SPT REPORT

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As it is well known, for common soils, the SPT provides reliable informations for foundation design purposes. However for structured soils like, very soft clays, saprolitic and lateritic soils, SPT results are not reliable.

Torque measurements in these tests, Décourt and Quaresma Filho (1991; 1994), and the concept of equivalent N, N_{eq} (Décourt, 1991; 2002), allowed a much better understanding of the behavior of soft clays and saprolitic soils.

However, for lateritic soils, no test, up to now, allows correct evaluation of their behavior.

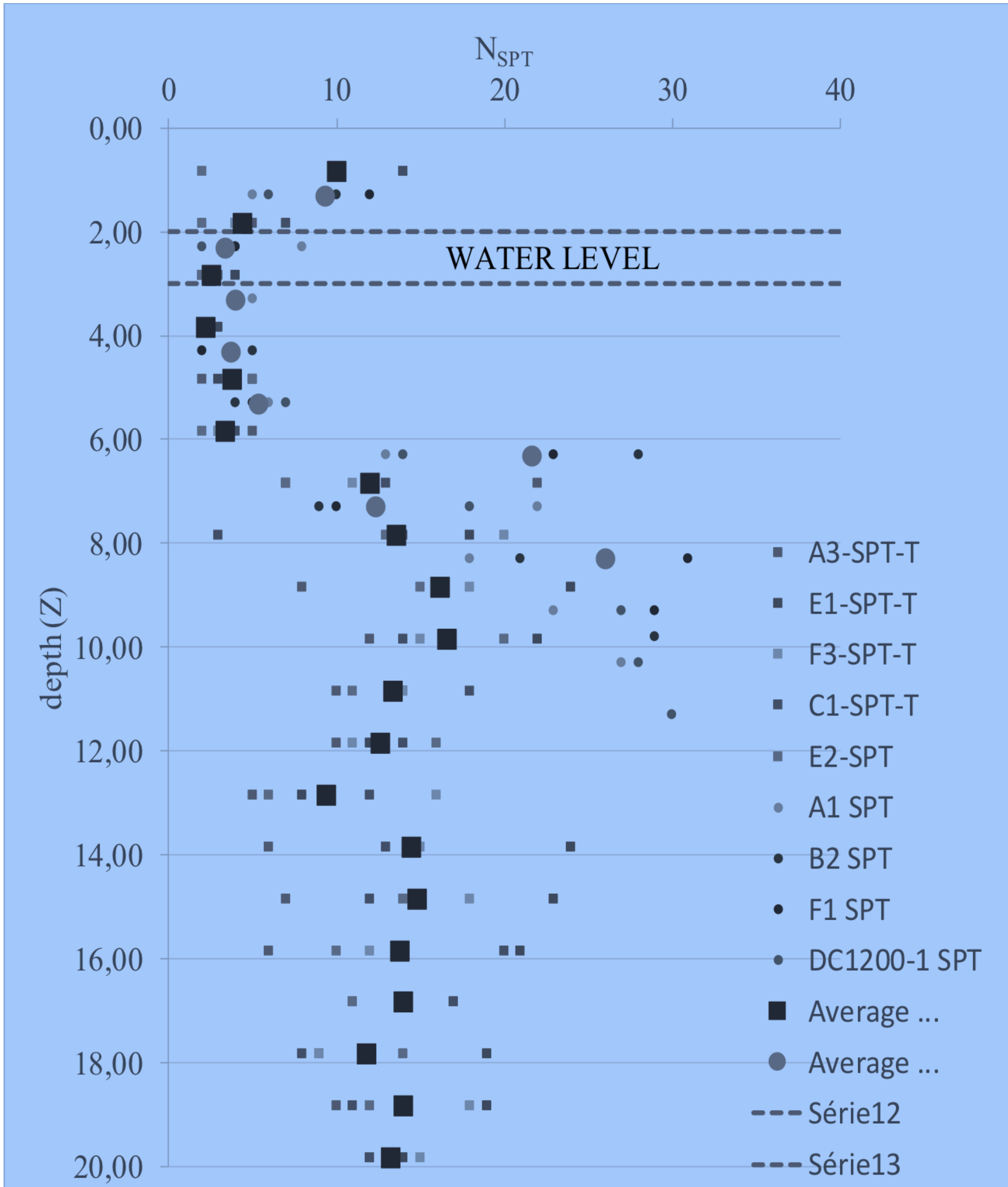

Figure 1 – Average values of N_{SPT}

z (m)	N_{SPT} (avarege)	z (m)	N_{SPT} (avarege)
0,85	10,00	1,30	9,33
1,85	4,40	2,30	3,33
2,85	2,60	3,30	4,00
3,85	2,20	4,30	3,67
4,85	3,80	5,30	5,33
5,85	3,40	6,30	21,67
6,85	12,00	7,30	12,33
7,85	13,60	8,30	26,00
8,85	16,20		
9,85	16,60		
10,85	13,40		
11,85	12,60		
12,85	9,40		
13,85	14,50		
14,85	14,80		
15,85	13,80		
16,85	14,00		
17,85	11,80		
18,85	14,00		
19,85	13,25		

Table I - Average N_{SPT} values

The energy effectively transferred to the rods, the so called Enthru Energy, was measured. On average, this energy corresponds to an efficiency of about 44%.

In order to apply to Santa Cruz de la Sierra soils, methods developed elsewhere, it is absolutely fundamental, that the efficiency of the Bolivian SPT, be well known.

For the soils of the TSBSP, torque, T, values, measured in kgf.m (N.m x 10^{-1}) are, on average, 1.2 times the Brazilian N_{SPT}, N_{72}, with an efficiency of 72%.

