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Study of Structural Elements for Feasibility in Construction Practices

P.M.Kokate[1] Prof. A.H.Deshmukh[2]
P.G Student in Structural EngineeringCollege of Engg.& Technology Akola-444001, Maharashtra, India
Professor In Civil Engg. DepartmentCollege of Engg.& Technology Akola-444001, Maharashtra, India
E-mail: pratikkokate@gmail.com[1], aditipohare@gmail.com[2]

Abstract
At present, India requires construction of many houses at right prices because of huge housing shortage. With the use of conventional or traditional materials and technology, it is not possible to complete the construction of buildings with rapid pace. Therefore, the industry must use some alternative materials and technology for fast-track building construction. The paper presents a comparative study on material consumptions other parameters such as base shear, deflection, shear and moment of building made up of Reinforced Cement Concrete (RCC), with the three different column positions. Taking the same plan, floor area, floor-to-floor height and loading conditions and same Earthquake Zone.from the study it is found that the structural system having constant spacing in column is more feasible than other two systems.
Keywords: Base shear, material consumed, staad analysis

I. INTRODUCTION

The basic need of human existences are food, clothes& shelter. From times immemorial man has been making efforts in improving their standard of living. The point of his efforts has been to provide an economic and efficient shelter. The possession of shelter besides being a basic, use, gives a feeling of security, responsibility and shown the social status of man.The engineer has to keep in mind the municipal conditions, building bye laws, environment, financial capacity, water supply, sewage arrangement, provision of future, aeration, ventilation etc., in suggestion a particular type of plan to any client.

II. Methodolgy

In this present work comparative study is being made between an R.C.C structure with different column positionc. The detail Methodology is as follows :-

A G+3 residential building is considered which is situated in zone II, three different types of column positions are taken as per the general practices, the plans are labeled as plan1, plan2,plan3.In plan1 (P_1) the columns are placed at the beam column junction. In plan2 (P_2) the columns are placed only at the exterior end joints and the beam column joints near staircase and lift. In plan3 (P_3) the columns are placed at an constant spacing of 3.625m. As stated above totally Nine models will be analyzed, and compared from costing point of view. The models are labeled as follows :-

PR_1	PR_2	PR_3

Where,
P = Plan,
R = Reinforced cement concrete1,2,3 = plan number

III. General considerations

The example consist of lifts and staircase block attached to the main building block from both side.
For all structural elements, M25 grade concrete and Fe-415 steel will be used.

1) The sizes of all the column are kept samein respective plan , but changes plan to plan according to loading.
2) Centre-line dimensions are followed for analysis and design. In practice, it is advisable to consider finite size joint width.
3) The sizes of all the beams are also kept same.
4) For analysis purpose, the beams are assumed to be rectangular so as to distribute slightly larger moment in columns. In practice a beam that fulfils requirement of flanged section in design, behaves in between a rectangular and a flanged section for moment distribution.
5) Seismic loads will be considered acting in the horizontal direction (along either of the two principal directions) and not along the vertical direction, since it is not considered to besignificant.
6) All dimensions are in mm, unless specified otherwise.

IV. Design Data

Live load : 3.0 kN/m2 at typical floor

: 1.5 kN/m2 on terrace
Floor finish : 1.0 kN/m2
Water proofing : 2.0 kN/m2
Terrace finish : 1.0 kN/m2
Location :Akola city
Wind load : As per IS: 875-Not designed for wind load, since earthquake loads exceed the wind loads.
Earthquake load : As per IS-1893 (Part 1) - 2002
Depth of foundation below ground :1.5m
Type of soil : Type II, Medium as per IS:1893
Storey height : Typical floor: 3.05 m,
Floor**s** : G.F. + 3 upper floors
Walls: 230 mm thick brick masonry walls only at periphery.

V. Material Properties

5.1 Concrete

All components unless specified in design: M20 grade all
$Ec = 5\,000\, fck \text{N/mm}^2$
$= 5\,000\, fck \text{MN/m}^2$
$= 20000 \text{ N/mm}^2$.

5.2 Steel

HYSD reinforcement of grade Fe 415 confirming to IS: 1786 is used throughout.

