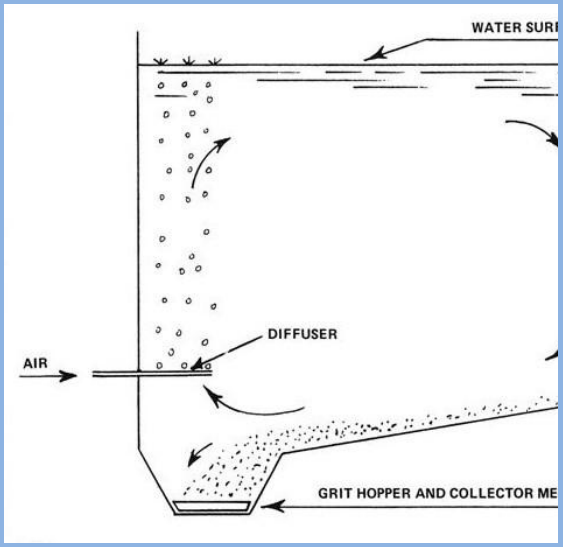
a) Receiving chamber
Size :- 4m*2m*3m +0.3m(free board)

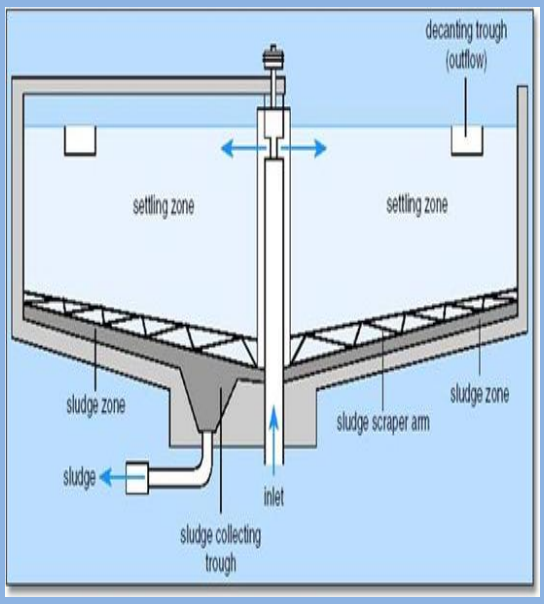
b) Coarse screen
Size :- 0.5m*0.7m +0.3m (free board)



c) Grit chamber

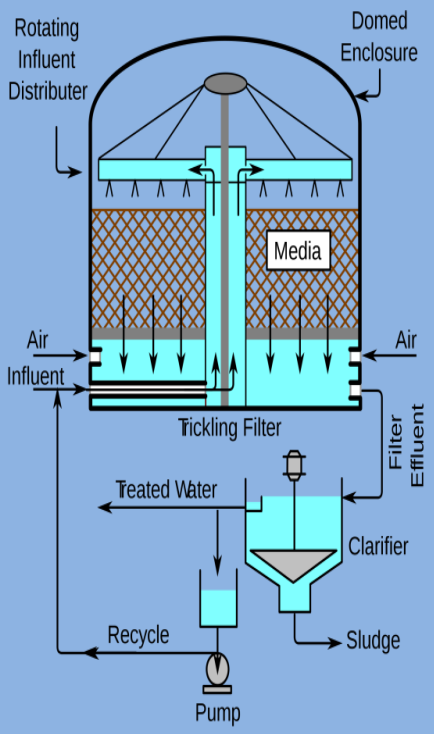
Dimension: - Length = 8 m
Width = 1.2 m
Height = 2 m +0.3m





d) Primary sedimentation tank
Dimension: - 24 m (dia.)*2.5 m (height) + 0.3 m (F.B)

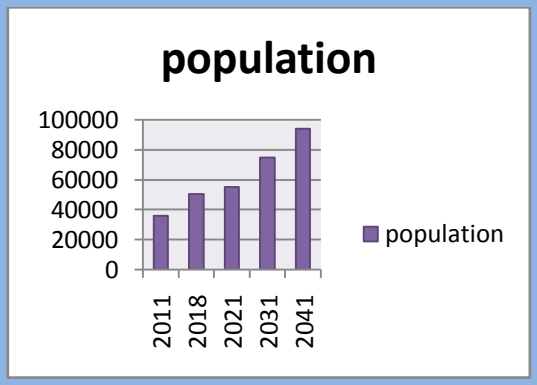
e) Trickling filter
Diameter = 20 m
Depth = 1.8 m



f) Secondary sedimentation Tank
Diameter = 30 m
Depth = 2.5 m
30 m (dia.)*2.5 m (depth) + 0.3 m (F.B)

5. Results Interpretation

In this research we show the sewage treatment plant with design capacity of 10.15 MLD for RAU city. The various elements shown in 3D MAX with its design capacity for period of 30 years.We use population forecasting to design adequate capacity for plant.

