Influence of Compacted Fill Layers on Enhancing Soil Bearing Capacity

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ABSTRACT

In this paper, plate load test was used to study the effect of compacted fill layers on bearing capacity. The test was developed using selected soil from HATTAB source. The soil was classified as low plastic soil, silty or clayey gravel with CBR 16% filled in trench foundation. Plate load test was carried out on each layer. Sand cone test also was done for each layer to determine the field density value. The analysis of results obtained from the experimental program showed that, settlement of layer decreases as the number of layers increased. The bearing capacity of layers increased as the number of layers increased; this situation is valid for certain thickness after which no considerable effect was recorded.

KEYWORDS: Compacted Fill Layers, Plate Load Test, Bearing Capacity.

I. INTRODUCTION

Foundations of engineering structures are designed to transfer and distribute their loading to the underlying soil and/or rock. This design is required to satisfy three main design criteria, namely the ultimate bearing capacity of the foundations (i.e. strength); the total and differential settlements (i.e. serviceability); and the economic feasibility of the foundation. This paper focuses on the first of these criteria that is the ultimate bearing capacity of shallow foundations and, in particular, foundations on cohesive and cohesive-frictional soil.

Bearing capacity failure occurs as the soil supporting the foundation fails in shear, which may involve either a general, local or punching shear failure mechanism.

This paper, however, focuses on the effect of compacted fill layers on soil bearing capacity of a multi-layered compacted soil.

II. SITE PREPARATION

Selected materials were brought from HATTAB source which is not far from Khartoum (Capital of Sudan), only 35 km away from Khartoum Airport.

HATTAB Soil characterized by the quality of the soil, especially for purposes of backfilling and compaction,

The foundation was prepared as shown in figure (1) below which is describing test sequence that can be considered real soil bearing capacity at each point

- Total depth = 2.4 m
- Area = 7.5 m²
- Slope = 1:2 (Accessibility)

III. PLATE LOAD TEST

Gravity loading or reaction loading method was used by constructed loading platform over the column placed on the test plate and test load is applied by placing dead weight in the form of concrete blocks.

Hydraulic jack was placed between the loading platform and the column top for applying the load to the test plate. The reaction of the hydraulic jack being borne by the loaded platform. This form of loading is termed as reaction loading.

The test load will be imposed to the top of the test square plates of 0.30m width by means of one hydraulic jack resting on the centre of the plate, reacting against kentledge reaction system. The hydraulic jack will have a nominal capacity of minimum 20% more than the maximum test load which will be applied. This is necessary to avoid heavy pumping effort when nearing maximum load.

