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Comparative Analysis and Design Of Flat Slab & Grid Slab In Multistoreyed Building Under Seismic Condition

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Abstract: *The flat slab construction is one in which the beam is used in the conventional methods of construction. The slab directly rests on column and the load from the slabs is directly transferred to the columns and then to the foundation. Drops panel or columns are generally provided with column heads or capitals. Grid Slab systems consisting of beams spaced at regular intervals in perpendicular directions, monolithic with slab. They are generally designed for large rooms such as vestibules, auditoriums, theatre halls, show rooms of shops where column free space is often the main requirement. The aim of the project is to determine the seismic analysis between the flat slab and grid slab. The proposed construction site is Sri Nirmal madhav apartment 4 manis nagar behind shardha square, Nagpur. The total length of slab is 45m and width is 30 m. total area of slab is 1350 sqm. It is designed by using Fe415 steel and M30 Grade concrete and Fe415 steel. Analysis of the grid slab and flat slab has been done both manually as well as software by IS 456-2000 and software also. Flat slab and Grid slab has been analyzed by ETABs software. Rates have been taken according to N.M.C. C.S.R...*
Keywords: *Grid Slab, flat slab, spacing of grids beams, Etabs*

I. Introduction

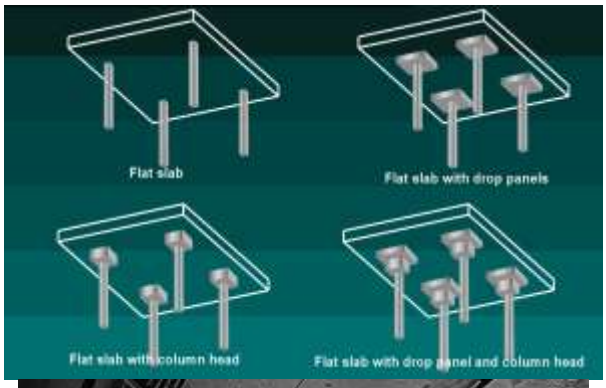
This project presents the "comparative study of flat slab and grid slab for multi storied building under seismic condition ". This work includes the analysis of flat slab and grid slab. The purpose of this study is to understand the characteristics, the method of analysis, and the design of flat slab and grid slab; and to find out which slab system with certain parameters is superior to other. A flat slab is a two dimensional planar structural element having thickness small compared to its other. It provide a working strenghth for 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. The floor system of a structure can take many forms such as in situ solid slab, ribbed slab or pre-cast units. Slabs may be supported on monolithic concrete beam, steel beams, walls or directly over the columns. Concrete slab behave primarily as flexural members and the design is similar to that of beams.

The advantage of grid over other types of floors is that the flat roof or floor is obtained. By using ordinary reinforced concrete construction and by increasing number of beams, the depth of beam can be shortened. Thus, greater clearance can be obtained. The structure is monolithic in nature and these types of floors have more stiffness. The maintenance cost of these floors is also negligible than that of steel-girders and prestressed concrete.

II. Economical Aspects Of Long Span Slabs Between Flat Slab And Grid Slab

2.1 FLAT SLAB

A reinforced concrete flat slab, also called as beamless slab, is a slab supported directly by columns without beams. A part of the slab bounded on each of the four sides by centre line of column is called panel. The flat slab is often thickened closed to supporting columns to provide adequate strength in shear and to reduce the amount of negative reinforcement in the support regions. The thickened portioni. the projection below the slab is called drop or drop panel. In some cases, the section of column at top, as it meets



2.3 ADVANTAGES OF FLAT SLABS

It is recognized that Flat Slabs without drop panels can be built at a very fast pace as the framework of structure is simplified and diminished. Also, speedy turn-around can be achieved using an arrangement using early striking and flying systems. Flat slab construction can deeply reduce floor-to –floor height especially in the absence of false ceiling as flat slab construction does act as limiting factor on the placement of horizontal services and partitions. This can prove gainful in case of lower building height, decreased cladding expense and pre-fabricated services. In case the client plans changes in the interior and wants to use the accommodation to suit the need, flat slab construction is the perfect choice as it offers that flexibility to the owner. This flexibility is possible due to the use of square lattice and absence of beam that makes channelling of services and allocation of partitions difficult.

