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**Research Article**

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# Application of the Road Earthmoving Guide to Platform Soils in the Region of Thies: Axises of Thies-Fandene and Thies-Sanghe

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**Abstract** After finding that there is no adequate document concerning road earthworks linked to the non-existence of national standards in Senegal defining the conditions for completion, the purpose of this document is to propose a method of good execution of the upper platform of the earthworks and the layers of form.
To do this, a study was carried out on platform soils in the Thiès region, which is one of the 14 regions and the second region of Senegal. It is at 72.4 km from Dakar (SENEGAL). Two 2.5 km long roadways have been chosen on Thiès to carry out manual surveys on these platform soils, the first axis is in the municipality of Fandène located northeast, at 8 km from the region, the second in the rural municipality of Sanghé located in the south, at6 km from the region.

**Keywords** platform; earthworks; form layer; guide; pavement

## 1. Introduction

The transport sector in Senegal is dominated by a predominance of the road sector where a lot of investments have been made in recent years. Road infrastructure has developed through the implementation of sectoral transport programs.
In 1991, the Transport Sector Adjustment Program (PAST) made it possible to reform the administration in the planning and programing of road projects [1].
The second Transport Sector Program (PST2), which came into effect in 2000, focuses on service efficiency and infrastructure improvement. This program meets the objectives of the poverty reduction strategy and the concern to protect the environment. It is within this framework and with the aim of improving overall efficiency:

- On the one hand, carry out geotechnical studies on existing platform soils in Senegal.
- On the other hand, establish a criterion for selecting and implementation of earthmoving materials.

Indeed, in the absence of a technical reference, the sizing of pavements in Senegal is usually based on specialized works capitalizing the experiences of countries in the tropical zones. Beyond the synthesis of the geotechnical conditions and the use of the materials represented by these feedback, it remains that they only take very partially into account the specificities of the Senegalese road context. The pavement structures to which they result do not always reflect the local conditions of execution of the works and even less an optimal use of the materials available locally [2-3].
However, this document reflects studies carried out on platform soils in the region of Thiès, but cannot provide an answer to all the questions raised by road construction.
In any road construction project it is essential to know the behavior of the soil during and after the completion of the road, hence the importance of earthworks.

Earthworks are the different movements of earth that are used to dig or alter the soil configuration. This change in soil levels is achieved through the use of cuttings and fill.

The objective of applying the road grading guide to the platform soils of the region of Thiès, will be done by implementation processes and these to give our roads the geometric characteristics, which will allow it to be compatible with its functional purpose, but also with regard to the materials to be used in earthworks, to make the most appropriate choices according to the type of project, the geographical and environmental sites encountered[14-21]. .

## 2. Materials and Methods

This study is concentrated in the region of Thiès. It consists of carrying out manual surveys on two roads, namely the Thiès-Fandène axis and the Thiès-Sanghé axis. Samples will be taken according to the following assumptions [4-5]:

- 100 cm depth for each manual survey ;
- 500 m linear spacing between roadways ;
- 2.5 km on each axis;
- At least 25 m separate each sounding from the road.

This operation made it possible to make a visual description of the soils in question and to take samples for their physical and mechanical characterization in the laboratory. The water table is not found at any of the sampling points.

Figure 1 and 2 show respectively the five holes on the Thiès-Fandène axis and the six holes on the Thiès-Sanghé axis. Surveys revealed the presence of sand on the first road route, and lateritic sand on the second.