VI. Loading Combinations

As per IS 1893 (Part 1): 2002 Clause no. 6.3.1.2, the following load cases have to be considered for analysis:
1.5 (DL + IL)
1.2 (DL + IL ± EL)
1.5 (DL ± EL)
0.9 DL ± 1.5 EL
Earthquake load must be considered for +X, -X, +Z and –Z directions. Moreover, accidental eccentricity can be such that it causes clockwise or anticlockwise moments. Thus, ±EL aboveimplies 8 cases, and in all, 25 cases as per Table 3 must be considered. It is possible to reduce the load combinations to 13 instead of 25 by not using negative torsion considering the symmetry of the building. Since large amount of data is difficult to handle manually, all 25-loadcombinations are analyzed using software.

VII. Base Shear Analysis

7.1 Plan1

The plan is attached in drawing section
Beam size :- 230mm x 380mm, Column size :- 230mm x 420mm, Slab thickness :- 120mm Unit weight of concrete :- 25 Kn/m^3
Unit weight of brick masonary :- 19 Kn/m^3
Weight calculation **:-**

1) Slab = Area x thickness x Unit wt. = ((21.75 x 7.46) – (3.23 x 2)) x 0.12 x 25 = 465.15Kn for all floor = 465.15 x 4 = 1860.62 Kn2) Wall= No. of walls x length x height x thickness x unit wt. = (3 x 19.65 x 2.67 x 0.23 x 19) + (6 x 7 2.67 x 0.23 x 0.38 x 25) = 1177.87Kn for all storey = 1177.87 x 3 = 3533.61 Kn3) Beam = Length x width x depth x unit wt= 129 x 0.23 x 0.38 x 25 = 281.87 Kn for all floor = 281.87 x 4 = 1127.46 Kn 4) Column= No. of column x height x thickness x depth x unit wt = 18 x 3.05 x 0.23 x 0.420 x 25 = 132.58 Kn
for all storey = 132.58 x 4 = 530.32Kn 5) Live load = Area x Intensity x No. of floor = ((21.75 x 7.46) – (3.23 x 2)) x 1.5 x 3 =621.72 Kn**Total weight** = 1 + 2 + 3 + 4 +5 = **7673.73 Kn**
Calc for V_B**:-**
Z = 0.10 I = 1 R = 5
T_a in X-direction = $\frac{0.09 \times 12.2}{\sqrt{21.75}} = 0.24$
T_a in Z-direction = $\frac{0.09 \times 12.2}{\sqrt{7.46}} = 0.40$
$\frac{Sa}{g} = 2.50$

$A_h = \frac{Sa}{g} \times \frac{Z}{2} \times \frac{I}{R}$

$A_h = 0.025$

$V_B = A_h \times W = 0.025 \times 7673.73$ $\mathbf{V_B = 191.84}$ **Kn**

7.2 Plan2

The plan is attached in drawing section
Beam size :- 230mm x 500mm, Column size :- 230mm x 600mm, Slab thickness :- 120mm Unit weight of concrete :- 25 Kn/m^3
Unit weight of brick masonary :- 19 Kn/m^3
Weight calculation**:-**
1) Slab = Area x thickness x Unit wt. = ((21.75 x 7.46) – (3.23 x 2)) x 0.12 x 25 = 465.15Kn
for all floor = 465.15 x 4 = 1860.62 Kn 2) Wall= No. of walls x length x height x thickness x unit wt. = (3 x 19.65 x 2.67 x 0.23 x 19) + (6 x 7 2.67 x 0.23 x 0.38 x 25) = 1177.87Kn for all storey = 1177.87 x 3 = 3533.61 Kn3) Beam = Length x width x depth x unit wt = (19.95 x 0.23 x 0.50 x 25 x 3) + (7.23 x 0.23 x 0.50 x 25 x 6)=296.79 Kn
for all floor = 296.79 x 4 = 1187.15 Kn 4) Column = No. of column x height x thickness x depth x unit wt = 10 x 3.05 x 0.23 x 0.60 x 25 = 91.5 Kn
for all storey = 91.5 x 4 = 366 Kn5) Live load = Area x Intensity x No. of floor = ((21.75 x 7.46) – (3.23 x 2)) x 1.5 x 3 =621.72 Kn

