The Journal of Engineering Drawing

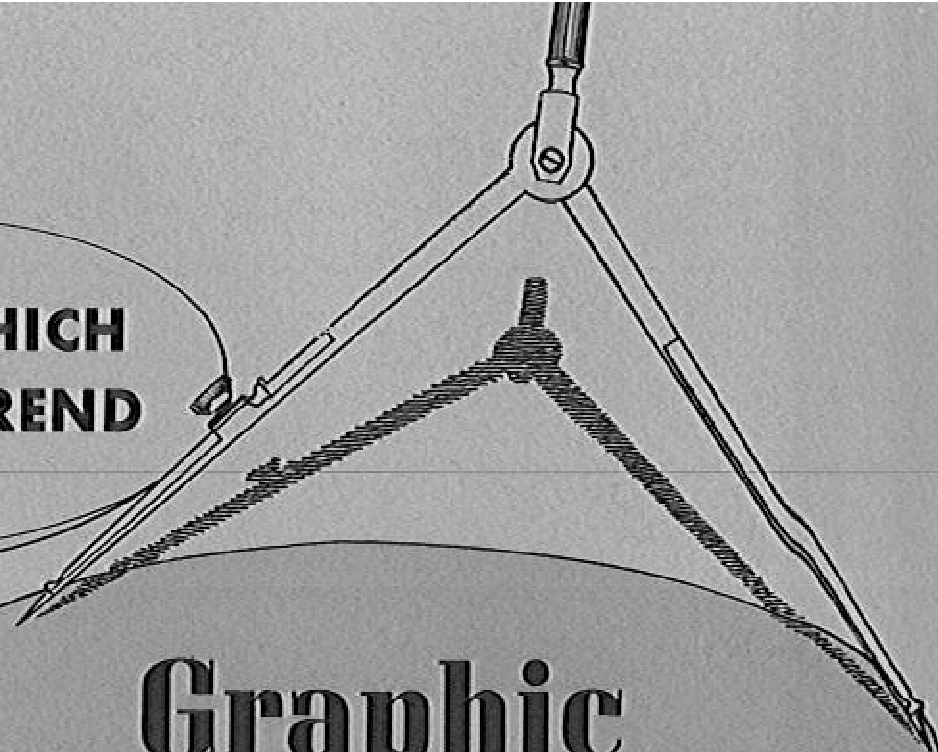
PORSCH

CONTENTS

VOL. 18, No. 3 — NOVEMBER, 1954 — SERIES No. 54

PUBLISHED BY THE DIVISION OF ENGINEERING DRAWING AND DESCRIPTIVE GEOMETRY OF THE AMERICAN SOCIETY FOR ENGINEERING EDUCATION.

A BOOK WHICH MEETS THE TREND



Graphic Representation

Emphasizing

- charts and graphs
- graphical mathematics
- freehand technique
- blueprint analysis

EUGENE G. PARÉ, *Associate Professor, Technical Drawing Department, Illinois Institute of Technology*

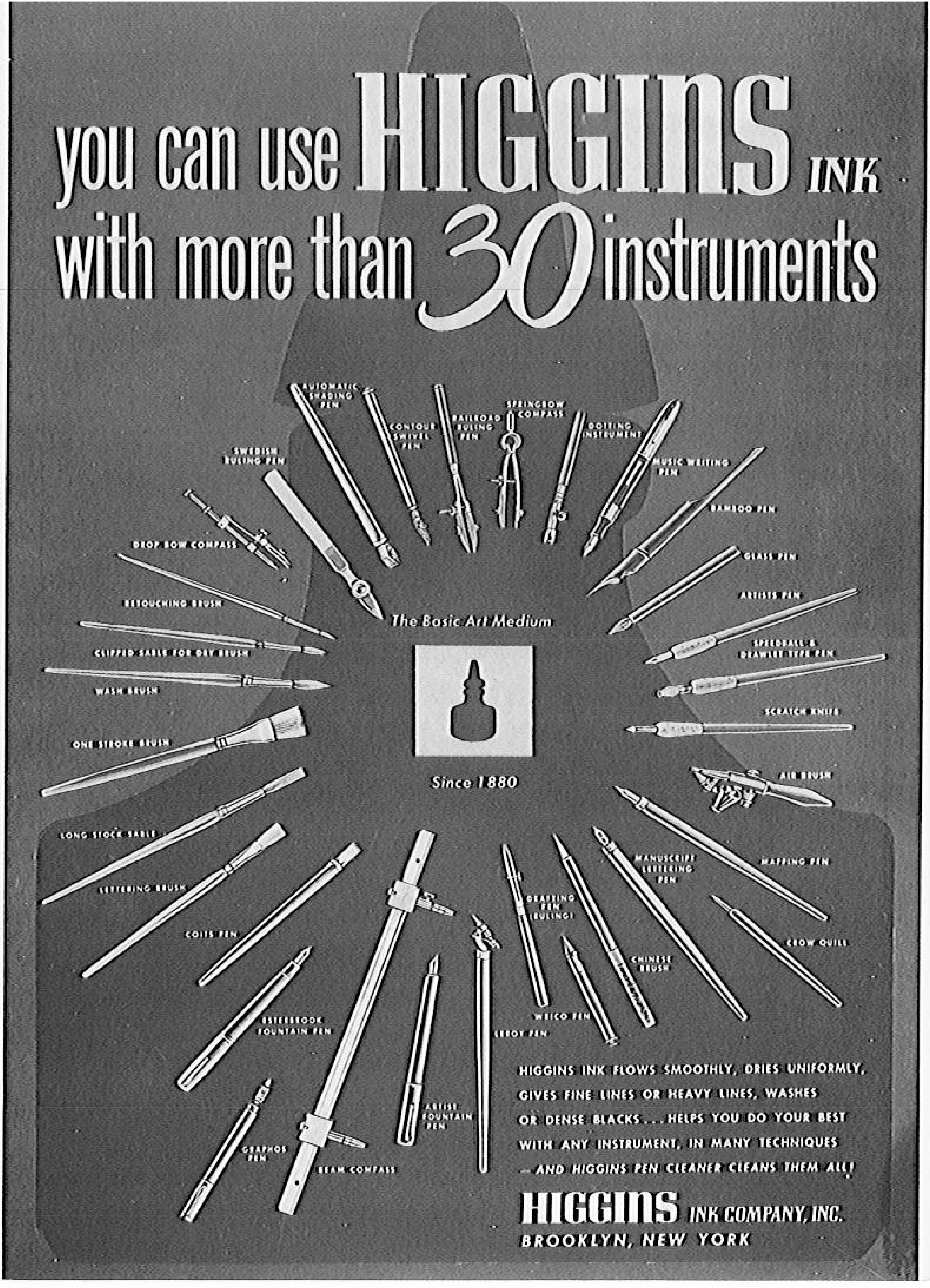
FRANK HRACHOVSKY, *Professor, Illinois Institute of Technology*

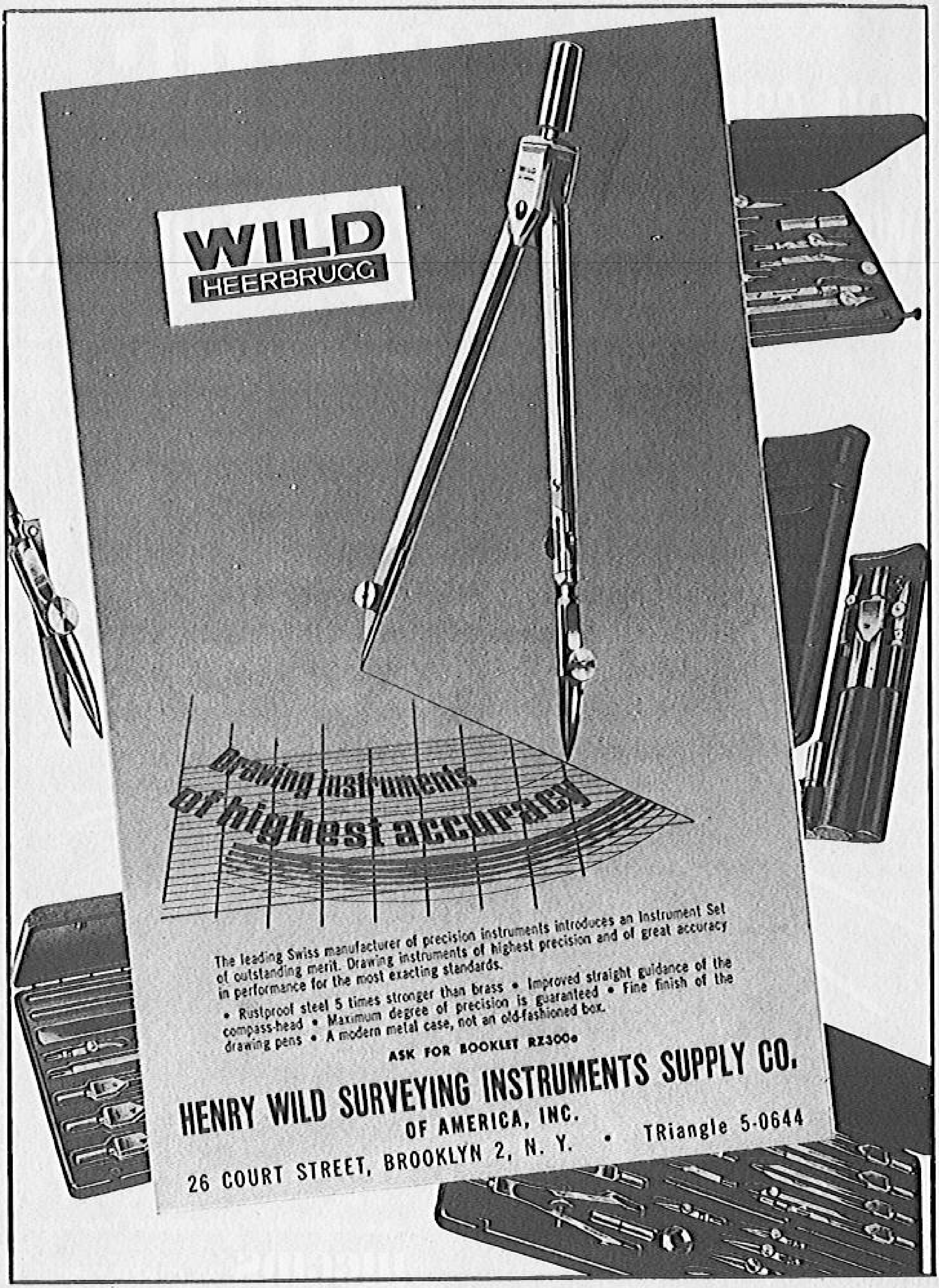
ELIOT TOZER, *Chairman, Department of Drawing, Northeastern University*

HERE is a beginning laboratory manual designed for the science student whose training should include the fundamentals of graphic communication. Outstanding is the comprehensive coverage of the graphic presentation and interpretation of data as visual aids in scientific and business analysis reports. The book treats the essentials of multiview drawing, pictorials and drawing techniques. Noteworthy are the sheets with problem material drawn to generous size, and complete problem instructions. The authors have carefully class-tested the material for a period of two years. *1954* *40 p.p.* *$3.60*

The Macmillan Company

60 FIFTH AVENUE, NEW YORK 11, N. Y.


you can use HIGGINS INK
with more than 30 instruments
AUTOMATIC SHADING PEN
CONTOUR SWIVEL PEN
RAILROAD RULING PEN
SPRINGBOW COMPASS
DOTTING INSTRUMENT
MUSIC WRITING PEN
SWEDISH RULING PEN
DROP BOW COMPASS
BAMBOO PEN
GLASS PEN
RETOUCHING BRUSH
ARTISTS PEN
The Basic Art Medium
CLIPPED SABLE FOR DRY BRUSH
SPEEDBALL & DRAWLET TYPE PEN
WASH BRUSH
SCRATCH KNIFE
ONE STROKE BRUSH
Since 1880
AIR BRUSH
LONG STOCK SABLE
MANUSCRIPT LETTERING PEN
MAPPING PEN
LETTERING BRUSH
DRAFTING PEN (RULING)
COITS PEN
CROW QUILL
CHINESE BRUSH
ESTERBROOK FOUNTAIN PEN
WELCO PEN
LEROY PEN
ARTIST FOUNTAIN PEN
GRAPHOS PEN
BEAM COMPASS
HIGGINS INK FLOWS SMOOTHLY, DRIES UNIFORMLY,
GIVES FINE LINES OR HEAVY LINES, WASHES
OR DENSE BLACKS . . . HELPS YOU DO YOUR BEST
WITH ANY INSTRUMENT, IN MANY TECHNIQUES
—AND HIGGINS PEN CLEANER CLEANS THEM ALL!
HIGGINS INK COMPANY, INC.
BROOKLYN, NEW YORK


WILD
HEERBRUGG
Drawing instruments
of highest accuracy
The leading Swiss manufacturer of precision instruments introduces an Instrument Set of outstanding merit. Drawing instruments of highest precision and of great accuracy in performance for the most exacting standards.
• Rustproof steel 5 times stronger than brass • Improved straight guidance of the compass-head • Maximum degree of precision is guaranteed • Fine finish of the drawing pens • A modern metal case, not an old-fashioned box.
ASK FOR BOOKLET RZ300e
HENRY WILD SURVEYING INSTRUMENTS SUPPLY CO.
OF AMERICA, INC.
26 COURT STREET, BROOKLYN 2, N. Y. • TRiangle 5-0644

THE DIVISION OF ENGINEERING DRAWING PASSES THE QUARTER CENTURY MARK

by
Professor Ralph T. Northrup, Sixteenth Division Chairman
Wayne University

Historically the Division of Engineering Drawing of the American Society for Engineering Education was a planned organization. It did not just, "grow up like Topsy."

The organization was well founded and placed upon a firm and solid foundation by the early leaders of our Division. Such names as Thomas E. French, Randolph P. Hoelscher, Frederick Higbee, Harry McCully, Henry H. Jordan, Clair V. Mann, Griswold Smith, and many others too numerous to list were active in the early planning of the Division.

In June, 1928, just twenty-six years ago, the idea of a separate Division of the then called Society for the Promotion of Engineering Education was conceived in the minds of the aforementioned leaders. I am told this idea was first suggested by our Frederick Higbee when discussing the convention with Dean Jordan and Clair V. Mann as the train upon which they traveled moved on its way towards Chapel Hill in North Carolina.

Why are we then celebrating our twenty-fifth anniversary this year when the teachers of Engineering Drawing first met previous to 1929? I believe you will agree with me that this is the official twenty-fifth year of regular annual meetings of the Drawing Division as a separate Division of the American Society for Engineering Education after I have reviewed briefly the historical account regarding its establishment and its official meeting dates.

With the rapid increase in student enrollment beginning about 1906, there was brought into being in the engineering colleges throughout the nation a large group of professionally trained young men whose major interests were centered in departments of drawing that were distinctly separate and not affiliated with any particular specialized interest or field of design.

When the society met in 1927 at the University of Maine, considerable emphasis and attention was given to the importance, place, and problems facing engineering drawing in engineering education. The announcement of this "sectional conference" was printed in the official program of the society as a "Conference on Drawing." It is reported this meeting was a distinct success, and because of the interest shown, it was suggested a second "Conference on Drawing" be held the following year in 1928.

It was through the combined efforts of the twenty-seven members present, principally from drawing departments, that a request for the establishment of a separate division to be known as the Division of Engineering Drawing was presented at the annual meeting held at the University of North Carolina, "Chapel Hill" in 1928 to the General Council of the parent organization (then known as The Society for Promotion of Engineering Education).

Impetus was given to the request and full meaning to the importance and place of engineering drawing in engineering education in June, 1927, by the election of the late Professor Thomas E. French of The Ohio State University to one of the Vice-Presidencies of the parent society, and by the election of Dean H. H. Jordan of the University of Illinois to the General Council.

Because of this representative movement, either by chance or planned design, committee No. 19 composed of teachers interested in Engineering Drawing and Design was assured representation upon the directive councils of the society. Such representation on the General Council gave strong assurance that the privilege of forming a separate division within the society would be granted at the time the request was submitted in June of 1928.

Fifty persons were present at the "Chapel Hill" meeting when permission to establish a Division of Engineering Drawing within the parent society was requested. The resolution, when presented to the General Council of the parent society, calling for a separate division whose duties and functions would include the work of committee No. 19, was formally approved with equal promptness, and permission to form a separate division was authorized.

I quote from an article written by Dean H. H. Jordan of the University of Illinois and published in the May, 1938, issue of the Journal of Engineering Drawing -- "The new division took over the functions of committee No. 19, which had a long and honorable career in the society, but which was necessarily dominated by the design emphasis which was given to it by engineers and teachers interested primarily in developing techniques of design and their presentation to students."

The first executive committee was composed of Professor T. E. French, R. P. Hoelscher, H. H. Jordan, W. G. Smith, Frederick G. Higbee, C. V. Mann, and H. M. McCully.

There have been four summer schools sponsored in connection with the division's activity since its founding:

1. Pittsburgh, 1930.
2. Wisconsin, 1936.
3. Washington University, St. Louis, 1945.
4. Michigan State College, 1951.

The year, 1929, marks the first official annual meeting of the Division of Engineering Drawing following the granting of permission to form such a division by the parent society in 1928. No meeting of the Society or Division was held in 1945 due to cancellation at the request of the war committee on conventions of the Office of Defense Transportation.