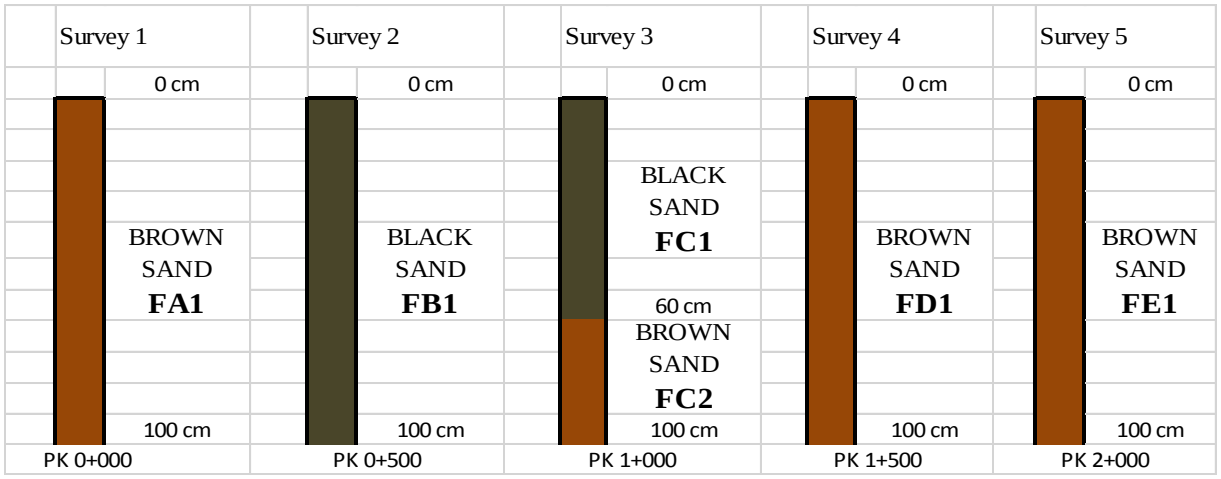


*Figure 1: Section of the polls on the Thiès-Fandène axis*

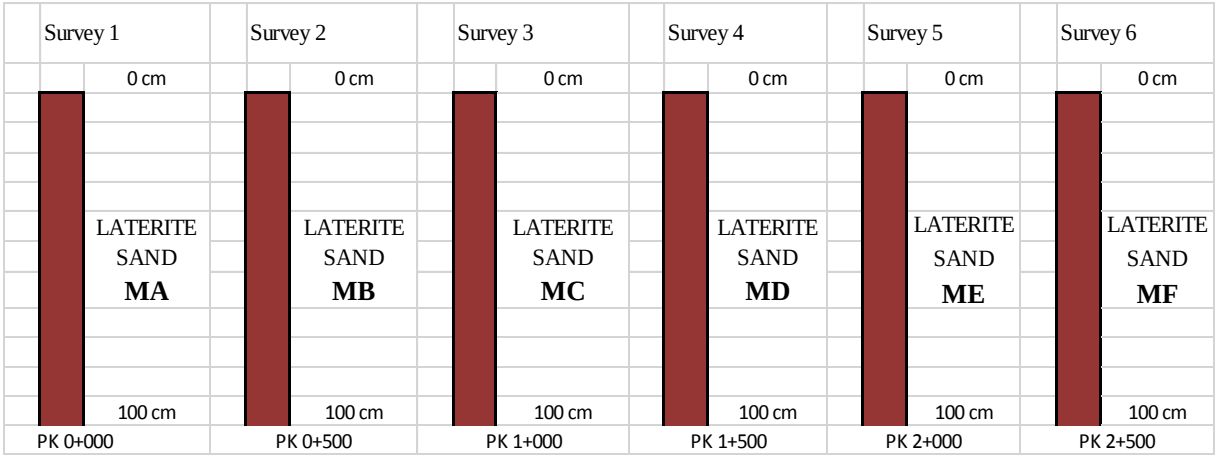


*Figure 2: Section of the polls on the Thiès-Sanghé axis*

Since the samples were made from soft soils, they were analysed according to the following laboratory test program:
Natural water content, Atterberg limits or sand equivalent depending on soil type, granulometric analysis, blue value, Proctor compaction test and CBR punching test [6-13].

