Geotechnik im Bauwesen
Geotechnical Engineering
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RHEINISCH-WESTFÄLISCHE TECHNISCHE HOCHSCHULE AACHEN

Research Topic:

"Geotechnical and Geological Sectorization and Risk Analysis of Railroad Paving Pathways – Case Study: Estrada de Ferro Carajas"

Research Institution:

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DAAD Deutscher Akademischer Austausch Dienst German Academic Exchange Service

CNPq Conselho Nacional de Desenvolvimento Científico e Tecnológico

VALE

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Carajás Railroad of the Mining Project - VALE SA.

Project Manager:

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Problem definition and objectives

The Carajás Iron Mine is the largest reserves of high content iron ore in the world. The ore is mined and transported via the Carajás Railway - EFC across the Amazon Forest Region and its transition zone along its 892 km long (Figure 1), linking the mine to the Port of Itaqui, located in São Luís (Maranhão State). About 100 million tons are transported annually. In 2010 Vale SA began the project of duplication of the EFC to increase the transport capacity of the railroad. The scope of the research project is to of this study is to develop a methodology for risk analysis in geotechnical construction and operation of railways, taking as case study of the Carajás Railroad of the Mining Project - VALE SA.

Figure 1: Location of the Carajás Railway - EFC

The development of the method is based on the concepts and techniques of classical risk analysis, based on the principles of the Mechanistic Method (Gomes, 2008), the concepts of geodynamic processes and principles of soil mechanics.

Development

The initial phase (Phase 1) of these studies is based on extensive data base and technical information provided by the railroad company. In the course of 2010 and 2011, the data were consolidated and systematized, compared to the records of geotechnical investigations conducted at the railroad, the data from the original design of the railway construction (1977/78), data from the design project of the duplication of the permanent railway (2005), and the realization of field work to collect data along the railroad in 2011. (Figure 2)

The field data were collected by Vale SA and performed within the initial phase of TMD methodology, which consists of the subdivision of the railroad in sectors or segments of reference (TR). For that, the 892 km of the railway were divided into 914 segments, which extensions were determined based on the local morphology.It is noteworthy that each part of the railroad consists of three parts: Right side (Ld), Left (Le) and the railway platform (PL).

