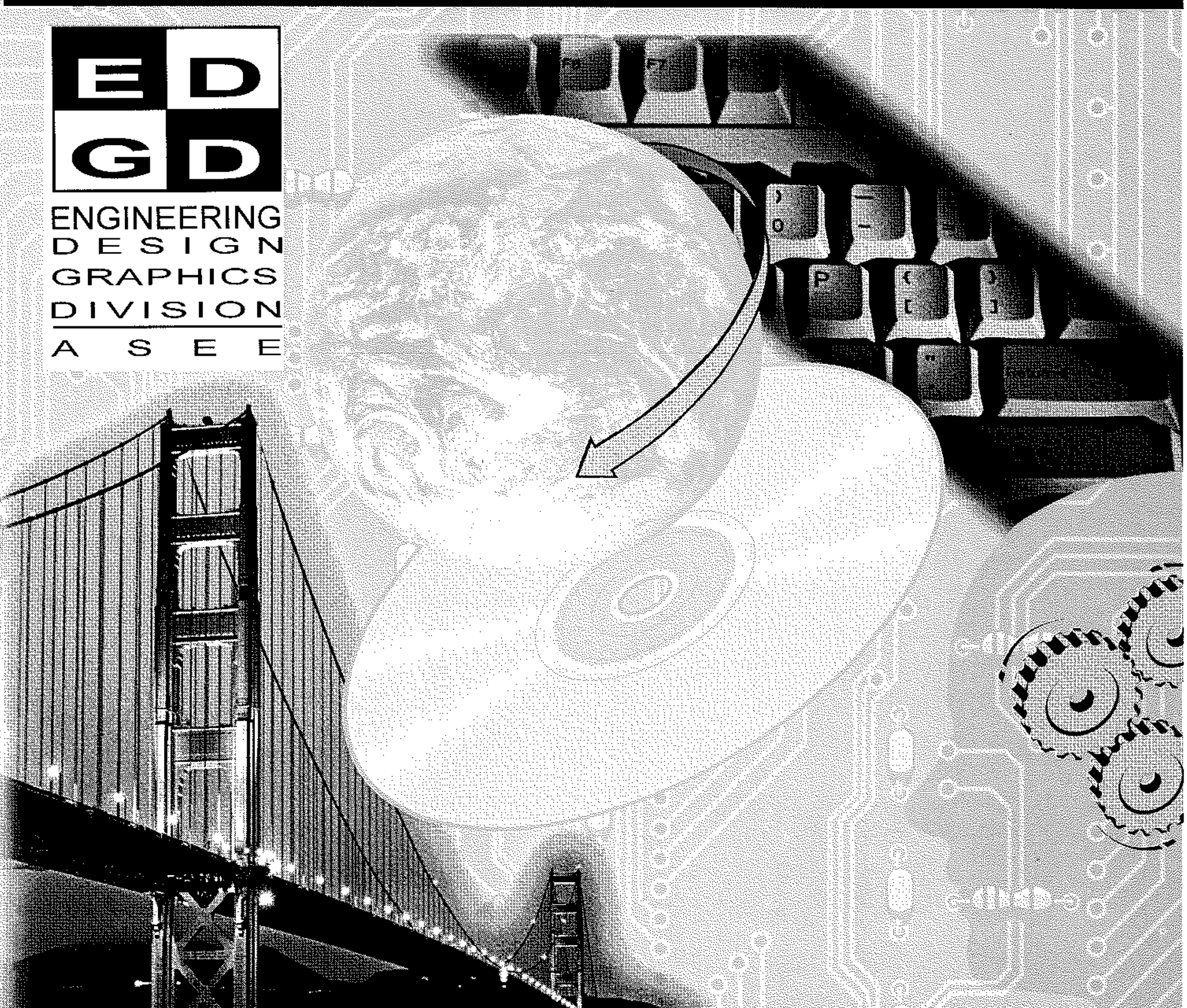
Spring 1997
Volume 61
Number 2

THE ENGINEERING DESIGN GRAPHICS JOURNAL INDEX 1975–1996



ENGINEERING DESIGN GRAPHICS DIVISION
AMERICAN SOCIETY FOR ENGINEERING EDUCATION

SDC
PUBLICATIONS

JP System 5
Desktop Rapid Prototyping™
★ ★ ★ ★ ★

ENGINEERING DESIGN GRAPHICS WORKBOOK

A Concurrent Engineering Approach

Barr, Juricic, Krueger, Wood and Miller
University of Texas-Austin

This workbook allows you to incorporate engineering design, analysis and manufacturing into your engineering graphics course. It takes an integrated approach to engineering design by utilizing sketching, CAD, FEA and building of a design model with a rapid prototyping system.

TABLE OF CONTENTS

Each module consists of the following sections:
1. Introduction
2. Text material
3. Manual sketching sheets
4. Computer lab exercise

Software and manufacturing tools used by this book: AutoCAD Release 12, AutoFEA, and JP Svstem 5.

Available: June, 1997 Net price $39.95 482 pages.

The version of this text using AutoCAD Release 13 will be available Fall, 1997.
Information on JP System 5 and an extended Table of Contents for this book are available on our web site.

Please contact Stephen Schroff for a complimentary examination copy. We will be showing JP System 5 and this text at the ASEE Annual Conference, June 15-18, 1997.

SCHROFF DEVELOPMENT CORPORATION

5424 Martway Drive
Mission, Kansas 66205

(913) 262-2664
FAX (913) 722-4936
E-mail: schroff@schroff.com

P.O. Box 1334
Mission, KS 66222

For information on all our products: http://www.schroff.com

- <u>Built-In</u> ACIS® Based Solid Modeling!
- Full Boolean Operations!
- Full 2D/3D Drafting & Design Power!
- EASY to Teach and Learn!
- NEW CADKEY® 97 Curriculum Materials Available!
- Selected by Thousands of Universities, Schools & Students!
- Chosen by Over 235,000 Commercial Users & Hundreds of Fortune 500 Companies Worldwide!
- <u>Unbelievable</u> Academic Pricing!
- Check Out www.cadkey.com!

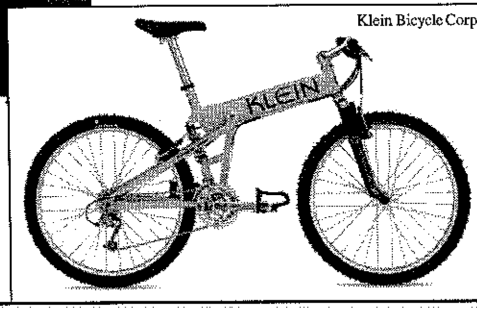
CADKEY® 97

World's First Built-in Wireframe-to ACIS®-Based Solid Modeling Converter!

Only $279 or <u>Less</u> per License!

Shelby American, Inc.

CADKEY



Klein Bicycle Corp.

Designed Using **CADKEY®**

If you are serious about giving this generation of students the tools they will need to be competitive tomorrow, CADKEY shoould be your choice for CAD education.

- Ken Webber, Ed.D.
Educational Consultant

We are making an effort to bridge the gap between the classroom and the real world...through hands-on learning. [CADKEY's] step-by-step approach helps students learn how to build one CAD skill upon another. The bottom line is that they see quick results in their progress...

- Christine Kastel
Willits H.S., CA

I still contend that CADKEY is the best product for PC based engineering and I know most of my students feel the same way even after their AutoCAD® experience.

- W. Denison Rounds
The Technical Ctr. at Springfield, VT

I am a student that is using your program in an engineering class and I must say that you really have one of the top programs that I have ever seen or used!

- Tarek Alkatout, Student

Not a "Limited" Version!

Available to Schools for Only **$279** or <u>Less</u> and to Faculty and Students for Only **$149**!
This same version is sold Commercially for $1195!

CALL
800-338-2238
for Info or for Your Local Dealer!
Tech Ed Concepts, Inc.
CADKEY & DataCAD North American Academic Distributor
35 South Main Street, Concord, NH 03301

WINDOWS 1996 WIN 100

CADKEY

EDGD
ENGINEERING DESIGN GRAPHICS DIVISION
ASEE

THE ENGINEERING DESIGN GRAPHICS JOURNAL

Volumn 61 Number 2 Spring 1997

The *Engineering Design Graphics Journal* is the official publication of the Engineering Design Graphics Division of ASEE. The scope of the Journal is devoted to the advancement of engineering design graphics, computer graphics, and subjects related to engineering design graphics in an effort to (1) encourage research, development, and refinement of theory and applications of engineering design graphics for understanding and practice, (2) encourage teachers of engineering design graphics to experiment with and test appropriate teaching techniques and topics to further improve the quality and modernization of instruction and courses, and (3) stimulate the preparation of articles and papers on topics of interest to the membership. Acceptance of submitted papers will depend upon the results of a review process and upon the judgement of the editors as to the importance of the papers to the membership. Papers must be written in a style appropriate for archival purposes.

ISSN 0046 - 2012

This is my last report as Director of Publications. After six years I am ready to pass the *Journal* to the capable hands of Judy Birchman, who will do a great job.

The Journal is in great shape financially. With Craig Miller as the Advertising Manager, we have managed to keep a good number of ads in each issue which helps us maintain a high quality publication and not go in the hole financially.

This issue of the *Engineering Design Graphics Journal* is an index which covers articles and some features over the past 25 years. Entries can be found under both Subject and Author headings, with abstracts available for each paper which has been printed in the *Journal* from 1972 to the present. This spring issue marks 50 years of successful journal publishing by the EDGD division and I am proud to have been a part of such a successful tradition.

I would like to thank Judy Birchman who has served as the Technical Editor, and Craig Miller and Dennis Short who served as the Advertising Managers during my term. I would especially like to thank Clyde Kearns who is the glue that holds the *Journal* together. Whenever there is a question about membership, tax numbers, past issues, etc., Clyde always has the answer. There will always be a special place the hearts of EDGD editors for Clyde Kearns. He makes our job much easier.

I would like to thank also, all of the members of the review board over the past six years. We can't have a reviewed publication without a prompt and decisive review board. These members have read, reviewed, and corrected all kinds of papers, including those submitted for the Annual Proceedings.

During my tenure I worked with six different Division Chairs. John Demel, Vera Anand, Barry Crittenden, Bill Ross, Mary Jasper, and Gary Bertoline. Each was asked by me three times a year to supply a Chair's message for the *Journal.* During these six years we have had a wide variety of interesting and stimulating reports from our leaders.

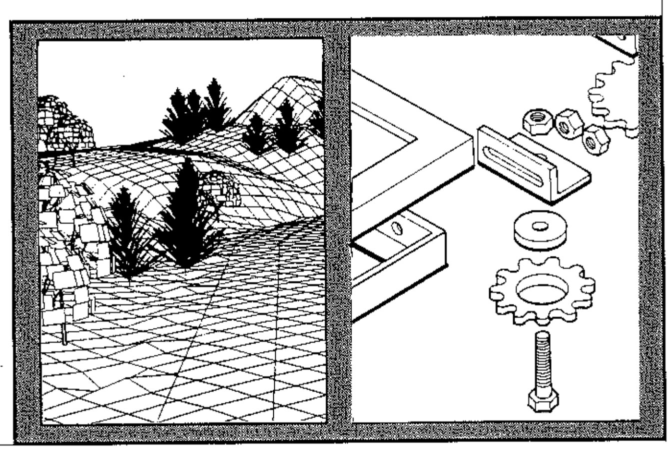
The best part about being Director of Publications and Editor of the *Journal* is the opportunity to interact with so many division members. I have met, talked to, or corresponded with an amazing number of individuals.

I will not lie. Doing the *Journal* is a lot of time-consuming work, but the rewards outweigh the negatives. I thank all of you who had the faith in me at election time, and hope that the *Journal* has met with your approval. I would say to Judy, "The good news is that you are the editor of the *EDGD Journal.* and the bad news is that you are the editor of the *EDGD Journal.*"

Mary A. Sadowski

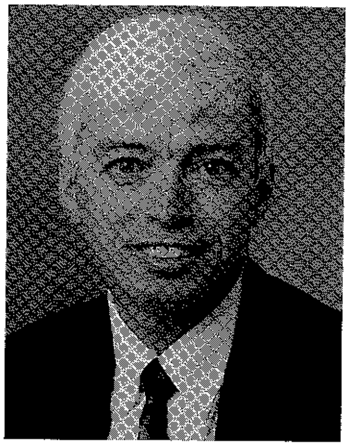
Contents

Cover Design by Carrie Flores



Special thanks to Carrie who did the lion's share of the work for this issue.

Division News and Notes



Chair's Message
Gary R. Bertoline

It does not seem that long ago that I was given the opportunity to lead the Division as Chair, yet here I am writing my last Chair's Message for the *Journal*. I have enjoyed the opportunity to lead the organization for the last year and have worked with some wonderful individuals in our Division. Many thanks to Mary Jasper who made my transition an easy one. I would also like to thank the Division members who had the confidence to elect me to this position. I wish I had more time to continue my work as Division Chair but I am sure that Jon Duff will be a great leader and visionary. In keeping with the theme of my last Chair's Message I urge all of you to contact Jon and let him know of your interest to help move the Division forward.

I would like to use my last message to urge the Division Membership to consider the role of graphics in engineering. There was a time approximately between the years 1910 through 1960 that graphics played a very important part in an engineer's education. Many universities had departments of engineering graphics to teach the graphics to engineering students. The typical engineering curriculum required a series of courses in engineering graphics for all engineering disciplines. As you well know graphics is no longer taught in as much breadth or depth as in the past.

This message is not to lament the downfall of graphics in engineering education. What has past cannot be changed. We have to focus on the present and future although we should reflect on why graphics has fallen on such hard times. It is my opinion that we should promote graphics as a communications tool. I like the term graphics communication to be used to describe what we do. No one will argue that engineers need to be able to communicate to be successful. I would add graphics communication as one very important type of medium that all engineers need to be successful.

Viewing graphics as a means of communication has significant impact on what we teach and why we teach it. Graphics would no longer be viewed as an end, like a piece of art, but as a method of communicating thoughts and information. Graphics would no longer be viewed as something that an engineer must contend with in a very narrow sense to complete the design process. If taught correctly and within context of engineering, graphics as a communications tool would be viewed as an indispensable part of an engineer's education. The great news is that graphics ***is*** an indispensable part of an engineer's education. Our task is to re-engineer our discipline so that graphics is viewed as a communication tool equal in importance to an engineerís education as is verbal and written communication.

Author Index

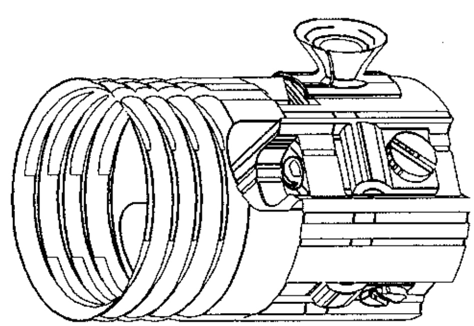
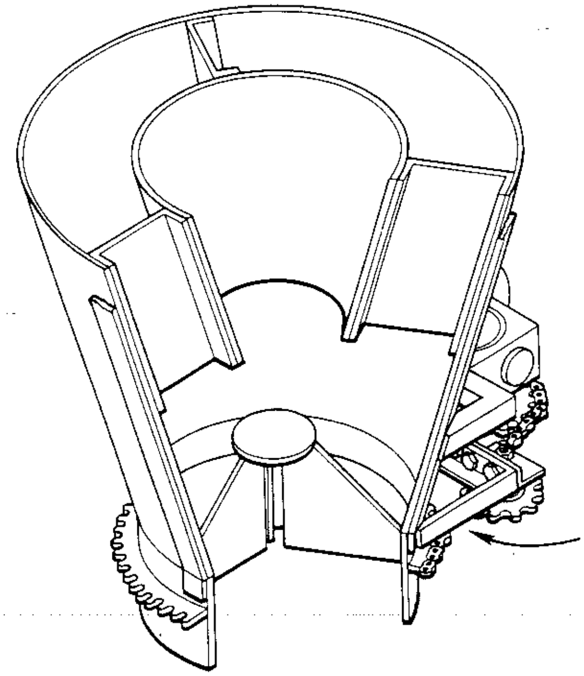


Illustration by Carrie Flores



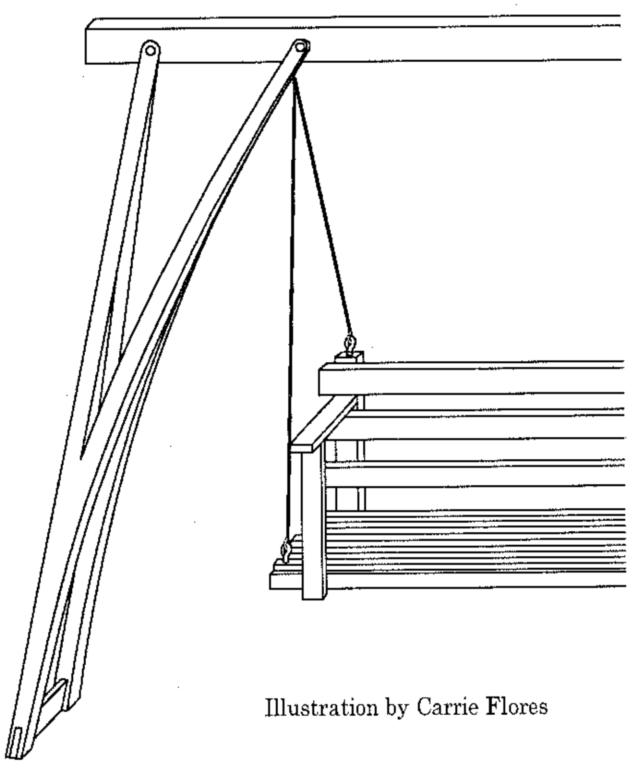
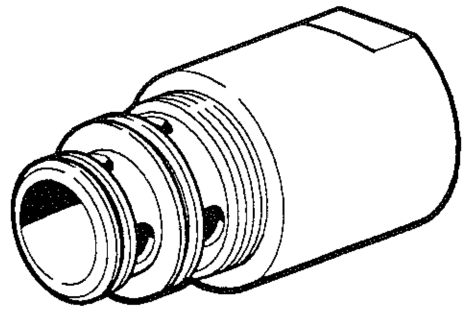
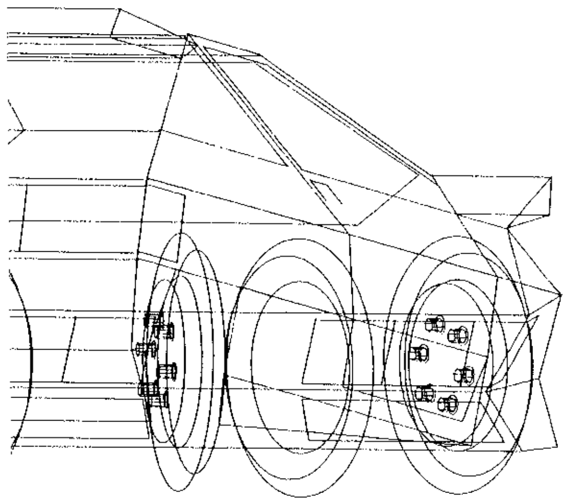
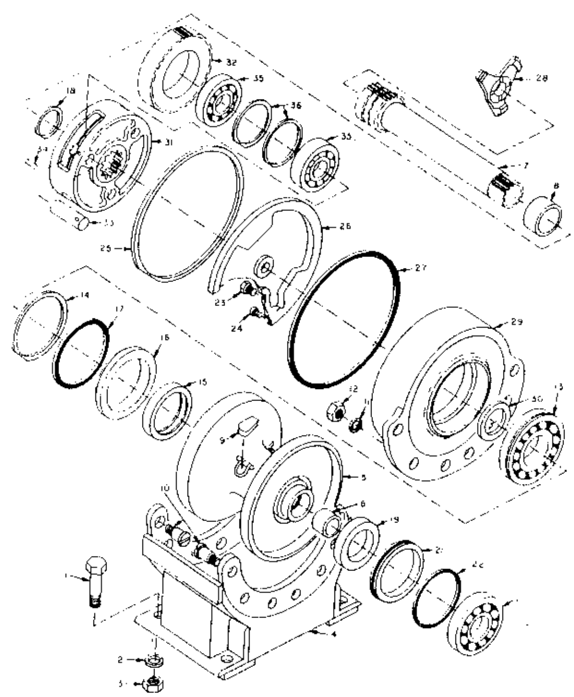


Illustration by Carrie Flores







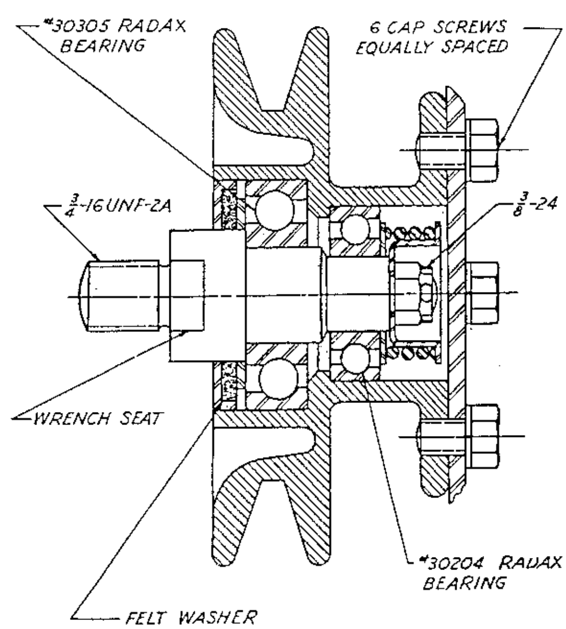
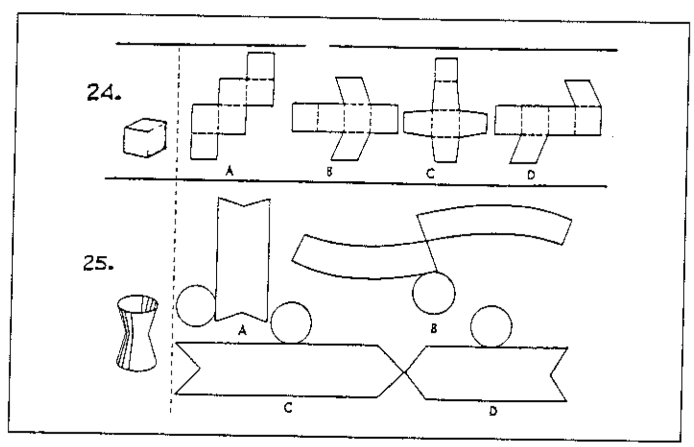
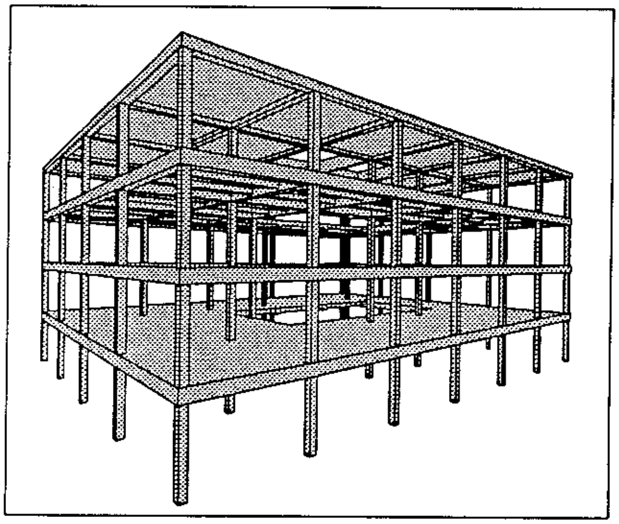
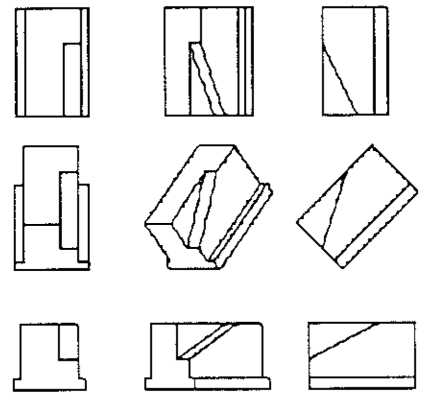


Illustration by John Penziol



24.
A
B
C
D
25.
A
B
C
D





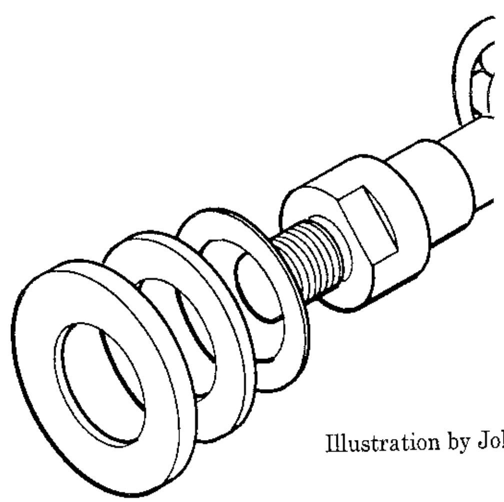
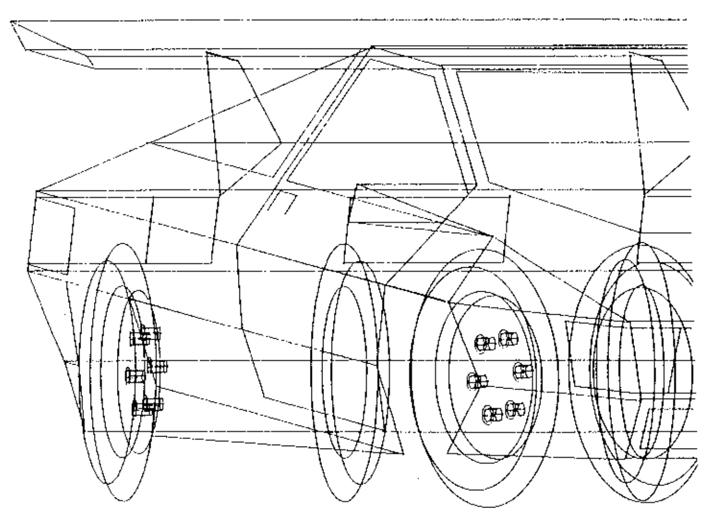
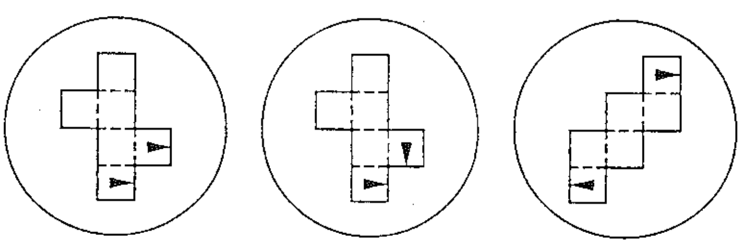


Illustration by John Penziol





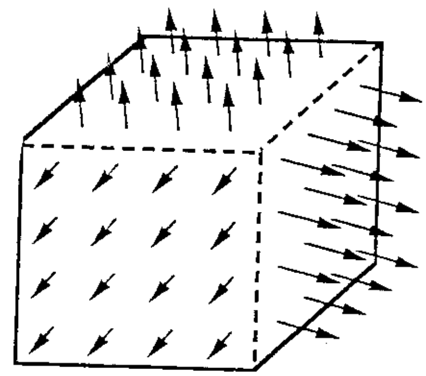
SUBJECT • INDEX

ENGINEERING DESIGN GRAPHICS DIVISION

A S E E

1975 to 1996

Subject Index



CAD

A Computer Graphics Program to Aid in Teaching of Cam Design 46(1) 82 24-32

Robert C. Weber & Vi-Son Rowe

Abstract: A computer graphics program to aid in the teaching of cam design and cam profiles is presented. The program requires the inputting of a displacement curve, the desired follower configuration, and the follower offset. Three types of followers are permitted: (1) knife edge followers, (2) roller followers, and (3) flat-faced followers. The program calculates the cam profile using standard graphical techniques and then displays the profile with the designated follower, offset, and displacement

Interactive Procedures for Geometric Data Entry and Modeling on a Small Educational CAD System 47(2) 83 15-24

Ronald E. Barr, Davor Juricic & Tim Lam

Abstract: Computer aided design and computer aided manufacturing (CAD/CAM) are new technologies being employed by industry to increase productivity. Computer aided design involves the use of computers to synthesize, analyze, and test new products without the need to build an experimental prototype. Common analytical tools offered by CAD include analytical tools offered by CAD include kinematics simulation, finite element analysis, and solid geometric modeling. Computer aided manufacturing deals with the automatic manufacture of products through the use of numerical control, robotics, and other computer-controlled processes. In realizing the full potential of CAD/CAM, the ultimate objective is to use the same geometric data base from design inception, through design analysis, and terminating with design manufacture.

The Student Developed Alaska Drafting System 49(1) 85 15-18

Edward J. Gauss

Abstract: Over a decade ago, the senior Engineering students at the University of Alaska developed a user friendly drafting system for use in the freshman drafting course. There, the drafting system was the student's first experience with the computer. A punched batch processor was used.

The resulting system has been in use in the drafting classes for nearly a decade. The simplicity of the language attracted users beyond the drafting class: An artwork from it was accepted by the All Alaska Juried Art Show, and research scientists have used the system to prepare drawings for publication.

The Basics of CAD 49(1) 85 44-47

Gary R. Bertoline

Abstract: People have recently turned to the computer as a means of easing tasks and becoming more productive in many different applications, including drafting-design, through the tool called CAD.

Computer Aided Design and Drawing of Safety Flange Coupling 49(2) 85 27-32

J. S. Duggal & M. L. Bourque

Abstract: With the development of basic subroutines such as rectangle, circle, polygon etc., for most computer systems, it is now possible to use these routines in a CAD system. In this paper a flange coupling design is taken as an example. Many more machine members could be designed and drawn simultaneously using the existing subroutines. A plot of a typical flange coupling design is shown.

Visualization: Can 2D Microcomputer CADD do a 3D Job in Introductory Engineering Graphics Courses? 50(2) 86 37-39

William A. Ross

Abstract: 3D micro-computer CADD software offers one unique attribute. It allows the student to construct a simulated model of the object and at the same time, directly interact with the graphical representation of the object. Although interactive computer simulations of 3D objects may lack the tactile quality of hand held 3D models, the ability to place the student in control of rotating, positioning and *building* the object is a powerful enhancement to learning. It is recommended to develop CADD based engineering graphics instruction along these lines.

Evaluation of Five Microcomputer CAD Packages 51(1) 87 13-22

James A. Leach

Abstract: A comparative analysis of the following five microcomputer CAD software packages was conducted:

AutoCAD (v.2.17)
CADKEY (v.2.0)
CADVANCE (v.1.0)
Super MicroCAD
VersaCAD Advanced (v.4.00)

The study showed a similarity among package formats and features, but the greatest differences were among command entry methods, advanced features, potential applications, and numbers of users.

Development and Implementation of a CAD Application 52(1) 88 24-31
J. Patten, T. A. Allison & H. Razavi
Abstract: This paper provides a description of the development of a CAD based system for the design, simulation, numerical control (NC) program generation and execution utilizing CAD/CAM principles and technology.

Techniques for Generating Objects in a Three-Dimensional CAD System 51(3) 87 29-35
Larry D. Goss
Abstract: So that we understand each other, let me start with a definition of terms. CAD in the context of this paper is the database generated by a computer defining the points of each primitive geometric element in terms of a spatial rather than planer location.

