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DISCUSSION

Proc. Paper 9965

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

TECHNICAL NOTES

Proc. Paper 10017

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

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.

9981 HYDROGRAPHY AND THE ENGINEER

KEY WORDS: Cartographic cameras; **Hydrographic surveys;** Hydrography; **Mapping; Navigation;** Ocean engineering; **Offshore structures;** Pipelines; **Surveying**

ABSTRACT: Engineers working offshore need accurate hydrographic information. A large amount is already available in the charts, Sailing Directions, and tide tables published by national hydrographic offices; considerably more exits as the results of the surveys on which the carts are based. The engineer needs to be able to evaluate the suitability of this information for his own purposes, so that he may decide whether a resurvey is warranted. Some of the factors bearing on this evaluation are also presented. Hydrographic surveys conducted for navigational purposes have limitations for the engineer of which he should be aware. Should he decide on a resurvey, the project should be reviewed with the hydrographer and specifications jointly agreed; some factors to be considered are listed.

REFERENCE: Weeks, Colin G. McQ, "Hydrography and the Engineer," *Journal of the Surveying and Mapping Division,* ASCE, Vol. 99, No. SU1, **Proc. Paper 9981**, September, 1973, pp. 1-14

9979 THE BOUNDARY OF THE SOVEREIGN

KEY WORDS: **Boundaries;** Environmental engineering; **High water mark; Hydrographic surveys;** Mangrove swamps; **Marshes;** Mean; Swamps; Tidal waters; **Tides; Wetlands**

ABSTRACT: The mean high water line has for many centuries been the boundary between public and private lands, its origin is based on natural phenomena and law, it is an extremely fair and impartial boundary line. Common laws dating some 1500 years ago undertook to define the shore. Case laws lead to the U.S. definition of mean high tide and that this line should be fixed by exclusive resort to tide cases. The quest for the marshlands is causing an erosion of private property rights and abortive, easier and faster, methods of mean high water line location. The sovereign boundary — the mean high water line — is becoming more important as concern for our environment heightens.

REFERENCE: O'Hargan, Paul T., "The Boundary of the Sovereign," *Journal of the Surveying and Mapping Division,* ASCE, Vol. 99, No. SU1, **Proc. Paper 9979**, September, 1973, pp. 15-19

10008 TUNNEL SURVEY AND TUNNELING MACHINE CONTROL

KEY WORDS: **BART;** Construction; **Laser beams; Lasers;** Quality control; **San Francisco;** Shields (tunneling); **Surveying; Surveying instruments;** Surveys; **Tunneling (excavation)**

ABSTRACT: An outline of the survey work necessary for the construction of a large tunnel project such as the San Francisco Bay area Rapid Transit System is presented. In the second part of the paper, a method for shield or tunneling machine control by laser and double target is described. This method has proven successful during the driving of the tunnels of the BART system both by hand and machine methods.

REFERENCE: Peterson, Edward W., and Frobenius, Peter, "Tunnel Survey and Tunneling Machine Control," *Journal of the Surveying and Mapping Division,* ASCE, Vol. 99, No. SU1, **Proc. Paper 10008**, September, 1973, pp. 21-37

10015 COMPUTER BASED LAND USE SUITABILITY MAPS

KEY WORDS: **Computer applications; Data processing;** Evaluation; **Land use; Land use zoning; Planning;** Regional planning; **Surveying;** Urban planning

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ABSTRACT: A computer-based method for generating land use suitability evaluations for urbanizing areas is presented. These evaluations are based on an analysis of the physical characteristics of land, such as topography, soil class, soil drainage, flood hazard, and depth to bedrock. This method allows a great deal of flexibility in analysis and provides the ability to look at land use suitability from a variety of viewpoints or development policies. The use of this computer-based system to prepare residential land use suitability maps for a 59.5-km^2 (23.0-sq mile) area containing 5,950-ha (2.47-acre) data cells is illustrated. Such a method could be a powerful planning tool when used in conjunction with an evaluation of the other social, economic, political, and environmental factors that shape the patterns of urban development.

REFERENCE: Kiefer, Ralph W., and Robbins, Michael L., "Computer Based Land Use Suitability Maps," *Journal of the Surveying and Mapping Division,* ASCE, Vol. 99, No. SU1, **Proc. Paper 10015**, September, 1973, pp. 39-62

10030 THREE-DIMENSIONAL INTERSECTION — VECTOR APPROACH

KEY WORDS: **Airborne equipment; Coastal surveillance;** Control surveys; **Geodesy;** Geodetic surveys; Geography; Helicopters; Offshore structures; **Photogrammetry; Position (location); Surveying;** Surveys; Vector analysis

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ABSTRACT: Systems of equations are derived and computational routines are outlined that can be used to determined the geodetic coordinates and elevation of a point by three-dimensional intersection using horizontal and vertical angles only. Equations are similarly derived and a computational routine is outlined that can be used to compute the geodetic coordinates and elevation of a point using horizontal angles, vertical angles, and slope distances. In both cases angles are used that have been measured from two or more points having known geodetic coordinates and elevations to a point of unknown position. All data consist of direct field measurements in the form of horizontal angles, vertical angles, and slope distance corrected only for refraction. The equations are exact with respect to a reference ellipsoid, but corrections may be required wherever the actual topographic surface differs significantly from the surface of the reference ellipsoid.

