Rehabilitation of Earth Retaining Wall for Slope Failure, due to Strength Reduction and Seismic Acceleration, Considering Nonlinear Soil-Structure Interaction

Jörg-Martin Hohberg

IUB Engineering Ltd., Bern, Switzerland

Contact: martin.hohberg@iub-ag.ch

Abstract

The usual design of retaining walls employs triangular earth pressure distributions with coefficients anticipating some compliance in sliding or tilting mode; if very stiff, pressure-at-rest is assumed. If seismic acceleration is to be accounted for, this is mostly done by the formula of Mononobe-Okabe, which is over 100 years old. Recent collapses of angular retaining walls, such as the one of Schönberg at the Brenner Motorway in March 2012, drew particular attention to their vulnerability due to unnoticed corrosion of the bending reinforcement in the cold joint between wall and base slab or a tail skid. Extensive risk analyses by both the Austrian ASFINAG and the Swiss ASTRA were triggered [1][2] as well as research projects at TU Graz and ETHZ Zurich. The following presentation investigates the failure modes of a staggered retaining wall in a steep slope, the stabilizing effects of prestressed ground anchors, and the influence of soil-structure interaction on stress redistribution in the reinforced concrete structure.

Keywords: retaining wall, ultimate limit state, nonlinear FEM, slope failure, seismic earth pressure, soil-structure interaction, corrosion of reinforcement, prestressed anchors.

1 Introduction

Laboratory research requires a starting decision as to what is the mechanism to be investigated. From a classical structural engineering point of view, it is the rotational capacity of a retaining wall subject to corrosion of reinforcement, particularly the vertical one on the rear side (uphill), where honeycombing due to an untight cold joint between slab and wall may occur. The bottom reinforcement of the base slab seems of lesser interest, even though it is strained by the same corner bending moment and may be subjected to about the same water pressure as the cold joint, albeit less exposed due to a lean concrete layer under the slab.

Figure 1. Typical loss of rebar cross-section due to advanced corrosion at the earth-covered rear side of an angular retaining wall [3]