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Research paper

Analytical Study of Physical & Mechanical Properties of Foamed Concrete Using ETABS

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Abstract

Foam concrete is a form of aerated lightweight concrete. Foamed concrete has emerged as most industrial fabric in Production Company. Foam concrete is produced while pre-fashioned foam is brought to slurry, the characteristic of froth is to create an air voids in cement–primarily based absolutely slurry. Foam is generated one by one via using foam generator; the foaming agent is diluted with water and aerated to create the froth. The cement paste or slurry set throughout the foam bubbles and whilst the froth being to degenerate, the paste has enough power to keep its form around the air voids. Consequently, this study investigates bodily and mechanical residences of foamed concrete. Ultimately comparative analyses had been finished to decide the relationships the various numerous mechanical homes parameters of the foamed concrete, especially the compressive strength, flexural electricity, splitting tensile electricity. The specimen analysed by means of the usage of the use of e- tab software program.

Keywords: *Analytical Study, Physical, Mechanical Properties, Foamed Concrete, ETABSS*

1. Introduction

The essential packages of foamed concrete encompass structural elements, non-structural walls and thermal insulating materials. Manufacturers evolved foam concretes of various densities to match the above necessities and these merchandise were used in trench reinstatement, bridge abutment; void filling, roof insulation, road sub base, wall production, tunneling and many others.
Foam concrete is a sort of aerated concrete; foam concrete does not comprise coarse combination and may be seemed as an aerated mortar. Foam concrete is produced when pre-shaped foam is added to slurry, the characteristic of foam is to create an air voids in cement–primarily based slurry. Foam is generated one by one by using the use of foam generator; the foaming agent is diluted with water and aerated to create the foam. The cement paste or slurry set around the foam bubbles and when the foam being to degenerate, the paste has sufficient energy to keep its form across the air voids. the foam concrete combination will become too stiff with lower content material, causing bubbles to break, whereas the combos turns into too skinny to preserve the bubbles with excessive water content, main to the separation of bubbles from the combination, water-cement (w/c) ratio generally stages from 0.4–1.25. Foam concrete may be designed to have any density within the dry density range of three hundred–1850 kg/m3.

1.1. Making of Foamed Concrete

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

- Foaming agent
- Binding agent
- Water
- Aggregate

Fig.1 shows the foam concrete.

Fig.1: Foam concrete

Foam concrete is a totally fluid, light-weight mobile concrete fill fabric, produced through blending a cement paste (the slurry or mortar), with a one by one synthetic, pre-shaped foam. the density of foam concrete is determined via the ratio of froth to slurry and densities range usually between 300 and 1600 kg/m^3. Sand, pulverized fuel ash (pfa), quarry dirt or limestone dirt can be used to in addition beautify the properties of foam concrete. Foam concrete is produced created through uniform distribution of air bubbles for the duration of the mass of concrete. The foam cells ought to have partitions, which remain solid throughout mixing, transportation, pumping and putting of sparkling concrete. The cells or bubbles are discrete and variety in length between 0.1 and 1mm. Foam concrete is a loose flowing and may be positioned without compaction.

2. Methodology

Fig.2 shows the methodology of the study.

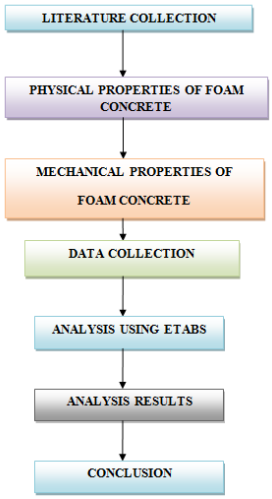

Fig.2: Methodology

3. Foam Concrete

Foam concrete is similar to traditional concrete because it makes use of the same ingredients. But, foam concrete differs from traditional concrete in that using aggregates in the former is removed. A foam aeration agent is used to take in humidity for so long as the product is uncovered to the surroundings, permitting the hydration manner of the cement to progress in its ever-continuing strength development.

