An Engineering Soil Survey of Fayette County, Kentucky

R. C. DEEN, Research Engineer, Kentucky Department of Highways

Agricultural soil scientists have developed a system of soil classification and mapping that has been and is continuing to be of great value to the soils engineer in reconnaissance and mapping. This report covers a statistical method of correlation used in a pilot study conducted in order to make engineering soils data available from a pedological map of Fayette County, Ky.

Assuming that the reliability of pedological classifications holds true for engineering properties, the engineering test constants for a given horizon of a given soil should fall within a narrow range; and the limits of this range should be reasonably determinable from the results of tests on a small number of random samples. In the present study a range with a confidence coefficient of 0.90 was determined by the statistical method used.

● THE NEED for soils data in the site selection, design, construction and maintenance of any major structure is generally appreciated by the engineer. The "rule of thumb" methods often used in developing smaller structures can prove unsatisfactory, or even disastrous, when applied to larger projects.

Probably the most pressing need is for use in preliminary surveying—maps and/or surveys giving the areal distribution of local soils and their engineering characteristics. Were such information available, together with the topographic maps now obtainable for many areas, much preliminary work for structures could be accomplished without the engineer's ever having to leave his office.

Agricultural scientists have developed a soil classification and mapping system that could be of great use to engineers. Belcher, et al. (2), appreciating this possibility, in 1943 published a report giving engineering significance to the pedological classification of Indiana soils. Since that time much work has been done toward translating and developing the data made available by the sciences of geology, physiography and pedology, and airphoto interpretations into terms familiar to the engineer. Many states are now preparing soil surveys and maps, using the principles of pedology and airphoto interpretation, for use by their engineers.

METHODS

As a first step in obtaining a soil map of Kentucky, an engineering soil survey of Fayette County was made. Since there was available a sufficiently reliable pedological soil survey and map of the county, no actual mapping or delineation of soil areas was required for this study. The problem became, therefore, one of determining the engineering test constants and giving engineering significance to the pedological soil classifications. The work consisted of field sampling, laboratory testing, analysis and correlation of data, and finally, preparing the material in a form suitable for use by the engineer.

The first step in the solution of the problem was to answer the question, "How many samples of each horizon of each soil series would be required to give significant results?" To obtain an answer, the question was approached from a statistical viewpoint.

If the thesis that the pedological properties of a given soil are similar wherever the soil is mapped is correct and can be applied to engineering properties also, then the engineering test constants for a given horizon of a given soil should fall within a more or less narrow range, determinable from considering test results from a few samples taken at random. This range of values for a given engineering property could be assigned to the particular soil horizon in question, and no matter how many times this horizon is sampled in the many different locations it may be mapped, it could be confidently assumed that the soil is sufficiently uniform for the test value to fall within the range established. The number of samples required to give such a significant range varies, of course, with the accuracy desired and with the variability of the parricular engineering test constant under consideration.

The limits first established for this project were such that the test results on a given sample out of a hundred might deviate from the mean by not more than 10 percent. The selection of these particular limits is not to be considered the establishment of a satisfactory range; it merely served as a starting point in determining the number of samples required. Assuming that the engineering test constants fall into a normal distribution about their respective means, this statement of accuracy desired can be represented by the general equation

$$z\,\sigma' = E\bar{X}' \qquad (1)$$

where $$z = \frac{X - \bar{X}'}{\sigma'}$$

σ' = standard deviation of the universe,
E = allowable error expressed as a decimal,
$\bar{X}'$ = mean of the universe, and
X = any value of the universe.

The above equation can also be stated in the following terms:

$$z\,\frac{\sigma}{\sqrt{N}} = E\bar{X} \qquad (2)$$

where σ = standard deviation of a group of samples,
N = number of items in the group of samples,
$\bar{X}$ = mean of a group of samples,
$\sigma' = \sigma/\sqrt{N}$, and
$\bar{X}' \approx \bar{X}$.

In arriving at Equation 2, two assumptions were made. The first was that the engineering test constants for a given soil series assume or are closely approximated by a normal or Gaussian distribution. This is not an unreasonable assumption to make. For example, if the liquid limit were determined for a very large number of samples of the C horizon of the Maury series, as many results would be expected to fall above the mean as would fall below, and these results would be concentrated about the mean. The second of the assumptions was that the mean of the universe was approximated by the mean of a group of samples. This assumption was based on the method of maximum likelihood; that is, the sample statistic is the maximum likelihood estimate of the corresponding universe parameter. This is usually the case and this method is favored by many statisticians (4).

In Equation 2, letting $z = 2.57$ satisfies the requirement that 99 of 100 sample results be within the desired range about the mean. Letting $E = 0.10$ establishes this range as ±10 percent of the mean. Using the values σ and X obtained from a group of samples, the number of samples, N, required can then be calculated.

By making a preliminary field sampling and laboratory testing of one soil series, it was estimated that three samples from each horizon of each soil series would be needed to meet the requirements established in all cases except that of the plastic limit and plasticity index. The number of samples required for these test values was as high as 30, seemingly an unreasonably large figure. Calculations indicated that test results from three samples, however, would show only a 20 percent deviation from the mean of the universe for these two test constants. On the basis of this preliminary study, it was decided to attempt to obtain samples of each horizon of each of the soil series from three different locations in the county.

The sample sites were located by reference to the pedological soil map and were selected in such a way as to distribute the sites in each soil series over the county. An attempt was made to place the sites near the centers of the large areas of a soil series in order to obtain typical samples and not fall in the transition zones between the series.

No unusual methods of sampling were used. Most of the samples were obtained by a 4-in., Iwan post hole auger; and this proved to be a quite satisfactory method except in the very wettest horizons. In these cases, sampling was delayed until the dry season. Samples were obtained to depths of 15 ft with the auger, and others were obtained from test pits. In all instances depth, color, texture, moisture conditions, and any other features that might be of interest or use in identification or classification were noted and recorded. A 20- to 30-lb disturbed sample was taken from each of the major horizons at every location and sent to the laboratory for testing.

