International Journal of Scientific Research in Civil Engineering
© 2022 | IJSRCE | Volume 6 | Issue 6 | ISSN : 2456-6667

Design of R.C.C. Framed Structure Considering the Effect of Stiffness of Slab

Bhojram, Pradeep Kumar Nirmal, Lokesh Singh
RSR Rungta College of engineering and Technology Bhilai, Madhya Pradesh, India

Article Info
November-December-2022

Publication Issue :
Volume 6, Issue 6

Page Number : 11-14

Article History
Accepted : 01 Nov 2022
Published : 07 Nov 2022

ABSTRACT

The slab is very important member in building and slab is one of the largest member consuming concrete. When the load acting on the slab is large or clear span between columns is more the slab thickness is on increasing. It leads to consume more material such as concrete and steel, due to that self-weight of slab is increase. So the self-weight of slab can be reducing by considering the stiffness of slab. Stiffness indicates the capacity of the structure to resist deformation. The aim of this research is to understand the behavior of moments induced in the columns when the stiffness of slab is considered. The present paper mainly focused on the behavior of the effect of floor slabs in the frame due to vertical loading and the moments induced in columns. STAAD software has been used to model the frame with and without considering the effect of stiffness of slab.

Keywords : Solid Slab, Corner Column, Loads and Moment Transfer

I. INTRODUCTION

The stiffness of a structure is generally understood to be the ability of a structure to resist deformation. Structural stiffness describes the capacity of a structure to resist deformations induced by applied load. Excessive deflection of reinforced concrete structure can cause serviceability problems and required repairs can be expensive with the use of higher strength and new materials in reinforced concrete, the importance of serviceability limits states become more apparent, currently deflections of reinforced concrete slabs must be calculated for slabs with thickness less than specified values in the American codes (ACI 318M-95).

In general the slab was designed only to resist vertical load. In addition when the span of the building is increasing deflection of slab is more important. Hence the slab thickness is increases. Increasing slab thickness makes slabs heavier and its leads to increased column and base size.

Flat slab is a reinforced concrete slab that usually does not have beams and the loads are transferred directly to the supporting concrete columns. So the deflection occur in the columns will be high. To avoid this various studies carried out and researcher suggest design the structure with considering the stiffness of the slab and form solid slab. It reduces the deflection which is occurred in the column as well as moment induces in the columns is reduced by 10 to 15% than moment occur in the column in flat slab condition. So it makes building stiffer and increases the moment

and axially forces carrying capacity of the column about 10 to 15% in the solid slab and also by the Indian design code Provision for designing the slab.

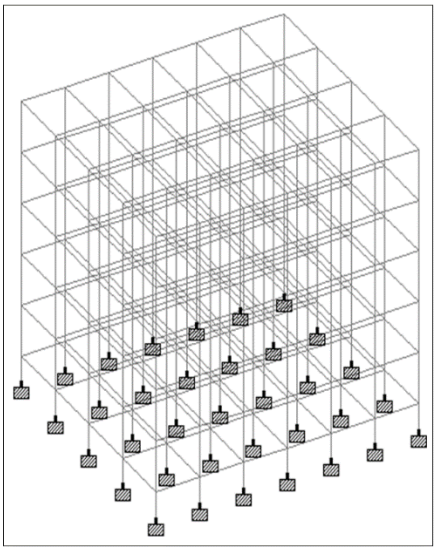


Fig. 1: Storey building without slab

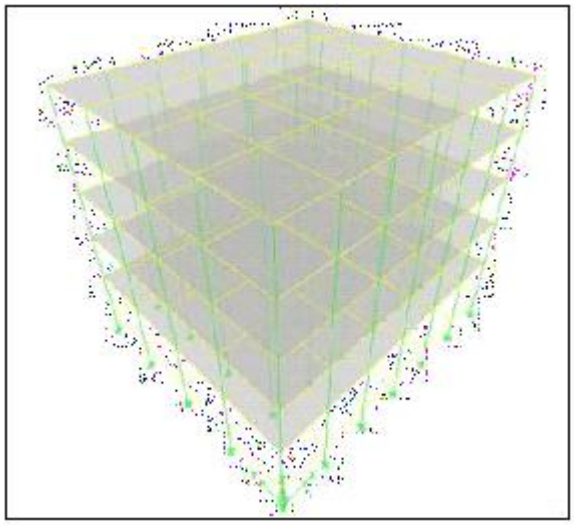


Fig. 2: 3D view of 5 storey building with slab

II. METHODOLOGY

The methodology followed out to achieve the above mentioned objectives is as follows:

1) Review of the exiting literatures by different researchers and also by the Indian design code Provision for designing the slab.

2) A broad literature review on the use of considering stiffness of slab in the framed structure.

3) Performing static analysis in the designing of stiffer building.

