Consolidation and reinforcing functions of Geo-composite in Kanto Loam Embankment

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Introduction

Recently use of marginal soils (e.g. Kanto Loam, G=2.68, WL=93.9%, PL=65.2%, $\gamma_{d\ max}$=8.5kN/m^3, OMC=59%) as construction fill in geosynthetic reinforced embankment/slopes have been gaining importance. While granular soils demonstrate good reinforcing bond with the geosynthetics, construction economy and some other factors necessitates the use of locally available soils as substitute of granular soil. When fine grained soils are used the problem of large settlement and pore pressure development complicates the functional mechanism of such structures when reinforced with Geosynthetics. Proper understanding of coupled functions of drainage-consolidation and reinforcing actions is lacking. In this paper, some models tests results on Kanto loam embankment have been reported. The use of Geo-composite–sand mat system for fast consolidation and reinforcing functions are highlighted.

Model test

The details of the earlier test series are reported elsewhere (Ghosh et al, 1999, Yasuhara et al, 1999). Present test series consist of preparation of model embankment in the same manner as before followed by saturation (Fig. 1) for 1 week and then pre-consolidation of the model embankment (458mm base, 231mm top width, 378mm high, 1V:0.6H slope) till settlement becomes stable under certain load. Finally load tests were done till failure or terminated at s/B=0.40, where s is the settlement of footing and B is the footing width. Three cases have been considered, depending on the placement depth of planar geotextile, method of saturation and consolidation, etc. Three layers of geo-composite were used in all cases at vertical spacing of 94.5mm. Since, footing width was relatively small (50mm), top layer was placed at 50mm, 74.5mm and 94.5mm in some tests. In case of embankment spacer block was kept till the completion of saturation. Consolidation tests were done, with and without the use of spacer block and recording were checked for one time saturation as well as complete saturation during entire period of test. For this purpose a special device were made to saturate the model embankment uniformly from all sides. As it is difficult to maintain complete saturation for the embankment slope, some tests have been conducted on the level bed with complete saturation. Both in-plane and cross plane permeability tests have been conducted on the geosynthetics using a simple device in the laboratory.

