Levee Erosion by Overtopping in New Orleans during the Katrina Hurricane

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Abstract: Erodibility of a soil is defined here as the relationship between the erosion rate of a soil dz/dt and the velocity v of the water flowing over it, or the relationship between the erosion rate of a soil dz/dt and the shear stress developed by the water at the water-soil interface. This is called the erosion function. The test used to measure the erosion function of the levee soils is the erosion function apparatus test. The test consists of eroding a soil sample by pushing it out of a thin wall steel tube and recording the erosion rate for a given velocity of the water flowing over it. Several velocities are used and the erosion function is defined. A new erosion category chart is proposed to reduce the erodibility of a soil or rock to a single category number. Twenty three samples were retrieved from 11 locations at the surface of the levees around New Orleans. Thirteen were samples from Shelby tubes while ten were bag samples. The results obtained show a large variation of erosion resistance among the soils tested. Some of the levees associated with the location of the samples resisted the overtopping erosion very well; others eroded completely. On the basis of the erosion test results and of the observed behavior of the levees during the hurricane, a chart is presented which can be used to select soils for overtopping resistance. Numerical simulations were performed using the program CHEN 3D to obtain the distribution of velocity vectors in the overtopping flow and of shear stresses at the interface between the water and the levee surface. The comparison of the numerical simulation results and of the erosion function gives added credibility to the proposed levee overtopping erosion chart.