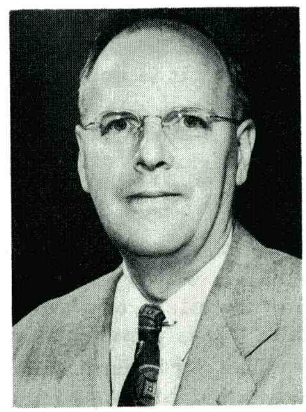
Screenings from the Soil Research Lab

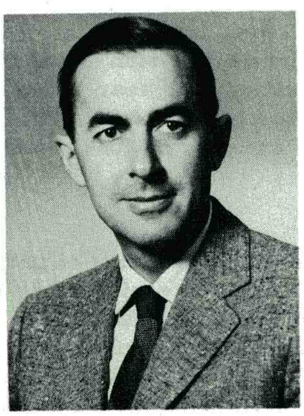
IOWA ENGINEERING EXPERIMENT STATION
IOWA STATE UNIVERSITY of Science and Technology
AMES, IOWA

Jan. - Feb., 1957
Vol. 1, No. 1

Dean J.F. Downie Smith
Director
Iowa Engineering
Experiment Station



George R. Town
Associate Director
Iowa Engineering
Experiment Station



Donald T. Davidson
Professor In Charge
Engineering Soils
Research Laboratory

HISTORICAL SURVEY OF THE FIELD OF ENGINEERING, AND THE REASON FOR THIS PUBLICATION

It was late spring of '27 when the groundhog stuck his head out of the ground and sniffed the air and said, "Forsooth! It is Spring, and I have much Soil Engineering work to do. I believe I shall have at it!" So saying, he turned around and went back down his hole and began his engineering works for the summer.

Our reason for mentioning this is that although groundhogs are a grand bunch they haven't always used a lot of science in their work. They still scoop out dirt and push it around. Technological improvement has been limited.

Then one day Ferguson (the groundhog) was sitting hunched over his third glass of tunnel drippings when a thought came to him. "Egad, Henrietta!" (Henrietta is also a groundhog. You don't expect groundhogs to live alone, do you?) "Egad, Henrietta, I am the acknowledged expert at pushing dirt around, yet I do not know that whereof I have been pushing! I am ignorant! I must become educated!" He then trundled off and read a book.

This was many years ago, and it is the first recorded instance of a soil engineer ever actually worrying about soil. We like to repeat it because it is such a landmark in our history. Soil engineering has, of course, gone on from there, particularly in recent years. Nowadays all soil engineers worry about soil. In fact in recent years there has been a tremendous multiplication of specialists called Research Groundhogs. That is our topic for today.

Research Groundhogs are distinctive in that their greatest delight is seeing what new can be dug up. We have quite a few of these characters laughing and cavorting and scooping the dirt around at Iowa State College. They are a conglomeration of civil engineers, geologists, chemical engineers and chemists, most of them working on soil stabilization.

With such a wide variety of approaches to different problems our Research Groundhogs have naturally unearthed some interesting things. They have, in fact, published scientific papers and reports in a flood to rival the Gargantuan deluge. The only difficulty is that as scientists they must write their reports giving all relevent information, which usually includes charts and graphs and masses of data. This does not make for a very high readability.

(Continued on next page)

HISTORICAL SURVEY (Continued)

Also we might point out that groundhogs don't often speak English; they insist on communicating by grunts and whistles. This is apparent as you read a few technical papers. Fortunately translation is not too difficult. Another problem is that after burrowing in the ground for many months a Research Groundhog may know very well that he has gotten somewhere, but due to the difficulties inherent in subterranean surveying, he may not know exactly where he has gotten. He is naturally impressed by the long and tortuous route. So in writing up his work as a thesis it is good scientific policy to miss the point or bury it way back at the end somewhere. That is the history of the experiment; that is how the mind works. Translation becomes a bit more difficult.

