METRIC

ENGINEERING DESIGN GRAPHICS JOURNAL

FALL 1979 VOLUME 43 NUMBER 3

BETTER BECOMES BEST in a new upcoming Third Edition...

GRAPHICS IN ENGINEERING DESIGN, 3rd Ed.

Alexander Levens, University of California at Berkeley, & William Chalk, University of Washington

"Levens and Chalk is a fresh approach to the graphics-design scene and will be welcomed by many of us who have been searching for this type of book for some time. There is no question in my mind that **the two authors have hit upon the right formula for a most successful and competitive graphics design text.**"

Percy H. Hill, Chairman, Dept. of Engineering Design, Tufts University

"Of all competitive texts I still think this is the best. ...sets the standard for excellence in presentation of orthogonal projection, intersections and graphical treatment of mathematics, empirical equations, and nomography. ...many topics are treated in more detail than can be utilized in most freshman courses; I feel this is an advantage and can stimulate some students to do a little exploration beyond minimum requirements of a course." Duane Ball, Associate Prof., Dept. of Engineering Design and Economic Evaluation, University of Colorado

Here's a new, highly praised and stimulating text that meets the needs of today's students through a planned, technical and goal-directed exploration of graphics. It lets your students examine potential solutions of complex engineering problems as it unveils the side effects of modern technology and vast technological problems. This edition covers man's early efforts and "design intent" as well as powerful modern-day applications of engineering graphics—expanding conventional practices, computer graphics, graphical solutions, design documentation and much more. Also new to this edition: 90% of the material is SI-Metric.

Three workbooks accompany this text: two have been revised and the third is entirely new, with new problems and an emphasis on the design process.

(1 01478-8) approx. 864 pp. 1980 $21.00 (tent.)

To request complimentary copies, write to
Art Beck, Dept. 0-7410
Please include course name, enrollment, and title of present text.

JOHN WILEY & SONS, Inc.
605 Third Avenue
New York, N.Y. 10016

In Canada: 22 Worcester Road, Rexdale, Ontario
Prices subject to change without notice.
0-7410

Time-honored texts in engineering graphics that keep pace with the times!

Engineering Graphics: Communication, Analysis, and Creative Design, ***Fifth Edition***
by James S. Rising and Maurice W. Almfeldt, formerly *Iowa State University,* and Paul S. DeJong, *Iowa State University*
1977/448 pages/Paper/$12.95
ISBN 0-8403-1593-7

The fifth edition of **Engineering Graphics** offers an integrated introduction to technical drawing as used by engineers, draftsmen, and technicians in industry today. **Engineering Graphics** covers a broad range of topics in basic drawing principles, descriptive geometry, and creative design, with new coverage of visualization and metrication, and many updated illustrations and new problems. All in all, it's the kind of text to choose for your beginning engineering drawing course.

Engineering Graphics Problem Book
by C. Gordon Sanders, Carl A. Arnbal, and Joe V. Crawford, *Iowa State University*
1977/126 pages/Paper/$8.95
ISBN 0-8403-1658-5

Widely adopted for almost 20 years, the revision of this popular problem book contains theoretical and practical application problems on the fundamentals of graphics and descriptive geometry. Flexible format and logical progression of material make the text a valuable problem book to be used in conjunction with a basic graphics course for freshman engineering students.

Please send me a copy of

_____ **Engineering Graphics** by Rising et al.

_____ **Engineering Graphics Problem Book** by Sanders et al.

_____ for adoption consideration

_____ for 30 days' free exam. (I understand that I may return my copy within 30 days without obligation.)

Name ____________________

Dept. ____________________

School ____________________

Address ____________________

City __________ State/ZIP __________

Kendall/Hunt Publishing Company
2460 Kerper Boulevard
Dubuque, IA 52001

F79-316a

ENGINEERING DESIGN GRAPHICS JOURNAL

Copyright © 1979 The American Society for Engineering Education. Individual readers of this Journal, and non-profit libraries acting for them, are freely permitted to make fair use of its content, such as to photocopy an article for use in teaching or research.

PUBLICATION BOARD

EDITOR
Mary A. Jasper
P.O. Drawer HT
Mississippi State University
Miss. State, MS 39762
Phone (601)325-5022 or (601)263-4927

ASSOCIATE EDITOR
Frank M. Croft, Jr.
Civil Engineering
Speed Scientific School
University of Louisville
Louisville, Kentucky
Phone (502)588-6276

ASSOCIATE EDITOR
Edward W. Knoblock
College of Engineering and Applied Science
University of Wisconsin-Milwaukee
3200 North Kramer Street
Milwaukee, Wisconsin 53201
Phone (414)963-5197 or 963-4967

CIRCULATION MANAGER
Garland K. Hilliard, Jr.
501 Poe Hall
North Carolina State University
Raleigh, N.C. 27607
Phone (919)737-3263

ADVERTISING MANAGER
Menno DiLiberto
Norwalk State Technical College
181 Richards Avenue
Norwalk, Connecticut 06855
Phone (203)838-0601

PUZZLE CORNER EDITOR
Robert P. Kelso
School of Engineering
Louisiana Tech University
P.O. Box 4875, Tech Station
Ruston, La, 71272

EX-OFFICIO
Frank Oppenheimer
Panoramaweg 14
8959 Hopfen Am See
West Germany

EXECUTIVE COMMITTEE OF THE ENGINEERING DESIGN GRAPHICS DIVISION

Chairman: Leon M. Billow
Vice-Chairman: Paul S. DeJong
Secretary-Treasurer: Charles W. Keith
Past Chairman: Clyde H. Kearns
Directors: Jack Brown
Arvid R. Eide
Larry Goss
George Pankratz
Mary A. Jasper

CALENDAR

ASEE ANNUAL CONFERENCES

1980 - University of Massachusetts, Amherst. June 22 - 27

1981 - University of Southern California

EDGD MIDYEAR CONFERENCES

1980-Cogswell College

1981-V.P.I. & S.U. - Williamsburg, VA

ENGINEERING DESIGN GRAPHICS JOURNAL is published - one volume per year, three numbers per volume, in Winter, Spring, and Fall - by the Engineering Design Graphics Division of the American Society for Engineering Education, for teachers and industrial practioners of Engineering Graphics, Computer Graphics, and Design Graphics, and Creative Design.

The views and opinions expressed by the individual authors do not necessarily reflect the editorial policy of the ENGINEERING DESIGN GRAPHICS JOURNAL or of the Engineering Design Graphics Division of ASEE. The editors make a reasonable effort to verify the technical content of the material published; however, final responsibility for opinions and technical accuracy rests entirely upon the author.

YEARLY SUBSCRIPTION RATES:

U.S., Mexico, Canada	
ASEE-EDG members	$1.50
ASEE but not EDG members	3.00
Non-members	5.00
Foreign subscribers	$10.00

SINGLE COPY RATES:

U.S., Mexico, Canada	
ASEE-EDG members	$1.00
ASEE but not EDG members	1.50
Non-members	2.00
Foreign subscribers	3.50

Back issues are available at single copy rates prepaid and are limited in general to numbers published within the past six years.
Subscription expiration date (last issue) is printed in upper right corner of mailing label, W79 for Winter 1979, S80 for Spring 1980, etc.

ENGINEERING DESIGN GRAPHICS JOURNAL OBJECTIVES:
The objectives of the JOURNAL are:
1. To publish articles of interest to teachers and practioners of Engineering Graphics, Computer Graphics and subjects allied to fundamentals of engineering.
2. To stimulate the preparation of articles and papers on topics of interest to its membership.
3. To encourage teachers of Graphics to innovate on, experiment with, and test appropriate techniques and topics to further improve quality of and modernize instruction and courses.
4. To encourage research, development, and refinement of theory and applications of engineering graphics for understanding and practice.

STYLE GUIDE FOR JOURNAL AUTHORS

The Editor welcomes articles submitted for publication in the JOURNAL. The following is an author style guide for the benefit of anyone wishing to contribute material to Engineering Design Graphics Journal. In order to save time, expedite the mechanics of publication, and avoid confusion, please adhere to these guidelines.

1. All copy is to be typed, double-spaced, on one side only, on white paper, using a black ribbon.

2. All pages of the manuscript are to be consecutively numbered.

3. Two copies of each manuscript are required.

4. Refer to all graphs, diagrams, photographs, or illustrations in your text as Figure 1, Figure 2, etc. Be sure to identify all such material accordingly, either on the front or back of each.
Illustrations cannot be redrawn; they are reproduced directly from submitted material and will be reduced to fit the columnar page.

Accordingly, be sure all lines are sharply drawn, all notations are legible, reproduction black is used throughout, and that everything is clean and unfolded. Do not submit illustrations larger than 198 x 280 mm. If necessary, make 198 x 280 or smaller photo copies for submission.

5. Submit a recent photograph (head to chest) showing your natural pose. Make sure your name and address is on the reverse side.

6. Please make all changes in your manuscript prior to submitting it. Check carefully spelling, structure, and clarity to avoid ambiguity and maximize continuity of thought. Proofreading will be done by the editorial staff. Galley proofs cannot be submitted to authors for review.

7. Enclose all material unfolded in large size envelope. Use heavy cardboard to prevent bending.

8. All articles shall be written using Metric-SI units. Common measurements are permissible only at the discretion of the editorial staff.

9. Send all material, in one mailing to:

Mary A. Jasper, Editor
P.O. Drawer HT
Miss. State University
Miss. State, MS 39762

REVIEW OF ARTICLES

All articles submitted will be reviewed by several authorities in the field associated with the content of each paper before acceptance. Current newsworthy items will not be reviewed in this manner, but will be accepted at the discretion of the editors.

DEADLINES FOR AUTHORS AND ADVERTISERS

The following deadlines for the submission of articles, announcements, or advertising for the three issues of the JOURNAL:
Fall--September 15
Winter--December 1
Spring--February 15

THE AMERICAN SOCIETY FOR ENGINEERING EDUCATION

Engineering Design Graphics Journal

FALL, 1979 VOLUME 43 NUMBER 3

LOOKING FOR SOMEONE?

ENGINEERING DESIGN GRAPHICS DIVISION
American Society for Engineering Education

Officers and Directors, 1979-1980

Chairman
Leon M. Billow
Naval Systems Engineering
U.S. Naval Academy
Annapolis, MD 21402
(301) 267-3872

Past Chairman
Clyde H. Kearns
Engineering Graphics
The Ohio State University
2070 Neil Avenue
Columbus, OH 43210
(614) 422-2634

Vice Chairman
Paul S. DeJong
Freshman Engineering
403 Marston Hall'
Iowa State University
Ames, IA 50011
(515) 294-8861

Secretary-Treasurer
Charles W. Keith
School of Technology
Kent State University
Kent, OH 44240

Director, Professional and Technical
Larry D. Goss
Engineering Technology
Indiana State University
Evansville, IN 47712
(812) 464-1892

Director, Zone Activities
George E. Pankratz
Engineering Graphics
The University of Toledo
2801 West Bancroft Street
Toledo, OH 43606
(419) 537-2425

Director, Liaison
Jack C. Brown
Engineering Technology
University of Alabama
PO Box 1941
University, AL 35486
(205) 348-6320

Director, Programs
Arvid R. Eide
Freshman Engineering
Iowa State University
Ames, IA 50011
(515) 294-8355

Director, Publications
Mary A. Jasper
Dept. of Engrg. Graphics
Miss. State University
PO Drawer HT
Miss. State, MS 39762
(601) 325-5022

TABLE OF CONTENTS Page

PHOTO CREDITS: Front & Back Cover, Page 9 V.P.I. News Service

EDITOR'S PAGE

After having pasted up 64+ pages for this, the first issue of the Journal under a new editor - me - I seem to have put off the worst job until last - writing the editorial.

What can I say? Paul DeJong left me with enough papers for three issues - more come in every week. You don't know how much I appreciate the former editor's help over the rough spots. (Everything was a rough spot!) The quality of these papers is apparent at first glance. Again, the international members have contributed some highly sophisticated articles to these pages - not to mention the second in the geometry series by Land.

Gene Pare' and Jerry Henderson gladden the teacher's heart with their articles - one written with a student, and the other written about student work. (Where do they find these high-caliber students?!) In addition, Dr. Nee's article on the PSI approach to Engineering Graphics should provide ample motivation for those of us who have been considering using this method in our own classes.

The "Puzzle Corner" has expanded again! Pat Kelso is doing a terrific job with this -- one of my favorite Journal features. From now on, "Puzzle Corner" fans can find problems and solutions right at the back of the Journal.

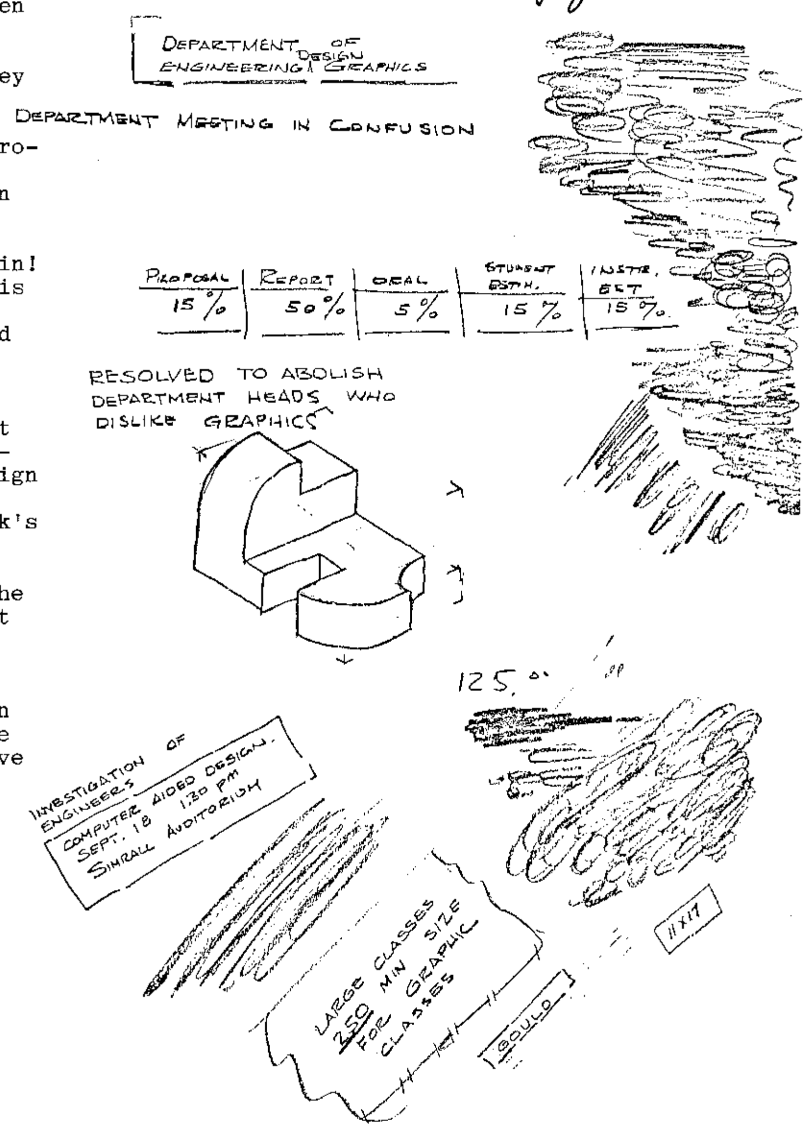
Last, but not least -- "done in", but not "pushed under" by the USPS -- the winners of the 1979 Creative Engineering Design Display are very much missing. I did not make notes on the winners, and Ed Knoblock's package did not arrive in time to include the listing and accompanying photographs of the winning designs in this issue of the Journal. However, look for a newsletter at Christmas, with a report on the CEDD.

Even though we do not have the CEDD winners, there are three great articles on freshman design. Jenison and Russell have a complete outline on how to run a creative design project successfully. (Give this as a Christmas present to those in your department who gripe about the "open-end method" of teaching design.) Jensen of Marquette University (winners in the 1979 CEDD - Freshman Division) bas written an article on another means of keeping the freshman students from going "off the deep end" with their projects. Leuba, on the other hand, shows us some of the pitfalls encountered when a freshman design course is not as successful as some think it might be.

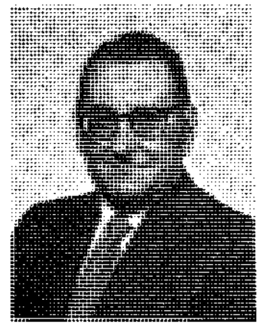
The illustration on this page is a "doodle" from one of my colleagues, drawn during a recent department staff meeting. "Reading between the lines" will tell you that my department (like so many others) is undergoing some sort of change. The Journal traditionally has been a "sounding board" for all sorts of changes. This should not stop now. Please keep your articles, letters and thoughts coming in, (including doodles, if you can talk your colleagues into lending them to a good cause.) We'll even have a new feature

"The Staff Meeting Doodle Corner".

Mary Jasper



CHAIRMAN'S MESSAGE



As the Engineering Design Graphics Division of the American Society for Engineering Education starts the second half of its first century of existence it can look back with pride at many things. First, the accomplishments and performances of its individual members, many of whom have reached the top of their profession. Second, the performances and achievements of the Division as a body is second to none. Through the untiring efforts, devotion, and performances of many members of our organization an excellent Journal is published three times a year, an outstanding Creative Engineering Design Display is held at each annual conference, and an International Conference on Descriptive Geometry, unequaled in its field, was held as part of the Division's 50th birthday celebration. These accomplishments along with the interesting workshops, conferences, and meetings it sponsors have contributed to its being an outstanding division of the A.S.E.E.

Much has been written concerning the above. However, we as educators should not look to the past and rest on the laurels of others but gaze into the future and continue to develop and build our organization so that it will always be referred to as "The Division."

Never before has the engineering profession had such a challenging future. It is in a period of substantial growth and opportunity and allows thousands of engineers to influence the private and business lives of people in our communities. If we truly believe that graphics professors, both individually and collectively, influence future engineers by their teaching and actions we can continue to build a strong and vital organization.

As you can see by the organization chart which is printed elsewhere in this magazine the Division Chairman benefits from the advice and assistance of officers, directors, and committee members who are hard-working, dedicated, progressive, and understanding. They, as well as all previous persons in positions of leadership, deserve the thanks of our members for their outstanding work and their assistance in helping to develop our organization.

The Executive Committee has supported the new chairman in two proposals he has made. The first is to present a certificate of appreciation from the Division to all those who speak or give papers on our programs at the mid-year and annual meetings. Many thanks to Claude Westfall who designed the certificate. He did an outstanding job. The second proposal is to set up a "committee of authority" or referral board to provide expertise in answering difficult questions in engineering graphics. The names of those on this committee will be published in the near future.

Speaking of the near future - it won't be long until we get together at Cogswell College in San Francisco for the mid-year meeting. Ron Pare', our host, will have the red carpet out for all members and, at Baton Rouge, told the group of the many fine things in store for us. Pete Miller, the program chairman has an excellent panel of speakers lined up - so - between the two they have planned a wonderful meeting. See you there.

Past Chairman, Clyde Kearns and Garland Hilliard, Journal Circulation Manager and Treasurer are now putting on a campaign to remind our "lost" members that, in 1978, Division members approved by vote the fact that E.D.G.D. dues would be increased $1.50 to purchase a one-year subscription to the Journal. Through an oversight many members did not include the extra dues when they paid their ASEE membership. For this reason they were dropped from the Division roster by ASEE. If you are one of our "lost" members and receive a letter, please be sure to pay your division dues. We want you as a member of our group.

Make your plans now to attend the mid-year meeting at San Francisco in November.

Again, many thanks and congratulations to all our officers, directors, and committee members.

Lee

ENGINEERING DESIGN GRAPHICS DIVISION
AMERICAN SOCIETY FOR ENGINEERING EDUCATION

O R G A N I Z A T I O N C H A R T 1979–1980
Officers, Directors, and Committee Chairmen

CHAIRMAN*
L.M. Billow (80)
U.S. Naval Acad.

PAST CHAIRMAN*
C.H. Kearns
Ohio State U.

CHAPLIN
C.E. Hall
L.S.U.

SECRETARY-TREASURER*
C.W. Keith (82)
Kent State U.

VICE-CHAIRMAN*
P S. DeJong (80)
Iowa State U.

By-Laws Committees

NOMINATING
R.D. LaRue
Ohio State U.

ELECTIONS
P.S. DeJong
Iowa State U.

POLICY
W.B. Rogers
V.P.I.&S.U.

DISTINGUISHED SERVICE AWARD
R.D. LaRue
Ohio State U.

Operations Committees

LIAISON *
J.C. Brown (80)
U. of Alabama

Membership Activities
M.C. Copeland
Westark Comm. Coll.
Educational Relations
Margaret Eller
Louisiana State U.
Industrial Relations
W.F. Elwood
U. of Alabama
International Relations
C.E. Hall
Louisiana State U.

TECHNICAL & * PROFESSIONAL
L.D. Goss (81)
Indiana State U.

Computer Graphics
F.A. Mosillo
U. of Illinois
Freshman Engr.
L.L. Northup
Iowa State U.
Human Factors
F.J. Jankowski
Wright State U.
Metrication
E.J. Mochel
U. of Virginia

Engr. Design Educ.

Teaching Techniques
M.L. Weed
Penn State U.
Theoretical Graphics
M.F. Blade
Cooper Union

ZONES * ACTIVITIES
G.E. Pankratz (81)
U. of Toledo

Zone 1
R.S. Lang
Northeastern U.
Zone II
F.A. Mosillo
U. of Illinois
Zone III
I.G. Skubic
S.Dakota State U.
Zone IV
R.W. Reynolds
Cal.Poly.St. U.

PROGRAMS *
A.R. Eide (80)
Iowa State U.

1980 Mid-Year Conf.
Program Chairman
P.W. Miller
Purdue Univ.
Liaison
R.C. Pare'
Cogswell College
1980 Annual Conf.
Program Chairman
A.R. Eide
Iowa State U.
Liaison
K.E. Kroner
U. of Mass.

PUBLICATIONS *
M.A. Jasper (82)
Miss. State U.

Circ.Mgr.-Treas.
G.K. Hilliard (80)
N.C. State U.
Advertising Mgr.
M. DiLiberto
Ohio Univ.
Assoc. Editor
E.W. Knoblock
U. of Wisconsin
Assoc. Editor
F.M. Croft
U. of Louisville
Asst. Editor
R.P. Kelso
Louisiana Tech. U.

CREATIVE ENGR. DESIGN DISPLAY
E.W. Knoblock
U.of Wisconsin

RESOLUTIONS
K.E. Kroner
U. of Mass.

*Executive Committee Member

ANNOUNCING---

LONG OVERDUE RECOGNITION

For Papers Presented at EDG MEETINGS

The Division

of

Engineering Design Graphics

American Society For Engineering Education

ENGINEERING DESIGN GRAPHICS DIVISION 19 28 ASEE

presents this certificate to

____

in appreciation for participating in the conference program of the division by promoting and providing stimulating ideas for professional dialogue among the membership.

____________________ DATE

____________________ CHAIRMAN

Lee Billow has suggested that all conference participants who present papers at EDGD sponsored meetings (i.e., the "Mid-Winter" meeting, I.C.D.G., etc.) or at EDGD sponsored or co-sponsored sessions at the A.S.E.E. annual meetings be recognized as contributing their time and effort to further the division's aims and goals. This suggestion was unanimously accepted by the EDGD executive committee at the 1979 Annual Meeting in Baton Rouge and Louisiana State University. The facsimile certificate pictured below, designed by Claude Westfall, University of Maine, is a part of this recognition. We believe this will encourage more of our membership to actively participate in the meetings of our division. Thanks and "hats-off" to Lee and Claude for this effort!--Ed.

The Division of Engineering Design Graphics
American Society for Engineering Education

has bestowed upon

William B. Rogers

its highest honor

THE DISTINGUISHED SERVICE AWARD

for his invaluable contributions to the Division and to Engineering Education, and as an expression of the high esteem of his professional colleagues.

Teacher, scholar, soldier, leader; William B. Rogers has served the engineering profession, its students, and his country for over thirty-five years. His achievements as an engineering educator include being an author, lecturer, counselor, and a teacher liked and respected by his students as well as his peers. Without dramatics, but always with humor to relieve a tense situation, Bill has significantly influenced the fundamental subjects in engineering education.

Bill joined the Society and this Division in 1947. After serving with distinction on many committees and in both appointive and elective offices, he was elected Vice-Chairman for 1971-72, and Chairman for 1972-73. As a Past-Chairman, Bill has continued to ably serve the Division by serving on designated committees and in dispensing his sage advice to succeeding administrators. He has always represented the ideals to which the members of this Division aspire.

In recognition and appreciation of his long service and hard work on our behalf, and as a symbol of our friendship and high esteem, we, his colleagues, present to William B. Rogers our Distinguished Service Award for 1979.

Presented this 26th day of June, 1979

at the Annual Conference, Louisiana State University

Chairman

Robert J. Foster

Secretary-Treasurer

DISTINGUISHED SERVICE AWARD

William B. Rogers

BOB HAMMOND'S INTRODUCTION

June 26, 1979

Bob J. Hammond
N. C. State University
Raleigh, N. C.

I think this sequence of events is a first for this division. In 1975, my dearest friend stood in the position that I am now in - and presented me with that year's Distinguished Service Award. Tonight it is a distinct honor and pleasure to reverse those roles and present the 1979 Award to William Bradley Rogers.

I have known Bill for 28 years, starting in 1951 when we reported for duty at the United States Military Academy. I cannot say that I have loved Bill all those years. For one thing, he started out by bragging that he was the World's Greatest Draftsman. That was absurd, because I knew I was. But as I watched him work, I had to concede the point. No - Bill has to grow on you.

Another thing - Bill is stubborn. Those early days were when automatic dishwashers were first on the market. Bill claimed they were the work of the Devil. He had been given an excellent dishwasher, his wife. One by one, all of us bought dishwashers. But not Bill! He wasn't going to waste his money! But then his wife, Martha, broke her leg. Can you guess who was the very next person to buy a dishwasher? That's right - Bill. But this proves that he is flexible and can make an excellent estimate of the situation. And also that he was fortunate to have found Martha--who is likely to be the only one who would have put up with him all these years.

One other incident merely proves the same qualities. TV sets were becoming popular at this time. Bill claimed that they were a waste of time; that a man should spend his spare time reading and talking. So his home was conspicuous in not having a TV antenna sticking up from the roof. But, his son became ill and had to reduce his physical activity. So a TV was duly installed in the Rogers' home. Guess who soon became the most knowledgeable about what was last night's midnight movie and knew what was on the next night? Again you're right - it was good old Bill. So - Bill is flexible and adaptable.

Well, Bill, I am not going to divulge any more ghosts from the past - we have too many and it would take all night. The time has come to talk seriously about you.

William B. Rogers received his B.S. degree in Mechanical Engineering from the University of Tennessee in 1947. Showing his wisdom, he had participated in ROTC and received his commission as a 2nd LT in the Corps of Engineers and went on active duty, serving in Europe. At the end of the war he left the service and became an instructor of Engineering Graphics at the University of Florida, working with another man whom most of you know, Jack Jacunski. While at Florida he earned a M.S. in 1951, the same year that he was recalled to active duty at West Point.

He has certainly proven his success as a teacher. Because of the rotation of instructors at West Point, there are few of you here that have started off more people on a teaching career. He knew when to compliment and when to berate. That he did it successfully is shown by the esteem in which all of his instructors held, and still hold, Col. Rogers.

While at this assignment, Bill co-authored what I think of as still the best Engineering Graphics text available. But, alas, it was too far in advance of the times and never made number one. But it was a significant contribution to the literature.

Bill has labored long and valiantly for this Division. In addition to many appointed tasks, he was elected Circulation Manager-Treasurer in 1962, Secretary in 1966, Vice-Chairman in 1971, and naturally, Chairman in 1972. An since he retired as Chairman he has continued every year to serve this Division.

So, Bill, it is a wonderful feeling to make this presentation to you.

WILLIAM B. ROGERS' ACCEPTANCE

June 26, 1979

William B. Rogers
V. P. I. & S. U.
Blacksburgh, VA

The words of one wrapped, even momentarily, in the mantle of veneration are respected by some as divine reflections of the wisdom of age and experience . . . . and dismissed by others as the sentimental ramblings of senility. Feel free to classify these remarks either way you choose . . . .