Total weight = 1 + 2 + 3 + 4 +5 = **7569.1 Kn**
Calc for V_B**:-**

$A_h = 0.025$
$V_B = A_h \times W = 0.025 \times 7569.1$
V_B = 189.23 Kn

7.3 Plan3

The plan is attached in drawing section
Beam size :- 230mm x 290mm,
Column size :- 230mm x 300mm,
Slab thickness :- 120mm
Unit weight of concrete :- 25 Kn/m^3
Unit weight of brick masonary :- 19 Kn/m^3
Weight calculation **:-**
1) Slab = Area x thickness x Unit wt. = ((21.75 x 7.46) – (3.23 x 2)) x 0.12 x 25 = 465.15Kn
for all floor = 465.15 x 4 = 1860.62 Kn
2) Wall = No. of walls x length x height x thickness x unit = (3 x 19.65 x 2.67 x 0.23 x 19) + (6 x 7 2.67 x 0.23 x 0.38 x 25) = 1177.87Kn
for all storey = 1177.87 x 3 = 3533.61 Kn
3) Beam= Length x width x depth x unit wt = (19.95 x 0.23 x 0.29 x 25 x 3) + (53.69 x 0.23 x 0.29 x 25) = 189.33 Kn
for all floor = 189.33 x 4 = 757.31 Kn
4) Column = No. of column x height x thickness x depth x unit wt = 21x 3.05 x 0.23 x 0.30 x 25 = 110 Kn
for all storey = 110 x 4 = 441.95 Kn
5) Live load = Area x Intensity x No. of floor =((21.75 x 7.46) – (3.23 x 2)) x 1.5 x 3 =621.72 Kn**Total weight** =1 + 2 + 3 + 4 + =**7215.21 Kn**
Calc for V_B**:-**
$A_h = 0.025$
$V_B = A_h \times W = 0.025 \times 7215.21$
V_B = 180.38 Kn

VIII. 8. Staad Analysis

8.1 Geometry
a) Plan1

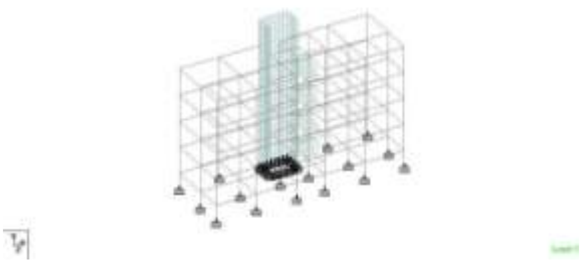


Fig no. 1 Geometry for plan1

b) Plan2

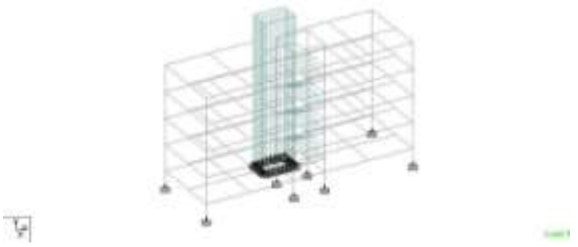


Fig no. 2 Geometry for plan2

c) Plan3

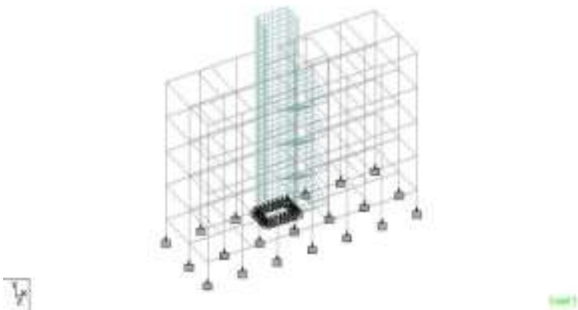


Fig no. 3 Geometry for plan3

8.2 Base Shear

Plan no.	P1	P2	P3
V_B Value	191.84 Kn	189.23 Kn	180.38 Kn

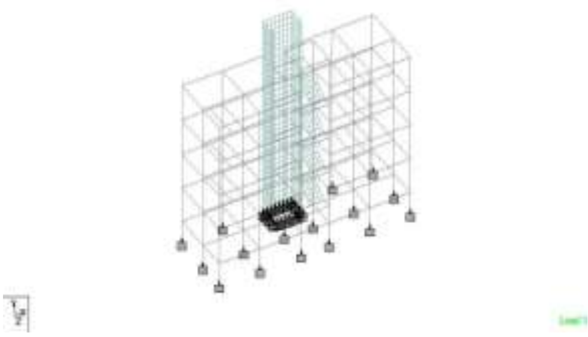
8.3 Material Consumed

Plan No.	P1	P2	P3
Concrete	74.6 (Cu.m)	61 (Cu.m)	59.60 (Cu.m)
Reinforcement	6882.8 (Kg)	7096.2 (Kg)	6726.1 (Kg)

