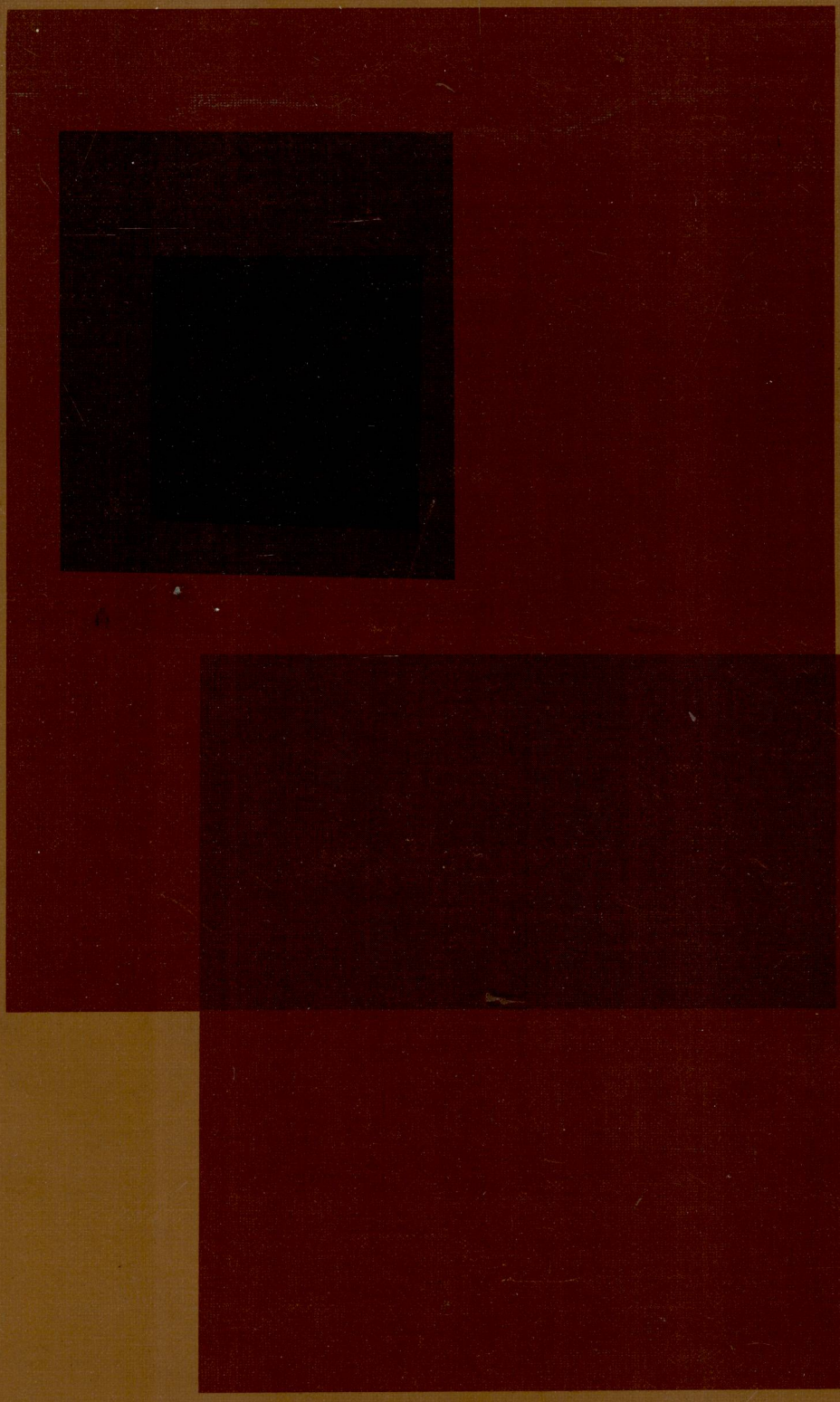

ENGINEERING DRAWING

FRENCH & VIERCK

TENTH EDITION

A Manual of ENGINEERING DRAWING *for Students & Draftsmen*

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Engineering Drawing

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Preface to the Tenth Edition

To the student. Engineering drawing may very well be the most important course you will ever take in your education for an engineering or technical career. This may seem to be a very sweeping statement, but actually it is not. Also, the statement does not at all discount the value of many other courses, including such as mathematics, physics, and chemistry. The reason why engineering drawing is so extremely important is that it is the *language of the engineer,* used to communicate designs and construction details to others. No matter how knowledgeable an engineer may be concerning the highly complex technical and scientific aspects of his profession, without a command of engineering drawing he would be completely ineffectual simply because he would fail miserably in transmitting his designs to others. Also, all the technical people working under the direction of an engineer must have the same command of the

language. The language of engineering drawing is written in the form of drawings which represent the shape and size of physical objects. The language is read by interpreting drawings so that physical objects can be constructed exactly as originally conceived by the engineer.