REFERENCE: Ball, William E., Jr., "Three-Dimensional Intersection-- A Vector Approach," *Journal of the Surveying and Mapping Division,* ASCE, Vol. 99, No. SU1, **Proc. Paper 10030**, September, 1973, pp. 63-78

9976 AERIAL TRIANGULATION WITH HEIGHT CONSTRAINT

KEY WORDS: **Aerial photography; Aerial surveys; Analytical photogrammetry;** Computers; Constraints; **Coordinates;** Height; **Surveying; Triangulation**

ABSTRACT: If the block triangulation and adjustment has been completed, the adjusted exterior orientation information for each of the photos can be used for subsequent post block work such as in cadastral alignment and construction surveys. The accuracy of the post block survey has been tested and found to be within limits for the projects under consideration. A new mathematical model for a functional height constraint, requiring no extra field observations, has been proposed and tested for its validity. The method seems to have definite advantage over the conventional aerial survey so far as improvement in planimetric accuracy is concerned.

REFERENCE: Rampal, Kunwar K., "Post Block Aerial Triangulation with Height Constraint," *Journal of the Surveying and Mapping Division,* ASCE, Vol. 99, No. SU1, **Proc. Paper 9976**, September, 1973, pp. 79-85

10007 THREE-DIMENSIONAL RESECTION VECTOR APPROACH

KEY WORDS: Control surveys; **Geodesy;** Geodetic surveys; Geography; **Position (location); Surveying; Vector analysis**

ABSTRACT: Systems of equations are derived and computational routines are outlined that can be used to determine the geodetic coordinates and elevation of a point by resection using horizontal and vertical angles only. Equations are similarly derived and a computational routine is outlined which can be used to compute the geodetic coordinates and elevation of a point using horizontal angles, vertical angles, and slope distances. In both cases angles are measured from the point of unknown position to three or more points having known geodetic coordinates and elevations. The equations are exact with respect to a reference ellipsoid but corrections may be required wherever the actual topographic surface differs significantly from the surface of the reference ellipsoid. Equations are derived using the three-dimensional methods of vector analysis.

REFERENCE: Ball, William E., Jr., "Three-Dimensional Resection--A Vector Approach," *Journal of the Surveying and Mapping Division,* ASCE, Vol. 99, No. SU1, **Proc. Paper 10007**, September, 1973, pp. 87-106

10034 SURVEY ERROR ANALYSIS AND ADJUSTMENT

KEY WORDS: **Accuracy; Errors; Least squares method; Precision; Probability theory; Statistical analysis; Surveying**

ABSTRACT: During the planning, field measuring, and adjusting of a survey the question of its accuracy is of critical importance because it affects the survey configuration and the necessary field measuring accuracies, and consequently the cost and execution time of the survey. The first purpose of this article >IS TO PRESENT THE GENERAL PRINCIPLE OF ERROR THEORY AND BRIEFLY INTRODUCE SOME VERY USEFUL TOOLS FOR EVALUATING THE ACCURACY OF A SURVEY. The second purpose is to analyze the necessity and general principles involved in adjusting a survey, and establishing the reliability of the adjusted values obtained. Finally we present a brief list of references for more complete coverage of the subjects reviewed in the article.

REFERENCE: Aguilar, Antonio M., "Principles of Survey Error Analysis and Adjustment," *Journal of the Surveying and Mapping Division,* ASCE, Vol. 99, No. SU1, **Proc. Paper 10034**, September, 1973, pp. 107-119

10028 NUMERICAL RADIAL TRIANGULATION METHODS

KEY WORDS: **Aerial photography;** Conformal mapping; **Control surveys;** Coordinates; Numerical analysis; **Stereographic projection; Stereomapping;** Surveying; Surveys; Transformations; **Triangulation**

ABSTRACT: Two new modifications in numerical radial triangulation for extending horizontal control are presented. The first method, called the Method of Independent Stereopairs, involves computation of pass point coordinates for each independent stereopair in an arbitrary system. A strip is then formed by successively transforming each independent stereopair into the coordinate system of the first stereopair. The second method, called the Triplets Method, is similar but uses three adjacent overlapping photos as the basic computational unit. In each case the arbitrary strip coordinates are finally adjusted to ground control using a two-dimensional conformal coordinate transformation. The two methods have been tested using both ficticious and real photography of varying topography, scale, and tilt conditions. Results quoted for one representative strip of real photography indicate that with only a glass scale, paper prints, and a desk top computer, horizontal control can be extended to a fairly high degree of accuracy.

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