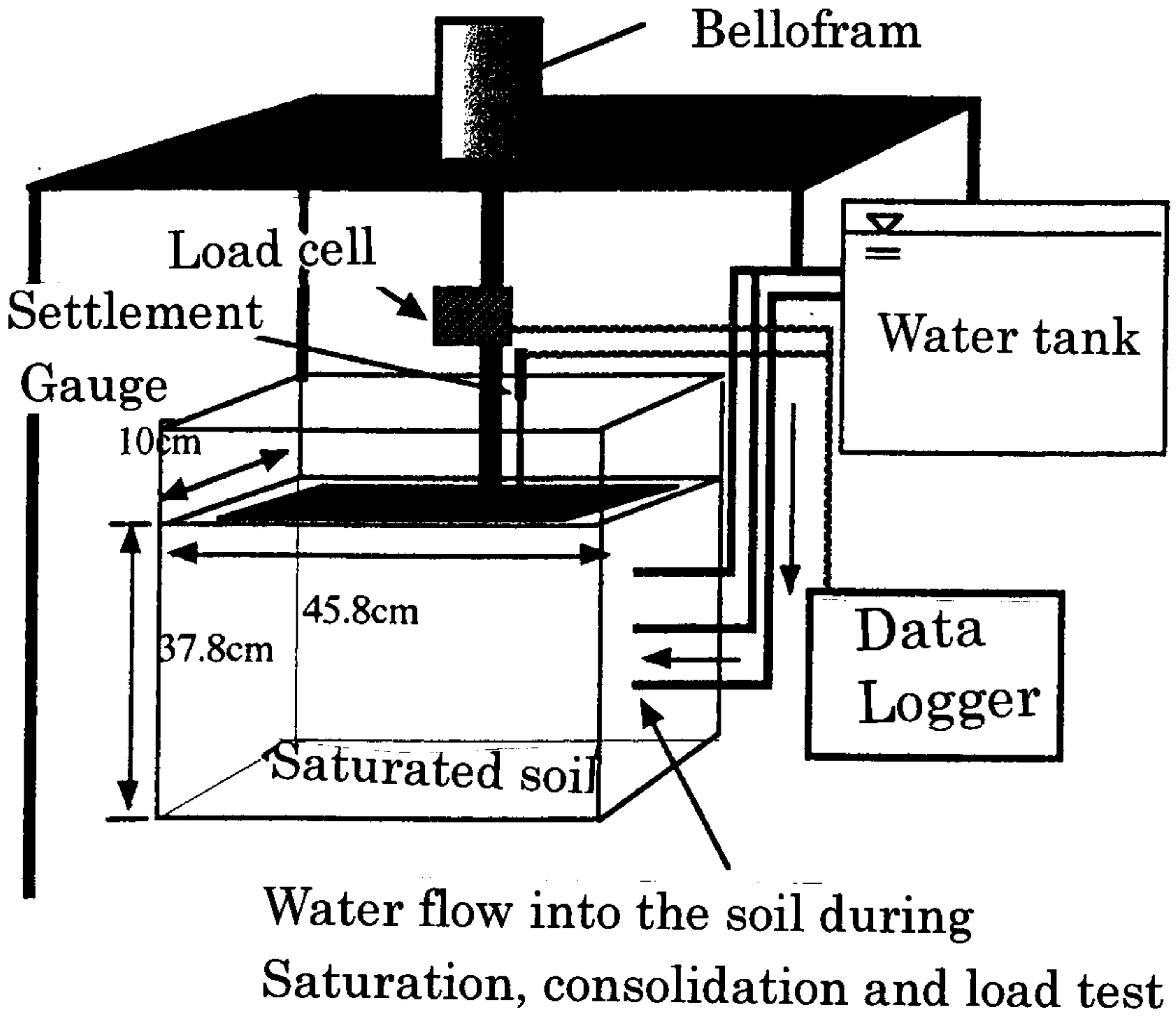

Fig. 1　Test arrangement for level reinforced bed

Tests results

In case of embankment with spacer block inside, there was very small (3 to 4mm) compression which is obvious due to the inappropriate saturation of the slope and increased confining effect by the spacer block. However, with the level reinforced bed, large consolidation settlement took place (Fig. 2). Stepped loading was used and max. load of 0.4kPa was reached within 24hrs and then it was maintained for 7days. Due to the presence of geo-composite and sand mat, drainage path reduced and most of the settlement occurred within 1st day. Load tests results on the same model are shown in Fig. 3. In this case top layer was placed at 50mm depth. After consolidation settlement of about 20mm, this layer came closer to the strip footing, which obviously showed more reinforcing effect during load test. Geo-composite has increased the bearing

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Keywords: Geo-composite, reinforcement, geosynthetics, saturation, consolidation.
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capacity of level Kanto loam bed significantly. Use of 10mm thick sand mat (Toyora sand) has demonstrated almost 100% increase in load capacity of the foundation. It can be noted that large settlement continued even during load test. This was possible due to uniformity in the sample bed with almost 100% saturation and effective drainage of pore water through sandmat-geo-composite layer. On the other hand consolidation settlement in the embankment were less due to presence of spacer block and relatively unsaturated (also compacted) slope face. During load test spacer block was removed. In this test not sufficient drainage could feasibly observed during pre-compression as well as load test(Fig. 4, nonwoven geotextile). However, the effect of depth of top layer (in Fig. 4, u= 94.5mm and in Fig. 5, u=74.5mm) as well as the effect of geocomposite-sand mat are significant.

