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GDM

Pullout behavior of square-shaped geocell reinforcement embedded in sand

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Geo-disaster Mitigation Engineering

Test apparatus, Materials and Methodology

This study investigates the effect of spacing of the transverse members (S_T) on the pullout behavior of square-shaped geocell reinforcement (Han, 2014) embedded in the sandy backfill. Seven pullout tests were done with varying S_T while keeping the other influencing factors constant (i.e. H_T=12.5mm, D_{50}=0.64mm, D_C=100% and σ_n=1kPa). 2D-DIC analysis (using *GOM Correlate 2017*) was done by using the digital images recorded during the pullout process..

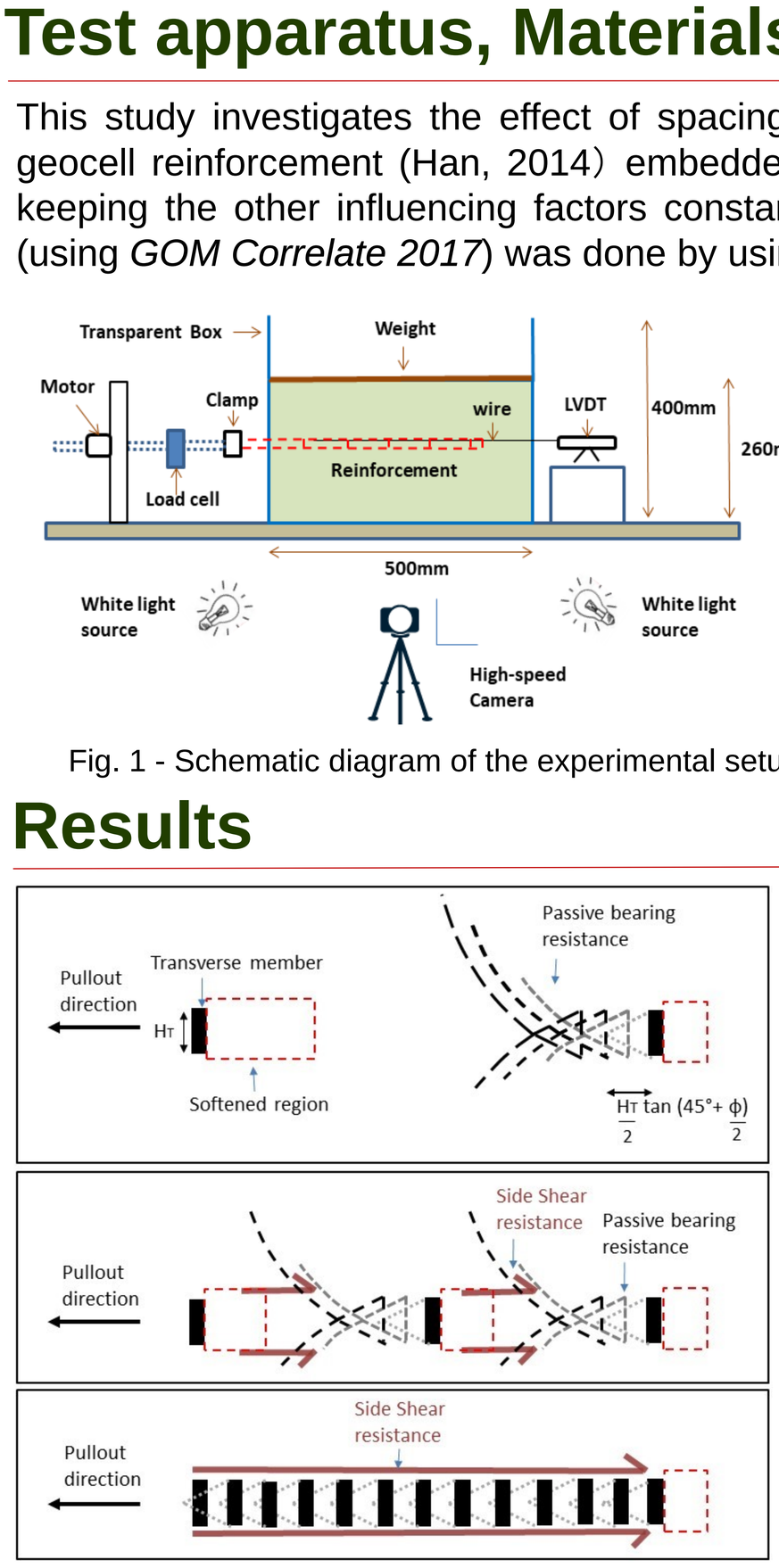
Fig. 1 - Schematic diagram of the experimental setup

Fig. 2 - Split-type geocell reinforcement

Fig. 3 - Backfill material (Colored sand No5)

H_T – Height of Transverse member (TM) **H_L** – Height of Longitudinal member (LM)
S_T – Spacing of TM **S_L** – Spacing of LM **PR** – Pullout resistance
PPR – Peak pullout resistance **D180** – Displacement of TM at 180mm from front face

