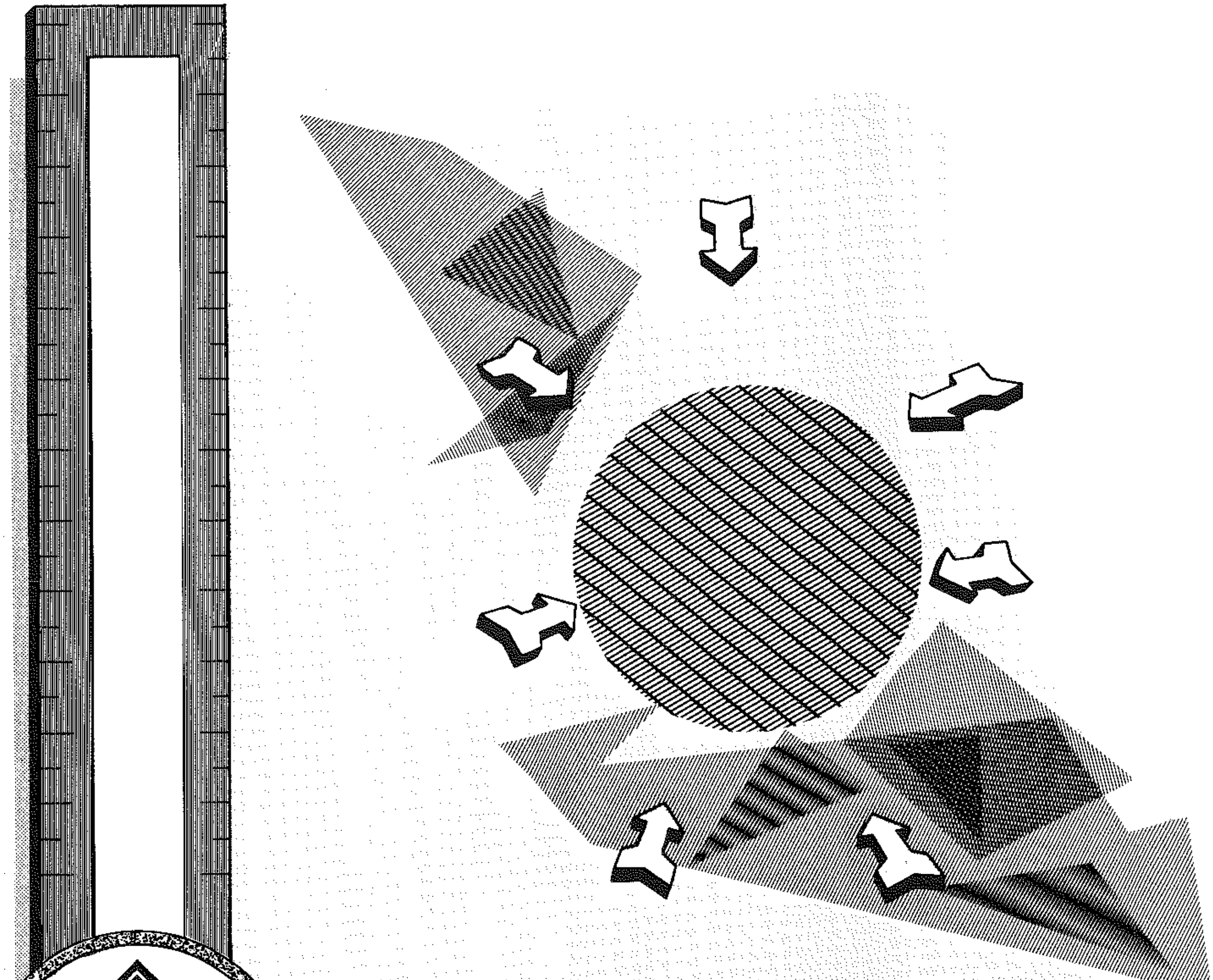
The Journal of Engineering Graphics

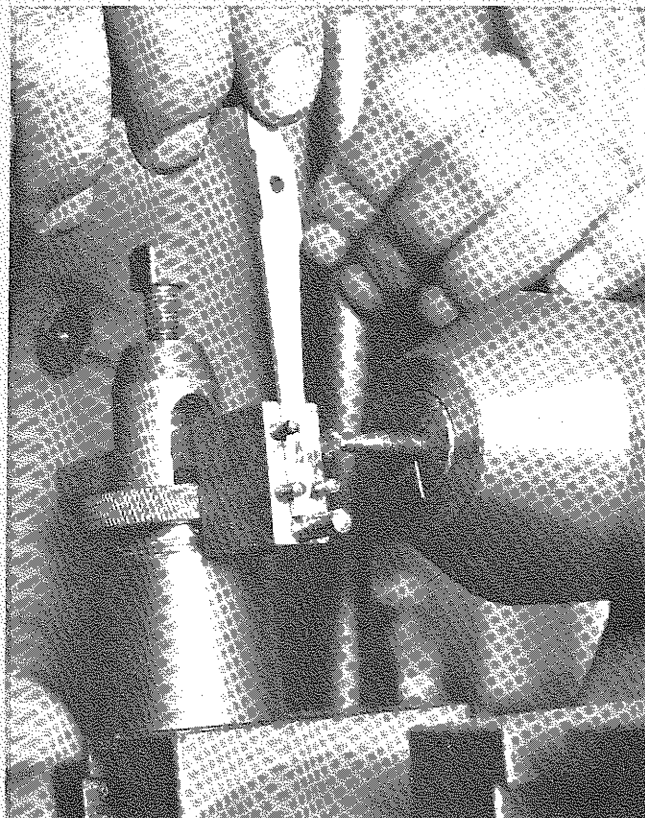


February (Winter) 1967 Vol. 31, No. 1, Series 91

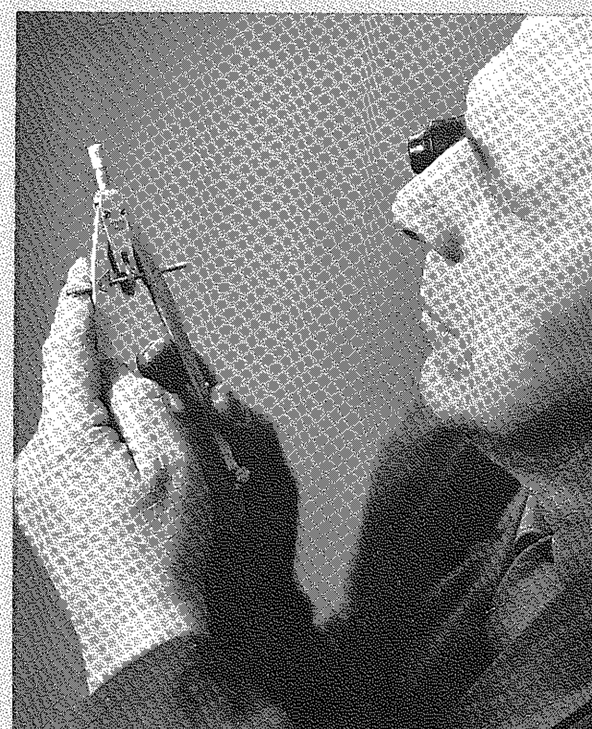
Published by the Division of Engineering Graphics, American Society for Engineering Education.

CRAFTSMANSHIP

OLD WORLD HANDWORK



+ PRECISION



= QUALITY

ASPEN, COLORADO PHOTO BY: BERKO

Gramercy

846 ELATI STREET • BLDG. 24
DENVER, COLORADO 80204
TEL. AREA CODE 303—534-4251
CABLES: GRAMPORCOM

Frank Oppenheimer, President

The Journal of Engineering Graphics

February (Winter) 1967 Vol. 31, No. 1, Series 91

The views expressed by the individual authors do not necessarily reflect the editorial policy of the Journal of Engineering Graphics or represent the official stand of the American Society for Engineering Education or the Engineering Graphics Division. The editors make reasonable effort to verify the technical correctness of material published; however, final responsibility for technical accuracy rests with individual authors.

EDITORIAL STAFF

EDITOR

Earl D. Black
General Motors Institute
Flint, Michigan 48502

CIRCULATION MANAGER and TREASURER

James H. Earle
Texas A&M University
College Station, Texas 77840

ADVERTISING MANAGER

Kenneth E. Botkin
MGEL 104A
Purdue University
W. Lafayette, Ind. 47907

ASSISTANT EDITORS

William B. Rogers
Dept. of Earth, Space and Graphic Sciences
United States Military Academy
West Point, New York 10996

E. E Sautter
General Motors Institute
Flint, Michigan 48502

Published for teachers and others interested in Engineering Graphics. It is published three times per year -- Fall (November), Winter (February), and Spring (May).

The subscription rates are: $2.00 per year in the United States (single copies 75 cents). Foreign rates upon request.

CONTENTS

ARTICLES

DEPARTMENTS

COMMITTEE REPORTS

Available For Examination Spring 1967

TECHNICAL DRAWING, Fifth Edition

By the late Frederick E. Giesecke, the late Alva Mitchell; revised by Henry Cecil Spencer, on leave, the Illinois Institute of Technology, and Ivan Leroy Hill, the Illinois Institute of Technology

Since the original publication of the First Edition, TECHNICAL DRAWING has been used by more than two and a half million students. In the painstaking process of constant revision, the authors have sought and achieved excellence: excellence in illustration and example; excellence in definition and explanation; and excellence in the production of a book which includes *all* of the basic graphics instruction needed by the engineer, the scientist, or the draftsman.

In this Fifth Edition, the authors have thoroughly revised all material to accord with the current *ASA Y14 American Standard Drafting Manual*, including the latest American Standard on *Dimensioning and Tolerancing for Engineering Drawings*. In addition, modern trends in engineering education have been taken into account. Leading engineers and manufacturers, mindful of the role of TECHNICAL DRAWING in the education of future engineers and scientists, have helped the authors incorporate the most current industrial thinking in this new edition. One example is the emphasis placed upon decimal dimensioning in the illustrations and problems. Technical sketching is also emphasized. Four entirely new chapters have been included: Electronic Diagrams, Alignment Charts, Empirical Equations, and Graphical Mathematics.

A text that has become *the* classic, the Fifth Edition of TECHNICAL DRAWING continues to uphold the standard of excellence set and maintained by the previous editions.

To accompany TECHNICAL DRAWING

TECHNICAL DRAWING PROBLEMS, Series I, Third Edition

By the late Frederick E. Giesecke, the late Alva Mitchell, and Henry Cecil Spencer; revised by Henry Cecil Spencer

Available Spring, 1967

TECHNICAL DRAWING PROBLEMS, Series II, Second Edition

By Henry Cecil Spencer

1961, 91 sheets, paper, $5.25

TECHNICAL DRAWING PROBLEMS, Series III

By Henry Cecil Spencer and Ivan Leroy Hill

1960, 80 sheets, paper, $4.50

Write to the faculty service desk for examination copies.

THE MACMILLAN COMPANY 866 Third Avenue, New York, N.Y. 10022

LETTERS TO THE EDITOR

Dear Sir,

Perhaps I'm a little slow, but I cannot see how the solution you published for "Can You Draw The Righthand View" can be valid unless it is allowed to be made from paper.

A solution which can be constructed from a solid block is shown:

Carved from styrofoam it looks a little like a sugar scoop.

Thank you for publishing the very interesting discussion of Desargue's Theorem.

Sincerely yours,

M. W. St. Clair
Instructor, Engineering
Foothill College
Los Altos Hills
California

Editor's Note:

It is admitted that the previous solution published would of necessity be made up of infinitely thin surfaces. Please turn to the File-to-File column for Mr. M. W. St. Clair's solution.

Dear Mr. Black:

Congratulations on your fine Publication.

In the last issue for the problem "Can you Draw the Right End," assuming the object to be solid, I have enclosed my solution. I have also enclosed a sketch showing necessary changes in order to make the solution correct as published in the November (Fall) 1966 edition of the Journal of Engineering Graphics.

Sincerely yours,

Frederick Halsall
Lecturer: Engineering
Drawing and Descriptive
Geometry
Saint Vincent College

Continued on Page 40

GRAPHITE DUST

MEDFORD, MASS. -- Based on the conviction that engineering design is central to the practice of engineering and therefore central to engineering education, Tufts University will offer a new graduate program leading to the Master of Science Degree in Engineering Design beginning in September of 1967. This program is intended to educate students for private practice as well as industrial employment. Innovative and inventive ability, the capability to evaluate design ideas, and a working knowledge of the problems in implementing a design will be stressed.

Courses of study include: Numerical Methods, Inventive Design, Experimental Design, Computer Aided Design, Seminar in Product Design, Automation, Internship in Design, Advanced Kinematics, Fractional Horsepower Electro-Mechanical Devices, Systems Design, and Design Thesis. Creative ability will be stressed in courses in Inventive Design, Seminar in Product Design, and the Thesis. Courses in Numerical Methods, Computer Aided Design, Advanced Kinematics, and Systems Design will strengthen analytical ability in the desired direction. The courses in Internship in Design and Experimental Design will strengthen the student's ability to develop his own relationships and data to support a solution. The engineer as an entrepreneur will be related to many of these courses.

Applicants for the program must have a background in physics, mathematics, engineering sciences, and a B.S. degree in an engineering field.

The program will be given in the Department of Engineering Graphics and Design under the Chairmanship of Professor Percy H. Hill. The department has recently constructed a Design Laboratory which will enhance the program. The laboratory consists of electronic and mechanical test equipment, a prototype construction area, machine tool area, conference room, graduate assistant's office, and a drafting room.

The American Institute of Steel Construction has published a new drafting textbook for students, engineers, and draftsmen on "Structural Steel Detailing." It includes numerous design examples and combines the previous Volumes 1 and 2 of the three-volume text "Structural Shop Drafting." It reflects many technological changes and advances that have occurred in the structural steel fabricating industry and illustrates current detailing practices. The book is listed at $10.00 per copy through the American Institute of Steel Construction, 101 Park Avenue, New York, New York 10017.

Editors' Board

EDITORIAL

PAST -- PRESENT -- OR FUTURE

Knowledge is the cutting edge of progress. A list of successful people who have had little or no formalized education and those who have, tends to indicate that it is the personal qualities of the individual rather than the subjects taught or the teachers who taught them which gives success to individuals. An old saying goes that the life of every man is a diary in which he means to write one story, and writes another. Also, his humblest hour comes when he compares the volume he has written with that he vowed to write.

The fact is that schools and colleges are supported by public and private funds because the average individual does better under an organized program of study, under regulated hours, and with positive objectives and requirements in mind. The time limit imposed stimulates the student to greater intensity of learning effort. His learning is longer lasting.

The greatest handicap in school learning is the mass of subject coverage which may become obsolete before the student has had a chance to use his knowledge in practical application on the job. Any school or college time spent in study, therefore, should be a short-cut to actual experience and should reduce the time table toward success.

The successful teacher of engineering will show interest and enthusiasm in not only the subject but also in the personal advancement of the individual student. Engineering courses enthusiastically taught by competent teachers, will help produce engineering graduates who are interested in becoming practical design engineers. Instructional coverage of one course should become integrated with the coverage taught in related courses.

Creativity can be developed, students may be stimulated, but student initiative must be encouraged with practical judgment rather than stifled by routine methods. The student should develop in ability to perform progressively difficult assignments, accept increasing responsibility for his own decisions, and exercise greater initiative in logical use of basic principles.

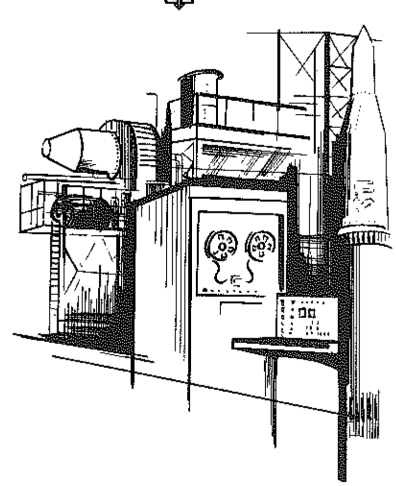
Engineering graphics is not only a scientific instrument of communication and solving problems, but it serves to force the student to integrate his scientific knowledge in making practical applications while solving design problems. Proper instruction in engineering graphics will stimulate the student to improve in understanding, visualization, and in ability to think through problems to a satisfactory solution. He will also improve in ability to analyze, solve, and communicate answers to the variety of three-dimensional problems that arise in the various fields of engineering.

There is a significant trend toward a versatility in applications of fundamental principles by using "open-end" problems in engineering design. Descriptive geometry may well be used as an analytical tool. The full utilization of vectors, graphs, and organization diagrams also come into use in many instances. As the foundation of graphical science unfolds, it can be developed into a cogent force for good in engineering education.

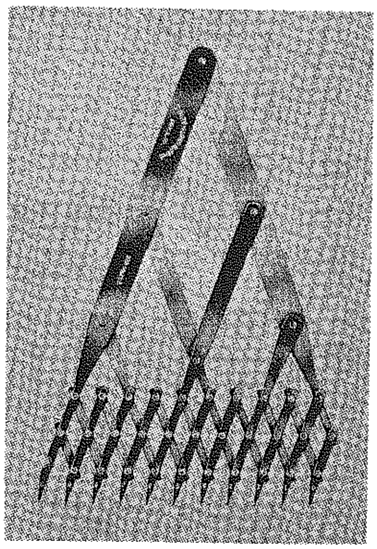
The vector principle is widely used in engineering. Students in engineering should acquire a working knowledge in both the mathematical and graphical approach to vectors. Vector analysis may be classified as a branch of mathematics, but the graphic approach is often preferred.

The technique of good drafting must be taught before advanced graphics and design can be taught successfully. The very nature of advanced design and graphics would indicate a need for a thorough mastery of basic principles and accuracy. Accuracy is not an arbitrary luxury. It is a necessity because of the nature of the usual design problem. Elimination of errors is important not only in making of a part but also because of the effect an engineering mistake has on the customer. Engineering graphics may well become the basic guide to computer design and computer programming. Only time will tell.

E.D.B.



THE SPACING DIVIDER



No. 2960—6 INCH
(ILLUSTRATION HALF SIZE)

This instrument consists of eleven points so adjusted that they divide their variable setting into ten or less equal parts. It can also be used inversely to give multiples up to ten and in graphic solution of ratios. Adjustable distance between points on the 6 Inch Instrument is minimum $\frac{3}{16}$", maximum $\frac{5}{8}$" and on the 12 Inch minimum $\frac{1}{4}$", maximum $1\frac{1}{4}$".

Catalog on Request Covering:

Drawing Instruments	Drafting Scales
Protractors	S.S. Straightedges
Rolling Parallel Rules	S.S. T-Squares
11 Pt. Spacing Dividers	S.S. Triangles

Circular and Linear Engraving

for the

DRAFTING ROOM—PATTERN LOFT—LAYOUT TABLE

THEO. ALTENEDER & SONS

Makers of Fine Instruments Since 1850

1217 Spring Garden Street Philadelphia 23, Pa.

The basics of engineering drawing in light of present day requirements

FUNDAMENTALS OF ENGINEERING DRAWING, Fifth Edition, 1965

by Warren J. Luzadder, Purdue University. Requiring no prerequisites, the Fifth Edition of this widely-adopted text gives a still more comprehensive coverage of the field, with particular emphasis on basic fundamentals. It contains over 1,200 illustrations, many with surface shading, and incorporates ASA and SAE standards and practices. The following chapters have been written or revised: Tool Design and Tool Drawing; Electronic Drawings, Shop Processes and Shop Terms; Multiview Drawing and Conventional Practices; Auxiliary Views and Basic Descriptive Geometry. Includes a 48-page appendix. 1965, 752 pages, $10.95

WORKSHEETS IN GRAPHIC SCIENCE AND CREATIVE DESIGN

by Morris D. Silberberg and Sandor T. Halasz, both of The City College of the City University of New York. This vinyl case-bound kit provides sufficient material for a full course in graphic science or engineering drawing. The instructor may select plates best fitting his program and objectives, and omit others, without endangering the continuity of presentation. The 95 worksheets are keyed to seven of the most widely used texts in the field. Unified treatment of orthographic and isometric reading and sketching exercises enables the student to view the problem of space visualization as a whole and not as a group of isolated spots. 1965, plates 8½" x 11", vinyl case, 11½" by 16¾", $7.95

BASIC GRAPHICS

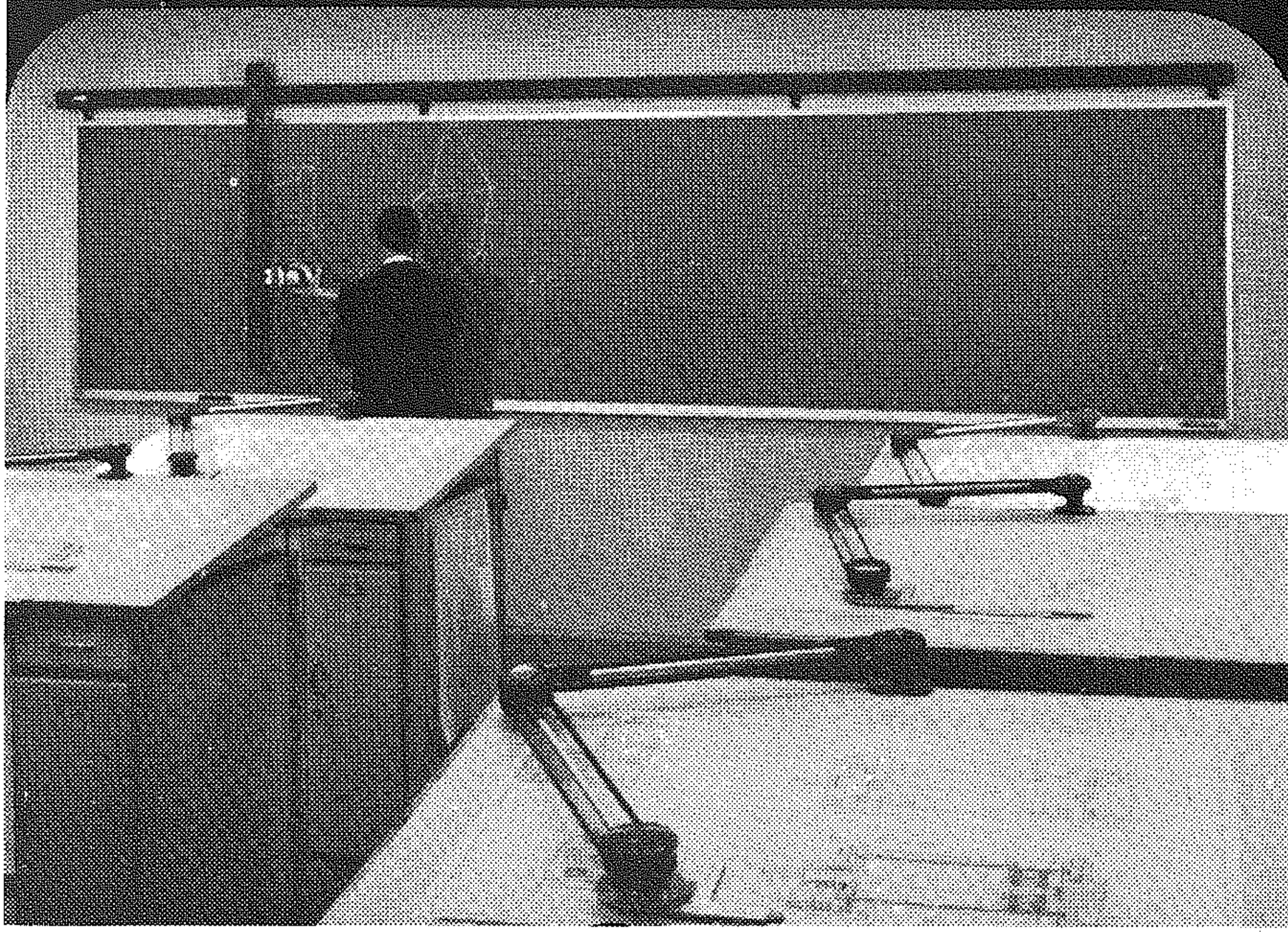
also by Warren J. Luzadder. The fundamentals essential to graphical solutions and communications. Each basic concept is discussed clearly and in detail, anticipating difficulties commonly encountered by students. Emphasis is on freehand drafting and pictorial sketching, and there are over 1,100 illustrations. All material is in full agreement with the ASA standards. 1962, 715 pages, 7½" x 10", $10.50

For approval copies, write: Box 903

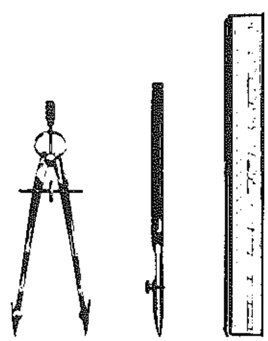
Prentice-Hall, Englewood Cliffs, N.J.

VEMCO'S MATCHED SET

for easier drafting instruction



V-TRACK Drafting Machine with Chalkboard Adapter for the Instructor. At the tables, Model 3300 Drafting Machine, with either 16", 18" or 20" arms, special disc brake, and automatic 15° indexing, for students.



Add VEMCO American-made all steel Instruments, guaranteed without time limit . . . compasses, dividers, ruling pens, scales . . . for a completely equipped classroom in drafting technique. Generous discounts on school orders.

Write for catalogs on V-Track; Model 3300; Instruments.

V. & E. MANUFACTURING CO.

766 S. Fair Oaks Ave. / Pasadena, Calif.

VEMCO

PROMOTING GRADUATE ENGINEERING EDUCATION

The first year of engineering education is not too soon for promising students to be encouraged to acquire sound fundamentals and appropriate grades for admission to graduate engineering education which is fast becoming a prerequisite for optimum service to, and advancement in our U.S. industrial and government organizations. Those of us in the engineering orientation and graphics program should make a real effort to discover and motivate those students who will really benefit from graduate engineering education.

Good performance in all academic areas is certainly desirable for success in the graduate school. Even more significant, however, is outstanding performance in our graphics oriented, introductory design projects which foster originality.

Our efforts in promoting graduate engineering education should be extended and publicized. In particular, major engineering department chairmen should be introduced to, or supplied with the names of those promising candidates who have demonstrated special creative talents. Since graduate school enrollment and development is a prime concern of our degree granting departments, this recruitment responsibility is one we must not take lightly.

The basic science and mathematic departments are hardly reticent about promoting their specialities to the cream of the freshman engineering class. The opportunity and responsibility to counter balance this influence of non-engineering departments rests with us who must provide a stimulating initial engineering experience to that crop of eager freshmen.

Eugene G. Pare
Vice Chairman

ENGINEERING GRAPHICS DIVISION NOMINEES, 1967-1968

For Vice Chairman:

J. N. Arnold, Purdue University
E. D. Black, General Motors Institute

For Secretary:

A. L. Hoag, University of Washington
S. M. Slaby, Princeton University

For Editor of the Journal of Engineering Graphics:

B. L. Kreimer, Northeastern University
H. W. Yankee, Worcester Polytechnic Institute

For Division Editor:

G. E. Pankratz, University of Toledo
C. G. Sanders, Iowa State University

For Director:

F. Oppenheimer, Gramercy Guild Group, Inc.
R. W. Reynolds, California State Polytechnic College

Nominating Committee

A. L. Hoag
A. P. McDonald
M. McNeary
Irwin Wladaver
B. L. Wellman, Chairman

ZIP YOUR MAIL

ARE WE CORRECT?

Please help us keep our mailing list up-to-date. If there is anything wrong with your address label, please correct it—adding Zip Code—and return it to us promptly. Postal regulations require Zip numbers for magazines mailed after January 1.

FIVE TESTED TEACHING AIDS FOR ENGINEERING DRAWING

BY CARL L. SVENSEN AND WILLIAM E. STREET

FOR USE WITH ANY TEXT OR NO TEXT

DRAFTING PROBLEM LAYOUTS

SERIES D, REVISED 1962

Work sheets covering Vertical and Inclined Lettering, Sketching, Use of Instruments, Engineering Geometry, Scales, Orthographic Projection, Revolution, Auxiliary Projection, Sections and Conventions, Isometric, Oblique, Dimensioning, Developments, Intersections, Screw Threads and Studies of Points, Lines, and Planes.

100 Work Sheets, 8 1/2" X 11" ____ $4.00

DRAFTING PROBLEM LAYOUTS

SERIES C , REVISED 1964

Work sheets covering Vertical and Inclined Lettering, Sketching, Use of Instruments, Engineering Geometry, Scales, Orthographic Projection, Revolution, Auxiliary Projection, Sectional And Conventions, Dimension, ing, Screw Threads and Bolts, Isometric, Oblique , Perspective, Developments, Intersections, Working Drawings.

95 Work Sheets, 8 1/2 " X 11 " ____ $4.00

LETTERING EXERCISES

A DIRECT METHOD - NEW AND INTERESTING

Vertical and Inclined Lettering with eight sheets of extra problems.

20 Work Sheets, 8 1/2 " X 11 " ____ $1.50

VERTICAL LETTERING EXERCISES

Vertical Lettering with instructions

6 Work Sheets, 8 1/2 " X 11 " ____ $0.60

INCLINED LETTERING EXERCISES

Inclined Lettering with Instructions

6 Work Sheets, 8 1/2 " X 11 " ____ $0.60

WRITE FOR EXAMINATION COPY OR ORDER FROM

W. E. STREET
ENGINEERING GRAPHICS DEPARTMENT
LOUISIANA STATE UNIVERSITY
BATON ROUGE, LOUISIANA 70803

Prepare your own problem book by selecting your drawings from these books in quantites of 25 or more of each layout.

Allow 90 days for order.

