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CONTENTS

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DISCUSSION

Proc. Paper 11602

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

KEY WORDS: **Aerial surveys;** Automation; Cadastral surveys; Computers; Coordinates; Data; Earth movements; **Geodesy; History;** Hydrography; Inertial forces; Lasers; **Mapping;** Photogrammetry; **Research; Surveying**

ABSTRACT: In 1965, the Research and Development Committee of the ASCE Surveying and Mapping Division prepared and later published an overall program for research in surveying and mapping over the decade 1966-1975. Now, 10 years later, this paper measures what has been done against the tasks that were set. Three of the original goals are considered for each of the six basic categories of the research program: Land surveys, engineering surveys, geodetic surveys, cartographic surveys, aerial survey services, and cartography. For each of the goals, an appraisal is made of the status of that objective today. The conclusion is drawn that most of the research goals set 10 yr ago have been attained or are in progress of being attained.

REFERENCE: Thompson, Morris M., "A Decade of Research in Surveying and Mapping," *Journal of the Surveying and Mapping Division,* ASCE, Vol. 101, No. SU1, **Proc. Paper 11626**, October, 1975, pp. 1-10

11624 CONTROL DENSIFICATION BY PHOTOGRAMMETRY

KEY WORDS: **Aerial photography;** Altitude; Analytical techniques; **Cameras; Computers;** Coordinates; Flight characteristics; Geodetic coordinates; **Geodetic surveys;** Mapping; **Photogrammetry; Precision;** Research

ABSTRACT: Numerical methods in photogrammetry began to receive wide-spread attention in the early fifties with the development of the large digital computers. The Worldwide Satellite Triangulation Program of the sixties proved that, with care and deliberate production controls, first-order geodetic accuracies could be obtained for precision photogrammetric cameras and numerical data reduction. Research is presently underway at the National Ocean Survey to develop equipment, flight configuration, and reduction techniques that will provide internal photogrammetric pointing precision of at least one part in 250,000 of the flight altitude for conventional mapping. The projected goals of the system are to produce ground coordinates with a standard deviation in position of ± 2.5 cm over an area of 48 km with peripheral horizontal geodetic control spaced at 16 km.

REFERENCE: Hull, Wesley V., "Control Densification by Analytic Photogrammetry," *Journal of the Surveying and Mapping Division,* ASCE, Vol. 101, No. SU1, **Proc. Paper 11624**, October, 1975, pp. 11-16

11625 AUTOMATIC CARTOGRAPHIC SYSTEMS

KEY WORDS: Automation; **Computer graphics;** Computers; Design; **Mapping; Surveying**

ABSTRACT: The application of automatic cartography to engineering mapping functions is technically and economically possible today because of the recent development of compact, small, interactive computer graphic systems. This paper presents a brief description of the history of automatic cartography, and the description, general configuration, general use, and advantages of the available interactive computer graphic systems. Finally, the paper takes a look at the future trends of automatic cartography as applied to engineering mapping functions and their effective use on a total interactive graphic system for engineering design.

REFERENCE: Aguilar, Antonio M., "Evaluation of Automatic Cartographic Systems for Engineering Mapping Functions," *Journal of the Surveying and Mapping Division,* ASCE, Vol. 101, No. SU1, **Proc. Paper 11625**, October, 1975, pp. 17-26

KEY WORDS: **Aerial surveys; Cartographic cameras;** Environmental impact statements; Information systems; Land use; **Mapping;** Oceanography; **Satellites (artificial); Surveying**

ABSTRACT: The present space research emphasis on earth resources and environmental monitoring has potential benefits for the mapping, planning, and ocean engineering professions. Mapping at scales of 1:500,000 and smaller, with accuracies satisfying national maps accuracy standards from LANDSAT-1 is performed routinely. Similar quality urban maps have been compiled from LANDSAT-1 at a scale of 1: 250,000. Regional land use maps of nine basic categories with over 90% classification accuracies are routinely prepared in the United States, and classifications of up to 34 different land-use types with 85% accuracies have been achieved in certain nonurban areas. Several high altitude aircraft flights are demonstrating the possibility of future spacecraft carrying a microwave (radar) payload for monitoring global sea states.

REFERENCE: Paul, Charles K., "Surveying-Mapping Research from Earth Satellites," *Journal of the Surveying and Mapping Division,* ASCE, Vol. 101, No. SU1, **Proc. Paper 11628**, October, 1975, pp. 27-42

11627 OCEANOGRAPHIC AND HYDROGRAPHIC SURVEYING

KEY WORDS: **Hydrographic surveys;** Hydrography; **Oceanographic surveys;** Oceanography; Research; **Surveying; Surveying instruments**

ABSTRACT: Surveying and charting activities in oceanography and hydrography are dictated by the objectives of these two disciplines. Hydrographic surveys are often performed to provide aids to navigation (charts) which permit the direction of a vessel through and over shoals or other potential hazards to safe passage. As another essential service, hydrographers provide the basemaps for offshore engineering and construction. Here depth is also critical, for an error of fractions of meters in depth determination may cost millions. Physical oceanographers pursue knowledge that will lead to greater understanding of currents, tides, and waves and thus provide information essential to the hydrographer. They too are concerned with depth, inasmuch as wave refraction, current deflection, and other motions involving energy transfer depend largely upon water depth and sea floor configuration. This paper will examine additional factors that currently frustrate hydrographers and oceanographers, and it will review existing research needs for surveying and charting activities.

