International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 06 Issue: 04 | Apr 2019 www.irjet.net p-ISSN: 2395-0072

P-Delta Analysis on Polypropylene Fiber Reinforced Concrete Structure

Sivalekshmi S Pillai[1], Chaithra S[2]

[1]Mtech Student, Sree Narayana Institute of Technology, Adoor, Kerala
[2]Assistant Professor, Sree Narayana Institute of Technology, Adoor, Kerala

---

Abstract – *This paper summarizes the research work on the p-delta analysis of polypropylene fiber reinforced concrete structures. P-delta analysis is the second order effect due to secondary moments. It occurs in every structure where axial load is subjected. In this study, the p-delta effect is analysing in different structures. Linear static analysis (without p-delta effect) and non-linear static analysis (with p-delta effect) on different structures having different number of storeys is carried out. For the analysis G+9 (10 storey) by using ETABS*

Key Words: P-Delta effect, Fiber reinforced concrete, Polypropylene fiber, Linear static analysis, Non-Linear static analysis, ETABS

1. INTRODUCTION

Nowadays, there is increasing in construction of buildings like flats apartments and so on. Therefore there is increase in analyses like p-delta effect.

P-delta effect is a secondary effect mainly due to axial load. It is depend on different factors like height, geometry, load, stiffness of the structure. Increasing the number of storeys, there is increasing the p-delta effect. Therefore the analysis of this effect is plays an important role.

Fiber is a small reinforcing material which have a certain properties. It may have different shapes like circular, flat and so on. The fiber added to the concrete it became fiber reinforced concrete. Therefore fiber reinforced concrete is defined as a type of concrete containing fibrous material which controls the cracking and improves the structural integrity.

In this study, polypropylene fiber is used. This type of fiber possess characteristic properties. In this, analysis are taken out by using software ETABS. For analyzing, 10 storeys structure is taken out. Here considering p-delta and without considering p-delta effect is analyzing by using software ETABS.

1.1 Objective

1. To find out effect of p-delta in different storey structures using polypropylene fiber.
2. To study the axial loading.
3. To find out the percentage change in the values of loads, displacements, drifts, fundamental time period, frequency, base shear and so on.
4. Analysing the results.

2. SOFTWARE

ETABS is an engineering software product that is used for multistorey building analysis and design. ETABS stands for Extended Three dimensional Analysis of Building Systems. It provides an unequaled suite of tools for structural engineers designing buildings.

3. PROPERTIES OF STRUCTURAL MODEL

The present study has different structures having different number of storeys. That is 10 storey polypropylene fiber reinforced concrete buildings.

Table -1: structure details

Plan dimension	28 m x 15 m
No. of storeys	10
Structure	Fiber reinforced concrete
Storey height	Base 4m and typical floor 3.5m
Base consideration	Fixed

Table -2: Material properties

Concrete grade of beam, column and slab	M25
Density of concrete	25 kN/mm^2
Grade of steel	Fe415
Modulus of elasticity	2500 x 10^3 kN/m^2

Table -3: Properties of polypropylene fiber reinforced concrete

Mass/unit volume	2549.448 kg/m^3
Modulus of elasticity	1049MPa
Poissons ratio	0.3
Co-efficient of thermal expansion	0.0000016

Table -4: Sectional properties

Beam	300 mm x 600 mm
Column	550 mm x 1150 mm
Slab	125mm

Table -5: Load detailing

Dead load	Typical floor:1.2kN/m Roof : 2kN/m
Live load	Typical floor : 3kN/m Roof : 1.5kN/m

Table -6: Seismic data

Zone	III (Moderate) T=2.15 and R=5
Soil type	II
Zone factor	0.16
Importance factor	1
Damping percentage	5%
Damping factor	1

4. ABOUT THE MODELS

4.1 TYPE -I

Having polypropylene building and which is analyzing without considering p-delta i.e. linear static analysis. This consists of three building models having 10 storeys and analyses without considering p-delta. In this, the effect of storey drift, storey displacement, time period is carried out.

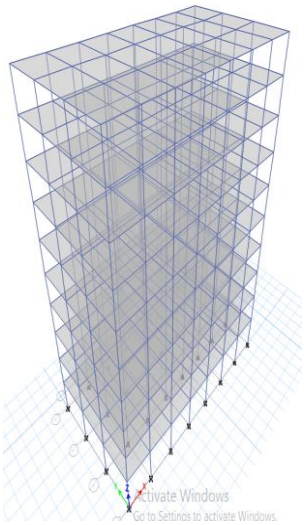

Fig -1: 3D model of 10 storey Polypropylene fiber reinforced concrete structure

4.2 TYPE –II

Having polypropylene fiber reinforced concrete building and here p-delta effect is considering that is non-linear static analysis. This consists of three building models having 10 storeys and analyses with p-delta effect. In this the effect of storey drift, fundamental time period and frequency is carried out.

