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Comparison of Two Dimensional and Three Dimensional Estimated Stresses during Vertical Excavation Using Finite Element Method

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Abstract

The stability of the vertical excavation are being examined at different depth and most critical stage of excavation is being examined using finite element method for an exact analysis with the help of three dimensional excavation and their experimental verification. Tension is being important in which excavation of three dimensional excavation .As in the case of the higher depth of excavation collapse behavior of the vertical cut is more significant .Hence to prevent from collapse , the proper soil injection or soil stabilization process are required to be carried out with the layer wise finite element method and experimental test.

1. Introduction

The depth of the vertical excavation were limited to 12.0 m accomplished in seven lift consisting of depth of 12.0, 11.0m,10.0m,8.0m ,4.0m ,2.0m and 1.00m.The width of the excavation was taken as 24.0m. The length of excavation was taken as 30.0 m.The value of the static and self weight of the turbo genetor were taken as the initial loading condition .The worst possible combination of the moment due to vertical and horizontal amplitude ,earth quake force were taken including the basis of the self weight of the foundation for the design of the foundation area and structural element such as reinforcement ,concrete and factor moment ,pressure intensity .Elastic properties were considered piece wise linear, different values were taken for each element in profile depending in its state of stress viz initial, part yield, tension and shear or tension failure.

Result and Discussion: vertical excavation using finite element method for three dimensional excavation using finite element method:

i) The estimated shear stresses at a depth of 12.0 meters below the ground surface were critical along the intermediate axes, but the shear stresses along major and minor axes had lower value than the intermediate axes. Hence while excavation extreme care were needed along minor –intermediate axes as well as major axes. The nature of stresses were tensile in nature . The soil was found quite weak in resisting the tensile stresses during the vertical excavation.

ii) The bearing pressure of all elements showed that higher bearing pressure of all elements. The higher bearing pressures were estimated corresponding to higher element .The higher bearing pressure estimated for three dimensional excavation using finite element method. The value of the bearing pressure showed the material of foundation was clay as indicated in appendix.

Experimental verification for vertical excavation using finite element method for three dimensional excavation using finite element method: i) The experimental verification of the major principal stresses with reference to minor and intermediate stresses were estimated with triaxial apparatus in laboratory.

iii) The variation of the major principal stresses were very high. The experimental verification of the normal stresses for three dimensional excavation using finite element method were estimated too high. These experimental values were 4.84 times of the finite element value. The experimental shear stresses were estimated as 3.771 times of the finite element method value of shear stresses.

iv) The value of experimental stresses were higher than the value of shear stresses based on finite element method .The experimental bearing pressures were estimated as 0.82 times of finite element value of bearing pressure.

v) The bearing pressures based on the experimental values were estimated lower than the values of the bearing pressures based on finite element method. In the analysis of the bearing pressure these values were lower than the actual values based on finite element method.

2. Result and Discussion

1. The nature of principal strain were estimated tensile along the minor axes. The direction of the major principal strain obtained based on the finite element were quite higher than intermediate and minor axes. The value of normal and shear stresses based on the finite element method values were estimated.
2. The negative stresses were developed during the excavation at the higher depth of excavation. The vertical excavation became critical. Hence extreme cares were required. The cohesive strength obtained as such for element showed that the material would have the lower cohesive strength corresponding to higher element layer.
3. The major principal strain at the higher depth of excavation had quite higher value and had significant effect over the excavated boundary at the corners and

vertical cut compared to minor and intermediate strain. Henceforth extreme care was needed for vertical excavation.

4. The experimental verification of the major principal stresses with reference to minor and intermediate stresses were estimated with triaxial apparatus in laboratory .The variation of the major principal stresses were very high.
5. The experimental shear stresses were estimated as was 3.771 times of the finite element method value of shear stresses. The values of experimental stresses were higher than the value of shear stresses based on finite element method.
6. The experimental bearing pressures were estimated as 0.82 times of finite element value of bearing pressure. The bearing pressures based on the experimental values were estimated lower than the values of the bearing pressures based on finite element method.