4) Determine the moments which is occure in beams and columns with and without considering the stiffness of plate by finite element method with the help of STAAD Pro.

5) Comparison of moments which is occure in beams and columns with and without considering the stiffness of plate.

6) Finally the observations of results and discussions.

Structural Modelling:

General: A building frame model involves the assemblage of structural elements viz., beams, columns etc to represent the structural aspects of a typical frame in a building and exhibit its behavior under external loading. This chapter deals with the modeling of the RC plane frames of four storey structure.

Loads: All loads acting on the building except wind load were considered. These are:

1. Dead Load
2. Live load
3. Lateral Load due to Earthquake

Dead Load: The dead load itself indicates self weight of the beams and columns. The unit weights of some materials are given from Table-1, IS 875 (part-1):1987.

Unit weight of Reinforced concrete, γc= 23.5 kN/m3

Lateral loads due to earthquake: The lateral loads were calculated in X-direction according to IS 1893 (part -1):2002 and applied at the nodal points in a direction considered. The lateral load along X-direction is denoted as EQx and the lateral load along Z-direction is denoted as EQz.

Load combinations: The load combinations considered in the analysis according to

IS 1983: 2002 are given below:

COMB1 = 1.5(DL+LL)

COMB2 = 1.5(DL+EQ)

COMB3 = 1.5(DL-EQ)

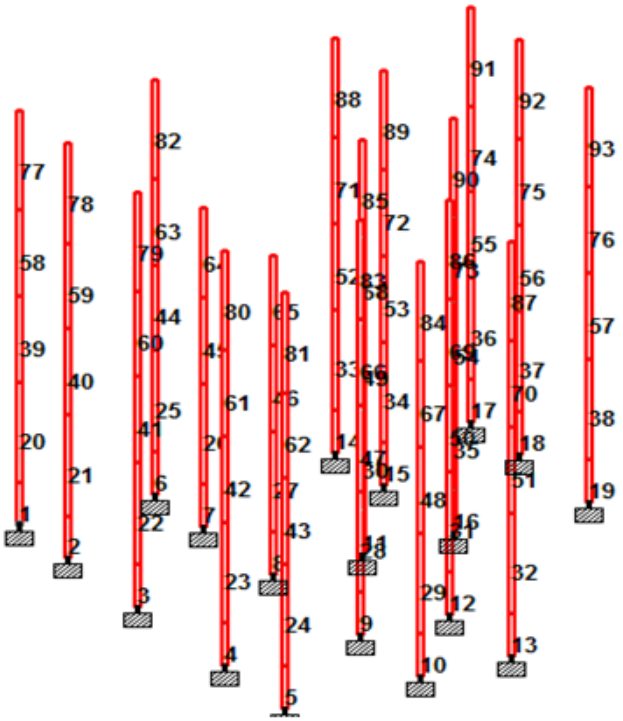
COMB4 = 0.9DL-1.5EQ
COMB4 = 0.9DL+1.5EQ

Modelling of Frame

All the preliminary modeling was done in staad.pro. The frames four Storeys without slab and with slab was modeled in STAAD.pro as shown in previous plan. The main aim is to derive the difference in moments induced and displacement in a column between these two frames.

Member properties:

1. All the beams in the frame were different sized to 0.23m X 0.3m, 0.23m X 0.4m, 0.23m X 0.45.
2. All the columns in the frame were sized to 0.3m X 0.3m but at top floor two columns in the frame were sized to 0.4 X 0.4 in both models.
3. Different thickness of the slab was calculated for the analysis purpose and assigned to each floor. The slab thicknesses are 125mm, 135mm, 150mm, 175mm, and 200mm.



III. RESULT AND DISCUSSION

1) The maximum capacities of beam and columns strengthened.
2) The moment which is occure in beams and columns is different than that of the moment which
3) Is occure in the beams and columns without considering the stiffness of slab.
4) The maximum capacity of the RCC framed structure strengthened.

IV.CONCLUSION

From above paper lots of research has been done on static analysis of solid slab building. So I would like to compare analysis between two models slab without stiffness and slab with stiffness (solid slab).

Some conclusion are seen in my analysis and they are-

1) The corner columns shows a significant reduction in moment when stiffness of slab is considered.
2) Deflection occurred in the column can be reduced.
3) The effect of solid slab significantly reduces the reinforcement requirement in the column in longer direction.

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Cite this article as :

Bhojram, Pradeep Kumar Nirmal, Lokesh Singh , "Design of R.C.C. Framed Structure Considering the Effect of Stiffness of Slab", International Journal of Scientific Research in Civil Engineering (IJSRCE), ISSN : 2456-6667, Volume 6 Issue 6, pp. 11-14, November-December 2022.
URL : https://ijsrce.com/IJSRCE22662