SOME GEOTECHNICAL PROPERTIES OF SOILS IN THE HADITHA AREA, W. IRAQ.

QUELQUES PROPRIÉTÉS GÉOTECHNIQUES DES SOLS DANS LA RÉGION D'HADITHA (OUEST DE L'IRAK)

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Abstract

The present study is part of the regional engineering geological survey of the western desert dealing with soil investigations attempting their classification and evaluation for engineering purposes. Field study has revealed that these soils are mainly of residual origin, partly they are colluvial and alluvial. Laboratory test results show that they composed of both coarse and fine fractions. The coarse-grained are mainly of SM-group, less frequently of SC-group. Fine-grained soils are of both CL- and ML groups in equal significance. These soils are seldom free from soluble salts, particularly sulphates in the form of secondary gypsum, some with a high content. Results are discussed in detail. Important engineering properties with suitability for engineering use are also given.

Résumé

Cette étude fait partie d'une étude géologique, et géotechnique régionale du désert de l'Ouest de l'Irak ; elle se rapporte à l'étude des sols en vue de leur classification géotechnique. L'étude de terrain a montré qu'ils étaient essentiellement d'origine résiduelle, et en partie colluviaux et alluviaux. Les sols à grain grossier sont essentiellement de la catégorie SM, moins fréquemment SC. Les sols à grain fin sont répartis également entre les catégories CL et ML. Pratiquement tous contiennent des sols solubles, et en particulier des sulfates sous la forme de gypse secondaire, et certains en quantités importantes. Les résultats des essais, de même que les caractéristiques géotechniques et les implications pratiques sont discutés dans l'article.

1 — Introduction

The study area of about 1 200 km² is located along the right bank of the Euphrates river from wadi Al-Akhthar to wadi Al-Fhaimi in the western part of Iraq (Fig. 1). A total of 216 pits were dug of which 116 were devoted to regional study, only 77 being sampled, the remaining 100 were assigned to detailed study, only 39 being sampled.

The method of sampling adopted (B.S., CP 2001, 1957) was to take representative samples from mappable soil units. Partly undisturbed samples were collected which are adequate for classification tests as well as other physical properties. Field study was performed including different engineering properties such as stratification, compactness, cementation.

The unified soil classification system (USCS) method was followed. Soluble salts content was computed from the results of chemical analyses.

With the exception of sheet no. NI-38-0563, which has been studied in detail, each sheet was studied regionally according to soil origin.

2 — Data presentation

2.1 — Regional study

2.1.1 — Residual soil

It is the main type of soil in the studied area, generally covering flat and very gently sloping areas. Gravels, 0-53.7 %, are frequently of subrounded to subangular shape. Calcite and or dolomite are the significant constituent minerals, less abundant are marly limestone and marl. Sands form 7.4-72.5 %. Fines including both silts and clays form 5-90.2 % (Fig. 2).

These soils are generally slight to medium compacted, un cemented to slightly cemented, essentially by secondary gypsum, rarely with calcite crystals. They are almost invariably dry, with an internal drainage system. Liquid limit ranges from 26-62 %, plastic limit 18-38 %, and plasticity index 3-39 %. Fig. 3 shows that almost all samples have liquid limits less than 50 % implying low plasticity. They fall within the CL-group denoting low-medium plasticity inorganic clay or “lean” clay, and the ML-group indicating low plasticity inorganic silts.

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No significant organic material was noted. Specific gravity ranges from 2.21-2.69. Dry bulk density ranges from 1.00-1.77 g/cm³ averaging 1.32 g/cm³. Porosity 27.8-39.8% averaging 31%. Specific gravity 2.42-2.68. Soluble salt content 2.2-41.9% of which sulphates form 0.07-17.2% and carbonates 18.8-32.6%. These soils are impermeable to semi-permeable, only 4 samples are satisfactory for compacted earth linings.

2.1.2 — Colluvial soil

Follows residual soil in occurrence, generally covering slopes, consisting of both coarse and fine-grained material.

Gravels (0-42.8%) are mainly of subrounded shape. Calcite and/or dolomite, marly limestone are the significant constituent minerals, less frequently are chalky/marly limestone. Sands form (18-69%), fines (13-82%) (Fig. 4).

These soils are entirely unstratified, mainly slightly cemented, mostly by secondary gypsum. They are almost dry, generally slightly compacted, frequently with an external drainage system.

Liquid limit ranges from 22-43%, plastic limit 17-25%, and plasticity index 5-18% (Fig. 5) shows that all samples have liquid limits less than 50% involving low plasticity. They fall within the CL and ML-groups, a few within the CL-ML-group.

No significant organic material was encountered. Dry bulk density ranges from 1.00-1.77 g/cm³ averaging 1.32 g/cm³. Porosity 27.8-39.8% averaging 31%. Specific gravity 2.42-2.68. Soluble salt content 2.2-41.9% of which sulphates form 0.07-17.2% and carbonates 18.8-32.6%. These soils are impermeable to semi-permeable, only 4 samples are satisfactory for compacted earth linings.

2.1.3 — Alluvial soil

Alluvial soil occurs as terraces, flood plains, and valley fills, consisting mainly of coarse-grained material.

Gravels (0-60%) are mainly of rounded to subrounded shape, of different mineral constituents in river terrace and flood plain deposits, and subrounded to subangular, of calcite and/or dolomite in valley fills and terraces. Sand forms (26-95.2%), fines 4.8-60.3% (Fig. 6).

These soils are mainly well-graded sands and gravelly sands, well-graded sandy gravels, and poorly-graded gravelly, silty sands. They are generally loose, un cemented with a small amount of fines in large valleys, and slightly compacted, slightly cemented, with appreciable amount of fines in small valleys.

Liquid limit ranges from 18-30%, plastic limit 16-22%, and plasticity index 2-8%. Fig. 7 shows that all samples have liquid limits less than 50% implying low plasticity. They fall almost equally within the CL and ML-groups.

Dry bulk density ranges from 1.14-1.97 g/cm³ averaging 1.32 g/cm³. Porosity 30.6-43.5% averaging 33%. Specific gravity ranges from 2.48-2.64. Soluble salt content 0.2-73.7% of which sulphates form 0.07-42.5% and carbonates 8.7-34.7%.

Mechanical abrasion and impact value range from 22.8-25.3% and 15.9-18.2% respectively. These soils are semipermeable to pervious; only 2 samples are satisfactory for compacted earth linings.