ENGINEERING DESIGN GRAPHICS JOURNAL

SPRING 1971 VOLUME 35 NUMBER 2 SERIES 104

JAMES H. EARLE
Division Chairman, 1970-1971

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Editorial Page

MEMBERS

The editor of your Journal was told not to mention a statistic that was given in a report to the executive committee of the Engineering Design Graphics Division. The reason given was that this statistic would cause members to wonder why they belong to ASEE. It seems that the Division official who made this "request" wants to hold members although there is no interest in the activities of the organization nor benefits to be derived from it, or he wishes to suppress dissenting thoughts. Perhaps we must begin to take stock of ourselves -- not only the officers, directors and committee members, but every member of the organization.

The purpose of any professional organization is to aid and assist its members in their professional activities. Those who want no assistance are not really interested in the profession. Those who do want assistance must go after it. The officers are not obligated to give each member anything, The officers are, however, obligated to provide the ways and means by which each member may receive the necessary assistance for professional improvement. Officers do not have the privilege to determine what the members are to teach nor whether they are to use methods prescribed by any individual. Each member does have the opportunity (through the Journal, at meetings or by private correspondence) to seek assistance or make suggestions concerning methods, materials and subject matter relevant to our discipline. Those who are seriously concerned with providing the best engineering education to their students would be interested in the ASEE; those who are in our profession because they can do nothing else are obviously unhappy with the Division and the Society since they seem to be unable to get something for nothing.

During recent meetings and through private conversations with several "colleagues" we learned that they are not getting "what they are paying for". When asked what they are paying for there is no answer. When asked whether they have a subscription to our Journal, the answer is usually "No". When asked whether they have ever written for the Journal, the answer is, most often, "No". When asked whether they have entered projects in the Annual Creative Design Display the answer is usually "No". When asked what they want of the Division, they usually cannot answer. How can the Division or the Society be of assistance to those who do not seek it, and in fact, seem to refuse it?

The Division is now in the process of trying to evaluate itself. There are two committees undertaking this enormous task. One is a committee whose members are considered to be in the western part of the United States and another in the east. Although the committees consist of only a handful of people, in reality every member of the Division must take part in this study. Each of us may be asked for opinions -- if so, give it. Should you feel that you would like to make suggestions -- do so by writing to William B. Rogers at Virginia Polytechnic Institute or to Robert LaRue at Ohio State University. Constructive suggestions are always beneficial to a progressive organization.

There are many members who may like to write articles for the Journal, but are afraid that their efforts may not be appreciated or they cannot find a subject about which they could write. Should one feel that their efforts would not be appreciated, may we suggest that you write the article and submit it to Professor Al Romeo at Ohio State University for review. If the piece is good, the Journal will print it; if it is not good, only you and Professor Romeo will know. Should you be looking for topics, ask any of your colleagues what type of information they would like to have, or ask the editor of the Journal for suggestions. There is much that young instructors, old instructors and the in-between instructors can write that is informative and of interest to Journal readers. Take advantage of this opportunity provided each member of the Division.

Very often something may happen at your school that should be publicized professionally. That is one of the purposes for our Journal. Perhaps your school had an "Engineers' Fair" and the display that was prepared by your students was judged to be the best. Shouldn't we all know about it? An article, accompanied by

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Officers' Page

A Review Of 1970-71

JAMES H. EARLE

It has been a pleasure to serve as a chairman of the Engineering Design Graphics Division' during 1970-71, the beginning of a new decade. Also, this was the beginning of the Division's operation under the new name, Engineering Design Graphics Division.

Many problems arise during the administration of a large membership that is distributed throughout the nation and in foreign countries. However, we have found that the members of our Division are eager to work together toward a common goal of the continual improvement of engineering education. Your cooperation and support during this year is appreciated by the Executive Committee and committee chairmen who have been active with a number of worthwhile projects.

It is fitting that the progress of our Division be reviewed periodically. Thus, I will attempt to review changes that have been agreed to by our Executive Committee during the last year.

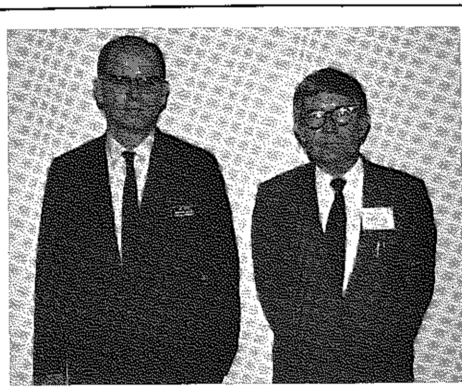
First, it has been agreed that future mid-year meetings will be held at sites that are selected to offer the greatest convenience for travel, accommodations and resources. The Executive Committee will be responsible for selecting the most appropriate locations for these meetings; and these sites will not necessarily be on college campuses or even in a college town. This added convenience and the appeal of the desirable meeting locations is expected to increase our attendance at mid-year meetings.

Secondly, plans are being made to gain financial support from commercial exhibitions at mid-year meetings that can be applied toward the annual design display which has been short of funds during the last few years.

Thirdly, a more systematic use of surplus funds from the Engineering Design Graphics Journal is being studied to more effectively apply these needed funds to our Division projects. The design display, committee projects and similar assignments are needs that are worthy of financial support.

I have enjoyed the hard work of serving as chairman of the Division and feel that a few strides have been made to improve our organization. Past chairman seldom hold elected offices in the Division after their term as chairmen other than those required by the bylaws. Consequently, my role with the Division will be that of a member rather than as an officer in the future.

Thank you for your support and patience during this year. I am sure that you will give the same assistance to Percy Hill and to Bill Rogers during their terms of office.



Houston Convention Hosts

Election Results 1971-1972

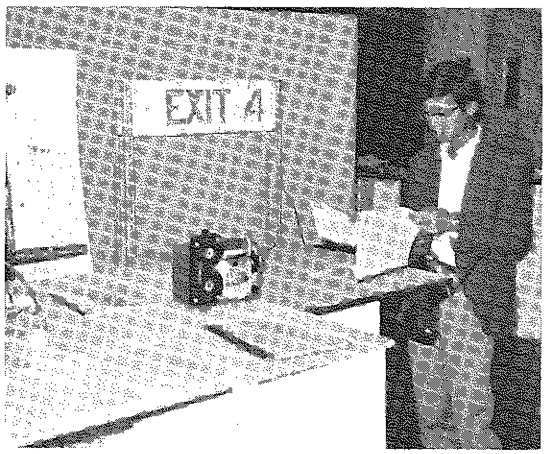
Ballots were counted to determine the results of the election of Division officers for the year 1971-1972. Approximately 290 votes were cast out of about 1000 members. This seems to be a poor voting turnout; however, it serves to elect excellent individuals as our new officers. Those who were elected are as follows;

Vice Chairman
WILLIAM B. ROGERS
Virginia Polytechnic Institute

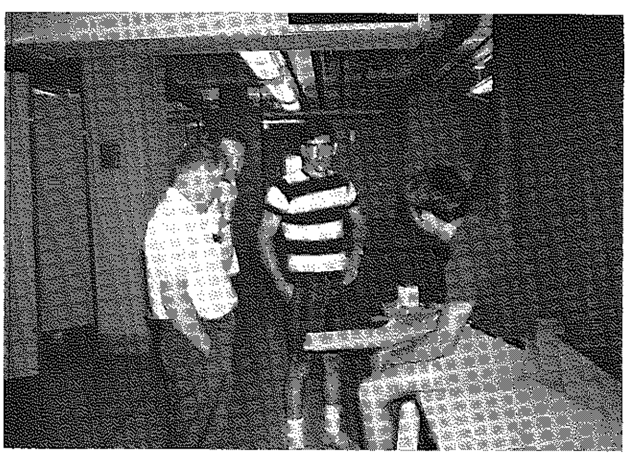
Secretary
Z. CLAUDE WESTFALL
University of Maine

Circulation Manager & Treasurer, Engineering Design Graphics Journal
ROBERT J. CHRISTENSON
General Motors Institute

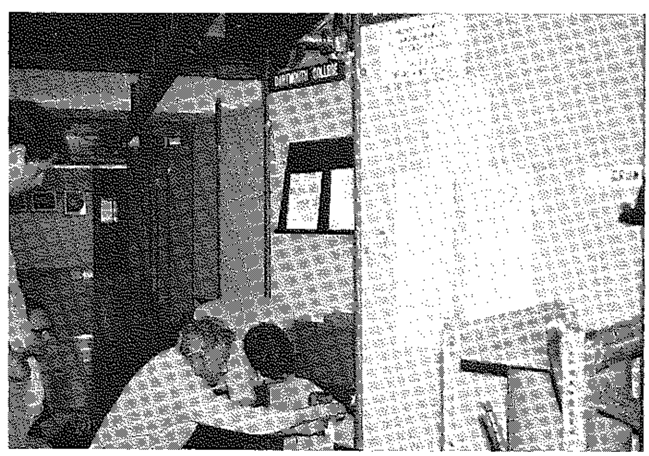
Director
EDWARD V. MOCHEL
University of Virginia



A Northeastern University student preparing his school's display at Penn State.



Professor LaRue and his student assistants relaxing after hours of preparation for the Creative Design Display at Ohio State.



Professor Stearns preparing the Dartmouth exhibit for the Creative Design Display at Ohio State.

PROFESSOR PHILIP O. POTTS

(From the Ann Arbor News, Thursday, December 17, 1970)

Philip O. Potts, 76, University of Michigan Professor-Emeritus of Engineering Graphics and a founder and former manager for 21 years of the Ann Arbor Symphony Orchestra, collapsed and died of a heart attack Wednesday afternoon in a University of Michigan parking lot.

He and three other musicians. in 1928, formed the musical group which grew into the civic orchestra. He was also instrumental in organizing the Michigan Association of Civic Orchestras, and had served as its secretary-treasurer, executive secretary and acting president.

Born on August 23, 1894, in Ridgeway, Michigan he first came to Ann Arbor in 1912 to enroll as a freshman at the University of Michigan. Professor Potts earned his bachelor's degree in Mechanical Engineering from the University in 1916, and a master's degree in Hydraulic Engineering in 1944.

