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Buckling Analysis of Bedded Rock Slope Subject to Seismic Force – a Case Study in Karakoram Highway, Pakistan

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Abstract: Buckling deformation of bedded rock slope is common in the northern region of the Hunza river along China-Pakistan International Karakoram Highway (KKH), Pakistan. In order to analyze the failure mechanism, an explicit general failure formula is established to depict the flexural buckling of plane slopes subject to seismic force based on the theory of column stability and stress equilibrium. A comparison is made between the flexural buckling subject to seismic force and the buckling without seismic force. The rock slope of K745 at KKH is analyzed to evaluate the effects of three key parameters – seismic force (horizontal acceleration), slope inclination angle and friction angle.

Keywords: China-Pakistan International Karakoram Highway, seismic force, buckling failure, column stability, bedded rock slope

1 Introduction

The China-Pakistan International Karakoram Highway (KKH) has been constructed through three high mountain terrains – the Himalayas, Karakoram and Pamir, and two earthquake belts – Karakorum Pamirs earthquake belt and Himalayas earthquake belt. The route of the highway is characterized by highly fractured rocks, extensive areas of debris accumulation and high rates of geomorphological activities and has encountered many extreme geohazards related to rock slopes, landslides and buckling failure. They have posed significant potential threats to the construction and maintenance of the KKH. This paper will concentrate on analysis of buckling failure in this area.

From the mechanism point of view, buckling failures are classified as flexural buckling of plane slopes, three hinge buckling of plane slopes and three hinge buckling of curved slopes (Goodman 1976). Flexural buckling failures may occur if certain geometrical conditions exist, as follows: 1) presence of stratified rocks with a columnar or slab shaped structure (Froldi and Lunardi 1995) and the cleavage is significant and regular, 2) the plane of the main discontinuities must parallel to the slope face, 3) both the length and the width of the rock

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