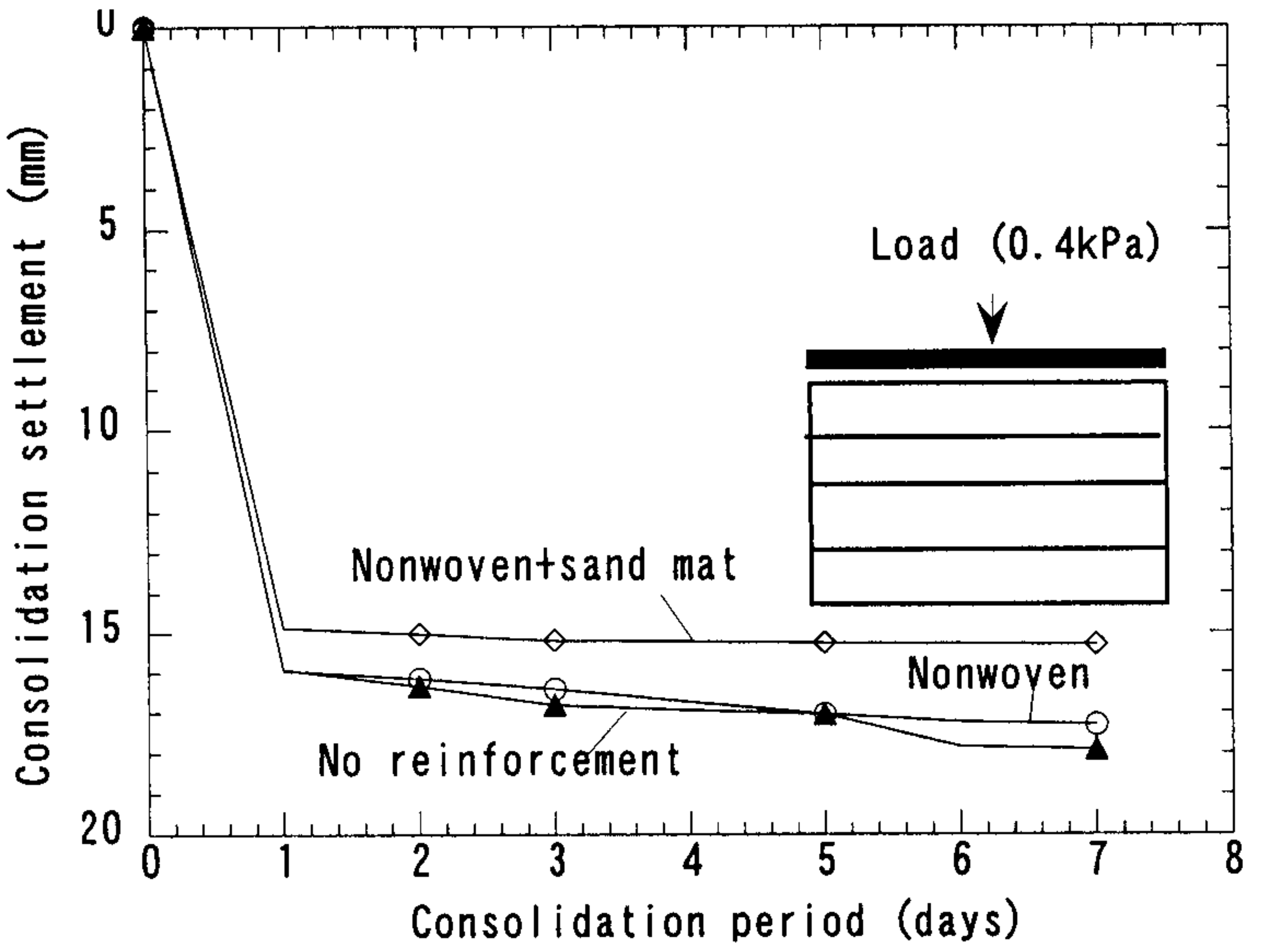

Fig. 2 Consolidation of level reinforced bed

