International Journal of Emerging Trends in Engineering and Basic Sciences (IJEEBS)
ISSN (Online) 2349-6967
Volume 7, Special Issue 4 (July-August 2020), PP. 107-113

ANALYSIS AND DESIGN OF FLAT SLA B

Akansha Wagh, Komal Umredkar, Shubham Dhawande, Payal Dugane, Mohammad Riyazuddin Siddique
Department of Civil Engineering, Priyadarshini J L College of Engineering, Nagpur, India

Abstract: Nowadays, India is a growing country in construction by using a flat slab is a more benefits it is reducing the floor height, it takes shorter construction time and it is also flexible in room layout. The main objective of writing this paper is to compare the moment, shear force and punching shear stress by different type of method of direct design method, Equivalent frame method, and finite element method by used (ETABS) software. By comparing this three method in Analytically, it is found that In direct design method Bending moment ,shear force and punching shear stress is dissimilar whereas In equivalent frame method (Elastic frame method) and finite element method. The punching shear stress, shear force and bending moment are approximately similar.

Keyword: Bending moment, Direct Design Method, Equivalent Frame Method, and Finite Element Method, Punching Shear Stress

I. INTRODUCTION

A Flat slab is a flexure of the member which is consider without using any beam and also known as **beamless slab, flat slab, waffle slab.** It is an economical for large span. It is a load transfer over a small parameter of column, resulting large bending moment. In uses of flat slab there are two types Drop Panel and Column Head. Drop Panel is a form of local thickening of slab around column, mainly for reducing shear stress. It also reduces the area of steel for a negative moment in the column. The thickness of drop shall be 1.25 to 1.5 and times the thickness of the slab. Column Head is contribute at the top of column basically to increase the punching shear stress capacity of the slab. Generally, it is rectangular or circular Column Head reduces the clear or effective span therefore reduce the moment on the flat slab floor. By type of flat slab Flat slab with drop panel, Flat slab with column head, Flat slab without a column head & drop panel, flat slab with a column head & drop panel.

There are two types of strip using a flat slab. Column strip a column strip is a design strip with a width on each side of column passing through centerline is known as columns strip. (0.25l). Middle strip A design of strip bounded by two columns is known as middle strip. (2x0.25l).

II. LITRATURE REVIW

Anghan Jaimis (2016): In their paper presented was specified the comparative study of slab in this paper two types of slab are used, they are flat or conventional slab. In their study, they're told the seismic performance of the building is very much important and the seismic confrigation of the building is overall geometry, structural system and load part that all the important parameter affected.

Mathai Prajapati (2014): In their paper work is to compare the behavior of flat slab with traditional two way slab. The maximum sidelong displacement storey drift and axial forces generated in the column. That is contained in the studies criterion.

Ravi Kumar Makode (2014): In their paper present discussed regarding about the flat slab building in which slab is directly resting on a column, the advantage of reduced floor to floor height meet the economic and architectural demands.

Vikunj K. Tilva (2011): In their paper discussed that to advantages for a comparison between flat slab with drop and without drop panel in four storey lateral building sidelong load resting building. A four storey building is deliver to gravity load + lateral load using ETABS software every storey was trading to SAFE software for analyzing punching effect due sidelong loads. On the basic of admissible punching shear criteria according to IS 456 provident thickness of flat slab. With drop and without drop are selected the effect showed that from economic point of view slab with drop procurement is desirable

Dr. Uttamasha Gupta (2012): The main concept of their paper is to be a comparison of the behavior of buildings having a flat slab with that of having two way slab with drop, beam and to analyze cause part shear wall on the performances of these two types of model under seismic force. The Present work provides a good origin of information on the parameter seismic base shear lateral displacement storey shear and storey drift.

III. METHDOLOGY

Determine for span of 6x6m and 9x9m by used Fe500 and M30 by below three Method

3.1 Direct Design Method
3.2 Equivalent frame Method
3.3 Finite Element Method
3.3.1 ETABS (Extend 3-dimensional building system)