The presentation of the Division's Distinguished Service Award has always been a happy moment for me. It has been my privilege to present this award on two occasions . . . . . and I have been personally acquainted with most of the recipients over the past thirty years. To be included in this company is both exhilarating and humbling.

It is quite comfortable to bask in the glow of self-satisfaction kindled by the praise and respect of professional colleagues. At the same time, the acute awareness of failures and shortcomings, known or remembered only by myself, chills the marrow . . . . reducing ego to embarrassment . . . . pride to humility.

Of course I am proud of this award. I am proud to have been a member of this Society and this Division for the past thirty-two years. I am proud to have contributed some small effort to the work done by our predecessors and our contemporaries in engineering drawing, graphics, and design. I am indebted to the American Society for Engineering Education and specifically to the Engineering Design Graphics Division for the association I have enjoyed with the truly great people of our profession.

A few of you may know . . . . but most of you are probably unaware that, like our distinguished colleague, Gordon Sanders, I, too, am a closet poet. I would not presume to carry the comparison any further, but when other words fail me, I fall back on rhyming lines. With your indulgence, I will favor you with the first . . . . and last . . . . public recitation of a few short stanzas composed especially for this occasion.

1. When told that I had won the prize,
That my friend, Bob, would eulogize

I quickly set about to write
Remarks appropriate for this night;

Remarks both clever and contrite,
But still expressing my delight

At this unearned acknowledgment
Of my alleged accomplishment.

2. Some of you might rightly wonder;
How could our Committee blunder . . .

Selecting such a nominee . . . .
From all the others, why choose me?

What have I done, or writ, or said
To merit your great accolade?

I'll try to lay your doubt to rest,
Explaining why I met the test.

3. For over thirty treasured years
I've sat among my honored peers,

On committees dull and dreary,
Into many midnights weary,

Through drawing, graphics, and design,
Computers that will scribe a line,

Debating this Division's need
With all the bureaucratic breed.

4. My skill at teaching has been praised,
But valid questions might be raised

About how much from talk or book
Of my instruction really "took".

Perhaps somewhere, someone, might find
Some poor indifferent student mind,

Retaining rare peripheral fact . . .
Residual from my classroom act.

5. My name you'll find on textbook covers
Catalogued et all . . . . and others;

Feuding with co-authors many;
Sharing every royalty penny,

To all textbook writers eager;
Be advised, rewards are meager;

To claim an author's wealth and fame,
Publish under a single name.

6. From one whose head is grayed with age,
Expect you still words deep and sage?

Words of wisdom . . . words of wonder . .
For the young to hear and ponder?

Or, is this mark of high distinction
A subtle symbol of extinction?

Euphemistically entreating
This old goat to cease his bleating?

7. Forgive me, please, my foolish rhyme,
A smokescreen that I crouch behind;

Concealing with a fatuous phrase
The tears I fear will blur my gaze,

But friends, believe me when I say
No prose, no verse, can quite convey

My deeply felt humility . . . .
How much this honor means to me.

8. Thank you, patient congregation,
Party to this celebration,
Witness to this presentation,

With your kind felicitation,
Momentary adulation,

Without further hesitation,
I accept this fine citation;
Ending thus, my recitation.

Grateful for its termination;
Honored by your grand ovation.

☆☆☆☆☆☆☆☆

Rogers Recognized in Engineering Education

VA. Tech. Info. Office
V. P. I. & S. U.
Blacksburg, VA

BLACKSBURG--"Without dramatics, but always with humor to relieve a tense situation, Bill Rogers has significantly influenced the fundamental subjects in engineering education."

This tribute to Virginia Tech engineering professor William B. Rogers appears on a certificate he received for being named the recipient of the 1979 Distinguished Service Award of the Engineering Design Graphics Division of the American Society for Engineering Education. This award was presented at the annual meeting of the society at Louisiana State University, Baton Rouge.

Rogers has been in the college teaching field since 1947, when he began as an instructor in the department of mechanical engineering at the University of Florida. He remained there for four years and spent the following 20 years on active duty with the U.S. Army Corps of Engineers, teaching basic engineering subjects to cadets of the United States Military Academy, at West Point, N.Y.

The move to Tech came in 1971. His children warned him it might be a "traumatic experience," working in a civilan environment again, "but it didn't turn out that way," Rogers smiled. The most obvious difference was the presence of women in his classes, "but that crept in slowly," he said.

"Women have a definite place in engineering, and as a group, are probably smarter than the men who enter the College. This is because only women with considerable academic ability are likely to undertake the rigorous engineering program," he said.

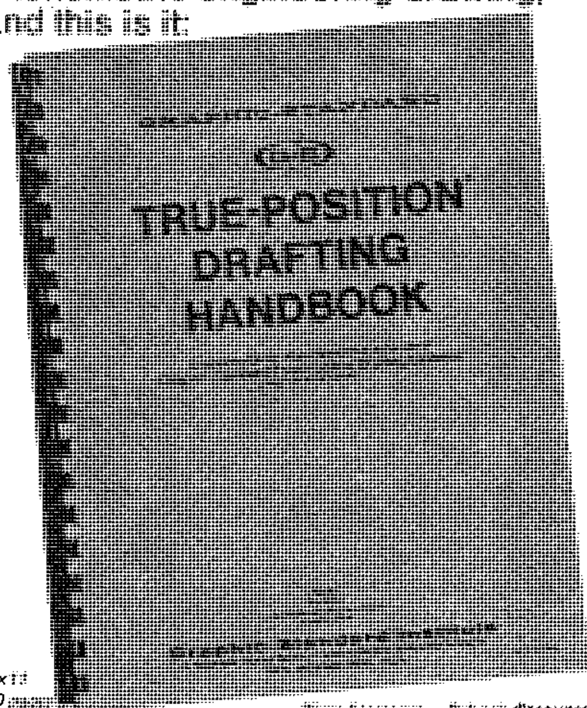
Rogers, assistant to the director of the engineering fundamentals program, believes Tech's method of introducing the entering freshmen classes to engineering is the "best way," since we are dealing with around 1200 students each year. The student learns about each of the 10 engineering fields in which undergraduate degrees are offered at Tech, and makes a choice of major just prior to entering the sophomore year.

"This method gives the beginning engineering student a home, a place where a freshman is important. In the division of engineering fundamentals, freshmen don't feel like second class citizens as they might in a department concerned primarily with upperclassmen," Rogers asserted. "There is a tremendous effort here to make the student feel like a worthwhile individual; this is part of the philosophy in the engineering college."

As the student progresses through the four-year academic program, Rogers feels the amount of material to be absorbed is "really too much." He would like to see the student concentrate more on the fundamentals such as English, mathematics, graphics, chemistry and physics. As it is now, "they are only able to skim these foundation subjects," Rogers said.

On a comparative basis, Rogers said he is "greatly impressed by the engineering program at Tech. I tend to be skeptical, but Tech has proven to be everything I expected it to be."

We wrote the book on standardized axonometric engineering drawing, and this is it:



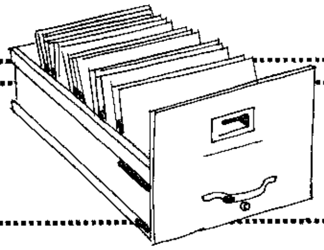
8½x11
130
239

discounts)

And we make all the special drafting tools you need for this advanced "visualizing" type of drafting.

GRAPHIC-STANDARD
GRAPHIC-STANDARD INSTRUMENTS COMPANY & THE GRAPHIC-STANDARD INSTITUTE
©1979 1101 ALLEN DRIVE, TROY, MICHIGAN 48084 ■ PHONE: (313) 585-4555 ■ CABLE: GRAPHSTAN

file to file



Many "on the line" teachers have ideas, suggestions, techniques, problems and questions they would like to share with the society. "File to File" provides the place for exchange of professional information. If you have an item for exchange, submit it to "File to File", EDGD Journal, PO Drawer HT, Miss State, MS, 39762.

SAVING DRAFTING TIME THROUGH REPRODUCTION

Mark A. Kappel
Menomonee Falls, WI

How many valuable drafting hours are spent on repetitive drawings? How many valuable hours are spent on revisions? How many valuable hours are spent re-drawing old or worn drawings? Unless today's reproduction techniques are utilized, the answer could very well be far too many. There are a number of time-saving short cuts that will produce as good if not better results than could be achieved by re-drawing the entire drawing.

The first and probably oldest method is the use of opaque line translucent (sepia) paper. A print of the drawing to be revised is run in the same fashion as a standard blueprint and on this print revisions can be made.

Sepia paper comes in two varieties, erasable and eradicable. The erasable is a little easier to use. Revisions can be made by merely erasing the unwanted section and drawing in the revised section. The sepia will then act as the new original. Sepias are also valuable when more than one original is required for making prints.

The second method is much the same as the sepia method but produces better line quality. Revisions to the drawing are indicated on a blue print and sent with the original to the reproduction specialist. He will then block out the sections to be revised and make an autopositive print of the original on vellum or mylar film. The revision can then be drawn in and the autopositive become the new original.

An autonegative (reverse reading) print can be a valuable tool when restoring drawings. Smudges, smears and tears can be opaqued out of the autonegative and an auto--positive made from that. This eliminates the need to re-draw the entire drawing.

Sometimes a section of a drawing reappears on many drawings. In this case a "paste - up" method can save a lot of time. The procedure is simple and only requires a pair of scissors and a bottle of rubber cement. First, make a black line copy of the section to be transferred (a photocopy will do). Then piece together the various sections and glue them down in position. Draw in any additional material and white-out undesired lines. Sometimes the edges of the pasted sections will produce a shadow. This problem can be eliminated by going around the edges with ordinary typists correction fluid. Once the "paste - up" has been completed, it is sent to the reproduction specialist where an auto-positive is made as described before.

Many companies are putting their drawings on microfilm. The most common medium is the aperture card. Revisions are an easy task with aperture cards. Simply make a print from the original card, make your revision on the print and from it, generate a new aperture card. Aperture cards also permit scale changes at a touch of a button.

These are just a few of the methods that can save valuable drafting time. See your reproduction specialist for the method that best suits your needs.

* NOTE: In years past, a special section of the Journal was devoted to the "exchange of professional information". Some of this information is of a general nature, eg. not relative to any of the division's Technical/Professional committees, and 'though it might be standard knowledge to some of us, those who have recently entered into the teaching of engineering graphics might be relieved to find one less question they need to ask of the "old grey-beards" in their office. --Ed.

LEAVE YOUR HEART IN SAN FRANCISCO

mid-year meeting

NOVEMBER 14-16, 1979

"HIGHLIGHTS" AS EDITORIALIZED BY RON PARE'

Does anyone need an excuse to come to San Francisco? For those who have been to the "city by the bay", it doesn't take much of a reason to get a chance to ride a cable car again. And at the wharf end of the Mason St. cable car line is the unique Sheraton at the Wharf Hotel. It has a tree-lined mini-boulevard, overhead bridges, and wide walkways. Spacious landscaped courtyeards are bedecked with flowers. Inside, your senses are assailed by the funky and the sublime, by the modern and the Victorian, by the familiar and the unique. An unusual combination of natural redwoods and borderboards is juxtaposed with an industrial look of sheet metal and rusted steel. With the contrasting use of burlaps, trellis ceilings, hanging plants and bright graphics, the entire effect is decorative, exciting and plush. Take the "Grand Exhibition" restaurant - a collage of thirty distinctive atmospheres, each enclosed and separate dining area for from two to eight. As the mood strikes, you choose from an array of environments such as "The Wine Cellar", "Sultan's Den", "The Tack Room", "Gay Nineties", "Safari Room", or "The Carriage". All this plus a full-service luxury hotel with over 500 rooms and meeting-banquet facilities for 300.

And let's not forget to venture outside the hotel, into the heart of San Francisco's Fisherman's Wharf. Aquatic Park has its magnificent view of the bay, city, and Marin County. The Maritime Museum's numerous old time vessels contrast with the marina and the sport and commercial fishing fleets. Chirardelli Square and the Cannery are former food processing plants restored to complexes of restuarants, specialty shops, and art galleries. The newest whart attraction is Pier 39, a collection of over 100 international shops and restuarants. The Division's Executive Committee will meet Wednesday evening for dinner and meeting in the "Think Tank". Thursday's and Friday's conference will be in the "Gathering Place". The Bay Area and California offer the possibility for interesting and unique programs. Imagine going behind the scenes to learn about the engineering of a "theme" amusement park; a new automated wine-making process or other food processing machinery; a wrist watch sized calculator; or a state-of-the-art microprocessor graphic computer terminal.

Don't leave your spouse at home! An excellent all-day tour of San Francisco will include the Golden Gate, Chinatown, Cliff House, Japan Cultural Center, St. Mary's Cathedral, and the Palace of Fine Arts. The second day will allow for getting away from the city on a Bay Cruise, to Alca-traz, the Muir Redwoods Park, or the Napa Wine country. And let's not forget the famous San Francisco night life. The traditional can choose among the big names at the Fairmont Venetian Room to the yet-to-be-discovered at the Purple Onion. For the more adventurous there is the unbelievable female impressionists at Finocchio's or the nightclubs of Northbeach and the Tenderloin.

The dates of this conference were selected to allow those who attend from northern schools with a Thanksgiving week holiday to make an extended stay in the west. In addition to extra days in San Francisco, side trips to Reno, Nevada or Southern California are possibilities.

So: set aside November 14 - 16, 1979 for the Engineering Design Graphics Division Mid-Year Conference in San Francisco.

1979-80 EDGD ANNUAL MID-YEAR CONFERENCE PRELIMINARY PROGRAM

DATES: November 14-16, 1979

SITE: Sheraton at Fisherman's Wharf, San Francisco, California

WEDNESDAY, NOVEMBER 14

2:00-5:00	Registration
3:00	Early Bird Walking Tour of Fisherman's Wharf
6:00	Executive Committee Dinner and Meeting

THURSDAY, NOVEMBER 15

8:00-10:30	Registration
8:30-8:35	Welcome
8:35-10:05	Session I
10:05-10:30	Coffee Break
10:30-12:00	Session II
12:15-2:00	Luncheon and Business Meeting
2:30-4:00	Session III
4:15-5:00	Committee Meetings
5:20-6:20	Personality Adjustment Hour
6:20-----	Dinner with Nite-Club Tour

FRIDAY, NOVEMBER 16

9:30-11:30	Session IV--Oppenheimer Award
1:30-----	Mr. & Mrs. Tours: Bay Cruise, Alcatraz, etc. or Campus Tours: Cogswell College, U.C. Berkeley, Stanford, etc.

SATURDAY, NOVEMBER 17

All Day Tours	Muir Woods, Napa Valley, etc.

SPOUSES PROGRAM

Thursday, November 15	Friday, November 16
City Tour with Lunch and Dinner with Nite-Club Tour	Sausalito Tour

PROGRAM CHAIRMAN:

Peter W. Miller
Engineering Graphics
Purdue University
West Lafayette, IN 47907

LIAISON CHAIRMAN:

Ronald Pare'
Cogswell College
600 Stockton Street
San Francisco, CA 94108

1979-1980 EDGD ANNUAL MID-YEAR CONFERENCE PRELIMINARY PROGRAM

TENTATIVE SPEAKER LIST

Presentation Title/Subject	Speaker	Affiliation
"What Are You Teaching In Graphics I, and How Are You Going About It?"	Mary Copeland	Westark Community College
"Conjugate Axis Block Shading for Technical Illustration"	Larry Goss	Indiana State University--Evansville
"Creator-Its Use, Software and Hardware"	John Demel	Texas A & M University
" " "	Jon M. Duff	Ohio State University
"Student Involvement in ASEE & EDGD"	Barbara Ramey	ASEE National Headquarters
"The Flexibility and Effectiveness of Modules in Teaching Graphics"	C.W. Staples	Worcester Polytechnic Institute
Teaching Techniques Committee Session	Merwin L. Weed (Moderator)	Pennsylvania State University--McKeesport
"Tbe Use of Modeling in Industry"	William C. Stenzel	Sargent & Lundy, Consultants

TRAVEL INFORMATION

Hotel & Meeting Site--Sheraton at Fisherman's Wharf: Mason, between Beach & North Point Streets.
Rates: $44 single; $48 double.
Reservations: (800) 325-3535 or wait for card in next mailing. If calling mention ASEE/EDGD to get this rate.

Airlines--Eighteen domestic airlines serve San Francisco International Airport with non-stop flights from most cities. Super-saver fares (up to 50% of regular coach rates) are available on most flights with no restrictions on time of travel or length of stay. Tickets must be purchased 30 days in advance to qualify for these rates, however. Full refunds are available if you must cancel, even at the last minute.

Airport to Hotel Transfer--An airport bus to downtown ($1.50) and a cable car ($.25) to the hotel. Taxi is $15.00.

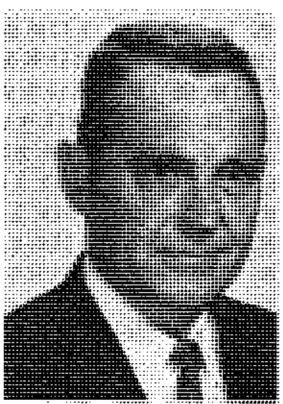
Auto Rental--There is National Auto Rental service in the hotel.

CANDIDATES FOR OFFICE

Again the nominating committee has come up with a great and impossible slate of candidates for the spring's elections. One only has to read the qualifications of the candidates to see that it is a great slate -- impossible because of the apparent difficulty involved in making a choice. But, choose, we must! And, here are . . .

t h e   c a n d i d a t e s!

VICE CHAIRMAN
(1980-81)



W. Hunter Eubanks
Miss. State Univ.

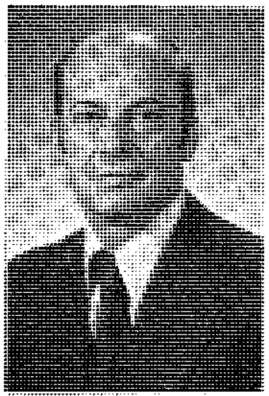
Jack C. Brown
University of Alabama

Hunter joined the Engineering Faculty at Mississippi State University in 1947. He has been professor and head of the department of Engineering Graphics since 1960. He has attended most of the sectional, midwinter, and annual meetings of ASEE since joining in 1950. He participated in the first NSF-sponsored Graphics Conference held at the University of Detroit in 1959, and in the Design Summer School held at Michigan State in 1967. He has served on several Division Committees and as Director of Zones from 1975-1978.

He is past secretary, vice-charman, and chairman of the Southeastern Section Design Graphics Division. Hunter is a registered Professional Engineer and a member of the NSPE. He and his lovely wife, Juanita, recently hosted the midwinter meeting of the Division at Miss. State Univ.

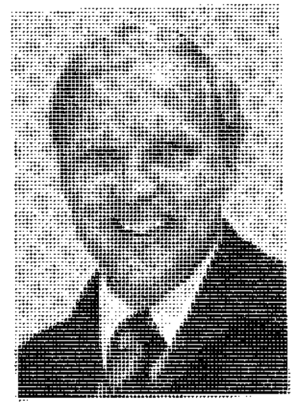
Jack is a Professor of Engineering Graphics, Engineering Technology Programs at the University of Alabama. He has over twenty years teaching experience in the graphics area. He holds the B.S.(CE) from the University of Alabama, M.S. in Graphics from Illinois Institute of Technology and Ph.D from Texas A & M University. He has served the division as program chairman (Annual Conference - 1976), Liason chairman (1977-present), Host of the 1978 Midwinter meeting and Registrar for the 1978 I.C.D.G. Jack is faculty advisor to the MU Chapter of Theta Tau, and enjoys woodworking, farming and work. Jack says that this past year his cattle herd increased significantly -- both cows had calves!

DIRECTOR: PROGRAMS (1980-83)



Byard Houck
North Carolina
State University

Roland K. Jenison
Iowa State University



Byard worked seven years as a professional engineer and has taught in engineerign for the past fourteen years. He has developed a number of courses and programs in computer graphics (CG). He has served two terms as chairman of the CG Committee of the EDGD. He is a member of two ANSI committees which are evolving national standards for CG and for computer generated drawings. He was program chairman for the EDGD annual conference in 1975, chairman of the CEDD Committee in 1978-79, and has developed several programs for minorities at NC State.

"Rollie" is an Associate Professor in the Department of Freshman Engineering at Iowa State University. He received a B.S. in Aerospace Engineering in 1961 and a M.S. in Aerospace Engineering in 1965 from Iowa State University. He has taught 18. years in the fields of graphics, design, engineering problems, computer programming and mechanical technology. In addition, he is the co-author of a new engineering problems textbook. He has served the division as program chairman at the 1979 ASEE Annual Meeting, and has presented six papers at regional and national ASEE meetings.

DIRECTOR: LIASON COMMITTEES (1980-83)

William F. Elwood
University of Alabama

Merwin L. Weed
Pennsylvania State
Univesity

Bill is Associate Professor of Engineering Graphics at the University of Alabama. He received his B.S. in 1959 from New Mexico State University, M.S. from Bradley University in 1965 and Ph.D from the University of Alabama. Bill has spent 11 years in the U.S. Navy on active duty; upon discharge he joined the community college system in Florida and coordinated engineering related programs. He is currently chairman of the EDGD Industrial Relations committee, past chairman of the EDGD Graphic Technology committee and has assited in the "Instructional Modules" workshop (I.C.D.G.-1978). Bill's major academic interest is Engineering Graphics and the application of educational techniques to engineering education.

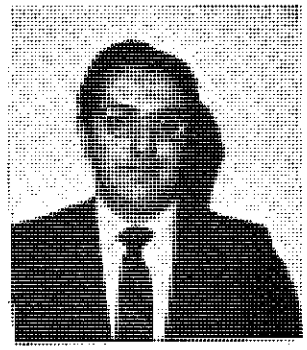
Merwin is Associate Professor of Engineering in the Penn State University System. He recieved his B.S. in engineering from Geneva College, B.S.C.E. and M.S.C.E. from the University of Pittsburgh. Merwin is currently chairman of the Teaching Techniques committee of the EDGD and has authored numerous papers for the EDG Journal and the ASEE Journal. Besides his academic interests of graphics and basic engineering courses, Merwin is active in church and community activities, receiving the Jefferson Award - Recognition of Outstanding Public Service by the American Institute for Public Service - in 1979. His hobbies include real estate and woodworking, and he was host-father for a German student for the year 1978-79.

CIRCULATION MANAGER - TREASURER

Engineering Design Graphics Journal

(1980 - 83)

John Demel
Texas A & M University



Francis A. Mosillo
University of Illinois
at Chicago Circle

John received his B.S. in M.E. at the University of Nebraska at Lincoln, and his M.S. and Ph.D degrees in Metallurgy from Iowa State University. He is presently a Associate Professor of Engineering Design Graphics at Texas A & M. John has taught in the mechanical engineering technology program at Savannah State College. He is the co-author of an Engineering Graphics text book and a computer graphics book. In recent years he has obtained several NSF grants to develop computer software and integrate mini-computers into the CG program at Texas A & M. He has given several papers at EDGD/ASEE meetings and won the Oppenheimer Award this year at Miss. State (Midwinter - EDGD - 1979).

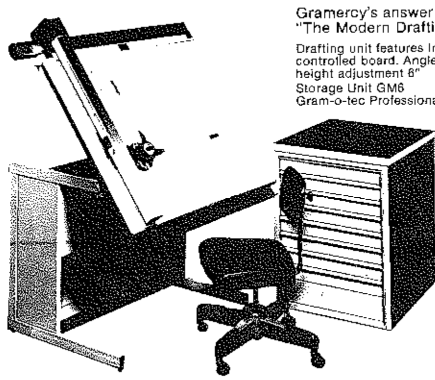
Francis is a graduate of Illinois Institute of Technology. He has twenty-one years of teaching experience there in addition to experience in industry and university administration. He has published papers on design graphics and computer graphics, as well as a text-workbook covering engineering drawing, descriptive geometry, design, and computer graphics. He has been a member of the ASEE and EDGD since 1955 and is currently serving as chairman of the Divisions's Computer Graphics committee and its Zone II Committee.

GRAM-O-TEC SERIES 6000

Semi-Automatic Training Station

Gramercy's answer to
"The Modern Drafting Room."

Drafting unit features include automatic, single lever controlled board. Angle adjustment 0° to 90°. Board height adjustment 6"
Storage Unit GM6
Gram-o-tec Professional Drafting Machine
12" and 18" Scales
Student Chair G-611
Complete Package
Price $1080



Gramercy Student Chair G-611

Seating with durability, comfort and good looks. Amply proportioned and cushioned for proper support and to minimize fatigue. Available in a brown vinyl back and excel nylon fabric seat.
$77.00

Gramercy Professional Drafting Machine GPT-3242
Made to rigid specifications, fully guaranteed for 2 years.
Heavy duty. With 12" and 18" scales **$299.00**

#GM 30 Semi-Automatic Table
1. Stable drafting base with rigid, arc-welded steel tube frame, "human engineered" for maximum working comfort and efficiency.
2. Single lever operated from seated positon locks board at any angle from horizontal to vertical.
3. Board is completely counter-balanced for drafting machine.
4. Drawing board is steel and honey-comb construction with washable self-sealing vinyl drawing surface and full length, 2-position pencil trough.
5. Board size: 32" x 42".
6. Ribbed rubber covered footrest for additional comfort and balance.
7. Flat top of drafting base provides reference surface.
8. Spacious bookshelf at rear of draft-base.
9. Full 6" height adjustment.

$409

Storage Unit GM-6
1. Individually cylinder locked storage for 6 students.
2. Exclusive multi-student drawer.
3. Washable non-glare walnut plastic top.
4 Floor levellers with 1" adjustment.
5. Attractive charcoal brown and white enamel finish.

Drawer size: 2-3/4" x 20-1/2" x 27-1/2".
Individually locked and master keyed drawers.
Attractive walnut grained top **$295**

PLEASE WRITE OR CALL FOR BID INFORMATION:

GRAMERCY CORPORATION
6750 East 46th Avenue • Denver, Colorado 80216
CALL TOLL FREE: 1-800-525-1343

WHO NEEDS GRAPHICS?

INDEED!!

Borah L. Kreimer
Northeastern University
Boston, Massachusetts

Ed.Note: Borah Kreimer, on leave this last year in Israel, answers Dean Karl Brenkard (EDG Journal S '79, p. 19) and supports Bill Rogers' "Comment" (Ibid, p. 20) with the following article. An interesting Comment with an international flavor!

During the period between March and July of 1979, I spent my time at the Technion in Haifa, Israel. Although two other universities in this country have engineering schools, Technion is known as the Israel Institute of Technology. There is much that can be said for the various curricula but for our purpose it is enough to know that there are about 2500 students studying for all degrees in thirteen different engineering faculties, physics, mathematics, chemistry and other sciences.

When I had the chance to read the ENGINEERING DESIGN GRAPHICS JOURNAL, which comes to Israel somewhat late, there was one article and its rebuttal that seemed to relate to what I have seen here. The article is entitled "Who Needs Graphics" by Dean Karl A. Brenkard, dean of engineering at the University of Mississippi. The rebuttal was written by Professor William B. Rogers of V.P.I.

In 1971, I had the opportunity to visit Israel as a tourist. At that time my activity as editor of the ENGINEERING GRAPHICS JOURNAL served as an introduction to several Technion faculty members who had submitted articles to the publication. This gave me the opportunity to visit with them as well as with others from degree granting faculties (departments). The cry of despair that our colleagues at the Technion had was the same as our own. They, too, were looking for ways and means to increase the involvement of graphics in engineering curricula. In 1971, it seemed obvious that this department, within the Mathematics Faculty, was on its last legs. Yet, in 1979, I saw a complete reversal of the previous situation. In fact, it would not be at all surprising that more staff will be needed in the Descriptive Geometry department within the next year.

It was expected that my visit to Technion would include a seminar and informal discussions on the teaching of Creative Engineering Design. The seminar was held as were the informal discussions. These sessions were more revealing to me than to those with whom I had the pleasure to work. Not only will there be no need to worry about losing the department, but there is some concern about staffing future requests for the teaching of engineering graphics. As a matter of fact, these people are not interested in the teaching of design to freshmen since there is no time for it after the required graphics is done. This situation did not "just happen". The members of the Descriptive Geometry Department took every opportunity, that was made available, to talk to their opponents. Little by little trial courses were developed for some of the engineering faculties, usually for a period of two years, after which an evaluation of the particular course is made. One of the principal reasons for permitting the development of graphics courses was, probably, the fact that students had no idea as to how to properly illustrate their thinking concerning required projects during their junior and senior years.