Once in the laboratory the samples were prepared for the determination of engineering soils constants by the following methods:

Soil Preparation	ASTM Designation: D 421-39
Mechanical Analysis	ASTM Designation: D 422-39
Liquid Limit	ASTM Designation: D 423-39
Plastic Limit & Plasticity Index	ASTM Designation: D 424-39
Specific Gravity	ASTM Designation: D 854-45T
Moisture-Density Relations	ASTM Designation: D 698-42T
Laboratory CBR	Kentucky Modified Procedure

A small portion of the material smaller than one micron was recovered by sedimentation and decantation from 17 selected soil samples. These fractions, representing the near-colloid portion of the soil and consisting predominantly of clay-type minerals, were leached with acid or otherwise treated to remove X-ray scattering and masking impurities and subsequently conditioned with ethylene glycol preparatory to analysis or identification by X-ray diffraction.

The diffractometer was a Hayes instrument using Cu radiation, 14 cm diameter twin cameras, and wedge-type powder mounts. Patterns were recorded on film and the lines measured on a plain vernier scale.

In order to be of value to the engineer, data obtained from an investigation such as this must be presented in a form that is quickly and easily read and understood. In an attempt to satisfy this requirement it was decided to give first a pictorial representation of each soil with a brief, general written description of each of the major horizons.

This was followed by a table of typical engineering test constants. Rather than give the mean of the test constants as obtained by laboratory testing, it was felt that some significant range should be reported. With this in mind, the 90 percent confidence limits for each test constant were calculated and the values recorded in the table. Since the number of samples was small in each case, it was decided to base these confidence limits upon a "t" of "Student's" distribution rather than the normal distribution as was done earlier. With small sample sizes, the "t" distribution will give better estimates of the universe parameter. The confidence limits were calculated by the procedure given by Duncan (4) from the limited data obtained during this investigation. These data are so determined, however, that regardless of the number of times the particular soil is sampled in the future the engineering test constants will fall within these limits 90 percent of the time. These ranges, then, do have some significance, since a given horizon of soil may be represented by a more or less narrow range of values for a certain property.

The three classifications (textural, HRB, the group index) given in the table are not subject to the previously mentioned analysis, but are the actual designations given each sample. The table is followed by a general discussion of some features and properties of the soil that might affect the engineering treatment of that soil.

This description of each soil—a pictorial view of the profile with description, a range of values with statistical significance for certain engineering test constants, and a general discussion of other items of interest—could be used with the agricultural soil survey of the county and with the topographic maps of the area and be of great value to the engineer in planning and carrying to completion the soils portion of his engineering work.

SOILS OF FAYETTE COUNTY

The pedological soil map of Fayette County published in 1931 is one of the five highest rated county maps of Kentucky. Its soil boundaries are accurately delineated, and modern nomenclature is used except in a few instances.

There are 17 soil series and 28 soil types recognized and used in Fayette County. All but three of these series, accounting for 99 7/10 percent of the total area of the county, were sampled during the present investigation. One hundred twenty-six samples from 47 locations were obtained from the remaining 14 soil series. No attempt was made to obtain a sample from each soil type; however, 18 of the 28 types are represented.

Most of the soils of the county are residual, developing for the most part from limestones or calcareous shales. These soils are relatively plastic, as shown by laboratory tests; but nonetheless they are very well drained, there being practically no poorly drained areas in the county. This well drained condition is possible because the joints, cracks and solution channels of the bedrock allow the water to escape quite rapidly and because the soils develop a fragmentary structure which results in a relatively permeable unit. When this natural structure is destroyed in engineering construction, the soils become plastic and react in much the same manner as other clay-like materials.

Soils formed in alluvium cover less than six percent of the area of the county. The alluvium has been derived from limestone uplands.

The topography is so gentle over the county that in most cases rock excavation is of no concern in highway construction. However, because of the solution channels, bedrock properties do become a point of concern in connection with foundations for large buildings.

The data for selected soil series were collected during the sampling and testing of the Fayette County soils. These data have been reviewed and reorganized and are presented in Figures 1, 2, 3, and 4 in a form suitable for field use. The field data are summarized in Table 1, the laboratory data in Table 2. A geological map of Fayette County is given in Figure 5, and a comparative pedological map in Figure 6.

REFERENCES

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4. Duncan, A. J., "Quality Control and Industrial Statistics." Richard D. Irwin, Inc., Homewood, Ill. (1955).
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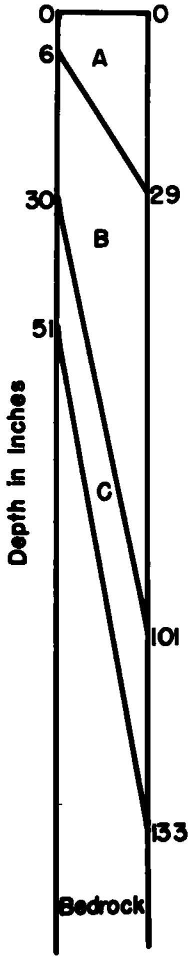
HAGERSTOWN

PROFILE



DESCRIPTION

Horizon A - Grayish-brown or dark brown silty clay or clay silt - friable.

Horizon B - Light brown to reddish-brown silty clay or clay silt - friable when dry, plastic and sticky when wet - common black concretions.

Horizon C - Light reddish-brown to yellowish-brown clay or silty clay - firm and slightly compact, brittle when damp.

Bedrock - Massive, hard limestone.

HAGERSTOWN

Engineering Test Constants	Horizon A	Horizon B	Horizon C
% Sand - 2 0 0 05mm	5-20	13-20	9-34
% Silt - 0.05 0.005mm	50-59	31-67	30-33
% Clay - −0.005mm	26-40	19-50	34-60
% Colloids −−0.001mm	7-19	6-24	17-35
Liquid Limit, %	32-39	36-45	40-56
Plasticity Index, %	10-14	16-20	14-28
Max. Dry Density, PCF	100-102	97-104	87-104
Opt. Moisture Content, %	20-24	20-26	22-30
Laboratory CBR, %	3-12	5-12	2-3
Textural Classification (Miss. River Comm)	Silty Clay or Clay Silt	Silty Clay or Clay Silt	Clay or Silty Clay
HRB Classification	A-6	A-7-6;A-6	A-7-6;A-6
Group Index	8-9	11-12	8-18
Clay Minerals	--	--	Illite

Topography: Level to gently rolling terrain.