CARTESIAN COORDINATES IN ENGINEERING DRAWING

by

Ed Wilks, Associate Professor
of Engineering Graphics
Georgia Institute of Technology
Atlanta, Georgia

Abstract

This paper develops a scheme for bringing Cartesian coordinates directly into the views of engineering drawing and descriptive geometry. The three dimensional rectangular coordinate system serves as a mathematical frame of reference for graphics. It brings the main body of freshman graphics closer to mathematics and should help students in both areas. A complete coordinate notation system is developed in parallel with regular descriptive geometry notation system is developed in parallel with regular descriptive geometry notation. Several applications are shown.

Three dimensional Cartesian coordinate systems are classified right hand or left hand according to the directions selected for the positive portions of the X, Y, and Z axes. A right hand system should be used in graphics to conform with the current usage of right hand systems in mathematics, physics, and mechanics. If the fingers of the right hand point from the positive portion of the X axis to the positive portion of the Y axis while the thumb points in the positive direction of the Z axis the system is said to be right handed.

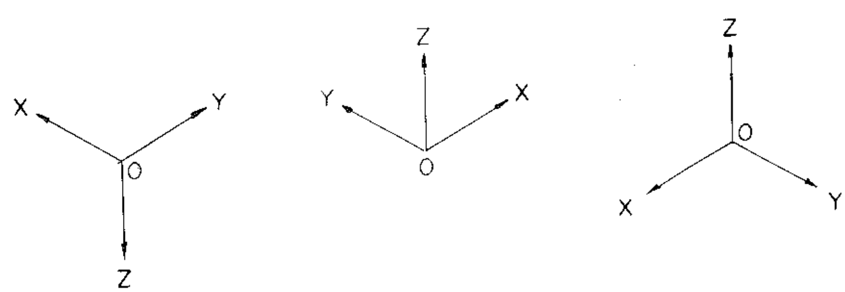


Figure 1 Trihedrals

Isometric trihedrals for three of the most commonly used right hand systems are shown in Figure 1. In each of these systems the X and Y axes are horizontal and the Z axis is vertical. Since the three axes are concurrent and mutually perpendicular, they may be considered to be intersecting edges of a child's ABC block or any other cube. The origin of coordinates (o) is at one corner of such a cube and three of the cube edges coincide with positive portions of the X, Y, and Z axes. Figure 2 shows cubes placed within each of the coordinate trihedrals of Figure 1.

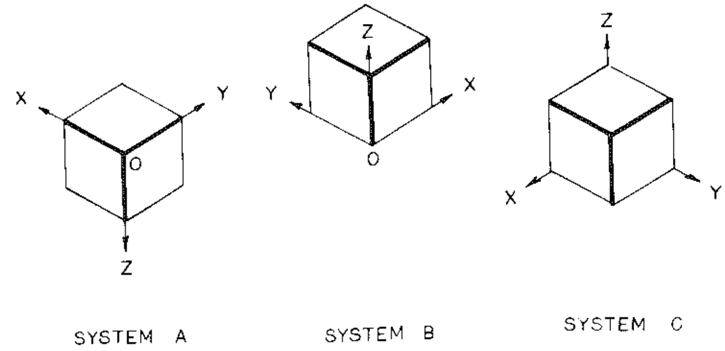


Figure 2 Cubes Within Trihedrals

Although each of the systems shown has certain advantages in particular areas of graphics, it was decided that a single coordinate system should be used consistently in freshman graphics. System A was chosen; it will be used exclusively in this paper.

The plane determined by the X and Y axes is called the XY coordinate plane or simply the XY plane. The plane of the X and Z axes in the XZ plane and the plane of the Y and Z axes is the YZ plane. The three visible surfaces of the System A cube of Figure 2 are in the coordinate planes. The three mutually perpendicular coordinate planes are infinite in extent; they divide space into octants. The octant determined by the positive portions of the three axes is the first octant. The other octants are numbered in Figure 3 for reference.

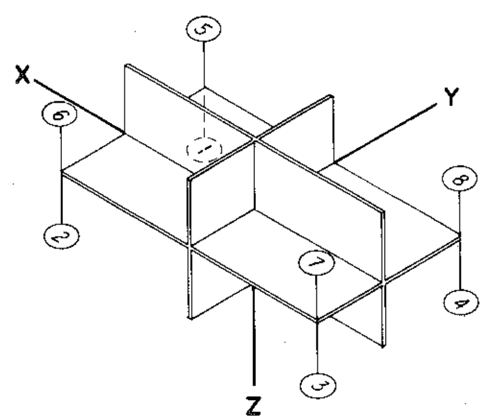


Figure 3 Octants

A point in space may be located with respect to an origin of coordinates by an ordered triple of numbers in the sequence X, Y, Z. The coordinates of a general point P (X_p, Y_p, Z_p) are distances from the coordinate planes. X_p is the distance from the YZ plane to the point; the distance is measured in the direction of the X axis. Y_p and Z_p represent similar distances measured in the directions of the Y and Z axes. The coordinates X_p, Y_p, and Z_p are particular values of the variables X, Y, and Z. Figure 4 shows several examples of points located by coordinates. Points

M, N, and Q are in the 5th, 2nd, and 4th octants respectively.

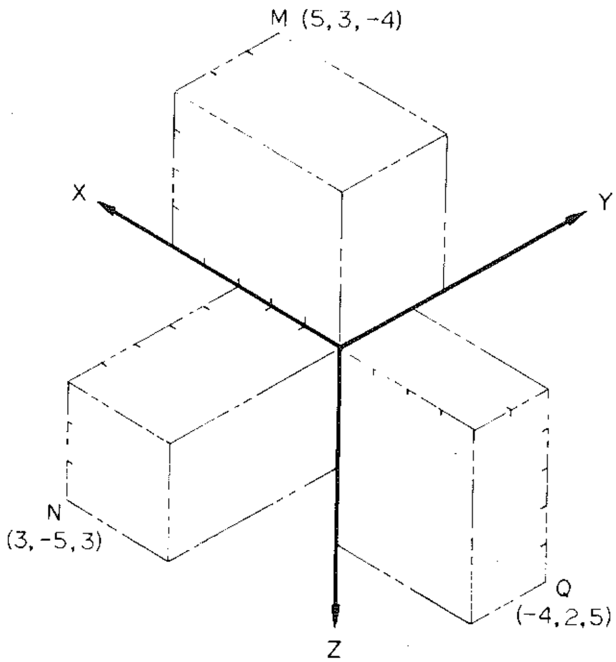


Figure 4 Point Locations by Coordinates

To develop a coordinate notation system suitable for general use in graphics, we begin with principal views. The object is in the first octant. Figure 5 shows the coordinate trihedral and the line of sight directions for the three regular principal views. In coordinate notation, the top view is to be called the Z view because the line of sight for the top view has the same direction and sense as the Z axis. For similar reasons the front view is to be called the Y view and the right side view the X view. Figure 6 shows regular and coordinate notation for two arrangements of principal views. The object is a box three units wide, four units deep, and two units high. Note that in each view, one axis is shown as a point directed into the paper; the view designating letter in coordinate notation is the letter corresponding to that axis. In each group of three related views, each of the axes shows as a point in one of the views. Figure 7 shows the location of the coordinate planes with respect to the object and with respect to the image planes. The equations for the surfaces of the box are:

Front Face . . . . $Y = Y_1$

Rear Face . . . . $Y = Y_1+4$

Top Face . . . . $Z = Z_1$

Bottom . . . . $Z = Z_1+2$

Right Side . . . . $X = X_1$

Left Side . . . . $X = X_1+3$

The equations for the image planes are:

Frontal Image Plane . . . $Y = -Y_{11}$

Horizontal Image Plane . . $Z = -Z_{11}$

Profile Image Plane . . . $X = -X_{11}$

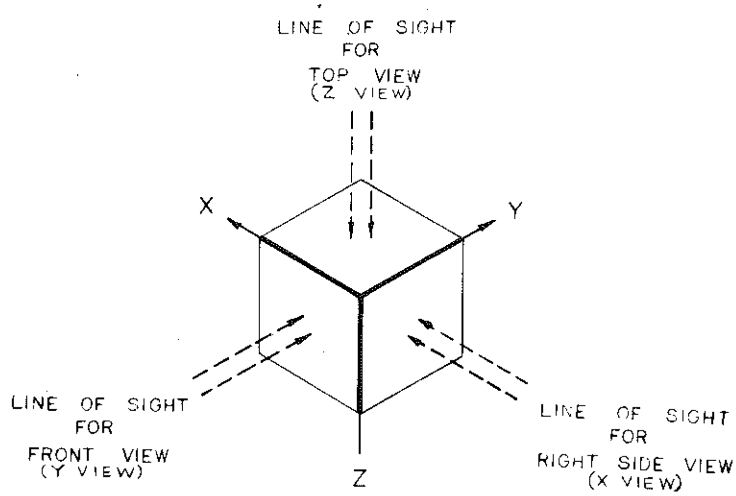


Figure 5 Lines of Sight for Principal Views

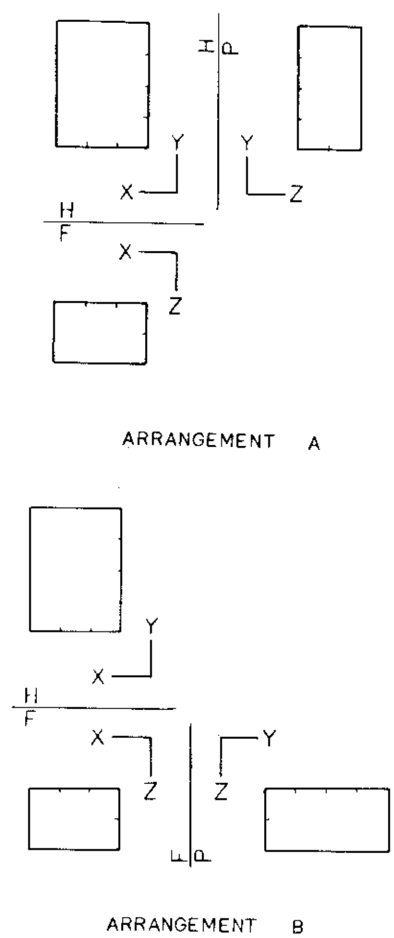


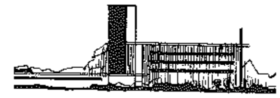
Figure 6 Coordinate Notation for Principal Views

Continued on Page 41

RESEARCH -- PROGRAMMED INSTRUCTION IN DESCRIPTIVE GEOMETRY

by

Charles R. Cozzens
Texas A&M University



Abstract

This report briefly summarizes a doctoral study conducted at Texas A&M University during the spring semester of 1964.

The study tested two self-instructional techniques of presenting engineering descriptive geometry. It was found that the self-scoring technique was a more effective method of presenting six selected principles of descriptive geometry. Futhermore, it was found that the students participating in this study were accurate as a group when scoring their assignments and reporting these scores. A third portion of this study indicated that the self-instructional instruments could be scored by four experienced graders in less time than could the conventional device.

Introduction

The purpose of this paper* is to summarize the findings of a doctoral study supervised by the Industrial Education Department in cooperation with the Engineering Graphics Department at Texas A&M University.

The study -- prompted in part by the ASEE Comittee on Programmed Instruction (1:117-123) and a doctoral dissertation by Professor J. H. Earle (2:101) of the Engineering Graphics Department at Texas A&M -- was designed to test a self-instructional technique which would allow students to complete basic preparatory assignments outside class. This process would then allow more class time for the inculcation to new ideas and graphical concepts as recommended by Wellman (4:32).

The Purposes of the Study

The study was intended: (1) to compare experimentally the effectiveness of introducing six principles of descriptive geometry with and without self-scoring as an immediate reinforcement to learning, (2) to determine the accuracy with which students score their own work, and (3) to determine if a self-scoring device could be scored more quickly than a conventional device.

The Design of the Testing Instruments

There were two types of testing instruments used in this study: self-scoring and conventional. Both were composed of two sheets of paper separated by a carbon medium and bonded together on all four edges. The top sheet of the instruments presented a basic descriptive geometry problem, a listing of general instructions for the problem, and a reference from the text used by the students (5). In addition, necessary points were situated on the page to assist students in locating reference lines for use in drawing auxiliary views.

The second sheet of the self-scoring instruments presented a grading scale as well as the basic problem and its solution. When solving the problem on the first sheet, a student's solution was transferred by the carbon to the second sheet. Ideally, if the student had properly placed his reference lines, his solution was drawn directly on the approved solution; however, allowances were made to permit normal inaccuracies. Upon completion, the student separated the two sheets and scored his solution.

The second sheet of the conventional instruments contained only an explanation that the student had not been given a self-scoring instrument.

The Collection of Data

Three hundred fifty-six descriptive geometry students at Texas A&M University during the spring semester of 1964 were divided into two groups A and B of approximately 178 students

*Given at the American Society for Engineering Education, Mid-Year Meeting, January 22-23, 1965 University of Florida, Gainesville, Florida.

each. These groups were equated on the basis of having successfully completed the basic course in engineering graphics at Texas A&M during the fall semester of 1963, and on the scores earned on a departmental examination administered at the end of that semester.

In administering the six phases of the study, the preparatory assignments in the self-scoring and conventional forms were distributed alternately to the two groups as shown in Figure 1. By the end of the experiment, each group had completed three out-of-class assignments on conventional instruments and three on self-scoring instruments. Those students in a group receiving self-scoring instruments had the additional assignment of scoring their own solutions and recording these scores on the second sheet of the instrument.

Upon returning to class, the testing instruments were collected and a second problem was distributed. This class assignment involved the same principle as the one solved outside of class, but it was to be completed under controlled conditions.

All assignments were returned to the experimenter who scored the class assignments and noted student accuracy in reporting self-derived scores.

At the end of this portion of the study, a group of four regularly employed graders in the Engineering Graphics Department served to determine which of the two devices could be scored in less time. This part of the study was accomplished by scoring eight replications of ten problems for each of the six selected principles of descriptive geometry. Four of these replications involved self-scoring devices and four involved conventional devices. The lengths of time required to score the 192 replications were analyzed to satisfy this portion of the study.

The Analysis of the Data

The scores earned on the classroom assignments were analyzed to determine how well the self-scoring device aids in solving subsequent

	GROUPS	
	A	B
Principle 1 The piercing point of a line on a plane	CONV.	S. S.
Principle 2 The intersection of two planes	S.S.	CONV.
Principle 3 The true size of a plane	CONV.	S.S.
Principle 4 The shortest distance from a point to a line	S.S.	CONV.
Principle 5 The shortest distance between two skewed lines	CONV.	S.S.
Principle 6 The true angle between a line and a plane	S.S.	CONV.

FIGURE 1

THE STATISTICAL DESIGN FOR DISTRIBUTING THE PREPARATORY ASSIGNMENTS

Continued on Page 26

GRAPHICS IN THE HIGH SCHOOLS

By

Lester J. Nypan

Associate Professor
School of Engineering
San Fernando Valley State College
Northridge, California

Abstract

This paper discusses the teaching of graphics in the high schools, and describes a course given to high school graphics teachers on the function and use of graphics in engineering and industry. The course grew out of concern with the preparation of high school graduates entering engineering programs or seeking employment as draftsmen in industry. A number of the individuals concerned felt that the proper material was not being emphasized in high school graphics classes due to a lack of understanding of current requirements of engineering and industry on the part of the high school teachers. This was not an unfavorable reflection on the teachers as they too were much concerned about improving their programs, but were without the means, and unsure of the method to accomplish this. A lecture course carrying college credit was organized for these teachers covering a variety of aspects of graphics, the lectures being given by volunteers who were interested and involved in this problem. The course was very well received by the high school teachers, and resulted in an identifiable change in their course emphasis even before the end of the series of lectures.

The increasing emphasis on science and the more sophisticated approach to engineering problems has resulted in the engineering curriculum being compressed to the point that material once taught in the colleges is now being taught in the high schools. With this curriculum compression, the time allotted to graphics in the engineering curriculum has decreased, and the material that is taught in high school graphics classes, and the emphasis given to it becomes of greater importance in the total preparation of future engineers. In view of this increased importance, engineering educators must become more concerned with the content and emphasis of the high school graphics courses, and also with the preparation of the high school graphics teachers. This concern should take the form of an active effort to improve the teaching of graphics in our high schools. Allies in this activity may be discovered in organizations employing terminal high school graduates as draftsmen. Such organizations and individuals usually have a considerable influence on the community and its schools, and by working with them engineering education can take effective action to improve graphics instruction in the high schools.

As an example of such a program, concern with the vocational preparation of high school graduates in Ventura County, California, led to the formation of a Vocational Resources Committee of local industrial leaders and educators to consider means of helping and advising schools. The drafting sub-committee of this Vocational Resources Committee has been active for over a year, working with high school teachers informally through meetings, suggestions, materials, and visits to working drafting offices.

Informal work by this Drafting Sub-Committee with high school teachers led to the idea of a formal course to be offered to these teachers for college credit so that participants could satisfy the school board salary encouragement program for continuing education. No suitable course existed, but the School of Education, San Fernando Valley State College, agreed to offer Education 486, Curriculum Construction for Adult Classes, two units, through the College Extension Program provided the School of Engineering of the college would provide an instructor to work with the Vocational Resources Committee in the development of this special section of the course.

In planning sessions it was decided not to attempt to develop manual skills on the part of the teachers, but to emphasize the desired result of a graphics program, and to suggest methods of achieving such a result. A series of 12 three-hour lectures on the graphic practices, procedures, and requirements of various areas of engineering was scheduled, with lectures being given by those members of the Drafting Sub-Committee most experienced in these areas.

Lectures scheduled were:

1. Basic Drafting
   Leroy Andrews
   Andrews Drafting Service

2. The Draftsman, the Drawing, and Drawing Technique
   Leroy Andrews

3. Mechanical Drafting I
   Gene Simpson
   Talley Corporation

4. Mechanical Drafting II
   Gene Simpson

5. Architectural Drafting I
   Reg Crowell
   Crowell and Company

6. Architectural Drafting II
   Reg Crowell

7. Electronic Drafting I
   Robert Hogan
   General Electric

8. Electronic Drafting II
   Robert Hogan

9. Oil Field Drafting
   Bill Jones, Chuck Cushing, Ted Hoffman
   Shell Oil Company

10. Civil Engineering and Surveying
    Bob Lewis
    Lewis and Lewis

11. Graphic Arts I
    Robert Nelson
    Space Technology Laboratories

12. Graphic Arts II
    Robert Nelson

Material presented in a course of this nature will probably be familiar to engineers, but is summarized to convey the emphasis of the course, and to assist in generating ideas for others who might be interested in developing similar courses.

The first set of lectures gave an overview of the subject of graphics, and its function. The general topic of graphics was classified into end-product drawings or graphic arts, such as renderings, plates for publication, charts, graphs, brochures, and non end-product drawings. Non end-product drawings are really tools used to produce another product. They transmit information defining the article as to size, finish, tolerance, material, and describing an operation to be performed such as purchase, change, assemble, machine, or inspect. The idea was presented that the drawing is frequently the only communication between the designer or planner and the builder of a product, and for this reason completeness and accuracy are essential.

Attention was called to the variability in materials, instruments, and techniques employed in such diverse areas of graphics as electronics, architecture, machinery, surveying, and mapping. These differences arise from the different requirements as to relative permanence, accuracy, speed, and economy of production of the drawings. Any device or material will be used if it will serve the purpose and result in a saving in time. Templates, pencil work, approximate constructions, drafting machines, tape, and adhesive details all have their place. The importance of dollars and cents to industry was emphasized. The student must be made aware that he will be paid for the amount of work he can produce in a given amount of time, that he will not be employed because someone feels he wishes to employ a draftsman, and that no matter how fine a drawing he may produce, it is useless to industry if it is not completed in time to meet the work schedule.

The desirability of having the classroom be as nearly identical to the industrial situation as possible was suggested. The materials and tools used should be those of industry. Buff paper might be traditional in the school, but is not used elsewhere. The atmosphere of the room should be like that of industry, and the work done should be as close to the drawings and plans actually produced and used by industry as is practicable. Samples of professional work should always be available and prominently displayed.

In the lectures on mechanical drafting, the qualifications that industry looks for in draftsmen were described. These went considerably beyond a knowledge of graphics fundamentals and included mathematics through trigonometry, familiarity with materials, processes, reference materials available such as specifications, catalogs, and manufacturing data. The individual starting in a typical industry might be hired as a Detailer-B, and progress through Detailer, Designer, Checker, and to Engineer with progressively increasing responsibility. A typical first assignment the beginner might meet with may be making changes to or redrawing existing drawings. With experience he would eventually become responsible for a complete manufacturing project requiring a layout .nd bill of material from which the detail, sub-assembly, and assembly drawings would be made, checked, and released to the blue-print or reproduction department.

A number of examples of such drawings that were surplus to the needs of local manufacturers were distributed and discussed. The frequent use of sectional views surprised some of the teachers, and led to a fuller treatment of principles and practices in sectional views.

The tools usually used in mechanical drafting were enumerated as the drafting machine, triangles, numerous templates, compass, almost every conceivable pencil, pencil pointer, and erasing machine and shield. There was some surprise that an ordinary mechanical or Number 2 office pencil might be used by a professional draftsman for lettering and other work. This led to emphasis of the importance to industry of the result and time taken rather than the means used to achieve the result. Any instrument to technique that saves time is used.

The lectures on architectural drafting considered its relationship to other fields of drafting, the layout of a typical architect's office, and the tools and materials used by the architect. Some of these were: the Architectural Index, cataloging articles on buildings recently designed by type of

Continued on Page 44

SCIENCE EDUCATION VERSUS ENGINEERING EDUCATION -- A SOLUTION TO THIS DILEMMA?

By

Dr. Luisa Bonfiglioli
Visiting Post-Doctoral Research Fellow
Department of Graphics and
Engineering Drawing
School of Engineering and Applied Science
Princeton University
(On leave from the Technion-Israel
Institute of Technology)

1965-1966

The most peculiar property of human beings is the need to understand the cause of every fact that happens in his daily life and to explain it according to the notions known at the time of his research.

This process prompted the development of knowledge and enlarged its horizons. So, the impact of knowledge, i.e., "Science" became more and more comprehensible and today there isn't any kind of human activity that is not related to scientific rules.

It is possible to assert that science governs all the events but every event can be and must be examined from two approaches. These two points of view are so deeply linked that they cannot possibly be separated but nevertheless, they are completely distinct in their ideology and in their purposes.

The first approach is based on the inquiry about the cause that originated the event and on its formulation according to mathematical, physical, chemical, etc. . . . rules.

The second approach is aimed to finding an application of the same event for the sake of the welfare of mankind and its effects on mankind.

Two examples are presented to clarify the previous statements:

Solar light has a certain cycle -- night is followed by day and day is followed by night.

The study of the physical laws that govern this cycle is very old and its origin is lost in the remoteness of history. But at the same time, in spite of the fact that these laws were unknown, people began to use the regularity of the sun cycle in a particular place in order to evaluate lapses of time by constructing the sundial.

The second example is related to the ignition of fire in the pre-historic epoc.

People knew that by rubbing two stones a spark could be produced and they developed several devices in order to facilitate the process a long long time before knowing what was the cause of the phenomena of fire.

These are only two examples among an infinity of cases that prove that there are people whose 'forma mentis' is abstract and they have not much interest in problems involving material work and practical solution, and there are other people that have a deep skill and a great amount of common sense and vivid imagination that apply the abstract achievements of science in planning and designing all the useful things that delight mankind, or invent them relying on their intuition.

To define these two categories of people, according to the modern language, we can say that those in the first group are "Scientists" and those in the second group are "Engineers." It is evident that the Scientists could not succeed in their investigation without the help of the Engineers and the Engineers could not invent all their devices without the support of the Scientists. The fantastic technical development of the last few decades is a new witness to this truth.

So, the importance of the second group in the development of Science is equal and the acknowledgment due to Engineers for their achievements must be divided into equal parts.

In our present world professional knowledge is acquired through study at the University or College and because of the equal importance between Scientists and Engineers the program of study should have been adapted so that it could supply the needs of both categories.

But recently very many universities began to enlarge the impact of abstract disciplines at the expense of human applicable ones and so, little by little, Engineering Education is restricted to a continuously diminishing number of subjects.

It follows that a new Engineer, at the end of his studies, is not prepared to accomplish his task in plants or private enterprises because the requirements of the industry and civil work are completely different from the baggage of knowledge given by the university.

This causes a feeling of discomfort and sadness and inferiority in the new Engineers and a kind of contempt in the employers.

The time that is required for these young Engineers to adapt themselves to the new conditions is very long because they must fill gaps in their engineering education and, especially because they must revise all their knowledge from the point of view of the reality whose aspect is completely contrasting from the aspect of abstractness.

There are large industrial firms that devote the first three working years of a new Engineer to his retraining towards his future task.

If this situation continues much longer, the number of the new Engineers will sharply decline and this will have a bad influence on the economy and future of the nation.

In what direction shall we look towards for a solution? The simplest idea is to restore the program of study that was in effect before the changes. But this is an unrealistic solution because this will provoke so much discord between the members of the universities that such a program will never be put into practice.

A second and best solution is based on the reorganization of the Engineering and Applied Science Schools into two separate institutes: School of Engineering and School of Engineering Science.

The two Schools will be administrated by the same overall administration but each one will be absolutely independent and autonomous in regard to decisions related to its program of study and educational activity.

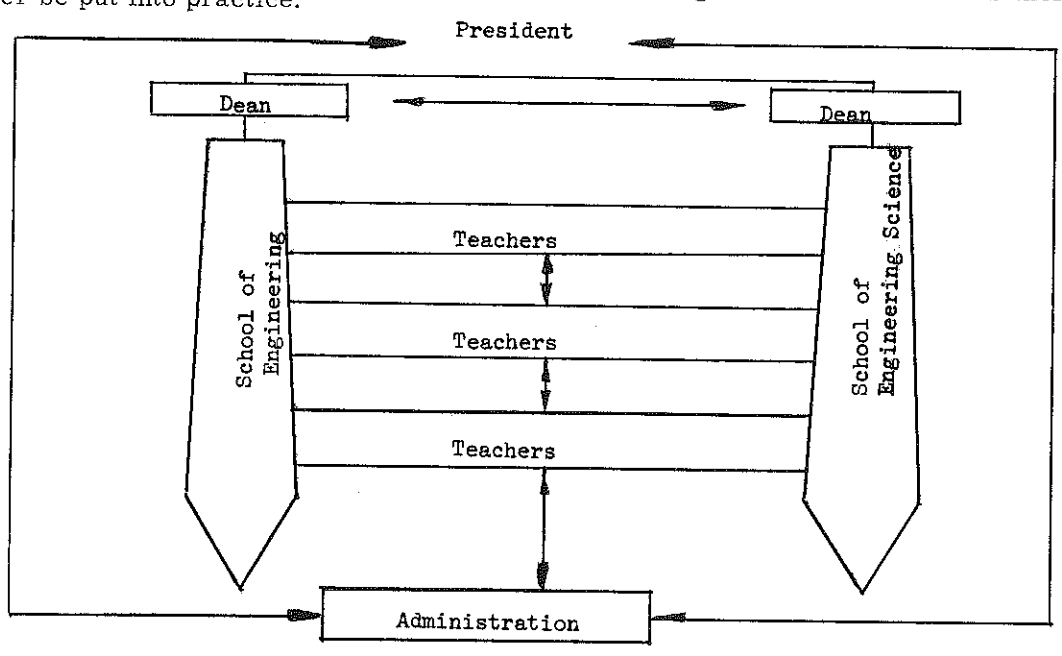
The task of the Dean (one for each school) is to supervise the activities of their particular schools, to improve the standard of the study and essentially to promote and intensify mutual exchange of ideas and knowledge between the two schools. This means that the two schools must work in complete harmony and on the basis of mutual physical and intellectual cooperation, but each one has his own right to select the content of the disciplines taught, evaluate their importance and decide from what point of view they have to be taught.

Each school will lead to equivalent degrees therefore, each one has to have undergraduate courses and graduate schools, whose programs will be adequate for their requirements. This implies a continuous mutual contact between the two Deans under the direction and supervision of the President of both the two schools who is finally the supreme authority of the two schools.

Because of the deep linkage existing between Engineering and Engineering Science all the teachers will depend on the administration of the joint schools and they will teach in both schools according to the needs of each school and the content of the subject taught by the particular teacher.

A special board will handle the distribution of the work between the teachers so no one will be overloaded.

The diagram of this solution is therefore:



GRAPHIC CALCULUS VERIFIED BY AN ANALOG COMPUTER

by

Fryderyk E. Gorczyca

Assistant Professor
Mechanical Engineering Department
Southeastern
Massachusetts Technological Institute
North Dartmouth, Massachusetts

Graphic calculus deals with chart construction involving two basic operations, differentiation and integration. In differentiating a given curve, the slope or rate of change of the given curve is determined with respect to a common abscissa whereas in integrating a given curve, the area under the given curve is determined with respect to a common abscissa. Both of these operations can be vividly illustrated by graphical means. As a result, a clear interpretation of the various relationships which are composed of consecutive differentiations or integrations emerges in terms of curves that are graphical operations on the given curve.

In a similar manner, the results of successive integrations or differentiations can be accurately illustrated by means of an analog computer. This is accomplished by combining the fundamental elements of the computer; namely, resistors, capacitors, and d-c amplifiers in such a manner that they perform the important operations of sign-inversion, multiplication, summation, and integration. The input and output variables of the computer are given in terms of voltage and current which are calibrated to units of a specific problem.