He joined the University of Michigan faculty in 1923 as an assistant professor in the College of Engineering and was promoted to associate professor in 1948 and to full professor in 1963. He retired in 1964 after serving 40 years on the faculty.

Before returning to Ann Arbor to join the U of M faculty, Professor Potts served as a cost statistician for the Michigan Central Railroad, worked as an engineer for various other firms, and taught at the Pratt Institute in Brooklyn, New York and at Wayne State University.

Professor Potts served as a lieutenant and captain in the United States Army from 1917 to 1919 during World War I, and from 1925 to 1940. He served as acting chairman of the Ann Arbor Recreation Department's adult activities committee. He was a member of the American Society for Engineering Education and had served as consultant to the American Institute for Design and Drafting.

He was the author of various articles and books, including "Power", "Machine Design", "Music Educators Journal", with R. T. Lindicoat "Laboratory Manual of Materials Testing", and "Engineering Statics".

A former member of the University of Michigan Marching Band while a student and a participant with the Alumni Band at Michigan football games for many years. He played for more than 40 years from the time of its founding as a quartet at the First Methodist Church and through its rapid growth into a community and then a civic symphony to the present.

Instrumental in its growth, he had served as its business manager until 1953.

He is survived by Mrs. Nina (Armstrong) Potts to whom he was married since 1920. He was preceded in death by a daughter, Dorothy, on December 28, 1964.

Memorial services were held on Friday, December 18, 1970 at the First United Methodist Church.

MEMBERS (continued from page 2)

pictures, sent to John Kreifeld at Tufts University will find its way into print. Every professional member of the Engineering Design Graphics Division of ASEE has an obligation to himself and his students to improve his professional capabilities.

No individual can cause the American Society for Engineering Education nor its Engineering Design Graphics Division to be beneficial for any other individual. The Society and the Division is only as effective as its members demand them to be. It is, now, your obligation to receive professional information and/or assistance through those channels and activities that are provided for your benefit.

PROPOSED ASEE ORGANIZATION

After due deliberation, including consideration of all comments submitted by members of the Society over the past year, the Board of Directors, at its meeting in January, unanimously adopted the draft of a new Constitution which will reflect its decisiond on restructuring the Society, This new Constitution appeared in the March issue of ENGINEERING EDUCATION for ratification by the total membership of ASEE.

PROPOSED ASEE ORGANIZATION

Officer Structure

EXECUTIVE COMMITTEE

Officer	Term	Remarks
President	One year	Automatic succession from President Elect
President Elect	One year	Elected by individual membership
Vice-President, Finance (&chairman, Finance Comm.)	One year (May succeed himself)	Elected by individual membership
*Vice-President, Geographic	One year	Elected by Board of Directors
*Vice-President, Professional Interest	One year	Elected by Board of Directors
**Chairman, Projects Board	Indefinite	Elected by Board of Directors
**Chairman, Long Range Planning Committee	Indefinite	Elected by Board of Directors
**Executive Director	Indefinite	Appointed by Board of Directors

* One designate First Vice-President and one Second Vice-President by vote of Board of Directors

** Without vote

BOARD OF DIRECTORS

Officer	Term	Remarks
President	One year	Automatic succession from President Elect
President Elect	One year	Elected by individual membership
Past President	One year	Automatic succession from President

BOARD OF DIRECTORS (continued)

Vice-President, Finance	One year (May succeed himself)	Elected by individual membership
Chairman, Projects Board	Indefinite	Elected by Board of Directors
Chairman, Long Range Planning Committee	Indefinite	Elected by Board of Directors
Executive Director (w/o vote)	Indefinite	Appointed by Board of Directors
Chairman of Sections, Zone I	Two years	Elected by individual members in Zone I
Chairman of Sections, Zone II	Two years	Elected by individual members in Zone II
Chairman of Sections, Zone III	Two years	Elected by individual members in Zone III
Chairman of Sections, Zone IV	Two years	Elected by individual members in Zone IV
Chairman, Council for Teaching & Learning	Two years	Elected by individual membership
Chairman, Council for Graduate & Continuing Education	Two years	Elected by individual membership
Chairman, Council for Public & Specialized Services	Two years	Elected by individual membership
Chairman, Council for Professional & Technical Education	Two years	Elected by individual membership
Chairman, Engineering College Council	Two years	Elected by representatives of Engineering College members
Chairman, Technical College Council	Two years	Elected by representatives of Technical College members
Chairman, Affiliate and Associate Member Council	Two years	Elected by representatives of Affiliate & Associate members
Chairman, Industrial Member Council	Two years	Elected by representatives of Industrial members
Chairman, Government Member Council	Two years	Elected by representatives of Government members
Chairman, Engineering Research Council	Two years	Elected by representatives of all participating institutional members

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Makeup of Councils of Divisions

COUNCIL for TEACHING & LEARNING

Divisions; Cooperative Education
Educational Research & Methods
Engineering School Libraries

Councils of Divisions (continued)

COUNCIL for GRADUATE & CONTINUING EDUCATION

Divisions;	Continuing Engineering Studies Graduate Studies

COUNCIL for PUBLIC & SPECIALIZED SERVICES

Divisions;	International Liberal Studies Relations with Industry
Costituent Committees;	Ethics & Legal Phases

COUNCIL for PROFESSIONAL & TECHNICAL EDUCATION

Divisions;	Aerospace Agricultural Engineering Architectural Engineering Chemical Engineering Civil Engineering Electrical Engineering Engineering Design & Graphics Engineering Economy Environmental Engineering Industrial Engineering Instrumentation Materials Mathematics Mechanical Engineering Mechanics Mineral Engineering Nuclear Engineering Physics Technical Institute
Constituent Committees;	Biomedical Engineering Education in Acoustics Energy Conversion Ocean Engineering Textile Engineering

Two Move On

Congratulations are in order for Professor George Devens at Virginia Polytechnic Institute. George took advantage of the opportunity to acquire the services of our new Division Vice Chairman, BILL ROGERS. Bill is retiring from the United States Military Academy as of August of 1971 and will report as an Associate Professor of Engineering Fundamentals to VPI in September ----- after assuming the position of Vice Chairman of the Division.

Condolences may be in order for Professor Jim Earle on the loss of one of his fine staff. Professor RICHARD VOGEL will be going to Western Washington State College in Bellingham, Washington. He will be responsible for the engineering graphics program in the Department of Technology.

Our best wishes to BILL ROGERS and DICK VOGEL on their new positions.

H. NIAYESH

Another Method to Solve Dihedral Angle Problems

The following letter was received by the editor from Mr. H. Niayesh, the head of the Engineering Graphics Center at Arya-Mehr, University of Technology in Tehran, Iran.

Dear Sir,

I have only recently received the Winter and Spring issues of your Engineering Design Graphics Journal.

To the article "Solution To A Class Of Problem Involving Dihedral Angles" I take the liberty to comment as follows:

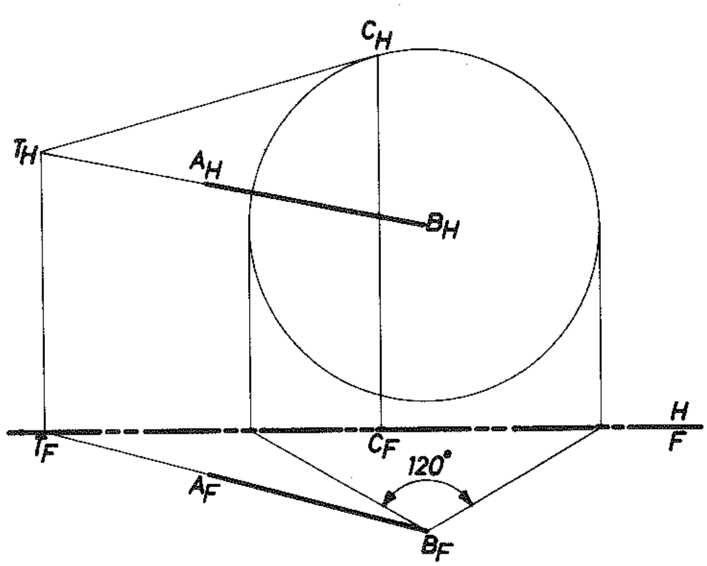
Although the solution given by Mr. Thomas Thorsen is original and interesting, I wonder why problem 1 should be solved in such an inconvenient manner when the following easy solution, without the use of auxiliary projections is available.

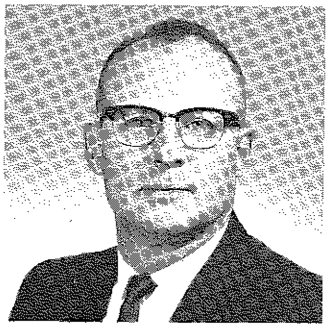
With point B as the vertex of a right circular cone having its base on the H-plane, we draw the F and H projections of the cone with a vertex angle of 120°. Finding the H-trace of the line AB, i.e. point T, and drawing a tangent from T_H to the horizontal projection of the cone base, the point of tangency, C, is found. The points A, B, and C define the plane required.

The second example could be handled first in exactly the same manner as given in figure 3 by Mr. Thorsen and then solved as mentioned above.

Very truly yours
H. Niayesh

Head, Eng. Graphics Centre





HIGH TIME TO TEACH AGAIN

W. GEORGE DEVENS
Virginia Polytechnic Institute

"When they start paying me for teaching, I'll learn to teach." Thus has spoken a young member of our faculty. Who among you has not heard similar comments from colleagues at your own institutions?

Recently, the Governor of the Commonwealth of Virginia, the Honorable Linwood Holton, speaking to the Association of Virginia Colleges, said, "I do not believe that much of the so-called student rebellion is an actual revolution. Rather it may simply be a reaction against the doctrine of 'publish or perish' and research grants above all. The students may be telling us that they believe a university should return to its first and foremost function ----- to educate."

The Association of American University Professors and the Association of American Colleges are currently sponsoring a program to improve college teaching. Apparently, then, the need for improvement in undergraduate instruction is duly recognized by students, faculty, and administrators alike. What can be done to satisfy this crying need?

The answer lies, as Governor Holton has indicated, in a return to our basic mission -------- education. Education involves provision of an environment for learning. Within this environment, there must be room for the development of new ideas and their communication to others. But first our students must learn basic concepts and this is best accomplished through excellence in instruction -- good teaching at the undergraduate level.