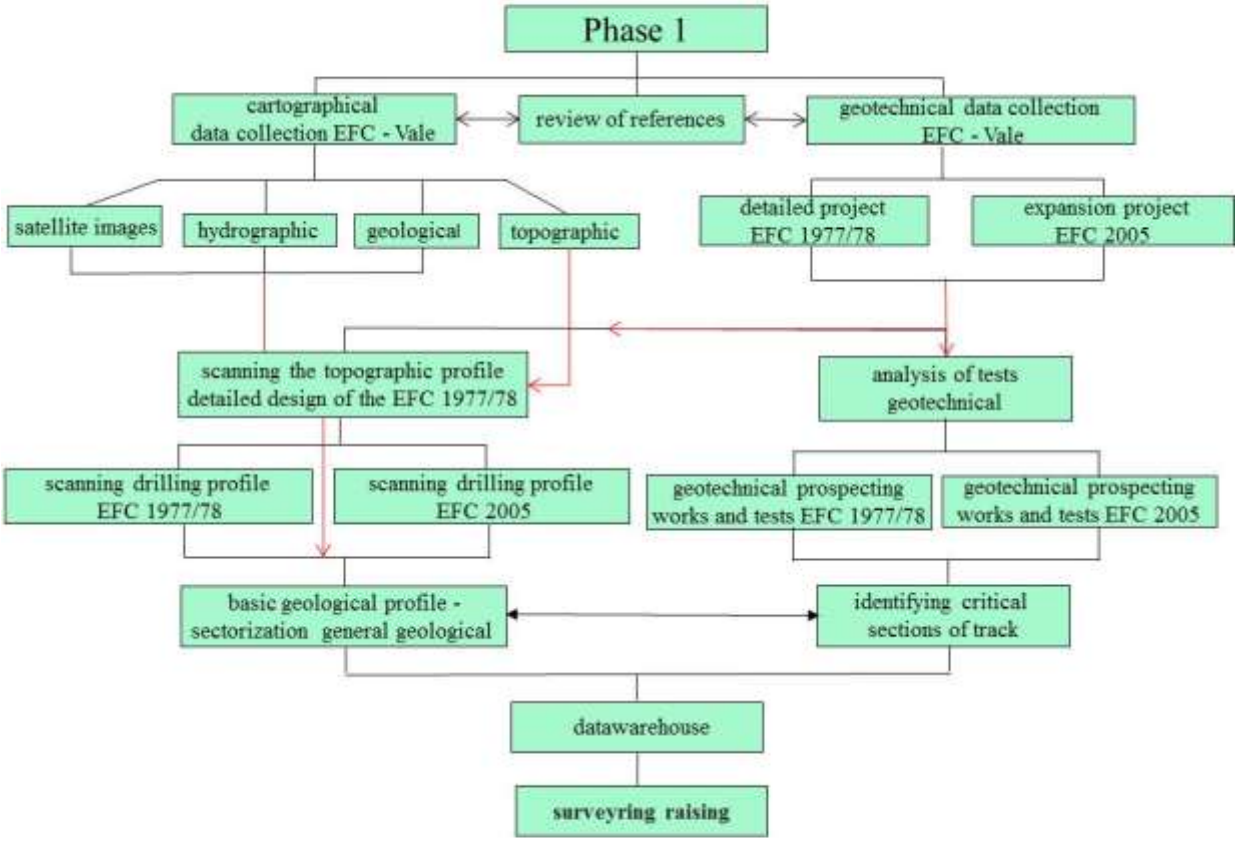

Figure 2: Activities that were developed on Phase1

The figure 3 shows the general flow of the activities that were developed on Step2. During these activities was developed the “Methodological for diagnostics of and geotechnical problems along a railroad”.

Recent work and results

The development of a methodology led to the completion of the field identification and analysis of occurrence of different geotechnical processes along the Carajás Railroad. The analysis was done based on 2742 field observation data, collected over 892 km along the railroad, and divided into 914 individual segments, cross-sectioned as left side, right side and central platform at each segment.

This process resulted in the “Framework for prioritization of the segments based on relevance hierarchy” (Figure 4). It allows the task of classifying segments that have higher Concentration of Geotechnical Processes (CPG)

The methodology also enabled the development of the calculation of Index Vulnerability (iV) of each part of the railroad regarding geotechnical processes that may result in paralysis of the railway.

