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Relationship between axial forces and cost of pad and pile footings and comparison with the help of mathematical models

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Abstract: - Footing element in structures plays very important role. Different types of footing are used in structure with respect to axial forces, nature of soil, earthquake zone, locality, etc. In this project, pad and pile footing in a residential building are mainly considered by considering two different models. It is very important to study the effect of these two in the structure according to the axial forces. To study the effect on costing as we replace the regular footing i.e. pad footing by pile footing, analysis is done. We take two RCC building with G+ 4 storey and analyze them with Staad-Pro assuming the same soil and other conditions. Manual design of all the footings in both cases is also done. Cost difference of two footings is also observed. Inter relations are obtained between axial forces and approximate cost of pad and pile footings. Mathematical models are developed for having approximate cost of one type of footing from another.

Keywords: - axial forces, costing, mathematical models, pad and pile footing

I. INTRODUCTION

Footing element in structures plays very important role. It transfers the load to soil beneath efficiently to support the structure. It is always not very much clear for deciding what type of footing will be suitable for particular type of structure. This is because of combination of reasons like different types of soil supporting conditions, earthquake zones, type of structure and axial load, etc. In this project, two types of footings i.e., pad footing and pile footings are considered. Pad footing is commonly used where soil conditions are normal whereas pile footings are used where there is a doubt with the supporting natural soil stabilization conditions. Another important part of this paper is consideration of axial forces. Type and size of footing is majorly dependent on the axial forces acting downwards. In this project, we have considered two types of footings with two models and compared pile footing by replacing pad footing. Estimation in both cases and costing as per the C.S.R Nagpur division is done for comparing the cost difference between two. Manual design of all the footings in both cases is also done.

In general, it takes lot of time and efforts to calculate axial forces and to design as well as finding approximate cost of construction of footings. Hence, it is necessary to develop such mathematical models which will be helpful in such tedious tasks.

The principal objectives of the paper are:

- To study different types of footings in same conditions with their behavior
- To develop the mathematical models using parameters like axial force and approximate construction cost of footing

In this paper, G+4 storeyed RCC buildings with no basement stories in two models are analyzed for pad and pile footings considering same soil conditions, earthquake zone, water table conditions, locality, material properties, etc. using STAAD PRO. Results of axial forces and bending moments are analyzed. Using the axial forces, design of pad and pile footing is done manually. According to design, estimation and costing is carried out with C.S.R. Nagpur division which gives idea about approximate cost of construction of footing. Note that labour cost, machine cost, etc. are not considered and only material cost is taken into account. A correlation is developed between the axial forces and approximate cost of footing in both cases. It is observed that mathematical models developed in this project can be very well used for having an idea about approximate cost of one type of footing from another.

It is also observed that cost of construction of pile footings is much higher than pad footing in these particular structures in Earthquake zone II. The performance of mathematical models developed correlating various parameters are found to be very important.

II. ABOUT THE STRUCTURE

Two R.C.C. (G+4) storey residential buildings with brick infills having no parking at basement is considered for the study purpose. The total area of one floor of the building is nearly 1200 square feet having storey height of 3m. The building is situated in earthquake zone II i.e., zone factor of 0.10. Soil is of type III (soft) and Importance factor considered is 1 with building frame system as OMRF. Model 1 has 19 columns and model 2 is consisting of 12 columns of different types. In practical, the structures are provided with pad footings.
The following loads are considered on the building:

1) Dead load of the building i.e., Self weight of all R.C.C. members and brickwork
2) Live load for all the floors = 2.5KN/m^2

