SANDARBH

2017-18

IPS ACADEMY INDORE

INSTITUTE OF ENGINEERING & SCIENCE
CIVIL ENGINEERING DEPARTMENT


RAGGING IS CRIME

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Pragya Sharma

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.

About the Department

Highlights of the Department

Faculties

Patents by the Faculties	02
Book Published by the Faculties	07
Post Doctoral Program	01
Special Awards	05
Paper Published	40
STTP/FDP/Seminars/Workshop Attended	77

Students

Received Gold and Silver Medals	02
Received Chancellor Scholarship	07
Selected in IES and other public Sectors	10
Established as an Entrepreneur	50
Projects with IEDC (DST)	10
Paper Published	111

Social Initiatives

- Weather Station installed.

State of the Art Laboratories

- Instrumentation Lab
- Heavy Structures Lab
- Simulation Lab

Life Membership

- Indian Concrete Institute.
- Indian Water Works Association.

Student Chapter

- Indian Concrete Institute.

Our Esteemed Alumina

- Akash Varshney - Virgin Atlantic Airways, London (0808CE041001
- Rachiyata Awasthi - Asst. Director Treasury (0808CE041032)
- Pratibha Mishra - SDO (0808CE041030
- Ashish Pandey - IES (AIR 120) (0808CE081008)
- Rajat Saklecha - IPS OFFICER (0808CE081042)

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
- Theory of structure lab

Major Softwares

- Staad Pro
- Auto Cad
- Civil 3d
- Primavera P6
- Primavera Contractor
- Ansys
- Sap 2000
- Abaqus 6.12
- Etab
- GMS 6.5 Aft Impulse

Major equipment

- Total station
- Utm & ctm
- Pumps & turbines
- Benkingum beam
- Bituminous testing apparatus
- Plate load test
- Scpt & Dcpt
- Polaris cope
- Fft analyser
- Data logger
- Weather station
- CBR

Expert Talk

FACTS ON EARTHQUAKE

Prof. Amit Sharma
Civil Engineering Department
IPS Academy, Institute of Engineering & Science
Indore (M.P.)

- Geologists rate earthquakes in magnitude, which is the amount of energy released during the quake.
- The largest recorded earthquake happened in **Chile** on May 22, 1960. It was a magnitude 9.5.
- The deadliest known earthquake happened in **China** in 1556. It killed about 830,000 people.
- Alaska has the record for the largest U.S. earthquake. On March 28, 1964, a magnitude 9.2 quake occurred and killed 131 people.
- Most earthquakes happen 50 miles (80 kilometers) or less below the Earth's surface. They can happen as deep as 400 miles (644 kilometers) below the surface.
- Southern **California** has about 10,000 earthquakes a year. Very few are felt.
- Alaska averages 24,000 earthquakes a year, the most seismic activity in North America.
- **Florida and North Dakota** have the fewest earthquakes in the U.S.
- In 1985, the jolt from an 8.1 magnitude earthquake in Michoacán, **Mexico** caused water to slosh out of a pool in Tucson, **Arizona**—1240 miles (2000 kilometers) away.
- Most earthquakes and volcanos—80%—happen close to where two plates meet.
- Depending on the plate, they move between 0.3 to 5.9 inches a year (1 to 15 cms) a year.
- Because of moving plates, geologists predict that Los Angeles will meet Alaska in 70 million years! (It'll be neighbors with San Francisco in 15 million years.)

Research Work by Students

Seismic Design of a Ten Story Building

Pawan Kushwaha, Rajat Danej, Sahil Mordiya, Nikhil Mandloi, Md. Adnan Mansoori, Sohail Khan

Abstract:

The aim of this paper is the evaluation of an existing RC multistory building and to study the structural design of multistory building when exposed to seismic loads using E-TABS software . The building studied is a ten storey residential building. It is constructed from reinforced concrete and designed for gravity loads and earthquake loads only according to the IS 1893 (part 1) 2002 . In the paper earthquake loads are calculated by Equivalent static method. The results from the analysis due to seismic and gravity loads are compared taking different dimensions of beams and columns.

Introduction:

Experience in past earthquakes has demonstrated that many common buildings and typical methods of construction lack basic resistance to earthquake forces. In most cases this resistance can be achieved by following simple, inexpensive principles of good building construction practice. Adherence to these simple rules will not prevent all damage in moderate or large earthquakes, but life threatening collapses should be prevented, and damage limited to repairable proportions. These principles fall into several broad categories:

- Planning and layout of the building involving consideration of the location of rooms and walls, openings such as doors and windows, the number of storeys, etc. At this stage, site and foundation aspects should also be considered.
- Lay out and general design of the structural framing system with special attention to furnishing lateral resistance.
- Proper dimensioning and orientation of structural members such as Beams and columns for stability and economy.

Objective:

The objective is to design and learn the behavior of the structure when the dimensions of structural members are changed against gravity and earthquake loading.

1) To increase strength & stability of building

2) To decrease the cost of construction, area of steel and members require

Problem:

A ten storey residential building has plan and elevation dimensions as shown in Figure 1 and 2. The building is located in seismic zone IV on a site with medium soil type 2. Design the building for seismic loads as per IS 1893 (Part 1): 2002

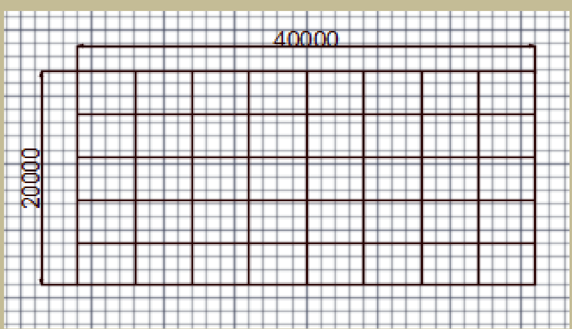


Fig 1 (Plan)

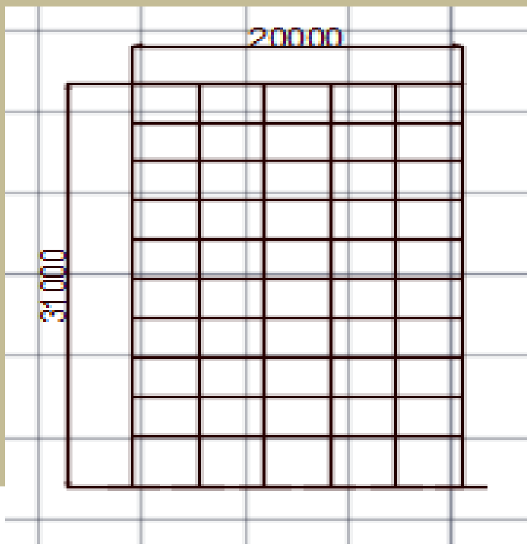


Fig 2(Section)

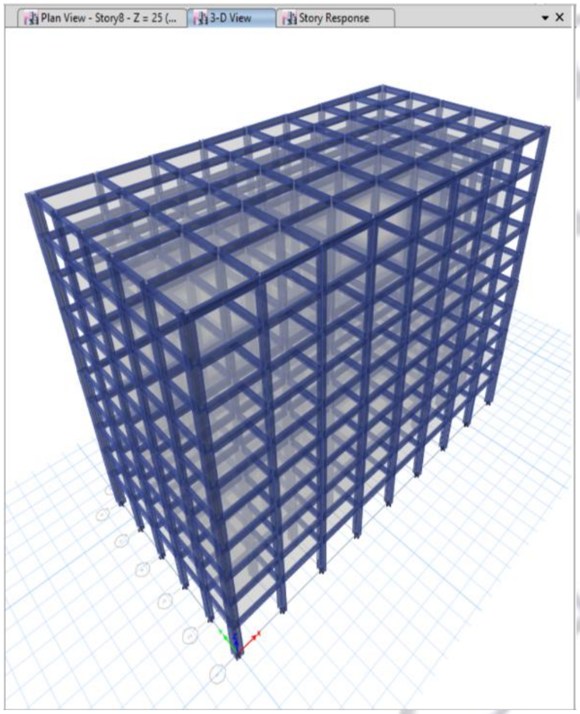


Fig 3 (3D View)

Members Specification

Beam size (230 x 500)

Column size:

Column Group	1st – 5th storey	6th – 10th storey
1	900 x 400	500 x 400
2	700 x 400	500 x 400
3	700 x 700	500 x 700

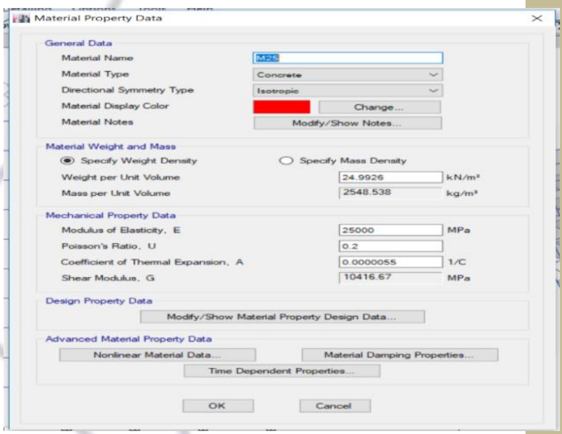
Slab size (140 mm)
Exterior wall thickness : 230mm
Partition wall thickness : 115mm
Parapet wall thickness : 115mm

Characteristic of Material

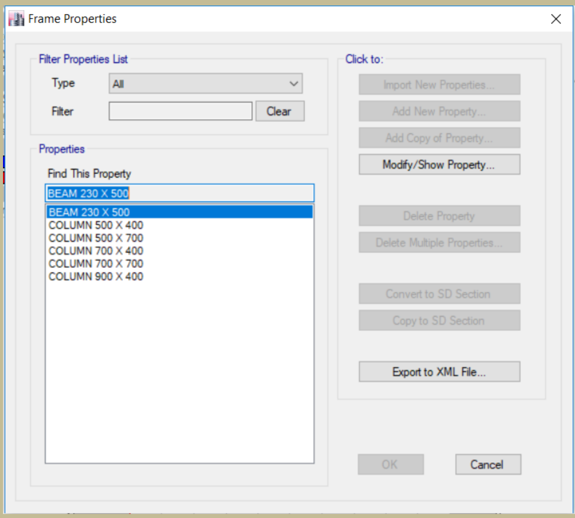
Grade of concrete M25 and M35
Grade of steel Fe 415 (main bars)
Grade of steel Fe 250 (confinement bars)
Type of soil : Medium soil (type II)