2.3 DESIGN OF FLAT SLAB

Multitudes of process and methods are involved in designing flat slabs and evaluating these slabs in flexures. Some of these methods are as following:

i. The empirical method
ii. The sub-frame method
iii. The yield line method
iv. Finite –element analysis

For smaller frames, empirical methods are used but sub-frame method is used in case of more irregular frames. The designs are conceptualized by employing appropriate software but the fact is using sub-frame methods for very complicated design can be very expensive. The most cost effective and homogenous installation of reinforcements can be achieved by applying the yield line method. A thorough visualization in

terms of complete examination of separate cracking and deflection is required since this procedure utilises only collapse mechanism. Structures having floors with irregular supports, large openings or bears heavy loads, application of finite- element analysis is supposed to be very advantageous. Great thought is put into choosing material properties or installing loads on the structures. Deflections and cracked width can also be calculated using Finite- element analysis.

3.4 GRID SLAB

Grid slab or waffle slabs have two major types,I.e, waffle slabs with hidden beams or waffle slabs with solid sections around columns. The first waffle slab type, with beams, behave like solid slab(slab with beams between columns) and the analysis method could also be similar to that of solid slab. And in most codes coefficients are provided for slabs with beam. This coefficients could be used to analyse grid slabs with beams. The second type, with solid section around columns, behave somewhat similar to flat slabs. And you can analyse it using direct design or equivalent frame methods. Please note that , codes specifiy limitations on the grid slab sections in order to show that analyzing the slabs as solid or flat slab is possible

III. Methodology

The process of analysis and design of structure performed on STAAD–Pro V8i in accordance with IS - 1893:2002 and IS456:2000 is shown through Flow Chart below

SN. NO.	SPECIFICATIONS	DIFFERENT TYPES OF SLAB SYSTEM	
		GRID SLAB	**FLAT SLAB**
1	Plan Dimension	42mx30m	42mx30m
2	Length of grid I x-direction	3m	-
3	Length of grid I z-direction	3m	*
4	Floor to floor height	3.2m	3.2m
5	No. of stories	13m	13m
6	Plinth level	1.5m	1.5m
7	Slab thickness	150	250m
8	Size of beam	500mm x 450mm	0.2mx0.2m
9	Size of column	0.7mx0.7m	0.7mx0.7m
10	Size of Grid	3x3m	-
11	Spacing of Grid	6m	6m
12	Grade of Concrete	m-40	m-40

3.1 LOADING CONDITION

The loads considered during design and analysis of multistoried building for grid size 3x3 having plan area 225m2 and loading calculation for other case changes as plan area changes due to change in depth of the slab.

1. Dead load :

It is taken as according to IS -875 (Part 1) : 1987

a) Plate load = Density of concrete x Slab thickness = 25kn/m3 x 0.150m = 3.125kn/m2
b) Masonry load on plate = 1kn/m2
c) Floor finishing = 1.5kn/m2 Total weight of slab =5.625kn/m2
2. Live Load:
It is calculated as per IS-875 (part 2) :1987
Live load on floors = 1.5kn/m2
3. Earthquake load:
It is calculated as per IS-1893 (part 1): 2002
Seismic Definition
Earthquake zone – III (Z=0.16)
Response reduction factor – 5
Importance Factor – 1.5 (Very Important Building) Rock and Soil Site Factor-1
(Medium Soil Building) Type of Structure- 1
Damping - 5% (0.05)
Soil Type: Medium soil
Natural Time Period (Ta) - 0.075h0.75 (Ta = 0.73199 sec) Seismic weight of floor on working story's = 4kn/m3
Seismic weight of top floor = 2kn/m

IV. Conclusion

1) It is seen that the quantity of concrete is increase with increase span / grid size of the structure for the same slab system.
2) The quantity of concrete is least for smaller span of the structure and it is most for larger span of the structure.
3) The maximum displacement is found to be most for grid slab system for same plan area of the structure and it is followed by flat slab system in all direction of the structure
4) Considering all the above inference made on analysis of all considered slab system multi story building, we finally conclude that the flat slab is most economical for all span consider in the analysis.

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