The first official annual meeting of the Division of Engineering Drawing at the Ohio State University in 1929 furnished ample evidence of the usefulness, importance, and mature insight on the part of the early leaders in the formation of a separate division within the society. Each of four standing committees reported at this meeting, and a great deal of constructive criticism followed.

Since its inception, the division has grown in importance and in membership; had has made its influence

(Continued on page 9)


DRAWING
DIVISION
25TH
ANNIVERSARY
DIVISION CHAIRMEN 1928·1954

(Continued from page 7)

felt throughout the years. The T-Square Page in the Journal of Engineering Education was established in 1928 with Frederick Higbee as its first editor. The Journal of Engineering Drawing was established and published in 1937. In 1931, the Division developed the "theme type" of meeting and has followed this policy for each of its meetings since that date.

Dean H. P. Hammond, in 1930, made the following comment regarding the first summer school held by the Division of Engineering Drawing and reported the same in the Council records and Journal of Engineering Education -- "The intrinsic values derived by the students will remain a perpetual source of stimulation to them."

In June, 1954, President L. E. Grinter expressed regrets that he was unable to attend the Twenty-Fifth Annual Banquet of the Division due to a previous dinner engagement. He states however, "I want to express my appreciation to you for the fine work you have done in connection with the activities of the A.S.E.E. I have a keen feeling of appreciation for co-operative effort and teamplay that has made this year so successful in the history of the society. I would appreciate your conveying my sincere appreciation to the active members of your group."

I quote also from the letter of our Vice-President Dean W. C. White: "I hope you will convey to all of your members my hearty felicitations on the celebration of the Twenty-fifth Anniversary of the founding of the Division of Engineering Drawing of the American Society for Engineering Education. Your division has been one of our strongest and most effective instructional units. It was very kind of you to invite me to be present at the Drawing Division Dinner on Tuesday evening, June 15, 1954, at the University of Illinois. Although I would very much enjoy being with you on this occasion, I have already committed myself to attend the joint ECAC-ECRC dinner on that same evening."

You should also be informed that since the inception of the division, the work in the field of Engineering Drawing and Descriptive Geometry has expanded and changed. If one reviews the early texts of the field of Engineering Drawing and some of the early writings in the Journal of Engineering Drawing, one finds emphasis placed upon skills, inking, line weights, testing, the direct method vs the classical method, better use of teaching time, lettering, simple dimensioning, selection and design of equipment, and a multitude of other fringe subjects. A transition has taken place since 1938 when Engineering Drawing became of age and took on the form of an art and science. We now talk in terms of Engineering Graphics in place of Engineering Drawing.

Such new subject material as Industrial Production Illustration, Advanced Descriptive Geometry, Freehand Sketching, Tolerancing and Limit Dimensioning, Surface Quality Finish, Delineation, Computing Devices, Graphical Calculus, Special Slide Rules, Construction, Graph Analogues, research in the field of Prosthetics and cancer; and more recently, simplified drafting methods have crept into our field of work. Yes, Engineering Drawing is changing; and for those of us who remain in the field, an open mind and progressive attitude is essential.

Let us now turn our attention to those men who have played a leading part in making the past twenty-five years such a phenomonal success. Perhaps their great works can be best expressed in the words of the master teacher who once said: "Neither do men light a candle and put it under a bushel, but put it on a candlestick and it giveth light unto all that are in the house." Surely these men have placed their candles in the form of light and knowledge in Engineering Drawing so all might see and be influenced by their contributions to our work.

The first Chairman of the Division was Professor Thomas E. French of The Ohio State University who served the Division from June, 1928, to June, 1930. He was the recipient of the Lamme Award in 1943 and Vice-President of the parent society in 1927.

The second Chairman of the Division was Professor Harry M. McCully of Carnegie Institute of Technology. He served the Division from September, 1930, to June, 1935.

The third Chairman and still an active member of the Division was John M. Russ of the University of Iowa. He has served the Division in many capacities over the years. He was one of the early advocates of testing in Engineering Drawing, and devised the test questions correlated with Engineering Drawing by French and Vierck.

The fourth Chairman of the Division of Engineering Drawing was Professor Carl L. Svensen, author, leader, teacher, recipient of the Engineering Drawing Award in 1953, and professional engineer. He served the Division as Chairman from September, 1938 to June, 1939.

The fifth Chairman of the Division was Dr. Clair V. Mann, formerly of the School of Mines at Rolla, Missouri; now an historian and professional engineer. He gave to us the idea of the selection and quality of students for engineering, and the measurement of space perception.

The sixth Chairman of the Division was Randolph P. Hoelscher who served from September, 1940, to June, 1941. Randolph was a founder of the Division, the first Secretary of the Division, is an author, active on A.S.A. Standards work, former dean of the Washington University Summer School, a leader in research in the field of Engineering Drawing and recipient of the Engineering Drawing Award for 1954.

The seventh Chairman of the Division was Walter E. Farnham of Tufts College. He served the Division from September, 1941, to June, 1944. It was during his term of office that Advanced Graphics received increased emphasis. Descriptive Geometry began to take on a useful form and practical meaning.

The eighth Chairman of the Division was Justus Rising of Purdue University. He served as Chairman from September, 1944, to June, 1946. He was Dean of the Wisconsin Summer School for Engineering Drawing teachers, and has contributed to a large measure towards the visual aid aspect of our work. Through his efforts, slides, films, and movies have found an important place in the teaching of engineering drawing and graphics.

The ninth Chairman of the Division was John T. Rule of Massachusetts Institute of Technology. He served the Division as Chairman from September, 1946, to June, 1947. Advanced graphics, the term graphics, and the application of drawing in research and higher mathematics were emphasized at a time when certain schools were cutting drawing time.

The tenth Chairman of the Division was Frank A. Heacock of Princeton University. He served the Division from September, 1947, to June, 1938. As Chairman of the Advanced Graphics Committee, Frank is well-known for his "Graphic Methods for Solving Problems" and for the efforts he has expended on our behalf in helping to interpret to the parent society that drawing was more than mere lines, skills, and lettering.

The eleventh Chairman of the Division was Henry C. Spencer of the Illinois Institute of Technology who served the Division from September, 1948, to June, 1949. Henry is well-known as an author. He is active on A.S.A. Standards Committee work; and, more recently, is known for the contribution he has made in trying to eliminate the shortage of drawing teachers by the experiment put into operation at his institution for granting of degrees in graphics.

The twelfth Chairman of the Division was Orrin W. Potter of the University of Minnesota. He served the Division as Chairman from September, 1949, to June, 1950. Orrin is at present making a national survey of drawing practices in industry and trying to correlate the same with the work being taught in our Engineering Drawing departments.

The thirteenth Chairman of the Division, although not a bit superstitious, was Ralph S. Paffenbarger of The Ohio State University. Ralph has rendered the Division esteemed service in helping to devise the standard tests for Engineering Drawing and in working with McGraw-Hill Book Company in developing their Engineering Drawing films. He has played an active part in the work of the Division for many years serving in many capacities.

During the past two years, he has been serving the Division as the Drawing Division representative on the General Council of A.S.E.E. and was just re-elected to continue in that capacity for the next two years.

The fourteenth Chairman was Clifford H. Springer of the University of Illinois. He served the Division from September, 1951, to June, 1952, when it became necessary to re-enunciate the value of Engineering Drawing in Engineering Education. Clifford Springer is known for his contribution to Industrial Production Illustration and his work as Chairman of the Policy Committee.

The fifteenth Chairman of the Division was Jasper Gerardi of the University of Detroit. He served the Division from September, 1952, to June, 1953. Jasper is well-known for his eagerness to challenge the members to discuss controversial subjects. His untiring work as a member on the Drafting Standards Committee of A.S.A. and S.A.E. is well-known. He is one of our several members who has been able to rise to the rank of Assistant Dean of the College of Engineering. Jasper Gerardi has written many articles dealing with dimensioning, tolerancing, screw threads, and more recently a critique on "simplified drafting."

In conclusion may I say, the Division has come a long way during the past Twenty-Five years, and I look forward to seeing twenty-five years of continued progress upward. Advanced graphics is here and is going to play a greater part in our work in the future. Better preparation of drawing faculty and students will and must take place if Engineering Drawing is to play its true role in Engineering Education.

Dean William D. Turnbull

Dean William D. Turnbull of the College of Engineering at Ohio State has just been retired after forty-five years of continuous service to that University. Dean Turnbull was a professor in the Department of Engineering Drawing from 1910 to 1928 before moving to the college office. He was replaced by Professor Harold A. Bolz, formerly Head of General Engineering at Purdue University, who became Associate Dean of the college on October 1.

Dean Turnbull is recognized as one of the outstanding producers of lettering and illuminations of all time. His maps and illuminations are indeed works of art. He is co-author of "Lessons in Lettering," Books I and II, with the late Thomas E. French.

LIFE'S MESSY MOMENT

"It seems Jimson got to doodling again.."

A POSITIVE PROGRAM FOR ENGINEERING DRAWING

by
R. S. Sherwood
Worthington Corporation

INTRODUCTION

At the Dartmouth meeting of the A.S.E.E. in 1952, the Engineering Drawing Division held a session on the theme: "Place of Engineering Drawing in an Engineering Educational Program." Some of the papers presented at that session seemed to build a defensive framework against further assault on the remaining credit hours of engineering drawing in the various curricula.

I happen to believe that a positive offense is very often a good defensive device. The objective of this paper is to suggest a positive program for engineering drawing which can help stem further de-emphasis of engineering drawing and help maintain undergraduate interest in design. In business, those who are concerned with developing the young engineer after he graduates are just as interested in this problem as you are, although our concern may have different motivation. Some of us give extensively of our time as speakers for the Machine Design Division of the A.S.M.E. in its campaign to rid seniors of their fear of a drawing board and to stimulate interest in mechanical design. We are also interested in maintaining at the highest possible level the native creativity or inventiveness which young men bring to their study of engineering.

As I go further you will detect that my experience has been confined largely to dealing with young men who are associated with design of machines, in college as well as in business. I would be the first to acknowledge that you are helping to train other men who will not design machinery. But it is necessary for me to be candid in order that you can evaluate my remarks more easily.

In addition, I want to acknowledge that you are in a position to know your own problems better than anyone else. In these remarks you will find no panaceas. But it is my hope that you will receive them as a sincere effort to be constructively helpful.

DEFINITIONS

In any discussion such as this, it will be fruitful to spend a little time on the meaning of certain words which are used frequently but which are not universally understood to mean the same thing. I think people in business are more likely to be guilty of this fault than are our friends at colleges. Such words as engineer, design engineer, draftsman, designer, and technician, are examples. It seems the meaning of certain of these words can be illustrated by comments showing their function. However, I want to consider only two, design engineer and draftsman.

a. Design Engineer. A design engineer uses his mind to establish what his design problem is, brings his creative talent and his grasp of the science to bear on solutions to the problem, and finally communicates his preferred solution in a way which reflects his experience and judgment. Notice that this statement doesn't tell whether the design engineer is a man or a woman, a college or high school graduate, or whether so much as a sketch was made. For the purpose of giving a general description of what a design engineer's function is, this is sufficient. However, the typical design engineer is a man qualified as an engineer who usually works part of the time at a drawing board creating and making drawings as comprehensive as a layout.

b. Draftsman. A draftsman is skilled in the art of using factual information and certain instruments to produce a drawing which conveys to the reader exactly what was intended by someone else. This does not say that a man who is a draftsman can't have creative and analytical ability. It is to say that a high order of creative and analytical talents are not required to be a draftsman. From my viewpoint, the detail drawing produced by an experienced draftsman who is a high school graduate is usually a more creditable work of artistry than a layout done by a design engineer who graduated from college. This is neither to criticize the engineer nor compliment the draftsman. Their functions are quite different.

OBJECTIVES OF ENGINEERING DRAWING

In leading up to presentation of a positive program for engineering drawing it seemed desirable to consider the objectives of these courses as they are normally taught in college. There is agreement among leading authors in this field that engineering drawing is the graphic language of the design engineer and draftsman. The primary objective of engineering drawing, as stated in the leading texts, seems to be the teaching of how to "write this language." In learning to write this language, the student also learns how to read the language.

Consider this objective closely. How does it relate to the student of engineering and why he is in college? Generally speaking, a student does not study engineering in college to gain manual skill. He certainly doesn't go to college and take mechanical engineering to become a machinist. Would a man enroll in some college engineering curriculum if his goal was to become a first-class draftsman? I seriously doubt it. High school, trade school, and apprentice courses will get him there faster.

It may be argued that the time now devoted to engineering drawing is so small that there isn't any possibility of over-developing real manual skill in the student. It would appear that this is probably true in most cases. A pertinent question can be asked, however. In spite of the short time available for engineering drawing, are we still trying to develop manual skill or are we trying to develop creative talents and ability to visualize?

It seems to me, however, that the true objective of engineering drawing courses should be to help develop the creative talents of an individual and to improve his sense of visualization, recognizing that you are participating in the training of a potential engineer not a draftsman. In doing this, I am sure he will learn something about how to "write the graphic language of the design engineer and draftsman." But specifically, the student in a college engineering drawing course can't be thought of as an apprentice draftsman. Excessive repetitive exercises have a deadening effect on originality and creativity. He isn't there just to acquire manipulative skill. In these times economics compel the shortest possible use of the young engineering college graduate as a draftsman. His value in an engineering organization will be in creating and laying out his designs, not in their detailing. A lot of smudgy layout drawings can be tolerated if the design engineer has creative talent and the capacity for visualization.

A POSITIVE PROGRAM

Any positive forward-looking program has to be based on the premise that most all things can be improved. I don't accept any value in change just for the sake of change. A change which is an improvement should be carefully considered, however. There are a number of points which I believe require your serious consideration and continued pressure. These points will be enumerated and discussed at the same time.

A. Reconsider your Objectives.

Be sure that the objective of your engineering drawing courses is correct. In all seriousness, ask yourself this question. Am I still trying to train draftsman? If your answer is yes, then it is my opinion that you must change your objective. You are really helping to train engineers, some of whom will do some drafting if they do design engineering. From my viewpoint, I think there has been a great deal accomplished in this regard. Inking exercises appear to have been soft-pedaled. A considerable increase in freehand sketching has been accomplished. I think also that drawings themselves are being more squarely evaluated. A drawing that is a work of art from the standpoint of line-weight, shape of arrow heads, and lettering, is hopeless if it contains errors which result in the part being scrapped after manufacture. On the other hand, a legible, accurate, and clearly presented drawing from which a good part results, is very useful, even if it is smudged and the lettering is shaky.

We all enjoy having someone agree with our own pet ideas. Suppose you believe that college engineering drawing courses should have twice as much time allotted as they now have. Now let's assume you ask the following question of the chief draftsman of a modest size corporation. "Do graduates of engineering colleges get enough engineering drawing?" He will likely answer, "No, they don't. I have high school graduates who are much better draftsmen." Sounds good, but if you asked the same question of a chief engineer, your answer might be something like this. "I'm sure they could profitably use more time if it is available, but what really concerns me is they have been scared away from the board. They have almost no accurate conception of what design is." What can be made out of this? One thing I'm sure of; there's no use doubling the time devoted to engineering drawing if the engineering graduates still rebel at going "on the board." Another observation can be made with respect to this hypothetical question. If you feel there is value in checking your course objectives with people in industry, be certain you are talking to the right people. I believe you will get more valid comments on course objectives from a Director of Research and Development than you will from a Chief Draftsman or someone in the standards department. In my opinion, this results primarily from a difference in perspective. It is in no sense of criticism of men such as chief draftsmen, who are very busy with their day to day work.

At the present time the A.S.E.E. is devoting considerable time and thought to the problem of teaching and developing creativity in engineering students. Without debating whether creativity can be taught, we can accept the fact that individuals have some level of creative talent. This creative flare for original action can either be stimulated or killed, depending on how the individual is handled. It is particularly important that the college engineering drawing courses be examined to insure that their methods do not kill this talent. An additional important step requires examination of drawing courses to find every practical means for teaching in such a way that individual creative effort is stimulated and allowed to grow. In my opinion, it is not sufficient to accept as the primary objective of engineering drawing courses the teaching of "How to Write the Graphic Language of the Design Engineer and Draftsman." The challenge of helping to develop the creative talent and sense of visualization of the student must be accepted too.

B. Reduce the Drawing Teacher's Load

I have no accurate way of knowing exactly what the average drawing teacher's load is these days. However, the information I do have indicates to me that during most of the time since World War II, the drawing teacher was in reality very heavily loaded. Now this opinion may not be entirely acceptable to administrators. They will counter that the man teaches, for example, only one course, working drawings, which has two 3-hour laboratories a week. He has to prepare only slightly more for four sections than he would for one, and is only in the classroom 24 hours during the week. It will be argued that the professor mechanical engineering is busier teaching a load composed of one section of kinematics and two sections of machine design. Such a man may have 9 hours of recitation and possibly 12 hours in laboratory. In this case we will say the kinematics laboratory was handled by a graduate student and the two machine design sections have split laboratory sections. On the one hand, the drawing teacher is tied up 24 hours per week while the mechanical engineer has 21 hours in class.

Personally, I believe in the above case, that the mechanical engineer is busiest. But it is also my opinion that the drawing teacher has the greater burden. Burden is something you carry; it weighs and wears you down. Repetition is deathly to bright aggressive teachers.

