Analytical Study on RC Framed Structures on effect of Performance of Different types of Piles in Seismic Region

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Abstract-*This thesis includes Analytical Study on RC Framed Structures on effect of Performance of Pile Foundation in Seismic Region. For our design section of a RC framed residential high rise building we are comparing mass irregularities and vertical irregularities with respect to Time period, Frequency, Displacement, Storey Drift Ratio and Storey Shear for Friction pile and End Bearing Pile.*

Keywords- End Bearing Pile, Friction Pile, Mass Irregularity, Pile Foundation, Vertical irregularity.

I. INTRODUCTION

Piles are long and thin individuals which exchange the heap to further soil or shake of high bearing limit keeping away from shallow soil of low bearing limits the principle sorts of materials utilized for heaps are Wood, steel and cement. Heap establishments are the structure used to convey and exchange the heap of the structure to the bearing ground situated at some profundity UG surface. The principle segments of the establishment are the heap top and the heaps. Heaps worked from these materials are driven, penetrated or jacked into the ground and associated with heap tops. In view of sort of soil, heap material and load transmitting trademark heaps are arranged appropriately.

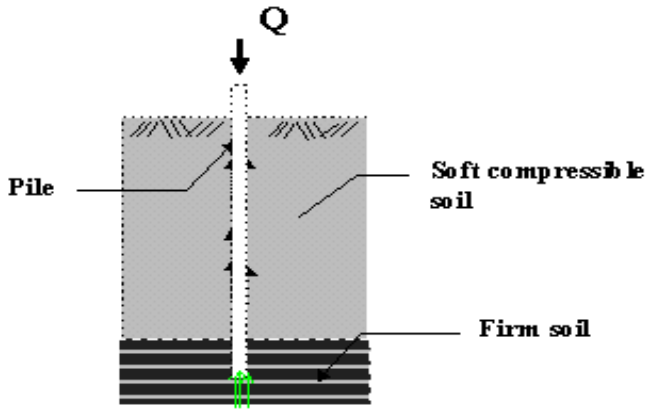
II. CLASSIFICATION OF PILES

Classification of pile with respect to load transmission and functional behaviour

- End bearing piles /point bearing piles
- Friction piles / cohesion piles
- Combination of friction and cohesion piles

2.1 End Bearing Piles

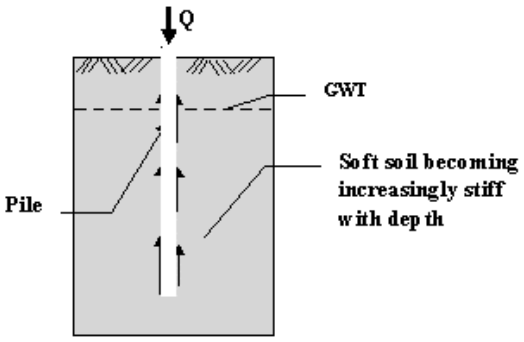
These stacks trade their load on to a firm stratum arranged at a broad significance underneath the base of the structure and they surmise the larger part of their passing on farthest point from the invasion resistance of the soil at the toe of the store (see figure 1-1). The load goes about as a standard fragment and should be arranged hence. In fact, even in frail soil a stack won't slump by catching and this effect require simply be considered if some segment of the store is unsupported. Load is imparted to the soil through disintegration or union. Regardless, occasionally, the soil including the store may hold fast to the surface of the stack and causes "Negative Skin Friction" on the pile. This, at times has amazing effect on the farthest point of the pile. Negative skin contact is delivered by the leakage of the ground water and mix of the soil. The building up significance of the store is impacted by the delayed consequences of the site investigate and soil test.



2.2 Friction or Cohesion Piles:

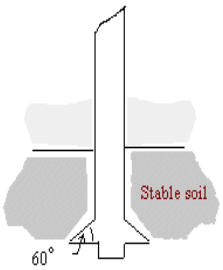
These piles trade their load to the ground along the skin contact. The path toward driving such stacks does not insignificant the soil basically. These sorts of load foundations are normal as floating store foundations.

