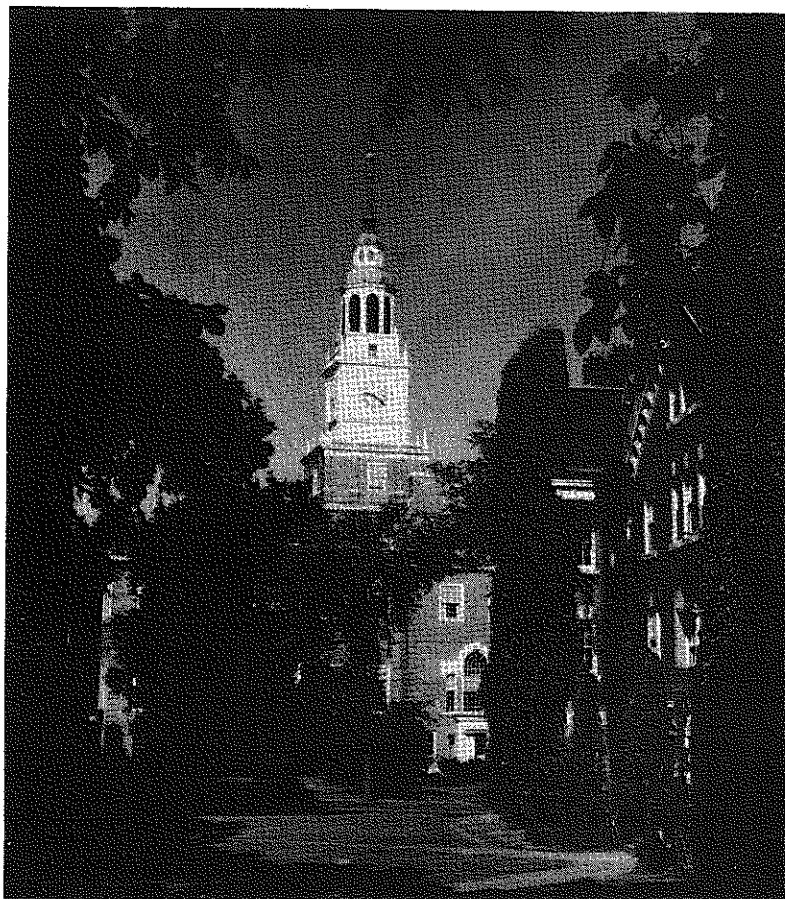


The Journal of Engineering Drawing



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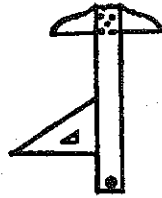
VOL. 16 No. 2

MAY, 1952

SERIES No. 47

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

EUGENE PARÉ
ROBERT LOVING
IVAN HILL

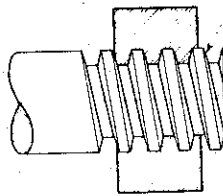


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THE AUTHORS HAVE DIVIDED the textual material of this new book into short homogeneous chapters and have followed the simplified organization of their previously published *Descriptive Geometry Worksheets* (Macmillan, 1950) in which new principles are introduced in order of need and difficulty. Both abstract and practical laboratory problems are conveniently located at the end of each chapter. Illustrations throughout the book are given in step-by-step form to ensure easy-to-follow constructions. Planned worksheet problem layouts are provided for each topic.

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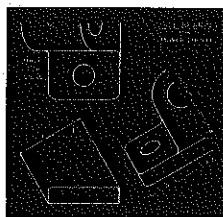
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PUBLISHED IN THE INTEREST OF TEACHERS OF ENGINEERING DRAWING
AND RELATED SUBJECTS

VOL. 16 No. 2

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THIS IS DARTMOUTH COLLEGE

Dartmouth College in Hanover, New Hampshire, one of the oldest and most distinguished of America's institutions of higher learning, is proud of a tradition which has remained unbroken throughout the 182 years of its existence: it is essentially an undergraduate college, not a university, and offers a liberal arts education.

It was Daniel Webster, one of Dartmouth's most famous graduates, who saved this tradition from extinction. Before the United States Supreme Court in 1818 he made a plea that the College be allowed to continue as a private institution, and in the renowned "Dartmouth College Case" the Court handed down its decision that Dartmouth's charter, granted in 1769 by King George III of England, could not be violated by the State Legislature of New Hampshire.

Webster closed his plea with these celebrated words: "It is a small college but there are those who love it." The first part of this statement is no longer true; Dartmouth College today has a student body normally of 2,700 men, enrolled from every section of the nation, a faculty of approximately 300 members, and endowment funds and plant worth thirty-five million dollars.

Dartmouth started as a school for Indians. The Rev. Eleazar Wheelock, its founder, had been conducting an Indian charity school in Connecticut, but he wanted to carry his work into the wilderness where there was a more plentiful supply of heathens to Christianize. So with funds raised in England, he moved the site to the broad plateau overlooking the Connecticut River. For the college motto, President Wheelock chose "Vox clamantis in deserto"; A Voice Crying in the Wilderness. The institution was almost named Wentworth in honor of the friendly and helpful governor of the Province of New Hampshire, but that modest man insisted that the College be named Dartmouth in honor of the Earl of Dartmouth, who had sponsored the raising of funds in England.

Since 1771, when four students were graduated, Dartmouth has never failed to send forth a graduating class every year. It is the only educational institution of pre-Revolutionary origin that has never suspended operation since its founding. The curriculum has undergone constant change throughout the years, yet in all its forms it has embodied Dartmouth's traditional purposes as a liberal arts college. Flexibility has long been one of its characteristics, so that courses of study and requirements for the degree might change to meet the needs of the day for both society and the individual.

Three schools for advanced study are associated with the College and a student may enter any one of the three after his first three years of study. Thayer School of Engineering dates from 1870 and bears the name of its founder, General Sylvanus Thayer, "father of the United States Military Academy." Dartmouth Medical School, now the third oldest in the country, has been in continuous operation since its founding in 1797. Tuck School of Business Administration, the first post-graduate institution of its type, was established in 1900 and is now widely known as one of the country's top business schools.

Baker Library with its white Colonial tower, dominates the Dartmouth campus from the north end of the College green. Baker, housing 650,000 books and operated on an informal, open-stack policy, has for some twenty years been a model among college libraries. Adjoining Baker at its northwest corner is Carpenter Fine Arts Building, containing a separate Art Library, exhibition galleries, studios for undergraduate artists and the College's art collection. At Baker's southwest corner stands Sanborn English House, headquarters of the English Department. The white brick Colonial buildings of Dartmouth Row look down on the green from the east and the Hanover Inn faces the green from the south side.

The comparative isolation of Hanover has given rise to a rare sense of unity and fellowship among Dartmouth men. This is the often-cited "Dartmouth Spirit," which seems to grow stronger in the years following graduation, and which has made the Dartmouth alumni body devoted to the College.

With so few distractions from studies and College associations, student life at Dartmouth is necessarily full. Nearly every part of the year's busy program is concentrated in the College itself. The best known event of the year is the annual Winter Carnival, sponsored by the Dartmouth Outing Club. This group turns out the crack ski teams which have dominated the intercollegiate field for so many years, and still sets the model for similar outing clubs in colleges all over the country.

Although all Dartmouth men do not fit the pattern of the rugged outdoor man, poet Richard Hovey, one of Dartmouth's well-known graduates, has written of them:

They have the still North in their souls
The hill-winds in their breath;
And the granite of New Hampshire
Is made part of them till death.

**DRAWING DIVISION
PROGRAM FOR THE ANNUAL MEETING
AT DARTMOUTH**

Prof. Clifford Springer, Chairman
Drawing Division, A.S.E.E.

The main theme for the program of the Drawing Division at the Annual Meeting at Dartmouth is "The Place of Engineering Drawing in an Engineering Educational Program". An attempt is being made to interest all Deans in this program. To that end, the following article has been included in the publication that goes to all Administrators.

ENGINEERING DRAWING

The Division of Engineering Drawing is planning a program at the Summer Meeting which is directed particularly towards administrators. This group has been very active in discussing their problems among themselves, but they feel they need more understanding with and by their Deans.

They are asking that you put on your calendar--and attend their sessions with the following interesting programs:

Monday, June 23 - 2:00 P.M.

Chairman - Professor R. S. Northrup

1. The Bases of Engineering Problem-Solving Skills.
Professor J. F. Calvert - Northwestern University.
2. Problem-Solving Skill in Drawing and Descriptive Geometry.
Professor R. A. Kliphardt - Northwestern University.
3. Applying Graphic Skills to the Solution of Differential Equations.
Mr. G. W. Walsh - Syracuse University.

Wednesday, June 25 - 2:00 P.M.

Chairman - Professor C. H. Springer

1. The Opportunity of Drawing in an Engineering Educational Program.
Dean S. C. Hollister - Cornell University.
2. The Contribution of Engineering Drawing in an Engineering Educational Program
Professor R. P. Hoelscher - University of Illinois.

3. Course Development in Engineering Drawing to meet the needs of Present Day Engineering Education.
Professor Ralph S. Paffenbarger - Ohio State University.

At the present time I would like to urge each member of the Drawing Division to follow up this notice with a special invitation to his own dean to attend these meetings. Secretary Bronwell has kindly arranged the time for these two conferences so that they do not conflict with either the Research or Administrators meetings.

Please call your Dean's attention to the fact that Dean Hollister is sufficiently interested in the possibilities of the Drawing Division that he is willing to make one of the principal talks. At this time all of our administrators are very much concerned about the improvement of Engineering Education. The study being made at Northwestern on Problem-Solving Skills should have as much significance to the Deans as to our own division.

The third conference of the Drawing Division will be a Technical Session with the following program.

Tuesday - 9:00 A.M.

Chairman - Dean Jasper Gerardi

1. Methods of Descriptive Geometry in use by Geologists.
J. S. Dobrovolny - University of Illinois.
2. A General Theory for Constructing Conic Sections.
Steven A. Coons - M. I. T.
3. Xerography -
John Hefferman - The Haloid Co., Rochester, New York
4. Drafting Problems Involved in Plotting a Map from Aerial Surveys.
Talbert Abrams, President, Abrams Aerial Survey Corporation.

Here is a chance for the Drawing Division to show how they can fit into a college program and provide valuable training for the student in his freshman year. Drawing is usually the only contact that the student has with engineering during his first year and this certainly provides a wonderful opportunity for our division to initiate any plans that the colleges may have for improving the complete education of the engineer.

I also hope that each member of the division will think about these problems and come prepared to discuss these papers, and give specific instances of things that have been done by the drawing departments.

DESCRIPTIVE GEOMETRY AS APPLIED TO SHIPBUILDING

Prof. Renato P. Iodice, Instructor,
The Cooper Union

Shipbuilding is one of the oldest sciences known to man; the first evidence of floating craft aside from the Ark being the dug-out canoe and reed and log rafts, which were from time to time improved upon the developed into craft capable of traversing the seas that were known at that time. The development of the ship from a hollow log to the graceful ocean liner of today has been a slow one. Much of the development has been achieved by "cut" and "try" methods. The early shipbuilders and shipwrights did not build from a sound scientific basis, but largely by the rule of thumb; preferring to make their craft from a small model, and enlarging the proportions of this to the full sized ship. Others, at a later date, built from a scale drawing that depicted the contours of the hull by the use of various shaped planes. One of the first in this work was J. Scott Russell, the designer of the "Great Eastern," who developed the science to a point where he was able to predict the performance of the finished ship from the design characteristics.

The form of ship is usually delineated on a scale drawing by the methods of descriptive geometry. This drawing is usually referred to as the lines drawing of the vessel. Every set of lines consists of at least three views, namely the "body plan," the "water lines" or "half-breadth plan" and the "sheer" or "profile" plan, as shown on figure 1.

The sheer plan is an elevation or a view of the ship from the side; the half-breadth plan is a top view looking down upon the vessel, and the body plan is a transverse view or end view. It is general practice to delineate only one side of the ship's form since all vessels are symmetrical about their longitudinal center planes.

When the general outlines and overall dimensions of the desired ship have been established, the designer then describes the curved surface of the hull by drawing in the station lines, water lines, buttock and bow lines and possibly diagonals.

The proper shapes or contours of the lines describing the hull are a matter of naval architecture and are dependent upon the speed of the vessel, displacement, the various ship coefficients, center of buoyancy, etc. It is not within the scope of this paper to discuss the principles involved in determining the proper shape of the lines, but rather to show how these various lines describe the surface and how they are interrelated.

Before we delve into the method of line drawing, it is well to get acquainted with some of the terms involved.

The lines of the vessel show the moulded shape of the ship, therefore they are known as moulded lines. It is rather difficult to give an all-inclusive definition of the term "moulded" as

applied to Naval Architecture; however, generally speaking, moulded dimensions and moulded lines define smooth curvilinear surfaces--surfaces without jogs. For example, for ships which have the usual type of frames, the moulded surface of the ship is that defined by the outside surface of the frame section.

The moulded base line is a very important datum line from which all vertical dimensions are taken. It is the lowest boundary of the moulded surface of the vessel. In vessels constructed with a flat plate keel, it sometimes happens that the line of the top of the keel plate coincides with the line of the bottom of the moulded surface; however, the moulded base line is used purely for design and reference purposes and need not be any part of the hull structure itself.

The forward perpendicular is a line perpendicular to the base line through the intersection of the designed waterline and the moulded line of the stem.

The after perpendicular is similarly determined from the intersection of the designed load waterline with the line of the after side of the straight portion of the rudder post. In some vessels with no well defined rudder post, the after perpendicular is taken as the center line of the rudder stock.

The length of the load water line between the forward and after perpendiculars is known as the length between perpendiculars. For the conventional type of ship, the length between perpendiculars is the length used in the calculations for propulsion, stability, displacement, etc.

Length over all is the distance measured parallel to the designed load water line from the forward part of the stem to the aftermost part of the stern. It is not usually referred to as a moulded dimension.

In commercial vessels the midship section is generally located midway between the fore and aft perpendiculars. In many modern vessels, the form of the cross section below the load waterline in the region of the half-way mark between perpendiculars, extends for an appreciable distance both forward and aft of midships. These vessels are said to have a parallel middle body; the extent of which is dictated by the speed of the vessel.

The moulded breadth or beam is the maximum moulded width of the vessel at the designed load waterline and is normally a maximum at the midship section.