One thing which can be done to reduce the drawing teacher's burden is to cut down on the volume of papers he has to correct. I won't even comment on hiring graders. It is not my idea that the student be asked to do any less work or that there be any fewer papers turned in. I don't think it is necessary, however, to grade or correct every single sheet a student turns in. This business of correcting every paper seems to be a fetish with some drawing teachers I have known. I think it would be perfectly ethical for the head of the drawing department to determine with his staff what constituted an adequate sample of a student's work for correction and grading.

The point in cutting down on the drawing teacher's load is not altruistic at all. The whole idea is to permit him to have more time for study, research, or even private practice. If this can come to pass, the vigor and morale of a drawing department staff should be high.

C. New Areas for Teaching and Research in Engineering Drawing.

It may seem like folly to consider additional course offerings and research if the college administrations seem bent on squeezing the credit hours in drawing. Frankly, I don't think there is need for concern if an engineering drawing department is moving ahead with a positive program.

There are areas which need working, and these areas can be cultivated by a drawing department as well as another department. The following thumbnail sketches will serve to point up what I am talking about.

1) If a course in creative design does not exist (where an engineering student can really test his imagination and visualization), why don't able engineering drawing teachers work up one? Let it be an elective, and drum up interest among the mechanical engineers just finishing machine design. At the present time there are only a very few engineering colleges which have a course in Creative Design. Anyone who contemplates organizing such a course should be an experienced design engineer who is completely open-minded. He has to be willing to give the students great latitude, exercising only a very light reign. In addition, such a teacher should have made a careful analysis of what he thinks the inventive or creative process is.

2) Several schools in this country are conducting sponsored research to find out what creativity is and how it is stimulated. Is there something which engineering drawing can contribute? Certainly, if an Engineering Drawing Department has on its staff teachers who are competent design engineers, they should be able to contribute something tangible. Such men will have had an unsurpassed opportunity to observe the characteristics of certain students who unquestionably possess inventive and creative flare. The synthesis of these observations can be a vital force in our greater understanding of how to stimulate creativity. On the negative side, it is possible for such teachers to observe practices which are known to have killed or stifled originality.

3) The problem of drawing and record storage gets to be a larger problem all the time. Why can't the staff of drawing departments do some work there? This question brings in economics as well as techniques. There are in this country many corporations which have multiple plant operations resulting from the purchase of several plants which were previously separate corporate entities. Such situations create tremendous problems in standardization particularly as it affects drawing numbering, part numbering, and pattern numbering systems. Such problems are usually resolved on the basis of what seems to be best for the particular corporation and its people. This may not, in reality, be a fruitful subject for organized academic research. On the other hand, it carefully offers a challenging area for consulting work by able engineering drawing teachers.

4) We can still use improved reproduction processes and equipment. Isn't this something on which an engineering drawing department could collaborate? It is recognized that over the years certain engineering drawing professors have made remarkable contributions in instrumentation. As you will know, several manufacturers in this country are continually working on improved processes for reproduction of drawings, but obviously we haven't reached the state of perfection. An engineering drawing professor who has interest in this problem and an inventive flare, might find a challenge in such development.

5) What research are engineering drawing departments conducting on simplified drawing procedures? It won't do to drag your feet or ridicule the idea. Remember the value of a mechanical drawing is in its utility, not its artistry. Economics is exerting heavy pressure to eliminate any unnecessary costs.

It is perfectly possible to go too far in adopting simplified drawing procedures. The more you simplify a layout drawing, for example, the more thinking the detail draftsman has to do. In certain situations this leads to higher hourly rates for draftsmen which might offset the economy which was anticipated for simplified drawing procedures. Similarly, shop personnel who have become accustomed to having all the possible information provided on a drawing, may spend more time than can be justified in interpreting the simplified drawing. These observations should not be construed as reasons for not going ahead with simplification of drawings. They do point out, however, some of the problems which need very careful and objective study. Engineering Drawing Departments should accept this trend as an area in which they can make great contributions by careful study of this problem.

CONCLUSION

If engineering drawing departments are to prosper and grow to the fullest extent, it will be only by positive aggressive action on their part. There are things which can be done and which need doing, most important of which is to continue re-examination of objectives. If this challenge is met by effective effort, there should be no real concern for the future of engineering drawing. From a purely selfish viewpoint, industry can profit from your positive action. Engineering drawing enthusiastically taught by competent men, will help produce engineering graduates who are interested in becoming design engineers.

The dried ink on improperly cleaned stencils may be readily moved by covering each side of the stencil with fresh ink and then letting it soften the old ink. This takes about fifteen minutes time. Then the old and new ink may be removed by a piece of Kleenex. The Kleenex wipes into the grooves of drawing lines thus does a better job than the blotter folder.

DRAWING TEACHERS IN THE ENGLISH DEPARTMENT

by
William J. Streib
State University of Iowa

A number of years ago Professor Farrell of the Engineering English Department at the State University of Iowa was eating lunch with Professor Russ of the Engineering Drawing Department. "John, what can be done to improve the quality of the drawings turned in with our technical writing papers?" asked professor Farrell. That was the beginning of the very successful consulting program we have with the Engineering English Department.

Our activities are undoubtedly not unique in the Drawing Division, but the success of the program and the cordial attitude of the Engineering English Department prompts me to believe that other members of the division may be interested in them.

HISTORY

The problem facing Professor Russ and Professor Farrell was not new. The students, finished with their drawing courses, forgot what they had learned.

The drawing department here at Iowa employs student paper graders, so Professor Russ suggested the most direct approach to the problem. An investigation was made into the possibility of grading the drawings turned in with the technical writing papers.

The name of a student qualified for such work was suggested by the head of the Drawing Department, and funds were made available in the Engineering English Department's budget to pay the prevailing hourly wage for such student help.

Realizing that quality was only one factor in determining the acceptability of a drawing that was included in a paper, discussions were held to consider how the actual grading would be accomplished. The conclusion was that three items must be considered:

1. Adequacy,
2. Appropriateness, and
3. Quality.

Under the heading of adequacy, the question was to be asked, "What drawings should be included with this paper?" The grader was to "skim" through each paper and decide what drawings, if included, would add to the paper. If the student failed to include these drawings, the grade on this item was to be reduced by an appropriate amount.

It was feared that this process would be time consuming, but it was later found that the graders quickly developed a skill at finding clues to the drawing requirements of a paper, and the time required was not prohibitive.

The appropriateness of the drawings that were included was to be questioned next. If a drawing served no useful purpose in the paper, the grade on this item was to be lowered. The problem of fitting the drawing to the probable background of the intended reader was considered here, and emphasis was placed on simplicity. A drawing that was more elaborate than necessary caused the grade to be lowered.

The aim of the first two considerations was to force the student to analyze the drawing requirements of his paper. The first item demands that the necessary drawings be included, while the second prevents the padding of a paper with drawings having little thought behind them.

The last item considered was to be the quality of the drawings. A grade was to be assigned based upon the quality demanded in the drawing courses.

So that the instructor of a technical writing course would have the drawing grades to assist him in assigning the final grade to a paper, the grading of the drawings was to be done as soon as the paper had been turned in. Notes and comments by the drawing grader were to indicate why the grades given were appropriate, and if the grade on any item was too low, additional drawings or redraws were to be required.

That the program was successful was apparent soon after the actual grading began. Quality improved, and the students were obviously using greater care in the selection and content of their drawings. These results encouraged the two departments to expand the scope of the activity. Figure 1 shows the present organization. Although apparently complicated, it requires a remarkably small amount of effort from the full time staffs of the two departments.

PRESENT ORGANIZATION

LECTURES

Professor Farrell attributes much of the success of the grading program to the psychological effect upon the students, created by the support and interest of the drawing department. To increase this effect, lectures on drawings for technical writing papers are given by members of the drawing department staff.

In their junior or senior years, engineering students at Iowa take two courses in technical writing. The first has the technical report as its main topic, while the second deals primarily with the technical article.

Each semester a lecture is given in each of these courses by a member of the drawing department. All sections are brought together in the evening to minimize the time necessary, and the staff of the Engineering English Department makes the necessary arrangements for lecture rooms, projector, and display boards.

Very few rules are set down in these lectures. Rather, they point out the necessary reasoning behind the selection of drawings to be included in a paper. Fitting the drawing to the background of the intended reader is emphasized, and the psychological effects upon the reader that result from poor drawing quality are pointed out.

FIRST COURSE IN TECHNICAL WRITING

The lecture to the group taking the first course explains why engineering drawings are included in technical papers, what drawings should be included in specific types of papers, and how standard engineering drawings can be adapted to the needs of the technical paper.

Slides showing the drawings that might be used with various papers are shown. The outline of the lecture is given below.

DRAWING LECTURE 1

DRAWINGS FOR TECHNICAL REPORTS

I. Why technical drawings are included
   - A. Engineers have two languages
     - 1. Written word
     - 2. The technical drawing
   - B. Function of the drawing in a report
     - 1. Emphasize
     - 2. Summarize
     - 3. Clarify

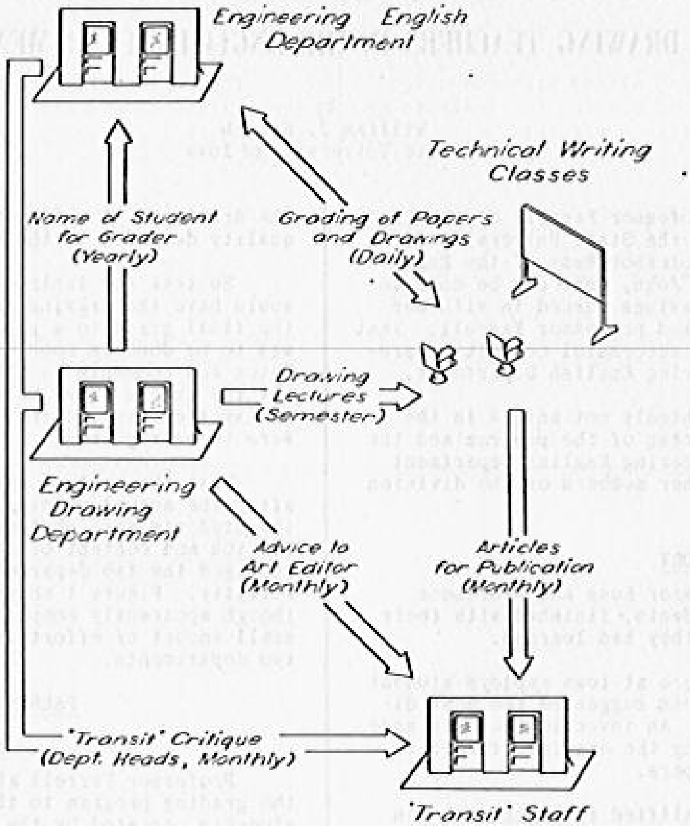


Figure 1

The Relationship Between the Engineering Drawing and Engineering English Departments

II. Special techniques
  A. Reasons for special techniques
    1. Must fit reader
    2. Parts not to be manufactured from drawings
  B. Drawings in the various types of papers
    1. Process Paper
      a. Flow sheet well adapted (summary)
      b. Block type
      c. Pictorial
    2. Directions Paper
      a. Shows equipment (emphasize, clarify)
      b. Must fit intended readers background
      c. All dimensions omitted except as referred to in paper
      d. Naming parts on drawing better than reference numbers or letters
    3. Apparatus Paper
      a. Drawing almost always required. (All three functions)
      b. Should show
        1) Shape
        2) Size - scale or principle dimensions
        3) Material
      c. Dimensioned assembly drawing finds use.
      d. Must show functions as well as size.
    4. Evaluation paper
      a. Visible design features of equipment
      b. Graphs to show performance
    5. Comparison paper
      a. Visible design features to be compared.
      b. Performance of each shown on same graph.
III. Preparation of drawings for this course.

SECOND COURSE IN TECHNICAL WRITING

The lecture to the students taking the second course deals with the drawing that is to be published. The topics ducussed are: how drawings for publication differ from those placed in a technical report, and the need for special drafting techniques to obtain good reproduction.

Sheets illustrating the effects of size reduction are given to the students for reference during the lecture. A display of "The Transit," the Iowa engineering student technical publication, is also set up. Original drawings are shown beside the corresponding published drawing in the magazine.

DRAWING LECTURE 2

PREPARING DRAWINGS FOR PUBLICATION

I. Extensive use in journals, advertising layout, instruction books and textbooks.

II. Like title, drawings must attract readers to the article.

III. Adopting various types of drawings for publication
  A. Orthographic
    1. Usually shape description only
    2. Simplify
      a. As few views as possible
      b. No unnecessary detail
  B. Pictorials
    1. Untrained reader
    2. Relieves technical appearance of article
  C. Flow sheet
    1. Pictorial shows something of the equipment
    2. Excellent summary of a process
  D. Diagrams
    1. Block diagram finds wide use
    2. Give values of components
  E. Charts and Graphs
    1. Indicates trends and approximate values
    2. Bar and pie graphs find use

IV. Special Techniques
- A. Process involved
- B. Photographic step allows size reduction
  1. Published drawing too small to be made without reduction
  2. Line quality improves
  3. Lettering improves
- C. Reductions usually 2/1, 3/1, or 4/1
- D. Effects of reduction (pass out reduction guides)
  1. Find lines do not reduce at same rate as heavy lines
  2. To overcome loss of contrast
     - a. Greater contrast on original drawings
     - b. Spacing of cross-hatching
     - c. Effect on grid for graphs
       1) Can not use printed graph paper
       2) Break out around notes
- E. Lettering
  1. Size of letters
  2. Line weight
  3. Corners of A, W, M, 4, etc.
  4. Do not use typewriter

V. Preparation of drawings for this course

THE "TRANSIT"

Because of the nature of the second course in technical writing, many of the papers submitted find their way into the "Transit." The possibility of a paper being published is an incentive for the student to do better work in the technical writing courses. The staff of the drawing department encourages the students to bring their drawing problems to the department for advice on obtaining better reproduction.

The student art editor of the "Transit" is responsible for all drawings published. Any drawing that he considers sub-standard, is redrawn. This student voluntarily comes to the Drawing Department once a month to check his plans for the next edition with a staff member. Such assistance requires little time, but appears to have resulted in an improvement in the drawing quality in the "Transit."

For a number of years, the student editors of the "Transit" have asked the heads of the drawing and engineering English departments to formally critique each issue of the magazine. For maximum effectiveness, the opinions expressed are mimeographed and distributed to the "Transit" staff. Through careful use of criticism and encouragement, this program has done much to improve the quality of the magazine.

FUTURE PLANS

The engineering profession has long recognized that the ability to express ideas in the language of the profession is a necessary tool possessed by successful engineers. To properly prepare their students, engineering colleges have for many years had technical writing courses in their curriculum.

Other professional colleges are becoming aware of the necessity of training their students in these same skills. Here at Iowa, a new three hour two semester course in business writing is to be offered. It will be the commerce equivalent of the engineering technical writing course. The engineering English program and staff are leading the way in this endeavor.

To prepare the commerce students for the writing of effective reports and letters, the English Department will be assisted by lecturers from the Engineering Drawing Department, School of Journalism, Department of Management and Business Education, Photographic Service, and the Bureau of Audio-Visual Instruction.

About ten lectures will be given by members of the Drawing Department's staff. This increase in the amount of time allotted for lectures on drawing was dictated by the lack of background possessed by the average commerce student. Although the students will do no work at the drawing board, they will become familiar with the following topics through lectures and demonstrations.

TOPICS TO BE DISCUSSED

1. Lettering, the use of appropriate styles of letters, and lettering devices.
2. Principles of projection. Instrument and freehand demonstrations of orthographic and pictorial representation.
3. Applications of charts and graphs.
4. Drawing for reproduction.

For the student who is especially interested or sees special applications for drawing in the work he plans after graduation, there is a survey course in drawing for non-engineers. At present it is designed primarily for graduate students in the sciences and commerce, but it might well serve as a follow-up for possible interest created by these lectures.

The rapid growth of the program, and its acceptance by the students and Engineering English Department is very significant. The staff of the Drawing Department is looking forward, with anticipation, to the challenge of this expansion into non-engineering courses.

DIVISION OF ENGINEERING DRAWING
OF THE
AMERICAN SOCIETY FOR
ENGINEERING EDUCATION

RESOLVED:

THAT, WITH THE PRESENTATION OF THIS AWARD, THE ENGINEERING DRAWING DIVISION OF THE AMERICAN SOCIETY FOR ENGINEERING EDUCATION BY THIS TOKEN ACKNOWLEDGES THE MANY DISTINGUISHED SERVICES RENDERED BY

RANDOLPH P. HOELSCHER

THROUGH THE YEARS 1912 - 1954

THE SOCIETY EXPRESSES ITS DEEP APPRECIATION FOR THOSE SERVICES, AND THE GREAT PERSONAL PLEASURE OF THE INDIVIDUAL MEMBERS IN HAVING HIS FRIENDSHIP.

PRESENTED THIS FIFTEENTH DAY OF JUNE IN THE YEAR OF OUR LORD NINETEEN HUNDRED FIFTY-FOUR.

ASEE

Chairman of the Division

Secretary of the Division

DISTINGUISHED SERVICE AWARD

RECIPIENTS OF ENGINEERING DRAWING DISTINGUISHED SERVICE AWARD

1950 - Frederic G. Higbee

1951 - Frederick E. Giesecke

1952 - George J. Hood

1953 - Carl L. Svensen

1954 - Randolph P. Hoelscher

THE A.S.E.E. ENGINEERING DRAWING DISTINGUISHED SERVICE AWARD

1954
Randolph Philip Hoelscher

Mr. chairman, members of the Drawing Division, and guests:

Tonight we honor a man who has been instrumental in turning the wheels; not only the wheels of the Engineering Drawing Division, but those in every endeavor that he has participated.

