

Ph.D. Thesis
on
**Structural Design of RBI Stabilized Mine Overburden Based Haul
Road Pavement Using Finite Element Modeling Technique**

Abstract

A well-stabilized haul road plays a vital role in achieving high productivity from an opencast mine. The failure of haul road leads to an increase in airborne dust, reduced traffic mobility, increase in cycle time, increase in the frequency of vehicle maintenance, and fuel consumption. Potholes, rutting, and corrugations are major failure modes observed in haul roads. Other problems include the slushy and slippery pavements. Sometimes, issues of haul road are due to mismatch of its load-bearing capacity with dumper capacity. In such cases, enhancement of the load-bearing capacity of haul road is of primary importance.

This research conducts laboratory tests on coal mine overburden materials such as murrum, top soil, and sub soil stabilized with commercial additive "Road Building International (RBI)" to check their suitability as pavement layers. The laboratory tests conducted on these materials includes physical, mechanical, chemical and micro-structural analysis.

The test results show that un-stabilized murrum, top soil, and sub soil are unsuitable for mine haul road pavement material, whereas the strength gain of developed composite is better for murrum followed by sub soil and top soil. One-way and two-way analysis of variance (ANOVA) shows that overburden material type contributes more to the mechanical properties than the RBI percentage. Developed multiple linear regression model between physical and mechanical properties shows excellent coefficient of determination.

Three-dimensional linear finite element models are developed to assess the pavement's structural design of the best overburden material (i.e., Murrum) in terms of strain and deformation. The effect of the modulus ratio is found to be more significant than the thickness ratio between the base and sub-base layers. A design chart is developed based on deformation and strain output from the finite element model for the selection of thickness and material property of the base and sub base of the pavement.

Key words: *Haul road design, RBI, Regression model, ANOVA, Finite element models, Design chart*