The moulded depth is the vertical distance measured from the moulded base line to the moulded line of the uppermost continuous deck at the side of the hull. The moulded depth is

(Continued on page 9)

Just Published

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THEIR USE IN ARCHITECTURAL RENDERING

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MECHANICS OF PROCEDURE
OBLIQUE PROJECTION PRINCIPLES
SLICING PLANES
REFERENCE SHADOWS
PROBLEMS AND SOLUTIONS
INDEX

By WILLIAM WIRT TURNER, *Professor and Head of the Department of Engineering Drawing, University of Notre Dame.* In a concise and understandable manner, this new textbook gives information for correctly determining the shades and shadows of objects, particularly architectural compositions. Its methods enlist the reasoning faculties from the very outset, with one principle evolving naturally from another. The text material is brief and as nearly self-teaching as possible. Since this study is really a special phase of descriptive geometry, the principles and nomenclature peculiar to that subject are both discussed and illustrated. Those methods of procedure in determining shades and shadows which are commonly used and easily remembered are explained and illustrated in detail. Practice problems cover the various architectural elements which are constantly occurring in professional practice. Useful as a direct aid to the student, and for purposes of review, is a series of rules which summarizes underlying principles.

To insure efficient coverage of the subject in a minimum of time, a series of twelve full-size, 13" x 17", outline work sheets has been designed to supplement the text material. On the work sheets, drill problems are set up ready for the immediate casting of shadows. These work sheets in miniature are also reproduced in the text, along with solutions to the problems. For reference purposes, the shades and shadows for a number of common architectural elements have been inserted immediately following the descriptive portion of the book, which concludes with a group of special assignment problems.

115 pages, 95 illustrations; work sheets available separately

A PICTORIAL APPROACH TO . . .

DESCRIPTIVE GEOMETRY

by HAROLD BARTLETT HOWE, *Professor and Head of the Department of Engineering Drawing, Rensselaer Polytechnic Institute.* This newly published textbook is based on a new method: the PICTORIAL APPROACH. Teachers and students will welcome and appreciate the many advantages that this clear-cut manner of presentation offers. For the instructor: the sketches facilitate his method of presentation; for the student: the sketches enable him to comprehend space relationships quickly and with ease—thus, perception and visualization, two important student capacities, are stimulated and developed. Each chapter concludes with exercise problems presented either by word description, orthographic projection or in picture form. The direct method is employed in the presentation. The final chapter offers forty-six pages of problems which give the student an opportunity to apply theory to practice. The ability to cope with original problems is strengthened by the pictorial sketches. A few of the outstanding features of this textbook are:

Each project with its drawings and explanation is complete on a single page or on facing pages.

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"Professor Howe has produced a remarkable piece of work . . . in a subject matter field already noteworthy for an amazing number of excellent, scholarly, and teachable textbooks, Professor Howe's book is destined to take a foremost position, unless I miss my guess by a mile."

—PROFESSOR
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—PROFESSOR A. B. WOOD,
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" . . . it is evident that Professor Howe has made a real contribution, especially in his well conceived pictorial drawings."

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FRANK A. HEACOCK,
Princeton University.

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always measured at the midship section.

The moulded draft is the vertical distance measured from the moulded base line to the surface of the water to which the ship is floating. Therefore the designed moulded draft is the draft measured to the designed load water line. The moulded draft is used for design purposes only and is not an actual draft--the actual draft is measured from the bottom of the keel to the water line and is known as a keel draft.

Now, for a description of the usual three views describing the vessel's form.

The vessel's length is considered to be intersected by a series of transverse vertical planes. Each of these planes intersects the vessel's form in a curved line known as a station line. When projected into the sheer plan and into the half-breadth plan, these planes appear as straight lines at each of the numbered stations. In the body plan, only one-half of each curve is shown, except for the midship section. The forward sections are drawn to the right of the center line, and the after sections are drawn to the left of the center line.

The curved lines that appear in the half-breadth plan are known as water lines. These curves represent the intersection of a series of horizontal planes with the vessel's hull; they are parallel to the designer's load water plane, and located both above and below it. These planes appear as straight lines when projected into either the sheer plan or the body plan, but in true form when projected into the half-breadth plan.

It is customary to space these planes or waterlines at equal intervals throughout the depth, say from one to four feet apart depending on the size of the vessel, with half-interval water lines near the bottom where the vessel's shape changes rapidly.

It is usual practice to use another set of intersecting planes known as bow and buttock planes. These are longitudinal vertical planes parallel to the vessel's longitudinal center plane. They are usually spaced from one to four feet apart with half intervals of spacing near the center line plane.

Each plane intersects the vessel's hull in a curve known as a bow line when in the fore body and a buttock line when in the after body. Each bow and buttock line appears in its true form in the sheer plan but as a vertical straight line in the body plan and as a horizontal straight line in the half-breadth plan.

The foregoing three types of intersecting planes giving respectively the transverse sections, waterlines, and buttock lines are sufficient to determine the form at all points on the vessel's surface.

If the form of a vessel were continuous and smooth, or fair, any lines of the surface would also possess the quality of fairness, except, of course, at the places of abrupt changes of form, as at a knuckle in way of the fore-castle or stern. If the lines of the surface were fair, then each of their projections would appear as fair lines on the respective reference planes.

For example, consider a point to be on the surface of the vessel--figure 1--at the ordinate station No. 16 and 12 feet above the moulded base line; it would be a point on the 12 foot water line. The horizontal distance of the given point from the vessel's longitudinal middle line plane would be determined by the distance in the body plan of the point in question from the ship's center-line. The projection of the point on the half-breadth plan would be on the ordinate station No. 16 and on the 12 foot water line.

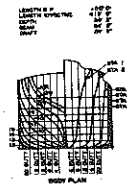
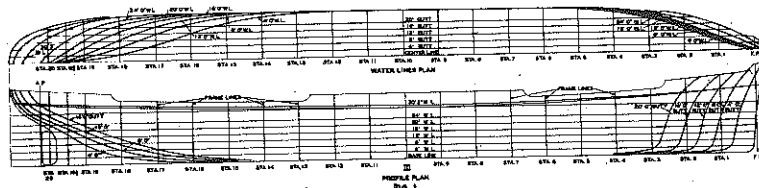
A test of the fairness of the point in question would be that the transverse offset in the body plan from the center line would exactly equal the transverse offset in the half-breadth plan. If this equality does not exist, the surface of the vessel in the region of the point in question would not be fair.

In designing the hull form of a proposed vessel, an entire reversal of the foregoing procedure is adopted. At the outset, such characteristics as the length, breadth, depth, draft, displacement, and all of the vessel's coefficients are regarded as known and fixed. Several other features are tentatively fixed, such as the general outline of the stem, stern and main deck.

The usual procedure in developing a set of lines is as follows:

The first thing to do is to lay out the grid for the lines. In the profile view the base line is drawn, the forward and after perpendiculars are erected and the distance between them is divided into the required number of spaces. At each point of division the station lines are drawn and numbered from the forward perpendicular; that is, the forward perpendicular is usually station 0. The load water line is

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drawn parallel to the base line and the other water lines are drawn above and below the load water line at predetermined intervals and parallel to it.

In the half-breadth plan, the longitudinal center line and the maximum half-breadth are drawn; the stations are projected from the profile plan and the buttock lines are drawn at proper intervals.

In the body plan, the center line is drawn, with the maximum half-breadth on either side. The water lines are projected from the profile plan and the buttock lines are projected from the half-breadth plan.

From the preliminary general arrangement plans, we know the type of bow and stern that is desired and the contour of these can be drawn on the sheer plan. The sheer line of the moulded main deck at the side is drawn--the amount of sheer allotted varies with each design. Next, there is drawn on the half-breadth plan the line describing the main deck throughout its length. In the body plan, we can now transfer the heights of the main deck from the sheer plan and the half-breadths from the half-breadth plan--the main deck line is drawn in. The bilge radius of the midship section is something that has already been determined and this can be drawn in; so in effect we have our midship station.

Before the remaining sections can be drawn, we must have some knowledge as to the area that is to be subtended by each station; that is, below the load water line. For this purpose, the naval architect uses what is known as a sectional area curve. This is a curve, the base of which represents the length of the ship, and the ordinates, the area of the sections at each point along the length of the vessel. The forward portion of the curve is known as the "entrance," and the aft portion as the "run." In between, there may or may not be a parallel middle body; that is, the area of the sections may or may not be constant and equal to the area of the midship section.

The general shape of this curve depends chiefly upon the speed of the vessel. The area under the curve represents the displacement of the vessel, and its longitudinal center of gravity represents the center of buoyancy.

The next step is to pick off from the curve of sectional areas, the area required for each of the stations -- divide each station area by the loaded design draft to obtain the width of the equivalent rectangle.

On the body plan, draw rectangles having the areas that each station should have in accordance with the sectional area curve. Next, sketch the sections free-hand, bearing in mind that the area cut away from the rectangles near the base line must be added to the outside of the rectangles at the load water line. We now have a set of sections that will give us the required displacement and center of buoyancy, but of course, they are not fair. Now, take a narrow strip of paper and

place it on one of the water lines on the body plan and mark off the half-breadth of each station at this water line. The half-breadths are transferred to the half-breadth plan at the corresponding stations making use of a thin wooden batten or spline, we try to run a fair line through the points thus obtained. Some of the points will not be along a fair curve; however, a fair curve is drawn as close as possible to the plotted points. The other water lines are drawn in the same manner. After all the water lines are drawn, we mark off the new half-breadths from the half-breadth plan at each station and transfer these points to the body plan and correct the sections to agree, only this time the shape of the sections are drawn with the aid of curves.

We will again find that some of the points will not fall on fair curves; nevertheless the sections are drawn as close as possible to the plotted points. The offsets from the body plan are again transferred to the half-breadth plan and the water lines are changed to agree. This procedure of altering each set of curves until corresponding points agree is known as "fairing," and the process must continue until the curves satisfy the practical eye of the designer.

In the meantime, a running check must be kept on the areas of the sections to see that they remain at their predetermined quantities. When the half-breadth and body plans are in fair agreement, the buttocks are drawn on the sheer plan; transferring the heights from the body plan and the intersections with the waterlines from the half-breadth plan. If the buttocks are not fair, adjustments must be made in the body and half-breadth plans until all three plans agree and all curves are fair.

In fine ships, the waterlines at the extremities of the vessel may be almost straight, and due to the small curvature, it is difficult to fair them. To make the fairing easier, the half-breadth plan is sometimes drawn using a larger scale for the breadth than for the length, thus increasing the curvature of the waterline. This is known as the contracted method of fairing.

Mold Loft

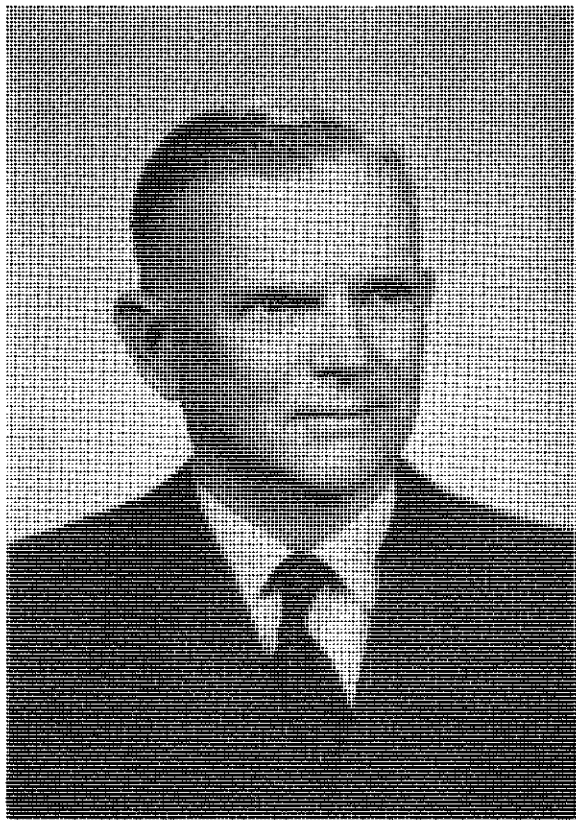
In general, the loft work may be split up into two distinct parts. The first, the laying down and fairing of the lines, the expansion of the shell plating, margin plate, tank top, etc., and the second, the making of battens, molds and templates for issue to the steel fabricating shops of the yard. The floor of the mold loft is constructed of heavy wood planking which are carefully sanded; for the surface must be smooth as it is in reality a huge drawing board. After the floor has been properly sanded, it is usually painted grey.

The loftsmen should be supplied with enough information to enable him to draw the vessel's lines on the floor full size, if space permits; otherwise, to be shown in contracted form, that is, with the heights and breadths full size, but the length reduced. This operation is known as

(Continued on page 33)

PERSONALITY SKETCH OF PROFESSOR CHARLES ELMER ROWE

by
J. D. McFarland
The University of Texas



Professor Charles Elmer Rowe has been a member of the Engineering faculty of The University of Texas since September 1905. The University regulations made it necessary for him to be placed on modified service in 1950, but he still has the carriage and enthusiasm of a much younger man, and remains a valuable member of the staff of the Drawing Department.

Professor Rowe has enjoyed a full and profitable life. He was born in Round Rock, Texas, September 20, 1879. He attended The University of Texas in 1896-1898, and the University of Colorado in 1898-1900, where he received the B.S. degree in Civil Engineering. He continued his studies at the Colorado School of Mines and received the degree of E.M., in 1902.

He worked as a draftsman, designer, surveyor, and similar engineering work in various industrial concerns before he was offered the position of Instructor in Mining Engineering at The University of Texas. He filled this position creditably until 1912, when he began teaching courses in drawing, with which field he has been affiliated ever since. He was made a full professor of drawing in 1927, and served as chairman of the department from 1927 to 1932, and again from 1937 to 1941. From 1944 until he was placed

on modified service he served as Assistant Dean of the College of Engineering.

In this long period of service at The University of Texas, Professor Rowe has not only distinguished himself as an educator in the field of drawing, but he has contributed to the life and welfare of the community in other ways. He has been a member of the Board of Stewards of the University Methodist Church for almost forty years. He served as Chairman of the Board of Directors of the University Co-Operative Society in 1930-1935, and as President of the Society in 1936-1941. He was president of the University Club for two years. As a member of the building committee he originated and drew the preliminary design plans ultimately adopted by the architects for the present main engineering building. He designed much of the equipment in use now in the drawing department. In addition to this he has found time to do design work for several industrial companies, travel over most of the North American Continent, and make two visits to Europe. All of this, of course, has contributed to a rich and useful life.

