Approach to the Geological Survey of Sandy Ground in Consideration of the Stratigraphic Classification

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1. Preface

When the New Austrian Tunnelling Method is being used to excavate tunnels in sandy ground, there is a risk of water seepage causing the working face to collapse where the degree of ground compaction is weak and the groundwater level is high. For this reason, when railway tunnels are being constructed through this type of ground, the tunnel alignment is divided into several sections according to the physical properties of the ground and the ability of the working faces to withstand water seepage. The level of difficulty of the tunnel excavation is evaluated on the basis of the rock classification. However, as the physical properties of the ground have spatial variations, it is sometimes difficult to determine the physical properties that are applicable to the rock classification. The Railway Technical Research Institute (RTRI) has therefore researched the relationship between the characteristics of sandy strata and the variations in the physical property values of the ground. RTRI has also researched geological survey methods that are suitable for evaluating the variations in the physical properties of the ground at the planning stage.

2. Stratigraphic classification and variation in physical property values

Here we show an example of the sandy strata of Pleistocene Age (Nos 1 formation) found in the Tohoku district which illustrates the relationship between the variation in physical property values and the unit of ground classification. The Nos 1 formation can be further classified into three strata: Nos 1-1 to Nos 1-3 on the basis of the difference in each facies. The degree of variation (variation coefficient) in physical property values of the Nos 1 formation and those of the three strata (Nos 1-1 to 1-3) is shown in Fig 1. When comparing the variation coefficient of the Nos 1 formation and that of each of the three strata (Nos 1-1 to 1-3), it can be seen that most physical property values of each of the individual strata are smaller than those of the Nos 1 formation. Generally, strata formed in rivers and shallow marine areas show different facies depending on each sedimentary deposition environment. For this reason we consider that physical property values are best obtained by fractionalizing the geological strata on the basis of observed differences in particle size, sedimentary deposition and structure.

3. Geological survey at the planning stage

A flowchart of the geological survey at the planning stage covering the facies of the different strata and the variation in physical property values is shown based on the result of Chapter 2 (Fig.2). First, documentary research and a geological survey of the land surface are carried out (Fig.2 (1)). Using these results, sample bores are taken at suitable locations to complete the geological survey (Fig.2). Next, the strata is classified on the basis of observed differences in the facies of the strata using criteria such as particle size and sedimentary structure taken from the geological survey (Fig2 (3) and Fig.3 (a) to (c)). The respective physical property values are obtained using soil tests for each individual stratum (Fig.2 (1)).
In this instance the geo-technical features of the ground can be more clearly shown by clarifying the degree of variation in each of the physical property values and by assessing the physical property values in terms of particle sizes (such as the fine fraction content and the uniformity coefficient) which have a comparatively large variation coefficient (Fig.1).
Moreover, if the various physical property values of the different strata exhibit average values and similar variations, we consider the strata to have similar geotechnical features; they can therefore be treated in technical terms in the same way (Fig.2 (5), Fig.3 (c) to (d)). It is important to determine the physical property values that apply to the rock classification. From now on we plan to examine the accuracy of the survey according to the scale of the structures involved.

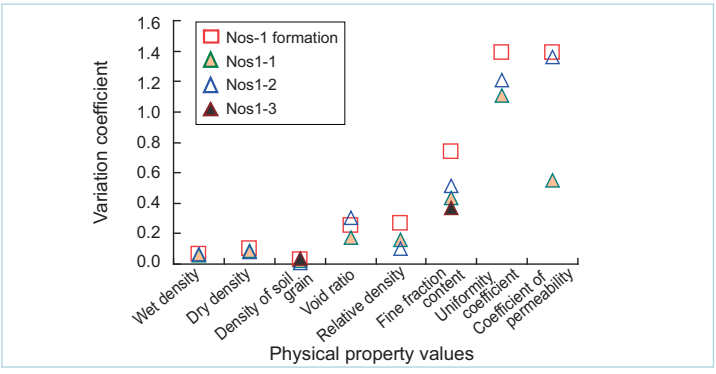

Fig.1 Degree of variation in physical properties per each geological stratum

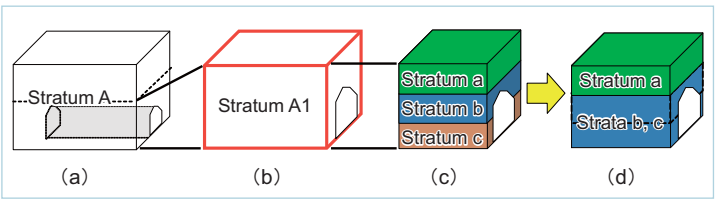

Fig.3 Concept of fractionalizing sandy ground

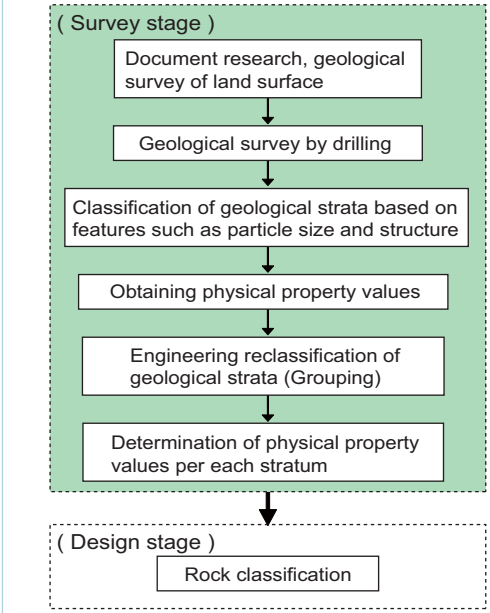

Fig.2 Flowchart of the geological survey