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Embankment on Soft Soil Reinforced by CMC Semi-Rigid Inclusions for the High-speed Railway SEA

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Abstract

The embankment going to Dordogne Viaduct crossed by the LGV South Europe Atlantic SEA is based on 4 000 semi-rigid inclusions (CMC) designed in accordance with ASIRI. Published in 2012, these recommendations are starting to be well known and applied around the world. Depending on the purpose of the CMC (stability or only settlement reduction), CMCs justifications differ. For the first case, verifications are more numerous and more severe. After CMC ground improvement work in 2013, the embankment had been performed and the rail is being installed. A monitoring setting up during project progress has allowed the comparison between predicted deformations and measurements.

Keywords: high-speed Railway, LGV, South Europe Atlantic SEA, Ground Improvement, Semi-Rigid Inclusion, CMC, ASIRI, Menard

1 Introduction

1.1 Project Description

In France a new high-speed railway 300 kilometers long is under construction between Tours and Bordeaux. The aim of the project LGV South Europe Atlantic SEA is to connect France to Spain crossing the south-west of France. Stemming from a public-private partnership, the concession granter is the French Railway network Company SNCF Réseau (formerly Réseau Ferré de France RFF) and the concession holder is LISEA. The future high-speed train will be used by the first passengers in middle of 2017 with expected commercial speeds higher than 320 km/h.

Located in Saint-Loubès (33 450) close to Bordeaux, the viaduct cross the Dordogne River near existing viaduct of highway A10 (See Figure 1).

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Figure 1: Aerial picture of the site, from COSEA

The railway viaduct is installed on deep foundation piles and is bordered by two embankments at each extremity. The engineered fill abutment is the link between the regular embankment and the viaduct, or between geotechnical engineering and civil engineering. Embankment height varies from 10 meters to 5 m over a distance of 300 m.

1.2 Soil Conditions

Geotechnical investigations were carried out by in situ testing campaigns: Menard pressuremeter tests, cone penetration tests, boreholes, vane shear-tests. Then laboratory tests were thoroughly performed such as density, water contents, Atterberg limits but also triaxial and oedometer tests.

Alluvial plain of Dordogne River is composed of quaternary subsoil. Thickness of materials vary along the site. The upper soil layer consists of a very soft clay about 3 to 7 m thick. Interbedded organic material has been observed in this high compressible soil hence creep phenomenon had to be included in the design phase. Layers beneath consist of a compact gravelly sand and a very stiff marl. The following Figure 2 presents the soft soil thickness over the project.

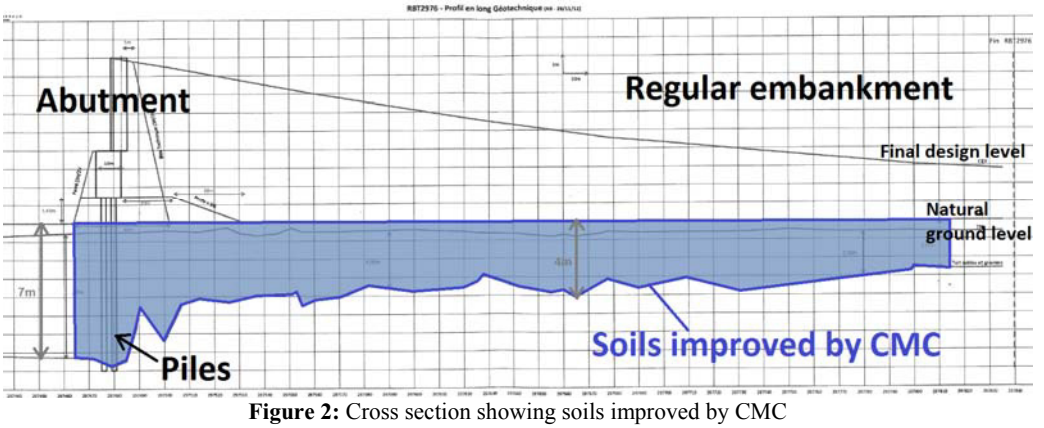

Figure 2: Cross section showing soils improved by CMC