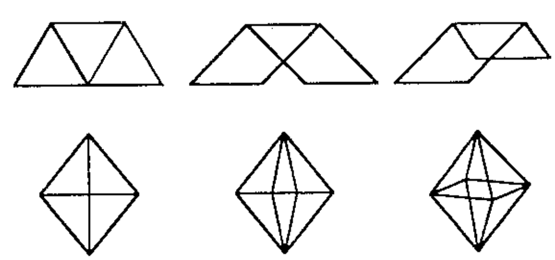
The Systems Side of Computer Aided Design: Computers, Software, Laboratories 52(2) 88 14-17
Dennis R. Short
Abstract: Implementation of Computer Aided Design laboratories requires careful planning and an understanding of how decisions will affect both the operation of the laboratory and pedagogical options available for delivering CAD instruction. The number of options may not be as numerous as the vendors would have you believe. The major decision is what software to use and how to integrate the CAD laboratory into other facilities and courses. Approached carefully, with no preconceived ideas, the development of CAD laboratories should be achieved with no more problem than any other educational facility.

Analyzing, Selecting, and Purchasing CAD LAN Systems 53(1) 89 27-38
Bradley S. Farver & John G. Nee
Abstract: Local Area Network (LAN) systems, one method of sharing information, are arranged into three main topologies according to one of three geometric configurations - bus, ring, or star. With the great number of LANs on the market, the connectivity must comply with standards established by the International Standards Organization (ISO). This assures conformity in designs. When choosing a LAN system, seven questions must be considered - will the system be a multi-use media, what is the length of the backbone, are heterogeneous connections to be considered, what data rates are required, are there any existing network facilities, what are the installation costs, and what flexibility's exist in design? Basing a decision on these questions can help produce a reliable system for any company.

2D and 3D Graphics Software for Lower Division Graphics Courses 53(2) 89 26-33
Steven K. Mickelson
Abstract: A description of the 2D graphics package, EDRAW, and the 3D graphics package, GEOM3D, both developed by the Freshman Engineering Department at Iowa State University, is given. Integration of this software usage into a course covering fundamentals of graphics, computer graphics, and engineering design is outlined.

Effects of MicroCAD On Learning Fundamental Engineering Graphical Concepts: A Qualitative Study 54(1) 90 25-34
James A. Leach & Randall L. Gull
Abstract: Students' reactions and performances are examined when taught engineering geometry concepts using a standard microcomputer-aided drafting (microCAD) software package. Two purposefully sampled groups were investigated: one group had extensive to moderate computer experience and the other had limited to no computer experience. Data were collected using videotapes, individual and group interviews, and document analysis. Interpretations and conclusions were deduced by coding and categorizing data into emerging trends. Recommendations are given for teaching engineering graphics courses using microCAD

Choosing a Graphics Software Package for Educational Software Development: A Comparison of PHIGS and HOOPS 54(3) 90 3-9
Judy M. Vance & Roland D. Jenison
Abstract: A major factor in software development for educational applications is the choice of a graphics interface. The amount of time required to write the code is a function of the level at which the software is interfaced with the hardware. Two graphics interface packages, PHIGS and HOOPS, are examined. Both have been purchased for the APOLLO and VAX workstations in the Engineering Computing and Information Laboratory (ECIL) at Iowa State University. A comparison of the two packages is made in light of the College of Engineering's needs for educational software. Conclusions based on programming experience using both PHIGS and HOOPS are also presented.

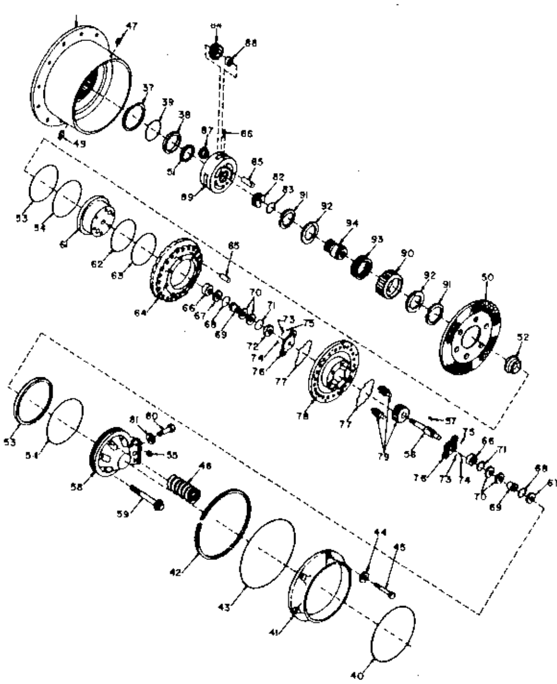


Faster Ellipse Drawing Algorithms **55(2) 91 42-51**
Sandra J. Cynar
Abstract: Improvements to the midpoint scam-conversion algorithms used to draw ellipses are described. The two methods described are each made more efficient. The first algorithm is a minimal pixel algorithm that requires more operations for selecting each pixel. The second algorithm requires fewer operations per pixel, but plots more pixels. The extra time for the added pixels often overbalances the time saved in computing their positions. Each of these disadvantages is lessened to make these algorithms more efficient.

Interactive Computer Graphics Software for Teaching CADD **55(3) 91 15-20**
John G. Cherng & Wen J. Wu
Abstract: This paper presents the methodology and approaches that are employed to develop interactive computer graphics for teaching CADKEY in a freshman Computer-Aided-Design-Drafting (CADD) course. The software was written in the CADKEY Advanced Design Language (CADL). The software consists of CADL subroutines (i.e., CADL files) and macros to provide the student with descriptions, examples, and exercises for several key functions of CADKEY.

The software is interactive, self-explanatory, and menu driven.. Students communicate with the software by responding to the prompts and taking properly instructed actions.The experiences received using this software and the availability of the software are outlined in this paper.

The Use of a Parametric Feature Based CAD System to Teach Introductory Engineering Graphics **59(1) 95 27-33**
Steven K. Howell
Abstract: New computer tools have significantly changed the role of engineering design graphics during the last few years. One tool, parametric feature based CAD, allows engineering graphics to go beyond the role of documentation and communication. The use of a parametric CAD system closely parallels the engineering design process. Parametric CAD systems allow an engineer to actually build a *virtual prototype* of a design idea or concept and subject that model to various scenarios which can be modified as the design solution is refined and implemented. AutoCAD Designer, was used as the primary tool to teach fundamental concepts of three dimensional geometrical modeling and design in an introductory engineering graphics course at Northern Arizona University. Parametric CAD promises to have a significant impact on the pedagogy and structure of engineering graphics courses.



Course Development

Descriptive Geometry By Freehand Technique **39(2) 75 29-30**
Richard Johnson
Abstract: Effective utilization of time in engineering and technical education has become more imperative than ever before. All content areas have expanded as industry places greater demands on the graduates of these programs. This need to productively use the student's time begins at the freshman level with engineering graphics and descriptive geometry. One practical way to increase usable time for descriptive geometry is to implement freehand sketching to a greater degree.

Creativity – Ingenuity – Or Frustration? **41(3) 77 38**
Robert D. LaRue
Abstract: When students are given the opportunity to participate in a design project of their own choosing, the results may be somewhat different than one would expect. Normal procedure for these projects is for the student to submit a brief write-up on the proposed project for instructor approval. Once this has been obtained, the student develops his solution. In addition to the final report submitted to the instructor, an oral report is presented to the class. Generally, overhead projector transparencies of certain phases of the project are used in these presentations.

The Overlay in Engineering Graphics 41(3) 77 58-59
Gilbert E. Hutchinson
Abstract: The rewards of teaching engineering graphics are many. Introducing graphics as a useful new language, encouraging the development of the skill and perception to read a drawing and hearing the comment, "This is fun!", are all exciting. But along the way, there is an apparent need to communicate to each student the degree of his progress, in a personal and constructive way. Whether the course is engineering graphics, spatial analysis, or technical drawing, effective feedback to each student is needed on the drawings made and submitted. The author has used the transparent plastic overlay for several years now to provide this feedback.

The Inevitability of Computer Graphics 43(1) 79 13-19
Robert N. McDougal
Abstract: This paper offers comments on traditionally taught Engineering Graphics. References are made to the comments of several educators and industrial representatives. The beneficial results of curriculum changes in Engineering Graphics at the University of Nebraska at Lincoln are discussed. Suggestions are offered relevant to the benefit of using visual aids, group participation, and particularly Computer Graphics as teaching and motivating tools. Included in the Appendix is a listing of visual aids sources, textbooks, etc. used by those Universities who respond to a survey made by the author.

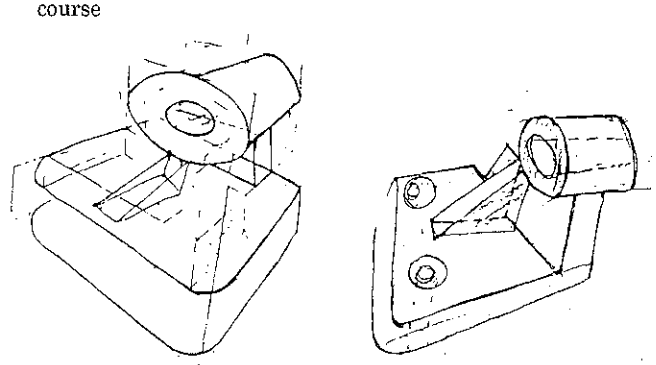
Coordinatographs for Automation of Drafting and Design 43(1) 79 38-40
Daniel L. Ryan
Abstract: This article deals with an attempt to modernize and update drafting course content through the design and construction of a micro-graphics unit known as a coordinatograph. A coordinatograph is a highly accurate plotting, scribing, cutting or marking device for the production of graphic materials that require close size tolerances.

A Large Freshman Engineering Design Course: Past Chronology, Future Directions and Some Observations 43(3) 79 28-35
Leuba, Richard J.
Abstract: This paper describes and discusses selected features of the freshman course, E-120, "Engineering Concepts," at North Carolina State University from the inception of the course in 1970 until its final year, 1979-1980.

Computer Graphics in Freshman Engineering Programs 45(1) 81 13-15
Daniel L. Ryan
Abstract: Computer aided engineering graphics has been incorporated into a second three-semester-hour course which takes the first year student beyond the first year course on engineering graphics. The computerized graphical procedures are presented in a simplified language. Examples are taken from mechanical, electrical, and civil engineering. The guiding principle of the course is application: automated design methods and hardware consideration are presented. Emphasis is given to the existing automated and computer aided graphics programs rather than to the procedures for writing new ones.

Computer Graphics – "Perplexing" and "Troublesome" Questions 45(1) 81 33-35
Francis A. Mosillo
Abstract: This article is a review of the questions pertaining to the implementation of computer graphics courses to give those who are concerned with these issues some ideas as to how these particular problems might be resolved.

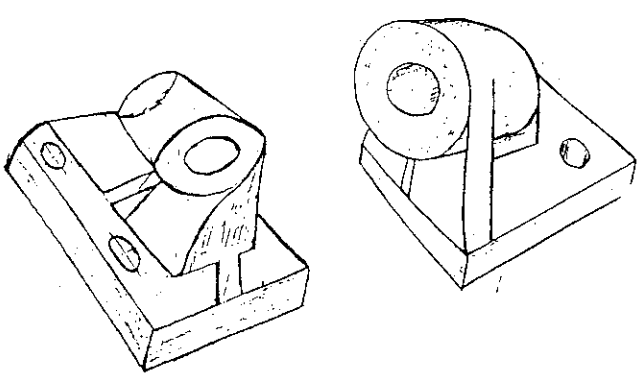
Computer Graphics use in Freshman Engineering Design Projects 45(3) 81 53-57
Wendell Deen & Ronald E. Barr
Abstract: The increasing use of computer graphics in industry has stimulated efforts to incorporate computer graphics in the freshman engineering programs at many universities. For the new engineering student, computer graphics adds a dynamic approach to drawing and offers a new tool for design. To the student who is unfamiliar with computers, computer graphics also offers a vibrant introduction to computer technology and programming. The two major problems associated with incorporating computer graphics in education are (1) obtaining the computer hardware, and (2) determining the best instructional approach . For the latter problem, the major dilemma is whether to teach computer graphics before, during, or after computer programming. This paper describes one approach towards using computer graphics in a freshman engineering graphics and design course



Development of Interactive Computer Aided Drawing Instruction: A Long Range Plan for Engineering Graphics at North Carolina State University 48(1) 84 25-27
William A. Ross
Abstract: The rapid evolution of microprocessors and expanding computer graphics capabilities have created a myriad of perceptions for those concerned with Engineering Graphics education. Enhancing the limitless visual-analytical powers of the human mind with an extremely fast and powerful problem solving tool is an exciting prospect. The computer presents a highly complex, controversial and perhaps unavoidable challenge for Engineering Graphics educators. The purpose of this paper is to describe how we are addressing this issue at North Carolina State University.

Engineering Graphics/Computer Graphics an Iowa State Interim Report 48(1) 84 28-33
Ronald D. Jenison
Abstract: Two years ago, a freshman engineering classroom accommodating 48 students was equipped as an instructional computer graphics facility. Twenty-five terminals, including one for the instructor station, were available for computer lectures and interactive exercises. The terminals were Digital GIGI with BARCO monitors. A VAX 11/780 served as the host machine. The facility could handle 350-400 students per semester operating on an 8 a.m. - 5 p.m. class schedule. Approximately 25 open laboratory hours were scheduled per week.

The Arc Subroutine Exercise 48(1) 84 34-36
William J. Kolomyjec
Abstract: One exercise that seems to work particularly well with freshman engineering students in an introductory computer graphics course involves producing *single view* drawings of objects with curvilinear shape. This article will present: a generalized arc drawing algorithm, a corresponding logic diagram, and an example. The material would be presented to the student in much the same way. However, we will go one step further and present a complete listing of the program in Applesoft BASIC at the article's conclusion.



The OSU Freshman Graphics and Programming Sequence 46(3) 82 16-21
Michael J. Miller, Jacob J. Wolf III & John T. Demel
Abstract: When Autumn Quarter 1980 opened at The Ohio State University 240 freshmen engineering students began a new, experimental course sequence designed to add interactive computer graphics programming skills to their graphics and programming courses. They were followed Winter Quarter by another 120 students. The sequence, consisting of three 3-credit hour courses to be taken during consecutive quarters, would lead each of them to write a complete computer aided interactive drafting package consisting of about 2000 lines of FORTRAN code using Tektronix PLOTIO graphics subroutine calls.

This new course sequence grew out of a perceived need to produce graduate engineers who are not only computer literate but are capable of contributing effectively in engineering departments of industrial firms that rely heavily on

University of Missouri-Rolla Computer Aided Drafting 48(3) 84 27-28
Wells N. Leitner
Abstract: The University of Missouri-Rolla installed its CAD/DAM system in 1980. It was first used in our freshman Engineering Graphics classes in the summer of 1981. Since then the equipment and software have been updated and improved.

Computer Aided Design Problems for Second-Year Graphical Design 48(3) 84 19-26
George L. Swancutt
Abstract: The University of Missouri-Rolla introduced computer aided graphics to the second-year graphical design students during the 1981 fall semester. This was made possible by the purchase of new computer equipment and software in 1980. The students can create detailed 3D drawings from *menus* with such drawing functions as lines, arcs, circles, crosshatching and dimensioning.

Engineering Graphics Instruction Using Applied Computer Aided Drawing: Status Report — 49(3) 85 39-43

William A. Ross

Abstract: The evolution of microprocessor technology and resulting developments in computer graphics are rapidly expanding the field of engineering graphics and merging it with sign and manufacturing. The unique ability to create, modify, manipulate and 'simulate' three-dimensional models of objects with computer graphics allows the creation of new instructional methods for assisting engineering graphics students in developing their visual and spatial thinking. Yet, ignorance of the elementary properties of spatial geometry is profound. We teach our students a great deal about triangles but almost nothing about the tetrahedron, a principal building block in constructions from the atomic structure of metals to the supports of giant bridges."

CAD Instruction: The "Buddy" System — 49(3) 85 48-49

Judy A. Watson

Abstract: Many schools today are faced with the challenge of adding CAD courses to their curriculum. As soon as CAD courses are initiated, the demand quickly surpasses the enrollment capacity. A major concern is how to serve large number of students without sacrificing hands-on experience. The Technical Graphics Department at Purdue, opted to use a "buddy" system as a means of increasing class size.

The Impact of Micro-CADD in Engineering Design Graphics Instruction — 50(2) 86 20-23

Michael H. Pleck & Thomas R. Woodley

Abstract: This paper presents a digest of project highlights and assesses the impact of micro-CADD and engineering design graphics instruction within the framework of departmental experience.

Cognitive Processing and the Teaching of Engineering Graphics — 50(3) 86 15-18

Deloss Bowers

Abstract: This paper presents the approach parameters, techniques and observations of two semesters of experience with the teaching of engineering graphics to freshmen engineering students based upon cerebral lateralization and cognitive processing theory.

An Attempt at Computer Graphics Education — 50(3) 86 41-48

Shinobu Nagashima & Hiroshi Isoda

Abstract: The authors attempt to create a course in computer graphics at their institution.

Design and Implementation of a CADD Lab at The University of Wisconsin-Milwaukee — 51(3) 87 36-45

Edward W. Knoblock

Abstract: Having followed the development of Computer-Aided-Graphics and Design for many years, our faculty was anxious to become participant. Yet, with very limited resources, we knew that it was paramount that the task be done carefully and correctly. This paper describes the process of planning, designing and implementing a CADD laboratory at the University of Wisconsin-Milwaukee. The lab serves both a freshman engineering graphics and a sophomore engineering design course. The paper also describes some of the impact that this development has had on other college facilities.

Using 3D Industrial CADD Software in a Teaching Environment — 51(3) 87 46-48

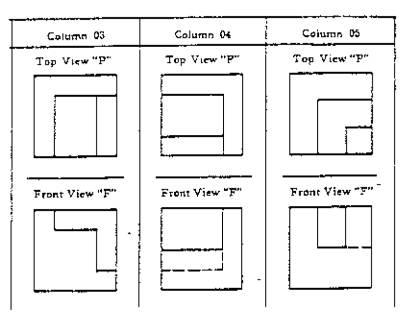
J. Simoneau, C. Fortin & R. J. Ferguson

Abstract: There is a firm commitment at the Royal Military College of Canada to introduce computer aided drafting and design (CADD) to all engineering students. It was decided to teach CADD by including it in the engineering graphics course, which is given to all second year engineering students. The goals are to teach the students the basics of CADD in general, and to make them aware of its possibilities and its power as a tool in engineering design and communication. On a longer term basis, we want to integrate CADD into the conventional graphics course and to use it to reinforce the students' understanding of pictorials, orthogonal views and descriptive geometry.

Engineering Graphics as a Lecture Course? — 54(1) 90 8-17

James C. Shahan & Paul S. DeJong

Abstract: The results of an experiment in teaching engineering graphics using the traditional lecture-homework-laboratory technique are compared to a newer lecture-homework proposal. While the newer method reduces professor-student contact, it may prove to be as effective as the older method requiring laboratory instruction.



Development of a Graduate Course in Computer Aided Geometric Design 55(3) 91 27-32
Holly K. Ault
Abstract: A graduate level course in computer aided geometric design for mechanical engineers has been developed at Worchester Polytechnic Institute. Results of several recent programs to study the modernization of the engineering design graphics curriculum are incorporated into the design of this course Although these studies focus primarily on freshman graphics programs, the important concepts which have been identified as fundamentals in engineering graphics education may be presented in more depth at the graduate level. This new course focuses on theory and techniques for ideation and refinement of geometric models used in mechanical engineering design applications.

Balancing Research and Professional Development with Engineering Graphics Instruction 55(3) 91 33-39
Paul S. DeJong & James C. Shahan
Abstract: Many engineers turned educator, find themselves expected to devote less time to a larger group of students and more time to conducting research. It is important to develop ways to assure survival of the faculty member's well-being, the students' education, and the institution's reputation. The authors have conducted a series of experiments to investigate alternative methods of managing lower division graphics courses. In this experiment, daily work was never collected and graded, but simply accounted for by evaluating project completion and *reasonable effort*. All class periods were devoted exclusively to student assistance, exercise accounting being done while proctoring exams. Non-exam grading time was reduced to nearly zero, creating time for professional growth, proposal development, and meaningful research. Results of the experiment are described and recommendations made based on tabulated and graphed student grade profiles, attitudes, and comparisons with control groups.

Integrating Geometric Modeling into Computer Aided Structural Engineering Courses 56(1) 92 9-13
Janice J. Trautner
Abstract: The modernization of two computer aided structural design and engineering courses is presented. Historically, the courses overlapped finite element course content significantly, lending little uniqueness and value to the courses aside from theory applications exclusively relevant to structural engineering. Development of the courses from computer aided analysis state to courses which include the history and mechanics of geometric modeling, and its applications to structural engineering is traced. The courses' prerequisites, objectives and how these objectives are met within 30 student-instructor contact hours per quarter is discussed and illustrated by presenting the general courses' syllabi.

Lecture material is discussed which supports homework assignments, presents the basic history and scientific development of computer graphics, defines computer graphic vernacular, and summarizes the general development and future of computer graphics in the structural engineering industry.

Hardware, Software, and Curriculum Decisions for Engineering Graphics Instruction Using CAD 56(1) 92 14-21
W. L. Lorimer & D. K. Lieu
Abstract: The integration of personal computers into engineering graphics instruction is particularly difficult at the freshman level. In Spring 1990, the Mechanical Engineering Department at the University of California, Berkeley converted its basic engineering graphics course, which traditionally enrolls approximately 300 students per year, entirely from drafting board to PC based CAD. IBM AIX was used as the primary operating system to provide networking, assignment file access, and file security for examinations. To provide software and file compatibility with student home PC's, the CAD software was DOS-based, operating under AIX. Recommendations for laboratory facility design and adaptation of traditional graphics curriculum are forwarded based upon this experience.

Scientific Visualization: An Experimental Introductory Graphics Course for Science and Engineering Students 56(1) 92 39-44
Eric N. Wiebe
Abstract: A new course, *Scientific Visualization'*, has been offered by the Graphic Communications Program at North Carolina State University. The purpose of the course was to allow undergraduates to use computer based graphics as both a problem-solving and communicative tool in engineering, the sciences and other technical areas. Rather than focus on the more traditional areas of engineering graphics, this course explored a much broader role of graphics in science and technology. The course consisted of lecture, demonstrations, field trips and both in-class and out-of-class lab work on the computers. In addition, there were readings in current applications of graphics in various scientific and technical fields. Recommendations are given to the future direction of this course and its role in the engineering design graphics curriculum.

Utilization of Solid Modeling in Engineering Graphics Courses 56(2) 92 5-10
James A. Leach & Robert A. Matthews
Abstract: This paper presents a proposed engineering graphics course sequence restructure employing current solid modeling technologies. Rationale given for the course restructure is based upon recent research and publications of the engineering graphics educational community as well as industrial trends in the design-to-manufacture sequence. The proposed course sequence makes use of computer-generated solid modeling geometry to exercise students' visualization capabilities and to emphasize concepts, standards and conventions of creating graphics for engineers.

On Teaching Computer Aided Design Concepts to Industrial Engineers 56(2) 92 11-18
Bopaya Bidanda, Larry J. Shuman & Richard Puerzer
Abstract: The Industrial Engineering Department, University of Pittsburgh, has designed and offered a course in Computer Aided Design (CAD). This course is required for junior industrial engineering students and is an elective for students from other departments. Design skills are developed through the completion of a series of unstructured problems. Students learn to manipulate the graphical database, extract information from it, and export that information to other software for further applications.

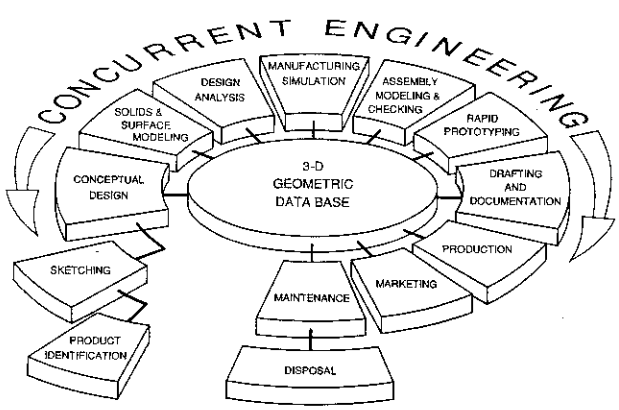
This paper describes the evolution of the course content over its history and also discusses how a knowledge of computer graphics and CAD system capabilities can be used to address a diverse range of industrial engineering applications. The relevance of computer graphics and CAD to other courses within the modern industrial engineering curriculum is also discussed. Finally, the application of these CAD concepts by industrial engineering students to two senior-level design problems is presented.

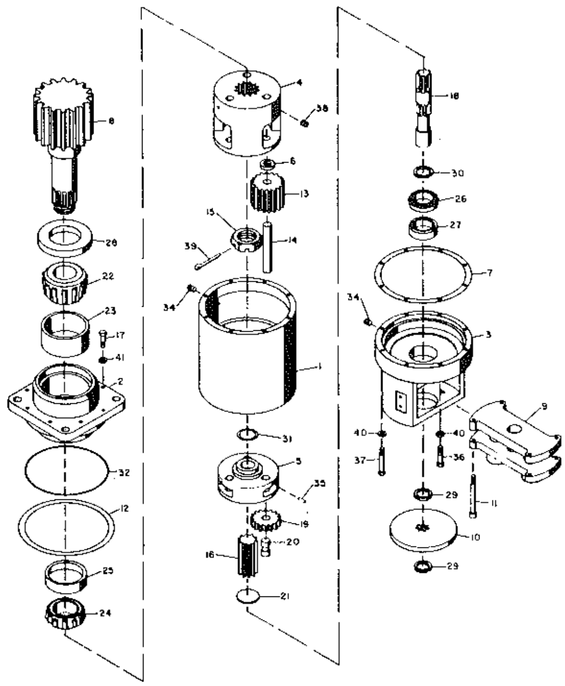
Freshman Engineering Graphics and the Computer 56(3) 92 5-11
C. E. Teske
Abstract: A gradual but definite change in the approach of teaching freshman engineering graphics is occurring at many institutions. The use of the computer in graphics is becoming the norm rather than the exception. This paper presents the approach taken at Virginia Tech and how handout material supplements printed material and supports the graphical solution to traditional engineering problems in mechanics.

Course Development Vol(No) Yr Pg

Engineering Graphics in Design Education: A Proposed Course Based on a Developed Concept 59(1) 95 5-11
James A. Leach & Mark R. Rajai
Abstract: This paper presents a course in Engineering Graphics at the University of Louisville that integrates an innovative approach to design for manufacturing of new products with traditional topics on engineering graphics for manufacturing. The need for engineering graduates to have practical design experience provided the motivation for the authors to develop a methodology entitled Design to Benefit Community and Industry (DBCI) to be implemented within the topical content of the proposed course. Pilot projects were offered in the 1994 spring and summer terms, resulting in successful student experiences and several potential inventions. Due to the versatile content of this course, the authors believe the course could be adopted by other engineering departments with minor modifications. The content of the course and its role in enhancing a student's competitive edge for the job market of tomorrow are discussed.

A Course for the Development of 3D Spatial Visualization Skills 60(1) 96 13-20
Sheryl A. Sorby & Beverly J. Baartmans
Abstract: In January 1993, the authors of this paper received NSF funding to develop a pre-graphics course for freshman engineering majors who are weak in 3D spatial visualization skills. A text and computer lab manual utilizing I-DEAS software were developed specifically for this course which is 3-credits (quarter system) with two hours of lecture and two hours of lab each week. It was offered at Michigan Technological University (MTU) for the first time during the 1993 Fall term. The Purdue Spatial Visualization Test: Rotations (PSVT:R) was administered during freshman orientation and those students who scored less than 60% correct were counseled into the course. The objective of the course was to provide the prerequisite spatial skills needed by students to succeed in their subsequent engineering design graphics courses.





Curriculum

Non-Engineers Need Graphics Too 39(2) 75 9-10
Earl T. Ratledge
Abstract: Engineering students, thanks to accreditation agencies and the like, have been required to take courses in the humanities, social studies, and the like for many years. This emphasis on wider horizons and broader education is beginning to show up in other colleges. In some universities the students are being.

The Anderson - Hennigan Syndrome 39(2) 75 26
D. Anderson & James K. Hennigan
Abstract: In comparatively recent years a unique affliction is becoming more evident in academic circles. It appears to be more concentrated in the area encompassing those institutions which offer graduate study in one or more of the engineering disciplines and especially those offering terminal degrees.

Engineering Graphics- An Updating Report 39(2) 75 27-28
Menno Di Liberto
Abstract: The writer has recently returned from a ten week "professional heave" granted by Ohio University for the purpose of updating himself in the field of engineering graphics. The term engineering graphics is used to cover the total field of solving engineering type problems using graphic techniques. These techniques involve the use of graphics such as descriptive geometry, graphical mathematics, vector analysis, working drawings, and computer graphics.

A Graphics Survey 39(3) 75 10-11
Clarence E. Hall & Charles T. Sands
Abstract: The Engineering Graphics Department of Louisiana State University recently conducted a survey of the graphics programs of fifty-three universities. This information was sought to complement the industrial input received from surrounding industries, and to also serve as a basis of comparison with other institutions. The results are published here.

A Review of the Visiting Engineer Program 40(1) 76 32-36
James H. Earle
Abstract: The Engineering Design Graphics Department of Texas A&M University initiated an industrial flavor to their two engineering design graphics courses in 1966. This program was an interface with industry which brought practicing engineers from industry into contact with freshman engineers on a working basis, enabling the students to obtain an introduction to the engineers' approach to problem solving. This program was called the Visiting Engineer Program.

What Industry Needs in Design Engineers 40(2) 76 10-13
Anthony E. Turner
Abstract: Academic curricula has, no doubt, been finely tuned over the years and supplemented whenever necessary by evolving technology. However, industry is still experiencing lack of practical understanding by "raw" graduates in many areas, particularly those involving needs and information, values and alternatives. An attempt is made to describe the requirements of the "real world" in which design engineers will ultimately be applying their skills.

What Others are Doing 40(2) 76 39-41
Clarence E. Hall
Abstract: What other teachers of graphics and descriptive geometry are doing in foreign countries should be of interest to all members of our Division.

During the current school year Professors Borah Kreimer and Clarence Hall have been in correspondence with several professors of graphics and descriptive geometry throughout Europe, Russia and Asia. One particular result of this correspondence was the receipt of a German textbook written by Professor Fritz Hohenberg, Technischen Hochschule in Graz, Austria. This is an outstanding text, and it has been translated into several languages with the exception of English. Professor Hohenberg is considered one of the most outstanding professors of mathematics and descriptive geometry in Europe.

Engineering Graphics at the University of Arizona 41(1) 77 36-37

Robert M. Barnett

Abstract: Engineering Graphics means different things to different people. To some it is basic drawing of mechanical parts, to others descriptive geometry, to others the designing of objects or devices, to others some combination of these. The University of Arizona has examined the background of our students, the time (credit hours) allotted for graphics, and the objectives of the departments in engineering. Courses students take concurrently with graphics and courses they will be taking subsequent to graphics, were examined. This information was used tp set up goals and objectives for our courses.

Who Needs Graphics? 43(2) 79 19-20

Karl A. Brenkard

Abstract: The author tells how he believes there will not be an expansion of engineering graphics in the engineering curriculum, but a continuing fight to keep it from being eliminated altogether.

Integrating Computer Graphics into a Technician Training Program 45(3) 81 22-25

Victor Langer

Abstract: Computer graphics was chosen by the Milwaukee Area Technical College (MATC) as the area with which to develop a model for career planning and partnership with industry. MATC proceeded with an NSF-CAUSE Project to retrain faculty, develop curriculum, develop partnerships with industry and workers, and simulate a work environment. With Co36 mputervision Corporation, as a partner, the computer graphics skills are being integrated into eleven occupational programs. The curriculum update resulted in modification of appropriate instructional units as well as the addition of a basic operator course and advanced courses. In the first year, over 200 students were enrolled in two-credit courses.

