RESULTS OF GEOTECHNICAL ANALYSIS OF THE BAJIINO AREA (CORIOLEI)

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1. Introduction

Since there are no previous reports on the geotechnical properties of the alluvial soils of the Shabelle river near Bajiino, nor on almost any of the soils of Somalia, we make use of the results of this research for a first approach to the geotechnical properties of soils near the Bajiino area.

This research was partially financed by the Konoike Construction Ltd., Tokyo, contracted to construct a reservoir for drinking-water for the population of Coriolei.

We would like to extend our thanks to the above company and to the Faculty of Geology, who gave us the possibility of carrying our this research, which will be useful for future works in the investigated area.

In this paper we present the results of the first phase of geotechnical testings made in the Coriolei area, particularly near Bajiino (Fig. 1).

The research was aimed at defining the lithostratigraphic sequence of two geognostic boreholes made in the area and, later, the execution of in-situ and laboratory tests on borehole samples.

The following paragraphs summarize the determinations carried out and their results:

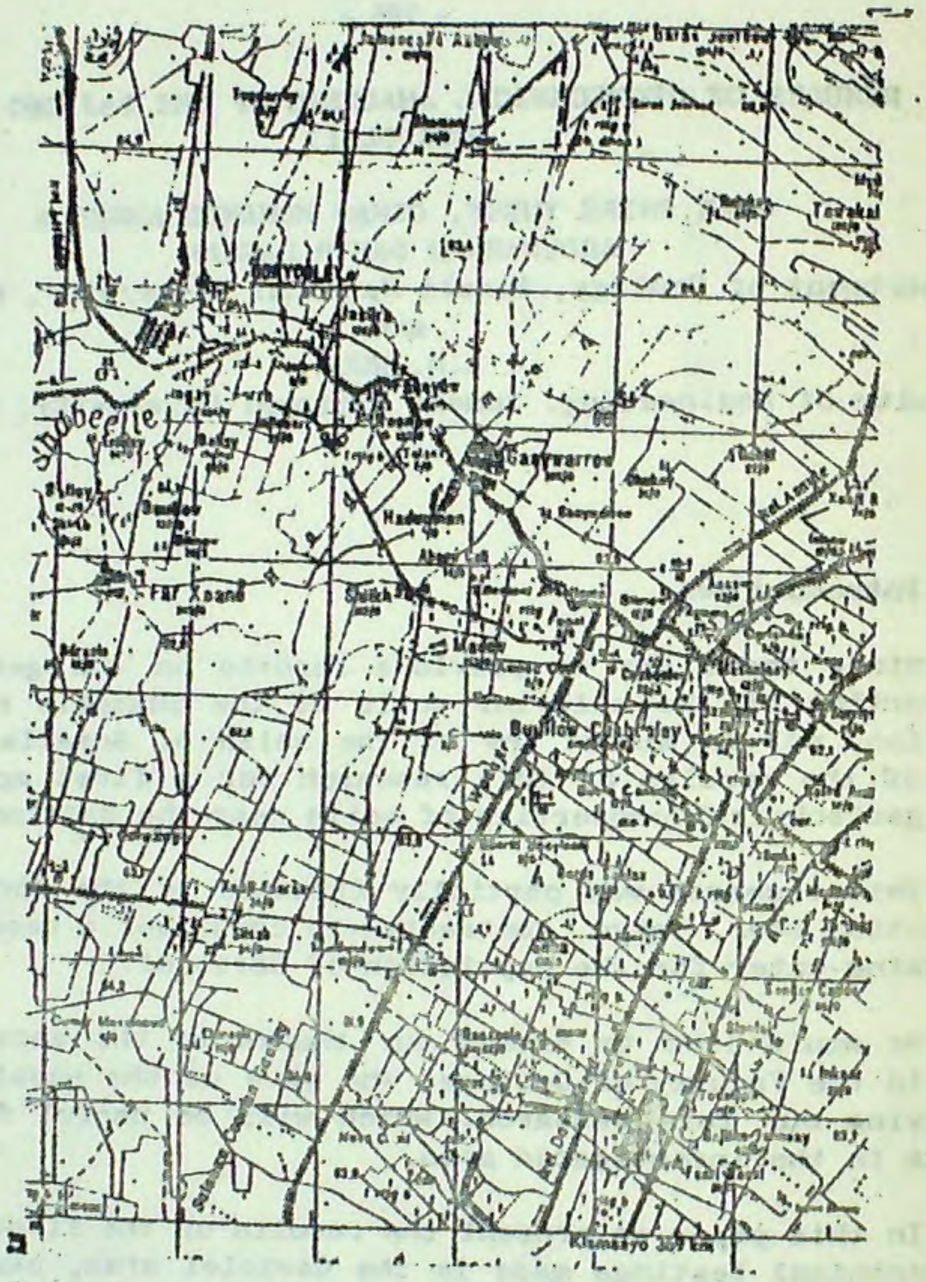

Fig.1: Location map of the studied area

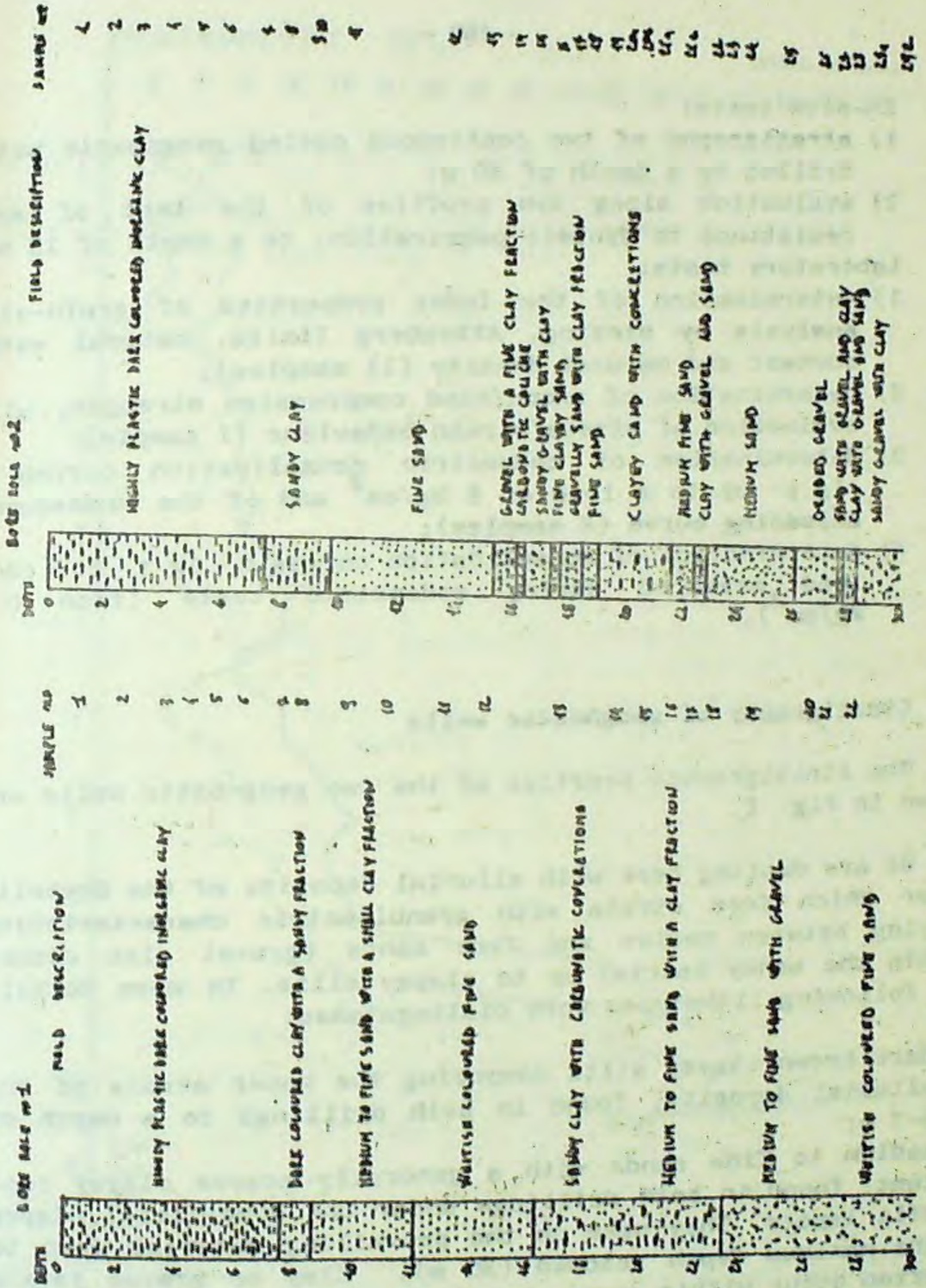

Fig.2: Stratigraphy of the studied bore holes

A) In-situ tests:
   1) stratigraphy of two continuous coring geognostic wells drilled to a depth of 30 m;