Contact store is used when the hard strata are connecting underneath a versatile significance and the rubbing of stack surface with the soil is used to withstand the load of the structure. Right when a load is collided with soil of truly uniform consistency and the tip is not arranged in a hard layer, the pile passing on cut-off of the stack is create by skin contact. The pile is moved to the associating soil by contact between the load and the neighboring soil. The load is convey diving and at the edge to the earth is called contact stack.



2.3 Combination of Friction Piles and Cohesion Piles

An expansion of the end bearing heap when the bearing stratum is not hard, for example, firm mud. The heap is driven far adequate into the lower material to create imperative frictional resistance. Other than variety of the end bearing heap is heaps with open up bearing ranges. This is achieved by pushing a globule of cement into the delicate stratum immediately over the firm layer to concede an augmented base. A homogeneous impact is delivered with exhausted heaps by building up an expansive cone or ringer at the base with a one of a kind reaming apparatus. Exhausted heaps which are contributed with a chime have a high rigidity and can be utilized as pressure heaps.



III. OBJECTIVES

- To study the earthquake response of multi storied building with End bearing pile and friction pile foundation by response spectrum analysis.
- To study the earthquake response of Multi storied Building having End bearing pile and friction pile foundation with mass irregularities by response spectrum analysis.
- To study the earthquake response of Multi storied Building having End bearing pile and friction pile foundation with vertical irregularities by response spectrum analysis.

IV. BUILDING DESCRIPTION

The analysis of 3Dimensional multi storey structure with pile foundation resting on Medium soil subjected to seismic load (response spectrum) according to the seismic code IS: 1893-2002(part 1) are carried out.

- Multi-storeyed building:
- Height of each floor = 3m
- Total height of the building = 14.4m
- Software = E-Tabs, AutoCAD

The building given is to be used for residential purpose. Plinth + 3Upper Floors + Roof + Overhead Water tank. The height of the ground floor is 3m and typical floor height is 3 m .Total height of the building is 14.4m above the plinth and each floor of the building comprises of one house, each floor consist of one Living room, one Master Bedroom, one Kitchen, one Dining room, toilet, staircase and balcony.

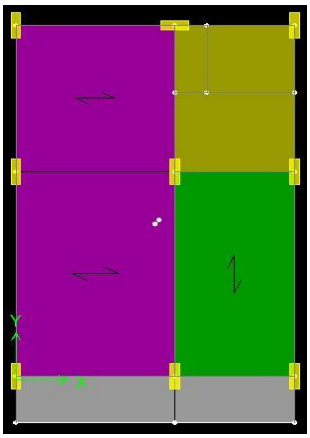


FIG.1: E-TABS MODEL- PLAN

Material of Construction

A. Concrete mix for columns: M25
B. Concrete mix for beams: M25
C. Concrete mix for all slabs: M25

TABLE 1
DENSITIES OF THE MATERIALS USED.

Density of Reinforced Concrete	25.0 kN/m^3
Density of Plain Concrete	24.0 kN/m^3
Density of Steel	78.5kN/m^3

TABLE 2
LIVE LOAD:

Live load on Typical slab	1.5 kN/m^2
Live Load on Typical Floor (Lobby, Balcony, Staircase etc...)	4 kN/m^2
Live Load on Terrace slab	1.5 kN/m^2

TABLE 3
FLOOR FINISHING:

All rooms , Kitchen Toilet and Balconies	2kN/m^2
Stairs	3 kN/m^2
Toilet and Balconies	1.5 kN/m^2
Terrace	3.25kN/m^2

