Abstract

This habilitation thesis resumes the scientific research, academic and professional activities of Prof. dr. ing. Horaţiu Popa, focusing on the period after obtaining the PhD title. The document is organized in three parts: in the first part (A) the scientific, academic and professional achievements are presented, in the second (B) the perspectives of the future carrier are described and in the third one (C) the scientific references are indicated.

Part A of the document is structured in two parts also. The first part *A.1. The research activity* consists of four chapters as following:

Chapter 1 makes a presentation of the soil – structure interaction phenomenon. In fact, this subject represents the main theme of the research developed by the author in his scientific activity since the PhD thesis. Generally, the soil – structure interaction is present for all geotechnical structures: shallow and deep foundations, slopes and reinforced earth, excavations and retaining walls. The interaction between soils and structures lies in the way in which both are influencing each other, causing the final behaviour under charges. Modelling this phenomenon is consequently extremely important in geotechnical structural analysis, although it is not simple and it involves the use of advanced theoretical models.

Chapter 2 develops the phenomena and the characteristic parameters of interaction for retaining structures. The effect of calculation method and of retaining structure characteristics are analysed: soil – structure relative stiffness, position and stiffness of props or anchors, excavation depth etc. The advantages of the 3D numerical modelling and the impact of constitutive law are also pointed out. The most used constitutive models are detailed, from the simplest and well known linear elastic – perfect plastic models, up to elastic nonlinear hardening criteria depending of the stress state in the soil. The chapter emphasises how to obtain and validate the advanced constitutive model parameters for using them in the structural modelling. Some numerical modelling calculations by finite element method are performed using different constitutive criteria and the differences between the results are highlighted and analyzed. Numerical results are compared also with experimental measures in order to conclude on the benefits or incovenients in using various constitutive models. The chapter concludes with an overview of the soil dynamic parameters used in modern constitutive criteria and their determination. The determination of the

shear modulus for very small strains for five sites in Bucharest is presented and analysed. The effect of shear modulus on the numerical results is also studied.

Chapter 3 analyses the interaction between a deep excavation and the neighbouring buildings. The development of the constructions leads to very dense zones and increasingly higher and deeper constructions. The effect of each other's cannot be ignored and may lead to important losses and even to severe accidents. In this chapter, the interaction between a retaining wall and a shallow foundation is analysed taking into account the geometrical parameters: wall - foundation distance, foundation and excavation depth, foundation width etc. In the second part of the chapter, the study of some real retaining structures is presented. These retaining walls were necessary for deep excavations with four and five underground levels in Bucharest. The study contains numerical modelling aspects and experimental measures on these structures and on the neighbouring buildings.

Chapter 4 concludes the part A1 presenting the general concept of the retaining structure calculation and design and the importance and the possibilities of their monitoring.

Part A.2. Academic and professional activity presents very briefly the author's studies, internships abroad at different universities or research centres, the academic activity developed at the Geotechnical and Foundation Department of the Technical University of Civil Engineering of Bucharest. Also, it presents the technical activity performed in framework of various contracts or technical projects at the university or as consultant, authorized technical verifyer or expert.

Part B describes the strategy of developing the scientific, academic and professional carrier. The proposed research directions as Director of the Geotechnical Engineering Research Centre are presented. As well, the possibilities of improving the academic performances and the collaboration with students during their scholarship are established. Last but not least, the author declares his motivation to continue the technical activity by collaborating with design and execution companies in field of special foundation works considered to be very important as part of the continuous formation of the author.

Part C concludes the thesis by presenting the main bibliographical references.