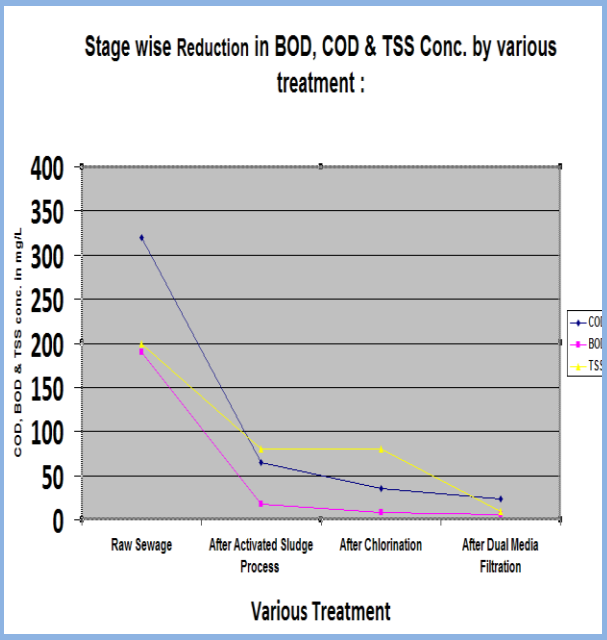


Graph shows population upto the end of 2041 and thus plant is design to fulfill requirement of this much population

Population is calculated by incremental increase method and we can see that population is increasing every consecutive year with large number so the waste water also increase so that a separate sewage treatment plant will be require which capable to handling such type of sludge.

6. Conclusions

A successful technical project involves integration of various fields. This is an attempt to combine several aspects of environmental, biological and chemical and civil engineering. Since, in RAU (INDORE) there is no proper treatment plant for sewage, it is necessary to construct a Sewage Treatment Plant. The plant is designed perfectly to meet the future expansion for the next 30 years in accordance with Indian Codal provisions. This project consists the design of the complete components of a Sewage Treatment Plant from receiving chamber, screening chamber, grit chamber, skimming tank, sedimentation tank, secondary clarifier, active sludge tank and sludge drying beds for sewage



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INTERNATIONAL CONFERENCE ON RECENT ADVANCES IN INTERDISCIPLINARY TRENDS IN ENGINEERING & APPLICATIONS

The main objective of the conference is to highlight the importance of today's requirement of interdisciplinary research to develop applications based on engineering and scientific discovery. A unique focus will be given to the researches made in interdisciplinary field by gathering the active national and international researchers from Mechanical, Civil, Electrical, Chemical, Fire, Electronics and Computer Science. This will help to groom the budding researchers to gain exposure and opportunity to interact and know active, established researchers around the world who serve our society with Knowledge, dedication and intelligence. We warmly welcome prospective researchers to submit their latest research paper and share the valuable results and experiences with top-scientist.

KEY-NOTE SPEECHES

Beyond Life-Safety: The Quest Continues

In the last century, seismic design has undergone significant advancements. Starting from the initial concept of designing structures to sustain no or minimal damage during an earthquake, the modern seismic design philosophy allows structures to respond to ground excitations in an inelastic manner, thereby allowing damage in earthquakes that are significantly less intense than the largest possible ground motion at the site of the structure. Current performance-based multi-objective seismic design methods aim to ensure life-safety in large and rare earthquakes and to limit structural damage in frequent and moderate earthquakes.

