

Method of calculating construction quantity using three-dimensional models (Research period: FY 2017)

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1. Introduction

The April FY 2017 Civil Engineering Work Quantity Calculation Procedure (draft) that the Ministry of Land, Infrastructure, Transport and Tourism revised in April 2017¹ (hereinafter the Quantity Calculation Procedure) permits three-dimensional quantity calculations using CAD software. Yet, the Procedure does not provide specific methods of construction quantity calculation using three-dimensional models. Therefore, the National Institute for Land and Infrastructure Management is studying methods to calculate the quantity using three-dimensional models based on the current categories provided in the Quantity Calculation Procedure.

For this fiscal year, the authors examined the quantity calculation methods using three-dimensional models of soil structures, concrete structures, and steel structures. This paper reports a proposal for a method to prepare a three-dimensional model to be used for quantity calculations targeting soil structures using the model shown in figure 1 as an example.

2. Quantity calculation method for soil structures using a three-dimensional model

The three-dimensional model used for the quantity calculation of soil structures is expressed using a three-dimensional ground model that depicts the ground surface and the surface of the soil layers and an earthwork model that expresses the formation level (subgrade surface) and slope surface. Details of the methods to create individual models are discussed below.

For the ground surface (figure 2 (a) [1]), a surface model is prepared based on survey data obtained through three-dimensional survey technologies. For the soil layer surface (figure 2 (a)[2][3]), a surface model is prepared using geological profiles based on boring data by mathematically complementing (estimating) spatial characteristics between two cross sections. Geological information in the space vertically below is registered for the surface models of individual soil layers.

The construction width and cut width of an earthwork model (figure 2 (b)) is expressed using a surface model.

These models are layered, and the quantity of the soil structure is calculated using the mensuration method based on the TIN division using the difference in volumes among the different models, a height method that uses the differences in heights, and the prismatic

method.

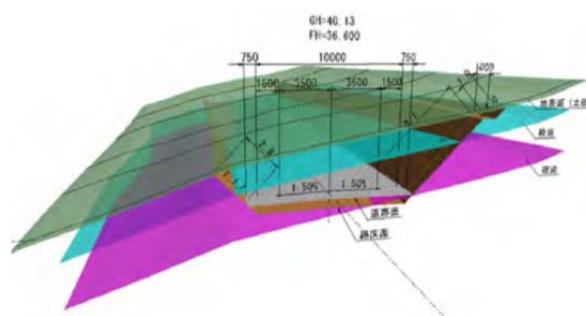
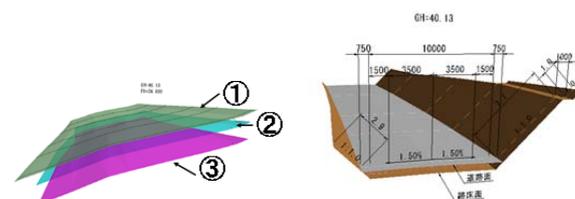


Figure 1. An example of expressing a three-dimensional model of a soil structure



(a) Three-dimensional ground model (b) An earthwork model

Figure 2. An example of expressing three-dimensional ground model and an earthwork model

3. Summary

In FY 2017, the authors prepared a revision proposal concerning the river and erosion management edition and the road edition of the Civil Engineering Work Quantity Calculation Procedure (draft) based on knowledge acquired through the research. In FY 2018, the authors are going to extract the challenges of quantity calculation using a three-dimensional model and find ways to overcome the challenges, as well as to expand the targeted types of construction through the implementation of operations and construction based on the revision proposal.

References

- 1) Ministry of Land, Infrastructure, Transport and Tourism: FY 2017 (April edition) Quantity Calculation Procedure (draft), Apr. 2017. <URL: <http://www.nilim.go.jp/lab/pbg/theme/theme2/sr/yoryo2904.htm>> (browsed in January 2018)