

TO STUDY THE FILLER SLAB AS ALTERNATIVE CONSTRUCTION TECHNOLOGY-A REVIEW

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ABSTRACT: *In the context, with the utilization of waste material in building construction and solving its disposal problem, a technology has been developed at the Central Building Research Institute (CBRI), Roorkee, India, to construct reinforced floor/roof slab with various materials as filler material. The paper describes the literature review studies and various results with context to embedded energy, Design and durability, Cost effective, Design optimization for filler slab. Compared to conventional in situ RC slab, this technique is economical and will result in saving of cement and steel and is an ideal step towards generation of affordable housing, for developing countries.*

Key Words: *Filler Slab, Materials, Emended Energy, Cost.*

INTRODUCTION

1.1 RELEVANCE:-

The basic need of human beings is food, clothing and shelter civil engineering deals with the third need i.e. shelter directly. Building construction is one of the earliest activities associated since the beginning of the human civilization. As man has always needed shelter against natural weather conditions and extremities Man has transformed a lot in shelter right from caves to huts and from huts to R.C.C structures.

A slab is a flat two dimensional planar structural element having thickness small compared to its other two dimensions. It provides a working flat surface or a covering shelter in buildings. It primarily transfers the load by bending in one or two directions. Reinforced concrete slabs are used in floors, roofs and walls of buildings and as the decks of bridges. Concrete slab behave primarily as flexural members and the design is similar to that of beams. A concrete slab is a common structural element of modern buildings. Horizontal slabs of steel reinforced concrete, typically between 100 and 500 millimetres thick, are most often used to construct floors and ceilings, while thinner slabs are also used for exterior paving.

1.2 CLASSIFICATION OF SLABS

Slabs are classified based on many aspects

- 1) Based of shape: Square, rectangular, circular and polygonal in shape.
- 2) Based on type of support: Slab supported on walls, Slab supported on beams, Slab Supported on columns (Flat slabs).
- 3) Based on support or boundary condition: Simply supported, Cantilever slab, Overhanging slab, Fixed or Continues slab.
- 4) Based on use: Roof slab, Floor slab, Foundation slab, Water tank slab.
- 5) Basis of cross section or sectional configuration: Ribbed slab /Grid slab, Solid slab, Filler slab, folded plate
- 6) Basis of spanning directions:
 - One way slab - Spanning in one direction
 - Two way slab - Spanning in two directions

1.3 INTRODUCTION TO RCC FILLER SLAB

Filler slab technology is a simple and a very innovative technology for a slab construction. The reason why, concrete and steel are used together to construct RCC slab is in their individual properties as separate building materials and their individual limitation. Concrete is good in taking compression and steel is good in tension. Thus RCC slab is a product which resists both compressions as well as tensile. Filler slab is a very cost effective roofing technology. It is not easy to remove, the concrete from the tension zone, hence concrete can be

replace (partially); that part of concrete using light weight and low cost filler material. This method of construction is called filler slab. Filler slab technology is being used across India, but substantial amount of work on the successful promotion and mostly adopted in South India.

These filler materials are so placed as not to compromise the structural strength, stability and durability, resulting in replacing unwanted and non-functional tension concrete, from below and thus resulting in economy of high energy material consumption and respective cost savings and decreased dead load of the slab and resulting in economy of high energy materials consumption and considerable cost saving and decreased dead load of the slab. An internal cavity can be provided between the filler material which adds an extra advantage; other than cost savings and energy savings; improved thermal comfort for the interiors. Also an added advantage of lower dead weight transferred to the supporting elements and finally onto the foundation to further adds up cost saving in design of these elements.

1.4 MATERIALS SELECTION AS PER NEED AND DESIGN

Light weight, inert and inexpensive materials such as low grade Mangalore tiles, Thermopolis Burnt Clay Bricks, Hollow Concrete blocks, Stabilized Mud blocks/ Hollow Mud blocks, Clay pots, Coconut shells etc. can be used as filler materials. These materials are laid in the grids of steel reinforcement rods and concreting/concrete topping is done over them.

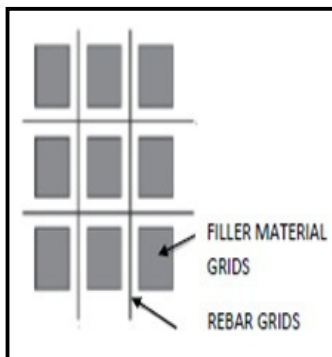


Figure 1 Arrangement of Filler slab

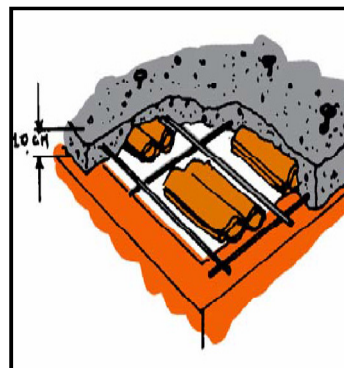


Figure 2 .Mangalore Tile as Filler Material

The following points should be considered for filler material selection:

- Filler material should be inert in nature. It should not react with concrete or steel in RCC slab constructed.
- Filler materials water absorption should be checked for as it will soak the hydration water from concrete.
- Filler material should be light in weight, so that overall weight of the slab reduces and also the dead load onto the foundations is reduced.
- Filler material should be low cost so that its cost is much lesser than the cost of the concrete it replaces. This is very important to achieve economy.
- Filler material should be of a size and cross-section, which can be accommodated within the spacing of the reinforcement and also thickness wise could be accommodated within the cross section of the slab.
- Filler material texture should match with the desired ceiling finish requirements so as not to provide an ugly ceiling pattern.