Randolph Philip Hoelscher was born in Evansville, Indiana, on December 12, 1890. He received his education in the schools of that city and graduated from Central High School in 1908. He had shown aptitude toward engineering and was particularly interested in Civil Engineering. He had read many accounts of the great civil engineers noteworthy of which was one about the father of our country, George Washington. George had thrown a silver dollar across the Potomac at one time and Randolph, in trying to emulate the feat of this great engineer and statesman, attempted it one day across the Ohio. To his dismay he saw the bright shiny dollar sink 200 and some feet off shore. In lamenting the fact to his father at the dinner table that evening his father offered the consoling words, "Don't worry Randy, a dollar would go much farther in those days."

Randolph entered Purdue University in the fall of 1908 and graduated in 1912 with the degree of Bachelor of Civil Engineering. He received the Master of Science degree at the University of Illinois in 1927 and his professional degree of Civil Engineer at Purdue in 1929. Following his graduation he entered the employ of the George L. Mesher Co. as a structural engineer and served with that company from 1912 to 1916.

He married a native of Evansville, Miss Hazel Heeger. They have two children, Bettie Marie and William Randolph, both of whom have graduated from the University of Illinois. Bettie showed her partiality for an engineer by marrying a very promising young civil engineer, and their three children have added much happiness to the life of grandma and grandpa Hoelscher. Their son, William, lives in Paxton and operates the Middlecoff Inn in that city.

In 1916, Randolph decided he wanted to enter the teaching profession so he came to a great state--the state of Ohio. He became an instructor in physics at Baldwin-Wallace College at Berea, Ohio. He served for two years in this capacity and then returned to the campus at Urbana and became an instructor in the Department of General Engineering Drawing. He was advanced by successive steps from the rank of Instructor to that of Professor and has served that department continuously except for the years 1946 to 1949 when he was made Associate Dean of Engineering Sciences and asked to set up the program at Navy Pier in Chicago for the University of Illinois. He did an exceptional job in this assignment. It was my privilege to visit him on two or three occasions. The only trouble with my visitations was that it was always at a time when you could not fish outside his office window. He returned to the campus at Urbana in 1949 to assume the chairmanship of the Department of General Engineering Drawing. Last fall this department was changed to that of General Engineering, and he is still the chairman.

Randolph is a fellow whose wall needs not be filled with mottoes to get things done. He has been extremely active in the American Society for Engineering Education, having been a member since his graduation from college. He was a charter member of the Engineering Drawing Division, serving as its chairman from 1940 to 1944 and on another occasion from 1948 to 1950. At present he is a member of the Policy Committee and the Executive Committee. He did an admirable piece of work as director of the Drawing Division Summer School in St. Louis in 1946. He has held many other important committee assignments and has long used the slogan: "If you're wrong you can't afford to argue, if you're right you don't need to."

As a member of the American Society of Civil Engineers he has served as Secretary of the Central Illinois Section and also as President of that Section in 1941.

As a member of the American Society of Mechanical Engineers he has been extremely active in the development of drawing and drafting standards, being a member of the sub-committee of Z14 which issued the last edition in 1946. He is at present the chairman of the Sectional Committee and chairman of the Executive Committee of Y14 (old Z14). This committee is now in the process of developing the new standards. He was chairman of the meeting of the American, British, and Canadian Conference on Unification of Drafting Standards in New York, in June, 1952.

In college he was a member of the Triangle Fraternity, Tau Beta Pi (honorary engineering). He is a Mason, Scottish Rite (32nd degree), member of the Presbyterian Church, member of the Champaign Urbana Kiwanis Club--having served that Club as president in 1940.

On the campus he has held the chairmanship of some of the important university committees. He was secretary of the Faculty Senate for six years. He was chairman of the Commencement Committee of this university for 18 years. He was chairman of the Committee on Admissions for Secondary Schools of 4 years. He is chairman of the Committee on Civil Defense and has been since 1941. He has served on many, many other committees.

As an author he is unexcelled, having been co-author of "Engineering Drawing" with Dean H. H. Jordan, co-author with A. B. Mays on "Basic Units in Mechanical Drawing" (2 vols.), author of "Teaching of Mechanical Drawing," co-author of "Industrial Production Illustration with Springer and Poole, co-author of "Graphic Aids in Engineering Computation" with Arnold and Pierce, co-author of "Essentials of Engineering Drawing" with C. H. Springer, and was co-editor with Justus Rising on the "Proceedings of Drawing Division Summer School-1946." He has had numerous articles in the Engineering Drawing Journal, Journal of Engineering Education, and other technical publications.

As a teacher, dean, director, author, and administrator he has inspired thousands who have come in contact with him. He has done as much toward the advancement of our work as any other living individual. His thoroughness, accuracy, honesty, integrity, and boundless energy have long been recognized as outstanding characteristics in a truly great individual.

Randolph as chairman of the Drawing Division Special Awards Committee I have the honor and privilege of presenting the Distinguished Service Award of the A.S.E.E. Division of Engineering Drawing for 1954 to you for your outstanding contributions to the field of Engineering Drawing.

A GRAPHICAL SOLUTION FOR THE REDUCTION OF NONINTERSECTING NONPARALLEL FORCES IN SPACE

by
E. J. Marmo
University of Nebraska

It is my intention in this discussion to explain the application of graphics to problems which deal with noncurrent, nonparallel forces in space. The use of graphical solutions for force problems has been restricted mainly to forces which lie in one plane. Some limited use has been made of graphics in force problems dealing with concurrent forces in space. It is my belief that with the proper knowledge of mechanics, combined with a proper knowledge of the principles of descriptive geometry, considerable time and effort can be saved by the engineer if he resorts to graphical solutions for problems dealing with forces in space.

When a rigid body is subjected to the action of forces which are directed so that they are neither parallel nor intersecting, the problem in the analysis of external force action can be resolved into one of four possibilities, depending upon the magnitude, direction, and point of application of the forces. The reduction may result into (1) a single force, (2) a single torque or couple, (3) a system of forces in equilibrium, (4) a force and a couple. The first three possibilities represent conditions which exist for special cases only. The reduction to a force and a couple represents the general case and it will be the one which concerns this discussion.

Regardless of how complicated a force system in space may become, it can be reduced to a single resultant couple. This force and couple can have a variety of forms, consisting of different parallel forces together with couples in various planes. To bring about the simplest reduction it is necessary to have the couple acting in a plane which is perpendicular to the force. This reduction is called a wrench or a screw. For a given force system, therefore, there is only one wrench or screw action to which it can be reduced.

The mathematical analysis for a problem of this type is well established. It can be summarized by the application of the following equations which have to be solved in order to find the resultant.

For Determining The Resultant Force -

(1) $$R = \sqrt{(\Sigma F_X)^2 + (\Sigma F_Y)^2 + (\Sigma F_Z)^2}$$

(2) $$\cos \theta_X = \frac{\Sigma F_X}{R}$$

(3) $$\cos \theta_Y = \frac{\Sigma F_Y}{R}$$

(4) $$\cos \theta_Z = \frac{\Sigma F_Z}{R}$$

For Determining The Resultant Couple -

(5) $$C = \sqrt{(\Sigma M_X)^2 + (\Sigma M_Y)^2 + (\Sigma M_Z)^2}$$

(6) $$\cos \beta_X = \frac{\Sigma M_X}{C}$$

(7) $$\cos \beta_Y = \frac{\Sigma M_Y}{C}$$

(8) $$\cos \beta_Z = \frac{\Sigma M_Z}{C}$$

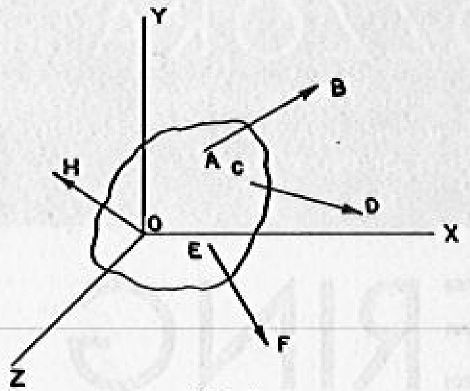


Fig. 1

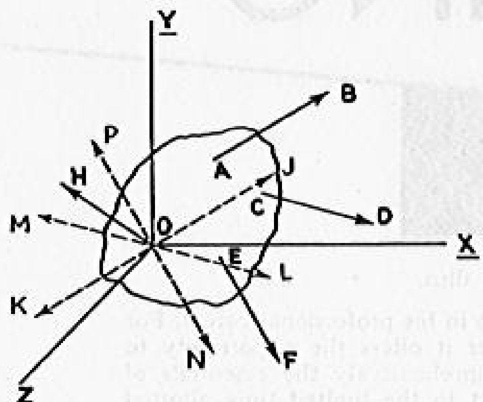


Fig. 2

For Determining The Wrench -

(9) Find angle β between R and C.

(10) Form two component couples $\underline{C \cos \beta}$ and $\underline{C \sin \beta}$.

(11) Replace $\underline{C \sin \beta}$ by an equivalent couple whose forces are parallel to R and equal in magnitude to R.

(12) The distance of the force parallel to and equal to R has been moved a distance equal to

$$\frac{C \sin \beta}{R}$$

The use and application of the foregoing equations can be illustrated by the following steps:

1. The original force system is shown by Figure 1. These forces act on a rigid body represented by the irregular line. The axes X, Y and Z are drawn through any convenient point.

2. Resolve each of the forces AB, CD and EF into an equal parallel force passing through O, and a couple. A couple consists of two equal parallel forces opposite in direction. The resolution of each force into a parallel force and a couple is accomplished by passing through the point O two equal, collinear, and opposite

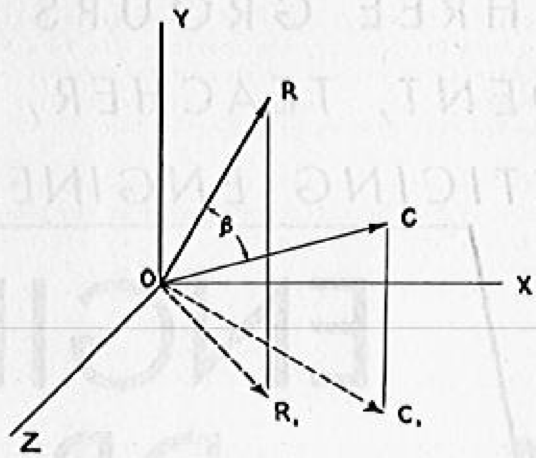


Fig. 3

forces of the same magnitude as the force which is to be resolved. Figure 2 illustrates the new force system which has the same external effect on the rigid body as the forces AB, CD, EF and OH had.

3. The four concurrent forces passing through point O are OH, OJ, OL and ON. The three couples are determined by parallel and opposite equal forces AB and OK, CD and OM, EF and OP. (Refer to Figure 2).
At this point, assuming that all the directions and magnitudes of the forces are known, the concurrent forces are resolved into X, Y and Z components. Equation 1 can now be solved, followed by the solution of equations 2, 3 and 4.

4. The vector representation of each couple, which will be discussed more in detail in the graphical analysis, has to be established by finding the perpendicular to each plane of the couples. The angles which these perpendiculars make with the X, Y and Z axes defines the direction of the planes of the couples. The magnitude of each couple is found by multiplying the value of either parallel force making up the couple by the perpendicular distance between them. When the direction and magnitude of each couple vector is established they are resolved into the X, Y and Z components. Equations 5, 6, 7 and 8 can now be solved.

5. Figure 3 shows the resultant couple C and the resultant force R which were determined by the first eight equations. In order to get the wrench action it is necessary to find the angle between these two vectors and then to apply equations 10, 11 and 12.

The mathematical procedure outlined above, as you can see, can become quite involved with the numerous space relationships involving trigonometry and algebra. The work becomes very tedious and for this reason the graphical solution can become an important part in the solution of space problems.

(Continued on page 24)

MEETS THE NEEDS
OF THREE GROUPS
STUDENT, TEACHER,
PRACTICING ENGINEER

FRANK ZOZZORA

PROFESSOR OF GENERAL ENGINEERING
HEAD, ENGINEERING DRAWING AND DESCRIPTIVE GEOMETRY
THE UNIVERSITY OF DELAWARE

ENGINEERING DRAWING

369 pages • 8½ x 11 • 650 illus. • $5.00

This text on engineering drawing meets the needs of three groups, and is specifically designed to present the essentials of the course in a short concise manner. The three groups . . . student, teacher, practicing engineer. It provides the student with the fundamentals of engineering drawing without requiring him to learn specialized details and techniques that will prove of little value in his professional career. For the teacher it offers the opportunity to cover comprehensively the essentials of the subject in the limited time allotted in the present-day curtailed curriculum. For the practicing engineer it affords an invaluable reference for review of basic procedures.

OUTSTANDING ILLUSTRATIONS

Over 600 carefully annotated illustrations make this book an extremely teachable text. The liberal use of attractive pictorials side by side with corresponding orthographic views aid the student in visualizing three-dimensional relationships. Many helpful notes on the illustrations guide the thinking of the student to a clear understanding of the problem.

CONCISE TREATMENT

The chapters and topics are carefully selected and arranged in a sequence that leads to easy progress in the study of the subject. After the chapter on lettering the student is introduced directly to orthographic projection, which is then followed by a chapter on freehand drafting. This permits the student to apply orthographic-projection, which is then followed by a chapter on freehand drafting. This permits the student to apply orthographic-projection theory immediately without first having to master the use of instruments. Thereafter the text covers the use and care of instruments, geometrical constructions, shop processes, dimensioning, sectioning and conventional practices, auxiliary views, pictorial drawings (isometrics and obliques), fasteners, assembly drawing, intersections and developments, cams and gears, and inking practice. No attempt is made to cover in detail the specialized fields of architectural drawing, aircraft drawing, jigs and fixtures, charts, graphs, perspective, and illustration. A detailed appendix is included containing tables and design information on commonly used fastening devices, on the classification of fits, and on other related matters. There is also an extensive bibliography of texts, pamphlets, and ASA Standards, and a comprehensive list of visual aids that may be used to supplement classroom lectures.

Send for copie

McGRAW-HILL BOOK COMPANY

ENGINEERING DRAWING PROBLEMS

KEYED TO ZOZZORA'S ENGINEERING DRAWING

72 pages $3.75

FEATURES

The work sheets in this book are directly keyed to Zozzora's textbook, *Engineering Drawing;* however, the material can be used in conjunction with any other standard text on the subject.

The plates offered are of a sufficient number and variety to cover the fundamental principles of the regular course work. Supplementary problems may be assigned from the text used.

The lettering plates have been placed at the front of the book, because of the importance of the subject in the preparation of acceptable drawings.

The problems have been carefully selected to acquaint the student with the necessary basic rules and conventions, and are arranged according to the most widely accepted method used in teaching the subject matter. The various kinds of paper generally employed in industrial usage have been used so that the student may become familiar with the particular conditions presented when called to work on cross section, tracing, or opaque papers.

The instructions and text references are printed in the margin of each sheet for ready reading and to avoid needless moving or turning of pages.

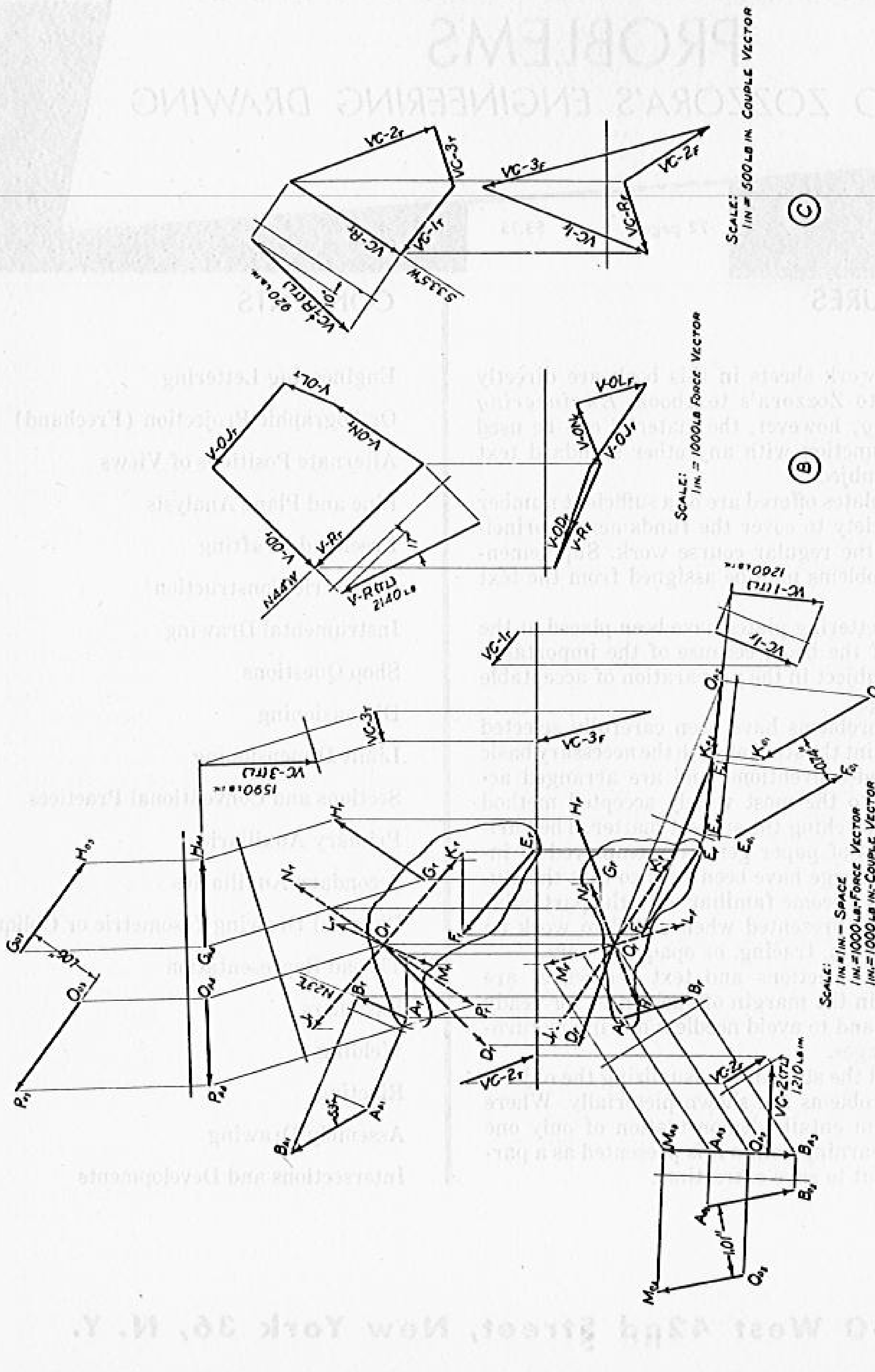
To aid the student in visualizing the objects many problems are shown pictorially. Where a problem entails demonstration of only one or two learning points it is presented as a partial layout to save extra time.