Procedure involved in ETABS

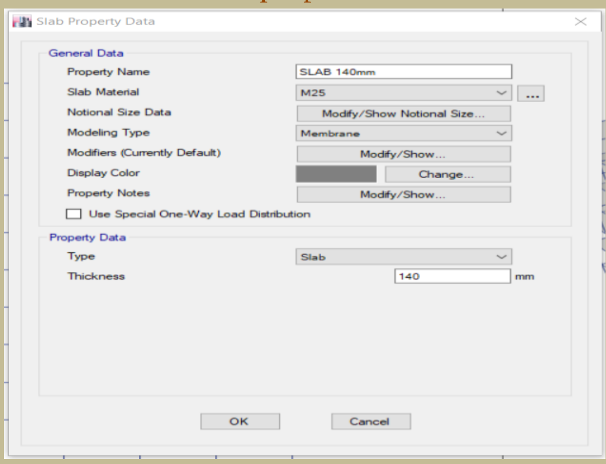
Defining material properties



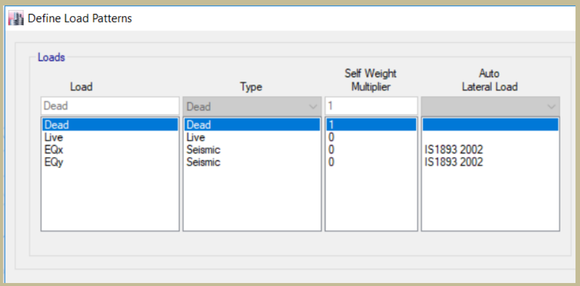
Section properties



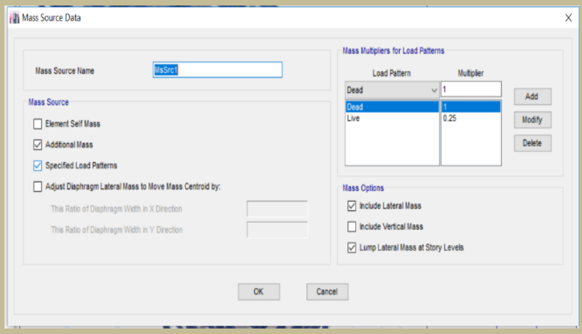
Slab properties



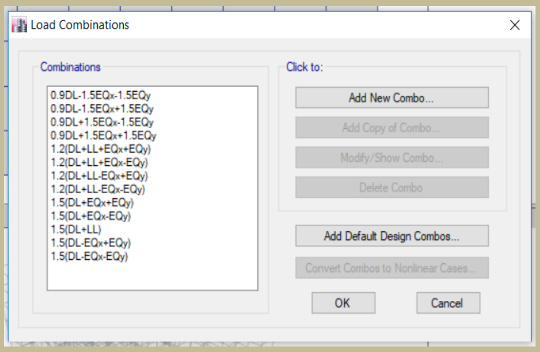
Load patterns



Mass source

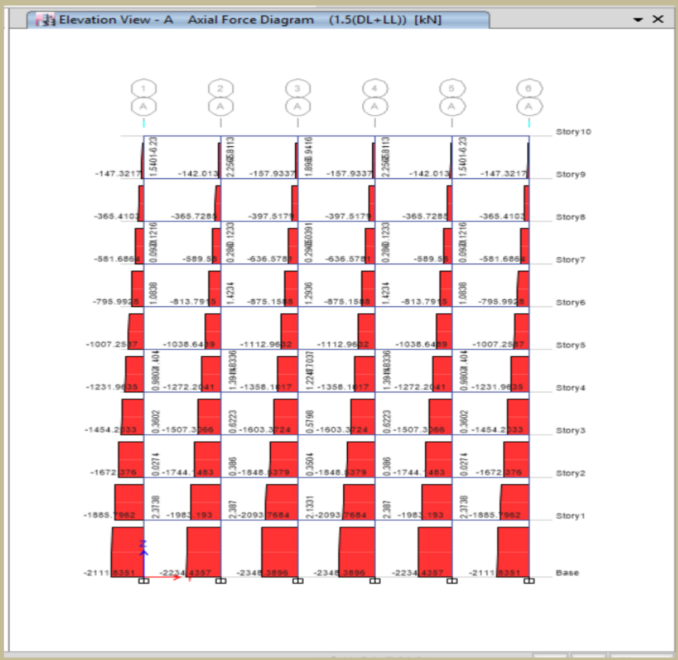


Load combinations

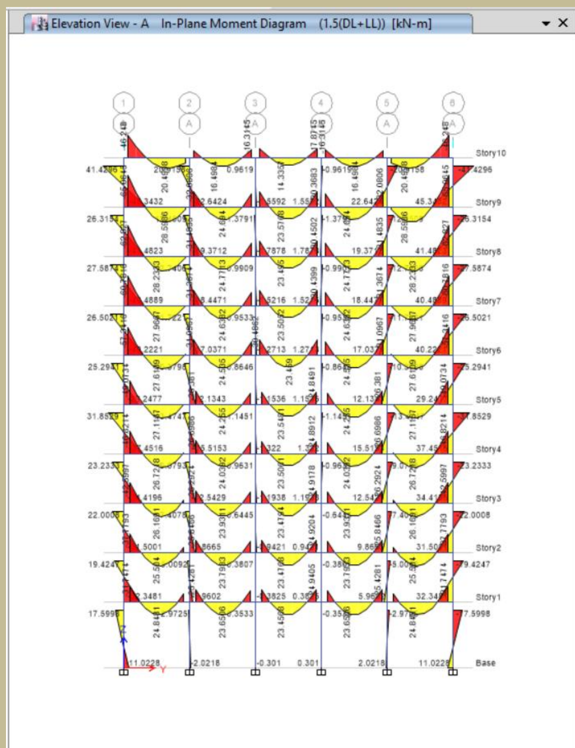


Observations:

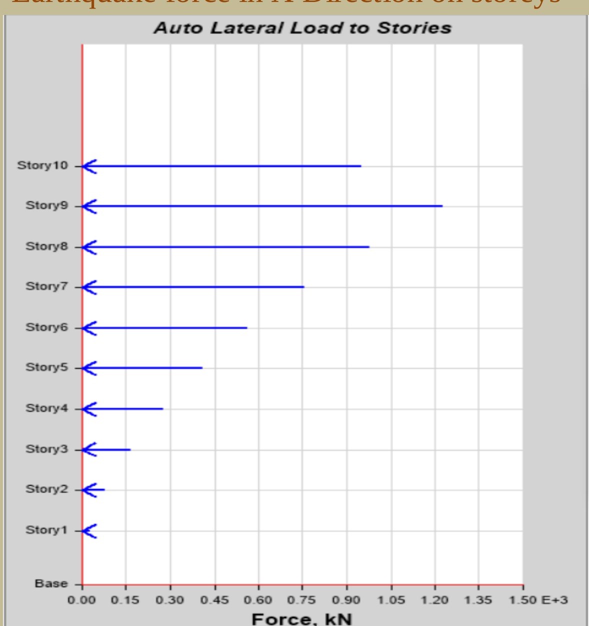
Axial Force



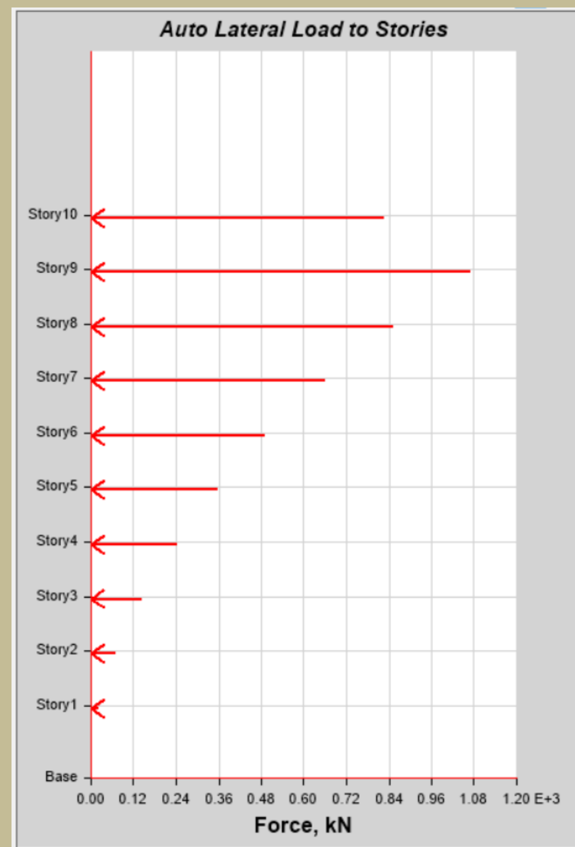
Bending Moment



Earthquake force in X Direction on storeys



Earthquake forces in Y Direction on storeys



Observation table

Lateral Force in X direction

Story Response

Story	Elevation m	Location	X-Dir kN	Y-Dir kN
Story10	31	Top	949.6783	0
Story9	28	Top	1227.1851	0
Story8	25	Top	978.3044	0
Story7	22	Top	757.599	0
Story6	19	Top	565.0686	0
Story5	16	Top	410.0222	0
Story4	13	Top	278.0348	0
Story3	10	Top	164.5177	0
Story2	7	Top	80.6137	0
Story1	4	Top	26.9442	0
Base	0	Top	0	0

Lateral Force in Y direction

Story Response

Story	Elevation m	Location	X-Dir kN	Y-Dir kN
Story10	31	Top	0	828.1067
Story9	28	Top	0	1070.0888
Story8	25	Top	0	853.0682
Story7	22	Top	0	660.616
Story6	19	Top	0	492.7322
Story5	16	Top	0	357.5338
Story4	13	Top	0	242.4426
Story3	10	Top	0	143.4572
Story2	7	Top	0	70.294
Story1	4	Top	0	23.4949
Base	0	Top	0	0

Proof checking for live load

For column group 1
2x5x4x10 = 400kN
For column group 2
2x2.5x4x10 = 200kN
For column group 3
2x2.5x2x10 = 100kN

Manual calculation	ETABS
400	373
200	196
100	117

Seismic Design
Slab
Self weight = .14 x 25 = 3.5kN
SIDL = 1kN/m^2
Total dead load on slab = 4.5kN/m^2
Slab
Self weight =20 x 40 x 4.5 =3600kN

Beam
Self weight (b x d) x 25 = 2.875kN/m

Total length of beam (1^{st} -5^{th} storey)

(20 x 9)-[(.7/2)2 + (.7)4]2 – [(.5/2)2 x (.5)4]7 + (40 x 6) –[(.7/2)2 +(.4)7]2 – [(.4/2)2+(.4)7] x 4
= 363.1m
Total length of beam (6^{st} -10^{th} storey)

(20 x 9)-[(.5/2)2 + (.5)4]2 – [(.7/2)2 x (.9)4]7 + (40 x 6) –[(.7/2)2 +(.4)7]2 – [(.4/2)2+(.4)7] x 4
= 377.7m
Column (1^{st} -5^{th} storey)
.9 x.4x 25=9kN /m x 28
.7 x .4 x 25=7kN/m x22
.7 x .7 x 25 = 12.25kN/m x 4

Column (6^{st} -10^{th} storey)

.5 x .4 x25 = 5kN/m x28
.5 x .4 x25 =5kN/m x22
.5 x.7 x 25 = 8.75kN/m x4

External wall (1^{st} -5^{th} storey)

(40-.4 x7-.7)2 + (20-.7x4-.7)2=106m
0.23x 20 x 106 = 487.6 kN/m (height)

External wall (6^{st} -10^{th} storey)

(40-.4 x7-.7)2 + (20-.5x4-.5)2=108m
0.23x 20 x 108 = 496.8 kN/m (height)

Internal wall (1^{st} -5^{th} storey)

(20 - .5x4 -.5)7 + (40-.4x7-.4)4= 269.7m
0.115 x 20 x 269.7 = 620.310kN/m (height)

Internal wall (6^{st} -10^{th} storey)
(20 - .9x4 -.7)7 + (40-.4x7-.4)4= 257.1m
0.115 x 20 x 257.1 = 591.330kN/m (height)

Imposed Load
$0.25 \times 2\ kN/m^2 \times 20 \times 40 = 400kN$

Seismic weight at storey 10

Slab = 20 x 40 x 4.5 = 3600kN
Beam= 2.875 x 377.7 = 1085.888 kN
External wall = 496.8 x (1+1) = 993.6 kN
Internal wall = 620.310 x (1+0) = 620 kN
Column = 1.5(5 x 28 + 20x5 + 8.75x4) = 427 kN
Live load = 0
Total = 6726.488 kN

Seismic weight at storey 9

Slab = 20 x 40 x 4.5 = 3600kN
Beam= 2.875 x 377.7 = 1085.888 kN
External wall = 496.8 x (1.5+1) = 1242 kN
Internal wall = 620.310 x (1.5+1) = 1550.775 kN
Column = 3(3 x 28+ 5x22 + 8.75x4)= 854 kN
Live load = 400 kN
Total = 8732.662 kN

Seismic weight at storey 8

Slab = 20 x 40 x 4.5 = 3600kN
Beam= 2.875 x 377.7 = 1085.888 kN
External wall = 496.8 x (1.5+1) = 1242 kN
Internal wall = 620.310 x (1.5+1) = 1550.775 kN
Column = 3(3 x 28+ 5x22 + 8.75x4)= 854 kN
Live load = 400 kN
Total = 8732.662 kN
Seismic weight at storey 7