In our efforts to bring honor and glory to our institutions, we seek to attract those individuals whose record indicates a marked degree of success in research and publication; or those who may attract substantial grants to support both themselves and the institution. There is nothing wrong with this approach unless it acts to the detriment of good teaching.

When we overemphasize research and publication, is it any wonder that our young faculty react as they do? They sense, immediately, that their personal progress will be dependent on their success in these areas while little or no premium is attached to excellence as a teacher.

We recruit and hire new faculty on the basis of degrees, experience, publications, etc. Do we ever take the trouble to check a man's ability to teach? Does it really matter? Students seem to feel that it does.

In most states, a teacher must be certified before instructing in the elementary and secondary schools. No such requirement exists at most of our institutions of higher education, nor may it be advisable. However, it would seem reasonable to expect that a faculty member be proficient at teaching. Our students certainly expect it.

A new faculty member generally arrives on campus just prior to the start of fall classes and is given a course or courses to teach. He may not have any previous experience in the classroom or with the courses. Surely, we could not reasonably expect very satisfactory performance in such a situation. Yet we see it rerepeated year after year.

As a first step to improve teaching, could we not require that every new teacher take or have taken a course in "Methods of Instruction"? He would, then, as a minimum, have been exposed to teaching techniques and proper lesson preparation. Next, let's bring him into his new environment during the preceding summer, pay him for his time, and thus give him the opportunity to adaquately prepare for his vital assignment. You would not attempt to drive a car in traffic without prior instruction and practice; why then, ask a man to teach without adaquate preparation?

Finally, let's provide the incentive for good teaching. Personal satisfaction at a job well done is not sufficient. Good teaching must be encouraged and supported by more than an occasional faculty award. Department heads, deans, and administrators must make it quite clear that excellence in instruction will be rewarded to the same extent as research and publication efforts. Until this is done many faculty will continue to give little effort to their teaching role, cheating both themselves and their students in the process. It's high time to get back to our basic function.

WILL TECHNOLOGISTS REPLACE ENGINEERS?

BOB STEDFELD
Editor, MACHINE DESIGN

The number of degrees in engineering technology will mushroom in the next ten years. Over 70 engineering schools have started four year programs in engineering technology, with more to follow.

Theoretically, engineering technology is a distinct and different field from engineering. Engineering technologists will be concerned primarily with the application of scientific and engineering methods. Engineers, on the other hand, will be concerned with the development of such methods --- or so the theory goes.

Engineering technology has been created because engineering schools accent science and mathematics in present engineering curricula. Thus, the degree in engineering will be reserved for the four-year graduate with a strong math/science/analytical background.

Industry has found that these graduates have difficulty fitting into prosaic, engineering jobs. They tend to orient themselves toward research and scientific analysis. But 50 to 70 percent of all engineers, according to Fred Landis of New York University, do work which has "a high degree of near-repetitiveness" and "demands little in terms of science-based knowledge or even in terms of being up-to-date."

The engineering technologist will meet industry's demand for men who can perform these prosaic tasks. The pragmatic technology curriculum will resemble, strangely enough, the engineering course of twenty years ago. (The two-year associate degree will continue as technician-level training.)

There will be, we feel, great confusion. Educators will try to maintain that engineering and engineering technology are different. But engineers and employers may not bother about such fine distinctions. Both types of graduates may well be lumped together as "engineers" since, after all, both have taken four-year courses leading to a baccalaureate degree.

If the differentiation is successfully maintained, engineers could wind up as an elite class --- and technologists as second-class citizens doing the grubby tasks.

If the differentiation is not maintained ---- a more likely possibility, we feel ---- the addition of technologists to the engineering work-force could lead to lower salaries for "engineers" and a general decline in status of the engineering profession. In either case, it's a sure bet that technologists will replace many engineers.

Practically speaking, the trend can't be stopped. Industry says it needs technologists. Educators are responding by mass-producing a new educational product. While the action might be regarded in some quarters as a return to educational sanity, it could also shatter the hopes of engineers who have their eyes on that golden dream of upgrading engineering to an elite-status profession.

AIDD ANNUAL MEETING

Our colleague, Wally Reynolds, will be using the experience afforded him by the Engineering Design Graphics Division to host the Annual Seminar and Membership Meeting of the American Institute for Drafting and Design.

The meeting will be held at the California State Polytechnic College in San Luis Obispo between Wednesday, August 25 and Friday, August 27, 1971. Anyone who may desire further information may do so by contacting

Professor Wallace Reynolds
California State Polytechnic College
San Luis Obispo, California 93401

VISUAL COMMUNICATION IN ENGINEERING GRAPHICS EDUCATION

RICHARD F. VOGEL
Texas A & M University

As a teacher of engineering graphics, I have periodically asked myself whether I presented the subject matter of the courses I am teaching in a manner that provides for optimum understanding by the students with a minimum of time involved in presentation? The reason for this question should be evident if you can read between the lines. Engineering graphics is becoming less of a subject in which the teacher has time to belabor the details of drafting techniques in lettering and line work along with multiple exercises of repetitive nature. The inclusion of engineering design and subsequent student projects along with orientation into the various branches of engineering expertise have become integral parts of the current freshman engineering graphics curriculum. With all this in mind it becomes more evident that evaluation of instructional presentation methods is essential in order that the desired course content be taught in the amount of time available.

Another factor that enters into the situation is that continuing administrative pressure to reduce the number of credit hours a student is required to complete for graduation in engineering. As recent experience has informed us, this reduction in required hours for graduation has tended to weed out the practical courses and emphasize the theoretical. Consequently, it is essential that engineering graphics educators provide the best program that we are capable of producing in the instructional time allotted.

Let us go back to my original question. Do you present the subject matter of your courses in a manner that provides for optimum student understanding with a minimum of time involved in the classroom presentation? Do not misunderstand this question. It does not mean that we should drop what we are presently doing in the classroom and engage ourselves in self-taught, high pressure, rapid action door to door sales campaigning. I am saying that we should periodically reflect back on our teaching and determine whether improvements could be made in our instructional methods. To add emphasis to the need for more effective and efficient instructional methods, I quote the following paragraph from "A Teachers Guide to Instructional Materials," published by the Scott Educational Division of the Scott Paper Company in 1970:

> "For many reasons, a teacher's role today is not an easy one. Classes are generally large. Frequently, there are wide variances in the ability levels of students. It is becoming more difficult to grasp and hold the attention of students because of their overwhelming exposure to out-of-school mass communications. The amount of subject information that a teacher must communicate increases daily. Add to this situation such barriers to pupil learning as: psychological blocks, referent confusion, daydreaming and physical discomfort. The difficulty of the teachers task is apparent."

Probably the least prevalent problem we have in the field of engineering graphics is that of determining what subject matter should be taught. However, some difficulties arise in determining how or with which form of media we can perform the most effective job of presenting the subject. Several years ago this problem was a relatively minor condition due to the limited number of media methods available. The teacher had a choice of chalkboard, printed material, lantern slides and models, all of which you could prepare yourself without excessive cost. Today, we have numerous methods available if we just had the money to purchase them.

If financial consideration was of no concern, the classroom could be equipped with audio-tutorial facilities in which each student will have access to an individual work station where he could press several buttons to program his instruction for the unit he wished to continue or proceed with. He would perform his student exercise on a sensitized work platform and receive immediate feedback on his progress. Another approach might be to provide scheduled lectures through closed circuit television in which the student receives instruction either in his dorm room or in a lecture hall with several hundred other students. Following the lecture he would have access to laboratory facilities in which he could receive individual assistance if the student deemed it necessary.

Getting back to ground level, these methods will undoubtedly become available sometime in the future, but most of us must use what is presently within our economic grasp. Several types of well known media are presently available and can be adapted to classroom use with limited financial outlay. These include the use of: overhead projectuals; 35mm slides; 35mm film strips; super 8 and 16 motion pictures and film loops; and cassette tape players and recorders that can be used in conjunction with any or all of the above mentioned visual media in presenting prepared lectures on selected subjects. You might even consider using 3D stereo viewmasters and/or programmed instruction lab manuals on an individual student instruction program.

INSTRUCTIONAL RESEARCH

Several research projects have been conducted within the past decade in engineering graphics to evaluate the efficient utilization of instructional time and teaching effectiveness of selected visual and audio-visual media. Statistical analyses of experiments using control and experimental group comparisons have indicated that some media provide more effective, time saving instruction than the conventional chalkboard lecture-demonstration method. The following is a brief summary of investigators and and the outcomes of their research.

Clayton Chance, at the University of Texas, conducted an experimental study to evaluate the use of color transparencies and overhead projection in teaching engineering descriptive geometry. Conclusions drawn from this experiment indicated that: student performance was increased through the use of transparencies: presentation time was reduced appreciably allowing for more time with individual instruction and assistance: faculty and student acceptance of the media form was unanimous.

H. M. Nealy, at Kansas State University, conducted a study to design and develop transparent overlays for teaching engineering graphics. From the data collected, Nealy concluded that through the use of overhead transparencies instructional methods benefited from increased continuity of subject content between instructors, and new faculty members adjusted to the course material more rapidly. In addition, instructional presentation time was reduced by one-third to one-half.

Dennis C. Nystrom studied the use of 16 mm animated film in selected subjects of engineering graphics at Texas A & M University. Nystrom determined that students learned and retained more of the instructional content through the use of animated movies. Student interest was enhanced by this method.

Ronald D. McCage made use of 35 mm slides and models in introducing descriptive geometry concepts at Texas A & M University. McCage used these materials as a supplement to the regular classroom instruction which utilized the lecture - demonstration with overhead color transparencies. Emphasis was placed on presentation of engineering applications of descriptive geometry through supplemental slides showing construction site work, terrain table and models. The study indicated that slide supplemented classroom instruction has significant qualities compared to the control method. Visualization was improved along with student interest and understanding of descriptive geometry fundamentals. The method did require additional time in presentation, however the benefits of this supplemental inclusion were determined to be of more importance. The students accomplished more during the semester through application of this method.

Regardless of the media method applied to a particular subject, it is essential to lay out plans for your media and establish some standards in regard to objectives of presentation. Assuming the students already have a textbook for reference and a reasonably good student layout workbook for application of principles presented, you should make use of efficient and effective methods of presenting the concepts and procedures necessary for the students to accomplish successful solutions to the layout problems.