CONTENTS

on approval

Inc., 330 West 42nd Street, New York 36, N. Y.

(Continued from page 21)



REDUCTION OF A GENERAL FORCE SYSTEM IN SPACE

Fig. 4

(Continued from page 21)

GRAPHICAL ANALYSIS

In presenting the graphical analysis it is not my intention to depreciate the importance of mathematics in engineering practice, but it should be realized that many engineering problems can be solved either mathematically or graphically. Both of these tools are used, although in many cases practicing engineers may prefer the graphical solution because it is less abstract than the mathematical solution. There is also less chance of using wrong values or wrong relations because the whole problem is in the field of vision rather than spread over many pages of mathematical computations.

Figure 4 (A) shows the vectorial representation in the top and front views of the forces AB, OD, EF and GH. The points of application are at A, O, E and G. The magnitude and direction of each of the four forces acting on the rigid body, represented by the irregular line, is shown by the following table:

Force	Magnitude	Bearing	Slope
AB	1200 lb.	N 23° E	53° Downward
OD	2000 lb.	S 45° W	14° Upward
EF	1700 lb.	N 50° W	27° Upward
GH	1500 lb.	N 34° E	12° Upward

The principles of descriptive geometry were employed to establish each of the force vectors in space since the magnitude, bearing and slope were known. Top view projections carry the subscript T and front view projections carry the subscript F. The auxiliary view with the subscript A_1 shows the method used in establishing vector AB in space. The same procedure was used in establishing the top and front views of OD, EF and GH. After the projections of the force vectors were established in both the top and front view, the first step in the solution of the problem was to resolve the force system in order to get a set of concurrent forces and a system of couples which together will have the same external effect on the rigid body as the original force system.

The point O was arbitrarily selected as a convenient point through which the concurrent forces should pass. Force AB was resolved into a force OL, equal in magnitude and parallel to AB, and a couple determined by the two equal and parallel forces AB and OM. This was done by applying two equal, opposite and collinear forces at point O. EF was resolved into a force and a couple by passing the two equal, opposite and collinear forces OJ and OK through the point O. GH was resolved into a force and a couple by passing two equal, opposite and collinear forces ON and OP through the point O. The original force system in its vector representation now consists of four concurrent forces OD, OJ, OL and ON and three couples determined by the three sets of equal, parallel and opposite forces AB and OM, EF and OK, GH and OP.

Determining The Resultant Force -

Figure 4 (B) shows the top and front view of the polygon of forces which was used to find the resultant of the four concurrent forces OD, OJ, OL and ON. The resultant will not depend upon the order in which the vectors are added, so in this particular case it was found more convenient to begin drawing the polygon with the free vector for the force ON (labeled V-ON), followed by V-OL, V-OJ and V-OD. The closing side of the polygon, as shown in the front and top view, represents the resultant. The direction was determined by pointing the arrowhead so that it opposes the arrowheads on the other vectors. The auxiliary view, not labeled, was drawn to determine the magnitude and slope of the resultant V-R. The reduction of the four concurrent forces is a force equal to 2140 lb. with a slope of 17° and a bearing of N 44°W. In other words the forces OD, OJ, OL and ON, for external force action only, can be replaced by the single force R which also passes through the point O.

Determining The Resultant Couple -

The step which followed the determination of the resultant of the concurrent forces was to find the resultant of the three couples involved in the problem. For convenience in explaining the analysis which follows, the couples determined by the two equal, opposite and parallel forces EF and OK will be referred to as couple 1, the one represented by the two equal, parallel and opposite forces AB and OM will be referred to as couple 2, and the one represented by the two equal, parallel and opposite forces GH and OP as couple 3.

The next step was to find a view in which the plane of each couple (two parallel lines determine a plane) appears as an edge view. This was done by looking at a plane in the direction of any horizontal or frontal line in the plane. The plane of couple 1 appears as an edge in the auxiliary view carrying the subscript A_2. This was obtained by drawing a view in the direction of a frontal line (not labeled). The edge view of couple 2 was obtained by drawing a view labeled with subscript A_3 in the direction of a frontal line and the edge view of couple 3 labeled with subscript A_4 by drawing a view in the direction of a horizontal line.

In order to find the magnitude of each couple it was necessary to find a view in which the two equal parallel forces, which make up the couple, are in their true length and, at the same time, the distance between the forces also appears in its true length. Taking the case for couple 1, the view labeled with the subscript O_1 shows that this oblique view was taken at right angles to the auxiliary view $E_{A_2}F_{A_2}$, $O_{A_2}K_{A_2}$. That is, a view was taken at right angles to the view in which the plane of the couple appears as an edge. This was also done for couples 2 and 3. In each case the letters carry the subscript O (oblique view).

The magnitude of each couple could now be found because the magnitude of each parallel force making up the respective couples and also the perpendicular distance between each pair of equal parallel forces was available. In the case of couple 1, the magnitude was found by multiplying the scaled value of 0.74 in., which is the perpendicular distance between the two forces, by the magnitude of either EF or OK (1700 lb.). The magnitude of couple 1 is 1260 lb.-in. In the case of couple 2 where

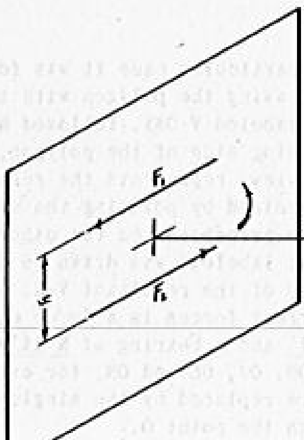


Fig. 5

the distance between forces is 1.01 in., the magnitude of the couple is 1210 lb.-in. Couple 3 has a magnitude of 1590 lb.-in.

The next step involves the representation of a couple by a vector. Figure 5 shows how this is done. If two equal forces such as F_1 and F_2 form a couple, the magnitude of the couple is F_1 or F_2 times the distance y. If F_1 is in pounds and y is in inches, the magnitude is in lb.-in. This magnitude can be presented by a vector V, by drawing to a definite scale, representing lb.-in., a line which is perpendicular to the plane of the couple and which is directed so that it projects outward from the view of the plane which shows the couple action appearing in the counterclockwise direction. This is a conventional usage which follows the right-hand screw thread rule. That is, the vector points in the direction which a right-hand screw would move if it were subjected to the twisting action represented by the couple.

Figure 4 Ⓐ shows how each of the three couples was represented by a vector. In the case of couple 1 a line representing a couple vector, was drawn at a convenient scale so that it was perpendicular to the edge view of the plane determined by EF on OK. The vector was labeled VC-1. Similarly VC-2 and VC-3 were established by being drawn perpendicular to the edge view of their respective planes. In each case the conventional rule for directing the vector was followed. In order to expedite the final step in the solution of this problem, it was necessary to carry the projections of the couple vectors for each couple back to the front and top views. The vector projections for couple 1 appears as $VC\text{-}1_F$ in the front view and $VC\text{-}1_T$ in the top view. Projection for couples 2 and 3 similarly carry their respective designations.

Figure 4 Ⓒ shows how the top and front projections of the couple vectors were combined with the use of the vector polygon of forces. Any order can be used in combining these vector projections. In this case the order was VC-2, VC-3 and VC-1. The closing side of the polygon is the resultant couple VC-R. The magnitude and direction of this resultant is found by taking an auxiliary view at right angles to the top projection $VC\text{-}R_T$. This view shows that the magnitude obtaining by scaling is 920 lb.-in. Its bearing is S 33.5°W and its slope 10°

Determining The Wrench

The point has been reached in the reduction where the original force system has been reduced to a resultant force R and a resultant couple C. Further simplification is required in order to get the force acting at right angles to the plane of the couple. This will bring about the so-called wrench action.

In Figure 6 the vector representation of force R is shown in the top and front views by lines labeled VR_T and VR_F respectively. The magnitude of this force is 2140 lb. and it has a slope of 17° and a bearing of N 44°W. The couple C is also represented by a vector and the labels used are VC_T and VC_F for the top and front views respectively. The magnitude of the couple is 920 lb.-in. and it has a slope of 10° and a bearing of S 33.5°W. A common point of intersection between the two vectors can be justified because the vector representation of a couple can be drawn perpendicular to a plane at any point on the plane. In this case it was drawn so that when extended it would pass through a point O on the resultant force R.

The next step in the solution was to find the edge view of the plane which is determined by the two intersecting lines, representing the vectors, VC and VR. This was done by looking at the plane in the direction of any line lying in the plane. In this case the frontal line OP was used. The auxiliary view labeled with the subscript A_3 shows the plane appearing as an edge. Auxiliary view labeled with subscripts A_1 and A_2 were used to establish the slope and true lengths of the force vector and couple vector respectively.

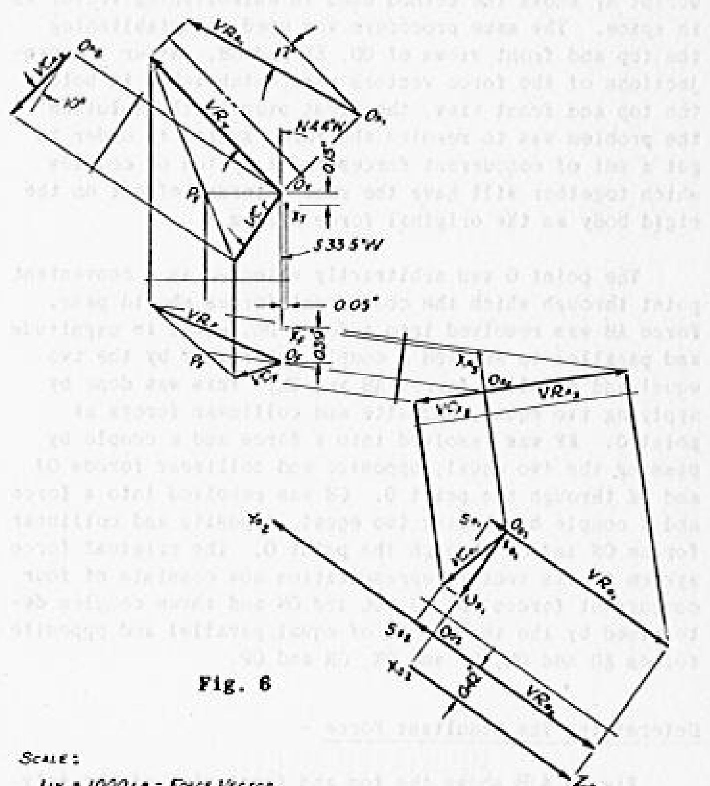


Fig. 6

Scale:
1in. = 1000 lb - Force Vector
1in. = 1000 lb in - Couple Vector
Linear Scale : 1in = 1in

Simplest Reduction of a Force and a Couple

The view drawn adjacent to the A_3 view is drawn in a direction which is perpendicular to both vectors. The purpose for this view is to show the two vectors appearing in their true lengths. Since this is an oblique view the subscript O_1 was used as a label.

The parallelogram of forces was then used to resolve the vector YC_{O_1} into two components, a component $O_{O_1}S_{O_1}$ in a direction collinear with the force VR and the other component $O_{O_1}U_{O_1}$ in a direction perpendicular to VR. The magnitude of OS, by scaling, equals 220 lb.-in. and that of OU equals 890 lb.-in.

The final step in the solution was to draw another oblique view, labeled with the subscript O_2, in a direction perpendicular to VR_{O_1} so that the couple vector OU appears as a point. In this view VR and OS still appear in their true length. The vector OU, which represents a couple, was now resolved back into two equal forces $S_{O_2}Y_{O_2}$ and $X_{O_2}Z_{O_2}$ parallel to each other, opposite in direction, and equal to VR. The distance between SY and XZ in order to keep the magnitude of the couple equal to 890 lb.-in. was determined to be 0.42 in. This value was obtained by dividing the magnitude of OU (890 lb.-in.) by the magnitude of VR (2140 lb.). The condition which now exists in the oblique view O_2 is one in which two equal collinear forces VR and SY cancel out because they are opposite in direction. This leaves the force vector XZ which by construction is equal to VR and therefore equal to 2140 lb. The direction is also the same as that of VR, but the point of application has changed from point O to point X as indicated on Figure 6. The line OS is the vector representation of a couple and by scaling is found to be 220 lb.-in. The plane of the couple OS is perpendicular to the direction of the resultant force vector XZ. This establishes the wrench action.

The point X which was first found in the oblique view labeled with subscript O_2 was projected back to the front and top views in order to determine its relative position with respect to point O. All dimensions are given in Figure 6.

To summarize, the original forces AB, OD, EF and GH have been reduced to a single force XZ (2140 lb.), which is equal to and has the same direction as the force VR, and to a single couple OS (220 lb.-in.) whose plane is at right angles to XZ. The point of application of the single force has changed from point O on the rigid body to a point X, also on the rigid body, which is located 0.05 in. to the right of, 0.39 in. above and 0.13 in. in front of point O.

It is evident from the foregoing discussion that the application of graphics can offer a splendid opportunity for arriving at a reasonably rapid solution for problems which deal with force action in space. It can also be used as a check on the more complicated mathematical solutions. The accuracy attained will depend upon the precision in workmanship and also upon the selection of suitable scales.

A LETTER FROM THE DIVISION CHAIRMAN

Dear Colleagues:

The Midwinter Meeting of the Engineering Drawing Division will be held at the University of Tennessee, Knoxville, Tennessee, on January 27, 28, and 29, 1955. I welcome and urge your attendance at this meeting. Professor A. B. Wood and his local staff are arranging an excellent program of technical papers and inspection trips.

The Drawing Division is singularly unique among the A.S.E.E. Divisions in that it has developed a Midwinter Meeting that is comparable in quality and size to the Annual Meeting of our Division.

New and challenging problems are on the agenda of every Engineering instructor. Our meetings provide a forum for exchange and presentation of your thoughts.

Come!

T.T. Aakhus, Chairman
Engineering Drawing Division

MIDWINTER MEETING

January 27-29, 1955
University of Tennessee
Knoxville, Tennessee

JOURNAL OF ENGINEERING DRAWING

Published by
DIVISION OF ENGINEERING DRAWING
AMERICAN SOCIETY FOR ENGINEERING EDUCATION

PUBLICATION COMMITTEE

Editor . . . . Warren J. Luzadder
Purdue University
West Lafayette, Indiana

Advertising Mgr. . . . . Harold B. Howe
Rensselaer Polytechnic Institute
Troy, New York

Cir. Mgr. and Treas. . . Edward M. Griswold,
The Cooper Union, Cooper Square
New York 3, New York

PUBLISHED. . . . . .FEBRUARY, MAY, NOVEMBER

Annual Subscription Price. . . . $1.25
Single Copy. $0.45

EDITORIAL STAFF

Irwin Wladaver . . . . .New York University
J. Norman Arnold . . . . .Purdue University

CARTOONIST

R. C. Carpenter. . . . . .Purdue University

Published in the Interest of Teachers and Others
Interested in Engineering Graphics

PERSONALITY SKETCH OF PROFESSOR CHARLES J. VIERCK

by
Professor R. S. Paffenbarger
Ohio State University

Charles John Vierck received his "25 year" service pin at the Staff Récognition Dinner given by the Board of Trustees of The Ohio State University in the Ohio Union on May 10, 1954. This recognition was for continued and devoted service to the Department of Engineering Drawing at Ohio State. He has advanced by successive steps from the rank of instructor in 1929 to that of assistant professor in 1936, associate professor in 1942, and to that of professor in 1946.

Professor Vierck is known by his many friends as "Chic" and is known far and wide for his excellent contributions to technical publications, particularly in the field of Engineering Drawing. His greatest achievements are the co-authorship and direction of publication of the 7th and 8th editions of the leading text in the field--"Engineering Drawing" by Thomas E. French.

Professor Vierck was born in Avoca, Iowa, February 23, 1906. Following his graduation from Avoca High School in 1924 he entered the college of engineering at The State University of Iowa, Iowa City, Iowa, from which University he received the degree of Bachelor of Mechanical Engineering in 1929. During three summer sessions he took the equivalent of a fifth year of college work, electing courses in accounting, business law, economics, money and banking, and special drawing problems.