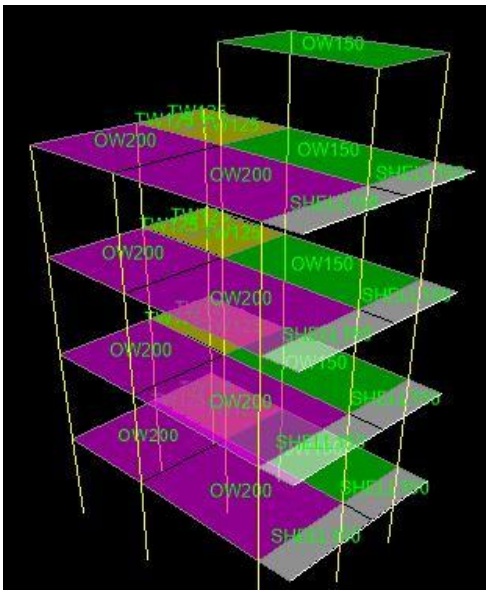


FIG.2: E-TABS MODEL- 3D

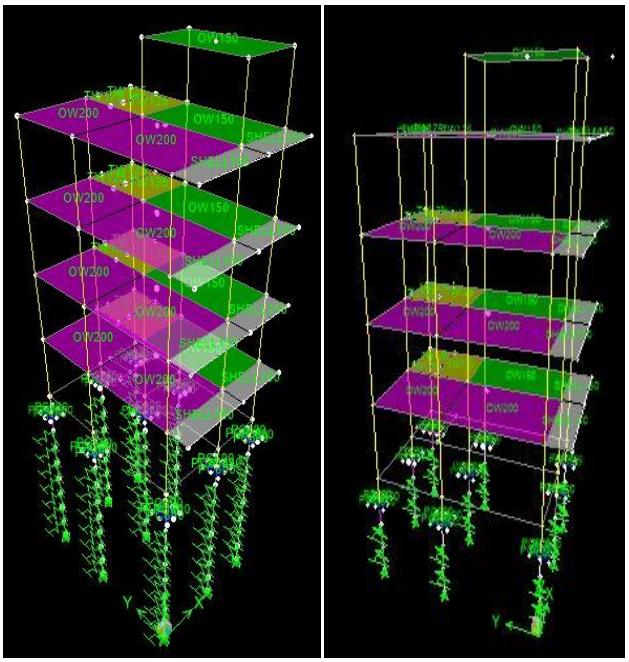


FIG.3:3D VIEW OF END BEARING PILE AND FRICTION PILE

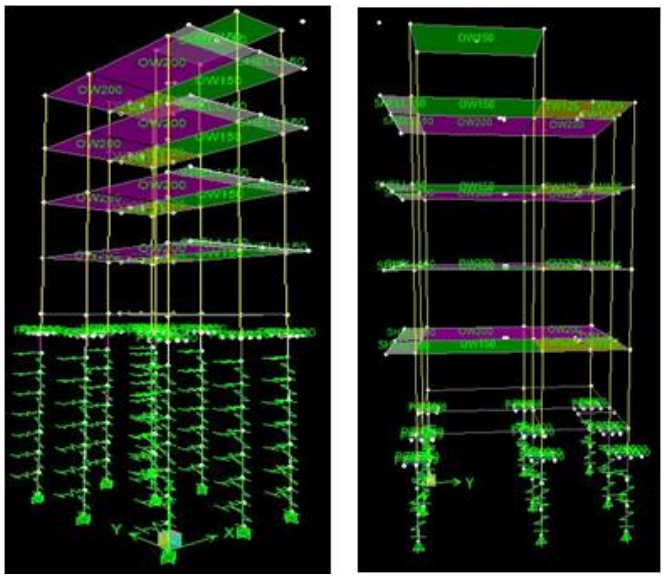


FIG.4:3D VIEW OF END BEARING PILE AND FRICTION PILE WITH MASS IRREGULARITY

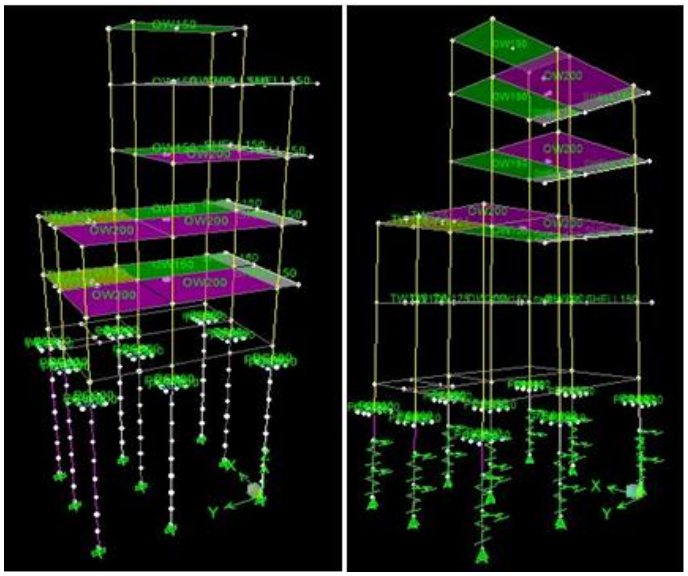


FIG.5:3D VIEW OF END BEARING PILE AND FRICTION PILE WITH VERTICAL IRREGULARITY

V. RESULTS AND DISCUSSIONS

The result of the comparison of structural response between the friction and end bearing pile condition are presented as such.

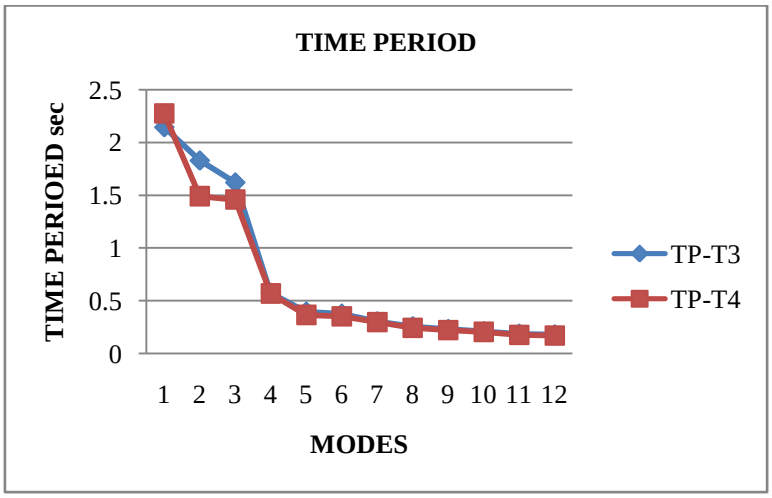
The following five parameters of multi storey structure with friction and end bearing pile are studied

- Time period
- Frequency
- Displacement