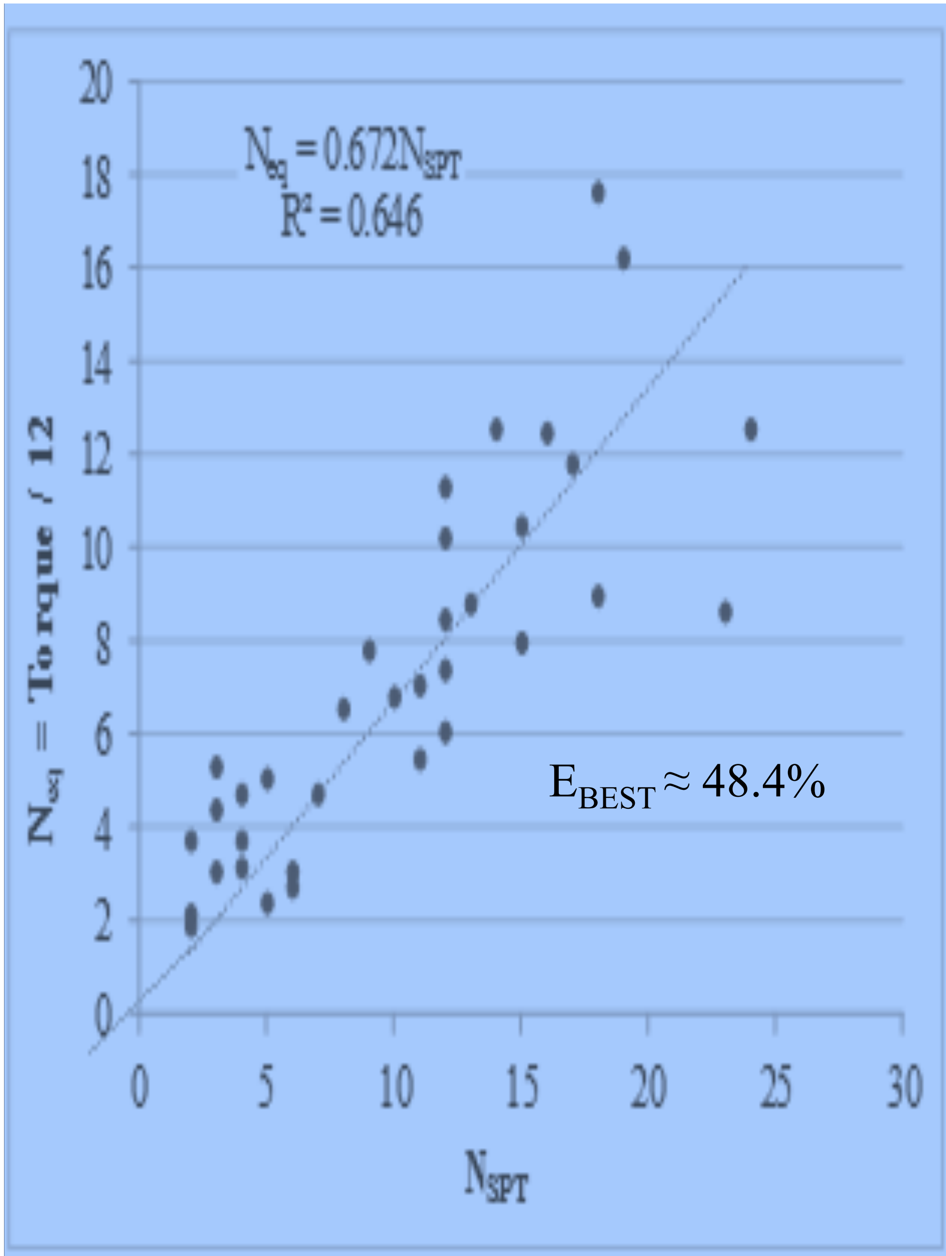

Figure 3 - Correlation between N_{eq} and N_{SPT}, imposing that the straight line passes through the origin

