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Application of RCC Filler slab Floors and Roofs

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Abstract: This paper clearly presents one method of design of RCC-Filler Slab floors and roofs by means of a numerical example. Filler slabs prove as a cost effective alternative resulting with around 25% of overall economy compared to conventional RCC slabs. These filler slabs instantly serve as energy efficient and eco-friendly construction systems. This paper will open ways to wide spread application of RCC-Filler slabs for floors and roofs.

Keywords: RCC slab, RC filler slab, Mangalore tile, strength, stiffness

1. Introduction

Flooring and Roofing play a major role in the construction of dwellings, especially when further expansion is expected. From the point of amount of labour and its cost, the practice of AC sheet roofing is suppressed by the application of RCC slabs adopting standard design codes. [1, 2 and 3]. Since 1980s, RCC-Filler slabs system is seldom adopted [4, 5, 6 and 7]. One of the various reasons behind is the lack of peer literature with design details supported with codes and evidences of applications lasting even after decades.

2. RCC-Filler slabs

It is an improved version of conventional RCC slab itself.

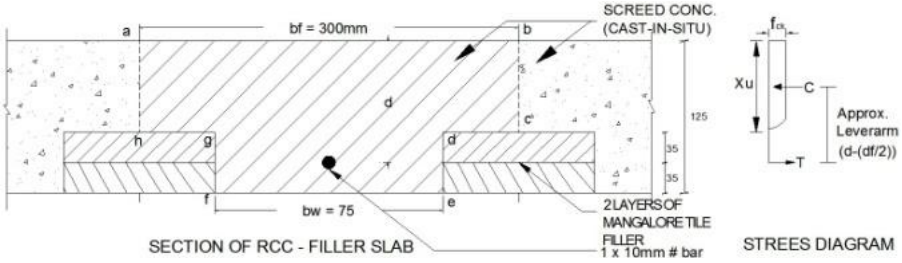

Figure 1: C/s of RCC-Filler Slab with Stress diagram

Figure 1 shows the cross section of RCC filler slab with stress diagram. The slab has non-load bearing fillers in tension zone, causing reduction in dead load.

2.1 Advantages of RC Filler Slab

The main advantages are, less material consumption, lesser weight, labour intensive, thermal comfort, sound proofing, aesthetically enhanced ceiling, environment friendly, overall economy 25% and readily suits for conversion of any existing Mangalore tiled building into RCC filler slab.

3. Fillers

The fillers may be mangalore tile, flat tile, coconut shell, shell type fired clay pan, plastic tray, any special shaped sheet metal bowls or trays etc. Based on the strength, integrity, finishing required and aesthetic aspect, any such filler may either be left in the slab or it can otherwise be removed conveniently, while removing the form work made for casting.

3.1 Mangalore tile as filler

The Mangalore tile is commonly employed as roof covering in the rural residential buildings with lean to roof or coupled roof systems. Being light in weight, economically viable, consists of folds / curves, it has good structural stability and hence often used in filler slabs by laying in single or double layers.

3.2 Re-bars

Grid layout of reinforcement bars are provided at the middle of the ribs in both short and long spans. The bars at their 90^0 junctions are tied using binding wire and usual concrete covering is also given. The reinforcements for negative moments at supports or ridges are also provided to adopt mirror image of main bars. It facilitates easy placement of the fillers.

3.3 Service lines

Electrification Lines, Telephone lines etc., can be laid well within the ribs. Care shall be taken to see that the change in direction of such service lines in plan is in right angled layout pattern only. Fan hooks and any such drop hooks can also be made in the rib portions as rib concrete is similar to that of the conventional slab itself.

4. Design

4.1 Slab analyzed as 'T' beam and cast as a slab

Referring to Fig.1, the points 'abcdefgh' show the alphabet 'T'-Shape. Forms for the ribs are cast by the mere presence of the fillers themselves. Hence, no extra formwork is needed. Minimum size of each rib is 75mm width and the minimum depth is to be as per the slab design. The 'T' beam is analysed for a single rib in the short span as follows.

4.2 External Moment of RCC Filler slab / Rib

Load calculation / m width of slab
Imposed Load (Roof) $=1.5\ kN/m^2$
Weathering Course $=0.6\ kN/m^2$
Self weight $=0.125x24.48=3.125\ kN/m^2$
Total Load $=5.16\ kN/m^2$
Factored Load $=5.16x1.5=7.84kN/m$
Assuming simply supported effective span of 3.1m,
Max. mid span moment/m $=(7.74x3.1^2)/8$
$=9.327x10^6$ Nmm
Hence, Moment/Rib (BM) $=9.327x10^6x0.3$
$=2.798$ kNm ..... (1)

4.3 Moment of resistance of RCC Filler slab / Rib

Assuming, over all depth=125mm on stiffness basis, Take, dia. of main bar =10mm, clear cover =15mm,
d (effective) available =125-15-5=105mm
Neutral axis depth $X_u=0.87xf_yxA_{st}/0.36xf_{ck}xb_f$ $=0.87x415x78.5/0.36x20x300$
$=13.12$mm
Resisting Moment $=(0.87xf_yxA_{st})x(d-0.42xX_u)$
$=(0.87x415x78.5)x(105-0.42*13.12)$
$=2.823$ kNm ..... (2)
Since, value in (2) is slightly greater than (1); the section is safe in flexure.
As far as the shear force is concerned, the slab (T-section) with larger flange portion will be safe only.
The table 1 refers design table of one way slab.

Table 1: RCC-Filler Slab Design for M20 & Fe 415

Clear span (metre)	*Permissible live load (kN/Sq.m)*	*Overall thickness (mm)*	*Numbers x Dia. of Short Span rebar (mm) / Rib (c/c of 300mm)*
2.44	2.0	90	1x10
2.44	3.0	90	2x8
3.00	2.0	100	2x8
3.30	1.5	114	12 or 2x8
3.60	3.0	114	1x16
5.10	1.5	135	2x12
5.10	2.0	155	2x12
6.60	3.0	180	2x16

Figure 2: A view of the RCC-Filler slab

Figure 2 shows the application of filler slab.

5. Structural dependency of Filler slab system

Most of the Civil engineers too, have the doubt as to whether the RCC filler slab has enough load carrying capacity, stiffness and durability? All the above questions are answered in solitary by the numerical example adopting the code [1], as in the previous section.

6. Conclusion

The RCC filler slabs are no longer inferior to conventional RCC slabs. RCC filler slab floors & roofs are very much feasible for vertical expansion of further floors above. They are also a boon for preservation of open land. The slabs consume lesser materials and they give room for air pockets within their cross section. Hence, apart from being economical, they are energy efficient and eco-friendly. The RCC filler slabs conserve natural resources at the same time.

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