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Behaviour of Reinforced Concrete Replacing Sand by Iron Ore Tailing

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ABSTRACT

Due to tremendous developments in the construction industry, the basic materials for construction reached a diminishing stage. On the other hand due to the developments in industrial production of waste materials is also increased. As such to satisfy the requirements of construction industry and also to safe guard the environment from the unwanted materials it is advisable to make use the industrial waste materials as basic materials in construction industry. The iron ore tailing is a by-product of iron ore industries which is dumped nearby which may produce the environmental hazards. The concrete is an essential material in construction industry. Due to globalization and development of countries leads to shortage in construction material which diverts the investigators to find alternative materials for construction without sacrificing strength and quality. With all this consideration and attempt is made to make use of iron ore tailing with replacing sand in concrete such as without sacrificing the basic properties like compressive strength, flexural strength. In these work sand is partially replaced by iron ore tailing in order of 0%, 10%, 20%, 30%, 40%, 60%, 80% and 100% in concrete. Here three cubes of size 150x150x150mm are casted and tested for compressive strength and three beams of size 1000x100x100mm with balanced reinforcement for each percentage replacement of sand by iron ore tailing in concrete are casted. The specimens are cured for 28 days by water bath and are tested for its compressive and flexural strength. The graphical representation of variation of compressive strength and flexural strength properties are prepared and comparative studies made with and without iron ore tailing.

I. INTRODUCTION

As modern engineering practices become more demanding there is an increase in need for a wider spectrum of construction materials with novel properties. it includes developing existing materials into one with modified properties in combination with other suitable materials. Reinforcement concrete with iron ore tailing members are subjected to dynamic loading during earthquake, in machine foundation, hurricane, cyclone.

Iron ore tailing is a waste generated from iron ore industry. Millions of tonnes of IOT dumped after processing and there is a site disposal problem for dumping of iron ore tailing, hence an attempt is made to use the IOT as construction material

Here IOT is used as a partial replacement of sand, cubes and beams are casted and tested for compressive strength and flexural strength respectively

1.1 Concrete ingredients

1. **Cement** : Cement is an extremely fine grounded material with adhesive and cohesive properties and acts as a binding material in concrete, following are the main tests conducted to know the cement properties

a) standard consistency test = 34%

b) initial setting time = 45minutes

c) final setting time = 6hours

d) specific gravity = 3.07

2. Aggregates: Aggregates are the important constituents of concrete and they constitute 75 to

80% of total volume of concrete. Following are the properties of aggregates which affect concrete size, shape, texture, strength.

3. Iron ore tailings: Iron ore tailing is very fine aggregate residue resulting from the extraction of iron from iron ore. Iron ore tailing is a siliceous material having more weight as compared with its volume due to present of iron. Iron ore tailing which is brought from kuduremukh iron ore company ltd. (KIOCL)

Following are the tests conducted on fine and coarse aggregates

a) specific gravity of fine aggregates=2.367
specific gravity of coarse aggregates=2.61
specific gravity of IOT =3.425

b) absorption : water absorption for fine and coarse aggregates is 0%

c) sieve analysis: sieve analysis of fine aggregates shows that the sand and iron ore tailings utilized for the preparation of moulds falls in zone 2 and zone 2 respectively. Sieve analysis of coarse aggregates shows that the aggregate utilized for preparation of moulds are well graded.

II. EXPERIMENTAL PROCEDURE

2.1 Procedure for casting cubes and beams

In this project we are casting cubes and beams of size 150*150*150 mm and 1000*100*100mm are casted. With a balanced reinforcement of 2 bars of 8mm diameter at bottom and 2 hanger bars of 6mm diameter at the top with a shear reinforcement of 6mm diameter at 300mmc/c the mix proportions of ingredients that is cement: sand: coarse aggregates: water is 1:1.37:2.95:0.5 .cubes and beams are casted by replacing sand by iron ore tailing for 0%, 10%, 20%, 30%, 40%, 60%, 80% and 100% in concrete. 24 cubes and 24 beams are casted in moulds and after 24hours they are kept in water for curing of 28 days .after 28 days cubes and beams are taken and tested for compressive strength and flexural strength

2.2 Ingredient Quantities for each Percentage of Iron Ore Tailing for Cubes

Table 1: ingredient quantities for cubes

% of iron ore tailings	Quantity of cement in kg	Quantity of sand in kg	Quantity of iron ore tailings in kg	Quantity of coarse aggregates in kg	Water in kg
0	4.425	6.06	0	13.053	2.212
10	4.425	5.454	0.606	13.053	2.212
20	4.425	4.848	1.212	13.053	2.212
30	4.425	4.242	1.818	13.053	2.212
40	4.425	3.636	2.424	13.053	2.212
60	4.425	2.424	3.636	13.053	2.212
80	4.425	1.212	4.848	13.053	2.212
100	4.425	0	6.06	13.053	2.212

2.2 Ingredient quantities for each percentage of iron ore tailing for beams

Table 2 ingredient quantities for beams

% of iron ore tailings	Quantity of cement in kg	Quantity of sand in kg	Quantity of iron ore tailings in kg	Quantity of coarse aggregates in kg	Water in kg
0	13.110	17.961	0	38.676	6.555
10	13.110	16.165	1.796	38.676	6.555
20	13.110	14.369	3.592	38.676	6.555
30	13.110	12.573	5.388	38.676	6.555
40	13.110	10.777	7.184	38.676	6.555
60	13.110	7.184	10.777	38.676	6.555
80	13.110	3.592	14.369	38.676	6.555
100	13.110	0	17.961	38.676	6.555

2.3 Procedure for testing cubes and beams

After curing 28 days cubes are tested for their compressive strengths. A compression testing machine used in this regard. The failure load is noted down and compressive strengths are calculated by following formula

i.e. compressive strength=P/A n/mm^2

Where P is load in N, A is cross sectional area of specimen in mm.

The beam specimens are tested under 2 point loading test in UTM , the deflections at the centre are noted down by using dial gauges the theoretical and actual deflection of beam is calculated by using the formula

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EXPERIMENTAL DATA

The experimental data are obtained in the tests.

1) Compressive test on cube

Table 3 compressive loads of different cubical specimens of concrete for different %of IOT

% OF IRON ORE TAILING	% COMPRESSIVE LOAD(KN)
0	750
10	800
20	831.67
30	840
40	861.67
60	820
80	790
100	770

2) Bending Test on Beam

Table4 deflection of beam specimens for different %of IOT

LOAD(KN)	DEFLECTION FOR % OF IOT(mm)							
	0	10	20	30	40	60	80	100
0.625	0	0	0.01	0	0.07	0	0	0
1.25	0	0	0.070	0.027	0.135	0.40	0	0
1.875	0.027	0	0.137	0.147	0.205	0.110	0.013	0
2.5	0.117	0.053	0.300	0.370	0.315	0.275	0.113	0.017
3.125	0.347	0.240	0.547	0.737	0.590	0.500	0.253	0.130
3.75	0.733	0.603	0.893	1.063	1	0.755	0.537	0.477
4.375	1.157	0.997	1.250	1.427	1.365	1.02	0.797	0.8
5	1.550	1.390	1.640	1.787	1.695	1.305	1.133	1.263
5.625	1.867	1.743	1.943	2.143	2.010	1.545	1.457	1.547
6.25	2.340	2.140	2.290	2.533	2.395	1.86	1.803	1.843
6.875	2.710	2.520	2.660	2.970	2.720	2.14	2.147	2.167
7.5	3.173	2.907	2.997	3.347	3.070	2.71	2.503	2.557
8.125	3.567	3.310	3.407	3.813	3.430	3.01	2.86	2.97
8.75	3.997	3.71	3.707	4.907	4.150	3.33	3.22	3.303
9.375	5.590	4.147	4.113	6.930	5.400	3.68	3.557	3.727
10	7.333	5.00	4.787	8.533	7.690	4	3.937	4.177
10.625	8.113	6.077	6.060	9.887	8.700	4.4	5.04	4.637
11.25	-	6.650	7.937	10.585	9.71	5.6	6.033	5.713
11.875	-	7.177	9.713	-	10.265	6.05	6.503	7.05
12.5	-	-	-	-	10.66	-	7.467	8.787
13.375	-	-	-	-	-	-	-	-

III **RESULTS**

The analysis of experimental data obtained from the experiments are carried out as follows

1) Compressive stress

Table 5 the compressive stress of cubical specimens for different %of IOT

% OF IOT	STRESS(n/mm^2)
0	33.33
10	35.56
20	36.96
30	37.33
40	38.3
60	36.44
80	35.1
100	34.22

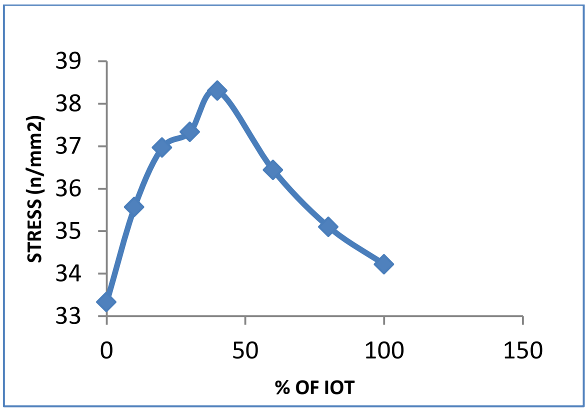

Fig1 the stress vs. % of IOT graph under compressive loads

The graph shows stress vs. % of IOT and it is found that the compressive strength goes on increases with increases in % of IOT up to 40% and after 40% the compressive stress decreases

2)Theoritical and experimental deflection of beam specimen with 40%

LOAD(KN)	THEORETICAL DEFLECTION(MM)	EXPERIMENTAL DEFLECTION(MM)
0	0	0
0.625	0.125	0.07
1.25	0.2315	0.135
1.875	0.338	0.205
2.5	0.4445	0.315
3.125	0.551	0.59
3.75	0.6575	1
4.375	0.764	1.365
5	0.8705	1.695
5.625	0.977	2.01
6.25	1.0893	2.395
6.875	1.19	2.72
7.5	1.2965	3.07
8.125	1.403	3.43
8.75	1.5095	4.15
9.375	1.616	5.4
10	1.7225	7.69
10.625	1.829	8.7
11.25	1.9355	9.71
11.875	2.042	10.265
12.5	2.1485	10.66
13.375	2.255	

Table 6 theoritical and experimental deflection for 40%IOT

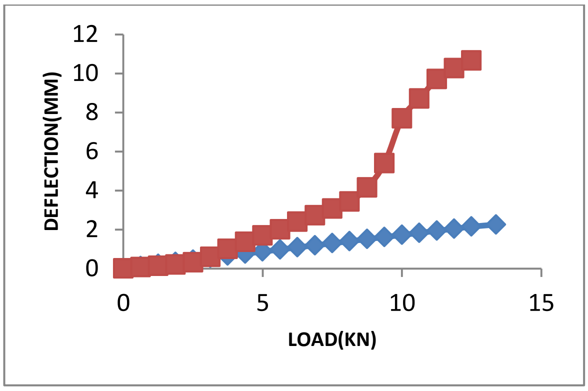

Fig. 2 deflection vs. load for 40%IOT

The graph shown above shows deflection vs. load under two point load test and it is found that deflection increases to a maximum of 10.66mm in the experimental determination and the theoretical deflection is found to be 2.1485mm for 0%of IOT

IV CONCLUSION

The problem of environmental pollution as increasing in disposing of iron ore tailing result of mining and processing has been getting the lowest priority in the developing country like India. However the recent awareness of public in general and technocrats in particular has fostered. The need to develop protective measures to mitigate the population problem associated with the unplanned exploitation of mineral sources.

In this experimental investigation an attempt has been made to make use of some of the waste generated by human activities.

The following are the important conclusions from the results of this investigation

1. We can effectively use iron ore tailing, the by product of iron ore industry to avoid environmental pollution.
2. We can replace 40% of sand by iron ore tailing without sacrificing the strength of concrete
3. The IOT can also be used in the flexure members without sacrificing its strength
4. The graphical representation shows the theoretical and experimental deflection.

5. The graph shows theoretical deflection is always less than the experimental deflection for all % of iron ore tailing
6. In flexure the beams can take maximum load with replacement of 40%of sand by iron ore tailing

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Study of PCU variation of vehicles by the effect of traffic volume, length and speed of car by using VISSIM software

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ABSTRACT

Traffic in cities of developing countries like India is highly varied having vehicles like Buses, Trucks, Auto rickshaw, etc. having a broad spectrum of static and dynamic characteristics. The non-uniform speed and vehicle dimensions are an impediment for moving in traffic lanes, so drivers find it practical to occupy any available lateral position on the road and hence the non-uniform speed and vehicle dimensions present a challenge to determine the traffic volume. The problem of determining heterogeneous traffic volume can be overcome by converting vehicles with non-uniform dimensions to passenger car units. The PCU values of different types of vehicle are a subject of particular road way and traffic condition. The present study reveals that the PCU estimates of the vehicle made through microscopic simulations (VISSIM) is not necessarily constant, varying not only on vehicle factors but also with some other factors connected with roadway and traffic conditions.

I. INTRODUCTION

India had a road network of over 4.68 million kilometers (2.91 million miles) in 2013, making it one of the second largest road networks in the world among which the urban roads in India forms a substantial portion (3.1 million kilometers) of the Indian road network. The congestion level is growing day by day on city roads, causing increased travel time, wastage of fuel, environmental pollution etc. Traffic in cities of developing countries like India is highly varied having vehicles like Buses, Trucks, Auto-Rickshaws, Bikes/Scooters, Cycles, and Rickshaws etc. having a broad spectrum of dynamic and static characteristics. The non-uniform speed and vehicle dimensions is an impediment for moving in traffic lanes, so drivers find it practical to occupy any available lateral position on the road. The non-uniform speed and vehicle dimensions also present a challenge to determine the traffic volume. By standardizing the vehicle volume as Passenger Car Unit (PCU) by converting vehicles with non-uniform dimensions to passenger car equivalents, the hurdle of determining heterogeneous traffic volume can be overcome. Studying how non-uniform interact and effect each other in traffic is complicated. The interaction among vehicles can be shown by the quantum of traffic flow impeded by a particular vehicle type (for which the PCU value is assigned by conversion). Passenger Car Unit (PCU) is used for measuring Relative Impedance. PCU is a standard unit for measuring traffic capacity or traffic volume. There are a number of studies taken up to come up with optimum values of PCE under given traffic conditions. In the HCM 2000 the definition of PCE is given by the amount of passenger cars, the given heavy vehicle displaces under the given traffic, road and control conditions. A passenger car is the given the PCU value of 1.0. Each vehicle type is given a single PCU equivalent to represent its relative disturbance to the flow under the prevailing traffic condition. Sometimes a set of PCU values is assigned to a particular type of vehicle to represent the

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various disturbances in its presence in different traffic situations.

PCU values for the dissimilar vehicle types on Indian roads have been suggested by IRC (IRC: 64-1990). The PCU values of different types of vehicles, proposed by IRC, are in the form of single set of constant values. Hence, it may be inferred that the PCU values are a subject of particular roadway and traffic condition. Actually, however, the PCU value of a type of vehicle is not necessarily constant; varying not only on the vehicle factors but also with some other factors connected with roadway and traffic conditions.

For example, the disturbances that motorbikes cause to the traffic stream could vary with the factors such as the movements at intersections, the flow conditions, the frequency of moving between formal lanes and the design of the section of the road system. Hence, its PCU value would differ with traffic situation and its performance within that environment. For example, the value can be as low as 0.5 or as high as 1or 1.5. So, PCU value should be considered as a dynamic quantity rather than assigning a constant value to it. Without a systematic analysis and careful relative experience on the applicability of each value, such a wide variety of PCUs from different sources causes confusion. Such confusion can also lead to significant errors in the estimation of the capacity of roadways. Hence, for mixed traffic management, it is important to have a better understanding of the PCU values for diverse vehicles under various conditions of traffic. The determination of PCU values are done by taking standard passenger car as the basis. More vehicles hit the road now a days having different dimensions, power to weight ratio and also speed ranges etc., hence it is necessary to define the characteristics of passenger car itself to accurately determine PCU. Current passenger cars in India can be categorized into hatchback sedan category and thus it is necessary to determine the effect of length and speed of different categories of cars on the PCU of other categories of vehicles.

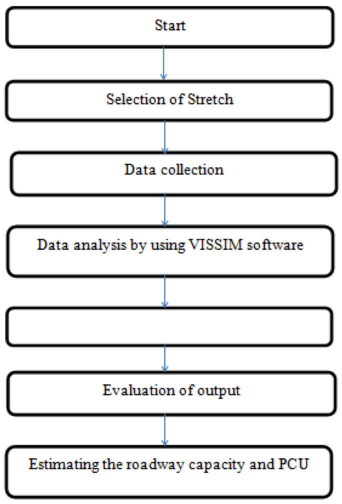
II.METHODOLOGY

Thepresent work is focused on studying the dynamic behavior of PCU values, i.e., The change in the magnitude of the PCU values at various flow levels and traffic composition and also effect oflength of car and speed on the PCU values of the other categories of vehicles is determined using simulation method

The PCU mainly depends on characteristics of road and traffic and the effect of these factors on vehicular movement. Hence these factors need to be studied for the correct estimation of PCU.

Carrying out such observations in the field takes time and it is difficult. Due to difficulties in carrying out such experiments in the field covering the wide variety of traffic conditions, the study of these characteristics can be done by the tool like computer simulation instead of doing it by analytical solution .VISSIM is the most accepted simulation software for the simulating both heterogeneous and homogeneous traffic.

- After data collection the data is then entered into the analysis platform, simulation software like VISSIM
- Model Building: The base model is prepared by using VISSIM software. The prepared model is calibrated and then validated and the model is then applied to study the various traffic parameters
- The results obtained from the base model are considered for the observed traffic condition



III. STUDY AREA

The stretch where the survey was carried out was urban mid-block section fulfilling the following conditions.a.The stretch should be straight b. The roadway should have uniform width. c. The stretch shouldnot have any direct contact from the adjacent areas.The study stretch selected was **Vijayanagarmain road** Bangalore (in front of TTMC). The stretch was four lane carriage way separated by a median of 2.5 meter widthinto two lanes in one direction, the width of the carriageway in one direction is7.5 meter with a paved shoulder width of 1.5m.

IV. TRAFFIC SURVEY

The data input required to formulate the model is collected from the selected study stretch.

The traffic volume was recorded for the period of one hour by using digital video camera.The analysis of the recorded video was done by reducing the video speed to the thirteen per cent of the actual speed and the data was extracted. For one hour study, the recorded volume was 1818 vehicles and the percentage of trucks was very small for simulation hence they were considered as buses since they are close to buses in respect of speed and size. The composition of field observed traffic after the above alteration is shown in figure.The speeds of all classes of the vehicles were obtained in the field by noting down the time taken by the vehicle to cover the distance of 15 meters (spot speed study) also the free speeds of different types of the vehicles were also measured under free flow condition.The car speed may be influenced by the make of the car, driver behaviour, and age. Hence the cars have wide speed ranges hence, the speeds of hatchback and sedan cars was measured separately The measured average minimum and maximum speeds of different vehicles types and the standard deviation are shown in the table1.The lateral clearances between the vehicles was taken from the literature study (**V.ThamizhArasan, Shriniwas S. Arkatkar**) and (**V.ThamizhArasan** and **K. Krishnamurthy**)

Dimensions of the vehicles were also measured with the help of measuring device like tape and is shown in table.