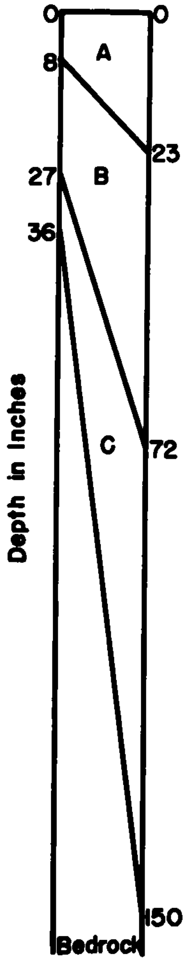
Drainage: Well drained. Surface and internal drainage good.

Distribution: Limestone areas in Pennsylvania, Maryland, West Virginia, Virginia, Kentucky, and Indiana.

Figure 1.

LORADALE

PROFILE



DESCRIPTION

Horizon A - Dark grayish-brown to dark reddish-brown clay silt or, occasionally, silty clay - friable.

Horizon B - Dark brown to reddish-brown silty clay or clay silt - sticky and plastic when wet, firm when moist, hard when dry a few small round dark concretions near top of horizon increasing to many small and medium round concretions, giving way to abundant splotches of soft irregularly shaped concretionary material mottled yellowish-brown to brownish-gray in lower portion of horizon.

Horizon C - Light olive brown to yellowish-brown clay - very sticky and very plastic when wet, very firm when moist, very hard when dry - a few small round dark concretions and some soft, black, irregularly shaped concretionary material - mottles of brownish-gray or light olive gray common.

Bedrock - Interbedded high-grade, medium phosphatic limestones and calcareous shales.

LORADALE

Engineering Test Constants	Horizon A	Horizon B	Horizon C
% Sand - 2.0-0.05mm	9-15	17-34	14-24
% Silt - 0.05-0.005mm	56-63	30-48	26-29
% Clay --0.005mm	25-32	31-41	49-58
% Colloids --0.001mm	7-11	12-19	31-35
Liquid Limit, %	33-39	33-41	51-59
Plasticity Index, %	11-15	12-21	18-32
Max. Dry Density, PCF	97-104	96-106	84-91
Opt. Moisture Content, %	20-22	21-25	28-33
Laboratory CBR, %	5-10	2-18	4-8
Textural Classification (Miss. River Comm)	Clay Silt or Silty Clay	Silty Clay or Clay Silt	Clay
HRB Classification	A-6;A-7-6	A-6; A-7-6 A-7-5	A-7-5 A-7-6
Group Index	8-10	8-14	14-20
Clay Minerals	--	--	Illite

Topography: Moderately rolling topography exhibiting in some areas a slight Karst configuration. Soil develops on gently sloping ridge tops and hillsides with slopes of 3 to 15 percent, occurring most commonly on the gentler slopes.

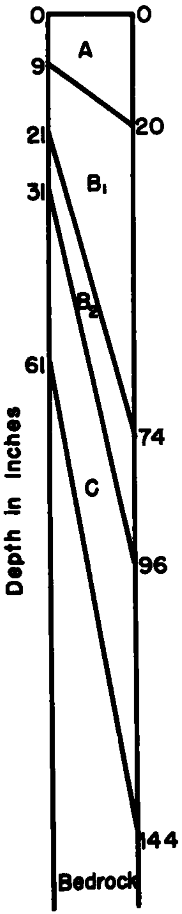
Drainage: Well drained; runoff medium to rapid; internal drainage medium.

Distribution: Extensive in the Inner Blue Grass Region of Kentucky and the Central Basin Area of Tennessee. Closely associated with Mercer soils.

Figure 2.

MAURY

PROFILE



DESCRIPTION

Horizon A - Dark brown or dark reddish-brown silty clay or clay silt -- very friable -- a few very small, almost black, round concretions.

Horizon B_1 - Dark reddish-brown to reddish-brown silty clay or clay silt -- friable in top portion becoming sticky and slightly plastic when wet in lower portion, firm when moist, hard when dry -- small, black concretions that increase in number with depth.

Horison B_2 - Yellowish-red, slightly variegated with brown, silty clay or clay -- sticky and plastic when wet, firm when moist, hard when dry -- many small, round, black concretions -- some soft, irregularly shaped concretionary splotches -- a few weathered fragments of chert and limestone in the power portion.

Horizon C - Yellowish-red to brown silty clay or clay, mottled with dark brown and yellowish-brown -- sticky and plastic when wet, firm when moist, very hard when dry -- few to common small, black concretions and soft, irregularly shaped concretionary splotches -- many weathered fragments of chert and limestone that increase in number with depth.

Bedrock - Highgrade phosphatic limestone.

MAURY

Engineering Test Constants	Horizon A	Horizon B_1	Horizon B_2	Horizon C
% Sand - 2.0-0.05mm	5-14	12-20	10-24	12-25
% Silt - 0.05-0.005mm	55-59	44-53	22-45	25-47
% Clay - -0.005mm	29-38	28-40	35-64	26-65
% Colloids - -0.001mm	9-14	10-18	18-45	8-43
Liquid Limit, %	35-38	38-41	47-54	45-61
Plasticity Index, %	11-13	15-19	19-23	18-32
Max. Dry Density, PCF	93-104	98-103	92-98	90-99
Opt. Moisture Content, %	20-25	21-23	24-29	24-33
Laboratory CBR, %	3-17	7-11	1-13	3*
Textural Classification (Miss. River Comm)	Silty Clay Clay Silt	Silty Clay Clay Silt	Silty Clay Clay	Silty Clay Clay
HRB Classification	A-6 A-7-6	A-6 A-7-6	A-7-6 A-7-5	A-7-6 A-7-5
Group Index	8-10	8-11	12-16	12-20
Clay Minerals	--	--	--	Illite

* Insufficient data to establish a meaningful range.

Topography: Gently to steeply sloping terrain with gradients generally 2 to 12 percent and some as great as 20 percent. Many areas have Karst topography.

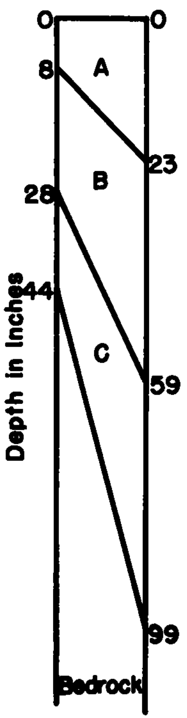
Drainage: Well drained. Runoff and internal drainage are medium.

Distribution: The most extensive of the highly phosphatic soils in the Inner Blue Grass Region of Kentucky and the Outer Basin Area of Tennessee. Found in close geopraphic association with soils of the McAfee, Braxton, Salvisa, Hagerstown, Loradale, Hampshire, Culleoka, Inman, and Hicks series.

