Utilization of Light Weight Building Structure Foam Concrete: A Review

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Abstract- *Multi-storied buildings are indispensable in urban areas due to the high cost of land, shortage of open space and scarcity of lands. Many times these multi-storey buildings are built with regular concrete, steel and other materials where the loads are high and require heavy structures and cost may not be effective. The use of lightweight foam concrete will reduce the dead load of a structure, which then allows the structural designer to reduce the size of the columns, footings, and other load-bearing elements. Structural lightweight concrete mixtures can be designed to achieve similar strengths as normal-weight concrete. We have considered a regular eight commercial building as part of the project. Then we developed the building frame model and analyzed and designed the structural elements such as columns, beams, slab and staircases by considering vertical loads.*

Concrete structures are prone to earthquake due to the mass of the structures. the primary use of structural lightweight concrete (SLWC) is to reduce the dead load of a concrete structure, which allows the structural designer to reduce the size of the structural members like a beam, column, and footings which results in a reduction of earthquake forces on the structure. '

In this paper we are review publications related to light weight structure techniques usin foam concrete.

Keywords- MIDAS, Structural Analysis, Forces, Cost Analysis, Lateral Forces, Displacement

I. INTRODUCTION

The structures are always subjected to two kinds of load namely static and dynamic. Static loads are constant with time while dynamic loads are time varying. As a rule, most of the common structures are composed of the presumption that every single connected load is static. The impact of dynamic load isn't being viewed as in light of the fact that the structure is once in a while subjected to dynamic load, more the investigation makes the arrangement more entangled and monotonous.

A portion of the time the need to diminish the greatness of an assistant segment isn't less basic than extending its quality, especially in over stressed structures, for instance, tall structures and platforms where the structure's weight is one of the guideline issues that face the originators. Despite the growing use and solicitation of Lightweight Concrete (LWC), the connected and helper plan perspectives for structures created utilizing LWC and Infra-Lightweight Concrete (ILWC) have not been sufficient elucidated. Issues, for instance, part estimations, affiliations, and fortress make and brings up of intrigue and furthermore short-and whole deal deformations and dynamic direct for LWC structures should be hidden in to-date codes. Along these lines, this examination deals with the sensible and assistant arrangement of structures delivered utilizing LWC and ILWC and generally involves two guideline objectives: - Development and production of new mixes for LWC and ILWC with constrained dry thickness and extraordinary mechanical and physical properties. - The ability to apply and incorporate these new materials in the improvement field through a heightened game plan of test tests on different assistant parts and relationship under static and dynamic weights. With the true objective to achieve the fundamental objective in the examination, two targets were portrayed, the vital: sensible stood up to ILWC for dividers with least dry thickness ($\square_{min}$ < 800 kg/m³), least warm conductivity enough to slaughter the glow insurance materials, and most noteworthy quality enough to restrict the vertical bearing stress from floors. The second target: sensible went up against LWC for improvement of floor lumps and bars with least dry thickness, least warm conductivity and most outrageous quality enough to contradict flexural and shear pushes for all intents and purposes indistinguishable to run of the mill strong (NC). When the ILWC and LWC materials were delivered and their mechanical and physical properties were settled, a movement of considerable scale tests was driven. For ILWC, a real application for example a one-family house in Berlin, was worked in 2006. Because of its optimal physical properties and its incredible toughness, ILWC invigorated with GFR was used out of nowhere as strong cast-in-site concrete to build up the outer dividers of this house with no additional insurance. Infra-lightweight bond is a fabricated imaginative material

whose potential and distinctive other framework viewpoints are not yet totally manhandled. The examination shows the purposes of containment of ILWC, yet what's more its marvelous potential for sensible went up against strong structures. For LWC, eight bars worked from the as of late made LWC mix with strong quality class of LC 30/33 and reinforced with glass-fiber bars and steel bars, despite two control columns created from average strong C 30/37 and braced with steel bars, were attempted probably for flexural quality breaking point, shear quality farthest point, pliable lead and bond direct in strain and weight zones of the poles. From the fiscal point of view, using LWC in the advancement of the floor pieces in tall structures will reduce the total costs of tall structures through the abatement of the proportion of steel fortress, the decline of foundation volume, and the diminishing of vertical people's cross-zones that saves the used dimension locale. Since they are the most affected pieces of tall structures in the midst of tremor excitations.

