Geotechnical investigations and data sources in New Mexico

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Geotechnical investigations and data sources in New Mexico

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Introduction

Development in New Mexico has generally taken place on building sites with stable soil conditions. However, as the population has grown, more and more structures are being constructed in areas characterized by unstable soil conditions. Problems with unstable areas can often be anticipated by reviewing readily available maps and reports. With the aid of engineering geologists and civil engineers, marginally unstable conditions can often be rendered stable and safe. This article provides information about common techniques and tests that may be used to identify potential problems with building sites. It also identifies sources where additional geotechnical information can be obtained. The objective of this report is to provide general technical guidance that can be used during the preliminary or feasibility stage of a project. Description of site-specific tests and studies that are recommended before or during construction are beyond the scope of this report.

New Mexico building codes do not require rigorous geotechnical investigations for all building sites. Fortunately, however, many lending agencies require at least minimal testing of foundation materials. Also, many homeowners and developers independently seek geotechnical data before beginning construction. The major causes of structural failure described below can be identified from relatively simple field and laboratory tests or observations. The extent of a testing program for a particular project depends on both the available funding and the geologic setting. Most of the physical tests described herein apply to relatively small, low-cost construction projects such as a single family dwelling in a relatively simple geologic setting. The tests are most effective when considered before contruction has been started.

The physical properties of the geologic materials (soil or rock) determine whether or not structures will perform as they were designed. Such properties can vary depending on the geologic setting and the degree of human modification. Among the causes for foundation failure are collapsible soils, excessive ground-water withdrawal, debris flows, rock dissolution, soil liquefaction, expansive soils and compressible soils. Other less common causes such as rockfalls and landslides also occur periodically.

As used in this report, *soil* is defined as the naturally occurring superficial deposits overlying bedrock (International Conference of Building Officials, 1982), and *rock* is defined as material that cannot be drilled with an earth auger and requires special techniques or equipment (such as blasting or rock-core barrels) to excavate.

Typical foundation problems in New Mexico

Structures built on geologically young mudflow deposits may become damaged if the soils beneath consolidate and settle (because of lawn watering, poorly maintained and leaky utilities, or other causes). These soils are referred to as collapsible. Alternatively, structures built on soils containing certain clays may become damaged due to wetting and the subsequent expansion of the clay minerals. Structures can also be damaged if they are built on weathered rock. Commonly, this latter type of damage results from differential soil settlement, due in part to the weight of the structure. Excessively wetted soils beneath a structure can be substantially weakened, which may result in loss of their bearing capacity. A number of geologic or man-induced processes can cause differential soil settlement. Another major cause is withdrawal of ground water and subsequent lowering of the water table.

Rock falls, rock topples, and rock slides are of concern in areas where structures are built along mountain flanks. Earth movement of this type can occur in response to intense rainfall, ground shaking from earthquakes, or even sonic booms. Of even greater concern, in areas that flank mountain fronts, is potential damage from debris flows. The most common cause of the flows is intense, short-duration rainfall, but they have also been caused by failure of manmade embankments designed to retard or stop runoff.

There are several other potential problems with building sites. Areas underlain by soluble rock such as limestone are likely to contain cavernous voids at shallow depths (karst topography). Houses and roads have been damaged by the sudden collapse of overburden into such features. Damage can also arise from the use of concrete aggregate containing certain deleterious materials; chert and obsidian are known to slowly but adversely react with concrete, which leads to cracking and weakening of the concrete. This phenomenon is known as alkali reactivity. Another notable problem is related to carbonate cementation of soil. Near-surface carbonate (caliche) may cause excavation difficulties. This problem is especially costly when a contractor's charges increase greatly because of "changed conditions." Finally, structures may be damaged by liquefaction of the underlying soils. Liquefaction is the transformation of a granular material, such as sandy soil, into a liquid state because of sudden increase in pore pressure; liquefied soil loses all its strength and can no longer support the load of a building. It occurs most commonly in saturated sandy soils that become subjected to ground shaking from earthquakes. In New Mexico, such soils are known to flank sections of the Rio Grande, but they may also exist in places where ground water is very shallow.

Rock and soil classification systems

A simple, yet very useful, rock classification system and two common soil classification systems are discussed because these systems enable geotechnicians to transmit meaningful technical data about a potential building site to builders, homeowners, or engineers.