Slab = 20 x 40 x 4.5 = 3600kN
Beam= 2.875 x 377.7 = 1085.888 kN
External wall = 496.8 x (1.5+1) = 1242 kN
Internal wall = 620.310 x (1.5+1) = 1550.775 kN
Column = 3(3 x 28+ 5x22 + 8.75x4)= 854 kN
Live load = 400 kN
Total = 8732.662 kN

Seismic weight at storey 6

Slab = 20 x 40 x 4.5 = 3600kN
Beam= 2.875 x 377.7 = 1085.888 kN
External wall = 496.8 x (1.5+1) = 1242 kN
Internal wall = 620.310 x (1.5+1) = 1550.775 kN
Column = 3(3 x 28+ 5x22 + 8.75x4)= 854 kN
Live load = 400 kN
Total = 8732.662 kN
Total = 8374.6kN

Seismic weight at storey 5

Slab = 20 x 40 x 4.5 = 3600kN
Beam= 2.875 x 363.1 = 1043.913 kN
External wall = 487.6 x (1.5+1) = 1219kN
Internal wall = 521.330 x (1.5+1) = 1478.325 kN
Column = 1.5(5x 28+ 5x22 + 8.75x4) + 1.5(9x28 +7x22+12.25x4)= 1109.500 kN
Live load = 400 kN
Total = 8850.738 kN

Seismic weight at storey 4

Slab = 20 x 40 x 4.5 = 3600kN

Beam= 2.875 x 363.1 = 1043.913 kN
External wall = 487.6 x (1.5+1) = 1219kN
Internal wall = 521.330 x (1.5+1) = 1478.325 kN
Column = 3(9x 28+ 7x22 + 12.25x4) = 1365 kN
Live load = 400 kN
Total = 9106.238 kN

Seismic weight at storey 3

Slab = 20 x 40 x 4.5 = 3600kN
Beam= 2.875 x 363.1 = 1043.913 kN
External wall = 487.6 x (1.5+1) = 1219kN
Internal wall = 521.330 x (1.5+1) = 1478.325 kN
Column = 3(9x 28+ 7x22 + 12.25x4) = 1365 kN
Live load = 400 kN
Total = 9106.238 kN

Seismic weight at storey 2

Slab = 20 x 40 x 4.5 = 3600kN
Beam= 2.875 x 363.1 = 1043.913 kN
External wall = 487.6 x (1.5+1) = 1219kN
Internal wall = 521.330 x (1.5+1) = 1478.325 kN
Column = 3(9x 28+ 7x22 + 12.25x4) = 1365 kN
Live load = 400 kN
Total = 9106.238 kN

Seismic weight at storey 1

Slab = 20 x 40 x 4.5 = 3600kN
Beam= 2.875 x 363.1 = 1043.913 kN
External wall = 487.6 x (1.5+0) = 717.900 kN

Internal wall = 591.330 x (1.5+1) = 886.995 kN
Column = (1.5+2)(9x 28+ 7x22 + 12.25x4) = 1592.5 kN
Live load = 400 kN
Total = 8241.308 kN
$W_s = \sum W_{si}$ = 86067.896 kN
Z = 0.24
I = 1
R = 5
$T_{a(x)}$ = .441 sec
$T_{a(y)}$ = .624 sec

Soil type = 2
$(S_a/g)_x$ = 2.5
$(S_a/g)_y$ = 2.179
$A_{h(x)}$ = .060
$A_{h(y)}$ = .052
$V_{b(x)}$ = 4944.483 kN
$V_{b(y)}$ = 4285.219 kN

storey	W_{si}	h_i	$W_{si}\, h_i^2$	Q_{ix}	Q_{iy}
1	6726.4	31	646.4	1016.5	881.0
2	8732.6	28	684.6	1076.6	933.1
3	8732.6	25	545.7	858.3	743.8
4	8732.6	22	422.7	664.5	576.0
5	8732.6	19	315.2	495.7	429.7
6	8850.7	16	226.5	356.3	308.8
7	9106.2	13	153.9	242.0	209.7
8	9106.2	10	91.1	143.2	124.1
9	9106.2	7	44.7	70.2	60.8
10	8241.3	4	13.2	20.7	17.9
			∑ 3144.1		

References

- IS 1893 Part 1
- IS 456 2000
- YouTube
- BC Punmia
- IIT Kharagpur earthquake design tips.

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.) Reduce disposal problem 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= $Mass of EPS/Mass of Cement$ ×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. Material Specification

- 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

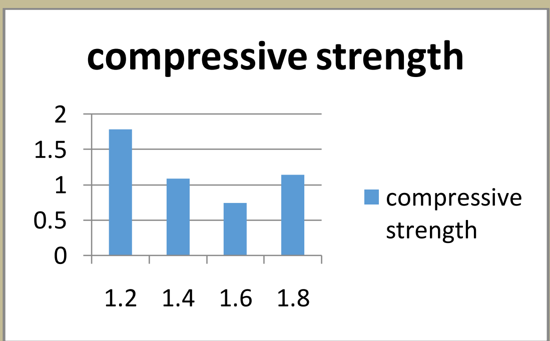
Values of R	*cubes*	*Compressive strength(N/mm2)*
1.8	*Cube 1*	*0.680*
1.8	*Cube 2*	*0.750*

(UTM). The load applied on specimen uniformly upto 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

1. 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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Crack and Repairing of Concrete

Richa Patel & Mayank Bariya

Abstract

Cracks in the concrete structures are early signs of distress which have to be diagnosed properly otherwise the repair of same crack takes place again and again causing loss of time and money. The structural cracks need more attention than non structural cracks. The repair materials and methodology are different depending upon types of cracks, their locations such as joints, structural members etc. and conditions such as dry or moist. The present paper focuses the various types of cementious and polymeric materials that are being used for repair of cracks.

Keywords

Cracks, Crack repairs, Cementious grouts, Polymer modified Cementious grouts, Epoxy injection

1. Introduction

Concrete inherits certain type of cracks in pre-hardening stage and also develops some other types of cracks in post hardening stage in due course of time due to various reasons, despite our utmost care in prevention of cracks. While concrete becomes older, these cracks become sources, of leakages and seepages and give easy access to the moisture, oxygen, chloride, carbon dioxide, and other aggressive chemicals and gases into the concrete leading to serious degradation of the structure and causing corrosion of steel and damage in the concrete in the form of spalling etc. and subsequently causing structural failure of the member. Cracking is the initial sign of distress of the structure baring other forms of distress and deterioration like deformation, surface deposits and construction defects etc. causing damage to structural strength, durability and serviceability

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2. Causes of Cracking

- **Overloading**

The cross section of concrete is designed with both calculated and estimated loads, determined from building codes. Design includes such factors as the strength of the concrete, the number, sizing, and placement of reinforcing bars, and size and shape of concrete cross section . When a structure os overloaded to the extent not covered in safety factors, concrete may be damaged or cyclic loading. Each of these has different cracking pattern to look for.

- **Corrosion**

There are two major causes of corrosion in the reinforcing steel; chloride penetration and carbonation. Chloride penetration reduces the ph level of the concrete when Oxygen, chlorides and moisture all penetrate the concrete (Pirro 2012, p.20) Chlorides can be found in potable water, which should never be used to mix concrete..They are also an environmental.

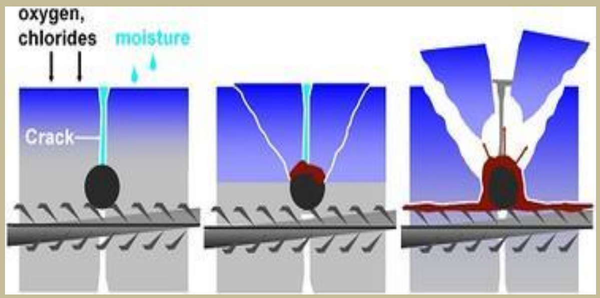


Figure 1: Process of chloride penetration

Over the lifespan of a structure. For instance, buildings exposed to salt water or de-icing salts may experience faster chloride build up from the salts (Emmons 1993, p. 12). The chloride penetration process can be viewed in Figure 1.

Carbonation occurs when carbon dioxide and moisture infiltrate the concrete, reducing the pH level of the concrete (Pirro 2012, p. 29). This process can be seen illustrated in

Figure 2.Both causes of corrosion end similarly. The pH level is the concrete's last barrier against corrosion, so the reinforcement begins to rust (Khan 2006, p. 14). Rust expands the steel to 10 times the volume, which can cause major problems in Figure 2: Process of carbonation the

- **Freeze/Thaw**

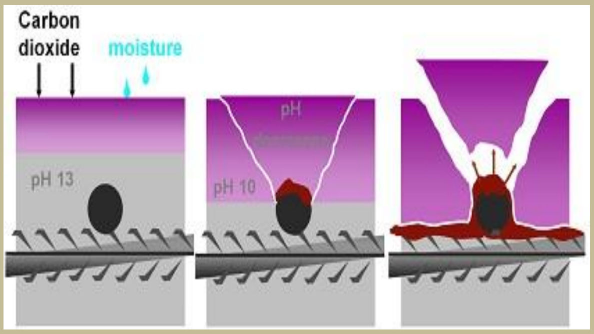
Freezing and thawing cycles can be very detrimental to concrete over time. Unless a protective coating is applied to the concrete, each cycle allows more moisture to penetrate into the concrete. The stress of the moisture freezing inside the concrete causes larger defects with each cycle. Air-entrained concrete can be used to help alleviate some of the expansive stresses of harsh temperature changes. However, not all freeze/thaw effects can be assuaged in this way and many structures may succumb to cracking either caused or worsened by these cycles.

Manufacturers of crack repair kits suggest that cracks less than 1/16" in thickness can be repaired without professional contractors ("Types" 2012). However, tolerable crack widths may be significantly less than this (0.016" and less depending on the environment) because cracks may allow deteriorating chemicals to damage the concrete in other ways (Emmons 1993, p. 13).

- **Alkali-Aggregate Reaction (AAR)**

AAR refers to chemical reactions taking place within the concrete mix. Certain aggregates inside the concrete may react with alkalis, causing concrete expansion. The alkalis may be also be from within the concrete mix, or may be from outside sources like sea or ground water, or deicing salts. Depending on the type of aggregate, AAR also goes by other names. In siliceous aggregates, the reactions are called "alklali silica reactivity" (ASR). In dolomitic carbonate rocks, the reactions are called "alkali-carbonate reactivity" (ACR) (Khan 2006, p.15).

When these types of ractions occur, they



create a gel-like substance that swells when moisture reaches it. The stresses from the swelling create internal tensile forces, which may crack the concrete from within (Khan 2006, p.15).

- **Shrinkage**

Concrete shrinkage may occur throughout a structure's life cycle for different reasons with the majority occurring within the first few months or years after casting. There are two primary categories of shrinkage: plastic (before hardening), and drying (after hardening). Immediately after concrete is poured, there can be settlement shrinkage, construction movement (e.g. formwork movement or removal), and drying shrinkage. After the concrete has fully hardened, a structure will undergo temperature, volume and chemical changes throughout the years (Winter bottom, p. 2). Each of these may also cause concrete shrinkage. Shrinkage is an expected phenomenon in a concrete structure, and can often be controlled with stress-relieving joints and properly placed reinforcing steel.

- **Poor Workmanship**

Concrete itself is so variable that properly constructing a concrete structure can be difficult. Some issues related to workmanship are as follows: over/under consolidated aggregates, improper location of rebar, over watering for workability, finishing surface before bleeding occurs. Each of these may end up not mattering overall, or may contribute to a structural failure.

3. Structural Cracks

- **Flexural Cracks**

Cracking in reinforced concrete flexural members subjected to bending starts in the tensile zone, e.g: at the soffit of beams. Generally beams and slabs may be subjected to significant loads and deflection under these loads, with the steel reinforcement and the surrounding concrete subject to tension and stretching. When the tension exceeds the tensile strength of the concrete, a transverse or flexural crack is formed (Fig. 1). Although in the short term the width of flexural cracks narrows from the surface to the steel, in the long-term under sustained loading, the crack width increases and becomes more uniform across the member.