Yongliang He et al (2019) the research paper presented a innovative techniquefor using foam concrete as a typical building material for soft structures in underground coal mines subjected to dynamic loading. The experimental apparatus included 30 specimen in order to present the behavior of Foam concrete with a diameter of 50mm and height 50mm using 75mm diameter split Hopkinson pressure bar (SHPB) device.
The primary parameters included in the investigation were the type of form concrete (Fly-ash and Sand), Density of the Foam concrete (1,000, 1,200 and 1,400 kg/m3) and the impact velocity (3.0, 4.0, 5.0, 6.0 and 7.0 m/s). Six different specimen were compared to test the static loading. The developed stress-strain curve under impact loading presented three different phase which generally starts with a linear elastic stage, accompanied with yield phase and lastly ends with pore wall destruction phase.

The analytical results presented dynamic increases the factor, along with ultimate compressive strength, persistence and theirs sudden increase in the absorption of energy with strain rate on same density. Impact Velocity was the major factor to affect the failure model and the behavior of foam concrete.

The results concluded that the stress-strain curves of the foam concrete displayed a strain stage because of the retention of a lot of vitality in both static pressure and dynamic effect tests. In the static pressure test, the pressure of the foam concrete expanded with expanding thickness. Under a similar thickness, the pressure of the foam concrete without fly ash was lower than that of the foam concrete with fly-ash. In the dynamic effect test, the pressure strain curve of foam concrete was separated into a direct flexible stage, a yield arranges, and a pore divider obliteration organizes. Under a similar effect speed, the level of the damage turned out to be progressively alarming with expanding density. At a similar thickness, the level of damage expanded with an expansion in the effect speed. In the dynamic stacking test, the dynamic compressive quality of foam concrete expanded with an expansion in the strain rate. The level of fracture likewise expanded, demonstrating a noteworthy connection with the strain rate. The connection between the DIF and important strain rate displayed critical damage relaxing the impact. Moreover, the effect sturdiness of foam concrete persistently expanded with an expansion in the normal strain rate

Pandule Ashok et al (2019) the research paper presented theanalysis of PSC Box Girder Deck Slab bridge using the analytical application Staad Pro. The project concentrated on the impact of seismic conduct of customary RCC bridge. Seismic conduct was analyzed for various parts of the flyover bridges in Staad Pro programming of PSC Box Girder Deck Slab bridge was the extension developed along a meeting expressway over an at-grade crossing point. It permits two-bearing traffic to stream at free-stream speed on the extension. The was one of the strategies for taking care of traffic issues at-level intersections on expressways. The diminished the voyaging time of vehicles, decreased risk of accidents, efficient investment funds of fuel utilization, simple way move, The results demonstrated that 35%-40% of the complete traffic volume redirected by the Bridge, vehicle delays was decreased by 30.41% over a similar period. The strategy was utilized in Staad Pro examination exploring the seismic investigation of a flyover.

The results led to the conclusion that 37.7 m Length Bridge was considered for investigation of box girder deck Chunk Bridge, and for every one of the cases, deflection, and stresses are inside the permissible limits. So as to obtain the finest results the pre-stressed on concrete brace design deck chunk can be exposed to pre/post-tensioning. Pre-stressing on concrete girder setup gives us the greater part of the structure parameter inside admissible limits of functionality, deflection and shear contrast to deck slab design.

