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GEOLOGIC MAP OF THE RAPID CITY EAST QUADRANGLE, PENNINGTON COUNTY, SOUTH DAKOTA

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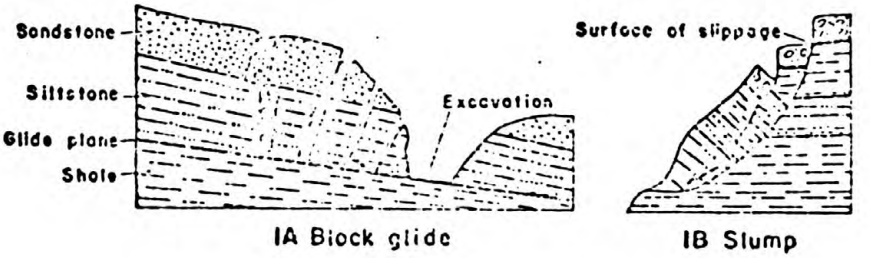
ENGINEERING GEOLOGY

Landslides and expansive soils are the principal engineering geologic problems in the Rapid City East quadrangle. Geologic resources economically feasible at the present time are deposits of gravel.

Landslides of the area consist of block glides and slumps. Block-glide landslides are formed when a coherent mass slides downward on an inclined planar surface. In this type of landslide the glide plane is generally along a bed with low shear strength, such as a shale or mudstone. Geologic conditions favorable for block-glide landslides are found along the hogback on the western side of the quadrangle. The resistant sandstones and siltstones of the Lakota and Fall River Formations that underlie the crest and east slope of the hogback are inclined (dip) 7°-20° eastward. Excavations in these strata may cause landslides by removing downslope support of a mass (fig. 1A). Slumps differ from block glides in that their surface of slippage is generally curved and greater disruption and differential movement of material occurs within the mass. Slumps are most prevalent on oversteepened slopes in fairly incompetent material (fig. 1B). Slumps that have formed on natural slopes are east of the city in secs. 33, 34, and 35, T. 2 N., R. 7 E.; some that have been caused by manmade excavations within Rapid City are in sec. 1, T. 1 N., R. 7 E. These slumps are all on the north side of ridgecrests.

The landslides east of the city in the Pierre Shale are part of the continuing process of mass wasting of the land surface. This



1A Block glide 1B Slump

sliding undoubtedly started thousands of years ago in Pleistocene time and has continued intermittently. After the original movement of a landslide, the landslide mass may become moderately stable. However, movement of the slide may begin again if natural or artificial excavations remove support from the lower part of the landslide or if they oversteepen the upper slopes. Slides are generally initiated during periods of high moisture content of the soil and rock. The water increases weight of the mass and causes high pore pressure to develop, which reduces the shear strength of the material. Factors that may have contributed to the landslides within Rapid City are grading and excavating for houses and roads, stripping of the protective cover of gravel deposits from hilltops, and changing of subsurface water conditions brought about by septic tanks and lawn irrigation.

Expansive soil is a geologic factor that should receive consideration and investigation for construction projects in the Rapid City East quadrangle. The clay mineral montmorillonite, known commercially as bentonite, increases greatly in volume when water is absorbed and this expansion generates forces that commonly are capable of disrupting roads or foundations. The Cretaceous shales of this area contain montmorillonite as discrete beds from a few inches to 3 feet thick and also as intermixtures with other clay minerals in the beds of shale. The discrete beds of montmorillonite are invariably an expansive hazard but the behavior of mixtures of clay minerals is difficult to predict. A test known as Potential Volume Change (PVC) has been developed (Lambe, 1960) that indicates the disruptive effect of expansive soil. This effect is rated as follows: noncritical, 0-1,700 psf. (pounds per square foot); marginal, 1,700-3,200 psf.; critical, 3,200-4,700 psf.; very critical, in excess of 4,700 psf. E. E. McGregor of the U.S. Geological Survey made a limited number of tests on representative samples of shaly rocks from the Cretaceous formations of the area and reported the following results:

Pierre Shale----------	critical to very critical
Niobrara Formation---------	marginal to critical
Carlile Shale----------	noncritical to marginal
Greenhorn Formation	
upper limestone unit-----	noncritical
lower shale unit---------	noncritical to marginal
Mowry Shale----------	critical to very critical
Newcastle Sandstone--------	noncritical
Skull Creek Shale----------	marginal to critical
Fall River Formation-------	noncritical
Lakota Formation----------	noncritical

All discrete beds of montmorillonite must be considered critical to very critical.

The gravel deposits of the quadrangle have been used as fill material, road aggregate, and crushed rock. The material of these

deposits runs about 90 percent hard resistant Precambrian quartz, quartzite, and siliceous schist, and 2-5 percent Paleozoic chert; pit-run grading is coarse and the sand content is low. The resistant nature of these gravels causes considerable wear of crushing equipment, but the crushed rock product is of excellent quality.

REFERENCES

Darton, N. H., and Paige, Sidney, 1925, Description of Central Black Hills, South Dakota: U.S. Geol. Survey Geol. Atlas, Folio 219.

Lambe, T. W., 1960, The character and identification of expansive soils: Federal Housing Adm. Tech. Studies Rept., 46 p.