- Storey drift ratio
- Storey shear

5.1 Time Period

TABLE 4
TIME PERIOD (SEC)

MODES	TP-T3	TP-T4
1	2.143443	2.272337
2	1.827572	1.489942
3	1.619822	1.45759
4	0.573636	0.56833
5	0.396024	0.365583
6	0.376887	0.352494
7	0.303306	0.297921
8	0.256555	0.243009
9	0.230866	0.222011
10	0.209686	0.204293
11	0.186548	0.176406
12	0.179459	0.170225



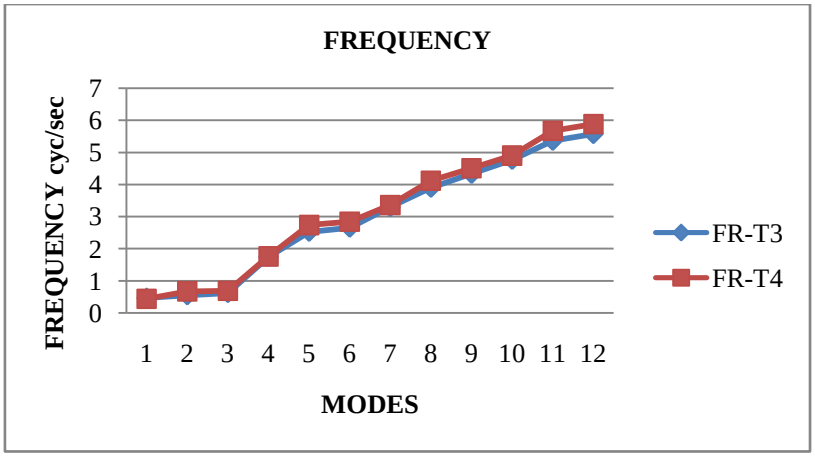
GRAPH 1: TIME PERIOD

- The Time Period for Friction Pile is more when compared to End Bearing Pile.
- A Time Period is the time needed for one complete cycle of vibration to pass a given point.
- Time period mainly depends on two important factors i.e., Mass and Flexibility of the structure.
- As the flexibility increases time period also increases.

