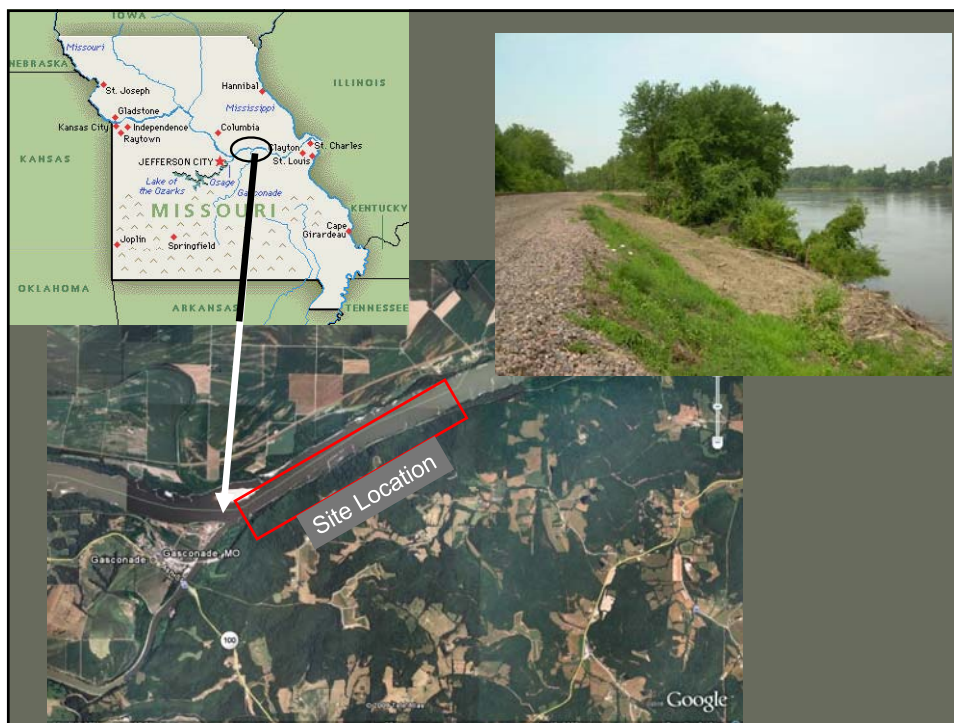
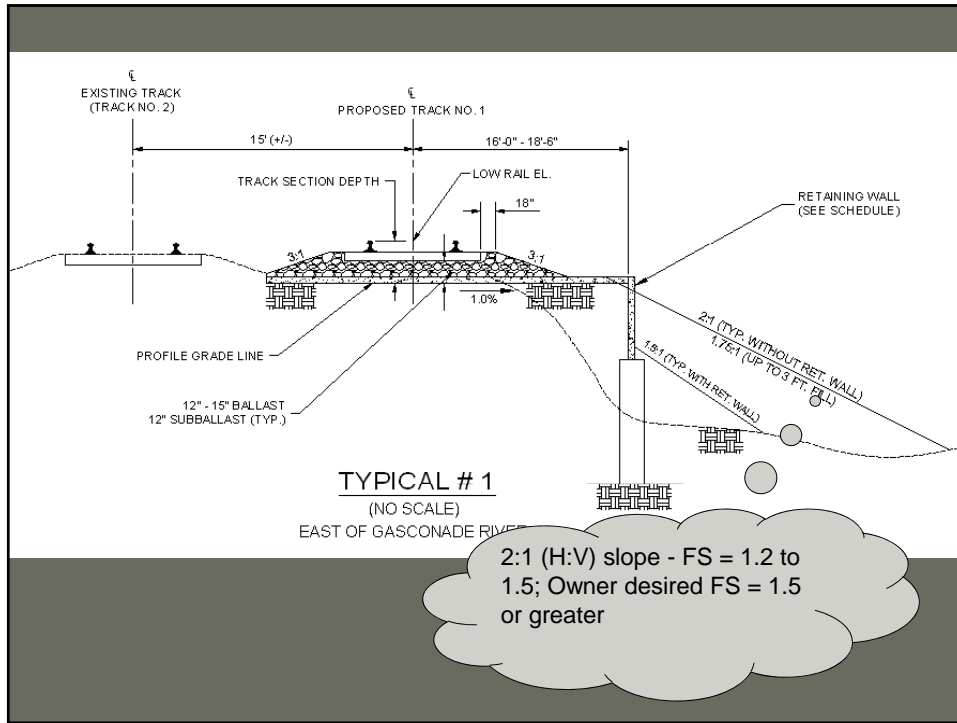


Case History: Value Engineering of Driven H-Piles for Slope Stability on the Missouri River

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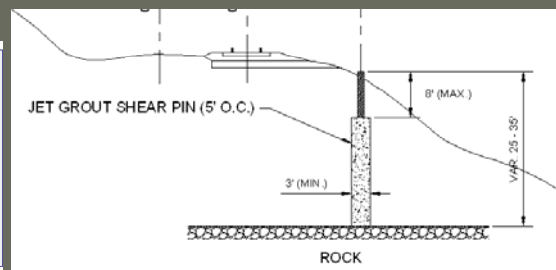
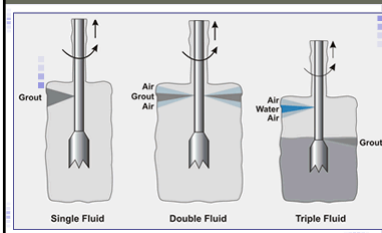
IFCEE 09, Orlando, Florida
March 16, 2009





As-Bid Jet-Grout Columns

- 0.9 m (3 ft) diameter jet-grout columns spaced 1.5 m (5 ft) c-c along crest of slope
- Eight sections from 15 to 305 m (50 to 1000 ft) in length.
- Slope heights from 7.6 to 11.3 m (25 to 37 ft).