Figure 3.

MERCER

PROFILE



DESCRIPTION

Horizon A - Dark grayish-brown to dark yellowish-brown clay silt, or, occasionally, silty clay - friable.

Horizon B - Yellowish-brown silty clay - friable when moist increasing in firmness until becoming brittle with depth. Sticky when wet - a few small round black concretions increasing in number and then gradually giving way to very abundant soft black, irregularly shaped concretionary splotches with greater depth - strong brown to light-brownish-gray distinct mottling near bottom of horizon.

Horizon C - Strong brown to light olive-gray clay or silty clay - mottled with yellowish-brown - firm when moist, sticky and very plastic when wet, very hard when dry - a few small round black concretions.

Bedrock - High-grade, medium phosphatic limestones with strata of calcareous shales.

MERCER

Engineering Test Constants	Horizon A	Horizon B	Horizon C
% Sand - 2.0-0.05mm	8-23	14-22	18-37
% Silt - 0.05-0.005mm	52-63	37-55	32-36
% Clay --0.005mm	21-32	31-42	23-61
% Colloids - -0.001mm	5-9	12-18	11-36
Liquid Limit, %	36-42	36-41	28-56
Plasticity Index, %	8-13	14-19	3-35
Max. Dry Density, PCF	88-108	99-108	93-109
Opt. Moisture Content, %	16-28	18-23	20-26
Laboratory CBR, %	2-11	3-18	9*
Textural Classification (Miss. River Comm)	Clay Silt or Silty Clay	Silty Clay	Clay or Silty Clay
HRB Classification	A-4;A-6 A-7-6	A-6 A-7-6	A-6 A-7-6
Group Index	8-10	9-11	11-18
Clay Minerals	--	--	Illite, Kaolinite & Montmorillonite(Nontronite)

* Insufficient data to establish a meaningful range

Topography: Nearly level to slightly sloping ridge tops with gradient usually from about 1 to 7 percent, sometimes as high as 10 percent.

Drainage: Moderately well drained. Runoff is slow to medium, internal drainage is slow. Fragipans often encountered at depths of 15 to 30 inches and range in thickness of about 10 to 20 inches.

Distribution: Fairly extensive soils of the Inner Blue Grass Region of Kentucky and the Outer Basin of Tennessee. Found in close geographic association with the Hampshire, Inman, Loradale, Hagerstown, Maury and Eden series.

Figure 4.

TABLE 1

SUMMARY OF FIELD DATA

Site No.	Location Description	Date Sampled	Slope Class	Water Table Depth	Solid Rock Depth	Pedological Soil Type	Sample No.	Field Description	Color	Horizon Depth
					Hagerstown Series					
34-20	30 ft W of centerline, 0.4 mi N of RR crossing in W. Fork of Ware Rd.	28 Apr 56	0-4%	-	10 ft-1 in.+	Hagerstown silt loam	20A	Friable silt loam.	Brown	0-29 in.
							20B	Sticky and plastic clay loam, many small black concretions (some ½-in. dia)	Bright reddish brown	29-101 in.
							20C	Friable clay loams, many large black concretions (½ in. dia)	Yellowish-brown	101-121 in.+
34-24	30 ft W of Russell Cave Rd, 0.2 mi N of Loradale.	5 May 56	0-4%	6 ft-8 in.	7 ft-0 in.	Hagerstown silt loam	24A	Friable silt loam	Brown	0-13 in.
							24B	Friable silt clay loam, small black concretions which increase in size and number at 35 in.	Reddish-brown	13-55 in.
							24C	Firm and sticky clay loam, many concretions.	Yellowish-brown	55-84 in.
34-26	135 ft E of Nicholasville Rd, 500 ft N of Wilson Rd.	12 May 56	0-4%	-	9 ft-1 in.+	Hagerstown silt loam	26A	Friable silt loam	Brown	0-20 in.
							26B	Friable silt clay loam, slightly firm, small black concretions.	Reddish-brown	20-44 in.
							$26C_1$	Firm but friable silty clay loam, few small black concretions, grayish streaks increase with depth.	Yellowish-brown	44-80 in.
							$26C_2$	Firm, friable silty clay loam, much black and gray mottling.	Yellowish-brown	80-109 in.+
					Loradale Series					
34-2	110 ft N of Lexington-Winchester Rd, 0.8 mi W of intersection of US 60 & Ky. 859.	14 Mar 56	0-4%	3 ft-10 in.	6 ft-0 in.+	Loradale silt loam	2A	Friable silt loam	Brown	0-22 in.
							2B	Firm silty clay, few black concretions.	Reddish-brown	22-46 in.
							2C	Plastic, sticky clay	Brownish-yellow to yellow.	46-72 in.+
34-10	900 ft S of Stone Rd, E of Southern RR	22 Feb 55	-	-	-	Loradale silt loam	10A	-	-	0-12 in.
34-18	30 ft E of Combs Ferry Rd, 0.4 mi N of Pine Grove.	28 Apr 56	0-4%	None	6 ft-8 in.	Loradale silt loam	18A	Friable silt loam	Brown	0-22 in.
							18B	Friable silty clay loam, many black concretions, gray mottling increasing rapidly at 43 in.	Reddish-brown slight yellowish tinge.	22-71 in.
							18C	Friable clay, black mottling, rock fragments encountered at 71-80 in.	Dark reddish-brown, yellowish tinge.	71-80 in.