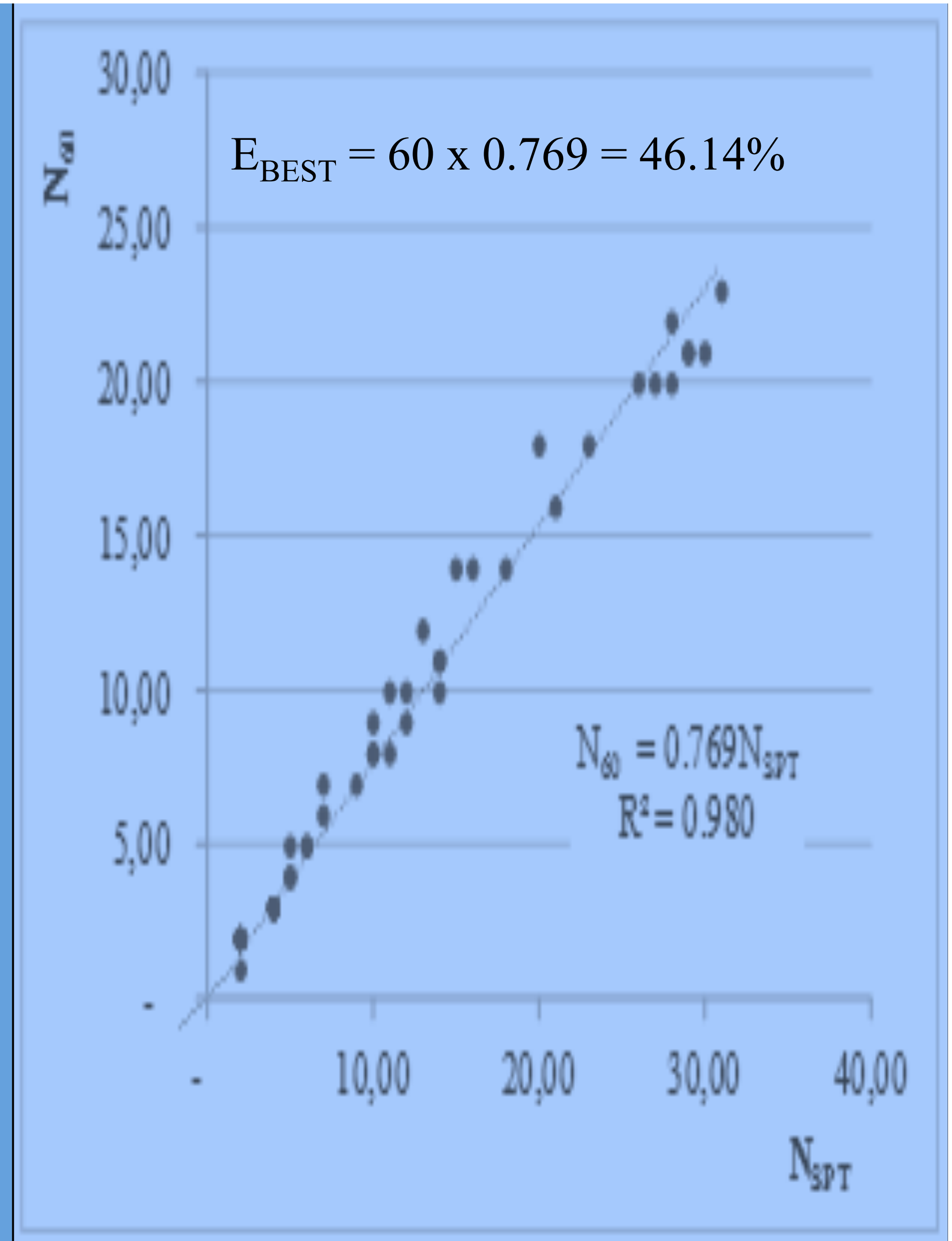

Fig. 5 – Correlations of N_{60}xN_{SPT} imposing that the straight line passes through the origin

Another possibility is to compare q_c (CPT) values with N_{SPT}.
Considering depths up to 17.85m, the ratio of the average values of q_c and of the average value of N_{SPT}, is:

$$q_c / N_{SPT} = 4.375/10.400 = 0.42$$

And for the Brazilian SPT, E_i = 72%, Velloso and Lopes (1996) proposed:

$$q_c/N_{72} \approx 0.6 \quad E_{BEST}=0,42 / 0,6 \times 72 = 50,4\%$$

Besides, as already mentioned on this report, the sampler had a provision for the use of liners, which, however, have never been used. This could yield to apparent efficiencies higher than the measured ones.

With basis on all these observations, it appears reasonable to assume for the SPTs carried out at B.E.S.T., an apparent average efficiency of 48%.

So, in order to convert the measured N_{SPT} values to N_{60}, the field values should be divided by a factor equal 1.25.

Another important consideration regards fine sands below the water table.

For fine sands, below the water table, the influence of pore pressure generation also effects N_{SPT} values. According to Terzaghi and Peck (1948; 1996), for saturated, very dense, fine sands, the measured N values should be reduced, as follows:

$$N_{corr} = 15 + 1/2\,(N_{SPT} - 15)$$

The efficiency of the SPTs considered in Terzaghi and Peck analysis was not known.

However, most likely, they were in the range of 45% - 50%, approximately, the same range of values determined for B.E.S.T. tests.

For dense sands, $N_{SPT} \geq 15$, the void ratios were assumed to be lower than those corresponding to the Critical State, and the tendency was the soil to dilate, with generation of negative pore pressures. As a consequence, the measured N_{SPT} values might be unrealistically high. For $_{NSPT}$ values lower than 15, the opposite happens.

In figures 6 and 7, the ratio of corrected values of N_{SPT}, N_{corr}, divided by N_{SPT} are presented, as a function of N_{SPT}.

The correction proposed by these authors had been extended for N_{SPT} values lower than 15, which was not their intention.