TABLE1:FREE SPEED PARAMETERS OF VARIOUS VEHICLE CATEGORIES

Type of vehicle	**Free speed parameters in Km/hr.**			
	Mini	**Maxi**	**Mean**	**Standard Deviation**
Car	20	55	33.19	18
Motor bike	30	80	44	28.46
LCV	10	30	20	10
Auto	20	50	35.46	15
Bus	10	20	17	5.38

TABLE2:DIMENSIONS OF DIFFERENT CATEGORIES OF VEHICLES

Vehicle type	**Length (m)**	**Width(m)**
Car	4	1.6
Motor bike	1.8	0.6
Auto rickshaw	2.6	1.4
LCV	6.67	2.6
Bus	10.3	2.5

TABLE 3: MINIMUM AND MAXIMUM LATERAL CLEARANCES

Vehicle type	**Lateral clearance share(m)**	
	At zero speed	At 50kmph speed
Motor bike	0.1	0.3
Car	0.3	0.5
Auto rickshaw	0.2	0.4
LCV	0.3	0.5
Bus	0.3	0.6

V. Development of simulation model

The 'base model' is created using the software, it represents the operational and design characteristics of the study stretch. The design attributes are road width, medians, shoulders, horizontal alignment and vertical gradients and the operational attributes are driver characteristics, vehicle characteristics and the traffic flow data.

Development of the base link or the network

Open VISSIM to create a new file Import the all-inclusive strategy of the study range as the foundation picture and scale the picture. Next the simulation parameters are set.

Links are drawn indicating the study stretch and this is the vital stage in the modelling process. In the current model two lane test link covering 500m was drawn signifying urban mid-block section located on vijayanagar main road as explained earlier.

Defining Model Parameters.

After drawing the links of existing road network then provide routing options that exists at the study area. Next enter the vehicle characteristics and the vehicle composition such as the type of vehicle i.e., car, bus, auto, bike, LCV with their respective desired speeds.

Desired speed distributions.

The input speed given to each vehicle category is in the form of desired speed distribution

The maximum and minimum speed values are entered and in between the distribution values are given to each vehicle types. As an example the speed distribution given to a vehicle type bike is shown in figure. In the same way the speed distribution profile for all categories of vehicles are given as input. Usually the speed distribution curve or profile for any vehicle type is ‘S’ shaped. The distribution of speed given in VISSIM represents the surveyed values in the field.

Model Calibration

After developing the model, the model is calibrated in such a way that it replicates the observed field data and observed field conditions. This is achieved by adjusting the driver characteristics, desired speed distributions, lateral clearances between the vehicles.

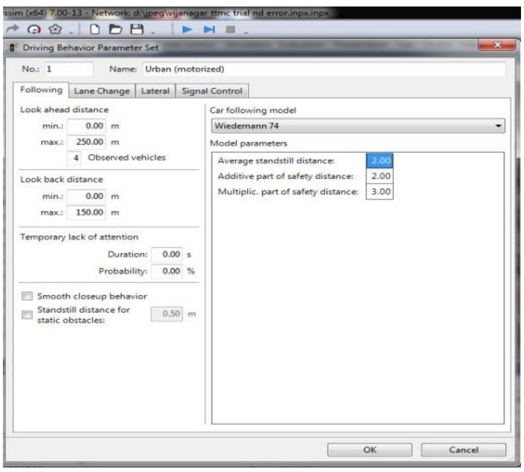


Fig1: Car Following Parameters

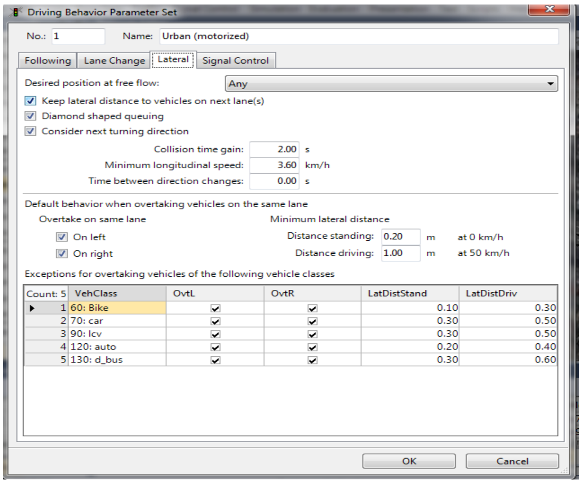


Fig2:Lateral Distance Parameters

Model validation

After preparing the model the simulation is carried out for a period of 3600 seconds and the validation is done by comparing simulated volume and the observed volume in order to make the simulated volume equal to observed volume the desired speed distribution is adjusted and the model is validated .

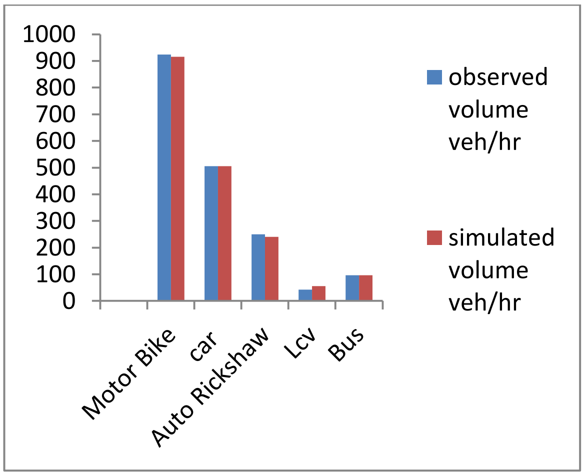


Fig3:Validation Results

From the above graph it can be observed that the simulated volume is equal to observed volume with less difference indicating the validation of the model. A paired T-test was done on the observed volume as well as simulated volume.

From standard t-distribution table the critical value of t-statistic for 5% significance level and for 5 degrees of freedom, is 2.36 .Therefore the calculated value of t-statistic(t_0) for the observed data is less than the corresponding table value . This

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represents that the simulated volume considerably represent the observed volume.

Model application

After model validation, the model is then used to estimate the roadway capacity by developing the speed volume relationship and to estimate the PCU values of each vehicle category under heterogeneous traffic condition and also the influence of vehicle composition on PCU values was studied.

Speed Volume Relationship

Speed flow relationship for the heterogeneous traffic is obtained by using the simulation model for the observed traffic and roadway conditions. For this the simulation runs are carried out for each traffic volumes beginning from 200 vehicles per hour to capacity of the road and the average speed of the stream is taken as the output for different traffic volumes and the graph is plotted to estimate the capacity.

The following procedure is followed when developing speed volume relationship and in determining the capacity.

Simulation runs are carried out by increasing traffic volume and the corresponding output speed is recorded, and further simulation runs are carried out, as there is increase in input traffic volume the exit traffic volume also increases at the output of the simulation stretch. After a number of simulation runs the increase in input traffic volume does not give rise to the increase of output traffic volume instead there is a decrease in the output traffic volume even though there is an increase in input traffic volume this shows that the facility as attained its capacity.

The results obtained were plotted and the capacityis estimated from the speed flow graph. .

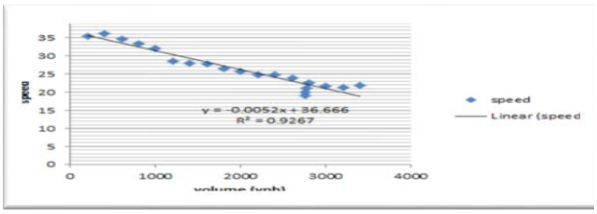

Fig4:Speed flow graph for the observed heterogeneous traffic

From the figure it can be observed that the capacity of the two lane urban mid-block section under heterogeneous traffic condition and observed traffic composition is 2776 vehicles per hour.

The same procedure is followed to estimate the capacity under homogeneous traffic i.e,100%cars

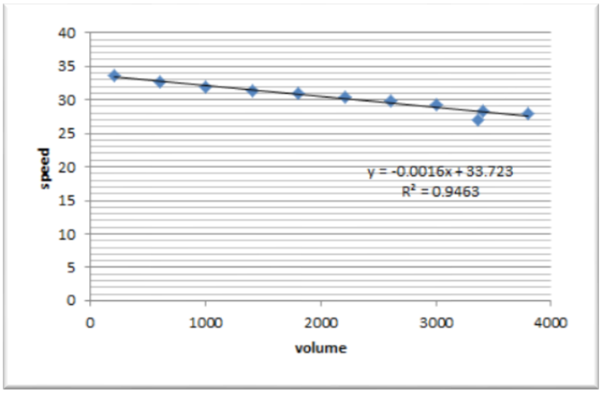

Fig5:Speed flow graph for homogeneous traffic condition

The capacity of the urban mid-block section under homogeneous traffic condition is found to 3361cars per hour.

VI. ESTIMATION OF PCU VALUES

Dynamic variation of the PCU values takes place with various flow parameters such as stream speed, volume capacity ratio, and vehicle composition of traffic. To determine the dynamic nature of the PCU value Sathish Chandra concept of dynamic PCU was considered

The PCU of the vehicle was calculated from the equation

$$PCU_i = \frac{Vc/_{Vi}}{Ac/_{Ai}} \quad \text{..............} (1)$$

Where,

PCU_i= Passenger car unit of vehicle type *i*;

Vc, *Vi*= Speed of a car and vehicles type *i*, respectively;

Ac, *Ai*=projected rectangular area of a car and vehicles type *i.*

Different volume-capacity ratios of , 0.125, 0.250, 0.375, 0.500, 0.625, 0.75, 0.875, 1.000 of heterogeneous traffic was considered and the simulation is carried out. The capacity value was taken from the speed flow graph equivalent to heterogeneous traffic condition. At each volume

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level field observed composition of heterogeneous traffic was simulated for 3600 seconds and the results obtained from the simulation runs is speed which is taken as input for equation 1 and the PCU values are calculated.

VII.RESULTS

TABLE4:PCU VALUES OF DIFFERENT VEHICLE CLASSES AT DIFFERENT V/C RATIOS

V/c ratio	Motor Bike	Car	Auto	LCV	Bus
0.125	0.12	1	0.55	4.07	7.46
0.250	0.14	1	0.58	5.62	7.09
0.275	0.14	1	0.58	5.29	7.06
0.5	0.16	1	0.53	5.07	6.67
0.625	0.15	1	0.57	4.97	6.32
0.75	0.15	1	0.56	4.68	6.59
0.875	0.15	1	0.56	4.52	6.23
1.00	0.15	1	0.55	4.74	6.36

From the above table it can be seen that for the vehicles larger than car like Bus and LCV the PCU increases at low volume levels and reduces with growth in traffic volume. The reason for this is at lower volume levels the subject vehicles like busses move slowly even under free flow condition and hence there is a larger space headway between the vehicles as a result cars can overtake the busses without much reduction in speed resulting in higher PCU values and at higher volume levels space headway decrease vehicles come very closer and there is an opposition to the movement of cars as a result the speed of the cars decreases resulting in decrease in the magnitude of PCU value. As a result of this, the difference in percentage speed change between cars and buses is lesser at higher V/C ratios, resulting in lesser PCU values.

For the vehicles smaller than car such as motorized two-wheelers, motorized three-wheelers, at lower volume levels PCU increases because the speed of these subject vehicles is greater than cars and at higher volume levels the PCU decreases because of lesser speed difference between cars and subject vehicle and also due to their smaller size comparatively with car can able to overtake cars even at high volume levels and hence PCU decrease Further the speed difference between the subject vehicles and cars are shown in the graph below

Speed differential is negative because in that case the speed of Car was less than Bike and Auto. But the trend of variation of the PCU values is same i.e. the PCU values increase with increase in percentage speed-differential

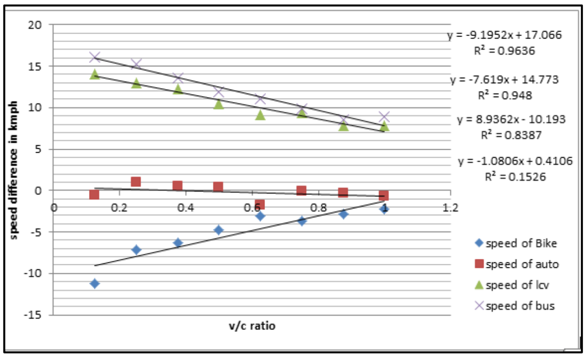

Fig6:Difference In Speed Between Cars And Other Vehicle Categories

VII.EFFECT OF PASSENGER CAR LENGTH AND SPEED ON PCU VALUES

Passenger car is taken as the basis for the determination of PCU of other categories of vehicles. But different types of passenger cars are being manufactured in India. They vary in their overall length and width, power to weight ratio, mileage, and acceleration and deceleration characteristics. Hence standard passenger car itself needs to be characterized for the correct estimation of PCU. Passenger cars that ply on Indian roads belong to hatchbacks and sedans group. This necessitates understanding the influence of type passenger car on the assessment of PCU factors relevant to various types of vehicles.The speeds of only sedan classes of cars were determined in the field and it was found that average speeds of these type of cars was slightly less when compared with that of the hatchback cars. In the present simulation model the standard passenger car was replaced by the sedan category of cars and the simulation runs were carried out for different V/C ratios and for the observed traffic composition. The observed speed for sedan category of cars in the field ranges from 15kmph-50kmph with an average speed of 29kmph. Dimension of the sedan category of car is 4.6 × 2meters. The obtained PCU values at different volume by capacity ratios are shown in table below

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TABLE5:PCU VALUES OF DIFFERENT VEHICLE TYPES BY TAKING SEDAN AS STANDARD PASSENGER CAR

V/C ratio	Motor bike	Car	Auto	LCV	Bus
0.125	0.07	1	0.33	3.05	4.4
0.250	0.08	1	0.34	2.82	4.01
0.375	0.08	1	0.35	2.71	4.03
0.5	0.09	1	0.35	3.14	3.81
0.625	0.08	1	0.33	3.2	4.13
0.75	0.08	1	0.33	3.15	4.41
0.875	0.07	1	0.32	3.16	3.71
1	0.07	1	0.32	2.56	4.17

When hatch back car was taken as standard passenger car smaller than sedan cars with an average speed of 37kmph having a dimension of 3.85×1.7 m.

TABLE6:PCU FOR DIFFERENT CLASSES OF VEHICLES BY TAKING HATCHBACK AS STANDARD PASSENGER CAR

V/C ratio	Motor bike	Car	Auto rickshaw	LCV	Bus
0.125	0.14	1	0.65	5.6	9
0.25	0.15	1	0.66	5.27	8.3
0.375	0.15	1	0.63	5.4	7.8
0.5	0.17	1	0.62	5.3	7.26
0.625	0.16	1	0.57	4.95	6.87
0.75	0.15	1	0.6	4.34	6.38
0.875	0.15	1	0.6	4.96	6.85
1	0.15	1	0.6	4.62	6.68

VIII.ACCURACY CHECK FOR THE ESTIMATED PCU VALUES

In order to estimate the accuracy the statistical analysis is done by performing the paired T-test on simulated cars/hour and Simulated traffic/hour.

From standard t-distribution table the critical value of t-statistic at 0.5% significance level and for 7degrees of freedom, is 4.79 .Therefore the calculated value of t-statistic (t_0) for the observed data is less than the corresponding table value . This indicates that the difference between the measured volume in terms of PCU per hour and cars per hour signifying that the projected PCU values for different vehicles are accurate.

IX.CONCLUSION

- The base model of the study area was created showing the present traffic condition at the study area using Microscopic traffic simulation software PTV-VISSIM-7 and from practical observations as well as from validation results of the model it can be able to confirm that VISSIM software is found to be satisfactory in simulating the heterogeneous traffic form.
- The speed volume relationship established to determine the capacity of the urban mid block section confirms to the further validation of the model.
- The capacity of a two lane urban mid -block section is found to be 2120 PCU/hour by simulating the heterogeneous traffic condition in VISSIM.
- It is discovered that PCU values of different vehicle classes obtained by simulating the traffic at different flow levels varies with the volume
- From the simulation results obtained it can be concluded that there is a decrease in the PCU values of the vehicle class with the growth in volume this is due to the reduction in speed difference as the volume increases from free flow to capacity.
- It is found from the study that there is a reduction in PCU value of all classes of vehicles when there is increase in its proportion.
- For considered traffic condition, it can be able to say that, the vehicles PCU value is treated as a dynamic measure rather than taking it as a stable value.
- It is found from the study that the length and speed of the car inversely depends on PCU values and the and by considering hatchbacks as standard passenger cars the PCU values are found to be higher when compared with that of the sedan car.

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Study on Geopolymer Concrete using Fly Ash & GGBS

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ABSTRACT

A concrete use around the world is second only to water. The production of ordinary Portland cement contributes 5-7% of total greenhouse gas emission. It also consumes large amount energy. Hence it is essential to find alternative to cement. Fly ash is a byproduct of coal obtained from thermal power plant. It is also rich in silica and alumina. Geopolymer is a material resulting from the reaction of a source material that is rich in silica and alumina alkaline solution and is totally cement free concrete. In geopolymer, fly ash and GGBS can be used for cement replacement and alkaline solution act as an activator. In this study, fly ash and GGBS are used to produce a geopolymer concrete. Alkaline solution used for present study is combination of sodium hydroxide (NaOH) and sodium silicate with ratio of 1:2.5. The mix was design for morality of 8M, and 16M of NaOH solution. The grade chosen for the investigation was M20 which is used to design the mix proportion for geopolymer concrete. Finally the compressive strength and Split tensile strength of geopolymer concrete is compared with normal concrete.

Key words: Fly ash, Geopolymer, Compressive strength, Split tensile strength.

Introduction

Concrete is produced mainly from portland cement clinker and it is the most widely-used material on the world after water. the annual production of cement is of the order of 1.8 billion tons and about 3 billion tons of natural resources per year (sarkan, 2003) are needed for its production; at the same time, about one ton of carbon dioxide is released into the environment during the production of 1 ton of clinker besides Co_2 and nox emissions. The geopolymer technology shows considerable promise for application in concrete industry as a alternative binder to the portland cement. In terms of global warming, the geopolymer concrete significantly reduce the co2 emission to the atmosphere caused by the cement industries .

The name geopolymer was formed by a French professor davidovits in 1978 to represent a broad range of materials characterized by network of inorganic molecules.

The geopolymer depends on thermally activated natural materials like industrial byproducts of fly ash or slag to provide a source of silicon (si) and aluminum (al).These silicon and aluminum is dissolved in an alkaline activating solution and subsequently polymerizes into molecular chains and becomes the binder

need for the study

i. To find an alternative product for the ordinary Portland cement.
ii. To design the optimum proportion on mix.
iii. To develop high strength concrete without cement content.