Graphics and Design in the Engineering Curriculum 45(3) 81 51-52

Gerard Voland

Abstract: Engineering design graphics courses offer the opportunity to achieve a wide range of educational goals to the instructor. Together with physics and mathematics, they form the foundation of a freshman engineering program.

Curriculum Vol(No) Yr Pg

Freshman Graphics at Triton College 47(3) 83 14-21

L. V. Brillhart & Eric A. Bell

Abstract: Engineering education has traditionally been a structured continuum. Students are introduced to scientific and mathematical fundamentals. The knowledge acquired from these courses is immediately applied to core engineering courses. Only after students are well acquainted with the basics of their chosen field are they introduced to the design process. Triton College felt that computers and specifically computer graphics should be introduced into the curriculum in an analogous manner. Students should be introduced to the fundamentals of computer usage and programming in the freshman year, continue their programming skills with further computer courses and then apply their skills in core courses. This sequence of exposure to the computer was felt to adequately prepare them for the decision making process of advanced courses, especially design courses.

Engineering Graphics Takes a New Direction 48(1) 84 12-18

Josann W. Duane

Abstract: The role of graphics in the engineering curriculum is changing. Engineering graphics faculty members at Ohio State recently became a part of this change as a result of: 1) The development of an undergraduate course sequence that integrates computer programming and engineering graphics through the common medium of computer graphics, and 2) the initiation of graduate level instruction in computer graphics for engineering design and analysis. This paper summarizes the thinking that has governed these recent changes in Ohio State's engineering graphics curriculum and presents the new direction we see this discipline taking.

The Problem of Abandoning Fundamentals in Academia 48(3) 84 35-36

G. Blakney

Abstract: While there are few propositions about which there is universal agreement at the university, that would appear to be the case for the proposition that undergraduate students learn something other than reading articles in Engineering Education would reveal. Exceptions appear in the form of those few recommendations oriented towards placing engineers experienced in industry in the classroom rather than engineers who have been students all their life. Another exception might be the acceptance of instruction in applications at the graduate level. In either case, it is not likely that proposals such as these would point out a significant reduction in the instruction of fundamentals.

The Impact of Computer Graphics on Instruction in Engineering Graphics 50(2) 86 24-33
Jon K. Jensen

Abstract: For an engineering college, keeping pace with advances in industry and being responsive to the needs of students is an important aspect of curriculum development.

Traditional Engineering Graphics Versus Computer Aided Drafting: A View From Academe 51(1) 87 38-43
Robert J. Foster

Abstract: It is the rare person who has not heard of the power of computer aided drafting, CAD, to assist the engineer in a primary role of engineering: Design. Indeed, many engineers are using CAD packages to assist them in their design work. So well covered in the media is the power of CAD that many persons may have the impression that manually expressed engineering graphics is an antiquated relic lingering within engineering curricula. Perhaps the day has arrived to answer this challenge to traditional engineering graphics.

Descriptive Geometry and Geometric Modeling 52(3) 88 1-11
J. Alan Adams

Abstract: An impressive evolution of computer interaction has occurred in the past twenty years. Before this evolution took place, the foundation courses for engineering study were based upon graphics and geometry. Educators struggle with how to cope with computer technology now that the computer can perform many of the manual tasks previously associated with graphics and geometry. The presence of personal computers and applications software has not made the decision any easier. All disciplines must struggle with what students should know before they begin to use the marvelous black (or white) boxes which apparently can produce solutions to just about any type of problem.

The best approach to the new educational needs of engineering students is again to develop foundation courses based upon graphics and geometry. They will not look like the previous courses, but the basic principles should still be there. The goals for the new foundation courses, in order of importance, should be as follows:

1. Develop a spatial awareness and reasoning capability.
2. Create both a graphical and mathematical foundation for solving geometric problems.
3. Learn to use the computer as a tool for analysis and design.

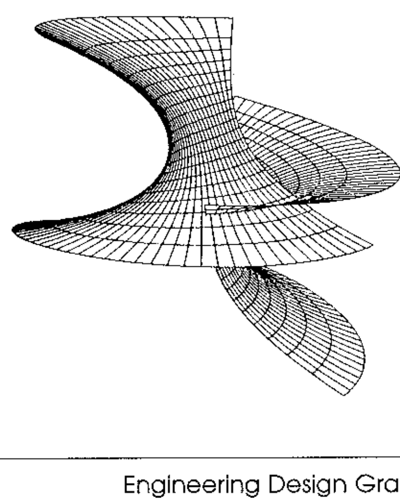
Facilitating Curricular Integration of Multidisciplinary Design 56(1) 92 5-8
Lawrence J. Genalo

Abstract: Many studies of engineering education in recent years have pointed to a needed improvement in multidisciplinary design education. The College of Engineering at Iowa State has undergone major changes, including the creation of a new administrative unit for multidisciplinary design education. The Division of Engineering Fundamentals and Multidisciplinary Design will extend the multidisciplinary effort through the entire four-year curriculum. In cooperation with several engineering departments, most notably Electrical and Computer Engineering, an attempt to infuse more realism in the senior capstone course has increased industrial participation in the selection and sponsorship of senior projects.

This paper will describe discipline-based, industrially-sponsored projects, the shortcomings noted, and the plan to integrate multidisciplinary design into the four-year curriculum.

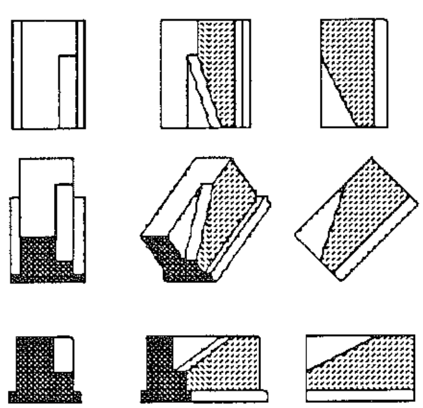
A New Look at the Engineering Design Graphics Process Based on Geometric Modeling 56(3) 92 18-26
Ronald E. Barr & Davor Juricic

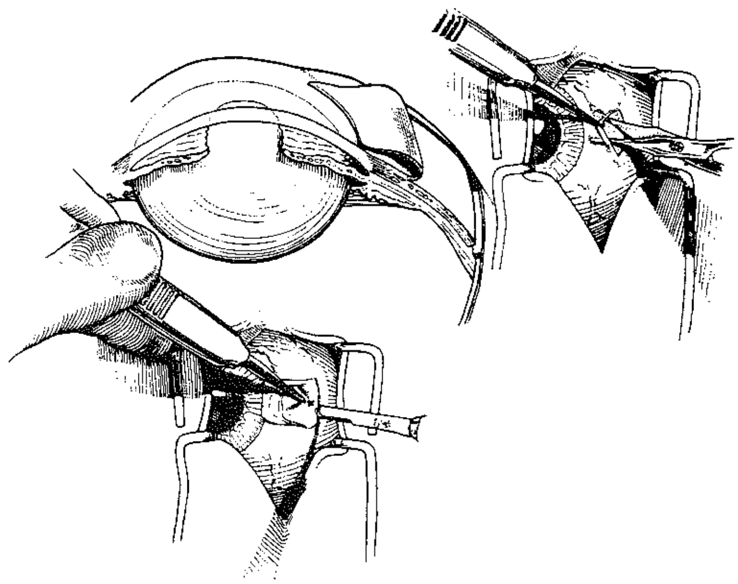
Abstract: Engineering Design Graphics (EDG) is a discipline directly related to and supportive of the engineering design process. As fundamental methods for engineering design change, it is reasonable to expect that the graphical requirements for engineering design also change. The proposed model for the EDG process, consisting of *Ideation, Development, Communication, and Documentation,* seems appropriate without regard to methodology. However, implementation of this EDG process in the modern engineering curriculum requires details which depend on the current design representation methodology. This paper reviews prevailing models of the evolving engineering design process and comments on its impact on the modern EDG process. The development of a 3D geometric model is proposed as the modern basis of the EDG process and as the *common thread* for an integrated undergraduate engineering design curriculum.



A Structure & Rationale for Engineering Geometric Modeling **57(3) 93 5-19**
Gary R. Bertoline
Abstract: This paper proposes an engineering graphics curriculum model by first categorizing human knowledge, then subdividing it into more manageable divisions. In this way a knowledge base for engineering design graphics is defined and logically organized. The major conceptual features of graphics knowledge is outlined to define a new paradigm used to develop engineering graphics curriculum content. This technique resulted in a more refined definition, logical place, and philosophical foundation for the existence of graphics in engineering education. The model was developed so that the subject matter could be grouped into more functional and manageable divisions useful when developing curriculum. Finally, a name change is recommended to reflect the paradigm shift and resulting curricular modifications.

Extending Engineering Design Graphics Laboratories to have a CAD/CAM Component: Implementation Issues **60(2) 96 26-41**
Davor Juricic & Ronald E. Barr
Abstract: This paper reports on the on-going, NSF-sponsored research project to extend the Engineering Design Graphics (EDG) curriculum to include introductory instruction and laboratory experience in CAD/CAM. The current EDG paradigm, which includes sketching, CADD, and solid modeling exercises, is being extended to include direct modeling applications to design analysis and prototype manufacturing. The proposed new EDG curriculum is more representative of modern engineering, will facilitate integration of design and manufacturing experiences throughout the engineering curricula, and has high potential to inspire lower division students to persist in their studies. This paper presents the background of the project and discusses the major issues for project implementation: introduction of finite element analysis to lower division students, feasibility of classroom prototype manufacturing, and curricular issues relevant to two- and four-year engineering programs.





Design

Design Simplification **40(1) 76 42-43**
Edward Holland, Jr.
Abstract: Many complex engineering problems can be solved by relatively elementary means. The piece of equipment shown, represents the ultimate in a simplified solution to a rather complicated engineering problem.

What is the Purpose of Design? **42(3) 78 37**
Francis A. Mosillo
Abstract: The author speaks in depth about the purpose of design:
1. To develop new products or systems
2. To bring recognition to one's institution
3. To be a vehicle for teachers to work in their area of expertise
4. To motivate the student in our competitive society

Look What Design has Done for the Toothbrush **43(2) 79 50-54**
J. Roger Guilfoyle
Abstract: The author explains what makes the new Reach toothbrush design different from all of the others while answering the question 'What's best in a toothbrush?'

The Geometry of Aesthetics – A Case Study **44(2) 80 33-37**
R. Patteson Kelso
Abstract: Greatest aesthetic success occurs when the geometrically similar areas within the canvas are also geometrically similar to the overall canvas shape.

Abstract: Presented in the article is a way to make an immediate impact with the subject and arouse interest and inquiry among the students about the kinematics of machine and cam design.

Abstract: This article is a demonstration on a recognized successful commercial design. It is not a harmonic analysis, but geometric derivations of the harmonically derived design features.

Abstract: In the case of a cam design the computer can be of real help to the design engineer, providing him with as great a number of alternatives as desired, for his decision making and optimal design.

Abstract: This paper is a result of a study made by a subcommittee of the Computer Graphics Committee of the Graphics Division of the American Society for Engineering Education. Representatives of Industry and Education responded to a letter of inquiry sent by the authors requesting the use of Computer Graphics as a design tool at their respective organizations. The results of the respondents indicate that computer graphics is being used as a design tool to some extent by both industry and education.

Abstract: This was a research project on fixture design. The fixtures, presently used for holding eleven different configurations of inserts in place for laying a bead of hot-melt caulking in grooves of each insert, were inappropriately designed. The inserts were for Ever-Strait doors made by the Pease Company in Fairfield, Ohio. The author and his students were asked to help design fixtures to replace those that presently used, as the Pease Industries, Inc., lacked manpower to do the job.

Abstract: The push-pull type of door is, in most cases, very practical. However, its handle, or knob, has not been given the attention it needs. The authors tell why this is so.

Abstract: Design is the distinguishing feature of engineering. Many designs prove unsuccessful because of a faulty design process (plan) or because the process was not followed. Today the industry is struggling for survival with the realization that efficient, thorough designs completed in a minimum time frame are absolutely necessary to remain in business.

The automobile industry and other large industries such as farm equipment and aircraft are investing heavily in techniques and equipment that bring about increased productivity, thus regaining a competitive advantage in the world marketplace. Computer aided design/computer aided manufacturing (CAD/CAM) techniques are seen as providing the advantage needed. Engineering education has the charge to keep pace with the rapidly changing approach to design and the use of CAD/CAM techniques in the industry.

Abstract: The United States patenting system is based upon the principle of quid pro quo (something for something); in exchange for publicizing his invention, a person receives the right to exclude others from making, selling, or using his invention in the United States for a period of 17 years (non-renewable).

Students in design courses often generate feasible and creative solutions to perplexing engineering problems. United States Patent applications can be easily submitted by out students for their designs if we provide them with a few basic guidelines about such submissions. In this paper, a brief historical review of the patenting process is given, together with information concerning: criteria for patents; requirements for record-keeping and witnesses; patent searches; the U.S. patent Classification System; and requirements for drawings which accompany the application.

Industrial Design 47(2) 83 8-9
Jon M. Duff
Abstract: Many teachers in engineering and engineering technology are unaware that the most sophisticated graphic techniques are requisite. The field of industrial design combines much of what engineers do in a non-mathematical sense with what visual artists do in a technical sense. It is the ideal occupation for someone who has strong technical interests but who has more of a visual/graphic orientation than that normally expected of an engineer.

Stimulating Creativity in Engineering Design Efforts 49(1) 85 23-29
Gerald Voland
Abstract: This article describes techniques that can be very effective – for some people – in stimulating their natural creativity. Each designer must discover, through experimentation, which techniques are most successful for him or her.

Design Analysis in the Freshman Engineering Problems Course 50(3) 86 19-22
Lawrence J. Genalo
Abstract: The Freshman Engineering Department at Iowa State University has employed color graphics terminals in classroom settings for four years. Various uses of the computer as a tool for instruction as well as a tool for problem solving have been explored. One such use as a tool for solving a design problem in an introductory problems course will be explored in this paper.

Microcomputer Solution to the Mathematical Equivalent of the Graphical Method for Finding Radiation Shape Factors 52(1) 88 45-49
David Alciatore
Abstract: The unit sphere method was developed in order to measure the shape factor between an elemental and a finite plane. This method was modified and illustrated in this study. Using elements of computational analytic geometry, a mathematical equivalent of the sphere method was derived. The solution technique was then programmed onto a microcomputer. The microcomputer input includes the (x, y, z) coordinates of each corner of the plane. The output is the required drawing for the solution and a calculated numerical value of the shape factor.

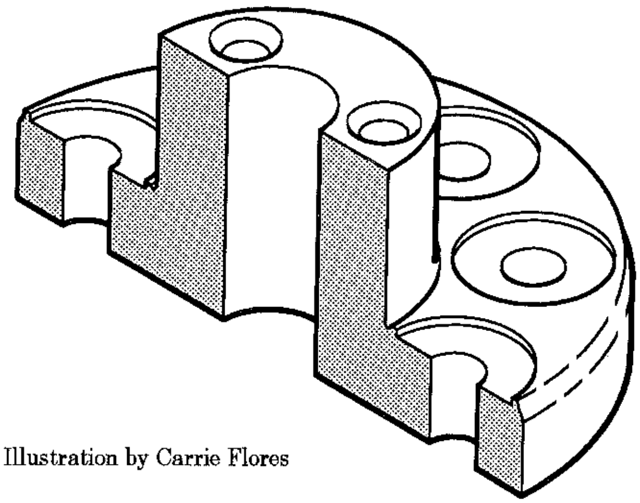
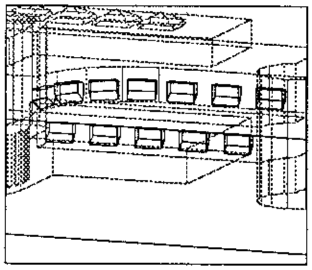
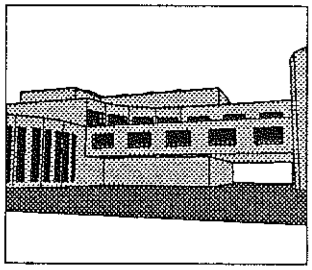


Illustration by Carrie Flores

Design for Success 53(3) 89 11-18
Gary R. Bertoline
Abstract: Integrating design projects into a curriculum can be an excellent opportunity for students to develop creativity, experience the design process, and apply engineering graphics principles. An existing course at The Ohio State University has been integrated with design problems from a local school for the mentally and physically disabled. The design problems were developed to give meaningful design experiences to students and at the same time provide assistance to disabled students at the Franklin County Early Childhood Education Center. The relationship with the school, which provided design projects and financial support, is described. The details of *Design for Success* are provided so that others can implement or use some of the ideas from this technique of teaching engineering graphics and design.

The Role of Graphics and Modeling in the Concurrent Engineering Environment 58(3) 94 12-21
Ronald E. Barr, Davor Juricic & Thomas J. Krueger
Abstract: Concurrent engineering is a new approach to product development in which conceptual design, analysis, manufacturing, marketing, maintenance, and even product disposal are considered simultaneously during the early stages of the design process. A key element in successful implementation of concurrent engineering is the development of an integrated Computer Aided Design and Manufacturing (CAD/CAM) data base. From this computer data base, a design representation or model of the product is derived for direct application to all phases of design, analysis, manufacturing, and marketing. This paper discusses the fundamental role that design representation plays in concurrent engineering, and illustrates the various graphics and modeling techniques that are appropriate for each aspect of the concurrent engineering design process.





Design Projects

Creative Engineering Design Display 39(1) 75 22
J. Tim Coppinger
Abstract: The Creative Engineering Design Display is sponsored by the Engineering Design Graphics Division of The American Society for Education. In the past seven years it has become one of the highlights of the Annual ASEE Conference. This year the Conference will be held at Colorado State University in Fort Collins, June 16-19, and will be the largest and best ever.

A Lesson for Detroit-Student Taught 39(1) 75 23-28
George T. Finley
Abstract: Recent projects from students at Art Center, long the breeding ground for the nation's auto designers, indicate capability to go beyond Detroit's cliches given freedom and proper encouragement.
implement freehand sketching to a greater degree.

Experience with Design Problems *39(2) 75 45-46*
Lawrence A. Schienbein
Abstract: At Saint Mary's University engineering design is introduced in two consecutive one semester freshmen courses: Engineering Design Graphics, and Design and Descriptive Geometry. A team design project was made a part of Engineering Design Graphics because it was thought that students entering the engineering program require a strong motivation in the first semester of studies.

Creative Design Translated into Reality 39(3) 75 6-9
Charles Baer
Abstract: Careful selection of design projects, willingness on the part of mechanical engineering students to buckle down and go to work, and encouragement by faculty have brought about the construction of a number of items from student designs that are in every day use. Four items have been designed by student in course ME 328, Introduction to Mechanical design, at the University of Kansas, and are in use either at the University or somewhere nearby.

Evaluation of Team Projects 39(3) 75 12-15
James H. Earle
Abstract: The educational process is greatly improved when realism is added to the instructional techniques and classroom presentations. This is more true of practical areas such as those encountered in engineering education where emphasis is placed on the application of knowledge.

The Library as a Design Project 40(2) 76 24-27
Francis A. Mosillo, Robert Pancner, Elmer Thogersen, & Joyce C. Werner
Abstract: Librarians and students were brought together in a unique problem-solving relationship recently when "Library Technology" was chosen as the project theme for an engineering class at the University of Illinois at Chicago Circle. All aspects of the library building, services, and procedures became subject to investigation by the students, with library staff members in all departments serving as consultants. The resulting exchange of ideas and discussion of library problems and goals proved profitable to the students for the preparation of their projects and provided the librarians with insights into the students' re-examine their own.

Freshman Engineering Design Projects 41(1) 77 38-42
Alan J. Brainard
Abstract: Freshman students in engineering at the University of Pittsburgh have some choice in their engineering course selection. A series of mini-courses or modules of seven-week duration have been developed and in service for the past three years. This paper is concerned with student projects in one of these, the creative design module.

Computer Use in Freshman Design Projects at Texas A&M University 43(2) 79 6-12
John T. Demel, Alan D. Kent & William H. Zaggle
Abstract: This paper presents the overall plan to use computer aided design and computer graphics in the freshman design project. Progress in software development and equipment evaluation is covered in some detail. Costs for data processing and proposed equipment are also discussed.

Taming the Freshman Project 43(3) 79 36-37
Jon K. Jensen
Abstract: At Marquette University engineering design is introduced in two consecutive one-semester freshman courses; Introduction to Engineering I & II. Introduction to Engineering II incorporates a team design project in addition to engineering design graphics.

Design Projects for Industry from the Student's Point of View 46(2) 82 25-28
Yuan H. Liu

Abstract: Some of my students and I successfully completed, four design projects for Pease Industries, Inc. in Cincinnati and Fairfield, OH. The Corporation primarily makes Ever-Strait Doors. The four design projects are as follows:

1. Design of fixtures to hold inserts for Ever-Strait Doors.
2. Design of automated still assembly.
3. Design of paint hanger dolly.
4. Design of impact test bracket.

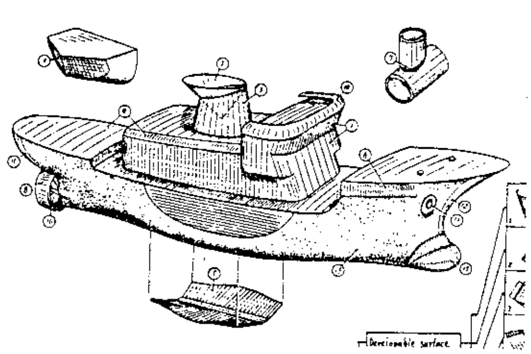
Five students in theDie Design class, were involved in the first design project. Four students in the Equipment Design Class, participated in the remaining three design projects.

Industrial Models: A Team Project Approach in Teaching Engineering Graphics 46(3) 82 26-31
William A. Ross

Abstract: This paper describes an instructional approach which was developed to introduce advanced technical drawing students at Athens Drive Senior High School in Raleigh, N. C. to organizing and conducting a simulated engineering team project. The drawings and resulting industrial model served as a medium and focal point for the project. Since this method was concerned with orienting advanced students to the engineering field and exposing them to the team approach, it may have potential for use in engineering graphics program.

Design of a Door Paint Dolly 47(3) 83 10-13
Yuan H. Liu

Abstract: This research project on the design of a door paint hanger transfer dolly was provided by Pease Industries, Inc., located in Fairfield and Cincinnati, Ohio. The dolly is used to carry door paint hangers, weighing one pound, twelve ounces each, from a place adjacent to where doors are painted to where doors are to be hooked up on hangers. After the doors are hung, they are carried away by fork lift. Each of the doors is then hung on a power-operated paint line conveyor for painting.



DesignProjects Vol(No) Yr Pg

Prosthetic Design: Reflecting the Importance of Careful Goal Identification 47(3) 83 22-25
Gerard Voland

Abstract: In engineering design, the problem which is to be solved must first be identified and then defined in terms of the specific goals to be achieved by any viable solution. In this paper, upper-limb, myoelectrically-controlled prosthetics are reviewed as examples of engineering designs which seek to achieve specific engineering and physiological goals, thereby demonstrating both the extent and the variety of goals which can be associated with an engineering project.

Freshman Engineering Design/ Graphics Problem Status: A National Study 58(3) 94 5-11
John G. Nee

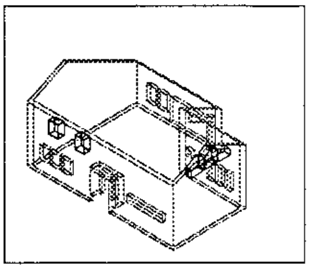
Abstract: Literature dealing with freshman level open-ended design/graphics problems has started to reveal some high interest as well as some concerns. The intent of this national study was to develop a greater understanding about the status of the design process that may or may not exist in United States university/college level freshman engineering/technical graphics classes.

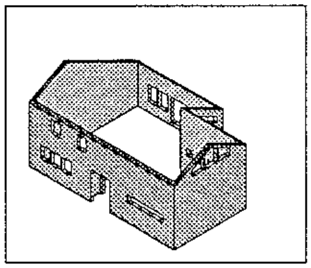
The study attempted to gather, analyze, and disseminate a summary of design/graphics' activities that presently exist across our programs throughout the United States. Study results indicated variations to design/graphics' approaches. Also, faculty opinions about freshman design issues and design/graphics examples were gathered via a comprehensive survey form.

Participants shared many of their opinions and perceptions dealing with design/graphics activities as well as numerous design/graphics problem examples. It is intended that the findings result in a more in-depth analysis and compilation of freshman level design/graphics' problems.

An Algorithm for Evaluating Team Projects 59(3) 95 18-20
Frank M. Croft Jr., Frederick D. Meyers & Audeen W. Fentiman

Abstract: Open-ended design or conceptual design is becoming more and more a part of freshman engineering programs. Nee (1992) reports that nearly 50% of the respondents to a survey on open-ended design use open-ended design problems in their freshman level graphics courses. Furthermore, he reports that 60% of the respondents believe that open-ended design should be used in freshman level technical graphics classes. The National Science Foundation has encouraged the use of design projects to teach engineering concepts through the Engineering Education Coalition Programs (NSF 93-58a). The ECSEL coalition includes *Design Across the Curriculum* in all of their freshman engineering programs (NSF 93-58c).





Dimensioning

Readability of Engineering Drawings – The Implications of Typographic Research **39(1) 75 19-21**
Andrew K. Clark
Abstract: Few in the technical world would disagree with the statement that engineering drawings are a major communications media in that world. The checker's role in verifying that the drawing will communicate accurately is admittedly a key one, but is it possible that the communicative power of a drawing is weakened by factors which are outside the checker's sphere of reference? There is a considerable body of typographic research findings which suggest that a potential source of error in engineering drawings lies in the collective drafting practices involving lettering on drawings.

Geometric Dimensioning and Tolerancing for Engineering Drawings Per American National Standard (ANSI) Y14.5 **45(3) 81 32-37**
George S. Tokunaga
Abstract: Eliminating time consuming text writing and its inherent danger of multiple interpretation, Y14.5's geometric characteristic symbol *runout* may be used as shown in this article.

Geometric Dimensioning Sentence Structure **55(2) 91 3-9**
Patrick J. McCuistion
Abstract: Many mechanical drawings have been dimensioned with the concepts and practices of geometric dimensioning and tolerancing. Complex relationships can sometimes make learning geometric dimensioning and tolerancing a difficult process. However, having the ability to read and speak the geometric dimensioning language is an increasingly important factor for employment in many positions in engineering and technology. One way to start learning the system is to learn how to interpret the dimensioning symbols.

EDG Division

Creative Engineering Design Display **40(3) 76 12-13**
Menno DiLiberto
Abstract: The June, 1976 "Creative Engineering Design Display," at Knoxville, Tennessee, was the ninth annual display since its initiation in 1968. It is sponsored by the Engineering Design Graphics Division of the ASEE. To this writer, it appears to be one of the highlights of the yearly ASEE Convention. Approximately 50 student design projects were on display and over 3,000 people came through the area to see the kinds of projects that engineering students are involved with. Most remarks from these people indicate their amazement at the ability of *College Students* in formulating and developing their solutions to the many different design problems. Their remarks providing us with assurance which insures the attainment of the primary objective of the *Creative Engineering Design Display* which is to encourage students to expend their best efforts on projects to be displayed and recognized nationally."

Zones **41(1) 77 10-11**
William H. Eubanks
Abstract: In the past many members of the Engineering Design Graphics Division have expressed confusion regarding the duties and responsibilities of the Director of zones. This article will hopefully serve to clarify to our members the duties and responsibilities of this office as well as the activities that take place within the zone and sectional levels.

Involved? **41(1) 77 12**
Garland K. Hilliard
Abstract: In this issue and successive issues of the *Engineering Design GraphicsJournal* we want to publicize in more detail the activities of the various EDG Division committees. Hopefully this will accomplish two goals. Division members and *Journal* readers should be informed of the Division's goals, accomplishments, and activities. Many members are unable to attend our regional, annual and mid-year conferences where current information is disseminated. The *Journal* should serve as the mouthpiece of Division activities through which we are informed and united behind common goals.

Profile and Practices of Contributors to the Engineering Design Graphics Journal **55(3) 91 21-26**

Robert A. Chin

Abstract: This study describes and evaluates selected bibliometric patterns associated with feature articles published in the *Engineering Design Graphics Journal (EDGJ)* from 1970 to 1989. Data from each issue of the journal were collected and compiled.

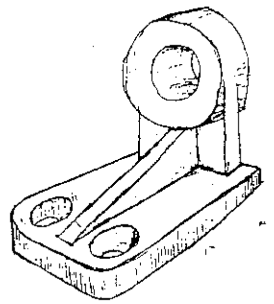
A profile of the contributors was developed in terms of author productivity and affiliation. A profile was also developed of selected authoring practices associated with the preparation of feature articles published in the *EDGJ.* The data suggests that certain individuals have an affinity for publishing in the Journal, and that individuals affiliated with selected organizations make frequent use of the *EDGJ* as a means of disseminating research findings.

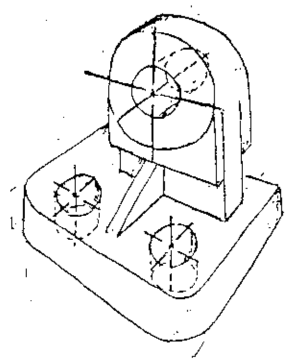
There is a general inclination on the part of researchers toward collaborative efforts and that selected individuals are more involved in collaborative efforts than others. Authors of feature articles are citing works associated with their research and works used in the preparation of their articles.

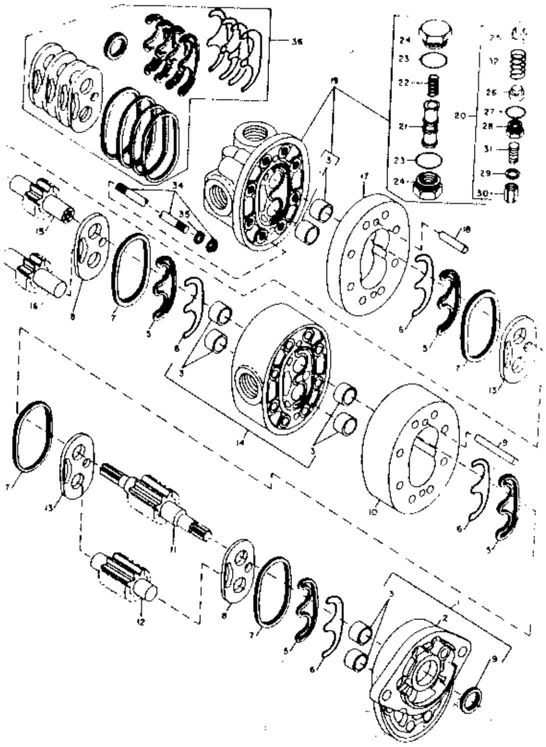
Impact of the Review Process on the Engineering Design Graphics Journal **58(1) 94 24-29**

Robert A. Chin

Abstract: A review process was introduced to the *Engineering Design Graphics Journal (EDGJ)* in 1986 with the publication of issue one, Volume 50. The first reviewed articles appeared in issue three of Volume 50. According to Jon Duff (1986), Editor of the *Journal* at that time, the purpose of incorporating the review process in the publication of technical papers was to "assure the kind of publication that best serves our Division and its members" (p. 4). An examination of the impact of the review process on the *EDGJ* was undertaken. The results tend to suggest that (a) adoption of the review process has, by one measure, improved the scholarliness of the *Journal,* and (b) there may exist a relationship between works published by the *Journal* since it adopted the review process and the makeup of the review board.







Education

Testing with Slides in Graphics **40(1) 76 27-31**

Edward Holland, Jr.