As an illustration of successive integrations or differentiations on a given curve, consider the relationships in dynamic analysis relating displacement, velocity, acceleration, and jerk or pulse as functions of time. In this case, velocity is defined as the rate of change of the displacement with respect to time or the slope of the displacement curve which can be written as

$$V = \lim_{\Delta T \to 0} \frac{\Delta S}{\Delta T} = \frac{dS}{dt}$$

where t = time, s = displacement and V = velocity; acceleration is defined as the rate of change of velocity with respect to time or the slope of the velocity curve which can be written as

$$A = \lim_{\Delta \to 0} \frac{\Delta V}{\Delta T} = \frac{dV}{dt}$$

where A = acceleration; jerk or pulse is defined as the rate of change of acceleration with respect to time or as the slope of the acceleration curve which can be written as

$$J = \lim_{\Delta \to 0} \frac{\Delta A}{\Delta T} = \frac{dA}{dt}$$

where J = jerk.

In summary, the relationships can be written as

$$J = \frac{dA}{dt} = \frac{d^2V}{dt^2} = \frac{d^3S}{dt^3}$$

Since

$$V = \frac{dS}{dt} = \text{slope of displacement curve.}$$

$$A = \frac{dV}{dt} = \text{slope of velocity curve.}$$

$$V = \frac{dA}{dt} = \text{slope of acceleration curve.}$$

By substituting:

$$A = \frac{d\left(\frac{dS}{dt}\right)}{dt} = \frac{d^2S}{dt^2}$$

$$\text{and } J = \frac{d\left(\frac{dV}{dt}\right)}{dt} = \frac{d^3S}{dt^3}$$

It can also be shown that since $V = \frac{dS}{dt}$ $dS = Vdt$ and displacement = S = $\int V\,dt$ = area under velocity-time curve. In a similar fashion since

$$A = \frac{dV}{dt}$$

$$dV = Adt$$

and velocity = V = $\int A\,dt$ = area under acceleration-time curve.

Finally, since

$$J = \frac{dA}{dt}$$

$$dA = J\,dt$$

and acceleration = A = $\int J\,dt$ = area under jerk-time curve. Combining, the relationships can be expressed as

$$S = \int V\,dt = \iint A\,dt\,dt = \iiint J\,dt\,dt\,dt.$$

Since

$$S = \int V\,dt = \text{area under velocity-time curve} = \iint A\,dt\,dt = \iiint J\,dt\,dt\,dt.$$

$$V = \int A\,dt = \text{area under acceleration-time curve} = \iint J\,dt\,dt.$$

$$A = \int J\,dt = \text{area under jerk-time curve.}$$

The operations listed above can be performed analytically by means of mathematical handling. But, in order to do this, an expression for the given curve must be determined in the form of an equation. Herein lies the advantage of the graphical solution insofar as no equation of the given curve is necessary in order to differentiate and integrate graphically. In addition, a visual inspection of the curves resulting from graphical integration or differentiation verifies the accuracy of the operation.

For a graphical illustration, assume that a curve is given upon which the integration operations are to be performed. The problem is stated as follows: Given $Y = f(x) = 1$. Find $Y_1 = \int Y\,dX$.

$Y_2 = \int Y_1 dX = \iint Y\,dX\,dX$, AND $Y_3 = \int Y_2 dX = \iint Y_1\,dX\,dX = \iiint Y\,dx\,dx\,dx$.

Also, show that

$$Y_2 = \frac{dY_3}{dX},\quad Y_1 = \frac{dY_2}{dX} = \frac{d^2Y_3}{dX^2} \text{ AND THAT}$$

$$Y = \frac{dY_1}{dX} = \frac{d^2Y_2}{dX^2} = \frac{d^3Y_3}{dX^3}.$$

The curves shown in Figure 1 satisfy the conditions of the problem in which case successive integrations down the curves from Y = (x) = 1 yield Y_1, Y_2, and Y_3 as functions of X whereas successive differentiations up the curves from Y_3 yield Y_2, Y_1, and Y as functions of X.

Table No. 1 lists the values of Y, Y_1, Y_2, and Y_3 for values of X ranging from 0 to 4. The integral or area under the given curve is determined by breaking the area under the curve down into small unit areas and adding these up. This procedure enables a graphical integration of the area under a given curve. To find the derivative or slope of a curve graphically requires the determination of the $\frac{\Delta Y}{\Delta X}$ ratio. By setting the ΔX value to one unit, the measurement of Y yields the slope or derivative of the curve at a given point. This procedure is illustrated for the individual derivatives at X = 3 on the curves shown in Figure 1.

The analog computer yields the same results as shown in Table No. 1. The computer diagram is shown in Figure 2 where an illustration is given of the relationship existing among the vari-

Continued on Page 37

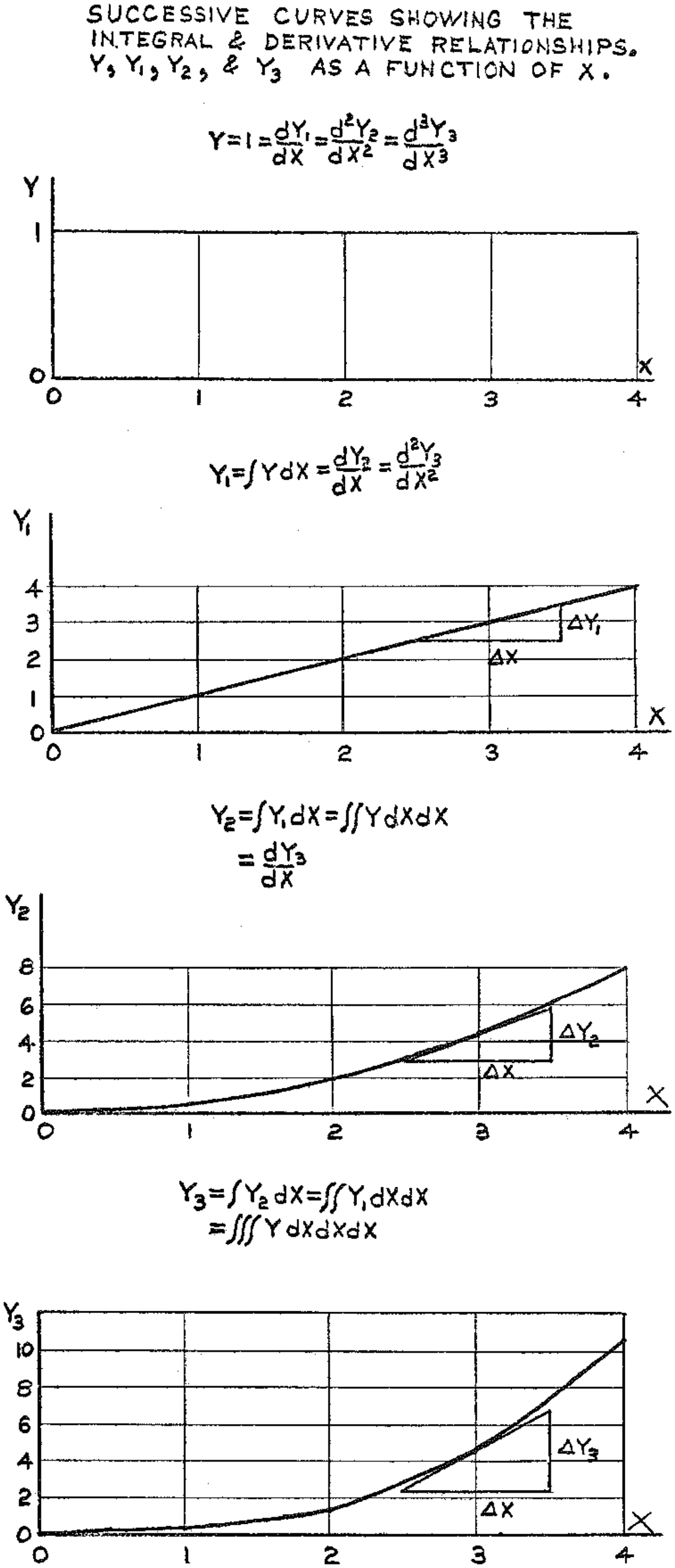


Figure 1

THE GRAPHICAL AND DIGITALIZED OUTPUT OF A DIFFERENTIAL EQUATION

by

Charles J. Baer & Steven Butner
The University of Kansas
Department of Mechanical Engineering

It is possible to solve a first-order differential equation by a graphical process called "marching." It is also possible to use this process in a digital computer for the solution of the equation. And it is also possible to have the solution appear in a graphical form if the computer is so programmed. This has been done with the equation,

$\frac{dx}{dt} + x = 20$, as follows.

x axis to x_n (or Point 2) is larger than the vertical distance height to x_{n-1} by an amount equal to the slope times the H distance.

Therefore we can write:

$$x_n = x_{(n-1)} + \frac{x}{1} H$$

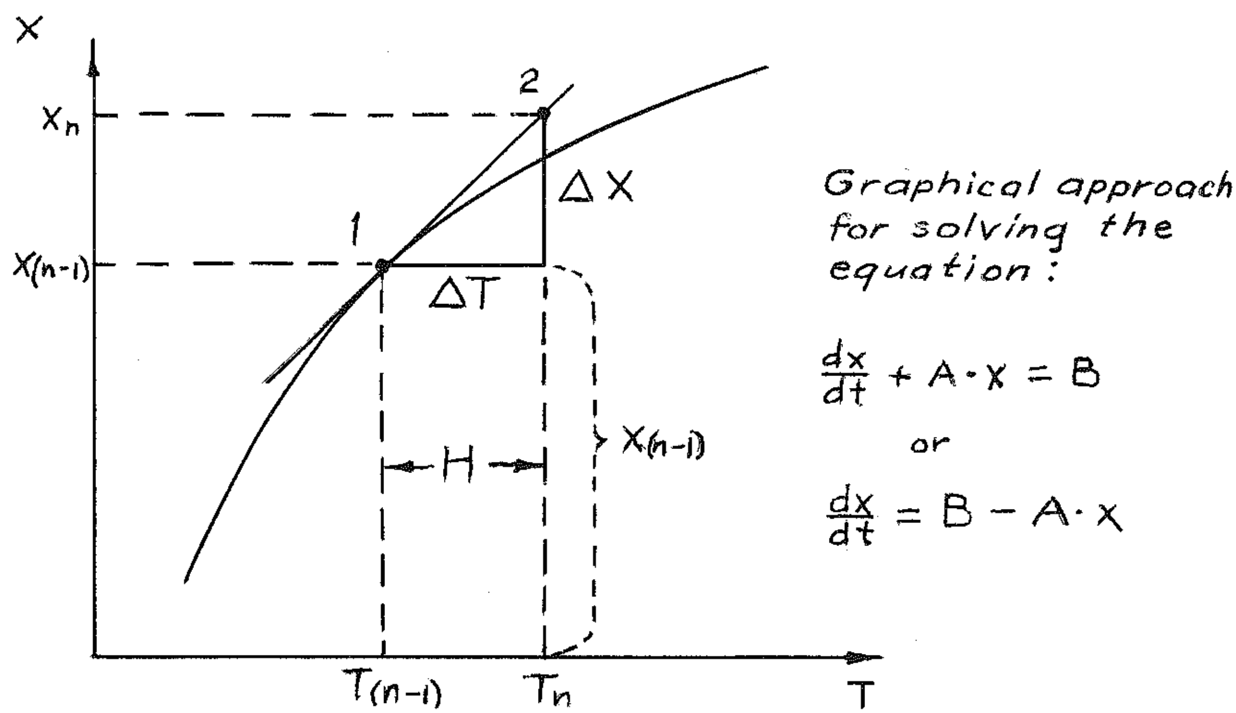


Figure 1

Figure 1 shows a curve which represents one equation. A known point (1) on that curve is shown by means of a dot, and the slope at that point is shown as $\frac{\Delta x}{\Delta T}$. A horizontal increment of H, greatly exaggerated, is shown on Figure 1. If this distance is made quite small, Point 2 will be on the curve, for all practical purposes.

The vertical distance from the bottom of the

or, writing $\frac{x}{1}$ as x^1

(1) $x_n = x_{(n-1)} + x^1 H.$

This is the first step in applying the "marching" method.

Now, the general form of the equation is:

(2) $dx + A \cdot x = B$

which is called the "canonical" form, but which can be written as,

$$\frac{dx}{dt} = B - A \cdot x$$

or

(3) $x_n^1 = B - A \cdot x_n$ at Point 1, and writing $\frac{dx}{dT}$ ad x^1.

It is also important to remember that A and B are functions of x and T and therefore are evaluated at x_n and T_n. The second step in the marching method is now performed by using the approximate slope at T_n to obtain the value of $x_{(n+1)}$. Doing this we obtain:

(4) $x_{(n+1)} = x_n + x^1 H.$

Now, because Equations (3) and (4) both have the x^1, we can eliminate the derivative and obtain the following equation:

(5) $x_{(n+1)} = x_n (1 - H \cdot A_n) + H \cdot B_n.$

Using formula (6), we can calculate discrete values of x from selected values of T. Because H can be made quite small and the computations can be done rapidly, this equation can be easily programmed on a digital computer with quite accurate results. The following first-order differential equation was programmed and solved on an IBM 7040 model.

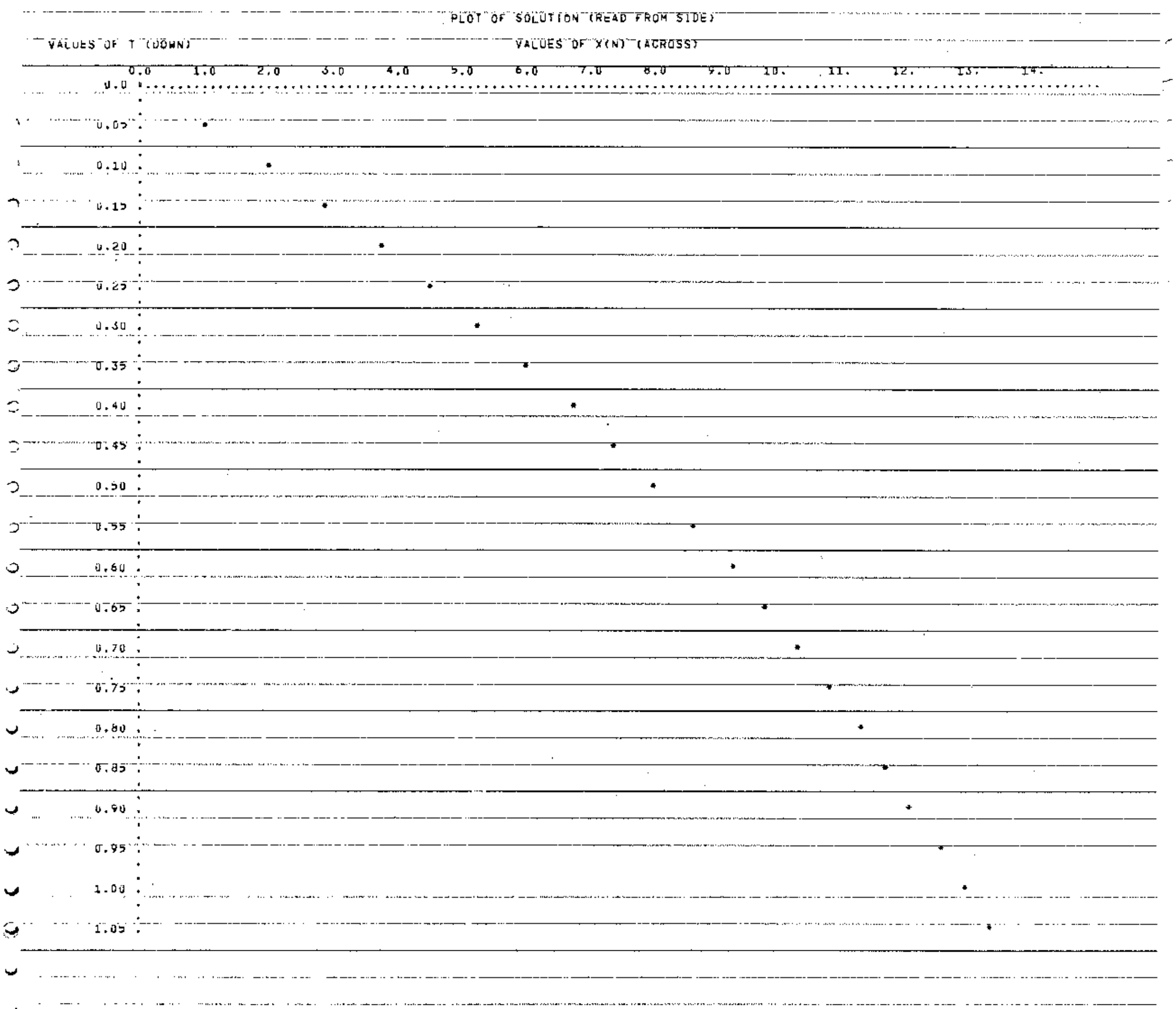
(6) DX/DT + X = 20 Initial condition x (0) = 0.

We observe that in this equation A = 1 and B = 20. Let us assign a value of 0.05 to H. After fitting our equation into our Marching Method formula, we obtain the following:

(7) $x_{n+1} = x_n (1-H) + 20 \cdot H$ H = 0.05.

Following is the computer program used to solve this equation. The coded language used in this program was Fortran IV. Notice statements numbered 26, 27, and 31 where the solution function is defined.

Below is the graphical output of an IBM 7040's solution using the previous program.



Continued on Page 61

Perspective

Editor's Note:

Two of the cartoons which Ernie submitted appeared in the Journal of Engineering Graphics, November (Fall) 1966, Vol. 30, No. 3, Series 90.

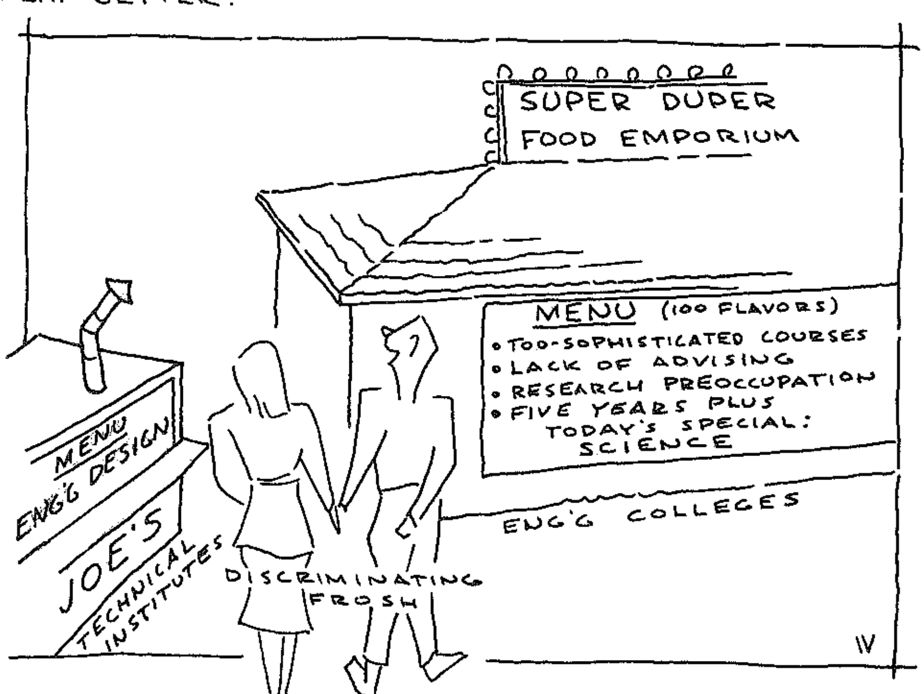
Earl,

I appreciate your invitation to give my views in an article for the Perspective Department of the Journal -- but a graphics teacher should use a graphical presentation!

Therefore, with these "Political" cartoons, I rest my case.

Ernest R. Weidhaas
Prof & Head
General Engineering

"NOPE, IT DON'T LOOK AS PURTY — BUT IT SURE TASTES A HEAP BETTER!"

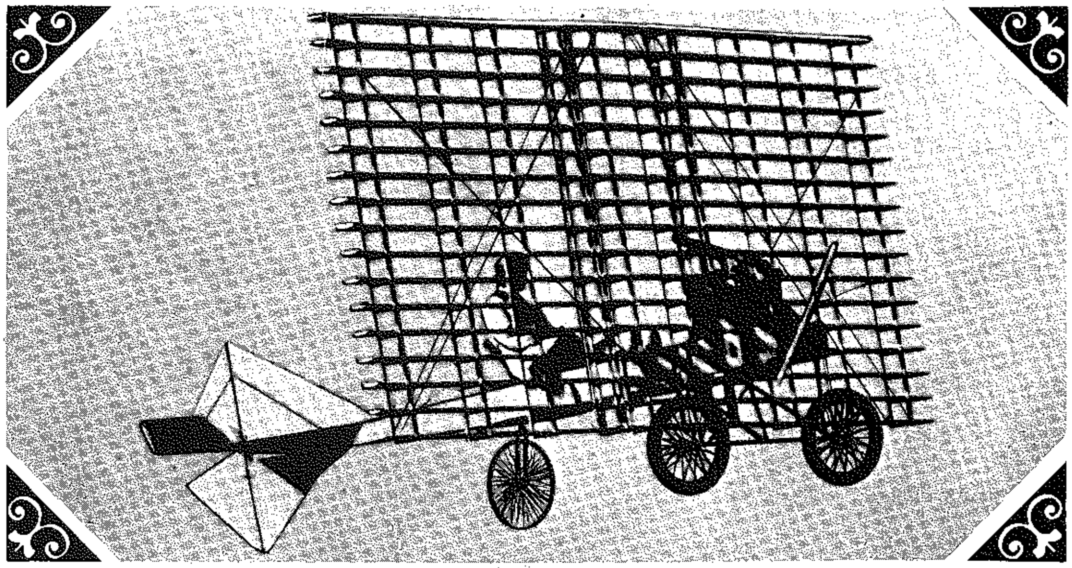


"----BUT THE FOOD'S BETTER AT JOE'S"

Continued on Page 39

LETS FACE IT

TO TEACH ENGINEERING DESIGN CANNOT BE DEBATED



A N N O U N C I N G

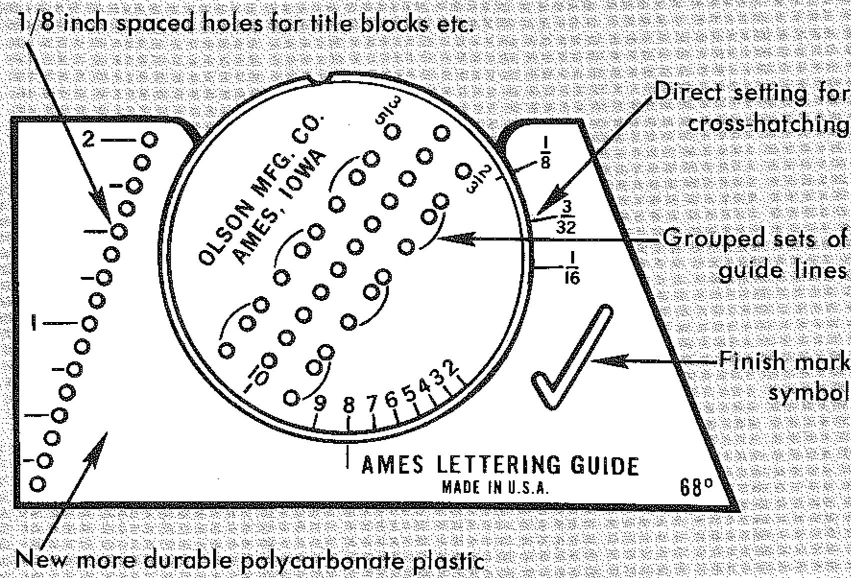
the 1967 A. S. E. E. SUMMER SCHOOL IN ENGINEERING GRAPHICS AND DESIGN will be held on June 15, 16, 17, 1967 at Michigan State University, Kellogg Center, East Lansing, Michigan immediately prior to the Annual Meeting.

The primary objective of the summer school program will be to present engineering graphics as a vehicle of instruction in engineering design and a method of motivating students towards creative and inventive effort. The intent is to broaden the educational outlook of graphics teachers in the area of design education and give them some guidance for instruction in this area. Invited lecturers will give attendees intense coaching in curriculum planning, writing of case studies, selection and writing of design projects, and the role of graphics in design. The school will bring recognized authorities in design education in contact with graphics teachers. The summer school will be conducted on a lecture-workshop basis with work assigned, and reviewed at each morning session. Every effort will be made to involve attendees in actual problem solving sessions so that they may experience what their students will be required to do in class. Attendees will gain experience in the writing of design problems to be used at their home institutions. Lectures will be somewhat formal in nature (entire group in attendance). Workshops will be informal (limited to about 25), with coaches available to answer questions and stimulate thinking on assigned work.

PRELIMINARY PROGRAM

TIME	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
8:00-9:00	A R R I V E	REGISTRATION	REVIEW ASSIGNMENT	REVIEW ASSIGNMENT
9:00-10:30		WELCOME-INTRODUCTION DESIGN PROCESS	TASK SPECIFICATIONS	SOLUTION AND GRAPHICS
10:30-10:45		C O F F E E B R E A K		
10:45-12:30		CASE HISTORY	CONCEPT PHASE AND GRAPHICS	CURRICULUM PLANNING AND COURSE OUTLINES
12:30-1:30		L U N C H		
2:00-4:30		WORKSHOP IDENTIFICATION OF NEEDS WRITING OF DESIGN PROJECTS, WRITING OF CASE STUDIES A | B | C | D | E | F | G | H	WORKSHOP WRITING OF TASK SPECS. AND CONCEPTUAL DESIGN OF AN ASSIGNED DESIGN PROJECT A | B | C | D | E | F | G | H	EVALUATING A DESIGN PROJECT SOLUTION SUMMARY SESSION
5:00-6:00	REGISTRATION AND COFFEE	INFORMAL DISCUSSION	INFORMAL DISCUSSION	RECEPTION
6:00-8:00				DINNER (SPEAKER ON DESIGN EDUCATION)
8:00-11:00		ASSIGNMENT	ASSIGNMENT	ANNUAL A. S. E. E. MEETING

THE NEW Ames Lettering Guide...



NOW WITH SEVERAL ADDED FEATURES

We would be happy to send a free new Ames Lettering Guide to any instructor. Write us on your departmental letterhead and it will be forwarded immediately. After trial and evaluation, we feel sure you will recommend it to your students.

OLSON MANUFACTURING CO.
P.O. Box 109 • Ames, Iowa
"Drafting Products by Olson of Ames"

Available through jobbers, distributors and dealers of drafting equipment everywhere.

Continued from Page 14

problems in descriptive geometry. Six individual analyses of variance were conducted on the data taken from the six in-class assignments. Then to determine any possible difference between the two groups of students, the data taken from two consecutive principles were combined to form three "sets." These data were analyzed as three 2 x 2 Latin squares as shown in Figure 2. Finally, an overall analysis of variance was conducted to determine the effect of the self-scoring device on student performance.

To ascertain student accuracy in self-scoring, a student's score for a particular paper was paired with a standard score for the same paper. This pairing was done for all self-scoring devices properly completed outside class. The differences between the two scores were analyzed using a paired t test.

A factorial analysis of variance was used to determine which of the two types of instruments could be scored in less time.

The Presentation of the Data

Table I shows a summary of the six statistical analyses performed after each of the six sets of data had been gathered. The reader may observe that for the first three principles there were no significant differences to be found between the two techniques of out-of-class preparations. Further inspection, however, reveals that the last three F ratios are significant. When considered in context with the means earned on the in-class assignments, it may be concluded that the self-scoring technique is a more efficient method of preparation outside class.

Table II presents the summary of the three statistical analyses derived by combining the data taken from two consecutive principles. It may be observed that no statistical difference existed between the groups in any of the three analyses. Closer observation will reveal that for Set I, no statistical difference existed between the two techniques of preparation used outside class; but for the last two sets, the reader may see that the self-scoring device was probably the more efficient means of preparation.

The overall analysis accomplished by pooling the data used for the three Latin squares is shown in Table III. The reader may see that there are two significant F ratios. The one of 13.47 for Technique suggests that there existed a highly significant difference between the average score of 81.58 for the conventional technique of preparation outside class as compared to the average score of 86.56 for the self-scoring technique. The F ratio of 4.65 for Order implies that there was a significant difference between the principle

Continued on Page 45

A DIRECT METHOD FOR AXONOMETRIC PROJECTION

by

Al Romeo
Assistant Professor of Engineering Graphics
The Ohio State University

Review of Existing Methods

The direct axonometric projection of an object from two principal views to produce a pictorial view of an object on any set of axes, was first suggested by Professor L. Eckhart in 1937 and was called the "method of intersections" (1). This method of direct pictorial projection was a significant improvement over any of the existing axonometric drawing methods which required special scales and, obviously, an improvement over the multiview projection method which was so tedious and time consuming.

The "method of intersections" as originally proposed required that the projection axes be preselected, to permit the geometric construction which is used to orient the principal views for projection. The preselection of the axes was on an "almost" random basis, in that judgment was made as to the combination of axes which would be most pleasing or which would accent a particular surface or feature of the object. Other authorities (2 and 3) have followed the same tack in that a guess at a desirable choice of axes is required.

One authority (4) noted that the rotation of the top view and the tilt of the other two views bears a relationship to the axes of the axonometric projection. Both the angles of rotation and tilt which were known or preselected, were used geometrically to construct the required axes. This permitted a preselection of the axes based on a predetermined position of the object in space.

A method was proposed in which the author (5) noted the geometrical relationship between the line-of-sight (LOS) and the axes of projection by identifying certain appropriate space measurements which would be used in a multiview projection. A specific selection of the axes, related to the given views and the LOS, is possible using this system. A similar method was proposed (6), in which a particular choice of two auxiliary planes whose intersection produced the LOS, could be used along with a simple construction, to define the axes in the axonometric view. This method also related the LOS to the existing principle views and to their positions in the axonometric views.

This approach was followed by another (7) in which it was recognized that a normal line will appear in the projection plane of each view which will be perpendicular to the projectors of the desired axonometric view. The identification and orientation of both the axonometric axes and the appropriate principal views for direct projection is readily determined in this approach.