Chic developed a profound respect and admiration for a number of people who helped him through the years. His first contact with engineering drawing came from Professor Fred Higbee, Chairman of the Department of Engineering Drawing at the University of Iowa. Fred sort of "took him under his wing" as a protege from the time he was a freshman and gave him considerable special instruction. As a sophomore, Fred employed him as Manager of the University Drafting Bureau, which position he held until his graduation in 1929. During this time Chic had constant contact with Fred Higbee, enjoyed the hospitality of his home, and through him gained a sense and appreciation for the finer things of life and for clean and wholesome living. Chic rightfully feels that Fred's counsel and friendship for twenty-nine years has been one of the finest experiences that could come to anyone. Fred Higbee, as all of us in the Drawing Division know, is one of the great men in Engineering Drawing of our time.

It was through Fred Higbee that Chic met Tom French and was employed as an instructor at Ohio State University shortly before the end of his senior year in college. After a few years at Ohio State, Chic began to work with Tom on "Engineering Drawing" and their friendship developed to a point where Chic thought of him as a second father and Professor French considered Chic almost as his own son. They were constantly working together, traveled and spent many enjoyable hours together in conversation and relaxation. Here again Chic was extremely fortunate in being associated with a "great man;" and Tom French's personality, intelligence, and wisdom lent further to his development. Through Tom he came to a greater appreciation of art, literature, and a way of life he had not known before. Tom encouraged Chic in his already developed skill of lettering and advanced his interest in the illumination of books and manuscripts. In addition to hand lettering many of the diplomas for Ohio State University from 1933 to 1940, Chic illuminated and designed covers for many manuscripts such as ones presented by the University to Julius F. Stone, Governor George White, Bob Zuppke of the University of Illinois, Colonel Townsend, Athletic Director L. W. St. John, and President George W. Rightmire. Many of these rank among the most beautiful illuminations ever produced in America. Through Tom French, Chic learned a number of writing secrets and gained an experience in many phases of his work that have been invaluable to him. He is extremely grateful for the many yearsof association with Dr. French. One of the hardest jobs Chic ever had to do was to design the headstone for Tom's grave.

In 1930, Chic was married to Esther Elizabeth Amadon and they make their home at 1626 Doone Road, Upper Arlington, in Columbus. They have three wonderful children: Sarah Jean, Charles, Jr., and Elizabeth May. Sarah Jean is a senior in the College of Education at Ohio State. She has been an honor student each year, being elected a member of each succeeding class honorary, and this year is president of her sorority, Kappa Kappa Gamma. Charles, Jr., has just started his freshman year in Engineering at Ohio State after a fine high school experience at Upper Arlington where he made the National Honor Society and was very active in sports. He won athletic letters in basketball and golf, ranking as one of the state's leading golfers. Elizabeth May is nine years old and enjoying life in a fine home environment.

Chic Vierck has always wisely believed in obtaining a wide and varied professional experience. In addition to his Drafting Bureau job as a student he worked on power plant design for B. P. Fleming, Head of the Department of Mechanical Engineering, The University of Iowa.

After graduation his experience includes:

Screw Machine Department, The Frigidaire Company, Dayton, Ohio, Summer, 1929.

Tunnel kiln design, Harrop Ceramic Service Co., Columbus, Ohio, Summer, 1930 and 1931.

Design of Cast and Forged Parts, The Allied Engineering Company, Cleveland, Ohio, Summers, 1933, 1934, and 1935.

Professor Vierck's technical writing has included the following:

Collaboration with Professor Thomas E. French on the 6th Edition of ENGINEERING DRAWING 662 p., McGraw-Hill, 1941.

Collaboration with Professor Thomas E. French and Professor H. M. McCully (Carnegie Inst. of Tech.) on ENGINEERING DRAWING SHEETS 11" x 17", McGraw-Hill, 1937 and 1941.

Collaboration with Professor Thomas E. French in the revision of the American Standard DRAWINGS AND DRAFTING ROOM PRACTICE (Z14.1).

Author of 16 page booklet and some explanatory material TESTS OF THE ABILITY TO READ ENGINEERING DRAWINGS, The Carnegie Foundation for the Advancement of Teaching, 1942.

Lettering of all sheets on lettering, ENGINEERING DRAWING PROBLEMS, Higbee and Russ, 8-1/2" x 11", Wiley, 1940.

Co-author of an Engineering Drawing examination for U.S. Army, 1943.

Co-author ENGINEERING DRAWING 7th edition, 1947, 8th edition, 1953.

Technical advisor for 10 sound motion pictures and 9 film strips to accompany ENGINEERING DRAWING.

Co-author ENGINEERING DRAWING PROBLEMS, Series I, II, 11" x 17" and Series A, 8-1/2" x 11", 1953.

Professor Vierck's memberships and listings in honorary, professional and social organizations include: American Society of Mechanical Engineers, American Society for Engineering Education, Sigma Chi and Theta Tau fraternities, Sigma Xi, "Who's Who in Engineering," "Who Knows and What," "The International Blue Book," The Ohio State University Faculty Club, Scioto Country Club, Camera Pictorialists, Registered Professional Engineer, and a member of First Community Church of Columbus, Ohio.

Chic has served on the publication board of the Journal of Engineering Drawing since 1948, having been the Advertising Manager for six years. He was recently elected to the Executive Committee of the Engineering Drawing Division A.S.E.E. for a five-year term. He is a member of the Y14 Committee on Drawing and Drafting Standards and chairman of Subcommittee No. 3 on Projections.

Professor Vierck, as he looks back with favor and appreciation on the people and events that have helped in his development, recalls his associations with the older departmental staff members and university administrators: Dean William D. Turnbull, Dean Lawrence D. Jones, Dean Charles E. MacQuigg, as well as former President George Rightmire and Business Manager Carl E. Steeb. His feeling has been that there are few "self made men" and that men arrive at what they are, attain what success they are capable of and develop whatever personality they have because of the train of events that brought them into contact with certain people. Something "rubs off" and little by little they change.

In the case of Charles J. Vierck, his associations and experiences coupled with his natural ability have been such as to make him a present day leading author and teacher in the field of engineering drawing.

IS DRAWING IMPORTANT TO THE PRACTICING ENGINEER?

I know all teachers of drawing are interested in the status Engineering Drawing (Graphics) in the undergraduate curriculum of our Engineering Colleges and schools giving undergraduate training for engineers.

Many of you know that I have been on Sabbatical leave from the University of Minnesota this past academic year. I have been making a study of "The Importance of Graphics in Engineering Practice." I have traveled around the country visiting as many schools and industrial plants as possible in order to discuss this problem in person with those most concerned. To date (May, 1954) I have visited 27 schools and 15 major industrial plants. I would like very much to visit every school in the country where drawing is being taught as well as all the major industrial plants, but of course, this is impossible. I have had to resort to the U.S. mail to get in touch with many of you.

I have sent out questionnaires to Engineering Colleges, Industries, and practicing Engineers. Some of these have not yet been returned. Kindly check and see if you have sent in your questionnaire. If, by any chance, you did not get a questionnaire and would like to participate in this study just drop me a line and I will see that you are supplied at once. The larger the number of replies, the more authentic and important will be the summary of these questionnaires.

I would like to take this opportunity to thank the Schools and Industries that I have visited thus far for their wonderful cooperation in this work. In every case I have received the utmost in courtesy and attention.

The results of this study will be made available to those interested.

Orrin W. Potter,
Professor of Drawing and
Descriptive Geometry,

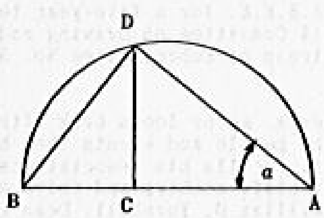
109 Main Engineering Building,
Institute of Technology,
University of Minnesota,
Minneapolis 14, Minnesota.

A CLOSE APPROXIMATION FOR THE SQUARING OF THE CIRCLE

by
Professor Paul Hessemer
The Johns Hopkins University

Analytical investigation of the so-called "Golden Section" or "Perpetual Division" of a line segment has - by sheer accident - led the writer to find a reasonably simple construction for the squaring of the circle (in approximation, of course).

Constructing a right triangle over the perpetually divided line segment as hypothenuse so that the foot of the altitude coincides with the point of division on the hypothenuse reveals the following:



1) $\frac{AB}{AC} = \frac{AC}{BC}$; $(AC)^2 = (AB) \times (BC)$; *

2) Pythagoras: $(BD)^2 = (AB) \times (BC)$;

Therefore: <u>AC = BD</u>;

3) $\cos.\ \alpha = \frac{AC}{AD}$; $\text{tang.}\ \alpha = \frac{BD}{AD}$;

Therefore: $\cos.\ \alpha = \text{tang.}\ \alpha = \frac{\sin.\ \alpha}{\cos.\ \alpha}$

$\sin.\ \alpha = \cos.^2\ \alpha = 1 - \sin.^2\ \alpha$

4) $\sin.^2\ \alpha + \sin.\ \alpha = 1$

The solution of this quadratic equation results in:

$\sin.\ \alpha = .618034$, $\alpha = 38°\text{-}10'\text{-}22''$

From 3) $\cos.\ \alpha = \sqrt{\sin.\ \alpha} = .786155$;

Value of $\frac{\pi}{4}$ = <u>.785398</u>

Length difference = .000757

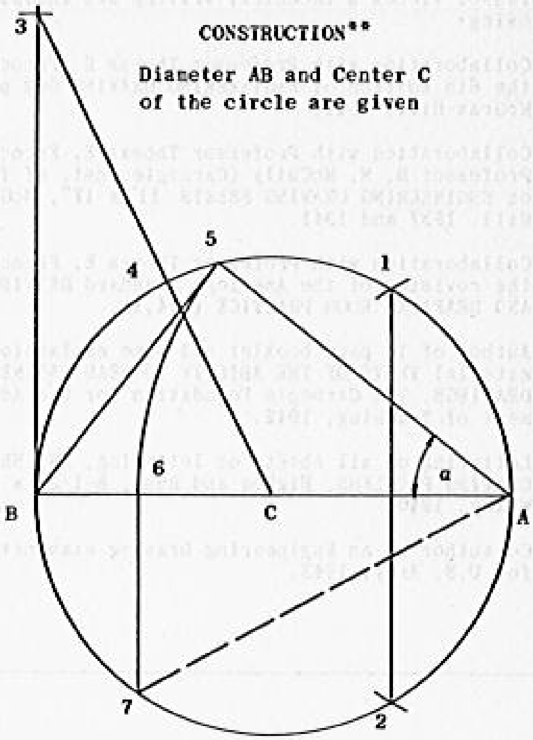
or about $\frac{76}{100{,}000}$

The relative error figures as .048% or 4.8×10^{-4}

The close approximation between the numerical values of $\frac{\pi}{4}$ and cos. 38°-10'-22", which latter can easily be found by combining the age-old construction of the "Golden Section" with the right triangle as shown above, furnishes a method for squaring the circle well within graphical accuracy and with only 7 points to construct.

CONSTRUCTION**

Diameter AB and Center C of the circle are given



Construct 1,2 perpendicular to A,C; draw B,3 = A,B parallel to 1,2; connect 3 with C and find 4 on circumference; draw B,5 = 3,4; and A,5 which equals (A,B) cos. α; on A,B lay off A,6 = A,5 and draw 6,7 parallel to 1,2 intersecting the circumference in point 7.

Then $A,7 = \sqrt{\frac{\pi}{4}(AB)^2}$ **to the limit given above.**

There are several other constructions for the approximate squaring of the circle, some with much smaller theoretical divergence, but requiring more points to construct.

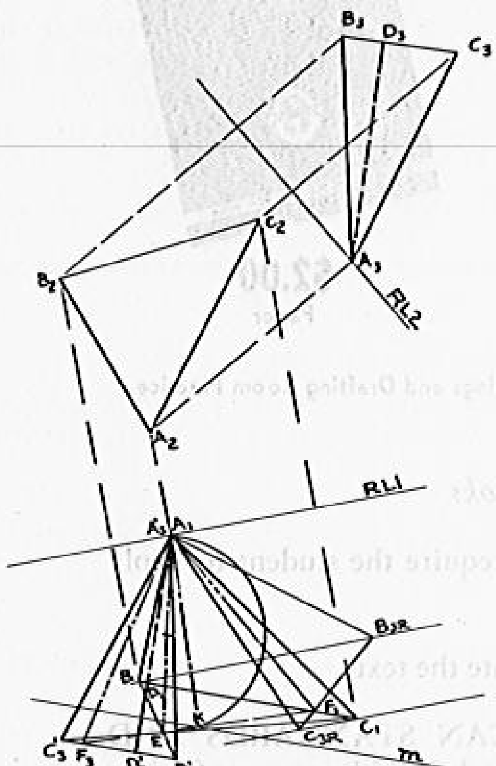
---

* This is the proportion of the "Golden Section."

** 3,4 is the larger part of the "perpetually divided" diameter A,B = B,3.

JOE DOAKES FINDS THE CENTRAL VIEW

Solution submitted by
Professor John T. Rule
Massachusetts Institute of Technology



Given $A_1B_1C_1$ and $A_3B_3C_3$, find $A_2B_2C_2$. The problem reduces itself to finding a line RL1 through A_1 and a line RL2 through A_3, such that the distances of B_1 and C_1 from RL1 shall equal the distances respectively of B_3 and C_3 from RL2.

SOLUTION: -

Draw the altitude from A_1 to B_1C_1 intersecting B_1C_1 at D_1, and from A_3 to B_3C_3 at D_3. Place view three on view one so that A_1 and A_3 are coincident and A_3D_3 lies along A_1D_1. Calling the new position $A_3'B_3'C_3'$, draw B_1B_3' and C_1C_3' intersecting at E.

Draw a line m midway between the parallel lines B_1C_1 and $B_3'C_3'$. (Both are perpendicular to A_1D_3).

Draw EA_1. Describe a circle on EA_1 as a diameter intersecting m in point K (note that there will be two such points; either one may be chosen).

Draw EK intersecting B_1C_1 in F_1 and $B_3'C_3'$ in F_3.

Now $B_3'C_3'$ is parallel to B_1C_1.

$\therefore$ $\Delta\ B_1C_1E$ is similar to $\Delta\ B_3'C_3'E$.

$$\therefore \frac{B_1F_1}{F_1C_1} = \frac{B_3'F_3}{F_3C_3'}$$

$\therefore$ since ratio is an invariant under orthographic projection, F_1 and F_3 represent a single space point F on BC in the original space triangle ABC. Also EKA_1 is a right angle (inscribed on a diameter), and $F_1K = F_3K$ (transversal cutting equally spaced parallels).

$\therefore$ $\Delta\ F_1A_1F_3$ is isosceles.

$\therefore$ $A_1F_1 = A_1F_3$ $(A_3'F_3)$.

Furthermore, these two lines represent the same line AF in the space Δ ABC, which is equally foreshortened in views one and three.

Rotate $\Delta\ A_3'B_3'C_3'$ around A_3' (i.e., A_1) until F_1 and F_3 coincide. This must occur, since $A_1F_1 = A_3'F_3$.

Call the new position $A_{3R}B_{3R}C_{3R}$.

Draw B_1B_{3R} and C_1C_{3R}.

Now

$$\therefore \frac{B_1F_1}{F_1C_1} = \frac{B_3'F_3}{F_3C_3'} = \frac{B_{3R}F_{3R}}{F_{3R}C_{3R}}$$

$\therefore$ $\Delta\ B_1F_1B_{3R}$ is similar to $\Delta\ C_1F_1C_{3R}$.

$\therefore$ B_1B_{3R} is parallel to C_1C_{3R}.

Draw RL1 through A_1 parallel to B_1B_{3R}. This is the required reference line since B_1 and B_{3R} and also C_1 and C_{3R} are equidistant from it.

The reference line RL2 in the original position of view three has the same orientation to $A_3B_3C_3$ that RL1 bears to $A_{3R}B_{3R}C_{3R}$ and can thus be drawn. The central view is of course obtained by drawing projectors perpendicular to the reference lines.

Since there are two points K there are two pairs of equally foreshortened lines—hence two possible solutions.

The notion of a line of equal foreshortening is an interesting one. It is a line in the space plane which makes equal angles with the two projection planes. There are always two such lines through any point in a plane. The lines of equal foreshortening in the first and third views of any three view system will always be the intersection of the space plane and a plane through the required point, (1) parallel to the plane bisecting the angle between the first and third projection planes and (2) a plane perpendicular to this latter plane and the central projection plane.

WESTERN UNION TELEGRAM

Newark, Delaware
1951 June 16 am 10:21

CLAIR V. MANN, Rolla, Mo.

American Association for State and Local History Convention at Newark, Delaware, gave the Regional Award of Merit last night to you as the individual in Missouri River States most outstanding in forwarding local History during year ending May one. The Region includes Minnesota, Iowa, Missouri, North and South Dakota, Nebraska, Kansas. Your Certificate of Merit will be sent later.

FLOYD C. SHOEMAKER
Secretary, State Historical Society of Mo.
Columbia, Missouri

GRAPHIC SOLUTION FOR COMPLEX QUADRATIC ROOTS

by
John F. Twigg
Massachusetts Institute of Technology

Many problems of a graphic or geometric nature involve locating the points of intersection of two curves. If, upon performing the construction, the curves in question do not intersect in the real plane, then we say that the intersections are complex. The problem of demonstrating graphically the existence of these complex points has many interesting aspects.