## 3. Results and Discussion

### 3.1. Mechanical Characterization

***-Water content***

The sands sampled on the Thies-Fandène axis have low water contents due to the absence of fines. On the other hand, lateritic sands have much higher water contents because they contain much more fine materials, this is reported in Table 1.

**Table 1 :** Results of water contents

| FANDENE | | | | | | |
|---|---|---|---|---|---|---|
| **Echantillons** | FA1 | FB1 | FC1 | FC2 | FD1 | FE1 |
| **Wn (%)** | 2.39 | 2.09 | 0.74 | 3.31 | 1.04 | 2.72 |

| SANGHE | | | | | | |
|---|---|---|---|---|---|---|
| **Echantillons** | MA | MB | MC | MD | ME | MF |
| **Wn (%)** | 8.29 | 7.40 | 8.55 | 9.26 | 10.35 | 7.34 |

***- Atterberg Limit***

The results of the plasticity index of the lateritic sands of the Sanghé zone are shown in Table 2 below.

**Table 2:** Atterberg limit test results

| SANGHE | | | | | | |
|---|---|---|---|---|---|---|
| **Echantillons** | MA | MB | MC | MD | ME | MF |
| **IP** | 8.64 | 14.40 | 12.92 | 11.40 | 12.60 | 10.12 |

According to the GTR1992 (Road Earthmoving Guide 1992), the results obtained for thelateritic sandsof the Thiès-Sanghé axis, we have soils weakly clayey since their plasticity index varies around 12.

***-Sand Equivalent***

According to the GTR, the results obtained for the sands of the Thiès-Fandène axis are represented in Table 3. We have soils of an average plasticity since their ES values are between 20 and 40.

**Table 3:** Test results of sand equivalent

| FANDENE | | | | | | |
|---|---|---|---|---|---|---|
| **Echantillons** | FA1 | FB1 | FC1 | FC2 | FD1 | FE1 |
| **ES** | 31.40 | 27.90 | 41.10 | 30.05 | 35.25 | 25.90 |

***-Granulometric analysis***

Figures 3 and 4 show, respectively, all the curves obtained during the particle size tests of the soil of Thies-Fandène and Thiès-Sanghé axises.

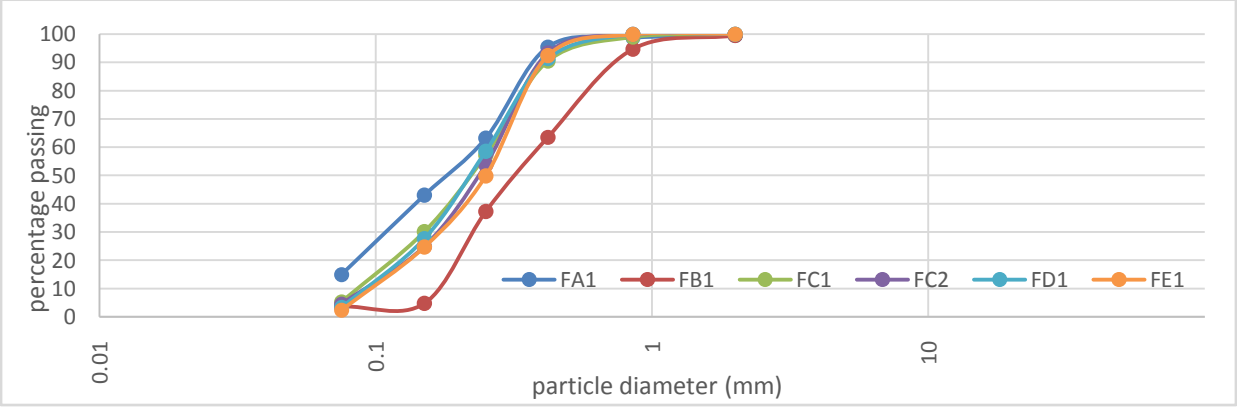


*Figure 3: Particle size analysis curve after sieving samples from the Thiès-Fandène axis*