REFERENCE: Palmer, Harold D., "Critical Areas for Research in Oceanographic and Hydrographic Surveying and Charting," *Journal of the Surveying and Mapping Division,* ASCE, Vol. 101, No. SU1, **Proc. Paper 11627**, October, 1975, pp. 43-50

11649 LAND SURVEYING RESEARCH: 1965-1975

KEY WORDS: Control surveys; Data systems; Education; **Engineering education; History; Measuring instruments;** Photogrammetry; Professional practice; **Research;** Standards; **Surveying;** Surveys

ABSTRACT: A review of land surveying research based on articles published during the period 1965-1975 is presented. The areas covered include: (1) Land identification systems; (2) monumentation and legal aspects; (3) land surveying methods and survey control; (4) instrumentation; (5) education and professional registration; and (6) current and future research need.

REFERENCE: Dearinger, John A., "Land Surveying Research: 1965-1975," *Journal of the Surveying and Mapping Division,* ASCE, Vol. 101, No. SU1, **Proc. Paper 11649**, October, 1975, pp. 51-64

KEY WORDS: **Data acquisition;** Geodetic surveys; **Research;** Site surveys; **Standards; Surveying; Surveys**

ABSTRACT: Engineering surveying is a basic, yet most vital, element of civil engineering design and construction. Recent concern for conservation has spurred an accelerated research activity in this field. International standards for tolerances in construction layout are being developed. The American civil engineer must become more aware of them and should participate in their determination. The proposed SI system requires the special attention of ASCE members in surveying. Continued growth and population explosion will force the survey engineer to find more efficient methods in data acquisition, monitoring of construction and measurements of existing old structures. Engineering surveying can be a challenging field for those with ability and imagination.

REFERENCE: Greulich, Gunther, "Research Activity and Needs in Engineering Surveying," *Journal of the Surveying and Mapping Division,* ASCE, Vol. 101, No. SU1, **Proc. Paper 11610**, October, 1975, pp. 65-72

11631 MARINE GEODESY — PRECISE OCEAN SURVEYS

KEY WORDS: **Geodesy;** Marine engineering; **Navigation; Oceanographic surveys;** Positioning; **Surveying; Topography;** Tsunamis

ABSTRACT: Various current and future problem areas of the ocean related to precise positioning are identified and described. These problem areas are highly diversified and include mapping the ocean floor, ocean depth determination, positioning and navigation of a submersible even under iced seas, boundary demarcation in deep ocean, tsunamis, ecology, etc. An estimate of desired positional accuracies, based upon the writer's consultations with the users and published literature, is given. A conceptual solution to achieve the desired positional accuracies has been given, which requires a hybrid system comprising of space, EDM, and acoustic instrumentation.

REFERENCE: Saxena, Narendra K., "Marine Geodesy — Precise Ocean Surveys," *Journal of the Surveying and Mapping Division,* ASCE, Vol. 101, No. SU1, **Proc. Paper 11631**, October, 1975, pp. 73-87

11623 GEODIMETER AND TELLUROMETER DISTANCES

KEY WORDS: **Distance measuring equipment; Distance perception; Electronic equipment;** Errors; Geodetic surveys; **Geodimeters;** Meteorological data; **Surveying; Surveying instruments;** Surveying instruments; **Tellurometers**

ABSTRACT: Meteorological effects on electronically measured distances depend on the carrier wavelength. Distances were measured simultaneously with the Geodimeter 8 and the Tellurometer MRA3 MkII, and three distance reduction methods applied; (1) The conventional correction procedure; (2) a procedure derived by using differences between lightwave and microwave distances, and (3) one derived by using simultaneous reciprocal zenith distances. The results indicate that the two unconventional procedures are superior to the conventional one. Advantages and disadvantages of the procedures are examined.

REFERENCE: Gopfert, Wolfgang M., "Simultaneous Geodimeter and Tellurometer Distances," *Journal of the Surveying and Mapping Division,* ASCE, Vol. 101, No. SU1, **Proc. Paper 11623**, October, 1975, pp. 89-100

KEY WORDS: **Control surveys;** Coordinates; **Maps; Monuments;** Municipal engineering; **Photogrammetry;** Records; Stereomapping; **Surveying;** Surveying instruments; **Surveys;** Targets; **Triangulation**

ABSTRACT: The Office of the State Land Surveyor in Missouri is actively engaged in a program of remonumenting the section and quarter section corners in the State of Missouri. One phase of this program is the township restoration projects. In 1973, a township in Iron County, Missouri was designated as a project area because of some known survey problems in the area. This township is situated in some of the most rugged terrain in Missouri and a photogrammetric solution was considered advisable. Additional problems have been discovered during the various phases of the project, not all of which have been resolved at the time of this writing.

