Strength-Deformation Characteristics of EPS

Byung-Sik Chun
Hanyang University, Seoul, Korea
Soo-Deok Lee and Hae-Sik Lim
Office of Korea National Housing Co., Seoul, Korea
Tae-bong Ahn
Korea Institute of Construction Technology, Seoul, Korea
Kwang-Hyun Ha
Korea Engineering Consultants Corp., Seoul, Korea

ABSTRACT

The EPS (Expanded Polystyrene) has the unit weight of only 0.02 ~ 0.03 t/m³ and is used as one of the methods acquiring the safety for settlement and bearing capacity. Parts of its applications are for backfill materials of structures on soft ground, retaining wall, and etc., to reduce horizontal earth pressure and for banking materials to secure the safety for settlement and bearing capacity by minimizing the stress increment.

Accordingly, this paper executed triaxial compression test on EPS with various densities and confining pressures. Through the analysis of test data, the behavior of EPS for strain-stress, tangential modulus and poisson's ratio can be expressed as functions of parameters using density and confining pressure of EPS.

From these results, this paper proposed the nonlinear model describing the behavior of EPS.

KEY WORDS: EPS, Nonlinear Numerical Model, Numerical Model of EPS

INTRODUCTION

There are many soil improvement methods concerning bearing capacity and shear strength of soils when soil fill or structures need to be constructed on the sites such as soft ground and slopes of which bearing capacity and shear strength are not sufficient to endure applied load. As an emerging method, the EPS (expanded polystyrene) method, one of the light weight fill methods, has several advantages such as light weight, self-standing characteristics, easy handling, and short time of construction.

When EPS need to be used, EPS should have appropriate strength and stress-strain behavior so that EPS can endure overburden stress and deformation. The exact behavior of EPS has to be predicted in order to decide installation shape and replacement area since the effectiveness of EPS varies depending on the installation shape.

Generally, EPS behaves differently with soils, and the strength and stress-strain behavior of EPS show large differences based on the EPS density.

The objective of this paper is to develop stress-strain model of EPS as a function of overburden stress when EPS is employed for light weight filling material. The proposed model can suggest proper EPS density, replacement area and the prediction of EPS behavior.

The typical EPS shows elasto-plastic behavior as shown in Fig.1 and elastic modulus is linear when strain varies 1% to 1.5% (Fig. 1). As EPS density increases, the modulus and axial stresses increase without peak stress values (BASF 1995). The Poisson ratio, which represents the deformation type, does not change within the limit of 1% of strain and lessens gradually after 1% of axial strain as shown in Fig. 2 (Chun et al. 1996, EPS CMDI 1993).

![Fig. 1 Typical Stress-Strain Curve of EPS (From EPS construction method development institution 1993)](image)

The volume change of EPS decreases linearly during compression, but the volume change rate depends on the density and confining stress, though the amount is very small so to catch the volume change rate accurate measuring technique is required according to Eiji Hamada and Toyotoshi Yamanouchi (1989).

The numerical EPS model has two kinds, one is linear elastic model using initial tangential modulus and the other one is nonlinear model which was developed by Cho (1992) as shown in Fig. 2 and Fig. 3, and the corresponding equations are expressed in Eq. (1) and Eq. (2).

\[
\sigma = (1 + E_{p} \varepsilon) \left[ 1 - \exp(-C \varepsilon^{2} - \frac{E_{i} \varepsilon}{I}) \right]
\]

\[
C = \frac{E_{i}}{IX_{c}} \frac{1}{X_{c}} \ln \left[ 1 - \frac{Y_{o}}{(1 + E_{p}X_{o})} \right]
\]