Therefore, the birth of a new journal! We will be go-between; translator; we will try to show the meaning of the grunts and whistles, to give intelligence to the unintelligible. This paper will enjoy a much wider distribution than our technical papers and will reach many non-technical persons. Our aim is to increase interest and inform; for the interested reader we will suggest appropriate reprints which describe more fully the work mentioned here.

Our main goal will be to disseminate findings from soil stabilization research. Furthermore you can expect us to be a little hoggish; we will like to point out what we have done. We're still groundhogs, you know; a groundhog can't see very far into the next burrow. That's not our problem; it's the other groundhog's. On the other hand don't worry; we will try to maintain a high general awareness and will not omit passing on pertinent information from other sources, giving credits of course, especially if they are friends.

RLH

ROAD RESEARCH PASSES THE HAT FOR A NEW CONSTRUCTION ERA

Since time immemorial man has preferred to follow the beaten path, so much so that he likes to have other people to run ahead and beat it down for him. From native boys sent ahead to hack out a jungle trail we have progressed to the modern Highway Engineer, whose job is somewhat more complicated even though on a roughly parallel pay scale. Today's manufacture of beaten paths requires much more than just a machete. It takes a bulldog, er, excuse me, a bulldozer, and a lot of other things as well. One of these things is materials. That is our subject for today.

The dominant materials in most roads are sand and gravel or crushed rock. This is true whether the road is made with asphalt, portland cement, or grandma's toothpaste. Even ordinary gravel roads contain gravel or rock, although some people estimate them at 100 percent dust. But it's a fact; gravel roads usually have gravel. This is turned into dust or flung from the road by a process of scramble and bounce. Then we have to put on more gravel or crushed rock.

This road maintanence plus bountiful new road construction leaves us with an urgency for more gravel and rock. In Iowa this is not so easy because of the gosh-blasted cold weather — not the cold weather now, but the cold weather a few thousand years ago when Iowa was smushed out under a series of mighty glaciers. As you know, a glacier dirties things up when it melts, and the glaciers really dirtied up Iowa. They left a lot of soil and covered up our nice rock. We engineers naturally look on this with some tinge of regret, but we'll be big about it and admit it's great for the corn. Still, we'd like more rock.

The apprehension over dwindling available rock resources had to lead somewhere, if only to ulcers and poor roads. A more productive attitude was to look towards research. The Iowa Highway Research Board boldly tackled the problem by sponsoring a wide variety of investigations by the Iowa Engineering Experiment Station and the Iowa Geological Survey. Suddenly the search was on! Since then, similar investigations have been started in other states and on a national level.

Soil Stabilization

The largest single effort in terms of personnel and money spent has been an intensive study of Iowa soils and methods of soil stabilization. Soil stabilization is simply that -- increasing the stability of soils under all weather conditions so they may be used as the structural members in roads. An ideal might be to sprinkle some magic substance over a muddy road and have it instantly dry up to have a strength equivalent to, say, soft steel. We are not quite so naive as to expect this, and we will settle for something less. We will settle for anything that will make soil strong enough to support light traffic on secondary roads. Furthermore it must be cheap. Not only will we save gravel; we will settle a lot of nasty old dust.

Soil stabilization research got a big boost in September, 1950, when a project was set up at the Iowa Engineering Experiment Station, Iowa State College, with funds from the Iowa Highway Commission. The title of the project is, "The Loess and Glacial Till Materials of Iowa; An Investigation of Their Physical and Chemical Properties and Techniques for Processing Them to Increase Their All-Weather Stability for Road Construction," a meaningful mouthful when you stop to read it.

(Continued on next page)

ROAD RESEARCH (Continued)

The project is under the supervision of the New Hampshire dynamo, Dr. Donald T. Davidson, who says, "We can stabilize anything soft, including a lady's smile. All we need is the right treatment or admixture."

