ANALYSIS OF BULKHEAD FAILURE, BAYTOWN, TEXAS

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A large slide occurred along the banks of Cedar Bayou in Baytown, Texas in January 1985. The slide was initially noted as a small scarp at the ground surface the day after pile driving started for a boat house at the lot next door. The magnitude of the slide progressed for 3 months until the failure scarp was about 10 feet high, and the original steel bulkhead along Cedar Bayou moved out about 15 feet.

The subsoils are stiff to very stiff Beaumont clay. Inverse slope stability analysis using the Bishop modified method indicated that the drained friction angle was about 22˚ when failure occurred (SF = 1.0).

A replacement bulkhead consisting of 40 foot long steel piling tied back to a deadman was initially designed. However, the section required to resist the shear and bending forces was so heavy that the sheets would have had to been imported from Europe. Also, the geotechnical and civil engineers advised that pile driving could trigger slope failures on the adjacent property. A replacement bulkhead consisting of 30 inch diameter by 31 feet long slurry drilled piers was designed and sent out for bids. The resulting cost was so high that the project was put on hold.

A civil engineer specializing in bulkheads designed a replacement bulkhead comprised of 20 foot long steel sheet piles with 40 foot long driven timber piles driven in front of each sheet pile. The bulkhead was tied back to a row of timber piles. The cost for this design was about 25 percent of the cost for the concrete pile bulkhead. The replacement bulkhead was completed in November 1985. However, the replacement bulkhead failed in December 1986 during drawdown after a large flood event.

Fill was frequently placed to level the surface after the failure, but continued movement occurred. In January 1993, a grouting contractor attempted to stabilize the slide by injecting a mixture of lime/fly ash to strengthen the clays along the failure surface. However, the repaired embankment failed in April 1993 when the water level in Cedar Bayou quickly dropped due to a dry northern. No major attempts have been made since this time period to correct the slope failure due to costs.

The timber piles penetrated thru the failure surface acting as shear keys, but they were sheared off during the slide. Finite element analysis has been preformed to analyze the complex soil/pile system to compute the shear strength of the clay subsoils along the failure plain. Inverse calculations indicate that the residual cohesion c' is about 150 psf, and that the residual angle of friction φ' is about 8˚.