Objectives

- To prepare a concrete without using cement by using Flyash and GGBS
- Comparison of geopolymer concrete with different molarities.
- Comparison of compressive and split tensile strength of geopolymer concrete with nominal concrete.

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MATERIALS

In this chapter varies materials and method of conducting the test was discussed in detail and detailed methodology of the work was presented.

Materials Used

- Fly ash
- Ground granulated blast furnace slag (GGBS)
- Chemicals: Sodium hydroxide, Sodium silicate
- Superplasticizer
-Aggregates: Fine aggregate, Coarse aggregate Title and

FLY ASH-Fly ash is one of the most abundant byproduct on the Earth. It is obtained as a waste material left after burning of coal in thermal power plant. And it is a pozzolana material that exhibits cementitious properties when combined with calcium hydroxide. There are two types of fly ash, Class F and Class C. Each class of fly ash has its own different properties

GROUND GRANULATED BLAST FURNACE SLAG- Ground granulated blast furnace slag comprises mainly of calcium oxide, silicon di-oxide, aluminium oxide, magnesium oxide. Both Flyash and GGBS are used in the mix design of Geopolymer concrete in three proportions, that is 80-20%, 65-35%, 50-50% respectively.

CHEMICALS-In this project chemicals such as Sodium Hydroxide and Sodium Silicate in liquid form are prepared and both are mixed in the ratio of 1: 2.5 by their volume one day early before preparation of concrete. This liquid mix is known as alkaline activator.

SUPERPLASTICIZER-Superplasticizers are water reducers which are capable of reducing water contents by about 30 percent and in this study CONPLAST SP 430 superplasticizer is used in the dosage of 2 percent by weight of cementitious material (Flyash and GGBS). This superplasticizer is mixed with 10% additional water to get good workability in Geopolymer Concrete.

SODIUM SILICATE-Sodium silicate solution obtained in liquid from local suppliers with the composition Na_2O=8%, SiO_2=28%, and water 64% by mass was used. . The mixture of sodium silicate solution and sodium hydroxide solution forms the alkaline liquid.

SODIUM HYDROXIDE-The sodium hydroxide solids in the form of pellets form with 99% purity, obtained from local suppliers and sodium hydroxide (NaOH) solution was prepared by dissolving these pellets distilled water. The concentrations of sodium hydroxide solution used in the study are 8M and 16 M.

FINE AGGREGATE-The fine aggregate used in the project was locally supplied and conformed to grading zone I as per IS: 383:1970. It was first sieved through 4.75mm sieve to remove any particles greater than 4.75mm

COARSE AGGREGATE-Locally available coarse aggregate having the maximum size of (10 - 20mm) were used in this project.

TABLE 1: CHEMICAL COMPOSITION OF CEMENT, FLYASH & GGBS

Sl.		**Percentage contents**		
		Cement	**GGBS**	**Fly ash**
1	Lime(Cao)	60-66	30-45	1.0-2.0
2	Silica(Sio2)	17-24	30-39	35-59
3	Alumina(Al2o3)	3-7	15-24	10-29
4	Iron oxide(Fe2o3)	0.5-0.6	0.5-2.1	4-9
5	Magnesia(Mgo)	0.1-4.0	4.0-16.0	.2-4.9
6	Sulpure	1.3-3.0	-	-0.28

Fig.1 Fly ash

Fig.2 GGBS

Fig.3 Fine aggregate

Fig.4 Coarse aggregates


Fig.5 Sodium Hydroxide crystals Fig.6 Sodium silicate crystals

V. METHODOLOGY

The methodology is explained in the following bellow.

- Geopolymer and Nominal concrete cubes of size 150*150*150 mm subjected to compressive loading.
- Geopolymer and Nominal concrete cylinders of size 150mm dia 300mm length is subjected to split tensile loading.
- Both the cubes and cylinders of geopolymer concrete are casted with two different molarities of 8 and 16.
- For Geopolymer concrete the heat curing is done by keeping in hot air oven for 24 hours at 60 degree Celsius and followed by air curing in room temperature.
- Comparison of Specimens are tested for 7 days and 28 days based on the test procedure given in IS 516-1959 code tests were conducted on specimens.

Initially mix design for normal cement concrete is done for M20 grade and the same procedure is used for Geopolymer concrete by complete replacement of Portland cement with different proportions of Fly ash and GGBS also the alkaline activator is used in equivalent volume as that of water. Table 2 shows the various mix proportions of Geo-polymer concrete.

TABLE 2: PROPORTION OF ADDING CEMENTITIOUS MATERIALS FOR PREPARATION OF GEOPOLYMER CONCRETE

MIX ID	Cementious Materials (%)	
	FLYASH	G
M	8	
M	6	3
M	5	5


Fig.7 Mixing of Constituent Materials Fig.8 Check for Workability


Fig.9 Casting of Cubes and Cylinders Fig.10 De-moulded Specimens

Fig.11 Heat curing for 24 hr at 60 degree Celsius

GEO-POLYMER MIX DESIGN-

A sample of mix design was shown that the aggregates occupy the largest volume in GPCs. The silicon and the aluminum in the fly ash are activated by a combination of sodium hydroxide and sodium silicate.

TABLE 3: MIX PROPORTIONS VALUE

Constituents	80-20% (kg/m3)	65-35% (kg/m3)	50-50% (kg/m3)
Coarse aggregate	1110	1119.38	1131.14
Fine aggregate	740	746.25	754.09
Fly ash	284.8	231.4	178
GGBS	71.2	124.6	178
Sodium	178 ltrs	178 ltrs	178 ltrs

silicate & sodium hydroxide			
Super plasticizer	7.12 ltrs	7.12 ltrs	7.12 ltrs

VI. RESULTS & DISCUSSIONS

The various strength test that are to be done listed as below

- Compressive strength
- Split tensile strength

The test specimens for compressive strength test were made of cubes having a size of 150mm x 150mm x 150mm cast iron steel moulds were used and for each mix proportion 2 numbers of cubes were cast and tested at the age of 7 days and 28 days confirming to IS 516-1959 code.

The test specimens for split tensile strength test were made of cylinders having a size of 150mm diameter and 300mm high cast iron moulds were used and for each mix proportion three numbers of cylinders were cast and tested at 28 days confirming to IS 516-1959 code. Table 4 shows the details of test specimen

TABLE 4: DETAILS OF TEST SPECIMEN

S.NO	NAME OF TEST	SIZE OF SPECIMEN (mm)	No. OF SPECIMEN
1	Compressive Strength	150 x 150 x 150	24
2	Split tensile test	150 x 300	24
Total			48

COMPRESSIVE STRENGTH TEST- The variations of compressive strength at the age of 7th and 28th days for different proportions are given in Table 5.

TABLE 5: COMPRESSIVE STRENGTH RESULTS

MIX ID	FLYASH (%)	GGBS (%)	Compressive			
			8M		16M	
			7th Day	28th Day	7th Day	28th Day
M1	80	20	34.	42.	38.	48.1
M2	65	35	39.	48.	42.	51.2
M3	50	50	71.	81.	73.	84.8
M20 grad	Ordinary Portland Cement		25.86- for 7 days		34.04- for 28 days	

SPLIT TENSILE STRENGTH-The variations of Split Tensile strength at the age of 7th and 28th days for different proportions are given in Table 6.

TABLE 6: SPLIT TENSILE STRENGTH

MIX ID	FLYASH (%)	GGBS (%)	Split Tensile			
			8M		16M	
			7th Day	28th Day	7th Day	28th Day
M1	80	20	4.0	4.1	4.8	5.1
M2	65	35	4.4	4.8	5.4	5.6
M3	50	50	4.8	4.9	6.5	6.8
M20 grade concrete	Ordinary Portland Cement Concrete		4.45 - for 7 days		4.565- for 28 days	

VII. CONCLUSION

Based on the experimental investigation the following conclusions are listed below:

- The optimum replacement level of fly ash by GGBS in GPC can produce high strength concrete.
- Water absorption property is lesser than the nominal concrete.
- Achieves strength in a short time i.e. 70% of the compressive strength in first 4 hours of setting.
- It is observed that the increase in molarity increase the strength of the geopolymer concrete.
- Comparsion between normal and geopolymer concrete is done, and found that geopolymer concrete shows better results.
- GPC has excellent properties as discussed earlier so it can be useful for rehabilitation and retrofitting works.

Fig.12 Testing on GPC Cylinders &cubes

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EXAMINE THE STRENGTH OF CONCRETE BY REPLACEMENT OF RIVER SAND WITH FOUNDRY SAND

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ABSTRACT

The recent trend in concrete technology is to develop a well performed concrete along with the characterized of eco friendly and economically affordable. In this project, investigation has been made on Foundry sand in spite of river sand which is to be very economical and increases the strength of concrete by its respective proportions. The concrete has been designed for M25 by using IS Code 10262. Concrete cubes (150 x 150 x 150 mm) are casted. A detailed scrutinize about the foundry sand has been done through various components and it has been adopted for the replacement of river sand since it convince the significant properties. An exhaustive examines represents that foundry sand acquires tremendous compressive strength.

Key words : Foundry Sand, Compressive Strength, Concrete Mix Design.

I. INTRODUCTION

a) Foundry sand is high quality silica sand with uniform physical characteristics

b) It is a byproduct of ferrous and nonferrous metal casting industries.

c) Foundry sand has been used for centuries as a molding material because of its thermal conductivity.

d) In modern foundry practice, sand is typically recycled and reused through many production cycles.

Industry estimates that approximately 100 million tons of sand are used in production annually of that 6 - 10 million tons are discarded annually and are available to be recycled into other products and in industry.

PROCEDURE

Concrete mix is to be designed based on Indian Standard Recommended guidelines.

The cement, fine aggregates (foundry sand) and coarse aggregates are weighed

The concrete mixture is prepared by hand mixing on a watertight platform in dry condition.

The water is added carefully accordingly so that no water is lost during mixing.

Potable tap water is used for the preparation of concrete and for the curing of specimens.

Cubical moulds of size 150mm x 150mm x 150mm are used to prepare the concrete specimens for the determination of compressive strength.

The specimens are allowed to remain in the steel mould for the first 24 hours at ambient condition.

After that these were de moulded with care so that no edges were broken and were placed in the curing tank at the ambient temperature for curing.

The ambient temperature for curing was 27 ± 2^0.

The compressive strength of specimen is determined on 7 days, 14 days and 28 days of curing.

Fig.1 Foundry Sand.

MIX DESIGN

Data Required for Concrete Mix Design

(i) Concrete Mix Design Stipulation

- Characteristic compressive strength required in the field at 28 days grade designation — M 25
- Nominal maximum size of aggregate — 20 mm
- Shape of CA — Angular
- Degree of workability required at site — 100 mm (slump)
- Degree of quality control available at site — As per IS:456
- Type of exposure the structure will be subjected to (as defined in IS: 456) — Mild
- Type of cement: opc conforming IS:455
- Method of concrete placing: pump able concrete

(ii) Test data of material (to be determined in the laboratory)

- Specific gravity of cement — 3.15
- Specific gravity of FA — 2.39
- Specific gravity of CA — 2.76
- Aggregate are assumed to be in saturated surface dry condition.
- Fine aggregates confirm to Zone II of IS – 383
- *Procedure for Concrete Mix Design of M25 Grade Concrete*

Step 1 — Determination Of Target Strength

Himsworth constant for 5% risk factor is 1.65. In this case standard deviation is taken from IS:456 against M 20 is 4.0.

$\mathbf{f_{target} = f_{ck} + 1.65 \times S}$

$\mathbf{= 25 + 1.65 \times 4.0 = 31.6\ N/mm^2}$

Where,

S = standard deviation in N/mm^2 = 4 (as per table -1 of IS 10262- 2009)

Step 2 — Selection of water / cement ratio:-

From Table 5 of IS 456, (page no 20)

Maximum water-cement ratio for Mild exposure condition = 0.55

Based on experience, adopt water-cement ratio as 0.5.

0.5<0.55, hence OK.

Step 3 — Selection of Water Content

From Table 2 of IS 10262- 2009,

Maximum water content = 186 Kg (for Nominal maximum size of aggregate — 20 mm)

Step 4 — Selection of Cement Content

Water-cement ratio = 0.5

Corrected water content = 197.16 kg /m^3

Cement content =394.32kg/m^3

From Table 5 of IS 456,

Minimum cement Content for mild exposure condition = 300 kg/m^3

394.32 kg/m^3 > 300 kg/m^3, hence, OK.

This value is to be checked for durability requirement from IS: 456.

In the present example against mild exposure and for the case of reinforced concrete the minimum cement content is 300 kg/m^3 which is less than 394.32 kg/m^3. Hence cement content adopted = 394.32 kg/m^3.

As per clause 8.2.4.2 of IS: 456

Maximum cement content = 450 kg/m^3.

Step 5: Estimation of Coarse Aggregate proportion:-

From Table 3 of IS 10262- 2009,

For Nominal maximum size of aggregate = 20 mm,

Zone of fine aggregate = Zone II

And For w/c = 0.5

Volume of coarse aggregate per unit volume of total aggregate = 0.62

Step 6: Estimation of the mix ingredients

a) Volume of concrete = 1 m^3

b) Volume of cement = (Mass of cement / Specific gravity of cement) x (1/100)

= (394.32/3.15) x (1/1000) = 0.125 m^3

c) Volume of water = (Mass of water / Specific gravity of water) x (1/1000)

= (197.16/1) x (1/1000) = 0.19716 m^3

d) Volume of total aggregates = a – (b + c) = 1 – (0.125+ 0.19716) = 0.677 m^3

e) Mass of coarse aggregates = 0.677x 0.558 x 2.76 x 1000 = 1042.63kg/m^3

f) Mass of fine aggregates = 0.677 x 0.442 x 2.39 x 1000 = 715.169 kg/m^3

Concrete Mix proportions for Trial Mix 1

Cement = 394.32 kg/m^3

Water = 197.16 kg/m^3

Fine aggregates = 715.169 kg/m^3

Coarse aggregate = 1042.63 kg/m^3

W/c = 0.5

Advantages

i. Least expensive and most widely used.

ii. Very flexible in shape, size, material and quantity.

I. Disadvantages

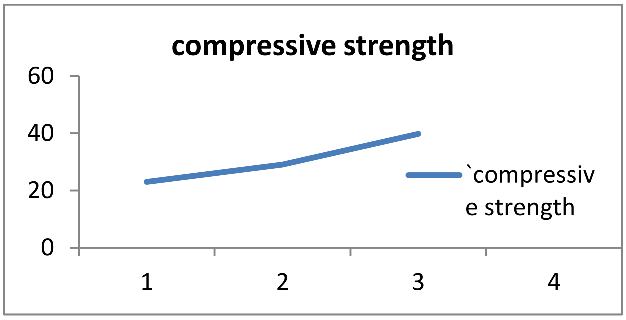
1. Foundry sand is black. In some concretes, this may caused the finished concrete to have a black tint, which may not be desirable.
2. It reduces workability of concrete.

Fig.2 Compressive Strength

RESULTS

Replacement of Foundry Sand by River Sand Which Increases the Compressive Strength by 11.5% than that of River Sand.

Sl.no	Grade	Compressive strength on 07 days of curing N/mm^2	Compressive strength on 14 days of curing N/mm^2	Compressive strength on 28 days of curing N/mm^2
01	M_{25}	23.07	29.04	39.75



The above chart represents the compressive strength v/s no of days

CONCLUSIONS

(a) Compressive strength of concrete increased with the increase in sand replacement with complete replacement of foundry sand

(b) Replacement of foundry sand, an increase in strength was observed with the increase in age

The compressive strength 7day foundry sand concrete of 100% replacement is almost equivalent to 14days compressive strength of ordinary sand

In com

Foundry Sand is Economical and Friendly

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Category: CIVIL

EXPERIMENTAL STUDY ON RUBCRETE

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ABSTRACT

Solid waste disposal is a worldwide problem. If not properly disposed, these materials become sources of environmental pollution and the problems related to it. Various studies are done worldwide to dispose these solid waste materials by using them for partial or complete replacement of aggregates in cement concrete. Discarded tyre rubber is an important solid waste material that destroys the ecological environment.

The suitability of waste tyre rubber in cement concrete as a partial replacement for natural river sand. M40 grade of concrete is designed as per IS 10262: 2010, with water/cement ratios of 0.4. Water–cement ratios of 0.45 was studied. The designated mix contain 0% 5% 10% 15% and 20% of partial replacement of crumb rubber which is soaked with 0.1N NAOH and replaced with fine aggregate by weight .and silica fumes are replaced for cement respectively in proportions for crumb rubber such as 0% 5% 10% 15% 20% to enhance the compressive strength of the concrete. Finally compared with normal concrete .The specimens with 0% discarded tyre rubber were taken as control mix. Tests were done to determine the compressive strength, flexural strength in concrete specimens.

I. INTRODUCTION

The concrete structure has more important in recent days. The durability for this type of structure has more comparatively constructed by using other type of materials. The maintenance is very easy to other type of structures.

In a olden days, the large number of structures are construction using older design codes all over the world and they are deficient to carry a loads as per new design codes. The maintenance of such structures is difficult and incurs a huge amount of public money and time.

Now a days, the rehabilitation and restoration of a structure is one of the most important things in civil Engineering field and also a very challenging thing is to select a strengthening method that will enhance the strength and serviceability of the structure.

The structure can be strengthened for various requirements it all depends upon the different situations.

1. Structure or structural member should carry a higher loads
2. Replacing of heavy mechanical equipment, to older equipment's.
3. Construction of partition or carrying modification works.
4. Strengthening is required by consideration of wind and seismic forces and also to improve resistance to blast loading.
5. Unknowingly the extra load a applied to structure, hence the structural member may damage so such member are to be strengthened.
6. Strengthened is also carried when we could not achieve the required design strength due to some in site problems. And
7. Restrict the space, constructability and the also strengthened demands the durability.

II. PROCEDURE

❖ **Experimental work**

1. Material collection

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- Cement
- Fine aggregate
- Coarse aggregate
- Water
- Reinforcing steellass fiber reinforced polymer (GFRP)
- Resin
- 0.1N sodium hydroxide (NaOH)
- Silica fumes

2. Evaluation of material properties

- Particle size distribution.
- Specific gravity.
- Moisture content.

2. Mix design calculation and preparation of specimens.

3. Conduction of tests to determine strength of specimen (7 & 28 days).

4. Conduction of tests to determine strength of RCC beams, columns and PCC column.

- Compression test and
- Flexural test.

Strengthening of Failure and original members by using GFRP Sheets. Again testing the Strengthened members and comparing the Results.