Conclusion

1. Many problems in geotechnical engineering are complex to analyze .It is due to geometric and materials properties of the soil. Hence computer aided design gave an exact analysis for design of foundation structure.
2. The result of finite element method were experimentally verified .The experimental value gave a realistic and exact analysis of the foundation structure.
3. The three dimensional excavation using finite element method gave realistic ,optimized economic analysis of the foundation compared to two dimensional excavation using finite element method .
4. The data mining and ware house concept might be used for the output result of three dimensional excavation using finite element method .These data might be used for design and consultancy of mega civil engineering work.
5. Tension is being important in which excavation of three dimensional excavation as in the case of the higher depth of excavation ,it is observed that the collapse behavior of the vertical cut is more significant .Hence to prevent from collapse the proper soil injection or soil stabilization process are being carried out with the layer wise finite element method and experimental test .
6. The stability of the vertical excavation are being examined by different slope and most critical slope is being examined with the finite element method for an exact analysis with the help of three dimensional excavation and their experimental verification .
7. Study for three dimensional excavation with different material and their experimental verification may be made to evaluate the failure mechanism in case of three dimensional excavation.

Conclusion of Comparison of two dimensional and three dimensional excavation using finite element method

Two dimensional excavation using finite element method	**Three dimensional excavation using finite method**
i. The shear stresses based on two dimensional analyses using finite element method were analyzed only for major-minor axes. The value of shear stresses at the vertical cut ,corners and bottom were estimated very critical at a depth of 12.0 meters from the ground level.	i. The shear stresses at higher depth of the excavation were estimated very high ,but these shear stresses were along all three mutually perpendicular axes. The six shear stresses components were analyzed in the three dimensional analysis. The major principal stresses and shear stresses were estimated very critical.
ii. The principal stresses were estimated along the major and minor axes .The value of major principal stresses were estimated tensile in nature .The values were very high compared to minor stresses.	ii. The major, minor and intermediate stresses were analyzed in the three dimensional stresses .The variation of the major principal stresses were 46% and 57 % for minor and intermediate stresses.
iii. The nodal strain rate from the	iii. The principal strains were high along major principal axes. The direction of the
iv. axes of ¼ th of the excavated boundary were observed high. The value of contours was very high at the corners and excavated boundaries.	iv. principal strain was steeper in major axes and intermediate axes compared to minor axes. The magnitudes of principal strain along major axes were more than minor axes and intermediate axes.
v. The bearing pressures based on the finite element method value were estimated. Based on the result of bearing pressure, the type of material could be analyzed.	v. The bearing pressure based on the finite element method value was estimated. The soil might be analyzed based on the result .The exact value of bearing pressure could be estimated based on three dimensional excavation.
Experimental two dimensional excavation using finite element method	**Experimental three dimensional excavation using finite element method**
1. The variation of major principal stresses experimental value was assessed as 41 % more than the finite element value of major principal stresses.	1. The variation of major principal stresses based on triaxial test conducted laboratory was assessed very high. These experimental results were in cooperated in the other parameter for analysis of exact

2. The value of the normal stresses was 2.801 times of the original value of finite method value of normal stresses. 3. The experimental variation of bearing pressure based on finite element method value of bearing pressure. The variation of experimental bearing pressure was 5.58 % more than the bearing pressure obtained based on finite element method 4. The variation of shear stresses were assessed from 32-88.9 % .The average shear stresses were 40 % more than the finite element method value of shear stresses 5. Based on Mohr's coulomb theorem, the value of shear stresses and normal stresses had a variation of 41 % and 5.7 % of the finite element value of normal and shear stresses.	value of soil parameters. 2. The experimental values of normal stresses were assessed as 4.84 times of the original value of finite element method of normal stresses. 3. The experimental value of bearing pressure was assessed as 78 % of the bearing pressure based on finite element method value. The bearing pressure estimated based on three dimensional were assessed as lower than the finite element method value. 4. The variation of experimental shear stresses was estimated based on finite element method value of shear stress. The variation of shear stresses was estimated as 3.771 times of the finite element value of shear stresses**.** 5. Based on the octahedral normal and shear stresses were estimated .These variation were 3.771 times of normal stresses and 4.84 times of shear stresses of finite element value.

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