Although the above review of the current state of the application of the "method of intersections" in axonometric projection is not intended to be exhaustive, it probably reflects the current practices.

Introduction to Direct Method

Rather than choosing a random set of axes, there may be positive criteria which may be of importance. For instance, as one criterion, a particular LOS may be chosen for which a pictorial view is desired. (Fig. 1.) This approach is fre-

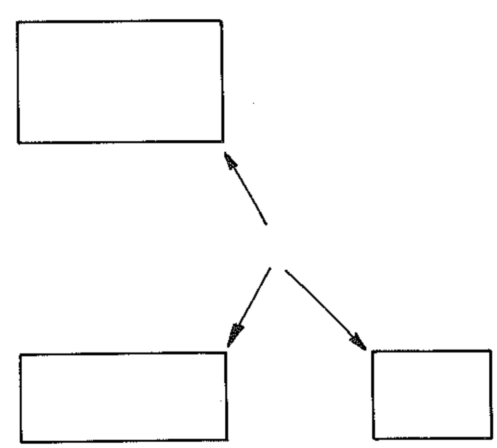


Figure 1

quently used for a theoretical development of an orthographic projection in which the point view of the line-of-sight (LOS) is the pictorial view desired. As another criterion, an oblique surface which is to appear normal in the pictorial view, may be required (Fig. 2). Neither of these criteria can readily be used for the preselected axis approach, because there is no demonstrated relationship between the principal views and the randomly chosen axes.

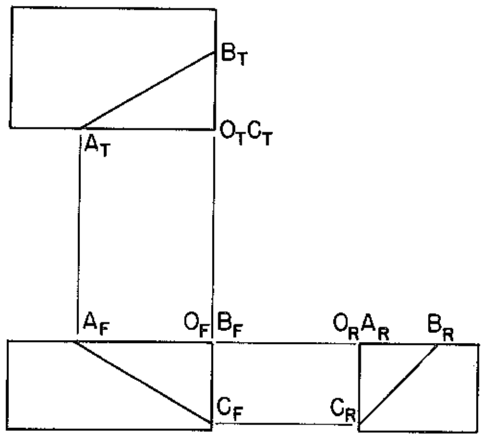


Figure 2

The three authorities cited (5, 6, and 7) have provided a mechanism for relating the principal views to the axis selection. Each of these methods is straight-forward; however, the explanation of the method is necessarily complex, although in all cases, the method itself is simple to use.

The following method, hopefully, will provide a simpler and more direct method of constructing the axes and orienting the views so that the method of intersections can be conveniently used for either of the aforementioned criteria.

Theory and Procedure

The theory of this method is based on certain geometric properties demonstrated by an oblique plane (real or imaginary) in the principal views of an object. If a pictorial view of the object, in which the oblique plane (triangle) will appear normal, is required, then each principal side of the plane is a normal line in both the pictorial view and in one of the principal views. These normal lines bear a unique relationship to the axes of the pictorial. The edges OA, OB, and OC (Fig. 2) will be the axes of the pictorial view and the sides of the plane BC, AC, and AB are, respectively, perpendicular to these axes. (The perpendicularity of two lines will always show its true relationship in any view where at least one of the lines appears normal (8).) If the pictorial view is to be a normal view of the plane, then in that view also, each axis (OA, OB, and OC) will appear perpendicular to a normal line (BC, AC, and AB). Thus, any oblique plane that is to appear normal in the pictorial view is completely defined and specified by the three normal lines that the plane cuts in the principal surfaces of the object. In the pictorial view, these lines will appear normal since they are defining the normal view of the plane and furthermore, they will appear perpendicular to their respective axes. Since these lines appear normal in their respective principal views, they can be reconstructed independently to define the normal view of the plane by using their true lengths as radii (Fig. 3). (To simplify the construction of

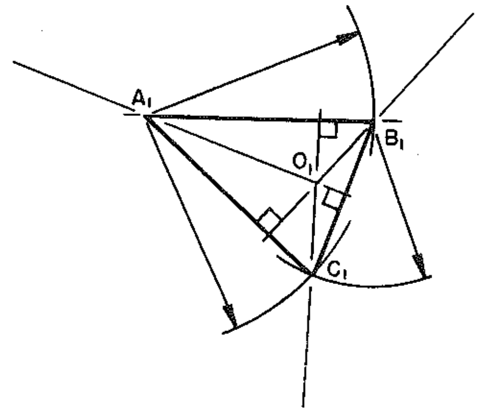


Figure 3

the axonometric view, note that line AB is constructed horizontally on the paper. However, this is not necessary but is only for the convenience of working with standard equipment.) Triangle ABC is normal in this view (Fig. 3) and, therefore, the axes of the axonometric projection will appear perpendicular to each of these lines in turn. Through the three Points A, B, and C the axes OA, OB, and OC can be constructed perpendicular to their respective opposite sides. (Since they are altitudes of a "triangle," they will intersect at the common Point O.) Obviously, in this view the axes (OA, OB, and OC) are foreshortened.

The orientation and location of the principal views around the axes is easily accomplished. Since AB is normal in the top view and was constructed normal in the axonometric view, the apparent parallel relationship of AB in these two views is specified by their projectors (Fig. 4).

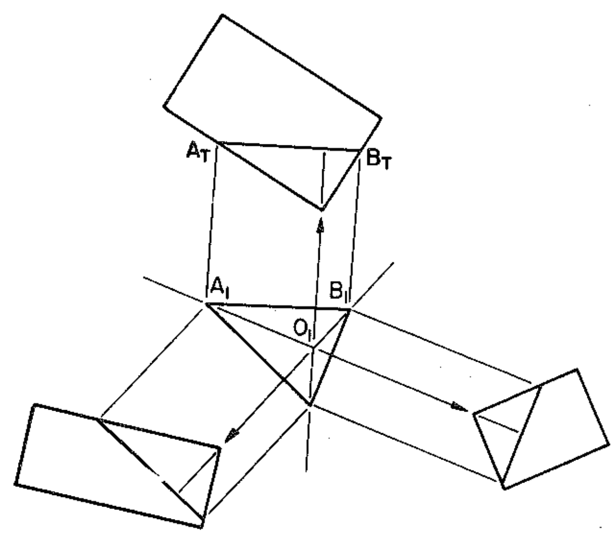


Figure 4

Therefore, the top view can be cut out and placed (or traced in a rotated position) to meet this specification. The two adjacent views of the normal line AB are tied together by projectors which

Continued on Page 62

ASSESSMENT OF THE GOALS OF ENGINEERING EDUCATION IN THE UNITED STATES

Excerpts From the

REPORT

of the

PANEL ON ENGINEERING EDUCATION

Convened at the Request of the

Engineers Joint Council

FOREWORD

Publication of "The Preliminary Report, Goals of Engineering Education," by the American Society for Engineering Education has provided a strong incentive for valuable and thoughtful consideration on the part of the entire engineering community of many issues of vital concern to the engineering profession.

Rather than add to this body of comment, the Panel has addressed itself to certain broad issues and problem areas of fundamental importance to the teaching and practice of engineering.

REASSESSMENT OF ENGINEERING EDUCATION

THE GROWING DEMANDS UPON THE PROFESSION OF ENGINEERING TO ASSUME LEADERSHIP IN THE CONSTRUCTIVE INTEGRATION OF TECHNOLOGICAL CHANGE AND HUMAN FULFILLMENT IN A TIME OF ACCELERATING CHANGE REQUIRES A TOTAL REASSESSMENT OF ENGINEERING EDUCATION.

No longer can the engineer remain a technical adviser to others in the application of science to human affairs. He must, because of his special understanding of the contributions of science and of their effective implementation in industry, government and society in general, assume an ever-increasing concern and broadened obligation in assuring the positive and constructive integration of technological change and the improvement of the human condition throughout the world.

This fundamental enlargement of the role of the engineer in our society and time requires the total reassessment of engineering education as a professional preparation, in the largest sense, to meet the demanding challenges for leadership which the explosion of scientific knowledge has caused.

NATIONAL GOALS

AS AN INSTRUMENT OF NATIONAL PURPOSE, ENGINEERING EDUCATION SHOULD PROVIDE THE FORMAL BASIS FOR PREPARING THE NATION'S ENGINEERING MANPOWER WITH THE CAPABILITY, KNOWLEDGE, UNDERSTANDING, AND INSIGHT TO FULFILL THE TECHNOLOGICAL NEEDS OF SOCIETY ON A TIMELY AND EFFECTIVE BASIS. SUCH PREPARATION SHOULD INCLUDE THE FOUNDATIONS FOR BREADTH OF VISION, LEADERSHIP, AND STATESMANSHIP WITH APPROPRIATE DISCIPLINARY BALANCE AND FLEXIBILITY TO MEET NEW TASKS AND OPPORTUNITIES.

Many of the great problems of contemporary society are related to technology. In the underdeveloped nations of Asia, Africa, and Latin America, pressures are mounting for a share by a growing number of nations in the greater well-being and security that come with advancing technology. Today, these aspirations are hampered by many factors -- economic, social, and political -- that result in a continued widening of the gap between those nations which have and those which have not.

This is a time of historic change in the relationship between man and his environment, a consequence primarily of new technology. Whether this potential works for the benefit of the world or to its detriment depends in part upon the development among all people of an understanding of the choice which technology offers.

Domestically, science and engineering are called upon to propose solutions to broad problems that have either been bypassed in the pursuit of other goals or generated by technology itself. The massive pollution of air and water, the congestion of our roads and our airways, and the mounting demands for increasing amounts of power cries out for new technology.

The time has come for the formulation of sound judgments and policies in areas of critical national importance.

The prospect is for a future degree of complexity that may well become unbearable unless we take every step to develop the understanding, the skill, and the determination to master it. Engineering education must provide the formal basis for preparing the engineering manpower of the nation to meet this challenge.

Time is not on our side. Five years now is the equivalent of ten years in the pace of new technology only a quarter-century ago. Looking ahead, we can be certain only that the time scale will grow shorter. There is an unchanging requirement for competent people to initiate, develop, and control the new products and systems of the future.

INSTITUTIONAL GOALS

THERE ARE A VARIETY OF USEFUL PATTERNS FOR INSTITUTIONAL RESPONSIVENESS TO NATIONAL ENGINEERING EDUCATIONAL GOALS. EACH INSTITUTION SHOULD EXAMINE ITS RESOURCES AND IDENTIFY GOALS MOST SUITED TO ITS OWN RESOURCES AND CAPABILITIES.

Each institution should examine its present and future capabilities to determine a reasonable role to play in achieving all or part of the national goals. It is not practicable to provide in one institution the breadth and depth of instruction to prepare all students for all aspects of engineering practice. Each institution should develop its own personality and stress those programs best suited to its students and faculty with consideration given to the needs of the industries and organizations which look to the institution for their engineering support.

The strength of engineering education should be its flexibility. It is desirable that different schools experiment with different programs and that students have the choice of selecting the program which best fits their needs.

It should not be cause for concern that institutional goals may differ one from another in recognition of the differences in resources, environment, students, and faculty. Institutional goals should be innovative, flexible, and daring in the commitment of resources aiming at excellence in the chosen role of the institution.

FOCUS ON THE INDIVIDUAL

TO PREPARE ENGINEERING STUDENTS FOR RAPID TECHNOLOGICAL CHANGE AND FOR GROWING RESPONSIBILITIES IN INDUSTRY AND GOVERNMENT, THE EMPHASIS IN INSTRUCTION MUST BE PLACED MORE UPON THE DEVELOPMENT OF THE POTENTIAL CAPABILITIES AND INSIGHTS IN THE INDIVIDUAL AND LESS UPON THE TRANSFER OF GENERALLY PRESCRIBED CONTENT IN STANDARDIZED COURSES.

A reassessment of engineering education should be focused upon the process of engineering education in developing the individual professional engineer far more than upon the details of curriculum, the precise timing of courses, and degrees, the devices of instruction, or the standardization of institutional programs. The nub of the problem is not content but process; not precise curriculum but growth in motivation and understanding; not what the student knows so much as his tone of attack, his precision of mind, and his creative powers in resolving accumulating knowledge into sound judgment and humane understanding of means and ends.

It is how the teacher uses knowledge as a means of drawing forth the potentialities for judgment and wisdom in the student that counts, not what the student knows at some precise time. It is the part of wisdom that we not pressume to establish at this time, or ever, a universal schedule for this delicate and demanding process.

FLEXIBILITY AND DIVERSITY

SINCE ENGINEERING STUDENTS VARY WIDELY IN PREPARATION, CAPACITY, INTEREST, AND POTENTIAL CONTRIBUTION, IT IS CONTRARY TO SOUND EDUCATIONAL POLICY TO STANDARDIZE CURRICULA, DEGREES, METHODS, OR PERIODS OF INSTRUCTION ACROSS INSTITUTIONS AT THE EXPENSE OF FLESIBILITY, EXPERIMENTATION, AND WHOLESOME DIVERSITY AMONG AND WITHIN INSTITUTIONS.

It is in the nature of American higher education that there will always be a diversity of approaches to the educational process. Students vary in potential capacity and contribution, preparation, interests, motivation, and rate of development. The educational process must be adjusted to the student and not the student to the process in a rigid pattern of predetermined courses or predetermined time schedules to channels. The more able student has wider and more diversified interests than the less able. He progresses faster if instruction parallels a growing sense of want of knowledge and of mastery rather than a fixed pattern based upon the highest common factor of faculty pre-judgments.

The effective teacher of professional men must be responsive to change. There is bound to be obsolescence in the knowledge content and the methods of instruction of the teacher no matter how dedicated he may be. This places grave responsibility upon engineering educators in our universities and schools to keep abreast not only with changing content, but, even more important, with the changing focus and intent of professional engineering education. It would be most unfortunate if past accumulated knowledge were to continue to be the major focus of teaching, rather than the stimulation of a tone of attack in the student to use acquired knowledge to discover what is new both to the student and to the teacher.

The teacher of engineering today must prepare students for a profession facing rapid change. He must create a want for discovery and not be satisfied with a competent transfer of past knowledge and known techniques. He must be ready and able to emphasize the newer contributions of higher mathematics, advanced physics, and many other sciences to the solution of engineering problems. Most of all, he must be truly sympathetic to the needs of his students for the valuable insights which the humanities and social sciences afford to the student who will be seeking to put science to work in human fulfillment.

Therefore, a statement of the goals of engineering education should emphasize what are truly goals and should not attempt standardization in content, period of courses, degrees, or instructional method.

THE EDUCATIONAL PROCESS

THE EDUCATIONAL PROCESS DEPENDS FOR ITS SUCCESS UPON CLOSE INTERACTION BETWEEN TEACHER AND STUDENT. STEPS SHOULD BE TAKEN TO INCREASE THE OPPORTUNITIES FOR THIS INTERACTION TO OCCUR TO PROVIDE THE ESSENTIAL GUIDANCE NEEDED BY THE STUDENT IN MATURING AS AN INDIVIDUAL, DEVELOPING A SENSE OF RESPONSIBILITY AND A WORTHWHILE SET OF VALUES, AND IN BECOMING COMMITTED TO IDEALS AND A COURSE OF ACTION.

During his undergraduate years a student faces the problems of becoming an independent individual, developing a sense and practice of responsibility, establishing worthwhile and stable values, and becoming committed to ideals and a course of action.

In engineering education, technical instruction may be well performed, but this is not the only commitment to be fulfilled. Engineering professors should help more effectively in establishing the total educational climate provided the student by the college.

The close interaction of teacher and student has become more difficult to achieve with the increase in total enrollments, but it is of such fundamental importance that efforts should be undertaken to reverse the trend.

An engineering curriculum should educate men in society as well as in science. Understanding of society is an indispensable, essential attribute of a professional engineer. Courses in the humanities are fundamental elements of professional education.

The growth of the individual and not precise content, should be the focus of all education. An individual's contribution to human fulfillment is the justification of all education, in engineering as much as in any other profession.

A special need of the student of engineering is a growing understanding of human organization, of how organizations are led, and the complexities which size and rapid change create in the organizations of today. It will be made real and specific by the interaction of students with professors who themselves have had experience, to some degree, in the organizations outside the university in which engineering becomes an element in a complex enterprise.

ACCREDITATION

ACCREDITATION OF SCHOOLS OF ENGINEERING IN THE FUTURE MUST BE RE-EXAMINED IN LIGHT OF THE NEED FOR FLEXIBILITY AND DIVERSITY AMONG INSTITUTIONS AND PROGRAMS, STANDARDIZATION BEYOND A MARGINAL LIMIT OF ACCEPTABILITY WILL RETARD RATHER THAN ENHANCE THE QUALITY AND EFFECTIVENESS OF ENGINEERING EDUCATION.

The motivation of the Engineering Education Goals Study would not have been necessary had the engineering profession been content with its present role in relation to society or its effectiveness in producing appropriately educated and trained graduates.

The major elements of educational philosophy so necessary to the future of engineering seem reasonably clear: a willingness to look upon education as the interaction of people and thus as the development of personalities and attitudes as well as professional competence; a realization that the changing nature of our society places the danger of obsolescence more than ever before in the forefront of our concerns and makes mandatory a continuing process of education for the professional person long after his formal education is completed; an attitude of flexibility of approach allowing individual institutions to deal with current needs in many and diverse ways and not according to prescribed patterns; a recognition of how important it is that all efforts be surrounded with a climate of relevance to the society in which we live and for which we plan.

It is unrealistic and unproductive to surround a philosophy of breadth and flexibility with a set of accreditation norms to which every institution is expected to conform. Standardization beyond a marginal limit of acceptability will retard rather than enhance the quality and effectiveness of engineering education.

Each institution should be encouraged to seek those paths most suitable to its own peculiar conditions of existence. It should be encouraged to be bold and daring and innovative within a framework of excellence. The spirit of an institution's efforts is judged to be at least as important as the specific substance of that effort, when a multitude of patterns is allowed to emerge, when every unorthodox approach is looked upon as a form of heresy, when a new willingness emerges to evaluate the results of engineering education in terms of what effect it has in developing people, as well as practitioners.

The final test of how deep and strong a commitment the leaders of the engineering profession have to fulfilling a new and more relevant role in society will come in the degree to which they show their awareness of the shortcomings of present accreditation procedures and their willingness to adapt them to modern necessities.

THE LICENSING PRINCIPLE

TO THE EXTENT THAT THE LICENSING PRINCIPLE REPRESENTS A RESTRICTIVE INFLUENCE ON FLEXIBILITY AND INNOVATION IN ENGINEERING EDUCATION, THE PRINCIPLE ITSELF AND THE LAWS ON WHICH IT IS BASED SHOULD BE REVIEWED AND MODIFICATIONS CONSIDERED BY THE PROFESSIONAL AND TECHNICAL SOCIETIES CONCERNED.

The fundamental objective of the licensing principle and the laws which provide a legal basis for its achievement are the protection of both the public and the engineer against malpractice and misrepresentation. A required minimum level of professional competence is established and measured by standards of training, experience, and examinations.

Today the laws have little relevance to the design of dynamic systems and other significant engineering developments of the past half century. This inapplicability can be measured in part by the lack of acceptance or endorsement by many engineers in both industry and education.

By its established standards and minimum requirements, licensing manifests an incompatibility with experimentation and flexibility in engineering education. It tends to be a restrictive influence on this creative process by encouraging rigidity and adherence to fixed norms.

A broad appraisal should be made of the licensing principle and the licensing laws and their control over schools, courses, and accreditation procedures.

Licensing must not become a limiting influence on the practice of engineering by the truly competent. Consideration should be given to the environment today and in the years to come.

ROLE OF ENGINEERING SOCIETIES

ENGINEERING SOCIETIES SHOULD REVIEW THEIR ROLE IN THE TOTAL SPECTRUM OF ENGINEERING EDUCATION, RESEARCH, AND PRACTICE, AND SHOULD DEVELOP OBJECTIVES AND PROGRAMS RESPONSIVE TO ADVANCES IN TECHNOLOGY AND THE NEEDS OF THE PROFESSION AND SOCIETY.

As advances and changes occur in engineering and in education, it is essential that the engineering societies advance and change accordingly.

It is important that the role of engineering societies keeps pace with advancing technology and education. The older societies should not be so rigid as to encourage the formation of a new organization each time a new area of technology emerges. The needs of 1986 or the year 2000 will be demanding and the societies must anticipate their growing role.

Each society should be encouraged to think through its own programs and objectives and consider how and in what manner it can contribute to the education of its members and to the improvement of its communications with universities, with licensing and accrediting bodies, and with practicing engineers.

LIFETIME LEARNING

LEARNING IS A LIFETIME PROCESS, CONTINUING THROUGH ALL OF THE FORMAL PHASES AND EXTENDING THROUGHOUT THE YEARS OF PROFESSIONAL PRACTICE. IT INCLUDES THE SUM OF ALL EXPERIENCE OUTSIDE THE CLASSROOM AND INSTRUCTION WITHIN. THE GOALS OF EDUCATION SHOULD GIVE RECOGNITION TO THIS PRINCIPLE AND EMPHASIZE THE NEED TO OPTIMIZE A LIFETIME OF LEARNING. SUCH OPTIMIZATION SHOULD CONSIDER BOTH THE EFFECTIVENESS OF THE PRE-COLLEGE PREPARATION AND THE MEANS AND METHODS OF EXTENDING THE POST-COLLEGE EDUCATIONAL PROCESS OVER THE LIFE SPAN OF THE ENGINEER.

In recognition of the need for lifelong learning, a coordinated effort must be made by all concerned to integrate pre-college preparation, the college period, and the years of post-graduate practice into a true continuum of education. Improvement must be stimulated in the means of communication and in the understanding of our cultural heritage, as well as in chemistry, physics, and mathematics. The quality and insights of entering-college students must be improved by developing as much knowledge, understanding and skills as possible in secondary education so that a broader spectrum and a higher level of attainment can be assured in the college curriculum.

Programs must be established to ensure and to facilitate the interchange of ideas between teachers of engineering and practitioners in industry. Arrangements should be made through the cooperation of universities, industry, and the government, as appropriate, for the participation of practicing engineers in university instruction and for the furnishing of teachers with industrial experience.

Pressures today are forcing science and engineering into more intimate association to speed the output of new technology. Engineers must keep abreast of developments in applied science as well as in engineering. Research and development now proceeds at a pace that virtually guarantees obsolescence of an engineering education within the span of a decade. This time period is likely to shorten substantially as the years pass and as technology enters even more pervasively into our daily activities.

In order to maintain existing engineering talents at top efficiency, opportunities and procedures should exist in every technical organization for staff members to keep their knowledge and understanding up to date. Programs of continuing education for the practicing engineer should be encouraged and sponsored by engineering societies, industry, and the universities.

Continued from Page 20

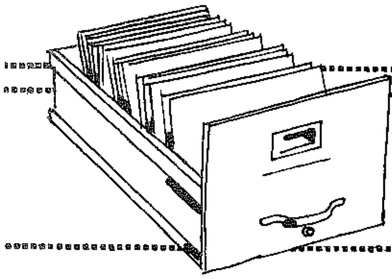
ous components needed to program the problem under consideration.

In conclusion, it has been shown that graphic calculus can be used as an effective tool to demonstrate the basic operations of successive integrations or differentiations. In turn, an analog computer can also be programmed to yield the same results. A problem of the form illustrated is presented to freshman Engineering Drawing students at Southeastern Massachusetts Technological Institute as part of an assignment dealing with Graphic Calculus.

```
0540
BUTNER        MARCHING METH                     FORTRAN SOURCE LIST                          05/26/66
  ISN          SOURCE STATEMENT

   0 $IBFTC MMPLOT  NODECK
   1           DATA BLANK, PLOT/1H ,1H*/
   2           DIMENSION X(25),CHAR(119)
       C       **THE PRECEDING STATEMENT RESERVES MEMORY AREA FOR THE VARIABLES**
       C       ******THESE NEXT TWO STATEMENTS CAUSE THE DATA TO BE READ IN******
   3           READ(5,2)H,A,B
   4         2 FORMAT(3F10.0)
   5           X(1)=0.0
       C       *FOLLOWING ARE THE OUTPUT FORMATS WHICH DESIGNATE THE OUTPUT FORM*
   6           WRITE(6,3)
   7         3 FORMAT(1H1,62X,7HRESULTS)
  10           WRITE(6,4)
  11         4 FORMAT(40H0THE EQUATION BEING SOLVED IS DX/DT+X=20)
  12           WRITE(6,5)
  13         5 FORMAT(46H0THE INITIAL VALUE OF X, X(1), IS GIVEN AS 0.0)
  14           WRITE(6,6)
  15         6 FORMAT(44H0THE INCREMENT USED IN THE SOLUTION WAS 0.05)
  16           WRITE(6,7)
  17         7 FORMAT(1H1,50X,33HPLOT OF SOLUTION (READ FROM SIDE))
  20           WRITE(6,8)
  21         8 FORMAT(19H0VALUES OF T (DOWN),40X,23HVALUES OF X(N) (ACROSS))
  22           WRITE(6,9)
  23         9 FORMAT(1H0,10X,3H0.0,5X,3H1.0,5X,3H2.0,5X,3H3.0,5X,3H4.0,5X,3H5.0,
              15X,3H6.0,5X,3H7.0,5X,3H8.0,5X,3H9.0,4X,3H10.,5X,3H11.,5X,3H12.,5X,
              23H13.,5X,3H14.)
  24           WRITE(6,10)
  25        10 FORMAT(1H ,7X,5H0.0 *,119H......................................................
              3...................................................................
              4..............)
       C       **************IN THIS DO LOOP THE EQUATION IS SOLVED**************
  26           DO 14 I=1,21
  27           J=I+1
  30           X(J)=X(I)*(1.0-H*A)+H*B
  31           T=FLOAT(I)*H
       C       ********THIS DO LOOP IS USED TO PLOT THE SOLUTION FUNCTION********
  32           DO 11 L=1,119
  33           CHAR(L)=BLANK
  34        11 CONTINUE
  36           M=X(J)/0.125+0.5
  37           CHAR(M)=PLOT
  40           WRITE(6,12)
  41           WRITE(6,12)
  42        12 FORMAT(11X,2H .)
  43           WRITE(6,13)T,CHAR
  44        13 FORMAT(1X,F10.2,2H .,119A1)
  45        14 CONTINUE
       C       ****THE LAST TWO STATEMENTS ARE USED TO TURN OFF THE COMPUTER*****
  47           CALL EXIT
  50           END
```

Continued on Page 60



file to file

Many "on the line" teachers have ideas, suggestions, techniques, problems, and questions they would like to share with the society. "FILE TO FILE" provides the place for exchange of professional information. If you have an item for exchange, submit it to "FILE TO FILE," E. D. Black, General Motors Institute, Flint, Michigan.

Dear Prof. Black:

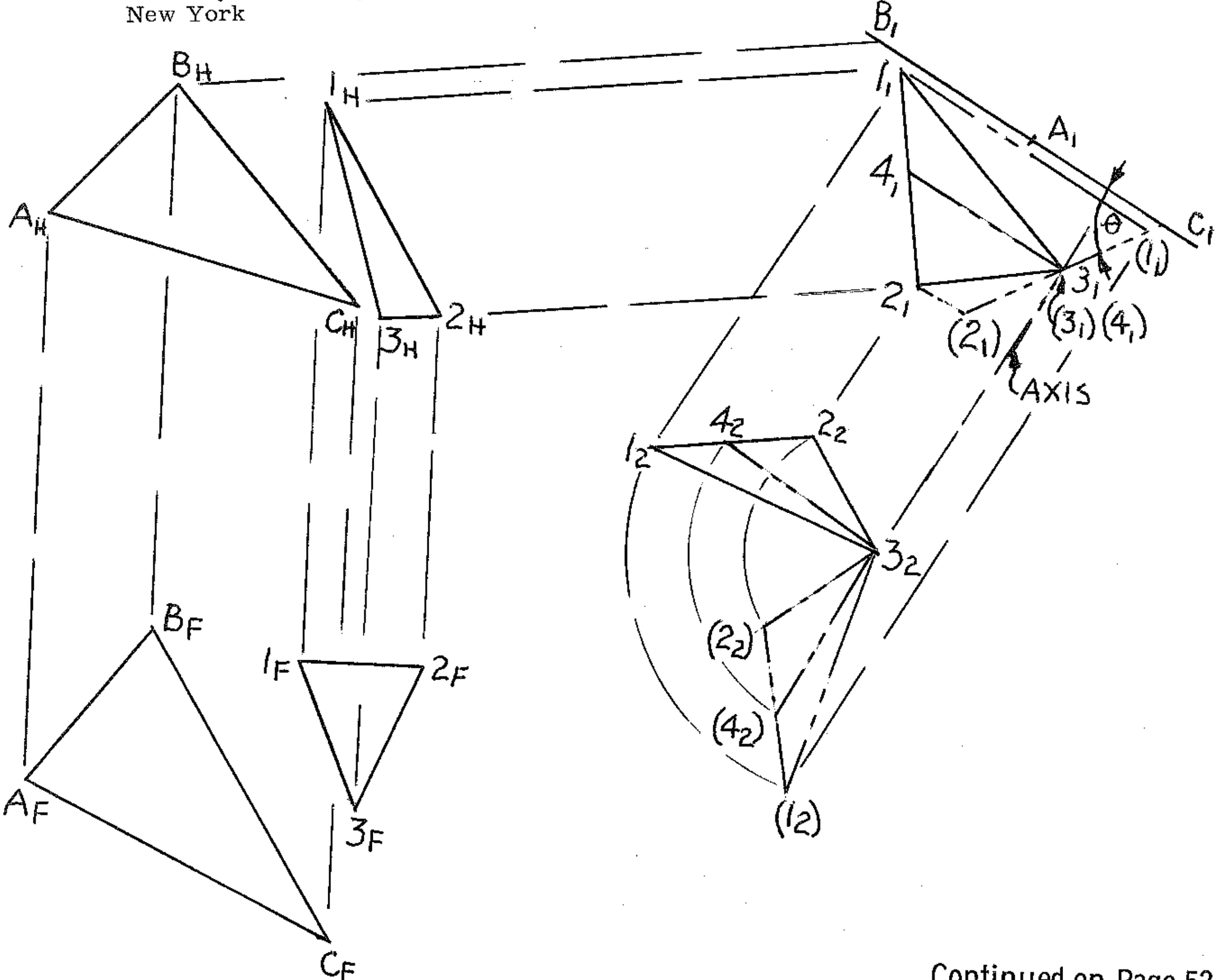
Attached is a copy of a construction that may be of interest to some readers of the Journal of Engineering Graphics. The method does not seem to be known; at any rate, it does not appear in any of the current textbooks on descriptive geometry, as far as I can see.