Abstract: A variety of audio-visual techniques have gained widespread acceptance in engineering graphics during the past two decades. Engineering graphics concepts have been successfully taught using such media as transparencies, slides and filmstrips, closed circuit television, and single concept film loops, with varying degrees of success. It appears that these instructional aids provide the instructor with an improved and more efficient mode of presentation than the lecture-chalkboard method, but these instructional aids lack one important ingredientóthat of placing the student in a more active learning environment.

Motivation Through Computer Graphics **40(1) 76 37-41**

Frances A. Mosillo & B. E. Wolf

Abstract: The need for engineering graduates to interpret blueprints continues to be vital while the need for them to be proficient draftsmen has diminished thus, more appropriate ways of presenting graphical material have become obligatory. This paper describes the program at the University of Illinois at Chicago Circle which was designed primarily to motivate and teach the basic principles of multiview projections. In addition, there have been several other beneficial effects resulting from introducing the student to the computer facilities and the computer graphics components.

Abstract: I am not sure that this title is self-explanatory. It suggested itself from the wide diversity in the present methods of teaching drawing, and the rather general feeling of unrest, as indicated partially by the abnormal number of text-books on drawing, and particularly on descriptive geometry, that have been appearing recently. The prevailing tone of defense or explanation in the introductions of these books echoes in a way the lack of satisfaction in some of the schools and a desire to do something for a change. To say that drawing is a fundamental subject in a technical school seems so trite as to be needless. It is of course recognized as a subject necessary for students as preliminary to all their engineering work.

Abstract: This article presents the experience of use of a CRT terminal, a teletype terminal, hardcopy and graphics tablet through the first year of the installation of the system as an educational center at Vanderbilt University. The system was used extensively nearly every day, including many days on the weekend, by undergraduates learning the techniques of graphic analysis, graduate students compiling and analyzing major portions of their thesis, and other members of the University for analyses of their research.

Abstract: The plan file shown provides a convenient and organized method to store student drawings and reference prints. The materials for the file consist of approximately 40 linear feet of 1x4 pine, 100 linear feet of either 4 inch diameter ABS pipe, or less expensive cardboard tube, and one piece of 1/4x3 Ωx24 inch masonite. The tubes can be glued together to form horizontal and vertical rows. The 24 inch tubes will accommodate 24"x36" drawings, and the 18" tubes will accommodate 18"x24" drawings.

Abstract: The real title of this article is, *The 3D Blind, the Recognition and the Cure.* The former was chosen to forcefully bring home to each graphics professor what we have in fact been doing without realizing it! After all these years how can the author be so presumptuous as to declare he has a solution? At this point it is hoped you are angered enough to read on and share the author's experience in this area.

Abstract: Implementation of this timesaving technique is readily accepted by both the faculty and students alike. They strive to have their own reasons added to the official list.

Abstract: The author describes here an interesting discovery he has made which may have far reaching effects.

Abstract: The engineering profession in Taiwan, Republic of China considers engineering graphics an important part of the educational process for engineering students in certain disciplines.

Abstract: This article presents a more effective way to present material in lecture rather than many other procedures.

Abstract: The experimental design of the study was a series of well-planned presentations making use of lecture and blackboard sketches and a second series using commercially available transparencies with well-planned and integrated lectures. The findings are shown.

Abstract: Engineering graphics teachers continually search for effective means to maintain standards and include the new ideas constantly appearing.

Abstract: This article contains comparative evaluations which were administered to module utilization and module writing.

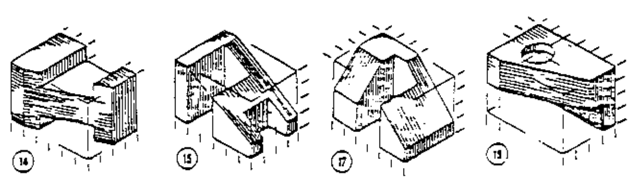
Developing the Complete Engineer 44(2) 80 17-20
Lee Harrisberger
Abstract: This article discusses some of the skills that should be in every engineer. These skills include teammanship, communication, professionalism and personal development.

Using Instructional Television for PSI in Engineering Graphics 44(2) 80 29-32
William J. Vander Wall
Abstract: Overall, the concept of using video tapes as supplementary instruction for PSI in Engineering Graphics appears encouraging. The concept was favorably received and student reaction suggested that the tapes helped them considerably over the "rough places" in the course. The instructors who have experimented with the instructional TV have also indicated their favorable impressions and have pointed out the advantages of being able to direct students to an additional source for further information. This allowed them time to concentrate on helping those students with more profound difficulties.

It's All in How You Look at It 44(3) 80 30-33
Raymond Nicyper
Abstract: Simplified, practical anaglyphic system speeds engineering graphics teaching.

Some Questions and Answers 44(3) 80 61-64
Richard E. Keebler
Abstract: How often have you wondered how graphics courses in other colleges or universities are administered and taught? We recently asked some questions of those in charge of engineering graphics at other institutions in an attempt to satisfy our curiosity and perhaps provide a basis for evaluating our program. You may also wish to compare your activities to our findings.

Computer Aided Instruction Using Student Interactive Visuals 45(1) 81 29-32
Jon K. Jensen
Abstract: Computer graphics can be of assistance in another area of engineering graphics, that of assisting the instructor with individualized attention. This can be accomplished by construction of interactive programs and specialized packages to assist students with individual concepts, acting as a tutorial



Lest we Forget the Goals 45(1) 81 36-38
Paul S. DeJong
Abstract: We have tried many different things in what some might consider a futile effort to re-establish or "save" graphics, since a lot of people seem quite willing and eager to bury us.

Engineering Graphics Requirements Now! 45(1) 81 44-47
L. Wyman & V. Valdez
Abstract: The authors were faced with a problem: the average Engineering Graphics requirements required for a Bachelor of Science Degree in an engineering discipline at the ECPD accredited colleges and universities.
What – information concerning Engineering Graphics requirements required for a Bachelor of Science Degree in an engineering discipline.
Why – for comparison purposes of material and content with their own institution.
Who – mailings to 189 similar institutions listed in the ECPD (Accredited Programs Leading to Degrees in Engineering).

Graphical Solutions in Structural Design 45(1) 81 53-59
Karl Raethe
Abstract: It may be argued that graphic statics and vector analysis is superseded by mathematics until one discovers that no analytical solution can match the simplicity of graphical solutions for statically indeterminate structures.

Some Common Characteristics in Industrial Applications of CAD/CAM 45(3) 81 14-18
Robert N. McDougal
Abstract: This paper presents the result of an inquiry to several industrial representatives asking for their response to questions related to their use of Computer Aided Design (CAD) and Computer Aided Manufacturing (CAM).

The results indicate that the most common use of CAD is in the areas of; the design of machine and structural elements and electrical circuit boards; the solution to problems using programs in finite element analysis; and interactive graphics design. The most common use of CAM is for scheduling; inventory and process control; numerically controlled machines; materials handling and monitoring; interactive parts nesting and testing procedures.

The author's concludes there is sufficient interest and application of CAD/CAM in industry to require it for all undergraduate and graduate engineering students.

Computer Graphics as an Aid in Beginning Design Projects **45(3) 81 38-41**
Roy A. Hartman
Abstract: The Engineering Design Graphics Department at Texas A&M has the primary function of teaching two beginning graphics courses to all freshman engineering students. The first course was Engineering Graphics and the second wass Engineering Descriptive Geometry. There were over 2,700 students in both courses the first with the next year projected to be 3,000. The ultimate goal of teaching computer graphics and computer aided design to all engineering freshmen is to say the least, challenging.

Achieving Cognitive, Affective and Psychomotor Educational Objectives by Means of a Design Project **45(3) 81 47-50**
Gerard Voland
Abstract: The author points out different conclusions that have been reached as a result of a certain course format.

Design at the Freshman Level?? **45(3) 81 58-62**
Donald L. Elfert
Abstract: In an effort to verify that a design project approach was achieving its purposes and goals, a number of graphics departments polled students at the end of their courses by means of confidential questionnaires. The results are shown in the article.

Results of Graphics Survey **45(3) 81 77-78**
Betty J. Butler
Abstract: This is a report of the findings of a survey concerning the teaching of Graphics in Engineering curricula in ABET accredited institutions. Of 248 questionnaires mailed, there were 142 responses. The results are summarized in this article

---

Engineering Graphics Instruction and Computer Graphics – A Necessary Merger **46(1) 82 5-9**
Roland D. Jenison & J. M. Vogel
Abstract: Industry is experiencing increasing productivity with the utilization of computer-based information in the design and manufacturing processes. The computer graphics terminal is rapidly becoming the drawing board. This points to the need for improved graphics education for the engineering student. However, engineering graphics instruction has decreased dramatically in most curricula over the past two decades. This paper proposes that a merger of computer graphics and engineering graphics instruction is the solution to the dichotomy. The impact of computer graphics on the traditional methods of teaching graphics is predicted to be profound.

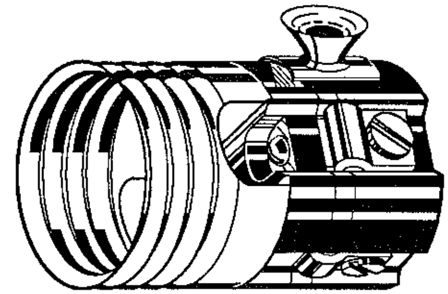


Illustration by Carrie Flores

Engineering Graphics is Alive and Well in the Peoples' Republic of China **46(2) 82 39-45**
Steve M. Slaby
Abstract: On March 3, 1981, I received a letter from Professor Zhu Fu-Xi inviting me to present a series of lectures on Theoretical Descriptive Geometry, focusing on Four dimensional Descriptive Geometry, at the South China Institute of Technology in Canton. Through a series of exchanges and correspondence between Prof. Zhu and me, my wife and I found ourselves heading towards Hong Kong via. From Hong Kong we traveled by a Chinese Train to the city of Guangzhau (Canton) in the People's Republic of China.

Combination of Manual and Computer Graphics **47(3) 83 8-9**
Retha E. Groom
Abstract: Computer graphics and engineering graphics have been linked together numerous times for logical reasons. But can computer graphics be used unobtrusively to teach beginning engineering graphics?

If so, the students would learn to accept the computer as one more tool available for graphical communication. A professional study was recently completed in the Engineering Design Graphics (EDG) Department at Texas A&M University to determine if the use of a combination of traditional manual drawing and user-oriented interactive computer graphics was an efficient method to teach engineering graphics and could serve as an introduction to computer graphics for first semester engineering graphics students.

Comparison of EG Instruction in the U.S. & China **47(3) 83 36-37**
Zeng Damin
Abstract: It will be difficult for me to make a complete comparison of engineering graphics instruction between the United States and China, since I have worked at only one university, Princeton University,-in the United States for an academic year. But from my observations to date, there exist many great differences and each country has its own advantages and disadvantages. This paper will compare the some of these differences.

Deaf Students in the Engineering Design Graphics Classroom 48(2) 84 6-7
Manjula B. Waldron & Susan Rose
Abstract: Until recently, technical education was available to the hearing impaired only at the National Technical Institute for the Deaf. With the assistance of litigation and legislation increased programming for the deaf student at post secondary institutions is expanding. In 1981, 50 such programs were available of which over 30 included technical vocational programs. More than half of the students enrolled in these institutions were in graphic, communication, engineering and health technology related areas. Since then both the number of students and programs have increased. The probability of finding a deaf person in some design graphics course is extremely high.

Proposal Preparation in Engineering Design 48(2) 84 20-24
Gerard Voland
Abstract: Engineers (particularly design engineers) are frequently involved in the development of proposals for project funding. Engineering students should be encouraged to prepare proposals for each project which they undertake in order to have their skills in this vital area of the profession.

Microcomputers in Engineering Graphics 48(2) 84 25-28
Leonard Nasman
Abstract: Ten years ago an electronics magazine published the plans for a personal computer based on a relatively new microprocessor chip. The response to the article was amazing. The magazine got more requests for reprints of this article than any that had gone before. A couple of kids in California worked up a kit they called the Apple. And Radio Shack, Commodore, and Atari, started marketing microcomputer systems for less than $1000. A couple of analysis program that they called Visicalc, and thousands of small businesses decided that they just had to have a microcomputer. In spite of the demonstrated usefulness of microcomputers, the computer science folks remained aloof for awhile, and tried to pass the machines off as toys. The entry of IBM into the market, however, seems to have made believers out of most of the holdouts.

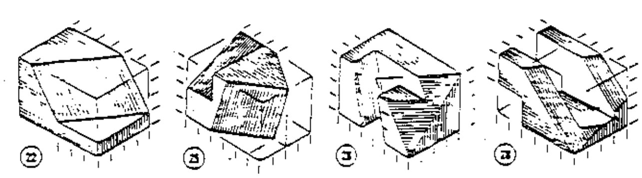
Microcomputers in Engineering Graphics Implications for the Future 48(2) 84 25-29
Leonard O. Nasman
Abstract: Within the last three or four years, microcomputers have made it feasible for every educational institution to consider purchasing one or more computer aided graphics systems.

A-T Graphics New Hybrid Yields Big Return 48(2) 84 32-39
Robert K. Snortland
Abstract: The challenge of designing a different teaching approach which would permit both the author and his students more flexibility and freedom with less repetition is discussed.

Teaching Graphics for Engineering Analysis 48(2) 84 42-48
Josann W. Duane
Abstract: The computer's impact on the theory, practice, and teaching of engineering graphics is reshaping engineering curricula today. Soon after World War II, engineers began to replace graphical methods of analysis such as descriptive geometry and nomography by applied mathematics. Engineering graphics usage became primarily limited to design documentation. However recently, engineering graphics again has become an integral part of the analysis process. Demonstrations include: applications of the finite element method to structural and thermal analysis; remote sensing and image interpretation; and analysis of fit, tolerance and mass properties.

University of Missouri-Rolla Computer Aided Drafting 48(3) 84 27-28
Wells N. Leitner
Abstract: The author tells how to set up a new student lab with computer terminals.

Laser Discs and Microcomputers State-of-the-Art Instructional Technology for Engineering Graphics Instruction 49(2) 85 10-14
Leonard O. Nasman
Abstract: Although laser videodisc technology has been available for a number of years, several factors have prevented widespread applications in engineering graphics education. Among these factors are: lack of information about the technology, the relatively high cost of hardware, difficulty of interfacing videodisc players to microcomputers, and the lack of availability of videodisc materials which have been specifically designed for engineering graphics instruction. This paper provides the reader with an overview of the current state-of-the-art of interactive videodisc technology, and outlines the author's plans to develop a videodisc specifically designed for use in engineering graphics instruction.



Geometrical Tolerancing in Design 49(2) 85 20-26
Graphics Education for the Present and Future
Richard S. Marrelli
Abstract: This treatise advocates incorporating instruction in geometric tolerancing in the design graphics curriculum to accommodate present and future demand from industry.

Geometric tolerancing is defined, a brief history is given, and its value in design engineering is explained. A resume is presented of the various geometric characteristics controlled by the system of geometric tolerancing and the advantages accrued from its use. Two examples are given to illustrate cost savings made possible. The importance of the subject in design and industrial engineering is stressed. Methods of qualifying prospective instructors are discussed; also the duration and format of possible courses are investigated and prerequisites are defined. All available texts are listed and briefly reviewed. Finally, information is given on visual aids and video training programs available at this time.

Improving Instruction of 49(2) 85 41-48
Engineering Graphics While Utilizing Microprocessors
David E. Roth, John N. Grode & David L. Huggins
Abstract: At Behrend College of Erie, and New Kensington Campus of New Kensington, both of the Pennsylvania State University, two pilot courses in engineering graphics were taught using a mixture of manual and computer techniques. This paper shares experiences in improving instruction of introductory engineering graphics using microprocessors.

Creativity and Problem Solving 51(2) 87 13-17
Mary A. Sadowski
Abstract: Often our own attitudes prevent us from seeking new ways of doing things. As graphics educators we need to be creative and innovative in our approach to solving problems. Old problems as well as new problems can benefit from unlocked minds and flexible thinking.

Utilizing the Computer in 52(1) 88 17-23
Freshman Design
Steven K. Mickelson
Abstract: The process of design is of great importance in engineering. As computers have increasingly become a vital tool in industrial design, they have also become a vital tool in engineering education of design.

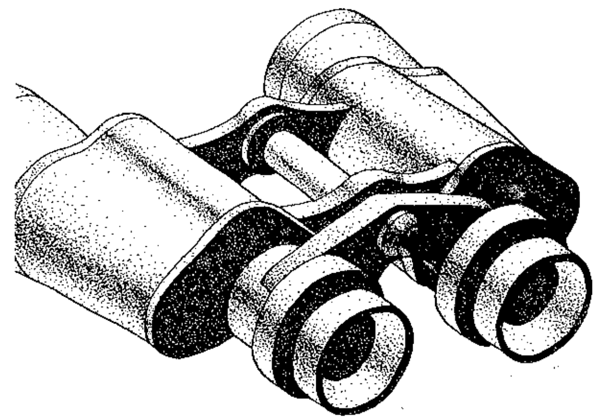


Illustration by Amy Longfellow

An Integrated Course in 52(1) 88 50-56
Computer Graphics: Merging Old and New
Manjula B. Waldron & John T. Demel
Abstract: The ability to simulate engineering systems and to represent them graphically appealed to the designers. There was a resultant increase in CAD/CAM software which provides more graphic media for representation.

The Role of Computers in 52(2) 88 18-22
the Design Process
Gary R. Bertoline
Abstract: The computer has been found to be an efficient and effective tool for many tasks when representing designs graphically. This has led to the introduction of CADD into engineering and technical drawing and other fields that require graphics for communication.

Computer Graphics at the 52(2) 88 23-29
Senior/Graduate Level
Vera B. Anand
Abstract: This paper describes possible content and applications of such courses and reviews the rationale for their implementation in the different engineering curricula.

CAD Education: Teaching 52(2) 88 31-34
Computer Aided Drafting/Computer
Aided Design and Now CAD Management!!
Michael D. Stewart
Abstract: CAD Education is different depending on the type of curriculum and eventual occupation, position, or level of job within an industry the graduate is seeking. This paper deals with the need for a new type of CAD Education – CAD Management – and how this can be done. The type of employment possibilities and demands for this type of occupation are explored.

Using 3D Geometric Models to Teach Spatial Geometry Concepts **55(1) 91 37-47**

Gary R. Bertoline

Abstract: With the introduction of computers for design and graphic communications, the methods used to teach traditional topics, such as spatial geometry relations, have changed. Traditional descriptive geometry problems were solved using successive auxiliary views based on Mongean principles developed in the late 1700's. Using 3D models for design and communications requires new methods to solve traditional problems. Successive auxiliary views using projection techniques are no longer required to solve design problems. What is required is that the designer have a full understanding of geometric principles and be able to use the computer to solve problems. An explanation of 3D CAD usage to teach spatial geometry concepts using nontraditional

Faculty Training in Computer Graphics and Analysis for Undergraduate Engineering Design Education **57(3) 93 20-25**

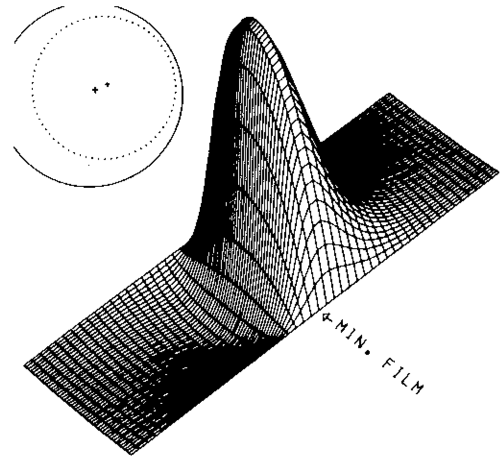
Vera B. Anand, Imtiaz U. Haque & Subhash C. Anand

Abstract: Two workshops on computer graphics, geometric modeling and finite element analysis, sponsored by Clemson University and the National Science Foundation, were held on the Clemson campus during the summers of 1990 and 1991. The purpose was to further educate engineering faculty who teach undergraduate courses in the cited areas on new methodologies needed for computer aided design. A total of 45 faculty members from a widely distributed national sample participated in these programs. The implementation details, workshop contents, and various ways in which participants benefited are described.techniques is given.

Principles of Design and Communication **59(2) 95 13-24**

Walter E. Rodriguez

Abstract: This paper introduces a principle-based approach for improving engineering design and design communication education. The approach consists of developing *systematic generalizable knowledge* for the field. However, this requires a paradigm shift from the present *standards & tools* approach to a universal "principle-based" approach. The development of guiding principles is essential to the establishment of any formal intellectual discipline.



Educational Survey

Bridging the Gap in a Survey of Recent Engineering Graduates from Two Universities **46(2) 82 8-12**

Walter I. Davis

Abstract: The undocumented statement, that universities are five to ten years behind is frequently expressed by industry and others. Studies that tend to bridge the gap between the universities and the industrial world could contribute to a better relationship between the two. The major purpose of this study was to determine whether or not the engineering student is receiving the engineering background for the field in which he or she will be professionally engaged. The study drew its population from two universities, Auburn University and Mississippi State University, limited to engineers graduating over a five year period from May 1976 to May 1981.

Summary Of CAD Survey Results **48(2) 84 8-13**

Ronald E. Barr

Abstract: During the 1982 ASEE Annual Conference, a computer graphics survey was addressed to the general membership of the EDG Division of ASEE. The major intent of the survey was to ascertain the status of computer graphics and CAD instruction in the early years of engineering undergraduate education. The primary purpose of this summary paper is to interpret these results, in a qualitative sense, and to present a committee-based opinion of the future direction of computer graphics and CAD in undergraduate engineering education, as perceived in the 1982-83 school year.

Graphics Competencies as Determined by the Delphi Method **49(1) 85 10-14**

Mary A. Sadowski

Abstract: The Delphi method was used to collect data which could be used to help determine a curriculum which would satisfy the needs of future students.

Student Attitudes Toward Drawing for Engineers **51(1) 87 30-37**
Deloss H. Bowers, Norman P. Wagner & George C. Beakley
Abstract: In the Fall of 1984 Arizona State University introduced a new concept in teaching engineering graphics and computer literacy to freshman engineering students. Since both the content and method of teaching engineering fundamentals differed from that which the students may have expected, an attitudinal survey was designed and administered to all students at the beginning and end of the semester for each of the two courses. This paper presents the results of statistical analyses of these data as well as an interpretation of their meaning to engineering education in general.

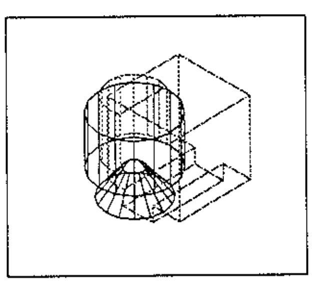
A Comparative Study on the Effectiveness and Influence of Required Supplemental Video Teaching Upon Students' Grades, Course Completion, Visualization Proficiency, and Course Attitudes **55(2) 91 10-16**
William J. Vander Wall
Abstract: An experimental study was conducted on two groups of students in an introductory engineering graphics class. One group (experimental) was required to watch thirty mini-video tapes presenting basic concepts of engineering graphics. The second group (control) was not allowed access to the video tapes. No differences were revealed between the groups for four postulated hypotheses.

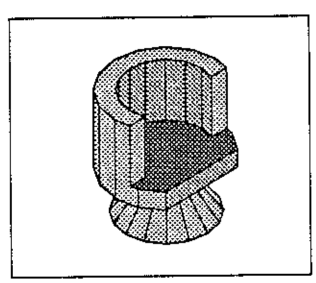
Are We Preparing Engineering Students with the Right Skills in Engineering Graphics and Computer Training? A Survey **58(2) 94 22-29**
Robert R. Britton, Audeen W. Fentiman & Frederick D. Meyers
Abstract: A study was done by the Department of Engineering Graphics at The Ohio State University to determine whether graduates of the College of Engineering had received adequate preparation in basic engineering skills necessary to function satisfactorily in the workplace. Nine hundred (900) former students and forty (40) employers of Ohio State University graduates were surveyed and the data assembled and evaluated to determine the effectiveness of the core engineering curriculum in two specific areas–graphics and computer skills.

The First Two Years – Are Engineering Students Learning the Skills they Need? **58(2) 94 30-37**
Audeen W. Fentiman, Robert R. Britton & Frederick D. Meyers
Abstract: The Department of Engineering Graphics at The Ohio State University conducted a survey of several hundred recent engineering graduates to determine whether the core engineering curriculum provided them with the skills required for their jobs. Four categories of skills were included in the study. The focus is on two of those categories: 1) Basic Engineering Skills and 2) Communication and Problem Solving. First line managers at companies that routinely hire engineers were asked to complete the same questionnaire. Comparisons were made between responses of graduates and those of employers.

Cooperative Learning in Engineering Graphics Courses **59(2) 95 25-30**
Theodore J. Branoff
Abstract: The purpose of this pilot study was to examine current research on undergraduate cooperative or collaborative learning and determine its effectiveness in engineering graphics courses. Cooperative learning involves students working together in teams to master material initially presented by the instructor. Students were assigned to groups of four individuals to work on activities in multiview sketching, pictorial sketching, dimensioning, threads and fasteners, and assembly drawings. The development and format of the activities, a summary of evaluations, and research on undergraduate cooperative learning are summarized in this paper.

1995 Graphics Salary Survey Report **60(1) 96 21-26**
Jon M. Duff
Abstract: Recent history has seen dramatic changes in graphics instruction, equipment, and applications. Once the purview of engineers and computer scientists, curricula across the university now teach courses in design, documentation, presentation, visualization, and information distribution based on computer graphics technology. The identification of a peer group of faculty teaching these courses and the collection of salary data establishes a level of marketability for future salary considerations.





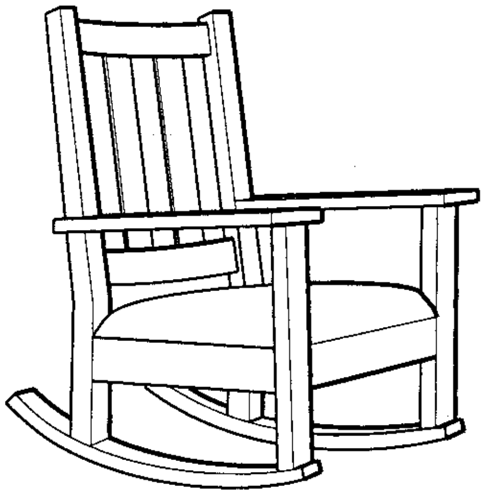
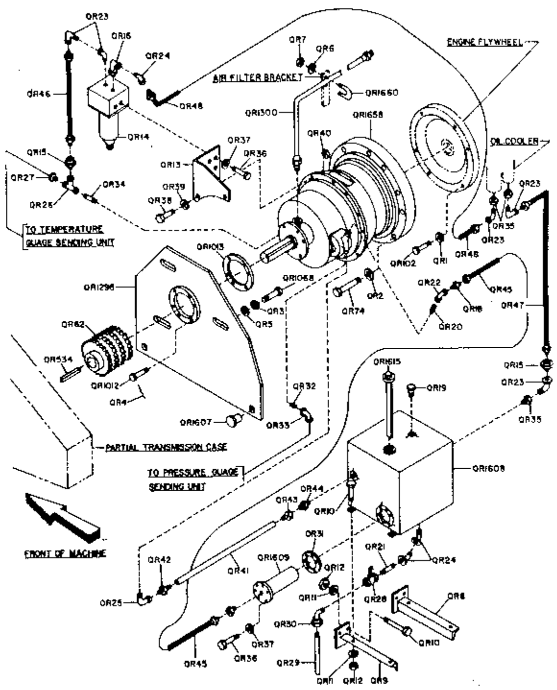


Illustration by Cory Powell

Evaluation



Finite Element Analysis

Graphics for Finite Element Analysis **49(2) 85 33-40**

Josann W. Duane & Michael M. Khonsari

Abstract: This paper describes the content of a graduate level course that was taught in the Summer 1984 on the fundamentals of graphics for finite element analysis: geometry modeling, mesh generation for numerical analysis, and results evaluation. Both the fundamentals of each of these aspects of graphics for finite element analysis and applications in engineering practice are presented. This paper addresses problems encountered in nonuniformity of the student's background, evaluates means of achieving a balance between fundamental concepts and use of commercial codes, and presents faculty and student evaluation of the first offering of the course. This course adds the research and analysis aspect of engineering graphics to a curriculum that now primarily presents engineering graphics as a tool for design and documentation.

Graphical Aspects of Numerical Analysis **52(1) 88 10-16**

Michael M. Khonsari & David E. Brewe

Abstract: This paper discusses various forms of graphical data presentation utilized in numerical analysis. Graphical aspects of two widely used numerical methods know as the finite element method and finite difference method are discussed. In addition, a case study of animation of numerically generated data is presented. The study pertains to the effect of cavitation on the performance of a dynamically loaded journal bearing.

Finite Element Analysis in a Freshman Graphics Course? **57(1) 93 29-32**

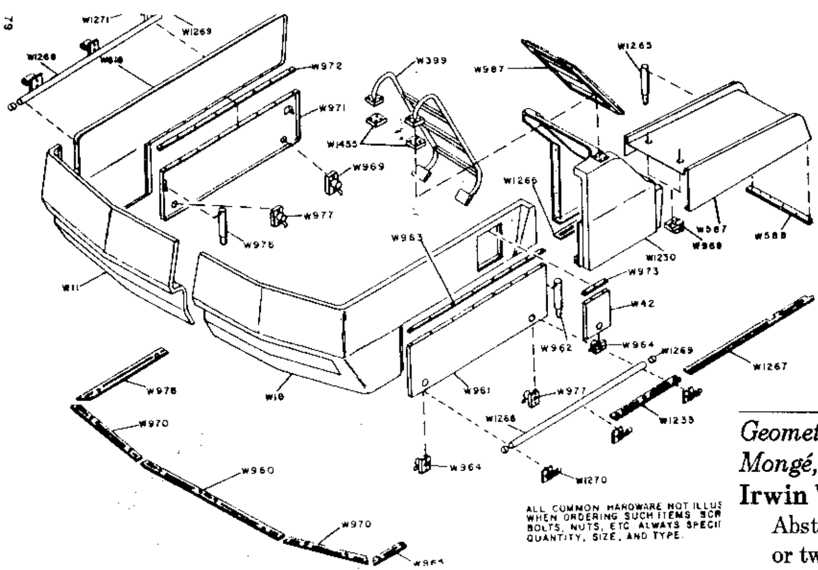
Steven K. Howell

Abstract: A course, Engineering Design Graphics, was instituted in 1991 to help reduce the high dropout rate during the freshman year by exposing students to the creative aspects of engineering through the design process. This was accomplished by introducing freshmen engineering students to the use of the computer as both a problem solving and communication tool in engineering. The basic philosophy of this course is to integrate traditional design principles and visual thinking with the new trends in computer graphics simulation and visualization techniques. The finite element method (FEM) is introduced in this course as a tool to be used in the refinement stage of the design process. Using COSMOS/M, a student can create a model of a part within minutes after completing a CAD drawing of the part. The part is then subjected to various loads, both mechanical and thermal, and the response to those loads can then be viewed graphically. Student feedback at the end of the first year has been encouraging, indicating a high level of enthusiasm and interest in engineering. Finite Element Analysis

Introducing Graphical Finite-Element Structural Analysis to an Undergraduate Curriculum *57(1) 93 33-39*

D. K. Lieu & N. H. Talbot

Abstract: The University of California, Berkeley, currently trains all of its undergraduate mechanical engineering students in graphical finite-element analysis as part of a regular course in the mechanical behavior of materials. This paper presents the hardware, software, and curriculum decisions made during the implementation of this new material. The emphasis of this part of the course is in the proper usage and interpretation of finite-element methods, rather than a theoretical development of the technique. Graphical presentation enhances the conceptual understanding of structural loading and their effects on the stresses of irregularly shaped objects. It becomes possible to introduce some elements of design into the traditional course material. A student can synthesize geometrically complex parts without an overriding concern or the burden of analytical complexity.