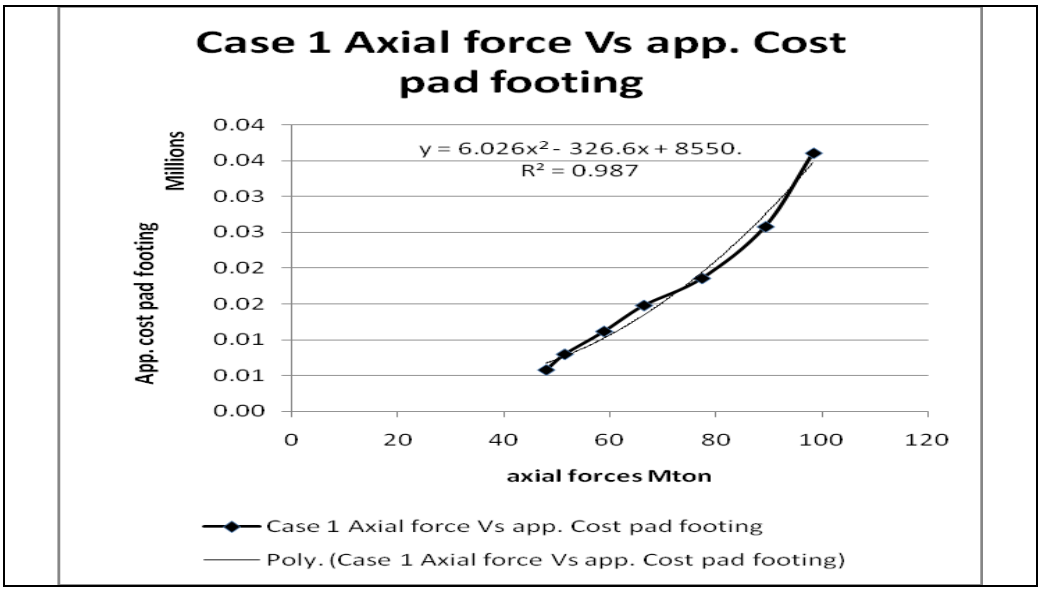
III. CRITICAL LOAD COMBINATIONS CONSIDERED

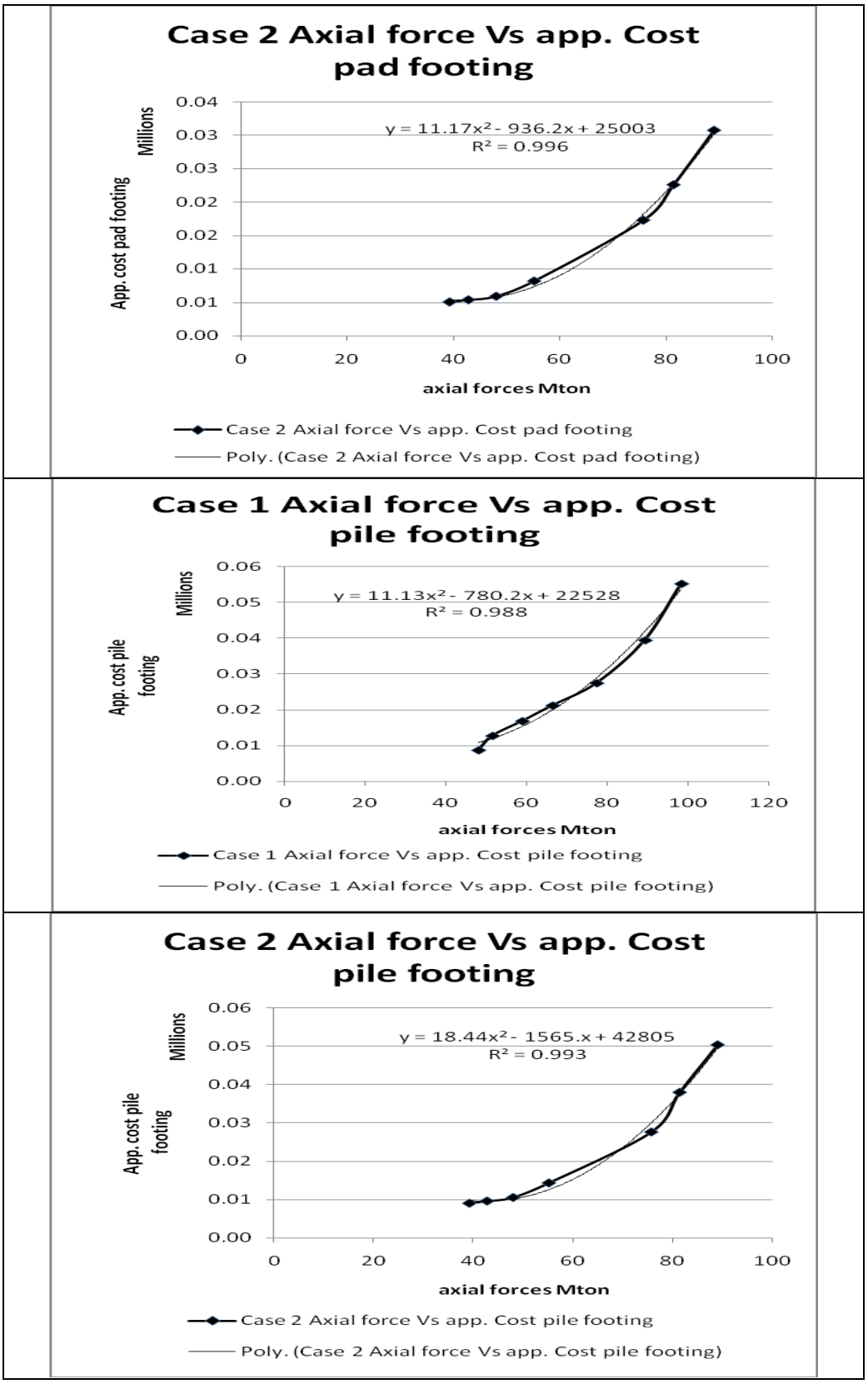
In case of axial forces : (1.5DL + 1.5LL)