During my visit, the course that has been given to Aeronautical Engineering students was evaluated. The instructor, Yehuda Charit, had to present his case to a committee of three Aeronautical Engineering faculty members. At a social gathering, I had the opportunity to speak with one of the members of this committee who informed me it was determined to cut the time for the graphics course from two semesters to one. However, the presentation made by Professor Charit convinced them that the present course is the minimum that should be given to accomplish results that are required by the degree granting faculty. Evidentally the program is doing its job well, especially in view of the fact that the Agricultural Engineering people requested the exact same course for their freshmen, from our friends.

Another example to indicate the realization of the need for more graphics is shown by the requests made of Yaacov Arwas who instructs the Industrial Engineering students in the required graphics. The dean (department head) of the faculty wanted more subject material to be included in the course. Since it is only given during one semester, a program is being developed, to be presented to the Industrial Engineering faculty, for a two semester course.

It is worthwhile mentioning that although Dr. Louisa Bonfiglioli has been retired she has been asked to return to assist in covering graphics sections in Architecture. This permits the regular graphics instructor for these students, Professor Friedman, to work with the students of Moshe Boleslavski, who was on sabbatical leave in West Germany.

Other graphics courses that are now required of students in Mechanical Engineering, Civil Engineering and Chemical Engineering are firmly included in their corresponding curriculum. In addition to these courses, another is offered in Descriptive Geometry to seniors majoring in mathematics; as was requested by the Mathematics Faculty (less the Descriptive Geometry Department). The "culprits" who brought back, to the various areas of engineering, courses in Engineering Graphics (including Descriptive Geometry) are Professor Yehuda Charit who is presently the chairman of the department, Professor Friedman who was chairman for many years, Moshe Boleslavski, Yaacov Arwas, Avram Banai who will spend the 1979-1980 school year at the Ohio State University and Josepha Stoessel. These instructors have assistants, who are from industry, to conduct the laboratory sessions. One of the leaders in the continuing process of convincing graphics opponents, is a retired young lady in her 70's who many of us know -- Professor Louisa Bonfiglioli.

Quoting from Bill Rogers' commentary on Dean Brenkard's paper "With a fixed amount of time available, it must be carefully apportioned to favor the most essential elements of the total program at the expense of the merely desirable. And this is what bothers me. Engineering Graphics, along with mathematics, physics and chemistry, is one of the four cornerstones upon which a sound engineering education is based." I wonder whether this concept has hit its required mark emough so that we, too, will regain our position in engineering education. I doubt that anyone can express this concept as well as Professor Rogers. However, I also believe that it is being wasted if the only people reading or hearing these words are all concerned with the teaching of our discipline. The International Conference on Descriptive Geometry was a good example of successful futility since we were all talking to ourselves. We all agree that Engineering Graphics is one of the "cornerstones" of engineering education. However, of what value is our opinion ----- as right as we may be ----- unless we can convince policymakers of that fact?

To prove the statement "Engineering Graphics along with mathematics, physics and chemistry, is one of the four cornerstones upon which a sound engineering education is based", and to convince those with influence that a sound engineering education is what our students should be getting, we must talk with those who believe differently. It is best, of course, to do the necessary campaigning at our own institutions; yet, what can we do if our local colleagues will turn a deaf ear? Perhaps a conference entitled "Graphics? Who Needs It?" would draw those who believe, as does Dean Brenkard, that graphics is necessary but only for one semester, one hour -- or perhaps two hours -- per week. It would also be attractive to those who want to completely eliminate the course from the curriculum. Perhaps such a meeting would interest some industry people who would want to show the value --- pro and con --- of graphics in industry. Once this heterogeneous group is together, it seems logical to afford them the pleasure of Professor Rogers and others like him.

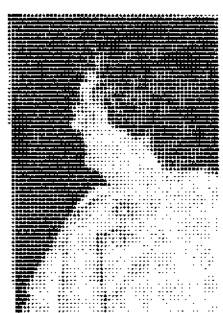
Copyright © Borah Kreimer 1979

ASEE ANNUAL CONFERENCE

Somewhere between Mississippi State University and Iowa State University there is a large brown manilla envelope containing, among other things, a very complete and well-written "recap" of the A.S.E.E. Annual Meeting held at Louisiana State University June, 1979. Rollie Jenison (I.S.U.-Freshman Engineering) did a great job in planning the program for this meeting. The sessions were interesting, entertaining and informative. Perhaps if the USPS finds this package before the deadline for the Winter, 1980 Journal, we will be able to include some of the highlights of L.S.U. in that issue. But, as you can see, Margaret Eller's little camera was very busy, and thanks to her, we do have some "copy" for this journal.

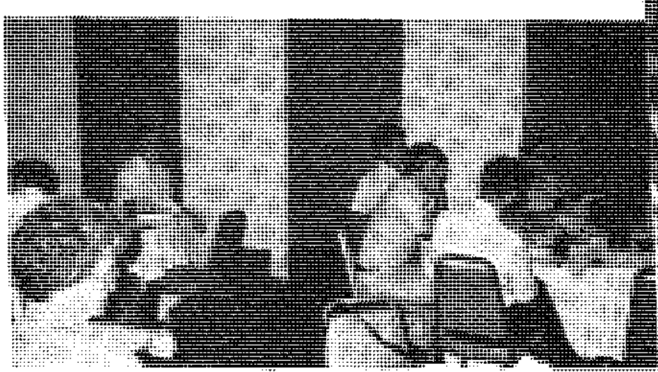
The following collage of photographs is left without the usual and appropriate captions. For those of you who attended, recall, if you will the fond memories of "Bayou Country". For those of you who were not there, just try to guess what was going on!

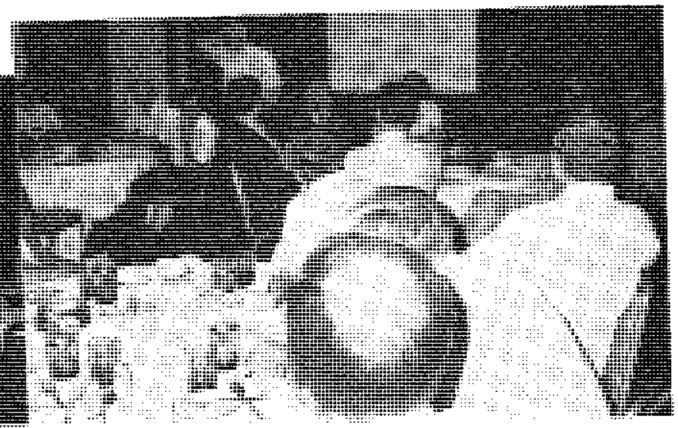
AT THE BANQUET . . . .



Louisiana State University & Baton Rouge

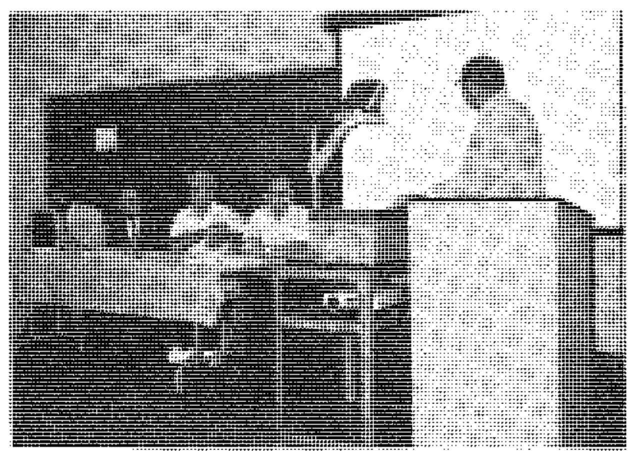
AT THE BUSINESS LUNCHEON . . .





AT THE CREATIVE DESIGN DISPLAY . . . .

AT THE SESSIONS . . . .



JUST TALKIN' AND

HAVIN' FUN . . .

CREATING A WINNING FRESHMAN DESIGN

Roland D. Jenison, Alan M. Russell
Department of Freshman Engineering
Iowa State University
Ames, IA

BACKGROUND

In 1974 Iowa State University's College of Engineering reorganized the Department of Engineering Graphics to form the Freshman Engineering Department. This reorganization broadened the responsibilities of the department to include:

-- advising freshman students who have not yet declared a major in an engineering specialty
-- conducting orientation programs for new students
-- teaching a freshman computations course in problem-solving procedures and calculator programming.
-- teaching an introductory course in engineering and the design process, which includes an open-ended student design project.

Approximately 100 freshman students enroll in the freshman design course each academic year. The course evolved from the design unit previously taught as a part of the freshman graphics courses; it has been expanded into a separate course in hopes of better meeting the department's goals in teaching design at the freshman level.

The prime objective of the course is to familiarize the students with the engineering design process and to develop a general appreciation for "what a design engineer does." In addition, the act of following a design problem through to completion gives the students experience with information research, ideation techniques, team decision-making, technical report writing, and oral presentations.

CURRENT COURSE

The students begin their design projects on the second day of the 11-week quarter by selecting design problems and forming teams of four to six students. Most frequently students suggest the design problems themselves, although the instructor sometimes offers problems from his experience or from communication with local industries and agencies. The instructor must oversee the class' selection of design problems to assure that they are of suitable nature and scope for a one-quarter freshman design project. When the class has selected four or five problems, every effort is made to allow each student to work on the problem which most interests him/her.

Once design problems have been selected and student teams formed, each team is asked to study their problem area briefly and write a description of the problem characterizing what change a successful solution will be expected to effect. This preliminary analysis is continued by listing:

-- The criteria which would be used in judging the relative merit of different solutions to the problem
-- The restrictions which laws, codes, and other circumstances will place on the nature of any prospective solution
-- Subject areas in which the team needs more information in order to develop and evaluate solution ideas for the problem -- often called "ignorance areas"

The teams then continue the design process by using the list of ignorance areas as a basis for the team's problem research. Typically, a team will assign a certain number of ignorance areas to each team member as a research assignment. The desired information can then be found through the appropriate avenues of inquiry, such as library references, manufacturer's catalogues, letters of inquiry, personal interviews, and consumer surveys.

Usually about three weeks are devoted to the students' research work; at the end of the research phase each student submits copies of a written report to the instructor and to the team on his/her research findings. With this research information in hand, the team may then wish to revise the original problem analysis to reflect their improved understanding of the problem area.

Following the research phase, each team works to generate ideas for problem solutions. Both individual home assignments and team discussions are used to produce solution ideas by utilizing both systematic and random ideation techniques. With the aid of a simple decision matrix, the teams evaluate the ideas generated with respect to the criteria in the revised problem analysis to choose the n best ideas (where n= the number of students on the team.) Each student then takes one of these chosen ideas to develop in more detail as an individual assignment. The form and function of each student's assigned ideas is described with a series of concept sketches and explanatory notes. Students are allowed about one week to complete their concept sketches for submittal to the instructor and the team.

At this point the team faces the task of choosing the solution idea which best meets the criteria set forth earlier by the team, after first satisfying themselves that each student's proposed concept meets the problem analysis restrictions. The team makes this choice with a more elaborate decision matrix, which allows them to compare the various concepts numerically with regard to the criteria. The team may then let the decision matrix direct them to specify one of the concepts as the preferred solution, or they may choose to develop a "hybrid" solution which combines features from two or more concepts to form a new solution.

The remaining weeks in the term are used in preparing a final written report on the entire design process and in giving an oral presentation to the class and to invited faculty members from other Engineering college departments. The final report describes the activities accompanying each step in the design process and contains a written description and design drawings for the specified final solution. On the penultimate day of class each team gives a 20-minute oral presentation on their design problem and specified solution.

PRODUCING A WINNING DESIGN

Iowa State has enjoyed moderate success during the past several years with student design projects in the national Creative Engineering Design Display (CEDD) competition. This success can be attributed to the benefits gained by both instructors and students in the freshman design course. During an academic year, some 150 student teams are involved in the development and presentation of a solution to a design problem. Instructors benefit by the judging of the oral presentations of several teams and students benefit by studying the efforts of teams that preceded them in the course. In addition, instructors nominate each spring the two best solutions, in their estimation, for entry into the national competition. Knowledge of the past winners in the national competition also assists greatly in the selection of future team entries.

It is important here to emphasize that Iowa State does not teach its freshman design course to develop excellent projects for national recognition. Instead "a winning design" is one in which the students select a meaningful problem, execute the design process, develop a viable solution, communicate the solution in a professional manner, and leave the course with a sense of accomplishment.

Before delving into specific procedures which aid in a successful team performance, a look at the course objectives is necessary. The objectives are quite obviously written for freshmen students who lack technical backbround but possess a desire to succeed in an engineering effort. Becuase this is the first experience in an "open-end" problem for most of the students, the objectives are explained carefully to the students at the beginning of the course and throughout the course.

- -- Develop a background of engineering design philosophy.
- -- Learn and apply principles and procedures in the engineering design process.
- -- Learn and apply various research techniques to a design problem.
- -- Learn how to incorporate pertinent knowledge and skills from various disciplines into the design process.
- -- Stimulate and sustain an active interest in, and enthusiasm for, engineering.
- -- Develop creative talents.
- -- Develop positive, productive habits and attitudes.
- -- Develop the ability to work effectively with other people.
- -- Learn and apply fundamentals of technical report writing.
- -- Learn and practice effective procedures and techniques utilized in an oral presentation of a design solution.

From the instructor's viewpoint, successful attainment of the objectives begins with the nature of the design projects. Generally, solutions to a design problem fall in three categories; devices, structures, and processes (systems). Examples of each of these are:

A) devices
1. a safer ladder
2. an improved bicycle brake
3. a safer electrical cord for appliances

B) structures
1. an underground residence
2. a bomb shelter
3. a sea farm

C) processes (systems)
1. a campus traffic plan
2. a desert irrigation system
3. an improved baggage handling system for airports

Experience with freshmen design at Iowa State has shown that problems which are solved with a new or midified device yield the best results. In fact, the more specifically the problem statement is written at the beginning, the better the team seems to execute the design process, thus yielding a practical and clearly specified solution.

It can be argued that structures and systems are necessary for a large share of solutions to design problems and to some extent they are made up of combinations of devices. However, in a 10-week period, freshmen cannot be expected to complete the necessary detail for a structure or a system.

In most cases a solution involving a structure or a system is difficult to justify becuase of the many details left out due to the time constraint. Student teams desiring to work on a large-scale problem are cautioned from the beginning as to the potential pitfalls.

Solutions involving devices can also lead to team difficulties if the device tends to be complicated. If the solution requires detailed mechanical linkages and/or sophisticated electrical circuitry, the students do not possess the necessary technical background to properly specify the solution. Instructor experience is very helpful in keeping the size of the problem reasonable.

The instructor serves a dual role in the course, that of a lecturer and a supervisor. As a lecturere, the instructor outlines the design process, presents examples of successful and unsuccessful design solutions from personal experience and/or outside reading, and administers homework efforts and examinations just as he/she would in an analysis course. In addition, the instructor acts as a supervisor of the team effors, on occasion acting as a couselor, moderator, motivator or sounding board.

The assignment sheet specifies strict deadlines for the steps of the design process. In the supervisory role, the instructor tries to insure that each team has attained the optimum result for each step of the design process. In order to clearly delineate the instructor's role as supervisor, the design steps are listed below.

1) Identification
2) Definition
3) Search
4) Criteria and Constraints
5) Alternative Solutions
6) Analysis
7) Decision
8) Specification
9) Communication

The first two steps have been discussed previously and are the most important if all that follows is to be successful. As the team begins to search for information about the problem, the enthusiasm is at a high level. A research plan is established by the team members and each student has a definite topic and a list of potential sources of the needed information. However, after a week, the enthusiasm has dropped markedly on most teams and the team begins to have doubts about the problem. Research sources have not proven as valuable as first thought and/or are on a high technical level; letters that have been sent are not yet answered; and the tedious work of information research is now apparent to each student.

At this point the instructor must be a motivator. Having the team or individual students turn in a comprehensive research report about three weeks after the search begins helps to motivate the student to locate pertinent information. A brief presentation of an actual design problem by the instructor can also be a motivator. Students are aften amazed that engineers in industry also encounter difficulties in their work.

Enthusiasm picks up again as the criteria and constraints are established. The knowledge gained from research begins to show in team discussions of the limitations that must apply to the solution. The instructor assists in assigning criteria and constraints to insure that the problem is not over-constrained. This is the last time in the design process that a major change can be made in the original problem statement.

The instructor becomes a moderator during the selection of alternative solutions. It is here that creativity is emphasized and formal idea-generating sessions such as brainstorming and Itemized Positive Response (IPR) are conducted. The instructor often assists the team in these sessions to optimize results.

During the analysis phase each member of the team is responsible for development of the form and function of a single solution concept. The instructor serves as a sounding board for ideas for the students to use in the concept development. A suggestion of a source of new research information, selection of a means or power for the solution idea, and graphical techniques for presenting the solution idea are among the items the instructor and student are apt to discuss.

After the team selects the final solution, the instructor carefully counsels the team to be prepared to justify the solution, not in terms of the numerical decision matrix, but in terms of the research and criteria. Again at this point, team enthusiasm is high but diminishes quickly as the solution specification begins. An entirely new set of problems arises: material requirements that have not been previously specified, fasteners, specific costs of each solution component, standard or non-standard parts, and the necessary drawings for complete specification. At the same time the specification phase is ongoing, the final written report is being prepared. This is perhaps the busiest time of the term for the students, and the instructor needs to be available to each student as much as possible. As the reports take shape, the students seem to sense the end and enthusiasm rises again. This enthusiasm generally carries on through the oral presentation.

In national competition, the key elements to success are a well-written and organized report describing a viable solution, excellent graphics, and a descriptive model of the solution. At Iowa State, the freshman design reports are organized in the order of steps of the design process with a table of contents and abstract preceding the main body of the report. The reports are typed except for drawings, sketches, and graphs. Correctness and clarity in writing are emphasized along with continui ty from section to section of the report. The use of third person passive voice is required. Approximately one-fifth of the report grade is assigned for appearance, organization, and proper use of the English language.

An engineering graphics course is the prerequisite to the Iowa State design course and the graphics text is required material for the course. Drawings must be of high quality, numbered in a logical manner, and appropriate for what is being described. Pictorials, assemblies, and detail drawings, integrated with the written material generate an impressive technical report when organized properly.

Models are optional for the oral presentation. The team must decide if the time and effort to design and construct a model will be offset by the benefits gained. It has been shown that good models generally enhance the oral presentation, and, of course, are beneficial for any consideration for the national competition.

Producing a winning design cannot be credited to the course and instructor alone. Much of the credit must go to the students who often exceed the basic requirements of the course. The class meets three times weekly for two hours, which, in a 10-week quarter (plus 1 week of final exams) is 60 hours of class time. Since 40% of the course grade is dependent on the final report and oral presentation, this means about 24 hours of class time per student per quarter is used for design project activities. In practice, somewhat more class time is made available for this purpose. Thus, counting outside class time normally associated with this type of course, a 6-person team will devote some 200-300 hours to a design solution.

As in any working situation with several person involved, personnel problems arise from time to time. Frequently the instructor is confronted by a student who is not working well within the team framework, or the related situation in which several team members are unhappy with another member's performance. Since part of the course grade is dependent upon peer evaluation, the instructor can track the performance of various team members and move to minimize conflicts within the team. As indicated earlier, one of the course objectives is to develop an ability to work with people.

It is obvious that a simple formula for success in a freshman design course does not exist. However, good planning and course organization are positive factors for success. The design course organization currently in use at Iowa State can provide a sound freshman design experience for engineering students.

REFERENCES

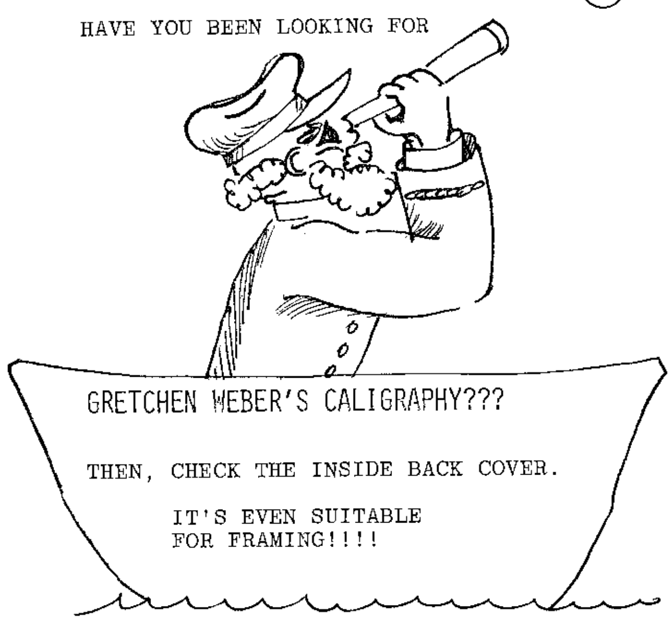
1. DeJong, P.S.,"Design Instruction for Freshman Engineers", a paper presented at the 79th Annual Conference of the American Society for Engineering Education, the U.S. Naval Academy, June 1971.

2. Eide, A.R., Jenison, R.D., Mashaw, L.H., and Northup, L.L., Engineering Fundamentals and Problem Solving, McGraw - Hill Book Company, New York, New York, 1979.

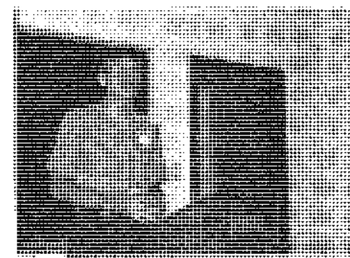
3. Hollins, G., et alia, "I.S.U. Headhouse and Greenhouse Heating", a design project report submitted to R.D. Jenison in Freshaman Engineering 171, Iowa State University, Ames, IA, 1978.

4. Jenison, R.D. and Northup, L.L., "'Engineering' Freshman", a paper presented at the 85th Annual Conference of the American Society for Engineering Education, the University of North Dakota, June 1977.

5. Rising, J. S., Almfeldt, M.W., and DeJong, P.S., Engineering Graphics: Communication, Analysis, Creative Design, Kendall/Hunt Publishing Company, Dubuque, IA, 1977.



A LARGE FRESHMAN ENGINEERING DESIGN COURSE: PAST CHRONOLOGY, FUTURE DIRECTIONS, AND SOME OBSERVATIONS



Dr. Richard J. Leuba
North Carolina State University

Foreword

Although this paper describes some elements of a multi-section freshman design course in a large engineering school, the paper is not an extended catalog description of the course; in other words, it is not a thorough account of the program.

Rather, this paper is intentionally a discussion of some aspects of the course with enough description to give the reader a framework for comprehension. Attention is given to some difficulties encountered and some successes during the program's ten year life.

For illustrative teaching materials and typical semester schedules, the reader is invited to write to the School of Engineering at North Carolina State University.

Editor's Note: This paper, presented at the 1979 Annual Meeting of the American Society for Engineering Education, held at Baton Rouge and Louisiana State University, June 25-28, addresses some of the problems encountered in teaching a freshman design course -- administrative problems are, of course, a major consideration. Because many schools are facing this same situation, or variations of this situation, it was felt that this paper should be included in this issue of the Journal.

Introduction

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.

Prior to 1970, engineering freshmen enrolled in a required one-hour, no-credit orientation. Responding to the 1968 ASEE Goals Study and to other concerns for freshman engineers, the Dean of Engineering appointed a faculty committee in 1969 to prepare plans for a full-fledged freshman course, and in 1970 NCSU -- in common with several other engineering schools in the nation -- placed in its curriculum a design-oriented freshman course, E-120. Stated course objectives were to "provide an exciting and motivating introduction to engineering using student involvement in a realistic freshman design project," and course content should include ". . . computational skills . . , the history of engineering, societal problems . . , and significant case studies." In contrast to the heavy exposure to non-engineering faculty in mathematics, chemistry, physics and English, students in the new course would be taught by engineers.

E-120 is a three credit-hour (semester plan) requirement for all freshman engineers who meet with their instructors for two recitation periods a week in small sections of 20-30 students each and meet in a large lecture hall once a week for a "Friday Lecture" session. While a body of definable content is taught, most of the students' time is devoted to a design project, from problem definition to ultimate presentation. The project experience stresses the design process, and understandably, does not place emphasis on advanced analysis. Typical projects are listed in Fig. 1.

E-120 "Engineering-Concepts" North Carolina State University

Civil Engineering Sections

variable depth swimming pool
route studies for local city transit authority
safer pedestrian crossing at busy thoroughfare
underwater welding chamber

Electrical Engineering Sections

vehicle steering with electronic control system
electronic control of greenhouse heating elements
digital readout display for airport radar

Mechanical Engineering Sections

toy for a blind child
game demonstrating a scientific principle
mechanical onion dicer
solar oven

Others

keyless doorlock
toothpaste dispenser
device to prevent electrical shock from appliance plugs
lecture hall seat adaptable to left-handed students
quick access safety pouch for hand-held calculator
learning stimulators for handicapped infants
food irradiator design (NE)
container design: radioactive waste storage (NE)
spring-loaded crop sprayer boom to reduce orchard tree damage
automobile fuel tank protector

Figure 1. Typical Students' Creative Design Projects -- A Few Examples Only.

The text, Engineering: An Introduction to a Creative Profession, by George C. Beakley and H. W. Leach of Arizona State University, was used initially, but after two semesters, the faculty agreed that this 548-page book was not justified on the grounds that it contained far more material than could be used in the course, and so a decision was made favoring locally-authored handouts. Mimeographed materials were prepared on such essentials as "organizing a 'company'", "selecting a project", dimensions and units, precision and accuracy, ethics, fields and functions of engineering, and a few others. The course was off to a running start, but the terrain was rough.

Course Reviews

E-120 was, from its start -- and still is--, controversial. Not every faculty member cares to teach freshmen, let alone teach to a project format. Some felt that it was premature, in the first year, for students to commence design without the coursework which would come later. Few faculty were accustomed to assigning "open-ended" problems. Students, left to their own devices -- or even with conscientious coaching by the instructor -- often spun their wheels, and impressions filtered throughout the faculty that the course was another Edsel. Some students were getting little out of E-120, and some faculty felt that they could be better occupied with teaching in their respective specialties.

In 1972, a faculty Review Committee was appointed to study the performance of the course. They drew up an instrument to obtain student opinion and used it at the end of the Spring 1972 semester. In addition, questionnaires were circulated to Juniors who had taken the course, faculty who had taught the course, and to the faculty in general. The Review Committee set out to learn how well the course was meeting its state objectives. Meantime, over a span of four semesters, partly overlapping the period sampled by the Review Committee, the then Course Director performed an independent analysis of the responses to the student questionnaires and prepared a report on the course.

While the Course Director's report emphasized the growing student acceptance of the course across four semesters, the Review Committee reflected faculty disenchantment and pointed-up the failure of the course to serve its objectives. Of those who had taught it, sixty percent or more indicated that the course had less educational value than other technical freshman offerings and felt that the course was too easy. And, while about half of the faculty who taught the course believed that the course did provide satisfactory exposure to a realistic design experience, far less felt that the course provided the students with career information, computer introduction, and motivation. Of the faculty, in general, more than 80% of those responding (more than half the faculty responded to the questionnaire) indicated that they would not like to teach the course as it was then constituted (in some departments the figure was 100%). Student opinion was hardly favorable: 42% of the respondents labeled the course "boring" or "uninterestint," and 83% said that it was either "relatively easy" or "Mickey Mouse." On the other hand, for the design project alone, 53% of the students responding said it was either "challenging" or "extremely challenging", and some interpreted the student surveys, generally, as favorable.

Measures expected to increase course success:

1. Improve procedures for selection of instructors.
2. Give instructors and departments greater latitude in choosing content.
3. Give students more choice in selecting subject matter.
4. Provide instructors with greater recognition.

Specific recommendations:

1. Appoint a steering committee to monitor any proposed future revisions and evolutionary changes over the life of the course.
2. Cut the number of weekly lectures in half. Retain those which are most popular.
3. Instead of one design project, use two, the first to illustrate project solving methodology, the second to be the students' major project.
4. Require teaching of the following skills: computation, project management, dimensions-units-measurements, ethics, and written-and-oral communication.

Course objectives (composed during the Report follow-up):

1. Increase the student's interest in pursuing a career in some field of engineering.
2. Increase the student's understanding of engineering by having the student take part in some phase of engineering work.
3. Begin the development of some of the skills required of an engineer.