Finding the DIHEDRAL ANGLE of two oblique planes is always burdensome, especially without having their line of intersection, even with the normal line method. The one described here seems the simplest of all. Details and proof may be left to the reader.

Sincerely yours,
S. T. Halasz
The City College of
The City University of
New York

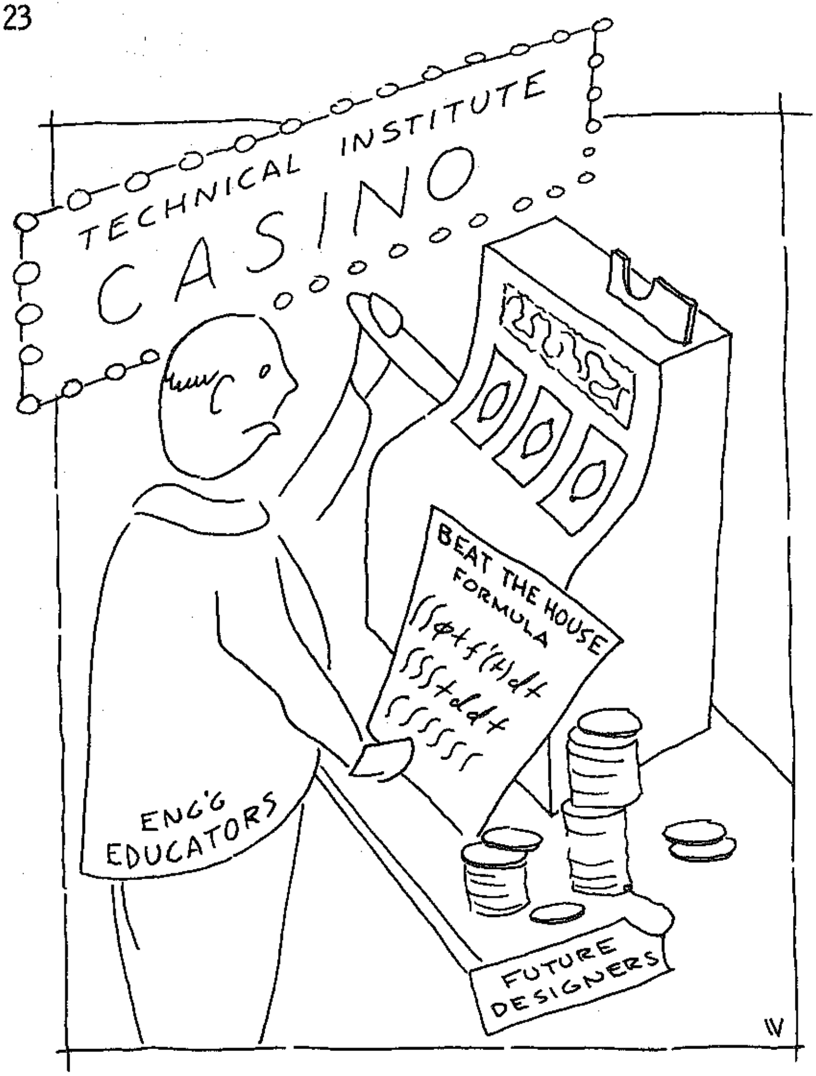
DIHEDRAL ANGLE BY REVOLUTION
LINE OF INTERSECTION NOT KNOWN.

1. Obtain edge-view of one plane, say ABC. Carry other plane 123; draw line 34 in plane 123 parallel to plane ABC and draw axis perpendicular to ABC at a convenient point.
2. In a second auxiliary parallel to ABC draw 123 only; revolve 123 around axis in views "2" and "1" such that line 34 appear in point view in view "1"
3. Measure dihedral angle in view "1" between revolved plane (123) and plane ABC.



Continued on Page 52

Continued from Page 23



"CAN'T UNDERSTAND IT --- I STILL KEEP LOSING"

THE LIFE OF A BUNGLER

Date: Any Time.

Place: Any Where.

"Dear Sir,

When I got to the building, I found that the hurricane had knocked some bricks off the top. So I rigged up a beam with a pulley at the top of the building and hoisted up a couple of barrels full of bricks. When I had fixed the building, there were a lot of bricks left over. I hoisted the barrel back up again and secured the line at the bottom. I then went up and filled the barrel with the left over bricks, and came down and cast off the line.

Unfortunately, the barrel of bricks was heavier than I was and before I knew what was happening, the barrel started down, jerking me off the ground. I decided to hang on, and halfway up I met the barrel coming down and received a severe blow on the shoulder. I then continued to the top, banging my head against the beam and getting my finger jammed in the pulley. When the barrel hit the ground it burst its bottom, allowing all the bricks to spill out.

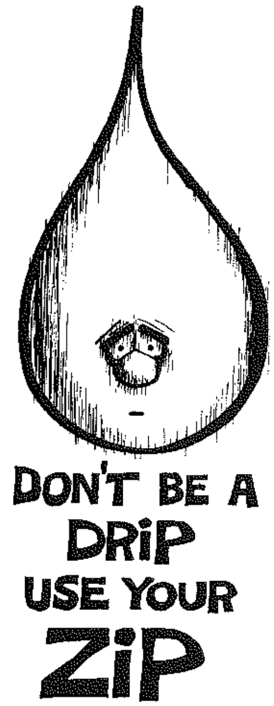
I was now heavier than the barrel and so started down again at highspeed. Halfway down, I met the barrel coming up and received severe injuries to my shins. When I hit the ground, I landed on the bricks, getting several painful cuts from the sharp edges. At this point I must have lost my presence of mind, because I let go of the line. The barrel then came down, giving me another heavy blow on the head which put me in the hospital.

I respectfully request sick leave."

Signed: The Bungler.

Good teaching can be defined in terms of the extent to which students are led to become partners in their own learning.

If there is anything wrong with the address as shown on your mailing label, please correct it and add the ZIP CODE, and return it to Professor James H. Earle, Texas A&M University, College Station, Texas 77840.



Better yet, why not turn to Page 67 of this issue and fill in the form and send it to him with your check for subscription renewal. Anyway, no zips or incorrect zips on your address label may mean a loss of your magazines in the mail.

Continued from Page 4

CAN YOU HELP US WITH THIS REQUEST?

Dear Mr. Black,

Please forgive my presumptuousness in applying to you, but I would be extremely grateful if you would consider giving me some information concerning a drafting publication entitled Drawing & Design Encyclopedia, Louis D. Prior, Inc.

I have endeavored to borrow this book through the National Library in the United Kingdom, but they request more details in order to trace it. The information they require being the name of the publisher, date of publication and current price.

I enjoy reading "Journal of Engineering Graphics."

Yours faithfully,

G. B. Davies
Engineering Research Department
Dunlop Semtex Limited
Drynmawr, Breconshire

WITTICISMS

Failure to examine and interpret ideas in terms of the effect they will have on others is almost criminal.

Today there is a teacher stirring the imagination into the fire that lights up the dreams of youth planting the ideas of character that bloom in great service to mankind.

Setting the stage for a class session usually is easier and produces more effective results than trying to drum learning into the heads of students.

If all problems could be solved by a formula, we could be replaced tomorrow by a computer.

Continued from Page 12

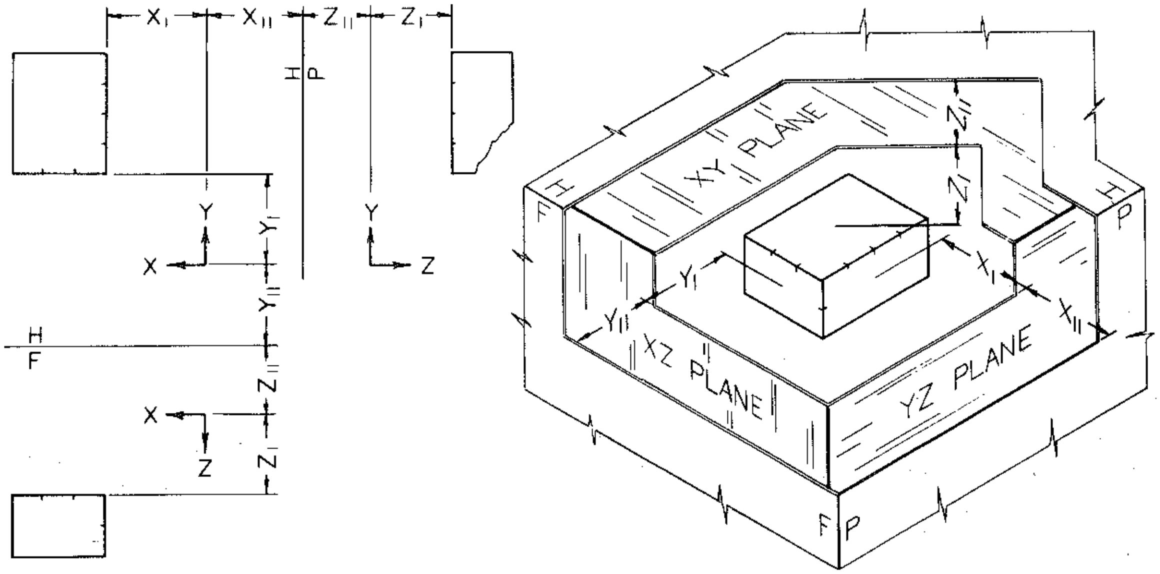


Figure 7 Relative Position of Coordinate Planes, Image Planes, and Object

Coordinate notation must be systematically extendible to successive auxiliary views. For each new auxiliary view a rotation of the coordinate trihedral is necessary. The axes are designated X', Y', and Z' after one rotation; X'', Y'', and Z'' after two successive rotations; X''', and Z''' after three; etc. One of the characteristics of principal view coordinate notation as seen in Figure 6 is the sequence of view designating letters. The sequence of view designating letters is the sequence of views in coordinate notation. The sequence in Arrangement A of Figure 6 is Y, Z, X in the direction front to top to right side; it is X, Z, Y in the opposite direction. The sequence in Arrangement B is X, Y, Z in one direction and X, Y, X in the other. For successive auxiliary views emanating from the front view of Arrangement A the sequence starting with the right side view (View X) would be X, Z, Y, X', Z'', Y''', X'''', etc. The corresponding names of these views in regular notation would be Right Side, Top, Front, 1st Auxiliary, 2nd Auxiliary, 3rd Auxiliary, 4th Auxiliary, etc. Notation for the X' view in this sequence will be developed in detail. See Figure 8. The trihedral rotation is determined by the requirement that the X' axis show as a point directed into the paper in the X' view. The XYZ trihedral is rotated about the Y axis through the angle θ into the position of the X'Y'Z' trihedral. Equations relating the X'Y'Z' system to the XYZ system are developed on Calculations Set No. I.

Figure 9 shows a left auxiliary view corresponding to the right auxiliary of Figure 8. The trihedral rotation angle (θ) in this case is greater than 90 degrees and less than 180 degrees. Equations relating the rotated X'Y'Z' system to the original XYZ system are developed on Calculations Set No. II. Transformation equations for other arrangements of first auxiliary views could be derived similarly. Similar equations for any

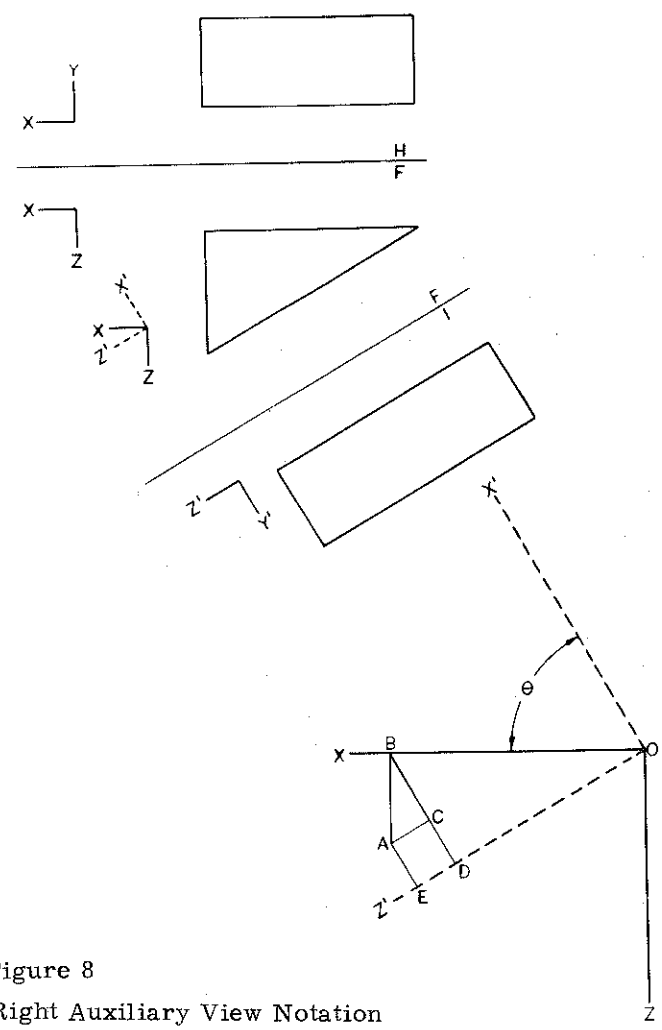


Figure 8

Right Auxiliary View Notation

higher numbered auxiliary view could be written if desired.

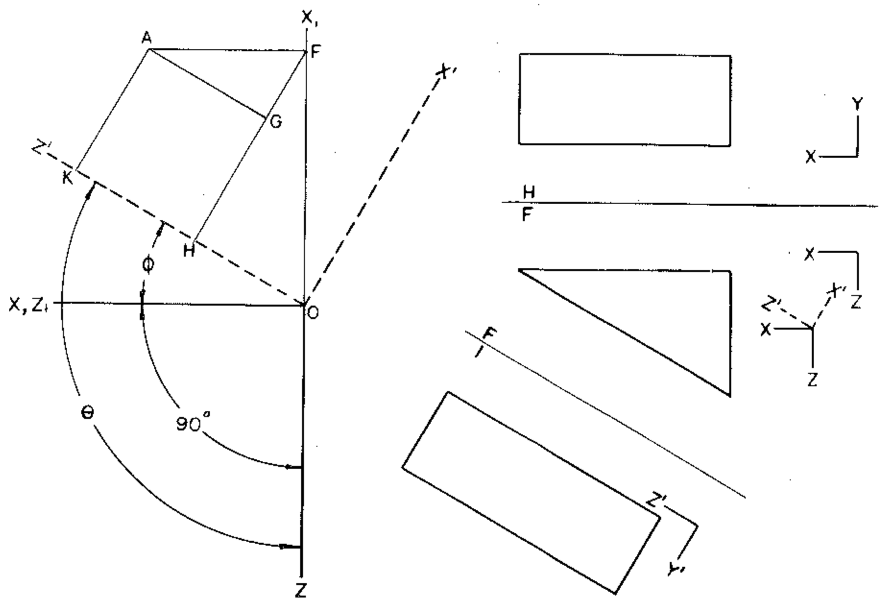


Figure 9 Left Auxiliary View Notation

The coordinate system provides additional language for definitions of terms, statements of problem conditions, and explanations of theory. The languages of solid analytic geometry and vectors become available for use in graphics. Several uses of rectangular components of distance may be seen in Figure 10. Components are illustrated there in conjunction with an additional view solution for true length and true slope of the line segment AB. The use of these components for alternate solutions by revolution or by vector addition may be visualized. The concept of distance components is also useful in pictorial drawing.

The coordinate system facilitates mathematical solutions of descriptive geometry problems. A mathematical solution of the intersection problem shown in Figure 11 is given as an illustration. See Calculations Set No. III. Graphical solutions of many engineering problems are easier than corresponding solutions using symbolic mathematics only. It should be advantageous to graphics to have standardized procedures for mathematical solutions in addition to the well established graphical procedures. If engineering students are shown both methods they will be quick to see and appreciate the difference between the easy way and the hard way.

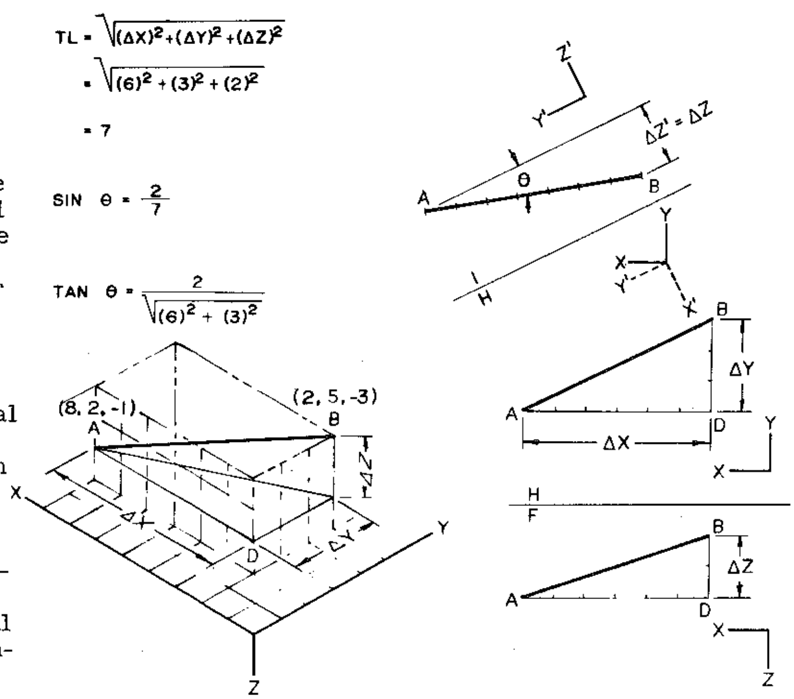


Figure 10 Rectangular Components of Distance

CALCULATIONS SET. NO. 1

(Referenced to Figure 8.)

Let A be a general point in the XZ plane. The coordinates of Point A in the XYZ system are (X, Y, Z); its coordinates in the X'Y'Z' system are (X', Y', Z'). Since the Y axis does not change position in the rotation, Y' = Y.

From Figure 8: $X = OB$ $\quad X' = AE$

$Z = AB$ $\quad Z' = OE$

From triangle ABC: $AC = AB \cos\theta = Z \cos\theta$

$BC = AB \sin\theta = Z \sin\theta$

From triangle BDO: $BD = OB \cos\theta = X \cos\theta$

$DO = OB \sin\theta = X \sin\theta$

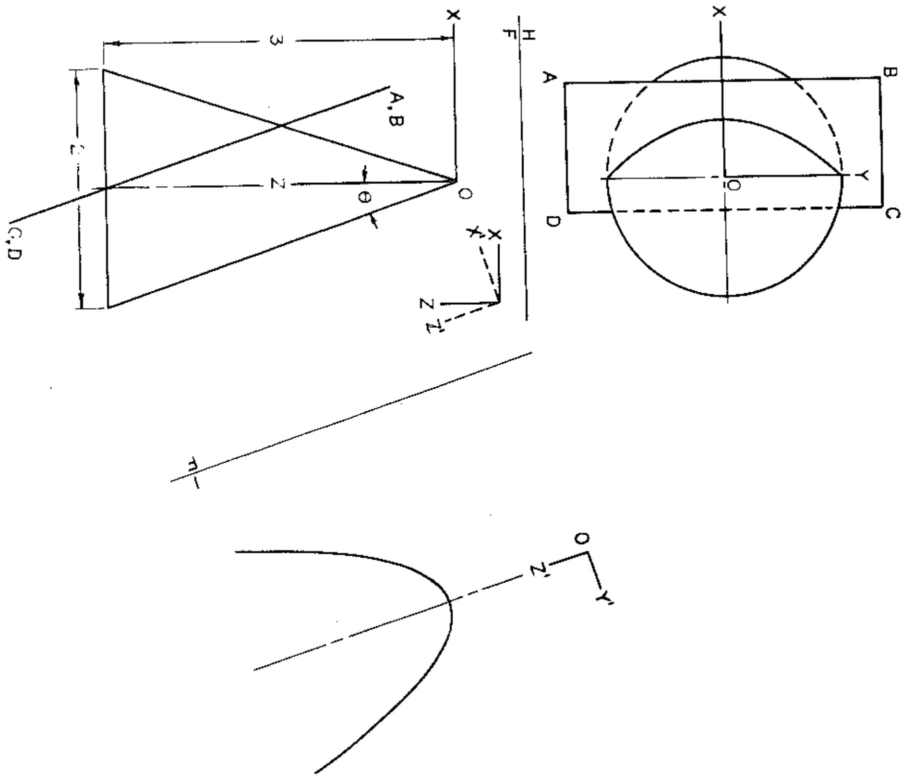


Figure 11 Intersection of Plane and Cone

Expressing X' and Z' as functions of X, Z, and θ:

$$X' = AE = BD - BC = X \cos\theta - Z \sin\theta$$

$$Z' = OE = AC + DO = Z \cos\theta + X \sin\theta.$$

Thus the transformation equations relating the X'Y'Z' system to the original XYZ system are:

$$X' = X \cos\theta - Z \sin\theta$$
$$Z' = Z \cos\theta + X \sin\theta$$
$$Y' = Y$$

CALCULATIONS SET NO. II.

(Referenced to Figure 9)

A is again a general point in the XZ plane. The rotation of the XYZ trihedral will be taken in two steps. It is first rotated about the Y axis through 90^o into an intermediate position designated $X_1Y_1Z_1$. The intermediate equations are: $X_1 = -Z$; $Z_1 = X$; and $Y_1 = Y$. The complete angle of rotation is θ as before. The second step rotation is through the angle ϕ, where $\phi = \theta - 90^o$. The second step rotation is from the $X_1Y_1Z_1$ position to the auxiliary view trihedral position (X'Y'Z').

From Figure 9: $X_1 = OF$ $\quad X' = AK$

$Z_1 = AF$ $\quad Z' = KO$

(For the general Point A)

From triangle OHF: $FH = OF \cos\phi = X_1 \cos\phi$
$HO = OF \sin\phi = X_1 \sin\phi$

From triangle AFG: $AG = AF \cos\phi = Z_1 \cos\phi$
$FG = AF \sin\phi = Z_1 \sin\phi$

Expressing X' and Z' as functions of X_1, Z_1, and ϕ:

$$X' = AK = FH - FG = X_1 \cos\phi - Z_1 \sin\phi$$
$$Z' = KO = AG + HO = Z_1 \cos\phi + X_1 \sin\phi$$

Expressing X' and Z' as functions of θ instead of ϕ:

From trigonometry: $\cos\phi = \sin(90^o + \phi) = \sin\theta$
$\sin\phi = -\cos(90^o + \phi) = -\cos\theta$

$$X' = X_1 \sin\theta + Z_1 \cos\theta$$
$$Z' = Z_1 \sin\theta - X_1 \cos\theta$$

Expressing X' and Z' as functions of X and Z instead of X_1 and Z_1:

(Using the intermediate equations $X_1 = -Z$ and $Z_1 = X$)

$$X' = -Z \sin\theta + X \cos\theta$$
$$Z' = X \sin\theta + Z \cos\theta$$

Rearranging terms and adding the Y' equation:

$$X' = X \cos\theta - Z \sin\theta$$
$$Z' = Z \cos\theta + X \sin\theta$$
$$Y' = Y$$

Note that the transformation equations for the left auxiliary view of Figure 9 are identical to those for the corresponding right auxiliary view of Figure 8.

CALCULATIONS SET NO. III

(Referenced to Figure 11)

The right circular cone has a height of three units and a base of two units diameter.

The plane ABCD has the same slope (θ) as the right extreme element of the cone.

The plane passes through the center of the cone base. The origin is at the vertex of the cone.

The equations for the surfaces written in terms of the XYZ system are:

Cone: $9X^2 + 9Y^2 = Z^2$

Plane: $Z = 3 - 3X$

A simultaneous solution of these equations, eliminating Z, yields the equation for the intersection projection in the top view (Z view).

$$9X^2 + 9Y^2 = (3 - 3X)^2$$

This simplifies to:

$$Y^2 + 2X - 1 = 0$$

θ is the angle of rotation of the trihedral.

$$\cos\theta = \frac{3}{\sqrt{10}} \quad \sin\theta = \frac{1}{\sqrt{10}}$$

The transformation equations are:

$$X = X'\cos\theta - Z'\sin\theta$$
$$Z = Z'\cos\theta + X'\sin\theta$$
$$Y \quad Y'$$

Putting in the particular value of θ these equations are:

$$X = \frac{3X'}{\sqrt{10}} - \frac{Z'}{\sqrt{10}}$$

$$Z = \frac{3Z'}{\sqrt{10}} + \frac{X'}{\sqrt{10}}$$

The equations for the surfaces written in terms of the X'Y'Z' system are:

$$\text{Cone}: 9\left(\frac{3X'}{\sqrt{10}} - \frac{Z'}{\sqrt{10}}\right)^2 + 9(y')^2 = \left(\frac{3Z'}{\sqrt{10}} + \frac{X'}{\sqrt{10}}\right)^2$$

This simplifies to : $8(X')^2 + 9(Y')^2 - 6X'Z' = 0.$

Plane: $X' = \frac{3}{\sqrt{10}}$

A simultaneous solution of these two equations yields the equation for the intersection projection in the auxiliary view (X' view).

$$8\left(\frac{3}{\sqrt{10}}\right)^2 + 9(Y')^2 - 6\left(\frac{3}{\sqrt{10}}\right)Z'$$

This simplifies to:

$$(Y')^2 \frac{2}{\sqrt{10}}Z' + \frac{8}{10}.$$

This is the equation of the parabala in the auxiliary view.

Continued from Page 16

building, local building codes and zoning ordinances, blue line paper, used in this office for all final prints in size 24 x 36 inches, blue lined grid sketch paper, bought in 18 inch by 50 yard rolls, T-square or parallel rules and triangles (drafting machines were mentioned as not commonly used in architectural work), templates for circles, hexheads, lettering guides, ships' curves, pencils in H and F grades, pink pearl erasers, and stainless steel erasing shields.

In the architect's office the employee must possess skill with his tools. His line work must be clean and dark. He must be able to organize a set of drawings as to what views are required, where on the paper, on what sheets, and where in the set of drawings. He should be able to produce all of the architect's sheets such as the plot plan, foundation plan, floor details, exterior elevations, sections through the building, roof plan, roof framing plan and details, interior elevation, room finish schedule, door schedule and details, window schedule and details, electrical plan, and others, all in a clear, concise, neat and accurate fashion. This requires a knowledge of construction materials, structural elements and their identification, a good working knowledge of construction details, architectural perspectives done in freehand and mechanical, reproduction processes, and some facility in freehand sketching and ink work. He must also be familiar with dimensions affecting humans such as door sizes, the appropriate height and location of electrical switches, and counter heights.

It was suggested that models of typical construction practices and details in framing, rafters, studs, reinforcing, and floor sections should be available to students in the drafting rooms. They should be encouraged to visit actual construction

Continued on Page 54

Continued from Page 26

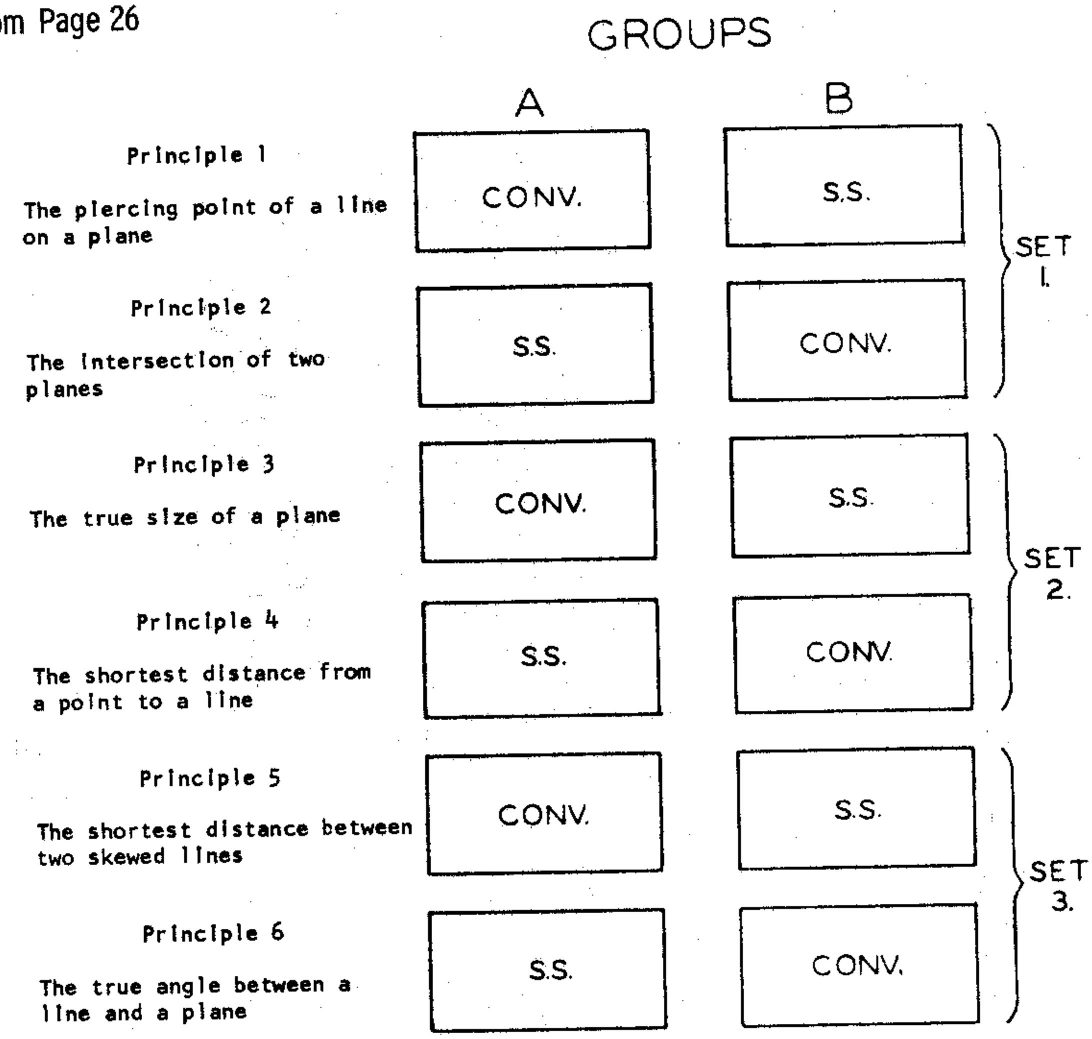


FIGURE 2

THE COMPOSITION OF THE THREE SETS

order 1, 3, 5 and 2, 4, 6. Since the principle order 1, 3, 5 is associated with the higher mean of 85.20, it is assumed that the students experienced less difficulty with these problems and that the appropriate sequence of course offering was observed.