Unified Rock Classification System

Although most urban development in New Mexico is on soil, situations arise periodically where one wishes to build a structure partially or wholly on rock. One problem is that design engineers may become confused by technical data collected by nonengineers (e.g., geologists). To circumvent this problem, the Unified Rock Classification System (URCS) was developed in 1959 to bridge the gap between the traditional geologic and engineering descriptions of the same material. It was first used during the construction of major flood control dams built by the U.S. Army Corps of Engineers. Because the URCS is so applicable to construction projects, it is summarized in Table 1.

The URCS provides a way to clarify terminology when classifying rock for civil engineering purposes: slight emphasis is placed on naming a rock and great emphasis is placed on describing important physical properties of rock material. The physical rock properties described are: 1) degree of weathering, 2) estimated strength, 3) discontinuities, and 4) unit weight or density (Table 1). By establishing limiting values for these physical properties, the URCS provides a means of transmitting reliable, meaningful data. In addition, it gives useful estimates of compressive strength, permeability, and shear strength—three important properties of rock masses.

To estimate the degree of weathering, one simply uses a hand lens and finger pressure to observe rock color and resistance to fracture. Strength is estimated by striking a sample with a hammer. The character of the impact mark gives an indication of unconfined compressive strength. The development of discontinuities (directional weaknesses), which affect the excavatability of a rock mass, are determined by observing the visible rock features, obvious fractures, alignment of mineral grains, and by striking the rock with a hammer and observing the nature of the fractures.

Unit weight or density, one of the more useful geotechnical properties, can be estimated in the field by weighing a sample of rock in air and then reweighing it while it is submerged in water. The unit weight is the weight in air divided by the weight loss when submerged. In general, the higher the unit weight of a rock the more suitable it is for construction purposes (Table 1).

TABLE 1—Generalized Unified Rock Classification System (URCS; after Williamson, 1984).

URCS symbol A	URCS symbol B	URCS symbol C	URCS symbol D	URCS symbol E
Degree of weathering				
Microfresh	Visually fresh	Stained and oxidized	Partly decomposed	Completely decomposed
Estimated strength				
Reaction to impact of 1-lb hammer				**Lab remolding potential**
Rebounds >15,000 psi	Pits 15,000–8,000 psi	Dents 8,000–3,000 psi	Craters 3,000–1,000 psi	Moldable <1,000 psi
Discontinuities				
Solid rock with very low permeability			**Open planes; may transmit water**	
Random	Preferred orientation	Latent planes of separation	Non-intersecting	Intersecting
Unit weight or density				
Very dense	**Dense**	**Medium dense**	**Light**	**Very light**
>2.44g/cm³ >160 pcf	2.55–2.40 g/cm³ 160–150 pcf	2.40–2.25 g/cm³ 150–140 pcf	2.25–2.10 g/cm³ 140–130 pcf	<2.10 g/cm³ <130 pcf

General engineering characteristics

URCS symbol	Typical material	Suitability for foundations	Excavatability	Suitability for fill	Suitability for concrete aggregate
A	Fresh crystalline rock	suitable	Requires blasting	Low	Good–excellent
B	Most rocks	suitable	Requires blasting	Low–good	Low–good
C	Sandstone	suitable	May require blasting	Low–good	Marginal
D	Shale	May not be suitable	Rippable	Low–good	Low–good
E	Adobe "grus"	Probably suitable	Easy	Low	Low

A system of letters is used in the URCS to identify the four fundamental physical properties described in Table 1. In general, rock material designated "AAAA" will require the least design evaluation while material designated "EEEE" will require the most and may, in fact, be totally unsuitable for the intended purpose.

U.S. Department of Agriculture soil classification system

The U.S. Department of Agriculture (USDA) soil classification system, used in county soil survey reports in the U.S., is based on the particle-size distribution of a soil. The older soil surveys emphasized the agricultural potential of soils, but recent reports also emphasize the suitability of soils for urban uses. Examination of the USDA textural classification chart (Fig. 1) reveals information about the suitability of the various classes of soils for building sites.

Sandy soils, in the lower left corner of the USDA chart, typically occur on gentle slopes and represent excellent building sites. With the exception of certain sands that may liquefy or collapse when wetted, localities containing sand and admixtures of sand, silt, and clay generally characterize high quality building sites.

