

Effect of anchor installation on settlement of nearby structures in soft soils

H.G. Kempfert & B. Gebreselassie
University of Kassel, Germany

ABSTRACT: Most often, the effect of anchor installation on the ground movements is ignored. This paper, however, reveals that this effect will be considerable in soft clays if appropriate drilling technique and support for the drill hole is not used. A case history shows that more than 70% of the total ground settlement had occurred at the surface during the anchor installation. An attempt is made to back analyse the effect of anchor installation on the ground movement with the help of finite element method and analytical approach.

1 INTRODUCTION

The main concern of an engineer in designing a temporary support for an excavation in an urban area is to avoid excessive ground movement in order to secure safe working condition and to provide sufficient safety to the existing nearby structures. To arrive at this objective, it is required to study the factors that control the ground movements around and in an excavation. According to Manna (1978), these factors are classified as a) factors under designer control such as type and stiffness of support system, degree of wall embedment and degree of pre-loading of anchors and struts; b) factors partially under designer control such as method of support system construction, construction period, method of construction within excavation and size of surcharge load, and c) fixed parameters not subjected to designer control such as subsoil condition and properties, surrounding structures, excavation shape and depth. It is the effect of the method of support system construction that interest us in this paper. The factors related with construction include: overexcavation, delays and inadequate support, drilling and driving process, grouting, and dewatering. Several reports indicated that appreciable ground settlement occurred during boring and placing of diaphragm and bored pile walls and driving and pulling of sheet pile walls. Fujita (1994) reported that about 50% of the total ground settlement at the surface in a 14.65 m deep braced excavation was caused by driving and extracting of the sheet piles. Burland & Hancock (1977) had also reported that the vertical and horizontal ground movements outside the excavation due to the installation of the diaphragm walls and piling amounted to approximately 50% of the total move-

ments recorded on the completion of the main design in London clay. Similarly, Lehar et al. (1993) indicated that about 60% of the total settlement at the ground surface was due to the installation of the diaphragm wall constructed in Salzburg lacustrine soft clay.

Likewise ground anchor installation also causes ground settlement at the surface. Its effect, however, is usually ignored since the hole required for placing the anchor is relative small. To date no report can be found on the effect of anchor installation in the literature. This paper presents a case history where anchor installation contributed to more than 70% of the total ground settlement at the surface of an excavation in soft lacustrine clay.

2 GENERAL DESCRIPTION OF THE EXCAVATION

2.1 *The site*

The excavation site is located in a built up area in southern Germany in the city of Constance near the lake Constance. It was intended for the basement of a multi-storey residential apartment and the construction work was completed in 1993. The site plan together with field instrumentation locations is shown in Figure 1. The excavation was 5.3 m to 7.0 m deep, and covered an area of 55 m x 60 m at the longer sides. In south, south-west, and west sides, the site is surrounded by 1- to 6-storey (one basement floor) residential buildings. All buildings are rested on mat foundation. At two sides (along MS2 and MS5) in particular, the excavation was very close (1.2 to 1.5 m) to the existing buildings.