

# Comparative Study of Flatslab and Beam-slab System for a Multi-storied RC building

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**Abstract** - In this new era of construction flat slab is playing one of the most important role, now days flat slab construction is widely adopted due to its main advantages like accessibility of more space, easier frame work and speedy construction compared to other slab systems. In this particular work comparison is done between flat slab system and beam-slab system for varied spans between columns and their rate analysis is done. For this work multi storied RC building (G+5) is considered, the modeling of both flat slab and beam-slab system is done using well known software ETABS for different spans between the columns i.e. 5m, 7m and 9m. The flat slab design is also done for all three spans. The quantity of steel and concrete is calculated for both flat slab and beam slab building and rate analysis is done.

## 1. INTRODUCTION

Flat slab is RC slab with no beams, the slab is directly kept on the columns of the building, and the loads coming from the slab is directly transferred to the columns.



There are many types of the flat slab depending on the load distributed on it. If the loads are minimum or common on the slab then slab is directly kept on the columns which are known as flat plate. If the load carried by the slab is more or dynamic then drop panels are provided which is commonly known as flat slab with drops. As shown in the fig. Since there are no beams and the slab is placed on the columns the under the application of the loads the columns try to punch through the slab. Therefore to avoid this column heads are provided. That type of slab is known as flat slab with column head. The flat slab is mainly used where zigzag column

alignments are there, now a day flat slab is often adopted due its advantages over the beam-slab systems. The flat slab is easy in construction since there are no beams in it and it makes the frame work during the construction also easy. Benefit of using flat slabs are manifold not only in terms of prospective design and layout efficacy but is also helpful for total construction process especially for easing off installation procedures and saving on construction time.

### 1.1 FLATSLAB SYSTEM

Flat slab is a slab with no beams where the load coming from the slab is directly transferred to the columns. In this work the flat slab with the drop panel is considered. The flat slab consists of different components like drop, column head, panel, middle strip and column.

**Drop**- This is the primary part of the flat slab to oppose the punching which is originating at the contact section of slab and column support.

**Column head**- When the loads at the column slab connection is more than the punching action will also be more hence its necessary to provide column head.

**Column**- Column is a vertical member which can resist uni-axial and biaxial stresses developed due to loads. It can undergo buckling with respective its length. The minimum percentage of steel 0.8% and maximum is 4%.

### 1.2 ADVANTAGES OF FLATSLAB

Its been observed that the flat slab without the drop panels construction can be achieved in very less time and also flat slab with the drop panels can be constructed in very less time as compared to conventional slab system.

The form work for the flat slab construction is easy and can be done in a very less time.

Since there are no beams the accessibility of the space inside the building is greatly increased.

The floor height can be reduced to great extent due to the absence of beams and no extra cost for false ceilings.

Since more space is available more versatile plans can be accommodated in the building to meet the client needs.

**2. BEAM-SLAB SYSTEM**

Beam-slab system is also called as the conventional slab system. This is a old and traditional method of construction used in the multi-storied structures. In this system the slab are kept on the beams, the loads coming from the slab is taken by the beam and the beams are connected to the column where further load is transferred.

This construction of this system involves complex frame work and the reinforcement. The depth of the beam mainly depends on the load and its span.



**ADVANTAGES:**

- It's a traditional method of construction.
- Long spans can be accommodated.
- The structure is very rigid.
- Availability of more floor height.

**DISAVANTAGES:**

- The frame work for this system is very complex due to the presence of the beams.
- Floor height should be more.
- Less accessibility of the space due to the presence of beam.
- Construction is not fast.

**3. SOFTWARES USED**

The work is mainly based on the software since the design and modeling is required. Following are the some software used in this project,

- a) CSI ETABS

- b) MICROSOFT EXCEL

ETABS- This software mainly provides a great interface for modeling the structure with all advanced configurations. In this work EATBS is mainly used to model the both flat slab and beam-slab buildings.

MICROSOFT EXCEL- The software is mainly used for the design calculations of the flat slab and quantity calculations of steel and concrete for both slab systems, the rate analysis is also done using this software.