   2) evaluation along two profiles of the test of soil resistance to dynamic penetration, to a depth of 13 m.

B) Laboratory tests:
   1) determination of the index properties of grain-size analysis by sieving, Attemberg limits, natural water content and natural density (11 samples);
   2) determination of unconfined compression strength, with evaluation of stress/strain behaviour (1 sample);
   3) determination of oedometric consolidation curves e -lg p up to a load of 8 kg/cm^2 and of the subsequent unloading curve (8 samples);
   4) determination of consolidation curves h - lg t for each load measured during eodometric tests (from 0.5 kg/cm^2).

2) Stratigraphy of geognostic wells

The stratigraphic profiles of the two geognostic wells are shown in Fig. 2.

We are dealing here with alluvial deposits of the Shabelle river which form strata with granulometric characteristics varying between medium and fine sands (gravel also occurs within the sandy matrix) up to clayey silts. In more detail, the following lithotypes were distinguished:

a) dark brown clayey silts composing the upper strata of the alluvial deposits, found in both drillings to a depth of 6-7 m;
b) medium to fine sands with a generally scarce clayey content, found in both drillings under the superficial clayey silt layers. They make up the prevailing material down to the maximum depth reached (30 m). Clay or gravel levels often occur within these sands. In particular, silty sandy levels with a noticeable clay content are found when passing from the upper clayey deposits to the lower sandy deposits (at a depth of 7-9 m).