TABLE 1 (Continued)

Site No.	Location Description	Date Sampled	Slope Class	Water Table Depth	Solid Rock Depth	Pedological Soil Type	Sample No.	Field Description	Color	Horizon Depth
					Loradale Series (Continued)					
34-21	40 ft W of Cleveland Rd, 1.3 mi N of US 60.	28 Apr 56	0-4%	None	6 ft-3 in.	Loradale silt loam	21A	Friable silt loam, small black concretions.	Grayish-brown; top 6 in.-chocolate brown	0-18 in.
							21B	Moderately friable silty clay, many small black concretions.	Reddish-brown	18-52 in.
							21C	Friable silty clay, few black concretions, clods have glossy appearance.	Yellowish-brown	52-75 in.
34-25	35 ft N of Ironworks Rd, 600 ft W of Newtown Pike.	5 May 56	0-4%	4 ft-2 in.	7 ft-4 in.	Loradale silt loam	25A	Friable silt loam	Grayish-brown	0-23 in.
							25B	Sticky clay loam, small black concretions, concretionary splotches.	Reddish-brown, slight yellowish tinge.	23-60 in.
							25C	Sticky clay, black concretions.	Yellowish-brown	60-88 in.
34-34	40 ft E of Crawley Lane, 700 ft S of Jacks Creek Rd.	14 May 56	0-4%	-	4 ft-8 in.+	Loradale silt loam	34A	Friable silt loam	Brown	0-32 in.
							34B	Friable gritty clay loam, many moderate sized black concretions.	Reddish-brown slight yellowish tinge in lower portion.	32-56 in.+
					Maury Series					
34-4	0.4 mi NW of Hospital entrance, on Lexington-Frankfort Rd, US 421 E of Rd, SE of RR.	Sept 54	-	-	-	Maury silt loam Slope phase	4A	-	-	-
							$4B_1$	-	-	-
							$4B_2$	-	-	-
							4C	-	-	-
34-5	100 ft N of Ironworks Rd, 600 ft E of intersection of Russel Cave Rd.	Sept 54	-	-	-	Maury silt loam	5A	-	-	-
34-6	1.2 mi W of Boone Creek on 1st Rd to the E south of Nihizertown.	Oct 54	-	-	-	Maury silt loam	6A	-	-	-
							$6B_1$	-	-	-
							$6B_2$	-	-	-
							6C	-	-	-
34-7	0.6 mi SW of Cave Hill Rd on Lexington-Harrodsburg Rd, US 68, 75 ft SE of Road. Samples from face of cut.	Sept 54	-	-	-	Maury silt loam	7A	-	-	-
							$7B_1$	-	-	-
							$7B_2$	-	-	-
							7C	-	-	-
34-11	100 ft E of Russell Cave Rd, 600 ft N of intersection with Ironworks Rd.	Sept 54	-	-	-	Maury silt loam	11A	-	-	-
							$11B_1$	-	-	-
							$11B_2$	-	-	-
							11C	-	-	-
34-12	75 ft E of Clays Mill Rd, 200 ft N of Holly Hill Drive.	26 Mar 56	0-4%	5 ft-10 in.	9 ft-0 in.+	Maury silt loam grayish-brown phase.	12A	Friable silt loam	Grayish-brown	0-16 in.
							$12B_1$	Sticky clay, small black concretions.	Reddish-brown	16-48 in.
							$12B_2$	Increasingly friable, black concretions increase in number.	Yellowish-brown, grayish mottling near bottom.	48-70 in.
							12C	Heavy clay, many black con-	Yellowish-	70-108 in.+

34-13	200 ft N of Holly Hill Drive, 800 ft E of Clays Mill Rd.	30 Mar 56	4-16%	-	10 ft-5 in.+	Maury silt loam Slope phase	13A	Friable silt loam	Brown	0-10 in.
							$13B_1$	Slightly plastic clay becoming friable in lower portion, black concretions increase in number with depth.	Reddish-brown, changes to reddish black near bottom.	10-75 in.
							$13B_2$	Friable silt loam, black concretions,gray sticky mottling encountered at 125 in.	Yellowish-brown, yellow inc. w/depth	75-125 in.+
34-14	25 ft N of Military Rd, 1.5 mi E of Little Texas.	11 Apr 56	0-4%	-	9 ft-9 in.+	Maury silt loam	14A	Friable silt loam, numerous roots.	Brown	0-48 in.
							$14B_1$	Sticky heavy clay loam, black concretions.	Reddish-brown	48-102 in.
							$14B_2$	Firm, friable clay, rock fragments 90-117 in. stopped sampling at 117 in. No sample.	Yellowish-brown	102-117 in.+
34-16	25 ft NW of Bowman Rd., 0.6 mi S of Parkers Mill Rd.	23 Apr 56	4-16%	None	4 ft-5 in.	Maury silty clay loam, slope phase	16B	Friable silty clay loam, rock fragments at 3 ft-6 in.	Grayish-brown	0-42 in.
							16C	Stiff clay loam, few black concretionary splotches.	Reddish-brown, slight yellowish mottling.	42-53 in.
34-17	25 ft S of Athens-Boonesboro Rd, 1.1 mi E of Athens. Samples from face of cut.	28 Apr 56	0-4%	None	6 ft-0 in.	Maury silty clay loam, slope phase	17A	Friable silt loam	Dark brown	0-18 in.
							17B	Friable clay loam, small black concretions.	Reddish-brown	18-68 in.
							17C	Plastic clay loam, with sticky light gray mottling. No sample.	Dark reddish-brown	68-72 in.
					Mercer Series					
34-1	120 ft N of Lexington-Winchester Rd, US 60, 0.5 mi W of Clark Co. line.	14 Mar 56	0-4%	6 ft-6 in.	6 ft-6 in.+	Mercer silt loam	1A	Friable silt loam	Blackish-gray	0-22 in.
							1B	Silty clay, clay content increases with depth, black concretions	Brownish-yellow	22-48 in.
							1C	Firm silty clay, black concretions, brown mottling.	Brownish-yellow	48-80 in.+
34-15	800 ft W of RR and Rd Intersection at Walnut Hill Station, samples from 6 ft cut face S of RR.	18 Apr 56	0-4%	None	8 ft-3 in.	Mercer silt loam	15A	Friable silt loam	Brownish-gray	0-18 in.
							15B	Friable silt clay, many black concretions.	Reddish-brown	18-65 in.
							15C	Friable clay loam, black concretions give way to grit and gravel in large amounts.	Bright brownish-yellow	65-99 in.
34-19	40 ft S of Ware Rd, 0.4 mi N of L&N RR crossing.	28 Apr 56	0-4%	None	3 ft-2 in.	Mercer silty clay loam, eroded phase	19A	Friable silt loam	Brown	0-23 in.
							19B	Silty clay loam, black concretions and mottling.	Reddish-brown, yellow tinge	23-38 in.
34-23	30 ft W of the Hume-Bedford Rd, 500 ft S of the Greenwich Rd Intersection.	5 May 56	0-4%	3 ft-7 in.	6 ft-8 in.+	Mercer silty clay loam, eroded phase	23A	Friable silt loam	Brown	0-4 in.
							23B	Plastic clay, gray mottling, red streaks, few black concretions.	Yellowish-brown	4-32 in.
							23C	Plastic clay with reddish streaks (planes of weakness), small, black concretions.	Gray, reddish coloring increases with depth.	32-80 in.+