The main aim of using this software is to reduce manual calculations and values are exact and error free.

**4. MODELING**

The modeling of the flat slab structure and beam-slab structure is done using well known software ETABS. The modeling of flat slab and beam slab is done for different spans that are 5m, 7m and 9m between the columns.

**5.1 MODELLING OF FLAT SLAB SYSTEM**

**Concrete and Steel details**

Concrete grade of normal slab & drop	M20
Concrete grade of column	M20
Density of concrete	25 KN/m <sup>3</sup>
Grade of steel	Fe415

**Flatslab with 5m span between the columns,**

Plan dimension	21m X 21 m
Total height of building	16.125 m
Building considered	(G+5)
Story height	3 m
Base consideration	Fixed
Depth of slab	225 mm
Depth of drop	375 mm

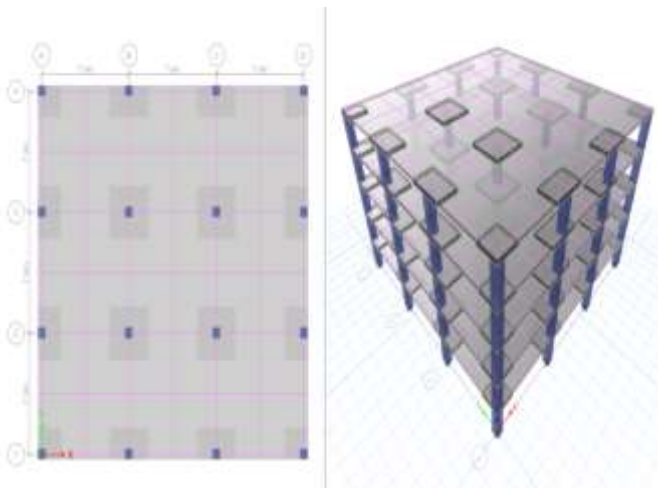


Figure 1 FLAT SLAB MODEL (5m)

**MODEL OF FLAT SLAB WITH 9m SPAN BETWEEN THE COLUMNS**

Plan dimension	21m X 21 m
Total height of building	16.125 m
Building considered	(G+5)
Story height	3 m
Base consideration	Fixed
Depth of slab	225 mm
Depth of drop	375 mm

**MODEL OF FLATSLAB WITH 7m SPAN BETWEEN THE COLUMNS**

Plan dimension	21m X 21 m
Total height of building	16.125 m
Building considered	(G+5)
Story height	3 m
Base consideration	Fixed
Depth of slab	225 mm
Depth of drop	375 mm