PREPARATION OF TRANSPARENCIES

The following procedure is recommended for the preparation of overhead transparencies and may be used for other media preparation as well. The problems should be broken down into the necessary basic steps for solution. Individual problems should be sketched out to a reasonable scale and proportion. A good standard format for most media reproduction has a size of two vertical to three horizontal. This size can be applied to slide and motion picture production as well as to overhead transparencies.

When preparing overhead transparencies, it is most essential that your projectuals fit the stage size of your projector. If commercially available frames are to be used, the size of the exercise should not overlap the edges. The master or complete solution should be drawn in ink on a good grade of dimensionally stable paper or film. At this stage you should isolate the steps to solution by overlapping the master and tracing in ink the initial problem and each step to solution on seperate sheets of tracing paper. Registration marks should be placed on the corners of all sheets so that alignment of transparencies will be a simple task when assembling the overlays. If color transparencies are to be used in a series, it is helpful during processing to have the color name printed on the outside edge along with the step number. Be sure that all steps are located on the overlay in a convenient place to read when presenting your lexture. In addition, you will find it helpful to print on the transparency the page number(s) on which text reference may be located by the student for the topic being presented.

Titles and notations on the transparency need to be large enough to be easily read from any place in the classroom. Some experimentation should be conducted to determine the optimum size of lettering. This can be accomplished by printing several sizes of lettering on a sample transparency and checking them out on the projector in the classroom. Don't make the mistake of producing several sets of projectuals and find the lettering too small A recommended minimum size is 3/16 inch letters and numerals; titles should be larger.

Color transparencies using Diazochrome prints provide a permanent teaching aid. Diazochrome film can be exposed and developed in most ozalid or blueline printers. Processing of this film requires slowing the machine speed considerably and varies according to color. When printing several transparencies at one time, it is advised to print all sheets on the same color at the same time to avoid problems in changing the exposure time.

Transparencies that are to be used several times should be mounted on a frame, preferably a commercially prepared frame designed for use on the stage size of your overhead projector. Of the two basic types of frames available, plastic and cardboard, the plastic frame is more durable. The base mount or title sheet should be permanently taped to the frame and the overlay sheets hinged from one edge. Hinging of overlay sheets can be accomplished with either commercially available hinges or Magic Mending transparent tape. It is not advisable to staple transparencies to the frame due to the fact that the staples tend to tear or scratch adjacent transparencies when filed in storage. File numbers should be marked on each projectual with a felt marking pen. The last step of assembling your transparencies should be to mount a sheet of 8 1/2 x 11 construction paper on the bottom of the frame. This sheet will protect your transparency from tears and scratches in file storage.

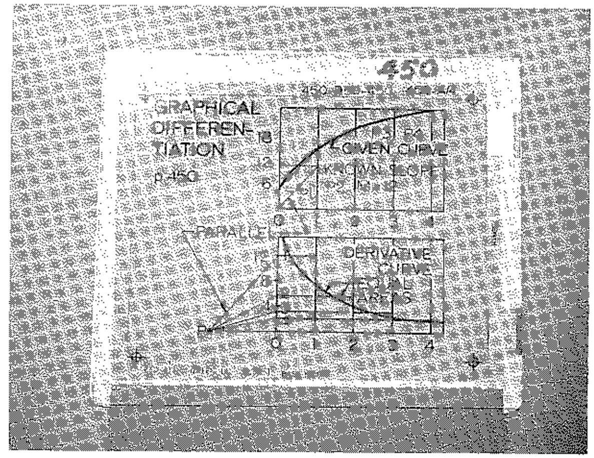


Figure 1

Transparent overlay projectual. Base mount is black with colored overlays permanently mounted on a plastic frame. Overlays hinge on right side.

Thermofax transparencies may be used in the same manner as Diazochrome film, the difference being that Thermofax will not give you colored lines. Thermofax has a series of transparency material that prints a black image on a colored transparent background. The colored background tends to tone down the harshness of the bright white especially if the room is darkened during projection. A distinct advantage of Thermofax transparencies is that of preparing from workbook layout problems. Projectuals may be made directly from a printed layout and problem solutions can be sketched or drawn with reasonable accuracy using projection pens or

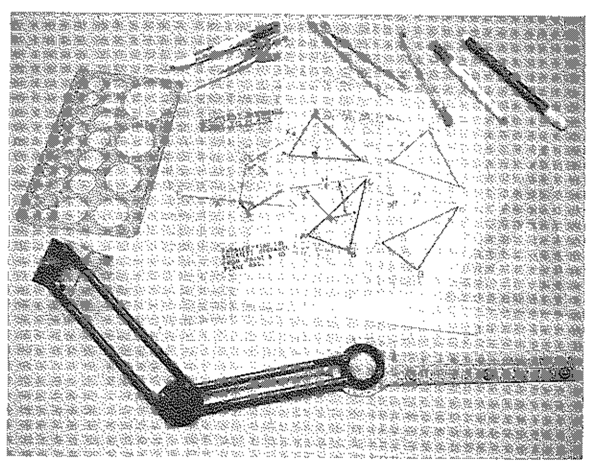


Figure 2

Basic materials for demonstration and construction on the overhead projector.

pencils. A small inexpensive drafting machine can be adapted for use on the overhead projector for use with the layout transparency. The drafting machine can be used very effectively when accompanied by an assortment of templates, triangles, transparent scales, dividers and a pencil compass. This combination of instruments provides an effective means of presenting descriptive geometry subjects.

Most overhead projectors are equipped with acetate rolls. The simple procedure of slipping your layout transparency under the roll acetate will provide an ideal arrangement for construction as you go, and eliminates the need to clean up the layout transparency after each use. This does require that the acetate roll be every week or so, but this can be accomplished without great difficulty. I suggest you make sure that all pens or pencils used on any transparency be water soluble and will not leave permanent marks on the acetate when left on the roll for any period of time.

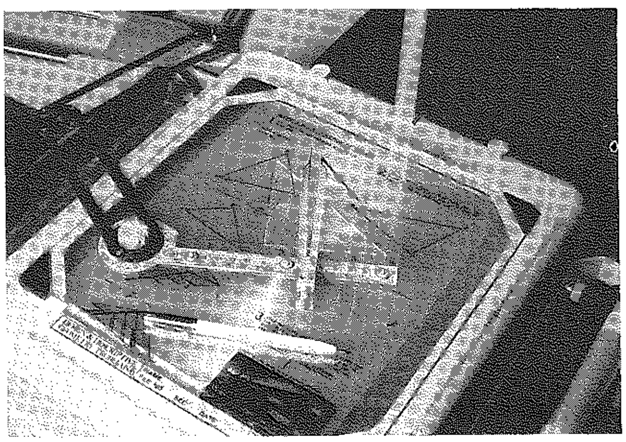


Figure 3

Thermofax transparencies of layout problems showing construction procedure with drafting equipment on the overhead projector.

Projection pens may be obtained in a variety of colors. The pencil form tends to be more satisfactory in that the lead does not dry up and discontinue to flow while you are in the middle of your presentation. Once again, make sure what ever pen or pencil you use is water soluble and can be removed easily after a period of a week or more.

CLASSROOM ARRANGEMENTS

The classroom arrangement of projector, screen, teacher and students needs to be a major consideration for effective use of any visual aid It is preferred to have the projector permanently assigned to the classroom and left there at all times. Not only will it be available when you need it, but you will find the cost of replacing projector bulbs due to moving the machine around to be an economic asset. The projector should be placed on a portable stand so that you could adjust your projected image for special case situations.

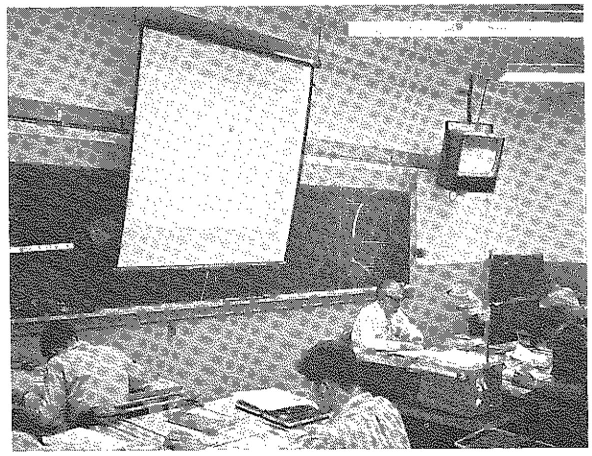


Figure 4

Classroom arrangement of screen and projector.

The screen should be large enough to project an image that can be easily viewed by all students. Of the three basic types of screen (glass beaded, lenticular and matte surface) the matte surface is recommended because it reflects light evenly to all areas of the room and gives a sharper image definition. The screen should be suspended from the ceiling and located an adaquate distance from the front wall of the room so that the bottom of the screen may be anchored back against the wall to compensate for keystoning of the projected image of your overhead projector. The image should not project trapezoidal if you want your students to pay attention to what you present. There is nothing more frustrating than having someone tell you this line is perpendicular to another and it obviously appears at an angle. The transfer of visual images in descriptive geometry or any other graphics subject is tough enough for a student without the teacher showing an inept example.

Most graphics classrooms are provided with an abundance of light with plenty of natural exterior lighting. It is not necessary for overhead projection to have the room darkened appreciably. In other words you will not need blackout screens to cut the natural light, but it is preferred to reduce light intensity somewhat. Overhead projection is most effective in slightly subdued lighting where the students can see to work as well as see the projected presentation. Of course, if you plan to use a multi-media instructional procedure, it will be necessary to darken the room so arrangements should be made according to your methods.

Versatility of the overhead projector provides some distinct advantages for the engineering graphics teacher. Through the use of the Xerox and Thermofax processes you may bring to the classroom many items that would normally have to be shown by printed material or photographed and projected through 35mm slides. Illustrations in texts and reference books may be reproduced and projected. Even photohraphs with good contrast may be prepared in this manner. Charts and graphs from technical reports and journals as well as drafting standards may be projected and discussed without breaking the students train of thought by having him thumb through pages to locate a particular page of information. Preparation of transparencies by this process involves having a Xerox copy made of the item you wish to project, then making a Thermofax transparency from the Xerox copy. High contrast black and white photographs may be reproduced if a screen is used in the Xerox process. You will find that some experimentation is necessary to accomplish satisfactory results with photographs but it can and has been done.