The distinction among foam concrete and ordinary concrete is the usage of combination in the foam concrete removed and been replaced with the aid of the homogeneous cells created by air within the shape of small bubble which make use of a solid air cellular structure in preference to subculture aggregates. Compare the unique power (strength-to-density ratio) of foamed concrete with regular weight concrete. Foam concrete mixture with extraordinary substances of the substances is used in this investigation.

- The physical houses (density) as well as a particular structural assets (compressive energy) of foam concrete mixtures have been received first, before the relationship among those houses were decided.
- Foam concrete cubes are organized and the tests are completed in university laboratory.
- Foamed concrete can be located without difficulty, by using pumping if necessary, and does no longer require compaction, vibrating or leveling. It has brilliant resistance to water and frost, and affords a excessive degree of both sound and thermal insulation.

Fig.3 shows the processing of foam concrete.

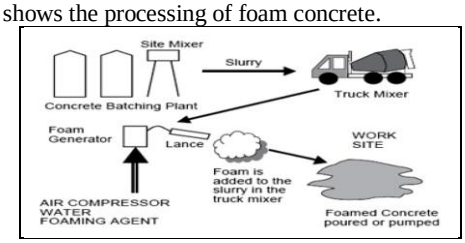

Fig.3: Processing of foam concrete

3.1. Constituent Materials

The foamed concrete has been produced by way of using the subsequent elements' viz. cementations cloth (i.e. cement & fly ash), sand, water and foaming agent. Cementations fabric portland cement is favoured over different cements, including pozzolana. For early stripping and surest mechanical residences, excessive-grade (early electricity) cement is recommended. Thick walls and while using battery-moulds, excess warmth is developing inside and can therefore ask for a lesser grade of cement. The slower, hardening and higher the final great of concrete. Where with in your budget, fly ash may be brought to the mixture to alternative some of the cement. fly ash generally will retard hardening though. on this investigation fifty three grade everyday Portland cement and pleasant fly ash has been used.

3.2. Sand

Best residences are completed while deciding on the maximum appropriate raw fabric. The sand is mostly desired from river, that is washed and must be with minimum 20% fines. Dirt in sand will increase the demand for water and cement, without including to the properties, it also increases shrinkage. A sure, small quantity of fines contributes in the direction of electricity. As in traditional concrete, the sand must be freed from natural material or other impurities. Beaten sand, due to sharp edges may also destroy the foam robotically. On this research, domestically to be had river bed sand has been used.

3.3. Water

Whilst water is used to provide foam, it has to be potable and for fine performance, it must not exceed 25°c. under no circumstances should the foaming agent be introduced in touch with any oil, fat, chemical or different fabric that could harm its feature (oil has a power at the floor-anxiety of water).the oil/wax used in moulds will no longer harm, because the foam by way of then will embedded in mortar. Water to put together the combination has to comply to widespread necessities for concrete.

3.4. Foam & Foaming Agent

Foam is produced by using distribution of fuel in a liquid underneath the impact of a foaming medium, including cleaning soap, oil, acid or a wetting agent. Throughout the manufacturing small bubbles are formed and are separated from liquid through a membrane. Virtually, there are many unique styles of foams with various programs. Consequently, there are many exceptional industries, which use foam-like merchandise.

4. Properties of Foam Concrete

4.1. Physical Properties of Foamed Concrete

Density, Workability, dry shrinkage, and carbonization has find out with laboratory and utilized.

4.2. Mechanical Properties of Foam Concrete

Mechanical residences of the foamed concrete has anticipated via using various constraints primarily based on compressive electricity, dry density, mix share split tensile power, water absorption and so on. compressive electricity of foamed concrete stimulated via many element which include density, age, curing method, aspect and mix proportion. This suggests that coarse sand reasons clustering of bubbles to form abnormal huge pores. For that reason it is able to be concluded that great sand effects in uniform distribution of bubbles and therefore effects in better energy than coarse sand at a given density.

4.2.1. Mix Proportion and Casting of Specimens

1. Cement + Fly Ash + Sand
2. Cement + (Fly Ash + Micro Silica + Sio2 Powder) + Sand
3. Cement + Clay + Sand
4. Cement + Rice Husk Ash + Sand

These mixes were casted under these mix ratios as cement: filler: sand.

