U.S. Geological Survey.

[Reports. Open file] no.709.

Preliminary Report on the Geologic and Geophysical Investigations of the Loveland Basin Landslide, Clear Creek County, Colorado

by

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UNITED STATES DEPARTMENT OF THE INTERIOR

Geological Survey

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This report is preliminary and has not been edited or reviewed for conformity with Geological Survey standards or nomenclature.

September 1963

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Abstract

Geologic and geophysical investigations of the Loveland Basin landslide, which formed at the cut for the east portal of the Straight Creek tunnel, were made by the U.S. Geological Survey in cooperation with the U.S. Bureau of Public Roads and the Colorado Department of Highways. The investigations indicate that the slide has a probable minimum volume of 500,000 cubic yards weighing 1,000,000 tons and probable maximum volume of 770,000 cubic yards weighing 1,600,000 tons.

Introduction

The Loveland Basin landslide lies in and above a cut made for the approach road and portal of the proposed Straight Creek tunnel. The proposed tunnel is to pass under the Continental Divide about 55 miles west of Denver. The geology of the tunnel area, including the area of the landslide, has previously been described by Robinson and Lee (1962).

The investigation of the landslide was conducted by the Geological Survey as a research project to determine the application of modern geologic and geophysical techniques to the problems of delineating landslides, and to determine, if possible, by these techniques a three-dimensional definition of the slide for the

U.S. Bureau of Public Roads and the Colorado Department of Highways for the purpose of designing methods of stabilizing the slide. This report presents the preliminary results of Geological Survey's investigations.

The geologic investigations were made by C. S. Robinson and F. T. Lee of the Geological Survey. A. Woodward Moore, W. L. Eager, and R. A. Behman, assisted by other members of U.S. Bureau of Public Roads and members of the Colorado Department of Highways, made the electrical resistivity measurements. R. D. Carroll and J. H. Scott, assisted by other members of the Geological Survey, made the seismic surveys. The base map, specially prepared by Continental Engineers Inc., and other control data were furnished by the Colorado Department of Highways. The interpretations of the geologic and geophysical results were made by C. S. Robinson, R. D. Carroll, and F. T. Lee.

Results of investigations

The preliminary results of the geologic and geophysical investigations are presented in the form of five maps and two cross sections:

Figure 1 is a geologic map of the landslide showing the location of the geophysical measurements. The bedrock of the area consists of Precambrian granite with inclusions of metamorphic rock--primarily fine-grained gneiss. The bedrock is overlain by unconsolidated material, 0.5 to about 25 feet in thickness, consisting of morainal material and colluvial deposits of soil and talus.

The bedrock of the landslide area has been intensively sheared and broken. Previous work (Robinson and Lee, 1962) determined that the average distance between fractures in this area ranged from less than 0.1 to 0.5 feet. In addition, the metamorphic inclusions in this area, for example in the west face of the cut, have been extensively altered to clay. The landslide consists mostly of the sheared and altered bedrock.

Geophysical and geologic data indicate that the movement of the landslide is probably taking place along a zone, from a few inches to possibly as much as 40 feet thick, at the base of the landslide. For this reason, 2 isopach and 2 structure contour maps of the landslide were prepared from the geophysical and geologic data; one assuming the base of the landslide to be at the top of the slip zone, and the other assuming the base of the landslide to be at the base of the slip zone.

Figure 2 is an isopach map showing the thickness of the landslide to the top of the slip zone. From this map it was calculated that the portion of the landslide above the slip zone consisted of about 500,000 cubic yards of material weighing about 1,000,000 tons. The weight was calculated using a value of 2.1 tons per cubic yard, which was determined from density and porosity measurements and from density of fracture calculation (Robinson and Lee, 1962) assuming complete water saturation. This mass of rock is believed to be that portion of the landslide that would be involved in any sudden failure of the landslide.

Figure 3 is a structure contour map of the top of the slip zone, showing the topography of the upper surface of the slip zone. From this map the dip of the top of the slip zone may be calculated for any area of the slide. Also, from this map it is possible to calculate for any position on the ground the angle and length of any drill hole that might be drilled to intercept the top of the slip zone.

