Pull-out behaviour of square-shaped geocell reinforcement using two-dimensional digital image correlation

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Abstract

1. Background

Geosynthetic reinforced soil retaining wall (GRS RW) has now become much popular in Japan mainly because of its high seismic stability. Instead of conventional geosynthetics like geogrids and geocells, new square-shaped geocell reinforcement (SG) that can be used in GRS RWs, with the potential of higher pullout resistance and seismic stability, is being researched at the University of Tokyo.

2. Objective

This study aimed to find the effect of spacing of the transverse members of the SG on pullout behavior.

3. Methodology

Laboratory pullout tests along with 2D-DIC analysis, were carried out. Split-type SG model with 7 different spacing (ST=15mm, 30mm, 60mm, 90mm, 120mm, 180mm and 360mm) was used as shown in Fig. 1. Poorly graded Silica sand was used as backfill material. Schematic diagram of the experimental setup and the actual setup are given in Fig. 2 and 3 respectively.

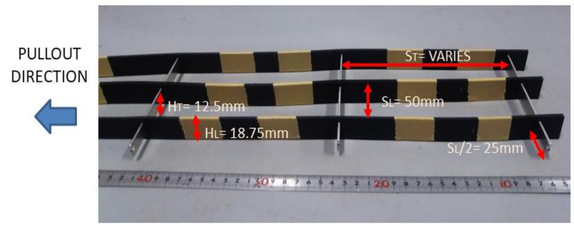

Fig. 1. Split-type Square-shaped geocell (SG) model

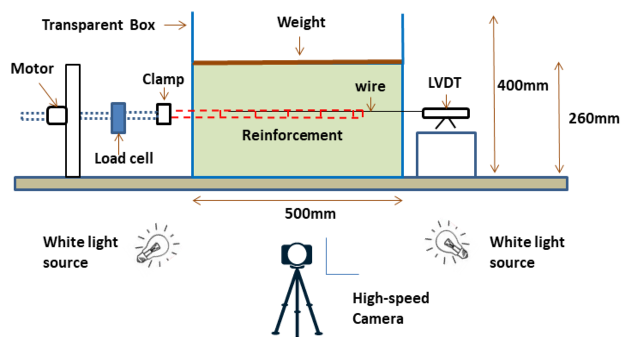

Fig. 2. Schematic diagram of the pullout apparatus and the experimental setup

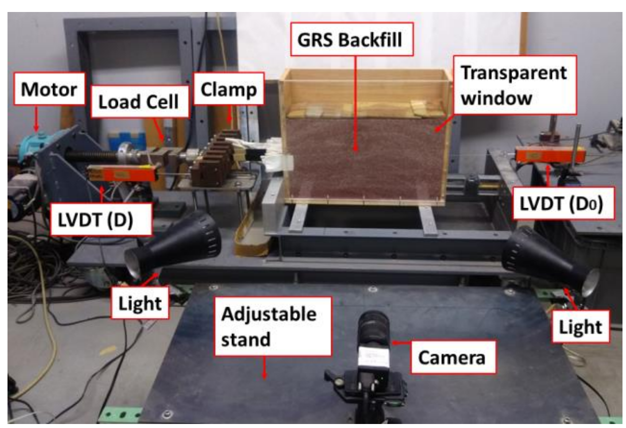

Fig. 3. Actual experimental setup

4. Results

Pullout failure mechanism involved 2 components namely the Shear resistance and the Passive bearing resistance. When Spacing/Height (ST/HT) increased, the model failed in 3 different failure modes as shown in Fig. 4 and 5.

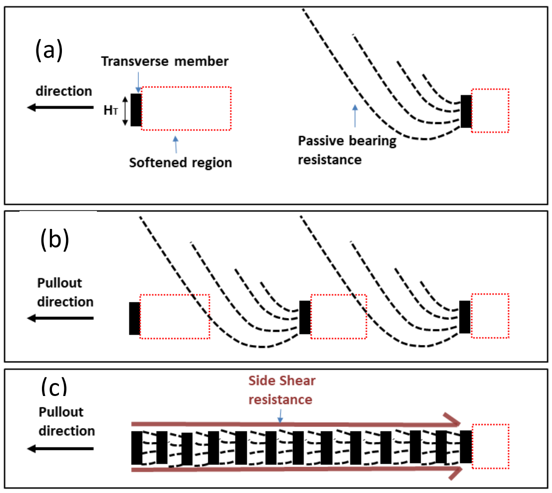

Fig. 4. Schematic diagram of the three failure modes: (a) Individual failure; (b) Interference failure; (c) Block failure

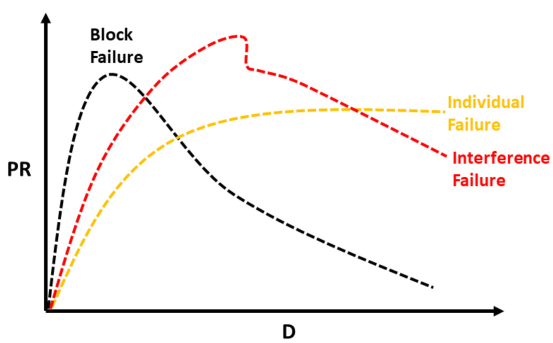

Fig. 5. Typical failure patterns of the 3 failure modes (PR-Pullout resistance, D-Distance)

As shown in Fig. 6, the PR Vs D curve for SGs embedded in sand followed above typical patterns. The threshold value, ST1/HT, between the block and interference is about 1.2 and ST2/HT, between interference and individual is about 14.4. The relationship is shown in Fig.7.

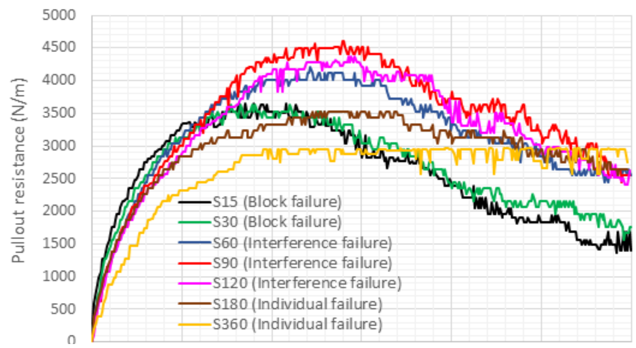

Fig. 6. PR Vs Displacement curve for SGs

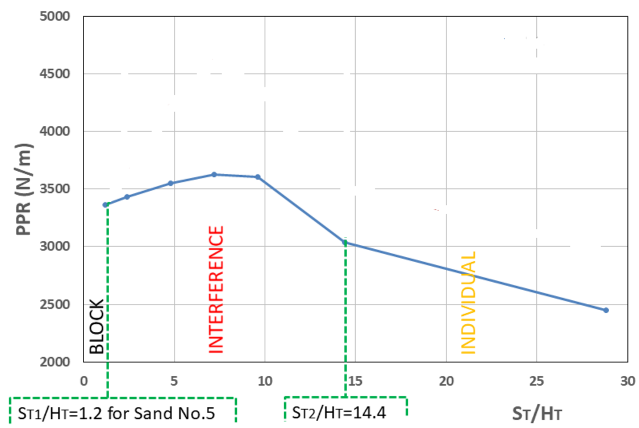

Fig. 7. Threshold values of the 3 failure modes (PPR-Peak Pullout Resistance)

5. Conclusion

Individual failure mode or S90 (i.e. ST/HT = 7.2) will be the best model to use in practical work as having the highest PPR and modest values of pre-peak stiffness and residual pullout strength.