Silty soils, in the lower right corner of the USDA chart, may represent suitable building sites, but it is prudent to consult with experts (Table 2) when considering development. Silty soils are prone to collapse when wet and commonly occur on flatter slopes, which are more susceptible to sheetwash flooding. Favorable attributes of silty soils are that they drain well yet retain enough water and fertilizer for crops to flourish, and they are relatively easy to excavate.

Clayey soils, in the top portion of the USDA chart, are soft, sticky, and weak when wet and very hard and strong when dry. These characteristics make their identification relatively easy; however, because clayey soils are nearly impermeable, drainage is poor and septic tanks do not function well. On steep slopes these soils are prone to soil creep and landslides.

Unified Soil Classification System

The Unified Soil Classification System (USCS) is utilized extensively by engineering geologists when classifying soil for use at building sites. The system is based on Atterberg limits and particle-size analyses (Fig. 2). Atterberg limits define the water-content boundaries between the liquid and plastic states (liquid limit) and between the plastic and semisolid states (plastic limit) of soil (explained below). In this system, soils are either coarse grained or fine grained. Coarse-grained material is divisible into gravel and sand and further divisible into eight groups based on grading, plasticity index, or Atterberg limits. Fine-grained material is divisible into silts and clays, which are further divisible into six groups based on plasticity index and liquid limit. A final division is made for highly organic soils such as peat and muck (Fig. 2). With few exceptions, any soil can be identified tentatively in the field and later identified more precisely in the laboratory using simple equipment. In this manner, one can rapidly classify a soil and generally assess its foundation suitability.

Clayey soils with high plasticity (Fig. 2, CH) may be susceptible to expansion because of high clay content. These soils are commonly associated with areas of soil creep or landslides. They are not suitable for septic tanks because they drain very slowly. Clayey soils with lower plasticity indices (Fig. 2, CL) are slightly more suitable for foundations, but they should be avoided if possible because they are likely to contain expansive clays and are also considered unsuitable for septic tanks. Special attention should be given to expected engineering performance of this class of soils before construction.

Organic soils (Fig. 2, OL and OH) commonly occur in marshy areas. Because of their high organic content they can be expected to

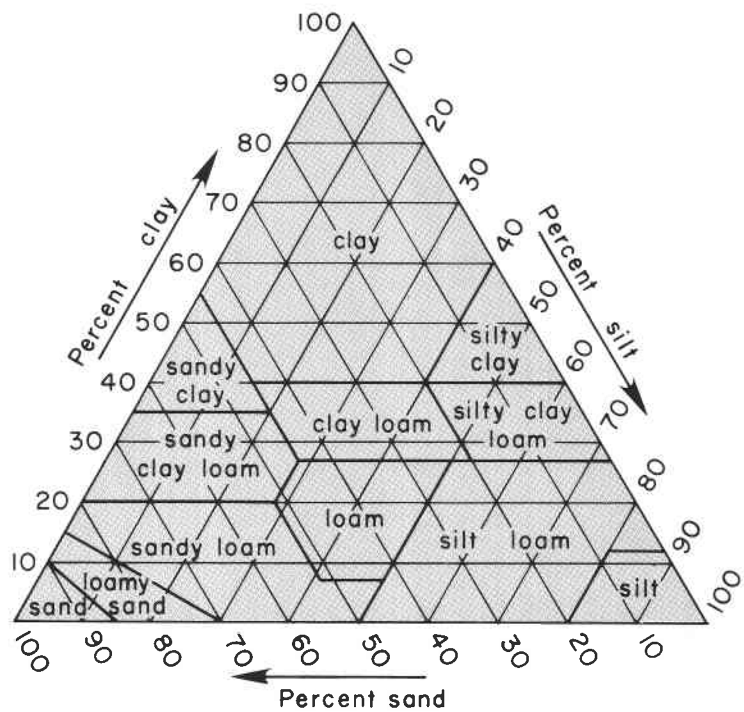

FIGURE 1—U.S. Department of Agriculture (USDA) textural classification chart (from Soil Conservation Service, 1975, 1981).