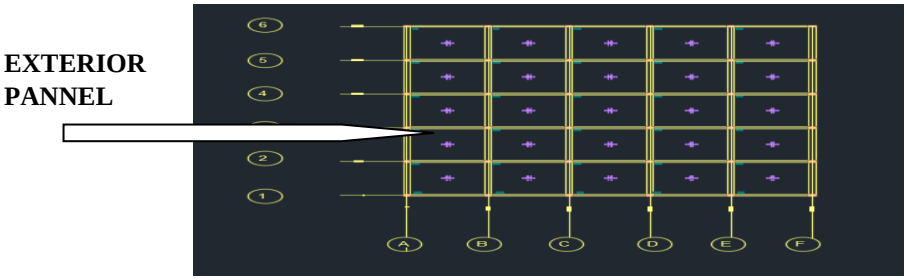


Fig -1.1 Autocad plan

Table-1.1

SIZE OF PANEL	COLUMN SIZE	DROP SIZE
6X6MM	450X450MM	-
9X9MM	600X600MM	4.5X4.5MM

3.1 Direct Design Method

The direct design method is a simplified and basic procedure of determining the negative and the positive design moment at a critical section in slab, using factual moment coefficient. For column strip and middle strip.

3.1.1 Exterior span moment

a. Column strip moment:

Exterior negative moment: $[\frac{0.65}{\alpha}]x1x\ M_d$ Interior negative moment**:** $[0.75-\frac{0.10}{\alpha}]x0.75xM_d$

Interior positive moment: $[0.63-\frac{0.28}{\alpha}]\ x0.6xM_d$

b. Middle strip moment:

Interior negative moment: [0.75-$\frac{0.10}{\alpha}$]x0.25xM_d Interior positive moment: [0.63-$\frac{0.28}{\alpha}$] x0.4xM_d

Calculation of Direct Design Method

Table -1.2

Span(m)	Depth(m)		Moment(KN-m)			Shear force(KN)	Punching shear stress KN/mm2
			negative exterior	positive interior	negative interior		
6x6m	235mm	C.S	226.55	110.08	224.81	456.35	1.48(unsafe)
		M.S	0	73.39	74.93		
9x9m	345mm	C.S	711.84	473.608	1002.08	1085.31	1.29
		M.S	0	315	323.45		

In direct design method calculated the exterior span moment, shear force and punching shear stress. In the span of 6x6m the punching shear stress was found to be unsafe hence applied peripheral beam in the next method. This is a main drawback of the Direct Design method.

3.2 Equivalent frame method

The equivalent frame method of design (also called elastic frame method) of two way beam supported slab, flat slabs, flat plates and waffle slabs.

The bending moment and shear force is equivalent frame are obtained.

Such concept simplifies the analysis of three dimensional reinforced concrete building by subdividing it into a series of two-dimensional (panel) frames ('equivalent frames') centered on column line in longitudinal as well as transverse direction.

3.2.1 Exterior span moment

a. Column strip moment:

Exterior negative moment: 100%M_U Interior negative moment: 60%M_U Interior positive moment: 75%M_U

b. Middle strip moment:

Interior negative moment: 20%M_U Interior positive moment: 12.5%M_U

In 6x6m span used Peripheral beam provide 300x400mm

Table-1.3

Calculation of Equivalent Frame Method

Span (m)	Depth (mm)		Moment (KN-m)			Shear force (KN)	Punching shear stress (KN/m^2)
			negative exterior	positive interior	negative interior		
6x6	235mm	C.S	93.86	120.44	282.69	271.9	0.79

		M.S	0	80.28	94.22		
9x9	345mm	C.S	572	491	1261	621.22	1.22
		M.S	0	207	262		

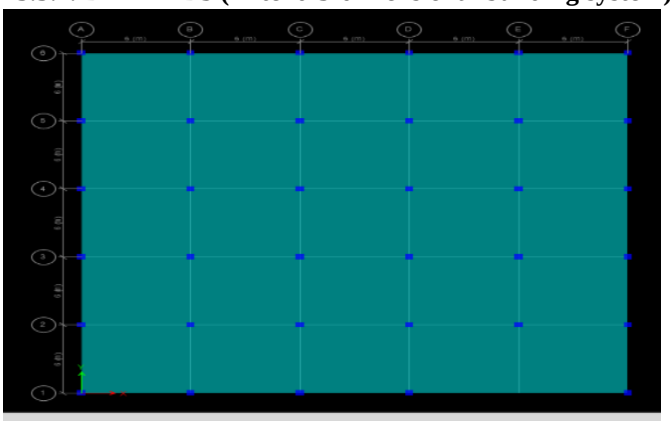
In this method the punching shear stress is found to be safe in total entire span.