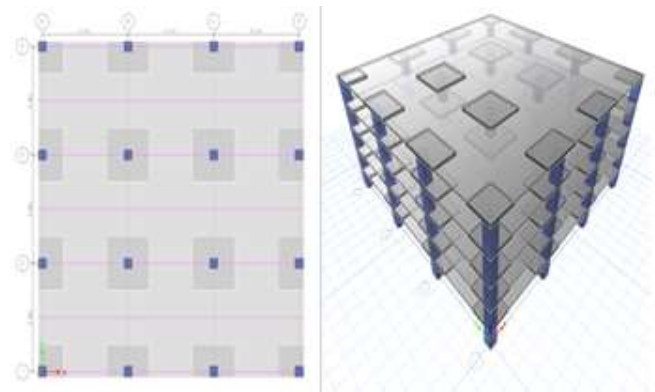


Fig 3 Flatslab model 9m span

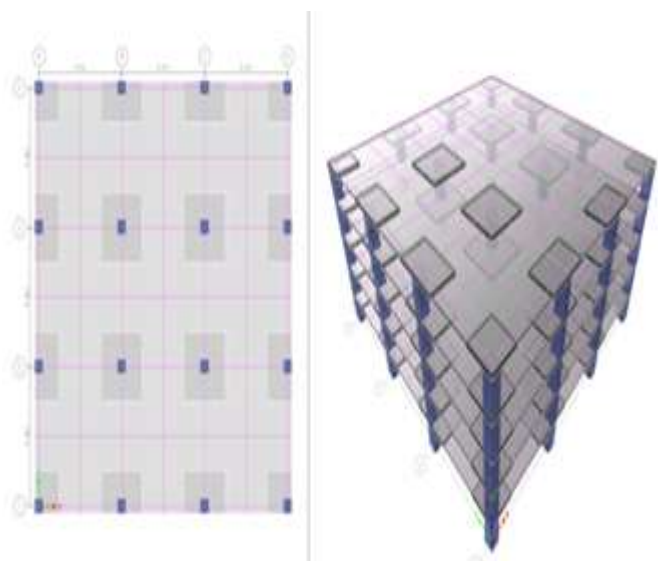


Figure 2 FLATSLAB MODEL (7m)

**5.2 MODELING OF BEAM-SLAB SYSTEM**

**Beam-slab for 5m span between the columns**

Plan dimension	15 m X 15m
Spacing between the columns	5 m
Total height of building	15.875 m
Building considered	(G+5)
Story height	3 m
Base consideration	Fixed
Size of the column	600*600 mm
Size of the beam	300*750 mm
Depth of the slab	175 mm

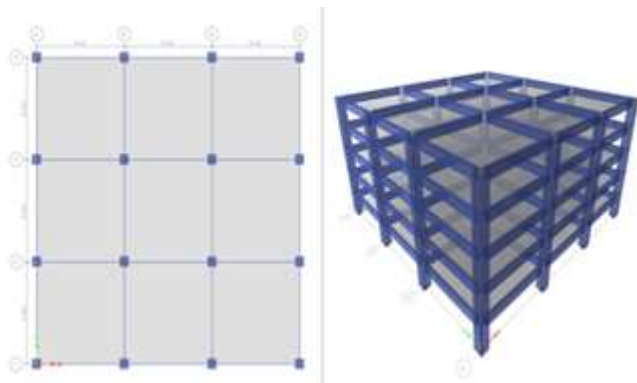


Figure 04 BEAM SLAB (5m)

Building considered	(G+5)
Story height	3 m
Base consideration	Fixed
Size of the column	600*600 mm
Size of the beam	300*750 mm
Depth of the slab	175 mm

**Beam-slab for 7m span between columns**

Plan dimension	21 m X 21 m
Spacing between the columns	7 m
Total height of building	15.875 m
Building considered	(G+5)
Story height	3 m
Base consideration	Fixed
Size of the column	600*600 mm
Size of the beam	300*750 mm
Depth of the slab	175 mm

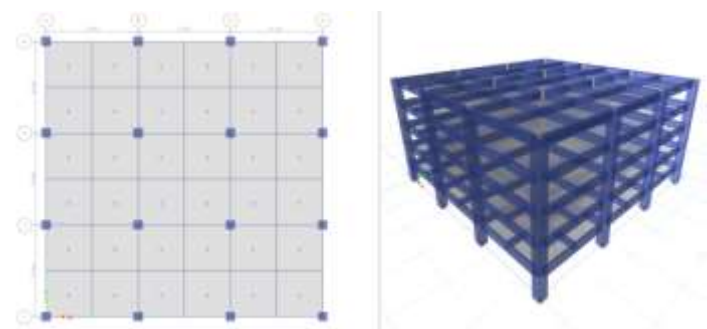


Fig 06 BEAM-SLAB (9m)

**6. DESIGN OF FLATSLAB**

The design of flat slab was carried out for three different spans i.e. 5m, 7m and 9m, as per Indian standards code IS456:2000. The details of reinforcement are given below,

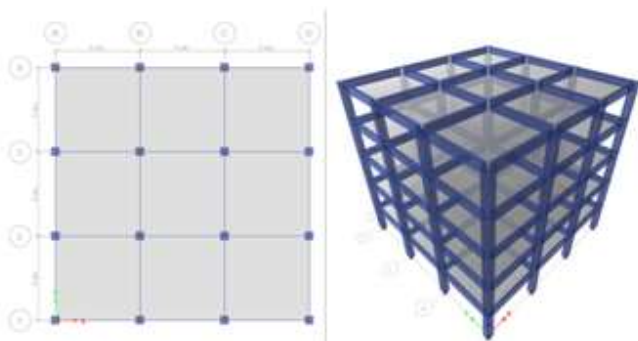


Fig. 05 Model of beam-slab 7m span

**Beam-slab for 9m span between columns**

Plan dimension	27 m X 27m
Spacing between the columns	9 m
Total height of building	15.875 m

