New control quality construction tools: performance related tests

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INTRODUCTION

In the aim of a national research project POCI/ECM/61114/2004, entitled "Interaction soil-rail track for high speed trains", financed by the Foundation for Science and Technology, it was established a protocol between the National Railway Network (REFER) (University of Minho – UM, National Laboratory of Civil Engineering – LNEC, New University of Lisbon – FCT-UNL and Technical University of Lisbon – IST) to develop the knowledge concerning the methodology for the construction and control of the railway embankments and railtrack layers for high speed trains. One of the objectives of this protocol is to establish a methodology for quality control of compacted layers by different available test methods, promoting continuous compaction control. For the materialization of this objective it was constructed a trial embankment in the railway of the Évora railway line, about 2,5 km far from railway station of "Monte das Flores", and the test campaign carried out between October and November of 2006.

This paper describes the trial embankment, the experimental program and the different tests carried out for moduli evaluation, including *static plate load test*, *light falling weight deflectometer, soil stiffness gauge* and *"Portancemètre"*, and establish correlations between results of these tests.

TRIAL EMBANKMENT AND EXPERIMENTAL PROGRAM

Considering the objective to establish a methodology for quality control of compacted layers by different available test methods, promoting continuous compaction control, it was constructed a trial embankment and performed an experimental plan for the evaluation of physic and mechanical properties of the studied materials.

In the trial embankment materials similar to the ones used on the new Évora railway line were used. Two types of materials were used: soil, for the embankment layers, and crushed aggregate for the sub-ballast layer. In the present paper only few of soil test results will be presented.

This embankment was constructed above a foundation layer with 0,60 m thickness. Different layer's thicknesses (30cm, 40cm, 50cm) and different moisture contents (w-2%, wopt, w+2%) were used for the embankment layers.

The experimental pan consisted of spot testes, namely, sand replacement method, water content, *static plate load test (PLT)* according AFNOR NF P91-117-1 and DIN 18134 standards, *light falling weight deflectometer (LFWD)* and *soil stiffness gauge* (*SSG)*, and continuous stiffness test by means of "Portancemètre". For this purpose each layer was divided in grids materialised in rows of two meters (A, B, C) and columns with 5m width (1 to 10). In row A and C was carried out every type of test, while in row B only non destructive tests were done (fig. 1). Note that in lanes A and C were executed passages of the "Portancemèmetre" after performed the *PLT* tests. Each layer was tested for different energy levels corresponding to 4, 6, 8, 10 and 12 roller repetitions.

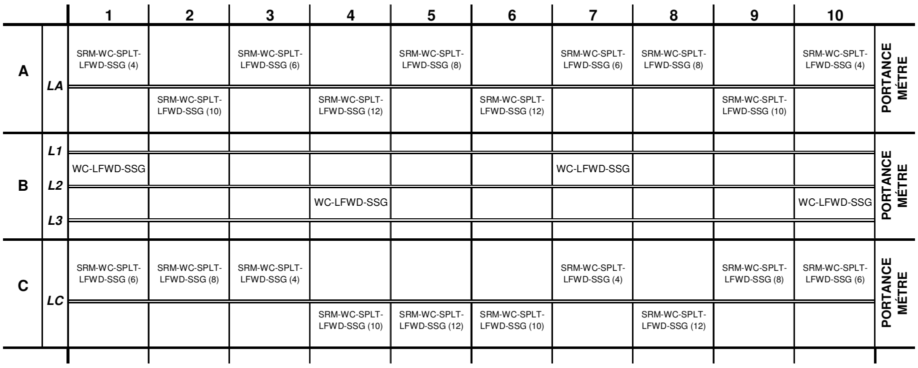
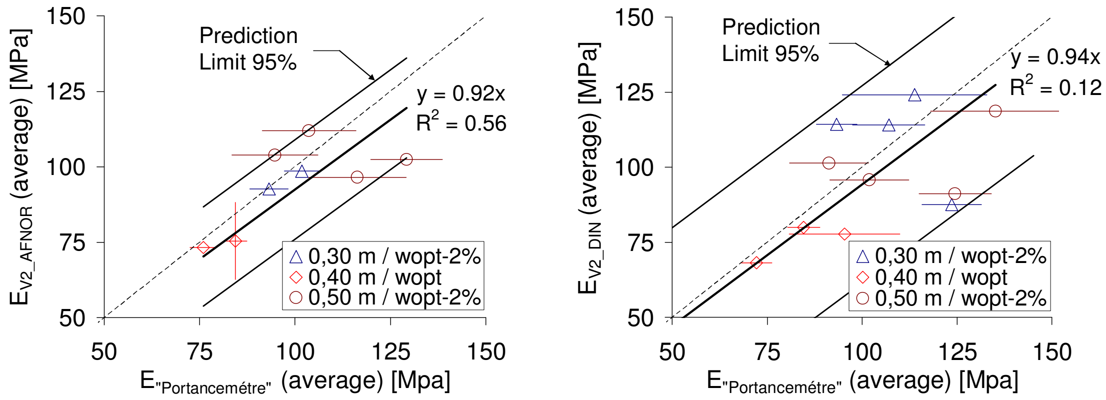