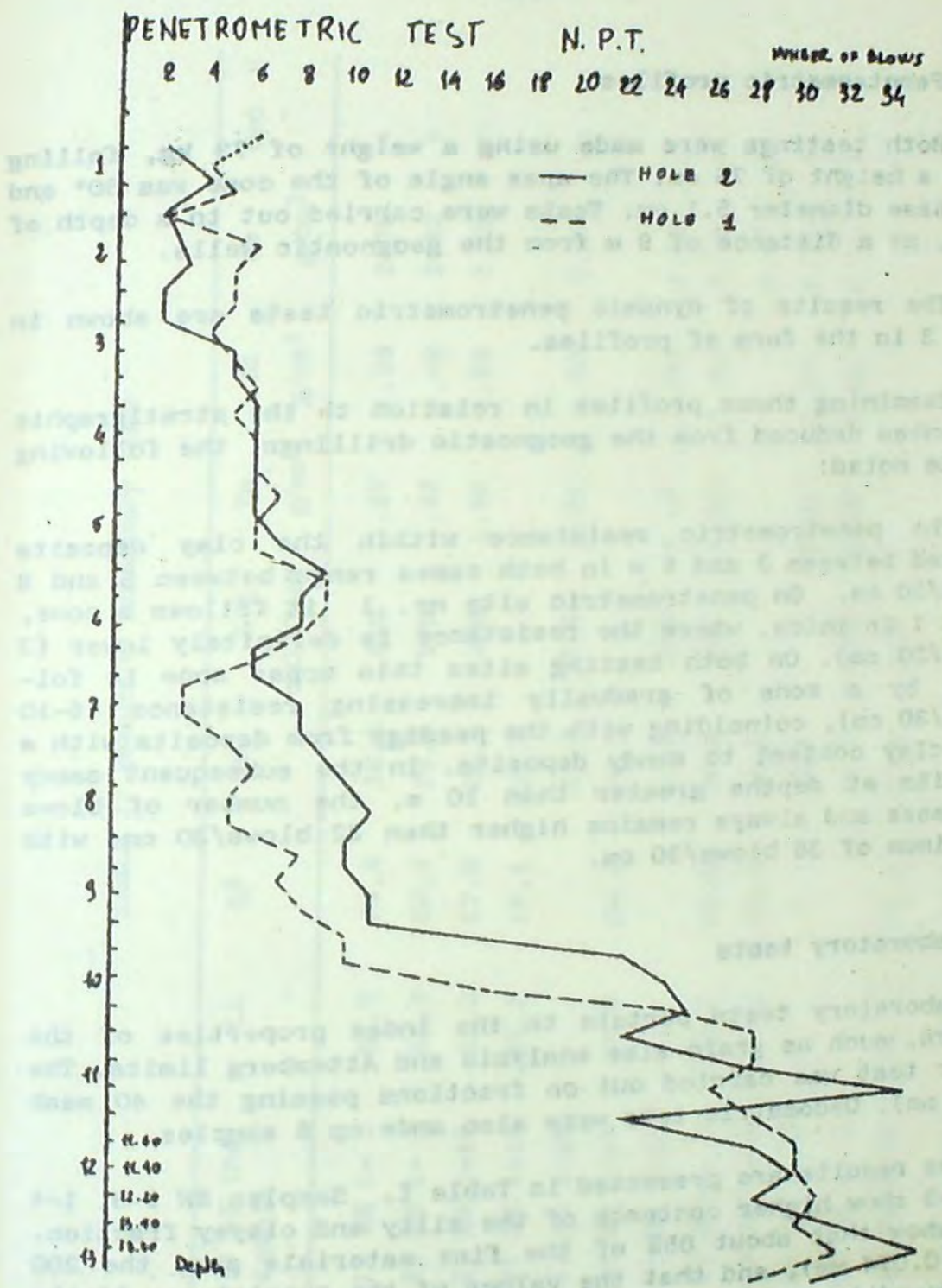

Fig.3: Penetrometric tests

3) Penetrometric profiles

Both testings were made using a weight of 73 kg, falling from a height of 75 cm. The apex angle of the cone was 60° and the base diameter 5.1 cm. Tests were carried out to a depth of 13 m, at a distance of 9 m from the geognostic wells.

The results of dynamic penetrometric tests are shown in Fig. 3 in the form of profiles.

Examining these profiles in relation to the stratigraphic sequences deduced from the geognostic drillings, the following may be noted:

The penetrometric resistance within the clay deposits located between 3 and 6 m in both cases ranges between 5 and 8 blows/30 cm. On penetrometric site no. 1 it follows a zone, about 1 in thick, where the resistance is definitely lower (3 blows/30 cm). On both testing sites this upper zone is followed by a zone of gradually increasing resistance (6-10 blows/30 cm), coinciding with the passage from deposits with a high clay content to sandy deposits. In the subsequent sandy deposits at depths greater than 10 m, the number of blows increases and always remains higher than 22 blows/30 cm, with a maximum of 36 blows/30 cm.