1. 1:1:1
2. 1:0.5:1.5
3. 1:0.5:2
4. 1:0.5:3

5. Foam Concrete Using E Tabs

Structural design and analysis has executed with the software program ETABS that's complicated, yet easy to use, software advanced particularly for constructing structures. ETABSs also can manage the biggest and maximum complex constructing models, consisting of a wide variety of nonlinear behaviours necessary for overall performance based totally design, making it the tool of preference for structural engineers within the constructing industry.

6. ETABS Results

Fig.4 shows the modelling of building in E tabs.

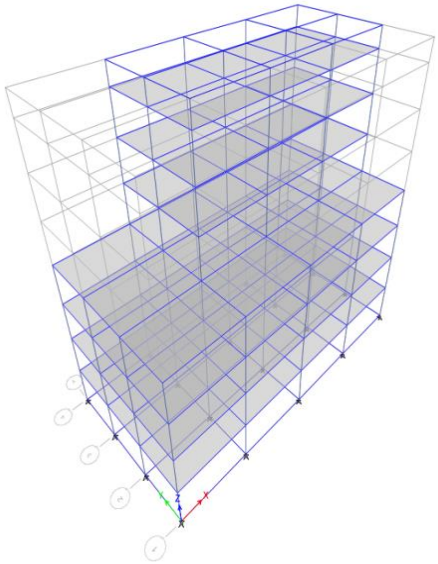

Fig.4: Modelling of building

6.1. Structure Data

This area provides model geometry information, including items such as story levels, point coordinates, and element connectivity.

6.1.1. Storey Data

Table 1 shows the storey data.

Table 1: Storey data

Name	Height mm	Elevation mm	Master Story	Similar To	Splice Story
Story8	1500	22500	Yes	None	No
Story7	3000	21000	Yes	None	No
Story6	3000	18000	Yes	None	No
Story5	3000	15000	Yes	None	No
Story4	3000	12000	Yes	None	No
Story3	3000	9000	No	Story4	No
Story2	3000	6000	No	Story4	No
Story1	3000	3000	No	Story4	No
Base	0	0	No	None	No

6.1.2. Grid data

Table 2 shows the grid systems.

Table 2: Grid systems

Name	Type	Story Range	X Origin m	Y Origin m	Rotation deg	Bubble Size mm
G1	Cartesian	Default	0	0	0	1250

6.1.3. Beam Connectivity Data

Table 3 shows the beam connectivity data.

Table 3: Beam connectivity data

Beam	I-End Point	J-End Point	Curve Type
B1	1	2	None
B2	2	3	None
B3	3	4	None
B4	5	6	None
B5	6	7	None
B6	7	8	None
B7	9	10	None
B8	10	11	None
B9	11	12	None
B10	13	14	None
B11	14	15	None
B12	15	16	None
B13	17	18	None
B14	18	19	None
B15	19	20	None
B16	1	5	None
B17	5	9	None
B18	9	13	None
B19	13	17	None
B20	2	6	None
B21	6	10	None
B22	10	14	None
B23	14	18	None
B24	3	7	None
B25	7	11	None

6.2. Properties

This area provides property information for materials, frame sections, shell sections, and links.

6.2.1. Materials

Table 4 shows the material properties.

Table 4: Material properties

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
A992Fy50	Steel	199947.98	0.3	76.9729	Fy=344.74 MPa, Fu=448.16 MPa
M30	Concrete	27386.13	0.3	13.7293	Fc=30 MPa
M30-1	Concrete	27386.13	0.3	13.7293	Fc=30 MPa

6.2.2. Frame Sections

Table 5 shows the frame sections summary.

Table 5: Frame sections – summary

Name	Material	Shape
A-Lat Bm	A992Fy50	Auto Select
column	M30-1	Concrete Rectangular
ISLB600	A992Fy50	Steel I/Wide Flange

6.2.3. Shell Sections

Table 6 shows the shell sections.

Table 6: Shell sections

Name	Design Type	Element Type	Material	Total Thickness mm
Slab2	Slab	Shell-Thin	M30	200

6.2.4. Reinforcement Sizes

Table 6 shows the reinforcing bar sizes.

Table 7: Reinforcing Bar Sizes

Name	Diameter mm	Area mm²
10	10	79
20	20	314

6.3. Loads

This area provides loading information as applied to the model.

