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DISCUSSION

Proc. Paper 12589

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.

12602 ARCTIC REFRACTION STUDY

KEY WORDS: **Astronomy; Atmospheric refraction; Cold weather operations; Geodesy; Navigation; Refraction;** Surveying

ABSTRACT: Atmospheric refraction corrections applied to observed zenith angles have long been considered the largest source of error in polar astronomic observations. The use of radiosonde data offers the possibility of overcoming restrictions imposed by the polar environment and of establishing the reliability of existing refraction tables for use in the Arctic. Solar observations taken during a 2-week period from a camp on the northeast coast of Ellesmere Island, Canada, are used to establish the correlation between actual refraction and refraction calculated from radiosonde data. Analysis of data for a 6-week summer period shows the refraction to be both stable and in substantial agreement with the published tables of Garfinkel.

REFERENCE: Johnson, Gerald W., "Arctic Refraction Study," *Journal of the Surveying and Mapping Division,* ASCE, Vol. 102, No. SU1, **Proc. Paper 12602**, December, 1976, pp. 1-7

12598 HORIZONTAL CONTROL IN KANSAS CITY

KEY WORDS: Control; **Control surveys; Coordinates; Land surveys; Missouri;** Plane surveys; **Properties;** Subdivisions; Surveys

p. 20

ABSTRACT: Kansas City, Mo., has grown through annexation from 60 sq miles in 1940 to 316 sq miles in 1963. This growth resulted in a need for a good horizontal control system with permanent field monuments and accurate office data. To obtain satisfactory results from a control system it is necessary to establish all control points very accurately using the most accurate measuring equipment, and mathematical balancing techniques available. Correcting errors and adding data to the system is a problem to sponsor and user, particularly the correction of known errors. The State Plane Coordinate System provides a common base for control. When properly utilized, the system provides a means of describing property control points, and is the basis for relocating those points in the field when required.

REFERENCE: Hurlbert, Don D., and McDonald, J. Douglas, "Horizontal Control in Kansas City by State Plane Coordinates," *Journal of the Surveying and Mapping Division,* ASCE, Vol. 102, No. SU1, **Proc. Paper 12598**, December, 1976, pp. 9-20

12612 HISTORY OF GEODETIC NETWORKS

KEY WORDS: **Control surveys;** Geodesy; **Geodetic surveys; History; Networks;** Surveying; Triangulation

ABSTRACT: The 50th anniversary of the Surveying and Mapping Division of ASCE provides an occasion to review some of the many advancements that have led to the current state of the art in geodesy. Beginning with the invention of the decimal and sexagesimal systems, the field of geodesy has relied upon many allied developments including the theory of triangulation, the definition of π, the invention of the telescope, and an accurate chronometer. In recent years electronic distance measuring instruments, satellite observations, and continued control network densification have pointed to the need for readjustment of the horizontal and vertical networks of North America.

REFERENCE: Plasker, James R., "History of Geodetic Networks," *Journal of the Surveying and Mapping Division,* ASCE, Vol. 102, No. SU1, **Proc. Paper 12612**, December, 1976, pp. 21-30

12605 PRESSURE AND GREAT LAKES VERTICAL CONTROL

KEY WORDS: **Control surveys;** Gravitation; **Great Lakes; Lakes; Pressure responses;** Surveying; Surveys; **Vertical indicators; Water levels**

ABSTRACT: This study investigated the warping effects of atmospheric pressure fields on the assumed level geopotential Great Lakes water surfaces during the 28-month period used in establishing the 1955 International Great Lakes Datum. The hydrostatic analysis used in the study indicated variations in lake water surface elevations of up to 4 cm during the study period. These variations were compared with computed gravitational effects similar to those included in the 1955 International Great Lakes Datum establishment. The atmospheric pressure effects were found to be of the same order of magnitude as those resulting from the nonuniform gravitational forces. Thus, the assumption that the water surfaces of the Great Lakes are level geopotential surfaces is erroneous and atmospheric pressure corrections should be included when establishing and revising the vertical control on the Great Lakes.