Mention was made that the projector stand should be portable for image adjustment on specase projectuals. By moving the projector toward or away from the screen, the image projected may be reduced or enlarged. Changing the projector position will create some keystone effect on the image but as long as the adjustment is not too radical the keystoning is negligible. If your students make use of flip charts in presentations of design problems, the overhead projector can be used to enlarge the charts or drawings. Tracing the item to be enlarged on the acetate roll then projecting the image on to the flip chart paper taped to a wall provides an easy method of preparing an outline of the necessary details to the desired size. Colored construction paper or felt pens can be applied to create an effective visual aid.

Color may be added to any projectual or transparency through the use of transparent colored pressure sensitive materials. This material is available in sheet or line form and can be specially prepared for use on the overhead projector. This must be done by photographic process and cost is a factor that can become prohibitive if you plan to use many projectuals prepared in this manner.

MULTI-MEDIA APPROACH

The faculty of the Engineering Design Graphics Department at Texas A&M University make use of the multi-media approach in virtually all subjects taught within the department. Overhead transparencies are used for the major portion of graphics instruction. A file containing over 200 department prepared transparencies is available in each of five classrooms. All transparencies are filed according to text reference location.

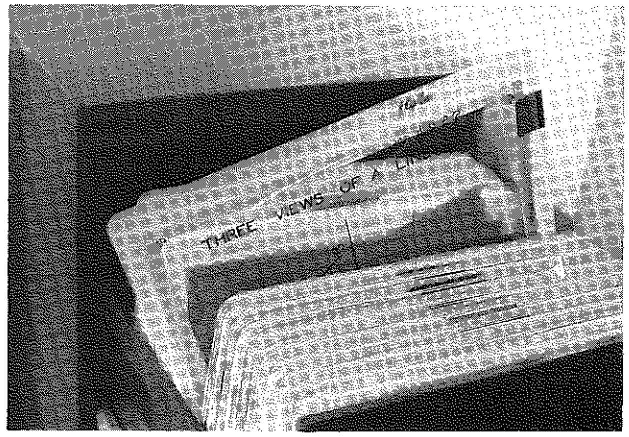


Figure 5

Permanent classroom storage of transparencies filed by textbook reference page location.

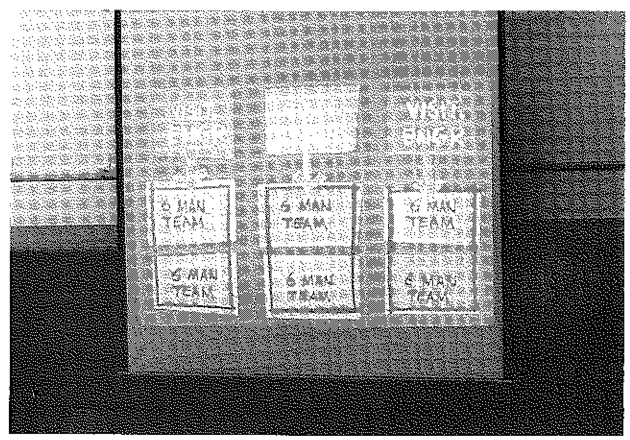
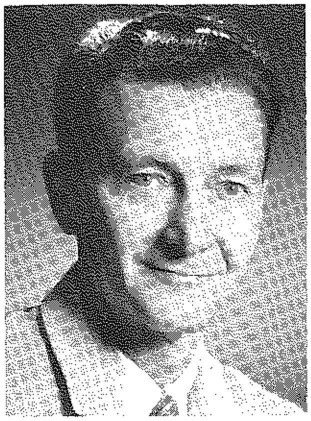


Figure 6

Explanation of Visiting Engineer program organization is quickly and easily presented through a slide series.

Supplemental information is provided through 35 mm slides and closed circuit television. Several slide series have been prepared that provide visual communication of practical applications of engineering graphics, the engineering design process and the visiting engineer program. The use of closed circuit television provides an opportunity to bring into the classroom 5 to 10 minute orientation films prepared by all of the departments in the college of engineering. By presenting one department each week throughout our first semester course, the students are able to learn something about all

(continued on page 22)



SYSTEMATIC DESIGN OF AN EFFECTIVE ENGINEERING GRAPHICS PROGRAM

CARL W. BECHTOLD
University of Colorado

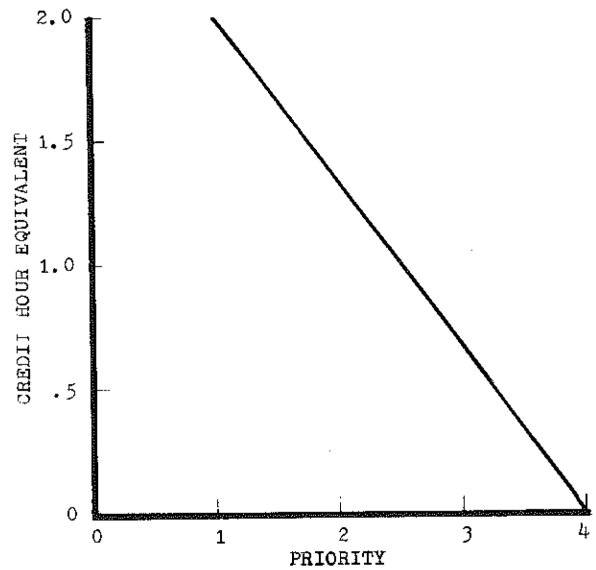
PREFACE

This study was prepared as a positive beginning to formulate instructional objectives for the course work in Engineering Graphics as is clearly pertinent to the engineering curricula at the University of Colorado. This study provides instructors of any and all engineering courses the opportunity to direct the author's personal attention to his center of interest and advise, in a positive manner, where the author's judgements may be right or wrong. It would then be possible to correlate these reflected attitudes into the instructional objectives. The reflections of the Electrical Engineering Department are being incorporated into the program during the first semester because of this study.

This systematic study clearly illustrates an effective way to determine the instructional objectives. The following are the author's personal evaluations and may not be the same as those of others, but this system does clearly define the basic objectives which can be revised periodically as a need is clearly shown.

INTRODUCTION

In order to develop an effective Engineering Graphics program, a study was made of each course listed in the College of Engineering bulletin of the University of Colorado for 1970-71, and an evaluation was made on a priority basis of the kind of Engineering Graphics instruction applicable to each of the engineering curricula offered in the College. First a priority system was set up, numbering priorities from one to four. Priority number 1 represents need for a relatively high proficiency requiring instruction in the amount of 2 credit hours or equivalent. Priority number 2 represents a requirement of instruction of 1 credit hour equivalent. Priority number 3 represents a requirement of about 1/2 credit hour equivalent. Priority number 4 represents very little relevance of graphical aplication toward the other engineering course. A



graph was prepared by priorities from 0 to 4 as abscissa and credit hour equivalent as the ordinate of the graph. This method provided the means for directly correlating average priorities of an entire curriculum with relative credit hour equivalent.

PRIORITY SYSTEM

Priority Number	Description
1	2 Cr. Hr. Equiv. of Instruction
2.	1 Cr. Hr. Equiv. of Instruction
3	½ Cr. Hr. Equiv. of Instruction
4	Very little Relevance

COURSE CONTENT

The content of Engineering Graphics may be divided into three general categories. The first will be called "Data Reduction and Assimilation", the second - "Descriptive Geometry" the third - "Production Drawing".

DATA REDUCTION AND ASSIMILATION

Under the heading of Data Reduction and Assimilation is included flow diagrams, graphs and charts, functional scales, nomograms, empirical curves, graphical calculus, alignment charts, and graphical mathematics. The analysis, reduction and assimilation of these data are among the prime activities of an engineer. The use of the computer and computer graphics should be used to the fullest extent in this portion of the student engineer's experience and instruction.

DESCRIPTIVE GEOMETRY

Descriptive Geometry can be defined as the projection of three dimensional figures onto a two dimensional plane of paper in such a manner to allow geometric manipulations to determine lengths, angles, shapes and other descriptive information concerning the figures. The type of problems lending themselves to solution by descriptive geometry, although very common, are usually more difficult to solve mathematically. The simple determination of the angle between planes is a basic descriptive geometry problem, but is difficult to determine by mathematics when the plane of the angle does not appear true size in the given views. In other words, training in descriptive geometry helps provide a clear mental understanding of the spacial relationships of the components of the engineering problem being solved.

PRODUCTION DRAWINGS

The heading Production Drawings includes all the necessary views of a physical object including size and space dimensions, kinds and types of fasteners, manufacturing processes and conventions; a complete drawing or set of drawings from which a product can be manufactured

Included in each of these three categories defined above, there are some common features which must be stressed; namely, engineering lettering, an ability to prepare sketches, the use of necessary drawing and drafting instruments, and the understanding of geometric construction. In the future, the computer will be used more and more by the engineer and an understanding of computer graphics and computer aided design must be included in the freshman's initial program.

After the curriculum for each engineering endeavor was analyzed and priorities established, a summary of all engineering curricula was prepared. That summary reflects that 54% of the student's instruction in engineering graphics should be relative to data reduction and assimilation, 34% should pertain to descriptive geometry, and 12% should pertain to production drawings. These relative percentages should be utilized if only one core program is to be used, as suggested by the recent ECPD visits to the University of Colorado. Utilizing the priority graph, mentioned previously, an estimated optimum instruction program was established. Accordingly, the following shows the requirements in credit hour equivalents;

SUMMARY OF ALL ENGINEERING CURRICULA

	DATA REDUCTION & ASSIMILATION	DESCRIPTIVE GEOMETRY	PRODUCTION DRAWINGS
AEROSPACE ENGINEERING SCIENCES	1.53	1.96	3.36
APPLIED MATHEMATICS	1.00	2.07	3.93
ARCHITECTURAL ENGINEERING	1.63	1.59	3.03
CHEMICAL ENGINEERING	1.59	2.50	3.19
CIVIL ENGINEERING	1.32	1.64	3.32
ELECTRICAL ENGINEERING	1.59	2.44	3.74
ENGINEERING DESIGN & ECONOMIC EVALUATION	1.34	2.06	3.06
ENGINEERING PHYSICS	1.34	1.97	3.78
MECHANICAL ENGINEERING	1.40	1.80	3.56
MEDIAN PRIORITIES	1.40	1.97	3.36
AVERAGE PRIORITIES	1.42	2.00	3.44
	54%	34%	12%

TABLE A

It will be noted that the average estimated credit hour equivalent is 2.93 credit hours of instruction necessary to obtain the desired proficiency in the various disciplines. All but two of the engineering curricula require only two credit hours of instruction. Therefore, the present program cannot fulfill the needed requirement. Additional analysis was made of the five curricula requiring 2 hours of EDEE 101 only. The content of the courses for these five departments should be 55% of data reduction, 36% of descriptive geometry, and 9% of production drawings, based upon the priority system established.