IX. Result and Conclusion

9.1 Results

From the above analysis it is found that the plan 3 is more feasible than the other two, the various parameters for plan three are :-



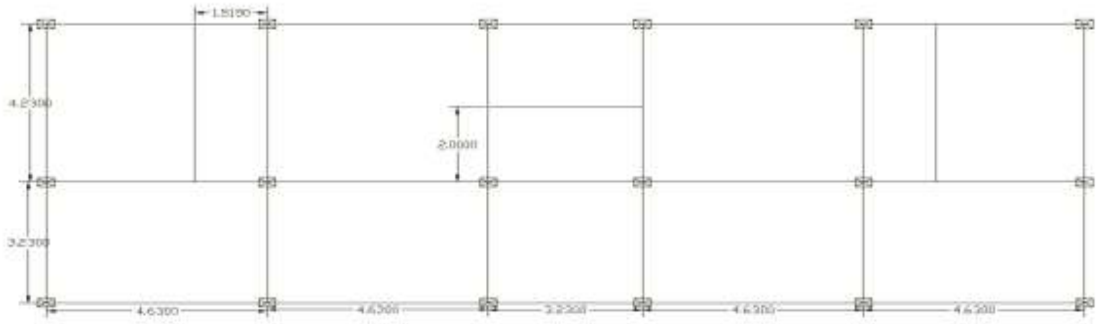
1) Geometry2) Base Shear = 180.38 KN3) Deflection = 14.778 (Resultant)
4) Force = 1189.209 (F_X)

5) Moment = 106.161 (M_{Z})

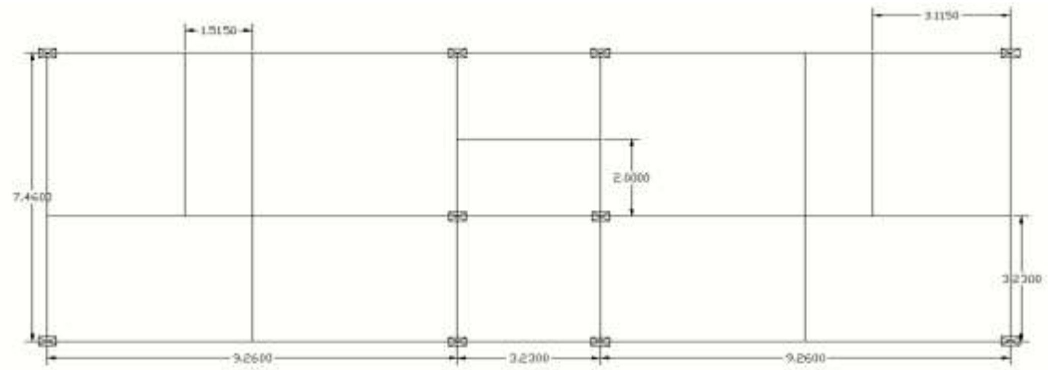
9.2 Conclusion

From the above results it is found that the structure having equally spaced column is more feasible than the other two systems. It will help in fast construction of multi-storey building also minimize the cost of formwork as it is used repeated.

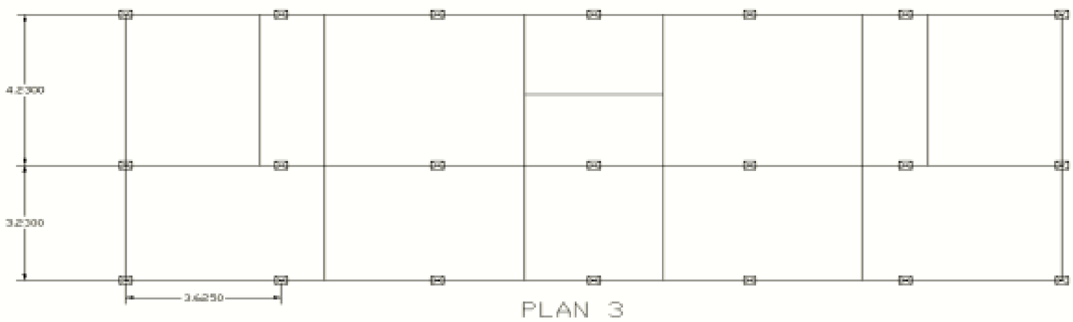
X. Drawing Section



PLAN 1



PLAN 2



PLAN 3

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