Commonwealth of Kentucky

Department of Highways

Proposed Working Plan

for

A SURVEY AND PEDOLOGICAL CLASSIFICATION OF KENTUCKY SOILS

In Accordance with Highway Engineering Usage

by

The Highway Materials Research Laboratory
Lexington, Kentucky

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INTRODUCTION

At the meeting of the Highway Research Board in Oklahoma City this year the Department of Soils Investigations devoted the major part of one session to a discussion of the pedological method of classifying soils. This was a marked departure from past policies for heretofore pedology in soil classification was largely a matter for research, and incidentally, a controversial matter.

Basically, pedology (9)* is the science of classifying soils by division into types in accordance with their origin. For example, those derived through the disintegration of limestone in place are included in one category. More detailed differentiation is then made according to characteristics of the limestone, its geological age and formation, topographic positions, depth of overburden above the bed rock, and other features which are considered to be influential on soil properties.

The development of this system for classification came originally through scientific curosity and was principally concerned with geologic aspects. Later - near the close of the last century - the agriculturists adopted the methods for preparing maps showing soil distribution, and for correlating these maps with crops adaptable to certain situations and the yield obtained therefrom. In the field of agriculture this technique has been extended and intensified by the U. S. Department of Agriculture (19), the several state soil surveys, and sometimes both working together in the preparation of reports (24). The state of Kentucky now has about fifteen counties mapped and analyzed in this way; however, many of these are obsolete and only eight are now in print and considered up-to-date.**

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*Numbers in parentheses refer to bibliography at end of this report.

**Jessamine (1916), Shelby (1919), Logan (1922), Muhlenberg (1924), Garrard (1924), Mercer (1930), Fayette (1931), Calloway (1937) counties have been mapped.

In addition, the Agricultural Experiment Station at the University is in the process of preparing a general soil map applicable to the entire state.

Only within the past few years have pedological principles been adopted in a general way by organizations interested in the engineering properties of soils. The work has been done mainly by highway departments, outstanding examples of which are Missouri (18), Michigan (8), Indiana (4), and Tennessee (14). During the war the Civil Aeronautics Administration conducted one extensive project (3) devoted to the entire country and designed to provide information for airfield location and construction. It is significant that the Highway Research Board has reached a point where open consideration of the merits of such a system is considered feasible; it is more significant that opinions relative to the discussion were sharply divided among the representatives from the numerous states.

POSSIBILITIES AND LIMITATIONS TO PEDOLOGICAL CLASSIFICATION

Probably the greatest detriment in the use of a pedologic system for an engineering soil analysis is the factor of misrepresentation or over emphasis by those who have not thoroughly investigated the limitations as well as the possibilities attendant to its use. Among these are the following:

It is a known fact that such a classification can only supplement rather than supplant the normal engineering procedures now used.

The greatest advantage of the system is its potential for saving time and labor in field and laboratory analyses. Certain physical characteristics can be predicted without going into the field. However, some test borings are required to check these predictions. This often amounts to a situation where ten borings planned and distributed in accordance with pedologic information will accomplish the same purpose as one hundred borings taken at random.

An established, basically sound method for soil classification is available, although knowledge of geological aspects and soil mechanics is required to make it usable. The logic behind pedological analyses is sound and clear, for nothing could be more simple than a method of identifying natural materials in accordance with the natural processes of their formation. There is every reason to believe that a rock formation of given character when exposed to a certain set of conditions in nature will decompose and disintegrate to form a soil having certain characteristics irrespective of geographic locations. For that reason, the limestones in the Shenondoah Valley of Virginia which are of the same age as those exposed in the inner bluegrass regions of Kentucky and the Nashville basin of Tennessee should be overlain with a mantel of residual soil whose general characteristics vary only in accordance with minor influences.

Such is the case according to the agriculturist's point of view (with certain reservations); for the Hagerstown and Maury soils in Virginia are the same as those similarly designated in Fayette county Kentucky and Davidson county Tennessee. Furthermore, the age of the underlying bed rock is often limited in significance because Hagerstown soils are recognized in southern Indiana and southern Missouri where the rock formations are somewhat younger than those previously mentioned.

