ABSTRACT

Duvvuru Mohan, Varenya Kumar. Master of Science in Civil Engineering, Purdue University, December 2011. Use of Tire Shred-Sand Mixtures as Backfill Material for Mechanically-Stabilized Earth-Retaining Walls.
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Enormous quantities of waste tires are generated annually in all countries around the world. Efforts have been made to find applications for scrap tires in various industries. As a result, over the last few years there has been increased use of scrap tires in a variety of applications. One of the applications of scrap tires in civil engineering is in their use as a lightweight backfill material for mechanically stabilized earth (MSE) walls, where the shredded tires are mixed with sand. This has been shown to have several advantages, including lower vertical stress on weak foundation soils, lower horizontal pressures on the wall and good drainage properties. For tire shred-sand mixtures to be used as backfill material for MSE walls, their geotechnical properties need to be estimated. The pullout resistance of reinforcements embedded in tire shred-sand mixtures and the shear strength characteristics of the mixtures need to be determined. Conventional testing equipment proved to be unsuitable due to their small sizes relative to the size of the tire shreds. In this study, large-scale laboratory pullout tests were performed on reinforcement ladders embedded in mixtures prepared with tire shreds (size: 50-100 mm in length) and Ottawa sand. The pullout tests were performed at various mixing ratios (0:100, 20:80, 25:75, 35:75 and 45:55 by weight of tire shreds to sand) and confining pressures (40, 65 and 90 kPa). Large-scale direct shear tests

were performed on tire shred-sand mixtures at mixing ratios of 20:80 and 35:65 by weight of tire shreds to sand. The results from the pullout tests showed that the pullout capacity of reinforcement ladders was higher in tire shred-sand mixtures than in pure sand. This can be attributed to the interlocking of tire shreds in the grids of the reinforcement ladder, thus providing higher passive resistance against pullout compared to that of pure sand. The pullout capacity increased with increases in the confining pressure at all mixing ratios. At a given confining pressure, increases in the tire shred content in the mixture typically resulted in higher pullout resistance. According to the results from the large-scale direct shear tests, critical-state friction angles of 30.1° and 32.0° and peak friction angles of 31.0° and 32° were obtained for tire shred-sand mixtures prepared at mixing ratios equal to 20:80 and 35:65 by weight of tire shreds to sand, respectively. When the results of the large-scale direct shear tests were plotted with a nonzero cohesive intercept, c-ϕ fitting parameters of 14.5 kPa and 27.1° and 10.3 kPa and 29.6° were obtained for tire shred-sand mixtures prepared at mixing ratios of 20:80 and 35:65 by weight of tire shreds to sand, respectively.