Professor Rowe is one of the pioneers of the direct method of teaching descriptive geometry, and his textbook *ENGINEERING DESCRIPTIVE GEOMETRY* published in 1939, is still considered one of the foremost in the field. In collaboration with Professor J. D. McFarland, he has contributed three workbooks of descriptive geometry problems, which have been very favorably received. The large number of papers which he has presented to technical societies, and his selection on the staff of the summer school faculty of the Drawing Division of A.S.E.E. at St. Louis in 1946, attest to the esteem in which he is held by his colleagues.

Perhaps Professor Rowe is best known for the work he has done in the design and construction of models used as aids in teaching the basic concepts of drawing and descriptive geometry. With the assistance of student mechanics these models have been constructed over a period of years, and represent probably the most unique and complete set to be found in any school in America. If Professor Rowe has one outstanding hobby there can be little doubt that it is the designing and building of models. He is a perfectionist and it certainly shows up in these models. Many of them are very ingenious and it is generally agreed that they are extremely valuable in teaching descriptive geometry.

Professor Rowe has received many honors in his profession. No doubt he finds satisfaction in being a member of Tau Beta Pi, in being listed in Who's Who in Engineering, in serving on various committees of the Drawing Division of A.S.E.E., and in other capacities in which his abilities have been recognized. It is more likely, however, that his greatest satisfaction comes from knowing that he has many friends, and that he is, above all, a gentleman. Our lives are enriched just by knowing men like him.

COLLEGE CREDIT FOR HIGH SCHOOL DRAWING

by
 Prof. Lewis O. Johnson
 and
 Prof. Irwin Wladaver
 New York University

Do you give college credit for high school drawing? Can you justify your action? What do you say to students from whom you withhold credit even though they may have had several hundred hours of high school drawing?

If you have found a satisfactory solution, this paper will hardly interest you. But if you still have a feeling of uneasiness about this vexing problem you may want to know what we are doing about it at the New York University College of Engineering. Our course of action was suggested by the results of a study which we started about two years ago.

In September, 1949, we welcomed 318 beginning freshman students to the College of Engineering. Of these, 150 had never had any "mechanical drawing" in high school. But the remaining 168 students had had drawing in high school in widely ranging amounts. One of them had had only 75 hours or so in a parochial high school. Another of the students had had about 1000 hours of drawing in one of the best technical high schools within many miles. Which one (if either) of these two would you have excused from taking your 100-hour college engineering drawing course? Well, you would probably have been wrong!

In our study of the situation here are some of the things we found out. If our study was properly conducted and if our tests were reliable and valid measuring devices, we can believe that:

1. The number of hours of high school drawing a college freshman has had cannot in itself tell us anything dependable about how much he knows about engineering drawing by the standards of our College tests.
2. The reputation of the high school from which a college freshman comes cannot in itself assure us in any dependable degree how much he knows about our drawing course.
3. If a student has had "some" high school drawing (say, 100 hours or more) we can predict with a high degree of precision how well he will do in his college drawing course. This is of great importance.
4. For that same student we can predict (but only roughly) his degree of success in his descriptive geometry course.
5. Most important of all, we feel reasonably confident that we know which students ought rightfully to be excused from taking our drawing course and which students ought not to be excused - without regard to the number of hours of high school drawing behind them. Generally speaking, the individual student feels satisfied that he has been given a fair chance to demonstrate his competence. In fact, many students who were offered exemption preferred to take the course, for one reason or another. Some of them said

that the examination they took seemed to hold interesting promise for the course itself.

Certain members of the Engineering Drawing Department of New York University had for several years been working toward the design of a comprehensive, "objective" examination in engineering drawing. We finally devised one which seemed to correlate particularly well with other engineering drawing tests we were using. In addition, it was quite searching and comprehensive in the sense that it dealt with most of the phases of drawing we considered essential to the student of engineering. We used the test as a final examination on a number of occasions and we were satisfied that it was the best one we had at the time.

When it turned out to be, in our opinion, a good measuring device, we were encouraged to try it out as a pre-test on entering freshmen who were asking why they had to submit to another hundred hours of college drawing after "all that high school drawing." We had our own (highly prejudiced) opinion about high school drawing. But we felt that it was manifestly unjust to make a student take the course with us if he could pass a reasonably tough comprehensive examination in the subject. And so, without making any commitments or promises, we administered the objective engineering drawing pretest to the entire group of entering engineering freshmen who had ever had a high school mechanical drawing course.

Of the 168 students who took the examination at the beginning of the semester, 33 earned passing grades of 60% or better. Sixteen of them made the equivalent of a "D" (60%-69%); ten of them scored the equivalent of "C" (70%-79%); five scored "B" (80%-89%); and two scored "A" (90%-100%).

We don't intend to present here the entire statistical analysis, but certain numerical relationships were quite surprising. For example, the average (mean) number of hours of high school drawing that these passing students had had was 266. Actually this average has little real meaning. One of the students had had only 54 hours and one had had 750 hours. The student with over 1000 hours at the best technical high school failed miserably. He made the lowest score ever attained on the test! It was a "minus 23." The test was graded "rights minus wrongs." The student with 75 hours of drawing in a parochial school got a middle "D" pass.

We display the following to show how little usefulness there is in an "average" when a great range exists between extremes: Of the 33 students who passed

- 6 had had fewer than 100 hours of instruction
- 10 had had fewer than 155 hours of instruction
- 23 had had at least 255 hours of instruction, and of these
- 14 had had at least 400 hours of instruction.

(Continued on page 15)

THE DESCRIPTIVE GEOMETRY THREE-DIMENSIONAL PROJECT
THE COOPER UNION
ENGINEERING SCHOOL - DAY SESSION

Prof. C. Higbie Young

"Bang went the gun!"

This was the way one student started his discussion of the model he had made of a solution to problem 32-13 of Wellman's descriptive geometry text. One-hundred and twenty such models were on exhibition and they were viewed by the entire student body as well as staff members and officers of The Cooper Union.

What is this exhibition that takes place each year just after the second semester begins in February? The week before the first semester ends each student in the freshman class is assigned a problem which he must solve during the two week intersemester period. The students select their individual problem from a list culled from several textbooks. This year's list is given in table 1. They are told in general terms how they are to approach the project. Each student is required to solve his problem graphically and then to make a three-dimensional model to illustrate the solution.

The student must first choose the method which he believes is best suited to the solution of his particular problem. This implies that he has analyzed the problem and has broken it down into its component parts. After he has completed his graphical solution, he must decide how he will construct the model, so as to best portray this solution. Again, this will include the selection of material and methods of construction to fit his personal resources in the way of tools, work space and skill. Later on he will have to discuss his work in class as each graphical solution and its model is passed around the group. Thus each student in turn examines and comments on the work of all his classmates. Meanwhile, the instructor evaluates the work in general terms and points out the interesting applications of the problem.

At the time the problems are assigned, the instructor explains the criteria which will be used in grading the solutions. All these have been agreed upon by the entire staff teaching Descriptive Geometry and a sample score sheet is shown in table 2. It is estimated that the average student could do a satisfactory solution in from three to four hours, but in many cases they become so enthusiastic that a much greater time is used for this purpose. It is for this reason that it is assigned when no formal classes are in session.

In past years after all the models were in, about one-third were placed on display in the Students Browsing Room in the school library. This year, with one-hundred and twenty excellent colorful models, it was felt that the Department should make a gala occasion of the display. All the models were spread on the drawing tables in one of our drafting rooms and everybody was invited to attend. Punch and cookies were served. The room was packed from three-thirty until six o'clock, when we had to clear the room so we could prepare for the evening session. Besides

the freshmen, the exhibit attracted upper classmen from the engineering school; students and staff from the fine arts school; staff members from the engineering departments, the museum and the library; and the President and the Business Officer of The Cooper Union. The student publication, "The Pioneer," carried a very attractive column reporting on the success of the affair. The photographs show three of the models, not necessarily the best by grading, but selected because they would photograph clearly.

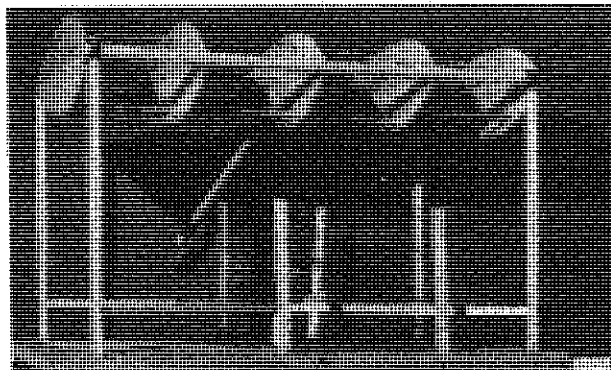


FIG. 1 WELLMAN - PROBLEM 46-14
AIRPLANE LANDING GEAR

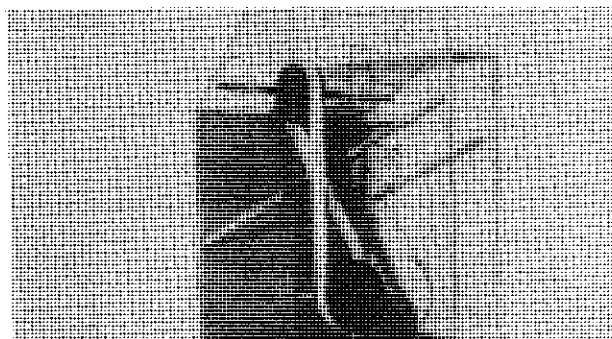


FIG. 2 WELLMAN - PROBLEM 27-13
MULE PULLEY

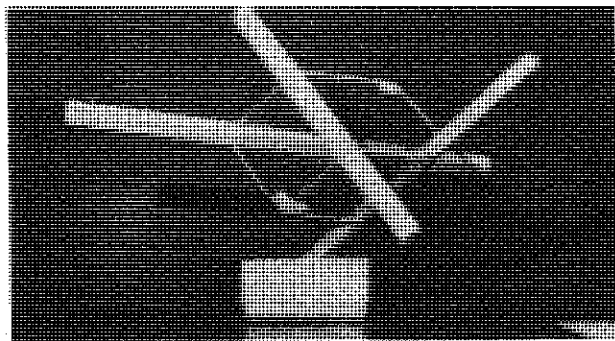


FIG. 3 WATTS AND RULE - PROBLEM 9
PARALLELEPIPED FROM 3 SKEW LINES.

(Continued on page 15)



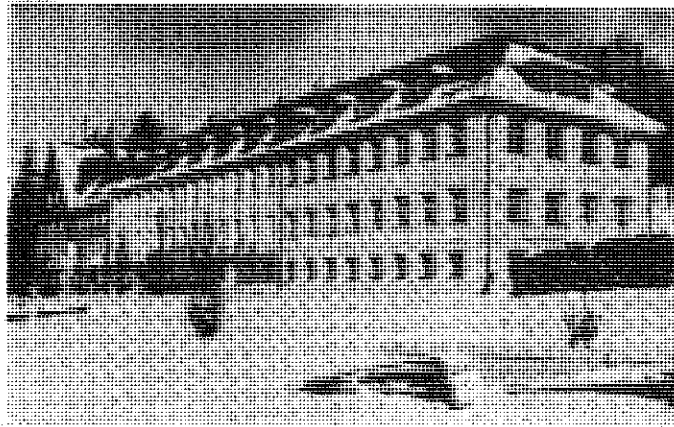
OPERATION IN CRAFTSMANSHIP

by RIEFLER*

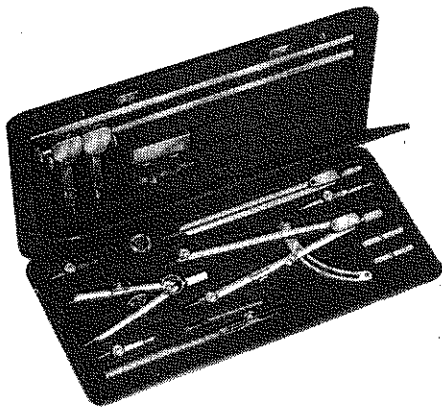
Ideas for drawing instrument design are constantly channeled from

American engineers to the Riefler factory in the heart of the Bavarian Alps.

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(Continued from page 12)

In the cases of the 33 who passed the test there was a reasonably high correlation (.42) between their scores and the previous hours of instruction. But this is information which has not very much value because it's necessary to give a test before knowing who will pass it!

Certain results of the study did not appear, naturally, until the end of the semester. As we stated earlier, some (14) of the students who made passing scores on the comprehensive exam elected to take the course anyway. In all, 141 of the original tested group of 168 students took and completed the engineering drawing course, with the following results:

Grade	A	B	C	D	E	F	Withdrawn
Number of Students	16	58	46	18	1	1	1
	(Total 141)						

Eight of the "A's," four of the "B's," one "C," and one "WD" went to the fourteen students who had passed the comprehensive test and elected to take the course.

The really surprising and encouraging result was the very high degree of correlation that turned up between the scores on the comprehensive pre-test and the final numerical (rather than letter) grades for the members of the pre-tested group who took our college engineering drawing course. The coefficient of correlation proved to be .52, a figure high enough to be considered unusual in educational studies. In a general way, the meaning of such a high correlation is that a low original score is likely to be paired with a comparatively low score later; similarly a high original score and a relatively high later score are likely to be paired. There are individual exceptions of course, but the group tendency is quite marked. This fact means that we can predict the degree of success in college engineering drawing with some precision if a student has had some high school drawing. This can have real educational significance.

By the summer of 1950 we had more data to examine. By that time the students in our study had finished the descriptive geometry course. We compared their numerical grades in descriptive geometry with their scores in the original engineering drawing pre-test. A high coefficient of correlation would mean that we could predict with

some precision how well a new group would make out in descriptive geometry (if the new group could be equated with the original group). A low coefficient of correlation would mean that our ability to predict would be impaired to that extent.

The coefficient of correlation between descriptive geometry scores and the engineering pre-test scores turned out to be .32, not a startling value to be sure. The substantial number of students in the study, however, assures us with this coefficient of correlation that a positive relationship exists. But the relationship is not sufficiently strong for us to make more than rough predictions for the group as a whole.

