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Publisher's version / Version de l'éditeur:

Geological Society of America Bulletin, 78, 9, pp. 1183-1184, 1967-11-01

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W. J. EDEN

BURIED SOIL PROFILE UNDER APRON
OF AN EARTH FLOW

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Publications Copy

Geological Society of America Bulletin, v. 78, p. 1183-1184, 2 pls., September 1967
Research Paper no. 335

NRC 9866

W. J. EDEN

BURIED SOIL PROFILE UNDER APRON OF AN EARTH FLOW

Abstract: Observations made in a sewer trench excavation through the apron of an old earth flow in sensitive clay are briefly described. The original soil profile found under the earth flow debris indicated

very wet conditions at the time of the landslide, a necessary requirement to explain the slope failure in the light of current slope stability theories.

One of the best examples of a classic earth flow in the sensitive postglacial clays of the St. Lawrence Valley is located at the eastern outskirts of the city of Ottawa. Approximately 35 acres of the upper clay terrace were removed through a series of retrogressive slips to form the crater of the landslide. As the successive slips occurred, the clay liquefied and flowed out over the level plain, forming the lower terrace and burying the existing surface vegetation. In Plate 1 an aerial view of the landslide shows the lower terrace, the apron of flowed material, the crater at a slightly higher elevation, and the upper terrace, which is approximately 100 feet higher than the lower terrace. The soil conditions consist entirely of highly sensitive postglacial clay. Recent stability studies (Crawford and Eden, 1967) indicate that the slope adjoining the crater of the landslide is stable under the present ground-water conditions. To explain failure of the clay slope in terms of current theories of soil mechanics, it is necessary to postulate fully saturated conditions of the clay slope.

In the summer of 1966, a deep sewer trench was excavated through part of the apron of the landslide, providing the opportunity to examine the former soil profile uncovered by excavation. This trench, about 25 feet deep, extended from the north, or outside, edge of the apron southward about 350 feet toward the crater. The trench revealed the entire thickness of the landslide debris, the former ground surface, and about 5 feet of the original soil profile.

The existence of the buried soil profile had been previously encountered in borings taken through the landslide apron. A fragment of a tree branch had been recovered and sent to the Radiocarbon Laboratory, Geological Survey of Canada. The piece of wood was dated 1140 BP $\pm$ 150 years (G.S.C. 550).

The trench extended towards the crater from the outer perimeter of the material that had flowed. The 20-foot depth of reconstituted clay appeared relatively uniform; lumps of the former dry surface crust and odd pieces of wood were scattered throughout the clay in an erratic manner, but formed only a minor part of the total mass. From its appearance, it was evident that the clay had been almost entirely liquefied during the landslide. No voids, such as one would expect if the clay had been only partially remoulded, were observed. Figure 1 of Plate 2 shows the texture of the clay as revealed by the excavation.

Along a 200-foot length of the trench, sampling and "inspection vane" testing (Andresen and Sollie, 1965) were carried out at 20-foot intervals about 3 feet above the buried peat layer. The average water content of the reconstituted clay was about 65 per cent, and its undrained shear strength ranged from one half to three quarters of the strength of the clay from the upper terrace. This may be compared to an average water content of 74 per cent and shear strength of 1600 psf measured in a boring taken on the upper terrace of the clay.

The original soil profile consisted of a layer of peaty material, varying in thickness from 2 inches to more than a foot, lying over natural clay. This natural clay showed no evidence of leaching or oxidation. The profile could be described as a peat phase of a gley soil. The peat itself was composed of woody fragments and debris typically found on a forest floor. On top of the peat layer was the debris of the forest standing at the time of the earth flow. The general orientation of the debris was northern, indicating that the trees had been struck by an onrushing wave of liquid clay from the landslide. Figure 2 of Plate 2 shows the position of such a fallen tree. This previous forest had very

shallow root development confined largely to the peat layer, again indicating very wet surface conditions. The peat layer and forest debris are being studied in detail by the Palynology Laboratory of the Geological Survey of Canada.

The observations described in this paper indicate that very wet conditions existed at the time of the landslide, which is in accordance with the requirements for a slope stability analysis.

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SOIL MECHANICS SECTION, DIVISION OF BUILDING RESEARCH, NATIONAL RESEARCH COUNCIL OF CANADA, OTTAWA, CANADA

MANUSCRIPT RECEIVED BY THE SOCIETY APRIL 28, 1967

PUBLICATION AUTHORIZED BY THE DIRECTOR, DIVISION OF BUILDING RESEARCH, NATIONAL RESEARCH COUNCIL OF CANADA

AERIAL VIEW OF GREEN CREEK SLIDE
Location of trench shown by heavy line (City of Ottawa);
photo by A. E. Simpson Ltd., Montreal

Figure 1. Reconstituted clay in side of trench

Figure 2. Fallen tree found in peat layer

BURIED SOIL PROFILE, ST. LAWRENCE VALLEY, OTTAWA, CANADA