4) Laboratory tests

Laboratory tests pertain to the index properties of the samples, such as grain-size analysis and Attemberg limits. The latter test was carried out on fractions passing the 40 mesh (0.42 mm). Oedometric tets were also amde on 8 samples.

The results are presented in Table I. Samples BH 1-3, 1-4 and 2-3 show higher contents of the silty and clayey fraction. They show that about 85% of the fine materials pass the 200 mesh (0.074 mm), and that the values of the consistency limits correspond to highly plastic inorganic clay on the Casagrande plasticity chart.

TABLE I: Results of laboratory tests

Nº of the sample	LL	LP	Wn	% < d=0,074mm	Yn g/cm³	Yd g/cm³	Gs g/cm³	Oed	U
1) BH 1- 3	66,7	23,6	35,6	85%	1,87	1,38	2,70	*	
2) BH 1- 4	54,3	22,2	29,4	97%	1,92	1,48	2,62	*	
3) BH 1-10	31,0	17,5	24,4	33%	1,98	1,59	2,65	*	
4) BH 1-15	29,2	19,1	37,8						
5) BH 1-16			21,7	51%	1,98	1,63	2,64	*	
6) BH 1-19	36,9	24,1	23,7						
7) BH 1-22			14,9	26%	2,16	1,88	2,66	*	
8) BH 2- 3	72,2	26,8	36,8	97%	1,90	1,40	2,76	*	
9) BH 2- 4	39,2	20,0	28,2				2,62	*	
10) BH 2- 6			24,7		2,02	1,62	2,70	*	*
11) BH 2- 9			29,9	73%	1,95	1,50	2,74	*	
12) BH 2-10	32,1	18,2	22,8	40%					