As a result, not many recently built buildings have collapsed and very few people have been killed in 21st century buildings even in large earthquakes. Nevertheless, the financial losses to the community arising from damage and downtime in these earthquakes have been unacceptably high. This has raised a new question; "what if we could minimize financial loss from earthquakes? It was well known before the earthquakes that our old and unreinforced masonry (URM) building stock was seismically deficient and needed urgent intervention to enhance their performance. These buildings were not expected to come out unscathed after such severe shakings. Still, it was very unfortunate that collapse of some of our old buildings resulted in significant loss of life.

Nevertheless, modern buildings built in the 21st century using the current design philosophy in general did better than what they were expected to do in much severer shakings than they were designed for. Consequently, some engineers have been (justifiably) claiming that the performance of building stock in the Canterbury earthquakes was generally better than expected. This has perplexed the public who are fully aware of the huge scale of financial loss caused by the earthquake. They may be pondering: "How can the engineers say we have done well? Do we need to go broke before they realize we have failed miserably?" This difference is mainly because of the different expectations of the engineers (life-safety) and the general public (economic consequences). Hence, it is high time that the seismic design objectives be matched in line with public expectations.

Prof. Rajesh Dhakal
Structural and Earthquake Engg.
University of Canterbury, New Zealand

The usage of the grid-characteristic method for the numerical simulation of hyperbolic problems in 2D and 3D.

The numerical methods and algorithms for correct simulation of dynamic processes occurring in layered structures, composite materials, and geological media during seismic prospecting/ seismic activity initiation are actively developed at the current moment. It should be noted that the ray-tracing methods widely used in the industry are approximate methods and do not make it possible to understand the behavior of most real fractured geological media. There are a great number of numerical methods for the simulation of seismic processes in complex media (the finite difference method, the Galerkin method, etc.). There are also various numerical methods actively used to construct hybrid calculation algorithms. Also note that, as the defining system of equations of elasticity that describes the propagation of seismic waves is hyperbolic, its numerical solution can be carried out by the grid- characteristic method. Apparently, the characteristic method was proposed for the first time in. It was described in detail for a one-dimensional case and later generalized for a multidimensional case. Because the points at which the solution is calculated might become concentrated and, accordingly, the accuracy of the calculation could decrease, this method did not become widely used. The interpolation procedure was introduced, and it allowed converting this method into an inverse characteristic method (grid-characteristic method). Earlier, the grid-characteristic method was used in the numerical solution of the problems of gas dynamics. It was adapted to solve the problems of deformed solid mechanics only in 1980s. At first, seismic fields were described by the characteristic method on unstructured triangular grids. It was used in for the numerical simulation of seismic response in multilayer geological media in a two-dimensional case.

Later, the grid-characteristic method was generalized for the case of the presence of a fluid-saturated crack in a uniform elastic medium. The numerical simulation of wave response was carried out with account for stratification and cracking. The response of a cluster (set) of fluid-saturated cracks was studied. Aside from the series of calculations in a two-dimensional case, a three-dimensional test calculation was carried out on unstructured grids. The modification of the method with the use of unstructured grids was described in detail. The main restriction in three-dimensional calculations is the computational complexity of the problem. However, if the grid-characteristic method proposed is used on hexahedral grids, then it is possible to increase the speed of calculations significantly and simulate the three-dimensional problem of the formation of the response of the cluster of fluid-saturated cracks located in a uniform medium.