MIX DESIGN

1.TARGET STRENGTH FOR MIX PROPORTION

$F_{CK}^{1}=f_{ck}+\{`1.65\times5\}$

$= 40+\{1.65\times5\}$

= 48.25 N\mm^2

2.W/C RATIO

Maximum water cement ratio=0.45

We are using water cement ratio= 0.45

$0.45\leq0.45$

Hence safe

3.CALCULATION OF W/C RATIO

For 20 mm size aggregates

From table-2 maximum water content= 186 litres

$=186+\{7.5/100\}\times186$

=199.95 litres

4.CALCULATION OF CEMENT

W/C RATIO=0.45

Cement content=199.95/0.45=445 kg/m^3

From table-3 IS-456 minimum cement for severe condition is 320 kg/m^3

= 445>320 kg/m^3

5.PROPORTION OF VOLUME OF COARSE AGREEGATES AND FINE AGGREGATES

From table-3volume of coarse aggregates corresponding to 20mm size aggregates and fine aggregates

=0.5-0.45=0.05

Volume of coarse aggregates for w/c ratio 0.45=0.62+0.02

Volume of coarse aggregates=0.62

Volume of fine aggregates=0.38

MIX CALCULATIONS

1.Volume of concrete = 1m^3

Volume of cement = {mass of concrete/ sp.gravity of cement}×{1/1000}

= {445/3.15}×{1/1000}

=0.141m^3

2.volume of water = {mass of water/sp.gravity of water}×{1/1000}

= {199.95/1}×{1/1000}

= 0.199 m^3

3. volume of aggregates = [1-{0.141+0.199}]=0.66m^3

4. Mass of coarse aggregates={ vol of aggrgates × vol of C.A×sp.gr C.A×1000} = {0.66 × 0.62 × 2.83 × 1000}
= 1158.036 kg/m^3

5. Mass of aggregates = {0.66×0.38 × 2.63 × 1000 }
= 659.04 kg/m^3

MIX PROPORTIONS FOR 1M^3

1. NOMINAL CONCRETE

Cement = 455 kg/m^3

Water = 199 kg/m^3

Fine aggregates = 659.04 kg/m^3

Coarse aggregates = 1158.03 kg/m^3

w/c ratio = 0.45

2. For 5% Replacement

Cement = 432.25 kg/m^3

Water = 199 kg/m^3

Fine aggregates = 626.05 kg/m^3

Coarse aggregates = 1158.036 kg/m^3

w/c ratio = 0.45

Rubber = 33.05 kg/m^3

Silica fumes = 22.75 kg/m^3

3. For 10% Replacement

Cement = 409.5 kg/m^3

Water = 199kg/m^3

Fine aggregates =593.1 kg/m^3
Coarse aggregates = 1158.036 kg/m^3
w/c ratio = 0.45
Rubber = 65.9 kg/m^3
Silica fumes = 45.5 kg/m^3

4. For 15% Replacement
Cement = 386.75 kg/m^3
Water = 199 kg/m^3
Fine aggregates = 560.15 kg/m^3
Coarse aggregates = 1158.036 kg/m^3
w/c ratio = 0.45
Rubber =98.85 kg/m^3
Silica fumes=68.25 kg/m^3

5. For 20% Replacement
Cement = 364 kg/m^3
Water = 199kg/m^3
Fine aggregates =527.2kg/m^3
Coarse aggregates = 1158.036 kg/m^3
w/c ratio = 0.45
Rubber = 131.8 kg/m^3
Silica fumes = 91 kg/m^3

Advantages

• 80+ years of lifespan and corrosion resistance
• 9 x lighter in weight than the equivalent strength of Steel rebar
• 3 x tensile strength of steel
• Non-conductive to heat and electricity
• Non-magnetic (transparent to electrical fields)
• High Fatigue endurance and Impact Resistance
• Non-existent corrosion, rust free
• Transparent to radio frequencies
• Cost effective vs. epoxy coated, galvanized and stainless steel rebar
• Impervious to chloride ion, low pH chemical attack and bacteriological growth
• Reduced whole of life project costs
• Low carbon footprint
• Maintenance free
• Standard/custom lengths, shapes and bends
• Non Toxic • Easily cut and machined
• Easy and Rapid Installation

Disadvantages:

➢ The G FRP material is risk of fire, accidental damage unless the strengthening is protected.

➢ The G FRP strengthening cost is relatively high comparatively to other type of strengthening.

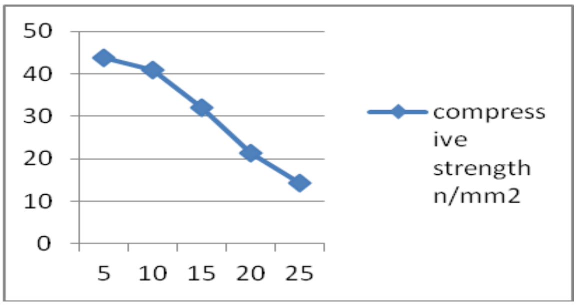
➢ The qualified & well experienced staff is required to carry out the work.

III. RESULTS

Even Though Compressive Strength Decreases as The %age of Rubber Increase 5%of rubber gives almost same compressive strength as nominal concrete

Compressive Strength on 28 Days of Curing

Sl.No	% Of Rubber	Compression Strength N/mm^2
01	00	43.73
02	00	44.02
03	05	41.33
04	05	40.78
05	10	32.44
06	10	31.91
07	15	23.02
08	15	22.65
09	20	14.88
10	20	14.22



The above chart represents the compressive strength v/s no.of days.

Fig3.1 Compressive Test

IV. CONCLUSIONS

COMPRESSIVE STRENGTH DECREASES AS THE PERCENTAGE OF WASTE CRUMB RUBBER INCREASES.

So these can include non-primary structural applications of medium to low strength requirements benefiting from other features of this type of concrete. Even if rubber tyre aggregate was used at relatively low percentages in concrete, the amount of waste tyre rubber could be greatly reduced due to the very large market for concrete products worldwide. Therefore the use of discarded tyre rubber aggregates in concrete shows promise for developing an additional route for used tyres.

WORKABILITY DECREASES AS THE PERCENTAGE OF WASTE CRUMB RUBBER INCREASES.

During the tests it was noted that as the percentage amount of shredded tires increased, the amount of energy required for casting specimens increased substantially, because of the reduction of workability in the concrete.

SELF WEIGHT DECREASES AS THE PERCENTAGE OF WASTE CRUMB RUBBER INCREASES.

Although synthetic lightweight aggregates specially shredded tires are more expensive, the increased strength-to-weight ratio offers sufficient overall saving in materials through the reduction of dead load to more than offset the higher aggregate cost per cubic meter of the concrete. Lower total loads mean reduced supporting sections and foundations, and less reinforcement.

The light unit weight qualities of rubberized concrete may be suitable for architectural application like, interior construction, interlocking blocks, stone baking.

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Category: CIVIL

COMPARATIVE STUDY ON HAIR FIBRE REINFORCEMENT MATERILAL

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ABSTRACT

We all know that human hair is a waste material generated from saloons, beauty parlours so we decided to use that waste as a fibre reinforced material for a cement concrete and to generate a use full product.

I. INTRODUCTION

Human hair is considered as a waste material in most parts of the world and is a common constituent found in municipal waste streams which cause enormous environmental problems.

This is an attempt to find the possibilities of using hair as fibre reinforcement in concrete, thereby forming an alternative way for the safe management of hair waste.

Human hair is strong in tension; hence it can be used as a fibre reinforcement material. Hair Fibre, an alternate non-degradable matter, is available in abundance and at a very cheap cost.

Present studies have been undertaken to analyse the effect of human hair on plain cement concrete on the basis of compressive, crushing and flexural strengths and cracking control to economize concrete and to reduce environmental problem

II. PROCEDURE

Materials required

1. Hair
2. Cement
3. Coarse aggregate
4. Fine aggregate
5. Plasticizers

1) Pre-Treatment Of Hair

The hair which is used for the preparation of concrete cubes are collected from various different sources such as saloons beauty parlor etc, they need to be treated before using the treatment is carried out in the following steps

Separating: The hairs which are collected from different sources contains different type of wastes such as the hairs collected from saloon and beauty parlor contains blades tissue papers and other saloon products, should be separated.

Washing: After separating hair from all unwanted impurities then it is washed with a normal water then it is dipped in acetone for minute.

Drying: The washed hairs are laid in a sheet of paper in different layer and are dried at room temperature or oven dried.

Sorting: The dried then sorted according to their length, color, quality and type of hair.

Fig2.1 Mixing of Hair

M_{30} Grade Mix Design:

2) Target strength for mix proportioning

$Fck' = fck + (1.65\times5)$

$Fck' = 30 + (1.65\times5) = 38.25\ N/mm^2$

3) Water cement ratio

Maximum water cement ratio = 0.45

We are using water cement ratio = 0.40

0.40 < 0.45 hence ok

3) **Calculation of water cement ratio**

For 20mm size aggregate

From table-2 maximum water content = 186liter

(For 25mm-5mm slump range of 20mm size aggregate

25mm = 3%

50mm =6%

=186+(6/100×186) = 197.16 ≈ 198litre

Using chemical admixture to reduce 20% of water content

=198-(20/100×198) = 158.4liter ≈159litre

4)Calculation of cement content

Water cement ratio = 0.40

Cement content = 159/0.40 = 397.5 kg/m^3 ≈398 kg/m^3

From table of IS456 minimum cement for severe exposure condition is 320 kg/m^3

398 kg/m^3 > 320 kg/m^3

Hence safe

Proportion of volume of coarse aggregate and fine aggregate

From table-3 volume of coarse aggregate corresponding to 20mm size aggregate and fine aggregate (zone-1) for water cement ratio of 0.5-0.6

(For early 0.05 change in w/c ratio increases 0.01 volume of coarse aggregate)

=0.5-0.4 =0.1

0.05 = 0.01

0.1 = ?

Volume of coarse aggregate for w/c ratio-0.4 = 0.60+0.02 =0.62

Volume of fine aggregate for w/c ratio-0.4 = 1-0.62=0.38

Mix calculation:

The mix calculation per unit volume of concrete shall be as follows

1) **Volume of concrete =1m^3**

Volume of cement = mass of concrete/sp.gr of cement × 1/1000

=(398/3.15) × (1/1000)= 0.126

2) **Volume of water = mass of water/ sp.gr of water ×1/1000**

=(159/1) × (1/ 1000) =0.159m^3

3) **Volume of chemical admixture = mass of admixture / sp.gr of admixture × 1/1000**

=(4.776/1.145) × (1/1000) = 4.17×10^{-3}m^3

4) **Volume of aggregate**

= 1- [0.126+0.159+ (4.17×10^{-3})] = 0.711m^3

5) **Mass of coarse aggregate = (vol. of aggregate × vol. of C.A × Sp.gr of C.A×1000)**

=(0.711 × 0.62 × 208 × 1000)

= 1234.29 kg/m^3 ≈ 1235 kg/m^3

6) **Mass of fine aggregate**

= (0.711 × 0.38 × 2.63 × 1000) = 710.57 kg/m ≈ 711 kg/m^3

Mix proportion for 1m^3

Cement- 398kg/m^3

Water -159kg/m^3

F.A - 711kg/m^3

C.A -1235 kg/m^3

Chemical admixture - 4.78kg/m^3

Water-cement ratio -0.40

Aggregate cement ratio -4.89

Design slump - 75-100mm

Admixture- BASF –

Dosage – 1.2% by weight of cement

To avoid micro cracks

Test is conducted by adding Human Hair of 1% , 1.5% & 2% by weight of cement.

1% of cement = 398×1/100 = 3.98kg/m^3

1.5% of cement = 398×1.5/100= 5.97kg/m^3

2% of cement = 398×2/100= 7.96kg/m^3

Grade of cement = OPC 53 Grade

Sand = M-Sand

Fig2.2 Dry Concrete Mix Fig2.3 Concrete Mix

➢ **Factors Effecting FRC:-**

a) Type of Fiber/

b) Aspect Ratio.

c) Quantity of Fiber.

d) Orientation of Fiber.
e) Relative Matrix Stiffness of a Fiber.

➢ **Advantages of Hair Fibre**

a) It reduce corrosion
b) It Increases strength of structure
c) To minimize cavitations /erosion damage in structures such as sluice-ways, navigational locks and bridge piers
d) It avoids Microscopic cracks which forming within the concrete.
e) It avoids catastrophic failures.

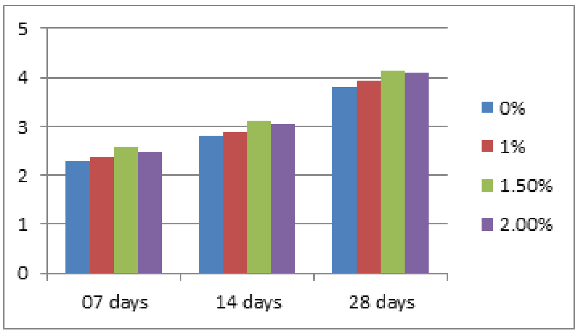
➢ **Diss-advantages of Hair Fibre**

The fibers have to be uniformly mixed and spread throughout the concrete mix, but this is found to be a difficult process and time consuming, If this limitation overcomes by new and effective methods of fabrication. Hair fiber reinforced concrete can be adopted for all common concrete works.

III. RESULTS

Using hair as a basic ingredient in cement concrete blocks it gave tremendous result, we found that by addition of 1.5% and 2.0% of hair to the weight of cement there was increase in compressive strength by 2%-12% to the conventional concrete and 2%-5% in flexural strength when compared with normal concrete.

Sl No.	*% of Hair*	*Compressive Strength N/mm^2*		
		07 days	*14 days*	*28 days*
01	*0.0%*	*22.84*	*28.04*	*38.26*
02	*1.0%*	*24.53*	*28.84*	*39.51*
03	*1.5%*	*26.17*	*31.06*	*41.38*
04	*2.0%*	*25.6*	*30.67*	*41.12*



The above chart represents the compressive strength v/s no.of days.

Fig 3.1 Compressive Test

IV. CONCLUSIONS

On studying the hardened property of Reinforced concrete from waste human hair as an additive material we can conclude that there is a gain in compressive strength for 1.5% of hair by weight of cement, in further addition of hair will result in loss of compressive strength.

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EVALUATION ON THE STRENGTH OF CONCRETE BY REPLACEMENT OF WATER BY ALOEVERA RESIN

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ABSTRACT

In Modern concrete technology, the replacement of conventional materials with the low usage or wastage materials is the current trend to protect the environment. An attempt has been made to use aloevera resin instead of water for making concrete. It increases the strength of concrete. The concrete mix has made using concrete ingredients such as cement (OPC 53) M-sand, course aggregates and aloe era resin for M25, M30 grade of concrete. *Aloevera* is the naturally available material, which increases bonding characteristics of concrete and also increases the strength of concrete. It is found to set with cement in ratios of 0.3, 0.35, 0.40, 0.45, 0.5, 0.55 and 0.6 by weight of cement. Tests were conducted on Aloevera Concrete Blocks of size (150*150*150mm) on 7th days, 14th days and 28th days. Compressive strength for both nominal and replacement of aloevera for concrete were found. It is found that by replacing water with aloevera resin, the strength of concrete was found to increase in all aspects which can be an adoptable for concrete in future.

I. INTRODUCTION

The required properties of concrete can be specified by the mix design. Features may include the properties of the fresh concrete, the mechanical properties of the hardened concrete and inclusions, exclusions or limit-specific ingredients. The mix design leads to the development of the concrete specifications. The proportioning (dosage) of the mixture refers to the process of determining the quantities of concrete ingredients. An adequately provided concrete must have the following qualities:

- Acceptable workability of fresh concrete
- Durability, strength and uniform appearance of hardened concrete
- Economy

After having chosen the features, one can obtain the relevant proportion mixing data from the field or laboratory. As most of the desired properties of the hardened concrete depend mainly on the quality of the cementitious paste, the first stage for the proportioning of concrete is the choice of an appropriate water–material relationship of the cementing material (binder) for the resistance and durability required. The water–cementitious material ratio (binder) is simply the mass of water divided by the mass of cementitious materials (Portland cement, blended cement, fly ash, slag, silica fume, natural pozzolan). The water/cementing ratio chosen for a mix design should be the least necessary to withstand the anticipated conditions of exposure. When durability is not the governing factor, the choice of the water–cementitious material ratio should be based on the compressive strength requirements. Resistance (compression or bending) is the indicator of the quality of concrete most universally used. Although this is an important feature, other properties such as durability, permeability and wear resistance are recognized today as equally important or, in some cases, of greater importance, especially when considering the life of the structure.

2. MATERIALS

1. Sand: The aggregates employed were river sand and crushed gravel with a maximum size of 20 mm. Their characteristics are presented in Table 1.

Aggregate	*Absorption (%)*	*Density (g/cm^3)*	*Fineness modulus*
Sand	1.29	2.57	2.88
Gravel	0.68	2.66	6.42

2. Cement: The cement employed in the mixtures was Portland cement; its chemical composition is shown in Table 2.

Table 2 Chemical composition of Portland cement.

Compound	***Content (%)***
SiO_2	16.79
Al_2O_3	4.14
Fe_2O_3	3.8
CaO	70.03
K_2O	0.71
MgO	0.83
MnO	0.04
Na_2O	1.88
P_2O_5	0.04
TiO_2	0.21
Fe	0.12
FeO	0.16
PxC a 950 °C	5.06

3. Aloevera: A mucilage solution obtained from the nopal cactus species Opuntia ficus-indica at concentration of 3.0% was used as substitute for water in the mixture. The nopal cactus mucilage was extracted by scalding, grinding, macerating, and finally filtering to obtain the nopal cactus mucilage solution. Bi-distilled water was used in the preparation of the nopal mucilage solution and in the different concrete mixtures and cement pastes. In order to achieve adequate workability in the concrete mixtures, a high range water-reducing admixture based on polycarboxylates was utilized; doses are indicated in Table 3.

Table 3 Mixture proportions and fresh concrete properties.

Materials	**W/C Ratio**			
	0.3 – 0.35	**0.4 – 0.45**	**0.5 – 0.55**	**0.6 – 0.65**
Gravel (kg)	1007	997	994	994
Sand (kg)	661	713	786	786
Cement (kg)	513	449	337	337
Water or mucilage solution (kg)	167	172	203	203
Slump (mm)	60	90	80	80
Unit weight (kg/m3)	2348	2329	2318	2318
Air content (%)	2	2	2	2
Temperature (°C)	23	26	24	24

3. METHEDOLOGY

1. Preparation and characterization of cement pastes: Thirty cement pastes with water/cement (w/c) and aloevera solution/cement (m/c) ratios of 0.30, 0.45, and 0.60 were prepared according to the ASTM C 305-99 standard. Eighteen of the pastes were prepared for SEM, 6 for XRD, and 6 more in duplicate for determination of flow and setting times in accordance with the ASTM C230-08 and ASTM C807-08 standards, respectively. Flow and setting time were determined at a temperature of 23 ± 2 °C. Microstructure was analysed at 28, 56, and 120 days by SEM with a JSM-6300. The hydration process was characterized by XRD, using a D8 Focus.

2. Preparation and Characterization of Concrete Mixtures: Concrete mixtures with water/cement (w/c) and mucilage solution/cement (m/c) ratios of 0.45 and 0.60. were designed and prepared in accordance with the ACI Method. The concrete mixtures with w/c or m/c = 0.30 were designed according to the method proposed by Aitcin and Mehta. Each mixture was used to cast 36 cylinders measuring 100 mm in diameter and 200 mm in length, with three cylinders considered for capillary water absorption and three for chloride diffusion. Tests were carried out in accordance with the ASTM C39-04, ASTM C642-06, and NORDTEST NT BUILD 443 standards, respectively. Table 3 shows

the proportions of the mixtures utilized, and their properties in fresh state.

