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A Review: Filler Slab as alternative to Roofing Technology

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ABSTRACT: Filler slab technology is an innovative and cost effective technology where the dead load of slab is reduced by replacing the concrete with filler material. The concept behind the use of filler - slab technology is to reduce a substantial portion of concrete in the tension zone, since all the concrete in the tension zone does not contribute to the tensile properties. This concrete is replaced with lightweight, inert and inexpensive filler without compromising with the quality and structural stability of the structure, slab is designed; the filler blocks are placed between the reinforcement spacing by providing a cover of 20mm. The filler materials are granite dust and foundry sand. This filler slab is analyzed using material cost and ANSYS software. Filler slab is compared with the conventional slab of same size. This study describes the Structural behavior and cost effectiveness of filler slab when compared to the standard slab.

KEYWORDS: Filler material, Tension zone, Stability, Cost Effectiveness.

I. INTRODUCTION

A concrete slab is a common structural component of contemporary buildings. Slabs in buildings mainly support dead load and live load. As a large portion of the building's weight is because of the dead load, reducing self-weight of slabs is important to reduce the total cost of the structure. The increase of slab thickness makes a slab heavier, and it leads to increase structural elements and base size. Thus, it makes building consume a lot of materials like concrete and steel. One of the alternative techniques to reduce this increase in slab weight is to adopt slab with hollow roofing tiles, normally referred as filler slabs. Filler-slab technology is nothing however an alternate of R.C.C. slab in which concrete and steel are used along to construct RCC block, is in their individual properties as separate building materials and their individual limitation.

Concrete is good in accepting compression and steel is good in taking tension. Thus, Reinforced Cement Concrete (RCC) slab is a product which can resist both compression and tension. The basic aim behind the use of filler-slab technology is to reduce the use of substantial amount of concrete below the neutral axis. A lot of Concrete below the neutral axis does not contribute to the tensile properties, thus serves only as filler material. This portion of concrete are often replaced by regionally accessible and lightweight weighted filler materials like double-layer Mangalore tiles, hollow burnt bricks or conventional bricks, hollow Concrete blocks, etc., that area unit more cost effective, locally available and possess better thermal insulation properties. It reduces the burden of the block as these materials area unit lightweight in weight as compared to the traditional R.C.C. slab that uses concrete only. This successively reduces the amount of reinforcement utilized in the slab thereby reducing the value of the slab.



II. LITERATURE REVIEW

PET bottles and coconut shells are employed as filler materials in this investigation. PET bottles that are discarded after use take a very long time to disintegrate, having an impact on the environment. Good thermal insulation is provided by coconut shell, which is also a byproduct of coconut trees. Studying the flexural behavior of filler and conventional slabs, it was discovered that filler slabs could withstand less load than conventional slabs. When PET bottles are used as filler, a luminosity test is conducted to measure the quantity of natural light that passes through the bottles. To investigate the thermal insulation offered by the coconut shell used as filler, temperature distribution on concrete is used [1].

This method, developed at the Central Building Research Institute (CBRI), Roorkee, India, manufactures reinforced floor/roof slab with various materials as filler material in the context of using waste material in building construction and solving its disposal problem. The literature review research and numerous findings with regard to embedded energy, design and durability, cost effectiveness, and design optimization for filler slab are described in the study. This method, which is more inexpensive and will save cement and steel than the standard in situ RC slab, is a great first step in creating affordable housing for poor nations [2].

By using a numerical example, this study demonstrates one approach to designing RCC-Filler Slab floors and roofs. Comparing filler slabs to traditional RCC slabs, filler slabs show to be a more economical option by about 25%. These infill slabs instantly function as environmentally responsible and energy-efficient building solutions. This study will lay the groundwork for widespread use of RCC-Filler slabs for floors and roofing [3].

The Central Building Research Institute (CBRI), in Roorkee, India, has developed a technology to produce reinforced floor/roof slab with diverse materials as filler material in the context of using waste material in building construction and solving its disposal problem. The advantages of a filler slab over a regular slab are discussed in this essay, taking into account factors like thermal performance, materials, construction methods, and acoustical advantages [4].

This study compares the filler slab to the conventional slab and describes the structural behaviour and cost-effectiveness of each. The filler blocks are positioned between the reinforcement spacing of the two-way slab by giving a cover of 20mm. Foundry sand and granite dust are the filling ingredients. Software from ANSYS and STAAD.Pro is used to assess this filler slab [5].