- **Shear Cracks**

These are caused by structural loading or movement after the concrete has hardened. Shear cracks are better described as diagonal tension cracks due to the combined effects of bending and shearing action. Beams and columns are generally prone to such cracking.

- **Internal Micro-Cracks**

Micro cracking can occur in severe stress zones, due to large differential cooling rates, or due to compressive loading. These are discontinuous microscopic cracks which can become continuous and become a visible sign of impending structural problems.

4. Non-Structural Cracks

Non-structural cracks include pre-hardening cracks, cracks in hardened concrete, and cracking due to chemical effects. Non-structural cracks are influenced by the constituent materials of the concrete, and other factors such as ambient temperature, humidity, overall exposure conditions, construction practices and restraint effects of either internal or external nature. Due to their cumulative nature, the intrinsic effects of one type of crack can be further exacerbated by the effects of another type. Some crack types allow penetration of aggressive chemical agents to the steel reinforcement, leading to corrosion of the steel and possible cracking and spalling. Intrinsic effects of cracking can usually be minimized and controlled by careful attention to both design details such as distribution and positioning of reinforcement and construction techniques.

- **Pre-hardening (Plastic) Cracks**

These cracks occur within a few hours after the placement and compaction of concrete, but before the concrete has fully hardened.

- **Plastic Shrinkage Cracks**

Caused by rapid drying of the concrete surface, within the first six hours (even within minutes) after placement, as a result of large moisture losses from the surface (Fig. 2). Strong winds, high air or concrete temperatures and low humidity, alone or in combination, can cause cracking because they promote evaporation of water which exceeds the rate of bleeding of water to the surface.

Plastic shrinkage cracks can form large map patterns or they may appear as diagonal or parallel cracks of various depths. Any drying cracks which appear before or during finishing operations should be immediately closed with either a wooden or steel float and curing should commence immediately following the progressive completion of final finishing operations.

VicRoads Standard Specification Section 610 – Structural Concrete 6 (Section 610) has prescribed requirements for controlling temperature, moisture evaporation limits and concreting operations to minimise the potential for plastic shrinkage cracking. Precautionary measures may include the use of aliphatic alcohol-based evaporative retarders where the evaporation limits of mixing water are exceeded. The use of aliphatic alcohol is mandatory if curing compounds are used on concrete decks and slabs (Fig. 3). If not prevented or minimised initially, plastic shrinkage cracking can be further exacerbated by subsequent drying shrinkage and thermal contraction (movement). keeping Victorians connected Cracks In Concrete Technical Note 38 2 Technical Note - No. 38 : December 2010

- **Plastic Settlement Cracks**

Caused by concrete settling under its own weight, especially when there is excessive bleeding and the settlement is impeded by a local restraint. The cracks occur in the hardening mass over restraints such as steel reinforcement, deep sections and steps in formwork. The cracks can be further exacerbated by inadequate compaction and the presence of voids under reinforcing bars. Plastic settlement cracks can be enlarged by subsequent drying shrinkage and become more obvious. These cracks tend to form longitudinally over the steel reinforcement and can be a cause of serious corrosion. Plastic settlement cracks can be prevented by ensuring that the concrete is a well graded, well balanced mix at appropriate water content which enables good compaction, and the formwork is rigid and not subject to movement.

- **Cracks Caused by Formwork Movement**

Movement of formwork after the concrete has started to stiffen but before it has gained enough strength to support its own weight, can cause cracking. Formwork must be left in place until the concrete has gained sufficient strength to support itself. Formwork must also be sufficiently strong to avoid excessive deflections.

- **Cracks in Hardened Concrete**

Cracking in hardened concrete can be attributed to drying shrinkage (loss of moisture), early thermal contraction (movement) and structural and chemical effects.

- **Craze Cracking**

Characterised by a series of very fine closely spaced map pattern cracks which are caused by the shrinkage of the cementitious material of the surface layer of concrete. The cracks are fairly shallow and affect the appearance more so than the structural integrity or durability. They are mainly caused by the use of wet concrete mixes, working the bleed water into the surface during finishing, and inadequate curing. Craze cracking can be prevented by ensuring that final finishing of concrete surfaces is only carried out after all bleed water has been removed, power trowels are not overused, driers such as dry sand, cement or stone dust are not used to absorb free water, by avoiding the use of wet concrete and by adopting good curing practices.

- **Drying Shrinkage Cracks**

Occur when concrete reduces in volume as a result of moisture losses into the atmosphere in its hardened state. If the concrete is unrestrained and free to move and undergo shortening without a buildup of shrinkage stresses, no shrinkage cracking will occur. However, the combination of shrinkage and sufficient restraint (for example, by another part of the structure) produces tensile stresses. When these stresses exceed the tensile strength of concrete, cracks (Fig. 4) will occur that, over time, can penetrate the full depth of the concrete. A significant proportion of shrinkage generally occurs within the first few weeks, with the drying environment surrounding the concrete having a major effect.

Shrinkage cracks generally appear after several weeks or even months after casting. Drying shrinkage can be reduced by increasing the amount of aggregate, particularly the larger coarse aggregate, and more importantly by reducing the total water content. Other factors which influence cracking in hardened concrete such as restraints, geometry and construction practices need to be addressed. Adequate and correctly positioned steel reinforcement can more evenly distribute shrinkage stresses within a reinforced concrete member and better control crack widths. Generally drying shrinkage can range from 450 to 750 micro strain for high quality special class concrete to about 1000 micro strain for normal class concrete.

- **Early Thermal Contraction (Movement) Cracks**

All immature concrete elements are subject to thermal contraction or movement for up to 14 days after placement, due to temperature rise from the heat of hydration of the cementitious material. This is more pronounced in the case of higher quality special class concrete which contains higher amounts of cementitious material. Thermal cracking may appear between one day and two weeks after construction. Larger and thicker members (i.e. columns, beams, footings, etc.) are more susceptible due to the greater heat and higher internal temperatures generated which can be as much as 45 oC to 65 oC. As the surface temperature falls to the ambient level, a concrete element (i.e. cooler concrete surface) is subjected to thermal contraction or movement due to the development of large temperature differentials (greater than 20oC) across the concrete element. If this contraction is restrained by either an internal restraint such as the inner core or adjacent previous pours, tensile stresses are induced which can cause cracking of the concrete once its low tensile strength capacity is exceeded. VicRoads Section 610 requires that temperature differentials are monitored and precautions are implemented where the temperature differential within a concrete element exceeds 20oC.

- **Cracks due to Chemical Effects**

The expansive effects of chemical reaction products from corrosion of steel reinforcement on alkali-aggregate reaction can also cause cracking in hardened concrete.

- **Corrosion of Steel Reinforcement**

Some cracks are induced by the expansive forces associated with corrosion of the steel reinforcement which crack and subsequently spall the concrete (Fig. 5). These cracks are mainly longitudinal in nature and are located directly above or below the reinforcement, run parallel with it and are often associated with shallow or porous cover concrete. Such cracking and spalling is noticeable at corners of columns and beams and usually show signs of rust stains. Cracking associated with corroded reinforcement usually takes a long time to become evident.

- **Alkali -Silica Reaction Cracks**

The chemical reaction between the alkali hydroxide in the concrete and reactive aggregates produces an expansive gel, causing map cracking or directional cracking (pre-stressed members) in the structure. Other visible signs of damage may be aggregate pop out and discoloration.

5. Methods of Crack Repair

Crack repair could be done to accomplish one or more of the following objectives: ·

1. Restore and Increase strength.
2. Restore and Increase stiffness ·
3. Improve functional performance.
4. Provide water tightness.
5. Improve appearance of the concrete surface.
6. Improve durability.
7. Prevent development of corrosion in steel.

Depending on the nature of damage, one or more repair methods may be selected, for example, tensile strength may be restored across a crack by injecting it with epoxy or other high strength bonding agent. However, it may be necessary to provide additional strength by adding reinforcement or using post-tensioning. Epoxy injection alone can be used to restore flexural stiffness if further cracking is not anticipated. To minimize future deterioration due to the corrosion of reinforcement, cracks exposed to a moist or corrosive environment should be sealed.
Key methods of crack repair to accomplish above objectives are outlined in following sub-paras:

❖ Repair of Dormant Cracks

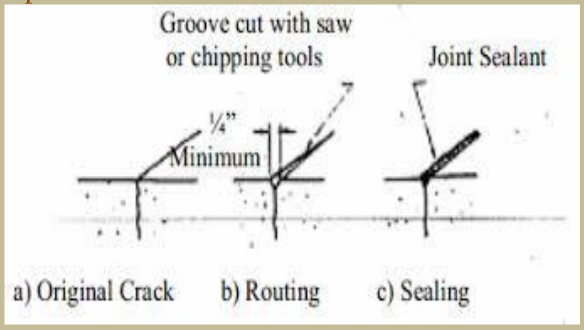
A. Sealing of Cracks

Sealing of cracks as standalone repair should be used in conditions where structural repair is not necessary. Isolated cracks whether extending through the concrete section or partially into it, should be sealed at the concrete surfaces. For this a slot of approx. 25mm wide should be saw cut upto 10mm deep along the crack keeping crack at the center of the slot. The concrete should be chiseled out from between the two saw cut edges and concrete should be further undercut beyond the 10mm depth up to say 20mm depth so that the base width is slightly greater than the surface width.

After the slot is thoroughly cleaned, soaked with water for 10 hrs. and surface dried, a bond coat/ primer coat, of an approximate latex bonding compound should be applied. Once the primer becomes tacky, high strength polymer modified cementitious mortar with specification mentioned in Para 10.1 should be filled in the slot, properly tamped and surface finished. Curing compound should be applied as soon as surface becomes touch dry. 7 days wet curing should be done by covering with wet Hessian and polythene sheet.

B. Routing and Sealing of Cracks

Alternatively a V-groove should be prepared along the crack at the surface ranging in depth from 6 to 25mm and minimum opening at surface of 6mm(Fig. 11) Fig. 11, Repair of Crack by routing and Sealing A concrete saw, hand tools or pneumatic tools may be used. The groove is then cleaned by air blasting, sand blasting or water blasting and dried. A sealant is placed into the dry groove and allowed to cure. The sealant may be any of several materials, including epoxies, urethanes, silicones, polysulphides, asphaltic materials or polymer mortars. A bond breaker may be provided at the bottom of the groove to allow the sealant to change shape, without a concentration of stress on the bottom. The bond breaker may be polyethylene strip or tape which will not bond to the sealant.



C. Bond Breaking

In some cases over bonding (strip coating) is used independently of or in conjunction with sealing. For this an area approx. 25 to 75mm on each side of the crack is sand blasted or cleaned by other means, and a coating (such as urethane) 1 to 2mm thick in a band is applied over the crack. A bond breaker may be used over the crack or over a crack previously sealed.

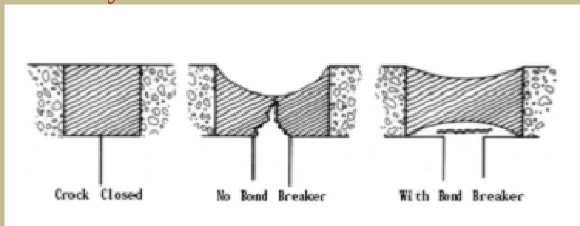


Fig. 3.2-Effect of bond breaker

Cracks subject to minimal movement may be over banded, but if significant movement can take place, sealing must be used in conjunction with over banding to ensure a water proof repair. . Fig.12, Effect of Bond Breaker a) Original Crack b) Routing c) Sealing ¼" Minimum Joint Sealant Groove cut with saw or chipping tools Crack Closed With Bond Breaker No Bond Breaker causes, evaluation and repair of cracks in concrete

D. Epoxy Injection

Cracks as narrow as 0.3mm can be bonded by the injection of epoxy successfully in buildings, bridges and other concrete structures. However, unless the cause of the cracking has been corrected, it will probably recur near the original crack. If the cause of the crack cannot be removed and it is not causing reduction in strength of the structure, then either the crack could be sealed with flexible sealant thus treating it as a joint or establish a joint that will accommodate the movement and then the crack should be grouted with epoxy. With the exception of certain moisture tolerant epoxies, this technique is not applicable if the cracks are actively leaking and cannot be dried out. Epoxy injection requires a high degree of skill for satisfactory execution, and the ambient temperature may limit application of the technique.