Figure 2. Excerpts from Task Force Report, Spring 1974.

In the face of this, the Dean appointed a blue ribbon Task Force, headed by a department head new to the School to prepare a curricular design and produce recommendations for making E-120 a success. After several months of detailed and exhaustive effort, the Task Force reported its conclusions (Fig. 2) and these became the policy foundation for the remaining six year life of the course. Thus, the program began to settle down. Responsibility was placed with the Associate Dean for Academic Affairs, to whom a newly created position, Course Coordinatro, reported.

One effect of the Task Force' recommendations was greater latitude for the Departments. Gradually, the sections were controlled more-and-more by the instructor assigned to that section (any by his Department), and there were fewer and fewer faculty meetings devoted to week-by-week teaching. One department elected to prepare its own 65-page "book", covering introductory content in that discipline. They put more emphasis on learning a body of technical knowledge and applying it than on open-ended problem solving.

With the program back on course again, let us examine some specific features.

The Lecture Program

While the design project is the centerpiece of the course, the lecture program is a border of stars. Lectures occur each Friday morning for all students in all sections. Some lectures materially assist in carrying out the design project while others serve such course objectives as increasing "the student's interest in pursuing a career in some field of engineering," and

Week	Topic
1	Course Outline and Objectives
2	The Story of Engineering (media presentation)
3	Creativity
4	Fields and Functions of Engineering
5	The "Caesars of Synthesis" -- Principles of Design
6	Problem Solving
7	Value Engineering
8	"THX-1138-4eb" -- John Lucas film. Discussion of impact of technology.
9	SALT Agreement
10	Construction of Cape Kennedy (Civil Engineer)
11	Societal Modeling: "Retail Gravitation" (Industrial Engineer)
12	Development of Maxwell House Instant Coffee (Chemical Engineer)
13	Going Metric
14	Energy Crisis

Figure 3. Friday Lecture Topics. (This is from one of the early years -- Spring '73.)

helping "the student to learn more about a chosen area of engineering."

Until the 1974 Task Force report, Friday lectures continued through the semester for 14 weeks. Topics typical of these years are listed in Fig. 3. Lecture substance was information, inspiration, motivation and project assistance. Attendance became a concern, and more will be siad of this in the next section on grading (and lecture attendance.)

Grading: Projects and Lectures

Students place considerable stock in grades. The Grade Point Average (GPA) affects financial aid, parental approval, job offers and admissions to graduate school. Grades are earned in courses, most course content is fixed in content and uniform for each student, and explicit requirements are everywhere. Grading pressure upon the frehman engineering student is considerable. Then, along comes a course with its major activity an open-ended creative design project, and how do you, as instructor, grade that?! So, as those in other engineering schools have done, NCSU invited engineers from the School and from industry to evaluate the students' final project presentations. Panels of jedges rendered subjective opinions on creativity, oral expression, organization, engineering judgment, and so forth, a procedure which gives the students a taste (not always sweet!) of the real world. The project, from the inception of an idea, to establishment of need, researching the problem, conceptualization of alternative solutions, decision, detail design, and finally to report writing and persuasive presentation before a professional panel, is one of academe's closest approaches to what occurs in actual engineering practice. This process nicely sidesteps the inpracticability of applying objective standards to divergent projects, and it provides a practical basis for grading.

The lectures, on the other hand, offer no obvious formula for grading what the students get out of them. They are an anomalous phenomenon -- well rated by students (see Fig. 4), but poorly attended. When lectures ran all semester, the attendance by the end of the run fell to below half the registration. With no assignments to turn in, no exams to take, no grade involved, students stopped coming. The press of <u>other</u> courses, with test grades at stake, was too compelling as a counter attraction. So, after the 1974 Report, the better lectures were retained and the program was reduced to six or seven weeks, and students could work on their projects in the time released. Student ratings of lecturers were, on the whole, gratifying (see Fig. 5), but attendance still slumped, usually to the 50% level by mid-semester.

It is difficult to integrate lecture content with the teaching in the twenty or more individual sections. Some instructors encourage lecture attendance with an essay question test or an assigned paper but few

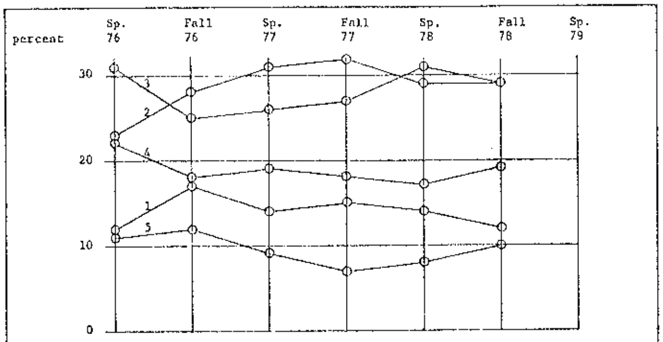


Figure 4(a). "Overall, I was helped in meeting course objectives by the Friday Lectures."

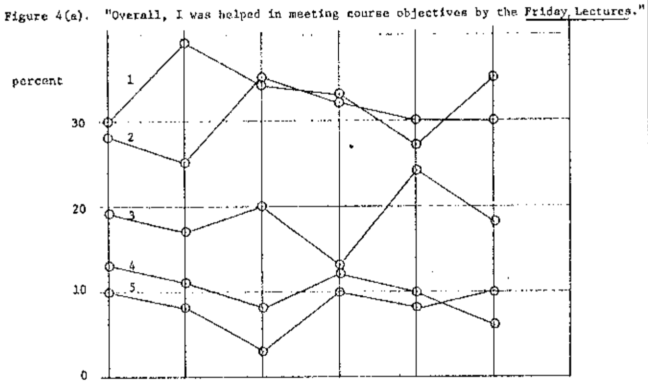


Figure 4(b). "Overall, I was helped in meeting course objectives by the Mini-Course."

Figure 4. Student Evaluations. [Legend: Very Much 1 2 3 4 5 Very Little]

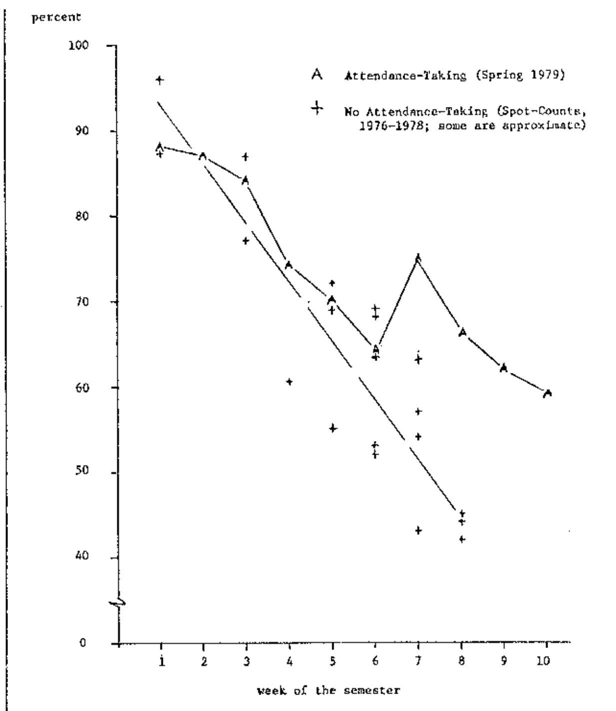


Figure 6. Attendance at Friday Lectures: With and Without Attendance-Taking.

burden themselves with the considerable task of evaluating such student writings.

Concerned by low attendance, the Coordinator urged instructors to place questions on the lectures in their quizzes and exams, and they did this -- some of them -- but without noticeable impact on attendance.

One of the items in the Course Evaluation Questionnaire is this invitation for a free response:

"Constructive Comments you would like to make about E-120______________."

Among the 464 students returning the questionnaire, only eleven entered a free response commenting on the lectures, and these eleven responses are transcribed below. The semester happened to be Fall 1977, in which the Friday Lectures topped out (see Fig. 4a).

- "The part of E-120 I enjoyed the most was the Friday Lectures. I was sorry to see them stop half-way through the semester. All of them were interesting and I enjoyed listening to them."
- "More Friday Lectures."
- "I believe more Friday Lectures are possible."
- "I enjoyed the lectures very much and would like to have heard a few more."
- "Friday Lectures good."
- "I want to re-emphasize how much I believe in the Friday Lectures. They are excellent!"
- "The best part where I think I learned more was the Friday Lecture. It gave a better understanding of what engineering is."
- "I really loved the lecture programs. It got me excited about engineering. Almost wish you could start the week off with the lectures. I think I would really work harder during that week. It gave me a real idea of what actual engineers were doing in real life."
- "I feel that there should be more films and lectures like those given on Fridays."
- "I feel that the lectures on Friday were valuable."
- "The Friday Lectures were the most influencing program for showing engineering practices and procedures."

Figure 5. Student Evaluations: Free Responses on the Friday Lectures.

Another ruse, with more success, is attendance-taking, carried out in the Spring, 1979 semester (Fig. 6). Whereas, formerly, attendance sagged to half by mid-semester, the figure held higher than 50% for ten weeks, with attendance-taking. (For other reasons, the Spring '79 run was extended to ten weeks.)

Thus, in practical terms, the lectures remain one of the program's "optional" inducements; there is much for the student who attends, but attendance is sometimes secondary to the compelling demands of the traditionally structured and graded physics, chemistry, math and English.

Mini-Courses

If it is not an administrative trick to schedule twenty-five sections of a course in 16 rooms, taught each semester by "ad hoc" faculty from eight departments and crowned with a volunteer force of Friday lecturers, then the addition of mini-courses *is*!

A mini-course is a four-week period of instruction exposing the student to a faculty member from another department in the School of Engineering and providing that student with some experience with the work -- and often the laboratory equipment -- in that field. Mini-courses give students a rationale for the academic curriculum, insights into the rigor required, and a heightened interest in that field.

Whereas about two-thirds of the freshmen take E-120 in the departments of their choice, about one-third are "uncommitted", i.e. have not yet declared a major, and it is for these 150-200 students that the mini-courses exist.

Beginning in 1975, a four-week block was carved out of the semester -- from the ninth to the thirteenth weeks -- and the uncommitted sections shut down while their students enrolled in these short, four-week two-classes-per-week mini-courses. Departments participating include AE, EE, IE, MAT, ME, NE, Engineering Science and Mechanics, and Biological and Agricultural Engineering. Thus, in addition to their section instructor, the uncommitted students were exposed -- in the mini-courses -- to another instructor in a different field of engineering. Later, another mini-course was added, taught by specialists in Career Planning and Placement.

Students report that they enjoy the mini-courses (Fig. 4). Whether or not the experience has led to better informed choices of an engineering major will never be known in the quantitative sense, but the intuitive feel of faculty and administrative officers close to the scene is favorable.

Block Grading

As explained, students' projects are evaluated by outside judges. Grading of most of the other class work is routine. This leaves a difficulty in appropriately rewarding those members of project teams who contribute the most in time, ideas and productive effort and of denying rewards to those who let others carry the load. A project team of, say, five students carries out a design project, keeps a log, prepares a mock-up or model, writes a report and makes a fifteen-minute presentation. The instructor is imperfectly aware of which team members are pulling at full steam. Because the project effort is carried on outside of class, there is much that the instructor does not see. Therefore, a convenient way to assign project grades is block grading, giving each member of the team the same grade, irrespective of individual contributions. Although incompatible with the usual tenets of grading, the message in this policy is not lost on the students. The criterion is success, whether everyone pitches in or wheter only two do the work and the others drift. It is speculated that the students who hve been through this experience one or more times will be more discriminating in the future with respect to who is and who is not assigned to project teams with them, buth in subsequent years of school and after. I believe that it is appropriate for the engineering curriculum to sensitize students to the imperative of sizing up the capabilities and contributions of colleagues. The real world is closer to this model than to the each-engineer-in-his own-box model. Fine, but: it does not quite do justice in terms of relative contributions. Hence the Peer Evaluation.

Peer Evaluation

At the end of the course, each student answers a confidential questionnaire (only the instructor sees it) in which he rates the relative contributions of himself and the other team members. The essential question is asked five different ways: Who "did not put forth his/her best effort?" Who "contributed the most?" On a one-to-five scale, rate the "value to the company" of each member. Of 100% total, what percent was "contributed by each? and "What grade should each get?". Some students are wary of assigning grades to peers and will simply list an A for each person, but they tend to be more candid with the 'did-the-most,' 'did-the-least' questions. An instructor, studying the five questionnaires from five members of a team can usually establish a defensible grade distribution. The beauty of the system is that is documented; it is not instructor guesswork. My own experience with peer evaluation proves that my casual observations are inadequate. Students who shirk work in their "companies" may be quite good at maintaining appearance when in the presence of the instructor. In meetings which I hold with the teams, members who speak up the most are not necessarily those who turn out to be of the most "value to the company". Peer evaluations, on the other hand, tell me who made the effort and who went fishing.

Student Evaluation of the Course

Each semester, students fill out a comprehensive evaluation form of some 43 items. The questions on the form derive from the course objectives and are of two general types. The first type asks about likes and dislikes, whereas the second asks the student for a self-assessment of his/her learning. The questionnaire includes a mix of both kinds of questions, most (21) in the former category, and (16) asking for a self-assesment of learning (with 6 items strictly demographic). The questionnaire does not measure learning; what it indicates is the extent that students' perceptions of their learning goes up or down from semester to semester.

Of the forty-three items, I have arbitrarily selected five to include here for discussion. The results of two global questions are illustrated in Fig. 7. There is a perceptible shift during the last years from "challenging" as a response to "relatively easy" as a response, with "relatively challenging" showing no pattern. As to difficulty, in terms of student standards, the course is middle-of-the-road, with only small minorities marking either "too difficult" or "too easy" (from my experience reading students' free comments, I infer that "too difficulty" applies as much to time demands as it does to intellectual difficulty.)

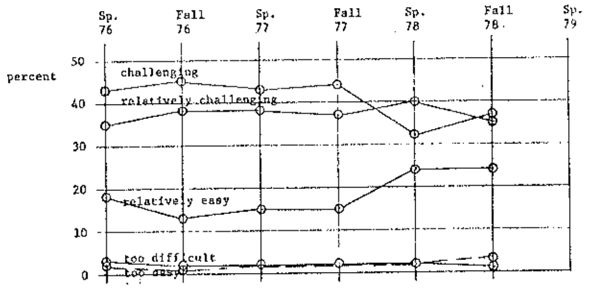


Figure 7(b). "I found E-120 to be . . ."

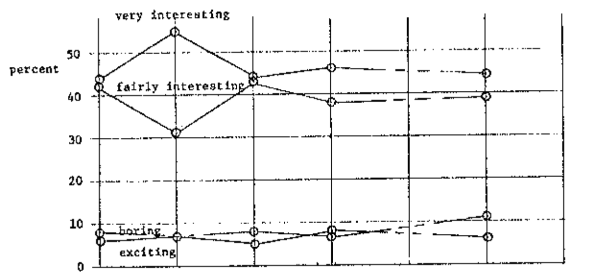


Figure 7(a). "I found E-120 to be . . ."

Figure 7. Student Evaluations: Global Questions.

The second global question (Figure 7b) shows that around seven or eight percent find the course "exciting," and about the same number find it "boring". About 85% find it "very interesting", or "fairly interesting", with no significant trend detectable.

Evidently, most students have good feelings towards most of the instructors, but the batting average fro the program is far from 100% as seen in Fig. 8a. Generally speaking, the design project, Fig. 8b, is regarded as a strong plus in meeting course objectives with perhaps a slight improvement in student opinion over the six semesters of record.

Finally, Fig. 4a, the students rate the Friday lectures a clearly better than neutral in the scale from "very much" to "very little." In excess of 40% of the students rate the lectures in one or other of the top two categories, while the bottom two categories receive an average of less than 30%.

Although more, perhaps, could be said about this data and about all of the other questionnaire results, only two brief comments will be made: The word "trend" was mentioned but "trend" is not the right word; the better term is fluctuations. Climate trends, but weather fluctuates, and this course is more like weather owing to the changing and unpredictable mix of faculty who happen to be assigned to teach it in any one semester. On the other hand, any adverse student reactions about a program which enjoys poor popularity among the faculty, tend to linger and multiply, creating a "climatic" trend. Negative faculty attitudes carry over presumably into the teaching and thus to the student evaluations. The other comment is a question: While the course does not please nor provide the best learning environment for all students, can it ever? Are the dissidents those who drop out of engineering?

In 1972, the Review Committee attempted to get a "handle" on students' estimation of the course in a different manner. Rather than gathering responses to absolute questions ("The course was challenging, interesting, or dull") they learned where the students rated the course with respect to their other current subjects: math, chemistry, physics and English. The results are given in Fig. 9. and show not only a trend improvement for the period in question but also show where the course rates relative to those other courses. But, there is a problem in this kind of self-assessment. Note that the question asks the student to rank the course in terms of ". . . how much you feel you are learning in each . . . ". From high school, students are conditioned to relate "learning" to cognitive development -- particularly academic content in the mold of math, chemistry, and physics. In E-120, students may gain insights into how you do and do not carry out a successful group project, they may gain experience interviewing experts, they learn -- perhaps subconsciously -- about pernal management of time, but they are un-accustomed to tallying these experiences as "learning" in the same columns where the total up their learnings from calculus and the physical sciences. When learning is non-traditional, the

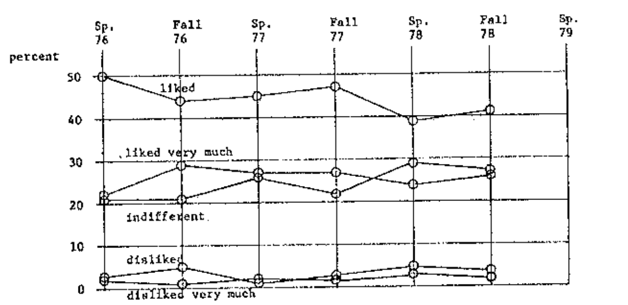


Figure 8(a). "The Design Project: --Contact With Your Instructor."

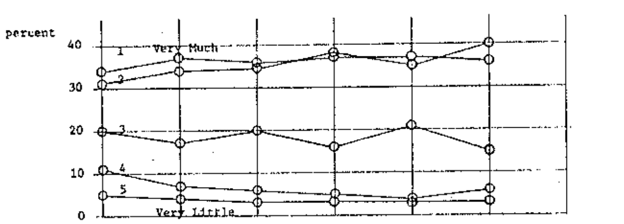
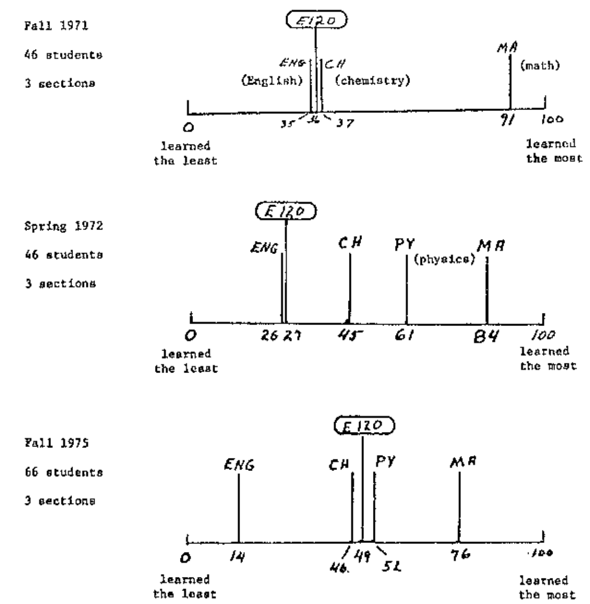


Figure 8(b). "Overall, I Was Helped in Meeting Course Objectives by the Design Project

Very Much 1 2 3 4 5 Very Little."

Figure 8. Student Evaluations.



Directions to students: "List the courses you are taking this semester. Now, rank these courses in an order determined by how much you feel you are learning in each course."

Figure 9. Student Evaluations, Electrical Engineering Sections Only. Top and Middle: Early years of the course. Bottom: With heavy EE content taught in the EE Sections of E-120.

instructor has the special responsibility of opening students' eyes to what they have learned. It is hypothesized that students are less aware of what they learn in E-120 compared to, say, physics.

Next, I turn to three further factors of the course which will be of interest to those interested in examining the practicalities of a freshman design course.

Faculty Attitude

Most faculty would prefer not to teach E-120. Faculty antithesis is understandable; they are more attracted by research and by teaching advanced students, and they are unfamiliar with teaching freshmen and with open-ended problem solving. It is also believed that salary and promotion rewards hinge less on E-120 teaching than on other faculty duties.

A recent (1979) review committee's formal report states that the course "lacks faculty enthusiasm, administrative commitment, structure and specificity, discipline on the part of the student, a sufficient information base for implementation of the engineering concept, and toughness of course content." The first two counts of the summation deal with factual matters, and few would disagree with the committee's verdict, but the remaining counts reflect various biases. For example, helping students to become more creative is incompatible with typical course "structure and specificity", so a judgment on this count depends on course goals. Freshmen "lack" all sorts of things; writing ability and verbal fluency, as well as an "information base" and "Discipline". Some would argue that part of what the design project is for is learning how to get an information base and learning some self-discipline; this requires instructor skill. "Toughness of course content" calls for a balancing act with the long-established goal of motivating students. This is less a fault of the course and more a problem of teaching. In short, faculty attitude -- besides the reasons already cited -- is probably darkened by the teaching difficulty.

Student Coat-Tailing on the Design Project

Student teams carry out design projects requiring roughly about 60% of total course time. The teams "run their own show" with a "Chief Engineer" selected by the group. Most work is done outside of the classroom, and unsurprisingly, some members contribute more work -- and therefore get more out of it -- than others. One instructor analyzed his section and concluded that 15-30% of his students were not engaged actively in the work of the team and that for them the project was an unprofitable experience. My own analysis of the peer evaluations of approximately 120 students in 25 teams indicates that in only 25% of the teams were all the members actively engaged and that of the total number of students about 25% were riding on the coat-tails of others. A knee-jerk reaction to these statistics is "something is wrong"; any program which wastes the time of a fourth of the students is out of whack. But, there is another view. All of our students are not "cut out" for engineering (or even for a university education) so it should be expected that some have little interest in putting effort into the project. Consider the team members who take more than average initiative: They are repaid for their large efforts with experience important to their careeers. Because so much of academic work is a solo responsi bility and so much of professional achievement hinges on joint contributions, some weight needs to be given to the relatively essential but unique learning for those who take the projects seriously and who plan, take initiative, cooperate with team members, and carry out the work. This is the elitist position. Coat-tailing is a price paid for the personal growth of the majority -- the achievers.

Design/Graphics Sequence

This writer has observed first semester freshmen in E-120 struggling without success to capture a three-dimensional idea on two-dimensional paper. We teach orthographic projection and sketching in "Engineering Graphics", but because of our staffing situation, half of our freshmen reach the graphics course after E-120, the design course. Of the faculty teaching design (E-120), and graphics, approximately teach exclusively one or the other, but not both. Even if it were possible for the several departments to staff the design course in the Spring for all of our freshmen, the graphics staff is not large enough to teach graphics to all of our freshmen in the Fall.

It would make logical sense, were it possible to do so, to delay the design course until after the graphics. Some schools do this with a two-semester graphics plan in which the culmination is a design-graphics project in the last term of the sequence.

Future Directions

Plans for the future of freshman engineering at NCSU have not been announced. Change is in the air, but the direction is unclear.

This year, 1978-79, the faculty, through their departments, has been given power to make change in the freshman year, and they have not hesitated: after a ten year life, E-120, the centrally coordinated design course, is to be abolished. At issue now is how to employ the three credit-hours. Each department has a different view. The trend is away from a common course.

A decision on a new plan is forthcoming.

Closure

E-120, unlike the majority of university offerings, has asked students to reach for new heights. Only some faculty can teach it well, and perhaps fewer still teach it with special enthusiasm. Not cast in the usual mold, the course asks students for performances unlike much of what they have previously experienced in high school. There is daring in asking a five-member student team to scout their worlds, come up with a problem and write a development proposal, carry out the steps to a solution, and write an engineering report and give an oral presentation. Things go wrong. Sometimes the students themselves will dig themselves out of a hole. The instructor counsels them, with facts, with leads to information, in scoping the problem and -- rather often -- helping students pare down the project to within manageable limits. E-120 has been a daring adventure -- something like the practice of engineering -- but it does not fit too well into the typically predictable patterns of engineering education.

Copyright © Richard K. Leuba 1979

!!! ATTENTION !!!

MEMBERS OF THE EDGD AND READERS OF THE JOURNAL:

DO YOU THINK THAT THE NAME OF THE JOURNAL SHOULD BE CHANGED?

YES ☐ NO ☐

WHAT CRITERIA OR RATIONALE WOULD YOU CONSIDER TO BE VALID IF THE NAME OF THE JOURNAL WERE TO BE CHANGED?

DO YOU HAVE A SUGGESTION FOR A NEW NAME FOR THE JOURNAL?

IF SO, WHAT IS YOUR SUGGESTION?

SEND ALL COMMENTS AND SUGGESTIONS TO: MARY A. JASPER, EDITOR, ENGINEERING DESIGN GRAPHICS JOURNAL, P.O. DRAWER HT, MISS. STATE, MS 39762.

Jon K. Jensen
Marquette University
Milwaukee, Wisconsin

TAMING THE FRESHMAN PROJECT

Introduction

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.

Introduction to Engineering I

The purpose of this first semester 4 credit course is to introduce engineering as a career, involve students in the design process and to begin developing their skill with computers. This is composed of two lecture hours, a two-hour design laboratory and a one-hour computer laboratory per week.

As a part of the design portion of the course an attempt is made to gain as many outside speakers as possible. This brings the real engineering world into the classroom. These speakers address varied topics from case studies to ethics and product liability. The design laboratory gives the student an opportunity to utilize the design process both as an individual and in group situations. Creativity is stressed as students attack two-hour mini projects. The optimum solution to a problem is seldom the true goal. Rather, emphasis is placed upon understanding and organization of the problem at hand. Under these conditions students most always arrive at a more creative solution, when a solution is requested.

High points in this half of the course are achieved when students are given the opportunity to compete against one another. Several projects can be employed at this time usually on a rotating basis. Examples are (1) building a toothpick tower using a set of criteria that define function and performance, (2) constructing a useful device from a given set of materials, eg., a mousetrap, (3) a carrier or package to transport an egg three stories to the ground without breaking the egg. Projects such as these are helpful in enhancing creativity and developing self-confidence in students' abilities.

Work on a semester-long design project, which begins in the second semester, has its origin in the first semester. In conjunction to their study of the design process, students are asked to identify the needs of society. This stage often fosters some rather bizarre ideas and almost always requires some toning down, eg., a device to neutralize nuclear weapons. Then through an iteritive process involving individual evaluations and group discussions, a list of project titles is obtained. From this list, each student selects a project and teams of 4-6 students are formed. In December, the listing of team members is published. This enables students to begin their information retrieval during semester recess.

Introduction To Engineering II

The purpose of this second semester 4 credit course is to understand the theory of basic engineering graphics, to develop the ability to graphically express oneself, and to provide an opportunity to plan, organize, and complete an engineering project. This is composed of two lecture hours, a three-hour graphics laboratory and a one-hour design seminar per week.

The team design project involves the formation of a fictitious company in which the principal instructor becomes the "President" and other involved staff become "Vice President" and "Contract Officer". Each project group first identifies the problem they intend to work on, then a Design Proposal and Contract are drawn up. The Contract binds the team to develop a solution and outlines deadlines for progress. During the project, four formal engineering reports are submitted to the company (1) Feasibility Study, (2) Preliminary Design, (3) Detailed Design, and (4) Final Design Report. Each written report is accompanied by an oral report to the rest of the class. At the beginning of the semester both written and oral reports seem poor at best, but as students progress, more pride is taken in their output. Perhaps this is due to the pressure that is placed on students in the form of progress report grades at this precise time.

The high point of the semester is a freshman design competition which is held each spring. Specifically for this three-day competition, groups of practicing engineers from the community are invited to participate as judges. Each successive day of competition involves a different group of engineers. Last year approximately 68 outside engineers participated in the competition. The organizational problems with this type of program at times become a logistical nightmare, however, the results have been worth it. At the end of the final competition, two projects are selected as winners. The two winning projects are then submitted to the annual Creative Engineering Display sponsored by ASEE.