A. V. Bhansali and R. R. Sarode (2019) the research paper focused towards reducing the density of concrete with the use of optimum content of foam considering an examination study influencing various density of foam added to quarry dust based foam concrete. The scope of densities explored were 800kg/m3, 1000kg/m3, 1200 kg/m3, 1400 kg/m3, 1600 kg/m3, 1800 kg/m3.The thickness of cement was changed by utilizing manufactured froth called sodium lauryl sulfate, for 30 litres of water 1 litre of foam was utilized independently and the equivalent was brought into the new concrete during

its blending by controlling its focus to its ideal thickness of cement was accomplished.

The research paper concluded Foam concrete has one of a kind qualities that can be used in structural designing works. It requires no compaction yet will stream promptly from an outlet to fill limited and unpredictable cavities, and it very well may be siphoned over huge separations and statures. Accordingly, it could be thought of as a free-streaming, self-setting fill. This report provided a brief of foam solid covering its constituents, generation, designing properties and use.

Walaa Mohammed Hamzah (2019) the research paper presented the various applications of Foam concrete in new construction work. Foam concrete can be interpreted as a type of such a aerated lightweight concrete which is not filled with course aggregates and is regarded as aerated mortar. Production of Foam concrete can be done with two methods such as Inline Method and Pre-foam method where the process included addition of slurry in order to foam the Foam concrete. The functionality of Foam liquid is to generate air bubbles in the slurry using Foam Generator. The process of its manufacturing includes dilution of foaming agent using water in order to create the foam. the Foam Concrete blend turns out to be excessively firm with lower content, making bubbles break, while the blends become too flimsy to even think about holding the air pockets with high water content, prompting the partition of air pockets from the blend, water-bond (w/c) proportion generally runs from (0.4–1.25). The Foam Concrete can be intended to include any thickness inside the dry thickness scope of (300–1850 kg/m3).

The conclusion stated the equation that The Density of Foamed Concrete is contrarily corresponding to the level of froth that is added to the mortar. Froth Concrete is a prudent material since it decreases the absolute expense of the solid utilized in the structure since Foam Concrete is less expensive than ordinary cement. The Compressive Strength and Density of Foam Concrete increments with age. The Compressive Strength of Foamed Concrete increments with increment in the Density. The Strength gain for frothed concrete is higher than that of ordinary cement in light of the fact that utilized the Fiber.

ZainorizuanMohdJaini et al (2018) the research paper focused on use of foam concrete as topping so as to reduce the dead load of composite slab. The variations were made on effect of thickness, damping ratio and energy dissipation of composite slab. In the experimental setup, the composite slab with a width and length of 800mm and 1800mm which was casting in five different thickness ratio which ranged between 75mm and 175mm. The design of the Foam concrete was in density of 1800 kg/m3 utilizing rice husk ash as partial sand replacement and polypropylene mega-mesh as fiber reinforcement. All through the compressive and parting ductile tests, foamed concrete accomplishes a reasonable quality with an estimation of 35.03 MPa and 2.01 MPa for compressive and rigidities, separately. The common recurrence was seen to diminish with the addition of thickness. On the other hand, the damping proportion and vitality scattering showed a noteworthy addition comparing to the thickness of the composite piece.

Ali KadhimSallal (2018) the research paper described application of Foam concrete in various construction application because of its advantage of being quite customizable In designing its densitydesigned to have any density within the dry density range of (300–1850 kg/m3).
The results stated that the Density of Foamed Concrete is inversely proportional to the percentage of foam that is added to the mortar. The use of Foam Concrete in the construction works helps to reduce the load on the foundations, columns and beams because of its density ranges from (300 - 1600) kg / m3 while the density of normal concrete ranges from (2200 - 2600 kg / m 3). The Compressive Strength and Density of Foam Concrete increases with the age. The Compressive Strength of Foamed Concrete increases with increase in the Density.

The results concluded Foam Concrete was an economical material because it reduces the total cost of the concrete used in the building because Foam Concrete was cheaper than normal concrete.