The engineer's drawings sometimes will be made freehand for draftsmen to follow in making final finished drawings. At other times, depending largely on complexity, the engineer may make accurate instrument drawings for the draftsmen to follow in making final drawings. This also does not mean that the engineer never makes a final drawing, because sometimes, depending somewhat upon the size of the engineering organization, he may do so. In any case, the engineer must be able to check and approve of the final drawings made by others. Thus, the absolute necessity for the engineer to have a comprehensive command of the language is evident.

Draftsmen and technicians must also have a complete command of the language because they must interpret the engineer's drawings and sketches and prepare final complete, concise, and accurate drawings. Skill in the writing of the language (making drawings) is, of course, mandatory for a draftsman.

Designers, possibly more than others, must have a superior command of the language because, as a design is worked on and brought to completion, the designer's sketches and drawings record his ideas and really become an integral part of design thinking.

From the foregoing discussion, the importance of engineering drawing is certainly evident. Therefore it behooves the student to study the subject diligently and purposefully, and if *you* do, later on in your career you will be very happy that you did.

To the teacher. If you have taught engineering drawing for some years, you are probably familiar with the history of this textbook. If you are a young teacher, you are probably familiar with the last one or two editions. Whatever your experience may be, it is appropriate to describe here the new additions and features of this, the tenth edition.

Over the years and through all of the editions, we have constantly added new explanations and illustrations and revised former material to bring the text up to date and make it more complete. This constant progress is especially evident in this edition.

Color has been employed for the first time to add greatly to the readability, understanding, and interest. The combination of the special ink and paper stock used produces a printed page which is much more interesting—easier and more comfortable to read than was possible in ink and paper combinations formerly employed.

Colored tints of brown and red shades have been used to add the functional advantages of color to the illustrations. The tints used add body and substance to the illustrations which formerly were only "black-and-white" drawings. Really functional use of color, for example, is evident in Chap. 5 where the planes of projection are identified by color as well as by name; in Chap. 6, where color distinguishes between the object and the drawing of it; in Chap. 7 where color is used to clarify the explanations; in Chap. 8 where color adds greatly to the "cutting-plane" theory and explanation; in Chap. 10 where a production piece is distinguished from the machine performing an operation; in Chap. 14 where color for charts and graphs adds much to readability, contrast, and emphasis; in Chap. 15 where the production is shown by the standard practice of drawing it in red; in a number of other chapters where color is used to show separation of parts; and in Chap. 23 where representation of the part itself (not the drawing of it) is emphasized by color.

All of the problem sections are identified by a light tint background to distinguish them from the text proper.

It is the opinion of the author that the use of color represents a major breakthrough in the design and manufacture of technical books and its use is especially significant for this text.

Many new problems have been added. These have been collected from a number of sources in widely diversified fields—among them oceanography, medicine, and basic research. This diversification follows the ever-expanding need for engineers in non-engineering fields.

Another feature of this revision is Chap. 23, The Fundamentals of Design. Recently, leading industries have practically demanded that the colleges of engineering include more design courses in the curriculum. There has also been much discussion of the importance, the trends, and the procedures for design in the meetings and publications of the ASME, SAE, ASEE, and other national organizations.

Chap. 23 is intended to fill the gap in available design information that exists between machine drawing and machine design. All texts on machine drawing that the author is familiar with are restricted to drawing techniques. Also, all texts on machine design are limited to discussions of mechanisms and the calculations of the strength of parts. In neither area is anything said about definitions of design, explanation of design categories, how a designer thinks, procedures for design, materials, good practices and proportioning, construction and manufacturing methods, or aesthetics, all of which are included in Chap. 23. This material will be expanded in future revisions as the need for more information may become evident.

New tabular material has been added to the Appendix.

To the practicing engineer. Traditionally, engineering students have kept their engineering drawing texts for their personal libraries, and have later purchased a new edition. Because of its completeness and modernization, we believe this, the tenth edition, is an excellent volume to have at hand for reference as needed.

Credits. To produce a textbook of the size and completeness of this one is a major task. One problem is to obtain authentic problem material, to adapt the material to the textbook format and style, and to make the necessary drawings. This has been accomplished through conferences with, and through the cooperation of, the author's colleagues in the Department of Engineering Graphics and Mechanical Engineering at the University of Florida. Professor E. W. Jacunski, Chairman of the Department of Engineering Graphics, supervised the work and made a number of the drawings, particularly the pictorials. E. H. Watts, Assistant Professor of Engineering Graphics, supplied problems on intersections and developments. C. W. Knight and J. H. Smith, both Assistant Professors of the Department of Mechanical Engineering, collected comprehensive and diversified problem material and supplied this in finished form for sections, screw threads, fasteners, keys, rivets, springs, dimensioning, working drawings, gears, structures, and the fundamentals of design. The author also appreciates the material supplied by Dale O. Miller of Rochester Gear, Inc., and by Anthony Dowell of the Palm Beach office of Merrill Lynch, Pierce, Fenner and Smith. Individual credits

for companies which supplied problem material are given with the problem statements and drawings.

Again available with this edition are the McGraw-Hill text-films designed especially for, and correlated with, the text and problems. These visual aids, consisting of motion pictures and filmstrips, have a high teaching value and illustrate certain principles and practices more effectively than can be done by a textbook alone.

There are problem books correlated directly with the text. Consultation materials are available to teachers.