3. Flow: Figure 2 shows the results of flow tests for pastes with w/c or m/c ratios = 0.30, 0.45, and 0.60. As can be observed, all m/c mixtures exhibited a decrease in flow, up to 26% with respect to the control w/c mixtures. This confirms the results obtained for self-consolidating concrete, where nopal cactus mucilage was successfully used as a viscosity modifying admixture.

RESULTS

1. **Effect on setting time:** The setting time ranges from 32-44 min for 0-20% aloevera resin content.
2. **Effect on compressive strength in concrete mortar cubes:**

Table 4 :Variation of Compressive Strength with respect to Aloevera content

S.No.	% of Aloevera Resin	Compressive Strength		
		7	14	28
1	0	28.23	31.11	36.45
2	15	30.21	33.95	34.53
3	30	31.01	38.93	40.12
4	60	33.40	39.82	42.25
5	100	29.58	42.88	44.51

The variation of Compressive strength with respect to Aloevera content is given in Table 4. The variations are also shown in Fig. 1, 2 and 3 respectively for 7th day, 14th day and 28th day strengths. From these figures, it can be seen that the compressive strength increases upto 100% replacement of water with Aloevera resin.

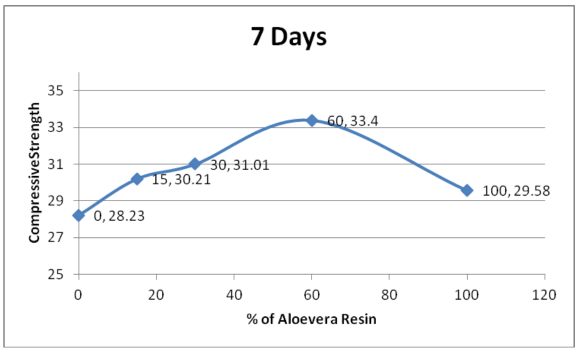

Fig.1.Compressive Strength for 7 days

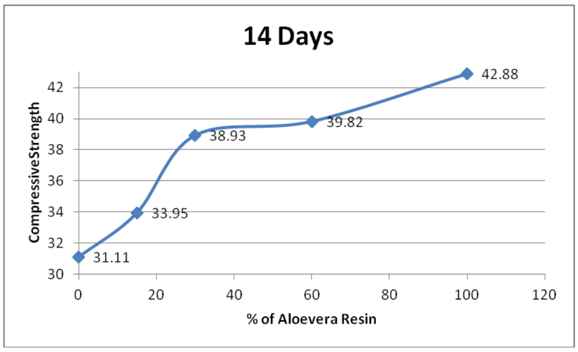

Fig.2.Compressive Strength for 14 days

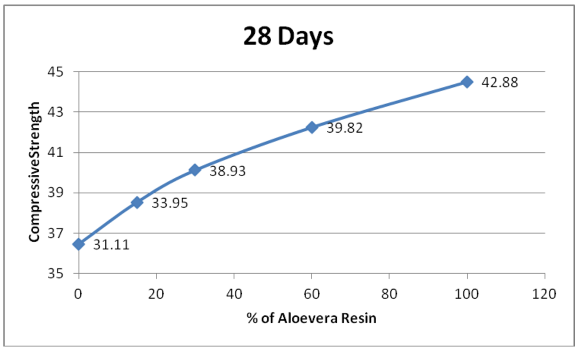

Fig.3.Compressive Strength for 28 days

CONCLUSION

1. It is found that Aloevera resin increases the strength of a concrete.
2. In place of water scarcity, the water is replaced by adding aloevera resin to the concrete mixture. Since the aloevera grows in abundant in dry places, it can be used and it does not affect the environment when added to the concrete mixture.
3. The cost of aloevera is of nil compared to water. The concrete strength is increased by using aloevera resin.

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EXPERIMENTAL STUDY ON BRICKS AND BLOCKS BY USING LIME GYPSUM QUARRY DUST AND POZZOLANA ASH

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ABSTRACT

In construction industry binding materials have great demand. By using lime, it is possible to reduce the consumption of cement. Thereby it reduces the emission of greenhouse gases into the atmosphere. The demand for natural sand is quite high in developing countries since the available sand cannot meet the requirements of construction sector. Because of its limited supply the cost of natural sand has incredibly increased and its consistent supply cannot be guaranteed. Under these circumstances, quarry dust, a by-product from the crushing process of stones which is available from rock quarries at low cost in many areas, can be an economical alternative to the river sand .In this project, the experimental investigation is carried out to find the optimum mix percentage of lime and rice husk ash bricks. However, the brick specimen of size 225mm x 105mm x 70mm were cast for different mix varying percentage of rice husk ash (12.5 to 50%), Gypsum (2%) and Lime (2.5 to 10%), compressive strength and percentage of water absorption values were determined for different mix proportions. For preparing mortar or cement blocks, cubes having various proportions of lime, cement, rice husk ash, gypsum and quarry dust. Keeping the quantities of gypsum and quarry dust as constant i.e. 2% and 53%, the percentages of lime, cement and rice husk ash are varied. Cubes of dimensions 7.05 cm x 7.05cm x7.05 cm are prepared to determine compressive strength and water absorption values.

INTRODUCTION

Accumulation of various waste materials is now becoming a major concern to the environmentalists. In order to achieve both the need of improving the properties and also to make use of the industrial wastes, the present experimental study is taken up. In this project the effect of Rice Husk ash and Lime on strength properties of bricks and blocks has been studied.

India is a major rice producing country. Rice milling generates a byproduct husk and the husk generated during milling is mostly used as a fuel in the boilers for processing paddy, producing energy through direct combustion and / or by gasification. About 20 million tons of RHA is produced annually. During milling of paddy about 78 % of weight is received as rice, broken rice and bran and rest 22 % of the weight of paddy is received as husk. This husk contains about 75 % organic volatile matter and the balance 25 % of the weight of this husk is converted into ash during the firing process, is known as rice husk ash (RHA). RHA in turn contains around 85 % - 90 % amorphous silica.

Rice Husk ash by itself has little cementitious value but in the presence of moisture it reacts chemically and forms cementitious compounds and attributes to the improvement of strength and compressibility characteristics of soils.

Lime because of its eco-friendly nature, good workability, improved bond strength and recyclability; it plays a vital role as a binder in the durability of ancient structures. This would be an added benefit not only in reducing the cost of the bricks and blocks, but also has implications in terms of the reduction of energy consumed in the manufacture of bricks and blocks are reduction in weight and eco-friendly nature. And partial replacement of cement by quarry dust is also an added advantage as it leads to reduction in the consumption of cement in the manufacture of blocks.

Procedure

Brick Manufacturing Process:

Manufacturing of bricks consists of the following four operations or steps:

1. Preparation of brick clay or brick earth
2. Moulding of bricks
3. Air drying of bricks
4. Burning of bricks

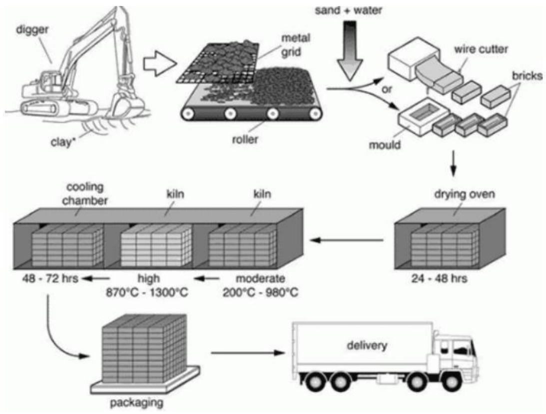

Fig : Brick making process

1. Preparation of brick clay or brick earth:

In this step the soil is excavated in steps and then laid on leveled ground. Then the sill is cleaned of impurities such as vegetation matter, stones or pebbles etc. After removing impurities it is exposed to weather for few months. This is called the process of weathering. After completion of weathering process the soil is blended with other material to prepare good brick earth. Then the mixed soil is tempered by being thoroughly broken up, watered and kneaded. The tempering is usually done in pug mill.

2. Moulding of bricks: Bricks are moulded in many ways depending on the quality of the product to be made. Generally the moulding is done in the following ways:-

-Hand moulding

-Machine moulding

For hand moulding the tempered clay is forced in the mould in such a way that it fills all the corners of the mould. Extra clay is removed either by wooden strike or frame with wire. Mould is then lifted up and raw brick is left on ground.

Machine moulding is used where large numbers of bricks are to be made. Machines used for moulding are generally of two types:

-Plastic clay machines

-Dry clay machines

In plastic clay machine the clay is plastic state is forced to rectangular openings of a size equal to the length and breadth of the bricks and are then cut into strips of thickness of the
brick with wires in frames.

In dry clay machines, dry clay is reduced to powder filled dry into mould by the machine and then are subjected to high pressure to form hard and well shaped bricks.

3. Drying of bricks:Drying is usually done by placing the bricks in sheds with open sides so as to ensure free circulation of air and protection from bad weather and rains. The bricks are allowed to dry till they are left with 5 to 7 percent moisture content. The drying period usually varies from 7 to 14 days.

The moulded bricks are dried for the following reasons:

- -if damp bricks or green bricks are directly taken to burning then, they are likely to be cracked and distorted.
- -To remove maximum moisture from the bricks so as to save time and fuel during burning.
- -To increase the strength of raw bricks so that they can be handled and stacked in greater heights in the kiln for burning without damage.

4. Burning of bricks: It is the most important step in the manufacture of bricks. Bricks may be burnt by two distinct methods given below:

- -Burning in a clamp or Pazawah known as clamp burning
- -Burning in a flame kiln or Bhatta known as kiln burning

In clamps, one batch of green bricks is heaped along with firewood, coal and sealed with clay. It is then fired slowly to intense heat which may take many days. Modern kilns, however, permanent structures consisting of many chambers. There are intermittent and continuous kilns. Moulded clay is stacked in the chambers. They are then slowly dried

and burnt to high temperature and cooled. One cycle of loading, drying, burning, cooling and emptying may take as much as two weeks. These processes are carried out intermittently in intermittent kilns and in cyclic order in continuous kilns.

Tests and Procedures: The following tests are conducted:

1. Compressive strength test
2. Water absorption test

Compressive strength test

Objective: Determination of compressive strength of bricks

Apparatus used: UTM compression testing machine

Procedure:

1. Unevenness observed in the bed faces of bricks is removed to provide 2 smooth and parallel faces by grinding. It is immersed in water at room temperature for 24 hours.
2. The specimen is then removed and any surplus moisture is drained out at room temperature.
3. The specimen is placed with flat faces horizontal, and placed carefully centered between plates of testing machine.
4. Load is applied axially at a uniform rate of 1KN till failure occurs. The maximum load at failure is noted down. The load at failure is considered the maximum load at which the specimen fails to produce any further increase in the indicator reading on the testing machine.
5. The compressive strength is calculated by using

Compressive strength (N/mm²) =Maximum load at failure in n Cross sectional area (mm²)

Water absorption test on bricks

Objective: To determine the percentage of water absorption of bricks.

Apparatus used: Balance and ventilated oven

Procedure:

1. Dry the specimen in ventilated oven at a temperature of 105-115 ºC till it attains substantially constant mass.
2. Cool the specimen to room temperature and obtain its weight (M1)
3. Immerse completely dried specimen in clean water at room temperature for 24 hours.
4. Remove the specimen and wipe out any traces of water with damp cloth and weigh the specimen after it has been removed from water (M2)
5. Water absorption can be calculated by using the following formula,

Water absorption = (M2-M1) x 100 %
M1

OBJECTIVES

1. To find the optimum mix design for making bricks and blocks having maximum compressive strength.
2. To utilize sustainable materials which decrease the evolution of greenhouse gases.
3. To compare the strength of lime bricks with standard bricks.

IV. SCOPE OF THE WORK

To cast bricks of the following proportions and conduct tests to determine the properties :

1. Soil with lime (2.5%, 5%, 7.5%, and 10%) (sun dried)
2. Soil with lime (2.5%, 5%, 7.5%, and 10%) (kiln burnt)
3. Soil with lime (2.5%), rice husk ash (12.5%, 25%, 50%) and gypsum (2%) (sundried)
4. Soil with lime (2.5%), rice husk ash (12.5%, 25%, 50%) and gypsum (2%) (Kiln burnt)
5. To find the optimum mix design for making bricks and blocks, achieving maximum compressive strength.
6. Reduce the consumption of cement by utilizing lime, which reduces the greenhouse gases.
7. Achieve economy in the manufacture of bricks and blocks by using pozzolana admixtures such as husk ash.
8. To verify whether the use of sustainable materials such as lime, pozzolana ash and quarry dust in manufacture of bricks and blocks will lead to improvement in their properties.

VI.TEST RESULS

Mix (Lime+ Rice husk ash+ Gypsum+ Quarry dust)

VARIOUS MIX PROPORTIONS IN % BY VOLUME				
Proportions	**Husk ash (%)**	**Lime (%)**	**Gypsum (%)**	**Quarry dust (%)**
I	7.5	37.5	2	53
II	10	35	2	53
III	12.5	32.5	2	53
IV	15	30	2	53
V	20	25	2	53
VI	25	20	2	53

TEST RESULTS FOR MIX:

LIME+ HUSK ASH+GYPSUM+QUARRY DUST

Proportions	**7 days test**		
	Load in N	Strength [N/mm^2]	Mean strength [N/mm^2]
I	26000	1.00	1.03
	27000	1.04	
	27000	1.04	
II	28000	1.08	1.07
	27000	1.04	
	28000	1.08	
III	29000	1.12	1.13
	29000	1.12	
	30000	1.16	
IV	49000	1.89	1.90
	50000	1.93	
	48000	1.85	
V	41000	1.59	1.59
	42000	1.63	
	41000	1.59	
VI	36000	1.39	1.40
	35000	1.35	
	37000	1.43	

Proportions	28 days test		
	Load in N	Strength [N/mm^2]	Mean strength [N/mm^2]
I	63000	2.43	2.40
	68000	2.63	
	62000	2.39	
II	75000	2.90	2.92
	76000	2.94	
	75000	2.90	
III	83000	3.21	3.20
	82000	3.17	
	84000	3.24	
IV	172000	6.65	6.64
	171000	6.61	
	172000	6.65	
V	141000	5.45	5.47
	142000	5.49	
	141000	5.45	
VI	104000	4.02	4.04
	104000	4.02	
	105000	4.06	

VII. CONCLUSION

BRICKS:

1. 1.Bricks with mix proportion of lime (2.5%) achieve maximum compressive strength i.e 7.65 N/mm² which is greater than 7.00 N/mm².
2. 2.Improvement of engineering properties such as light weight.
3. Maintain uniform size, shape of bricks .

LIME BASED BRICKS:

1. 1.Mix proportion IV (husk ash-15%, lime-30%, gypsum-2% and quarry dust-53%) gives maximum compressive strength i.e. 6.64 N/mm² for 28 days.
2. Mix proportion D (husk ash-15%, lime-12%,cement-18% gypsum-2% and quarry dust-53%) gives maximum compressive strength i.e. 14 N/mm² for 28 days .

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NCETAR - 17

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EXPERIMENTAL STUDY ON STRENGTH OF CONCRETE BY COMPLETE REPLACEMENT OF ROBO SAND AND PARTIAL REPLACEMENT OF RICE HUSK ASH

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ABSTRACT

Construction industry relies heavily on conventional materials such as cement and sand for the production of concrete .Due to the shortage of river sand, attempt is being made in this project to use the locally available materials that is Robo sand and also to produce low cost concrete. Rice-husk ash has been used in concrete to reduce the structural weight. In this research rice-husk ash and robo-sand is used as fine aggregate and cement material in concrete and test were conducted for the compressive strength for M20 and M25 concrete by completely replacing the Robo sand up to 100% and rice husk up to 20%. The cost analysis has been comparison is made between a concrete with and without robo sand and rice husk ash .Strength analysed individually and it has been graphically explained.

Keywords: Robo sand ,Rice-husk ash ,Cement ,Fine aggregates, Compressive strength.

I. INTRODUCTION

The concept of complete replacement of fine aggregates and cement with robo sand and rice-husk ash plays an important role in construction felid. Robo sand is used for aggregate material less than 4.75mm that is processed from crushed rock or gravel and intended for construction use. The fineness property of robo sand coincide with river sand and also bulk density of robo sand is sightly more than river sand which will increase the overall density of concrete.

Rice-husk ash is a outer cover of paddy and accounts for 20-25% of its weight. RHA is a pazzolonic material that can be blended with portland cement for the production of durable concrete and at the same time it is a value added product. Addition of RHA to portland cement doesn't only improve the early strength of concrete ,but also form calcium hydrate gel around the cement particles which is highly dense and less porous and may increase the strength of concrete against cracking.

The combination of robo sand and rice husk ash will enhance the workability ,durability and strength of concrete when compared with a concrete having a river sand as a fine aggregates.

. Information about final paper submission is available from the conference website.

II. PROCEDURE

a) Concrete mix is to be designed based on Indian Standard Recommended guidelines.

b) The cement, fine aggregates (robo sand) ,rice husk ash and coarse aggregates are weighed .

c) The concrete mixture is prepared by hand mixing on a watertight platform in dry condition.

d) The water is added carefully accordingly so that no water is lost during mixing.

e) Potable tap water is used for the preparation of concrete and for the curing of specimens.

f) Cubical moulds of size 150mm*150mm*150mm are used to prepare the concrete specimens for the determination of compressive strength.

g) The specimens are allowed to remain in the steel mould for the first 24 hours at ambient condition.

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h) After that these were de moulded with care so that no edges were broken and were placed in the curing tank at the ambient temperature for curing.

i) The ambient temperature for curing was 27 ± 2^0.

Fig.2.1 Concrete Mix

k) The compressive strength of specimen is determined on 7 days, 14 days and 28 days of curing

MIX DESIGN: Concrete mix design is required to achieve target strength in structures. Concrete Mix design of M20, M25, M30 grade of concrete can be calculated from example below.