TABLE 2

SUMMARY OF LABORATORY DATA

Sample No.	Liquid Limit	Plasticity Index	Specific Gravity	Grain Size Distribution: 2.0-0.05 mm % Sand	0.05-0.005 mm % Silt	0.005 mm % Clay	0.001 mm % Colloids	Std. Proctor: Maximum Density	Opt. M.C.	Lab. CBR	Classification: U. S. Bureau of Soils	Miss. River Commission	HRB	Clay Minerals
Hagerstown Series														
34-20A	33.0	11.6	2.68	8.0	58.0	34.0	10.0	101.2	21.4	8.0	Silty clay	Silty clay	A-6(9)	--
34-24A	36.1	10.7	2.63	17.0	54.0	29.0	12.0	--	--	--	Silty clay loam	Clay silt	A-6(8)	--
34-26A	37.1	13.1	2.72	12.0	51.0	37.0	17.0	101.0	22.0	6.7	Clay	Silty clay	A-6(9)	--
34-20B	37.9	16.9	2.74	14.0	54.0	32.0	14.5	102.7	20.9	9.6	Clay	Silty clay	A-6(11)	--
34-24B	40.8	19.5	2.74	17.0	56.0	27.0	10.0	100.4	23.4	5.9	Silty clay loam	Clay silt	A-7-6(12)	--
34-26B	42.7	17.3	2.77	18.0	37.0	45.0	20.5	98.6	24.1	9.7	Clay	Silty clay	A-7-6(12)	--
34-20C	37.4	12.8	2.87	36.0	32.0	32.0	17.0	105.2	22.4	--	Clay	Sandy clay	A-6(8)	--
34-24C	53.4	27.9	2.89	23.5	32.0	44.5	23.0	89.2	30.0	2.7	Clay	Silty clay	A-7-6(18)	Illite
34-26C_1	51.7	21.0	2.80	16.0	29.0	55.0	34.0	91.0	27.4	2.9	Clay	Clay	A-7-6(16)	--
34-26C_2	47.7	22.0	2.81	11.5	32.5	56.0	31.0	96.9	25.2	2.4	Clay	Clay	A-7-6(14)	--
Loradale Series														
34-2A	36.9	11.3	2.64	8.0	56.0	36.0	11.5	98.3	20.0	3.0	Silty clay	Silty clay	A-6(9)	--
34-10A	36.8	16.3	2.71	18.1	53.2	28.7	11.7	107.3	20.1	--	Silty clay loam	Clay silt	A-6(10)	--
34-18A	33.9	10.7	2.71	13.0	64.0	23.0	8.0	101.0	20.9	9.3	Silty clay loam	Clay silt	A-6(8)	--
34-21A	31.9	10.5	2.70	13.0	61.0	26.0	8.0	104.0	19.6	7.5	Silty clay loam	Clay silt	A-6(8)	--
34-25A	41.8	13.9	2.66	11.5	61.0	27.5	6.5	96.6	23.6	6.2	Silty clay loam	Clay silt	A-7-6(10)	--
34-34A	33.4	13.3	2.67	9.5	61.5	29.0	6.5	97.6	22.2	10.0	Silty clay loam	Clay silt	A-6(9)	--
34-2B	42.1	23.2	2.75	17.0	40.0	43.0	19.0	104.4	21.7	4.5	Clay	Silty clay	A-7-6(14)	--
34-18B	37.4	15.7	2.91	39.5	22.5	38.0	19.0	92.9	26.2	--	Clay	Sand clay	A-7-5(9)	--
34-21B	38.3	17.1	2.76	20.0	44.0	36.0	14.5	100.3	24.8	5.4	Clay	Silty clay	A-6(11)	--
34-25B	37.5	15.6	2.75	26.0	45.0	29.0	11.5	102.5	21.9	9.8	Clay loam	Clay silt	A-6(10)	--
34-34B	30.0	9.5	2.73	24.0	44.0	32.0	12.5	104.8	20.0	20.0	Clay	Silty clay	A-4(8)	--
34-2C	58.7	29.1	2.82	13.0	28.5	58.5	34.0	83.6	29.6	5.7	Clay	Clay	A-7-6(20)	--
34-18C	51.6	21.2	2.82	22.0	26.5	51.5	35.0	85.6	33.2	--	Clay	Clay	A-7-5(15)	--
34-21C	53.6	18.6	2.75	21.0	28.0	51.0	32.0	90.2	29.8	6.3	Clay	Clay	A-7-5(14)	Illite
34-25C	56.6	30.0	2.88	21.0	26.5	52.5	31.0	89.5	28.6	--	Clay	Clay	A-7-6(19)	--
Maury Series														
34-4A	38.2	9.2	2.68	6.0	59.5	34.5	12.0	--	--	--	Silty clay	Silty clay	A-4(8)	--
34-5A	40.3	15.3	--	--	--	--	--	--	--	--	--	--	A-7-6(--)	--
34-6A	35.8	14.5	2.69	6.2	57.4	36.4	12.5	--	--	--	Silty clay	Silty clay	A-6(10)	--
34-7A	31.6	8.9	--	--	--	--	--	--	--	--	--	--	A-4(--)	--