ESTIMATED OPTIMUM INSTRUCTION*

	DATA RED.		DESC. GEO.		PROD. DRG.		OPTIMUM CR.HR.EQ.	% ADJUSTMENT (2 CR. HR.)
AEROSPACE ENGINEERING SCIENCES	1.5	+	1.10	+	.34	=	2.94	68.
APPLIED MATHEMATICS	2.0	+	0.93	+	0	=	2.93	68.
ARCHITECTURAL ENGINEERING	1.3	+	1.40	+	.50	=	3.20	125.
CHEMICAL ENGINEERING	1.4	+	0.75	+	.40	=	2.55	78.
CIVIL ENGINEERING	1.7	+	1.30	+	.34	=	3.34	60.
ELECTRICAL ENGINEERING	1.4	+	0.77	+	.15	=	2.32	86.
ENGINEERING DESIGN & ECONOMIC EVALUATION	1.7	+	0.95	+	.45	=	3.10	129.
ENGINEERING PHYSICS	1.7	+	1.00	+	.10	=	2.80	71.
MECHANICAL ENGINEERING	1.58	+	1.20	+	.23	=	3.01	66.
MEDIAN CR.HR.EQ.	1.53	+	1.00	+	.27	=	2.80	
AVERAGE CR.HR.EQ.	1.60	+	1.00	+	.33	=	2.93	68.
AVERAGE CR.HR.	1.09 54%	+	0.68 34%	+	.23 12%	=	2.00 CR.HR.	

* Using the PRIORITY GRAPH

ADJUSTMENT is the percentage relationship of PRESENT CREDIT HOUR INSTRUCTION to the EXTIMATED OPTIMUM CREDIT HOUR EQUIVALENT.

TABLE B

CURRICULA REQUIRING EDEE 101 - ONLY 2 CR. HR.

	DATA REDUCTION & ASSIMILATION	DESCRIPTIVE GEOMETRY	PRODUCTION DRAWINGS
AEROSPACE ENGINEERING SCIENCES	1.53	1.94	3.36
CIVIL ENGINEERING	1.32	1.64	3.32
ELECTRICAL ENGINEERING	1.59	2.44	3.74
ENGINEERING PHYSICS	1.34	1.97	3.78
MECHANICAL ENGINEERING	1.40	1.80	3.56
MEDIAN PRIORITIES	1.40	1.94	3.56
AVERAGE PRIORITIES	1.44	1.96	3.55
CURRICULA REQUIRING EDEE 102 - ONLY 2 CR. HR.			
APPLIED MATHEMATICS	1.00	2.07	3.39
CHEMICAL ENGINEERING	1.59	2.50	3.19
AVERAGE PRIORITIES	1.30	2.28	3.56
CURRICULA REQUIRING EDEE 101 & 102 - 4 CR. HR.			
ARCHITECTURAL ENGINEERING	1.63	1.59	3.03
ENGINEERING DESIGN & ECONOMIC EVALUATION	1.34	2.06	3.06
AVERAGE PRIORITIES	1.48	1.82	3.04

TABLE C

Only two curricula require EDEE 102 to fulfill their 2 hour graphics requirement. The course content for these two curricula -- Applied Mathematics and Chemical Engineering --- can be based on the average of the priorities. If so, the course content should be 61% data reduction and assimilation, 30% descriptive geometry, and 9% production drawing.

AVERAGE COURSE CONTENT DISTRIBUTION

EDEE 101 - ONLY

1.5 + 1.0 + .25	= 2.75 Cr. Hr. Equiv. (from Graph)
2. Cr. Hr. ÷ 2.75	= .73 = 73% Adjustment
1.10 + .73 + .17	= 2. Cr. Hr.
55% + 36% + 9%	= COURSE CONTENT

EDEE 102 - ONLY

1.7 + .85 + .23	= 2.78 Cr. Hr. Equiv.
2. Cr. Hr. ÷ 2.78	= .72 72% Adjustment
1.22 + .61 + .17	= 2.0 Cr. Hr.
61% + 30% + 9%	= COURSE CONTENT

EDEE 101 & 102

1.48 + 1.18 + .5	= 3.16 Cr. Hr. Equiv.
4 Cr. Hr. ÷ 3.16	= 1.26 = 126% Adjustment
1.86 + 1.49 + .65	= 4 Cr. Hr.
47% + 37% + 16%	= COURSE CONTENT

TABLE D

Considering the curricula requiring EDEE 101 and 102, for 4 credit hours of engineering graphics -- Architectural Engineering and Engineering Design and Economic Evaluation -- should have a course content of 47% data reduc- and assimilation, 37% descriptive geometry, and 16% production drawing. Table D shows how the average course content distribution was calculated utilizing the priority graph and the average priority numbers for the various groupings of curricula: the credit hour equivalent from the graph, the ratio between the number of credit hours provided in each curriculum for engineering graphics to the credit hour equivalent, and the percentage adjustment made to determine the average course content.

ADJUSTED COURSE CONTENT DISTRIBUTION

	DATA REDUCTION		DESCRIPTIVE GEOMETRY		PRODUCTION DRAWING	
AEROSPACE ENGINEERING SCIENCES	1.02 51% 14	+	.75 37% 10	+	.23 12% 4	= 2. Cr. Hr. 28 Periods
APPLIED MECHANICS	1.36 68% 19	+	.64 32% 9	+	0. 0. 0	= 2. Cr. Hr. 28 Periods
*ARCHITECTURAL ENGINEERING	1.63 41% 23	-	1.75 44% 24	+	.62 15% 9	= 4. Cr. Hr. 56 Periods
CHEMICAL ENGINEERING	1.09 54% 15	+	.59 30% 8	+	.32 16% 5	= 2. Cr. Hr. 28 Periods
CIVIL ENGINEERING	1.02 51% 14	+	.78 39% 11	+	.20 10% 3	= 2. Cr. Hr. 28 Periods
ELECTRICAL ENGINEERING	1.20 60% 17	+	.66 33% 9	+	.13 7% 2	= 2. Cr. Hr. 28 Periods
*ENGINEERING DESIGN & ECONOMIC EVALUATION	2.19 55% 31	+	1.23 31% 17	+	.58 14% 8	= 4. Cr. Hr. 56 Periods
ENGINEERING PHYSICS	1.21 61% 17	+	.71 36% 10	+	.08 3% 1	= 2. Cr. Hr. 28 Periods
MECHANICAL ENGINEERING	1.04 52% 15	+	.79 40% 11	+	.17 8% 2	= 2. Cr. Hr. 28 Periods
AVERAGE Cr. Hr. PERIODS REQUIRED	1.13 56% 14	+	.70 35% 9	+	.17 9% 2	= 2. Cr. Hr. 25 Periods

*Excluded from averages

TABLE E

Additional studies were made to determine the percentage course content of the three graphics categories for each engineering curriculum. All engineers must have some ability to understand production drawings. An absolute minimum ability can be acquired in four work periods when integrated into a course of this kind. This fact was considered in the development of the "Basic Engineering Graphics Course" content. (see Table F). This Basic Course has been developed to meet the needs of all curricula requiring 2 semester hours of Engineering Graphics. The plan of instruction for 1970-71 will correlate the academic and scholarly activities of five members of the faculty into a team to fulfill the instructional objectives established for the engineering graphics courses.

BASIC ENGINEERING GRAPHICS COURSE

PROGRAM FOR 15 WEEKS - 30 PERIODS

	DATA REDUCTION		DESCRIPTIVE GEOMETRY		PRODUCTION DRAWING		
101 COURSE CONTENT (CORE)	.86	+	.64	+	.28	=	1.78 Cr.Hr.
PERIODS REQUIRED	12		9		4*	=	25
	43%		32%		14%		
PLUS 3 PERIODS INDIVIDUAL RELATED (11%)							3
2 PERIODS FOR QUIZZES							2
TOTAL PERIODS							30
PLUS FINAL EXAM							

* MINIMUM NUMBER OF PERIODS TO PRESENT BASIC CONCEPTS.

ARCHITECTURAL ENGINEERING, ENGINEERING DESIGN & ECONOMIC EVALUATION "CORE"	.86	+	.64	+	.28	=	1.78 Cr. Hr.
PLUS 11% RELATED TO DESCRIPTIVE GEOMETRY			.22				
COURSE CONTENT	.86	+	.86	+	.29	=	2.0
	43%		43%		14%		100%

TABLE F

Choice graphics problems were received from departmental faculty members and assembled into departmental publications (Student Laboratory Workbooks). Each of the five participating instructors will prepare a series of lectures related to the phases of the courses most nearly reflecting his own professional expertise. All instructional methods will rely heavily upon visual aid materials prepared during the past year and will be augmented where desirable.

CUSTOMIZED TOPICS *

	DATA REDUCTION		DESCRIPTIVE GEOMETRY	PRODUCTION DRAWING	
AEROSPACE ENGINEERING SCIENCES	2	+	1		= 3 Periods
APPLIED MATHEMATICS	3				
ARCHITECTURAL ENGINEERING			3		
CHEMICAL ENGINEERING	3				
CIVIL ENGINEERING	1½	+	1½		
ELECTRICAL ENGINEERING	3				
ENGINEERING DESIGN & ECONOMIC EVALUATION			3		
ENGINEERING PHYSICS	3				
MECHANICAL ENGINEERING	1½	+	1½		

* These customized topics should be in the form of a project related to the specific interest of each individual student. Use of Computer Graphics should be encouraged.