3.3. Finite Element Method

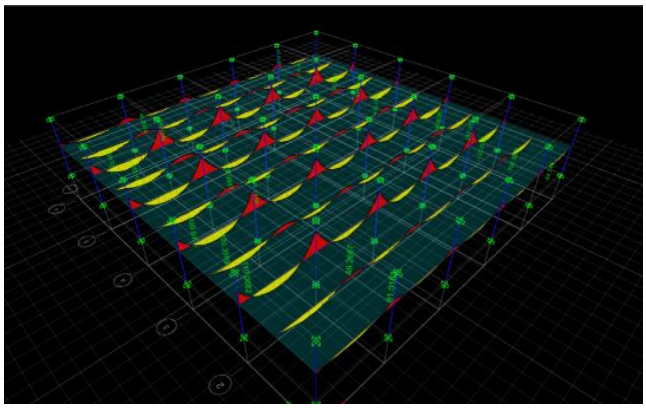
The digital computer has exerted a profound impact on engineering education, research and practice. A basic numerical method in the hands of engineers is the finite element method (FEM). A general purpose program based on FEM implemented on a computer provides a universal tool for engineering analysis design optimization and stimulation. More advanced application of FEM is identified further study.

To achieve the above objectives, the analyst has at his disposal three distinct approaches: (1) analytical methods; (2) experimental techniques and (3) numerical methods.

3.3.1. BY ETABS (Extend 3-dimensional building system)

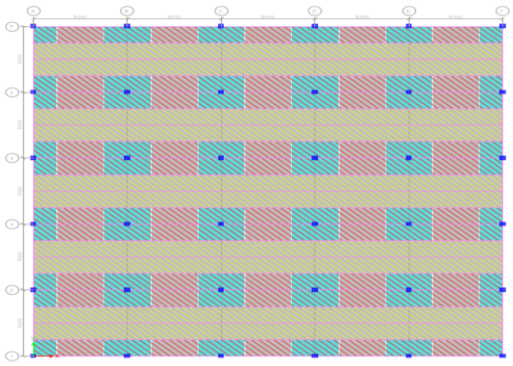


3-d View

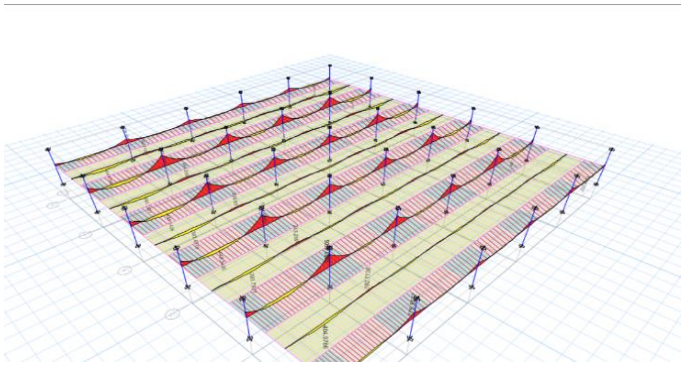


Plan view

Fig -1.2
Span 6x6m



Plan view



3-d View

Fig-1.3

Span 9x9m

In 6x6m span used Peripheral beam provide 300x400
By using ETABS software for 6x6m punching shear stress are not applicable because using peripheral beam.