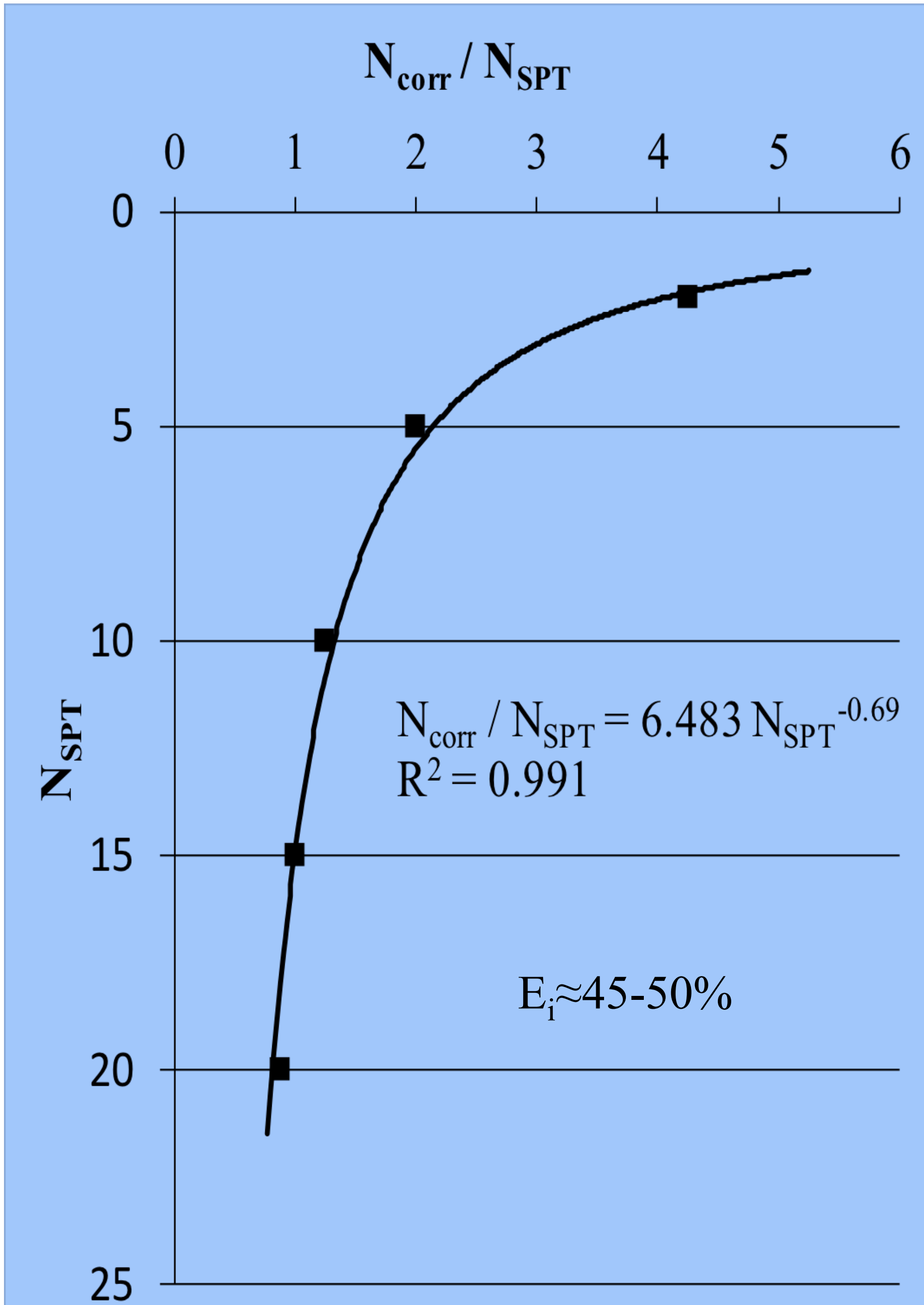

Fig. 6 – Corrections to measured N_{SPT} values, in fine sands below the water level ($E_i \approx 45\text{-}50\%$)