5.2 Frequency

TABLE 5
FREQUENCY (cyc/sec)

MODES	FR-T3	FR-T4
1	0.466539	0.440076
2	0.547174	0.671167
3	0.617352	0.686064
4	1.743266	1.759541
5	2.525099	2.735357
6	2.653315	2.836928
7	3.297	3.356595
8	3.8978	4.115074
9	4.331517	4.504281
10	4.769036	4.89493
11	5.360551	5.668741
12	5.572303	5.874578



GRAPH 2: FREQUENCY

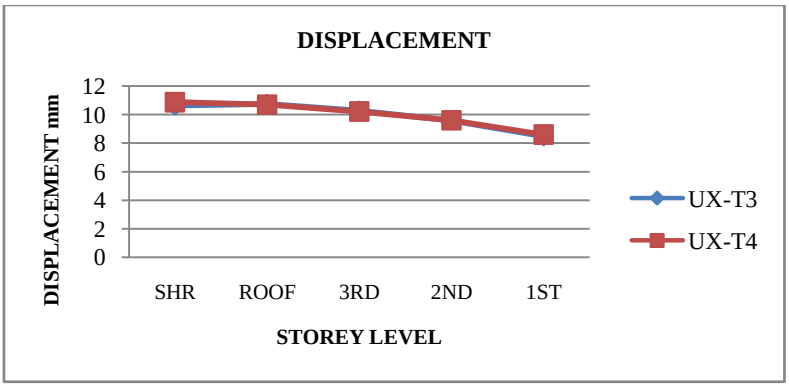
The Frequency of End Bearing Pile and Friction Pile are as shown in the graph

- The Frequency is defined as the ratio of time period. i.e., f= 1/T
- The Frequency for End Bearing Pile is more when compared to Friction Pile.
- As the frequency of a wave increases, the time period of the wave decreases.

5.3 Displacement

TABLE 6
EARTH QUAKE IN X-DIRECTION

STOREY	UX-T3	UX-T4
SHR	10.6265	10.8649
ROOF	10.7338	10.6879
3RD	10.2643	10.2078
2ND	9.565	9.5982
1ST	8.4772	8.594



GRAPH 3: DISPLACEMENT

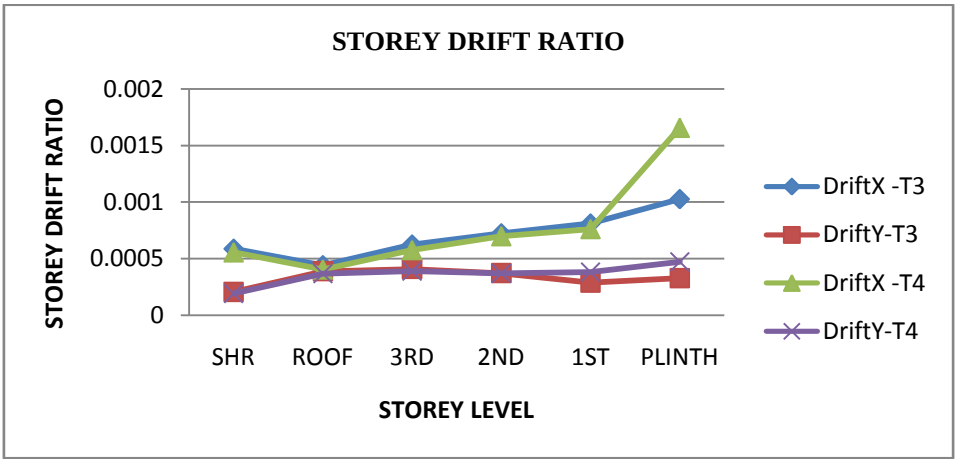
- The lateral displacement is more for Friction Pile in x-direction and End Bearing in y-direction.
- Increase in displacement decreases the stability and durability of the building.

Hence this is not good for human comfort.