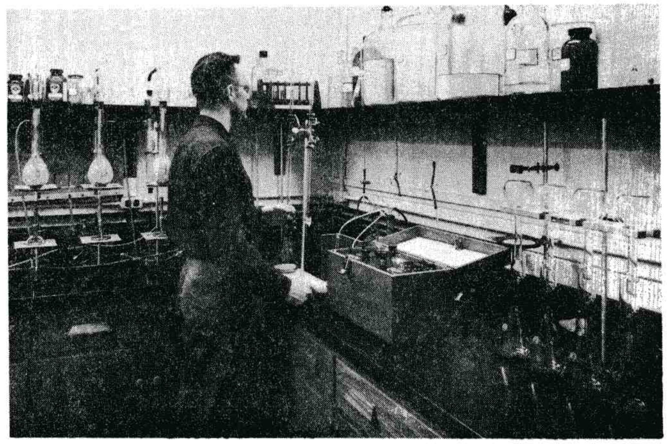
You tell them, Doc; the only question is how do we find the right treatment or admixture? Men have looked for the one answer for years; our fervent hope is that soils will be easier to engineer for permanence than a feminine smile. Otherwise we give up.

The Scientific Approach

As for soil stabilization, our plan is to put some science in the research. You can tell we've been watching cigarette ads. There are two ways to launch into research; trial-and-error, and the scientific approach. Trial-and-error is easiest but also a little blind; each trial gives you a yes or no, and your chances for a yes are little better after 10,000 no's than they were after the first. Science allows you to figure out how and why, so your trials and errors mean something. Then you can use your wits and go ahead with better and fancier trials and perhaps fewer errors.

Since this is to be a scientific approach, first we must know soil. A knowledge of soil is basic and essential to the whole operation; how are you going to figure out what happens if you don't know what you're working with? Unfortunately soil is not just soil; it varies literally all over the place. So soil stabilization rightly starts in the outdoors with a field study of soils. A part of this study is the intelligent collection of samples. Actually this is a critical phase of the investigation; there is nothing so worthless or insulting as a poor sample. You can spend six years running laboratory tests on a bad sample and think you've gotten somewhere when actually all you've done is learn how. The sample must represent something or results cannot be properly evaluated or applied to soil in the field.

Field sampling completed, we can go into the lab; objective, to know the soil. One can start by identifying the minerals. If your impression of minerals comes from animal-vegetable-mineral idea, forget it; this is something different. Minerals in soils are crystalline chemical compounds with definite atomic arrangements -- such things as mica and quartz. The kinds of minerals present have a terrific influence on a soil's engineering properties. Also the mineralogical composition will determine reactions with chemical stabilizing treatments.



Laboratory study begins with an investigation of fundamental properties of soils. Dr. J.B. Sheeler titrates a soil to determine its alkalinity.

In the laboratory the soil samples are sieved, separated, studied under a polarizing microscope, ground, boiled, baked, treated burned, treated with chemicals, melted, X-rayed, photographed, stained or whatever else may help. Directly or indirectly one tries to find out all that present techniques allow. We measure percentages, particle sizes, surface areas, and what all.

This much is pure science, with practical applications practically invisible. Now we can come up with a little engineering use. One can measure engineering properties such as plasticity, bearing capacity, shrinkage, etc., the plan being to compare these data with the wealth of background information on each soil. For example, plasticity should be related to composition, and as it turns out it is. Similarly, composition is related to field relationships. You can see the ready possibilities for shortcuts in future studies of these soils. This is science, learning about the orderly arrangement of things.

We still haven't discussed trial-and-error. Soil stabilization is so new there is little else a beginner can do. But after a few trials he is no longer a beginner; he can look at his results and look at the soil and say this or that will or won't work and why. This is trial-and-error with an open eye. If the eye gets sleepy and tends to close sometimes we say that's OK, take a break and go fishing. But come back with an open eye. The laboratory research pattern boils down to this: (1) Select a problem and if possible predict the answers, (2) design the research to satisfactorily test the predictions, (3) do the work, (4) analyze the results, paying as little heed as possible to all those loose predictions, (5) to every result apply the ubiquitous question "why." Possibilities for "Why" often show the way and give the predictions for new and better research and carry us closer to the final answer.

RLH