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LOW DENSITY RCC CONCRETE BLOCK

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Abstract: Approximate 5-10 mm sea level rising due to global warming effect. Indirectly due to sea level rising many area of land will be submerged in water is next 20-25 years. In this study we try to construct light weight structures which can float on water. To construct light weight structure we will utilize Expanded Clay Aggregate and EPS beads to reduce density of concrete.

Keywords: RCC, Floating, Low Density Concrete block, Light Weight, EPS Beads

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INTRODUCTION

All the framed structure or load bearing mainly constructed using concrete. Density of cocrete depends upon the basic material required like coarse aggregate, fine aggregate, cement etc. & density all these materials are generally more than one. So, if we construct structure using conventional concrete that weight of structure is very & it is impossible that these type of structure can float or any type of liquid. When aggregate is mixed together with dry Portland cement and water, the mixture forms a fluid slurry that is easily poured and molded into shape. The cement reacts chemically with the water and other ingredients to form a hard matrix that binds the materials together into a durable stone-like material that has many uses[1]. Concrete is a composite material composed of coarse aggregate bonded together with a fluid cement that hardens over time. Most concretes used are lime-based concretes such as Portland cement concrete or concretes made with other hydraulic cements, such as ciment fondu. However, asphalt concrete, which is frequently used for road surfaces, is also a type of concrete, where the cement material is bitumen, and polymer concretes are sometimes used where the cementing material is a polymer.[1].Nowadays people are working more on light weight concrete structure to reduce earthquake & other dynamic force. Also cost of any structure depends upon the seismic weight of structure. Autoclaved aerated concrete(AAC), also known as autoclaved cellular concrete (ACC), autoclaved lightweight concrete (ALC), autoclaved concrete, cellular concrete, porous concrete, Aircrete, Hebel Block, and Ytong is a lightweight, precast, foam concrete building material invented in the mid-1920s that simultaneously provides structure, insulation, and fire- and mold-resistance. AAC products include blocks, wall panels, floor and roof panels, cladding panels and lintels[2].The rewards of low weight concrete block is less cost in construction its strength and strenghth is high. The consuption of mortar less compare to brick masonary. Low weight conctrete block is heat, damp and fire resistance cost of labour is comparitively low. Global warming, also referred to as climate change, is the observed century-scale rise in the average temperature of the Earth's climate system and its related effects.[3][4] Multiple lines of scientific evidence show that the climate system is warming.[5][6][7] Many of the observed changes since the 1950s are unprecedented in the instrumental temperature record which extends back to the mid-19th century, and in paleoclimate proxy records covering thousands of years.[8]

II. MATERIALS

Light weight concrete blocks

- Light weight concrete block has density 300 kg/m^3 to 1800 kg/m^3[10]. It is lighter than conventional concrete. The main advantage of light weight concrete block is reduction in dead load and reduction in cost.

Water

- Ordinary tap water was used for both mixing the constituents of the bricks as well as for the curing of bricks.

Normal Course Aggregates

- Aggregates are the most mined materials in the world. Aggregates are a component of composite materials such as concrete and asphalt concrete; the aggregate serves as reinforcement to add strength to the overall composite material.

- Due to the relatively high hydraulic conductivity value as compared to most soils, aggregates are widely used in drainage applications such as foundation and French drains, septic drain fields, retaining wall drains, and road side edge drains.

Lightweight expanded clay aggregates

- Lightweight expanded clay aggregate (LECA) or expanded clay (ex. clay) is a light weight aggregate made by heating clay to around 1200 ºC (2190 ºF) in a rotary kiln.
- The yielding gases expand the clay by thousands of small bubbles forming during heating producing a honeycomb structure.
- LECA has an approximately round or potato shape due to circular movement in the kiln, and is available in different sizes and densities.
- LECA is used to make lightweight concrete products and other uses.

Super Plasticizer

- Super plasticizers also known as high range water reducers, are chemical admixtures used where well-dispersed particle suspension is required Their addition to concrete or mortar allows the reduction of the water to cement ratio, not affecting the workability of the mixture, and enables the production of self-consolidating concrete and high performance concrete.
- The strength of concrete increases when the water to cement ratio decreases. However, their working mechanisms lack a full understanding, revealing in certain cases cement-super plasticizer incompatibilities.

III. MIX DESIGN

As per IS – 10262:2009 we tried to mix design for low density concrete. To reduce weight of concrete, we replaced normal conventional coarse aggregates with low density aggregates like Expanded clay Aggregate

a) type of cement : OPC 43 grade
b) Maximum size of aggregate : 20mm
c) Exposure condition : moderate
d) Workability : 150 mm slump
e) Minimum cement content : 320 kg/m^3
f) Maximum w/c ratio : 0.45
g) Method of concrete placing : pumping
h) Degree of supervision : good

i) Type of aggregate : crushed angular aggregate
j) Maximum cement content : 450 kg/m^3
k) Chemical admixture type : super plasticizer
l) Specific gravity of cement : 3.15
m) Specific gravity of C.A : 2.74
n) Specific gravity of F.A : 2.74
o) Water absorption
coarse aggregate : 0.5 percentage
fine aggregate : 1.5 percentage
p) Free surface moisture
coarse aggregate: NIL
Fine aggregate: NIL
grading of C.A conforming to table 2 IS: 383 , grading of F.A conforming to grading zone – 1 of table of IS : 383.