A crane had been used to move all equipment to the experimental site

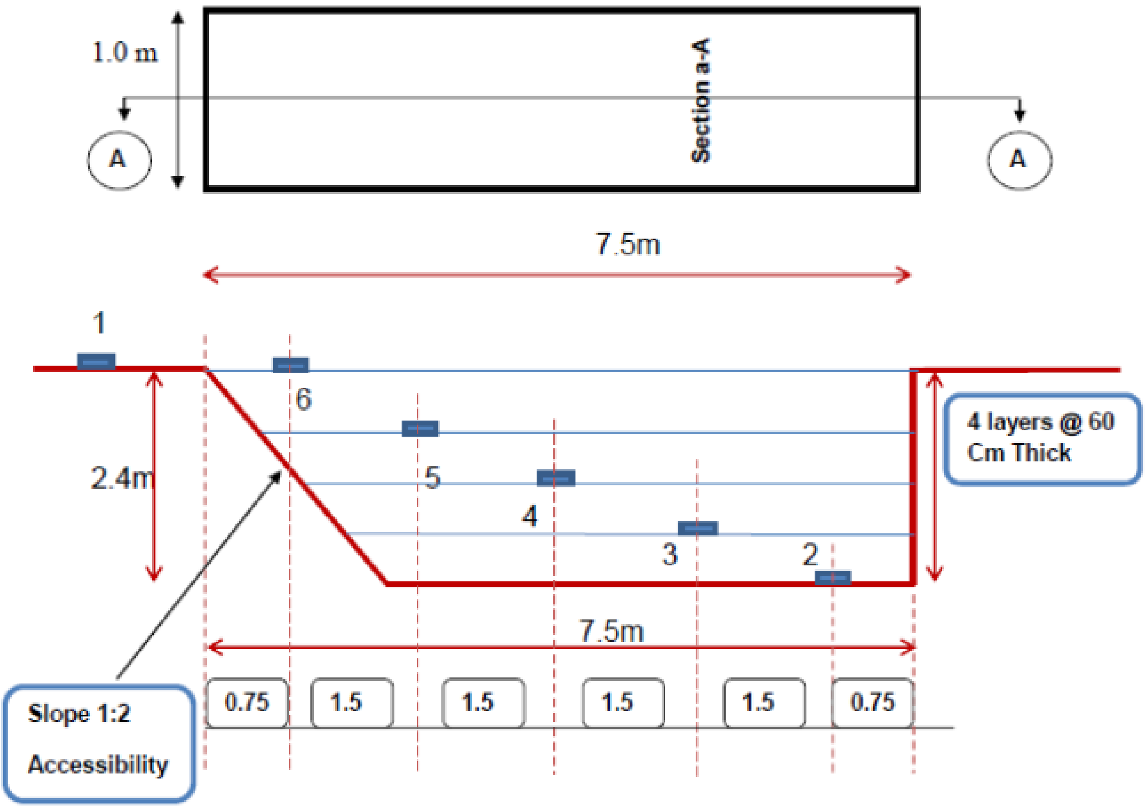
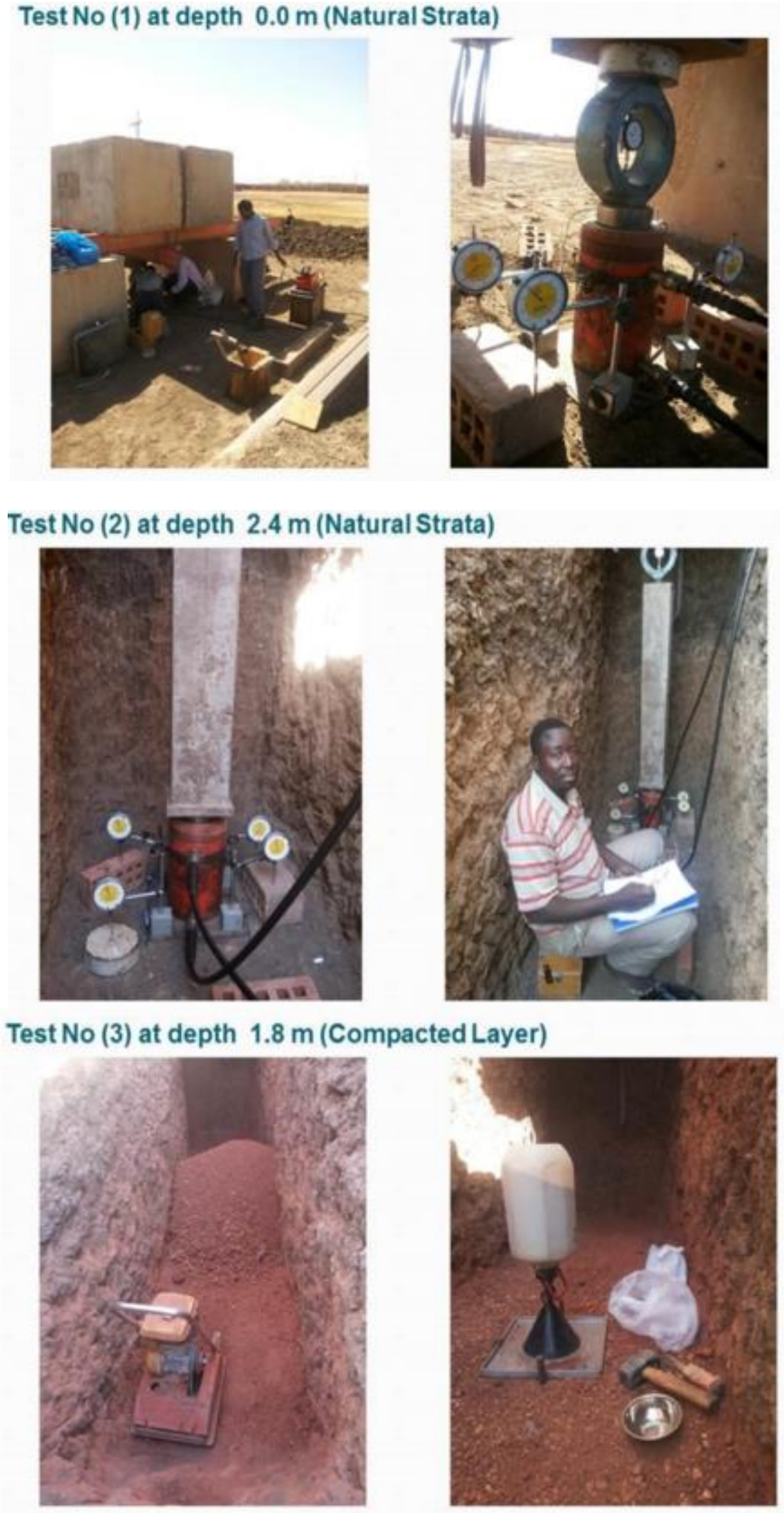


