VOL.99 NO.SM2. FEB. 1973

JOURNAL OF THE SOIL MECHANICS AND FOUNDATIONS DIVISION

PROCEEDINGS OF
THE AMERICAN SOCIETY
OF CIVIL ENGINEERS

CONTENTS

Papers Page

Constructional Deformations in Rockfill Dam
by Arthur Penman and Andrew Charles 139

Use of Cycloidal Arcs for Estimating Ditch Safety
by Harold B. Ellis 165

Comments on Conventional Design of Retaining Structures
by Leo Casagrande 181

Model Investigations of Pile Groups in Sand
by Andrzej F. Tejchman 199

→

This Journal is published monthly by the American Society of Civil Engineers. Publications office is at 345 East 47th Street, New York, N.Y. 10017. Address all ASCE correspondence to the Editorial and General Offices at 345 East 47th Street, New York, N.Y. 10017. Allow six weeks for change of address to become effective. Subscription price to members is $8.00. Nonmember subscriptions available; prices obtainable on request. Second-class postage paid at New York, N.Y. and at additional mailing offices. HY, SM.

DISCUSSION

Proc. Paper 9524

Behavior of Laterally Loaded Piles: III—Socketed Piles, by Harry G. Poulos (Apr., 1972).
errata 221

Engineering Properties of Compacted Fly Ash,[a] by Donald H. Gray and Yen-Kuang Lin (Apr., 1972).
by Dimtcho Evstatiev 221

Duplication of Dilatancy in Analysis of Jointed Rocks, by Richard E. Goodman and Jacques Dubois (Apr., 1972).
errata 224

In Situ Shear Wave Velocity by Cross-Hole Method,[a] by Kenneth H. Stokoe, II and Richard D. Woods (May, 1972).
by Wolfgang A. Haupt 244

INFORMATION RETRIEVAL

The key words, abstract, and reference "cards" for each article in this Journal represent part of the ASCE participation in the EJC information retrieval plan. The retrieval data are placed herein so that each can be cut out, placed on a 3 × 5 card and given an accession number for the user's file. The accession number is then entered on key word cards so that the user can subsequently match key words to choose the articles he wishes. Details of this program were given in an August, 1962 article in CIVIL ENGINEERING, reprints of which are available on request to ASCE headquarters.

[a]Discussion period closed for this paper. Any other discussion recieved during this discussion period will be published in subsequent Journals.

9560 CONSTRUCTIONAL DEFORMATIONS IN ROCKFILL DAM

KEY WORDS: Computers; Construction; **Dams (rockfill); Deformation; Finite elements;** Research; **Settlement (structural); Soil mechanics; Strain gages; Surveying**

ABSTRACT: Movements of 26 steel plates buried in the downstram rockfill of Llyn Brianne Dam (90 m) were measured during construction in relation to reference pillars founded on rock away from the dam, by both triangulation and three-dimensional trilateration and the use of three horizontal plate gages, of which the plates formed a part. These movements are compared with those predicted from fill properties derived from large-scale laboratory tests by an analysis using a finite element technique. In general the movements were greatest at the boundary between the rockfill and the clay core, and decreased towards the toe. Horizontal movement of the downstream slope was greatest at about mid-height where it was 0.68 % of dam height and similar to the horizontal movement measured at two other rockfill dams. The movements are analyzed and compared with those of three other rockfill dams and one earthfill dam during failure.

REFERENCE: Penman, Arthur, and Charles, Andrew, "Constructional Deformations in Rockfill Dam," *Journal of the Soil Mechanics and Foundations Division,* ASCE, Vol. 99, No. SM2, **Proc. Paper 9560,** February, 1973, pp. 139-163

9566 CYCLOIDAL ARCS FOR ESTIMATING DITCH SAFETY

KEY WORDS: Cohesion; **Curves; Ditches;** Embankments; **Failure; Geometric shapes; Internal friction; Safety factor;** Shear stress; **Slope stability; Soil mechanics;** Vertical drains

ABSTRACT: A method of analysis is presented for estimating the factor of safety of ditches and similar excavations taking into account the unit weight and shearing strength of the soil. The method is based on the theory that the shear failure, if it occurs, will occur along a surface which is cycloidal in shape. Equations for shear stress and strength are derived from Coulomb's shear strength equation and the equation for safety factor developed and results presented in tabular form. For cases where a soil will not stand vertically and must be sloped, a definition for critical slope is presented and the equation to determine critical slope is derived and presented in tabular form.

REFERENCE: Ellis, Harold B., "Use of Cycloidal Arcs for Estimating Ditch Safety," *Journal of the Soil Mechanics and Foundations Division,* ASCE, Vol. 99, No. SM2, **Proc. Paper 9566,** February, 1973, pp. 165-179

9568 DESIGN OF RETAINING STRUCTURES

KEY WORDS: **Anchorages; Anchored bulkheads;** Cellular structures; Cofferdams; **Design assumptions; Earth pressure; Retaining walls; Soil mechanics**

ABSTRACT: The performance of earth retaining structures is analyzed to illustrate certain weaknesses in the conventional design practice. It is shown that the yielding of a retaining structure by an amount required for the earth pressure to drop to the minimum active state does not necessarily provide assurance that active earth pressure will prevail for more than a limited period of time. If a design is based on the active earth pressure, while the actual earth pressure may at times be equal to or greater than the earth pressure at rest, the actual factor of safety would be close to unity. It is demonstrated that anchored bulkheads are particularly vulnerable in this respect because the design of a competent anchorage may require an assumption of forces at the anchor level that are equal to two to three times those computed on the basis of a conventional design using active earth pressure.

REFERENCE: Casagrande, Leo, "Comments on Conventional Design of Retaining Structures," *Journal of the Soil Mechanics and Foundations Division,* ASCE, Vol. 99, No. SM2, **Proc. Paper 9568,** February, 1973, pp. 181-198