The analyses to determine the accuracy with which the students scored their own work are shown in Table IV. This table indicates that on five of the six individual principles, the students could be trusted to score their work and accurately report these scores.

The overall analysis of student accuracy, shown in Table V, indicated that the students were accurate in reporting scores.

Table VI shows the statistical results obtained in determining which of the two techniques could be scored in less time. The most important part of this analysis is seen in the F ratio of 148.14 for technique. This ratio indicates a very highly significant difference between the lengths of time required to score a replication of self-scoring devices and a replication of conventional devices. Inspection of the means shows that the self-scoring device could be scored in less time.

The F ratio of 21.76 for Graders suggests that some of the graders were faster than others. The F ratio of 15.76 for Principle indicates that some of the principles could be scored in less time than others. The F ratio of 13.18 for Replications implies that some of the replications required more time to complete than others. The F ratio of 4.52 for the Grader-Technique interaction suggests that improvement in time due to technique varies from one grader to another. The F ratio of 2.75 for the Principle-Technique interaction indicates that gains in speed due to technique varies with the principle being scored as well as with the grader scoring the principle.

Toward the end of the experiment, the author became curious about how the students had

TABLE I

THE ANALYSES OF THE SIX SETS OF DATA

	Source	d.f.	Sums of Squares	Mean Square	F	Mean		Standard Dev.		Number	
						Conv.	S.S.	Conv.	S.S.	Conv.	S.S.
Principle 1	Total	221	194,951.36			83.6	84.4	31.70	28.01	120	102
	Technique	1	34.34	34.34	.038						
	Error	220	194,917.02	885.99							
Principle 2	Total	250	139,252.07			78.9	82.8	28.53	18.82	141	110
	Technique	1	906.23	906.23	1.63						
	Error	249	138,345.84	555.60							
Principle 3	Total	234	130,713.02			82.9	85.2	25.15	22.42	103	132
	Technique	1	290.00	290.00	.518						
	Error	233	130,423.02	559.75							
Principle 4	Total	224	145,816.00			81.1	89.1	28.48	20.86	104	121
	Technique	1	3,633.54	3,633.54	5.70*						
	Error	223	142,182.46	637.59							
Principle 5	Total	265	103,292.65			83.9	91.2	27.06	19.45	132	134
	Technique	1	2,402.28	2,402.28	6.28*						
	Error	264	100,890.37	382.16							
Principle 6	Total	246	185,530.37			79.4	86.7	30.03	23.50	112	135
	Technique	1	3,292.28	3,292.28	4.43*						
	Error	245	182,238.09	743.83							

received the new idea of self-scoring descriptive geometry problems. To ascertain student consensus of the two techniques of presentation, a five-item questionnaire was designed for and distributed to the students for their completion. Figure 3 shows the five items and a compilation of the students' responses.

Summary

This study was designed to test the effectiveness of two self-instructional techniques for use in teaching engineering descriptive geometry. Only one of these techniques, however, offered immediate reinforcement to learning as recommended by Pressey (3:75).

It was found that the students in this study generally benefited by using the self-scoring instruments as a means of out-of-class preparation. This beneficial effect was reflected by the scores taken from assignments completed by the students in class. Further, an overall analysis indicated that students could be trusted to score their own assignments and report these scores accurately. Finally, it was shown that the self-scoring device required less time to evaluate than did the conventional.

Recommendations

It is recommended that further work be done to confirm or disprove the findings of this study. If further research should show that the self-instructional technique described in this study is not feasible or as efficient as indicated by the data presented herein, it is recommended that other methods of self-instruction be explored. These methods should, however, be designed to

TABLE II

THE ANALYSES OF THE THREE LATIN SQUARES

Source	d.f.	Sums of Squares	Mean Square	F	Means: Conv.	S.S.	Prin. 1	Prin. 2	Group A	Group B
Technique	1	651.65	651.65	.91						
Principle	1	1,170.85	1,170.85	1.63	81.25	83.60	84.00	80.85	83.20	81.65
Group	1	283.49	283.49	.39						
Error	469	336,234.54	717.11							
Technique	1	3,050.08	3,050.08	5.12*			Prin. 3	Prin. 4		
Principle	1	126.78	126.78	.21	82.0	87.15	84.05	85.10	86.00	83.15
Group	1	934.09	934.09	1.57						
Error	456	271,867.84	596.20							
Technique	1	6,821.12	6,821.12	10.57**			Prin. 5	Prin. 6		
Principle	1	10,287.00	10,287.00	15.94**	81.65	88.95	87.55	83.05	85.30	85.30
Group	1	0	0	0						
Error	509	328,427.94	645.20							

TABLE III

THE OVERALL ANALYSIS OF STUDENT PERFORMANCE

ANALYSIS OF VARIANCE

Source	d.f.	Sums of Squares	Mean Square	F
Technique	1	8,798.638	8,798.638	13.47
Group	1	777.405	777.405	1.19
Order	1	3,040.215	3,040.215	4.65*
Set	2	2,155.357	1,077.678	1.65
Tech-Set	2	1,484.707	742.357	1.14
Group-Set	2	498.177	249.088	.38
Order-Set	2	728.422	364.211	.56
Error	1,434	936,620.320	653.152	

	Conv.	S. S.	Order 1,3,5	Order 2,4,6
Number	721	725	723	723
Mean	81.58	86.56	85.20	83.00

TABLE IV

THE ANALYSIS OF STUDENT ACCURACY WHEN SCORING THE SIX PRINCIPLES

Principle	Students' Mean Score	Standard Mean Score	Mean Difference	Number	Std. Dev.	t
1	78.41	78.23	:178	102	12.85	.14
2	82.94	83.82	.888	141	10.54	1.00
3	92.36	89.93	2.431	132	9.15	3.05**
4	90.20	90.43	.221	157	4.39	.63
5	90.79	91.16	.375	160	5.27	.90
6	89.27	89.84	.573	153	4.63	1.53

TABLE V

THE OVERALL ANALYSIS OF STUDENT ACCURACY WHEN REPORTING SCORES

Students' Mean Score	Standard Mean Score	Mean Difference	Number	Std. Dev.	t
87.94	87.66	.286	845	8.81	.98

TABLE VI

THE ANALYSIS TO DETERMINE WHICH TECHNIQUE CAN BE SCORED IN LESS TIME

Source	d.f.	Sums of Squares	Mean Square	F
Total	191	417.51		
Grader	3	51.17	17.06	21.76***
Principle	5	62.33	12.47	15.76***
Technique	1	116.11	116.11	148.14***
Replications	3	31.00	10.33	13.18***
Gdr*Princ	15	16.95	1.13	1.44
Gdr*Tech	3	10.63	3.54	4.52**
Gdr*Rep	9	5.99	.67	.85
Princ*Tech	5	10.76	2.15	2.75*
Princ*Rep	15	10.69	.71	.91
Tech*Rep	3	.79	.26	.34
Gdr*Princ*Tech	15	33.26	2.22	2.83*
Gdr*Princ*Rep	45	23.48	.52	.67
Gdr*Tech*Rep	9	2.78	.31	.39
Princ*Tech*Rep	15	6.25	.42	.53
Error	45	35.27	.78	

relieve an instructor of the monotonous tasks of lecturing, drilling, and grading repetitious exercises (6:120).

Bibliography

BIBLIOGRAPHY

1. American Society for Engineering Education Combined Committee on Programmed Instruction, "A Report on Programmed Instruction." The Journal of Engineering Education. 53:118-123, October, 1962.

2. Earle, James H., "An Experimental Comparison of Three Self-Instruction Formats for Descriptive Geometry," Unpublished Doctor's dissertation, Texas A&M University, College Station, 1963.

3. Press, S. L., "All About Teaching Machines In One Easy Filmstrip," Contempory Psychology. 6:75, May, 1961.

4. Rising, James S., "Course Content in Basic Engineering Graphics," The Journal of Engineering Graphics, 23:32-34, November, 1958.

5. Svensen, C. L. and W. E. Street, Engineering Graphics, Princeton, New Jersey: D. Van Nostrand Company, Inc., 1962.

6. Williams, E. M., "Some Experiments With Programmed Materials," The Journal of Engineering Education, 52:557-560, October, 1962.

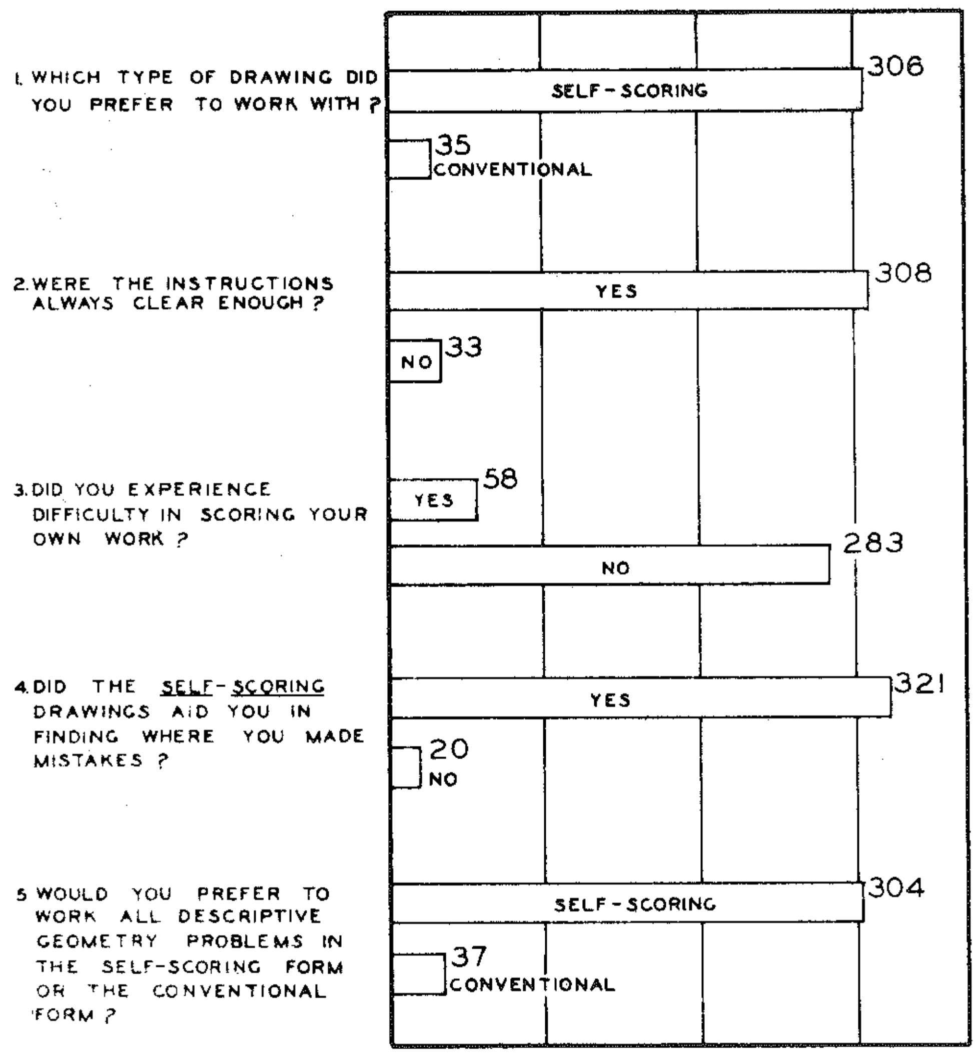


FIGURE 3

THE SUMMARY OF STUDENT OPINION
OF THE TWO TECHNIQUES

A complete program for engineering graphics

Textbook

FUNDAMENTALS OF THREE-DIMENSIONAL DESCRIPTIVE GEOMETRY

by STEVE M. SLABY, Princeton University

Published last Spring and already in wide use in technical institutions, colleges, engineering schools, and universities throughout the country, this textbook presents the basic concepts of three-dimensional descriptive geometry and, in a logical and sequential manner, shows their practical applications through orthographic examples and construction programs. Color is used—for the first time in a descriptive geometry text—to clarify relationships among lines and to identify planes in constructions. Distorted labels maintain a consistent three-dimensionality throughout the illustration program. Sample quizzes and examinations and 135 practice problems reinforce the text presentation. "The best text on descriptive geometry yet to be published."—R. Kenneth Jacobs, Georgia Institute of Technology.

383 pages, $7.50

Instructor's Manual

INSTRUCTOR'S MANUAL AND SOLUTIONS

Presents a course syllabus, lecture outlines, and solutions to all the problems in the textbook. Available to instructors who have adopted FUNDAMENTALS OF THREE-DIMENSIONAL DESCRIPTIVE GEOMETRY for basic class use. Just published

3 Workbooks with Solutions Manuals

WORKBOOK FOR FUNDAMENTALS OF THREE-DIMENSIONAL DESCRIPTIVE GEOMETRY

by STEVE M. SLABY and H. SANFORD GUM, College of San Mateo.

Contains problems derived from the text, with a detachable transparent sheet of grid-lined paper bound between each page on which the student can sketch his preliminary solution. Grid-lines are printed in the same color used in the textbook. Separate Solutions Manual in preparation. Spiralbound. 72 sheets with 96 drawings, plus overlays. $5.95

ENGINEERING PROBLEMS FOR FUNDAMENTALS OF THREE-DIMENSIONAL DESCRIPTIVE GEOMETRY

by H. LANE CALENDAR and W. J. BROWN, Rutgers University.

With Solutions Manual. Publication: January, 1967

APPLIED PROBLEMS FOR FUNDAMENTALS OF THREE-DIMENSIONAL DESCRIPTIVE GEOMETRY

by ROBERT SEID, Bronx Community College of the City University of New York.

With Solutions Manual. Publication: Spring, 1967

These new workbooks, together with the one by Professors Slaby and Gum which was published with the text, give the instructor a wide choice of problems for use with FUNDAMENTALS OF THREE-DIMENSIONAL DESCRIPTIVE GEOMETRY. The ENGINEERING PROBLEMS by Professors Calendar and Brown provides practical problems, including some that introduce vector notation and operations. It also discusses some topics—topology, for example—that are not covered in the text. The APPLIED PROBLEMS by Professor Seid contains simple problems illustrating particular theories, followed by problems involving practical applications of the theory in engineering terms. The workbook by Professors Slaby and Gum offers problems that work out more purely theoretical concepts.

EXAMINATION COPIES ON REQUEST.

Harcourt, Brace & World, Inc.
New York / Chicago / San Francisco / Atlanta

4 important books in the field from... Barnes & Noble

1. Engineering Descriptive Geometry

78 Examples with Complete Solutions. 139 Problems including Answers or Suggestions. Diagrams Drawn to Scale on Cross-Section Paper.

by Steve M. Slaby. "The style is simple and uncomplicated. It is geared to the needs of the average college student and is well organized. Drawings are unusually clear, uncluttered, and admirable in every way. . . .It would make a welcome addition to the shelves of the high school teacher of solid geometry."--*Mathematics Teacher*

"Presenting the basic principles of descriptive geometry in clear, annotated pictorial representations followed by graphic examples."--*Science News Letter*

Paperback $2.50

2. Engineering Drawing

Basic Principles and Rules with Problems & Tables ASA Standard Drawings & Drafting Room Practice

by Lombardo, Johnson, Short and Lombardo. "The purpose of this text is to provide a comprehensive, practical guide that will aid the student to master the essentials of engineering drawing. The text is designed to introduce him to develop working skill and efficiency."--*Design News*

"Should prove useful not only to the student, but also to the engineer wishing to refresh his memory on a particular point."--*Engineering Journal*

Paperback $2.50

3. Technical Writing

A Guide to Manuals, Reports, Proposals, Articles, etc., in Industry & the Government

by Richard W. Smith. Written for the embryo technical writer with heavy emphasis placed on the industrial aspects of the subject giving broad application to the engineering field. It includes -- useful chapters on "The Mechanics of the Trade," a comprehensive bibliography; an appendix entitled "Are You Ready to Write" offering review examination that covers basic grammar rules and skill in expository writing, with answers and explanations.

"It's an excellent summary of the whole field, which includes many areas of technical writing that most books neglect."--*James Stokley, Michigan State University*

Paperback $1.25

4. Thinking With a Pencil

With 692 Illustrations Showing Easy Ways to Make and Use Drawings in Your Work and in Your Hobbies

by Henning Nelms. This work begins with drawings which are so simple that they require no skill at all. Each chapter prepares the reader for the next and at the same time provides an effortless review of the material already studied. The reader learns to draw by making drawings that he can use. The formal practice required by other approaches to drawing is almost entirely eliminated.

"In my opinion your book would definitely be a valuable addition to any engineering student's library. Any medium which helps an engineer to convey his ideas to another person is without question a vital and necessary part of an engineer's education."--*Steve M. Slaby, Princeton University*

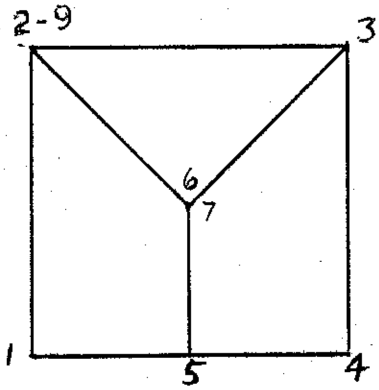
Paperback $1.95

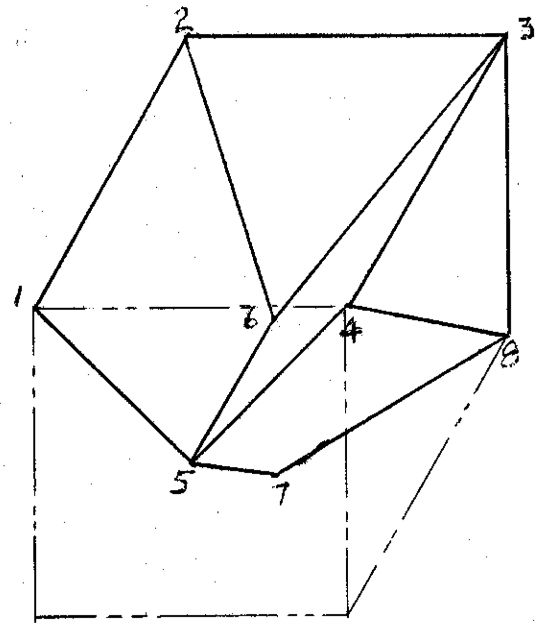
Free examination copies of paperbacks are available to instructors

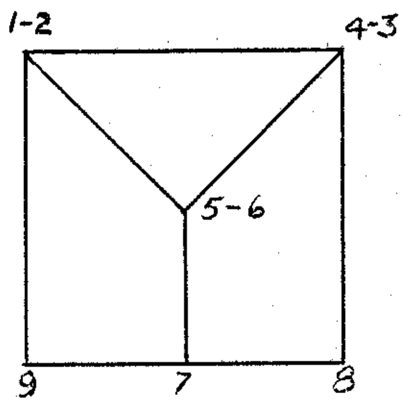
Barnes & Noble, *Inc.* 105 Fifth Avenue, New York 3, N.Y.

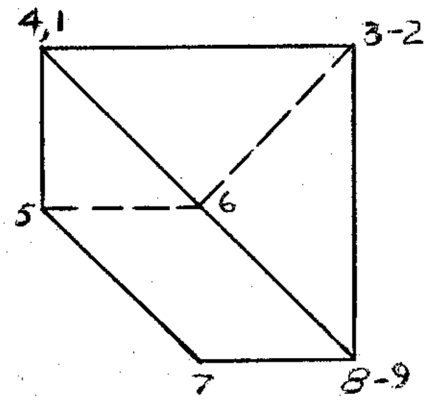
Continued from Page 38

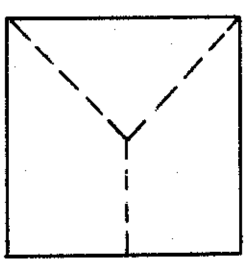
FILE TO FILE

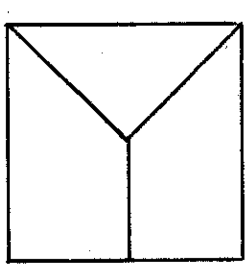


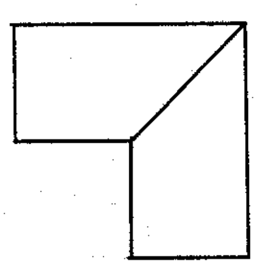


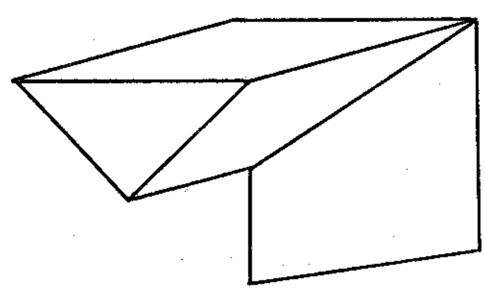












Frederick Halsall

Continued on Page 59

Eclipse a Lietz ellipse?

Never!

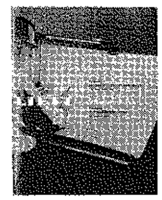
Or so the experts tell us.

Lietz ellipse templates have mathematically calculated, precision-engineered cutouts (10° to 80° in 5° increments). Come in ⅛″ to 4″ sizes. Rate among the finest in the field. So it's natural that the real pros — and serious students, too — insist on Lietz to keep their drawings sharp and accurate.

And ellipses are just part of our line. We're also very large in circles, squares, triangles, and dozens of others (we're not called Template Headquarters, U.S.A. for nothing).

Day in and day out, Lietz templates set the standard in countless industries: Civil and mechanical engineering; processing; construction; architectural; electronics. You name it — Lietz is there with a template.

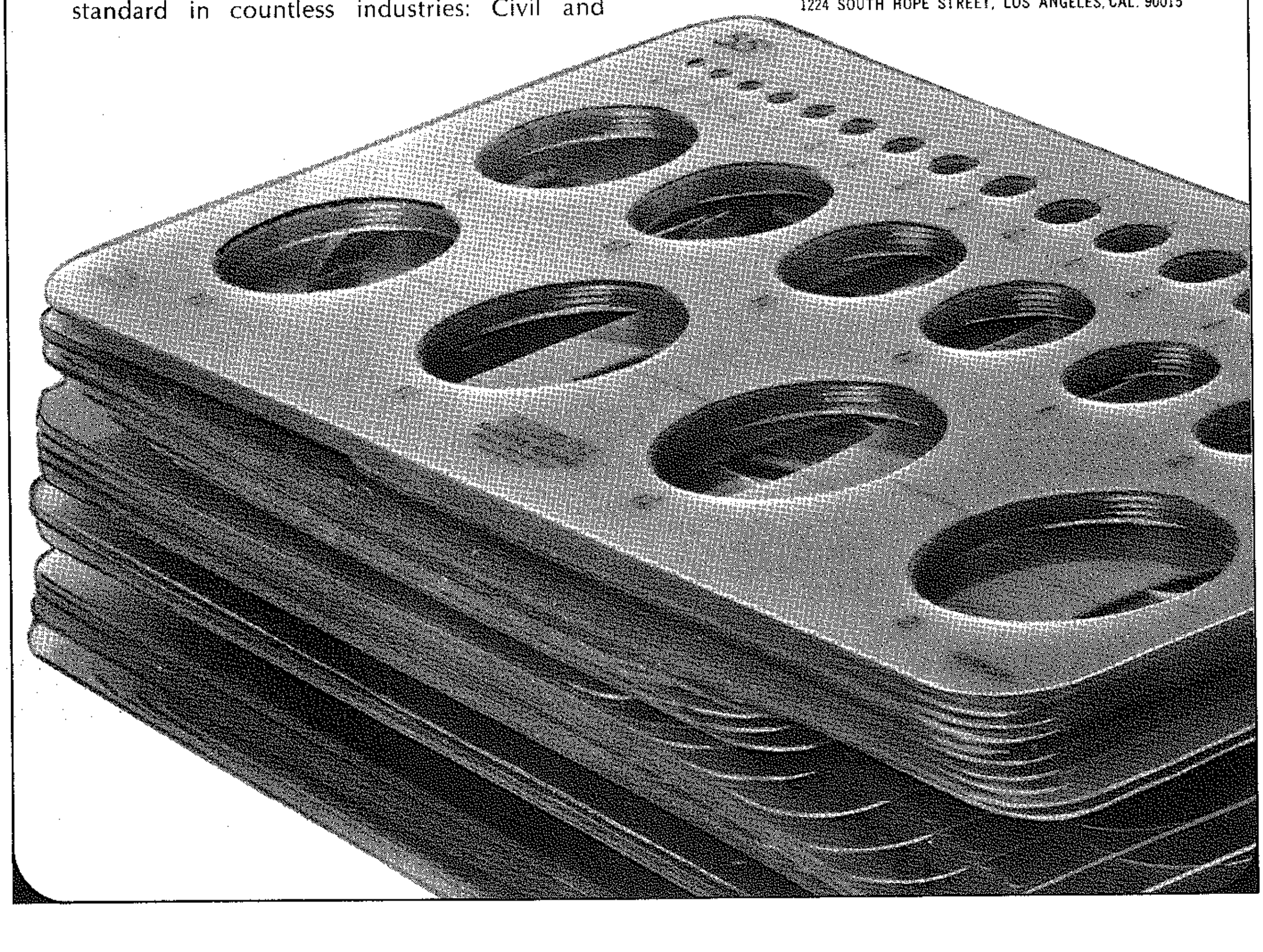
If you're not now acquainted with our product, we'd be pleased to send you a copy of our complete template line catalog with all the facts and figures. Write Dept. 51—EG



LIETZ

THE LIETZ COMPANY

330 COREY WAY—SOUTH SAN FRANCISCO, CAL. 94080
1224 SOUTH HOPE STREET, LOS ANGELES, CAL. 90015



Continued from Page 44

jobs and to ask questions about what they observe. Requiring each student to check another student's completed drawings was also suggested as a simple method of gaining experience in the checking of drawings.

Prints that had resulted in the construction of buildings were distributed for the teachers to study and keep. While the plans were out before the teachers, the sheets were explained as to what is there, why it is there, and how it was drawn.

The role of graphics in the electronics industry was covered in Lectures 7 and 8. Graphics was described as the language of the industry, and an important means of communication of ideas. The symbols and terminology used in electronic drafting are greatly influenced by military specifications since much of the advanced equipment produced is made for government consumption. To work in the electronics industry a draftsman must have a good understanding of mechanical drafting, be motivated to work in electronics, know and understand symbols, components, and their function, and be familiar with military and other standards.

Miniature electronic devices and components were displayed and passed around while they were identified and their function described. Some of the components were disasembled, and drawings that had been used in their production were distributed and examined. Printed circuit boards in various stages of completion were discussed, the steps in their fabrication was explained, and the use of black tape to make a negative for a printed circuit board was demonstrated. References and sources of additional information on electronic drafting techniques were cited and displayed for examination.

Graphics in the petroleum industry was the object of a field trip to a drafting department of the Shell Oil Company. Here the class split up into three smaller groups to encourage more individual participation. The groups rotated between the lecturers so as to be exposed to the maximum possible amount of material.

To function in an oil industry drafting department, an individual must become familiar with oil field operations, vocabulary, equipment, geology, and mapping. Special equipment must often be designed, maps are frequently required, and art work for displays or presentation may occasionally be produced. Drawings in this office were almost always inked on plastic film with a rapidograph pen. All lettering was done with templates to ensure uniformity, and to permit changes to be made by any draftsman without having two styles of lettering appear on a drawing. A portable parallel rule was frequently used.

The tenth lecture was devoted to the function of graphics in recording and presenting the results of a land survey. A set of prints from professionally drawn material was distributed to each teacher and the steps required to produce a report of survey were described. A survey is required whenever a new property line is to be drawn, and the report which is filed begins with the collection of all existing information on the property such as old field notes, courthouse records, old surveys, title reports, and deeds. This material is collected and turned over to a draftsman who transfers it to a "hard copy" done in pencil on vellum. Prints of this accompany the surveyor into the field to assist him in making his new field notes which will again be turned over to the draftsman to prepare the final map to be filed in the county office. The finished map is inked with a rapidograph pen on 13 x 18 or 18 x 26 inch vellum. There are no rigid requirements as to how the map should look, other than the usual requirements of neatness, legibility, and accuracy. Map scales depend on the area mapped and the size of the paper but are usually in the neighborhood of 1" = 100' or 1" = 400'.

