

Accepted Manuscript

Seismic Distortions of a Deep Circular Tunnel in Elastic Slightly Anisotropic Ground

Antonio Bobet, Haitao Yu

PII: S2467-9674(17)30013-2

DOI: <http://dx.doi.org/10.1016/j.undsp.2017.05.001>

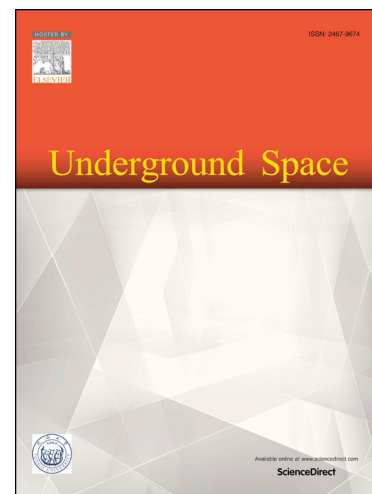
Reference: UNDSP 19

To appear in: *Underground Space*

Received Date: 11 February 2017

Revised Date: 1 May 2017

Accepted Date: 9 May 2017



Please cite this article as: A. Bobet, H. Yu, Seismic Distortions of a Deep Circular Tunnel in Elastic Slightly Anisotropic Ground, *Underground Space* (2017), doi: <http://dx.doi.org/10.1016/j.undsp.2017.05.001>

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

Seismic Distortions of a Deep Circular Tunnel in Elastic Slightly Anisotropic Ground

Antonio Bobet^{1,2} and Haitao Yu^{3,4*}

¹Lyles School of Civil Engineering, Purdue University, West Lafayette, IN 47907, USA

²High-End Foreign Expert at Tongji University, Shanghai 200092, China

³Key Laboratory of Geotechnical and Underground Engineering of Ministry of Education, Tongji University, Shanghai 200092, China

⁴State Key Laboratory for GeoMechanics and Deep Underground Engineering, China University of Mining and Technology, Beijing, 100083, China

*E-mail: yuhaitao@tongji.edu.cn

Abstract

Tunnels must withstand not only the demands stemming from normal working conditions but also from extreme events such as earthquakes. Indeed, there is consistent evidence in the technical literature that indicates that tunnels are vulnerable to damage and must be designed to adequately support the demand imposed by the earthquake. Such demand should be estimated using dynamic numerical methods that include soil-structure interaction and incorporate realistic models for the support and surrounding ground. For preliminary analysis, however, or when the seismic demand is insufficient to take the ground beyond its elastic regime, analytical solutions may provide a reasonable estimate of the tunnel behavior, especially if the tunnel is sufficiently far from the seismic source such that a pseudo-static analysis is acceptable. Most analytical solutions are based on the assumption that the ground is isotropic, which may not be realistic, as e.g. depositional processes may result in engineering properties that depend on the direction of deposition. The work presented in the paper builds on the results by Bobet (2011) and (2016) who provided closed-form solutions for deep tunnels in elastic transversely anisotropic ground; however, the paper provides much simpler solutions for those cases where the ground is slightly anisotropic. A comparison between the approximate and the exact solutions shows that the errors are negligible when the ground anisotropy is small and grow, albeit slowly, as the ground anisotropy increases. The conclusion applies to different loading conditions, drained and undrained, and to different ground-support interfaces, tied or frictionless.

Keywords: seismic behavior, deep tunnel, transversely anisotropic ground, drained and undrained loading

1. Introduction

In recent years, considerable attention has been given to the response of underground structures to earthquake loading. Arguably, it was the failure of the Daikai station during the 1995 Hyogoken-Nambu earthquake that sparked interest in the subject (Ida et al., 1996; Shawky and Maekawa, 1996), even though a somewhat extensive body of work on the topic had been already available in the literature, e.g. Wang (1993). The Daikai station was perhaps the first well-documented underground structure that collapsed due to

Download English Version:

<https://daneshyari.com/en/article/6784403>

Download Persian Version:

<https://daneshyari.com/article/6784403>

[Daneshyari.com](https://daneshyari.com)