The important fact is the markedly high correlation (.52) between the pre-test scores and the final numerical grades in engineering drawing course. On this account, we have no hesitation in recommending to the College authorities that a student who passes the pre-test as a result of his high school drawing be exempt from the college course. And the fact that students who fail seem satisfied that they have something yet to learn is good for their morale - and for ours.

A final warning: Since the recommendation for exemption (or for non-exemption) from a course depends on the result on a single, objective examination, the examination should be subjected to scrutiny from every angle. If your test lacks high reliability, to that extent your action is based on questionable judgment. If your test lacks substantial correlation with your regular drawing quizzes and tests, then any steps you take must be tentative and cautious. And if the examination lacks high validity you cannot be reasonably sure that your decision is on a sound basis.

But if these three elements are present: reliability, high validity, and substantial correlation with your other regular standards, you can have considerable confidence in the justice of exempting certain students from your drawing course. And you can have considerable confidence that you are not doing anyone an injustice when you insist that the other students take your course, no matter how much drawing they have had in high school.

(Continued from page 13)

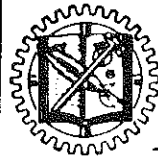
In speaking of grading, it must be remembered that all students do not have the same facilities at home, and hence the instructor takes this into account. Because a model may have been made from parts machined on power tools did not mean it rated higher than that made on the kitchen table with a pen knife out of spoons, sipping straws and tooth-picks. In fact the staff is making a study of evaluating the models on the basis of the ingenuity and manipulative ability demonstrated as compared to the score in the spatial visualizing part of the freshman entrance examination. This may show

some relation between the test and the kinesthetic ability demonstrated in making the model.

We believe this project serves a number of purposes. Besides encouraging the student to visualize his problems, it points out the importance of analyzing the task and planning the approach before rushing blindly into the paper work. It also emphasizes the tie-in between the design drawing and the construction and demonstrates that some laying out on paper must be done before the things we use in our everyday

(Continued on page 39)

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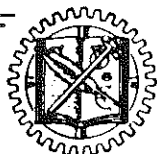
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DEVELOPMENT OF SHELL PLATING BY THE MEAN-NORMAL METHOD

Lieutenant W. J. Dixon

This method is used wherever shell plates have roll and twist.

Wherever twist appears, other methods will produce a different shape of the developed plate depending upon the direction in which it is run, i.e., away from amidship or toward amidship. In practice, although it is not necessary with the Mean-Normal Method, Shell Plating is developed away from amidship, because the plates nearest amidship are usually erected first and when urgently required are fabricated first.

Shell Plates are usually developed and Marked so that they can be laid out on the inner surface. All required center punch marks will then be on the proper side. These are necessary for the proper location of the plate and its adjacent members.

Since "F" strake is an outside strake, the plate is developed from its upper and lower sight edges. A sight edge is the line formed by the top or bottom edge of an outer strake. On the body at each frame starting with frame 37, strike cords between the sight edges of upper and lower "F", locate a point preferably near the center of the plate at frame 37. From the chord of frame 37, square the working point ahead to frame 36. Now holding the same point and the chord of frame 36, square back. Because of twist there will be a slight difference in these points. The mean of these points will be the new working point. Square ahead and back in similar fashion until frame 31 is reached.

Sketch showing Body Plan in area of Shell Plate F-1.

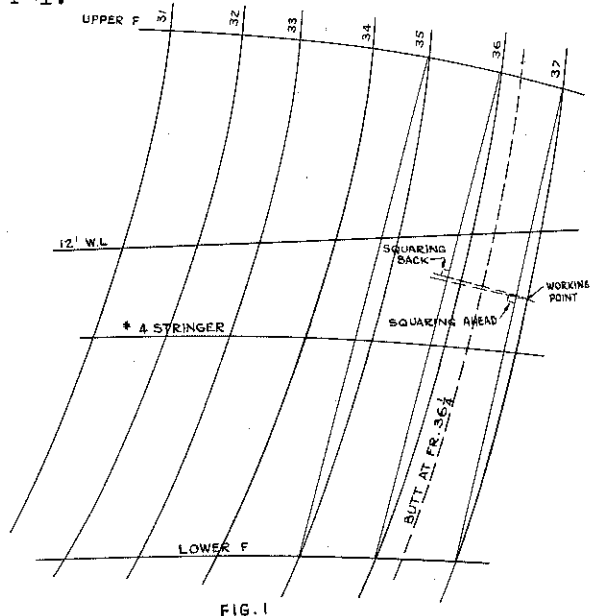


FIG. 1

* Frame spacing is 4 feet.

Frames are squared ahead and back in order to reduce the amount of error caused by twist. The imaginary triangles involved in squaring ahead and back are as indicated below.

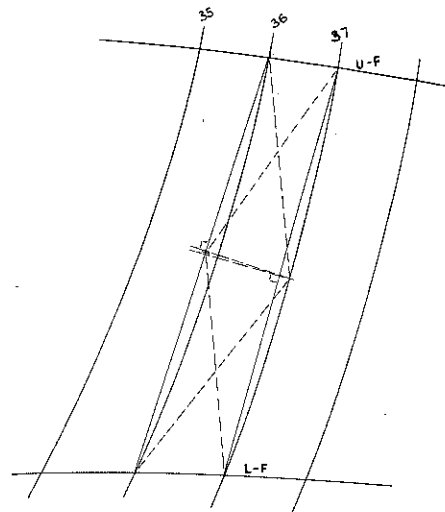


FIG. 2

Now the frames are girthed, using a batten of the same thickness as the shell plate; in this case 5/8". The girth stick is placed in the same relative position on the body as the completed plate will occupy on the ship, so that the mean girth of the batten and steel are similar. Because this is an outer strake, the batten is placed away from the frame line at a distance equal to the thickness of the inner plates, which are also 5/8". Frames are girthed by holding a set spot on the batten at each working point of the various frames and marking off the sight edges on the stick. The 12'-0" Water Line and the traces of longitudinal stringer #4 will be picked up at this time.

The length of the plate along the sight edges, called the expansion, must now be obtained. Hold a batten along the sight edge in the body. Mark off the intersection of each frame line. Strike 4'-0" frame spaces and a base line on the floor. Hold a set mark on each batten at the base line and lay off the marks of each frame on the frame space. A batten equal to the thickness of the shell plate being developed, is nailed a distance equal to the thickness of the inside strake away from these spots, for each sight edge and the spots picked up on the batten. These are sections cut by planes normal to the sight edges.

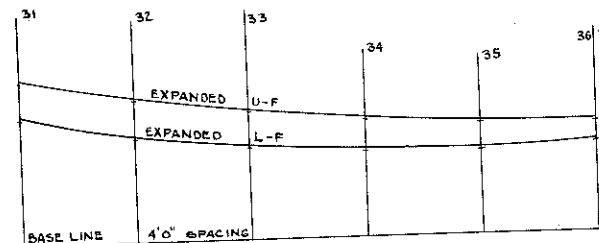


FIG. 3

The stretch-out is made as follows: nail the girth stick to the square holding the set spot at (Continued on page 37)

ENGINEERING DESIGN AS RELATED TO RESEARCH

by
Forest McFarland, Chief Engineer,
Design and Research Division,
Packard Motor Car Company, Detroit Michigan

In considering the subjects covered by the title, the first questions which might well be asked are, "What is Design?", and, "What is Research?". Webster states that design is "the production of a scheme or plan for making of anything". This is certainly a definition in its briefest form. He also states that research is "careful or critical inquiry or examination in seeking facts or principles". This is likewise brief and broad.

Many definitions have been offered to explain the meaning of research. None is entirely adequate. From the standpoint of final result, the statement that "research has been called insurance against capital loss" is significant. Rather than attempt to define design or research further, a few examples will be given to illustrate these two functions of engineering and their relationship.

What can we classify as design in a broad sense? What is its history? When did designing start?

Excavation by Sir Arthur Evans on the Island of Crete revealed the remains of the Neolithic or Later Stone Age culture which reached back 13,000 or 14,000 years. Man's real design and construction effort, however, could not begin until he ceased to wander in search of a precarious livelihood.

What examples do we find of early design? According to M. C. Burkett, Lecturer of Archaeology and Anthropology at Cambridge University, the oldest known wheeled vehicle was discovered at Kisch, the world's oldest city, and was built about 3,200 B. C.

Much has been written about the structures erected by the Egyptians, Greeks and Romans throughout the centuries following, the last two periods being marvelous eras of unsurpassed architectural design.

After the fall of Rome, architectural design of a grand order disappeared in Europe and western Asia until the Middle Ages when the building of cathedrals and monasteries again revived it. Design of a more mechanical nature began to appear. Time keepers are one interesting and common example of design of this type. Starting with the sun dial, apparently used as early as 2,000 B. C. in the valleys of the Tigris and Euphrates, we next come upon the Clepsydra or Greek water clock invented by Ctesibius at Alexandria in the second century B. C. Sand took the place of water in many clocks, one variation being the 28-second sand glass used for a long time for determining the number of knots or nautical miles per hour covered by a vessel. The origin of the first design of mechanical clock is somewhat in doubt, but in 1360 there was evidence of at least one mechanical clock designed by Henry Weeck, or Henry DeVick as afterward called, of Wurtemberg, for Charles V of France. Clock

and watch designs appeared in many forms finally developing into those which we have today. Space prevents mentioning many more examples of design, such as the works of Leonardo de Vinci, Cellini and other marvelous craftsmen with whom we are all familiar.

What was occurring in research, taking it in its broadest sense, over this period of time?

In Egypt the practice of preserving the bodies of the dead by mummification has excited the wonder of mankind for ages. G. Elliott, Professor of Anatomy, University of London, states this practice extended over at least thirty-five centuries and that it underwent an unbroken series of different techniques. That I would call a "long-term" research project.

One example of a very complete report on early investigations came to my attention a number of years ago in a curious way. In the mathematical analysis of a problem, I came across a proposition in plane geometry with which I was unacquainted. This aroused my curiosity. As I needed a new geometry reference book, I journeyed to the Detroit Public Library and surveyed all the works available and found one by Sir Thomas Heath, in three volumes, which was very complete -- a new translation taking into account all of the information unearthed since previous translations had been made. I found the proposition that had been new to me, and discovered that the geometry taught me in high school was from a very much abridged edition of the complete works compiled by Euclid in thirteen books to cover the information available 300 years B. C.

De Morgan, the British mathematician, stated in 1848, "There never has been, and till we see it we never shall believe that there can be, a system of geometry worthy of the name, which has any material departures (we do not speak of corrections or extensions or developments) from the plan laid down by Euclid". Heath states that had De Morgan lived at that time (1925) he would still be of the same mind. The fact that this work has lived for twenty-two centuries without any revisions or significant additions marks it as being an investigation and summary of the highest order. The elegance of the propositions in their simplicity and choice of language commands further respect and should cause all of us to reappraise some of our contributions in the light of that from which we have had to draw.

The history of design in clocks was mentioned. Prof. W. I. Milham, in his book "Time and Timekeepers", states that since 1368 when the pendulum was introduced into the clock mechanism, there have probably been nearly three hundred different designs of escapements experimented upon and nearly one hundred escapement designs for watches. So we realize the designs of our

(Continued on page 19)

(Continued from page 18)

modern mechanical clocks and watches are the result of an enormous amount of investigations and tests.

We could list many investigations made over the centuries labeled as discoveries, developments, and so on, from the wealth of material available. Two or three examples were touched upon to stress the point that design and research are by no means items peculiar to the last half century or so.

In considering the relationship of contemporary design to research, there are two broad phases which are diametrically opposed which immediately come to mind. The first is where designs are partially developed and to be completed must wait for research work to permit their completion. The second phase is where "long term" research develops products which are eagerly seized upon by designers after they are introduced and often used in many forms never anticipated by those who developed the product.

Let us consider the first phase, particularly in the automotive field and aircraft engine field in which the writer is best acquainted.

For many years we have all been trying to make automatic transmissions for cars that would do a better job than the hand shift mechanism. In the minds of some of us for a long time and over the last ten years in particular, the idea has been present that a better design could be evolved if the torque converter invented by Fottinger in 1906 could be made acceptable for passenger car use. This has resulted in our designs being held up, so to speak, until sufficient research work was done to give assurance that this element could be included in the design. This work has resulted in four distinct and different combinations being in production today. We have them because the research work on the product indicated four answers, all of them acceptable commercially.

Another example of design waiting for research is in stress determination. During the last war, test experience disclosed a weakness in an existing design of blade connecting rods in an aircraft engine manufactured by the company with which the writer is associated. A Stresscoat, or brittle lacquer investigation, showed a highly stressed point which was greatly reduced by removing metal from the existing design. Test results confirmed the findings and approximately one-quarter million dollars worth of blade rods were saved by reworking the existing rods. This is clearly a case of design "waiting" for research.

Another example which the writer has cited is in regard to surface finish on the cam followers of the same engine on which a smooth honed finish was discontinued, using the ground finish only, present before the honing. This procedure eliminated approximately ninety percent of the scuffing of the followers, present with the original finish. Another case of design waiting for research for improvement. This particular item points out one highly significant fact in engineering design -- that the parts themselves will tell you what operating conditions they like

or what is "good" or not, which may well be at variance with certain theories not based on facts. This leads to the moral that one must have an open mind at all times until competent testing reveals the facts.

Another example of design waiting for research was in the development of the transmission brought out by the writer's company two years ago.

The direct clutch and torque converter assembly had a combination of members, all of which were Stresscoated with brittle lacquer and spun at a series of increasing speeds to determine the highly stressed points. A considerable number of design changes were made to reduce these stress raisers and a final check was made by bursting all of the parts involved.

Many more examples could be given to show that design must wait for investigation or research before it can proceed safely. This is one of the biggest unknowns in attempting to "time" the commercial introduction of basically new designs.

I may be challenged by some for including some of these examples as research. My only answer is that present research covers a very broad field. We have all heard much about the new nuclear research. Most of us, however, have not heard of and do not realize the vast amount of manufacturing research that is going on. One other example is the work of Dr. Hans Ernst with the Cincinnati Milling Machine Co., on the actual behavior of the metal in the cutting process. His exceptionally clear high-speed movies show that ordinary chip removal is definitely a shearing process at a well established angle instead of being a "paring" process as pictured in many illustrations for years. This is a definite contribution to our knowledge of a process used for centuries.

Let us take the other side of this picture where designers use the products of research. This can probably be illustrated best by a number of examples.