Sub-division plans may also be requested of a surveyor's office. These begin with a feasibility study that includes a rough topographical map to check slopes and drainage, an investigation of present and proposed zonings of the property, a title report of easements, incumberances, and mineral rights, the availability of utilities, and a geologic report on the composition and stability of the ground. If the feasibility study is well received, the draftsman will lay out lots on a sub-division drawing over an aerial topographic survey. The finished sub-division map is then offered to the planning commission for approval. If the approval is given, a complete set of plans including a plot plan, grading plan, water plan, sewer plan, and improvement plan are produced.

To be employed by an office that produces work suchas this, an individual must have skill with the pen, T-square and triangles, and be able to work comfortably with mathematics through trigonometry to interpret the surveyor's field notes.

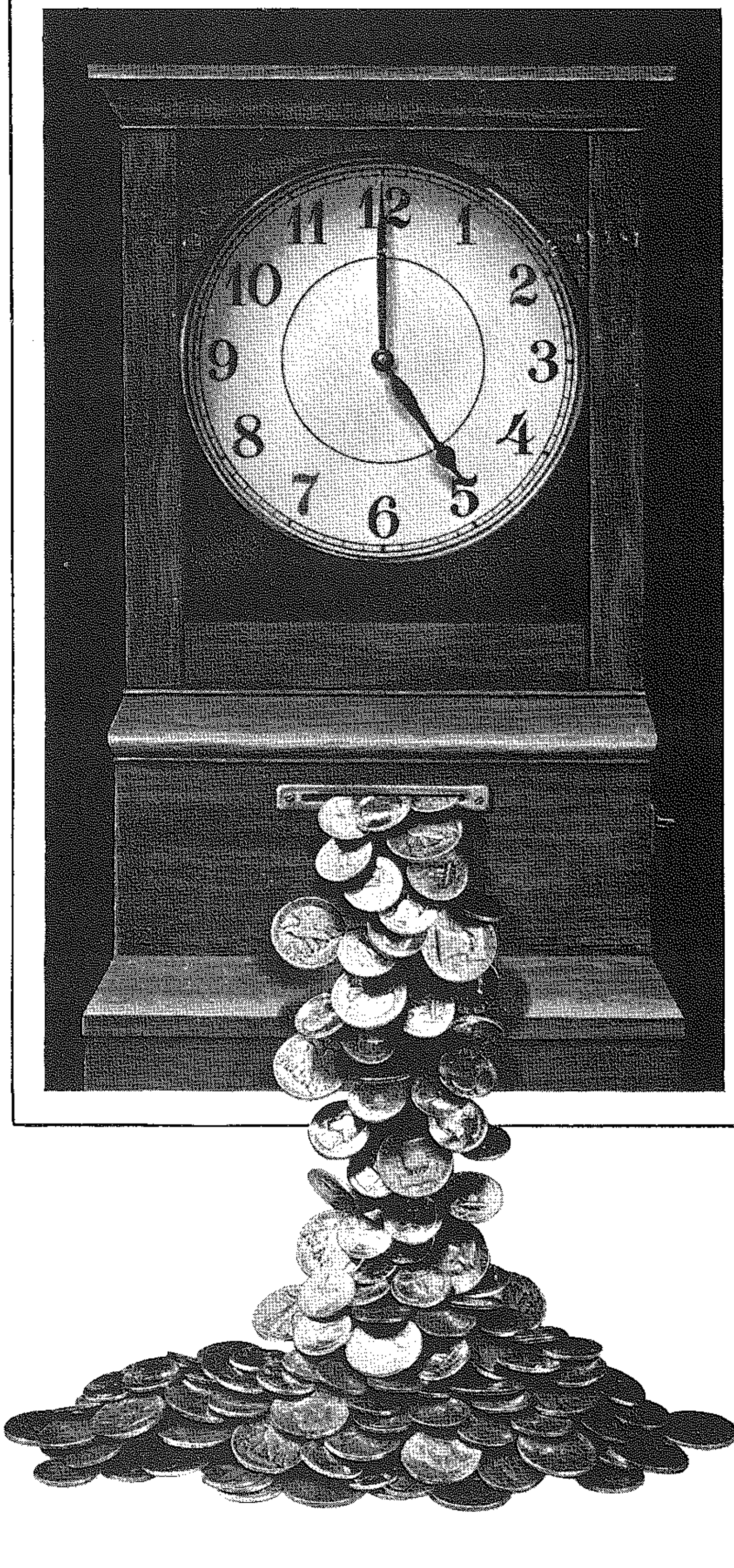
In the final pair of lectures attention was directed to the importance of the graphic arts to our economy. Their importance lies in the fact that before the sale of an industrial item can take place, the graphic arts have had a part in the planning, and in the initial proposals prior to the manufacture and sale of the item.

Flip charts were used to demonstrate their function and to present the five areas of the graphic arts as line illustration, lettering, technical illustration, air brush work, and illustrative rendering.

Line illustration accounts for the greatest percentage of the work load in industrial art. This consists of charts, graphs, schematics, pasteups, and tracings. It is usually accomplished with colored tape, crayons, paints, or ink and speedball pen, and requires the least amount of education and artistic ability.

Continued on Page 59

Mr. Bruning's more expensive sepia paper pays off every day at 5!



Why? Because it's from 28 to 52 percent faster than any other paper you can use.

And faster sepias pay off in three ways:

1. Faster papers mean less operator time at the machine.
2. Faster papers mean increased production.
3. Faster papers give your operators much greater latitude in operating conditions to produce perfect prints. Wastage takes a nosedive.

Because Mr. Bruning's new sepia paper is so much faster, your operator can often switch from making blueline prints to sepias without having to adjust machine speed.

What else do you get? Superior drafting and eradication qualities. If you haven't tried Mr. Bruning's faster sepia, you'll be surprised at its ability to take pencil or ink revisions—and then maintain high legibility through various generations of prints.

Are we knocking our less costly sepia? Not one bit. It's a top-quality paper in its own right—just not as fast. Moral: people interested in profits buy value, not just price.

The Bruning man will stand behind everything we've said. Make him prove it—with a demonstration in your own shop. Give him a call. By now, you probably even know his home phone number.

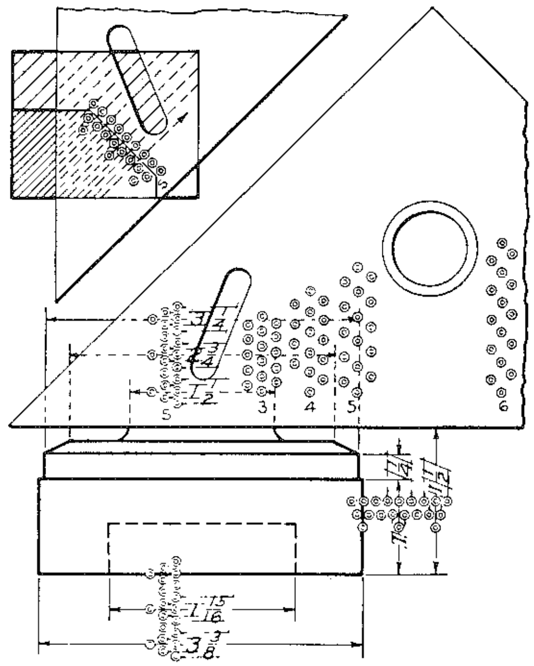
Bruning
DIVISION OF
ADDRESSOGRAPH MULTIGRAPH CORP

BRADDOCK LETTERING ANGLES

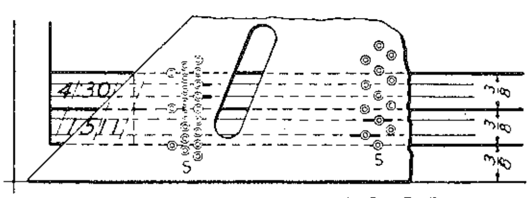
VERSATILE LETTERING TRIANGLES FOR

SYSTEMATIC DIMENSIONING
UNIFORM LETTERING

ACCURATE SPACING
PRECISE DRAWING



SYSTEMATIC DIMENSIONING



LAYING OUT TITLE STRIP

Style "A"

5"-60
6"-60
7"-60
8"-60
9"-60
4"-45
5"-45
6"-45
7"-45
8"45

6"-45 Brd.-Rowe

8"-45 Style "C"

Style "B"

5"-60
6"-60
7"-60
8"-60
9"-60
4"-45
5"-45
6"-45
7"-45
8"-45

6"-45 Brd.-Rowe

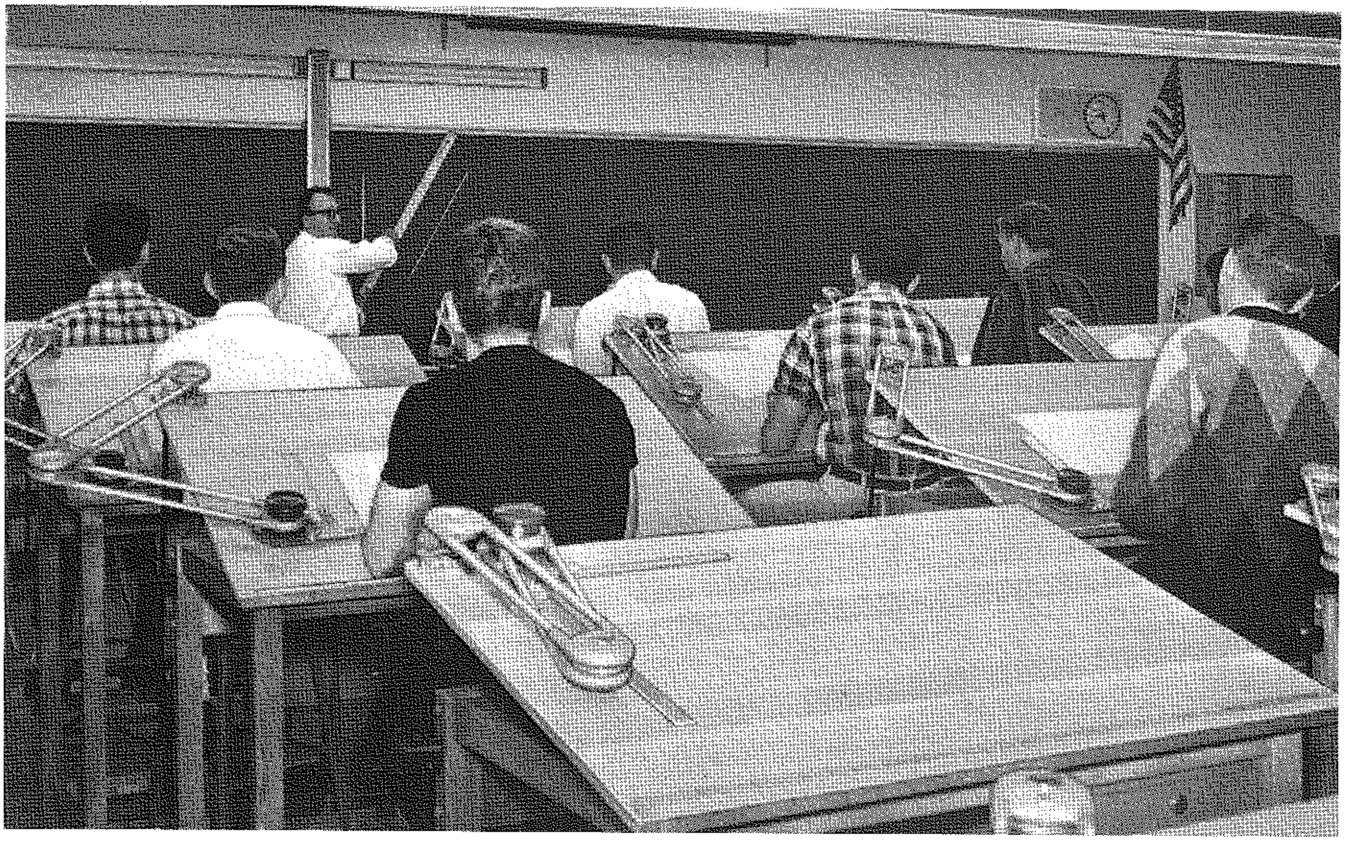
Lettering Device

8"-45 Style "B" Brd.-Rowe

Our Braddock Lettering Angles are designed to give a quick and easy method of making accurately spaced guide lines for lettering drawings, etc. The simplicity of their application permits the subject to be presented accurately and intelligently.

BRADDOCK INSTRUMENT COMPANY

PITTSBURGH, PA.



Industrial-type drafting papers and films, used with modern drafting machines, enable students to learn professional techniques more quickly, and to acquire industrial-level drafting skills.

Teaching and learning are faster with modern POST drafting media and techniques

You may be entirely satisfied with the drafting and tracing materials you are now using. But is it possible that you are inadvertently using materials no longer completely compatible with modern drafting and reproduction techniques?

Many new techniques

Within the past few years, many drafting and reproduction techniques have gone through radical changes. For example, tracing has almost become an obsolete art in many drafting rooms. Original drawings are made on vellum, tracing cloth or drafting film; further refinements are often made on intermediate prints, which are then used as master copies.

For industry-type training

After your students have mastered basic drafting techniques on conventional drawing papers, you may want to consider industry-type training, using POST Blutex drafting vellum and POST Polytex polyester drafting films. POST offers 48 varieties of drafting media—thirteen drawing papers, five sketching sheets, six bonds, nine vellums, eleven tracing cloths and four polyester films, each desired for specific characteristics and needs.

POST supplies the tools

Drawings on most of these media can be used for making intermediate master prints, so widely used in industry. Here, too, POST can serve you by supplying the tools. White-printers and supplies, from portable Rotolite diazo copiers to the POST Diazo/Matic copiers, can be used to advantage by drafting classes and other departments, as well.

To teach the "professional" concept, you may be interested in POST drafting machines and drafting furniture—equipment which will enable your students to acquire industrial drafting skills at the educational level.

Free samples and literature

Write today for free sample swatches of POST drawing papers and films, and copies of the new School Buying Guide.

FREDERICK POST COMPANY

P. O. Box 803, Dept. 64, Chicago, Illinois 60690

POST

engineering and copying products

Reflecting the need for a broader understanding of a powerful design tool..........

ENGINEERING GRAPHICS

For Design and Analysis

ROBERT H. HAMMOND, *United States Military Academy*
CARSON P. BUCK, *Syracuse University*
WILLIAM B. ROGERS, *United States Military Academy*
GERALD W. WALSH, Jr., *Jefferson Community College*
HUGH P. ACKERT, *University of Notre Dame*

THIS CLASS-TESTED TEXT BOOK reflects the growing need for a broad comprehension of graphics as a powerful tool in the design process. Its prime purpose is to provide the student with a complete understanding of the role the graphic language plays in the conception, analysis, and communication of ideas. At the same time, the book presents sufficient material to enable the student to understand basic production drawings and to provide the background for the understanding of more complex drawings.

Emphasis is on the theory of projection and on analysis rather than on the techniques and skills required in preparing a production drawing. The development of skill is emphasized as it affects the concepts of accuracy in the use of graphics for analysis. Spatial relationships required for the analysis of three-dimensional problems are presented so that the student can develop his own solution for any particular problem. Numerous step-by-step illustrations supplement the text, and no concept is applied until its theory has been developed for the general case.

A wide range of student problems offer abundant exercises in both representation and analysis. *1964. 534 pp., illus. $9.50*

PROBLEMS — Engineering Graphics For Design And Analysis

Designed for use with ENGINEERING GRAPHICS, this manual provides a full range of graphics problems adaptable to meet most course requirements. The 118 problems are graduated according to difficulty, within five parts, beginning with simple concepts and progressing to those more thought provoking.

1965. 397 pp. $4.50

The Ronald Press Company

..........................15 East 26th Street / New York, N.Y.

Continued from Page 54

Lettering artists are always in demand. They must be able to lay out lettering, do speedball and brush lettering, and have a complete knowledge of roman script, old English, and other lettering styles.

A technical illustrator requires a thorough knowledge of mechanical drafting, orthographic and oblique projections, perspectives, and reproduction techniques. The work pays well, but demands a considerable talent and skill.

An air brush is much used in retouching photographs, and in the preparation of illustrations where an air of clarity and reality is desired. The air brush requires knowledge of perspective drawing, tonal values, the effect of color, and reproduction methods.

To produce illustrative renderings requires a high degree of artistic ability plus considerable knowledge of perspective drawing, color, tonal values, composition, and design.

The function of these five areas of graphic arts was demonstrated by numerous samples of art work and renderings prepared for proposals and illustrations. A film depending heavily on animated techniques was viewed, and a chronological sequence of stages in the conception and development of a full page advertisement that had appeared in national magazines was presented.

The lecturer prevailed upon one of his artist friends to bring his air brush and a CO_2 tank to the class to demonstrate the techniques involved in its use, and the work that it can accomplish.

If enthusiasm on the part of the lecturers and teacher-students was any measure of the effectiveness of the instruction, the course was an unreserved success. Student evaluation and comment was universally favorable, and the lecturers all expressed surprise at the interest shown through questions, comments, and willingness to accept suggestions by these teachers.

As the course carried college credit, a method of formal evaluation to assign grades was necessary. This was accomplished by requiring the teacher-students to prepare a folder of notes and other materials acquired throughout the course for evaluation by the lecturers. The collections of material were rated independently by several of the lecturers, and a composite grade was assigned for each student. The correlation between independent ratings was remarkably high, and there were no substantial differences in opinion as to the grades to be assigned.

The course was an extremely interesting experiment in which to participate, and appears to have resulted in a significant transfer of information on industrial practices in the various areas of graphics. It will certainly result in better motivation on the part of high school students to realize that the material they are learning is immediately useful to them should they go to college or not. The course will also result in instructional time being more effectively used to teach the skills and techniques that are most important in graphics, and conversely permit a smaller proportion of time to be spent on those topics that are not of such great importance.

Continued from Page 52

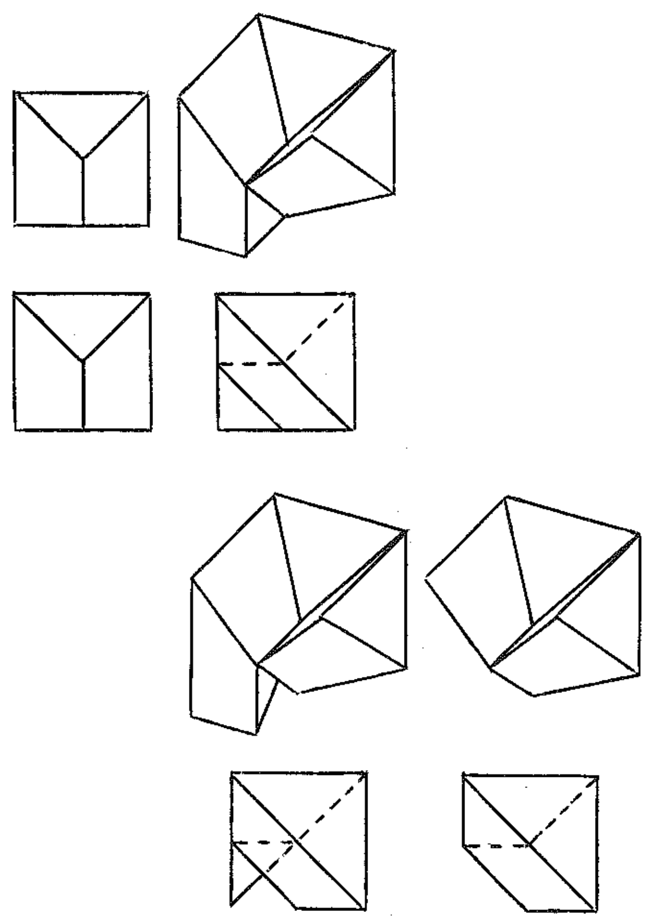
Dear Earl:

I have been studying the solution to the missing view problem given in the Fall Journal by Professor Knoblock and I am inclined to question it. I am most likely wrong but since no pictorial is given, I cannot see it as a solution.

Instead I offer my own version as inclosed. Since the first two solutions are non-symmetrical, their mirror image versions could be two more answers. Anyways it is lots of fun. Hope you have more. They are more on my level than computers and four-dimensional geometry.

Hope to see you in Boston in March.

Yours truly
Kevin B. O'Callahan



KEVIN B. O'CALLAHAN

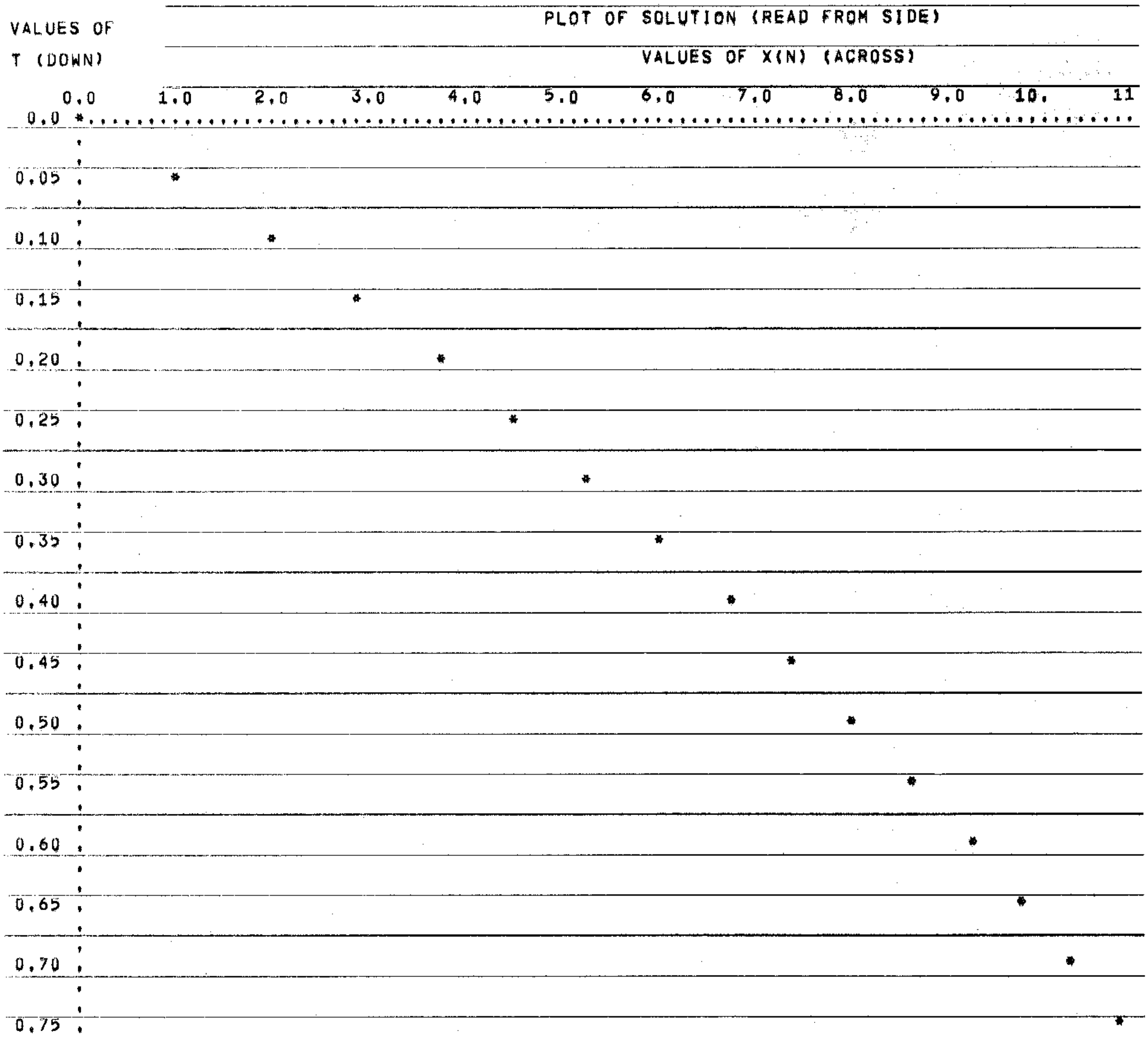


TABLE NO. 1

$Y, Y_1, Y_2, \& Y_3$ FOR GIVEN VALUES OF X

X	Y	Y_1	Y_2	Y_3
0	1	0	0	0
1	1	1	0.5	0.167
2	1	2	2	1.33
3	1	3	4.5	4.5
4	1	4	8	10.67

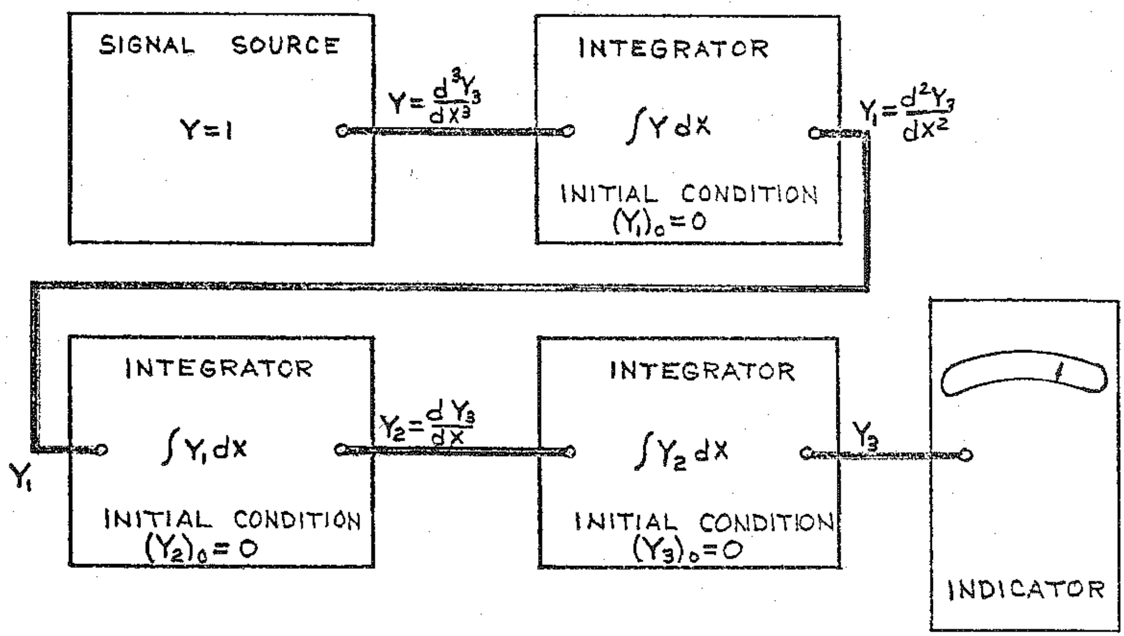


FIG. 2
COMPUTER DIAGRAM

Continued from Page 22

Now let us consider how the solution function is plotted once the differential equation has been solved. Statements numbered 16 through 25 set up the labels and axes for the plot. An arbitrary distance of eight spaces was alotted for a change of 1 in x_n. To make the actual plot, an array of characters is defined and placed in the memory of the computer. The definition of these characters occurs in Statement 1. The characters are of two types, blank and plot. The blank consists of a blank space and the plot consists of an asterisk. This array of characters is placed in memory as the dimensioned variable CHAR. After the titles are printed on the output paper, there are 119 spaces left. We therefore store exactly 119 characters in CHAR equal to blank. This is the first step in plotting the function. Next we take first solution value of the function, x(2), and divide it by 1/8 or 0.125. This enables us to find its approximate location in a position a proportional distance from 0.0. This position is expressed as a space number ranging from 1 to 119, and therefore the number must be an integer. We choose the integer variable name M to represent this number and automatically any fractional remainder is truncated. In order to insure that M is the closest possible integer, we add 0.5 to M before it is truncated. Now we are ready for the second step in plotting the function. We set the M^{th} character of CHAR, CHAR(M), equal to a plot. This causes an asterisk to be stored in the M^{th} position. Since all of the rest of CHAR are blanks, this character will be printed out as a plotting symbol, it will occur in the M^{th} position, a distance proportional to the value of the solution function at that time. We repeat this operation several times by means of a Do loop to obtain the X vs. T plot.

Because the computer can only print out the plot in the manner previously described, we must understand that the independent variable, T, is along the vertical axis and the dependent variable x(n) is along the horizontal axis. For better understanding, it is recommended to read the plot from the side.

By the methods we have discussed, a digital computer can not only solve ordinary differential equations, but it can display the solution function in graphical representation of the solution, many of its properties can be studied.

A highly trained technological expert with a good character and personality is a much better engineer and more valuable to his company than a sociological freak or a misfit with the same technical training.

Continued from Page 28
are perpendicular to both views of line AB. The front and side views are tilted and located similarly. Note that in the principal view where the axis appears as a point, its projection will align with the axis in the axonometric view.

There is an advantage to this property, which will further simplify the construction and permit working from a specified LOS as noted earlier. If the LOS can be identified and is located so that it points directly at Point O, (Fig. 5) the LOS will be in a position so that it is simpler to orient and align the principal views.

