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An Alternative Method to the West African Compaction (WAC) Test Procedure

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Abstract

It had been suggested to use the West African Compaction Test Procedure since the early 1950's so as to determine the CBR of gravel lateritic soils in West African countries [1]. This test procedure called West African Compaction (WAC) [2] is largely used in road construction in West African countries and had the particularity to be long and use a large amount of material. This note is the result of several comparisons between test procedures taken to determine the CBR from the WAC method to the standardized laboratory test commonly used to determine the CBR.

Keywords: West African Compaction Test Procedure, Compaction, Proctor, Gravel, Lateritic Soils, AASHTO

1. Introduction

The soils considered in this study were collected from different locations within Senegal. Standard laboratory tests were conducted to classify these soils and determine their properties. Laboratory testing consisted of particle size analysis (mechanical sieving and hydrometer analysis), specific gravity, consistency limits, and Modified Proctor compaction test (**Figure 1** and **Table 1**). Laboratory tests were conducted on the investigated soils following the standard procedures of the American Society for Testing and Materials (ASTM). The Modified Proctor compaction test was conducted using the AASHTO T 99 procedure [3]. Test results showed that the selected soils are classified mainly as A-26 materials according to AASHTO. The CBR tests have to be determining under these different compaction efforts (10, 25, 55 blows). The value of the CBR at 95 % of the OMP is graphically obtained by determining the value of the CBR at 95 % OMP (**Figure 2**). The standardized method as related by the AASHTO T 193 [4] standard method of test procedure consist of determining the value of the CBR at the optimum of the compaction characteristics (γ_{dmax}, $W_{opt.}$) (**Figure 3**). This test method provides for the determination of the CBR of a material at optimum water content or a range of water content from a specified compaction test

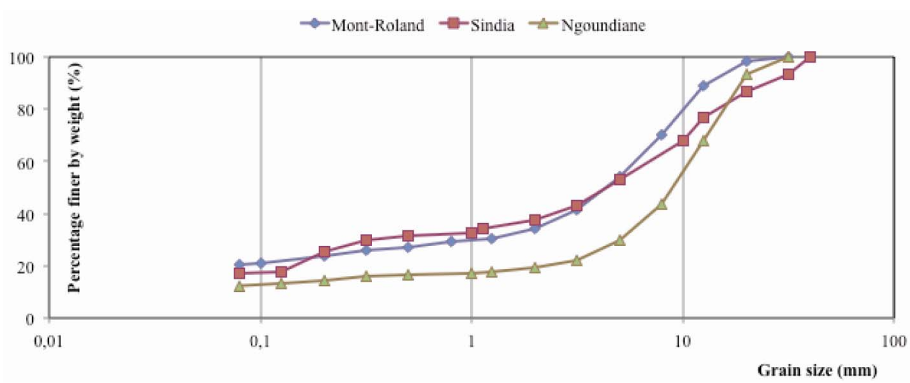

Figure 1. Grain size distribution of the gravel lateritic soils.

Table 1. The lateritic soil characteristics.

	Wl (%)	*Wp* (%)	*Ip* (%)	γ_s (kN/m^3)	*AASHTO*	γ_d max at OMP (kN/m^3)	$W_{Opt.}$ (%)
Sindia	35	18	17	28.3	A 2-6	19.5	10, 5
Ngoundiane	53	26	27	27.1	A 2-6	19.22	11
Mont-Rolland	46	20	26	27.6	A 2-6	19.6	12.25

Table 2. CBR values from the two procedures and from different time of wetting.

	West African Compaction (WAC) *Values of the CBR at 95% OMP in function of the time of immersion*					*CBR at the optimum value of the water content*				
	0 h	24 h	48 h	72 h	96 h	0 h	24 h	48 h	72 h	96 h
Sindia	139.9	83.2	57	45.3	40	142	85	62	47	42
Ngoundiane	47	36.1	31.5	30	28.7	49.2	39.4	33.7	29	29
Mont-Rolland	185	167.9	146.8	122	120.2	189	172	150	124	123

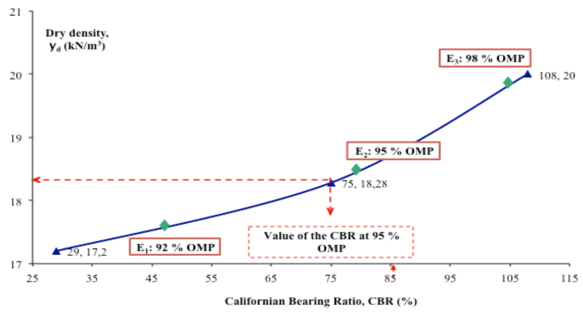

Figure 2. An example of the West African Compaction (WAC) method of determination of the CBR.

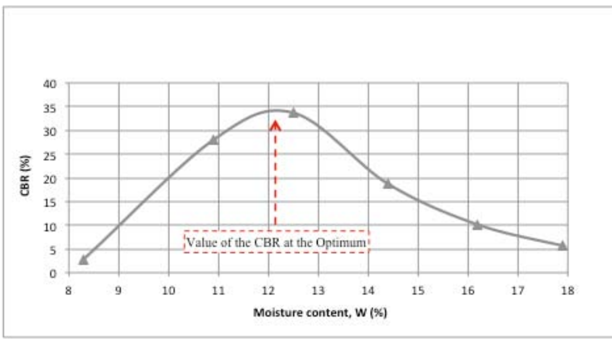

Figure 3. The CBR obtained from the Optimum of the Moisture content (the standardized method).

and a specified dry unit mass.