The same principles apply to materials derived from other sources whether they be of glacial or wind-blown origin or formed by water deposition. The loessial or wind-blown materials that prevail on the uplands east of the Mississippi River are alike from the Gulf of Mexico to the Ohio. Further than that, more extensive loessial soils in Missouri, Iowa, and as far west as Washington - although not so named - are not far different from these despite differences in present climatic influences.

Engineering characteristics of the various pedological groups must be determined by test. Naturally, the mere fact that agricultural ends are best served by grouping widely scattered soils into one category does not mean that the engineering properties of those materials are so nearly uniform that the same general differentiation is practical for engineering purposes. However, evidence accumulated through soil surveys made elsewhere indicated that the engineering classification can be more simple than that reached by the agriculturist.

PURPOSE

In order, then, to verify or reject the thesis that similar materials under similar conditions develop similar soils, a study is proposed whereby soils from the different pedologic groups will be sampled in many places throughout the state and subjected to a variety of laboratory tests. The ultimate objective will be to provide engineering significance for pedological designations, and in turn to record the engineering data by maps or other means so that they will be in a form suitable for field application.

SCOPE

All soils of different origin and varied characteristics throughout the state will be included in this survey. In addition, samples of materials thought to be similar to those in Kentucky but located in other states nearby will be obtained through correspondence. In that way, a more thorough and conclusive study can be made and the application will be broader.

MATERIALS

Soils of different classifications may be generally grouped into principal categories as follows:

Residual - Those derived from:

(a) limestone (massive)

(b) sandstone (massive)

(c) interbedded limestone and shale

(d) interbedded sandstone and shale

(e) shale

Soils of the coastal plain - Those materials in the Jackson Purchase which have not been covered to appreciable depths by wind-blown soil.

Loess - Wind-blown soils confined mainly to the Jackson Purchase but also occurring in isolated sections bordering the Ohio River below Louisville.

Alluvial soils - Those material deposited by flowing waters in streams and rivers; subdivided into:-

(a) terraces

(b) recent alluvium

Further subdivision for the purpose of classification will be in accordance with age differentials among the bed rocks from which the soils are derived, topographic positions, character of the rock formation, and similar features.

All these, of course, merely constitute a means of classification and provide very little information concerning the engineering characteristics of the materials involved. However, into these different classifications will be inserted results of engineering tests in the laboratory and field observations relative to problems concerned with highway construction and maintenance. The end point, of course, is a thorough analysis and correlation of data from many different locations to the extent that a given name in pedologic literature will mean certain soil properties in accordance with engineering nomenclature.

PROCEDURES

With an ultimate aim of producing one or more soil maps of the entire state, showing the general distribution of the various soil groups the following procedure was outlined:

1. Soil Sampling - Soils similar in origin but widely separated in location will be sampled from time to time and logged through the depth of their profiles for variations observed in the field and in turn for differences found by means of laboratory tests. As the records are developed they will be examined for evidence of similarity in engineering characteristics so that interpretation of soils in the different groups can be firmly established as rapidly as possible. Because of the fact that only a very limited portion of the state has been mapped in detail, it will be necessary to project experience from one section to another where the soils are known to be nearly alike because they are derived from a common source.

2. Aerial Photographs - Projection of data need not be based entirely on experience, however, since a considerable portion of the state has been photographed from the air. These aerial pictures can be used for recognizing similar patterns and thus identifying the soils in regions which have not been mapped. The principles of photographic interpretation have been well established (2), (3), however, their use is not merely a matter of the investigator becoming familiar with certain patterns characteristic of certain formations and conveying certain definite information. Reliable interpretation is dependent upon a thorough knowledge of the various factors of soil formation as well as soil properties that would determine the air photo pattern.