For 5m span			
Middle strip		Column strip	
Top in "mm C/C"	Bottom in "mm C/C"	Top in "mm C/C"	Bottom in "mm C/C"
300	300	160	300
For 7m span			
Middle strip		Column strip	
Top in "mm C/C"	Bottom in "mm C/C"	Top in "mm C/C"	Bottom in "mm C/C"
300	300	85	260
For 9m span			
Middle strip		Column strip	
Top in "mm C/C"	Bottom in "mm C/C"	Top in "mm C/C"	Bottom in "mm C/C"
300	300	140	270

### 7. QUANTITIES

The quantities for steel and concrete for both flat slab and the beam-slab were calculated using the design details, quantities are given below,

For flat slab:

FLATSLAB (FOR ONE FLOOR)			
Span in m ->	5	7	9
MATERIAL	QUANTITIES		
Steel in 'kg'	3120	8104	11309
Concrete in 'm <sup>3</sup> '	50.7	117.7	242

For Beam-slab :

BEAM-SLAB(FOR ONE FLOOR)			
Span in m ->	5	7	9
MATERIAL	QUANTITIES		
Steel in 'kg'	4721	10747.4	25908
Concrete in 'm <sup>3</sup> '	44.1	106.15	194.4

### 8. RATE ANALYSIS

From the quantity analysis which is done above we have got the total quantities for the steel and the concrete, by considering present day cost for concrete and steel we have calculated the cost for both flat slab and beam-slab systems for all the three spans and analysis was done between them.

#### The present costs for concrete and steel

For mixing and laying concrete :

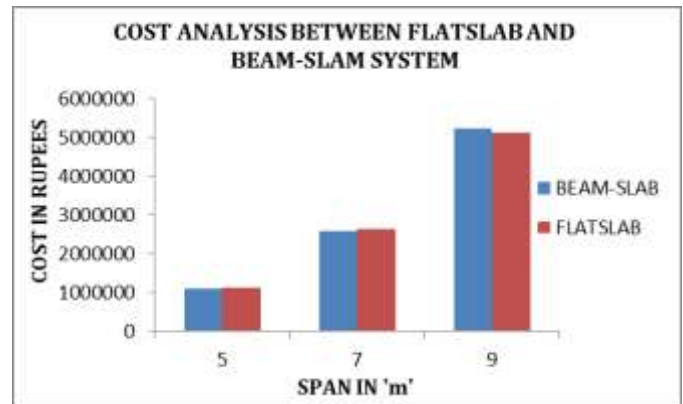
Slab : Rs. 520/- per cft

Beams : Rs. 580/- per cft

For steel bending and placing : Rs. 60/kg

RATE ANALYSIS			
COST IN RS.			
SPAN in m	CONVENTIONAL	FLATSLAB	RATE DIFFERENCE
5	1090620	1117207	26587
7	2599631	2646113	46482
9	5224566	5130073	94493

### Graph of rate analysis:



### 9. CONCLUSIONS

This project represents the comparative study between Flatslab and beam-slab systems for a multi-storied RC building (G+5) for varied span between the columns, on the basis of above results we can conclude that

1. By observing the above results and graph we can say that for shorter spans the flatslab is costlier than the conventional slab systems.
2. But we can see that as span between column increases the quantities for beam slab increases and hence the cost of the beam slab also increases.
3. For 9m span between the columns the rate of beam-slab is more than the cost of flat slab, so we can conclude that as the span between columns increases the beam slab gets costlier than the flatslab.
4. Hence by this project we can say that by adopting the flat slab systems in larger span construction will save lot of money and since flat slab is more advantageous than the beam slab, construction will be easier, fast, economic and affordable.

### 10. REFERENCES

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