In the early Thirties, the writer had occasion to work on the development of the first rubber crankshaft vibration damper used by our company on passenger car engines. Our tests had shown that there must be a combination of an elastic coupling and friction present between the damper flywheel and the crankshaft. Our tests also showed that rubber had no friction present of commercial value. This resulted in our employing friction discs in addition to the rubber elastic coupling. If we were to design this damper today, we would have available rubber "loaded" with certain compounds that would add friction to it or give a "hysteresis loop" of sizable value so we would doubtless eliminate the friction plates. However, research has also brought another party into this picture -- silicone fluids of constant high viscosity which are now used in dampers, eliminating the mechanical friction materials and rubber, also. In our early work we had visualized how nice it would be to mount a flywheel in a casing only but knew the oils we were acquainted

(Continued on page 31)

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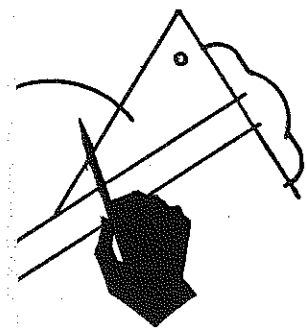
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RESEARCH FOR IMPROVING THE TEACHING OF GRAPHICS

by
 Prof. H. B. Howe
 Rensselaer Polytechnic Institute

Dr. James Conant, the President of Harvard University, has said, "Democracy is a small hard core of common agreement, surrounded by a rich variety of individual differences." It seems to me that this definition for democracy can be adapted to our thinking about the teaching of the graphic language. The students we teach and the subject matter we teach them are pretty much the same. It is only the variety of individual differences which we, on these occasions, talk about. These individual differences fuel our satisfactions and accelerate our desires to do our job still better. I am sure we all agree that each of us teaches best when using methods which our interest and abilities dictate. However, we as teachers are ever looking for those little ideas which will fit into our own pattern of thinking to make our teaching more effective and more enjoyable. What I have said so far, and what I may say, will probably have little effect on your thinking, unless somehow, shall I say, pertinent common thoughts, spiked with interest, can be aroused. Then and only then is it possible for each of us to really profit by discussing our individual differences.

I am sure all of us who attended the summer school at Michigan State will remember Professor Miller's graphic illustration of how a problem to be solved, or a subject to be explored, can be accomplished only by reaching for the pieces which we have previously stored on our mental shelves. He told us that by logically fitting these pieces of past experience into our present situation our problem may be solved. I can readily conceive a problem which could be solved if I had just a few more pieces. No matter how carefully I search they have either been mislaid, or perhaps I never did place them on my shelf. To obtain the answer, I need them now and am now ready to ask that you offer assistance from your shelf. What I have tried to say here by the use of Professor Miller's shelf illustration, is that a situation is created where a partial solution of the problem is built up by using my own thoughts to a point where I not only need but want your help. This is the point in the students thinking where the teacher can really do some effective teaching.

To reach this point, where the student will eagerly listen, requires some previous conditioning of the student - and teacher as well. We must create a common understanding in our thinking and make use of proper timing or our well meant suggestions to our students will be mislaid on their shelves instead of being promptly effectively used. It is by their immediate use that principles are most thoroughly fixed in mind and then properly filed ready for some future use.

I know we all agree that interest plays a major part in how much we learn and how easily we learn it. It therefore seems that in teaching our fundamentals, first, we must make use of principles tied to problems which the student - and teacher - both have a desire to solve. This is difficult to do in some cases, but most

students who choose to study engineering and science have these interests and we should not lose sight of them in planning our fundamental courses. Next we must consider the students mental preparation for handling most effectively the course as planned. Is it too advanced for him? Is the pace too rapid? Is it a repetition of his previous experience? These are questions we must not only ask, but answer. We are all aware that it is as unsatisfactory to teach under the student's mental level as it is to teach above it. New thoughts timely presented in the proper amounts must smoothly tie in with past experiences.

Entrance requirements and testing programs help to determine in a general way student capacities for further learning. Instructor observations combined with departmental questionnaires will uncover feelings and interests, and grading results will determine the limits to be used in setting up our courses. Do we make sufficient use of these available sources of information? Do we think enough about them to appreciate their value? However, thinking about this information is not enough. After critical thinking we must put our conclusions into action, make more tests of what we have done and, again follow these by more thinking. This continuous repetition of thinking, doing, and testing will eventually improve our teaching. The appraisal of the results of our improved and more effective methods of teaching comes first from those we teach, our students. What they think and say about the way we teach them may be more important than we often realize.

Many of our older practices must be revised to fit today's requirements. Formerly, in our own experience, each student was assigned a different problem, which in the instructor's opinion fitted his capabilities, and with little guidance he worked it through. A good rugged system, but one which required considerable and often excessive out of class time for preparation. A drawing after numerous conferences and with very little general explanation was stamped with approval. At times, after numerous attempts to correct it, a drawing failed to receive approval; in which case the student went back to his room to do it over again. The time element did not so seriously enter into this former method of teaching as it does today. For most of us, the time allotted for teaching graphics has been gradually but materially reduced, as the many other educational essentials have been worked into our curriculum. To meet the changing conditions, more efficient methods for teaching the most carefully selected material, in strictly limited amount, is replacing our former well-founded but more time consuming procedures. Thus we continually search for the effective means to maintain our standards and include the new ideas which are constantly appearing. To effectively cope with our constantly changing standards of living, Charles F. Kettering, Director and Research Consultant of General Motors Corporation, has said, "Research and evaluative experimentation are essential."

(Continued on page 25)

"ADVANCED DRAWING", ITS USEFULNESS TO THE ENGINEERING STUDENT AND TO INDUSTRY

by

Prof. Robert R. Hagen
Michigan College of Mining and Technology

The many technical advances of the last ten years have made it imperative to re-value certain skills which are critical in an age of industrial planning such as the era which now confronts us. Drawing is one of these skills.

During these years drawing teachers have called upon industrial specialists to state their opinions as to the effectiveness of college instruction. Dependence on industrial wisdom and cooperation was not meant to indicate a weakness on the instructor's part, but is a conscientious effort to give better preparation to the products of their various institutions to benefit those who employ them. Some of these opinions are listed as follows:

1. Certain phases of our course content is antiquated and do not parallel present day requirements of production and design.
2. Engineering Drawing instructors have not had enough industrial experience.
3. High proficiency in "manual" skills is of secondary importance upon graduation.
4. The major educational emphasis should be placed on design.
5. The student engineer must be made thoroughly aware that the highest paid designers work over a drawing board.

What have we done to adapt our views to these advances? Considering that the time spent on Basic Engineering Drawing in most colleges is equal to eight weeks in industry and that many types of engineering must be served, modern practices especially in the use of Drafting Standards and dimensioning have been improved upon. Subject matter which cannot be restricted to suit certain branches of industry has been carefully surveyed, weighed, and quite generally standardized. Teachers are more concerned with the application of their instruction to industrial usage and have taken the opportunity to gain actual experience of various sorts. Criteria for the "manual" skills have been kept high, but not to the detriment of a sound training in other fundamentals. Student aversion to "working on the board" has in part been broken down, during the last decade, by the realization that engineering, and design in particular, is one of our greatest national assets and may well be the salvation of a free world.

It has been generally agreed that there is too great a gap, too great a loss of continuity, between Basic Engineering Drawing and the later courses involving graphics. Advanced Drawing has been included in the curricula of many colleges, generally speaking, for two purposes:

1. As an aid to the various types of engineering,
2. As a direct training for the "design" students.

Its aim has been to enrich the background of prospective engineers, regardless of their major

field of specialization, and thereby accelerate and expand their potentialities.

Specifically, how can advanced drawing aid the graduate engineer employed in industry? First, an engineering graduate upon entering industry should have something to sell. We assume he has a fundamental background of engineering knowledge, but can he do a saleable job of detailing? Many large industrial organizations have reached the conclusion that they must train their own designers. This group usually makes up the bulk of drafting room personnel. The trainee is most often a high school graduate, and may have had additional experience of a vocational nature. The training period is long and costly. Basic engineering knowledge is lacking and design experience is necessarily impeded. Consider the many small concerns. Usually they do not have enough capital to embark on a training program; neither can they afford to train a man and then have him jump to another company. The employee is not under contract as are professional athletes. While small industries provide opportunities for rapid advancement, that advancement can be delayed by lack of a saleable ability in drawing. The time is long past when a knowledge of the arbitrary symbols of drawing was sufficient.

Second, those men desirous of becoming first-class designers must be forever aware of the importance of "Shop Processes". An advanced course in drawing is usually given after much of this subject has been covered. Correlation paves the way mentally for the later uses of such special skills as Metallurgy, Gear and Cam Design, testing techniques, etc. as well as basic engineering fundamentals. The correlation between the two is a most practical tool of the detailer or detail designer. It is a part of the analysis of the problem. It is saleable.

Third, "Advanced Drawing" courses are not concerned particularly with the production of "good looking" drawings. The student becomes less concerned with manipulative processes and more concerned with the physical and mechanical characteristics of the mechanisms and parts that are being depicted on the drawing. Industrial training in "short cuts", such as the judicious use of views, sectioning, omission of unnecessary lines and a more realistic training in dimensioning, tends to shift the thought of "manual" operations to the plane of industrial usability.

Fourth, much of the Basic Engineering Drawing subject matter has had to be "dished out" due to time limitations and to the fact that at least two-thirds of the students have either had no drawing experience or inadequate experience. As a result, many design students, who often have had no further training in drawing, are at a loss as to how to proceed from a drafting room standpoint when assigned a problem and told, "You're on your own". Previous Advanced Drawing experience would condition and mature the student for

(Continued on page 25)



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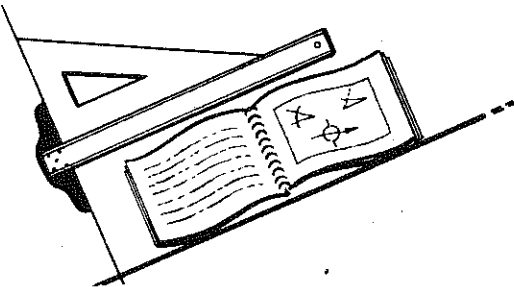


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Continuing on he asks and answers the question, "And what is research? It is simply trying to find out, what we are going to do, when we can't keep on doing what we are now doing."

Statistics and questionnaires may help us to find out what to do as these changes occur and I am sure we are keenly aware of the complexities involved. We find in analyzing these statistics that their greatest value is not that they tell what to do, but as they cause us to weigh more critically what we are doing because of what they say. We also find in studying these charts, as may be expected, that often our first conclusions when supported with the continuous adding of new evidence become either more conclusive or we find them to be less and less convincing. When changes are made, in the attempt to obtain better results, it is very difficult to appraise the effects which these

changes produce. This is due largely to the fact that we are continually in transition in respect to our own as well as our students' abilities and attitudes. This is as apparent now as it was previously when the teaching of GI's in large numbers necessitated the use of many inexperienced instructors. What is ahead? How will universal military training, if it comes, effect us? And later, in the 1960's, as statistics indicate, how can we prepare for teaching these larger groups of students? These are only some of the coming questions in addition to our present ones, which we must answer. Should we not carefully analyze what we have done and what we are now doing and vigorously continue to search for better ways to teach the graphics language to our students?

Followed by charts.

INTERESTING

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

Dear Prof. L:

TO WJL, ON RENEWING A SUBSCRIPTION;
Or, Minus Solvit Qui Tarde Solvit

A gentleman who has to separate his colleagues from their money. Has a job which can't be always called a honey. In every profession this task presents a problem polemic-- And it's probably no different in the profession academic. In a way, it's easy to understand why that should be-- At least, I think that the reason could be That only fools and their money are soon parted, And therefore check-writing is less easily started By those who obviously are not what I've just mentioned,

But are by earthly standards well-intentioned-- And fully intend to help EDDG With annual subscriptions to the JED. Lest I--as if I could--forget each fine, well-chosen word Uttered by you, and which I heard. In learned gathering the other day After--or was it during?--the splendid luncheon in John Jay, Let me enclose, because it's time I oughter, My check, made out to you, for one dollar and a quarter.

Sincerely,

(Signed) M. A. Thomas

M. G. Thomas
Keuffel & Esser Co.

MGT:lmc

(Continued from page 23)

these engineering responsibilities.

Fifth, an advanced type of drawing more emphatically brings to the student the meaning of "thinking engineering". It ties up fundamentals learned in basic drawing courses with their industrial application. A student's work becomes meaningful. The better a student becomes prepared for his final courses involving drawing, the less chance there is that he will become disgruntled and impatient to get ahead once he is employed in industry.

In summarizing, "advanced drawing" can achieve the following:

1. More fully prepare the engineer, whatever his major field.
2. Enable those students particularly interested in "design" to grasp what

engineering really is in a practical sense.

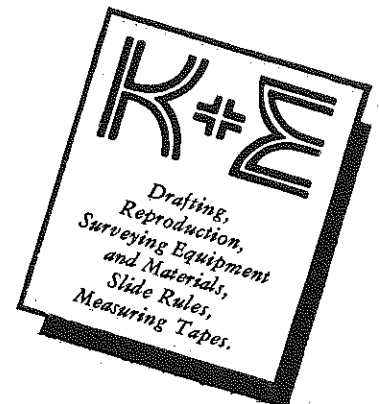
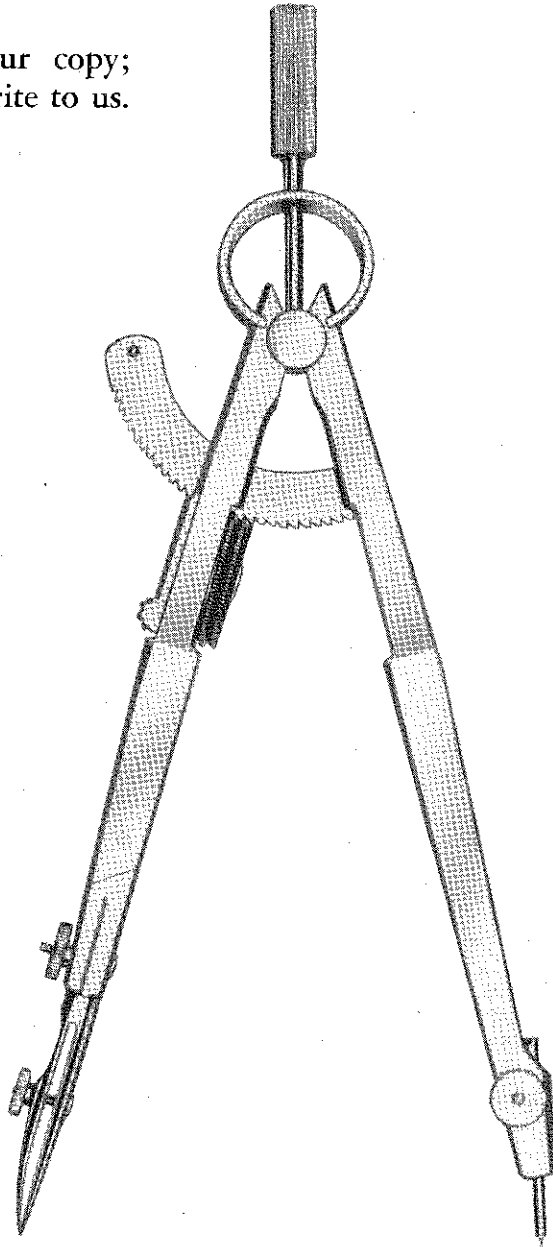
3. Give the student opportunities to think and work on his own.
4. Develop drafting and designing abilities which will more closely parallel the known needs of industry.