Results



Ductile failure
Pullout resistance (PR) is controlled by the passive resistance

Intermediate failure
PR is controlled by both the passive resistance and the shear resistance

Brittle failure
PR is controlled by the shear resistance

Fig. 4 - Conceptual mechanism (3 failure modes depending on S_T)

Table 1 - Test cases with results

Symbol	Spacing (S_T)	No. of Transverse members	Pre peak stiffness	Residual pullout resistance	Peak pullout resistance (N/m)	Time at PPR (S)	Failure mode
S360	360mm	2	Very low	High	2450	440	Ductile
S180	180mm	3	Low	High	3038	360	Ductile
S120	120mm	4	Low to modest	Modest to high	3602	280	Intermediate
S90	90mm	5	Modest	Modest	3626	247	Intermediate
S60	60mm	7	Modest to high	Low to modest	3552	200	Intermediate
S30	30mm	13	High	Low	3430	180	Brittle
S15	15mm	25	Very high	Very low	3426	140	Brittle

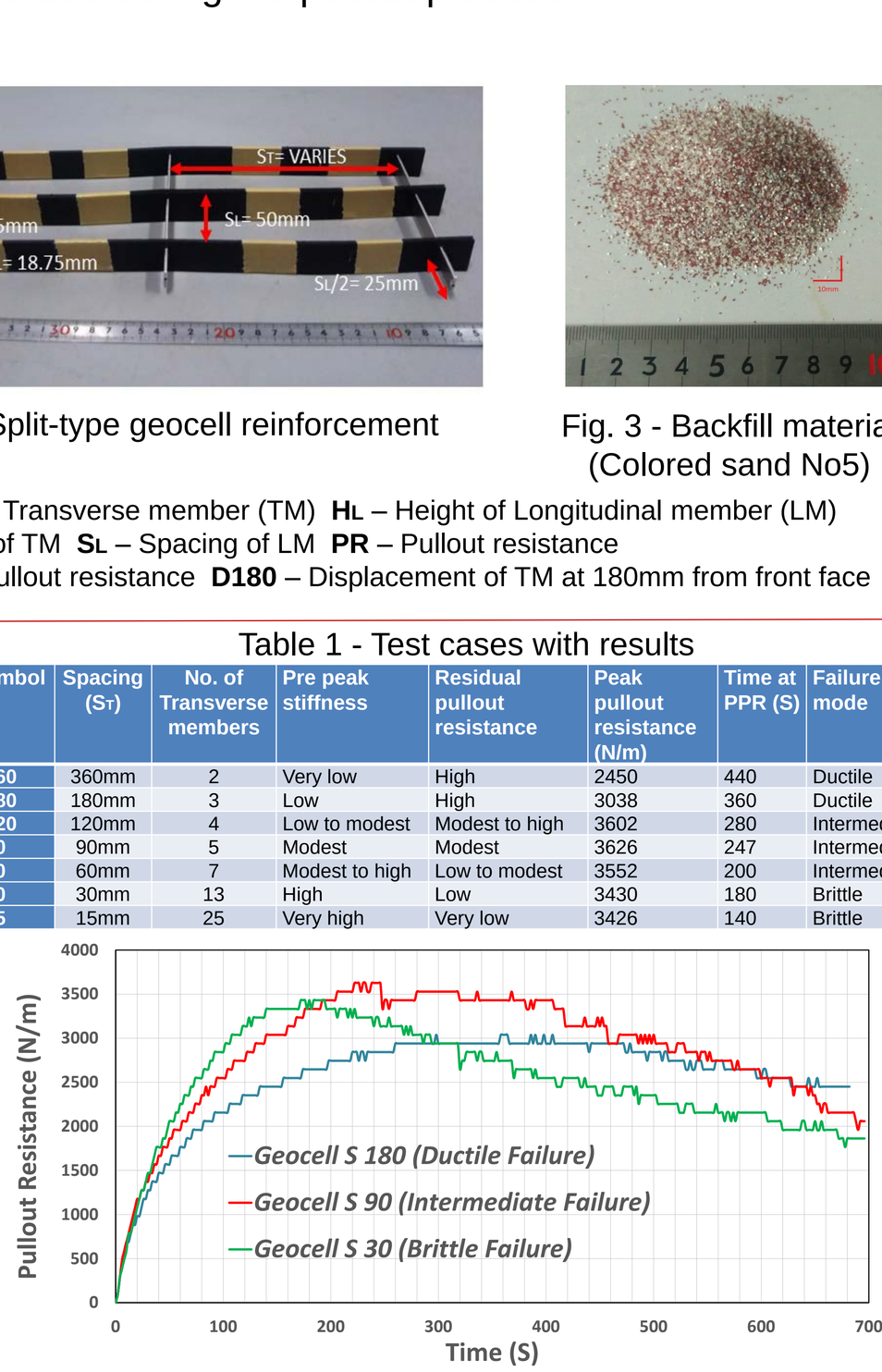
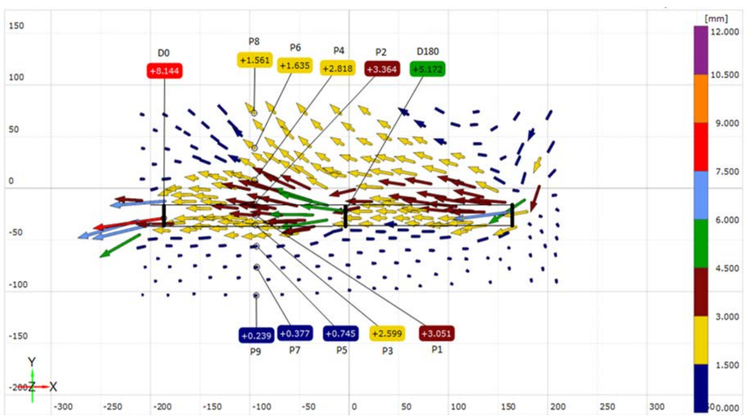
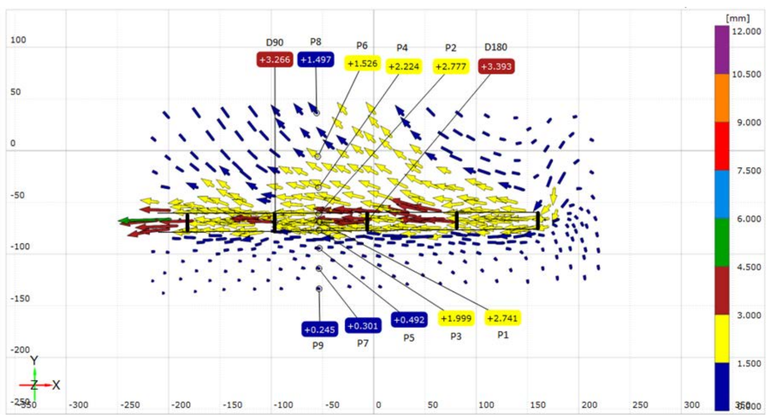