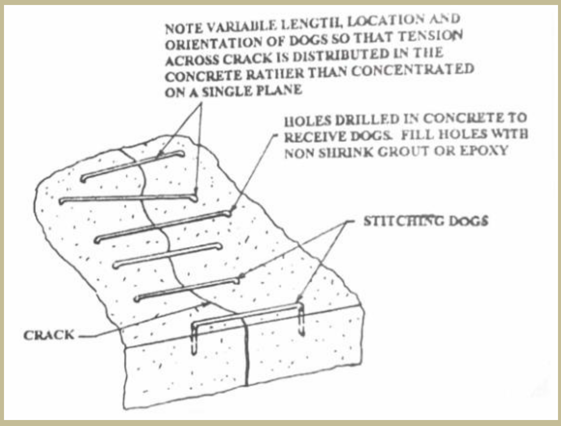
❖ **Repair to Active Cracks**

A. Drilling and Plugging through Crack

One of the approximate methods would be to drill holes normal to cracks, fill them with a suitable epoxy or epoxy-mortar formulation and then place reinforcement bars (of predetermined sizes and lengths) in them to stitch across the cracks. The bars may be placed in the clean holes prior to filling the epoxy (so as to save loss of epoxy) but then great care is needed not to entrap any air.

B. Stitching

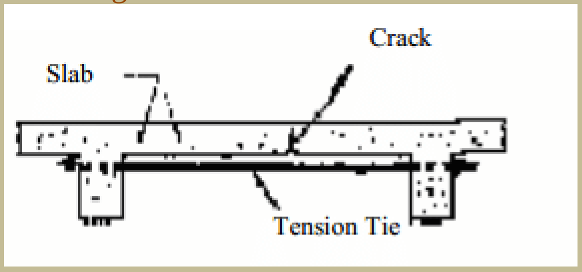
Stitching involves drilling holes on both sides of the crack and grouting in U-shaped metal units with short legs (staples or stitching dogs) that span the crack as shown in Figure.



Stitching across Crack Stitching should be used when tensile strength has to be restored back across major cracks. Stitching a crack tends to stiffen the structure and the stiffening may increase the overall structural restrain, causing the concrete to crack elsewhere. Therefore, it is necessary that proper investigation is done and if required, adjacent section or sections are strengthened using technically designed reinforcing methods. Because stresses are often concentrated, using this method in conjunction with other methods may be necessary. The procedure consists of drilling holes on both sides of the crack, cleaning the holes and anchoring the legs of the staples in the holes, with either a non-shrink cement grout or any epoxy resin-based bonding system. The staples should be variable in length, orientation, or both and they should be located so that the tension transmitted across the crack is not applied to a single plane within the section but is spread over an area.

C. External Prestressing

The flexural cracks in reinforced concrete can be arrested and even corrected by the 'Post –tensioning' method. It closes the cracks by providing compression force to compensate for tensions and adds a residual compression force. This method requires anchorage of the tierods (or wires) to the anchoring device



(the guide – bracket- angles) attached to the beam . Post Tensioning Cracked Beam The rods or wires are then tensioned by tightening the end-nuts or by turning of turnbuckles in the rods against the anchoring devices. However, it may become necessary in certain critical case to run at least an approximate stress-check to guard against any possible adverse effects

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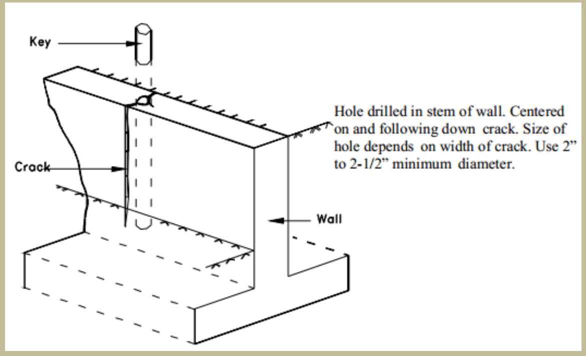
D. Drilling and Plugging

When cracks run in reasonable straight lines and are accessible at one end, drilling down the length of the crack and grouting it to form a key as shown in Fig. 15 could repair them. Crack Slab Tension Tie Form key with precast concrete or mortor plugs set in bitumen. The bitumen is to break the bond between plugs and hole so that plugs will not be cracked by subsequent movement of the opening. If a particularly good seal is required, drill a second hole and plug with bitumen alone, using the first hole as a key and the second as a seal.



Drilling and Plugging a hole of 50 to 75mm dia depending on width of crack should be drilled centered on and following the crack. The hole must be large enough to intersect the crack along its full length and provide enough repair material to structurally take the loads exerted on the key. The drilled hole should then be cleaned, made tight and filled with grout. The grout key prevents transverse movements of the sections of concrete adjacent to the crack. The key will also reduce heavy leakage through the crack and loss of soil from behind a leaking wall. If water tightness is essential and structural load transfer is not, the drilled hole should be filled with a resilient material of low modulus in lieu of grout. If the key effect is essential, the resilient material can be placed in a second hole, the first being grouted.

A. Gravity Filling

Low viscosity monomers and resins can be used to seal cracks with width of 0.03mm to 0.3mm by gravity filling. High molecular-weight methacrylates, urethanes and some low viscosity epoxies could be used successfully. Lower the viscosity, finer the cracks that can be filled. First the surface should be cleaned by air blasting and/ or water blasting. Wet surfaces should be permitted to dry several days to obtain the best crack filling. The monomer or resin can be poured on the surface and spread with brooms or rollers.

B. Cement Grouting

Wide cracks, particularly in mass concrete abutments/piers and masonry substructures may be repaired by filling with Portland cement grout. This method is effective in sealing the crack in concrete, but it will not structurally bond cracked sections.

C. Chemical Grouting

It consists of solutions of two or more chemicals, such as urethanes, sodium silicates, and acrylomides that combine to form a gel, a solid precipitate, or foam. Cracks in concrete as narrow as 0.05mm could be filled with grout.

6. Conclusion

Cracks in the concrete structures are early signs of distress which have to be diagnosed properly otherwise the repair of same crack takes place again and again causing loss of time and money. The structural cracks need more attention than non structural cracks. The repair materials and methodology are different depending upon types of cracks, their locations such as joints, structural members etc. and conditions such as dry or moist. A thorough and logical evaluation of the current condition of a concrete structure is the first step in any repair project. Regular inspection and monitoring is essential to detect problems with concrete structures. The structures should be inspected a minimum of once per year. It is important to keep written records of the dimensions and extent of deterioration as scaling, disintegration, efflorescence, honeycombing, erosion, spalling, popouts, and the length and width of cracks. Structural cracks should be monitored more frequently and repaired if they are a threat to the stability of the structure. Photographs provide invaluable records of changing conditions. All maintenance and inspection records should be kept.

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Use of Recycled LDPE Waste in PPC Cement Mortar

Vineet Kumar Saha, Harsha Gupta, Shweta Rathore, Jaya Pal

Abstract

Extensive research work has been done to improve the decreasing sustainability of environmental condition through plastic wastes. Improper land disposal of plastic wastes results in the depletion of fertility of soil as well as resulting adverse effect over environment and living being. This paper emphasizes on effect on properties of recycled plastic waste in cement mortar as a replacement of fine aggregate in varying percentages. The study reveals decreasing environmental problems and the feasibility of recycled waste inclusion as partial aggregate replacement in normal cement mortar. It involves three replacement levels of wastes into cement mortar for each mix design. In the design mix of plastic wastes cement mortar, percentage of fly ash and w/c ratio is kept constant (32 % and 0.5) and recycled Low-Density Polymer Ethylene (LDPE) is varied from 0 to 30 % by weight of natural sand. The test results indicate that the mechanical properties of Recycled LDPE modified mortar are improved, whereas the water absorption is increased upto as compared to that of plain mortar.

Keywords

Recycled LDPE, Eco-friendly, Water absorption, Economic, Punning.

1. Introduction

Cement mortar has great significance in structural material. Mortar is a homogeneous mixture, produced by intimately mixing cementitious materials, water and inert materials, such as sand to the required consistency for use in building together with masonry units. Due to growing environment concern and the need to conserve energy, various research efforts have been directed toward the utilization of waste materials in cement mortar. With ever-increasing environmental problems because of plastic waste, comes a great need to use this non-biodegradable waste in an appropriate manner to reduce health and environmental problems. The use of recycled Low-Density Polymer Ethylene (LDPE) made cement mortar economical and without affecting normal strength. Efforts has been made to perform recycling of waste plastic such as Low Density Polymer Ethylene (LDPE), LDPE is a thermoplastic made from the monomer ethylene. However, due to its ubiquitous nature, and resistance to biodegradability, the disposal strategies are critical and need attention.

the partial solution to environmental and ecological problems. Use of these materials not only helps in getting them utilized in cement mortar, concrete and other construction materials, it helps in reducing the cost of cement and fine aggregates (sand), but also has numerous indirect benefits such as reduction in masonry and finishing cost, saving in energy, to reduce the fatal effect on the loss of fertility of soil and protecting the environment from possible threat due to pollut

2. Objective

Following objectives are driven: -

Proper mix proportioning of recycled LDPE waste and fine aggregate is utilized for modified cement mortar.

- To investigate variation in compressive strength of cement mortar with sand and recycled LDPE waste. To determine optimum content of recycled LDPE waste as a replacement of fine aggregate.

- To study the density of modified mortar formed by utilization of different mix proportion of sand and recycled LDPE.

3. Literature Review

Oliveira used fibers made from recycled PET bottles in reinforced mortar. He added different volumes of fiber with the variable quantity of 0.0%, 0.5%, 1.0%, and 1.5% to the dry mortars. The results showed that using PET fibers makes a significant improvement on compressive strength of mortars, in addition to a noticeable effect on the flexural strength along with increase in their toughness.

Yousef Ghernouti et al. The study presents the partial replacement of fine aggregate in concrete by using plastic fine aggregate obtained from the crushing of waste plastic bags. Plastic bags waste was heated followed by cooling of liquid waste which was then cooled and crushed to obtained plastic sand having finesse modulus of 4.7. Fine aggregate in the mix proportion of cement mortar was replaced with plastic bag waste sand at 10%, 20%, 30% and 40% whereas other materials remain same for all four mixes.

4. Materials Required

Cement

The cement used in experiment should be fresh, of uniform consistency and free of lumps and foreign matter. Cement used in the experiment was Portland Pozzolona Cement (PPC) consists of 32% Fly-ash conforming to IS 1489-1991 (Part I) . The cement was tested and the physical properties of the cement were computed, the results obtained were within limit as specified in Indian Standards and are as follows: Normal Consistency -33%, Initial Setting Time - 30min And Final Setting Time - 600 min, Specific Gravity =3.15, Density Of Cement - 3.10 gm/cc, Fineness 300 m2/kg, Dry shrinkage – 0.15%, soundness – 10 mm.

Fine Aggregate

Normal weight fine aggregate (sand) is the most common aggregate used in cement mortar. It should be clean, hard, strong, free of organic impurities and deleterious substances and relatively free of silt and clay. It should be inert with respect to other materials used and of suitable type with respect to strength, density, shrinkage and durability of the mortar made with it. Grading of the sand is to be such that a mortar of specified proportions is produced with a uniform distribution of the aggregate, which will have a high density and good workability and which will work into position without segregation and without use of high water content. The sand was sieved using 4.75mm and the fraction passing 4.75mm was used for all experiments The sand belongs to zone -II as per IS: 383-1970. The physical properties of fine aggregate were computed according to IS 383-1970 and results obtained are as follows: Fineness Modulus-2.83, Silt Content - 0.5%, Specific Gravity - 2.65.