Major divisions			Group symbols	Typical names
Coarse-grained soils (More than 50% of the material is *larger than* No. 200 sieve size)	Gravels (More than 50% of coarse fraction is *larger than* No. 4 sieve size)	Clean gravels (Little or no fines)	GW	Well-graded gravels, gravel–sand mixtures, little or no fines
			GP	Poorly graded gravels or gravel–sand mixtures, little or no fines
		Gravels with fines (Appreciable amount of fines)	GM	Silty gravels, gravel–sand–silt mixtures
			GC	Clayey gravels, gravel–sand–clay mixtures
	Sands (More than 50% of coarse fraction is *smaller than* No. 4 sieve size)	Clean sands (Little or no fines)	SW	Well-graded sands, gravelly sands, little or no fines
			SP	Poorly graded or gravelly sands, little or no fines
		Sands with fines (Appreciable amount of fines)	SM	Silty sands, sand–silt mixtures
			SC	Clayey sands, sand–clay mixtures
Fine-grained soils (More than 50% of material is *smaller than* No. 200 sieve size)	Silts and clays (Liquid limit is *less than* 50)		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
			OL	Organic silts and organic silty clays of low plasticity
	Silts and clays (Liquid limit is *greater than* 50)		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
			CH	Inorganic clays of high plasticity, fat clays
			OH	Organic clays of medium to high plasticity, organic silts
Highly organic soils			Pt	Peat and other highly organic soils

Particle-size limits

Silt or clay	Sand			Gravel		Cobbles	Boulders
	Fine	Medium	Coarse	Fine	Coarse		

No. 200 No. 40 No. 10 No. 4 3/4 inches 3 inches 12 inches

U.S. standard sieve size

FIGURE 2—Modified Unified Soil Classification System (USCS). Soils that have characteristics of two groups are designated by combinations of group symbols.

compress considerably. Usually, costly measures must be employed to render these soils suitable for construction.

Silty soils of high plasticity (Fig. 2, MH) must be examined on a case-by-case basis because there may be problems similar to the finer grained soils described above. However, in places where they have been built upon, they seem generally suitable for smaller structures such as single family dwellings.

Silty soils with low plasticity (Fig. 2, ML) are more suitable for foundations than any of the soils discussed so far in this section because they drain better and are easier to excavate. However, these soils are susceptible to liquefaction when saturated. In the arid and semi-arid environments of much of New Mexico this problem is not great, except perhaps along the floodplains of perennial rivers and around the edges of reservoirs and lakes. Also, these soils are related to a family of soils in New Mexico that could be collapsible. Soils that are potentially collapsible require additional field and laboratory testing to confirm how they will perform after construction and human modification (Johnpeer et al., 1985).

The coarse-grained sands and gravels (Fig. 2, upper portion) represent, with some exceptions, soils most desirable for building foundations. The coarse-grained soils generally have good drainage characteristics, stand well during excavations for pipelines, electric utilities, etc., and compact well when backfilled. Where foundation conditions are not suitable, coarse-grained material is usually hauled in to improve the site conditions. However, poorly graded sand can liquefy and some sandy soils are known to be collapsible; many of these soils are thought to have been deposited as debris flows in the recent geologic past.

Common physical tests on soils

Simple physical tests are used routinely to supply information about the suitability of a site for the intended use. There are a number of field tests and studies that can be conducted to provide evaluations of site conditions. These range from complex geophysical tests using borehole devices to simple tests using only a hand lens. The following discussion is concerned only with simple tests that are conducted routinely in the laboratory. The USCS classification system (Fig. 2) is used in the test descriptions.

Particle-size distribution

Particle-size distribution is a common means of identifying the particle-size groups that a soil contains. The test is conducted by sieving material through a stack of mesh sieves (Fig 3). Material that

FIGURE 3—Mesh sieves used for determining particle-size distribution.