Figure (1) Trench foundation Section (A – A)

Readings of time, load and settlement/movement are recorded immediately before and after the application of each load increment or decrement.


Test No (1) at depth 0.0 m (Natural Strata)
Test No (2) at depth 2.4 m (Natural Strata)
Test No (3) at depth 1.8 m (Compacted Layer)

IV. = EXPERIMENTAL RESULTS

The results of the plate load test are summarized the records of applied loads and settlement/movement over the test.

The loads vs settlement curves were presented in **(Figure 2 – Figure 7)**

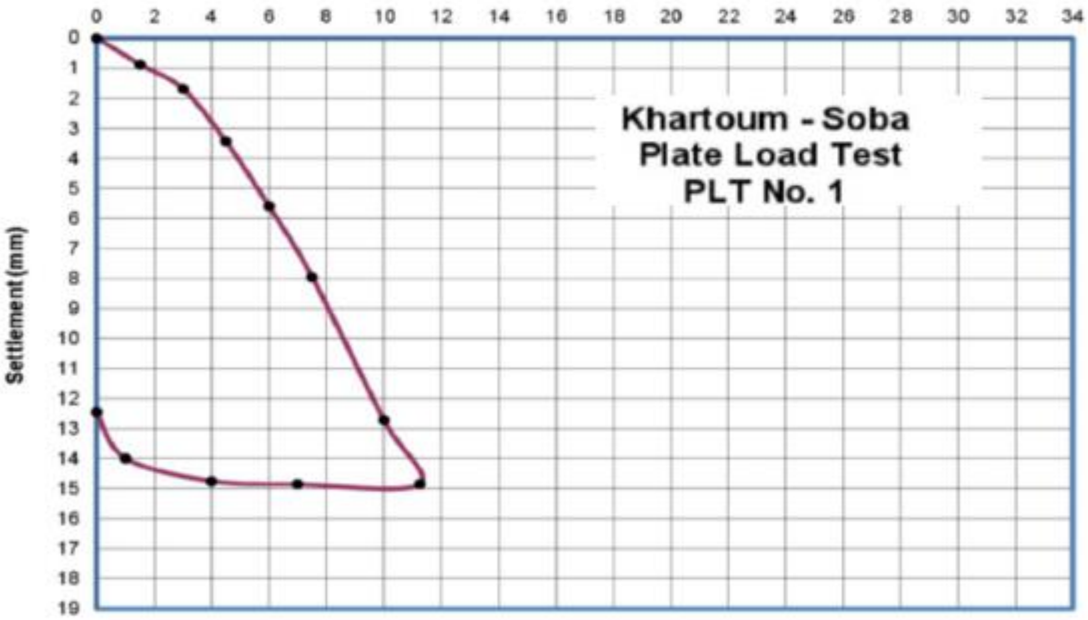


Figure (2): Load – Settlement Curve PLT-1

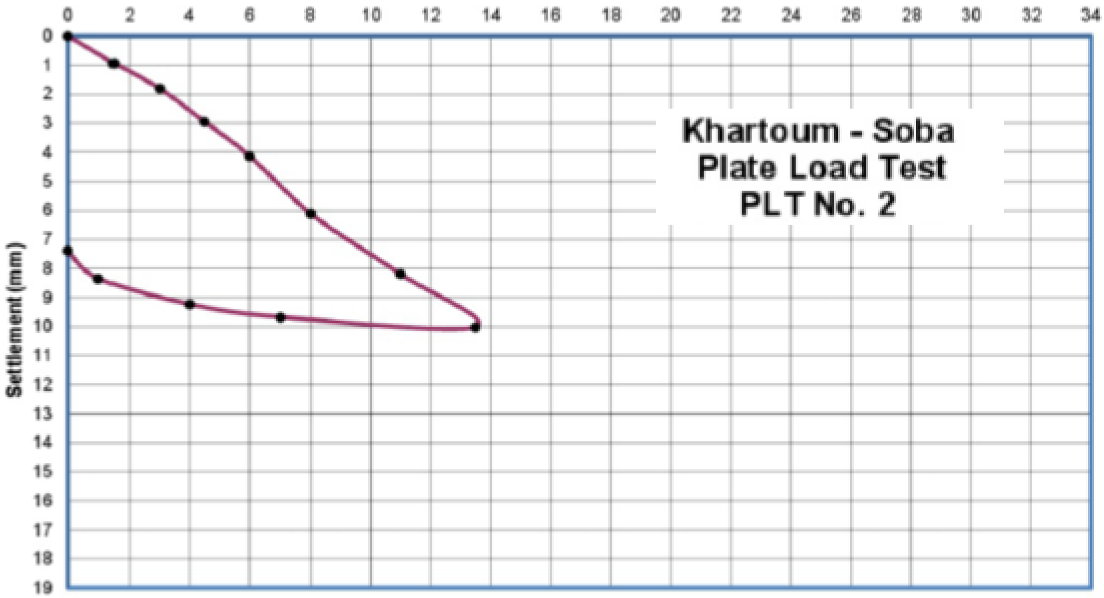


Figure (3): Load – Settlement Curve PLT-2

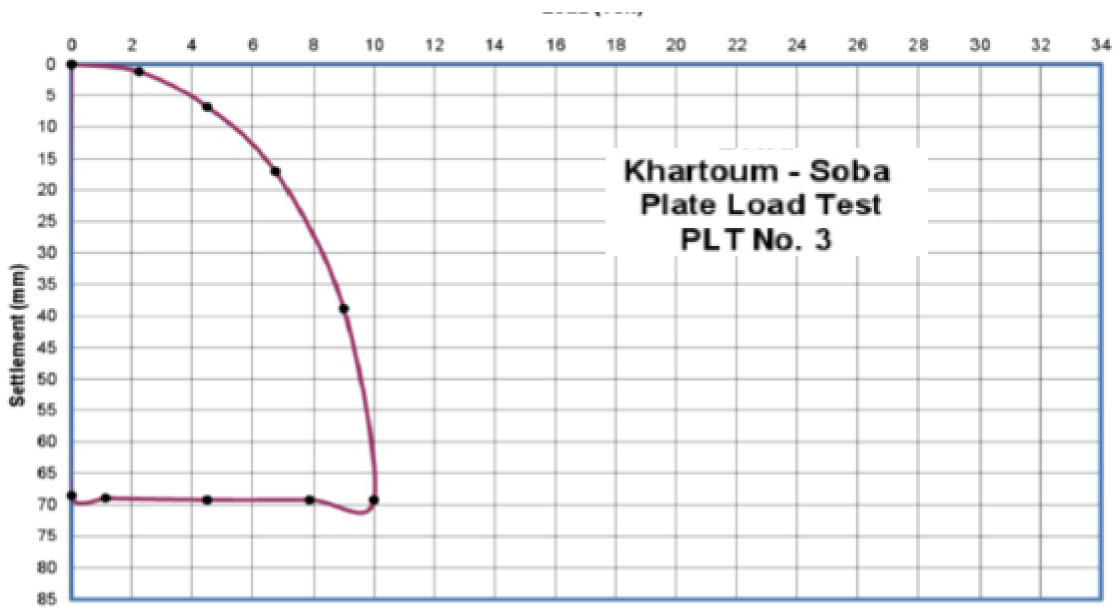


Figure (4): Load – Settlement Curve PLT-3

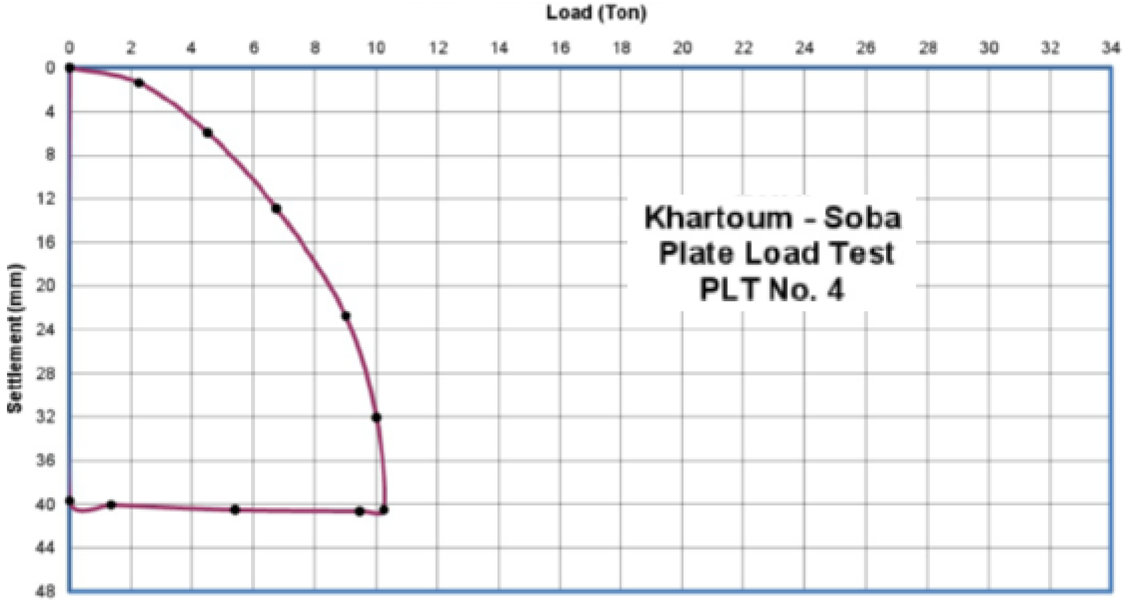