Geometry

The Dilemma of Descriptive Geometry 40(3) 76 19-20
Moshe Boleslavski
Abstract: It is no exaggeration that the discipline known as Descriptive Geometry has been undergoing a crisis throughout the world for the last three decades. In many universities it was dropped from the curriculum altogether or replaced by assorted forms of Engineering Graphics; where it still survives, it has shrunk badly in terms of both syllabus and time quota.

The Relevance of Descriptive Geometry 41(2) 77 8-9
Amogene F. DeVaney
Abstract: At a recent meeting a professor of electrical engineering asked me to tell him in what way descriptive geometry is relevant to the work of an engineer. I am not happy with the answer I gave him. At the time, the answer to the question seemed so obvious that it did not deserve a serious answer. However the engineer seemed sincere as he continued, "I don't think it should be a required course for engineers. In many colleges it is no longer taught." You have heard this statement voiced many times, and you probably felt as I did. In the times since this meeting, however, I have given his question some thought, and I have tried to formulate in my mind a good answer to this question: Is descriptive geometry relevant, and if it is, to what?

Geometry Cotee, Gaspard Mongé, and the Modern System 41(3) 77 30-34
Irwin Wladaver
Abstract: The task I have set for myself is to present one or two basic elements of each of the first two systems named in the title. I then propose to illustrate how each system can be applied to solve a simple problem. For reasons that ought to be obvious, I don't dare to attempt a hard one. I have arbitrarily selected a dihedral angle problem, that is, the angle formed by two distinct, non-parallel planes.

The Use of SI Units in Descriptive Geometry 42(2) 78 16-19
Frank M. Croft
Abstract: The cold turkey approach was used in the instruction of Descriptive Geometry at the Speed Scientific School, University of Louisville, this past fall semester. This paper relates my experiences in teaching this course using the cold turkey approach in SI units.

A Quick Approximation of the Development Angle of an Oblique Cone 42(2) 78 36-39
Yaaqov (Jack) Arwas & A. Banai
Abstract: The two authors speak of the development of an oblique cone and some equations used to derive the cone.

Engineering Decision Making with the Computer 42(3) 78 55-58
Yaakov (Jack) Arwas & Borah L. Kreimer
Abstract: Both of the problems that were mentioned in this paper illustrate a use for Descriptive Geometry that has not previously been emphasized.

A Small Flaw in the Ointment 43(1) 79 11-12
R. Patteson Kelso
Abstract: The author shows that the elliptical natures of certain figures become apparent when the diameters lengths are compared in two views.

A Method for Determining the Limits of Cut or Fill for a Circular Highway Curve on a Grade 43(1) 79 27-32
W. D. Teter
Abstract: The method of extending the straight, diverging grade lines through (around) a circular curve requires only the simple construction of a few arcs based upon the involute of a square. Once the technique is mastered the determination of limits of cut or fill becomes quite simple. Of particular importance is the orientation of the square and selection of proper arc centers in order to produce correct divergency or convergency on either the inside or the outside of the highway curve.

Graphical Construction of Clothdidal Highway Curves 43(1) 79 33-35
H. Niayesh
Abstract: In modern highway engineering, the clothoid or spiral Cornu long ago replaced the arc of a circle which necessitates heavy breaking if entered into at high speeds. In this replacement, due to the continuous change in curvature of the clothoid, entry into the curve is smooth, brakes might be applied only moderately and sometimes it will even be sufficient to leave the gas pedal free.

A Reassessment of the Mathematical Concept of the Point at Infinity 43(1) 79 36-37
David W. Brisson
Abstract: The purpose of this paper is to show that the conception is based on a misuse of the concept of measurement. It will be shown that when comparing lines of finite length to lines of infinite length, the finite lines must be considered isotropic. Thus, the coefficients of the Plücker coordinates of the linear equations defining a set of parallel lines are the same for any two such lines.

Automation in Solving Position Problems with the Aid of Auxiliary Spheres 43(1) 79 41-43
J. Charit
Abstract: Automated design and drawing involves computer aided solution of certain geometrical problems of surface intersection. This paper describes the solution procedure based on use of auxiliary spheres.

A New Approach to Solving Ellipse Guide Angles in Axonometric Projection 43(3) 79 46-50
Ming H. Land
Abstract: This is the second in a series of articles by the author on the descriptive and analytical geometry of graphics principles.

Geometry Vol(No) Yr Pg

Pictorial Parallelism 43(3) 79 51-52
Eugene G. Paré
Abstract: The author describes different projects that he and his students have had a great time developing and testing on descriptive geometry in pictorial rather than the traditional orthographic format.

Angle Between a Line and a Plane – A Simplified Approach 43(3) 79 53-54
Cynthia M. Stewart & Jerald M. Henderson
Abstract: The rotation method of finding the true length of a line and the angle the line makes with a plane is presented in most textbooks on descriptive geometry and engineering graphics. A typical problem is shown.

An Unavailable Proof – Aid for Teachers of Descriptive Geometry 44(1) 80 32-33
Moshe Boleslavski
Abstract: Two proofs are suggested for the lemma: The horizontal projection of the major diameter of an elliptical section of the cone of rotation is always the major diameter of the horizontal projection of the section

---

The Inner World of the Square – Geometrical Form-Bases for Pictures and Films, Especially for a "Visual Music" 44(1) 80 48-61
Reinhard Lehnert
Abstract: This article deals with a totally novel, elementary and voluminous class of geometrical figures called *inner-stars.*

The Rationale of the Funicular Diagram 44(2) 80 22-24
Hugh W. Munson
Abstract: This type of superficial explanation of the physical significance of the funicular diagram lessens true understanding and confidence. This example is intended to more fully explain the reasons for the procedure and also to correlate the graphic and the algebraic solutions.

Innate Geometry? 44(3) 80 34-35
R. Patteson Kelso
Abstract: About one person in ten occasionally experiences a strange phenomenon just before waking up. While still suspended in the 'hypnopompic' state that sometimes preceded full awakening, the waker experiences a spontaneous and extraordinarily vivid visual image of a space filling design of arresting geometrical regularity and beauty.

Geometry Vol(No) Yr Pg

Using the Computer to Plot the Center of Gravity of Plane Areas **45(1) 81 25-28**
Yaaqov (Jack) Arwas
Abstract: This article illustrates how to find the Center of Gravity of the plane areas of practically all commonly used geometrical figures, such as triangles, rectangles, trapezoids, and segments of circles.

The Graphic Plotting of Complex Slopes of Ordinary Differential Equations. **45(2) 81 50-51**
David W. Brisson
Abstract: The author points out the derivative of the vertex parabola can be expressed in complex terms.

Hidden Lines Elimination for Parametrized Surfaces **46(1) 82 18-23**
P. Saillen
Abstract: A new algorithm is described for perspective representations, with visibility of a part of a surface given by parametric equations.

Funicular Diagram Beam Analysis **46(2) 82 29-33**
Hugh W. Munson
Abstract: The two most common methods of determining the shear and moment in a beam are the free-body diagram method and the semigraphical method. A third method, not commonly used, but yet available, employs the funicular diagram. Both the moment equation for any region in the beam, and the moment diagram for the entire beam can be produced directly and quickly.

A Discussion of the General Solution in Descriptive Geometry **46(2) 82 18-24**
R. Patteson Kelso
Abstract: Descriptive Geometry may be defined as that branch of Projective Geometry which determines directions-of-sight needed to best describe certain geometric principles. Unless unique directions of sight (projection) are involved, then the principles peculiar to descriptive geometry are not present-only the conventionally adopted six-principal-views-presentation-principles.

A Computer Program for the Solution of Descriptive Geometry Problems **46(2) 82 34-38**
A. Rotenberg
Abstract: Descriptive Geometry is a branch of geometry that studies relationships between figures in an n-dimensional space and their graphical representations on planes. Accordingly, every descriptive geometry problem involves three basic components: a figure f in space, its representation f' on a plane and an apparatus transforming f into f. We have considerer only the case n=3 and representations obtained by orthogonal projection combined with linear scaling. Depending on which of the three basic components is to be defined, we can identify three types of descriptive geometry problems.

It is intended to investigate some general methods of solution of each of the three types of problems and attempt to create computer programs to solve them.

The Geometry of an Oblique Osteotomy **46(3) 82 22-25**
Y. Charit
Abstract: This paper sets forth a geometrical solution for three-dimensional reorientation of the femoral head in Legg Calve Perthes disease. The problem was posed by the Head of the Orthopedic Department of the Rothschild University Hospital in Haifa (Israel). Dr. D.G. Mendes. He and his colleagues, Dr. M. Rofman and Dr. S. Liberson, had been engaged in working out the methodology of an oblique Osteotomy for the above mentioned disease.

Computational Geometry **46(3) 82 32-34**
J. MacGregor Smith
Abstract: Computational Geometry is concerned with the design and analysis of computer algorithms for solving geometric representation, construction, and design problems. These geometric problems include all the classical Euclidean construction problems plus many others which have emerged from computer graphics, computer aided design, and other engineering design applications. These can generally be placed into one of the following categories:

1. Location, nearest neighbor, spatial organization, network design,
2. Inclusion, area/volume calculations, polygon inclusion, statistical clustering
3. Intersection, polygon intersection interference/hidden surface, combinatorial optimization

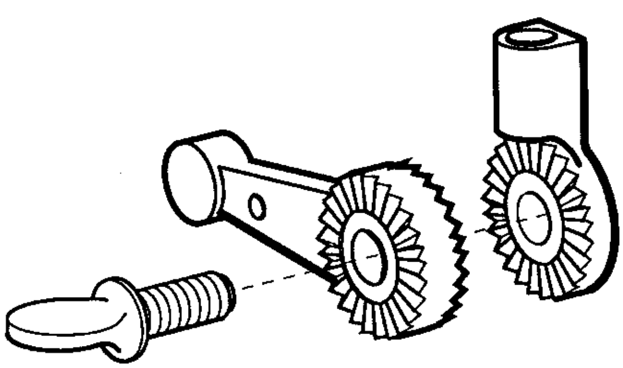


Illustration by Carrie Flores

Computerized Descriptive Geometry 46(3) 82 37-43
Dao-Ning Ying
Abstract: Euclid had for *ground rules* the requirement that geometry problems be solved only with straight-edge and compass. Mongé probably had crude drafting instruments, perhaps T-square and triangle, and more recent draftsmen have had universal drafting machines.

Computerized descriptive geometry, making use of the interactive computer instead of ruler and compass or more sophisticated drafting devices, is probably one of the most interesting topics in the computer era.

A Graphical Teaser **47(1) 83 21**
R. Patteson Kelso
Abstract: What two types of geometric surfaces have not curvature? The plane and the catenoid (a catenary of revolution).

Descriptive Geometry Based CAD **47(3) 83 26-35**
Steve M. Slaby & Eric F. S. Pai
Abstract: With the advent of high-speed, low-cost technology, scientists and engineers have devised numerous applications for their own specific work on large processors. One area, that of Computer Aided Design (CAD), has received a great deal of attention in recent has been developed addressing CAD. Yet while some of them focus on specialized functional areas (three-dimensional drawing, for example), others do not.

Computer Aided Drawing of Intersections and Developments Using Position Vectors **48(1) 84 6-11**
G.F. Pearce
Abstract: Position vectors provide a convenient method of obtaining equations for use in the computer aided drawing of the intersection of two objects and their developments. The essence of the method is to equate the position vector of a point on one object with a point on the other. The resulting vector equation is then solved for the intersection points. The developments are readily computed from true lengths involving the intersection points.

Generalized Method for Multi-Dimensional Descriptive Geometry **49(3) 85 31-34**
C. Ernesto & S. Lindgren
Abstract: In the first half of the 20th century, several attempts were made to devise a method of graphical representation of geometric figures embedded within multi-dimensional Euclidean hyper-spaces, an effort parallel to that accomplished in analytic geometry through direct extension of the Cartesian method. Even though some progress was made, the resulting proposed methods proved to be cumbersome in addition to presenting certain difficulties in relating the methods for each of the scaling number of dimensions of the hyper-spaces.

Development By Triangulation and Construction of Warped Surfaces **49(3) 85 35-38**
Kenjiro Suzuki, Tatsuhiko Aizawa & Hiroshi Isoda
Abstract: Curved surfaces are classified into single-curved, warped, and double-curved surfaces. Of these surfaces, only the single-curved can be developed theoretically. Practicably, however, warped surfaces are sometimes developed approximately by triangulation (in which, the warped surfaces are assumed to be made up of a large number of triangular strips). Odaka pointed out that the area of the development by triangulation is larger than the surface area of the original warped surface(1).

Non-Orthodirectional, Orthographic Projection **49(3) 85 50-59**
David Sanders & R. Patteson Kelso
Abstract: Descriptive Geometry is often poorly defined if it is defined at all. This seems to be due to it being equated with "projective geometry operations." This paper defines Descriptive Geometry as:
The Science (art?) of determining the direction of viewing an object such that a particular geometry of an object appears in the most descriptive manner

The Construction of the Axes of an Ellipse Having a Pair of Given Conjugate Diameters from the Viewpoint of a Central Projection **50(1) 86 29-32**
Kazuhiko Takeyama
Abstract: The author tells of the relationship between the axes and a pair of conjugate diameters of an ellipse.

Descriptive Geometry and the Computer **50(1) 86 41-46**
Lester F. Smith, Jacob J. Wolf III, Mark R. Hopkins & Ding T. Jou
Abstract: An interactive computer program, DEGE, was written to replace the traditional *tools* with a two screen interactive workshop. The objectives of developing DEGE were:

1. Reduced time demands on engineering students
2. Increased student understanding of concepts
3. Improved accuracy of drawing
4. Improved clarity of drawing
5. Reversible recovery capability, and
6. Exposure of engineering students to computer graphics

Abstract: This paper relates the different use and characteristics of the descriptive geometric model through the citation of five groups of examples.

Practices both in computing and production have proved that the descriptive geometric model is an effective way in the solution of very complex surface problem. In the computer information processing systems for modern engineering, the determination of space position and shape of some surfaces which have special requirements can be expained using these techniques.

Abstract: This article addresses four lines and their inscribed sphere. The approach is to draw spheres tangent to two lines, then three, and then four.

Abstract: This paper describes a method of solving descriptive geometry problems in which students gain expertise in working with a 3D database. In this method the figure is first translated to the origin then subjected to a series of rotations about the appropriate axes (and possibly further translations) so the distance or angle of interest shows its true value in the X-Y plane.

Abstract: A computer algorithm has been described for obtaining the coordinates of vertices, chord factors, and dihedral angles of n-frequency spherical and ellipsoidal octahedral and icosahedral geodesic domes with or without truncation, for plotting orthographic and axonometric projections, and for tabulating the chord lengths and dihedral angles for sawing the structural elements for construction.1 A recent paper describes the fundamentals of hidden line removal for convex polyhedra. This paper illustrates an application of this basic procedure, also described by Demel and Miller, for hidden line removal in a design application involving geodesic domes. In addition, the algorithm is expanded to include gray scaling of the geodesic dome faces for various light sources.

Geometry Vol(No) Yr Pg

Abstract: Two methods of rectifying circular arcs are described and rectifying errors are compared.

Abstract: Properties of four-dimensional geometric elements projected onto three-dimensional space are developed. This lays the foundation for development of a new, simplified method for solution of four-dimensional engineering problems. The new method is based upon the invariant properties of geometric elements in four-dimensional space projected into three-dimensional space. This method simplifies solution of four-dimensional engineering problems by projecting geometric elements in four-dimensional space into three-dimensional space, establishing a Cartesian coordinate system, and then solving the governing equations in the Cartesian system.

Abstract: Formulas for the area of regular polygons are developed using the properties that all regular polygons can be inscribed in or circumscribed about a circle and that each regular polygon can be decomposed into a set of congruent isosceles triangles. Basic geometric and trigonometric properties are used to determine the area when given the three most common parameters used by drafters: distance across corners, distance across flats, or length of a side. A summary of formulas for the area of the most common regular polygons is given.

Abstract: Properties of rotating transformations and invariant properties of four-dimensional unit coordinate systems are presented. Such properties are part of a new method developed for solving four-dimensional engineering problems.

Abstract: In recent years the number of computer graphics courses taught in the People's Republic of China has grown rapidly. Many universities and institutes have set up computer graphics curriculum or added the

contents of computer graphics to engineering drawing courses. In addition, many universities have begun research in the computer graphics area and have developed interactive software for learning descriptive geometry and engineering drawing. Significant accomplishments have already been achieved.

Multiple Cubic Bezier Curves **54(2) 90 3-9**
Michael M. Khonsari & Douglas Horn

Abstract: An efficient algorithm is described for generating smooth curves of first-order continuity. The algorithm, referred to as the multiple cubic Bezier curve, is composed of several cubic Bezier curves joined together at the user defined control points. The multiple cubic Bezier curve satisfies all of the user-defined control points except the first and last points which, in the method presented, are used to define the direction of the curve at the end points

---

Formulae for Numerically Determining Line of Intersection and Dihedral Angle Between Two Planes **54(2) 90 21-28**
Daniel M. Chen

Abstract: In civil engineering it is often necessary to find the line of intersection of two plane segments which are defined by their strike and dip angles. When this problem occurs, a general method for numerically finding the bearing and slope angles for the line of intersection is very helpful. The formulae for determining these two angles is developed based on the properties of trigonometry. By substituting the strike and dip angles of two given plane segments directly into the formulae, extremely accurate values can be calculated for the bearing and slope angles of the line of intersection. The formula for numerically determining the dihedral angle between two plane segments is also developed.

Spirograph **54(2) 90 29-38**
Wang Shu

Abstract: Specific characteristics of various Spirographs are described. It is shown that (1) the curve generated by the locus of a point on or within a circle of radius B rolling inside a fixed circle of radius A creates the same figure as the locus of a similarly located point on or within a circle of radius A-B rolling inside a fixed circle of radius A, (2) N-leaved rose curves are spirographs, implying a transformation exists between the two curve forms, and (3) a transformation exists between the hypocyloid and the epicycloid.

Geometry vs. Descriptive Geometry and Graphics vs. 3D Modeling - In Search of Correct Terminology **55(1) 91 9-15**
Davor Juricic & Ronald E. Barr

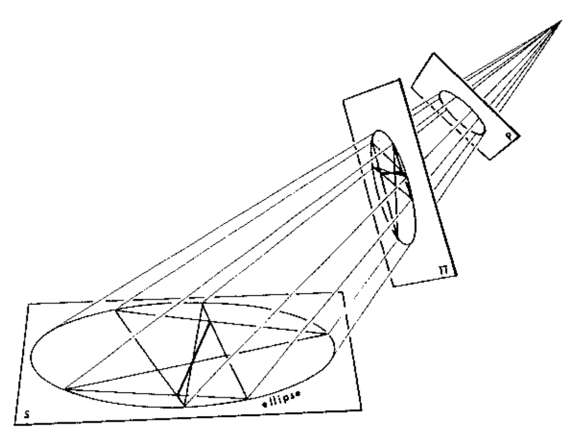
Abstract: It is no surprise that some confusion has developed in the field of engineering design graphics; the transfer of the latest computer graphics technology to engineering design graphics has brought some new concepts which collide with the way of thinking that has been in use for centuries. An attempt is herein made to clarify the difference between geometry and descriptive geometry and between graphics and three-dimensional geometric modeling. It is meant to stimulate discussions and promote a constructive exchange of opinions concerning the basic concepts of the engineering design graphics field.

Computer Aided Development of Spherical Surfaces by the Gore Method **55(3) 91 40-45**
Chinyere Onwubiko

Abstract: The difficulty in graphically representing nondevelopable surfaces led to approximate representations. One method used for spherical surfaces is called the Gore Method. This paper describes the computer generated development of a sphere using the Gore Method and presents an approach to fabricating a sphere with minimum material waste.

Improved Roberts Algorithm and its Implementation **56(2) 92 19-23**
Renzhi Zhu & Yalin Xiong

Abstract: This paper presents an algorithm of interpenetration line drawing and hidden line removal in 3D convex object case. Essentially, it is a modified Roberts algorithm but more efficient. Based upon this algorithm, a FORTRAN algorithm has been developed for drawing 3D interpenetrating objects. The result is presented in the appendix. Furthermore, because of the proper data structure and objective space which the algorithm adopts, many graphic transformations and interaction techniques can be easily implemented.

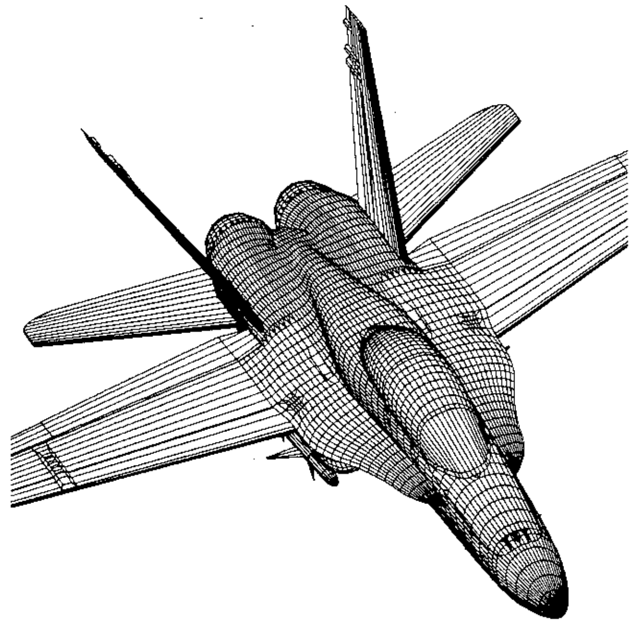


Using Pictorial Graphics to Enhance Descriptive Geometry Instruction 58(1) 94 17-23
Ronald C. Paré
Abstract: For many years, traditional descriptive geometry courses have depended solely upon the principles of multiview projection for presenting the course subject material and for solving problems. Today, many engineering and technology students are not prepared in multiview projection skills when they enroll in descriptive geometry courses or attempt to obtain a descriptive geometry solution. To assist these individuals, the technique of solving problems in pictorial format using descriptive geometry concepts has evolved. This paper will present five pictorial techniques , Descriptive Geometry, and compare them graphically to the parallel multiview projection techniques.

Determining the Dimensions of Similar Ellipses of Specified Area and the Dimensions of Confocal Ellipses 59(1) 95 12-17
John F. Freeman & William M. Waters, Jr.
Abstract: A method is provided to determine the dimensions of nested similar ellipses, meeting the requirement that each ellipse have an area which is a specified multiple of the area of its predecessor, given the lengths of the semi-minor and semi- major axes of the original. Numerical and graphical examples of the method are provided. An extension of the method for nested confocal ellipses is also provided.

Points, Planes & Lines 60(2) 96 5-14
Paul J. A. Zsombor-Murray
Abstract: Points and planes in three dimensional Euclidean space are represented by four homogeneous coordinates. The equivalence of points on the plane at infinity and planes on the origin is described. Similarly, the uniqueness of the plane at infinity and the point on the origin becomes evident, as does the fact that no point or plane is specified by the homogeneous coordinates (0:0:0:0). The linear equation of the plane given by three point coordinate sets and that of the point given by three plane coordinate sets is derived in the context of numerical examples. One sees that the numerical coefficients so obtained are, respectively, the coordinates of the unique plane or point which was given.

The plane's coordinates are revealed to be the set of negative reciprocals of that plane's intercepts in point space. Finally, linear equations of a line are derived, in terms of two sets of given homogeneous coordinates. The six homogeneous line coordinates emerge as coefficients of these equations, one in terms of plane coordinates, the other in terms of point coordinates. The equivalence of these two definitions is shown and a vector interpretation of line coordinates is given.



Graphics

Geometrical Pictures 39(1) 75 7-18
Reinhard Lehnert
Abstract: Children play and tinker perseveringly and passionately. They prepare themselves in this way for their future lives. The simplest, the most diversified and effective hobby is drawing and painting. Two-dimensional pictures can be produced more easily than three-dimensional objects. A piece of paper and a lead pencil are always at hand, colored pencils are to be had at reasonable prices. By playing and tinkering, especially by drawing and painting, also by looking at and examining pictures, the children should be initiated into the study of mathematics, as far as that is possible in this way.

If we can succeed in guiding the child to drawing and painting with geometrical instruments, in an activity that catches and satisfies him in a similar way to freehand drawing and painting, we shall have found a natural and incomparably valuable method of guiding the child towards geometry and moreover towards the totality of mathematics.

Engineering Computer Graphics 39(1) 75 29-34
Clarke W. Pidgeon
Abstract: Many topics in engineering graphics provide suitable theory for applications in computer graphics. This paper illustrates results in several areas and discusses how to start to build up a system of engineering computer graphics software. The approach used here in a simple fortran program has been extended to develop a complex projection system called COGR based on the principles of descriptive geometry. COGR is designed for use in teaching computer graphics as well as for general use.

Abstract: Those of us who are associated with Engineering Design Graphics and appreciate the value of graphic display are aware of the fact that mathematic functions may be, indeed long have been, portrayed graphically. We are equally aware that some are quick to point out that such graphics displays are, at best, imprecise representations of ideas. But regardless of how precise or imprecise a presentation may be, a graphic display remains a very useful tool for communicating mathematic concepts.

Abstract: Optical light projection techniques are commonly used for the inspection of a wide variety of engineering products such as gauges, small gears, screw threads, etc. The method used is to place the object to be inspected in the path of a collimated beam of light with its shadow being projected on a flat screen or surface. The contour of the object's shadow is then compared to or overlaid on an accurate master drawing or template (usually referred to as "the master") to assess the degree of accuracy of the object's shape. The master usually represents a flat face or plane section of the object in its desired degree of accuracy.

Abstract: Computer graphics in its early days was being sold to the public, industry, educators, and administrators as a concept and system that would eventually replace all draftsmen and designers would also be placed in the category of obsolete people. *True believers* trumpeted it as the panacea for solving the *problem of drafting and designing.*Pioneers in the field of computer graphics have included I.E. Sutherland of the Massachusetts Institute of Technology and his *sketch pad* project at the Lincoln Laboratory at MIT, Steve Coons who worked with Sutherland on the development of the *sketch pad,* William Fetter of the Boeing Company, and Paul Reinhard who through his NSF Engineering Graphics Course Content Development project in the 1960's energized many of us to examine this area for the first time.

Abstract: It is the purpose of this article to demonstrate a method for the synthetic perception of four-dimensional figures. This method uses well-established mathematical projections in wide use since the early part of this century. It also uses a simple extension of the principle of the stereograms. The article will first discuss the stereogram and its use in the synthetic perception of three-dimensional, figures. Then the method of hyper-stereograms will be presented for the purpose of the synthetic perception of four-dimensional figures.

Abstract: Printed circuit boards are extensively used in the Bell System for packaging the discrete and small to medium scale Integrated Circuit Devices. This paper describes the use of Interactive Computer Graphics to support the design and manufacturing processes of Printed Circuit Boards.

Abstract: Today's students must know how to program a computer. Learning to program has been difficult because present teaching methods many times use abstract problems. A set of practical problems with a continuous theme can speed the learning process and stimulate the students' interest. This paper will show how a carefully chosen set of graphics problems requires the students to learn programming statements in a step-by-step approach.

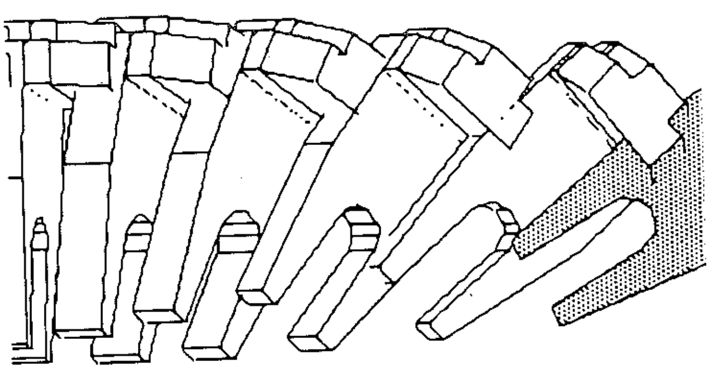
Abstract: Unfortunately, many odd and seldom used curve or distribution graphical sheets are not made commercially. It is the purpose of this paper to present a method to construct the needed graph sheet by the rapidly expanding technology of computer graphics. The method is explained by some examples.

Abstract: Graphics is an important part of the engineering curriculum because it is a vital communication process for engineers. An engineer often thinks in terms of graphics and visualizes problems and solutions graphically. Not only do engineers communicate with one another through graphics, but it is important for clear and accurate communication with the public the engineer serves.

Abstract: The acceleration polygon method is probably the fastest and most common among the graphical methods employed in solving problems in Mechanisms. The procedure for solving the problems is described.

Abstract: In the following elaboration, the radii of curvature for different projections of the hyperbolas are calculated at their vertices for an approximation.

Abstract: The age-old problem of finding the centers of the pitch circles of the external and the annular gears which mesh with a set of three planetary gears has been handled in many ways. A computer grid search is one of the more recent attempts.



Abstract: The construction and various applications of funicular diagrams to coplaner force systems are explained along with the use of funicular diagrams for the solutions of problems involving spatial force systems.

Abstract: This paper consists of five main discussions:
1. Graphic communication challenges in the space age
2. Graphic communication of necessity
3. Graphic communication of convenience
4. Graphic communication for promotion
5. Graphic communication of the future

Abstract: This paper describes an approach to the solution of the multi-loaded shaft problem, in which use is made of a graphical technique, similar to that generally employed in the development of shear diagrams in beams. This technique is best illustrated where the stresses and deformations in shaft sections are determined for torsional and axial loadings.

Abstract: A sophisticated and complex graphical procedure has been implemented in an interactive graphic format. The original manual graphical procedure, described in reference required several hours of work to produce even one solution and usually days to obtain good solutions. This process is not reduced to a matter of minutes. At the same time, much more information is presented to the designer to improve optimization of the solution.

Abstract: A professor speaks about different courses and problems designed to introduce computer aided graphics to graphical design students.

Abstract: Graphing mathematical functions by hand is an activity that most graphics people disdain and avoid. However, with a microcomputer this task can actually be enjoyable. A versatile program will be presented for plotting two dimensional functions. This software is extremely general and can optimize the graph to fit any specified portion of the display area. Moreover, it can be the used as a utility to graphically explore mathematical functions. Put away your calculators and irregular curves and grab the nearest Appleô microcomputer. Plot-A-Function is more exciting than Veg-O-Matic.

Abstract: "Hypergraphics" is a term which was coined to describe graphics that transcend traditional means. It is a term that combines the meaning of hyper (above, super, extra, beyond) with the meaning of graphics (writing, drawing printing) to define a concept of work that extends beyond the traditional methods of image-making. In very specific terms, it is related to mathematics of n-dimensional descriptive geometry. In the broad sense in which it is defined above, any system of thought, technical process or philosophical attitude that extends existing methods of visualization would fall into the category of Hypergraphics.

Abstract: Often, those who wish the ironical representation of a mathematical function are torn between plotting by hand or using some sort of a digital machine. The first is usually out of the question and the second calls for the availability of specialized equipment, specialized techniques, or both. While the advent of microcomputer systems have inspired some excellent work on the plotting of two-dimensional functions (Kolomyjec, 1983), the generation and control of digital software is still a somewhat formidable task. Using analog or hybrid computation techniques is a viable alternative to digital methods. Once a problem is stated in mathematical terms, it can also be mechanized in terms of an electronic analogy. This mechanization is a simple process, whose details are shown in many good textbooks like those by Jackson (1960) or Korn and Korn (1972).

This exposition examines the alternative ways of thinking in analog function generation. The simple parabolic function has been chosen as a case in point. As it will be shown, this simple function can be implemented by analog means derived through different points of view. Five different approaches are described which clearly demonstrate the versatility of the analog technique.