REFERENCE: Brown, Norman L., "Corner Restoration in Missouri," *Journal of the Surveying and Mapping Division,* ASCE, Vol. 101, No. SU1, **Proc. Paper 11658**, October, 1975, pp. 101-105

11655 LANDSLIDE HAZARD MAPPING ON A SHOESTRING

KEY WORDS: **Aerial photography;** Costs; **Landslides; Land use; Mapping;** Maps; Planning; **South Dakota; Surveying**

ABSTRACT: Low out-of-pocket cost preparation of a landslide susceptibility map is described for the Rapid City East quadrangle, South Dakota. The map classifies all terrain from Class 1 — very low probability of landslide, to Class 6 — very high probability of landslides by an interpretation of geologic, slope, and landslide information. Each information area is prepared as a map. The geologic map was prepublished. The slope map is hand-prepared from a topographic map. The landslides are identified using borrowed air photos, marked on photo-covering acetate, and transferred to a topographic map. Maps are then combined by overlaying and the susceptibility class determined by proportion of landslide area for each slope-geologic unit.

REFERENCE: Drennon, Clarence B., and Schleining, William G., "Landslide Hazard Mapping on a Shoestring," *Journal of the Surveying and Mapping Division,* ASCE, Vol. 101, No. SU1, **Proc. Paper 11655**, October, 1975, pp. 107-114

11657 NEW ADJUSTMENT OF NORTH AMERICAN DATUM

KEY WORDS: Aerial photography; **Engineering education;** Geodesy; **Geodetic surveys; Photogrammetric surveys;** Photogrammetry; **Surveying; Triangulation**

ABSTRACT: A new adjustment of the horizontal geodetic control (triangulation) of the North American continent has begun which will probably include Greenland, Canada, the United States, Mexico, and the Central American countries. The impact of this effort on the surveying community is examined along with comments relating to the importance of tying to the national control network. The potential of analytical photogrammetry is exploited for the purposes of relating local control to the national network. Educators are requested to aid in the education of the surveying community in connection with the perils of inconsistent control. The importance of a national cadastre is stressed.

REFERENCE: Bossler, John D., Stephens, William E., Plasker, James R., Hull, Wesley, and Lee, Douglas R., "New Adjustment of North American Datum and Surveyor," *Journal of the Surveying and Mapping Division,* ASCE, Vol. 101, No. SU1, **Proc. Paper 11657**, October, 1975, pp. 115-120

KEY WORDS: Construction; Control; **Dams;** Design; **Engineering education;** Hydrography; **Municipal engineering; Municipal government;** Photogrammetry; Planning; Plans; **Professional development;** Specifications; **Surveys; Topography**

ABSTRACT: Economical survey programs for civil works projects require special consideration because of the time span from start to completion, the interrelationship and the time lapse that usually occurs between the various phases (feasibility, design, and construction), and the many engineering disciplines involved. The various technical and nontechnical aspects affecting the planning and execution of the survey program are examined to provide an insight to the task confronting the survey manager.

REFERENCE: Angeloni, William A., "Survey Program for Civil Works Projects," *Journal of the Surveying and Mapping Division,* ASCE, Vol. 101, No. SU1, **Proc. Paper 11662**, October, 1975, pp. 121-127

11656 SURVEYING SAFETY MANUAL FOR MISSOURI

KEY WORDS: **Missouri; Safety; Standards; Surveying**

ABSTRACT: The Manual includes suggestions for making field and office operations of land surveyors safer and detailed reporting requirements under the OSHA for job-related deaths, injuries, and illnesses. Accident questionnaires were used to determine the types of accidents or illnesses that occurred most frequently in surveying operations and surveying activities were also observed in the field. Safety literature was obtained from a number of sources, and information was abstracted and categorized, e.g., snake bite, surveying in traffic, fire prevention, and electrical storms. The manual was divided into six major sections dealing with responsibilities for safety and health, accident reporting, public relations, general safety practices, field surveying safety, and office safety.

REFERENCE: Malisch, Ward R., and Jacobs, Arthur W., "Preparation of Surveying Safety Manual for Missouri," *Journal of the Surveying and Mapping Division,* ASCE, Vol. 101, No. SU1, **Proc. Paper 11656**, October, 1975, pp. 129-135

11630 ELECTRO-OPTICAL SHORT-RANGE SURVEYING

KEY WORDS: Electronic equipment; **Geodetic surveys;** Lasers; Leveling devices; **Measuring instruments; Surveying;** Surveys; **Topography**

ABSTRACT: A summary of EOSS instruments is given. Emphasized are the areas of applications where EOSS instruments have been used and can be used. Basic concepts and instrumentation theory have been omitted, as these can be found in instrument manuals and in published papers. Also presented are the instrumentation requirements for an average size modern engineering survey firm.

REFERENCE: Saxena, Narendra K., "Electro-Optical Short-Range Surveying Instruments," *Journal of the Surveying and Mapping Division,* ASCE, Vol. 101, No. SU1, **Proc. Paper 11630**, October, 1975, pp. 137-147

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