Low Density Polymer Ethylene(LDPE)

LDPE are thermoplastics made from the monomer ethylene, LDPE is high molecular weight polyolefin material, it is an acronym for Low Density Polyethylene and is a thermoplastic derived from petroleum. Like all polyolefins, LDPE is nontoxic, non-contaminating and exhibits a high degree of break resistance. It is lighter than water, easily withstands environmental exposure. As a result, LDPE is naturally very flexible without the addition of plasticizers and melts at a relatively low temperature (85-115°C). This thermoplastic is available in the range of flexibilities depending on the production process. High density materials are the most rigid, the polymers can be formed by wide varieties of thermoplastic processing methods and is particularly useful where moisture resistance and low cost are required.

Properties of LDPE: -

Following are some of general properties of LDPE Waste: -

Properties	Values
Melting Point	85- 115° C
Density	0.920 - 0.940 g/cm^3
Water absorption	High

Water

Water is an important component of cement mortar. Water cement ratio plays crucial role in mixing of matrix, when cement comes in contact with water, an exothermic reaction occurs and setting of cement starts. Water used in the mixing is to be fresh and free from any organic and harmful solution which will lead to deterioration in the properties of the mortar. Salt water is not acceptable but chlorinated drinking water can be used. Potable water is fit for use as mixing water as well as for curing.

Applications of recycled LDPE in cement mortar

- Punning
- Cement roofing sheets
- Cement mortar plaster
- Boundary walls/fencing
- Flooring over foundation.

5. **Mix proportion**

We have casted cubes of size 70.6×70.6×70.6 mm. Following material proportion with constant w/c ratio 0.5 have been used. Nominal mix of 1:3 cement mortar with variant recycled LDPE is used.

6. Experimental investigation

- **Compressive Strength Test**

In order to study the effect of recycled LDPE waste as partial fine aggregate replacement on the strength of cement mortar (1:3), cubes of size 70.6 mm × 70.6 mm × 70.6 mm were cast for different percentage of recycled LDPE waste and for 0% waste for a mix have been cast in the laboratory, for making the mortar cubes, IS 2250-1995 (Code of practice for preparation and use of masonry mortar) .

An effort has been made here to compare the strength of cubes made up with different percentage of recycled LDPE waste to the respective strength of conventional cement mortar at the end of 7,14, and 28 days of curing and to have an idea about the optimum percentage of recycled LDPE waste which does not affect the strength of recycled mortar considerably. Water cement ratio adopted was 0.50

Table I
Design mix proportion for modified Mortar Samples (1:3)

Mix type	Cement (gm)	Sand (gm)	LDPE (gm)	Water
$M_{(0)}$	250	750	00	0.5
$M_{(10)}$	250	675	75	0.5
$M_{(20)}$	250	600	150	0.5
$M_{(30)}$	250	525	225	0.5

Table II
Compressive Strength of Mortar with Constant W/C Ratio7 Days

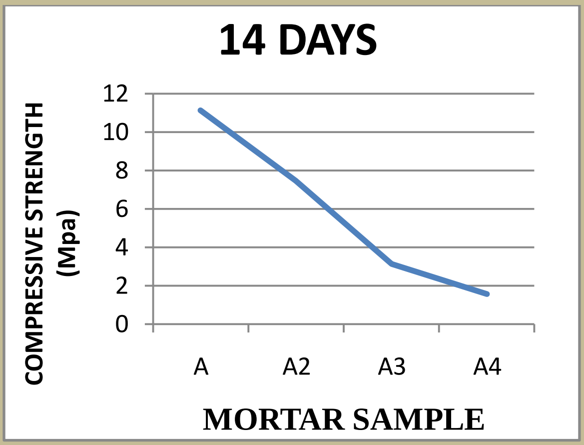
MIX TYPE	W/C Ratio	LDPE (%)	**Compressive Strength(MPA)**
A	0.50	0	7.83
A1	0.50	10	5.45
A2	0.50	20	1.83
A3	0.50	30	1.13

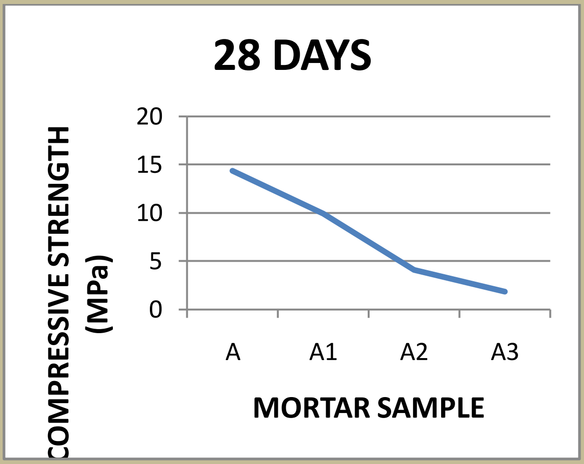
Table III
Compressive Strength of Mortar with Constant W/C Ratio14 Days

MIX TYPE	W/C Ratio	LDPE (%)	**Compressive Strength(MPA)**
A	0.50	0	14.34
A1	0.50	10	9.89
A2	0.50	20	4.08
A3	0.50	30	1.85

Table IV
Compressive Strength of Mortar with Constant W/C Ratio 28 Days

MIX TYPE	W/C Ratio	LDPE (%)	**Compressive Strength(mpa)**
A	0.50	0	11.14
A1	0.50	10	7.46
A2	0.50	20	3.14
A3	0.50	30	1.58





- **Water Absorption Test**

Water absorption is the measurement of the water proofness of the mortar mix. All the mixes were subjected to water absorption test at the end of curing period of 28 days after demoulding. The 70.6 mm x 70.6 mm x 70.6 mm size cube after casting were immersed in water for 28 days curing. These specimens were then oven dried for 24 hours at the temperature 85° C until the mass became constant and again weighed. This weight was noted as the dry weight (W1) .After that the specimen was kept at 85° C for 24 hours. Then this weight was noted as the wet weight (W2).Now using formula, water absorption of various mortar samples is calculated.

Water absorption = [(W2– W1) / W1] x 100

Where,

W1 = Oven dry weight of cubes in grams

W2 = After 24 hours wet weight of cubes in grams

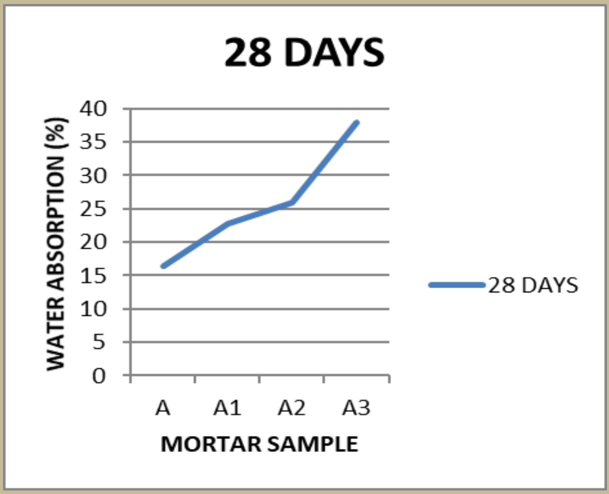
It results in low infiltration of moisture to bricks and absorbs moisture to great extent than normal cement mortar through wall plaster which acts as damp proof material.

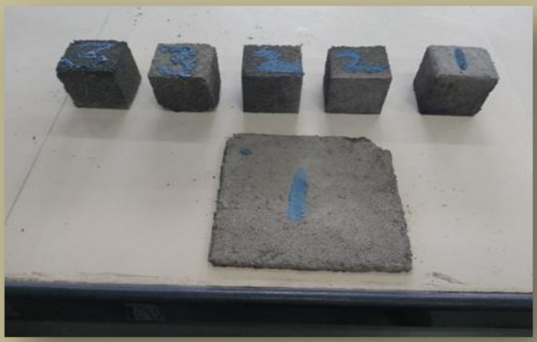
The results so obtained are listed in table below

Table II

Water Absorption of Mortar 28 Days

S.NO	Mix designation	Mix Type (%)	Water Absorption(%)
1	A1	$Mix_{(0)}$	16.45
2	A2	$Mix_{(10)}$	22.83
3	A3	$Mix_{(20)}$	25.95
4	A4	$Mix_{(30)}$	37.88





7. Conclusion

- It has several indirect benefits such as cost effective, reduction in masonry and finishing cost, saving in energy.
- It was observed that compressive strength upto 10% LDPE replaced cement mortar has slightly changed from normal mortar.
- The test results indicate that not more than 15 % of Recycled LDPE waste are replaced
- Use of recycled LDPE plays significant role to resist the loss of fertility of soil and reducing environmental threats
- It was found that the water absorption is increased to that of plain mortar without affecting its mechanical property.
- It results in low infiltration of moisture to bricks, which acts as damp proof material.

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Study on Saw Dust Ash As Partial Replacement With Cement

Anurag Mishra & Chandan Patidar

ABSTRACT

Saw dust ash is a byproduct of cutting drilling or otherwise resulting from the mechanical milling or processing of timber into various sizes and shapes. The dust is usually used as a domestic fuel. Experimental investigation to evaluate the possibility of using saw dust as a construction material partially replaced by cement. In this cement was replaced by saw dust ash as 5%, 10%, 15%, ,by weight for M-25 mix. The concrete cubes were tested for compressive strength at the age of 7 days, 14 days and 28 days. The result obtained was compared with normal concrete M-25 mix. The objective of this paper is saw dust was replaced by cement for gain more compressive strength compare to normal concrete M-25 at age of 28 days.

Keywords:

Concrete, Saw Dust Ash, Ordinary Portland cement, Compressive Strength

1. Introduction

The development in the construction industry all over the world is progressing. Attempts have also been made by various researchers to reduce the cost of its constituent, increase in compressive strength etc. and hence total construction cost by investigating and ascertaining the usefulness of material which could be classified as local materials. Some of these local materials are agricultural or industrial waste which includes sawdust, concrete debris, fly ash, coconut shells among others which are produced from milling stations, thermal power station, waste treatment plant and so on. As a result of the increase in the cost of construction materials, especially cement, crushed stone (coarse aggregate), fine sand (fine aggregate); there is the need to investigate the use of alternate building materials which are locally available. In this changing time, sawdust particles might just be one of an infinite number of solutions for low cost housing.

Concrete is necessary in Modern society‟s interest with new roads, industry, buildings and other constructions. Concrete has unlimited opportunity for advanced application design and construction technique. It is the material of choice where strength, performance, fire resistance, durability are required. Concrete with the advanced technologies such as Reinforce cement concrete and fiber reinforced concrete provides extra strength and durability against sliding cracking buckling and overturning. Its high compressive strength and mould ability provides its widespread use in various constructional.

Concrete properties can be improved by use of industrial and domestic waste such as rice husk ash, timber sash steel fibers glass fibers etc. in this paper saw dust ash was used as prime material for the improvement of the compressive strength of concrete at age of 7 days , 14 days and 28 days of curing period.
Sawdust is an industrial waste in the timber industry and causes a nuisance both to the health and environment when not properly disposed. The present utilisation of sawdust is as fuel, and a very small quantity as filler or aggregate material in concrete. The use of sawdust ash (SDA) as partial replacement of cement is new and this has twofold effect, i.e., reducing or total elimination of the material as a waste and reducing the quantity/cost of cement used for concrete works. In the latter the material acts as a pozzolana.

2. Literature Review

Elilnwa and Ejeh (2004) consider the effect of incorporation of waste of fly ash in

cement paste mortar. Cheah and ramli (2011) investigate the implementation of wood waste ash as a partial cement replacement material in the production of structural grade concrete and mortar.
Elilnwa et al. (2008) assessed the fresh concrete properties of self compacting concrete contain saw dust ash. Mahmoodb (2002) considered ash from timber waste as cement replacement material.