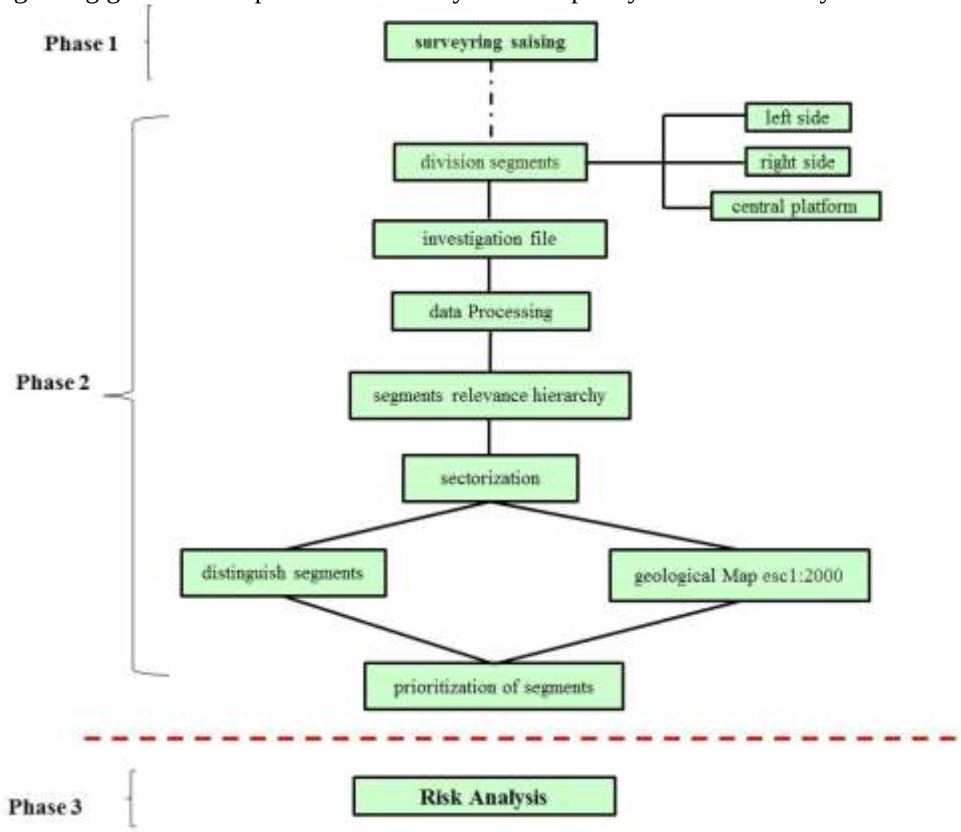

Figure 3: "Methodological for diagnostics of and geotechnical problems along a railroad"

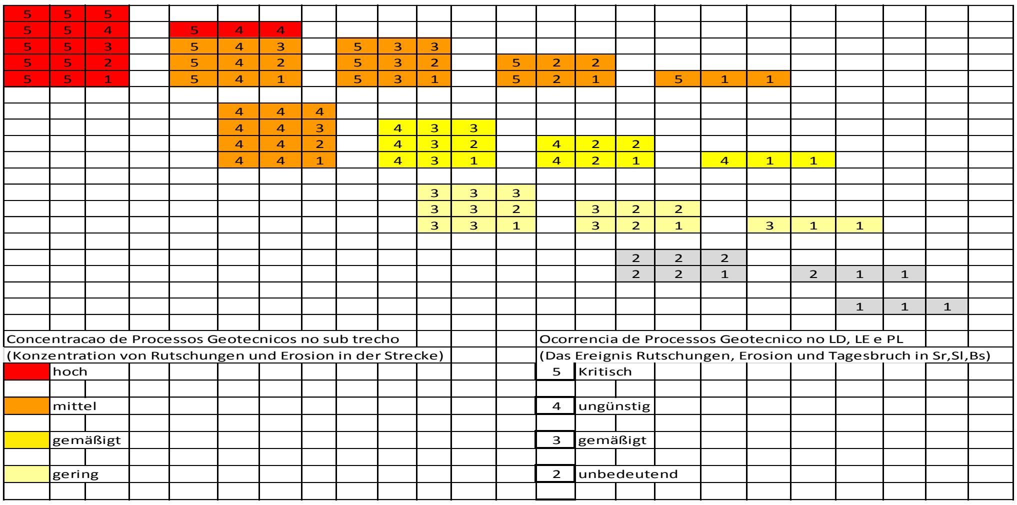

Figura 4: "Framework for prioritization of the segments based on relevance hierarchy"

From the development of the "Methodological and for diagnostics of geotechnical problems along the railroad" was possible to generate a program to control and track maintenance. This program aims to promote control of the conditions of the track, and the prioritization of maintenance, as the completion of the works and soon to inspections the Carajás Railroad. (Figure 5).

r/Ab Sb/Tb	NA Ws	Trecho (Km aKm) Streck (km bis Km)	Td Br	Te Bl	Pl Bs	IG IG	Setor- IP Sektor -IP	Setor- Geo Sektor - Geo
r/a	na	654+050 A 655+280	2	2	4	3,10		Formacao Codó (Kc)
r/a	na	655+980 A 657+170	3	5	5	6,75		
	na	657+640 A 658+100	2	2	3	1,48		
r/a	na	658+900 A 660+280	3	3	4	3,50		
r/a		661+320 A 662+880	3	3	3	0,88		
r/a	na	662+880 A 663+710	2	2	4	3,10		
r/a	na	663+950 A 664+750	2	2	5	4,60		
	na	665+620 A 667+200	3	2	4	2,80		
r/a	na	667+200 A 667+850	3	3	5	5,00		
r/a		667+850 A 669+300	3	3	5	3,50		
		669+300 A 671+000	2	4	5	4,05		Qa Ki

	Anschüttung
	Abtragböschung
	Abtragböschung -Anschüttung
r/a	Setzungsberechnung oder Tagesbruch
na	Wasserspiegel

Sr: Seite recht
Sl: Seite links
Bs: Bahnstreck
IG: Anfälligkeit
Sektor IP: Sektor Anfällikeit
Sektor Geo: Sektor Geologie

Figure 5: sample excerpt from the ECF with problems identified from the program control and maintenance on railroad

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