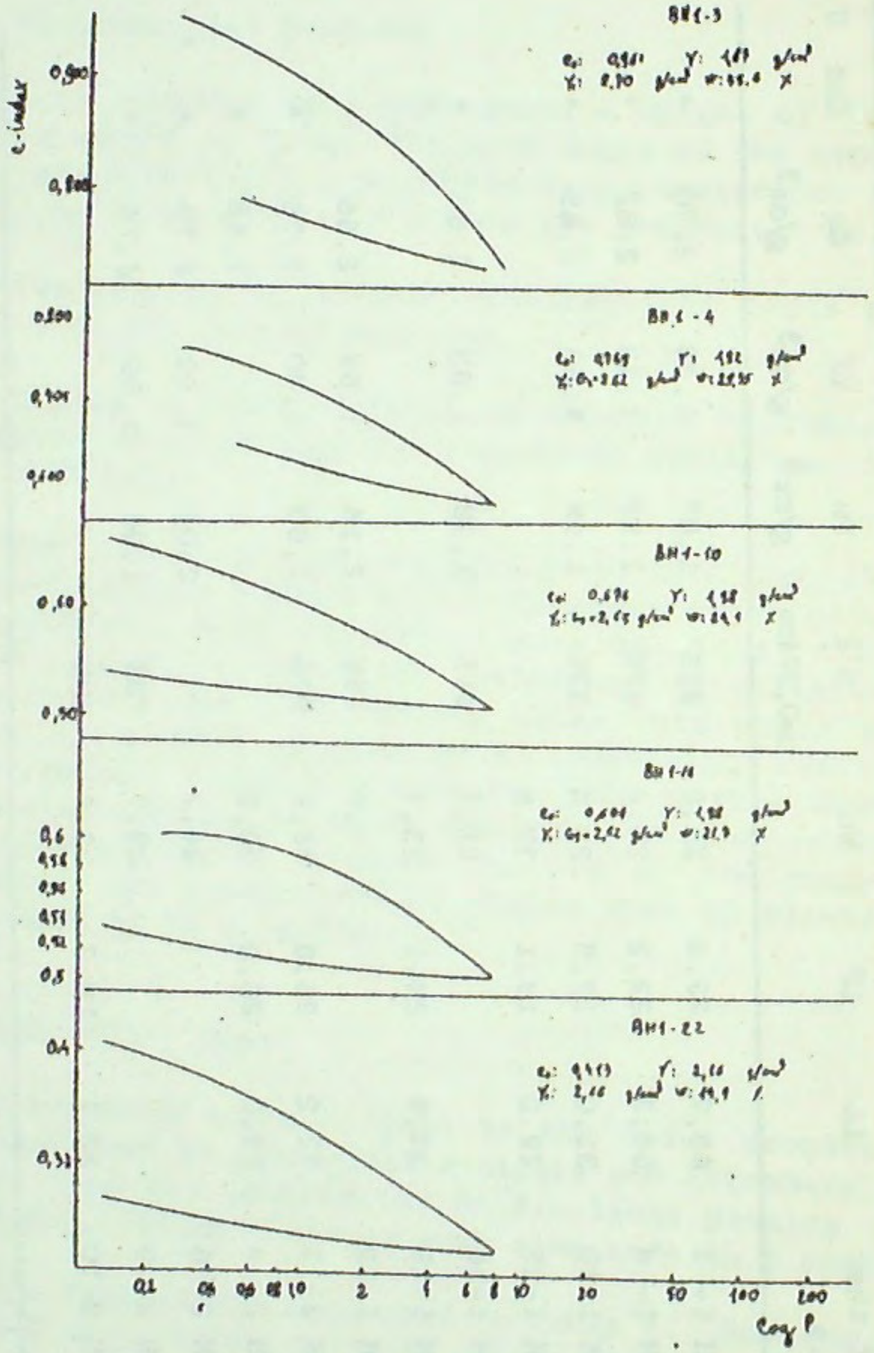

Fig.4: Confined compression tests

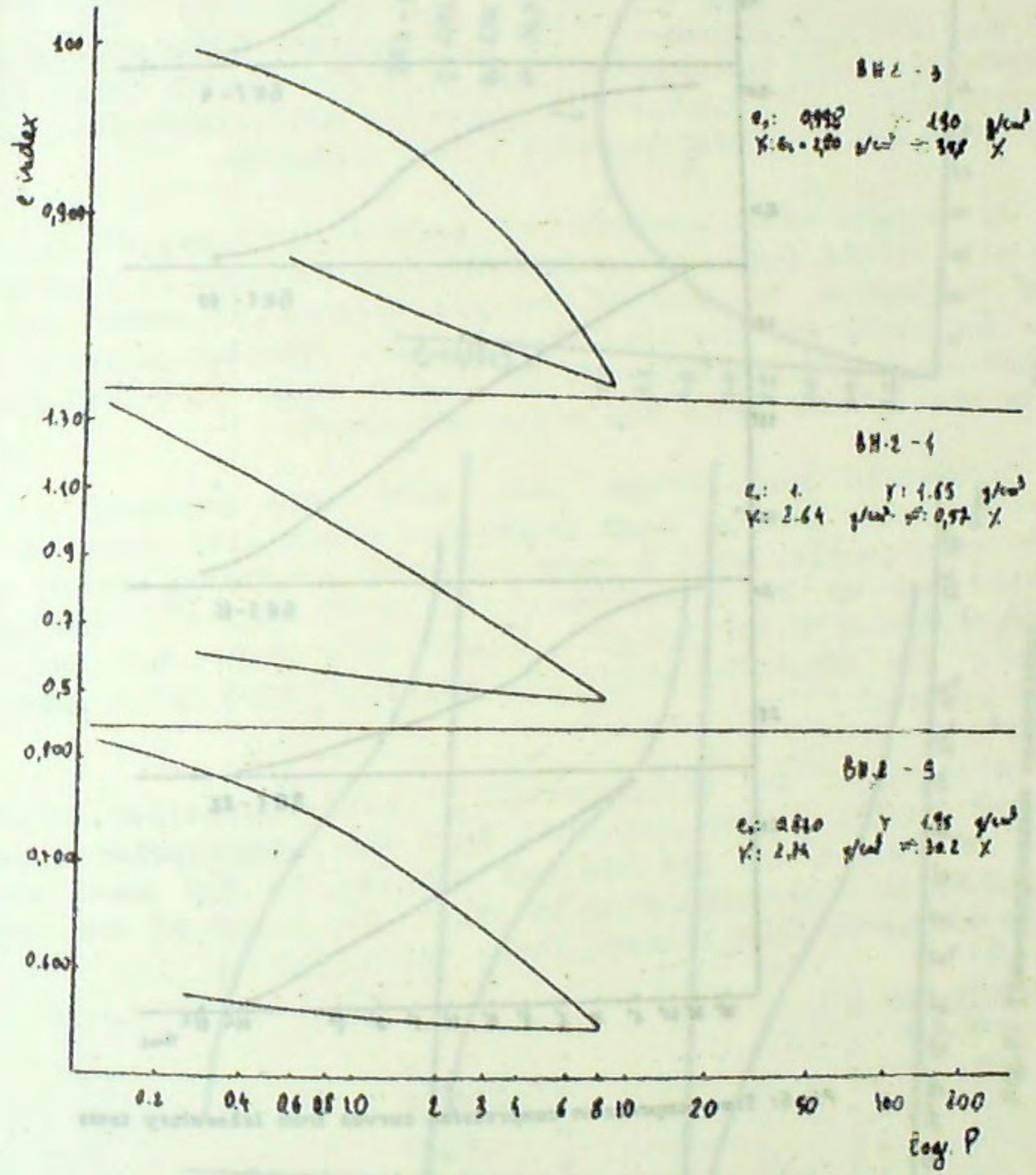

Fig.5: Confined compression tests

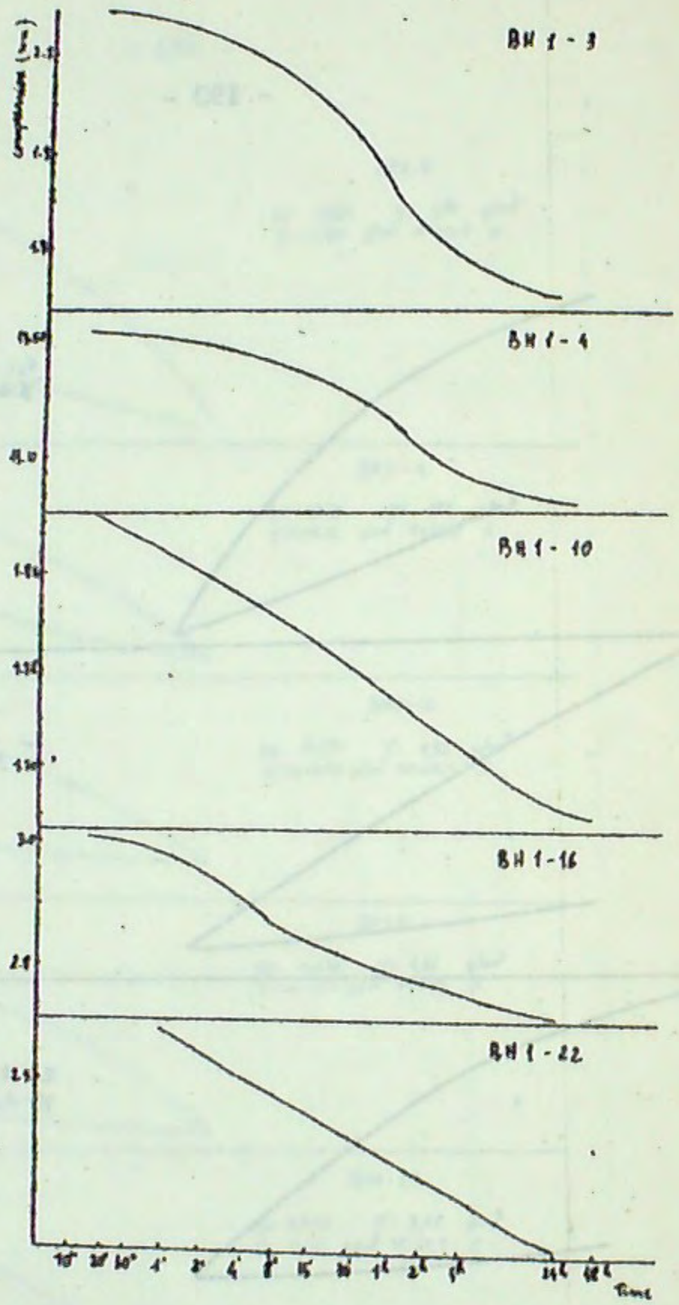

Fig.6: Time-compression compression curves from laboratory tests

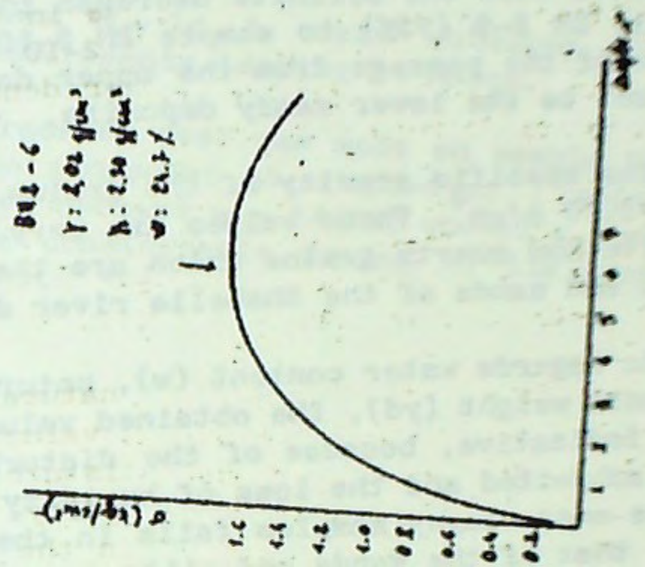

Fig.8: Unconfined compression tests

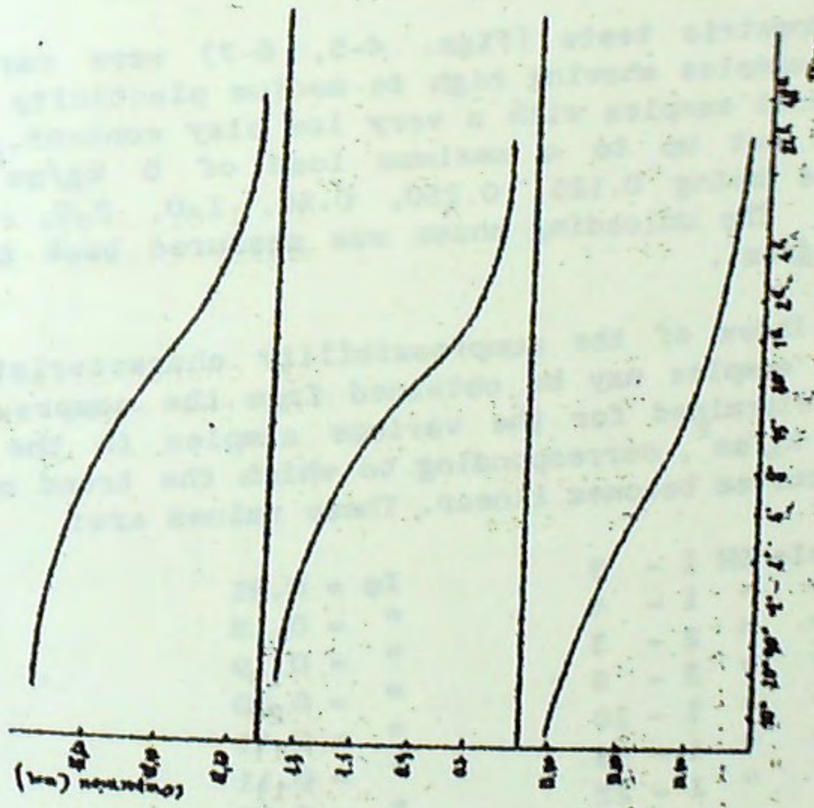

Fig.7: Time-compression compression curves from laboratory tests

Of the deeper samples, the percentage of materials passing the 200 mesh (0.074 mm) is generally lower than 50%. It should be noted that the definite decrease in the fine fraction, from