Crookston Landslide Stabilization

CIVIL • ENVIRONMENTAL • MANUFACTURING • MINING • OIL & GAS • POWER GENERATION

PROJECT DESCRIPTION

Nicholson Construction Company

Crookston, Minnesota, USA

FLAC3D™

In 2003, a landslide developed along the Red Lake river bank inside the city of Crookston, Minnesota. Although several attempts were made to solve the problem, in 2008, a second event occurred, and extensive instrumentation was then put in place to monitor the slope and gain a better understanding of the situation. In 2013, the Minnesota Department of Transportation issued a design and build project to improve the stability of the river bank.

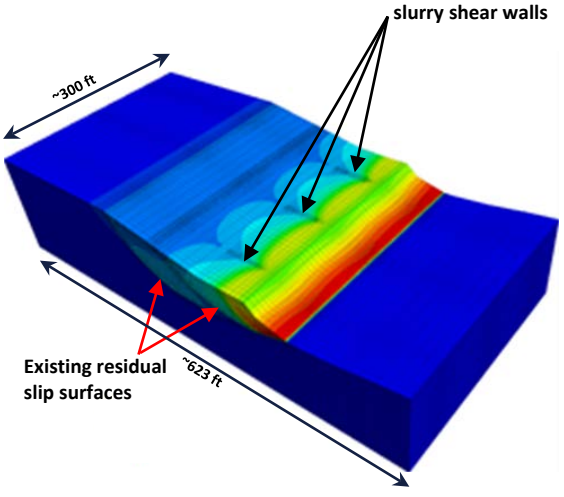
The remediation is a design and build to stabilize a relatively gentle slope in clay subject to erosion. Since drainage was not admitted, Nicholson (General Contractor) proposed a solution with long and deep slurry shear walls in order to increase the strength of the slowly sliding material (by causing arching of the soil between panels and the transfer of load through the walls to the glacial till). The spacing between the walls and execution technique are the peculiarities of the project.

ITASCA'S ROLE

Itasca carried out extensive three-dimensional numerical analyses to assess the proposed slurry shear wall design (approximately 30 m long with 24 m spacing). The Strength Reduction Method (SRM) was adopted to provide information regarding the displacements necessary to mobilize the strength of the wall, to analyze multiple potential mechanisms simultaneously, and to accommodate potential strain softening behavior of the shear walls. Numerical models evaluated the interaction of the slope and the shear walls (i) along existing residual slip surfaces, (ii) along possible new slip surfaces, of the shear walls, and (iii) of the cement bentonite trenches during construction. Due to the uncertainty of the location of the existing shear bands, two different shear band configurations were considered.

PROJECT RESULTS

Based on the amount of displacement and velocity, the slope and the walls are predicted to be stable for both possible shear band configurations in excess of the required 1.5 factor of safety. The numerical analyses have allowed significant optimization, showing the efficiency of the proposed solution. The project was awarded in 2013.



FLAC3D model showing ground displacement contours for one case includes three slurry shear walls and two slip surfaces.

Satellite view of the site undergoing remediation using slurry shear walls (Google, 2017).

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