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Comparative Analysis of Conventional Slab & Waffle Slab of Different Span Length

Anjali Mishra[1] and Anurag Bajpai[2]

[1]PG Student (M.Tech. Structural Eng.), Civil Engineering Department, Institute of Engineering and Technology, Lucknow
[2]Assistant Professor, Civil Engineering Department, Institute of Engineering and Technology, Lucknow
E-mail: [1]am91.sweety@gmail.com, [2]bajpaianurag5@gmail.com

Abstract—*A reinforced concrete slab is used to create flat horizontal surface such as floors, roof, deck. A slab is few inches thick and supported by beam, column and ground. A two-way joist slab system comprises of ribs constructed within the perpendicular direction and intersecting ribs placed at regular interval & interconnected to a slab of nominal thickness is understood as Waffle slab or Grid slab. The utilization of waffle slabs is column free area is that the main requirement. There are various methods available for analyzing the grid or waffle slab system. These methods are studied namely Rankine Grashoff's method (approximate method), Rigorous analysis (Timoshenko's plate theory) and stiffness method (based on ETABS 2018 Software) and given results are compared with one another. A reinforced concrete floor area is to be considered of size 12*18m, 18*24m, 24*30m. The flexural parameters like bending moments (Mx & My), shear force (Q_x& Q_y) and deflection is calculated. The magnitude of span to depth ratio considered is 20. Thickness of slab is 125mm. The deflection at mid span developed in grid floor are predicted and check the deflection value within the permissible limit as per IS 456:2000.*

Keywords: *Waffle Slab, Rankine Grashoff's method, Rigorous analysis, stiffness method ETABS 2018 etc.*

INTRODUCTION

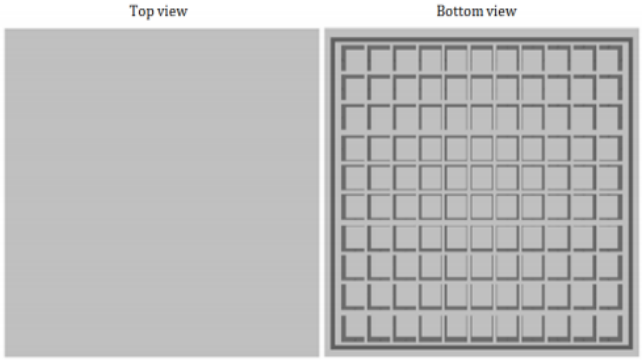


FIG. : Top and bottom view of waffle slab

Conventional slab is supported with beam and column, with the load transferred to those elements. Conventional slab is classified as one-way slab and two-way slab. Waffle slab are very feasible for architectural purpose for large span like auditoriums, complex, theatre halls, show rooms of outlets where this type of section is column free space is typically the foremost requirement. this type of section used for heavy loads and massive span structures as they exhibit very high stiffness and very small deflection. The void formed section within the ceiling leads to reduction in load and is advantageously utilized for concealed architectural and beautiful looking lighting. These types of slabs are also used because the inspiration for several differing kinds of buildings and structures, but are most commonly utilized in commercial or industrial buildings. Waffle and ribbed slab foundations are resistant to cracking and sagging and should hold how greater amount of weight than traditional concrete slabs. Waffle slabs are conventionally analyzed by the tactic proposed by Rankine Grashoff's method (approximate method), Rigorous analysis (plate theory) and stiffness method. Now a day's software is employed to hold out analysis of ETABS software are going to be used for analysis and style purpose.

MATERIAL & GEOMETRICAL PROPERTIES

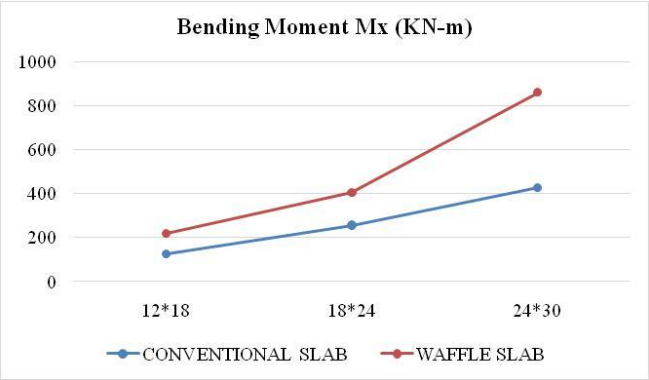
TABLE1: Material properties and geometrical properties

S.NO.	STRUCTURAL PART	DIMENSION
1	Size of grid	12*18m,18*24m,24*30m
2	Concrete	M 20
3	Rebar	Fe 415
4	Thickness of slab	125 mm
5	Width of rib	200 mm
6	Overall depth of rib	600,900,1200 mm
7	Spacing of ribs	1500 mm

RESULT:

TABLE 2: Bending moment in conventional slab & waffle slab in x-direction

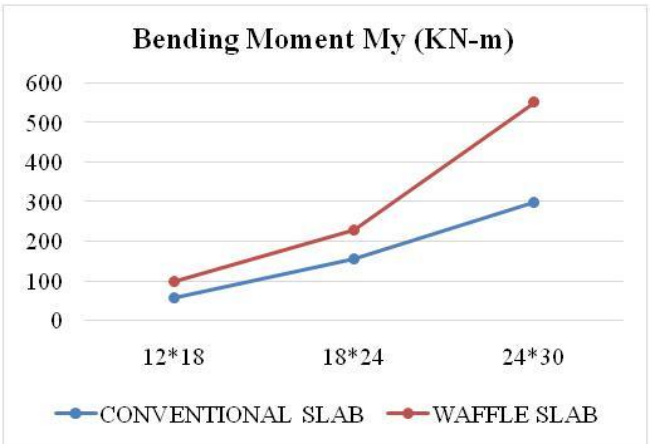
	Bending Moment M_x (KN-m)	
Span	**Conventional Slab**	**Waffle Slab**
12*18	126.24	219.18
18*24	256.74	403.87
24*30	427.29	859.74