Charles J. Vierck

Preface to the First Edition

THERE IS a wide diversity of method in the teaching of engineering drawing, and perhaps less uniformity in the courses in different schools than would be found in most subjects taught in technical schools and colleges. In some well-known instances the attempt is made to teach the subject by giving a series of plates to be copied by the student. Some give all the time to laboratory work; others depend principally upon recitations and homework. Some begin immediately on the theory of descriptive geometry, working in all the angles; others discard theory and commence with a course in machine detailing. Some advocate the extensive use of models; some condemn their use entirely.

Different courses have been designed for different purposes, and criticism is not intended, but it would seem that better unity of method might result if there were a better recognition of the concep-

tion that drawing is a real language, to be studied and taught in the same way as any other language. With this conception it may be seen that except for the practice in the handling and use of instruments, and for showing certain standards of execution, copying drawings does little more in the study as an art of expression of thought than copying paragraphs from a foreign book would do in beginning the study of a foreign language.

And it would appear equally true that good pedagogy would not advise taking up composition in a new language before the simple structure of the sentence is understood and appreciated; that is, "working drawings" would not be considered until after the theory of projection has been explained.

After a knowledge of the technic of expression, the "penmanship and orthography," the whole energy should be directed toward training in constructive imagination, the perceptive ability which enables one to think in three dimensions, to visualize quickly and accurately, to build up a clear mental image, a requirement absolutely necessary for the designer who is to represent his thoughts on paper. That this may be accomplished more readily by taking up solids before points and lines has been demonstrated beyond dispute.

It is then upon this plan, regarding drawing as a language, the universal graphical language of the industrial world, with its varied force of expression, its grammar and its styles, that this book has been built. It is not a "course in drawing," but a textbook, with exercises and problems in some variety from which selections may be made.

Machine parts furnish the best illustrations of principles, and have been used freely, but the book is intended for all engineering students. Chapters on architectural drawing and map drawing have been added, as in the interrelation of the professions every engineer should be able to read and work from such drawings.

In teaching the subject, part of the time, at least one hour per week, may profitably be scheduled for class lectures, recitations, and blackboard work, at which time there may be distributed "study sheets" or home plates of problems on the assigned lesson, to be drawn in pencil and returned at the next corresponding period. In the drawing-room period, specifications for plates, to be approved in pencil and

some finished by inking or tracing, should be assigned, all to be done under the careful supervision of the instructor.

The judicious use of models is of great aid, both in technical sketching and, particularly, in drawing to scale, in aiding the student to feel the sense of proportion between the drawing and the structure, so that in reading a drawing he may have the ability to visualize not only the shape but the size of the object represented.

In beginning drawing it is not advisable to use large plates. One set of commercial drafting-room sizes is based on the division of a $36'' \times 48''$ sheet into $24'' \times 36''$, $18'' \times 24''$, $12'' \times 18''$, and $9'' \times 12''$. The size $12'' \times 18''$ is sufficiently large for first year work, while $9'' \times 12''$ is not too small for earlier plates.

Grateful acknowledgment is made of the assistance of Messrs. Robert Meiklejohn, O. E. Williams, A. C. Harper, Cree Sheets, F. W. Ives, W. D. Turnbull, and W. J. Norris of the staff of the Department of Engineering Drawing, The Ohio State University, not only in the preparation of the drawings, but in advice and suggestion on the text. Other members of the faculty of this University have aided by helpful criticism.

The aim has been to conform to modern engineering practice, and it is hoped that the practical consideration of the draftsman's needs will give the book permanent value as a reference book in the student's library.

The author will be glad to cooperate with teachers using it as a textbook.

Thomas E. French

Columbus, Ohio
June, 1911

Engineering Drawing Films

THE FOLLOWING 16-mm sound motion pictures are especially recommended for use with various chapters of this book:

According to Plan. An introduction to engineering drawing (9 min). *For Chap. 1.*

Orthographic Projection. Shape description and the principles of orthographic projection (18 min). *For Chap. 5.*

Pictorial Sketching. Basic principles of axonometric, oblique, and perspective pictorial sketching (11 min). *For Chap. 6.*

Auxiliary Views: Single Auxiliaries. Reviews orthographic projection and explains auxiliary projection (23 min). *For Chap. 7.*

Auxiliary Views: Double Auxiliaries. The theory and practice of double-auxiliary or oblique view (13 min). *For Chap. 7.*

Sections and Conventions. Theory and practice of sectioning and conventional principles (15 min). *For Chap. 8.*

Simple Developments. What simple developments are and how they are used (11 min). *For Chap. 9.*

Oblique Cones and Transition Developments. Animated drawings illustrate oblique cones and transitions (11 min). *For Chap. 9.*

Drawings and the Shop. Relationships between the drawing and production operations in the shop; basic machines (15 min). *For Chap. 10.*

Selection of Dimensions. Principles governing choice of dimensions and their applications (18 min). *For Chap. 11.*

Prints of these films may be purchased from Text-Film Department, McGraw-Hill Book Company.

Appendixes

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Page references preceded by A *indicate Appendix material*