

## Determination of Geomechanical Parameters and Allowable Bearing Capacity of the Rock Foundations of Surface Crude Oil Tanks in Khark Island

Soltani Mohamadi, S.<sup>1</sup>; Zare, S.<sup>2</sup>; Nikkiah, M.<sup>3</sup>; Ghanavati Nasab, M.<sup>4</sup>

1- MSc of Mining Engineering- Rock Mechanics, Shahrood University of Technology

2- Associate Professor Faculty of Mining, Petroleum and Geophysics, Shahrood University of Technology

3- Assistant Professor Faculty of Mining, Petroleum and Geophysics, Shahrood University of Technology

4- Expert Iranian Oil Terminals Company

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### ABSTRACT

#### Summary

In the design of foundations on rock masses, it is necessary to examine the rock mass from different aspects. One aspect, in addition to settlement and instability, is determining the bearing capacity of rock foundations. Rock foundations have more strength and rigidity compared to soil foundations due to their rocky essence. In dead this aspect leads rock foundation to show the required bearing capacity against many incoming loads. However the factors of rock foundation such as crushed rock masses, discontinuities, high weathering, karst cavities, faulting, etc. reduce their bearing capacity. Due to

the deployment of many structures on rock foundation and problems caused by structures instability on the inappropriate rock foundations, today, it is so necessity to examine rock foundations and estimate the effective parameters related to their bearing capacity, accurately and comprehensively. Studies have shown that the discontinuities have a great influence on the bearing capacity of rock foundations. In fact studies also have approved that the bearing capacity and settlement of Khark Island are allowed and it is suitable for construction of tanks.

### Introduction

Khark Island is one of the most important Iranian oil export terminals. Huge tanks with different capacities have been constructed in order to storage crude oil at the highest point of the Khark Island, in an area about 120 hectares. Oil storage tanks are very important especially in critical areas. So special considerations about their foundation should be taken account. In fact these tanks required an appropriate foundation in order to have sufficient bearing capacity as well as reducing the subsidence, Any deficiency in these rock foundations could be able to make huge irreparable damages.

### Methodology and Approaches

In these research different approach of bearing capacity determination such as use building codes, experimental methods, analytical and numerical methods will be examined. Then bearing capacity and settlement of rock foundations of crude oil storage tanks in Khark Island determined by various methods. First, using experimental and analytical methods the bearing capacity and settlement of the rock foundations of Khark Island is evaluated. Then, using numerical modeling by finite difference method using FLAC<sup>3D</sup> software the bearing capacity and settlement of tanks foundation will be examined. Finally parametric studies and sensitivity analysis of design parameters was performed. In order to examine discontinuities and weak structural factors, the geological strength index is used.

### Results and Conclusions

In this study, the bearing capacity and settlement of the foundation of crude oil storage tanks in Khark Island is studied using different methods. Initially using experimental and analytical methods the bearing capacity and settlement were evaluated. Then using numerical modeling with FLAC<sup>3D</sup> software the bearing capacity and settlement of the foundation of tanks were evaluated. The results of this study are as follows:

- 1- Although rock foundations are reliable for most structures, in cases where the rock has poor quality, there is a need to study and estimate the bearing capacity of rock foundations especially for sensitive and important structures.
- 2- The Studies in this research shows that the bearing capacity and settlement of the foundation of crude oil storage tanks in Khark Island is in allowable limit and there is not problems.
- 3- Since the layer of coral limestone has modulus of elasticity higher than marl stone at the site of oil storage tanks in khark Island, this layer bear most of the load and the stability of foundation primarily is dependent on this layer. In this case, due to the relatively low thickness of coral limestone and plastic behavior and very low compressibility of marl stone buckling failure is more likely.
- 4- All analysis in this research both performed with regard to the weight of the rock mass and without weight of the rock mass. If the weight of rock mass to be considered in the calculations of bearing capacity, it increases. So calculate the bearing capacity of rock mass without weight is conservatively.
- 5- In this research to investigate discontinuities in rock mass the geological strength index (GSI) was used. Compare the values of bearing capacity in different jointed conditions show that discontinuities can have a great impact on the bearing capacity of rock foundation. The bearing capacity of foundation increase by increasing the GSI and reducing the discontinuities.
- 6- The bearing capacity obtained from different methods is different according to various theories that are used in them. The appropriate method should be selected based on the type and behavior of the rock mass and due to the extent of its load, possible failure modes, the probability of failure and the importance of structure.
- 7- Between various methods that were investigated, the allowable bearing capacity of foundation of crude oil tanks without considering the weight of rock, is lowest with Serrano- Olalla 2000 method and with Bell method will have highest value. The bearing capacity obtained by numerical modeling has intermediate values. The ultimate bearing capacity of foundation of crude oil tanks with considering the weight of rock is lowest using Hook-Brown method and numerical modeling with Hook-Brown models and will have highest value with Serrano- Olalla 1994 method. The bearing capacity values of numerical modeling with Mohr-Coulomb model will be more than Hoek-Brown model.