In the WAC test Procedure [1,2,5,6], each sample has to be wetted for 4 days and compacted with the required Proctor Energy (E_1, E_2 and E_3). The engineering value of the CBR is obtained from the correspondence between the dry density at 95 % OMP plotted to the experimental curve and directly read in the CBR axis. It's mainly a non-linear interpolation. Note that, the energies of compaction are below:

- Proctor Energy E_3

(55 *blows of the Modified Proctor hammer*),

- Proctor Energy E_2

(25 *blows of the Modified Proctor hammer*);

- Proctor Energy E_1

(10 *blows of the Modified Proctor hammer*).

In the Classical CBR Determination, each sample wetted for 4 days represent the CBR value for each point determined for the compaction curve. The Energy of Compaction remains the same (Modified Proctor: 55 blows for 5 layers). The engineering value of the CBR is obtained from the Optimum of the Water Content. The CBR test procedure stills the same for each sample.

2. Comparison between CBR Values

On **Figures 4**, **5** and **6** we represented the variations of the CBR according to the moisture content. They represent the evolution of the soil for various water contents considered to establish the Proctor curve of each lateritic soil with the modified Proctor energy (55 blows). This classical procedure is different from the traditional West African method, which is usually carried out in the African geotechnical laboratories where CBR test is carried out with various compactions energies (10, 25 and 55 blows) and with a time of immersion of 96 hours. These figures show that these three materials are sensitive to water; indeed the more the materials last in water the more their CBR lowers. The comparison of the CBR values determined after 96 hours of immersion for each of the three lateritic soils with that of the traditional

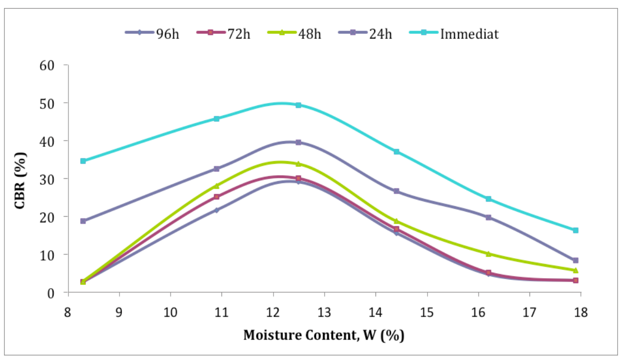

Figure 4. CBR versus moisture content according to time of immersion (Ngoundiane).

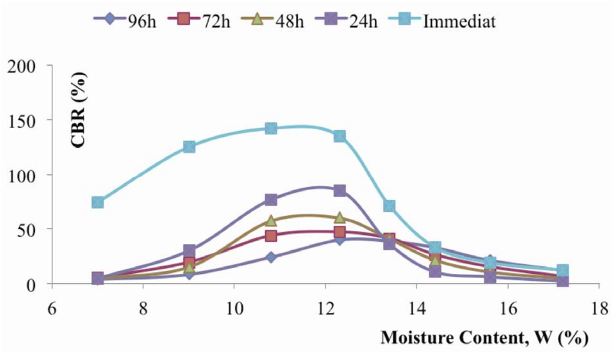

Figure 5. CBR versus moisture content according to time of immersion (Sindia).

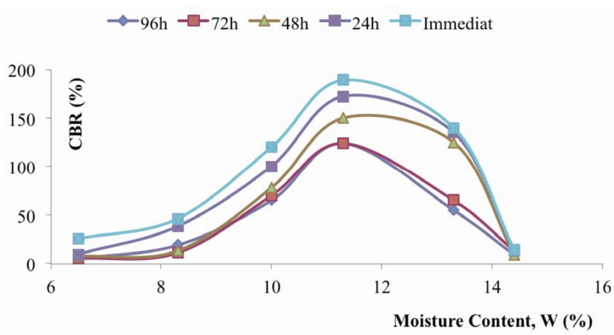

Figure 6. CBR versus moisture content according to time of immersion (Mont-Rolland).

of the three lateritic soils with that of the traditional method shows that we have almost similar values (**Table 1**) with differences in CBR ranging between 2 and 4: this proves that we can otherwise determine the CBR than by the traditional method.

Figure 7 represents the variation of CBR according to the time of immersion. According to these figures we note that the CBR is sensitive to water. While passing from the immediate condition (0 day) to an immersion condition (1, 2, 3 and 4 days), the CBR decreases considerably. This fall of CBR is most important for the first

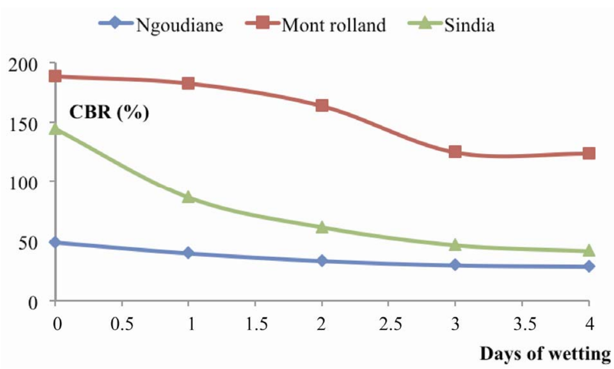

Figure 7. Evolution of the CBR with the days of immersion.

three days, and then the CBR evolves in a stagnant way between the third and the fourth day. This lets think that saturation is reached at the third day. Ackroyd [5] finds that under the semi arid weather conditions, a period between 24 hours and 48 hours of immersion seems sufficient.

3. Conclusions

In Senegal and in the most West African countries, the determination of the CBR is done with the WAC method [6]. This method consists in determining the CBR index to 95 % of the OMP and after 96 hours of immersion, from samples compacted to the water content of the OMP and with various energies of compaction (10, 25, 55 blows). This note showed that the two methods are appreciably the same ones. A CBR at four days of immersion recommended in the standards is justified.

4. Acknowledgements

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