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DISCUSSION

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Proc. Paper 10905

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 received during this discussion period will be published in subsequent Journals.

10908 HYDROGRAPHIC SURVEYS OFFSHORE—ERROR SOURCES

KEY WORDS: Bathymetry; Coastal engineering; **Error functions; Hydrographic surveys; Hydrography;** Measurement; **Surveying; Tide gages**

ABSTRACT: Waves at sea limit both the resolution and accuracy of bathymetric surveys. Vessel roll introduces errors difficult to correct. By limiting operations to calm days according to criteria given, these errors can be controlled. Heave and roll appear as wiggles on the record, masking bottom irregularities. Speed limitations are given to assure seeing irregularities of a given size. Three tidal datum plane are defined, and indirect methods of obtaining offshore tidal data are described.

REFERENCE: Cross, Ralph H., "Hydrographic Surveys Offshore—Error Sources," *Journal of the Surveying and Mapping Division,* ASCE, Vol. 100, No. SU2, **Proc. Paper 10908**, November, 1974, pp. 83-93

10906 PLANNING ECONOMICAL TUNNEL SURVEYS

KEY WORDS: Alignment; **Benefit cost analysis;** Control surveys; **Economics; Planning; Surveying; Tunnels;** Water tunnels

ABSTRACT: Economical tunnel surveys require careful advance planning. Methods and criteria for planning the surveys are examined, as are the factors affecting the choice of method to be used. A well-planned basic control system is shown to be essential for keeping survey costs at a minimum. Traverse, triangulation, and trilateration methods are compared and recommendations given for their use. The amount of positional uncertainty which can be tolerated in the tunnel alinement may be determinative in the choice of method, but often other considerations may take overriding precedence. Problems in reproducing the design alinement in the tunnel are greatly simplified by the advance in instrumentation and horizontal accuracies of one part in 30,000 can be obtained with comparative ease and economy when supported by a properly designed basic control system.

REFERENCE: Thompson, Bruce J., "Planning Economical Tunnel Surveys," *Journal of the Surveying and Mapping Division,* ASCE, Vol. 100, No. SU2, **Proc. Paper 10906**, November, 1974, pp. 95-98

10925 PRECISE DAM SURVEYS - LOS ANGELES

KEY WORDS: **California; Control systems; Dam stability;** Geodetic surveys; Monitoring; Precision; **Surveillance; Surveys**

ABSTRACT: The Los Angeles County Flood Control District performs precise control surveys on eight concrete arch and gravity dams, five earthfill dams, and 12 major earthfill debris basins. Probable error in position of surveillance points varies generally from ± 0.5 to ± 2 mm with extreme values ranging to ± 6 mm for unfavorable geometric or refractive conditions, or both. Techniques are considered excellent and optimal with base-line precisions generally at 0.5 ppm - 1 ppm in probable error, and angular direction probable error on the order of ± 0.5 sec. Standards for precision should be based on reasonable effort consistent with that magnitude of movement with adequate reliability that would induce response action if exceeded. The standards should in addition be dependent on the nature of the structure, associated risks, and the limitations of the site geometry comprising the precise system.

REFERENCE: Keene, Don F., "Precise Dam Surveys—Los Angeles County Flood Control District," *Journal of the Surveying and Mapping Division,* ASCE, Vol. 100, No. SU2, **Proc. Paper 10925**, November, 1974, pp. 99-114

10938 INVESTIGATION OF DYNAMIC TAPING

KEY WORDS: Experimental data; Investigations; **Slope indicators; Surveying; Taping; Vibration**

ABSTRACT: The preferred time for reading tape length when using dynamic taping is suggested, differing from the one previously proposed. The dynamic taping technique has been suggested as a method for eliminating catenary corrections. An experimental investigation in which the measured length and tape tension were measured as functions of time was conducted to confirm or suggest modifications to the time at which the length should be measured. An analytical method for determining the time-placement relationship of one end of the tape is presented and theoretical curves are shown for a range of amplitudes of tape oscillation. Comparison between an experimental cycle and the theoretical values resulted in good correlation in the critical regions. The tape force-time relationship depends on the observer, and the length-time relationship depends on the force, length, and cross section of the tape. However, the minimum reading of the tape appears to give a more accurate result than the reading previously proposed.

REFERENCE: Golley, Bruce W., and Sneddon, John, "Investigation of Dynamic Taping," *Journal of the Surveying and Mapping Division,* ASCE, Vol. 100, No. SU2, **Proc. Paper 10938**, November, 1974, pp. 115-122

10896 STRUCTURAL AND TERRAIN MOVEMENTS

KEY WORDS: Computation; Control surveys; **Deformation; Errors;** Measuring instruments; **Motion;** Safety; **Surveying;** Triangulation

ABSTRACT: This paper is to be Chapter 17 of the proposed Manual on Engineering Surveys now being prepared by the Committee on Engineering Surveying of the Surveying and Mapping Division. It is essentially an outline of survey procedures that are specifically applicable to the problem of measuring terrain movements and structural deformations. The scope is limited to the determination of absolute movement by precise survey methods. Emphasis is placed on designing a movement study so that propagated errors in position and elevation remain smaller than the minimum expected movement. Error propagation equations for some of the survey and computational methods used in movement studies and a comprehensive list of pertinent references are appended.