34-17A	38.5	12.9	2.70	18.0	55.0	27.0	9.5	97.0	23.0	10.7	Silty clay loam	Clay silt	A-6(9)	--
34-4B1	41.9	16.5	2.76	10.0	47.0	43.0	21.5	100.1	22.4	--	Clay	Silty clay	A-7-6(11)	--
34-6B1	43.6	22.8	2.76	--	--	--	--	103.1	21.1	--	--	--	A-7-6(--)	--
34-7B1	44.4	18.6	--	--	--	--	--	102.6	20.6	--	--	--	A-7-6(--)	--
34-11B1	38.0	16.3	2.74	--	--	--	--	99.4	23.2	--	--	--	A-6(--)	--
34-12B1	35.9	15.1	2.74	15.5	49.5	35.0	12.0	102.8	20.7	11.2	Clay	Silty clay	A-6(10)	--
34-13B1	40.7	17.1	2.73	15.0	48.5	36.5	18.0	103.8	20.8	10.7	Clay	Silty clay	A-7-6(11)	--
34-14B1	39.3	19.2	2.74	12.0	49.0	39.0	15.0	103.0	21.5	10.8	Clay	Silty clay	A-6(11)	--
34-16B	37.2	10.6	2.67	20.0	57.0	23.0	7.0	93.2	24.1	5.3	Silty clay loam	Clay silt	A-6(8)	--
34-17B	38.1	14.8	2.80	21.5	40.0	28.5	11.5	97.8	25.0	7.4	Clay loam	Clay silt	A-6(9)	--
34-4B2	50.6	20.8	2.84	12.5	36.5	51.0	31.0	94.8	27.0	--	Clay	Silty clay	A-7-6(14)	--
34-6B2	49.2	26.1	--	--	--	--	--	97.8	23.7	--	--	--	A-7-6(--)	--
34-7B2	51.6	20.1	--	--	--	--	--	98.0	25.4	--	--	--	A-7-5(--)	--
34-11B2	47.0	20.2	--	--	--	--	--	91.2	29.4	--	--	--	A-7-6(--)	--
34-12B2	45.8	17.3	2.79	21.0	38.5	40.5	23.0	97.0	24.3	8.1	Clay	Silty clay	A-7-6(12)	--
34-13B2	58.5	20.8	2.84	17.0	25.5	57.5	40.0	89.4	31.6	6.2	Clay	Clay	A-7-5(16)	--
34-4C	47.4	19.7	2.80	19.0	39.0	42.0	21.0	--	--	--	Clay	Silty clay	A-7-6(13)	--
34-6C	67.4	38.4	--	--	--	--	--	102.4	35.6	--	--	--	A-7-6(--)	--
34-7C	52.0	18.3	--	--	--	--	--	89.6	30.0	--	--	--	A-7-5(--)	--
34-11C	46.5	20.2	2.76	--	--	--	--	93.9	25.0	--	--	--	A-7-6(--)	---
34-12C	62.7	31.7	2.82	13.5	28.5	58.0	37.0	92.2	24.6	3.3	Clay	Clay	A-7-5(20)	Illite
34-16C	41.7	18.5	2.77	24.0	40.0	36.0	18.5	95.4	25.7	--	Clay	Silty clay	A-7-6(12)	--
							Mercer Series							
34-1A	35.2	8.8	2.68	13.0	58.0	29.0	8.0	103.1	18.8	4.0	Silty clay loam	Clay silt	A-4(8)	--
34-15A	38.9	9.1	2.54	19.0	60.0	21.0	7.0	87.6	23.2	9.0	Silty clay loam	Clay silt	A-4(8)	--
34-19A	40.0	11.4	2.68	23.0	51.0	26.0	5.0	99.1	23.5	6.7	Silty clay loam	Clay silt	A-6(9)	--
34-23A	41.5	13.7	2.62	8.5	61.0	30.5	9.0	--	--	--	Silty clay	Silty clay	A-7-6(10)	--
34-1B	35.3	16.9	2.75	20.5	43.0	36.5	12.0	109.1	18.2	14.2	Clay	Silty clay	A-6(11)	--
34-15B	38.2	13.4	2.75	17.0	49.0	34.0	14.0	104.0	20.5	11.8	Clay	Silty clay	A-6(9)	--
34-19B	41.0	17.3	2.79	20.0	37.5	42.5	19.0	100.6	23.2	5.5	Clay	Silty clay	A-7-6(11)	--
34-23B	39.0	18.0	2.77	13.0	55.0	32.0	14.5	101.6	20.2	--	Clay	Silty clay	A-6(11)	--
34-1C	40.0	17.5	2.70	26.0	35.0	39.0	18.0	102.5	22.5	8.2	Clay	Silty clay	A-6(11)	Kaolinite & Montmorillonite (Nontronite)
34-15C	34.9	10.3	2.87	34.0	34.0	32.0	20.0	104.3	21.4	15.5	Clay	Sandy clay	A-6(8)	Kaolinite & Montmorillonite (Nontronite)
34-23C	50.7	29.1	2.80	23.0	33.0	54.0	32.0	95.2	25.0	2.2	Clay	Clay	A-7-6(18)	Illite