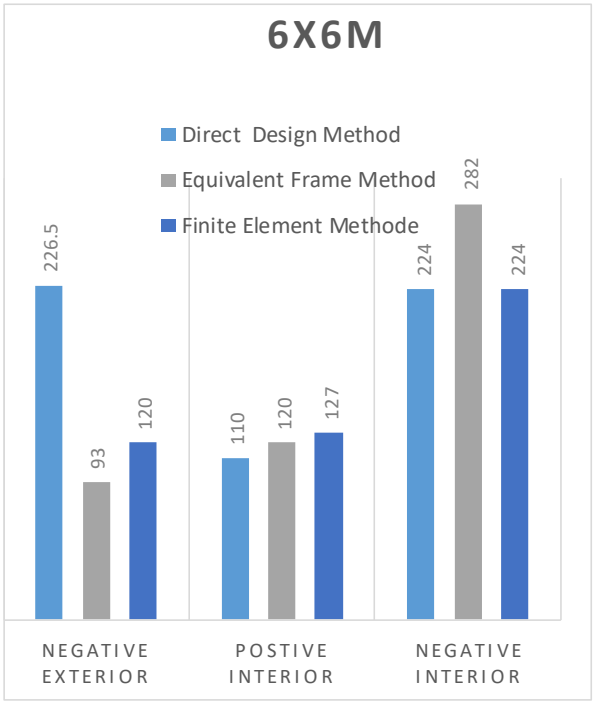
Calculation of ETABS

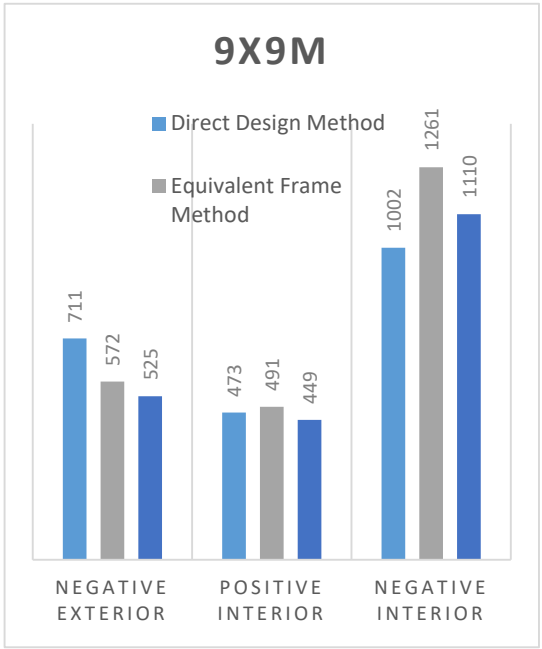
Table-1.4

Span (m)	Depth (mm)		Moment (KN-m)			Shear force (KN)	Punching shear stress (KN/m^2)
			negative exterior	positive interior	negative interior		
6x6	235	Column strip	120.1	127	224	325	N/A
		Middle strip	0	109	66.08		
9x9	345	Column strip	525	449	1503	1041	0.864
		Middle strip	0	389	215		

VI. COMPARSION BETWEEN DIFFERENT TYPE OF METHOD

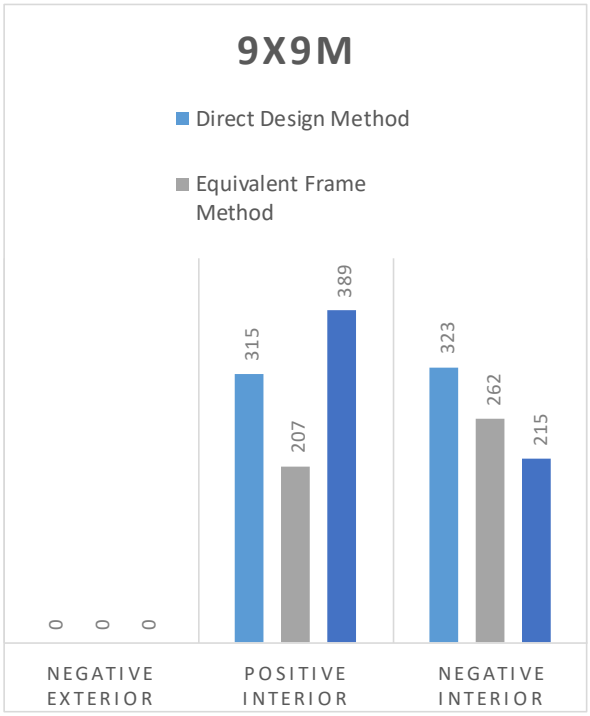
4.1 Compare Column strip Moment:

