Legal Minute

A Dirty Secret*

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When it comes to construction litigation in the Black Hills, I have seen one issue come up more than any other over the years: foundation movement as a result of expansive soils. The fact that Western South Dakota is known for expansive soils will come as no surprise to many of you, but if you are new to the area or are not involved in site work on a regular basis, you may not be familiar with the issue.

The Web site www.Geology.com provides some useful information on this topic. One article defines the issue this way: "Expansive soils contain minerals such as smectite clays that are capable of absorbing water. When they absorb water they increase in volume. The more water they absorb the more their volume increases. Expansions of ten percent or more are not uncommon. This change in volume can exert enough force on a building or other structure to cause damage."

The Web site has a map with the location of known expansive soils in the United States. That portion of the map for Western South Dakota indicates, "Over 50 percent of these areas are underlain by soils with abundant clays of high swelling potential."

Most of the lawsuits that I am aware of related to expansive soils fall into a typical pattern. The foundation is placed on native soils. Structural movement is noticed after some time has gone by. Sometimes this can take a number of years, and sometimes it will happen in a relatively short time. The timing depends upon how long it takes for moisture to get below the foundation. Poor drainage and wet years will result in the structure moving sooner.

Typically a geological engineer is consulted. Bore hole samples are taken to confirm the presence of expansive soils. The recommended repairs often include removal of the slab, excavation of the soils, and placement of engineered fill below a new slab. If the footing is moving as well, piers or other techniques designed to shore up the footings are used.

As you can imagine, this process is very expensive. Depending upon the severity of the problem, I have seen repair estimates at more than 50 percent of the value of the home. This creates a very difficult situation for all parties involved.

The good news is that this issue is almost always preventable. I am not aware of any lawsuits in the Black Hills where the soil was tested and engineered fill was used where appropriate. It may cost a little more to test the soil and use engineered fill, but the increased cost is far preferable to the consequences associated with structural movement as a result of expansive soil.

For more information about this article, send me an email at jsmiley@gpnalaw.com.

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*This article presents general information for informational purposes only and does not constitute specific legal advice. Jason M. Smiley was born and raised in Rapid City, where he lives with his wife Darby and their two children. He is a partner at the law firm of Gunderson, Palmer, Nelson & Ashmore, LLP, and is admitted to practice in South Dakota and Wyoming.

GEOLOGIC QUADRANGLE MAP
RAPID CITY EAST QUADRANGLE, SOUTH DAKOTA
GQ-986

EXPLANATION

QUATERNARY

Qal — Alluvium

Qag — Alluvium and gravel

Ql — Landslide deposits
Queried where doubtful

Qts — Sturgis terrace deposit

Qbg, Qrg, Qdg — Gravel deposits
Qbg, *gravel deposits of Boxelder Creek*
Qrg, *gravel deposits of Rapid City*
Qdg, *gravel deposits of Dry Creek*

TERTIARY(?) AND QUATERNARY — *Pliocene(?) and Pleistocene*

QTg — Gravel deposits

TERTIARY — *Oligocene to Pliocene(?)*

Tg — Gravel deposits

CRETACEOUS

Upper Cretaceous

Pierre Shale

Kn — Niobrara Formation

Kc — Carlile Shale

Kgu, Kgl — Greenhorn Formation
Kgu, *upper limestone unit*
Kgl, *lower shale unit*

Kbf — Belle Fourche Shale

Mowry Shale

Lower Cretaceous

Newcastle Sandstone

Ks — Skull Creek Shale

Inyan Kara Group

Fall River Formation

Kl — Lakota Formation

JURASSIC — *Upper Jurassic*

Morrison Formation

Unkpapa Sandstone

Sundance Formation

Contact
Dashed where approximately located, short dashed where indefinite or inferred

Fault
Showing direction of dip
Dashed where approximately located

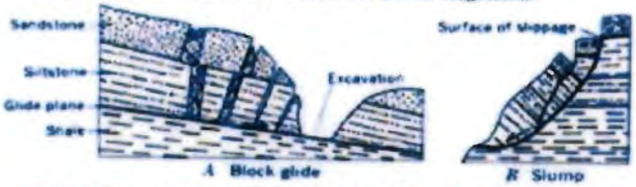
Strike and dip of beds

Water well
From which lithologic information was obtained (J. P. Gries, South Dakota School of Mines and Technology, unpub. data, 19[illegible])

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. 1*A*). 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. 1*B*). 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.



A Block glide *B* Slump

FIGURE 1—LANDSLIDE TYPES OF THE RAPID CITY AREA

The landslides east of the city in the Pierre Shale are part of the continuing process of mass wasting of the land surface. This 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 development of high pore pressure, 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.

For sale by U.S. Geological Survey, price $1.00