Mohammad Iqbal Malik is presented a paper on Concrete industry is one of the largest consumers of natural resources due to which sustainability of concrete industry is under threat. The environmental and economic concern is the biggest challenge concrete industry is facing. In their paper, the issues of environmental and economic concern were addressed by the use of saw dust ash as partial replacement of cement in concrete. Cement was replaced by Saw Dust Ash as 5%, 10%, 15% and 20% by weight for M-25 mix. The concrete specimens were tested for compressive strength, durability (water absorption) and density at 28 days of age and the results obtained were compared with those of normal concrete. The results concluded the permissibility of using Saw Dust Ash as partial replacement of cement up to 10% by weight for particle size of range 90micron.

3. Objectives

• To compare the compressive strength of partially replacement of cement with saw dust ash concrete and ordinary Portland concrete.

• To increase strength & durability of concrete by reducing cement content.

• Reduce disposal problem by using industrial waste as a concrete ingredient

• Our experimental research tries to implicate thatsawdust-cement-gravel mix has an equal advantage like the standard mix of cement-sand-gravel

4. Scope

• It has many advantages over traditional concrete, such as Internal curing due to the absorbed water in the sawdust.
• Better heat dissipation and heat insulation property.
• Lower pollution from the disposal of sawdust.
• Decrease in the self weight as compared to the normal concrete
• Efficient disposal of sawdust is possible
• Lack of availability of cement can be compensated

5. Significance of the Study

As aforementioned in the purpose of the study, the significance of this study will impact the industry both theoretically and practically, thus adding to the knowledge-base on the use of timber ash and ash in general as a cement replacement alternative and also add more potential for modified cement products to the industry that can be of the same use as ordinary cement.

6. Materials

6.1 Saw dust ash
Saw dust is also known as wood dust. It is the waste material of timber industry. It is a by-product of cutting, grinding, drilling, sanding, or otherwise pulverizing wood with a saw or other tool. It is composed of fine particles of wood. The saw dust used for this project was collected from nearby sawmill.

6.2 Cement

Ordinary Pprtland Cement of 43 grade cement was used.

Table: 1

	Characteristics	Values

1	Specific Gravity	3.12
2	Initial Setting Time	30 minutes
3	Final Setting Time	600 minutes

7.3 Aggregate

• Coarse aggregate:

Coarse aggregates used consisted of machine crushed stone angular in shape passing through 20mm IS sieve and retained on 4.75mm IS sieve with specific gravity of 2.7.

• Fine aggregate:

Fine aggregates used throughout the work comprised of clean river sand with maximum size of 4.75mm conforming to zone II as per IS383-1970 with specific gravity of 2.6.

- Characteristic of Material
- ➢ Cement: 43 grade of ordinary Portland cement
- ➢ Aggregate: 20 mm maximum nominal size of aggregate
- ➢ Sand: Fine aggregate
- ➢ Water: Potable water
- ➢ Admixture: We have used saw dust ash obtained by sawmill.

7. Experimental Program

For this experimental study, 9 cubes of size 150 mm x 150 mm x 150 mm were casted of design mix of M25 grade. The specimens were tested after the curing period of 7 days, 14 days and 28 days, the first three specimens normal concrete cubes were used for the basis of comparison with the partial replacement of cement with the saw dust ash. The saw dust ash was used in the various proportions of 5%, 10%, 15% with partial replacement of the cement and casted three cubes for each proportion. The concrete mix was prepared as per Indian standard design mix of M25 (1:1:2) with a water cement ratio of 0.4

Table: 2

%	Saw dust ash replacement	Cement kg/m3	Sand kg/m3	Aggregate kg/m3	Water kg/m3	w/c
0%	0	1.872	1.885	3.952	0.917	0.49
5%	0.093	1.778	1.885	3.952	0.917	0.49
10%	0.187	1.684	1.885	3.952	0.917	0.49
15%	0.280	1.600	1.885	3.952	0.917	0.49

8. Results

• Compressive strengths of partial replacement of saw dust by cement are shown below :

Table: 3

DAYS	M-25 Concrete Compressive Strength (Mpa)	5% Saw Dust Ash Replacement Compressive Strength (Mpa)
7 Days	19.30	22.30
14 Days	20.75	24.10
28 DAYS	23.80	27.80

Table: 4

DAYS	M-25 concrete Compressive Strength (Mpa	10% Saw dust ash Replacement Compressive Strength (Mpa
7 Days	19.30	20.44
14 Days	20.75	22.79

28 DAYS	23.80	25.65

Table: 5

DAYS	M-25 concrete Compressive Strength (MPa)	15% Saw dust ash Replacement Compressive Strength (MPa)
7 Days	19.30	15.20
14 Days	20.75	16.41
28 DAYS	23.80	19.49

Table: 6
Compressive strength of all replacement

Curing Age In Days	Normal Concrete M-25 Compressive Strength (Mpa)	5% Saw Dust Ash Compressive Strength (Mpa)	10% Saw Dust Ash Compressive Strength (Mpa)	15% Saw Dust Ash Compressive Strength (Mpa)
7 Days	19.30	22.30	20.44	15.20
14 Days	20.75	24.10	22.79	16.41
28 DAYS	23.80	27.80	25.65	19.49

9. Conclusion
10.

The result obtained from compressive test conducted on concrete containing various percentage of saw dust ash from different percentage was as follows:

• At 5% replacement of saw dust ash gives 7.55% , 10.22% and 16.69% increase in the compressive strength of concrete at 7 days , 14 days and 28 days.

• In the 10% replacement of saw dust ash gives 4.89%, 6.12% and 8.70% increase in the compressive strength of concrete at 7 days, 14 days and 28 days.

• At 15% replacement of saw dust ash gives 15.02%, 17.21% and 21.58% decrease in the compressive strength of concrete at 7 days, 14 days and 28 days.

It was observed that saw dust ash increase as well decrease the compressive strength at age of 7 days , 14 days and 28 days.
• • Weight of the sawdust concrete was reduced as compared with normal concrete and also become more economical.

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Analysis on properties of concrete as a partial Replacement of sand with stone dust

Aditya Mehta1, Akash Jain, Aditeya Singh, Archana Hardiya, Dharmendra Gokhale, Mahendra Singh Bias, Govind Patidar

ABSTRACT:- With the still increase in the require of natural river fine aggregate and decrease in its availability, there is an immediate need for finding suitable alternatives which can replace fine aggregate partially or at a high proportion.Many research studies investigates the effect of several waste products such as Glass sheet powder, Incinerated Sewage sludge, foundry bed waste, crushed rock flour, building demolition waste in the partial replacement of river fine aggregate.

Utilization of Stone dust and steel scrap are one of the active research area that encompass the effectiveness of replacement in all the aspects of construction materials. It is very essential to develop eco-friendly concrete from ceramic waste. This thesis deals with the experimental study on the mechanical strength properties of M20 grade concrete with the partial replacement of sand by using stone dust. In order to analyze the mechanical properties such as Compressive Strength, Flexural Strength, and Workability the samples were casted with 10%, 20%, 30%, replacement of sand using stone dust and tested at a different periods of curing 7 days, 14 days and 28 days. The optimum of percentage addition of stone dust are analyzed considering the requirements of mechanical properties of concrete.

Keywords:-
Stone Dust, Mechanical properties, Silt content, Crushing value and Consistency.

1. Introduction

Concrete is a most commonly used construction material which is a mixture of cement, fine aggregate, coarse aggregate and water. It is used for construction of multistory buildings, dams, road pavement, tanks, offshore structures, canal lining. The method of selecting appropriate ingredients of concrete and determining their relative amount with the intention of producing a concrete of the necessary strength durability and workability as efficiently as possible is termed the concrete mix design. The compressive strength of harden concrete is commonly considered to be an index of its extra properties depends upon a lot of factors e.g. worth and amount of cement water and aggregates batching and mixing placing compaction and curing. The cost of concrete prepared by the cost of materials plant and labour the variation in the cost of material begin from the information that the cement is very costly than the aggregates thus the intent is to produce a mix as feasible from the practical point of view the rich mixes may lead to high shrinkage and crack in the structural concrete and to development of high heat of hydration is mass concrete which may cause cracking. The genuine cost of concrete is related to cost of materials essential for produce a minimum mean strength called characteristic strength that is specific by designer of the structures. This depends on the quality control measures but there is no doubt that quality control add to the cost of concrete. The level of quality control is often an inexpensive cooperation and depends on the size and type of job nowadays researchers, engineers and scientists are trying to enhance the strength of concrete by adding the several other economical and waste material as a partial substitute of cement ,fine aggregate or as a admixture fly ash, silica fume, steel slag steel chips etc are the few examples of these types of materials. These materials are generally by-product from further industries for example fly ash is a waste product from power plants and stone dust. If the large amount of waste material generated is used instead of natural material in the construction and industry, there would be three benefits:

1. Conserving natural resources
2. Disposing of waste materials and
3. Freeing up valuable land for their uses

2. Literature Review

Ashish Patel and S.K. Jaiswal In this Research, **[1]**In the given analysis, a fraction of fine mixture utilized in concrete is replaced by stone dust, a by-product of stone crushing and therefore the sample cube is tested to work out the compressive strength of concrete. Tests to work out the physical properties of sample cube like relative density, fineness modulus, and wetness content are performed. Stone dust is best various for the fine mixture as a result of fine mixture (natural fine aggregate) and stone dust has similar physical and mechanical properties. This paper shows some relevant studies relating to the impact of stone dust on mechanical property like compressive strength.

MD. Nuruzzaman1, MD Saiful Islam2, M.Salauddin1, MD. Saiful Islam1, **[2]** Due to the auspicious attribute of concrete like handiness, skillfulness, smart compressive strength, it'sone amongst the foremost normally used building materials throughout the planet. The demand for infrastructural facilities is increasing day by day that creates an amazing pressure on concrete yet as on natural aggregates. Apparently it becomes inescapable to appear for different materials. On the opposite hand, disposal of stone dirt generated from stone device is turning into a haul. Work fine combination by stone dirt can serve the waste management yet because the different material in concrete. This research's aim is to search out the strength of concrete by stone dust as a partial replacement of fine combination. These take a look at specimens were made up of 3 totally different grades of concrete i.e. combine ratios 1: 1.5: 3, 1: 2: 4, 1:2.5:5 and each compressive yet as strength tests were conducted. The fundamental strength properties of concrete were investigated by replacement natural fine combination by Stone dust at replacement levels of , 10%, 20%, 30%, 40%, 50% & 60%.

K. Shyam Prakash1 and Ch. Hanumantha Rao2, **[3]**The thought of replacement of natural fine combination by quarry dust that is highlighted within the study may boost the consumption of quarry dust generated from quarries. By replacement of quarry dust, the need of land\ fill space will be reduced and might conjointly solve the matter of natural fine combination inadequacy. It even causes burden to dump the device dust at one place that causes environmental pollution.From the results of experimental investigations conducted, it's complete that the quarry dust will be used as a replacement for fine combination. The compressive strength is quantified for variable share and grades of concrete by replacement of fine combination with quarry dust.

Amit Kumar Singh, Vikas Srivastava, V.C. Agarwal., **[4]**Stone dust is a waste material obtained from crusher plants. It has potential to be used as partial replacement of natural river fine aggregate in concrete.. In the present investigation, an experimental program was carried out to study the workability and compressive strength of concrete made using stone dust as partial replacement of fine aggregate in the range of 10% - 100%. M20 grade of concrete was designed using Portland pozzolana cement (PPC) for referral concrete. Workability and Compressive strength were determined at different replacement level of fine aggregate viz a viz referral concrete and optimum replacement level was determined based on compressive strength. Results showed that by replacing 60% of fine aggregate with stone dust concrete of maximum compressive strength can be made as compared to all other replacement levels.

***A. Suribabu1, DrU.Rangaraju 2, Dr.M. Ravindra Krishna3,* [5]** River fine aggregate is most typically used fine combination within the production of concrete poses the matter of acute shortage in several areas. Quarry rock dust may be Associate in Nursing economic different to the watercourse fine aggregate. Quarry Rock dust as 100% substitutes for Natural Fine combination in concrete. combine style has been developed for M20 and M40 grades victimization style approach IS for each standard concrete and quarry dust concrete. Tests were conducted on cubes and beams to review the strength of concrete manufactured from Quarry Rock dust and therefore the results were compared with the Natural Fine combination Concrete. it's found that the compressive and flexural strength of concrete manufactured from Quarry Rock dust are nearly 100% over the standard concrete. Tests were additionally conducted on cubes and beams that are exposed to temperatures of 300°C for 1hr, 3hr durations severally.