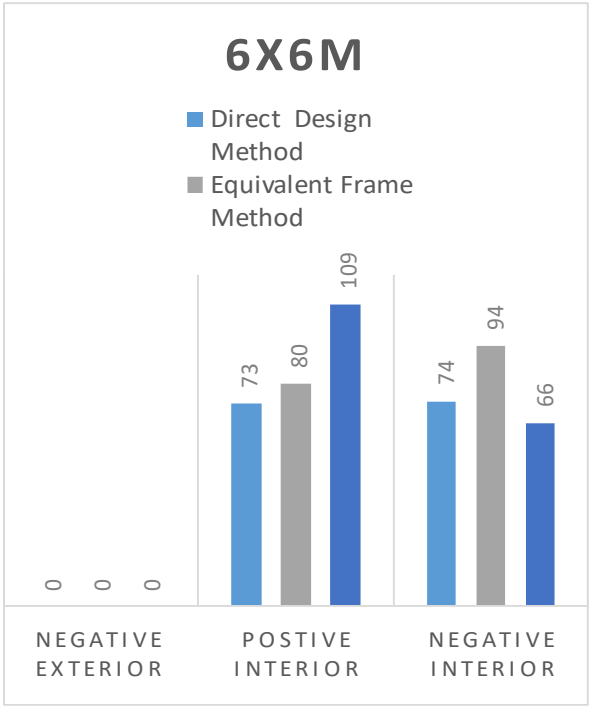




Graph-1.1

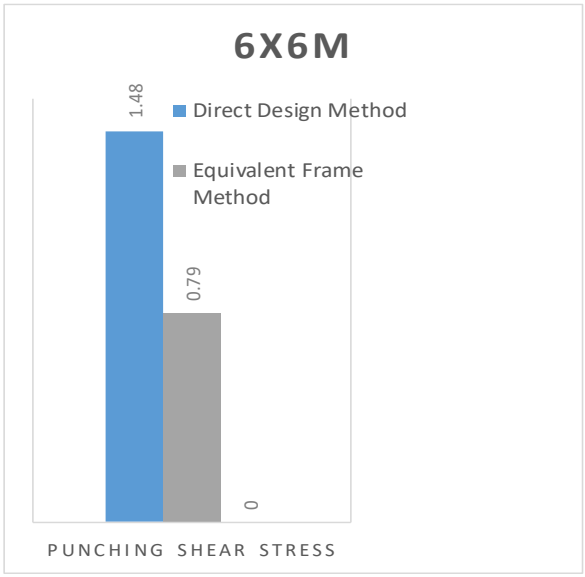
4.2 Compare middle strip moment:

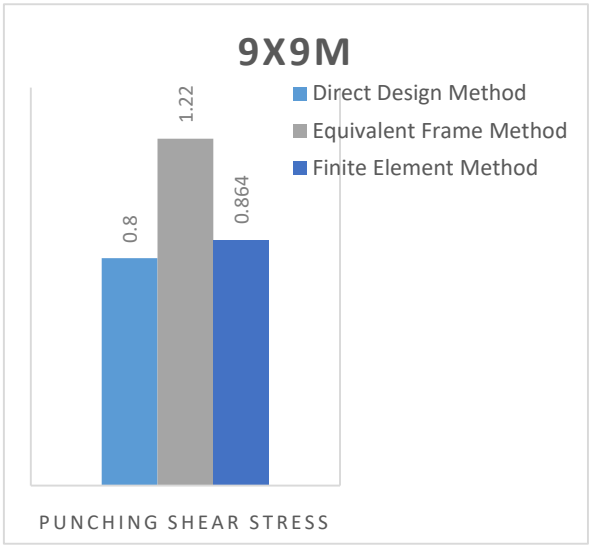




Graph-1.2

4.3 Compare punching shear stress





Graph -1.3

V. CONCLUSION

5.1. In direct design method the negative moment is approximately difference in 200-300 KN-m more than comparatively other methods.
5.2. The equivalent frame method is more accurate than DDM.
5.3. In an equivalent frame method and finite element method moment has been given to the similarities.
5.4. In the span of 6x6m the design without drop providing the punching shear stress is found to be unsafe with the compare of permissible shear stress in direct design method. (That is a drawback of the direct design method).
5.5. In direct design method has more limitations by compared to the equivalent frame method.

REFERENCES

[1] Anghan Jaimis , Mithan Kathrotiya, "Comparative Study of the Flat Slab and Conventional Slab using Software Aid" GRD Journal for Engineering Vol.001, No.1 29, and March 2016.
[2] Madhavi Prajapati , Vivek Tiwari, Sumit Pawah "Analytical Approach to Study Effect of Shear Wall on Flat Slab and Two Way Slab" International Journal of Emerging Technology and advanced engineering Vol.4,Issue 7,July 2014.
[3] Ravi Kumar Makode, Geeta Batham, Salim Akhtar "Dyanamic Analysis of Multistory RCC Building Frame with Flat Slab and Grid Slab" International Journal of Research and Application ISSN 2248-9622 Vol .4, Issue 2 (Version 1) February 2014.
[4] Vikunj K. Tilva, B. A. Vyas "Cost Comparison Between Flat Slabs Seismic Behavior of Buildings Having Flat Slab with Drops" International Journal of Emerging Technology and advanced engineering, ISSN 2250-2459, Vol.2, Issue 10 October 2012.
[5] Dr. Uttamasha Gupta, Shurti Ratnaparkhe, Padma Gome,"Sesmic Behaviour of Building Having Flat Slabs with Drops" International Journal of Emerging Technology and Engineering, ISSN 2250-2459,Vol.2, Issue 10 October 2012.
[6] P. C. Varghese (second edition) "Advance Reinforcement concrete" Design of two-way slabs by direct design method, Equivalent frame Analysis of flat slab.
[7] Indian Standard Plain and Reinforced Concrete Code of Practice IS 456:2000