ABSTRACT

The stability of geosynthetics along slopes in covers and liners of landfills depends partly on their mobilized tensile strength and partly on the efficiency of the anchors holding the geosynthetics at the berms or top of the slope. The pull induced on these geosynthetics in the lining or cover system is in an inclined direction parallel to the slope. But due to difficulty in modelling of inclined pullout behaviour experimentally, very few studies have so far been conducted on geosynthetics embedded in anchor trenches and even these studies are limited to sheet-type geosynthetics. For this purpose, an inclined pullout device was conceptualized and developed during the course of this study. This device can perform pullout tests on geosynthetics at continuously varying inclinations.

Since geogrids are widely used as veneer reinforcement, inclined pullout tests are conducted on geogrids embedded in run-out, I-type and L-type anchors in the sand under low confinement. The influence of the angle of inclination of pullout force on the anchor capacity of the geogrid and the variations in the failure mechanism for different types of anchors have been studied. The inclined pullout behaviour has also been studied for sheet geosynthetic embedded in run-out, I-type and L-type anchors under low confinement and compared with the corresponding behaviour of geogrid. For proper comparison, the surface characteristics of the sheet and the geogrid were kept the same by manually fabricating the sheet. The influence of the type of sand on the behaviour of the sheet and the geogrid is also investigated. The results show that the maximum pullout resistance in both the geogrid and the sheet increases by more than 20% as the pull inclination increases from 0° to 30° in all the three types of anchors. In both the sheet and
the geogrid, I-type anchor provides approximately 50% and L-type anchor provides more than 90% higher pullout force than the run-out anchor.

Model tests have also been conducted to investigate the effectiveness of longitudinal and transverse members of the bitumen-coated polyester-yarn geogrids under low normal stress. The tests compare the pullout behaviour of geogrids with different spacing of longitudinal and transverse members. The results show that the spacing between transverse ribs has very little influence on peak pullout resistance of the geogrids, but the residual pullout resistance increases significantly once the transverse rib spacing is greater than a critical value. Increase in spacing between longitudinal ribs reduces the peak pullout resistance considerably.

The model tests on the inclined pullout of geogrids embedded in three types of anchors have been simulated numerically using three-dimensional finite element analyses software PLAXIS 3D. The soil behaviour is represented by the elastic-perfectly plastic Mohr-Coulomb model and the geogrid behaviour with linear-elastic plate elements. The geogrid is modelled using the geometrical and index properties of the geogrid used in model tests. The results show that the peak pullout force values for different values of inclinations and types of anchors were predicted with reasonable accuracy by the numerical modelling approach used in the study. However, the post-peak response for run-out and I-type anchors and the stiffness in case of trench anchors (I- and L-type anchors) are not satisfactorily modelled.

A design formulation to determine pullout capacity of geosynthetics embedded in run-out, I-type and L-type anchors in sand is proposed. The accuracy of this method is tested by comparing it with the results of the present study and reported results in the literature.