Figure (5): Load – Settlement Curve PLT-4

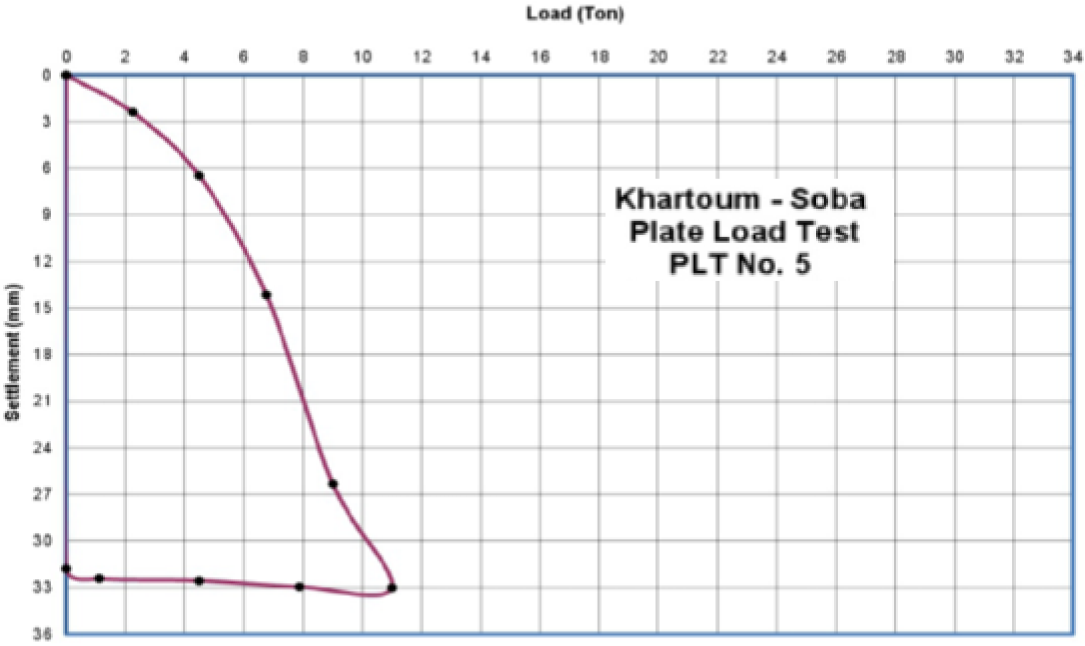


Figure (6): Load – Settlement Curve PLT-5

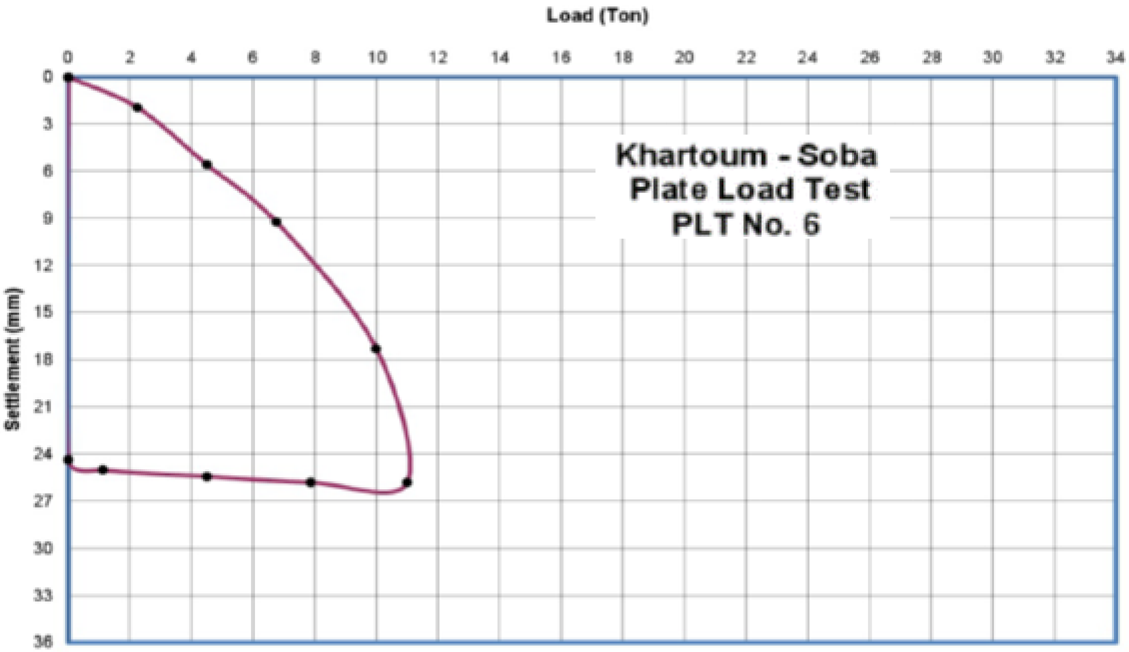


Figure (7): Load – Settlement Curve PLT-6

The maximum loads and corresponding settlements of soil profile considered for this study are presented in Table (1). The layers are classified as a Low Plastic Soil, Silty or clayey gravel with CBR 16%