5. RESULTS

5.1 STOREY DISPLACEMENT

It is defined as the total displacement of the storey with respect to the ground.

Table -7: Displacement of each storey in mm with and without p-delta effect for 10 storey building

Storey No.	Displacement with p-delta (mm)	Displacement without p-delta (mm)
10	0.028334	0.028325
9	0.025215	0.025220
8	0.021973	0.021917
7	0.018591	0.018571
6	0.015115	0.015107
5	0.011634	0.011623
4	0.008279	0.008240
3	0.005217	0.005160
2	0.002653	0.002598
1	0.000826	0.000797

5.2 STOREY DRIFT

It is defined as ratio of displacement of two consecutive floor to height of that floor.

Table -8: Drift of each storey

Storey No.	Drift with p-delta	Drift without p-delta
10	0.2	0.005
9	0.023	0.0052
8	0.018	0.0054
7	0.009	0.00562
6	0.002	0.00561
5	0.001	0.0053
4	0.002	0.0048
3	0.007	0.0040
2	0.002	0.0028
1	0.027	0.001

5.3 STOREY STIFFNESS

Table -9: Stiffness of each storey

Storey No.	With p-delta (kN/m)	Without p-delta (kN/m)
10	4563.462	6539.509
9	8952.645	12854.548
8	12074.148	17411.11
7	14376.873	20852.011
6	16337.816	23833.336
5	18458.673	27035.213
4	21423.774	31389.426
3	26629.047	38818.212
2	38562.722	55540.425
1	87877.245	124119.813

5.3 TIME PERIOD AND FREQUENCY

Table -10: Time period and frequency of each modes

Mode	Modal period (sec)		Frequency (cyc/sec)	
	With p-delta	Without p-delta	With p-delta	Without p-delta
1	5.27	4.374	0.229	0.19
2	3.228	2.982	0.335	0.31
3	2.427	2.314	0.432	0.412
4	1.035	0.987	1.013	0.966
5	0.538	0.531	1.884	1.859
6	0.534	0.527	1.898	1.874
7	0.397	0.389	2.572	2.52
8	0.21	0.209	4.782	4.755
9	0.207	0.205	4.874	4.82
10	0.203	0.203	4927	4.924
11	0.197	0.196	5.096	5.071
12	0.185	0.185	5.42	5.41

6. CONCLUSIONS

Analysis of polypropylene fiber reinforced concrete structure having 20 storeys are carried out by considering p-delta effect and without considering p-delta effect.

- The displacement is maximum at 10th storey with considering p-delta effect.
- The storey drift is maximum at 10th storey with considering p-delta effect.
- The time period and frequency is maximum at mode 1.
- As the height of the structure increases the parameters like storey displacement, storey drift, storey stiffness, time period and frequency is found to increase when considering p-delta effect.

ACKNOWLEDGEMENT

The Author(s) wish to express their special gratitude to **Dr. P. G. Bhaskaran Nair**, PG Dean, Sree Narayana Institute of Technology, Adoor. All the teaching and non-teaching staff of SNIT. Above all the author(s) thank **GOD** almighty for his grace throughout the work.

REFERENCES

[1] Hsiu-Lung Huang, Chao- Lung Hwqang, Sheng- Szerpeng, Chun-Tsun Chen, Hui-Chuan Lee, "Study on the properties of high strength polypropylene fiber concrete ", Advances in Civil, Environmental and Materials Research, August26-30, 2012.
[2] Milind V.Mohod, "Performance of Polypropylene Fiber Reinforced Concrete", IOSR Journal of Mechanical and Civil Engineering, Volume12, Issue 1, Jan- Feb2015.
[3] NikunjMangukiya, Arpit Ravani, Yash Miyani, "Study of P-Delta Analysis for RC Structure", GRD,2016.
[4] Bhavani Shankar, Naveen Kumar, "Study on Effects of P-Delta Analysis on RC Structures", IRJET,2017.
[5] Rizwan Akhter, Shree Prakash, "P-Delta effect on high rise buil
[6] ding subjected to EQ and WL",IJESC,2017.