Data Required for Concrete Mix Design

(i) Concrete Mix Design Stipulation

- Characteristic compressive strength required in the field at 28 days grade designation — M 25
- Nominal maximum size of aggregate — 20 mm
- Shape of CA — Angular
- Degree of workability required at site — 100 mm (slump)
- Degree of quality control available at site — As per IS:456
- Type of exposure the structure will be subjected to (as defined in IS: 456) — Mild
- Type of cement: opc conforming IS:456
- Method of concrete placing : non- pump able concrete

(ii) Test data of material (to be determined in the laboratory)

(a) Specific gravity of cement — 3.15
(b) Specific gravity of FA — 2.50
(c) Specific gravity of CA — 2.48
(d) Aggregate are assumed to be in saturated surface dry condition.
(e) Fine aggregates confirm to Zone II of IS – 456

Estimation of the mix ingredients

a) Volume of concrete = 1 m^3
b) Volume of cement = (Mass of cement / Specific gravity of cement) x (1/100)
= (394.32/3.15) x (1/1000) = 0.125 m^3
c) Volume of water = (Mass of water / Specific gravity of water) x (1/1000)
= (191.6/1) x (1/1000) = 0.1916 m^3
d) Volume of total aggregates = a – (b + c) = 1 – (0.125 + 0.1916) = 0.6834 m^3
e) Mass of coarse aggregates = 0.6834 x 0.62x 2.48 x 1000 = 1050.79kg/m^3
f) Mass of fine aggregates = 0.6834 x 0.38 x 2.50 x 1000 = 649.23kg/m^3

Concrete Mix proportions for Trial Mix 1

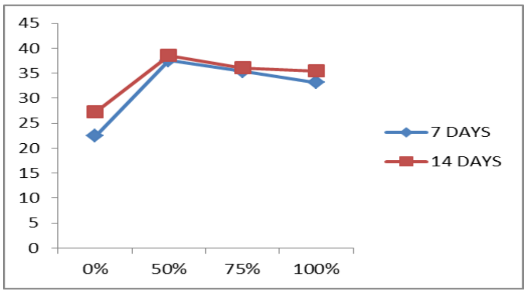
Cement = 383.2 kg/m^3
Water = 191.6 kg/m^3
Fine aggregates = 649.23 kg/m^3
Coarse aggregate = 1050.79 kg/m^3
W/c = 0.5

II. RESULTS

Using robo sand and rice husk ash as a basic ingredient in cement concrete blocks it gave tremendous result, we found that by replacing 100% of fine aggregates with robo sand and partial replacement of rice husk ash with cement gives increase in compressive strength by comparing to the conventional concrete .

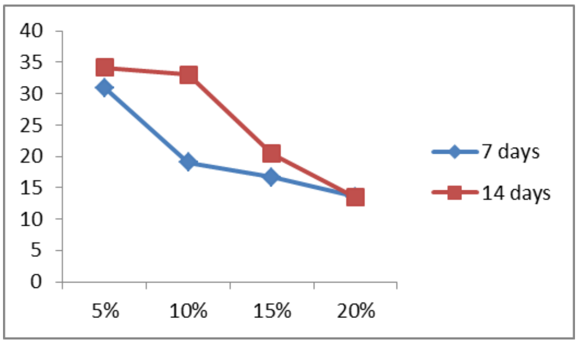
Sl.No	%of replacement of robo sand	Compressive strength at 7 days (N/mm2)	Compressive strength at 14 days (N/mm2)
01	0%	22.43	27.26
02	50%	37.511	38.53

03	75%	35.37	36.08
04	100%	33.15	35.46



Graphical representation of compressive strength

Sl.No	%of replacement of RHA	Compressive strength at 7 days (N/mm2)	Compressive strength at 14 days (N/mm2)
01	5%	30.93	34.13
02	10%	18.97	33.06
03	15%	16.63	20.44
04	20%	13.51	13.48



Graphical representation of compressive strength

FIG.2.2 COMPRESSIVE STRENGTH.

CONCLUSIONS

- Compressive strength of concrete increases by replacing sand with robo sand and cement with rice husk ash.
- Reduce permeability and enhance the durability.
- Reduce the availability of river sand.

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STRUCTURAL PERFORMANCE OF PERVIOUS CONCRETE IN CIVIL ENGINEERING CONSTRUCTION

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ABSTRACT

Pervious concrete is a zero-slump, open graded material consisting of hydraulic cement, coarse aggregate, admixtures and water. Because pervious concrete contains little or no fine aggregates such as sand, it is sometimes referred to as “no-fines” concrete. It is a special type of concrete having a high void content of about 30%, is becoming popular nowadays due to its potential to reduce the runoff to the drainage systems which can provide a water flow rate around 0.34 cm/second.

Pervious concrete has a large open pore structure hence less heat storage and faster. Pervious concrete also find its effective application in low loading intensity parking pavements, footpaths, walkways and highways. The pervious concrete is considered as an Environmental Protection Agency (EPA) for providing pollution control, storm management and suitable development. Here, pervious concrete mix is designed without sand and adding silica fume as an admixture using ACI 522R-06 code, the mechanical strength of the concrete is increased to an extent. The aim of this project is to lay the pervious concrete in platform and car parking thus transmitting the water to the underground surface very easily for maintaining the ground water table even in all the places.

Key Words: Pervious, Air Voids, Drainage, Porosity, Ground Water.

Introduction

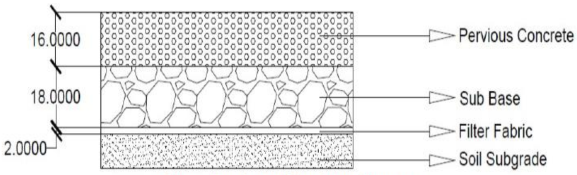
Pervious concrete (also called porous concrete, permeable concrete, no fines concrete and porous pavement) is a special type of concrete with a high porosity used for concrete flat applications allows water from precipitation and other sources to pass directly through, thereby reducing the runoff from a site and allowing groundwater recharge. Pervious concrete is made using large aggregates with little to no fine aggregates. The concrete paste then coats the aggregates and allows water to pass through the concrete slab.

Pervious concrete is traditionally used in parking areas, areas with light traffic, residential streets, pedestrian walkways, and green houses. It is an important application for sustainable construction and is one of many low impact development techniques used by builders to protect water quality.

The basic ingredients of pervious cement concrete mix are not very different from the conventional cement concrete mix, except in the proportion of ingredients. The main ingredients are cementations material, water, aggregate and if required, admixtures. The initial use of porous concrete was in the United Kingdom in 1852 with the construction of two residential houses and a sea groaned. Cost efficiency seems to have been the primary reason for its earliest usage due to the limited amount of cement used. It was not until 1923 when porous concrete re surfaced as a viable construction material.

This time it was limited to the construction of 2-story homes in areas such as Scotland, Liverpool, London and Manchester. Use of porous concrete in Europe increased steadily, especially in the World War II era. Since porous concrete use less cement than conventional concrete and cement was scare at that time.

It seemed that porous concrete was the best material for that period. Porous concrete continued to gain popularity and its use spread to areas such as Venezuela, West Africa, Australia, Russia and the Middle East. After World War II, porous concrete became wide spread for applications such as cast-in-place load-bearing walls of single and multistory houses and, in some instances in high-rise buildings, prefabricated panels, and stem-cured blocks. Also applications include walls for two-story houses, load-bearing walls for high-rise buildings (up to 10 stories) and infill panels for high rise buildings.



Cross Section of Pervious Concrete

MATERIAL COLLECTION

Cement: Ordinary Portland cement, 53Grade conforming to IS: 269 – 1976.Ordinary Portland cement, 53Gradewas used for casting all the Specimens. Different types of cement have different water requirements to produce pastes of standard consistence. Different types of cement also will produce concrete have a different rates of strength development. The choice of brand and type of cement is the most important to produce a good quality of concrete. The type of cement affects the rate of hydration, so that the strengths at early ages can be considerably influenced by the particular cement used. It is also important to ensure compatibility of the chemical and mineral admixtures with cement.

Coarse Aggregate: Locally available crushed blue granite stones conforming to graded aggregate of nominal size 12.5 mm as per IS: 383 – 1970. Crushed granite aggregate with specific gravity of 2.77 and passing through 4.75 mm sieve and will be used for casting all specimens. Several investigations concluded that maximum size of coarse aggregate should be restricted in strength of the composite. In addition to cement paste – aggregate ratio, aggregate type has a great influence on concrete dimensional stability.

Silica Fume: Obtained from ELKEM India (P) Ltd.,Navy Mumbai conforming to ASTM C 1240 as mineral admixture in dry form. Silica fume is one of the artificial pozzolanas, commonly used as mineral admixture. Silica fume is very fine non- crystalline silica, produced in electric arc furnaces, as a byproduct of the production of elemental silicon or alloys containing silicon also known as condensed silica fume or micro silica. There are two reactions in the silica fume, Pozzolanic reactions are, Silica fume reacts with the calcium hydroxide, which is liberated during process of Hydration, about 22-24 percent and produces calcium-silicate-hydrate (C-S-H). The following are the chemical reactions that are taking place.

The second function silica fume performs in cementations compounds is a physical one. Because silica fume is 100 to 150 times smaller than cement particle it can fill the voids created by free water in the matrix. This function, called particle packing, refines the microstructure of concrete, creating a much denser pore structure. Impermeability is dramatically increased, because silica fume reduces the number and size of capillaries that would normally enable contaminants to infiltrate the concrete. Thus silica fume modified concrete is not only stronger, it lasts longer, because it's more resistant to aggressive environments. As a filler and pozzolan, silica fume's dual actions in cementitious compounds are evident throughout the entire hydration process.

Water: Casting and curing of specimens were done with the potable water that is available in the college premises.

FLEXIBLE PAVEMENT VS PERVIOUS PAVEMENT

Flexible pavement

- Deformation in the subgrade is transferred to the upper layers
- Design is based on the load distributing characteristics of the component layers
- Have low flexural strength

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- Load is transferred by grain to grain contact
- Have low completion cost but repair cost is high
- Have low life span (high maintenance cost)
- Surfacing cannot be laid directly on the subgrade but a sub base is needed
- No thermal stress is induced as the pavement has the ability to contract and expand freely. That's why expansion joints are needed
- Strength of the road is highly dependent on the strength of the subgrade
- Rolling of the surfacing needed
- Road can be used for traffic with in 24hrs
- Force of friction is less deformation in the subgrade is not transferred to the upper layers
- Damaged by oils and certain chemicals

Pervious Pavement

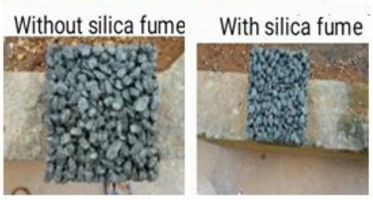
- Deformation in the subgrade is not transferred to subsequent layers
- Design is based on flexural strength or slab action
- Have high flexural strength
- So such phenomenon of grain to grain load transfer exist
- Have low repair cost but completion cost is high
- Life span is more when compared to the flexible pavements (low maintenance cost)
- Surfacing can be directly laid on the subgrade
- Thermal stresses are more vulnerable to be induced as the ability to contract and expand is very less in concrete. That's why expansion joints are needed
- Strength of the road is less dependent on the strength of the subgrade
- Rolling of the surfacing is not needed
- Road cannot be used until 14 days of curing
- Force of friction is high
- No damage by oils and greases

NEED FOR PERVIOUS PAVEMENT DESIGN

- Joints are designed to take care of the environmental stresses
- Thickness of the pervious pavement slab is decided based on the following two points:
- The maximum bending tensile stress resulting out of maximum wheel load stress and critical environmental stress should be less than the flexural strength of concrete
- The Pervious Concrete pavement should withstand the expected number of repetitions of axle loads during its design life.

ADVANTAGES OF PERVIOUS CONCRETE

- Recharge of local aquifer
- Water budget retention and pollution removal
- Less need for storm sewer
- Green building alternative suitable for many applications
- Natural run-off allows rainwater to drain directly to sub-base
- Reduced construction requirements for drainage structures
- Reduced pollution prevents environmental damage
- Protects streams and lakes and allows local vegetation to thrive.



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Compression test result

The result show before starting the experiment

Trails	With silica fume (1:4)	Without silica fume(1:4)
@3 days cross section (N/nm$^{2)}$	2.5	2.31

This result shows while main work done

slno	Mix proportion	@3days (N/nm$^{2)}$	@7days (N/nm$^{2)}$
1	1:4	2.5	2.7
2	1:6	2.3	1.6

CONCLUSION

The smaller size of coarse aggregate should be able to produce a higher compressive strength and at the same time produce a higher permeability rate.

The mixtures with higher aggregate /cement to be useful for a pavement the requires low compressive strength and permeability rate.

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ANALYSIS, DESIGN, ESTIMATION & VALUATION OF A RESIDENTIAL BUILDING

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ABSTRACT

In order to compete in the ever growing competent market, it is very important for a structural engineer to save time as a sequel to this an attempt is made to analyze and design a residential building by using software packages STAAD pro and AutoCAD. For analysis and design of a residential building one has to consider all the possible loadings and see that the structure is safe against all possible loading conditions. There are several methods for analysis of different frames like Kanis method, cantilever method, portal method and matrix method. Design is done using limit state design method.

The present project deals with the Analysis, Design, Estimation and Valuation of residential building of G+2. The dead load and live load are applied and the designs for columns, slabs, beams, staircase and footing are obtained. Estimation is done using center line method. STAAD pro with its new features surpassed its predecessors and competitors with its data sharing capabilities with other major software like AutoCAD and MS Excel. We conclude that STAAD pro is a very powerful tool which can save much time and is very accurate in analysis and design. Design is done using AutoCAD also.

Keywords: Analysis, Design, STAADPRO, AutoCAD, Estimation, Structural designing.

1. INTRODUCTION

1.1 General:Objective of our project is to know the various design aspects like planning, analysis, design, estimation and valuation. So we are designing a residential building of three floors(G+2).The planning is done as per the requirements and regulations given by the Bengaluru International Airport Area Planning Authority (BIAAPA).

1.2 Planning considerations: We used AutoCAD for planning and detailing. The proposed site area is 503sq.meters.The residential building is of rectangular shape in plan. This building consists of ground floor, first floor and second floor. Major setbacks are provided along the sides of building for parking etc. Floor height of the building is kept 3.3m and the height of parapet wall is 0.9m.The staircase is provided with good space.

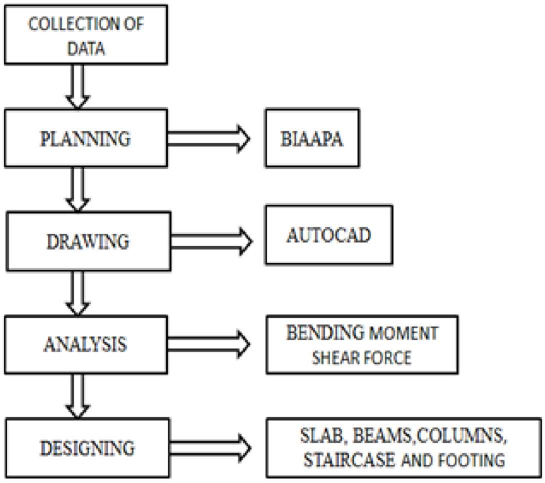
Area of each floor given below:

Ground floor = 155 sq. meters First floor = 155 sq. meters Second floor = 119 sq. meters Total area = 429 sq. meters

2. Literature survey:

V.Varalakshmi: The design and analysis of multistoried G+5 building at Kukatpally, Hyderabad, India. The Study includes design and analysis of columns, beams, footings and slabs by using well known civil engineering software named as STAAD.PRO. Test on safe bearing capacity of soil was obtained. P.Jayachandran: The design and analysis of multistoried G+4 building at Salem, Tamilnadu, India. The study includes design and analysis of footings, columns, beams and slabs by using two software's named as STAAD PRO and RCC Design Suit.

3. Methodology



4. Specifications

4.1 Footing: Depth of 1.5m is proposed for foundation in earthwork excavation below ground level. The safe bearing capacity of soil is taken as 245KN/m2 for design. Isolated footings are provided with M25 grade of concrete. The ultimate load of 1260KN is taken from analysis result for the design of the isolated footing.

4.2 Damp proof coarse:Around the plinth level damp proof coarse is provided with C.M 1:6 with a thickness of 20mm.Also the column below the ground level are provided with damp proof coarse of CM 1:6.

4.3 Plinth beam:Plinth beam is provided above ground level with M25 grade of concrete and Fe415 steel.

4.4 Frames:Reinforced cement concrete (RCC) structural components are designed using M25 grade of concrete and Fe415 steel. Separate loading condition is considered for each member in design and its location as per IS 456-2000 and SP-16 codes. Slab, beam, column and footing dimensions are designed as IS 456-2000 code. Column is designed as per the design codes given in SP-16 Load was taken from STAAD pro analysis results.

4.5 Super structure:Burnt brick masonry in CM 1:6 is used with wall thickness of 0.23m and partition walls of brick masonry in CM 1:6 of thickness0.115m.

4.6 Roof:RCC Roof is to be laid with M25 grade of concrete. Jelly cement concrete is to be used to resist weathering action. Design of roof slab is not same as ground or first floor slab.

4.6 Flooring:Rooms in each floor are to be provided with P.C.C. 1:4:8 as flooring base. Materials used in flooring are granite or basalt or trap jelly concrete (40mm).

4.7 Plastering:Walls and structural members will be plastered smooth with C.M.1:4 internally and externally, using 20mm thick plastering mortar.

4.8 Doors and windows:All the doors are to be provided with wood. The windows are provided with wood and glazing is provided to supply a good light from outside.

4.9 Staircase:Dog-legged staircase is provided with M25 grade of concrete and Fe415 steel with a rise of 150mm and tread of 230mm.Design of staircase is done using IS 456-2000.

4.10 Prime coat, distemper painting, painting:All the walls are coated first with prime coat or distemper then coloring as required. Iron works and wood works are to be finished with synthetic enamel paint. Mat finishing is to be provided over toilet walls.

5. Design:

To save time and to avoid confusion proper nomenclature should be given to floors, frames and designing elements for designating structural members. Two methods are used to design structural elements; they are working stress method and limit state method. In working stress method structures are designed to its elastic limit, whereas in limit state method structural members are designed up to its plastic limits. We adopted the limit state method for designing all the structural elements of our project.

5.1 Design of slab:We have designed two types of slabs namely floor slab and roof slab. Slabs may be either one way or two way slabs. Roof slab is on the top of building also known as terrace. Most of the time except few occasions terrace remains empty and hence less live loads. Terrace slab is designed by taking following loads:

Self-weight of slab = (0.15*25) = 3.75 KN/m 2Weather proof concrete = (0.02*9.9) = 0.25 KN/m2 Ceiling plastering = (0.012*20.4) = 0.25 KN/m^2

live load = 1KN/m^2

For floor slabs live loads are more as compared to roof slab. For designing floor slab, following loads are taken into consideration: self-weight of slab = (0.15*25) = 3.75 KN/m^2

flooring =1KN/m^2

ceiling plastering = (0.012*20.4) = 0.25KN/m^2 weight of partition walls = 2KN/m^2

live load = 2KN/m^2.

The above loads are taken into consideration as per IS 875- 1987, PART 1&2 codes.

5.2 Design of beams: A reinforced concrete beam should be able to resist tensile, compressive and shear stresses as induced in it by the loads on the beam. Due to low tensile strength concrete beams are thus limited in carrying capacity. Reinforced concrete beam is made by the provision of reinforcement in tension zone to overcome the tensile weakness of concrete, because steel is very strong in tension.

Maximum bending moment of the section is compared with the calculated Mulim of the given section. If Muis less than Mulim, the section is designed as a singly reinforced section. Calculation of Mu/bd2 is done and percentage of steel required in tension and compression corresponding to grade of steel is obtained from SP 16.Using the provisions laid down in clauses 26.5,40.1 and 40.3 of IS 456-2000.