Figure 4 is an isopach map of the probable maximum thickness of the landslide to the base of the slip zone. From this map it was calculated that about 770,000 cubic yards, weighing about 1,600,000 tons, of material are involved in the landslide. These maximum figures should be used in calculating the load required at the toe to stabilize this slide.

Figure 5 is a structure contour map at the probable maximum depth of the landslide, i.e., to the base of the slip zone. The purpose of this map is to allow the calculation of the angle and length of any drill hole or trench, as one for drainage purposes, that may be designed to penetrate to the base of the landslide and the entire slip zone.

Figure 6 shows a longitudinal and transverse section through the landslide. The purpose of this figure is merely to illustrate in section the topography of the slip zone, and the relation of the slip zone to the entire slide.

Reference cited

Robinson, C. S., and Lee, F. T., 1962, Geology of the Straight Creek tunnel site, Clear Creek and Summit Counties, Colorado, and its predicted effect on tunnel construction: U.S. Geol. Survey open-file report, Dec. 21, 1962.

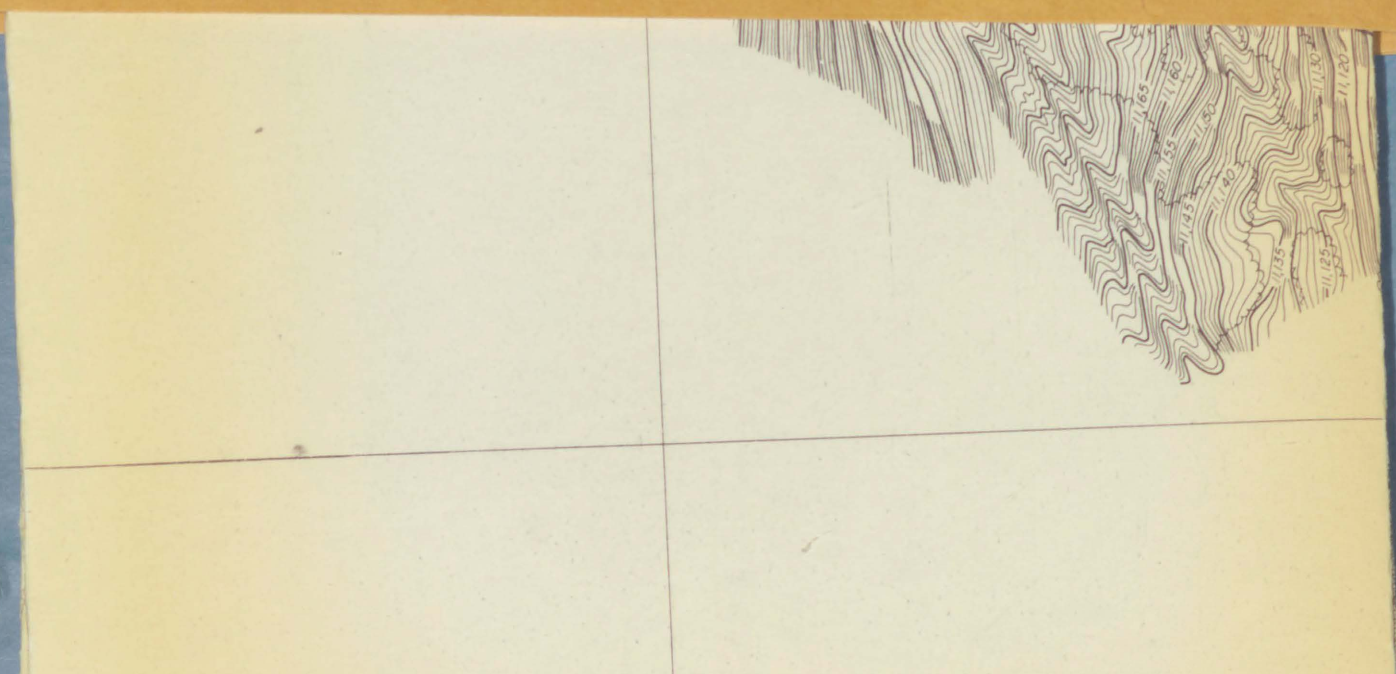

FIGURE 3: STRUCTURE CONTOUR MAP OF THE TOP OF TH

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