RamavathRamya and M. Satheeshkumar (2018) the research paper presented the utilization of Indian Road Congress (IRC: 6) suggestions a support box support connect two-path made up of prestressed concrete is broke down for moving burdens. The investigation was done utilizing SAP2000 connect wizard and prestressed with allegorical ligaments in which use full area. The different range to profundity proportion considered to get the genuine profundity at which stress and avoidance criteria were fulfilled. The exploration paper incorporated the examination of section 15 (general itemizing prerequisites) of IRC: 112 with the old codes IRC: 18 and IRC: 21 and it likewise included correlation of flexural and shear configuration approach by utilizing IRC: 112 with the old codes.

The conclusion expressed the bending moment and shear force results received from the traditional strategy for the dead load was similar to that of the finite element method. For live load, bending moment and shear forces result from the traditional strategy were 5 to 15% varieties which were

adequate. Because of the impact of the curb on the deck slab bridge, the greatest reactions (bending moment and shear forces) were diminishing that will reduce the structured reinforcement in the deck slab bridge.

MD Jalal et al (2017) the research paper stated the reliability of Foam concrete of being a material to be a desirable replacement for such high tech industrialized building system.

The initial findings have shown that the foam concrete has a desirable strength to be an alternative construction material for the industrialized building system. The quality of foam concrete was low for lower thickness blend. Huge decrease of by and large weight brings about saving structural casings, footing or heaps and quick and generally straightforward development.

The thickness was diminished because of the augmentation of voids all through the example brought about by the foam and subsequently the decline in the compressive quality of the solid. Foam concrete required no vibration or compaction and it fills all pits, voids and creases over a long separation. It offers quick and without settlement development with great warmth protection and air content. It has great warm protection, great stop/defrosting properties and has amazing imperviousness to fire properties.

Aswathy .M (2017) the research paper presented various advancement achieved in concrete utilizing Light weight concrete blocks which is one of the most appropriate alternative for the enhancement of Industries for natural conservation. The preparation of sample started with making of slurry (Cement+ Fly Ash +Water) which was additionally mixed with the development of pre-formed stable foam in a standard strong blender under encompassing conditions.

The results led to the conclusion that daily curing provided better thermal insulation leading to increase in strength followed with a low labour cost.Foam concrete has a user-friendly with and low workmanship. It helps in the decrease of dead load; increment the advancement of the structure, and lower transport and dealing with cost. Subsequently foam solid square was naturally superior to anything the other customary concrete blocks.

Shibi Varghese (2017) the authors research paper was based on properties of foam concrete which even included the manufacturing process with silica fume and its further effects on foam concrete performance. The paper described two different foaming agents namely natural and synthetic.A partial replacement of binding material is done with silica fume which provides additional strength compared to foam concrete without silica fume.

The analytical results presented that the preparation of Foam concrete can be done with the use of any natural foaming agents, besides, in cost term analysis natural foaming agents are widely available at a much cheaper cost in comparison to synthetic foaming agents. As natural FA carry low consistency and in appropriate strength,Hence for a given proportion, the density of FC with natural foaming agents higher than that of foam concrete with synthetic foaming agents. For a given proportion, the ratio of compressive strength, flexural strength and splitting tensile strength for FC with synthetic foaming agents to that of FC with natural foaming agents were obtained as 0.4,0.61& 0.33 respectively. Compressive strength of FC, both natural and synthetic, was influenced by the substitution of silica fumes.

Tian-yuan HUANG (2017) the research paper proposed a construction method with inside step slope on embankment, cast-in-situ solid perplex structure outwardly of dyke and foam cement to fill bridgehead subgrade, investigated to take care of the issue of earth pressure and cone-shaped slant setting at projection just as upgrade projection to be the structure without cone-shaped slant, in order to lessen the range which might be developed because of cone-shaped slant and incredibly cut undertaking cost. Simultaneously, utilizing this strategy, settlement and uneven settlement diminished and post-development settlement of projection filling was eliminated to abstain from knocking at bridge head and lessen upkeep cost.