GRAPH 1: Bending moment in conventional slab & waffle slab in x-direction

TABLE 3: Bending moment in conventional slab & waffle slab in y-direction

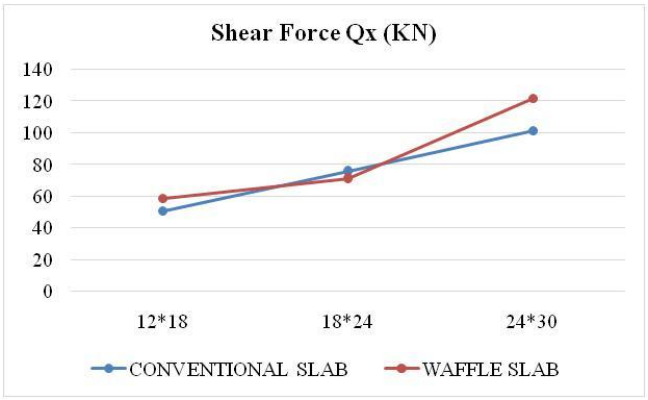
	Bending Moment My (KN-m)	
Span	**Conventional Slab**	**Waffle Slab**
12*18	55.84	97.41
18*24	152.95	227.18
24*30	296.19	550.23



GRAPH 2: Bending moment in conventional slab & waffle slab in y-direction

TABLE 4: Shear force in conventional slab & waffle slab in x-direction

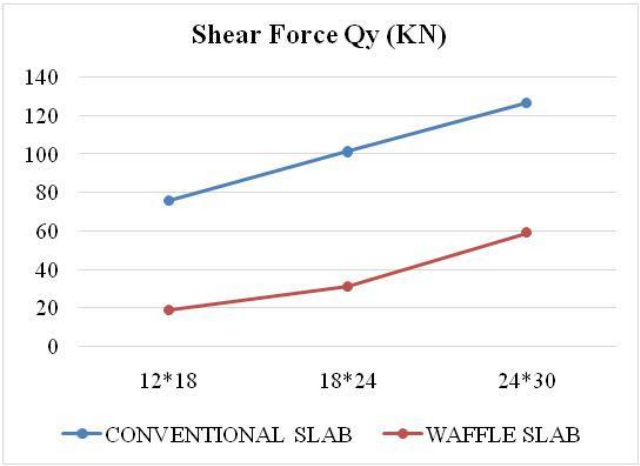
	Shear Force Qx (KN)	
Span	**CONVENTIONAL SLAB**	**WAFFLE SLAB**
12*18	50.58	58.65
18*24	75.87	71.37
24*30	101.16	121.51



GRAPH 3: Shear force in conventional slab & waffle slab in y-direction

TABLE 5: Shear force in conventional slab & waffle slab in y-direction

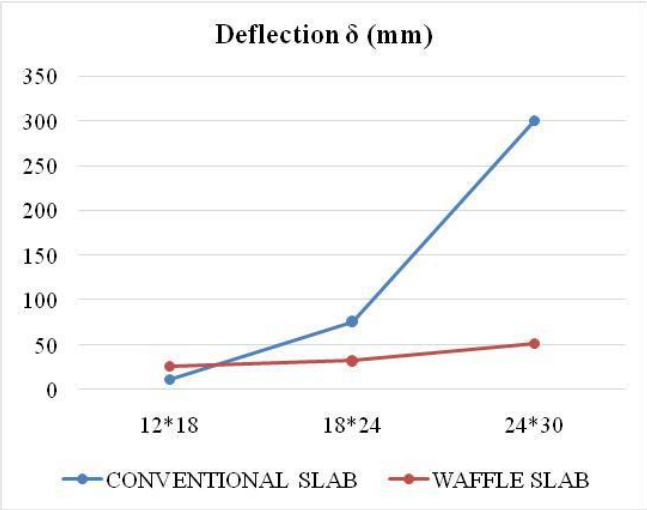
	Shear Force Qy (KN)	
Span	**CONVENTIONAL SLAB**	**WAFFLE SLAB**
12*18	75.87	18.91
18*24	101.16	30.91
24*30	126.45	58.74



GRAPH 4: Shear force in conventional slab & waffle slab in y-direction

TABLE 6: Deflection in conventional slab & waffle slab

	Deflection δ (mm)	
Span	**CONVENTIONAL SLAB**	**WAFFLE SLAB**
12*18	11.26	26
18*24	76	32
24*30	300	51



GRAPH 5: Deflection in conventional slab & waffle slab

CONCLUSION

- The load carrying capacity on waffle slab is high as compared to conventional slab.
- According to IS code 456:2000, deflection of waffle slab is within permissible limit but in conventional slab deflection is very high and not in the permissible limit.
- In waffle slab spacing of grid beam increases, bending moment decreases, this is because as the spacing increases the number of ribs decreases and there will be a reduction in dead load.
- The conventional slab is not practically feasible to provide for large span area but in terms of deflection and economy waffle slab is perfect for large span area.
- The thickness of waffle slab is reducing or very much less as compared to conventional slab.
- In this paper various parameter and practical benefits of waffle slab in comparison with conventional slab is clearly elaborated.

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