Proposed H-Pile Alternative (Post-Bid)

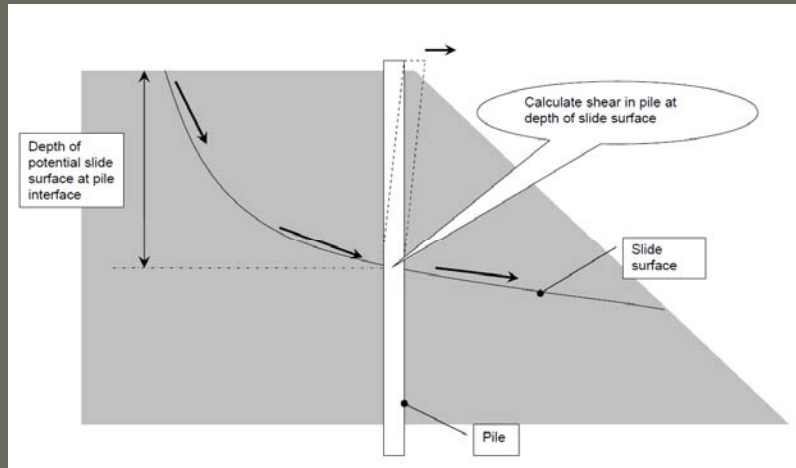
- Driven HP 310x79 (HP12x53) A572 Grade 50
- Spaced 0.9 m (3 ft) c-c along the crest of the slope
- Piles extending from the ground surface down to bedrock.

Analysis Steps

- Stability analyses of the existing and proposed no improvement conditions (2:1 slope) to replicate original design (drained analyses; $FS < 1.5$)
- Back analyses of existing embankment plus existing data to estimate minimum undrained shear strength for the embankment soils for pile-soil response analyses

Analysis Steps

- Lateral pile-soil response analyses to predict the shear resistance developed in the piles due to loading by soil movement.



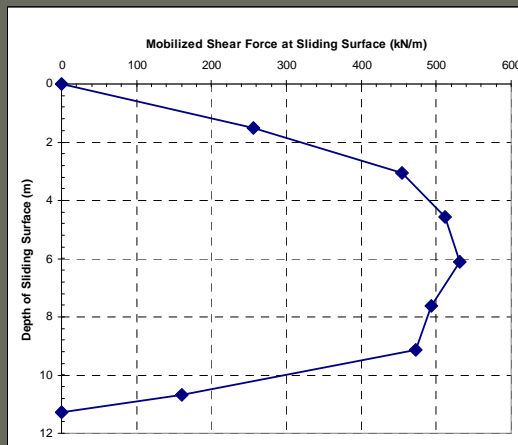
Analysis Steps

- Lateral pile-soil response: Calculate shear resistance mobilized in the pile at various depths due to soil movement loading the pile

Soil movement = 127 mm (5 in)

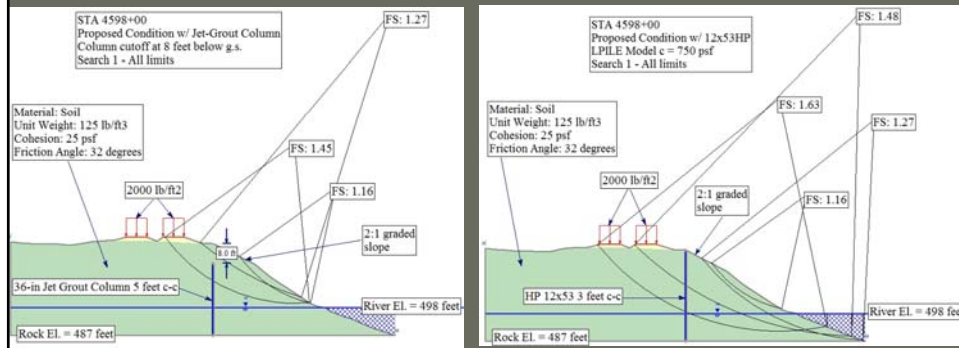
Depth increment = 1.5 m (5 ft)

Undrained Shear Strength = 36 kPa (750 psf) to 48 kPa (1000 psf)



Analysis Steps

- Embankment stability analyses with the effect of the piles included as a user-defined reinforcement element.
- Comparison of stability analyses using jet-grouted column shear pins to the H-piles.



Results

- H-piles would provide similar or superior stabilization.
- Approx. 10,400 m (34,000 ft) of pile was installed at a cost savings of over \$275,000.
- Piles installation time was about half the estimated time for installation of the jet grout shear pins.
- Additional cost and schedule savings were provided by eliminating temporary work areas required for staging jet grout equipment.