Table (1) Load, Settlement and Bearing Capacities

No	Max load (Ton)	Max settlement (mm)	B.C (kN/m²)
Top	11.25	14.852	1226.22
Bottom	13.50	10.017	1471.56
1	10.00	69.217	1090.00
2	10.25	40.495	1117.22
3	11.00	32.957	1199.00
4	11.00	25.812	1199.00

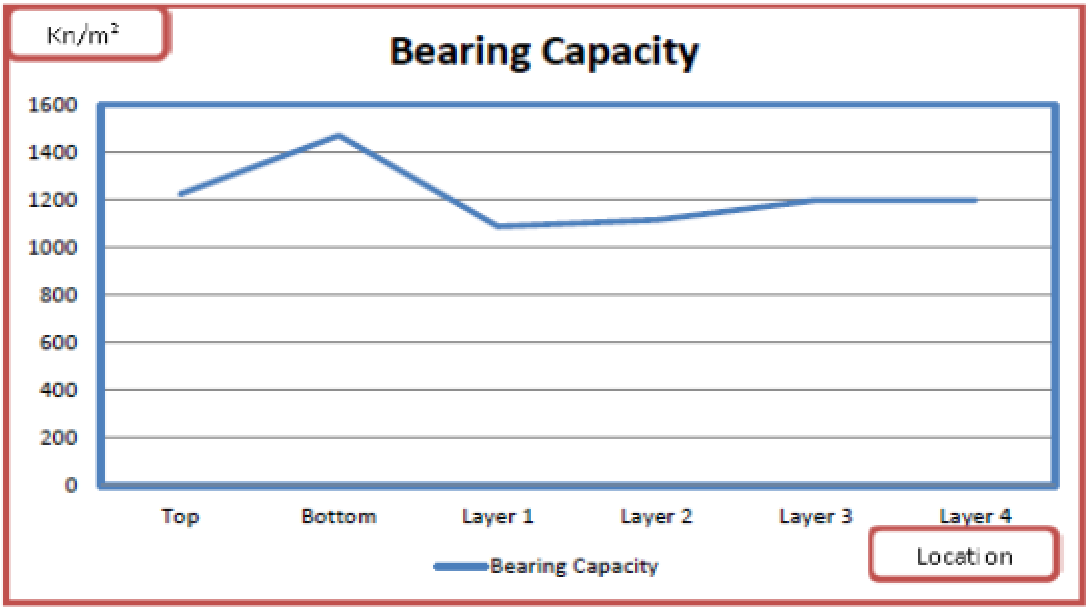


Figure (8): Bearing Capacity of Layers

- The selected material from HATTAB source was low plastic Soil, Silty or clayey gravel with CBR 16%.
- The Bottom Point (2.4 m depth) had a minimum value of settlement and that is referring to high bearing capacity due high cohesion of bottom natural stratum, while the top point also had very little settlement which is naturally compacted and stressed previously.
- The analysis of results obtained from the experimental program showed that, settlement of layer No 1 was 69.2 mm then decreased to 40.5 mm, 33 mm, 25.8 mm at layer No 2, layer No 3, and layer No 4 respectively.
- The bearing capacity of layer No 1 was (1090 kN/m²) then increased at layer No 2 (1117.22 kN/m²) and at layer No 3 (1199 kN/m²) and became constant at layer No 4 (1199 kN/m²).

V. DISCUSSION OF RESULTS

For the type of tested soil, loading conditions and procedure used in the investigation, the following discussion can be drawn:

VI. CONCLUSIONS

- Significant increment in bearing capacity can be achieved by adding more compacted layers.
- When adding layer, no 4 bearing capacity increment was almost negligible, accordingly the process of adding a fifth layer for such soil will not be economically accepted.

VII. REFERENCES

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