In this paper, a key innovation for froth solid lightweight bank with cast-in-situ perplex rather than the cone like incline at bridgehead was examined. Fundamental ends expressed that Construction strategy for froth solid lightweight dyke with cast-in-situ bewilder rather than the cone-shaped incline at bridgehead could significantly diminish filling load and the extra worry of delicate establishment, restrain settlement and parallel relocation of delicate soil establishment just as improve the dependability of the bank. Utilizing this development technique, the unexpected difference in material firmness at consolidating site of projection and dyke could be diminished. Pressure settlement of filler was disposed of. Its development is advantageous and needs less space and little work surface. Froth concrete utilized for dyke area filling could, with a burden on establishment after filling significantly diminish ground treatment force. For self-supporting of froth cement and its little impact of pushing and pulling on projection structure, the tapered incline at projection was not required to amplify the space under the extension and diminish the length of the bridge.

Nipa Chauhan and Farhan A. Vahora(2016) the research paper introduced a correlation of superstructures of two sorts of prestressed slabs, that was prestressed concrete slab and prestressed voided. The examination was done with elective spans of the bridge slab. For that reason model with various length however, a similar width was prepared and the investigation was executed utilizing SAP2000. A correlation for the bending moment and shear forces for various spans in the two kinds of slabs was finished. A slab design for a suitable span was done with the purpose to analyse the results for both solid and voided slabs.

Results stated that the shear force and bending moment were higher in solid concrete slabs with a most extreme for 40 m span. In light of bending moment and shear forces got through investigation, it was said that the voided slabs were progressively advantageous and proficient when contrasted with the strong slabs for bridge plan. From Comparative investigation, the reduction at the moment for strong slabs to voided slabs was 11.15 %, 7.77% and 5.45% individually for 20m, 30m and 40m span. Correspondingly, the reduction in shear forces for concrete solid slabs to voided slabs was 16.04%, 11.53% and 7.18% separately for 20m, 30m and 40m span.

Qin xin (2016) the research paper presented the properties of Foam Based concrete along with its process of preparation of Blending materials, addition of various admixtures and fibers and analysis was done on effect on the performance of Foam concrete. This even included its development and application as a sustainable material for future structures.

The conclusion stated Economical advancement is an interminable point, and there's a need to utilized a wide range of mechanical squander slag or building materials to manufacture foamed concrete. Simultaneously, there's a requirement for extensive and careful research on the presentation of foam concrete, with the goal that its high efficiency can be sensibly applied. The improvement course of China's foamed concrete was clear, the approach condition was controlled, and the application showcase was wide.

Nipa Chauhan and Farhan A. Vahora (2016) the research paper presented a comparative analysis in between two superstructures namely a pre-stressed concrete slab and a Pre-stressed Voided slab. It even included various alterations in span of bride slabs. The modelling program SAP 2000 was used to model the various span length with same width and the analysis was done on the same program. The parameters of comparison of the different slabs was done on their reaction to its bending moment and generated shear forces of each slab.

The results stated that shear force and bending moment was found quite high in concrete solid slabs with a maximum for 40m span. The result led to the conclusion that voided slabs were found far more stable and appropriate in comparison to concrete solid slabs for the designing of bridges.

Zi-bo Tang et al (2015) the research paper presented indoor proportion experimental study on lightweight and high-strength foam concrete (LHFC). The results led to the realization that the arrangement of foam concrete materials with a thickness level of 1200kg/m3 and uniaxial compressive quality of 10-15MPa by chemical frothing strategy and enhancing proportion through including three materials which were silica, slag and fly ash to coordinate with the structural arrangement of "concrete + fine sand".