Dr. A.D. Pofale1. Syed Raziuddin *Quadri2*., [6]The purpose for taking up this investigation owing to the fact that now a days naturalfine aggregate confirming to Indian Standards is becoming scarcer and costlier due to its non availability in time because of Law of Land, illegal dredging by fine aggregate mafia, accessibility to the river source during rainy season, non confirming with IS 383-1970. Hence the present investigation was taken up with view to verify the suitability, feasibility and potential use of crusher dust, a waste product from aggregate crushing plant in concrete mixes, in context of its compressive strength and workability and in terms of slump, compacting factor, flow table and modified flow respectively. In view of above discussion, an attempt is made to replace the natural fine aggregate I concrete control mixes of M20 and M30 grades designed for 100 to 120mm slump at replacement levels of 30%, 40%, 50% and 60% using Portland Pozzolana Cement. There were in all 5 mixes in each grade of concrete including control mix and four mixes with crusher dust as a partial replacement of natural fine aggregate. It was observed that with use of crusher dust at all replacement levels, the workability of concrete was reduced from 1-6%. From the test results, it was observed that the replacement of natural fine aggregate by crusher dust increased the compressive strength of concrete by 5-22%. It was also found that amongst all the mixes, the highest compressive strength was obtained for 40% replacement of fine aggregate by crusher dust. Hence it could be concluded and recommended that crusher dust could be effectively used in concrete of above grades for replacement levels of fine aggregate by 30-60% economically leading to sustainable development.

G.Balamurugan*, Dr.P.Perumal,[7]This experimental study presents the variation in the strength of concrete when replacing fine aggregate by quarry dust from 0% to 100% in steps of 10%. M20 and M20 grades of concrete were taken for study keeping a constant slump of 60mm. The compressive strength of concrete cubes at the age of 7 and 28 days were obtained at room temperature. Also the temperature effect on concrete cubes at 100oC on 28th day of casting was carried out to check the loss of strength. From test results it was found that the maximum compressive strength is obtained only at 50% replacement at room temperature and net strength after loss due to hike in temperature was above the recommended strength value due to 50% replacement itself. This result gives a clear picture that quarry dust can be utilized in concrete mixtures as a good substitute for natural river fine aggregate giving higher strength at 50% replacement.

Brajesh Kumar Suman,Vikas Srivastava, **[8]**This study aims owing to increased construction activities for different regions and utilities scaring of natural resources is being forced due to its over exploitation. Depleting natural resources posed threat to the environment. Hence conservation of natural resources is great challenge for civil engineers since construction activities cannot be diminished as it is intimate able. The only way is to search alternatives material which can fully or partially replaced naturally available material in construction. Stone dust is such an alternative material which can be effectively being used in construction as partial replacement of natural fine aggregate. In the present investigation an experimental programmed was carried out to study the suitability and potential use of stone dust as partial replacement of fine aggregate in concrete. To accomplish this specimen were cast for different replacement level at an interval of 10 percent to determine workability and compressive strength of concrete at different level of fine aggregate with stone dust. Results show that optimum replacement with stone dust is 60 percent based on compressive strength**.**

JoffreyCheruiyot, Sylvester OchiengAbuodha, Charles Kabubo, This research evaluated the suitability of stone dust in the design and production of High Performance Concrete (HPC). HPC mix was designed, tested, costed and a comparison of concrete classes used in the market (Class 25, 30 and 35) done using Cost Benefit Analysis (CBA). The cost benefit was analyzed using Internal Rate of Return (IRR) and Net Present Value (NPV). Laboratory tests established the properties concrete obtained from the design mix.
Compressive strength, slump, and modulus of elasticity were tested and analyzed. Structural analysis using BS 8110 was done for a 10 storey office building to establish the structural member sizes. Members obtained from concrete Classes 25, 30, 35 and the new compressive strengths from HPC (Class 80) were obtained and compared. Analysis was done for structural members' sizes and area freed as a result of designing with HPC as well as the steel reinforcement used. The minimum class of concrete used in design was limited to Class 25 N/mm2. The research shows that it is possible to manufacture high strength concrete using locally available stone dust.

3. Materials & Methodology

Material used

- Fine Aggregate
- Cement (OPC)
- Coarse Aggregate
- Stone Dust
- Fine aggregate

3.1 Fine Aggregate:

- Specific Gravity: 2.53
- Fineness Modulus: 3.08.
- Density: 1.63 gm/cc.
- Void ratio: 0.55.

Fine aggregate is a naturally occurring coarse material collected of finely separated rock and mineral particles. Fine aggregate is a naturally occurring granular material collected of finely divided rock and mineral particles. It is defined by size, being finer than gravel and coarser than silt. Fine aggregate may also consign to a textural class of soil or soil type; i.e. a soil contain more than 85% fine aggregate-sized particle (by mass). In terms of particle size as usedb y geologists, fine aggregate particle range in diameter as of 0.0625 mm to 2 mm. A individual particle in this range size is termed a *fine aggregate grain*. Fine aggregate grains are among gravel (with particles ranging from 2 mm up to 64 mm) and silt(particles smaller than 0.0625 mm down to 0.004 mm).

3.2 Cement (OPC)

Specific gravity: 3.10
Grade of cement: 53
Initial setting time: 38 min.
Final setting time: 8 hrs.

Fineness: 8% residue on IS 90 micron sieve. Ordinary Portland cement is used to prepare the mix design of M-20 grade. The cement used was fresh and \without any lumps Water – cement ratio is 0.42 for this mix design using IS 456:2007. Cement is a particularly ground material having adhesive and cohesive properties which offer a binding medium for the distinct ingredients. Chemically cement constitutes 60-67% Lime (CaO), 17-25% Silica (SiO_2), 3-8% Alumina (Al_2O_3), 0.5-6% Iron Oxide (Fe_2O_3), 0.1-6% Magnesia (MgO), 1- 3% Sulphur Trioxide (SO_3), 0.5-3% Soda And Potash (Na_2O+K_2O).

3.3 Aggregate

Maximum size Stone: 20 mm
Specific Gravity: 2.98
Fineness Modulus: 6.36.
Density: 1.58 gm/cc.

Aggregate are the essential constituent in concrete. They provide body to the concrete, decrease shrinkage and effect economy. Construction aggregate, or basically "Aggregate", is a wide group of coarse particulate material used in construction, as well as fine aggregate, gravel, crushed stone, slag, recycled concrete.. Aggregates are the mainly mine material in the world. Aggregates are an element of composite materials such as concrete and asphalt concrete; the aggregate serve as reinforcement to add strength to the overall combined material.

3.4 Stone Dust

Specific Gravity: 2.57
Fineness Modulus: 2.41.
Density: 1.85 gm/cc.
Void ratio: 0.42

Stone Dust is a byproduct of washing Crushed Ores inside the Ore Washing Plant. It can also be obtained by placing cobblestone inside the Thermal Centrifuge. This material is especially useful in 4

Rebuilding worn out soils but can be beneficial on most any soil. First one must have the proper stone available. Glacial till is a good source, also volcanic and sites, lavas or volcanic ash, new or old. However the stones used must have a wide range of minerals available.

4. Testing of material

4.1 Cement
4.2 Fine aggregate
4.3 Aggregate

4.1 Cement
4.1.1 Consistency test
4.1.2 Initial and final setting time

4.1.1 Consistency test: This is a test conducted to estimate the quantity of water to be mixed with cement to form a paste of standard consistency for make use of in other tests.

Procedure

1. Obtain 300 gm of cement and put it in the enameled tray.

2. Mix about 35% water by weight of dry cement thoroughly to get a hold cement paste. Whole time taken to achieve thoroughly mixed water cement paste i.e. "Gauging time" Must not be extra than 3 to 5 minutes.

3. Fill up the vicat's mould, resting upon a glass platter, with this binder paste.
4. After filling the mould totally, smoothen the surface of the paste, making it level with top of the mould.
5. Place the complete assembly (i.e. mould + cement paste + glass plate) under the rod Bearing plunger.
6. Subordinate the plunger soothingly so as to stroke the surface of the test block and rapidly release the plunger allowing it to sink into the paste.
7. Calculate the depth of penetration and record it.

4.1.2 Initial and final setting time test:
Initial Setting Time of Cement Test

Procedure:

1. Take 300 gram of cement and mix up it through water percentage as mention in consistency test of cement.
2. Now prepared cement paste is filled in the vicat'smould.
3. The square needle of cross-section 1 mm x 1 mm is attached to the movable rod of the Vicat apparatus.
4. Then the needle is allowed to quickly release and allowable to penetrate in the cement paste. In primary stage, the needle penetrates completely. It is after that taken out and dropped at a clean place. The test process is repeated at regular intervals till the needle does not penetrate entirely. The needle must enter up to about *5* mm measured from base.
5. The initial setting time is found out by taking the distance between the additions of water to cement and the stage once needle stops to penetrate totally. The time should be about 30 minutes for ordinary cement.

4Final Setting Time of Cement Test

Procedure:

1. Change the needle of the vicat apparatus by the needle with an annular ring
2. Lower the needle and quickly release.
3. Repeat the method until the annular ring makes an impression on the mould.
4. Record the period elapsed between the time of addition water to the cement to the time when the annular ring fails to make the impression on the mould as the final Setting time.

Table No 1 Cement Test Results

Consistency	34%
Initial Setting Time	38min.
Final Setting Time	8hrs.
Specific Gravity	3.10

4.2 Fine Aggregate
4.2.1 Silt Content
1. Fill 1% solution of common salt and water in the measuring cylinder up to 50 ml mark.
2. Now add sand to be tested to this solution till the level of the salt solution shows 100 ml mark.
3. Top up the level of salt solution up to 150 ml mark.
4. Shake the mixture of sand and salt solution well and keep it undisturbed for about 3 hours.
5. The silt being of finer particles than sand, will settle above the sand in a form of layer.
6. Measure the thickness of this silt layer.

Table no. 2 Silt Content

S.NO	Description	Sample
1	Vol. of Sample V1 (ml)	**500 ml**
2	Vol. of Silt after 3hr V2(ml)	**38 ml**
3	% Silt by Vol. (V2/ V1) X100	**7.2%**

4.3 Aggregate
4.3.1 Crushing Test
The aggregate passing 12.5mm IS sieve and retained on 10mm IS sieve is selected for standard test. The aggregate should be in

surface dry condition before testing. The aggregate may be dried by heating at a temperature 1000C to 1100C for a period of 4 hours and is tested after being cooled to room temperature. The cylindrical measure is filled by the test sample of aggregate in three layers of approximately equal depth, each layer being tamped 25 times by the rounded end of the tamping rod. After the third layer is tamped, using the tamping rod as a straight edge levels off the aggregate at the top of the cylindrical measure. About 6.5kg of aggregate is required for preparing two test samples. The test sample thus taken on compression testing machine. Load is then applied through the plunger at a uniform rate of 4 tonnes per minute until the total load is 40 tonnes, and then the load is released. Aggregates including the crushed portion are removed from the cylinder and sieved on a 2.36mm IS sieve. The material, which passes this sieve, is collected. The above crushing test is repeated on second sample of the same weight in accordance with above test procedure. Thus two tests are made for the same specimen for taking an average value.

Aggregate crushing value = (W2/W1) x 100%.

Table no. 3
Observation of Crushing Value

Wt. of Aggregate W1(kg)	Wt. of residue after passing 2.36 mm sieve W2(kg) %	Crushing Value
0.330	0.050	15.15

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Events organized by CIVILIPSA

SAMEEKSHA 2017

Civilipsa organises its annual quiz event "SAMEEKSHA" in the month of September since last Six 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 2017

CIVILIPSA organizes its annual affair “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, BridgIT & 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 2018

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.