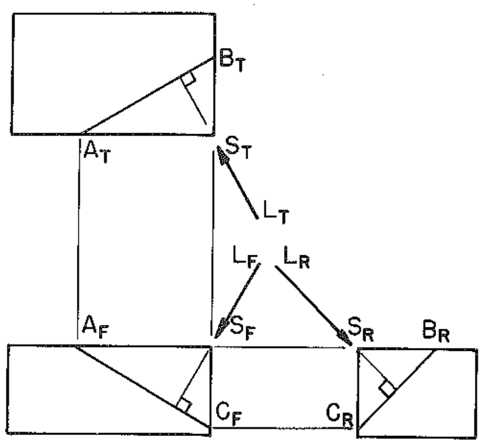


Figure 5

However, it will first be necessary to define the particular LOS associated with the oblique plane. If a normal view of the oblique plane is required, the appropriate LOS for that normal view must be perpendicular to the oblique plane and every line in the plane. This LOS is easily identified because each of the principal views of the object contains a normal line of the oblique plane, which appears and is perpendicular to the LOS (Fig. 5). Therefore, the LOS is constructed perpendicular to AB, BC, and AC in the top, right, and front views, respectively. (If the LOS is extended into the view as illustrated, the subsequent orientation and alignment of the principal views will be more accurate.)

With the LOS defined, the axonometric axes are constructed as noted in Figure 3. The subsequent orientation and location of the views is graphically simpler (Fig. 4) because the line-of-sight must be in projection with the Point O and aligned with the respective axes of the axonometric view.

Obviously, if the LOS is specified initially instead of the oblique plane, the required oblique plane can be constructed in the principal views by reversing the procedure discussed above. That is, in each of the principal views there will be a normal line that is perpendicular to the LOS. The first of these lines can be constructed in any convenient location, but since they define the reauired oblique plane, the other two lines must appropriately intersect with the first and therefore, be constructed accordingly (Fig. 5).

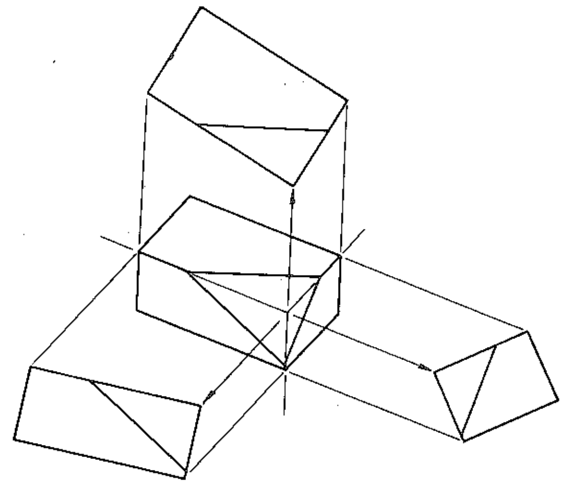


Figure 6

Figure 6 demonstrates the complete construction for an axonometric projection. Figure 7 is a pictorial view defining the relationship existing among projection planes, the normal lines, the line-of-sight, and the axes of the axonometric view.

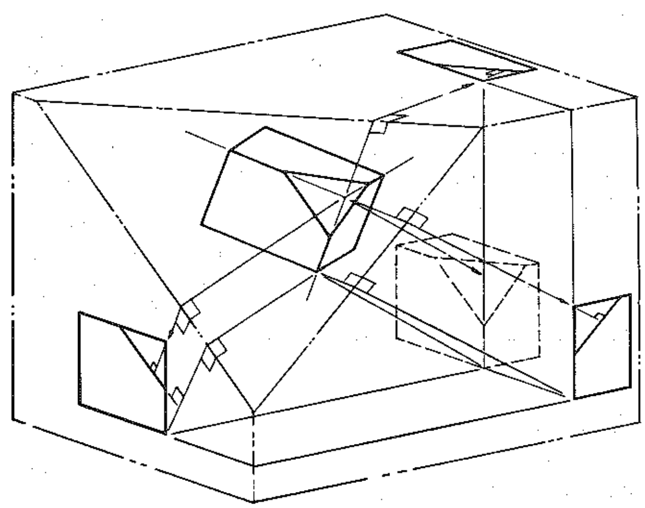


Figure 7

Application

Although the illustrations demonstrated the construction using three views, only two views are necessary for an axonometric projection unless there are curved features in all three of the principal planes of the principal views. However, a third view may be desirable as a self-checking device and to improve the accuracy. If two views are used, in some circumstances, a particular combination of the two may result in poor graphic intersections. This can be readily predicted in an examination of the axes. The two most desirable views should correspond with the axes that have the sharpest intersection (Fig. 8). The two-view combination involving the top and front views would not yield an accurate solution, since the projection lines are parallel to and intersect at the same angle as the axes do. Either of the other two-view combinations (the top and right views or the front and right views) would permit a more accurate construction for this particular LOS.

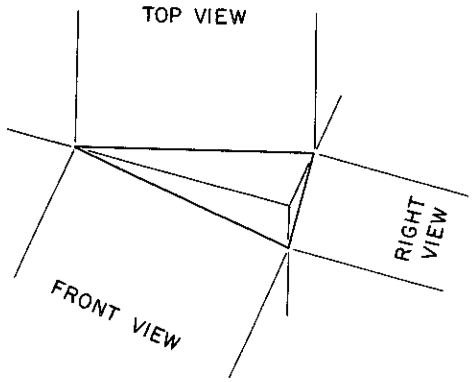


Figure 8

In the event only two views are used in the projection, it will still be necessary to define the true length of the normal line in the third view, if it is not already available. This is accomplished simply by rotating one of the existing projections of the missing line.

A two-view axonometric projection is demonstrated in Figures 9 and 10. Figure 10 demonstrates an example of "boxing in" the views for the construction. Figure 10 also demonstrates an example of a situation where the right side view is used instead of the front view, because the intersections projected from the front view would be too "shallow" to produce accurate results.

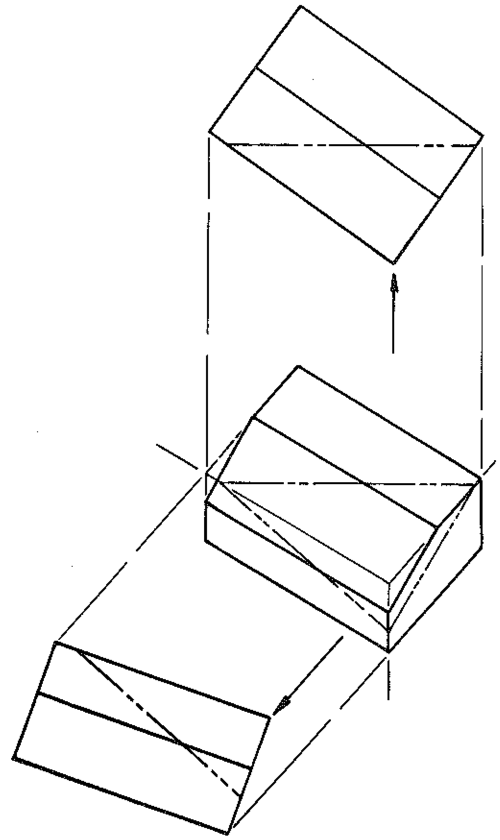
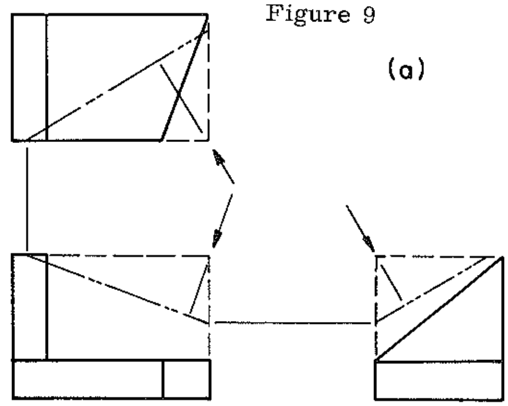
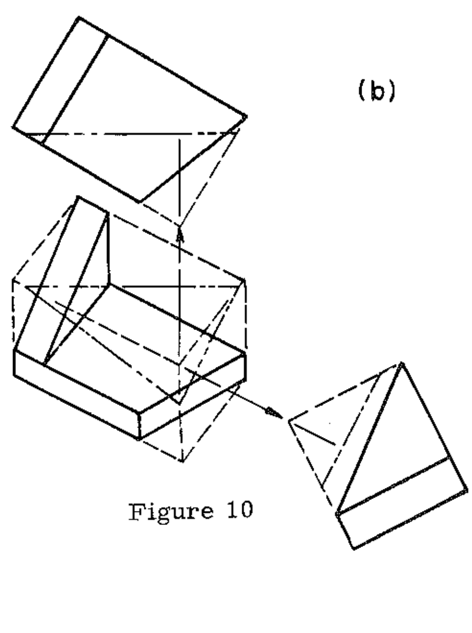


Figure 9

(a)





(b)

Figure 10

Summary of Method

The step-by-step procedure of this method is summarized as follows:

1. Box in the object, if necessary, to large enough portions to produce accurate graphical constructions.

2. Identify and locate the LOS so that it is pointing to the corner of the object which is to be emphasized (nearest) in the axonometric view.

3. Construct the oblique plane perpendicular to the LOS by constructing intersecting normal lines in each view perpendicular to the LOS.

4. Find the true length of the third line, if only two views are available.

Books for Architecture Courses *from*

ARCHITECTURAL DRAWING

by **Lawton M. Patten,** *Professor, Department of Architecture*
and **Milton L. Rogness,** *Associate Professor, Department of Engineering Graphics*
Iowa State University

This text presents architectural graphics, building construction fundamentals, and methods of drawing for a one year course in architectural drawing. Hundreds of expertly reproduced drawings and diagrams, and numerous illustrations of well-known architects' work heighten the value of the textual material. The chapter on Building Construction contains criteria for choosing building materials and types of building construction. Two fundamental principles for constructing shadows on perspective drawings are outlined and photographs of existing buildings illustrate shades and shadows from sunlight. Typical charts and graphs that an architect might use in presenting preliminary studies and reports are included.

The chapter headings are: 1. Lettering; 2. Basic Drawing Tools; 3. Types of Projection Drawing; 4. Oblique Projection–Oblique Drawing; 6. Sections; 7. Building Construction; 8. Dimensioning; 9. Graphical Vector Analysis; 10. Geometry in Architecture; 11. Perspective Drawing; 12. Shades and Shadows; 13. Reflections; 14. Presentation Drawings; 15. Charts and Graphs.

190 Pages — 8½″ × 11″ — Cloth Bound — $6.00

ARCHITECTURAL DRAWING PROBLEMS

by **Milton L. Rogness,**
and **Robert I. Duncan,** *Assistant Professor of Engineering Graphics*
Iowa State University

This workbook is a collection of 109 problems which are correlated with the textbook described above. The problems are designed to be thought provoking, logical, and practical. The alternate assignments permit added drill when necessary, and variation of assignments for different classes. In order to emphasize the practical value of the fundamentals, special effort was made to provide architecturally oriented problems.

112 Pages — 8½″ × 11″ — Wire Coil Binding — $3.75

Complimentary Copies Available Upon Request

WM. C. BROWN COMPANY PUBLISHERS

135 SOUTH LOCUST STREET • DUBUQUE, IOWA 52003

Proven Successful

ENGINEERING GRAPHICS

by **James S. Rising**, *Professor and Head of Engineering Graphics*
and **Maurice W. Almfeldt**, *Professor of Engineering Graphics*
Both of Iowa State University

$7.25

This text presents the basic principles and graphical theory of communication drawings in a logical and integrated manner. Innovations include the initial introduction of orthographic and multiview projection by the study of a *point* and its spatial location. Experience has shown that the student can better visualize the principles of projection applied to a point in space rather than to a solid object with the complications of invisible edges and surfaces. The next logical step joins two points to form a *line*, with succeeding steps to develop basic theory of the *plane* and the *solid*.

Included are numerous illustrations and all appear on the same or facing page as the related textual material. This third edition contains an enlarged unit on Production Dimensioning which includes ASA cylindrical parts; Z and N charts; and concurrency charts.

Practice problems from the several fields of engineering illustrating principles previously discussed are presented at the end of each unit. 416 pages. Cloth bound.

ENGINEERING GRAPHICS Problem Book 1

by **James S. Rising** *and* **Carl A. Arnbal**, *Assistant Professor of Engineering Graphics, Iowa State University*

$3.50

This is a complete set of problems for the work of one semester of engineering graphics covering the first 16 units of the text. This workbook contains 76 sheets of problems; layouts for practice of graphical theory, engineering applications and worded problems; and high quality green tinted drawing paper for all problems.

ENGINEERING GRAPHICS Problem Book 2

by **Maurice W. Almfeldt**, *Professor of Engineering Graphics, and*
Carl A. Arnbal, *Iowa State University*

$4.50

This set of engineering graphics problems is keyed to units 17-37 of the text and is also designed for a semester's work. This workbook contains 88 sheets of problems; graph paper in 10 × 10, log and semi-log for the graphical analyses found in units 33-37; and green tinted paper for all problems.

SPECIAL EDITION PROBLEM BOOKS

LET US TAILOR-MAKE A WORKBOOK FOR YOU

Select only the problems which you need from the above workbooks or from our stock of more than 180 additional problems and have them bound in a special edition problem book fitting your specific needs. With a minimum yearly student use of 250 or more, we will prepare for you books of your choice and specification. Samples of all the problems will be furnished upon request. Write us today for complete details.

Complimentary Copies Available Upon Request

WM. C. BROWN BOOK COMPANY

135 SOUTH LOCUST STREET • DUBUQUE, IOWA 52003

5. Construct a normal view of the oblique plane (triangle) with one side in a horizontal position.

6. Construct through each of the vertices of the triangle, lines perpendicular to the opposite sides. These are the axes.

7. Separate the two given views and orient one of the views so that the LOS points away from the intersection of the axes and is aligned with (in "projection" with) the corresponding axis.

8. Locate and orient the second view so that the LOS of that view is also pointing away from and is aligned with the appropriate axis.

9. Construct projectors parallel to the line-of-sight (and the corresponding axis) from each of the two given views toward the axes.

10. At the intersections of corresponding projectors, identify corresponding points in the axonometric view.

REFERENCES

1. Giesecke, Mitchell & Spencer -- Technical Drawing, Macmillan Co., 4th Edition, 1961.

2. Hoelscher & Springer -- Engineering Drawing and Descriptive Geometry, John Wiley & Sons, 2nd Edition, 1961.

3. Hoelscher, Springer & Pohle -- Industrial Production Illustration, McGraw-Hill Book Co., Inc., 2nd Edition, 1946.

4. French & Vierck -- Engineering Drawing, McGraw-Hill Book Co., Inc., 8th Edition, 1953.

5. Hood, G. J. -- Geometry of Engineering Drawing, McGraw-Hill Book Co., Inc., 3rd Edition, 1946.

6. Pare, Loving & Hill -- Descriptive Geometry, Macmillan Co., 1952.

7. Rule & Coons -- Graphics, McGraw-Hill Book Co., Inc., 1961.

8. Shupe & Machovina -- Engineering Geometry and Graphics, McGraw-Hill Book Co., Inc., 1956.

It is easy to be afraid of unknown problems to be faced, to look back to the safety of the past for solutions, to be lulled by precedent.

INFORMATION FOR AUTHORS

Manuscripts. Articles or papers may be descriptive, theoretical, documentary, tutorial in nature, or they may be reviews. Editorial considerations suggest most papers should be 2000 to 4500 words in length. The topic should receive professional treatment in depth. One or two copies of the manuscript should be submitted. Articles should be typewritten and double spaced with typing only on one side of each sheet. Pages should be numbered to avoid omissions. References, footnotes and illustrations should be listed on separate sheets and not inserted within the text.

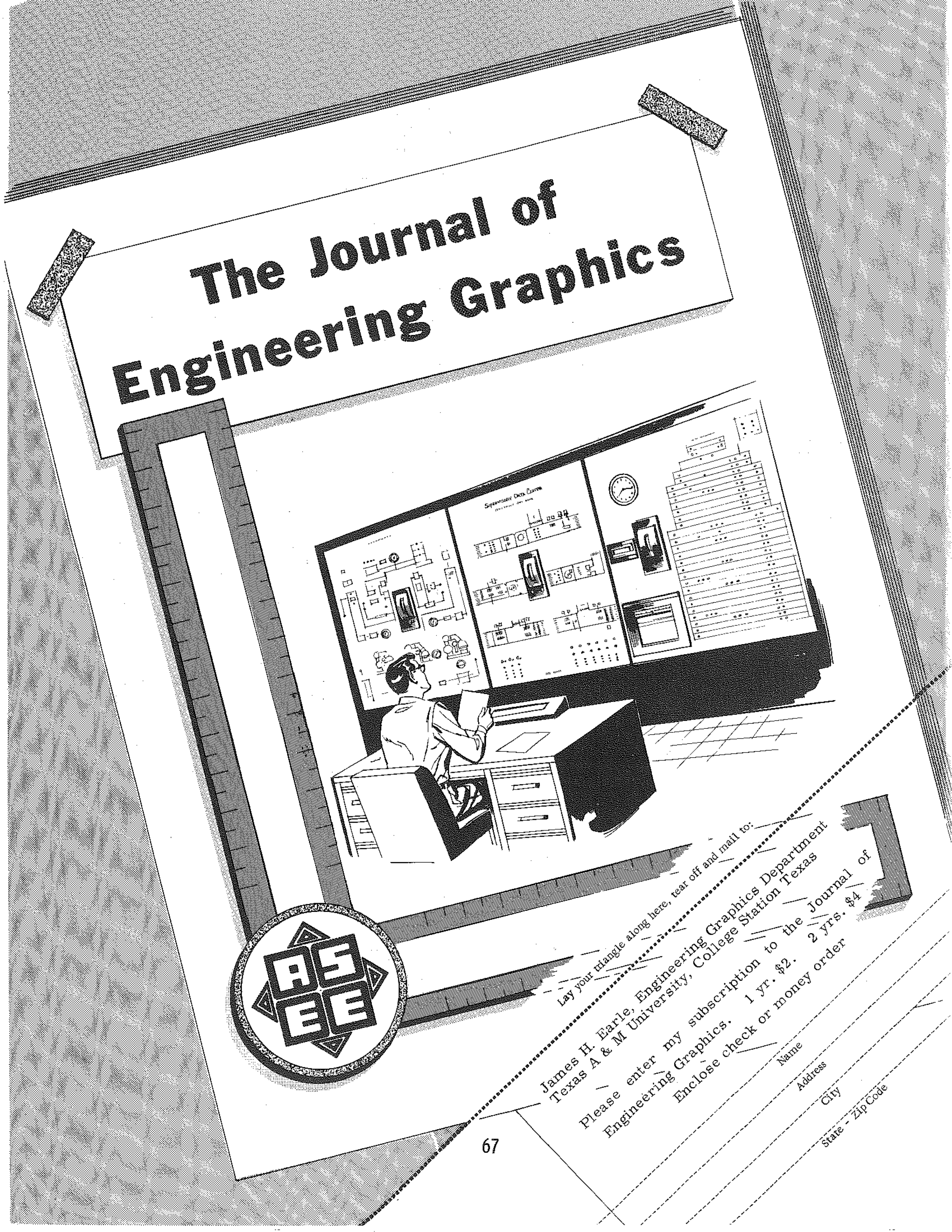
Illustrations. Line drawings may be prepared in pencil or India ink with mechanical lettering. If mechanical lettering is not available, freehand lettering should be placed on a separate overlay sheet. Photocopies (same size or reduced) of the original line drawings are accepted if they are clean, clear and sharp in contrast. Illustration width limitations are (1) single column, 4-1/8 inch, and (2) double column, 9 inches. Height limitation is 11-3/4 inches for either column width. When illustrations are reduced 20 per cent, all lettering must be large enough to remain clear and legible. Photographs should be 8 x 10 glossy prints. Figure numbers and captions should be listed on a separate sheet. If there could be any doubt about the positioning of the illustration, identify its top with a blue pencilled note in the margin. Figure numbers should be lightly written on the back of each illustration. If the illustration is prepared on translucent material, a blue pencilled note might be made in the lower margin on the face of the illustration.

Correspondence. Your candid observations via brief communications are welcomed. Your observations; criticism of, or comments on, previously published articles; or other timely notices of interest to the members of the Engineering Graphics Division are welcomed. Please indicate whether submitted correspondence may be published.

Writing Style. Spelling and capitalization should follow Webster's Seventh New Collegiate Dictionary, which also offers guidance in punctuation. For more detailed information of the editorial style, see United States Government Printing Office Style Manual, 1959.

If you have further questions -- write to the Editor.

Earl D. Black, Editor
The Journal of Engineering Graphics
General Motors Institute
Flint, Michigan 48502


The Journal of
Engineering Graphics
SUPERVISORY DATA CENTER
ASEE
Lay your triangle along here, tear off and mail to:
James H. Earle, Engineering Graphics Department
Texas A & M University, College Station Texas
Please enter my subscription to the Journal of
Engineering Graphics. 1 yr. $2. 2 yrs. $4
Enclose check or money order
Name
Address
City
State - Zip Code

CREATIVE PRODUCT EVOLVEMENT

Published 1965
Price $5.00

by J. Liston, P. E. Stanley

190 pages, 8½" x 11", — a book which is profusely illustrated with example cases of new-product evolvement, and contains a large number of practice problems particularly designed to stimulate imaginative thinking. Many of these problems are based on real situations that offer the challenge which comes from knowing that a good answer might have commercial potential.

Unique in its field, and particularly emphasizing the methods of synthesis, a step-by-step procedure is presented for conceiving, describing, and proving ideas and proposals for new and better products.

Chapter titles are: 1. *Preparatory Steps in Evolving a Complex Product.* 2. *Conceptual Methods and Techniques in Creative Product Evolvement.* 3. *Spatial Visualization.* 4. *Disclosures and Patents.* 5. *Feasibility and Optimization Studies.* 6. *Feasibility and Optimization Studies with Analog Computers.* 7. *Feasibility and Optimization Studies with High-Speed Digital Computers.* 8. *Experimental Confirmation of Feasibility.* 9. *Planning the Feasibility Test Facilities.* 10. *Proposal Reports for New Products. Appendix: Practice Problems in Creative Synthesis.*

*DESCRIPTIVE GEOMETRY PROBLEMS and **ADDITIONAL DESCRIPTIVE GEOMETRY PROBLEMS

***Published 1962**
****Published 1965**
Price $4.50 (for both)

by S. B. Elrod, C. H. Zacher, H. F. Gerdom

**128 problem sheets, 8½" x 11", on good quality paper, perforated and bound into a book.*

Appropriate for an extensive course of 90–100 lab hours. Content includes: basic orthographic projection, fundamental spatial relationships of elements; applications of descriptive geometry to design and manufacture. There is extensive coverage of intersections and developments, including ruled surfaces; also, axonometric and perspective projection are treated.

***ADDITIONAL, — includes a number of problems on: Lofting, Compound Locus Relations, - also includes improved instruction and variations of certain problem sheets in the 1962 set.*

WORKSHEETS FOR INTRODUCTORY GRAPHICS – FORM A

Published 1958
Price $4.00

by J. N. Arnold, M. H. Bolds, S. B. Elrod, J. H. Porsch, R. P. Thompson

One hundred sheets, mostly 8½" x 11" with a few 11"x 17", on good quality paper, perforated and bound into a book.

Principal topics are: *Lettering, Geometry, Multiview Drawing, Pictorial Drawing, Intersections, Developments, Contoured Surfaces, Functional Design; also, a few sheets each on Vectors, Graphical Calculus, Empirical Equations, Representation of Data and Equations.*

GRAPHIC AIDS IN ENGINEERING COMPUTATION

1963 Printing
Published 1952
Price $5.75

by R. P. Hoelscher, J. N. Arnold, S. H. Pierce

This well-known text of 197 pages, 6" x 9", in hard covers, deals with alignment charts, empirical equations, the design of special slide rules, and the use of the standard slide rule. Examples are numerous, and there are problems at the end of each chapter.

The seven chapters are: (1) *Standard Slide Rules,* (2) *Empirical Equations from Engineering Data,* (3) *Alignment Charts,* (4) *Graphical Calculus,* (5) *Alignment Charts with Determinants,* (6) *Special Slide Rules,* (7) *Movablescale Nomographs.*

Formerly available from McGraw-Hill; now a Balt book.

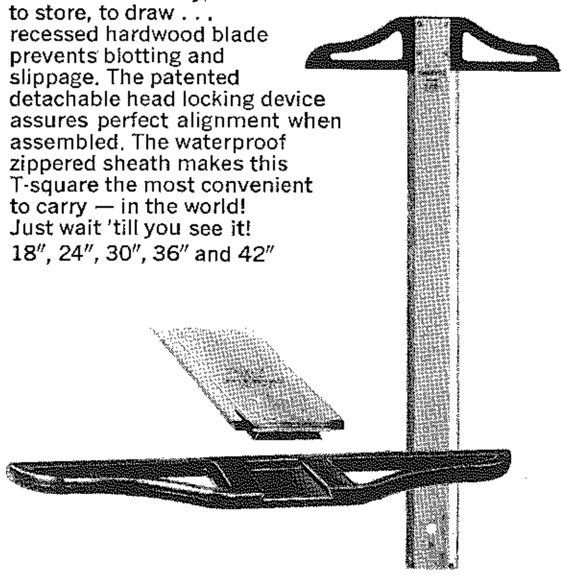
Examination copies of any of these are available upon request.

BALT PUBLISHERS

308 STATE STREET WEST LAFAYETTE, INDIANA 47906

designed with **YOU** in mind!

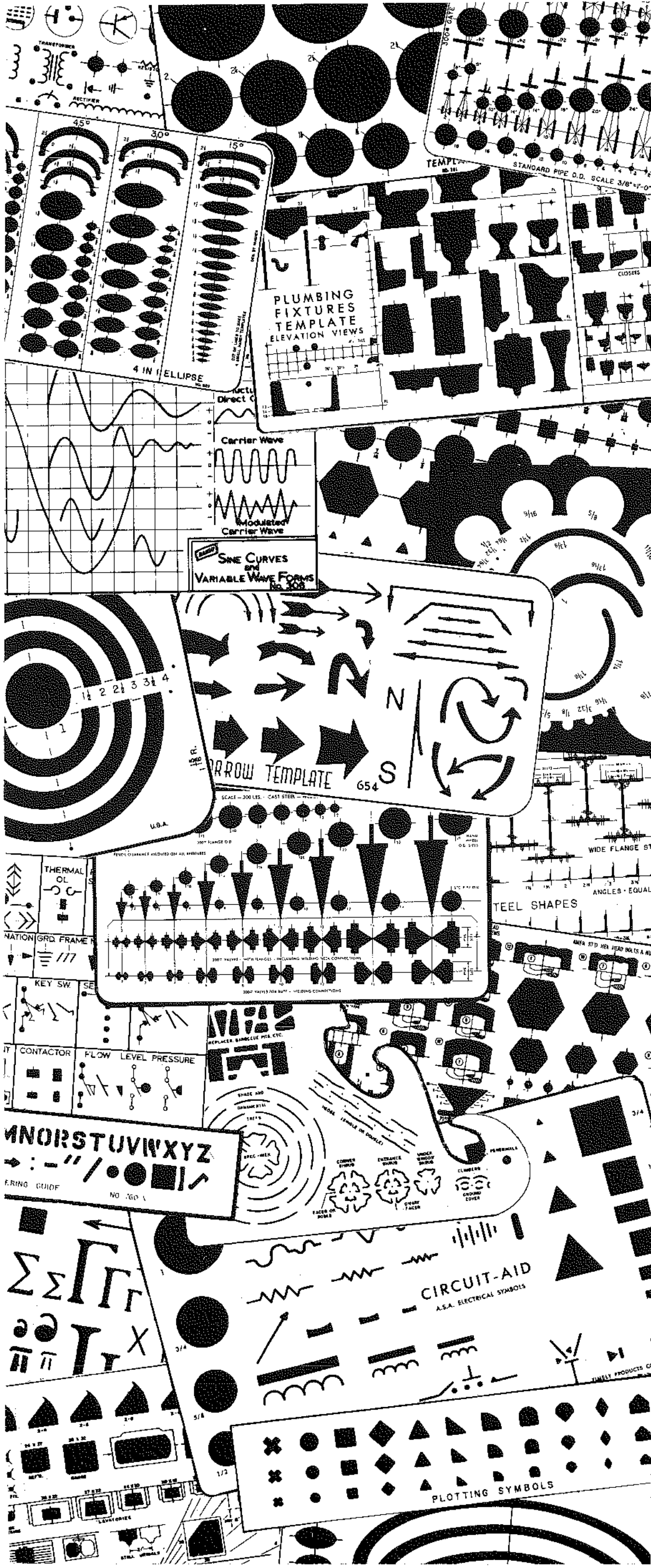
This is the T-square every one will want because it is the most convenient to carry, to store, to draw . . . recessed hardwood blade prevents blotting and slippage. The patented detachable head locking device assures perfect alignment when assembled. The waterproof zippered sheath makes this T-square the most convenient to carry — in the world! Just wait 'till you see it!
18″, 24″, 30″, 36″ and 42″



charvoz
SAFE-T-LOCK
T SQUARES

. . . the most convenient to carry
— in the world!

charvoz-carsen corporation
50 COLFAX AVENUE, CLIFTON, NEW JERSEY 07013
In Canada: 31 Scarsdale Road, Don Mills, Ontario



Template Designs for Every Trade & Profession

Modern, Timesaving Drawing, Designing and Sketching Aids for Unlimited Applications —

ALVIN

YOUR TEMPLATE SUPPLY HOUSE

A Complete Stock Of

ARCHITECTURAL • MECHANICAL • ELECTRONIC STRUCTURAL • MATHEMATICAL • ELECTRICAL LETTERING • ELLIPSES • SCIENTIFIC PLOTTING • PROCESSING • GENERAL SYMBOLS CIRCLES • CHEMICAL • MISC. SPECIALIZED

Templates

Custom Templates Made To Order

ALVIN & COMPANY, INC.

Importers, Manufacturers, Distributors

WINDSOR, CONNECTICUT

Area Code 203-6884931

"for Quality At The Right Price"