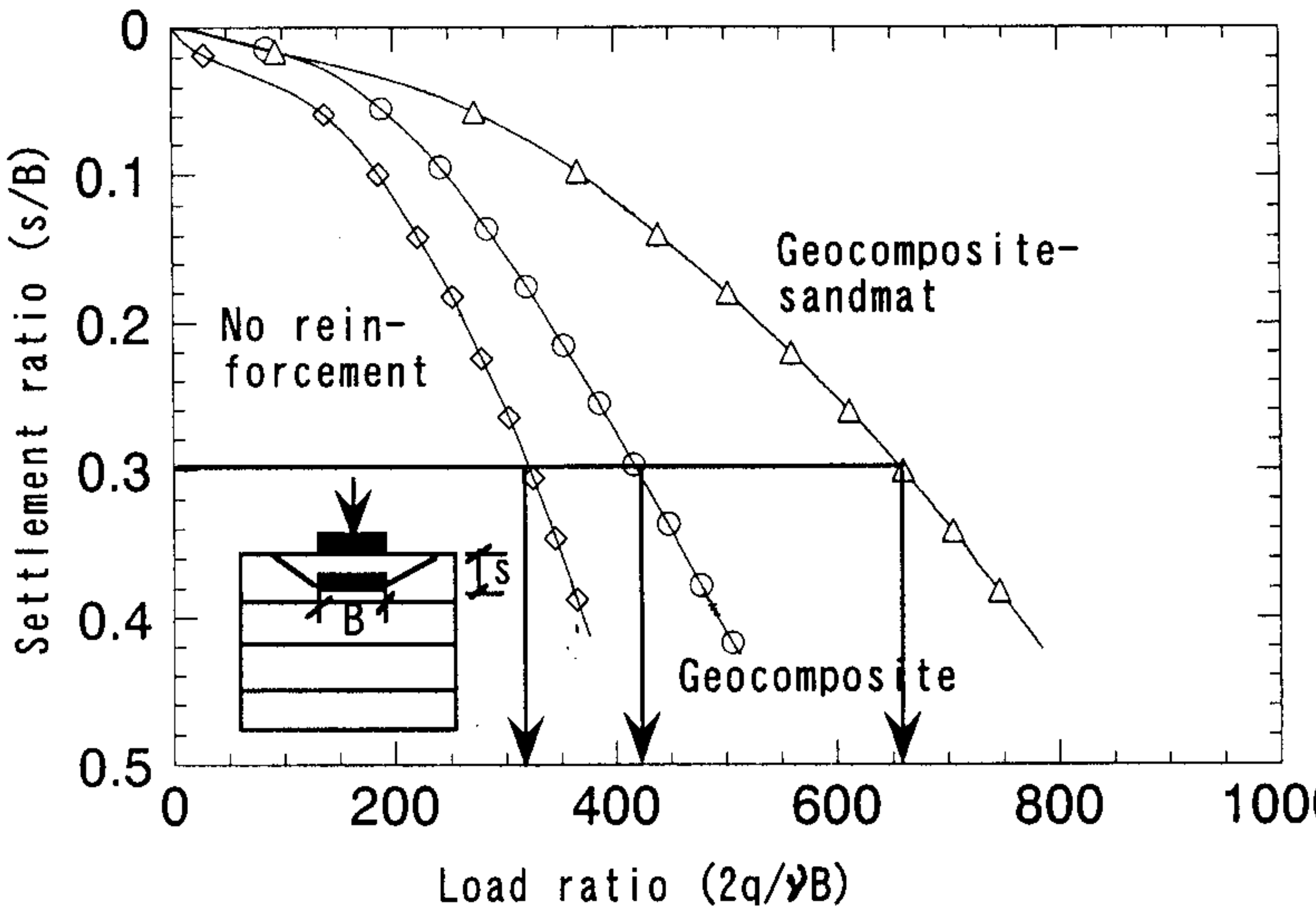

Fig. 3 Load-settlement response of level bed after consolidation