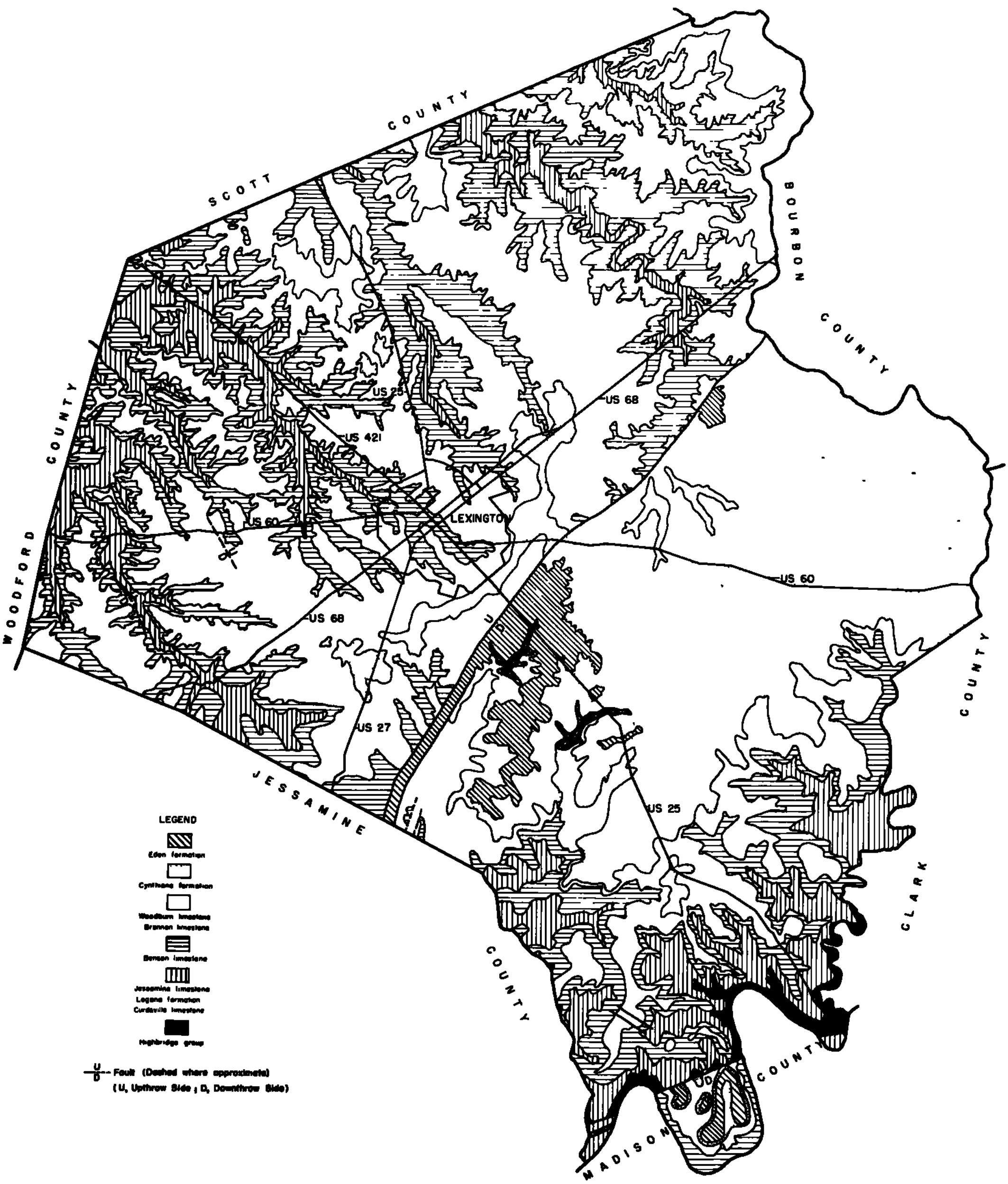


Figure 5. Geological map of Fayette County, Kentucky.

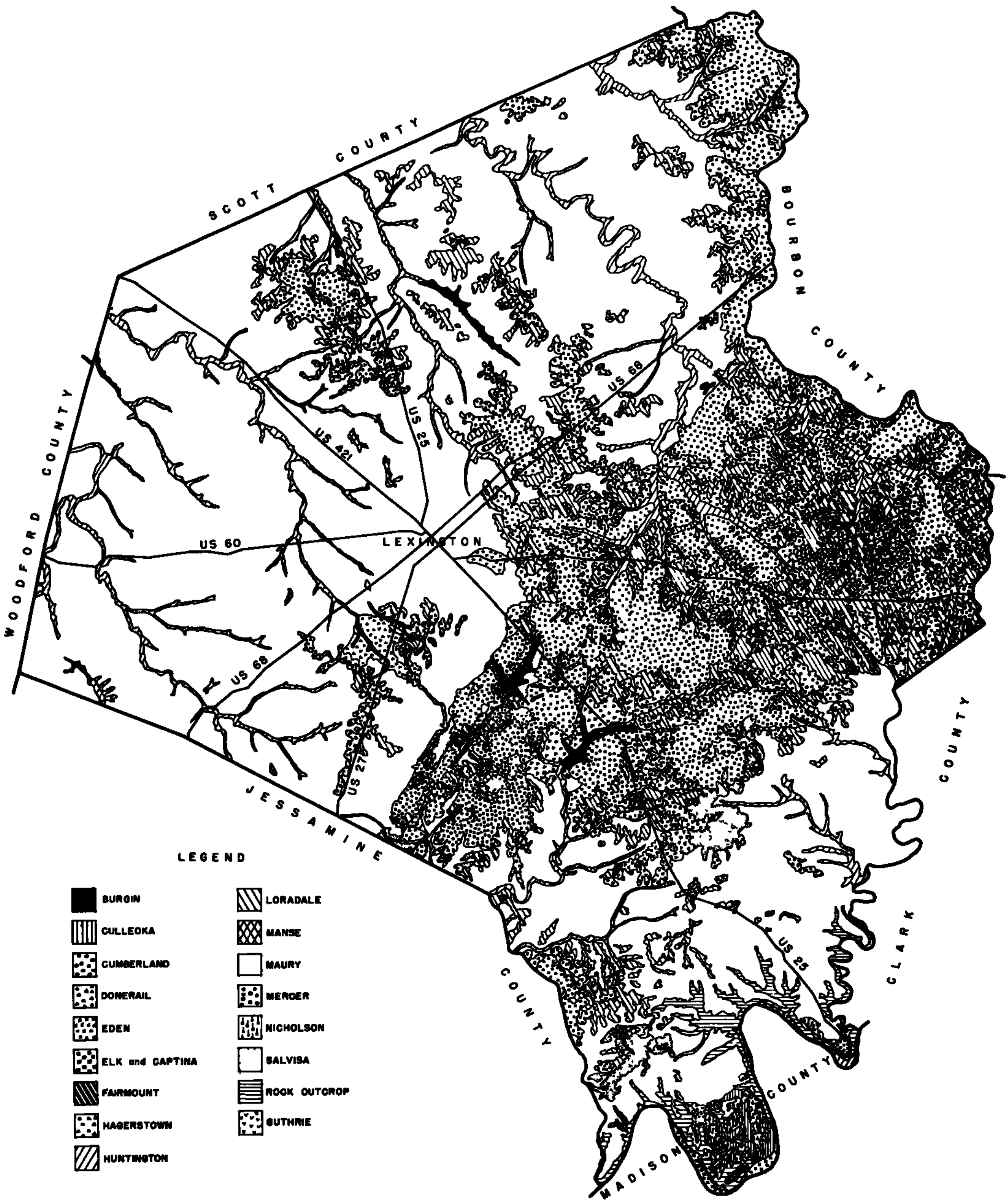


Figure 6. Pedological map of Fayette County, Kentucky.

Discussion

JAMES H. McLERRAN, Assistant Chief, Photographic Interpretation Research Branch, U. S. Army Snow Ice and Permafrost Research Establishment—The author has applied a commendable approach to the problem of obtaining the range of values for a given engineering property to be assigned to a particular soil horizon of a certain soil series. The range of values as shown with his soil descriptions are sometimes rather wide. Note the values of percent clay in the C horizon and the plasticity index for the Mercer soil. This wide range could be narrowed if the soil type was chosen to describe rather than the soil series.

A description of the soil series is fine for a generalized report on a statewide basis, but when you have a county map available this information should not be generalized by defining only the soil series. There are differences within a soil series that are significant to the engineer and are defined by the soil type.

Since the surface texture is strongly influenced by what lies below it, there will be differences throughout the profile for different soil types within a series. This is particularly true in residual soils but also is true of other soils.