5.4 Storey Drift Ratio

TABLE 7
EARTH QUAKE IN X-DIRECTION

STOREY	Drift X-T3	Drift Y-T3	Drift X-T4	Drift Y-T4
SHR	0.000588	0.000205	0.000555	0.000192
ROOF	0.000442	0.000389	0.000403	0.000366
3RD	0.000625	0.000408	0.000575	0.00039
2ND	0.000724	0.000371	0.000698	0.00037
1ST	0.000811	0.000288	0.000761	0.000381
PLINTH	0.001027	0.000327	0.001658	0.000471



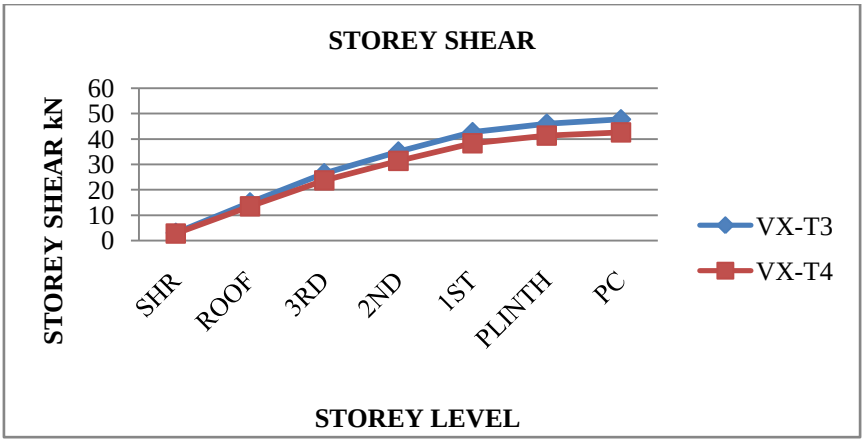
GRAPH 4: STOREY DRIFT RATIO

- Storey drift is the displacement of one level relative to the other level above or below.
- Storey drift ratio is more for friction pile in x-direction and End Bearing Pile in y-direction.
- Storey drift creates strain, stress and torsion in local elements such as beam and column which is most dangerous.

5.5 Storey Shear

TABLE 8
EARTH QUAKE IN X-DIRECTION

STOREY	VX-T3	VX-T4
SHR	3.03	2.76
ROOF	15.01	13.45
3RD	26.48	23.69
2ND	35.06	31.4
1ST	42.68	38.3
PLINTH	46	41.34
PC	47.74	42.56



GRAPH 5: STOREY SHEAR

- Storey Shear is the sum of all the horizontal forces at the base.
- There is a slight increase in Storey shear for End Bearing Pile when compared to Friction Pile in x-direction.
- If earthquake acts in x-direction then End Bearing Pile gives good result when compared to friction pile.

VI. CONCLUSION

The Current Study makes an effort to estimate the effect of performance of End Bearing Pile and Friction Pile in seismic region of a multi storey structure situated in zone V on medium type of soil. The study also spreads to find the structural parameters like Time Period, Maximum Lateral Displacement, Storey Drift ratio and Storey Shear.

The Study leads to following conclusions:

6.1 Time Period

By considering all the three cases Friction pile is giving good result than compared to End Bearing Pile.

6.2 Frequency

- In all the three cases, the Frequency for End Bearing Pile is more when compared to Friction Pile.
- As the frequency of a wave increases, the time period of the wave decreases.

6.3 Maximum Lateral Displacement

By considering all the three cases,

- Earthquake response of the building in x-direction is reduced in End Bearing Pile.
- Earthquake response of the building in y-direction is reduced in Friction Pile.

6.4 Storey Drift Ratio

- For case one - End Bearing Pile is giving good result for both x-direction and y- direction.
- For case two - End Bearing Pile is giving good result in x-direction.

  Both End Bearing Pile and Friction Pile are giving similar results in y- direction.

For case three - End Bearing Pile is giving good result for both x-direction and y- direction.

6.5 Storey Shear

- If earthquake acts in x-direction then End Bearing Pile gives good result when compared to friction pile.
- If earthquake acts in y-direction then Friction Pile gives good result when compared to End Bearing pile.

Overall it is concluded that End Bearing Pile performs better than Friction Pile in most of the above stated parameters.

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