For an example of the method used in aerial photographs consider a condition where the upland near a large stream drains at lower elevations onto a terrace (a formation of granular material deposited by the river in the distant past during periods of rapid flow); and at still lower elevations onto alluvium deposited by the stream in relatively recent times. As indicated by the sketch Figure 1, erosion patterns would result if surface flow from the upland to the terrace continued to the stream.

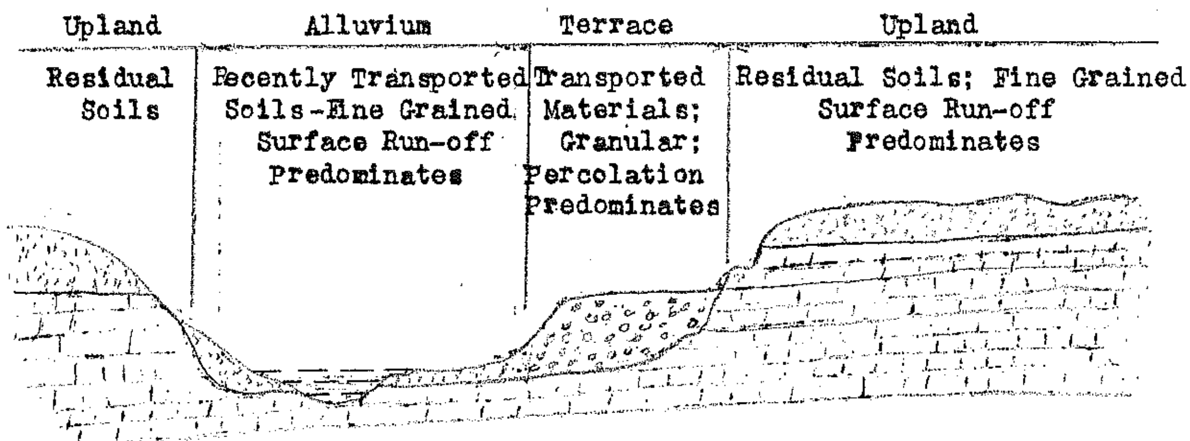

Fig. 1 - Section Through Hypothetical River Valley Showing Soil Distribution

However, the soil on the terrace being granular, infiltration predominates and there is little or no surface flow; consequently, little or no erosion would be evident in the air photo pattern. In the alluvium below the terrace the soil again is generally fine grained and not so permeable; therefore, surface run-off is evident. Furthermore, alluvial patterns are unmistakable due to the outlines characteristic of major stream action.

Similar factors are used in aerial photographs for determining properties of soils in the other general classes. Differences in topography resulting from the disintegration of limestone versus sandstone or shale are readily transmitted to the interpreter through the features of aerial photographs. Sometimes, stereoscopic observations are helpful in these determinations. It should be kept in mind in dealing with this method of analysis that there are some limitations on depth and detail which make well planned field borings and laboratory tests a necessary correlative. On the other hand, the advantages accruing through almost unlimited areal coverage and permanency of record cannot be denied.

3. Laboratory Tests - The laboratory tests will include most of the standard physical tests normally conducted in a soils laboratory: such as, (a) Gradation (b) Atterburg limits (c) Proctor compaction (d) Permeability (e) Specific gravity (f) Capillarity, and (g) Shrinkage and bearing values. It is possible that a few tests may be conducted to determine fundamental information on shearing resistance and quantitative measurements of cohesion. Also of interest may be the chemical and physical characteristics of the soil particles (23).

After these tests have been conducted, the results will be correlated with the pedological data, and a basis derived for establishing highway problems that are characteristic of a given soil type.

EQUIPMENT

Aside from aerial photographs and incidental soil and geologic maps, practically all the equipment necessary for this study is now available in the Highway Research Laboratory. The Division of Planning has a file of aerial photographs (limited coverage) which have been taken in the past and which may be drawn upon for reference or for field correlations. In addition, the Agriculture Adjustment Agency has photographs of all but eight counties (two counties, Johnson and Lawrence, are being photographed at present).

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