Added to the afore-mentioned services, a great value can also be rendered in the professional development of the teaching membership. Many instructors have been teaching over and over again two or three basic drawing courses. They are important, but they permit only a sampling of fundamentals. Advanced Drawing ably administered and capably taught is bound to stimulate and broaden those who are entrusted with its great potentialities. A static industry cannot survive; neither can the static college and still call itself the true educator of our youth.

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FROM THE POLICY COMMITTEE

LETTER OF TRANSMITTAL

To the Council of the American Society for Engineering Education.

Gentlemen:

Enclosed herewith is a recommendation from the Division of Engineering Drawing to the Engineer's Council for Professional Development.

The Division of Engineering Drawing respectfully requests the Council of the American Society for Engineering Education to take cognizance of and forward the enclosed recommendation to the Engineers' Council for Professional Development.

The Division of Engineering Drawing, recognizing that these recommendations are of wide engineering educational interest, prefers to have these recommendations transmitted to the Engineers' Council for Professional Development through regular American Society for Engineering Education channels; and requests that appropriate publicity be given these recommendations in the Journal of Engineering Education.

Respectfully,

The Division of Engineering Drawing
by its Policy Committee:

Randolph P. Hoelscher
Justus Rising
F. G. Higbee, Chairman

The Division of Engineering Drawing of the American Society for Engineering Education for several years has been making a study of trends in engineering education which affect the teaching of engineering drawing, descriptive geometry, and engineering graphics.

The Division is much concerned about two elements revealed by this study:

1. The continued accrediting of engineering curricula in engineering institutions where the allotment of time for the teaching of these subjects is sub-normal;
2. The trend in engineering institutions to reduce the amount of time allotted to the teaching of these basic subject.

At its annual meeting at Michigan State College in June, 1951, the Division directed its Policy Committee to bring these matters to the attention of the Engineers' Council for Professional Development and to suggest to them ways and means for improving conditions which are a cause for increasing professional concern.

The Policy Committee therefore suggests in future inspections by the Engineers' Council for Professional Development that:

- A. The Division of Engineering Drawing be notified of the names of the institutions to be inspected and be asked to identify those institutions on the list whose overall work in engineering graphics is sub-normal,
- B. In institutions where sub-normality is alleged to exist, the Division of Engineering Drawing be asked to inspect this work and report their findings to the Engineers' Council for Professional Development,
- C. This policy be publicized and engineering educational institutions be notified of the practice.

In making these recommendations the Policy Committee of the Division of Engineering Drawing wishes to assure the Engineers' Council for Professional Development of complete cooperation in any program which will improve not only instruction in engineering graphics but instruction in engineering education as a whole.

Respectfully submitted,

The Division of Engineering Drawing
by its Policy Committee:

Randolph P. Hoelscher,
University of Illinois

Justus Rising,
Purdue University

Chairman, F. G. Higbee,
State University of Iowa

DRAWING DIVISION DISTINGUISHED

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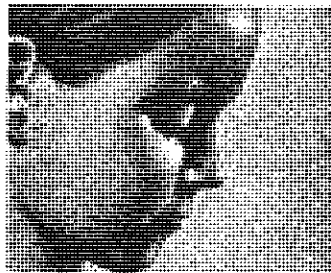
1. Purpose. To recognize and encourage outstanding contributions to the teaching of students of engineering drawing, descriptive geometry and other graphics courses.
2. The Award. The award shall consist of a certificate presented at the annual dinner of the Drawing Division of A.S.E.E.
3. Requirements. In order to receive the award a person must have made a clearly discernable contribution to the art and science of teaching courses in a recognized field of graphics in several of the following ways of which section (e) shall not be omitted.
 - (a) Success as a teacher must be established both as to competence in subject matter and ability to inspire students to high achievement.
 - (b) Improvements of the tools of, and conditions for teaching. Evidence of such achievement may consist of subject

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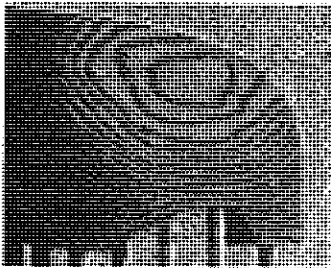
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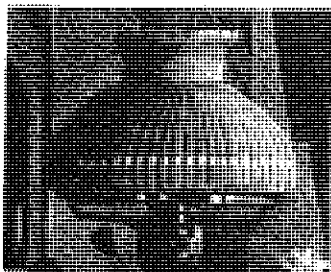
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Hair and skin texture are convincingly represented. Halftone adds dominance to the main subject and variety to the wall.



The finest lines show up well in scratchboard. Here they catch the feel of grained wood.



The qualities of glass were given full justice by the skillful use of light and shadow.

James Neebe, who is 25, won the 1951 Gold Brush Award with this delightful study. The textural treatment is superb. Careful draftsmanship gives meaning to every line and shadow. Tonal values range in a subtle, related harmony from the pure white of the scratchboard surface to the deep, intense black of the Higgins ink.

Neebe has been using Higgins ink since his early student days. He likes its smoothness, its uniformity and the way it lends itself to every shade of expression. Higgins is the only ink to be found in the studio of Neebe and Associates, Chicago, where this art work was executed for use in an Ipana advertisement.

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**EDITORIAL,
FIRST THINGS LAST?**

We were surprised to learn from an educator who is active in the drawing division of the American Society of Engineering Education that the trend toward minimizing the importance of mechanical drafting in engineering curricula has made considerable progress.

The natural, progressive desire of engineering colleges to graduate versatile, well-rounded individuals is laudable. But many educators (and chief engineers who employ graduates) believe it is reasonable for industry to expect that a young engineer be able to prepare a preliminary design drawing from which the draftsman can proceed with layout and detail drawings.

It's obvious that this ability will be lacking in the graduates of engineering schools that have eliminated drawing from the curricula. Furthermore, the minimum desired training level probably is not attained by men who have had only a single course in technical sketching, as required by several colleges.

If mastery of engineering fundamentals is to be achieved while upholding the importance of designing done by engineers who work at the drafting board, it would seem that the saturation point has been reached for injection of "arts and sciences" into engineering curricula.

Without intending to deprecate the value of studies intended to broaden the engineer's education, we feel that drawing courses might well be grouped with such vital subjects as physics and mathematics as building blocks around which an engineering curriculum is arranged.

Surely, there's no denying that the creative designer at the drafting board is a prime factor in the success of any industrial establishment and in promoting the productivity that insures a rising standard of living.

(Signed) John T. Benedict

EXPLANATORY LETTERS

February 26, 1952

To the Members of the Drawing Division
American Society for Engineering Education

Gentlemen:

As you know, there has been considerable discussion regarding the amount of time which is allotted to the teaching of Engineering Drawing.

An editorial which supported the position of our Drawing Division appeared in the February issue of Design News, a technical magazine which is published in Detroit and circulated nationally. Since the editor's position concerning the study of "arts and science" courses does not quite agree with that of the Drawing Division, I assumed the responsibility of clarifying it.

Enclosed is a copy of the editorial and a copy of my letter to the editor which I thought might be of interest to you.

Sincerely yours,

(Signed) J. Gerardi

J. Gerardi, Vice Chairman
Division of Engineering Drawing
A.S.E.E.

February 5, 1952

Mr. John T. Benedict
Executive Editor
Design News
4612 Woodward Avenue
Detroit 1, Michigan

Dear Mr. Benedict:

I wish to express my personal thanks and sincerest appreciation for your editorial entitled, "First Things Last?" which appeared in your February issue of Design News. Your editorial will also be appreciated by every member of the Drawing Division of the American Society for Engineering Education, since the decrease in time allotted to drawing courses has been and is receiving serious consideration by the Division.

I should like, however, to clarify the Drawing Division's position regarding "Arts and Science Courses" in an engineering curriculum. The American Society for Engineering Education recommends that approximately 20 percent of the courses taken by engineering students should be in the field of Humanities. The Drawing Division approves of this recommendation.

We are opposed to the insertion of any courses in the field of Humanities or highly specialized technical courses which may not be required for graduation, but which necessitates the elimination of drawing courses in an engineering curriculum. Drawing courses today differ materially from those of twenty-five years ago. In the past, stress was on technique. Today technique has been minimized and knowledge of subject matter is emphasized. Nevertheless, the basic fundamentals of drawing and the amount of technique which should be taught certainly require more time than one semester. I seriously question any school's ability to do a good job even in two semesters.

Once again, many thanks for your support and for a most timely editorial.

Sincerely yours,

(Signed) J. Gerardi

J. Gerardi
Assistant Dean

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(Continued from page 19)

with would change too much in viscosity to be commercial.

The development of plastics has made designs possible that could not be considered a few years ago. Gears can now be molded from nylon at a fraction of the cost of cutting them. For many purposes the nylon gears are superior to the metal gears. This is only one of many uses plastics are being put to.

The DuPont Company has just completed an experimental station for fundamental research, built over the last three years at a cost of 30 million dollars. DuPont defines scientific research as "a critical investigation in the physical sciences directed to discovery of new knowledge". The company divides research into three categories: Improvement in existing processes and products; development of new ones; and fundamental research to uncover new knowledge without regard to specific commercial objectives. DuPont says it does research because it has to. This can be well understood when we realize that more than half of the company's sales in 1950 were in products either unknown or in their commercial infancy twenty years ago.

In thinking about the relationship between design and research, one thing always comes to my mind -- that is the importance of proper analysis of the design in the light of what it is to accomplish. I have seen a goodly number of designs that were not operable which could have been "saved" or made to operate by being properly analyzed and the indicated steps taken to correct the design. There is no function in engineering design or development that pays off so well for the effort expended.

To properly and efficiently analyze designs, the young engineer should know his fundamentals well, not just have a speaking acquaintance "with" or "of" them. I found my own collegiate

education lacking in elementary mathematics, kinematics, advanced mechanics, particularly in vibrations and some other courses. I feel my own collegiate education would have been more valuable had more time been spent on the fundamentals of all the sciences and less on general reading courses. After the student has finished his formal or "official" education, he has to read and glean information all his life anyway. The time spent at college can be used best in equipping him with the "best" tools possible for his future use.

What must industry have, to be willing to finance research on a long-term basis particularly to yield products that designers or others may use? Industry must be able to reap a fair reward for promoting many projects, most of which will not pay out as it is only a gleaning of the many projects that finally becomes one of the future products of the company. Over a period of time, engineers and others will thrive only as the organization they are in thrives. We each have a personal responsibility to do our bit toward keeping our economic and governmental structure on a sound basis. That permits and encourages companies to extend themselves research-wise with reasonable rewards possible for developing new and better products.

Companies and individuals must continue to operate in an atmosphere where individual freedom continues to encourage research and design so they will continue for the benefit of the many, and will result in the satisfaction of creativeness in the individuals engaged in the work which is one of the major dividends to them.

I hope these few brief remarks and examples will serve in a small way to demonstrate how research and design work together and under what conditions they can operate most effectively.

(Continued from page 27)

- matter (textbooks, etc.); courses or curricula; diagrams and models; laboratory and other teaching equipment; and other similar activities.
- (c) Improvement of teaching through various activities, including the development of teachers in a department or in other schools, testing or guidance programs, promotion of co-operation with other types of educational institutions or with industry, development of testing and guidance programs, and the coordination of fields of subject matter.
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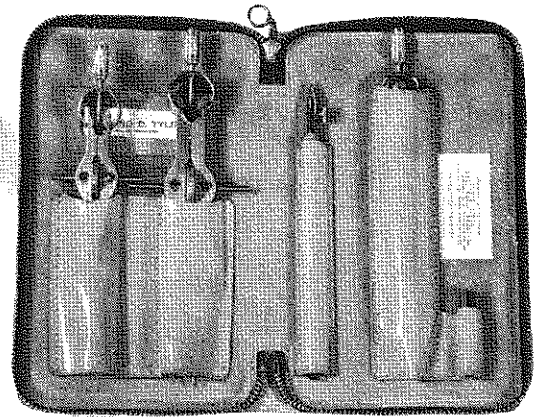
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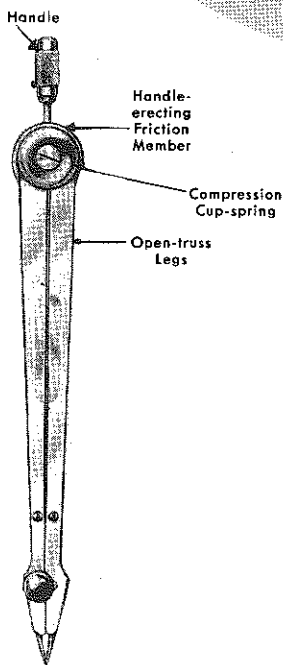
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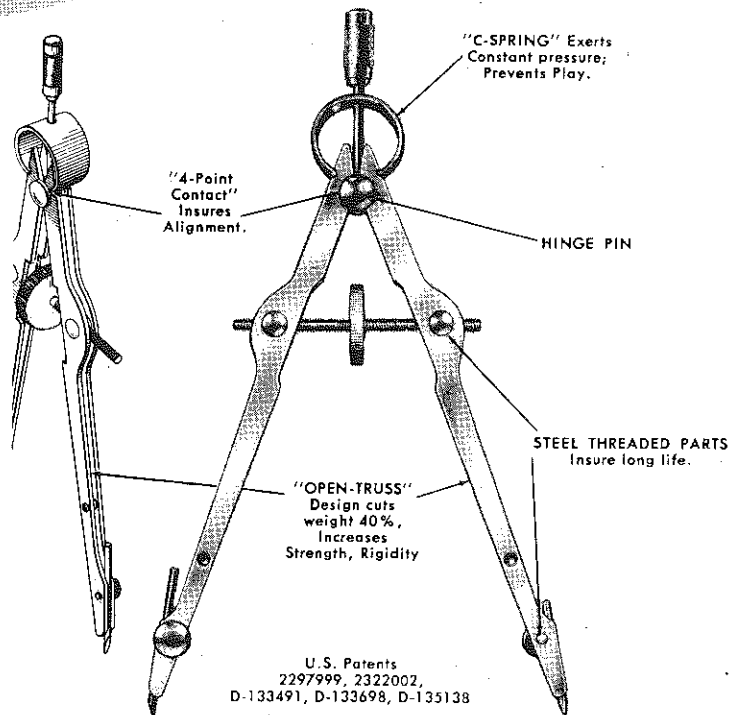
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(Continued from page 10)

"laying off" or laying down the lines.