Dr. Golubev Vasily Ivanovich
Applied Mathematics
Moscow IPT, Russia

Some glimpses of International Conference RAITEA-2019

Events organized by CIVILIPSA

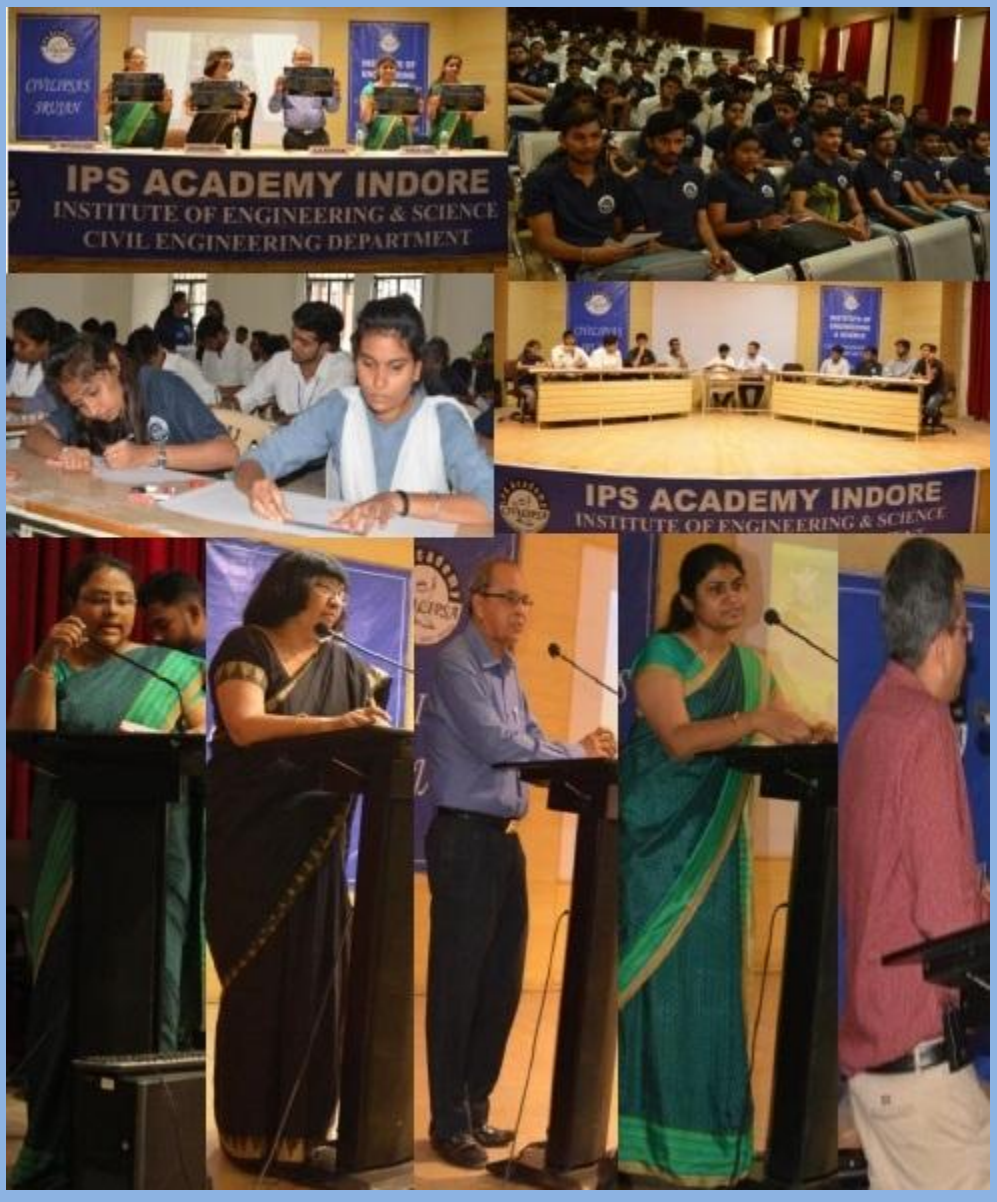
SAMEEKSHA 2018

CIVILIPSA organizes its annual quiz event “SAMEEKSHA” in the month of September since last nine years. Sameeksha tests the normal intelligentsia and knowledge in general civil engineering. The quiz is conducted for teams comprising of two members each. There is no limit to the number of teams from one college.

SRUJAN 2018

CIVILIPSA organizes its annual event “SRUJAN”, two days National Seminar on various themes in the first week of October every year. The seminar is symphony of various events including Expert lectures, Panel Discussion, Paper presentation, Technical Hunt , Conundrum Model making, Bridge IT & various on the spot events.

“SRUJAN” aims to bring mutually professionals, architects, engineers, academicians, research scholars and students on a widespread dais and have interactive brain storming sessions and thereby attempts to be made for overlay technique to innovation with economy, quality and safety in the field of Civil Engineering.



NEEV 2019

CIVILIPSA is organizing its annual event “NEEV”, National Level Student’s Paper Presentation since last 7 years on first week of April.

“NEEV ” aims to stimulate the spirit of inventiveness & managerial skill among students and to encourage innovative thoughts, creativity, exploration, technological & presentation skills and also to expand the decision-making skills among the students so that the creative talent of individuals could be harnessed for the benefit of the nation.