Observations and Recommendations

The following are observations and recommendations for improvement based on the experience with freshman engineering so far.

1. Many students felt that they were being underestimated in terms of the first semester creative projects. Many stated they were a waste of time. I remain in belief that most of these small projects (eg., toothpick tower, etc.) are most valuable when used properly. The solution lies in an appropriate student orientation to the objective of that particular project.
2. A considerable portion of the first semester evaluations indicated that many students considered studying the design process to be a waste of time. By the time the second semester was finished most of these students had completely changed their minds. However, some students remained discouraged because an attempt to solve the energy crisis or eliminate pollution from the earth was no made.
3. Approximately 1/2 of the second semester team project reports were poor in terms of structure and style. The purpose of the team projects was not to improve writing skills. However, communication in engineering is a must and this became one of the hurdles in the course. This emphasis paid off in the long run with better organized and clearer engineering reports. In most of these cases sketches and drawings were satisfactory.
4. The majority of the oral progress reports were satisfactory to begin, but increasingly improved. This also prepared students for the design competition at the end of the semester. Oral presentations during the competition allowed students to not just present a project, but to present it in a most relevant way--to a group of practicing engineers. Many of the students dressed formally for the occasion, although not required to, and the quality of many of the final presentations were in the very good to excellent category.
5. There were several times when it seemed that the benefit from organizing a complicated competition would be minimal. However, it seems to have been worth the trouble, and many of the guest engineer judges enjoy participating and request to be invited again. There is an obvious advantage to being located in an industrial area in terms of arranging for this type of experience.
6. Perhaps 2/3 of the groups chose team projects that were too complex in terms of the objectives of the course. A more thorough critique of project proposals is needed at an early date. This is not to say that 2/3 of the projects were less than satisfactory when completed. But rather that some of these project groups required many extra consultation and research hours in areas beyond their immediate capabilities. This was really incompatible with realistic course objectives. After a final judging session last semester, a visiting judge was overheard saying to another "If these kids would do something like redesigning the paperclip, they would have every engineer here in their pocket." His statement is perhaps an exaggeration of the problem, yet it deserves some strong consideration when evaluating course objectives.

Conclusion

The purpose and format of the freshman Introduction to Engineering courses have been discussed briefly in the preceding sections. As with any other course, a certain amount of success is achieved along with some dissatisfaction. One can only improve with experience. A major point to be made is that instructors must at all times have a clear unobstructed view of what is to be achieved by students during a course, and the manner in which it is achieved. This goes beyond the stating of valid and worthwhile instructional objectives. It may mean--taming the freshman project.

References

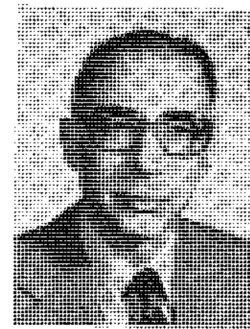
Beakley, G. and Chilton, E., Introduction to Engineering Design and Graphics, Macmillan Co., 1973.

Earle, James H., Engineering Design Graphics, 3rd Edition, Addison-Wesley Publishing Co., 1977.

Krick, Edward, An Introduction to Engineering: Methods, Concepts, and Issues, Wiley and Sons, Inc., 1976.

Copyright © Jon K. Jensen 1979

RECOMMENDATION FOR AN INTERNATIONAL STANDARD IN DRAWING HEXAGON–HEAD BOLTS AND HEXAGON NUTS, BASED ON THEORETICAL CONSIDERATIONS



H. Niayesh
Arya-Mehr University of Technology
Tehran, Iran

For Hexagon-Head Bolts and Hexagon Nuts, the hyperbolic curves formed by the intersection of the six faces of the hexagonal prism with the chamfer cone at 30°, as shown in Figure 1, are normally approximated by circular arcs which are much easier to draw. In the following elaboration, the radii of curvature for different projections of the hyperbolas are calculated at their vertices for that approximation.

The equation of the right circular cone, having its vertex at the coordinate origin, with base radius r and altitude h is known from analytic geometry as being $\frac{x^2}{r^2} + \frac{y^2}{r^2} - \frac{z^2}{h^2} = 0$. For the 30° chamfer of the hexagon head in Figure 1, with the distance across corners being e, it is $r = \frac{\sqrt{3}}{4} e$ and $h = \frac{e}{4}$.

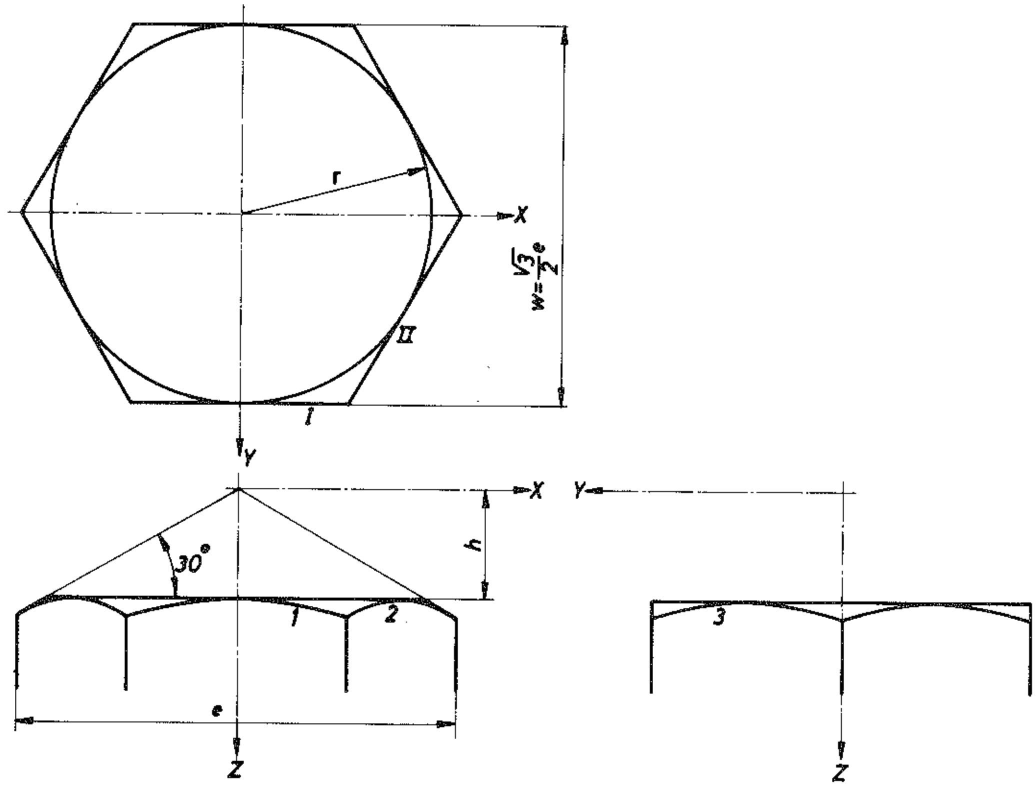


Figure 1

Consequently the equation of the chamfer cone is:

$$\frac{x^2}{\frac{3e^2}{16}}+\frac{y^2}{\frac{3e^2}{16}}-\frac{z^2}{\frac{e^2}{16}}=0 \qquad \text{or} \qquad \boxed{z^2+y^2-3z^2=0}$$

Plane I in the top view, with the equation $y=\frac{\sqrt{3}}{4}e$ cuts the above cone, and the intersection curve 1 in front view has the equation:

$$x^2+\frac{3e^2}{16}-3z^2=0 \qquad \text{or} \qquad \boxed{\frac{z^2}{(\frac{e}{4})^2}-\frac{x^2}{(\frac{\sqrt{3}}{4}e)^2}=1}$$

This is a hyperbola with half axes

$$a=\frac{e}{4} \text{ and } b=\frac{\sqrt{3}}{4}e.$$

It is again known from analytic geometry that the radius of curvature of the hyperbola at its vertex is $R=\frac{b^2}{a}$. So for the hyperbola 1 in front view:

$$R_1=\frac{\frac{3e^2}{16}}{\frac{e}{4}} \qquad \text{or} \qquad \boxed{R_1=\frac{3e}{4}}$$

Plane II in the top view with the equation $\frac{x}{\frac{e}{2}}+\frac{y}{\frac{\sqrt{3}}{2}e}=1$ or $y=-\sqrt{3}\,x+\frac{\sqrt{3}}{2}e$.

cuts the chamfer cone $x^2+y^2-3z^2=0$ in a curve with the equation resulting in:

$$x^2+(-\sqrt{3}\,x+\frac{\sqrt{3}}{2}e)^2-3z^2=0 \qquad \text{or}$$

$$x^2+3x^2-3ex+\frac{3}{4}e^2-ez^2=0,$$

resulting in :

$$(x-\frac{3}{8}e)^2+\frac{3}{64}e^2-\frac{3}{4}z^2=0 \qquad \text{or} \qquad \boxed{\frac{z^2}{(\frac{e}{4})^2}-\frac{(x-\frac{3}{8}e)^2}{(\frac{\sqrt{3}}{8}e)^2}=1}$$

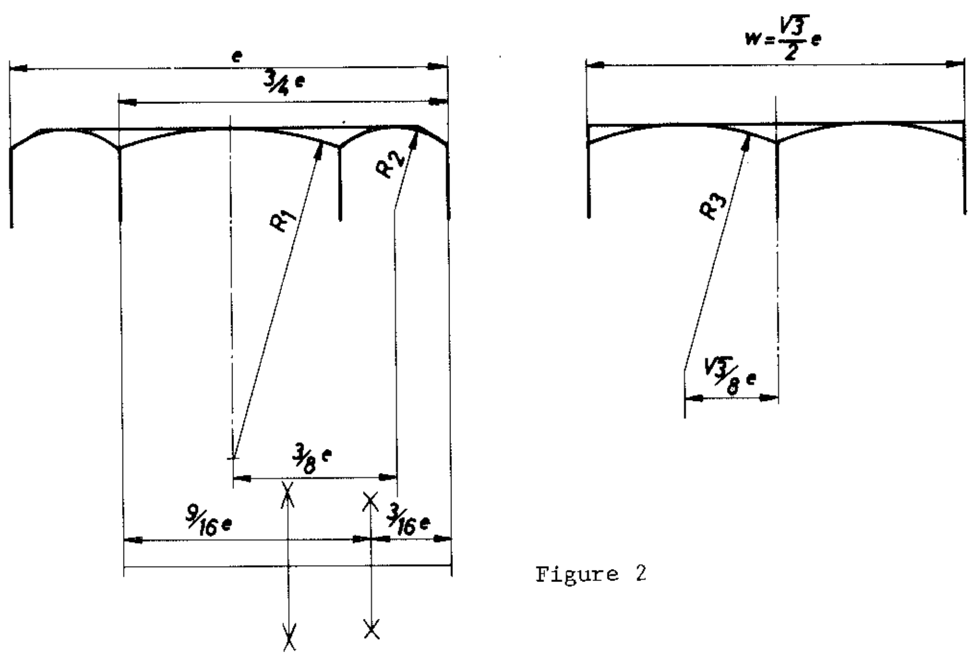


Figure 2

The radius of curvature at the vertex of this hyperbola 2 in front view is:

$$R_2 = \frac{\frac{3e^2}{64}}{\frac{e}{4}} \quad \text{or} \quad \boxed{R_2 = \frac{3e}{16}}$$

The equation for the projection of the intersection curve of plane II with the chamfer cone in the right side view can be obtained by writing the equation of plane II

in the form $x = \frac{-y}{\sqrt{3}} + \frac{e}{2}$ and determining its

intersection with the chamfer cone by eliminating x :

$$\left(\frac{-y}{\sqrt{3}} + \frac{e}{2}\right)^2 + y^2 - 3z^2 = 0 \quad \text{or} \quad \frac{y^2}{3} - \frac{e}{\sqrt{3}}y + \frac{e^2}{4} + y^2 - 3z^2 = 0,$$

resulting in:

$$\left(y - \frac{\sqrt{3}}{8}e\right)^2 + \frac{9}{64}e^2 - \frac{9}{4}z^2 = 0 \quad \text{or} \quad \boxed{\frac{z^2}{\left(\frac{e}{4}\right)^2} - \frac{\left(y - \frac{\sqrt{3}}{8}e\right)^2}{\left(\frac{3}{8}e\right)^2} = 1}$$

This is the equation of hyperbola 3 in the right side view. Consequently the radius of curvature at the vertex of hyperbola 3 is:

$$R_3 = \frac{\frac{9}{64}e^2}{\frac{e}{4}} \quad \text{or} \quad \boxed{R_3 = \frac{9}{16}e}$$

It is very easy to approximate the hyperbolas 1, 2 and 3 by three circles with radii R_1, R_2 and R_3 respectively, as shown in Figure 2, because $R_1 = \frac{3}{4}$ e is directly obtainable from the front view. Halving R_1 twice graphically gives both $R_2 = \frac{3}{16}e$ and $R_3 = \frac{9}{16}e$, also shown in Figure 2.

The following table gives a comparison of the radii of circles, as used in U.S.A., U.S.S.R., U.K. and Germany with the theortically calculated ones. For this purpose, most of those are calculated from the conventional graphical constructions.

Origin	R_1	R_2	R_3
U.S.A.	$\frac{\sqrt{3}}{2}e \approx 0.87e$	$\frac{\sqrt{3}}{8}e \approx 0.22e$	$\frac{e}{\sqrt{3}} \approx 0.58e$
U.S.S.R.	$\frac{3}{4}e = 0.75e$	$\frac{3-\sqrt{5}}{4}e \approx 0.19e$	$\frac{1}{2}e = 0.50e$
U.K.	$\frac{3}{5}e = 0.60e$	$\frac{3}{16}e \approx 0.19e$	$\frac{3}{8}e \approx 0.38e$
Germany	$\frac{3}{4}e = 0.75e$	$\frac{3-\sqrt{5}}{4}e \approx 0.19e$	$\frac{1}{2}e = 0.50e$
Theory	$\frac{3}{4}e = 0.75e$	$\frac{3}{16}e \approx 0.19e$	$\frac{9}{16}e \approx 0.56e$

The same table, calculated with respect to the width across flats w instead of e, is as follows:

Origin	R_1	R_2	R_3
U.S.A	w	$\frac{w}{4} = 0.25w$	$\frac{2}{3}w \approx 0.67w$
U.S.S.R.	$\frac{\sqrt{3}}{2}w \approx 0.87w$	$\frac{3-\sqrt{5}}{2\sqrt{3}}w \approx 0.22w$	$\frac{w}{\sqrt{3}} \approx 0.58w$
U.K.	$\frac{2\sqrt{3}}{5}w \approx 0.69w$	$\frac{\sqrt{3}}{8}w \approx 0.22w$	$\frac{\sqrt{3}}{4}w \approx 0.43w$
Germany	$\frac{\sqrt{3}}{2}w \approx 0.87w$	$\frac{3-\sqrt{5}}{2\sqrt{3}}w \approx 0.22w$	$\frac{w}{\sqrt{3}} \approx 0.58w$
Theory	$\frac{\sqrt{3}}{2}w \approx 0.87w$	$\frac{\sqrt{3}}{8}w \approx 0.22w$	$\frac{3\sqrt{3}}{8}w \approx 0.65w$

As known, for drawing purposes, in the above countries e or w are chosen as follows:

U.S.A.	w = 1.5D
U.S.S.R.	e = 2D
U.K.	e = 2D
Germany	w from tables for different values of D.

where D is the major diameter of the thread.

References:

1) Ivan Leroy Hill et al, Technical Drawing, Macmillan Publishing Co., Inc., New York, 1974.

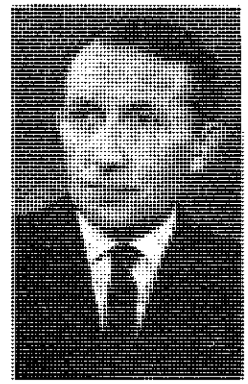
2) A. Serebrayakov et al, Mechanical Drawing, Mir Publishers, Moscow, 1969.

3) T.H. Hewitt, Engineering Drawing, University of London Press Ltd., London, 1963.

4) P. Boettcher, Technisches Zeichnen, B.G., Teubner Verlag. Stuttgard, 1972.

Copyright © 1979 H. Niayesh

DISTORTION PARAMETER IN PERCEPTION OF PERSPECTIVE REPRESENTATION



Y. Charit
Technion-Israel Inst. of Technology
Technion, Haifa
Israel

Any textbook of perspective drawing contains recommendations on choice of view angle, i.e., the apex angle of the vision cone subtended by the viewed object. Most authors restrict this angle, without any theoretical basis, to $28^\circ - 37^\circ$, noting that a wider angle makes for distorted perception. On the other hand, the desire for a perspective from an accessible center (as e.g. in the case of large building in a relatively narrow street) necessitates wide-angle viewing.

The problem in a nutshell is as follows. When centrally projected (center Z, Fig. 1) on a plane screen, objects subtending equal angles γ are enclosed within segments of different length on the screen. If the viewer* is also situated at point Z, the vision rays coincide with the projection rays and the objects are perceived in their natural proportions. If, however, the viewer is at some other point A, the segments of the screen corresponding to equal angles γ subtend varying angles α_i at A, and the pencil of vision rays is distinct from that of the projection rays; as a result, the represented objects are perceived in distorted proportions.

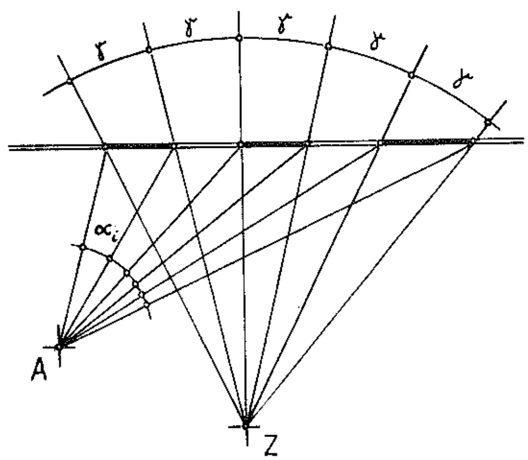


Figure 1.

A very interesting study of this problem was made by Hauchk (1), with the conclusion that compromise is necessary between the requirements of collineation and conformity. Accordingly, he proposed the so-called "subjective" perspective, based on development of circles combined with collineation of the of the vertical lines (2). Later publications proposed auxiliary curves and surfaces (8), (10), (12), and stereographic (3) and cartographic projections (9), as means of achieving "distortion-free" perspectives. A comprehensive review is given in Bartel's textbook (4).

*Monocular vision is assumed throughout.

In contrast to the strictly subjective approaches in all the above methods, this paper puts forward a quantitative parameter for evaluating the distortion. This parameter - derived from the principle of angle-oriented estimation of proportions, as practiced by a painter drawing from nature - is the change of the viewing angle as function of the projection angle:

$$u = \frac{d\alpha}{d\gamma} \quad . \tag{1}$$

In the above case of central projection on a plane, we have (Fig. 2):

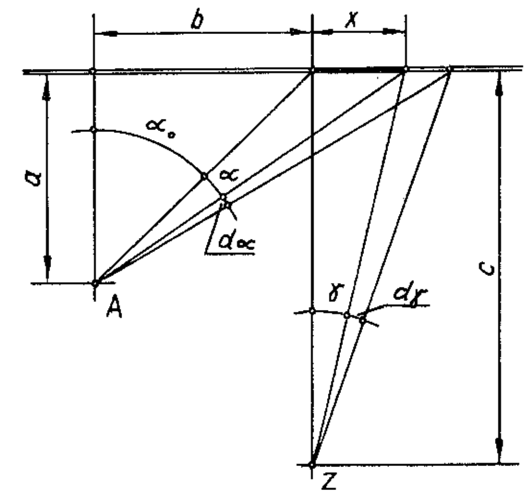


Figure 2.

$$x = c \tan \gamma \quad , \qquad x+b = a \tan(\alpha+\alpha_0)$$

$$u = \frac{\frac{c}{a}}{\cos^2 \gamma + \left(\frac{c}{a} \sin \gamma + \frac{b}{a} \cos \gamma\right)^2} \quad , \tag{2}$$

which in the particular case b+) (10) reduces to:

$$u + \frac{1}{\frac{a}{c} \cdot \cos^2 \gamma + \frac{c}{a} \cdot \sin^2 \gamma} \quad . \tag{2a}$$

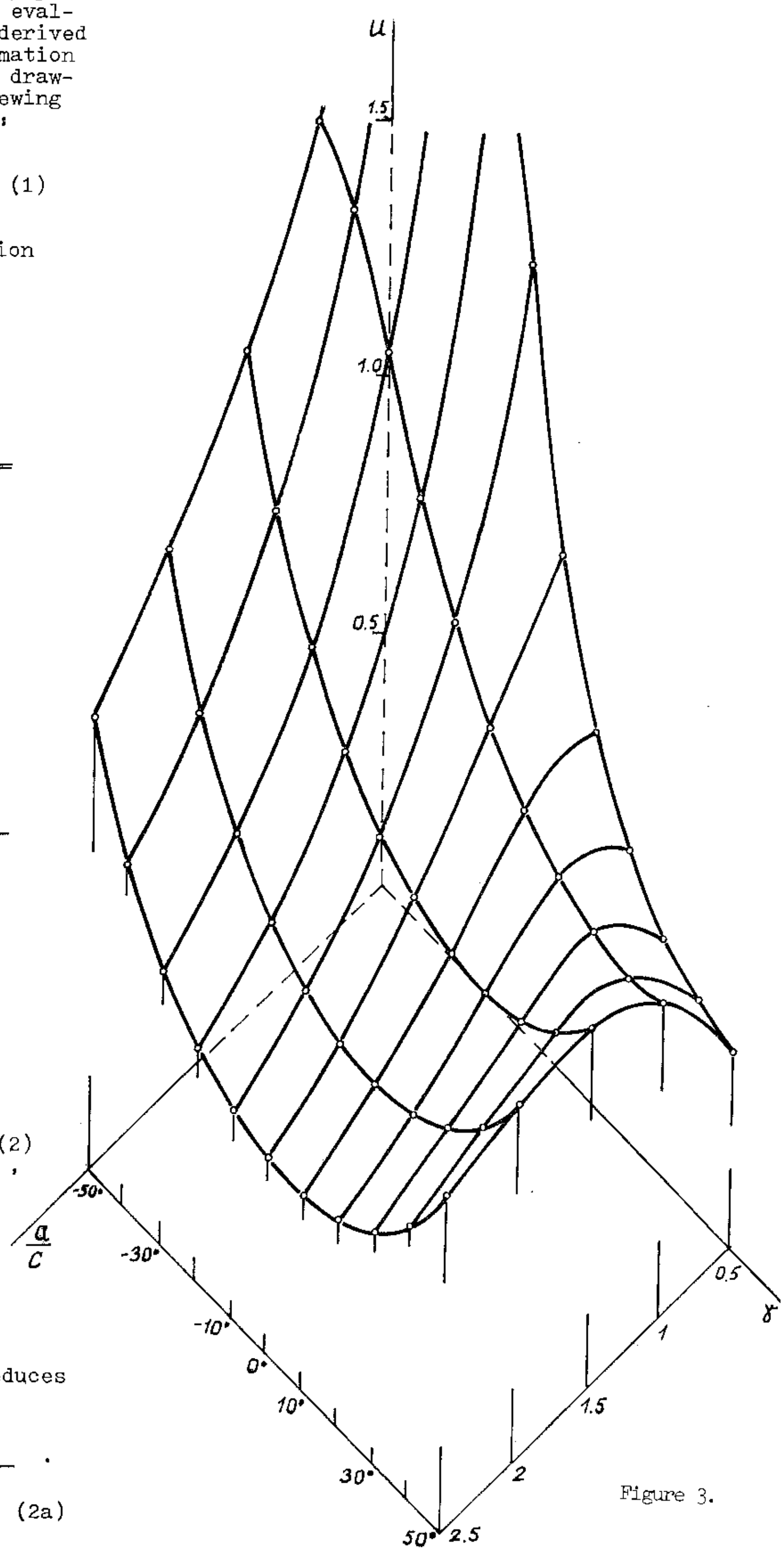


Figure 3.

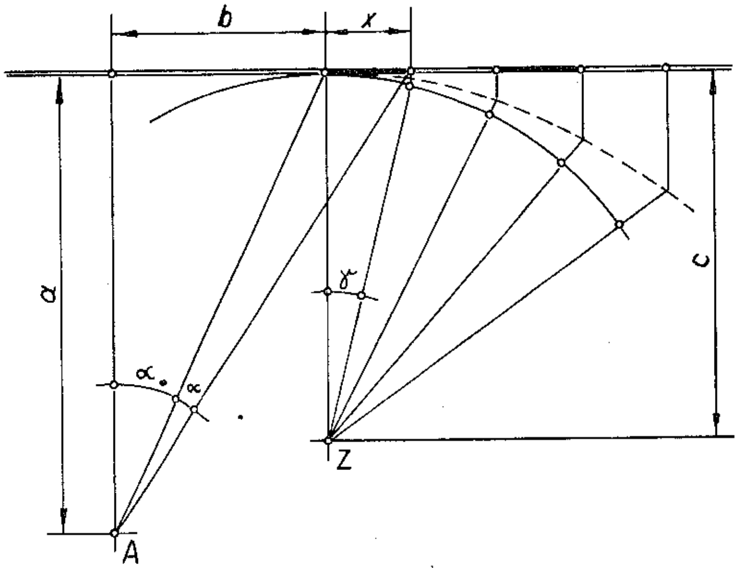


Figure 4.

As a second example, we consider Möhrle's adaptation (8) of Hauck's idea of development of the principal circle with aid of an auxiliary curve. Here (Fig. 4) the rectilinear segment is equal in length to its arc counterpart, i.e. $x=c\gamma$, and as before $x+b = a\tan(\alpha+\alpha_0)$, and we have:

$$u = \frac{\frac{c}{a}}{1 + (\frac{c}{a}\cdot\gamma + \frac{b}{a})^2} \quad (3)$$

Fig. 3 and 5 show, for the above two cases respectively, so-called "distortion surfaces" - triaxial diagrams of u as functions of γ and c/a. These surfaces are obtainable for any value of b, with the aid of a computer. With the desired interval set for u, they can be used in finding the domains of optimal, satisfactory and unacceptable perception.

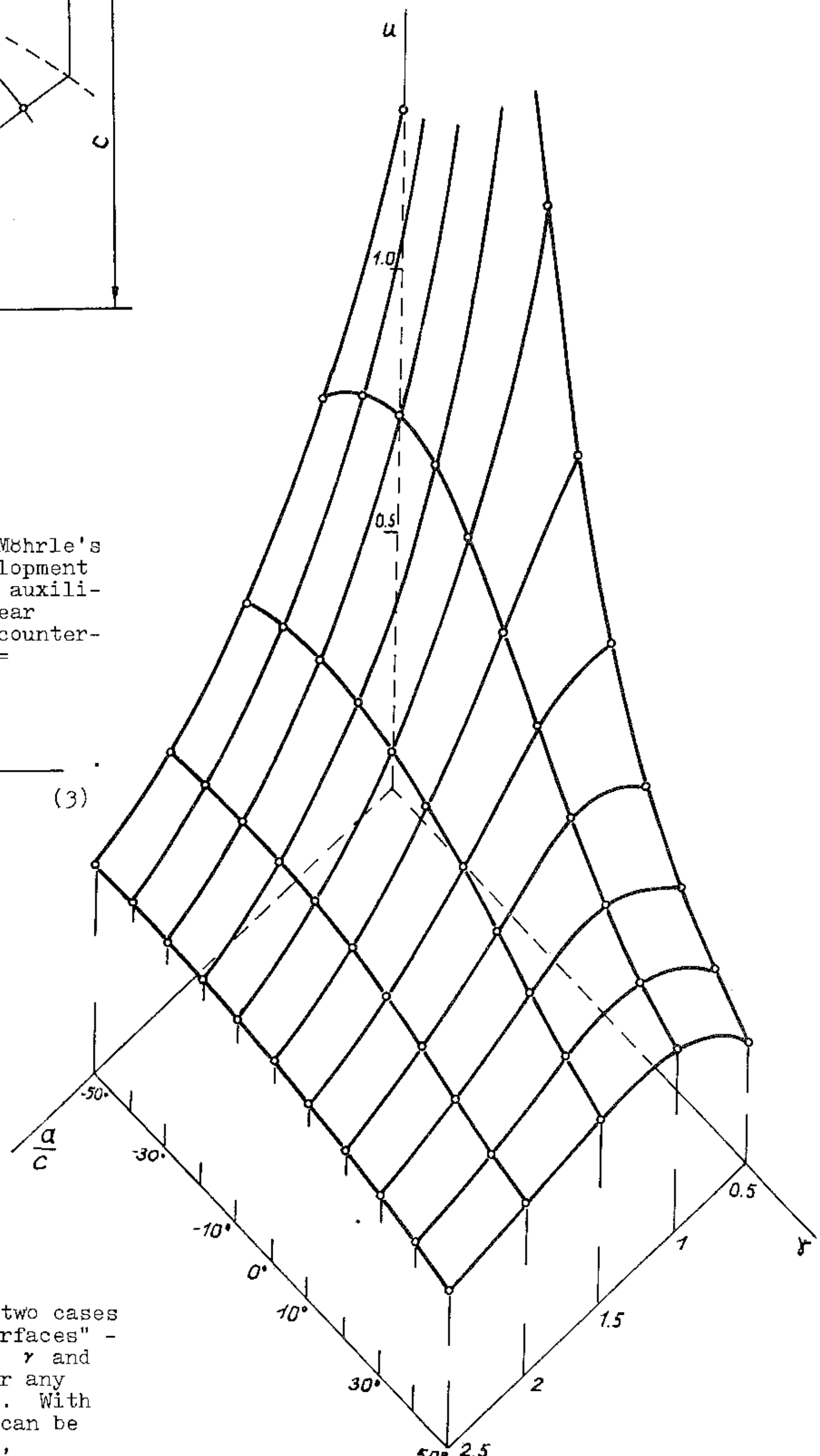


Figure 5.