For this purpose, the loftsmen needs not only the lines drawing but also a list of the measurements that he must use in locating the points through which the various curves must be drawn.

The information that the drawing office supplies the mold loft is usually as follows:-

1. A drawing of the stem and stern contours fully dimensioned.
2. The half-breadths at each waterline at each station.
3. The half-breadths and heights of the deck lines at each station.
4. The height of each station on the buttock lines.

These dimensions are scaled from the lines plan and are called a "table of offsets."

Armed with these figures, the loftsmen proceeds to lay down the vessel's lines on the mold loft floor. Due to the inaccuracies in the drawing room offsets, the loftsmen must "fair" the lines on the floor; but as the lines have already been faired on the drawing room lines plan, his fairing consists chiefly in taking out the humps and hollows.

The "offsets" that the drawing room supplies the mold loft are labelled "preliminary," but after the lines have been faired on the loft floor, another set of offsets is lifted and returned in tabular form to the drawing office. These are referred to as mold loft or finished offsets and are used by the designer in his working drawings. They are usually expressed in feet, inches and eights-of-an-inch and are given at every frame in the ship, whereas the preliminary offsets were given at the stations only.

The Plating Model

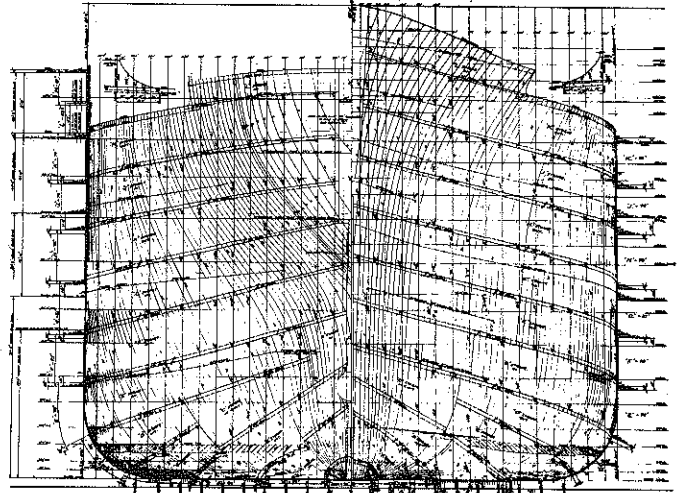
The plating model is a half model of the ship, made immediately after the lines plan is finished and on the same scale. It is used principally for the purpose of laying out the run of the shell plating, the decks, tank top, longitudinal, frames, etc.

The shell plating can be, and usually is, ordered from the model before the finished offsets are received. Shell plates are not ordered to their real dimensions and therefore any small discrepancies that occur due to the unfairness of the model are taken up by the allowances made in the overall dimensions of the plates.

The expanded sizes of the shell plates are lifted from the model by pressing pieces of tracing paper against the model and tracing the outline of the plate.

In the meantime, the mold loft has received enough information from the drawing office so that the actual structure can be shown on the body-plan.

Figure 2 is a reproduction of a structural



body plan, very similar to what is laid down on the mold loft floor. You will note that, in addition to showing the shape of the ship at every frame, it also shows the following:

- (1) The "run" or points of crossing at each frame, of the shell plating seams, together with the changes in width of seams.
- (2) The "outer trace" or point of crossing at each frame, of shell girders, longitudinal, side stringers, decks, flats, and longitudinal bulkheads on the shell.
- (3) The run or trace of the bilge keel.
- (4) The trace of the points of intersection of the double bottom margin plate with the molded frame line.

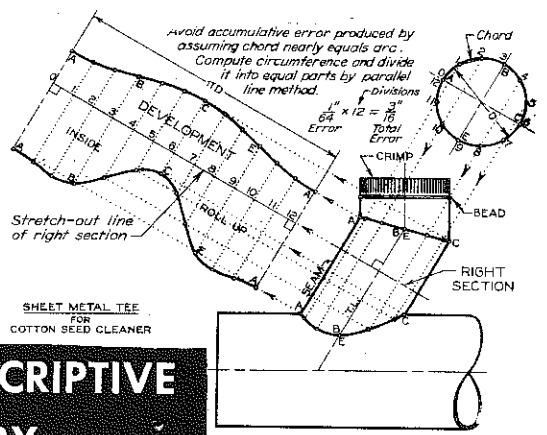
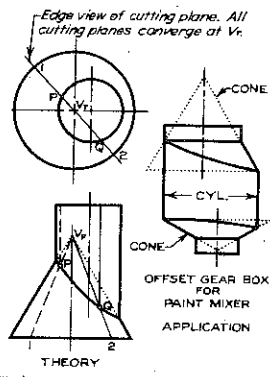
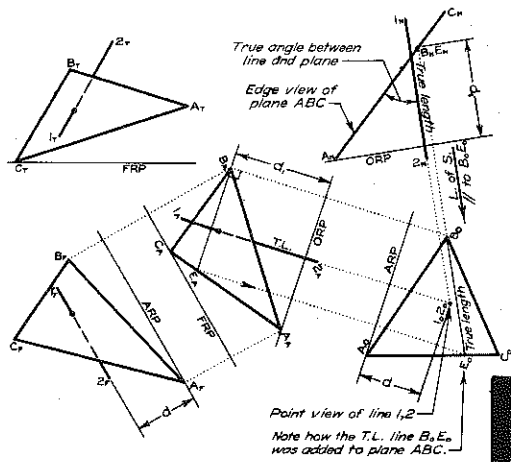
In short, this plan indicates all structure and factors affecting the shell plating and framing.

As for the expansion of shell plating, there are numerous methods that can be used, and of course the method varies with the shipyard. However, one of the most popular methods is the "center spot squaring" or "Mean Normal Method."

I will very briefly run through the principal steps involved. The details of the development you will witness at the Brooklyn Navy Yard this afternoon.

In Figure 3, assume that the portion of the shell plating to be developed lies between frames 20 and 26. At each frame draw chord lines from the lower to the upper sight edges of the plate. On the frame line located nearest amidships, which is frame 26, place the center spot "P" somewhere near the center of the plate; from the chord line of frame 26 square point P to frame line 25, locating point B. In a similar manner, from the chord line of frame 25, square point P back to frame 25, locating point A. Since there is a twist in the frame line, there will be a slight difference between points A and B. This difference is bisected and the midpoint designated as P₁. The same procedure is now followed

(Continued on page 35)



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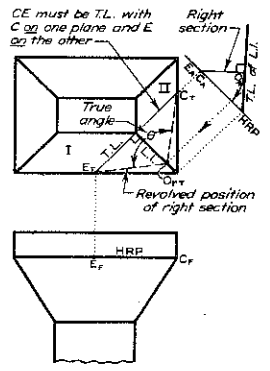
*Figures shown here 1/4 actual size

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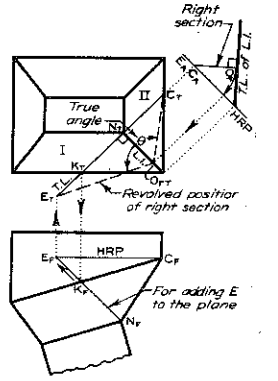
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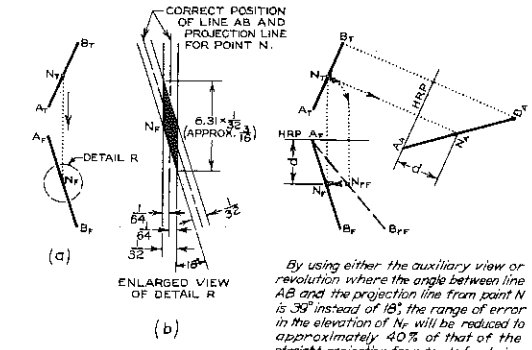
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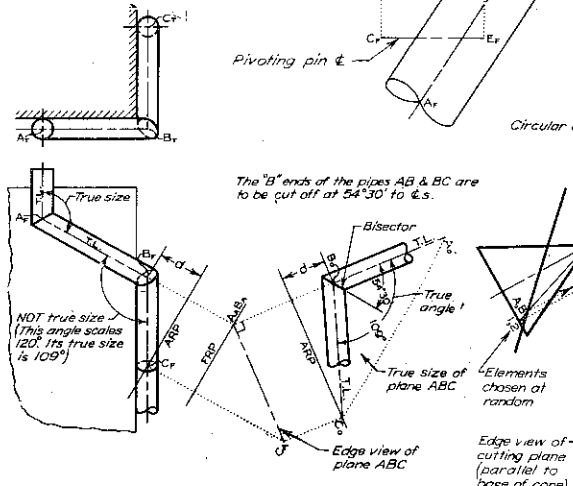
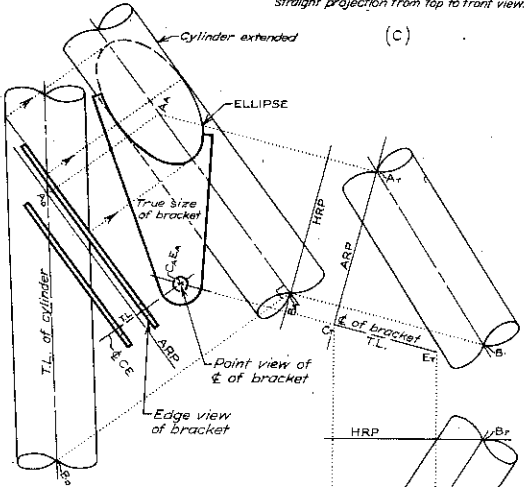
Find the edge view of the right section, then revolve it. The angle is EOC.



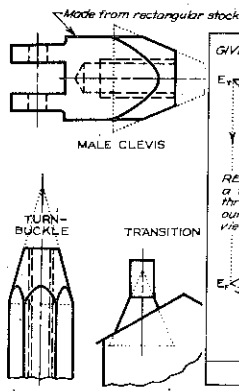
Angle KOC is not the correct angle because KC is not T.L. The angle is EOC.



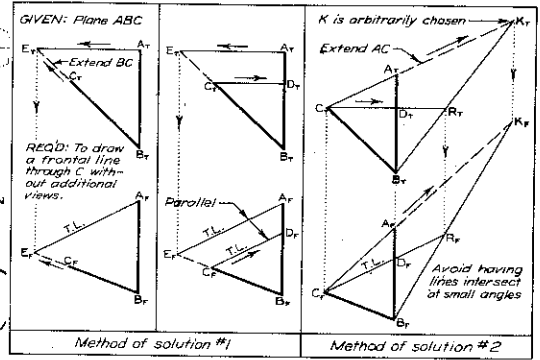
By using either the auxiliary view or revolution where the angle between line AB and the projection line from point N is 35° instead of 18° , the range of error in the elevation of N_r will be reduced to approximately 40% of that of the straight projection from top to front view.



THEORY (a)



APPLICATION (b)



(a)

(b)

(Continued from page 33)

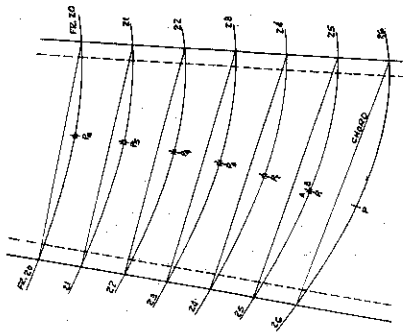


FIG. 3

from P₁ as was followed from P, except that the chord lines 25 and 24 are used thereby obtaining points P to P₆ on the frames 26 to 20 respectively.

Next the set spot of a girth stick is placed at the center spot of each frame line and the girths of the shell plate between the sight edges is picked up at each frame.

On separate sticks, pick up the traces of the upper and lower sight edges and expand them out on the frame spaces, after which the expansions can be picked up on separate battens.

Now to lay down the development of the shell plate see Figure 4. Strike a line on the floor and on it from the girth stick, place the girth of frame 26, and also the

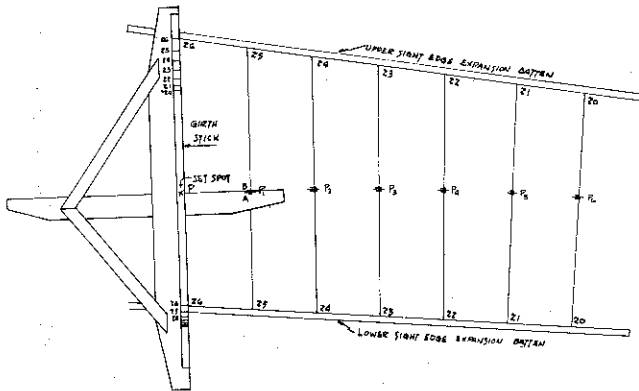


FIG. 4

set spot which is point P. Nail down the expansion battens at their respective positions; being sure while doing so to set the spots of frame 26 on the battens to the girth spots on the straight line. Now from frame 26 square point P to the vicinity of frame 25 to obtain point B. Move the square forward the frame space distance and square point P back to the vicinity of frame 25 getting point A. Before disturbing the square, draw in about 5 to 6 inches of frame line 25 in way of the points A and B. Because there is a twist to the frames a slight difference will be found between points A and B at frame 25. Bisect this difference and designate the midpoint as P₁.