Types of reinforced concrete beams:

a) Singly reinforced beams

b) Doubly reinforced beams

c) Flanged beams

5.3 Design of column:Column may be defined as a structural member which carry direct axial load which causes compressive stresses of such magnitude and these stresses largely control its design. In columns the loads and moments are different in frames. All the columns are designed separately. Strength of material, shape and size of the cross section are the factors on which strength of column depends. A column may be square, rectangular, circular or polygon in cross section. Columns undergo axial loads(Pu) and uniaxial bending moment (Mu).Columns are designed above and below the beam column joint and larger of the two reinforcements are provided.IS 456-2000 and SP-16 codes are followed for designing columns.

Table 1: Column schedule

Column type	Mix	Size	Main steel	Column numbers
Group 1	M25	0.3x.4m^2	4#16	5
Group 2	M25	0.3x.4m^2	4#16	4
Group 3	M25	0.3x.4m^2	4#16	4
Group 4	M25	0.3x.4m^2	4#16	1

5.4 Design of footing: Structural members that transfer loads from the building or individual column to the earth are called foundations. Foundations are designed to prevent excessive settlement and to provide adequate safety against sliding and overturning only when the loads are properly transmitted. We done design of isolated footing by taking safe bearing capacity (SBC) of soil as 245KN/m2 and provisions laid down in IS 456-2000 and SP-16 codes.

Table2: Design of footing

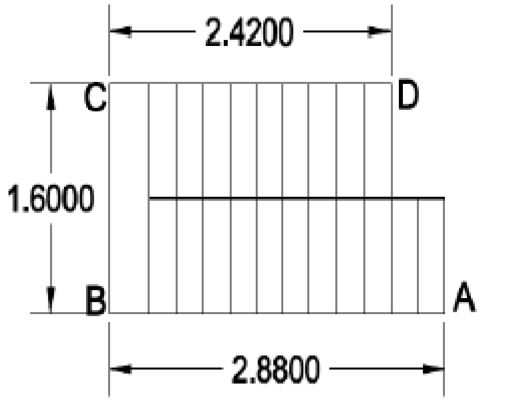
Footing type	Mix	Size	Reinforcement	Footing depth
1	M25	1.2x1.2m^2	6#16 mm ϕ Both ways	0.40m
2	M25	1.5x1.5m^2	8#16 mm ϕ Both ways	0.52m
3	M25	2.1x2.1m^2	12#16 mm ϕ Both ways	0.55m
4	M25	2.3x2.3m^2	16#16 mm ϕ Both ways	0.60m

5.5 Design of staircase: In a building the purpose of staircase is to provide pedestrian access to different floors. Steps in stairs are arranged in series and requires good and careful consideration. In our project we designed Dog-legged staircase.

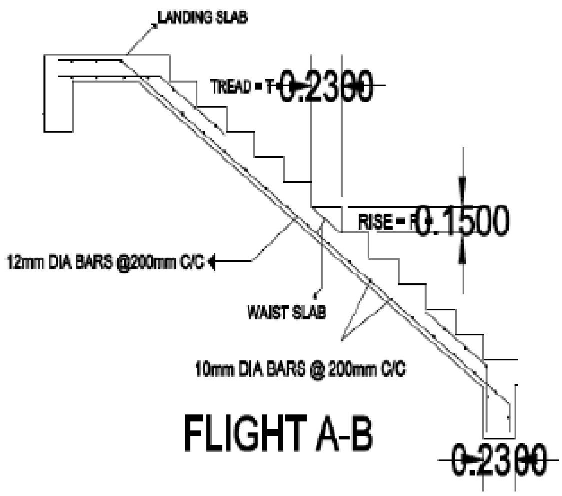
We assumed rise =150mm and tread =230mm, no. of risers =3300/150=22.

So for flight-1:12 and for flight-2:10

For staircase provide 12 mm ϕ bars @300 mm c/c as main reinforcement and 10mm ϕ bars @300 mm c/c as distribution reinforcement.



PLAN OF DOG LEGGED STAIR-CASE



FLIGHT A-B

6. Cost estimation

Estimation: An estimate is the anticipated or probable cost of work and is usually prepared before the construction is taken up. Before undertaking any work or project it is necessary to know is probable cost which is obtained or derived by estimating. The estimate is prepared by computing or calculating the quantities required and then calculating the cost at suitable rates, to get the expenditure likely to be incurred in the construction of the work or structure.to make out an estimate for a work the data necessary are- drawings(plans, sections, etc…), specifications and rates.

Types of Estimate-

1) Preliminary estimate
2) Plinth area estimate
3) Cube rate estimate
4) Approximate quantity, method estimate
5) Detailed estimate
6) Revised estimate
7) Supplementary estimate
8) Supplementary and revised estimate
9) Annual report estimate

Valuation: Valuation is a technique of estimating or determining the fair price or value of a property such as building, factory and other engineering structures of various types, land etc. by valuation the present value of a property is determined. The present value of property may decide by its selling price, income or rent it may fetch. The value of property depends on its structure, life, maintenance, location, bank interest, legal control etc. The value also depends on supply on demand and the purpose for which valuation is required.

CONCLUSIONS

In our project we have analyzed and designed various structural elements (slabs, beams, columns, footing etc.) of a residential building consisting of ground , first and second floor(G+2) situated at Yelehanka, Bengaluru using STAAD PRO and AutoCAD software. Live loads and dead loads are calculated using IS 875-1987 and various design provisions have been taken from IS 456-2000 and SP-16.we have also done the estimation and valuation of the structure which gives us probable cost that we are going to invest in the construction of structure.

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Estimation of Materials Required For Residential Buildings Using Ms Office Excel

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ABSTRACT
Estimation is the art of forecasting the probable cost of the proposed buildings. Estimation helps to find out the quantities of various materials required as well as the labour force necessary to carry out the construction activities. The preparation of estimates is complex in nature and it takes time for the preparation of detailed estimate. However an approximate estimate is required in many cases such as preliminary studies, tax calculations, estimation of loan requirement, etc. An attempt has been made during the study to establish a relationship between the plinth area of buildings and material requirement. Detailed estimates were prepared using M.S.Excel spread sheet for buildings. The quantity of bricks, cement bags, timber, sand and coarse aggregate required were found out. The materials required per unit area of residential buildings have been worked out. Graphs have been prepared which will help to estimate the approximate quantities of materials required for single bed, double bed and three bed room houses. Spreadsheets have also been developed to find out the quantities of material required for septic tank, overhead water tank and doors. Graphs have been prepared which help in estimating the approximate amount of various materials required for these miscellaneous structures.

Keywords : Estimation, Construction Materials, MS Excel.

I. INTRODUCTION

Estimation is the art of predicting the probable cost of the proposed buildings. The process of preparing an estimate consists of two stages namely

- Taking out quantities and
- Abstracting.

The procedure by which the quantities of the various items in a particular structure are worked out is known as taking out quantities. The quantities are obtained from the drawings of the building. The unit of measurement of quantities depends on the size and shape of the particular item. If the item of work has considerable dimensions in the x, y and z planes, the unit of that item will be measured in m^3. If the item has one dimension which is small compared to the other two dimensions, the unit of measurement will be in square meter. Example for this category of item is plastering. If any item has two dimensions which are smaller compared to the other dimension, the unit of measurement will be in running units. For some of the items such as grill work, steel etc, the unit of measurement will be in kilograms.

A. Rate Analysis: The process of determining the rate of an item is known as rate analysis. Rate analysis will help to determine the cost of an item per unit quantity. The rate of an item depends on the cost of the materials and cost of labour.

The quantities of materials required for an item can be worked out based on the specification of that item. However the cost of the materials will vary from place to place and time to time. Hence the details of the material cost and the transportation cost, loading and unloading charges if any etc are to be collected to arrive at the rate of any item.

The amount of labour force required to carry a particular item is to be known in order to estimate the cost of labour for an item. The quantum of work done by the labour force depends on the efficiency of the labour. The wages of labour also vary from place to place and time to time. Hence knowledge about the labour force and the details of the wages are essential in order to work out the rate of any item.

B. *Schedule of Rates:* Schedule of rates is an important document prepared by agencies like central public works department or public works department. The CPWD schedule of rates contains the rates of materials, labour, transportation charges etc, for more than 3000 items which are commonly used in buildings, road work, water supply and drainage works. Due to the charges in the market rates, the schedule of rates needs to be revised periodically.

II. PLANNING AND DESIGN OF BUILDINGS

A building used for dwelling purposes is known as residential building. The residential buildings need to be planned according to the needs of the occupants and also according to available funds. The residential buildings are to be planned on the basis of a family as a unit. However , the number of family members, their age, and relationships, vary largely and thus the requirements in accommodation vary from family to family and from one income group to another income group.

A residential building such as a bungalow or a flat can be divided into three major areas. They are:

- Living area
- Sleeping area
- Service area

1. Living area: The area is for general use. Hence the living and drawing room should be planned near the entrance. It should be planned taking into view the following considerations.

i) It should not provide direct passage/access to the bed room and W.C. or bath.

ii) It should be adjacent to the dinning room.

iii) It should be comfortable and spacious in order to accommodate furniture and also allow proper circulation area.

iv) It should be sufficiently lighted and offer an attractive view of the surrounding landscape, garden, etc.

v) It should have a southern and northern aspect.

2. Sleeping area: This area provides bed rooms for sleeping and relaxing. Bed rooms may be with attached toilets. Their size depends upon the number of beds. They should be located so as to give privacy and should accommodate beds, easy chair, cup boards etc. They should have a North-West or South-West aspect.

3. Service area: This area includes the kitchen, dinning room, bath room, W.C.

- *Kitchen:* It may be adjacent to the dinning room or seprate. It consists of a cooking area, i.e. kitchen, otta, sink, and cup board ; It should have an eastern north-eastern aspect.
- *Dinning*: This room may be attached to the living room or to the kitchen. It is a room in which meals are served. Kitchen activities should be screened from the dinning area by means of cup-boards or a screen. A service window may be provided between the kitchen and dinning room.
- *Bath* and W.C.: They should be approachable from all the rooms. Dadoes or glazed tiles should be provided or otherwise walls should be finished with smooth water-proof cement. They should also be provided with necessary fixtures. Size and type of W.C. pans, wash basin, electrical installations for hot water, plumbing fixtures, etc. control the size of the bath room and W.C.
- *Other* rooms: Other rooms such as office, pooja room, study etc. may be suitably located near the living room, bedroom or kitchen.

During the present study, excel spread sheets were prepared to estimate the quantities of bricks, cement bags, fine aggregate, coarse aggregate, etc., for single, double and three bed room residential houses. Using these spread sheets, the quantities were worked out for a number of houses with varying plinth area. From these data, the quantities of materials required per unit area have been worked out. Regression equations were developed using which, one can approximately get the

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quantities of materials required for residential buildings.

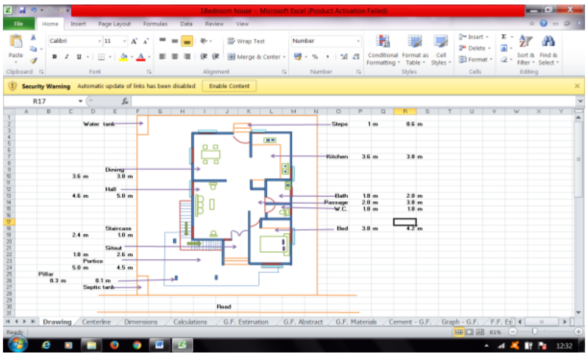

Fig. 1 Sample of Single Bed Room House

This building consists of a sitout, living room, dining room, kitchen, bedroom, bath room and W.C. It has six doors and nine windows.

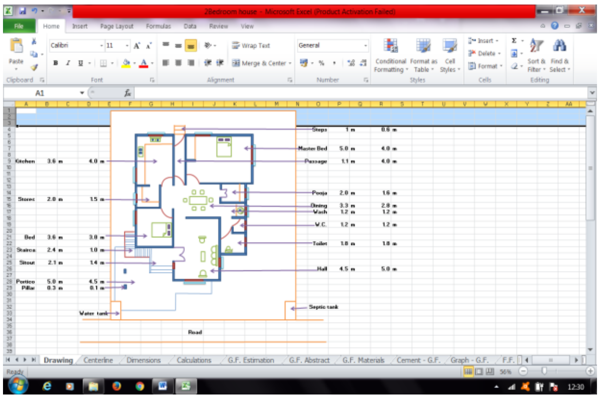

Fig. 2 A typical plan of a Double Bed Room House

This building consists of a sitout, living room, dinning room, kitchen, bedroom, bath room and W.C. It has eight doors and eleven windows.

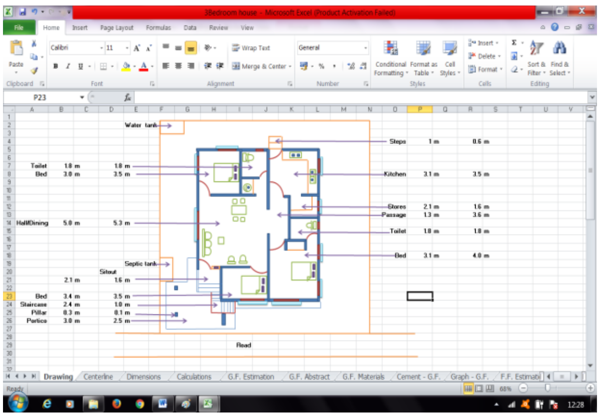

Fig. 3 Plan of Three Bed Room House

This building consists of a sitout, living room, dinning room, kitchen, bedroom, bath room and W.C. It has eight doors and ten windows.

The plan of a septic tank is shown in fig.4. It has estimated and results have been evaluated through graph.

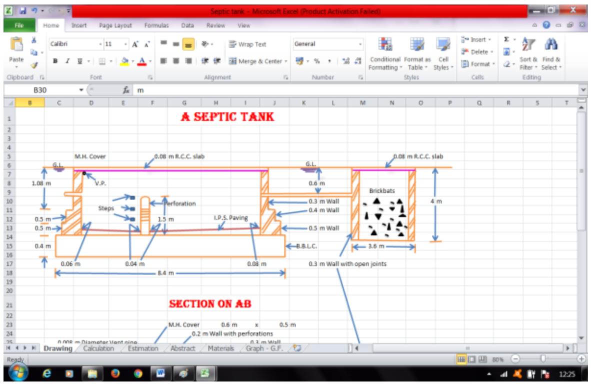

Fig. 4 Plan of a Septic Tank

The dimensions of the house and septic tank can be varies and the detailed estimation can be prepared using the excel sheets.

III. RESULTS

A detailed estimate has been prepared for the single, double and triple room house using a Microsoft Excel spread sheet. The estimate consists of 48 items.

The dimensions of the rooms and the veranda were changed and the quantities of various items have been worked out for 150 plans. Graphs showing the variation of materials like bricks, cement, coarse aggregate, fine aggregate have been plotted with respected to the plinth area. In order to see the variation of wall area with respect to plinth area, graphs have been plotted. Another set of graphs showing the material requirement with respect to the area/ perimeter ratio has also been plotted. The developed Excel spread sheet has been verified with the text book problem and it was found that the material requirement estimated by the spread sheet was in agreement with that of the values given in the text book. The requirement of bricks, cement, coarse aggregate and fine aggregate with respect to plinth area are shown respectively in Fig.5, Fig.6, Fig.7, Fig.8 and Fig.9.

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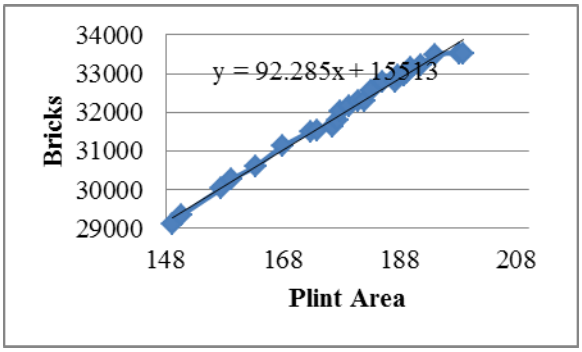

Fig. 5 Requirement of Bricks verses Plinth Area

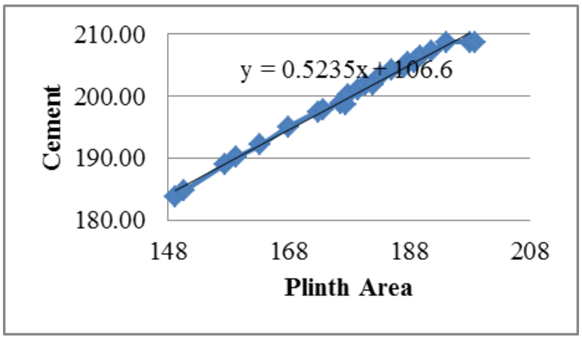

Fig. 6 Requirement of Cement verses Plinth Area

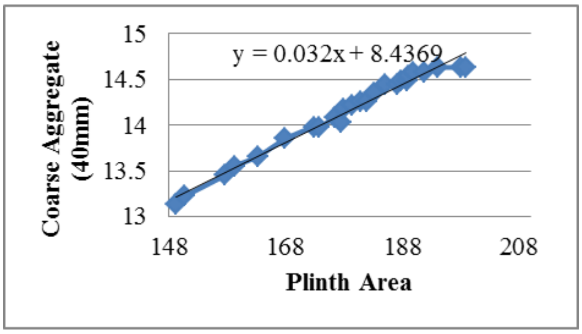

Fig. 7 Requirement of Coarse Aggregate (40mm) verses Plinth Area

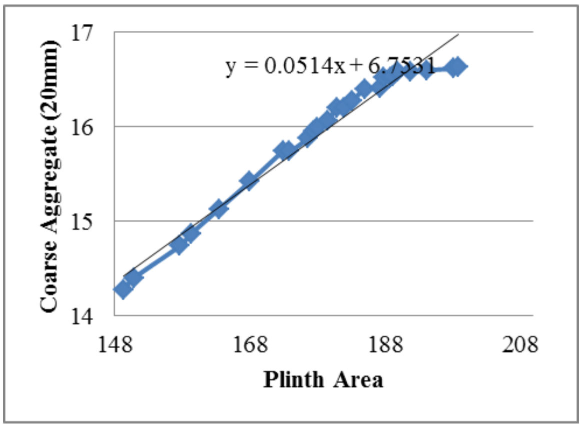

Fig. 8 Requirement of Coarse Aggregate (20mm) verses Plinth Area

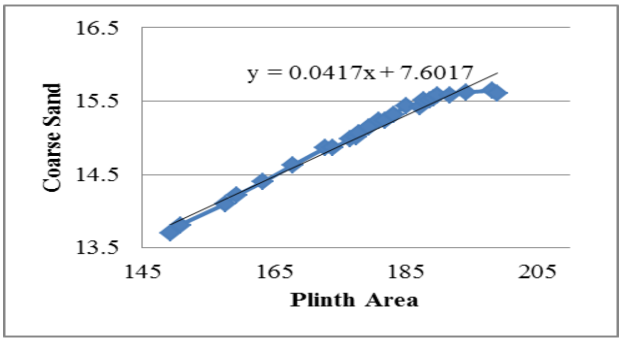

Fig. 9 Requirement of Coarse Sand verses Plinth Area

IV. CONCLUSIONS

An excel spread sheet has been developed to prepare the estimate and quantity of materials required for residential buildings. Regression equations were developed to estimate. The quantities of materials required for the construction of various building materials. This sheet will be useful for practicing engineers.