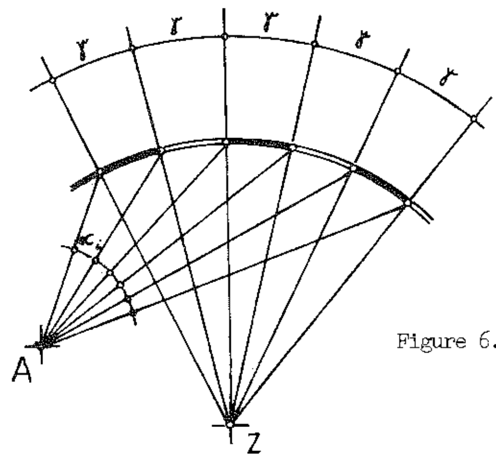


Figure 6.

The above analysis is of practical use, for example, to movie theater designers, in that it provides a reliable criterion for seat rating. Fig. 6 shows the scheme of a cylindrical screen with the projector at Z and the viewer in set A. According to Fig. 7:

$$x = c \sin \gamma$$

$$x + b = (a - e) \cdot \tan(\alpha + \alpha_0)$$

$$e = c(1 - \cos \gamma)$$

$$u = \frac{d\alpha}{d\gamma} = \frac{m \cdot \cos \gamma + n \cdot \sin \gamma}{m^2 + n^2} \qquad (4)$$

where

$$m = \frac{a}{c} - 1 + \cos \gamma$$

$$n = \frac{b}{c} + \sin \gamma$$

The resulting distortion surface (Fig. 8) permits optimization of the hall layout.

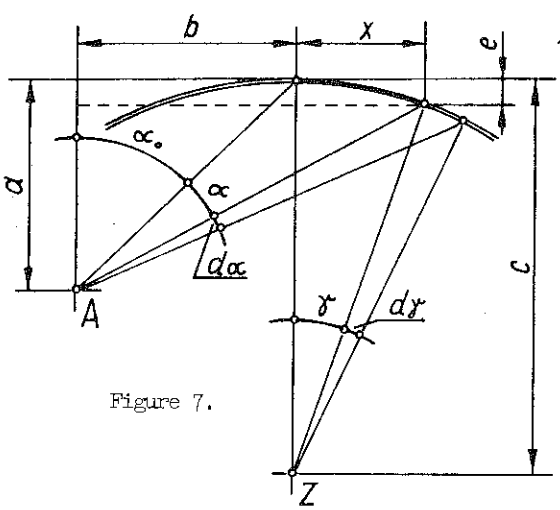


Figure 7.

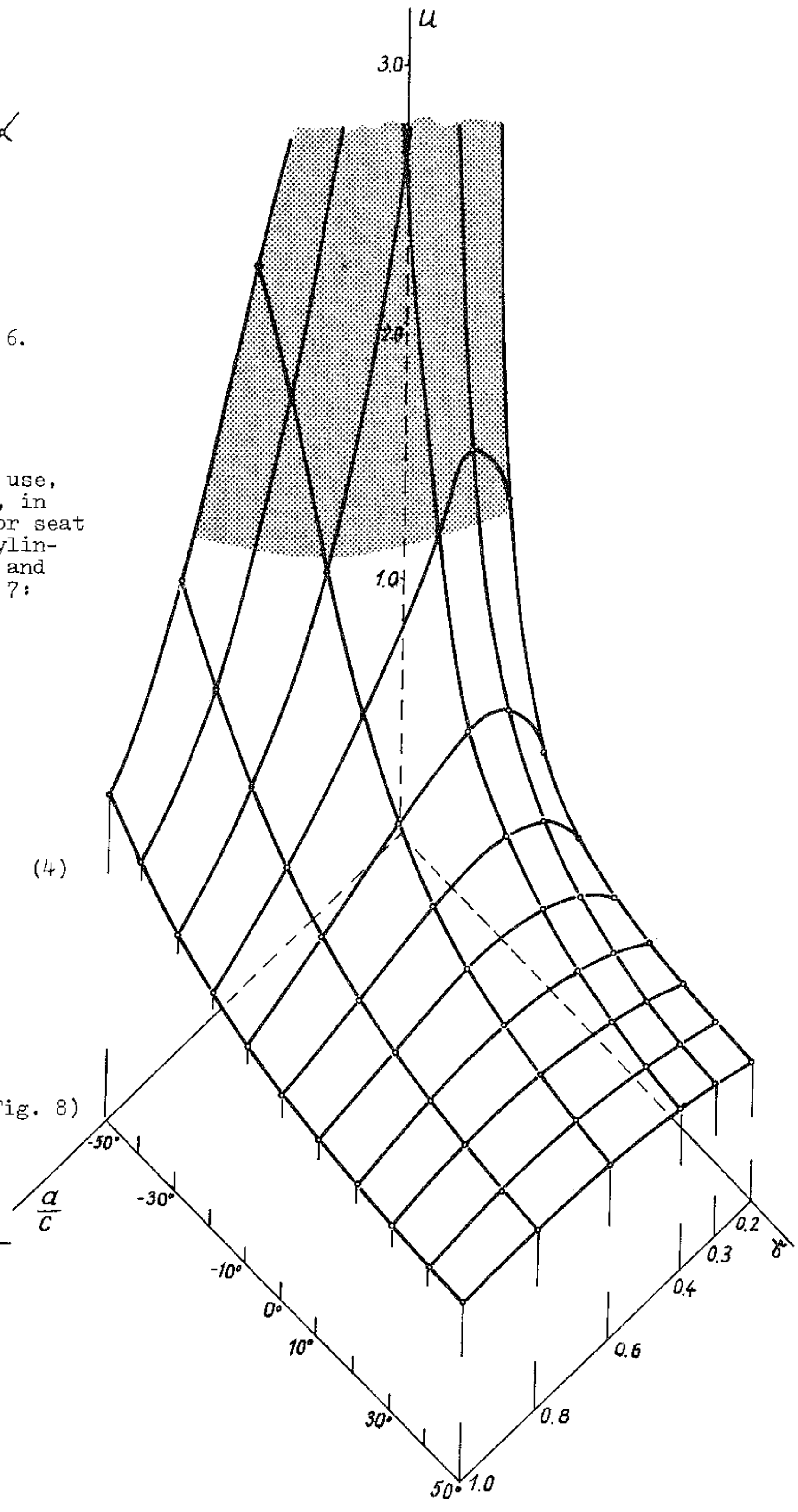


Figure 8.

Bibliography

1. Hauck, G., Die malerische Perspektive, ihre Praxis, BegrUndung and ästhetische Wirkung, Berlin, 1882.

2. Hauck, G., Die subjektive Perspektive und die horizontalen Kurvaturen des dorischen Stils, Stuttgart, 1879.

3. Scholz, W., Anwendung der stereographischen Projektion auf die Perspective, Berlin, 1875.

4. Bartel, K., Perspektywa malarsha, Warszawa, 1958.

5. Kargin, D. I., O razmerakh ugla zreniya pri prakticheskom postroenii perspektivy, Moskva, 1938.

6. Dobryakov, A., Kurs nachertatelnoi geometrii, Moskva, 1949.

7. Hegenwald, H., Das Probleme der Netzhautbildperspektive, Breslau, 1931.

8. Möhrle, H., Das Netzhaut-Perspektivblatt, Stuttgart, 1941.

9. Baryshev, D. G., Perspektiva po printsipu uglovykh opredelenii, Leningrad, 1951.

10. Charit, Y., Ob iskazheniyakh v shirokougolnoi perspektive, Gomel, 1958.

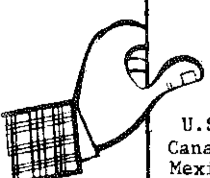
11. Klimukhin, A. G., Nachertatelnaya geometriya, Moskva, 1973.

12. Koroev, J. & Fedorov, M., Architektura i osobennosti zritelnogo vospriyatiya, Moskva, 1954.

Copyright © Y. Charit 1978

ENGINEERING DESIGN GRAPHICS JOURNAL

MEMO *START (RENEW) MY SUBSCRIPTION NOW*



Name ____________________

Mailing Address ____________________

City and State ____________________

Zip Code ____________

Yearly subscription rates:

		1 yr.	2 yr.	5 yr.
U.S. Canada Mexico	ASEE members	$ 3.00	$ 5.00	$10.00
	Non-members	5.00	10.00	25.00
	Foreign	10.00	20.00	---

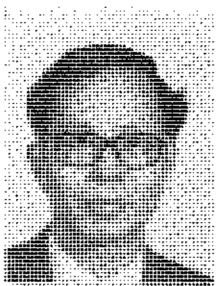
Amount Enclosed $__________

MAIL TO

Engineering Design Graphics Journal
G. K. Hilliard, Circulation Manager
510 POE HALL
NORTH CAROLINA STATE UNIVERSITY
RALEIGH, N. C. 27607

Please make your check payable to: Engineering Design Graphics Journal

A NEW APPROACH TO SOLVING ELLIPSE GUIDE ANGLES IN AXONOMETRIC PROJECTION



Ming H. Land
Industrial Education Dept.
Miami University
Oxford, Ohio

Ed. Note: This is the second in a series of articles by Dr. Land on the descriptive and analytical geometry of graphic principles. The third and fourth articles will be published in succeeding issues of the <u>Journal</u>.

To produce an axonometric projection, it is necessary to place the object so that its principal edges make certain angles with the plane of projection. In Figure 1(a) is shown a multiview drawing of a cube. At (b), the cube is shown revolved a certain angle about an imaginary vertical axis, and then tilted forward about an imaginary horizontal axis. The front view thus obtained is a true axonometric projection. Since the principal edges of the cube are inclined to the plane of projection, the lengths of the axonometric axes are foreshortened. Let the three foreshortened scales be d, e, and f respectively, for the depth, width, and height axes, and their respective angles with the plane of projection θ , ϕ , and ω . Then the degree of foreshortening of any axis depends on the <u>cosine</u> of its angle with the plane of projection; the greater the angle the greater the foreshortening. This relationship can be expressed in the following mathematical forms:

$$d = \cos\theta$$

$$e = \cos\phi \qquad \ldots\ldots\ (1)$$

$$f = \cos\omega$$

Since the angle between each principal edge and the plane of projection is equal to the angle between the edge view of its opposite plane and the line of sight, these equations can be utilized to determine the latter angle, which is the angle used for ellipse guide in axonometric projection. In other words, if we know the foreshortened scales d, e, and f of an axonometric projection, then the ellipse guide angles are θ , ϕ , and ω , for the front, right side, and top planes, respectively.

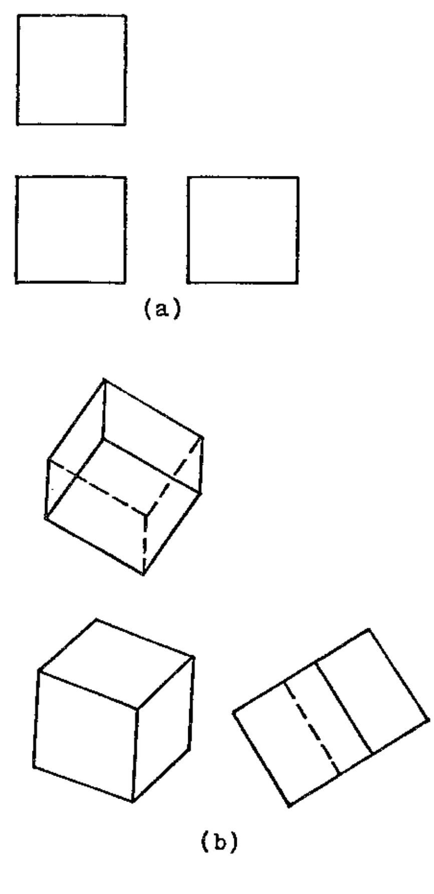


FIGURE 1

Development of the Equations

By the Method of Descriptive Geometry

The conventional method of finding ellipse guide angles for axonometric projection requires the construction of auxiliary views in which the principal planes appear as edge views as shown in Figure 2 (Earl, 1977, p. 550). The ellipse guide angle for each principal plane is the angle between the edge view and the line of sight. In Figure 2, it can be proved from plane geometry that $\angle F_1' O_1 F_1 = \angle O_1 D_1 G_1 = \omega$ in the right side view.

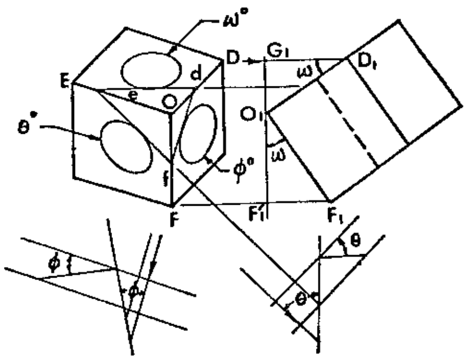


FIGURE 2

Since $O_1 F_1' = O_1 F_1 \cdot \cos \angle F_1' O_1 F_1$ then $O_1 F_1' = O_1 F_1 \cdot \cos \omega$ is obtained. Since $OF = O_1 F_1'$, we obtain $OF = O_1 F_1 \cdot \cos \omega$. Assuming that $O_1 F_1$ (true length line) is equal to 1 in scale, we obtain the foreshortened scale for OF as follows:

$$f = \cos \omega .$$

Similarly, we can obtain $d = \cos \theta$, and $e = \cos \phi$. From these equations, we obtain ellipse guide angles for axonometric projection as follows:

$$\theta = \cos^{-1} d \quad \text{(for frontal plane)}$$

$$\phi = \cos^{-1} e \quad \text{(for profile plane)}$$

$$\omega = \cos^{-1} f \quad \text{(for horizontal plane)}$$

By Odaka's (1978) Equations

Let's assume a given dimetric projection of a cube as shown in Figure 3 where $\beta = \gamma$.

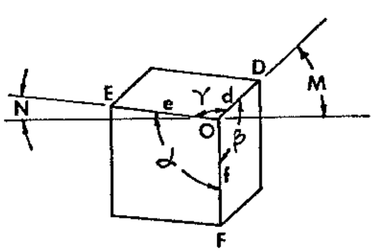


FIGURE 3

The angles that the three axes OD, OE, and OF make with the plane of projection are θ, ϕ, and ω, respectively. The following Odaka's (1978) equations are found:

$$\cos^2 \theta = \frac{\cos \alpha}{\cos \alpha - \cos \beta \ \cos \gamma}$$

$$\cos^2 \phi = \frac{\cos \beta}{\cos \beta - \cos \alpha \ \cos \gamma}$$

$$\cos^2 \omega = \frac{\cos \gamma}{\cos \gamma - \cos \alpha \ \cos \beta}$$

Since $\beta = \gamma$, $\cos \beta = \cos \gamma$,

$$\cos^2 \theta = \frac{\cos \alpha}{\cos \alpha - \cos^2 \beta}$$

$$= \frac{\cos \alpha}{\cos \alpha - \left(\cos \frac{360^\circ - \alpha}{2}\right)^2}$$

$$= \frac{\cos \alpha}{\cos \alpha - \left(-\cos \frac{\alpha}{2}\right)^2}$$

$$= \frac{\cos \alpha}{\cos \alpha - \left(\frac{1 + \cos \alpha}{2}\right)^2}$$

$$= \frac{2 \cos \alpha}{\cos \alpha - 1}$$

$$= \frac{2 \cos (90^\circ + N)}{\cos (90^\circ + N) - 1}$$

$$= \frac{-2 \sin N}{-\sin N - 1} = \frac{2 \sin N}{\sin N + 1}$$

Substitute sin N with Niayesh's (1977, p. 27) equation IX,

$$\sin N = \frac{(1 - e^2)(1 - f^2)}{e f} \quad \text{and} \quad e = f,$$

$$\frac{2 \sin N}{\sin N + 1} = \frac{\frac{2(1 - e^2)}{e^2}}{\frac{(1 - e^2)}{e^2} + 1} = \frac{2 - 2e^2}{1}$$

$$= 2 - 2e^2$$

From Niayesh's equation VII,

$$d^2 + e^2 + f^2 = 2,$$

$$2 - 2e^2 = d^2 + e^2 + f^2 - 2e^2$$

$$= d^2 + e^2 + e^2 - 2e^2$$

$$= d^2$$

Similarly,

$$\cos^2\phi = \frac{\cos\beta}{\cos\beta - \cos\alpha\cos\gamma}$$

$$= \frac{\cos\beta}{\cos\beta - \cos\alpha\cos\beta}$$

$$= \frac{1}{1 - \cos\alpha}$$

$$= \frac{1}{1 - \cos(90^\circ + N)}$$

$$= \frac{1}{1 + \sin N}$$

$$= \frac{1}{1 + \frac{1 - e^2}{e^2}} = e^2$$

Similarly, $\cos^2\omega = f^2$

Thus,

$$d^2 = \cos^2\theta$$
$$e^2 = \cos^2\phi \qquad (2)$$
$$f^2 = \cos^2\omega$$

Since $\theta < 90^\circ$, $\phi < 90^\circ$, $\omega < 90^\circ$, we obtain equations (1) as follows:

$$d = \cos\theta$$

$$e = \cos\phi$$

$$f = \cos\omega$$

Cross-Validating Niayesh's and Odaka's Equations

From Niayesh's equation VII, we have $d^2 + e^2 + f^2 = 2$. Since $d^2 = \cos^2\theta$, $e^2 = \cos^2\phi$, and $f^2 = \cos^2\omega$, we obtain

$$\cos^2\theta + \cos^2\phi + \cos^2\omega = 2$$

which is an Odaka's (1978) equation.

Practical Applications

Equations (1) can easily be applied to determining ellipse guide angles in axonometric projection once the foreshortened scales are known. Together with Niayesh's equations VII, VIII, and IX, all scales and angles data can easily be obtained.

Isometric Projection

In isometric projection of a cube where $d : e : f = 1 : 1 : 1$, and from Niayesh's equation VII, we obtain

$$d^2 + e^2 + f^2 = 2,$$

$$3d^2 = 2,$$

$$d^2 = \frac{2}{3},$$

$$d = \sqrt{\frac{2}{3}} = 0.8165.$$ (In practice it is taken $d = e = f = 1$)

From equation (1), $d = \cos\theta = 0.8165$, we have $\theta = 35^\circ 16'$, $\phi = 35^\circ 16'$, $\omega = 35^\circ 16'$. (Isometric)

Also from Niayesh's equation VIII and IX,

$$\sin M = \frac{\sqrt{(1 - d^2)(1 - f^2)}}{df}.$$

$$\sin N = \frac{\sqrt{(1 - e^2)(1 - f^2)}}{ef}.$$

we have $\sin M = \sin N = \dfrac{\sqrt{(1 - \frac{2}{3})^2}}{\frac{2}{3}} = \dfrac{1}{2}$

thus, $M = N = 30^\circ$. (See Figure 4)

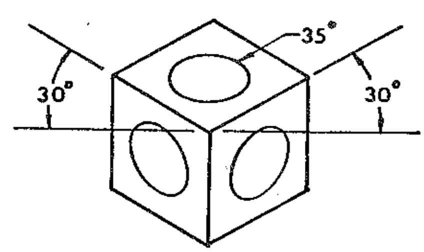


FIGURE 4

Dimetric Projection

In a dimetric projection where d : e : f = : 1 : 1 as an example, we obtain

$$d^2 + e^2 + f^2 = 2,$$

$$\frac{9}{16} e^2 + e^2 + e^2 = 2,$$

$$41 e^2 = 32,$$

$$e = \frac{32}{41},$$

$$e = 0.8835.$$

$$f = 0.8835$$

$$d = 0.8835 \times \frac{3}{4} = 0.6626.$$

(In practice the dimetric drawing is made $d = \frac{3}{4}$, $e = f = 1$)

From equations (1), we obtain

$$d = \cos\theta = 0.6626, \quad \theta = 48^\circ 30'.$$

(Use 50° ellipse in practice)

$$e = \cos\phi = 0.8835, \quad \phi = 27^\circ 56'.$$

(Use 30° ellipse in practice)

$$f = \cos\omega = 0.8835, \quad \omega = 27^\circ 56'.$$

(Use 30° ellipse in practice)

Also from Niayesh's equations VIII and IX, we obtain

$$M = 36^\circ 50'.$$

$$N = 16^\circ 20'.$$ (See Figure 5)

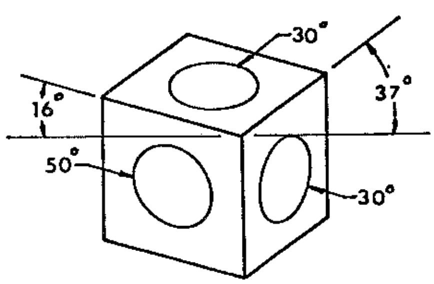


FIGURE 5

Trimetric Projection

In a trimetric projection where d : e : f = .6 : .9 : 1 as an example, we obtain

$$d = 0.5760, \quad \theta = 54^\circ 50'.$$

(Use 55° ellipse in practice)

$$e = 0.8640, \quad \phi = 30^\circ 14'.$$

(Use 30° ellipse in practice)

$$f = 0.9600, \quad \omega = 16^\circ 16'.$$

(use 15° ellipse in practice)

Also from Niayesh's equations VIII and IX, we obtain

$$M = 24^\circ 17'.$$

$$N = 9^\circ 47'.$$

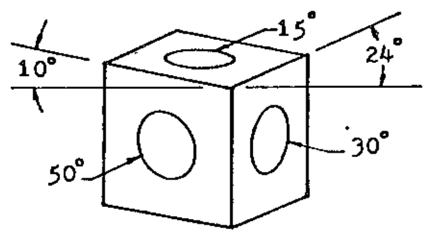


Figure 6

Foreshortening Scales and Ellipses

We have already observed that an axonometric projection and an axonometric drawing in practice differ in size. In the isometric drawing a unit cube is drawn with unit lengths drawn along the three isometric axes with scale ratios of 1:1:1, which are called the relative ratios; while in an isometric projection the edges of the cube are drawn with foreshortening scale ratios of $\sqrt{2/3}$: $\sqrt{2/3}$: $\sqrt{2/3}$, which are called the absolute ratios. Therefore, the isometric drawing is an enlarged picture of an actual isometric projection, and the enlargement factor, E, in the isometric drawing is a constant and equal to $\sqrt{3/2}$ or 1.2247. Accordingly, when we draw any circular features in an isometric projection, the isometric ellipse template whose ellipses have been enlarged 1.2247 times are used. If we use the 35° -ellipse template whose ellipses are no enlarged, we have to choose ellipses with diameters $1\frac{1}{4}$ times larger than the actual diameters.

In the case of a dimetric drawing with the relative ratios of 3/4 : 1 : 1 and a dimetric projection with the absolute ratios of 0.6626:0.8835 : 0.8835, the enlargement factor would be 1/0.8835 or 1.1319. As another example, a diametric drawing has ralative ratios of $\frac{1}{2}$:1 :1, and the same dimetric projection has absolute ratios of

0.4714 : 0.9428 : 0.9428, the enlargement factor would be 1/0.9428 or 1.0607. In the case of a trimetric drawing with the ralative ratios of 0.6:0.9:1, the absolute ratios are 0.576:0.864:0.960, and the enlargement factor would be 1.0417. Thus it can be seen that except in the isometric drawing where the enlargement factor is 1.2247, the enlargement factors, E, for dimetric and trimetric drawings vary and are equal to

$$E = \frac{\text{Relative Ratio (any axis)}}{\text{Absolute Ratio (corresponding axis)}}$$

Since it is not feasible to have all the exact size angle-ellipses, approximate size angle-ellipses are generally employed for dimetric and trimetric drawings.

In a previous Engineering Design Graphics Journal article by the author (Land, 1979), it was stated that an enlargement factor of $1\frac{1}{4}$ should be used for drawing ellipses in all axonometric drawings. Obviously this statement should be applied to the isometric drawing only. For each dimetric or trimetric drawing a different enlargement factor should be determined by the formula given above.

It should also be noted that the three absolute ratios d, e, and f for an axonometric projection are not independent, but are determined by the angles of ratation and tilt. Since $d^2 + e^2 + f^2 = 2$, the numbers, d, e, and f, are always less than 1. Accordingly, the three ralative ratios for an axonometric drawing are not wholly unbounded in range. However, we may choose two of the three ralative ratios, the third ratios is then determined by the two given ratios. Assume that the two ralative ratios X and Y are given, then the third ratio Z must fall within the following range (Rule & Coons, 1961):

$$\sqrt{X^2 + Y^2} > Z > \sqrt{X^2 - Y^2}$$

$$\text{where } X > Y$$

For example, let us consider the ralative ratios 1, 0.75 and Z for a trimetric drawing. Then Z lies between the range:

$$\sqrt{1^2 + 0.75^2} > Z > \sqrt{1^2 - 0.75^2}$$

$$\text{or } 1.25 > Z > .6614$$

Thus if we choose Z to be .5, which is smaller than .6614, and, therefore, it should not be used.

Let's consider another example of a dimetric drawing with relative ratios of 1 : 1 : Z. Z will range between:

$$\sqrt{1^2 + 1^2} > Z > \sqrt{1^2 - 1^2}$$

$$\text{or } \sqrt{2} > Z > 0$$

Thus, we can have dimetric drawings with various different ralative ratios such as 1 : 1 : 3/8, 1 : 1 : 1/2, 1 : 1 : 3/4, and 1 : 1 : $1\frac{1}{4}$, but not 1 : 1 : $1\frac{1}{2}$.

In sum, the Equations (1) described in this paper, together with Niayesh's equations, can be used to determine angles for axonometric axes and ellipse guides for any combinations of foreshortened scales in axonometric drawing. With these equations, the engineer and illustrator has a much more flexible selection of proper viewing angle for each object than with other conventional approaches in producing axonometric illustrations.

Copyright © Ming H. Land 1979

References

Earl, James H. Engineering Design Graphics. Reading, Mass.: Addison-Wesley, 1977.

Land, Ming H. Applications of Odaka's Equations of Perspective Projection to the Determination of Scales and Ellipse Guides in Axonometric Drawing. Engineering Design Graphics Journal, Spring, 1979.

Niayesh, H. Critical Review of Pictorial Drawing in U.S. Graphical Literature. Engineering Design Graphics Journal, Winter, 1977.

Odaka, Shiro. Fundamental Equations of Perspective Projection and its Applications. Paper presented at the International Conference on Descriptive Geometry, Vancouver, Canada, June, 1978.

Rule, John T. & Coons, Steven A. Graphics. New York: McGraw-Hill, 1961.