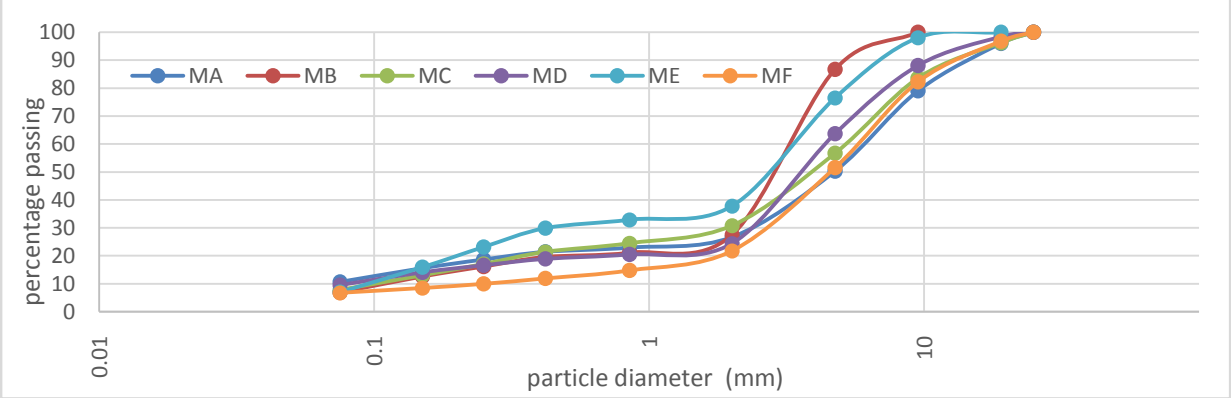


*Figure 41: Particle size analysis curve after sieving samples from the Thiès-Sanghé axis*

***-Value in Blue***

The results obtained for the test vbs are presented in Table 4.

**Table 4:** VBS test results

| **FANDENE** | | | | | | |
|---|---|---|---|---|---|---|
| **Echantillons** | FA1 | FB1 | FC1 | FC2 | FD1 | FE1 |
| **VBS** | 0.60 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 |

| **SANGHE** | | | | | | |
|---|---|---|---|---|---|---|
| **Echantillons** | MA | MB | MC | MD | ME | MF |
| **VBS** | 0.20 | 0.17 | 0.23 | 0.25 | 0.15 | 0.21 |

According to the GTR, the results obtained for the sands of the Thiès-Fandène axis, we have soils weakly silty(soil little plastic and sensitive to water) since their values of VBS are between 0.2 and 1.5. For the laterite soil of the Thiès-Sanghé axis, their VBS values are around 0.2, hence the presence of sandy or water-insensitive soils.

***- Proctor***

Figure 4 shows the different proctor curves obtained after testing on lateritic soils of Sanghé.