Set off the girth stick at frame 25 by holding the set spot on the girth stick at point P₁. Then nail the expansion battens down to the girth spots.

To obtain the development between frames 25 and 24, the same method is followed from P₁ as was followed from P except that the frames used for squaring are 25 and 24 respectively. This is continued until the last frame is

reached, obtaining points P to P₆ on frame lines 26 to 20. The frame spots and sight edges can now be transferred from the expansion battens to the floor and the frames, seams, etc. drawn in.

After the plate has been developed, a mold or template is made. The material of the template depends upon the usage that it will receive; if a large number of plates are to be laid out from one template, then it will be made of wood framing; if it is to be used only a few times, then ordinary heavy template paper will suffice.

On these templates there is placed all the information necessary for the complete fabrication of each piece of structural material in the ship. For instance, for a shell plate, the location of all seams and butts, the size of the holes, the countersinking for the rivet holes and the location of connecting structure, together with the particulars of the connection whether riveted or welded.

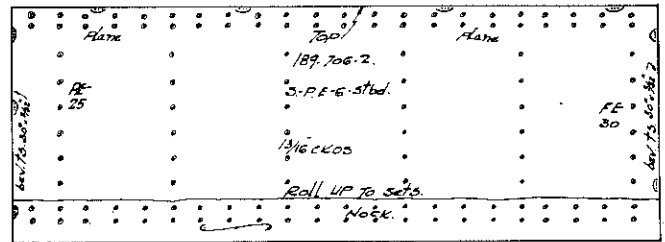


Fig. 5 Shell Plate With Markings

Figure 5 is the reproduction of a shell plate with markings which are typical of those used on other sections erected in the yard.

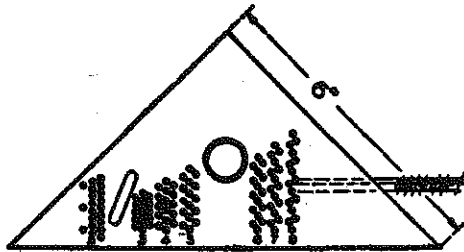
A description of the markings is as follows:-

- bev. ts 30° x 3/32 (Bevel plane this side 30° starting 3/32" from the edge of plate)
- Plane (Plane a square edge on that side of plate)
- AE 25 (This end of the plate fastens to frame 25)
- Top (This designates the top edge of the plate)
- 189 (This is the hull number)
- 706-2 (This is the shell plating drawing charge number)
- E (The strake - a fore and aft row of shell or other plating)
- 6-E6 (The strake number. Strakes start at the forward end with No. 1, 2, 3, progressing aft. The E6 means the sixth plate of E strake)
- Stbd (The starboard side of the ship)
- 13/16 (The size of holes in the plate)
- C.K.O.S. (Countersink on other side)
- Roll up to sets (Sets are templates for rolling a plate to the proper curvature)
- N.O.C.K. (No countersink)
- FE 30 (This end of the plate fastens to frame 30)

In the process of erecting the various structural steel units, the fairing must necessarily be exact; otherwise the whole system would fail. In other words, the result of what are called minor errors may be far-reaching and it is necessary to erect the vessel in such a way that slight adjustments are always practicable and the sequence of riveting and welding should be determined with this in view.

BRADDOCK LETTERING ANGLES

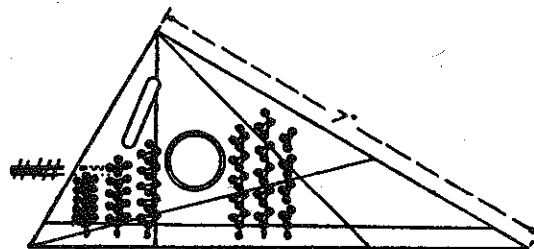
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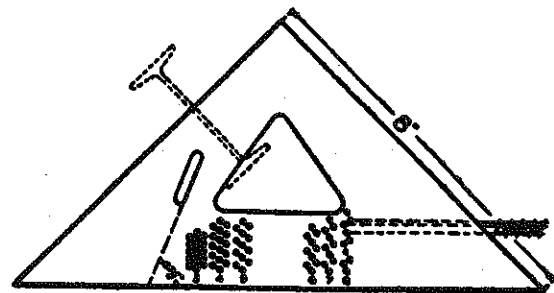
1. As an ordinary standard triangle, it is exceedingly accurate.
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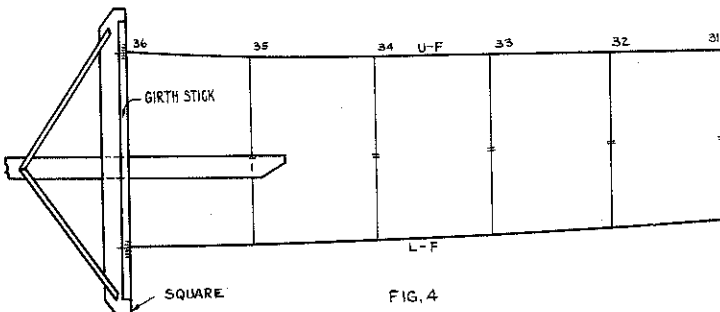
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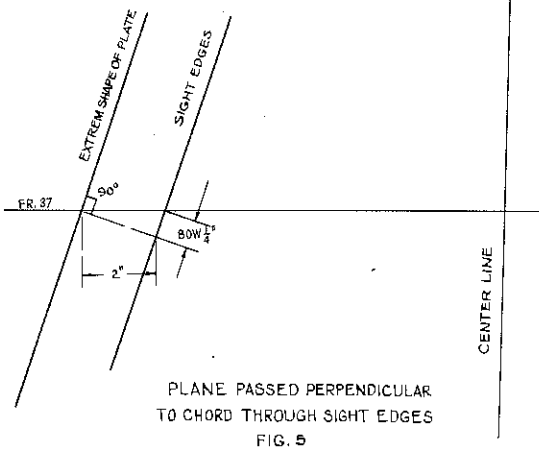
the intersection of the two straight edges of the square. Snap a straight line on the template paper, for a starting line. This will represent frame 37.

Line up frame 37 on the girth stick with frame 37 on the expansion battens. Mark the position of the set spot on the paper and square ahead to frame 36. Advance the square to frame 36 on the expansion battens and hold the set spot on frame 37. This will produce a second spot at frame 36. Take the mean of the two spots. This is the working point for frame 36. Align the set spot on the square with the working point and the sight edge battens with the corresponding frame line on the square and nail down the expansion battens. This establishes the relationship between the set spot of frame 37 and the frame lines at the sight edges of frame 36 producing a stretch-out, of the imaginary triangles arrived at, on the body.

Square ahead from the working point to frame 35 and proceed as before to frame 31. After all the frame spots are on the paper, the sight edges are scratched on after being checked with a fairing batten. The template is now essentially complete.



Because the shell plate is rolled and is not parallel to the C/L of the ship, the frame lines must be curved, when developed into a template. Naturally these frame lines will appear as a straight line when viewed from a point within the plane of the frame, and in addition would develop as a straight line on a template if the plate itself were a surface generated by a line parallel to the Center-Line.

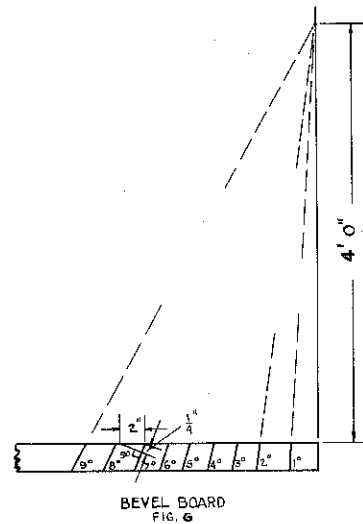


The difference between a straight line or chord and the developed curved frame line, is called the bow of the frame line.

To determine the bow, select the point on the body where the distance between the chord and the frame is greatest. This will generally be about the center of the plates. Measure the distance from the chord to the frame line.

At frame 37 this distance is 2". At the same point find with a bevel board the number of degrees generally referred to as frame set to the nearest frame (7 degrees at frame 37.)

The bevel board is a device that shows the slope and relationship of angles produced to 4'-0" (or any frame space) taken from a common center. On the bevel board measure 2" along the 4' edge of the board at the 7° mark, Draw a line intersecting this point and perpendicular to the 7° bevel. Mark the intersection at the 7° bevel.



The distance from this point to the edge of the board is the amount of bow. Repeat for each frame. This distance is then layed off the chord on the template at the approximate same point as measured. Then the developed frame line is faired in from these three points.

The spots for the water line and stringer #4 are then located on the true frame line, holding the mean normal point. Any variation in girth is marked for correction if necessary.

In order to roll the plate to it's proper shape, three wooden roll molds known as shell sets are made, one each at frame 31 1/2 and 36 1/2 and one at frame 34. Three sets are made because of fore and aft shape (backset).

Three equidistant parallel base lines are struck in the body at points convenient for the size of the sets. A spider (a batten with legs for nailing down) is nailed down to follow the frame line for each set.

A separate set is made at the three frames selected and a straight line for a datum line is marked on them.

REPORT OF THE BIBLIOGRAPHY COMMITTEE.

by
Professor H. H. Fenwick
University of Louisville.

NEW AND REVISED BOOKS

Author	Title	Ed.	Publisher	Year	Pages	Price
Elwood F. G.	Problems in Architectural drawing.	1	C. A. Bennett Co.	'50	168	\$ 2.80
Farmer J. H. & Hoecker A. S. & Vavrin F. F.	Illustrating for tomorrow's production.	1	Macmillan Co.	'50	199	5.00
Hoelscher R. P. & Peirce S. H.	Graphic Arts in Engineering Compu- tations.	1	McGraw-Hill	'51
Kulmann C. A.	Nomographic Charts	1	McGraw-Hill	'51	244	6.50
Lent Deane	Machine Drawing	1	Prentice-Hall	'51	560	...
Littleton C. T.	Industrial Piping	1	McGraw-Hill	'51	394	8.00
Luzadder W. J.	Technical Drafting Essentials.	1	Prentice-Hall	'51	326	...
Ramsey C. G. & Sleeper H. R.	Architectural Graphic Standards.	4	J. Wiley & Sons	'50	614	10.00
Rotmans E. A.	Drafting Simplified.	1	Delmar Publishers, Inc.	'50	397	3.75
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Smutz F. A. & Gingrich	Descriptive Geometry.	3	D Van Nostrand	'51	142	3.00
Street W. E.	Technical Descriptive Geometry.	1	D Van Nostrand	'51	179	3.00
Rowe and McFarland	Engineering Descriptive Geometry Problems.	1	D Van Nostrand.	'52	...	3.00

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Bleiweis J. L.	Home-made fixtures aid in finishing drafting instruments.	Metal Finishing	49	70-2	Dec. '51
Bowen H. J.	Taking the Greek out of Blueprints by use of scale models.	Oil & Gas J.	49	226	Mar. '51
	Filing unit for drawings.	Engineer	191	460	Apr.-6 '51
Gray A. W.	Secrecy or Patent? Inventor cannot have both under U. S. Patent Law.	Mach. Design	23	119-21	Dec. '51
	Lamps for Blueprinting Machines.	Elec. R. (Lon.)	149	256	Aug.-3 '51
	Layout to Blueprint - No Draftsman.	Factory Management	109	88-9	June '51
Lloyd T. G.	Specifying Standard Parts.	Mach. Design	23	106-12	May '51
Moody G.	Selecting Print Making Equipment.	Product Eng.	22	137-9	Apr. '51
Nachod C. P.	Nomograph for the volume of cones or pyramids.	Product Eng.	22	209	May '51
	New Aerial Camera permits Mapping of large Areas.	Civil Eng.	21	236	Apr. '51
Rowbotham G. E.	Competent engineering checkers promote economical production.	Product Eng.	22	160-2	July '51
Sherman R. M.	Drafting problems encountered in structural steel fabrication	J Eng. Educ.	41	615-20	June '51
	Some applications of geometry in the Pattern Shop.	Foundry	79	143-4	Mar. '51
Swain P.	Isometric Sketching.	Power	95	140	Oct. '51
			95	148	Nov. '51
			95	148	Dec. '51

(Continued on page 39)

(Continued from page 15)

life can be made. Thus in a subtle way we again point out the importance of graphics to the engineering student.

TABLE 1

SUGGESTED PROBLEMS FOR MODEL PROJECT

Wellman:

- Problem 46-14 - airplane landing gear.
- 45-18 - drip-pan and engine clearance.
- 32-13 - from what window was that shot fired?
- 27-13 - mule pulley.
- 47-32 - airplane shock absorber.
- 50-17 - slot in the trap door.
- 55-10 - factory layout.
- 47-31 - location of guy wires on a derrick.
- 7-7 - sewer pipe clearance.
- 64-12 - path of center of rolling ball.
- 54-3 - pipe connections.
- 64-10 - intersection of a hopper and a pipe.
- 40-11 - mining problem.
- 35-13 - construction of a polyhedron.
- 32-16 - shadow cast by a pedestal.

Special Problem Sheets from Watts and Rule:

- 1 - line thru a point, intersecting two skew lines.
- 5 - line thru a point, intersecting one line, parallel to a plane.
- 8 - four equidistant parallel planes.
- 9 - parallelepiped from 3 skew lines.
- 13 - sphere containing 4 given pts.

TABLE 2

EVALUATION OF THE SOLUTION OF THE "MODEL" PROBLEM

NAME _____ SECTION _____

A. Graphic Solution and Written Analysis

- 1. Choice of Method. _____
- 2. Clarity of Analysis. _____
- 3. Accuracy of Solution. _____
- 4. General Appearance and Presentation Including Clarity of Labeling. _____

B. Three-Dimensional Solution.

- 5. Method of Illustrating Problem and Solution. Ingenuity. _____
- 6. Appropriateness of Materials Selected for the Model. _____
- 7. Sturdiness of the Constructed Model. _____
- 8. Clarity of Labeling of the Elements of the Problem. _____
- 9. General Appearance and Attractiveness. _____

COMMENTS: _____

GRADE _____

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Author	Title	Magazine	Vol	Page	Date
	Telephone - Call delivery service of Blueprints results in large savings (Northrop Air.)	Mach.	58	173	Oct. '51
Varnum E. C.	Circular Nomogram Theory and Construction Technique	Product Eng.	22	152-6	Aug. '51
	Vibax Isometric and Dimetric Drafting Machine	Mach.	58	214-15	Oct. '51
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