VOL. 109 NO. 9. SEP. 1983

ISSN 0733-9410
CODEN: JGENDZ

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Journal of Geotechnical Engineering

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CONTENTS

The Journal of Geotechnical Engineering (ISSN 0733-9410) is published monthly by the American Society of Civil Engineers. Publications office is at 345 East 47th Street, New York, NY 10017-2398. Address all ASCE correspondence to the Editorial and General Offices at 345 East 47th Street, New York, NY 10017-2398. Allow six weeks for change of address to become effective. Subscription price to members is $18.50. Nonmember subscriptions available; prices obtainable on request. Second-class postage paid at New York, NY and at additional mailing offices.

POSTMASTER: Send address changes to Journal of Geotechnical Engineering, ASCE, 345 East 47th Street, New York, NY 10017-2398.

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DISCUSSION

Paper 18204

Piles as Barriers for Elastic Waves

By Javier Avilés[1] and Francisco J. Sánchez-Sesma[2]

Abstract: A theoretical study is presented on the usefulness of a row of rigid piles as an isolating barrier for elastic waves. The problem is formulated as one of multiple scattering and diffraction. A set of cylindrical coordinate systems is used in such a way that it allows solving in an exact form the problem of multiple scattering for circular cross-sections. Some numerical results are presented. The effectiveness of this isolation system is discussed.

Introduction

There are structures in which it is necessary to reduce the level of vibrations generated in the neighborhood by explosions, machines, or traffic. In some cases, delicate equipment can be severely damaged when subjected to vibrations, particularly at certain frequencies. The problem can be solved by direct isolation of the source of vibrations by means of mechanical devices (6–8). However, if that solution is not feasible, the use of barriers of some kind should be attempted.

The use of trenches as barriers has been studied by several authors (5,14,16,17,21), mainly for incident Rayleigh surface waves. Experimental and, in some cases, analytical results have given understanding and insight into the problem, which provide general guidelines for the practical use of trenches. Sometimes, however, the depth required to expect good isolation is very large and practical construction difficulties arise. This is the case in very soft ground or high water table level locations.

Apparently, the idea of using cylindrical piles as barriers of waves was first given by Richart, et al. (16). Experimental research using holography has been done by Woods, et al. (22) by producing Rayleigh waves and studying the effects of cylindrical hole barriers on the wave field. Effective isolation was found for wavelengths less than about 6 diam and separations less than a quarter of the wavelength. No similar results were reported for solid barriers, but they "were found to be effective" and "their behavior was fundamentally different from that of void barriers" (22). For acoustic and electromagnetic waves, some experimental (13) and analytical (9,12,19) results have been obtained which suggest that rows of piles could be successfully used as barriers in problems of isolation of elastic waves. There is, however, a lack of criteria for selecting the optimum array for such an isolation system.

In this paper a theoretical study is presented on the usefulness of a row of rigid piles as an isolating barrier for elastic waves. The piles have a circular cross section and are embedded in an elastic, homogeneous,

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Note.—Discussion open until February 1, 1984. To extend the closing date one month, a written request must be filed with the ASCE Manager of Technical and Professional Publications. The manuscript for this paper was submitted for review and possible publication on June 30, 1982. This paper is part of the *Journal of Geotechnical Engineering*, Vol. 109, No. 9, September, 1983. ©ASCE, ISSN 0733-9410/83/0009-1133/$01.00. Paper No. 18227.