Abstract: In this paper we describe a fourth approach to teaching computer graphics that we have found to be especially appropriate to the needs of architecture and graphic art students who want to gain a sound, fundamental understanding of computer graphics as a design medium. It forms the basics of a very popular introductory course that we have taught at the Graduate School of Architecture and Urban Planning UCLA, for a number of years.

Abstract: In this article a parallel is drawn between graphical analysis of forces and replenishment and depletion of inventory in industrial situations. Vectors representing quantities, such as number of bolts, bottles of soda etc., can be used to solve inventory problems in similar manner to vectors representing forces used in solving shear and moment problems in statics.

Abstract: Chairpersons and/or leaders of engineering graphics departments from seven universities across the country participated in a panel discussion. Each panel member presented a brief summary of the status of engineering graphics in their institutions today, and what they would predict in 1990 as well as the year 2000. A brief summary

---

Abstract: Kaleidoscope is a comprehensive computer graphics program for artists, designers, engineers and architects. Kaleidoscope combines a highly effective user interface with a wide range of tools for manipulating two-dimensional design elements and color. Full color, computer generated images can be reproduced in the form of high resolution slides.
based on their submitted abstracts is included.

Abstract: This article expands on the aspects of using analog computation methods in generating mathematical functions. The techniques shown are based on the direct electronic mechanization of an equation or a system of equations that represents a given problem

Abstract: This paper presents current trends in the development of *expert systems* within the Department of the Navy, particularly research into expert graphics systems intended to support the *Authoring Instructional Methods* (AIM) research project. The project has essentially three parts: 1) the creation of smart text tools, 2) the creation of smart graphics tools, and 3) the creation of smart production tools. This paper is a result of the author participating in a Navy/ASEE Summer Research Fellowship with NPRDC during the summer of 1986

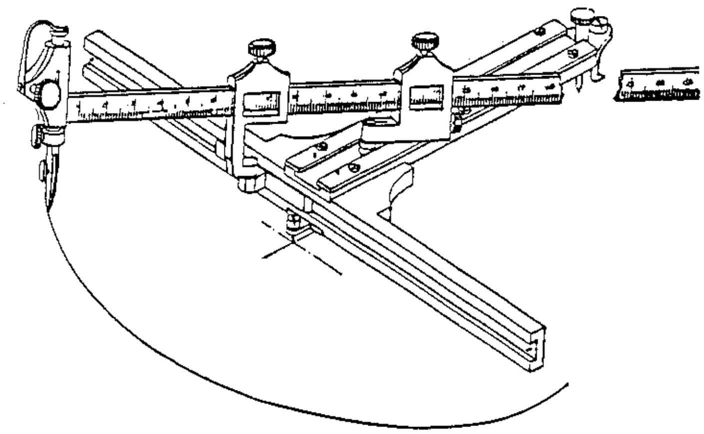
Abstract: Since ancient times the process of engineering design has required some methods and tools that would help a designer in his activities. This is equally true for a detail designer, whose main concerns are about the shape and size of the design product. The first and maybe the most important need of a detail designer is a procedure that helps in visualizing, composing and spatially solving the design problem. Another important need of a detail designer is a method of recording and communicating his design solutions..

Abstract: This is the third article on the mechanization of mathematical functions by means of analog electronics. Earlier works by Karayanakis explored the use of purely analog mechanization of functions and showed examples of cyclic curve cases. Emphasis was placed in using the classical sine-cosine oscillator. It was shown that mathematical functions like those of the higher plane curves can be easily generated and outputted without using digital computers.

Abstract: Numerous graphic production and reproduction techniques are available to today's engineers and designers. Design and engineering concerns can function more effectively and efficiently through the judicious use of these techniques. The techniques are examined in the context of producing and reproducing graphic products. In addition, the shortcomings of depending on selected techniques and technologies is explored as well as the benefits of melding those techniques and technologies. Engineering graphics, as suggested, is more than simply the generation of original graphic products. It also involves the management and dissemination of those products.

Abstract: Many relationships encountered in the study of mechanics can be modified as geometric identities between shapes. For relationships involving the identity between rectangles of equal area, such an identity is shown to be uniquely related to the *mean proportional* of a triangle formed by two adjacent sides of the rectangle or square. A graphical illustration is presented indicating how the mean proportional, once established for one set of conditions of an identity, can be used to generate any other set of conditions for the same identity. Examples presented are just a few of many in which the mean proportional principle has been or can be applied in developing graphical solutions to engineering problems.

Abstract: An assessment of research activities in engineering design graphics was undertaken. A panel of experts was identified and asked to provide input on the research activities currently underway and the nature of research efforts that must be undertaken in the next five years. The findings suggest that some disparity exists between research underway and research that must be conducted in the next five years.



History

A History of the Engineering Design Graphics Division 41(3) 77 42-57
Ralph S. Paffenbarger
Abstract: Because of the marked changes in curricula in the degree-giving departments following World War II, many departments found it necessary to lower credit hours and in many cases eliminate essential courses. By 1950, the continued curriculum crowding due to an ever-increasing number of professional courses, eliminated most shop courses, and in some instances not only basic drawing was reduced, but often descriptive geometry was eliminated. Throughout the 1950s, some schools experienced so much loss of credit that it became impossible to adequately cover the essentials necessary for an adequate design future. Fortunately the trend changed in most progressive schools in later years, when and how will be noted as the years are covered.

Ethics in Engineering Design 46(3) 82 9-15
Gerard Voland
Abstract: Leonardo da Vinci revealed that he had chosen to not disclose his design of a submarine for fear that it would be used to drill holes in enemy vessels.

Engineers are often confronted by ethical conflicts: for example, to whom does the engineer owe his primary loyalty - his family and himself, his colleagues, his employer, his clients, or society in general?

A brief review of the history of ethics as a topic of professional concern in engineering, particular case studies, the development of codes of conduct, and the role of professional societies in the enforcement of such codes will lead us to specific suggestions for teaching ethics in engineering.

On Deforge's Research about Technical Graphics 47(1) 83 22-25
Guido Laghi
Abstract: Toward the end of 1981 an original and innovative book appeared in France written by Professor Yves Deforge, a chief inspector of technical education. The title of the book, *Le Graphisme Tecyhnique:son Histoire et son Enseignement*, emphasizes the author's purpose to talk about technical drawing and the means useful to communicate technical information: sketches, diagram, mathematical models, symbolic notations, and so on. In the past centuries in France drawing was called *dessein* (in 1567 Philibert Delorme wrote *dresseing*). Today this means design, a project in its complexity, while the term *dessein* is reserved for drawing.

Tangency Solution 48(2) 84 40-41
William Harrison, Jr.
Abstract: Those familiar with the works of Gaspard Mongé (1746-1818) will recognize the "Tangent Circles Problem" *(Engineering Design Graphics Journal,* Spring, '83) as one of the degenerate cases of Apollonius' famous tangency problem to which Mongé apparently devoted some attention. Using Gergonne's construction , the solution can be expressed in a single sentence.

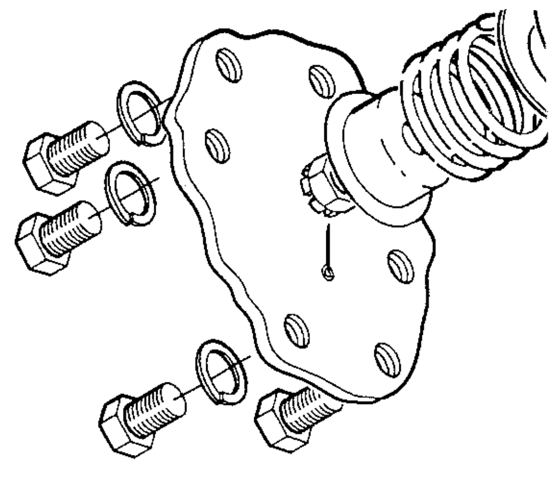
History of Graphics 49(3) 85 60-63
Daniel L. Ryan
Abstract: The idea for this article came to this writer during a recent visit to the British Museum of Egyptology located in Cambridge, England. I was touring the Computer Aided Design Centre in Cambridge and mentioned that a special interest of mine was the history of engineering graphics. My host at the CAD Centre suggested that I spend a day at the museum. Several days later, I was still fascinated by the amount of graphics contained in the displays, and at the same time, annoyed that I had not made this connection between Egyptian antiquities and graphic history during my first visit there in the summer of 1980.

History of Graphics Part II 50(1) 86 34-38
Daniel L. Ryan
Abstract: This article is a condensed version of a history of graphic communication which appears in another publication. In this second part we shall explore our roots during the middle ages.

Early Influences of the U. S. Military Academy on Engineering and Engineering Graphics Education in the United States 56(1) 92 22-26
William L. Ross & William A. Ross
Abstract: In 1802, Congress authorized the establishment of a military academy at West Point, New York. Although the first graduates of the military academy were neither professional soldiers nor engineers, the early curriculum at the institution included practical courses designed to meet the technical needs of the country. In 1817, *descriptive geometry* was introduced at West Point, and by the Year 1820, the academy had established the first engineering program in the United States. The intent of this article is to address the evolution of the engineering program and its drawing component at West Point, the influence of Sylvanus Thayer on the curriculum of the military academy, and the effect that the early faculty and graduates had upon other institutions of higher education.

Abstract: This paper examines methods used by engineering graphics educators over the past fifty years. The paper specifically addresses how our methods have changed in presenting techniques and procedures for drawing or displaying the curved entities or surface models used in engineering design. It begins with: an examination of texts and manuals from fifty to one hundred years ago, their content with respect to drawing instruments, and their approach to geometric constructions and problem solution techniques in the representation of curves and surfaces. The paper then addresses the changes that have taken place in teaching techniques and changes brought about through changes in graphics tools involving computer technology. Finally the paper examinse current technology and teaching methods used in surface modeling and design, and what we can expect in the future.

Abstract: Spatial visualization, for years a central part of the engineering graphics curriculum, is receiving renewed attention in journals and at conferences. As the engineering curriculum in the United States is undergoing critical evaluation and review, a renewed interest in spatial abilities has occurred. Engineering educators again are realizing that a successful engineer must have strong spatial abilities and be able to specifically visualize solutions to design problems. To provide a reference for future research, this article reviews previous research by the engineering graphics educators in spatial abilities as reported in the Engineering Design Graphics Journal. The intent is to give future researchers a basis on which to review, compare, and add research in the area of spatial abilities in the context of engineering graphics.



Illustration

Abstract: Freshman graphics or engineering drawing introduced most of us to fiendish device known as the French or irregular curve. Very often the curve we finally drew bore a minimal relationship to the correct solution, but we went blithely on with our *eyeball* methods because we really lacked better methods. Professional drafters had a curve-drawing device called a spline, really a flexible strip which could be bent to an eyeball correct curve and then held in place while the curve was drawn.

Abstract: Though this example deals with identifying and ranking job variables for technical illustrators, those interested in any area of technical training will find valid and reliable tools for establishing specific job requirements. The use of these job analysis and market research tools, along with the knowledge and expertise of the staff, can provide for effective, efficient, and demand-based instruction.

Abstract: The subject of this article is a shading technique which will reduce and work well on microfiche.

What Industry Seeks in Pictorial Documentation 46(2) 82 13-17
Dennis Foster

Abstract: Industry's production managers know what they want to communicate in pictorial form, however none know just what the most effective pictorial form is for their particular project. No statistical data exists in construction management and engineering graphics literature which would indicate exactly what the effectiveness of various types of line drawings, photographs and models is.

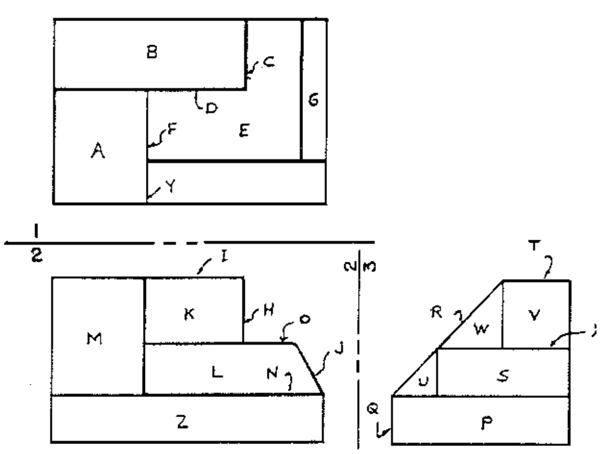
Based on the previous data perhaps three directions could be suggested for teachers of Engineering Graphics:

1. Industry today needs a new format for its pictorial documentation.
2. Research needs to be done equally on the potential of photography and modeling as they become automated in the next decade.
3. There is a need to expand on the quantitative data obtained in this pilot study. Research can be done with industry to determine the effect of the pictorial documentation in their contractual communication packages.

ILLUSTRATION

Creating Accurate Standard Axonometric Projections by Direct Construction Using Two-Dimensional PostScript® Drawing Programs 58(1) 94 4-10
Jon M. Duff

Abstract: Modern practice relies on PostScript drawing programs to produce both line and shaded technical illustrations. When 3D CAD data is available, the model should be positioned in CAD and exported to PostScript to form the basis of the illustration. When 2D CADD data exists, it should be exported to PostScript and sheared into axonometric position. Otherwise, existing engineering drawings can be read and standard axonometric views constructed from a template of unitary cubes. PostScript illustrations are completed as engineering pictorials, line weight renderings, or realistically shaded images.



Imaging

Computer Symbiotic Imagery 47(2) 83 31-32
William J. Kolomyjec

Abstract: Symbiosis is the effect where the visual whole is greater than the sum of its component parts. This is an excellent example of a type of imagery naturally suited for the execution using the medium of computer graphics. Any computer with graphics capabilities can be programmed to generate an array of centers upon which individual modules or *tiles* can be centered. Each module is scaled to just touch adjacent modules. The effect is a tessellation where each module is a tile that interacts visually with its neighbor. If properly done, individual modules disappear into the overall composition producing a symbiotic image.

Layered Geometrical Surface Designs: Form-Bases for Pictures, Films and "Visual Music" 42(3) 78 42-54
Reinhard Lehnert

Abstract: In the accompanying article the author presents an interesting and novel mathematical art form which he calls "visual music". The geometrical background is simple and yet gives rise to an infinite variety of pictures. The addition of color to the pictures shown will enhance the presentation of the material as well as improve the aesthetic quality of the art form.

Birth of Engineering Reprographics 45(2) 81 52-56
Guido Laghi

Abstract: A revolutionary invention has placed on a new basis the reproduction technique. It was a question of reproducing drawings through the help of light, the so-called photocopying process.

Trends and Techniques in Imaging Science 57(3) 93 26-30
Deloss H. Bowers

Abstract: In a recent paper, the author pointed to relationships among Engineering Graphics, Graphic Science, and Imaging Science. Common learned capabilities and subject matter among these disciplines may have implications for the development of curricula and teaching strategies in the future. This paper develops the concept of Imaging Science as an interdisciplinary field which seeks further investigation and understanding of a wide variety of processes and phenomena through the application of computer-processed images of all sorts.

Metric

We've Got those Metrication Blues **41(1) 77 21-29**
Fred O. Leidel
Abstract: One of the details that seems to have been neglected in the volumes of literature on metrication is the choice of drafting scale that is the metric replacement if not the equivalent of the three scale types used in the English system. The purpose of this paper is to supply these details.

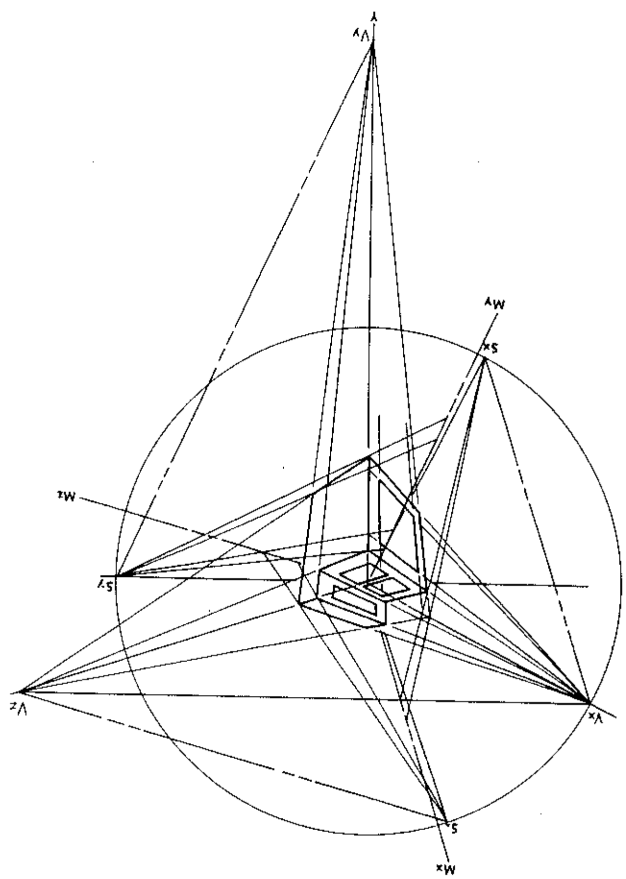
Reading Metric Scales Using Scientific Notation **41(3) 77 39-41**
Ronald E. Barr
Abstract: With the current trend toward metrication in the United States, there is an increasing need to also instruct the engineering student in the use of the Metric Scale. Unlike the architects' and engineers' scales, which have fixed measuring formats, the currently available Metric scales offer a range of measuring ratios (such as 1:10, 1:400, 1:1250, etc.) and it appears that no standard scale format has yet been adopted. This variation in Metric scale format only tends to increase the difficulty associated with the introduction of metric measurement to engineering graphics courses.

Metric Conversion – The Imaginary Problem **42(1) 78 20-21**
D. W. McAdam
Abstract: It is the purpose of this article to give information on drawing scale used in Canada and experience at the University of British Columbia.

Metrics in the Marketplace **42(2) 78 30-35**
Larry D. Goss
Abstract: This paper presents examples that are indicative of the types of error in SI labeling which currently can be seen on the shelves of any supermarket or hardware store in the United States. A number of errors in each example, plus additional comments, are listed at the back of the article.

A Metric America: Why Haven't we Gotten There Sooner? **43(2) 79 23-25**
Klaus E. Kroner
Abstract: Although metrication is making good progres, in some isolated sectors of our society, the effort for the United States as a whole is dragging along at a slow pace. It is the purpose in this article to identify some of the reasons for this situation and to suggest that we need not wait for government guidance in order to contribute our share to this national goal.

"Going SI" **43(2) 79 26-29**
Edward V. Mochel
Abstract: The title of this paper started as, *Where Are We Going*, but since I believe we are *Going SI*, the paper will concern itself with two related questions. They are... (1) how fast are we going? (2) what path will we follow?



Solid Modeling for Architects? 57(1) 93 5-9
James E. Bolluyt

Abstract: This paper will discuss the potential of solid modelers in architectural design and the introduction of solid modeling techniques to architecture students at Iowa State University. During the spring semester of 1990, students were introduced to the use of solid modeling for architectural design in the, *Introduction to Computer Applications in Architecture* course. This course is the first in a series of three elective courses on computers in architecture.

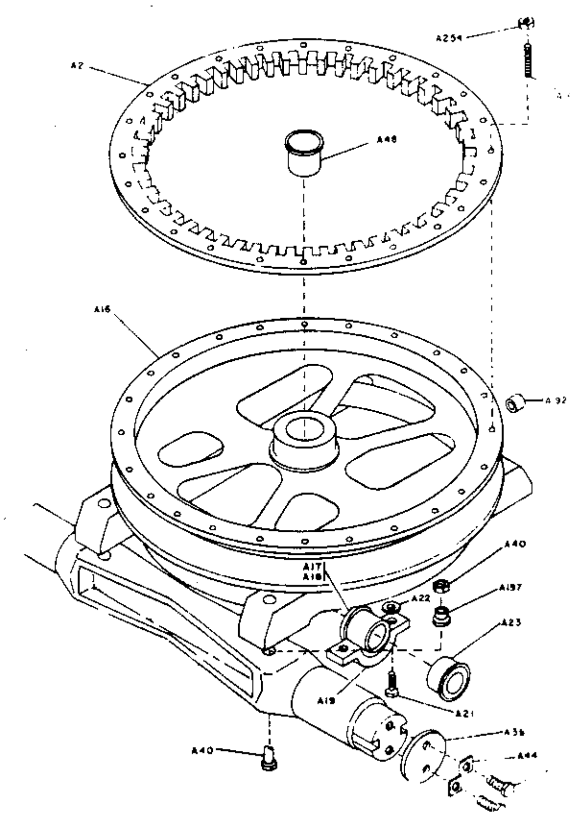
Most applications of solid modeling seem to suggest that it is applicable only in mechanical engineering and related areas. But many of the characteristics of solid modelers make them excellent tools for architectural design, from preliminary design to final presentation and documentation.

Construction Strategies in Solid Modeling 57(2) 93 13-21
Holly K. Ault, M. Barsoum & R. Qureshi

Abstract: Methods for the construction of solid models are compared. A variety of parts are selected and modeled using constructive solid geometry and boundary representation methods. The models are evaluated based on the effort required to create the model and the size of the resultant model. Concepts used in solid modeling are identified and recommended for the development of curriculum or training programs in solid modeling.

The Effect of Solid Modeling Software on 3D Visualization Skills 58(2) 94 4-11
Richard Devon, Renata S. Engel, Robert J. Foster, Dhushy Sathianathan & Goeffrey F. Turner

Abstract: Solid Modeling has been introduced into the first-year engineering course at The Pennsylvania State University. This paper describes an effort to measure the effect of the solid modeling curriculum on the development of 3D spatial visualization skills in the students. The main instrument used was the Mental Rotation Test (MRT). Although the MRT and our methodology have their limitations, the data generally support the inferences that solid modeling does enhance spatial visualization skills more than wireframe CAD or graphics taught traditionally. New directions in the research are also reported.



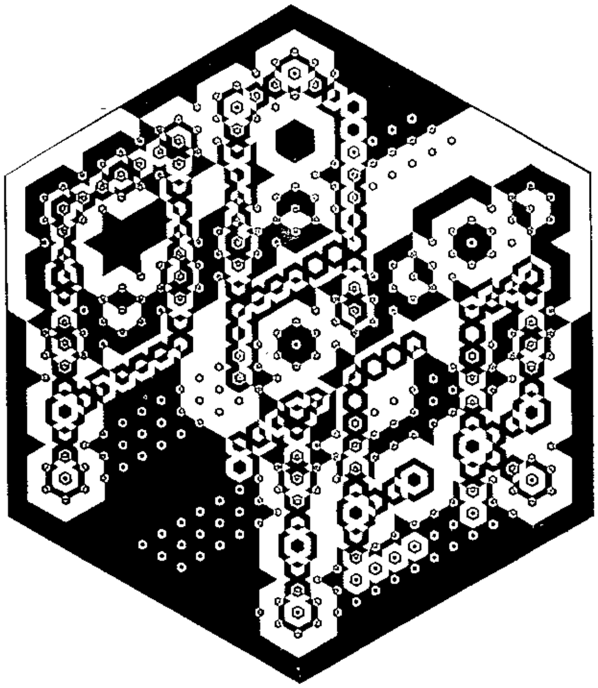
Multimedia

The Development of a Multi-Media Instructional Package for CAD 55(1) 91 3-8
Leonard O. Nasman

Abstract: Introducing large numbers of engineering majors to CAD provides a special instructional challenge. To meet this challenge, The Ohio State University Engineering Graphics Department has evolved a multi-media approach for CAD teaching. Also being developed is a complete "on-demand" training system for future use.

A Procedural Model for Interactive Multimedia Development 60(2) 96 15-25
James L. Mohler

Abstract: This paper discusses a model for the development of interactive multimedia. Through the use of five stages, it gives a methodical procedure of creating multimedia products. The uniquess of the Multimedia Development Model is that it allows for the total planning and increases communication within group settings; reducing and sometimes eliminating errors. Although rigorously adhering to any one model would be unrealistic, it chronologically presents the major points of concern when developing interactive multimedia.



Programming

How Would You Draw It? 42(2) 78 42-45
Robert D. LaRue
Abstract: This paper points out that user and programmer aspects of hardware are easily understood and that a computer language can be learned without much difficulty. Furthermore, a great deal can be done in computer graphics using mathematics at a level no higher than simple analytical geometry and trigonometry. In fact, a strong background in engineering graphics may be more useful than an equivalent mathematical background.

Application of Bezier Curve for Engineering Designs 48(3) 84 29-34
Michael M. Khonsari
Abstract: Bezier curves and surfaces are well-known design tools in CAD. Aircraft and particularly automobile industries have developed various practicable programs which utilize a Bezier scheme for surface design. While many degrees of sophistication of such programs exist is "real-world design", a simple Bezier program seems to be a very good and interesting exercise for computer graphics courses.

In this paper we briefly describe the principle behind the method, present a two-dimensional Bezier computer program written in FORTRAN, and document sample results. We will also make some suggestions on extending the program to more interesting and challenging cases for subsequent exercises in computer graphics.

Enhancing the Programmability of the MOVIE.BYU General Purpose Graphics Software Package 50(1) 86 39-40
Larry K. Goolsby
Abstract: The use of a technique such as the one described in this article enhances the programmability of MOVIE.BYU and provides a means to make efficient use of the software for a wide variety of analysis and instructional purposes.

PROGRAMMING

Computer Graphics: A Way to Teach CNC Programming With or Without Machine Tools 50(3) 86 32-36
Teruo Fuji & Robert Speckert
Abstract: This article discusses how some students are beginning to use computer graphics which simulate actual machine-shop techniques to provide a better way for them to gain a stronger understanding of manufacturing tools in a shorter period of time and with close to zero scrap-machined parts.

Engineering Graphics in Education 51(2) 87 18-23
M. S. Audi
Abstract: This paper includes examples of engineering graphics produced by available(commercial) programs and others produced by high level language programming in a limited credit hour segment of an educational program. Regardless of the microcomputer and the level of programming used, we believe that with careful consideration and judicious implementation we can integrate teaching microcomputer based graphics. By using both commercially available programs and high level language programming in our engineering curricula, engineering graphics can be taught without encroaching on the fundamental engineering courses.

A Short Algorithm for Orthogonal Axonometric Representation 48(3) 84 14-18
Y. Charit
Abstract: The paper presents a short algorithm and a computer program for orthogonal axonometric representation of an object under a freely chosen direction of projection. The result is an orthogonal trimetric axonometric. Orthogonal diametric and isometric representations and orthographic projections are obtained as particular, with corresponding simplifications of the program. Practical examples are given.

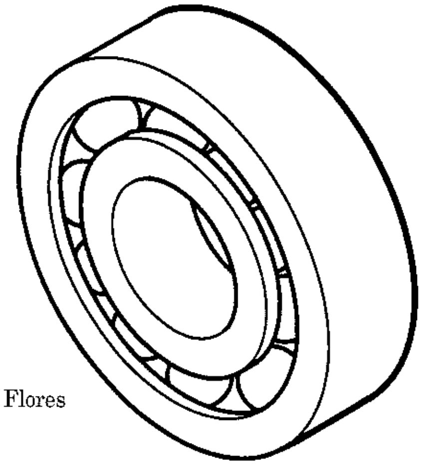


Illustration by Carrie Flores

Projection

The Stereographic Net as a Graphical Aids **40(1) 76 20-26**
William G. Stinson
Abstract: A stereographic projection of a sphere is a conical or perspective projection of a sphere in which the plane of projection contains the center of the sphere and the point of concurrence of the projectors is the pole of this plane, i.e. the top point of the sphere when this plane is horizontal. The projections of all points of the lower hemisphere will fall within the great circle intersection of the plane of projection with the sphere, and projections of all points of the upper hemisphere will fall outside this same great circle. Obviously those points on the upper hemisphere near the upper most point will have projections at very great distances outside the limiting circle separating the two hemispheres. For this reason, normally the projection is restricted to that of the hemisphere falling inside the limiting circle.

Orthographic Views **40(2) 76 20-23**
Boris W. Boguslavsky
Abstract: An orthographic projection, or view, of an object is a drawing obtained by connecting the eye of the observer (located at an infinite distance from the object) by parallel lines of sight to points on the object and then interposing a picture plane perpendicular to the lines of sight, and connecting the points at which the lines of sight pierce the picture plane.

Using Inversion to Solve a Construction Problem **40(3) 76 37-39**
J. Charit
Abstract: This paper offers a solution to a problem that appeared when designing an elbow corner of a pipe header branching through an elliptical cone reducer needed for technical purposes.

Critical Review of Pictorial Drawing in U.S. Graphical Literature **41(1) 77 25-28**
H. Niayesh
Abstract: In U.S. engineering graphical literature, Pictorial Drawings using parallel rays of projection are divided into axonometric and oblique projections. The word "axonometric" is thus interpreted to mean orthographic, as opposed to oblique, an interpretation incorrect in both geometrically and linguistically.

Visibility of Points on the Isometric View of a Sphere **41(1) 77 43-45**
Yaaqov (Jack) Arwas
Abstract: It is generally easy to determine the visibility of a given point on the isometric view of a sphere, especially if it can be related to some line on the sphere envelope. In some cases, however, the answer is not quite obvious. This paper establishes a method to determine the visibility of any point on the isometric drawing of a sphere.

An Exercise in Coordinate Plotting **41(1) 77 54-63**
Edward Holland, Jr.
Abstract: Coordinate plotting is the process of locating the position of contour points or the end points of boundary lines in a plane survey by means of X and Y coordinates. By using the intersection of the X and Y axes as the origin (o, o), points can be plotted by means of their coordinate distances from the origin.

Representation of Curved Surfaces by Computer Graphics **41(2) 77 20-25**
A. Rotenberg
Abstract: The problem of computer drafting of outlines of curved surfaces is quite distinct from that of Polyhedra. The edge on a surface of a polyhedron is a property independent of the projection apparatus. A silhouette of a curved surface is a line whose shape depends on the position of the centre of projection with respect to the surface.

Use of the Stereographic Net in Structural Geology Problems Involving Rotation **41(2) 77 41-45**
William G. Stinson
Abstract: As I pointed out in an earlier introductory article on the use of stereographic nets, such nets when used in structural geology are the stereographic projection of the lower half of a sphere having N-S axes and E-W line lying in the horizontal plane of projection. The spherical surface is represented by its great circle intersection with the plane of projection and by the projection of the lower half of a family of meridian circles established every two degrees and by the projection of

the lower half of small circles located every two degrees and lying in planes perpendicular to the N-S axis (like parallels of latitude).

Computer Aided Determination of Intersection Lines for Surfaces of Revolution Having Parallel Axes **41(2) 77 46-49**

J. Charit

Abstract: Machine-part design frequently involves intersecting surfaces of revolution with parallel axes. A method is presented below for computer aided construction of an intersection line of the latter type, including the determination of visibility. The basic assumption is that the surface contours are irregular curves, continuous or discontinuous, with or without rectilinear segments.

The procedure consists of three stages:
Scanning of the drawing.
Determination of the intersection line.
Plotting of its projections.

A Visual Aid for Instruction in Orthographic Projection **42(1) 78 9**

Tim A. Jur & Mohammad Sarraf

Abstract: This brief paper has to do with the educational side of engineering drawing, in particular, those first and important series of lectures on orthographic projection. Students who are exposed to this material for the first time usually have to struggle a bit before they are able to grasp the principles involved. At this early stage in the course, a liberal use of visual aids can be very helpful. In this paper a very simple yet effective visual aid is described for use in teaching orthographic projection.

Distortion Parameter in Perception of Perspective Representation **43(3) 79 41-45**

Y. Charit

Abstract: A comprehensive review is given of a means of achieving 'distortion free' perspective

A New Orthographic Model **43(2) 79 44**

R. Patteson Kelso

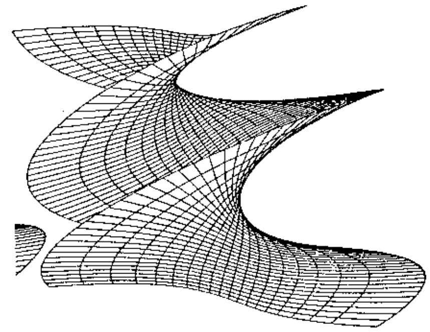
Abstract: In an effort to help students visualize multiple successive auxiliary views the author devised an orthographic model that is described in the article.

