



# Numerical Analysis of Top-Down Construction Method of High-Rise Buildings and its Effects on Substructures with their Corresponding Heights

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## Abstract

The Top-Down construction method has been used widely in urban areas, particularly in high-rise buildings with basements. This paper presents the Nanjing Jinmao Plaza II Tower in Nanjing-China as a case study, which consists of 68 floors with a height of 283.6 m and five basements with a depth of 27.5 m. A numerical finite element simulation in PLAXIS 3D was performed to analyze the construction of soil excavation and basement structure and their corresponding heights. The study concluded that the effect of adding floors to the superstructure had little effect on the underground excavation process. Likewise, the condition of column piles is in different stages of construction. In view of that, this paper has analyzed and summarized construction guidelines for the top-down construction method to ensure safety, optimize design, and provide recommendations for this promising construction technique.

**Keywords:** top-down construction method; high-rise building; deep foundation excavation; deformation; displacement.

## 1 Introduction

Currently, the process of urbanization in the world has been accelerated, urban construction has been well developed, and the super high-rise buildings in the commercial center area of cities have become more and more crowded. The height of buildings continues to rise, and the use of underground space becomes more complicated [1]. That led to an increase in the depth of the excavations and the complexity of the construction, so the related technology was constantly applied and innovated, including Top-down technology [2-5]. The top-down method has been widely used in the deep foundation pit supporting structure, which has produced significant results [6-8]. Because of its advantages, that can be used in the construction of

narrow construction sites, complex surrounding environments, short project periods, the low safety level of foundation, high settlement, and deformation requirements of surrounding structures [9]. In addition, it has good economic savings. Therefore, the Top-Down method has been widely used and developed in many parts of the world since it came into being [5, 10]. The Estimation of displacement caused by excavation is always the main problem in deep excavation pit. Several techniques were advanced in knowledge of the displacement mechanism of deep excavation [11,12]. Among these methods, numerical methods are the most effective ones which could take each geotechnical and structural detail in deep excavations, so it is more and more popular [13]. Depending on the case study of Nanjing Jinmao