Consider the well-known geometric construction, found in many texts, for locating the roots of a quadratic equation of the form

$$x^2 - ax + b = 0$$

To perform the construction, rewrite the equation in the form

$$x^2 - (-a)\ x + b = 0$$

Lay off on the line $y = 0$, $OA = (+a)$ Figure 1, paying attention to the sign within the parenthesis. Erect a perpendicular to the line $y = 0$ at A, and lay off on it $AB = b$, again paying attention to sign. Mark point P: (0,1). Describe a circle on PB as a diameter. If the circle intersects the line $y = 0$ as in points M and N, then OM and ON are the roots of the equation. If no real intersection occurs, then the roots are complex, and occur in pairs of the form $(x \pm iv)$. The natural question now arises whether these complex roots may be found by a modification or extension of the given construction.

The answer in general terms involves finding the intersection of any line and any circle. In the instance above, the line $y = 0$ and any circle. Obviously, we cannot plot a complex number entirely in the real plane. Moreover, the complex intersection of a line and a circle takes the form $(x \pm iv)$ and $(y \pm iw)$. This would suggest that we might use two planes; a real plane to describe

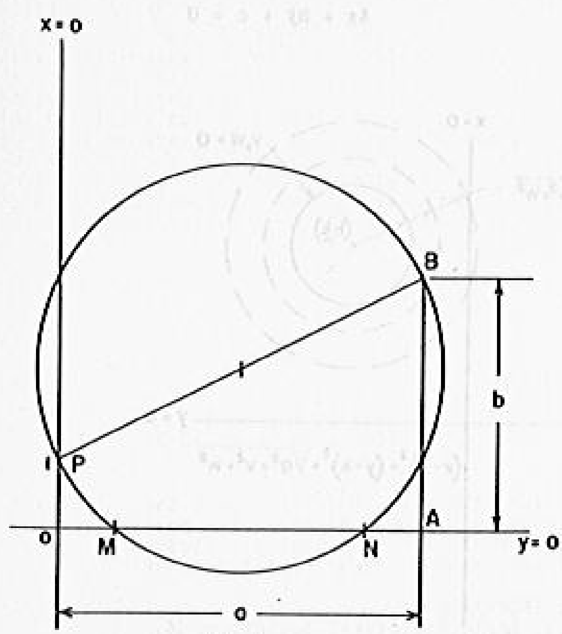


Fig. I

the relationship of x and y, the real variables, and an imaginary plane to describe the corresponding relationship between iv and iw.

Consider the line $Ax + By + c = 0$ and allow both the variables to take on complex values.

We have then

(1) $A(x + iv) + B(y + iw) + c = 0.$

On expanding

(2) $Ax + Aiv + By + Biw + c = 0.$

In such an expression, the sum of the real parts and the sum of the imaginary parts must equal 0 independently.

Therefore:

(3) $Ax + By + c = 0$ plotted in the real plane in Figure 2 (a).

and

(4) $Aiv + Biw = 0$ plotted in the imaginary plane Figure 2 (b).

Plotted thus on their respective planes, we see that we not only have the real line in Figure 2 (a), but in addition an imaginary line in iv and iw, in Figure 2 (b). Moreover, in each instance the slope of the lines is $-\frac{A}{B}$, and the lines are parallel. Furthermore, the imaginary line passes through the point $iv = 0$, $iw = 0$.

Consider now the circle

(5) $(x - h)^2 + (y - k)^2 = a^2$ and similarly allow the variables to take on complex parts. Then

(6) $(x + iv - h)^2 + (y + iw - k)^2 = a^2$

Performing the indicated operation we have

(7) $x^2 + (iv)^2 + h^2 + 2x\ (iv) - 2hx - 2h(iv) + y^2 + (iw)^2 + k^2 + 2y(iw) - 2ky - 2k(iw) - a^2 = 0.$

Again separating the real and imaginary parts and rearranging terms and remembering that $(i)^2 = -1$ we have

(8) $x^2 - 2hx + h^2 + y^2 - 2ky + k^2 - a^2 - v^2 - w^2 = 0$

and

(9) $2x\ (iv) - 2h(iv) + 2y(iw) - 2k(iw) = 0$

Equation (8) yields

(10) $(x-h)^2 + (y-k)^2 = a^2 + v^2 + w^2$ plotted in the real plane in Figure 3 (a) and (9) yields

(11) $iw = -iv\frac{x-h}{y-k}$ plotted in the imaginary plane in Figure 3 (b).

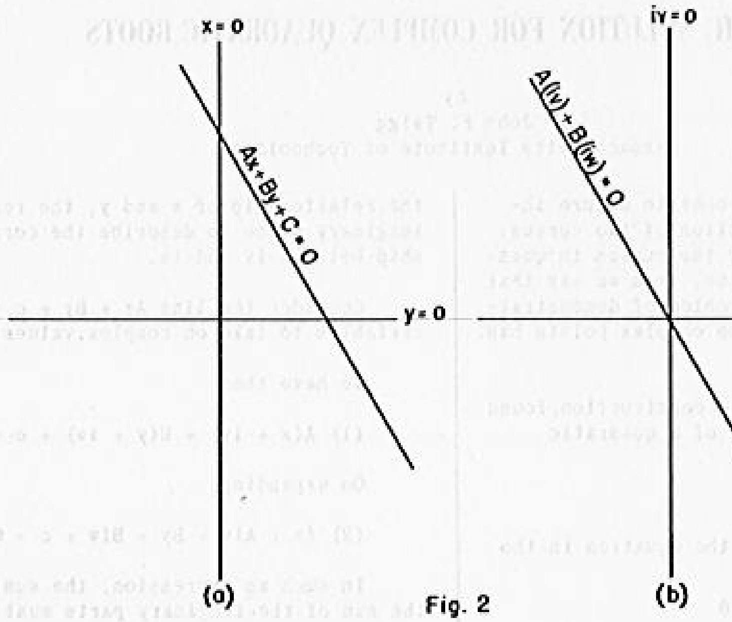


Fig. 2

In the real plane we now have a family of concentric circles, with center at (h, k) and radii varying as $a^2 + v^2 + w^2$. The imaginary plot gives a family of lines radiating from the origin and with slopes varying as $-\frac{x-h}{y-k}$. By differentiating the equation of the circle, we find that this expression is the slope of the tangent line to the circle in the real plane.

The problem of constructing the complex intersection of the line and the circle now resolves itself into plotting the line in both the real and imaginary planes (equations 3 and 4) and in finding the particular member of the family of real circles (equation 10) and the particular complex line (equation 11) which will yield the desired intersection points.

In order that we have a solution, or intersection in the imaginary plane, we can see that the imaginary part of the real line from equation (4) and the imaginary part of the circle, which is also a line from equation (11) must coincide. Otherwise, the solution is trivial, namely $iv = 0$ $iw \times 0$ Figure 4 (a).

In the real plane we must now determine the particular member of the family of concentric circles (equation 10) which will yield the real parts (x,y) of the complex intersection. We now note that in the analytic solution for the complex intersection, the real variables x and y take on only a single value each. That is, are represented by a single point. The only member of the family of circles in the real plane which would yield this result, namely a single point, is that circle tangent to the real line. Figure 4 (b). That this is the case can be shown analytically, if we consider the solution of the intersection of the real line $Ax + By + c = 0$ and any real circle with center at (h, k).

$$(x-h)^2 + (y-k)^2 = a^2$$

$$Ax + By + c = 0$$

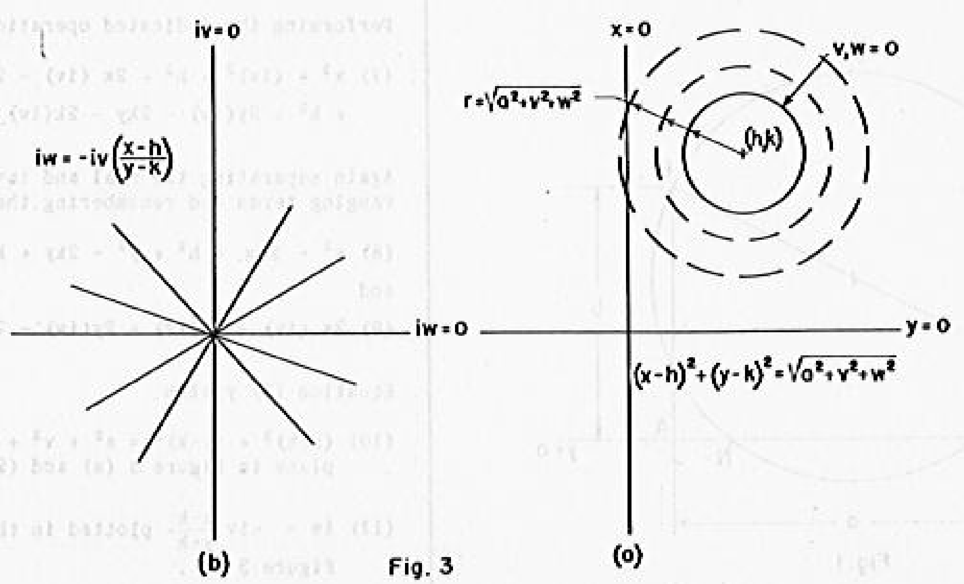


Fig. 3

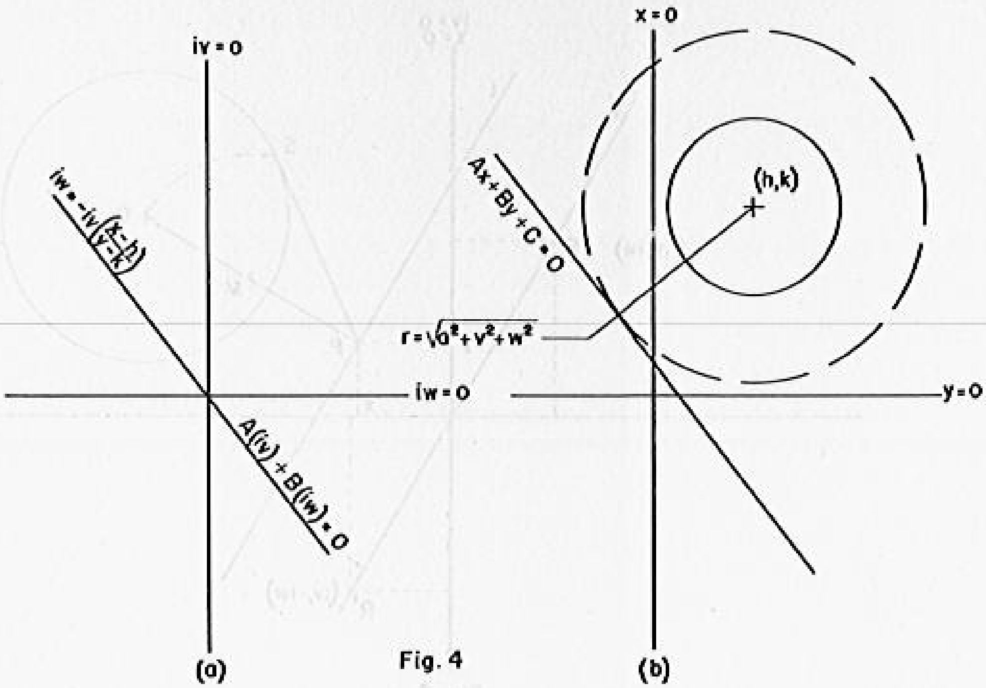


Fig. 4

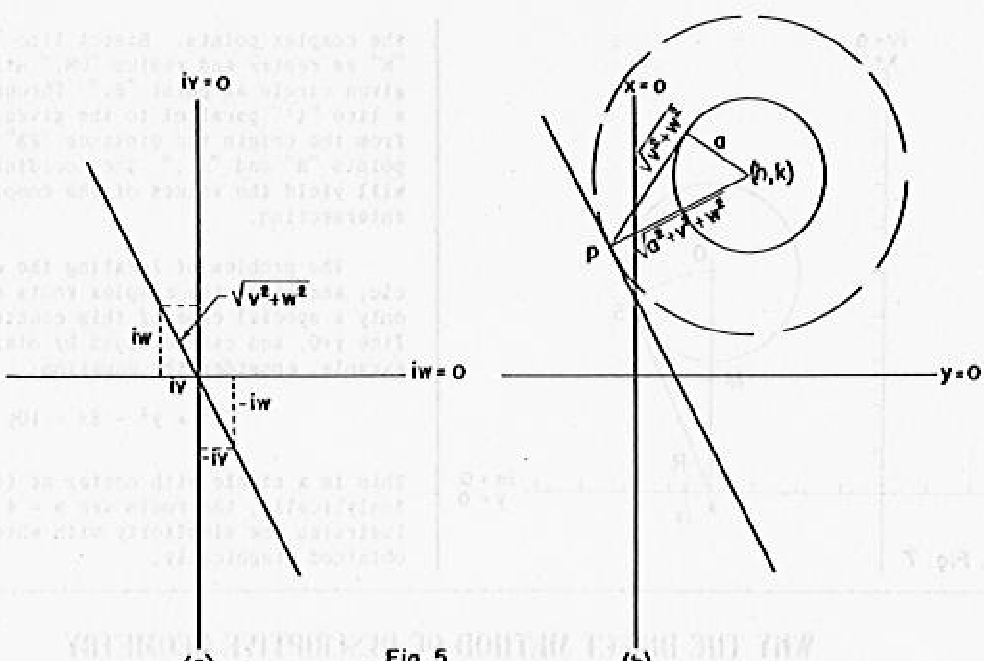


Fig. 5

Solving these equations simultaneously for x we have a quadratic expression which we can symbolize as

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Examination of this solution shows that, depending on the value of the radical $b^2 - 4ac$ we may have for x two real unequal solutions if $b^2 - 4ac$ is positive and $\neq 0$. One real value if $b^2 - 4ac = 0$, and two complex values if $b^2 - 4ac$ is negative. The one real value appearing in the second case can result only from a circle tangent to the given line.

The circle which is tangent to the given line has as its radius $\sqrt{a^2 + v^2 + w^2}$, Equation (10). The solution point Figure 5 (a) in the imaginary plane has as its distance from the origin $\sqrt{v^2 + w^2}$. This distance may be found from the real plane. From the point of tangency P on the given line we construct a tangent to the original circle, Figure 5 (b). The length of this tangent is $\sqrt{v^2 + w^2}$.

The complex intersections can now be constructed. For simplicity, we will superimpose the (x,y) and (u,w) planes. From the center "O" of the given circle Figure 6 construct a line perpendicular to the given line "ℓ." This will be the radius of the tangent circle. The intersection "P," of this perpendicular and the given line will yield the values (x,y) which are the real parts of

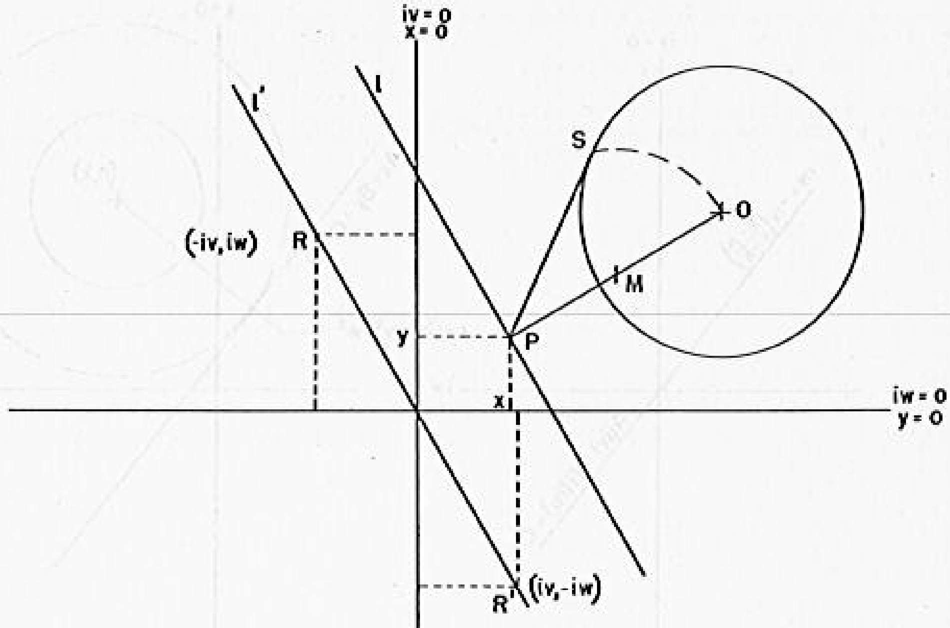


Fig. 6

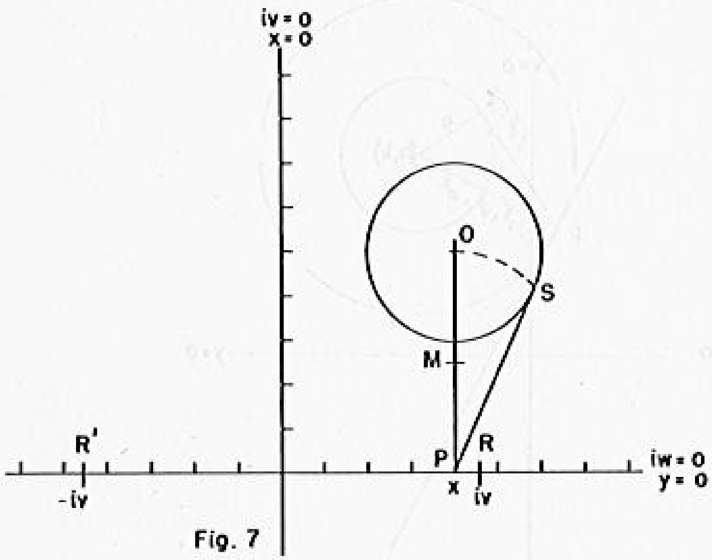


Fig. 7

the complex points. Bisect line "OP" at point "M." With "M" as center and radius "OM," strike an arc cutting the given circle at point "S." Through the origin construct a line "ℓ'" parallel to the given line. On "ℓ'" lay off from the origin the distance "PS" in both directions to points "R" and "R'." The coordinates of these two points will yield the values of the complex parts (u,v) of the intersection.