S.Yuvaraj et al (2015) the research paper conducted experimental study of using M-Sand as replacement material in order to determine compressive strength of foam concrete block. The analytical report exhibited the prospect of the use of M-sand as 0 %, 20 %, 40 %, 60%, 80% and 100% for sand in foam concrete. Blend configuration was planned and created for four distinct proportions of quarry sand in foam concrete. Tests were directed on foam solid squares of size 150mm x 150mm x 150mm to contemplate the compressive quality of solid squares made of M-sand and results were contrasted against the control specimen. It was discovered that the compressive quality of foam concrete made of M-sand was almost 43% more than the control specimen. Immediately under the load, high compressive stress was instigated. Hence the load was applied through a pressing of compressed wood strip, accordingly, the solid shape falls flat at a definitive loading. The experimental results led to the recommendation that burnt clay bricks can be effectively replaced with foam concrete blocks. At long last, the cost assessment appraisal was done to demonstrate the economy of the foam solid blocks and it was discovered quite practical and cost-effective material.

Conclusion demonstrated the benefits associated with the use of Foam concrete was that it could be even prepared as low density high strength concrete.They can be utilized as high warm protection and lightweight cement. This sort of cement is the shelter for remote regions where sand alone is accessible. It tends to be utilized in garden structures where water permeation is high. At the point when fractional substitution of sand is finished by M-sand, because of this, eco-accommodating cement can be accomplished. 60% substitution of M.sand from the sand as the compressive quality increments by up to 60% and diminishes after that. Assembling and throwing are a quick and simple procedure.

As the foam concrete is lightweight, the brickwork in dividers can be supplanted by the foam concrete since it lessens the dead loads.

Ashish S. Moon et al (2015) the research paper presented classification of aerated lightweight concrete into foamed concrete and non-autoclaved concrete.the test apparatus included 1:1 mix [Cement: sand + quarry dust + both]. It was seen that blend in with quarry dust presented more stability when contrasted with sand as it were. If the sand and quarry dust when both utilized in mix show great quality as that in quarry dust alone. All blend was set up by keeping the water-bond proportion steady at 0.5. This foam concrete is a feasible structure development material as sand can be supplanted with quarry dust up to 100% likewise and these blends were made with the measure of aluminium powder at a steady measure of 0.05% to the dry load of cement. For further examination water-bond proportion, Aluminum powder substance can likewise be changed with its conduct in the mechanical and physical properties of foam concrete.

MAHESHKUMAR H. THAKRELE (2014) The research paper presented investigation of two different foam concrete mixture with combination of using one sample with sand and other sample without sand and selection was done for the correct proportion of foam concrete mix to target a plastic density of around 1900 kg/m3, the specimen of 18 cubes were prepared and tested with the mixture and further investigation was done to attain the density and compressive strength. The Prepared sample properties on parameters such as specific strength and percentage strength gain of foam concrete was compared with traditional weight concrete.

The results concluded that The Compressive Strength and Density of Foam Concrete increases with age. The Compressive Strength of Foamed Concrete increases with increase in the Density. De-moulding of higher density foamed concrete panels is possible after 24 hours but it requires minimum 3 days for lower density foamed concrete panels. The starting of Strength gain for foamed concrete is on higher side than that of normal weight concrete and Strength gain beyond 28 days is faster than normal weight concrete. Improved structural efficiency in terms of strength to density ratio resulting load reduction on the structure and substructure. Both the foamed concrete mixed proportions can be used for making partition walls in buildings. Strength and density is smaller compared to the conventional concrete.

II. CONCLUSION

Past researches demonstrated that Implementation of the lighteight solid structure is conceivable in structure work, analysts in past additionally expounded the work in utilizing diverse lightweight materials to improve solid properties.

In our examination, we selected foam concrete for the plan of lightweight RC concrete, and to think about its benefits and negative marks over the ordinary structure and to oppose sidelong forces in elevated structure.

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