ANALYSIS OF A LARGE DATABASE OF GCL INTERNAL SHEAR STRENGTH RESULTS

Jorge G. Zornberg, M.ASCE[1] ; John S. McCartney, S.M.ASCE[2] ; and Robert H. Swan Jr.[3]

Abstract: A database of 414 large-scale direct shear test results was assembled to evaluate variables governing geosynthetic clay liner (GCL) internal shear strength. The tests were conducted by a single independent laboratory over 12 years using procedures consistent with current testing standards. A wide range of GCL types, normal stresses, and shear displacement rates allowed investigation of the effect of reinforcement, pore water pressure generation, and sources of shear strength variability. Reinforced GCLs showed higher strength than unreinforced GCLs, with needle-punched GCLs performing better than stitch-bonded GCLs. Thermal locking of needle-punched GCLs was found to be effective at high normal stress, but hydration using low hydration normal stress was found to decrease the effectiveness of thermal locking. Shear-induced pore water pressures were indirectly evaluated using shear strength results from tests conducted using normal stresses above and below that corresponding to the GCL swell pressure. The peak shear strength was found to increase with decreasing shear displacement rates for high normal stresses, while the opposite trend was observed for low normal stresses. Shear strength envelopes showed a bilinear response, with a break at normal stresses consistent with the GCL swell pressure. Good repeatability of test results was obtained using the same-manufacturing-lot GCL specimens, while comparatively high variability was obtained using different-lot specimens. Peak shear strength variability was found to increase linearly with normal stress, but to be insensitive to specimen conditioning procedures. Evaluation of reinforced and unreinforced GCL test results indicates that, in addition to reinforcement variability, bentonite variability contributes to the shear strength variability of reinforced GCLs. Peel strength was found not to be a good indicator of the contribution of fibers to the GCL peak shear strength.

Full reference:

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