PROJECTION

Application of Odaka's Equations for Perspective Projection to the Determination of Scales and Ellipse Guides in Axonometric Drawing **43(2) 79 55-59**

Ming H. Land

Abstract: Equations of perspective projection from which other equations for other types of pictorial projection can be derived are outlined.



A Diagrammatic Representation of the Basic Motion Equations **44(3) 80 44-45**

Lyndon O. Barton

Abstract: This article recalls the basic motion equations and presented is a simple diagrammatic approach that can be a useful alternative to the normal derivations.

A Review of Some Mathematical Techniques for Projecting Axonometric Projection **44(1) 80 34-37**

Ming H. Land

Abstract: Among the various types of three-dimensional projections which find applications in engineering illustration, axonometric projection is used most extensively in catalogs, in general sales literature, and in engineering and technical literature.

The Sine Double Angle Equations of Axonometric Projection for Solving Angles and Scale Ratios **44(2) 80 25-28**

Ming H. Land

Abstract: Graphical solutions to angles and scale problems in axonometric projection are not only tedious but also time-consuming. Therefore engineers have looked for convenient mathematical solutions to these problems. One of the mathematical techniques for solving these problems is Odaka's equations for axonometric projection (Odaka, 1978). However, the mathematical calculations using Odaka's equations are still somewhat complicated. A new method, using the sine double angle equations, has recently been developed by the author.

The Extension of Shiro Odaka's Equations for Perspective Projection to Four Dimensions **44(3) 80 39-40**

David W. Brisson

Abstract: This paper presents an extension of Shiro Odaka's equations for perspective projection to spaces of more than three dimensions. Diagrams are presented to demonstrate the graphics involved.

Abstract: The graphic method for finding the ellipse angles when constructing an isometric protractor has been given by Thomas. This paper will describe a new mathematical method for solving the ellipse angles on an isometric protractor.

Abstract: The purpose of this article is to present an analysis of scales in pictorial drawings constructed by Hoenberg's method, and, for logical purpose, to provide a brief review of projection procedures, advantages, and limitations underlying this method.

Abstract: This paper examines the following two conditional invariants of orthographic projections: a. Constancy of an angle other than $\pi/2$ between two intersecting lines, and b. Constancy of a ratio of two arbitrary lines.

Abstract: It is the author's belief that the overwhelming majority of engineering graphics texts are not accurate in the usage of reference planes any more than the belief in Columbus' day that the world was flat. In fact, the same premise is in question here; should an orthographic view be viewed as flat or three dimensional in nature? That is, should we teach just relationships between two dimensional views, or should we use every available tool necessary to encourage three dimensional visualization?

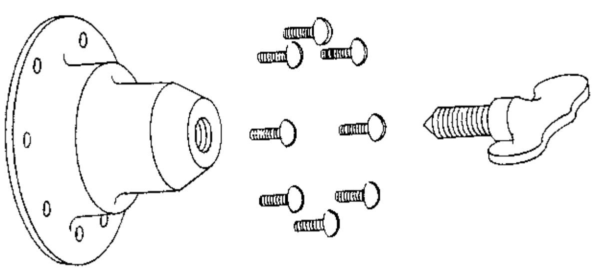


Illustration by John Penziol

Abstract: When an object is placed so that none of its principal edges are parallel to the picture plane, the resulting view is a three point perspective. Each of the three sets of parallel lines will converge to its vanishing point, and the graphical construction becomes more involved. Therefore, three point perspective is not often used in engineering drawing. However, three point perspective is the most realistic form of pictorial. It is effective for realistic illustration for tall structure and for bird's-eye views where the heights of the objects are to be emphasized for special effects.

Abstract: The most pleasant surprise about 3D graphics is how easy it is to make basic orthographic and axonometric drawings. While most computer graphics texts are replete with matrices and matrix manipulation techniques, multi-view and pictorial drawings can be made using simple algebra. During the past year I was able to teach in three one-hour lectures enough computer graphics so that the freshman student could make any set of principle views and pictorial desired. The lectures were given in the middle of the Engineering Graphics course after the students had learned conventional drawing practices. They had either completed one course in Fortran with or without plotting or were taking a Fortran course coincidentally with my Graphics course. Computer Graphics lectures consisted of one lecture each of data base construction, 3D to 2D conversions, and translation and rotation.

Abstract: This article is an excerpt from a book in progress by Dr. Kolomyjec entitled "Computer Drawing". Brooks/Cole will be the publishers, the data of publication yet to be determined. The cover illustrations were produced by a version of this program.

Abstract: The two Methods of Descriptive Geometry, Projection and Direct, are founded on two different basic ideas. Each method has its own basic principles, and each requires its own attitude of mind.

Abstract: When a designer needs a perspective view of a cylinder of revolution, it would be useful for him to be able to use a computer plotter and software subroutine for plotting a perspective view of the cylinder. This plotter and subroutine could be used for the design of a pump, piston, axle, column, water tower, or for any other purpose.

Abstract: One of the objectives of engineering graphics is the two dimensional representation, as multi-view drawings, of three dimensional objects.

Abstract: Mathematical analysis of axonometric projection have been conducted and reported by a number of authors. This paper will present additional analyses of axonometric projection and their applications to three-point perspective projection.

Abstract: Oblique projection can be produced from two principal orthographic views of an object. It is usually practical to use the plan and profile views for projectors and the frontal viewing plane as the *picture* or *oblique* viewing plane. This paper defines the analytical relationships for the foreshortening and receding angle of an oblique line as a function of the lines of sight to the object as represented in the plan and profile views. It also illustrates a procedure for creating oblique projections of objects from principal orthographic views of the object using computer graphics. The CADAM Computer graphics program was used to develop the procedure described in this paper.

Abstract: Straight forward techniques of defining a cylinder as right-circular and right-elliptical are defined.

Abstract: In this paper, the effects of two visualization aids were studied as they pertain to the teaching of orthographic projection. One aid used tactile models, a plastic transparent bow and a Goss Box, where the other used a computer Tutor program. The Goss Box provided the student the opportunity to touch and feel the object as well as see it in its principal views. The Tutor computer program allowed the student to "see" the two-dimensional representation of the object, manipulating views and surface identification. It was found that both of these aids had a positive effect on learning isometric and principal view drawing. Though not statistically significant, the results show that multisensory learning does assist the process of visualizing objects in three-dimensional space.

Abstract: This paper presents a good treatment of a fundamental problem in graphics: how to make an ellipse formed by orthogonal projection fit the world of perspective projection. The method outlined here approximates a perspective ellipse by fitting an orthogonal ellipse within a correctly constructed enclosing form.

Abstract: In order to provide a better understanding of the theory of oblique projection, this paper will present an analysis of the mathematical principles of oblique projection and techniques of applying these principles to computer graphics.

Abstract: This article is a continuation of a paper in the spring 1985 issue of the Engineering Design Graphics Journal entitled *Putting the Ellipse in Perspective.*

Multiview Projection Using CADKEY: Freeze-Frame Demonstrations **52(3) 88 20-27**

R. Patteson Kelso & M. Reza Ziai

Abstract: A three-dimensional CAD software package, CADKEY, is used to create a model from which to demonstrate orthographic orthodirectional projection theory to a classroom. The software allows storage of images on various levels which may be made visible and invisible. The selective use of visible and invisible levels allows the simulation of motion, in the manner of the freeze-frame seen on TV.

A Technique for Drawing Auxiliary Views Using 2D CAD (CADKEY) **53(2) 89 10-14**

Ernesto R. Ramirez & R. Patteson Kelso

Abstract: A technique for creating auxiliary views of three-dimensional objects using 2D CADKEY is demonstrated.

Axonometric Projections **53(2) 89 19-25**

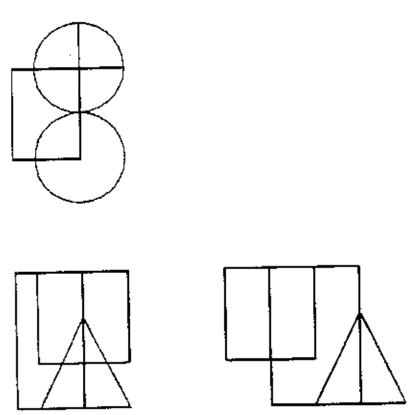
Lenuel J. Chastain

Abstract: An alternative to the method of double-rotational transformation is described for the generation of diametric and trimetric projections which avoids any explicit statement of angular measure.

Representation of Projection and Coordinate Systems in Engineering Graphics **54(1) 90 35-47**

William A. Ross

Abstract: Inconsistencies have been noted in methods used to graphically depict first and third angle projection in engineering graphics texts. Also noted is the lack of attention to the inconsistency in the relationship of projection to coordinate systems. A comparison of the methods illustrated in several of the market's established textbooks is presented. During the period of transition from manually generated engineering graphics to computer generated two and three-dimensional data bases, the adoption of a standardized graphical representation for projection and its relationship to X-Y-Z coordinate space is deemed useful for engineering graphics education.



The Matrix for the Transformation of an Auxiliary Orthographic Projection and a New Computation of the Axonometric Drawing **54(3) 90 10-16**

Li Liangxun

Abstract: Currently the theory presented in most books and articles on the computation of an axonometric drawing is based on the concept of rotation. Thus, it is not possible to show the relationship between views of the object, the line of sight, and the axonometric drawing itself. A new computation that improves this situation, based on the theory of auxiliary orthographic projection, is presented. A matrix for transformation is derived. Using this matrix, the coordinates of the vertices of outlines of the object in the axonometric drawing can be computed.

Perspective Projection: Artificial and Natural **56(3) 92 27-35**

R. Patteson Kelso

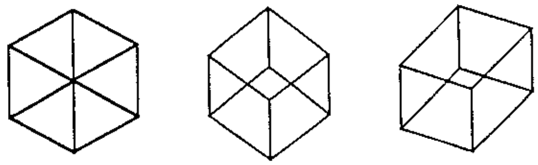
Abstract: Artificial Perspective Projection is the name given by Leonardo da Vinci to what we today call Classical Perspective Projection. Natural Perspective Projection is the name given by Leonardo to the projection that produces the image beheld by the eye.

The author has independently discovered a phenomenon first investigated by Leonardo da Vinci: the difference between Artificial Perspective Projection and Natural Perspective Projection. Acknowledging Leonardo's priority in the appropriate areas, this paper demonstrates: (1) that in order for Artificial Perspective to appear the same to the eye as does Natural Perspective, the eye must view the Artificial Perspective image from the spatial Station Point, (2) that the distortion inherent in Artificial Perspective Projection is non-linear, (3) the theoretical determination of the horizon line, (4) the projective geometry that produces Natural Perspective Projection and, finally, (5) the paper offers certain conclusions on the distortion inherent to Natural Perspective Projection.

A Simple Convenient Method of Constructing Ideal Perspective **59(3) 95 47-48**

Ding Zhong Kun

Abstract: This paper offers a simple quick method to locate and draw the measuring points of the ideal perspective, even when the placement of the vanishing point is situated beyond the edge of the paper. It can still conveniently construct the measuring point, thus it manages to construct ideal perspective.



Rapid Prototyping

Stereolithography: Fast Model/ Prototype-Making with CADD at the University Level **58(1) 94 11-16**
John G. Nee

Abstract: The time required to generate models of new or redesigned parts is key to maintaining a competitive advantage in the manufacturing environment. The increased use of Computer Aided design and drafting (CADD) has significantly reduced design time, but the formation of a model representing the part is still expensive and time consuming. To address the need for the generation of models with reduced turnaround time and a concomitant decrease in expense, the technology of solid imaging and model/prototype making has developed.

Stereolithography may help make the leap to designer-directed construction of 3D models and prototypes. Stereolithography (3D printing) permits the use of computer-generated designs and associated databases in the construction of plastic models.

The paper presentation shows how a major Michigan university has integrated stereolithography and solid modeling methods into design and engineering graphics, engineering technology, and computer-integrated manufacturing.

CAD Processes for Rapid Prototyping **59(2) 95 5-12**
Vederaman Sriraman & Gary Winek

Abstract: In less than a decade many rapid prototyping systems have emerged in the market. These systems generate a physical prototype of a part based upon geometric definitions stored in a Computer Aided Design (CAD) file. The rapid prototyping process can cut the prototype development time from weeks or months to a few hours or days. Thus rapid prototyping can facilitate concurrent engineering and shorten the time-to-market lead times of new products. In this paper we will consider certain practical aspects, from an engineering graphics perspective, that are associated with the CAD input file generation needed for rapid prototyping. The paper will deal with geometric modeling for rapid prototyping, selection of appropriate CAD models, CAD file formats for interfacing with rapid prototyping software and using AutoCAD, release 12 with AME, as a front-end for rapid prototyping.

Virtual Reality

The Performance of Graphical User Interfaces in 3D Interactive Animation (Virtual) Environments **56(3) 92 12-17**
Shane McWhorter, Walter E. Rodríguez & Larry Hodges

Abstract: Experimental data on the effect of GUI parameters on task performance in a 3D interactive animation environment is presented. Subjects performed an object recognition and 3-dimensional manipulation task in a virtual environment given real-time visual feedback by dynamic display techniques. The subjects controlled a *virtual crane* by the movements of a SpaceBall ™ input device. The interaction of stereoscopic depth cues with viewpoint position is evaluated in this experiment. Six conditions were tested by the combination of values of stereoscopic depth cues and one of three viewpoints. The data indicate that choice of viewpoint and the presence of stereoscopic depth cues is important to the performance of this task. The presence of stereoscopic cues does not guarantee increased usability for all display tasks, but as this investigation confirms, stereoscopic cues can increase user performance of complex interactive tasks.

Virtual Reality: Implications for Research in Engineering Design Graphics **57(2) 93 5-12**
William A. Ross & Steven Aukstakalnis

Abstract: Computer systems have recently been developed which enable the prototyping of 3D CAD models as though the designed objects were actually real. With this emerging technology, currently referred to as Virtual Reality, the systems incorporate the use of display devices which are worn on the user's head, instrumented gloves which provide tactile feedback and enable the intuitive manipulation of virtual objects, and 3D acoustic displays. This paper gives a brief overview of such systems, review a number of current applications developed for use within the engineering and design community, and suggest future applications.

The second objective of this paper is to suggest that Virtual Reality offers the necessary capability, because of its immersive nature, to monitor, record, and allow for analysis of the types of spatial acuity and visualization skills useful in engineering design graphics. Specific scenarios for developing engineering design graphics research tools utilizing VR technology are discussed.

Illustration by John Penziol

Visualization

An Extension of the Experiments of Kunio Kondo and Taro Tajima with Stereo Vision without Optical Aid 46(2) 82 5-7
David W. Brisson
Abstract: The following paper is an extension of the stereo principles used by Kondo and Tajima . These basic ideas are well-known in their simple form as stereograms, and have been adapted as hyperstereograms by Brisson for the American association for the Advancement of Science Annual Conference in Washington, DC in 1978. A particularly interesting aspect of their work concerns the arrays of stereographic elements that they have generated. They have produced the basis of stereo effects from single image construction. This paper is a discussion of some of the possibilities of that aspect.

The Inner World of the Plane – From Bases for Pictures, Films, and "Visual Music" 45(2) 81 24-38
Reinhard Lehnert
Abstract: This article deals with geometric primitive forms discovered by the author, and pictures designed on these forms as form-bases, and films, and thus with a basis for a *visual music*, an art form which offers something analogous and equivalent to the eye as music is to the ear. In it the inner-stars are to play a role such as the scales *play* in music. In addition, this article offers an outlook on inner-stars of sP3 with still more *complicated* gradients.

"Johnny" – An Algorithm for Reading Orthographic Drawings 46(1) 82 10-17
A. Rotenberg
Abstract: The author points out a new approach towards visual thinking and the design process.

Increasing Understanding and Visualization Abilities Using Three-Dimensional Models 45(2) 81 72-74
William J. Vander Wall
Abstract: The author proposes a closer look at using 3-dimensional models for learning-reinforcement. Based upon personal experience in designing, fabricating, and using various geometric objects in the classroom, the article stresses that the benefits derived from such models far outweigh the necessary work required in developing and producing them.

Methods for quickly producing similar models rather quickly and inexpensively from insulation foam board were also explained and described. In addition, the value of using 3-dimensional models in subject areas other than Engineering Graphics is suggested. It is concluded that more opportunity for hands-on use of three-dimensional models in the classroom results in better student understanding of subject matter and increased ability to visualize geometric shapes.

Improving Visualization: Fact or Fiction? 41(1) 77 47-53
Paul S. DeJong
Abstract: The work described in this paper is the outgrowth of several seemingly disconnected thoughts and observations, separated in both subject and time, and which must be outlined and properly related to explain the project. The visualization discussed here is simply that ability to construct and retain a strong, vivid mental image of a problem at hand.

Testing Student Understanding of Three-Dimensional Space 42(1) 78 10-11
James A. Hardell
Abstract: The author shows different problems that can indicate if students are really understanding the visual three-dimensional world.

Revitalizing the Art of Graphics in Mechanics 43(2) 79 13-18
Jerald M. Henderson, S. L. Cotter & J. L. Meriam
Abstract: The message of this article is simply that "'Thinking with pictures is an essential strand in the intellectual history of technology development".

Visual Perception: The Problem of Creating Virtual Space 43(2) 79 42-43
Jon M. Duff
Abstract: The author offers problems with visual perception and a great deal of careful thought on which to build solutions to the problems.

Consulting in Graphics – Good for the Faculty and Good for the Student 45(2) 81 17-21
Larry D. Goss
Abstract: The main goals for this article is:

Monetary Support – Your students are basically in school because they are after additional monetary support other than what they can get from flipping hamburgers at a fast food establishments or being a supervisor of a department at a discount house.

They need some experience in the field in which they are endevoring to enter.

Visibility of Spatial Bodies: A Quick Method 47(3) 83 38-44
Louisa Bonfiglioli
Abstract: When a certain body is observed from a specific point of view E (eye) not all its parts are visible; the invisible ones are, generally, omitted in drawing the body's picture

---

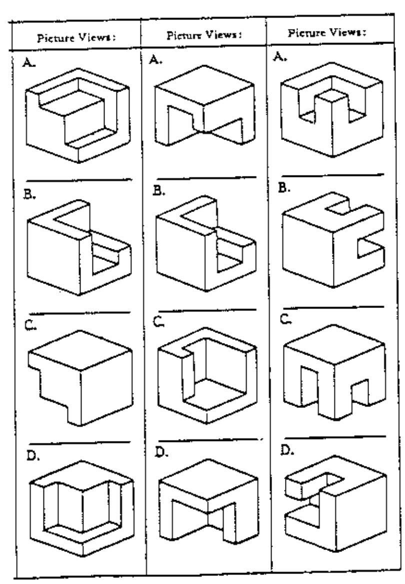
Use of 3D Graphics to Improve Visualization Skills 51(2) 87 25-29
Vera B. Anand, Nadim M. Aziz & C. Agrawal
Abstract: The importance of spatial visualization for engineering students has been well recognized in the education community for many years. This is an area in which students receive very little training, leading to vast differences in their ability to visualize in 3D.

Advocating the Development of Visual Perception as a Dominant Goal of Technical Graphics Curricula 53(1) 89 1-12
Scott E. Wiley
Abstract: Many have recognized that visual disciplines in higher education have enjoyed an exciting, yet frustrating period of change. Greater emphasis is being placed on new technology, curricula are becoming more vocationally oriented, and graduates are expected to demonstrate greater competence in both specialized and diversified areas of their fields. Yet along with these changes, traditional problems still exist. Visual disciplines continue to have tighter departmental budgets, lower student enrollment and faculty pay, limited course offerings, and lower amounts of scholarly activity when compared to verbal or quantitative subject areas.

Visualization in Graphics: Time for a Change? 53(3) 89 28-38
James C. Shahan & Roland D. Jenison
Abstract: The advent of computers and computer graphics has placed a heavy burden on introductory graphics courses. There are too many topics but not enough time. An important part of graphics is visualization. At Iowa State University a more intuitive approach to visualizing 2D and 3D geometry is being adopted. Past approaches are described, new approaches are presented, and results from initial classroom use are shown.

Computer Graphics and the Development of Visual Perception in Engineering Graphics Curricula 54(2) 90 39-45
Scott E. Wiley
Abstract: Like all educational goals, the development of visual perception must be purposely designed into curricula. Visual perception is defined, the need to develop it is described, and methods which engineering graphics educators can use to develop it are outlined in the context of new computer graphics technology integrated throughout a revised curriculum.

2D and 3D CAD: Complements to Visualization 54(3) 90 17-29
Paul J. A. Zsombor-Murray
Abstract: A proposition that 3D CAD provides an array of unambiguous solutions to engineering problems is illustrated. This proposition assumes that engineering problems are conceived in parallel processing mode while they are solved in sequential processing mode.



Visualization Vol(No) Yr Pg

An Hierarchy of Visual Learning **54(3) 90 30-35**
Scott E. Wiley

Abstract: A hierarchy of visual learning is proposed giving three primary stages of visual learning as well as seven hierarchical stages. A clarification of terms associated with visual learning is also presented.

Visualization of Three-Dimensional Form: A Discussion of Theoretical Models of Internal Representation **57(1) 93 18-28**
Eric N. Wiebe

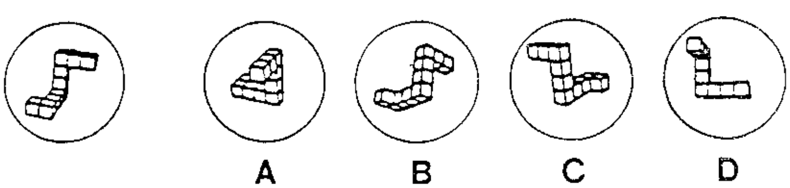
Abstract: Current research in perception, cognition, and human-computer interaction is explored as a source of theories explaining the process by which three-dimensional forms are visualized. A number of theoretical models are summarized and compared in an attempt to uncover variables important to future research conducted by the EDG profession. The appropriateness of dynamic versus static imaging techniques to develop a student's visualization abilities becomes a vehicle for applying some of these theoretical models and proposing specific display techniques.

Visual Perception, Spatial Visualisation and Engineering Drawing **58(2) 94 12-21**
J.Roorda

Abstract: The processes of the visual thinking, imagining, visualisation and engineering drawing are examined against the background of some studies in the psychology of visual perception. Questions of object recognition and the *mechanics* of transforming mental images, and how these relate to the understanding, interpretation and preparation of engineering drawings, are raised. The results of a test in drawing interpretation and freehand sketching are presented and discussed to illustrate the key points of the paper.

A Dual Approach to Engineering Design Visualization **54(3) 90 36-44**
Walter E. Rodríguez

Abstract: The new freshman engineering graphics course at Georgia Tech covers essential design visualization and documentation concepts using a dual approach. Traditional and computer graphics concepts are taught along two parallel and complementary paths (or phases) that eventually merge into an integrated design visualization/documentation phase.



Study of Journal Bearing Dynamics Using Three-Dimensional Motion Picture Graphics **50(3) 86 23-25**
David E. Brewe & Donald J. Sosoka

Abstract: Computer-generated motion pictures of three-dimensional graphics are being used to analyze journal bearings under dynamically loaded conditions. The motion pictures simultaneously present the motion of the journal and the pressures predicted to develop within the fluid film of the bearing as they evolve in time. The correct prediction of these fluid film pressures can be complicated by the development of cavitation within the fluid. The numerical model that is used predicts the formation of the cavitation bubble and its growth, downstream movement, and subsequent collapse. A complete physical picture is created in the motion picture as the journal traverses through the entire dynamic cycle.

A Visualization and Orthographic Drawing Test Using the Macintosh Computer **54(1) 90 1-7**
Gary R. Bertoline & Daniel C. Miller

Abstract: An examination to determine a student's visualization capabilities has been developed which uses orthographic drawings displayed on the Macintosh computer. This examination, the Spatial Visualization Test (SVT), has two versions, both developed to measure visualization ability, time to visualize, and reaction time. The SVT indicates the learner's ability to visualize complex 3-dimensional objects from the six principal views. All of these measures are automatically recorded by the computer during the testing process and results are printed after the student completes the test. This process gives the student and his instructor an indicator of the student's ability to visualize and read orthographic drawings.

A Computerized Method of Distortion Analysis of Simultaneously Drawn Mirror Image Figures **55(2) 91 17-24**
Howard E. Dunn, Larry D. Goss & Benjamin P. Miller

Abstract: Individuals have been observed simultaneously drawing mirror image figures with their right and left hands indicating that this ability might relate to personality traits and/or creativity. A computerized method is described whereby a mirror image pair simultaneously drawn by the right and left hands can be compared. The mirror image figures are collected as digital data from two digitizing pads interfaced with a personal computer. The program computes the mean relative size and a measure of the distortion of one figure relative to the other. The distortion measure is based on the departure from a condition of rigidity employed in the physics of rigid bodies. This program should be applicable to a variety of psychological studies.

Static vs. Dynamic Visuals in Computer-Assisted Instruction 55(2) 91 25-33
Patrick J. McCuistion

Abstract: An experiment was conducted to determine which of two methods of presenting graphic images (static or dynamic) would enhance student achievement and spatial abilities. The objectives of the study were to ascertain if a series of static or dynamic visuals would allow students to achieve higher performance test scores and/or higher mental rotation test scores. The results of the experiment revealed that the students who viewed the static presentation achieved slightly higher scores on performance tests, while students who viewed the dynamic presentation made larger gains on the mental rotation tests.

Spatial Visualization Research and Theories: Their Importance in the Development of an Engineering and Technical Design Graphics Curriculum Model 55(3) 91 5-14
Craig L. Miller & Gary R. Bertoline

Abstract: Traditionally, engineering design graphics has described visualization as the ability to read and develop orthographic drawings or to solve descriptive geometry problems. If a student were able to develop orthographic or descriptive geometry drawings then the student had visualization ability. The accuracy of traditional approaches of visualization in engineering graphics has recently been challenged by many educators in the profession. If engineering graphics educators are convinced that the traditional approaches of visualization are incorrect then they should undertake research in the area of visualization. But what the profession must realize is that there is a vast area of visualization

---

Enhancing Visual Literacy of Engineering Students Through the Use of Real and Computer Generated Models 56(1) 92 27-38
Craig L. Miller

Abstract: Engineering graphics educators are continually looking for strategies to implement more effective instruction. Technology is advancing rapidly in its ability to provide educators with a wealth of potential tools for providing many different experiences. The utilization of the computer and other instructional technology tools in educational settings must be controlled by the existing literature in learning styles, and instructional systems design. The use of technology has come into the engineering graphics curriculum with limited identifiable research efforts in these areas. This study investigated the use of real and computer-generated models and the learning styles of visual and haptic, to determine if an interaction of instructional treatment and learning style developed and advanced the spatial abilities of engineering graphics students.

Effect on Spatial Visualization: Introducing Basic Engineering Graphic Concepts Using 3D CAD Technology 56(3) 92 36-43
Timothy J. Sexton

Abstract: Computer Aided Design technology has revolutionized the way geometry is conceptualized and described. Yet, instructional strategies in engineering graphics have not taken advantage and/or kept pace with this technological revolution. This study attempted to evaluate Computer Aided Design technology's 3D wireframe modeling capability in fostering spatial visualization abilities while introducing basic projection theory to beginning level engineering graphics students.

Design-Implementation-Based Simulation: A Graphics Tool 59(1) 95 18-26
Walter E. Rodríguez & Augusto Opdenbosch

Abstract: This paper presents a graphics tool for visualizing and simulating design-implementation processes in real-time. The Interactive Visualizer Plus Plus, or IV++, is an interactive visual simulation system that considers the dynamic nature of design-implementation processes. IV++ allows three-dimensional real-time visual simulations integrating time and spatial relationships with the physical constraints of actual design-implementation processes.

This paper discusses IV++'s graphic-user-interface (GUI) and its Dynamics, Controls, and Reactive modules which uses knowledge-based rules to alter the behavior of graphic-objects and primitives according to the current status of the computer graphics environment.

The Relationship of Previous Experiences to Spatial Visualization Ability 59(3) 95 5-17
John A. Deno

Abstract: This study examined whether variations in performance on a measure of spatial visualization were related to prior spatial experiences, and to the developmental period when the prior experiences occurred. Analysis was conducted to determine whether specific experiences discriminated among subjects on the basis of spatial visualization ability.

The findings revealed that non-academic activities had the most positive significant relationship to spatial visualization ability for men, but not for women. It was also found that non-academic activities differentiated men when grouped by spatial ability and that experiences during high school accounted for the most variance in spatial ability.

Further experimental, causal-comparative, and longitudinal research using the findings of this study should be very useful in the design of curricula to enhance spatial ability.

Engineering Design Graphics Division (EDGD) of the American Society for Engineering Education (ASEE) Bylaws

ARTICLE 1: NAME AND OBJECTIVES

Section 1. The name of this Division of the American Society for Engineering Education (the Society shall be the Engineering Design Graphics Division (the Division).

Section 2. The objectives of the Division shall be to:

a. Provide leadership and guidance for those engaged in the teaching of conceptual design and graphical analysis and their use in industry.

b. Investigate matters relating to engineering graphics and to inform the membership of current developments.

c. Encourage the early participation of engineering students in the areas of graphics and design.

d. Promote, stimulate and provide opportunities for the professional interchange of ideas among the membership.

ARTICLE II: MEMBERSHIP

The membership of the Division shall consist of all members of the Society who have indicated an interest in the Division and paid the annual Division dues. Division dues are billed, due and payable with the Society dues on the anniversary of the date on which a member joined the Society. Division dues are deposited by the Society to the account of the Division and disbursed upon request of the Division Chair or Secretary-Treasurer. Dues fund Division publications sent to each member.

ARTICLE III: OFFICERS AND DUTIES

Section 1. The Division shall be administered by an Executive Committee consisting of the following elected officers plus the immediate past chair: (See Art. VI)

Chair	1 Year
Vice Chair	1 Year
Secretary-Treasurer	3 Years
Directors (5)	3 Years

Terms of office shall conform with the Society-year, beginning in June following the Annual Conference of the calendar-year in which elected (See Art. IV, Sec. 1f).

Section 2. The duties of the Division officers shall be those usually associated with the respective office and described as follows:

2a. Chair

2a(1). The Chair is the chief executive officer of the Division and of the Executive Committee and an ex official member of all Division committees. The Chair presides at all business meetings of the Division and the Executive Committee.

2a(2). The Chair is the senior member of the Division on the Executive Board of the ASEE Council for Professional and Technical Education.

2a(3). The Chair shall review the annual Division budget as prepared by the Secretary-Treasurer [See Art. III, Sec. 2c(6)]. The Vice-Chair shall be consulted during this review. If necessary, adjustments to the budget will be made and discussed with the Secretary-Treasurer. When finalized, the budget shall be presented by the Chair to the Executive

Committee. Upon approval, the budget shall be submitted to the Executive Director of the Society.

2a(4). The Chair shall prepare a written report, including budget expenditures, for the term of office just completed and transmit, not later than thirty (30) days following completion of the term of office, copies to the Secretary-Treasurer.

2a(5). The Chair shall keep the Vice-Chair informed of all Division activities during the term of office, and transmit to the Vice-Chair at the end of the term all material needed to maintain continuity.

2a(6). The Chair shall appoint all bylaw committees (See ART. VII) except the Nominating and Elections Committees, designating the chair of each committee except where the chair is specified by the bylaws.

2a(7). The Chair shall appoint the chairs and, at his discretion, members of committees not specified by the bylaws but considered necessary for the adequate administration operation of the Division, and assign such committees to the Vice-Chair or appropriate Director for Administrative control.