PICTORIAL PARALLELISM

Eugene G. Paré
Washington State University

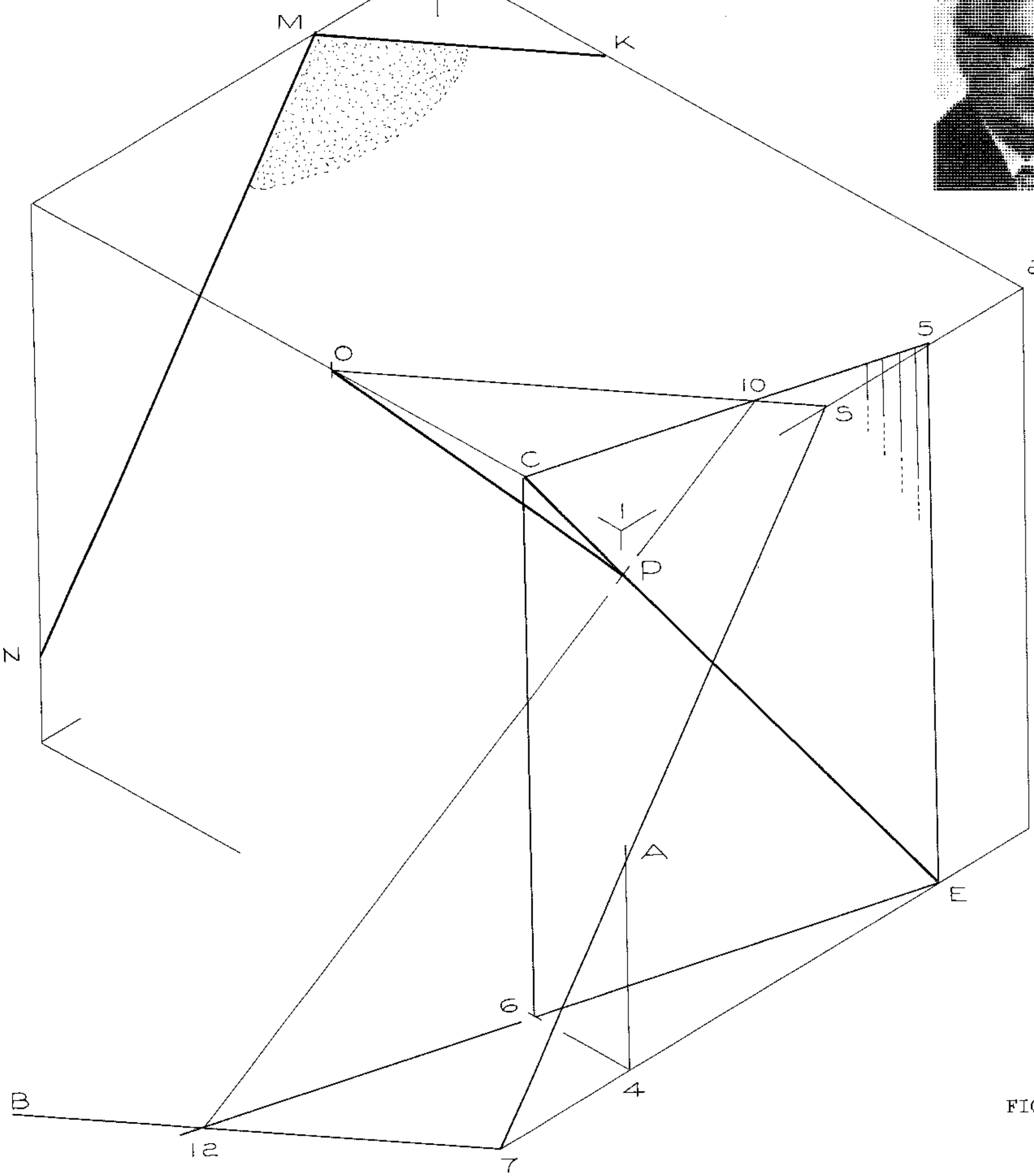


FIGURE 1

Over the past several years, my students and I at Washington State University have had a great time developing and testing a variety of descriptive geometry projects in pictorial rather than the traditional orthographic format. Previously we have considered intersection and shadow problems in Isometric, Oblique, and Perspective pictorials. Just this past year, pictorial material has been expanded to include pictorial parallelism, two examples of which will be included in this presentation.

For the first project, Figure 1, let us assume the following specifications: In the isometric pictorial, locate a line through point O that is parallel to plane MNK and that intersects line CE. First, a plane parallel to MNK through point O is needed. This new plane will contain all lines parallel to plane MNK. Then the

Copyright © 1979 Eugene G. Paré

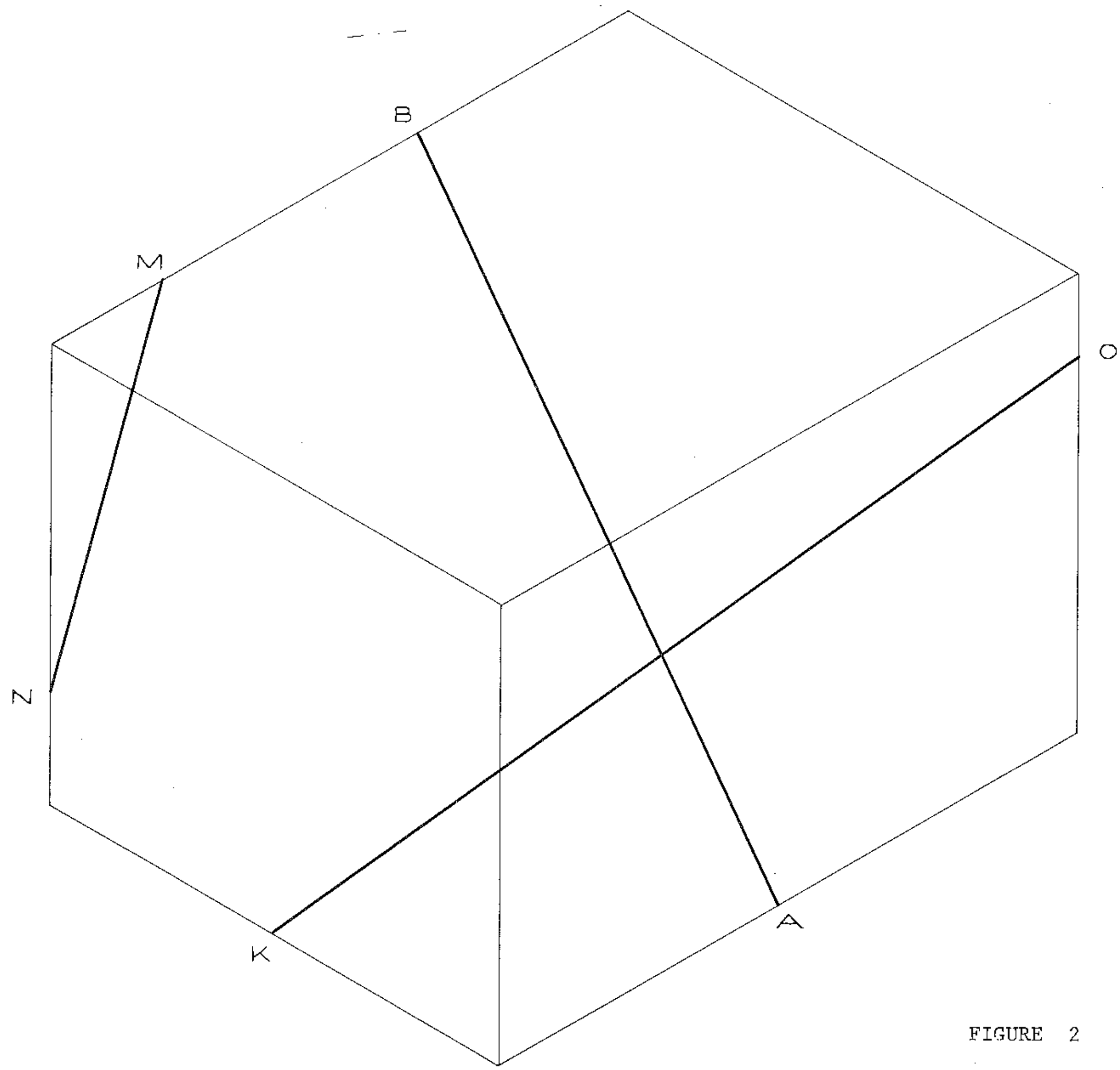


FIGURE 2

intersection of CE with the parallel plane is required. A line through this intersection of CE with the parallel plane is required. A line through this intersection point and point O completes the solution. For the isometric solution, the following procedure may be employed. A plane through O parallel to MNK requires the following construction. In the top horizontal surface of the pictorial, a line OS is drawn parallel to MK which also exists in this same top surface. In the isometric plane 1, 2, 3, 4, a line SA is provided parallel to MN which lies in an isometric plane parallel to plane 1, 2, 3, 4. For subsequent use, line SA is lengthened to point 7 on base line 3, 4 extended. Then line 7B is added parallel to OS providing an enlarged plane OS7B parallel to MNK.

The cutting plane method is next used to secure the intersection of CE with plane OS7B. This cutting plane which must contain line CE could take several directions; but in this example, the cutting plane C5E6 is used. This cutting plane not only contains line CE but conveniently consists of horizontal lines C5 and E6 and vertical lines 5E and C6.

Now, the line of intersection of the cutting plane and plane OS7B is needed. Since lines OS and C5 both lie in the same top surface of the pictorial, they intersect at point 10. In the lower horizontal surface of the pictorial, lines 7B and E6 extended intersect at point 12. Line 10-12 is now the line of intersection of the cutting plane and plane OS7B. The intersection of CE and 10-12 establishes the piercing point P of CE with plane OS7B. Line PO is the required line parallel to plane MNK and intersecting line CE.

For your entertainment, the following project, Figure 2, is presented without solution, although I trust your JOURNAL editor would welcome solutions for a subsequent JOURNAL issue. Project specifications: Show a line parallel to line MN and intersecting skew lines OK and AB.

ANGLE BETWEEN A LINE AND A PLANE-

A SIMPLIFIED APPROACH

Cynthia M. Stewart
Undergraduate Engineering Student

Jerald M. Henderson
Professor of Mechanical Engineering
University of California, Davis

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/or engineering graphics. A typical problem is shown in Figure 1. End B moves in a plane parallel to projection plane 1. While the line sweeps out a conical surface the angle with projection plane 1 is maintained.

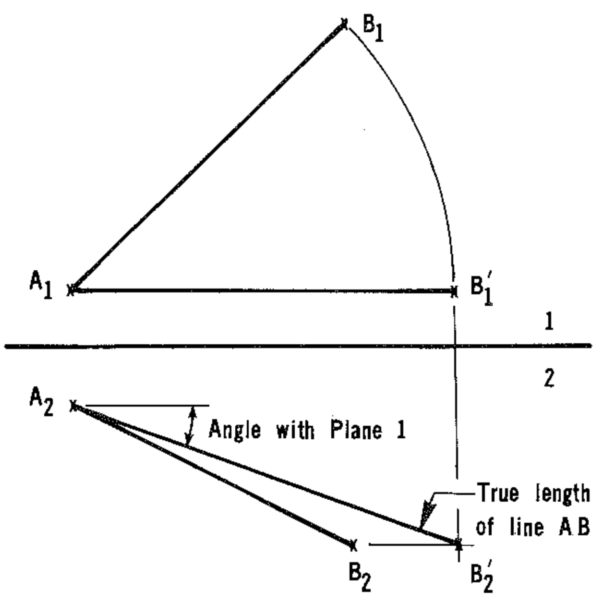


Figure 1 – Typical Rotation Problem

If the 1 and 2 views of line AB were given and one wished to find the angles line AB makes with each of the six projection planes shown in Figure 2 the use of the rotation method would suggest first obtaining the 3, 4, 5, and 6 views of line AB. The rotation method requires the rotation of the line in the view corresponding to the plane with which the angle of interest is to be measured.

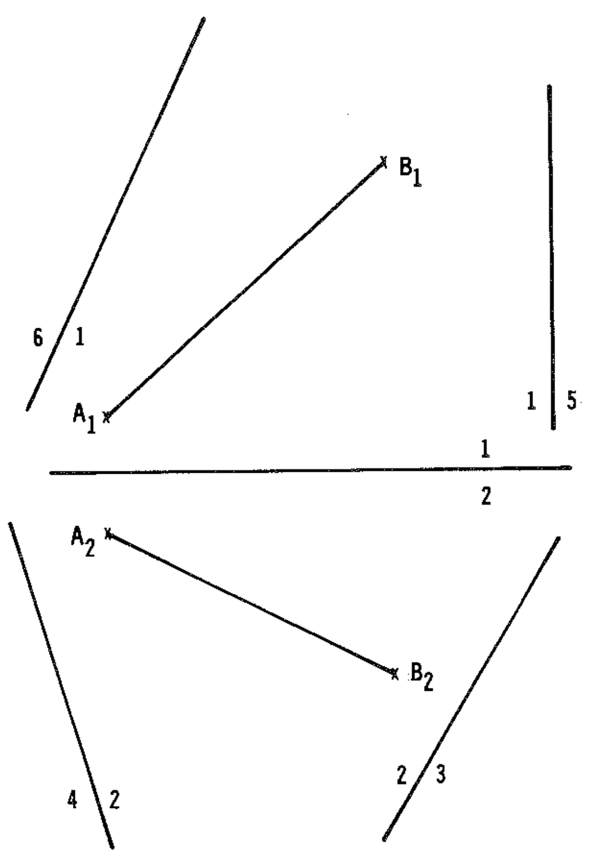


Figure 2 – Two Views of Line AB and Six Projection Planes

But note that once the true length of the line is known the angles with the various projection planes in Figure 2 can be obtained by simply using the true length of the line and the fact that when the line is rotated the point (end) being moved takes a path parallel to the plane of interest. For example, in Figure 3 the angle θ_4 between line AB and projection plane 4 is obtained by finding the intersection of a line through B parallel to the intersection of planes 2 and 4 (the 2/4 fold line) and the arc centered at A with a radius equal to the true length of the line. All six angles line AB makes with the projection planes in Figure 2 are shown in Figure 3 using this simplified approach.

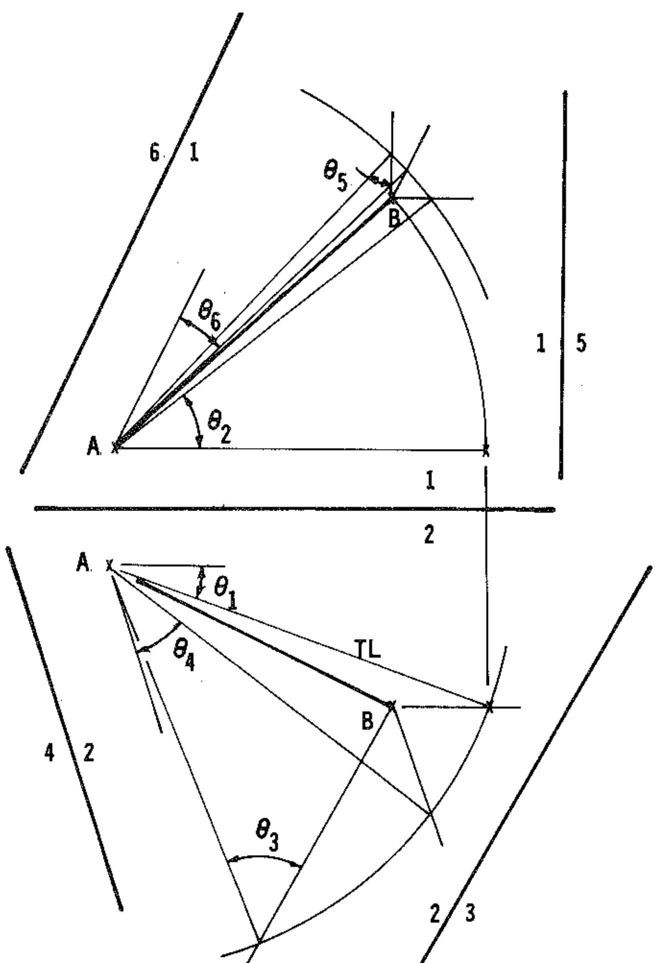


Figure 3 – The Method

This technique also simplifies finding the angle between a line and a plane that is not a projection plane. Consider the 1 and 2 views of plane ABC and line m shown in Figure 4.

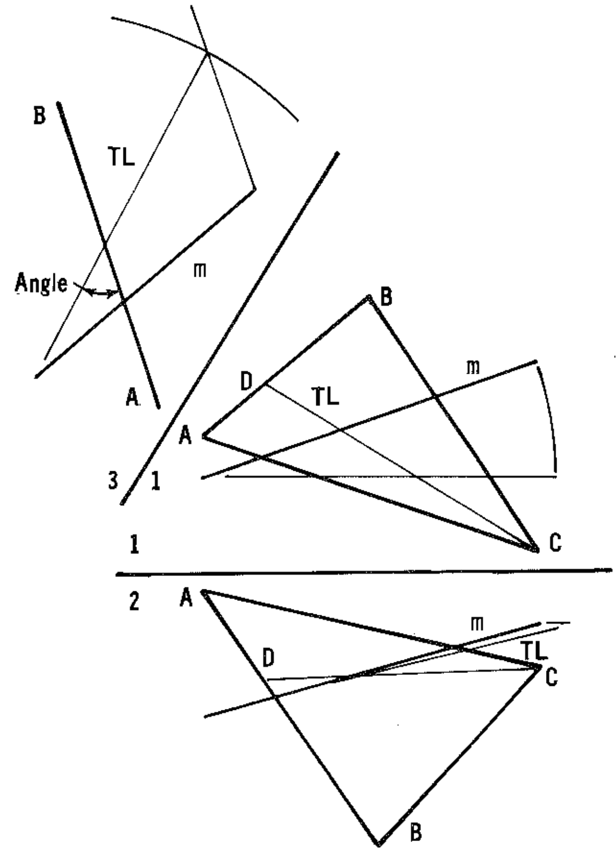
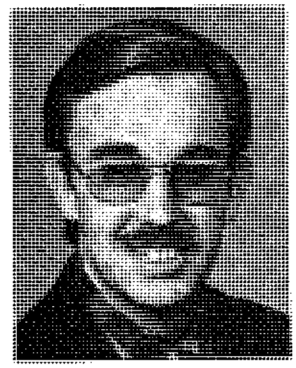


Figure 4 – Angle Between Line and Plane

In these original two views line CD in the plane is introduced so it shows in true length in view 1 and the true length of line m is determined using rotation. Then by taking a point view of line CD projection 3 gives an edge view of plane ABC. Now the rotated position of line m can be determined by the intersection of a line through one end of line m parallel to plane ABC and the arc having a radius equal to the true length of line m. Thus, the usual second auxiliary view in which the rotation of the line is shown is eliminated.

The study of engineering graphics, in particular descriptive geometry, serves two purposes in an engineering curriculum. The basic principles and techniques are important as analysis and synthesis tools as well as background for related subjects such as mechanical drawing. In addition, descriptive geometry problems serve as excellent mental exercises to help gain spatial visualization skills. We suggest that this alternate method of obtaining the angle between a line and plane be included with future presentations of the "rotation method". This method is both a useful tool and a useful mental exercise.

Copyright © J. M. Henderson and C. M. Stewart 1979



THE PSI APPROACH TO TEACHING ENGINEERING GRAPHICS

Dr. John G. Nee
Central Michigan University

An important objective of engineering graphics education has been the improvement of instruction. This need becomes very apparent as we study professional journals and note the increase in subject matter content without an additional increase in instructional time allotted. Thus, engineering graphics teachers continually search for the effective means to maintain standards and include the new ideas constantly appearing.

Individualized instruction can increase the teacher's personal contact with the students. The self-paced feature of individualized instruction (each student proceeding at his own rate) can at least partly eliminate the problem of the slower and faster learners who cannot adequately be taught by presentations designed for and aimed at the middle of the group.

What is PSI? PSI is an instructional system, an alternative to the usual lecture-demonstration-recitation method of teaching, which permits an instructor to give personal instruction to as many as 100 students at a time. It achieves greater teaching efficiency without increasing the cost of instruction in most cases. Perhaps most imprtant of all, it is a system which makes instruction more humane to the student.

The principal feature of PSI is that each student works independently from carefully written study guides which state specific objectives and suggest a procedure of accomplishing them. These may include reading in conventional textbooks, working problems, using computers, programmed instruction, viewing films, or doing experiments.

The five "distinguishing features" of PSI and their rationales are linked together logically by deriving each from the mastery learning approach:

1. You want everyone to master the material (the unit-perfection requirement - individual students stay with a topic until it is mastered).
2. Therefore, you have to let the slow student take longer than the fast students. This is self-paced.
3. If students are moving at different paces, you cannot use lectures to dispense critical information, since that would set a pace. Lectures and demonstrations are to be used as vehicles of motivation rather than as sources of critical information.
4. If you do not use lectures, you must replace them with something, such as written study guides or other carefully prepared software.
5. With lots of units and a test on each one, you need a corps of in-class peer group tutors. The use of tutors permits repeated testing, immediate scoring and a marked inhancement of the personal-social aspect of the educational process.

The three essential parts of a PSI unit are the objectives, the procedures (both in a study guide) and the test. PSI, just as with any effective teaching method, requires that the objectives, the procedure and the test must be consistent and the procedures must be adequate to accomplish the objectives.

The objectives state precisely what the student is able to do upon completion of the unit while the procedures tell specifically what to do to accomplish the objectives.

The following explanation of how PSI works at Central Michigan University might be used as an introduction of the method to students in engineering graphics.

Introduction. The method by which this course will be run is not typical of most courses offered at Central Michigan University. It has been used widely at other colleges and universities, and students generally prefer it. We hope you, too, will like the approach.

We have prepared detailed study guides for each of the 12 units of work for the course. These study guides tell you just what you are responsible for and how to go about learning the engineering graphics concepts. You can work on units at home as well as in the drafting classrooms where there will be people to help you if need it.

When you complete one of the 12 units, working at your own speed, you will be asked to prove that you have met the objectives of that unit by taking a short performance examination. The test will take about 30-45 minutes to complete, and you will need your standard drafting instruments to solve the problems. Each question or problem will be directly related to the stated unit objectives, so you should know in advance generally what the questions will be. The tests will be graded immediately by your tutor or the instructor. To pass this test you must get at least 90 percent of the test questions correct! However, if you miss more than 10 percent, it is not a serious matter. You will simply have to try again later (at least 30 minutes later, in fact) on a retest. You have up to three chances to pass, and failures will not count against you except that they waste your time.

The above procedure is used in each of the 12 units of this course. These procedural steps are shown graphically in Figure 1, and can be summarized as:

1. Start your PSI program by obtaining the first unit study guide from the student tutor or from your instructor.
2. Use the unit study guide to follow:
   a. reading assignment;
   b. work problems; and
   c. study questions and check solutions with the tutor.
3. Take the self-test which is provided in the course textbook and is explained in the unit-study guide.
4. At this point you are ready to take the unit mastery test. This test can be obtained from the student tutor or the instructor
5. Have the tutor or instructor check the unit mastery test. If you pass the test, ask the student tutor for the next unit study guide. If you do not pass the test, review those areas not passed by restudying the appropriate unit segments.

Grades. You should be able to get an A in this course. All you have to do is earn 1500 points. You can get points by passing units, by scoring high on the final exam, and by helping tutor other students in the classroom. You can also get a few bonus points by passing units ahead of schedule. Figure 2 shows the minimum pace, and also lists recommended dates by which to pass each unit.

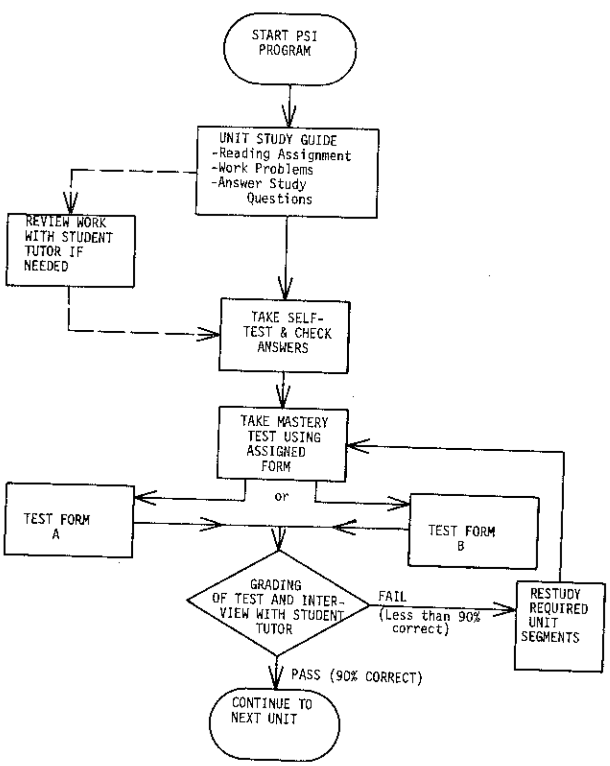


FIGURE 1

PSI UNIT SYSTEM FOR ENGINEERING GRAPHICS

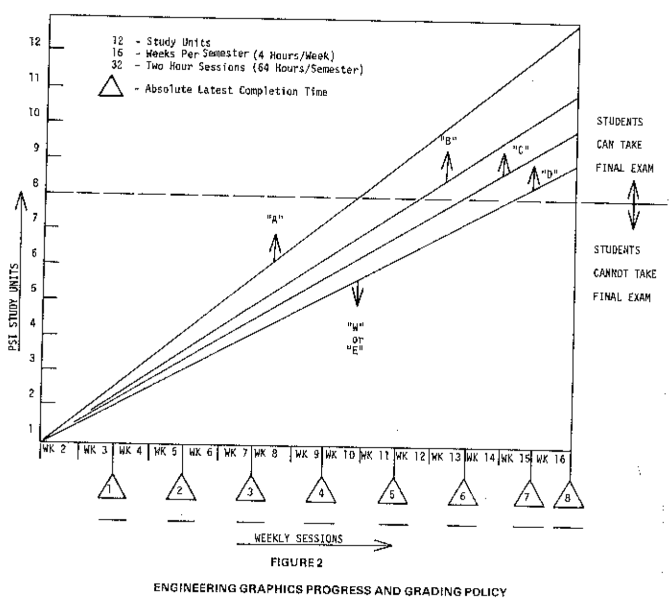


FIGURE 2

ENGINEERING GRAPHICS PROGRESS AND GRADING POLICY

Although you can get an A in this course, you will find that the course is hard work. You will have to establish a regular study routine. In other courses you may be able to get through by cramming just before exams; that will not work here. You should plan on using all class time for work and should schedule an additional study time at home several times a week.

The details of your grade calculation are as follows:

Each unit counts 100 points so 12 x 100 equals (plus 5 bonus points per unit ahead of schedule and 10 bonus points per unit if tutoring)	1200 pts.
Special handout problem counts	300 pts.
Final Exam (up to 300 points or fraction according to score)	300 pts.
Total points (without bonus or tutoring points)	1800 pts.

1500 points or more = A
1300 points or more = B
1200 points or more = C
1100 points or more = D
Less than 1100 = E

Progress chart. During the course your tutors and the instructor will be using the progress chart illustrated in Figure 3. You are encouraged to keep track of your unit test points, tutoring points, and points for being ahead of schedule. As a result, you should be able to calculate your own final grade.

Results. Those who have tried PSI and have published data find an inverted normal distribution of grades: more A's than C's. Such comparisons are debatable and usually do not convince skeptics anyway.

The final grade distribution for an entering class numbering 34 students showed the frequency of A's and B's quite high, but well in line with the goals of PSI. There were no failures or D's and only one C. This certainly does not represent a typical grade distribution for an engineering graphics class.

The frequency of W's (withdrawals) and I's (incompletes) were high. Some PSI experimenters advocate ignoring them, on the grounds that surely these students know in advance what is expected of them. If they choose not to work, that is their privilege. Certainly if someone has been prodded to work all his life, it may take some time to learn to work without the prod. If we prod the student some more, he will never have a chance to learn self-motivation.

This policy is very hard on the instructor. He wants his group to do well. This puts a pressure on him to get in touch with slow students and to push them on. Perhaps additional short-term rewards, a clearly announced policy that I's are hard to get, and increased guidance in setting paces (calendars), could result in avoiding large scale procrastination.

Of the students receiving W's, all withdrew before the sixth unit and five students withdrew upon completing just the first unit.

The majority of students receiving I's were committed to completing the course, but they needed more time. Why not give it to them? One student had completed 11 units and insisted on completing unit 12 to finish the course.