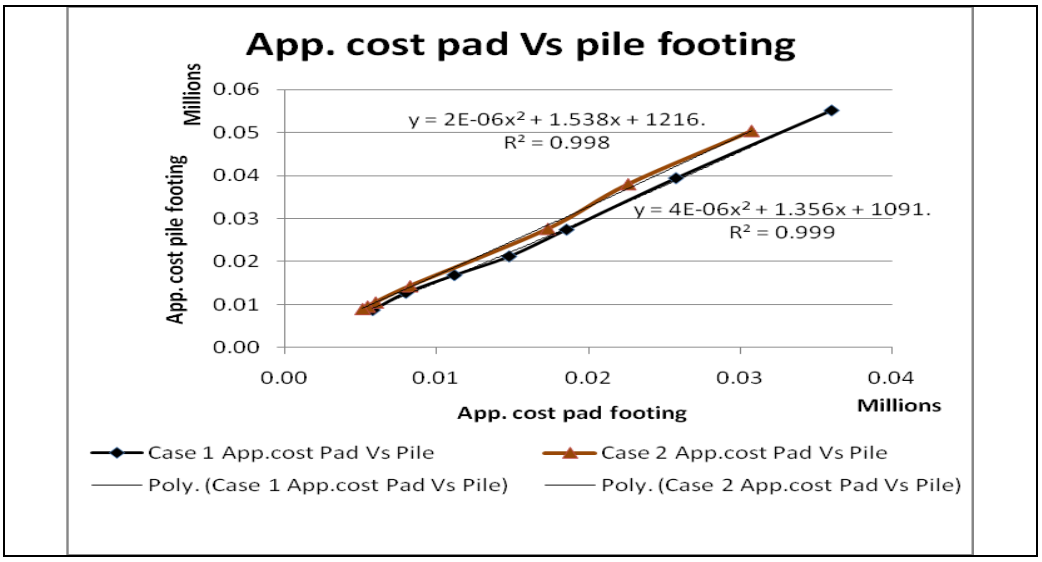
IV. ANALYSIS AND DESIGN

Manual design is done for all the footings as per the axial forces acting downward in both the cases and compared with the design by STAAD PRO. After making designs for pad footings, same procedure is done for pile footings. Both pad and pile footing are compared and analyzed. Using C.S.R. of Nagpur division, costing is worked out for all types of footings in both cases and both type of footings. Cost difference is also analyzed and compared. The data generated is assembled and used for making graphs.
Mathematical models developed for calculation of approximate cost of pad and footings from the axial forces and approximate cost of pile footing from approximate cost of pad footings are as follows.