REFERENCE: Dearinger, John A., "Structural and Terrain Movements," *Journal of the Surveying and Mapping Division,* ASCE, Vol. 100, No. SU2, **Proc. Paper 10896**, November, 1974, pp. 123-142

10948 MULTISPECTRAL REMOTE SENSOR DATA

KEY WORDS: **Computers; Data systems; Mapping; Remote sensing;** Satellites (artificial); Spectrum analysis; **Surveying**

ABSTRACT: The United States Army Engineer Waterways Experiment Station is engaged in a study to detect from ERTS-1 satellite data alterations to the absorption and scattering properties caused by the movement of suspended particles and solutes in selected areas of the Chesapeake Bay and to correlate the data to determine the feasibility of delineating flow patterns, flushing action of the estuary, and sediment and pollutant dispersion. Data processing techniques have been developed that permit automatic interpretation of data from any multispectral remote sensor with computer systems which have limited memory capacity and computing speed. The multispectral remote sensor is considered as a reflectance spectrophotometer. The data that define the spectral reflectance characteristics of a scene are scanned pixel-by-pixel. Each pixel whose spectral reflectance matches a reference spectrum is identified and the results are shown in a map. This paper describes the interpretation technique and presents as an example interpretated data from the ERTS-1.

REFERENCE: Williamson, Albert N., "Interpretation of Multispectral Remote Sensor Data," *Journal of the Surveying and Mapping Division,* ASCE, Vol. 100, No. SU2,

10962 PROCEDURE FOR NUMERICAL RELATIVE ORIENTATION

KEY WORDS: **Aerial surveys; Numerical analysis; Orientation;** Orthogonal functions; **Photogrammetry;** Random processes; Rotation; **Surveying**

ABSTRACT: A random rotation approach has been suggested herein to tackle the problems of relative and exterior orientations. This new method circumvents the problem posed with iterative solutions. Problems of relative and exterior orientations may be reduced to a common form, from which they would appear simply as the problems of absolute orientation. Thus, exterior and relative orientations are not problems in analytical photogrammetry. The results obtained during the course of investigations carried by the writer are encouraging. Some more applications of this approach may be envisaged in other fields of analytical photogrammetry.

REFERENCE: Mahajan, Santosh K., "New Procedure for Numerical Relative Orientation," *Journal of the Surveying and Mapping Division,* ASCE, Vol. 100, No. SU2, **Proc. Paper 10962**, November, 1974, pp. 155-169

ENGLISH-SI CONVERSION FACTORS

In accordance with the October 1970 action of the ASCE Board of Direction, which stated that all publications of the Society should list all measurements in both customary (English) and SI (International System) units, the list below contains conversion factors to enable readers to compute the SI unit values of measurements. A complete guide to the SI system and its use has been published by the American Society for Testing & Materials. Copies of this publication (ASTM E-380-1972) can be purchased from ASCE at a price of 75¢ each; orders must be prepaid.

All authors of Journal papers are being asked to prepare their papers in this dual-unit format. Until this practice affects the majority of papers published, we will continue to print this table of conversion factors:

To convert	To	Multiply by
inches (in.)	millimeters (mm)	25.40
inches (in.)	centimeters (cm)	2.540
inches (in.)	meters (m)	0.0254
feet (ft)	meters (m)	0.305
miles (miles)	kilometers (km)	1.61
yards (yd)	meters (m)	0.91
square inches (sq in.)	square centimeters (cm^2)	6.45
square feet (sq ft)	square meters (m^2)	0.093
square yards (sq yd)	square meters (m^2)	0.836
acres (acre)	square meters (m^2)	4047.
square miles (sq miles)	square kilometers (km^2)	2.59
cubic inches (cu in.)	cubic centimeters (cm^3)	16.4
cubic feet (cu ft)	cubic meters (m^3)	0.028
cubic yards (cu yd)	cubic meters (m^3)	0.765
pounds (lb)	kilograms (kg)	0.453
tons (ton)	kilograms (kg)	907.2
one pound force (lbf)	newtons (N)	4.45
one kilogram force (kgf)	newtons (N)	9.81
pounds per square foot (psf)	newtons per square meter (N/m^2)	47.9
pounds per square inch (psi)	kilonewtons per square meter (kN/m^2)	6.9
gallons (gal)	cubic meters (m^3)	0.0038
gallons (gal)	liter (dm^3)	3.8
acre-feet (acre-ft)	cubic meters (m^3)	1233.
gallons per minute (gpm)	cubic meters/minute (m^3/min)	0.0038
newtons per square meter (N/m^2)	pascals (Pa)	1.00