6.3.1. Load Patterns

Table 8 shows the load patterns.

Table 8: Load Patterns

Name	Type	Self Weight Multiplier	Auto Load
Dead	Dead	1	
Live	Live	0	
sei	Seismic	0	IS1893 2002
wi	Wind	0	Indian IS875:1987

6.3.2. Calculated Base Shear

Table 9 shows the calculated base shear.

Table 9: Calculated base shear

Direction	Period Used (sec)	W (kN)	V_B (kN)
X	0.426	6306.1445	567.553
Y	0.477	6306.1445	567.553
X + Ecc. Y	0.426	6306.1445	567.553
Y + Ecc. X	0.477	6306.1445	567.553
X - Ecc. Y	0.426	6306.1445	567.553
Y - Ecc. X	0.477	6306.1445	567.553

Fig.5 shows the Lateral load in x – direction

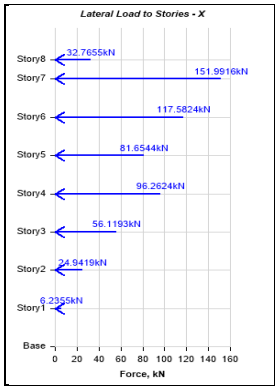

Fig.5: Lateral load in x - direction

Table 10 shows the Lateral load in x – direction

Table 10: Lateral load in x – direction

Story	Elevation	X-Dir	Y-Dir
	m	kN	kN
Story8	22.5	32.7655	0
Story7	21	151.9916	0
Story6	18	117.5824	0
Story5	15	81.6544	0
Story4	12	96.2624	0
Story3	9	56.1193	0
Story2	6	24.9419	0
Story1	3	6.2355	0
Base	0	0	0

Fig.6 shows the Lateral load in Y – direction

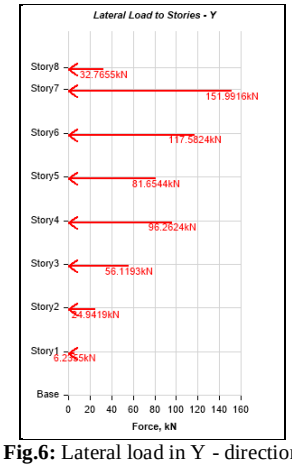

Fig.6: Lateral load in Y - direction

Table 11 shows the Lateral load in Y - direction

Table 11: Lateral load in Y – direction

Story	Elevation	X-Dir	Y-Dir
	m	kN	kN
Story8	22.5	0	32.7655
Story7	21	0	151.9916
Story6	18	0	117.5824
Story5	15	0	81.6544
Story4	12	0	96.2624
Story3	9	0	56.1193
Story2	6	0	24.9419
Story1	3	0	6.2355
Base	0	0	0

Fig.7 shows the rendering view for structure.

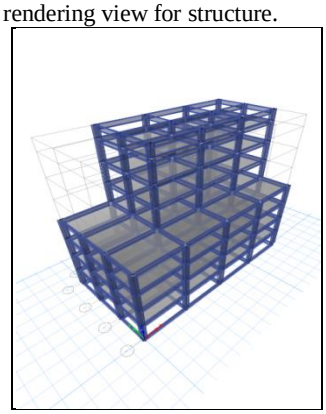

Fig.7: 3D Rendered View for Structure

Fig.8 shows the slab assignment.

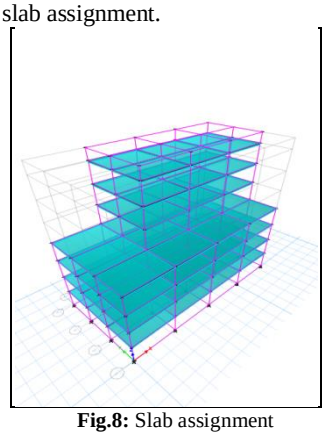

Fig.8: Slab assignment

7. Conclusion

From the study we conclude that foam concrete is weight less with strength while compare with conventional concrete when it was highly porous. The result has been achieved through the analysis

and designs the foam concrete in ETABS software and mechanical tests.

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