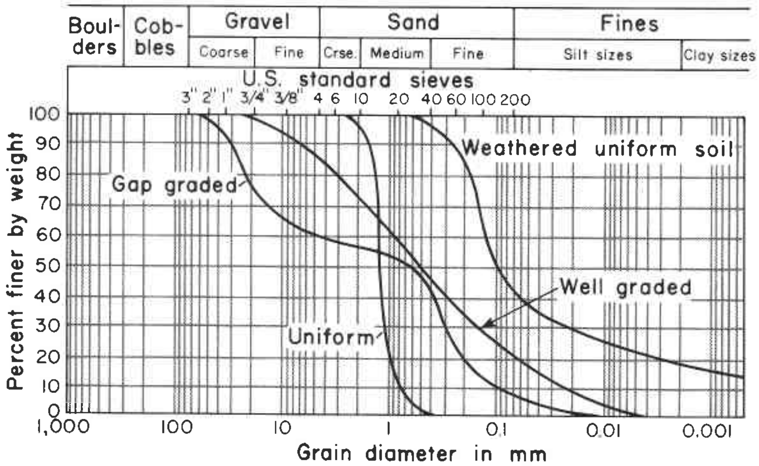

FIGURE 4—Grain-size chart showing particle-size distribution curves for four types of soil (from Sowers, 1979).

is too small to sieve (silt and clay) is commonly analyzed using a hydrometer or pipette settling technique. The results of a particle-size analysis are presented graphically on a grain-size chart as distribution curves (Fig. 4). To a trained interpreter, the shape of a particle-size distribution curve also shows the general engineering characteristics of a soil.

Atterberg limits

Atterberg limits are the liquid limit, plastic limit, and plasticity index of a material. The liquid limit is determined by filling a small bowl with wetted soil in a liquid-limit device (Fig. 5). A groove is made through the soil with a specially calibrated tool that makes a 1-cm-wide groove through the center of the sample. The liquid-limit device is designed to drop the sample a standard distance until the groove closes. The moisture content is varied until it takes 25 drops to close the groove, and the moisture content or liquid limit is then determined by oven drying the sample. The plastic limit is determined by rolling a long thread of soil into a standard diameter of 1/8 inch (Fig. 6). The moisture content at the point the soil begins to crumble is the plastic limit. The numerical difference between the liquid limit and plastic limit is defined as the plasticity index. This is a useful value because some soils with high plasticity indices, such as expansive clays, can absorb large quantities of water that will produce significant volume changes. The plasticity index indicates the range of moisture contents within which the soil has plastic properties. Clean sands and silty sands characteristically have low (or no) plasticity indices. Soils with high plasticity indices may be highly compressible. In general, soils with high plasticity indices are more likely to cause foundation failure than soils with low plasticity indices.

Clay mineralogy

As is evident from the above discussion, both clay mineralogy and water content can have significant effects on the physical properties of a soil. Although the moisture content is easily determined, the clay mineralogy (do not confuse with clay size material, which is less than 2 microns in diameter) is more difficult to determine and is therefore usually determined only in special circumstances. One means of identifying the clay mineralogy is with an x-ray diffraction device. A common procedure is to place a sample of clay size material containing clay minerals on a glass slide. The slide is placed in the path of an x-ray beam, and the angle of x-ray diffraction is measured. The very small distance between successive layers of clay atoms can be determined. This so-called "d-spacing" is used to identify the clay mineralogy. Other nonclay minerals can also be identified in this manner.

Two types of clay, either expansive or nonexpansive, commonly occur in soils. A main objective for studying clay mineralogy is to determine the dominant type of clay or the relative abundance of

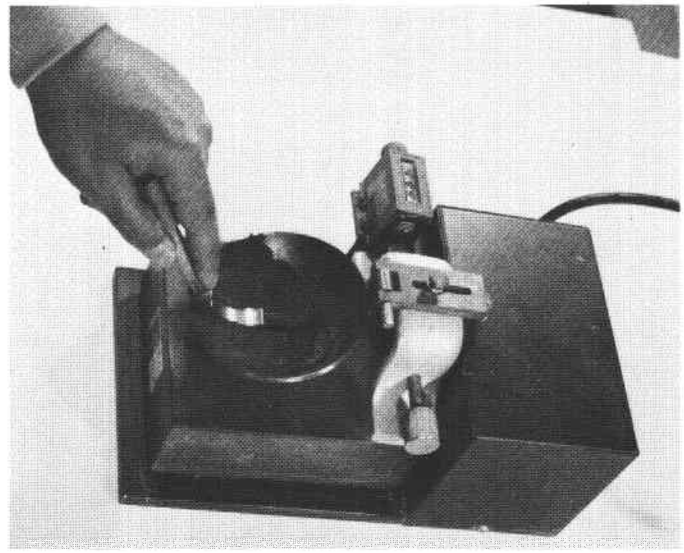

FIGURE 5—Device used for determining the liquid limit of a soil.