This research talks about filler slabs as a possible solution for roofing in buildings for ECBC compliance. A framework is developed that selects the optimum combination of the materials based on different parameters like u value for different commercial building typologies in five climatic zones of India. This mathematical model generates the result for six building typologies, five climatic zones, three levels of ECBC, two grades of steel and concrete each and six slab thickness, a total of 2208 cases. This optimization model produces the optimum choice for filler material in different cases based upon the variables and associated constraints. In the cases where the solution cannot be derived, it is deduced that filler slabs alone are not feasible to be used as a solution for the ECBC compliance [6].

To overcome the wastage of concrete in tension zone, a new cost effective method called as Filler slab technique is used. Low price and lightweight filler substance like Mangalore tiles that will decrease the dead weight in addition to the total cost of this slab to some degree. Being environmentally accountable, the utilization of waste substances is a vital step in creating a sustainable future. The Eggshell, which is usually disposed as a poultry waste can be used as an alternate of cement in powdered form, since the shell is made up of Calcium having a chemical composition same as limestone. Partial replacement of cement by eggshell powder is done in different proportions like 2.5%, 5%, 7.5% & 10%. In this paper, the filler slab has been created additional cost effective with the



addition of eggshell powder because partial replacement of cement. Following a healing period of 28 days, there's a version in compression and flexural strength of concrete using eggshell powder compared to conventional concrete [7].

India is a developing country with only 20% of the highest paid group. Affordable housing can be considered affordable for a lower middle-income person if the family can get a unit of housing for up to 30% of the family income. Affordable housing is a related and closely related budget and seeks to reduce construction costs through better management, efficient use of local resources, skills and technologies without sacrificing the energy and health of the building. The “Rat Trap Mouse and Filler Slab” approach can be applied to a housing project to achieve cost effectiveness and structural stability without compromising the strength and durability of the system. This project work on Rat Trap Bond and Filler Slab Concept for alternative low-cost construction material. It was analyzed in this case study of Ajni in Nagpur district of Maharashtra [8].

Self-compacting concrete (SCC) is an innovative concrete that does not require vibration for placing and compaction. It is able to flow under its own weight, completely filling formwork and achieving full compaction, even in the presence of congested reinforcement and its engineering properties are similar to traditional concrete. This work highlights on the behavior of filler slab using self-compacting concrete with terracotta pots as filler. The materials used in Self compacting concrete are cement, mineral admixture- fly ash, chemical admixture- super plasticizer Glenium B233, crushed sand, water. The fresh properties of mortar were found by conducting Flow cone test, V- funnel test as specified in EFNARC (European Federation of National Associations Representing for Concrete) and optimum dosage of super plasticizer was found to be 2% with 25% fly ash. Mix design for SCC of M35 grade was done based on IS 10262:2009 & EFNARC. The fresh properties of concrete were found by conducting Slump flow test, Vfunnel test, L-box test as per EFNARC and the concrete satisfies the conditions specified in it. Then the slab specimen were cast in different sizes and tested for their flexural behavior and the results are compared with the theoretical values [9].

This project works on Rat Trap Bond and Filler Slab Concept for alternative low cost construction material. The need of alternative building technologies and materials has arisen in the past few years. There are many such options available at our disposal which when used in suitable combinations can save huge amounts of money and hence can result in affordable construction costs. One such building technique is the use of Rat Trap masonry. Contrary to other technologies, this amazing building technology is not new to us. In this modern age, we have overlooked this extremely useful technology which, while providing the same strength to the walls also saves us time and labor and also material cost to the extent of about 23% when compared with a standard 230mm brick masonry wall. In this project we have outlined the importance of RTB technology along with the construction details and also provided some comparative calculations to highlight the savings that can be achieved against the conventional solid brickwork [10].



III. CONCLUSION

Concrete being the highest consumed material on earth after water (Cement Industry Federation, Australia), is produced and used at a large scale in the construction industry. Ideas to reduce the usage of concrete without compromising the quality of construction will not only lead to cost effective buildings but also reduce carbon emissions when looked at a large scale. Many innovative techniques and economical methods are being proposed and filler slab technology is one such innovative and cost-effective technology where a dead load of the slab is reduced by replacing the concrete. Concrete is good in withstanding compressive forces and steel is good in withstanding tensile forces. The main aim behind the use of filler-slab technology is to condense a substantial portion of concrete below the neutral axis since all concrete in the tension zone does not add to the tensile properties. This concrete is replaced with lightweight, inert and inexpensive filler without neglecting the quality and structural strength of the structure. By reducing the quantity and weight of concrete, the slab becomes less expensive, but the strength has to remain the same as the conventional slab. In many of the areas, to reduce the heat impact in the building during hot weather at an economic cost, the filler-slab technology acts as an excellent thermal insulator and brings down the temperature inside the building.

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