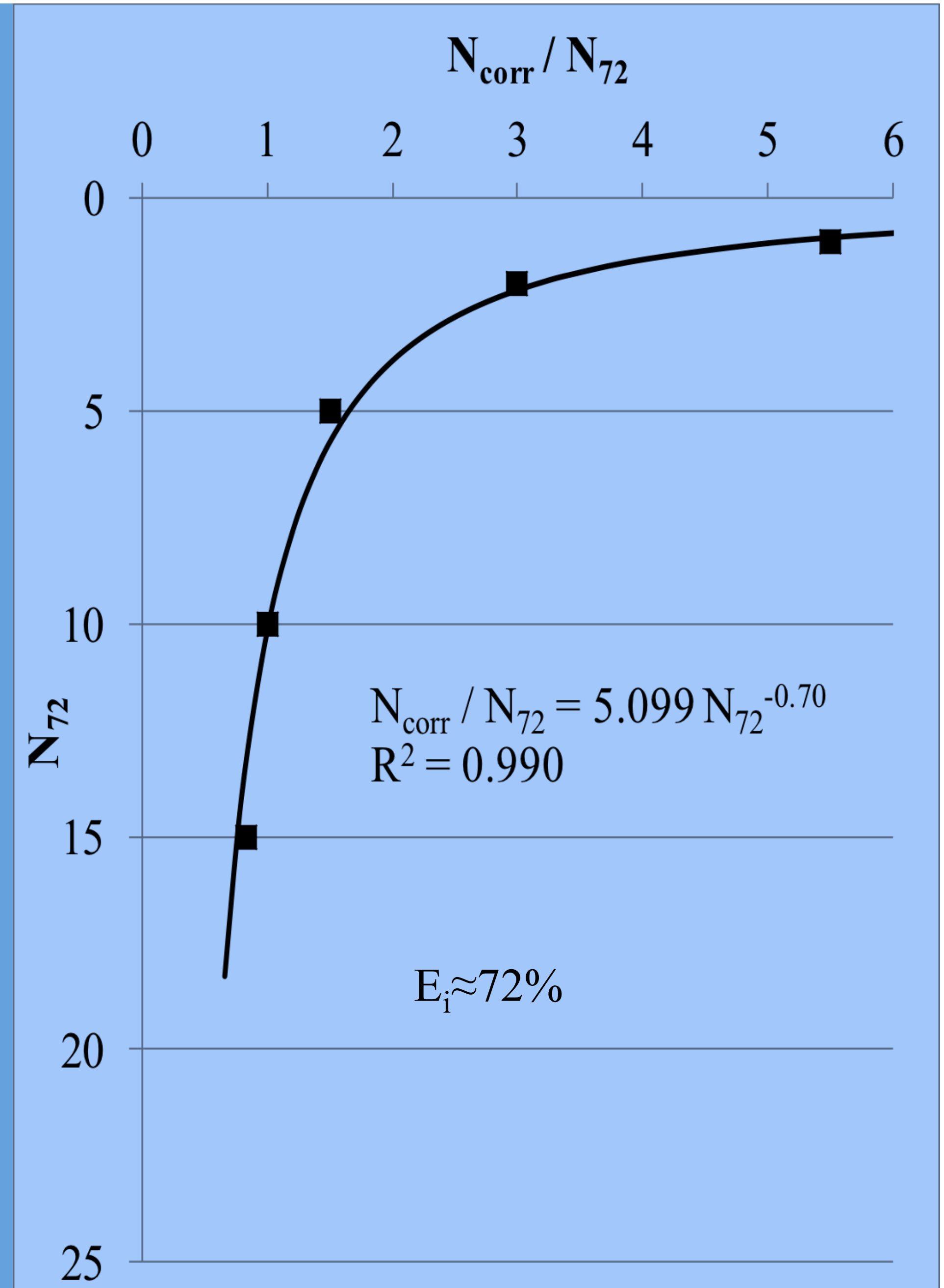

Fig. 7 – Corrections to measured N_{SPT} values, in fine sands below the water level ($E_i \approx 72\%$)

In some cases, like the mentioned in Décourt (1986) these unrealistic low N_{SPT} values were the most likely explanation for the fact that the capacities of displacement piles, computed using Décourt and Quaresma method (1978; 1982) were much lower than those provided by loading tests. Once the low N_{SPT} values were corrected as suggested in figure 7, the differences between predicted and measured capacities become negligible.

CONCLUSIONS

As previously reported by the author, the semi-empirical formulas based on N_{SPT} values, that have been successfully used for predicting bearing capacities of both, piles and shallow foundations, badly under predict the capacities of foundations in lateritic clays. However, the number of cases so far analyzed by the author is small to allow definitive conclusion to be taken.

Nevertheless, all of them have yield to the conclusion that the actual capacity of foundations in these soils are two to three times higher than those predicted by the formulas derived on basis of tests on non-lateritic soils.