2.0 Role in construction as alternate technology:

2.1 Embedded energy

B.V.Venkatarama Reddy (Department Of civil Engineering & center of sustainable technology, Indian institute of science, Bangalore, India) studied certain issues pertaining to the energy, environment, alternative building technologies and sustainable building construction. He worked on energy consumption in manufacture and transportation of some common and alternative building materials and the implications on environment. He discussed on impacts of alternative building technologies on energy and environment.

Building element	Unit	Energy per unit (MJ)
<i>Walling systems</i>		
Burnt brick masonry	m ³	2141
SMB masonry	m ³	550
Steam cured block masonry	m ³	1396
<i>Roofing systems (for 3.6 m span)</i>		
Reinforced concrete slab	m ²	730
SMB filler slab	m ²	590
Composite panel roof	m ²	560
Ribbed slab roof	m ²	490
Brick masonry vault roof	m ²	575
SMB masonry vault roof	m ²	418
Mangalore tile roof	m ²	227
Ferroconcrete tile roof	m ²	158

Figure 3 Emended Energy For Various Materials

2.2 Design and durability

National Building Code of India 2005 specifies the filler slab is satisfactory and confirms to the provisions of relevant parts regarding material, design and construction and the material, method or work offered is for the purpose intended. The provisions of this part are not intended to prevent use of any construction techniques including any alternative materials, nonspecifically prescribed by the Code, provided any such alternative has been approved. The Authority may approve any such alternative such as ferrocement construction, row-lock (rat trap) bond in masonry, stretcher bond in filler slab and filler slab provided it is found that the proposed alternative is satisfactory and conforms to the provisions of relevant parts regarding material, design and construction and that material, method, or work offered is, for the purpose intended, at least equivalent to that prescribed in the Code in quality, strength, compatibility, effectiveness, fire and water resistance, durability and safety.



Figure 4 Casting of Filler Slab

2.3 Design optimization

In 2006 Prof. Ing. Petr Hajek, Csc., Ing. Ctislav fiala, Czech Technical University in Prague, has studied Reinforced concrete floor slab with integrated installation fillers made of recycled plastic materials and he has suggested installation of shells as filler material which are made of recycled non-sorted plastics obtained from municipal waste. The lightening of RC floor slabs is very important especially regarding current requirements for material savings and other economical and environmental criteria. The study focuses on the design optimization for floor slabs with fillers produced from recycled non-sorted plastic from municipal waste. The installation fillers enable a construction of floor slabs with an integrated cavity for conduction of the installation. It is possible to use this principle for monolithic, prefamolithic and prefabricated floor slabs.

Cost ford director P.B.Sajan focused on the air pocket formed by the contours of the tiles makes an excellent thermal insulation layer. A HUDCO-sponsored test carried out at the Anna University in 1988 proved that a filler slab was as good as the conventional one in terms of load bearing capacity.

2.4 Cost effective:

In 2008 Nilangan Sen Gupta studied Use of cost effective construction technologies in India mitigate climate change. Concentration of greenhouse gases play major role in raising the earth's temperature. Carbon dioxide, produced from burning of fossil fuels, is the principle greenhouse gas and efforts are being made at international level to reduce its emission through adoption of energy-efficient technologies. The UN Conference on Environment and Development, 1992 made a significant development in this field by initiating the discussion on sustainable development under the Agenda 21. Cost-effective construction technologies can bring down the embodied energy level associated with production of building materials by lowering use of energy-consuming materials. This embodied energy is a crucial factor for sustainable construction practices and effective reduction of the same would contribute in mitigating global warming. The cost-effective construction technologies would emerge as the most acceptable case of sustainable technologies in India both in terms of cost and environment. He has explained that by adopting method of filler slab in construction the emission of carbon dioxide (i.e. green house gas) is reduced up to a considerable percentage (20%) as compared to conventional slab.

M.P.Jaisingh, L.jaisingh and B.Singh, Central building research institute, Roorkee, India has studies A RC filler slab with non-autoclaved cellular concrete blocks for sustainable construction. They have used cellular concrete blocks as filler material in Construction of filler slab. Their study based on structural as well as functional performance.

A comparison of the consumption of materials and cost of construction of the filler slab with conventional RC slab is given in below fig.. In case A, the comparison has been made for a 3.6 m x 3.6 m two way spanning continuous slab and in case B for a one way spanning simply supported slab of span 3.6 m.

Slab	Item	Cement (kg/n?)	Steel (kg/m ²)	cost (Rs./m ²)
A. Two way spanning continuous slab	a) Conventional slab 120 mm thick	38.4	7.1	415
	b) Filler slab 150 mm thick	32.0	4.0	346
	c) Savings (percentage)	16	44	17
B. One way spanning simply supported slab	a) Conventional slab 120 mm thick	48.0	6.5	450
	b) Filler slab 150 mm thick	32.0	3.5	338
	c) Savings (percentage)	33	46	25

Figure 5 Cost Compression with conventional slab

CONCLUSION:

After carrying out the study and various papers it can be stated that this technology can be proved to stand as cost effective and alternate technology for construction.

1. Strength of conventional slab and filler slab is nearby same. Therefore no any no effects of making filler slab instead of conventional slab.
2. Economic point of view, 30% of concrete is saving in filler slab technique. In filler slab technique 30% cost is saving, which is greatly effect on economy.
3. In manufacture of cement, filler slab technique saves 30% of carbon emission which proves eco-friendly.
4. Aesthetic: There is no need of extra expenditure for interior decoration purpose.

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