Fig. 5 - Typical failure patterns



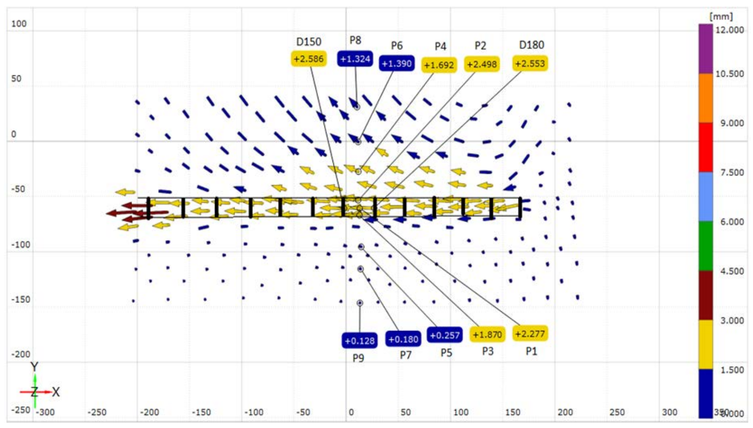
Ductile failure
Non-symmetrical and progressive deformation

Fig. 6(a) - Deformation of S180 at peak (at 360 S, D180 = 5mm)



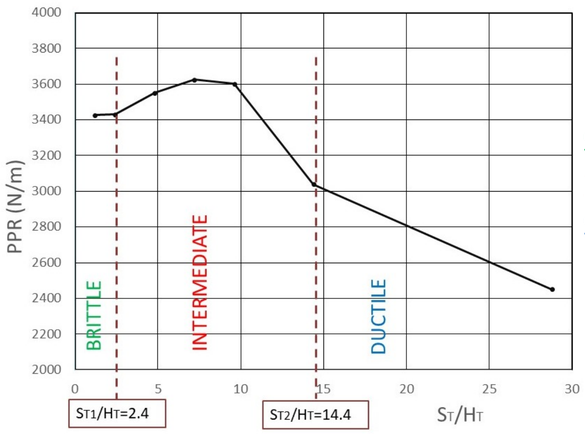
Intermediate failure
Non-symmetrical and less progressive deformation

Fig. 6(b) - Deformation of S90 at peak (at 247 S, D180 = 3.5mm)



Brittle failure
Non-symmetrical and monolithical deformation

Fig. 6(c) - Deformation of S30 at peak (at 180 S, D180 = 2.5mm)



S_T/H_T < 2.4 - Brittle failure
14.4 > S_T/H_T > 2.4 - Intermediate failure
S_T/H_T > 14.4 - Ductile failure

Fig. 7 - Threshold limits of the 3 failure modes