REFERENCE: Quinn, Frank H., "Pressure Effects on Great Lakes Vertical Control," *Journal of the Surveying and Mapping Division,* ASCE, Vol. 102, No. SU1, **Proc. Paper 12605**, December, 1976, pp. 31-37

12607 IMAGE ERROR AND PHOTOGRAMMETRY

KEY WORDS: **Aerial surveys;** Analytical techniques; **Errors; Images;** Mapping; **Photogrammetry;** Precision; **Requirements;** Research; Surveying; **Triangulation**

ABSTRACT: A major factor limiting photogrammetric accuracy is the effect of residual errors that displace the photographic image from its ideal (projective) position. Sources of image error and their typical magnitude are reviewed in the context of the photogrammetric accuracy requirements in: (1)Map compilation; (2)aerotriangulation to supply supplementary control for map compilation; and (3)aerotriangulation to provide higher order control for geodetic, engineering, and cadastral survey tasks. The basis for image error tolerances of 18 μm (0.71 mil), 6 μm (0.24 mil), and 3 μm (0.12 mil), respectively, are presented for these photogrammetric processes.

REFERENCE: Marks, G. Warren, "Image Error and Photogrammetric Requirements," *Journal of the Surveying and Mapping Division,* ASCE, Vol. 102, No. SU1, **Proc. Paper 12607**, December, 1976, pp. 39-52

12642 OCEAN-BOTTOM CONTROL NET-UNIT CONFIGURATION

KEY WORDS: **Geodesy;** Marine engineering; **Ocean bottom;** Ocean surveillance; Optimization; **Surveying; Transponders**

ABSTRACT: This paper describes and justifies the necessity of a four-transponder unit for ocean-bottom control net. It should be noted that although in the literature various transponder units have been mentioned — especially the classical three-transponder unit, four-transponder unit, and six-transponder unit — none of them could reasonably justify the need of the required number of transponders in each unit. This investigation explains by means of three-dimensional geometry the necessity of a four-transponder unit for an optimized system.

REFERENCE: Saxena, Narendra K., and Xirodimas, Dimitrios P., "Ocean-Bottom Control Net-Unit Configuration," *Journal of the Surveying and Mapping Division,* ASCE, Vol. 102, No. SU1, **Proc. Paper 12642**, December, 1976, pp. 53-57

12648 ENGRG. SURVEYS: CHAPT.2, 5, 6, 8, 16, & 20

KEY WORDS: **Computer applications; Coordinates;** Environmental effects; Environmental factors; **Environmental impact statements; Photogrammetry; Roads; Streets;** Surveying; Surveys; **Utilities**

ABSTRACT: Selected chapters of a Manual on Engineering Surveying is being published for review by members of the ASCE and by readers of the Journal. The included chapters cover problems of coordinate systems and computer applications (Chapter 2), engineering photogrammetry (Chapter 5), specifications for engineering surveys (Chapter 6), roads and streets (Chapter 8), cross-country utility surveys (Chapter 16), and environmental resources surveys (Chapter 20). The Task Committee is requesting discussions on these chapters to be forwarded for publication and consideration for the prepared Manual.

REFERENCE: Mayfield, George M., Chmn., "Engineering Surveying: Chapters 2, 5, 6, 8, 16, and 20," *Journal of the Surveying and Mapping Division,* ASCE, Vol. 102, No. SU1, **Proc. Paper 12648**, December, 1976, pp. 59-94

U.S. Customary-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 U.S. Customary and SI (International System) units, the following list 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 and Materials. Copies of this publication (ASTM E-380) 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
acre-feet (acre-ft)	cubic meters (m^3)	1233
gallons per minute (gal/min)	cubic meters per minute (m^3/min)	0.0038
newtons per square meter (N/m^2)	pascals (Pa)	1.00