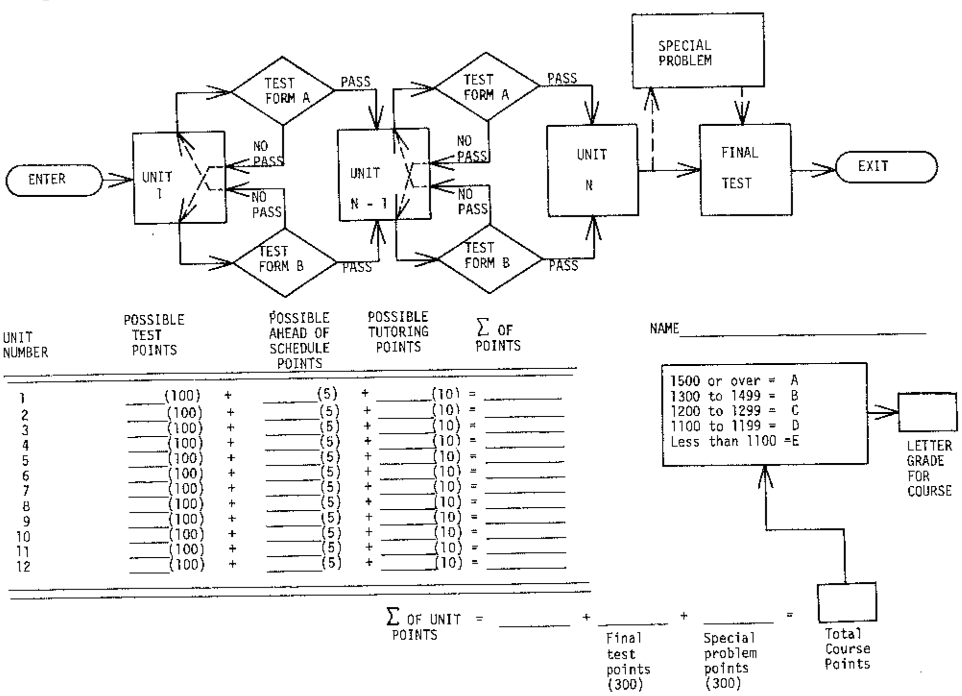


FIGURE 3

PSI PROGRESS AND GRADING WORKSHEET

The rest of the students with incompletes had completed between three and eight of the total 12 uints.

The number of alternate unit tests retaken because of test failure was high. The high frequency of failures upon taking the first test for unit one would seem to show problems in adjusting to the PSI approach and also the difficulties of first term freshman. The frequency of failures for the remaining units remains very low except for unit four (introduction to planes). This signaled to the instructor a lack in terms of materials provided the students. The unit four materials were simply not adequate to get the job done. Revision of this unit material is in order.

The fore mentioned data permits experimentation in future courses. The instructor now has a much better understanding of where and when the course material and other related independent variables are not what they should be in terms of meeting course objectives. The emphasis of the PSI approach is obviously away from norm referenced grading and toward criterion referenced grading.

The PSI approach is not perfect. It accepts a dogma presently under attack in education: The teacher should select for the student what the student is to learn once he is enrolled in the course. PSI denies that having the student bathe in the aura of the charismatic instructor is the most effective and efficient process of learning. If the course centers on the personality of an instructor, the PSI approach is not a viable alternative. But if there are specific things to be learned in engineering education, the PSI approach should do the job effectively and most students will enjoy it.

SUGGESTED REFERENCES:

Dressler, Alex J.,"Teaching Without Lectures", Rice University Review, 1971, Spring Issue.

Green, B.A., "Physics Teaching by the Keller Plan at MIT", American Journal of Physics, Vol.39, 1971.

Green, B.A., "Is the Keller Plan Catching On Too Fast?", Journal of College Science Teaching, Vol.1, 1971.

Nee, John G., "The PSI Approach to Vocational Education", Industrial Education, Feb.,1976.

Keller, F.S.,"Goodby, Teacher...", Journal of Applied Behavior Analysis, Vol.1, 1968.

Koen, B.V., "Self-Paced Instruction in Engineering", IEEE Transactions, Feb. 1971

Copyright © John G. Nee 1979

PUZZLE CORNER

Robert P. Kelso
Louisiana Tech University

FALL '79 PUZZLE

Given: Two adjacent orthographic views of an angle of general size defined by intersecting lines of general lengths and in general positions.

Required: A Non-Normal orthographic view* of the plane of the angle such that the angle appears true size.

*and, if possible, all the views such that the angle appears true size as defined by a General Solution (see Puzzle Corner, Winter '79, Spring '79, and below).

Solutions received before November 15 will run in the Winter issue. Please submit solutions to:

Robert P. Kelso
Assistant Editor
Engineering Design Graphics Journal
Department of Industrial Engrg
and Computer Science
Louisiana Tech University
Ruston, LA 71272

SPRING '79 PUZZLE

Given: Two successive orthographic projections of two oblique limited planes of arbitrary orientation that do not appear to intersect.

Required: Without determining the line of intersection between the pl planes, construct a third oblique plane such that it makes a specified angle with one of the given planes and a different specified angle with the other given plane.

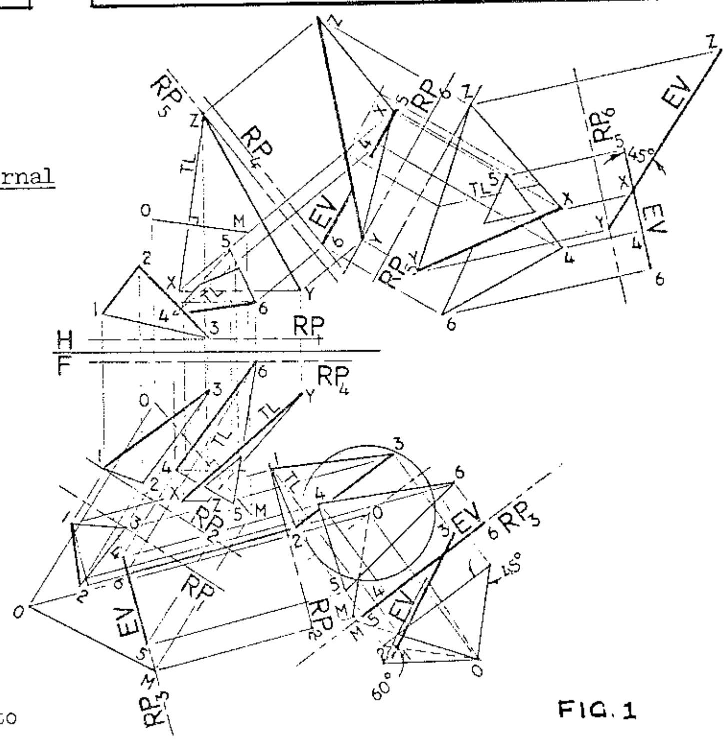


FIG. 1

Figure 1 is a solution to the Spring '79 puzzle. The specified angles are chosen to be 30° and 45°. The-Complimentary-Line-Method as defined by intersecting cones is chosen rather than the Plane-Tangent-to-Two-Cones-Method. By projecting from the front view, a line (O-M) forming 60° and 45° complimentary angles respectively with each of the given planes, 1-2-3 and 4-5-6, is obtained in the third auxiliary (O-M is extended somewhat to aid accuracy). It is elected rather to construct the required plane perpendicular to O-M in the auxiliaries, to project line O-M into the principle views and construct the required plane, X-Y-Z, perpendicular to O-M in these views.

As a verification, plane X-Y-Z and one of the given planes, 4-5-6 are projected into an edge view (starting from the top view) and found to form a 45° angle as predicted by the method. Note that the edges views are obtained by projecting from the view in which one plane appears true size and in a direction parallel-to-a-TL-line-on-the-other-plane.

"PERPLEXAHEDRON" (Paraphrased)
Winter '79 Puzzle

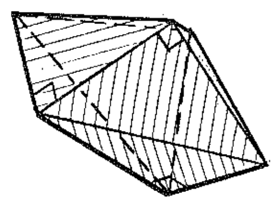


FIG. 2

Given: A "Perplexing" Octahedron with all surfaces formed by right isosceles triangles of equal size.

Required: Construct two adjacent orthographic views using conventional drawing techniques. (No calculations)

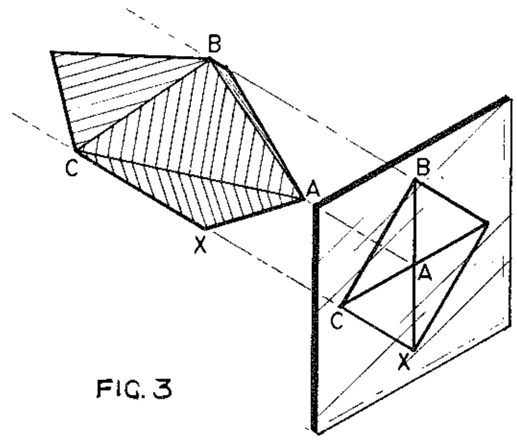


FIG. 3

The derivation (1) of a General Solution such that any pairs of nonparallel lines will appear perpendicular is shown in Figure 4.

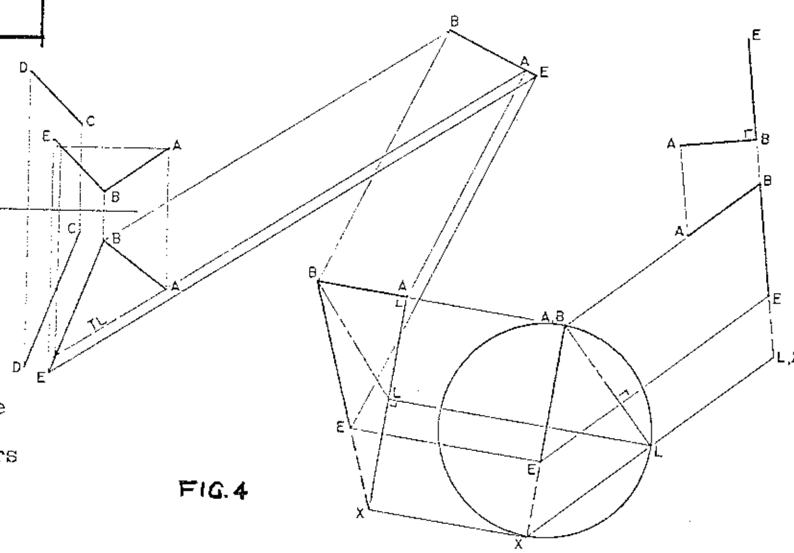


FIG. 4

Bob Christenson's puzzle of the Perplexahedron, Figure 2, is another kettle of fish or more aptly a can of worms! To attack this problem the 'Corner elected to attempth the "end view" from which the geometry of the other views will follow. As seen in Figure 3, the phenomenon occurs of a 45° true angle in space (∡ BAC) appearing as a 90° angle on the planeoof projection of the "end view". (Another phenomenon occurs of a true 45° angle, ∡ BCA, appearing as a 45° angle although the plane of the angle is not viewed Normally -- and this gives us the new 'Corner puzzle!)

The solution thus reduces to obtaining a single view such that (1) the BAC appears as 90° and that (2) line-length A-B appears equal to line-length A-C.

This latter (2) solution may be obtained from Abe Rotenberg's General Solution of any-pairs-of-non-parallel-lines-appearing-equal-length (see Winter '79 and Spring '79 Puzzle Corner). If, then, a General Solution of-any-pairs-of-non-parallel-lines-appearing-perpendicular may also be derived, then the line of intersection between these two General Solutions (cones) will represent the line of sight such that the given lines will appear perpendicular and equal-in-length.

A-B and C-D are skew lines of general lengths. In the principle views B-E is constructed parallel and equal-in-length to C-D. For simplicity C-D is not projected into the auxiliaries but if done so it will, of course, always appear equal in length and parallel to B-E -- including the final auxiliary in which a representative solution is demonstrated. The second auxiliary, besides representing a Normal view of plane ABE, also represents the "triangular" view of a cone constructed with apex at B and base perpendicular to A-B at A. Point L is any arbitrary point on the cone base, therefore, any element B-L, of the cone will represent a line-of-sight such that A-B and B-E will appear perpendicular.

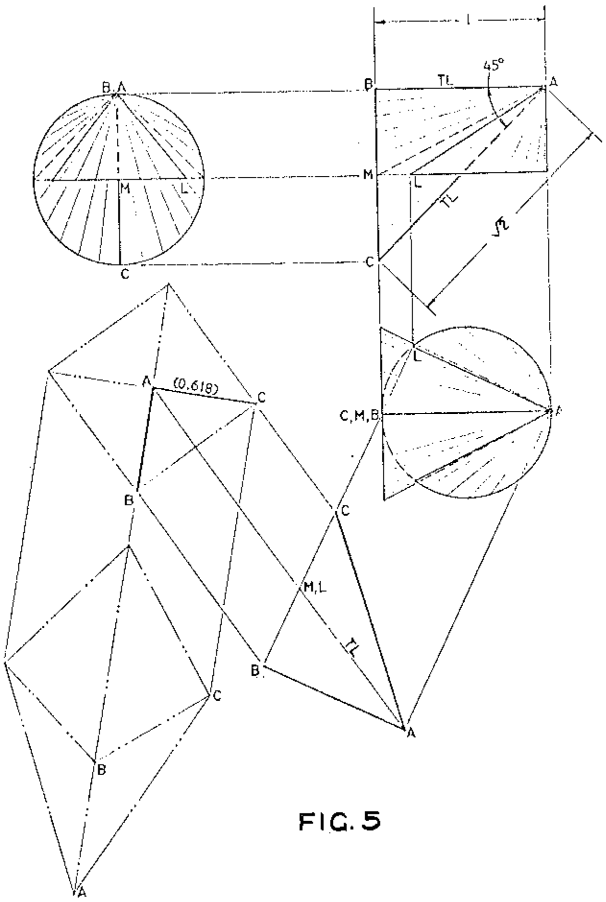


FIG. 5

In Figure 5 the two General Solutions of "equal-length" and "perpendicular lines" are combined for a solution to the Perplexahedron.

A Normal view of plane BAC from the Perplexahedron is shown in the top view. The Rotenberg equal-length-appearing-pairs-of-non-parallel-lines-General-Solution-Cone is constructed with the apex at A and the base perpendicular to BC at mid-point M. The 'Corner's perpendicular-appearing-pairs-of nonparallel-lines-General-Solution-cone is constructed with apex at A and base perpendicular to A-B at B. The end view of the line of intersection, A-L, yields the expected solution of A-B and A-C appearing equal-length and perpendicular. The phantom lines show the "end View" of the Perplexahedron superimposed. From this an adjacent orthographic view may be projected and completed from the other implied specifications. The completed solution is shown in Figure 6. A TL line has been projected and compared to the specifications as a verification.

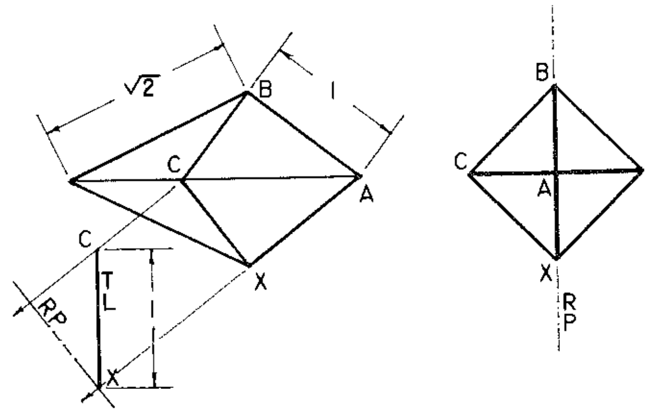


FIG. 6

Although the conditions rule out calculations, Dick Leuba of North Carolina State University submitted a calculated solution based on the geometric analysis shown in Figure 7.

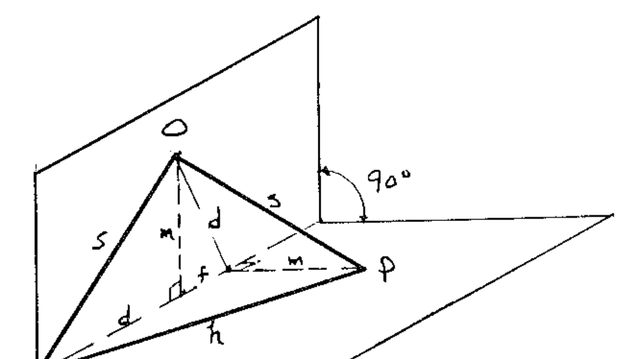


FIG. 7

His answer was $m = \sqrt{\frac{3 - \sqrt{5}}{2}} = 0.618 \ldots$

Notice that the calculated solution turns out to be the Fibonacci Series ratio (which gives rise to the Golden Mean, Devine Rectangle, et al). Strange!

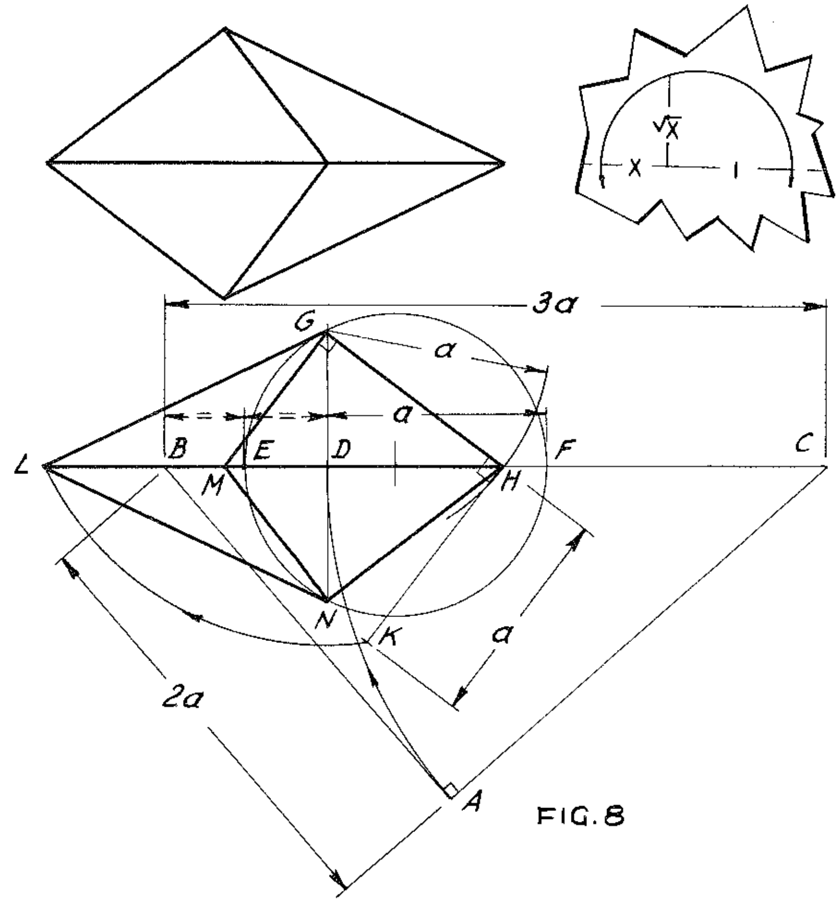


FIG.8

Let "a" be the side of each square of the "perplexahedron given.

1. Construct a right-angled ΔABC with side AB=2a and hypotenuse BC=3a.
2. CD=AC
3. BE=ED
4. DF=a
5. DG ⊥ BC; G is on a circle with EF as diameter
6. GH= a
7. GM ⊥ GH
8. KH ⊥ GH; KH=a
9. GL=GK
10. DN=DG
11. The two principal views are congruent figures.

Figure 8 (our inset) is a "PERPEXOLUTION" submitted by Abe Rotenberg of the University of Melbourne. It appears he made a calculation similar to Leuba's and then devised the geometry to satisfy the calculation -- a truly piece of geometry, but, strictly speaking, not within the conditions of the puzzle.

Most othere solutions submitted were based on trial-and-error principles.

Again, thanks to Bob Christenson of the General Motors Institute at Flint for a real jewel.

See ya in 'Frisco.

Robert P. Kelso

Now Available

Proceedings

INTERNATIONAL CONFERENCE ON DESCRIPTIVE GEOMETRY

ENGINEERING DESIGN GRAPHICS DIVISION 1928 1978 50TH ANNIVERSARY VANCOUVER, B.C.

Sponsored by the
ENGINEERING DESIGN GRAPHICS DIVISION, ASEE
on its 50th Anniversary

LIBRARY OF CONGRESS CATALOG CARD NUMBER 78-68611 **PRICE: $15.00**

The International Conference on Descriptive Geometry was held June 14-18, 1978, in Vancouver, B. C., Canada. The conference, sponsored by the Engineering Design Graphics Division of ASEE, provided the opportunity for geometrists all over the world to convene, exchange ideas and discuss new developments and applications of descriptive geometry.

Historically, the Conference commemorated the Engineering Design Graphics Division's 50th year of providing significant leadership in engineering education. There were a total of 115 registrants and 53 spouses and guests who convened from 11 countries, 6 Canadian provinces and 30 states, resulting in a truly international atmosphere.

Taking almost 4 years from idea to reality, the Conference was perhaps the largest undertaking of the Engineering Design Graphics Division in its long history. According to participants, the Conference was most successful and left attendees eager to plan a similar conference in the near future.

The PROCEEDINGS are a complete and permanent document of the International Conference on Descriptive Geometry. Its 196 pages include the complete papers of 41 authors of worldwide esteem who participated in the Conference. Papers are organized in chronological order as they were presented so that the reader may experience the Conference just as it happened. Hundreds of photographs and figures are included to illustrate the text material. The name and address as well as a photograph and biographical sketch of each author are included with each paper. In addition, an alphabetical listing of all attendees with their addresses is included in the Appendix.

ORDER YOUR COPY(S) NOW

Whether or not you attended the International Conference on Descriptive Geometry, certainly you will want to purchase a copy of the PROCEEDINGS. Anyone teaching or doing research in the field of Engineering Graphics will find the PROCEEDINGS a most complete and up-to-date summary of the "state of the art" in descriptive geometry, computer graphics, and modular instruction in graphics.

To order your copy simply complete the order form below and mail with your check for the proper amount to:

Garland K. Hilliard, Editor
Proceedings: ICDG
510 POE HALL
NORTH CAROLINA STATE UNIVERSITY
RALEIGH, N. C. 27607

PLEASE PRINT OR TYPE

NAME ______________________________

ADDRESS ______________________________

____

____

Please send me ______ copies of the PROCEEDINGS: INTERNATIONAL CONFERENCE ON DESCRIPTIVE GEOMETRY at $15.00 each. A check for ________ is enclosed.

FOREIGN ORDERS PLEASE NOTE!

Foreign orders will be mailed Air Mail. To cover the cost of postage, please add $2.00 for each copy ordered. Also, please send a check for the full amount made out to be drawn from a United States bank in US dollars.

MAKE ALL CHECKS PAYABLE TO:

Engineering Design Graphics Journal


Bruning's PD80 engineering copier lets you breathe a lot easier.
Ah! The sweet smell of fresh air. But the ammonia-free PD80* isn't today's most popular convenience copier just because it's ventless and odorless. With instant on off, it operates on a convenient 115 volts to deliver dry prints of your engineering drawings in seconds.
And here's another breath of fresh air. Our rental plan with an option to buy means no capital investment, no long-term commitment. At only $40 a month,* we're sure you'll like it. All rent applies toward purchase for the first three months.
And the PD80 is backed by the respected Bruning tradition of service and support to the engineering profession.
Breathe easier. Call your local Bruning Sales Office. Or write Bruning, 1834 Walden Office Square, Schaumburg, Illinois 60196.
Bruning
the Informationists

Release me from the craving to straighten out everybody's affairs. With my vast store of wisdom, it seems a pity not to use it all. But Thou knowest, Lord,

Keep me from the fatal habit of thinking I must say something on every subject and on every occasion.

I WANT A FEW FRIENDS LEFT AT THE END

Seal my lips on my aches and pains; they are increasing and my love of rehearsing them is becoming sweeter as the years go by.

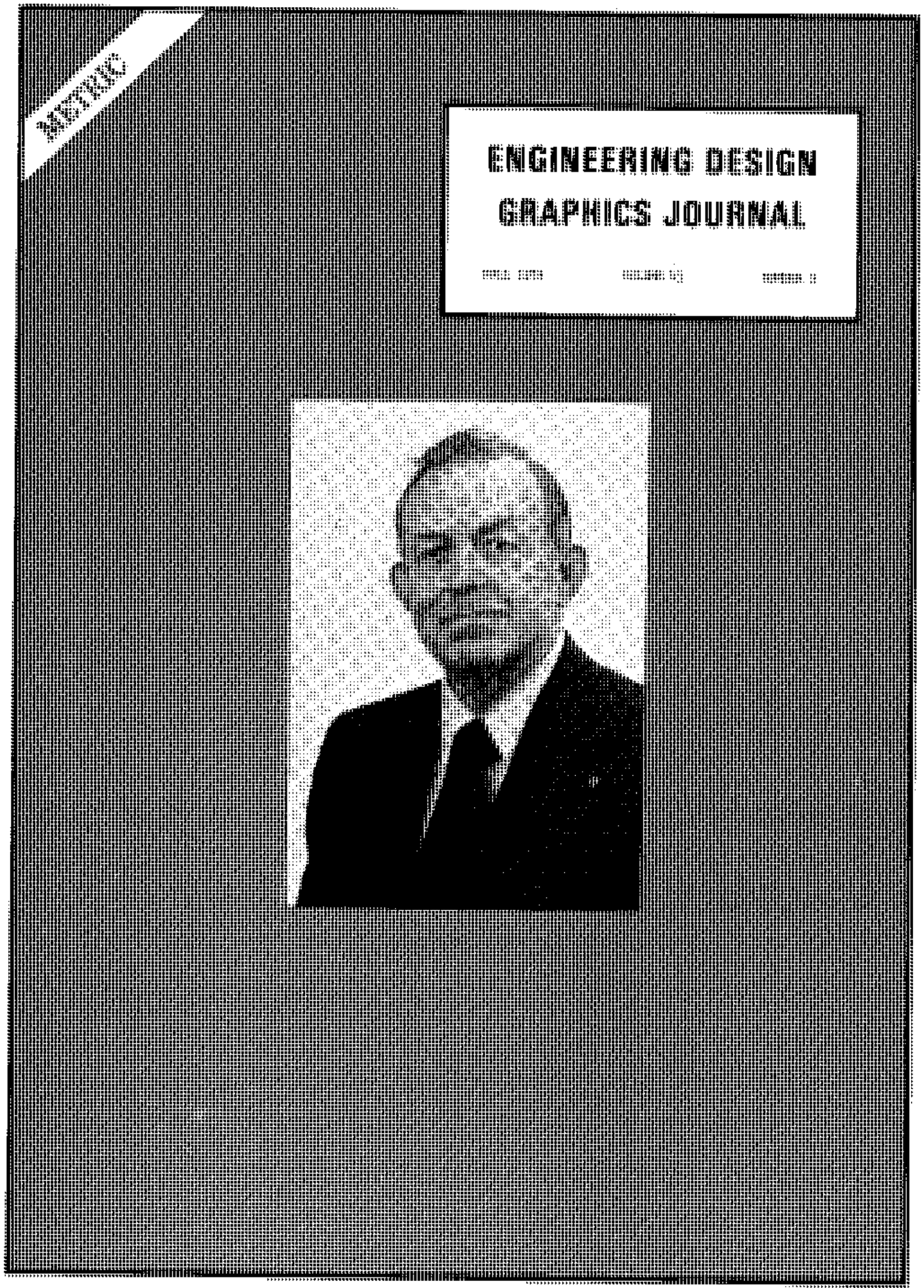
Keep my mind from the recital of the endless details.

Teach me the glorious lesson that occasionally it is possible for me to be mistaken.

Give me wings to get to the point.

Help me extract all possible fun out of life. There are so many funny things around us. I don't want to miss any of them. Amen.

PRAYER FOR THE NEW YEAR · ATTRIBUTED TO ERIC SEVAREID · GRETCHEN WEBER · SCRIBE



Engineering Design Graphics Journal
G. K. Hilliard, Circulation Manager
510 POE HALL
NORTH CAROLINA STATE UNIVERSITY
RALEIGH, N. C. 27607

(Address Correction Requested)

Nonprofit Org.
U.S. Postage
PAID
Bulk Rate
Dubuque, Iowa
Permit No. 477