V. GRAPHS




Case 2 Axial force Vs app. Cost pad footing
Millions
App. cost pad footing
y = 11.17x² - 936.2x + 25003
R² = 0.996
0.04
0.03
0.03
0.02
0.02
0.01
0.01
0.00
0
20
40
60
80
100
axial forces Mton
Case 2 Axial force Vs app. Cost pad footing
Poly. (Case 2 Axial force Vs app. Cost pad footing)
Case 1 Axial force Vs app. Cost pile footing
Millions
App. cost pile footing
y = 11.13x² - 780.2x + 22528
R² = 0.988
0.06
0.05
0.04
0.03
0.02
0.01
0.00
0
20
40
60
80
100
120
axial forces Mton
Case 1 Axial force Vs app. Cost pile footing
Poly. (Case 1 Axial force Vs app. Cost pile footing)
Case 2 Axial force Vs app. Cost pile footing
Millions
App. cost pile footing
y = 18.44x² - 1565.x + 42805
R² = 0.993
0.06
0.05
0.04
0.03
0.02
0.01
0.00
0
20
40
60
80
100
axial forces Mton
Case 2 Axial force Vs app. Cost pile footing
Poly. (Case 2 Axial force Vs app. Cost pile footing)



VI. OBSERVATIONS

Following observations are made from the tables and graphs:

1) In this project, Quantity of steel required in pile footing is 29% more than pad footing. But, Quantity of concrete required is 21% less in pile footing.
2) It is observed that construction cost of pile footing is nearly 30-35 percent more than pad footing in this particular project although the axial forces and other conditions are same.
3) Data analysis shows that direct co relations between axial forces and approximate quantity of material required or approximate amount required for construction of pad or pile footing can be established.

VII. CONCLUSIONS

1) Construction cost of pile footing in most of the cases will be more than applying pad footing.
2) Mathematical models developed can predict the approximate cost of pad and pile footing from axial forces as well as approximate cost of one type of footing from another which can be very much useful for design engineers and practitioners.

VIII. FUTURE SCOPE

1) Comparison between other types of footings can be done.
2) Various other parameters like moments, earthquake forces, wind forces, etc can be considered for different types of structure.
3) Cost comparison of plant, equipment and manpower required for construction can be done.

REFERENCES

[1] M.M. Eslamia, A. Aminikhahb, M.M. Ahmadib, 'A comparative study on pile group and piled raft foundations (PRF) behavior under seismic loading', *Comp. Meth. Civil Eng., Vol. 2*, pp 185-199
[2] Asskar Janalizade Choobbasti, Meysam Saadati, Hamid Reza Tavakoli, 'Seismic response of pile foundations in liquefiable soil: parametric study', *Arabian Journal of Geosciences, Volume 5, Issue 6*, pp 1307-131
[3] Weiming Gong, Guoliang Dai, Haowen Zhang ,'Experimental study on pile-end post-grouting piles for super large bridge pile foundations', *Frontiers of Architecture and Civil Engineering in China Volume 3, Issue 2* , pp 228-233
[4] Indian Standard Designation, IS 456-2000, Plain and Reinforced Concrete -Code of Practice, Bureau of Indian Standards
[5] Indian Standard Designation, IS 2911, Pile Footing-Code of Practice, Bureau of Indian Standard
[6] Dr B.C. Punmia, A. K. Jain, Text book of "*reinforced concrete structure- volume ii*" (Laxmi Publication (P) Ltd.)
[7] S. Unnikrishnan Pillai, Text book of "*reinforced concrete design*" (Laxmi Publication (P) Ltd.)
[8] M. L. Gambhir, Text book of "*design of reinforced concrete structures*" (PHI Learning Private Ltd.)