MASTER'S DISSERTATION AT GEOTECHNICAL ENGINEERING

DEPARTMENT OF CONSTRUCTION SCIENCES | FACULTY OF ENGINEERING LTH | LUND UNIVERSITY

ARON SANDSTRÖM
ar5301sa-s@student.lu.se

BJÖRN ELFVING
vov15bel@student.lu.se

PRESENTATION
May 2020

REPORT
Will be published as
Report TVGT-5068

SUPERVISORS
ERIKA TUDISCO *PhD*
Div. of Geotechnical Engineering, LTH

Professor OLA DAHLBLOM
Dept. of Construction Sciences, LTH

MATS SVENSSON *PhD Soil Mechanics/Geophysics*
Tyréns AB

EXAMINER
SUSANNE HEYDEN *Associate Professor*
Dept. of Construction Sciences, LTH

IN COOPERATION WITH
TYRÉNS

THE WORK IS PERFORMED AT
GEOTECHNICAL ENGINEERING,
LTH & TYRÉNS, MALMÖ

FINITE ELEMENT MODELLING AND OPTIMISATION OF RETAINING STRUCTURES FOR VERTICAL SHAFTS WITH ELLIPTICAL CROSS-SECTION

Bilden t v från företaget Mcmillen Jacobs Associates.

INTRODUCTION

With cities growing larger there is an increasing need for exploitation of the subsurface. Access to the subsurface is granted by constructing vertical shafts, which are often constructed with a circular cross section in order to utilise the arching effect in the retaining structure. The circular shape is an effective shape when it comes to controlling forces acting in the retaining wall, but not as effective when it comes to the demand of ground surface area. For a tunnelling project, an elliptical shape of the shaft would be preferred as it demands less ground space and still allows transporting long pipes and tunnelling equipment up and down. An elliptical retaining structure could also utilise the arching effect but would not be as efficient as the circular shape as it gives rise to a different stress state in the structure.

Apart from ensuring the stability of the structure, the retaining wall needs to deal with the groundwater. If the excavation is located below the groundwater surface, there will be seepage of groundwater into the excavation. By constructing a retaining structure which is impervious to water, e.g. diaphragm wall, the retaining wall will prevent lateral water inflow. Some other problems related to the groundwater that needs to be dealt with is the groundwater intrusion through the bottom of the shaft and the uplifting effect on the retaining structure due to buoyancy. By founding the retaining structure at sufficient depth under the excavation bottom, the intrusion of the groundwater can be maintained on acceptable levels and the uplifting force counteracted.

AIM AND OBJECTIVES

The aim of this master thesis is to explain and analyse different design methods of retaining structures for vertical shafts with circular and elliptical cross sections, related to an ongoing tunnelling project between Malmö and Lund. The goal is also to provide some guidelines about the optimal elongation for an elliptical shaft, where the shaft remains stable through the arching effect and not requiring reinforcing ring-beams. This master thesis will also enlighten the relation between the foundation depth of the retaining structure below the excavation bottom, the groundwater intrusion into the shaft and the uplifting effect on the retaining structure.

METHOD

Numerical finite element analysis will be performed regarding the interaction between the retaining structure, the soil and the groundwater for a vertical shaft with a circular and elliptical shaped cross section. The commercial software PLAXIS will be used to perform the finite element analysis. The numerical results from the FE-analysis will be verified against analytical results. Geotechnical data from a recent tunnelling project in Malmö will be used as material input in the analysis.

DIVISION OF GEOTECHNICAL ENGINEERING Dept. of Construction Sciences
Faculty of Engineering LTH, Lund University, Box 118, SE-221 00 Lund, Sweden
• Tel: + 46 (0)46-222 73 70 • Fax: + 46 (0)46-222 44 20 • www.geoteknik.lth.se

xpTVGT-5068 (2020-02)