Solution:-

1.Target mean strength

f_{ck} = 25 N/mm^2
f_{ck}' = fck + 1.65s
= 25 + 1.65*4
= 31.6 N/mm^2 [from table 6.4,for M25 concrete, standard deviation S = 4]

2. Selection of W/C ratio

from table – 5 of IS; 456-2000 [table -6.5] for moderate condition
Maximum W/C ratio = 0.50
Here, W/C ratio taken as 0.40

3.Selection of water content

- Maximum water content for 20 mm size of aggregate = 186 litre
- This is for 50 mm slump but here slump .
- Increase 3% of water for every 25mm slump over and 50 mm slump .we have slump value of 150 mm, hence increase water content by 9%.
- Estimated water content for 150 mm slump = 186 + 9/100*186= 202 litre
- Here we use plasticizer,the water content reduced up to 20% and above. Assume 25% reduction in water content due to plasticizer.

actual water content is to be used = 202 * 0.75 = 152 litre

4. Calculation of cement content

- W/C ratio = 0.40
- Water used = 152 litre
- Cement content ,

W/C = 0.40
C = 152/0.40 =380 kg/m^3

Here as per IS: 456-2000, table -5, minimum cement content for moderate exposure condition = 300 kg/m^3 here, cement content = 380 kg/m^3> 300 kg/m^3

5. Coarse aggregate and fine aggregate content

- from table 6.8, volume of coarse aggregate corresponding to 20 mm maximum size of aggregate and fine aggregate (Zone 1) for water cement ratio 0.50 = 0.60.
- In the present W/C ratio is 0.40, i.e. Less by 0.10. As the W/C ratio is reduced it is desirable to increase the C.A content to decrease F.A content.
- For every decrease of W/C ratio by 0.05, the C.A volume may be increased by 1.0%.
- As the W/C ratio is less by 0.10, the C.A volume is increased by 0.02.
- Corrected proportion of volume of C.A = 0.60 + 0.02 = 0.62
- Final volume of C.A = 0.62 * 0.90 = 0.56
- Final volume of F.A = 1 – 0.56 = 0.44

6. Calculation of mix proportions

I. Volume of concrete = 1 m^3

II. Volume of cement = mass of cement/specific gravity of cement * 1/1000
= 380/3.075 * 1/1000
= 0.123 m^3 [cement is 30% replaced by fly ash]

III. Volume of water = mass of water / specific gravity of water * 1/1000
= 202/1 * 1/1000= 0.20 m^3

IV. Here mass of chemical admixture = 2*370/100 = 7.4 kg/m^3
Assume specific gravity of admixture = 1.145

V. Volume of chemical admixture (plasticizer) @ 2.0 % by mass of comentitious material = mass of chemical admixture/ sp. Of chemical admixture * 1/1000 = 7.6/1.145 * 1/1000 = 0.0065 m^3

- Absolute volume of all the materials excepts total aggregates
= 0.120 + 0.202 + 0.0065= 0.326 m^3
- Absolute volume of total aggregate = 1- 0.326= 0.674 m^3 .
- Mass of C.A = V_a * volume of C.A * sp. Gravity of C.A * 1000
= 0.674 * 0.56 * 1.905 * 1000

= 720 m^3 [here C.A. is 50% replaced by scoria]

- Mass of F.A = Va * volume of F.A * sp. Gravity of F.A * 1000
  = 0.674 * 0.44 * 2.34 * 1000
  = 694 m^3 [here F.A is 20 % replaced by EPS beads]

7. Mix proportions

cement : 380 kg/m^3
water : 152 litre
Fine aggregate : 694 kg/m^3
Coarse aggregate : 720 kg/m^3
Chemical admixture : 7.4 kg/m^3
Wet density of concrete = 1953 kg/m^3
W/C ratio = 152 / 380 = 0.40

8. Site corrections for water absorption and surface moisture

- Absorption of F.A = 1.0 % = 1*694/100= 6.94 litre
- Absorption of C.A. = 0.5 % = 0.5 * 720/100= 3.6 litre
- Total absorption = 6.94 + 3.6= 10.54 litre
- Actual amount of water to be used = 152 + 10.54= 162.54 litre
- Actual mass of C.A. = 694 - 6.94 = 687.06 kg
- Actual mass of F.A. = 720 – 10.54 = 709.46 kg

9.Mix proportions (by mass)

Water	Cement	F.A.	C.A.
162.54 lit.	380 kg/m^3	709.46 kg/m^3	687.06 kg/m^3
0.428	1	1.867	1.80

Table 1 (Mix proportions by mass)

IV. TESTING

Compression Test

Light weight concrete block samples were made by using Cement, Ennore sand, Normal Aggregates and Light weight expanded clay aggregates. Moulds with dimensions of 200 mm× 200 mm× 300 mm. After casting, all moulds were placed in a normal temperature of room with a relative humidity of more than 90% for a period of 24h. After de-moulding, the specimens were placed for the curing for 28 days. After it Compression test carried out at 7th, 14th and 28th day.

Days/ Curing method	Compressive strength (N/mm^2)
7th Days	07.23
14th Days	16.59
28th Days	20.56

Table 2- Compression test results

CONCLUSION

In this study we have replaced conventional coarse aggregate to Expanded Clay Aggregate to reduce density of concrete to make structure lighter. But fact is that using light weight aggregates reduces the compressive strength of Concrete. Partial replacement of normal aggregates with ECA reduced density upto 7 to 8 kN/m^3but also reduced strength of 5-6 N/mm^2.

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