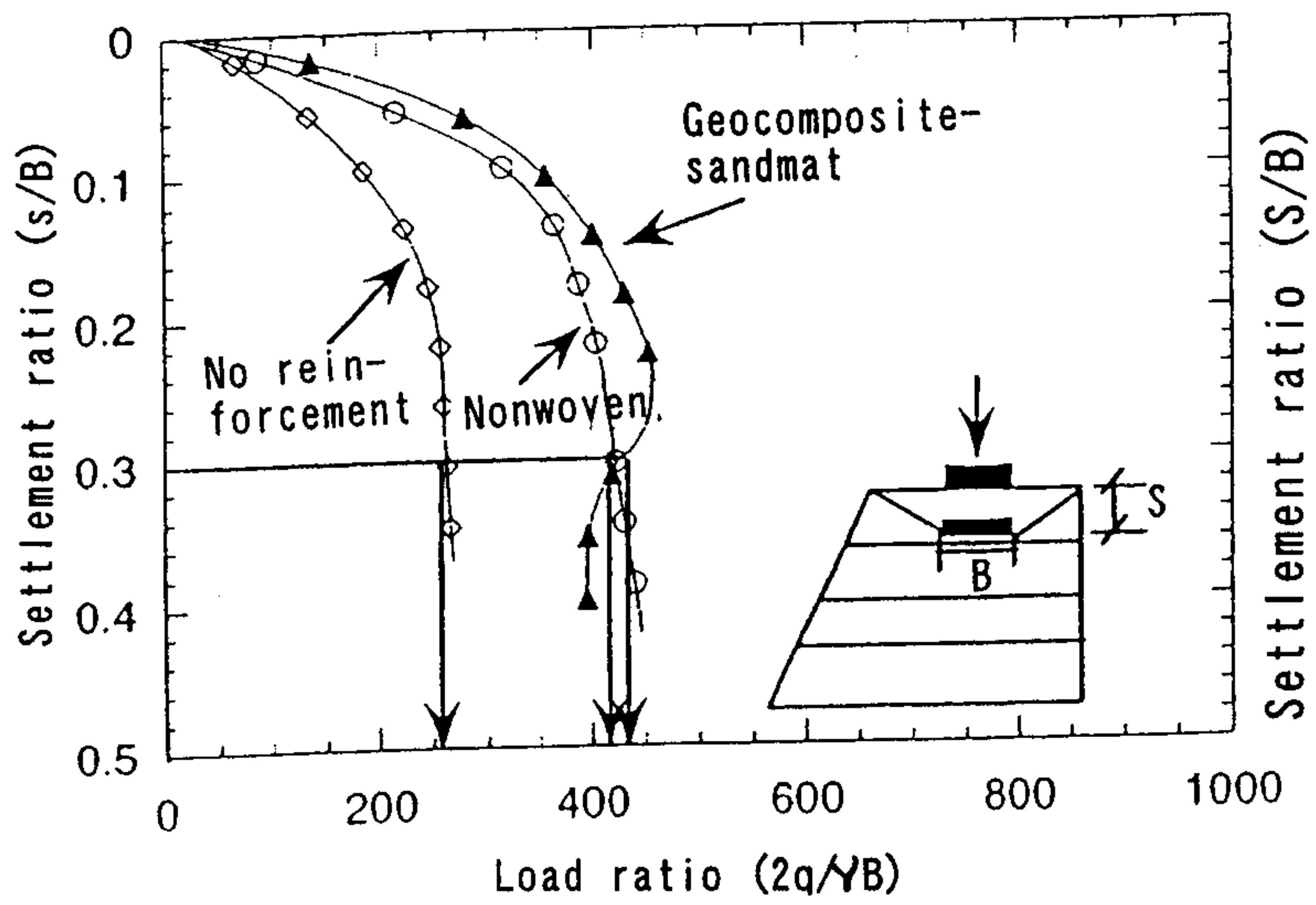

Fig. 4 Load-settlement response of embankment after pre-compression (u=94.5mm)

