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Finite Element Analysis for improving the bearing capacity of Existed strip footings

Khaled Mohamed Bahloul

Assistant Professor, Construction Engineering Department, October High Institute For Engineering And Technology, khaled_bahloul1@yahoo.com

Mohamed EL Siragy

Assistant Professor of Geotechnical Engineering, Department of Structural Engineering, Faculty of Engineering, 6th of October University, Egypt, siragy2000@yahoo.com

Abstract:

Existing foundation is usually subjected to additional loads from different sources like increasing floor number, additional live load and eccentric loads. A result the foundation bearing capacity failure and excessive settlement are exhibited. Consequently, the aim of this work is to predict using a finite element method software (PLAXIS 3D) the reliability of increasing the loaded strip footing bearing area method on increasing the ultimate bearing capacity of the footing and decreasing settlement. The foundation soil used was dense sand (Dr=81%). Numerical analysis are validated by comparing the numerical results with results obtained using various analytical methods by Meyerhof, Hansen and Vesic. The effect of increasing footing size on the bearing capacity factor ($N\gamma$) is studied. Finally, the effect of load eccentricity was studied. It was concluded that ultimate load capacity is increased by as much as 67% in case of increasing footing area by 100% ($\Delta B/B = 1$) with significant reduction in settlement that found to be 37%. As well, it was found that the bearing capacity factor ($N\gamma$) is reduced when the footing size increases which agree with previous works done on this issue. It was found also, that increasing footing area decreases significantly the load eccentricity effect on bearing capacity and modifying the bearing capacity failure from general to punching shear failure.

Keywords:

Strip footing, Sand, Bearing capacity, Settlement, strengthening, eccentricity, numerical analysis

References:

1- Greenfield, S and Shen, C., "Foundation on Problem Soil" Prentice Hall, Inc., Englewood Cliffs. 1992.
2- Day, R. W., "Performance of Single-Family Houses During the Earthquake" Bull. Of Assoc. of Eng. Geologists, 31(a), 1994 pp. 507-515.
3- Verma, B. P. and Char, A. M., "Bearing Capacity Tests on Reinforced Sand Subgrades" ASCE Journal of Geotechnical Engineering Vol. 112. 1986 Pp. 701-706.
4- Mahmoud, M. A., "Plate Loading Tests on Reinforced Choesionless Soil" Journal of the Egyptian Society for Soil Mechanics and Foundation Engineering Division, 3, 1988.
5- Verma, B. P. and Jha, J. V., "Three Dimensional Model Footing Tests for Improving Subgrade below Existing Footings " Proceeding of the International Symposium on Earth Reinforcement. Balkema, Rotterdam, 1992 pp. 677-682.
6- Mandal, J. N., and Manjunath, V. R., " Bearing capacity of Strip Footing Resting on Reinforcing Sand Subgrade" Construction and Building Materials, Vol.9, No.1, 1995 pp. 35-38.
7- Bahloul, M. M., et al., "Strengthening of Loaded Footing-Soil System by Vertical Extensible Reinforcement" 5th International Conference on: Ground Improvement technique, 2004, Malaysia.
8- Azzam, W. R. and Farouk, A. "EXPERIMENTAL AND NUMERICAL STUDIES OF SAND SLOPES LOADED WITH SKIRTED STRIP FOOTING" Electronic Journal of Geotechnical Engineering. Vol. 15, Bond H, 2010. pp. 795-812.
9- Elif Cicek, Erol Guler, and Temel Yetimoglu. "Effect of reinforcement length for different geosynthetic reinforcements on strip footing on sand soil" Soils and Foundations 55 (2015) 661–677.
10- Hasan NI, Mohd Taib A, Muhammad NS, Mat Yazid MR, Mutalib AA, Abang Hasbollah DZ. "Effectiveness of strip footing with geogrid reinforcement for different types of soils in Mosul, Iraq". PLoS ONE 15(12): e0243293, 2020.
11- Gourav Gill, Ravi Kant Mittal and Rahul Dandautiya. "Pressure Settlement Behaviour of Strip Footing Restingon Unreinforced and Tire Chips Reinforced Copper Slag" KSCE Journal of Civil Engineering (2021) 25(1):92-106. DOI 10.1007/s12205-020-0606-0.
12- Mirzababaei,M., Inibong, E., Mohamed, M., Miraftab, M. "Behaviour of strip Footing on fiber reinforced model slopes", Ground Improvement and Geosynthetics Geotechnical Special Publication), 2014, pp. 425-434.
13- Masoud, M. and Ehsan, B. "Comparison of bearing capacity of footing with the Same area resting on reinforced sand" International Journal of GEOMATE, Jan., 2017, Vol. 12, Issue 29, pp. 9-16 Geotec., Const. Mat. & Env., ISSN: 2017 pp 2186-2982(P), 2186-2990(O), Japan.
14- Nawghare S, Pathak S and Gawande S (2010). "Experimental investigation of bearing capacity for eccentrically loaded footing". International Journal of Engineering Science Technology 2(10): 5257–5264. Okamura M, Takemura J and Ueno K.
15- Nasr, A. M., and Azzam W. R. (2017). "Behaviour of eccentrically loaded strip footings resting on sand". International Journal of Physical Modelling in Geotechnics. Volume 17 Issue 3, September, 2017, pp. 177-194

16- Bringreve, Zampich and Ragi Manoj. (2019): "Plaxis 3D Connect edition manual), Delft University of Technology & PLAXIS bv, The Netherlands.
17- Brinkgreve, R.B.J., Engin, E. and Engin, H.K. (2010) "Validation of empirical formulas to derive model parameters for sands", Knowledge base publications of plaxis, Plaxis B. V., Delft, Netherlands.
18- M.N. EL Siragy. "Improving the ultimate capacity of loaded strip footing using additional contact area under excessive loads" Life Sci J 2019;16(12):147-153].
19- Vesic, A. S. (1973) "Analysis of ultimate loads of shallow foundations", J. of SMFED, ASCE, 99 (SM1), 45-73.
20- Meyerhof, G., G. (1951) "The ultimate bearing capacity of foundations", Geotechnique, (2(4), 301-332.
21- Hansen, J.B., 1970. A revised and extended formula for bearing capacity. Danish Geotech. Inst. Bull., 28: 5-11.
22- Terzaghi, K. (1943) Theoretical soil Mechanics, Wiley, New York.

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