TABLE G

It is planned to utilize the newly-developed sound-slide projector system. This equipment permits recording a 35 second message on the sound track around each 35 mm slide. The use of this kind of equipment will provide a means of developing high quality instruction methods. It will help to assure more uniform instruction to all students, and hopefully result in the kind of student satisfaction reflected by the comments from the author's students of the Fall of the previous year.

The well prepared lectures will be presented via live closed circuit television. An intercom system will permit questions from any classroom. All five instructors will participate in each lecture session, being the first hour of each 3 hour period. However, only two instructors will participate in the final 2 hours of the class meeting and teaching assistants will help monitor the progress of this work period.

ENGINEERING GRAPHICS II

	DATA REDUCTION		DESCRIPTIVE GEOMETRY		PRODUCTION DRAWING		
ARCHITECTURAL ENGINEERING	1.63	+	1.75	+	.62	=	4. Cr.Hrs.
ENGINEERING GRAPHICS I	.86	+	.86	+	.28	=	2.
ARCHITECTURAL ENGINEERING ENGINEERING GRAPHICS II	.77	+	.89	+	.34	=	2.
ENGINEERING DESIGN & ECONOMIC EVALUATION	2.19	+	1.23	+	.58	=	4. Cr.Hrs.
ENGINEERING GRAPHICS I	.86	+	.86	+	.28	=	2.
ENGINEERING DESIGN & ECONOMIC EVALUATION ENGINEERING GRAPHICS II	1.33	+	.57	+	.30	=	2.
102 COURSE CONTENT "CORE"	.77	+	.57	+	.32	=	1.66
	38%		29%		16%		83%

PLUS 17% TO BE RELATED TO INDIVIDUAL STUDENT:
Descriptive Geometry for ARCHITECTURAL ENGINEERINT
Data Reduction for ENGINEERING DESIGN & ECONOMIC EVALUATION

PROGRAM FOR 15 WEEKS (30 PERIODS)

	DATA REDUCTION		DESCRIPTIVE GEOMETRY		PRODUCTION DRAWING		
102 COURSE CONTENT (CORE)	.77	+	.57	+	.32	=	1.66 Cr.Hrs.
PERIODS REQUIRED	11	+	8	+	4	=	23
PLUS 5 PERIODS INDIVIDUAL RELATED							5
2 PERIODS FOR QUIZZES							2
TOTAL PERIODS							30
PLUS FINAL EXAM							

TABLE H

NOTE: Complete details of this study may be obtained from

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Department of Engineering Design
and Economic Evaluation
Engineering Center OT 6-34
University of Colorado
Boulder, Colorado 80302

VISUAL __________ (continued from page 18)

of the engineering degree options available at Texas A&M University.

The multi - media approach has provided this department with a great deal of versitility in our instructional presentations. The department has been utilizing the multi - media approach for the past four years. Evaluation of presentation materials has been a continuing process. Many items have been revised os disgarded due to instructional inadaquacy. Multi-media has given us the capability of bringing into the classroom numerous examples of engineering applications and requires a minimal amount of instruction time.

Figure 7

Slide projector and storage cabinet permanently assigned to each classroom provides ready access to this valuable instructional aid.

CREATIVE DESIGN AND ENGINEERING GRAPHICS AT LOUISIANA STATE UNIVERSITY

C. E. HALL
Louisiana State University

The creative design program is currently used to engender creativity and enhance the quality of educational programs as well as making the course work more meaningful for students. This innovation has proved quite successful since it provides students an opportunity to engage in creative thinking and participate in open ended problem solving situations.

The Engineering Graphics Department of the College of Engineering, Louisiana State University, Baton Rouge invited a visiting engineers program in conjunction with its creative design program. Professional engineers from industry are being invited to attend the different engineering graphics classes and work with the students on various problems pertaining to creative design. Two or more professional engineers are invited to work with each class dur- a semester. This action was initiated to introduce the beginning engineering students to the creative and challenging aspects of professional engineering. The assignment pertaining to the creative design program is one of the last assignments for each course. It is delayed until the students have learned essential elements of engineering graphics design and communications as they relate to engineering practices. It is felt that the students will better understand the discussion as presented by the visiting engineers after having been first introduced to the language of the engineering profession. This practice has received the overwhelming support of the vising engineers.

To set the stage for the creative design assignment professional engineers from industry are invited to meet with individual classes during the third or fourth week of the semester. Two engineers are requested to work with each class. Since engineering as a whole is creative, no effort is made to have engineers of any particular discipline visit any specific class.

When making the initial visit the engineers are requested to discuss in general terms how engineering problems arise in their plant(s) and in what manner these problems are directed through engineering channels. They are also requested to make suggestions relative to ideas that would be suitable for class problems. The problems are to be open ended in nature and ones that may be worked by freshman students. The students are expected to reach a tenable solution within fifteen to twenty clock hours.

According to reports from the staff, the visiting engineers discuss all phases of their work, i. e., the importance of professional preparation, registration, employment, salaries, incentive toward excellence, engineer's role in management, the engineer in international work and the role of graphics as a tool for communications. They also stress the value of good (neat and accurate) engineering drawings as tools to be used in the presentation of ideas to top management concerning maintenance, new products, plant modification or even the expansion of various facilities.

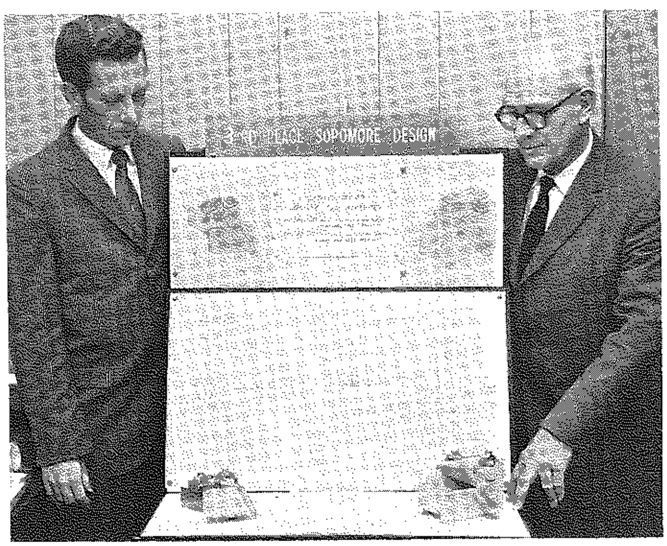
Following the initial visit of the engineers from industry, each instructor continues to motivate his students relative to creative design. This motivation is derived through brief discussion periods during the laboratory sessions, wherein the application of specific graphics theories, standards and conventional practices are emphasized. Near the end of the semester the students in each class are assigned to work on a creative design project of their choice (with the approval of the instructor). They work in groups, of two, three or four students each. Each member of the group is held responsible for some phase of the assignment. The complete assignment includes a written report and a set of working drawings. As a rule, one student is responsible for making the assembly drawing and preparing the parts list, while other members prepare the report and make the detail working drawings. The report treats the need for such an undertaking and the goals established relative to solving the problem. All preliminary sketches and analyses are included in the report. The research pertaining to the selection of materials, establishing production and marketable data, and manufacturing and production schedules are also included in the report.

During the last week of the semester, after all creative design assignments have been completed the professional engineers are invited to return to the classroom to hear the oral presentation of the reports by the students. The engineers often enter into the discuddion following the presentation of each report and give their critique of the work. Preliminary judging of the students' work is also done at this time.

This educational innovation is now in its third year and is actually serving two real needs as expressed by the participants, i. e., the students and the engineers. The students are being highly motivated toward their work as is evidenced by the increased enthusiasm with which they work on the different designs and the visiting engineers relate to this experience provides them an opportunity to renew their acquaintance with the academic world.

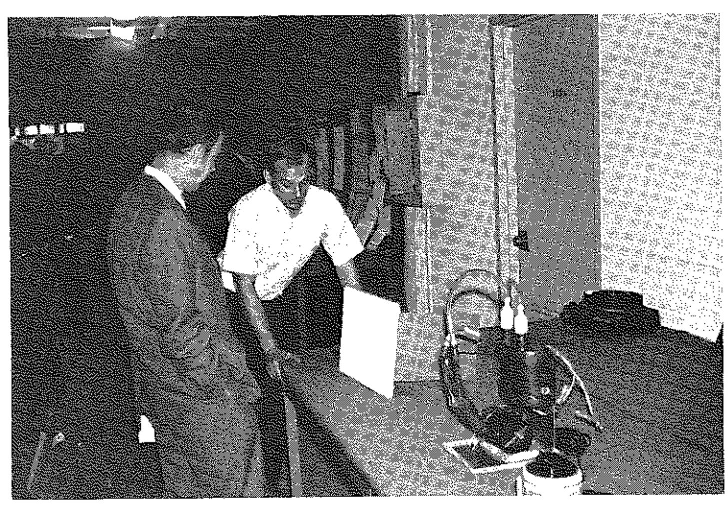
The Engineering Graphics Department selects the better projects from among the entire group for entries in the Annual Creative Engineering Design Display at the annual convention of the American Society for Engineering Education. At the ASEE meeting the class projects are entered in competition with projects from other engineering colleges and universities in the United States and Canada.

The result of this phase of the Engineering Graphics Department's efforts to enhance the quality of engineering education have been quite successful thus far. Not only have the students' interest in their work increased the the other departments within the College of Engineering have expressed very favorable opinions concerning the program.

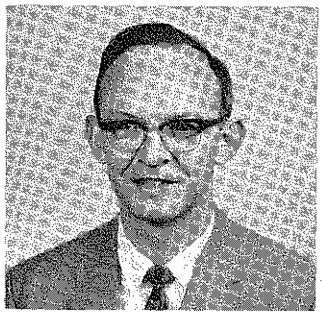


Mr. JIM MATHIES and Dr. WILLIAM STREET examining award winning project.