Figure 1. Experimental plan for each layer

MAIN RESULTS AND CONCLUSIONS

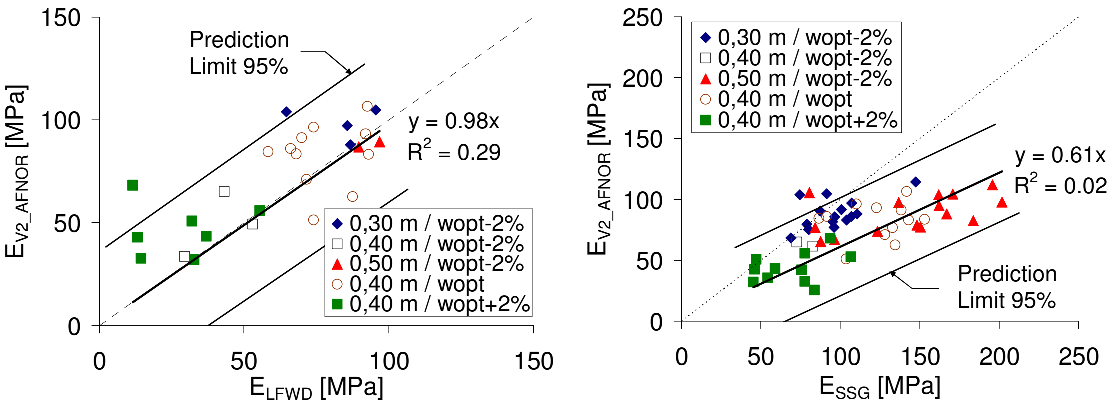
For the studied soil correlations close to unit was observed between "Portancemètre"modulus $E_{Portancemètre}$ and *PLT* E_{V2} modulus, according AFNOR and DIN standards, for an energy level corresponding to twelve passages of the roller, as it is shown in Figure 2. Good correlation is verified with AFNOR results and a much poor for DIN results, where higher scatter of results were obtained. These results in this soil demonstrate the advantage in using a plate with bigger diameter.

It was also found reasonable correlation between *PLT* (AFNOR standard) and *LFWD*. The poorest correlation was obtained between *PLT* (AFNOR standard) and *SSG* (fig. 3).



a) b)

Figure 2. Relationship between deformability modulus E_V obtained by "Portancemètre" and by interpretation of: a) AFNOR standard $E_{V2\text{-}AFNOR}$; b) DIN standard $E_{V2\text{-}DIN}$



a) b)

Figure 3. Relationship between E_{V2} modulus, for different soil layers state conditions, obtained with *PLT* (AFNOR standard $E_{V2\text{-}AFNOR}$) and with: a) *LFWD* $E_{V2\text{-}LFWD}$; b) *SSG* $E_{V2\text{-}SSG}$

Figure 3 shows that *LFWD* and *PLT* correlation is close to unit, while *SS*G results tend to be approximately 40% higher then *PLT*.

It was also observed that moduli values comparisons between “Portancemètre” and *LFWD* and also *SSG*, show high scatter.

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