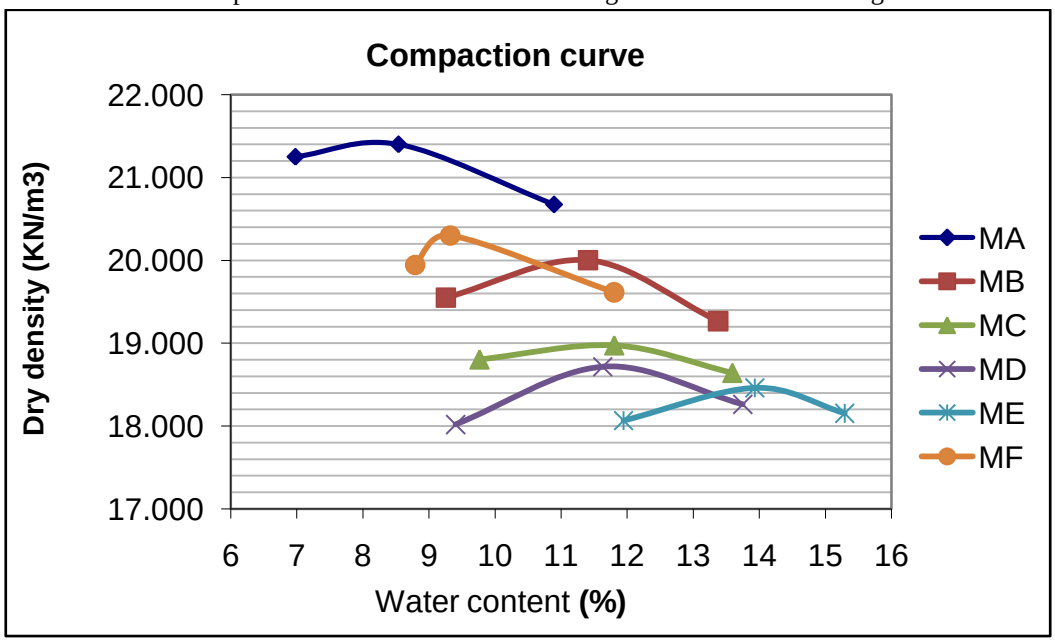


*Figure 4: Compaction curve Proctor of sands (Thiès-Sanghé).*

The results obtained at the Proctor optimum are given in the following table 5:

**Table 5:** Proctor test results

| FANDENE | | | | | | |
|---|---|---|---|---|---|---|
| **Echantillons** | FA1 | FB1 | FC1 | FC2 | FD1 | FE1 |
| $w_{opt}$ **(%)** | 5.75 | 9.40 | 7.62 | 7.60 | 9.98 | 7.25 |
| $\gamma_{dmax}$ | 19.35 | 19.20 | 18.80 | 19.37 | 17.89 | 19.37 |

| SANGHE | | | | | | |
|---|---|---|---|---|---|---|
| **Echantillons** | MA | MB | MC | MD | ME | MF |
| $w_{opt}$ **(%)** | 8.20 | 11.30 | 11.60 | 11.66 | 13.82 | 9.20 |
| $\gamma_{dmax}$ | 21.43 | 20.01 | 19.00 | 18.75 | 18.46 | 20.31 |

***-CBR***

The results obtained for the test CBR are presented in Table 6.

**Table 6:** CBR test results

| FANDENE | | | | | | |
|---|---|---|---|---|---|---|
| **Echantillons** | FA1 | FB1 | FC1 | FC2 | FD1 | FE1 |
| **I.CBR** | 12 | 14 | 13 | 14 | 11 | 18 |

| SANGHE | | | | | | |
|---|---|---|---|---|---|---|
| **Echantillons** | MA | MB | MC | MD | ME | MF |
| **I.CBR** | 22 | 11 | 14 | 19 | 12 | 35 |

The CBR values in this table are bigger than 5, which justifies the fact that it does not require any earth strike for both our study areas, which leads us to confirm that the soil in situ will play the role of a ground support layer.

The different results obtained have allowed to characterize the Fandène sands as well as the lateritic sands of the Sanghé area. They also show that they have all the qualities required in terms of lift and plasticity to be used as a road surface layer.

## 4. Conclusion

The different results obtained have allowed to characterize the Fandène sands as well as the lateritic sands of the Sanghé area. The results of the geotechnical studies carried out along the route of each axis are presented and discussed in this document. Thus the Platform soils of our axes have 95% CBR indices of the OPM between 11 and 35, and their lift classes are S3, S4 and S5. These results allowed us to classify these soils according to the French GTR Road Earthmoving Guide of 1992 at first and then to give their conditions of use in embankment and in form layer as illustrated in this document.

This study made it possible to better control the mechanical behavior of the soils encountered during the boreholes. Thus, it is apparent that the use of these backfill materials will have to take into account parameters such as their water state as well as the weather situation.

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