sample BH 2-9 (73%) to sample BH 2-10 (40%), is further evidence of the passage from the upper deposits with a high clay content to the lower sandy deposits.

The specific gravity of the grains (Gs) falls in the range 2.62-2.76 g/cm^3. These values are very similar to those of the calcite and quartz grains which are the main components of the silts and sands of the Shabelle river deposits.

As regards water content (w), natural unit weight (yn) and dry unit weight (yd), the obtained values should be considered only indicative, because of the disturbance to which samples were subjected and the loss of humidity. The dry density (yd) of the most clayey samples falls in the range 1.4-1.48 g/cm^3, while that of the sands and silts increases.

Oedometric tests (Figs. 4-5, 6-7) were carried out on clayey samples showing high to medium plasticity and also on sandy silt samples with a very low clay content. Tests were carried out up to a maximum load of 8 kg/cm^2, the load sequence being 0.125, 0.250, 0.50, 1.0, 2.0, 4.0 and 8.0 kg/cm^2. The unloading phase was measured back to a load of 0.125 kg/cm^2.

An index of the compressibility characteristics of the various samples may be obtained from the compression values (Ic), determined for the various samples in the load range 2.0-8.0 kg/cm^2, corresponding to which the trend of the oedometric curves becomes linear. These values are:

Sample BH 1 - 3	Ic = 0.21
" " 1 - 4	" = 0.18
" " 2 - 3	" = 0.19
" " 2 - 9	" = 0.20
" " 1 - 10	" = 0.11
" " 1 - 16	" = 0.11
" " 1 - 22	" = 0.05

Consolidation curves h - lg t were obtained for all samples by means of measurements lasting 24 hours.

An unconfined compression test was made on sample BH 2-6, using axial deformation equipment at a speed of 1 mm/minute. The sample, with a water content w = 24.7%, showed a number of small fractures due to considerable drying in its container before the test (Fig. 8).