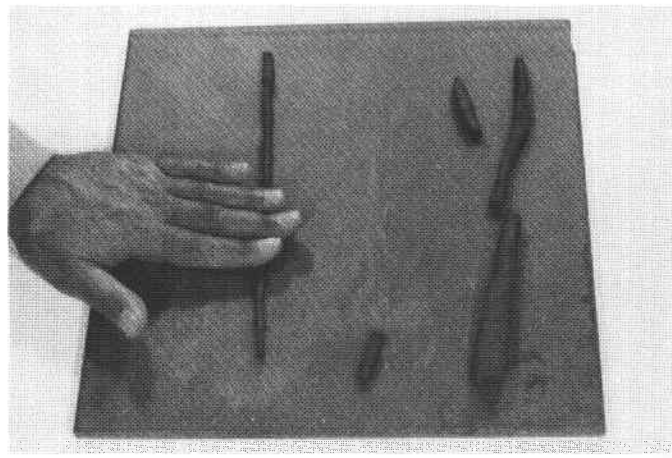

FIGURE 6—Method of determining the plastic limit of a soil.

each type. Smectite and vermiculite are clays that can expand when they become moist. If expansive clays are used in foundation material they may later dry and leave large desiccation cracks as the clays shrink. Mica and chlorite are generally nonexpansive clays, but they can weather to become expansive clays. Kaolinite is an end product of the weathering process and as such does not expand. The pressures produced by some expansive clays are tremendous; if not properly designed for, they can differentially raise and destroy a foundation. In general, when placing a foundation on soils containing expansive clays, the footings should extend below the depth of annual moisture change. In addition, proven landscape techniques have been designed that provide for drainage of surface water before it can soak in. Concrete foundations, substantially strengthened with rebar, can withstand the pressures that could arise from building on either expansive clays or collapsible soils. The advice of experts is highly recommended when construction is anticipated on soils containing expansive clays.

Data Sources

In the quest for geotechnical data the professional as well as the homeowner is often perplexed. Frequently much time and money are expended searching for information, only to find that with the proper "lead" it could have been obtained much earlier and perhaps at a considerable cost savings. Actually, the body of existing data that pertains to most sites is remarkably large. The types of data concerned with engineering geology studies generally fall within six categories: topography, geology, geophysics, remote sensing, hy-

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TABLE 2—Geotechnical data sources for New Mexico. *See reference list for full citation.

Data source number	Type of Geotechnical Data: Geotechnical data—general	Topography	Geology	Geo-physics	Remote sensing	Hydrology	Clima-tology
1					X		
2	X						
3					X		
*4			X	X		X	
5	X	X			X	X	
*6	X		X	X		X	
7			X	X		X	
8						X	
9					X		
10						X	
11	X		X	X		X	
12	X	X	X	X	X	X	
13						X	
14							X
15		X			X		
16		X			X		
17		X		X	X		X
18		X		X			
19	X	X	X	X	X	X	X
20		X	X	X	X	X	X
21	X	X	X	X	X	X	
22		X			X		
23	X		X	X		X	
24						X	
25			X	X		X	
26			X	X			
27	X		X			X	
28	X		X		X	X	X
29						X	
30	X		X			X	
31					X		
*32	X						
33			X			X	
34		X	X		X		
35			X				
36							X
37			X	X		X	
38	X		X			X	
*39						X	
40	X	X	X	X	X	X	
41					X		
42	X						
*43	X		X				
44		X				X	
45						X	
46	X						
47	X						
48	X		X		X		
49	X		X		X		
50	X	X	X		X		

1. Aerial Photography Field Office
USDA-ASCS, P.O. Box 30010
Salt Lake City, UT 84130-0010
(801) 524-5856

2. American Society of Civil Engineers
United Engineering Center
345 E. 47th Street
New York, NY 10017-2398
(202) 705-7491