First place award for graduate design



GRAPHICAL DETERMINATION OF FLOW AREA THROUGH RADIAL FLOW COMPRESSOR OR TURBINE WHEEL



DONALD E. KEYT
Department of Mechanical Engineering Technology
Spring Garden College

When a new compressor or turbine wheel is designed, the information arriving at the designer's desk from the engineer specializing in fluid flow calculations usually consists of the following quantities:

1. Inlet area
2. Inlet blade angle
3. Outlet area
4. Outlet blade angle
5. Wheel outside diameter
6. Number of blades

Starting with this scanty amount of information, the mechanical designer determines how much space he will need at the hub to provide for securing the wheel to the shaft. He then calculates the dimensions of the wheel and its shroud (impeller case if the wheel is unshrouded) at the entrance and exit of the gas passages. He next fits smooth curves of an arbitrary shape between the points located from these dimensions to define the shape oi tne wheel and its shroud. In the same manner, starting with the specified entrance angle of the blades, smooth curves are fit so as to provide blades which terminate with the required exit angle. Aside from mechanical details, the designer has completed his job at this point except for one very important factor. For efficient compression or expansion of the gas in the wheel, the gas passage cross sectional area should be constant through the wheel or increase, or decrease at a uniform rate. The shape of the wheel and its shroud can easily be altered to adjust the cross sectional area of the gas passage. However, how can the size og the gas passage be determined?

To answer this question is "by the use of descriptive geometry". To accomplish this task the engineer need understand no more about descriptive geometry than he learns in a modern one semester graphics course. Once he has made the initial construction, he can explain the method to a competent draftsman and pass on to him the week or more of drawing required to determine the shape of the initial passage and altered passages if redesign is required. While the method is not exact, it should give results which are as accurate as the other calculations on which the design is based.

A close approximation to the cross section of the gas passage is the figure formed by the intersections of the plane perpendicular to the center line of the gas passage with the impeller wheel, its shroud (or surface tangent to the top of the blades of an unshrouded wheel), and the blades. To determine the size and shape of this figure, it is necessary to have a representation drawn to scale of the proposed impeller or turbine which shows the intersections of the blades with the wheel and shroud (top edges of blades for unshrouded impellers). Unfortunately, the passage center line will probably not be shown on the drawing of the wheel. To approximate the center line it is only necessary to add a aurface, having the shape of a blade, half-way between the two existing blades. The center line of the gas passage can then be represented by a line which passes half-way between the root and the crest of this blade-like surface.

To obtain the area variation along the gas passage, the following described construction must be repeated a number of times. To decrease the work, a number of prints should be made from the drawing showing the wheel with the additional surface containing the passage center line drawn in. Then starting with one of these prints, point "P" on the passage center line is selected and the following projections are obtained as follows:

1. <u>Obtain a true length projection of a vector drawn tangent to the center line of the gas</u>

passage at the point "P". To do this, it is sufficient to project a few points of the center line into a plane which is parallel to the top view of the tangent vector and to draw in the tangent vector tangent to the curved line passed through these points at "P" (see the figure). The auxiliary plane is called the F-1 plane in the figure.

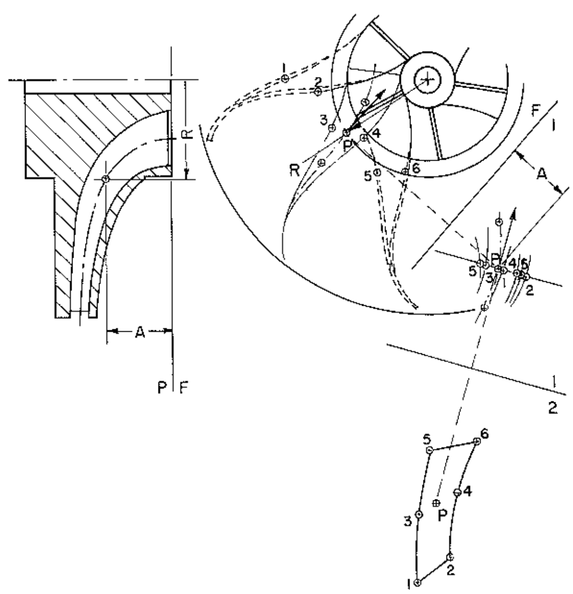
2. Draw a line projection of the plane which is perpendicular to the tangent vector and contains "P". Since the projection of the tangent vector in this auxiliary plane is a true length projection the line drawn through the point "P" which is perpendicular to the tangent vector is a line projection of the plane which is perpendicular to the tangent vector.

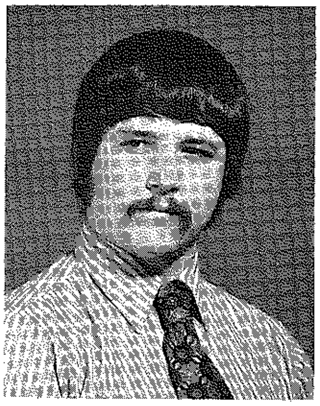
3. Determine the intersection of the plane perpendicular to the tangent vector with the surrounding surfaces of the gas passage. After arbitrarily locating several points on one of the lines of intersection of the surfaces surrounding the gas passages, project these points into the F-1 plane and pass a smooth curve through the points. The curved line crosses the line representing the perpendicular to the tangent vector at a point on the periphery of the desired flow passage cross sectional area. Other points are obtained in the same manner. The sides representing the blades can with little error be considered straight lines. To obtain the greatest accuracy, additional points on the two curved edges can be found by drawing in additional blade-shaped surfaces in the original drawing and projecting the lines of intersection into the F-1 plane as described in step 3.

4. Construct a true shape projection of the cros sectional area. If an additional auxiliary plane is drawn which is parallel to the plane which is perpendicular to the tangent vector, and all of the points of intersection of the perpendicular plane with the gas passage surfaces are projected into this plane and joined with the proper straight lines or smooth curves, the approximate shape of the flow passage will have been obtained at the point "P".

5. Measure the area of the flow passage at point "P". The final step can easily be performed with the aid of a planimeter or by covering the final projection with a squared transparent overlay and count-squares.

Once the final projection has been drawn, the location of the assumed gas passage can be checked to see if it is actually in the center of the passage. If it is not, the center line should be relocated and the construction redrawn.





Book Review

ALLAN CLEMOW

BASIC LESSONS IN TECHNICAL DRAFTING, G. W. Shalkouser and R. M. Coleman; The Pruitt Press; 1968; 338 pages

The authors of this text describe it as a step by step program for introductory students in technical drawing. This program takes the form of small sections, or lessons, each covering one particular aspect or technique. All of the 42 lessons are clear in their interpretation and contain many examples of the techniques involved. Basically, the coverage includes sketching techniques, orthographic projection including conventional practices, pictorial representations, and also five lessons on the practice of inking.

This is a how-to book as it details the use of instruments, their care and feeding, and tips on how to utilize your equipment efficiently. The book does not have a large amount of verbage but uses illustrations and drawings to achieve its. points All the rules that are enumerated are developed with some kind of graphical interpretation. At the end of most lessons are problems for the student. Coupled with the text is a folder containing two booklets for practice in lettering, blank sheets for homework problems, sheets of vellum, and grid sheets for objects orthographically and pictorially.

Again, this is an introductory text and covers only the basics of formal drawing proceedures but does so in an excellent format without confusing the student. Indeed, this text could be used by students without formal lectures as a self-learning text.

A FORTRAN IV PROBLEM SOLVER, W. A. Manning and R. S. Garnero; McGraw-Hill; 1970; 162 pages

This book points out a problem that confronts every author and user of computer texts. Specifically, the problem is the variability of preparing instructional material to cover a number of operating systems. Even with the standard Fortran IV, many installations have differences in the compiler which detracts from the usefulness of any particular book. This is one of the main reasons for the plethora of texts on the market. Each instructor must gear his course for his own operating system. This leads to distinct problems in selecting a text. If a general, non-specific language publication is used, the instructor must supply all of the operating characteristics. If a more specific text is adopted, changes must be recognized and taken care of. This reviewer does not want to color anyone's opinion about this publication, but these thoughts emerge when one reads a computer text.

Specifically, this book is a problem oriented text which the authors feel should be used with another text that covers Fortran more deeply However, the examples provide information on the structure of the basic executable statements. At this point it should be mentioned that this book was designed to be used with the IBM 360 Level H compiler. There are 66 problems as numbered that provide opportunities for the student to learn the Fortran language through practice with flow charts, programs, and simple usage problems. Students have a chance to work in both directions, writing programs and interpreting those already existing. Following the exercise-problem section are eighteen application problems stressing the generation of programs. These are designed, in some cases, to build upon one another with additional information provided. Most of these application problems are in the area of statistics and data processing.

BASIC FOR BEGINNERS, W. Y. Gately and G. G. Bitter; McGraw-Hill; 1970; 167 pages

This paperback was generated by the need for instructional materials over and above those provided by the parent computer company for use on a particular machine. It is billed as a self-instruction book but is not in the form of a programmed learning text. There are eight chapters with the first two being concerned with an introduction to computers and the use of the terminal. The remaining chapters deal with the fundamentals of the Basic language and its use in program arrangements. At the end of each chapter is s set of questions provided with solutions and following that a set of exercises for homework.

The authors have tried to keep the text as general as possible and have included information on the special characteristics of the major manufacturers' operating systems. Then a program is shown in the operating system of each of these companies' machines. Also, there are additional problems listed for further study in several areas.

INTRODUCTION TO DIGITAL COMPUTER USING FORTRAN IV, W. L. Dunn; McGraw-Hill; 1969; 269 pages

This text is a programmed instruction book dealing with the basics of Fortran. It is split into two parts; the first being the instructional material and the second part comprised of reference notes and tests keyed to the first part. Also available to the student is a supplement with answers to the test material and computer decks for several of the problems. This book is comparable to most texts in the field as coverage of the basic language material is concerned. It has additional areas of interest in coding of programs with keypunches and ten computer problems ending with numerical integration. There is also one section on plotter subroutines, but the subroutines listed are for one installation.

The sequence of material would seem to be more or less standard with computer problems inserted when the author feels the student is ready to practice. There is quite a bit of material in this book, but as programmed instruction would imply, it is served to the student in small quantities to be easily digested. It has been prepared to be as general as possible to fit the widest scope of adaptability. Even materials concerning keypunches have a schematic so as not to show differences between models. This book would be a very interesting experience for students, but this reviewer believes that perhaps a synopsis of the Fortran rules would also be helpful as a ready reference for course work.

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