The problem of locating the complex roots of a circle, and hence the complex roots of any quadratic is now only a special case of this construction, considering the line y=0, and can be found by similar construction. For example, consider the equation:

$$x^2 + y^2 - 8x - 10y + 37 = 0$$

This is a circle with center at (4,5) and radius = 2. Analytically, the roots are $x = 4 \pm 4.6i$. Figure 7 illustrates the simplicity with which these roots may be obtained graphically.

WHY THE DIRECT METHOD OF DESCRIPTIVE GEOMETRY

(An Older Fogey Strikes Back)

by
Professor Emeritus George J. Hood
University of Kansas

In the May, 1954, Number of the Journal of Engineering Drawing, Professor Henry C. T. Eggers asks: "What do you mean 'Direct?' or, An Old Fogey Strikes Back."

An Older Fogey now answers his question. Professor Eggers says he is 61. I am 76. He has taught 35 years. I have taught for 46 years. That makes me an older fogey by 62.7 per cent. Or, is it only by 27 per cent?

Professor Eggers quotes Professor McNeary: "The gradual shift in the teaching of descriptive geometry by the indirect, or plane trace method, to the direct, or auxiliary view method, logically may be claimed to have been caused by the superior transferability of the direct method to engineering practice."

As to "the superior transferability of the direct method to engineering practice" there seems to be quite a general agreement. But the linking together of the words: "direct, or auxiliary view method," aptly illustrates a common misconception of the fundamental principles on which the direct method is based. Spoken and written statements made by some teachers of descriptive geometry indicate a belief that the basic purpose of the Direct Method is to make a general use of auxiliary views. That belief is erroneous. A careful reading of the first few chapters of the textbook on the Direct Method should make this clear.

The two Methods of Descriptive Geometry, Projection and Direct, are founded on two different basic ideas.

Each method has its own basic principles, and each requires its own attitude of mind.

The Projection Method specifies that objects are projected on planes. It makes use of various planes of projection, quadrants, ground lines, traces of planes, and of projections on planes. These have no place in the Direct Method, nor are they used by the practicing engineer when he thinks about the structures that he visualizes, designs, and draws.

By the Direct Method, the visualized structure or object is viewed in any desired direction. The lines of sight are parallel. Each view of the object shows what the observer sees when he looks at the object. And, when reading the drawing, each view is visualized so that the object stands out as if it were the three-dimensional object itself. The view is never thought of as a flat projection on a plane. This direct way of thinking about the object and its views promotes thorough visualization and produces better designs.

The absence from the Direct Method of the projection idea, and of all the accompanying impediments of the Projection Method that stand in the way of thinking about the object itself, make the Direct Method direct. This method is now thirty and more years old. It was developed by the writer over a period of years while he was teaching by the Projection Method.

Twenty years ago, Professor Thomas E. French wrote: "In the Direct Method the student looks directly at the object itself without the conscious intervention of projection planes." Now, as to the linking together of the words: "direct,or auxiliary view method." A projection, or view, is not a Method of Descriptive Geometry. A projection, or view, is but one of the elements of a method. We do not think, or speak of a "vertical projection method," or a "front view method." Likewise, there is no "auxiliary view method." The above quotation links together two dissimilar and incompatible terms.

And, how has it come about that the Direct Method has been considered by some to be an "auxiliary view method?" A teacher thumbs through the textbook on the Direct Method, without carefully reading the printed explanations of the fundamental ideas on which this method is based. He looks mainly at the illustrations, and he notes a considerable use of auxiliary and oblique views. A reading of the text, however, will show that the greater use of auxiliary views is not a basic purpose or requirement of this method. Such increased use has come about because auxiliary and oblique views often expedite the solutions of problems, and also because such views are used to show the true geometrical relations between certain geometrical parts or elements of the structure of object. In addition, auxiliary and oblique views are readily drawn by those who think in terms of the flexible Direct Method, by which objects are readily viewed in any desired direction.

Some authors of descriptive geometry textbooks claim to be using the Direct Method, since they use auxiliary views, even though they explain and base the theory on the Projection Method as the foundation for the subject. Other authors even claim that they use both methods. Such claims are unfounded. The two methods are radically different in their basic concepts. Each method requires its own attitude of mind, and its own basic theory, principles, and vocabulary. Logically, the two cannot be mixed.

Each of the Methods of Descriptive Geometry, Projection and Direct, is founded on its own basic principles. And each requires its own attitude of mind toward the object and toward the drawings that represent the object. The Projection Method is based on the idea of projecting objects on planes of projection. The Direct Method is based on the idea of viewing an object in any desired directions. There is no "auxiliary view method."

PROGRAM

MIDWINTER MEETING

ENGINEERING DRAWING DIVISION OF THE A.S.E.E.
University of Tennessee
January 27, 28, and 29, 1955

TENTATIVE PROGRAM

The midwinter program has been planned to provide discussion at the close of each presentation. The program utilizes local situations to provide interest and depth. The Oak Ridge trip naturally stands out. Busses will transport the entire group to the Oak Ridge National Laboratories for guided visitations to certain declassified facilities. An alternative for those interested would be a trip to the TVA Kingston Steam Plant, the world's largest.

While special plans are being made for the ladies they will undoubtedly look forward to the Saturday afternoon trip to the Smoky Mountains and environs. Arrangements are being made for demonstrations of various crafts by the mountain people whose homespun products are world famous.

A Tentative Program follows:

Thursday, January 27, 1955:

6:30 - Dinner Meeting - Executive Committee.

Friday, January 28, 1955:

8:30 - Registration.
8:30-9:30 Browsing through Drawing Department - classes will be in session.
9:45 - REPORT "Graphics in Engineering Practice" - O. W. Potter, University of Minnesota.
10:30 - LESSON "How to Begin Advanced Graphics" - A. S. Levens, University of California at Berkeley.
11:15 - PAPER "Nomography" - Dale S. Davis, Virginia Polytechnic Institute.
12:00 - LUNCHEON.
1:00 - Board Busses for Technical Trip.
2:00-4:30 Oak Ridge National Laboratories.
6:30 - BANQUET.
7:30 - PAPER "The Greatest Single Responsibility of the Drawing Division."
8:15 - PAPER "What Drawing Must Contribute to Engineering Education" - Dean N. W. Doughtery, University of Tennessee, President A.S.E.E., 1954-55.

Saturday, January 29, 1955:

9:00 - PAPER (This paper is an answer to the challenge issued by Dean L. E. Grinter in the last paragraph of his article in the February, 1954, Journal of Engineering Drawing. The host committee would welcome a volunteer equal to the task.
9:45 - DEMONSTRATION "Blackboard Techniques" - A. J. Philby, Ohio State University.
10:30 - SUMMARIZING PANEL - It is the purpose of this panel to allow three members to present terse, meaty digests of what the meeting has produced that is worth taking home and using. There should be ample opportunity for widespread audience participation. This session will close between 11:30 and noon.

No plans are being made for Saturday Noon Luncheon.

1:00 - Trip to mountain craftsmen and Great Smoky Mountain National Park. Stops will be made at specific points.

BRADDOCK TRIANGLES

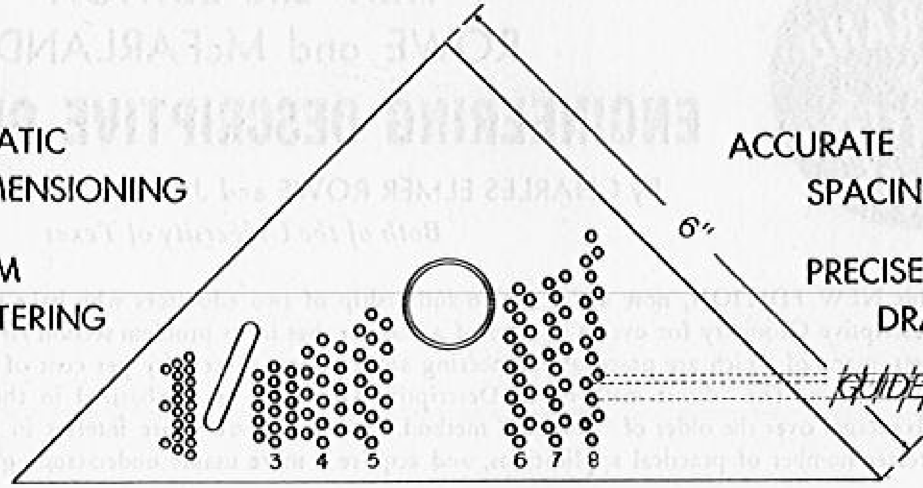
VERSATILE LETTERING TRIANGLES FOR

SYSTEMATIC DIMENSIONING

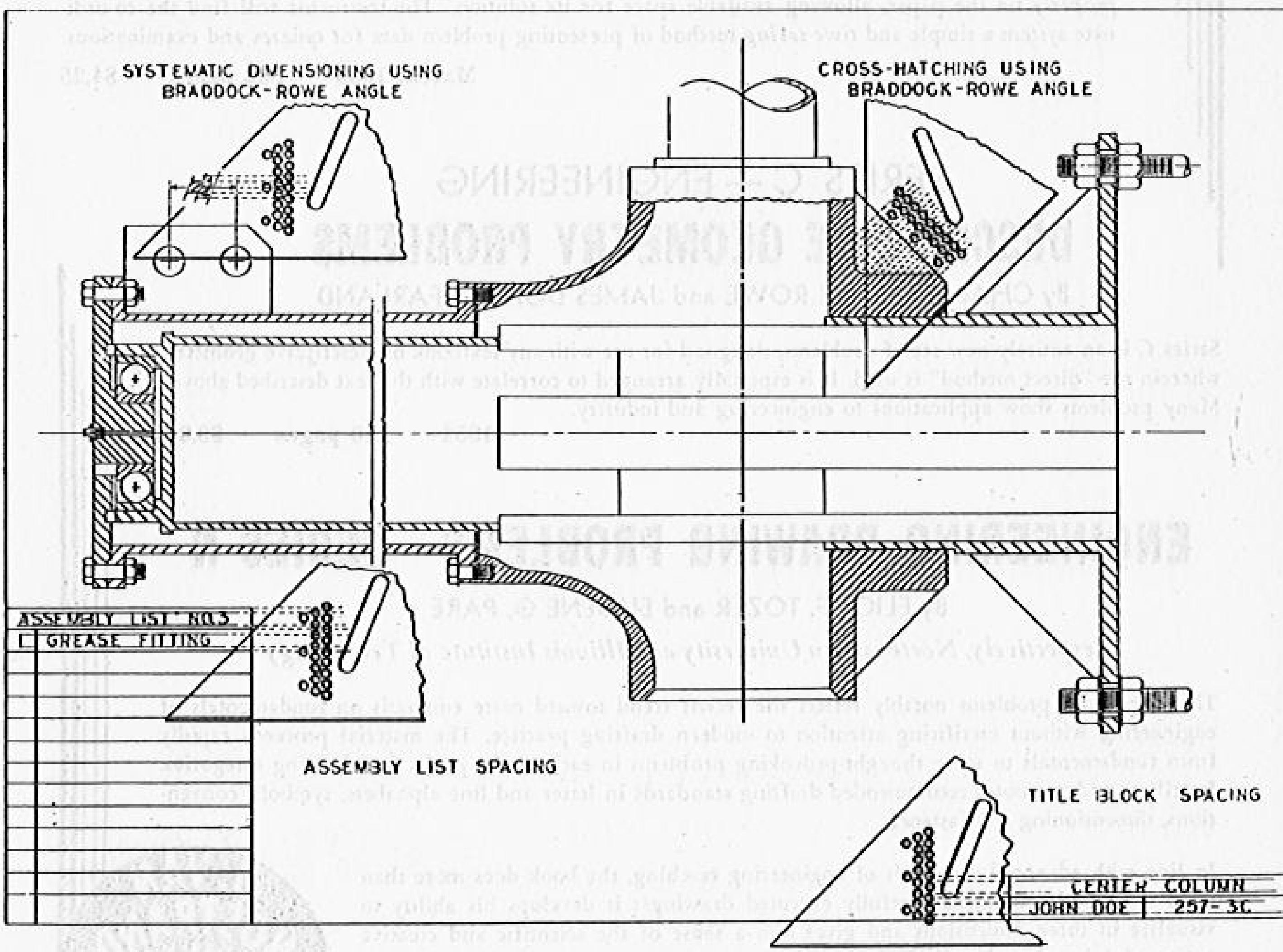
UNIFORM LETTERING

ACCURATE SPACING

PRECISE DRAWING



6"-45' STYLE B BRADDOCK-ROWE TRIANGLE

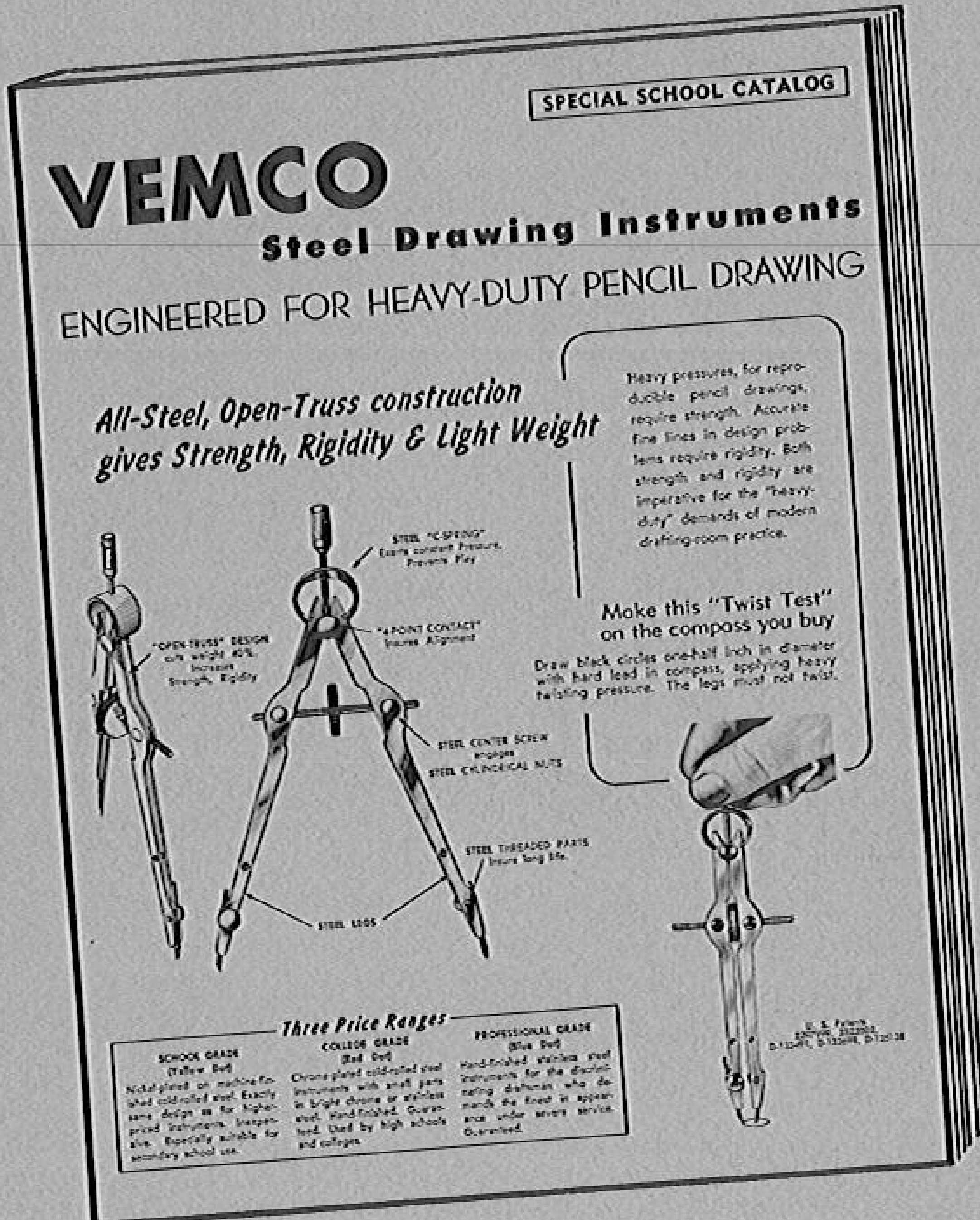


BRADDOCK INSTRUMENT CO.

PITTSBURGH 18, PA.

MAKERS OF QUALITY TRIANGLES FOR FORTY YEARS

FREE School Catalog



Illustrates how use of Vemco Steel Instruments enables schools to

SAVE 32%

Write for your free copy today,

V. & E. MANUFACTURING CO.

P.O. Box 950M — Pasadena 20, Calif.