3. American Society of Photogrammetry
210 Little Falls Street
Falls Church, VA 22046-4398
(703) 534-6617

4. Berquist et al., 1981*

5. Consulting Engineers Council of New Mexico
P.O. Box 3642
Albuquerque, NM 87190
(505) 242-5700

6. Dodd et al., 1985*

7. Environmental Evaluation Group
320 Marcy Street, P.O. Box 968
Santa Fe, NM 87504-0968
(505) 827-8280

8. Environmental Improvement Division
P.O. Box 968
Santa Fe, NM 87504-0968
(505) 984-0020

9. EROS Data Center
User Services Section
U.S. Geological Survey
Sioux Falls, SD 57198
(605) 594-6511

10. Federal Emergency Management Agency
National Flood Insurance Program
500 C Street, SW
Washington, DC 20472
(202) 646-2500 general
(202) 646-4600 publications

11. Geological Society of America
Engineering Geology Division
3300 Penrose Place
P.O. Box 9140
Boulder, CO 80301
(303) 447-8850

12. GEOREF
American Geological Institute
4220 King Street
Alexandria, VA 22302
(800) 336-4764

13. Hydrologic Information Unit
U.S. Geological Survey
419 National Center
1221 Sunrise Valley Drive
Reston, VA 22092
(703) 860-6867

14. Dr. Kenneth Kunkel
State Climatologist
New Mexico State University
Las Cruces, NM 88003
(505) 646-3007

15. National Archives and Records Service
Cartographic Archives Division
General Services Administration
Washington, DC 20408

16. National Cartographic Information Center
U.S. Geological Survey
507 National Center
Reston, VA 22092
(703) 860-6045

17. National Geodetic Information Center, OA/C18
National Oceanic and Atmospheric Administration
Rockville, MD 20852
(301) 443-8631

18. National Oceanic and Atmospheric Administration
National Geophysical Data Center
Mail Stop E/CG-1
325 Broadway
Boulder, CO 80302
(303) 497-6607

19. National Technical Information Service
U.S. Department of Commerce
5285 Port Royal Road
Springfield, VA 22161
(703) 487-4650

20. NEDRES Progam Office
Assessment and Information Services Center
NOAA/NESDIS
3300 Whitehaven Street, NW
Washington, DC 20235
(202) 634-7722

21. New Mexico Bureau of Mines and Mineral Resources
New Mexico Institute of Mining and Technology
Socorro, NM 87801
(505) 835-5420

22. New Mexico Geographic Information Advisory Committee
c/o Technology Application Center
2500 Central, SE
University of New Mexico
Albuquerque, NM 87131
(505) 277-3622

23. New Mexico Geological Society
Campus Station
Socorro, NM 87801
(505) 835-5420

24. New Mexico Water Resources Research Institute
P.O. Box 3167
New Mexico State University
Las Cruces, NM 88003-3167
(505) 646-4337

25. Nuclear Regulatory Commission
Regional Office (Region 4)
611 Plaza Drive, Suite 1000
Arlington, TX 76011
(817) 860-8100

26. Petroleum Information Log Service
500 North Baird Street
P.O. Box 1356
Midland, TX 79702
(915) 682-0591

27. Noel M. Rosenburg
Executive Director
Association of Engineering Geologists
P.O. Box 1068
Brentwood, TN 37027
(615) 377-3578

28. Soil Conservation Service
Education and Publications Ofc.
U.S. Department of Agriculture
P.O. Box 2890
Washington, DC 20013
(202) 477-5973
–or–
Soil Conservation Service
517 Gold Ave., SW, Room 3301
Albuquerque, NM 87102
(505) 766-3277

29. State Engineer Office
101 Bataan Memorial Building
Santa Fe, NM 87503
(505) 927-6140

30. Office of Surface Mining
Office of Public Affairs
U.S. Department of the Interior
Washington, DC 20240
(202) 343-4719

31. Technology Application Center
2500 Central, SE
University of New Mexico ☞

Albuquerque, NM 87131
(505) 277-3622

32. Trautmann and Kulhawy, 1983*

33. U.S. Army Corps of Engineers
Albuquerque District
P.O. Box 1580
Albuquerque, NM 87103
(505) 766-2732

34. U.S. Bureau of Land Management
P.O. Box 1449
Santa Fe, NM 87501
(505) 988-6316

35. U.S. Bureau of Mines
Building 20
Denver Federal Center
Denver, CO 80225
(303) 236-0450

36. U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Climatic Data Center
Federal Building
Asheville, NC 28801-2696
(704) 259-0682

