Foundation repair part II

Here are the factors contributing to repair activity within an area in relation to soil properties

By Robert Wade Brown

According to the Dallas study on foundation repair discussed in Part I in the previous issue, factors other than soil problems contribute to the repair activity within an area. Some of these more important influences are: (1) size and residential density of the area considered, (2) income level of the property owners, (3) age of the development. These factors must be weighed when attempting to correlate activity within an area to Atterberg Limit data or other soil properties.

Table I presents soil test data from various locations within the Dallas area. Each set of data is lettered A through K. In all cases the individual data (moisture content, plastic limit, liquid limit, plasticity index and linear shrinkage) reflect the weighted average values to a soil depth of 15 feet. The Atterberg Limits are consistently less favorable for soils within the active areas than for other sections, and in (or very near) all problem areas, the plasticity index is within the critical range.

TABLE I *Soil Test Data*[a]

Test Designation	Moisture Content, Percent	Plastic Limit, Percent	Liquid Limit, Percent	Plasticity Index	Linear Shrinkage, Percent	Description of Stratum
Irving, Texas:						Medium stiff brown, gray, and tan silty clay to
A1*	18	16	50.4	34.4	13.5	6 feet. Stiff tan and gray clay to 36 feet. Blue
	17	10	51.7	40.7	15.7	shale.
A2*	26	32	77.8	45.8	20	Medium stiff clay to 3 feet. Stiff tan clay to 28
	24	31.9	75.0	43.1	19	feet. Blue shale.
B*	25	26	72.1	46.1	19	Stiff tan clay to 25 feet.
C	20	20.9	38	17.1	10	Stiff brown and gray sandy clay to 6 feet. Stiff tan and gray clay to bottom of test at 20 feet.
Richardson, Texas:						
D* (area 2)	38	26.5	63.4	36.9	20	Plastic dark brown clay to 8 feet. Brown and
	32	27.3	62.8	35.5	19	tan limey clay to 18 feet. Fractured limestone.
Dallas, Texas:						Stiff brown and tan silty clay (fills) to 3 feet.
E* (area 1)	20	14	41	27	20	Stiff gray and tan sandy clay to 13.5 feet. Firm
	22	15	40	25	22	tan sand to bottom of test at 20 feet.
F	20	11	32	21	10	Stiff dark brown clay to 6 feet. Plastic brown, tan and gray sandy clay to 11.5 feet. Firm tan sand to 28 feet. Blue shale.
Duncanville, Texas:						
G	—	25	37	12	7	Stiff dark brown silty clay to 1.5 feet. Fractured limestone.
Garland, Texas:						
H	25	18	48	30	12	Stiff brown and tan clay to 2.5 feet. Fractured limestone.
I*	23	16	52	36	17	Dark brown clay to 3 feet. Tan limey clay to 20 feet. Limestone.
J*	23	21	50	29	17	Stiff dark brown clay to 7.5 feet. Fractured limestone.
Seagoville, Texas:						
K	16	14	32.2	18.2	11.5	Dark brown sandy clay to 1.5 feet. Stiff brown, tan and gray sandy clay to 9 feet. Firm tan sand to 11.5 feet. Brown silty clay to 25 feet. Blue shale.

a. Test data the courtesy of Mr. G. B. Mitchell, Southwestern Laboratories, Dallas, Texas.
* Indicates tests in or very near the areas of concentrated foundation repair.

TABLE II PVC Meter Soil Test Data

Sample	Swell Index Number per square foot	PVC Category	Approximate Plasticity Index
Dallas, Texas			
15. Denton clay, Dallas, Texas*	3800	Critical	30
16. Soil, Dallas, Texas*	5050	Very Critical	39
17. Soil, Dallas, Texas	2800	Marginal	22
18. Soil, Dallas, Texas	5200	Very Critical	42
19. Soil, Dallas, Texas	4050	Critical	32
20. Soil, Dallas, Texas	4400	Critical	34
21. Soil, Dallas, Texas	5450	Very Critical	43
22. Soil, Dallas, Texas	900	Non-Critical	9
Duncanville, Texas			
24. Soil, Duncanville, Texas	2200	Marginal	18
25. Soil, Duncanville, Texas	1400	Non-Critical	13
Garland, Texas			
28. Soil, Garland, Texas	5400	Very Critical	43
29. Soil, Garland, Texas	4700	Critical	37
30. Soil, Garland, Texas	5650	Very Critical	44
Irving, Texas	1550	Non-Critical	14
35. Soil, Irving, Texas			
Lancaster, Texas			
38. Soil, Lancaster, Texas	4700	Critical	37
Mesquite, Texas			
39. Soil, Mesquite, Texas	2800	Marginal	22
Plano, Texas	6300	Very Critical	51
40. Soil, Plano, Texas			
Richardson, Texas			
41. Soil, Richardson, Texas	5850	Very Critical	47

* Sample and text by Elvin F. Henry

* Tests numbered 16-41 under the direction of Mr. Herschel Smith, Dallas, Texas

Table II presents similar soil data. For all practical purposes these data mirror those presented in Table I. Note particularly the indicated PVC (potential volume change) categories. These certainly indicate that Dallas represents one of the more severe problem areas and also show a correlation of swell tendencies to the plasticity index.

Area correlation

It appears that treatment techniques could be correlated from area to area provided suitable knowledge is known or available defining the soils in the area climatic rating, Atterberg Limits and the mineralogical content of the soil. The first two do not pose a problem. In time, perhaps the latter will be commonly available.

It is apparently certain that the principal volume change results from the presence of montmorillonite in the soil. However, the amount of montmorillonite varies considerably and the higher the content of this clay, the more severe the soil problem.

Intuitively this would necessitate technique modification from area to area if optimum results are to be realized. Unfortunately the mineralogical breakdown of the Dallas soils was not available at the time of this report. When this information becomes available it might develop that modification of the repair technique will eliminate re-dos or permit a more economical approach. In any event this knowledge should permit correlation of other soil problem areas to Dallas and provide a key for proper treatment design universally.

The information sought in the report could provide a technical basis for designing soil stabilization (lime or otherwise) for preconstruction as well as remedial applications. Soil, properly stabilized, should not produce foundation problems. Nonetheless, if the history developed in the Dallas area could be realized in all other problem areas, foundation repair could become relatively routine.

Research program

Currently a research project is underway which hopefully will furnish supplemental information to help make this a reality. The program is intended to establish such facts as: (1) the relationship between volume change tendencies, stabilization requirement, and mineralogical composition; (2) the chemical and physical mechanisms for stabilization; (3) effect of CA++ ion & pH on stabilization (could a less noxious CA++ ion vehicle be substituted for lime, for example); (4) reversibility of stabilization reactions; (5) does the plasticity index adequately relate various soils with respect to volume change tendencies; and (6) can a stabilization agent, superior to lime, be developed. These data will be published by Robert Wade Brown & Associates, Dallas, Texas, when they become available.

This is the final portion of the two-part article on foundation repair. Part I appeared in CONCRETE CONSTRUCTION in July 1971, pages 283-285.

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