2a(8). The Chair shall review and approve the composition of all committees.

2a(9). The Chair shall assure the effective operation of the Division by revoking the appointment of any appointee who is not satisfactorily performing the duties of the position to which appointed.

2a(10). The Chair shall, with the advice and consent of the Executive Committee, request the resignation of any officer of the Division who is not satisfactorily performing the duties of the office to which elected, and shall appoint another member of the Division to that office for the remainder of the unexpired term. If the officer refuses to resign or does not respond to the resignation request within thirty (30) days, the Chair shall relieve that office by executive fiat and appoint a replacement to serve the remainder of the unexpired term (see ART. IV, Sec. 1g).

2a(11). The Chair is responsible for all meetings of the Division and of the Executive Committee.

2a(12). The Chair shall arrange for a letter of welcome containing information about the Division and its objectives to be sent to each new member of the Society who has indicated an interest in the Division.

2b. Vice-Chair

2b(1). The term of office of the Vice-Chair begins with the Society-year beginning in June following the Annual Conference of the calendar-year in which elected (SeeART. III, Sec. 1).

2b(2). The Vice-Chair succeeds to the Chair of the Division at the beginning of the Society-year following the term as Vice-Chair.

2b(3). In the event that the Chair is unable to perform the duties of the office, the Vice-Chair shall assume the Chair.

2b(4). In the absence of the Chair, the Vice-Chair shall preside at all business meetings of the Division and of the Executive Committee.

2b(5). The Vice-Chair shall be the junior member of the Division on the executive board of the ASEE Council for Professional and Technical Education.

2b(6). The Vice-Chair shall assist the Chair in the administration and operation of the Division.

2b(7). To provide continuity, the Vice-Chair shall, through communication with the Chair, keep informed on all current activities and become familiar with the Division's operational procedures.

2b(8). The Vice-Chair shall appoint the Nominating and Elections Committees (See ART. VII, Secs. 1a and 1b) subject to the approval of the Executive Committee.

2b(9). The Vice-Chair is the chair of the Elections Committee, and with the aid of the other members of the Elections Committee, counts the election ballots and submits a confidential report of the results of the election to the Chair of the Division.

2b(10). The Vice-Chair shall prepare a list of committees for the following year for presentation to the Division. Printed copies of this list shall be made available to the Executive Committee and provided to all persons attending the annual business meeting of the Division.

2b(11). The Vice-Chair is responsible for the functioning and performance of the following Bylaws Committees: Nominating, Elections and Distinguished Service Award. The duties and composition of these committees are defined in Art. VII, Sec. 1.

2c. Secretary-Treasurer (S-T)

2c(1). The Secretary-Treasurer is Secretary-Treasurer of the Division and of the Executive Committee.

2c(2). The S-T shall keep complete records of all meetings of the Division and of the Executive Committee and within sixty (60) days following each meeting or group of meetings shall provide copies of the minutes to all members of the Executive Committee and proxies. The S-T shall distribute copies of the minutes of the previous annual and mid-year business meetings to all members in attendance at the annual business meeting in June.

2c(3). The S-T shall receive and preserve copies of all reports and papers presented at the meetings of the Division and of the Executive Committee.

2c(4). The S-T shall transmit to the Director: Publications (See ART. VIII, Sec. 1a), the Division archivist, all archival records (minutes, proceedings, lists, etc.).

2c(5). When changes are made to these Bylaws, the S-T shall, within sixty (60) days following the annual conference at which the changes become effective, provide each Division officer with a copy of the (revised) Bylaws.

2c(6). The S-T shall prepare an annual budget and submit it to the Division Chair for review prior to presentation to the Executive Committee for final approval or revision.

2c(7). The S-T shall receive any Division money excluding Division dues and other funds under control of the Publications Committee. Such money shall promptly be placed on deposit in a suitable account in a federally-insured financial institution under the name of the EDGD-ASEE with signatures of both the S-T and Chair on file, with either having access to the account.

2c(8). The S-T shall be the disbursing agent for the Division, and will disburse funds upon approval of the Division Chair.

2c(9). The S-T shall submit an annual financial report at the annual business meeting and an interim report at the mid-year meeting.

2d. Directors

2d(1). There shall be five Directors, each elected to serve for a three-year term. No more than two (2) directors shall be elected for any Society-year. Each Director shall be responsible for all committees in one of the following categories:

A. Liaison
B. Professional and Technical
C. Programs
D. Publications
E. Zones Activities

2d(2). General Duties of Directors
Directors are responsible for establishing functions and guidelines for the operations of each of their assigned committees. Each year, prior to the Annual Conference, they shall recommend to the incoming Chair names of suggested committee chairs and members of committees under the Director's jurisdiction. A Director whose term is ending should consult with the elected replacement as to the committee composition. The actual appointments should not be made until approved by the Executive Committee and the Division Chair as described in ART. III, Sec. 2a(8). Directors shall maintain contact with the chairs of their assigned committees to ensure timely performance of the committees' functions. Directors are responsible for the presentation of reports on the activities of their assigned committees at the Executive Committee meetings during the Annual and Mid-Year Conferences. Directors may recommend the creation of new committees (or the discontinuance of committees that have fulfilled their function) within the category under their jurisdiction.

Recommended actions must be approved by the Executive Committee and the Division chair. Directors shall be responsible for notifying the Division Chair of any appointee under their supervision whose unsatisfactory performance could require action under the provisions of Article III, Sec. 2a(9).

2d(3a). Director: Liaison Committees
The Director is responsible for the functioning and performance of all liaison committees as defined in ART. VII, Sec. 2a(1).

2d(3b). Director: Professional and Technical Committees
The Director is responsible for the functioning and performance of all professional and technical committees as defined in ART. VII, Sec. 2a(2).

2d(3c). Director: Programs
The Director is responsible for the programs of all Conference sessions during the term of office. The Director shall be responsible for issuing a call for papers to be presented at each Conference. The Director shall maintain a Manual of Procedures to aid the Program Chair in planning the conference for which they are responsible, as well as keeping the Program Chair informed of all pertinent information regarding that conference including papers submitted, requests to participate, theme, and general guidelines. The Director will approve all proposed programs before submitting them for approval of the Division Chair and the Executive Committee. The Director: Programs is responsible for ensuring that all program committees are properly functioning and maintaining their time schedule. In the absence of both the Division Chair and Vice Chair, the Director: Programs will serve as interim chair, assuming the duties and responsibilities of Division Chair [See ART. VII, Sec. 2a(3)].

2d(3d). Director: Publications
The Director shall serve as Editor of the Engineering Design Graphics Journal (the Journal) and the Division archivist, and is responsible for the effective performance of all members of the Publications Committee (See ART. VIII).

2d(3e). Director: Zone Activities
The director shall encourage and suggest activities by maintaining contact with Division zone chairs to share information of activities occurring in other zones [See ART. VII, Sec. 2a(4)].

ARTICLE IV: ELECTIONS AND SUCCESSION OF OFFICERS

Section 1. Elected personnel shall be nominated and elected according to the following procedures:

1a. A slate of two candidates, for each office to be filled, shall be prepared by the Nominating Committee. An eligible candidate must be a current member of the Division who has expressed a willingness to accept nomination and to serve if elected to the office to be filled. The slate shall be published in the Winter issue of the Journal.

1b. A candidate for an elective office may be nominated by a written petition addressed to the Chair of the Nominating Committee bearing ten (10) signatures of members of the Division and accompanied by a statement from the nominee affirming a willingness to serve if elected. The names of candidates nominated by petition shall be added to the slate as prepared by the Secretary-Treasurer under the provisions of par. 1d, below.

1c. The nomination period shall close on December 31. A petition for nomination received after December 31 cannot be accepted.

1d. Not later than February 15, and returnable before March 15, the Secretary-Treasurer shall mail to each member of record (as provided by the Journal Circulation Manager-Treasurer) of the Division a ballot bearing the slate submitted by the Nominating Committee together with additional names presented by petition. A candidate receiving the largest number of votes for the office sought shall be declared elected. The ballot shall be designed to facilitate return mailing and bear the name and address of the chair of the Elections Committee, The Division Vice-Chair.

1e. The holder of an elective office whose term continues beyond the current Society-year is not eligible for nomination to another office or appointed position.

1f. Assumption of office by newly elected personnel shall be concurrent with that of the offices of the Society.

1g. If any elected person is unable or fails to perform the duties of the office, the Division Chair shall, with the advice and consent of the Executive Committee, appoint another Division member to serve in that office for the remainder of the term (See ART III, Sec 2a (101)}.

1h. If the Chair-elect is unable to assume or continue in office, the Vice-Chair shall assume the office of Chair and the Executive Committee will elect a Vice-Chair from its membership. The newly elected Chair will appoint a qualified member to fill the vacancy on the Executive Committee.

1j. If both the Chair and Vice-Chair are unable to assume or continue in office, the Director: Programs shall serve as Interim Chair until a Chair and Vice-Chair can be duly nominated and elected at the next scheduled Division election. The Interim Chair may, if desired, appoint a qualified member to serve as acting Director: Programs.

1k. The Division Chair may be removed from office for failure to satisfactorily perform the duties and responsibilities of that office. Action to remove the Chair may be initiated by a petition, addressed to the chair of the Policy Committee, signed by at least three (3) members of the Executive Committee or ten (10) members at large of the Division. Upon receipt of such petition the chair of the Policy Committee will seek the counsel and approval to proceed from three (3) or more other members of the Policy Committee. The chair of the Policy Committee will either return the petition to its source without further action or poll the Executive Committee on the question of removing the Chair from office. A telephone poll, confirmed in writing, shall be conducted as expeditiously as practicable. Six (6) of a possible eight (8) votes will be required to remove the Chair from office. The chair of the Policy Committee will notify the Chair that the removal action is pending and of the results of the poll, and if the vote favors removal, request the Chair's resignation. If the resignation is not forthcoming, the Chair will be removed by executive fiat, and the Executive Secretary of ASEE so notified. Replacement of the removed Chair shall be in accordance with the provisions of ART. IV, Secs. 1h, 1i, or 1k, as applicable.

Article V: Conferences

Section 1. Annual Conference.

There shall be an Annual Conference of the Division to be held concurrently with the Annual Conference of the Society, and it shall include the annual Division dinner meeting, one or more conference sessions, and a luncheon business meeting. The Annual Conference shall be planned to include areas of interest to instructors in technical education as well as those instructing at junior and senior levels and employers of graduates. Joint meetings with other divisions and constituent committees of the Society are to be encouraged.

1a. Program for Annual Conference

The program for the Annual Conference shall be considered by the Executive Committee at the Mid-Year Conference of the Division at the mid-year luncheon business meeting along with other items of business. Written reports of committees shall be received and distributed.

1a(1). The chair shall transmit the program for the Annual Conference to the Executive Director of the Society. The tentative draft of the program shall be submitted when requested by the Society subject to modifications enacted by the Executive Committee at the Mid-Year Conference. The Division program for the Annual Conference shall be published in the Spring issue of the Journal.

Section 2. Mid-Year Conference

There shall be a Mid-Year Conference to be held at an appropriate date annually between November 1 and January 31, and shall include a Division Mid-Year dinner meeting, one or more technical/professional sessions, and a luncheon business meeting.

2a. Program for Mid-Year Conference

The program for the Mid-Year Conference shall be considered by the Executive Committee at the Annual Conference of the Division. The Chair shall present the Mid-Year Conference program to members of the Division at the annual luncheon business meeting. The program for the Mid-Year Conference shall be published in the Fall issue of the Journal.

2a(1). Site Selection for Mid-Year Conferences

Individuals wishing to host a Mid-Year Conference shall submit a letter of proposal to the the Chair of the Division no later than one-year in advance of the Conference date. The Chair of the Division shall then include the proposal on the agenda for the next regularly scheduled Executive Committee meeting. A representative of each campus wishing to host a Mid-Year Conference must be present at the Executive Committee meeting to present a brief proposal to the Committee. The Executive Committee will then be responsible for selecting sites for conferences. Whenever possible, preference will be given to geographic distribution of conference sites.

Section 3. Periodic Summer Schools shall be held at the direction of the Executive Committee.

Section 4. Division members are urged to plan group meetings of engineering design graphics instructors in connection with sectional conferences of ASEE, and are urged to make those meetings of interest to instructors in technical education and of junior and senior college levels with a view of including such instructors as members of the Division.

Section 5. Members of the Society and other interested persons are eligible to attend all open conferences and meetings of the Division.

Article VI: Executive Committee

Section 1. Duties

1a. The Division shall have an Executive Committee whose duty shall be to administer the affairs of the Division and report to the Division at the Mid-Year and Annual Conferences.

1b. The Executive Committee shall convene for a meeting prior to the annual and mid-year business meetings in order to receive and discuss written reports from the Division's committees and to conduct such other business as required.

1c. The Executive Committee shall schedule and arrange for annual conferences, mid-year conferences and summer schools. It shall administer such other activities as may be desirable for the promotion of the objectives of the Division, including the appointment of special committees.

Section 2. Officers

The officers of the Executive Committee shall be the officers of the Division.

Section 3. Members

The members of the Executive Committee shall be the officers of the Division and the immediate past chair.

Section 4. Proxies

A member of the Executive Committee who cannot attend a meeting may designate a proxy. If no proxy is designated, the Chair of the Division may appoint a proxy from the membership of the Division.

Section 5.

The Chair of the Division is responsible for the agenda of the Executive Committee meeting and the Division business meeting. Persons desiring a place on either agenda should submit a written request, including a brief statement of purpose and justification, to the Chair at least thirty (30) days prior to the scheduled meeting. Persons not on the agenda desiring the floor at an Executive Committee or Division business meeting may be recognized at the discretion of the Chair.

Article VII: Committees

Section 1. Bylaw Committees

Each chair of a Bylaw committee is expected to submit a report to the Vice-Chair of the Division well in advance of the Executive Committee meeting at the Annual and Mid-Year Conferences. The Vice-Chairman will consolidate the reports of the committee chairs into a single report submitted to the Division Chairman. The report should be available for study by members of the Executive Committee so that controversial or other critical issues may by intelligently discussed and action taken at the Executive Committee meeting.

1a. Nominating Committee

A Nominating Committee shall be recommended by the incoming Vice-Chair to be confirmed by the Executive Committee at its annual meeting in June. The Nominating Committee shall consist of five members, three of whom shall be the most recent past Chairs of the Division, and two other qualified members. The chair of the Nominating Committee shall be the senior past chairman, so appointed.

1b. Elections Committee
The Elections Committee for the following year shall consist of the Vice-Chair in office and two members of the Division appointed by the Vice-Chair. The appointments shall be subject to approval by the Executive Committee. The Vice-Chair shall chair the Elections Committee.

1b(1). The chair of the Elections Committee shall transmit the results of the election to the Chair of the Division. The Chair shall inform each candidate (including those not elected) of the results of the election for his office and shall transmit the names of the newly-elected officers to the Editor of the Journal for publication in the Spring issue of the Journal. The chair of the Elections Committee shall report the results of the election to the Division at the annual business meeting.

1c. Policy Committee
A Policy Committee shall be recommended by the incoming Chair to be confirmed by the Executive Committee at its annual meeting in June. The Policy Committee shall be composed of three (3) or more members, of whom three (3) shall be past Chairs of the Division. The Policy Committee shall consider all matters of policy for the Division that are assigned to it and make recommendations to the Division and the Executive Committee (See ART. III, Sec. 1k).

See ART. Vii. Sec. Ea (2) Professional and Technical committees for ANSI responsibility.

1d. Distinguished Service Award Committee
The Distinguished Service Award Committee shall be composed of the three immediate past Chairs of the Division. The senior past Chair shall chair the Committee. The Committee shall consider as possible recipients of the Distinguished Service Award those nominees thought to be worthy of the award because of exceptional service to the engineering profession, the Division, and to engineering education. Since the recipient is recognized by both the Division and the Society as a person of considerable professional stature, the Committee need not select a recipient in any year that none of the nominees fully meet the requirements established by the Division and set forth in these Bylaws.

1d(1). The purpose of the Distinguished Service Award is to encourage and recognize those persons who have made outstanding contributions to the teaching of students of engineering graphics, descriptive geometry, computer graphics, and other courses within the realm of interest of the Engineering Design Graphics Division.

1d(2). The Award. The award shall consist of an appropriate certificate and/or plaque presented at the annual awards dinner of the Engineering Design Graphics Division of ASEE.

1d(3). Requirements. In order to receive the Distinguished Service Award, a person must have made a clearly discernible contribution to the art and science of teaching courses in a recognized field of graphics in several of the following ways of which item (e) shall not be omitted:

(a) Success as a teacher must be established both as to competence in a subject matter and ability to inspire students to high achievement.

(b) Improvement of the tools of, and conditions for teaching. Evidence of such achievement may consist of subject matter (textbooks, etc.), courses of curricula, diagrams and models, laboratory and other teaching equipment, and other similar activities.

(c) Improvements of teaching to include: the development of teachers in a department or in other schools, testing or guidance programs, promotion of cooperation with other types of educational institutions or industry, development of testing and guidance programs, and the coordination of fields of subject matter.

(d) Scholarly contributions to literature, significant honors, etc.

(e) Service to the Engineering Design Graphics Division of ASEE as evidenced:

• By regular attendance at its meetings as an indication of interest in the improvement of teaching.

• Service on its committees or an officer with a record of definite achievement.

• Contribution to its publications or summer school programs.

1d(4). Nominations. Nominations may be made by any member or group of members of the Division except members of this Awards Committee.

1d(5). Nomination Form. A nomination form shall be prepared by the Distinguished Service Aware Committee which will outline the qualifications and will provide space for a brief description of a nominee's performance in each category. This form shall accompany the election ballot (See ART. IV, Sec. 1d).

1d(6). The report of this Committee shall be made at the appropriate time and place.

1d(7). Nominees from the previous three years may also be considered for the award by this committee. A list of names of those individuals, and all supporting information, shall be passed on to the incoming chair of the Committee by the outgoing chair.

Section 2. Non-Bylaw Committees

Non-Bylaw committees shall be assigned to one of the following described categories under the supervision of the appropriate Director. They may be appointed by the Division Chair or by the Executive Committee when such a committee is deemed necessary for the proper functioning of the Division. Some special-purpose committees may be assigned under the control of the Chair or Vice-Chair.

2a(1). Liaison

Committees in this category are those whose purpose is to provide a connection between the Division and other related or interested groups both within and without the Society.

2a(2). Professional and Technical

The purpose of committees within this category is the advancement of knowledge in the many areas encompassed by the Division.

The Director: Professional and Technical Committees shall recommend, as required, an ANSI Committee to act for the Division to consider and approve or disapprove any American National Standards Institute (ANSI) Drafting Standards submitted to it in accordance with ASEE policy.

2a(3). Programs

Committees in this category are responsible for planning and implementing the ongoing programs of the Division. There shall be an Ad Hoc Program Committee for each Annual and Mid-Year Conference, and it shall be responsible for all conference sessions sponsored totally or jointly by the Division during that conference. Each program committee shall be appointed at the conference occurring approximately 18 months prior to the conference for which it is responsible, and shall cease to exist following the conference for which it was formed. A Program Committee shall generally consist of the Division Vice-Chair, the Director: Programs, a Program Chair, and at least one other person closely allied with, or especially qualified to represent and act as liaison for, the institution or area in which the particular conference is to be held. This person may also be the Program Chair.

2a(4). Zone Activities

Committees in this category are to increase and promote Section and local activities of Division members within the various zones. There shall be a committee from each of the sections in the particular zone.

Section 3. Committee Chairs

Committee chairs are responsible for following the guidelines established by their Director and for keeping the appropriate Director informed of the activities of their committee. The chair directs the activities of the committee members within the constraints of those guidelines. The committee chair may suggest to the appropriate Director such additional activities as deemed necessary for the committee's proper functioning. Each chair shall prepare and submit reports to the appropriate Director in time for the reports required of the Director to be prepared. Required reports are interim for presentation at Mid-Year Conference and annual for presentation at the Annual Conference.

3a. Program Chair

Each Program Chair shall submit proposed programs to the Director: Programs for approval. The Director will in turn submit the proposal to the Division Chair and Executive Committee for their approval. The Program

Chair for an Annual Conference and the Division Chair shall attend the ASEE planning meeting for that particular conference. The Program Chair, with the assistance of the Program Committee, determines the number, type and specifics of all national events, including participants and session moderators. Although it is the Director's responsibility to pass on to the Program Chair all available papers, abstracts, program suggestions and other pertinent information, it shall be the responsibility of the Program Chair to select and schedule the actual events and participants after the program has been approved by the Director: Programs and the Executive Committee.

The Program Chair shall also be responsible for preparing feature articles or announcements publicizing the program in the appropriate journal (s) and in other ways assist in the proper advertising and promotion of the program.

ARTICLE VIII: PUBLICATIONS

Section 1. Publications Committee

The Publications Committee shall be composed of the Director-Editor (See ART. III, Sec. 2d(3d)}, the Circulation Manager-Treasurer, the Advertising Manager, and such Assistant Editors as are deemed necessary by the Director-Editor.

1a. The Publications Committee shall be responsible for the timely publication of the Engineering Design Graphics Journal, and any other Division publications, as authorized or directed by the Executive Committee. A minimum of three issues of the Journal shall be published each year.

Section 2. Selection of the Publications Committee

2a. The Director: Publications shall be elected for a three-year term as described in Article IV.

2b. Circulation Manager-Treasurer

The Circulation Manager-Treasurer shall be appointed by the Director: Publications, subject to the approval of the Executive Committee. The term of appointment shall be indefinite and continue for so long as: it is mutually agreeable with the appointee, the supporting institution, and the Director: Publications and the responsibilities of the office are properly served. The appointment may be terminated by resignation or death, by request from the supporting institution, or for cause by action of the Executive Committee. A recommendation to terminate the appointment may be made to the Executive Committee by the Director: Publications or may be initiated by the Executive Committee after suitable notice to the Director: Publications. Termination, for whatever reason, shall consider the best interests of the Division and be handled in such a manner as to ensure continuity of the operations of this office.

2c. The Advertising Manager shall be appointed by the Director: Publications and serve a concurrent term with and at the pleasure of Director: Publications.

Section 3. Duties

The duties of the members of the Publications Committee shall be as follows:

3a. Director-Publications

The - Director: Publications is chair of the Publications Committee and Editor of the Engineering Design Graphics Journal and a member of the Executive Committee.

3a.(1). The Editor is responsible for soliciting, selecting and editing all articles and other material published in the Journal.

3a(2). The Editor will cooperate with the editor of the Society publication, Engineering Education, as to material referred to the Engineering Design Graphics Journal for publication, and as to material referred to Engineering Education for publication. The Editor shall supply two copies of each issue of the Journal to the Managing Editor of Engineering Education.

3a(3). The Editor shall make such arrangements and agreements as are necessary for the publication and distribution of the Journal.

3a(4). The Editor shall report on all matters pertaining to the Journal to the Executive Committee at all of its meetings and at other times as requested.

3a(5). The Editor shall appoint, subject to the approval of the Executive Committee, any Assistant Editors required to assist in the editorial tasks incident to the publication of the Journal.

3b. Circulation Manager-Treasurer
The Circulation Manager-Treasurer (CM-T) is responsible to the Director-Editor for all matters pertaining to the circulation and finances of the Journal.

3b(1). The CM-T shall solicit subscriptions from viable non-member sources and provide current subscriber lists to the Editor.

3b(2). The CM-T shall assist the Editor in any way requested to expedite distribution of the Journal.

3b(3). The CM-T shall receive all monies due the Journal from non-member subscriptions, advertising income, fees, etc., and deposit such monies in a suitable account in a federally-insured financial institution under the name of the Engineering Design Graphics Journal. Signatures of both the CM-T and the Editor shall be on file with either having access to the account(s).

3b(5). The CM-T shall pay by check all costs, approved by the Editor, connected with publication of the Journal.

3b(6) The CM-T shall maintain accurate financial records in a standard bookkeeping form and submit a financial statement and a report on other activities at the mid-year and annual meetings.

3b(7). The Journal financial records shall be presented annually for audit by an ad hoc audit committee appointed by the Division Chair.

3b(8). When a new CM-T is appointed, the financial records will be audited and the incumbent CM-T will transmit to the successor CM-T all financial records, together with all monies in the Journal account(s).

3b(9). The CM-T shall maintain the Division-member roster and provide membership lists and/or mailing addresses to the Editor and to the Division officers or committee chairs who request them. Membership rosters and/or mailing addresses will not be released to other individuals or organizations without specific authorization from the Division Executive Committee.

3c. Advertising Manager
The Advertising Manager shall be responsible to the Editor for all matters pertaining to advertising in the Journal.

3c(1). The Advertising Manager shall actively solicit and procure advertisement from all appropriate sources.

3c(2). The Advertising Manager shall represent the Journal in all business matters with advertisers, submitting bills according to the current rates, and promptly transmitting monies received to the Circulation Manager-Treasurer.

3c(5). The Advertising Manager shall maintain logs of advertising accounts, contracts, accounts receivable and recommendations for changes in advertising policy.

3c(6). The Advertising Manager shall submit reports on the status of all advertising activities to the Editor prior to the mid-year and annual meetings.

3d. Assistant Editors
Their duties shall be as assigned by the Editor.

Section 4. Advertising Rates
The Publications Committee shall fix advertising rates subject to the approval of the Executive Committee.

Section 5. Subscription Rates
The publications Committee shall fix subscription rates for non-members subject to the approval of the Executive Committee.

Section 6. Finances

The Publications Committee will conduct an annual financial review of the Journal and other publications financed from Journal funds and prepare an operating budget for the coming year. In addition to the operating fund, an emergency contingency fund of sufficient amount to finance Division publications for one year will, financial solvency permitting, be maintained in a suitable account in a federally-insured financial institution in the name of the Engineering Design Graphics Journal. Funds in excess of the operating budget and emergency contingency fund may, by action of the Executive Committee, be transferred to the custody of the Division Secretary-Treasurer for deposit in the Division fund account to be used as the Executive Committee may direct. Available Division funds may, with the approval of the Executive Committee, be transferred to the CM-T of the Publications Committee, to meet existing or anticipated deficits in operating funds or to finance special or unusual "one-time" projects. No separate account will be maintained by the Secretary-Treasurer of funds received from the Publications Committee, nor will funds made available to the Publications Committee by the Secretary-Treasurer be limited to amounts previously deposited.

Article IX: Parliamentary Authority

Section 1.

The rules contained in Robert's Rules of Order (latest edition) shall govern the Division in all cases to which they are applicable and in which they are not inconsistent with the Constitution and Bylaws of the ASEE, the Bylaws of The Council of Technical Divisions and Committees, or the Bylaws of the Division; in other cases the Constitution and Bylaws of ASEE shall govern.

Article X: Amendments to Bylaws

Section 1.

These Bylaws may be amended at any annual business meeting of the Division by a two-thirds majority vote of the members of the Division who are present.

Section 2.

These Bylaws may also be amended by a letter ballot of the members of the Division as recorded in the office of the American Society for Engineering Education, mailed by the Secretary-Treasurer of the Division; the amendment being approved if two-thirds of the ballots returned within thirty (30) days are favorable.

Section 3.

Proposed amendments may be submitted in only four ways as follows:

a. By a majority vote of the Executive Committee.

b. By petition to the Chair signed by ten (10) individual members of the Division.

c. By recommendation to the Division Chair by the Constitution and Bylaws Committee of the Society through its Executive Director.

d. By unanimous vote of the Policy Committee of the Division.

EDGD Journal Editors

1936-37	Frederick G. Higbee
	John M. Russ
	Clair V. Mann
1937-38	John M. Russ
	Clair V. Mann
	Frank A. Heacock
1938-39	Clair V. Mann
	Frank A. Heacock
	Fred W. Slantz
1939-42	Fred W. Slantz
1942-44	R. R. Worsencroft
1944-46	William E. Street
1946-52	Theodore T. Aakhus
1952-55	Warren J. Luzadder
1852-55	Irwin L. Wladaver
1958-61	Wayne L. Shick
1961-64	Mary Blade
1964-67	Earl D. Black
1967-72	Borah L. Kreimer
1972-73	Al Romeo
1973-76	James H. Earle
1976-79	Paul S. Dejong
1979-82	Mary A. Jasper
1982-88	Jon M. Duff
1988-91	John B. Crittenden
1991-97	Mary A. Sadowski
1997-	Judy A. Birchman

"The editorship was quite a job. I had never worked so hard before and surely not since. But despite its agonies and frustration, it nevertheless gave the editor great satisfaction, at least until the letters started arriving, pointing out typgraphical errors and faulty syllabication."

Irwin Wladaver,
Journal editor
1955-58.

ED GD
ENGINEERING DESIGN GRAPHICS DIVISION
ASEE

Submission Guidelines

The *Engineering Design Graphics Journal* is published by the Engineering Design Graphics (EDG) Division of the American Society for Engineering Education (ASEE). Papers submitted are reviewed by an Editorial Review Board for their contribution to Engineering Graphics, Graphics Education and appeal to the readership of the graphics educators. By submitting a manuscript, the authors agree that the copyright for their article is transferred to the publisher if and when their article is accepted for publication. The author retains rights to the fair use of the paper, such as in teaching and other nonprofit uses. Membership in EDGD-ASEE does not influence acceptance of papers.

Material submitted should not have been published elsewhere and not be under consideration by another publication. Submit papers, including an abstract as well as figures, tables, etc., in quadruplicate (original plus three copies) with a cover letter to

Judy Birchman, Editor
Engineering Design Graphics Journal
1419 Knoy Hall / Technical Graphics
Purdue University
West Lafayette, IN 47907-1419
FAX: 765-494-9267 PH: 765-494-7312

Cover letter should include your complete mailing address, phone and fax numbers. A complete address should be provided for each co-author. Use standard 8-1/2 x 11 inch paper, with pages numbered consecutively. Clearly identify all figures, graphs, tables, etc. All figures, graphs, tables, etc. must be accompanied by a caption. Illustrations will not be redrawn. All line work must be black and sharply drawn and all text must be large enough to be legible if reduced. The editorial staff may edit manuscripts for publication after return from the Board of Review. Upon acceptance, the author or authors will be asked to review comments, make necessary changes and submit both a paper copy and a text file on a 3.5" disk.

Page Charges

A page charge will apply for all papers printed in the *EDG Journal.* The rate is determined by the status of the first author listed on the paper at the time the paper is received by the Editor. The rates are as follows:

$5 per page for EDGD members
$10 per page for ASEE, but not EDGD members
$25 per page for non-ASEE members

This charge is necessitated solely to help offset the increasing costs of publication. Page charges are due upon notification by the Editor and are payable to the Engineering Design Graphics Division.

The *EDG Journal* is entered into the ERIC (Educational Resources Information Center), Science, Mathematics, and Environmental Education/SE at:

The Ohio State University
1200 Chambers Road, 3rd Floor
Columbus, OH 43212.

Article copies and 16, 35, and 105 mm microfiche are available from:

University Microfilm, Inc.
300 Zeeb Road
Ann Arbor, MI 48106

The *Engineering Design Graphics Journal* is published three times a year by the Engineering Design Graphics Division (EDGD) of the American Society for Engineering Education (ASEE). Subscription rates: ASEE/EDGD members , $6.00; non-members, $20.00. If you would like to become a member of EDGD/ASEE, write ASEE, Suite 200, 11 Dupont Circle, Washington, D. C. 20036, and request an ASEE membership application. Non-members can subscribe to the *EDG Journal* by sending their name, address, telephone number, and a $20.00 check or money order payable to Engineering Design Graphics. Mail to:

Clyde Kearns
The Ohio State University
2070 Neil Avenue
Columbus, OH 43210

The Engineering Design Graphics Journal
Technical Graphics
1419 Knoy Hall
Purdue University
West Lafayette, IN 47907-1419 USA

ADDRESS CORRECTION REQUESTED