37. U.S. Department of Energy
Albuquerque Operations Office
P.O. Box 5400
Albuquerque, NM 87115
(505) 846-3118

38. U.S. Department of the Interior
Bureau of Reclamation
Engineering and Research Center
Denver, CO 80225-0007

39. U.S. Geological Survey, 1979*

40. U.S. Geological Survey
Branch of Distribution
Box 25286, Federal Center
Denver, CO 80225
(303) 236-7477

41. U.S. Geological Survey
Photographic Library
Room 2274, Building 25
Denver Federal Center
Denver, CO 80225
(303) 234-4404

42. University Microfilms International
300 North Zeeb Road
Ann Arbor, MI 48106
(800) 521-3042

43. Ward et al., 1981*

44. Water Resources Division
U.S. Geological Survey
505 Marquette Ave., NW, Rm. 720
Albuquerque, NM 87102
(505) 766-2246

45. WATSTORE/NAWDEX
U.S. Geological Survey
421 National Center
Reston, VA 22092
(703) 860-6031 NAWDEX
(703) 860-6871 WATSTORE

46. American Institute of Professional Geologists
7828 Vance Drive, Ste. 103
Arvada, CO 80003
(303) 431-0831

47. Construction Industries Division
Bataan Memorial Building
Santa Fe, NM 87503
(505) 827-6251

48. New Mexico State Highway Department
Geotechnical Section
P.O. Box 1149
Santa Fe, NM 87504
(505) 982-0955

49. Energy and Minerals Department
Mining and Minerals Division
525 Camino de Los Marquez
Santa Fe, NM 87501
(505) 827-5970

50. U.S. Forest Service
517 Gold Ave., SW
Albuquerque, NM 87102
(505) 842-3292

drology, and climatology. The main sources for these data are libraries, federal agencies, and state agencies. Affordable computerized database systems can also provide rapid access to specific types of studies within all six categories.

The data sources listed in Table 2 are the general sources one might consult during the preliminary or feasibility phase of a project. They are intended to serve as guides for those seeking engineering geology data. Site-specific data are not included here because such data generally require both surface and subsurface investigations by a qualified geotechnical engineer or engineering geologist. Although many of the data are highly technical, many are easily understood by the layman. Some of the data sources were taken from Trautmann and Kulhawy (1983), and additional specific sources are given for New Mexico.

Summary

In New Mexico, structural damage has occurred from a number of causes including collapsing soil, liquefaction, ground-water withdrawal, landslides and debris flows, ground subsidence, rock dissolution, alkali reactivity, and expansive soils. In many instances, the major causes of foundation failure could have been mitigated if proper studies had been made of prospective building sites. Using the data sources given in Table 2 and the advice of engineering geologists and geotechnical engineers, marginal construction sites may be rendered stable and safe.

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Society of Economic Paleontologists and Mineralogists upcoming projects

March 6–7, 1986 SEPM short course "Modern and ancient deep sea fan sedimentation," in Calgary, Alberta.

April 7–9, 1986 SEPM short course "Platform margin and deep water carbonates," in Calgary, Alberta.

May 8–9, 1986 SEPM short course "Relationship of organic matter and mineral diagenesis," in Houston, Texas.

May 11–14, 1986 SEPM field seminar "The description and depositional analysis of marine carbonates—a field techniques workshop," in Little Rock, Arkansas.

For more information or to register for any of the above courses, contact: Joni C. Merkel, Society of Economic Paleontologists and Mineralogists, P.O. Box 4756, Tulsa, Oklahoma 74159-0756, (918) 743-2498.

New Mexico Geological Society news

The New Mexico Geological Society will hold its annual spring meeting on Friday, April 4, 1986, in the Macey Center on the campus of New Mexico Tech in Socorro, from 9 to 5. This meeting, which is intended to disseminate the results of recent research on the geology of New Mexico, will include four sessions: mineral fuels (oil, gas, coal, and uranium), ground water, sedimentary geology, and a general session. A cocktail party and banquet will conclude the day's activities. Information on registration, accommodations, and other activities planned for this meeting will be mailed to NMGS members in February. Inquiries should be directed to: Ron Broadhead or Dave Love, General Chairmen, NMBMMR, Campus Station, Socorro, NM 87801; (505) 835-5202 or 835-5146.