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APPLICATION OF OUTRIGGER IN HIGH RISE BUILDINGS TO REDUCE FUNDAMENTAL TIME PERIOD

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ABSTRACT

Tall building development has been rapidly increasing world-wide introducing new challenges that need to be met through engineering judgment. In modern tall buildings, lateral loads induced by wind or earthquake are often resisted by a system of coupled shear walls. But when the building increases in height, the stiffness of the structure becomes more important and introduction of outrigger beams between the shear walls and external columns is often used to provide sufficient lateral stiffness to the structure. The main objective of the project is to reduce the fundamental time period in case of slender high rise buildings by using outrigger criterion. The outrigger is commonly used as one of the structural system to effectively control the excessive drift due to lateral load, so structural damage can be minimized. For high rise buildings, particularly in seismic active zone or wind load dominant, this system can be chosen as an appropriate to structure. The fundamental time period of a building is essential to calculate the design base shear and lateral forces. Most seismic codes specify empirical formulae to estimate the fundamental vibration of the buildings.

I. INTRODUCTION

Mankind has always fascinated for height and throughout our history, we have constantly sought to metaphorically reach for the stars. From the ancient paramedical era to today's modern technological era power and wealth of a civilization or country has been repeatedly expressed through spectacular and monumental structures. Today, the symbol of economic power and leadership is the skyscraper. There exists a demonstrated competitiveness in mankind to proclaim to have the tallest building in the world. In ancient pyramidcal era the huge structures are build only to express the power and wealth of the civilization or kingdom. But in the present era development of skyscrapers is not only to express power and wealth but also to meet the scarcity of living space within the cities. Last few centuries particularly from the late 19th century saw a skyscraper height race with the completion of 30 storey Park Row Building in New York city in 1899. This height race reached to the new heights in 1931 with the completion of 102 storey Empire State Building. Today this phenomenon of skyscraper has come out of U.S.A and so called "American Building Type" is now a worldwide architectural trend. Now Asian countries have largest share of skyscrapers in the world. According to the emporis.com the Asian countries shares 32.2% of the tall building in the, most of them in China. The report also said that the number of 200m-plus buildings has increase from 261 to 830, from the year 2000 to 2013. An astonishing increase of 318% in just time period of 13 year. This kind of increase is due to the mass flow of population from the village to the cities. Also due to the increase in the increase in quality of mass transportation system and safety measures of the government. Because increase in capacity of mass transportation and safety measures from the governmental side will definitely increase the

FSI(Floor Space Index) of the cities and thus will lead to the increase in the number of stories.

This undying pursuit for conquering heights has laid out incredible opportunities for the building profession in India also. From the early moment frames to today's ultra efficient mega-braced structures, the structural engineering profession has come a long way. The recent development of structural analysis and design software coupled with advances in the finite element method has enabled the creation of many architecturally innovative and structurally challenging skyscrapers.

However, increased reliance on computer analysis is not the solution to the challenges that lie ahead in the profession. The basic understanding on behavior of structure while leveraging on computer software and modern instruments are the essential elements that will definitely change basic concept in designing and building the structures.

The fundamental criteria in the design of skyscrapers or any other structures are strength, serviceability and stability. Here both physical and psychological comfort of the inhabitants of the building should also be considered primarily. Because it is people feeling the motion, not that building is going to fail. So psychologically making the people comfortable is main factor. According to the guidelines of the Indian Standard codes stability and strength criteria is met by the ultimate limit state design method and serviceability applies to the short term and long term deflection whole structure.

II. NEED OF INCREASE IN LATERAL STIFFNESS OF STRUCTURE

Lateral loads imposed on the structure is the governing factor in designing of any high rise building. As buildings go taller and narrower, the structural engineers will be increasingly challenged to meet the imposed lateral drift at top due to wind and earthquake loads. In response to this challenge, the professionals across the has proposed a great number of schemes that are now practiced designing and construction of skyscrapers.

The rapid increase in the development of high rise building is introducing new challenges to the structural engineers that need to met with pure engineering judgment. Usually in buildings taller than certain height wind or earthquake induced lateral forces are resisted by a system of coupled shear walls or core walls. But when the building increases in height, moment resisting frames or core wall will not function adequately or may fail to provide sufficient lateral resistance to wind and earthquake because of inadequate lateral stiffness.

Thus in this case stiffness of the structural elements and whole structure becomes more important. That is when the aspect ratio of the building is more than four

The probability of increase in lateral stiffness of the building by increasing the size of the structural elements is not possible. Because the structure will not function its intended architectural purpose. Thus have to look for other solutions to increase overall stiffness of the building. In this study the outrigger is considered in increasing the overall stiffness of the building by reducing the fundamental time period of the building.

III. NEED FOR THE PRESENT STUDY:

High land value and increased FSI is forcing the builders and architects to design extraordinary slender and dense apartment complex. Also builders want to exploit the maximum permissible FSI. Thus in this process there arise a challenge of lateral stability of building system against the wind and earthquake forces. Fundamental time period and the drift ratios should be well with the limit suggested in code for better performance of the building system. All this should be in a very cost effective way. Considering all the parameters mentioned above outrigger system is considered to be most effective system.

Objective

- Facilitate construction of the multistorey skyscraper buildings wherein the high FSI (Floor Space Index) is there with lesser space of the ground area for e.g. Newyork, London, Tokyo, Mumbai, Bangalore etc.
- To reduce the fundamental time period of the building.

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- To stiffen the building by providing the bracings so that the drift ratios and deflections shall reduce during the event of earthquake and wind.
- To redistribute the forces from the shear walls or core walls to columns so that the differential axial shortening effect of the high rise building gets reduced.

IV. METHODOLOGY

- Study the Architectural design and align the structural elements to suit from the structural
- engineering point of view.
- Create the framing plan.
- Create the mathematical model in internationally rated F.E.M software (Etabs).
- Assign dead load, live loads, wind loads and earthquake loads.
- Performing the analysis with linear static and dynamic natures of the loads.
- Finding out the lateral stability of the building and assist the major effects as stated below.
  - i. Fundamental time period of the building, 0.1x N (Whereas N= number of floors)
  - ii. Wind deflections and seismic drifts of the building.
  - iii. Overall building deflection and its effect on the structural stability for short term and long term
  - iv. Analyse the different ways of reducing the drift and deflection of the building.

As stated above the conceptually same four example model is modelled using the Etabs software. The four models are created and analysed for the better understanding of the variation of the Fundamental time period with increase in height. The trial and error method is adopted for finding optimum position of outriggers in the structural systems.

Except increase in height there is no variation in the plan dimensions in the models. There is no discontinuity in the core wall or shear wall. table 3 shows the geometry of the building systems and height of the building system and figure 6 and figure 7 shows the 3 dimensional view and plan of example model with 30 stories.

Table 3.1: Structural dimensional details of the example models.

No. of Storey	30 storey	40 storey	50 storey	60 storey
Height of Building	89 m	119 m	149 m	179 m
Dimension in X-direction	10.5	10.5	10.5	10.5
Dimension in Y-direction	17.5	17.5	17.5	17.5
Typical Storey height	3m	3m	3m	3m
Height of Story just above foundation	2m	2m	2m	2m

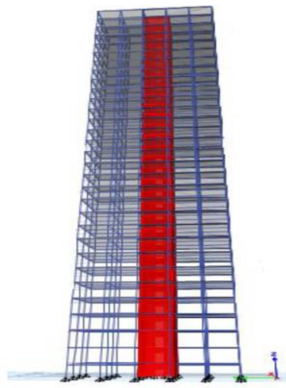

Fig3.1: 3D view of 30 storey building system

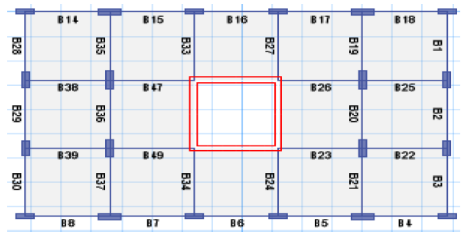

Fig3.2: plan of Example model building system

Table 3.2: Summary of material properties used in example model.

Name	Type	E MPa	V	Unit Weight kN/m³	Design Strengths
A615Gr60	Rebar	199947.98	0.3	76.9729	Fy=413.69 MPa, Fu=620.53 Mpa
M25	Concrete	25000	0.2	24.9926	Fc=25 MPa
M30	Concrete	27386.13	0.2	24.9926	Fc=30 MPa
M50	Concrete	35355.34	0.2	24.9926	Fc=50 MPa

In the designation of concrete name 'M' refer to the mix and the number to the specified compressive strength of 150 mm size cube at 28 days. The geometry and the properties (grade) of concrete of the structural elements in the structural system is changed as increase in height. This is to imitate real procedure in the site and to get accurate value of the fundamental time period for corresponding structural system. The cross-section of columns and the beams of the building are such that the reinforcement percentage is well within 0.8 to 2% of cross-sectional area.

Table 3.3: Summary of shell section used in example model.

Name	Design Type	Material	Element Type
S 120mm	Slab	M30	Shell-Thin
SHEARWALL	Wall	M30	Shell-Thin

The table 3.5 shows the Frame section properties of the models.

Name	Material
B 200X600	M50
B 300X2000	M50
C 250X300	M50
C 250X350	M50
C 250X400	M50
C 250X450	M50
C 250X500	M50
C 250X600	M50
C 250X700	M50
C 250X800	M50
C 250X900	M50
C 300X800	M50
C 300X900	M50
C 350X900	M50
C 400X1000	M50
C 400X900	M50
C 500x1000	M50
C 600X1000	M50
C 600X1200	M50
C 700X1400	M50

After studying architectural plan a framing plan of live project is created to suit the structural engineering point of view.

Special Moment Resisting Frames (SMRF) type of system has been considered while analyzing and designing of this building. As per IS1893-2002 Table-7, R factor of 5 has been considered while performing the analysis.

In the above proposed project there are stiff RC Shear walls, RC Columns connected by the RC beams. The slab"s are considered as a part of diaphragm wherein Semi rigid diaphragm has been considered. Semi rigid diaphragm analyzes the cut-outs or openings in the slabs and considers the actual stiffness of the slab giving precise results. Hence such system has been adopted while analyzing the structure.

Secondly slabs are considered as membrane elements means its out of plane stiffness is nullified. Hence for horizontal sway RC Cores, Walls and columns are connected with the RC Beams.

ANALYSIS

Seismic analysis is an important step in the design of a high rise building, it actually the calculation of the response of the structural system to earthquake forces. This analysis is inevitable part of structural design in earthquake prevalent zones or area. Actually this a analysis where in the earthquake forces acting at various height of the structure is evaluated also this analysis include the study of effect of those lateral forces on the behavior of the structural system at earthquake. As per the code provisions, the analysis may be static or dynamic in approach.

V. RESULTS

In this study to outrigger is applied in the different level of the building system (30 storey, 40 storey, 50 storey and 60 storey) to find the optimum level of outrigger in the structural system. The optimum number of the outriggers is found by placing outriggers in only one level, two level and three level and by varying the wall thickness. Fundamental time period of the 30, 40, 50 and 60 storey is shown in figure 5.1.

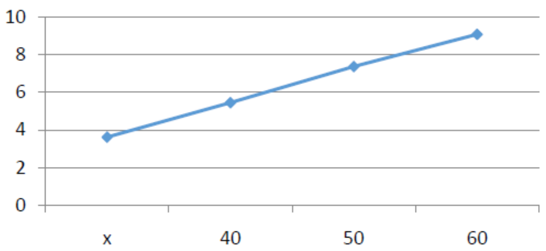

Fig 5.1. Fundamental time period of the 30, 40, 50 and 60 storey

Table 5.1: Fundamental time period of 30 storey structural system with single outrigger System

Name of model	250mm wall	300mm wall	350mm wall
With cap truss	3.416	3.424	3.42
with top 1/5 th	3.348	3.351	3.342
with top 1/4 th	3.34	3.343	3.332
with top 1/3 rd	3.297	3.298	3.283
with bottom 1/5th	3.262	3.258	3.243
with bottom 1/4 th	3.213	3.209	3.191
with bottom 1/3 rd	3.193	3.193	3.169
with mid	3.249	3.247	3.227

Table 5.5: Fundamental time period of 30 storey structural system with two outrigger System

Name of model	250mm wall thickness	300mm wall thickness	350mm wall thickness
With cap truss and top 1/5 th	3.389	3.401	3.413
With cap truss and TOP 1/4 th	3.343	3.354	3.351
With cap truss and TOP 1/3 rd	3.296	3.305	3.297
With cap truss and mid	3.227	3.232	3.219
With cap truss and bottom 1/5 th	3.255	3.259	3.264
With cap truss and bottom 1/4 th	3.22	3.224	3.213
With cap truss and bottom 1/3 rd	3.215	3.219	3.224
With 1/5 th top and bottom	3.158	3.157	3.137
With 1/4 th top and bottom	3.118	3.117	3.099
With 1/3 rd top and bottom	3.075	3.071	3.05

Table 5.9: Fundamental time period of 30 storey structural system with Three outrigger System

Name of model	250mm wall thickness	300mm wall thickness	350mm wall thickness
With cap and top & bottom 1/5 th	3.192	3.199	3.191
With cap and top & bottom 1/4 th	3.15	3.157	3.145
With cap and top & bottom 1/3 rd	3.102	3.106	3.091

From the above table it is found that the application of outrigger in two level at 1/3rd distance from top and bottom is very effective in reducing the fundamental time period of the building. If the fundamental time period of the building system is brought to the limit(0.01 x N ,N= no: of floors) all the other parameters such as the deflection, inter storey drift etc will be in the limit. Thus the lateral stability of the building is checked by applying the outrigger in 1/3rd distance from top and bottom in live project.

Table 5.17: First mode Vibration in translation

TABLE: Modal Participating Mass Ratios												
Case	Mode	Period	UX	UY	UZ	Sum UX	Sum UY	Sum UZ	RZ	Sum RX	Sum RY	Sum RZ
		sec										
Modal	1	3.171	**0.6169**	0.0106	0	0.6169	0.0106	0	**0.124**	0.0037	0.2126	0.124
Modal	2	2.755	0.1132	0.2124	0	0.7301	0.223	0	0.4057	0.0905	0.2538	0.5297
Modal	3	2.407	0.0118	0.4647	0	0.7419	0.6877	0	0.2221	0.3144	0.2584	0.7518
Modal	4	0.92	0.1125	0.0008	0	0.8545	0.6885	0	0.0093	0.3161	0.6398	0.761
Modal	5	0.757	0.0126	0.0217	0	0.867	0.7101	0	0.0909	0.3621	0.6753	0.852
Modal	6	0.617	0.0005	0.1426	0	0.8676	0.8527	0	0.0217	0.6397	0.6764	0.8736
Modal	7	0.513	0.0371	0.0003	0	0.9046	0.853	0	0.005	0.6403	0.7359	0.8787
Modal	8	0.402	0.0097	0.0046	0	0.9143	0.8577	0	0.0331	0.6485	0.753	0.9117
Modal	9	0.334	0.023	0.0002	0	0.9373	0.8579	0	0.0058	0.6491	0.8141	0.9175
Modal	10	0.297	0.0002	0.0472	0	0.9374	0.9052	0	0.0054	0.7398	0.8144	0.9229
Modal	11	0.254	0.0052	0.003	0	0.9426	0.9082	0	0.0211	0.7465	0.828	0.944
Modal	12	0.228	0.0143	0.0001	0	0.9569	0.9083	0	0.0014	0.7467	0.8693	0.9454
Modal	13	0.179	0.0035	0.0033	0	0.9604	0.9116	0	0.0029	0.7546	0.879	0.9484
Modal	14	0.177	0.0012	0.0263	0	0.9616	0.9379	0	0.0007	0.8185	0.8823	0.9491
Modal	15	0.165	0.0058	0.0015	0	0.9674	0.9394	0	0.0077	0.8225	0.8981	0.9568
Modal	16	0.134	0.0076	0.0005	0	0.975	0.94	0	0.0008	0.8241	0.9201	0.9576
Modal	17	0.116	0.0006	0.0162	0	0.9756	0.9562	0	1.27E-05	0.8681	0.922	0.9576
Modal	18	0.094	0.0082	0.0027	0	0.9838	0.9589	0	0.002	0.8756	0.9473	0.9596
Modal	19	0.079	0.0021	0.012	0	0.986	0.9709	0	3.42E-05	0.9088	0.9538	0.9596
Modal	20	0.053	0.0081	0.0025	0	0.9941	0.9734	0	0.0001	0.9162	0.98	0.9597
Modal	21	0.042	0.0007	0.0158	0	0.9947	0.9892	0	0.0001	0.9643	0.9822	0.9598

The clause 7.8.4.2 of IS1893 (part 1) : 2002 states that the number of modes to be used in the analysis should be such that the sum total of modal masses of all modes considered is at least 90 percent of the total seismic mass.

VI. CONCLUSION

1. For 30 storey building system application of two outrigger in 1/3rd distance from top and bottom is found very effective. It reduced the fundamental time period by 15.6% compared to model without outrigger. The application of two outrigger system shown 3.37% difference compared to single outrigger system. The application of three outrigger system did not give significant reduction in time period maximum of only 1.13% difference is found in time period as compared to two outrigger system.
2. For 40 storey building system application of two outrigger in 1/3rd distance from top and bottom is found very effective. It reduced the fundamental time period by 5.8% compared to model without outrigger. In case of application of single outrigger system 1/4 distance from bottom is found very effective. The application of three outrigger system did not give significant reduction in time period maximum of only 0.92% difference is found in time period as compared to two outrigger system.
3. For 50 storey building system application of two outrigger in 1/3rd distance from top and bottom is found very effective. It reduced the

fundamental time period by 4.25% compared to model without outrigger. In case of single outrigger system 1/4th distance from bottom is found very effective it reduced the time period by 4.02% compared to model without outrigger. In case of two outrigger system outrigger in top floor and other at 1/3rd distance from top also has same effect of 1/3rd distance from top and bottom. The application of three outrigger system did not give significant reduction in time period maximum of only 0.77% difference is found in time period as compared to two outrigger system.

4. For 60 storey building system application of two outrigger in 1/3rd distance from top and bottom, Single outrigger at 1/5th from bottom and outrigger in top floor with second at 1/3rd distance from top is found very effective. It reduced the fundamental time period by average 2.74 % compared to model without outrigger. The application of three outrigger system did not give significant reduction in time period maximum of only 0.079% difference is found in time period as compared to all effective outrigger system.
5. Overall application of two outrigger beams with 1/3rd distance from top and bottom and outrigger in top floor with second at 1/3rd distance from top effective in reducing the fundamental time period of building system.

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