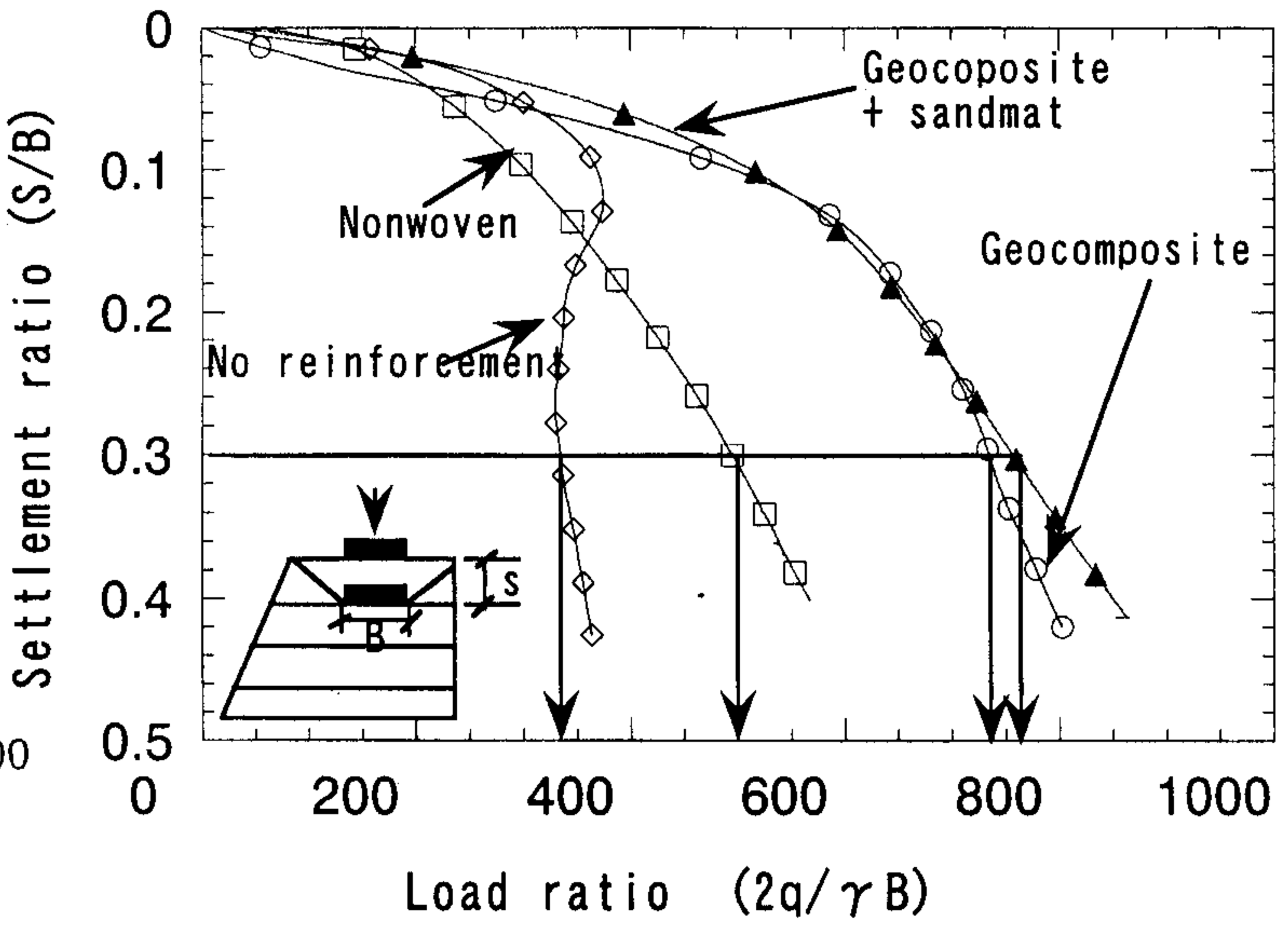

Fig. 5 Load-settlement response of embankment after pre-compression (U=74.5mm)

Conclusions

Based on the present model studies, the effectiveness of geo-composite-sandmat system for the improvement of marginal soils have been confirmed, at least in quantitative terms. In near future realistic mechanisms of the drainage-consolidation-reinforcement functions of the total system needs to be evaluated.

References:

Ghosh, C. Yasuhara, K. Murakami, S. and Hirai, T. (1999) Model and field tests on geosynthetic reinforced clay embankments. 54th Japanese Nat. Conf, JSCE, Hiroshima, Vol. III-B290, pp. 580-581.

Yasuhara, K., Ghosh, C. Hirai, T. and Tanabashi, Y. (1999) Small and large scale tests on reinforced Kanto loam embankment. 14th Japanese Nat. Conf. on Geosynthetics, Osaka, Vol. 1, pp. 264-275.